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SAWITN - South American Working Group in Interventional and Therapeutic Neuroradiology
The Chinese INR Coordinating Committee of the Chinese Doctor Association
INSHCM - Interventional Neuroradiology Society of HCM City, Viet Nam

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JSNET - Japanese Society of Neuro Endovascular Therapy
FIO - Italian Federation of Ozone Therapy
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WFITN 2019 NAPLES

15th Congress of the World Federation of Interventional and Therapeutic Neuroradiology

Program of Symposium for Nurses, Technicians and Radiographers in cooperation with ESMINT

Abstract Book

Past WFITN Meetings

1991	Zurich – *Anton Valavanis*
1993	Vancouver – *Karel terBrugge*
1995	Kyoto – *Waro Taki*
1997	New York – *Alejandro Berenstein*
1999	Algarve – *Jorge Campos*
2001	Seoul – *In Sup Choi*
2003	Recife – *Ronie Leo Piske* †
2005	Venice – *Marco Leonardi*
2007	Beijing – *Ling Feng*
2009	Montreal – *Jean Raymond and Daniel Roy*
2011	Capetown – *Allan Taylor and David Lefeuvre*
2013	Buenos Aires – *Pedro Lylyk and Luis Lemme Plaghos*
2015	Gold Coast – *Winston Chong, Hal Rice and Laetitia de Villiers*
2017	Budapest – *István Szikora, Zsolt Kulcsár*
2019	Naples – *Alessandra Biondi and Mario Muto*

Welcome Message from the Presidents of WFITN 2019

Dear Colleagues, dear Friends,

it is a great honor and privilege for us to welcome you in Naples to the 15th congress of the WFITN, held from 21st – 24th October 2019.

The goal of our scientific society is to keep trained members and to share worldwide experience. As usual, a mix of clinical diagnostic knowledge and technical skills will characterize our meeting, underlining that teams in which the target is the patient obtain the best result.

The meeting will be organized in plenary sessions and morning and lunch seminars; more space is going to be available to young researchers to which we will dedicate specific sessions for worldwide talent. Important hot topics will be discussed, there will be the area of labs and hands-on courses to experience new devices and materials.

There will be the possibility of benefit from Educational Grants provided by MedTech Member Companies to support medical education.

We hope that you will enjoy the Congress and that your interaction with your colleagues from many different countries will stimulate a creative exchange of ideas.

We are confident that the crucial importance of the contribution that everyone will bring to this event will make this experience unforgettable, and will be another starting point for the future scientific progress of the international interventional and therapeutic Neuroradiology.

Again, we are delighted to welcome you and we hope and trust that you will enjoy your visit to the very beautiful and exciting city of Naples.

The 15th WFITN Presidents

Alessandra Biondi
Chief of the Department of Neuroradiology and Endovascular Therapy Jean Minjoz University Hospital – Besançon, France

Mario Muto
Chief of the Diagnostic and Therapeutic Neuroradiology Department Neuroscience of Cardarelli Hospital – Naples, Italy

Welcome Message from the President of WFITN

Dear Colleagues, dear Friends,

Thirty years ago, a few medical pioneers practiced Interventional Neuroradiology. Coming from many specialties, with different backgrounds and nationalities, they formed from the beginning an international community. This small group has since grown tremendously and techniques have certainly improved. The benefit to the patients has been verified in large studies. As a result, neurointervention is today an integrated part of any neurovascular center.

So, we have indeed been very successful!

However, there are still many hurdles. The most obvious is the lack of trained INR specialists to take in charge the increased demand for thrombectomy. This has created a situation when it is tempting for physicians without proper training to perform INR procedures.

During the Gold Coast congress was created a multi-society document: ''Training Guidelines for Endovascular Ischemic Stroke Intervention: An International multi-society consensus document'', published simultaneously in the twelve participating societies journals. This powerful document has been very helpful to our friends in the USA.

As this is written, we are in the process of finalizing a second multi-society document, created during the Budapest congress: ''Standards of Practice in Acute Ischemic Stroke Intervention''.

Such documents may seem a little boring but are extremely important since they define our specialty; the training and the competence required performing endovascular procedures in the brain, in this case mechanical thrombectomy.

The intention is to continue and deepen this collaboration with all major neuroscience societies, to create common documents, guidelines and research projects. Common goals and scientific collaboration are very important not only for relationships between societies, but also for personal reasons. A great opportunity to renew old friendships and create new bonds is the WFITN biannual congress, this time in Naples. There are many cities around the world, but Naples is very special. It is situated in a magnificent bay, between the beauty, the island Capri, and the beast, the volcano Vesuvius. It is a very old city with many interesting museums, pieces of art and artifacts. Do not miss the ''Veiled Christ'' in the Sansevero Chapel! The center of the city is a world heritage; take your time to stroll along the narrow streets.

The food is well known to be excellent and here you can get the best pizza in the world! Naples was an advocate for Italian unification during the Neapolitan War. Let Naples be the place where we all unite, share our knowledge, create new friendships and enjoy a great meeting!

Our hosts will be Alessandra Biondi and Mario Muto. They will for sure create an excellent program.

Looking forward to meeting Naples for the 15th WFITN congress!

Current President of WFITN

Michael Söderman MD
Associate Professor, Vice President Symposium Neuroradiologicum (Taipei), Head Neurointervention, Dept of Neuroradiology Karolinska University Hospital, Stockholm, Sweden

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World Federation of Interventional and Therapeutic Neuroradiology

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The Information Desk of WFITN's Secretariat will be available throughout the Congress to provide information about WFITN, membership, new applications, INR Journal, payment of membership fee (etc.).

Sabine Heckmann

Email: secretary@wfitn.org
Phone: +49 171 261 6661
web: www.wfitn.org

World Federation of Interventional and Therapeutic Neuroradiology

WFITN 15th Meeting Naples, 2019

Alessandra Biondi & **Mario Muto**
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PROGRAM AT A GLANCE

Time	Monday 21st					
	Auditorium Europa	Egadi Room	Eolie - Stromboli Room	Eolie - Panarea Room	Sicilia Room	Sardegna Room
08.15-09.50	Plenary Session 1 Stroke A					
09.50-10.00	Opening Ceremony					
10.00-10.30	Coffee Break					
10.30-12.00	Plenary Session 2 Stroke B					
12.00-13.00	Industry sponsored Symposium	Industry sponsored Symposium			Industry sponsored Symposium	
13.00-14.00	Lunch					
14.00-16.00	Main Session Topic 1 Radioprotection	Oral Papers Session A Spine / Tumors			Oral Papers Session B Material / Technique / Miscellaneous	
16.00-16.30	Coffee Break					
16.30-18.30	Oral Papers Session C Stroke 1	16.30-17.42 Oral Papers Session D Spinal AV Shunts 17.42-18.30 Oral Papers Session E Pediatric	Oral Papers Session F Stroke 2	Oral Papers Session G Stroke 3	Oral Papers Session H Stroke 4	Oral Papers Session I Stroke 5
19.00	Welcome Reception					

Time	Tuesday 22nd					
	Auditorium Europa	Egadi Room	Eolie - Stromboli Room	Eolie - Panarea Room	Sicilia Room	Sardegna Room
08.00-10.00	Plenary Session 3 Intracranial AVMs and Dural AVFs				ETMINT Symposium for Angiosuite Personnel Session A	
10.00-10.30	Coffee Break					
10.30-11.30	Plenary Session 4 Psychology in INR					
11.30-13.00	2nd MEETING Women in Neuro-Interventional Practise (including Angiosuite Personnel)					
13.00-14.00	Lunch					
		Industry sponsored Symposium	Industry sponsored Symposium			
14.00-16.30	Main Session Topic 2 Spine				Main Session Topic 3 Pediatric	ETMINT Symposium for Angiosuite Personnel Session B
16.30-17.00	Coffee Break					
17.00-18.00	General Assembly					
20.00	San Carlo Theater and Social Dinner					

Time	Wednesday 23rd					
	Auditorium Europa	Egadi Room	Eolie - Stromboli Room	Eolie - Panarea Room	Sicilia Room	Sardegna Room
08.00-09.30	Plenary Session 5 Spinal AVMs/AVFs and Dural AVFs				ETMINT Symposium for Angiosuite Pesonnel Session C	
09.30-10.00	The Pierre Lasjaunias Memorial Lecture					
10.00-10.30	Coffee Break					
10.30-11.30	Plenary Session 6 Intracranial Stenosis				ETMINT Symposium for Angiosuite Pesonnel Session D	
11.30-13.00	Plenary Session 7 From Bench to Bed: Research and Development					
13.00-14.00		Industry sponsored Symposium				
	Lunch					
14.00-15.30	Oral Papers Session J AVMs 1	Oral Papers Session K Dural AVFs 1	Oral Papers Session L AVM/Dural AVFs 2/ Miscellaneous	Oral Papers Session M Aneurysms *Multimodality / Surgery*	Oral Papers Session N Aneurysms *Coiling*	Oral Papers Session O Aneurysms *Stent assisted coiling*
15.30-16.00	Special Session The life of a Scientific Journal					
16.00-16.30	Coffee Break					
16.30-17.30	Plenary Session 8 Aneurysms (a)					
17.30-18.45	Oral Papers Session P Aneurysms *Flow divertert stenting*	Oral Papers Session Q Aneurysms *Flow divertert stenting*	Oral Papers Session R Aneurysms *Flow divertert stenting*	Oral Papers Session S Aneurysms *Flow study* *Vessel wall imaging*	Oral Papers Session T Aneurysms *Intra-aneurysmal flow disruption*	Oral Papers Session U Aneurysms *Stent assisted coiling*

Time	Thursday 24th					
	Auditorium Europa	Egadi Room	Eolie - Stromboli Room	Eolie - Panarea Room	Sicilia Room	Sardegna Room
08.00-09.00	Oral Papers Session V Aneurysms *Fusiform / Dissecting*	Oral Papers Session W Aneurysms *Blood Blister Like / Ruptured*	Oral Papers Session X Aneurysms *Ruptured / Vasospasm*	Oral Papers Session Y Miscellaneous	Oral Papers Session Z Aneurysms *Imaging & Follow-Up*	Oral Papers Session ω Miscellaneous
09.00-10.00	Plenary Session 9 Aneurysms (b)					
10.00-10.10	Best Papers Award Ceremony					
10.10-10.30	Coffee Break					
10.30-12.00	Plenary Session 10 Aneurysms (c)					
12.00-13.00	Aneurysms (d)					
	Lunch					
13.00-14.00	Industry sponsored Symposium	Industry sponsored Symposium			Industry sponsored Symposium	Industry sponsored Symposium
14.00-15.00	Plenary Session 11 How to introduce new devices? *Ethical and business considerations*					
15.00-16.00	Plenary Session 12 The future is today: New insights on NRI					
16.00	Closing Ceremony					

WFITN 2019 SCIENTIFIC PROGRAM

Monday, 21st October 2019

08.15–09.50 **AUDITORIUM EUROPA**
Plenary Session 1: Stroke A

Chairperson: T. Moulin, *France*
Moderators: T.M. Pham, *Vietnam* – **P. Mordasini**, *Switzerland*

08.15–08.30 Pre-thrombectomy Imaging: CT, MRI, Ultrasound Helmet
D. Dormont, *France*

08.30–08.45 Pre-thrombectomy Imaging: The value of Perfusion and Collateral Imaging
H. Rowley, *USA*

08.45–09.00 Radial approach in the endovascular management of stroke
P. Jabbour, *USA*

09.00–09.15 Vessel Wall Imaging in Stroke: is there a role?
J. Schaafsma, *Canada*

09.15–09.30 What does the neurologist expect from imaging in patients with a TIA?
D. Leys, *France*

09.30–09.40 Artificial Intelligence in stroke care
B. Baxter, *USA*

09.40–09.50 Discussion

09.50–10.00 **Opening Ceremony of the 15th WFITN Congress**

10.00–10.30 **Coffee Break**

10.30–12.00 **AUDITORIUM EUROPA**
Plenary Session 2: Stroke B

Chairperson: M. Goyal, *Canada*
Moderators: W. Van Zwam, *The Netherlands* – **P. Machi**, *Switzerland*

10.30–10.45 Overview of Recent Trials and Techniques: aspiration vs stent or both?
P. Brouwer, *Sweden*

10.45–11.00 Which patients should not be treated?
M. Goyal, *USA*

11.00–11.10 Posterior Circulation Stroke: where are we?
J. Fiehler, *Germany*

11.10–11.20 Distal Vessel Occlusion Treatments: when and how?
R. Nogueira, *USA*

11.20–11.30 Treatment of Tandem Lesions in acute Stroke
D. Frei, *USA*

11.30–11.45 Results of clot composition research and the impact of histological clot composition in embolic stroke
S. de Meyer, *Belgium*

11.45–12.00 Discussion

12.00–13.00

AUDITORIUM EUROPA	**Industry sponsored Symposium**
EGADI ROOM	**Industry sponsored Symposium**
SICILIA ROOM	**Industry sponsored Symposium**

13.00–14.00 **Lunch**

13.00–14.00 **STROMBOLI ROOM**
Federal Assembly

14.00–16.00 **AUDITORIUM EUROPA**
Parallel Main Session – Topic 1: Radioprotection

Chairperson: M. Söderman, *Sweden*
Moderators: W. Lee, *Singapore* – **S. Husain**, *India*

14.00–14.12 General Electric: Dose Reduction System in our Angio-Suite
B. Hassem, *France*

14.12–14.24 Philips: Dose Reduction System in our Angio-Suite
M. Mauti, *The Netherlands*

14.24–14.36 Siemens: Dose Reduction System in our Angio-Suite
P. Bernhardt, *Germany*

14.36–14.48 Canon: Dose Reduction System in our Angio-Suite
A. Patz, *Germany*

14.48–15.00 Discussion

Chairperson: W. Chong, *Australia*
Moderators: F. Ricolfi, *France* – **S. Renowden**, *UK*

15.00–15.20 The real radiation risk for the neuro-interventionist and for the patient in INR procedures
A. Trianni, *Italy*

15.20–15.40 How to be best protected against radiations for the neuro-interventionist
J. Pfaff, *Germany*

15.40–16:00 Discussion

14.00–16.00 **EGADI ROOM**
Oral papers – Parallel Session A: Spine / Tumors O 001 to O 015
Moderators: M. Bellini, *Italy* – **H.K. Lee**, *USA*

14.00–14.06 O 001
The 'Stent-Screw Assisted Internal Fixation' (SAIF) technique to reconstruct the vertebral body in severe osteoporotic spinal fractures with middle column involvement.
D. Distefano, P. Scarone, M. Isalberti, M. Reinert, L. La Barbera, T. Villa, J.A. Hirsch, G. Bonaldi, A. Cianfoni, *Switzerland, Italy, USA*

14.08–14.14 O 002
The Stent-Screw Assisted Internal Fixation (SAIF) technique to reconstruct the vertebral body in neoplastic extreme osteolysis.
A. Cianfoni, D. Distefano, P. Scarone, M. Reinert, G. Pesce, V. Espeli, L. La Barbera, T. Villa, G. Bonaldi, J.A. Hirsch, M. Isalberti, *Switzerland, Italy, Usa*

14.16–14.22 O 003
Pilot Study of Stent-Screw Assisted Internal Fixation (SAIF) technique for treatment of osteoporotic severe vertebral body collapse.
M. Pileggi, R. Delfanti, M. Isalberti, D. Distefano, P. Scarone, A. Cianfoni, *Switzerland, Italy, Usa*

14.24–14.30 O 004
''Armed Kyphoplasty'': an indirect central canal decompression technique in burst fractures.
A. Venier, L. Roccatagliata, M. Isalberti, P. Scarone, D.E. Kuhlen, M. Reinert, B. Bonaldi, A. Cianfoni, *Switzerland, Italy*

14.32–14.38 O 005
Percutaneous laser cervical disc decompression with Discolux Siad System: evaluation of our clinical and radiologic experience of this new therapeutic modality in the cervical discal herniations.
F. Fasano, G.E.M. La Tessa, A. Negro, V. D'Agostino, F. Somma, V. Piscitelli, C. Sicignano, M. Tecame, L. De Bellis, M. Prudente, O. Vargas, A. Pisani, G. Sirabella, *Italy*

14.40– 14.46 O 006
Percutaneous laser disc decompression with Discolux Siad System: evaluation of our clinical and radiologic experience of this new therapeutic modality in the lumbar discal herniations.
F. Somma, V. D'Agostino, A. Negro, O. Vargas, F. Fasano, C. Sicignano, V. Piscitelli, M. Tecame, M. Prudente, G. Sirabella, L. De Bellis, A. Pisani, G. La Tessa, *Italy*

14.48–14.54 O 007
Percutaneous cervical disc decompression with Deko (Sinteaplustek): evaluation of our clinical and radiologic experience of this new therapeutic modality in the cervical discal herniations.
A. Negro, G. La Tessa, M. Tecame, F. Somma, F. Fasano, C. Sicignano, V. Piscitelli, M. Prudente, O. Vargas, L. De Bellis, A. Pisani, V. D'Agostino, G. Sirabella, *Italy*

14.56–15.02 O 008
Percutaneous lumbar disc decompression: evaluation of our clinical and radiologic experience of a new therapeutic modality in the lumbar discal herniations.
M. Tecame, G. La Tessa, A. Negro, F. Somma, V. D'Agostino, E. Prudente, O. Vargas, F. Fasano, L. De Bellis, V. Piscitelli, C. Sicignano, A. Pisani, G. Sirabella, *Italy*

15.04–15.10 O 009
Radiofrequency and vertebroplasty to treat vertebral metastases.
M. Muto, G. Leone, G. Ambrosanio, G. Guarnieri, M. Muto, *Italy*

15.12–15.18 O 010
Challenge for chronic intractable lumbosacral radicular pain: pulsed radiofrequency treatment and volumetric modifications of the lumbar dorsal root ganglia.
A. Negro, F. Somma, V. D'agostino, M. Arenella, F. Tortora, *Italy*

15.20–15.26 O 011
Percutaneous treatment of atypical and aggressive symptomatic vertebral hemangioma.
G. Leone, M. Muto, G. Ambrosanio, P. Vassallo, G. Guarnieri, M. Muto, *Italy*

15.28–15.34 O 012
Invasive vertebral hemangioma, management and role of interventional radiology.
A. Sultan, T. Hassan, A. Yehia, T. I. Metwally, *Egypt*

15.36–15.42 O 013
Pre-operatory management of sporadic intradural extramedullary hemangioblastomas.
D.Tampieri, R. Alkins, A. Menard, J. Rossiter, *Canada*

15.44– 15.50 O 014
Endovascular treatment of hypervascular brain tumors other than meningiomas.
L. Nico, J. Ognard, E. Magro, J. Gentric, *France*

15.52–15.58 O 015
Pre-operative direct-puncture embolization of head and neck hypervascular tumors using Squid 12.
A. Pedicelli, E. Lozupone, I. Valente, F. D'Argento, A. Alexandre, L. Chiumarulo, C. Colosimo, *Italy*

14.00–16.06 **SICILIA ROOM**
Oral papers – Parallel Session B: Material, Technique and Miscellaneous **O 016 to O 031**
Moderators: C. Papagiannaki, *France* – **B. Moon Kim,** *South Korea*

14.00–14.06 O 016
Usefulness of vessel models made with 3d printer in endovascular therapy.
T. Imai, T. Osanai, T. Soyama, D. Abo, K. Kudo, *Japan*

14.08–14.14 O 017
Non-X Ray Imaging System for simulators using 3d rapid prototyping model.
K. Fukasaku, H. Yokota, T. Kuchiura, M. Iwabuchi, Y. Ohya, M. Negoro, *Japan*

14.16–14.22 O 018
High-Resolution Cone-Beam CT in INR Procedures. Advances and new indications.
M. Tanaka, K. Kadooka, H. Saitoh, *Japan*

14.24–14.30 O 019
Flat Panel Computer Tomography in hybrid operating room for neurological intervention: a phantom and retrospective study.
A. El Mekabaty, C. Aberle, K. Blackham, D. Zumofen, *Switzerland*

14.32–14.38 O 020
Novel operation support robot with sensory-motor feedback system for neuroendovascular intervention.
S. Miyachi, Y. Nagano, T. Hironaka, R. Kawaguchi, T. Ohshima, N. Matsuo, R. Maejima, *Japan*

14.40–14.46 O 021
Endovascular transvenous access to brain tissue by trans-vessel wall technique.
R. Grankvist, J. Lundberg, F. Arnberg, M. Sandell, I. Jonsson, V. Lövljung, T. Tran, S. Jonsson, S. Holmin, *Sweden*

14.48–14.54 O 022
Magnetic Resonance guided focused ultrasound thalamotomy in essential tremor: single center 1-year experience.
E. Ciceri, S. Tamburin, M. Tinazzi, T. Bovi, A. Nicolato, M. Longhi, R. Foroni, S. Montemezzi, C. Bovo, A. Agnello, G. Ricciardi, *Italy*

14.56–15.02 O 023
Brain tissue iron quantification at the periphery of the hematoma by MRI in patients with intracerebral hemorrhage: translational evidence in first 10 patients.
N. Chaudhary, A. Pandey, J. Griauzde, J. Gemmete, G. Xi, R. Keep, *USA*

15.04–15.10 O 024
Can VW-MRI assess the difference between thunderclap headache in patients with aneurysms?
L. Cirillo, A. Rustici, C. Bortolotti, C. Princiotta, M. Dall'Olio, P. Cortelli, C. Sturiale, M. Cellerini, S. Cevoli, *Italy*

15.12–15.18 O 025
Effect of choice of treatment modality on the incidence of shunt-dependent hydrocephalus after aneurysmal subarachnoid hemorrhage.
M. Koyanagi, H. Fukuda, M. Saiki, Y. Tsuji, T. Kawasaki, Y. Ioroi, R. Fukumitsu, R. Ishibashi, M. Oda, O. Narumi, M. Chin, S. Yamagata, S. Miyamoto, *Japan*

15.20–15.26 O 026
Detectability and anatomical variations of perforating arteries from vertebral artery on 3D-DSA evaluated in patients with normal vertebral arteries
S. Tanoue, H. Kiyosue, Y. Matsumaru, Y. Matsumoto, H. Endo, M. Hiramatsu, W. Tsuruta, M. Sato, M. Hirohata, T. Abe, *Japan*

15.28–15.34 O 027
Visualization of the human intracranial vasa vasorum in vivo.
L. Zhang, *China*

15.36–15.42 O 028
Staff eye-lens dose monitoring during interventional neuroradiology procedures.
S. Busoni, F. Rossi, S. Doria, S. Piffer, L. Redapi, S. Mangiafico, *Italy*

15.44–15.50 O 029
Safeguard manual assist technique for the management of femoral percutaneous acces in cerebral neurovascular procedures: a single center prospective analysis.
F. Di Caterino, G. Vitale, E. Pomero, A. Biondi, *France*

15.52–15.58 O 030
Endovascular management of cranio-cervical arterial pathologies using Stent Graft.
M. Gupta, Nadarajah, L. Sebastian, S.B. Gaikwad, A. Garg, *India*

16.00–16.06 O 031
Retrospective analysis of Flow Diverter Therapy for internal carotid artery aneurysms regarding aneurysm morphology.
H. Oishi, *Japan*

16.00–16.30 **Coffee Break**

16.30–18.30 **AUDITORIUM EUROPA**
Oral papers – Parallel Session C – Stroke 1 **O 032 to O 046**
Moderators: M. Shigero, *Japan* – **T. Andersson**, *Sweden*

16.30–16.36 O 032
AAFITN acute stroke management consensus.
S. Miyachi, J. Mahadevan, W. Chong, *Japan, Malaysia, Australia*

16.38–16.44 O 033
Treatment of acute stroke – the japanese experience – project for spreading mechanical thrombectomy.
S. Miyachi, T. Ohshima, S. Okuda, I. Nakahara, M. Mase, T. Izumi, S. Yoshimura, N. Sakai, *Japan*

16.46–16.52 O 034
Effectiveness of 'trip-and-treat' for acute stroke patients undergoing endovascular reperfusion therapy.
M. Hayakawa, M. Sato, M. Yoshimura, A. Tsurumi, T. Kawai, H. Kasuya, T. Ohashi, K. Oshima, Y. Ito, A. Marushima, N. Kato, Y. Matsumaru, *Japan*

16.54–17.00

O 035
Mothership versus drip and ship – a retrospective analysis of a regional stroke registry with 2797 patients.
F. Seker, S. Bonekamp, S. Rode, S. Hyrenbach, M. Bendszus, M. Möhlenbruch, *Germany*

17.02–17.08

O 036
Impact of bridging thrombolysis on clinical outcome in stroke patients undergoing thrombectomy.
F. Seker, S. Bonekamp, S. Rode, S. Hyrenbach, M. Bendszus, M. Möhlenbruch, *Germany*

17.10–17.16

O 037
Geographic service delivery for endovascular clot retrieval: using discrete event simulation to optimise resources.
Y. Ren, M. Phan, J. Wu, P. Luong, D. Shell, M. Burney, C. Sean, J. Maingard, K. Zhou, A. Lamanna, H. Kok, R. Chandra, A. Jhamb, V. Thijs, D. Brooks, H. Asadi, *Australia*

17.18–17.24

O 038
Withdrawn
Code stroke: a new open source communication platform to streamline acute stroke management.
H.M. Seah, M. Burney, J. Wu, M. Phan, D. Shell, O. Brooks, B. Coulton, J. Maingard, G. Yazdabadi, J. Seah, J. Tang, C. Barras, H.K. Kok, B. Tahayori, R. Chandra, V. Thijs, D.M. Brooks, H. Asadi, *Australia*

17.26–17.32

O 039
Economic impact of First Pass Effect (FPE) in endovascular stroke treatment with the Embotrap II device from the Arise II study – annual healthcare resource use economic analysis from an european perspective.
T. Andersson, M. Ribo, H.P. Mattle, A. Ehm, C. Crivera, H.L. Cameron, R.A. Qadeer, O.O. Zaidat, *Sweden, Spain, Germany, Usa*

17.34– 17.40

O 040
Procedural and hospitalization-related economic impact of First Pass Effect (FPE) in endovascular stroke treatment with the Embotrap II device from The Arise II Study – An european economic analysis.
T. Andersson, M. Ribo, H.P. Mattle, A. Ehm, C. Crivera, H.L. Cameron, R.A. Qadeer, O.O. Zaidat, *Sweden, Belgium, Spain, Switzerland, Germany, Canada, Usa*

17.42–17.48

O 041
Latam Experience: cost effectiveness of endovascular stroke therapy. Analysis from a colombian healthcare perspective.
B. Pabon, C. Diaz, J. Tellez, J. Arcos, P. Guijarro, C. Resendiz, *Colombia, Mexico*

17.50–17.56

O 042
Self-reported intraprocedural patient comfort during thrombectomy without prior sedation.
G. Jacquin, A. Poppe, L. Gioia, Y. Deschaintre, C. Odier, N. Daneault, A. Weill, D. Roy, J. Raymond, D. Iancu, D. Volders, J. Ghostine, C. Stapf, *Canada*

17.58–18.04

O 043
Thrombectomy in stroke patients without prior sedation: frequency of intraprocedural use of analgosedation.
G. Jacquin, L. Gioia, Y. Deschaintre, N. Daneault, C. Odier, A. Poppe, A. Weill, D. Roy, J. Raymond, D. Iancu, D. Volders, J. Ghostine, C. Stapf, *Canada*

18.06–18.14

O 044
Validation of a new scale allowing systematic evaluation of intraprocedural patient comfort during thrombectomy.
G. Jacquin, A. Poppe, L. Gioia, Y. Deschaintre, N. Daneault, C. Odier, A. Weill, J. Raymond, D. Iancu, D. Volders, J. Ghostine, C. Stapf, *Canada*

18.16–18.22 O 045
Validation of a new scale allowing systematic evaluation of operators' perception of procedural ease in thrombectomy without prior sedation.
G. Jacquin, A. Poppe, L. Gioia, Y. Deschaintre, N. Daneault, C. Odier, A. Weill, D. Roy, J. Raymond, D. Iancu, J. Ghostine, D. Volders, C. Stapf, *Canada*

18.24–18.30 O 046
The effect of procedural hemodynamic changes during anesthetic management on functional outcome after endovascular treatment for ischemic stroke: results from the Mr. Clean Registry.
N. Samuels, R.A. Van De Graaf, C.A.L. Van Den Berg, I. Eralp, K.M. Treurniet, B.J. Emmer, R.V. Immink, C.B.L.M. Majoie, W.H. Van Zwam, R.P.H. Bokkers, M. Uyttenboogaart, B.A.A.M. Van Hasselt, J. Mühling, B. Roozenbeek, H.F. Lingsma, D.W.J. Dippel, A.C.G.M. Van Es, A. Van Der Lugt, *The Netherlands*

16.30–17.42 **EGADI ROOM**
Oral papers – Parallel Session D – Spinal AV Shunts **O 047 to O 055**

Moderators: D. Tampieri, *Canada* – **S. Kominami**, *Japan*

16.30–16.36 O 047
Spinal cord arteriovenous shunts and pregnancy; natural history and management. A monocentric study of 10 consecutive cases.
A. Consoli, M. Ohlsson, F. Di Maria, A. Sgreccia, G. Rodesch, *France, Sweden, Italy*

16.38–16.44 O 048
Endovascular treatment of spinal AVM: report of three cases treated with transvenous approach in combination with the retrograde pressure cooker technique.
C.P. Stracke, M. Walloch, S.M. Pilgram-Pastor, E. Celik, R. Chapot, *Germany*

16.46–16.52 O 049
Embolization of spinal dural AVF using the pressure cooker technique.
C.P. Stracke, S. Pilgram-Pastor, E. Celik, M. Wallocha, E. Yamac, R. Chapot, *Germany*

16.54–17.00 O 050
Intraoperative Direct Puncture And Embolization Through The Drainage Veins For Sacral Vascular Malformation In Hybrid Operating Room: A Clinical Pilot Study For Safety And Feasibility
Y. Ma, H. Zhang, M. Ye, C. He, G. Li, L. Sun, T. Hong, C. Yang, F. Ling, *China*

17.02–17.08 O 051
Concomitant conus medullaris arteriovenous shunts and sacral dural arteriovenous fistulas: pathophysiological links related to the venous drainage of the lesions in a series of five cases.
A. Rosi, F. Di Maria, A. Consoli, S. Condette-Auliac, O. Coskun, A. Guedon, G. Rodesch, *France, Switzerland*

17.10–17.16 O 052
Clinical outcome and preoperative diagnosis of the spinal arteriovenous fistula using the usual and modified minimum intensity projection imaging.
S. Sato, Y. Niimi, T. Mochizuki, K. Yoshida, S. Shima, B. Ryuu, T. Inoue, K. Kuwamoto, Y. Okada, *Japan*

17.18–17.24 O 053
Significance of pre-operative angiographic diagnosis in cases of spinal dural and epidural arteriovenous fistula.
K. Nishi, M. Hiramatsu, K. Sugiu, T. Yasuhara, T. Hishikawa, N. Kidani, Y. Takahashi, S. Murai, I. Date, *Japan*

17.26–17.32 O 054
Angioarchitecture and endovascular treatment for Cervical Epidural Arteriovenous Fistulas (CEAVFS).

Y. Niimi, S. Sato, T. Inoue, K. Kuwamoto, B. Ryu, S. Shima, T. Mochizuki, K. Yoshida, Y. Okada, *Japan*

16.34–17.40 O 055
Embolization of cranial and spinal arteriovenous fistulas using precipitating hydrophobic injectable liquid (PHIL) in 9 patients.
R.H. Dahl, V. Eskesen, L. Poulsgaard, G. Benndorf, *Denmark, Usa*

17.42–18.30 **EGADI ROOM**
Oral papers – Parallel Session E – Pediatric **O 056 to O 061**

Moderators: F. Causin, *Italy* – **D. Roy**, *Canada*

17.42–17.48 O 056
Safety of selective supra-aortic arteries and superselective intracranial catheterization in pediatric population: 11-years experience.
T. Casseri, P. Gennari, S. Cioni, I. M. Vallone, S. Leonini, T. Hadijstilianou, S. De Francesco, D. Guglielmucci, M. Caini, R. Tinturini, F. Tarantino, S. Bracco, *Italy*

17.50–17.56 O 057
Pediatric AVM treated with histoacryl glue embolization. Our experience.
E. Ciceri, A. Agnello, R. Augelli, N. Mandruzzato, A. Nicolato, M. Longhi, A. Pasqualin, G. Pinna, P. Biban, P. Zampieri, *Italy*

17.58–18.04 O 058
Fetal and neonatal MRI findings associated with aggressive early clinical course in newborns with vein of Galen malformation.
L. Arko, D. Zurakowski, D. Orbach, *Usa*

18.06–18.12 O 059
Large-bore neurovascular access for embolization of vein of Galen malformations in newborns and infants.
Y. Baytar, S. Balci, B. Bilginer, A. Arat, *Turkey*

18.14–18.20 O 060
Endovascular management of vein of Galen aneurysms.
A. Sultan, T. Hassan, T. Rayan, *Egypt*

18.22–18.28 O 061
Dural Sinus Malformation with Giant Pouch (DSMGP): symptoms and treatment.
F. Requejo, *Argentina*

16.30–18.30 **STROMBOLI ROOM**
Oral papers – Parallel Session F – Stroke 2 **O 062 to O 076**

Moderators: B. Pabon, *Colombia* – **S. Mangiafico**, *Italy*

16.30–16.36 O 062
Multiphase CT Angiography as a patient selection tool for mechanical thrombectomy in anterior circulation stroke.
N. Witoon, A. Churojana, B. Sangpetngam, P. Withayasuk, E. Chankaew, T. Aurboonyawat, D. Songsaeng, *Thailand*

16.38–16.44 O 063
8-months of Rapid (Rapid Processing of Perfusion and Diffusion) experience in stroke patient selection for endovascular treatment.
S. Piccinini, L. Verganti, F. Sacchetti, G. Zelent, F. Tari Capone, S. Vallone, *Italy*

16.46–16.52 O 064
Evaluation of C-Arm CT Perfusion parameters for acute intracranial large artery occlusion before and immediately after mechanical thrombectomy.
H. Itokawa, M. Fujimoto, M. Moriya, N. Okamoto, Y. Tsuge, J. Sasanuma, *Japan*

16.54–17.00 O 065
A multiphase MRA collateral imaging: prediction of neurologic outcome in patients with acute ischemic stroke .
H. J. Kim, H.G. Roh, H.J. Lee, J.J. Park, S.B. Lee, Y.S. Jeon, T.J. Lee, Y.J. Jung, S.Y. Ryu, *South Korea*

17.02–17.08 O 066
Willisian collateral failure in anterior circulation mechanical thrombectomy: its consequences and bailout.
S. Lee, J.M. Hong, J.W. Choi, D. Kang, Y. Kim, Y. Kim, J. Hong, J. Yoo, C. Kim, S. Sohn, Y. Hwang, J.S. Lee, *South Korea*

17.10–17.16 O 067
Arterial Spin Labeling images in patients with acute middle cerebral artery ischemic stroke.
Y. Lee, J. Lee, D. Park, T. Kim, *South Korea*

17.18–17.24 O 068
Impact of basal ganglia damage after successful endovascular recanalization for acute ischemic stroke involving lenticulostriate arteries.
N. Horie, Y. Morofuji, Y. Iki, Y. Matsunaga, T. Kanamoto, T. Izumo, T. Anda, T. Matsuo, *Japan*

17.26–17.32 O 069
Relationship between 3-D rotational angiography and perforator infarction following percutaneous transluminal angioplasty for middle cerebral artery stenosis.
H. Yamazaki, M. Morimoto, C. Hikita, M. Iwasaki, Y. Inaka, S. Fukuta, H. Sato, *Japan*

17.34–17.40 O 070
Avoidance of perforator occlusion during endovascular treatment for the symptomatic intradural arterial stenosis with evaluation of the plaque by magnetic resonance wall imaging.
S. Kim, M. Ohtaki, N. Mikuni, *Japan*

17.42–17.48 O 071
Treatment of intracranial atherosclerosis disease with drug-coated balloon angioplasty.
A. Wang, C.H. Chang, *China*

17.50–17.56 O 072
Endovascular treatment in patients with large acute ischemic stroke.
Y.S. Jeon, H.G. Roh, H.J. Kim, J.J. Park, Y.I. Chun, J.W. Choi, S.B. Lee, *South Korea*

17.58–18.04 O 073
Efficacy and safety of endovascular thrombectomy for selected patients with large vessels occlusion beyond 6 hours after stroke.
M. Morimoto, M. Iwasaki, H. Yamazaki, C. Hikita, Y. Inaka, S. Fukuta, H. Satow, *Japan*

18.06–18.12 O 074
6 to 24 hours endovascular thrombectomy for large intracranial vessel occlusion without perfusion CT patient selection: single center experience.
A. Alexandre, F. Giubbolini, I. Valente, E. Lozupone, F. D'Argento, C. Colosimo, A. Pedicelli, *Italy*

18.14–18.20 O 075
Clinical outcome after thrombectomy in patients with pre-stroke Modified Rankin Scale >1.
K. Oda, T. Kojima, N. Sato, M. Oinuma, K. Horiuchi, T. Ichikawa, T. Maeda, T. Oikawa, K. Saito, *Japan, China*

18.22–18.28 O 076
Early venous drainage sign after mechanical thrombectomy in ischemic stroke predicts hemorrhagic transformation.
P. Gao, G. Li, J. Chen, L. Jiao, H. Zhang, *China*

16.30–18.30 **PANAREA ROOM**
Oral papers – Parallel Session G – Stroke 3 **O 077 to O 091**

Moderators: Y. Matsumaru, *Japan* – **H. Desal**, *France*

16.30–16.36 O 077
Alternative vascular access in acute ischemic stroke patients with failed/impossible femoral access.
R. Abdalla, M. Sukumaran, D. Cantrell, B. Jahromi, M. Potts, A. Shaibani, M. Hurley, S. Ansari, *USA*

16.38–16.44 O 078
Floating aortic thrombus: a rare cause of acute ischemic stroke necessitating modification of access route for thrombectomy.
S. Balci, A. Arat, E.M. Arsava, M.A. Topcuoglu, *Turkey*

16.46–16.52 O 079
Effectiveness of transradial neuroendovascular interventions for anterior circulation lesions as the first-line vascular access: original experience with a 6-FR Simmonds-type guiding sheath.
Y. Hanaoka, J. Koyama, D. Yamazaki, T. Horiuchi, *Japan*

16.54–17.00 O 080
This randomized study of endovascular therapy with versus without intravenous tissue plasminogen activator for acute stroke with ICA and M1 occlusion aims to clarify the efficacy and safety of direct EVT compared with bridging therapy.
Y. Matsumaru, K. Suzuki, M. Takeuch, M. Morimoto, R. Kanazawa,Y. Kamiya, K. Shigeta, N. Ishii, Y. Takayama, Y. Koguchi, A. Hyodo, M. Hayakawa, T. Ota, S. Okubo, H. Naito, K. Akaji, N. Kato, M. Inoue, T. Hirano, K. Miki, T. Ueda, K. Kimura, *Japan*

17.02–17.08 O 081
Prior antiplatelet use in patients undergoing endovascular treatment for acute ischemic stroke: results from the Mr. Clean Registry.
R. Van De Graaf, S.M. Zinkstok, V. Chalos, R.B. Goldhoorn, C.B.L.M. Majoie, R.J. Van Oostenbrugge, A. Van Der Lugt, D.W.J. Dippel, Y.B.W.E.M. Roos, A.C.G.M. Van Es, B. Roozenbeek, *The Netherlands*

17.10–17.16 O 082
How Safe And Useful Is Selective Intra-Arterial Administration Of Urokinase In Mechanical Thrombectomy Era?
N. Mandruzzato, Augelli, A. Agnello, M. Plebani, P. Zampieri, A. Grazioli, G. Ricciardi, E. Ciceri, *Italy*

17.18–17.24 O 083
Pre-morbid statin treatment affects neuroimaging findings in acute ischemic stroke patients.
F. Di Giuliano, F. Sallustio, E. Picchi, S. Minosse, A. Mascolo, F. Marrama, G. Koch, F. Alamseged, F. De Crescenzo, V. Da Ros, D. Morosetti, F. Garaci, M. Diomedi, R. Floris, *Italy*

17.26–17.32 O 084
Mechanical thrombectomy for acute ischemic stroke in anticoagulated patients.
T. Kojima, N. Sato, M. Oinuma, K. Horiuchi, T. Ichikawa, K. Oda, T. Maeda, K. Saito, *Japan*

17.34–17.40 O 085
The Impact of Nets in stroke and myocardial infarction.
T. Boeckh-Behrens, J. Novotny, C. Schulz, P. Oberdieck, B. Friedrich, H. Poppert, C. Zimmer, *Germany*

17.42–17.48 O 086
Investigating the effect of platelet contraction on the mechanical properties and microstructure of clot analogues with varying hematocrit.
S. Johnson, J.Y. Chueh, M.J. Gounis, M. Gilvarry, R. McCarthy, J.P. McGarry, P.E. Mchugh, *Ireland, USA*

17.50–17.56 O 087
An in-vitro study to examine changes in clot properties from exposure to recombinant tissue plasminogen activator and predict possible implications for mechanical thrombectomy in stroke.
S. Duffy, F. Weafer, A. Alone, E. Rainsford, R. McCarthy, *Ireland*

17.58–18.04 O 088
Interactive clot atlas enabling intuitive exploration and comparison of thrombus composition and the thrombectomy procedure.
S. Duffy, J. Thornton, M. Farrell, E. MacCarthy, R. McCarthy, *Ireland*

18.06–18.12 O 089
Association between acute ischemic stroke etiology and macroscopic aspect of retrieved clots.
A. Sgreccia, Z. Duchmann, J.P. Desilles, B. Lapergue, J. Labreuche, M. Kyheng, R. Bourcier, A. Consoli, *Italy, France*

18.14–18.20 O 090
Efficacy of Adapt technique in acute ischemic stroke: correlation with thrombus features.
D.G. Romano, E. Visconti, A. Pedicelli, E. Lozupone, I. Valente, R. Saponiero, *Italy*

18.22–18.28 O 091
Radiation exposure in modern endovascular stroke treatment – dose reference levels in anterior circulation ischemic stroke.
C. Weyland, F. Hemmerich, M.A. Möhlenbruch, M. Bendszus, J.A.R. Pfaff, *Germany*

16.30–18.30 **SICILIA ROOM**
Oral papers – Parallel Session H – Stroke 4 **O 092 to O 106**

Moderators: C. Tran Chi, *Vietnam* – **G. Tedeschi**, *Italy*

16.30–16.36 O 092
Identifying the predictors of first pass effect and its influence on clinical outcome in the setting of endovascular thrombectomy for acute ischemic stroke: results from a multicentric prospective registry.
F. Di Maria, M. Kyheng, A. Consoli, B. Gory, R. Fahed, S. Richard, G. Rodesch, J. Girot, C. Dargazanli, G. Marnat, B. Lapergue, R. Bourcier, *France*

16.38–16.44 O 093
Acute stroke thrombectomy using a direct aspiration first pass technique (ADAPT): results in 189 consecutive acute ischemic stroke patients treated in a single center in the last seventeen months.
F. Taglialatela, S. Isceri, C. Barbara, A. Zaniboni, G. Procaccianti, L. Cirillo, C. Princiotta, A. Zini, L. Simonetti, *Italy*

16.46–16.52 O 094
Multicenter experience with the Penumbra 3D revascularization device for mechanical thrombectomy in acute stroke: subset of the complete registry.
O. Zaidat, J. Fifi, A. Hassan, A. Nanda, A. Doerfler, *USA, Germany*

16.54–17.00 O 095
Initial multicenter experience with a new generation large bore catheter for acute stroke thrombectomy.
O. Zaidat, J. Fifi, B. Woodward, A. Hassan, *USA*

17.02–17.08 O 096
Efficacy of Adapt with large-bore reperfusion catheter in anterior circulation acute ischemic stroke: a multicentric experience.
D.G. Romano, G. Frauenfelder, A. Pedicelli, E. Lozupone, I. Valente, R. Saponiero, *Italy*

17.10–17.16 O 097
Distal intracranial large bore catheter navigation without microcatheter or microguidewire – The Sofia intermediate catheter snake35 technique.
M. Colasurdo, J.D. Gabrieli, G. Cester, D. Simonato, F. Causin, *Italy*

17.18–17.24 O 098
A novel swim technique using 6 FR Navien catheter as aspiration catheter in the treatment of acute ischemic stroke due to anterior circulation occlusion: a comparative study with SR thrombectomy in a single center.
Q. Zhang, J. Sun, X. Zhang, Z. Chen, *China*

17.26–17.32 O 099
Two-Stage Aspiration Technique (TSAT) with proximal flow arrest by a balloon guiding catheter for acute ischemic stroke: clinical results of 102 consecutive patients.
H. Nishiyama, H. Matsumoto, D. Izawa, N. Toki, *Japan*

17.34–17.40 O 100
Impact of balloon guide catheter on technical and clinical outcome in the beyond-SWIFT registry.
B. Friedrich, J. Kaesmacher, C. Maegerlein, T. Meinel, T. Dobrocky, E. Piechowiak, M. Heldner, P. Mosimann, P. Michel, S. Hajdu, M. Ribo, M. Requena, V. Costalat, A. Benali, L. Pierot, M. Gawlitza, J. Schaafsma, V. Pereira, J. Gralla, U. Fischer, *Germany, Switzerland, Spain, France, Canada*

17.42–17.48 O 101
Efficacy of a ballon-assisted proximal aspiration in treating an occluded common carotid artery, intra and extracranial internal carotid artery.
D.L. Lauretti, A. Grigolini, G.A. Lazzarotti, M. Cosottini, *Italy*

17.50–17.56 O 102
Preliminary single center experience with the new Aperio thrombectomy device as a rescue approach after aspiration: first 30 cases.
N. Cavasin, E. Cagliari, M. Cazzagon, A. Critelli, *Italy*

17.58–18.04 O 103
Mechanical Thrombectomy (MT) performed with Embotrap: the Verona hospital experience.
R. Augelli, A. Agnello, N. Mandruzzato, M. Conte, G.K. Ricciardi, M. Plebani, P.G. Zampieri, E. Ciceri, *Italy*

18.06–18.12 O 104
Treatment of distal branch occlusion in the middle cerebral artery territories: the Verona hospital experience.
R. Augelli, M. Conte, A. Agnello, N. Mandruzzato, G.K. Ricciardi, P.G. Zampieri, M. Plebani, A. Grazioli, A. Bucci, E. Ciceri, *Italy*

18.14–18.20 O 105
Mechanical thrombectomy for isolated M2 segment occlusion of the middle cerebral artery.
T. Maeda, T. Kojima, N. Sato, M. Oinuma, K. Horiuchi, T. Ichikawa, K. Oda, K. Iwatate, M. Kawakami, K. Saito, *Japan*

18.22–18.28 O 106
Refractory thrombectomy: who, when and how?
R. Abdalla, M. Darwish, D. Cantrell, M. Hurley, M. Potts, B. Jahromi, A. Shaibani, S. Ansari, *USA*

16.30–18.30 **SARDEGNA ROOM**

Oral papers – Parallel Session I – Stroke 5 **O 107 to O 121**

Moderators: L. Valvassori, *Italy* – **S. Bracco**, *Italy*

16.30–16.36 O 107

Acute endovascular treatment of tandem lesion of the anterior circulation: an italian multicenter experience.

T. Casseri, S. Bracco, M. Zanoni, S. Cioni, I.M. Vallone, P. Gennari, S. Leonini, M.A. Mazzei, D.G. Romano, R. Saponiero, R. Augelli, N. Mandruzzato, M. Plebani, P.G. Zampieri, R. Tassi, G. Martini, S. Forlivesi, R. Napolitano, E. Ciceri, *Italy*

16.38–16.44 O 108

Emergency carotid artery stenting in concomitant with intracranial thrombectomy in acute ischemic stroke: a single center experience.

E.H. Ihm, Y.Y. Seo, H.K. Lee, H.J. Woo, Y.M. Han, *South Korea*

16.46–16.52 O 109

Acute thrombosis and occlusions of dual-layer carotid stents in endovascular treatment of tandem occlusions.

J.A.R. Pfaff, C. Maurer, E. Broussalis, H. Janssen, R. Blanc, C. Dargazanli, V. Costalat, M. Piotin, F. Runck, A. Berlis, M. Killer-Oberpfalzer, J. Hensler, M. Bendszus, F. Wodarg, M.A. Möhlenbruch, *Germany, Austria, France*

16.54–17.00 O 110

Emergency stenting with ACCLINO flex and neurospeed balloon catheter after failed thrombectomy: multicenter experience.

C.P. Stracke, L. Meyer, H. Leischner, J. Fiehler, G. Thomalla, L.U. Krause, S. Lowens, R. Chapot, *Germany*

17.02–17.08 O 111

Safety and feasibility of carotid revascularization with stents in patients with cerebral embolic strokes.

J. Kovoor, J. Tejada, M. Martinez, *USA*

17.10– 17.16 O 112

Multilayer Stent (CMFM) for carotid angioplasty: Buenos Aires experience.

C. Bleise, I. Lylyk, J. Chudyk, N. Perez, R. Viso, P. Lylyk, *Argentina*

17.18–17.24 O 113

A Retrospective multicenter study of endovascular treatment for acute carotid non-T occlusion.

T. Ota, K. Shigeta, T. Amano, J. Kaneko, *Japan*

17.26–17.32 O 114

Feasibility and potential complications associated with hybrid recanalization of chronic cerebral carotid occlusion.

X. Gao, *China*

17.34–17.40 O 115

Preliminary results of selective balloon dilatation after carotid artery stenting.

T. Izumi, M. Ishida, M. Nishihori, T. Tsukada, M. Otawa, R. Oshima, T. Kawaguchi, A. Kropp, M. Ikezawa, S. Goto, T. Wakabayashi, *Japan*

17.42–17.48 O 116

Asymptomatic cerebral vasoconstriction after carotid artery stenting.

C. Kang, J. Roh, J. Baek, S. Kim, S. Baik, *South Korea*

17.50–17.56 O 117
Effect of hemodynamics in development of carotid intraplaque haemorrhage.
M. Hayashi, S. Fujita, Y. Hiramoto, K. Aoki, N. Saito, N. Hirai, K. Ito, H. Nakayama, T. Sakurai, S. Yagi, N. Hattori, S. Iwabuchi, *Japan*

17.58–18.04 O 118
Stenting of stenosed posterior communicating artery for hemodynamic insufficiency caused by internal carotid artery occlusion.
X. Lu, B. Yang, Y. Ma, L.Q. Jiao, *China*

18.06–18.14 O 119
Endovascular treatment of acute basilar artery occlusion: tama-registry of acute thrombectomy (TREAT) study.
J. Kaneko, T. Ota, T. Tagami, K. Unemoto, K. Shigeta, T. Amano, M. Ueda, Y. Matsumaru, Y. Shiokawa, T. Hirano, *Japan*

18.16–18.22 O 120
Early aggressive treatment of the occlusion-underlying stenosis is associated with improved outcome in patients undergoing mechanical thrombectomy for basilar artery occlusion.
S. Nardai, B. Kis, I. Gubucz, Z. Berentei, P. Orosz, Z. Vajda, A. Nagy, I. Szikora, *Hungary*

18.24–18.30 O 121
Mechanical thrombectomy for tandem vertebrobasilar stroke; recanalization rates and outcome.
D.J. Kim, S.H. Baik, B.M. Kim, J.W. Kim, *South Korea*

19.00–21.00 **Welcome Reception**

Monday, 21st October 2019 – E-Posters

14.00–15.00 **E-POSTERS AREA**
Poster Session 1: Stroke **P 001 to P 021**

Moderator: F. Di Caterino, *France*

14.00–14.02 P 001
Optimising mechanical thrombectomy workflow through inter-disciplinary cross training in National Neuroscience Institute (NNI).
B. Weng Fei, H. Sook Leng, Q. Yi Ping, Z. Almuthar, *Singapore*

14.02–14.04 P 002
Temporal trends for endovascular treatments in acute ischemic stroke in Italy.
V. Saia, G. Pracucci, P. Nencini, D. Inzitari, F. Sallustio, A. Zini, R. Tassi, R. Gasparotti, S. Vallone, M. Bergui, F. Causin, A. Saletti, F. Zappoli Thyrion, M. Longo, E.G. Puglielli, R. Menozzi, L. Castellan, D. Toni, S. Mangiafico, *Italy*

14.04–14.06 P 003
Acute ischaemic stroke treatment at AORN Cardarelli, Naples. A retrospective analysis of the first 250 patients.
P. Candelaresi, G. Servillo, G. Alfieri, V. Andreone, W. Di Iorio, G. Maniscalco, V. Manzo, M. Napolitano, A. Ranieri, R. Renna, M. Rippa, G. Ambrosanio, G. Guarnieri, P. Vassallo, M. Benincasa, A. Iannuzzi, R. Nasti, F. Paladino, C. Florio, M. Muto, *Italy*

14.06–14.08 P 004
Current status of thrombectomy call of acute ischemic stroke for single neurointerventionist in regional hospital.
N. Matsubara, K. Ota, *Japan*

14.08–14.10 P 005
Quality of revascularisation and clinical outcomes of stroke patients admitted during office hours versus night time or weekends in arise II
T. Andersson, H.P. Mattle, H. Bozorgchami, M. Ribó, J.L. Saver, O.O. Zaidat, *Sweden, Switzerland, USA, Spain*

14.10–14.12 P 006
Rapid door to puncture time can increase the rate of favorable outcome and decrease the UNF.
J. Aoki, K. Kentaro, S. Numao, A. Kutsuna, T. Katano, T. Kanamaru, K. Kimura, *Japan*

14.12–14.14 P 007
Reducing of pre-procedural time reflects to improve mechanical thrombectomy treatment outcome in siriraj comprehensive stroke center: a comparison of pre-post stroke workflow.
A. Homsud, *Thailandia*

14.14–14.16 P 008
Colorviz: a new helpful processing tool for evaluation of acute stroke patient before interventional procedure.
M.J. Kim, S.M. Lim, *South Korea*

14.16–14.18 P 009
Emergent large vessel occlusion screen is an ideal scale to detect endovascular therapy eligible patients.
K. Suzuki, *Japan*

14.18–14.20 P 010
Comparison between MRI-DWI and pooled cerebral blood volume mapping before and after thrombectomy for acute cerebral artery occlusion.
K. Yoshida, H. Oishi, *Japan*

14.20–14.22 P 011
Thrombectomy for acute ischemic stroke with large vessel occlusion for patient of late presentation: sub-analysis of rescue-Japan registry 2.
K. Uchida, S. Yoshimura, N. Sakai, H. Yamagami, T. Morimoto, *Japan*

14.22–14.24 P 012
The impact of occlusion location and bridging therapy in patients affected by acute ischemic stroke in determining the total number of passes required to remove the clot and the final revascularization outcome.
R. Rossi, S. Fitzgerald, O.M. Mereuta, A. Douglas, A. Pandit, I. Szikora, G. Tsivgoulis, K. Psychogios, B. Murphy, P. Brennan, S. Power, A. O'hare, J. Thornton, A. Rentzos, T. Tatlisumak, K.M. Doyle, *Ireland, Hungary, Greece, Sweden*

14.24–14.26 P 013
Manual aspiration thrombectomy with the PACMAN technique is non-inferior to pump to obtain first pass recanalization in middle cerebral artery occlusion.
V. Da Ros, J. Scaggiante, A. Di Martino, F. Sallustio, M. Diomedi, A. Wlderk, A. Bozzi, F. Di Giuliano, V. Semeraro, D. Morosetti, R. Argirò, M. Nezzo, R. Floris, R. Gandini, *Italy*

14.26–14.28 P 014
Endovascular therapy versus intravenous tissue plasminogen activator in patients with M2 occlusion.
S. Numao, *Japan*

14.28–14.30 P 015
The value of initially angiographic morphology in acute middle cerebral artery occlusion.
D.S. Kim, J.H. Sung, M.H. Lee, *South Korea*

14.30–14.32 P 016
The efficacy of recanalization in mechanical thrombectomy for acute ischemic stroke: a comparison of direct aspiration and stent retriever techniques.
A. Kolyanee, J. Klaychoi, N. Witoon, A. Churojana, P. Withayasuk, B. Sangpetngam, T. Aurboonyawat, E. Chankaew, *Thailand*

14.32–14.34 P 017
Effectiveness and safety of mechanical thrombectomy for acute ischemic stroke in over 80 years old patients.
K. Kitazawa, Y. Ito, M. Koyama, M. Toriyabe, H. Ohara, M. Minagawa, *Japan*

14.34–14.36 P 018
Transarterial selective cooling infusion with endovascular therapy for acute ischemic stroke with large vessel occlusion: protocol to investigate efficacy and safety of the randomized controlled trial.
A. Kutsuna, J. Aoki, S. Numao, K. Suzuki, T. Kanamaru, Y. Nishiyama, S. Okubo, K. Kazumi, *Japan*

14.36–14.38 P 019
Experimental comparison of physical properties depending on the unsheathing level of stent: solitaire versus trevo retriever.
H.J. Jeon, J.H. Ahn, J.Y. Lee, *South Korea*

14.38–14.40 P 020
Initial experience with the embotrap II stentriever for the treatment of acute ischemic stroke to report our experience with the embotrap II clot-retrieval device for the revascularization of large artery occlusions in acute ischemic stroke.
I. Valente, S. Nappini, L. Renieri, A. Pedicelli, E. Lozupone, C. Colosimo, S. Mangiafico, N. Limbucci, *Italy*

14.40–14.42 P 021
Removal of unwanted detached solitaire FR by using new solitaire FR – ''distal capture and pull'' technique: a case report.
J.H. Mun, B.S. Kim, J.S. Lim, *South Korea*

15.00–16.00 **E-POSTERS AREA**
Poster Session 2: Stroke **P 022 to P 042**

Moderator: M. Bergui, *Italy*

15.00–15.02 P 022
Efficacy and safety of reperfusion therapy in anterior versus posterior circulation stroke. A systematic review and meta-analysis.
S.H. Lee, J. Han, I. Jung, J. Jung, *South Korea*

15.02.-15.04 P 023
Mortality of acute basilar artery occlusion in the thrombectomy era: a multicenter retrospective observational study – rescue Japan registry 2.
T. Yoshimoto, H. Yamagami, K. Uchida, M. Ihara, K. Toyoda, T. Morimoto, N. Sakai, S. Yoshimura, *Japan*

15.04–15.06 P 024
Mechanisms of acute ischemic stroke in the setting of trauma.
Z. Voronich, D. Sorte, *Island*

15.06–15.08 P 025
Prognosis of endovascular thrombectomy in acute ischemic stroke patients with current malignancy.
B.H. Cho, S. Yu, K. Cho, M. Park, *South Korea*

15.08–15.10 P 026
Postpartum period and ulcerative colitis: a dangerous couple – a case report of an ischemic stroke.
S. Corraine, A. Ferrari, F. Fusaro, F. Schirru, V. Palmisano, C. Ganau, S. Comelli, *Italy*

15.10–15.12 P 027
Eagle syndrome, an unusual cause of acute ischemic stroke requiring a thrombectomy approach.
M. Plebani, P. Zampieri, A. Grazioli, R. Augelli, A. Gasparini, G. Talenti, S. Forlivesi, S. Forlivesi, E. Ciceri, *Italy*

15.12–15.14 P 028
Successful mechanical thrombectomy of embolic posterior circulation stroke at 23 hours after onset in a young female with cardiac myxoma.
V. Bhatia, A. Kumar, C. Jain, *India*

15.14–15.16 P 029
Usefulness of total thrombus-formation analysis system in predicting hemorrhagic complications during neuroendovascular treatment.
K. Arimura, A. Nishimura, K. Iihara, *Japan*

15.18–15.20 P 030
Risk prediction of parenchymal hematoma after endovascular thrombectomy for acute ischemic stroke with anterior circulation large vessel occlusion
J. Kang, C.H. Kim, O.Y. Kwon, *South Korea*

15.20–15.22 P 031
Analysis of the factors related to the failure of successful recanalization and the influence of thrombus length on swi, in stent retriever mechanical thrombectom
D.H. Lee, J.H. Sung, M.H. Lee, *South Korea*

15.22–15.24 P 032
Visualization of thrombus using flow-sensitive black-blood magnetic resonance angiography in patients with acute ischemic stroke: a possibility of determination of etiology
M. Takagaki, A. Murasawa, K. Nakao, H. Nakamura, H. Kishima, *Japan*

15.24–15.26 P 033
Composition of retrieved thrombus assessed by morphological, histopathological and ex vivo MRI analysis
C. Yoon, P. Hyun, P. Ki-Jong, K. Young Soo, R. Jieun, B. Seung Kug, *South Korea*

15.28–15.30 P 034
Clot collection and analysis in the excellent registry
R. Qadeer, R. Nogueira, S. De Meyer, K. Doyle, J. Fiehler, W. Hacke, R. Hanel, T. Jovin, D. Kallmes, D. Liebeskind, A. Yoo, O. Zaidat, A. Siddiqui, *Sweden, Belgium, USA, Ireland, Germany*

15.30–15.32 P 035
Post-contrast hyperintense vessel on delayed gd-enhanced T1W TSE image in acute infarct
D. W. Park, T.Y. Kim, *South Korea*

15.32–15.34 P 036
Endovascular treatment for acute large vessel occlusion due to atherosclerosis
M. Shirakawa, S. Yoshimura, N. Sakai, H. Yamagami, K. Uchida, T. Morimoto, *Japan*

15.34–15.36 P 037
Balloon angioplasty and stenting for intracranial atherosclerotic stenosis
T. Ueda, S. Takaishi, T. Yoshie, N. Usuki, K. Tatsuno, Y. Hamada, H. Ohtsubo, Y. Suzuki, *Japan*

15.36–15.38 P 038
Usefulness of balloon expandable stenting for atherosclerotic severe stenosis of intracranial artery.
M. Hirohata, *Japan*

15.38–15.40 P 039
Prediction of underlying intracranial atherosclerotic stenosis using visibility of the stent during mechanical thrombectomy procedure for acute large artery occlusion.
B.H. Lee, J.W. Kim, Y.J. Hwang, *South Korea*

15.40–15.42 P 040
Risk factors for periprocedural complications of angioplasty/stent for intracranial stenosis.
H. Ishihara, F. Oka, T. Nishimoto, K. Okazaki, M. Suzuki, *Japan*

15.42–15.44 P 041
Bilateral ophthalmic artery occlusion in a case of antiphospholipid antibody syndrome.
W.B. Seung, H. Jeong, *South Korea*

15.44–15.46 P 042
Thrombectomy and stenting of an acute intracranial dissection: clinical and hystological considerations
J.D. Gabrieli, G. Cester, A. Angelini, M. Fedrigo, M. Colasurdo, D. Simonato, F. Causin, *Italy*

16.00–17.00 **E-POSTERS AREA**
Poster Session 3: Carotid **P 043 to P 068**

Moderator: P. Machi, *Switzerland*

16.00–16.02 P 043
Management of tandem occlusion stroke with carotid stenting and intra-arterial Abciximab.
E. Portela De Oliveira, A. Cora, F. Essbaiheen, U. Erdenebold, M. Kassab, A. Quateen, B. Drake, H. Lesiuk, S. Finitsis, D. Iancu, *Canada*

16.02–16.04 P 044
Endovascular recanalization of acute tandem cervical carotid and intracranial occlusions: efficacy of cervical balloon angioplasty alone then intracranial target recanalization strategy.
D. Kang, *South Korea*

16.04–16.06 P 045
Effect of emergent carotid artery stenting on cervical internal carotid artery occlusion or pseudo-occlusion with mild neurological deficits.
Y. Tsuboi, M. Narikiyo, H. Nagasaki, S. Nagao, C. Kambayashi, *Japan*

16.06–16.08 P 046
Pseudo-occlusion of the internal carotid artery in acute ischemic stroke: clinical outcome after mechanical thrombectomy.
W.S. Jung, Y.C. Lim, J.W. Choi, *South Korea*

16.08–16.10 P 047
Carotid artery dissection: natural history, selection criteria and endovascular technique based on our personal experience.
F. Taglialatela, S. Isceri, C. Barbara, L. Simonetti, *Italy*

16.10–16.12 P 048
Endovascular treatment in patients with carotid artery dissection without intracranial large vessel occlusion.
J.G. Kim, D. Lee, D. Suh, Y. Song, *South Korea*

16.12–16.14 P 049
Usefulness of intravascular ultrasound imaging navigating microwire in the true lumen in the acute ischemic stroke case due to spontaneous internal carotid dissection.
S. Saito, A. Takemura, N. Narita, H. Tomita, *Japan*

16.14–16.18 P 050
Navigation of a 6-french guiding sheath into the common carotid artery using a tri-axial catheter system in transbrachial carotid artery stenting.
S. Sakamoto, T. Matsushige, T. Okazaki, J. Oshita, K. Kurisu, *Japan*

16.18–16.20 P 051
Usefulness of triple coaxial system for navigating 9FR balloon guiding catheter in patients with specific aortic anatomy.
Y. Suzuki, N. Toma, R. Yasuda, Y. Miura, M. Shiba, H. Suzuki, *Japan*

16.20–16.22 P 052
Clinical results and technical considerations about a double-layer carotid stent: experience in 78 patients.
F. Taglialatela, S. Isceri, C. Barbara, L. Simonetti, *Italy*

16.22–16.24 P 053
The safety of carotid artery stenting in elderly patients.
M. Takasaki, *Japan*

16.24–16.26 P 054
Carotid artery stenting for restenosis following endarterectomy: periprocedual complications and long-term follow-up results.
H. Endo, K. Shindo, H. Sugio, T. Ogino, T. Murahashi, K. Kamiyama, Y. Seo, T. Osato, H. Nakamura, *Japan*

16.26–16.28 P 055
Treatment experience and characterization of Radiation–Induced Carotid Stenosis (RICS) in our hospital.
I. Oh, *South Korea*

16.28–16.30 P 056
Internal carotid artery stenosis with incomplete segmental agenesis: a case report.
T. Kawaguchi, T. Izumi, A. Kropp, M. Ikezawa, S. Goto, K. Otawa, R. Oshima, T. Tsukada, M. Nishihori, T. Wakabayashi, *Japan*

16.30–16.32 P 057
Case report: carotid artery stenting with persistent primitive hypoglossal artery.
K. Masato, K. Hideki, S. Kensaku, S. Nao, *Japan*

16.32–16.34 P 058
Prediction of cerebral hyperperfusion phenomenon after carotid endarterectomy or carotid stenting by computed tomography perfusion imaging.
K. Shindo, T. Ogino, H. Endo, H. Sugio, T. Murahashi, K. Kamiyama, T. Oosato, H. Nakamura, *Japan*

16.34–16.36 P 059
Assessment of cerebral hemodynamics using fluid-attenuated inversion recovery hyperintense vessels in patients with cervical internal carotid artery stenosis.
T. Nishimoto, H. Ishihara, F. Oka, M. Suzuki, *Japan*

16.36–16.38 P 060
Numerical analysis of the hemodynamics in the extracranial carotid artery before and after angioplasty with stent via CFD.
L.J. Haas, C.R. Schwatz, I.A.D. Fiamoncini, H.F. Meier, J.C.S.C. Bastos, G.V. Staedele, W.R. Berticelli, M. Becker, M.C. Harger, C.B. Lima, J. Martins, B.R. Sabel, F.J. Cobra, M.D. Soares,

L.C.O. Camilo, V.D. De Almeida, C.G.J.L. Brasileiro, J.D. Hessmann, L.M. Silva, A. De Oliveira Junior, D. Malacarne, B. Sartori, *Brazil*

16.38–16.40 P 061
Cerebral blood flow changes along with staged angioplasty for the patients with carotid artery stenosis.
F. Oka, H. Ishihara, T. Oku, H. Yoshino, A. Kawano, T. Nishimoto, K. Okazaki, M. Suzuki, *Japan*

16.40–16.42 P 062
Carotid artery stenting using additional duplex-guidance.
T. Ohashi, *Japan*

16.42–16.44 P 063
Cerebral ischemia detected with diffusion-weighted magnetic resonance imaging in patients treated with carotid artery stenting: comparison of inserting embolic protection device before and after balloon predilatation.
K. Kwon, M. Byun, *South Korea*

16.44–16.46 P 064
Risk factors of ipsilateral, contralateral and vertebrobasilar microembolic infarctions following carotid artery stenting.
D.W. Park, T.Y. Kim, *South Korea*

16.46–16.48 P 065
Effect of general anesthesia on hemodynamic instability and periprocedural complications during carotid angioplasty and stent.
S. Cho, J. Kim, *South Korea*

16.48–16.50 P 066
Efficacy of carotid artery stenting under general anesthesia with an intraoperative monitoring.
T. Osanai, T. Aoki, M. Gekka, K. Houkin, *Japan*

16.50–16.52 P 067
Imaging follow up after carotid artery stenting with carotid wallstent using ct angiography.
T. Nomura, D. Sasamori, T. Nonaka, T. Onda, Y. Yonemasu, S. Inamura Y. Hashimoto, O. Honda, M. Daibo, *Japan*

16.52–16.54 P 068
Investigation of LDL cholesterol for in-stent plaque, post carotid artery stenting.
H. Wada, K. Kamada, *Japan*

Tuesday, 22nd October 2019

08.00–10.00 **AUDITORIUM EUROPA**
Plenary Session 3: Intracranial AVMs & Dural AVFs
Chairperson: S. Pongpech, *Thailand*

Moderators: L. Lopez-Ibor, *Spain* – **A.C. Januel**, *France*

08.00–08.15 Prediction of AVM rupture by biology and vessel wall imaging
T. Krings, *Canada*

08.15–08.30 Un-ruptured AVMs management: is there anything new under the sun?
J.C. Gentric, *France*

08.30–08.45 Update on the venous approach for the treatment of AVMs
R. Chapot, *Germany*

08.45–09.00 Discussion
Chairperson: A. Malek, *USA*
Moderators: L. Biscoito, *Portugal* – **S. Mangiafico**, *Italy*

09.00–09.15 Update on the surgical treatment of Dural AVFs
L. Thines, *France*

09.15–09.30 Update on the endovascular treatment of Dural AVFs
L. Spelle, *France*

09.30–09.45 Novel approaches for the treatment of cavernous sinus dural AVFs
J. Wenderoth, *Australia*

09.45–10.00 Discussion

10.00–10.30 **Coffee Break**

10.30–11.30 **AUDITORIUM EUROPA**
Plenary Session 4: Psychological and Behavioral aspects in INR
Chairperson: M. Negoro, *Japan*

Moderators: D. Roy, *Canada* – **Z. Kulcsár**, *Switzerland*

10.30–10.45 I had a major complication: how to manage the patient, its family and myself? What is it good to say and to do and what is it not?
B. Leslie-Mazwi, *USA*

10.45–11.00 Health Care Policy Update: Burn Out of the Neuro-Interventional Specialist
J. Hirsch, *USA*

11.00–11.15 How improve the Work Life Balance
P. Moskowitz, *USA*

11.15–11.30 Discussion

11.30–13.00 **AUDITORIUM EUROPA**
2nd Meeting – Women in Neuro-Interventional Practice
President: R. Agid, *Canada*

Moderators: I. Saatchi, *Turkey* – **J. Mahadevan**, *Malaysia*

11.30–11.35 Opening remarks
R. Agid, *Canada*, **I. Saatci**, *Turkey*, **A. Biondi**, *France*

11.35–12.05 Women in male dominant professions: what do we know?
N. Baxter, *Canada*

12.05–12.30 Survey results: Women and Men in INR
R. Agid, *Canada*, **S. Power**, *Ireland*

12.30–12.50 Debate: "Female vs. Male neurointerventionalists – Does gender influence actual practice? Are women as good as men?''
D. Roy, *Canada* – **A.C. Januel**, *France*

12.50–13.00 WFITN plans for futur support
J. Mahadevan, *Malaysia* – **S. Pongpech**, *Thailand*

13.00–14.00 **Lunch**

13.00–14.00 **EGADI ROOM Industry sponsored Symposium**
STROMBOLI ROOM Industry sponsored Symposium

14.00–16.30 **AUDITORIUM EUROPA**
Parallel Main Session – Topic 2: Spine
Chairperson: I. Kaminsky, *USA*

Moderators: K. Murphy, *Canada* – **G. Bonaldi**, *Italy*

14.00–14.15 Physiopathology of spine pain
J. Jennings, *USA*

14.15–14.30 Spine metastasis: role of percutaneous treatment
A. Brook, *USA*

14.30–14.45 Mini-invasive approaches to primary spine tumors
A. Cianfoni, *Switzerland*

14.45–15.00 Osteoporosis and percutaneous management
M. Johnson, *USA*

15.00–15.15 Mini-invasive approach to spine trauma
A. Kastler, *France*

15.15–15.30 Disk and facets treatment
S. Marcia, *Italy*

15.30–15.45 How do I manage spontaneous IC hypotension
P. Mordasini, *Switzerland*

15.45–16.00 Percutaneous treatment of spinal stenosis
L. Manfrè, *Italy*

16.00–16.15 Do we need more EBM in spine intervention?
S. Kyu Lee, *USA*

16.15–16.30 Discussion

14.00–16.30 **SICILIA ROOM**
Parallel Main Session – Topic 3: Pediatric
Chairperson: A. Berenstein, *USA*

Moderators: A. Churojana, *Thailand* – **S. Bracard**, *France*

14.00–14.20 Pediatric cerebral AVMs: congenital or acquired lesions?
D. Orbach, *USA*

14.20–14.40 Complications in pediatric INR AVM management
G. Rodesch, *France*

14.40–15.00 New insights on the endovascular treatment of Vein of Galen Malformations
J. Moret, *France*

15.00–15.15 Discussion
Chairperson: M. Mawad, *Lebanon*
Moderators: L. Hacein-Bey, *USA* – **L. Lemme-Plaghos**, *Argentina*

15.15–15.30 Flow Diversion Stenting in pediatric population
V. Pereira, *Canada*

15.30–15.45	Pediatric dissection and dissecting aneurysm **D. Orbach**, *USA*
15.45–16.00	Pathogenesis and clinical aspects in Pediatric/Young Stroke **M. Kossorotoff**, *France*
16.00–16.15	Pediatric stroke: medical or interventional treatment? **F. Causin**, *Italy*
16.15–16.30	Discussion
16.30–17.00	**Coffee Break**
17.00–18.00	**AUDITORIUM EUROPA** **General Assembly**

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Program of Symposium for NTR 2019

Tuesday, 22nd October 2019 – ETMINT Symposium

08.00–10.00 **SICILIA ROOM**
Symposium for Angiosuite Personnel: Nurses, Radiographers and Technicians *in cooperation with ESMINT*
Session A: Stroke

Moderators: **A. Mastenbroek**, *The Netherlands* – **K. Jones**, *Australia*

08.00–08.05 Opening
A. Mastenbroek, *The Netherlands* – **A. van Es**, *The Netherlands*

08.05–08.25 Workflow in an acute stroke center, the Croatian experience
J. Mamic, *NRT, Croatia* – **I. Komesarovic**, *NRT, Croatia*

08.25–08.45 Pros and cons of a Mobile Stroke Unit
K. Keigher, *NRT, USA*

08.45–09.00 Thrombectomy in children
A. van Es, *MD, The Netherlands*

09.00–09.20 Specificities of peri-procedural management of children undergoing neurointerventional procedures
J. Ducasse, *NRT, France*

09.20–09.40 Pros and cons of mechanical aspiration
P. Brouwer, *MD, Sweden* – **T. Andersson**, *MD, Sweden*

09.40–10.00 Young stroke website
H. Petersen-Baltussen, *NRT, The Netherlands*

10.00–10.30 **Coffee Break**

11.30–13.00 **AUDITORIUM EUROPA**
2nd Meeting – Women in Neuro-Interventional Practice

13.00–14.00 **Lunch**

14.00–16.30 **SARDEGNA ROOM**
Symposium for Angiosuite Personnel: Nurses, Radiographers and Technicians *in cooperation with ESMINT*
Session B: Miscellaneous

Moderators: **D. Olivares-Gomez**, *Sweden* – **H. Genins**, *Sweden*

14.00–14.20 Thrombectomy techniques, Experience with radial access
T. Bertram, *NRT, Germany*

14.20–14.40 Nursing coordination for hybrid recanalization of occluded carotid artery
H. Zhang, *NRT, China*

14.40–15.00 Mechanical thrombectomy – many ways to remove the clot
T. Andersson, *MD, Sweden*

15.00–15.20 Education for technicians in stroke
W. H. Van Zwam, *MD, The Netherlands*

15.20–15.40 INR and AI, reality or not?
F. Menu, *NRT, France*

15.40–16.00 Biological optimization of endovascular vascular treatment of aneurysms
A. Rouchaud, *MD, France*

16.30–17.00 **Coffee Break**

Tuesday, 22nd October 2019 – E-Posters

08.00–09.00 **E-POSTERS AREA**
Poster Session 4: Aneurysms **P 069 to P 093**

Moderator: **Z. Kulksar,** *Switzerland*

08.00–08.02 P 069
Endovascular treatment of 31 anterior choroidal artery aneurysms.
T. Sugawara, N. Kimura, M. Yokosawa, R. Doijiri, K. Takahashi, T. Kikuchi, *Japan*

08.02–08.04 P 070
Embolization for internal carotid-posterior communicating artery aneurysm.
M. Ezura, H. Sakata, H. Uenohara, *Japan*

08.04–08.06 P 071
Coil embolization for unruptured cerebral aneurysm in elderly people (over 70 years old).
K. Orito, S. Kajiwara, Y. Takeuchi, M. Hirohata, M. Morioka, *Japan*

08.06–08.08 P 072
Treatment outcomes of coil embolization for subarachnoid hemorrhage in patients over 80 years of age.
K. Fukutome, S. Takai, R. Matsuoka, R. Maeoka, K. Takahashi, H. Ohnishi, S. Yamamoto, T. Nishioka, Y. Kodama, Y. Kuga, H. Ohnishi, *Japan*

08.08–08.10 P 073
The results of endovascular treatment for elderly cerebral aneurysm in the super-aging society age.
R. Yagi, R. Hiramatsu, H. Ohnishi, N. Matsubara, S. Miyachi, T. Kuroiwa, S. Kawabata, *Japan*

08.10–08.12 P 074
Cost-effectiveness analysis of coil embolization for small cerebral aneurysms.
T. Ueno, *Japan*

08.12–08.14 P 075
Usefulness of aneurysm analysis software for determination of optimal working projection in coil embolization of intracranial aneurysms.
N. Iwata, **M. Sakamoto**, *Japan*

08.14–08.16 P 076
The timing of coil embolization for aneurysmal subarachnoid hemorrhage.
T. Koiso, T. Sato , N. Hashimura, T. Ishiguro, H. Chikuie, G. Ikeda, E. Hamano, M. Nishimura, J. Takahashi, *Japan*

08.16–08.18 P 077
Long-term durability of simple and balloon-assisted coil embolization for treatment of intracranial aneurysms.
Y. Kayan, J. Delgado Almandoz, J. Scholz , A. Milner , M. Mulder, *USA*

08.18–08.20 P 078
Prospective registry of embolization of intracranial aneurysms using hydrosoft coils: results of the Japanese hydrosoft registry.
H. Imamura, N. Sakai, Y. Ito, C. Sakai, A. Hyodo, S. Miyachi, Y. Matsumaru, S. Yoshimura, T. Abe, H. Yamagami, M. Hayakawa, H. Sato, T. Fujinaka, K. Tanabe, *Japan*

08.20–08.22 P 079
Comparison of surgical clipping vs endovascular coiling for posterior projecting anterior communicating artery aneurysm.
N.U.H. Maria, U. Rasheed, *Pakistan*

08.22–08.24 P 080
Multimodality treatment for coil migration during endovascular embolization.
S.Y. Chung, *South Korea*

08.24–08.26 P 081
Acute treatment strategy and perioperative management of ruptured cerebral aneurysm accompanied with hematoma.
K. Muraoka, Y. Kegoya, Y. Sotome, Y. Matsuda, Y. Sato, T. Tanabe, N. Hirotsune, S. Nishino, *Japan*

08.26–08.28 P 082
Salvage of coil embolization with nbca for a ruptured aneurysm.
S. Echizenya, M. Kawabori, K. Hurukawa, M. Iwasaki, T. Osanai, Y. Niiya, *Japan*

08.28–08.30 P 083
Intraprocedural rupture management for intracranial aneurysm rupture during coil embolization by manual common carotid artery compression.
J.H. Kim, *South Korea*

08.30–08.32 P 084
Analysis of the recanalization of brain aneurisms post embolization.
L.J. Haas, G.V. Staedele, W.R. Berticelli, M. Becker, M.C. Harger, C.B. Lima, J. Martins, B.R. Sabel, F.J. Cobra, M.D. Soares, L.C.O. Camilo, V.D. De Almeida, C.G.J.L. Brasileiro, J.D. Hessmann, L.M. Silva, B. Sartori, D. Malacarne, A. De Oliveira Junior, D. De Lara, F.L. Cabral, C.I.C. Bernardes, V.H.T. Boer, L.R.G.O. Mello, *Brazil*

08.32–08.34 P 085
Recurrence of aneurysm with incorporated aneurysm after coil embolization.
H.J. Bae, *South Korea*

08.34–08.36 P 086
De novo intracranial aneurysms detected on imaging follow-up of coiled aneurysms in Korean population.
C. Ryu, Y. Cho, E. Yeon, E. Kim, *South Korea*

08.36–08.38 P 087
Impact of reducing the procedure time on thromboembolism after coil embolization of cerebral aneurysms.
H.J. Choi, J.P. Jeon, J.S. Yang, S.H. Kang, Y.J. Cho, S.H. Lee, *South Korea*

08.38–08.40 P 088
Suspected distal embolization of metallic material during cerebral aneurysm coiling: detection using susceptibility weighted MR imaging.
D.H. Yoo, Y.D. Cho, H.S. Kang, *South Korea*

08.40–08.42 P 089
Cross-regional embolization technique in the treatment of intracranial irregular aneurysm.
Y. E., Z.L. *China*

08.42–08.44 P 090
Scaffolding technique: a new double-catheter technique in the coil embolization of wide-necked aneurysms.
K. Murao, *Japan*

08.44–08.46 P 091
Proposal of shaping for micro catheter by three-dimensional imaging.
K. Fukasaku, H. Yokota, K. Takahashi, H. Yoshioka, F. Saito, M. Negoro, *Japan*

08.46–08.48 P 092
Extra-cranial internal carotid artery aneurysms: results and outcome after surgical and endovascular treatment.
F. Taglialatela, A. Sonetto, S. Isceri, C. Barbara, A. Pilato, G. Faggioli, M. Gargiulo, L. Simonetti, *Italy*

08.48–08.50 P 093
Treatment of pseudoaneurysm of internal maxillary artery resulting from needle injury – case report.
J.Y. Kim, J.W. Choi, Y.M. Koo, *South Korea*

09.00–10.00 **E-POSTERS AREA**
Poster Session 5: Aneurysms **P 094 to P 118**

Moderator: **S. Gallas**, *France*

09.00–09.02 P 094
Endovascular treatment of extracranial pseudoaneurysm by flow divertion technique.
F. Petra, **A. Aguado, G. Caballero, J. Lizundia, M. Grana, L. Parra**, *Argentina*

09.02–09.04 P 095
Stent assisted aneurysm coiling in acute subarachnoid haemorrhage.
A. Kumar, M. Joshi, V. Bhatia, S. Vyas, C. Ahuja, *India*

09.04–09.06 P 096
A radiologic and clinical comparison of neuroform ATLAS and LVIS jr stent assisted coil embolization for unruptured cerebral aneurysms in distal small branches.
J.W. Baek, H.W. Jeong, S.T. Kim, Y.G. Jeong, J.H. Seo, S.C. Jin, O.K. Kwon, *South Korea*

09.06–09.08 P 097
Rescue stenting using the neuroform atlas stent during coil protrusion for ruptured intracranial aneurysms.
V. Semeraro, M. P. Ganimede, S Vidali, E Lozupone, N M Lucarelli, V Gisone, M Resta, N Burdi, *Italy*

09.08–09.10 P 098
The use of bare stent in less than 2.0 mm cerebral artery for aneurysm treatment.
H. Yoshioka, T. Uno, A. Kambe, H. Takeuchi, M. Sakamoto, M. Kurosaki, *Japan*

09.10–09.12 P 099
Antiplatelet therapy for stent-assisted coil embolization of cerebral aneurysms.
H. Fukumoto, Y. Horio, K. Fukuda, M. Iwaasa, K. Nii, T. Inoue, T. Higashi, *Japan*

09.12–09.14 P 100
A case of symptomatic multiple cerebral enhancing lesions after stent-assisted coil embolization of unruptured cerebral aneurysm.
M. Katayama, M. Murase, S. Suga, S. Suga, *Japan*

09.14–09.16 P 101
Treatment of unruptured intracranial aneurysms using the pipeline embolization device: a single-center experience with short-term follow-up results.
M. Zhou, H. Lu, G. Li, H. Zhang, *China*

09.16–09.18 P 102
A single-center experience with flow-diverter devices for intracranial unruptured aneurysm treatment.
T.K. Jee, P. Jeon, *South Korea*

09.18–09.20 P 103
Efficacy and safety of flow diverter stents in the treatment of cerebral aneurysms less than five mm.
E. Akgul, H. B. Onan, H.T. Balli, Z. Gungoren, E .H. Aksungur, *Turkey*

09.20–09.22 P 104
Flow-diverter stents in aneurysmal subarachnoid hemorrhage.
A. Alexandre, F. Giubbolini, G. Garignano, I. Valente, E. Lozupone, F. D'argento C. Colosimo, A. Pedicelli, *Italy*

09.22–09.24 P 105
Single center experience in mini flow-diverter aneurysm embolization.
N. Marotti, U. Rozzanigo, G. Luppi, A. Comai, F. Ferro, G. Nano, M. Bonatti, B. Petralia, *Italy*

09.24–09.26 P 106
Stentriever anchor technique during aneurysms embolization with flow-diverter.
G. Garignano, E. Lozupone, A. Alexandre, F. D'Argento, I. Valente, A. Pedicelli, *Italy*

09.26–09.28 P 107
Delayed high jet flow into an aneurysm after flow diverter placement.
R. Nakae, T. Takigawa, Y. Kawamura, Y. Tanaka, M. Nagaishi, A. Hyodo, K. Suzuki, H. Yokota, *Japan*

09.28–09.30 P 108
Open versus flow diversion treatment of small unruptured carotid-ophthalmic aneurysms: a sistematic review.
E. Paschoal, C. R. Orocha, A. C. Pires, L. Lobato, F. LA. Tobelem, L. Msantos, M. Isr, A. Ldcosta, F. M Paschoal Jr, R. Mrburbano, J. Rnbrito , J. Srogerio, Â. R-Dos-Santos, J. Aslima, A. de M. Lima Neto, *Brazil*

09.30–09.32 P 109
Factors associated with ipsilateral distant subarachnoid hemorrhage after flow diverter placement.
T. Kikuchi, A. Ishii, M. Okawa, Y. Yamao, H. Nishi, I. Ono, S. Miyamoto, *Japan*

09.32–09.34 P 110
Delayed rupture of ic cavernous large aneurysm after ped treated by transarterial coil/onyx embolization.
I. Nakahara, S. Matsumoto, Y. Suyama, J. Oda, A. Hasebe, T. Suzuki, J. Tanabe, S. Watanabe, K. Suyama, *Japan*

09.34–09.36 P 111
In vivo aneurysm pressure transition for several hours after placement of a pipeline embolization device.
H. Chihara, A. Ishii, T. Kikuchi, H. Ikeda, D. Arai, S. Miyamoto, *Japan*

09.36–09.38 P 112
Application of 3D fusion in pipeline apposition evaluation.
Y. Lviu, *China*

09.38–09.40 P 113
Occlusion rate of flow diverter depends on aneurysm morphology.
T. Sunohara, N. Sakai, H. Imamura, S. Tani, H. Adachi, R. Fukumitsu, N. Fukui, Y. Oomura, T. Akiyama, T. Fukuda, *Japan*

09.40–09.42 P 114
Neurointerventional management of large or giant aneurysm in the circle of Willis by using physiologic flow diversion
B. Kwon, Y. Song, J. Ryu, D.C. Suh, *Japan*

09.42–09.44 P 115
Comparison of hemodynamic stress of healthy side artery in parent artery occlusion and flow diverter stent treatment for large internal carotid artery aneurysm with 3D cine PCMR analysis.
T. Tsukada, T. Izumi, M. Nishihori, R. Ooshima, T. Kawaguchi, K. Ootawa, A. Kropp, S. Gotou, M. Ikezawa, H. Isoda, T. Wakabayashi, *Japan*

09.44–09.46 P 116
Mega giant partially thrombosed aneurysm of the anterior communicating artery: an astonishing surgical treatment and clinical outcome.
C. Bombardieri, C. Ceccotti, K. Pardatscher, T. Fukushima, *Italy, USA*

09.46–09.48 P 117
A single-center experience in the endovascular treatment of carotid siphon aneurysms using the WILLIS covered stent.
C. Fang, L. Ma, J. Xu, S. Yan, H. Feng, *China*

09.48–09.50 P 118
Long-term follow-up of intracranial fusiform aneurysms of vertebral arteries.
S. Kohyama, S. Iihoshi, S. Kasakura, S. Yoshikawa, E. Tsukagoshi, F. Yamane, *Japan*

10.00–11.00 **E-POSTERS AREA**
Poster Session 6: Aneurysms **P 119 to P 142**

Moderator: L. Biscoito, *Portugal*

10.00–10.02 P 119
Bilateral vertebral artery dissecting aneurysm: compressing brain stem, hidden aneurysm.
K. Chae, Y. Choo, S. Lee, *South Korea*

10.02–10.04 P 120
Lateral medullary infarction after distal vertebral artery trapping for management of dissecting aneurysm.
J.W. Choi, Y.S. Seo, D.H. Kim, J.Y. Kim, *South Korea*

10.04–10.06 P 121
Endovascular treatment with stents for ruptured dissecting aneurysms.
A. Ito, Y. Suzuki, Y. Oyama, K. Uno, M. Miyamoto, K. Hoya, F. Yamane, A. Matsuno, *Japan*

10.06–10.08 P 122
Delayed development of de novo contralateral vertebral artery dissecting aneurysm after endovascular treatment (2 cases).
J. Cho, Y. Kwak, *South Korea*

10.08–10.10 P 123
Endovascular treatment of dissecting aneurysm of the posterior communicating artery.
T. Kataoka, K. Takahira, *Japan*

10.10–10.12 P 124
A case of early migration of intracranial stent after dissection aneurysm treatment.
J. Cho, S. Kim, K. Cho, Y. Na, M. Kang, Y. Na, Y. Lee, *South Korea*

10.12–10.14 P 125
A ruptured recurrence aneurysm of posterior inferior cerebellar artery associated with persistent primitive hypoglossal artery.
T. Naito, T. Hasegawa, T. Kato, T. Tanei, K. Ishii, E. Tsukamoto, *Japan*

10.14–10.16 P 126
Clinical and angiographic outcome of ruptured blood blister-like aneurysms of the internal carotid artery with stents-assisted coil embolization: single center experience.
Y.K. Ihn, J.H. Sung, D.H. Lee, H.J. Lee, J.H. Shin, *South Korea*

10.16–10.18 P 127
Complementary functions of open surgery and endovascular treatment in ruptured internal carotid artery dorsal wall aneurysm (2 cases).
J. Cho, Y. Kwak, *South Korea*

10.18–10.20 P 128
Re-rupture of a ''successfully treated'' dissecting ICA aneurysm.
U.M. Ciochon, G. Gal, G. Benndorf, *Denmark*

10.20–10.22 P 129
Effectiveness of parent artery occlusion with NBCA and coils for peripheral cerebral artery aneurysm.
S. Fujita, M. Hayashi, R. Suzuki, N. Hirai, Y. Hiramoto, H. Nakayama, N. Saito, K. Ito, K. Aoki, S. Iwabuchi, *Japan*

10.22–10.24 P 130
Intracranial mycotic aneurysms caused by an extremely rare bacterium, Corynebacterium Diphtheriae in developing country.
E. Chanthanaphak, V. Suraratdecha, S. Chaovorawinyoo, M. Apirakkan, *Thailand*

10.24–10.26 P 131
Unusual presentation of infectious intracranial aneurysm with sequential hemorrhagic and ischemic components.
J.H. Ko, J.W. Chung, J.S. Ahn, *South Korea*

10.26–10.28 P 132
Small aneurysms may grow fast.
N. Fujumura, S. Nakashima, T. Aoki, R. Sakamoto, Y. Okamoto, M. Morioka, *Japan*

10.28–10.30 P 133
Vessel wall imaging of unruptured intracranial aneurysms
T. Matsushige, K. Shimonaga, T. Mizoue, H. Takahashi, Y. Hashimoto, M. Kaneko, C. Ono, S. Sakamoto, K. Kurisu, *Japan*

10.30–10.32 P 134
3D HR MR VWI (3-dimensional high-resolution magnetic resonance vessel wall imaging) for the evaluation and management of cerebral aneurysms
S. Suh, W. Yoon, H. Roh, H. Bae, T. Kwon, *South Korea*

10.32–10.34 P 135
Aneurysm wall enhancement a biomarker of aneurysm progression?
E. Paschoal, L. Batista, M. Piani, G. A Lien, *Brazil*

10.34–10.36 P 136
Quantitative wall enhancement of unruptured aneurysms on vessel wall imaging MRI is associated with growth on delayed angiography.
M. Alexander, A. De Havenon, J. Mcnally, A. Elkhatali, D. Parker, S. Kim, P. Taussky, R. Grandhi, *USA*

10.36–10.38 P 137
Quantitative wall enhancement increases with size of unruptured aneurysms on vessel wall imaging MRI.
M. Alexander, A. De Havenon, J. McNally, A. Elkhatali, D. Parker, S. Kim, P. Taussky, R. Grandhi, *USA*

10.38–10.40 P 138
Persistent enhancement of unruptured cerebral aneurysm following endovascular treatment compared to untreated aneurysms.
M. Alexander, A. De Havenon, J. McNally, A. Elkhatali, D. Parker, S. Kim, P. Taussky, R. Grandhi, *USA*

10.42–10.44 P 139
Creation of elastase-induced aneurysms in rabbits.
Y. Zhang, Y. He, T. Li, *China*

10.44–10.46 P 140
The use of Chitosan gel as an embolic agent in experimental aneurysm models of rabbits: a focus on angiographic and histopathologic findings.
D.H. Hwang, K.J. Lee, S.T. Park, C.W. Hur, J. Hur, M.J. Lee, B.K. Kwack, *South Korea*

10.46–10.48 P 141
Spontaneous intracranial hypotension as a rare complication of aneurysmal subarachnoid hemorrhage.
A. Rustici, L. Cirillo, M. Dall'olio, C. Princiotta, M. Cellerini, *Italy*

10.48–10.50 P 142
Global mirna expression profile reveals novel molecular players in aneurysmal subarachnoid haemorrhage
E. Paschoal, F. M. Paschoal Jr, V. Apabastos, E. B-S-Shu, Â. R-Dos-Santos, *Brazil*

11.00–11.15 **E-POSTERS AREA**
Poster Session 7: Vasospasm **P 143 to P 147**

Moderator: D. C. Suh, *South Korea*

11.15–11.17 P 143
Early detection of cerebral vasospasm or delayed cerebral ischemia after subarachnoid hemorrhage: a meta-analysis.
E. Paschoal, F. Mtuji, A. P. Lobo, F. M Paschoal Jr, R. Mrburbano, V. Apabastos, A. R-Dos Santos, J. Srogerio, A. O. Barbosa, E. B-S-Shu, *Brasil*

11.17–11.19 P 144
Early detection of vasospasm using ct perfusion after aneurysmal subarachnoid hemorrhage.
S.Y. Kim, K.C. Cho, J.M. Cho, *South Korea*

11.19–11.21 P 145
Dual antiplatelet therapy associated with reduced risk of clinical vasospasm in aneurysmal subarachnoid hemorrhage
D.W. Kim, *South Korea*

11.21–11.23 P 146
Intra-arterial injection of fasudil hydrochloride for cerebral vasospasm secondary to bacterial meningitis
T. Ishikawa, K. Yamaguchi, T. Funatsu, S. Eguchi, Y. Omura, T. Nonaka, T. Kawamata, *Japan*

11.23–11.25 P 147
Arterial spin labeling magnetic resonance imaging to diagnose contrast-induced vasospasm after intracranial stent embolization.
G. Frauenfelder, R. Saponiero, G. Locatelli, A. Siani, S. Tartaglione, D.G. Romano, *Italy*

11.15–11-45 **E-POSTERS AREA**
Poster Session 8: AVM **P 148 to P 159**

Moderator: G. Lanzino, *USA*

11.15–11.17 P 148
Silent MRA; arterial spin labeling magnetic resonant angiography with ultra-short time echo assessing cerebral arteriovenous malformation.
N. Arai, T. Akiyama, H. Fujiwara, M. Jinzaki, K. Yoshida, *Japan*

11.17–11.19 P 149
Cure of cerebral arteriovenous malformation after partial embolization is just a chance or a hemodynamic process.
A. Sultan, T.I. Metwally, T. Hassan, *Egypt*

11.19–11.21 P 150
Posterior fossa arteriovenous malformations: a review of natural history and patient outcome in Siriraj hospital.
A. Potigumjon, A. Churojana, T. Aurboonyawat, E. Chankaew, D. Songsaeng, B. Sangpetngam, P. Withyasak, *Thailand*

11.21–11.23 P 151
Preliminary experience with novel liquid embolising agent: precipitating hydrophobic injectable liquid (PHIL).
A. Kumar, V. Bhatia, *India*

11.23–11.25 P 152
The endovascular management of brain arteriovenous malformations by ethanol sclerotherapy.
Y. He, W. Bai, T. Li, *China*

11.25–11.27 P 153
Microcatheter rupture during AVM embolization and management in anterior choroidal artery: a case report.
T.Y. Kim, D.W. Park, *South Korea*

11.27–11.29 P 154
De novo AVM in asymptomatic adult patient.
L. Milonia, E. Lozupone, P. Trombatore, F. D'argento, A. Alexandre, I. Valente, C. Colosimo, A. Pedicelli, *Italy*

11.29–11.31 P 155
The value of intraoperative angiography for excision of brain arteriovenous malformation.
P. Lueangapapong, C. Kobkitsuksakul, S. Pongpech, *Thailand*

11.31–11.33 P 156
Patients eye lens dose during brain ArterioVenous Malformation (AVM) interventional neuroradiology (INR) procedure.
R. Wongsung, R. Thana, J. Tantivatana, A. Krisanachinda, *Thailand*

11.33–11.35 P 157
Relationship between Notch4 gene polymorphism and brain arteriovenous malformation development: a systematic review.
E. Paschoal, F. M Paschoal Jr, V. A.P.A. Bastos, R. M.R.Burbano, F. M.Tuji, E. B-S-Shu, Â. R-Dos-Santos, *Brazil*

11.35–11.37 P 158
Relationship of specific genetics polymorphisms as a risk factors for the brain arteriovenous malformations development: a systematic review.
E. Paschoal, L. M.Santos, V. A.P.A.Bastos, F. M.Paschoal Jr, V. F.R.Farias, C. R.O.Rocha, A. C.Pires, A. L.D.Costa, J. R.N.Brito, G. A.L.R. Andrade, F. L.A.Tobelem, R. M.R.Burbano, M. I.S. Rocha, E. B-S-Shu, E. G.Figueiredo, Â. R-Dos-Santos, *Brazil*

11.39–11.41 P 159
MIRNAS profile in patients with brain arteriovenous malformation.
E. Paschoal, G. S. J-A-Liem, V. N. Yamaki, J. A. Doss. Lima, F. M. Paschoal Jr, J. R.N. Brito, J. S. Rogerio, J. M. De Jesus, R. M.R. Burbano, F. M.Tuji, V. A.P.A. Bastos, L. M. Santos, V. F.R. Farias, C. R.O. Rocha, A.C. Pires, E. G. Figueiredo, E. B.-S.-Shu, Â. R-Dos-Santos, *Brazil*

11.45–12.45 **E-POSTERS AREA**
Poster Session 9: AVF **P 160 to P 185**

Moderator: A. Consoli, *Italy*

11.45–11.47 P 160
Diploic arteriovenous fistulas: report of 2 cases.
R. Anxionnat, S. Bracard, R. Tonnelet, A.L. Derelle, L. Liao, B. Gory, *France*

11.47–11.49 P 161
Neuronavigation system might be useful for direct puncture of the targeted venous sinus in embolization of dural arteriovenous fistula.
Y. Nakagawa, Y. Mine, H. Kagami, M. Inaba, *Japan*

11.49–11.51 P 162
Initial experience of steerable microcatheter for the selective tve of dural AVFs.
K. Tokuyama, H. Kiyosue, Y. Hori, H. Nagatomi, M. Okahara, *Japan*

11.51–11.53 P 163
Angioarchitecture of cranial ventral type dural arteriovenous fistulas: embryological, anatomical, and clinical considerations,
N. Toma, Y. Suzuki, Y. Miura, M. Shiba, H. Suzuki, *Japan*

11.53–11.55 P 164
Clinical significances of dural arteriovenous shunts with retrograde cortical venous ectasiae.
F. Yamane, S. Kohyama, M. Miyamoto, K. Uno, A. Itou, A. Matsuno, *Japan*

11.55–11.57 P 165
A case of ethmoidal dAVF treated with transarterial embolization.
M. Yokota, T. Oshima, R. Kawaguchi, N. Matsuo, S. Miyachi, *Japan*

11.57–11.59 P 166
Dural arteriovenous fistula with vein of Galen dilatation mimicking vein of Galen malformation in adult.
J.W. Choi, J.Y. Kim, *South Korea*

11.59–12.01 P 167
Angioarchitecture and endovascular treatment results of tentorial dural arteriovenous fistulas: four different locations
H. Kiyosue, S. Ide, Y. Hori, K. Tokuyama, M. Okahara, *Japan*

12.01–12.03 P 168
Diagnosis and treatment of dural arteriovenous fistulas with superior petrosal vein.
Y. Cheng, Y. Ma, H. Zhang, F. Ling, *China*

12.03–12.05 P 169
Intracranial dural arteriovenous fistula mimicking pontine glioma.
Y.W. Kim, *South Korea*

12.05–12.07 P 170
Prognosis of the patients with dural arteriovenous fistulas in the sigmoid sinus.
T. Akiyama, T. Horiguchi, S. Takahashi, K. Yoshida, *Japan*

12.07–12.09 P 171
Superselective transvenous coil embolization for dural AVF at hypoglossal canal.
H. Ohta, K. Saitou, K. Yokogami, H. Takeshima, *Japan*

12.09–12.11 P 172
Arteriovenous fistulas at the craniocervical junction.
L.X. Xu, Y. Ma, H. Zhang, M. Li, G. Li, L. Sun, *China*

12.11–12.13 P 173
Transarterial N-BUTYL-2 cyanoacrylate embolization for dural arteriovenous fistula of the sinus of the lesser sphenoid wing.
R. Kikuchi, T. Akiyama, A. Nakamura, H. Miyazaki, *Japan*

12.13–12.15 P 174
Trigemino-carvernous fistula treated by balloon embolization.
V. Suraratdecha, M. Apirakkan, *Thailand*

12.15–12.17 P 175
Cortical dAVF mimicking a cavernous sinus fistula obscured by MRI.
R. Holmoe Dahl, V. Eskesen, G. Benndorf, *USA*

12.17–12.19 P 176
Endovascular therapy for carotid-cavernous sinus dural arteriovenous fistula without cortical venous reflux presenting with severe retro-orbital pain
T. Funatsu, T. Ishikawa, S. Eguchi, K. Yamaguchi, T. Kawamata, *Japan*

12.19–12.21 P 177
Selective transvenous embolization combined with balloon angioplasty of occluded inferior petrosal sinus for the treatment of cavernous sinus dural arteriovenous fistulas.
S. Ide, H. Kiyosue, K. Tokuyama, Y. Hori, M. Okahara, R. Shimada, Y. Hisamitsu, T. Kubo, *Japan*

12.21–12.23 P 178
The so called ''occult'' inferior petrosal sinus.
R. Holmoe Dahl, G. Benndorf, *USA*

12.23–12.25 P 179
Cavernous sinus dural fistula in a patient with graves ophtalmopathy: complete resolution after medical treatment.
N. Cavasin, E. Cagliari, M. Cazzagon, M. Bellamio, T. Scaravilli, *Italy*

12.25–12.27 P 180
Treatment of carotid-cavernous fistula presenting with contralateral exophthalmos; several experiences of graft stent.
S.Y. Chung, M.S. Park, S.H. Chang, *China*

12.27–12.29 P 181
Comparison of radiosurgery and endovascular treatment outcomes for cavernous sinus dural arteriovenous fistulas.
C.B. Luo, C. Lin, H. Yang, W. Guo, H. Wu, W. Chung, *China*

12.29–12.31 P 182
A case of traumatic carotid-cavernous fistula associated with persistent primitive trigeminal artery successfully treated by in-stent coil embolization.
R. Kawaguchi, T. Oshima, N. Matsuo, S. Miyachi, *Japan*

12.31–12.33 P 183
First experience of endovascular treatment of post-traumatic carotid-cavernous fistulas using flow-diverter stents.
A. Sufianov, S. Karasev, R. Khafizov, R. Rustamov, R. Sufianov, *Russia*

12.33–12.35 P 184
Spontaneous resolution traumatic carotid cavernous fistula associated with venous outlet stenosis: two case reports.
M. Apirakkan, *Thailand*

12.35–12.37 P 185
Angiographic change on time interval in traumatic-direct carotid cavernous fistula without venous reflux, and treatment with LVIS stent alone.
C.Y. Lee, *South Korea*

Wednesday, 23rd October 2019

08.00–09.30 **AUDITORIUM EUROPA**
Plenary Session 5: Spinal AVMs & Dural AVFs

Chairperson: F. Ling, *China*
Moderators: A. Casasco, *Spain* – **G. Rodesh**, *France*

08.00–08.30 The debate on the technique of treatment of Spinal Dural AVFs:
Almost all must be treated by embolization
H. Henkes, *Germany*
Almost all must be treated by surgery
E. Houdart, *France*

08.30–08.45 Particles embolization is often the best technique for medullary AVMs
E. Houdart, *France*

08.45–09.00 Advantage of NBCA in Embolization of Spinal Cord AVMs
S. Kominami, *Japan*

09.00–09.15 Paravertebral and Osteo-dural Shunts
D. C. Suh, *South Korea*

09.15–09.30 Discussion

09.30–10.00 **The Pierre Lasjaunias Memorial Lecture**
High-resolution intravascular imaging in neurointervention
M. Gounis, *USA*

10.00–10.30 **Coffee Break**

10.30–11.30 **AUDITORIUM EUROPA**
Plenary Session 6: Intracranial and Internal Carotid Artery Stenosis

Chairperson: H. Zhang, *China*
Moderators: T. Andersson, *Sweden* – **L. Thines**, *France*

10.30–10.45 Management of Atherosclerotic and Dissecting Intracranial stenosis
L. Jiao, *China*

10.45–11.00 Results of endovascular techniques in the treatment of Internal Carotid Artery Disease
B. Moon, *South Korea*

11.00–11.15 Surgical management of Moya-Moya and Moya-Moya like stenosis
M. Czabanka, *Germany*

11.15–11.30 Discussion

11.30–13.00 **AUDITORIUM EUROPA**
Plenary Session 7: From Bench to Bed – Research and Development

Chairperson: A. Wakhloo, *USA*
Moderators: G. Benndorf, *Denmark* – **E. Ciceri,** *Italy*

11.30–11.45 Braiding technology for aneurysm treatment devices
C. Iosif, *Greece*

11.45–12.00 Myth or Reality in reduced thrombogenicity surface modification of new devices: do clinical results confirm laboratory data?
D. Lopes, *USA*

12.00–12.15 Are simulation, animal and flow models useful in the treatment of ICAs?
V. Constalat, *France*

12.15–12.30 Selective Brain Cooling in Acute Ischemic Stroke
W. Brinjikji, *USA*

12.30–12.45 Neuro-Oncology: MR-guided intra-arterial treatments
S. Hetts, *USA*

12.45–13.00 Discussion

13.00–14.00 **Lunch**

13.00–14.00 **EGADI ROOM** **Industry sponsored Symposium**

14.00–15.30 **AUDITORIUM EUROPA**
Oral papers – Parallel Session J: AVMs 1 **O 122 to O 132**

Moderators: S. Renowden, *UK* – **M. Longo**, *Italy*

14.00–14.06 O 122
3T PET-MRI analysis of unruptured brain AVMs: a single-center preliminary experience.
D. Simonato, M. Anglani, G. Cester, J.D. Gabrieli, M. Colasurdo, D. Cecchin, F. Causin, *Italy*

14.08–14.14 O 123
Radiographic visualization performance of liquid embolic agents.
J. Mason, G. Benndorf, *Denmark*

14.16–14.22 O 124
Multimodal cerebral arteriovenous malformation treatment: a 12-year cohort with comparison to the ARUBA trial.
B. Pulli, P.H. Chapman, C.S. Ogilvy, C.J. Stapleton, A.B. Patel, T.M. Leslie-Mazwi, J.A. Hirsch, J.D. Rabinov, *USA*

14.24–14.30 O 125
Management strategies for complex brain arterio-venous malformations: early experience.
W. Aziz, *United Arab Emirates*

14.32–14.38 O 126
Morbidity and mortality associated with sequential flow reduction embolization technique of cerebral arteriovenous malformations with n-butyl cyanoacrylate (N-BCA).
J A. Alara, M. Mohammaden, D. Brunozzi, G. Atwal, F. Charbel, *USA*

14.40–14.46 O 127
Pre-operative embolisation of ArterioVenous Malformations (AVMs) using the precipitating hydrophobic injectable liquid (PHIL) embolic agent in a same day dual procedure: a case series.
J. Siddiqui, P. Grover, M. Murphy, P. Rangi, *USA, UK*

14.48–14.54 O 128
Initial experience with micro vascular plug for the treatment of grade 4 and 5 cerebral ArterioVenous Malformations (AVMs).
A. Rustici, L. Cirillo, M. Dall'Olio, C. Princiotta, M. Cellerini, *Italy*

14.56–15.02 O 129
Transvenous embolization for brain arteriovenous malformations: curability vs safety?
Y. He, W. Bai, T. Li, *China*

14.04–15.10 O 130
Forced injection of PHIL liquid embolic agent by dual lumen balloons in treatment of complex arteriovenous fistulas using coaxial technique, single operator experience.
L. Borota, *Sweden*

15.12–15.18 O 131
Cranial pial arteriovenous fistulae – a series of 41 cases.
L. J. D. Sebastian, N. Jain, P.K. Thimmegowda, A. Garg, S.B. Gaikwad, *India, USA*

15.20–15.26 O 132
Recurrence of brain arteriovenous malformations following apparent angiographic cure
S. Hetts, A. Copelan, R. Khangura, G. Drocton, M. Amans, A. Abla, N. Gupta, H. Fullerton, C. Dowd, V. Halbach, R. Higashida, H. Kim, J. Nelson, D. Cooke, *USA*

14.00–15.30 **EGADI ROOM**
Oral papers – Parallel Session K: Dural AVFs 1 **O 133 to O 143**

Moderators: H. Zhang, *China* – **A. Rouchaud**, *France*

14.00–14.06 O 133
Application of four-dimensional magnetic resonance angiography without contrast enhancement for intracranial dural arteriovenous fistulas.
K. Tokairin, T. Osanai, N. Fujima, K. Houkin, *Japan*

14.08–14.14 O 134
Intracranial dural arteriovenous fistulae: an institutional experience and proposal of a new functional classification system.
L.J.D. Sebastian, A. Jain, P.K. Thimmegowda, A. Garg, S.B. Gaikwad, *India*

14.16–14.22 O 135
Endovascular embolization of 103 cranial dural arteriovenous fistulas with Onyx: an observational study with analyses of occlusion rates, complication rates and the influence of angioarchitectural features on the treatment success.
D. Vollherbst, C. Herweh, S. Schönenberger, F. Seker, S. Nagel, P. Ringleb, M. Bendszus, M. Möhlenbruch, *Germany*

14.24–14.30 O 136
Trans arterial embolization of intracranial dural arteriovenous fistulas in the Onyx embolic era: a Kobe experience.
Y. Omura, H. Imamura, S. Tani, H. Adachi, R. Fukumitsu, T. Sunohara, N. Fukui, N. Sasaki, T. Akiyama, T. Fukuda, S. Kajiura, M. Shigeyasu, K. Asakura, R. Horii, N. Sakai, *Japan*

14.32–14.38 O 137
Preliminary experience of endovascular embolization of cerebral dural arteriovenous fistulas with Squid 12.
E. Lozupone, P. Trombatore, L. Milonia, F. D'argento, A. Alexandre, I. Valente, C. Colosimo, A. Pedicelli, *Italy*

14.40–14.46 O 138
Transarterial balloon-assisted liquid embolization of dural arteriovenous fistulas using a dual-lumen micro-balloon catheter.
D. Vollherbst, C. Herweh, S. Schönenberger, S. Nagel, M. Bendszus, M. Möhlenbruch, *Germany*

14.48–14.54 O 139
Transvenous coil-assisted liquid embolisation of intracranial dural arteriovenous fistulae.
N. Mahboobani, P.T. Yuen, J.K. Sham, V.W.T. Chan, K.W. Shek, K.F. Fok, W.L. Poon, *Hong Kong*

14.56–15.02 O 140
Endovascular treatment by transarterial approach of anterior ethmoidal dural arterio-venous fistulas (dAVF). The experiences of a single center.
F. Di. Caterino, G. Vitale, F. Descourvieres, A. Biondi, *France*

14.04–15.10 O 141
Endovascular treatment of anterior cranial fossa fistulas: the significance of retrograde transvenous approach.
B. Pabon, C. Diaz, O. Vargas, J. Mejia, M. Patiño, N. Serna, *Colombia*

15.12–15.18 O 142
Posterior fossa dural arteriovenous fistulas: outcomes of endovascular treatment.
L. Detraz, K. Orlov, V. Berestov, V. Borodetsky, A. Rouchaud, L. Mattos, C. Mounayer, *France, Russia*

15.20–15.26 O 143
Angiographic anatomy and endovascular treatment of the lateral foramen magnum dural arteriovenous fistula
H. Kang, T. Boonchai, D. Yoo, Y. Cho, M. Han, *South Korea*

14.00–15.30 **STROMBOLI ROOM**
Oral papers – Parallel Session L: AVM, Dural AVFs 2 and Miscellaneous **O 144 to O 154**

Moderators: M. Szainer, *Poland* – **W. Brinjikji**, *USA*

14.00–14.06 O 144
Endovascular treatment of craniofacial high flow artero-venous malformation – blessing or curse?
A. Ferrari, F. Schirru, F. Fusaro, S. Corraine, V. Palmisano, C. Ganau, S. Comelli, *Italy*

14.08–14.14 O 145
Adenosine-triphosphate induced cardioplegia in endovascular treatment of high-flow AVM fistulas.
A. Petrov, S. Goroshenko, A. Ivanov, L. Rozchenko, *Russia*

14.16–14.22 O 146
Statin intake is associated with a lower degree of venous stenosis in patients with non haemorrhagic cerebral arteriovenous malformations.
A. Alaraj, H. Mostafa, A. Hussein, M. Mohammaden, D. Brunozzi, G. Atwal, F. Charbel, *USA*

14.24–14.30 O 147
Bevacizumab effect on an angiogenesis animal model.
C. Papagiannaki, F. Clarencon, C. Yardin, C. Mounayer, C. Couquet, *France*

14.32–14.38 O 148
Cerebral Proliferative Angiopathy: 14 cases in a single-center and a systematic review.
E. Paschoal, G. S. J-A-Liem, V. N.Yamaki, F. M. Pachoal Jr, J. R.N.Brito, J. M.De Jesus, R. M.R.Burbano, F. M.Tuji, V. A.P.A.Bastos, E. G.Figueiredo, M. J.Teixeira, J. A.Dos S.Lima, A. De M.Lima Neto, Â.R. Dossantios, E. B.SS, *Brazil*

14.40–14.46 O 149
Efficacy of intraoperative cone beam computed tomography in evaluating and treating cavernous sinus dural arteriovenous fistula.
K. Kadooka, M. Tanaka, *Japan*

14.48–14.54 O 150
Different techniques of carotido-cavernous fistula embolization: single center experience.
F. Hassan, *Egypt*

14.56–15.02 O 151
Consideration of relationships between shunt segments and draining veins in the cavernous sinus dural arteriovenous fistulae.
S. Eguchi, T. Ishikawa, T. Funatsu, B. Ryu, K. Yamaguchi, T. Kawamata, *Japan*

15.04–15.10 O 152
Cavernous dural arteriovenous fistula presenting as headache without high intraocular pressure.
M. Miyamoto, Y. Oyama, T. Uno, A. Ito, F. Yamane, A. Matsuno, *Japan*

15.12–15.18 O 153
Utility of flow diverter stent in Slow Flow Carotid Cavernous Fistulas (SFCCFs).
F. Petra, A. Aguado, G. Caballero, J. Lizundia, M. Grana, L. Parra, *Argentina*

15.20–15.26 O 154
Flow diversion in direct carotid cavernous fistula – a way to get out of the corner?
F. Schirru, F. Fusaro, S. Corraine, A. Ferrari, V. Palmisano, C. Ganau, S. Comelli, *Italy*

14.00–15.30 **PANAREA ROOM**
Oral papers – Parallel Session M: Aneurysms *Multimodality / Surgery* **O 155 to O 165**

Moderators: I. Szikora, *Hungary* - **P. Primikiris**, *Greece*

14.00–14.06 O 155
Endovascular treatment of middle cerebral artery aneurysms: a single center experience of 320 aneurysms.
L.J. Haas, B.R. Sabel, J. Martins, G.V. Staedele, W.R. Berticelli, M. Becker, M.C. Harger, C.B. Lima, F.J. Cobra, M.D. Soares, L.C.O. Camilo, V.D. De Almeida, C.G.J.L. Brasileiro, J.D. Hessmann, J.M. Silva, V.H.T. Boer, D. De Lara, C.I.C. Bernardes, F.L. Cabral, A. De Oliveira Junior, B. Sartori, D. Malacarne, L.R.G.O.M. Mello, *Brazil*

14.08–14.14 O 156
Endovascular treatment of complex superior cerebellar artery aneurysms using different techniques.
V. Kiselev, R. Gafurov, A. Perfilev, A. Sosnov, *Russia*

14.16–14.22 O 157
Multimodality endovascular treatment of partially thrombosed intracranial aneurysms: a single center retrospective study.
Y. Enomoto, Y. Egashira, H. Matsubara, S. Yoshimura, T. Iwama, *Japan*

14.24–14.30 O 158
Endovascular treatment of large and giant cranial aneurysms.
H. Kang, J. Lee, Y. Cho, D. Yoo, M. Han, *South Korea*

14.32–14.38 O 159
Assisted with balloon occlusion technique for large or giant unruptured paraclinoid aneurysm clipping in hybrid operation.
W. Xu, S. Xiang, P. Hu, C. He, X. Li, J. Li, H. Zhang, *China*

14.40–14.46 O 160
The analysis about the visualization of superior hypophyseal artery and post-procedural visual field deficit.
M. Otawa, T. Izumi, M. Nishihori, T. Tsukada, R. Oshima, T. Kawaguchi, S. Goto, M. Ikezawa, A. Kropp, *Japan*

14.48–14.54 O 161
Endovascular approach through direct carotid exposure for treatment of unruptured intracranial aneurysms.
F. Maruyama, T. Ishibashi, I. Kan, N. Kato, T. Kodama, Y. Murayama, *Japan*

14.56–15.02 O 162
Emergency EC-IC bypass treatment for intracranial complex aneurysm: a hybrid strategy.
W. Feng, G. Wang**, S. Qi, G. Zhang, M. Li,** *China*

15.04–15.10 O 163
Efficacy of transcranial motor-evoked potential monitoring in neuroendovascular surgery for anterior choroidal artery aneurysms.
A. Ito, K. Sato, Y. Matsumoto, T. Tominaga, *Japan*

15.12–15.18 O 164
Acute in-stent thrombosis and role of clopidogrel in dual antiplatelet therapy for flow-diverter stents: is still a gold standard drug or is it time to switch?
F. Fusaro, A. Ferrari, C. Ganau, S. Corraine, F. Schirru, S. Comelli, *Italy*

15.20–15.26 O 165
Utility of dual platelet testing in endovascular aneurysm treatment.
H. Batur, M.A. Topcuoglu, E.M. Arsava, A. Arat, *Turkey*

14.00–15.30 **SICILIA ROOM**
Oral papers – Parallel Session N: Aneurysms *Coiling* **O 166 to O 176**

Moderators: F. Briganti, *Italy* – **A. Pedicelli**, *Italy*

14.00–14.06 O 166
Results of hybrid, prospective randomized multicenter study of hydrogel coil vs bare platinum coil for intracranial aneurysms in Japan.
N. Sakai, H. Imamura, C. Sakai, A. Hyodo, Y. Ito, S. Miyachi, Y. Matsumaru, S. Yoshimura, M. Sasaki, W. Taki, *Japan*

14.08–14.14 O 167
Endovascular treatment of intracranial aneurysm with coils Pioneer®.
L.J. Haas, L.C.O. Camilo, V.D. De Almeida, G.V. Staedele, W.R. Berticelli, M. Becker, M.C. Harger, C.B. Lima, J. Martins, B.R. Sabel, F.J. Cobra, M.D. Soares, C.G.J.L. Brasileiro, J.D. Hessmann, L.M. Silva, A. De Oliveira Junior, D. Malacarne, B. Sartori, F.L. Cabral, D. De Lara, V.H.T. Boer, L.R.G.O. Mello, C.I.C. Bernardes, *Brazil*

14.16–14.22 O 168
Early Experiences with a new, surface coated coil, the Trellix.
G. Gál, *Denmark*

14.24–14.30 O 169
Durability of treatment for the penumbra smart coil system at one year in patients with ruptured aneurysms: subset analysis of the SMART registry.
A.M. Spiotta, D.J. Fiorella, B.N. Bohnstedt, C.M. Schirmer, R.J. Bellon, R.A. Deleacy, R.M. Starke, *USA*

14.32–14.38 O 170
One-year follow-up on the utility of the penumbra smart coil system for treatment of intracranial aneurysms and malformations in 740 patients.
A.M. Spiotta, M.S. Park, C.M. Schirmer, B.N. Bohnstedt, R.J. Bellon, R.A. Deleacy, D.J. Fiorella, *USA*

14.40–14.46 O 171
Behavior of coils when aneurysms recanalize after embolization.
M. Shojima, D. Nakagawa, T. Kin, H. Nakatomi, *Japan*

14.48–14.54 O 172
Feasibility, intra and post procedural complications of coiling embolization of brain ruptured aneurysms under Conscious Sedation (CS) versus General Anestesia (GA): a prospective single center experience.
F. Petra, A. Aguado, G. Caballero, M. Grana, J. Lizundia, L. Parra, *Argentina*

14.56–15.02 O 173
Clinical experience of intra-procedural aneurysm rupture during endovascular treatment of cerebral aneurysm: two centers report.
S.T. Kim, H.W. Jeong, J.W. Baek, J.H. Seo, Y.G. Jeong, S.C. Jin, J.E. Roh, C.H. Kang, *South Korea*

14.04–15.10 O 174
Effectiveness of a novel microcatheter tip shaping utilizing vascular configuration for intracranial aneurysm coiling: original experience with in vivo ''endovascular shaping''.
D. Yamazaki, J. Koyama, Y. Hanaoka, T. Horiuchi, *Japan*

15.12–15.18 O 175
Ultra-small catheter shaping method with a sheath dilator: usefulness for coil embolization of cerebral aneurysms.
H. Matsumoto, H. Nishiyama, N. Toki, D. Izawa, *Japan*

15.20–15.26 O 176
Computational simulation of micro-catheter delivery for an aneurysm in different types of the shaping.
S. Fujimura, H. Takao, Y. Uchiyama, H. Ohno, T. Ishii, T. Okudaira, T. Ishibashi, K. Otani, K. Fukudome, M. Yamamoto, Y. Murayama, *Japan*

14.00–15.30 **SARDEGNA ROOM**

Oral papers – Parallel Session O: Aneurysms *Stent Assisted Coiling* **O 177 to O 187**

Moderators: M. Killer, *Austria* – **H. Riina**, *USA*

14.00–14.06 O 177

Pre-procedural simulation for [illegible]-assisted coiling of challenging wide-neck aneurysms.

N. Kaneko, S. Tateshima, C. Colby, V. Szeder, M. Jahan, A. Minhas, J. Hinman, R. Jahan, G. Duckwiler, *USA*

14.08–14.14 O 178

Application of 3D-space combined with 3D-TOF sequence for follow-up evaluation of stent-assisted coil embolization for intracranial aneurysm.

S. Qiuji, L. Tianxiao, L. Li, L. Qiang, *China*

14.16–14.22 O 179

Long term outcome of in-stent stenosis after stent assisted coil embolization for cerebral aneurysm. **J.H. Ko, Y.J. Kim,** *South Korea*

14.24–14.30 O 180

Leo Stent for endovascular treatment of broad-necked intracranial aneurysms: a series of 120 cases. **F. Villasante, F. Navarro, E. Loncharic Haag, H. Moya, M. Pereira, A. Ceciliano,** *Argentina*

14.32–14.38 O 181

Treatment of broad-based intracranial aneurysms with low profile Leo baby stents: a single centre analysis of 119 patients.

T. Djurdjevic, V. Young, R. Corkill, M. Fuschi, D. Briley, W. Kuker, *UK*

14.40–14.46 O 182

Institutional experience with the LVIS Jr stent for treatment of intracranial aneurysms.

Y. Kayan, J. Delgado Almandoz, J. Scholz, A. Milner, M. Mulder, *USA*

14.48–14.54 O 183

Accero stent assisted coiling: early experience review.

A. Nania, N. Dobbs, J. Duplessis, P. Keston, J. Downer, *UK*

14.56–15.02 O 184

Safety and effectiveness of Y-configured low-profile stent-assisted coil embolization for basilar bifurcation aneurysms.

M. Sakamoto, H. Yoshioka, H. Takeuchi, T. Uno, Kurosaki, *Japan*

15.04–15.10 O 185

The pCONus Device in treatment of wide-necked aneurysms: technical, clinical and angiographic results.

R. Viso, I. Lylyk, C. Bleise, P. Lylyk, N. Perez, J. Chudyk, *Argentina*

15.12–15.18 O 186

pCONus-HPC: hydrophilic coating allows stent implantation under single antiplatelet therapy.

H. Henkes, V. Hellstern, M. Almatter, C. Serna Candel, E. Henkes, H. Baezner, O. Ganslandt, M. Aguilar-Perez, *Germany*

15.20–15.26 O 187

Y-stenting vs Pulserider assisted coiling in the treatment of wide-neck bifurcation aneurysms. The role of anatomical features on mid-term results.

N. Limbucci, S. Nappini, L. Renieri, A. Laiso, C. Cirelli, I. Valente, A. Rosi, S. Mangiafico, *Italy*

15.30–16.00 **AUDITORIUM EUROPA**
Special session: The life of a Scientific Journal

Chairperson: K. terBrugge, *Canada*
Moderators: M. Komiyama, *Japan* – **L. Pierot**, *France*

15.30–15.40 Editor in Chief of a Scientific Journal: what does the future look like?
F. Alburquerque, *USA*

15.40–15.50 How to improve the impact of a scientific journal
R. von Kummer, *Germany*

15.50–16.00 Conclusion remarks
M. Söderman, *Sweden*

16.00–16.30 **Coffee Break**

16.30–17.30 **AUDITORIUM EUROPA**
Plenary Session 8: Aneurysms *a*
Chairperson: M. Tanaka, *Japan*
Moderators: A. Bonafé, *France* – **H. Riina**, *USA*

16.30–16.45 Is there any advance in the treatment of Giant and Fusiform Aneurysms?
A. Siddiqui, *USA*

16.45–17.00 By pass technique is often very useful in Giant and Fusiform Aneurysms
L. Thines, *France*

17.00–17.15 By pass technique is rarely useful in Giant and Fusiform Aneurysms
S. Cekirge, *Turkey*

17.15–17.30 Discussion

17.30–18.45 **AUDITORIUM EUROPA**
Oral papers – Parallel Session P: Aneurysms *Flow Diverter Stenting* **O 188 to O 196**

Moderators: A. Churojana, *Thailand, Brazil* – **T. Liebig**, *Germany*

17.30–17.36 O 188
The pipeline embolization device: changes in practice and reduction of complications in the treatment of anterior circulation aneurysms in a multicenter cohort.
A. Dmytriw, K. Phan, M. Salem, N. Adeeb, J. Moore, C. Griessenauer, P. Foreman, H. Shallwani, H. Shakir, A. Siddiqui, E. Levy, J. Davies, M. Harrigan, A. Thomas, C. Ogilvy, *Canada, USA*

17.38–17.44 O 189
Retrograde pull-up method for pipeline implantation for extremely difficult IC cavernous aneurysm.
Y. Ito, H. Hasegawa, B. Kikuchi, K. Kitazawa, M. Koyama, H. Ohara, Y. Fujii, M. Minagawa, *Japan*

17.46–17.52 O 190
SCOPE-AUS: the safety and clinical effectiveness of pipeline™ flex embolization devices with shield technology™ in patients with intracranial aneurysms: a multicentre retrospective study of an australian cohort.
M.A. Owusu, H.A. Rice, L.E. De Villiers, J. Wenderoth, A. Chiu, N. Manning, A. Cheung, W. Mcauliffe, T. Phillips, A. Rossiter, L. Ninnes, S. Gatty, I. Hughes, C. Rapier, T. Green, *Australia*

17.54–18.00 O 191
Preliminary results with Surpass Evolve flow diverter.
S. Derakhshani, A. Arat, *Turkey*

18.02–18.08 O 192
Preliminary experience with the new Surpass Evolve flow diverter: technical considerations and case study.
E. Orru, A. K. Wakhloo, J M Klostranec, A. L. Coon, I Radovanovic, I Yang, N. M. Cancelliere, K. D. Bhatia, H. Kortman, T. Krings, V. M. Pereira, *Canada, USA, China*

18.10–18.16 O 193
Midterm treatment results using the FRED flow diverter.
C. Ulfert, M. Moehlenbruch, M. Bendszus, *Germany*

18.18–18.24 O 194
The FRED Jr flow diverter – first in man, long term follow-up from a single centre experience.
J. Chudyk, I. Lylyk, N. Perez, C. Bleise, R. Viso, P. Lylyk, *Argentina*

18.26–18.32 O 195
Seven years follow-up of intra-cranial aneurysms treated with different types of flow diverter stents. **G. Vitale, M.A. Moubark, F. Di Caterino, M. Findler, A. Abdallah, F. Turjman, A. Biondi,** *France, Egypt*

18.34–18.40 O 196
Long term follow-up result of flow diversion in unruptured large and giant intracranial aneurysm. **D.Y. Cho**, *South Korea*

17.30–18.45 **EGADI ROOM**
Oral papers – Parallel Session Q: Aneurysms *Flow Diverter Stenting* **O 197 to O 205**

Moderators: M. Aguilar-Perez, *Germany* – **L. Lemme-Plaghos**, *Argentina*

17.30–17.36 O 197
Flow diversion of anterior circulation aneurysms using p64: occlusion rate, procedural morbidity and mortality.
H. Henkes, V. Victoria, M. Almatter, C. Serna, E. Henkes, O. Ganslandt, H. Bäzner, M. Aguilar-Perez, *Germany*

17.38–17.44 O 198
The diversion p64 study: a prospective, multicentre registry in the treatment of intracranial aneurysms with p64 flow modulation device in more than 400 patients.
A. Bonafe, A. Biondi, *France*

17.46–17.52 O 199
The P64 flow diverter. Mid and long-term results from a single center.
S. Sirakov, A. Sirakov, *Bulgaria*

17.54–18.00 O 200
Preliminary clinical experience with flow diverters p48 and p48-HPC.
L. Pierot, P.F. Manceau, S. Soize, *France*

18.02–18.08 O 201
The italian multicentric experience with new low-profile flow diverter Silk Vista Baby: preliminary results.
L. Cirillo, A. Rustici, S. Bracco, L. Chiumarulo, C. Cristaudo, F. Di Paola, V. Gavrilovic, G. Iannucci, G. Lazzarotti, D. Mardighian, R. Menozzi, M. Natrella, R. Padolecchia, A. Paolucci, R. Papa, S. Peschillo, B. Petralia, D. Romano, P. Zampieri, *Italy*

18.10–18.16 O 202
Breaking new ground – flow diversion beyond the circle of Willis: endovascular aneurysm treatment in peripheral cerebral arteries employing a novel low-profile flow diverting stent.
S. Schob, K. Hoffmann, U. Quaeschling, *Germany*

18.18–18.24 O 203
The use of flow diversion stent in vessels less than 2.5mm in diameter – a single centre experience. **J. Chudyk, C. Bleise, I. Lylyk, N. Perez, R. Viso, P. Lylyk,** *Argentina*

18.26–18.32 O 204
LVIS blue as a stand alone flow diverter and coil adjuvant: an institutional experience.
M. Koch, S. Raymond, C. Stapleton, A. Patel, *USA*

18.34–18.40 O 205
Flow diversion for the treatment of basilar apex aneurysms.
A. Dmytriw, N. Adeeb, A. Kumar, C. Griessenauer, K. Phan, C. Ogilvy, P. Foreman, H. Shallwani, N. Limbucci, S. Mangiafico, C. Michelozzi, T. Krings, V. Pereira, C. Matouk, Y. Zhang, M. Harrigan, H. Shakir, A. Siddiqui, E. Levy, L. Renieri, C. Cognard, A. Thomas, T. Marotta, *USA, Italy, France*

17.30–18.45 **STROMBOLI ROOM**
Oral papers – Parallel Session R: Aneurysms *Flow Diverter Stenting* **O 206 to O 214**

Moderators: P.K. Nelson, *USA* – **N. Sourour**, *France*

17.30–17.36 O 206
Advenced intracranial aneurysms treatment – the Derivo embolization device.
M. S. Medenica, D. Nestorovic, F Vitosevic., I. Vukasinovic, *Serbia*

17.36–17.42 O 207
A prospective multicentre registry of patients treated for unruptured intracranial aneurysms with the Derivo flow diverter: procedural safety and core-lab adjudicated angiographic baseline results.
C. Taschner, C.P. Stracke, F. Dorn, K. Kadziolka, K. Kreiser, M. Pham, J.H. Buhk, B. Turowski, W. Reith, H. Janssen, O. Beuing, O. Jansen, M. Knauth, R. Chapot, *Germany, Poland*

17.42–17.48 O 208
First experience with Derivo Embolization Device (DED) in Argentina: long term follow-up.
A. Ceciliano, F. Navarro, M. Pereira, H. Moya, E. Loncharic, F. Villasante, *Argentina*

17.48–17.54 O 209
A retrospective experience of 243 patients treated with 1 year follow-up
S. Derakhshani, A. Arat, *UK, Turkey*

17.54 –18.00 O 210
Carotid aneurysms presenting with cranial nerve symptoms; the comparison of treatment outcomes between coiling and flow diverter.
S. Koizumi, J. Desilles, R. Fahed, S. Escalard, S. Smajda, G. Ciccio, H. Redjem, M. Mazighi, R. Blanc, M. Piotin, *France*

18.00–18.06 O 211
Assessment of carotid sinus reflex during flow-diverter stent deployment.
S. Goto, T. Izumi, M. Nishihori, T. Tsukada, M. Otawa, R. Oshima, T. Kawaguchi, T. Wakabayashi, *Japan*

18.06–18.12 O 212
Flow diverter devices in the treatment of recanalized intracranial aneurysms.
E. Akgul, H.B. Onan, H.T. Balli, I. Islek, G. Ertan, S.S. Bilgin, *Turkey*

18.12–18.18 O 213
Persistent residual aneurysm after flow diversion. what must we do? Two cases of trans circulation coiling and 2 cases of telescopic flow diverter.
L. Nico, J. Ognard, J. Gentric, *France*

18.18–18.24 O 214
An evaluation of health-related quality of life in patients with unruptured intracranial aneurysms treated with endovascular flow.
M.A. Owusu, B. Urbi, C. Rapier, L. de Villiers, H. Rice, R. Dunning, H. McEvoy, T. Green, *Australia*

17.30–18.45 PANAREA ROOM
Oral papers – Parallel Session S: Aneurysms *Flow Study / Vessel Wall Imaging* O 215 to O 223
Moderators: G. Benndorf, *Denmark* – **J. Schaafsma**, *USA*

17.30–17.36 O 215
Investigation on the relations of hemodynamics and growth of unruptured cerebral aneurysms.
T. Okudaira, H. Takao, S. Fujimura, Y. Uchiyama, H. Ohno, T. Ishii, T. Ishibashi, K. Otani, K. Fukudome, M. Yamamoto, Y. Murayama, *Japan*

17.38–17.44 O 216
Hemodynamic investigation on recanalized and stable aneurysms using virtual coiling technique.
T. Ishii, H. Takao, S. Fujimura, Y. Uchiyama, H. Ohno, T. Okudaira, T. Ishibashi, K. Otani, K. Fukudome, M. Yamamoto, Y. Murayama, *Japan*

17.46–17.52 O 217
Role of computational fluid dynamics for endovascular aneurysm intervention.
Y. Murayama, S. Fujimura, T. Ishibashi, H. Takao, *Japan*

17.54–18.00 O 218
Analysis of the relationship between the hydrodynamic resistance, MSA and pore density of flow diverter stents.
B. Csippa, D. Gyurki, G. Zavodszky, G. Paal, I. Szikora, *Hungary*

18.02–18.08 O 219
Investigation of the effect of flow diverter's pore density on stagnation fluid flow zones inside a giant aneurysm using a Lagrangian coherent structure technique.
O. Mutlu, A. B. Olcay, C. Bilgin, B. Hakyemez, *Turkey*

18.10–18.16 O 220
Validation of a technique for extraction of patient-specific blood flow conditions from 4D digital subtraction angiography.
H. Ohno, H. Takao, T. Suzuki, S. Fujimura, Y. Uchiyama, K. Katayama, Ishii, T. Okudaira, T. Ishibashi, K. Otani, K. Fukudome, M. Motosuke, M. Yamamoto, Y. Murayama, *Japan*

18.18–18.24 O 221
Association of low flow conditions and histologic signs of inflammation in intracranial aneurysms with focal enhancement on MR vessel wall imaging.
P. Berg, S. Saalfeld, C. Flüh, N. Larsen, *Germany*

18.26–18.32 O 222
Vessel wall imaging to improve risk prediction of growing and stable intracranial aneurysms.
E. Leemans – Van Katwijk, B. Cornelissen, B. Coolen, H. Boogaarts, W.J. Van Rooij, R. Van Den Berg, Y. Roos, W. Vandertop, C. Slump, E. Van Bavel, A. Nederveen, H. Marquering, C. Majoie, *The Netherlands*

18.34–18.40 O 223
Vessel wall enhancement of intracranial aneurysms on high resolution MRI: a rupture sign? The ICARUS study.
L. Dinia, L. Gramegna, C. Vert, M. Luzi, F. Arikan, D. Hernandez, P Coscojuela., E. Martinez Saez, A. Rovira, A. Tomasello, *Spain, Italy*

17.30–18.45 **SICILIA ROOM**
Oral papers – Parallel Session T: Aneurysms *Intra-aneurysmal flow disruption* **O 224 to O 232**

Moderators : D. Lopes, *USA* – **M. Szainer**, *Poland*

17.30–17.36 O 224
WEB colombian multicenter experience (web.com): clinical and radiological mid-term results in the treatment of intracranial aneurysms.
B. Pabon, C. Diaz, J. Mejia, M. Patiño, R. Almeida, F. Orozco, J. Fernandez, N. Lobelo, D. Mantilla, *Colombia*

17.38–17.44 O 225
Short term results in the treatment of unruptured sidewall intracranial aneurysms with the use of intrasaccular aneurysm flow disruption devices.
F. Di Caterino, G. Vitale, A. Biondi, *France*

17.46–17.52 O 226
Mechanical properties of flow disruptors: impact of oversizing by in vitro compression testing.
B. Pogácsás, E. Bognár, L. Pelyhe, P. Nagy, I. Kientzl, Z. Kiss, M. Czencz, M. Kondor, Á. Vadász, I. Szikora, *Hungary*

17.54–18.00 O 227
Web compaction during follow-up: the Bicêtre experience.
J. Caroff, C. Mihalea, I. Pagiola, M. Iacobucci, V. Chalumuea, L. Ikka, S. Gallas, A. Ozanne, J. Moret, L. Spelle, *France*

18.02–18.08 O 228
Aneurysm treatment with WEB in the cumulative population of 3 prospective, multicenter series: 2-year and 3-year anatomical results.
L. Pierot, J. Byrne, L. Spelle, *France*

18.10–18.16 O 229
Clipping of recanalized intracerebral aneurysms initially treated by WEB device.
L. Litre, *France*

18.18–18.24 O 230
Preliminary experiences with a new, electrically datachable, intrasaccular flow diverter, the Contour.
G. Gál, *Denmark*

18.26–18.32 O 231
Mid-term experiences with a new, intrasaccular neck-bridging device, the Neqstent.
G. Gál, *Denmark*

18.34–18.40 O 232
Experience with an endosaccular flow diverter device: Nexsys.
I. Lylyk, C. Bleise, J. Chudyk, N. Perez, R. Viso, P. Lylyk, *Argentina*

17.30–18.45 **SARDEGNA ROOM**
Oral papers – Parallel Session U: Aneurysms *Stent assisted coiling* **O 233 to O 241**

Moderators: M. Bergui, *Italy* – **S. Gallas**, *France*

17.30–17.36 O 233
Safety and performance of the Neuroform Atlas stent system (Atlas) in the treatment of intracranial aneurysms: a prospective, observational, multicentre, post-market european study (Atlas EU PMCF study).
E. Houdart, A. Bonafé, V. Costalat, P. Schramm, T. Eckey, X. Barreau, M. Piotin, A. Berlis, W. Weber, S. Fischer, K. Zelenak, A. Narata, M. Hartmann,J. Gentric, *France, Germany, Slovak Republic*

17.38–17.44 O 234
Stent assisted coil embolization of intracranial aneurysms using Neuroform Atlas stent.
H.W. Jeong, J.W. Baek, S.T. Kim, Y.G. Jeong, J.H. Seo, S.K. Baik, W.B. Seung, *South Korea*

17.46–17.52 O 235
Neuroform Atlas stent (NAS) in intracranial aneurysms: initial experience.
F. Villasante, F. Navarro, E. Loncharic, H. Moya, M. Pereira, A. Ceciliano, *Argentina*

17.54–18.00 O 236
Neuroform Atlas stent in the treatment of wide-necked intracranial aneurysms. A single center experience.
A. Alexandre, F. Giubbolini, I. Valente, E. Lozupone, F. D'Argento, C. Colosimo, A. Pedicelli, *Italy*

18.02–18.08 O 237
The 'Y'-configuration of double Neuroform Atlas assisted coil embolization for treatment of bifurcation wide-neck aneurysms. A multicentric experience.
V. Semeraro, S. Vidali, E. Lozupone, M. Ganimede, N. Lucarelli, N. Burdi, *Italy*

18.10–18.16 O 238
A simple and reliable way to use Neuroform Atlas stents with Scepter balloon catheters: a technical report of the 'balloon-stent' technique.
J. Roh, S.K. Baik, C.H. Kang, H.W. Jeong, *South Korea*

18.18–18.24 O 239
Waffle cone technique using the Atlas intracranial device in ruptured aneurysms.
F. Petra, A. Aguado, G. Caballero, J. Lizundia, M. Grana, L. Parra, E. Isuany, *Argentina*

18.26–18.32 O 240
Neuroform Atlas stent-assisted coiling of ruptured aneurysms in not-premedicated patients. A multicenter study
R. Russo, G. Bradac, L. Castellan, I. Gallesio, D. Garbossa, G. Iannucci, D. Mardighian, R. Menozzi, A. Pitrone, G. Romano, F. Venturi, G. Vercelli, M. Bergui, *Italy*

18.34–18.40 O 241
Stent-assisted coiling of cerebral aneurysms with the Neuroform Atlas stent with one year follow up
S. Derakhshani, *UK*

Wednesday, 23rd October 2019 – ETMINT Symposium

08.00–10.00 **SICILIA ROOM**
Symposium for Angiosuite Personnel: Nurses, Radiographers and Technicians *in cooperation with ESMINT*
Session C: Aneurysms and AVMs

Moderators: **C. Wetzel**, *Germany* – **F. Menu**, *France*

08.00–08.10 Opening
F. Menu, *NRT, France*

08.10–08.30 WEB, flow diverters or coils? Different treatment strategies and different morphologies
T. Nawka, *MD, Germany*

08.30–08.50 WEB device: what NRTs should know
F. Menu, *NRT, France*

08.50–09.10 Indications of stenting and flow diversion in treatment of cerebral aneurysm
L. Pierot, *MD, France*

09.10–09.30 Management and nursing for carotid artery stenting related hemodynamic depression
Z. Wang, *NRT, China*

09.30–10.00 Interactive case
J. Bukh, *MD, Germany*

10.00–10.30 **Coffee Break**

10.30–13.00 **SICILIA ROOM**
Symposium for Angiosuite Personnel: Nurses, Radiographers and Technicians *in cooperation with ESMINT*
Session D: Aneurysms and AVMs

Moderators: **H. Genins**, Sweden – **A. Mastenbroek**, *The Netherlands*

10.30–10.50 The diversity of embolic agents for treatments of AVMs
J. Ducasse, *NRT, France*

10.50–11.10 4D interest analysis and treatment of brain AVM
S. Traore, *NRT, France* – **A. Rouchaud**, *MD, France*

11.10–11.30 Interactive AVM case
P. Brouwer, *MD, Sweden*

11.30–11.50 Nursing coordination for hybrid recanalization of 44 symptomatic vertebral arteries occlusion patients
H. Tang, *NRT, China*

11.50–12.10 Mechanical Thrombectomy – how many retrieval attempts are enough?
F. Flottmann, *MD, Germany*

12.10–12.25 Management of patients receiving a cumulative radiation dose more than 3000mGy
P. Pöder, *NRT, Sweden*

12.25–12.40 Different dose rates in neurovascular treatments and how to prevent high doses in the angiosuite
J. Åkerblom, *NRT, Sweden*

12.40–13.00 Radiation dose, Comparison of mechanical thrombectomy in single vs biplane angiosuites, an international study
M. Maury, *NRT, France* – **A.C. Januel**, *MD, France*

13.00–14.00 **Lunch**

16.30–17.00 **E-POSTERS AREA**
Poster Session ETMINT *in cooperation with ESMINT*

Moderator: A. van Es, *The Netherlands*

16.30–16.32 PE: 1
Analysis of feasibility and safety of endovascular recanalization of chronic occlusion of large intracranial artery
S. Li, L. Jiao, *China*

16.32–16.34 PE: 2
Management and nursing for carotid artery stenting related hemodynamic depression
Z. Wang, J. Hou, L. Jiao, *China*

16.34–16.36 PE: 3
Nursing coordination for hybrid recanalization of occluded carotid artery
H. Zhang, Z. Wang, H. Tang, W. Li, M. Sun, L. Jiao, *China*

16.36–16.38 PE: 4
Nursing coordination for hybrid recanalization of 44 symptomatic vertebral artery occlusion patients
H. Tang, L. Jiao, Q. Xiao, F. Feng, G. Li, Z. Wang, *China*

16.38–16.40 PE: 5
Recanalization of long segmental occlusion at extracranial vertebral artery by hybrid technique: case report
Q. Song, Y. Ma, L. Jiao, *China*

16.40–16.42 PE: 6
Nursing cooperation in the hybrid surgery of complex spinal vascular malformation: experiences from 111 cases
T. Wu, **Q. Qin, Y. Tang, X. Chen, X. Niu, Z. Wang, B. Han,** *China*

16.42–16.44 PE: 7
Dural arteriovenous fistulas involving the superior petrosal veins: case series
T. Jie, M. Yongjie, Z. Hongqi, L. Feng, L. Guilin, *China*

16.44–16.46 PE: 8
Hybrid operation for stylocarotid artery syndrome: a case report and literature review
F. Zhu, L. Jiao, *China*

Wednesday, 23rd October 2019 – E-Posters

10.30–11.00 **E-POSTERS AREA**
Poster Session 10: Pediatric **P 186 to P 196**

Moderator: G. Guarnieri, *Italy*

10.30–10.32 P 186
Endovascular treatment of complex pediatric intracranial unruptured aneurysms.
L. Jiang, G. Zeng, X. Zhi, J. Li, H. Zhang, *China*

10.32–10.34 P 187
Successful treatment of ruptured basilar mycotic aneurysm in an infant with endovascular parent artery occlusion.
K. Somboonnithiphol, E. Chantanaphak, S. Pongpech, *Thailand*

10.34–10.36 P 188
Endovascular treatment of dural sinus malformation with AV shunt in infants: a case report.
M. Mitsuhito, Y. Nishikawa, N. Aihara, *Japan*

10.36–10.38 P 189
A case of pediatric dural arteriovenous fistula treated with transvenous embolization using NBCA.
M. Okawa, *Japan*

10.38–10.40 P 190
Vein of Galen malformations in neonates: multidisciplinary approach and neuroendovascular treatment.
T. Shigematsu, A. Berenstein, J. Fifi, R. De Leacy, *USA*

10.42–10.44 P 191
Orbital Arterio-Venous Shunt (AVS) co-existing with Veno-Lymphatic Malformations (VLM) of the right orbit in a 11-year-old boy: a case report of our therapeutic experience from Ramathibodi hospital.
P. Jiarakongmun, E. Chantanaphak, M. Apirakkarn, K. Somboonnithiphol, *Thailand*

10.46–10.48 P 192
Endovascular management of pial fistula in infancy.
M. Mahmoud, R. Nader, M. Farid, *Egypt*

10.50–10.52 P 193
Preoperative superselective endovascular embolisation helps in complete endoscopic excision of juvenile nasopharyngeal angiofibroma.
S. Kumar, K. Bhavana, *India*

10.54–10.56 P 194
Superselective Intra-Arterial Chemotherapy (SIAC) for retinoblastoma a safety technique: 9 years experience.
F. Villasante, F. Navarro, E. Loncharic, M. Varela, P. Schaiquevich, G. Chantada, A. Fandiño A. Ceciliano, *Argentina*

10.58–11.00 P 195
Combination of stent + PTA + bypass surgery in an evolutive MCA finally stenosis leading.
M. Bergui, B. Siri, P. Saracco, A. Lanterna, *Italy*

10.50–10.52 P 196
Screening of findings of computed tomography for minor blunt head trauma among paediatrics in Alexandria University emergency department: a center experience.
K. Saad', E. Gaber, T. Ibrahim, A. El Kafafy, W. Foad, *Egypt*

11.00–11.20 **E-POSTERS AREA**
Poster Session 11: Spine **P 197 to P 203**

Moderator: S. K. Lee, *South Korea*

11.00–11.02 P 197
Spontaneous regression of the herniated lumbar disc: clinical and imaging predictors.
A. Sultan, A. Elwany, D. Mokhtar, A. Alnagar, *Egypt*

11.02–11.04 P 198
Presurgical trans-arterial embolization of hypervascularized spinal tumors: a review of the technique and results in 972 patients.
F. Taglialatela, S. Isceri, C. Barbara, S. Bandiera, A. Gasbarrini, L. Simonetti, *Italy*

11.04–11.06 P 199
Hemangioblastoma of filum terminale mimicking with a spinal arteriovenous shunt.
N. Uranslip, M. Apirakkan, *Thailand*

11.06–11.08 P 200
4D DSA for spinal cord vascular malformations exploration: preliminary experience.
F. Clarençon, S. Lenck, E. Shotar, A. Boch, K. Premat, J. Chiras, N. Sourour, *France*

11.08–11.10 P 201
Spinal epidural arteriovenous fistula co-existing with spine tumor, the challenging diagnosis.
U. Wongkhum, C. Kobkitsuksakul, *Thailand*

11.10–11.12 P 202
Spinal epidural arterio-venous malformations – an institutional experience.
L. J. D. Sebastian, J. Nadarajah, M. Gupta, A. Garg, S.B. Gaikwad, N.K. Mishra, *India*

11.12–11.14 P 203
An adult case of nonvertebral paraspinal arteriovenous fistulas along the segmental nerve with perimedullary reflux: a case report and a description of novel technique in treatment of high-flow large fistulas.
T. Asano, K. Ozaki, S. Kubota, K. Kado, S. Mitsuhashi, I. Yamakami, Y. Kageyama, *Japan*

12.00–12.32 **E-POSTERS AREA**
Poster Session 12: Miscellaneous **P 204 to P 219**

Moderator: J.S. Shin, *South Korea*

12.00–12.02 P 204
Day-hospital as a feasible setting for cerebral digital subtraction angiography.
I. Valente, F. D'argento, A. Alexandre, E. Lozupone, G. Garignano, A. Romi, A. Bartolo, A. Pedicelli, *Italy*

12.02–12.04 P 205
The angiographic quality in term of radiologist satisfaction using the different percentage of the contrast media concentration.
P. Poonkarun, P. Thomya, P. Poonkarun, N. Rodiead, *Thailand*

12.04–12.06 P 206
Investigation of puncture site hematoma after neuroendovascular surgery.
R. Oshima, T. Izumi, M. Ikezawa, S. Gotoh, A. Kropp, M. Otawa, T. Kawaguchi, T. Tsukada, M. Nishihori, T. Wakabayashi, *Japan*

12.06–12.08 P 207
Extracranial and intracranial anastomosis and its clinical implications in therapeutic neurointerventions.
V. Bhatia, A. Kumar, *India*

12.08–12.10 P 208
Isolated trochlear nerve palsy in a patient with superior cerebellar rete mirabile.
E.J. Kim, Y. Shin, C.W. Ryu, K.M. Lee, E.K. Yeon, J.S. Lee, *South Korea*

12.10–12.12 P 209
A rare case of post-infectious moyamoya syndrome: case report and review of the literature.
P. Trombatore, E. Lozupone, S. Gaudino, L. Milonia, A. Alexandre, F. D'argento, I. Valente, C. Colosimo, A. Pedicelli, *Italy*

12.12–12.14 P 210
Diagnosis and treatment of brain stem venous hypertensive congestion.
L. Yan, Y.J. Ma, G.L. Li, T. Hong, L.Y. Sun, H.Q. Zhang, *China*

12.14–12.16 P 211
Neurovascular manifestations of NFI-a pictorial essay based on our cases.
L. J. D. Sebastian, J. Nadarajah, M. Gupta, A. Garg, S.B. Gaikwad, *India*

12.16–12.18 P 212
Cerebro vascular manifestations of neurofibromatosis type 1 – a pictorial review.
N. Jain, M. Gupta, J. Nadarajah, L. Deverajan, S. Gaikwad, *India*

12.18–12.20 P 213
Extracranial vertebral arteriovenous fistula in a patient with neurofibromatosis type 1.
T. Nakazawa, A. Tsuji, Y. Yoshimura, K. Tsuji, K. Nozaki, *Japan*

12.20–12.22 P 214
Infiltrated embolization of meningioma with dilute cyanoacrylate glue.
O. Hiroyuki, T. Kenkichi, M. Kenichi, K. Yuji, K. Yoshihiro, O. Hideyuki, *Japan*

12.22–12.24 P 215
Preoperative embolization via non internal carotid artery for intracranial meningioma or solitary fibrous tumor is a safe and useful method.
J. Suenaga, N. Shimizu, T. Ogura, S. Matsumoto, K. Fujii, A. Ohshima, T. Nakamura, N. Ikegaya, M. Sato, K. Tateishi, H. Murata, T. Yamamoto, *Japan*

12.24–12.26 P 216
Combined management of hypervascular brain tumors in hybrid operating room.
R. Mori, I. Kan, T. Kodama, T. Ishibashi, Y. Akasaki, Y. Murayama, *Japan*

12.26–12.28 P 217
Parent artery occlusion for traumatic vertebral artery injury.
Y. Matsunaga, Y. Morofuji, N. Horie, T. Izumo, T. Anda, T. Matsuo, *Japan*

12.28.12.30 P 218
The algorithm and the results of the treatment for chronic subdural hematoma in our hospital, and identity of the feeder embolization by the intervention.
Y. Makoto, *Japan*

12.30–12.32 P 219
Regulatory science aspect of post-market surveillance of neuro-endovascular devices in Japan.
C. Sakai, N. Sakai, H. Imamura, A. Ishii, Y. Matsumaru, S. Yoshimura, *Japan*

Thursday, 24th October 2019

08.00–09.00 **AUDITORIUM EUROPA**
Oral papers – Parallel Session V: Aneurysms *Fusiform / Dissecting* **O 242 to O 248**

Moderators : F. Hui, *Singapore* – **R. Anxionnat**, *France*

08.00–08.06 O 242
Application of low-profile flow-diverting stents in the treatment of fusiform, distal aneurysms or for destructive operations.
A. Petrov, S. Goroshenko, L. Rozchenko, *Russia*

08.08–08.14 O 243
Endovascular therapy for ruptured vertebral artery dissecting aneurysms in Japan: results from nationwide, retrospective, multi-center registries.
H.H. Nakamura, Fujinaka, T. Nishida, H. Kishima, N. Sakai, *Japan*

08.16–08.22 O 244
Reconstructive endovascular treatment of v4 segment of vertebral artery dissecting aneurysm with Willis covered stent: a retrospective study.
S. Xiang, G. Li, C. He, J. Ren, H. Zhang, *China*

08.24–08.26 O 245
Segment occlusion vs. reconstruction experience with endovascular strategies for ruptured vertebrobasilar dissecting aneurysms.
S.S. Schob, K.T. Hoffmann, U. Quaeschling, *Germany*

08.28–08.34 O 246
The fate of unruptured intracranial vertebrobasilar dissecting aneurysm with brain stem compression according to different treatment modalities.
D.Y. Cho, *South Korea*

08.36–08.42 O 247
Endovascular deconstructive technique for dissecting posterior cerebral artery aneurysms: a single-center case series.
F.F. Hassan, *Egypt*

08.44–08.50 O 248
Dissecting distal cerebellar artery aneurysms: PVO vs parent vessel preserving strategies.
G.G. Anil, L. Sein, V. Nga, K. Teo, C. Ning, C. Yang, T. Yeo, *Singapore*

08.00–09.00 **EGADI ROOM**
Oral papers – Parallel Session W: Aneurysms *Blood Blister Like / Ruptured* **O 249 to O 255**

Moderators: B. Pabon, *Colombia* – **M. Shigeru**, *Japan*

08.00–08.06 O 249
Flow-diverter stent deployment in blister-like and dissecting aneurysms in acute phase with long term follow-up. Italian single center experience.
G. Sanfilippo, A. Sgreccia, F. Zappoli Thyrion, E. Lafe, *Italy*

08.08–08.14 O 250
Treatment of ruptured blister-like aneurysms with Fred flow-diverter: a multicenter experience.
M.M. Möhlenbruch, M. Killer, N. Kocer, *Germany, Austria, Turkey*

08.16–08.22 O 251
Recurred blood blister-like aneurysm after treatment: additional treatment and follow-up.
J.S. Byun, T.K. Nam, H.H. Choi, *South Korea*

08.24–08.30 O 252
Stent-assisted coil embolization for ruptured intracranial dissecting aneurysms: initial and follow-up results.
T.T. Higashi, H. Fukumoto, A. Horio, K. Fukuda, M. Iwaasa, K. Nii, T. Inoue, *Japan*

08.32–08.38 O 253
Stent-assisted coil embolization of ruptured very small aneurysms: a single center experience.
E.H. Ihm, Y.Y. Seo, H.K. Lee, H.J. Woo, Y.M. Han, *South Korea*

08.40–08.46 O 254
Angiographic follow-up for small ruptured intracranial aneurysm treated by endovascular treatment: follow-up plan and long-term follow-up results.
J.H. Ko, Y.J. Kim, *South Korea*

08.48–08.54 O 255
Incidence of intra-procedural complications in relation to timing of endovascular treatment in ruptured intracranial aneurysms
C. Gaudino, F. Biraschi, L. Caschera, A. Paolucci, F.M. Triulzi, A. Bozzi, V. Conte, V. Da Ros, S.E. Navone, *Italy*

08.00–09.00 **STROMBOLI ROOM**
Oral papers – Parallel Session X: Aneurysms *Ruptured / Vasospasm* **O 256 to O 262**

Moderators: I. Wanke, *Switzerland* – **C. Cristaudo**, *Italy*

08.00–08.06 O 256
Complications in stent-assisted embolization for ruptured cerebral aneurysms in the acute period: a retrospective review.
G.G. Wong, S. Yu, J. Zhuang, S. Wong, *Hong Kong*

08.08–08.14 O 257
Flow diverter in the treatment of ruptured intracranial aneurysms – a single center experience.
A.A. Mahajan, G. Goel, V. Banga, A. Chatterjee, K.S. Narang, V.P. Singh, H. Sapra, *India*

08.16–08.22 O 258
Flow diversion of challenging ruptured intracranial aneurysms with aspirin monotherapy.
J. Wenderoth, N. Manning, A. Cheung, *Australia*

08.24–08.30 O 259
Is epilepsy a possible issue for the use of intra-arterial vasodilatators in SAH-induced vasospasm?
L. Nico, J. Ognard, R. Leimassi, S. Saib, J. Gentric, *France*

08.32–08.38 O 260
Balloon and stent angioplasty for treatment of cerebral vasospasm in patients with aneurysmal subarachnoid haemorrhage – a single-centre experience.
M. Banez, L. Lai, R. Chandra, H. Asadi, L. Slater, W. Chong, *Australia*

08.40–08.46 O 261
Mechanical angioplasty using stentriever for delayed symptomatic vasospasm after subarachnoid hemorrhage.
G. Garignano, E. Lozupone, A. Alexandre, F. D'argento, I. Valente, A. Pedicelli, *Italy*

08.48–08.54 O 262
Stellate ganglion block under vascular road-map control and intra-arterial treatment. A ''one-stop shop'' for cerebral vasospasm after subarachnoid hemorrhage
M. Pileggi, M. Isalberti, P. Merlani, M. Reinert, P. Mosimann, A. Cianfoni, *Switzerland*

08.00–09.00 **PANAREA ROOM**
Oral papers – Parallel Session Y: Miscellaneous **O 263 to O 269**

Moderators: C. Bao Luo, *Taïwan* – **L. Saleh,** *UK*

08.00–08.06 O 263
Our first experience of simultaneous endovascular embolization of proximal flow – related aneurysm and arteriovenous malformation of the brain with liquid embolic agent.
A. Sufianov, S. Karasev, R. Khafizov, R. Sufianov, *Russia*

08.08–08.14 O 264
Management of aneurysm associated with moyamoya disease: a case series of 5 patients with literature review.
N.U.H. Maria, *Pakistan*

08.16–08.22 O 265
Investigation of late granuloma-like changes after endovascular treatment; summary of 9 cases in Aichi prefecture.
M.M. Nishihori, T. Izumi, T. Tsukada, R. Oshima, K. Otawa, T. Kawaguchi, S. Goto, M. Ikezawa, A. Kropp, T. Wakabayashi, *Japan*

08.24–08.30 O 266
Congenital segmental dolichoectasia in adult mimicking aneurysm: a brief review with illustrating a case series.
S. Derakhshani, A. Moussa, N. Chan, S. Abdulla, *UK*

08.32–08.38 O 267
Capillary Malformation/Arteriovenous Malformation (CM/AVM)
Y.Y. Iizuka, Y. Tsutsumi, A. Berenstein, *Japan, USA*

08.40–08.46 O 268
Novel rasa1 mutations in japanese pedigrees with capillary malformation-arteriovenous malformation.
Y.Y. Moteki, H. Akagawa, Y. Niimi, Y. Okada, T. Kawamata, *Japan*

08.48–08.54 O 269
Endovascular treatment of Dural Arteriovenous Fistulas of the Anterior Condylar Vein.
R.H. Dahl, A. Biondi, F. Di Caterino, G. Vitale, G. Benndorf, *France, Denmark*

08.00–09.00 **SICILIA ROOM**
Oral papers – Parallel Session Z: Aneurysms *Imaging & Follow-Up* **O 270 to O 276**

Moderators: S. Renowden, *UK* – **C. Taschner**, *Germany*

08.00–08.06 O 270
Victoria – virtual neck curve and true ostium reconstruction of intracranial aneurysms.
S. Voß, S. Saalfeld, O. Beuing, P. Berg, *Germany*

08.08–08.14 O 271
Growth rates of intracranial aneurysms undergoing surveillance imaging. A single centre study defining patient and aneurysm-related risk factors, growth chronology and patient outcomes.
J. Siddiqui, P. Grover, D. Dasgupta, O. Sluijters, N. Oskooee, P. Cowley, A. Toma, *UK*

08.16–08.22 O 272
Is CTA with metallic artifact reduction technique to be follow up study after coil embolization of the aneurysm?
M.H. Rho, J. Kim, *South Korea*

08.24–08.30 O 273
Image quality and radiation dose of volume of interest imaging combined with metal artifact reduction reconstruction technique in follow-up after treatment of intracranial aneurysm.
B. Kim, D. Cho, H. Bae, J. Choi, Y. Shin, N. Shin, J. Jang, Y. Choi, S. Jung, K. Ahn, *South Korea*

08.32–08.38 O 274
Reduced radiation dose with volume-of-interest cone-beam CT combined with metal artifact reduction in flow diverter placement of cerebral aneurysm.
K. Sugiu, M. Hiramatsu, T. Hishikawa, N. Kidani, Y. Takahashi, S. Murai, K. Nishi, Y. Yamaoka, I. Date, *Japan*

08.40–08.46 O 275
Acute interactions and healing process after flow diverter implantation. First in humans analysis using Optical Coherence Tomography (OCT) imaging.
B. Pabon, C. Diaz, J. Mejia, O. Vargas, M. Patiño, J. Gutierrez, N. Serna, *Colombia*

08.48–08.54 O 276
Skull base bone reossification after endovascular treatment of carotid siphon aneurysms responsible for bone-eroding mass effect. An indirect sign of effective treatment.
C. Iosif, F. Di Caterino, G. Vitale, N. Chartier, A. Biondi, *France*

08.00–09.00 **SARDEGNA ROOM**
Oral papers – Parallel Session ω: Miscellaneous **O 277 to O 283**

Moderators: L. Biscoito, *Portugal* – **S. Pongpech**, *Thailand*

08.00–08.06 O 277
Endovascular management of life-threatening epistaxis secondary to cavernous Internal Carotid Artery (ICA) injury– an institutional experience.
N. Jain, L. Sebastian, M. Gupta, J. Nadarajah, S. Gaikwad, *India*

08.08–08.14 O 278
Venous stenting in idiopathic intracranial hypertension.
R. Seshadri, A.K. Gupta, H.R. Arvinda, *India*

08.16–08.22 O 279
Endovascular treatment of idiopathic intracranial hypertension: analysis of epidemiologic profile and immediate outcome of 7 patients.
L.J. Haas, B.R. Sabel, J. Martins, G.V. Staedele, W.R. Bertinelli, M. Becker, M.C. Harger, C.B. Lima, F.J. Cobra, M.D. Soares, L.C.O. Camilo, V.D. De Almeida, C.G.J.L. Brasileiro, J.D. Hessmann, L.M. Silva, V.H.T. Boer, D. De Lara, C.I.C. Bernardes, F.L. Cabal, A. De Oliveira Junior, B. Sartori, D. Malacarne, L.R.G.O. Mello, *Brazil*

08.24–08.30 O 280
Endovascular intervention for recurrent chronic subdural haematoma.
D. Le Feuvre, A. Taylor, *South Africa*

08.32–08.38 O 281
Post-surgical prophylactic embolization of chronic sub-dural hematomas in patients with high recurrence risk: a monocentric study.
E. Shotar, B. Mathon, S. Lenck, L. Meyblum, V. Degos, K. Premat, N. Sourour, A.L. Boch, A. Carpentier, F. Clarençon, *France*

08.40–08.46 O 282
Comparison of surgical versus intradiscal ozone treatment of sciatica due to lumbar disc herniation.
N.U.H. Maria, U. Rasheed, Q.U. Ain, *Pakistan*

08.48–08.54 O 283
Long-term evaluation (>3 years) of ozone chemonucleolysis in lumbar disc herniation.
G. Campione, M. Ezeldin, C. Princiotta, M. Dall'Olio, F. De Santis, M. Celerini, L. Cirillo, *Italy*

09.00–10.00 **AUDITORIUM EUROPA**
Plenary Session 9: Aneurysms *b*
Chairperson: N. Sakai, *Japan*
Moderators: I. Linfante, *USA* – **I. Wanke,** *Switzerland*

09.00–09.15 Blood blister like aneurysms remain challenging lesions to treat
N. Kocer, *Turkey*

09.15–09.25 Treatment of very small aneurysms (not BBL)
C. Cognard, *France*

09.25–09.35 More accurate indication for the treatment of un ruptured aneurysms: Aneurysm wall imaging
D. Hasan, *USA*

09.35–09.45 Aneurysm wall enhancement: fact or fiction?
R. Van den Berg, *The Netherlands*

09.45–10.00 Discussion

10.00–10.10 **Best Papers Award Ceremony**

10.10–10.30 **Coffee Break**

10.30–12.00 **AUDITORIUM EUROPA**
Plenary Session 10: Aneurysms

Aneurysms *c*
Chairperson: G. Lanzino, *USA*
Moderators: Y. S. Shin, *South Korea* – **L. Pierot**, *France*

10.30–10.50 More than 10 years of Flow Diverter Stenting. What did we learn?
I. Szikora, *Hungary*

10.50–11.10 Update on the Woven EndoBridge (WEB) device
T. Liebig, *Germany*

11.10–11.30 Contour, Neqstent and other intrasaccular flow disrupter devices
G. Gál, *Denmark*

11.30–11:50 Stenting and Y-stenting. Are they still useful in Diverter/Disrupter Era?
I. Saatchi, *Turkey*

11.50–12-00 Discussion

Aneurysms *d*
Chairperson: D. Le Feuvre, *South Africa*
Moderators : L. de Villers, *Australia* – **N. Kocer**, *Turkey*

12.00–12.15 Pulse Rider, pCONus and other neck control devices
M. Aguilar-Perez, *Germany*

12.15–12.30 There is no consensus for antiaggregant drugs in INR
L. Thiebault, *Canada*

12.30–12.45 Is DSA the gold standard in the evaluation of angiographic results of new devices?
F. Turjman, *France*

12.45–13.00 Discussion

13.00–14.00

AUDITORIUM EUROPA	**Lunch Industry sponsored Symposium**
EGADI ROOM	**Lunch Industry sponsored Symposium**
SICILIA ROOM	**Lunch Industry sponsored Symposium**
SARDEGNA ROOM	**Lunch Industry sponsored Symposium**

14.00–15.00 **AUDITORIUM EUROPA**
Plenary Session 11: How to introduce new devices? Ethical and Business considerations

Chairperson: C. Cekirge, *Turkey*
Moderators: J. de Vries, *The Netherlands*, **S. Gaikwad**, *India*

14.00–14.10 The point of view of the regulatory expert
H. Monstadt, *Germany*

14.10–14.20 The point of view of the industry
J. Dion, *USA*

14.20–14.30 The point of view of the interventional neuroradiologist
C. Taschner, *Germany*

14.30–14.35 Flash news from Europe. CE marking: fake news or reality?
M. Killer, *Austria*

14.35–14.40 Flash news from USA. FDA approval for new devices: so difficult to get?
P. K. Nelson, *USA*

14.40–14.45 Flash news from Elsewhere. What happens in unregulated markets?
A. Taylor, *South Africa*

14.45–15.00 Discussion

15.00–16.00 **AUDITORIUM EUROPA**
Plenary Session 12: The future is today: new insights on Neuro-Interventional Field
Chairperson: **A. Taylor**, *South Africa*
Moderators: **D. Tampieri**, *Canada* – **C. Islak**, *Turkey*

15.00–15.10 Endovascular intervention for recurrent chronic subdural hematoma
D. Fiorella, *USA*

15.10–15.25 High-resolution cone-beam CT in INR procedures. Advances and new indications
M. Tanaka, *Japan*

15.25–15.40 Neurodegenerative disease and novel drug-delivery strategies
M. Marosfoi, *USA*

15.40–15.45 Flash news: Something new that we did not know when this program was done
P. Lylyk, *Argentina*

15.45–16.00 Discussion

16.00 **Closing Ceremony**

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Oral Presentations

SESSION A: Spine/Tumor

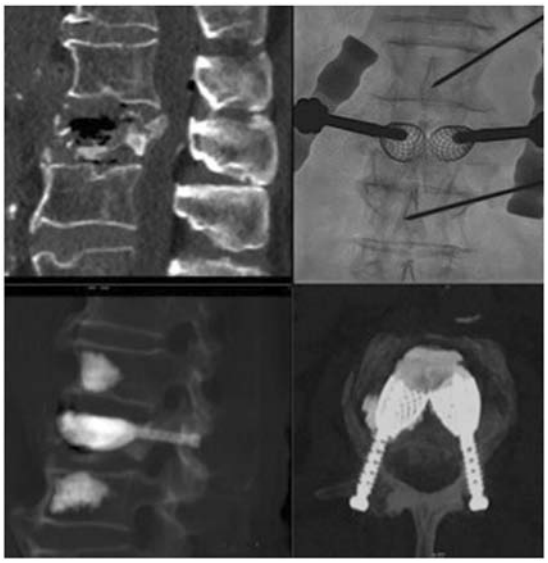
O 001

THE 'STENT-SCREW ASSISTED INTERNAL FIXATION' (SAIF) TECHNIQUE TO RECONSTRUCT THE VERTEBRAL BODY IN SEVERE OSTEOPOROTIC SPINAL FRACTURES WITH MIDDLE COLUMN INVOLVEMENT

D Distefano[1], P Scarone[2], M Isalberti[1], M Reinert[2,3], L La Barbera[4], T Villa[4], JA Hirsch[5], G Bonaldi[6] and A Cianfoni[1,7]

[1]Department of Neuroradiology, Neurocenter of Southern Switzerland, Ospedale Regionale di Lugano, Lugano, SWITZERLAND
[2]Department of Neurosurgery, Neurocenter of Southern Switzerland, Ospedale Regionale di Lugano, Lugano, SWITZERLAND
[3]Department of Neurosurgery, Inselspital University Hospital of Bern, Bern, SWITZERLAND
[4]Laboratory of Biological Structure Mechanics, Department of Chemistry, Materials and Chemical Engineering Giulio Natta, Milano, ITALY
[5]Department of Radiology, Massachusetts General Hospital, Harvard Medical School, Boston, USA
[6]Department of Neuroradiology, Papa Giovanni XXIII Hospital, Bergamo, ITALY
[7]Department of Interventional and Diagnostic Neuroradiology, Inselspital University Hospital of Bern, Bern, SWITZERLAND

Purpose: The treatment of highly fragmented osteoporotic/traumatic vertebral fractures (VFs) with middle-column (MC) involvement is controversial, especially in neurologically-intact patients. Surgery offers immediate stability but it is invasive whereas vertebral augmentation (VA) might represent an undertreatment as the MC, represented by the posterior third of the VB and pediculo-somatic junction, is rarely reinforced and rather left as a non-augmented ''bare area''. The ''Stent-Screw Assisted Internal Fixation'' (SAIF) technique is a new percutaneous image-guided procedure combining use of vertebral-body-stents (VBS) and percutaneous fenestrated cement-augmented screws, intended to restore axial-load capability of the VB. The stents reconstruct the anterior-column, and screws strengthen the MC, bridging pedicular fractures, and anchor VBS to the posterior elements, avoiding their mobilization. The purpose of this study is to retrospectively assess feasibility, safety and clinical outcome of VB reconstruction through SAIF technique in patients with osteoporotic spinal fractures with high level of deformity and osseous fragmentation, with middle column compromise.
A finite element (FEM) analysis supports the SAIF technique.



Materials and Methods: Retrospective analysis of 76 consecutive levels with severe osteoporotic VFs (grade II and III McCormack and/or Genant) with MC involvement treated with SAIF in 69 patients. VB-reconstruction was independently evaluated on post-procedure CT by one neurosurgeon and one neuroradiologist. Clinical and radiological follow-up were performed at 1 month and 6 months, and thereafter at variable intervals, following clinical practice. Clinical benefit on back pain was assessed with change in visual analogue scale (VAS) and with Patient's Global Impression of Change scale (PGIC) (7-point scale from 1 'very much worse' to 7 'very much improved').
Results: SAIF was performed at 50 lumbar and 26 thoracic levels. VB-reconstruction was satisfactory in 97% of levels. Cement leaks were visible in 10.5% of levels, all asymptomatic. Follow-up at 1 month was available in 74/76 levels, at 6 months or more (6–23 months, mean 7.5 months) for 68/76 levels. Pain amelioration observed in 63/69 patients (mean VAS on admission 8.34, 3.79 at 1 month and 2.49 at 6 months). The Patient's Global Impression of Change scale (PGIC) revealed an improvement (mean score 5.6 at 1 month and 6.1 at 6 months). Target-level stability maintained in all cases during follow-up. FEM proved SAIF more effective than VA in reducing the strains on the MC.

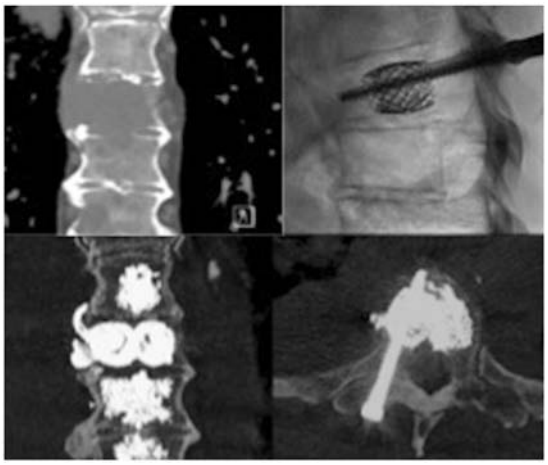
Conclusion: SAIF might represent a minimally invasive and safe option to obtain VB-reconstruction in severe osteoporotic VFs with MC involvement.
Keywords: Vertebral body stents, Kyphoplasty, Osteoporotic fractures

O 002

THE STENT-SCREW ASSISTED INTERNAL FIXATION (SAIF) TECHNIQUE TO RECONSTRUCT THE VERTEBRAL BODY IN NEOPLASTIC EXTREME OSTEOLYSIS

D Distefano[1], P Scarone[2], M Reinert[2,3], G Pesce[4], V Espeli[4], L La Barbera[5], T Villa[5], G Bonaldi[6], JA Hirsch[7], M Isalberti[1] and A Cianfoni[1,8]
[1]Department of Neuroradiology, Neurocenter of Southern Switzerland, Ospedale Regionale di Lugano, Lugano, SWITZERLAND
[2]Department of Neurosurgery, Neurocenter of Southern Switzerland, Ospedale Regionale di Lugano, Lugano, SWITZERLAND
[3]Department of Neurosurgery, Inselspital University Hospital of Bern, Bern, SWITZERLAND
[4]Department of Neuro-oncology, Oncology Institute of Southern Switzerland, Ospedale Regionale di Bellinzona e Valli, Bellinzona, SWITZERLAND
[5]Laboratory of Biological Structure Mechanics, Department of Chemistry, Materials and Chemical Engineering Giulio Natta, Milano, ITALY
[6]Department of Neuroradiology, Papa Giovanni XXIII Hospital, Bergamo, ITALY
[7]Department of Radiology, Massachusetts General Hospital, Harvard Medical School, Boston, USA
[8]Department of Interventional and Diagnostic Neuroradiology, Inselspital University Hospital of Bern, Bern, SWITZERLAND

Purpose: In extensive lytic lesions of the vertebral body (VB) stability-restoration requires anterior and posterior instrumentation. The anterior approach to stabilise the anterior column carries significant invasiveness and morbidity. Standard vertebral augmentation might represent an undertreatment. The ''Stent-Screw Assisted Internal Fixation'' (SAIF) technique is a new percutaneous image-guided procedure combining use of vertebral-body-stents (VBS), cannulated fenestrated percutaneous pedicle screws, and cement-augmentation, intended to restore axial-load capability of the VB. VBS scaffolds the VB and help cement-containment while screws anchor the stents to the posterior elements reducing the risk of their mobilization, bridging the middle column.
The purpose of this study is to retrospectively assess feasibility, safety and clinical outcome of VB reconstruction through SAIF technique in 'extreme' lytic lesions considered unstable or potentially unstable according to SINS score. A finite element (FEM) simulation supports SAIF technique.



Materials and Methods: Retrospective analysis of 36 consecutive levels (from T1 to L5) with extensive lytic VB destruction (Tomita 4–6), in 35 patients, treated with SAIF under fluoroscopy-guidance. VB-reconstruction was independently evaluated on post-procedure CT by one neurosurgeon and one neuroradiologist. Clinical and radiological follow-up was performed at 1 month and thereafter at intervals in accordance with oncological protocols.
Results: SAIF was performed at 16 lumbar and 20 thoracic levels. VB-reconstruction was satisfactory in 94.5% of levels for both readers (Cohen's kappa = 0.8). Cement leaks, with epidural or foraminal location at 7/36 levels (19%), caused transient radicular pain in 1 patient, and required surgical decompression with no permanent deficit in 1 patient.
Follow-up at 1 month was available for 30/36 treated levels, at 3 months for 24/36 levels, at 6 months or more (6–30 months, mean 11.5 months) for 16/36 levels.
SAIF implant stability was observed in 35/36 cases (97%).
Conclusion: Our preliminary results support off-label use of SAIF as a minimally invasive procedure of stabilization in patients with extensive lytic VB lesions.
Keywords: Vertebral body stents, Screws, Extreme osteolysis

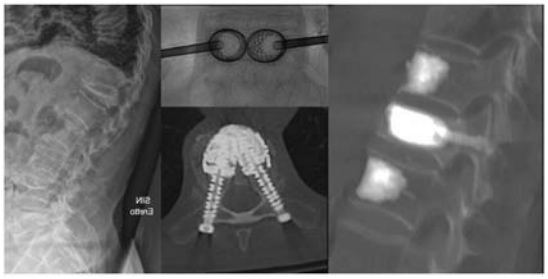
O 003

PILOT STUDY OF STENT-SCREW ASSISTED INTERNAL FIXATION (SAIF) TECHNIQUE FOR TREATMENT OF OSTEOPOROTIC SEVERE VERTEBRAL BODY COLLAPSE

M Pileggi[1], R Delfanti[2], M Isalberti[1], D Distefano[1], P Scarone[3] and A Cianfoni[1]
[1]Neurocenter, Regional Hospital of Lugano – Department of Neuroradiology, Lugano, SWITZERLAND
[2]University of California San Diego – Department of Neuroradiology, San Diego, USA
[3]Neurocenter, Regional Hospital of Lugano – Department of Neurosurgery, Lugano, SWITZERLAND

Purpose: Vertebral body fractures are one of the most common osteoporotic injuries, yet they can be difficult to treat. The ideal treatment addresses the consequences of

extreme vertebral body collapse: pain relief, height restoration, correction of kyphotic deformity and stabilization of the target level. Balloon kyphoplasty has inconsistent results in both height restoration and kyphosis correction, due to balloon compliance following the path of least resistance and the deflation effect. We describe a new kyphoplastic technique employing vertebral body stents (VBS) with cement-augmented pedicular screws, termed Stent-Screw Assisted Internal Fixation (SAIF) to overcome these limitations.



Materials and Methods: We performed a pilot retrospective single institution study to evaluate the feasibility, radiologic and clinical efficacy of using the SAIF technique for treating 31 osteoporotic fractures with vertebra plana configuration, which we defined as greater than 70% vertebral body height loss. All patients had pre- and post-procedural cross-sectional imaging from which height restoration and kyphotic angle correction were measured. Additionally, assessment of pain was performed prior to and following treatment, using a numeric rating scale (0 [minimal pain] – 10 [maximal pain]).
Results: SAIF was successfully completed in all patients who underwent the procedure. Following treatment, the average percentage of height restoration was 130% (range: 19% – 332%). The average kyphotic angle improved with a reduction from 14.2 to 8.8 degrees. The average follow-up period of this cohort was 4.6 months (range 1–12 months). Of the 16 patients with clinical follow-up, the average NRS prior to treatment was 7.6 compared to 3.5 post-treatment.
Conclusion: These preliminary results support the use of the SAIF as a safe and clinically effective option for the treatment of challenging severe osteoporotic vertebral body fractures.
Keywords: Kyphoplasty, Vertebra plana, Vertebral stent

O 004

"ARMED KYPHOPLASTY": AN INDIRECT CENTRAL CANAL DECOMPRESSION TECHNIQUE IN BURST FRACTURES

A Venier[1], L Roccatagliata[1], M Isalberti[1], P Scarone[1], DE Kuhlen[1], M Reinert[1], B Bonaldi[2] and A Cianfoni[1]
[1]Neurocentro della Svizzera Italiana – Ospedale Regionale di Lugano, Lugano, SWITZERLAND
[2]Ospedale Papa Giovanni XXIII di Bergamo, Bergamo, ITALY

Purpose: Burst fractures are characterized by middle column disruption and posterior wall retropulsion (PWR), and their treatment indications remain controversial. Recently introduced vertebral augmentation techniques, using intra-vertebral distraction devices, such as vertebral body stents (VBS) and Spinejack (SJ), could be effective in fracture reduction and fixation, and might obtain canal clearance through ligamentotaxis.
In this study we assess the results of "armed kyphoplasty" (AKP) using VBS or SJ in traumatic, osteoporotic and neoplastic burst fractures with regard to vertebral body height (VBH) restoration and correction of PWR.
Materials and Methods: Retrospective assessment of 53 burst fracture with PWR and no neurological deficit, in 51 consecutive patients, treated with AKP. PWR and VBH were measured on pre- and post-procedure CT. Clinical and radiological follow-up charts were reviewed.
Results: AKP was performed as a stand-alone treatment in 43 patients, combined to posterior instrumentation in 8, with laminectomy in 4. Pre-AKP and post-AKP mean PWR was 5,76 mm and 4,5 mm respectively ($p < 0,001$), and mean VBH was 10,82 mm and 16,66 mm respectively ($p < 0,001$). No significant clinical complications occurred. Clinical and radiological follow-up (1–36 months, mean 8 months) was available in 39 patients. Three treated levels showed refracture, but no patients showed neurological deterioration, and no re-treatment was necessary.
Conclusion: In the treatment of burst fractures without neurological deficit AKP obtains fracture reduction, internal fixation, and indirect canal decompression, and might therefore represent a suitable minimally-invasive treatment option either stand alone or in combination with posterior stabilization.
Keywords: Burst fracture, Ligamentotaxis, Kyphoplasty

O 005

PERCUTANEOUS LASER CERVICAL DISC DECOMPRESSION WITH DISCOLUX SIAD SYSTEM: EVALUATION OF OUR CLINICAL AND RADIOLOGIC EXPERIENCE OF THIS NEW THERAPEUTIC MODALITY IN THE CERVICAL DISCAL HERNIATIONS

F Fasano[1], GEM La Tessa[1], A Negro[1], V D'agostino[1], F Somma[1], V Piscitelli[1], C Sicignano[1], M Tecame[1], L De Bellis[1], M Prudente[1], O Vargas[1], A Pisani[2] and G Sirabella[1]
[1]U.O.C. Neuroradiologia, Ospedale del Mare, ASL NA 1Centro, Napoli, ITALY
[2]U.O.C. Chirurgia Vertebrale, Istituto Ortopedico IOMI, Messina, ITALY

Purpose: To evaluate the clinical effect of percutaneous laser disc decompression (PLDD) in the treatment of cervical disc herniation in the short term period.
Materials and Methods: From January 2017 to January 2019, 37 patients with cervical disc herniation (76 cervical disc)

were treated with PLDD. The inclusion criteria were initial cervical discal herniation/protrusion diagnosis by MRI and absence of response to conservative treatment (fisiotherapy, SAID, NSAID) during minimally 3 months. The clinical evaluation must be in accordance with imaging studies, which must demonstrate cervical herniation/protrusion congruent with the clinical symptoms. Other concomitant spinal pathologies were excluded (significant structural deformity of spine, severe vertebral osteoarthrosis, fractures, suspected infectious/inflammatory or neoplastic bone lesions and vertebral vascular malformations). Calcified hernia and hypo-intense disc signal on TSE T2 weighted sequences should not be present. Absolute contra-indication to the procedure were referred pregnancy, serious motor deficits and myelopathy. Relative contra-indications to the procedure were: bleeding disorder. There were 29 males and 8 females with an average age of 52 years, ranging from 35 to 69 years. The lesion were located at the levels of C3,4 in 10 discs, C4,5 in 25 discs, C5,6 in 21 discs, C6,7 in 20 discs. The laser fiber was introduced into the center of the herniated disc space by percutaneous puncture from anterior neck surface under CT guidance. Laser reduced the intra-disc pressure through the vaporization of disc nucleu. The adopted Ho:YAG laser total output power was decided depending on the degenerative degree of the disc and the reactive process of heat, ranging from 300 to 1 000 J. The clinical evaluation of the pain was done with VAS score at T0 (before PLDD) and at T1 (after 90 days).

Results: 69% of patients showed a moderate reduction of the VAS score (superior to 50%) between T0 and T1, 12% of patients a slight reduction of the VAS score (inferior to 50%) and 19% of patients no significantly difference. 77% of patients stopped taking anti-inflammatory drugs. A major initial volume of the HDs with an increased T2 signal intensity seemed to be positive prognostic factor for the success of the treatment.

Conclusion: PLDD can relieve the symptoms and signs of patients suffering from cervical disc herniation with less complication. The manipulation of PLDD is easy, safe and mini-invasive.

Keywords: Cervical spine, Cervical disc hernation, Percutaneus disc decompression

O 006

PERCUTANEOUS LASER DISC DECOMPRESSION WITH DISCOLUX SIAD SYSTEM: EVALUATION OF OUR CLINICAL AND RADIOLOGIC EXPERIENCE OF THIS NEW THERAPEUTIC MODALITY IN THE LUMBAR DISCAL HERNIATIONS

F Somma[1], V D'agostino[1], A Negro[1], O Vargas[1], F Fasano[1], C Sicignano[1], V Piscitelli[1], M Tecame[1], M Prudente[1], G Sirabella[1], L De Bellis[1], A Pisani[2] and G La Tessa[1]

[1]Ospedale del Mare, Napoli, ITALY

[2]IOMI, Messina, ITALY

Purpose: Percutaneous laser disc decompression (PLDD) is one of the well-known minimal invasive treatment methods of disc herniations. Aim of this study is to present our clinical and radiologic experience and to show the benefits of this technique in the lumbar discal heniations (LDH).

Materials and Methods: A total of 81 patients, with low back pain/lumbar sciatica and lumbar cruralgia who met the criteria of PLDD, underwent treatment between January 2017 and January 2019. Inclusion criteria were: initial lumbar discal herniation/protrusion diagnosis by MRI and no response to 3-months conservative treatment; clinical evaluation in accordance with imaging; exclusion of other concomitant spinal pathologies (spinal significant structural deformity, severe vertebral osteoarthrosis, fractures, suspected infectious/inflammatory or neoplastic bone lesions and vertebral vascular malformations). Calcified hernia and hypo-intense disc signal on TSE T2-w images were excluded, as well as pregnancy, serious motor deficits, myelopathy or cauda equine syndrome. Relative contra-indications to the procedure were bleeding disorder. For each patient age, gender, level of the LDH and pain relief were documented. The clinical evaluation of the pain was done with VAS score at T0 (before PLDD) and at T1, T2, T3 and T4 (7, 15,30 and 90 days after PLDD). Volumetric changes in lumbar disc herniation (LDH) were assessed using three-dimensional measurements obtained by magnetic resonance imaging (MRI) in order to identify possible factors affecting such changes, using the method improved by Seo JY et al. 2014, with specific tools of common post processing software of DICOM files.

Results: A complete evaluation before and after treatment was obtained: mean age 44 years (SD: 7 years); 27/81 female and 54/81 men; 41,94% of LDH at L4-L5 level; pain relief between T1-T2, T2-T3 and T3-T4 (between 7 and 90 days after PLDD) with statistically significant negative linear trend was detected, and reduction of middle VAS score at T0 from 7,06 (SD:0,84) to 0,90 (SD 0,96). One-third of repeat magnetic resonance imaging scans at 30/40 days after PLDD treatment showed moderate decrease (>50%) of disc herniation. An inferior age and a major initial volume of the HDs with an increased T2 signal intensity seemed to be positive prognostic factor for the success of the treatment. No procedural, No early or late neurological or infectious complications were reported following PLDD treatment.

Conclusion: PLDD is a safe and effective procedure in the treatment of lumbar chronic discogenic pain if the patient meets the selection criteria. It could be chosen when others non-invasive procedures fail.

Keywords: disc herniation, laser, decompression

O 007

PERCUTANEOUS CERVICAL DISC DECOMPRESSION WITH DEKO (SINTEAPLUSTEK): EVALUATION OF OUR CLINICAL AND RADIOLOGIC EXPERIENCE OF THIS NEW THERAPEUTIC MODALITY IN THE CERVICAL DISCAL HERNIATIONS

A Negro[1], G La Tessa[1], M Tecame[1], F Somma[1], F Fasano[1], C Sicignano[1], V Piscitelli[1], M Prudente[1], O Vargas[1], L De Bellis[1], A Pisani[2], V D'agostino[1] and G Sirabella[1]

[1]Neuroradiology Service ospedale del Mare ASL NA1, Naples, ITALY

[2]Orthopaedics Service I.O.M.I., Messina, ITALY

Purpose: To evaluate the clinical effect of percutaneous disc decompression with Deko SinteaPlustek (Deko PCDD) in the treatment of cervical disc herniation in the short term period.

Materials and Methods: From January 2017 to January 2019, 21 patients with cervical disc herniation (36 cervical disc) were treated with Deko PCDD. Deko percutaneous discetomy system allows to perform a minimally invasive procedure by using the Archimedean screw mechanics to remove the nucleus pulposus in case of non-extruded hernia, thus reducing the pressure on the disc and on the area surrounding the painful nerve root. The inclusion criteria were initial cervical discal herniation/protrusion diagnosis by MRI and absence of response to conservative treatment (fisiotherapy, SAID, NSAID) during minimally 3 months. The clinical evaluation must be in accordance with imaging studies, which must demonstrate cervical herniation/protrusion congruent with the clinical symptoms. Other concomitant spinal pathologies were excluded (significant structural deformity of spine, severe vertebral osteoarthrosis, fractures, suspected infectious/inflammatory or neoplastic bone lesions and vertebral vascular malformations). Calcified hernia and hypo-intense disc signal on TSE T2 weighted sequences should not be present. Absolute contra-indication to the procedure were referred pregnancy, serious motor deficits and myelopathy. There were 11 males and 10 females with an average age of 45 years, ranging from 36 to 62 years. The lesion were located at the levels of C3,4 in 5 discs, C4,5 in 8 discs, C5,6 in 13 discs, C6,7 23 in discs. The clinical evaluation of the pain was done with VAS score at T0 (before treatment) and at T1 (after 90 days).

Results: 69% of patients showed a moderate reduction of the VAS score (superior to 50%) between T0 and T1, 12% of patients a slight reduction of the VAS score (inferior to 50%) and 19% of patients no significantly difference. 77% of patients stopped taking anti-inflammatory drugs. No geneder relkated difference was fonud. An inferior age (>45 years old) correlated with a grater decrease VAS score at T1. A major initial volume of the HDs with an increased T2 signal intensity seemed to be positive prognostic factor for the success of the treatment.

Conclusion: Deko PCDD can relieve the symptoms and signs of patients suffering from cervical disc herniation with less complication. The manipulation of Deko PCDD is easy, safe and mini-invasive.

Keywords: Chronic Radicular Pain, DEKO disc decompression, pain relief

O 008

PERCUTANEOUS LUMBAR DISC DECOMPRESSION: EVALUATION OF OUR CLINICAL AND RADIOLOGIC EXPERIENCE OF A NEW THERAPEUTIC MODALITY IN THE LUMBAR DISCAL HERNIATIONS

M Tecame[1], G La Tessa[1], A Negro[1], F Somma[1], V D' Agostino[1], E Prudente[1], O Vargas[1], F Fasano[1], L De Bellis[1], V Piscitelli[1], C Sicignano[1], A Pisani[2] and G Sirabella[1]

[1]Neuroradiologia Ospedale del Mare, Napoli, ITALY

[2]Istituto Ortopedico IOMI, Messina, ITALY

Purpose: Percutaneous lumbar disc decompression (PLDD) is one of the well-known minimal invasive treatment methods of disc herniations. We present our clinical and radiologic experience in order to evaluate the short term outcome of for discogenic radicular pain that has failed conservative management.

Materials and Methods: 40 patients with low back pain/lumbar sciatica and lumbar cruralgia who met the criteria of Lumbar disc decompression, underwent treatment between January 2017 and January 2019. Inclusion criteria: radicular pain in a dermotomal/sclerotomal distribution; Concordance of nerve root impingement signs on physical examination concordant with the symptomatic dermatome/myotome including an asymmetric muscle stretch reflex, myotomal strength asymmetry, or a positive dural tension sign; MRI demonstrating a focal disc protrusion, disc extrusion, or diffuse disc bulge causing subarticular or foraminal stenosis resulting nerve root impingement at a level concordant with that expected based on clinical history and physical examination. Failure to improve significantly after a minimum of 3 months of physical therapy, oral anti-inflammatories, and at least 1 transforaminal epidural steroid injection, indicated by concordant clinical history, physical examination, and MRI findings. Patients with less than 50% preservation of disch eight at the site of disc herniation,a herniation>6 mm or sequestered disc fragments were excluded from the study. Calcified hernia and hypo-intense disc signal on TSE T2 weighted sequences should not be present. Patients with blood dyscrasia, spondylolisthesis, spondylolysis, or infection at the intended site of needle insertion were excluded. Each patient underwent Lumbar disc decompression immediately followed by a therapeutic transforaminal epidural steroid injection at the involved level. For each patient age, gender, level of the LDH and pain relief were documented. The clinical evaluation of the pain was done with VAS score at T0 (before Decompression) and at T1 (after 90 days).

Results: We obtained a complete evaluation before and after treatment and results were as follows: mean age: 40 years (SD: 5 years); 15/40 female and 25/40 men; 41,94% of LDH at

L4-L5 level; pain relief between T0-T1, with a reduction of middle VAS score from 7,05 (0,85) to 5,01 (SD: 0,60). An inferior age and a major initial volume of the HDs with an increased T2 signal intensity seemed to be positive prognostic factor for the success of the treatment. No procedural, no early and late neurological or infectious complications were reported.
Conclusion: Safe and effective procedure in the treatment of lumbar chronic discogenic pain if the patient met the selection criteria and could be chosen when others non-invasive procedures fail.
Keywords: Spine, Lumbar, Decompression

O 009

RADIOFREQUENCY AND VERTEBROPLASTY TO TREAT VERTEBRAL METASTASES

M Muto[1], G Leone[2], G Ambrosanio[2], G Guarnieri[2] and M Muto[2]
[1]Università degli Studi di Napoli Federico II Dipartimento di Neuroscienze e Scienze Riproduttive ed Odontostomatologiche, Napoli, ITALY
[2]Azienda Ospedaliera Antonio Cardarelli, Napoli, ITALY

Purpose: We sought to investigate the role of radiofrequency associated with vertebroblasty (RF + VP) in the treatment of vertebral metastatic lesions and its outcomes. Vertebral secondary lesions are in the vast majority of cases osteolytic or mixed, and they can be either paucisymptomatic or extremely painful if they erode the vertebral cortical layer. These lesions are worrisome as their worsening can lead to mielo-radicular syndromes exacerbating the oncologic condition. The multidisciplinary management of patients carrying these lesions is pivotal for their optimal treatment, which is different depending on the primitive tumor and so far it avails of advanced chemo-radio-therapeutic and also percutaneous techniques.
Materials and Methods: Seventy-five patients (49 women and 26 men) were treated in our institution with RF + VP from January 2014 to April 2019. They were affected by different primitive tumors (35 breast, 30 lung, 8 renal and 2 bladder), with a pain score from 8 to 10 (VAS scale) and no myelin disorders. Forty lesions were located in the lumbar spine, 10 were dorsal and only in 10 cases there was an epidural involvement, although without myelin disorders at the moment of treatment. All patients were treated with a percutaneous approach, in 40 cases monopeduncolar and in 35 cases bipeduncolar, with at least 2 radiofrequency cycles (DFine Merit system) followed by the injection of high viscosity cement (DFine Merit). Twenty-eight patients received a double-level treatment whereas 47 a single level one. Forty-five patients underwent radiotherapy before the percutaneous approach whereas in 30 patients radiofrequency application and vertebroplasty was the first line treatment, then followed by radio-chemo-therapy.
Results: Seventy-two out of 75 patients were followed-up and at 1 and 3 months after treatment there was a reduction of pain score from 8 to 4 in 78% of patients. The 12 months follow up was available for 45 patients and in which the symptoms improvement persisted while 2 patients reported a local relapse of the disease at 18 months.
Conclusion: Radiofrequency combined with vertebroplasty is a valid treatment for vertebral secondary lesions either before or after chemo-radio-therapy to relief pain and to reduce the risk of an abrupt downfall of the fragile oncologic stability.
Keywords: metastasis, vertebroplasty, radiofrequency

O 010

CHALLENGE FOR CHRONIC INTRACTABLE LUMBOSACRAL RADICULAR PAIN: PULSED RADIOFREQUENCY TREATMENT AND VOLUMETRIC MODIFICATIONS OF THE LUMBAR DORSAL ROOT GANGLIA

A Negro[1], F Somma[2], V D'agostino[2], M Arenella[3] and F Tortora[4]
[1]Neuoradiology Service University of Campania; Neuroradiology Service Ospedale del Mare ASL NA1, Naples, ITALY
[2]Neuroradiology Service Ospedale del Mare ASL NA1, Naples, ITALY
[3]Univeristy of Campania, Naples, ITALY
[4]Neuroradiology Service University of Campania, Naples, ITALY

Purpose: Study of the therapeutic outcome of CT guided pulsed radiofrequency (PRF) treatment adjacent to the lumbar dorsal root ganglion (DRG) for patients with chronic intractable lumbosacral radicular pain in order to evaluate clinical and radiological predictive factors of safety and therapeutic success.
Materials and Methods: Thirty patients, from 2016 to 2018, were enrolled (age: 42–80aa, 66.7% men and 33.3% females) with low back pain, lumbosciatalgia and/or lumbocruralgia, resistant to previous medical and physical treatments for a period not <3 months, failure of surgical and chemiodiscolysis with ozone oxygen therapy. Each patient was subjected to a clinical evaluation (antalgic walking, sensitive deficit, interviews with specific questionnaires: ODI, RDQ, VAS) and to a radiological evaluation with MRI examination, before and thirty days after the CT guided PRF treatment. Measurements of the thickness of the involved and not involved DRG were carried out using a common post-processing software of MRI exams in order to have measurement parameters for comparison.
Results: Significant improvements of the clinical outcomes with a good resolution of the pain symptoms (VAS evaluation: the score fell from 68,47 to 39,17 with a difference of 29,3 and a reduction of the 42,79% in the perceived pain). The thickness of DRG falls from an average media of 0,586 cm to 0,448 cm, with a difference of 0,138 cm and a percentage reduction of 22,30%.

Conclusion: PRF treatment of the DRG may be considered for patients with chronic severe lumbosacral radicular pain refractory to conventional medical management and when other non-invasive or surgical procedures fail.
Keywords: Chronic lumbosacral radicular, pulsed radiofrequency treatmen, dorsal root ganglia

O 011

PERCUTANEOUS TREATMENT OF ATYPICAL AND AGGRESSIVE SYMPTOMATIC VERTEBRAL HEMANGIOMA

G Leone[1], M Muto[1], G Ambrosanio[1], P Vassallo[1], G Guarnieri[1] and M Muto[1]
[1]Diagnostic and Therapeutic Neurolodiology Unit, Cardarelli Hospital, Naples, ITALY

Purpose: Vertebral hemangioma (VHs) are benign tumors with a rich vasculature. They represent 2–3% of all spinal tumors, and are identified in 10–12% of all vertebral autopsies. Only 0.9–1.2% of VHs are symptomatic. Symptoms vary from vertebral pain, sometimes resistant to conservative medical treatment to progressive neurological deficits due to a vertebral fracture or medullary compression related to extension of the lesion to the vertebral body/vertebral arch. The management of VHs is complex. Surgery or radiotherapy have been first-line treatments for several years, but are worsened by intraoperative and postoperative hemorrhagic complications related to the rich vascularization that characterizes this type of lesion. Recently, vertebroplasty has been introduced as an alternative to traditional surgical and radiotherapy of symptomatic VHs. The principle of vertebroplasty is to completely fill the vertebral lesion with cement (PMMA) to achieve irreversible sclerosis of the hemangiomatous venous pool, thus obtaining an antalgic effect. Moreover, in the case of vertebral fracture due to compression from tumor growth, the cement stabilizes the movements of the trabecular microfractures of the spongious bone which is responsible for the pain, and it also makes the VB more compact and resistant.
Materials and Methods: We retrospectively evaluated our series of atypical (55 patients) and aggressive (18 patients) vertebral hemangiomas (age 37–72 years) between January 2003 and March 2018. The diagnosis of aggressive hemangioma has always been based on CT morphology and MRI characteristics (signal intensity, contrast-enhancement and eventual epidural extension). In 12 patients with aggressive vertebral hemangiomas epidural extension on MRI was identified. In all the cases vertebroplasty (VP) was performed as the treatment of choice obtaining the best possible filling. In 3 cases (the last treated) alcohol injection was also performed before PMMA injection, to obtain better sclerosis. The follow-up range varies from a minimum of 2 to a maximum of 7 years.
Results: In all the patients there was a reduction or disappearence of painful symptoms, even in patients with aggressive angiomas with an epidural component. In a patient at 7 years of follow-up, there was a recurrence of the epidural angiomatous component, with evidence of significant epidural compression and subsequent surgical and radiotherapy treatment.
Conclusion: Percutaneous treatment with VP of atypical or aggressive symptomatic vertebral hemangiomas is a reliable technique for the resolution of pain symptoms, in order to guarantee the greatest resistance of the metamer and reduce the epidural angiomatous component.
Keywords: hemangioma, aggressive, vertebroplasty

O 012

INVASIVE VERTEBRAL HEMANGIOMA, MANAGEMENT AND ROLE OF INTERVENTIONAL RADIOLOGY

A Sultan[1], T Hassan[1], A Yehia[1] and TI Metwally[1]
[1]Neurosurgery Departemnt, Alexandria University, Alexandria, EGYPT

Purpose: Hemangioma is a common benign lesion of the vertebral column with a rare incidence of spinal compression due aggressive nature of some of them. Massive intraoperative hemorrhage is encountered during surgery. We describe management of some cases of the aggressive lesions.
Materials and Methods: retrospective analysis of cases of aggressive vertebral hemangioma revealed 8 cases treated in our institution in the last ten years.
Results: eight patients presented with progressive neurological deficits (8), back pain (7) and neck pain (1) was diagnosed with invasive vertebral hemangioma with neural structure compression. One patient with cervical C4 lesion undergone transarterial embolization followed by corpectomy and fixation. The other patients undergone vertebropalsty using bone cement and decompression with or without fixation. All patient are doing well after intervention. The neurological deficits improved during 6 months. One of the patient was completely paraplegic but with intact deep sensation, this patient improved dramatically and can walk unsupported.
Conclusion: vertebral hemangioma can present in an invasive manner that necessitate intervention. Preoperative embolization or vertebroplasty are helpful methods to decrease intraoperative catastrophic hemorrhage.
Keywords: hemangioma, vertebral, embolization

O 013

PRE-OPERATORY MANAGEMENT OF SPORADIC INTRADURAL EXTRAMEDULLARY HEMANGIOBLASTOMAS

D Tampieri[1], R Alkins[1], A Menard[1] and J Rossiter[1]
[1]KHSC Department of Radiology, Queen's University, Kingston, CANADA

[2]KHSC Department of Neurosurgery, Queen's University, Kingston, CANADA
[3]KHSC Department of Radiology, Queen's University, Kingston, CANADA
[4]KHSC Department of Pathology, Queen's University, Kingston, CANADA

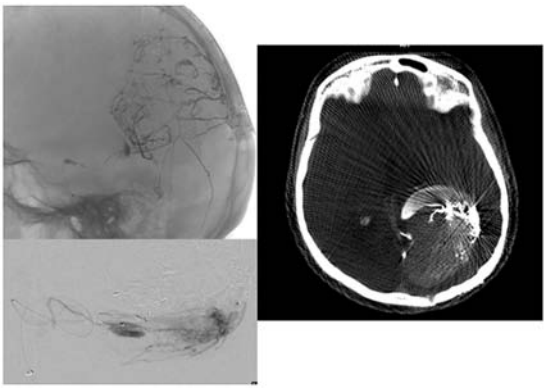
Purpose: The aim of this presentation is to report on the rare occurrence of sporadic intradural extramedullary hemangioblastomas and describe the endovascular management in order to enable the surgical excision.
Spinal hemangioblastomas account for 1%–5% of intradural tumours, more frequently encountered in patients with Von Hippel Lindau Syndrome (VHL).
Intradural extramedullary hemangioblastomas not associated with VHL disease are infrequent.
In this presentation we would like to illustrate the endovascular management of two cases of sporadic hemangioblastomas one located intra-dural at the sacral level, the other along a cervical nerve root.
Materials and Methods: We report two patients with hyper vascular space occupying lesions located intradurally in the sacrum at S2 level (Case 1) and along the left C3 nerve root at the cervical level (Case 2).
The vascular supply to the tumour was from the lateral sacral arteries in Case 1 and from short perforators arising from the left vertebral artery, which was totally encased by the tumour (Case 2).
Results: The management of the two lesions of course was different.
In case 1 we proceeded to pre-operatory embolization with selective catheterization of the lateral sacral arteries followed by particles embolization to reduced the vascularity and enable surgical resection.
In Case 2 in order to enable a total en block resection of the tumour we proceeded to test balloon occlusion of the left vertebral artery followed by sacrifice of the artery, trapping the artery at the level of the tumour. No complication occurred.
In both cases the surgical resections were successful with contained blood loss, without any need for transfusion and total resection was achieved.
Conclusion: Although rare the suspicion for hemangioblastoma has to be raised when an intra-dural extra medullary highly vascularized mass is detected.
The Endovascular management should be tailored to the location, size and vascular supply of the lesion in order to achieve a de-vascularized tumour and enable total surgical resection.
Many techniques including particles embolization, use of glue or Onyx have been described. Endovascular trapping of the vertebral artery has not been previously reported.
When necessary parent artery occlusion can be achieved, safely. In this case the occlusion of the left vertebral artery was advantageous not only to enable an en block resection but also in order to completely de-vascularize the mass to facilitate surgery and control the intra-operative blood loss.
Keywords: Hemangioblastoma, Embolization, Extramedullary

O 014

ENDOVASCULAR TREATMENT OF HYPERVASCULAR BRAIN TUMORS OTHER THAN MENINGIOMAS

L Nico[1], J Ognard[1], E Magro[1] and J Gentric[1]
[1]CHRU Brest, Brest, FRANCE

Purpose: The presurgical embolization of hypervascular brain tumors other than meningiomas is a practice currently performed on selected cases after discussion with the neurosurgeon. In literature there is still a lack of evidence on efficacy and safety of presurgical endovascular treatment in this type of lesions.
Materials and Methods: We selected 4 cases for video recording during surgical resection. We performed a presurgical embolization in all the cases for a total of 8 sessions. Histopathology confirmed the diagnosis of hemangiopericytoma for 1 patient, hemangioblastoma for 2 patients and the diagnosis of metastatic lesions for 1 patient. During embolization, one patient presented a hemorrhagic complication with appearance of subdural hematomas.
Results: With an analysis of the relationship between surgical video recording and endovascular procedures, we want to report our experience in the embolization of hypervascular brain tumors other than meningioma to discuss indications and usefulness, anatomical aspects that may lead to complications and possible technical choices and pitfall to avoid, in particular about liquid embolic agents.



Conclusion: Three take home message: aggressive endovascular treatment may be necessary in selected cases of difficult surgery. In these cases arterial access through pial afferences may be neccesary. Therefore particular concern is needed during catheterization at pial-dural connection because of high risk of perforation.
Keywords: tumor, embolization, liquid embolic agent

O 015

PRE-OPERATIVE DIRECT-PUNCTURE EMBOLIZATION OF HEAD AND NECK HYPERVASCULAR TUMORS USING SQUID 12

A Pedicelli[1], E Lozupone[1], I Valente[1], F D'Argento[1], A Alexandre[1], L Chiumarulo[2] and C Colosimo[1]
[1]Fondazione Policlinico Universitario A. Gemelli IRCCS, Roma, ITALY
[2]Azienda Ospedaliero Universitaria Consorziale Policlinico di Bari, Bari, ITALY

Purpose: The authors have evaluated their experience in pre-operative direct puncture embolization of hypervascular tumors of the head and neck using SQUID 12, an embolic liquid agent.
Materials and Methods: Between July 2016 and December 2018, the authors retrospectively reviewed clinical, embolization and surgical data of 8 consecutive patients with 9 hypervascular head and neck tumors who had undergone pre-operative embolization using SQUID 12. Percutaneous embolizations were performed by inserting a 19–22 Gauge needle directly into the tumor under ultrasound, fluoroscopic and/or endoscopic guidance. The hub of the needle was connected to a 15-cm DMSO-compatible extension tube and the SQUID 12 was injected until at least a total or near-total devascularization was reached.
Results: Total or near-total devascularization was achieved in eight over nine cases. Complete en-bloc tumor removal by surgery was achieved in all cases. Only one patient required blood transfusion. No major periprocedural adverse events were recorded.
Conclusion: Direct puncture embolization of hypervascular tumors of the head and neck using SQUID 12 seems to be safe and effective. It may offer almost complete devascularization due to homogenous, deep penetration in the tumor, with optimal visibility of the agent throughout the percutaneous procedure. It may reduce intraoperative blood loss and the need for transfusion, thus facilitating complete surgical resection.
Keywords: Head and Neck, Tumor, SQUID

SESSION B: Material/Technique/Miscellaneous

O 016

USEFULNESS OF VESSEL MODELS MADE WITH 3D PRINTER IN ENDOVASCULAR THERAPY

T Imai[1], T Osanai[2], T Soyama[3], D Abo[3] and K Kudo[3]
[1]Hakodate central general hospital – Department of neurosurgery, Hakodate, JAPAN
[2]Hokkaido University – Department of neurosurgery, Sapporo, JAPAN
[3]Hokkaido University – Department of Diagnostic and Interventional Radiology, Sapporo, JAPAN

Purpose: One of the difficulties in endovascular therapy is that it is hard to understand the 3-dimensional (3D) structure of vessels from the 2D picture. 3D-digital subtraction angiography (DSA) is available, but we think solid models are more useful than 3D pictures on the screen. We made several vessel models using 3D printer and verified the usefulness.
Materials and Methods: We selected several cases of cerebrovascular diseases and made the models of their vascular lesions. We used Digital Imaging and Communication in Medicine (DICOM) data obtained from cerebral angiography and translated them into Stereolithography (STL) files with the software (InVesalius ver. 3.1). The STL files were repaired by another software (MeshMixer ver 3.5.474), and by using them we fabricated 3D models with 3D printer (Form2). All models were made of flexible resin, and some of them were hollow models and others were solid models. We evaluated what kind of structure we could make and if endovascular surgeons could simulate surgical procedure using these 3D models.
Results: The required time for printing models is about four to eight hours. The cost per one model is about one to two dollars. The models which had relatively simple structure (e.g. cerebral aneurysm, carotid artery stenosis) were easy to make and we could simulate surgical procedure by understanding 3D structure, but complicated models (e.g. arteriovenous malformation, arteriovenous fistula) were difficult to make because they collapsed partially when we printed out, so they were not enough to make us understand the 3D structure. The difference was more remarkable in hollow models than solid models. Moreover, with our method we could hardly separate vessels and bone when we extracted only vessels from the lesions surrounded by bone structure. Therefore the most available structure to make was simple lesion and separate from complicated bone structure. Although we could make models at relatively low cost, our method took several hours to make models, so it is not available for emergent cases.
Conclusion: 3D-printed vessel models help us to understand the 3D structure of the vascular lesions and to simulate endovascular procedure if we choose the adequate cases.
Keywords: 3D printer, vessel model, simulation

O 017

NON X RAY IMAGING SYSTEM FOR SIMULATORS USING 3D RAPID PROTOTYPING MODEL

K Fukasaku[1], H Yokota[1], T Kuchiura[3], M Iwabuchi[3], Y Ohya[3] and M Negoro[2]
[1]Image Processing Team, RIKEN, Wako-shi, JAPAN
[2]Centre of Neurointervention, Ichinomiya-NIshi Hospital, Ichinomiya, JAPAN
[3]Department of Cardiovascular Medicine, Nephrology and Neurology, University of the Ryukyus, Naha, JAPAN

Purpose: Training and simulation are important for endovascular intervention to intracranial vessels, coronary arteries and other sites. Recently, patient specific vascular

models are built with rapid prototyping (RP) system and real materials such as micro catheters are used for this purpose. However, their imaging system is not well-established, and conventional X ray system or optical camera has been used. Here, we have developed a fluorescent imaging system, and able to simulate endovascular intervention without X ray imaging system.

Materials and Methods: Fluorescent dye was used as radiopaque materials such as catheters themselves and contrast material. Our imaging system could be put on RP model and fluorescent dye painted catheter system was placed in the model. Fluorescent dye solution was also used as contrast materials. Exciting light from LED was given and fluorescence from the dye was obtained by an optical camera through hight pass filter. The camera was mounted on electrically controlled C arm. The images were processed by PC and simulated standard X ray fluoroscopy or road map images could be obtained.

Results: Under RP models, our imaging system could reproduce various mode of X ray fluoroscopic images. Of course, dye on balloon catheters was lost on inflation. Otherwise, dyes on the materials could stay enough for catheter manipulation. RP based patient specific models were beneficial for simulation and training for vascular intervention. Clinical X ray imaging systems are the standard imaging method for RP simulators, so have several problems such as radiation exposure and occupying the DSA rooms to disturb emergent treatment. On the other hand, our system doesn't require X ray, so can be used in non- radiation controlled area and also can be used without protecters. Fluorescent dye is nontoxic and able to use without regulation.

Conclusion: We develop non X ray imaging system for simulation of interventional procedure. Our system is built on fluorescent images and do not use X ray, which is safe and effective for simulator using RP models.

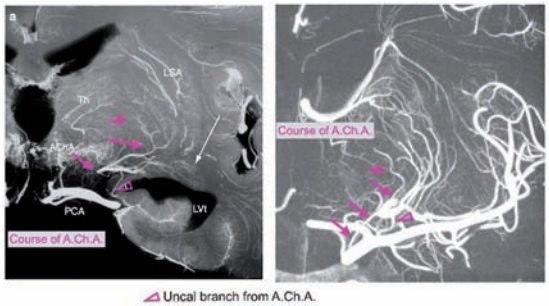
Keywords: non X ray imaging, simulation, fluorsent dye

O 018

HIGH-RESOLUTION CONE-BEAM CT IN INR PROCEDURES. ADVANCES AND NEW INDICATIONS

M Tanaka[1], K Kadooka[1] and H Saitoh[1]
[1]Kameda Medical Center, Kamogawa, JAPAN

Purpose: The efficacy of high-resolution cone beam CT (CBCT) was evaluated based on the 506 cases of INR procedures and the clinical impact of this modality was discussed.



Materials and Methods: From 2013 to 2018, 506 consecutive cases of INR procedures were studied. Embolization of intracranial aneurysms, dural AVFs, AVMs, meningiomas, head and neck tumors and mechanical thrombectomies of acute ischemic stroke were enrolled. Flat-panel detector biplane angiography unit (Allura Clarity FD20/20; Philips Medical Systems) was used. The C-arm takes a circular trajectory of 220°. The motorized frontal C-arm was used to acquire 30 projection images/s at 80 kV, the scanning time was 20 seconds, and the detector format used was 22 cm × 22 cm. The concentration of contrast medium was optimized with the use of dual head injector of both contrast and saline.

The objects of the assessment were the adjacent perforators of the target lesion, the shunt point, the terminal feeders of the shunt pathology, the intratumoral vascular network, the intranidal angioarchitecture of AVMs, the anterior and posterior spinal artery, the plaque image of carotid atherothrombosis, and the location of thrombus formation in acute ischemic stroke. The visibility of these objects was evaluated and measured on the 3D workstation. The identification of the objects was compared to the findings of the superselective angiography and the MRI.

Results: The sensitivities of the perforators over 150 micron meter were 94% in the area of basilar bifurcation, 82 % in the vertebro-basilar union. In the dural AVFs, the sensitivity of the shunt location was over 97% and the tip of the microcatheter in the affected sinus was well visualized during procedure. The quality of the images depended on the regional concentration of the contrast and the timing of acquisition. The arrival time of the contrast to the objects was important factor to visualize the microanatomical structure.

Conclusion: If the parameters of acquisition in the region of interest would be appropriate, the sensitivity of the high-resolution CBCT was sufficient to identify the angioarchitecture of the target lesion and adjacent microvascular anatomy. It was feasible to provide the numerous information in the IVR procedures.

Keywords: Cone beam CT, IVR, angioarchitecture

O 019

FLAT PANEL COMPUTER TOMOGRAPHY IN HYBRID OPERATING ROOM FOR NEUROLOGICAL INTERVENTION: A PHANTOM AND RETROSPECTIVE STUDY

A El Mekabaty[1], C Aberle[2], K Blackham[1] and D Zumofen[3]
[1]University Hospital Basel – Diagnostic and Interventional Neuroradiology Section, Basel, SWITZERLAND
[2]University Hospital Basel – Department of Radiology, Basel, SWITZERLAND
[3]University Hospital Basel – Department of Neurosurgery, SWITZERLAND

Purpose: Recent advancement in minimally invasive neurosurgical procedures, as well as the spread of hybrid

operating rooms (OR), resulted in increasing number of three-dimensional (3D) rotational angiography (RA) flat panel computer tomography (FPCT) studies being performed in hybrid-OR. We conducted a phantom study to evaluate different intraoperative settings and FPCT protocols, and compare the radiation dose to a cohort of patients' data.

Materials and Methods: An anthropomorphic x-ray head phantom, with or without neurophysiological monitoring electrodes and BIS-monitoring cable, was used. Following frames were used; A. Metal Mayfield head holder, B. Carbon Mayfield plus steel pins, C. Carbon Mayfield plus half titanium pins, D. Carbon Mayfield plus titanium pins, E. Carbon Mayfield plus rubber head holder, or F. Carbon angiography table. The following 3D protocols (Artis Pheno, Siemens – Erlangen, Germany) were tested; 1. 4 sec 3D RA; 2. 4 sec 3D RA Head Care; 3. 5 sec 3D RA-FPCT; 4. 4 sec FPCT Head Care; 5. 6 sec FPCT 70KV; and 6. 6 sec FPCT 109KV. Subjective analysis of image quality was performed by two experienced readers, where they assigned a grade (1 to 3; poor, moderate, or excellent) in regard to metal artefact and noise. Clinical 3D RA and FPCT performed in our hybrid-OR from January to December 2018 were analysed as control.

Results: The presence of neurophysiological monitoring electrodes and BIS (bispectral index)-monitoring cable did not have an effect on either the radiation dose (mean 0.21 mSv with cables vs. 0.20 mSv without, $p = 0.9$) in 3D RA acquisitions. The radiation dose was similar for the metal Mayfield head holder, either with steel or half titanium pins, compared to all other settings in 3D RA acquisitions (mean 0.46 mSv vs. 0.48 mSv, $p = 0.9$). Radiation dose of acquisitions in carbon Mayfield with either steel, half titanium or titanium pins were comparable within each protocol (ranging from 0.50 mSv in 4 sec 3D RA to 2.5 mSv in 6 sec FPCT 109KV acquisitions). Subjective analysis ranked image quality of the different head holders as follows; A. Steel Mayfield: 1.3; B. Carbon Mayfield plus titanium pins: 2.0; C. Carbon Mayfield plus half titanium pins: 2.0; D. Carbon Mayfield plus steel pins: 1.9, E. Carbon Mayfield plus rubber head holder: 2.1; and F. Carbon angiography table 2.6. Overall interrater agreement was kappe $= 0.66$ ($p < .001$).

Conclusion: We believe our result present a useful clinical tool to assist in achieving an acceptable 3D acquisition image quality during hybrid-OR procedures, while maintaining the radiation dose as low as reasonable.

Keywords: Hybrid operating room, Flat panel computer tomography, Radiations dose

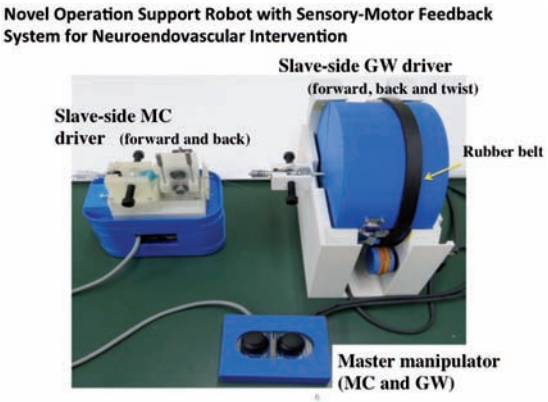
O 020

NOVEL OPERATION SUPPORT ROBOT WITH SENSORY-MOTOR FEEDBACK SYSTEM FOR NEUROENDOVASCULAR INTERVENTION

S Miyachi[1], Y Nagano[2], T Hironaka[3], R Kawaguchi[4], T Ohshima[5], N Matsuo[6] and R Maejima[7]

[1]Department of Neurosurgery and Neuroendovascular Therapy, Aichi Medical University, Nagakute, JAPAN
[2]Department of Electronic Control and Robot Engineering, Aichi University of Technology, Gamagori, JAPAN
[3]Graduate School of Medical Sciences, Nagoya City University, Nagoya, JAPAN
[4]Department of Neurosurgery, Aichi Medical University, Nagakute, JAPAN
[5]Neuroendovascular Therapy Center, Aichi Medical University, Nagakute, JAPAN
[6]Department of Neurosurgery, Aichi Medical University, Nagakute, JAPAN
[7]Department of Neurosurgery, Aichi Medical University, Nagakute, JAPAN

Purpose: Robotic technology is rapidly developing in the medical field, particularly contributing to support operative intervention using the da Vinci system during endoscopic surgery. Neuroendovascular intervention robot surgery is preferred when aiming to reduce radiation exposure among surgeons.



Materials and Methods: We developed a prototype of support robot with two independent slaves manipulating both micro-catheter and micro-guide-wire connected with the remote master driver with two joysticks. This design simulates usual catheterization with both hands. Slave manipulator has a sufficient output force greater than 1 Newton to reproduce the exact master intervention without slip and delay. This machine has a unique function that indicates the reaction force of the resistance on wire stuck using the sensor system. We investigated the master–slave response, reliability of the force gage and the degree of slippage of the slave motion on the table, and checked the controllability, safety, and reproducibility of microcatheterization and insertion maneuver into the experimental aneurysm in the in-vivo silicone vessel model.

Results: We realized the well master-slave response with a stable driving speed of the microguidewire at approximately 1 mm/s and with linear correlation between the output voltage and driving force. Also, we confirmed the well safety function to avoid the overloading to the vascular wall with the slippage of the slave roller on loading >1 N pushing force. Successful microcatheterization and insertion into the aneurysm model was performed in the wet vascular model corresponding to the 3-dimensional handling without excessive stress to the vascular or aneurysmal wall.

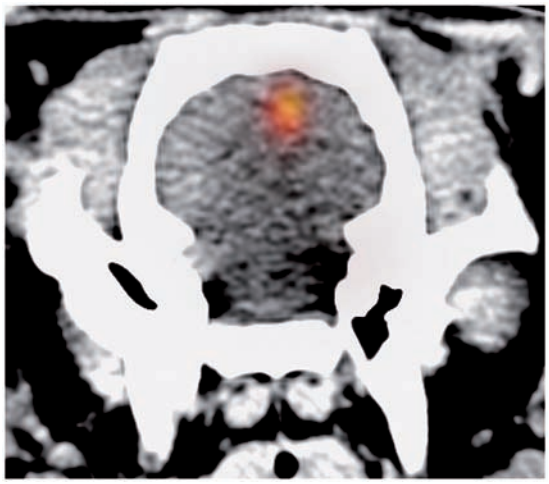
Conclusion: Neuroendovascular intervention requires delicate power adjustment with fine finger control. Our support robot for neuroendovascular interventions demonstrated the accurate reproducibility of the operator's maneuver and safe operation in the vascular model using the sensor system. This system will realize the neurointervention without human operators in the AngioSuite and may facilitate telesurgery with remote control in the near future.
Keywords: robotics, remote control, coil embolization

O 021

ENDOVASCULAR TRANSVENOUS ACCESS TO BRAIN TISSUE BY TRANS-VESSEL WALL TECHNIQUE

R Grankvist[1], J Lundberg[1], F Arnberg[1], M Sandell[2], I Jonsson[3], V Lövljung[1], T Tran[3], S Jonsson[2] and S Holmin[1]
[1]Dept of Clinical Neuroscience, Karolinska Institutet and Dept of Neuroradiology, Karolinska University Hospital, Stockholm, SWEDEN
[2]Materials Science, Royal Institute of Technology, Stockholm, SWEDEN
[3]Dept of Clinical Neuroscience, Karolinska Institutet and Deptt of Radiopharmacy, Karolinska University Hospital, Stockholm, SWEDEN

Purpose: We have previously developed a trans-vessel wall micro-endovascular system (Extroducer) for direct access to tissue in any organ. The system can be navigated through a 2.4 French micro catheter and the design permits vessel wall puncture with exit from the intravascular space to the extravascular space, without causing hemorrhage or thrombosis, for direct tissue access via a micro-working channel. In this work, we investigated if the system could be used transvenously to reach the cranial dural sinuses and then penetrate the dura mater at an angle to reach the brain tissue for delivery of cells or substances, or tissue sampling.
Materials and Methods: All animal experiments were approved by the local ethics committee. The Extroducer was manufactured as previously described with a distal outer diameter of 194 m. Eight swine were catheterized with clinical routine equipment. By transfemoral vein access we navigated to the internal jugular vein and with conventional and rotational angiography, combined with cone beam CT, we could analyze the anatomy, visualize injections and evaluate potential complications. A modified deflectable 2.4F micro catheter was used to enter the cranial dural sinuses and for subsequent puncture with the Extroducer system at an appropriate angle to the dural wall. Brain parenchymal injections with iodine contrast and 111-Indium radiolabeled macrophages were performed via the Extroducer system. Efficacy and potential side effects were evaluated with cone beam CT and SPECT/CT.
Results: A robust transvenous route to the cranial dural sinuses of swine was described by careful analysis of the swine venous anatomy (n = 2). Multiple punctures of the superior and inferior sagittal sinuses and subsequent iodine contrast injections to the parenchyma via the Extroducer system was performed (n = 2) and visualized with cone beam CT. Macrophages were successfully labeled with 111-Indium. Trans-dural cell injections were performed (n = 4) and imaging with SPECT/CT confirmed the intraparenchymal location of the cells (Fig showing coronal fusion images). All dural punctures and brain parenchymal injections were performed without hemorrhagic or thrombotic complications. Control angiograms showed normal appearance of the sinuses after the punctures.



Conclusion: In conclusion, we have demonstrated safety and efficacy of transvenous access to the brain parenchyma with the trans-vessel wall technique. The establishment of an endovascular micro-working channel to the brain parenchyma can potentially be of great value for delivery of cells and substances, and for sampling. In addition, this technique could be used in swine for the development of animal models of CNS disease without requiring craniotomy.
Keywords: Transvenous, Tissue access, Endovascular

O 022

MAGNETIC RESONANCE GUIDED FOCUSED ULTRASOUND THALAMOTOMY IN ESSENTIAL TREMOR: SINGLE CENTER 1 YEAR EXPERIENCE

EF Ciceri[1], S Tamburin[2], M Tinazzi[2], T Bovi[2], A Nicolato[3], M Longhi[3], R Foroni[4], S Montemezzi[5], C Bovo[6], A Agnello[1] and G Ricciardi[1]
[1]Verona University Hospital-Department of Neuroradiology, Verona, ITALY
[2]Verona University Hospital-Department of Neurology, Verona, ITALY
[3]Verona University Hospital-Department of Neurosurgery, Verona, ITALY
[4]Verona University Hospital-Department of Medical Physic, Verona, ITALY
[5]Verona University Hospital-Department of Radiology, Verona, ITALY
[6]Verona University Hospital-Health Direction, Verona, ITALY

Purpose: Magnetic resonance-guided focused ultrasound (MRgFUS) thalamotomy of the ventralis intermedius (Vim) nucleus is emerging as a minimally invasive treatment for patients with disabling and medication-refractory essential tremor (ET). We report our preliminary one-year experience on 20 patients with ET treated from January 2018 to April 2019 in a single center.
Materials and Methods: From January 2018 to April 2019, 20 patients (9 men, 11 women, age: 72.2 ± 8.2 years) underwent MRgFUS thalamotomy of the Vim nucleus for disabling and refractory ET (tremor duration: 25.6 ± 12.2 years) with a 3T magnetic resonance scanner at Verona University Hospital.
Results: At baseline the total Clinical Rating Scale for Tremor (CRST) score was 37.9 ± 20.4, and the Quality of Life in Essential Tremor Questionnaire (QUEST) score was 41.3 ± 16.1. At one-month follow-up, the total CRST score was 8.8 ± 5.2 and the QUEST) score was 7.6 ± 4.5. Response persisted in the majority of patients at three- and six-month follow-up. Side effects related to Vim nucleus thalamotomy included transitory ataxia, ballism, and mild lower-limb hypasthenia.
Conclusion: Our data confirm that MRgFUS thalamotomy of the Vim nucleus is an effective treatment for disabling and refractory ET.
Keywords: MRgFUS, Thalamotomy, Essential Tremor

O 023

BRAIN TISSUE IRON QUANTIFICATION AT THE PERIPHERY OF THE HEMATOMA BY MRI IN PATIENTS WITH INTRACEREBRAL HEMORRHAGE: TRANSLATIONAL EVIDENCE IN FIRST 10 PATIENTS

N Chaudhary[1], A Pandey[1], J Griauzde[1], J Gemmete[1], G Xi[1] and R Keep[1]
[1]Michigan Medicine, Ann Arbor, USA

Purpose: Intracerebral hemorrhage (ICH) has devastating consequences in the human population. No specific outcome modifying treatment or objective risk stratifying measure currently exists in ICH patients. The goal of our study is to validate an MRI based algorithm to reliably quantify the iron levels in the periphery of the hematoma.
Materials and Methods: Institutional IRB was obtained for the study. The study protocol was to obtain MRI at day 3, 14 and 30 following ICH. The MRI scans were performed without contrast. The sequences performed were T1, T2 and PADRE plus a multi-echo susceptibility weighted sequence. Relaxivity (1/T2* – R2*) maps were then created utilizing the multi-echo sequence in Matlab. Two consecutive volumes of interest (VOI) 1 & 2 rings were then manually drawn on the maps around the periphery of the hematoma, on all the axial slices demonstrating the hematoma, on all available date points in each individual patient. Identical contralateral brain VOI (Normal Control – NC) was also drawn at each corresponding MRI axial image slice. The average measurement values were then tabulated at pre-specified time points over a period of one month following the ICH. The R2* value was then extrapolated to an iron concentration (IC) measured from an iron phantom MRI with identical sequences.
Results: 10 eligible patients with ICH and two controls were recruited to the study. The Mean R2* value Day 3: VOI 1; 53.59 (SD: 6.01) – IC 0.16 SD 0.02, VOI 2: 28.35 (SD:5.17) – IC 0.08 SD 0.02, NC: 19.47 (SD:2.85) – IC 0.05 SD 0.01. Day 14: VOI 1; 47.97 (SD:5.43) – IC 0.14 SD 0.02, VOI 2: 27.19 (SD: 2.19) – IC 0.08 SD 0.01, NC: 18.94 (SD: 1.62) – IC 0.05 SD 0.01. Day 30: VOI 1; 49.14 (SD: 6.44) – IC 0.15 SD 0.02, VOI 2: 30.10 (SD: 3.41) – IC 0.09 SD 0.01, NC: 19.93 (SD: 2.82) – IC 0.05 SD 0.01.
Conclusion: Our study, the first translational study of its kind, shows relatively reliable iron concentration measurements by MRI at the periphery of the hematoma over a period of 1 month following the ICH, showing good correlation with previous animal study data over a similar duration. Larger study is needed with extended 180 day follow up to further validate the measurement algorithm with a view to potentially becoming an MRI based risk stratification strategy in ICH patients. In addition, the algorithm may be utilized for monitoring iron chelate therapy in ICH.
Keywords: Hemorrhagic Stroke, MRI, Iron quantification

O 024

VW-MRI CAN ASSESS THE DIFFERENCE BETWEEN THUNDERCLAP HEADACHE IN PATIENTS WITH ANEURYSMS?

L Cirillo[1], A Rustici[2], C Bortolotti[3], C Princiotta[3], M Dall'olio[3], P Cortelli[1], C Sturiale[3], M Cellerini[3] and S Cevoli[3]
[1]Università degli Studi di Bologna – IRCCS – Istituto delle Scienze Neurologiche di Bologna, Bologna, ITALY
[2]Università degli Studi di Ferrara, Ferrara, ITALY
[3]IRCCS – Istituto delle Scienze Neurologiche di Bologna, Bologna, ITALY

Purpose: A warning headache is reported in up the 40% of patients before aneurysmal SAH. However many other neurological conditions may mimic a warning headache. Several advancements in MRI have led to the introduction of Vessel Wall Imaging (VWI), to assess the features of the VW and to potential evaluate the risk of aneurysmal rupture. Therefore, this technique may be adopted to discriminate between a warning leak in an unstable aneurysm to other confounding conditions in patient with an intracranial aneurysm. We present 2 patients in which thunderclap headaches and intracranial aneurysm to show how the VWI could be helpful to the management.
Materials and Methods: 1° Case: A 37yo female, suffering from migraine, presented a more intense headache than the usual ones. At the CT scan perfumed at the Emergency Department, a 10 mm AComA aneurysm was found, without any sign of SAH. She underwent MRI with VWI that did not show wall enhancement. Considering the young age, her risk factors and the morphology of aneurysm, the patient

undergone craniotomy for clipping. At the surgical inspection no signs of hemorrhage and vessel inflammation were demonstrated. Post-operative neuroimaging demonstrates the complete occlusion of the aneurysm. Moreover, few weeks after the intervention, migraines attacks relapsed both with typical and atypical presentation as the one which has lead the patient to ED.

Results: 2° Case: A 67yo female with no history of headache suddenly presented headache with visual loss in her right eye. She was admitted to the ED, where the CT scan showed a 7 mm right carotid-ophthalmic aneurysm with no sign of SAH. The following MRI with VWI demonstrated enhancement of the aneurysmal sac. The aneurysm was then treated with coils without complications and the exclusion of the aneurysm was demonstrated. At discharge the patient is in good clinical condition and she never reported similar headache attacks, allowing us to conclude that the pre-treatment episode would be a real warning leak.

Conclusion: We reported two cases of thunderclap headache in patient with unruptured intracranial aneurysm, with different pattern of sac enhancement. The VWI is a promising tool for prioritizing treatment in unruptured aneurysm, allowing to recognize early signs of potential sac instability as the grade of endothelial inflammation, therefore assessing the risk of rupture. Further studies are needed to validate this result and better interpretate this technique in a clinical setting.

Keywords: Vessel Wall imaging, thunderclap headaches, intracranial aneurysm

O 025

EFFECT OF CHOICE OF TREATMENT MODALITY ON THE INCIDENCE OF SHUNT-DEPENDENT HYDROCEPHALUS AFTER ANEURYSMAL SUBARACHNOID HEMORRHAGE

M Koyanagi[1], H Fukuda[2], M Saiki[3], Y Tsuji[3], T Kawasaki[2], Y Ioroi[4], R Fukumitsu[3], R Ishibashi[2], M Oda[3], O Narumi[4], M Chin[2], S Yamagata[2] and S Miyamoto[5]

[1]Amagasaki Gen Med Cntr / Kokura Memorial Hospital, Amagasaki, JAPAN
[2]Kurashiki Central Hospital, Kurashiki, JAPAN
[3]Otsu Red Cross Hospital, Otsu, JAPAN
[4]Amagasaki General Medical Center, Amagasaki, JAPAN
[5]Kyoto University Hospital, Kyoto, JAPAN

Purpose: Shunt-dependent hydrocephalus (SDHC) may arise after aneurysmal subarachnoid hemorrhage (aSAH) as cerebrospinal fluid resorptive mechanisms are disrupted. Using propensity score analysis, the present study aimed to investigate which treatment modality, surgical clipping or endovascular treatment, is superior in reducing rates of SDHC after aSAH.

Materials and Methods: Our multicenter SAH database, comprising 3 stroke centers affiliated with Kyoto University, Japan, was used to identify patients treated between January 2009 and July 2016. Univariate and multivariable analyses were performed to characterize risk factors for SDHC after aSAH. Propensity score model was generated for each treatment group, namely surgical clipping and endovascular treatment, incorporating relevant patient covariates to detect any superiority for prevention of SDHC after aSAH.

Results: 566 patients were enrolled in this study. SDHC developed in 127 patients (22%). On multivariable analysis, age of more than 53 years, the presence of intraventricular hematoma, and surgical clipping as opposed to endovascular coiling, were independently associated with SDHC after aSAH. After propensity score matching, 136 patients treated with surgical clipping and 136 with endovascular treatment were matched. Propensity score–matched cohorts exhibited significantly fewer incidence of SDHC when patients were treated by endovascular procedure compared to those by surgical clipping (16% versus 30%, $P = 0.009$; OR 2.2; 95% CI 1.2–4.2). SDHC was independently associated with poor neurological outcomes (mRS3-6) at discharge (OR 4.3; 95%CI 2.6–7.3; $P < 0.001$).

Conclusion: SDHC after aSAH was significantly more frequent in patients who underwent surgical clipping. Strategies for treatment of ruptured aneurysms should be used to mitigate SDHC and minimize poor outcomes.

Keywords: subarachnoid hemorrhage, hydrocephalus, cerebrospinal fluid shunt

O 026

DETECTABILITY AND ANATOMICAL VARIATIONS OF PERFORATING ARTERIES FROM VERTEBRAL ARTERY ON 3D-DSA EVALUATED IN PATIENTS WITH NORMAL VERTEBRAL ARTERIES

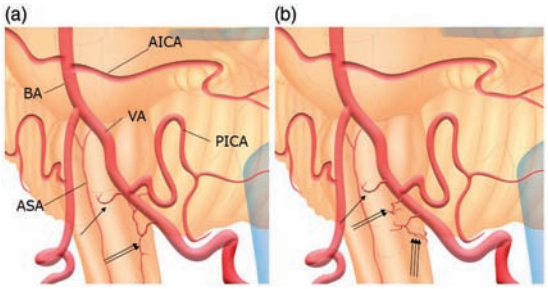
S Tanoue[1], H Kiyosue[2], Y Matsumaru[3], Y Matsumoto[4], H Endo[5], M Hiramatsu[6], W Tsuruta[7], M Sato[3], M Hirohata[1] and T Abe[1]

[1]Kurume University School of Medicine, Kurume, JAPAN
[2]Oite University School of Medicine, Oita, JAPAN
[3]University of Tsukuba Hospital, Tsukuba, JAPAN
[4]Konan Hospital, Sendai, JAPAN
[5]Tohoku University Graduate School of Medicine, Sendai, JAPAN
[6]Okayama University Hospital, Okayama, JAPAN
[7]Toranomon Hospital, Tokyo, JAPAN

Purpose: To evaluate the detectability and anatomical variations of perforating arteries arising from vertebral artery by using 3D-DSA in patients without any vertebral arterial lesions.

Materials and Methods: In 120 patients without vertebral arterial lesions who undergone rotational vertebral arteriography, the anatomical configurations of perforating arteries arising from vertebral artery (VA) were retrospectively evaluated on the bi-plane DSA and reconstructed images. The images were interpreted with focusing on the numbers and

types of perforating arteries, and anatomy of vertebral artery with consensus of 2 or 3 experienced reviewers (neurosurgeon and neuroradiologist).
Results: The detected number of perforators were zero in two, one in 51, two in 56, three in nine, four in one, and six in one patient (median, two perforators per one vertebral artery). The total 220 perforators were classified into 166 terminal and 54 longitudinal type of course, and 32 ventral, 171 lateral, and 17 dorsolateral type of distribution.



All ventral type perforators were terminal type. In contrast, longitudinal type was seen in 25% of lateral type and 65% of dorsolateral type. Regarding the difference of origin of posterior inferior cerebellar artery (PICA), non-PICA type VA (PICA originated from anterior inferior cerebellar artery) gave off significantly largest number of perforators than other types of VA, including VA giving of PICA from intracranial segment and extracranial segment.
Conclusion: Perforators can be observed in most of normal VA. Non-PICA type VA significantly give of larger number of perforator than other types; this indicate the trapping of non-PICA type VA has a risk of ischemic complications.
Keywords: vertebral artery, perforating artery,3D-DSA

O 027

VISUALIZATION OF THE HUMAN INTRACRANIAL VASA VASORUM IN VIVO

L Zhang[1]
[1]Xuanwu hospital capital medical university, Beijing, CHINA

Purpose: To explore if OCT is able to visualize of the human Intracranial vasa vasorum.
Materials and Methods: A 46-year-old man presented with recurrent vertigo and unsteady gait under the optimal medication treatment for 2 months. Magnetic resonance imaging suggested bilateral cerebellar and occipital lobe infarction. Digital subtraction angiography confirmed severe stenosis of the left intracranial vertebral artery (Fig. 1A) and contralateral vertebral artery occlusion. Cross-sectional optical coherence tomography (OCT) (ILUMIEN OPTIS, Abbott) presented several signal-poor tubuloluminal structures which were located within the plaque (Figs. 1B to 1D) and in the adventitial layer (Figs. 1F to 1G). Three-dimensional OCT images showed the adventitial tubuloluminal structures extended in the longitudinal direction of the arterial lumen following a distinct arborization pattern (Fig. 1H).
Results: Adventitial vasa vasorum and intraplaque neovessels are defined as a poor-signal microchannel in multiple contiguous OCT images and have been confirmed by histology in human coronary artery(1,2). The tubuloluminal structures presented in current case are consistent with this diagnostic criterion. To our best knowledge, this is the first report of intracranial artery adventitial vasa vasorum and intraplaque neovessel in vivo by OCT.
Conclusion: The three-dimensional reconstruction of OCT image provides a preferable visualization.
Keywords: optical coherence tomography, intracranial stenosis, vertebral artery

O 028

STAFF EYE-LENS DOSE MONITORING DURING INTERVENTIONAL NEURORADIOLOGY PROCEDURES

S Busoni[1], **F Rossi**[1], **S Doria**[2], **S Piffer**[2], **L Redapi**[2] and **S Mangiafico**[3]
[1]Careggi University Hospital – Department of Health Physics, Firenze, ITALY
[2]University of Florence – Medical Physics Residency program, Firenze, ITALY
[3]Careggi University Hospital – Interventional neurovascular unit, Firenze, ITALY

Purpose: For professional exposures, the ICRP118 reduced the equivalent dose limit for the eye-lens to 20mSv.
The aim of this study is to perform a survey on the eye-lens equivalent dose absorbed by staff members during interventional neuroradiology(INR) procedures, using a personal dosimeter placed close to the eye-lens.
Materials and Methods: Staff member eye-lens dose was measured in-vivo for the most relevant procedures, with respect to radiation protection, routinely performed in our centre: Studies, ArterioVenous Malformations(AVM), Aneurysms(ANE).
Monitored workers were surgeon(S), surgeon assistant(SA), nurse(N) and anesthetist(A). Radiographers are not included since they worked in the shielded console room during radiation emission.
Each worker, for each type of procedure, wore a personal, not shielded, eyeglasses equipped with two dosimeter placed on the external side of the eyeglasses temples, close to the eye-lens.
Dosimeters were provided by an ISO-17025 accredited Dosimetry Service, thus assuring a certified metrological chain. The dosimeters were LiF100 ThermoLuminescent Dosimeters (model Ext-Rad, HarshawThermofisher), with a detection limit of 50 μSv.
Surgical room was equipped with a biplanar angiographic system (model Philips Azurion), with skirt and ceiling-suspended shielding (CSS) (0.5 mm Pb).

During all procedures, S and SA eyes were in the same fixed position at 1 m from the irradiated field and were completely shielded by the CSS, while the nurse moved around the operating table.

Results: Monitored procedures and corresponding patient averaged KAP are reported in Table1.

For each staff member and for each procedure, the most exposed eye-lens dose value, averaged over the number of procedures, is reported in Table2.

Dose values already take into account the effective time spent in the operating room during x-ray emission and the effect of the CSS for S e SA (measured radiation attenuation close to 50).

Anesthetist entered in the surgical room during radiation emission only in one AVM and two ANE procedure, with the most exposed eye-lens dose equal to 100μSv and 60μSv respectively.

	Procedure		
	Study	AVM	Aneurysm
Number of procedures	31	17	19
KAP_{mean} per patient (Gy*cm²)	430	1300	1900

Table1: Number of monitored procedures and mean KAP per patient for single procedure

	Procedure		
	Study	AVM	Aneurysm
Surgeon (with CSS)	21	91	68
Surgeon Assistant (with CSS)	16	62	45
Nurse (without CSS)	13	40	26

Table2: Most exposed eye-lens equivalent dose for single procedure (µSv)

Conclusion: S and SA involved in more than about 5 INR procedures per year, may easily exceed eye-lens dose limit if eye shielding is not used.

The use of a CSS is thus strongly recommended, and a personal dedicated routine monitoring is required to ensure that shielding is effective.

If protective eyeglasses are used, the effective shielding has to be investigated since irradiation geometry of the eye-lens may play a relevant role.

Nurse eye-lens dose limit may be reached only with more than 400 procedures per year.

Keywords: Radioprotection, Eye lens dose, Interventional neuroradiology

O 029

SAFEGUARD MANUAL ASSIST TECHNIQUE FOR THE MANAGEMENT OF FEMORAL PERCUTANEOUS ACCESS IN CEREBRAL NEUROVASCULAR PROCEDURES: A SINGLE CENTER PROSPECTIVE ANALYSIS

F Di Caterino[1], G Vitale[1], E Elisa[1] and A Biondi[1]

[1]CHU Besancon – Service de neuroradiologie et therapie endovasculaire, Besancon, FRANCE

Purpose: The percutaneous femoral approach represents the most used route for neuroendovascular procedures.

Different closure devices can be used to achieve hemostasis of the access puncture site in a shorter time, with earlier ambulation but many studies show an association with an increased risk of local complications, furthermore it is not clear if it is safe to restick an artery that has been previously closed with them.

We evaluated the efficacy of the Safeguard Manual Assist Technique in the management of femoral access hemostasis.

Materials and Methods: A single center prospective study was conducted from September 2014 through December 2017: 878 patients that underwent cerebral arteriograms and interventions using a size 4 through 6 Fr vascular sheath were enrolled.

The use of antithrombotic medication was documented in 244 patients: 137 with aspirin, 37 with Plavix, 68 with double antiplatelet therapy and 2 with Coumadin.

Statistical significance was assessed by Fisher's text.

Results: The safeguard device was successful in 861 cases (98 %) with postoperative bleeding that occurred in 17 patients.

Statistical association with postoperative bleeding complications included increased age and use of sheath size greater than 5F, while no association was found with use of one or two antithrombotic medication.

Conclusion: The Safegurad Manual Assist Technique is effective in the management of femoral access hemostasis with a low hematoma risk that increased with the use of sheath size greater than 5F and with increasing age, moreover, the absence of endovascular components makes it particularly safe in the case of an early restricking of the same artery.

Keywords: vascular closure devices, femoral access, restricking femoral artery

O 030

ENDOVASCULAR MANAGEMENT OF CRANIO-CERVICAL ARTERIAL PATHOLOGIES USING STENT GRAFT

MM Gupta[1], J Nadarajah[2], L Sebastian[3], SB Gaikwad[4] and A Garg[5]

[1]All India Institute of Medical Sciences, New delhi, INDIA
[2]All India Institute of Medical Sciences, New Delhi, INDIA
[3]All India Institute of Medical Sciences, New Delhi, INDIA
[4]All India Institute of Medical Sciences, New Delhi, INDIA
[5]All India Institute of Medical Sciences, New Delhi, INDIA

Purpose: Cranio-cervical arterial pathologies include aneurysms, arterio-venous fistulas and atherosclerotic diseases. Surgical management is associated with enormous operative difficulty due to the complexity of these lesions. Nowadays endovascular treatment although challenging, has become mainstay in management. Treatment options are parent vessel occlusion with coils, detachable balloons and liquid embolic agents or vessel preservation by stent assisted coiling, graft. In carefully selected patients, off label

use of stent graft can provide cost-effective outcome. Here, we share our experience in the endovascular management of these difficult conditions using stent graft.

Materials and Methods: From our institutional data base, we retrospectively reviewed all cases of Cranio cervical arterial pathologies treated by stent graft from January 2015 to May 2019 and identified 17 patients. We excluded cases of atherosclerotic extra cranial carotid disease. Demographic details, clinical presentation, imaging findings, immediate and long-term functional outcome following endovascular treatment were analyzed.

Results: Of these 17 patients,12 were male with mean age of 42.3 years (4–76 years). ICA was involved in 15 out of 17 with cavernous segment most frequently affected (53%), followed by cervical ICA (33%). Petrous and Cervico petrous junction was involved in remaining two. Two had diseased vertebral artery involving its V2 segment. Out of 17, 13 had dissecting aneurysms, 2 had arterio venous fistula, one had internal carotid artery dissection and remaining one had intracranial atherosclerotic disease. No risk factor was noted in 6 patients. In remaining 11 patients, 3 had skull base surgery, 3 had neck infection, one had road traffic accident, one had fire arm injury, one had connective tissue disorder (NF-1), one had ICAD and remaining one it was iatrogenic following lymph node biopsy. Clinical presentation was ophthalmoplegia in 4, epistaxis in 3, progressive neck swelling in 2, neurodeficit in 5, neck pain in 2, and one had giddiness. Graft Master (Abbott Vascular, Illinois, USA) was used in 14 and Fluency (Bard, Tempe, AZ) in three patients. No major periprocedural complications were noted except in one patient with epistaxis who developed instant thrombosis necessitating parent vessel occlusion. Of these remaining 16, one patient showed stent thrombosis during follow up CT angiography at 4 months without adverse event. Rest of the 15 patients showed patent stent with complete resolution of symptoms.

Conclusion: Although stent graft has limited trackability for routine intra cranial use, in carefully selected patients with favorable anatomy it is safe, cost effective tool in the management of these complex lesions.

Keywords: Stent Graft, Dissecting Aneurysms, Arterio Venous fistula

O 031

RETROSPECTIVE ANALYSIS OF FLOW DIVERTER THERAPY FOR INTERNAL CAROTID ARTERY ANEURYSMS REGARDING ANEURYSM MORPHOLOGY

H Oishi[1]

[1]Department of Neuroendovascular Therapy, Tokyo, JAPAN

Purpose: Flow diverter therapy using pipeline embolization devices (PEDs) has become an important treatment option for large and giant internal carotid artery (ICA) aneurysms. But the available data regarding the differences in treatment results between aneurysm morphologies is insufficient. We retrospectively analyzed ICA aneurysms treated with PED embolization at our university hospital.

Materials and Methods: Patients: 126 patients with 136 aneurysms were treated with PED embolization from December 2012 through October 2018. They were divided into 4 groups according to maximum sizes and shapes of the aneurysms: group L (less than 15 mm), group G (15 mm or larger), group S (saccular shape), group F (fusiform shape).

Results: Group L comprised of 67 patients/75 aneurysms, group G (59/61), group S (82/86), group F (50/40). The aneurysm locations in group L were (intradural 66.7%/transient 8.0%/extradural 25.3.%), in group G (26.2%/0%/73.8%), in group S (69.8%/5.8%/24.4%), in group F (12.0%/2.0%/86.0%). Complications with clinical medications occurred in group L/G (2.7%/14.8%), group S/F (2.3%/18.0%). Deterioration of 1 or more on the mRS 30 days after the treatment were recognized in group L/G (1.3%/6.6%), group S/F (1.2%/8.0%). Complete aneurysm occlusion was achieved in group L/G (81.3%/44.8%), S/F (83.7%/31.9%) at 6 months; and L/G (86.5%/58.7%) and S/F (90.6%/41.2%) at the 1-year follow-up angiographies.

Conclusion: PED embolization for ICA aneurysms measuring less than 15 mm or those of saccular shape showed very low complication and high complete occlusion rates. However, the treatment results of aneurysms measuring 15 mm or larger or those of fusiform shape were less than satisfactory.

Keywords: flow diverter, aneurysm morphology, treatment result

SESSION C: Stroke 1

O 032

AAFITN ACUTE STROKE MANAGEMENT CONSENSUS

S Miyachi[1], **J Mahadevan**[2] **and W Chong**[3]

[1]Department of Neurosurgery, Aichi Medical University, Executive Committee of AAFITN, Nagakute, JAPAN

[2]Interventional Radiology, Pantai Hospital, Executive Committee of AAFITN, Kuala Lumpur, MALAYSIA

[3]Interventional Radiology, Monash University, Executive Committee of AAFITN, Clayton, AUSTRALIA

Purpose: The health resources available in the AAFITN member countries varies enormously. Some nations have health systems that rival the best in the world, whilst others do not have enough resources to provide sophisticated treatment such as comprehensive acute stroke treatment.

It is against this background that a ''Stroke Challenge'' forum was held at the recent 13th AAFITN Congress in Malaysia.

The objective was to determine what resources are available in each member country and how acute stroke is being managed currently and what are the future plans.
Materials and Methods: A questionnaire was sent to each member nation. It had 6 headings with detailed questions under each heading. The headings are Site Conditions, Stroke Facilities, Angiographic Suite, Procedural Volumes, Operational guidelines/Medical Personnel and Anaesthetic Teams.
The member countries presented their answers at the forum which were used to develop the AAFITN Stroke consensus.
Results: As expected the results varied widely. Some countries had very well developed primary (IV TPA only) centres with good transfer systems to comprehensive stroke centres to countries that were just contemplating starting IV TPA. Some countries did not have any stroke interventionists or suitable facilities. Some countries were developing secondary centres where interventionists performed Clot Retrieval only.
Conclusion: There is a wide variation in health for the management of acute stroke. Based on these results AAFITN is developing a Stroke Consensus document that will enable each member country to develop the best acute stroke system based on their available resources and to improve their system in the future.
Keywords: acute stroke c, thrombectomy, stroke consensus

O 033

TREATMENT OF ACUTE STROKE – THE JAPANESE EXPERIENCE – PROJECT FOR SPREADING MECHANICAL THROMBECTOMY

S Miyachi[1], T Ohshima[1], S Okuda[2], I Nakahara[3], M Mase[4], T Izumi[5], S Yoshimura[6] and N Sakai[7]
[1]Department of Neurosurgery and Neuroendovascular Therapy Center, Aichi Medical University, Nagakute, JAPAN
[2]Department of Neurology, Nagoya Hospital Organization, Nagoya Medical Center, Nagoya, JAPAN
[3]Department of Comprehensive Strokology, Fujita Health University, Toyoake, JAPAN
[4]Department of Neurosurgery, Nagoya City University, Nagoya, JAPAN
[5]Department of Neurosurgery, Nagoya University Graduate School of Medicine, Nagoya, JAPAN
[6]Department of Neurosurgery, Hyogo College of Medicine, NIshinomiya, JAPAN
[7]Department of Neurosurgery, Kobe City Medical Center General Hospital, Kobe, JAPAN

Purpose: According to the society-oriented survey, RESCUE Japan study we found high regional discrepancy about the number of operations and physicians. As one of the preliminary on-going projects we introduce our regional model to improve the quality of the treatment for acute stroke under the collaboration of four universities in Aichi prefecture and thanks to the support of Japanese stroke association and prefectural government.
Materials and Methods: We asked the questionnaire about the actual situation of acute stroke care to 140 institutes in the prefecture. Contents included annual numbers of stroke patients and treatment methods, the circumstance (equipment and staff) and the problem on stoke management. Then, we produced the seminar containing lectures of basic knowledge of pathophysiology of ischemia and know-how of MT as well as hands-on training using vascular or simulation model for all available devices. Announcement of the seminar was sent to institutes in the prefecture particularly to the depopulated area for MT. We also issued a special textbook to facilitate understanding of trainees.
Results: Responses to questionnaire were obtained from 115 institutes (a response rate: 82%). MT was performed in 432 patients in 31 instituted within 2017, which means about 15% of cerebral embolism patients. The rate of the implementation of MT was higher in urban areas, however it was very low in rural sides, less than 10 % of urban rate. The seminar was performed the whole day with 141 participants including 40 hands-on trainees. Most participants impressed the practices were very fruitful, but requested more time to round each hands-on section. Based on the results we plan to back-up the trainees who encounter acute stroke patients because they do not yet have sufficient skills for the clinical cases even though they completed the seminar.
Conclusion: National guideline emphasizes the importance of training qualified interventionists and of the systematic establishment of comprehensive stroke center. Japanese stroke society recommends to authorize the thrombectomy stroke center (TSC) as the higher-level primary stroke center with at least 3 neurointerventionists, 2 strokologist and 2 neurosurgeons, and with more than 12 cases of MT per year. The various projects and actions to train the interventionists of MT are established in each region obeying to the national promotion for MT (Kobe declaration 2016). To take it easier it is essential to establish the collaboration between government, association, university and cooperation between emergency services and actual clinicians in TSCs.
Keywords: acute stroke, mechanical thrombectomy, training

O 034

EFFECTIVENESS OF 'TRIP-AND-TREAT' FOR ACUTE STROKE PATIENTS UNDERGOING ENDOVASCULAR REPERFUSION THERAPY

M Hayakawa[1], M Sato[2], M Yoshimura[3], A Tsurumi[4], T Kawai[5], H Kasuya[6], T Ohashi[7], K Oshima[8], Y Ito[2], A Marushima[2], N Kato[9] and Y Matsumaru[1,2]
[1]Division of Stroke Prevention and Treatment, Faculty of Medicine, University of Tsukuba, Tsukuba, JAPAN
[2]Department of Neurosurgery, Faculty of Medicine, University of Tsukuba, Tsukuba, JAPAN

[3]Department of Neurosurgery, Tsuchiura Kyodo General Hospital, Tsuchiura, JAPAN
[4]Department of Neurosurgery, Tsurumi Neurosurgery, Koga, JAPAN
[5]Department of Neurosurgery, Koyama Memorial Hospital, Kashima, JAPAN
[6]Department of Neurosurgery, Seirei Memorial Hospital, Hitachi, JAPAN
[7]Department of Neurosurgery, Tokyo Medical University Ibaraki Medical Center, Ami, JAPAN
[8]Department of Neurosurgery, Ishioka Cardiology and Neurosurgery Hospital, Omitama, JAPAN
[9]Department of Neurosurgery, National Hospital Organization, Mito Medical Center, Mito, JAPAN

Purpose: Interhospital transfer to endovascular-capable centers (ECCs) is reported to correlate with worse clinical outcome after endovascular stroke reperfusion therapy (ESRT) compared to direct admission to ECCs. 'Trip-and-treat' is a new interhospital cooperative model which provides on-site ESRT by mobile endovascular stroke team (MEST) for acute stroke patients who are directly admitted stroke centers with endovascular capacity despite absence of full-time neurointerventionalsits. The aim of this study was to clarify the effectiveness of 'trip-and-treat' model by comparison with interhospital-transfer model.
Materials and Methods: The Registry of Ibaraki endovascular COnsortium for acute major VEssel occlusion and Reperfusion therapY (RICOVERY) study retrospectively registered 575 patients with large vessel occlusion who were admitted to and underwent ESRT at 16 stroke centers in Ibaraki prefecture, located just northeast of Tokyo, within 24 hours of onset between January 2015 and December 2017. We extracted the 'trip-and-treat' cohort and the interhospital-transfer cohort from patients with out-of-hospital stroke onset, with premorbid mRS of 0–2, and who underwent ESRT within 6 hours of onset. The primary outcome was favorable outcome (FO), defined as a modified Rankin Scale of 0–2 at discharge.
Results: The 'trip-and-treat' group included 27 patients and the interhospital-transfer group included 51 patients, respectively. There was no significant difference between the 'trip-and-treat' and the interhospital-transfer groups in age (75.8 ± 9.3 vs 75.7 ± 9.6 years; $P = 0.912$), sex (29.6% female vs 43.1% female; $P = 0.243$), and median baseline National Institutes of Health Stroke Scale (NIHSS) score (18 vs 17; $P = 0.4$). In the 'trip-and-treat' group, the proportions of patients with prior stroke and patients with coronary artery disease were higher than those in the interhospital-transfer group (37% vs 11.8%; $p = 0.009$, and 25% vs 2.2%; $p = 0.005$, respectively). The rate of successful reperfusion, defined as a modified Thrombolysis in Cerebral Infarction (TICI) grade of 2b or 3, were similarly high in both groups (85.2% vs 88.2%; $P = 0.731$). Median onset-to-puncture time was shorter in the 'trip-and-treat' group than in the interhospital-transfer group (173 min vs 215 min; $P = 0.05$), and the rate of FO in the 'trip-and-treat' group was higher than in the interhospital-transfer group (51.9% vs 23.5%; $p = 0.012$). After multivariate adjustment, 'trip-and-treat' was positively associated with FO (Odds ratio, 4.764; 95% confidence interval, 1.583–14.337).
Conclusion: In this Japanese real-world study, 'trip-and-treat' using MESTs was associated with a shorter delay of ESRT and higher chance of FO within a 6-hour time window compared with interhospital patient transfer.
Keywords: stroke thrombectomy, acute large vessel occlusion, trip and treat

O 035

MOTHERSHIP VERSUS DRIP AND SHIP – A RETROSPECTIVE ANALYSIS OF A REGIONAL STROKE REGISTRY WITH 2797 PATIENTS

F Seker[1], S Bonekamp[1], S Rode[2], S Hyrenbach[2], M Bendszus[1] and M Möhlenbruch[1]
[1]Heidelberg University Hospital, Department of Neuroradiology, Heidelberg, GERMANY
[2]Qualitätssicherung im Gesundheitswesen Baden-Württemberg GmbH, Stuttgart, GERMANY

Purpose: This study aims at comparing short-term clinical outcome after thrombectomy in patients directly admitted to a comprehensive stroke center (mothership, MS) with patients secondarily transferred from a primary stroke center (drip and ship, DS).
Materials and Methods: In a prospective regional stroke registry, all stroke patients with premorbid modified Rankin Scale (mRS) 0–2 who were admitted within 24 hours after stroke onset and treated with thrombectomy between 2014 and 2017 were analyzed retrospectively. MS and DS were compared regarding the proportion of good outcome (discharge mRS 0–2), median discharge mRS, mRS shift (difference between premorbid mRS and mRS on discharge) and occurrence of symptomatic intracranial hemorrhage.
Results: Of 2797 patients, 1051 (37.6%) achieved good clinical outcome. In the MS group ($n = 1657$), proportion of good outcome was higher (MS 42.2% vs. DS 30.9%, $P < 0.001$) and median discharge mRS (MS 3 vs. DS 4, $P < 0.001$) and median mRS shift (MS 3 vs. DS 4, $P < 0.001$) were lower. The rate of symptomatic intracranial hemorrhage was similar in both groups (MS 9.3% vs. DS 7.5%, $P = 0.101$). Multivariate analysis revealed that direct admission (MS) was an independent predictor of good clinical outcome (adjusted OR 1.32, CI 1.09–1.60, $P = 0.004$).
Conclusion: These results confirm prior studies stating that direct admission to a comprehensive stroke center (MS) leads to better outcome compared to DS in stroke patients undergoing thrombectomy.
Keywords: Thrombektomy, Mothership, Drip and Ship

O 036

IMPACT OF BRIDGING THROMBOLYSIS ON CLINICAL OUTCOME IN STROKE PATIENTS UNDERGOING THROMBECTOMY

F Seker[1], S Bonekamp[1], S Rode[2], S Hyrenbach[2], M Bendszus[1] and M Möhlenbruch[1]
[1]Heidelberg University Hospital, Department of Neuroradiology, Heidelberg, GERMANY
[2]Qualitätssicherung im Gesundheitswesen Baden-Württemberg GmbH, Stuttgart, GERMANY

Purpose: It is unclear whether stroke patients should receive intravenous thrombolysis (IVT) prior to endovascular thrombectomy (EVT). This study aims at analyzing the impact of bridging IVT on short-term clinical outcome.
Materials and Methods: In a prospective regional stroke registry, all stroke patients with premorbid modified Rankin Scale (mRS) 0–2 who were admitted within 4.5 hours after onset and treated with EVT were analyzed retrospectively. Patients receiving IVT prior to EVT (IVEVT) were compared to those undergoing EVT only regarding the proportion of good outcome (discharge mRS 0–2), discharge mRS, mRS shift (difference between premorbid mRS and mRS on discharge), hospital mortality and occurrence of symptomatic intracranial hemorrhage.
Results: In total, 2022 patients were included of which 816 patients (40.4%) achieved good clinical outcome. 1293 patients (63.9%) received bridging IVT. There was no significant difference between both groups regarding the proportion of good outcome (IVEVT 41.4% vs. EVT 38.5%, $P = 0.231$), discharge mRS (median, IVEVT 3 vs. EVT 3, $P = 0.178$) and mRS shift (median, IVEVT 3 vs. EVT 3, $P = 0.960$). Hospital mortality was non-significantly higher in IVEVT (IVEVT 19.3% vs. 11.0%, $P = 0.984$). Bridging IVT was not associated with clinical outcome ($P = 0.231$). Symptomatic intracranial hemorrhage was significantly more frequent in IVEVT (9.3% vs. 5.2%, $P = 0.001$).
Conclusion: According to this analysis of a regional stroke registry with 2022 patients, bridging thrombolysis does not lead to better clinical outcome. However, it is associated with a higher rate of symptomatic intracranial hemorrhage.
Keywords: Thrombectomy, Bridging thrombolysis, rtPA

O 037

GEOGRAPHIC SERVICE DELIVERY FOR ENDOVASCULAR CLOT RETRIEVAL: USING DISCRETE EVENT SIMULATION TO OPTIMISE RESOURCES

Y Ren[1], M Phan[2], J Wu[2], P Luong[3], D Shell[2], M Burney[4], C Sean[2], J Maingard[1], K Zhou[2], A Lamanna[1], H Kok[5], R Chandra[2], A Jhamb[6], V Thijs[7], D Brooks[1] and H Asadi[1]
[1]Interventional Radiology, Austin Health, Melbourne, AUSTRALIA
[2]Interventional Radiology, Monash Health, Melbourne, AUSTRALIA
[3]Mathematical Science, Monash University, Melbourne, AUSTRALIA
[4]Deloitte Digital, Sydney, AUSTRALIA
[5]Radiology, Northern Health, Melbourne, AUSTRALIA
[6]Radiology, St Vincent's Hospital, Melbourne, AUSTRALIA
[7]Stroke, Florey Institute of Neuroscience and Mental Health, Melbourne, AUSTRALIA

Purpose: Endovascular thrombectomy is the standard of care for acute ischaemic stroke caused by large vessel occlusion. Reducing stroke symptom onset to reperfusion time is associated with improved functional outcomes. In this study we aimed to develop a computational model to predict and identify time-related outcomes of community stroke calls within an area based on variable parameters.
Materials and Methods: A model to simulate and predict ECR service delivery at capable hospital within a geographic area, city or state was designed using Simply. Geolocation data defined by the user as well as that used by the model is sourced using the Google Maps API. Variables are customized by the user based on their local environment to provide more acute prediction. In addition, this model is applied to Victoria stroke care system to compare between the 2 ECR hub system and 3 ECR hub system.
Results: This model can estimate the delay between the time of that emergency services are notified of a potential stroke and cerebral reperfusion using ECR at capable hospital. Factors including area size and population, number of ECR capable hospitals, capacity of each hospital, and time of each event can be adjusted to observe the effect of modifying each parameter input. In addition, this model indicates 3 ECR hub system is superior to 2 ECR hub system in Victoria in terms of reducing the number of patients failed to receive ECR.
Conclusion: This proposed novel computational DES model is able to aid the development and optimisation of delivery and coordination of a stroke service within an area, city or state. This model has potential to be applied to any areas around the world.
Keywords: Interventional radiology, Endovascular clot retrieval, Discrete event simulation

O 038

CODE STROKE – A NEW OPEN SOURCE COMMUNICATION PLATFORM TO STREAMLINE ACUTE STROKE MANAGEMENT

HM Seah[1], M Burney[2], J Wu[3], M Phan[4], D Shell[3], O Brooks[3], B Coulton[4], J Maingard[5], G Yazdabadi[2], J Seah[6], J Tang[7], C Barras[8], HK Kok[9], B Tahayori[3], R Chandra[4], V Thijs[5], DM Brooks[5] and H Asadi[4]
[1]Royal Adelaide Hospital, Adelaide, AUSTRALIA
[2]Sydney, AUSTRALIA

[3]Monash University, Melbourne, AUSTRALIA
[4]Monash Health, Melbourne, AUSTRALIA
[5]Austin Health, Melbourne, AUSTRALIA
[6]Alfred Health, Melbourne, AUSTRALIA
[7]Melbourne Health, Melbourne, AUSTRALIA
[8]South Australian Health and Medical Research Institute, Adelaide, AUSTRALIA
[9]Northern Health, Melbourne, AUSTRALIA

Purpose: Effective, time-critical intervention in acute stroke is crucial to mitigate mortality and morbidity, but delivery of reperfusion treatments is often hampered by pre-, in-or inter-hospital system level delays. Disjointed, repetitive and inefficient communication is a consistent contributor to avoidable treatment delay for acute stroke patients. In the era of rapid reperfusion therapy for ischaemic stroke, systems which synchronise the flow of clinical information are increasingly important across the entire stroke journey.
Materials and Methods: We aim to develop Code Stroke Alert, an open source multi-platform application that provides a purpose-built, efficient, user-friendly communication system that links pre-hospital emergency services, stroke and neuro-interventional teams, aiming to reduce the time from first medical contact to cerebral reperfusion time. The Health Insurance Portability and Accountability Act (HIPAA) compliant, open-source platform can be accessed by EMS and hospital staff involved in acute stroke care. When a new stroke alert is lodged by EMS, the application will prompt calculation of relevant clinical scores that aid decision making. Depending on the patient's clinical status, clinical expertise and staffing, an appropriate hospital is recommended and will be pre-notified of impending stroke patient arrival. Empowered by geotagging, an estimated time of arrival (ETA) of both the patient and relevant staff are broadcast to all relevant team members, ensuring effective communication between teams.
Results: Code Stroke Alert streamlines communication and coordination of stroke care, possibly negating any room for errors. This facilitates and accelerates the logistical processes required to achieve reperfusion, ultimately improving patient outcome.
Conclusion: Code Stroke Alert will be freely available to health networks globally. The open-source nature of the software offers valuable potential for future development of plug-ins and add-ons, based on individual institutional needs. Electronic data logs provide an additional, auditable trail of relevant quality improvement metrics, potentially offering significant value-add to overall system quality improvement and to aid research in this field.
Keywords: Telecommunication, Software application, Mechanical thrombectomy

O 039

ECONOMIC IMPACT OF FIRST PASS EFFECT (FPE) IN ENDOVASCULAR STROKE TREATMENT WITH THE EMBOTRAP II DEVICE FROM THE ARISE II STUDY – ANNUAL HEALTHCARE RESOURCE USE ECONOMIC ANALYSIS FROM A EUROPEAN PERSPECTIVE

T Andersson[1,2], M Ribo[3], HP Mattle[4], A Ehm[5], C Crivera[6], HL Cameron[7], RA Qadeer[7] and OO Zaidat[8]
[1]Karolinska University Hospital and Clinical Neuroscience Karolinska Institutet – Department of Neuroradiology, Stockholm, SWEDEN
[2]AZ Groeninge – Department of Medical Imaging, Kortrijk, BELGIUM
[3]Vall d'Hebron University Hospital – Department of Neuroradiology, Barcelona, SPAIN
[4]Inselspital, University of Bern – Department of Neurology, Bern, SWITZERLAND
[5]Johnson & Johnson Medical GmbH, Norderstedt, GERMANY
[6]Johnson and Johnson, Irvine, USA
[7]Cornerstone Research Group, Burlington, CANADA
[8]Mercy St. Vincent Medical Center, Toledo, USA

Purpose: First pass effect (FPE) is the ability of a thrombectomy device and the applied technique to achieve complete or near complete revascularization (modified Thrombolysis in Cerebral Ischemia [mTICI] 2c/3) in a single pass. FPE has been shown to be an independent predictor of good functional outcome (modified Rankin Scale [mRS] 0–2), which subsequently impacts healthcare costs. The purpose of this analysis was to assess the potential annual economic impact of achieving FPE in four European countries (France, Italy, Sweden, and United Kingdom [UK]) based on functional outcomes from the ARISE II study.
Materials and Methods: Clinical outcomes data were obtained from the ARISE-II study investigating the safety and efficacy of the EMBOTRAP II device ($n = 227$). Patients who did not achieve mTICI 2c/3 were excluded. The proportions of patients achieving each mRS score at 90 days were assessed, stratified by FPE status. Costs for annual care after 90-days were taken from the published literature and were inflated to 2018 country-specific currencies. Based on the 90-day mRS, costs for annual care were calculated and compared between patients that did or did not achieve FPE; incremental differences were calculated.
Results: In ARISE-II, 76% of patients ($n = 172$) achieved mTICI 2c/3; among these patients, 53% achieved FPE. A significantly higher percentage of patients that achieved FPE had good functional outcomes vs. those that did not achieve FPE (80.5% vs. 61.0%, $p = 0.006$) with lower estimated costs for annual care after 90-days, leading to potential per-patient cost-savings across all countries (€2,140 for France, €694 for Italy, SEK 12,777 for Sweden, and 2,041 for UK) (Table 1). In the absence of healthcare resource use and cost data reported in ARISE-II, healthcare resource use after 90-days and subsequently, costs for healthcare resource use were obtained from the literature, which may not be generalizable across settings and is a

limitation of this analysis. Additionally, the literature used to obtain the costs for annual care after 90-days, based on 90-day mRS, did not report costs for death (i.e. mRS 6), which had a lower incidence among patients who achieved FPE (5.75% vs. 14.29%).

Conclusion: Among patients with complete or near complete revascularization (mTICI 2c/3), patients benefiting from FPE may be associated with annual cost-savings across European countries (France, Italy, Sweden, and UK) due to improved functional outcomes.

Table 1. Estimated per-patient costs for the first year after stroke based on functional outcomes for patients in ARISE-II achieving or not achieving FPE.

Inputs						
mRS	% Achieving mRS Score		Average Costs for Annual Care stratified by 90-days/mRS Score by Country			
	FPE (n=91)	Not Achieving FPE (n=81)	France (2018 €)	Italy (2018 €)	Sweden (2018 SEK)	UK (2018 £)
0	41.38%	19.48%	€12,870	€2,051	SEK 71,600	£3,116
1	21.84%	27.27%	€12,870	€2,412	SEK 94,000	£3,665
2	17.24%	14.29%	€12,870	€2,774	SEK 147,200	£4,215
3	9.20%	7.79%	€22,337	€5,468	SEK 178,700	£14,995
4	2.30%	11.69%	€40,313	€7,397	SEK 233,900	£20,289
5	2.30%	5.19%	€40,313	€16,430	SEK 284,700	£32,946
6	5.75%	14.29%	-	-	-	-
Results by country						
FPE (n=91)			€14,263	€2,904	SEK 103,890	£5,419
Not Achieving FPE (n=81)			€16,402	€3,598	SEK 116,666	£7,460
Difference*			**-€2,140**	**-€694**	**-SEK 12,777**	**-£2,041**

Numbers may not sum due to rounding.
* For all countries, the differences in per-patient costs for annual care after 90-days, based on 90-day mRS, between patients achieving or not achieving FPE were calculated in three steps. Firstly, country-specific costs for annual care after 90-days were multiplied by the percent of patients achieving each mRS score in ARISE II, stratified by FPE status. Secondly, total per-patient costs for patients achieving or not achieving FPE were calculated by summing the relevant products obtained in step one. Thirdly, incremental differences between costs for annual care after 90-days for patients that did or did not achieve FPE were calculated.

Keywords: First pass effect, Economic analysis, Annual healthcare resources

O 040

PROCEDURAL AND HOSPITALIZATION-RELATED ECONOMIC IMPACT OF FIRST PASS EFFECT (FPE) IN ENDOVASCULAR STROKE TREATMENT WITH THE EMBOTRAP II DEVICE FROM THE ARISE II STUDY – A EUROPEAN ECONOMIC ANALYSIS

T Andersson[1,2], M Ribo[3], HP Mattle[4], A Ehm[5], C Crivera[6], HL Cameron[7], RA Qadeer[7] and OO Zaidat[8]

[1]Karolinska University Hospital and Clinical Neuroscience Karolinska Institutet – Department of Neuroradiology, Stockholm, SWEDEN
[2]AZ Groeninge – Department of Medical Imaging, Kortrijk, BELGIUM
[3]Vall d'Hebron University Hospital – Department of Neuroradiology, Barcelona, SPAIN
[4]Inselspital, University of Bern – Department of Neurology, Bern, SWITZERLAND
[5]Johnson & Johnson Medical GmbH, Norderstedt, GERMANY
[6]Johnson and Johnson, Irvine, USA
[7]Cornerstone Research Group, Burlington, CANADA
[8]Mercy St. Vincent Medical Center, Toledo, USA

Purpose: First pass effect (FPE) is the ability of a thrombectomy device and the applied technique to achieve complete or near complete revascularization (modified Thrombolysis in Cerebral Ischemia [mTICI] 2c/3) in a single pass. A post hoc analysis of ARISE-II data showed that FPE was associated with reduced procedural and hospitalization-related healthcare resource use. The purpose of this analysis was to assess the procedural and hospitalization-related economic impact of achieving FPE based on healthcare resource costs in six European countries (France, Germany, Italy, Spain, Sweden, and the United Kingdom [UK]).

Materials and Methods: Clinical outcomes data were obtained from the ARISE-II study (n = 227). FPE was defined as complete or near complete revascularization (mTICI 2c/3) after the first pass of the EMBOTRAP II device. Patients who did not achieve mTICI 2c/3 within the ARISE-II population were excluded from the analysis. Procedural and hospitalization-related healthcare resources included total hospital length of stay (LOS), days in the intensive care unit (ICU), standard bed days, and procedural device use (stent retrievers and aspiration devices). Country-specific healthcare resource costs, in 2018 currencies, were obtained from the literature or market research.

Results: In ARISE-II, 76% of patients (n = 172) achieved mTICI 2c/3; among these patients, 53% achieved FPE. Baseline characteristics were well-balanced between groups. Procedural and hospitalization-related healthcare resource use was lower among patients that achieved FPE as patients that achieved FPE had a significantly shorter LOS (6.1 vs. 9.5 days, p = 0.004) and fewer days spent in a standard bed (3.1 vs. 6.1, p = 0.004). Additionally, patients that achieved FPE required only a single EMBOTRAP II device whereas 35% of patients not achieving FPE required additional devices. Overall, the reduction in procedural and hospitalization-related healthcare resource use associated with achieving FPE led to estimated per-patient cost-savings in every country studied (€1,563 for France, €2,164 for Germany, €2,884 for Italy, €4,513 for Spain, SEK 28,727 for Sweden, and 1,711 for UK) (Table 1). In the absence of cost data from ARISE-II, costs for healthcare resource use were obtained from the literature, which may not be generalizable across settings and is a limitation of this analysis. Additionally, this analysis did not include all components of healthcare resource use that may impact costs (e.g., procedure time).

Conclusion: Among patients with complete or near complete revascularization, achieving FPE may lead to cost-savings across European countries due to reductions in procedural and hospitalization-related healthcare resource use.

Table 1. Average per-patient procedural and hospitalization-related healthcare resource use costs for patients achieving or not achieving FPE.

	France (2018 €)	Germany (2018 €)	Italy (2018 €)	Spain (2018 €)	Sweden (2018 SEK)	UK (2018 £)
FPE (n=91)						
LOS*	€1,387	€3,028	€3,092	€6,480	SEK 66,440	£2,890
Devices/methods used	€2,325	€1,415	€3,458	€2,709	SEK 26,424	£2,416
Total	€3,712	€4,444	€6,550	€9,189	SEK 92,864	£5,306
No FPE (n=81)						
LOS*	€2,155	€4,706	€4,805	€10,070	SEK 86,134	£3,786
Devices/methods used	€3,120	€1,902	€4,628	€3,632	SEK 35,457	£3,231
Total	€5,275	€6,608	€9,433	€13,703	SEK 121,591	£7,017
Difference	**-€1,563**	**-€2,164**	**-€2,884**	**-€4,513**	**-SEK 28,727**	**-£1,711**

Numbers may not sum due to rounding.
* Costs for LOS for UK and Sweden were based on total LOS and proportion of standard bed vs. ICU days (standard bed and ICU days costed separately). Costs for LOS for France, Italy, Spain, and Germany were based on total LOS (separate costs for ICU stay and standard bed days not found in the literature; as such, a general cost for LOS was used).

Keywords: First pass effect, Economic analysis, Procedural healthcare resource

O 041

LATAM EXPERIENCE: COST EFFECTIVENESS OF ENDOVASCULAR STROKE THERAPY. ANALYSIS FROM A COLOMBIAN HEALTHCARE PERSPECTIVE

B Pabon[1], C Diaz[1], J Tellez[2], J Arcos[2], P Guijarro[2] and C Resendiz[3]

[1]Angioteam/Clinica del Norte/Clinica Las Americas/ Universidad De Antioquia, Medellin, COLOMBIA
[2]Medtronic, Bogota, COLOMBIA
[3]Medtronic, Mexico, MEXICO

Purpose: To assess the cost-effectiveness of stent-retriever mechanical thrombectomy in combination with Intravenous Tissue Plasminogen Activator (IV-tPA) versus IV-tPA alone for the Treatment of Acute Ischaemic Stroke in Colombia.
Materials and Methods: Clinical data were taken from the SWIFT PRIME clinical trial. A lifetime Markov state transition model defined by the modified Rankin Scale score was developed to estimate costs and health outcomes (life years gained and quality adjusted life years). A Colombian National Health System perspective (direct medical costs) was considered. Resource utilization was extracted from National Payment Manuals and databases of open access. Costs are expressed in Colombian Pesos (COP). Deterministic and probabilistic sensitivity analyses were performed.
Results: Stent-retriever thrombectomy with Intravenous Tissue Plasminogen Activator (IV-tPA) was associated with better outcomes (4.38 life years gained and 2.96 quality adjusted life years) and savings of COP $1,824,733 resulting in a dominant therapy over intravenous tissue plasminogen activator alone. A net monetary benefit of COP $66,005,604 was obtained considering a willingness-to-pay threshold of COP $69,081,720. DiscussionThe results were consistent with a previously published cost-effectiveness analysis and reinforce the likeliness of the selection of stent-retriever mechanical thrombectomy plus intravenous tissue plasminogen activator over intravenous tissue plasminogen activator alone.
Conclusion: Stent-retriever thrombectomy in combination with Intravenous Tissue Plasminogen Activator is a dominant alternative over intravenous tissue plasminogen activator alone (more effective and less costly) for the treatment of acute ischemic stroke patients with large vessel occlusions in Colombia.
Keywords: health economics, ischemic stroke, Cost-effective

O 042

SELF-REPORTED INTRAPROCEDURAL PATIENT COMFORT DURING THROMBECTOMY WITHOUT PRIOR SEDATION

G Jacquin[1,3,4], A Poppe[1,3,4], L Gioia[1,3,4], Y Deschaintre[1,3,4], C Odier[1,3,4], N Daneault[1,3,4], A Weill[2], D Roy[2], J Raymond[2], D Iancu[2], D Volders[2], J Ghostine[2] and C Stapf[1,3,4]

[1]Neurovascular Health Program, Division of Neurology, Centre Hospitalier de l'Université de Montréal (CHUM), Montreal, CANADA
[2]Dept. of Radiology, Centre Hospitalier de l'Université de Montréal (CHUM), Montreal, CANADA
[3]Dept. of Neurosciences, Faculté de Médecine, Université de Montréal, Montreal, CANADA
[4]Neurovascular Group, Centre de recherche du Centre Hospitalier de l'Université de Montréal (CRCHUM), Montreal, CANADA

Purpose: In stroke patients with acute large vessel occlusion (LVO), endovascular therapy (EVT) may be performed with or without sedation. Our aim is to describe self-reported intraprocedural comfort in patients undergoing EVT without prior sedation.
Materials and Methods: We are currently performing a prospective observational single-center study of patients undergoing EVT without prior sedation. Patients are systematically interviewed on the day following intervention using a structured questionnaire addressing 5 domains (nausea/vomiting, pain of any kind, physical discomfort, emotional discomfort, team interaction); each domain is scored 0–2 points for a maximum total of 10 points (a higher score indicating greater discomfort). In addition, satisfaction with procedural comfort is rated on a 0–100 point visual analog scale (VAS, 100 corresponding to highest satisfaction), and patients report whether they would have preferred more, less, or the same amount of sedation.
Results: The analysis includes 66 complete questionnaires from 137 patients who underwent EVT without prior sedation between October 2018 and March 2019. We excluded questionnaires that were either incomplete (30 patients with aphasia), or missing (41). The median score on the structured 5-domain questionnaire was 1 (IQR 0–2). On the VAS, average satisfaction with procedural comfort rating was 90 (SD $\pm$ 24.0). Patients were satisfied with the amount of sedation in 45 cases (68%), while some would have preferred either more 11 (17%) or less 3 (5%) sedation.
Conclusion: Our findings suggest EVT without prior sedation seems to be well tolerated, including high self-reported patient satisfaction. Systematic self-evaluation of patient comfort appears feasible and may be integrated into clinical routine.
Keywords: Thrombectomy, Sedation, Patient centered outcome

O 043

THROMBECTOMY IN STROKE PATIENTS WITHOUT PRIOR SEDATION: FREQUENCY OF INTRAPROCEDURAL USE OF ANALGOSEDATION

G Jacquin[1,2,3], L Gioia[1,2,3], Y Deschaintre[1,2,3], N Daneault[1,2,3], C Odier[1,2,3], A Poppe[1,2,3], A Weill[2], D Roy[2], J Raymond[2], D Iancu[2], D Volders[2], J Ghostine[2] and C Stapf[1,2,3]

[1]Dept. of Neurology, Centre Hospitalier de l'Université de Montréal (CHUM), Montreal, CANADA
[2]Dept. of Radiology, Centre Hospitalier de l'Université de Montréal (CHUM), Montreal, CANADA
[3]Dept of Neurosciences, Faculté de Médecine, Université de Montréal, Montreal, CANADA
[4]Neurovascular Group, Centre de recherche du Centre Hospitalier de l'Université de Montréal (CRCHUM), Montreal, CANADA

Purpose: In stroke patients with acute large vessel occlusion (LVO), endovascular therapy (EVT) may be performed with or without prior sedation. While several studies have evaluated patients treated under conscious sedation, only limited data are available on EVT performed without prior sedation. Our aim was to determine the proportion of non premedicated patients who will eventually require analgosedation during the procedure.
Materials and Methods: We analyzed data from the prospective Montreal Neurovascular and Stroke Data Repository (MONSTER) on patients undergoing EVT for acute LVO without prior sedation for acute stroke treatment.
Results: Between January and December 2018, 219 consecutive patients (mean age: 70 years SD $\pm$ 15, 52 % women) underwent EVT for acute LVO without prior sedation. Overall, median procedural time was 36 minutes (IQR 27–59) and recanalization (TICI 2b/3) was achieved in 184 (84%). One hundred and sixty-three procedures (74%) were completed without the use of any systemic analgosedation. Fifty-six patients (26%) required some sedation during the procedures including 6 (3%) who required intubation. Proportions of favorable outcomes (mRS 0–2 at 90 days) did not differ whether patients received analgosedation during EVT or not (58.5% vs 57.0%, $p = 0.87$).
Conclusion: Our findings suggest thrombectomy without prior sedation is feasible in the majority of cases. Only one fourth of non-premedicated patients eventually require intraprocedural analgosedation and only rarely intubation. Further studies are needed to evaluate the impact of sedation on procedural parameters, patient comfort and stroke outcome.
Keywords: Thrombectomy, Sedation, Patient centered outcome

O 044

VALIDATION OF A NEW SCALE ALLOWING SYSTEMATIC EVALUATION OF INTRAPROCEDURAL PATIENT COMFORT DURING THROMBECTOMY

G Jacquin[1,3,4], A Poppe[1,3,4], L Gioia[1,3,4], Y Deschaintre[1,3,4], N Daneault[1,3,4], C Odier[1,3,4], A Weill[2], J Raymond[2], D Iancu[2], D Volders[2], J Ghostine[2] and C Stapf[1,3,4]
[1]Neurovascular Health Program, Division of Neurology, Centre Hospitalier de l'Université de Montréal (CHUM), Montreal, CANADA
[2]Dept. of Radiology, Centre Hospitalier de l Université de Montréal (CHUM), Montreal, CANADA
[3]Dept. of Neurosciences, Faculté de Médecine, Université de Montréal, Montreal, CANADA
[4]Neurovascular Group, Centre de recherche du Centre Hospitalier de l Université de Montréal (CRCHUM), Montreal, CANADA

Purpose: In stroke patients with acute large vessel occlusion, endovascular therapy (EVT) may be performed with or without sedation. Our aim was to develop a pragmatic scale allowing systematic evaluation of intraprocedural patient comfort, and to evaluate its feasibility and interobserver agreement.
Materials and Methods: We performed a prospective observational single-center study of patients undergoing EVT at a tertiary stroke center. A 5-domain scale (vocalization, nausea/vomiting, body movements, vital signs, coping), each item scoring 0–2 points for a maximum total of 10 points (a higher score indicating greater discomfort), was used to assess patient comfort as perceived by the medical team. Patients were independently scored by the treating stroke nurse and vascular neurologist present during the procedure. Proportional scoring agreement and interobserver agreement (weighted kappa) were calculated for both overall scores and by domain using standard statistical procedures.
Results: Between October 2018 and March 2018, 136 patients underwent EVT. Overall, 110 patients were fully evaluated, while 26 were excluded due to at least one missing evaluation (81% completeness). The proportion of scoring agreement between evaluators was moderate to good including the domains vocalization (proportion of agreement 80%; $k = 0.61$, 95%CI:0.45–0.76), nausea/vomiting (97%; $k = 0.71$, 95%CI:0.53–0.90), body movements (71%; $k = 0.53$, 95%CI:0.39–0.67), vital signs (67%; $k = 0.34$, 95%CI:0.18–0.49), and coping (76%; $k = 0.44$, 95%CI:0.28–0.61).
Conclusion: In patients undergoing EVT, a pragmatic scale evaluating patient comfort appears feasible, shows high proportional and moderate to substantial interobserver agreement between two independent evaluators and could potentially be used as a marker of sedation efficacy.
Keywords: Thrombectomy, Sedation, Patient centered outcome

O 045

VALIDATION OF A NEW SCALE ALLOWING SYSTEMATIC EVALUATION OF OPERATORS' PERCEPTION OF PROCEDURAL EASE IN THROMBECTOMY WITHOUT PRIOR SEDATION

G Jacquin[1,3,4], A Poppe[1,3,4], L Gioia[1,3,4], Y Deschaintre[1,3,4], N Daneault[1,3,4], C Odier[1,3,4], A Weill[2], D Roy[2], J Raymond[2], D Iancu[2], J Ghostine[2], D Volders[2] and C Stapf[1,3,4]
[1]Dept. of Neurology, Centre Hospitalier de l'Université de Montréal (CHUM), Montreal, CANADA
[2]Dept. of Radiology, Centre Hospitalier de l'Université de Montréal (CHUM), Montreal, CANADA
[3]Dept of Neurosciences, Faculté de Médecine, Université de Montréal, Montreal, CANADA

[4]Neurovascular Group, Centre de recherche du Centre Hospitalier de l'Université de Montréal (CRCHUM), Montreal, CANADA

Purpose: In stroke patients with acute large vessel occlusion (LVO), endovascular therapy (EVT) may be performed with or without sedation. In our center, sedation is used only as needed, and most procedures are completed without systematic sedation. Our aim was to develop a pragmatic scale to assess the impact of non-sedation on procedural ease and operator satisfaction with the procedure.
Materials and Methods: We developed and validated a simple and pragmatic questionnaire to systematically assess procedural comfort of the operator. A 5-domain scale (arterial access, navigation ease, patient movement, quality of diagnostic imaging, overall satisfaction with the procedure), each item scoring 0–2 points for a maximum total of 10 points (a higher score indicating greater procedural difficulty), was used to assess operator's comfort during the procedure. Two assessors performing the procedure (attending neuroradiologist and fellow) scored independently each intervention. Results were then correlated with the type of sedation used.
Results: Between October 2018 and March 2019, 106 patients were fully evaluated. The proportion of scoring agreement between evaluators was moderate to substantial in all domains including arterial access (proportion of agreement 90%; $k = 0.52$, 95%CI:0.34–0.71), navigation (83%; $k = 0.56$, 95%CI:0.38–0.74), quality of imaging (72%; $k = 0.45$, 95%CI:0.28–0.63), patient movements (67%; $k = 0.43$, 95%CI:0.28–0.58), and overall satisfaction (77%; $k = 0.48$, 95%CI:0.32–0.64). Overall operator comfort scores were low (median score 2 IQR (0-3), but trended to be higher during procedures in patients under sedation ($n = 46$; median score 3 IQR(1-4) as compared to procedures without sedation (n=60; median score 1 IQR(0-2).
Conclusion: A pragmatic scale evaluating operator comfort and procedural ease during EVT appears feasible and shows high interobserver agreement between two independent evaluators. Overall, EVT without sedation does not seem to lower operator satisfaction. Systematic evaluation of procedural technical difficulty may be easily integrated into clinical routine to guide use of analgosedation.
Keywords: Thrombectomy, Sedation, Patient centered outcome

O 046

THE EFFECT OF PROCEDURAL HEMODYNAMIC CHANGES DURING ANESTHETIC MANAGEMENT ON FUNCTIONAL OUTCOME AFTER ENDOVASCULAR TREATMENT FOR ISCHEMIC STROKE: RESULTS FROM THE MR CLEAN REGISTRY

N Samuels[1], RA Van De Graaf[1], CAL Van Den Berg[1], I Eralp[1], KM Treurniet[2], BJ Emmer[2], RV Immink[2], CBLM Majoie[2], WH Van Zwam[3], RPH Bokkers[4], M Uyttenboogaart[4], BAAM Van Hasselt[5], J Mühling[6], B Roozenbeek[1], HF Lingsma[1], DWJ Dippel[1], ACGM Van Es[1] and A Van Der Lugt[1]

[1]Erasmus MC University Medical Center, Rotterdam, THE NETHERLANDS
[2]Amsterdam University Medical Center, Amsterdam, THE NETHERLANDS
[3]Cardiovascular Research Institute Maastricht, Maastricht University Medical Center, Maastricht, THE NETHERLANDS
[4]University Medical Center Groningen, Groningen, THE NETHERLANDS
[5]Isala Hospital, Zwolle, THE NETHERLANDS
[6]Radboud University Medical Center, Nijmegen, THE NETHERLANDS

Purpose: Conscious sedation (CS) during endovascular treatment (EVT) may be associated with worse functional outcomes compared to local anesthesia (LA). We evaluated whether the effect of anesthetic management on functional outcome could be explained by procedural hemodynamic changes.
Materials and Methods: Patients treated with EVT for acute ischemic stroke in the MR CLEAN Registry between March 2014 and November 2017 in centers with CS or LA as standard protocol and blood pressure data available were analyzed. We evaluated whether the effect of anesthetic management on functional outcome (90-days modified Rankin Scale) changed after adjustment for depth and duration (area under the threshold (AUT), 10%-drop from baseline in mmHg*minute) or depth (lowest mean arterial pressure from baseline (delta-LMAP) in mmHg) of hypotensive episodes.
Results: In 230 patients treated with EVT, hypotensive episodes were longer and deeper under CS ($n = 139$) compared to LA ($n = 91$) ((median AUT/min) 2.0 [IQR 0–9.4] vs. 0 [IQR 0–0.4], $p < 0.01$ and median delta-LMAP 24.7 mmHg [IQR 9.7–40.3] vs. 2.3 mmHg [IQR 0–16.3], $p < 0.01$). CS was associated with worse functional outcome compared to LA (adjusted common odds ratio (acOR) 0.33, 95%CI 0.19–0.59). This association did not change after adjustment for AUT (acOR 0.36, 95%CI 0.19–0.66) or delta-LMAP (acOR 0.34, 95%CI 0.18–0.63).
Conclusion: CS was associated with poorer functional outcome and more hemodynamic changes than LA. However, hemodynamic changes did not explain the association between CS and poor outcome.
Keywords: Anesthesia, Blood pressure, Endovascular treatment

SESSION D: Spinal AV Shunts

O 047

SPINAL CORD ARTERIOVENOUS SHUNTS AND PREGNANCY; NATURAL HISTORY AND MANAGEMENT. A MONOCENTRIC STUDY OF 10 CONSECUTIVE CASES

A Consoli[1], M Ohlsson[2], F Di Maria[1], A Sgreccia[3] and G Rodesch[1]

[1]Diagnostic and Interventional Neuroradiology, Foch Hospital, Suresnes, FRANCE
[2]Department of Neuroradiology, Karolinska University Hospital and Department of Clinical Neuroscience, Karolinska Institu, Stockholm, SWEDEN
[3]Diagnostic and Interventional Neuroradiology, San Matteo Hospital, Pavia, ITALY

Purpose: Spinal cord arteriovenous shunts (scAVS) are rare, affecting less than 1 in 20 000 persons and pose special challenges when present or symptomatic in pregnant patients. Here, we present a series of ten cases of scAVS.
Materials and Methods: Five cervical, four thoracic and one lumbar AVMs were referred to and treated in our center. Seven shunts were niduses, and three micro AV-fistulae. Patients became symptomatic during the first, second or mainly third trimester and all patients presented with moderate to severe spinal cord dysfunction, but regained some function when they were seen and subsequently treated. All cases had pial venous reflux and six cases had pseudoaneurysms.
Results: After embolization, 4 women recovered almost completely, and 4 women had partial recovery. Only one case did not improve after recovery and treatment. One case was lost to follow-up. Our data supports previous reports that spinal cord arteriovenous shunts have a low risk of rebleeding after the ictal event even during pregnancy and may thus be closely followed until the child has been safely delivered. A model is proposed for management of scAVS:s during pregnancy; we suggest treatment should be primarily endovascular and performed after delivery and a recovery period.
Conclusion: Women with known scAVS:s should not be discouraged from becoming pregnant, however it seems wise to embolize their lesions before pregnancy as this treatment if properly performed offers protection for further risks during pregnancy.
Keywords: pregnancy, AVM, spinal cord

O 048

ENDOVASCULAR TREATMENT OF SPINAL AVM: REPORT OF THREE CASES TREATED WITH TRANSVENOUS APPROACH IN COMBINATION WITH THE RETROGRADE PRESSURE COOKER TECHNIQUE

CP Stracke[1], M Wallocha[1], SM Pilgram-Pastor[1], E Celik[1] and R Chapot[1]
[1]Alfried Krupp Hospital, Essen, GERMANY

Purpose: Endovascular treatment of spinal pial AVMs is limited by low rates of complete cure. Transarterial extensive treatment with liquid embolics carries the risk for clinically relevant ischemic complications. We report three cases of symptomatic spinal AVMs treated by transvenous approach using the retrograde pressure cooker technique.
Materials and Methods: In three selected cases, transvenous navigation with the aim of a retrograde pressure cooker embolization was performed.
Results: Retrograde venous navigation was possible with two parallel microcatheters and the pressure cooker technique with Ethylenvinylalcohol-polymer could be used in all cases. One AVM was occluded completely and two subtotally. One transient paresis of a leg occurred.
Conclusion: In certain pial spinal AVMs, a transvenous approach for embolization with liquid embolics can be considered.
Keywords: AVM, Spinal, Embolisation

O 049

EMBOLIZATION OF SPINAL DURAL AVF USING THE PRESSURE COOKER TECHNIQUE

CP Stracke[1], S Pilgram-Pastor[1], E Celik[1], M Wallocha[1], E Yamac[1] and R Chapot[1]
[1]Alfried Krupp Hospital, Essen, GERMANY

Purpose: Embolization of dural spinal arteriovenous Fistula has technical limitations. Succesful Penetration of the Fistula from the arterial to the venous is often not possible. We present a series of four cases where a modified pressure cooker technique is used.
Materials and Methods: In four Patients with spinal dural avf an arterial Approach with two microcatheters is used to apply the pressure cooker technique for controlled Penetration of the Fistula. Single- and souble Guiding catheter approaches were used for Access.
Results: In all cases the spinal dural avF could be cured without complications. In cases with small segmental artery, two Guiding catheters and microcatheters entered the supplying vessel consecutively to achieve the Access needed for pressure cooker embolization.
Conclusion: The pressure cooker tehnique seems also feasible and helpful in Treatment of spinal dural avF. Small segmental arteries require a modification of the technique with two Guiding catheters.
Keywords: davF, Embolization, pressure cooker

O 050

INTRAOPERATIVE DIRECT PUNCTURE AND EMBOLIZATION THROUGH THE DRAINAGE VEINS FOR SACRAL VASCULAR MALFORMATION IN HYBRID OPERATING ROOM: A CLINICAL PILOT STUDY FOR SAFETY AND FEASIBILITY

Y Ma[1], H Zhang[1], M Ye[1], C He[1], G Li[1], L Sun[1], T Hong[1], C Yang[1] and F Ling[1]
[1]Department of Neurosurgery, Xuanwu Hospital, Capital Medical University, Beijing, CHINA

Purpose: To present a novel approach to embolize sacral vascular malformation and evaluate the feasibility and safety.

Materials and Methods: Intraoperative direct puncture and embolization through the drainage vein was performed in 13 patients (August 2016-October 2018) at the Neurosurgical Department, Xuanwu Hospital, Capital Medical University. All the data of 13 patients were prospectively collected. Spinal cord function was evaluated according to modified Aminoff and Logue's Scale (mALS) before surgery and at 6 months after treatment.
Results: Among 13 patients with sacral vascular malformation, 10 were male. Three patients (3/13,23.1%) were diagnosed as extradural arteriovenous fistulas (AVFs), four cases (4/13,30.8%) were filum terminale AVFs, and 6 cases (6/13,46.1%) were spinal dural arteriovenous fistulas (SDAVFs). Four patients (30.8%) had previous history of operations (3 underwent embolization and 1 underwent microsurgery) before hybrid operations. The rate of immediate angiographic occlusion of the AVMs was 100%. No procedural or clinical complications were observed. The mean mALS before hybrid operation were 7.15 (range 4–10, SD = 2.48). And the mean mALS at 6 months follow-up were 4.77 (1–9,2.26).
Conclusion: Intraoperative direct puncture and embolization through the drainage veins is feasible and effective to treatment of sacral vascular malformations when strict anatomical selection is respected. And this technique may improve cure rates.

Table showing summary of the cases

Patients No.	Age/Sex	Time between onset and hybrid treatment	diagnosis	mALS		Angiography Follow-up
				Before procedure	Follow-up	Occlusion
1	47/M	36	Extradural AVF	9	8	Yes
2	65/M	7	Extradural AVF	10	4	Yes
3	64/M	9	FT AVF	9	9	Yes
4	68/M	48	FT AVF	8	6	Yes
5	47/M	18	FT AVF	4	3	Yes
6	41/M	6	FT AVF	4	2	Yes
7	55/M	7	SDAVF	3	1	Yes
8	65/M	10	SDAVF	7	7	Yes
9	43/F	14	SDAVF	7	4	Yes
10	72/M	9	SDAVF	10	6	Yes
11	62/F	2	SDAVF	4	3	Yes
12	69/F	7	SDAVF	8	4	Yes
13	67/M	12	SDAVF	10	5	Yes

Keywords: spinal vascular malformation, hybrid operation, transvenous

O 051

CONCOMITANT CONUS MEDULLARIS ARTERIOVENOUS SHUNTS AND SACRAL DURAL ARTERIOVENOUS FISTULAS: PATHOPHYSIOLOGICAL LINKS RELATED TO THE VENOUS DRAINAGE OF THE LESIONS IN A SERIES OF FIVE CASES

A Rosi[2], F Di Maria[1], A Consoli[1], S Condette-Auliac[1], O Coskun[1], A Guedon[1] and G Rodesch[1]

[1]Department of Diagnostic and Therapeutic Neuroradiology, Hôpital Foch University of Versailles Saint Quentin-en-Yveli, Suresnes, FRANCE
[2]Diagnostic and Interventional Neuroradiology, Geneva University Hospital, Geneva, SWITZERLAND

Purpose: Spinal cord arteriovenous shunts (scAVSs) are a group of lesions located in the spinal cord itself or in the surrounding structures. The most common scAVSs are spinal dural arteriovenous fistulas (sDAVFs), which are acquired lesions. The pathogenesis of sDAVFs involves thrombosis and venous hypertension as trigger factors. Intradural scAVSs such as spinal cord arteriovenous nidus type malformations (AVMs) and pial arteriovenous fistulas are less common than sDAVFs and are considered to have a so-called 'congenital' origin. The association between different concomitant scAVSs is very rare and the association of sDAVFs with intradural scAVSs has been described in only a few case reports.
Materials and Methods: We describe a case series of six patients presenting with a conus medullaris AVS associated with a lower lumbar or sacral DAVF.
Results: Four of our patients were <30 years old at presentation. In five of these five cases the intradural scAVS drained caudally, engorging the epidural plexus in the same location as the sDAVF. In only one case, who presented with thrombosis of the drainage of the main compartment of a conus medullaris pial AVF, was the location of the DAVF opposite to the location of the residual drainage.
In one case, In one case, a lumbar epidural shunt developed secondarily four years after treatment of the intradural shunt, with drainage in the same venous area of the intradural scAVS, leading to identical clinical symptoms.
Conclusion: We discuss the pathophysiological link between scAVS and sDAVF on the basis of the rarity of the DAVF, the uncommon association between scAVS and sDAVF, the presence of sDAVF in young patients, and the venous hypertension created by the venous drainage towards the sacral area responsible for angiogenesis creating the dural shunt. A very delayed development of a dural shunt despite the improvement of the caudally oriented venous hypertension is also possible.
Keywords: conus medullaris pial shunt, dural AVF, venous drainage

O 052

CLINICAL OUTCOME AND PREOPERATIVE DIAGNOSIS OF THE SPINAL ARTERIOVENOUS FISTULA USING THE USUAL AND MODIFIED MINIMUM INTENSITY PROJECTION IMAGING

S Sato[1], Y Niimi[2], T Mochizuki[1], K Yoshida[2], S Shima[1], B Ryuu[1], T Inoue[1], K Kuwamoto[1] and Y Okada[1]

[1]Department of Neurosurgery, St Luke's International Hospital, Tokyo, JAPAN

[2]Department of Neuroendovascular Therapy, St Luke's International Hospital, Tokyo, JAPAN

Purpose: To explore the efficacy of the preoperative angiographical evaluation of the fistula site for the spinal arteriovenous fistula (SAVF) by using the usual and modified minimum intensity projection (MIP) images.
Materials and Methods: The clinical data of 25 patients with spinal arteriovenous fistula (9 dural, 11 epidural, 2 radicular and3 perimedullary,) were experienced from 2014 to 2018 were retrospectively analyzed. The location of the fistula was preoperatively assessed by spinal MRI and catheter angiography. The MIP images were made using the usual mode by injecting contrast material from the parent artery, and by manual injection mode from the microcatheter in the radiculomedulllary artery for subtle intradural lesions. Fusion images of the MIP from different feeders were created especially for high flow lesions. Fusion images of MRI and MIP were obtained for differentiating between radicular AVF and perimedullary AVF. Endovascular treatment was selected for the first line for all cases. Open surgery was performed for the cases uncurable by endovascular therapy.
Results: 8 Patients with dural AVF were treated by endovascular treatment and one patient was treated by open surgery. All cases were completely obliterated. 10 patients with epidural AVF were treated by endovascular treatment. One case of low flow shunt was surgically obliterated after partial embolization. 4 patients with high flow epidural AVFs were treated by transvenous approach, of which 2 patients resulted in partial occlusion. Modified MIP images and fusion images were useful to assess the detailed angioarchitecure of intradural lesions. The small fistula was more clearly identified by the MIP images created by 20 s Dyna CT micro (Siemens) than the usual 5sDSA mode. Two radicular AVFs and one perimedullary AVF were obliterated by open surgery, 2 cases of the radicular AVF were obliterated by open surgery.
Conclusion: The usual and modified MIP images of the preoperative angiography were useful for not only detecting the location of the fistula but also selecting the strategy for the endovascular therapy.
Keywords: Spinal arteriovenous fistula, Endovascular therapy, Preoperative imaging

O 053

SIGNIFICANCE OF PRE-OPERATIVE ANGIOGRAPHIC DIAGNOSIS IN CASES OF SPINAL DURAL AND EPIDURAL ARTERIOVENOUS FISTULA

K Nishi[1], M Hiramatsu[1], K Sugiu[1], T Yasuhara[1], T Hishikawa[1], N Kidani[1], Y Takahashi[1], S Murai[1] and I Date[1]
[1]Okayama University Graduate School of Medicine, Okayama, JAPAN

Purpose: In the diagnosis of spinal dural arteriovenous fistula (SDAVF), differentiation from spinal epidural arteriovenous fistula (SEAVF) and the presence of normal spinal artery from the feeder can affect the treatment strategy.
Materials and Methods: Subjects consisted of 20 patients with SDAVFs and 8 with SEAVFs exhibiting intradural drainage of shunt flow admitted to our department between January 2007 and December 2018. We analyzed vascular anatomy, especially differences between SDAVFs and SEAVFs, and the detection rate of normal spinal arteries branched from feeders of SDAVFs. Furthermore, treatment and follow-up results were evaluated.
Results: Of the eight patients in the SEAVF group, six patients (75%) had been misdiagnosed with SDAVFs at the time of treatment.
In the comparison of SDAVF and SEAVF, the rates of patients with a history of spinal surgery, lumbar vertebral lesions, involvement of a dorsal somatic branch, involvement of multiple segmental arteries, or involvement of bilateral segmental arteries were significantly higher in the SEAVF group. As for post-treatment course, there were significant difference in the recurrence rate after endovascular treatment (SDAVF group: 6%, SEAVF group: 63%, respectively, $p < 0.05$).
Detection rates of normal spinal arteries from feeders of SDAVFs were 10% (1/10) before February 2013 and 30% (3/10) after March 2013. We started to use flat panel detector from March 2013, and normal spinal arteries could be confirmed only by the slab maximum intensity projection image. As a curative treatment, direct surgery was performed in 3 cases of SDAVF with normal spinal arteries and embolization was performed in another one case which had multiple feeders, and complete occlusion of shunt was obtained without any complication in all cases.
Conclusion: It is necessary to analyze detailed and accurate vessel anatomy using the latest imaging modality to distinguish between SDAVF and SEAVF and to diagnose the presence of normal spinal arteries from the feeder.
Keywords: spine, dural arteriovenous fistula, epidural arteriovenous fistula

O 054

ANGIOARCHITECTURE AND ENDOVASCULAR TREATMENT FOR CERVICAL EPIDURAL ARTERIOVENOUS FISTULAS (CEAVFS)

Y Niimi[1], S Sato[1], T Inoue[1], K Kuwamoto[1], B Ryu[1], S Shima[1], T Mochizuki[1], K Yoshida[2] and Y Okada[1]
[1]St. Luke's International Hospital, Tokyo, JAPAN
[2]Keio University, Tokyo, JAPAN

Purpose: In order to assess the angiographic characteristics and endovascular treatment.
Materials and Methods: From December 2013 to November 2018, we diagnosed 8 CEAVF cases. Angioarchitecture and treatment were retrospectively reviewed.

Results: There were 5 males and 3 females with the age ranging from 18 to 75 (mean 54). The level of the lesion ranged from C1 to C7 with 4 cases of multiple levels including 2 cases of bilateral involvement. All but one case of dorsal epidural AVF were anterolateral epidural AVFs. All were supplied by segmental meningo-osseous branches with one case at the C2 level with additional pial feeders which harbored an aneurysm causing SAH. High flow lesions tended to have multiple feeders and multiple level involvement. Intradural venous drainage was not seen in any case. Two patients presented with hemorrhage (1 SAH, 1 EDH), 3 with myelopathy, 1 with radiculopathy, and 2 were asymptomatic. Asymptomatic lesions were discovered during work up for other symptomatic spinal vascular lesions and were not treated. One simple dorsal CEAVF presented with symptomatic epidural hematoma and was treated by surgery. Remaining 5 cases were treated by embolization, one by trans-arterial approach, 1 by trans-venous approach, and 3 by combination of both. Onyx and/or NBCA was used for trans-arterial embolization and coils and/or Onyx was used for trans-venous embolization. All 5 embolized lesions were completely occluded with improvement of symptoms.

Conclusion: CEDAVFs have a variety of angioarchitectures and symptoms. They can have pial feeders which can develop feeder aneurysms causing intradural hemorrhage. Embolization is safe and effective for even complex high flow lesions. Trans-arterial, trans-venous, or combination of approach as well as embolic materials should be carefully selected based on the angioarchitecture of the lesion.

Keywords: epidural arteriovenous fistula, cervical, embolization

O 055

EMBOLIZATION OF CRANIAL AND SPINAL ARTERIOVENOUS FISTULAS USING PRECIPITATING HYDROPHOBIC INJECTABLE LIQUID (PHIL) IN 9 PATIENTS

R Holmboe Dahl[1], V Eskesen[2], L Poulsgaard[2] and G Benndorf[1,3]

[1]University Hospital Rigshospitalet, Department of Radiology, Copenhagen, DENMARK
[2]University Hospital Rigshospitalet, Department of Neurosurgery, Copenhagen, DENMARK
[3]Baylor College of Medicine, Department of Radiology, Houston, USA

Purpose: Liquid embolic agents play a major role in the endovascular management of arteriovenous fistulas (AVFs). Precipitating hydrophobic injectable liquid (PHIL™; Microvention, California, USA) is a new non-adhesive liquid embolic agent with a lower but more homogenous radiopacity and potentially improved distal penetration when compared to other DMSO-based embolic agents. We present our preliminary experiences using PHIL™ for transarterial embolization of dural and scalp arteriovenous shunts.

Materials and Methods: Between January 2017 and April 2019, nine patients with various AVFs in the cranial and spinal dura mater and in the scalp were included in this retrospective study. Seven patients had intracranial high-grade dural AVFs, 1 had a spinal dural AVF and 1 had a scalp AVF. All patients underwent endovascular treatment with transarterial embolization using PHIL™ either alone or in combination with other liquid embolic agents. Tri-axial catheter systems with distal access catheters (Sofia) and a 1.3 F microcatheter (Headway Duo) for distal catheter positioning were used. All patients underwent 3-month FU DSA to assess durability of the treatment and clinical outcome.

Results: Three patients were female, and the mean age was 56 years. Seven patients were solely treated with PHIL™, while 2 patients were treated in multiple sessions with PHIL™, one in combination with SQUID, another with NBCA. Complete angiographic obliteration was achieved in 4 patients after a single session. Final complete fistula occlusion was achieved in 7 patients and near-complete occlusion in 1 patient due to unfavorable anatomy of the pial supply. One patient is currently planned for additional treatment sessions. Two patients with dural AVFs showed recanalization after initial complete obliteration.

Adverse events occurred in two patients. One patient developed transient lower extremity weakness due to untoward migration and another an asymptomatic subdural contrast effusion after embolization of a tentorial dural AVF. Follow-up between 3 months and 1 year showed a good outcome in all 8 patients who had finished treatment.

Conclusion: In this small case series PHIL™ was relatively safe and effective for treatment of various arteriovenous shunts including high-grade dural AVFs. Fluoroscopic visualization and treatment durability were perceived somewhat inferior when compared to other DMSO based liquids. More data and longer FUs are needed to fully assess the role of PHIL™ in the treatment of cranial and spinal AV shunts.

Keywords: PHIL, Arteriovenous fistulas, Liquid embolic agents

SESSION E: Pediatric

O 056

SAFETY OF SELECTIVE SUPRA-AORTIC ARTERIES AND SUPERSELECTIVE INTRACRANIAL CATHETERIZATION IN PEDIATRIC POPULATION: 11-YEARS EXPERIENCE

T Casseri[1], P Gennari[2], S Cioni[2], IM Vallone[2], S Leonini[2], T Hadijstilianou[3], S De Francesco[3], D Guglielmucci[4], M Caini[4], R Tinturini[5], F Tarantino[5] and S Bracco[2]

[1]Department of Medical, Surgical and Neurosciences, Le Scotte University Hospital, Siena, ITALY
[2]Neuroimaging and Neurointervention (NINT) Unit, Le Scotte University Hospital, Siena, ITALY

[3]Retinoblastoma Reference Center, Le Scotte University Hospital, Siena, ITALY
[4]Pediatrics Unit, Le Scotte University Hospital, Siena, ITALY
[5]Neurosurgical Anesthesia and Intensive Care Unit, Le Scotte University Hospital, Siena, ITALY

Purpose: The importance of diagnostic cerebral angiography via trans-femoral catheterization progressively diminished due to the improvement of non-invasive imaging techniques such as MRI. It remains necessary in the endovascular treatment of some pediatric vascular diseases (i.e. MAV) and, more recently, in the management of intraocular retinoblastoma (RTB) with direct intraarterial (ophthalmic artery) chemotherapy (IAC).
The aim of this study is to evaluate the safety of the selective supra-aortic catheterization and super-selective intracranial microcatheterization in children.
Materials and Methods: We considered all consecutive pediatric patients admitted at our Institution for RTB that underwent at least one cerebral angiography for IAC.
For each patient we considered age and temporary or permanent complications.
Results: In the period 1/01/2008–31/12/2018, 953 IAC procedures were performed in 191 eyes of 177 children with RTB. Mean age was 31,1 months (s.d. 27,1; range 5–120); 127 children were under 3 years old.
A short 4 Fr introductor was positioned in the left or the right femoral artery, trying to change the side of the puncture site every session. After systemic heparinization, a selective internal carotid artery (ICA) catheterization (4 Fr. catheter) was performed, in order to detect the ophtalmic artery (OA). If the OA was not visible, the external carotid artery was catheterized. Under road-map, a super-selective micro-catheterization (1.2 Fr. microcatheter) of the OA was performed. After achieving the stability of the microcatheter, the prescribed drugs were administred during a 30-minutes infusion. After a final angiogram to rule out procedure-related complications such as vasospasm, embolism or arterial dissection and when the activated clotting time (ACT) test resulted within the limits, the femoral introductor was removed. A manual compression was performed for 1 hour.
In our population, 18 complications (1,9%) were observed, none of which permanent. Mean patients age was 23,5 months (s.d. 10,8; range 12–42) ($p > .05$). Cerebral thromboembolism was observed in 4 cases, successfully treated with antiplatelet therapy, vasospasm in 8 cases, treated with intra-arterial nimodipin administration, and 6 bleeding at groin puncture site, none of which resulted in an hematoma requiring surgical dreinage. Notably, all complications occurred in the first procedure.
Conclusion: Catheterism and microcatheterism of supra-aortic branches in children have low complication rates, in line with those reported in the adult population. The high catheter-to-vessel ratio does not increase the risk of complications. In conclusion this procedure is safe when performed by a dedicated neurointerventional team.
Keywords: Safety, Intracranial catheterization, Supra-aortic catheterization

O 057

PEDIATRIC AVM TREATED WITH HISTOACRYL GLUE EMBOLIZATION. OUR EXPERIENCE

E Ciceri[1], A Agnello[1], R Augelli[1], N Mandruzzato[1], A Nicolato[2], M Longhi[2], A Pasqualin[2], G Pinna[2], P Biban[3] and P Zampieri[1]
[1]Neuroradiology Verona University Hospital, Verona, ITALY
[2]Neurosurgery Verona University Hospital, Verona, ITALY
[3]Paediatric Emergency and Critical Care Verona University Hospital, Verona, ITALY

Purpose: The diagnosis of arteriovenous malformations (AVM) in the pediatric population is difficult, usually is done after bleeding, unlike in adults whom often present epileptic seizures at onset. The therapeutic path is often controversial, but must include a multidisciplinary approach. We describe pediatric cases of AVM treated by endovascular approach utilizing histoacryl glue, combined with surgery and/or radiosurgery, between December 2015 and April 2019 at our Hospital.
Materials and Methods: Our series includes 7 cases of pediatric patients with cerebral AVM (age: 7–17 years, F: M = 4:3). All were subjected to CT, MRI and Angiography (DSA), performed in anticipation of a possible endovascular approach. The clinical management and pathological characteristics of the treated patients will be extensively presented.
Results: The symptoms found at onset were headache, dizziness, nausea and vomiting, in 1 case in the absence of cerebral bleeding. In one patient with haemorrhagic onset, DVP was urgently needed for acute hydrocephalus.
In all patients, an area of possible bleeding origin was identified by DSA and a superselective devascularization procedure was planned according to size and location of the arterial feeders, speed of the AV shunt and accessibility of the branch to be embolized. Only histoacryl glue was utilized, sometimes in combination with platinum coils. In 5 cases only one procedure was performed, while in 2 cases of longer observation, 3 embolization procedures were performed.
No technical or clinical complications after endovascular treatments were observed.
Sterotactic radiosurgery followed the embolization in 3 cases (in one case after cerebral hematoma removal). In one patient, the radiosurgical treatment was performed in 2009. Two cases were sent to neurosurgery. Patients undergoing radiosurgery are still under follow-up.
The patients undergoing surgery performed control DSA that confirmed complete removal of the AVM.
Conclusion: Endovascular procedures in pediatric AVMs present specific criticalities compared to the adult population. In our experience, treatment with histoacryl glue if performed cautiously can be utilized in emergency when a bleeding source is identified. Radiation dose and contrast medium administration should be carefully monitored during procedures. To complete the treatment a

multidisciplinary approach should include neurosurgical and radiosurgical options.
Keywords: pediatrics avm, embolization, Histoacryl glue

O 058

FETAL AND NEONATAL MRI FINDINGS ASSOCIATED WITH AGGRESSIVE EARLY CLINICAL COURSE IN NEWBORNS WITH VEIN OF GALEN MALFORMATION

L Arko[1], D Zurakowski[2] and D Orbach[3]
[1]Boston Children's Hospital- Department of Neurosurgery, Boston, USA
[2]Boston Children's Hospital- Department of Anesthesia, Boston, USA
[3]Boston Children's Hospital- Department of Radiology, Boston, USA

Purpose: Neonates born with vein of Galen malformation (VOGM) bifurcate into either (a) a cohort that experiences cardiopulmonary failure and/or early cerebral injury necessitating urgent neonatal embolization, or (b) a cohort where embolization is deferred until infancy. In this study, MRI characteristics obtained from fetal and early neonatal scans were evaluated to assess their predictive potential for urgent neonatal intervention or neonatal death.
Materials and Methods: Newborns with VOGM who underwent early MRI scans and/or fetal MRI scans from 2007–2018 at a single tertiary referral center were evaluated. On these MRI scans, 18 anatomic vessel parameters were measured to ascertain whether any parameters correlated with neonatal death or urgent neonatal embolization (neonatal at-risk cohort, NAR) versus survival to treatment in infancy (infantile treatment cohort, IT). Multivariable logistic regression was applied to determine independent predictors that could differentiate NAR and IT cohorts. Area under the curve (AUC) by ROC analysis was used to assess predictive accuracy of MRI measurements with cut off values determined by the Youden J-index to identify patients likely to be in the NAR cohort.
Results: Patients with early MRI included 21 patients in NAR cohort and 11 patients in the IT cohort. Maximal diameter (AUC = 0.838, 95% CI: 0.692–0.984, $P < 0.001$) and circumference (AUC = 0.805, 95% CI: 0.651–0.958, $P < 0.001$) at the narrowest point of the straight/falcine sinus and RICA diameter (AUC = 0.840, 95% CI: 0.697–0.983, $P < 0.01$) as most predictive. There were 16 patients with fetal MRI scans(11 NAR patients and 5 IT patients). The maximal diameter (AUC = 0.964, 95% CI: 0.877–1.00, $P < 0.001$) and circumference (AUC = 1.00, 95% CI: 1.00–1.00, $P < 0.001$) at the narrowest point of the straight/falcine sinus were found to be highly predictive. Based on early MRI scans, maximal diameter >7.5 mm, circumference >34 mm, and RICA >3.4 mm predicted high likelihood of NAR. On fetal MRIs, NAR cohort cut off values were similar to early MRI scans.
Conclusion: Based on 32 newborns with VOGM, MRI measurements on both early neonatal scans and fetal scans were significantly different between NAR and IT cohorts. Predictive measurements and cut-off values were derived based on ROC analysis and can be used for early prognostication and risk stratification.
Keywords: Vein of galen, predictive measurments, fetal imaging

O 059

LARGE-BORE NEUROVASCULAR ACCESS FOR EMBOLIZATION OF VEIN OF GALEN MALFORMATIONS IN NEWBORNS AND INFANTS

Y Baytar[1], S Balci[1], B Bilginer[2] and A Arat[1]
[1]Hacettepe University Faculty of Medicine Department of Radiology, Ankara, TURKEY
[2]Hacettepe University Faculty of Medicine Department of Neurosurgery, Ankara, TURKEY

Purpose: Small femoral arterial diameters in newborns and infants pose technical access-related challenges for endovascular treatment. Typically endovascular access is limited to a 4F vascular sheath for children less than 5 years old however a 4F system is frequently not sufficient to obtain enough distal access support for many of the current endovascular devices. We used a coaxial access system composed of a 5F distal access, 4F support catheter and a large bore microcatheter in endovascular treatment of 6 cases with vein of Galen aneurysmal malformation (VGAM). This coaxial system was directly inserted through a femoral or umblical transarterial route and the 5F distal access catheter was navigated as far as possible in the carotid or vertebrobasilar circulation.
Materials and Methods: We retrospectively evaluated 6 children (4 of them in neonatal period) with VGAM treated with endovascular embolization in 10 sessions. 4 patients underwent two sessions. Transumbilical route was used in two children whereas in 4 children transfemoral access was used. Distal access catheters with inner diameters of 0.044 to 0.058 inches were inserted directly from the site of arterial access without a vascular sheath. They were navigated to select the distal/intracranial vertebral artery in %90 of sessions and the intracranial internal carotid artery in %30 of sessions. Liquid embolic agents were injected with dual lumen balloon assistance in 6 sessions of 4 children. Coil embolization was performed in 7 sessions of 5 children. In 3 sessions both techniques were used.
Results: 3 children presenting in critical status immediately after birth died as a result of cardiopulmonary failure soon after endovascular procedure (interval from procedure to death: 0–12 days). Cause of deaths were unrelated to procedure. 3 patients well tolerated the procedures with good clinical outcomes. In one patient the left femoral artery was occluded at the end of procedure while on follow up there was no sign of vascular compromise in the lower extremity.

In 2 sessions mild transient femoral artery spasm occurred without clinical significance. There were no access site related complications in 7 sessions.

Conclusion: Distal access catheters can be directly used without a vascular sheath in endovascular treatment of newborns and young children with VGAM providing large bore area and better distal support. The larger bore access provides the operator with the ability to use a variety of endovascular tools including dual lumen balloons and dual catheters in small children.

Keywords: Vein of Galen (VGAM), Pediatric Access, Endovascular Embolization

O 060

ENDOVASCULAR MANAGEMENT OF VEIN OF GALEN ANEURYSMS

A Sultan[1], T Hassan[1] and T Rayan[1]
[1]Alexandria University, Alexandria, EGYPT

Purpose: Vein of Galen malformations carry life threatening and catastrophic sequelae in children. Endovascular intervention became the only suitable treatment for this pathology. We present a single center experience of 24 patients.

Materials and Methods: Twenty-four patients admitted to the main university hospitals and Smouha neuroendovascular and computational flow dynamic center. Those patients were diagnosed with vein of Galen anomaly associated with intracranial and extracranial complications. Transarterial embolization using NBCA was done in most cases in one or more sessions.

Results: 13 patients presented at the age of one year or less. 11 patients had the age of 2 years or more. 14 cases presented with hydrocephalus. 4 cases presented with heart failure. 13 cases were Mural type. 5 cases were choroidal type, 2 cases were combined. 4 cases had vein of Galen varix.

endovascular treatment was successful in 17 cases. 2 cases died before intervention. One case had spontaneous occlusion of the shunt. One case with choroidal AVM was sent to radiosurgery. 2 cases were followed up and required no intervention (varix). Intervention was failed in one case.

Conclusion: transarterial embolization of vein of Galen malformations yielded significant improvement of the previously untreatable pathology.

Keywords: Galen, trans-arterial, embolization

O 061

DURAL SINUS MALFORMATION WITH GIANT POUCH (DSMGP), SYMPTOMS AND TREATMENT

F Requejo[1]
[1]hospital J P Garrahan, buenos aires, ARGENTINA

Purpose: The aim of this study is to decribe the clinical manifestations and treatment options of patients having Dural Sinus Malformation with giant pouch (DSMGP) in a tertiary pediatric centre.

Introduction: Dural sinus malformation with giant pouch (DSMGP) ia a rare vascular malformation affecting fetuses newborns and infants. It is characterized by a dilated dural sinus frequently thrombosed with arteriovenous fistula (AVF) in its wall. There is a few information about symptoms, best treatment and prognosis of the disease.

CASE	GENDER	AGE	SYMPTOMS	OTHER VM	AVF	THROMBUS	LOCALIZATION	FEEDERS	TREATMENT	OUTCOME
1	M	0 months	MASS EFFECT (prenatal)	NO	NO	TOTAL	1/3 posterior SSS + torcula	NO	SURGERY	CURED
2	M	4 months	SEIZURES	NO	YES	PARTIAL	TS	PICA, TENTORIAL ARTERY, ECA BRANCHES	EMBOLIZATION	DEAD
3	M	9 months	EXOPHTALMUS	CM/ VLM	YES	PARTIAL	TS	ECA BRANCHES, TENTORIAL ARTERY	EMBOLIZATION	PARTIAL OCCLUSION
4	F	2 months	MASS EFFECT	NO	YES	PARTIAL	anterior 2/3 SSS	BILATERAL ECA BRANCHES	EMBOLIZATION AND SURGERY	CURED
5	F	2 months	CHF	NO	YES	PARTIAL	TS	ECA BRANCHES	EMBOLIZATION	TOTAL OCCLUSION
6	M	40 years	EXOPHTALMUS	VLM	YES	PARTIAL	TS	BILATERAL ECA BRANCHES	EMBOLIZATION	PARTIAL OCCLUSION
7	F	0 months	MASS EFFECT	NO	NO	TOTAL	torcula both TS	NO	SURGERY	CURED
8	F	1 months	MASS EFFECT	NO	NO	TOTAL	torcula both TS	NO	SURGERY	CURED
9	M	2 months	EPISTAXIS, FACIAL VEINS DILATATION	NO	YES	NO	TS	BILATERAL ECA BRANCHES	EMBOLIZATION	PARTIAL OCCLUSION

Materials and Methods: Medical charts of cases of DSMGP were retrospectuvely analized from january 2010 to january 2019. Our hospital is a pediatrc tertiary center. An adult patient managed by the authors in another institution was added to the series.

Results: Results are summarized in Table.

Eight pediatric patients from 0 to 9 months were managed, four were males. The adult patient was a 40 years old male. Symptoms were mass effect in 4 pediatric cases. Exophtalmus was present in a pediatric case and in the adult case. Both cases had venolimphatic malformation of the orbit. Congestive heart failure (CHF), epistaxis and facial vein engorgement and intracranial hemorrhage (ICH) were the symptoms in other 3 cases. A child has spontaneous resolution of the disease.

ABBREVIATIONS OF THE TABLE

AVF: arteriovenous malformation; CHF: congestive heart failure; CM: cavernous malformation; ECA: external carotid artery; PICA: posteroinferior cerebellar artery; TS: transverse sinus; VM: vascular malformation; VLM: venolimphatic malformation;

Conclusion: Transverse sinus and superior sagittal sinus are affected more commonly.

Patients with totally thrombosed pouch had mass effect symptoms and were managed by surgical excision.

When AVFs are present, clinical manifestations were secondary to cerebral venous hypertension or cardiac overload. They are amenable to embolization, achieving the control of the venous hypertension in most cases.

Cavernous malformation could be present and must be controlled because its enlargement could be a sign of uncontrolled venous hypertension. On the other hand DSMGP can be accompained by venolimphatic malformation conforming a cerebral venous metameric syndrome.

Keywords: Dural sinus malformatuion, giant pouch, venous hypertension

SESSION F: Stroke 2

O 062

MULTIPHASE CT ANGIOGRAPHY AS A PATIENT SELECTION TOOL FOR MECHANICAL THROMBECTOMY IN ANTERIOR CIRCULATION STROKE

N Witoon[1], A Churojana[1], B Sangpetngam[1], P Withayasuk[1], E Chankaew[1], T Aurboonyawat[1] and D Songsaeng[1]
[1]Neurointervention, Siriraj hospital, Bangkok, THAILAND

Purpose: The purpose of this study is to evaluate the effectiveness of multiphase CT Angiography (MCTA) as a selection tool for mechanical thrombectomy in patients with anterior circulation stroke.
Materials and Methods: A total of 212 patients with anterior circulation stroke who underwent MT at Siriraj Hospital, Bangkok, Thailand, between Nov 2009 to Dec 2018 were retrospectively reviewed. A patient with collateral scoring from MCTA equal or more than 3, was considered to be a candidate for MT. The patient outcome at 30 and 90 days, and complications were compared between patient selection with MCTA and without MCTA groups.
Results: There were 128/212 (60.37%) patients who were selected by using criteria of MCTA. Successful recanalization (TICI 2b-3) was achieved in 170/212 (80.18%). The successful recanalization with favorable outcome (mRS less than 2) at 30 and 90 days were 44.54% and 50.9% in the group with MCTA, whereas 21.42% and 38.09% in the group without MCTA, with p 0.009 and 0.006 respectively. The symptomatic hemorrhage occurred 9.3% with MCTA and 38.9% without MCTA, respectively (p 0.006). By using selection criteria of MCTA; 16 patients who had stroke onset beyond 8 hours and 7 cases with wake up stroke underwent successfully MT with favorable outcome at 90 days 56.25% and 71.42% respectively.
Conclusion: Multiphase CT Angiography is an appropriate tool in patient selection for mechanical thrombectomy in anterior circulation stroke. In combination with ASPECT score from non-contrast CT, collateral score from MCTA can provide higher favorable outcome and lower complication rate. For the wake up stroke or uncertain onset of stroke, MCTA can be considered as a beneficial tool to select a proper candidate for MT.
Keywords: Multiphase CT Angiography, Patient selection, Mechanical thrombectomy

O 063

8-MONTHS OF RAPID (RAPID PROCESSING OF PERFUSION AND DIFFUSION) EXPERIENCE IN STROKE PATIENT SELECTION FOR ENDOVASCULAR TREATMENT

S Piccinini[1], L Verganti[1], F Sacchetti[1], G Zelent[1], F Tari Capone[1] and S Vallone[1]
[1]Neuroradiology Department, Azienda ospedaliero-Universitaria di Modena, Modena, ITALY

Purpose: CT perfusion (CTP) is affordable and easily accessible in the acute stroke setting, and it is recognized as a reliable diagnostic tool to select patients for re-perfusion therapy. DAWN and DEFUSE 3 introduce standardized CTP post processing with validated threshold in clinical setting for patient selection. However, the reliability of standard CTP post-processing is already debated, so we decide to review our RAPID experience to assess CTP diagnostic accuracy. Given EXTEND-IA and SWIFT-PRIME results, we chose to evaluate how reliable is CTP in delineating ischemic core before re-perfusion endovascular treatment.
Materials and Methods: We retrospectively reviewed CTP examinations performed from 1 May to 15 December 2018 in every patients who underwent a thrombectomy procedure. Re-perfusion was evaluated with mTICI score. The ischemic core was assessed before treatment with CTP RAPID results, and visually compared to both NCCT scan in the acute setting and 24-hours follow-up CT scan after treatment.
Results: 61 patients (M 35, F 31) was included. 73% had a good/very good re-perfusion (mTICI: 2b-3) after thrombectomy. Among patients (36%) with negative pre-treatment NCCT (ASPECT score 10), RAPID analysis successfully identified the ischemic core with 100% accuracy. Among patients (64%) with positive pre-treatment NCCT (ASPECT score < 10), RAPID results were not consistent with the pre-treatment NCCT in 25/42 patients, mainly in the basal ganglia region. However, the 24-hours follow-up NCCT demonstrated the ischemic core in the hypo-perfusion (Tmax > 6s) territory shown by RAPID maps in mTICI 1–2a patients.
Conclusion: Ischemic core visual estimation on RAPID maps is fast and reliable for endovascular treatment, especially in patients with negative NCCT. So far, RAPID analysis is not adequate in the evaluation of basal ganglia region, so careful revision of pre-treatment NCCT is mandatory. However, Tmax maps could have a prognostic value in unsuccessful thrombectomy. Further investigation is needed.
Keywords: RAPID, ischemic core, thrombectomy

O 064

EVALUATION OF C-ARM CT PERFUSION PARAMETERS FOR ACUTE INTRACRANIAL LARGE ARTERY OCCLUSION BEFORE AND IMMEDIATELY AFTER MECHANICAL THROMBECTOMY

H Itokawa[1], M Fujimoto[1], M Moriya[1], N Okamoto[1], Y Tsuge[1] and J Sasanuma[1]
[1]SHIN-YURIGAOKA General Hospital, Kawasaki, JAPAN

Purpose: A novel software application introduced on a conventional flat panel C-arm angiographic system allows the acquisition of X-ray projection images during continuous back and forth C-arm rotations. This enables the calculation of computed-tomography perfusion (CTP) parameters, such as cerebral blood flow (CBF), cerebral blood volume (CBV), mean transit time (MTT), and time to peak (TTP) inside the angiography suite. We present results on the clinical utility of cerebral C-arm CTP before and immediately after

mechanical thrombectomy for acute intracranial large artery occlusion in the angiography suite.

Materials and Methods: 13 patients (7 males, 6 females, mean age 73.9 years) with acute intracranial large artery occlusion (ICA in 6, MCA in 7) were included in this study. C-arm CTP images were acquired on a biplane flat-panel angiography system (Artis zee biplane, Siemens) using a protocol that collected projection images during 10 back and forth C-arm rotations. For each patient, C-arm CTP images were acquired before and immediately after thrombectomy. CBF, CBV, MTT and TTP maps were reconstructed and analyzed using prototype software. We manually placed regions of interest (ROIs) on lesions that were classified as either infarcted or salvaged based on MRI images after treatment. We determined relative ratios of perfusion parameters in ROIs in the infarcted and salvaged lesions, both before and immediately after treatment.

Results: On pretreatment C-arm MTT and TTP maps, significant perfusion deficits were detected at the occluded vessel's territory in all cases. CTP maps demonstrated marked reduction of relative CBF and CBV ratios in the ischemic core (CBF: 0.45 ± 0.14, CBV: 0.62 ± 0.14) and mild reduction of these ratios in the salvaged lesions (CBF: 0.78 ± 0.13, CBV: 0.89 ± 0.09). After thrombectomy, cerebral perfusion was markedly improved in the revasculized territory on MTT and TTP maps. In lesions salvaged by the therombectomy, the relative CBF and CBV ratios were relatively stable immediately after treatment (CBF: 0.88 ± 0.15, CBV: 0.98 ± 0.23). However, these ratios demonstrated irregular changes in the ischemic core (CBF: 1.08 ± 0.40, CBV: 1.05 ± 0.51).

Conclusion: Our results suggest that pre-treatment MTT and TTP maps can clearly identify tissue areas with perfusion abnormalities. These maps are also useful to confirm revascularization of these areas on post-treatment C-arm CTP. On the other hand, pre-treatment C-arm CBF and CBV maps are helpful to identify tissue areas that fall below the ischemic threshold. Therefore, C-arm CTP is a useful tool to support treatment decisions for ischemic stroke and to judge the effect of treatment in real-time inside the angiographic suite.

Keywords: C-arm CT perfusion, angiography, ischemic stroke

O 065

A MULTIPHASE MRA COLLATERAL IMAGING: PREDICTION OF NEUROLOGIC OUTCOME IN PATIENTS WITH ACUTE ISCHEMIC STROKE

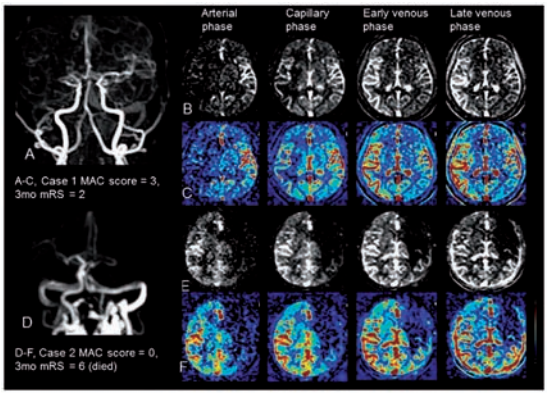
HJ Kim[1], HG Roh[2], HJ Lee[3], JJ Park[4], SB Lee[5], YS Jeon[6], TJ Lee[5], YJ Jung[5] and SY Ryu[5]

[1]Daejeon St. Mary's Hospital, The Catholic University of Korea, Department of Radiology, Daejeon, SOUTH KOREA
[2]Konkuk University Medical Center, Deopartment of Radiology, Seoul, SOUTH KOREA
[3]Daejeon St. Mary's Hospital, The Catholic University of Korea, Department of Neurosurgery, Daejeon, SOUTH KOREA
[4]Konkuk University Medical Center, Deopartment of Neurology, Seoul, SOUTH KOREA
[5]Daejeon St. Mary's Hospital, The Catholic University of Korea, Department of Neurology, Daejeon, SOUTH KOREA
[6]Konkuk University Medical Center, Deopartment of Neurosurgery, Seoul, SOUTH KOREA

Purpose: We developed multiphase MRA collateral Imaging (mMRA Collateral Map) and grading methods (MR Acute ischemic stroke Collateral score, MAC score) for collateral assessment in patients with acute ischemic stroke (AIS). This study was to verify the predictive value of the mMR Collateral Map and MAC score for neurologic outcome in patients with AIS.

Materials and Methods: From a prospectively maintained registry of AIS, consecutive patients with steno-occlusive lesion of the unilateral ICA and/or M1 MCA were enrolled. We generated 4-phase MRA Collateral Map (arterial phase, capillary phase, early venous phase, and late venous phase) using dynamic signals from time-resolved contrast-enhanced MR angiography and graded the collateral status using MAC scores (5 = excellent, 4 = good, 3 = intermediate to good, 4 = intermediate to poor, 1 = poor, 0 = very poor). Pretreatment clinical variables including baseline NIHSS score and stroke risk factors, imaging variables including initial infarct volume as well as MAC score, and parameters of endovascular therapy (EVT) were assessed. And their association with good neurologic outcome (mRS 0–2) at 3 months was analyzed.

Results: 163 patients (101 males, mean age of 68.6 ± 12.8) were included. EVT was performed in 94 patients (57.7%). In univariate analysis, younger age, lower initial NIHSS score, absence of hypertension, successful reperfusion (mTICI 2b to 3), less infarct volume, current smoker, MAC scores of 3–5 were associated with a good outcome. In multivariate analysis, younger age (OR, 0.93; 95% CI, 0.88–0.97), lower initial NIHSS score (OR, 0.86; 95% CI, 0.78–0.95), and MAC scores of 3–5 (MAC 3: OR 14.19[95% CI 1.84–109.66]; MAC 4: OR 27.11[95% CI, 2.76–264.79]; MAC 5: OR 23.85[95% CI, 1.28–443.82]) were independent predictors of a good outcome. In 94 patients treated with EVT, younger age, lower initial NIHSS score, successful reperfusion, less infarct volume, current smoker and MAC score of 4 were associated with a good outcome in univariate analysis, and younger age (OR, 0.93; 95% CI, 0.88–0.99) and MAC score 4 (OR, 36.02; 95% CI, 2.11–616.11) were independent predictors of a good outcome in multivariate analysis.



Conclusion: This novel mMRA Collateral Map and grading methods for collateral estimation can be used as a reliable predictor of neurological outcome in patients with AIS.
Keywords: Acute Ischemic Stroke, Collateral, Magnetic Resonance Imaging

O 066

WILLISIAN COLLATERAL FAILURE IN ANTERIOR CIRCULATION MECHANICAL THROMBECTOMY: ITS CONSEQUENCES AND BAILOUT

S Lee[1], JM Hong[1], JW Choi[2], D Kang[3], Y Kim[4], Y Kim[5], J Hong[6], J Yoo[6], C Kim[7], S Sohn[6], Y Hwang[8] and JS Lee[1]

[1]Ajou University School of Medicine, Department of Neurology, Suwon, SOUTH KOREA
[2]Ajou University School of Medicine, Department of Radiology, Suwon, SOUTH KOREA
[3]School of Medicine, Kyungpook National University, Department of Neurosurgery/Radiology, Daegu, SOUTH KOREA
[4]School of Medicine, Kyungpook National University, Department of Neurology/Radiology, Daegu, SOUTH KOREA
[5]School of Medicine, Kyungpook National University, Department of Radiology, Daegu, SOUTH KOREA
[6]Keimyung University Dongsan Medical Center, Department of Neurology, Daegu, SOUTH KOREA
[7]Keimyung University Dongsan Medical Center, Department of Neurosurgery, Daegu, SOUTH KOREA
[8]School of Medicine, Kyungpook National University, Department of Neurology, Daegu, SOUTH KOREA

Purpose: In endovascular treatment (EVT) for large vessel occlusion of the anterior circulation, Willisian collateral failure has critical consequences. It may occur if ipsilateral A2 or fetal posterior cerebral artery is occluded along with the middle cerebral artery, or if contralateral anterior circulation is also impaired. It may occur at presentation (complex T occlusions [CTO]), or encountered during mechanical thrombectomy (MT) (dynamic Willisian failure [dWF]). We evaluated the impact of Willisian failure on clinical outcomes.

Table 1. The initial presenting occlusion changes and occlusion changes encountered during reperfusion process.

	complex T (n=34)	Simple T (n=156)	ICA I (n=34)	MCA M1 (n=300)	P
Dynamic Willisian collateral					<0.001
No aggravation	34 (100.0%)	137 (87.8%)	19 (55.9%)	286 (95.3%)	
Simple T occlusion	0 (0.0%)	0 (0.0%)	2 (5.9%)	0 (0.0%)	
Other territory	0 (0.0%)	0 (0.0%)	8 (25.8%)	4 (1.3%)	
Dynamic Willisian failure (MCA+ACA or PCA)	0 (0.0%)	19 (12.2%)	5 (14.7%)	10 (3.3%)	

Table 2. Clinical characteristics, imaging, endovascular therapy findings, and outcomes according to presence of baseline and dynamic complex Willisian collateral status in acute anterior circulation occlusions.

	CTO (n=34)	STO or IIO or M1O		P value
		dWF (n=34)	SACO (n=456)	
sex, male	17 (50.0%)	20 (58.8%)	246 (53.9%)	0.764
Age	71 ±12	68 ± 12	67 ± 13	0.124
Diabetes mellitus	10 (29.4%)	12 (35.3%)	116 (25.4%)	0.414
Hypertension	25 (73.5%)	19 (55.9%)	280 (61.4%)	0.284
Atrial fibrillation	22 (64.7%)	18 (52.9%)	228 (50.0%)	0.248
Initial NIHSS, median [IQR]	20.5 [18.0 – 22.0]	17.0 [14.0 – 22.0]	16.0 [13.0 – 20.0]	0.001*
ASPECTS, median [IQR]	5.0 [2.0 – 8.0]	6.0 [3.0 – 8.0]	7.0 [5.0 – 9.0]	0.001*
Tandem occlusion	4 (11.8%)	4 (11.8%)	46 (10.1%)	0.914
Intravenous tPA	21 (61.8%)	19 (55.9%)	258 (56.5%)	0.829
Onset-to-puncture	257 ± 133	291 ± 155	284±154	0.573
Procedure time	84 ± 53	93 ± 56	71 ± 43	0.007†
Primary intracranial modality				0.570
Stent retrieval	14 (42.4%)	9 (26.5%)	141 (32.6%)	
Direct aspiration	19 (57.6%)	25 (73.5%)	286 (66.1%)	
Others	0 (0.0%)	0 (0.0%)	6 (1.4%)	
Balloon guide catheter use	27 (79.4%)	21 (61.8%)	328 (71.9%)	0.264
Successful reperfusion	25 (73.5%)	21 (61.8%)	357 (78.3%)	0.078
PH2 or SAH 3-4	12 (35.3%)	3 (8.8%)	41 (9.0%)	<0.001
Favorable outcomes	11 (32.4%)	12 (35.3%)	250 (54.9%)	0.005
Grave outcomes	16 (47.1%)	15 (44.1%)	99 (21.5%)	<0.001

* CTO vs. SACO, p<0.005, post hoc Bonferroni test.

† dWF vs. SACO, p<0.05, post hoc Bonferroni test.

Figure 1. A diagram of willisian failure in anterior circulation occlusions

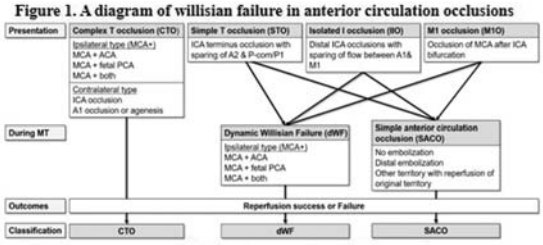


Figure 2. An example of dynamic Willisian failure during MT.

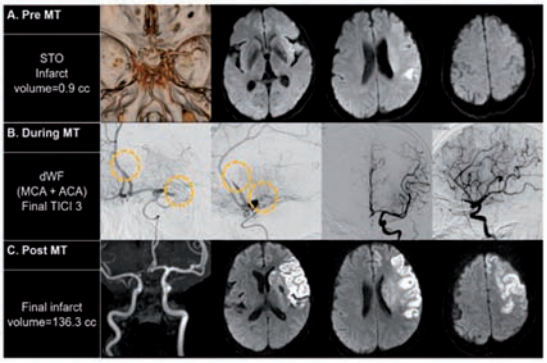


Table 3. Logistic regression models to predict grave outcomes according to initial and dynamic Willisian collateral status.

		Odds ratio (95% CI)	p
Model 1 (Baseline occlusion pattern)			0.099
	M1O	Reference	
	IIO	1.476 [0.593 – 3.674]	0.403
	STO	1.496 [0.905 – 2.473]	0.116
	CTO	2.575 [1.133 – 5.855]	0.024
Model 2 (Baseline + during procedure)			0.009
	SACO	Reference	
	dWF	2.69 [1.22 – 5.94]	0.015
	CTO	2.36 [1.07 – 5.24]	0.034
Model 3 (Baseline + during procedure)			0.002
	SACO	Reference	
	CTO or dWF	2.52 [1.40 – 4.55]	-

Adjusted by age, sex, premorbid mRS, admission NIHSS, onset-to-puncture time, IV rtPA administration, and final successful reperfusion.

Materials and Methods: From an EVT registry with 720 consecutive patients, patients with anterior circulation occlusions (middle cerebral artery [MCA] M1 or intracranial ICA) with onset-to-puncture <720 min. Patients presenting with CTO were identified. Patients that experienced dWF during EVT was further classified. The rest of the patients without CTO or dWF were classified as simple anterior circulation occlusion (SACO). Comparative and multivariable analyses were performed for grave outcomes (3-month modified Rankin Scale of 5–6). Factors predictive of good outcomes (3-month modified Rankin Scale of 0–2) in the dWF group was further analyzed for hints of bailout in this grave situation.

Results: Of 524 patients (73% of cohort), 34 presented with CTO, dCWO was experienced in 34 patients, while 457 patients had SACO. Compared to SACO, CTO patients presented with higher initial National Institute of Health Stroke Scale, lower Alberta Stroke Program Early CT scores, and more frequent hemorrhagic complications, while grave outcomes were similarly experienced in both CTO and dCWO patients (21.7% vs. 47.1% vs. 44.1%, $p < 0.001$). When entered into a logistic regression model, Both CTO (odds ratio: 2.35, 95% confidence interval [1.06–5.22], $p = 0.036$) and dCWO (OR: 2.65, 95% CI [1.20–5.86], $p = 0.016$) expected grave outcomes after correcting for final reperfusion status among other confounding factors. In the dWF group, a good outcome was associated with shortened procedure time (OR: 0.95, 95% CI [0.91–0.99], $p = 0.025$) and reperfusion of the anterior cerebral artery [ACA] (OR: 26.37, 95% CI: [1.75–396.90], $p = 0.018$), while conventional reperfusion goal of TICI 2B or higher was not predictive.

Conclusion: Both initial CTO and procedural dWF are significantly associated with grave outcomes. If dWF is encountered during EVT, rapid reperfusion should be seeked with focus on reperfusion of the ACA to improve outcomes.

Keywords: Mechanical thrombectomy, collaterals, Willisian collateral failure

O 067

ARTERIAL SPIN LABELING IMAGES IN PATIENTS WITH ACUTE MIDDLE CEREBRAL ARTERY ISCHEMIC STROKE

Y Lee[1], J Lee[1], D Park[2] and T Kim[2]

[1]Hanyang University Hospital, Seoul, SOUTH KOREA
[2]Hanyang University Guri Hospital, Guri, SOUTH KOREA

Purpose: Arterial spinal labeling (ASL) image can be used for evaluation of cerebral blood flow (CBF) with the advantage of no need of contrast agent injection. Besides the CBF, pial collaterals can also be demonstrated by arterial transit artifact (ATA). The purpose of our study was to see if there is any additional information from ASL images in patients with acute middle cerebral artery (MCA) ischemic stroke.

Materials and Methods: A total of 29 patients with acute ischemic stroke from MCA M1 ($n = 17$) or M2 occlusion ($n = 12$) were enrolled. Nine of them underwent endovascular thrombectomy. All patients underwent MR imaging including FLAIR, SWI, DWI, and ASL images using 3T MR machine within 2 days after symptom onset. ASL images were obtained by pseudo-continuous ASL (PCASL) technique with1600 msec of post-label delay time. We classified cortical ASL signal as follows; high (full gyriform high signal intensity), intermediate (area of low signal intensity with partial gyriform high signal intensity), and low ASL signal (area of low signal with or without peripheral spotty high signal intensity), and basal ganglia ASL signal as either high or low signal intensity compared to contralateral side. ASL images were compared with angiograms, SWIs (hemorrhage or hypointense vessel sign) and FLAIR images (hyperintense vessel sign).

Results: Patients who failed in recanalization of MCA at the time of MRI examination had more poor ASL signal intensity (5 of 11) than the patients with recanalization (1 of 18) ($p = 0.018$). Cortical hemorrhage on SWI had no significant relationship with ASL signal intensity ($p = 0.63$). Seventeen patients had basal ganglia infarct on DWI, and 9 of them had hemorrhage on SWI. However, there was no significant relationship between basal ganglia hemorrhage and high ASL signal ($p = 0.48$). Patients with SWI hypointense vessel sign were more related with poor ASL signal (5 of 8) than patients without SWI hypointense vessel sign (1 of 21) ($p = 0.0025$). FLAIR hyperintense vessel sign had no significant relationship with ASL signal intensity ($p = 0.117$).

Conclusion: ASL signal intensities in patients with acute MCA ischemic stroke are more related with recanalization and are not an adequate indicator of the penumbra zone or hemorrhage.

Keywords: Acute ischemic stroke, Arterial spinal labeling, Middle cerebral artery

O 068

IMPACT OF BASAL GANGLIA DAMAGE AFTER SUCCESSFUL ENDOVASCULAR RECANALIZATION FOR ACUTE ISCHEMIC STROKE INVOLVING LENTICULOSTRIATE ARTERIES

N Horie[1], Y Morofuji[1], Y Iki[1], Y Matsunaga[1], T Kanamoto[1], T Izumo[1], T Anda[1] and T Matsuo[1]
[1]Nagasaki University, Nagasaki, JAPAN

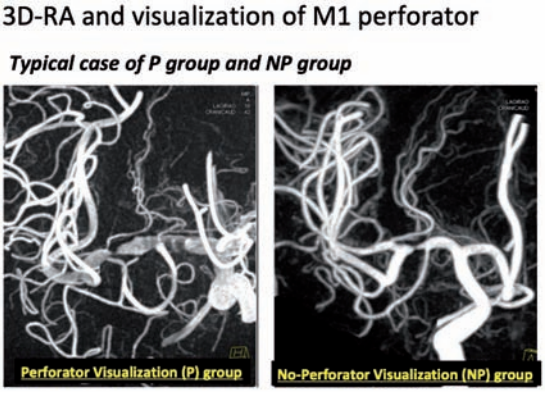
Purpose: Regional ischemic vulnerability of the brain reportedly differs between the cortex and basal ganglia, which has been poorly assessed in the setting of endovascular mechanical thrombectomy. This study was conducted to determine the fate of ischemic basal ganglia and its contribution to the clinical outcome after successful endovascular recanalization for acute ischemic stroke with large vessel occlusion involving the lenticulostriate arteries.
Materials and Methods: Clinical and radiological findings were retrospectively analyzed in consecutive patients with acute ischemic stroke characterized by large vessel occlusion involving the lenticulostriate arteries. Mechanical thrombectomy was performed in all patients using a stent retriever. The fate of ischemic basal ganglia based on location (lentiform nucleus, caudate nucleus, and internal capsule) and the insular cortex were assessed according to the ASPECTS. Pre- and post-intervention magnetic resonance imaging was performed to assess secondary infarction and hemorrhagic transformation. The clinical outcome was assessed using the modified Rankin scale (mRS) at 3 months post-stroke.
Results: Of 126 patients with large intracranial vessel occlusion who achieved successful endovascular recanalization, defined as a thrombolysis in cerebral infarction grade of $> 2B$, involvement of the lenticulostriate arteries was seen in 46 patients (internal carotid artery, 31; proximal middle cerebral artery, 15). Preoperative infarction was detected in the lentiform nucleus (63.0%), internal capsule (13.0%), and caudate nucleus (34.8%), all of which showed secondary advancement in spite of successful recanalization (82.6%, 32.6%, and 56.5%, respectively; $p < 0.05$). The secondary infarct advancement did not correlate with onset to reperfusion time. Postoperative hemorrhagic transformation was detected in 19 (41.3%) patients, mostly in the lentiform nucleus. Involvement of insular ribbon infarction was significantly high in patients with hemorrhagic transformation in the basal ganglia ($p < 0.001$). Univariate analysis showed that age ($p < 0.01$), initial NIHSS score ($p = 0.01$), initial ASPECTS ($p = 0.02$), postoperative ASPECTS ($p = 0.03$), and postoperative infarction in the insular ribbon ($p = 0.04$) were significantly different between patients with a good and poor mRS score. Interestingly, no differences were detected in postoperative infarction or hemorrhagic transformation in the basal ganglia. Multivariate analysis showed that only the initial NIHSS score independently affected the occurrence of poor clinical outcomes (OR, 1.14; $p = 0.02$).
Conclusion: The basal ganglia are vulnerable and readily develop secondary infarction and hemorrhagic transformation in spite of successful recanalization. However, this does not have a significant impact on the clinical outcome of acute ischemic stroke with large vessel occlusion involving the lenticulostriate arteries.
Keywords: Lenticulostriate Arteries, Trombectomy, Basal Ganglia

O 069

RELATIONSHIP BETWEEN 3-D ROTATIONAL ANGIOGRAPHY AND PERFORATOR INFARCTION FOLLOWING PERCUTANEOUS TRANSLUMINAL ANGIOPLASTY FOR MIDDLE CEREBRAL ARTERY STENOSIS

H Yamazaki[1], M Morimoto[1], C Hikita[1], M Iwasaki[1], Y Inaka[1], S Fukuta[1] and H Sato[1]
[1]Yokohama Shintoshi Neurosurgical hospital, Yokohama, JAPAN

Purpose: Percutaneous transluminal angioplasty (PTA) for middle cerebral artery (MCA) stenosis can cause perforator infarction. This study was conducted to clarify the relationship between visualization of perforator from stenosis in preprocedural 3-D rotational angiography (3D-RA) and postprocedural perforator infarction.
Materials and Methods: The subjects were 43 consecutive patients who underwent PTA for symptomatic stenosis of MCA M1 segment between April 2013 and April 2018. The subjects were classified into those who with perforator-visualization group (P group) and no-perforator-visualization group (NP group) from stenosis in preprocedural 3-D RA, and the background factors and procedure contents, and clinical outcomes were compared retrospectively.



Results: In P group ($n = 15$) and NP group ($n = 28$), baseline median NIHSS was 2 and 1; M1 proximal stenosis 2/15(13/54%); M1 distal stenosis 13/13(87/46%); preprocedural perforator infarction 11/10(73/36%); preprocedural cortical infarction 6/15(40/50%); preprocedural median stenotic rate 75/76%, median stenotic length 5.3/4.1 mm; postprocedural median stenotic rate 46/49%; placement of intracranial stent 0/1(0/4%); postprocedural symptomatic perforator infarction 3/2(20/6.3%); mRS 0–2 at 3 month 12/24 (80/86%).

Conclusion: In P group, M1 distal stenosis and postprocedural symptomatic perforator infarction were high. Preprocedural 3-D RA is important to predict the risk of perforator infarction following PTA.
Keywords: PTA, Perforator infarction,3-D rotational angiography

O 070

AVOIDANCE OF PERFORATOR OCCLUSION DURING ENDOVASCULAR TREATMENT FOR THE SYMPTOMATIC INTRADURAL ARTERIAL STENOSIS WITH EVALUATION OF THE PLAQUE BY MAGNETIC RESONANCE WALL IMAGING

S Kim[1], M Ohtaki[1] and N Mikuni[2]
[1]Obihiro Kosei General Hospital, Obihiro, JAPAN
[2]Sapporo Medical University Hospital, Sapporo, JAPAN

Purpose: The rate of hemorrhagic and ischemic complication within thirty days led to unfavorable outcome in SAMMPRIS study. The key factor to let the endovascular treatment for the intradural arterial stenosis succeed is to avoid these complications. We postulated that we could evade a branch disorder during endovascular procedure by making a diagnosis of the localization of the plaque of the intradural artery by vessel wall imaging.
Materials and Methods: Thirty-seven consecutive cases that provided endovascular treatment for the symptomatic intracranial arterial stenotic lesion with more than 70% degree after 2013. We set an index for the evasion of perforator occlusion to confirm the distribution of the plaque of the intradural artery in vessel wall imaging by the three dimensional turbo spin echo method of the three tesla magnetic resonance imaging (Achieva 3.0T, Philips, Netherland).
Results: Balloon angioplasty were carried out for an average of 3.1 (median 3) times, and on an average of 21.9 (median 19) day after the onset. A stenosis degree improved 83% to 38%. No intraprocedural complication including vessel perforation, dissection and acute thrombosis was observed. Two ischemic events occurred within 30 days after the treatment. The mean observation period was 22.2 months, no any stroke event in that period.
Conclusion: With detailed imaging evaluation and avoidance for early intervention, as the principal objective for the endovascular treatment of intracranial arterial stenosis permitting remained stenosis by perioperative complication evasion and thorough medical management could be accepted as safe and effective intervention.
Keywords: Plaque Imaging, Middle Cerebral Artery, Perforator

O 071

TREATMENT OF INTRACRANIAL ATHEROSCLEROSIS DISEASE WITH DRUG-COATED BALLOON ANGIOPLASTY

A Wang[1] and CH Chang[2]
[1]Guangdong Provincial Hospital of Chinese Medicine, Guangzhou, CHINA
[2]Chang Gung Memorial Hospital, Taoyuan

Purpose: Intracranial atherosclerosis disease (ICAD) is a major cause of stroke. To prove the efficacy of any treatment, a low peri-procedural risk and a sustained treatment effect are crucial. Angioplasty for ICAD is safe, but a dauntingly high in-stent restenosis rate exists. Drug-coated balloon (DCB) angioplasty might reduce the chance of in-stent restenosis while maintaining the overall safety of the procedure.
Materials and Methods: The inclusion criteria included symptomatic patients with more than 50% intracranial artery stenosis. Intermediate catheters were distally located and the lesions were pre-dilated with conventional balloon and post-dilated with DCB. The primary end point was any stroke or death within 30 days and ipsilateral ischemic stroke afterward. The secondary end point was arterial restenosis of more than 50% during follow up.
Results: Fifty-one sessions of DCB angioplasty in 50 lesions were performed in 46 patients between October 2015 and April 2018 in a single center. All the DCBs can be navigated to the lesions and technique successful rate of 98% can be achieved. The average stenosis percentage of the lesions were: 71% +/- 9.8% before treatment, 31.8%+/−10.5% after treatment, and 25.8% +/- 19.2% at follow-up. Peri-procedural complications were noted in three patients (6.5%, 3/46). Four lesions had stenosis over 50% in the follow-up period (9.1%, 4/44) and one was retreated with DCB angioplasty.
Conclusion: In this study, the application of DCB in the treatment of ICAD patients was feasible and safe. The effect of treatment was durable and improved over time.
Keywords: Intracranial stenosis, Angioplasty, Drug-coated balloon

O 072

ENDOVASCULAR TREATMENT IN PATIENTS WITH LARGE ACUTE ISCHEMIC STROKE

YS Jeon[1], HG Roh[2], HJ Kim[3], JJ Park[4], YI Chun[1], JW Choi[2] and SB Lee[5]
[1]Department of Neurosurgery, Konkuk University Medical Center, Konkuk University School of Medicine, Seoul, SOUTH KOREA
[2]Department of Radiology, Konkuk University Medical Center, Konkuk University School of Medicine, Seoul, SOUTH KOREA
[3]Department of Radiology, Daejeon St. Mary Hospital, The Catholic University of Korea, Daejeon, SOUTH KOREA

[4]Department of Neurology, Konkuk University Medical Center, Konkuk University School of Medicine, Seoul, SOUTH KOREA
[5]Department of Neurology, Daejeon St. Mary Hospital, The Catholic University of Korea, Daejeon, SOUTH KOREA

Purpose: Whether to perform or not to perform endovascular treatment (EVT) for acute stroke patients with extensive infarction on the pre-treatment imaging is undetermined. The aim of this study is to evaluate the effect of EVT on clinical outcome in patients with a large acute ischemic stroke from successful recanalization.
Materials and Methods: From a prospectively maintained registry of acute ischemic stroke, we identified and retrospectively analyzed 26 patients (15 males, 70.5 ± 14.9 years) treated with EVT within 8 hours of symptom onset for large acute infarction (MR ASPECTS < 5) due to ICA and/or MCA occlusion between December 2015 and January 2019. We assessed baseline clinical and neuroimaging characteristics including risk factors, National Institutes of Health Stroke Scale (NIHSS) score, infarct size, multiphase CTA and/or MRA collateral status, parameters of endovascular treatment, follow-up imaging, and clinical outcome. Successful recanalization was defined as a modified Thrombolysis in Cerebral Infarction (mTICI) score 2b-3. The Modified Rankin Scale Score (mRS) 0, 1 and 2 at 3 months were defined as good outcome.
Results: Overall, median infarct volume of the initial diffusion-weighted imaging (DWI) was 90 mL (interquartile range 67–128 mL). All patients had poor or intermediate collaterals. Successful recanalization was achieved in 18 (69.2%) patients, and a good outcome was observed in 6 (23.1%) patients, whilst only one patient (3.8%) died at 3 months. Hemorrhagic transformation (parenchymal hematoma type 1 or 2) was detected in 3 (11.5%) patients, and decompressive surgery due to severe brain swelling was needed in 4 (15.3%) patients. Younger age and earlier reperfusion were associated with good outcome, and all patients with poor collaterals on multiphase CTA or mTICI < 2b recanalization had poor outcome.
Conclusion: Small but non-negligible number of patients with a large acute ischemic stroke can benefit from EVT, and earlier reperfusion and younger age were associated with a good outcome.
Keywords: Stroke, Endovascular treatment, Diffusion weighted imaging

O 073

EFFICACY AND SAFETY OF ENDOVASCULAR THROMBECTOMY FOR SELECTED PATIENTS WITH LARGE VESSELS OCCLUSION BEYOND 6 HOURS AFTER STROKE

M Morimoto[1], M Iwasaki[1], H Yamazaki[1], C Hikita[1], Y Inaka[1], S Fukuta[1] and H Satow[1]
[1]Yokohama Shintoshi Neurosurgical Hospital, Yokohama, JAPAN

Purpose: The efficacy and safety of mechanical thrombectomy for acute large vessel occlusion (LVO) stroke within 6 hours after onset have been demonstrated by several randomized trials. Recently, DAWN trial has supported the benefit of the therapy in patients presented beyond the 6-hour time window with anterior circulation LVO. We retrospectively analyzed the effect of the therapy for patients with a mismatch between deficit and infarct within 6–24 hours from onset in our single center.
Materials and Methods: Of the 152 cases with acute mechanical thrombectomy at our institution between Jan 2017 and Dec 2018, we examined 32 cases with anterior circulation LVO that were treated 6–24 hours from onset. They underwent clinical assessment (NIHSS score) and imaging evaluation (DWI-ASPECT) where all cases showed mismatch between the severity of clinical deficit and infarct volume. Endovascular treatment involves aspiration, use of a retrievable stent, or both methods.
Results: The mean age of the 32 patients was 74.2 years old. 16 patients (50.0%) were male. The mean NIHSS score before operation was 16.1 (range: 5 to 30). The mean DWI-ASPECTS was 7.0 (range: 2 to 10). Good reperfusion (TICI score, 2B or 3) was achieved in 29 cases (90.6%). Post-operation intracranial hemorrhage on CT was found in 10 cases (31.3%), of which 1 was associated with symptoms. The mean NIHSS score after operation was 12.1 (range: 0 to 30), and improvement of NIHSS score was found in 25 (78.1%) cases. Scores on the mRS at 90 days were as follows: 0–2 (15 cases)<46.9%>, 3–5 (11 cases), and 6 (6 cases).
Conclusion: Evaluation of clinical symptoms (NIHSS score) and volume of core infarction (DWI-ASPECT score) before operation to exclude high-risk cases when applying mechanical thrombectomy for LVO beyond 6 hours after onset may improve clinical outcomes.
Keywords: endovasular thrombectomy, beyond 6 hours, large vessels occlusion

O 074

6 TO 24 HOURS ENDOVASCULAR THROMBECTOMY FOR LARGE INTRACRANIAL VESSEL OCCLUSION WITHOUT PERFUSION CT PATIENT SELECTION: SINGLE CENTER EXPERIENCE

A Alexandre[1], F Giubbolini[1], I Valente[1], E Lozupone[1], F D'argento[1], C Colosimo[1] and A Pedicelli[1]
[1]Fondazione Policlinico Universitario A. Gemelli IRCCS, Roma, Italia. UOC Radiologia e Neuroradiologia, Roma, ITALY

Purpose: The effect of endovascular thrombectomy that is performed more than 6 hours after the onset of ischemic stroke has recently been shown by DAWN and DEFUSE-3 trial, and further validated by other studies. In these trials strict criteria were employed for patient selection, including perfusion CT.

We performed a retrospective single center evaluation of patient treated 6 to 24 hours after stroke onset without perfusion CT selection.

Materials and Methods: A retrospective single center evaluation of patient treated 6 to 24 hours after stroke onset in the period ranging from March 2016 to January 2019. On a total of 212 patients who received endovascular trombectomy for a major intracranial vessel occlusion, we identified 55 patient who has been treated 6 to 24 hours after stroke onset. Patient has been selected on the basis of clinical and radiological criterias, including non contrast CT, multiphase CT angiography.

Co-primary end points were the rate of functional independence (0, 1, or 2 on the mRS) at 90 days, and post-treatment symptomatic intracranial hemorrhage according to ECASS II criteria.

Secondary end points were an early therapeutic response (defined as a decrease in the NIHSS score of >/= 10 from baseline or an NIHSS score of 0 or 1 on day 5, 6, or 7 of hospitalization or at discharge if it occurred before day 5), successful recanalization (which was defined as a grade of 2b or 3 on the mTICI scale on postprocedural conventional angiography).

The safety end points were endovascular thrombectomy related complications and stroke-related death at 90 days.

Results: Out of 55 patient, 25 (45,4%) were functional indipendent at 90 days (mRS 0–2), of these 9 were mRS 0, 9 were mRS 1, and 7 were mRS 2; while the rate of symptomatic intracranial hemorrhage was 4 out 55 (7%), of which 1 was a parenchymal haematoma type 2, and 3 a parenchymal haematoma type 1.

Early therapeutic response was achieved in 22 patients out of 55 (40%).

Successful recanalization (TICI score 2b or 3) was achieved in 44 patients out of 55 (80%).

Stroke related mortality at 90 days was 6 on 55 (10%).

Conclusion: Our data confirm that endovascular thrombectomy for a large intracranial vessel occlusion in later time window (6 to 24 hours) is safe and effective, even without CT-perfusion patient selection.

A larger population of patients can potentially benefit from endovascular thrombectomy, even without applying strict selection criterias, compared to DWAN and DEFUSE-3 trials.

Keywords: thrombectomy,6–24 hours stroke, stroke after 6 hours

O 075

CLINICAL OUTCOME AFTER THROMBECTOMY IN PATIENTS WITH PRE-STROKE MODIFIED RANKIN SCALE >1

K Oda[1], T Kojima[2], N Sato[3], M Oinuma[4], K Horiuchi[4], T Ichikawa[5], T Maeda[6], T Oikawa[1] and K Saito[2]

[1]Minamisoma Municipal General Hospital, Minamisoma, JAPAN

[2]Fukushima Medical University, Fukushima, JAPAN

[3]Masu Memorial Hospital, Nihonmatsu, JAPAN

[4]Southern TOHOKU General Hospital, Koriyama, JAPAN

[5]Japanese Red Cross Society Fukushima Hospital, Fukushima, JAPAN

[6]Ohta-Nishinouchi Hospital, Koriyama, JAPAN

Purpose: The American heart association / American stroke association recommend that patients with pre-stroke modified Rankin scale (mRS) 0–1 should receive mechanical thrombectomy (MT). Nevertheless, many stroke teams regularly perform MT in patients with pre-stroke mRS > 1 to preserve patients' activities of daily living (ADL).

Therefore, we analyzed the clinical outcome of patients with pre-stroke mRS > 1 underwent MT.

Materials and Methods: Between January 2016 and December 2018, 241 patients had MTs in Fukushima Medical University and its affiliated hospitals. We evaluated the patients' demographic and clinical background, treatment technique, clinical outcome, and prognosis in two groups: independent group (pre-stroke mRS 0–1), and dependent group (pre-stroke mRS 2–5).

Results: Of the 241 cases who underwent MT, 189 cases were of the independent group and 52 cases were of the dependent group. Dependent group characterized by more old patients, more females, more cases with a history of stroke, and more patients on warfarin. The t-PA was administered less frequently in the dependent group. Time from onset to door, door to picture, picture to puncture and puncture to reperfusion were similar in both groups. Thrombolysis in cerebral infarction (TICI) 2b-3 was similarly achieved in both groups (84.6% of independent group versus 71.2% of dependent group). Ninety-days mRS 0–2 rate was significantly lower in the dependent group (33.3% versus 11.5%, p = 0.016), but in 30.8% of the dependent group, the mRS at 90-days didn't show significant deterioration.

Conclusion: In the dependent group, it was difficult to achieve mRS 0–2 at 90-days after stroke onset. Nevertheless, the rate of unchanged mRS in dependent group was similar to the rate of mRS 0–2 at 90-days in the independent group. In conclusion, MT is a therapeutic option to preserve patient's ADL even if pre-stroke mRS was 2–5.

Keywords: acute ischemic stroke, mechanical thrombectomy, pre-stroke mRS 2–5

O 076

EARLY VENOUS DRAINAGE SIGN AFTER MECHANICAL THROMBECTOMY IN ISCHEMIC STROKE PREDICTS HEMORRHAGIC TRANSFORMATION

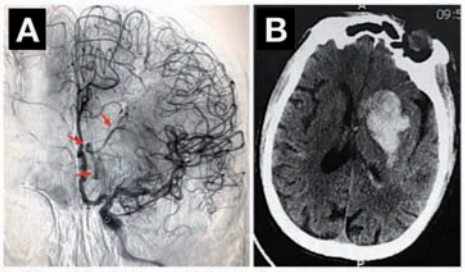
P Gao[1], G Li[1], J Chen[1], L Jiao[1] and H Zhang[1]

[1]Department of Neurosurgery, Xuanwu Hospital of Capital Medical University, Beijing, CHINA

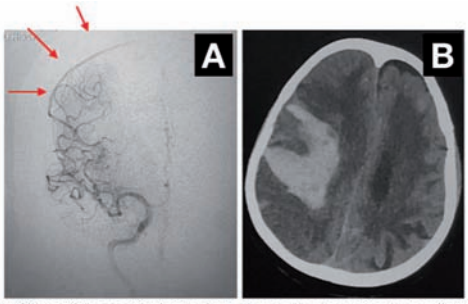
Purpose: The angiographic findings in cerebral infarction has been previously divided as initial dilatation, precapillary arteriovenous shunts (or early venous drainage, EVD) and mass effect. There are two types of EVD: early filling of the thalamo-striate vein from the lenticulo-striate arteries and that of the cortical vein from the cortical arteries. The purpose of this study is to determine whether EVD immediately following intra-arterial mechanical thrombectomy (MT) is associated with post-MT hemorrhagic transformation among patient with acute occlusion of intracranial large vessels.

Patient characteristics, stratified by presence of EVD

	EVD (n=12)	no EVD (n=33)	p value
Age (mean, years)	60	60.5	0.82
Male (%, n)	75% (9)	79% (26)	0.89
NIHSS (median)	13	12	0.27
ASPECT (median)	9	9	0.09
Onset-to-treatment (min, median)	260	380	0.67
IV-tPA use (%, n)	50.0% (6)	48.4% (16)	0.93
AF (%, n)	41.7% (5)	36.4% (12)	0.98
ICAD (%, n)	8.3% (1)	39.4% (13)	0.1
Others (%, n)	50.0% (6)	24.2% (8)	0.2
TICI			
<2b	0% (0)	9.1% (3)	
≥2b	100% (12)	90.9% (30)	0.55
Hemorrhagic transformation (%, n)	66.7% (8)	24.2% (8)	0.02
90-day mortality (%, n)	16.7% (2)	3.0% (1)	0.17



A: early filling of the thalamo-striate vein from the lenticulo-striate arteries immediately after reperfusion (red arrow); B, CT showed hemorrhagic transformation in the basal ganglia after mechanical thrombectomy, which is corresponding to the early filling of the thalamo-striate vein.



A: early filling of the cortical vein from the cortical arteries immediately after reperfusion (red arrow); B, CT showed hemorrhagic transformation in the right fronto-parietal lobe after mechanical thrombectomy, which is corresponding to the early filling of the cortical vein.

Materials and Methods: We retrospectively evaluated patients with acute occlusion of the proximal anterior circulation who underwent MT with stent-retriever devices of the M1 and internal carotid artery from Jan 2018 to Jan 2019 in our center. EVD was noted as present or absent, deep (thalamo-striate vein) or superficial (cortical vein) on angiography after recanalization. The primary outcome was the presence of hemorrhagic transformation, which was defined as hyper-densities on simulated images of virtual non-contrast (VNC) on dual-energy computed tomography (DE-CT) after MT (within 24 hours). An independent neuroradiology investigator (Liqun Jiao), who was blinded to the angiography results, assessed the CT results.

Results: Two patients were excluded due to subarachnoid hemorrhage caused by wire perforation. Among the remaining 45 eligible patients, 12 (26.7%, 12/45) presented with EVD (1 had cortical EVD, 10 had thalamo-striate EVD, and 1 had both); whereas 16 (35.5%, 16/45) developed hemorrhagic transformation with 3 in the parenchyma and 13 in the basal ganglia. The demographic and variables were comparable between patients with EVD and those without EVD (Figure 1). In adjusted analysis, patients with EVD sign had higher rates of hemorrhagic transformation (66.7% vs 24.2%, $P = 0.02$) and higher rates of 90-day mortality (16.7% vs. 3.0%, Fisher's exact test, $P = 0.17$) than those without EVD sign. Sensitivity/specificity/positive predictive value were 50%/86%/75%, respectively, for the EVD sign to predict hemorrhagic transformation ($P = 0.022$).

Conclusion: Presence EVD after MT has a detrimental effect on outcome and is associated with the risk of hemorrhagic transformation following MT. EVD assessment may have a role in predicting prognosis among patients with MT.

Keywords: Early venous drainage sign, mechanical thrombectomy, hemorrhagic transformation

SESSION G: Stroke 3

O 077

ALTERNATIVE VASCULAR ACCESS IN ACUTE ISCHEMIC STROKE PATIENTS WITH FAILED/ IMPOSSIBLE FEMORAL ACCESS

R Abdalla[1], M Sukumaran[1], D Cantrell[1], B Jahromi[1], M Potts[1], A Shaibani[1], M Hurley[1] and S Ansari[1]
[1]Northwestern University, Chicago, USA

Purpose: Endovascular thrombectomy through femoral puncture is the standard of care for treatment of Acute ischemic stroke (AIS) secondary to large vessel occlusion. However, challenging anatomy could result in failure to access the target vessel and subsequently failure of recanalization. Aim of our study is to evaluate safety and efficacy of Carotid/brachial access as alternative to femoral approach in anterior/ posterior circulation strokes secondary to large vessel occlusion.

Materials and Methods: A retrospective analysis of all AIS patients treated with endovascular thrombectomy between Jan 2015 and December 2018. We identified patients group requiring alternative vascular approach to the standard femoral access for catheterizing occluded artery. We compared baseline characteristics and outcomes between alternative- and femoral- approach groups. Access specific complications in alternative group were documented. A statistical analysis was conducted between both groups using Fisher exact and Mann Whitney for categorical and continuous variables respectively.

Results: We identified 7 out of 253 (2.8%) patients of whom alternative vascular access was performed. 6/229 (2.6%) anterior circulation/carotid puncture and 1/24 (4.2%) posterior circulation/brachial puncture patients. All alternative approach procedures were rescue treatments to except for 1 patient treated primarily with direct carotid puncture.
Patients in the alternative access group were significantly older (Median age: 87 vs 70; $p = 0.0001$). No significant difference in median NIHSS (13 vs 16; $p = 0.121$), CT ASPECTS, or IV tPA utilization between both groups.
Median groin to revascularization time was significantly higher in the alternative access group (85 min vs 49 min; $p = 0.002$), however, no significant difference in onset to revascularization time between both groups. Median time between groin to alternative access was 50 minutes (32 min–128 min).
Successful recanalization (TICI 2b/3) was achieved in 100% vs 90% for the alternative vs femoral group with complete recanalization (TICI 2c/3) achieved in 57.1% vs 47.7%, respectively. There was a trend toward better outcome in the femoral group patients (20% vs 51.8%; $p = 0.205$). No significant difference in Symptomatic intracranial hemorrhage or mortality between both groups. Alternative group had significantly higher risk of previous strokes/TIA (71.4% vs 22.4%; $p = 0.009$).
Three patients had post-procedure neck hematoma, one was self-limiting and 2 developed a pseudo aneurysms that were treated by ultrasound guided compression and watchful waiting.
Conclusion: Alternative vascular access in AIS is safe and effective in patients with failed femoral access or where femoral vascular access is deemed not possible from the start. Patients requiring alternative access were likely older in age with significant history of previous strokes or TIAs.
Keywords: Endovascular, Carotid puncture, Brachial

O 078

FLOATING AORTIC THROMBUS: A RARE CAUSE OF ACUTE ISCHEMIC STROKE NECESSITATING MODIFICATION OF ACCESS ROUTE FOR THROMBECTOMY

S Balci[1], A Arat[1], EM Arsava[2] and MA Topcuoglu[2]
[1]Hacettepe University Department of Radiology, Ankara, TURKEY
[2]Hacettepe University Department of Neurology, Ankara, TURKEY

Purpose: To evaluate technical aspects and procedural details of two patients with floating aortic thrombi and acute occlusion of middle cerebral artery (one left; one right) successfully treated by mechanical thrombectomy performed via right transbrachial access.
Materials and Methods: Both patients presented to our department with acute ischemic stroke and NIHSS scores of 17 and 16. They had floating aortic arch thrombi on neck – head computed tomography angiography imaging precluding safe transfemoral access due to risk of further iatrogenic embolization. Moreover both patients had lung malignancy causing hypercoagulopathy (paraneoplastic etiology, Trousseau's syndrome) as the probable underlying cause of both aortic thrombi and acute ischemic stroke. Mechanical thrombectomy in the setting of a floating aortic thrombus has been mentioned only once as part of general management of floating aortic thrombi in the whole body. To the best of our knowledge, it has never been described previously in the literature in the context of cerebral mechanical thrombectomy technique.
Results: Both patients tolerated the procedures well with TICI 2B scores and discharged 5 days after the procedure. By the time of discharge, NIHSS scores of first patient was 4, second patient was 5. Both had modified Rankin scores of 1 on first month follow-up, first patient had residual aphasia allowing almost complete communication.
Conclusion: The diagnosis of floating aortic thrombus bears clinical importance for it can modify the treatment approach in the context of acute ischemic stroke. A modified transbrachial approach allowed us to treat both patients without neurologic complications. The cross sectional imaging of acute stroke patients should include an evaluation of the aortic arch and should be scrutinized in detail especially in patients with possible hypercoagulable state. Flat panel computed tomography technology allowed us to obtain such an imaging study in the angiography suite.
Keywords: Mechanical thrombectomy, Transbrachial access, Protruding aortic thrombus

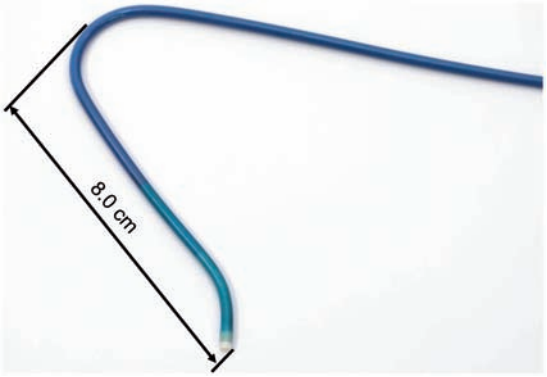
O 079

EFFECTIVENESS OF TRANSRADIAL NEUROENDOVASCULAR INTERVENTIONS FOR ANTERIOR CIRCULATION LESIONS AS THE FIRST-LINE VASCULAR ACCESS: ORIGINAL EXPERIENCE WITH A 6-FR SIMMONDS-TYPE GUIDING SHEATH

Y Hanaoka[1], J Koyama[2], D Yamazaki[1] and T Horiuchi[1]
[1]Department of Neurosurgery, Shinshu University School of Medicine, Matsumoto, JAPAN
[2]Neurointervention Center, Shinshu University Hospital, Matsumoto, JAPAN

Purpose: Transfemoral neurointervention can be problematic due to access site complications as well as technical difficulties related to peripheral vascular disease and/or anatomical variations of the aortic arch. The purpose of this study was to clarify the feasibility, safety, and effectiveness of transradial neuroendovascular intervention for anterior circulation lesions as the first-line vascular access with a novel guiding sheath specifically designed for transradial approach. To the best of our knowledge, our study shows the first report to perform transradial neuroendovascular

intervention for anterior circulation lesions as the first-line vascular access.



Materials and Methods: A total of consecutive 110 patients (carotid artery stenting: 64 patients, coil embolization of cerebral aneurysms: 46 patients) who underwent transradial neuroendovascular intervention, between September 2016 and January 2019, were included in this study. The guiding sheath has an inner diameter of 6-Fr (2.24 mm, 0.088 inch), and is 90 cm long with a soft distal part and a particular distal shape like a modified Simmonds catheter. The technique used to navigate the 6-Fr Simmonds-type guiding sheath into the target common carotid artery (CCA) varied according to three basic artery classifications: right, bovine left, and nonbovine left subgroups, and the morphology of the aortic arch. In the case of cerebral aneurysm coiling, a 6-Fr distal access catheter was additionally delivered into the internal carotid artery at the petrous portion. We retrospectively analyzed technical and procedural success, crossover to transfemoral approach, perioperative complications and radial access site complications.

Results: In all 110 patients (51 right CCA group, 6 bovine left CCA group, and 53 nonbovine left CCA group), a 6-Fr Simmons-type guiding sheath could be introduced into the target CCA without crossover to transfemoral approach, and provide a high stability during the procedure. Transradial neurointerventions were successfully achieved in all 110 patients. Moreover, there were no perioperative or puncture-site complications.

Conclusion: Transradial neuroendovascular intervention with a 6-Fr Simmonds-type guiding sheath is feasible, safe, and effective way for anterior circulation lesions. The preoperative assessment of the access route and the anatomical characteristics of the aortic arch are an indispensable prerequisite for favorable outcome.

Keywords: Transradial approach, Anterior circulation, Simmonds-type guiding sheath

O 080

THIS RANDOMIZED STUDY OF ENDOVASCULAR THERAPY WITH VERSUS WITHOUT INTRAVENOUS TISSUE PLASMINOGEN ACTIVATOR FOR ACUTE STROKE WITH ICA AND M1 OCCLUSION AIMS TO CLARIFY THE EFFICACY AND SAFETY OF DIRECT EVT COMPARED WITH BRIDGING THERAPY

Y Matsumaru[1], K Suzuki[2], M Takeuch[3], M Morimoto[4], R Kanazawa[5], Y Kamiya[6], K Shigeta[7], N Ishii[8], Y Takayama[9], Y Koguchi[10], A Hyodo[11], M Hayakawa[1], T Ota[12], S Okubo[13], H Naito[14], K Akaji[15], N Kato[16], M Inoue[17], T Hirano[18], K Miki[19], T Ueda[20] and K Kimura[2]

[1]Division of Stroke Prevention and Treatment, Department of Neurosurgery, Faculty of Medicine, University of Tsukuba, Ibaraki, JAPAN
[2]Department of Neurological Science, Nippon Medical School Hospital, Tokyo, JAPAN
[3]Department of Neurology, Seisho Hospital, Kanagawa, JAPAN
[4]Department of Neurosurgery, Yokohamashintoshi Neurosurgical Hospital, Kanagawa, JAPAN
[5]Department of Neurosurgery, Nagareyama Central Hospital, Chiba, JAPAN
[6]Department of Neurology, Showa University Koto Toyosu Hospital, Tokyo, JAPAN
[7]Department of Neurosurgery, National Hospital Organization Disaster Medical Center, Tokyo, JAPAN
[8]Department of Neurosurgery, New Tokyo Hospital, Chiba, JAPAN
[9]Department of Neurosurgery, Akiyama Neurosurgical Hospital, Kanagawa, JAPAN
[10]Department of Neurology and Neurosurgery, Chiba Emergency Medical Center, Chiba, JAPAN
[11]Department of Neurosurgery, Dokkyo Medical University Koshigaya Hospital, Saitama, JAPAN
[12]Department of Neurosurgery, Tokyo Metropolitan Tama Medical Center, Tokyo, JAPAN
[13]Department of Cerebrovascular Medicine, NTT Medical Center Tokyo, Tokyo, JAPAN
[14]Department of Neurosurgery, Funabashi Municipal Medical Center, Chiba, JAPAN
[15]Department of Neurosurgery, Mihara Memorial Hospita, Gunma, JAPAN
[16]Department of Neurosurgery, Mito Medical Center, Ibaraki, JAPAN
[17]Department of Neurosurgery, National Center For Global Health and Medicine, Tokyo, JAPAN
[18]Department of Stroke and Cerebrovascular Medicine, Kyorin University Faculty of Medicin, Tokyo, JAPAN
[19]Department of Endovascular Surgery, Tokyo Medical And Dental University, Tokyo, JAPAN
[20]Department of Stroke, St. Marianna University Toyoko Stroke Center, Kanagawa, JAPAN

Purpose: This randomized study of endovascular therapy with versus without intravenous tissue plasminogen

activator for acute stroke with ICA and M1 occlusion aims to clarify the efficacy and safety of direct EVT compared with bridging therapy.

Materials and Methods: This is an investigator-initiated, multicenter, prospective, randomized, open-treatment, blinded-endpoint clinical trial. The target patient number is 200, comprising 100 patients receiving direct EVT and 100 receiving bridging therapy. Randomization is performed within 4 hours after symptom onset. EVT can use several devices without restrictions. Patients randomized to the bridging therapy group receive IVT preceding EVT. Intravenous recombinant tissue plasminogen activator (rt-PA) is 0.6 mg/kg body weight up to a maximum of 60 mg, 10% as bolus, and 90% as continuous infusion over 1 h according to the Japanese guidelines. EVT has to be initiated as soon as possible, within 90 min from hospital admission. Trained neurologists or neurosurgeons will perform clinical assessment at baseline, at 24 h (±8 h), at 72 h (±8 h), at hospital discharge, and at 90 days after stroke onset. Neurological severity is evaluated using the National Institutes of Health Stroke Scale (NIHSS). At 90 days, a physician or clinical research coordinator who is blinded to treatment assignment assesses modified Rankin Scale (mRS) and adverse events by telephone interview. The primary efficacy endpoint is a modified Rankin Scale score of 0–2 at 90 days. Safety outcome measures are any intracranial hemorrhage at 12–36 hours.

Results: This study had started at January 2017 and is ongoing. 170 patients had been registered until April 2019.

Conclusion: This trial may help determine whether direct EVT should be recommended as a routine clinical strategy for ischemic stroke patients within 4.5 hours from onset. Direct EVT would then become the choice of therapy in stroke centers with endovascular facilities depending on the results of this study.

Keywords: Thrombectomy, large vessel occlusion, direct endovascular therapy

O 081

PRIOR ANTIPLATELET USE IN PATIENTS UNDERGOING ENDOVASCULAR TREATMENT FOR ACUTE ISCHEMIC STROKE: RESULTS FROM THE MR CLEAN REGISTRY

R Van De Graaf[1], SM Zinkstok[2], V Chalos[1], RB Goldhoorn[3], CBLM Majoie[4], RJ Van Oostenbrugge[3], A Van Der Lugt[1], DWJ Dippel[1], YBWEM Roos[4], ACGM Van Es[1] and B Roozenbeek[1]

[1]Erasmus MC University Medical Center, Rotterdam, THE NETHERLANDS

[2]Onze Lieve Vrouwe Gasthuis, Amsterdam, THE NETHERLANDS

[3]Cadiovascular Research Institute Maastricht, Maastricht University Medical Center, Maastricht, THE NETHERLANDS

[4]Amsterdam UMC, Location AMC, Amsterdam, THE NETHERLANDS

Purpose: Antiplatelet agents may improve functional outcome after endovascular treatment (EVT) for ischemic stroke, despite the potentially increased risk of symptomatic intracranial hemorrhage (sICH). A large proportion of patients are on antiplatelets prior to occurrence of stroke, which risks and benefits have not been addressed in large cohorts. We aimed to compare outcomes of patients undergoing EVT in patients with and without prior antiplatelet use.

Materials and Methods: We analyzed patients registered in the MR CLEAN Registry between March 2014 and June 2016, for whom data on antiplatelet use was available. We used multivariable regression analyses to compare prior to no prior antiplatelet use, adjusted for baseline prognostic factors. Primary outcome was symptomatic intracranial hemorrhage (sICH). Secondary outcomes were 90-day functional outcome (modified Rankin Scale), successful recanalization (extended-thrombolysis-in-cerebral-infarction >/= 2B) and 90-day mortality.

Results: 1469 Patients were analyzed, of which 493 (34%) patients were on prior antiplatelets. The risk of sICH was increased for patients on prior antiplatelets (9% vs. 4%; adjusted odds ratio (aOR) 2.05, 95%confidence interval (CI) 1.17–3.58). No significant associations were found between prior antiplatelet use and functional outcome (adjusted common OR 0.89, 95%CI 0.68–1.17), successful recanalization (aOR 0.96, 95%CI 0.71–1.29), or mortality (aOR 1.21, 95%CI 0.82–1.77).

Conclusion: Although prior antiplatelet use seems to increase the risk of sICH after EVT, no effect on functional outcome, recanalization or mortality was observed. However, these results might be hampered by residual confounding.

Keywords: Antiplatelet, prior use, endovascular treatment

O 082

HOW SAFE AND USEFUL IS SELECTIVE INTRA-ARTERIAL ADMINISTRATION OF UROKINASE IN MECHANICAL THROMBECTOMY ERA?

N Mandruzzato[1], R Augelli[1], A Agnello[1], M Plebani[1], P Zampieri[1], A Grazioli[1], G Ricciardi[1] and E Ciceri[1]

[1]Neuroradiology, Azienda Ospedaliera Universitaria Integrata Verona, Verona, ITALY

Purpose: There is no certainty about the optimal approach for acute ischemic stroke patients after failure or partial success of the mechanical thrombectomy (MT), carried out by thrombo-aspiration (TA) or ''Stent-retriever based thrombectomy'' (STR) or both of them, particularly in case of previous intravenous administration of recombinant tissue plasminogen activator (rt-PA),

We report our experience in evaluating safety and feasibility of intra-arterial super selective administration of urokinase (UK) in patients treated for acute intracranial stroke with

mechanical thrombectomy, alone or after rt-PA intravenous administration.

Materials and Methods: We reviewed our series on consecutive acute ischemic stroke patients treated during a 2-year interval (2016–2018), with or without UK, also after 0.9 mg/kg IV rt-PA, was reviewed.

As safety indicators, primary endpoint was evaluation of symptomatic intracranial hemorrhage and mortality rate compared with those observed in our center in Patients who underwent to MT without UK administration. As useful indicators, secondary endpoint was analysis of recanalization rate and improvement of TICI score. These data were analyzed also considering timing from stroke onset, ASPECT score, NIHSS and mRS (modified Ranking Scale) pre- and post-stroke.

Data will be analyzed utilizing multivariate analysis with logistic regression, controlling for confounding factors to investigate association and obtain ORs with 95% CIs. A P value of less than 0.05 will be used to determine statistical significance.

Results: Over a total number of 176 MT procedures for acute ischemic stroke patients, 29 patients (16,4%) received UK administration during the procedures, 17 of them (58%) already treated with intravenous administration of rt-PA. The UK dosage administration ranged between 100.000 and 1.000.000 UI for case.

Our preliminary results suggest that there is not higher incidence of symptomatic intracranial hemorrhage and mortality in the patients treated with UK; even if they were treated with intravenous administration of rt-PA.

Conclusion: Our data even if very limited, support the idea that, in patients with persisting occlusion of LVO or distal vessels, UK administration appears to be safe also after IV rt-PA. More cases are needed in order to validate the data presented.

Keywords: Mechanical Thrombectomy, Urokinase, Intracranical hemorrhage

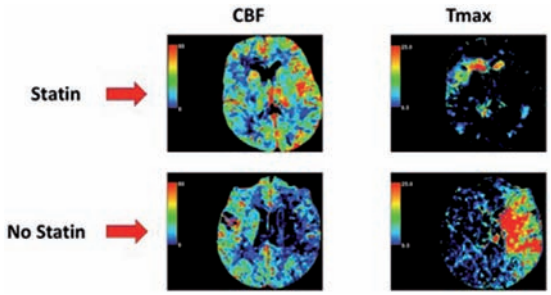
O 083

PRE-MORBID STATIN TREATMENT AFFECTS NEUROIMAGING FINDINGS IN ACUTE ISCHEMIC STROKE PATIENTS

F Di Giuliano[1], F Sallustio[1], E Picchi[1], S Minosse[1], A Mascolo[1], F Marrama[1], G Koch[1], F Alamseged[1], F De Crescenzo[1], V Da Ros[1], D Morosetti[1], F Garaci[1], M Diomedi[1] and R Floris[1]

[1]Università Policlinico Tor Vergata, Roma, ITALY

Purpose: statins seem beneficial in acute ischemic stroke patients. We aimed to evaluate the association between pre-morbid statin treatment and neuroimaging findings in acute ischemic stroke patients



Materials and Methods: a retrospective analysis of patients with acute stroke secondary to large vessel occlusion of anterior circulation evaluated by means of CT, CT-angiography (CTA) and CT perfusion (CTP) before endovascular treatment was performed. Patients with premorbid statin treatment were matched by age, gender and vascular risk factors with those without statin treatment.

Results: among 430 patients 52 on statin and 55 not on statin evaluated by means of CT and CTA were matched each other. CTA ASPECTS and clot burden score was significantly higher in statin group (median 8, IQR:7-10 vs 7, IQR:5-8; $p < 0.001$; 7, IQR:6-8 vs 6, IQR: 4–7; $p = 0.01$, respectively). No difference were found in the rate of good collateral flow. Subgroup analysis of CTP (29 patients on statin vs 32 patients without statin) showed significant smaller volume in the statin group in all perfusion maps except for Tmax,v16-25 s. 24 hours CT ASPECTS was significantly higher in the statin group (median: 8, range 4.25–9 vs median 6, range 4–7; $p = 0.01$). Onset NIHSS was significantly lower in statin group (14 ± 6.1 vs 16 ± 4.5; $p = 0.04$). No difference were found in 3-month functional independence, any intracranial bleeding and mortality.

Conclusion: pre-morbid statin treatment is associated with a favourable imaging condition before endovascular treatment of acute ischemic stroke in terms of ischemic lesion size, thrombus burden, ischemic core and ischemic penumbra volume.

Keywords: CT perfusion, endovascular treatment, statin

O 084

MECHANICAL THROMBECTOMY FOR ACUTE ISCHEMIC STROKE IN ANTICOAGULATED PATIENTS

T Kojima[1], N Sato[2], M Oinuma[3], K Horiuchi[3], T Ichikawa[4], K Oda[5], T Maeda[6] and K Saito[1]

[1]Fukushima Medical University, Fukushima, JAPAN
[2]Masu Memorial Hospital, Nihonmatsu, JAPAN
[3]Southern TOHOKU General Hospital, Koriyama, JAPAN
[4]Japanese Red Cross Society Fukushima Hospital, Fukushima, JAPAN
[5]Minamisoma Municipal General Hospital, Minamisoma, JAPAN
[6]Ohta-Nishinouchi Hospital, Koriyama, JAPAN

Purpose: The purpose of this study was to investigate the efficacy and safety of mechanical thrombectomy in anticoagulated patients at the time of stroke onset.
Materials and Methods: We analyzed a retrospective multicenter database of consecutive ischemic stroke patients treated with mechanical thrombectomy from January 2016 to December 2018. Patients taking oral anticoagulants were compared with non-anticoagulated patients. The modified Rankin Scale (mRS) score $<=2$ at 90 days and symptomatic intracranial hemorrhage (ICH) were compared between groups to evaluate treatment efficacy and safety.
Results: The study population comprised 241 patients, 63 patients were taking oral anticoagulants, and 178 patients were not anticoagulated. Intravenous thrombolysis had been performed in 35% and 58% of anticoagulated and non-anticoagulated patients, respectively. The anticoagulant group was older (82 vs 77, $P = 0.0101$), more in-hospital stroke onset (29 vs 11%, $P = 0.0007$) and less functional independence (79 vs 93%, $P = 0.0019$) compared with the non-anticoagulated group. There was no significant difference between groups for the rates of the mRS score $<=2$ at 90 days and symptomatic ICH. In the regression logistic analysis, anticoagulation status was not associated with mRS score $<=2$ at 90 days (OR 0.79, 95%CI 0.42 to 1.49; $P = 0.46$) and symptomatic ICH (OR 0.71, 95%CI 0.21 to 2.34; $P = 0.57$).
Conclusion: Mechanical thrombectomy appears to be effective and safe in anticoagulated patients with acute ischemic stroke.
Keywords: mechanical thrombectomy, acute ischemic stroke, anticoagulant

O 085

THE IMPACT OF NETS IN STROKE AND MYOCARDIAL INFARCTION

T Boeckh-Behrens[1], J Novotny[2], C Schulz[2], P Oberdieck[2], B Friedrich[1], H Poppert[3] and C Zimmer[1]
[1]Department of Neuroradiology, School of Medicine, Technical University Munich, Munich, GERMANY
[2]Medizinische Klinik und Poliklinik, Klinikum der Universität München, Ludwig-Maximilian-Universität, Munich, GERMANY
[3]Department of Neurology, School of Medicine, Technical University Munich, Munich, GERMANY

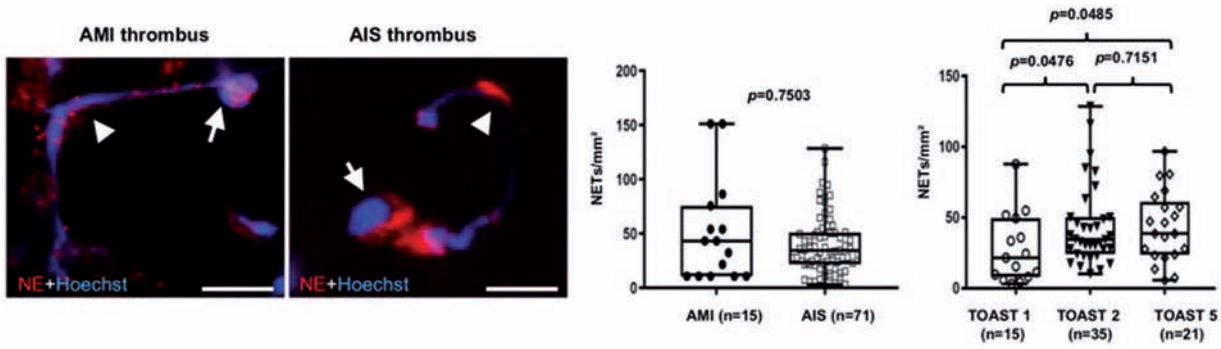
Purpose: Acute ischemic stroke (AIS) and acute myocardial infarction (AMI) are important manifestations of acute arterial occlusive diseases. In addition to platelets, leukocytes and in particular neutrophil extracellular traps (NETs) have recently been identified as important players in this condition promoting blood coagulation and platelet activation. Whether thrombus immune cell composition and NET content compares between AIS and AMI, and whether it associates with clinical outcome or mechanical properties in AIS is poorly understood.
Materials and Methods: Thrombi from AIS ($n = 71$) and AMI ($n = 72$) patients were retrieved during endovascular arterial recanalization and analyzed by immunohistology. Immune cell composition and NET content in arterial thrombi of AIS and AMI patients were quantified and associated with procedural and outcome parameters.
Results: Amounts of leukocytes ($p = 0.133$) and neutrophils ($p = 0.56$) were similar between AIS and AMI thrombi. Monocytes ($p = 0.0052$), eosinophils ($p < 0.0001$), B-cells ($p < 0.0001$) and T-cells ($p < 0.0001$) were more abundant in stroke compared to AMI thrombi. Neutrophil extracellular traps (NETs) were present in 100% of AIS and 20.8% of AMI patients. Their abundance in thrombi was associated with poor outcome scores in AIS patients and with reduced ejection fraction (EF) in AMI patients. Multivariate analysis suggests an impact on thrombus stability parameters like TICI and thrombus fragmentation.
Conclusion: In our detailed histological analysis of arterial thrombi, thrombus composition and especially abundance of leukocyte subsets differed between AIS and AMI patients. Presence and amount of NETs was associated with patients' outcome after AIS and AMI, supporting a critical impact of NETs on thrombus stability in both conditions.
Keywords: Stroke, Thrombus Histology, Myocardial Infarction

O 086

INVESTIGATING THE EFFECT OF PLATELET CONTRACTION ON THE MECHANICAL PROPERTIES AND MICROSTRUCTURE OF CLOT ANALOGUES WITH VARYING HEMATOCRIT

S Johnson[1], JY Chueh[3], MJ Gounis[3], M Gilvarry[2], R Mccarthy[2], JP Mcgarry[1] and PE Mchugh[1]
[1]Biomedical Engineering, National University of Ireland Galway, Galway, IRELAND
[2]Galway Neuro Technology Centre CERENOVUS, Galway, IRELAND
[3]New England Centre for Stroke Research, Department of Radiology, University of Massachusetts, Worcester, MA, USA

Purpose: Mechanical thrombectomy has recently been added to the standard of care for the treatment of AIS. Clinically relevant thrombus analogues provide an extremely useful tool in the pre-clinical testing of these devices, as the success of these procedures is significantly affected by the mechanical properties of the thrombus itself. Clot mechanical properties are influenced by clot composition, the arrangement of components within the clot and internal contractile forces caused by activated platelets, that cause the fibrin network to contract and reduce in volume. The aim of this study is to investigate what effect clot contraction has on the mechanical behaviour and microstructure of clot material.
Materials and Methods: Clot analogues were prepared from ovine blood, by mixing platelet-rich plasma (PRP) and



platelet-poor plasma (PPP) with red blood cells (RBCs) to form contracted and uncontracted clots with varying haematocrit. Clot weight was measured before and after contraction to determine the percentage contraction. Dynamic mechanical analysis (DMA) was performed at UMass, following the procedure by Chueh et al.(2011), to compare the mechanical behaviour of the clot analogues to previously tested human emboli.

Analogue samples were fixed in a 2.5% glutaraldehyde solution, dehydrated, frozen in liquid nitrogen and fractured, to examine the interior surface of the clots under SEM. Sections of the clot analogues were also fixed in formalin and embedded in a paraffin wax before staining with MSB

Results: Overall, the contracted clot analogues were found to be stiffer than non-contracted analogues, across all hematocrits. The contracted clot analogs were also found to fall within the range of behavior of the human red emboli. The extent of clot contraction was found to be haematocrit-dependent, with greater contraction observed in clots with a lower haematocrit.

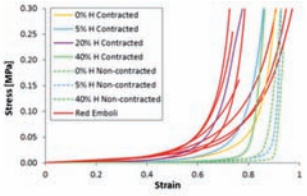


Figure 1. Stress vs Strain curve showing the results from the DMA testing, comparing non-contracted and platelet contracted clot analogues with human clot data previously published by Chueh et al. (2011).

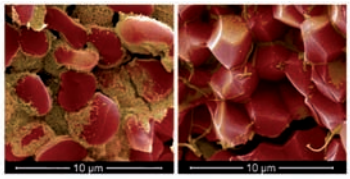


Figure 2. SEM images of non-contracted (left) and contracted clots (right) with a 40% hematocrit. Fibrin is in shown yellow and the RBCs in red.

The histological study determined that there was little difference in the fibrin and RBC content between the contracted and non-contracted groups at the same hematocrit levels. However, the microstructure of the two groups varied significantly. The SEM imaging showed that the non-contracted clots consisted of a loose fibrin mesh with biconcave-shaped RBCs throughout, whereas the contracted clots consisted of compressed fibrin structures, compacted around polyhedrocyte-shaped RBCs.

Conclusion: This study found that platelet contraction significantly effects the clot microstructure, and in turn clot stiffness. The significant difference in mechanical properties and microstructure but without an appreciable difference in histology, implies that histological studies of explanted human clots alone may not prove to be predictive of the mechanical behaviour of the clots in thrombectomy.

Keywords: Mechanical Characterisation, Clot Microstructure, Clot Contraction

O 087

AN IN-VITRO STUDY TO EXAMINE CHANGES IN CLOT PROPERTIES FROM EXPOSURE TO RECOMBINANT TISSUE PLASMINOGEN ACTIVATOR, AND PREDICT POSSIBLE IMPLICATIONS FOR MECHANICAL THROMBECTOMY IN STROKE

S Duffy[1], F Weafer[2], A Alone[3], E Rainsford[4] and R Mccarthy[1]

[1]Galway Neuro Technology Centre, Cerenovus, Galway, IRELAND

[2]College of Engineering and Informatics, National University of Ireland, Galway, IRELAND

[3]Haematology Laboratory, Pathology Department, Bon Secours hospital, Galway, IRELAND

[4]Galway Medical Technologies Centre, Galway Mayo Institute of Technology, Galway, IRELAND

Purpose: Recombinant tissue plasminogen activator (rt-PA) achieves successful recanalization in less than 60% of AIS patients with large vessel occlusions treated with the drug; clot size, location and composition are known factors that predict recanalization with rt-PA. Structural changes from rt-PA exposure may alter the clot's stability, having possible implications on clot deformation and fragmentation during mechanical thrombectomy.

In this study we aimed to:

a) Investigate the effect of clot composition on the lytic efficacy of rt-PA.
b) Examine changes in clot microstructure and mechanical properties exposed to rt-PA.

Materials and Methods: Six different types of clot analogues were prepared, each with a varying composition of red

blood cells (RBC) and fibrin. The clots were introduced to an in vitro glass model intended to replicate an M1 occlusion with circulating fresh plasma. A clinical dose of rt-PA (Actilyse, Boehringer Ingelheim) was administered, for a fixed period at 37°C. The lytic efficacy of the drug was determined by measuring the percentage mass loss of each clot at different time points. The microstructural gradient of the clots was examined using Scanning Electron Microscopy (SEM) and compared to baseline samples exposed to plasma only. Baseline plasma samples (before rt-PA was injected into the model) and plasma samples after rt-PA exposure were obtained for measurement of the D-Dimer concentration using an immunoturbidimetric method. Unconfined compression testing was performed on clots exposed to rt-PA and compared to those that were not exposed to the drug.

Results: Through measurement of the decrease in clot mass it was observed that rt-PA incurred significant thrombolysis of RBC rich clots, while fibrin rich clots were more resistant to thrombolysis. Under examination of the microstructure with SEM, distribution and location of fibrin fibre cleavage was observed to be affected by the composition of the clots. Measurement of the plasma D-Dimer concentrations confirmed that thrombolysis was occurring in all clot types, with the fibrin rich clots correlated with the highest D-Dimer concentration.

Conclusion: The observation that clot composition affects the resistance to rt-PA lysis may explain, in part the limited efficacy of the drug in some situations. Patterns of cleavage in the fibrin fibres of clots suggest that some clots are more permeable to rt-PA. This may affect clot deformation and fragmentation. On one hand these changes to the mechanical nature of the clots may make clots easier to retrieve but on the other hand it may increase the risk of distal embolization during thrombectomy.

Keywords: Thrombus composition, rt-PA, mechanical properties

O 088

INTERACTIVE CLOT ATLAS ENABLING INTUITIVE EXPLORATION AND COMPARISON OF THROMBUS COMPOSITION AND THE THROMBECTOMY PROCEDURE

S Duffy[1,2], J Thornton[3,4], M Farrell[5], E Maccarthy[2] and R Mccarthy[1]

[1]Cerenovus, Galway Neuro Technology Centre, Galway, IRELAND

[2]Galway Medical Technologies Centre, Galway Mayo Institute of Technology, Galway, IRELAND

[3]Interventional Neuroradiology Service, Department of Radiology, Beaumont Hospital, Dublin, IRELAND

[4]Royal College of Surgeons in Ireland, Dublin, IRELAND

[5]Neuropathology Department, Beaumont Hospital, Dublin, IRELAND

Purpose: In recent years, the explosion in the number of mechanical thrombectomies has led to an increasing number of researchers collecting and analysing thrombi from acute ischemic stroke (AIS) patients. Knowledge of the composition of the occluding thrombus may be used to improve procedural success through procedure refinement and device design improvements. Additionally, thrombus composition may be used to inform decisions in secondary treatment strategies. We histologically examined thrombi collected from each pass in 60 thrombectomy cases. This per-pass analysis of thrombus enables the granular exploration of the progression of the cases, where often the approach taken for each pass in a case and between cases can vary significantly. However, visualization and exploration of these data can be cumbersome, when the viewer may simultaneously want to see the population summary analysis as well as images of thrombi from single passes in a case. For this purpose, we created an interactive clot atlas to navigate these complex data.

Materials and Methods: Thrombus fragments from 60 patients were collected following thrombectomy; relevant clinical (occlusion location and length, suspected aetiology) and procedural data (rt-PA administration, time of device deployment, techniques applied, devices used) were recorded for each case. Thrombi retrieved in each pass were maintained as individual samples and processed histologically. The red blood cell, fibrin and white blood cell composition of the fragments retrieved in each pass were calculated. The statistical analysis and histological images were displayed in the form of an interactive clot atlas using Tableau data visualization software and MS PowerPoint.

Results: Thrombus fragments were retrieved in 106 out of 138 passes (77% of passes). In cases where more than 2 passes were required, a significant difference was observed in the RBC and fibrin composition of fragments retrieved in earlier versus later passes ($p = 0.001$). The study results can be navigated on an individual case-by-case basis and by means of clinical or procedural factors which include suspected aetiology, occlusion location, rt-PA administration, non-thrombus components, mTICI score and technique applied.

Conclusion: This novel interactive clot atlas tool serves as a useful way to display and communicate clinical, procedural and thrombus compositional data. Looking to the future when much larger studies than that reported here become available, this data visualization and exploration approach provides an easy-to-navigate resource for communicating studies on AIS thrombi.

Keywords: Thrombectomy, Clot atlas, Per-pass thrombus composition

O 089

ASSOCIATION BETWEEN ACUTE ISCHEMIC STROKE ETIOLOGY AND MACROSCOPIC ASPECT OF RETRIEVED CLOTS

A Sgreccia[1], Z Duchmann[2], JP Desilles[3], B Lapergue[4], J Labreuche[5], M Kyheng[5], R Bourcier[2] and A Consoli[4]
[1]Neuroradiology – Interventional Radiology, Fondazione IRCCS Policlinico San Matteo, Pavia, ITALY
[2]Department of Diagnostic and Interventional Neuroradiology, Hopital Guillaume et Rene Laennec, Nantes, FRANCE
[3]Laboratory of Vascular Translational Science INSERM U1148, Fondation Rothschild, Paris, FRANCE
[4]Department of Stroke Centre and Diagnostic and Interventional Neuroradiology, Foch Hospital, University of Versailles an, Suresnes, FRANCE
[5]Santé publique: épidémiologie et qualité des soins, F-59000, CHU Lille, University of Lille EA2694, Lille, FRANCE

Purpose: Only few case reports have considered the chromatic aspect of retrieved clots and the possible association with their underlying etiology. The aim of our study was to analyze the frequency of the TOAST ischemic stroke typical (atrial fibrillation, dissection, atheroma) and atypical (infective endocarditis, cancer-related, valve-related thrombi) etiologies depending on the chromatic aspect of retrieved clots.
Materials and Methods: Two-hundred and fifty-five anonymized and standardized clot photos of consecutive patients treated by mechanical thrombectomy for acute ischemic stroke were included. A double-blind evaluation was performed by two senior interventional neuroradiologists, who classified the visual aspects of the clots into two main patterns: red/black or white. Main patient characteristics, distribution of underlying stroke etiologies, and outcomes were compared between the two study groups.
Results: The inter-reader agreement for clot colors was excellent ($k = 0.78$). Two hundred and thirty-three patients were classified as having red/black clots and 22 as having white clots. A statistically significant association ($p = 0.001$) between atypical etiologies and white clots was observed.
Conclusion: White clots were significantly associated with atypical etiologies in this cohort, in particular, with infectious endocarditis.
Keywords: clot, etiology, thrombectomy

O 090

EFFICACY OF ADAPT TECHNIQUE IN ACUTE ISCHEMIC STROKE: CORRELATION WITH THROMBUS FEATURES

DG Romano[1], G Frauenfelder[2], E Visconti[1], A Pedicelli[3], E Lozupone[3], I Valente[3] and R Saponiero[1]
[1]AOU San Giovanni e Ruggi D'aragona, Salerno, Salerno, ITALY
[2]Università Campus Bio Medico di Roma, Roma, ITALY
[3]Policlinico A. Gemelli, Roma, Roma, ITALY

Purpose: ADAPT is an alternative technique as optimal first-line thrombectomy for large-vessel occlusion in acute ischemic stroke, still debated when compared to first-line stent retriever. To correlate thrombus characteristics with ADAPT efficacy in acute ischemic stroke.
Materials and Methods: A total of 71 acute ischemic stroke were retrospectively included and evaluated with CT. Presence or absence of hyperdense vessel sign was recorded and Hounsfield Unit (HU) was measured on cerebral thrombus before and after contrast injection. Thrombus length was also measured. Angiography was used to confirm large vessel occlusion and to perform recanalization (thromboaspiration and/or stent retriever). Thrombus material was histological analysed to differentiate red-blood-cell-dominant or fibrin-dominant composition. Multivariate analysis based on clinical (onset, NIHSS, time-to-puncture, vascular tortuosity, concomitant intravenous thrombolysis) and radiological (hyperdensity vessel sign, HU measurement, TICI, complications) data was made for evaluation of ADAPT efficacy.
Results: Hyperdense vessel sign was present in 62% of cases (44/71). ADAPT was started in 100% (71/71) of patients with large bore reperfusion devices and was completed with SOLITAIRE, EMBOTRAP or SOLUMBRA stent retriver in 14% (10/71). Hyperdense vessel sign with $HU > 66$ was related to red-blood-cell-dominant composition. Cardioembolic thrombi demonstrated higher fibrin-dominant portion and was related to hyperdense sign (75,6%). Successful recanalization ($TICI > 2a$) was obtained in 87% of ADAPT with a median of 1.3 aspiration attempts. Time-to-puncture, hyperdense vessel sign and concomitant intravenous thrombolysis were significative related to ADAPT efficacy ($TICI > 2a$).
Conclusion: Hyperdense vessel sign is related to thrombus composition. Time-to-puncture, hyperdense vessel sign and intravenous thrombolysis could predict ADAPT efficacy in acute stroke.
Keywords: acute ischemic stroke, tromboaspiration, thrombus

O 091

RADIATION EXPOSURE IN MODERN ENDOVASCULAR STROKE TREATMENT – DOSE REFERENCE LEVELS IN ANTERIOR CIRCULATION ISCHEMIC STROKE

C Weyland[1], F Hemmerich[1], MA Möhlenbruch[1], M Bendszus[1] and JAR Pfaff[1]
[1]Heidelberg University Hospital, Department of Neuroradiology, Heidelberg, GERMANY

Purpose: Radiation exposure of endovascular stroke treatment (EST) is of growing significance due to the worldwide establishment of EST. We investigated the radiation exposure as a function of maneuver count to establish dose reference levels (RL) for uncomplicated EST of the anterior circulation.
Materials and Methods: In this retrospective analysis of radiation exposure (as per dose area product (DAP) in μGy cm^2during the intervention) we included patients receiving endovascular stroke treatment for anterior circulation large vessel occlusion between April 2016 to April 2018 at a comprehensive stroke center equipped with biplane angiographic systems. DAP values were taken from the examination protocols automatically created by the angiographic systems. Due to the known relation between predictably high radiation exposure and complex procedures, we excluded patients who received stent- or ballonangioplasty of the carotid or middle cerebral artery and patients with intraprocedural complications. Furthermore ESTs of interventionalists with less than 25 procedures experience and peri-interventional flat-panel CT-scans (FPCT) where excluded from this analysis.
Results: Data from 356 patients (male: n = 149 (41.9 %), age: mean (SD): 74 (13), median NIHSS of 15 (10-20)) were analyzed. The time from stroke onset to groin puncture was in median 207 minutes (IQR: 140–286). Mostly the occlusion was located in M1- (n = 177 (49.7 %)) or M2-segments (n = 99 (27.8 %)) of the middle cerebral artery, followed by intracranial Carotid-T occlusions (n = 77 (21.6 %)). The rate of successful recanalization result (TICI 2b-3) was 87.4 %. For all analyzed cases the dose area product (DAP: median (IQR)) was 10752 (6852-15402) with a median fluoroscopy time of 26 minutes (IQR: 35–85) and a median of 2 (IQR: 1–3) thrombectomy maneuvers. Subdividing EST procedures as per maneuver count reveals a significant increase of radiation exposure between cases requiring only a single maneuver (DAP: 6846 (5102-9962)) as opposed to two maneuvers (DAP: 10724 (7853-15015); p-value: < 0.0001). Likewise, the radiation exposure is increased significantly by an additional third thrombetcomy maneuver (DAP: 13927 (10851–18454); p-value: 0.011).
Conclusion: As expected, radiation exposure during endovascular stroke treatment increases significantly with the maneuver count. With this analysis, for the first time, dose reference levels are at hand for uncomplicated interventions of the anterior circulation by maneuver count. Establishing dose reference levels for endovascular stroke treatment contributes in monitoring and may lead to a minimization of the radiation exposure's stochastic risk and helps avoiding deterministic risks for patients and interventionalists.
Keywords: mechanical thrombectomy, radiation exposure, dose reference levels

SESSION H: Stroke 4

O 092

IDENTIFYING THE PREDICTORS OF FIRST PASS EFFECT AND ITS INFLUENCE ON CLINICAL OUTCOME IN THE SETTING OF ENDOVASCULAR THROMBECTOMY FOR ACUTE ISCHEMIC STROKE: RESULTS FROM A MULTICENTRIC PROSPECTIVE REGISTRY

F Di Maria[1], M Kyheng[2], A Consoli[1], B Gory[4,5], R Fahed[3], S Richard[4,5], G Rodesch[1], J Girot[6], C Dargazanli[7], G Marnat[8], B Lapergue[9] and R Bourcier[6]
[1]Department of Diagnostic and Therapeutic Neuroradiology, Hôpital Foch University of Versailles Saint Quentin-en-Yveli, Suresnes, FRANCE
[2]University of Lille, CHU Lille, EA 2694- Santé publique: épidémiologie et qualité des soins, Lille, FRANCE
[3]Department of Interventional Neuroradiology Fondation Ophtalmologique A. De Rothschild, Paris, FRANCE
[4]Department of Diagnostic and Therapeutic Neuroradiology, University Hospital of Nancy, Nancy, FRANCE
[5]University of Lorraine, INSERM U1254, IADI, F-54000, Nancy, FRANCE
[6]Department of Radiology, University Hospital of Angers, Angers, FRANCE
[7]Department of Neuroradiology Guy de Chauliac University Hospital, Montpellier, FRANCE
[8]Department of Diagnostic and Interventional Neuroradiology, University Hospital of Bordeaux, Bordeaux, FRANCE
[9]Department of Neurology, Hôpital Foch, University of Versailles Saint Quentin-en-Yvelines, Suresnes, FRANCE

Purpose: The First Pass Effect (FPE), defined as a complete or near-complete recanalization after one pass (FPE) of a mechanical thrombectomy (MT) device, has been related to better clinical outcome than good recanalization after more than one pass in acute ischemic stroke. We searched for predictors of FPE by analysing the results within a large prospective multicentric registry (ETIS).
Materials and Methods: We included patients treated by MT for isolated anterior intracranial occlusions. All procedures were performed using either an aspiration catheter, a stent retriever or both. Number of passes, angiographic result after first pass and final procedural result were noted according to the mTICI grading system Angiographic data were reviewed to identify an FPE subgroup using the following three criteria: (1) single pass of the device, (2) near-

complete revascularization of the large vessel occlusion and its downstream territory (mTICI 2c/3), and (3) no use of rescue therapy. Clinical and angiographic outcomes were compared among FPE and non-FPE populations and noted.A multi-variate logistic regression analysis was carried out to search for predictors of FPE. We also analyzed the percentage of patients with 90-day modified Rankin Scale (mRS) score 0 to 2, excellent outcome (90-day mRs 0 to 1), 24-hour NIHSS change and 90-day all-cause mortality.

Results: Among the 1832 patients included, after a first pass of thrombectomy device, near to complete recanalization (mTICI 2c/3, defined as first pass effect) was achieved in 417 patients (22.8%; 95%CI, 20.9 to 24.8%). Clinical outcome at 90 days was significantly better in FPE patients (50.6% vs. 38.9% in patients without FPE), with a center-adjusted OR associated with FPE of 1.74 (95%CI, 1.24 to 1.77). Older age, a lower systolic blood pressure, an MCA-M1 occlusion, higher DWI-ASPECTS at admission, MT under local anesthesia and combined first-line device strategy were independent predictors of first pass effect.

Conclusion: In this study, a strategy combining thrombectomy and thrombo-aspiration was more effective than other strategies in achieving FPE. In addition, we confirm that clinical outcome was better in patients with FPE compared to non-FPE patients.

Keywords: Thrombectomy, First pass effect, outcome

O 093

ACUTE STROKE THROMBECTOMY USING A DIRECT ASPIRATION FIRST PASS TECHNIQUE (ADAPT): RESULTS IN 189 CONSECUTIVE ACUTE ISCHEMIC STROKE PATIENTS TREATED IN A SINGLE CENTER IN THE LAST SEVENTEEN MONTHS

F Taglialatela[1], S Isceri[1], C Barbara[1], A Zaniboni[2], G Procaccianti[3], L Cirillo[4], C Princiotta[4], A Zini[2] and L Simonetti[1]

[1]IRCCS Istituto delle Scienze Neurologiche di Bologna – Neuroradiology Unit Ospedale Maggiore, Bologna, ITALY
[2]IRCCS Istituto delle Scienze Neurologiche di Bologna – Neurology-Stroke Unit, Ospedale Maggiore, Bologna, ITALY
[3]former Neurology-Stroke Unit, Ospedale Maggiore, Bologna, ITALY
[4]IRCCS Istituto delle Scienze Neurologiche di Bologna – Neuroradiology Unit Ospedale Bellaria, Bologna, ITALY

Purpose: Aim of this study was to describe procedural aspects and clinical outcomes in a consecutive series of 189 patients in whom Mechanical Thrombectomy withThrombus Aspiration technique was performed as the first treatment modality. Other techniques (stentriever) were used only in case of failure of recanalization(Direct Aspiration first Pass technique, ADAPT).

Materials and Methods: A retrospective review of a prospectively acquired acute stroke intervention database was performed. ADAPT was carried out with a preference for the largest catheter considered to be trackable into the target occlusive lesion. A total of 189consecutive patients presenting in the last 17 months with acute ischemic stroke underwent intra-arterial therapy using the ADAPT technique. Procedural and clinical data were captured for analysis. Occlusion locations included the M1 (62%), M2 (10%), internal carotid artery terminus (10%) tandem occlusions (7%) and the vertebrobasilar artery (11%).

Results: The aspiration component of the ADAPT technique alone was successful in achieving TICI 2b or 3 revascularization in 80.3% of cases. The additional use of stent retrievers improved the TICI 2b/3 revascularization rate to 84.1%. The average time from groin puncture to at least TICI 2b recanalization was 42 min. A Sophia Plus 0.70 demonstrated similar success to a 5MAXACE 0.68 in achieving TICI 2b/3 revascularization. Patients presented with an admitting median National Institutes of Health Stroke Scale (NIHSS) score of 17.0 (6.0–21.0). Ninety day functional outcomes (modified Rankin Scale, mRS) is currently available in the 87% of the patients; it were 54.6% (modified Rankin Scale (mRS) 0–2) and 13.8% (mRS 6).

There were 1 procedural complications and 4.2% symptomatic intracerebral hemorrhages.

Conclusion: The ADAPT technique is a fast, safe, simple, and effective method that has facilitated our approach to acute ischemic stroke thrombectomy by utilizing the latest generation of large bore aspiration catheters to achieve previously unparalleled angiographic outcomes. The efficacy of the procedure for distal occlusions was somewhat inferior to those for proximal occlusions, which might be resolved by next generation devices.

Keywords: adapt, stroke, thrombus aspiration

O 094

MULTICENTER EXPERIENCE WITH THE PENUMBRA 3D REVASCULARIZATION DEVICE FOR MECHANICAL THROMBECTOMY IN ACUTE STROKE: SUBSET OF THE COMPLETE REGISTRY

O Zaidat[1], J Fifi[2], A Hassan[3], A Nanda[4] and A Doerfler[5]

[1]Mercy Health St. Vincent Medical Center, Toledo, USA
[2]Mount Sinai Hospital, New York, USA
[3]Valley Baptist Medical Center, Harlingen, USA
[4]SSM Health St. Clare Hospital, Fenton, USA
[5]Erlangen University Hospital, University Erlangen-Nuremberg, GERMANY

Purpose: To report safety and efficacy of the 3D Revascularization Device (3D) for mechanical thrombectomy in patients with acute ischemic stroke due to large vessel occlusions (LVO).

Materials and Methods: COMPLETE is a prospective, single-arm, multi-center observational registry which includes patients with intracranial LVO who had planned frontline endovascular thrombectomy with the Penumbra System (PS). The 3D, a component of the PS, is a self expanding

binary nitinol retrievable device that captures clot and facilitates removal under direct aspiration. This interim report details outcomes of patients in the COMPLETE registry who were treated with 3D. Successful revascularization (mTICI $>=$ 2b), time to revascularization, device and procedure related complications, good functional outcome (mRS 0–2) at 90 days, and all-cause mortality at 90 days were evaluated.

Results: One hundred and eight patients (mean age 67.2 $\pm$ 14.4; 53.7% female) were included in this analysis. The primary reperfusion catheters used with 3D were the Penumbra JET 7 (34.3%), ACE 68 (31.5%), and Penumbra JET D (15.7%). Baseline NIHSS (mean $\pm$ SD) was 15.2 $\pm$ 7.5. Median ASPECT Score was 9.0 (IQR, 8.0–10.0). Target vessel location was ICA (5.6%; 6/108), ICA-T (8.3%; 9/108), MCA M1 (58.3%; 63/108), MCA M2 (18.5%; 20/108), MCA M3 (1.9%; 2/108) and posterior circulation (7.4%; 8/108). Median time from onset to puncture was 330 (IQR 204–587) minutes. Mean time from puncture to reperfusion was 38.0 $\pm$ 27.3 minutes. The 3D device was used frontline in 86% (93/108) and as rescue in 14% (15/108) of cases. Overall, successful revascularization (mTICI $>=$ 2b) was achieved in 93% of cases. For 3D frontline cases, successful revascularization was achieved in 55.9% after first pass, and 93.5% post-procedure. For 3D rescue cases, post-procedure successful revascularization was achieved in 86.7% of cases. Procedure- and device- related SAE within 24 hours occurred in 7.4% (8/108) and 3.7% (4/108) of cases respectively. Symptomatic ICH occurred in 4.6% (5/108) of cases; of these, 2 were device-related. Other device-related SAEs included 1 intraprocedural (reversible) vasospasm and 1 progression of index stroke. There were no vessel perforation or embolization in new territories. All cause mortality at 90 days was 14.8% (16/108), and good functional outcome at 90 days (as yet available) was observed in 47.2% (25/53) of cases. Data collection for the COMPLETE registry is ongoing.

Conclusion: Mechanical thrombectomy with the 3D Revascularization Device under direct aspiration appears to be safe and effective, resulting in high rates of successful revascularization.

Keywords: Stroke,3D Revascularization Device, Thrombectomy

O 095

INITIAL MULTICENTER EXPERIENCE WITH A NEW GENERATION LARGE BORE CATHETER FOR ACUTE STROKE THROMBECTOMY

O Zaidat[1], J Fifi[2], B Woodward[3] and A Hassan[4]

[1]Mercy Health St. Vincent Medical Center, Toledo, USA
[2]Mount Sinai Hospital, New York, USA
[3]Fort Sanders Regional Medical Center, Knoxville, USA
[4]Valley Baptist Medical Center, Harlingen, USA

Purpose: To report initial real world experience using the Penumbra JET 7 (JET 7), a new generation larger bore reperfusion catheter, in patients with acute ischemic stroke due to large vessel occlusions (LVO).

Materials and Methods: COMPLETE is a prospective, single-arm, multi-center observational registry, including patients with intracranial LVO and planned frontline treatment with the Penumbra System (PS). We performed an interim comparison between frontline JET 7 (inner diameter 0.072 inches, recently launched in the United States) cases and frontline other-PS cases. Reported outcomes include revascularization success (mTICI $>=$2b), time to revascularization, device and procedure related complications, and good functional outcome (mRS 0–2) and all-cause mortality at 90 days.

Results: Seventy-eight JET 7 cases (mean age 67.8 $\pm$ 12.2; 55.8% female) and 143 other-PS (primarily ACE68 (58.7%)) cases (mean age 68.4 $\pm$ 14.7; 53.5% female) were included. Median ASPECTS was identical (9.0, IQR 8.0–10.0) between the groups. Median baseline NIHSS was 15.0 (IQR 8.0-19.0) with JET 7 and 14.0 (IQR 9.0-20.0) with other-PS. IV-tPA was administered in 34.6% of JET 7 cases and 56.6% of other-PS cases. Target vessel location (JET 7, other-PS) was ICA (10.3%, 5.6%), ICA-T (10.3%, 4.9%), MCA M1 (56.4%, 55.2%), MCA M2 (14.1%, 19.6%), MCA M3 (0%, 2.8%), ACA (0%, 2.1%), and posterior (9.0%, 9.8%). Mean puncture-to-reperfusion time was 29.0 $\pm$ 21.3 minutes with JET 7 and 34.9 $\pm$ 28.2 minutes with other-PS. Successful revascularization was achieved in 94.9% (74/78) of JET 7 cases, and 94.4% (135/143) of other-PS group. Device-related SAE within 24 hours occurred in 1.3% with JET 7 and 2.1% with other-PS. Procedure-related SAE within 24 hours occurred in 3.8% with JET 7 and 4.2% with other-PS. Occurrence of symptomatic ICH was 3.8% with JET 7 and 3.5% with other-PS. There was no embolization in new territories or vessel perforation in either cohort. One extracranial vessel dissection occurred in the JET 7 cohort (1.3%; reported as unrelated to JET 7) compared to none in the other-PS cohort. Good functional outcome at 90 days was observed in 54.3% (19/35) of JET 7 cases, and 57.8% (37/64) of other-PS cases. All cause mortality at 90 days was 12.8% (10/78) with JET 7 and 10.5% (15/143) with other-PS. Data collection is ongoing.

Conclusion: Aspiration thrombectomy with the new Penumbra JET 7 catheter may allow for faster procedure times and higher rates of successful revascularization as compared with other currently available thrombectomy devices.

Keywords: Stroke, Thrombectomy, Penumbra JET 7

O 096

EFFICACY OF ADAPT WITH LARGE-BORE REPERFUSION CATHETER IN ANTERIOR CIRCULATION ACUTE ISCHEMIC STROKE: A MULTICENTRIC EXPERIENCE

DG Romano[1], G Frauenfelder[2], A Pedicelli[3], E Lozupone[3], I Valente[3] and R Saponiero[1]

[1]AOU San Giovanni e Ruggi d'Aragona, Salerno, ITALY
[2]Università Campus Bio-Medico di Roma, Roma, ITALY
[3]Policlinico Universitario A. Gemelli, Roma, ITALY

Purpose: A Direct Aspiration, First Pass Technique (ADAPT) is an alternative technique as optimal first-line thrombectomy for large-vessel occlusion in acute ischemic stroke, still debated when compared to first-line stent retriever. To retrospectively evaluate technical and clinical outcome of the ADAPT as first line treatment for anterior circulation acute ischemic stroke with large-bore reperfusion catheters.
Materials and Methods: A multicentric data collection from 14 medical centers was retrospectively analyzed. Large-bore catheters had a distal diameter between 0.64in–0.71in; stent retriever was added when aspiration alone failed. Baseline characteristics, technical and clinical variables were collected, including NIHSS, Thrombolysis in Cerebral Infarction (TICI), periprocedural complications, 90-day mRS, and 90-day mortality.
Results: Overall, 501 patients were treated. No statistically significant difference in terms of baseline features or tPA administration was recorded between patients treated with ADAPT and with additional stent retriever. ADAPT alone was successful in achieving TICI 2b/3 in 71,8% with a median of 1.55 aspiration attempts. In terms of TICI 2b/3, ADAPT alone was better than additional stent retriever ($p < 0.001$), while no statistical difference was achieved from catheter diameter. Embolization to a new territory was less frequent in ADAPT group (5,2% vs 18%; $p = 0.0026$). Patients treated with ADAPT alone had better clinical outcomes in terms of mRS < 3 ($p < 0.001$).
Conclusion: ADAPT could be a valid technique with respect to the rates of TICI 2b/3 recanalization and 90-day mRS scores for acute ischemic stroke. In this series, an attempt at recanalization with ADAPT with larger-bore reperfusion catheter demonstrated to be preferable prior to stentriever thrombectomy.
Keywords: Angiography, Stroke, Thrombectomy

O 097

DISTAL INTRACRANIAL LARGE BORE CATHETER NAVIGATION WITHOUT MICROCATHETER OR MICROGUIDEWIRE – THE SOFIA INTERMEDIATE CATHETER SNAKE35 TECHNIQUE

M Colasurdo[1], JD Gabrieli[2], G Cester[2], D Simonato[3] and F Causin[2]

[1]Dipartimento di Neuroscienze, Imaging e Scienze Cliniche Università G. d'Annunzio, Chieti, ITALY
[2]U.O.C. Neuroradiologia, Azienda Ospedaliera Padova, Padova, ITALY
[3]Istituto di Radiologia, Università degli Studi di Padova, Padova, ITALY

Purpose: The Sofia (Soft torqueable catheter Optimized for Intracranial Access; MicroVention) is a catheter designed to enable distal intracranial access as close as needed to the site of occlusion. Sofia catheter navigation into the intracranial circulation without microcatheter or micro-guidewire (SNAKE) support has already been described in.
The purpose of our paper is to describe the highest successful series in navigating the Sofia 5Fr and 6Fr without microcatheter or micro-guidewire support in the distal intracranial circulation at the proximal site of occlusion with the assistance of a 0.035 guidewire described as SNAKE35 technique.

	Total procedures (n=76)		Successfull SNAKE35 (n=60)		Unsuccessfull SNAKE35 (n=16)	
	6Fr	5Fr	6Fr	5Fr	6Fr	5Fr
M1	45	7	38	4	7	3
M2	6	10	4	7	1	3
A2	1	/	1	/	/	/
Carotid Terminus	8	1	6	1	2	/

Materials and Methods: We retrospectively identified patients that underwent a Neurointerventional acute thrombectomy procedure between September 2017 and February 2019. We then excluded all patients that had a posterior circulation ischemic stroke and all procedures in which SOFIA catheters were not used. In the remaining 76 cases in which the SOFIA catheter was utilized size choice (5F or 6F) was at the neurointerventionalist discretion for each case. The Sofia 5Fr or 6Fr was navigated under continuous roadmap guidance and positioned in contact with the proximal end of the occlusion at the M1, M2, A1, A2 or distal ICA segments. All Sofia catheters' tips were preshaped with steam at a 90-degree angle or specific angles based on each patient's peculiar anatomy. The Sofia catheters were mounted with a 0.035 hydrophilic guidewire, that was used as a support inside the catheter locked with a torque device to avoid any minimal luminal exposure or contact with the endothelium – SNAKE35 technique. If further advancement of the catheter was needed a tri-axial system was setup with a 0.021 microcatheter and a microwire (0.014).
Results: Of the total seventy-six cases we successfully positioned the Sofia catheters at our target location facing the site of the occlusion in sixty cases (79%) solely using the SNAKE35 technique; 48 cases were successful with the Sofia

6F catheter and twelve cases were successful with the Sofia 5Fr catheter.
Of the remaining sixteen cases, distal navigation with the large bore catheter was achieved using a standard triaxial approach with the addition a microcatheter and a microguidewire in 13 cases, while in the remaining 3 cases the target occlusion was reached only with the microcatheter and the relevant mechanical thrombectomy device.
Conclusion: The Sofia non-wire advancement technique 35 (SNAKE35) is an effective and safe technique for Sofia navigation up to the site of intracranial occlusion.
Keywords: Stroke, Thrombectomy, Intracranial Navigation

O 098

A NOVEL SWIM TECHNIQUE USING 6 FR NAVIEN CATHETER AS ASPIRATION CATHETER IN THE TREATMENT OF ACUTE ISCHEMIC STROKE DUE TO ANTERIOR CIRCULATION OCCLUSION: A COMPARATIVE STUDY WITH SR THROMBECTOMY IN A SINGLE CENTER

Q Zhang[1], J Sun[1], X Zhang[1] and Z Chen[1]
[1]Shanghai Tenth's People's Hospital of Tongji University, Shanghai, CHINA

Purpose: Purpose: The endovascular recanalization strategy is still going through evolution owing to the advances in both devices and concepts. This study is to introduce 666 SWIM technique using the combination of 6 Fr long shuttle catheter, 6 Fr Navien catheter, and 6–30 Solitaire FR.
Materials and Methods: Materials and Methods: A retrospective analysis of prospective data of patients treated with 666 SWIM or SR thrombectomy due to anterior circulation occlusion was performed. For the 666 SWIM, 6 Fr Navien catheter, used as a large-bore aspiration catheter, was advanced into intracranial vessels and placed as close as possible to the stent-engaged clot. Clot aspiration thrombectomy was performed after stent retriever thrombectomy. The efficacy and safety of 666 SWIM was assessed through comparison with SR thrombectomy. The following parameters were analyzed: recanalization success (Thrombolysis in Cerebral Infarction 2b or 3), the number of pass to achieve successful recanalization, procedure time, procedure-related complications, and the modified Rankin scale (mRS) score at 90 days.
Results: Between January 2016 and February 2019, a total of 178 acute ischemic stroke patients with anterior circulation occlusion underwent mechanic thrombectomy in our stroke center. 666 SWIM as the primary treatment was performed in 92 cases, however, 11cases were converted to SR thrombectomy due to failure in the advancement of 6 Fr Navien catheter to the intracranial vessels. Therefore, 81 cases were treated with 666 SWIM technique and 97 cases with SR technique finally. 666 SWIM group achieved higher good recanalization rate (95.1%, 77/81) with less procedure time (average: 28 minutes) than SR group, in which they were 83.5% (81/97) and 46 minutes respectively. No catheter advancement-related complication like vessel dissection or perforation was observed in patients treated with 666 SWIM. The poor recanalization due to thrombus migration was very low (2.5%, 2/81) in 666 SWIM group when compared with SR group (9.3%, 9/97). At 90 days, 666 SWIM also outperformed SR (mRS 0–2, 56.8% vs.52.6%) though there was no statistical difference.
Conclusion: Conclusion: 6 Fr Navien catheter could be safely advanced to the intracranial vessels in the majority of cases, and 666 SWIM technique using 6 Fr Navien catheter as large-bore aspiration catheter allowed for more efficient recanalization and less complications when compared with SR thrombectomy.
Keywords: acute ischemic stroke, mechanic thrombectomy, Navien catheter

O 099

TWO-STAGE ASPIRATION TECHNIQUE (TSAT) WITH PROXIMAL FLOW ARREST BY A BALLOON GUIDING CATHETER FOR ACUTE ISCHEMIC STROKE: CLINICAL RESULTS OF 102 CONSECUTIVE PATIENTS

H Nishiyama[1], H Matsumoto[1], D Izawa[1] and N Toki[1]
[1]Department of neurological surgery Kishiwada tokusjukai hospital, Osaka, JAPAN

Purpose: Our clinical experience using the two-stage aspiration technique (TSAT) with proximal flow arrest by a balloon guiding catheter is presented. In TSAT, aspiration is applied with the 5MAX ACE and also with the 3MAX catheter with a Penumbra aspiration pump, while arresting proximal flow by balloon inflation.
Materials and Methods: In patients treated with TSAT, clinical data including National Institutes of Health Stroke Scale (NIHSS) score at admission and the modified Rankin Scale (mRS) score at discharge, as well as procedural data including the Thrombolysis in Cerebral Infarction (TICI) score, procedural time, and complications, were analyzed.
Results: A total of 102 consecutive patients (56 men (55%); mean age 73.2 years) were treated with TSAT using a balloon guiding catheter. Eighty-nine lesions were occluded in the anterior circulation. The patients presented with a mean NIHSS score of 17.9, and 61 (59.8%) patients received IV tissue plasminogen activator. The median time from groin puncture to successful recanalization was 38 min. All patients were successfully revascularized; TICI 2b or better recanalization was achieved in 87 (85.3%) patients. Eleven (10.8%) patients needed additional treatment with a stent retriever. Procedure-related complications occurred in two (1.9%) patients. Symptomatic intracranial hemorrhage occurred in 6 (5.9%) patients, asymptomatic subarachnoid hemorrhage occurred in 3 (2.9%) patients. There were no cases of embolization of new territory (ENT). The mean NIHSS score at discharge improved to 6.2. Forty-eight

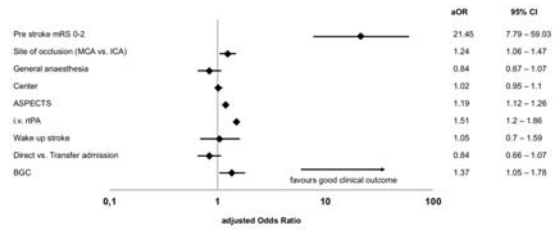
patients (47.1%) achieved a good outcome with a mRS score of 0–2 at discharge.
Conclusion: TSAT with proximal flow arrest by a balloon guiding catheter is an effective, safe method to achieve good clinical and angiographic outcomes. This method may reduce ENT and additional treatment in the ADAPT technique.
Keywords: two stage aspiration technique, thrombectomy, stroke

O 100

IMPACT OF BALLOON GUIDE CATHETER ON TECHNICAL AND CLINICAL OUTCOME IN THE BEYOND-SWIFT REGISTRY

B Friedrich[1], J Kaesmacher[2], C Maegerlein[1], T Meinel[3], T Dobrocky[2], E Piechowiak[2], M Heldner[3], P Mosimann[2], P Michel[4], S Hajdu[5], M Ribo[6], M Requena[6], V Costalat[7], A Benali[7], L Pierot[8], M Gawlitza[8], J Schaafsma[9], V Pereira[10], J Gralla[2] and U Fischer[3]
[1]Department of Diagnostic and Interventional Neuroradiology, Klinikum rechts der Isar, Technical University Munich, Munich, GERMANY
[2]University Institute of Diagnostic and Interventional Neuroradiology, University Hospital Bern, Inselspital, University, Bern, SWITZERLAND
[3]Department of Neurology, University Hospital Bern, Inselspital, University of Bern, Bern, SWITZERLAND
[4]Department of Neurology, CHUV Lausanne, Lausanne, SWITZERLAND
[5]Department of Radiology, CHUV Lausanne, Lausanne, SWITZERLAND
[6]Department of Neurology, Vall dHebron University Hospital, Barcelona, SPAIN
[7]Department of Neuroradiology, CHU Montpellier, Montpellier, FRANCE
[8]Department of Neuroradiology, CHU Reims, Reims, FRANCE
[9]Department of Neurology, Toronto Western Hospital, Toronto, CANADA
[10]Joint Department of Medical Imaging, Toronto Western Hospital, Toronto, CANADA

Purpose: Complete and immediate reperfusion after the first thrombectomy maneuver is the most relevant modifiable predictor of good outcome in ischemic stroke patients presenting with large vessel occlusion. Previous studies reported balloon guide catheters (BGC) to have a positive impact on technical and clinical outcomes. The aim of this study was to examine the effects of BGC on outcome in the BEYOND-SWIFT registry to provide further real-world evidence for the benefit of BGC.



Materials and Methods: 1460 Patients (n = 742 treated with BGC, n = 718 without BGC) from the multicenter BEYOND-SWIFT registry were analyzed. Primary endpoint was the rate of complete reperfusion after a single thrombectomy maneuver (First Pass Thrombolysis in Cerebral Infarction 3, FP-TICI3). Secondary endpoints were rates of first-pass successful reperfusion (FP-SR), clinical outcome at day 90 (good clinical outcome defined as modified Rankin Score 0–2), and symptomatic intracerebral hemorrhage.
Results: FP-TICI3 (29.2% vs. 9.7%; $p < 0.001$) and FP-SR (44.8% vs. 16%; $p = 0.014$) were more frequently achieved using BGC. Less maneuvers were necessary (median 1 vs. 2; $p < 0{,}001$) and procedure times were shorter (52 vs. 62 minutes, $p < 0.001$) using BGC to reach final angiographic results. BGC use was an independent predictor for achieving good clinical outcome (aOR 1.34 95% CI 1.04–1.75, $p = 0.027$). The use of BGC resulted in a significant decrease regarding the occurrence of symptomatic intracranial hemorrhages (aOR 0.57 95% CI 0.35–0.91, $p = 0.019$).
Conclusion: BGC use appears mandatory in endovascular stroke treatment, as both, technical and clinical outcomes were superior in the group with BGC usage.
Keywords: Ballon guide catheter, endovascular stroke treatment, outcome

O 101

EFFICACY OF A BALLON-ASSISTED PROXIMAL ASPIRATION IN TREATING AN OCCLUDED COMMON CAROTID ARTERY (CCA), INTRA AND EXTRACRANIAL INTERNAL CAROTID ARTERY (ICA)

DL Lauretti[1], A Grigolini[1], GA Lazzarotti[1] and M Cosottini[1]
[1]University of Pisa- Neuroradiology Unit, Department of translation research and new technologies in medicine and surgery, Pisa, ITALY

Purpose: To evaluate the technical success of the sole proximal aspiration through Balloon Guide Catheter (BGC) in a series of Common Carotid Artery (CCA) and intracranial/extracranial Internal Carotid Artery (ICA) obstructions.
Materials and Methods: 19 patients with Internal Carotid Artery (ICA) obstructions were retrospective selected and divided in to two groups. Five patients were grouped as having a tandem obstruction (CCA/extracranial ICA occlusions associated an intracranial ICA's obstruction).
The second group of 14 patients presented isolated intracranial ICA occlusion.

In our groups the first therapeutic approach was the proximal aspiration through BGC, with an outer diameter of 8Fr and an inner diameter of 0.084 inch.
During the aspiration of the CCA/extracranial ICA occlusion the distal tip of the BGC was placed proximal to the clot, instead of the petrous segment in the cases of intracranial ICA occlusion. In all cases, the balloon is inflated prior to the aspiration in order to block the orthodromic blood flow.
Results: The treatment of the CCA/ICA extracranial obstructions with a proximal aspiration through BGC allowed a complete recanalization in 100% of the cases (2 left CCAs, 1 left ICA and 2 right ICAs) (Fig.1).
The sole aspiration through BGC of intracranial ICA obstructions yielded a success rate of 47% (9 out of 19 patients) (Fig.2).

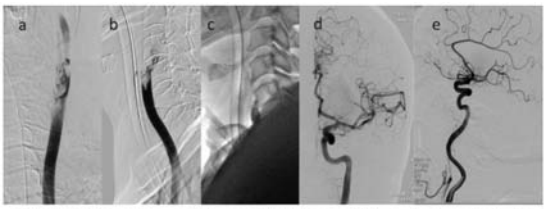


Fig.1: a-b left CCA occlusion, c- BGC with inflated balloon in CCA, with the tip proximal to the clot, d-e angiografy check after recanalization through the sole proximal aspiration by BGC.

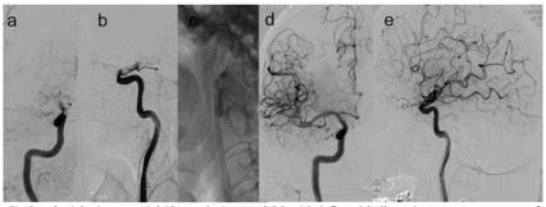


Fig.2: a-b right intracranial ICA occlusion, c- BGC with inflated balloon in petrous segment of ICA, d-e angiografy check after recanalization through the sole proximal aspiration by BGC.

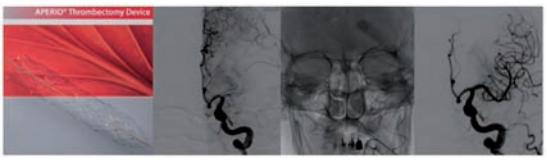
In the remaining 53% of the cases (10 out of 19 patients) a distal aspiration catheter and/or a stentriever device was necessary to re-vascularized the intracranial ICA.
By evaluating the site of intracranial ICA obstruction we revealed that in 11 cases where the obstruction was at the origin of the ophthalmic artery, the recanalization rate was 73%, while in 8 cases where the obstruction was distal to the ophthalmic artery origin, the recanalization rate was 9%.
Conclusion: The sole proximal aspiration trough a BGC is a successful technique in the recanalization of the CCA and extracranial ICA.
In the Intracranial ICA, the efficacy of recanalization is strictly related to the site of obstruction. The success rate is higher when the clot involves the origin of the ophthalmic artery because of the aspiration capability improves, lacking a patent collateral vessels.
Hence a single proximal aspiration offers a high rate of recanalization also in selected cases of intracranial ICA obstruction and probably reduces the number of the used devices and the risks for patients.
Keywords: Proximal aspiration, Ballon occlusion, Stroke

O 102

PRELIMINARY SINGLE CENTER EXPERIENCE WITH THE NEW APERIO THROMBECTOMY DEVICE AS A RESCUE APPROACH AFTER ASPIRATION: FIRST 30 CASES

N Cavasin[1], E Cagliari[1], M Cazzagon[1] and A Critelli[1]
[1]Neuroradiology Department, Ospedale dell'Angelo, Mestre, Venezia, ITALY
[2]Neuroradiology Department, Ospedale dell'Angelo, Mestre, Venezia, ITALY
[3]Neuroradiology Department, Ospedale dell'Angelo, Mestre, Venezia, ITALY
[4]Neurology Department, Ospedale dell'Angelo, Mestre, Venezia, ITALY

Purpose: Endovascular revascularization has become the treatment of choice in case of intracranial large vessel occlusion (LVO) acute stroke. It can be achieved with direct aspiration, with thrombectomy or the combination of the 2 techniques. Several thrombectomy devices ar now available but there is a limited number of papers about the safety and efficacy of APERIO thrombectomy device. We evaluated safety and efficacy of the nitinol hybrid cell design APERIO thrombectomy device in the treatment of LVO as a rescue after failed aspiration.
Materials and Methods: In acute stroke cases with LVO we routinely use direct aspiration as the first line strategy. We then shift to thrombectomy or thrombectomy during aspiration as a rescue technique when direct aspiration fails to reopen the occluded vessel.
We retrospectly analized the data of 30 patients (15 males and 15 females; mean age 62) with acute ischemic stroke due to a large vessel occlusion treated between September 2017 and February 2019 whith APERIO, a non-detachable self expanding mechanical thrombectomy device with an hybrid cell design, in combination with manual aspiration. We report on the patients' clinical condition at baseline and at 3 months follow up (mRs), patients clinical history and NIHSS on arrival. We reviewed recanalization rates (TICI score) and analyzed technical issues and complications.



Results: The primary goal of this study was to evaluate the efficacy of APERIO in obtaining revascularization of the target vessel (mTICI score). Successful recanalization (TICI $>$ 2b) was achieved in 70% of the cases. The primary safety end point was the evaluation of symptomatic intracerebral hemorrhage. Secondary end points included functional independence (mRS 0–2) and all causes of mortality at 90 days.
Conclusion: Failure of direct aspiration as a first technique in LVO acute stroke is usually associated with particularly complex cases or hard clots. Our preliminary experience with APERIOR thrombectomy device as a rescue approach

in this subset of patients has shown good results in terms of high reperfusion rates and adeguate safety profile due to low rates of complications.
Keywords: Thrombectomy, APERIO, Rescue treatment

O 103

MECHANICAL THROMBECTOMY (MT) PERFORMED WITH EMBOTRAP: THE VERONA HOSPITAL EXPERIENCE

R Augelli[1], A Agnello[1], N Mandruzzato[1], M Conte[1], GK Ricciardi[1], M Plebani[1], PG Zampieri[1] and E Ciceri[1]
[1]Neuroradiology Department, University Hospital, Verona, ITALY

Purpose: To evaluate feasibility and safety of EmboTrap revascularization device in acute ischemic stroke treatment.
Materials and Methods: We examined all patients data with acute stroke treated with the EmboTrap device from April 2018 and April 2019 in our center undergone to MT. We analyzed clot localization and lenght, number of passages in a single vessel and number of passages in different vessels in the same patient, evaluating rate of complication related to device, recanalization rate (using Thrombolysis In Cerebral Infarction – TICI score) and clinical outcomes at 3 months (modified Rankin Scale (mRS) 0–2).
Results: We used EmboTrap in 15 patients (4 with posterior stroke and 8 with Middle Cerebral Artery (MCA) occlusion and 3 with Internal Carotid Artery and MCA tandem lesions). Clot length was estimated between 2–5 mm. As first-line, we treated 8 patients (in 1 used in two different branches of MCA, with a total of 9 vessels treated); in 4 cases EmboTrap-retriever was the lone procedure performed in one pass, in 2 cases we performed 2 passes, and in other 2 cases EmboTrap was followed by thrombo-aspiration (TA). In only 2 cases the device was unsuccessfull (both of them on fronto-opercular M2-M3 branches). As second-line approach after TA, in all cases we obtained complete recanalization both in Large Vessels Occlusion (LVO) partially reopened with aspiration, than in distal branches occlusion. We never observed distal fragmentation after EmboTrap use; we observed one case of subarachnoid hemorrhage device-related, asymptomatic. In 4 cases at first-line treatment we obtained a TICI 3; in all the other cases we observed a significant improvement of TICI score. With regard to clinical outcome, 5 patient are still waiting for the 3 month FU, (treated from January to April 2019), while among the other 10 patients, mRS was <3 in 6 patients, between 3–5 in 3 patient. One patient died after 10 days for causes not related with ischemic stroke nor MT/EmboTrap (pulmonary embolism).
Conclusion: Based on our experience in LVO cases as in selected cases of distal occlusion (dominant straight artery), EmboTrap seems to be effective and safe. More data need in order to reach a statistical analysis value.
Keywords: embotrap, stent-retriever, mechanical thrombectomy

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TREATMENT OF DISTAL BRANCH OCCLUSION IN THE MIDDLE CEREBRAL ARTERY TERRITORIES: THE VERONA HOSPITAL EXPERIENCE

R Augelli[1], M Conte[1], A Agnello[1], N Mandruzzato[1], GK Ricciardi[1], PG Zampieri[1], M Plebani[1], A Grazioli[1], A Bucci[1] and E Ciceri[1]
[1]Neuroradiology Department, University Hospital Of Verona, Verona, ITALY

Purpose: Evaluate the safety and efficacy of endovascular treatment of distal occlusions in the middle cerebral artery territory.
Materials and Methods: Among data collected prospectively between January 2016 and December 2018 relating to patients with Ischemic Stroke subjected to endovascular treatment, both primary and associated with intravenous thrombolytic therapy, we retrospectively analyzed those related to distal occlusions in the middle cerebral artery territory. The efficacy of the treatment was evaluated taking into account the obtained recanalization rate, evaluated by TICI (Thrombolysis In Cerebral Infarction) score and its variation after the treatment of distal territories, the observed complication rate and the degree of post-Stroke disability, evaluated by mRS (modified Rankin Scale) at 90 days. The observed data were compared with what is already known in the literature.
Results: In the analyzed period 177 patients with stroke were treated endovascularly; among the strokes in the territory of the middle cerebral artery in 10 cases revascularization of the occlusion of M2-M3 traits has been attempted. In 5 cases a superselective fibrinolytic treatment was performed with intra-arterial injection of Urokinase, in 4 case the thrombus was removed using a stent-retriever, while in 1 case no revascularization was obtained after treatment.
Conclusion: The occlusions of the M2 and M3 can be safely and successfully treated by endovascular therapy. These results, although derived from a low number of cases, are statistically in line with the current literature.
Keywords: distal occlusion, middle cerebral artery, mechanical thrombectomy

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MECHANICAL THROMBECTOMY FOR ISOLATED M2 SEGMENT OCCLUSION OF THE MIDDLE CEREBRAL ARTERY

T Maeda[1], T Kojima[2], N Sato[3], M Oinuma[4], K Horiuchi[4], T Ichikawa[5], K Oda[6], K Iwatate[2], M Kawakami[1] and K Saito[2]
[1]Ohta-Nishinouchi Hospital, Koriyama, JAPAN
[2]Fukushima Medical University, Fukushima, JAPAN
[3]Masu Memorial Hospital, Nihonmatsu, JAPAN
[4]Southern Tohoku General Hospital, Koriyama, JAPAN
[5]Japanese Red Cross Society Fukushima Hospital,

Fukushima, JAPAN
[6]Minamisoma Municipal General Hospital, Minamisoma, JAPAN

Purpose: The purpose of this study was to reveal the safety and efficacy of mechanical thrombectomy for isolated M2 segment occlusion of the middle cerebral artery (MCA).
Materials and Methods: From January 2016 to December 2018, we retrospectively reviewed records of 108 patients had mechanical thrombectomy for acute MCA occlusions. Twenty-eight cases (25.9%) were M2, and 80 (74.1%) were M1 occlusions. We compared between both groups regarding baseline characteristics, technical details, successful reperfusion (Thrombolysis in Cerebral Infarction 2b/3), complications, and clinical outcomes.
Results: There were no statistically significant differences in age (mean, 78 in M2 versus 75 years in M1, $p = 0.22$), baseline NIHSS (median, 15 in M2 versus 17 in M1, $p = 0.17$), ASPECTS (median, 9 in M2 versus 9 in M1, $p = 1$), time from onset to groin puncture (median, 142 in M2 versus 159 minutes in M1, $p = 0.37$), procedure time (median 55 in M2 versus 46 minutes in M1, $p = 0.2$), successful reperfusion (71.4% in M2 versus 87.5% in M1, $p = 0.07$), symptomatic intracranial hemorrhage (3.6% in M2 versus 10.0% in M1, $p = 0.44$), good clinical outcome (53.6% in M2 versus 48.8% in M1, $p = 0.83$), and mortality rate (14.3% in M2 versus 12.5% in M1, $p = 0.75$). The rate of patients received only thrombus aspiration was higher in M2 occlusion (35.7% in M2 versus 15.0% in M1, $p = 0.03$).
Conclusion: In our series, mechanical thrombectomy for acute isolated M2 occlusion demonstrated safer and reasonable results. Mechanical thrombectomy may provide a good outcome for patients of M2 occlusions with severe symptoms similar to M1 occlusion's patients. Further comparative studies between the mechanical thrombectomy and medical treatment options are needed.
Keywords: stroke, mechanical thrombectomy, M2 segment occlusion

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REFRACTORY THROMBECTOMY: WHO, WHEN AND HOW?

R Abdalla[1], M Darwish[1], D Cantrell[1], M Hurley[1], M Potts[1], B Jahromi[1], A Shaibani[1] and S Ansari[1]
[1]Northwestern University, Chicago, USA

Purpose: Emergent large vessel occlusion due to underlying vessel wall pathology may be refractory to the endovascular stroke thrombectomy requiring further intracranial interventions to achieve successful recanalization. The aim of our study was to determine the prevalence of refractory thrombectomy requiring further intervention, compare their baseline characteristics, adjunctive intracranial interventions, and outcomes.
Materials and Methods: We retrospectively reviewed 253 patients treated with mechanical thrombectomy for ELVO from Jan 2015 to December 2018. Refractory thrombectomy was defined as patients requiring emergent intracranial angioplasty/stenting, intraprocedural antiplatelet therapy, or patients suffering re-occlusion in the same artery within one day of the procedure. Baseline characteristics and outcomes were compared between the refractory and the standard treatment groups using Mann-Whitney, Fisher Exact and Chi square tests. Outcomes were also compared within the refractory group undergoing different treatment modalities. Favorable outcome was defined as $mRS < 2$ after 3 months.
Results: Refractory thrombectomy was identified in 22 cases (8.7%) with no statistically significant differences in baseline characteristics, median NIHSS score (15 vs. 17, $P = 0.14$), and percentage of favorable outcomes (45 % vs 51.3%, $P = 0.64$) versus the standard thrombectomy group, respectively. Patients in the refractory cohort had a significantly higher prevalence of diabetes (45.5% vs. 19.9%, $P = 0.013$), while the standard group patients presented with significantly higher rates of atrial fibrillation (47.8% vs. 18.2%, $P = 0.007$). Diabetes was the sole independent predictor of refractory thrombectomy with OR 3.717 (95% CI: 1.266–10.989, $p = 0.017$). Within the refractory group, 11 patients were treated with intracranial angioplasty/stenting (50%), 7 received intra-arterial/intravenous eptifibatide infusion (31.8%), and 4 developed silent re-occlusions (18%). There was a trend toward better outcome in angioplasty/stenting group compared to eptifibatide infusion (60% vs 14.3, $p = 0.13$). No symptomatic intracranial hemorrhages were observed with either treatment.
Conclusion: Refractory thrombectomy is more common in diabetics. Emergent intracranial stenting and eptifibatide antiplatelet are safe and effective adjuvant treatments after stroke thrombectomy in the setting of underlying vessel wall pathology.
Keywords: Endovascular, Intracranial stenting, Eptifibatide

SESSION I: Stroke 5

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ACUTE ENDOVASCULAR TREATMENT OF TANDEM LESION OF THE ANTERIOR CIRCULATION: AN ITALIAN MULTICENTER EXPERIENCE

T Casseri[1], S Bracco[2], M Zanoni[1], S Cioni[2], IM Vallone[2], P Gennari[2], S Leonini[2], MA Mazzei[1], DG Romano[3], R Saponiero[3], R Augelli[4], N Mandruzzato[4], M Plebani[4], PG Zampieri[4], R Tassi[5], G Martini[5], S Forlivesi[6], R Napolitano[7] and EFM Ciceri[4]
[1]Unit of Diagnostic Imaging, Department of Medical, Surgical and Neuro Sciences, Le Scotte University Hospital, Siena, ITALY
[2]Neuroimaging and Neurointervention (NINT) Unit, Le Scotte University Hospital, Siena, ITALY

[3]Neuroradiology Unit, S. Giovanni di Dio e Ruggi d'Aragona Hospital, Salerno, ITALY
[4]Neuroradiology, University Hospital, Verona, ITALY
[5]Stroke Unit, Le Scotte University Hospital, Siena, ITALY
[6]Stroke Unit Neurology Department, University Hospital, Verona, ITALY
[7]Stroke Unit, S. Giovanni di Dio e Ruggi d'Aragona Hospital, Salerno, ITALY

Purpose: Acute ischemic strokes (AIS) due to Tandem Lesions (TLs) of the aterior circulation are often associated to poor outcome. TLs are defined by the presence of two lesions on the same vascular axis, being the proximal one (extracranial internal carotid artery- ICA- plaque or dissection) responsible of the distal one (intracranial large vessel occlusion –LVO). This causality could occur because of thromboembolism or hemodynamic insufficiency. Endovascular treatment (EVT), with or without emergent carotid stenting, could be a valid treatment option.
Materials and Methods: Retrospective review of prospectively collected thrombectomy databases from 3 major Italian Stroke Centers between 2015 and 2018. Consecutive patients with AIS due to TLs were selected. Primary endpoint was the good functional outcome (90-day modified Rankin Scale -mRS $<=$2). Secondary endpoints were the good angiographic revascularization of intracranial LVO (TICI 2b-3) and of the ICA.
Results: 93 patients were included. Mean age was 66,2 years (s.d. 12,2), median NIHSS was 18,0 (IQR 12–21), median ASPECTS was 9 (IQR 7–9). Extracranial ICA was occluded (n $=$ 56), suboccluded (n $=$ 29) or with $>$ 80% stenosis and features of plaque instability (n $=$ 8). Dissection of extracranial ICA was observed in 21 cases.
An intracranial ICA occlusion was observed in 8 cases, T-type ICA in 32, M1 in 33 and M2-M3 in 17; proximal ICA extracranial occlusion with no intracranial LVO in 3. Endovenous rtPA was administred in 58 cases.
The procedure was performed under general anesthesia in 85 cases. In 45 cases (48,4%), a carotid stent was positioned, with a distal-to-proximal approach in 30. At the end of the procedure, tirofiban was administred in 38 cases, aspirin in 13 and tirofiban $+$ aspirin in 1. A good extracranial revascularization was achieved in 77 cases (82,8%) and a TICI 2b-3 in 70 cases (75,3%) in particular in 6/70 without achieving carotid revascularization.
Median ASPECTS after 24 hours was 7 (IQR 6–8) and median NIHSS at discharge was 7,0 (IQR 2,5-19,0).
43 cases (46,2%) resulted in 90-day mRS $<=$2. Symptomatic intracranial hemorrage (sICH) occurred in 8 cases (8,6%). sICH rate was significantly higher in patients who received antiplatelet therapy, however without any difference related to the administred antiplatelet drug. 14 patients died at 90-days follow-up, in 6/14 as a result of cerebral ischemia.
Conclusion: In AIS due to TLs, intra-arterial revascularization, with or without emergent carotid stenting, is a valid treatment option in order to obtain a good revascularization of the occluded vessels, resulting in funcional improvement at 90 days follow-up.
Keywords: Acute Ischemic Stroke, Tandem Lesions, Endovascular Treatment

O 108

EMERGENCY CAROTID ARTERY STENTING IN CONCOMITANT WITH INTRACRANIAL THROMBECTOMY IN ACUTE ISCHEMIC STROKE: A SINGLE CENTER EXPERIENCE

EH Ihm[1], YY Seo[2], HK Lee[3], HJ Woo[4] and YM Han[5]
[1]Andong Hospital, Andong, SOUTH KOREA
[2]Inje University Sanggye Paik Hospital, Seoul, SOUTH KOREA
[3]Andong Hospital, Andong, SOUTH KOREA
[4]Andong Hospital, Andong, SOUTH KOREA
[5]Andong Hospital, Andong, SOUTH KOREA

Purpose: Acute intracranial arterial occlusion with additional extracranial carotid artery occlusion or high-grade stenosis was recognized as an independent risk factor for poor outcome in patients treated with systemic thrombolysis. Therefore, emergency carotid artery stenting (CAS) with endovascular recanalization treatment is potentially effective treatment option. We retrospectively evaluated the safety and effectiveness of endovascular recanalization treatment with concomitant emergency CAS.
Materials and Methods: Thirty-eight consecutive patients who underwent endovascular treatment for acute ischemic stroke at out center from Octoter 2009 to Octoer 2018 were retrospectively analyzed.
Angiographic, clinical and procedural data were drawn.
Clinical outcomes were evaluated using the National Institute of Health Stroke Scale (NIHSS) and the modified Rankin scale (mRS).
Results: Thirty-eight consecutive patients, with a mean age of 71.28 years and a mean admission NIHSS of 15.29(7$\sim$28), underwent this procedure and were included. 17 patients had total occlusion of the proximal ICA and the remaining 21 patients had near total occlusion or severe stenosis. Recanalization of all indentified intracranial occlusions was achieved in all patients, with a Thrombolysis in Cerebral Infarction (TICI) score $>$ 2 a achieved in each cases. Mean time from of stroke symptoms to recanalization was 309 min; mean time from first angiography to recanalization was 105 min. Follow-up CT or MRI revealed PH1 in three patients (7.9%) and 2 (5.2%) was PH2 and asymptomatic. Asymp̃tomatic subarachnoid hemorrhage occurred in one patient (2.6 %).
At 90 days follow-up, 25 patients (65.8%) had a favoŕable outcome (mRS $<$ 3). Two patient had died due to MI (Myocardial Infarction), pneumonia.
Conclusion: In the setting of acute ischemic stroke, treatment of tandem extracranial ICA and intracranial arterial occlusions with emergent CAS followed by concomitant

intracranial mechanical thrombectomy is both safe and effective, and a promising treatment option.
Keywords: Ischemic Stroke, Thrombectomy, Carotid stenting

O 109

ACUTE THROMBOSIS AND OCCLUSIONS OF DUAL-LAYER CAROTID STENTS IN ENDOVASCULAR TREATMENT OF TANDEM OCCLUSIONS

JAR Pfaff[1], C Maurer[2], E Broussalis[3,4], H Janssen[5,6], R Blanc[7], C Dargazanli[8], V Costalat[8], M Piotin[7], F Runck[2], A Berlis[2], M Killer-Oberpfalzer[3,4], J Hensler[9], M Bendszus[1], F Wodarg[9] and MA Möhlenbruch[1]

[1]Heidelberg University Hospital, Department of Neuroradiology, Heidelberg, GERMANY
[2]University Hospital Augsburg, Department of Diagnostic and Interventionell Radiology and Neuroradiology, Augsburg, GERMANY
[3]Paracelsus Medical University, Institute of Neurointervention, Salzburg, AUSTRIA
[4]Paracelsus Medical University, Department of Neurology, Salzburg, AUSTRIA
[5]Paracelsus Medical University, Campus Nuremberg, Department of Neuroradiology, Nuremberg, GERMANY
[6]Klinikum Ingolstadt, Department of Neuroradiology, Ingolstadt, GERMANY
[7]Rothschild Foundation Hospital, Department of Interventional Neuroradiology, Paris, FRANCE
[8]Hospital Güi-de-Chauliac, Centre Hospitalier Universitaire de Montpellier, Department of Neuroradiology, Montpellier, FRANCE
[9]University Hospital Schleswig-Holstein, Campus Kiel, Department of Radiology and Neuroradiology, Kiel, GERMANY

Purpose: To evaluate the occurrence and risk factors of acute in-stent thrombosis or stent-occlusion in patients with tandem occlusions receiving intracranial mechanical thrombectomy and emergent extracranial internal carotid artery stenting with a dual-layer carotid stent.
Materials and Methods: Multicentric retrospective data collection and analysis of stroke databases of 7 comprehensive stroke centers from 3 European countries.
Results: Overall 160 patients (age: mean (SD) = 66 (12); male: n = 104 (65%); median baseline NIHSS (IQR): 14 (9–18), IV lysis: n = 97 (60.6%) were treated for a cervical carotid artery occlusion or stenosis using a CASPER Stent (MicroVention) and received mechanical thrombectomy for an intracranial occlusion between April 2014 and November 2018. During the procedure or within 72 h, formation of thrombus and complete occlusion of the CASPER-Stent was observed in 33/160 patients (20.8%), respectively in 12/160 patients (7.5%). In 25/33 (75.8%), respectively in 9/12 patients (75%) this occurred during the procedure. No statistical significant difference was observed between patients with and without thrombus formation with regard to a pre-existing long-term medication with anticoagulants or intraprocedural administration of either heparin, ASA or heparin and ASA. Favorable early neurological outcome was similar in patients with (n = 15; 45.5%) and without (n = 63; 49.6%) thrombus formation at the CASPER-Stent.
Conclusion: Acute thrombosis or occlusion of CASPER-stents in thrombectomy patients receiving emergent extracranial internal carotid artery stenting for tandem occlusions can be observed more often during the procedure rather than within 72 h follow-up, were less frequent then previously reported and showed no impact on early neurological outcome.
Keywords: tandem occlusion, double-layer carotid stent, stent thrombosis/occlusion

O 110

EMERGENCY STENTING WITH ACCLINO FLEX AND NEUROSPEED BALLOON CATHETER AFTER FAILED THROMBECTOMY: MULTICENTER EXPERIENCE

CP Stracke[1], L Meyer[2], H Leischner[2], J Fiehler[2], G Thomalla[2], LU Krause[3], S Lowens[3] and R Chapot[1]

[1]Alfried Krupp Hospital, Essen, GERMANY
[2]University Hospital Eppendorf, Hamburg, GERMANY
[3]KLinikum Osnabrueck, Osnabrueck, GERMANY

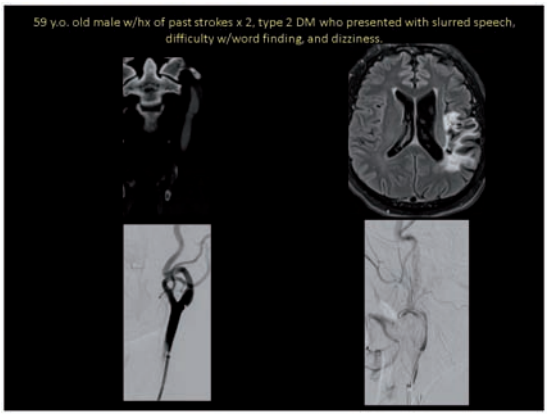
Purpose: To report on feasibility, safety and outcome of acute intracranial stenting (ICS) with the Acclino® (Flex) – Stent and NeuroSpeed® Ballon Catheter in cases of failed Mechanical Thrombectomy (MT) for Acute ischemic Stroke (AIS)
Materials and Methods: We retrospectively reviewed data of patients that were treated with acute bailout-stenting after failed MT in three large neuro-interventional using exclusively the Acclino® (Flex) – Stent and the NeuroSpeed® Balloon Catheter. Functional outcome was assessed by the rate of major early neurological recovery (mENR) at 24 h and at 90-days with the modified Rankin scale (mRS). Safety evaluation included symptomatic intracranial hemorrhage (sICH), mortality and intervention related serious adverse events (SAEs).
Results: 50 patients with a median age of 71 years met the inclusion criteria and 52% (26/50) of the occluded vessels were located within the anterior circulation. A mENR was observed in 38.8% and 90-days favorable outcome of mRS 2 or less was 38.8% (13/32). Higher NIHSS scores on admission were significantly associated with poor functional outcomes (mRS 3 or higher) at 90-days (adjusted OR 1.28; 95CI 1.07–1.53; p = 0.007). sICH occurred in two cases of the study population. There was no intervention related SAE.
Conclusion: Intracranial Bailout-Stenting with the Acclino® (Flex) – Stent and the NeuroSpeed® Balloon Catheter after failed MT is a feasible and effective recanalization-method for atherosclerotic stenosis based stroke that is associated especially with low rates of sICH.
Keywords: rescue stenting, thrombectomy, stent

O 111

SAFETY AND FEASIBILITY OF CAROTID REVASCULARIZATION WITH STENTS IN PATIENTS WITH CEREBRAL EMBOLIC STROKES

J Kovoor[1], J Tejada[1] and M Martinez[1]
[1]Indiana University School of Medicine, Indianapolis, USA

Purpose: Carotid webs refer to an area of non-atherosclerotic fibromuscular dysplasia most often arising at the posterior internal carotid artery bulb. Carotid webs are increasingly identified as a cause of ischemic embolic strokes, particularly in younger patients with no other known risk factors. The best way to treat these symptomatic carotid webs remains unknown and currently most patients being treated undergo carotid endarterectomy. Treatment of carotid webs with carotid artery stenting has been reported in only a few case series. We report on the safety and technical feasibility of carotid stenting in patients with embolic strokes caused by carotid webs.



Materials and Methods: Institutional review board(IRB) approval was obtained. Eight consecutive patients with embolic strokes caused by carotid webs demonstrated on CT angiography and treated with carotid artery stenting were identified between 2014–2018. Data on patient demographics, clinical presentation, imaging findings, antiplatelet medication protocol, endovascular treatment and follow up were retrospectively collected.
Results: Eight consecutive patients presented with ipsilateral stroke caused by a carotid web. The mean age at presentation was 50 years (range 37–71) with four male and four female patients. All patients underwent carotid stenting except one patient, who underwent carotid endarterectomy. In one stented patient, significant and persistent hypotension was noted in the post procedural period. This resolved after 1 week. No other peri procedural complications were seen. The patients were followed for a mean of 5.5 months (range 1.5–12 months). No recurrent stroke or TIA occurred. There was no evidence of in-stent stenosis.
Conclusion: Endovascular treatment with stent deployment is safe and feasible for treatment of carotid webs in patients presenting with ischemic embolic strokes.

Keywords: Carotid Web, Carotid stenting, Intimal fibromusculardysplasia

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MULTILAYER STENT (CMFM) FOR CAROTID ANGIOPLASTY: BUENOS AIRES EXPERIENCE

C Bleise[1], I Lylyk[1], J Chudyk[1], N Perez[1], R Viso[1] and P Lylyk[1]
[1]ENERI- Department of Neurointerventional Radiology, Buenos Aires, ARGENTINA

Purpose: The purpose of this series is to report our experience with a multilayer stent Cardiatis (Isnes, Belgium) for carotid angioplasty.
Materials and Methods: Between January 2011 and Dec 2018 Thirty-one patients (76,1% male, mean age 64 years) underwent protected carotid angioplasty with Cardiatis MFM device. Clinical and angiographic data at the end of the procedure are reported. The clinical control and carotid ultrasound follow-up was performed in all patients by independent neurologist and cardiologist at 1, 3, 6 months and/or 1 year.
Results: Clinical presentation was: ischemic stroke in 16 patients, TIA in 10 patients; and asymptomatic stenosis greater than 70% in 4 patients. 27 patients had atheromatous plaque and 4 carotid dissections. In three patients was necessary to perform additional angioplasty at the distal part of the stent (Fish mouth) with balloon in one case and with balloon expandable stent in two cases. No hemorrhagic complications in the periprocedural time. Technical deployment success was 88,9%. Mortality was 0% and Morbidity 3.2% (1 pt.). FUP was accomplished in 95,2% of patients. 27 patients have mRS 0, 4 patients with mRS 1–2. No changes in neurological status at 1 year.
Conclusion: In this selected group of patients, the use of this novel Multilayer CMFM for the Carotid disease seems to avoid the late micro embolus, frequently present in this procedure due to the plaque rupture and showed better visualization in MRI. More experience and longer follow up are needed to prove its safety and efficacy.
Keywords: Carotid Stenosis, Multilayer stent, Cardiatis

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A RETROSPECTIVE MULTICENTER STUDY OF ENDOVASCULAR TREATMENT FOR ACUTE CAROTID NON-T OCCLUSION

T Ota[1], K Shigeta[2], T Amano[3] and J Kaneko[4]
[1]Tokyo Metropolitan Tama Medical Center, Tokyo, JAPAN
[2]National Hospital Organization Disaster Medical Center, Tokyo, JAPAN
[3]Kyorin University, Tokyo, JAPAN
[4]Nippon Medical School Tama Nagayama Hospital, Tokyo, JAPAN

Purpose: The functional prognosis of patients with carotid T occlusion (CTO) is poor, but few comprehensive studies have investigated carotid non-T occlusion (CNTO), in which the terminal internal carotid artery (ICA) portion is unobstructed. We aimed to elucidate the clinical features of CNTO by comparing patients with acute CTO and CNTO.
Materials and Methods: This was a retrospective observational study based on data from TREAT (UMIN-CTR: UMIN000026888), a multicenter registry of mechanical thrombectomy (MT) for acute large vessel occlusions (LVO) in the Tama area of Tokyo. Among 362 patients who underwent thrombectomy between January 2015 and June 2018, 20 and 61 were diagnosed with CNTO and CTO, respectively. We compared preoperative clinical findings, treatment strategies, treatment complications, and functional outcomes between the two groups.
Results: Age, sex, preoperative NIHSS, cerebral infarction subtypes, and medical history did not significantly differ. In contrast, preoperative DWI-ASPECTS were 9 (1–11) and 6.5 (0–11) for the CNTO and CTO groups, respectively ($p = 0.015$). The duration of treatment or the median number of passes (2.5 vs. 2.0), the numbers of patients with TICI 2b/3, bleeding complications, and mRS scores of 0–2 on POD 90 did not significantly differ between the two groups. Manual aspiration before, and ICA arrest while crossing a lesion and injection of the contralateral side were significantly more frequent in the CNTO group. Intracranial ICA stenosis was significantly more frequent in the CNTO ($n = 4$, 20%), than the CTO ($n = 0$) group, and 10% of patients with CNTO had arterial dissection.
Conclusion: Patients with CNTO had a background of intracranial ICA stenosis or arterial dissection more than patient with CTO. The classification of CTO and CNTO was very practical in terms of facilitating MT in the emergency setting and improving the clinical outcomes of patients with CNTO.
Keywords: carotid non-T occlusion, carotid T occlusion, mechanical thrombectomy

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FEASIBILITY AND POTENTIAL COMPLICATIONS ASSOCIATED WITH HYBRID RECANALIZATION OF CHRONIC CEREBRAL CAROTID OCCLUSION

X Gao[1]
[1]Shenyang Northern Hospital, Shenyang, CHINA

Purpose: Patients with chronic cervical internal carotid artery occlusion (ICAO) and cerebral ischemia may benefit from revascularization. The feasibility of recanalization for chronic ICAO has been reported recently, but the safety of hybrid operation for recanalization is still unproven. We report the follow-up results of 61 chronic ICAO patients who underwent hybrid recanalization, focusing on potential vascular complications and corresponding management.
Materials and Methods: Hybrid recanalization for chronic ICAO was attempted in 61 consecutive patients with either recurrent neurological deficit or objective ipsilateral hemisphere ischemia. Mean duration from occlusion documentation to the procedure was 186.2 days (range, 56 to 405 days). Adverse events while in the hospital and during the 3-month follow-up were recorded.
Results: Successful recanalization was achieved in 55 of 61 patients (90.2%). Three-month cumulative stroke and death rate was 4.9% (3 of 61).
Conclusion: Certain immediate or delayed vascular complications may develop during or after the recanalization for chronic ICAO. Although periprocedural death and stroke rate is limited in our study, further study combining neuroimaging tools and cognitive function evaluation is mandatory to assess its utility and appropriateness in patients with chronic ICAO.
Keywords: Chronic Cerebral Carotid Occlu, recanalization, Hybrid

O 115

PRELIMINARY RESULTS OF SELECTIVE BALLOON DILATATION AFTER CAROTID ARTERY STENTING

T Izumi[1], M Ishida[1], M Nishihori[1], T Tsukada[1], M Otawa[1], R Oshima[1], T Kawaguchi[1], A Kropp[1], M Ikezawa[1], S Goto[1] and T Wakabayashi[1]
[1]Nagoya University – Department of Neurosurgery, Nagoya, JAPAN

Purpose: Post dilatation is considered as main cause of debris generation in carotid artery stenting (CAS). We limited to perform post dilation for only the patient with a

certain residual stenosis after stent placement from 2015 to prevent the ischemic complication. In this study, we compared the result of CAS with one in the past.

Materials and Methods: We performed post dilatation in all CAS cases from 2010 to 2014, this period was defined as period A. Selective post dilatation was done from 2015 to 2016, this was defined as period B. We retrospectively compared the both result in terms of ischemic findings in post-DWI, ipsilateral cerebral infarction within 30days after stenting, restenosis within one year after stenting. Restenosis was defined as more than 300 cm/s in flow velocity in ultrasonography of stent.

Results: CAS was done for 149 and 52 cases in period A and B. Post dilation was done among 96% of cases in period A, among 31% of ones in period B. The mean minimum luminal diameter just after stenting was significantly larger in period A (4.3 mm vs 3.7 mm). The positive rate of DWI and ipsilateral cerebral infarction within 30days in period A were more than ones in period B (28% vs 18%, 4.7% vs 1.9%). The restenosis rate in period A was lower than one in period B (3.3% vs 9.1%). The rate of ipsilateral cerebral infarction after 30days in period A is little lower than one in period B (0.7% vs 1.9%)

Conclusion: CAS can be safer by limiting post dilatation to selective patients. The restenosis rate increased, but it seemed to be within the acceptable range.

Keywords: carotid stenosis, carotid stenting

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ASYMPTOMATIC CEREBRAL VASOCONSTRICTION AFTER CAROTID ARTERY STENTING

C Kang[1], J Roh[1], J Baek[2], S Kim[3] and S Baik[1]

[1]Department of Interventional neuro-radiology, Pusan National University Yangsan Hospital, Yangsan, SOUTH KOREA

[2]Department of Diagnostic radiology, Busan Paik Hospital, Inje University, Busan, SOUTH KOREA

[3]Department of Neurosurgery, Busan Paik Hospital, Inje University, Busan, SOUTH KOREA

Purpose: Carotid artery stenting (CAS) and carotid endarterectomy (CEA) are widely performed for treatment of carotid stenosis to improve cerebral perfusion and prevent recurrence of stroke. Not only morphology of the stenotic vessel but also hemodynamic of cerebral perfusion alters after CAS. Some changes are immediately notable, even on angiography taken right after the procedure. The purpose of this retrospective study is to present our observation on multifocal narrowing of arteries in the ipsilateral anterior circulation at immediate post-stenting angiography in patients with near total occlusion (NTO) of proximal ICA.

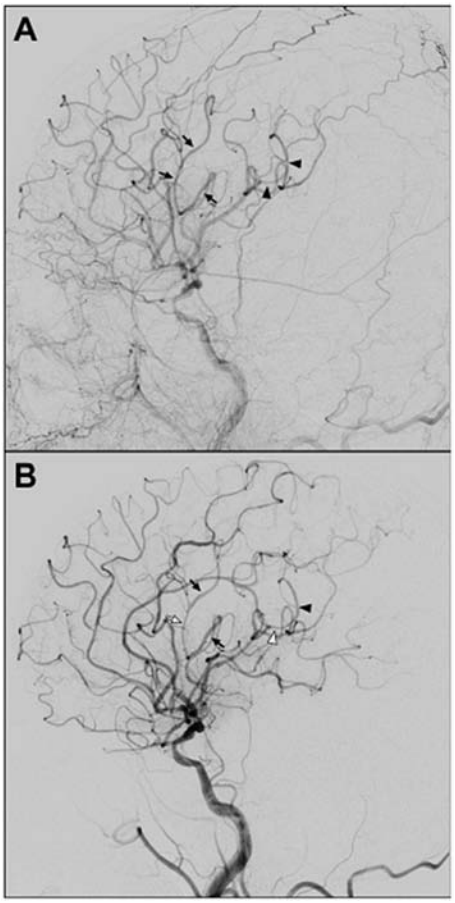

Fig. 2. A representative case of vasoconstriction after revascularization therapy (case no. 24). A superior division branch of left MCA is marked with black arrows, and an inferior division branch is pointed with arrowheads on angiography image before stenting (A). On post-stenting angiography (B), those branches are showing narrowing-and-dilatation appearance, and the narrowed (believed to be constricted) segments are marked with blank arrow and blank arrowhead, respectively. Vasoconstriction phenomenon can be seen in arteries other than marked branches. There are notable discrepancy of full-filling phase on pre- and post-stenting angiography images, especially when compared with the external carotid artery filling. MCA: middle cerebral artery

Materials and Methods: We reviewed data from December 2008 to December 2018, retrospectively. Among 361 stenting procedures (286 patients), 28 patients of NTO were enrolled in the analysis. Two interventional neuro-radiologists reviewed final cerebral angiography of the CAS procedure to evaluate presence of vascular narrowing on final angiography. And they also reviewed pre-procedural DSA or magnetic resonance angiography (MRA) images to see if the

vascular territory was isolated from the contralateral anterior circulation or posterior circulation. Isolated circulation was defined as 1) signal intensity drop of ipsilateral MCA/ICA territory, and 2) absence of ipsilateral A1 segment and posterior communicating artery, when evaluated on time of flight (TOF) MRA. Clinical data were collected and analyzed to find factors relevant to the presence of vascular narrowing.

Results: 28 patients with NTO (mean age 69.0 ± 6.5 years, 92.9% female) were analyzed. Ten patients showed multifocal vascular narrowing considered as vasoconstriction in the treated territory, and 18 patients did not show significant vasoconstriction after CAS. There were no statistically significant differences in comorbidity, frequency of symptomatic lesions, antiplatelet medication, mean procedure time, initial NIHSS, and baseline modified Rankin scale (mRS) between the two groups. But, vasoconstriction is more likely to happen in patients with isolated territory from the contralateral anterior circulation and posterior circulation (61.5 % in isolated territory group and 13.3 % not-isolated territory group; $p < 0.05$). There was no headache or neurologic deficit in all 10 patients with cerebral vasoconstriction.

Conclusion: Asymptomatic cerebral vasoconstriction is a frequently-noted change in patients with NTO after CAS and it is more likely to happen in patients with isolated perfusion territory. Further investigation with larger patient cohort is indicated to enlighten clinical significance of the vasoconstriction after CAS.

Keywords: Cerebral vasoconstriction, Carotid stenting, RCVS

images by spin echo method. From taken image, using proprietary software, tissue-specific plaque color map was constructed and the location of IPH was evaluated. MR plaque images were taken at least over 3 months period. From change of IPH over time, they were classified into three types: increase/development, maintained, decrease of IPH. Then CFD was calculated on basis of Time-of-flight MR angiography which were examined at the first time. From direction of streamline on CFD, they were separated into three groups of large reverse flow, small reverse flow and without the reverse flow. The relationship between reverse flow on CFD and change in IPH were analyzed.

Results: In initial MRI, 33(94.3%) of 35 lesions detected IPH, and in 15 (42.9%) of 35 lesions, reverse flow on CFD were confirmed at the occurrence site of IPH. There was no correlation between the occurrence site of IPH and reverse flow ($p = 0.68$). For change in IPH over time, 12(34.3%) of 35 lesions were found with increase/development of IPH, maintained in 10 (28.6%), decrease in 13(37.1%). Nine (75.0%) of 12 lesions with increase of IPH detected reverse flow, but on the other hand, 11 (84.6%) of 13 lesions with decrease of IPH did not detect reverse flow ($p < 0.01$). Thirteen of 15 lesions with reverse flow were found to increase/development or maintained IPH, statistically significantly more than decrease of IPH ($p = 0.01$). Moreover, 7 (87.5%) of 8 lesions with large reverse flow were found to increase/development of IPH.

Conclusion: It was suggested that the reverse flow, especially large reverse flow on CFD effect development of IPH.

Keywords: Carotid Stenosis, Intraplaque Hemorrhage, CFD

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EFFECT OF HEMODYNAMICS IN DEVELOPMENT OF CAROTID INTRAPLAQUE HEMORRHAGE

M Hayashi[1], S Fujita[1], Y Hiramoto[1], K Aoki[1], N Saito[1], N Hirai[1], K Ito[1], H Nakayama[1], T Sakurai[1], S Yagi[2], N Hattori[3] and S Iwabuchi[1]

[1]Toho University Ohashi Medical Center – Department of Neurosurgery, Tokyo, JAPAN
[2]Waseda University – Center of Advanced Biomedical Sciences, Tokyo, JAPAN
[3]Toho University Ohashi Medical Center – Division of RAdiology, Tokyo, JAPAN

Purpose: It is known that carotid intraplaque hemorrhage (IPH) is associate with the occurrence of subsequent cerebrovascular events in patients with carotid stenosis. Development of IPH is caused by various factors. We hypothesized that the blood fluid hemodynamics has an effect in development of IPH, and have evaluated the effect of hemodynamics to change in IPH over time using MR plaque image and computational Fluid Dynamics (CFD).

Materials and Methods: Between September 2011 and Februarys 2017, 27 patients and 35 carotid stenosis with multiple MR plaque imaging over time were analyzed. MR plaque images were taken with the T1-weighted axial

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STENTING OF STENOSED POSTERIOR COMMUNICATING ARTERY FOR HEMODYNAMIC INSUFFICIENCY CAUSED BY INTERNAL CAROTID ARTERY OCCLUSION

X Lu[1], B Yang[1], Y Ma[1] and LQ Jiao[1]

[1]Xuanwu Hospital Capital Medical University, Beijing, CHINA

Purpose: Common therapeutic strategies of hemodynamic insufficiency caused by cervical artery occlusion include conservative medication, extracranial-intracranial bypass and arterial recanalization. We report a case of hemodynamic insufficiency caused by internal carotid artery (ICA) occlusion successfully treated by stenting of stenosed posterior communicating artery (PCoA).

Materials and Methods: Patient was a 60-year-old female, presented with paroxysmal right limbs weakness for 6 months. She had history of systemic hypertension and diabetes mellitus. Physical examination found right homonymous hemianopsia. Her symptom persisted though optimal medication was given. Head MRI showed remote infarction of left optic radiation and cortex, as well as multiple lacunar infarction of bilateral internal watershed area, with left side was worse. Positron emission tomography (PET) scan indicated relative hypoperfusion of left

hemisphere. Angiography showed left ICA was occluded. The anterior communicating artery (ACoA) was patent but the left A1 segment was very thin. The left vertebral artery (VA) terminated after sending off left posterior inferior cerebellar artery (PICA). Injection of right VA showed left PCoA was patent and lead to opacification of left middle cerebral artery (MCA), but it was stenosed at the segment close to ICA. Transcranial collaterals from left occipital artery supplied the left occipital cortex. High resolution MRI suggested the stenosis of left PCoA was atherosclerotic. The left anterior choroidal artery had a substantial diameter.

Results: A 2.5–15 mm Neuroform EZ® was placed successfully. Patient's symptom improved after treatment. The perfusion of left MCA territory improved significantly, which was proved by both intraoperative control angiography and postoperative PET scan. Postoperative MRI showed no fresh infarction at the territory of left PCoA. The long-term follow-up is undergoing.

Conclusion: Stenting of atherosclerotic stenosis of posterior communicating artery for hemodynamic insufficiency caused by internal carotid artery occlusion can be technically safe and radiologically effective.

Keywords: Stenting, ICA occlusion, PCoA stenosis

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ENDOVASCULAR TREATMENT OF ACUTE BASILAR ARTERY OCCLUSION: TAMA-REGISTRY OF ACUTE THROMBECTOMY (TREAT) STUDY

J Kaneko[1], T Ota[2], T Tagami[1,3], K Unemoto[1], K Shigeta[4], T Amano[5], M Ueda[6], Y Matsumaru[7], Y Shiokawa[8] and T Hirano[5]

[1]Department of Emergency and Critical Care Medicine, Nippon Medical School Tama Nagayama Hospital, Tokyo, JAPAN
[2]Department of Neurosurgery, Tokyo Metropolitan Tama Medical Center, Tokyo, JAPAN
[3]Department of Clinical Epidemiology and Health Economics, School of Public Health, The University of Tokyo, Tokyo, JAPAN
[4]Department of Neurosurgery, National Hospital Organization Disaster Medical Center, Tokyo, JAPAN
[5]Department of Stroke and Cerebrovascular Medicine, Kyorin University, Tokyo, JAPAN
[6]Department of Neurology and Stroke Medicine, Tokyo Metropolitan Tama Medical Center, Tokyo, JAPAN
[7]Division of Stroke Prevention and Treatment, Department of Neurosurgery, University of Tsukuba, Ibaraki, JAPAN
[8]Department of Neurosurgery, Kyorin University, Tokyo, JAPAN

Purpose: The effectiveness of mechanical thrombectomy (MT) for acute basilar artery occlusion (ABAO) remains unknown. We evaluated the feasibility, safety, and efficacy of endovascular treatment for ABAO.

Materials and Methods: We retrospectively investigated patients with ABAO who underwent MT, using modern stent retrievers and an aspiration device, between January 2015 and December 2017 at 12 comprehensive stroke centers. Functional outcomes and 90-day mortality were analyzed as primary outcomes.

Results: Forty-eight patients were included. Good outcome (modified Rankin Scale mRS 0–2) was achieved in 20/48 patients and the all-cause 90-day mortality rate was 25%. Successful recanalization (modified Thrombolysis In Cerebral Infarction [mTICI] grade 2b and 3) was achieved in 47/48 patients. National Institutes of Health Stroke Scale, posterior circulation Alberta Stroke Program Early CT Score (pc-ASPECTS), DWI Brain Stem Score, mTICI ($3 > 2b$), and intracranial hemorrhage were significantly different between good and poor functional outcome groups. The occlusion site of BA was significantly different between patients with moderate outcome (mRS 0–3) versus others. We found that age, pc-ASPECTS and mTICI were significantly associated with functional outcomes in the logistic regression model.

Conclusion: MT with stent retrievers and an aspiration device for ABAO results in high successful recanalization and good outcomes. Further studies are required to confirm our results.

Keywords: basilar artery occlusion, mechanical thrombectomy, successful recanalization

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EARLY AGGRESSIVE TREATMENT OF THE OCCLUSION-UNDERLYING STENOSIS IS ASSOCIATED WITH IMPROVED OUTCOME IN PATIENTS UNDERGOING MECHANICAL THROMBECTOMY FOR BASILAR ARTERY OCCLUSION

S Nardai[1], B Kis[1], I Gubucz[1], Z Berentei[1], P Orosz[1], Z Vajda[1], A Nagy[1] and I Szikora[1]

[1]National Institute of Clinical Neuroscience, Budapest, HUNGARY

Purpose: Basilar artery occlusion (BAO) is a devastating condition characterized by high mortality and poor chances of functional recovery. Intra-cranial atherosclerotic stenosis (ICAS) is a frequent etiology of BAO, that may alter the efficacy of endovascular therapy (EVT). Our aim was to clarify the prognostic significance of ICAS in BAO patients undergoing EVT.

Materials and Methods: We performed retrospective analysis of our prospectively collected database of BAO patients treated by EVT between February 2014 and January 2019 in a single, high-volume comprehensive stroke center. We compared the baseline characteristics, procedural data and clinical outcomes of BAO cases with or without ICAS, and we studied the effect of immediate stent implantation on the clinical outcomes in BAO with occlusion-underlying

stenosis. Due to the limited local availability of dedicated intra-cranial stents We have predominantly implanted short, balloon expandable bare metal stents (BMS) (Omega, Boston Scientific INC, Marlborough, MA, USA) with or without pre-dilatation of the lesion by over-the-wire balloon (Gateway, Stryker Neurovascular INC, Minneapolis, MN, USA). Balloon expandable stents were undersized by 0,5 mm to the estimated distal reference diameter of the basilar artery, and the intended final diameter was reached applying over-dilatation under roadmap control, with high pressures preferably not exceeding the rated-burst-pressure (RBP) specified on the device's label. In two cases self-expandable stents (Solitaire AB, Medtronic INC, Dublin, Ireland) were used due to the operators' preference.

Results: We studied 91 consecutive BAO cases treated by EVT within 5 years. BAO patients with underlying ICAS ($n = 42$) were characterized by male predominance (92.86% vs. 51.02%; $p = 0.0001$), more proximal occlusions of the basilar artery (50% vs. 26.53% $p = 0.0296$), longer symptom-onset-to-reperfusion times ($p = 0.0050$), lower TICI 2b-3 reperfusion rates (66.67% vs. 89.80%; $p = 0.0093$), and higher overall mortality (HR: 2.283 $p = 0.0123$) compared to the BAO cases without ICAS ($n = 49$). The patients undergoing stenting of the occlusion-underlying stenosis with immediate administration of dual antiplatelet therapy (DAPT) ($n = 20$) had improved functional recovery (3-months mRS0-2: 40.0% vs. 9.1%; OR:6.67 $p = 0.0296$) and higher chances of survival (HR:3,533; $p = 0.0043$) compared to the ICAS patients treated without stenting ($n = 22$), despite having comparable end-procedure TICI 2b-3 reperfusion rates (75.00% vs. 59.09%; $p = 0.3377$).

Conclusion: ICAS significantly altered the prognosis of BAO patients undergoing mechanical thrombectomy (MT), while the early aggressive treatment of the occlusion-underlying stenosis with immediate stenting and DAPT was associated with improved overall survival and better functional outcomes; likely due to the more durable reperfusion of the basilar artery.

Keywords: Basilar artery occlusion, Stenting, Stroke

O 121

MECHANICAL THROMBECTOMY FOR TANDEM VERTEBROBASILAR STROKE; RECANALIZATION RATES AND OUTCOME

DJ Kim[1], SH Baik[1], BM Kim[1] and JW Kim[1]
[1]Yonsei University College of Medicine, Seoul, SOUTH KOREA

Purpose: The characteristics and treatment outcome of tandem vertebrobasilar (VB) stroke is not well known. The purpose of this study was to investigate the characteristics and outcome of mechanical thrombectomy (MT) in patients with tandem VB stroke.

Materials and Methods: Patients with acute basilar artery occlusion (BAO) who underwent MT between March 2010 and April 2019 were retrospectively analyzed. Vertebral artery (VA) steno-occlusion was considered as the mechanism of the tandem BAO when angiography revealed $> 70\%$ stenosis/occlusion of the VA with impaired distal flow or partial filling of the VA from collaterals. Clinical/angiographic characteristics, recanalization rate, procedure time and clinical outcome were analyzed.

Results: VA steno-occlusion was the cause of tandem BAO in 30 of the 105 patients (28.6%). The initial median NIHSS score was 17. The VA steno-occlusive lesion involved the orifice ($n = 21$) or distal ($n = 9$) VA. The location of the BAO was proximal ($n = 4$), mid ($n = 12$), and distal ($n = 14$) basilar artery. The uninvolved ($n = 14$) or the involved ($n = 16$) VAs were used for intracranial access. Balloon/stent angioplasty for the VA lesion was performed during the MT session in 7 of 16 patients with the involved VA approach. Overall, successful recanalization (TICI 2b-3) was achieved in 26 patients (86.7%). Symptomatic ICH was seen in 3 patients (10.0%). Good clinical outcome (3 m mRS; 0–2) and mortality were seen in 8 (26.7%) and 7 (23.3%) patients, respectively. The recanalization rate, good clinical outcome, symptomatic ICH, and mortality rates for the uninvolved and involved VA approaches were 92.9% vs 81.2% ($p = 0.60$), 35.7% vs 20.0% ($p = 0.43$), 7.1% vs 12.5% ($p = 1.00$), and 28.6% vs 20.0% ($p = 0.68$), respectively.

Conclusion: Tandem VB occlusion may be a frequent pathologic mechanism of posterior circulation stroke. Good recanalization rates and outcome may be achieved with strategic management of the BAO and the VA lesion.

Keywords: Basilar artery occlusion, tandem, mechanical thrombectomy

SESSION J: AVMs 1

O 122

3T PET-MRI ANALYSIS OF UNRUPTURED BRAIN AVMS: A SINGLE-CENTER PRELIMINARY EXPERIENCE

D Simonato[1], M Anglani[2], G Cester[2], JD Gabrieli[2], M Colasurdo[3], D Cecchin[1] and F Causin[2]
[1]Università degli Studi di Padova, Padova, ITALY
[2]Azienda Ospedaliera di Padova, Padova, ITALY
[3]Università degli Studi Chieti-Pescara, Pescara, ITALY

Purpose: Evolving neuroradiology techniques are improving regards the ability to assess the brain Artero-Venous Malformations (bAVM) angioarchitecture, nidus profile and perfusion disturbances, together with the bAVM relationship to eloquent cortical areas as well as white matter tracts. Unfortunately, such strategies cannot reliably establish the impact of bAVM on the adjacent brain metabolism.
The aim to this study is to describe the metabolic disturbances in untreated unruptured bAVMs.

Materials and Methods: Since February 2016 a total of 16 symptomatic patients (13 women, 3 men, with a median age of 33 years) with unruptured brain AVMs performed pre-

treatment 3T-PET-MRI scan (Biograph mMR Siemens) one hour after the injection of 18-Fludeoxyglucose (18-FDG) in resting conditions. Consequently, whole-brain standardized uptake values (SUV) values were analyzed, focusing on perinidal cortical tissues, homolateral lobes as well as contralateral cerebellar parenchyma.

Results: Following the analysis of 3T-PET-MRI scan group, 4 patients presented none to minimal, 10 moderate and 2 marked hypometabolism of the brain tissue surrounding of the AVM. Surprisingly, at least one case showed a significant contralateral cerebellar diaschisis. Eventually, metabolic abnormalities were prone to be more pronounced in the lesions with higher Spetzler-Martin grade.

Conclusion: Our preliminary short series showed how 18F-FDG 3T-PET-MRI could reveal metabolic disturbances of the brain metabolism in patients with unruptured bAVMs rather than pure MRI signal abnormalities, which are not strictly correlated to clinical picture. Further studies are required to better understand the possible role of 3T-PET-MRI in bAVM, in order to provide support for a proper treatment planning.

Keywords: bAVM, PET-MRI, brain metabolism

O 123

RADIOGRAPHIC VISUALIZATION PERFORMANCE OF LIQUID EMBOLIC AGENTS

J Mason[1] **and G Benndorf**[2]
[1]Baylor College of Medicine, Houston, USA
[2]Rigshospitalet, Copenhagen, DENMARK

Purpose: Liquid embolic agents (LEAs) play a major role in the treatment of cerebral arteriovenous malformations (AVMs) and dural arteriovenous fistulas (DAVFs). Injection under subtracted live fluoroscopy (Blank Road Map, RM) is the preferred technique, especially when using ethylene vinyl copolymer (EVOH) based agents. Optimal visual control during injection is of crucial importance to avoid catheter entrapment or non-target embolization and is strongly dependent on Road Map (RM) quality. Available LEAs differ in their radiopacity the main factor for visual control. We present a comparison study of radiographic visibility of various LEAs using a novel injectable angiographic phantom.

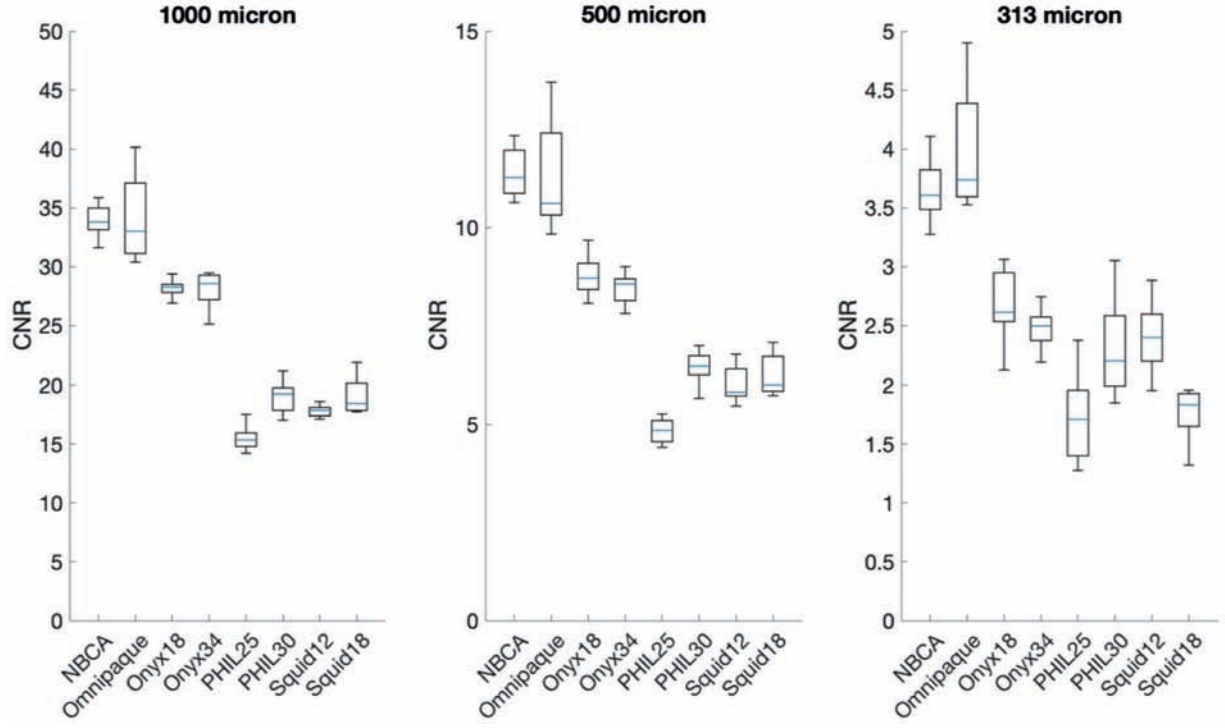
Materials and Methods: An injectable angiographic phantom was designed consisting of parallel tubings between 313 and 1000 micron. Under RM, eight radiopaque liquid agents were injected: Onyx®18, 34®, SQUID®12, 18, PHIL 25®, 30®, Trufill® (NBCA) 30% dilution and Omnipaque® 300.

The phantom was imaged using an Artis Zeego (Siemens Healthineers, Erlangen, Germany) with consistent settings (''RM Glue'', RM K40 EA3, 15 p/s). Image analysis was performed with ImageJ (NIH, Bethesda, Maryland) and Matlab (MathWorks, Inc., Natick, MA). Contrast resolution (CR) was evaluated as a contrast to noise ratio (CNR) and calculated as mean peak signal (Sa) minus mean background signal (Sb) divided by the standard deviation of the background signal (Std). (CNR = (Sa-Sb)/(Std)).

Results: Omnipaque® 300 and Trufill demonstrated significantly the highest CNR (CNR 11.3-11.4 at 500 micron and CNR 34.1-34.2 at 1000 micron).

Onyx ®18 and Onyx ®34 (8.5–8.8 at 500 micron and 28.1–28.2 at 1000 micron) both showed significantly higher CNR than all SQUID® and PHIL® concentrations. There was no significant difference between SQUID ®12, SQUID®18, and PHIL®30 (CNR 6–6.4 at 500 micron and CNR 17.8-19 at 1000 micron).

PHIL®25 (CNR 4.8 at 500 micron and CNR 15.4 at 1000 micron) demonstrated the lowest CNR for all measurements.



CNR results were consistent across 1000 and 500 micron tubing sizes with minor variation at 313 micron.
Conclusion: There is significant variability in CR for the various LEAs under the RM conditions used in this study. Significantly different CR between most LEAs (except Trufill®) and iodinated contrast media was evident and should be considered prior to injection. Knowledge and understanding of different visualization performance among various LEAs are important to avoid non-target vessel embolization. Subsequent studies are needed to further establish this method for improving image quality and increase patient's safety during EVT of cerebral AVMs and DAVFs.
Keywords: Liquid Embolics, Contrast Resolution, Roadmap

O 124

MULTIMODAL CEREBRAL ARTERIOVENOUS MALFORMATION TREATMENT: A 12-YEAR COHORT WITH COMPARISON TO THE ARUBA TRIAL

B Pulli[1], PH Chapman[2], CS Ogilvy[3], CJ Stapleton[2], AB Patel[2], TM Leslie-Mazwi[2,4], JA Hirsch[1] and JD Rabinov[1,2]
[1]Massachusetts General Hospital, Neuroradiology Division, Boston, MA, USA
[2]Massachusetts General Hospital, Department of Neurosurgery, Boston, MA, USA
[3]Beth Israel Deaconess Medical Center, Neurosurgical Service, Boston, MA, USA
[4]Massachusetts General Hospital, Department of Neurology, Boston, MA, USA

Purpose: Research examined safety and efficacy of multimodal treatment of Bran AVMs in a 12 year cohort of patients at our institution with 5 year follow up. Comparison with key outcomes of the ARUBA Trial was evaluated.

Table 1. Key Clinical Outcomes – Comparison to ARUBA

	ARUBA eligible (N=142)	ARUBA intervention (N=106) *	P-value†	ARUBA medical management (N=120) *	P-value‡
Complete AVM obliteration (%)	80 (56.3%)	47 (44.3%)	0.073	n/a	n/a
mRS 0-1 at 5 years (%)	54/62 (87.1%)	25/42 (59.5%)	**0.002**	45/54 (83.3%)	0.607
Disability (mRS ≥2) at 5 years (%)	5/62 (8.1%)	13/42 (31.0%)	**0.004**	7/54 (13.0%)	0.54
Symptomatic stroke (ischemic or hemorrhagic) (%)	13 (9.2%)	42 (39.6%)	**0.0001**	11 (9.2%)	1.000
Death (%)	3 (2.1%)	4 (3.8%)	0.465	2 (1.7%)	1.000

mRS modified Rankin Scale. * 5-year data from personal communication with J.P. Mohr MD. †ARUBA eligible vs. ARUBA intervention arm (as treated). ‡ARUBA eligible vs. ARUBA as-treated medical management arm. All comparisons were performed with Fisher exact test.

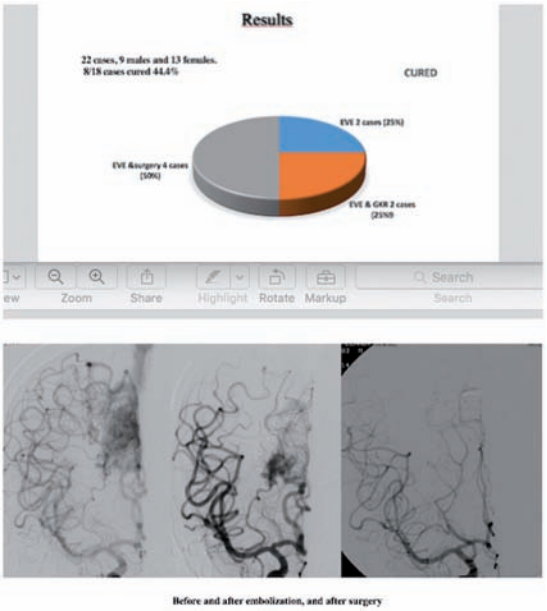
Materials and Methods: Retrospective analysis was performed on 318 consecutive adult patients with brain AVMs treated at our institution with embolization, surgery, and/or proton-beam radiosurgery. Sub-analysis was completed on 142 ARUBA eligible patients (baseline mRS 0–1, no history of hemorrhage), and results were compared to primary and secondary outcomes from ARUBA, as well as to natural history cohorts.
Results: Annualized stroke rate (hemorrhagic or ischemic) in our cohort was 1.8%, 4.9% in the first 12 months, and 0.8% after the first 12 months, lower than natural history studies and the ARUBA medical management arm ($p = 0.001$). The primary ARUBA endpoint (symptomatic stroke or death) was reached in 13 patients (9.2 %), which compares favorably to the ARUBA intervention arm (39.6%, $p = 0.0001$) and is similar to the ARUBA medical management arm (9.2%, $P = 1.0$). The secondary ARUBA endpoint (mRS 2–6 at 5 years follow-up) was reached in 14.3% of patients compare to 40.5% in the ARUBA intervention arm ($p = 0.002$) and 16.7% in the ARUBA medical management arm ($p = 0.6$).
Conclusion: Our multimodal approach to brain AVM patient selection and treatment yields good clinical outcomes with key safety endpoints (stroke, death and mRS 0–1). Treatment outcomes in this cohort of asymptomatic Brain AVMs are better than the ARUBA intervention arm and similar to the ARUBA medical arm at 5 years follow-up. Results compare favorably to natural history cohorts at longer follow-up times. This suggests that tertiary care centers with integrated programs, expertise in patient selection and individualized treatment approaches may allow for better clinical outcomes than reported in ARUBA. It supports current registry studies and merits consideration of future randomized controlled trials of brain AVM patients.
Keywords: Embolization, Surgery, Radiosurgery

O 125

MANAGEMENT STRATEGIES FOR COMPLEX BRAIN ARTERIO-VENOUS MALFORMATIONS, EARLY EXPERIENCE

W Aziz[1]
[1]Faculty of medicine, Alexandria University, Alexandria, EGYPT
[2]Mediclinic hospitals, Dubai, UNITED ARAB EMIRATES

Purpose: To report our experience in the treatment of complex brain arteriovenous malformations.



Before and after embolization, and after surgery

Materials and Methods: From November 2010 to Agust 2017, 22 patients with brain arteriovenous malformations were treated endovascularly. They were 9 men and 13 women with a mean age of 32 years. A total of 34 endovascular procedures were performed with Onyx or Squid embolic agent.
Results: The course of endovascular treatment was completed in 18 patients. In 8 patients, an angiographic cure was achieved using embolization as the sole therapeutic technique. 6 patients underwent radiosurgical treatment after nidal size reduction <2 cm was accomplished by endovascular treatment. 4 cases underwent surgery after embolization. Further endovascular treatment was planned in 4 patients, Procedure-related transient neurologic deficits were observed in 1 patient, experienced mild transient hemiparesis resolved soon after treatment. There was no procedure related permanent morbidity or deaths.
Conclusion: Liquid embolic material allows obtaining higher rates of anatomic cures compared with those obtained previously with other embolic agents in the treatment of brain arteriovenous malformations.
Keywords: arterio-venous malformtion, strategies, brain

O 126

MORBIDITY AND MORTALITY ASSOCIATED WITH SEQUENTIAL FLOW REDUCTION EMBOLIZATION TECHNIQUE OF CEREBRAL ARTERIOVENOUS MALFORMATIONS WITH N-BUTYL CYANOACRYLATE (N-BCA)

A Alaraj[1], M Mohammaden[1], D Brunozzi[1], G Atwal[1] and F Charbel[1]
[1]Univeristy of Illinois at Chicago, Department of Neurosurgery, Chicago, USA

Purpose: Endovascular embolization of cerebral arteriovenous malformations (AVM) with liquid n-butyl cyanoacrylate (n-BCA) serves multiple purposes including flow reduction in preparation for other treatment modalities. The objective is to study the clinical, structural and angiographic factors affecting complications associated with (n-BCA) AVM embolization, using a sequential flow reduction embolization technique followed by surgical resection, radiosurgery or embo for cure.
Materials and Methods: We performed a retrospective review of all patients who underwent endovascular embolization of cerebral AVM at our institution between 1998 and 2018. Patient underwent embolization of high risk features first including perinidal aneurysms, intranidal fistula, followed by multiple pedicles per each session. Patient had multiple sessions of embolization separated by 2–3 weeks intervals.
Results: Among 212 patients who underwent 509 sessions, 47.9 % of patients presented with ruptured AVM, those Patients were significantly older in age (years) 41.6 vs. 35.7 in non-ruptured group ($P = 0.001$), and had a significantly higher incidence of infratentorial AVM ($P < 0.001$), AVM in eloquent area ($P = 0.01$) and of small size (cm) (2.8 vs. 3.3, $P < 0.0001$), also ruptured AVM was significantly associated with presence of flow related aneurysm(either feeder or intranidal) 42 vs.26, $P = 0.008$. The mean number of procedure session per patient is 2.4. The permanent morbidity of n-BCA embolization occurred in 5 (2.4%) patients while the mortality (1.9 %) of total patients with all morbidity and mortality were related to hemorrhagic complications. Among demographic, clinical and angiographic factors related to occurrence of complications, younger age, un-ruptured, supratentorial AVM and presence of nidus fistula had higher complication rates however not statistically significant. Complete AVM cure by embolization and mean number of embolization sessions were not significantly different between patients who developed complications and who did not, $P = 0.16$ and $P = 0.12$, respectively. Since 2008 only 2 patients among 43 who was treated by n-BCA embolization developed complications (asymptomatic SAH and Intracerebral hemorrhage that caused mild neurological deficit.
Conclusion: Risk factors of AVM rupture are old age, AVM that are infratentorial, in eloquent area, small in size, with flow related aneurysms and without nidus fistula. Embolization with n-BCA for the safe of flow reduction is safe with low overall morbidity and mortality which were not significantly associated with demographic, structural and angiographic features of AVM.
Keywords: Flow reduction, Complications, NBCA

O 127

PRE-OPERATIVE EMBOLISATION OF ARTERIOVENOUS MALFORMATIONS (AVMS) USING THE PRECIPITATING HYDROPHOBIC INJECTABLE LIQUID (PHIL) EMBOLIC AGENT IN A SAME DAY DUAL PROCEDURE: A CASE SERIES

J Siddiqui[1], P Grover[2], M Murphy[2] and P Rangi[1]
[1]Lisholme Department of Neuroradiology, National Hospital for Neurology and Neurosurgery, London, UNITED KINGDOM
[2]Department of Neurosurgery, National Hospital for Neurology and Neurosurgery, London, UNITED KINGDOM

Purpose: Pre-operative embolisation can be used to facilitate surgical management of cerebral arteriovenous malformations (AVMs). Precipitating hydrophobic injectable liquid (PHIL) is a relatively new embolic agent, favoured in AVM treatments due to its physical properties enabling deep nidal penetration. This analysis investigates the AVM characteristics, imaging and clinical outcomes and risks of preoperative AVM embolisation using PHIL in a case series.

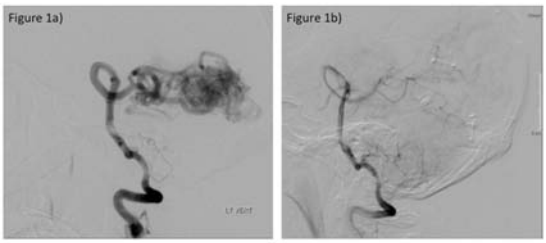


Figure 1 a) (left) and b) (right) demonstrates the pre- and post-procedural angiograms respectively, specifically left vertebral angiogram lateral views, showing a moderate-sized occipital AVM cured by PHIL embolisation followed by surgical excision

Materials and Methods: A retrospective analysis of our departmental database was performed from 1st January 2016 to 31st December 2018, searching for all patients undergoing AVM embolisation with PHIL followed by immediate, same day surgical excision. Patients with arteriovenous fistulae were not included. Seven patients fit the selection criteria over the timeframe. All cases had undergone multidisciplinary discussion at the institution's neurovascular specialist meeting. In addition, risks and benefits were discussed at length with all patients in a multidisciplinary, complex neurovascular clinic, prior to consent and procedure. This technique is reserved for complex cases, where isolated treatment with gamma knife, embolisation or surgery alone is unlikely to give a durable outcome.

Results: Mean AVM volume was 24.2cm3 and the median combined Spetzler Martin/ Lawton Young supplementary grading was 6. Average number of feeding pedicles embolised was 1.6. Most patients (6/7; 85%) were followed up with diagnostic cerebral angiogram ranging from 9 days to 18 months following the procedure. One patient has so far had MRI follow up only six months following the procedure. Latest clinical follow up occurred from four to eighteen months following the procedure. Post-procedural CT was performed in all patients, with no haemorrhage demonstrated post embolisation. Following embolisation and surgery, all patients achieved complete AVM occlusion with no AVM visible on follow up imaging (see figure 1). No recurrences were seen. One patient suffered a post-operative CSF infection, requiring antibiotic treatment. No ischaemic complications were seen. Unexpected adverse sequelae occurred in 1/7 (14%) patients, where transient neurological deficit was seen, namely aphasia and weakness, which improved within four months.

Conclusion: All seven AVMs treated with PHIL embolisation followed by excision in this series achieved radiological cure, with no residual or recurrent disease demonstrated. This highlights the exciting potential of this technique in the management of complex AVMs. An unexpected transient neurological deficit was seen in one patient. As with all neurovascular procedures, the importance of clear and informed consent regarding potential risks is emphasised. Larger series are needed to assess the efficacy, durability and safety profile of this technique.

Keywords: AVM, PHIL embolic, Embolisation

O 128

INITIAL EXPERIENCE WITH MICRO VASCULAR PLUG FOR THE TREATMENT OF GRADE 4 AND 5 CEREBRAL ARTERIOVENOUS MALFORMATIONS (AVMS)

A Rustici[1], L Cirillo[2,3], M Dall'olio[2], C Princiotta[2] and M Cellerini[2]

[1]Università degli Studi di Ferrara, Ferrara, ITALY
[2]IRCCS – Istituto delle Scienze Neurologiche di Bologna, Bologna, ITALY
[3]Università degli Studi di Bologna, Bologna, ITALY

Purpose: Cerebral Arteriovenous Malformations (AVMs) are uncommon vascular lesions and their management is controversial. In fact, cerebral AVMs represent unique challenges for interventional neuroradiologist and neurosurgeons, even if these lesions have traditionally been treated with surgical resection, the technical advancements in endovascular therapies have greatly expanded these options, improving the effectiveness and safety of endovascular embolization. A relevant number of new techniques, materials and devices have recently developed in the endovascular field. We describe a novel approach to the treatment of grade 4 and 5 brain AVMs using the Medtronic Micro Vascular Plug™ (MVP) for the selective presurgical occlusion of high flow intranidal direct AV shunt. This technique may allow a complete and gradually progressive angiographic obliteration of intranidal high-flow direct AV shunt in a single treatment session. There are few retrospective studies on this relatively new device. The aim of this report is describing our preliminary experiences in a small series of patients.

Materials and Methods: This retrospective single-center case series includes all 3 patients with grade 4 and 5 cerebral AVMs treated with the MVP between September 2016 and November 2018 in our institution. In all cases, 3 devices were deployed and used as the sole device. All procedures were carried out on a biplane angiography system (Allura XPer FD20/20; Philips). The target vessel diameters were assessed using the 3D angiography acquisition performed before treatments.

Results: In all cases (3 of 3 devices deployed), the target vessel was reached, and the device was deployed at the intended site, whit no residual flow between the device and vessel for the appropriate sizing. An instantaneous reduction of blood flow was observed in all cases after device deployment. Follow-up examinations by CT, DSA and MRI showed persistent occlusion of the target vessel in all cases.

Conclusion: The present series of cases shows that the MVP is a suitable instrument for the selective occlusion of high-flow direct intranidal AV shunts in grade 4 or 5 cerebral AVM. One main advantage of the MVP is its compatibility whit most of the microcatheters. The microvascular plug offers potential advantages, in fact compared to liquid embolic materials, it does not carry the risk of propagation into remote distal parenchymal branches. In conclusion, it is

a fast, safe and relatively cheap way to progressively occlude high-flow direct intranidal AV shunts. Further studies are needed to assess the long-term outcome in a larger number of patients treated with this device.
Keywords: Micro Vascular Plug, Arteriovenous Malformation, high flow intranidal shunt

O 129

TRANSVENOUS EMBOLIZATION FOR BRAIN ARTERIOVENOUS MALFORMATIONS: CURABILITY VS SAFETY?

Y He[1], W Bai[1] and T Li[1]
[1]Cerebrovascular Division, Interventional Center, Henan Provincial People's Hospital, Zhengzhou University, Zhengzhou, CHINA

Purpose: Transvenous embolization for brain arteriovenous malformations (AVMs) seems to be a developing method with high curability. However, due to the very limited data, the transvenous embolization is still considered an unproven salvage therapy. The purpose of this study was to explore the safety and curability of transvenous embolization treatment.
Materials and Methods: Between November 2016 and November 2018, consecutive patients with brain AVMs who underwent transvenous embolization therapy were prospectively followed. Therapeutic decision making was based on Spetzler-Martin grades and angioarchitecture. The safe was evaluated by the procedure-related complications occurred within 1 month, and the curability was evaluated by complete angiographic obliteration of the AVMs nidus on the follow-up.
Results: Twenty three patients (16 male and 7 female, mean age 28 ± 16.6) with were enrolled. The Spetzler-Martin grades before the transvenous embolization session were high for 15 (65.2%). The lesions were deeply seated in 20 (87%) and in eloquent locations in 18 (78.3%) of cases. The pre-operative modified Rankin scale score (mRS) was 0–2 for 14 (60.9%), and 11 (47.8%) patients also had deep venous drainage.
The procedure was technically feasible in 21 (91.3%) cases, two patients didn't get transvenous embolization duo to the failure of microcatheter navigation, and 18 (78.3%) patients had immediate angiographic occlusion. Procedure-related complications were 7 (30.4%), including 6 (26.1%) hemorrhages and 1 (4.3%) infarction, which caused 1 (4.3%) disability and 2 (8.7%) death. Significant difference of the complication rate was found between deep and superficial venous drainage ($P = 0.024$). The median angiographic follow-up for all 14 surviving patients was 5.5 (3–15) months, and 13 (92.9%) complete obliteration of the nidus conformed. Among them 1 patient in whom immediate angiographic occlusion was not achieved showed spontaneous occlusion at the 13-month follow-up. The median clinical follow-up for all 21 surviving patients was 16 (1–25) months. Beyond 1 month, epilepsy occurred in one patient, and the mRS scores of all follow-up patients except one were less 2.
Conclusion: This prospective study demonstrates that transvenous embolization for brain AVMs may have a high rate of complete brain AVMs obliteration but also a high rate of procedure-related disabling and fatal complications, which need further investigation before expansion to other centers.
Keywords: AVM, Transvenous Embolization, Curability

O 130

FORCED INJECTION OF PHIL LIQUID EMBOLIC AGENT BY DUAL LUMEN BALLOONS IN TREATMENT OF COMPLEX ARTERIOVENOUS FISTULAS – SINGLE CENTRE, SINGLE OPERATOR EXPERIENCE

L Borota[1]
[1]Uppsala University Hosapital, Uppsala, SWEDEN

Purpose: To demonstrate efficacy of forced injection of Phil liquid embolic agent by dual lumen balloon catheters in treatment of complex arteriovenous fistulas.
Materials and Methods: In total 15 patients have been treated for their fistulas: two patients for high-flow head and neck fistulas and 13 patients for dural arteriovenous fistulas. There were in total 20 interventions. In 9 cases newly diagnosed fistula was embolized in one session, in one case in two sessions and in one case in three sessions. In remaining four cases re-canalized fistulas were embolized. In all cases forced injection of PHIL embolic material by dual lumen balloon catheter was applied in order to embolize the fistula and to prevent the reflux of embolic material along the catheter.
Results: In eleven patients the aim of the treatment, occlusion of the fistula, was achieved in one session, in one patient in two sessions and in one patient in three sessions. All re-canalized fistulas were occluded in one session. One complication was registered: unintended injection of the Phil in nutritive arteries of the nerves of jugular foramen caused minor disturbances of the sensitivity in the tongue.
Conclusion: The forced injection of the Phil embolic agent by dual lumen balloon catheter enhances penetrability of this liquid embolic agent and this way contributes to faster embolization of entire fistula, lower dose of irradiation, better control of injection of embolic material, more predictable course and better outcome of the intervention. In order to augment penetrability of this agent, to prevent reflux of the embolic material and to achieve complete occlusion of particularly complex segments of these fistulas.
Keywords: arteriovenous, fistulas, PHIL

O 131

CRANIAL PIAL ARTERIOVENOUS FISTULAE – A SERIES OF 41 CASES

LJD Sebastian[1], N Jain[1], PK Thimmegowda[1], A Garg[1] and SB Gaikwad[1]
[1]All India Institute of Medical Sciences, New Delhi, INDIA

Purpose: 1. To analyze the angiographic features and their clinical correlates of cranial pial arteriovenous fistulae (CPAVF) 2. To analyze the implications of clinical presentation and angioarchitecture in the management and outcome of our set of CPAVF patients.
Materials and Methods: From our Departmental neurovascular database 41 cases of CPAVF who presented during 2005 to April, 2019 were identified. Details on demographics, clinical presentation, imaging, management and follow up were obtained for each patient. Angiographic records were independently reviewed by two neuroradiologists for location, type of fistula, venous varix, arterial feeders, venous drainage, pial venous refflux, venous ectasia/stenosis/thrombosis and status of dural sinuses.
Results: Of the 41 patients (Mean age 16.9 yrs) 29 were males. Seventeen patients were more than 18 yrs at presentation. Seizures (24/41) were the leading cause of presentation followed by acute intracranial bleed (18). Imaging showed venous varix in 39 cases with 20 of them showing wall calcification. Fresh or old bleed, focal atrophy and local edema were among other imaging findings. DSA showed 56 fistulae (in 41 patients)- 35 single hole and 21 multihole fistulae. Arterial angiopathic changes were seen in a minority of cases (8) in contrast to venous angiopathy (29). Size of the venous varix and presence of calcification were inversely related to presentation with bleed, the correlation reaching statistical significance. Dural sinus thrombosis or stenosis were seen in 14 cases. Transarterial embolization was the preferred treatment modality (36/37) with good angiographic and clinical outcome in 86% of patients. Post procedure complications included normal pressure breakthrough bleed in 2 patients, sub-arachnoid hemorrhage in 2, sinus thrombosis in one and increased seizure frequency in 3 patients. One patient died after embolization. One patient was treated by radiosurgery with good outcome.
Conclusion: Our series is distinctive for the presence of higher number of adults at presentation.
Smaller non calcified venous varix is significantly associated with bleed. Endovascular embolization is safe and effective in the treatment of CPAVF.
Keywords: Pial AVF, High Flow Fistula, Glue Embolization

O 132

RECURRENCE OF BRAIN ARTERIOVENOUS MALFORMATIONS FOLLOWING APPARENT ANGIOGRAPHIC CURE

S Hetts[1], A Copelan[1], R Khangura[1], G Drocton[1], M Amans[1], A Abla[1], N Gupta[1], H Fullerton[1], C Dowd[1], V Halbach[1], R Higashida[1], H Kim[1], J Nelson[1] and D Cooke[1]
[1]UCSF, San Francisco, USA

Purpose: Arteriovenous malformation (AVM) recurrence following complete obliteration on post-therapy cerebral angiography is thought to be rare but has been described predominantly in children. As one of the highest volume AVM centers in the world, we present our own experience with this entity and offer insights into risk factors for recurrence and recommendations for follow up.
Materials and Methods: We retrospectively reviewed 433 consecutive patients from 1996–2017 at our institution who underwent post-operative cerebral angiography following treatment of a brain AVM with surgery, gamma knife, endovascular, or combination therapy. One-hundred ten patients were excluded as angiographic cure was not achieved, giving us a total of 323 patients. Recurrence was defined as a new AVM within or immediately adjacent to the treatment bed on follow up catheter cerebral angiography.
Results: AVM recurrence was demonstrated in 5.9% of patients (19/323) with previously documented angiographic cure. In those with recurrence, the mean patient age at initial treatment was 9.4 years (range, 3–19 years) and at time of angiographic recurrence was 13.5 years (range, 4–25 years). Initial presentation with hemorrhage was seen in 94.7% (18/19) and deep location with deep venous drainage in 84.2% (16/19). While 73.7% (14/19) of recurrences were incidental at follow up, 26.3% (5/19) presented with repeat intracranial hemorrhage.
Conclusion: AVM recurrence after complete angiographic obliteration is not an insignificant risk, particularly in the pediatric population. While the majority of recurrences are discovered incidentally at angiographic follow up, patients may present with a more ominous clinical picture, including recurrence of intracranial hemorrhage. At a minimum, a 5 year follow up angiogram is recommended for those patients initially treated prior to 18 years of age.
Keywords: AVM recurrence, Angiography, Pediatrics

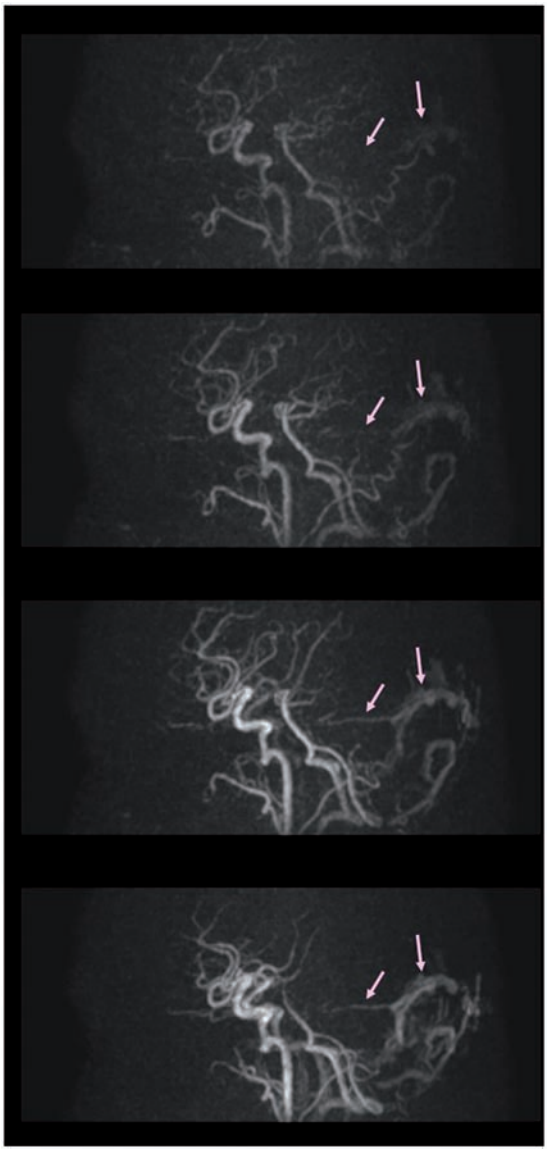
SESSION K: Dural AVFs 1

O 133

APPLICATION OF FOUR-DIMENSIONAL MAGNETIC RESONANCE ANGIOGRAPHY WITHOUT CONTRAST ENHANCEMENT FOR INTRACRANIAL DURAL ARTERIOVENOUS FISTULAS

K Tokairin[1], T Osanai[1], N Fujima[2] and K Houkin[1]
[1]Department of Neurosurgery, Hokkaido University Graduate School of Medicine, Sapporo, JAPAN
[2]Department of Diagnostic and Interventional Radiology, Hokkaido University Hospital, Sapporo, JAPAN

Purpose: The digital subtraction angiography (DSA) is gold standard modality for hemodynamic evaluation in intracranial dural arteriovenous fistula (dAVF) and is necessary for precise diagnosis and treatment strategy of dAVF. However, it is invasive and cannot be ignored of repetitive DSA during follow-up period whether or not the treatment is performed. In recent years, the technology of four-dimensional magnetic resonance angiography (4D-MRA) which can reflect temporal resolution have been reported in intracranial diseases such as moyamoya disease or arteriovenous malformation. Thus, we aimed to apply this technology for intracranial dAVFs and to evaluate its usability.
Materials and Methods: From February 2018 to December 2018, 8 patients who were diagnosed as intracranial dAVF by DSA were enrolled to this study. They underwent 4D-MRA at almost same time of DSA. 4D-MRA was performed without contrast enhancement by 3.0-tesla scanner (Achieva TX, Philips Medical Systems, Bets, Netherland). The pulsed arterial spin labeling was performed using echo planar imaging and signal targeting with alternating radiofrequency (EPI-STAR) technique. Image acquisition was performed using look-locker sampling. A total of eight phases were acquired between 200 and 1250 milliseconds after labeling. A turbo-field echo-planar imaging (TFEPI) sequence was used as readout. 4D-MRA findings was evaluated by venous drainage route visibility and compared with DSA findings.
Results: Average age of objected patients was 66.6 (24–83) years-old. Seven patients were performed DSA and 4D-MRA before the treatment or as control of observation, while the other was performed after treatment. The lesion varied as follows; 1 superior sagittal sinus, 2 anterior condylar confluence, 4 transverse and/or sigmoid sinus and 1 traumatic middle meningeal AVF. Venous sinus drainage route and cortical venous reflux route were visualized by 4D-MRA which were mostly corelated with DSA findings in all 7 patients who had not been treated at the time.
Conclusion: 4D-MRA without contrast enhancement is less-invasive and allows repetitive taking. 4D-MRA has the possibility of effective modality in intracranial dAVF management such as detecting chronological hemodynamic change or monitoring post-treatment recurrence.



Keywords: dural arteriovenous fistula, magnetic resonance angiography, catheter angiography

O 134

INTRACRANIAL DURAL ARTERIOVENOUS FISTULAE: AN INSTITUTIONAL EXPERIENCE AND PROPOSAL OF A NEW FUNCTIONAL CLASSIFICATION SYSTEM

LJD Sebastian[1], A Jain[1], PK Thimmegowda[1], A Garg[1] and SB Gaikwad[1]
[1]All India Institute of Medical Sciences, New Delhi, INDIA

Purpose: 1. To retrospectively analyze the angioarchitecture and clinical presentations of cranial dural arteriovenous fistula and their implications in the management and outcome.
2. To develop a new comprehensive classification system which can better explain clinical features and help devise optimal management strategies.

Materials and Methods: Clinical, imaging and angiographic records of all the patients with intracranial dural arteriovenous shunts who presented to the Department of Neuroimaging and Interventional Neuroradiology, AIIMS, New Delhi, in the period between January 2005 and August 2015 were analysed retrospectively. Clinical presentation was categorised into aggressive, intermediate or benign severity. Digital subtraction angiograms were analysed for topographic location of the lesions, arterial feeders, venous drainage pattern and the presence of cortical and leptomeningeal reflux and strain. These angioarchitectural features formed the basis for a new classification and were correlated with clinical presentation. Dural sinus shunts (DSS) and extra sinus shunts (ESS) are the major categories based on venous drainage. Focal cortical venous ectasia or congestion indicated cortical venous strain (CVS) while parenchymal venous strain (PVS) was identified by tortuous, engorged pial/medullary veins. Records also were reviewed for treatment modality administered and for angiographic and clinical outcome.
Results: Out of the 59 patients (male: female = 44:15, mean age −42.8 years), 24 (40.66%) presented with aggressive symptoms while 13 (22%) and 22 (37.28%) patients presented with intermediate and benign symptoms respectively. Of the 33 patients (55.9%) with dural sinus shunts 16 patients had cortical venous reflux (CVR). Among them, CVS and PVS were seen in 10 of whom 5 had aggressive clinical presentation. Six patients with PVS only had intermediate symptoms. Six out of 17 patients without CVR had PVS and presented with symptoms of raised pressure. Overall, in DSS presence of CVR had significant correlation with haemorrhage ($p < 0.05$) while PVS correlated significantly with raised intracranial pressure. Majority of the 26 patients with extra sinus shunts presented with aggressive symptoms (77%). Treatment and outcome details are available for 42 patients. Thirty-three patients were treated by endovascular embolization and 93% of them showed clinical improvement.
Conclusion: Classification of CDAVFs into dural sinus shunts and extra sinus shunts with consideration of parenchymal and cortical venous strain was more practical and correlated well with clinical severity. Endovascular therapy appears to be effective for the treatment of intracranial dural fistulae with low complication rates.
Keywords: Dural AVF, Onyx Embolization, Transvenous embolization

O 135

ENDOVASCULAR EMBOLIZATION OF 103 CRANIAL DURAL ARTERIOVENOUS FISTULAS WITH ONYX: AN OBSERVATIONAL STUDY WITH ANALYSES OF OCCLUSION RATES, COMPLICATION RATES AND THE INFLUENCE OF ANGIOARCHITECTURAL FEATURES ON THE TREATMENT SUCCESS

D Vollherbst[1], C Herweh[1], S Schönenberger[2], F Seker[1], S Nagel[2], P Ringleb[2], M Bendszus[1] and M Möhlenbruch[1]
[1]Heidelberg University Hospital, Department of Neuroradiology, Heidelberg, GERMANY
[2]Heidelberg University Hospital, Department of Neurology, Heidelberg, GERMANY

Purpose: Endovascular embolization can be an effective treatment for dural arteriovenous fistulas (DAVF). However, a considerable number of DAVFs still cannot be treated sufficiently. The purpose of this study was to report our single-center experience of endovascular embolization of DAVFs with Onyx including the investigation of the influence of angioarchitectural features on the treatment success.
Materials and Methods: Clinical data, angiographic features, complications, treatment success (defined as complete symptom remission for low-grade DAVFs and complete angiographic occlusion for high-grade DAVFs), and occlusion rates were assessed. The influence of angioarchitectural factors (e.g. location, type and grade of the DAVF, cortical venous drainage, involved feeder territories and number of feeding arteries) on the treatment success was assessed.
Results: 97 patients with 103 DAVFs were treated in 124 treatment procedures. The treatment success and complete occlusion rates were 81.6% and 90.2%, respectively. Most of the DAVFs were located at the transverse and/or sigmoid sinus (40.8%), followed by tentorial/petrosal location (23.3%). The majority of DAVFs were high-grade fistulas (Cognard III-IV / Borden III; 72.8%). The predominant feeder territories were the middle meningeal artery (87.4%) and the occipital artery (75.7%). The ascending pharyngeal artery was involved in 25 (24.3%) DAVFs. After a mean follow-up of 20.6 months, 95.1% of the patients showed complete symptom remission or symptom relief. The overall complication rate was 8.9% (4.8% asymptomatic, 2.4% transient and 1.6% permanent complications with fatal outcome). Three of the investigated parameters showed significant influence on the treatment success: the grade of the DAVF ($p = 0.050$), involvement of the ascending pharyngeal artery ($p = 0.021$) and the number of feeding arteries ($p = 0.039$). The odds ratios were 3.06 (95% CI: 0.89–9.9) for a low grade of the DAVF, 3.15 (95% CI: 1.01–9.05) for involvement of the ascending pharyngeal artery, and 3.08 (95% CI: 1.01–8.24) for 10 or more than 10 feeding arteries. Treatment success tended to be higher for DAVFs located at the torcular and at the superior sagittal sinus as well as for DAVFs with 5 or more than 5 feeder territories, however, without reaching statistical significance.

Conclusion: Endovascular embolization of DAVFs with Onyx is effective and safe. A low grade, multiple feeding arteries and involvement of the pharyngeal artery are negative prognostic factors for treatment success.
Keywords: Dural arteriovenous Fistula, Embolization, Onyx

O 136

TRANS ARTERIAL EMBOLIZATION OF INTRACRANIAL DURAL ARTERIOVENOUS FISTULAS IN THE ONYX EMBOLIC ERA: A KOBE EXPERIENCE

Y Omura[1], H Imamura[1], S Tani[1], H Adachi[1], R Fukumitsu[1], T Sunohara[1], N Fukui[1], N Sasaki[1], T Akiyama[1], T Fukuda[1], S Kajiura[1], M Shigeyasu[1], K Asakura[1], R Horii[1] and N Sakai[1]
[1]Kobe City Medical Center General Hospital, Kobe, JAPAN

Purpose: Endovascular transarterial Onyx embolization with balloon assisted flow reduction technique 'damp and push technique' was described as a promising treatment technique for dural arteriovenous fistulas. The purpose of this study was to evaluate the technical efficiency and safety of this treatment technique.
Materials and Methods: Six patients diagnosed with intracranial dAVF were treated by transarterial Onyx embolization with damp and push technique between April 2016 to December 2017. Prospectively collected data were reviewed to assess the obliteration and complication rate, clinical outcome.
Damp and push technique was designed to reduce blood flow of shunt site by using balloon catheter on the major feeder other than Onyx injection feeder, in order to obtain more superior Onyx penetration to the feeders, thereby enabling a more safety and controlled Onyx embolization in complex intracranial dAVFs.
Results: Dural AVF was located at the transverse sinus-sigmoid sinus in the 3 patients, the superior sagittal sinus in the 2 patients, the tentorium in 1 patient. There were 3 cases of Cognard type2a + b, 2 cases of Cognard type4, 1 case of Cognard type2b. 1 All patients were treated with transarterial Onyx injection combined other ECA feeder flow reduction by the double lumen balloon catheter. In all cases, MMA or OA were related to the fistula as the main feeding artery and Onyx were injected via MMA in 5 cases and OA in 1 case. In addition, the blood vessel for blood flow reduction of fistula was the ipsilateral OA in the 3 cases and contralateral MMA in the 2 cases, ipsilateral MMA in a case. Complete occlusion was achieved in 5 cases and optimal occlusion was obtained in all cases. There were no immediate or delayed postinterventional complication.
Conclusion: Transarterial Onyx embolization with damp and push technique of dural AVF is safe and afford a high complete occlusion rate of complex intracranial dAVF.
Keywords: dural AVF, ONYX, transarterial embolization

O 137

PRELIMINARY EXPERIENCE OF ENDOVASCULAR EMBOLIZATION OF CEREBRAL DURAL ARTERIOVENOUS FISTULAS WITH SQUID 12

E Lozupone[1], P Trombatore[1], L Milonia[1], F D'argento[1], A Alexandre[1], I Valente[1], C Colosimo[1] and A Pedicelli[1]
[1]Fondazione Policlinico Universitario A. Gemelli IRCCS, UOC Radiologia e Neuroradiologia, Roma, ITALY

Purpose: Cerebral dural arteriovenous fistulas (cDAVF) are pathologic dural-based shunts and account for 10%–15% of all intracranial arteriovenous malformations. Endovascular therapy with EVOH embolic agents is currently the gold standard for the treatment of these acquired vascular malformation. SQUID 12 is a new generation of EVOH polymer which differs from the other EVOH agents in terms of lower viscosity.
Materials and Methods: Between June 2017 and January 2019 the authors retrospectively reviewed clinical, demographic and embolization data of 13 consecutive patients (8 F, 5M; median age 61 yrs-old, range 37–80) with cDAVF (3 IIb, 5 Cognard III, 5 Cognard IV) who underwent embolization using the SQUID 12. Four patients were symptomatic for headache, two patients presented with vertigo and confusion, two patients with tinnitus, one patient with bruit, one patient with aphasia; three patients were asymptomatic. No hemorrhage were detected. The number of arteries catheterized for embolization, the total amount of embolic agent, the rate of occlusion, the time of the procedure and the rate of complication were recorded. Mid-term follow-up with MR and DSA is reviewed.
Results: In 11 patients, the cDAVF closure was accomplished at the end of the procedure; in one case a double staged treatment was performed while in one case a small remnant was left. The average time of injection was 36 minutes (range, 15–82 minutes), and the average amount of SQUID 12 was 2,8 mL (range, 0.5–6 mL). One patient with a cDAVF of traverse sinus region (Cognard III) experienced a facial palsy which resolved after 2 weeks of corticosteroids; no other periprocedural complication nor delayed complications were recorded.
Mid-term MR and angiographic follow-up confirmed complete occlusion of the cDAVFs in 12 patients; in 1 patients with a infratentorial a small relapse was detected.
Conclusion: The treatment of the DAVFs by using SQUID 12 seems to be effective and safe. The lower viscosity allow a distal migration of the agent, a lesser proximal reflux and a deeper penetration in the cDAVF.
Keywords: dural arteriovenous fistulas, SQUID 12

O 138

TRANSARTERIAL BALLOON-ASSISTED LIQUID EMBOLIZATION OF DURAL ARTERIOVENOUS FISTULAS USING A DUAL-LUMEN MICRO-BALLOON CATHETER

D Vollherbst[1], C Herweh[1], S Schönenberger[2], S Nagel[2], M Bendszus[1] and M Möhlenbruch[1]

[1]Heidelberg University Hospital, Department of Neuroradiology, Heidelberg, GERMANY
[2]Heidelberg University Hospital, Department of Neurology, Heidelberg, GERMANY

Purpose: To report our single-center experience of patients with dural arteriovenous fistulas (DAVFs) who were treated with transarterial balloon-assisted liquid embolization using a dual-lumen micro-balloon catheter.
Materials and Methods: A retrospective analysis of a prospectively collected database was performed. Demographic data, clinical data, angiographic features, procedural parameters, complications, treatment success, follow-up imaging and clinical outcome were assessed.
Results: Twenty patients were treated in 26 treatment procedures. All but two patients were symptomatic (90.0%). Five patients (25.0%) initially presented with intracerebral hemorrhage. Four patients (20.0%) suffered from cerebral venous congestion. Most DAVFs (95.0%) were high-grade fistulas (presence of cortical venous reflux). Direct cortical venous drainage was present in 85.0% of the DAVFs. The most frequent localization was the transverse and/or sigmoid sinus (50.0%), followed by the tentorial localization (25.0%). In three procedures (11.5%) transarterial balloon-assisted liquid embolization was combined with transvenous balloon-assisted protection of the affected venous sinus. Complete angiographic occlusion was achieved in 90.0% of the patients (75.0% initial angiographic occlusion, 15.0% complete angiographic occlusion during follow-up after initial subtotal embolization). There was one complication (vessel perforation with a subsequent small, transiently symptomatic intracerebral hemorrhage), resulting in a complication rate of 4.0%. There were no permanent complications and no procedure-related deaths. After a mean follow-up period of 17.1 months, 14 patients (70.0%) achieved complete symptom remission, while the remaining 6 patients (30.0%) showed symptom relief.
Conclusion: Transarterial balloon-assisted liquid embolization using a dual-lumen micro-balloon catheter is an effective and safe technique for the treatment of dural arteriovenous fistulas.
Keywords: Dural arteriovenous Fistula, Embolization, Balloon

O 139

TRANSVENOUS COIL-ASSISTED LIQUID EMBOLISATION OF INTRACRANIAL DURAL ARTERIOVENOUS FISTULAE

N Mahboobani[1], PT Yuen[2], JK Sham[2], VWT Chan[1], KW Shek[1], KF Fok[2] and WL Poon[1]

[1]Department of Radiology & Imaging, Queen Elizabeth Hospital, Hong Kong, HONG KONG
[2]Department of Neurosurgery, Queen Elizabeth Hospital, Hong Kong, HONG KONG

Purpose: Endovascular embolisation is the main treatment for intracranial dural arteriovenous fistulae (DAVF). There is limited literature on transvenous embolisation of DAVF using a combination of coils and liquid embolic agents. We report our experience using this technique with angiographic and clinical outcomes.
Materials and Methods: Retrospective review of clinical presentation, angiographic features, technical aspects, angiographic and clinical outcomes of all patients who underwent transvenous embolisation for their DAVF using double microcatheter pressure cooker technique with coils and liquid embolic agents from 2014 till 2018.
Results: Eleven patients (8 males; mean age 52 years, range 23–76 years) underwent 12 transvenous coil-assisted liquid embolisation procedures. Eight (72.7%) patients presented with neurological symptoms which impacted their daily activities. Eight (72.7%) patients demonstrated cortical venous reflux (Borden type II; Cognard type IIb) on diagnostic cerebral angiograms. Arterial feeders of the DAVF in all patients were tiny tortuous vessels not amenable to superselective catheterisation. The DAVF were mainly located in the transverse-sigmoid sinus ($n = 5$, 45.4%) and the superior sagittal sinus ($n = 3$, 27.2%). The involved sinus segment did not contribute to the venous drainage of normal brain. All embolisation procedures were done using double microcatheter pressure cooker technique with initial coil embolisation of the venous outlfow tract and involved sinus segment followed by liquid embolisation to completely fill and embolise the diseased segment and outflow tract. The use of coils allowed reduction of flow on the venous side, provided a scaffold for the liquid embolic agents and helped to reduce the volume of liquid embolic agent needed and thus the total procedure time, whilst the liquid embolic agent permeated and obliterated the fistula sites. Complete obliteration of the DAVF was achieved in 6 (54.5%) patients. Near-total occlusion of DAVF with significant reduction in arteriovenous shunting was achieved in 5 (45.5%) patients. All symptomatic patients reported alleviation of their neurological symptoms post-embolisation. There was no non-target embolisation. One patient developed progression of arteriovenous shunting and cortical venous reflux during angiographic follow-up and underwent a second transvenous combined coil and liquid embolisation procedure.
Conclusion: Transvenous embolisation of DAVF using double microcatheter pressure cooker technique with coils and

liquid agents is a safe and effective technique for treatment of DAVF which are not amenable to transarterial embolisation with a good success rate.
Keywords: Dural arteriovenous fistula, Transvenous, Embolisation

O 140

ENDOVASCULAR TREATMENT BY TRANSARTERIAL APPROACH OF ANTERIOR ETHMOIDAL DURAL ARTERIO-VENOUS FISTULAS (DAVF). THE EXPERIENCES OF A SINGLE CENTER

F Di Caterino[1], G Vitale[1], F Descourvieres[1] and A Biondi[1]
[1]Chu Besandon – Service de Neuroradiologie et Therapie Endovasculaire, Besancon, FRANCE

Purpose: Anterior Ethmoidal dural Arterio-Venous Fistulas (dAVF) are rare intracranial lesions (5.8% of all dAVF) associated with a high risk of intracranial hemorrhage. The fistula is supplied, more often, by the ethmoidal branches, arising from the ophthalmic artery but it can be fed by branches of the external carotid artery (Falcine artery from the middle meningeal artery, branches from the internal maxillary artery). The venous drainage is usually through cortical veins draining into the superior sagittal sinus or through the deep leptomeningeal venous system draining into the basilar vein. The endovascular treatment of these lesions is feasible, however the transarterial approach trough the ophthalmic artery is associated with the risk of retinal damage. We report our experience in the treatment of these lesions.
Materials and Methods: Between July 2011 and July 2018, 8 patients (5 women and 3 men, mean age 63.7 years) with an anterior ethmoidal dAVF were identified. Two patients presented with an intracranial hemorrhage, one with papilledema, one with vertigo, one with face hypoesthesia, one with left MCA stroke and in two patients the dAVF was diagnosed incidentally on a MRI performed respectively because of endocarditis and pulmonary lesion. In two cases the treatment was not performed; the patient with endocarditis died and the another one, with papilledema, refused the treatment. In the remaining 6 patients, the endovascular treatment was performed through the ophthalmic artery, in 4 cases, and through the falcine artery in the other 2 cases. Trans-arterial embolization was performed using Glue (Glubran 2) in one case, Onyx and Glue in another one and only Onyx in 4 cases. In all cases treated trough the ophthalmic artery, transarterial administration of nimodipine in the ophthalmic artery was performed during the procedure to prevent vasospasm of the ophthalmic artery and therefore subsequent retinal ischemia.
Results: Complete occlusion of the dAVF was obtained in 5 cases and confirmed at 1 year follow-up. The only patient with a residual shunt moved to another city and he was treated by surgery. No technical or clinical complications occurred.
Conclusion: The endovascular treatment of the Anterior Ethmoidal dAVFs using a transarterial approach is feasible. The treatment performed through the ophthalmic artery is associated with high risk of retinal ischemic damage but the selective periprocedural administration of nimodipine in the ophthalmic artery can avoid ophthalmic artery vasospasm and therefore the risk of ischemic complications.
Keywords: Anterior Ethmoidal dAVF, ophthalmic artery, nimodipine

O 141

ENDOVASCULAR TREATMENT OF ANTERIOR CRANIAL FOSSA FISTULAS: THE SIGNIFICANCE OF RETROGRADE TRANSVENOUS APPROACH

B Pabon[1], C Diaz[1], O Vargas[1], J Mejia[1], M Patiño[1] and N Serna[1]
[1]Angioteam /Clinica Del Norte/Clinica Las Americas/ Universidad De Antioquia, Medellin, COLOMBIA

Purpose: Anterior cranial fossa (ACF) Dural arteriovenous fistulae (DAVFs) are infrequent lesions, and usually treated by surgical disconnection or endovascular embolization via the ophthalmic artery. The retrograde transvenous route is a rarely used approach. This paper describes our experience in terms of safety and efficacy of embolization of DAVF of the anterior cranial fossa with different embolic agents through the venous side.
Materials and Methods: Between September 2016 and march 2019 a retrospective review was performed. A total of 9 Patients with DAVF of the anterior cranial fossa managed with embolization through the venous side with Onyx / PHIL were selected. Information on demography, symptoms and signs, angiographic examinations, interventional treatments, angiographic and clinical results, and follow-up was collected and analyzed.
Results: Nine patients were included in this study, patients were between 14 and 79 years old (mean 45.6). Six primarily presented with intracranial hemorrhage. All fistulas were fed by the bilateral ethmoidal arteries arising from the ophthalmic artery and by the anterior branch of the middle meningeal artery. One case with history of type D CCF. The abnormal shunt drained into the superior sagittal sinus with interposition of the cortical veins in all nine patients. All of the cases had high-grade Cognard classifications (III-IV). 4(44%) patients had been treated via trans arterial embolization (TAE) via the AEA of the OA. All cases were treated via transvenous embolization (TVE), 8 of 9 (88%) were treated with the trans-SSS approach. Complete angiographic cure was achieved in all patients, without postprocedural complications. There were nearly no symptoms among the patients during follow-up.
Conclusion: Embolization of DAVF of the anterior cranial fossa via retrograde using Transvenous approach with

embolic agents is safe, effective, and a good choice for management of this rare condition. Endovascular treatment (EVT) can completely obliterate the fistula point and correct the venous shunting. More cases are needed to verify these findings.

Keywords: Dural Fistula, Anterior Fossa, Retrograde

O 142

POSTERIOR FOSSA DURAL ARTERIOVENOUS FISTULAS: OUTCOMES OF ENDOVASCULAR TREATMENT

L Detraz[1], K Orlov[3], V Berestov[3], V Borodetsky[2], A Rouchaud[2], L Mattos[2] and C Mounayer[2]

[1]CHU de Nantes, Neuroradiologie, Nantes, FRANCE
[2]CHU de Limoges, Neuroradiologie, Limoges, FRANCE
[3]E. Meshalkin National Medical Research Center of the Ministry of Health of the Russian Federation, Novosibirsk, RUSSIA

Purpose: Dural Arterio-Venous Fistulas (dAVF) located in the posterior fossa are a rare entity. Objectives of the study were to analyze the anatomy of the dAVF, their endovascular treatment strategies and clinical outcomes.

Figure 1 : Transvenous approach.
Petrosal dAVF with petrosal outflow, fed by the recurrent tentorial branch of the ILT and a posterior meningeal branch, draining into the intern temporal vein. Retrograde catheterization of the straight sinus via jugular golf and lateral sinus. Two Echelon 10 microcatheters were navigated to the foot vein located on the superior petrosal vein. By one microcatheter, platinium coils were rolled, then through the second microcatheter Onyx 18 was injected. dAVF was totally cured at the end of the intervention.
a- Lateral initial angiogram
b- Transvenous coiling
c- Transvenous Onyx injection
d- Cast of Onyx and coils

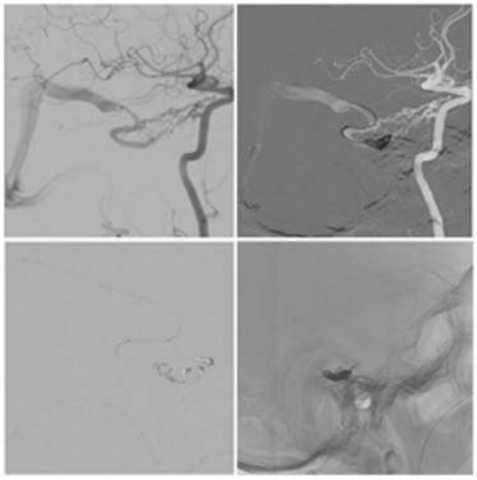
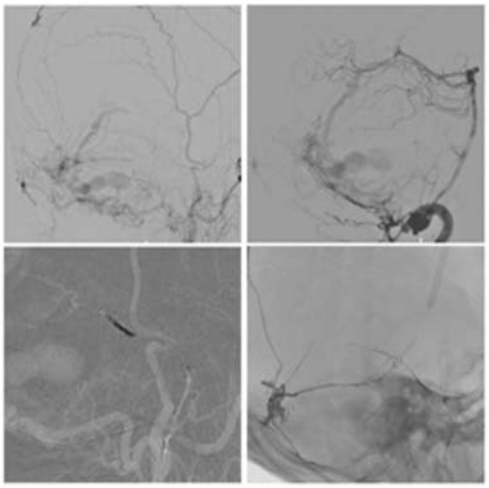


Figure2: Arterial access via MMA : Ruptured dAVF with a shunt located into the declival vein and venous outflow into the cerebellar veins, fed by the PMA of the VA, transosseous of OA,squamous branch of the MMA. MMA was catheterized and platinium coils were rolled into the MMA to improve NAEL penetration, then NAEL was injected.
a- Lateral initial angiogram via the ECA
b- Lateral initial angiogram via the VA
c- Coils pressure cooker in the MMA
d- Final cast of Onyx and coils



Materials and Methods: Two centers retrospectively selected patients treated between January 2009 and June 2018 for posterior fossa dAVF. We collected patient demographics, clinical presentation, arterial and venous outflow anatomy of the dAVF and treatment outcomes.

Results: Twenty-six patients treated endovascularly for posterior fossa dAVF type III, IV or V, have been included. 100 % of the dAVF were occluded: transarterial approach was performed in 23 dAVF (88.5 %), combined transarterial and transvenous approach for 2 dAVF (7.7 %) and transvenous approach alone for 1 dAVF (3.8 %). Middle meningeal artery (MMA) was the most common artery chosen to inject embolic liquid (46 %, 12/25), followed by the occipital artery (28 %, 7/26). Procedure related morbidity was 15.4 % at 24 hours, 7.7 % at discharge and 0% 6 months. Procedure related mortality was 0%.

Conclusion: Endovascular treatment offers high occlusion rates for posterior fossa dAVF with low morbi-mortality rates. Arterial approach is the first line preferred approach even if transvenous or combined approach can be a safe and effective option for patients with favorable anatomy.

Keywords: dural arteriovenous fistulas, posterior fossa, endovascular

O 143

ANGIOGRAPHIC ANATOMY AND ENDOVASCULAR TREATMENT OF THE LATERAL FORAMEN MAGNUM DURAL ARTERIOVENOUS FISTULA

H Kang[1], T Boonchai[1], D Yoo[1], Y Cho[1] and M Han[1]

[1]Seoul National University Hospital, Seoul National University College of Medicine, Seoul, SOUTH KOREA
[2]National Veterans Hospital, Seoul, SOUTH KOREA

Purpose: To report the clinical manifestations, angiographic anatomy, and outcome of endovascular treatment in patients with the lateral foramen magnum dural arteriovenous fistulae (DAVF).
Materials and Methods: During the period from February 2005 and April 2019, 16 patients were diagnosed as the lateral foramen magnum DAVF and 15 were treated with endovascular means. There were 14 male and 2 female patients (male to female ratio, 7:1). Their ages ranged from 37 to 73 years. 7 patients presented with intracranial hemorrhage, 5 with myelopathy, and 4 with nonspecific symptoms.
Results: The fistulae were located around the lateral foramen magnum region. The feeders included C1 dural branch from the vertebral artery, jugular and/or hypoglossal branches from the ascending pharyngeal artery, stylomastoid branch from the posterior auricular artery or from the occipital artery, and transmastoid branch from the occipital artery. Cognard grades were III in 2 patients, IV in 3, and V in 11 patients. One patients refused treatment; the other patients were treated with liquid embolic agents, which included n-butylcyanoacrylate, Onyx, and PHIL. Sceptor balloon catheters were used in 2 patients. 2 patients received additional surgical or radiosurgical treatment. Angiographically complete occlusion was achieved in all the patients.
Conclusion: The lateral foramen magnum DAVF is a highly aggressive lesion and proper diagnosis and treatment is of utmost importance. It should be differentiated from the anterior condylar confluence (hypoglossal canal) or marginal sinus lesions. Endovascular treatment has a central role in its treatment.
Keywords: dural fistula, foramen magnum, craniocervical junction

SESSION L: AVMs 2 /Dural AVFs 2 /Miscellaneous

O 144

ENDOVASCOULAR TREATMENT OF CRANIOFACIAL HIGH FLOW ARTERO-VENOUS MALFORMATION – BLESSING OR CURSE?

A Ferrari[1], F Schirru[1], F Fusaro[1], S Corraine[1], V Palmisano[2], C Ganau[1] and S Comelli[1]
[1]Azienda Ospedaliera Brotzu, Cagliari, ITALY
[2]Azienda Ospedaliera Universitaria, Cagliari, ITALY

Purpose: When we are asked to consider to treat an extensive high flow craniofacial artero-venous malformation what we have to do? Presentation of an illustrative complex case and literature review on treatment option and therapeutic work-out.
Materials and Methods: We present the case of a 45 y.o. male with an extensive high flow craniofacial arterovenous malformation formerly treated with different embolization techniques. After the two last more aggressive embolization attempts with last generation of liquid embolic, a probably worsening of the MAV was triggered, with unexpected malformative shunts opening, flow redirectioning without angiographic reduction of the diffuse AVM, comparable to a malignant tumor, neither sintomatology relief.
Results: A PubMed Search using the search terms 'high flow arteriovenous malformation therapy' and 'facial AND arteriovenous AND malformation' were performed. Relevant articles were identified by screening for suitable titles, abstracts and full texts.
Conclusion: The treatment of HF-AVMs of the head and neck remains challenging due to high recurrence rates and the risk of gross disfigurement or functional impairment. However, the relatively small number of patients underline the need for uniform reporting and documentation of rare diseases in order to obtain evidence-based treatment guidelines.
Keywords: High-Flow AVM, Cranio-facial, Embolization

O 145

ADENOSINE-TRIPHOSPHATE INDUCED CARDIOPLEGIA IN ENDOVASCULAR TREATMENT OF HIGH-FLOW AVM FISTULAS

A Petrov[1], S Goroshenko[2], A Ivanov[3] and L Rozchenko[4]
[1]Russian Polenov Neurosurgical Institute – vascular neurosurgery department, S-Petersburg, RUSSIA
[2]Russian Polenov Neurosurgical Institute – vascular neurosurgery department, S-Petersburg, RUSSIA
[3]Russian Polenov Neurosurgical Institute – vascular neurosurgery department, S-Petersburg, RUSSIA
[4]Russian Polenov Neurosurgical Institute – vascular neurosurgery department, S-Petersburg, RUSSIA

Purpose: This method was first proposed by Professor Tomoki Hashimoto J. Anesthesiology 10 2000. vol. 93. when transvenous administration of adenosine into the right atrium reached temporary cardioplegia and was initially used in cardiovascular surgery. In 2016 appeared the first articles about the use of adenosine-induced cardioplegia in neurosurgery. The aim of the study was to determine the indications, contraindications, advantages and prospects for the use of Adenosine Triphosphate induced cardioplegia in intravascular embolization of AVM with Onyx 18 and Squid 12/18, in contrast to standard techniques such as pressure cooking technic, DMSO-compatible balloon catheters, the use of glue or non-adhesive embolizing materials of high viscosity. To eliminate the risk of migration of embolisate in the draining veins and sinuses. In our clinic we have been using Adenosine-triphosphate induced cardioplegia since 2018 as an option for the embolization of AVM with high-flow compartments with non-adhesive embolizates.
Materials and Methods: We performed 43 operations in 41 patients aged from 18 to 69 years, 17 males, 24 females.

Cardioplegia was implied once in 31 operations, twice in 10 operations and three times in 2 cases. Asystole was achieved in 65% of cases, bradycardia in 35% of cases.
Results: All patients were embolized with onyx or squid in conditions of asystole or severe bradycardia. The goals and objectives of each stage of embolization were achieved to the extent provided for by preoperative planning. In 7 cases, total embolization was archived, in 1 case, subtotal, followed by a surgical removal of the AVM.
Conclusion: Using of this technique significantly reduces the time of operation, makes unnecessary additional devices (catheters, coils, gallons, glue – nothing), that is why the economy is obvious. It is possible to embolize the high flow fistulas with non-adhesive embolising material of any viscosity (ONYX18, SQUID12/18) the viscosity does not matter, there was not a single case of massive migration of non-adhesive in the draining veins or sinuses with their obliteration, which makes adenosine triphosphate induced cardioplegia effective and safe method during embolization of high -flow arterio venous fistulas. One important thing is that the anesthesiologist is a key player in the team.
Keywords: Adenosin inducted asistolia, cardioplegia, High-flow AVM

O 146

STATIN INTAKE IS ASSOCIATED WITH A LOWER DEGREE OF VENOUS STENOSIS IN PATIENTS WITH NON HEMORRHAGIC CEREBRAL ARTERIOVENOUS MALFORMATIONS

A Alaraj[1], H Mostafa[1], A Hussein[1], M Mohammaden[1], D Brunozzi[1], G Atwal[1] and F Charbel[1]
[1]University of Illinois at Chicago, Department of Neurosurgery, Chicago, USA

Purpose: Factors affecting the degree of stenosis of draining veins of cerebral arteriovenous malformations (AVM) are poorly understood. Dyslipidemia was previously shown to be an independent risk factor for venous stenosis, and here we study the relationship between the history of intake of lipid lowering agents (statins) and the degree of venous outflow stenosis in cerebral AVMs.
Materials and Methods: The charts of all patients with a supratentorial AVMs seen at our institution between 1998 and 2018 were retrospectively reviewed. Patient charts were reviewed for demographic and atherosclerotic risk factors including age at presentation, gender, race, type 2 diabetes mellitus, hypertension, coronary artery disease, cigarette smoking, clinical presentation at time of diagnosis, and statin intake. In addition, data about the degree of venous stenosis was collected from the charts, after which univariate and subgroup analyses were performed to assess the relationship between the various factors and the degree of stenosis.
Results: 318 patients were included (mean age 39.4 years, 52.8 % males). Venous stenosis was present in 142 patients (50 % of the sample). In the subgroup of patients who did not initially present with bleeding, those who were taking statins had a significantly lower degree of stenosis (mean stenosis = 13.7 %) than those who were not (mean stenosis = 32.7 mm). This is equivalent to a 58% associated decrease in stenosis in the patients taking statins relative to those who were not (p-value = 0.025).
Conclusion: History of prior statin intake is associated with a 58% reduction in the degree of venous stenosis in patients with AVMs who did not initially present with bleeding. Targeting modifiable risk factors such as dyslipidemia may reduce the degree of venous stenosis in these patients. Further studies are needed to assess the possibility of addressing other modifiable atherosclerotic risk factors in order to decrease the degree of venous stenosis in these patients.
Keywords: Venous stenosis, Statin, Arteriovenous Malformation

O 147

BEVACIZUMAB EFFECT ON AN ANGIOGENESIS ANIMAL MODEL

C Papagiannaki[1], F Clarencon[2,3], C Yardin[2,4], C Mounayer[2,5] and C Couquet[2,6]
[1]Chu Rouen, Department of Interventional Neuroradiology, Rouen, FRANCE
[2]University of Limoges, CNRS, XLIM, UMR 7252, F-87000, Limoges, FRANCE
[3]Pitie Salpetriere Hospital, Department of Interventional Neuroradiology, Paris, FRANCE
[4]Chu Limoges, Department of Cytology-Histology and Biology, Limoges, France
[5]Chu Limoges, Department of Interventional Neuroradiology, Limoges, FRANCE
[6]Haute Vienne Departmental Laboratory for research and analysis, Limoges, FRANCE

Purpose: The purpose of this study was to test the effect of intra-arterial antiangiogenic administration on a swine angiogenesis model that features brain AVM histological characteristics.
Materials and Methods: Ten pigs were divided into 2 groups: Five animals underwent endovascular left external and common carotid artery occlusion (group A) and 5 animals underwent the same procedure and had an intra arterial in situ injection of Bevacizumab (group B) 2 months after the occlusion. A Digital Subtraction Angiography (DSA), associated with 3D rotational angiography was performed at day 0 and at 3 months in both groups. Retia volumes were calculated. Finally, the animals were sacrificed at 3 months and the retia were harvested for pathological and immunohistochemistry examinations.
Results: The volume of the retia increased in both groups without difference between groups. Media thickness was comparable in both groups.VEGF receptors were blocked

on the site of injection 1 month later and there was a local enhanced endothelial proliferation and apoptosis with similar results on inflammation.
Conclusion: A single in situ injection of Bevacizumab in this swine angiogenesis model did not affect retia volumes. Vessels' media thickness increased in group B but without significance. VEGF receptors were completely blocked one month after the injection and a higher apoptosis of actively dividing cells was observed in group B.
Keywords: Animal model, Antiangiogenics, Arterivenous Malformation

O 148

CEREBRAL PROLIFERATIVE ANGIOPATHY: 14 CASES IN A SINGLE-CENTER AND A SYSTEMATIC REVIEW

E Paschoal[1], GS J-A-Liem[2], VN Yamaki[9], FM Paschoal Jr[12], J RN Brito[2], JM De Jesus[2], RMR Burbano[11], FM Tuji[2], VA.PA Bastos[3], EG Figueiredo[9], MJ Teixeira[9], JA Dos S. Lima[2], A De M. Lima Neto[4], Â. R Dossantios[10] and E. B.S.S.[9]
[1]Unidade Neurológica do Complexo Hospitalar – Universidade Federal do Pará/ EBSERH, Belém, BRAZIL
[2]Instituto Neurológico do Hospital Ophir Loyola, Belém, BRAZIL
[3]Instituto AVC da Amazônia, Belém, BRAZIL
[4]Grupo de Pesquisa – Amazônia Neurovascular – UFPA/ CNPq, Belém, BRAZIL
[5]Faculdade de Medicina da UFPA, Belém, BRAZIL
[6]Faculdade de Medicina da UEPA, Belém, BRAZIL
[7]Faculdade de Medicina do CESUPA, Belém, BRAZIL
[8]Neurogenesis Instituto de Neurociências, Belém, BRAZIL
[9]Universidade de São Paulo, São Paulo, BRAZIL
[10]Laboratório de Genética Médica e Humana da UFPA, Belém, BRAZIL
[11]Laboratório de Biologia Molecular do Hospital Ophir Loyola, Belém, BRAZIL
[12]Faculdade de Medicina da Universidade Federal do Pará, Belém, BRAZIL

Purpose: Cerebral Proliferative Angiopathy (CPA), previously called diffuse nidus type or holohemispheric giant cerebral AVM, is a recently identified clinical entity with less than a hundred reported cases. Studies estimate a CPA incidence of 3.4–4.5% among all AVMs. Purposes: The authors described cases of CPA in a single health care center and performed a systematic review of all reported cases. Also they intend to present a score to aid how to recognize this subtype of lesion.
Materials and Methods: In a retrospective analysis 550 cases of brain arteriovenous malformation databank from a reference center since 2009. We found 14 cases (2.54%) with clinical and angioarchitectural findings harmonious to CPA. CPA was determined based on the definitions proposed on the literature recently. The patient's clinical and hospital charts were reviewed by an experienced interventional neuroradiologist whom classified the cases based on angiomorphological fidings, based on cerebral angiogram and magnetic resonance imaging.
Results: We found a high prevalence of CPA in young adults with median age of 28 years old (range 9–56 years), no gender predominance was notice. Chronic headache was the most common synptom (12/14), also three cases developed a hemorrhagic event and 6 showed a stroke like presentation. None of the patients was managed through endovascular procedure. Only one patient was sent to surgery caused hydrocephalus gradual development.
Conclusion: Neurovascular surgeons and neuroradiologists need to understand this typical neurovascular entity cause its diffuse angiogenetic behaviour is presumably related to a conservative medical management over its natural history. Despite we known its ''benign'' evolution, CPA can present complications that require an aggressive medical care strategy. At last the systematic review showed up that stroke-like events are the most common presentation and until now no ideal treatment was discovered to cure the patient. Also, we presented offer a score based on this systematic review with our cases to guide specialists to distint CPA from a classic AVM.
Keywords: Proliferative angiopathy, Arteriovenous Malformation, Stroke

O 149

EFFICACY OF INTRAOPERATIVE CONE BEAM COMPUTED TOMOGRAPHY IN EVALUATING AND TREATING CAVERNOUS SINUS DURAL ARTERIOVENOUS FISTULA

K Kadooka[1] and M Tanaka[1]
[1]Kameda Medical Center, Kamogawa, Chiba, JAPAN

Purpose: Exact identification of feeding arteries, shunt points, and draining veins is essential in treating dural arteriovenous fistula (dAVF). Cavernous sinus dAVF(CS dAVF) often has transosseous feeders through bony structures(eg: clivus). In addition to digital subtraction angiography (DSA) and 3-dimensional rotational angiography (3DRA), high-resolution cone beam computed tomography (CBCT; especially 80-kv high-resolution cone beam computed tomography) have been performed in recent years. We evaluated the efficacy of CBCT in treating CS dAVF.
Materials and Methods: Twelve CS dAVFs were treated with endovascular embolization between January 2013 and April 2019. Two board certified neurointerventionists retrospectively examined these cases regarding information from DSA, 3DRA, and CBCT with undiluted contrast medium.
Results: Although all procedures can evaluate feeding arteries, shunt points, and draining veins, CBCT can provide the best definition of feeders and their course through the bony structures. In addition, CBCT revealed the compartment of CS and cranial nerves at the same time. Moreover, CBCT with placed microcatheter in the CS can

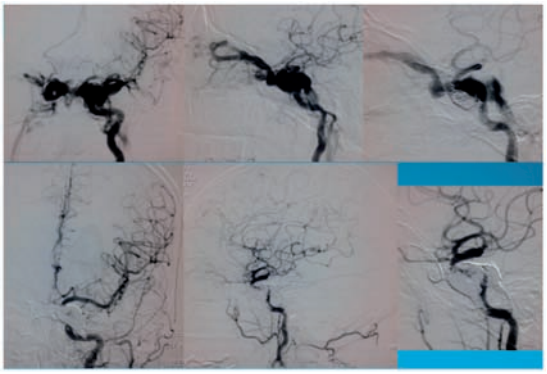
reveal whether the microcatheter is set at the appropriate compartment to be embolized.
Conclusion: The efficacy of CBCT in treating CS dAVF is illustrating the relationships among the bony structures and feeders, compartment of CS, cranial nerves and the position of the microcatheter. Detailed information obtained with CBCT can lead to fewer complications and more effective treatment.
Keywords: cavernous sinus, dural arteriovenous fistula, cone beam computed tomography

O 150

DIFFERENT TECHNIQUES OF CAROTIDO-CAVERNOUS FISTULA EMBOLIZATION: SINGLE CENTER EXPERIENCE

F Hassan[1]
[1]Interventional Radiology Unit, Faculty of Medicice, Cairo University, Cairo, EGYPT

Purpose: Different techniques of carotido-cavernous fistula (CCF) endovascular embolization were described in the literature. This study reports, validates and compares these techniques in our series of 34 cases, aiming to standardize the most effective and safest approach.



Materials and Methods: A retrospective analysis of all patients that underwent endovascular embolization of either direct or indirect CCF between January 2011 and December 2018 in our high flow tertiary care center was performed. The technical and clinical results of different techniques were analyzed.
Results: Among our 44 patients, 36 had direct CCF (DCCF) and 8 had indirect CCF (ICCF). Among the 36 DCCFs, 2 were caused by intracavernous aneurysmal rupture; one of them was coiled and the other one was treated by partial coiling and flow diverter stent, 1 was caused by spontaneous rupture of a carotid dissection which was treated by carotid occlusion and 33 were caused by direct head trauma. Among these 33 cases, 5 were treated by occlusion of the fistula using detachable balloon, 7 were treated by cavernous sinus occlusion either from arterial or venous approaches using coils, 10 were treated by cavernous sinus occlusion using coils and onyx and 11 were treated by carotid occlusion using coils and/or detachable balloons ± histoacryl glue. Among the 8 ICCFs, 6 were treated by cavernous sinus occlusion, and 2 slow flow cases were conservatively managed. Among the 6 ICCFs, 2 cases were treated by facial vein puncture, the inferior petrosal sinus was catheterized in 1 case, 1 case was treated by puncture of surgically exposed superior ophthalmic vein and in 2 cases transarterial injection was exceptionally used. No procedure related complications. Recurrence occurred in 2 cases which were successfully treated in a second session.
Conclusion: CCF can be effectively and safely treated by different endovascular approaches taking into consideration some technical points.
Keywords: Carotido-cavernous fistula, Embolization, Coils

O 151

CONSIDERATION OF RELATIONSHIPS BETWEEN SHUNT SEGMENTS AND DRAINING VEINS IN THE CAVERNOUS SINUS DURAL ARTERIOVENOUS FISTULAE

S Eguchi[1], **T Ishikawa**[1], **T Funatsu**[1], **B Ryu**[1], **K Yamaguchi**[1] **and T Kawamata**[1]
[1]Tokyo Women's Medical University, Department Of Neurosurgery, Tokyo, JAPAN

Purpose: It is well known that patients with the cavernous sinus dural arteriovenous fistulae (CS-DAVF) developed diverse syndromes due to their shunt segments and draining patterns. It is important to identify the location of shunt segments in the management of DAVF but sometimes difficult. The goal of this study is to clarify the anatomical relationships between shunt segments and draining veins.
Materials and Methods: A total of 11 patients with CS-DAVF who were treated at a single institute was included. In this cohort, 9 women were included and mean age was 71.1 ± 12.1 years. Initial symptoms were diplopia (9 patients), ocular hyperemia (4), exophthalmos (2), Headache/Ophthalmalgia (3). Seven developed cortical venous reflux (Boden type 2), and the others did not (Borden type 1). Only one patient suffered from hemorrhagic stroke. Shunt segment and draining veins were examined by digital subtraction angiography (DSA) and Time-of-flight magnetic resonance angiography (TOF MRA).
Results: In 4 case without inferior petrosal sinus (IPS) obliteration, 3 drained to IPS. There was a significant difference between IPS occlusion and the drainage to IPS ($p = 0.024$). Five cases had shunt segments at the posterolateral (PL) side of CS while 3 cases had posteromedial (PM) side. Both the PL and PM were detected in 3 cases. In PL alone cases, 2 cases of venous reflux to superficial middle cerebral vein (SMCV) and 2 cases drainage to superior petrosal sinus (SPS) were identified, respectively. In PM alone, venous reflux to uncal vein was detected in only one case but reflux to sphenoparietal sinus (SpPS) was occurred in 2

cases. Shunt segments other than PM were highly correlated with venous reflux to SMCV but not significant ($p = 0.055$).
Conclusion: Anatomically, SMCV, SpPS, SPS and pterygoid plexus flow in the lateral side of the CS. On the other hand, intercavenous sinuses, basilar plexus and uncal vein join in the medial side. Supra- and infraorbiral veins and inferior petrosal sinus are located in the intermediate. IPS is the primary drainer of CSDAVF. But in cases of IPS obliteration, venous reflux to the SMCV and SpPS are reasonable if the shunt is created at the lateral side. Also posteromedial shunt segment causes reflux to the uncal vein. So the venous reflux helps us to detect the shunt segments correctly.
Keywords: Csdavf, Shunt Segments, Drainers

O 152

CAVERNOUS DURAL ARTERIOVENOUS FISTULA PRESENTING AS HEADACHE WITHOUT HIGH INTRAOCULAR PRESSURE

M Miyamoto[1], Y Oyama[1], T Uno[1], A Ito[1], F Yamane[1] and A Matsuno[1]
[1]Teikyo University, Tokyo, JAPAN

Purpose: Typical symptoms are exophthalmosm, chemosis and pulsatile tinnitus in cavernous dural arteriovenous fistula (CDAVF). However, some patients in CDAVF shows only headache. We consider the clinical indication and characteristics in these cases from literature.
Materials and Methods: We experienced 3 cases of headache CDAVFs. A 80-years-old-female had the symptom with left head pain and sudden blindness in Case 1. MRA couldn't show CSDAVF and she was treated as torsa hunt syndrome. Because her symptoms didn't improve, we decided to do angiography. It showed slight L DAVF and DAVF was treated by IVR. The symptoms were disappeared after surgery. Case 2 showed left head pain and angiography showed L DAVF and the symptoms were disappeared after IVR. Case 3 showed left head pain and slight diplopia (oculomotor palsy). The patient had L DAVF and the symptoms were recovered after treatment.
Results: All 3 cases didn't show exophthalmosm, chemosis and pulsatile tinnitus and MRA couldn't indicate CSDAVF. However, MRI T2WI showed dilated SOV in all cases. Headache was disappeared after treatment without no complication. The patient in case 1 presented with sudden blindness without exophthalmosm and chemosis after headache onset. Headache is considered to be a pre-symptomatic situation, however, it couldn't explain the reason why she was blind without eye other symptoms. So, we decide to treat CSDAVF with only intolerable headache.
Conclusion: The case with head and eye pain and dilated SOV in T2WI is consider to be CSDAVF. Surgical indication is controversial from past literature. Blind patient makes us changing indication.
Keywords: Dural arteriovenous fistula, Pain, Cavernous

O 153

UTILITY OF FLOW DIVERTER STENT IN SLOW FLOW CAROTID CAVERNOUS FISTULAS (SFCCFS)

F Petra[1], A Aguado[2], G Caballero[3], J Lizundia[4], M Grana[5] and L Parra[5]
[1]Hospital Santa Isabel De Hungria, Mendoza, ARGENTINA
[2]Hospital Santa Isabel De Hungria, Mendoza, ARGENTINA
[3]Hospital Santa Isabel De Hungria, Mendoza, ARGENTINA
[4]Hospital Santa Isabel De Hungria, Mendoza, ARGENTINA
[5]Hospital Santa Isabel De Hungria, Mendoza, ARGENTINA
[6]Hospital Santa Isabel De Hungria, Mendoza, ARGENTINA

Purpose: To evaluate the safety, feasibility and clinical response of the use of a high mesh flow diverter stent in Slow flow Carotid Cavernous Fistulas (SFCCFs).
Materials and Methods: Between May 2015 and April 2019 thirty two patients were admitted at our institution presenting carotid cavernous fistulas (CCFs). Nine of them were spontaneous SFCCFs, Barrow type B. All of them were fed by branches of the meningeal branches of the internal carotid artery. Transvenous or arterial hiperselective approach was not feasible, so a high mesh flow diverter stent (SurPass Device) deployment was decided.
Results: In 7 cases after 6 month follow up, complete remission of the symptoms was observed with total obliteration of the fistulous image at DSA control and total clinical response. In 1 case no angiographic or clinical response was observed so Carotid sacrifice was decided after performing an positive occlusion test. In 1 case DSA obliteration of the CCFs was observed, even though no clinical improvement was detected due to thrombosis of the superior oftalmic artery. In this case after the event antiphospholipid syndrome was detected, and was considered responsible of the adverse event, improving symptomatology after anticoagulation was decided.
Conclusion: The utilization of High Mesh Flow Diverter stent is a feasible and safe technique in SFCCFs pathology.
Keywords: Carotid Cavernous Fistulae, Slow Flow, Flow Divertion

O 154

FLOW DIVERSION IN DIRECT CAROTID CAVERNOUS FISTULA – A WAY TO GET OUT OFF THE CORNER?

F Schirru[1], F Fusaro[1], S Corraine[1], A Ferrari[1], V Palmisano[2], C Ganau[1] and S Comelli[1]
[1]Azienda Ospedaliera Brotzu, Cagliari, ITALY
[2]Azienda Ospedaliera Universitaria, Cagliari, ITALY

Purpose: When the standard treatment with transvenous coil embolization fails, is the transarterial embolization with flow diversion a good therapeutic alternative?
Materials and Methods: We present three cases of direct carotid cavernous fistula (CCF), respectively spontaneous, traumatic and post aneurysm's rupture, in whom the

transvenous coiling was impossible. In all the cases a Pipeline flow diverter stent was placed in the affected carotid. 6 month follow up demonstrated closure of the fistula with reconstruction of the diseased vessel. A PubMed literature search was performed from 2008 to 2018 to find studies on the potential safety and efficacy of flow diversion in treatment of direct CCFs.

Results: A total of 30 direct CCF cases treated with flow diversion (including the three current illustrative cases) were found. Twelve patients were primarily treated with flow diversion and 18 patients were treated secondarily with flow diversion. All fistulas were cured at the end of the follow.

Conclusion: Despite transvenous coiling embolization still remains the standard treatment option for direct CCFs, flow diversion is a potentially safe and effective alternative. Flow diversion is typically used as an adjunctive treatment and should be used cautiously as standalone therapy.

Keywords: Carotid-Cavernous Fistula, Flow-diverter, Off-Label

SESSION M: Aneurysms Multimodality/Surgery

O 155

ENDOVASCULAR TREATMENT OF MIDDLE CEREBRAL ARTERY ANEURYSMS: A SINGLE CENTER EXPERIENCE OF 320 ANEURYSMS

LJ Haas[1], BR Sabel[2], J Martins[2], GV Staedele[2], WR Berticelli[2], M Becker[2], MC Harger[2], CB Lima[2], FJ Cobra[2], MD Soares[2], LCO Camilo[2], VD De Almeida[2], CGJL Brasileiro[2], JD Hessmann[2], JM Silva[2], VHT Boer[1], D De Lara[1], CIC Bernardes[1], FL Cabral[1], A De Oliveira Junior[1], B Sartori[1], D Malacarne[1] and LRGOM Mello[1]

[1]Hospital Santa Isabel, Blumenau, BRAZIL
[2]University of Blumenau – FURB, Blumenau, BRAZIL

Purpose: Our purpose was to analyze the epidemiologic profile of the patients and the immediate outcomes of embolization in a consecutive series of MCAAs chosen for endovascular treatment (EVT) in a Neurosurgery reference hospital.

Materials and Methods: we performed a retrospective observational study of patients who were diagnosed with MCAAs. The data were obtained from medical records of patients who underwent EVT from March 2006 to December 2018. The variables analyzed were sex, age, comorbidities, aneurysm profile, characteristics of the procedure and immediate outcomes.

Results: 75% of the patients were female (n = 240), and 25% were male (n = 80). The average age was 54,5 years (17–86). High blood pressure was present in 50% (n = 163), smoking in 25% (n = 80), diabetes in 9% (n = 29), dyslipidemia in 27% and polycystic kidney disease in 0,6%. 65% of the aneurysms were incidental findings and the procedure was previously scheduled. The mostly affected segment of the artery was the bifurcation of the MCA (80%), followed by M1 (9%), trifurcation of the MCA (6%), M2 (4%), M4 (0,6%) and M3 (0,4%). The right side was mostly affected (55%). 85% of the aneurysms were small, 14% were large and 1% were giant. The most common type of aneurysm was the saccular (98%). 6% of the patients had multiple aneurysms, 7% had 3 aneurysms, 22% had 2 aneurysms and 65% had only one. The techniques involved the use of coils only (76%), coils and stent (20%), stent only (3,7%) and flow-diverter only (0,3%). The immediate outcomes showed that 4% of the patients presented paresis, 2% presented palsy, 2% presented aphasia and 2% died after the procedure.

Conclusion: We found a profile of patients diagnosed with MCAAs similar to that found in the scientific literature. Our series of 320 endovascular treated MCAAs demonstrates that select lesions can be treated with minimal neurological morbidity. Moreover, according to our analysis and to the literature, thesafety of the EVT of MCAAs showed very few rates of complication in immediate outcomes.

Keywords: aneurysm, middle cerebral artery, endovascular treatment

O 156

ENDOVASCULAR TREATMENT OF COMPLEX SUPERIOR CEREBELLAR ARTERY ANEURYSMS USING DIFFERENT TECHNIQUES

V Kiselev[1], R Gafurov[1], A Perfilev[1] and A Sosnov[1]

[1]Federal Neurosurgical Center of Novosibirsk, Novosibirsk, RUSSIA

Purpose: To evaluate efficiency and safety using different techniques in endovascular treatment of complex superior cerebellar artery aneurysms (SCAA)

Materials and Methods: For the period from 05.2014 till 12.2018 in the department of vascular neurosurgery, 27 patients with SCAA were operated. There were 7 males (26%) and 20 females (74%). The average age was 48 years. 13 (48%) patients had multiple aneurysms. All aneurysms were divided into three groups with respect to basilar artery (BA) and superior cerebellar artery (SCA), so the first group 2 (7.4%) – aneurysms were located only on the BA, not involving the branches of the posterior cerebral artery (PCA) and/or SCA in the structure of their neck; the second group – 12 (44.4%) aneurysms partially involved PCA or SCA in structure of their neck; the third group – 11 (40.7%) aneurysms were located on the SCA. In 2 (7.4%) cases, the distal SCA aneurysms occurred. In size: less than 5 mm – 9 (33.3%), 6–14 mm – 13 (48.1%), 15–24 mm – 5 (18.6%) aneurysms. All patients were operated on in the post-hemorrhagic period or did not have aneurysm rupture.

Results: 27 endovascular procedures on SCAA were performed. Coiling were used only in 4 (14.8%) patients, coiling with stent-assisted occlusion were 13 (48.1%), balloon-assisted were 4 (14.8%), implantation of flow diverter (FD)

was in 1 (3, 7%) and in 5 (18.6%) cases there were a combination of techniques.
Complete occlusion of the aneurysms immediately after surgery was achieved in 15 (55,5%). Occlusion rate was not evaluated in 4 (14.8%) patients after the implantation of the FD. A favorable clinical result (mRs 0–1) was obtained in 17 (63%) patients. The frequency of intraoperative complications was 1 (3.7%) and the postoperative complications were 4 (14.8%). Mortality was in 1 (3.7%) case. Long-term results (after 6 months) were evaluated in 17 (63%) patients. Of these, R&R I – 12 (70.6%) patients. All 4 aneurysms treated with FD are continued to fill after 6 months. Favorable clinical result (mRs 0–1) after 6 months was obtained in 14 (82.4%) patients.
Conclusion: Endovascular treatment of aneurysms of the SCA is accompanied by a high frequency of favorable outcomes. The low complete occlusion rate directly depends on the geometric features of the aneurysm, especially the involvement of the SCA in the cervical structure of the aneurysm, which significantly complicates its complete occlusion due to possible ischemic complications.
Keywords: Aneurysm, Endovascular treatment, Superior cerebellar artery

O 157

MULTIMODALITY ENDOVASCULAR TREATMENT OF PARTIALLY THROMBOSED INTRACRANIAL ANEURYSMS: A SINGLE CENTER RETROSPECTIVE STUDY

Y Enomoto[1], Y Egashira[1], H Matsubara[1], S Yoshimura[2] and T Iwama[1]
[1]Department of Neurosurgery, Gifu University Graduate School of Medicine, Gifu, JAPAN
[2]Department of Neurosurgery, Hyogo Collage of Medicine, Nishinomiya, JAPAN

Purpose: Partially thrombosed intracranial aneurysms are highly associated with poor prognosis and remain challenging lesions to treat by both surgical and endovascular treatment. Endovascular treatment has been progressively more accepted worldwide, and its treatment indication have expanded to more difficult, more complicated aneurysms. To know long-term clinical and angiographic outcome of endovascular treatment for partially thrombosed intracranial aneurysm, we retrospectively analyzed our single-center data of multimodality endovascular treatments for the patients with thrombosed intracranial aneurysm.
Materials and Methods: We assessed the data from 35 endovascular procedures for 31 consecutive patients with partial thrombosed large or giant intracranial aneurysms treated in our institution between December 2004 and December 2018. To clarify the factor related to long-term aneurysm occlusion, the rate of aneurysm recurrence was compared among each treatment modalities and analyzed the related factor by multivariate analysis.
Results: Endovascular treatments were performed by deconstructive ($n = 10$) or reconstructive techniques($n = 21$). Although 5 patients (16%) died in periprocedural period, 23 patients (74%) had good outcome at 6months after the procedures. Among 26 patients with long-term follow up, the aneurysm recurrence was observed in 6 patients (23.1%, median duration from 1st treatment was 33.2 months). The aneurysm recurrence was significantly higher in basilar artery aneurysm ($p = 0.0421$) and stroke-onset case ($p = 0.0307$). In multivariate analysis, long-term aneurysm occlusion was significantly related with the use of hydrocoils ($p = 0.0229$) and bladed stents ($p = 0.0188$).
Conclusion: Multimodality endovascular treatment for partially thrombosed intracranial aneurysm were performed with acceptable clinical and radiological outcome. Hydrocoils and bladed stent might be helpful for long-term aneurysm occlusion.
Keywords: thrombosed aneurysm, large aneurysm, hydrocoil

O 158

ENDOVASCULAR TREATMENT OF LARGE AND GIANT CRANIAL ANEURYSMS

H Kang[1], J Lee[2], Y Cho[1], D Yoo[1] and M Han[3]
[1]Seoul National University Hospital, Seoul National University College of Medicine, Seoul, SOUTH KOREA
[2]Dongguk University Hospital, Dongguk University, Seoul, SOUTH KOREA
[3]National Veterans Hospital, Seoul, SOUTH KOREA

Purpose: Management of large and giant cranial aneurysms is frequently very difficult, and carries significant morbidity and mortality. Clinical decision making on the treatment modality is still problematic. We aimed at summarizing clinical and anatomical outcomes of patients with large and giant cranial aneurysms after endovascular treatment.
Materials and Methods: During the period between January 2006 and January 2019, we performed endovascular treatment for 144 patients with large and giant cranial aneurysms with aneurysmal volumes greater than 500 mm3. There were 112 female and 23 males patients (female to male ratio, 3.5:1). The mean age was 59.6 ± 12.5 years. There were 119 unruptured and 25 ruptured aneurysms. There were 86 internal carotid artery aneurysms (including 16 posterior communicating artery aneurysms), 29 posterior circulating aneurysms, 18 anterior cerebral artery aneurysms (including 16 anterior communicating artery aneurysms), 10 middle cerebral artery aneurysms, and 1 common carotid bifurcation aneurysm. 131 patients underwent coil embolization, and 64 without stent assistance (Group A) and 67 with stent assistance (Group B) among them. The other 13 patients underwent flow diverting stent implantation (Group C).
Results: In Group A, long-term stable aneurysmal occlusion could be achieved in 39%, and the recurrent rate was 42%.

A patient of distal vertebral artery aneurysms developed progressive mass effect after trapping. In Group B, stable aneurysmal occlusion could be achieved in 43%, and the recurrent rate was 40%. There was a patient with delayed stent thrombosis and cerebral infarction, and another patient with basal ganglia infarction and fatal intracerebral hemorrhage in this group. In group C, complete or near complete occlusion could be achieved in 62% during the follow-up. 2 patients (15%) produced aneurysmal ruptured in 8 and 11 days after treatment, resulting in a mortality and a significant morbidity.
Conclusion: Coil embolization with or without stent resulted in long-term stability in around 40% of patients with large and giant aneurysms. Flow-diverting stent produced successful outcome in more than 60% of patients, with some risk of aneurysmal rupture within 2 weeks of treatment.
Keywords: giant aneurysm, coil embolization, flow diverter

O 159

ASSISTED WITH BALLOON OCCLUSSION TECHNIQUE FOR LARGE OR GIANT UNRUPTURED PARACLINOID ANEURYSM CLIPPING IN HYBRID OPERATION

W Xu[1], S Xiang[1], P Hu[1], C He[1], X Li[1], J Li[1] and H Zhang[1]
[1]Xuanwu Hospital Capital Medical university, Beijing, CHINA

Purpose: To evaluate the outcome of using balloon occlussion technique for large or giant unruptured parachonoid aneurysm clipping.
Materials and Methods: Retrospective analysis 8 those patients(11 aneurysms) who underwent aneurysm clipping assisted with balloon occlussion in hybrid operation in Neurosurgery department of XuanWu Hospital from Jan.2014 to Mar.2017. All were female, the median age was 54.9 years(range, 47–64 years).
Results: Total 9 aneurysms were treated, including 8 large or giant paraclinoid aneurysms and 1 carotid cave aneurysm. All treated aneurysms were successfully obliterated. But one patient suffered patency artery occulssion and severe stenosis, respectively. Three patients encountered ischemic events, two experienced transient diabetes insipidus and 1 sustained CSF rhinorrhea. GOS score at discharge 5 in 5 patients, 4 in 1, 3 in 2. During the follow up, GOS 5 in 7 patients, GOS 4 in 1 patient. And the ophthalmic symptom relieved in 7 patients, stable in 1 patient.
Conclusion: Hybrid operation assisted the aneurysm, large or giant unruptured parachonoid aneurysm, clipping successfully, but the property of the interventional device still to be improved.
Keywords: hybrid operation, balloon occlusion, paraclinoid aneurysm

O 160

THE ANALYSIS ABOUT THE VISUALIZATION OF SUPERIOR HYPOPHYSEAL ARTERY AND POST-PROCEDURAL VISUAL FIELD DEFICIT

M Otawa[1], T Izumi[1], M Nishihori[1], T Tsukada[1], R Oshima[1], T Kawaguchi[1], S Goto[1], M Ikezawa[1] and A Kropp[1]
[1]Nagoya university hospital, Nagoya, JAPAN

Purpose: Surgical treatment for paraclinoid aneurysm of the internal carotid artery can lead to visual field deficit due to compromised blood flow to the superior hypophyseal artery (SHA). During open surgery, a direct visualization of SHA is possible, but it is rarely visualized angiographically, and discussions about preserving SHA in neuro-endovascular procedures are scant. Since 2014, we have started using the biplane angiographic suite (ArtisQ; Siemens) with high spatial resolution. We have retrospectively analyzed the presence and absence of the SHA in paraclinoid aneurysms.
Materials and Methods: 63 cases treated between 2014 and 2018 at our neuro-endovascular department were included in this study. Ophthalmologically symptomatic patients as well as patients with follow-up treatments were excluded. Pre- and postprocedural multi-planner reconstruction (MPR) image and three-dimensional rotation angiography (3D-RA) were carefully reviewed and retrospectively analyzed for SHA status.
Results: 51 female cases with a mean age of 53.8 years were included in this study. All cases had a regular aneurysmal shape with a mean diameter of 7.05 mm (4–15.8 mm). SHA was visualized in 26 cases (41%) and the mean number of pre-procedurally visualized SHA were 1.12 (1-2). Location of SHA origin was the aneurysmal neck in 11 cases (42%) or the medial wall of C2 and C3 portion in 15 cases (58%). In 2 out of 11 aneurysmal neck cases, SHA was noticed before coil embolization and was able to be preserved after neuro-endovascular procedure. In the remaining 9 cases, SHA was not noticed pre-procedurally, and coiling was conducted without consideration. Visual field deficit occurred in 1 out of these 9 cases; however, symptoms were transient with full recovery.
Conclusion: With thorough imagine review, we were able to visualize the SHA in more than 40% of cases with one case exhibiting post-procedural transient visual field loss. Therefore, we recommend preservation of SHA in cases where it is clearly localized.
Keywords: superior hypophyseal artery, visual field loss, paraclinoid aneurysm

O 161

ENDOVASCULAR APPROACH THROUGH DIRECT CAROTID EXPOSURE FOR TREATMENT OF UNRUPTURED INTRACRANIAL ANEURYSMS

F Maruyama[1], T Ishibashi[1], I Kan[1], N Kato[1], T Kodama[1] and Y Murayama[1]
[1]Jikei University School of Medicine, Tokyo, JAPAN

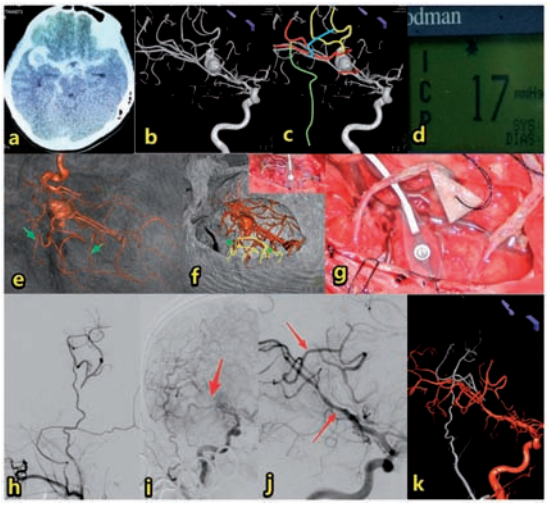
Purpose: Vessel tortuosity due to atherosclerotic changes often create difficulties of access in the treatment of unruptured aneurysms in elderly patients. The transcarotid approach can reach aneurysms minimally invasive without concern of arteriosclerosis. However, its benefits are less reported. Therefore, we evaluated the safety and efficacy of endovasuclar treatment for unruptured aneurysms of elderly patients.
Materials and Methods: From January 2003 to January 2019, a total of 11 unruptured aneurysms in elderly patients were treated with the transcarotid approach. Main reason for choice of the approach was difficulty of transfemoral approach or transbrachial approach due to tortuosity of aorta or orgin portions of its major branches. A small transverse skin incision(3 cm) was performed under ultrasonic control over common carotid artery and guiding catheter was inserted into the carotid artery. All cases were successfully performed endovacular treatment and no morbidity and mortality.
Results: The average age of the patients was 79 years(72–89), and 10 cases were women. Aneurysms ranged 7 to 21 mm, with a mean of 16.3 mm. There were 7 cases of internal carotid artery aneurysms, 2 cases of middle cerebral aneurysm and 2 cases of anterior cerebral artery aneurysms. Pipeline Flex flow diverter(FD) stent deployed in 5 of the 7 cases of internal carotid artery aneurysms. From the remaining two, one was coil embolization and one was stent-coil embolization. The two middle cerebral artery aneurysms were all distal type at M3. The reasons for choosing the transcarotid approach is the finding of advanced arteriosclerosis and the location of aneurysm during preoperative diagnostic angiography. All procedures were successful in achieving the planned objective. One patient showed vascular dissection due to internal carotid artery injury at the time of sheath insertion, but without particular consequences. One patient had one point decrease in modified rankin scale(mRS) at the time of discharge, but not in relation to the carotid artery approach. Postoperative subcutaneous hematoma swas or infection were not observed.
Conclusion: Direct exposure transcarotid approach for endovascular treatment is safe and has fewer complications. Therefore, it is feasible alternative for endovascular treatment in the anterior circulation in elderly patient with advanced arteriosclerosis.
Keywords: flow diverter embolization, trans carotid approach, aneurysm

O 162

EMERGENCY EC-IC BYPASS TREATMENT FOR INTRACRANIAL COMPLEX ANEURYSM: A HYBRID STRATEGY

W Feng[1], G Wang[1], S Qi[1], G Zhang[1] and M Li[1]
[1]Nanfang hospital of southern medical university, Guangzhou, CHINA

Purpose: To evaluate the safety and short-term efficacy of emergency EC-IC bypass treatment for intracranial complex aneurysm based on hybrid strategy.



Materials and Methods: A retrospective study was performed in 4 patients with ruptured aneurysm collected in the Department of Neurosurgery, Southern Hospital, Southern Medical University, from April 2015 to May 2018. All enrolled patients underwent emergency one-stage hybrid surgery, among which 2 cases with 3 aneurysms were provided with clipping and the remaining 2 cases with 2 aneurysms received endovascular parent artery occlusion, extracranial-intracranial bypass were performed for cerebral revascularization in all 4 cases. Intraoperative DSA angiography was applied to evaluate the aneurysms and graft patency. Selective decompressive craniotomy was performed according to the GCS score and intraoperative cranial pressure. All patients received MRI and CT perfusion and clinical follow up.
Results: All 4 extracranial-intracranial bypass were confirmed graft patency according to the intraoperative angiography, which also showed total obliteration of the 3 clipped aneurysms and the other 2 embolized aneurysms. 1 patient received decompressive craniotomy. No new infarction was found in all the 4 patients after operation, and. The Glasgow Outcome Scale (GOS) score was 5 in 2 patients, 4 in 1, and 3 in 1 at discharge. No new neurological dysfunction was found at clinical follow up, and 1 patient showed improved GOS. 3 underwent DSA, revealing no aneurysm recurrence and patent graft.
Conclusion: Emergency EC-IC bypass based on the hybrid strategy is a safe and effective approach for the treatment of complex ruptured aneurysms.

Keywords: hybrid surgery, ruptured aneurysm, emergency bypass

O 163

EFFICACY OF TRANSCRANIAL MOTOR-EVOKED POTENTIAL MONITORING IN NEUROENDOVASCULAR SURGERY FOR ANTERIOR CHOROIDAL ARTERY ANEURYSMS

A Ito[1], K Sato[1], Y Matsumoto[1] and T Tominaga[2]
[1]Kohnan Hospital, Department of Neuroendovascular Therapy, Sendai, JAPAN
[2]Took University Graduate School of Medicine, Department of Neurosurgery, Sendai, JAPAN

Purpose: Efficacy of motor-evoked potential (MEP) monitoring in open neurosurgical procedures has been well established. However, application of MEP monitoring in neuroendovascular surgery are limited, therefore little discussion has been given to the feasibility and efficacy. Herein we retrospectively reviewed our data base of neuroendovascular therapy to examine the feasibility and efficacy of transcranial MEP monitoring in intra-aneurysmal coil embolization for anterior choroidal artery (ACh) aneurysms.
Materials and Methods: We retrospectively reviewed 22 consecutive patients presenting with unruptured ACh aneurysms who underwent initial intra-aneurysmal coil embolization between January 2014 and December 2018. Since September in 2017, our institute has routinely used transcranial MEP monitoring during neuroendovascular surgery for ACh aneurysms. Eleven patients were treated by intra-aneurysmal coil embolization with transcranial MEP monitoring. We divided the patients into 2 groups: a non-MEP group, patients treated without MEP monitoring, and MEP group, patients treated with MEP monitoring. We collected clinical and radiographic data concerning these patients from our database of neuroendovascular therapy and retrospectively compared them between two groups. Furthermore, we accessed the correlation of MEP monitoring change and radiographical finding of the anterior choroidal artery in MEP group.
Results: There was no difference in patients baseline characteristics and aneurysmal size between two groups. MEP group had significantly higher aneurysmal embolization rate than non-MEP group (MEP 30.14% and non-MEP 23.64%). And adjunctive techniques (balloon or double catheters) were used more frequently in MEP group (MEP 16.67% and non-MEP 80.00%). One patient in MEP had a surgical complication. She experienced radiographical disappearance of anterior choroidal artery and transient postoperative hemiparesis, but fortunately discharged without deficit. In MEP group, three patients experienced MEP monitoring change. Surprisingly, there was no change of angiographical filling of anterior choroidal artery in all of these three cases. We changed surgical strategy depending on MEP monitoring change and had no postoperative complication in these cases.
Conclusion: This study suggested two important things. One was that transcranial MEP monitoring during intra-aneurysmal coil embolization of ACh aneurysms can contribute to higher aneurysmal embolization rate. The other was that angiographical filling of ACh artery does not always guarantee preservation of motor function.
Keywords: motor evoked potential, anterior choroidal artery, aneurysm

O 164

ACUTE IN-STENT THROMBOSIS AND ROLE OF CLOPIDOGREL IN DUAL ANTIPLATELET THERAPY FOR FLOW-DIVERTER STENTS: IS STILL A GOLD STANDARD DRUG OR IT'S TIME TO SWITCH?

F Fusaro[1], A Ferrari[1], C Ganau[1], S Corraine[1], F Schirru[1] and S Comelli[1]
[1]Neuroradiology and Interventional Radiology Department – A.O. BROTZU Emergency Hospital, Cagliari, ITALY

Purpose: Despite recent encouraging literature on new generation of thienopyridine and pyrimidine (Prasugrel and Ticagrelor) for intracranial stenting procedures, Clopidogrel in association with Acetylsalicylic acid (ASA) is still the most-used worldwide standard antiplatelet therapy (ATP) after flow-diverter stents (FDs).
We report our experience in acute in-stent thrombosis with a look on recent neurointerventional Literature about new prospectives on dual APT for FDs.
Materials and Methods: From April 2018 to April 2019, our Center treated 23 aneurysms with FDs in 22 Patients. In all Patients we prescribed dual APT (ASA 100 mg and Clopidogrel 75 mg daily), usually started seven days before and followed for 3 months after the procedure, with subsequent lifelong ASA 100mg daily.
Results: Technical stent deployment success rate was 95,6% (22/23), and aneurysmal occlusion rate at 6 month follow-up was 73,9% (17/23). Two Patients (8,7%) experienced acute in-stent thrombosis within 36 hours from the FDs deployment. In the first case, the FDs was used to treat recanalization of previously coiled carotid-ophtalmic ruptured aneurysm, progressively enlarged on follow-up imaging. In the second case, FDs was used to treat a giant dissecting intrapetrosal internal carotid unruptured aneurysm, symptomatic for headache and some recent episode of epistaxis. The first Patient experienced acute major stroke 6 hours after awakening: emergent CT-angiography (CTA) and subsequent Digital Angiography (DSA) demonstrated in-stent acute thrombosis without any visible stent misplacement. Thrombosis was approached with intra-arterial Tirofiban thrombolysis during selective catheterization of internal carotid artery followed by maintenance of intravenous Tirofiban infusion for 12 h, without any significant benefit or stent re-opening. After occlusion platelet inhibition levels were

tested with VerifyNow P12Y12 Assay (Accumetrics, San Diego, CA, USA), demonstrating Clopidogrel hyporesponsiveness. The second Patient showed stent occlusion on pre-discharge CTA obtained 36 hours after procedure, but no stroke symptoms occurred due to efficient leptomeningeal collateral supply. In this case VerifyNow test showed regular reaction on Clopidogrel.

Conclusion: We are actually facing a lack of guidelines on ATP therapy for intracranial stenting, whilst main neurointerventional Literature takes for granted dual ATP with Clopidogrel/ASA. Moreover, the overall incidence of Clopidogrel hyporesponders in studies evaluating complications following FDs procedures ranges from 4 to 58,8%. Based on specific Literature, most of interventional cardiology protocols have recently replaced Clopidogrel with Ticagrelor or Prasugrel in coronary stenting procedures. In order to better outline our patients' periprocedural path without unnecessary risks we just have two options: randomization or strictly look at interventional cardiology Literature (as has often happened in the past).

Keywords: Flow Diverter, Antiplatelet Therapy, Stent Thrombosis

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UTILITY OF DUAL PLATELET TESTING IN ENDOVASCULAR ANEURYSM TREATMENT

H Batur[1], MA Topcuoglu[2], EM Arsava[2] and A Arat[3]

[1]University of Health Sciences Ankara Numune Hospital – Department of Radiology, Ankara, TURKEY

[2]Hacettepe University – Department of Neurology, Ankara, TURKEY

[3]Hacettepe University – Department of Radiology, Ankara, TURKEY

Purpose: In endovascular treatment of intracranial wide necked or non-saccular aneurysms stents and flow diverters are being used frequently. Due to the bare metal components of these devices; intraoperative, preoperative and postoperative anti-aggregation therapy is required. While excessive platelet inhibition may cause dreaded complications like intracranial hemorrhage, insufficient inhibition is related to ischemic complications. In our retrospective study, we aimed to compare two point-of-care platelet function tests (VerifyNow and Multiplate) for assessing anti-aggregation levels in patients undergoing intracranial aneurysm treatment with stents and flow diverters.

Materials and Methods: A total of 321 patients, undergoing endovascular aneurysm treatment by stent assisted coiling and flow diverters were included. After overnight fasting, venous blood was collected from patients. Clinical data, laboratory data (PRU, BASE, TRAP, ADPtest, MPV (mean platelet volume), hematocrit, platelet count) were collected. Intraoperative and perioperative complications, use of intraoperative tirofiban were also noted. While VerifyNow provides inhibition as a percentage (automatically calculated as 1-PRU/BASE by device), there is no such calculation performed by Multiplate device. We used ADP/TRAP ratio based on the measurements of Multiplate test as a percentage for uninhibited platelets for comparison and correlation of these two tests.

Results: At least one procedural adverse event (clinical or technical) was noted in 28 (8.7%) patients. Hemorrhagic adverse events were seen in 8 (2.5%) procedures. Ischemic complications were noted in 20 (6.2%) patients. No difference was noted in terms of demographics, risk factors or hematological profile in these complicated (either ischemic or hemorrhagic) procedures compared to uneventful ones. Verify® and Multiplate® measures showed a good correlation. (correlation coefficient, $r = -0{,}4867$ (95%CI: $-0{,}5693$ to $-0{,}3944$, $p < 0{,}0001$) The optimum bleeding threshold for Verify® was found to be 63%. The optimal threshold value for Multiplate® is 19.3%, which can be translated as a platelet inhibition of 80.7%.

Conclusion: Dual platelet testing with point-of-care platelet function tests can be used to achieve higher platelet inhibition while reducing ischemic complications and preventing hemorrhagic complications. Correlation exists between the two very commonly used point-of-care platelet function tests, yet tresholds for adverse events differ for platelet inhibition as measured in percentages.

Keywords: platelet function tests, flow diverter, stent asisted coiling

SESSION N: Aneurysms Coiling

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RESULTS OF HYRESULTS OF HYBRID STUDY, PROSPECTIVE RANDOMIZED MULTICENTER STUDY OF HYDROGEL COIL VS BARE PLATINUM COIL FOR INTRACRANIAL ANEURYSMS IN JAPAN

N Sakai[1], H Imamura[1], C Sakai[1], A Hyodo[2], Y Ito[3], S Miyachi[4], Y Matsumaru[5], S Yoshimura[6], M Sasaki[7] and W Taki[8]

[1]Kobe City Medical Center General Hospital, Kobe, JAPAN

[2]Dokkyo Medical University, Koshigaya, JAPAN

[3]Shinrakuen Hospital, Niigata, JAPAN

[4]Aichi Medical Universuty, Nagakute, JAPAN

[5]Tsukuba Universuty, Tsukuba, JAPAN

[6]Hyogo College of Medicine, Nishinomiya, JAPAN

[7]Iwate Medical Universuty, Morioka, JAPAN

[8]Koseikai Takeda Hospital, Kyoto, JAPAN

Purpose: To present results of HYBRID study, whether second generation hydrogel coils for the treatment of intracranial aneurysms improves outcomes compared with bare platinum coils.

Materials and Methods: HYBRID study is investigator-initiated, prospective, randomized, multicenter trial with open label treatment, blinded endpoint evaluation at 12 months in Japan (NCT01516658). Inclusion criteria are

20–80 age, 7–20 mm size, unruptured or ruptured with WHNS grade I-III. For hydrogel coil arm HG group), recommended to use 50% length or more with maximum effort. Primary endpoint is recanalization evaluated on DSA at 1-year after embolization, and aneurysm rupture, re-treatment and adverse events are secondary endpoints.
Results: 431 cases enrolled in 44 centers for March 2012 to March 2016, and completed last follow-up on March 2017. Primary endpoint is lower in HG group compared in Bare-Platinum coil arm. And also, no aneurysm rupture in both group and less adverse event in HG group. We continue detail analysis and results will be presented at the congress.
Conclusion: Second generation hydrogel coils decreases adverse outcomes including recanalization and unfavorable clinical events in endovascular treatment for intracranial aneurysms.
Keywords: Coil, Hydrogel, Randomized study

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ENDOVASCULAR TREATMENT OF INTRACRANIAL ANEURYSM WITH COILS PIONEER®

LJ Haas[1], LCO Camilo[2], VD De Almeida[2], GV Staedele[2], WR Berticelli[2], M Becker[2], MC Harger[2], CB Lima[2], J Martins[2], BR Sabel[2], FJ Cobra[2], MD Soares[2], CGJL Brasileiro[2], JD Hessmann[2], LM Silva[2], A De Oliveira Junior[1], D Malacarne[1], B Sartori[1], FL Cabral[1], D De Lara[1], VHT Boer[1], LRGO Mello[1] and CIC Bernardes[1]
[1]Hospital Santa Isabel, Blumenau, BRAZIL
[2]University Of Blumenau – Furb, Blumenau, BRAZIL

Purpose: Intracranial aneurysms are a potentially life-threatening condition and its detection have been increasing. The prevalence ranges from 3.2 to 6.9% of the population depending on the comorbities. The rupture of an aneurysm causes subarachnoid hemorrhage (SAH), a devastating event. Aneurysmal SAH are estimated to occur in 6 to 16 per 100,000 population. The aneurysms can be treated surgically or via endovascular therapy, and the indications varies with size, site and other risk factors. Each case should be evaluated individually regarding the indications of treatment. This study aims to evaluate the treatment of ruptured and unruptured intracranial aneurysms treated with coils Pioneer®(First Line Company).
Materials and Methods: This is an observational study, in which, it was reviewed 64 cases of intracranial aneurysms treated with coils pioneer from January 2016 through December 2018 in the Neurosurgery department of a Hospital.
Results: The sample had a total of 64 patients with a mean age of 49 years (22–83), and female majority with 70,3% (n = 45). About risks factors, it was possible identify 65,6% of the patients with systemic arterial hypertension (n = 42), 39,0% smokers (n = 25) and 32,8% with dyslipidemic disorders (n = 21). The most common location of the aneurysms was the posterior communicating artery with 11 cases (17,1%), followed by the of the middle cerebral bifurcation artery with 10 cases (15,6%), the anterior communicating artery with 9 cases (14,0%), the basilar artery and the inferior cerebelar artery with 8 cases each (12,5%), the middle cerebral artery with 5 cases (7,8%), the cavernous carotid segment with 4 cases (6,3%), however, the internal carotid bifurcation artery, the anterior cerebral artery, the postero-inferior cerebellar artery and the trifurcation of middle cerebral artery totalized 2 cases each with 3,1%, and the petrous segment of the carotid artery with only 1 case (1,6%). There was a predominance of small aneurysms with 50 cases (78,1%), big aneurysms in 10 cases (15,6%), and giant aneurysms in 4 cases (6,3%). Saccular aneurysms in 63 cases, with 98,4%. The coils Pioneer® was used in all cases, and in association with stent in only one of them. In 8 patients was necessary reapproach. Nobody had complications during the procedure, but 2 patients (3,1%) died after the procedure: one ruptured of the aneurysms and one for vasospasm.
Conclusion: Despite the difficulty of the treatment of aneurysms, this data comproves that the endovascular treatment of them with coils Pioneer® is one technique with low morbidity and mortality, with minimal risk of complications.
Keywords: Aneurysm, Pioneer Coils, Embolization

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EARLY EXPERIENCES WITH A NEW, SURFACE COATED COIL, THE TRELLIX

G Gál[1]
[1]Odense University Hospital, Odense, DENMARK

Purpose: To report our preliminary results in the EVT of intracranial aneurysms, CCF, DAVF and spontaneous dissection with a new, detachable coil, coated with Shape Memory Polymer, which has large surface that facilitates thrombosis.
Materials and Methods: Between June 2018 and May 2019, 17 patients were treated with the aforementioned coil at the Odense University Hospital. There were 14 aneurysms, 1 CCF, 1 DAVF and 1 sontaneous dissection. 4 of the aneurysms were ruptured, 2 large and 2 giant, the latter with cranial nerve deficit. The coils were delivered through a ProwlerPlus microcatheter in 16 and through an Excelsior XT17 in 1 case. The following adjunctive devices were used: remodelling balloon in 5 cases, stent in 11, of which 1 intrasaccular, 1 intrasaccular FD and PHIL in 1 case. There were two technical complications, premature detachment of the coil in the microcatheter in both cases, salvaged with stent placement. There were no clinical complications. The DSA of 2 aneurysms, the CCF and the DAVF at the end of the procedure showed complete occlusion.
Results: Follow up DSA of 4 aneurysms between 6–8 months and the CCF at 4 months showed complete occlusion. Clinical follow up of the patients with the giant aneurysms showed good regress of the neurological deficit.
Conclusion: Our preliminary results show that the Shape Memory Polymer coating of the coil promotes early or

immediate thrombosis and subsequent healing of the different intracranial vascular pathologies treated. The coils have some special properties requiring different strategy compared to the other commercially available coils. The detachment system needs further improvement.
Keywords: New coils, surface coated, facilitate thrombosis

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DURABILITY OF TREATMENT FOR THE PENUMBRA SMART COIL SYSTEM AT ONE YEAR IN PATIENTS WITH RUPTURED ANEURYSMS: SUBSET ANALYSIS OF THE SMART REGISTRY

AM Spiotta[1], DJ Fiorella[2], BN Bohnstedt[3], CM Schirmer[4], RJ Bellon[5], RA DeLeacy[6] and RM Starke[7]
[1]Medical University of South Carolina, Department of Neurosurgery, Charleston, SC, USA
[2]Stony Brook University Medical Center, Neurosurgery and Radiology, Stony Brook, NY, USA
[3]Oklahoma University Medical Center, Neurosurgery, Oklahoma City, OK, USA
[4]Geisinger Medical Center, Neurosurgery, Danville, PA, USA
[5]Swedish Medical Center, Dept of Interventional Neuro Radiology, Denver, CO, USA
[6]Mount Sinai, Neurosurgery and Radiology, New York, NY, USA
[7]University of Miami Hospital, Dept. of Neurological Surgery, Miami, FL, USA

Purpose: The Penumbra SMART COIL System includes a novel generation of embolic coils comprising complex and WAVE shape properties with varying levels of softness to promote dense packing and durable long-term occlusion. We report a subset analysis to assess the durability of treatment with SMART COIL System at one-year follow-up in patients with ruptured aneurysms enrolled in the SMART registry.
Materials and Methods: The SMART registry is a prospective, multi-center registry study. Procedures must employ >=75% of the SMART, PC400, or POD coils to meet registry criteria. SMART registry endpoints include retreatment rates through one-year follow-up, procedural device-related serious adverse events (SAE), and the ability to achieve adequate occlusion at immediate post-procedure. Multivariate analysis was performed to identify predictors of outcomes at one year.
Results: Of the first 740 patients with one-year follow-up or early termination, 31.0% (209/675) of aneurysm patients had ruptured aneurysms (72.7% female; mean age 57.8 ± 13.7 years). Ruptured aneurysms were medium (<11 mm) in 88.0% (184/209), large (11 to 25 mm) in 11.5% (24/209), and giant (> 25 mm) in 0.5% (1/209) of patients, and 51.2% (103/201) were wide-neck (dome-to-neck ratio < 2 or neck width >= 4 mm). Stent-assisted coiling and balloon-assisted coiling were performed in 7.7% (16/209) and 35.4% (74/209) of patients, respectively. Median packing density for ruptured aneurysms was 28.0% (IQR 21.0–40.7). In patients with ruptured aneurysms, Raymond Occlusion Class I and II was achieved in 86.0% (178/207) at immediate post-procedure and 80.7% (113/140) at one-year follow-up. The recanalization rate at one year was 23.6% (33/140). The retreatment rate through one year was 18.4% (28/152). Procedural device-related SAE were observed in 3.8% (8/209) of subjects. In multivariate models, neck size (>= 4 mm) was an independent predictor of Raymond Occlusion Class III at one-year follow-up (odds ratio [OR] = 4.04; 95% confidence interval [CI] = 1.55, 10.55, p = 0.0043). Balloon-assisted coiling (OR = 2.87, 95% CI = 1.26, 6.54, p = 0.012) and age (OR = 0.97, 95% CI = 0.94, 1.00, p = 0.039) were predictive of recanalization at one-year follow-up. Family history of aneurysms or malformations (OR = 2.67, 95% CI = 1.02, 6.98, p = 0.046) and female sex (OR = 0.32, 95% CI = 0.13, 0.76, p = 0.0099) were predictive of retreatment rates through one-year follow-up.
Conclusion: This subset analysis suggests that the SMART COIL System achieves adequate embolization in a ruptured aneurysm cohort at one year follow-up. Wide neck size, balloon-assisted coiling, age, family history of aneurysms or malformations, and female sex were predictive for aneurysm incomplete occlusion, recanalization, and retreatment.
Keywords: Coiling, Ruptured, SMART

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ONE YEAR FOLLOW-UP ON THE UTILITY OF THE PENUMBRA SMART COIL SYSTEM FOR TREATMENT OF INTRACRANIAL ANEURYSMS AND MALFORMATIONS IN 740 PATIENTS

AM Spiotta[1], MS Park[2], CM Schirmer[3], BN Bohnstedt[4], RJ Bellon[5], RA DeLeacy[6] and DJ Fiorella[7]
[1]Medical University of South Carolina, Department of Neurosurgery, Charleston, SC, USA
[2]University of Virginia, Department of Neurosurgery, Charlottesville, VA, USA
[3]Geisinger Medical Center, Neurosurgery, Danville, PA, USA
[4]Oklahoma University Medical Center, Neurosurgery, Oklahoma City, OK, USA
[5]Swedish Medical Center, Dept of Interventional Neuro Radiology, Denver, CO, USA
[6]Mount Sinai, Neurosurgery and Radiology, New York, NY, USA
[7]Stony Brook University Medical Center, Neurosurgery and Radiology, Stony Brook, NY, USA

Purpose: The Penumbra SMART COIL System includes a novel generation of embolic coils comprising complex and WAVE shape properties with varying levels of softness to promote dense packing and durable long-term occlusion. We report an analysis of the first 740 patients at 63 U.S./Canada sites with 1-yr follow-up or early termination in the SMART registry to assess the utility of the SMART COIL

System in the treatment of intracranial aneurysms and other malformations.

Materials and Methods: The SMART registry is a prospective, multi-center registry study. Procedures must employ >=75% of SMART, PC400, or POD coils to meet inclusion criteria. SMART registry endpoints include retreatment rates through 1-yr follow-up, procedural device-related serious adverse events (SAE), and the ability to achieve adequate occlusion at immediate post-procedure. Follow-up was conducted through 1 yr. Predictive analysis on treatment outcomes are provided.

Results: This analysis of 740 patients (71.9% female; mean age 59.9 ± 13.2 yr) included cerebral aneurysms (91.2%, 675/740), of which 31.0% were ruptured; arteriovenous malformations (0.8%); fistulae (4.1%); and other lesions (3.9%). Aneurysms were medium (<11 mm) in 88.1% (595/675) of patients, large (11 to 25 mm) in 11.6% (78/675), and giant (>25 mm) in 0.3% (2/675); 63.4% (410/647) of patients had wide-neck (dome-to-neck ratio <2 or neck width >=4 mm) aneurysms. Median coil deployment time, defined as the time from the first coil deployed until the last coil detached, was 17.0 min (IQR 8.0–33.0), and median time of fluoroscopic exposure was 39.0 min (IQR 24.0–58.0). Stent-assisted coiling was performed in 35.0% of patients, and balloon-assisted coiling was performed in 20.4% of patients. The median packing density achieved was 28.8% (IQR 21.0–39.0). Raymond Occlusion Class I and II was observed in 79.5% (531/668) of aneurysm patients at immediate post-procedure and 88.7% (501/565) at 1-yr follow-up. The overall recanalization rate was 13.1% (79/601) and retreatment rate was 7.5% (47/627) through 1-yr follow-up. Procedural device-related SAE were observed in 2.6% (19/740). In multivariate models, a large or giant aneurysm size (odds ratio [OR] = 3.85, p = 0.0001), balloon-assisted coiling (OR = 2.72, p = 0.0010), and ruptured aneurysm status (OR = 2.18, p = 0.0086) were predictors of Raymond Occlusion Class III at 1-yr follow-up. Large or giant aneurysms (OR = 2.56, p = 0.020) and ruptured aneurysm status (OR = 5.56, p < 0.0001) were also predictive of retreatment through 1-yr follow-up.

Conclusion: Results suggest that the SMART COIL System achieves adequate embolization in a variety of neurovascular lesions with low retreatment rates over 1 yr. Aneurysm size, balloon-assisted coiling, and rupture status were predictive of incomplete occlusion at 1-yr and retreatment through 1-yr follow-up.

Keywords: Coiling, Aneurysm, SMART

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BEHAVIOR OF COILS WHEN ANEURYSMS RECANALIZE AFTER EMBOLIZATION

M Shojima[1], D Nakagawa[2], T Kin[2] and H Nakatomi[2]

[1]Saitama Medical University General Hospital, Saitama, JAPAN

[2]The university of Tokyo, Tokyo, JAPAN

Purpose: Coil embolization is an effective treatment option for cerebral aneurysms. However, it remains to be solved that about one-fifth of the aneurysms would recanalize after coil embolization and half of them require re-treatment. We wondered that what kind of changes were happening in the coils when the aneurysms recanalized after coil embolization. Were the coils translated or deformed according to hemodynamic force? When the coils were deformed, were they compacted or expanded? To seek the answers for such questions, we performed computational fluid dynamic analysis in 20 internal carotid artery aneurysms.

Materials and Methods: Intradurally located internal carotid artery aneurysms that were coiled completely were included in this study. Cases with stents were excluded. Finally, 22 cases with 22 aneurysms were subjected to this study. The aneurysms were divided into recanalized group or stable group. The recanalized aneurysms were defined as the aneurysms that deteriorated more than 1 point in Raymond Roy occlusion classification one year after the embolization. The 3D-RA images before, just after and one-year after the embolizations were registered in the 3D workstation. Then, the coils just after and one-year after the embolizations were segmented. The center of gravity and the volume of coil occupying area were calculated for each coil, and then, the translation and deformation of the coils were calculated as the distance of center of gravity and the volume ratio of coil occupying area, respectively. Vessel shapes were segmented from the 3D-RA image before the embolization and used for computational fluid dynamic analysis to calculate such hemodynamic parameters as mean flow velocity in the aneurysm and at the neck, etc. The translation and deformation of the coils and the hemodynamic parameters were compared between the stable and recanalized aneurysms.

Results: There were 5 recanalized aneurysms and 17 stable aneurysms. In the recanalized group, the coils were translated about 1.2 mm one-year after the embolization. It was significantly larger than the stable aneurysms, in which the coils were translated about 0.6 mm. There were a tendency that the coil occupying area became larger in recanalized group one-year after the embolization. The translation and deformation one-year after the coil embolizations were significantly related to the hemodynamic stresses at the aneurysm orifices.

Conclusion: In the recanalized aneurysms, the coils were moved and transformed according to the hemodynamic stress at the aneurysm orifices.

Keywords: Recanalization, Computational fluid dynamics, Coil

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FEASIBILITY, INTRA AND POST PROCEDURAL COMPLICATIONS OF COILING EMBOLIZATION BRAIN RUPTURED ANEURYSMS UNDER CONSCIOUS SEDATION (CS) VERSUS GENERAL ANESTESIA (GA): A PROSPECTIVE SINGLE CENTER EXPERIENCE

F Petra[1], A Aguado[1], G Caballero[1], M Grana[1], J Lizundia[1] and L Parra[1]

[1]Hospital Santa Isabel De Hungria, Mendoza, ARGENTINA

Purpose: Coiling embolization for ruptured intracranial aneurysms is performed usually under general anesthesia (GA) due to potential patient safety. We aim to compare feasibility, safety, and outcomes of coiling performed in patients under GA versus Conscious Sedation (CS)

Materials and Methods: Between March 2012 and March 2018, 90 patients presenting brain ruptured aneurysms, were randomized randomized to two groups: Group A:Patients treated under CS; Group B: patients going under GA. All patients presented a baseline Glasgow Scale of 12 or more as exclusion criteria. Technical details (duration, radiation exposure, fluoroscopy) and procedure-related complications were prospectively reviewed.

Results: A total of 41 of 45 procedures were successfully performed in Group A. During embolization 4 procedures were converted from CS to GA. In group B all cases were performed with succes. Mean procedure from angiosuite admission, was 1 hour 07 minutes (23 minutes–2 hours 32 minutes range) in Group A, and 1 hour 54 minutes (1 hour and 56 minutes–3 hours 32 minutes range) in Group B. Mean $\pm$ SD values for fluoroscopy time and radiation exposure were 25.07 ± 28.4 minutes and 1048 ± 897 mGy, respectively in Group A and 19.07 ± 21.1 minutes and 933 ± 697 mGy, respectively in Group B. The mean amount of contrast material administered was 199.20 ± 63.5 mL in group A and 169.20 ± 59.6 mL in group B. In both groups a Canada B grade exclusion or higher was obtained. Permanent neurological complications were seen in 2 patients in group A and 3 patients in group B were mRanking (score of 3 or more) at 6 months. None of this neurological complications, in both groups were secondary to intra-procedural complications.

Conclusion: CS during endovascular ruptured intracranial aneurysm in patients presenting 11 points Glasgow scale or higher, is feasible and safe compared to GA.

Keywords: Aneurysm, Ruptured, Anesthesia

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CLINICAL EXPERIENCE OF INTRA-PROCEDURAL ANEURYSM RUPTURE DURING ENDOVASCULAR TREATMENT OF CEREBRAL ANEURYSM: TWO CENTERS REPORT

ST Kim[1], HW Jeong[2], JW Baek[2], JH Seo[3], YG Jeong[1], SC Jin[4], JE Roh[5] and CH Kang[5]

[1]Inje University Busan Paik Hospital – Department of Neurosurgery, Busan, SOUTH KOREA

[2]Inje University Busan Paik Hospital – Department of Radiology, Busan, SOUTH KOREA

[3]Inje University Busan Paik Hospital – Department of Neurology, Buasn, SOUTH KOREA

[4]Inje University Haeundae Paik Hospital – Department of Neurosurgery, Busan, SOUTH KOREA

[5]Pusan National University Yangsan Hospital – Department of Radiology, Yangsan, SOUTH KOREA

Purpose: The purpose of this study was to report our clinical experience of Intra-procedural rupture (IPR) during endovascular treatment of cerebral aneurysm.

Materials and Methods: Between January 2010 and October 2018, 19 times of IPR occurred in two center during endovascular treatment of cerebral aneurysm. Thirteen patients were women. Mean age was 57.1 years-old ranging from 26 to 77. Eleven cases were ruptured condition. Mean size of the aneurysms was 4.86 mm ranging from 2.3 to 7.52 mm.

Results: The most common location of IPR was anterior communicating artery ($n = 9$). IPR developed at the procedural steps of coil framing ($n = 5$), further coil packing ($n = 7$), coil packing under stent jailing ($n = 6$), and removal of coil delivery microcatheter after coiling ($n = 1$). The locations of IPR were dome ($n = 9$), bleb of the dome ($n = 5$), neck ($n = 3$), and trunk of dissecting aneurysm ($n = 2$). In 5 cases, IPR occurred when the marker of coil delivery wire passed the proximal marker of the microcatheter. In 4 cases, the microcatheter protruded into subarachnoid space when packing coils into the aneurysm. IV heparin was used in 13 cases. Protamine sulfate for reversing heparin was in 4 cases. All cases of rescue management after IPR were performed without balloon occlusion. Additional stent was deployed in 2 cases. In all cases, angiographic occlusion of the aneurysm was eventually achieved. Mean contrast leakage time was 11.1 minutes ranging from 1 to 31 minutes. Immediate radiologic outcome was complete ($n = 12$), residual neck ($n = 5$), and residual sac ($n = 2$). IPR related with focal neurological deficits developed in 2 patients all of who suffered from temporary motor weakness (grade IV). To control IICP or acute hydrocephalus, temporary external ventricular drain was performed in 8 cases (42.1%) but permanent VP shunt was performed in 2 cases presented initially with subarachnoid hemorrhage. Recent 5 cases were treated under intraoperative monitoring (NIOM) with somatosensory evoke potential (SSEP) and motor evoke potential (MEP). Decrease of SSEP amplitude firstly was checked in all 5 cases of IPR under NIOM. 5 cases of IPR under NIOM showed recovery of amplitude of SSEP or MEP

showing no focal neurological deficits. One patient died with non-procedural complication. Clinical follow-up was possible for 23.5 months, and there was not a rebleeding event.
Conclusion: In our series, favorable clinical outcome may probably be expected if suitable rescue manage could be performed after IPR. Additionally, NIOM especially SSEP might be useful modality for predicting clinical outcomes of patients with IPR.
Keywords: aneurysm, intraprocedural rupture, coil embolization

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EFFECTIVENESS OF A NOVEL MICROCATHETER TIP SHAPING UTILIZING VASCULAR CONFIGURATION FOR INTRACRANIAL ANEURYSM COILING: ORIGINAL EXPERIENCE WITH IN VIVO ''ENDOVASCULAR SHAPING''

D Yamazaki[1], J Koyama[2], Y Hanaoka[1] and T Horiuchi[1]
[1]Department of Neurosurgery, Shinshu University School of Medicine, Matsumoto, JAPAN
[2]Neurointervention Center, Shinshu University Hospital, Matsumoto, JAPAN

Purpose: An optimal shaping of microcatheter tip during coiling is the key factor for successful endovascular coil embolization of cerebral aneurysms. However, stabilization and optimal shaping of microcatheter are occasionally challenging. We devised a novel microcatheter tip shaping technique, ''endovascular shaping'', by placing the catheter tip into a branching artery from the parent artery. To the best of our knowledge, our method shows the first report to complete shaping of microcatheter only inside patient's body. The purpose of this study was to assess the usefulness of endovascular shaping to establish an appropriate microcatheter tip shape for intracranial aneurysm coiling. Before clinical application, we did an experimental simulation using an artificial vascular model to evaluate the ''bend angle'' of the microcatheter tip following endovascular shaping. In this endovascular model experiment, we realized that the deeper the advancement of the microcatheter into the selected branch with longer placement time, the larger the bending angle toward the aneurysm.
Materials and Methods: Clinically, consective 14 patients (challenging 14 aneurysms) treated with endovascular shaping were included in this study. We retrospectively analyzed acquisition rate of the tip bending toward the selected branch after shaping, success rate of cannulation into the aneurysm, catheterization method into the aneurysm and clinical outcome.
Results: In all patients, the endovascularly shaped microcatheter could be bent toward the placed branch, excellently guided into the aneurysm, and coil embolization was accomplished without complication.
Conclusion: Based on our results, endovascular shaping provides a high stability during microcatheter insertion into the aneurysm and safer coiling compared to conventional shaping methods outside the patient's body (the microcatheter will never face straightening or rotation problems). Besides, this might shorten the operation time, lessen the exposure to radiation and avoid related hazardous events. Endovascular shaping is a simple, feasible and effective way for aneurysm coiling, in particular, for small and/or ruptured aneurysms.
Keywords: intracranial aneurysm, coiling, microcatheter shaping

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ULTRA-SMALL CATHETER SHAPING METHOD WITH A SHEATH DILATOR: USEFULNESS FOR COIL EMBOLIZATION OF CEREBRAL ANEURYSMS

H Matsumoto[1], H Nishiyama[1], N Toki[1] and D Izawa[1]
[1]Kishiwada Tokushukai Hospital, Kishiwada, JAPAN

Purpose: Microcatheter shaping is an important factor for coil embolization of cerebral aneurysms. However, it is difficult to create an ultra-small shape measuring 3 mm or less in diameter. We devised a method to readily create an ultra-small shape at the microcatheter tip using a sheath dilator. In the present study, we introduce the creation method and report its usefulness.
Materials and Methods: For mandrel formation, 7 Fr. or 4 Fr. sheath dilators were used. 1) A small, round loop was prepared by rolling a mandrel on a sheath dilator. 2) The mandrel with an ultra-small loop was inserted into the tip of a straight-type microcatheter. 3) The microcatheter tip was heated using a heat gun. 4) The mandrel was removed from the microcatheter tip. Using the catheter which has ultra-small shaped tip, coil embolization was performed.
Results: The mandrel loop diameter was 3 mm when a 7 Fr. sheath dilator was used. It was 2 mm when a 4 Fr. Sheath dilator was used. It was possible to create various ultra-small shapes, such as J, S, and pigtail shapes, at the catheter tip. Ultra-small shaped catheters were used to treat 25 cerebral aneurysms. In all patients, catheters could be readily guided into the aneurysms, and their stability after insertion was favorable.
Conclusion: Ultra-small catheter shaping method with a sheath dilator makes it possible for any neuroendovascular surgeon to easily and accurately create various ultra-small shapes measuring 2–3 mm in diameter at the microcatheter tip. The use of this method may facilitate microcatheter guiding into peripheral or tiny aneurysms.
Keywords: Ultra-small Catheter Shaping, cerebral aneurysm, coil embolization

O 176

COMPUTATIONAL SIMULATION OF MICRO-CATHETER DELIVERY FOR AN ANEURYSM IN DIFFERENT TYPES OF THE SHAPING

S Fujimura[1,2], H Takao[1,2,3], Y Uchiyama[1,2], H Ohno[1,2], T Ishii[1,2], T Okudaira[1,2], T Ishibashi[3], K Otani[3,4], K Fukudome[5], M Yamamoto[5] and Y Murayama[3]

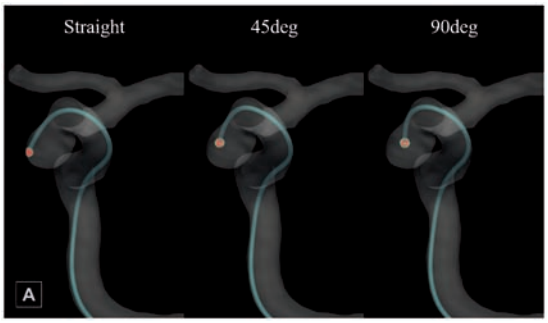
[1]Tokyo University of Science – Graduate School of Mechanical Engineering, Tokyo, JAPAN
[2]The Jikei University School of Medicine – Department of Innovation for Medical Information Technology, Tokyo, JAPAN
[3]The Jikei University School of Medicine – Department of Neurosurgery, Tokyo, JAPAN
[4]Siemens Healthcare K.K., Tokyo, JAPAN
[5]Tokyo University of Science – Department of Mechanical Engineering, Tokyo, JAPAN

Purpose: The safety and stability of micro-catheter delivery during coil embolization largely depend on the micro-catheter tip position in an aneurysm. To optimize the tip position, surgeons frequently select shaped micro-catheters. However, the problem is to find a suitable shape of the catheter for a particular aneurysm. In the present study, we developed a computational simulation technique for micro-catheter delivery for an aneurysm using finite element method (FEM). Four different types of micro-catheters were numerically delivered and their tip positions were evaluated.

Materials and Methods: A middle-sized internal carotid artery (ICA) aneurysm was selected and the three-dimensional geometrical data of the artery and aneurysm were generated. Three types of pre-shaped micro-catheter were generated based on Stryker Excelsior SL-10 Straight, 45deg, and 90deg. FEM simulation was performed to deliver each micro-catheter. After the micro-catheter reached the aneurysm, it was released under stress-free condition for 5 seconds. Time-series of the tip coordinate were exported for the final 2.5 seconds at 0.01-second interval. From these, we calculated the micro-catheter tip density at each position by counting the number of micro-catheter tips within a radius of 0.5 mm and visualized the tip density as color maps. In addition, the distance from the maximum density point to the closest aneurysmal wall was calculated.

Results: The color maps of the tip density for each micro-catheter shape are summarized in the figure. It shows positions where the tip easily settled for each micro-catheter shape (i.e., the red regions indicate tip positions that have high probabilities since the density became highest when the tip remained at the same position). The calculated distances between the maximum density point and the closest aneurysmal wall were 0.05 mm for Straight, 0.28 mm for 45 deg, and 0.32 mm for 90 deg micro-catheters, respectively. Although the simulation had limitations including the assumptions of a rigid artery without blood flow taken into account, the difference among the micro-catheters could be evaluated.

Conclusion: We were able to visualize the most probable settled tip position of the Straight, 45 deg, and 90 deg micro-catheters and found that the micro-catheter tips are settled at an inherent distance from the aneurysmal wall. This simulation may be useful to estimate a micro-catheter tip position in an aneurysm when the micro-catheter shapes are changed before surgery. Additionally, the shape of semi-order-made steam shaped micro-catheter may be optimized.



Keywords: Micro-catheter, Coil Embolization, Computational Simulation

SESSION O: Aneurysms Stent assisted coiling

O 177

PRE-PROCEDURAL SIMULATION FOR STENT-ASSISTED COILING OF CHALLENGING WIDE-NECK ANEURYSMS

N Kaneko[1], S Tateshima[1], G Colby[1,2], V Szeder[1], M Nour[1,3], A Minhas[4], J Hinman[3], R Jahan[1] and G Duckwiler[1]

[1]Department of Radiological Sciences, David Geffen School of Medicine, University of California Los Angeles, Los Angeles, USA
[2]Department of Neurosurgery, David Geffen School of Medicine, University of California Los Angeles, Los Angeles, Los Angeles, USA
[3]Department of Neurology, David Geffen School of Medicine, University of California Los Angeles, Los Angeles, Los Angeles, USA
[4]Georgetown University School of Medicine, Washington DC, USA

Purpose: Endovascular treatment of wide-neck aneurysms is still challenging. Although lower profile stents such as the LVIS Jr. and Neuroform ATLAS are available and useful to treat wide-neck aneurysms, it is difficult to predict the degree of expansion of the stent in a patient-specific anatomy, the ability to protect a side branch, and behavior of devices after stent deployment based on the 2D screen images. Patient-specific vascular models are emerging and accurate way to simulate a procedure before the treatment. We previously developed a low-cost method to create a patient-specific, silicone vascular model. The aim of the study is to describe our experience with pre-procedural simulation for stent-assisted coiling.

Materials and Methods: DICOM data were exported and post-processed to add the necessary inlet, outlet, and casing for the aneurysm model. The 3D image was converted to an stl file and 3D solid vascular mold was printed from acrylonitrile butadiene styrene (ABS) plastic using a 3D printer. The vascular mold was soaked in ABS solvent to smooth the stair-like surface of the printed objects. After drying, the smoothed mold was filled with silicone, cured, and then immersed in acetone to remove the ABS plastic. To simulate endovascular treatment, the vascular model was connected to a silicone tube with a peristaltic pump.

Results: Five patients were included in the study. All patients had wide neck aneurysms, carotid terminus, middle cerebral artery, anterior distal anterior cerebral artery, aretery-basilar superior cerebral artery and basilar apex. In the simulations, we tested and evaluated different types of stent and the expansion of the stent. The simulations showed a realistic route of the microcatheter, and how the coil spread in the aneurysm and the stent protect the side branch. In all cases, the aneurysms were treated according to the plan optimized by the findings obtained in the simulations, which gave the physician firm confidence and saved time during the case intervention.

Conclusion: Pre-procedural simulation using patient-specific models can provide information useful for device selection and prediction of device behavior with a goal of reducing intra-procedural complications.

Keywords: aneurysm, stent-assisted coiling, simulation

O 178

APPLICATION OF 3D-SPACE COMBINED WITH 3D-TOF SEQUENCE FOR FOLLOW-UP EVALUATION OF STENT-ASSISTED COIL EMBOLIZATION FOR INTRACRANIAL ANEURYSM

S Qiuji[1], L Tianxiao[1], L Li[1] and L Qiang[1]

[1]Cerebrovascular Disease Center, Henan Province People's Hospital, Zhengzhou City, CHINA

Purpose: To assess the application of 3D T1-SPACE combined with 3D-TOF sequence for follow-up evaluation of stent-assisted coil embolization for intracranial aneurysm.

Materials and Methods: Between December 2017 and October 2018, we enrolled 25 patients with intracranial aneurysm who underwent stent-assisted coil embolization. All patients were followed up for 6∼10 months after endovascular treatment using 3D-TOF Magnetic resonance angiograph (MRA), 3D T1-SPACE sequence and Digital subtraction angiography (DSA) examination to evaluate aneurysm remnants and in-stent lumen visibility after interventional embolization.

Results: With regards to aneurysm occlusion?the sensitivity of 3D-TOF MRA combined with source images was 50% (1/2), the specificity was 86.9% (20/23), the positive predictive value was 25%(1/4), the negative predictive value was 95.2% (20/21) and the accuracy was 84% (21/25). In-stent lumen for all 25 patients evaluated using 3D T1-SPACE were visible clearly with no artifacts caused by stents.

Conclusion: 3.0T MR 3D T1-SPACE sequence could be used to assess parent artery patency, with in-stent lumen being clearly visible. 3D-TOF MRA combined with source images could evaluate intracranial aneurysm remnants. The combination of these methods could be used as an optional follow-up evaluation after endovascular treatment for intracranial aneurysms?

Keywords: Intracranial aneurysm,3D T1-SPACE, Endovascular treatment, Stent, Follow-up

O 179

LONG TERM OUTCOME OF IN-STENT STENOSIS AFTER STENT ASSISTED COIL EMBOLIZATION FOR CEREBRAL ANEURYSM

JH Ko[1] and YJ Kim[1]

[1]Department of Neurosurgery, College of Medicine, Dankook University, Cheonan, SOUTH KOREA

Purpose: The objective of this study was to evaluate long-term radiologic prognosis and characteristics of In-stent stenosis (ISS) after Stent assisted coiling (SAC) for cerebral aneurysm and analyze its risk factors.

Materials and Methods: Radiological records of 362 cases of SAC during 10 years were retrospectively reviewed. Patients were included in this study if they had follow-up angiogram using catheter selected angiography at least twice. All subjected were followed up from 12 months to over 30 months. Of 120 patients, 123 aneurysms were enrolled. Patient data including age, sex, aneurysm size, neck size, procedural complication, kinds of stent, ISS associated symptom, ruptured state, location of ISS, degree of ISS, radiologic prognosis of ISS, follow-up period of time, and medical comorbidities such as hypertension, diabetes mellitus (DM), dyslipidemia, and smoking were collected. Statistical comparisons of group clinical characteristics were conducted for the total population.

Results: Among 123 cases of aneurysm, 22 (17.9%) cases of ISS were revealed on follow-up angiography. Multiple stenting was performed in 3 cases and intra-procedural rupture occurred in 2 cases. Most cases were asymptomatic and symptomatic stenosis was identified in only one case. Sixteen cases were ruptured aneurysm. Mild stenosis was observed in 11 cases. Moderate stenosis was found in 8 cases and severe stenosis was identified in 3 cases. Mean timing of identification of ISS was 8.90 months. The most common type was proximal type. Most cases were improved or not changed on follow-up angiography. Only one case was aggravated from mild stenosis to occlusion of parent artery. Mean follow-up period was 44.3 months. We compared risk factors and characteristic between ISS group and non-ISS group using univariate analysis. Multiple stenting was performed for 3 (13.6%) cases of the ISS group and 4 (4.0%) cases of the non-ISS group, showing no statistical

difference between the two groups. ($p = 0.108$)Additionally, the proportion of patients who had more than two risk factors among four medical risk factors (hypertension, DM, dyslipidemia, and smoking) was higher in the ISS group than that in the non-ISS group, the difference between the two was not statistically significant either. (31.8% vs. 12.9%, $P = 0.05$)

Conclusion: Clinical course and long-term prognosis of ISS might be benign. Most cases of ISS could be improved or not aggravated. Control of medical co-morbidity might be important. To the best of our knowledge, our study had more cases with longer follow-up period of time than other reports.

Keywords: Cerebral aneurysm, Stent assisted coiling, In-stent stenosis

O 180

LEO STENT FOR ENDOVASCULAR TREATMENT OF BROAD-NECKED INTRACRANIAL ANEURYSMS: A SERIES OF 120 CASES

F Villasante[1], F Navarro[2], E Loncharic Haag[3], H Moya[4], M Pereira[5] and A Ceciliano[6]

[1]Hospital Aleman – Sanatorio Finochietto / Department Interventional Neuroradiology, Ciudad De Buenos Aires, ARGENTINA
[2]Hospital Aleman – Sanatorio Finochietto / Department Interventional Neuroradiology, Ciudad De Buenos Aires, ARGENTINA
[3]Hospital Aleman – Sanatorio Finochietto / Department Interventional Neuroradiology, Ciudad De Buenos Aires, ARGENTINA
[4]Hospital Aleman – Sanatorio Finochietto / Department Interventional Neuroradiology, Ciudad De Buenos Aires, COLOMBIA
[5]Hospital Aleman – Sanatorio Finochietto / Department Interventional Neuroradiology, Ciudad De Buenos Aires, ARGENTINA
[6]Hospital Aleman – Sanatorio Finochietto / Department Interventional Neuroradiology, Ciudad De Buenos Aires, ARGENTINA

Purpose: The aim of this study is to present our experience in endovascular treatment of broad-necked intracranial aneurysms using a closed cell self-expanding, nitinol LEO stent.

Materials and Methods: Retrospective review of clinical and image data of 120 patients with broad-necked cerebral aneurysms. Leo + Stent or Leo + Baby Stent (Balt, Montmorency France) was used in broad-necked aneurysm with stent-assited coiling technique. Degree of aneurysm occlusion was examined using digital subtraction angiography (DSA) after the procedure and during follow-up, and was graded using the modified Raymond classification. We also observed complications to evaluate the safety and effectiveness of this therapy.

Results: 126 broad-necked aneurysms in 120 patients (70 women) were treated using Leo Stent. 128 stents were placed (65 Leo Baby and 63 Leo Plus). 118 aneurysms were treated with stent-assited coils and 8 stent alone. 72 patients present headaches, 42 SAH and 6 III CN palsy. Anterior circulation: 102/126. All patients after acute SAH underwent coil embolization, in a second time stent-assited coiling implantation. Target stent success rate was 98%, in 14 cases there were difficulties with stent deployment. Immediatly aneurysm occlusion in all patients who underwent stent placement and coil embolization were Ray. I: 83%, Ray II: 14%, Ray.III: 3%. Distal arterial modification was observed with Leo Stent. Occlusion with Stent alone technique: 6/8 patients. There were 5 thromboembolic complications due to stent. Use of abciximab led to patency the stent and parent vessel in 3/5 patients.

Conclusion: Application of Leo stents in cases of broad-necked intracranial aneurysms is safe and effective with excellent arterial apposition and low complication rate.

Keywords: Leo Stent, Aneurysm, Broad Necked

O 181

TREATMENT OF BROAD-BASED INTRACRANIAL ANEURYSMS WITH LOW PROFILE LEO BABY STENTS: A SINGLE CENTRE ANALYSIS OF 119 PATIENTS

T Djurdjevic[2], V Young[1], R Corkill[1], M Fuschi[1], D Briley[3] and W Kuker[1]

[1]Oxford University Hospitals Foundation Trust, Oxford, UNITED KINGDOM
[2]Medical University, Innsbruck, AUSTRIA
[3]Stoke Mandeville Hospital, Aylesbury, UNITED KINGDOM

Purpose: Low profile braided stents have facilitated the endovascular treatment of broad based intracranial aneurysms.

Materials and Methods: Between 2013 and March 2019, we attempted 122 Leo baby stent placements in 119 patients. Locations were AComA 46 (38.7%), MCA bifurcation 29 (24.4%) and basilar artery 26 (21.8%) aneurysms. Mean neck size was 4.9 mm (2.2–8.2). 60 aneurysms were incidental, 37 of 45 recurrent aneurysms had ruptured before.

Results: Stent deployment was successful in 89.4 %. Common reasons for failure were inability to access the parent artery ($n = 5$) or to deploy the stent across the aneurysm neck ($n = 4$).

Two patients had poor outcomes within 24 hours. One patient developed a brain haemorrhage caused by guide wire perforation (MRS 5), the other an early thrombotic stent occlusion (MRS 4). No patient died.

One patient had a rupture during the coiling of the previously unruptured aneurysm after stent placement.

4 (3.4%) patients had strokes beyond the first 24 hours after stent treatment due to stent occlusion.

10 (8.4%) patients experienced transient neurological deficits with ischaemic lesions on DWI.
Initially Raymond-Roy class 1 occlusion was achieved in 27 aneurysms (22.7%), class 2 occlusion in 43 (36.1%), class 3 occlusion in 38 (31.9%). Follow-up imaging in 104 patients shows stable or improved occlusion grades in 71.4%. 7 patients required retreatment while the rest were managed conservatively. Eight delayed stent occlusions occurred, with severe morbidity in one patient (MRS 5) and moderate morbidity in two (MRS 3).
There were no delayed aneurysm ruptures or deaths.
Conclusion: Stent assisted treatment of broad-based aneurysms with the Leo baby stent is effective. The frequency of delayed thrombotic complications is similar to other stents.
Keywords: Stent, Leo baby, aneurysm

O 182

INSTITUTIONAL EXPERIENCE WITH THE LVIS JR STENT FOR TREATMENT OF INTRACRANIAL ANEURYSMS

Y Kayan[1], J Delgado Almandoz[1], J Scholz[1], A Milner[1] and M Mulder[2]
[1]Abbott Northwestern Hospital – Neurointerventional Radiology, Minneapolis, USA
[2]Abbott Northwestern Hospital – Critical Care Medicine, Minneapolis, USA

Purpose: To evaluate the safety and efficacy of the Low-profile Visualized Intraluminal Support (LVIS) Jr stent for treatment of intracranial aneurysms.

Treatment-Related Complications		
	N	%
Any intra-operative technical difficulty:	17	12
Resulting in mRS>2:	1	0.7
Any perioperative complication (up to POD 30):	14	9.9
Resulting in mRS>2:	5	3.5
Any delayed complication (after POD 30):	3	2.1
Resulting in mRS>2:	1	0.7
Treatment-related complications resulting in mRS>2:	7	5.0

Materials and Methods: We conducted a retrospective review of all consecutive patients with intracranial aneurysms treated with the LVIS Jr stent between February 6th, 2014 and April 11th, 2019 at our institution. Baseline patient and aneurysm characteristics, procedural variables, complications and aneurysm occlusion at follow-up were recorded.
Results: 126 patients underwent 141 procedures to treat 145 intracranial aneurysms using the LVIS Jr stent, 93 women (74%), mean age 59 years (median 60 years, 27–87 years). 64 aneurysms were incidental (44%), 61 recurrent (42%), 14 ruptured (10%), and 6 symptomatic (4.1%). Mean aneurysm size was 6.4 mm (median 5.4 mm, 1.5–31.3 mm), mean neck 3.9 mm (median 3.3 mm, 0.9–13.7 mm), mean dome-to-neck ratio 1.4 (median 1.3, 0.6–2.7). Aneurysm locations were: 53 anterior communicating artery, 37 middle cerebral artery (MCA), 16 basilar tip, 14 anterior cerebral artery, 10 internal carotid artery, 6 posterior communicating artery, 6 vertebral artery and 1 each posterior inferior cerebellar, superior cerebellar and posterior cerebral arteries. Aneurysm embolization techniques were: 139 stent-assisted coiling (96%), 5 flow diversion (3.4%) and 1 stent-assisted WEB (0.7%). Y-stenting was used for 19 aneurysms (13%), T-stenting for 2 aneurysms (1.4%) and X-stenting for 2 aneurysms (1.4%). The LVIS Jr was deployed via a Scepter XC balloon in 64 procedures (50%). Mean packing density was 42% (median 40%, 8.8–91%), mean procedure time was 84 minutes (median 75 minutes, 28–225 minutes). The table summarizes treatment-related complications in our cohort. Treatment-related mortality was 2.4%, overall neurological mortality 4.8%. Angiographic follow-up was performed in 126 aneurysms (93%, 9 aneurysms pending follow-up). Follow-up was completed with MR angiography in 117 aneurysms (93%) and catheter angiography in 9 aneurysms (7.1%). Mean time to last follow-up was 13.0 months (median 6.5 months, 0.3–45.7 months). At last follow-up, 94 aneurysms were completely occluded (75%, Raymond 1), 12 had residual neck (9.5%, Raymond 2) and 20 had residual aneurysm (16%, Raymond 3). 10 aneurysms were retreated (7.9%).
Conclusion: The LVIS Jr stent is a safe and effective tool for the treatment of intracranial aneurysms, achieving high medium-term complete/near complete aneurysm occlusion rates with low treatment-related morbidity and mortality and low re-treatment rates.
Keywords: Coiling, Stent-assisted

O 183

ACCERO STENT ASSISTED COILING: EARLY EXPERIENCE REVIEW

A Nania[1], N Dobbs[1], J Duplessis[1], P Keston[1] and J Downer[1]
[1]NHS Lothian-Department of Clinical Neuroscience, Edinburgh, UNITED KINGDOM

Purpose: Accero is an innovative, fully visible, self expanding braided stent with platinum –nitinol composite wire technology, produced by Acandis. The aim of our study was to assess the technical success and the safety of this new stent by evaluating the intraprocedural behaviour and complication rate.
Materials and Methods: Thirteen patients suitable for stent assisted coiling were selected for the use of Accero in a 4 months period. We recorded clinical, procedural and angiographic data, as well as 30 days morbidity. We analysed the angiographic results and early clinical follow up at 30 days.
Results: Thirteen aneurysms were treated with stent assisted coiling. All cases were elective, of which seven treated ''de novo'' and six recurrent. Aneurysms' location was: basilar tip (seven cases), MCA bifurcation (three cases),

ICA (two cases) and anterior communicating artery (one case). We had no thromboembolic complications, with successful angiographic end result obtained in 100% of our patients. We experienced suboptimal apposition of the stent with the aneurismal neck post stent deployment in one case. This was overcome by recannulating the stent, with satisfactory end result. The only complication at 30 days was a post operative hematoma at the arteriotomy site, managed conservatively.
Conclusion: Stent coiling with Accero braided stent proved safe and effective.
Keywords: Braided stent, Stent coiling, Accero

O 184

SAFETY AND EFFECTIVENESS OF Y-CONFIGURED LOW-PROFILE STENT-ASSISTED COIL EMBOLIZATION FOR BASILAR BIFURCATION ANEURYSMS

M Sakamoto[1], H Yoshioka[1], H Takeuchi[2], T Uno[1] and Kurosaki[1]
[1]Division of Neurosurgery, Department of Neurological Sciences, Tottori University, Yonago, JAPAN
[2]Department of Neurosurgery, Nojima Hospital, Kurayoshi, JAPAN

Purpose: Coiling for basilar bifurcation aneurysm (BBA)s usually requires adjunctive techniques, because of its wide-neck morphology and high recurrence rate after coiling. Thanks to its low-profile construction, Neuroform Atlas and LVIS Jr. stent can be deployed via a microcatheter dedicated to coil delivery. The purpose of this study is to report safety and short-term radiographic results of Y-configured low-profile stent-assisted coiling for BBAs.
Materials and Methods: Between December 2010 and March 2019, 37 BBAs in 35 patients were treated with coiling including 17 unruptured, 18 ruptured and 2 recurrent aneurysms. All unruptured and recurrent BBA patients were treated with stent-assisted coiling. The subjects selected for analysis were 5 patients (5 female, mean age 72.6) receiving Y-configured low-profile stent-assisted coiling. In 2 cases, two Neuroform Atlas stent were used for Y-stent, and in 3 cases, both Neuroform Atlas and LVIS Jr were used for Y-stent (hybrid Y-stenting). Initially, in hybrid Y-stenting, an open-cell intracranial stent (Neuroform Atlas) was deployed in the posterior cerebral artery which branches more sharply from the basilar artery to prevent stent migration and achieve good wall apposition. Secondly, a braided stent (LVIS Jr) was deployed to lower the stent porosity and then the aneurysm was embolized with coils between the stent struts. In crossing Y-stents, the second stent is generally deployed through the interstices of the first stent. Therefore, if a closed-cell stent is used as the first stent, there will be a narrowed structure of the second stent and that may lead to a higher risk of thromboembolic complications. To avoid this, we deployed open cell stent firstly. As a result, kinking of second stent were not observed in all cases. A braided stent was used as a second stent to be a firm scaffold of the coils.
Results: The mean aneurysm size was 10.4 mm (range 8–14 mm). In all patients, low-profile Y-stenting and coiling were accomplished successfully. There were no hemorrhagic and ischemic complications in the perioperative period and 3 months after operation. The immediate near complete occlusion was achieved in 3 cases, and 2 patients had neck remnants. At 6-months radiological follow-up, 4/5 of the aneurysms were stable, and one case involving major recanalization.
Conclusion: Hybrid, Y-configured, dual low-profile stent-assisted coiling is a safe and effective method in the treatment of wide-necked BBAs in short-term follow-up. But radiological follow-up is mandatory to detect coil compaction, because long-term durability is not unclear.
Keywords: Y-stent, basilar bifurcation aneurysm, low-profile stent

O 185

THE PCONUS DEVICE IN TREATMENT OF WIDE-NECKED ANEURYSMS: TECHNICAL, CLINICAL AND ANGIOGRAPHIC RESULTS

R Viso[1], I Lylyk[1], C Bleise[1], P Lylyk[1], N Perez[1] and J Chudyk[1]
[1]ENERI- Departament of Neurointerventional Radiology, Buenos Aires, ARGENTINA

Purpose: A variety of devices for treatment of wide-necked bifurcation aneurysms are emerging. Here we report our results using the new pCONus device with special emphasis on the morphological and anatomical requirements for successful implantation.
Materials and Methods: In this study we treated 64 patients with 65 aneurysms by endovascular interventions between may 2012 and december 2018.
After providing informed consent, patients were included according to the following criteria: aneurysm dome to neck ratio < 2 or neck diameter > 4 mm. The primary end points for clinical safety were the absence of death, absence of major or minor stroke and absence of transient ischemic attack.
Results: A total of 65 aneurysms in 64 patients were treated with pCONus-assisted coiling. In all patients the implantation of the device was successful and these aneurysms showed an adequate occlusion after 6 months in 85%. The complication rate was low (4,6%) with three case of minor neurological complications.
Conclusion: The use of the pCONus device and coiling in wide-necked bifurcation aneurysms is safe and provides good occlusion rates.
Keywords: pCONUS, Wide Neck Aneurysm, Bifurcation Aneurysm

O 186

PCONUS_HPC: HYDROPHILIC COATING ALLOWS STENT IMPLANTATION UNDER SINGLE ANTIPLATELET THERAPY

H Henkes[1], V Hellstern[1], M Almatter[1], C Serna Candel[1], E Henkes[1], H Baezner[2], O Ganslandt[3] and M Aguilar Pérez[1]
[1]Neuroradiological Clinic, Klinikum Stuttgart, Stuttgart, GERMANY
[2]Neurological Clinic, Klinikum Stuttgart, Stuttgart, GERMANY
[3]Neurosurgical Clinic, Klinikum Stuttgart, Stuttgart, GERMANY

Purpose: To summarize the experience with the stent-assisted coil occlusion of intracranial aneurysms, using pCONUS_HPC, with a focus on single antiplatelet therapy (SAPT). The occurrence of thrombus formation and thrombo-embolic complications was the main topic. The proof of the concept pCONUS_HPC implanted under SAPT. was the purpose of this evaluation. pCONUS is a bifurcation stent for the assisted coil occlusion of wide-necked bifurcation aneurysms. pHPC is a hydrophilic coating, which reduces the thrombophilicity of the surface of vascular implants such as stents and flow diverters.
Materials and Methods: The data were retrospectively generated from a prospectively maintained data base. pCONUS_HPC became available after almost 200 uncoated pCONUS bifurcation devices have been implanted in a single institution. it was in all eligible cases used for the assisted coil occlusion of wide necked bifurcation aneurysms. The decision to use of dual antiplatelet therapy (DAPT) or SAPT was based on medical circumstances and the discretion of the operator.A total of 26 aneurysms had been treated with pCONUS_HPC.
Results: A total of 15 ruptured and 11 non-ruptured aneurysms were treated. DAPT was used in 2 ruptured and 5 un-ruptured aneurysms. SAPT was used in 13 ruptured and 6 un-ruptured. Thrombus formation was encountered in 1/11 un-ruptured aneurysms under SAPT and in 3/15 ruptured aneurysms (1x DAPT, 2x SAPT). Thrombus resolved after IV/IA injection of an eptifibatide bolus.
Conclusion: pCONUS_HPC can be used under SAPT in selected aneurysms.
Keywords: pCONUS,pHPC, Assisted Coiling

O 187

Y-STENTING VS PULSERIDER ASSISTED COILING IN THE TREATMENT OF WIDE-NECK BIFURCATION ANEURYSMS. ROLE OF ANATOMICAL FEATURES ON MID-TERM RESULTS

N Limbucci[1], S Nappini[1], L Renieri[1], A Laiso[1], C Cirelli[1], I Valente[1], A Rosi[1] and S Mangiafico[1]
[1]Neurovascular Interventional Unit, Careggi University Hospital, Florence, ITALY

Purpose: Y-stenting is an effective but challenging approach for wide-neck brain aneurysms. PulseRider ® (Cerenovus) is a new device designed to provide scaffolding during coiling but has never been compared to other techniques. Our aim is to compare the immediate and 6-month results of Y-stenting vs PulseRider assisted coiling. We also tried to assess the role of aneurysm anatomical features on mid term results.
Materials and Methods: 105 consecutive patients were retrospectively divided in two groups (73 Y-stenting; 32 PulseRider). All patients underwent angiographic 6-month follow-up. We assesses immediate and 6-months occlusion rates and clinical outcome. The groups were compared. We evaluated if some anatomical features (aneurysm size, location, neck size, sac-neck ratio) could influence treatment results.
Results: The groups were homogeneous. Complication rates were similar in Y-stenting (8.2%) and PulseRider group (6.2%). Immediate adequate occlusion was similar (94.5% vs 96.9%). At 6 months, adequate occlusion was 93.1% after Y stenting and 84.3% after PulseRider ($p = 0.28$), complete occlusion was significantly higher after Y-stenting: 90.3% vs 62.5% ($p = 0.0017$). Occlusion grade worsening occurred in 6.9% Y-stenting and 18.7% PulseRider patients ($p = 0.09$). Neck size was associated to occlusion grade in both groups. Maximal aneurysm size was associated to occlusion grade in the PulseRider group ($p = 0.023$) but not in the Y-stenting group ($p = 0.06$). After PulseRider, 6-month occlusion rate was higher in small (< 10 mm) than in large aneurysms ($p = 0.0094$); this was not observed after Y-stenting ($p = 0.54$). Location did not significantly affect the mid-term occlusion rate in both groups. After PulseRider, occlusion was more stable in basilar than anterior or middle cerebral artery aneurysms.
Conclusion: Y-stenting and PulseRider are both effective with similar immediate and mid-term results. However, treatment stability seems higher after Y-stenting. Aneurysm size seems to negatively affect PulseRider results.
Keywords: Aneurysms, Bifurcation, Stent

SESSION P: Aneurysms Flow diverter stenting

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THE PIPELINE EMBOLIZATION DEVICE: CHANGES IN PRACTICE AND REDUCTION OF COMPLICATIONS IN THE TREATMENT OF ANTERIOR CIRCULATION ANEURYSMS IN A MULTICENTER COHORT

A Dmytriw[1], K Phan[2], M Salem[2], N Adeeb[2], J Moore[2], C Griessenauer[2], P Foreman[3], H Shallwani[4], H Shakir[4], A Siddiqui[4], E Levy[4], J Davies[4], M Harrigan[3], A Thomas[2] and C Ogilvy[2]
[1]Toronto Western Hospital, Toronto, CANADA
[2]Beth Israel Deaconess Medical Center, Boston, USA
[3]University of Alabama at Birmingham Medical Center, Birmingham, USA
[4]State University of Buffalo and New York Neurosurgery, Buffalo, USA

Purpose: The Pipeline Embolization Device (PED; Medtronic, Dublin, Ireland) has become an important tool for the treatment of cerebral aneurysms. Since FDA approval, there are ongoing efforts to increase aneurysm occlusion rates and reduce the incidence of complications. The objective was to assess aneurysm occlusion and complication rates over time.
Materials and Methods: Retrospective analysis of consecutive anterior circulation aneurysms treated with a single PED between 2011 and 2016 at 3 academic institutions in the US was performed. Factors contributing to changes in aneurysm occlusion and complication rates over time were identified and evaluated.
Results: A total of 284 procedures were performed on 321 anterior circulation aneurysms in 284 patients. At a median follow-up of 13 mo (mean 18 mo), complete or near complete occlusion (>90%) was achieved in 85.9% of aneurysms. There was no significant change in aneurysm occlusion rate or procedure length over time. Thromboembolic complication occurred in 8.1% of procedures, and there was a trend toward decreased incidence from 16.3% in 2011/2012 to 3.3% in 2016 (P = .14). Hemorrhagic complications significantly decreased from 8.2% in 2011/2012 to 0 to 1.0% in 2014–2016 (P = .1).
Conclusion: We report a notable drop in the rate of hemorrhagic and to a lesser extent thromboembolic complications with increased experience with PED in a multicenter cohort. Multiple factors are believed to contribute to this drop, including the evolved interpretation of platelet function testing, the switching of clopidogrel nonresponders to ticagrelor, and the reduced use of adjunctive coiling.
Keywords: pipeline embolization device, complications, learning curve

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RETROGRADE PULL-UP METHOD FOR PIPELINE IMPLANTATION FOR EXTREMELY DIFFICULT IC CAVERNOUS ANEURYSM

Y Ito[1], H Hasegawa[2], B Kikuchi[2], K Kitazawa[1], M Koyama[1], H Ohara[3], Y Fujii[2] and M Minagawa[1]
[1]Department of Neurosurgery, Shinrakuen Hospital, Niigata, JAPAN
[2]Department of Neurosurgery, Niigata University, Niigata, JAPAN
[3]Department of Neurology, Shinrakuen Hospital, Niigata, JAPAN

Purpose: Pipeline Flex is one of choice for large and giant IC cavernous aneurysms. There still exist difficulties in delivering Marksman to the distal IC and delivering Pipeline. Utilization of retrograde approach through Pcom sometimes solve this problem. We report and 2 discuss about its tips and pitfalls of this approach.
Materials and Methods: 2 cases of cavernous aneurysm were treated with Pipeline utilizing retrograde pull-up method.
Results: Case 1: 31ys Female. Proximal IC occlusion and high flow bypass was made for lt cavernous giant aneurysm 7 years ago. Her small lt cavernous small aneurysm at that time grow to 35 mm size within 7years and. PED implantation was attempted, however failed after 6 hours trial because of absence of definite neck and sharp angulation of ICA just distal of the aneurysm, microcatheter could not be delivered beyond distal of the aneurysm. 2nd treatment was attempted 3month later. From lt VA∼BA∼rt PCA approach, 14 microwire and SL10 was delivered into the aneurysm through rt Pcom and ICA retrogradely. Goose neck snare with Marksman was introduce into the aneurysm from rt ICA antegradely. 14 wire was captured within the aneurysm with snare, Marksman was pull up to the origin of Pcom by withdrawing 14 wire and SL10. After this procedure, 1st Pipeline was implanted from IC just proximal of Pcom to aneurysmal sac. Two more same retrograde approach was conducted, finally 3 telescoped Pipeline was placed to cover whole aneurysm. Post operative course was uneventful with minor asymptomatic ischemic lesion. Case 2: 66ys Male. Pipeline placement was attempted for lt cavernous large aneurysm. Marksman could not be delivered to the distal IC of the aneurysm. Even small diameter of Pcom, we tried retrograde approach. 14 wire and SL10 was advanced to Pcom from lt VA∼BA∼lt PCA route. However, 14 wire could not be delivered into ICA and minor extravasation was observed. Pcom origin was embolized with coil and post operative course was uneventful in spite of infarction at Pcom perforator territory. Simple coil embolization was done after 6 months.
Conclusion: Large∼Giant IC cavernous aneurysm with no definite neck, sharp angulation of ICA just distal of the aneurysm. Retrograde pull-up method for PED implantation is one of choice for this situation. However, indication of this approach should be limited considering Pcom size and risk of ischemic and hemorrhagic complications.
Keywords: Pipeline, Retrograde approach, Pcom

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SCOPE-AUS: THE SAFETY AND CLINICAL EFFECTIVENESS OF PIPELINE™ FLEX EMBOLIZATION DEVICES WITH SHIELD TECHNOLOGY™ IN PATIENTS WITH INTRACRANIAL ANEURYSMS: A MULTICENTRE RETROSPECTIVE STUDY OF AN AUSTRALIAN COHORT

MA OWUSU[1], HA Rice[1], LE De Villiers[1], J Wenderoth[2], A Chiu[3], N Manning[4], A Cheung[2], W Mcauliffe[3], T Phillips[3], A Rossiter[1], L Ninnes[5], S Gatty[1], I Hughes[1], C Rapier[1] and T Green[1,6]

[1]Gold Coast University Hospital, Gold Coast, AUSTRALIA
[2]Prince of Wales Hospital, Sydney, AUSTRALIA
[3]Sir Charles Gardiner Hospital, Perth, AUSTRALIA
[4]Liverpool Hospital, Sydney, AUSTRALIA
[5]Bond University, Gold Coast, AUSTRALIA
[6]Queensland University of Technology, Brisbane, AUSTRALIA

Purpose: The Pipeline™ Flex Embolization Device with Shield Technology™ has been available in Australia for 5 years to treat intracranial aneurysms of the anterior and posterior circulation in both elective and ruptured presentations. There is the potential for Shield Technology™ device surface modification to reduce platelet adhesion and platelet specific thrombogenicity1. SCOPE-AUS will address gaps in the scientific literature by answering the following research questions: What are the real-world safety and effectiveness outcomes in Australian patients receiving Pipeline™ Flex Embolization Devices with Shield Technology™ to treat an intracranial aneurysm(s) up to 12 months after the procedure? And what are the predictive factors that influence the clinical outcomes of the procedure?

Materials and Methods: This retrospective observational cohort study will analyse real world-data2 from 500 consecutive cases performed between 01 April 2015–30 June 2018 at four major centers in Gold Coast, Sydney and Perth Australia will be presented. Pre-defined data variables are collated in a databank of patient socio-demographics, patient history, modifiable and non-modifiable risk factors; aneurysm, procedure and device characteristics; safety (adverse events) and functional outcomes at 30 days, 6 months and 12-month timepoints. Independent neurointerventionist assessments will determine the effectiveness of intracranial aneurysm treatment using validated grading scales to report complete aneurysm occlusion. Safety endpoints will be adjudicated by an independent neurointerventionalist to classify the aetiology of a neurological adverse event. Data abstraction metrics reporting interrater reliability ($\kappa + 0.80$) and intrarater reliability (ICC 0.75-0.90) will be presented.

Results: Comprehensive statistical analysis of the data will report total prevalence, morbidity, mortality and time-to-event analyses at post procedural timepoints (30 days, 6 months and 12 months) using descriptive statistics, Kaplan Meier curves and logistic regression models. Both crude and adjusted estimations of association and risk for confounding or predictive factors in the patient population will be reported. Both relative risk and odds ratios with 95% confidence intervals and p-values will be presented.

Conclusion: The findings from this study will present the real-world evidence2 presenting the risk-benefit profile of Pipeline™ Flex Embolization Devices with Shield Technology™ in elective, emergency and unscheduled clinical presentations from high volume centers in Australia. The research findings can be used to generate hypotheses for prospective trials that may allow clinicians to test the potential for Shield Technology™ to modify, standardise or eliminate the use of long-term dual antiplatelet therapy in contemporary practice.

Human Research Ethics approval number HREC/17/QGC/331; clinicaltrial.gov registration NCT03815149; Grant funding: Medtronic External Research Program, Medtronic Australasia Pty Ltd, Australia.

Keywords: real-world evidence, clinical effectiveness, shield technology

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PRELIMINARY RESULTS WITH SURPASS EVOLVE FLOW DIVERTER

S Derakhshani[1] and A Arat[2]

[1]Queen's University Hospital, Greater London, UNITED KINGDOM
[2]Hacettepe University Hospital, Ankara, TURKEY

Purpose: To discuss the outcome or to present angiographic and clinical results of our first 20 cases with new SurpassEvolve flow diverter.

Materials and Methods: We share the angiographic outcome and safety results in a consecutive group of patients treated with Surpass Evolve flow diverter in presenting centers.

Results: The technology is safe with favourable Raymond Class I and II occlusion.

Conclusion: Surpass Evolve is a safe and effective flow diverter in our preliminary results.

Keywords: Flow Diverter, Surpass Evolve, Surpass Flow Diverter

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Preliminary Experience with the New Surpass Evolve Flow Diverter: Technical Considerations and Case Study

E Orru'[1,2], AK Wakhloo[2], JM Klostranec[1], AL Coon[3], I Radovanovic[4], I Yang[1,2,3,4,5], NM Cancelliere[1], KD Bhatia[1], H Kortman[1], T Krings[1–4] and VM Pereira[1,2,3,4]

[1]Toronto Western Hospital, University Health Network, Division of Neuroradiology, Department of Medical Imaging, Toronto, ON, Canada

[2]Lahey Hospital and Medical Center, TUFTS University Medical School, Division of Neurointerventional Radiology, Burlington, MA, USA

[3]Carondelet Saint Joseph's Hospital, Carondelet Neurological Institute, Tucson, AZ, USA

[4]University Health Network – Toronto Western Hospital, Division of Neurosurgery, Department of Surgery, Toronto, ON, Canada

[5]Kaohsiung Medical University Hospital, Department of Medical Imaging, Kaohsiung

Purpose: Flow diverters (FDs) are highly effective for a variety of unruptured and selected ruptured intracranial aneurysms (IA). Positive results from the SCENT IDE study led to FDA approval of the Surpass Streamline (SS) flow diverter. Objective We present engineering aspects of the new generation of Surpass FD, the Surpass Evolve (SE) and our preliminary, first-in-human clinical experience.

Materials and Methods: Five consecutive patients (4 male; mean age 61 years) harboring an anterior or a posterior circulation aneurysm were treated with a SE using standard endovascular approach. The newly designed SE implant is delivered through a 2.7F microcatheter. A total of 8 SEs were implanted successfully in all subjects. A patient with a fusiform, partially-thrombosed vertebrobasilar aneurysm required 4 FDs. No periprocedural complications were observed and all patients remained at baseline mRS 0 at 30-day follow-up.

Conclusions: The unique features of the newly designed SE represent a significant advancement in FD technology by maintaining the unique engineering characteristics of Surpass FD family, including a precise placement due to its lower foreshortening and a high mesh density. Compared to its predecessor, changes to a lower profile delivery system allow an easier access to tortuous vasculature. Our preliminary data shows a high safety profile for the SE.

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MIDTERM TREATMENT RESULTS USING THE FRED FLOWDIVERTER

C Ulfert[1], M Moehlenbruch[1] and M Bendszus[1]

[1]Heidelberg University Hospital, Heidelberg, GERMANY

Purpose: Flowdiverters have become an accepted and widely used treatment option for intracranial aneurysms. There have been a number of studies covering the immediate procedure results as well as mid and long term follow up data for a variety of products that have been available. But especially for the newer products there is still little data for mid term occlusion results. We report a series of 70 patients that were treated with the Flow-Redirection Endoluminal Device (FRED) flow diverter and in whom there is at least 2 years of follow up imaging available.

Materials and Methods: We retrospectively selected all endovascular procedures from our aneurysm database that were treated with a FRED flowdiverter and have obtained at least 24 months of follow up imaging.

All patients received regular follow ups with MRI imaging as well as clinical examinations. Clinical outcome was assessed using the mRs (modified Rankin scale). Aneurysm occlusion was measured using the Raymond Roy Occlusion (ROC) classification.

Results: Out of the 70 included patients there were 48 (68.6%) female and 22 (31.4%) male patients. Four patients had suffered a subarachnoid haemorrhage prior to treatment. The median age was 54 years ranging from 15 to 80. The mean aneurysm dimensions were 9.1 mm width, 7.0 mm in height and 7.1 mm in depth. The parent vessels had an average size of 3.6 mm proximal to the aneurysm and 3.3 mm distally. During treatment there was 1 technical complication (1.4%). Two patients (2.8%) had a clinical complication with a transient neurological deficiency after the intervention. The mean follow up time was 35.7 months after treatment ranging from 24 to 69 months. At that point 57 (81.4%) aneurysms were completely occluded (ROC 1), 12 (17.1%) had a neck remnant (ROC 2) and in 1 (1.4%) there was still aneurysm perfusion (ROC 3).

Conclusion: The FRED flowdiverter is safe to use with a comparable complication rate to the known literature.

With a complete occlusion rate of 81.4% and an adequate occlusion rate of 98.6% (ROC 1 + 2) at a minimum follow up time of 2 years it is at least equivalent to the last generation of flowdiverters and to other treatment techniques for intracranial aneurysms and provides a reliable treatment option.

Keywords: Flowdiverter, Aneurysm, Intervention

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THE FRED JNR FLOW DIVERTER – FIRST IN MAN, LONG TERM FOLLOW UP FROM A SINGLE CENTRE EXPERIENCE

J Chudyk[1], I Lylyk[1], N Perez[1], C Bleise[1], R Viso[1] and P Lylyk[1]

[1]ENERI- Department of Neurointerventional Radiology, Buenos Aires, ARGENTINA

Purpose: The use of flow diverters to treat aneurysms arising from small calibre parent vessels has been reported. Here we report the results of the first in man experience with the FRED Jnr, a device specifically designed to target

vessels 2–3 mm in diameter, and longer-term results (12–24months).

Materials and Methods: We retrospectively reviewed our prospectively maintained database to identify all patients treated with the FRED Jnr. device between January 2015 and September 2018 at our institution. We recorded the patient demographics, aneurysm characteristics, angiographic and clinical follow-up as well complications.

Results: We identified 10 patients (10 aneurysms) of average age 57.3 ± 20.2 years. Seven (70%) of the aneurysms were located in the anterior circulation. Half of the aneurysms were dissecting and half were saccular and the majority were unruptured (n = 6, 60%). The average aneurysm dome height was 10.2 ± 9.8 mm (range 1–30 mm), dome width was 8.45 ± 7 (range 2–23 mm), and neck width 5.4 ± 3.1 mm (range 2–11 mm). The average parent vessel diameter was 2.45 ± 0.4 mm (range 1.7–2.8 mm). Angiographic follow-up was available in 8 patients (7.125 ± 3.2months). Early angiographic follow-up at 5.5 ± 1.2months (range 3–6months) showed 2 aneurysms aneurysms (33.3%) were completely occluded (RRC 1), 2 (33.3%) had small neck remnants (RRC II), and two (33.3%) showed continued filling of the aneurysm dome (RRC III). Delayed radiographic follow-up was available in 5 patients. On delayed angiography performed on average 14.4 ± 5.4 (range 12–24months) four aneurysms (80%) were completed excluded from the circulation (RRC I) and one (20%) showed persistent filling of the aneurysm dome (RRC III). Neurological morbidity and mortality were 0%.

Conclusion: The FRED Jnr. Flow diverter can be safely used to treat aneurysms arising from small parent vessels. The occlusion rate of the aneurysms is similar to that seen for aneurysms arising from larger vessels.

Keywords: Fred Jr., Small Vessels, Flow Diversion

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SEVEN YEARS FOLLOW-UP OF INTRA-CRANIAL ANEURYSMS TREATED WITH DIFFERENT TYPES OF FLOW DIVERTER STENTS

G Vitale[1], MA Moubark[2], F Di Caterino[1], M Findler[3], A Abdallah[2], F Turjiman[3] and A Biondi[1]

[1]Department of Neuroradiology and Endovascular Therapy, Besancon University Hospital, Besancon, FRANCE

[2]Department of Diagnostic and Interventional Radiology, Assiut University Hospital, Assiut, EGYPT

[3]Department of Interventional Neuroradiology, Hospices Civils de Lyon, Lyon, FRANCE

Purpose: Aneurysms exclusion by Flow Diverter Stents (FDSs) has become a widely used treatment for intracranial aneurysms. However, our knowledge about their long-term complications and their clinical implications is very limited and mainly focused on the Pipeline Embolization Device. We report our experience in long-term clinical follow-up of patients who underwent treatment with different types of FDSs in order to assess the incidence of complications and the long-term clinical status of the patients.

Materials and Methods: We performed a retrospective analysis of intracranial aneurysms treated with FDSs from February 2011 to July 2016 in two French tertiary care centers (209 patients harboring 216 cerebral aneurysms). Post-procedural long-term devices related complications were analyzed and the long-term clinical follow-up ranged from 24 to 91, median 45.5, months (IQR: 36–60).

Results: Long-term follow-up was available in 202/209 (96.65%) patients harboring 209 cerebral aneurysms. At 12–18 months, procedure related complications occurred in 5 of 202 patients (2.47%): two ischemic complications, one delayed rupture, one silent intra-stent stenosis and one patient developed epileptic seizures after withdrawal of antiplatelet therapy. Among these 5 patients, symptoms occurred in 3 patients (1.48%). The incidence of delayed complications increased significantly if more than one FDS was used for the aneurysm treatment ($P < 0.045$). After 18 months no further procedure related complications or death were recorded.

Conclusion: Our study suggests that intracranial aneurysms treatment using FDSs is safe and effective, with favorable long-term follow-up, regardless the type of FDSs.

Keywords: cerebral aneurysms, flow diverter, endovascular

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LONG TERM FOLLOW UP RESULT OF FLOW DIVERSION IN UNRUPTURED LARGE AND GIANT INTRACRANIAL ANEURYSMS

DY Cho[1]

[1]Ewha Womans University Seoul Hospital, Seoul, SOUTH KOREA

Purpose: Unruptured large and giant intracranial aneurysms are difficult to treat. Flow diversion can provide aneurysm sac occlusion with endothelial remodeling. The aim of this study was to evaluate the outcome of flow diversion in treating unruptured intracranial large and giant aneurysms.

Materials and Methods: Total 33 patients with aneurysm larger than 15 mm were treated with flow diversion. Baseline characteristics, location and size of aneurysms, the patient's symptoms and prognosis, perioperative events, clinical and angiographic outcomes were analyzed.

Results: Mean age of patients was 53.2 (12–75) and mean follow up period was 25.1 month. Mean aneurysm size was 23.8 (±9.7) mm. The location of aneurysms was ICA (78.8%), MCA (6.1%), BA (6.1%) and VA (9.1%). 25 patients were symptomatic. During the procedure, six foreshortening of stents (18.1%), three kinking of stents (9.1%), one intraoperative rupture (3%), and two in stent thrombosis (6%) had occurred. One subarachnoid hemorrhage (3%), one cerebral infarction (3%), two death due to delayed rupture (6%), five in stent stenosis (15.1%), three branch occlusion (9%) had occurred postoperately. Diagnostic angiography

after three months showed seven total occlusions (21.2%), four near total occlusions (15.2%), 12 partial occlusions (36.4%) and seven incomplete occlusions (21.2%) of aneurysms. Within 19 partial and incomplete occlusion cases, follow up angiography was performed in 15 patients after 1 year and showed 14 progression of occlusion (93%). Reduction of aneurysm size was shown in 17 patients (44.8%) and symptom improvement in 14 patients (56%).
Conclusion: Flow diversion in large and giant aneurysm shows high rate of aneurysm occlusion with reduction of aneurysm size and symptom improvement.
Keywords: Endovascular treatment, Intracranial aneurysm, Prognosis

SESSION Q: Aneurysms Flow diverter stenting

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FLOW DIVERSION OF ANTERIOR CIRCULATION ANEURYSMS USING P64: OCCLUSION RATE, PROCEDURAL MORBIDITY AND MORTALITY

H Henkes[1], V Victoria[1], M Almatter[1], C Serna[1], E Henkes[1], O Ganslandt[3], H Bäzner[2] and M Aguilar Pérez[1]
[1]Klinikum Stuttgart, Neuroradiological Clinic, Stuttgart, GERMANY
[2]Klinikum Stuttgart, Neurological Clinic, Stuttgart, GERMANY
[3]Klinikum Stuttgart, Neurosurgical Clinic, Stuttgart, GERMANY

Purpose: To retrospectively evaluate the efficacy and safety of the p64 flow modulation device in the endovascular treatment anterior circulation saccular aneurysms. Efficacy endpoint was the sufficient occlusion of the concerning aneurysms during angiographic follow-up. Safety endpoints were transient neurological deficit, permanent neurological deficit and death.
Materials and Methods: Patients treated in a single institution for one or more untreated, unruptured anterior circulation intracranial saccular aneurysm(s), either side-wall or bifurcation, with at least one attempted p64 flow diverter implantation were evaluated in retrospect. Aneurysms with concomitant intrasaccular treatment (coils, Medina) were included. The location and size of the aneurysms, the size and number of the implanted p64 devices, the occurrence of procedural complications, the clinical outcome after the treatment and during the follow-up were registered (modified Rankin scale (mRS)). The aneurysm occlusion was assessed by DSA, scheduled 3, 9 and 24 months after the treatment (complete occlusion, neck remnant and aneurysm remnant).
Results: Until March 2018 a total of 752 patients treated with flow diversion for a neurovascular aneurysm were evaluated. Of those a total of 355 consecutive patients with 407 aneurysms were eligible. The median diameter of aneurysm neck and fundus was 3 mm and 4 mm, respectively. The procedural success rate was 98% (p64 implanted). The cumulative rate of complications was 7.4% (3.4% periprocedural, 1.7% postprocedural, 2.2% during the follow-up). The morbidity/mortality rates for the entire subgroup were 4.3% and 1%, respectively.
The rate of complete occlusion/neck remnant was: at 111 days (n = 364/399, 91%) 215/63 (76%), at 294 days (n = 286/399, 72%) 223/29 (88%), at 861 days (n = 172/399, 43%) 144/17 (94%).
Conclusion: p64 is a safe and efficacious device for the endovascular treatment of selected anterior circulation aneurysms.
Keywords: Flow diversion,p64, Anterior circulation

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THE DIVERSION P64 STUDY: A PROSPECTIVE, MULTICENTRE REGISTRY IN THE TREATMENT OF INTRACRANIAL ANEURYSMS WITH P64 FLOW MODULATION DEVICE IN MORE THAN 400 PATIENTS

A Bonafe[1]
[1]Chu Gui De Chauliac, Montpellier, FRANCE

Purpose: Diversion-p64 is a prospective, multicentre post-market clinical follow-up study conducted to assess the safety and effectiveness of the p64 Flow Modulation Device (phenox GmbH, Germany) in the treatment of intracranial aneurysms within the anterior circulation. The study protocol allowed all additional types of coiling. The study focused on the rate of complete aneurysm occlusion and the rate of major stroke or neurological death, after treatment and follow-up period (3–6 months and 7–12 months).
Materials and Methods: 451 patients were enrolled across 11 countries in 26 study sites. A preliminary data set of 265 patients without haemorrhage and documented modified Rankin Scale (mRS) at discharge is evaluated regarding baseline, procedural feasibility, clinical safety and procedural results.
Results: 87.2 % of patients were female and the mean age was 55.0 (range: 25–88). Aneurysm locations were ICA (80.8%), PcomA (7.16%), ICA/PcomA (2.26%), AcomA (1.50%), ACA (0.75%), AChoA (0.75%), MCA (0.75%), SCA (0.75%), VA (0.75%), BA (0.37%). The aneurysm's dome width was categorized as small (<7 mm) 58.9%, medium (7–10 mm) 17.1%, large (11–25 mm) 21.7% and giant (>25 mm) 2.26%. The mean dome-to-neck ratio was 1.56 +/- 0.76 mm. Additional coiling was performed in 12.5% of aneurysms. Overall 278 p64 devices were used in 265 patients with 98.2% being implanted in the target location. 95.3% were properly opened. The p64 procedure was abandoned in 3 patients (1.11%). Antiplatelet drugs were administered according to standard of care. Main device related complications included in-stent stenosis, thrombosis and occlusion for 2.9% of the cases. There were reported cerebral artery occlusion (1.11%), subarachnoid haemorrhage (0.38%), vasospasm (1.89%), injury of artery (0.38%),

contrast media toxicity (0.38%), dissection (0.75%). Puncture site complications occurred in 5.28% of cases. One patient had a minor stroke (0.4%). Four patients suffered from a post-procedural major ischemic stroke, two patients had a neurological deterioration (mRS = 5) and two patients died due to major stroke in the treated brain territory. One further patient died due to myocardial infarction following a procedure related dissection in the ascendant aorta. Mortality rate (mRS = 6; 3 patients) was 1.1% in total. Post-procedural neurological outcome was assessed via mRS score: 81.1% of patients had an excellent neurological outcome (mRS = 0), 17.3% had a good outcome (mRS = 1-2) and 0.75% had a mRS = 3-4 and 0.75% mRS = 5, respectively.

Conclusion: These preliminary results suggest that the p64 Flow Modulation Device can be used safely and effectively for the treatment of unruptured intracranial aneurysms.

Keywords: P64 Flow Diverter, Prospective Study, Unruptured Aneurysm

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THE P64 FLOW DIVERTER – MID AND LONG TERM RESULTS FROM A SINGLE CENTER

S Sirakov[1] and A Sirakov[1]
[1]UH St Ivan Rilski, Sofia, BULGARIA

Purpose: The p64 is a flow modulation device, designed for endovascular treatment of intracranial aneurysms. There is limited data on the long-term effectiveness of the device. We sought to determine the safety and long-term efficacy of this device.

Materials and Methods: Seventy-two aneurysms in 72 patients were treated with a p64 flow modulation device between March 2015 and November 2018 at our institution. Anatomic features, intraprocedural complications, clinical, and angiographic outcomes were reviewed.

Results: Device placement was successful in all patients. Follow-up angiographic imaging at 6 months showed complete occlusion complete occlusion (OKM D) in 55 (76.3%) patients, subtotal aneurysmal filling (OKM B) in 10 (13.8%) patients, and neck remnant (OKM C) in 7 (9.7%) patients. Catheter angiography at 12-months was available in 70 patients (97.2%) and of these patients 91.4% of aneurysms were completely occluded (OKM D) (64/72). Delayed angiography at 24-months was available in 68 patients (94.4%) and of these 98.5% (67/68) were completely occluded. At 36-months angiography was available in 61 patients (84.4%) at which point all aneurysms were completely occluded (100%). Permanent morbidity due to delayed aneurysmal rupture occurred in one patient (1.38%). Mortality rate was 0%. Self-limiting mild intimal hyperplasia was seen in 2 patients (2.72%).

Conclusion: Treatment of intracranial aneurysms with p64 is safe and effective with a high success rate and infrequent complications.

Keywords: p64, flow diverter, embolization

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PRELIMINARY CLINICAL EXPERIENCE WITH FLOW DIVERTERS P48 AND P48-HPC

L Pierot[1], PF Manceau[1] and S Soize[1]
[1]CHU Reims, Reims, FRANCE

Purpose: Flow diversion is now a well-established endovascular technique for the treatment of intracranial aneurysms. Initially indicated for the treatment of large and giant aneurysms located on the internal carotid artery, indications of flow diverters have progressively enlarged to smaller aneurysms located more distally. As distal aneurysms are located on smaller vessels, they are not treatable with regular flow diverters like P-64, the reason why the P-48 was developed. In parallel, a glycan-based multilayer polymer coating was developed (HPC: Hydrophilic Polymer Coating) in order to reduce the aggregation of platelets on the devices placed in the arteries. We report our initial single-center clinical experience with P-48 and P-48 HPC.

Materials and Methods: All aneurysms treated with a flow diverter P-48 or P-48 HPC were prospectively included in a local database. For all patients, patient and aneurysm characteristics, antiplatelet regimen, procedural conditions, and adverse events were collected. As per usual clinical practice, all patients had a 3T-MRI 24/48 hours after the procedure including a diffusion sequence. As for all patients treated with flow diverters, imaging follow-up included MRI at 3 months, and DSA and MRI at 6 and 12 months.

Results: From November 2018, 10 patients with 10 aneurysms were included, 5 treated with P-48 bare and 5 with P-48 HPC. A preliminary evaluation of feasibility, safety, and efficacy of treatment is presented.

Conclusion: Preliminary experience with P-48 shows a good feasibility and safety of the treatment. Further evaluation is needed, singularly for the HPC coating.

Keywords: Aneurysm, Flow diverter, Coating

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THE ITALIAN MULTICENTRIC EXPERIENCE WITH NEW LOW-PROFILE FLOW DIVERTER SILK VISTA BABY: PRELIMINARY RESULTS

L Cirillo[1], A Rustici[2], S Bracco[3], L Chiumarulo[4], C Cristaudo[5], F Di Paola[6], V Gavrilovic[7], G Iannucci[8], G Lazzarotti[9], D Mardighian[10], R Menozzi[11], M Natrella[12], R Padolecchia[13], A Paolucci[14], R Papa[15], S Peschillo[16], B Petralia[17], D Romano[18] and P Zampieri[19]
[1]Unibo – IRCCS – Istituto delle Scienze Neurologiche di Bologna, Bologna, ITALY
[2]Università degli Studi di Ferrara, Ferrara, ITALY
[3]Università degli Studi di Siena, Siena, ITALY
[4]Ospedale consorziale policlinico di Bari, Bari, ITALY
[5]Azienda ospedaliera Cannizzaro Catania, Catania, ITALY
[6]Ospedale Ca' Foncello Treviso, Treviso, ITALY

[7]Azienda ospedaliera universitaria Udine, Udine, ITALY
[8]Ospedale San Bortolo Vicenza, Vicenza, ITALY
[9]Ospedale Pisa, Pisa, ITALY
[10]Spedali Civili Brescia, Brescia, ITALY
[11]Ospedale Parma, Parma, ITALY
[12]Ospedale Aosta, Aosta, ITALY
[13]Ospedale Santa Corona Pietra Ligure, Pietra Ligure, ITALY
[14]Fondazione IRCCS Ca Granda Ospedale Policlinico Maggiore, Milano, Milano, ITALY
[15]Azienda ospedaliera universitaria Policlinico Gaetano Martino Messina, Messina, ITALY
[16]Policlinico Umberto I Roma, Roma, ITALY
[17]Ospedale Bolzano, Bolzano, ITALY
[18]Azienda ospedaliera universitaria Salerno, Salerno, ITALY
[19]Azienda ospedaliera universitaria Verona, Verona, ITALY

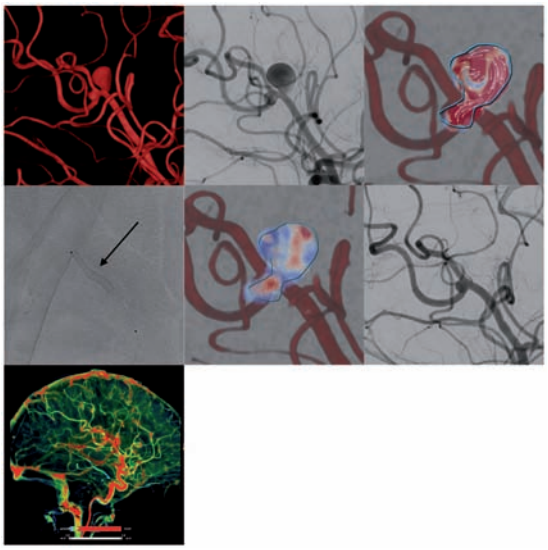
Purpose: Newer Flow Diverter (FD) stent with lower profiles has emerged, such as the new low-profile Flow Diverter silk Vista Baby (sVB, Balt Extrusion, Montmorency, France) received the CE mark in 2018. There are limited data on the efficacy and procedural experience with this device. We report preliminary results in 42 patients treated in 20 Italian centers.
Materials and Methods: Technical success, safety by evaluating the intraprocedural and periprocedural complication and preliminary results were analyzed.
Results: Forty-two patients with aneurysms were treated with the new flow-diverter devices in 20 Italian centers from June to December 2018 and then evaluated. Thirty-seven cases were unruptured; 5 aneurysms previously ruptured and in 3 cases the sVB was implanted in the acute/subacute phase. Thirteen cases were treated because of recurrence after coiling. No significant difficulties were observed to place the stents; no one was removed. Thirteen aneurysms (31%) were dissecting or fusiform and 29 (69%) were saccular (11 large and 18 small). Aneurysms locations were M1 segment in 2 cases (4.8%), M2 segment in 5 cases (11.9%), Middle Cerebral artery (MCa) bifurcation in 5 cases (11.9%), Anterior Communicating artery/A1/A2 in 18 cases (42.9%), Pericallosal artery in 2 cases (4.8%), Vertebral artery (V4 segment) in 3 cases (7.1%), Posterior Communicating artery (PCa) in 4 cases (9.5%), Superior Cerebellar artery (SCa) in 1 case (2.4%) and Basilar artery (Ba) in 2 cases (4.8%).
Conclusion: Our early experience shows that the treatment of intracranial aneurysms with new sVB device is technically effective. Although we recognize this study is still limited, the results appear promising, and larger series with longer-term follow-ups are needed to corroborate the effectiveness of this newly released device.
Keywords: silk Vista Baby, Flow Diverter, multicenter study

O 202

BREAKING NEW GROUND – FLOW DIVERSION BEYOND THE CIRCLE OF WILLIS: ENDOVASCULAR ANEURYSM TREATMENT IN PERIPHERAL CEREBRAL ARTERIES EMPLOYING A NOVEL LOW PROFILE FLOW DIVERTING STENT

S Schob[1], K Hoffmann[1] and U Quaeschling[1]
[1]Department for Neuroradiology, University Hospital Leipzig, Leipzig, GERMANY

Purpose: Flow diversion (FD) has emerged as superior minimally-invasive therapy for cerebral aneurysms.
However, especially aneurysms of small peripheral vessel-segments have not yet been sufficiently treatable. More specifically, currently established devices necessitate large micro-catheters, which impede atraumatic maneuvering. The Silk Vista Baby(SVB), a novel flow diverter offers the yet unique feature of deliverability via a 0.017'' microcatheter. Our study reports our first experience with the SVB in challenging intracranial vessels employing a vessel-specifically tailored microcatheterstrategy.



Materials and Methods: 25 patients (27 aneurysms) were prospectively included. A total of 30 SVBs were employed, predominantly targeting demanding aneurysms of the AcomA-complex. Efficacy of FD was estimated using 2D-vector based perfusion and conventional digital subtraction angiography after implantation as well as in the first follow-up(FU) at 3 months. The 1stFU was available in 22 patients.
Results: All devices were implanted without technical or clinical complications. Eleven treatments were performed using the recommended Headway17. In fourteen interventions the even more maneuverable Excelsior-SL10 was used, which was priorly tried and tested for safety 'in-vitro' as alternative delivery system. Aneurysmal influx was strongly reduced after implantation. All parent vessels remained patent. 17/27 aneurysms were completely occluded at 1st FU (2.7months). 6/27 aneurysms showed decreased influx

or delayed washout, one remained unchanged. In 3 cases FU was unavailable.
Conclusion: SVB provides enhanced controllability in vulnerable segments beyond the circle of Willis. Smaller variants (2.25 mm, 2.75 mm) can safely be implanted via the superiorly navigable Excelsior-SL-10.
Hence, the SVB represents the next evolutionary step in minimally-invasive treatment of cerebral
aneurysms.
Keywords: peripheral aneurysms, low profile flow diverter, first experience

O 203

THE USE OF FLOW DIVERSION STENT IN VESSELS LESS THAN 2.5MM IN DIAMETER – A SINGLE CENTRE EXPERIENCE

J Chudyk[1], C Bleise[1], I Lylyk[1], N Perez[1], R Viso[1] and P Lylyk[1]
[1]ENERI- Department of Neurointerventional Radiology, Buenos Aires, ARGENTINA

Purpose: We present our data on the use of FDS to treat aneurysms arising from parent vessels with diameter less than 2.5 mm in maximal diameter.
Materials and Methods: We performed a retrospective analysis of prospectively maintained database to identify all patients with and aneurysm arising from a vessel less than 2.5 mm in diameter. Patients with both saccular and fusiform aneurysms were included. Ruptured aneurysms were excluded from the analysis as were patients that had adjunctive coiling at the time of flow diversion. We searched our database between September 2009 and December 2018. The local ethics committee approved this study.
Results: We identified 29 patients (22 female, 76%) with average age 56.2 ± 15.9 (range 21–83).
The average parent artery diameter was 2.1 ± 0.37 mm (range 1.3–2.5 mm). Aneurysms were located in both the anterior and posterior circulation with the majority located in the anterior circulation (76%, $n = 22$). All anterior circulation aneurysms were located distal to the circle of Willis and the internal carotid artery (ICA) bifurcation.
Conclusion: The use of FDS in vessels less than 2.5 mm is technically feasible with good aneurysm exclusion rates. The introduction of FDS
Keywords: Small Vessel, Distal Aneurysm, Flow Diversion

O 204

LVIS BLUE AS A STAND ALONE FLOW DIVERTER AND COIL ADJUVANT: AN INSTITUTIONAL EXPERIENCE

M Koch[1], S Raymond[1], C Stapleton[1] and A Patel[1]
[1]MassaChusetts General Hospital, Boston, USA

Purpose: Flow diversion fundamentally changes the treatment approach of intracranial aneurysms. Most currently available stents do not have flow diverting properties, and established flow diverters have limited efficacy and safety data beyond the proximal anterior circulation; the distal and posterior circulations remain areas of active research. LVIS Blue is a stent with 28% metal coverage approved for use as a coil adjuvant. Both in vitro and in vivo studies indicate potential flow diverter properties. We sought to evaluate the LVIS Blue as a coil adjuvant and stand-alone flow diverter for the treatment of intracranial aneurysms.
Materials and Methods: We performed an observational single-center study to evaluate initial occlusion and occlusion at 6 months follow-up for patients with intracranial aneurysms treated with the LVIS Blue at our institution.
Results: Sixty-four aneurysms were treated over the course of 3 years with forty-six patients having 6 month angiographic followup. Thirty-three aneurysms were treated with adjuvant coils throughout the proximal and distal anterior and posterior circulations, (7 Acomm, 5 BTA, 2 M3 MCA, 4 Clinoidal ICA, 6 Pcomm, 4 ICA terminus, 3 SCA, 1 PICA, and 1 Pericallosal). Thirteen aneurysms were treated with stand-alone flow diversion, (6 Acomm, 2 BTA, 2 Pcomm, 1 PCA, 1 Pericallosal, and 1 MCA). Overall closure rate, mRRC 1 or 2, was 79% with the use of coils and 62% without additional coils. Closure rate was significantly associated with sidewall versus bifurcation configuration for aneurysms treated with coils ($p = 0.03$), but not for stand-alone flow diversion ($p = 0.7$). Only one intracranial complication occurred, an in-stent thrombosis managed with eptifibatide infusion without clinical sequlae.
Conclusion: LVIS Blue is associated with good closure rates when used with coils and demonstrates efficacy as a stand-alone flow diverter. Further data regarding long-term efficacy is needed.
Keywords: Aneurysm, Flow Diversion, Embolization

O 205

FLOW DIVERSION FOR THE TREATMENT OF BASILAR APEX ANEURYSMS

A Dmytriw[1], N Adeeb[2], A Kumar[1], C Griessenauer[2], K Phan[2], C Ogilvy[2], P Foreman[3], H Shallwani[4], N Limbucci[5], S Mangiafico[5], C Michelozzi[6], T Krings[1], V Pereira[1], C Matouk[7], Y Zhang[1], M Harrigan[3], H Shakir[4], A Siddiqui[4], E Levy[4], L Renieri[5], C Cognard[6], A Thomas[2] and T Marotta[2]
[1]St. Michael's & Toronto Western Hospital, Toronto, USA
[2]Beth Israel Deaconess Medical Center, Boston, USA
[3]University of Alabama at Birmingham, Birmingham, USA
[4]University of New York at Buffalo Neurosurgery, Buffalo, USA
[5]Careggi University Hospital, Florence, ITALY
[6]CHU de Toulouse, Toulouse, FRANCE
[7]New Haven Hospital Yale, New Haven, USA

Purpose: Flow diversion for basilar apex aneurysms has rarely been reported. The objective was to assess flow diversion for basilar apex aneurysms in a multicenter cohort.
Materials and Methods: Retrospective review of prospectively maintained databases at 8 academic institutions was performed from 2009 to 2016 to identify patients with basilar apex aneurysms treated with flow diversion. Clinical and radiographic data were analyzed.
Results: Sixteen consecutive patients (median age 54.5 yr) underwent 18 procedures to treat 16 basilar apex aneurysms with either the Pipeline Embolization Device (Medtronic Inc, Dublin, Ireland) or Flow Redirection Endoluminal Device (Microvention, Tustin, California). Five aneurysms (31.3%) were treated in the setting of subarachnoid hemorrhage. Seven aneurysms (43.8%) were treated with flow diversion alone, while 9 (56.2%) underwent flow diversion and adjunctive coiling. At a median follow-up of 6 mo, complete (100%) and near-complete (90%–99%) occlusion was noted in 11 (68.8%) aneurysms. Incomplete occlusion occurred more commonly in patients treated with flow diversion alone compared to those with adjunctive coiling. Patients with partial occlusion were significantly younger. Retreatment with an additional flow diverter and adjunctive coiling occurred in 2 aneurysms with wide necks. There was 1 mortality in a patient (6.3%) who experienced posterior cerebral artery and cerebellar strokes as well as subarachnoid hemorrhage after the placement of a flow diverter. Minor complications occurred in 2 patients (12.5%).
Conclusion: Flow diversion for the treatment of basilar apex aneurysms results in acceptable occlusion rates in highly selected cases. Both primary flow diversion and rescue after failed clipping or coiling resulted in a modified Rankin Scale score that was either equal or better than at presentation and the technology represents a viable alternative or adjunctive option.
Keywords: basilar apex, ped, fred

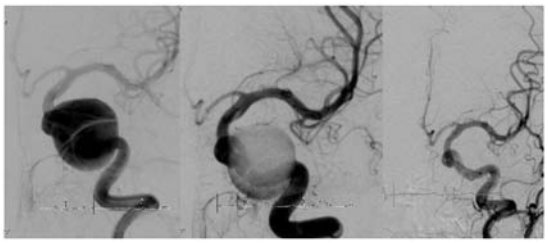
SESSION R: Aneurysms Flow diverter stenting

O 206

ADVENCED INTRACRANIAL ANEURYSMS TREATMENT – THE DERIVO EMBOLIZATION DEVICE

S Milosevic Medenica[1], D Nestorovic[2], F Vitosevic[3] and I Vukasinovic[4]
[1]Center of Radiology and MR, Clinical Center of Serbia, Belgrade, SERBIA
[2]Center of Radiology and MR, Clinical Center of Serbia, Belgrade, SERBIA
[3]Center of Radiology and MR, Clinical Center of Serbia, Belgrade, SERBIA
[4]Center of Radiology and MR, Clinical Center of Serbia, Belgrade, SERBIA

Purpose: DERIVO embolization device is relatively new flow diverting stent showing very good x-ray visibility and simplified delivery system. In recently published studies DERIVO FD showed a high rate of procedural safety and good occlusion rates. The purpose of our study is to evaluate our results in endovascular treatment of large and giant aneurysms with DERIVO flow diverting device.
Materials and Methods: In the period from 2016 until this year (2019) we treated 10 patients with 10 unruptured aneurysms with DERIVO device. All aneurysms were large or giant, and all were in anterior circulation (8 ICA and 2 MCA aneurysms). Patients complained for headache and/or ocular symptoms. We evaluated procedural details, 30 days morbidity, as well as occlusion rates on the 6 -months control angiography.
Results: Embolization was successful in all patients. In two cases the stent did not open completely during deployment (fish mouth appearance), but it was straightened by only one pass of microguidewire. In all other case there were no problems during deployment. We didn't have hemorrhagic, neither visible ischemic complications. One patient with giant ICA aneurysm had vision loss on the contralateral side after intervention that did not improve in spite of corticosteroid therapy. On the 6 months control angiography there was a complete occlusion in 6 patients with preserved patency of blood vessel. In one patient there was a small segment of incomplete wall apposition at the point where ICA itself was stenosed and irregular, with endoleak and residual filling of giant aneurysm. As the retreatment of this case was not possible, we followed up this patient and found a gradual decrease in aneurysm filling on each control, now being very small. For three patients we don't have yet follow up study.



Conclusion: Our experience on this small series of patients shows a high level of technical feasibility, safety and a very good occlusion rate. More data are needed to prove a long-term efficacy of device.
Keywords: Aneurysm, Flow diverter, Endovascular treatment

O 207

A PROSPECTIVE MULTICENTRE REGISTRY OF PATIENTS TREATED FOR UNRUPTURED INTRACRANIAL ANEURYSMS WITH THE DERIVO FLOW DIVERTER: PROCEDURAL SAFETY AND CORE-LAB ADJUDICATED ANGIOGRAPHIC BASELINE RESULTS

C Taschner[1], CP Stracke[2], F Dorn[3], K Kadziolka[4], K Kreiser[5], M Pham[6], JH Buhk[7], B Turowski[8], W Reith[9], H Janssen[10], O Beuing[11], O Jansen[12], M Knauth[13] and R Chapot[2]

[1]University Hospital Freiburg, Freiburg, GERMANY
[2]Alfried Krupp Krankenhaus, Essen, GERMANY
[3]University Hospital München (Lmu), München, GERMANY
[4]Grodzisk Mazowiecki, Warszaw, Poland
[5]University Hospital München (Tu), München, GERMANY
[6]University Hospital Würzburg, Würzburg, GERMANY
[7]University Hospital Hamburg (Uke), Hamburg, GERMANY
[8]University Hospital Düsseldorf, Düsseldorf, GERMANY
[9]University Hospital Homburg, Homburg, GERMANY
[10]Klinikum Nürnberg, Nürnberg, GERMANY
[11]University Hospital Magdeburg, Magdeburg, GERMANY
[12]University Hospital Kiel, Kiel, GERMANY
[13]University Hospital Göttingen, Göttingen, GERMANY

Purpose: The study objective is to examine the safety and efficacy of the Derivo flow-diverter (Acandis, Pforzheim, Germany) for the treatment of unruptured intracranial aneurysms.
Materials and Methods: A prospective multicentre, observational, single arm, uncontrolled registry trial was conducted at 12 centres in Germany and Poland. Patients aged 18 to 75 years with untreated unruptured intracranial aneurysms were eligible. Additional coiling was allowed as clinically required. Angiographic images at baseline were reviewed by an independent imaging core laboratory. Primary end point is clinical outcome at 18 months follow-up.
Results: Patient inclusion was started in April, 2013, and was stopped in January, 2018, after enrollment of 104 patients. Six patients were excluded for missing data. Ninety-eight patients were analyzed on an intention-to-treat basis (25 (25%) were men, 18–86 years of age; mean age 54.1 years. Baseline modified Rankin scale (mRS) scores were 0 in 74 (75%) patients and 1 in 24 (25%) patients. 83 (86%) aneurysms arose from the ICA, 1 (1%) from the ACA, 1 (1%) from the MCA, 8 (8%) from the vertebral artery, and 4 (4%) from the basilar artery. 77 (79%) aneurysm were saccular and 21 (21%) fusiform. Median aneurysm diameter was 9.0 mm (range 5.4–13.5), and median neck size was 5.2 mm. All treatments were performed under double anti-platelet therapy. Additional coiling occurred in 51 (52%) patients. 81 (83%) patients were treated with one, 16 (16%) patients had two, and 1 (1%) patient had three Derivo Flow diverter (FD) placed. In 18 (18%) patients PTA was performed after FD placement. Technical complications occurred in 9 (9%) of cases. For analysis of initial angiographic results 91 data sets were available for review. The core lab reported 1 (1%) FD that was not completely open distally, 4 (5%) that were not completely open proximally. FD torsion of the FD occurred in 1 (1%) patient. Three (3%) patients experienced a periprocedural stroke, and one (1%) patient had a symptomatic ICH. MRS at discharge was 0 in 81 (83%), 1 in 14 (14%), 2 in 2 (2%), 4 in 1 (1%) patients, respectively.
Conclusion: Treatment of unruptured intracranial aneurysm with the Derivo FD is technically feasible and can be achieved with a safety profile comparable to other FD available on the market.
Keywords: PROSPECTIVE TRIAL, FLOW DIVERTER, UNRUPTURED ANEURYSM

O 208

FIRST EXPERIENCE WITH DERIVO EMBOLIZATION DEVICE (DED) IN ARGENTINA: LONG TERM FOLLOW UP

A Ceciliano[1], F Navarro[2], M Pereira[3], H Moya[4], E Loncharic[5] and F Villasante[6]

[1]Hospital Aleman – Sanatorio Finochietto / Department Interventional Neuroradiology / Department Interventional Neuroradi, Ciudad De Buenos Aires, ARGENTINA
[2]Hospital Aleman – Sanatorio Finochietto / Department Interventional Neuroradiology / Department Interventional Neuroradi, Ciudad De Buenos Aires, ARGENTINA
[3]Hospital Aleman – Sanatorio Finochietto / Department Interventional Neuroradiology / Department Interventional Neuroradi, Ciudad De Buenos Aires, ARGENTINA
[4]Hospital Aleman – Sanatorio Finochietto / Department Interventional Neuroradiology / Department Interventional Neuroradi, Ciudad De Buenos Aires, COLOMBIA
[5]Hospital Aleman – Sanatorio Finochietto / Department Interventional Neuroradiology / Department Interventional Neuroradi, Ciudad De Buenos Aires, ARGENTINA
[6]Hospital Aleman – Sanatorio Finochietto / Department Interventional Neuroradiology / Department Interventional Neuroradi, Ciudad De Buenos Aires, ARGENTINA

Purpose: DED is a hybrid nitinol flow diverter device with low thrombogenecity, in our first experience (Group A:GA) we used assisted coiling technique mostly. In this second experience (Group B:GB), we evaluated the safety and efficacy of DED alone.
Materials and Methods: We treated 42 unruptured aneurysms using 40 devices in 38 patients with wide-necked aneurysms. Headache was the most frequent symptom. 40 aneurysms were located in the anterior circulation. Dual antiplateled medication were administrated 5–7 days before the procedure. The first follow-up angiography in GA were planned to be performed after 3–6 months, and in GB after 12–18 months.
Results: In all patients, the device was successfully implanted. One hemorrhagic complication was seen during microguidewire exchange. 37 patients were

discharged without any neurologic deficit. GA: Immediately total occlusion have been seen in 9/16 aneurysms mostly with coiling technique, other 6/16 were totally closed at 6 months and 1 aneurysm still remain open. GB: Immediately total occlusion 0/26, 22/26 (84%) were totally closed between 12–18 months follow up. General morbidity was 2,6 %, and mortality was 0%.
Conclusion: The DED shows to be effective and safe for the treatment of wide-neck aneurysms, with no
thrombosis complication. The highest occlusion rate was seen after 12 months.
Keywords: Derivo Embolization Device, Aneurysm, Flow Diversion

O 209

A RETROSPECTIVE EXPERIENCE OF 243 PATIENTS TREATED WITH 1 YEAR FOLLOW UP

S Derakhshani[1], A Arat[2] and S Balci[2]
[1]Queen's University Hospital, Greater London, UNITED KINGDOM
[2]Hacettepe University Hospital, Department of Radiology, Ankara, TURKEY

Purpose: To present retrospective angiographic and clinical results of 243 patients with 253 aneurysms treated using the Surpass Streamline® Flow Diverter from January 2013 through March 2018 with 1 year follow up (14 month mean).
Materials and Methods: 243 patients in presenting institutions with cerebral aneurysms treated with Surpass Streamline flow diverter.
Results: Technical success 94%, Raymond I and II:87%, Safety rate 3.1%
Conclusion: Surpass Streamline is a safe and efficient flow diverter for treatment of cerebral aneurysms.
Keywords: Surpass Steamline, Surpass Flow Diverter, Flow diverter

O 210

CAROTID ANEURYSMS PRESENTING WITH CRANIAL NERVE SYMPTOMS; THE COMPARISON OF TREATMENT OUTCOMES BETWEEN COILING AND FLOW DIVERTER

S Koizumi[1], J Desilles[1], R Fahed[1], S Escalard[1], S Smajda[1], G Ciccio[1], H Redjem[1], M Mazighi[1], R Blanc[1] and M Piotin[1]
[1]Rothschild Foundation, Department of Interventional Neuroradiology, Paris, FRANCE

Purpose: Several studies have claimed that flow diverter (FD) is superior to coiling to ameliorate the cranial nerve compression symptoms of the intracranial aneurysms. However, the numbers of studies comparing the 2 modalities directly are still limited in number. The goals of our study are to compare the treatment result between the 2 modalities and to clarify the factors related to the improvement of cranial nerve symptoms.
Materials and Methods: Patients who underwent endovascular treatments for their intracranial carotid siphon aneurysms between January 2012 and December 2017 presented with cranial nerve symptoms were included. They were usually followed up 1 year after the treatment by a diagnostic angiography and a clinical examination. If the follow up was unavailable, we tried to perform a telephone interview to assess his or her symptom changes. Statistical analyses were performed to clarify the factors affecting the improvement of cranial nerve compression symptoms.
Results: During the study period, 89 treatments were performed for 81 aneurysms (8 patients undertook 2 staged treatments of coiling and FD). Of those, follow up data were obtained in 49 patients (18 in the FD group and 31 in the coil group). In the FD group, ophthalmic aneurysms were more common (44 vs 6%, $P = 0.0027$) and the patients had larger aneurysms (median volume 1933 vs 122 mL, $P < 0.001$) than in the coil group. As for symptoms, the patients in the FD group had more optic nerve symptoms (56% vs 13%, $P = 0.0027$) and they suffered for a longer period of time (median symptom duration 170 vs 11 days, $P < 0.001$)). The symptom recovery was obtained in 8 (44%) in the FD group and 20 (65%) in the coil group, which was not statistically significant ($P = 0.23$). In the multivariate analysis, the cavernous aneurysms ($P = 0.019$, odds ratio = 1.45 (95% confidence interval 1.08–1.96)) and the lower aneurysmal volumes ($P = 0.045$, odds ratio = 1.006 (95% confidence interval 1.000–0.011 in each 100 mL reduction)) were the positive predictors of the symptom recovery.
Conclusion: No significant difference of the treatment outcome was observed in our cohort, probably due to the background difference between the 2 groups. Further studies are awaited to clarify the mechanisms underlying the symptom recovery after the treatment.
Keywords: aneurysm, vision, flow diversion

O 211

ASSESSMENT OF CAROTID SINUS REFLEX DURING FLOW-DIVERTER STENT DEPLOYMENT

S Goto[1], T Izumi[1], M Nishihori[1], T Tsukada[1], M Otawa[1], R Oshima[1], T Kawaguchi[1] and T Wakabayashi[1]
[1]Nagoya university hospital, Nagoya, JAPAN

Purpose: Bradycardia and hypotension are sometimes observed during procedure of the Pipeline Flex Embolic Device (PED) deployment. It might be caused by pushing the PED delivery system farther in whether to promote adequate opening or apposition of the PED against the vessel wall, triggering a carotid sinus reflex (CSR). Therefore, we retrospectively analyzed the vital signs during the PED

deployment and considered the relationship between the PED deployment and the CSR.

Materials and Methods: Between September 2017 and December 2018, patients who underwent the PED deployment in our institution were included in this study. Patients characteristics; location of aneurysms; position of the guiding catheter; type of the distal access catheter; time needed to deploy the PED; pulse rate and systolic blood pressure (SBP) of before, during, and after the deployment of the PED; and procedural complications were recorded and evaluated retrospectively.

Results: Twenty-three patients underwent PED deployment with an average age of 64.0 years old, and 17.3% (4/23 cases) male. In 1 case, deployment of PED failed because of tortuous vessels in the deployment area. The location of the aneurysms were second segment of the internal carotid artery (n = 7), third segment of the internal carotid artery (n = 3), and fourth segment of the internal carotid artery (n = 13). The time need to deploy the PED was 17.1 minutes. Fluctuation of the SBP, which dropped during deployment and recovered after deployment, was observed in 9 cases, of which 2 cases showed severe transient bradycardia, and 1 case suffered a transient cardiac arrest. By pulling the delivery system back down and reducing tension to the carotid sinus, a normal sinus rhythm was immediately restored in all 3 cases. There were no statistically differences in the recorded factors between the cases with and without CSR.

Conclusion: Carotid sinus reflux is one of the major complications during PED deployment. It is important to recognize its possibility, and adjust the delivery system accordingly during procedure.

Keywords: Flow diverter, carotid sinus reflex, complication

O 212

FLOW DIVERTER DEVICES IN THE TREATMENT OF RECANALIZED INTRACRANIAL ANEURYSMS

E Akgul[1], HB Onan[2], HT Balli[2], I Islek[1], G Ertan[1] and SS Bilgin[1]

[1]Istanbul Medipol University, Istanbul, TURKEY
[2]Cukurova University, Adana, TURKEY

Purpose: In the literature, study data of the endovascular treatment with flow diverter (FD) of recanalized or residual aneurysms are limited. In this study, we assessed the safety and efficacy of the FD devices in the treatment of recanalized or residual intracranial aneurysms treated endovascularly or surgically.

Materials and Methods: We retrospectively evaluated 32 recanalized or residual aneurysms treated with FD devices in 30 patients with angiographic follow-ups. Of the patients included in the study, 12 were females and 18 were males (mean age: 48.1). While 30 (93.3%) aneurysms were in the anterior circulation, 2 (6.7%) were in the posterior. Intracranial stent medication was accomplished in all patients. All patients were evaluated one day later for any ischemic lesion with DWI. The first and second follow-up angiograms were planned to be performed 3–6 and 9–12 months later.

Results: The treatment was successful in all patients. In two patients periprocedural complications were encountered. One was the need of second FD insertion. The other was in-stent thrombosis relieved with IV tirofiban. Sixth-month follow-up angiography showed in-stent stenosis in two patients and these stenosis were treated balloon angioplasty and stent. No hemorrhagic complication was detected on CT performed immediately following the procedure. Diffusion MRI showed some new small ischemic foci in 5 patients (16.7%). No neurological complication was seen. All patients were discharged without any neurological deficit. Mean follow-up period were 29.8 (6–66) months. While 31 (96.9%) of 32 aneurysms in 29 patients were totally closed, only one aneurysm was still open at 33rd-month follow-up angiography.

Conclusion: The FD devices are safe and effective in the treatment of recanalized or residual intracranial aneurysms treated endovascularly or surgically.

Keywords: recanalized cerebral aneurysm, endovascular treatment, flow diverter

O 213

PERSISTENT RESIDUAL ANEURYSM AFTER FLOW DIVERSION. WHAT MUST WE DO? TWO CASES OF TRANS CIRCULATION COILING AND 2 CASES OF TELESCOPIC FLOW DIVERSION

L Nico[1], J Ognard[1] and J Gentric[1]

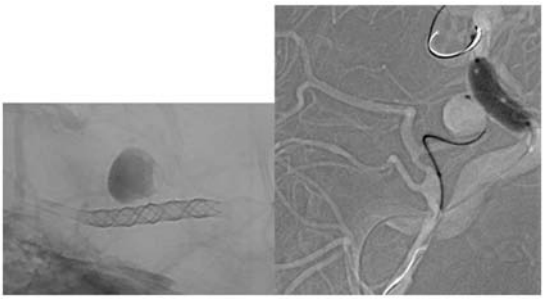
[1]CHRU Brest, Brest, FRANCE

Purpose: Flow diversion has become a valuable tool in the treatment of cerebral aneurysms. Persistent filling after treatment with flow diverter stents (FD) have been reported between 10% and 20% of the cases. Despite that, persistent aneurysm growth is very unusual. In this study we report 4 cases of persistent filling/growth aneurysm after treatment with FD and their management. We also analyze retreatment techniques and possible factors that can lead to failure of FD treatment through a literature review.

Materials and Methods: We retrospectively revised all consecutive patients treated with FD in our institution for unruptured and ruptured aneurysms.

Results: In our database, 4 aneurysms showed persistent filling/growth after technically successful treatment with FD: 1 unruptured posterior cerebral artery aneurysm; 1 unruptured posterior communicating artery aneurysm; 1 posterior communicating artery aneurysm with past history of rupture; and 1 ruptured blood blister-like internal carotid artery aneurysm. All aneurysms were retreated: 2 aneurysms with telescopic FDs and 2 aneurysms with transcirculation coiling technique (2 PComA aneurysms). 3 aneurysms retreated showed total obliteration at 3–6 months

angiographic follow up but 1 aneurysm is still circulating. No complications occurred. All patients were mRS at follow up.



Conclusion: Persistent aneurysm growth after treatment with FD is rarely reported, especially for unruptured aneurysm. Delayed persistant aneurysm filling after FD treatment is a quite frequent but tricky situation. Retreatment in this setting can be technically challenging. Possible failure of treatment with FD should not be forgotten and anatomical factors need to be taken into consideration before choosing the endovascular retreatment strategy.

Keywords: flow diverter, retreatment, persistant filling

O 214

AN EVALUATION OF HEALTH-RELATED QUALITY OF LIFE IN PATIENTS WITH UNRUPTURED INTRACRANIAL ANEURYSMS TREATED WITH ENDOVASCULAR FLOW DIVERSION THERAPY (ELEVATE)

MA Owusu[1], B Urbi[1,2], C Rapier[1], L De Villiers[1], H Rice[1], R Dunning[1], H Mcevoy[1] and T Green[1,3]

[1]Gold Coast University Hospital, Gold Coast, AUSTRALIA
[2]Griffith University, Gold Coast, AUSTRALIA
[3]Queensland Unversity of Technology, Gold Coast, AUSTRALIA

Purpose: Endovascular flow diversion therapy (EFDT) has emerged as an innovative treatment for unruptured intracranial aneurysms (UIA), demonstrating favourable clinical outcomes. Patient reported outcome measures (PROMs) integrate the use of assessment tools to allow patients to self-report their health-related quality of life (HRQOL) by reporting symptoms, side effects, satisfaction with treatment and treatment adherence[1]. HRQOL is useful for determining how effective a treatment is and to assist with health care planning[2]. This study has been designed to address the lack of literature describing patient-reported outcomes post EDFT to capture the effects of treatment on functional, cognitive and psychosocial domains.

Materials and Methods: A prospective cohort was assessed using a convergent mixed method parallel design. The study population was obtained from a convenience sample of 15 patients referred to the Interventional Neuroradiology service at Gold Coast University Hospital from 2017–2019. Both quantitative and qualitative data are drawn from the same participants during a single interview. Participants complete standardised assessment tools to indicate the functional (Modified Rankin Scale – mRS), cognitive (Montreal Cognitive Assessment – MOCA) and psychosocial status (Hospital Anxiety and Depression Scale – HADS; EuroQol instrument – EQ-5D^{TM}; The Short Form Health Survey – SF-36) of their health. Semi-structured interviews explored participants' health values, perceptions and experiences. Participants completed both components 6 weeks before and 6 weeks after their procedure.

Results: Descriptive statistics will summarise demographics and the results from the standardised scoring systems of each data collection tool. Changes pre and post intervention will be analysed using paired t tests, $p < 0.05$ will be considered statistically significant. Text data obtained from the interview transcripts will be analysed using conventional content analysis. Triangulation will be used to integrate all data sources in gain a holistic understanding of findings. All full analysis of the quantitative and qualitiative data reporting patient values and preferences will be displayed.

Conclusion: The use of patient reported outcome measures reflects a growing appreciation of the importance of how patients feel and how satisfied they are with treatment in addition to the traditional focus on clinical outcomes. PROMs can be used to gain a better understanding of the impact of interventions. The study findings will inform clinicians of the impact of EDFT and inform an evidence-based intervention for patients with UIAs.

Keywords: patient report outcome measure, health related quality of life, flow diversion therapy

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SESSION S: Aneurysms Flow study / Vessel wall imaging

O 215

INVESTIGATION ON THE RELATIONS OF HEMODYNAMICS AND GROWTH OF UNRUPTURED CEREBRAL ANEURYSMS

T Okudaira[1,2], H Takao[1,2,3], S Fujimura[1,2], Y Uchiyama[1,2], H Ohno[1,2], T Ishii[1,2], T Ishibashi[3], K Otani[3,4], K Fukudome[5], M Yamamoto[5] and Y Murayama[3]

[1]Tokyo University of Science – Graduate School of Mechanical Engineering, Tokyo, JAPAN
[2]The Jikei University School of Medicine – Department of Innovation for Medical Information Technology, Tokyo, JAPAN
[3]The Jikei University School of Medicine – Department of

Neurosurgery, Tokyo, JAPAN
[4]Siemens Healthcare K.K., Tokyo, JAPAN
[5]Tokyo University of Science – Department of Mechanical Engineering, Tokyo, JAPAN

Purpose: Aneurysm growth is considered a cause of increased rupture risk. If prediction of aneurysm growth at an early stage after aneurysm detection is possible, it can be an important factor in choosing an appropriate treatment strategy for each patient. Unfortunately, the mechanisms underlying aneurysm growth are not fully understood, however, hemodynamics are considered to play an important role. This study aims to investigate the relation between aneurysm growth and hemodynamic parameters estimated from computational fluid dynamics (CFD).
Materials and Methods: Digital subtraction angiography images of aneurysms located on the middle cerebral artery (MCA) and the internal carotid artery (ICA) were selected. The cases were classified as growth or non-growth cases using a growth rate defined as the aneurysm volume increase rate between before and after follow-up term. Cases with a growth rate of 20% or more were defined as growth cases, and cases with a growth rate of 5% or less and a follow-up term of at least 2 years were defined as non-growth cases. A total of 62 cases were investigated, including 31 MCA cases (16 growth, 15 non-growth) and 31 ICA cases (10 growth, 21 non-growth). CFD simulation accounting for pulsation was performed on all cases. The results were statistically analyzed using Mann-Whitney's U-test to compare 15 hemodynamic parameters between growth and non-growth groups. The hemodynamic parameters were assumed to have statistically significant difference for $p < 0.05$.
Results: For MCA cases, growth cases had statistically significant higher pressure values ($p = 0.03$) and higher tensile strength on the aneurysm walls ($p = 0.03$). Qualitatively, strong blood flow impingements to the aneurysm walls were observed in growth cases. This flow pattern could potentially be the cause of elevated pressure and tensile strengths acting on the walls and in turn triggering aneurysm growth. For ICA cases, non-growth cases had statistically significant lower pressure values ($p = 0.03$) and higher compressive strength on the aneurysm walls ($p = 0.02$). The lower pressure and higher compressive strength acting on the aneurysm walls can be thought as a force holding down the aneurysm towards the parent vessel, and as a result, restraining aneurysm growth.
Conclusion: The CFD results reveal that pressure, tensile, and compressive strengths acting on the walls of aneurysms are strongly related to aneurysm growth. The results also suggest that MCA and ICA aneurysms might have different growth mechanisms. With further research including more variety of aneurysm locations and a larger population, prediction of aneurysm growth may be possible.
Keywords: Cerebral Aneurysms, Aneurysm Growth, Computational Fluid Dynamics

O 216

HEMODYNAMIC INVESTIGATION ON RECANALIZED AND STABLE ANEURYSMS USING VIRTUAL COILING TECHNIQUE

T Ishii[1,2], H Takao[1,2,3], S Fujimura[1,2], Y Uchiyama[1,2], H Ohno[1,2], T Okudaira[1,2], T Ishibashi[3], K Otani[3,4], K Fukudome[5], M Yamamoto[5] and Y Murayama[3]
[1]Tokyo University of Science – Graduate School of Mechanical Engineering, Tokyo, JAPAN
[2]The Jikei University School of Medicine – Department of Innovation for Medical Information Technology, Tokyo, JAPAN
[3]The Jikei University School of Medicine – Department of Neurosurgery, Tokyo, JAPAN
[4]Siemens Healthcare K.K., Tokyo, JAPAN
[5]Tokyo University of Science – Department of Mechanical Engineering, Tokyo, JAPAN

Purpose: Hemodynamics have been considered to play an important role in recanalization of coil embolized intracranial aneurysms. To study the factors associated with recanalization, blood flow after coil embolization has been simulated using computational fluid dynamics (CFD), and for accurate simulations coil geometry should be included. In this study, the coils were modeled using a virtual coiling technique proposed by Morales et al. (2013). We performed CFD simulations for both recanalized and stable cases before and after coil embolization and aimed to investigate the factor of recanalization.
Materials and Methods: Recanalized cases were defined as aneurysms that required re-operation after the first embolization. In contrast, stable cases were defined as aneurysms that had no recanalization and remained stable during follow-up term. We used digital subtraction angiography images of 42 internal carotid artery (ICA) aneurysms (8 recanalized, 34 stable) and 30 middle cerebral artery (MCA) aneurysms (7 recanalized, 23 stable). The coil shapes were reproduced by a virtual coiling technique considering the diameter, length and number of coils used in actual treatments. Hemodynamic parameters were computed from the results of CFD simulations. Multivariate logistic regression was performed to compare hemodynamic effects between recanalized and stable aneurysms.
Results: The multivariate logistic regression revealed that recanalization of ICA aneurysms is associated with high pressure regions on their neck surface after coil embolization ($p = 0.01$) and low coil packing densities ($p = 0.03$). In aneurysms with low coil packing density, compaction of the coil cluster is more likely to occur and when high pressure load occurs, the risk of recanalization increases. In contrast, recanalization of MCA aneurysms is associated with high velocity of blood flow entering the aneurysmal sac after coil embolization ($p = 0.04$). Recanalization is also associated with a decrease of the inflow area on the neck surfaces after coils embolization compared to the case before the embolization ($p = 0.04$). Because of the smaller inflow area, the blood flow impingement on the coil cluster is

concentrated on a small surface, which may cause recanalization.
Conclusion: For ICA aneurysms, not only low packing densities but also high pressure at the neck surface are the main factors associated with recanalization. On the other hand, for MCA aneurysms, high velocities entering the aneurysmal sac and high reduction rates of the inflow area are associated with recanalization. These findings suggest the possibility to predict recanalization using CFD.
Keywords: Coil embolization, Recanalization, Computational fluid dynamics

O 217

ROLE OF COMPUTATIONAL FLUID DYNAMICS FOR ENDOVASCULAR ANEURYSM INTERVENTION

Y Murayama[1], S Fujimura[1,2], T Ishibashi[1] and H Takao[1]
[1]Jikei University, Tokyo, JAPAN
[2]Tokyo University of Science, Tokyo, JAPAN

Purpose: We review the clinical role of computational fluid dynamics (CFD) to assess risk of intracranial aneurysms rupture and role of clinical evaluation of endovascular devices.
Materials and Methods: A literature review was performed to identify reports on CFD of aneurysms by PubMed search. Usefulness of various hemodynamic parameters such as wall shear stress (WSS), Oscillatory Shear Index (OSI) and its role for aneurysm rupture risk analysis and clinical usefulness were analyzed.
Results: We identified a total of 258 published articles evaluating rupture risk, growth, and endovascular device assessment. Of these 113 articles matching for CFD, hemodynamic parameters such as WSS, OSI, were identified to contribute to the risk of rupture.
The most promising and feasible application of CFD may be endovascular device evaluation or development. CFD analysis has been performed to evaluate the effectiveness of devices such as flow diverter (FD) stents or embolic coils, by observing the blood flow changes between pre and post device application in treated aneurysms. We report our CFD analysis of 50 complex aneurysms before and after intervention.
Conclusion: Although there is still controversy on which risk factors contribute to predict aneurysm rupture, CFD can provide additional parameters to assess rupture risk and this technology can contribute to clinical decision making or evaluation for efficacy of endovascular methods and devices.
Keywords: computational fluid dynamics, aneurysm, rupture risk

O 218

ANALYSIS OF THE RELATIONSHIP BETWEEN THE HYDRODYNAMIC RESISTANCE, MSA AND PORE DENSITY OF FLOW DIVERTER STENTS

B Csippa[1], D Gyurki[1], G Zavodszky[1,2], G Paal[1] and I Szikora[3]
[1]Budapest University of Technology and Economics, Department of Hydrodynamic Systems, Budapest, HUNGARY
[2]University of Amsterdam, Computational Science Lab, Amsterdam, THE NETHERLANDS
[3]National Institute of Clinical Neurosciences, Department of Neurointerventions, Budapest, HUNGARY

Purpose: Geometric properties (MSA and pore density) of flow diverter (FD) stents have been under investigation for more than 10 years, but never in conjunction with their hydrodynamic resistance. In the last few years our group developed a measurement method to quantify the hydrodynamic resistance of FD stents (a quadratic and linear pressure-loss coefficient). The aim of our current study is to find a relationship between the FD strut structure with its hydrodynamic performance, with stents introduced into our measurements by a medical expert to capture a real-life scenario.
Materials and Methods: Hydrodynamic resistance was measured by placing the device within a plastic tube with a hole on its side and measuring the pressure gradient throught the hole before and after the FD under continuous fluid flow as described earlier. Before each resistance measurement the length of deployment was recorded and a picture was taken of the strut structure with a microscope to calculate the Metal Surface Area (MSA) and pore density. Furthermore, after removal of stents from the tube we re-quantified these properties in an unconstrained condition. Two types of stents (Type1 [64 wires], Type2 [48 wires]) were measured in three deployment scenarios. Five and 4 mm FDs were deployed into tubes matching the nominal diameter of the FD, and 5 mm stents were placed into 4 mm diameter tubes also to mimick oversizing.
Results: Type1 FDs constantly demontstrated higher hydrodynamic resistance as Type2 ones, likely related to the higher number of struts. Howevere, resistance was not directly related to MSA. Although, Type2 stents have less struts, the deployed FDs may have higher MSA yet lower resistance Type1 stents with the same sizing. The results can be explained with the pore density (pore/mm2), as Type1 stents displayed a higher value of 5–15 pore/mm2 both in deployed and unconstrained condition.
Conclusion: According to our results, the MSA value itself is not sufficient to characterize the hydrodynamic resistance of certain deployment scenarios, as it is influenced by the pore density as well. Furthermore, according to our experience, forthshortening of Type1 stents impacted the hydrodynamic performance more than with Type2 stents. This study was supported by grant No 2017–1.2.1-NKP-2017-00002 from the National Brain Research Program.
Keywords: Flow diverter, Hydraulic resistance, MSA

O 219

INVESTIGATION OF THE EFFECT OF FLOW DIVERTER'S PORE DENSITY ON STAGNATION FLUID FLOW ZONES INSIDE A GIANT ANEURYSM USING A LAGRANGIAN COHERENT STRUCTURE TECHNIQUE

O Mutlu[1], AB OLCAY[2], C Bilgin[3] and B Hakyemez[4]
[1]Yeditepe University, Faculty of Engineering, Department of Mechanical Engineering, Istanbul, TURKEY
[2]Yeditepe University, Faculty of Engineering, Department of Mechanical Engineering, Istanbul, TURKEY
[3]Uludag University School of Medicine, Department of Radiology, Bursa, TURKEY
[4]Uludag University School of Medicine, Department of Radiology, Bursa, TURKEY

Purpose: Giant aneurysms are generally treated using flow diverter (FD) stents. Prior to treatment, an interventional radiologist can consider diameter and length of the FD and diameter of the blood vessel in which a giant aneurysm is present, ease of use of the stent and pore density of FD. In this study, one of the most common FD used in clinics, namely Fred (MicroVention, Inc., CA, USA), is evaluated based on its pore density property to understand how pore density of an FD is related with stagnated fluid flow in the aneurysm sac.
Materials and Methods: A time-dependent computational fluid dynamics (CFD) model was utilized for three cardiac cycles long to study hemodynamic inside a saccular aneurysm in an internal carotid artery of a forty-six years old female patient. At the aneurysm neck, a flow diverter is defined as a porous medium and stent's porosity and permeability calculations were performed by placing 32E-6 m thick porous medium into a center of 10 mm long pipe. In the present study, FRED-4017, FRED-4038 and FRED-4539 FD stents have been defined to the neck of an aneurysm for the CFD model and velocity vectors obtained from CFD simulations were further processed to determine the finite time Lyapunov exponent (FTLE) fields in the aneurysm sac.
Results: Porosity and permeability values of FRED-4017, FRED-4038 and FRED-4539 FD stents were calculated to be 0.58 and 9.93469E-11, 0.66 and 1.58538E-10, 0.74 and 2.60879E-10, respectively based on pore density values of FDs. Particle analysis results demonstrate that 42% of the particles were able to stay inside the aneurysm region for FRED-4017 while 40% and 39% of the particles remained inside the aneurysm region for FRED-4038 and FRED-4539, respectively. The ridges of FTLE field demonstrated Lagrangian coherent structures (LCSs) implying stagnated flow zone formations and it was noted that the largest stagnation fluid flow zones were observed for the FRED-4017 while these zones were the smallest for the FRED-4539 FD based on enclosed areas determined by LCSs.
Conclusion: CFD simulations along with LCS analysis indicated that stagnated flow zones can be identified inside a saccular aneurysm of a forty-six years old female patient. Highest pore density having the smallest permeability value FD, namely FRED-4017, resulted in the most occlusion in the aneurysm sac based on both particle and LCS analyses.
Acknowledgements: This work was supported by The Scientific and Technological Research Council of Turkey (TUBITAK) under the 1001 Program, (Project no. 117M491).
Keywords: Computational fluid dynamics, Flow diverter stent, Lagrangian coherent structure

O 220

VALIDATION OF A TECHNIQUE FOR EXTRACTION OF PATIENT-SPECIFIC BLOOD FLOW CONDITIONS FROM 4D DIGITAL SUBTRACTION ANGIOGRAPHY

H Ohno[1,2], H Takao[1,2,3], T Suzuki[2], S Fujimura[1,2], Y Uchiyama[1,2], K Katayama[1], T Ishii[1,2], T Okudaira[1,2], T Ishibashi[3], K Otani[3,4], K Fukudome[5], M Motosuke[5], M Yamamoto[5] and Y Murayama[3]
[1]Tokyo University of Science – Graduate School of Mechanical Engineering, Tokyo, JAPAN
[2]The Jikei University School of Medicine – Department of Innovation for Medical Information Technology, Tokyo, JAPAN
[3]The Jikei University School of Medicine – Department of Neurosurgery, Tokyo, JAPAN
[4]Siemens Healthcare K.K., Tokyo, JAPAN
[5]Tokyo University of Science – Department of Mechanical Engineering, Tokyo, JAPAN

Purpose: Hemodynamics is believed to be related to the pathology of cerebral aneurysms such as rupture or growth, so those phenomena have been investigated using computational fluid dynamics (CFD). In previous studies, we have used the same inflow condition to simulate blood flow regardless of patients' differences, although the heartbeat cycle and flow velocity differed from patient to patient. To conquer this situation, we created a new technique to extract the patient-specific heartbeat cycle and blood flow velocity from four-dimensional digital subtraction angiography (4D-DSA) data containing spatial and temporal information of contrast media. However, we had not confirmed the accuracy of the extracted heartbeat cycle and blood flow velocity. In this study, we performed experiments using a flow phantom that we scanned with 4D-DSA to confirm the accuracy of the extracted flow cycle and flow velocity.
Materials and Methods: We created a rigid body phantom with an S-shaped flow path structure. To reproduce the blood flow condition, a pulsating pump which could generate waveforms similar to heartbeat cycles was connected to the phantom. A volume of 24.0 ml of iodinated contrast media was injected at an inflow rate of 4.00 ml/sec and 4D-DSA data of the phantom were acquired. At the same time, the flow rate was measured with an ultrasonic flowmeter. From the 4D-DSA data, we extracted the flow cycle duration, and the maximum and minimum flow velocity at the centerline of the phantom structure. To assess the accuracy of the

patient-specific flow condition extraction technique, we compared the flow cycle duration extracted from 4D-DSA to the flow velocity measured in the experiment.
Results: The 4D-DSA analysis gave a flow cycle duration of 0.950 s, a maximum flow velocity of 0.591 m/s, and a minimum flow velocity of 0.269 m/s. The measured results gave a flow cycle duration of 0.903 s, a maximum flow velocity of 0.532 m/s and a minimum flow velocity of 0.286 m/s. The cycle duration error of 4D-DSA analysis to measured results was 5.2 %, the maximum flow velocity error was 11.1 %, and the minimum flow velocity error was 5.9 %.
Conclusion: Patient-specific flow cycle and velocity could be extracted from 4D-DSA with our technique. This technique will help us to improve the accuracy of patient-specific flow simulation.
Keywords: 4D digital subtraction angiogr, Validation, Flow dynamics

O 221

ASSOCIATION OF LOW FLOW CONDITIONS AND HISTOLOGIC SIGNS OF INFLAMMATION IN INTRACRANIAL ANEURYSMS WITH FOCAL ENHANCEMENT ON MR VESSEL WALL IMAGING

P Berg[1], S Saalfeld[2], C Flüh[3] and N Larsen[4]
[1]University of Magdeburg – Laboratory of Fluid Dynamics and Technical Flows, Magdeburg, GERMANY
[2]University of Magdeburg – Department of Simulation and Graphics, Magdeburg, GERMANY
[3]University Hospital Schleswig-Holstein Campus Kiel – Department of Neurosurgery, Kiel, GERMANY
[4]University Hospital Schleswig-Holstein Campus Kiel – Department of Radiology and Neuroradiology, Kiel, GERMANY

Purpose: Intracranial aneurysm (IA) wall enhancement using MR vessel wall imaging is associated with inflammatory and degenerative processes. For the assessment of individual rupture risk, enhanced regions are related to local hemodynamics.
Materials and Methods: Nine middle cerebral artery aneurysms with focal enhancement were imaged using T1-weighted black blood MRI and three-dimensional rotational angiography. Afterwards, histologic analysis was performed for observation of inflammatory markers and atherosclerotic remodeling. Furthermore, precise vessel segmentations, image co-registrations and detailed blood flow simulations were carried out to describe the time-dependent hemodynamics. Finally, relevant morphologic and hemodynamic parameters were compared in the enhanced and non-enhanced areas.
Results: Four aneurysms with focal wall enhancement occupying less than half of the aneurysm circumference were negative for MPO-expressing cells, CD34-positive neovessel endothelium or vasa vasorum. Five aneurysms were positive for at least one of the histologic markers. Extracellular lipid deposition was detected in two aneurysms. Hyalinosis, fibrosis and calcification were common features in all cases. The flow analysis revealed that vessel wall enhancement is associated with lower cycle-averaged wall shear stresses, decreased oscillatory shear, and increased low shear areas compared to the overall aneurysm surfaces (see Table 1). Furthermore, complex flow structures occur in the vicinity of the enhancements.

Table 1: Calculation of shear-related parameters for all aneurysms: time-averaged wall shear stress (AWSS), the maximum oscillatory shear index (maxOSI), and the low shear area (LSA).

	AWSS [Pa]		maxOSI [-]		LSA [%]	
No.	Whole aneurysm	Enhanced region	Whole aneurysm	Enhanced region	Whole aneurysm	Enhanced region
1	3.98	2.28	0.42	0.1	87.9	100
2	7.01	0.9	0.43	0.17	28.5	100
3	5.58	1.76	0.46	0.4	79	96.5
4	6.6	3.8	0.46	0.38	64.2	83.9
5	3.77	2.13	0.25	0.02	77.2	100
6	6.98	3.54	0.48	0.48	71.5	90.8
7	11	0.94	0.45	0.18	66.7	100
8	1.75	1.49	0.48	0.48	61	68.4
9	13.74	3.29	0.45	0.4	5.7	99
mean	**6.71**	**2.24**	**0.43**	**0.29**	**60.2**	**93.18**
sd	**3.5**	**1.03**	**0.07**	**0.16**	**24.9**	**10.2**

Conclusion: The interplay of hemodynamics and vessel wall remodeling is present in patients harboring IAs. Hence, MR vessel wall imaging in combination with precise blood flow modeling may be beneficial in the evaluation of unruptured aneurysms regarding rupture risk assessment.
Keywords: vessel wall imaging, focal wall enhancement, hemodynamic simulation

O 222

VESSEL WALL IMAGING TO IMPROVE RISK PREDICTION OF GROWING AND STABLE INTRACRANIAL ANEURYSMS

E Leemans – Van Katwijk[1], B Cornelissen[1,2,3], B Coolen[1,2], H Boogaarts[4], WJ van Rooij[5], R van den Berg[2], Y Roos[6], W Vandertop[7], C Slump[3], E van Bavel[1], A Nederveen[2], H Marquering[1,2] and C Majoie[2]
[1]Department of Biomedical Engineering & Physics, Amsterdam UMC, University of Amsterdam, Amsterdam, THE NETHERLANDS
[2]Department of Radiology and Nuclear Medicine, Amsterdam UMC, University of Amsterdam, Amsterdam, THE NETHERLANDS
[3]MIRA Institute for Biomedical Engineering and Technical Medicine, University of Twente, Enschede, THE NETHERLANDS
[4]Neurosurgical Centrum Nijmegen, Radboud UMC, Nijmegen, THE NETHERLANDS
[5]Radiology, AZ Turnhout, Turnhout, THE NETHERLANDS
[6]Department of Neurology, Amsterdam UMC, University of Amsterdam, Amsterdam, THE NETHERLANDS
[7]Neurosurgical Center Amsterdam, Amsterdam UMC, University of Amsterdam, Amsterdam, THE NETHERLANDS

Purpose: Most incidentally found intracranial aneurysms are small. However, a proportion of these small aneurysms do rupture. Therefore, better rupture risk predictors are necessary. Aneurysm wall enhancement (AWE) on magnetic

resonance imaging (MRI) after contrast-agent administration has been suggested to be related with inflammation, aneurysm instability and rupture. Although the association of AWE with rupture is often studied, the relation with growth and instability is still unclear. The primary aim of this study is to evaluate the relation between AWE and recently detected aneurysm growth.

Materials and Methods: This study is a multicenter, cross-sectional study conducted between 2016 and 2019. Each patient underwent a 7T MRI consisting of anatomical and vessel wall imaging before and after gadolinium-based contrast admission, as well as 4D phase-contrast scan of the intracranial arteries. Aneurysm growth and AWE were assessed by an experienced neuroradiologist. Aneurysm were marked as stable when the size or shape did not change for at least two years. We included 24 patients with 33 aneurysms of which five grew. In four patients, MRI was aborted early due to peripheral nerve stimulation or claustrophobia. For one stable aneurysm the AWE could not be evaluated due to imaging artefacts. AWE assessment was completed for 28 aneurysms (four growing (14%)).

Results: Most aneurysms were at the MCA (13 cases (46%)) with a maximum diameter of 5 ± 2 mm. Six aneurysms showed local AWE (21%). No circumferential AWE was seen. All aneurysms showing AWE were stable for the last two years, none of the growing aneurysms showed AWE. For eight cases data on follow-up was available, of which two showed enhancement, both remained stable within 1.5 years after the 7T MRI.

Conclusion: None of the growing aneurysms showed enhancement on post-contrast MRI and no growth was measured after AWE. Therefore, the current data suggests that AWE is not related to aneurysm growth. Ongoing research on this dataset will focus on quantifying aneurysm wall thickness and enhancement and evaluate the association between wall characteristics and intra-aneurysmal hemodynamics.

Keywords: aneurysm wall enhancement, growth, MRI

O 223

VESSEL WALL ENHANCEMENT OF INTRACRANIAL ANEURYSMS ON HIGH RESOLUTION MRI: A RUPTURE SIGN? THE ICARUS STUDY

L Dinia[1], L Gramegna[2], C Vert[1], M Luzi[3], F Arikan[1], D Hernandez[1], P Coscojuela[1], E Martinez Saez[1], A Rovira[1] and A Tomasello[1]

[1]Section of Diagnostic and Interventional Neuroradiology. Department of Radiology. Hospital Universitari Vall d Hebron., Barcelona, SPAIN
[2]IRCSS Istituto di Scienze Neurologiche, Bologna, ITALY
[3]Università Politecnica delle Marche, Ancona, ITALY

Purpose: Saccular intracranial aneurysm (SIA) rupture has still devastating consequences. Instability state is still difficult to estimate. Inflammation plays a major role in aneurysm formation and rupture and literature suggests that aneurysm wall enhancement (WE) on magnetic resonance imaging (MRI) may be a surrogate of vessel wall inflammation. Main aim of the study is to assess the capability of WE to identify intracranial aneurysms in real danger for rupturing.

Materials and Methods: Cohort prospective observational study. Consecutive patients with ruptured and un-ruptured aneurysms underwent contrast 3T-MRI and histology to confirm wall inflammation. Statistical analysis was performed to investigate the association of WE with risk factors and histological markers of inflammation.

Results: A preliminary group of 50 patients was included. WE was present in 100% of ruptured, in 50% of unruptured symptomatic, and in 33% of asymptomatic aneurysms ($p = 0.003$). Cut-offline of 4 in PHASES score was found, above which most of the aneurysms begin to enhance ($p < 0.001$). Logistic regression analysis demonstrated as independent predictors of rupture: WE ($p = 0.018$) and presence of multiple aneurysms ($p = 0.016$). Independent predictors of wall enhancement were: size ($p = 0.001$), presence of variables of circle of Willis ($p = 0.005$) and irregular morphology ($p = 0.016$). Analysis of WE as a predictor of rupture has shown ($p = 0.002$):100% sensitivity, 64% specificity, 28% VPP, 100% VPN. At a cut-off of 7, there is a direct correlation between the number of altered immunohistochemical inflammation markers and presence of WE ($p = 0.043$). A score higher than 7 entails a 100% sensitivity, specificity, VPP and VPN in relation to presence of WE.

Conclusion: Wall enhancement identifies instability-state in SIA and can be a new and powerful rupture sign that could be crucial in deciding whether and how to treat SIA, even in small aneurysms. Final purpose is to offer a practice tool to personalize the therapeutic approach, distinguishing different aneurysm ''activation'' stages, in order to reduce intracranial bleeding and improving long-term outcome. Taking into account not only the dimensions and the morphology but, above all, the pathophysiology of the aneurysm itself, will allow tailoring therapeutic options. Further implication of the results will be the development of new personalized devices aiming at lowering the inflammation of the wall.

Keywords: Aneurysm rupture risk, Wall Enhancement, Subarachnoid hemorrhage

SESSION T: Aneurysms Intra-aneurysmal flowdistruption

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WEB COLOMBIAN MULTICENTER EXPERIENCE (WEB.COM): CLINICAL AND RADIOLOGICAL MID-TERM RESULTS IN THE TREATMENT OF INTRACRANIAL ANEURYSMS

B Pabon[1], C Diaz[1], J Mejia[1], M Patiño[1], R Almeida[2], F Orozco[2], J Fernandez[3], N Lobelo[4] and D Mantilla[5]
[1]Angioteam /Clinica Del Norte/Clinica Las Americas/ Universidad De Antioquia, Medellin, COLOMBIA
[2]Neurodinamia, Cartagena, COLOMBIA
[3]Clinica Porto Azul, Barranquilla, COLOMBIA
[4]Clinica Colombia, Bogota, COLOMBIA
[5]Fundacion Cardiovascular, Bucaramanga, COLOMBIA

Purpose: Woven EndoBridge (WEB) is a novel device for the treatment of ruptured and unruptured bifurcation aneurysms. To our knowledge none experience in Latin America has been reported. In the present study, we present a multicenter early experience and mid-term follow data for patients treated with WEB.
Materials and Methods: 32 consecutive patients with 33 intracranial aneurysms underwent endovascular treatment using WEB between March 2016 and February 2019 in four different centers and cities. We retrospectively evaluated the angiographic results at the end of the procedure and at follow-up, technical considerations, the clinical status and complications.
Results: All attempted cases were treated, but one. Non-procedural rupture was recorded. Aneurysm locations were internal carotid artery bifurcation (n = 6), middle cerebral artery (n = 17), anterior communicating artery (n = 4), Basilar Trunk (n = 1) and basilar tip (n = 5). Eight patients were treated in the setting of acute subarachnoid hemorrhage. 1.12 Devices per aneurysm. 32 of 33 cases treated with web without coils. In five cases was necessary additional stenting- 15%. 16/29 with angiographic follow-up, complete occlusion A-B in 15/16. Procedural mean time 17 min.
Conclusion: This series is at the moment the only, multicenter, Latin American experience of patients treated with WEB. The treatment demonstrates to be safe and highly success in the management of WNB intracranial aneurysms.
Keywords: Intrasaccular, WEB, Bifurcations

O 225

SHORT TERM RESULTS IN THE TREATMENT OF UNRUPTURED SIDEWALL INTRACRANIAL ANEURYSMS WITH THE USE OF INTRASACCULAR ANEURYSM FLOW DISRUPTION DEVICES

F Di Caterino[1], G Vitale[1] and A Biondi[1]
[1]Chu Besancon Service de Neuroradiologie et Therapie Endovasculaire, Besancon, FRANCE

Purpose: Intrasaccular aneurysm flow disruption represents a new endovascular approach for intracranial aneurysm treatment. This type of device is predominantly used for wide-necked and bifurcation aneurysms, while their use and effectiveness is not yet well known in the cases of sidewall aneurysms. We evaluate the safety and efficacy of intrasaccular flow disruption for the treatment of these sidewall intracranial aneurysms.
Materials and Methods: Between April 2014 and April 2019, 80 patients (mean age 55.6 years, 61 female, 19 male) presenting with 88 aneurysms, were treated by two types of intrasaccular flow disruption device (21 by LUNA and 67 by WEB) in a single center. Among these, 16 (23.8%) were sidewall aneurysms: 7 (43.7%) at paraophthalmic segment, 3 (18.7%) at the anterior choroidal artery segment, 3 at the posterior communicating artery segment and 3 at M1 segment of the middle cerebral artery. The aneurysms were treated with a single WEB with no case of implantation failure. Aneurysm occlusion was assessed using the WEB Occlusion Scale – (WOS).
Results: There were neither periprocedural complications nor procedure related morbidity and mortality during hospitalization. At short term follow-up (3–6 months) the patients underwent angiographic revaluation showing: complete occlusion (WOS: A, B) in 56.2%, neck remnants (WOS: C) in 25%, and aneurysms remnants (WOS: D) in 18.7%.
Conclusion: Our series suggests that the treatment of unruptured intracranial sidewall aneurysms by the WEB device is safe and effective at short term follow-up. A longer follow-up period and larger series are needed for definitive conclusions.
Keywords: web, sidewall aneurysms, unruptured aneurysms

O 226

MECHANICAL PROPERTIES OF FLOW DISRUPTORS: IMPACT OF OVERSIZING BY IN VITRO COMPRESSION TESTING

B Pogácsás[1], E Bognár[1], L Pelyhe[1], P Nagy[2], I Kientzl[2], Z Kiss[3], M Czencz[4], M Kondor[5], Vadász[5] and I Szikora[5]
[1]IMEDIM Ltd., Budapest, HUNGARY
[2]FERR-VÁZ Ltd., Budapest, HUNGARY
[3]Budapest University of Technology and Economics, Faculty of Mechanical Engineering, Department of Polymer Engineering, Budapest, HUNGARY
[4]Department of Neurology and Stroke, Hungarian Defence

Forces Medical Center, Budapest, HUNGARY
[5]Department of Neurointerventions, National Institute of Clinical Neurosciences, Budapest, HUNGARY

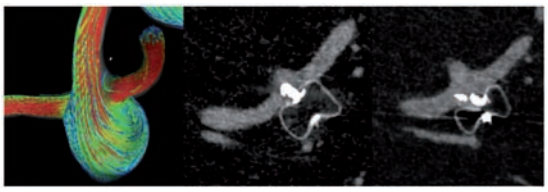
Purpose: Intrasaccular flow disruptors (FDR) are increasingly used for the endovascular treatment of wide neck bifurcation aneurysms. For the WEB FDR (Microvention, Aliso Viejo, CA, USA), an average of 1 mm radial versizing and 1 mm axial downsizing is recommended in relation to the mean diameter and heights of the aneurysm to achieve stable aneurysm occlusion. Such oversizing is supposed to increase the device's capacity to resist the dynamic forces of pulsatile blood flow at the neck of the aneurysm. The goal of our research was to study if radial oversizing of the WEB significantly increases the longitudinal resistance of the device under experimental conditions.
Materials and Methods: We performed a series of compression tests to detect the longitudinal resistance of WEB devices in relation to radial compression. One piece of 6×3, 6×5, 7×4, 8×5 and 8×6 WEB devices were tested. Each device was placed within a cylindrical hole of a proprietary aperture device with precisely adjustable internal diameter simulating the aneurysm cavity. Compression tests were performed using a Zwick Z005 tensile test machine. Each device was tested 10 times with the hole's diameter matching its nominal diameter (nominal test) and another 10 times in a 1 mm smaller diameter hole (compressed test). The devices were pushed longitudinally until compressed by 1/3 of their nominal length by a mandrel, moving with 5 mm/min crosshead speed, using the tensile test machine. The forces required during longitudinal compression and decompression were continuously recorded by testXpert V11.0 software. The maximum value of the resulting curve indicated the maximal force recorded by the machine throughout the cycle.
Results: The mean values, standard deviation and coefficient of variation of the maximal forces were calculated for each device both under the nominal test and the compressed test conditions and were compared by Mann–Whitney U test at 5% ($p = 0.05$) significance level. Maximal forces were found from 7% to 68% higher under compressed condition compared to the nominal test condition, the difference being statistically significant in each case ($p = 0.00$ or $p = 0.03$ by sample 8×5).
Conclusion: Our experimental findings confirm the hypothesis of radial oversizing significantly increasing the longitudinal resistance of the WEB device. This study was funded in part by grant No. 2017-1.2.1-NKP-2017-00002 of the National Brain Research Program. Test devices were provided by Sequent Medical, Aliso Viejo, CA, USA.
Keywords: aneurysm, WEB, compression test

O 227

WEB COMPACTION DURING FOLLOW-UP: THE BICÊTRE EXPERIENCE

J Caroff[1], C Mihalea[1], I Pagiola[1], M Iacobucci[1], V Chalumuea[1], L Ikka[1], S Gallas[1], A Ozanne[1], J Moret[1] and L Spelle[1]
[1]Hôpital Bicêtre, Paris, FRANCE

Purpose: WEB shape modification is a potential cause of poor angiographic outcome during follow-up despite initial complete occlusion. The frequency, the factors affecting WEB compaction and the ways to prevent this phenomenon are only partially established.



Materials and Methods: All patients treated in Bicêtre hospital with a WEB device between were included. Thanks to cone-beam rotational acquisitions systematically performed after implant and during follow-up we have analyzed aneurysms biometric parameters and WEB morphology over time. Angiographic occlusion was evaluated according to the Bicêtre occlusion scale (BOSS).
Results: Between October 2015 and January 2019, 94 aneurysms were treated with a WEB device and included in this register. Aneurysms were located in MCA location in 36% of cases and 26% in anterior communicating artery location.
Conclusion: These data report the frequency of WEB shape modification, its influence over occlusion rates and the impact of the oversizing strategies.
Keywords: WEB, Recurrence, Compaction

O 228

ANEURYSM TREATMENT WITH WEB IN THE CUMULATIVE POPULATION OF 3 PROSPECTIVE, MULTICENTER SERIES: 2-YEAR AND 3-YEAR ANATOMICAL RESULTS

L Pierot[1], J Byrne[1] and L Spelle[1]
[1]CHU Reims, Reims, FRANCE

Purpose: WEB treatment is an innovative endovascular approach for treatment of wide-neck bifurcation aneurysms. Initial studies have shown high safety with good efficacy at short-term confirmed by the Good Clinical Practice (GCP) conducted in US (WEB-IT [Intra-saccular Therapy]) and in Europe (WEBCAST [WEB Clinical Assessment of Intrasaccular Aneurysm], French Observatory, and WEBCAST-2). The purpose of the current analysis is to report the 2-year anatomical results of the WEB treatment in the cumulative

population of 3 European GCP Studies and 3-year anatomical results in WEBCAST and WEBCAST 2.

Materials and Methods: In French Observatory, 2-year clinical and anatomical data were collected. In WEBCAST and WEBCAST 2, 2-year follow-up was optional and collected when performed. In these 2 studies, 3-year follow-up was mandatory. Aneurysm occlusion was evaluated using the 3-grade scale: complete occlusion, neck remnant, and aneurysm remnant.

Results: Aneurysm occlusion was evaluated at 2-year in 121/169 aneurysms (71.6%) and at 3-year in 59/106 aneurysms (55.7%). At 2-year, complete occlusion was observed in 62/121 aneurysms (51.2%), neck remnant in 36/121 aneurysms (29.8%), and aneurysm remnant in 23/121 aneurysms (19.0%). The global retreatment rate at 2-year was 9.2%. At 3-year, complete occlusion was observed in 31/59 aneurysms (52.5%), neck remnant in 18/59 aneurysms (30.5%), and aneurysm remnant in 10/59 aneurysms (16.9%). The global retreatment rate at 3-year was 11.4%.

Conclusion: In the European WEB GCP studies, anatomical results are stable at 2-year and 3-year with a similar rate of complete occlusion (51.2% and 52.5%, respectively) and adequate occlusion (80.1% and 83.1%, respectively).

Keywords: Aneurysm, Endovascular treatment, Flow disruption

O 229

CLIPPING OF RECANALIZED INTRACEREBRAL ANEURYSMS INITIALLY TREATED BY WEB DEVICE

L Pierot[1] and Litre[1]

[1]CHU Reims, Reims, FRANCE

Purpose: Intrasaccular flow disruption (ISFD) using WEB is a safe and effective method to treat intracranial aneurysms, particularly wide-neck bifurcation aneurysms (WNBA). However mid- and long-term follow up imaging can show an aneurysm remnant or recanalization and retreatment is therefore sometimes necessary. In most cases retreatment is performed by an endovascular approach. The present series reports and analyzes aneurysm clipping of recanalized or incompletely occluded aneurysms following WEB treatment.

Materials and Methods: All patients treated with the WEB device since the beginning of our experience in June 2011 are prospectively collected in a local database. Among them, the patients who were retreated by clipping for aneurysm remnants were included in the present series.

Results: In the cumulative population of 130 patients with aneurysms treated by the WEB device from June 2011 to February 2019, 4 patients (3.1%) were retreated with surgical clipping due to incomplete occlusion (2 patients) and aneurysm recanalization (2 patients). Three of the 4 aneurysms retreated (75%) were located in middle cerebral artery and 1 in the anterior communicating artery (25.0%). The aneurysm was ruptured in one of four patients (25%). Clipping was performed 10 to 54 months after initial treatment with WEB. Surgical exposure showed that the WEB device was inside the aneurysm sac in all cases. Clipping was easily performed in all but one case. Control DSA showed complete occlusion in two aneurysms and a neck remnant in two.

Conclusion: Clipping is a feasible option for treating aneurysm remnants following initial treatment with intrasaccular flow disruption using WEB.

Keywords: Aneurysm, Flow disruption, Clipping

O 230

PRELIMINARY EXPERIENCES WITH A NEW, ELECTRICALLY DATACHABLE, INTRASACCULAR FLOWDIVERTER, THE CONTOUR

G Gál[1]

[1]Odense University Hospital, Odense, DENMARK

Purpose: To report our preliminary experience with the aforementioned device, in the endovascular treatment of cerebral aneurysms.

Materials and Methods: Between March 2018 and March 2019, 10 aneurysms in 9 patients were treated with the Contour at the Odense University Hospital. All cases were elective, all patients were premedicated with double platelet inhibitors, and the effect was measured with the VerifyNow device. The location of the aneurysms were as follows: 3 ACom, 3 MCA, 1 BA bifurcation, 1 PCom,1 SCA, 1 Pericallosal artery, The device was delivered through an 0,027 inch microcatheter, positioned at the neck of the aneurysm, inside the sac, and detached upon confirmation of the desired placement with DSA. In some cases, the detachment was delayed up to 40 minutes, in order to verify that no immediate thromboembolic occlusion of the parent artery or its branches occurred. No complications occurred. All patients continued on double platelet inhibitors.

Results: All patients are clinically well. In one case, the final DSA at the end of the procedure showed complete occlusion of the aneurysm, although the patient's platelets were heavily overinhibited. Follow up DSA of 2 aneurysms at 7 and 6 months showed good regress of the aneurysms, although one of these patients is on lifelong platelet inhibitor treatment. The rest of the patients await angiographic follow up.

Conclusion: The device is easy to deliver and place at the neck of the aneurysm, without any contact to the distal, more vulnerable part of the aneurysm. Its tight mesh acts as an efficient intrasaccular flowdiverter, In our opinion, this is a safe device, especially useful in the treatment of wide-necked, bifurcational aneurysms. By the time of the WFITN meeting, the follow up angiograms of the remaining cases will be available, to evaluate the efficacy of the device.

Keywords: electrically detachable, intrasaccular, flowdiverter

O 231

MIDTERM EXPERIENCES WITH A NEW, INTRASACCULAR NECK-BRIDGING DEVICE, THE NEQSTENT

G Gál[1]
[1]Odense University Hospital, Odense, DENMARK

Purpose: To report our midterm experience with the aforementioned, electrically detachable device, which is delivered through an 0,027 inch microcatheter. Following the placement of the device at the neck of the aneurysm, in an intrasaccular position, it was either penetrated or bypassed with an 0,017 inch microcatheter, to deliver the coils into the sac, and detached after completed treatment.
Materials and Methods: Between August 2017 and February 2019, 8 cerebral aneurysms in 7 patients were treated with the Neqstent and detachable coils at the Odense University Hospital. All cases were elective, all patients were premedicated with double platelet inhibitors, whose effect was measured with the VerifyNow device, and continued on antiplatelet medication after the treatment. 4 aneurysms were located on the MCA, 3 at the BA bifurcation, and one at the orifice of the PCom. There were neither technical complications related to the device, nor immediate clinical complications. One patient developed a large intracerebral bleeding in the other hemisphere opposite to the treated side on the third postoperative day, and subsequently died.
Results: 6 of 7 patients are clinically very well. Follow up DSA of 4 aneurysms showed complete occlusion, of which one was only loosely packed, due to anatomical reason. The remaining patients await angiographic follow up.
Conclusion: The Neqstent is easy to deliver and place at the neck of the aneurysm, where it acts as a scaffold, giving good support for the coils, allowing tight packing of the aneurysm. Since there's no metal left in the parent artery, the need of double antiplatelet medication can be evaluated with more clinical experience. In our opinion, the device is ready for a prospective clinical study, to define its place in the armamentarium of the INR community.
Keywords: Intrasaccular, neck bridging device, dens packing

O 232

EXPERIENCE WITH A ENDOSSACULAR FLOW DIVERTER DEVICE: NEXSYS

I Lylyk[1], C Bleise[1], J Chudyk[1], N Perez[1], R Viso[1] and P Lylyk[1]
[1]ENERI-Department of neurointerventional radiology, Buenos Aires, ARGENTINA

Purpose: Endoluminal reconstruction with flow diverting devices proved low rate of recanalization and higher rate of cure compared with coils in treatment of aneurysm, although the need of antiaggregating for acute ruptured aneurysm, and bifurcation aneurysms where lateral branches can be jailed, are important limitations for this option. The NeXsys endovascular device (Cerus Endovascular Device, Palo Alto CA) represents a new alternative for the treatment of terminal and bifurcation aneurysms without the disadvantage of antiaggregation in acute ruptured aneurysms. The purpose is to show our initial experience with NeXsys.
Materials and Methods: 3 Patients with 3 unruptured bifurcation and terminal aneurysms, treated in 2016. Angiographic and clinical control were performed until 6 months follow up. All patients gave informed consent before treatment.
Results: 3 patients with 3 aneurysms (2 female; mean age 67 years), all the aneurysms were incidental, all of them were in anterior circulation and small sized. All the aneurysms were successfully treated with NeXsys device, and the aneurysms (100%) achieved complete occlusion at 3 months follow up, no patient died due to secondary cause before angiographic control. We have not technical complications. The morbility was 0%, No death related with the procedure.
Conclusion: The NeXys endovascular device proved to be an alternative for the treatment of bifurcation and terminal aneurysms, although more studies and cases and long term follow up are needed to prove safety and evaluate recanalization.
Keywords: Bifurcation Aneurysm, Endosaccular Device, NeXsys

SESSION U: Aneurysms stent assisted coiling

O 233

SAFETY AND PERFORMANCE OF THE NEUROFORM ATLAS STENT SYSTEM (ATLAS) IN THE TREATMENT OF INTRACRANIAL ANEURYSMS: A PROSPECTIVE, OBSERVATIONAL, MULTICENTRE, POST-MARKET EUROPEAN STUDY (ATLAS EU PMCF STUDY)

E Houdart[1], A Bonafé[2], V Costalat[2], P Schramm[3], T Eckey[3], X Barreau[4], M Piotin[5], A Berlis[6], W Weber[7], S Fischer[7], K Zelenak[8], A Narata[9], M Hartmann[10] and J Gentric[11]
[1]Lariboisière Hospital, Paris, FRANCE
[2]Gui de Chauliac Hospital, Montpellier, FRANCE
[3]University of Lübeck, Lübeck, GERMANY
[4]CHU Pellegrin, Bordeaux, FRANCE
[5]Adolphe de Rothschild Foundation, Paris, FRANCE
[6]Augsburg Hospital, Augsburg, GERMANY
[7]University Hospital Knappschaftskrankenhaus, Bochum, GERMANY
[8]Martin University Hospital, Martin, SLOVAK REPUBLIC
[9]Bretonneau Hospital, Tours, FRANCE
[10]HELIOS Hospital Berlin-Buch, Berlin, GERMANY
[11]Cavale Blanche Hospital, Brest, FRANCE

Purpose: This is a prospective, observational post market European study conducted to assess the safety and performance of the Neuroform Atlas™ Stent System in the treatment of intracranial aneurysms. The protocol allowed for

use of all types of coils and adjunctive technologies as deemed appropriate. The study focused on the permanent morbidity and mortality rate within 12–16 months following the procedure. We present here a descriptive analysis of procedure feasibility, clinical safety and angiographic results.

Materials and Methods: 106 patients were enrolled, 75.5 % female; mean age was 55.4 +/−9.81 years; 82.1% of the target aneurysms were unruptured; 76.4% were elective cases and 5.7% were symptomatic. Of the target aneurysms 17.9% had been previously treated. Most of the aneurysms (87.7%) were $<$7 mm, 9.4% were 7–10 mm, and 2.8% were $>$10 mm). At baseline, 88 patients (83.0%) were symptom-free (mRS = 0); 16 had mRS = 1 and 2 had mRS = 2. Antiplatelet drugs were administered according to standard of care.

Results: In total, 132 Atlas stents were used in 106 patients with 93.9% being successfully implanted. 23 patients received multiple stents and 19 of them had Y-stenting technique. One patient was abandoned. Two patients (1.9%) experienced severe, permanent complications reported as device and procedure related: 1 patient died due to arterial perforation in Y-stenting, 1 patient had a delayed stroke leading to a mRS 2. Additionally, one device thrombosis occurred in a Y-stent resulting in a 1-point mRS worsening. Six additional device-related events and eight procedure-related events were documented, with no worsening of mRS. Currently, of the 54 remaining reported events, one death occurred, related to known cancer. At 3–6 month follow-up, control images were performed in 93 patients. All implanted Atlas stents were patent. The aneurysm occlusion rates show that 83.9% of patients had a complete obliteration (Raymond Roy score class 1), 14% a Raymond Roy score 2 (residual neck), and 2.1% had a Raymond Roy score 3 (residual aneurysm). At final follow-up (12–16 month), 65 patients have been assessed with a Raymond Roy score 1 for 87.7%, Raymond Roy score 2 for 7.7% and Raymond Roy score 3 for 4.6%.

Conclusion: These results suggest that the Neuroform Atlas™ Stent System allows an adequate aneurysm embolization with a morbidity-mortality rate comparable to that reported in the meta-analysis with Neuroform Stent System published in 2015. The complication rate with Y-stenting technique should be investigated in a larger series.

Keywords: aneurysm, embolization, stent

O 234

STENT ASSISTED COIL EMBOLIZATION OF INTRACRANIAL ANEURYSMS USING NEUROFORM ATLAS STENT

HW Jeong[1], JW Baek[1], ST Kim[2], YG Jeong[2], JH Seo[3], SK Baik[4] and WB Seung[5]

[1]Inje University Busan Paik Hospital – Department of Radiology, Busan, SOUTH KOREA
[2]Inje University Busan Paik Hospital – Department of Neurosurgery, Busan, SOUTH KOREA
[3]Inje University Busan Paik Hospital – Department of Neurology, Busan, SOUTH KOREA
[4]Pusan National University Yangsan Hospital – Department of Radiology, Yangsan, SOUTH KOREA
[5]Dongguk University Gyeongju Hospital – Department of Neurosurgery, Gyeongju, SOUTH KOREA

Purpose: To evaluation of radiologic and clinical efficacy of Neuroform Atlas stent for endovascular coiling of unruptured intracranial aneurysms.

Materials and Methods: During 2018, 56 aneurysms in 48 patients were treated with stent assisted coil embolization using Neuroform Atlas stent in our institution. Two ruptured aneurysms were excluded from our study. Accordingly, 46 patients with 54 unruptured saccular cerebral aneurysms were included in our study (47 females, mean age: 60.6 ± 11.6 years). Demographic data, aneurysm characteristics, treatment technique, periprocedural and device related complications and initial and follow up angiographic and clinical results were evaluated.

Results: There was one case of procedural failure due to a downward slip during stent deployment. The technical success rate was 98.1% (53/54). Aneurysm locations were as follows: 31 in the distal internal carotid artery, 2 in the ophthalmic artery, 9 in the posterior communicating artery, 2 in the anterior communicating artery, 8 in the middle cerebral artery, 1 in the posteroinferior cerebellar artery and 1 in the basilar top aneurysm. The mean aneurysm neck diameter was 4.03 mm, and the mean dome-to-neck ratio was 1.15. A post-procedure control angiogram showed complete or residual neck occlusion in 33 (33/53, 62.3%) aneurysms. There were two cases of in-stent thrombus formation while procedure. But after intra-arterial tirofiban infusion (0.6 mg and 1 mg), thrombus was complete resolved. The modified Rankin scale score at discharge was 0 in all patients. Follow-up data at a mean of 7.8 months were available for 42/53 (79.2%) aneurysms with digital subtraction angiography, and they revealed complete occlusion in 29 (29/42, 69%) and remnant neck in 11 (11/42, 26.2%). One aneurysm revealed minor recanalization (1/42, 2.4%). An aneurysm, which was observed as residual sac on immediate post procedure angiography was still observed as residual sac on 6 months follow up angiography, so additional coil embolization was performed at 7 months after the first procedure.

Conclusion: Our findings suggest the Neuroform Atlas stent can be useful for the coiling of unruptured cerebral

aneurysms without significant complications regardless of aneurysm location.
Keywords: Neuroform Atlas stent, coil embolization, stent assisted

O 235

NEUROFORM ATLAS STENT (NAS) IN INTRACRANIAL ANEURYSMS: INITIAL EXPERIENCE

F Villasante[1], F Navarro[2], E Loncharic[3], H Moya[4], M Pereira[5] and A Ceciliano[6]
[1]Hospital Aleman – Sanatorio Finochietto / Department Interventional Neuroradiology, Buenos Aires, ARGENTINA
[2]Hospital Aleman – Sanatorio Finochietto, Buenos Aires, ARGENTINA
[3]Hospital Aleman – Sanatorio Finochietto, Buenos Aires, ARGENTINA
[4]Hospital Aleman – Sanatorio Finochietto, Buenos Aires, ARGENTINA
[5]Hospital Aleman – Sanatorio Finochietto, Buenos Aires, ARGENTINA
[6]Hospital Aleman – Sanatorio Finochietto, Buenos Aires, ARGENTINA

Purpose: The objective of this study is to report our initial experience in the use of Neuroform Atlas Stent (NAS) for the treatment of wide neck aneurysms and dissection.
Materials and Methods: Wide neck Intracraneal aneurysms were treated by stent-assisted coiling and disecction just with NAS, all patients were retrospectively evaluated. Patient demographics, clinical presentation, aneurysm characteristics, technical success, arterial modification due stent, and clinical and immediately angiographic follow-up were analysed.
Results: Eighteen patients were treated using one NAS, 17/18 with NAS assisted coiling technique (10 women/age average: 58y.), 17 harboring intracranial sacular aneurysms (SAH 7/17) and one intracranial disecction (TIA). All the aneurysms were located in the anterior circulation (7 ACM, 4 AcoP, 4 AcoA and 2 Pericalloso), intracraneal disecction was located in a distal branch of the M2 left segment. Go through the NAS with the microcatheter in this new laser cut open cell stent was easy (7/17), minimal arterial modification were seen. There were no clinical adverse events, 95% of patients had Raymond-Roy score of 1 or 2 aneurysmal immediately occlusion.
Conclusion: NAS were easy and predictable to placed in all patients. Showing safety and efficacy and no trombogenecity, with minimal alteration of the antomy in distal arteries.
Keywords: ANEURYSM, WIDE NECK, NEUROFORM ATLAS STENT

O 236

NEUROFORM ATLAS STENT IN THE TREATMENT OF WIDE-NECKED INTRACRANIAL ANEURYSMS. SINGLE CENTER EXPERIENCE

A Alexandre[1], F Giubbolini[1], I Valente[1], E Lozupone[1], F D'argento[1], C Colosimo[1] and A Pedicelli[1]
[1]Fondazione Policlinico Universitario A. Gemelli IRCCS, Roma, Italia. UOC Radiologia e Neuroradiologia., Roma, ITALY

Purpose: Wide-necked intracranial aneurysms therapy remains a challenge for neurointerventionalists, mainly for the high recurrence rate. In our series we report clinical and angiographic results of Neuroform Atlas stent-assisted coiling.
Materials and Methods: A retrospective single center evaluation of patient treated from November 2015 to April 2018 for wide-necked intracranial aneurysms using the low profile Neuroform Atlas stent. We treated 31 patients with 32 aneurysms. Age range 31–78, mean age 59. 22 Female and 9 male. 19 aneuryms were located in the AcomA complex, 6 in the ophthalmic segment of the internal carotid artery, 3 in the communicating segment of the internal carotid artery, 3 in the basilar artery, and 1 in the carotid bifurcation. The Atlas stent-assisted coiling procedures were performed under general anesthesia with stent-through or jailing techniques. In 8 cases an Y stent technique was used, in 1 case a telescopic techninque, and in 22 a single stenting technique. Patients were followed with a three and six months MR/angio-MR, and with a 12 months DSA, performed to assess the recurrence rate through the modified Raymond-Roy occlusion scale (RROC). Moreover, patients were evaluated clinically to analyse the degree of disability according to the mRS.
Results: In all the procedures it was feasible to navigate the Neuroform Atlas to the goal vessel and deploy the stent across the aneurysmal neck. The immediate occlusion rate was RROC 1 in 27 patients (87,5%), RROC 2 in 3 patients (9,5%) and RROC 3 in 1 patient (3%). The 12 months follow-up showed RROC of 1 in 28 patients (90%), RROC 2 in 2 patients (6%). No aneurysm has been retreated. Intra-procedural complications were 3 out of 31 treatments: in 2 cases a small intrastent aggregate was immediately solved with a glycoprotein IIb/IIIa receptor antagonist, while in 1 case there was a small sac perforation with the second coil. These complications had no clinical consequences. Late complications were 4: 1 patient had a retroperitoneal hematoma for femoral access, requiring surgery, 2 patients had a minor ischemic stroke in the 15 days following the treatment due to poor adherence to antiaggregant therapy, and 1 patient died for a subarachnoid hemorrhage 2 months after the treatment.
Conclusion: In our single center experience the Neuroform Atlas stent assisted-coiling has shown to be a safe and effective technique for the treatment of wide-necked intracranial aneurysms with encouraging clinical and angiographic results.
Keywords: Wide-necked aneurysms, stent-assisted coiling

O 237

THE 'Y'-CONFIGURATION OF DOUBLE NEUROFORM ATLAS ASSISTED COIL EMBOLIZATION FOR TREATMENT OF BIFURCATION WIDE-NECK ANEURYSMS. A MULTICENTRIC EXPERIENCE

V Semeraro[1], S Vidali[1], E Lozupone[3], M Ganimede[2], N Lucarelli[2] and N Burdi[2]

[1]Department of Diagnostic Imaging, Molecular Imaging, Interventional Radiology and Radiation Therapy, University Hospital, Rome, ITALY
[2]Radiology, SS Annunziata Hospital, Taranto, ITALY
[3]Policlinico Gemelli, Rome, ITALY

Purpose: Despite the consistent technical and technological improvements seen during the last years, endovascular treatment of bifurcation wide-neck aneurysms still represents an important therapeutic challenge both in terms of procedural success rate and long-term treatment efficacy. The purpose of this study is to report a mid-term follow-up of a multicentric series of patients diagnosed with bifurcation aneurysms, treated with 'Y'-configuration double Neuroform Atlas (NA) stents assisted coil embolization to provides a mechanical scaffold, preventing coil protrusion.
Materials and Methods: Between 2016 and 2019 we collected data from 18 consecutive patients (6 men, mean age 61 years) who underwent Y-stenting assisted coil embolization. The location of the aneurysms were: 6 in middle cerebral artery (MCA) (33.3%), 9 anterior communicating artery (AComA)(50%) and 4 basilar artery (16.7%). Follow-up was performed with 3-months MR-angiography (MRA) and 11–13 months MRA plus standard digital subtraction angiography (DSA).
Results: Procedural Technical success was achieved in 100% of patients. No NA stent delivery or deploy complication occurred. Three months MRA showed aneurysm complete occlusion (CO) in 16 out of 18 cases; residual neck (NR) was observed in 2 out of 18 cases. MRA showed evidence of blood flow inside bifurcation vessels and peripheral arterial branches in 18 out of 18 cases. At 11–13 months MRA, according to the Modified Raymond-Roy Occlusion Classification 14 Class I (77.8%), 3 Class II (16.7%), and 1 Class IIIa (5.5%) were documented. No major or minor ipsilateral stroke was observed at the end of procedure and at follow-up.
Conclusion: Y-stent reconstruction-assisted coil embolization represents a safe and effective technique demonstrating high rate of aneurysm occlusion at mid-term angiographic follow-up.
Keywords: y-stenting, neruform atlas, aneurysms

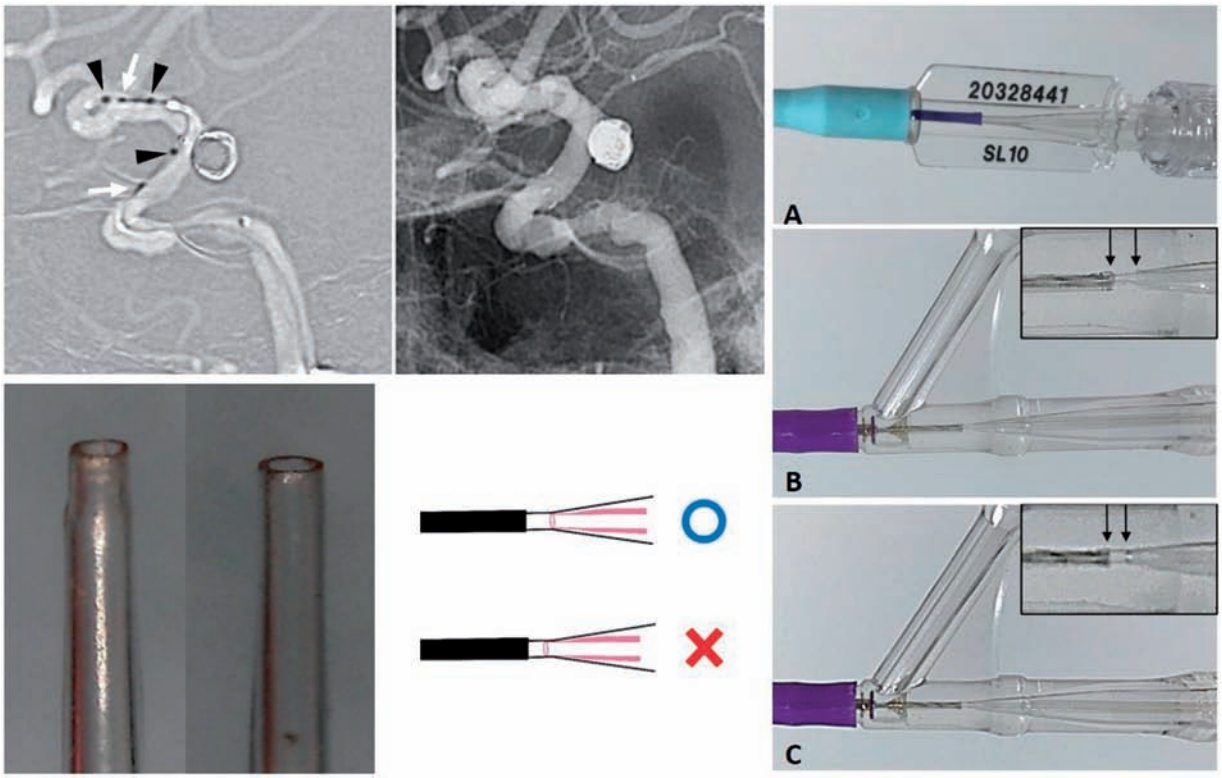
O 238

A SIMPLE AND RELIABLE WAY TO USE NEUROFORM ATLAS STENTS WITH SCEPTER BALLOON CATHETERS: A TECHNICAL REPORT OF THE 'BALLOON-STENT' TECHNIQUE

J Roh[1], SK Baik[1], CH Kang[1] and HW Jeong[2]

[1]Pusan National University Yangsan Hospital, Yangsan, SOUTH KOREA
[2]Pusan Paik Hospital, Busan, SOUTH KOREA

Purpose: Neuroform Atlas stent (Stryker Neurovascular, Fremont, USA) is a relatively new, open-cell stent for aneurysm treatment and its biggest advantage over the former version of Neuroform family is that it is designed to be delivered through 0.0165 inch microcatheters. The authors of this article utilized Scepter balloon catheters (Microvention, Tustin, California, USA) as Atlas stent-delivery catheter, to enhance advantages of balloon-stent technique in distal internal carotid artery (ICA) wide-neck aneurysm coiling.
Materials and Methods: Thirteen consecutive patients with distal ICA aneurysms were treated with the balloon-stent technique, and 16 Atlas stents (over 14 procedures) were used with Scepter balloon catheters. Treatment was initiated with the balloon-remodeling technique, and if stenting was needed, instead of exchanging the balloon catheter with another microcatheter, Scepter catheter was used as the stent-delivery catheter. Clinical information and images of the cases were retrospectively reviewed.
Results: In 3 cases, the Atlas stent failed to advance through the Scepter balloon catheter. After careful inspection of failed devices, we determined that the introducer sheath of the Atlas stent should not be pushed to the Scepter hub and should be in contact with the hub wall. Once a stent was passed through the hub and loaded safely within the balloon catheter, stent deployment was similar to other recommended delivery catheters. We have been using the Atlas through Scepter with a 100% success rate.
Conclusion: Scepter balloon catheters can be used as delivery catheters when deploying Neuroform Atlas stents in endovascular treatment of intracranial aneurysms. Operators should carefully engage the introducer sheath of the stent system into the balloon catheter hub. The Scepter-Atlas combination may strengthen the advantages of the balloon-stent technique, without the need to exchange a balloon catheter with a stent-delivery catheter.
Keywords: aneurysm, balloon remodeling technique, stent-assisted coiling



O 239

WAFFLE CONE TECHNIQUE USING THA ATLAS INTRACRANIAL DEVICE IN RUPTURED ANEURYSMS

F Petra[1], A Aguado[1], G Caballero[1], J Lizundia[1], M Grana[1], L Parra[1] and E Isuany[1]
[1]Hospital Santa Isabel De Hungria, Mendoza, ARGENTINA

Purpose: To show the feasability of Waffle cone Technique in Ruptured aneurysm.
Materials and Methods: From November 2015 and March 2019, 316 patients presenting ruptured intracranial brain aneurysm, were treated by endovascular way. 26 of them went under Atlas No Tip waffle-cone technique.
Results: The 26 patients presented complex, wide-neck, bifurcation cerebral aneurysms. The angles between the parent artery and the lession neck went from 0 to 167 degrees. 8 ruptured aneurysms were located at the basilar tip, 5 were located at the anterior communicating artery, 5 at middle cerebral artery bifurcation, and 8 at the carotid T. 24 patients showed Grade I Raymond classification after procedure and 2 presented Grade II. No intraoperative complications were observed. During early follow up, 3 patients presented vasospasm associated stroke, who required decompressive craniectomy. 6 patients required external ventricular drainage with no additional complications. 2 patients (included in the craniectomy group) died during 30 days after procedure. Between the 24 patients that were discharged, 20 presented a Modified Ranking Score from 0 to 2, and 4 a score from 3 to 4.
Conclusion: Waffle-cone Atlas embolization assisted coiling is safe, feasible and effective for the treatment of complex and wide-necked bifurcation aneurysms. The absence of distal tip of the device and it's low profile allows to applied the technique in a diverse kind of complex wide neck aneurysm.
Keywords: Aneurysm, Ruptured, Waffle Cone

O 240

NEUROFORM ATLAS STENT-ASSISTED COILING OF RUPTURED ANEURYSMS IN NOT-PREMEDICATED PATIENTS. A MULTICENTER STUDY

R Russo[1], G Bradac[2], L Castellan[3], I Gallesio[4], D Garbossa[5], G Iannucci[6], D Mardighian[7], R Menozzi[8], A Pitrone[9], G Romano[10], F Venturi[11], G Vercelli[12] and M Bergui[13]
[1]Azienda Ospedaliera Città della Salute e della Scienza di Torino, Torino, ITALY
[2]1
[3]IRCCS San Martino, Genova, ITALY
[4]Azienda Ospedaliera S. Antonio e Biagio e C. Arrigo, Alessandria, ITALY
[5]1
[6]Ospedale San Bortolo, Vicenza, ITALY
[7]Spedali Civili di Brescia, Brescia, ITALY
[8]Ospedale Maggiore, Parma, ITALY

[9]AOU Policlinico G. Martino, Messina, ITALY
[10]Ospedale S. Croce e Carle, Cuneo, ITALY
[11]1
[12]1
[13]1

Purpose: The aim of our study was to assess efficacy, safety, and to discuss the optimal medical management of stent-assisted coiling of ruptured aneurysms.
Materials and Methods: Ruptured intracranial aneurysms treated by stent-assisted coiling in eight different institutions were retrospectively reviewed. Outcomes, safety, efficacy and complications were analyzed and related to different drug therapies.
Results: 61 consecutive patients (Male/Female 23/38), aged 59.1 years (36–86) were analyzed. Patients were not pre-medicated with antiplatelets; salicylate 500 mg was given just after stent deployment. 22/61 (36.1%) stent thrombosed during the procedure. Heparin, given as bolus in 15 patients, was unsuccessful to avoid thrombosis. Thrombosis resolved with intravenous antiGP2b3a, without causing hemorrhages or increasing overall complications rate. No late stent thrombosis were seen, regardless single or double antiplatelets; overall complication rate was similar for both regimen. At three months, 34 out of 38 patients with HH grade 1–2 (89.4%), and 11 out of 23 with Hunt-Hess grade of 3–4 (47.8) were independent (Modified Ranking Scale 0–2).
Conclusion: Stent assisted coiling of ruptured aneurysm is effective and safe. The optimal medical treatment is still controversial. In our series, a high rate of perioperative stent thrombosis was successfully managed using bail-out intravenous antiGP2b3a. After procedure, double was not superior to single antiplatelet therapy. These data may be used to design a drug-sparing strategy and to tailor the treatment on individual basis.
Keywords: Ruptured aneurysms, Stent-assisted coiling, Endovascular treatment

O 241

STENT-ASSISTED COILING OF CEREBRAL ANEURYSMS WITH THE NEUROFORM ATLAS STENT WITH ONE YEAR FOLLOW UP

S Derakhshani[1]
[1]Queen's University Hospital, Greater London, UNITED KINGDOM

Purpose: A retrospective study of the patients treated by stent assisted coiling using Neuroform Atlas.
Materials and Methods: All intracranial aneurysms treated by stent-assisted coiling using a single AS in a single institution were retrospectively evaluated. Patient demographics, aneurysm characteristics, stented branch, technical success, and clinical and angiographic follow-up were analyzed.
Results: Forty-five consecutive aneurysms treated using Atlas-assisted coiling. The majority of the cases were located in anterior circulation with overall technical success rate of 100%. One minor stroke in a territory completely irrelevant to the stented location. There were no clinical events with permanent morbidity. The majority of the patients had Raymond-Roy score of 1 or 2 aneurysmal occlusion at a mean follow-up duration of 6.4 months.
Conclusion: Atlas stent-assisted coiling was associated with a favorable 1 year outcomel outcome and angiographic results in this series. This stent can be used for distally causing minimal alteration of the arterial anatomy.
Keywords: Stent, Assisted coiling, Neuroform Atlas

SESSION V: Aneurysms Fusiform / Dissecting

O 242

APPLICATION OF LOW-PROFILE FLOW-DIVERTING STENTS IN THE TREATMENT OF FUSIFORM, DISTAL ANEURYSMS OR FOR DESTRUCTIVE OPERATIONS

A Petrov[1], S Goroshenko[2] and L Rozchenko[3]
[1]Russian Polenov Neurosurgical Institute – vascular neurosurgery department, S-Petersburg, RUSSIA
[2]Russian Polenov Neurosurgical Institute – vascular neurosurgery department, S-Petersburg, RUSSIA
[3]Russian Polenov Neurosurgical Institute – vascular neurosurgery department, S-Petersburg, RUSSIA

Purpose: Despite the rare occurrence of distal aneurisms 0.3–1%, they require individual analysis especially with the advent of new devices. Objective: to Assess the role and capabilities of low-profile flow-diverting stents in endovascular treatment of distal aneurysms and destructive operations.
Materials and Methods: we analyzed the features of endovascular treatment of 15 patients with fusiform, distal aneurysms who underwent endovascular procedures in 2018–2019. the Average age of patients was 45 years, the ratio of gender – female15 (100%). ACA aneurysm localization was observed in 6 (40%) cases, MCA in 6 (40%), PCA in 3 (20%).
Results: in 11 (73%) cases, low-profile flow-diverting stents were implanted, (1 case of re-stenting after distal stent migration), in 3 (20%) – destructive operations were performed, in 1 (7%) case of BTO high functional significance of the artery and the lack of technical conditions for stent installation were observed. All patients were discharged mRs-0-1.
Conclusion: Distal, fusiform aneurysms usually have individual geometry and hemodynamic characteristics. Especially important is that the supplying arteries are usually of small diameter. Installation of flow-diverting stents was preferred in the cases of fusiform and giant aneurysms, where they make it possible to achieve reconstruction of the artery, changing the direction of blood flow and turning off the

aneurysm. Destructive operations were performed after occlusion tests and assessment of collateral blood flow and neurological status. In the case of a negative test result, destructive operations are an adequate and technologically available alternative to the installation of a flow diverting stents.

Keywords: low profile flow diverters, distal aneurism, fusiform aneurism

O 243

ENDOVASCULAR THERAPY FOR RUPTURED VERTEBRAL ARTERY DISSECTING ANEURYSMS IN JAPAN: RESULTS FROM NATIONWIDE, RETROSPECTIVE, MULTI-CENTER REGISTRIES

H Nakamura[1], T Fujinaka[2], T Nishida[1], H Kishima[1] and N Sakai[3]

[1]Osaka University Graduate School of Medicine, Department of Neurosurgery, Suita, JAPAN

[2]Osaka National Hospital, Department of Neurosurgery, Osaka, JAPAN

[3]Kobe City Medical Center General Hospital, Department of Neurosurgery, Kobe, JAPAN

Purpose: Ruptured vertebral artery dissecting aneurysm (VADA) causes subarachnoid hemorrhage (SAH), and parent artery occlusion (PAO) with endovascular technique (EVT) has been the first-line treatment for ruptured VADA. In this study, we evaluated clinical data of ruptured VADA extracted from nationwide, retrospective, multi-center registries in Japan, to investigate factors that influenced outcome and procedure-related complications. Additionally, we compared the results with data from previous studies to identify changes in treatment trends during this decade in Japan.

Materials and Methods: The Japanese Registry of Neuroendovascular Therapy (JR-NET) is a nationwide, retrospective, multi-center registration of therapeutic procedures and outcomes from the certified board members of the Japanese Society for Neuroendovascular Therapy (JSNET). This registration began in January 2005, and data were collected in three different periods (2005–2006, 2007–2009, and 2010–2013), these are JR-NET1, 2 and 3, respectively. In JR-NET3, the total number of intracranial aneurysms treated with EVT was 15,851 (unruptured: 9546, ruptured: 6305), and we extracted 530 ruptured VADA, treated via PAO with EVT from JR-NET3, and analyzed factors associated with outcome at 30 days and procedure-related complications.

Results: Complete occlusion was achieved in 497 (93.8%) and favorable outcome (modified Rankin Scale: 0–2) was obtained in 303 (59.1%). Older age (>60 years), male sex, use of general anesthesia, non-specialist as the responsible doctor, and time delay from onset to treatment (>24 hours) were negative factors for favorable outcome in multivariate analysis, although these factors were not associated with the rate of procedure-related complications. To understand the changes in treatment trends during this decade, we compared data from JR-NET3 with that from previous studies (JR-NET1 and 2). The percentage of severe SAH (WFNS grade 4–5) patients treated with PAO increased gradually from JR-NET1 to 3 (48.8%, 52.9%, and 57.7%, respectively), however, the percentage of patients with favorable outcome did not decrease. Regarding severe SAH patients, the rate of favorable outcome increased from 31.7%, 31.3%, and 56.2% in JR-NET1, 2, and 3, respectively.

Conclusion: Even as treatment has been increasingly performed for severe SAH in this decade, the percentage of patients with favorable outcome did not decrease. This might be due to not only the improvement in endovascular treatment itself, but also the increased availability of endovascular specialists or standardization of management with the use of recognized guidelines.

Keywords: Vertebral artery, Dissecting aneurysm, Parent artery occlusion

O 244

RECONSTRUCTIVE ENDOVASCULAR TREATMENT OF V4 SEGMENT OF VERTEBRAL ARTERY DISSECTING ANEURYSM WITH WILLIS COVERED STENT: A RETROSPECTIVE STUDY

S Xiang[1], G LI[1], C He[1], J Ren[1] and H Zhang[1]

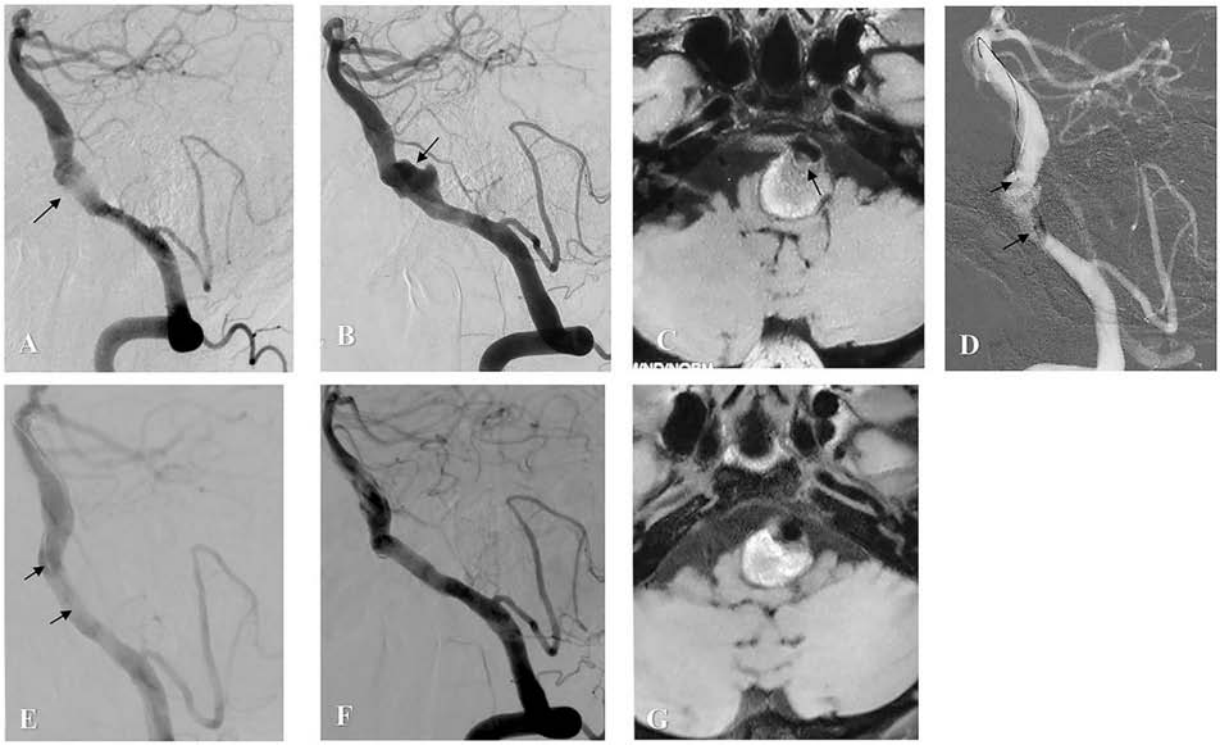
[1]Department of Neurosurgery Xuanwu Hospital, Capital Medical University China International Neuroscience Institute, Beijing, CHINA

Purpose: Preliminary studies suggest that Willis covered stents may be suitable for the treatment of wall defect in internal carotid artery (ICA), but their efficacy and safety in vertebral artery (VA) dissecting aneurysms needs further investigation.

Materials and Methods: Consecutive patients who underwent placement of Willis covered stent for treatment of the aneurysm in V4 segment of the VA between September 2015 and December 2017 at our institution were retrospectively reviewed. The efficacy, complications, angiographic, and clinical follow-up results were collected and analyzed.

Results: Sixteen covered stents were successfully implanted into the vertebral artery in 12 patients with 12 dissecting aneurysms. The technical success rate of stenting placement was 100%. Complete exclusion was achieved in 11 patients immediately after the stent placement, with transient endoleakage in 1 aneurysm. Angiographic follow-up (9.9 ± 4.0 months, mean $\pm$ SD) were performed in 9 patients and demonstrated complete stabilization of the obliteration aneurysm. The clinical follow-up (20.1 ± 9.6 months, mean $\pm$ SD) demonstrated a full recovery in 11 patients and 1 patient suffered from acute myocardial infarction.

Conclusion: Reconstruction using Willis covered stent is an efficient, safe and attractive alternative in definitive treatment of intracranial VA dissecting aneurysm; longer



follow-up and expanded clinical trials are needed for further validation of this technique.

Keywords: Willis covered stent, intracranial dissecting aneury, vertebral artery

0 245

SEGMENT OCCLUSION VS. RECONSTRUCTION EXPERIENCE WITH ENDOVASCULAR STRATEGIES FOR RUPTURED VERTEBROBASILAR DISSECTING ANEURYSMS

S Schob[1], KT Hoffmann[1] and U Quaeschling[1]
[1]Department for Neuroradiology University Hospital Leipzig, Leipzig, GERMANY

Purpose: Ruptured dissecting aneurysms of the intracranial vertebral arteries exhibit an extraordinarily high risk for morbidity and mortality and are prone to re-rupture. Therefore, early treatment is mandatory to induce stagnation of the critical dynamic mural process. Appropriate endovascular approaches are segment sacrifice and reconstruction, however, both carry specific risks and benefits. To date most studies discuss only one of these approaches and focus on one specific device or technique. Therefore, our study aimed to present our experiences with both techniques, providing a considered approach on when to perform endovascular reconstruction or sacrifice.

Materials and Methods: We retrospectively reviewed patients with subarachnoid hemorrhage in our database, suffering from dissecting aneurysms of the intradural vertebral arteries and treated endovascularly in the acute setting. A total of 16 cases were included. Clinical history, radiologic findings and outcomes were analyzed.

Results: In 7 patients a reconstructive approach was chosen with 4 of them receiving stent-assisted coiling as primary strategy. One of the 7 patients suffered early re-bleeding due to progression of the dissection and therefore treatment was augmented with implantation of 2 flow diverters. The remaining 2 patients were primarily treated with flow diverters in telescoping technique. In 9 patients a deconstructive approach was followed: 6 patients were treated with proximal coil-occlusion of the V4 segment, 3 patients received distal coiling of the V4 segment. Two patients died (GOS 1) in the subacute stage due to sequelae of recurrent episodes of raised intracranial pressure and parenchymal hemorrhage. Two patients kept severe disability (GOS 3), six patients had moderate disability (GOS 4) and seven patients showed full recovery (GOS 5). None of the patients suffered from a procedural or postprocedural ischemic stroke.

Conclusion: In patients with good collateral vascularization, proximal, or distal partial segment sacrifice via with endovascular coil occlusion seems to yield the best risk-benefit ratio for treatment of ruptured dissecting V4 aneurysms, especially since no continued anticoagulation is required and possibly essential surgery remains feasible in this scenario. If possible, PICA occlusion should be avoided–although even proximal PICA occlusion can become necessary, when weighing against the risk of an otherwise untreated ruptured V4 dissecting aneurysm. Contrarily, if the dominant V4 segment is affected, the hemodynamic asymmetry prohibits occlusion and necessitates reconstruction of the respective segment. For this, implants with high metal

coverage treating the entire affected segment appear to be the most promising approach.
Keywords: Dissecting Aneurysm, SAH, Reconstruction vs. Occlusion

O 246

THE FATE OF UNRUPTURED INTRACRANIAL VERTEBROBASILAR DISSECTING ANEURYSM WITH BRAIN STEM COMPRESSION ACCORDING TO DIFFERENT TREATMENT MODALITIES

DY Cho[1]
[1]Ewha Womans University Seoul Hospital, Seoul, SOUTH KOREA

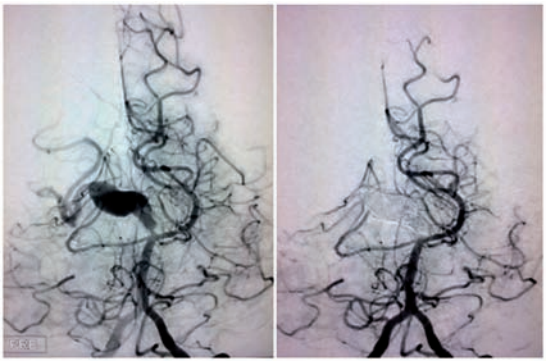
Purpose: Unruptured intracranial vertebrobasilar dissecting aneurysm (IVBDA) with brain stem compression is difficult to treat. In the present study, the clinical and radiological outcomes of unruptured IVBDA with brain stem compression based on different treatment modalities was evaluated.
Materials and Methods: This study included 28 patients with unruptured IVBDA with brain stem compression treated from January 2009 to December 2016. Treatment methods were observation ($n = 6$), stent-assisted coil embolization (SACE; $n = 9$), parent artery occlusion (PAO; $n = 6$), and flow diversion (FD; $n = 8$). The data of baseline characteristics, change of aneurysm size, retreatment rate, stroke occurrence and alteration of mRS score were obtained from retrospective chart review.
Results: The initial size of dissecting aneurysm was largest in the FD group (22.5 ± 7.7 mm), followed by PAO (20.3 ± 8.4 mm), SACE (11.7 ± 2.2 mm), and observation groups (17.8 ± 5.5 mm; $p = 0.01$). The reduction rate of aneurysm size was highest in the PAO group ($26.7 \pm 32.1\%$), followed by FD ($14.1 \pm 28.7\%$), SACE ($-17.9 \pm 30.3\%$), and observation groups ($-31.5 \pm 30.8\%$; $p = 0.007$). Additional treatment was needed in observation group (4/6, 66.7%) and SACE group (3/9, 33.3%; $p = 0.017$). Improvement of Modified Rankin Scale (mRS) score on follow-up was observed in the FD group (6/7, 85.7%) and PAO group (4/6, 66.7%) but not in the SACE and observation groups. A worsened mRS score was most common in the observation group (4/6, 66.7%), followed by SACE (3/9, 33.3%), PAO (2/6, 33.3%), and FD groups (0/7, 0%).
Conclusion: When treating IVBDAs with brain stem compression, PAO and FD should be considered to reduce aneurysm size and improve mRS score.
Keywords: Dissection, Vertebral artery, Basilar artery

O 247

ENDOVASCULAR DECONSTRUCTIVE TECHNIQUE FOR DISSECTING POSTERIOR CEREBRAL ARTERY ANEURYSMS: A SINGLE-CENTER CASE SERIES

F Hassan[1]
[1]Faculty of Medicice, Cairo University, Cairo, EGYPT

Purpose: The aim of this study was to evaluate the efficacy and safety of endovascular embolization of dissecting posterior cerebral artery (PCA) aneurysms of P1 and P2 segments using the deconstructive technique.



Materials and Methods: We retrospectively analyzed the angiographic features, technical details and clinical outcome of 9 consecutive patients presented to our department between January 2012 and December 2017, for endovascular embolization of dissecting aneurysm of the posterior cerebral artery. Patients were 6 males and 3 females, with age range of 36–63 years (mean: 48.1). Five patients had dissecting aneurysm of P1 segment and 4 patients had dissecting aneurysm of P2 segment. Five patients presented by headache, 1 patient presented by epilepsy and headache and 3 patients presented by subarachnoid hemorrhage.
Results: Balloon occlusion test was performed in 1 patient. Six patients were treated by endovascular parent artery occlusion, one patient was treated by aneurysmal coiling, one patient ruptured and died before treatment and one patient refused treatment and asked for follow up. No cortical infarctions occurred after parent artery occlusion. Two patients with P1 occlusion had post-procedural small thalamic infarctions that recovered to mRs:1 at 3 months follow up. P2 segment occlusion was asymptomatic in all patients. One patient showed partial aneurysmal recurrence.
Conclusion: Endovascular parent artery occlusion is an effective and safe treatment approach for the dissecting aneurysms of PCA even without occlusion test. Risk of perforator infarction should be considered in P1 occlusion even with dissecting aneurysms.
Keywords: Dissecting aneurysm, Posterior cerebral artery, Embolization

O 248

DISSECTING DISTAL CEREBELLAR ARTERY ANEURYSMS: PVO VS PARENT VESSEL PRESERVING STRATEGIES

G Anil[1], L Sein[1], V Nga[1], K Teo[1], C Ning[1], C Yang[1] and T Yeo[1]
[1]National University Hospital, Singapore, Singapore, SINGAPORE

Purpose: Parent vessel occlusion (PVO) is the conventional endovascular treatment (EVT) for dissecting distal cerebellar artery aneurysms (DCAA). The associated ischemic sequelae are often well -tolerated. However, at the outset the magnitude of this risk is uncertain. Meanwhile, non-PVO endovascular treatments (EVT) are deemed to provide incomplete protection from a rebleed. This study reviews our experience in the management of dissecting DCAA with emphasis on the effectiveness of parent vessel preserving endovascular strategies as compared to PVO.
Materials and Methods: Our institutional database was reviewed for all the dissecting DCAA aneurysms treated by endovascular means between Nov 2015 to Oct 2018. Their clinical presentations, imaging findings, EVT techniques as well as clinical outcomes were retrospectively evaluated.
Results: Eighteen dissecting DCAA were identified: 13 in the posterior-inferior cerebellar artery (PICA); 3 in anterior-inferior cerebellar artery (AICA) and 2 in superior cerebellar artery (SCA). Median patient age was 61 years (range 40–86; average 60.7 years) with a 5:1 female predominance. Nine (6 in the PICA and 3 in the AICA) patients were managed by parent-vessel preserving strategies (6 with isolated endosaccular-coiling and 3 with telescoping stents) while the remaining 9 (7 in the PICA and 2 in the SCA) were treated by PVO. The frequency of early rebleed was same (11%) in both the treatment arms. One patient from the PVO arm suffered an extensive cerebellar infarct that mandated decompressive craniectomy and adversely affected her recovery. There were no such complications in patients treated with parent vessel preserving strategies. No recurrence/rebleed was encountered in the 3 aneurysms secured using telescoping-stents. Overall, excellent clinical outcomes (mRS of 0 &1) were sparsely seen in the patients who had PVO (89 Vs 23%).
Conclusion: In dissecting DCAA, aforedescribed parent vessel preserving strategies are as effective as the more frequently used option of PVO in preventing an early rebleed. However, these are technically challenging, may be feasible in a smaller proportion of patients and would need meticulous imaging follow-up in the acute period. When successfully implemented, these strategies can deliver excellent clinical outcomes and eliminate the uncertain risk of ischemic complications associated with PVO.
Keywords: Dissecting aneurysms, Distal cerebellar artery, SCA, AICA, PICA aneurysms

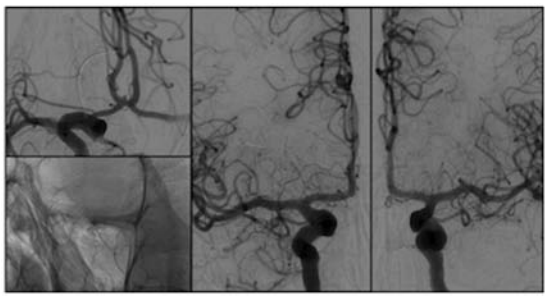
SESSION W: Aneurysms Blood Blister Like / Ruptured

O 249

FLOW-DIVERTER STENT DEPLOYMENT IN BLISTER-LIKE AND DISSECTING ANEURYSMS IN ACUTE PHASE WITH LONG TERM FOLLOW-UP. ITALIAN SINGLE CENTER EXPERIENCE

G Sanfilippo[1], A Sgreccia[1], F Zappoli Thyrion[1] and E Lafe[1]
[1]Fondazione Irccs Policlinico San Matteo – Neuroradiologia, Pavia, ITALY

Purpose: Blister-like and dissecting aneurysms are specific pathological entities which imply some challenges both in neurosurgical and endovascular treatments. Recent studies showed controverse results about the flow-diverter use for these types of aneurysms. We report our single-center experience concerning the treatment of blister-like and dissecting aneurysms by flow-diverter deployment in the acute phase and long-term follow-up.



Materials and Methods: We retrospectively collected 8 patients, in a period between 2011 and 2018, with SAH and blister-like or dissecting aneurysms diagnosed by DSA. The follow-up lasted from 1 to 7 years and the functional outcome was calculated with the modified Rankin Score. All patients were treated in acute phase, except for 1 patient who underwent endovascular treatment 40 days after SAH onset because no aneurysm was depicted with DSA at time-zero and a flow-diverter was deployed when an aneurysm was detected at the last angiogram, so he was considered eligible as well. Normal diagnostic work-up, such as CT and MRI, was performed in all patients. DSA was repeated at 3 months after stent deployment and a long-term DSA for 4 patients included in the longer follow-up.
Results: We collected 3 typical blister aneurysms of ICA, 1 blister-like Acom aneurysm, 1 basilar fusiform aneurysm, 1 circumferential basilar branch dissecting aneurysm, 1 dissecting aneurysm of the intracranial vertebral artery and 1 cerebral posterior artery P2-P3 aneurysm, all associated with SAH. Six patients were treated by a single flow-diverter deployment PED (Medtronic, Irvine, CA), Derivo (Penumbra Inc., Alameda, CA) and FRED (Microvention, Tustin, CA) and two of them by double FD. Aggrastat (iv bolus and venous pump infusion) was administered during FD deployment, and 12 h later double anti-platelet therapy (ASA 100 mg

and Clopidogrel 75 mg) was introduced. Seven out of eight patients were male and mean age was 52.9 y.o. Seven out of 8 (87,5%) patients had a good functional outcome (mRS 0–3) in a period that ranges from 1 to 7 years follow-up, with a complete aneurysm occlusion at 3 months DSA control. One patient died suffering from large fusiform basilar artery aneurysm, Fisher 4 SAH, and GCS-3 at hospitalization.
Conclusion: Despite the technical challenges and the mortality rates provided by such aneurysms, especially with the classical neurosurgical techniques, flow-diverter deployment is a feasible and effective technique also in the acute phase with good long-term functional and angiographic outcome.
Keywords: FLOW-DIVERTER, BLISTER, SAH

O 250

TREATMENT OF RUPTURED BLISTER-LIKE ANEURYSMS WITH FRED FLOW-DIVERTER: A MULTICENTER EXPERIENCE

M Möhlenbruch[1], M Killer[2] and N Kocer[3]
[1]Department of Neuroradiology, Heidelberg University Hospital, Heidelberg, GERMANY
[2]Department of Neurology/Research Institute of Neurointervention, Paracelsus Medical University, Salzburg, AUSTRIA
[3]Division of Neuroradiology, Istanbul University Cerrahpasa Medical Faculty, Istanbul, TURKEY

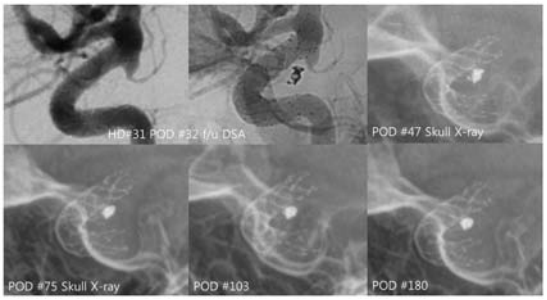
Purpose: Treatment of ruptured blister-like aneurysms (BAs) is challenging. The current literature describing surgical and endovascular interventions in BAs offers no clear consensus on the optimal treatment modality. The aim of this study was to assess the clinical and angiographic features of ruptured BAs treated with the FRED flow-diverter.
Materials and Methods: A retrospective analysis from prospective databases was established at three comprehensive neurointerventional centers to collect data on ruptured BAs treated with FRED during a 7-year period. From this merged database, 33 cases were examined. Relevant data including antiplatelet therapy, technical issues, complications, and imaging findings at follow-up (at least 6-month after treatment) were collected and analyzed.
Results: Thirty-three patients had ruptured BAs with SAH. Clinical and imaging data were available on all cases with a median follow-up at 13 months. Two patients died from the SAH during the acute illness without any sign of rebleeding. There was no other major intraprocedural or symptomatic, delayed morbidity. Twenty-nine aneurysms were occluded. Residual filling of the base of the aneurysm was observed in four cases.
Conclusion: Treatment of ruptured BAs using a FRED flow-diverter is a promising strategy that can be performed with acceptable clinical and good radiological results.
Keywords: Blister, Flow-diverter, SAH

O 251

RECURRED BLOOD BLISTER-LIKE ANEURYSM AFTER TREATMENT: ADDITIONAL TREATMENT AND FOLLOW-UP

JS Byun[1], TK Nam[1] and HH Choi[1]
[1]Chang-Ang University Hospital, seoul, SOUTH KOREA

Purpose: Blood blister-like aneurysms (BBA) arise from non-branching sites on the supraclinoid internal carotid artery (ICA) and are suspected to originate from a dissection. According to recent systematic review, a rescue or second treatment was required in 21% of patients. Our aim is to evaluate characteristics, treatment of BBA and follow-up modality of recurred BBA



Materials and Methods: We treated the 11 cases of ruptured BBA admitted to our center from Aug. 2013 to Feb. 2019. Three of the 11 patients (female, mean age 55.7 years) showed recurrence (27.3%) within 3 weeks after 1st treatment. We retrospectively reviewed additional treatment method after initial stent assisted coiling and follow-up modality.
Results: One of the recurred patients showed poor outcome, who additionally treated by endovascular ICA occlusion because of rebleeding. Two patients were additionally treated by multiple stent assisted coiling and showed good outcome (modified Rankin Scale Score < 2 at six months). One of the two patients showed the location and morphology changes of the coil mass according to resolution of thrombus between stent and coil mass after final treatment on follow up skull X-ray.
Conclusion: In case of BBA, close follow up is mandatory even though BBA was successfully treated by stent assisted coiling because of high recurrence rate. The location and morphology of coil mass could be changed by blood filling or thrombus formation in the neck of BBA that can be differentiated by DSA. During follow up, skull X-ray could be useful modality to detect the location and morphology change of the coil mass caused by thrombus formation or resolution.
Keywords: blood blister-like aneurysm, recurred aneurysm, follow up

O 252

STENT-ASSISTED COIL EMBOLIZATION FOR RUPTURED INTRACRANIAL DISSECTING ANEURYSMS: A INITIAL AND FOLLOW-UP RESULTS

T Higashi[1], H Fukumoto[2], A Horio[2], K Fukuda[2], M Iwaasa[2], K Nii[1] and T Inoue[2]
[1]Fukuoka University Chikushi Hospital, Chikushino, JAPAN
[2]Fukuoka University Hospital, Fukuoka, JAPAN

Purpose: Recently, stenting or stent-assist coiling is a possible treatment option for intracranial dissecting aneurysm, when sparing the parent vessel patency is necessary. However, antiplatelet or anticoagulation therapy makes it difficult to apply this treatment for ruptured intracranial dissection. We reviewed our experiences and studied the appropriate timing, the anti-thrombotic treatment, and the follow-up results.
Materials and Methods: We reviewed angiographic images and prospectively collected database. Among recent 224 subarachnoid hemorrhage patients who received the surgical intervention, 46 cases were due to ruptured dissecting aneurysms. Eight cases were treated with stent-assisted coil embolization.
Results: Average age was 51.9 years (38–65 years, 3 females and 5 males). The anatomical locations were 3 basilar trunk, 2 vertebral and 2 internal carotid arteries. Average aneurysm size at the dilated part was 6.5 mm (3.5–8.3 mm). Initial five cases were treated at subacute phase (average 15.2 days), and one case (5th case) was treated when the aneurysm was re-ruptured. Other three cases were treated at acute phase (average 1.0 day). Anti-coagulation treatment was performed during endovascular treatment in every case. Anti-platelet treatment was started before embolization in 5 cases and during embolization in 2 cases. There was no rupture after the treatment. During follow-up periods (average 1097 days), average mRS was 0.8 (0-2). Two cases were re-treated (coil embolization or additional stent).
Conclusion: Reconstructive stent-assisted coil embolization for a ruptured dissecting aneurysm is useful when sparing the parent vessel patency is necessary. Appropriate timing and antithrombotic therapy are necessary for successful treatment.
Keywords: dissecting aneurysm, subarachnoid hemorrhage, stent-assisted embolization

O 253

STENT-ASSISTED COIL EMBOLIZATION OF RUPTURED VERY SMALL ANEURYSMS: A SINGLE CENTER EXPERIENCE

EH Ihm[1], YY Seo[2], HK Lee[3], HJ Woo[4] and YM Han[5]
[1]Andong Hospital, Andong, SOUTH KOREA
[2]Inje University Sanggye Paik Hospital, Seoul, SOUTH KOREA
[3]Andong Hospital, Andong, SOUTH KOREA
[4]Andong Hospital, Andong, SOUTH KOREA
[5]Andong Hospital, Andong, SOUTH KOREA

Purpose: To evaluate the safety and efficacy of stent-assisted coil embolization of ruptured very small (< 4 mm) aneurysms and risk factors for periprocedural complications.
Materials and Methods: Data from patients with ruptured intracranial saccular aneurysms less than 4 mm treated with stent assisted coil embolization in the period between October 2009 and October 2018 were retrospectively assessed. Factors influencing procedural complications and angiographic and clinical outcomes were analyzed.
Results: Forty-six consecutive patients with ruptured intracranial very small saccular aneurysms were included in the analysis. Coil embolization and stent deployment were carried out difficulty in all cases. Immediate complete occlusion (34 cases) and occlusion with the residual neck (11 cases) was achieved in almost cases (97.8%). Periprocedural hemorrhagic complications were stated in 3 patients (6.5%, intraprocedural rupture, affected site asymptomatic ICH, remote site asymptomatic ICH, respectively). Thromboembolic complications were observed in 6 patients (13.0% in-stent-stenosis in 4, silent infarct in 2 patients). However, those were not affected the clinical outcome. At follow-up five patients were deceased. With the exception of eight patients who died of pneumonia, MI (Myocardial Infarction), ARDS (Acute Respiratory Distress Syndrome), septic shock, other aneurysm rupture, no clinical evidence of neurologic deterioration with hemorrhagic and thromboembolic complication was seen during the follow-up period of 37.6 months in remaining patients. Among them, 25 patients (75.8%) had a independent in day-to-day activities with a mRS < 3. Follow-up angiography for 6 to 73 months (mean, 20.5 months) was available in 33 patients, and no aneurysm recanalization was found.
Conclusion: Stent-assisted coil embolization of very small ruptured aneurysms were feasible and effective with low complication rates and achieved good immediate aneurysm occlusion. Stent-assisted coil embolization significantly lowered the recurrence rate without additional risks.
Keywords: Stent-assisted coil embolizati, Very small intracranial aneury, ruptured

O 254

ANGIOGRAPHIC FOLLOW-UP FOR SMALL RUPTURED INTRACRANIAL ANEURYSM TREATED BY ENDOVASCULAR TREATMENT: FOLLOW-UP PLAN AND LONG TERM FOLLOW-UP RESULTS

JH Ko[1] and YJ Kim[1]
[1]Department of Neurosurgery, College of Medicine, Dankook University, Cheonan, SOUTH KOREA

Purpose: Although endovascular treatment for intracranial aneurysms is considered effective and safe, its durability is still debated because of the risks of rebleeding and recanalization. Also, few studies have described angiographic follow-up plan after endovascular treatment of intracranial aneurysm, especially in ruptured cases. Hence, we report the long term results of follow-up catheter selected angiography.
Materials and Methods: Radiological records of 639 cases of coil embolization treated for a ruptured aneurysm of anterior circulation from March 2003 to December 2016 were retrospectively reviewed. Patients within 20 to 80 years old who received endovascular treatment of a saccular aneurysm less than 7 mm resulted with near complete occlusion (Raymond class I and II) were included to this study. Among them, 238 patients who had received more than one follow-up catheter selected angiography were enrolled. The first angiographic follow-up was conducted at 3 to 6 months postoperatively according to clinical outcome and immediate angiographic results. The next one was performed at 12 months later depending on angiographic results of the first follow-up. The third one was performed at 12 to 24 months later depending on results of the second follow-up. According to our protocol, we classified 4 periods of angiographic follow-up as followed; follow-up within post-treatment 1 year (first period), from 1 to 2 years (second period), 2 to 5 years (3rd period) and over 5 years.
Results: We could identified 14 cases of recurrence which required retreatment, from 218 aneurysms from follow-up angiography in first period. Among 143 aneurysms from second period, 5 cases of recurrence were identified. There were no recurrence in 97 cases who received angiography in third period. Also, there were no recurrences in 28 cases received angiography over 5 years. Moreover, in 6 case of follow-up over 10 year, there were no recurrence.
Conclusion: We suggest that at least 2 to 3 times of DSA within post-treatment 4 year may be necessary for follow-up. If angiographic result is favorable at post-treatment 3 years, long-term angiographic result is favorable.
Keywords: Angiographic follow-up, intracranial aneurysm, endovascular treatment

O 255

INCIDENCE OF INTRA-PROCEDURAL COMPLICATIONS IN RELATION TO TIMING OF ENDOVASCULAR TREATMENT IN RUPTURED INTRACRANIAL ANEURYSMS

C Gaudino[1], F Biraschi[2], L Caschera[1], A Paolucci[1], FM Triulzi[1,3], A Bozzi[4], V Conte[5], V Da Ros[4] and SE Navone[6]
[1]Department of Diagnostic and Interventional Neuroradiology, Fondazione IRCCS Ca Granda Ospedale Maggiore Policlinico, Milan, ITALY
[2]Department of Diagnostic and Interventional Neuroradiology, Policlinico Umberto I, Rome, ITALY
[3]Università degli Studi di Milano, Milan, ITALY
[4]Department of Diagnostic and Interventional Radiology, Policlinico Tor Vergata, Rome, ITALY
[5]Department of Neurological Intesive Care Unit, Fondazione IRCCS Ca Granda Ospedale Maggiore Policlinico, Milan, ITALY
[6]Department of Neurosurgery, Fondazione IRCCS Ca Granda Ospedale Maggiore Policlinico, Milan, ITALY

Purpose: The American Heart Association (AHA) recommends treatment of patient with ruptured intracranial aneurysms as early as feasible to reduce the rate of rebleeding, but without specifying the occurrence of procedure-related complications. The aim of this study was to analyze the incidence of intra-procedural complications related to time between endovascular treatment and subarachnoid hemorrhage (SAH).
Materials and Methods: We retrospectively analyzed all patients who underwent endovascular treatment for ruptured intracranial aneurysms at the Fondazione IRCCS Ca' Granda Ospedale Maggiore Policlinico of Milan, Policlinico Umberto I of Rome and Policlinico Tor Vergata of Rome from June 2015 to December 2018. For all patients imaging and clinical data were analyzed using Fisher and Hunt & Hess scale at admission and modified Rankin score (mRS) at discharge. Aneurysm's type, mean dimension and different treatment techniques were analyzed. Intra-procedural complications were defined as thrombus formation at the aneurysm's neck, thromboembolic events and rupture of the aneurysm. Patients were divided into three groups according to time between SAH and treatment ($<$12 h hyper-early, 12–36 h early, $>$36 h delayed). Chi square test and logistic regression were used to perform statistical analysis in global population and within the different groups.
Results: We analyzed 220 patients (pts) (59 ± 13 years, 144/76 = M/F) with 221 ruptured intracranial aneurysms. 84 patients (38%) underwent hyper-early, 103 patients (47%) early and 33 patients (15%) delayed endovascular treatment. The patient demographics and neurological conditions on admission among groups showed no statistical significance. In 12 patients (5.4%) pretreatment rebleeding were observed (6 pts in the hyper-early, 4 pts in the early and 2 pts in the delayed group). The patients treated after 36 h showed a significant higher rate of total intra-procedural complications (48%) compared to both, hyper-early

(29%) and early (26%) group ($p < 0.05$). Delayed treatment was associated with an increased risk of complications (OR 2.65; 95% CI 1.244-5.648, $p = 0.012$). In delayed treatment particularly a higher rate of thrombus formation and thromboembolic events was observed (36% versus 23%; $p < 0.05$).
Conclusion: Hyper-early and early endovascular treatment in ruptured intracranial aneurysms seems to be safer in terms of intra-procedural complications. In patients treated more than 36 h after SAH particular care should be made to reduce with medications the risk of thrombus formation and thromboembolic events during the procedure.
Keywords: Subarachnoid hemorrhage, Ruptured aneurysms, Intra-procedural complications

SESSION X: Aneurysms Ruptured/Vasospasm

O 256

COMPLICATIONS IN STENT-ASSISTED EMBOLIZATION FOR RUPTURED CEREBRAL ANEURYSMS IN THE ACUTE PERIOD: A RETROSPECTIVE REVIEW

G Wong[1], S Yu[1], J Zhuang[1] and S Wong[1]
[1]The Chinese University of Hong Kong, Hong Kong, HONG KONG

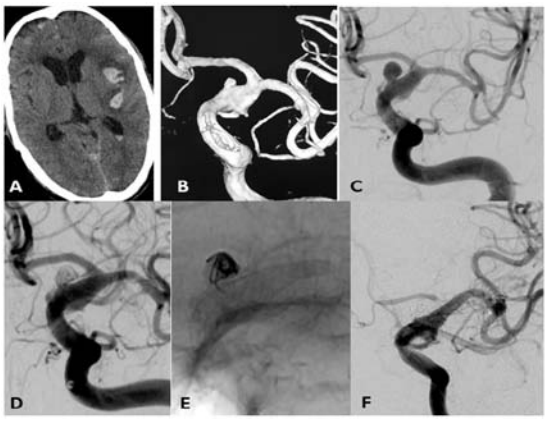
Purpose: The purpose of this study was to report the authors' experiences in stenting for ruptured cerebral aneurysms in the acute period and to evaluate the hemorrhagic and ischemic complications and risk factors.
Materials and Methods: Between January 2013 and October 2018, fifty-four patients had stenting with or without coiling for treatment of acutely ruptured cerebral aneurysms that were not amendable to coiling alone. Hospital notes were retrospectively reviewed. All patients had a dose of intravenous abciximab 10 mg and heparin 2000 unit before stenting and dual antiplatelet loading and daily treatment started after procedure.
Results: Of the 54 patients, twenty-nine (54%) had braided stents, nine (17%) had laser-cut stents, and 16(30%) had flow diverters. Thirty-seven (69%) had also coiling and 17(31%) had stenting alone. There was 2(4%) rebleed in two patients with braided stent and partial embolization resulting in mortality. There were three (6%) procedure-related cerebral infarction. There were 3(6%) significant intraventricular hemorrhage and intracerebral hemorrhage.
Conclusion: In patients undergoing stenting for acutely ruptured cerebral aneurysms, partial embolization and ICP catheter insertion were risk factors for complications and mortality. Procedure-related infarction rate was 6%. Stenting could be considered as an alternative treatment strategy for acutely ruptured cerebral aneurysms not amendable to coiling alone.
Keywords: Stent, Subarachnoid Hemorrhage, Stroke

O 257

FLOW DIVERTER IN THE TREATMENT OF RUPTURED INTRACRANIAL ANEURYSMS – A SINGLE CENTER EXPERIENCE

A Mahajan[1], G Goel[1], V Banga[1], A Chatterjee[1], KS Narang[2], VP Singh[2] and H Sapra[3]
[1]Department of Neurointervention Surgery, Medanta The Medicity, Gurgaon, INDIA
[2]Department of Neurosurgery, Medanta The Medicity, Gurgaon, INDIA
[3]Department of Neuroanaesthesia, Medanta The Medicity, Gurgaon, INDIA

Purpose: The aim of this study was to evaluate the safety and technical feasibility of flow diverter in acutely ruptured aneurysm.



Materials and Methods: We retrospectively reviewed patients having subarachnoid hemorrhage who were treated by FD placement at our hospital between May 2014 and June 2018. Detail analysis of medical records were done to obtain patient age, gender, clinical history, Hunt-Hess grade, Fischer grade, results of radiographic and procedural details including technical success and complication, clinical outcome and follow up angiographic results.
Results: Our search identified 42 patients with 42 aneurysms who were treated with flow diverter out of which 38 (90%) aneurysms were in the anterior circulation and 4 (9.5%) aneurysms in the posterior circulation. Only one FD was used in each patient with size ranging from 3×20mm to 4.5×21mm. 36 (86%) patients achieved favorable clinical outcome (mRS 0–1) at 3 months. There were 4 mortality due to rerupture of aneurysm, EVD related complication (meningitis), poor grade SAH and one due to underlying invasive CNS fungal infection. Angiographic follow up results were assessed by O'Kelly-Marotta grading scale in 38 surviving patients and showed Grade D result (no filling) in 35 aneurysms at 3 and 6 months.
Conclusion: FD can be safely and effectively utilized for the treatment of ruptured intracranial aneurysm which are difficult to treat by conventional clipping and coiling, however larger and comparative studies with long term follow up are needed to confirm our findings.

Keywords: Aneurysm, Subarachnoid hemorrhage, Flow diverter

O 258

FLOW DIVERSION OF CHALLENGING RUPTURED INTRACRANIAL ANEURYSMS WITH ASPIRIN MONOTHERAPY

J Wenderoth[1], N Manning[1,2,3] and A Cheung[1,2,3]
[1]Prince of Wales Hospital, Sydney, AUSTRALIA
[2]Liverpool Hospital, Sydney, AUSTRALIA
[3]University of New South Wales, Sydney, AUSTRALIA

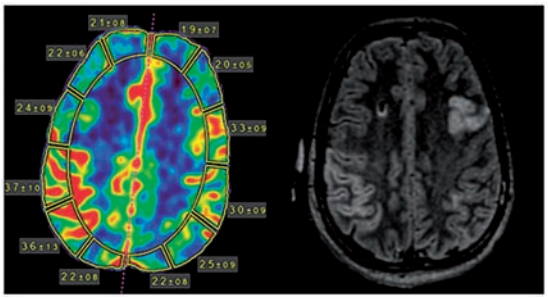
Purpose: Some ruptured aneurysms are difficult or unsuitable for treatment with either open or conventional endovascular strategies. Recent developments in flow diverter technology (Pipeline with Shield technology – PED-Shield) have created the possibility to treat these aneurysms with flow diverters using a single antiplatelet agent. This paper is a review of our experience to date with this technique, including the evolution of our periprocedural management, leading to the development of a prospective single arm clinical trial to examine the effectiveness of the technique.
Materials and Methods: At the time of writing,19 patients have been treated with PED-Shield and aspirin monotherapy. Patients were assessed by the neurointerventionist and open vascular neurosurgeon, and a decision reached that no safe strategy for conventional repair was available. All patients received at least one flow diverting stent and aspirin as their sole antiplatelet agent. Clinical and imaging follow up will be presented.
Results: Two haemorrhagic and two ischaemic complications occurred, of which three were symptomatic. There was one early stent occlusion. As practice has evolved, we have avoided preiprocedural heparin, and have had no further haemorrhagic complications. Since we have adopted a twice daily aspirin dosing regimen, there have been no further stent occlusions or ischaemic events.
Conclusion: Early experience with flow diversion and aspirin monotherapy has produced encouraging results in these challenging aneurysms. As a consequence, ethics approval has been sought and granted to conduct a prospective single arm clinical trial to investigate this technique further.
Keywords: Blister aneurysm, Flow diversion, Aspirin

O 259

IS EPILEPSY A POSSIBLE ISSUE FOR THE USE OF INTRA-ARTERIAL VASODILATATORS IN SAH-INDUCED VASOSPASM?

L Nico[1], J Ognard[1], R Leimassi[1], S Saib[1] and J Gentric[1]
[1]Chru Brest, Brest, FRANCE

Purpose: Convulsive seizures occur in between 6% and 26% of patient with aneurismal subarachnoid hemorrhage (aSAH) and nonconvulsive seizures are seen in about 8% to 18%. The risk of seizure is higher in patients with a poor clinical grade (poor neurologic examination and/or thick cisternal blood). This population of patients has also a higher risk of cerebral vasospasm. While complications of percutaneous transluminal angioplasty (PTA) of resistant vasospasm are reported, complications of intra-arterial injection of drugs (chemical angioplasty) are less known. We report our experience in vasospasm treatment using intra-arterial vasodilatator and an unexpected complication: a case of a 59 y.o. woman with aSAH complicated with malignant seizure due to chemical angioplasty that result in severe clinical deterioration and poor outcome. We also discuss the pathophysiological mechanism of this complication and possible implications on indications of chemical angioplasty.
Materials and Methods: We retrospectively reviewed all patients treated in our institution for aSAH during the 4 last years. All imaging and clinical data of patients treated with of intra-arterial nimodipine and milrinone infusion and/or additional PTA were reviewed for research of procedural complication. 44 patients were treated for a total of 68 sessions of endovascular treatment for vasospam. During these 68 sessions we performed 67 chemical angioplasties and 21 PTA. 12/44 (28%) patients also had epilepsy.
Results: During PTA treatment we had 2 procedural complications (1/21, 5%): 1 asyntomatic intracranial arterial dissection. During chemical angioplasty we had 2 procedural complications (2/67, 3%): 1 asyntomatic distal emboli and 1 patient developed complex partial epileptic crisis once begun chemical angioplasty. Perfusion CT and IRM imaging were compatible with a right parietal epileptic focus with progression in neuronal loss and gliosis. The patients developed left hemiplegia, stereotyped movements of right leg and cognitive deterioration with only partial improvement during hospitalization. The patients developed also symptomatic left internal temporal and left insular ischemia.



Conclusion: In our knowledge this complication after chemical angioplasty has not yet been described in the literature. Complication rate of endovascular treatment for aSAH resistant vasospasm is probably low (6% in our series) but dilatory effect and related hyperperfusion of chemical angioplasty could maybe lead to development of malignant epileptic foci. Until further evidence from RCT with regards to chemical angioplasty and its benefit, the presence of

epilepsy should probably be taken into consideration in the choice between PTA and chemical angioplasty.
Keywords: Vasospasm, Complication, Chemical Angioplasty

O 260

BALLOON AND STENT ANGIOPLASTY FOR TREATMENT OF CEREBRAL VASOSPASM IN PATIENTS WITH ANEURYSMAL SUBARACHNOID HAEMORRHAGE – A SINGLE-CENTRE EXPERIENCE

M Banez[1], L Lai[1], R Chandra[1], H Asadi[1], L Slater[1] and W Chong[1]
[1]Monash Imaging, Monash Health, Monash University, Melbourne, AUSTRALIA

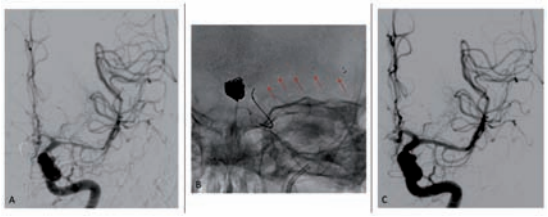
Purpose: Vasospasm is one of the most serious sequelae of subarachnoid haemorrhage from ruptured intracranial aneurysms. Angioplasty, whether using balloons or stents, is one of the recognised treatments for vasospasm, with the aim of producing a more durable result by mechanically dilating the involved vessels.
This study aims to assess the safety and efficacy of balloon and stent angioplasty in our institution.
Materials and Methods: An electronic search of the institutional imaging archive was conducted for patients who had undergone endovascular vasospasm treatment. Digital subtraction angiography (DSA) images were assessed for severity of vasospasm, according to the following grading scale: none, mild (<50% reduction in vessel diameter), moderate (50%–75% reduction), and severe (>75% reduction). Pre and post-angioplasty vessel diameters were compared. Durability of the angioplasty was assessed on the basis of whether or not there was recurrence of vasospasm in the treated vessel. Any complications in the treatments were likewise noted.
Results: From July 2015 to December 2018, 17 patients had undergone balloon or stent angioplasty for vasospasm secondary to SAH. 14 of these received treatment to multiple vessels, for a total of 60 vessels treated. Fifty (83.3%) of the vessels were treated with balloon angioplasty, with the remaining ten (16.7%) treated with stentplasty. Overall, 54% of vessels treated with balloon angioplasty and 60% of those treated with stentplasty had recurrent vasospasm for which further treatment was done. There was one complication out of the 17 patients in which rupture of the A1 segment of the anterior cerebral artery occurred during balloon angioplasty. This yielded a complication rate of 5.9% for all patients, 1.6% for all angioplasties, and 2% for balloon angioplasties.
Conclusion: Results vary in terms of the durability of balloon or stent angioplasty, with recurrent vasospasm in 54% of vessels treated with balloon angioplasty and 60% of those treated with stentplasty. Angioplasty appears to be relatively safe, with a 2% complication rate for balloon angioplasty and no reported complication for stentplasty in our patient population.
Keywords: Balloon Angioplasty, Stentplasty, Vasospasm

O 261

MECHANICAL ANGIOPLASTY USING STENTRIEVER FOR DELAYED SYMPTOMATIC VASOSPASM AFTER SUBARACHNOID HEMORRHAGE

G Garignano[1], E Lozupone[1], A Alexandre[1], F D'argento[1], I Valente[1] and A Pedicelli[1]
[1]Fondazione Policlinico Universitario A. Gemelli IRCCS, Rome, ITALY

Purpose: To evaluate the use of Stentriever in the treatment of cerebral vasospasm as a second option after intra-arterial nimodipine administration failure.
Materials and Methods: Three patients developed cerebral vasospasm of the middle cerebral artery after subarachnoid hemorrhage due to an acutely ruptured cerebral aneurysm. Since the vasospasm was non-responsive to local intra-arterial nimodipine administration, we temporarily deployed a stentriever in the stenotic artery to achieve mechanical vasodilation. Stentriever deployment was technically feasible in all cases. We experienced a successful and stable resolution of the vasospasm in all patients and good clinical outcome was demonstrated at discharge.



Results: -
Conclusion: Mechanical angioplasty with stentriever could be a feasible option for the treatment of subarachnoid hemorrhage-induced vasospasm.
Keywords: Stentriever, Cerebral vasospasm, Mechanical angioplasty

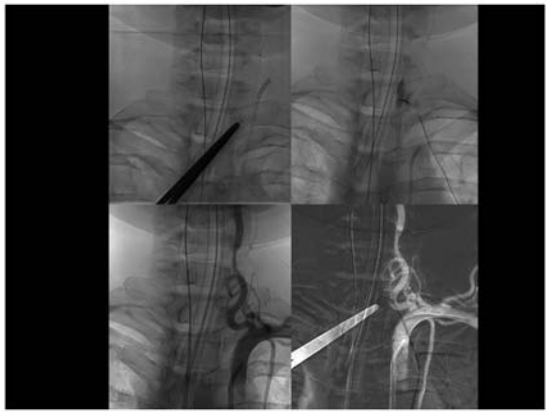
O 262

STELLATE GANGLION BLOCK UNDER VASCULAR ROAD-MAP CONTROL AND INTRA-ARTERIAL TREATMENT. A ''ONE-STOP SHOP'' FOR CEREBRAL VASOSPASM AFTER SUBARACHNOID HEMORRHAGE

M Pileggi[1], M Isalberti[1], P Merlani[2], M Reinert[3], P Mosimann[4] and A Cianfoni[1]
[1]Neurocenter, Regional Hospital of Lugano – Department of Neuroradiology, Lugano, SWITZERLAND
[2]Regional Hospital of Lugano – Intensive Care Unit, Lugano, SWITZERLAND
[3]Neurocenter, Regional Hospital of Lugano – Department of

Neurosurgery, Lugano, SWITZERLAND
[4]Neurocenter, Inselspital University Hospital – Department of Neuroradiology, Bern, SWITZERLAND

Purpose: Cerebral vasospasm (CV) is a frequent cause of morbidity and mortality following aneurysmal subarachnoid hemorrhage (aSAH). ''Triple-H'' therapy and endovascular interventions represent the mainstays of modern treatment of CV; nevertheless some CV cases remain a serious clinical challenge. Stellate ganglion block (SGB) has been proposed as adjuvant treatment for refractory CV, with the aim to improve brain perfusion reducing the sympathetic vascular tone of cerebral vessels. We describe a fluoroscopy-guided SGB technique that allows to avoid feared vascular complications, such as dissection or embolization, by performing SGB during a diagnostic or interventional angiography in the setting of CV, with the aid of a vascular ''road-map'' to have control of the supra-aortic neck vessels. We report feasibility and safety of the procedure, based on retrospective review of 9 consecutive cases.



Materials and Methods: Retrospective review of clinical and procedural charts of 9 consecutive patients with severe refractory CV after aSAH, treated at our institution between January 2016 and April 2019, with unilateral or bilateral SGB, aided by supra-aortic arteries road-map control, during a cerebral angiography. Patient underwent cerebral angiography for diagnostic purposes and/or to be treated with a variable combination of intra-arterial infusion of vasodilators and balloon angioplasty. A detailed description of the technique is provided. Representative illustrative cases are described.
Results: 9 SGB procedures were performed in 9 patients (3 M, 6 F, age range: 37–66, mean 49.7). SGB was performed bilaterally in 6 cases, unilaterally in 3 cases. SGB was associated to intra-arterial CV treatment (intra-arterial infusion of nimodipine and/or balloon angioplasty) in 8 cases, while it was performed as a stand-alone treatment in one case due to hemodynamic instability. Technical success in performance of SGB was achieved in all patients. In all the procedures an optimal visualization of both common carotid and vertebral arteries was obtained in the same ''road-map'' image and was used as a reference during the needle insertion for SGB. No major or minor complications related to the SGB were encountered.
Conclusion: Adjuvant SGB for the treatment of CV can be performed in a single session in the angio suite during diagnostic angiography and/or endovascular treatment, with increased safety, due to the use of vascular road-map of the supra-aortic arteries. This makes the angio suite a ''one-stop shop'' for diagnosis and comprehensive treatment of CV. More evidence is needed to demonstrate SGB clinical efficacy in CV following aSAH.
Keywords: Vasospasm, Stellate ganglion, Angiography

SESSION Y: Miscellaneous

O 263

OUR FIRST EXPERIENCE OF SIMULTANEOUS ENDOVASCULAR EMBOLIZATION OF PROXIMAL FLOW – RELATED ANEURYSM AND ARTERIOVENOUS MALFORMATION OF THE BRAIN WITH LIQUID EMBOLIC AGENT

A Sufianov[1], S Karasev[1], R Khafizov[1] and R Sufianov[2]
[1]Federal Center of Neurosurgery, Tyumen, RUSSIA
[2]First Moscow State Medical University named after I.M. Sechenov Ministry of Health of the Russian Federation, Moscow, RUSSIA

Purpose: To evaluate the result of embolization of a proximal flow – related aneurysm and arteriovenous malformation with a liquid embolic agent.
Materials and Methods: In our clinical case, patient V. is represented., Male, 41 years old. Diagnosis: Anomaly of cerebral vessels. Arteriovenous malformation (AVM) in the right fronto-parietal region (Spetzler-Martin 4) with proximal flow – related aneurysm of the anterior cerebral artery (ACA). Symptomatic epilepsy. In order to determine the tactics of treatment, CT scan – angiography with cerebral vascular perfusion and selective cerebral angiography were performed. An arteriovenous malformation of the fronto-parietal region (Spetzler-Martin 4) was detected with proximal flow – related aneurysm of the anterior cerebral artery measuring $11.5 \times 7.0 \times 6.0$ mm with a neck size 5.0 mm. Considering the nature of the AVM and the presence of the proximal flow – related aneurysm, we made a decision about simultaneous embolization of the AVM and the proximal flow – related aneurysm with a liquid embolic agent PHIL 25% (MicroVention). At the first stage, we performed the embolization of AVM with three doses of liquid embolic agent PHIL 25% (MicroVention). The second stage was a superselective angiography of ACA, in order to assess the vascular bed in the area of the aneurysm neck. Considering the presence of normal vessels in the neck of the aneurysm, we decided to embolize the liquid embolicn agent PHIL 25% (MicroVention) at low blood pressure. The microcatheter is wound up in the cavity of the anerism, positioned in the area of the dome. Blood pressure is reduced to 80/60 mmHg, embolization is performed. On the control angiography, the complete disconnection of the AVM and aneurysm is

determined. Microcatheter removed without technical difficulties. Endovascular instrumentation extracted. Hemostasis, bleeding.
Results: On the second day, a CT scan was performed, the AVM and aneurysm from cerebral blood flow were completely turned off. The early postoperative period was uneventful. Neurological status of the patient without features. Was discharged in good condition on the 3rd day after the intervention.
Conclusion: The clinical case showed the efficacy and safety of using low-viscosity liquid embolic agents, not only for embolization of AVMs, but also for the proximal flow – related aneurysm. In our opinion, the use of a liquid embolic agent for embolization of the proximal flow – related aneurysm is justified only in cases where the aneurysm is localized on the AVM terminal afferents, and there is no high risk of distal embolism by the liquid embolic agent.
Keywords: proximal flow related aneurysm, arteriovenous malformation, liquid embolic agent

O 264

MANAGEMENT OF ANEURYSM ASSOCIATED WITH MOYAMOYA DISEASE: A CASE SERIES OF 5 PATIENTS WITH LITERATURE REVIEW

NUH Maria[1]
[1]Punjab Institute of Neuroscinces, Lahore, PAKISTAN

Purpose: To evaluate the management patients with aneurysms associated with Moyamoya Disease.
Materials and Methods: Retrospective review was conducted on 6 patients who presnted at Punjab Institute of Neurosciences/Lahore General Hospital, Lahore. Total 5 patients (n = 5) with aneurysms associated with Moyamoya disease were identified and reviewed. They were admitted with subarachnoid hemorrhage and definitive diagnosis of Moyamoya disease with associated aneurysm was made on cerebral angiography. Age range was 18–45, female predominance (n = 3, 60%), males n = 2 (33.3%), anterior communicating artery aneurysms n = 2 (40%), bifurcation of ICA and AchA n = 1 (20%), posterior communicating n = 1 (20) and paraclinoidal artery aneurysm n = 1 (20%). Hunt-Hess score was 3 in n = 4 (80%) cases and was 4 in n = 1 case with anterior communicating artery aneurysm. Surgical clipping with STA-MCA anastomosis was performed in one patient n = 1 with anterior communicating artery aneurysm while the other one had only clipping performed and he died on 2nd postoperative days, endovascular coiling was performed for the rest of the patients n = 3. Since the incidence of the disease is lower and aneurysms are associated in only 3–14% of patients with Moyamoya disease, thorough literature review was done and the cases were discussed with the endovascular neurointerventionists. The results were matched with case reports and case series available in literature and also with data available from other hospitals.
Results: Patients who underwent endovascular coiling had a better outcome as compared to the surgically treated group. Surgery is challenging in the case of Moyamoya disease. Many surgeons do not have enough experience to perform surgeried in cases with Moyamoya disease, many do not have experience of STA-MCA anastomsis as well. The risk of vasoconstriction is high after surgical manipulations and there can be disruption of the established collateral circulation during surgery.2 patients (both with anterior communicating artery aneurysm) were surgically treated,1 had a good recovery while the other died. Those patients who were treated with endovascular coiling made a remarkable recovery.
Conclusion: From our study we conclude that endovascular coiling is a safe and better option for patients having aneurysm associated with Moyamoya disease.
Keywords: Moyamoya, Aneurysm, Coiling vs clipping

O 265

INVESTIGATION OF LATE GRANULOMA-LIKE CHANGES AFTER ENDOVASCULAR TREATMENT; SUMMARY OF 9 CASES IN AICHI PREFECTURE

M Nishihori[1], **T Izumi**[1], **T Tsukada**[1], **R Oshima**[1], **K Otawa**[1], **T Kawaguchi**[1], **S Goto**[1], **M Ikezawa**[1], **A Kropp**[1] and **T Wakabayashi**[1]
[1]Nagoya University Graduated School of Medicine, Nagoya, JAPAN

Purpose: Since the introduction of coated microcatheters for neuro-endovascular procedures, there have been reports of delayed granuloma-like changes, especially after coil embolization. It seems to be caused by a delayed allergy (type IV allergy) to the hydrophilic polymer coating of the microcatheters. As the indication and the number of endovascular treatments is continuously increasing, investigating this matter is important. The authors have summarized and analyzed similar cases which occurred in Aichi Prefecture, Japan.
Materials and Methods: Clinical information and image information were collected by electronic medical records and questionnaires on 9 similar cases reported from 7 facilities in Aichi Prefecture in the past 10 years.
Results: 7 cases were female, with an average age of 62 (44–79). All cases were aneurysm coil embolization with one stent-assisted coiling, and in all cases two or more microcatheters were used. Four cases (44%) had symptomatic onsets such as seizures and paresis. After approximately 1 month of treatment (median; 1 to 74), abnormalities were observed in the perfusion region of the treated blood vessel in all cases. In addition, MRI findings were relatively similar: T1WI-Gd-enhanced image showed multiple nodule-like changes with central enhancement while DWI was negative, T1WI low, and T2WI high. Brain biopsy was performed in 3 cases, but only non-specific inflammatory cells were detected without a foreign body. There were no metal

allergies identified before surgery, and a test was performed in 3 cases after treatment with 2 positive findings (1 cobalt and 1 zinc per case). Steroids therapy was initiated in 6 cases, and image findings improved drastically in 5 of them. In one these cases, follow up coil embolization was performed without recurrence of this condition with subsequent steroid administration. As for the 3 asymptomatic cases without steroid therapy, new small similar abnormal lesions in other locations were detected during follow-up although the old abnormal image findings were gradually improving.

Conclusion: Delayed granuloma-like changes after neuroendovascular treatment are rare and likely to occur around 1 month after coil embolization. It is important to recognize this pathological condition as a differential diagnosis. It can be regarded as inflammatory changes that can be improved with steroids.

Keywords: hydrophilic polymer coating, granuloma-like changes, coil embolization

O 266

CONGENITAL SEGMENTAL DOLICHOECTASIA IN ADULT MIMICKING ANEURYSM: A BRIEF REVIEW WITH ILLUSTRATING A CASE SERIES

S Derakhshani[1], A Moussa[1], N Chan[1] and S Abdulla[1]
[1]Queen's University Hospital, Greater London, UNITED KINGDOM

Purpose: To illustrate cases with Intracranial arterial dolichoectasia (IADE) mimicking aneyrysms, their underlining pathology and discuss requirement for any endovascular treatment.

Materials and Methods: Intracranial arterial dolichoectasia (IADE) is a form of dilative arteriopathy, the pathophysiology of which is largely unknown. We present three cases of IADE, two involving the internal carotid artery and one involving the posterior cerebral artery. The pattern of disease in each case can be explained with reference to the underlying embryology, and serve to illustrate specific stages in the development of the cerebral arteries. These cases represent a developmental subtype of IADE not previously described. The clinical findings and subsequent follow up collectively support a conservative management approach to this condition.

Results: All cases withIntracranial arterial dolichoectasia (IADE) were mimicking aneurysms in their initial imaging. No endovascular treatment were offered. Patients were followed up consertiveley.

Conclusion: Several recent papers have exposed the lack of understanding of this vascular phenomenon. IADE appears to represent a group of diseases with a common pathological denominator, namely involvement of the tunica media. This case series raises the possibility of a further developmental aetiology, with no known genetic syndromic association. It also reinforces the management strategy currently espoused by other authors, that IADE is best managed conservatively. The condition does not warrant an endovascular treatment.

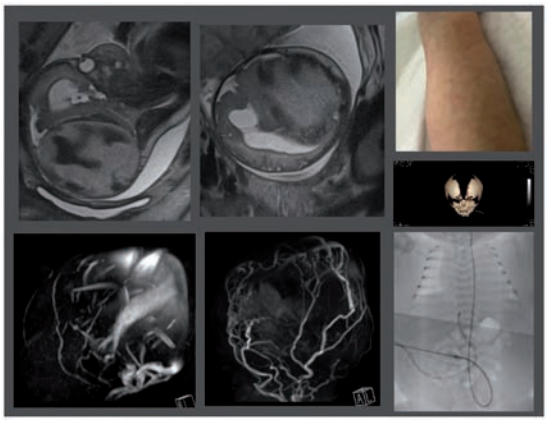
Keywords: dolichoectasia, Congenital dolichoectasia, mimicking aneurysm

O 267

CAPILLARY MALFORMATION/ARTERIOVENOUS MALFORMATION (CM/AVM)

Y Iizuka[1], Y Tsutsumi[2] and A Berenstein[3]
[1]Kashiwatanaka Hospital, Kashiwa, JAPAN
[2]National Center for Child and Development, Tokyo, JAPAN
[3]Health System, New York, USA

Purpose: CM-AVM is an autosomal dominant syndrome of cutaneous capillary malformations (CM) with arteriovenous malformations (AVM), fistulas (AVF), median prosencephalic choroidal AVFs, or Klippel-Trenaunay-Weber syndrome (KTWS), congenital dural AVFs, and segmental cervical AVFs. We review six cases managed by the neurovascular team.



Materials and Methods: Six cases were identified by a retrospective chart and database review of our patients over a ten-year period. All had features of CM- AVM.

Results: Mean age at presentation was 6.4 years (range 0 ~ 24). Presentations were subarahnoid hemorrhage, focal neurological deficit, convulsion, and cardiac failure. Two patients had brain cortical AVFs, one had median prosencephalic choroidal AVFs, one had congenital DAVFs, segmental cervical AVFs, and one had spinal perimedullary AVFs. All patients were treated with endovascular transarterial embolization with NBCA, coils and plugs. Mean follow up was eight years and three months. All patients were alive except one case at last follow up.

Conclusion: This case series demonstrates the varied nature and presentation of RASA1-related CNS AVM and AVFs. The presence of hallmark cutaneous CM lends itself to potential early disease recognition, screening and timely endovascular intervention of associated asymptomatic, but high risk CNS fast-flow AV shunts.

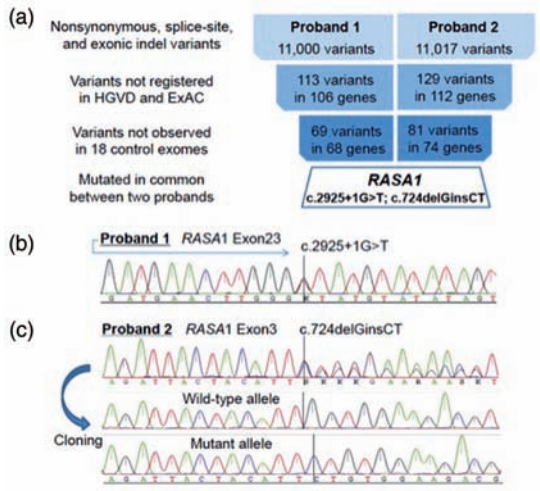
Keywords: Pediatrics, CMAVM, AVFs

O 268

NOVEL RASA1 MUTATIONS IN JAPANESE PEDIGREES WITH CAPILLARY MALFORMATION-ARTERIOVENOUS MALFORMATION

Y Moteki[1], H Akagawa[1], Y Niimi[2], Y Okada[2] and T Kawamata[1]
[1]Tokyo Women's Medical University, Tokyo, JAPAN
[2]St. Luke's International Hospital, Tokyo, JAPAN

Purpose: Capillary malformation-arteriovenous malformation (CM-AVM, MIM#608354) is a rare autosomal dominant disorder characterized by multiple cutaneous capillary malformations co-occurring with fast-flow vascular anomalies, such as arteriovenous malformation or fistula. Despite the identification of RASA1 as the first causative gene in Western patients with CM-AVM, there have been no literature reports of Japanese patients with this gene mutation. Herein, we report its genetic background in Japanese patients.
Materials and Methods: Subjects were two Japanese pedigrees harboring multiple affected members with CM-AVM, whose two probands were treated in our hospital. The whole exome sequencing was performed for two probands and common dysfunctional genes were exhaustively detected. Then, for confirming that the detected variants were disease causative, co-segregation of the variants with disease and non-existence of variants in general populations were checked.
Results: Whole-exome sequencing in the two probands identified novel heterozygous mutations in RASA1, which were co-segregated with the disease in each family and were not reported in large-scale sequencing databases. One was a frameshift mutation and the other a splice-site mutation causing aberrant splicing, confirmed by a minigene assay. There were no other genes commonly disrupted among these probands.



Conclusion: RASA1 was a major causative gene even in Japanese patients with CM-AVM, although obvious locus heterogeneity was known for this disease.
Keywords: CM-AVM, RASA1, Japanese pedigree

O 269

ENDOVASCULAR TREATMENT OF DURAL ARTERIOVENOUS FISTULAS OF THE ANTERIOR CONDYLAR VEIN

R. H. Dahl[1,2], A. Biondi[3], F. Di Caterino[3], G. Vitale[3] and G. Benndorf[1,4]
[1]Department of Radiology, University Hospital Rigshospitalet, Copenhagen, DENMARK
[2]Department of Neurology, Aalborg University Hospital, Aalborg, DENMARK
[3]Department of Interventional Neuroradiology, Besançon University Hospital, Besançon, FRANCE
[4]Department of Radiology, Baylor Collegeof Medicine, Houston, TX, USA

Purpose: Dural arteriovenous fistulas (DAVF) of the anterior condylar canal (ACC) involve the venous plexus of the hypoglossal canal. These fistulas constitute 3-4% of all intracranial DAVFs and often present with bruit or hypoglossal nerve palsy. The venous plexus, often denoted the anterior condylar vein (ACV), surrounds the hypoglossal nerve and neuromeningeal branch of the ascending pharyngeal artery (APA). Transarterial embolization of ACV fistulas with injection of liquid embolic agents carry a risk of cranial nerve palsies and potential non-target embolization into the territory of the carotid or vertebral arteries through anastomoses. We report 2 cases of DAVFs involving the ACV in which transvenous coil embolization was technically possible and resulted in complete occlusion of the AV shunting with no recurrence.
Materials and Methods: Case 1: 76-old man presented with numbness of his left tongue and a bruit on the same side. MRI with MR angiography suggested a small AV shunting lesion adjacent to the right jugular bulb. Digital subtraction angiography (DSA) revealed a small DAVF involving the right ACC that was enlarged by a venous pouch. Transvenous embolization using a triaxial system was performed. The fistula was retrogradely approached through a narrow stenotic segment and coils were deployed into 2 small pouches as well as some of the contralateral feeders arising from the APA. Overpacking of the pouch was intentionally avoided. The patient's recovery was uneventful and he reported complete resolution of his symptoms over a period of 6 months. Case 2: A 61-year-old female presented with severe disabling bruit. DSA images revealed a DAVF involving the ACV with drainage into the suboccipital sinus (SOS). Transvenous catherization was performed through a tortuous cervical venous plexus using and coils were deployed into the initial portion of the ACV until the AV shunting disappeared. The patient recovered completely for her symptoms (severe disabling bruit)
Conclusion: Dural arteriovenous fistulas involving the ACV are exceedingly rare lesions that may present with bruit or isolated hypoglossal nerve palsy. Endovascular management is the preferred treatment choice and can be successfully performed using transarterial or transvenous methods. A thorough understanding of the complex venous anatomy

of the region is essential if the standard transjugular approach fails. The use of coils is effective and safe, in particular when overpacking is avoided minimizing the risk of CN palsy.

SESSION Z: Aneurysms Imaging & Follow-Up

O 270

VICTORIA – VIRTUAL NECK CURVE AND TRUE OSTIUM RECONSTRUCTION OF INTRACRANIAL ANEURYSMS

S Voß[1], S Saalfeld[1], O Beuing[2] and P Berg[1]
[1]Research Campus STIMULATE – University of Magdeburg, Magdeburg, GERMANY
[2]Institute of Neuroradiology – University Hospital Magdeburg, Magdeburg, GERMANY

Purpose: The assessment of intracranial aneurysm (IA) rupture risk highly depends on morphological as well as hemodynamic parameters that are calculated based on the aneurysm sac [1]. Furthermore, therapy planning requires a detailed knowledge of the individual aneurysm neck size to select an appropriate treatment strategy and device, respectively [2]. With advancing imaging modalities, three-dimensional representations of IAs are increasingly used. However, it has been reported that the separation between parent vessel and aneurysm sac strongly varies between involved research groups. Hence, this might lead to insufficient analyses and in consequence to unreliable conclusions.
Materials and Methods: Therefore, the study ''VIrtual neck Curve and True Ostium Reconstruction of Intracranial Aneurysms (VICTORIA)'' aims on a standardization of IA neck curve and ostium reconstructions based on automatized algorithms. To improve existing techniques [3], expert-knowledge from experienced physicians and biomedical engineers is desired. Within this online study, which is carried out by well-known scientific aneurysm challenge organizers [4,5], participants will be requested to identify the neck curve and ostium of several aneurysm models.
Results: VICTORIA is ongoing and will be active until the congress. Afterwards, the outcome of this international comparison will be presented in an oral talk of a related aneurysm session. Furthermore, based on the local feedback as well as critical discussions with the audience, a consensus document will be generated to summarize the findings.
Conclusion: The integration of world-wide expert knowledge regarding aneurysm necks and ostia will strongly improve the quality and consistency of morphological metrics. This will support the implementation of automated and standardized tools for routine procedures like IA volume calculation. In addition, future aneurysm research would profit from increased objectivity among different groups. Hence, a consensus on appropriate aneurysm/parent vessel separation is beneficial for physicians as well as biomedical engineers.
Keywords: aneurysm neck, aneurysm ostium, international study

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O 271

GROWTH RATES OF INTRACRANIAL ANEURYSMS UNDERGOING SURVEILLANCE IMAGING. A SINGLE CENTRE STUDY DEFINING PATIENT AND ANEURYSM-RELATED RISK FACTORS, GROWTH CHRONOLOGY AND PATIENT OUTCOMES

J Siddiqui[1], P Grover[2], D Dasgupta[2], O Sluijters[3], N Oskooee[3], P Cowley[1] and A Toma[2]
[1]Lisholme Department of Neuroradiology, National Hospital for Neurology and Neurosurgery, Queen Square, London, UNITED KINGDOM
[2]Department of Neurosurgery, National Hospital for Neurology and Neurosurgery, Queen Square, London, UNITED KINGDOM
[3]UCL Medical School, Gower Street, London, UNITED KINGDOM

Purpose: Following the publication of the International Study on Unruptured Intracranial Aneurysms (ISUIA), monitoring of low risk intracranial aneurysms with serial imaging has become commonplace in neurosurgical centres. Since this, few large-scale studies on aneurysmal growth have been published. This retrospective analysis aims to assess a large cohort of unruptured intracranial aneurysms for aneurysmal growth, assess timelines of growth and to identify patient and aneurysmal factors that may be associated with growth.
Materials and Methods: A retrospective analysis of our departmental imaging database was performed from 2012 to 2018, searching for all patients undergoing CTA or MRA imaging for aneurysm surveillance. From radiology reports and clinical records, patient demographic information such as age, sex and ethnicity and aneurysm factors such as morphology and size on serial imaging were recorded. Patients with mycotic or traumatic pseudoaneurysms were excluded. Numbers that had either continued surveillance or treatment were also recorded. Incidence of subsequent subarachnoid haemorrhage was also documented. Where imaging was available, imaging of growing aneurysms was re-analysed by a subspeciality neurovascular radiologist, in particular aneurysmal size and morphology.

Results: A total of 1018 patients were available for analysis over the time period and within these 1076 number of aneurysms. Following analysis of serial imaging reports, 46 unruptured aneurysms were seen to have grown (4.3%). The majority of these aneurysms (87%) were sited in the anterior circulation. Imaging frequency usually occurred between six months and two years, the majority MRA. Further analyses of aneurysm morphology and haemorrhage rates will be conducted.
Conclusion: The preliminary results of this large single centre series of patients under surveillance of unruptured aneurysms demonstrated a small proportion of patients showing aneurysmal growth, lower than the reported rates in the literature of 14–18%. Further details of patient and aneurysm growth risk factors in this cohort will be discussed following analysis. Factors associated with subsequent haemorrhage and poor clinical outcome will also be presented.
Keywords: Aneurysm, Subarachnoid haemorrhage, Surveillance

O 272

IS CTA WITH METALLIC ARTIFACT REDUCTION TECHNIQUE TO BE FOLLOW UP STUDY AFTER COIL EMBOLIZATION OF THE ANEURYSM?

MH Rho[1] and J Kim[1]
[1]Department of Radiology, Kangbuk Samsung Hospital, Sungkyunkwan University School of Medicine, Seoul, SOUTH KOREA

Purpose: Follow up study after coil embolization is transfemoral cerebral angiography or MRA. The aim of our study was that CT angiography using metallic artifact reduction technique (MAR) can be an alternative method of follow-up study after coil embolization.
Materials and Methods: Thirty two aneurysms in 30 patients who underwent CTA using MAR after aneurysmal coiling, were evaluated. Class 1 (Modified Raymond–Roy Occlusion Classification) embolization was achieved in 31 aneurysms. Two radiologists evaluated coil mass change, recanalization, visualization of the parent artery, stenting site, degree of artifact. After coiling, angiographic follow-up varied from 7 days to 150 months (mean, 49 months).
Results: Exact shape of coil mass was not visualized in all aneurysms due to blooming artifact, but overall shape and outline of the coil mass was clearly defined by contrast adjustment. The relationship between coil mass and parent artery was relatively well defined in 26 aneurysms (81%). In 6 ones, parent artery near the coil mass was not visible due to artifact and location. The coil loop protrusion in parent artery was seen as part of the coil mass in 3, and a linear coil extension into the parent artery was noted in 2. Stenting site was clearly visible in 6 stent assisted coiling, and 2 Atlas stent markings had more blooming artifact than 4 Enterprise stent markings. Two coiling after partial clipping could be evaluate without clip artifact.
Conclusion: Although mild metallic artifact is seen around coils, CTA using MAR could be an alternative follow-up study for major recanalization that need retreatment.
Keywords: CTA, Follow-up study, coil embolization

O 273

IMAGE QUALITY AND RADIATION DOSE OF VOLUME OF INTEREST IMAGING COMBINED WITH METAL ARTIFACT REDUCTION RECONSTRUCTION TECHNIQUE IN FOLLOW-UP AFTER TREATMENT OF INTRACRANIAL ANEURYSM

B Kim[1], D Cho[2], H Bae[1], J Choi[1], Y Shin[1], N Shin[1], J Jang[1], Y Choi[1], S Jung[1] and K Ahn[1]
[1]Seoul St. Mary's Hospital, Seoul, SOUTH KOREA
[2]Ewha University Seoul Hospital, Seoul, SOUTH KOREA

Purpose: Volume of interest imaging combined with metal artifact reduction reconstruction (VOI + MAR) technique is a novel technique for reduction of both radiation dose and metallic artifact. We performed this study to evaluate the diagnostic value of this technique in follow-up of intracranial aneurysm after the endovascular and surgical treatment.
Materials and Methods: Thirty-two patients were imaged with VOI + MAR on follow-up after endovascular ($n = 24$) and surgical ($n = 9$) treatment of 33 intracranial aneurysms. Image quality and radiation dose of VOI + MAR were compared with low-dose 5 s 3D DSA and 10 s DynaCT which are our routine protocol for posttreatment follow-up.
Results: Quantitative evaluation results demonstrated that VOI + MAR effectively reduces metallic artifact. Image quality of multiplanar reconstruction images of VOI + MAR in the evaluation of aneurysm and parent vessels were better than those of 10 s DynaCT and comparable to those of low-dose 3D rotational DSA. VOI + MAR showed lowest radiation dose to patients calculated by dose-area-product among the three protocols.
Conclusion: In the posttreatment follow-up of intracranial aneurysm, VOI + MAR is effective in reduction of metallic artifact with lower radiaton dose compared to both full volume DynaCT and low-dose 3D rotational DSA,
Keywords: Flat panel CT, Radiation dose, Metalic artifact reduction

O 274

REDUCED RADIATION DOSE WITH VOLUME-OF-INTEREST CONE-BEAM CT COMBINED WITH METAL ARTIFACT REDUCTION IN FLOW DIVERTER PLACEMENT OF CEREBRAL ANEURYSM

K Sugiu[1], M Hiramatsu[1], T Hishikawa[1], N Kidani[1], Y Takahashi[1], S Murai[1], K Nishi[1], Y Yamaoka[1] and I Date[1]
[1]Okayama University Graduate School of Medicine, Department of Neurological Surgery, Okayama, JAPAN

Purpose: A new Volume-of-Interest (VOI) reconstruction algorithm was developed for low dose acquisition of cone-beam CT (CBCT) images. The purposes of this study are to evaluate image quality of VOI CBCT in comparison with conventional CBCT, and to confirm the feasibility of VOI reconstruction combined with Metal Artifact Reduction (MAR) in cases of cerebral aneurysms treated with flow diverter.
Materials and Methods: Ten patients who received both conventional CBCT and VOI CBCT acquisition with intra-arterial injection of 20% contrast medium were included in this study. We constructed maximum intensity projection (MIP) and slab MIP images of both acquisitions. Image quality was independently evaluated in each case using a five-point scale by two experienced physicians. They rated the overall image quality, as well as detailed image quality measures of stent struts visibility, stent apposition to the vessel, parent artery, branch of parent artery, and aneurysm. The reduction of equivalent radiation dose was assessed with five fluorescence glass dosimeters placed around each eye position on a head phantom. Patients who received coil embolization in addition to flow diverter placement were invited to image quality evaluation to confirm the feasibility of VOI/MAR combination.
Results: Both standard CBCT and VOI CBCT images were successfully obtained from all patients. The median overall image quality score of VOI CBCT showed no significant difference compared with that of conventional CBCT ($p > 0.05$). For the detailed image quality measures, there were no significant differences between the ratings for VOI CBCT and conventional CBCT. The equivalent radiation dose for eye lens by conventional CBCT (22.49 mSv) was significantly reduced by VOI CBCT (0.97 mSv, $p < 0.05$). The streak artifact around coil mass was certainly reduced after VOI/MAR combined reconstruction. However, artifacts still remained around adjacent area among coil, parent artery and flow diverter stent. The visibility of stent struts and stent apposition to the vessel weren't clearly improved.
Conclusion: The VOI CBCT software reduced radiation dose with comparable image quality to conventional CBCT, and the combination of VOI/MAR was feasible in cases of cerebral aneurysms treated with flow diverter. Further improvement is expected to visualize flow diverter stents close to large coil mass.
Keywords: Digital subtraction angiograph, Cone-beam CT, Flow diverter stent

O 275

ACUTE INTERACTIONS AND HEALING PROCESS AFTER FLOW DIVERTER IMPLANTATION.-FIRST IN HUMANŚ ANALYSIS USING OPTICAL COHERENCE TOMOGRAPHY (OCT) IMAGING

B Pabon[1], C Diaz[1], J Mejia[1], O Vargas[1], M Patiño[1], J Gutierrez[1] and N Serna[1]
[1]Angioteam / Clinica del Norte /Clinica Las Americas/ Universidad de Antioquia, Medellin, COLOMBIA

Purpose: Flow diverters are used for the treatment of complex wide-neck intracranial aneurysms. Devices commercially available aims to improve its thrombogenic profile in acute settings and improve healing rates based on design modifications. Incomplete wall apposition has been described as a potential factor for delayed effect of FD́s technology. However, subjects regarding healing process remain unsolved and multiple details are unknown. Optical coherence tomography (OCT) is an intravascular imaging test with high resolution which identifies acute thrombus occurrence and neointimal growth over stents. We evaluated two different kind of flow diverters: Pipeline™ Flex Embolization Device with Shield Technology™ (Pipeline Shield), and Flow Re-direction Endoluminal Device (FRED; MicroVention, Tustin, California, USA). implanted on intracranial vessels using OCT.
Materials and Methods: In this study we evaluated four devices (two PED́s – two FRED́s) in four patients. Serial carotid and vertebral angiographic and OCT images were obtained on days 0 (immediately after implantation) and six weeks later. The data analyzed included: acute thrombus formation, wall apposition, neck coverage, proximal and distal FD ends, neointimal area (lumen area – stent area), neointimal ratio ([lumen area – stent area]/stent area), and the neointimal thickness ratio (minimum neointimal thickness/maximum neointimal thickness).
Results: There was no significant difference in the acute phase. None differences in acute thrombus formation between mono or dual layer devices. After six weeks we identified more neointima formation and more homogeneous healing in PED shield in comparison with dual layer device. Additional index and healing indicators are well described.
Conclusion: In this experience we report novel OCT assessment of FD́s in living human subject. Under the described technique, OCT imaging of the intracranial vasculature is potentially safe, and suitable. OCT assessment of PED and FRED demonstrated accurate strut wall apposition and concentric neointimal growth after 6 weeks follow up. The added value of OCT, its indications and role remain to be extended in further studies and preferably using OCT technology specifically designed to navigate intracranial vasculature.
Keywords: Optical Coherence Tomography, Healing, Flow Diverter

O 276

SKULL BASE BONE REOSSIFICATION AFTER ENDOVASCULAR TREATMENT OF CAROTID SIPHON ANEURYSMS RESPONSIBLE FOR BONE-ERODING MASS EFFECT
AN INDIRECT SIGN OF EFFECTIVE TREATMENT

Christina Iosif[1,2], Fortunato Di Caterino[1], Giovanni Vitale[1], Nathalie Chartier[1] and Alessandra Biondi[1]
[1]Department of Interventional Neuroradiology, Jean Minjoz University Hospital, Besancon, FRANCE
[2]School of Medicine, European University of Cyprus, Nicosia, CYPRUS

Purpose: Carotid siphon aneurysms may be responsible for bone erosion of the skull base, often involving the sphenoid sinus. Cataclysmic epistaxis is a rare but often dramatic complication of this type of aneurysms. The work presented herein aimed at studying the evolution of aneurysm-related bone erosion after treatment of carotid siphon aneurysms by endovascular means.
Materials and methods: Consecutive patients harboring bone-eroding carotid siphon aneurysms, which were treated by endovascular means from a single operator during 10 years (January 2005 to September 2015), were included in the study. The patients underwent CT controls at 3-6 months and at one year post intervention. Reossification was evaluated independently by two senior Neuroradiologists and was correlated to the angiographic controls.
Results: Two hundred forty carotid siphon aneurysms were treated during ten consecutive years. Fifty six patients, 46 women and 10 men (mean age: $53 \pm 14{,}1$ y-o), harboring 57 aneurysms (3 small, 39 larges and 15 giant, mean diameter: 19.9 mm) responsible for skull base bone erosion were included in the study. All aneurysms were treatd by endovascular means [13 parent artery occlusion (PAO), 22 flow diverting stent deployment (FDS) and 22 treated by coils +/- stent +/-remodelling]. Forty eight patients (49 aneurysms) had imaging controls including CT scan with bone windowing. At 3-6 months, 35/49 aneurysms (71.4%) were excluded from the circulation and 14 (28.6 %) had still residual filling. One reossification was found among the twenty nine [29/35 (82.8%)] totally occluded aneurysms. At one-year follow up 38/49 (77.5%) aneurysms were occluded, all of them associated with reossification. Bone erosion was found to persist in 10 cases with still circulating aneurysms. One large aneurysm still circulating and still associated with bone erosion was retreated before the control at one year. Reossification was never observed in cases of aneurysms not completely occluded in this study. Reossification was observed in all patients after total aneurysm occlusion, regardless of the technique used. Nevertheless, PAO and FDS were more effective in obtaining total aneurysm occlusion and reossification
Conclusion: Carotid siphon aneurysms, especially large and giant ones, can be in the root of a bone erosion of the skull base. Reossification has been observed after endovascular treatment, in cases of complete aneurysm occlusion without recanalization.

SESSION ω: Miscellaneous

O 277

ENDOVASCULAR MANAGEMENT OF LIFE THREATENING EPISTAXIS SECONDARY TO CAVERNOUS INTERNAL CAROTID ARTERY (ICA) INJURY– AN INSTITUTIONAL EXPERIENCE

N Jain[1], L Sebastian[2], M Gupta[3], J Nadarajah[4] and S Gaikwad[5]
[1]Artemis Hospital, Gurugram, INDIA
[2]All India Institute of Medical Sciences, New Delhi, INDIA
[3]All India Institute of Medical Sciences, New Delhi, INDIA
[4]All India Institute of Medical Sciences, New Delhi, INDIA
[5]All India Institute of Medical Sciences, New Delhi, INDIA

Purpose: Craniofacial trauma or mishaps during trans-sphenoidal surgeries, can injure Internal carotid artery (ICA) – particularly its cavernous segment – leading to life threatening epistaxis. Rarely it can also be spontaneous secondary to rupture of giant, dissecting or mycotic cavernous ICA aneurysms. Surgical management of them is often cumbersome and difficult, whereas endovascular methods can offer better solutions. Here, we share our experience in the endovascular management of these difficult conditions.
Materials and Methods: We retrospectively analysed 17 patients who presented to our Institution, with severe and recurrent epistaxis, during 2011 to December 2017. Clinical and imaging records were analysed for demographics, clinical presentation, angiographic features, treatment instituted and follow up.
Results: All the 17 patients were male, with mean age of 33.7 yrs (18-60 yrs). Twelve patients developed epistaxis post-trauma, 3 patients post – skull base surgery and 2 patients had spontaneous epistaxis. Nine patients (50 %) had associated carotico-cavernous fistula (CCF). Fifteen patients were managed with endovascular modes of treatment, while two patients underwent surgery. Out of 15 patients in the endovascular group, 6 were managed with coiling of the pseudoaneurysm with parent vessel preservation, 5 with detachable balloons, 3 patients with parent vessel sacrifice, and one with trans-venous coiling. Both patients who underwent surgery had trapping of the psuedoaneurysm with additional ECA-MCA bypass in one patient. All the 17 patients had a minimum follow up of 3 months, with all of them showing complete resolution of symptoms. One of the patient treated with detachable balloon showed asymptomatic recurrence, which was treated with stent assisted coiling.
Conclusion: Cavernous ICA involvement as the cause of epistaxis, can be effectively by endovascular means. The mainstay of endovascular mode of treatment is either coiling or use of detachable balloons, latter being commonly used when CCF is associated.
Keywords: Epistaxis, carotico cavernous fistula, ICA aneurysm

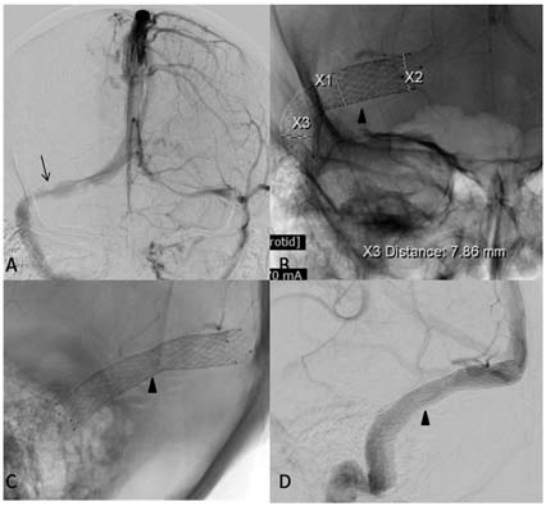
O 278

VENOUS STENTING IN IDIOPATHIC INTRACRANIAL HYPERTENSION

R Seshadri[1], AK Gupta[1] and HR Arvinda[1]
[1]Jss Medical College & Hospital, Mysuru, INDIA

Purpose: Idiopathic intracranial hypertension (IIH) has been called for long as idiopathic and benign. With advancement of knowledge it is neither idiopathic nor benign. It has been discovered to be primarily due to cerebral venous hypertension due to an occult stenosis of venous outflow from the

brain resulting in reduced CSF drainage into the venous system. The study attempts to show the dramatic effects of venous sinus stenting to reduce the venous hypertension in alleviating the intracranial hypertension.



Materials and Methods: This is a retrospective study of all the cases of IIH due to venous stenosis, refractory to medical management, and having a pressure gradient across the venous stenosis of more than 10 mm of Hg and were treated by endovascular stenting of the stenosis. The exclusion criteria included cases of increased intracranial tension in which the pressure gradient across the venous stenosis was less than 10 mm of Hg.
Results: All the 7 patients were females (15 to 40 years); BMI ranged from 29 to 37, with a mean of 32.5. Presenting complaints were blurring of vision (7); headache (4); vomiting (2); neck pain (1), tinnitus (2), diplopia (4) and bilateral ptosis (1). Papilledema was present in all patients. The opening pressure of CSF ranged from 100 to 400 mm of water. The mean pressure gradient across the venous stenosis was 26 mm of Hg(range – 15 to 33 mm of Hg). Unilateral endovenous self-expandable stents were placed in all 7 patients. All patients had dramatic improvement in venous pressure gradients immediately post-stenting. All the patients had significant improvement of their symptoms and papilledema in the immediate post-operative period. The follow-up ranged from 3 months to 3 years. At longest follow-up, stented patients had no recurrence of their symptoms and no papilledema. In one patient there was stenosis (endothelial hyperplasia) of the transverse sinus proximal to the stent without clinical detrioration and pressure gradient across being only 9 mm of Hg. Hence no further angioplasty or stenting was performed. Wilcoxan signed rank test showed significant reduction in the venous pressure gradient from pre-stenting to post-stenting status ($p = 0.028$).
Conclusion: Venous stenting should be primary modality of treatment in IIH due to venous sinus stenosis refractory to medical management. IIH should be aptly named Intracranial Hypertension due to Venous stenosis (IHVS).
Keywords: Iih, Venous Stenting, Venous Stenosis

O 279

ENDOVASCULAR TREATMENT OF IDIOPATHIC INTRACRANIAL HYPERTENSION: ANALYSIS OF EPIDEMIOLOGIC PROFILE AND IMMEDIATE OUTCOME OF 7 PATIENTS

LJ Haas[1], BR Sabel[2], J Martins[2], GV Staedele[2], WR Bertinelli[2], M Becker[2], MC Harger[2], CB Lima[2], FJ Cobra[2], MD Soares[2], LCO Camilo[2], VD De Almeida[2], CGJL Brasileiro[2], JD Hessmann[2], LM Silva[2], VHT Boer[1], D De Lara[1], CIC Bernardes[1], FL Cabal[1], A De Oliveira Junior[1], B Sartori[1], D Malacarne[1] and LRGO Mello[1]
[1]Hospital Santa Isabel, Blumenau, BRAZIL
[2]University Of Blumenau – Furb, Blumenau, BRAZIL

Purpose: Idiopathic Intracranial Hypertension (IIH) is a condition characterized by high levels of intracranial pressure with no established etiology. This disorder is more associated with obesity and females in reproductive age. The incidence worldwide in the risk groups is 12–20 cases per 100.000 people per year, and 0,5-2 cases per 100.000 people in the general population. Patients can present symptoms of intracranial hypertension such as headaches, visual loss, pulsatile tinnitus, among others. It is common the presence of venous sinus stenosis. The purpose is evaluate the epidemiologic profile and the immediate outcome of patients diagnosed with IHH that underwent endovascular treatment (ET) in a Neurosurgery reference hospital.
Materials and Methods: This was a retrospective observational study of 7 cases of IHH. The data was obtained from medical records of patients who underwent ET from July, 2015 to December, 2018. The variables analyzed were sex, age, symptoms, comorbidities, stenosis level and characteristics of the procedure.
Results: 7 medical records of 7 patients who underwent ET were analyzed. The average age was 40,42 years (27-67). The predominant sex was the female, with 7 women (85%) and only 1 man (15%). The right side was the most commonly affected, in 6 patients (85%) and only 1 patient was affected on the left side. Dizziness and headache were present in 85% of the patients. There weren't cases of stroke. The patients didn't have history of high cholesterol, hypertension, diabetes, heart disease or smoking. 42% of the patients ($n = 2$) presented stenosis of 95% of the transverse-sigmoid sinus, followed by stenosis of 90% in 42,8% of the patients ($n = 2$) and 99% in 14,4% of the patients ($n = 1$). The femoral access was made in 100% of the cases. There weren't cases of death during the procedure.
Conclusion: The data found were similar to those in the literature. The procedures were performed safely and showed excellent results. The outcomes suggests that endovascular treatment for IHH could be an effective solution for this condition.
Keywords: Intracranial Hypertension, Venous Stenosis, Endovascular Treatment

O 280

ENDOVASCULAR INTERVENTION FOR RECURRENT CHRONIC SUBDURAL HAEMATOMA

D Le Feuvre[1] and A Taylor[1]
[1]Groote Schuur Hospital/University of Cape Town, Cape Town, SOUTH AFRICA
[2]Groote Schuur Hospital/University of Cape Town, Cape Town, SOUTH AFRICA

Purpose: The incidence of recurrence of chronic subdural haematmas is quoted to be as high as 33%. This has led to multiple studies looking at various aspects of surgical management to decrease this incidence.
As the pathophysiology of chronic subdural haematomas has been better understood treatment modalities have evolved. Knowing that inflammation plays intricate role and that the middle meningeal artery (MMA) is the vessel responsible for mediating this inflammatory response has given us a new mode of treatment-namely embolisation of the MMA.
Materials and Methods: Since 2011 we have had 5 patients with recurrence of chronic subdural we chose to embolise. One patient had a bilateral CSDH. The most number of surgical procedures because of recurrence was 5 before embolization and in only one patient was the embolisation done at the first recurrence.
Results: Under GA patients were embolised using PVA 150–250 microns or coils. (NBCA/liquid embolic agent or gelfoam can also be used). In 2 of the patients PVA particles were used and in 4 patients coils were used to occlude the MMA. In those patient in which coils were used we were unable to get the micro catheter into a position where we were sure we would not get particles into the petrosal or meaning-lacimal variant. None of the patients required redrainage of their chronic subdurals. We found no difference which embolisation material was used.
Conclusion: Our series is small but in agreement with the published literature. Embolisation of the MMA is very effective in preventing chronic subdural recurrence. We are in the process of doing a randomised study to decide whether this should be standard of treatment.
Keywords: chronic subdural haematoma, recurrence, embolisation

O 281

POST-SURGICAL PROPHYLACTIC EMBOLIZATION OF CHRONIC SUB-DURAL HEMATOMAS IN PATIENTS WITH HIGH RECURRENCE RISK: A MONOCENTRIC STUDY

E Shotar[1], B Mathon[1], S Lenck[1], L Meyblum[1], V Degos[1], K Premat[1], N Sourour[1], AL Boch[1], A Carpentier[1] and F Clarençon[1]
[1]Pitié-Salpêtrière HospitalHospital, Paris, FRANCE

Purpose: The gold standard treatment for chronic subdural hematomas (cSDHs) is the surgical evacuation through a burr hole. Recurrence after such surgical procedure may occur in 10 to 20% of the cases. Embolization through the middle meningeal artery (MMA) is a promising technique for the treatment of cSDHs. The purpose of our study was to evaluate the feasibility, safety and effectiveness, in terms of recurrence reduction, of post-surgical embolization of cSDH in patients with a high risk of recurrence.
Materials and Methods: Monocentric retrospective study performed on prospectively collected data at the Pitié-Salpêtrière Hospital. From March 2018 to February 2019, embolizations with calibrated microparticles through the MMA were performed in patients surgically treated for a cSDH with a high risk of recurrence, defined as follows: 1) previous recurrence of cSDH or 2) antiplatelet therapy or 3) full anticoagulation therapy or 4) coagulation disorder or 5) hepathopathy or 6) chronic ethylism. In all patients, a pre-embolization supra-aortic trunks (SATs) CT-angiography was performed to rule out a dumb-bell thrombus on the aortic arch or severe atheroma/tortuosity of the SATs.
Results: Forty-four patients met the inclusion criteria during the inclusion period. Two patients were excluded (one in a prolonged comatose state and another with a chronic renal failure). Two patients refused the embolization procedure. A last patient was excluded due to major atheroma on the SATs. Finally, 39 patients with 43 cSDHs (4 patients had bilateral SDHs) underwent the embolization procedure. Thirty-seven embolization procedures (95%) were performed under local anesthesia. Among the 43 cSDHs, 5 (9%) could not be embolized due to catheterization failure (4 cases) or to the presence of a ''dangerous anastomosis'' (1 case). No complication (either major or minor) was recorded. Only one recurrence (2.6%) requiring a surgical retreatment was recorded during the follow-up period.
Conclusion: Post-surgical embolization through the MMA is a simple and safe procedure, which may reduce the recurrence risk of cSDHs. These preliminary results should be confirmed by randomized controlled trials.
Keywords: Subdural Hematoma, Embolization, Recurrence

O 282

COMPARISON OF SURGICAL VERSUS INTRADISCAL OZONE TREATMENT OF SCIATICA DUE TO LUMBAR DISC HERNIATION

NUH Maria[1], U Rasheed[1] and QU Ain[1]
[1]Punjab Institute of neurosciences, Lahore, PAKISTAN

Purpose: To compare the outcome of surgical versus ozone treatment of sciatica due to lumbar disc herniation.
Materials and Methods: The study was a randomized control trial conducted at departments of neurosurgery and neuroradiology Punjab institute of neurosciences/LGH Lahore for 1 year from January 2017 to January 2018 on a total number of 72 patients who were equally divided into those who underwent surgical treatment and the ones who were treated with

ozone nucleolysis. Outcome assessed using VAS (Visual Analogue Scale). Effect modifiers controlled by stratification of data, post stratification chi square test applied. P value of < 0.05 considered as significant. Cases with motor loss, cauda equine or calcified disc are excluded from ozone nucleolysis.

Results: Satisfactory outcome was observed as $n = 24$ (66.7%) and $n = 13$ (36.1%) for ozone nucleolysis and surgical group respectively. This difference was statistically significant ($p = 0.009$).

Conclusion: Ozone nucleolysis treatment of sciatica due to lumbar disc herniation is the better than surgical treatment in cases of disc herniation without meylopathic signs and symptoms especially in early course of disease. This therapy is especially useful for patients who are either in a younger age group where surgical management would lead to inadvertent surgical exposure and delayed complications due to increased life expectancy as well as in the older age group where surgical risk is high. So, this study considering the fact that ozone nucleolysis treatment is safe and useful option for providing early relief in sciatica due to lumbar disc herniation and this intervention should be considered before surgical options.

Keywords: Ozone therapy, Conservative therapy, Sciatica

O 283

LONG-TERM EVALUATION (>3 YEARS) OF OZONE CHEMONUCLEOLYSIS IN LUMBAR DISC HERNIATION

G Campione[1], M Ezeldin[1], C Princiotta[2], M Dall'olio[2], F De Santis[2], M Celerini[2] and L Cirillo[2]

[1]Alma mater studiorum – UNIBO, Bologna, ITALY
[2]IRCCS Istituto delle Scienze Neurologiche di Bologna, Bologna, ITALY

Purpose: Ozone chemonucleolysis is a well-known minimally-invasive procedure used in the treatment of symptomatic lumbar disc herniation; nonetheless its long-term outcome is poorly described. The aim of this study is to evaluate retrospectively the long-term result of ozone chemonucleolysis on lumbar disc herniation and to evidence eventual parameters that may have impact on the outcome.

Materials and Methods: 90 subjects, aged 42–91, with symptomatic lumbar disc herniation, with an anatomically congruent single or multiple levels herniated nucleus pulposus demonstrated by MRI. All the patients selected were treated at least once with ozone chemonucleolysis between 2013 and 2018 and their outcomes were evaluated with a questionnaire based on Oswestry Low Back Pain Disability Questionnaire before the procedure, 1 month and 6 months after the therapy. A questionnaire was administered by phone call to each subject involved to evaluate long-term clinical outcomes.

Results: Of 90 subjects enrolled, 24 (26,7%) were asymptomatic. Pain characteristics and disability of the recurrences were separately evaluated. According to the phone interviews, pain frequency resulted occasional in 30 patients, frequent in 13 and persistent in 23. Pain intensity was described as mild by 17 of the recurrences, as moderate by 30 and as severe by 19; furthermore, functional improvement appeared to have similar satisfactory outcomes: 36 patients had no functional symptom, 40 described their daily activity as partially limited and 14 as strongly limited. The overall perception of the procedure was also good, with 64 subjects (71,1%) that consider the treatment as effective with high grade of satisfaction. MacNab classification was ultimately used in order to standardize the data collected, evidencing 24 excellent, 41 good and 16 fair outcomes, that were considered as success (90,0%), while the outcome was poor in 9 patients (10,0%).

Conclusion: By the results of the questionnaires, we consider ozone chemonucleolysis a success in terms of clinical outcome and satisfaction. Nonetheless there is no evidence of side effects directly related to medical ozone. For these reasons, ozone chemonucleolysis may be considered as a safe option in the treatment of lumbar disc herniation.

Keywords: Ozone therapy, Lumbosciatica, Disc herniation

POSTER PRESENTATIONS

SESSION: Stroke

P 001

OPTIMISING MECHANICAL THROMBECTOMY WORKFLOW THROUGH INTER-DISCIPLINARY CROSS TRAINING IN NATIONAL NEUROSCIENCE INSTITUTE (NNI)

B Weng Fei[1], H Sook Leng[1], Q Yi Ping[1] and Z Almuthar[1]

[1]National Neuroscience Institute, Singapore, SINGAPORE

Purpose: Demand for mechanical thrombectomy in acute ischemic stroke patients presenting with large vessel occlusions has grown exponentially in the past few years, since the release of major clinical trials proving its effectiveness. These same studies also revealed that quicker treatment favours better clinical outcome. Key to this is reducing delays in existing stroke workflows. Another issue raised by angiosuite nurses and radiographers in endovascular stroke treatment was the high stress levels caused by dealing with multiple stakeholders and handovers in a time-sensitive and safe manner. Angiosuite personnel, interventionalists, anesthetists, neurologists, and other members of the multidisciplinary stroke team, identified pain points and collaboratively worked on a series of measures to streamline the mechanical thrombectomy workflow within NNI's angiosuite.

Materials and Methods: Inter-disciplinary brainstorming sessions were held to identify areas for improvement. Roles and responsibilities were identified, and smaller teams held separate discussions to work on specific areas,

such as anesthetic support, imaging support and handovers. Training plans were drawn up and staff was systematically cross-trained to handle optimised roles. Time from arrival to puncture, pre- and post-workflow changes, was assessed for effectiveness of the measures. Staff also gave feedback pre- and post-training.

Results: Timing data from cases of mechanical thrombectomy done between January 2017 and December 2018 were retrospectively reviewed, and the impact of the new measures on time of arrival to groin puncture was assessed. Time, from patient arrival in the angiosuite to groin puncture, decreased from a median of 75 minutes in 1st quarter 2017 to 53 minutes in 4th quarter 2018. This represented a reduction of 29%. Staff also expressed higher satisfaction and confidence levels in handling their roles after undergoing structured training.

Conclusion: Interprofessional development and cross-training is an essential component in improving the angiosuite workflow for mechanical thrombectomies in acute stroke patients. As endovascular therapy workload increases, optimising workflows become increasingly important, and patients and staff alike can benefit greatly from such initiatives.

Keywords: Mechanical Thrombectomy, Cross Training, Workflow Improvement

P 002

TEMPORAL TRENDS FOR ENDOVASCULAR TREATMENTS IN ACUTE ISCHEMIC STROKE IN ITALY

V Saia[1], G Pracucci[2], P Nencini[2], D Inzitari[2], F Sallustio[3], A Zini[4], R Tassi[5], R Gasparotti[6], S Vallone[7], M Bergui[8], F Causin[9], A Saletti[10], F Zappoli Thyrion[11], M Longo[12], EG Puglielli[13], R Menozzi[14], L Castellan[15], D Toni[16] and S Mangiafico[17]

[1]Santa Corona Hospital, Stroke Unit, Pietra Ligure, ITALY
[2]University of Florence, NEUROFARBA Department, Neuroscience section, Florence, ITALY
[3]UTN Policlinico Tor Vergata, Stroke Unit, Rome, ITALY
[4]IRCCS Istituto di Scienze Neurologiche di Bologna, Maggiore Hospital, Department of Neurology and Stroke Center, Bologna, ITALY
[5]Ospedale S. Maria delle Scotte-University Hospital, Stroke Unit, Siena, ITALY
[6]Interventional Neuroradiology Unit, Spedali Civili, Brescia, ITALY
[7]Interventional Neuroradiology Unit, Nuovo Ospedale Civile S. Agostino-Estense, Modena, ITALY
[8]Interventional Neuroradiology Unit, San Giovanni Bosco Hospital, Torino, ITALY
[9]Interventional Neuroradiology Unit, University Hospital, Padova, ITALY
[10]Interventional Neuroradiology Unit, University Hospital Arcispedale S. Anna, Ferrara, ITALY
[11]Diagnostic and Interventional Neuroradiology, San Matteo Hospital, Pavia, ITALY
[12]Interventonal Neuroradiology Unit, Policlinico G. Martino, Messina, ITALY
[13]Vascular and Interventional Radiology Unit, Ospedale Civile Mazzini, Teramo, ITALY
[14]Interventonal Neuroradiology Unit, University Hospital, Parma, ITALY
[15]Interventonal Neuroradiology Unit, IRCCS San Martino-IST, Genova, ITALY
[16]Stroke Emergency Department Stroke Unit, Department of Human Neurosciences, Sapienza University, Roma, ITALY
[17]Interventonal Neuroradiology Unit, Careggi University Hospital, Firenze, ITALY

Purpose: Selection criteria for endovascular treatment (ET) in acute ischemic stroke (AIS) are rapidly evolving due to the results of recent trials. We aimed to explore the impact of these changes on clinical practice in Italy.

Materials and Methods: The Italian Registry of ET for AIS consecutively collects data of patients treated with ET in 43 comprehensive stroke centres. Efficacy measures are 3-month mRS 0–2, and TICI score 2b-3. Safety measures include symptomatic intracranial haemorrhage (s-ICH), procedural adverse events and death.

Results: From 2011 to 2017, 5559 patients were treated, median age 72 years, 51% male patients. Median baseline NIHSS was 18. TICI 2b-3 was achieved in 75%, and 3-months Mrs 0–2 in 46% of patients. S-ICH and procedural adverse events accounted respectively for 8% and 4%. Death rate was 20%. From 2011 to 2017 patients aged over 80 years increased from 8% to 27%, as well as patients sent from Spoke Centres, from 20% to 37%. Time-based contraindication to intravenous fibrinolysis declined from 22% in 2011 to 14% in 2017. The use of thromboaspiration devices steeply raised from 17% in 2011 to 54% in 2017. A significant decline in time-to-groin puncture from 255 to 216 minutes and time-to-end of procedure from 351 to 290 minutes was observed through years.

Conclusion: Our results highlight changes in real-world management of AIS patients treated with ET in our Country over time.

Keywords: Endovascular treatment, Acute Stroke treatment, Stroke treatment Registry

P 003

ACUTE ISCHAEMIC STROKE TREATMENT AT AORN CARDARELLI, NAPLES. A RETROSPECTIVE ANALYSIS OF THE FIRST 250 PATIENTS

P Candelaresi[1], G Servillo[2], G Alfieri[3], V Andreone[4], W Di Iorio[5], G Maniscalco[6], V Manzo[7], M Napolitano[8], A Ranieri[9], R Renna[10], M Rippa[11], G Ambrosanio[12], G Guarnieri[13], P Vassallo[14], M Benincasa[15], A Iannuzzi[16], R Nasti[17], F Paladino[18], C Florio[19] and M Muto[20]

[1]Neurology And Stroke Unit, Aorn Cardarelli, Napoli, ITALY
[2]1
[3]1
[4]1

[5]1
[6]1
[7]1
[8]1
[9]1
[10]1
[11]1
[12]Neuroradiology And Interventional Neuroradiology, Aorn Cardarelli, Napoli, ITALY
[13]12
[14]12
[15]Emergency Department, Aorn Cardarelli, Napoli, ITALY
[16]15
[17]15
[18]15
[19]1
[20] 12

Purpose: The widespread availability of acute stroke treatments has historically been patchy especially in the South of Italy. Here we present the analysis of the first year of acute ischaemic stroke treatment at AORN Cardarelli Hospital, Naples, Italy.

	2017	2018
Number of treated patients	39(28.2%)	211(45.1%)
IVT	29(74.3%)	116(55%)
Bridgings	2(5.1%)	54(25.6%)
Primary EVT	8(20.5%)	41(19.4%)
Prehospital delay(IQR)	71 min(53-149)	100 min(67-142)
Basal NIHSS(IQR)	14(11-16)	12(7-18)
Door-to-needle time(IQR)	107(88-172)	80(59-111)
Door-to-Groin time(IQR)	191(150-260)	138(117-186)
Discharge NIHSS(IQR)	7(3-14)	3(0-10)
Wake-up/unwitnessed	1(2.5%)	24(11.3%)

	Jan-March	Apr-June	July-Sept	Oct-Dec	
Door-to-needle	117	87	63	78	P<0.05
Door-to-Groin	167	140	126	135	Pns

SICH	15(6%)
Fatal ICH	7(2.8%)
Angioedema	1(0.5%)
Arterial dissection	1(0.9%)
Arterial perforation	1(0.9%)

Materials and Methods: Data regarding the first 250 consecutive patients (female 49.6%) undergone reperfusion treatments since August 2017, to December 2018. We analysed: 1) number and percentage of patients admitted to our ward treated with acute therapies; 2) pre-hospital and in-hospital delays; 3) early outcome defined as the DeltaNIHSS score between admission and discharge; 4) complications. A subgroup analysis demonstrates trends in time.
Results: see image 1. At 90-days follow up, 54.8% patients were independent (mRS 0–2), whereas 30% were dead.
Conclusion: This analysis showed the increase in the number of patients treated with acute reperfusion therapies since August 2017. Accordingly, the in-hospital delays progressively and significantly lowered. Further lowering of in-hospital delays and patients' loss at follow-up are the coming objectives.
Keywords: Thrombolysis, Thrombectomy, In-Hospital Delay

P 004

CURRENT STATUS OF THROMBECTOMY CALL OF ACUTE ISCHEMIC STROKE FOR SINGLE NEUROINTERVENTIONIST IN REGIONAL HOSPITAL

N Matsubara[1] and K Ota[2]
[1]Osaka Medical College, Takatsuki, JAPAN
[2]Anjo Kosei Hospital, Anjo, JAPAN

Purpose: The purpose of this study was to investigate the current status of thrombectomy-call of acute ischemic stroke for neurointerventionist.
Materials and Methods: The authors retrospectively evaluated the patients with thrombectomy-call for neurointerventionist from January to November 2016 in our hospital, where single board-certified neurointerventionist conducts endovascular interventions. Number, frequency and time of thrombectomy-call were analyzed. Matters of patients ineligible for revascularization were analyzed although the neurointerventionist was called.
Results: For 11-month (334-day), the number of calls was 105, which contained 48 in duty hours and 57 in off-duty hours. Neurointerventionist was called once in 3.2-day in total, once in 4.7-day in duty hours, once in 5.7-day in off-duty hours of working day, and once in 6.2-day in holiday. Thrombectomy was performed in 37 cases (35%). Thrombectomy was performed once in 9.1-day and once in 2.8-call. Twenty-four patients presented ischemic stroke with large vessel occlusion although they were determined to be ineligible for thrombectomy because of progression of ischemia in 7, poor clinical condition in 7, or symptom recovery/recanalization in 10. Diagnoses of 42 patients who did not have the indication for thrombectomy were including ischemic stroke without major artery occlusion in 24, intracerebral hemorrhage in 14.
Conclusion: In regional hospital with single neurointerventionist, frequency of thrombectomy-call was once in about 3-day and approximately half of them were occurred in off-duty hours. Thrombectomy was performed once in about 9-day and once in about 3 thrombectomy-calls. Measures should be taken to reduce the burden on neurointerventionists in stroke centers, especially in understaffed institutes.
Keywords: mechanical thrombectomy, thrombectomy call, neurointerventionist

P 005

QUALITY OF REVASCULARISATION AND CLINICAL OUTCOMES OF STROKE PATIENTS ADMITTED DURING OFFICE HOURS VERSUS NIGHT TIME OR WEEKENDS IN ARISE II

T Andersson[1,2], HP Mattle[3], H Bozorgchami[4], M Ribó[5], JL Saver[6] and OO Zaidat[7]
[1]Karolinska University Hospital and Clinical Neuroscience Karolinska Institutet – Department of Neuroradiology, Stockholm, SWEDEN

[2]AZ Groeninge – Department of Medical Imaging, Kortrijk, BELGIUM
[3]Inselspital, University of Bern – Department of Neurology, Bern, SWITZERLAND
[4]Oregon Health & Science University, Portland, USA
[5]Vall d'Hebron University Hospital – Department of Neuroradiology, Barcelona, SPAIN
[6]David Geffen School of Medicine – Department of Neurology, Los Angeles, USA
[7]Mercy St. Vincent Medical Center – Department of Neuroscience, Toledo, USA

Purpose: Patients admitted during night time or weekends may have worse outcomes than patients admitted during regular working hours. We investigated this question for stroke in the ARISE II study.
Materials and Methods: ARISE II (Analysis of Revascularization in Ischemic Stroke with EmboTrap) was a single-arm, prospective, multicenter study to assess the effectiveness of the EmboTrap device for endovascular treatment of stroke caused by large vessel occlusion. Complete dataset for this analysis was available for 214 of 227 patients in the study. 97 patients were admitted during regular working hours to the treating hospital (8am–5pm) and 117 patients during non-office hours, weekends (Saturday and Sunday) or holidays.
Results: Mean age (66.1 vs 69.6 years, $p = 0.06$) and stroke severity (NIHSS 16.1 vs 15.7, $p = 0.45$) were similar among the two groups treated during office vs non-office hours. Time from admission to groin puncture was shorter during office hours (1 hr vs 1.2 hrs, $p = 0.007$). Revascularisation was the same in both groups, i.e. mTICI 2c-3 after first pass was 38% vs 42% ($p = 0.58$), mTICI 3 after first pass 28% vs32% ($p = 0.55$), mTICI 2c-3 after 3 passes 64% vs 60% ($p = 0.58$), mTICI 3 after 3 passes 45% vs 44% ($p = 0.80$), final mTICI 2c-3 72% vs 79% ($p = 0.27$) and final TICI 3 was 52% vs 51% ($p = 0.97$). Clinical outcome assessed as mRS 0–1 was 50% vs 53% ($p = 0.72$) and mRS 0–2 was 65% vs 70% ($p = 0.42$).
Conclusion: Time from admission to groin puncture was shorter in patients treated during office hours compared to treatment during non-office hours, however, time of treatment had no effect on quality of reperfusion or clinical outcomes in ARISE II.
Keywords: mechanical thrombectomy, time, clinical outcome

P 006

RAPID DOOR TO PUNCTURE TIME CAN INCREASE THE RATE OF FAVORABLE OUTCOME AND DECREASE THE UNFAVORABLE OUTCOME AFTER ENDOVASCULAR THROMBECTOMY

J Aoki[1], K Kentaro[1], S Numao[1], A Kutsuna[1], T Katano[1], T Kanamaru[1] and K Kimura[1]
[1]Nippon Medical School, Tokyo, JAPAN

Purpose: Onset to reperfusion time is one of the determinants of favorable outcome after endovascular thrombectomy (EVT). Recent progress in comprehensive stroke center has decreased the door-to-groin puncture time (DGPT). In this retrospective analysis, we studied the impact of shortening the DGPT on clinical outcome among patients treated using EVT.
Materials and Methods: From our prospective stroke registry, data on EVT patients between 2011 and 2018 were retrospectively reviewed. Only patients with National Institutes of Health Stroke Scale (NIHSS) sore more than 8 and diffusion weighted image-Alberta Stroke Programme Early CT score (DWI-ASPECTS) more than 6 were included. Clinical outcome was evaluated using modified Rankin Scale score (mRS) at 3 months after stroke onset.
Results: During the study periods, 197 EVT patients (age 77 [68–84], male 115 [58%], NIHSS score 17 [12–23], DWI-ASPECTS 8 [7-9], onset-to-door time 128 [53–296] min.) were studied. In total cohorts, the DGPT was calculated as 80 [55–127] min. after onset. Twenty-four (13%) patients had it less than 30 min. (1st. DGPT); 35 (18%) patients had 30–60 min. (2nd DGPT); 78 (40%) patients had 60–120 min. (3rd DGPT); and 56 (29%) patients had more than 120 min. (4th DGPT). When we assessed the clinical outcome at 3 months, mRS score of 0–1 was clearly associated with the DGPT grades as 54%, 37%, 24%, and 25% in patients with 1st DGPT, 2nd DGPT, 3rd DGPT, and 4th DGPT, respectively ($p = 0.026$). Contrary, mRS score of 5–6 increased as 8%, 29%, 30%, 36%, respectively ($p = 0.100$). Regarding the clinical parameters, patients with 1st DGPT had similar age ($p = 0.776$), gender ($p = 1.000$), NIHSS score (0.829), DWI-ASPECTS ($p = 0.127$), ICA occlusion ($p = 0.796$), compared to those with 2nd, 3rd and 4th DGPT, while onset to door time was significantly longer as 227 (205-335) min. vs 95 (43–270) min. ($p < 0.001$). Reperfusion with thrombolysis in cerebral infarction more than 2b was frequently achieved in the 1st DGPT group compare to other groups (96% vs. 77%, $p = 0.020$). Finally, when we conducted multivariate regression analysis DGPT within 30 min. was one of the independent positive parameters related to the mRS 0–1 at 3 months (3.16 [95% Confidence interval 1.20–8.31], $p = 0.020$) and negative factors of the mRS 5–6 at 3 months (0.179 [0.037–0.859]. $p = 0.032$) after adjusting parameters of age, gender, atrial fibrillation, NIHSS score, DWI-ASPECTS, onset to door time, and internal carotid occlusion.
Conclusion: Speed up the hospital practice to achieve the short DGPT may promote the clinical recovery and prevent unfavorable outcome after stroke.
Keywords: endovascular thrombectomy, door-to-groin puncture time, acute ischemic stroke

P 007

REDUCING OF PRE-PROCEDURAL TIME REFLECTS TO IMPROVE MECHANICAL THROMBECTOMY TREATMENT OUTCOME IN SIRIRAJ COMPREHENSIVE STROKE CENTER: A COMPARISON OF PRE-POST STROKE WORKFLOW

S Homsud[1]
[1]Siriraj Hospital, Bangkok, THAILAND

Purpose: The recent clinical trials demonstrated efficacy and safety of endovascular treatment in patients with large vessel. Delayed reperfusion will cause unfavorable outcome, especially pre-procedural time. Since 2016, The Siriraj guideline for mechanical thrombectomy (MT) stroke workflow (SW) was established. The patient who was at potential indication for MT was selected by CTA multiphase or CTP for anterior circulation (AC) stroke, and MRI to evaluate core infarction for posterior circulation (PC) stroke. The purpose of this research is to study if reduction of time in pre-procedural period can improve the treatment outcome in acute ischemic stroke who is treated by endovascular technique and comparison of pre- and post-SW era.
Materials and Methods: We retrospectively reviewed 199 executive acute ischemic stroke patients with large vessel occlusion; AC and PC; who underwent endovascular treatment between 2009 to 2018. We divided pre and post SW era as before 2016 and after 2016, respectively. We recorded the timing when patient arrived to the ED (door) to imaging and imaging to groin puncture. The pre-post effectiveness of SW on pre-procedural timing, favorable outcome (90-day modified Rankin Score; mRS; 0-2), symptomatic intracranial hemorrhage (SIH) and mortality rate were analyzed. Median (IQR) was reported for the pre-procedural timing. P value < 0.05 is statistically significant.
Results: Time from door to imaging of AC and PC stroke, imaging to groin puncture times and door to groin puncture time(DGPT) had significantly decrease. The favorable outcome (mRS 0-2) had significantly increase in the post SW era for both AC stroke (29% for pre and 60 % for post SW, $P < 0.001$) and PC stroke (mRS = 0-2; 19% pre and 75% post SW, $P = 0.003$). Furthermore, mortality rate was also decreased in AC stroke (22% for pre and 4% post SW, $P < 0.001$) and PC stroke (43% for pre and 8% for post SW, $P = 0.54$). SIH revealed significantly decrease in AC stroke (30% for pre and 6.4% for post SW, $P < 0.001$) and PC stroke (14.3% for pre and 0% for post SW, $P = 0.28$).
Conclusion: Reducing pre-procedural time (DGPT) can significantly improve clinical outcome especially independent clinical status, decrease mortality rate and lower incidence of SIH after endovascular treatment in acute ischemic stroke patients. Hence, established stroke workflow revealed the very effective stroke management in our institute.
Keywords: Stroke, Flow Stroke, mechanical thrombectomy

P 008

COLORVIZ: A NEW HELPFUL PROCESSING TOOL FOR EVALUATION OF ACUTE STROKE PATIENT BEFORE INTERVENTIONAL PROCEDURE

MJ Kim[1] **and SM Lim**[1]
[1]Ewha Womans Univ. Seoul Hospital, Seoul, SOUTH KOREA

Purpose: The purpose of study was to demonstrate the relationship between distal subtraction angiography (DSA), multiphase computed tomography angiography (CTA) and ColorViz of Fast Stroke (GE healthcare), and to evaluate the benefit of using ColorViz in addition to the multiphase CTA and DSA.
Materials and Methods: From January 2018 to March 2019, among 46 patients who performed mechanical thrombectomy, 12 patients (mean age, 62.6 years; age range, 33-81 years) were enrolled. Inclusion criteria were 1) performed multiphase CTA after symptom onset and before the mechanical thrombectomy, 2) M1 segment occlusion. Multiple arterial occlusion including M1 segment was excluded. Each phase of multiphase CTA has 6 seconds delay. Multiphase CTA of 12 patients were analyzed using ColorViz of Fast Stroke (GE healthcare) software. ColorViz presents angiography using three colors; red for pre-venous phase, green for venous phase and blue for post-venous phase. Time period between red and green were modified to the color change time from green to red at the M1 and pial collaterals of normal contralateral hemisphere. DSA, multiphase CTA and ColorViz images were reviewed by two radiologists with 4 and 24 years of experience in neurointerventional radiology. Collateral vessels of infarcted area was graded according to Goyal et al. study. Analysis of ColorViz classified as followed criteria; 1) red (R) or red and green (RG) account for good collateral vessels, 2) mix up of red, green and blue (RGB) account for intermediate collateral vessels, 3) green and blue (GB) or blue (B) account for poor collaterals.

Results: On DSA, among the 8 of 12 patients showed intermediate collateral vessels, 6 patients appeared GB or G and 2 patients presented RG on Color Viz. 4 of 12 patients with good collaterals showed RG in 2 patients and GB in other 2 patients. In different from DSA, on multiphase CTA, 2 patients appeared intermediate collaterals and 10 patients showed good collaterals. 2 intermediate collateral patients showed GB and G on ColorViz. 4 of 10 patients with good collateral showed RG and 6 of 10 patients showed GB.
Conclusion: ColorViz is aid in the visualization of the timing of collateral vessels using the multiphase CTA. Also, it has benefit of conspicuity of occlusion site and grade of collateral vessels. On this study, ColorViz showed better correlation of collateral vessels with DSA, standard study of acute stroke evaluation, than multiphase CTA only. It is helpful to dynamic evaluation of intracranial arteries in acute stroke patient.
Keywords: ColorViz, DSA, Multiphase CT angiography

P 009

EMERGENT LARGE VESSEL OCCLUSION SCREEN IS AN IDEAL SCALE TO DETECT ENDOVASCULAR THERAPY ELIGIBLE PATIENTS

K Suzuki[1], J Aoki[1], S Numao[1], A Kutsuna[1], Y Sakamoto[2] and K Kimura[1]
[1]Nippon Medical School, Tokyo, JAPAN
[2]Jyusendo hospital, Koriyama, JAPAN

Purpose: We previously designed our original prehospital scale for emergent paramedics to pick up patients with large vessel occlusion (LVO). Advantage of our scale is consisted of 3 factors, which costs minimal time, and designed focusing on cortical symptoms. One observation; presence of eye deviation and two questions. Paramedics show an object and ask; what is this? Then, paramedics show four fingers, and ask; how many fingers are there? If the presence of eye deviation and/or one or more of the two questions were incorrect, ELVO screen was identified as positive. This scale achieved an excellent detectability, a sensitively of 85%, a specificity of 72% and a negative predictive value of 93% respectively. However, it was not clear whether all patient detected by ELVO screen received the endovascular thrombectomy (EVT).
Materials and Methods: This is a retrospectively analysis of our prospective ELVO screen registry. We focused on data from 2 hospitals where have EVT equipmen. At first, we evaluated the actual number of EVT cases among patients picked up by the ELVO screen. Next, we evaluated 1) number of patients who were diagnosed as positive with ELVO screen but not treated with EVT; and 2) patients characteristics of those who were as negative with ELVO but treated with EVT. Finally we calculated the sensitivity, specificity, positive predictive value, negative predictive value and accuracy for the ELVO screen to predict EVT patients.
Results: Date on 249 patients (age, 74 ± 13 years; male, 150 [60%]) were analyzed. Final diagnosis was ischemic stroke, 161 (65%); brain hemorrhage, 55 (22%); subarachnoid hemorrhage, 5 (2%) and not stroke, 28 (11%). ELVO screen judged as positive in 105 patients and 65 patients of them underwent EVT. 144 patients showed ELVO screen negative and 6 patients of them underwent EVT. Regarding 6 patients who were ELVO screen negative and underwent EVT, 3 patients had posterior cerebral artery occlusion; 2 patients had right M1 distal occlusion and 1 patient was arteriosclerotic internal cerebral artery occlusion. Sensitivity, specificity, positive predictive value, negative predictive value and accuracy for the ELVO screen to predict EVT eligible patients were 87%, 68%, 38%, 96% and 71% respectively. The important point is that only 6 (4%) were treated by EVT among 144 patients with negative ELVO screen, which indicated to be an ideal scale to avoid missing EVT.
Conclusion: The ELVO screen is a simple, fast, and reliable prehospital scale for paramedics to identify EVT eligible stroke patients.
Keywords: prehospital scale, ischemic stroke, endovascular therapy

P 010

COMPARISON BETWEEN MRI-DWI AND POOLED CEREBRAL BLOOD VOLUME MAPPING BEFORE AND AFTER THROMBECTOMY FOR ACUTE CEREBRAL ARTERY OCCLUSION

K Yoshida[1] and H Oishi[2]
[1]Tokyo Metropolitan Hiroo Hospital, Tokyo, JAPAN
[2]Juntendo university school of medicine department of neurosugery, Tokyo, JAPAN

Purpose: The information about cerebral blood circulation in the acute phase of major cerebral artery occlusion can be useful for making decision of endovascular treatment. We report about the relationship between MRI and pooled blood volume (PBV) measured using angiographic flat panel detector before and after thrombectomy.
Materials and Methods: Twelve patients whose cerebral blood volume was measured with PBV before and after thrombectomy in patients undergoing acute cerebral infarction in our hospital. Among them, the relation between the DWI findings and the cerebral blood volume with qualitative evaluation and the clinical outcome before and after treatment were examined.
Results: There were cases in which the range of decrease in cerebral blood volume and the range of DWI positive coincided, and different cases were recognized. In 10/12, suspected ischemic core (PBV) matched with final infarct and in 8/12 final infarct was overestimated. In all patients, collateral status could be evaluated, and the better the collateral status, the smaller the final infarction area. Although not statistically significant, poor collaterals seem to be a risk factor for overestimation of final infarction area on PBV. It is presumed that DWI positive and cerebral hypovolemic site is likely to be ischemic core but hypovolemic site involved with ischemic penumbra. It is useful as a qualitative

evaluation of cerebral blood volume measurement, but needed when decide whether endovascular treatment or not, because of overestimating infarct area by PBV.
Conclusion: The cerebral blood volume measurement in the angiography room can be useful information for endovascular treatment.
Keywords: cerebral blood volume, thrombectomy, infarction

P 011

THROMBECTOMY FOR ACUTE ISCHEMIC STROKE WITH LARGE VESSEL OCCLUSION FOR PATIENT OF LATE PRESENTATION: SUB-ANALYSIS OF RESCUE-JAPAN REGISTRY 2

K Uchida[1], S Yoshimura[1], N Sakai[2], H Yamagami[3] and T Morimoto[4]
[1]Department of Neurosurgery, Hyogo College of Medicine, Nishinomiya, JAPAN
[2]Department of Neurosurgery, Kobe City Medical Center General Hospital, Kobe, JAPAN
[3]Department of Stroke Neurology, National Hospital Organization Osaka National Hospital, Osaka, JAPAN
[4]Department of Clinical Epidemiology, Hyogo College of Medicine, Nishinomiya, JAPAN

Purpose: The effectiveness of endovascular treatment for acute ischemic stroke has been established, and in 2018, the selected patients even in cases 6–24 hours after onset had significant improvement in functional outcome at 90 days compared with standard care alone. Our aim is to determine the outcome and sub-analysis of good outcome in AIS patients undergoing EVT with late presentation stroke after 6 h from time witnessed stroke onset.
Materials and Methods: Recovery by Endovascular Salvage for Cerebral Ultra-acute Embolism (RESCUE)-Japan Registry 2 in Japan registered patients with acute ischemic stroke due to large vessel occlusion who were admitted within 24 hours of onset between 2014 and 2017. We analyzed the effectiveness of endovascular therapy for patients presented with onset to door time between 6 to 24 hours, suffered with anterior circulation and evaluated with MRI. Primary outcome was good functional outcome defined by modified Rankin Scale (mRS) of 0–2 at 90 days after onset. Secondary outcome was the mortality within 90 days after onset. Safety endpoints were all bleeding included intracerebral hemorrhage, recurrence of stroke within 90 days. Adjusted odds ratio (OR) was estimated by logistic regression model accounted for potential confounders.
Results: Among 2399 patients registered, 438 patients were analyzed. 164 received (EVT group) and 274 were treated with standard care alone (No EVT group). Mean age was 75 and 78 years in EVT and No EVT patients, respectively. ASPECTS on baseline MRI consisted of 9 and 8 of EVT and No EVT patients, respectively. Good outcome was observed in 34.2% and 19.0% the EVT and No EVT patients, respectively ($p = 0.0004$). Adjusted OR of good outcome of EVT relative to No EVT was 1.93 (95%CI: 1.11-3.33). Subgroup analyses showed the EVT was significantly effective for those with NHSS > 15 [adjusted OR 7.54 (95%CI 2.15-26.4)] while not for those NHSS $= <15$ [adjusted OR 1.34 (95%CI 0.68-2.64)] (interaction $p = 0.011$). The mortality was 6.7% and 13.9 % in EVT and No EVT patients ($p = 0.02$), but adjusted OR was not also statistically significant.
Conclusion: Endovascular therapy decreased disabilities at 90 days in real-world patients with acute cerebral large-vessel occlusion even in 6–24 hours after onset.
Keywords: Acute ischemic stroke, Late presentation, Endovascular therapy

P 012

THE IMPACT OF OCCLUSION LOCATION AND BRIDGING THERAPY IN PATIENTS AFFECTED BY ACUTE ISCHEMIC STROKE IN DETERMINING THE TOTAL NUMBER OF PASSES REQUIRED TO REMOVE THE CLOT AND THE FINAL REVASCULARIZATION OUTCOME

R Rossi[1], S Fitzgerald[1,2], OM Mereuta[1,2], A Douglas[1,2], A Pandit[2], I Szikora[3], G Tsivgoulis[4], K Psychogios[4], B Murphy[5], P Brennan[5], S Power[5], A O'hare[5], J Thornton[5], A Rentzos[6], T Tatlisumak[7] and KM Doyle[1,2]
[1]National University of Ireland, School of Medicine, Department of Physiology, Galway, IRELAND
[2]National University of Ireland, CÚRAM, Centre for Research in Medical Devices, Galway, IRELAND
[3]National Institute of Clinical Neurosciences, Department of Neurointerventions, Budapest, HUNGARY
[4]Metropolitan Hospital, Department of Neurology, Piraeus, GREECE
[5]Royal college of Surgeons in Ireland, Department of Radiology, Beaumont Hospital, Dublin, IRELAND
[6]Sahlgrenska University Hospital, Department of Interventional and Diagnostic Neuroradiology, Gothenburg, SWEDEN
[7]Sahlgrenska University Hospital, Department of Neurology, Gothenburg, SWEDEN

Purpose: Our purpose was to assess the impact of occlusion location in patients suffering from Acute Ischemic Stroke (AIS) on the total number of passes (attempts) necessary to retrieve the clot and on final revascularization outcome. Moreover, we analysed the impact of bridging-therapy, i.e. the concomitant use of IV tPA (intravenous tissue plasminogen activator) and mechanical thrombectomy (MT) on the different categories of occlusion locations.
Materials and Methods: 550 mechanically extracted thrombi were collected from four partner hospitals: Beaumont (Dublin) Sahlgrenska (Gothenburg), National Institute of Clinical Neurosciences (Budapest) and Metropolitan Hospital (Piraeus). In the vast majority of the cases (311 patients, 56.5%) the thrombus was located in the Middle Cerebral Artery (MCA), followed by Carotid Terminus/ Internal Carotid Artery (ICA) in 89 cases (16.2%) and by

vertebral/basilar artery (45 patients, 8.2%). In 65 cases (11.8%) a tandem occlusion, i.e. the occlusion of both ICA and MCA was found, while a dual occlusion occurred in 26 cases (4.7%). 248 patients (45.1%) underwent bridging-therapy, while 291 patients (52.9%) were treated with MT alone. For 11 patients (2%) we have no information whether tPA was administered or not. Recanalization rate was defined by using the modified Thrombolysis In Cerebral Infarction (mTICI) score. Non-parametric Kruskal-Wallis test using IBM SPSS-25 software was used for statistical analysis.

Results: Occlusion location had a significant impact on the total number of passes required to retrieve the clot as well as on final revascularization outcome. The cases with tandem and dual occlusion showed higher number of procedural passes and lower percentage of complete revascularizations (mTICI = 3, Table 1).

Bridging-therapy did not significantly reduce the total number of passes or improve the recanalization rates for patients with singular occlusion. On the other hand, bridging-therapy significantly lowered the total number of passes to remove the clot in patients with dual and tandem occlusion (N = 87, mean for MT + tPA = 2.63 ± 1.73, MT alone = 3.80 ± 2.14, H1 = 7.608, p = 0.006*), but had no statistically significant effect on the final mTICI score (N = 87, H1 = 0.266, p = 0.606).

Table 1. Impact of occlusion location on total number of passes and final mTICI score

Variable	Occlusion Location						Statistical analysis
	MCA	Carotid T/ ICA	Vertebral/basilar	Other	Tandem occlusion	Dual occlusion	
Mean Number of passes (±SD)	2.04±1.76	2.97±1.83	1.71±1.12	1.89±1.05	3.46±2.48	3.23±1.86	N=545, H_1=61.346, p=0.000*)
Final mTICI score (N (%))							
mTICI 0	3 (1.0)	4 (4.5)	0 (0.0)	0 (0.0)	1 (1.5)	0 (0.0)	N=538, H_1=22.635, p=0.000*
mTICI 1	5 (1.6)	0 (0.0)	1 (2.4)	0 (0.0)	2 (3.1)	0 (0.0)	
mTICI 2a	14 (4.5)	6 (6.8)	1 (2.4)	1 (11.1)	6 (9.2)	2 (7.7)	
mTICI2b	66 (21.4)	19 (21.6)	9 (21.4)	3 (33.3)	24 (36.9)	11 (42.3)	
mTICI 2c	46 (14.9)	15 (17.0)	7 (16.7)	0 (0.0)	15 (23.1)	4 (15.4)	
mTICI 3	174 (56.5)	44 (50.0)	24 (57.1)	5 (55.6)	17 (26.2)	9 (34.6)	

Conclusion: This study suggests that occlusion location significantly influences the total number of procedural passes in MT procedures as well as the final revascularization outcome. Furthermore, bridging-therapy lowers the number of procedural passes in cases of tandem and dual occlusion without having significant effect on final mTICI score.

Funding: Science Foundation Ireland (Grant Number 13/RC/2073) and Cerenovus.

Keywords: Acute Ischemic Stroke, Thrombolytics, Mechanical Thrombectomy

P 013

MANUAL ASPIRATION THROMBECTOMY WITH THE PACMAN TECHNIQUE IS NON-INFERIOR TO PUMP TO OBTAIN FIRST PASS RECANALIZATION IN MIDDLE CEREBRAL ARTERY OCCLUSION

V Da Ros[1], J Scaggiante[1], A Di Martino[1], F Sallustio[1], M Diomedi[1], A Wlderk[1], A Bozzi[1], F Di Giuliano[1], V Semeraro[1], D Morosetti[1], R Argirò[1], M Nezzo[1], R Floris[1] and R Gandini[1]

[1]Fondazione Policlinico Tor Vergata, Rome, ITALY

Purpose: A Direct Aspiration first Pass Technique (ADAPT) is effective to perform mechanical thrombectomy but, the technique is still evolving. The aim of this study was to compare two aspiration modalities for ADAPT and detail the PACMAN technique used at our institution.

Materials and Methods: We retrospectively analyzed prospectively collected data of all patients with an isolated middle cerebral artery (MCA) occlusion (i.e. M1 segment) treated with the PACMAN technique at our institution between January and November 2018. 69 Patients received PACMAN performed either with a 60cc syringe or aspiration pump. The primary outcome was the successful reperfusion rate (mTICI 2b or 3). We also compared the modified Rankin scale (mRS) at 90 days and procedural details (timing, number of passages, % of clot ingestion, need for additional devices).

Results: In the syringe and pump group, the median passage to revascularization was 1 (SD = 0.9, range = 1-5) and 2 (SD = 1.5, range = 1–7); TICI 3 score was obtained at first-pass recanalization (FPR) in 67.6% and 45.7%; mRS0-2 at 90 days rate was 61.8% vs 48.6%; stent-retrievers were used in 2.9% vs.14.3%, respectively. No correlation between procedural TICI score and aspiration techniques (RR:2.06; 95%CI:1.6-2.6; P = .08) were observed. Symptomatic intracerebral hemorrhage occurred in 10.1% of participants, without differences among aspiration techniques (P = 0.73). Overall, complete clot ingestion with PACMAN was obtained in 71% of cases.

Conclusion: Our study shows that syringe aspiration is non-inferior to pump to obtain FPR successful of M1-MCA occlusion and may reduce procedural costs. The PACMAN technique seems to increase the rate of FPR.

Keywords: ADAPT, Thrombectomy, First pass recanalization

P 014

ENDOVASCULAR THERAPY VERSUS INTRAVENOUS TISSUE PLASMINOGEN ACTIVATOR IN PATIENTS WITH M2 OCCLUSION

S Numao[1], K Suzuki[1], A Kutsuna[1], T Katano[1], T Kanamaru[1], J Aoki[1] and K Kimura[1]

[1]Nippon Medical School Hospital, Tokyo, JAPAN

Purpose: Endovascular therapy (EVT) are the established treatment in acute ischemic stroke patients with proximal intracranial arterial occlusion. However, it is unclear whether patients with M2 occlusion should be performed EVT. The aim of this study is to assess effect of EVT in acute stroke patients with M2 occlusion.

Materials and Methods: We performed a retrospective, single center analysis in stroke patients with the M2 occlusion who underwent EVT or/and intravenous recombinant tissue plasminogen activator (IVT) from January 2011 to December 2018. Patients with pre-modified rankin scale (mRS) less than 2 were enrolled. We divided all patients into EVT group (including bridging therapy with EVT and IVT) and IVT group. The primary outcome is the mRS scale at 90 days.

Results: 117 patients (age, 73 ± 11 years; male, 79 [68%]) were enrolled and divided to two groups (EVT group, 78

[67%]; IVT group, 39 [33%]). Although presence of hypertension was higher in IVT group, neurological severity ($p = 0.31$) and rate of any intracranial hemorrhage($p = 0.26$), rate of symptomatic intracranial hemorrhage ($p = 1.00$) were no significant difference between 2 groups. Regarding clinical outcome, mRS scale at 90 days was lower in IVT group rather than EVT group (1[1–4] vs. 3[1–4], $P = 0.04$). Even if we limited in severe stroke patients with initial NIHSS score more than 6, clinical outcome was better in IVT group rather than EVT group (2[1–4] vs. 4[1–5], $P = 0.04$). DWI-ASPECTS (8[7–9] vs. 7[6–8], $p = 0.01$) was lower and onset to treatment time (157[117-180] vs. 216[125-482], $p < 0.01$) were longer in EVT group. Finally, when we conducted multivariate regression analysis, EVT was not the independent parameters related to the mRS 0–2 at 90 days ($p = 0.67$) after adjusting factors of age, gender, hypertension, initial NIHSS score, DWI-ASPECTS, onset to treatment time, and IVT.

Conclusion: Our results demonstrated that EVT was not associated with good outcome in patients with M2 occlusion. Randomized trials are necessary to accurately evaluate the value of EVT in patients with M2 occlusion.

Keywords: acute ischemic stroke, endovascular therapy, M2 occlusion

P 015

THE VALUE OF INITIALLY ANGIOGRAPHIC MORPHOLOGY IN ACUTE MIDDLE CEREBRAL ARTERY OCCLUSION

DS Kim[1], JH Sung[1] and MH Lee[1]

[1]St. Vincent's Hospital, The Catholic University of Korea, Suwon, SOUTH KOREA

Purpose: The goal of this study was to evaluate whether initially angiographic morphology in occluded MCA segment is worthy as a predictor of successful recanalization.

Materials and Methods: A retrospective study was performed in 140 patients underwent mechanical thrombectomy with the stent retriever between December 2010 and October 2017, to analyze occlusions in the middle cerebral artery (MCA) with mechanical thrombectomy. Successful recanalization was defined as Thrombolysis in Cerebral Infarction (TICI) grade 3 or 2b. Initially angiographic morphology in occluded MCA segment were classified as either sharp appearance or flat appearance.

Results: The mean age was 67.3 ± 13.3 years, 58 of the patients (41.4%) were male. Of the 140 patients, 115 (82.1%) resulted successful recanalization. Atrial fibrillation, occluded MCA angiographic morphology (odds ratio [OR] 3.60; 95% confidence interval [CI] 1.47–8.80; $P = 0.005$) were independently associated with the successful recanalization. Independent potential risk factors of occluded MCA angiographic morphology on logistic regression model resulted that atrial fibrillation, dyslipidemia, smoking, good collateral, onset to procedure end time, number of passes, re-occlusion were emerged as potential risk factors of sharp appearance.

Conclusion: The initially angiographic morphology in occluded MCA segment was predictable factor of successful recanalization.

Keywords: mechanical thrombectomy, M1 shape, MCA occlusion

P 016

THE EFFICACY OF RECANALIZATION IN MECHANICAL THROMBECTOMY FOR ACUTE ISCHEMIC STROKE: A COMPARISON OF DIRECT ASPIRATION AND STENT RETRIEVER TECHNIQUES

A Kolyanee[1], J Klaychoi[1], N Witoon[1], A Churojana[1], P Withayasuk[1], B Sangpetngam[1], T Aurboonyawat[1] and E Chankaew[1]

[1]Siriraj Center of Interventional Radiology – Faculty of Medicine Siriraj Hospital, Bangkok, THAILAND

Purpose: Mechanical thrombectomy has been accepted to be the most effective maneuver for reperfusion therapy in acute large vessel ischemic stroke. The sooner the recanalization can be achieved, the greater the benefit. The mechanical thrombolytic devices using in Thailand are aspiration catheters and stent retrievers.

The purpose of this study is to compare the efficacy of recanalization using contact aspiration and stent retriever techniques for the treatment of acute large vessel occlusion in anterior circulation stroke.

Materials and Methods: The techniques of mechanical thrombectomy in a total of 203 patients with anterior circulation stroke who underwent revascularization therapy at Siriraj Hospital, Bangkok, Thailand, between Nov 2009 to Dec 2018 were retrospectively reviewed. The endovascular techniques were categorized into 3 groups: (1) direct manual aspiration alone (2) stent retriever alone (3) combined stent retriever and aspiration. Recanalization rate and time from groin puncture to recanalization were compared among each technique.

Results: Contact aspiration alone were performed in 41 patients and stent retriever alone in 103 patients. Of 59 patients with combined maneuver, 36 were primary planed with solumbra technique, 12 were used stent retriever after first-line contact aspiration failure, and 11 had combined aspiration after stent retriever failure. The overall successful recanalization rate (TICI 2b-3) was 79.3% (161/203 patients) and median (Min-Max) time to recanalization was 46.5 (8-253) minutes. The successful recanalization rate of the direct aspiration, stent retriever and combined maneuver were 97.56%, 80.58% and 79.66%, the median (Min-Max) time to recanalization of each technique were 26.5 (8-147), 56 (12-240) and 48.5 (9-253) minutes, respectively.

Conclusion: There were no significant statistical difference of recanalization rate among contact aspiration, stent retriever and combined maneuver. However, direct aspiration had taken a shorter time to recanalize, even by using manual technique. We suggest to choose a contact aspiration catheter as the first-line device. A stent retriever should be used

as a combination, once aspiration alone is failed, in the treatment of acute large vessel stroke.
Keywords: ischemic stroke, stent retriever, aspiration

P 017

EFFECTIVENESS AND SAFETY OF MECHANICAL THROMBECTOMY FOR ACUTE ISCHEMIC STROKE IN OVER 80 YEARS OLD PATIENTS

K Kitazawa[1], Y Ito[1], M Koyama[1], M Toriyabe[1], H Ohara[1] and M Minagawa[1]
[1]Shinrakuen Hospital, Niigata, JAPAN

Purpose: Mechanical thrombectomy (MT) is standard treatment for acute ischemic stroke. However, effectiveness and safety of MT in elderly patients has not been revealed. We retrospectively analyzed clinical outcome of MT patients including elderly patients.
Materials and Methods: Retrospective analysis was conducted for consecutive 21 patients who received MT for acute ischemic stroke between January 2018 and April 2019 in our hospital. We divided all patients into two groups, group A: <80 years old patients and group B: >= 80 years old patients. We analyzed revascularization, clinical outcome and hospitalization-associated complication in each group.
Results: Among 21 patients, there were 9 in group A and 12 in group B including 3 over 90 years old. The averages of age were 78.1 (±13.8) years among all patients, 67 (±11.1) years in group A and 86.5 (± 4.8) years in group B. The averages of puncture to recanalization time (P2R) were 49.2(±37.4) minutes among all patients, 50.4 (±21.9) minutes in group A and 48.3 (±46.2) minutes in group B. The rates of successful revascularization (TICI 2B-3) were 85.7% (18 patients) among all patients, 77.8% (7 patients) in group A and 91.7% (11 patients) in group B. We made the comparison between the modified Rankin scale (mRS) before onset of acute ischemic stroke and after MT. 57.1% (12 patients) among all patients was stable or one rank worsening in mRS before acute ischemic stroke and after MT, 55.6% (5 patients) in group A, and 58.3% (7 patients) in group B. Two patients died and both were 83 years old. One died from completed stroke, though the thrombus in basilar artery was removed after MT, was and the other died from choke after sudden nasal bleeding. There were 2 urinary tract infection, one retroperitoneal hematoma, one ileus and one enteritis. All hospital-associated complications happened in group B.
Conclusion: The successful rate of revascularization and the stability of mRS were similar between two groups. However, hospitalization-associated complications were likely to happen in >= 80 years old patients. These findings demonstrate that MT in elderly patients would be successful as same as in young patients but it is important to prevent hospitalization-associated complications.
Keywords: acute ischemic stroke, mechanical thrombectomy, elderly

P 018

TRANSARTERIAL SELECTIVE COOLING INFUSION WITH ENDOVASCULAR THERAPY FOR ACUTE ISCHEMIC STROKE WITH LARGE VESSEL OCCLUSION: PROTOCOL TO INVESTIGATE EFFICACY AND SAFETY OF THE RANDOMIZED CONTROLLED TRIAL

A Kutsuna[1], J Aoki[1], S Numao[1], K Suzuki[1], T Kanamaru[1], Y Nishiyama[1], S Okubo[2] and K Kazumi[1]
[1]Nippon Medical School Hospital, Department of Neurology, Tokyo, JAPAN
[2]NTT Medical center Tokyo, Department of Stroke medicine, Tokyo, JAPAN

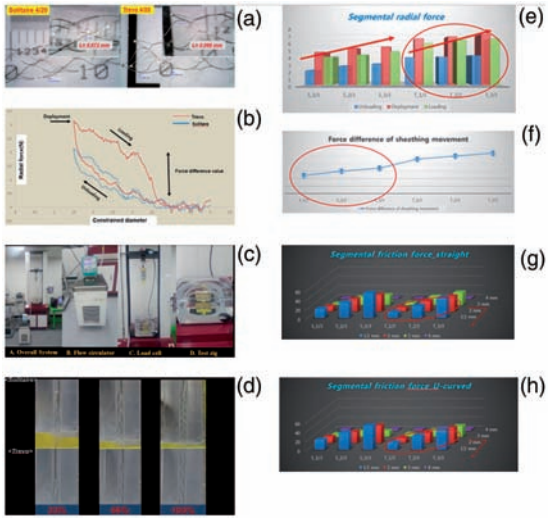
Purpose: Recently, several randomized controlled trials proved the efficacy of endovascular therapy for acute ischemic stroke patients with large vessels occlusion. However, there were still some patients with poor outcomes after successful recanalization. Previous reports indicated one of the factors ischemia/reperfusion injury. Transarterial selective cooling infusion was shown in various animal transient ischemic models to be effective, but it is unclear whether transarterial selective cooling infusion is effective in human. We hypothesised that transarterial selective cooling infusion would be effective for patients with ischemia/reperfusion injury. The aim of this study is to investigate efficacy and safety of this therapy.
Materials and Methods: This is multicenter, prospective, randomized clinical trial. Inclusion criteria show that age is more than 18, the National Institutes of Health Stroke Scale score is more than 2, occluded site is anterior circulation (ICA, M1 and M2), diffusion weighted image Alberta Stroke Programme Early CT score is more than 5 and onset to puncture time remains less than 480 min. Patients achieved the thrombolysis in cerebral infarction (TICI) grade over 2a reperfusion are randomized to transarterial selective cooling infusion group (TA-SCI) or control group. Patients with TA-SCI group is infused 100 ml saline at 4 degrees for 10 minutes and patients with control group is infused 100 ml saline at 22–23 degrees for 10 minutes.
Results: The primary efficacy end-point is modified Rankin Scale (mRS) 0–2 at 90 days. The secondary end-point is mRS 5–6 at 90 days, shift analysis of mRS and difference between initial DWI high intensity volume and Fluid-attenuated inversion recovery (FLAIR) high intensity volume after 24 hours. The safety outcome measures are any and symptomatic intracranial hemorrhage beyond 24 hours from stroke onset.
Conclusion: This trial may help determine if transarterial selective cooling infusion should be recommended for acute ischemic stroke patients with large vessels occlusion after successful recanalization.
Keywords: acute ischemic stroke, endovascular therapy, selective cooling infusion

P 019

EXPERIMENTAL COMPARISON OF PHYSICAL PROPERTIES DEPENDING ON THE UNSHEATHING LEVEL OF STENT: SOLITAIRE VERSUS TREVO RETRIEVER

HJ Jeon[1], JH Ahn[2] and JY Lee[3]
[1]Department of Neurosurgery, Kangdong Sacred Heart Hospital, Hallym University College of Medicine, Seoul, SOUTH KOREA
[2]Department of Neurosurgery, Hallym University Sacred Heart Hospital, Hallym University College of Medicine, Anyang, SOUTH KOREA
[3]Department of Neurosurgery, Kangdong Sacred Heart Hospital, Hallym University College of Medicine, Seoul, SOUTH KOREA

Purpose: This study compared the physical properties depending on the unsheathing level of Solitaire and Trevo stent and provided an experimental information about the controlling of STR over M2 or A2 trunk vessels.



Materials and Methods: The following stents were tested in five section based on the degree of microcatheter's unsheathing: Trevo 4/20 and Solitaire 4/20 mm. Experimental silicone models such as 1.5 / 2 / 3 / 4 mm were applied to check the frictional force and continuously flushed with 37° C saline. Radial force repeatedly measured 10 times for each segment and friction force of the segments compared into individual silicon tubes along the straight and U-curved paths.
Results: Trevo demonstrated higher radial forces than solitaire in overall physical changes (Unloading: 1.5 vs 0.75 N/mm, deploying: 1 vs 0.5 N/mm, Loading: 1.75 vs 1 N/mm, $p < 0.05$). According to the decreased section of unsheathing level, maximal deploying and loading radial force was gradually decreased in each stent, but the physiological force difference between two portions was lesser in Trevo stent ($p < 0.05$). Depending on those sections, friction force of each stent was also gradually reduced less than 3 mm tube. Under a 2 mm tube, trevo stent appeared a relatively low force than Solitaire in all unsheathing sections ($p < 0.05$), but Solitaire showed the highest force at the peak of the U-curved path ($p < 0.05$).
Conclusion: Radial and frictional is possible to be controlled by reducing the unsheathing level of both stents. Over the distal M2 or A2 branch, trevo stent may be better in procedural retrieval and solitarire may be better in unsheathing and re-sheathing control.
Keywords: Ischemia, Stent, microcatheter

P 020

INITIAL EXPERIENCE WITH THE EMBOTRAP II STENTRIEVER FOR THE TREATMENT OF ACUTE ISCHEMIC STROKETO REPORT OUR EXPERIENCE WITH THE EMBOTRAP II CLOT-RETRIEVAL DEVICE FOR THE REVASCULARIZATION OF LARGE ARTERY OCCLUSIONS IN ACUTE ISCHEMIC STROKE

I Valente[1], S Nappini[2], L Renieri[2], A Pedicelli[1], E Lozupone[1], C Colosimo[1], S Mangiafico[2] and N Limbucci[2]
[1]Fondazione Policlinico Universitario A. Gemelli IRCCS, Roma, ITALY
[2]AOU Careggi, Firenze, ITALY

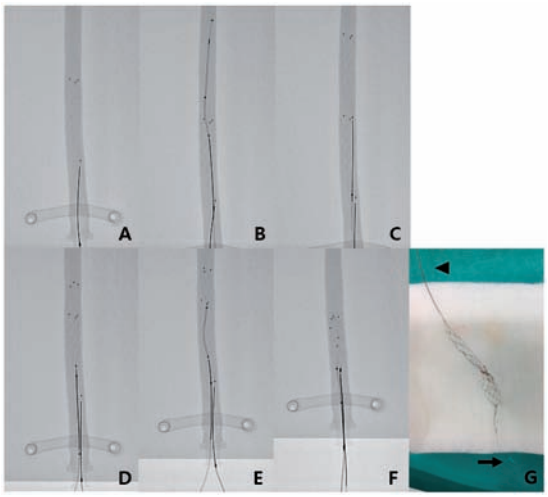
Purpose: To report our experience with the EmboTrap II clot-retrieval device for the revascularization of large artery occlusions in acute ischemic stroke.
Materials and Methods: Twenty-nine patients with acute ischemic stroke due to large artery occlusion underwent mechanical thrombectomy with the new EmboTrap II in two Italian centers. Clinical, procedural and radiological data were collected. Angiographic results and neurological outcomes were analyzed.
Results: Only large vessel occlusions were included. Intravenous thrombolysis was administered in 72% of patients. Successful reperfusion (TICI 2b-3) was obtained in 76% of patients treated exclusively with EmboTrap II. No device-related permanent complications occurred.
Conclusion: In our experience, mechanical thrombectomy with EmboTrap II is safe and effective. Reperfusion rate was comparable to that obtained with other stent retrievers.
Keywords: Stentriever, Embotrap, Stroke

P 021

REMOVAL OF UNWANTED DETACHED SOLITAIRE FR BY USING NEW SOLITAIRE FR – ''DISTAL CAPTURE AND PULL'' TECHNIQUE: A CASE REPORT

JH Mun[1], BS Kim[1] and JS Lim[1]
[1]Kwangju Christian Hospital, Gwangju, SOUTH KOREA

Purpose: We had an actual case of unwanted detachment in intra-arterial thrombectomy using Solitaire retriever stent and with 'distal capture and pull' technique, newly suggested method that the unwanted detached stent could be removed.



Materials and Methods: Brain CTA was performed and absence of flow in distal portion of stent was found. For flow recanalization, removal of Solitaire retriever stent was planned and after insertion of 6Fr shuttle, Navien 072(Navien^{TM} Intracranial Support Catheter, COVIDIEN) intermediate catheter was advanced to distal ICA. After 90' steam shaping of Rebar 18 microcathether, it was navigated to distal portion of unwanted detached stent under guidance of Synchro 14. Solitaire FR 4*20, the same stent as previously used, was deployed from more distal portion, confirming the left MCA flow recanalization. Then, the existing unwanted detached stent was removed by making its distal marker to be stuck between the struts of newly deployed Solitaire FR retriever stent. No contrast leakage was found on post-procedural angiography and Left MCA distal flow was shown to be intact.
Results: The technique used in the above case(distal capture& pull) is a method of deploying another solitaire FR with microcatheter penetrating stent strut or the center of stent, through the distal marker of unwanted detached and pulling out the stents after making the distal end of detached stent stuck in the strut of stent and tangle when retrieving. In this procedure, there are risks of arterial dissection, vasospasm and vessel perforation. Therefore, the technique can be attempted when the benefits of removal exceed the risks of stent remaining and the removal is necessary.
Conclusion: Since there are risks of vessel injury when using distal capture and pull technique, it can be attempted when the benefits of removing unwanted detached stent are greater than the risks of leaving it.
Keywords: Unwanted Detachment, Solitaire FR, Mechanical Thrombectomy

P 022

EFFICACY AND SAFETY OF REPERFUSION THERAPY IN ANTERIOR VERSUS POSTERIOR CIRCULATION STROKE. A SYSTEMATIC REVIEW AND META-ANALYSIS

S Lee[1], J Han[1], I Jung[1] and J Jung[1]
[1]Department of Neurology, Korea University Ansan Hospital, Korea University College of Medicine, Ansan, SOUTH KOREA

Purpose: We performed a systematic review and meta-analysis integrating current evidence from observational studies to compare the influence of posterior circulation stroke (PCS) with that of anterior circulation stroke (ACS) on the efficacy and safety of reperfusion methods in acute ischemic stroke.
Materials and Methods: Multiple comprehensive databases were searched to investigate whether the efficacy and safety of intravenous thrombolysis (IVT) with or without intra-arterial thrombolysis, and mechanical thrombectomy (MT) for PCS is different from that for ACS. We performed a systematic review and meta-analysis after including results from the Korea University Stroke Registry consisting of 3 university hospitals. Symptomatic intracerebral hemorrhage (sICH), all-type ICH (aICH), mortality, and functional outcomes at 3 months were evaluated. Recanalization rate was only assessed in the MT group.
Results: After the literature search, 20 studies in addition to studies from our stroke registry were finally included. For IVT, 10,175 patients were classified as ACS and 1,393 as PCS. For MT, 2,379 were classified as ACS and 360 as PCS. Compared with the ACS group, the PCS group had a lower risk of ICH including sICH and aICH and tended to have favorable functional outcomes after IVT at 3 months. However, mortality was similar in the two groups. In terms of MT, sICH and post-procedural recanalization rates were comparable between the two groups, although the PCS group had a higher mortality risk and lower tendency for favorable functional outcomes.
Conclusion: IVT had better efficacy and safety for PCS than for ACS patients. MT was less effective for PCS than for ACS patients; however, the severity of the symptoms in patients with BAO should be considered at the time of hospitalization. The safety of MT was sufficiently identified to the extent that hemorrhagic complications and recanalization rates were comparable between PCS and ACS patients.
Keywords: anterior circulation stroke, posterior circulation stroke, mechanical thrombectomy

P 023

MORTALITY OF ACUTE BASILAR ARTERY OCCLUSION IN THE THROMBECTOMY ERA: A MULTICENTER RETROSPECTIVE OBSERVATIONAL STUDY – RESCUE JAPAN REGISTRY 2 –

T Yoshimoto[1], H Yamagami[2], K Uchida[3,4], M Ihara[1], K Toyoda[5], T Morimoto[4], N Sakai[6] and S Yoshimura[3]
[1]National Cerebral and Cardiovascular Center, Department of Neurology, Suita, JAPAN
[2]National Cerebral and Cardiovascular Center, Division of Stroke Care Unit, Suita, JAPAN
[3]Hyogo College of Medicine, Department of Neurosurgery, Nishinomiya, JAPAN
[4]Hyogo College of Medicine, Department of Clinical Epidemiology, Nishinomiya, JAPAN
[5]National Cerebral and Cardiovascular Center, Department of Cerebrovascular Medicine, Suita, JAPAN
[6]Kobe City Medical Center General Hospital, Department of Neurosurgery, Kobe, JAPAN

Purpose: Acute basilar artery occlusion (BAO) is a catastrophe type of acute ischemic stroke (AIS) with high mortality and disability rates. We aimed to clarify the mortality and its predictors in patients with AIS due to acute BAO in real-world clinical practice using modern stroke treatment.
Materials and Methods: We enrolled consecutive AIS patients who were aged 20 years or older and hospitalized within 24 hours of the onset of acute BAO in the RESCUE-Japan Registry 2 (Recovery by Endovascular Salvage for Cerebral Ultra-acute Embolism Japan Registry 2), which was a prospective, multicenter registry enrolling consecutive patients with acute large vessel occlusion in 46 centers between October 2014 and September 2016 in the nationwide registry study. Mortality was defined as the rate of the modified Rankin Scale (mRS) score 6 at 3 months and the favorable outcome as mRS 0–2 at 3 months. An sICH indicated neurological worsening more than 4 points in National Institutes of Health Stroke Scale (NIHSS). Successful reperfusion was defined as modified Thrombolysis In Cerebral Infarction scores 2b or 3 at the end of EVT in the patients underwent EVT.
Results: The present study included 182 AIS patients {122 (67%) male; mean $\pm$ standard deviation age, 71 $\pm$ 11 years old} due to acute BAO within 24 hours of onset. The median NIHSS score was 25 (interquartile range 11–31) on admission. Intravenous thrombolysis, endovascular therapy (EVT) and combination therapy were performed in 70 (38%), 136 (75%) and 57 patients (31%). The mortality was 15% and the rate of favorable outcome was 43%. Of 136 patients treated with EVT, successful reperfusion was found in 126 (95%) patients. Compared with the survival group ($n = 154$), the mortality group ($n = 28$) had lower rate of premorbid mRS < 3 (75% vs 91%, $p = 0.03$), higher baseline NIHSS score (median, 30 vs 23, $P < 0.01$), and was more frequently treated with EVT (57% vs 78%, $p = 0.03$). In the multivariable logistic regression analysis, predictors of mortality were EVT (OR, 0.20; 95% CI, 0.07-0.61; $p < 0.01$) and higher baseline NIHSS score (OR, 1.09; 95% CI, 1.04-1.14; $p < 0.01$).
Conclusion: Approximately three quarters of acute BAO patients are treated with EVT and it may lead to the low mortality rate in real-world clinical practice of the thrombectomy era. Baseline NIHSS score and EVT were significant predictors of the mortality in patients with acute BAO.
Keywords: basilar artery occlusion, acute ischemic stroke, endovascular therapy

P 024

MECHANISMS OF ACUTE ISCHEMIC STROKE IN THE SETTING OF TRAUMA

Z Voronovich[1] and D Sorte[2]
[1]University of New Mexico – Department of Neurosurgery, Albuquerque, UNITED STATES MINOR OUTLYING ISLANDS
[2]University of New Mexico – Departments of Radiology and Neurosurgery, Albuquerque, UNITED STATES MINOR OUTLYING ISLANDS

Purpose: Traumatic cerebrovascular injures have been described as high energy, non-penetrating or penetrating trauma that results in a disruption in one or more layers of cervical carotid or vertebral artery wall. Intimal defects in the setting of non-penetrating trauma can result in exposed subendothelial collagen, triggering platelet activation and thrombosis, and leading to thromboembolism or arterial occlusion with critical stenosis. Acute ischemic stroke (AIS) can then ensue due to embolism or flow impairment. Penetrating traumatic cerebrovascular injuries can also result in direct extracranial or intracranial artery injury, leading to AIS by similar mechanisms. However, at our regional trauma center, we also observed much more unusual causes of AIS in trauma patients. We aim to present a compendium of classic instructive cases of AIS in trauma, while also identifying novel mechanisms. Additionally, we plan to report incidence of AIS in trauma patients and their associated characteristics, as seen at our busy regional trauma center.
Materials and Methods: We queried our trauma program patient registry to identify all trauma patients admitted to our center between 01/01/2007 and 06/30/2018 who underwent cerebral arteriography, based on ICD-9 and ICD-10 codes. Since these studies are obtained as part of our standard of care for AIS patients, we anticipate that we will be able to identify most, if not all, trauma patients with AIS in this patient population. We identified 2,445 patients with such imaging who will be screened for evidence of AIS. In patients with AIS, the underlying cause of AIS (including cerebrovascular injury), trauma mechanism and injuries, interventions, outcomes, and demographics will be reviewed.
Results: We identify and describe classic cases of AIS in trauma, such as posterior circulation AIS in the setting of vertebral artery dissection after a motor vehicle collision, delayed AIS in the setting of internal carotid artery dissection after a cervical injury at wrestling practice, fat embolism, and hypoperfusion states. Unusual causes of AIS in trauma, such as missile embolus embolization to the middle cerebral artery after femoral artery injury repair, will also be presented.
Conclusion: We conclude that AIS should be part of the differential when assessing trauma patients for neurologic decline. The underlying cause of AIS in trauma can be unusual, and may be due to injury that is distal to the craniocervical region. A thorough understanding of all of the patient's traumatic injuries and related interventions can lead to better directed prevention and treatment of AIS in the setting of trauma.
Keywords: Cerebrovascular injury, Trauma, Unusual embolisms

P 025

PROGNOSIS OF ENDOVASCULAR THROMBECTOMY IN ACUTE ISCHEMIC STROKE PATIENTS WITH CURRENT MALIGNANCY

B Cho[1], S Yu[1], K Cho[1] and M Park[2]
[1]Korea University Anam Hospital, Seoul, SOUTH KOREA
[2]Chonnam National University Hospital, Gwangju, SOUTH KOREA

Purpose: The role of endovascular thrombectomy in the treatment of cancer patients with acute stroke remains unclear. However, cancer patients have been excluded from clinical trials because of prediction of poor outcome. Our study aimed to investigate the clinical and imaging outcomes of endovascular recanalization treatment in patients with acute large vessel occlusion stroke who had active cancer.
Materials and Methods: We reviewed prospectively collected stroke registry for ischemic stroke from our institution from January 2011 to September 2016. Acute stroke patients with large artery occlusion in the anterior circulation who had active cancer were identified. Baseline clinical characteristics and postprocedural and long-term clinicoradiological outcomes were evaluated. A good outcome was defined as a 90-day modified Rankin Scale score of 0 to 2. Outcomes were also compared with those of non-malignancy patients who had received endovascular therapy during the same period.
Results: A total 378 ischemic stroke patients received endovascular treatment, of whom 27 had current malignancy. In patients with current malignancy, a low baseline NIHSS score and male sex were associated with functional independency at 90 days. When comparing with non-malignancy patients, no significant differences in the proportions of patients with symptomatic intracranial hemorrhage and good functional outcome were found in the malignancy patients, even though higher mortality was observed in malignancy patients at 90 days.
Conclusion: Endovascular treatment might be a feasible therapeutic option for acute ischemic stroke patients with current malignancy when candidates are selected carefully. Future large-scale prospective studies are necessary.
Keywords: Endovascular thrombectomy, Current malignancy, Acute ischemic stroke

P 026

POSTPARTUM PERIOD AND ULCERATIVE COLITIS: A DANGEROUS COUPLE – A CASE REPORT OF AN ISCHEMIC STROKE

S Corraine[1], A Ferrari[1], F Fusaro[1], F Schirru[1], V Palmisano[2], C Ganau[1] and S Comelli[1]
[1]Azienda Ospedaliera Brotzu, Cagliari, ITALY
[2]Azienda Ospedaliera Universitaria, Cagliari, ITALY

Purpose: Presentation of a case report of an ischemic stroke and peripheral thrombotic complication in a young woman in postpartum period (4th month), with ulcerative colitis, and literature review on the topic.
Materials and Methods: Aa 32 y.o. female came to our Emergency Department 4 month after an uneventful induced vaginal delivery, with an history of ulcerative colitis, recently relapsed. She present aphasia and mild right arm weakness (NIHSS = 6). The CT angiography demonstrated a thrombotic minus in the left carotid bulb without intracranial LVO. A proximal thrombectomy with ADAPT technique was performed, followed by vasospasm complication. After intra-arterial infusion of Nimodipine we observed neurological symptoms full regression. One week later she presented with critical ischemia of right leg due to a thrombotic occlusion of distal superficial femoral artery and popliteal artery. An endovascular direct aspiraton of the thrombus was performed with complete revascularization of the lower limb.
Results: A PubMed search using the search terms 'postpartum thrombosis', 'IBD thrombosis' and 'Ulcerative colitis thrombosis' were performed. Relevant articles were identified by screening for suitable titles, abstracts and full texts.
Conclusion: The period of highest stroke risk is the peripartum/postpartum phase, coinciding with the highest risk for hypertensive disorders of pregnancy and peak gestational hypercoagulability. Thromboembolic events are also a well-documented extra-intestinal manifestation of IBD.
The correct diagnosis and on-time management both require a high degree of suspicion in patients with IBD during postpartum together with ''fully set for endovascular thrombectomy'' Angiosuite.
Keywords: Ischemic Stroke, Post-partum, Ulcerative Colitis

P 027

EAGLE SYNDROME, AN UNUSUAL CAUSE OF ACUTE ISCHEMIC STROKE REQUIRING A THROMBECTOMY APPROACH

M Plebani[1], P Zampieri[1], A Grazioli[1], R Augelli[1], A Gasparini[1], G Talenti[1], S Forlivesi[1], S Forlivesi[1] and E Ciceri[1]
[1]AOUI, Verona, ITALY

Purpose: Eagle syndrome can be a cause of brain stroke resulting from carotid dissection due to an elongated styloid process. It is important to recognize it for the risk of ischemic and dissecting recurrences.

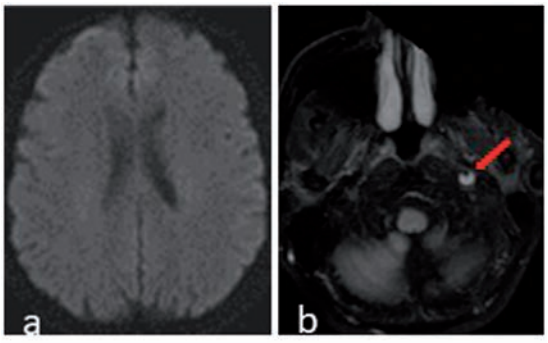


Fig. 1: (a) Diffusion weighted MRI sequence of the patient showing no acute cerebral infarction. (b) On FLAIR sequence is demostrated left high signal crescent sign of left extra-cranial carotid artery (red arrow).

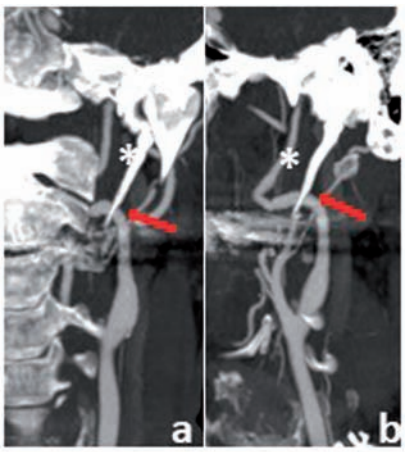


Fig. 2: CT-angiography (a: coronal view; b: sagittal view) shows an elongated styloid process (ESP) (red arrow) in close proximity to the left internal carotid artery (ICA). Left ICA dissection (*) is demonstrated distal to elongated styloid process abutting the vessel.

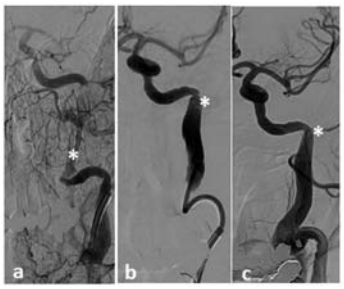


Fig. 3: (a) left cervical ICA angiogram demonstrates vasal dissection (*) and slowing of intracranial circulation. (b) Thromboaspiration was performed demonstrating an annular stenosis of cervical ICA (*). (c) Cervical ICA angioplasty was carried out with good recovery of vascular lumen (*).

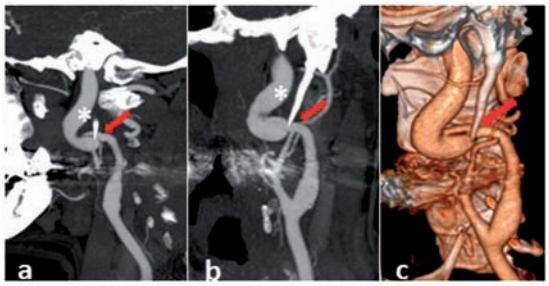


Fig. 4: one-month CT-a (sagittal MIP-image in a, para-coronal MIP-image in b) demonstrating pseudoaneurismatic evolution of left cervical ICA (*) and persistence of an intimal flap at the elongated styloid process contact with internal carotid artery (red arrow). (c) VRT image showing in more details the elongated styloid process (red arrow) impression on the wall of the left ICA.

Materials and Methods: We report a recent experience in a case of stroke caused by dissecting lesion of the left internal carotid artery (ICA) in a 50-y-o patient. Due to a sudden upper limb deficit he falls from motorcycle, and transferred to ER, with neurological fluctuating symptoms. A dissection with tightened stenosis in correspondence of lengthened styloid process was seen at CT-a, without cerebral involvement (Fig.1, 2).

Results: The patient underwent systemic thrombolysis, but given the worsening of the symptoms with stable aphasia and hemiplegia, a urgent DSA study was performed, followed by mechanical thrombectomy and angioplasty (Fig.3 and 4). He was discharged without any deficit under anticoagulation regimen, and he returned at 3 months follow-up, unchanged.

Conclusion: In the event of stroke after a trauma, with evidence of dissection of the carotid artery in the neck, Eagle syndrome should be considered and ruled out. Acute treatment of thromboembolic occlusion following the dissection may include mechanical thrombectomy, as in our case, if the necessary requirements are met. The vessel dissection can be further managed with anticoagulant or antiplatelet therapy according to local therapeutic schemes in agreement with neurologists, as there are no codified international guidelines. In the case presented, we observed complete recovery of the deficits, but in those cases in which failure of medical treatment occurs, with ischemic recurrences or persistent neck pain, resection of the styloid process may represent a therapeutic option.

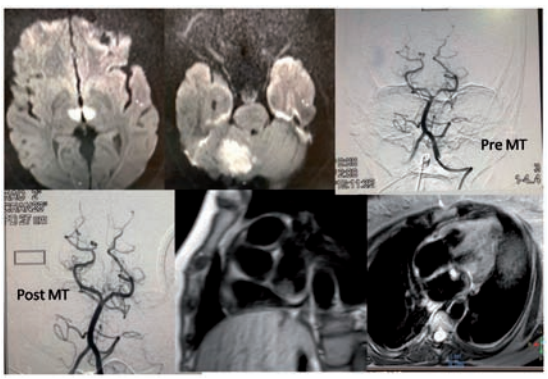
Keywords: Eagle syndrome, dissection, stroke

P 028

SUCCESSFUL MECHANICAL THROMBECTOMY OF EMBOLIC POSTERIOR CIRCULATION STROKE AT 23 HOURS AFTER ONSET IN A YOUNG FEMALE WITH CARDIAC MYXOMA

V Bhatia[1], A Kumar[2] and C Jain[3]
[1]Pgimer, Chandigarh, INDIA
[2]Pgimer, Chandigarh, INDIA
[3]Pgimer, Chandigarh, INDIA

Purpose: Purpose of this case is to demonstrate the successful mechanical thrombectomy and clinical outcome in posterior circulation stroke presenting after 23 hours of onset. On subsequent work up a cardiac myxoma was demonstrated in left atrium likely the source of embolus.



Materials and Methods: 42 year old female with sudden onset loss of consciousness of 23 hours duration with right

upper and lower limb weakness was brought to emergency stroke services with suspected dissection involving vertebral artery. Patient had no other co-morbidities. On examination, GCS was E3V1M5 with anisocoria and right sided pin-point pupil and NIHSS score of 28. Non contrast CT head was done and revealed infarcts involving right cerebellar hemisphere and bilateral thalami. CT angiography showed partially occluding thrombus involving basilar top extending to bilateral posterior cerebral arteries (P1 PCAs). Short protocol MRI revealed pc-ASPECTS of 5 with additional involvement of paramedian midbrain and DWI – FLAIR match. Patient was shifted immediately for endovascular management. Door to puncture time was 1 hour. Long sheath was placed in left subclavian artery and guiding catheter was placed in left vertebral artery. Diagnostic runs confirmed basilar top occlusion extending to bilateral P1 PCAs. Microcatheter was negotiated across occlusion into right PCA and Trevo® stent retriever (Stryker) was deployed. Single pass was taken.

Results: TICI 3 recanalization was achieved in 15 minutes. On table, patient's GCS improved to E3V1M6 status. Patient did not require intubation during or after procedure and was shifted to intensive care unit. NIHSS at 24 and 48 hours was 15 and 8 respectively. Further workup including echocardiography and cardiac MRI revealed enhancing left atrial myxoma measuring 15 × 11 mm attached to interatrial septum.

Conclusion: Cardiac myxoma stroke is rare and affects young females. Management includes intravenous thrombolysis and endovascular management in urgent setting. Surgical excision of myxoma is necessary to prevent recurrence.

Keywords: Posterior circulaton, stroke, myxoma

P 029

USEFULNESS OF TOTAL THROMBUS-FORMATION ANALYSIS SYSTEM IN PREDICTING HEMORRHAGIC COMPLICATIONS DURING NEUROENDOVASCULAR TREATMENT

K Arimura[1], A Nishimura[1] and K Iihara[1]

[1]Department of Neurosurgery, Kyushu university, Fukuoka, JAPAN

Purpose: Antithrombotic agents are usually administered to patients with cerebrovascular disease before elective neuroendovascular treatment, but a method for precise monitoring to predict hemorrhagic and ischemic complications has not yet been established. Total Thrombus-Formation Analysis System (T-TAS) was developed for quantitative analysis of platelet thrombus formation using flow-microtip chambers with thrombogenic surfaces. We investigated the usefulness of T-TAS in predicting perioperative complications with neuroendovascular treatment.

Materials and Methods: We prospectively analyzed 30 consecutive cases who underwent neuroendovascular treatment with T-TAS monitoring in our hospital between March 2017 and July 2018 (Aneurysm: 25, Carotid artery stenosis: 5). Preoperative blood samples were obtained from the patients. We investigated the correlation between the area under the pressure curve with two types of microtips (collagen, platelet chip: PL-chip, collagen plus tissue factor, atheroma chip: AR-chip) and perioperative complications. We also evaluated platelet function with VerifyNow for all included patients.

Results: The average age was 63.6 ± 10.1 years (median: 65.6), and the median follow-up period was 6 months. All patients were administered at least one antiplatelet agent. Symptomatic ischemic complications occurred in one patient and asymptomatic DWI-positive ischemic spots were evident in 22 patients on postoperative MRI; these did not correlate with T-TAS analysis. However, symptomatic hemorrhagic complications, which occurred in four patients, showed significant correlation with T-TAS analysis with AR-chip, though not with PL-chip or VerifyNow.

Conclusion: These results suggest that T-TAS can predict perioperative hemorrhagic complications in neuroendovascular treatment.

Keywords: T-TAS, Antithrombotic agents, monitoring

P 030

RISK PREDICTION OF PARENCHYMAL HEMATOMA AFTER ENDOVASCULAR THROMBECTOMY FOR ACUTE ISCHEMIC STROKE WITH ANTERIOR CIRCULATION LARGE VESSEL OCCLUSION

J Kang[1], CH Kim[1] and OY Kwon[1]

[1]Department of Neurology, Gyeongsang National University Hospital, Gyeongsang National University College of Medicine, Jinju, SOUTH KOREA

Purpose: Endovascular thrombectomy (EVT) has become a standard treatment in acute ischemic stroke with anterior circulation large vessel occlusion (ACLVO). However, hemorrhagic transformation, especially parenchymal hematoma (PH), is a major challenge after EVT and associated with unfavorable outcome. We sought to identify predictors for PH and develop a grading scale to predict the risk of PH after EVT.

Materials and Methods: In consecutive patients with acute ischemic stroke of ACLVO who underwent EVT in our center from February 2016 to November 2018, clinical and imaging data were analyzed to identify predictors for PH type 1 and 2 using logistic regression. We derived the scale by assigning points to independent factors for PH. Predictive value of the scale was tested with area under a receiver operating characteristic (ROC) curve.

Results: Among 233 patients (mean age, 72.3 ± 11.3 years; male, 46.4%) who met the inclusion criteria, the rate of PH after EVT was 18.0% (n = 42). Our risk prediction scale (0 to 6 points) comprised embolic stroke (yes = 1; OR, 3.47; 95% CI, 1.15-10.48), glucose level on admission (>145 mg/dL = 1; OR, 2.56; 95% CI, 1.09-6.02), sex (male = 1; OR, 3.16; 95% CI, 1.39–7.15), prior lipid-lowering agent medication (yes = 1; OR, 2.56; 95% CI, 1.13–5.85), M1 perforator

infarction on diffusion weighted image (yes = 1; OR, 2.98; 95% CI, 1.09–8.13), and the extent of infarction (Lobar type- = 1; OR, 2.94; 95% CI, 1.30–6.63). The area under ROC was 0.771 (0.712–0.824; $p < 0.001$) for PH.

Conclusion: The risk prediction score model is a reliable scale to assess the risk of PH after EVT for ACLVO. External validation of the score is needed to support its generalization.

Keywords: stroke, endovascular thrombectomy, parenchymal hematoma

P 031

ANALYSIS OF THE FACTORS RELATED TO THE FAILURE OF SUCCESSFUL RECANALIZATION AND THE INFLUENCE OF THROMBUS LENGTH ON SWI, IN STENT RETRIEVER MECHANICAL THROMBECTOM

DH Lee[1], JH Sung[1] and MH Lee[1]

[1]St. Vincent's Hospital, The Catholic University of Korea, Suwon, SOUTH KOREA

Purpose: Susceptibility-weighted imaging (SWI) enables visualization of thrombotic material in acute ischemic stroke. We aimed to analyse the association between thrombus length on SWI and successful recanalization.

Materials and Methods: A retrospective study was performed in 128 patients showed a MCA thrombus on pretreatment SWI, separated into 2 groups, a successful recanalization group and a failure of successful recanalization group. Thrombus visibility and location on SWI were compared to those on maximum intensity projection (MIP) in CT angiography. A comparative analysis was performed in terms of clinical and radiologic outcomes and complications with respect to multiple categories.

Results: There were no significant differences in baseline characteristics and clinical outcomes between the 2 groups. However, compared with the successful recanalization group, the failure of successful recanalization group had a larger number of stent passages, and a longer thrombus length ($p = 0.027$, 0.014, respectively). Multivariate analyses revealed that a larger mean number of stent passages was a predictive factor for failure of successful recanalization (odds ratio [OR] 1.60; 95% confidence interval [CI] 1.12–2.08; $p = 0.04$). Thrombus length (OR 9.91; 95 % CI 3.89–13.87; $p < 0.001$) and atrial fibrillation (OR 5.38; 95 % CI 1.51–9.58; $p = 0.008$) were independently associated with more than 3 passage of stent.

Conclusion: Failure of successful recanalization seems to be affected by a larger number of stent passages. Especially, more than 3 passage of stent correlates well with atrial fibrillation and in MCA occlusion thrombus length as measured on pretreatment SWI.

Keywords: mechanical thrombectomy, thrombus length, SWI

P 032

VISUALIZATION OF THROMBUS USING FLOW-SENSITIVE BLACK-BLOOD MAGNETIC RESONANCE ANGIOGRAPHY IN PATIENTS WITH ACUTE ISCHEMIC STROKE: A POSSIBILITY OF DETERMINATION OF ETIOLOGY

M Takagaki[1], A Murasawa[2], K Nakao[2], H Nakamura[1] and H Kishima[1]

[1]Osaka University Graduate School of Medicine – Department of Neurosurgery, Osaka, JAPAN

[2]Kawachi General Hospital – Department of Neurosurgery, Osaka, JAPAN

Purpose: Recently, interventional devices have drastically improved treatment outcomes in patients with acute cardiogenic cerebral embolism. The onset to reperfusion time should be shortened to further improve the treatment outcomes in such patients. Imaging analysis is performed to acquire extensive information not only regarding the brain parenchyma but also occluded vessels in a short period. We performed magnetic resonance imaging (MRI) with flow-sensitive black-blood (FSBB) imaging to reveal the occlusion site in patients with acute ischemic stroke. The purpose of this study was to evaluate the efficacy of FSBB in such patients.

Materials and Methods: We retrospectively analyzed the data of all patients with acute ischemic stroke at our hospital between 2016 and 2017. Patients who underwent MRA-FSBB before and after mechanical thrombectomy were enrolled in this study. Data, including patient characteristics, occluded vessels, thrombus intensity, and distal vessel visibility, were analyzed.

Results: The study included 12 patients (mean age 74.6 years, female 66.6%). Reperfusion of TICI 2b–3 was achieved in 83.3% (10/12) of the patients. The occluded vessels were the internal carotid artery in 4 patients and the middle cerebral artery in 8. The thrombus showed iso-intensity or high intensity compared with the cerebrospinal fluid. In all patients, vessels distal to the occluded segment were clearly visualized. In 1 patient with atherothrombotic middle cerebral occlusion, the occluded segment was found to be extremely short.

Conclusion: FSBB imaging features differ between patients with atherothrombotic occlusion and cardioembolic occlusion, which might help in the detection of the etiology of the occlusion site before mechanical thrombectomy. FSBB imaging is useful to detect the occlusion site and etiology in patients with acute ischemic stroke.

Keywords: acute ischemic stroke, MRI, FSBB

P 033

COMPOSITION OF RETRIEVED THROMBUS ASSESSED BY MORPHOLOGICAL, HISTOPATHOLOGICAL AND EX VIVO MRI ANALYSIS

C Yoon[1], P Hyun[2], P Ki-Jong[3], K Young Soo[4], R Jieun[5] and B Seung Kug[5]

[1]Department of Neurology, Gyeongsang National University Changwon Hospital, Changwon, SOUTH KOREA
[2]Department of Neurosurgery, Gyeongsang National University Changwon Hospital, Changwon, SOUTH KOREA
[3]Department of Neurology, Gyeongsang National University College of Medicine, Institute of Health Science, Jinju, SOUTH KOREA
[4]Department of Neurosurgery, Masan MH Younsei Hospital, Changwon, SOUTH KOREA
[5]Department of Radiology, Pusan National University Yangsan Hospital, Yangsan, SOUTH KOREA

Purpose: The aim of this study was to assess whether we could distinguish stroke subtype by analyzing the size, weight, shape, color and imaging characteristics of the retrieved thrombus.

Materials and Methods: From October 2013 to January 2016, 28 thrombi were classified as cardioembolism and 16 were large artery atherosclerosis. The size, shape, and color characteristics of the thrombus were analyzed. The weight of total thrombi of each case was measured. The weight, length, and sectional area of the largest thrombus of each case was measured again. For shape, we compared the degree of circularity, roundness, aspect ratio, and solidity of the largest thrombus. In the color analysis, the color image of the largest thrombus was analyzed by using RGB histograms. Retrieved thrombus was subjected to post- MRI under ex vivo conditions.
Results: When the linear by linear association statistics are used, the probability of stroke due to cardioembolism increases as the RBC composition of thrombus increases, and the probability of stroke due to large artery atherosclerosis increases as the fibrin composition of thrombus increases ($p = 0.018$). The size of the cross-sectional area of the largest thrombus (22.38 ± 21.48mm2 vs. 12.15 ± 10.86mm2, $p = 0.043$) is larger in the cardioembolism group. Also, the weight of total thrombi (140.00 ± 231.39 mg vs. 37.50 ± 30.31 mg, $p = 0.049$) and the weight of the largest thrombus (46.14 ± 47.34 mg vs. 17.94 ± 16.89 mg, $p = 0.013$) is heavier in the cardioembolism group. Higher RGB values in the large artery atherosclerosis group mean that the thrombus of the large artery atherosclerosis group is brighter than the thrombus of the cardioembolism group. In multivariate logistic regression analysis, the mean Green value of RGB (OR 1.488, 95% CI 1.032-2.146; $p = 0.033$) was independently associated with large artery atherosclerosis. Blooming artifacts of the post-MRI under ex vivo conditions well correlate with that of the pre-MRI ($p = 01016$), and blooming artifacts of the post-MRI under ex vivo conditions was associated with red blood cell composition of thrombus ($p = 0.005$; Spearman correlation coefficient; 0.419).
Conclusion: The shape of the thrombus did not help to determine the stroke subtype. However, the weight, cross-sectional area, and color difference of the thrombus helped to distinguish cardioembolism and large artery atherosclerosis, and the mean Green value of RGB was found to be the most significant predictor. And blooming artifacts of the post-MRI under ex vivo conditions was well correlated with that of the pre-MRI and red blood cell composition of thrombus.

Keywords: Morphological analysis, Retrieved thrombi, Ex Vivo MRI

P 034

CLOT COLLECTION AND ANALYSIS IN THE EXCELLENT REGISTRY

T Andersson[1,2], R Nogueira[3], S De Meyer[4], K Doyle[5], J Fiehler[6], W Hacke[7], R Hanel[8], T Jovin[9], D Kallmes[10], D Liebeskind[11], A Yoo[12], O Zaidat[13] and A Siddiqui[14]

[1]Karolinska University Hospital and Clinical Neuroscience Karolinska Institutet – Department of Neuroradiology, Stockholm, SWEDEN
[2]AZ Groeninge Department of Medical Imaging, Kortrijk, BELGIUM
[3]Emory University School of Medicine – Department of Neurology, Atlanta, USA
[4]Laboratory for Thrombosis Research, KU Leuven, Campus Kulak Kortrijk, Kortrijk, BELGIUM
[5]National University of Ireland, Galway, IRELAND
[6]University Medical Center Hamburg, Hamburg, GERMANY
[7]University of Heidelberg – Department of Neurology, Hiedelberg, GERMANY
[8]Baptist Stroke and Cerebrovascular Center, Jacksonville, USA
[9]University of Pittsburgh Medical Center – Department of Neurology, Pittsburgh, USA
[10]Mayo Clinic Department of Radiology, Rochester, USA

[11]University of California Los Angeles – Department of Neurology, Los Angeles, USA
[12]Texas Stroke Institute Dallas Fort Worth, Plano, USA
[13]Mercy St Vincent Medical Center, Toledo, USA
[14]State University of New York at Buffalo, Buffalo, USA

Purpose: Clot samples will be collected from a subset of patients enrolled in the EmboTrap® Extraction & Clot Evaluation & Lesion Evaluation for NeuroThrombectomy (EXCELLENT) Registry. Clot composition will be assessed from imaging by an independent Core Laboratory and compared with a histopathologic analysis performed by a Central Laboratory. Potential relationships between histopathological findings and subject baseline characteristics, revascularization rates, and clinical outcomes will also be analyzed.
Materials and Methods: This is a prospective, global, multicenter, single-arm, observational registry that will enroll subjects at approximately 50 sites across Europe, the United States and other regions to assess the efficacy of the EmboTrap® Revascularization Device when used by a large number of interventionalists and centers in routine clinical practice, as well as to explore associations between clot characteristics and clinical factors. Up to 1000 subjects will be enrolled with a minimum target of 500 subjects with clot collected for analysis. The clots will be collected per-pass and evaluated by a Central Laboratory blinded to clinical data. All subject images will be reviewed by an independent Imaging Laboratory also blinded to clinical data.
Results: Clot components to be evaluated will include Red Blood Cells (RBC), White Blood Cells (WBC), platelets, fibrin, and other fibrous proteins. Successful achievement of the study endpoint will be effective removal of clots that span the range from RBC-poor (<25%) to RBC-rich content (>75%), as assessed by the independent Central Laboratory. An exploratory analysis will be performed to discover the relationships between histopathological and clinical factors. Regression analyses will be executed to examine the associations between: 1) baseline subject comorbidity and clot characteristics where clot characteristics will be treated as dependent variables; 2) clot characteristics and reperfusion where reperfusion scores will be treated as dependent variables; 3) baseline subject comorbidities/clot characteristics/reperfusion and clinical outcomes where clinical outcomes will be treated as dependent variables.
Conclusion: Per-pass clot collection and histopathological analysis by an independent Central Laboratory as part of the EXCELLENT study will allow for exploring the relationship between clot composition and clinical factors in mechanical thrombectomy for acute ischemic stroke and to gain better insight into the etiology of the disease and means for effective clot removal.
Keywords: mechanical thrombectomy, histology, core laboratory

P 035

POST-CONTRAST HYPERINTENSE VESSEL ON DELAYED GD-ENHANCED T1W TSE IMAGE IN ACUTE INFARCT

DW Park[1] and TY Kim[1]
[1]Hanyang University Guri Hospital, Guri, SOUTH KOREA
[2]Hanyang University Guri Hospital, Guri, SOUTH KOREA

Purpose: To evaluate hyperintense vessels on delayed Gd-enhanced T1W TSE image and their clinical significance in acute infarct of middle cerebral artery (MCA).
Materials and Methods: 68 patients with acute MCA infarction were retrospectively reviewed. Hyperintense vessels on delayed Gd-enhanced T1W TSE and T2-FLAIR images were visually evaluated and compared by two neuroradiologists with statistical analysis. The territory of hyperintense vessels on delayed Gd-enhanced T1W TSE image and the perfusion deficit on dynamic susceptibility contrast enhanced (DSC) perfusion study was estimated and statistically compared.
Results: Hyperintense vessels on delayed Gd-enhanced T1W TSE image were significantly well visualized than those on T2-FLAIR image ($P < 0.05$), which were identical to slow collateral arteries. Hyperintense vessels on delayed Gd-enhanced T1W TSE and T2-FLAIR images were estimted with excellent agreement. The territories of hyperintense vessels on delayed Gd-enhanced T1W TSE image were significantly correlated with perfusion deficits on DSC perfusion study ($P < 0.05$).
Conclusion: Hyperintense vessels on delayed Gd-enhanced T1W TSE image in acute MCA infarct may be associated with slow collateral arterial flows. Hyperintense vessels on delayed Gd-enhanced T1W TSE image correspond to hyperintense vessels on FLAIR image, of which the territories are correlated with perfusion deficits on DSC perfusion study.
Keywords: acute infarct, middle cerebral artery, hyperintense vessel

P 036

ENDOVASCULAR TREATMENT FOR ACUTE LARGE VESSEL OCCLUSION DUE TO ATHEROSCLEROSIS

M Shirakawa[1], S Yoshimura[1], N Sakai[2], H Yamagami[3], K Uchida[1] and T Morimoto[4]
[1]Department of Neurosurgery, Hyogo College of Medicine, Nishinomiya, JAPAN
[2]Department of Neurosurgery, Kobe City Medical Center General Hospital, Kobe, JAPAN
[3]Department of Stroke Neurology, National Hospital Organization Osaka National Hospital, Osaka, JAPAN
[4]Department of Clinical Epidemiology, Hyogo College of Medicine, Nishinomiya, JAPAN

Purpose: Effectiveness of endovascular therapy (EVT) for acute large vessel occlusion was recognized by several randomized studies. The aim of this study was to evaluate

clinical results of acute endovascular treatment for atherosclerotic large vessel occlusion (LVO) and then to compare to those of cardiogenic embolism.

Materials and Methods: This study is a sub-analysis of nationwide multicenter registry of acute LVO, Recovery by Endovascular Salvage for Cerebral Ultra-acute Embolism Japan Registry 2 (RESCUE-Japan Registry 2). A total of 1,277 of 2,420 registered patients were treated with EVT. Among them, 688 cases who matched to recommendation of AHA guideline were classified into two groups based on the etiology of stroke; atherosclerotic brain infarction group (ATBI group): $n = 137$, and cardioembolic group (CE group): $n = 551$. We analyzed clinical characteristics and results of those two groups.

Results: Patients in ATBI group were younger than those in CE group (71.9 vs 76.1, $p < 0.001$), and initial National International Health Stroke Scale (NIHSS) was lower in ATBI than in CE (15 vs. 18, $p < 0.001$). Alberta Stroke Program Early CT Score (ASPECTS) of both groups were not different statistically. The median reperfusion time from the onset was longer in ATBI than in CE (340 vs. 250, $p < 0.001$). The rate of good reperfusion and the adjusted rate of good outcome (modified Rankin scale 0–2) were not significantly different (88.3% vs 87.1%, 42.3% vs 42.1%; $p = 0.7$, 0.28).

Conclusion: The clinical outcome of EVT in the patients with atherosclerotic LVO was similar to those of the patients with cardiogenic LVO despite of the longer recanalization time from the onset. These results suggested that the patients with atherosclerotic LVO may have longer time to obtain good outcome by EVT.

Keywords: Atherosclerosis, Endovascular treatment, Large vessels occlusion

P 037

BALLOON ANGIOPLASTY AND STENTING FOR INTRACRANIAL ATHEROSCLEROTIC STENOSIS

T Ueda[1], S Takaishi[1], T Yoshie[1], N Usuki[1], K Tatsuno[1], Y Hamada[1], H Ohtsubo[1] and Y Suzuki[1]

[1]St. Marianna University Toyoko Hospital, Kawasaki, JAPAN

Purpose: Intracranial atherosclerotic stenosis (ICS) is an important cause of ischemic stroke, particularly in the Asian population. Endovascular treatment, such as balloon angioplasty with and without stenting have emerged as therapeutic options for symptomatic (ICS) since the 1990s and the Wingspan stent was approved at 2014 in Japan. This study investigated the periprocedural complication rates, long-term outcome and restenosis of endovascular treatment for intracranial atherosclerotic stenosis (ICS) at our hospital.

Materials and Methods: We retrospectively analyzed the clinical data of 217 patients comprising 256 endovascular treatments for high-grade symptomatic ICS. The lesion was located in the internal carotid artery in 77, the middle cerebral artery in 111, the basilar artery in 29 and the vertebral artery in 39. Patients were divided into two groups, before (early-phase group, 1999–2013) and after approval of Wingspan (late-phase group, 2014–2017).

Results: In the early-phase group ($n = 163$), 157 lesions were treated by balloon angioplasty and 31(17%) by coronary stenting. In the late-phase group ($n = 54$), 33 lesions were treated by balloon angioplasty and 35(52%) by Wingspan stenting. Overall technical success rates were 96% in the balloon angioplasty and 100% in stenting groups. The 30-day rate of stroke, TIA and death were 4.8% in the early-phase group and 4.4% in the late-phase group. There was 1 minor stroke and 2 TIAs during the follow-up period in the late-phase group.

Conclusion: This study demonstrated the safety and efficacy of balloon angioplasty with and without stenting for symptomatic intracranial atherosclerotic stenosis if patients are properly selected.

Keywords: Intracranial artery stenosis, Balloon angioplasty, stenting

P 038

USEFULNESS OF BALLOON EXPANDABLE STENTING FOR ATHEROSCLEROTIC SEVERE STENOSIS OF INTRACRANIAL ARTERY

M Hirohata[1]

[1]Kurrume University hospital, Kurume, JAPAN

Purpose: Intracranial stenosis is one of the most common etiology of stroke. Stenting using balloon expandable stent will be a optimal treatment. Purpose of this study is to assess the safely and feasibility of balloon expandable stent for the patients with severe stenosis of intracranial artery.

Materials and Methods: Between 2004 to 2017, forty-four patients (40 men, 4 women; mean age 70,2 years) with severe stenosis of intracranial artery including ICA: 36 (Extradural:25, Intradural: 6), MCA: 5, BA:4 and VA 4 were treatment with balloon expandable stenting. Patient records were analyzed for clinical and angiographic characteristics, Use od device, surgical complications and angiographical and clinical outcomes.

Results: Of these patients, 36 presented with ischemic stroke (TIA or minor stroke: 32, major stroke: 4) and another 4 were asymptomatic. Balloon expandable stenting was successfully performed in all patients. Degree of stenosis were 72–97 (mean:88.4) %. Coronary stents were used in all cases (S 660:4, Driver mine or Sprint: 36, Integrity:4) and diameter and length of stents were 2.5–4 (mean 2.55 mm) and 9–15 (mean 12.8) mm. After stenting, stenosis was improved to 5–20 (mean 19.5) %. Two patients had ischemic complications. One patient with basilar artery stenosis had a brainstem infarction due to perforator occlusion, and another vertebral artery stenosis had embolic cerebellar infarction. In the follow up period (8–156: mean 65 month), 4 patients suffered with ischemic stroke of stented territories and 2 patients showed the asymptomatic in stent occlusion (intradural ICA and MCA).

Conclusion: In this study, balloon expandable stenting appears to eb safe and feasible treatment for the patient s with intracranial artery stenosis.
Keywords: Intracraninal, stenosis, stent

P 039

PREDICTION OF UNDERLYING INTRACRANIAL ATHEROSCLEROTIC STENOSIS USING VISIBILITY OF THE STENT DURING MECHANICAL THROMBECTOMY PROCEDURE FOR ACUTE LARGE ARTERY OCCLUSION

BH Lee[1], JW Kim[2] and YJ Hwang[3]
[1]Department of Radiology, Ilsan Paik Hospital, Inje University College of Medicine, Goyang, SOUTH KOREA
[2]Department of Radiology, Ilsan Paik Hospital, Inje University College of Medicine, Goyang, SOUTH KOREA
[3]Department of Radiology, Ilsan Paik Hospital, Inje University College of Medicine, Goyang, SOUTH KOREA

Purpose: The aim of this study was to investigate whether the shape of the stent strut during mechanical thombectomy procedure could predict of the underlying intracranial atherosclerotic stenosis (ICAS) in patients with acute ischemic stroke.
Materials and Methods: We retrospectively reviewed consecutive patients with acute intracranial large artery occlusion who were treated by intra-arterial thrombectomy using Trevo stent device as a first-line endovascular procedure. The stent was deployed to cover the thrombus and then left in place for 3–5 minutes. Patients were assigned to the full expansion (+) group or the full expansion (-) group based on the shape of the stent strut under fluoroscopy. Underlying ICAS were compared between the two groups. ICAS was determined if the significant fixed focal stenosis remained after thrombectomy on follow-up or final angiography.
Results: The present study included 48 patients. Underlying ICAS was identified in 6 patients (12.5%). Thirty-two patients (66.7%) showed stent full expansion during the procedure. Underlying ICAS were identified in one patient (3.1%; 1 of 32) in full expansion (+) group and 5 patients (31.3%; 5 of 16) in full expansion (-) group. There was a statistically significant difference between the two groups ($p = 0.012$).
Conclusion: Observation of the degree of stent expansion during the procedure can be a useful predictor of underlying ICAS in the endovascular treatment of acute large artery occlusion.
Keywords: thrombectomy, stentriever, atherosclerosis

P 040

RISK FACTORS FOR PERIPROCEDURAL COMPLICATIONS OF ANGIOPLASTY/STENT FOR INTRACRANIAL STENOSIS

H Ishihara[1], F Oka[1], T Nishimoto[1], K Okazaki[1] and M Suzuki[1]
[1]Department of Neurosurgery, Yamaguchi University School of Medicine, Ube, JAPAN

Purpose: The aim of this retrospective study is to evaluate medium-term results of balloon angioplasty and stenting for symptomatic high-grade stenosis of a major intracranial artery, and to identify the risk factors associated with complications.
Materials and Methods: This study included 43 consecutive symptomatic patients with high-grade (70-99%) stenosis of a major intracranial artery who underwent balloon angioplasty only (35 patients) or with intracranial stent deployment (8 patients) between 2007 and 2018. From 2014, cone beam CT was used for the pre-treatment evaluation of perforators. The main outcomes included periprocedural complications and any stroke or death within 3 month. We also evaluated functional outcomes and restenosis in patients on follow-up.
Results: A total of 43 lesions in 43 patients (mean age: 63.5 ± 13.9 years) were treated with a technical success rate of 98%. Five lesions were treated in acute phase (within 48 hours after onset), and the other lesions were treated two or more days after onset (medium 22 days). In 3 (7%) patients, the treatment site was occluded relatively early after treatment. All of these lesions were long and angulated lesions, and two of them were the patients who treated in the acute phase. Although no patient developed major stroke or death within 3 month, four (9.3%) patients developed perforator stroke during procedure. All of their symptoms due to perforator stroke were recovered within one month. After introducing the cone beam CT, there were no unexpected perforator stroke. Intracranial hemorrhage was observed in 1 (2%) patient. Mean follow-up period was 49 ± 42 months (range 4–144) and one patients developed major stroke in treatment site, one another patient experienced minor stroke during the follow-up period.
Conclusion: In this retrospective single-center study, main periprocedural complications were acute occlusion and perforator stroke. The risk factors associated with acute occlusion after procedure were morphology of the lesion and timing of the treatment. Evaluation of perforator branch sites might be useful to reduce perforator stroke. There was low complication rate in chronic phase after treatment.
Keywords: angioplasty, intracranial artery stenosis, intracranial stent

P 041

BILATERAL OPHTHALMIC ARTERY OCCLUSION IN A CASE OF ANTIPHOSPHOLIPID ANTIBODY SYNDROME

W Seung[1] and H Jeong[2]
[1]Department of Neurosurgery, Dongguk University Gyeongju Hospital, Dongguk University College of Medicine, Gyeongju, SOUTH KOREA
[2]Department of Diagnostic Radiology, Busan Paik Hospital, Inje University, Busan, SOUTH KOREA

Purpose: To report on a rare case of antiphospholipid antibody syndrome (APS) with complete bilateral ophthalmic artery occlusions.
Materials and Methods: A 72-year-old female with a history of hypertension, Parkinson's disease, and nephritic syndrome presented with complaints of sudden, painless loss of vision in both eyes 3 hours ago. Her visual acuity in both eyes was 'perception of light'. Brain magnetic resonance angiography and Conventional cerebral angiography revealed bilateral ophthalmic artery occlusions.
Results: Left ophthalmic artery was recanalized by intra-arterial chemical thrombolysis (Urokinase 20,000 IU) through microcatheter selection and stenosis was observed at the origin of the ophthalmic artery. However, the right ophthalmic artery failed to perform microcatheter selection because the orifice was not found, and intra-arterial chemical thrombolysis (Urokinase 60,000 IU) was performed near the origin of ophthalmic artery. After that, aspirin 100 mg and clopidogrel 75 mg were continuously administrated and visual acuity improved to 0.5 on the right side and 0.63 on the left side. Thrombocytopenia was identified at the time of admission. APS was diagnosed after various labolatory analysis.
Conclusion: This case highlights the importance of early diagnosis and prompt management of bilateral OA occlusions induced by thrombosis of APS.
Keywords: Antiphospholipid antibody synd, ophthalmic artery, Occlusion

P 042

THROMBECTOMY AND STENTING OF AN ACUTE INTRACRANIAL DISSECTION: CLINICAL AND HYSTOLOGICAL CONSIDERATIONS

JD Gabrieli[1], G Cester[1], A Angelini[1], M Fedrigo[1], M Colasurdo[1], D Simonato[1] and F Causin[1]
[1]Padova University Hospital, Padova, ITALY

Purpose: To present a case of acute M1 occlusion in which hystological examination of the retrieved specimen confirmed the presence of a subintimal dissection.
Materials and Methods: A 27-year old woman was admitted to our institution with acute onset of post-coital aphasia and right hemiplegia NIHSS21; CT scan which revealed initial ischemic damage in the left MCA territory:ASPECTS8 with loss of density of the insular rim and the putamen; subsequent CTA showed a proximal left MCA occlusion. Iv-tPA was initiated while the patient was transferred to the angiosuite. The endovascular procedure was performed in local anesthesia and conscious sedation; contact with the occluded segment was achieved at +8 minutes from groin puncture nevertheless multiple unsuccessful attempts were performed with aspiration, stentriever and combined techniques without retrieval of clots; superselective injection of the M1 segment obtained in between attempts revealed signs suggestive of intracranial dissection, ultimately a ''skin-like'' material attached to the external wall of the stent was removed. Facing an unsuccessful reperfusion (mTICI = 0) and considering the probability of an intracranial dissection, we decided to acutely stent the vessel: antiaggregation was induced with Tirofiban according to our institutional protocol for acute intracranial stenting subsequently the stentriever (Solitaire AB 4x20) was permanently released (+86 minutes from groin puncture); dual antiplatelet therapy was imbricated the following day. Final angiogram revealed a successful reperfusion mTICI = 2B. Clinical course was favorable and the patient recovered almost completely at 3 months follow-up (mRS1).
Results: The ''skin like'' material was stored in formalin and our pathologist was informed about the suspected etiology of the stroke. Histologic analysis of the specimen revealed a sub-intimal dissection characterized by an intact layer of internal elastic lamina, indeed the presence of an intact layer of internal elastic lamina points towards a spontaneous (not iatrogenic) subintimal dissection.
Conclusion: Histologic analysis of retrieved specimens allows deeper understanding of the treated pathology.
Keywords: stroke, intracranial dissection, histology

SESSION: Carotid

P 043

MANAGEMENT OF TANDEM OCCLUSION STROKE WITH CAROTID STENTING AND INTRA-ARTERIAL ABCIXIMAB

E Portela De Oliveira[1], A Cora[1], F Essbaiheen[1], U Erdenebold[1], M Kassab[1], A Quateen[1], B Drake[1], H Lesiuk[1], S Finitsis[2] and D Iancu[3]
[1]University of Ottawa, Ottawa, CANADA
[2]Aristotle University of Thessaloniki, Thessaloniki, GREECE
[3]University of Ottawa and University of Montreal, Ottawa and Montreal, CANADA

Purpose: The goal of this study was to retrospectively evaluate the feasibility of the combined use of emergent carotid stenting and intra-arterial (IA) Abciximab with intracranial revascularization in the setting of acute ischemic stroke and carotid occlusions.
Materials and Methods: We retrospectively review a prospectively maintained, observational database of acute

ischemic strokes from 2015 to 2018. We included twenty-two consecutive patients with complete cervical carotid occlusion and concomitant intracranial ICA and/or MCA occlusion who underwent ICA recanalization employing carotid stenting and IA Abciximab associated with intracranial mechanical thrombectomy. Complications and outcome of all cases were evaluated using post procedure NIH Stroke Scale (NIHSS) and Modified Rankin Score (mRS).

Results: The mean age of the patients was 66 years (51–78), with average baseline NIHSS of 13.8 (6–22) and ASPECT 8.7 (7–10). 19 (86,3%) of the patients had cervical recanalization achieved using a retrograde approach, with carotid stenting and IA Abciximab performed after intracranial thrombectomy. Intracranial recanalization was achieved with mTICI of 2B or 3 in 63.6% and 2A in 16.4%. Cervical ICA recanalization was achieved in all cases with 86,3% mTICI of 2B or 3. Average NIHSS 24 h post procedure was 5.5 (0–17). 5 patients (22.7%) demonstrated intracranial hemorrhage on follow up CT in 24–48 h. Mean mRS was 2.2 (0–6). Overall mortality was 18.1% (4/22).

Conclusion: Endovascular treatment of tandem occlusions follow by intracranial IA Abciximab is technically feasible, achieves recanalization rates and rates of good clinical outcome.

Keywords: Tandem Occlusion, Carotid Stenting, Abciximab

P 044

ENDOVASCULAR RECANALIZATION OF ACUTE TANDEM CERVICAL CAROTID AND INTRACRANIAL OCCLUSIONS: EFFICACY OF CERVICAL BALLOON ANGIOPLASTY ALONE THEN INTRACRANIAL TARGET RECANALIZATION STRATEGY

D Kang[1]

[1]Kyungpook National University Hospital, Daegu, SOUTH KOREA

Purpose: Tandem cervical carotid and intracranial occlusions are a well-known cause of complicated endovascular thrombectomy (EVT) in acute ischemic stroke. We aimed to evaluate safety and efficacy of an anterograde approach, which involved carotid balloon angioplasty (BA) alone without carotid artery stenting.

Materials and Methods: Between April 2009 and March 2017, 62 patients with tandem lesions confirmed in the cervical carotid and simultaneously in the intracranial arteries had EVT performed to target these lesions. Clinical, imaging, and angiographic outcomes for these patients were analyzed and compared.

Results: Overall, successful reperfusion was achieved in 80.6% (50/62) and a favorable outcome in 61.3% (38/62) of patients. BA alone was enough to maintain access for TR in 85.5% (group A and B; 53/62), although more than one half (31/53; group B) required rescue CAS at the end of EVT due to elastic recoil. In contrast, emergent CAS was additionally required for the remaining 9 patients to maintain distal access (group C). In a subgroup comparison, procedure time (PT) to target recanalization was significantly shorter in group A and B than group C (P [0.002). A multivariate regression model revealed age, parenchymal hematoma, and PT to target recanalization as independent predictors of favorable outcome.

Conclusion: EVT for tandem cervical carotid and intracranial occlusions showed optimistic results in terms of clinical and angiographic outcome. The anterograde EVT strategy of cervical BA alone then intracranial TR was effective in 85.5% of patients, which was likely to reduce PT to target recanalization.

Keywords: Carotid, Stroke, Tandem

P 045

EFFECT OF EMERGENT CAROTID ARTERY STUNTING ON CERVICAL INTERNAL CAROTID ARTERY OCCLUSION OR PSEUDO-OCCLUSION WITH MILD NEUROLOGICAL DEFICITS

Y Tsuboi[1], **M Narikiyo**[1], **H Nagasaki**[1], **S Nagao**[1] and **C Kambayashi**[1]

[1]Kawasakisaiwai Hospital, Kawasaki, JAPAN

Purpose: From January 2010 to December 2018, we examined 20 patients of cervical internal carotid artery occlusion or pseudo-occlusion with mild neurological deficits who underwent carotid artery stenting (CAS).

Materials and Methods: We examined patients with 5 or less NIHSS at hospitalization. They divided into a group in which CAS was performed within 24 hours (emergency group) and a group in which CAS was performed after medical treatment (waiting group), and the results of treatment were compared.

Results: There were eleven cases in the emergency group and nine cases in the waiting group. The emergency group was aged 46 to 88 years (average 66.2 years old), and all the patients were men. NIHSS ranged from 0 to 5 (average 2.9), occlusion was 5 cases, pseudo-occlusion was 6 cases. The waiting group was aged 57 to 90 years (average 64.1 years old), 7 males and 2 females. NIHSS ranged from 0 to 5 (average 3.3), occlusion was 8 cases, pseudo-occlusion was 1 case. The period from hospitalization to treatment was 2 to 31 days (average 11.2 days). A good outcome (mRS 0–2) at discharge was 90.9% in the emergency group and 44.4% in the waiting group. Five of nine patients in the waiting group showed worsening symptoms during medical treatment. Only one patient got a good outcome in 5 patients who showed worsening symptoms. Neither emergency group nor waiting group showed perioperative complications.

Conclusion: In this study, emergent CAS was more effective than CAS after medical treatment for patients with acute cervical carotid artery occlusion or pseudo-occlusion with mild neurological deficits.

Keywords: emergent CAS, CAS after medical treatment, mild neurological deficits

P 046

PSEUDO-OCCLUSION OF THE INTERNAL CAROTID ARTERY IN ACUTE ISCHEMIC STROKE: CLINICAL OUTCOME AFTER MECHANICAL THROMBECTOMY

WS Jung[1], YC Lim[2] and JW Choi[1]
[1]Ajou University Hospital, Depratment of Radiology, Suwon, SOUTH KOREA
[2]Ajou University Hospital, Depratment of Neurosurgery, Suwon, SOUTH KOREA
[3]SOUTH KOREA

Purpose: Pseudo-occlusion (PO) of cervical internal carotid artery (cICA) in CTA can be caused by distal ICA occlusion. We explored the clinical impact of PO after mechanical thrombectomy (MT).

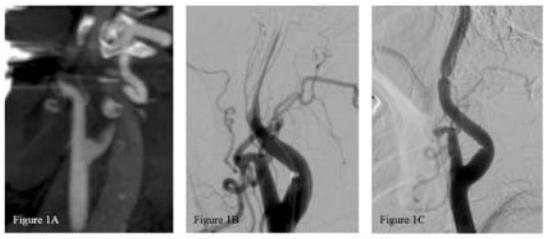


Figure 1. Example of cervical ICA pseudo-occlusion on CTA with a noncorresponding cause of apparent occlusion found on DSA. (A) Pseudo-occlusion of the left cervical ICA in a 69 year-old woman. CTA shows a sharp, flame shaped leading contrast edge at the level of the cervical ICA, with T-occlusion present. (B) DSA of this patient shows a slowly moving upward of contrast and finally a patent ICA (C) after mechanical thrombectomy for the distal ICA occlusion.

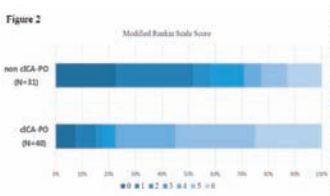


Figure 2. Shown is the distribution of scores on the modified Rankin scale (mRS). Scores range from 0 to 6, with 0 indicating no symptoms, 1 no clinically significant disability, 2 slight disability (patient is able to look after own affairs without assistance but is unable to carry out all previous activities), 3 moderate disability (patient requires some help but is able to walk unassisted), 4 moderately severe disability (patient is unable to attend to bodily needs without assistance and unable to walk unassisted), 5 severe disability (patient requires constant nursing care and attention), and 6 death. The mRS score at 3 months according to the presence of cervical ICA pseudo-occlusion (cICA-PO). More patients experiencing poor outcomes (mRS 4-6) were observed in the cICA-PO group.

Materials and Methods: All patients who underwent MT to treat distal ICA occlusions revealed by CTA between July 2012 and March 2018 were retrospectively reviewed. A cICA-PO was defined as when CTA revealed a gradual decline in contrast above the level of the carotid bulb in the arterial phase. A poor outcome was defined as a 3-month mRS score of 4 to 6. Binary logistic regression analyses were used to investigate the relationship between a cICA-PO and outcome; we also explored the association between successful recanalization and outcome.

Results: A total of 71 patients with distal ICA occlusions were included, of whom 40 (56.3%) exhibited cICA-POs. The latter patients were more likely to experience poor outcomes (80.0% vs. 25.8%, $P < 0.001$), hemorrhagic transformation (32.5% vs. 9.6%, $P = 0.01$), and a lower rate of successful recanalization (65.0% vs. 90.3%, $P = 0.014$) than the non-PO group. In binary logistic regression analyses, a cICA-PO was independently associated with a poor outcome (odds ratio, 4.278; 95% CI, 1.080–33.006; $P = 0.045$) after adjustment. In the cICA-PO group, all patients who failed recanalization ($n = 15$) after MT experienced poor outcomes, as did 69.2% of patients in whom recanalization was successful ($P = 0.018$).

Conclusion: cICA-POs are common finding and experience worse outcomes than non-PO patients. Patients with cICA-POs are more likely to exhibit poor outcomes after MT, particularly when recanalization fails.

Keywords: pseudo-occlusion, distal ICA occlusion, mechanical thrombectomy

P 047

CAROTID ARTERY DISSECTION: NATURAL HISTORY, SELECTION CRITERIA AND ENDOVASCULAR TECHNIQUE BASED ON OUR PERSONAL EXPERIENCE

F Taglialatela[1], S Isceri[1], C Barbara[1] and L Simonetti[1]
[1]IRCCS Istituto delle Scienze Neurologiche di Bologna – Neuroradiology Unit Ospedale Maggiore, Bologna, ITALY

Purpose: Carotid artery dissections can be traumatic or spontaneous, and healing is generally spontaneous with the patient requiring antithrombotic treatments alone. However, there is a minority of patients who, though immediate institution of therapy, show long lasting symptomatology, represented by micro embolization-induced TIA and compressive symptoms due to possible presence of aneurysmatic sacs. Aim of our study was to review these series of patients treated by stenting, focusing in particular on the technical aspects of the treatments.

Materials and Methods: Our series included 91 patients, 62 males and 29 females, with age ranging from 5 to 49 years. Carotid artery dissection was spontaneous in 42 cases, traumatic in 46 and post-TEA in 3 cases. All patients were submitted to Angio-CT follow-up at 1 and 3 months. In 59 patients, complete healing of the vessel was observed after institution of the double antithrombotic or antiplatelet therapy alone, with absence of symptomatology during observation. Persistence of complete occlusion of the vessel was observed in 3 patients. In 28 patients, the 3-month follow-up studies showed persistence of anatomical alteration of the vessel, accompanied by symptomatology (TIA and/or compression syndrome):

- 9/28 persistent stenosis with intimal flap
- 10/28 severe stenosis with pseudo-aneurysm
- 9/28 mild stenosis with pseudo-aneurysm.

We use a 90 cm long 6F introducer or a 6F guiding catheter. With a floppy microwire in a microcatheter, we carefully pass through the dissected segment; subsequently, through the microcatheter, we position a stiffer exchange microwire for the stent; this, to avoid traumas to the dissected segment. We use auto expandable stents long enough to cover the segments from one healthy portion to another.

To lower the risk of complications, and because we consider them as not useful, we do not use

- pre or post dilatation devices
- the so-called protection devices
- post stenting coiling of the pseudoaneurysmal sac
- covered stent.

Results: All treated patients showed recovery of the vessel calibre, with spontaneous occlusion of the pseudoaneurysmal

sacs within 2 months from the treatment. Peri-procedural or long term complications were not observed.
Conclusion: Generally, carotid artery dissections heal spontaneously due to self-reparation ability of the vessel. In some selected cases, due to persistence of the pathologic condition, the healing process is aided by stent positioning (employing low risk techniques).
Keywords: Carotid, Dissection, Treatments

P 048

ENDOVASCULAR TREATMENT IN PATIENTS WITH CAROTID ARTERY DISSECTION WITHOUT INTRACRANIAL LARGE VESSEL OCCLUSION

J Kim[1], D Lee[2], D Suh[2] and Y Song[2]
[1]Jeju National University Hospital, Jeju, SOUTH KOREA
[2]Asan Medical Center, Seoul, SOUTH KOREA

Purpose: The purpose of this study was to describe the clinical characteristics and outcome of endovascular treatment in patients with carotid artery dissection (CD) without intracranial large vessel occlusion.

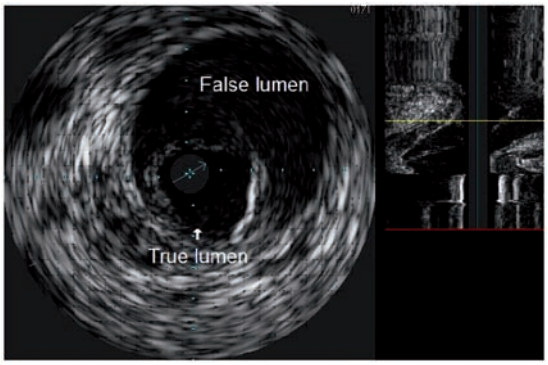
Materials and Methods: A retrospective review of patients endovascular treated for spontaneous or posttraumatic CD with acute ischemic stroke, over a 13-year period from September 2005 to November 2017 was performed.. The inclusion criteria for ET for acute ischemic stroke related with CD were as follows: (1) Patients with acute ischemic stroke related CD which showed clinical-diffusion mismatch or symptom fluctuation with small pretreatment lesion size on diffusion-weighted imaging (DWI), and (2) Patients for whom performing ET for CD was judged to be beneficial by discussion between neurologist and neurointerventionist about onset-to-door time, symptoms, patient information, and initial neuro-image. We excluded patients when (1) incidentally identified CD without clinical symptom, (2) onset to puncture time $>$ 1 week, (3) large(1/3) pretreatment lesion size on DWI, (4) performed mechanical thrombectomy due to intracranial large vessel occlusion, and (5) any intracerebral hemorrhage detected on the initial computed tomography (CT) or magnetic resonance imaging (MRI).
Results: Twenty-two dissected carotid arteries were found which were performed balloon angioplasty and stent placement. The patients (6 women and 16 men; mean age, 46 years) had a total of 22 patients. Twelve patients were free of any trauma history. Recombinant tissue plasminogen activator was administered in 2 (9.1%) CD cases. The patients with CD exhibited a high rate of successful revascularization (Thrombolysis In Cerebral Infarction: 2b or more, 22 patients (100 %)), a low risk of symptomatic intracranial hemorrhage 4 (18.2%), and good global functional outcomes (modified Rankin Scale (mRS): 2 or less, 19 (86.4%)). Symptomatic intracranial hemorrhage resulted in poor clinical evolution (mRS $>$ 2) in patients with acute ischemia associated with CD.
Conclusion: Although attention to the hemorrhagic complication is required, endovascular treatment for selective patients with cerebral ischemia associated with CD is a safe and acceptable treatment strategy for reconstruction of luminal patency, with good clinical outcomes.
Keywords: Dissection, Carotid artery, Stent

P 049

USEFULNESS OF INTRAVASCULAR ULTRASOUND IMAGING NAVIGATING MICROWIRE IN THE TRUE LUMEN IN THE ACUTE ISCHEMIC STROKE CASE DUE TO SPONTANEOUS INTERNAL CAROTID DISSECTION

S Saito[1], A Takemura[2], N Narita[1] and H Tomita[3]
[1]Hirosaki Stroke and Rehabilitation Center, Hirosaki, JAPAN
[2]Aomori City Hospital, Aomori, JAPAN
[3]Hirosaki University Graduate School of Medicine, Hirosaki, JAPAN

Purpose: It is rarely reported that intravascular ultrasound (IVUS) imaging navigated microwire in true lumen in the acute ischemic stroke patient of spontaneous internal carotid dissection. We report that IVUS-guided procedure was useful for accessing microwire in true lumen in the acute ischemic stroke case.



Materials and Methods: An 52-years-old men noticed left hemiparesis and dysarthria when he wake up at 6 AM and was taken to the our hospital about 7 hours after he was last known to be well. It was also recognized as left hemispatial neglect. NIHSS was 10 points. Head MRI showed that DWI-ASPECTS was 8 points. Cerebral angiography revealed that right internal carotid artery (ICA) in cervical distal portion was occluded, and that collateral flows were observed barely through anterior communicating artery and right ophthalmic artery as retrogradely. We considered the indication of mechanical thrombectomy. 9-Fr balloon guide catheter was navigated from right femoral artery to right cervical ICA. Direct aspiration with balloon guide catheter and ADAPT technique with 5MAX ACE 068 were performed, but neither of reperfusion was achieved. He had hypertension, dyslipidemia, diabetes mellitus and smoking however atrial fibrillation was not detected. We had the Initial diagnosis of atherothrombotic brain infarction and percutaneous transluminal angioplasty (PTA) with PTA dilatation catheter (2.0×9 mm and 2.5×9 mm) was performed under brain protection. Although right ICA was not recanalized, the blood flow was observed slightly with clots to petrous portion. Solitaire Platinum 6×30 mm was deployed over the thrombus. the clots were retrieved, whereas spiral dissection was found in right ICA. For the first time, we noticed that the cause of right ICA occlusion was spontaneous dissection. The microwire could not access the true lumen. We performed Intravascular ultrasound imaging in false lumen and its imaging navigated the other microwire to the true. The microwire in false lumen was removed and Precise 7×30 mm and ENTERPRIZE2 4.5×23 mm were deployed in true lumen from cervical to petrous portion in right ICA after double antiplatelet therapy was started.
Results: Right carotid dissection was almost repaired and TICI grade 3 was obtained. NIHSS was improved from 10 to 2 points. Head and neck CT did not show large infarction and hemorrhage. mRS was 1 after 3 months.
Conclusion: IVUS was useful for accessing microwire in the true lumen in the acute ischemic stroke case due to spontaneous internal carotid dissection.
Keywords: Intravascular ultrasound image, Carotid dissection, Acute Ischemic stroke

P 050

NAVIGATION OF A 6-FRENCH GUIDING SHEATH INTO THE COMMON CAROTID ARTERY USING A TRI-AXIAL CATHETER SYSTEM IN TRANSBRACHIAL CAROTID ARTERY STENTING

S Sakamoto[1], T Matsushige[1], T Okazaki[1], J Oshita[1] and K Kurisu[1]

[1]Hiroshima University Hospital – Department of Neurosurgery, Hiroshima, JAPAN

Purpose: Placement of a large-bore guiding sheath into the common carotid artery (CCA) is crucial in transbrachial carotid artery stenting (CAS). Herein, we describe technical tips for the navigation of a 6-French guiding sheath into the CCA using a tri-axial catheter system in transbrachial CAS.
Materials and Methods: A total of 33 patients underwent transbrachial CAS. For the right side, a 6-French straight guiding sheath was navigated directly into the CCA using a tri-axial catheter system, with a 4-French Simmons catheter placed through a 6-French straight guiding catheter. For the left side, a 6-French Simmons guiding sheath was navigated into the CCA using a tri-axial catheter system, with a 4-French Simmons catheter placed through a 6-French Simmons guiding catheter. After the placement of a 6-French guiding sheath into the CCA, CAS was performed under distal filter or balloon protection.
Results: Seventeen patients had a right carotid stenosis and 16 patients had a left carotid stenosis. The 6-French guiding sheath was safely placed with ease and provided adequate stabilization for CAS. All procedures were successfully performed without any complications.
Conclusion: The use of a tri-axial catheter system for the navigation of a 6-French guiding sheath into the CCA appears safe and efficient, allowing transbrachial CAS, with 6-French guiding sheath stabilization, to be performed without any complication.
Keywords: brachial artery approach, carotid artery stenting, tri-axial system

P 051

USEFULNESS OF TRIPLE COAXIAL SYSTEM FOR NAVIGATING 9FR BALLOON GUIDING CATHETER IN PATIENTS WITH SPECIFIC AORTIC ANATOMY

Y Suzuki[1], N Toma[2], R Yasuda[3], Y Miura[4], M Shiba[5] and H Suzuki[6]

[1]Mie University Graduate School of Medicine, Tsu, JAPAN
[2]JAPAN
[3]JAPAN
[4]JAPAN
[5]JAPAN
[6]JAPAN

Purpose: A 9Fr balloon-mounted guiding catheter (BGC) is often used for proximal protection in carotid artery stenting (CAS) or mechanical thrombectomy (MT) for acute ischemic stroke due to anterior circulation large vessel occlusion (LVO). However, the procedure navigating a 9Fr BGC into common carotid artery (CCA) is sometimes difficult in patient with tortuous aortic arch or CCA. We propose the 'triple coaxial system' consisting of a 6Fr 118 cm intermediate catheter and a 4Fr 145 cm Simmons catheter to navigate a 9Fr 90 cm BGC into CCA.
Materials and Methods: From January 2013 to April 2019, 109 CAS and 78 MT were performed in our hospital. We retrospectively reviewed the access system for these procedures.
Results: In CAS procedures, a 9Fr BGC was used for proximal protection in 80 cases (73.4%). In 55 of the 80 cases (68.8%), a 4–5-6Fr tapered-tip JB2 catheter was initially

used to navigate a 9Fr BGC. Among them, 4 cases required to exchange the inner catheter to a 4-5-6Fr tapered-tip Simmons catheter, 2 cases needed the triple coaxial system. In 24 cases (30%), the triple coaxial system was used from the beginning. As a result, a 9Fr BGC was successfully navigated into CCA using the triple coaxial system in 26 cases. In MT procedures, a 9Fr BGC was employed in all the cases. The first-employed inner catheter was a 4-5-6Fr tapered-tip JB2 catheter in 69 cases (88.5%), and in 4 cases of them required to exchange the inner catheter to a 4-5-6Fr tapered-tip Simmons catheter, and one case needed the triple coaxial system to overcome tortuous aortic arch. A 4-5-6Fr tapered-tip Simmons catheter was initially used in 8 cases and the triple coaxial system was used from the beginning in only one case.

Conclusion: The triple coaxial system may not be preferred for MT because it is time-consuming to establish the system. However, in cases with tortuous aortic arch or CCA, to access with the triple coaxial system might spend less time in navigating a 9Fr BGC. In conclusion, the triple coaxial system is useful for navigating 9Fr BGC in cases with tortuous access route. We believe that this system will facilitate catheter access in such a case not only in CAS but also MT.

Keywords: triple coaxial system, balloon guiding catheter, specific aortic anatomy

P 052

CLINICAL RESULTS AND TECHNICAL CONSIDERATIONS ABOUT A DOUBLE-LAYER CAROTID STENT: EXPERIENCE IN 78 PATIENTS

F Taglialatela[1], S Isceri[1], C Barbara[1] and L Simonetti[1]
[1]IRCCS Istituto delle Scienze Neurologiche di Bologna – Neuroradiology Unit Ospedale Maggiore, Bologna, ITALY

Purpose: Over the last decades, carotid artery stenting (CAS) of carotid stenosis has been introduced as an alternative to endarterectomy in symptomatic stenosis. However, the major risk of stent placement appears to be the possibility of periprocedural embolic strokes due to released debris during the several phases of endovascular manipulation. The new double layer nitinol ''CASPER'' carotid artery stent has been created with two layers of nitinol, the inner layer presenting pores small enough to prevent embolic release. Our aim is to present our experience, to evaluate the use of CASPER in the treatment of patients with severe carotid artery stenosis.

Materials and Methods: From April 2015 to April 2019, we performed 131 CAS in consecutive patients, including 78 with Casper stents. The last group was treated with monolateral carotid artery stenting on primary atherosclerotic plaque or dissection (75 pts, 9 of them in emergency, for endovascular treatment of stroke) or post-TEA restenosis (3 pts). Average degree of stenosis in the treated arteries was 76.5%. All patients received sonography detection of the carotid stenosis and CT-Angiography to assess the ultrasound diagnosis and to characterize the atherothrombotic structure of the plaques (with the exception of patients with acute stroke, who were subjected only to CT-Angiography). CASs were performed without pre-ballooning, with 9 post-ballooning and without embolus protection device. Radiographic control was performed to detect the natural expansion of the self-expandable device. All interventions were performed in systemic heparinization and after at least 48 hours with double antiplatelet platelet therapy, with the exception of patients with acute stroke.

Results: Technical success was achieved in all patients, without any complication in patients not in acute phase; there were no peri- or post-interventional stroke and no stroke or restenosis after 6 months in the 72 followed-up patients. The stent exhibited foreshortening of about 20%. On plain RX control, we observed the following results: absence of dilatation in 6 cases; poor dilatation in 12 cases; good dilatation in 8; spontaneous complete vessel restoration in 2 cases. Among the 9 patients treated in acute, we observed 1 acute thrombosis in stent. It involved a patient with preocclusive stenosis on predominantly calcific plaque, which could not receive therapy with antiplatelet load.

Conclusion: Our first clinical results using the new CASPER stents how that it provides a safe implantation without occurrence of ischemic events. Its structure, compared with the stent we have more experience with (CAROTID WALLSTENT), shows:

- acceptableflexibility;
- less radial force;
- increasedforeshortening.

Keywords: Double-Layer, Carotid Stent, Carotid Stenosis

P 053

THE SAFETY OF CAROTID ARTERY STENTING IN ELDERLY PATIENTS

M Takasaki[1]
[1]Kansai Electric power Hospital, Osaka, JAPAN

Purpose: With regard to the treatment of carotid artery stenosis in the elderly, Carotid Endoarterectomy (CEA) is considered to have a better outcome than Carotid Artery Stenting(CAS) in previous large studies. In this study, we examined the safety and efficacy of CAS for carotid artery stenosis in the elderly.

Materials and Methods: 46 cases of 47 patients who underwent either CAS or CEA treatment intervention from October 2012 to November 2018 were included. Plaque characteristics on carotid MRI and patient background factors, perioperative complications, prognosis, presence of restenosis were compared and examined for elderly people over 70 years old respectively.

Results: Cases older than 70 years were followed: CAS 21/23 (91%), CEA 17/24 (70%). There was a tendency to have more unstable plaques presenting high signal of carotid MRI T1 in CEA cases (CEA 19 cases (79%), CAS 8 cases (34%); P: 0.06). Stroke and 30 days morbidity, modified Rankin scale after 90 days, and mortality showed no significant difference.

Restnosis after intervention occurred in 2 cases with CAS and 2 cases with CEA. In restenosis patients of CAS, both of them were cases with T1 high signal plaque on carotid MRI.
Conclusion: In our hospital, basically, for plaque lesions that show high signals in carotid MRI T1-weighted images, we consider that there is a risk of thrombotic complications such as plaque proliferation, and CEA is 1st choice as intervention. Therefore, there were few results of carotid MRI T1 high signal plaque group in CAS group. In this study, there were no significant differences in treatment results between CEA and CAS in the elderly. Fewer vulnerable plaques in CAS cases were suggested to have a role in good treatment outcome. Although it is necessary to accumulate and examine additional cases, it is thought that CAS can be safely performed even in the elderly by selecting appropriate treatment depending on the case based on plaque characteristics.
Keywords: carotid artery stenting, elderly patients, carotid endoarterectomy

P 054

CAROTID ARTERY STENTING FOR RESTENOSIS FOLLOWING ENDARTERECTOMY: PERIPROCEDUAL COMPLICATIONS AND LONG-TERM FOLLOW-UP RESULTS

H Endo[1], K Shindo[1], H Sugio[1], T Ogino[1], T Murahashi[2], K Kamiyama[1], Y Seo[1], T Osato[1] and H Nakamura[1]
[1]Nakamura Memorial Hospital – Department of Neurosurgery, Sapporo, JAPAN
[2]Nakamura Memorial South Hospital – Department of Neurosurgery, Sapporo, JAPAN

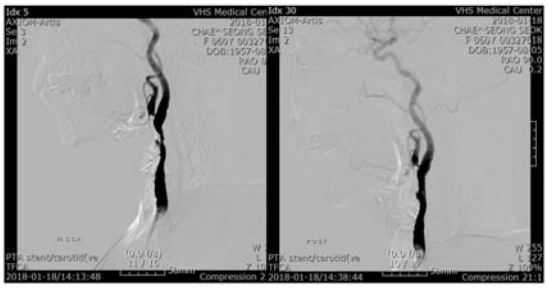
Purpose: Recurrent stenosis following carotid endarterectomy (CEA) is an important complication, and second surgery may have increased morbidity. The long-term follow-up results of carotid artery stenting (CAS) for restenosis following endarterectomy are unclear. The aim of this study was to evaluate the procedural complications and more than 2-year long-term follow-up results of CAS for restenosis following endarterectomy.
Materials and Methods: Ten CAS procedures, performed in nine patients with recurrent stenosis after CEA in our institution between 1998 and 2014, were included in this study. One patient had bilateral lesions. The mean interval between CEA and restenosis (peak systolic velocity >200 cm/sec.) was 8.7 months. The mean interval between CEA and CAS was 15.1 months. One patient presented transient ischemic attack associated with carotid restenosis after CEA, and the others were asymptomatic. CAS procedures were performed under local anesthesia with distal balloon protection (n = 2), distal filter protection (n = 5), and no protection (n = 3). We retrospectively analyzed the periprocedural complications within 30 days and more than 2-year follow-up results.
Results: All CAS procedures were successfully performed. No periprocedual complications occurred, except one patient with hypotension at 6 hour after CAS. The mean duration of follow-up was 9 years. One patient was developed ipsilateral minor stroke (lacunar infarction) at five year after CAS. No in-stent restenosis (>50%) was detected.
Conclusion: In our series, the clinical outcomes of CAS for restenosis following endarterectomy, including more than 2-year long-term follow-up results, were acceptable. Early restenotic lesions following endarterectomy are mainly consisted of intimal hyperplasia; therefore, CAS can be performed with low risk of complications. The medical management of risk factors is also important in a long-term follow-up.
Keywords: carotid artery stenting, carotid endarterectomy, restenosis

P 055

TREATMENT EXPERIENCE AND CHARACTERIZATION OF RADIATION–INDUCED CAROTID STENOSIS (RICS) IN OUR HOSPITAL

I Oh[1]
[1]Veterans Health Service Medical Center, Seoul, SOUTH KOREA

Purpose: While carotid endarterectomy(CEA) is considered to be risky in the treatment of radiation-induced carotid stenosis(RICS), it is a tendency to treat with carotid artery stenting (CAS) recently.



Materials and Methods: In the last 5 years, we analyzed 7 times CAS in 4 patients treated by RICS.
Results: Of the 4 patients, 2 were laryngeal cancer, 1 was gliotic cancer, and 1 was thyroid cancer. The average duration from the time of radiation therapy to the time of CAS is 10 years. At the time of moderate carotid stenosis, it took 30 months (14 months, 22 months, 29 months, 55 months) to get worse just before CAS. In most cases, we were able to observe vulnerable plaques and ulceration by imaging. All procedures have been successful and have never been immediatelyocclusion. No deaths occurred within 30 days. One patient had very small asymptomatic cerebral infarction due to the procedure. One patient underwent three treatments due to frequent recurrence, and restenosis was observed in the proximal and distal portions of the stent.
Conclusion: In RICS, the appearance of the lesion was unstable, ulceration was often accompanied, and stenosis progressed relatively fast. Although CAS has been used for stable treatment, it is necessary to confirm the occurrence of restenosis and new lesions by periodic examination.
Keywords: CAS, post-irradiation, restenting

P 056

INTERNAL CAROTID ARTERY STENOSIS WITH INCOMPLETE SEGMENTAL AGENESIS: A CASE REPORT

T Kawaguchi[1], T Izumi[1], A Kropp[1], M Ikezawa[1], S Goto[1], K Otawa[1], R Oshima[1], T Tsukada[1], M Nishihori[1] and T Wakabayashi[1]

[1]Nagoya University Hospital, Nagoya, JAPAN

Purpose: There are several reports about anatomical abnormalities of the internal carotid artery. We report a case of an internal carotid artery with incomplete segmental agenesis, on which we performed CAS.

Materials and Methods: A 74-year-old man presented with right body sense disorder. Although the symptoms were transient and disappeared completely, MRI revealed a new cerebral infarction on his left parietal lobe. He was admitted for conservative treatment. Examination after admission revealed an internal carotid artery (ICA) with incomplete segmental agenesis. It formed a loop vessel from the common carotid artery (CCA) to the ICA, which branched from the external carotid artery (ECA). At the level between the 3rd and 4th cervical vertebrae, severe stenosis of the CCA was observed. A filter was placed in the distal ICA and CAS was performed. He was discharged without postoperative complications.

Results: The segmental agenesis of the ICA is thought to have caused some segments to regress early in development. The CCA does not divide into the internal or external carotid arteries, and ECA branches directly from the ICA. It is called Non-bifurcating cervical carotid artery and is found only in 0.21% of population. In this report, the ICA is connected with the ECA through the proatrantal artery, which usually regresses early in embryological development, causing an incomplete agenesis of the ICA main stem. In addition, the CCA stenosis often occurs at the original bifurcation point of the ICA and ECA, seen in this case as well. Other reports suggest a histological component such as the carotid sinus might be causing a turbulent flow initiating the agenesis.

Conclusion: We report a case of right internal carotid artery agenesis where CAS was performed with discussion of embryogenesis, clinical presentation, and imaging findings.

Keywords: ICA, CAS, anatomical abnormality

P 057

CASE REPORT:CAROTID ARTERY STENTING WITH PERSISTENT PRIMITIVE HYPOGLOSSAL ARTERY

K Masato[1], K Hideki[1], S Kensaku[1] and S Nao[1]

[1]Wakakusa-Daiichi-Hospital, Higashiosaka, JAPAN

Purpose: We use some protection devices(filer device, proximal balloon device, distal balloon device) considering clinical cases. We report a case of symptomatic internal carotid artery(ICA) stenosis with persistent primitive hypoglossal artery (PPHA), which was treated by carotid artery stenting (CAS) with double distal balloon protection devices at ICA and PPHA.

Materials and Methods: A 72-year-old man suffering from heart failure was referred to our hospital. He admined to cardiology. He had chronic renal failure and had been receiving dialysis. When he was undergoing dialysis, he suffered from loss of consciousness. Diffusion-weighted image showed a left cerebral infarction and MR angiography revealed a PPHA and left ICA stenosis, located just proximal to the origin of the PPHA. The stenosis was more than 50% so CAS was scheduled. Since lesion located just proximal to the origin of the PPHA(less than 1 cm), using filter protection device was difficult. We used double distal balloon protection devices at ICA and PPHA. Bilateral vertebral were hypoplasia, further anterior and posteriol communicating artery were absent. We thought he had no ischemic tolerance, so CAS was performed under general anaesthesia.

Results: Using 7 Fr guiding sheath, GuardWire System was inserted as distal balloon protection devices into the distal left ICA and PPHA. Temporary occlusion of left ICA and PPHA was achieved with inflation of balloons. Carotid wall stent(10 mm diameter/31 mm length) was introduced, but the length was not enough. We added Precise(10 mm diameter/40 mm length). The occulusion time was 16 minutes.CAS was performed without complication. The patient awoke from general anaesthesia without neurological deficits.

Conclusion: We did CAS with persistent primitive hypoglossal artery and we adopted double distal balloon protection devices at ICA and PPHA.

Keywords: carotid, stenting, hypoglossal

P 058

PREDICTION OF CEREBRAL HYPERPERFUSION PHENOMENON AFTER CAROTID ENDARTERECTOMY OR CAROTID STENTING BY COMPUTED TOMOGRAPHY PERFUSION IMAGING

K Shindo[1], T Ogino[1], H Endo[1], H Sugio[1], T Murahashi[1], K Kamiyama[1], T Oosato[1] and H Nakamura[1]

[1]Nakamura Mrmorial Hospital, Sapporo, JAPAN

Purpose: Single-photon emission computed tomography (SPECT) with acetazolamide challenge is useful in the prediction and assessment of post- carotid endarterectomy (CEA) or – carotid stenting (CAS) cerebral hyperperfusion(CHP). However, serious adverse reactions of acetazolamide has been reported so far. The purpose of this study was to predict CHP by computed tomography perfusion imaging (CTP).

Materials and Methods: SPECT with acetazolamide challenge and CTP, as preoperative study, were used in 116 patients had CEA or CAS from August 2015 to August 2018. 21 patients was determined as having risk of CHP by SPECT with acetazolamide challenge. After co-registration of

the CTP and SPECT image, we assessed the relationship between the parameters of CTP and SPECT findings in 21 patients regarded as high risk of CHP. CTP maps were assessed for cerebral blood flow(CBF), cerebral blood volume(CBV), mean transit time(MTT), time to peak(TTP), time to start(TTS) and time to drain(TTD).
Results: Increased CBV, delayed TTD and delayed TTP were observed in all 21 patients. Six of 21 patients had CHP. In these 6 patients, delayed MTT and delayed TTS was observed. Delay of MTT and TTS strongly correlated with post-operative CHP ($p < 0.05$).
Conclusion: Pre-operative CTP would be useful for the prediction of cerebral hyperperfusion.
Keywords: Computed tomography perfusion, Hyperperfusion, Carotid artery stenting

P 059

ASSESSMENT OF CEREBRAL HEMODYNAMICS USING FLUID-ATTENUATED INVERSION RECOVERY HYPERINTENSE VESSELS IN PATIENTS WITH CERVICAL INTERNAL CAROTID ARTERY STENOSIS

T Nishimoto[1], H Ishihara[1], F Oka[1] and M Suzuki[1]
[1]Department of Neurosurgery, Yamaguchi University School of Medicine, Ube, JAPAN

Purpose: Fluid-attenuated inversion recovery hyperintense vessels (FHV) are linked to sluggish or disordered blood flow through. We investigated the correlation between FHV and cerebral blood flow (CBF) in patients with cervical internal carotid artery stenosis (CICAS).
Materials and Methods: Chronic CICAS patients who underwent carotid artery stenting in our department between March 2011 and October 2018 ware enrolled. We compared FHV with the age, sex, medical history, cerebral angiographic findings using digital subtraction angiography (DSA), and CBF evaluation measured using single-photon emission computed tomography with acetazolamide challenge. The degree of stenosis was calculated from DSA according to the North American Symptomatic Carotid Endarterectomy Trial (NASCET) criteria. The resting CBF (rCBF) and the cerebrovascular reactivity (CVR) in the middle cerebral artery area were determined.
Results: Overall, 173 patients were analyzed retrospectively. Ninety-two patients (53.2%) exhibited FHV. Patients with FHV had more severe stenosis [median NASCET, 85.0%; interquartile range (IQR), 80%–90% vs. median NASCET, 75%; (IQR), 70%–87%, $P < 0.01$] and more leptomeningeal collateral vessels (41.9% vs. 14.9%, $P < 0.01$). Furthermore, compared to FHV negative patients, FHV positive patients exhibited no difference in the rCBF [median, 28.6 mL/100g/min; (IQR), 25.0–32.6 mL/100g/min vs. median, 29.4 mL/100g/min; (IQR), 25.4–34.0 mL/100g/min, $P = 0.29$), but showed reduced CVR [median, 11.3%; (IQR), 1.3%–25.4% vs. median, 31.3%; (IQR), 15.3%–47.0%, $P < 0.01$].
Conclusion: FHV correlates with severe stenosis and leptomeningeal collaterals in patients with CICAS. Furthermore, FHV can assess hemodynamic impairment in patients with CICAS.
Keywords: carotid artery stenosis, hemodynamic impairment, FLAIR hyperintense vessels

P 060

NUMERICAL ANALYSIS OF THE HEMODYNAMICS IN THE EXTRACRANIAL CAROTID ARTERY BEFORE AND AFTER ANGIOPLASTY WITH STENT VIA CFD

LJ Haas[1], CR Schwatz[2], IAD Fiamoncini[2], HF Meier[2], JCSC Bastos[2], GV Staedele[2], WR Berticelli[2], M Becker[2], MC Harger[2], CB Lima[2], J Martins[2], BR Sabel[2], FJ Cobra[2], MD Soares[2], LCO Camilo[2], VD De Almeida[2], CGJL Brasileiro[2], JD Hessmann[2], LM Silva[2], A De Oliveira Junior[1], D Malacarne[1] and B Sartori[1]
[1]Hospital Santa Isabel, Blumenau, BRAZIL
[2]University Of Blumenau – Furb, Blumenau, BRAZIL

Purpose: The common carotid artery (CCA) is the main vessel responsible for transporting blood to all areas of the head and neck. This vessel, however, can suffer from atherosclerosis, which is a pathology characterized by the accumulation of a monocyte and platelet plaque on the surface of vessel walls, blocking the lumen partially or fully. This plaque hinders the blood flowing to the brain, resulting in a possible ischemic stroke, which is responsible for the second highest death tollin the world. Nevertheless, such narrowing of the artery can be treated with the insertion of stents. The purpose is evaluate the hemodynamics inside a right extracranial carotid artery before and after angioplasty, with the use of Computational Fluid Dynamics (CFD) tools.
Materials and Methods: In the pre-processing step,a carotid artery geometry was developed based on images obtained in a rotational angiography exam of a67-year-old female patient. This right carotid artery used as a model presented a stenosis degree of 70%. Once the geometry was built, a numerical mesh was created, in order to discretise the spatial domain and solve the conservation equations. The preprocessing step utilized Blender v2.79 and AnsysICEM v15.0 software. For the processing step, a constant inflow velocity was adopted, rheological models were used andcompared to a Newtonian approach. Additionally, the k-epsilon turbulence model was also tested.
Results: It was analysed that in the artery before angioplasty, velocity contours presented a higher non uniformity, when compared to the post-surgery geometry. In both cases, the use of a turbulence model had negligible differences in the parameters obtained, such as velocity, molecular viscosity and wall shear stress (WSS). As for the rheological models, a non-Newtonian approach showed higher molecular viscosity values, which consequently resulted in higher WSS values. Additionally, the geometry after angioplasty showed a lower Reynolds number. Moreover, WSS values were considerably lower in the post-surgery geometries and when not using a turbulence model.

Conclusion: The angioplasty resulted in a higher uniformity of the velocity profiles, as well as lower Reynolds numbers and WSS values, which might reduce the risks of a restenosis. These lower values were observed due toan increase of 12% in the lumen diameter after surgery. Furthermore, CFD is a useful tool that can be applied to aid physicians with further analysis of the hemodynamics.
Keywords: Hemodynamics, Computational Fluid Dynamics, Stenosis

P 061

CEREBRAL BLOOD FLOW CHANGES ALONG WITH STAGED ANGIOPLASTY FOR THE PATIENTS WITH CAROTID ARTERY STENOSIS

F Oka[1], H Ishihara[1], T Oku[1], H Yoshino[1], A Kawano[1], T Nishimoto[1], K Okazaki[1] and M Suzuki[1]
[1]Yamaguchi University School of Medicine, Ube, JAPAN

Purpose: Hyperperfusion (HP) syndrome is a potentially devastating complication after carotid artery revascularization. Although staged angioplasty (SAP) has been reported as an effective method to avoid HP after carotid artery revascularization, there are less evidences and cerebral blood flow (CBF) changes along with each stage have not been studied yet. Here, we studied the safeness and effectiveness of SAP and examined CBF changes in detail.
Materials and Methods: Before carotid artery stenting, N-isopropyl-p-[I-123] iodoamphetamine single-photon emission computed tomography (123I-IMP SPECT) was performed to measure CBF and the patients who showed decreased CBF after the Diamox challenge (i.e. steal phenomenon) were allocated to perform SAP. The patients were performed an angioplasty with 3–3.5 mm balloon catheter (1st stage) followed by a full stenting (2nd stage) 2 weeks later. 123I-IMP SPECT was performed for 4 times (pretreatment, within 2 hours after 1st stage, 1 week after 1st stage, within 2 hours after 2nd stage) for each patient. We focused on the CBF changes in the territory of middle cerebral artery (MCA) on the ipsilateral side of carotid artery stenosis. HP phenomenon was defined as asymmetry index of more than 120% compared to the normal side and also increase of more than 40% compared with preoperative values.
Results: Twenty-five patients met the criteria and allocated to perform SAP. Because of restenosis due to elastic recoil after the angioplasty, 7 of 25 (28%) patients were required stent placement during the 1st stage. Within 2 hours after the 1st stage, none of the patients who were finished with only angioplasty with the balloon catheter as we planned showed HP phenomenon, whereas 2 of 7 (29%) patients who required direct stenting showed HP phenomenon. One week after the 1st stage, cerebrovascular reactivity (CVR) after the Diamox challenge was increased in all but one patient and mean CVR was significantly increased from $-14.6 \pm 9.3\%$ to $10.8 \pm 14.7\%$. Within 2 hours after the 2nd stage, none of the patients showed HP phenomenon. One patient (4%) suffered minor ischemic stroke 1 week after the 2nd stage and none of the patients showed HP syndrome.
Conclusion: Hemodynamic improvement was seen 1 week after the 1st stage and seems reasonable to have 2 weeks interval between the first and the second stage. SAP seems safe and effective to avoid HP in these selected patients.
Keywords: caroti artery stenting, cerebral blood flow, hyperperfusion syndrome

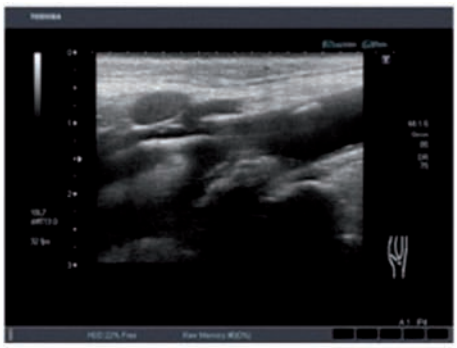
P 062

CAROTID ARTERY STENTING USING ADDITIONAL DUPLEX-GUIDANCE

T Ohashi[1]
[1]Kashima Heart Clinic, Kamisu, JAPAN
[2]Toko Medical University Ibaraki Medical Center, Ami, JAPAN

Purpose: Carotid artery stenting with additional duplex-guidance is useful especially for cases of renal disfunction, some allergic diseases and mobile plaque. We report 16 cases of carotid artery stenting with additional duplex-guidance.
Materials and Methods: We perfomed Carotid Artery Stenting with duplex-guidance for 16 cases, with combination of Flow reversal technique. We checked a position of stenosis, true lumen, reversed flow when introduced flow reversal method and in-stent trouble after stent deployed with duplex-guidance.
Results: We used contrast media 0–30 ml(Ave.5.25 ml), in 11 of 16 cases we did not use contrast media. Reason of choosing this method: renal dysfunction:11, allergy for contrast media:2, mobile plaque:3, totally occluded:1. Stent were applied successfully in all cases. But in 2 cases, We have to use additional stent because of inappropriate stent position.
Conclusion: Carotid artery stenting with additional duplex-guidance is useful especially for cases of renal disfunction, some allergic diseases and mobile plaque. It is sometimes difficult about stent positioning, which can be resolved by fusion image of MRA and Cervical CT.
Keywords: Carotid Artery Stenting, Cerebral infarction, Echo guided

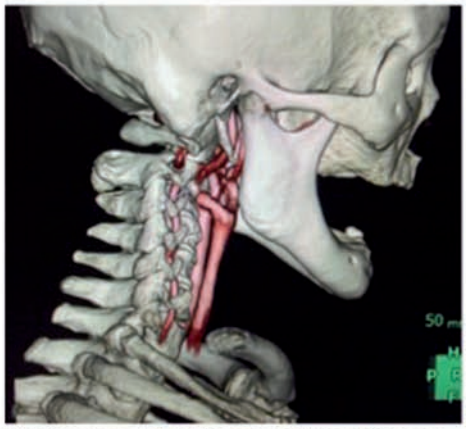
1	84	M	asthma	0	Distal Balloon	Wallstent	
2	81	M	renal dysfunction	0	Flow Reversal	Precise	
3	81	M	renal dysfunction	10	Flow Reversal	Wallstent	
4	73	M	mobile plaque	24	Flow Reversal	Wallstent	
5	55	M	renal dysfunction	0	Flow Reversal	Wallstent x2	
6	77	M	renal dysfunction	0	Distal Balloon	Wallstent	
7	75	F	renal dysfunction	0	Flow Reversal	Wallstent	
8	77	M	allergy for CE	0	Distal Filter	Wallstent x2	
9	66	M	renal dysfunction	0	Flow Reversal	Protégé	
10	81	M	renal dysfunction	10	Flow Reversal	Wallstent	hyperperfusion
11	62	M	mobile plaque	0	Flow Reversal	Wallstent	
12	66	M	total occluded	30	Flow Reversal	Wallstent	
13	65	M	renal dysfunction /mobile plaque	0	Flow Reversal	Wallstent	
14	76	M	renal dysfunction	0	Flow Reversal	Wallstent	
15	82	M	renal dysfunction	0	Flow Reversal	Wallstent	hemiparesis
16	68	M	renal dysfunction	10	Flow Reversal	Wallstent	
				5.25			



Ultrasonography enabled to see tip of microguidewire and to cross the lesion avoiding mobile plaque.

Examiner of ultrasonography is using radiopaque gloves.

Color doppler image can easily show reversal flow of internal carotid artery .



Fusion images of MRA and cervical CT are helpful for stent positioning.

P 063

CEREBRAL ISCHEMIA DETECTED WITH DIFFUSION-WEIGHTED MAGNETIC RESONANCE IMAGING IN PATIENTS TREATED WITH CAROTID ARTERY STENTING: COMPARISON OF INSERTING EMBOLIC PROTECTION DEVICE BEFORE AND AFTER BALLOON PREDILATATION

K Kwon[1] and M Byun[1]

[1]Mediplex Sejong Hospital, Incheon, SOUTH KOREA

Purpose: The purpose of this study was to compare the incidence of cerebral embolic lesions on diffusion-weighted magnetic resonance imaging (DWI) in patients treated with carotid artery stenting (CAS) and postprocedural embolic events between inserting embolic protection device (EPD) before and after balloon predilatation.

Materials and Methods: Eighty-one patients with high-grade proximal internal carotid artery stenosis underwent CAS. The cases of EPD insertion before balloon predilatation (group A) were 39 (48%) and after balloon predilatation (Group B) were 42 (52%). All of the patients were evaluated pre- and postoperatively with DWI to depict the number of new embolic lesions and examined on symptomatic embolic events.

Results: New cerebral embolic lesions on DWI were detected in 26 (66.7%) of group A and 15 (35.7%) of group B ($P = 0.008$). The mean number of total, ipsilateral, contralateral, cerebellar new cerebral ischemic lesions was 2.92, 1.92, 0.38, and 0.62 in group A and 1.95, 1.00, 0.79, and 0.17 in group B, respectively. Postprocedural embolic events were developed in 7 (17.9%) of group A and 1 (2.4%) of group B ($P = 0.026$). There was no mortality in both groups.

Conclusion: In the sequence of CAS, EPD insertion before balloon predilatation has much more chance of cerebral embolism on DWI and symptomatic embolic events than that after balloon predilatation. It seems likely that during the CAS, EPD insertion after balloon predilatation is safe step to prevent periprocedural embolism.

Keywords: carotid stenting, embolic protection device, predilatation

P 064

RISK FACTORS OF IPSILATERAL, CONTRALATERAL AND VERTEBROBASILAR MICROEMBOLIC INFARCTIONS FOLLOWING CAROTID ARTERY STENTING

DW Park[1] and TY Kim[1]
[1]Hanyang University Guri Hospital, Guri, SOUTH KOREA
[2]Hanyang University Guri Hospital, Guri, SOUTH KOREA

Purpose: To evaluate the risk factors of ipsilateral and contralateral internal carotid and vertebrobasilar microembolic infarctions (MIs) on diffusion-weighted imaging (DWI) following protected carotid artery stenting (CAS).
Materials and Methods: 126 CASs in 116 patients were performed, who all obtained DWI within 48 hours after the procedures. Seventy-one (61.2%) patients with new MIs revealed on DWI were enrolled. They were divided into ipsilateral, contralateral and vertebrobasilar groups based on the side of the CAS and MIs. The ipsilateral group includes new MIs exclusively on the side of CAS, while contralateral and vertebrobasilar groups includes new MIs on the opposite side of the CAS and vertebrobasilar territory, respectively, irrespective of new MIs on the other territories. Patient characteristics, morphology of the carotid artery and aortic arch, and procedural data were retrospectively assessed and compared between the three groups.
Results: 45 (38.8%), 20 (17.2%) and 6 (5.2%) patients were assigned to the ipsilateral, contralateral and vertebrobasilar groups, respectively. Advanced age, left-sided stenosis, previous ipsilateral recent infarcts and prominent aortic arch calcification on CT angiography significantly increased the occurrence of contralateral and vertebrobasilar MIs. On multivariable logistic regression analysis, previous ipsilateral recent infarcts and prominent aortic arch calcification were statistically more frequent in the contralateral and vertebrobasilar groups.
Conclusion: Contralateral and vertebrobasilar microembolic infarctions after CAS don't rarely occur. Previous ipsilateral recent infarcts and advanced aortic atherosclerosis with calcifications is statistically predictive for contralateral and vertebrobasilar microembolic infarctions. CT angiography is useful for estimating aortic wall calcifications in candidates for CAS.
Keywords: acute infarct after procedure, risk factor, carotid artery stenting

P 065

EFFECT OF GENERAL ANESTHESIA ON HEMODYNAMIC INSTABILITY AND PERIPROCEDURAL COMPLICATIONS DURING CAROTID ANGIOPLASTY AND STENT

S Cho[1] and J Kim[1]
[1]Yeouido St. Mary's hospital, Catholic university of Korea, Seoul, SOUTH KOREA

Purpose: Incidence and risk factor for the occurrence of hemodynamic instability during and after carotid angioplasty and stenting(CAS) under general anesthesia (GA) were not established. The purpose of this study was to determine the effect of GA on hemodynamic instability and periprocedural complications during and after CAS.
Materials and Methods: The study reviewed demographics, risk factors. and angiographic data from the patients receiving CAS under GA between 2010 and 2017 at a single institution. Hemodynamic instability was defined as hypertension (systolic blood pressure [SBP] $>$ 160), hypotension (SBP $<$ 90), or bradycardia (heart rate $<$ 60). Transient ischemic attack (TIA), stroke, myocardial infarction (MI), and death within 30 days of the procedure were evaluated as periprocedural complications.
Results: Fourty-seven CAS were performed in fourty-three patients. Thirty-seven were men (86%). Mean age was 69.5 years-old. Twenty-three patients (53.4%) were symptomatic. Eleven patients (18.6%) underwent HI. The degree of stenosis was significant statically correlated with the occurrence of HI ($p < 0.03$). No other factors have a correlation with HI. 1 TIA and 1 MI were occurred.
Conclusion: Hemodynamic instability during and after CAS under GA were occurred less frequently than those under local anesthesia. However, the patients with severe degree of stenosis have a high risk of HI, so need a close observation.
Keywords: carotid stent, general anesthesia, hemodynamic instability

P 066

EFFICACY OF CAROTID ARTERY STENTING UNDER GENERAL ANESTHESIA WITH AN INTRAOPERATIVE MONITORING

T Osanai[1], T Aoki[2], M Gekka[1] and K Houkin[1]
[1]Department of Neurosurgery, Faculty of <edocome amd Gradiate Scjool of Medicine, Hokkaido University, Sapporo, JAPAN
[2]Department of Neurosurgery, Hokkaido Memorial Neurosurgical Hospital, Sapporo, JAPAN

Purpose: During carotid artery stenting (CAS) procedure, it is sometimes experienced that the carotid sinus reflex causes the hemodynamics to be unstable, and the surgeon should manage it. Although it is reported that general anesthesia stabilizes the intraoperative hemodynamics, it is impossible to check the neurological condition during procedure under general anesthesia. In this study, we investigated intraoperative hemodynamics change and perioperative complications of CAS under general anesthesia and evaluate its efficacy of SEP during procedure to detect perfusion reduction during.
Materials and Methods: From April 2011 to March 2016, 53 consecutive patients who underwent carotid artery stenting under general anesthesia in our facility were evaluated. All patients were monitored by NIRS and SEP during procedure.

Patient background, a kind of protection methods during CAS, intraoperative hemodynamic change (blood pressure and pulse rate), intraoperative NIRS and SEP change, perioperative complication were evaluated retrospectively.
Results: In all cases, carotid artery stenosis was improved by CAS. Fifteen cases (28.3%) showed intraoperative hypotension defined as SBP was 100 or lower. 11 cases (20.8%) showed intraoperative bradycardia, No case showed systolic blood pressure lower than 50 mm Hg from baseline. As complications associated with CAS, No cases showed postoperative hyperperfusion symptoms after surgery. 3 cases (5.7%) showed postoperative infarction. 2 cases (3.8%) showed postoperative cerebral ischemic symptoms. No complications associated with general anesthesia were observed. The decrease in intraoperative SEP was observed in 21 cases (39.6%). Of those, 5 cases (23.8%) showed temporally and permanent postoperative cerebral ischemic symptom.
Conclusion: As in past reports, CAS under general anesthesia prevented surgical artery sinus reflux, stabilized hemodynamics during surgery, suppressed body movements, and was able to perform CAS procedures safely and accurately. Compared with clinical trials, complications due to general anesthesia and increased incidence of cerebral infarction after surgery were not observed. The incidence of hyperperfusion after surgery was decreased. In addition, by using SEP for general anesthesia CAS, it is possible to evaluate perfusion reduction during surgery in real time, and it is very useful for cases suspected to be at risk of postoperative hyperperfusion, intraoperative hypotension or intraoperative disturbance.
Keywords: Carotid artery stenting, general anesthesia, Carotid sinus reflux

P 067

IMAGING FOLLOW UP AFTER CAROTID ARTERY STENTING WITH CARORID WALLSTENT USING CT ANGIOGRAPHY

T Nomura[1], D Sasamori[3], T Nonaka[1], T Onda[1], Y Yonemasu[1], S Inamura[2], Y Hashimoto[2], O Honda[2] and M Daibo[2]
[1]Sapporo Shiroishi Memorial Hospital – Department of Neuroendovascular Therapy, Sapporo, JAPAN
[2]Sapporo Shiroishi Memorial Hospital – Department of Neurosurgery, Sapporo, JAPAN
[3]Sapporo Shiroishi Memorial Hospital – Department of Radiology, Sapporo, JAPAN

Purpose: Computed tomography angiography (CTA) is useful for postoperative evaluation of re-stenosis and plaque protrusion after carotid artery stenting (CAS). However, in the image evaluation by CTA, artifacts of the stent depends on the characteristics such as the stent structure and raw materials. Especially, Carotid Wall stent Monorail (Boston Scientific, Natick, MA, USA, following CWS) in cobalt-chromium alloy and tantalum, has strongly artifacts compared with the Nitinol stents because of the high atomic number. CWS is closed-cell stent, so braided wire is characterized by a linear and cyclic. Therefore, we considered that it was possible to avoid the overlap of tantalum if devised positioning of the patient. In this study, we investigated the optimal protocol of CTA after CAS using CWS.
Materials and Methods: Lightspeed Ultra (General Electric Medical Systems, Milwauke, WI, USA) was used for CT, and the imaging data were analyzed using GE Advantage workstation (version 4.0, GE Healthcare, Wauwatosa, WI, USA). Acrylic cylinders of 4–10 mm in diameter were made to be a simulated blood vessel, and CWS (10 x 24 mm) was deployed in each. The tilt angle of the stent with respect to the Z axis was changed from 0° to 60° after the diluent contrast media was filled, and the image was made by the curved MPR method. The tilt angle and artifacts were examined. For the evaluation of the artifact, the average of Noise SD measured at 3 points in the stent was used. And continuous 30 cases which deployed the CWS, tilt angle and the Noise SD were examined retrospectively. The tilt angle in the CTA was set by retroflexion or lateral flexion of the cervix based on the shape and running of CWS.
Results: Noise SD was smallest at the tilt angle of 40–45° when the vessel diameter was less than 7 mm. On the other hand, when the diameter of the blood vessel was 7 mm or more, it was the smallest at the tilt angle of 35°–45°. The clinical results of 30 consecutive 3D-CTA cases following CWS placement were similar to those of simulated vessels.
Conclusion: In the image evaluation by CTA after the CWS placement, the accurate observation of the stent lumen with reduced artifacts was possible by the scanning method based on the features of the structure of CWS.
Keywords: Carotid artery stenting, CT angiography, Wallstent

P 068

INVESTIGATION OF LDL CHOLESTEROL FOR IN-STENT PLAQUE, POST CAROTID ARTERY STENTING

H Wada[1] and K Kamada[1]
[1]Asahikawa Medical University, Asahikawa, JAPAN

Purpose: LDL is known as a risk factor for peripheral obstructive artery disease and coronary artery disease. For surgical treatment of arteriosclerotic diseases, it is necessary to know the characteristics of plaque. In this study, we report LDL as a factor related to postoperative cerebral infarction and in-stent plaque which is a factor of restenosis, and investigated retrospectively.
Materials and Methods: We studied 162 cases (CAS; 48) of LDL from Asahikawa Medical University, 2017 to 2018, neuro IVR treatment conducted at the neurosurgical department. And for CAS treatment, the items examined were age, gender, medication of statin or other DLP agents, kind of stent, number of MRI-DWI lesions that appeared, presence of in-stent plaque, and MRS at discharge.
Results: After CAS administration, MRI and DWI positive rate was 37 cases (52.9%). 9/48 cases (17.0%) were able to confirm in-stent plaques by CTA or ultrasound after CAS.

In one patient, additional treatment (2.1%) was performed. It was 99/162 (61.1%) who was able to measure LDL at the time of admission, 101.2 ± 31 for men, 117.8 ± 31 for females (P = 0.55), 119.4 ± 36 for those under the age of 70 and over 70 years old (P = 0.087) was 98.2 ± 23.9. About in-stent plaque of CAS treatment, when cutoff was set to 102 mg / dl, there was significant difference in group with high LDL at hospitalization (P = 0.021). As a result of multivariate analysis, there was no significant difference in the presence or absence of statin, the presence or absence of symptoms, sex, and age.e, and MRS at discharge.
Conclusion: LDL was also found to be involved in postoperative plaque which could lead to complications of CAS treatment. New agents such as PCSK 9 can significantly decrease LDL in a short period of time than statin. Deploying these agents can make CAS more safely.
Keywords: CAS, in-stent plaque, LDL cholesterol

SESSION: Aneurysms

P 069

ENDOVASCULAR TREATMENT OF 31 ANTERIOR CHOROIDAL ARTERY ANEURYSMS

T Sugawara[1], N Kimura[1], M Yokosawa[1], R Doijiri[2], K Takahashi[2] and T Kikuchi[2]
[1]Iwate Prefectural Central Hospital, Department of Neurosurgery, Morioka, JAPAN
[2]Iwate Prefectural Central Hospital, Department of Neurosurgery, Morioka, JAPAN
[3]Iwate Prefectural Central Hospital, Department of Neurosurgery, Morioka, JAPAN
[4]Iwate Prefectural Central Hospital, Department of Neurology, Morioka, JAPAN
[5]Iwate Prefectural Central Hospital, Department of Neurology, Morioka, JAPAN
[6]Iwate Prefectural Central Hospital, Department of Neurology, Morioka, JAPAN

Purpose: Anterior choroidal artery (AChA) supplies important areas of the nervous system, particularly the posterior limb of the internal capsule and optic radiation. AChA aneurysms are difficult to treat and relatively rare, representing 2–5% of all intracranial aneurysms. Few literature reports have focused on surgical or endovascular treatment. The purpose of this study was to document the outcome and follow-up results of endovascular coil embolization in patients with AChA aneurysms. We analyzed the surgical results of endovascular coiling for AChA aneurysms performed in a single institution.
Materials and Methods: Between Jun 2000 and Dec 2018, 30 patients with 31 AChA aneurysms (12 subarachnoid hemorrhage,9 ruptured and 22 unruptured AChA aneurysms) were treated with endovascular coil embolization. This group included 5 men and 25 women with ages ranging from 35 to 86 years(mean, 63 years). There were 29 small aneurysms(<10 mm) and 2 large aneurysms, with a mean aneurysms diameter of 5.3 mm. Multiple aneurysms were 12 cases (40%). Efficacy and safety were evaluated based on the degree of initial occlusion, procedure-related complications, patient outcome(modified Rankin Scale: mRS) and follow-up results.
Results: The degree of angiographic occlusion of the aneurysms was complete for 12 aneurysms(39 %), neck remnant for 15 aneurysms (48%), and body filling for 4 aneurysms(13%). There were 3 (9.6 %) symptomatic procedure-related complications due to thromboembolic events. The thromboembolic events caused one transient dysarthria, two completed deficits(dysesthesia and hemianopsia). A favorable outcome (mRS 0–2) was achieved in all unruptued cases at the time of discharge. Major aneurysm recanalization occurred in one case necessary for retreatment. No bleeding of treated AChA aneurysms was occurred during follow-up periods(mean 44 months).
Conclusion: Coil embolization enables procedural recognition of arterial compromise and immediate reestablishment of flow, thus contributing to a favorable outcome. Endovascular coil embolization is a safe and effective treatment modality in cases of AChA aneurysms.
Keywords: anterior choroidal artery, cerebral aneurysms, coil embolization

P 070

EMBOLIZATION FOR INTERNAL CAROTID-POSTERIOR COMMUNICATING ARTERY ANEURYSM

M Ezura[1], H Sakata[1] and H Uenohara[1]
[1]NHO Sendai Medical Center, Sendai, JAPAN

Purpose: Neuroform Atlas stent made the indication of internal carotid artery (ICA) aneurysm wide. We summarize the embolization for ICA-Posterior communicating artery (PcomA) aneurysm after introduction of Neuroform Atlas stent.
Materials and Methods: We have 58 cases of embolization for ICA-PcomA aneurysm in 2017 and 2018.
Results: There are 8 males and 50 females. Acutely ruptured cases are 26, and chronic ruptured or unruptured cases are 32. Embolization methods are simple coiling in 26, stent assist in 26 (Neuroform Atlas 14, LVIS 10, Enterprise 2), balloon assist in 2, double catheter in 3, and Pipeline in 1 (simultaneous treatment with proximally located giant aneurysm). Only Neuroform Atlas is used in acutely ruptuered case (4 cases) and is used as the stent placed in the PcomA itself (3 cases). PcomA is not necessarily preserved if the P1 is obvious, but there is no ischemic event in ipsilateral posterior cerebral artery territory. There is one case in which embolization was performed together with small perforator deriving from aneurysm dome and hemiparasis and consciousness disturbance appeared after embolization.
Conclusion: Neuroform Atlas made the indication of ICA aneurysm wide. Preservation of perforator of PcomA is more important than that of PcomA itself.

Keywords: internal carotid artery, posterior communicating artery, stent

P 071

COIL EMBOLIZATION FOR UNRUPTURED CEREBRAL ANEURYSM IN ELDERLY PEOPLE (OVER 70 YEARS OLD)

K Orito[1], S Kajiwara[1], Y Takeuchi[1], M Hirohata[1] and M Morioka[1]

[1]Kurume university Department of neurosurgery, Fukuoka, JAPAN

Purpose: The efficacy and problems of endovascular surgery for unruptured cerebral aneurysms in elderly (over 70 years old) patients were examined in our hospital.

Materials and Methods: 107 patients (F:M = 83: 24, mean age 73.4 y.o.) underwent surgery for unruptured cerebral aneurysm in our hospital from January 2001 to June 2018. The locations were ICA (59, 55.1%), AcomA or ACA (24, 22.4%), VA and BA (15, 14%), and MCA (6, 5.6%). 29 cases were large aneurysms. The treatment was performed under general anesthesia with two antiplatelet agents managed one week before in all cases. Coil embolization was performed using various adjunctive techniques (double catheter: 29, balloon neck remodeling: 30, stent assisted: 30).

Results: Angiography performed before discharge revealed complete CE in 47, small neck remnant in 42, and dome filling in 12 patients and attempted in 5. Arteriosclerosis was strong in all five cases that resulted in attempt, and approach was difficult. Symptomatic complications were observed in 4 cases (3.8%). 1 case intraoperative rupture and 2 other patients were noticed cerebral infarction after CE. Postoperative intracerebral hemorrhage in parietal lobe was noted in 1 patient with pipeline case. The aneurysm ruptured in 2 cases after treatment. Average observation period was 6.5 years.

Conclusion: Aneurysm embolization for elderly people older than 70 years tends to have a slightly lower complete embolism rate (43.9%) and a higher symptomatic complication rate (4.8%) compared to young people. However, the effect as aneurysm rupture prevention is sufficient and seems to be a useful treatment.

Keywords: elderly people, unruptured aneurysm, coil embolization

P 072

TREATMENT OUTCOMES OF COIL EMBOLIZATION FOR SUBARACHNOID HEMORRHAGE IN PATIENTS OVER 80 YEARS OF AGE

K Fukutome[1], S Takai[1], R Matsuoka[1], R Maeoka[1], K Takahashi[1], H Ohnishi[1], S Yamamoto[1], T Nishioka[1], Y Kodama[1], Y Kuga[1] and H Ohnishi[1]

[1]Ohnishi neurological center, Akashi, JAPAN

Purpose: With a rapidly ageing society, the number of elderly patients with subarachnoid hemorrhage (SAH) is also increasing. Coil embolization is often chosen as the surgical treatment of choice for elderly patients with SAH because of its minimally invasive nature. We assessed the treatment outcomes of coil embolization in patients aged 80 years and over with ruptured cerebral aneurysms and compared them retrospectively with those in patients aged < 80 years.

Materials and Methods: Between April 2016 and March 2019, 74 patients with SAH underwent coil embolization due to ruptured cerebral aneurysm in our hospital. Based on their ages, patients were classified into those aged 80 years and over (group A, n = 12) and those aged < 80 years (group B, n = 62). We retrospectively compared these groups with respect to prehemorrhage modified Rankin scale (mRS), world federation of neurosurgical societies (WFNS) grade, aneurysm location, acute hydrocephalus, procedural success, surgery-related complications, symptomatic spasm, shunt surgery and mRS at discharge. Outcome-related factors (mRS0-2 at discharge was considered as a good outcome) were also examined for group A. $p < 0.05$ was considered to be a statistically significant difference using chi-square test.

Results: Group A comprised 12 females (mean age, 86.7 years), whereas group B comprised 17 males and 45 females (mean age, 61.7 years). All participants underwent surgery and procedure-related embolic complications were observed only in one case in group B. Compared to group B, group A had significantly fewer cases of WFNS grade I-II ($p = 0.03$) and mRS0-2 at discharge ($p < 0.01$), but more cases of acute hydrocephalus ($p = 0.03$). Only WFNS grade I–II was a factor of good outcome ($p = 0.045$) in Group A. However, prehemorrhage mRS, aneurysm location, procedural success, surgery-related complications, symptomatic spasm or shunt surgery did not differ between groups.

Conclusion: Coil embolization can be safely and effectively performed even in elderly patients with SAH. Although the surgery may lead to poor outcomes in elderly patients with severe SAH, an aggressive treatment may lead to good outcomes in those with low WFNS grade.

Keywords: subarachonoid hemorrhage, coil embolization, elderly

P 073

THE RESULTS OF ENDOVASCULAR TREATMENT FOR ELDERLY CEREBRAL ANEURYSM IN THE SUPER-AGING SOCIETY AGE

R Yagi[1], R Hiramatsu[1], H Ohnishi[2], N Matsubara[1], S Miyachi[3], T Kuroiwa[1,4] and S Kawabata[1]

[1]Osaka Medical College, Takatsuki, JAPAN
[2]Ohnishi Neurological Hospital, Akashi, JAPAN
[3]Aichi Medical University Hospital, Nagakute, JAPAN
[4]Tesseikai Neurological Hospital, Shijonawate, JAPAN

Purpose: In 2017, Japanese life expectancy survey was 81.09 years for men and 87.26 for women, and the population is becoming super-aging. In the future the opportunities to treat elderly patients will be increase. In fact, subarachnoid hemorrhage(SAH) tends to increase year by year with 12, 307 people in Japan. In addition, the rupture rate of cranial aneurysms at all ages is 0.95% annually, but the rupture rate in elderly people is 3% annually at 80 years or. And the rupture ratio in elderly people is reported to be high. Then, in elderly people, treatment results after SAH were predominantly poor at age 75 and older, and perioperative mortality at age 65 and older was 23% for ruptured cases and 1% for unruptured cases. The importance of preventive surgery for unruptured aneurysms has also been reported for the elderly. In this study, we examined the results of endovascular treatment of elderly cerebral aneurysms in our institution with the aim of examining the treatment policy in the age of aging.
Materials and Methods: The subjects were 247 patients who underwent endovascular coil embolization at our hospital between April 2012 and August 2018. The target cases were classified into the rupture group and the unruptured group, the age was classified into 3 ages groups of under 65, 65–74, over 75, and the following items were examined. The items are aneurysm site, size, dome / neck ratio, use of assist technique and intermediate catheter used during operation, number of DWI high signal area, presence or absence of treatment difficulty, treatment outcome was examined. The difficult cases were cases in which wire and catheter were replaced and access root was changed.
Results: There were many cases where induction was difficult in the late elderly group, but there were no cases where treatment was abandoned by devising. Thromboembolic complications were more frequent in patients using assist technique, especially in patients with stents. In unruptured cerebral aneurysms, asymptomatic microischemic lesions on MRI the day after surgery significantly increased in the elderly group but did not affect morbidity / mortality. In ruptured cerebral aneurysms, the outcome after subarachnoid hemorrhage was poor in the elderly over 75 years old.
Conclusion: Even in the elderly, coil embolization for unruptured cerebral aneurysms had the same treatment outcome as non-elderly. In surgery, it is important to consider the access route, and it is necessary to be careful about puncture problems and thromboembolic complications in cases using assist technique.
Keywords: Aneurysm, Elderly patients, coil embolisation

P 074

COST-EFFECTIVENESS ANALYSIS OF COIL EMBOLIZATION FOR SMALL CEREBRAL ANEURYSMS

T Ueno[1]
[1]Tokyo Metropolitan Geriatric Medical Center, Tokyo, JAPAN

Purpose: The purpose of the present study is to compare coil embolization with observation for unruptured small cerebral aneurysms by using cost-effectiveness analysis.
Materials and Methods: A Markov model with microsimulation is built by incorporating annual estimated rupture rate of aneurysms, patient's age, sex, commonly reported clinical outcome, annual natural mortality rate, and so on. Comparisons between two groups were made based upon quality adjusted life years (QALYs).
Results: For an aneurysm with 1% of annual rupture rate, QALYs were greater in the embolization group if a patient's age is under 68 years old. For one with 2%, greater under 79 years old. In case that a patient become depressive after being informed of having an aneurysm, control health status (i.e., health utility value) can be assumed to become compromised. For example, if health utility value of the mentally-depressed patient who has an aneurysm with 1% of annual rupture rate is changed from 1.0 to 0.95, QALYs are greater in the embolization group if a patient's age is under 79 years old.
Conclusion: A risk of having a small cerebral aneurysm untreated should not be exaggerated too much so as to make a patient lean on undertaking treatment.
Keywords: markov model, aneurysm, qaly

P 075

USEFULNESS OF ANEURYSM ANALYSIS SOFTWARE FOR DETERMINATION OF OPTIMAL WORKING PROJECTION IN COIL EMBOLIZATION OF INTRACRANIAL ANEURYSMS

N Iwata[1] **and M Sakamoto**[1]
[1]Tottori University Hospital, Yonago, JAPAN

Purpose: Aneurysm analysis software(Siemens) is an analysis tool for intracranial aneurysm. When perform an Aneurysm analysis, ostium plane and cutting plane of the intracranial aneurysm are automatically calculated. And then both plane are displayed on 3D image. We thought that it becomes optimal working projection during neurovascular therapy, by setting each plane to perpendicular angle on 3D image. Thus, an operator can get the above-mentioned angle easily visually by using this analysis tool. The aim of this study is comparison of working projection which used in past therapy(WP-True) with working projection which find by this method(WP-Analysis).
Materials and Methods: We find WP-analysis from past neurovasucular therapy case. And then compared WP-analysis with WP-true. Number of cases is 38 and use machine is Artis Q.zen biplane(Siemens). A statistical analysis were performed by using Spearman's rank correlation coefficient(ρ) and Wilcoxon signed-rank test.
Results: There was high coefficient between WP-true and WP-analysis in both plane (Ostium plane: $\rho = 0.91$, $p < 0.001$, Cutting plane: $\rho = 0.89$, $p < 0.001$). However, there was significant difference between WP-true and WP-analysis in both plane($p < 0.001$).

Conclusion: Aneurysm analysis software is able to help the determination of optimal working projection during neurovascular therapy. By using this method, we are able to find optimal working projection more easily and with little differences among operators.
Keywords: working projection, aneurysm analysis, working angle

P 076

THE TIMING OF COIL EMBOLIZATION FOR ANEURYSMAL SUBARACHNOID HEMORRHAGE

T Koiso[1], T Sato[2], N Hashimura[1], T Ishiguro[1], H Chikuie[1], G Ikeda[1], E Hamano[1], M Nishimura[1] and J Takahashi[1]
[1]National cerebral and cardiovascular center, suita, JAPAN
[2]Hitachi general hospital, Hitachi, JAPAN

Purpose: Although the patients with aneurysmal subarachnoid hemorrhage (SAH) are treated by interventional radiology (IVR) more frequently than direct surgery, the optimal timing of IVR for those more than 72 hours after onset remains unclear. The purpose of this study was to verify the efficacy and safety of IVR for aneurysmal SAH > 72 hours after onset.
Materials and Methods: This was a single-center, retrospective cohort study. A total of 335 consecutive aneurysmal SAH patients treated in our institute between January 2012 and December 2017 were enrolled. 238 patients who underwent direct surgery, eight patients with multiple aneurysms, 13 patients with history of treatment for intracranial aneurysms, three patients with treated by parent artery occlusion, one patient whose onset time was unknown, and one patient who treated later than 14 days after onset were excluded, and remaining 71 patients (16 male and 55 female patients with a median age of 66 years [range 34–91 years]) who underwent endosaccular coiling were investigated. They were divided into two groups according to the timing of treatment; patients who underwent IVR within 72 hours after onset were group E while who underwent IVR after 72 hours were classified as group D. The rate of intraprocedural complications, symptomatic vasospasm, hydrocephalus, retreatment, and patients' independence (modified Rankin Scale score of 0 to 2) at discharge between two groups were compared.
Results: Patient numbers in the group E and D were 56 (78.9%) and 15 (21.1%), respectively. In group D, all patients came to the hospital > 72 hours after onset. Age, sex, rerupture rate before treatment, location and size of aneurysm, and the rate of adjunctive technique usage were not significantly different. On the other hand, the rate of patients with WFNS grade 1 to 3 and the existence of vasospasm in the access route at the time of IVR were significantly higher in group D than in group E (93.3% vs 60.7%; $p = 0.027$, 33.3% vs 3.6%; $p = 0.0037$, respectively). There were no significant differences in the rate of intraprocedural complications, symptomatic vasospasm, shunt dependency, retreatment, and patients' independence ($p = 0.73$, $p = 0.45$, $p = 0.16$, $p = 1.00$, $p = 0.24$, respectively).
Conclusion: Prompt coiling for patients with ruptured aneurysms whose arrival later than 72 hours after onset can be safely performed.
Keywords: aneurysmal SAH, optimal timing of IVR, more than 72 hours

P 077

LONG-TERM DURABILITY OF SIMPLE AND BALLOON-ASSISTED COIL EMBOLIZATION FOR TREATMENT OF INTRACRANIAL ANEURYSMS

Y Kayan[1], J Delgado Almandoz[1], J Scholz[1], A Milner[1] and M Mulder[2]
[1]Abbott Northwestern Hospital – Neurointerventional Radiology, Minneapolis, USA
[2]Abbott Northwestern Hospital – Critical Care Medicine, Minneapolis, USA

Purpose: To determine recanalization and post-treatment rupture rates in a large cohort of patients with intracranial aneurysms treated with simple or balloon-assisted coil embolization.

Table 1. Independent Predictors of Aneurysm Recanalization at Last Follow-Up

	All aneurysms treated:	Recanalized aneurysms: (%)	p-value:
Patient age ≤49 years:	495	109 (22)	<0.0001
Incomplete initial aneurysm occlusion:	787	161 (20.5)	<0.0001
Ruptured aneurysm status:	544	135 (24.8)	<0.0001
Aneurysm treatment prior to 1/1/2008:	792	154 (19.4)	0.0001
Packing density ≤29.3%:	674	158 (23.4)	0.0009
Aneurysm neck >3.1mm:	558	135 (24.2)	0.0013
Last angiographic follow-up <2 years:	454	107 (23.6)	0.014
Aneurysm size >5.8mm:	717	166 (23.2)	0.019
Use of simple coiling:	549	111 (20.2)	0.038

Table 2. Recanalization Rates by Aneurysm Location and Rupture Status

Aneurysm Location:	All Recanalized: (%)	Unruptured Recanalized: (%)	Ruptured Recanalized (%):	p-value:*
All (n=1,574)	254 (16.1)	119 (11.6)	135 (24.8)	<0.0001
ICA (n=424)	53 (12.5)	36 (9.9)	17 (28.8)	0.0002
Acomm (n=346)	53 (15.3)	14 (9.2)	39 (20.2)	0.006
MCA (n=310)	42 (13.5)	28 (11.7)	14 (20)	0.08
Pcomm (n=221)	51 (23.1)	20 (18.3)	31 (27.7)	0.11
Basilar tip (n=104)	23 (22.1)	9 (14.8)	14 (32.6)	0.05
Other posterior circulation (n=102)	19 (18.6)	5 (8.6)	14 (31.8)	0.004
Other ACA (n=67)	13 (19.4)	7 (15.9)	6 (26.1)	0.34

*p-value for the difference in recanalization rates between unruptured and ruptured anerysms

Materials and Methods: We retrospectively reviewed consecutive patients with intracranial aneurysms treated with simple or balloon-assisted coil embolization at our institution from August 8th, 1995 to September 30th, 2017. Baseline aneurysm and patient characteristics, procedural variables and angiographic outcomes were recorded. Aneurysm recanalization was defined as Raymond 3 or Raymond 2 with a neck remnant at least 4 mm or at least 33% of initial aneurysm volume. Multivariate regression analysis was performed to identify independent variables associated with aneurysm recanalization.

Results: 1,634 patients with 1,935 intracranial aneurysms were included, 1,196 women (73%), mean age 56 years (median 56 years, 8–97 years). 1,125 aneurysms were incidental (58.1%), 752 ruptured (38.9%) and 58 symptomatic (3%). Mean aneurysm size 6.3 mm (median 5.5 mm, 1.6–27.9 mm), mean neck 3 mm (median 2.8 mm, 0.6–16.2 mm), mean dome-to-neck ratio 1.7 (median 1.5, 0.7-6.5). Aneurysm locations: 502 ICA (25.9%), 461 Acomm (23.8%), 375 MCA (19.4%), 276 Pcomm (14.3%), 128 basilar tip (6.6%), 79 other ACA (4.1%) and 114 other posterior circulation (5.9%). 749 aneurysms were treated with simple coiling (38.7%) and 1,186 with balloon-assisted coiling (61.3%), mean packing density 33.4% (median 31.5%, 6.5–94.9%). Angiographic follow-up was completed in 1,574 of 1,730 aneurysms available (91%), mean time to last follow-up 5.3 years (median 4.4 years, 0–20.5 years). Aneurysm occlusion at last follow-up was Raymond 1 in 878 aneurysms (55.8%), Raymond 2 in 496 aneurysms (31.5%), and Raymond 3 in 200 aneurysms (12.7%). There were 254 aneurysm recanalizations at last follow-up (16.1%), and 202 aneurysms were retreated (12.8%). Table 1 summarizes independent predictors of aneurysm recanalization in our cohort. Table 2 summarizes recanalization rates by location and rupture status. 13 aneurysms ruptured after coiling (0.8%), corresponding to an annual post-treatment rupture rate of 0.15%. Mean time from treatment to rupture was 5.8 years (median 4.5 years, 0–12.7 years). Mean time from last angiographic evaluation to rupture was 2.2 years (median 1 year, 0–10.2 years). Aneurysm occlusion at the last angiographic evaluation prior to rupture was Raymond 1 in 4 aneurysms, Raymond 2 in 3 aneurysms, and Raymond 3 in 6 aneurysms. 12 post-treatment ruptures occurred in aneurysms treated before 1/1/2008.

Conclusion: Endovascular aneurysm treatment with coils alone is associated with relatively high long-term recanalization and post-treatment rupture rates, especially after treatment of ruptured aneurysms. Long-term angiographic follow-up and early retreatment of recanalized aneurysms would be prudent.

Keywords: Coiling, Balloon-assisted, Durability

P 078

PROSPECTIVE REGISTRY OF EMBOLIZATION OF INTRACRANIAL ANEURYSMS USING HYDROSOFT COILS: RESULTS OF THE JAPANESE HYDROSOFT REGISTRY

H Imamura[1], N Sakai[1], Y Ito[2], C Sakai[3], A Hyodo[4], S Miyachi[5], Y Matsumaru[6], S Yoshimura[3], T Abe[7], H Yamagami[8], M Hayakawa[6], H Sato[9], T Fujinaka[10] and K Tanabe[11]

[1]Department of Neurosurgery, Kobe City Medical Center General Hospital, Hyogo, JAPAN
[2]Department of Neurosurgery, Shinrakuen Hospital, Niigata, JAPAN
[3]Department of Neurosurgery, Hyogo College of Medicine Hospital, Hyogo, JAPAN
[4]Department of Neurosurgery, Dokkyo Medical University Saitama Medical Center, Saitama, JAPAN
[5]Department of Neurological Surgery, Aichi Medical University, Aichi, JAPAN
[6]Division of Stroke Prevention and Treatment, Faculty of Medicine, University of Tsukuba, Ibaraki, JAPAN
[7]Department of Radiology, Kurume University School of Medicine, Fukuoka, JAPAN
[8]Department of Cerebrovascular Medicine, National Cerebral and Cardiovascular Center, Osaka, JAPAN
[9]Department of Neuroendovascular Therapy, Tokyo Metropolitan Police Hospital, Tokyo, JAPAN
[10]Department of Neurosurgery, National Hospital Organization Osaka National Hospital, Osaka, JAPAN
[11]Division of Medical Statistics, Translational Research Center for Medical Innovation, Hyogo, JAPAN

Purpose: The effect of HydroSoft coils, which are second-generation hydrogel-coated coils, on the prevention of recanalization and thrombosis after embolization is unclear. We herein report the results of the single-armed prospective Japanese HydroSoft Registry.

Materials and Methods: Aneurysms with a diameter of $<$10 mm that were treated with a $>$50% length of HydroSoft coils were registered. We evaluated the safety and recanalization rate and analyzed the factors related to recanalization and thrombosis of the treated aneurysms 1 year after the procedure.

Results: In total, 122 aneurysms were registered. Their mean maximum diameter and neck length were 6.4 and 3.9 mm, respectively. The mean length of the HydroSoft coils was 84.3% (median length, 100%). No intracranial hemorrhagic complications occurred, but one patient developed transient ischemic attack and one developed ischemic stroke. Angiographic examination immediately after the procedure showed complete obliteration (CO), neck remnant (NR), and body filling (BF) in 20 (16.4%), 32 (26.2%), and 67 (54.9%) cases, respectively. One-year follow-up angiography showed CO, NR, and BF in 68 (55.7%), 15 (12.3%), and 15 (12.3%) cases, respectively. Five aneurysms (4.1%) were recanalized before or at the 1-year follow-up angiographic examination, 4 aneurysms of which were BF and 1 was NR with their initial angiographic result. Other 11 aneurysms were still BF, although their thrombois was promoted. No significant factors related to recanalization were identified. A high volume embolization ratio (VER) was only the significant factor associated with thrombosis 1 year after embolization with HydroSoft coils.

Conclusion: The safety and prevention of recanalization 1 year after the treatment appeared acceptable. The high VER associated with HydroSoft coils could induce progression of thrombosis for aneurysms characterized by NR and DF during the follow-up period.

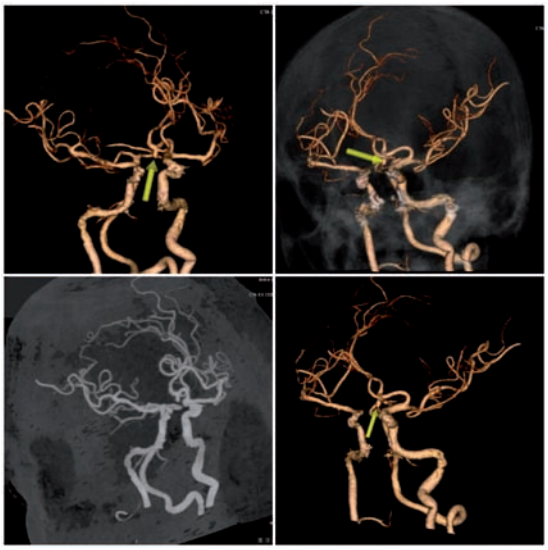
Keywords: Hydrogel-coated coil, cerebral aneurysm, coil embolization

P 079

COMPARISON OF SURGICAL CLIPPING VS ENDOVASCULAR COILING FOR POSTERIOR PROJECTING ANTERIOR COMMUNICATING ARTERY ANEURYSM

NUH Maria[1] and Umair Rasheed[1]
[1]Punjab Institute of Neurosciences, Lahore, PAKISTAN

Purpose: To compare surgical clipping with endovascular coiling for posterior projecting anterior communicating artery aneurysm in terms of peroperative technical feasibility and possible complications such as rupture, perioperative complications and postoperative mortality and morbidity.



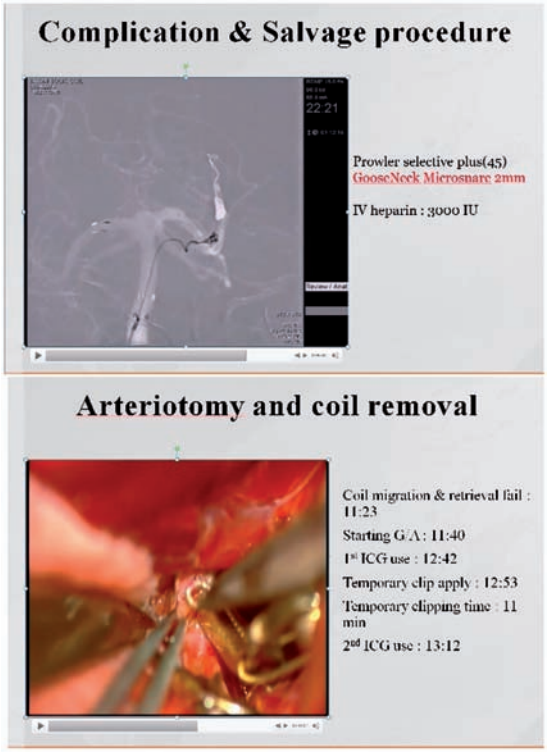
Materials and Methods: The study was conducted at Punjab Institute of Neurosciences. Total 6 cases were studied,3 of them (n = 3, 50%) were operated by surgical clipping and 3 (n = 3.50%) underwent endovascular coiling. Average age was 52yrs, 90% were hypertensive, 80% were smokers. All presented through emergency with subarachnoid hemorrhage.2 of the patients in each surgical and endovascular group presented at ER with Hunt and Hess grade 3 (n = 2,33.3%) the others were at Hunt and Hess grade 2 (n = 4,66.6%). The average time from hemorrhage to surgery and coiling was 25 days. Outcome assessed using modified Rankin score and a score of 2 was considered satisfactory.
Results: In the surgically treated arm 2 patients had mRS of 2 while the 3rd one had 4. In the endovascular coiling group 1 had mRS of 1,1 had mRS2 and 3rd had m RS of 3. Despite the very small sample size the outcome in terms of mRS indicated slightly better results for patients undergoing coiling.
Conclusion: Endovascular coiling is better in the treatment of posteriorly projecting anterior communicating artery aneurysm.
Keywords: Posterior projecting aneurysm, Anterior communicating artery, Coiling vs clipping

P 080

MULTIMODALITY TREATMENT FOR COIL MIGRATION DURING ENDOVASCULAR EMBOLIZATION

SY Chung[1] and SH Chang[1]
[1]Department of Neurosurgery, Eulj University Hospital, Daejeon, SOUTH KOREA

Purpose: Distal coil migration during endovascular treatment of intracranial aneurysm occurs in 2∼6% of cases. As endovascular coil embolization of aneurysms has become popular, the incidence of intra-procedural coil migration increases. The consequences of coil migration vary significantly from asymptomatic to as severe as large territory cerebral infarction. However, delayed removal of migrated coil could leave a permanent neurological deficit.



Materials and Methods: Unintended coil migration occurred in 4(0.81%) patients among approximately 500 patients treated between Dec 2013 and Jul 2017 in Eulji university hospital. We report three cases of endovascular retrieval performed with snare technique and retrieval stent technique, and one case with microsurgical extraction. Surgical or endovascular removal of migrated coil is commonly used.
Results: All 4 patients with coil migration were treated successfully immediately. For 2 cases, we used Amplatz Goose Neck Snare device to remove coil. And Solitare stent was used for retrieval and coil for 1 case was successfully removed. In last case, All endovascular retrieval technique failed and subarachnoid hemorrhage was combined. Due to emergent situation microsurgical craniotomy and arteriotomy was performed and migrated coil was removed. All patients recovered without any complication.

Conclusion: Migration of coil following embolization of an intracranial aneurysm is rare but can be a fatal complication. Recently the incidences and different results of management have been increasingly reported. In our institution, we performed three cases of endovascular retrieval and one case of surgical retrieval of migrated coil during endovascular coil embolization of intracranial aneurysm. In such urgent situation, operator should consider not only the retrieval of migrated coil but also the consequences following the event such as intracranial hemorrhage or cerebral infarction. Decision between surgical or endovascular retrieval of migrated coil should lead to avoid devastating consequences.

Keywords: coil migration, aneurysm, multimodality treatment

P 081

ACUTE TREATMENT STRATEGY AND PERIOPERATIVE MANAGEMENT OF RUPTURED CEREBRAL ANEURYSM ACCOMPANIED WITH HEMATOMA

K Muraoka[1], Y Kegoya[1], Y Sotome[1], Y Matsuda[1], Y Sato[1], T Tanabe[1], N Hirotsune[1] and S Nishino[1]

[1]Hiroshima City Hiroshima Citizens hospital, Hiroshima, JAPAN

Purpose: Rupture of cerebral aneurysm is often accompanied with intracerebral hematoma or massive subarachnoid hemorrhage. Treatment in the acute phase requires a strategy that takes into account the adverse effects of hematoma, in addition to preventing rebleeding of the aneurysm. In particular, suppressing the brain injury due to postoperative hematoma expansion is important for improvement of outcome. In our hospital treatment of ruptured cerebral aneurysm accompanied by hematoma, we focused on the presence or absence of an increase in hematoma volume after acute phase surgery and retrospectively examined the perioperative treatment strategy.

Materials and Methods: The target period is from January 2007 to September 2018. 106 cases suffered by ruptured cerebral aneurysms accompanied with hematoma who underwent surgery during the acute phase (average age of 61 years, 59.4% of women) were included. In these cases, we examined the relationship between the volume and localization of hematoma, treatment for aneurysm, start timing of postoperative anti-vasospasm treatment as postoperative hematoma increasing factors.

Results: An increase in hematoma volume was observed in 23 cases (21.7%), and 83 cases (78.3%) did not exhibit any significant changes. In cases where the hematoma increased, the average volume was 36.3 ml, which was smaller than the average hematoma volume of those that did not increase in size (63.7 ml). As a characteristic of the localization of hematoma, massive hematoma of the sylvian fissure accounted for 48% of the increased group, which was higher than the non-increased group (24%). Regarding treatment option, endovascular surgery was greater in the increased group (73.9%) than open surgery (26.1%). The time to start anti – vasospasm treatment was earlier for the increased group. Regarding the outcome, mRS 5, 6 was higher in the increased group (increased group 73.9% vs non-increased group 38.6%).

Conclusion: In the treatment of ruptured aneurysm accompanied with hematoma, prevention of hematoma increase in acute stage may contribute to improvement of outcome. For that purpose, it was considered preferable to consider the localization of hematoma, to select open surgery as much as possible and to start postoperative anti – vasospasm treatment after about 24 hours.

Keywords: rupture of cerebral aneurysm, increase of hematoma, treatment strategy

P 082

SALVAGE OF COIL EMBOLIZATION WITH NBCA FOR A RUPTURED ANEURYSM

S Echizenya[1], M Kawabori[2], K Hurukawa[1], M Iwasaki[1], T Osanai[2] and Y Niiya[1]

[1]Otaru General Hospital, [1]-1-1. Wakamatsu, Otaru 047–8550. Hokkaido, Japan., Otaru, JAPAN

[2]Hokkaido University Hospital, Kita 14-jo Nishi 5-chome. Kita-ku, Sapporo 060–8648. Hokkaido, Japan., Sapporo, JAPAN

Purpose: With a coil embolization, occasionally intraprocedural rupture of extravasation is occurred and have difficulty in stop breeding. We report a case of ruptured aneurysm during coil embolization and treated with N-butyl cyanoacrylate(NBCA) in an unavailable situation to add coil injection.

Materials and Methods: A-49-year-old woman with a history of asthma was admitted to our hospital to treat unruptured IC aneurysm by coil embolization. The preliminary

cerebral angiographic test revealed an irregular 5-mm narrow necked saccular aneurysm of the Lt. internal carotid-ophthalmic artery. Endovascular coil embolization was selected and the patient underwent embolization under general anesthesia using balloon-remodeling technique. With a 6- French FUBUKI guiding catheter placing in the Lt. IC (distal cervical portion). An Excelsior SL-10 with CHIKAI14 microguidewire could reach the lesion and catheterization into the aneurysm, and during injection of coil into the lesion, sudden extravasation of coil and contrast agent occurred. We applied to additional coil to plug a perforation and continued several times. Finally, no more coils were injected into the aneurysm unless remove a microcatheter although the hemorrhage was not stopped. We tried to embolize lower concentration (about 20%) of N-butyl cyanoacrylate (NBCA) glue which was successfully occluded the perforation.

Results: Post therapeutic angiography showed no aneurysm and extravasation. After the treatment, the patient suffered contrast medium encephalopathy and needed rehabilitation for several weeks, but few months later, she recovered without neurological deficits.

Conclusion: Endovascular treatment with NBCA can be a good treatment option for intractable case with coil embolization.

Keywords: Ruptured aneurysm, coil embolization, N-butyl cyanoacrylate (NBCA)

P 083

INTRAPROCEDURAL RUPTURE MANAGEMENT FOR INTRACRANIAL ANEURYSM RUPTURE DURING COIL EMBOLIZATION BY MANUAL COMMON CAROTID ARTERY COMPRESSION

J Kim[1], Y Jung[2] and C Chang[3]

[1]Yeungnam University Medical Center, Daegu, SOUTH KOREA
[2]Yeungnam University Medical Center, Daegu, SOUTH KOREA
[3]Yeungnam University Medical Center, Daegu, SOUTH KOREA

Purpose: Coil embolization is a widely accepted treatment for cerebral aneurysms[1], and intraprocedural rupture(IPR) is one of the most feared complications of endovascular treatment[2]. IPR of intracranial aneurysms during coil embolization is associated with significant periprocedural disability and death. Several methods are used to manage IPR, but they are often time consuming or ineffective. We perform manual common carotid artery(CCA) compression and aneurysm obliteration at the point of rupture and consider this to be a rapid and effective method. Here, we describe two cases of IPR management of an intracranial aneurysm by coil embolization and manual CCA compression.

Materials and Methods: In 2017, 115 patients received endovascular therapy for a ruptured intracranial aneurysm at Yeungnam University Medical Center. All acutely ruptured aneurysms were treated within 4 hours of admission, and all endovascular treatments were performed under monitored anesthesia care using dexmedetomidine. IPR occurred in 2(2/115, 1.7%) of these patients; 2 with an anterior communicating(Acom) artery aneurysm. IPR was diagnosed by extravasation of contrast medium from the aneurysm sac by periprocedural cerebral angiography. In all cases, manual CCA compression and aneurysm obliteration at point of rupture were applied simultaneously. Short-term pressure was applied to the ipsilateral CCA(by applying gentle lateral or vertical pressure) to reduce bleeding, and simultaneously, endovascular treatment was continued. This pressure was maintained for less than 5 min in all cases, and the balloon-assisted technique was not used nor was protamine sulfate administered for heparin reversal, because systemic heparinization was not performed due to ruptured aneurysm. Final cerebral angiography showed complete aneurysm obliteration in all cases.

Results: A 70-year-old male patient with a chief complaint of severe headache arrived at our emergency department. Brain CT showed SAH and DSA showed a ruptured Acom artery aneurysm(Fig.2A). During pre-procedural DSA, the patient could not lie down motionless and contrast medium extravasation was observed from the aneurysmal sac(Fig.2B). Simultaneously, manual CCA compression was applied for 5 minutes to the right CCA to reduce bleeding and endovascular coiling was performed as soon as possible. Final DSA showed no extravasation of contrast medium(Fig.2C). Postprocedural CT imaging showed diffuse contrast extravasation and an enlarged ventricle(Fig.2D). In addition, EVD was necessary due to hydrocephalus and conscious level deterioration. The patient was discharged at 4 weeks after the procedure with no definite neurologic deficit.

Conclusion: Early IPR detection followed simultaneous endovascular coiling and manual CCA compression may lead to a benign clinical course in most cases of IPR.

Keywords: coil, aneurysm, manual compression

P 084

ANALYSIS OF THE RECANALIZATION OF BRAIN ANEURISMS POST EMBOLIZATION

LJ Haas[1], GV Staedele[2], WR Berticelli[2], M Becker[2], MC Harger[2], CB Lima[2], J Martins[2], BR Sabel[2], FJ Cobra[2], MD Soares[2], LCO Camilo[2], VD De Almeida[2], CGJL Brasileiro[2], JD Hessmann[2], LM Silva[2], B Sartori[1], D Malacarne[1], A De Oliveira Junior[1], D De Lara[1], FL Cabral[1], CIC Bernardes[1], VHT Boer[1] and LRGO Mello[1]

[1]Hospital Santa Isabel, Blumenau, BRAZIL
[2]University of Blumenau – FURB, Blumenau, BRAZIL

Purpose: The rate of recanalization of intracerebral aneurysms treated endovascularly varies from 9 to 34% in the literature, being higher in the first 6 months and smaller after 2 years of treatment. This study purposes to evaluate the rate and degree of recanalization of ruptured and unruptured cerebral aneurysms treated by endovascular

approach, as well as to describe their morphological characteristics and the epidemiological profile of the sample.
Materials and Methods: Retrospective study was performed with the medical records of 699 patients who underwent to endovasculartreatment for ruptured and unruptured aneurysms, in a neurosurgery service, during the period from February 2006 to December 2018. The patients had a brain arteriography made every year.
Results: The sample was composed by 699 patients with a medium age of 51.20 years, of which 75.68% were female and 24.32% were male. As comorbidities, 42.92% were hypertensive, 24.89% smokers, 16.88% dyslipidemic and 5.01% were diabetic. In relation to the size, 71.60% were small, 17.88% were large and 10.44% were giant. 115 (16.45%) patients, out of the 699, had an aneurism recanalization over the years, from which 68.70% were women and 31.30% were male, the medium age was 52.37 years, 35.65% were hypertensive, 22.61% were smokers, 10.43% were dyslipidemic and 6.1% were diabetic. About the recanalization time, 38.26% happened in the first year, 37.20% in the second year, 9.57% in the third, 8.70 in the fourth, 11.30 in the fifth and the remaining 9.57% between 6 and 9 years. Raymon-Roy's classification for recanalized aneurisms, 34.78% were Raymond-Roy II, 41.74% were Raymond-Roy IIIa and 23.48% were Raymond-Roy IIIb. According to morphology, 94.78% were sacculate, 4.35% fusiform and 0.87% had a different morphology. 21.74% of the 115 were presented as ruptured aneurisms, and 78.26% unruptured. As to the localization of happening, 26.09% happened at the ophthalmic segment of the internal carotid artery (ICA), 19.13% at the cavernous segment of the ICA, 13.91% at the anterior communicant artery, 13.04% at the posterior communicant artery, 4.35% at the bifurcation of the medium cerebral artery and 23.48% other localization. Relating to treatment, 58.26% were treated only coils, 18.26% stent and coils and 18.26% only stent and 0.87% flow diverter.
Conclusion: The recanalization rate found on this study agrees with the current literature, most of them occurring on the first 2 year of treatment (75.46%), especially in giant aneurysms, treatment only with coils. These results suggest that a recent arteriography control can be appropriate to detect early recanalization.
Keywords: ANEURYSM, RECANALIZATION, EMBOLIZATION

P 085

RECURRENCE OF ANEURYSM WITH INCORPORATED ANEURYSM AFTER COIL EMBOLIZATION

H Bae[1]
[1]The Catholic University of Korea Seoul ST Marys Hospital, Seoul, SOUTH KOREA

Purpose: According to the development of endovascular technique and devices, an aneurysm with a branch incorporated into sac has recently been treated with coil embolization. However, it is careful to treat these aneurysms by coiling because of concerns about occlusion of the incorporated arteries or recurrence of the aneurysm. The aim of this study is to evaluate the safety, outcome of treatment and predictors of recurrence of coil embolization for branch-incorporated aneurysm.
Materials and Methods: From January 2012 to June 2013, this study retrospectively reviewed 225 patients with 239 intracranial unruptured aneurysms with coil embolization. 52 Aneurysms with branch incorporated into the sac was divided into NP group (Incorporated Branch with Nearby Parent artery, $n = 31$) and DP group (Incorporated Branch with Distant Parent artery, $n = 21$). We analyzed the association of these two groups with recurrence of aneurysm.
Results: 4 patients had major recurrence that required retreatment and 6 patients had minor recurrence that did not required retreatment. Of the retreatment case($n = 4$), 3 cases were an aneurysm with an incorporated branch away from the parent artery. NP group, broad neck of aneurysm and packing index were independent risk factors for recurrence of aneurysm in multivariate logistic regression analysis.
Conclusion: An aneurysm with an incorporated branch away from the parent artery tended to have a recurrence rate than nearby parent artery or without incorporated branch after coil embolization.
Keywords: Incorporated branch, coil, recurrence

P 086

DE NOVO INTRACRANIAL ANEURYSMS DETECTED ON IMAGING FOLLOW-UP OF COILED ANEURYSMS IN KOREAN POPULATION

C Ryu[1], **Y Cho**[2], **E Yeon**[3] **and E Kim**[3]
[1]Kyung Hee University Hospital at Gangdong, Seoul, SOUTH KOREA
[2]Seoul University Hospital, Seoul, SOUTH KOREA
[3]Kyung Hee University Medical Center, Seoul, SOUTH KOREA

Purpose: It is well known that coiled aneurysms may recanalize over time, making follow-up evaluations mandatory. Although de novo intracranial aneurysms (DNIAs) are detected on occasion during routine patient monitoring, such events have yet to be formally investigated. Herein, we generated estimates of DNIA development during long-term observation of coiled cerebral aneurysms, focusing on incidence and the risk factors involved.
Materials and Methods: A total of 773 patients undergoing coil embolization of intracranial aneurysms between 2008 and 2010 were reviewed retrospectively, assessing medical records and radiologic data that accrued during extended monitoring (mean, 52.7 ± 29.7 months). DNIA was detected on follow-up MRA (and/or DSA) of coiled aneurysms. The incidence of DNIAs and related risk factors were analyzed using Cox proportional hazards regression and Kaplan-Meier product- limit estimator.
Results: In 19 (2.5%) of the patients with coiled aneurysms, DNIAs (0.56% per patient-year) developed during continued

long-term monitoring (3395.3 patient-years). Nine of these (47.4%) were detected within 60 months, with 10 (52.6%) emerging thereafter. The most common site involved was posterior communicating artery (n = 6), followed by middle cerebral artery (n = 5), and basilar top (n = 4). Multivariate analysis indicated that younger age (HR = 1.045; p = 0.010) and recanalization of coiled aneurysms (HR = 2.560; p = 0.047) were significant factors in DNIA formation, whereas female gender, smoking, and hypertension fell short of statistical significance. Cumulative survival rates without DNIA were significantly higher in older subjects (>60 years; p < 0.001) and in the absence of post-coiling aneurysm recurrence (p = 0.006).
Conclusion: In most patients with coiled aneurysms, development of DNIAs during long-term monitoring is rare. However, younger patients (<50 years) or patients with recurring aneurysms seem predisposed to DNIAs.
Keywords: aneurysm, follow-up, coil embolization

P 087

IMPACT OF REDUCING THE PROCEDURE TIME ON THROMBOEMBOLISM AFTER COIL EMBOLIZATION OF CEREBRAL ANEURYSMS

HJ Choi[1], JP Jeon[1], JS Yang[1], SH Kang[1], YJ Cho[1] and SH Lee[2]
[1]Department of neurosurgery Hallym University Chuncheon Sacred Heart Hospital, Chuncheon, SOUTH KOREA
[2]Department of neurology Hallym University Chuncheon Sacred Heart Hospital, Chuncheon, SOUTH KOREA
[3]Chuncheon, SOUTH KOREA
[4]Chuncheon, SOUTH KOREA
[5]Chuncheon, SOUTH KOREA

Purpose: There is still controversy regarding which procedure-related factors affect the occurrence of periprocedural thromboembolism. This study aimed to investigate which procedure-related risk factors can be modified to prevent adverse thromboembolic events after coil embolization of intracranial aneurysm.
Materials and Methods: Using a single-center database, we retrospectively identified a consecutive series of patients with symptomatic and asymptomatic cerebral aneurysms treated with coil embolization. We evaluated the following procedure-related factors: procedure time, procedure methods (simple coiling, stent-assisted coiling, and use of multiple microcatheters), and number of coils inserted. The primary outcome was the development of thromboembolism before and after coil embolization confirmed by diffusion-weighted imaging (DWI) irrespective of the location of the procedure. Pearson's chi-square, Student's t-test, multivariable logistic regression analysis, and sensitivity analysis with multinomial logistic regression analysis were used in the statistical analyses.
Results: Of 180 cases enrolled, 146 (81.1%) had evidences of thromboembolism confirmed by DWI, and 13 (7.2%) had neurologic symptoms. Among the documented modifiable procedure-related factors, every 10 min increase in the procedure time was independently associated with the risk of thromboembolism, after adjusting the analysis (adjusted odds ratio 1.11; 95% confidence interval 1.01–1.21). The coiling methods, use of multiple catheters, and number of coils inserted did not change the effect of the procedure time on thromboembolic events (p for interactions > 0.05).
Conclusion: This study showed that the procedure time might be the most effective modifiable factor for reducing thromboembolic events irrespective of the procedure methods used during coil embolization of cerebral aneurysms.
Keywords: Aneurysm, Embolization, Procedure Time

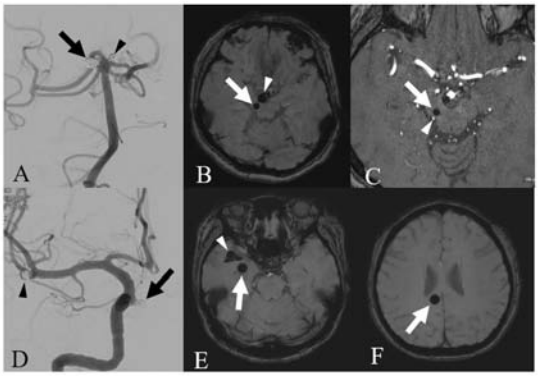
P 088

SUSPECTED DISTAL EMBOLIZATION OF METALLIC MATERIAL DURING CEREBRAL ANEURYSM COILING: DETECTION USING SUSCEPTIBILITY WEIGHTED MR IMAGING

DH Yoo[1], YD Cho[1] and HS Kang[2]
[1]Seoul National University Hospital, Department of Radiology, Seoul, SOUTH KOREA
[2]Seoul National University Hospital, Department of Neurosurgery, Seoul, SOUTH KOREA

Purpose: To provide pronounced visibility under fluoroscopy as well as durability, devices used for coil embolization of cerebral aneurysms contain metallic substances. During the follow up after the embolization using TOF MRA, round dark lesions are encountered on the source images at brain parenchyme, which raises suspicion as being a micro-fragment of metallic material. However, on the TOF MRA, the lesions are not readily noticeable, and whole brain is not covered. In this study, we aim to evaluate frequency of distal embolization of metallic material during cerebral aneurysm coiling using susceptibility weighted imaging(SWI), and investigate the cause and clinical implication of the lesion.
Materials and Methods: From September 2018 to March 2019, 702 patients underwent MRI exam including TOF MRA and SWI, for the purpose of follow up after aneurysm coiling. SWI was reviewed to detect the dark signal lesion. We supposed that the circularly round lesion larger than 5 mm in diameter would be metallic material. The size and location of the lesions, as well as characteristics of the aneurysms were recorded. In patients with the lesion in question, the procedural records were reviewed to identify the devices used, including coils, microcatheter, stents, and etc. Medical records were also reviewed to determine whether the lesion manifested as specific symptom.
Results: Total of 20 patients (2.8%) showed 25 lesions on SWI. The diameter ranged from 5 mm to 11 mm (median; 8 mm). All but two lesions were located at brain region downstream to the aneurysms. All lesions were, however, present on the vascular territory of the vessel where guiding catheter was placed, suggesting that embolization of metallic material occurred during navigation to aneurysms or retrieval of the devices. No device was identified to have been used commonly in patients with the SWI lesion,

except Synchro 14, which was used in all but two of the total 702 patients. None of the patients with the SWI lesion developed focal neurologic symptom correlating to the location of the lesion.



A. Coil embolization of aneurysms at right SCA aneurysm (arrow) and basilar top (arrowhead) was done. B. On SWI 20 months later, an 8mm round dark signal lesion is noted at right midbrain (arrow), as well as a dark signal by the coil mass (arrowhead). C. On the source image of TOF MRA, the same lesion is measured as 4mm (arrow). Right SCA (arrowhead) is seen coursing just posterior to the lesion. D. In another patient, coil embolization of right paraclinoid aneurysm (arrow) and MCA bifurcation aneurysm (arrowhead) was done. E. On SWI 6 months later, a 10mm round dark signal lesion is noted at right temporal lobe (arrow), as well as a dark signal by the coil mass and the stent (arrowhead). F. Another 10mm round dark signal lesion is present at right corpus callosum (arrow).

Conclusion: Although a causative device or mechanism remains unclear, distal embolization of metallic material during cerebral aneurysm coiling is not rarely encountered on follow up MR imaging. These lesions seem to have no impact on the clinical course of the patients.

Keywords: Coil embolization, Susceptibility weighted image, Metal

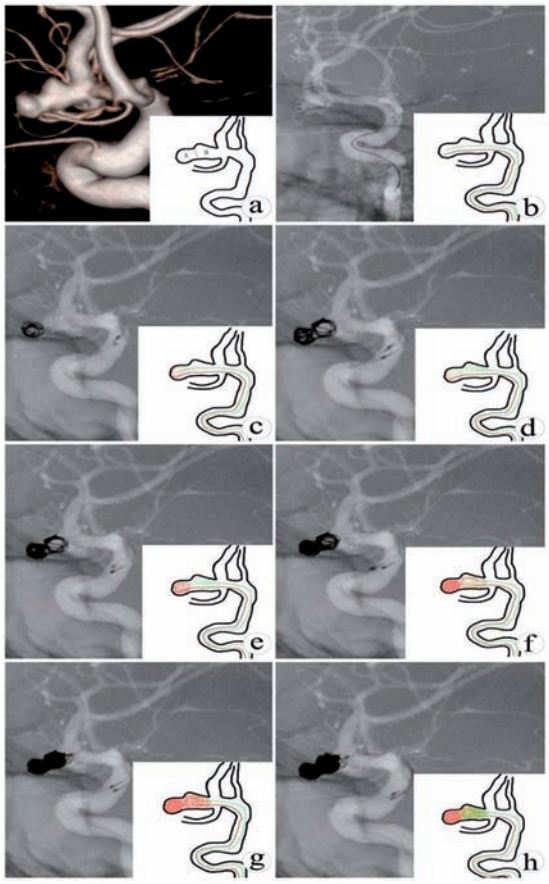
P 089

CROSS-REGIONAL EMBOLIZATION TECHNIQUE IN THE TREATMENT OF INTRACRANIAL IRREGULAR ANEURYSM

Y E[1] and Z L[1]

[1]Affiliated Hospital of Hebei University, Baoding, CHINA

Purpose: To evaluate the feasibility of cross-regional embolization technique with dual microcatheter in the treatment of intracranial irregular aneurysms.



Materials and Methods: The clinical data of 19 cases with intracranial irregular aneurysms treated with cross-regional embolization technique in authors' hospital from May 2016 to May 2017 were collected, and the embolic strategy formulation, selection of embolization materials, procedure process and embolization effect were retrospectively analyzed. Cross-regional embolization technique was performed as follows. Firstly, a comprehensive angiographic examination was made to understand the whole cerebrovascular condition, focusing on the location, size, shape and neck condition of aneurysm, accurately measuring the neck and body size, and determining the working angle. Secondly, according to the angiographic results, the aneurysm was divided into appropriate zones, and a careful embolization strategy was formulated. The general principle is to use double catheter embolization technique to achieve cross-regional basket formation in more than one zone, that is, the basket formation is intersected between adjacent zones to maximize the stability of the basket formation, and then two catheters are used to fill alternately.

Results: All the 19 cases with intracranial irregular aneurysms treated with cross-regional embolization technique achived success except 1 case, stent was used as remedial measure, which was due to one coil loop sliped into the parent artery in the process of aneurismal neck embolization. The technical success rate was 95%. 15 cases achieved complete embolization, and 3 cases achieved subtotal embolization.

Conclusion: Cross-regional embolization technique is a safe and effective method for the treatment of some specified intracranial irregular aneurysms.
Keywords: irregular aneurysm, cross-regional embolization, dual microcatheter

P 090

SCAFFOLDING TECHNIQUE: A NEW DOUBLE-CATHETER TECHNIQUE IN THE COIL EMBOLIZATION OF WIDE-NECKED ANEURYSMS

K Murao[1]
[1]Shiroyama Hospital-Department of Neurosurgery, Habikino-Osaka, JAPAN

Purpose: We describe a new technique used to treat a wide-necked aneurysm in which the neck is incorporated with the parent artery.
Materials and Methods: The patient was a 71-year-old woman with a large, wide-necked unruptured aneurysm of the basilar bifurcation area with the right posterior cerebral artery (PCA) incorporated in the aneurysm sac.
A microcatheter (C1) tip was placed near the right PCA orifice. Another catheter (C2) was placed within the aneurysm lumen. In order to avoid the framing coil (Microplex18/12 mm) from the C2 catheter involve the right PCA orifice, another ''scaffolding'' coil (Microplex18/10 mm) from the C1 catheter was placed around the right PCA orifice previously. After confirming the framing coil did not obstruct the right PCA flow, then the ''scaffolding'' coil was repositioned in the framing coil. Subsequent coils were introduced in the framing coil in order to embolize the inflow zone in front of PCA orifices referring to lateral projection with the bilateral PCA orifices superimposed in the translucent view.
Results: In the follow-up of three years, there is no coil compaction nor regrowth.
Conclusion: This scaffolding technique may be an effective and safe therapeutic option for wide-necked aneurysms instead of permanent placement of a stent in the parent artery.
Keywords: double-catheter technique, wide-necked aneurysms, scaffolding technique

P 091

PROPOSAL OF SHAPING FOR MICRO CATHETER BY THREE DIMENSIONAL IMAGING

K Fukasaku[1], H Yokota[2], K Takahashi[1], H Yoshioka[1], F Saito[1] and M Negoro[3]
[1]Department of Neurosurgery, Niiza Shiki Chuo General Hospital, Shiki, JAPAN
[2]Centre of Neurointervention, Ichinomiya-Nishi Hospital, Ichinomiya, JAPAN
[3]Image Processing Team, Extreme Photonics, RIKEN, Wako, JAPAN

Purpose: Shaping of micro-catheter is important for aneurysm embolization to have smooth guiding and stable retention. The shape deeply depends upon operator's experience. We tried to have objective and reproductive shape for this purpose from three dimensional (3D) images.
Materials and Methods: 3D data was obtained from 3D DSA, CTA or MRA, mainly DSA. Branches at the proximal from the aneurysm and parent branches distal from the neck were erased manually to simplify the pass way. Simplified 3D data set was skeletonize on ImageJ. The 3D skeleton was printed by 3D printer or 2D printer and the shape was copied to shaping mandril manually. The micro catheter was shaped using the mandril and steam. For assessment, vascular model was built from the original 3D image by lost wax technique. Shaped microcatehter was placed and coils were tried to deliver.
Results: The shaped micro catheter could easily access the aneurysm. However, delivering coils, the catheter was not very retentive. Placing a relatively larger coils, the catheter was easily pushed back. Shaping catheter by experience, curve to support the catheter was usually given to stabilize and the tip location was also adjusted. Automatic simple skeletonization did not consider such stabilization. Clinically, if placing neck remodeling balloon, the problem of stabilization possibly solved. Some catheters having braided tip were difficult to give same shape with skeletonization.
Conclusion: To have smooth and stable catheterization for aneurysm embolization, we tried to shape catheter with skeletonization of parent and aneurysm. Catheter shaping by skeletonization could be possible proposal but for better result, at least more experience should be added.
Keywords: brain aneurysm, coil embolization, shaping of catheter

P 092

EXTRA-CRANIAL INTERNAL CAROTID ARTERY ANEURYSMS: RESULTS AND OUTCOME AFTER SURGICAL AND ENDOVASCULAR TREATMENT

F Taglialatela[1], A Sonetto[2], S Isceri[1], C Barbara[1], A Pilato[3], G Faggioli[2], M Gargiulo[2] and L Simonetti[1]
[1]IRCCS Istituto delle Scienze Neurologiche di Bologna – Neuroradiology Unit Ospedale Maggiore, Bologna, ITALY
[2]Vascular Surgery, Policlinico S. Orsola-Malpighi, Bologna, ITALY
[3]Vascular Surgery, Ospedale Maggiore, Bologna, ITALY

Purpose: The ideal approach for the treatment of Extracranial Internal Carotid Artery Aneurysms (EICAA) has not been identified yet, due to the infrequent occurrence of this disease. The purpose of this study was to analyse short and long-term results of surgical (ST) and endovascular treatment (EVT).
Materials and Methods: A retrospective analysis of all cases of EICAA treated from 1974 to 2018 in 2 tertiary vascular centres was performed. Follow-up surveillance protocol consisted in clinical examination and duplex ultrasound 3

months postoperatively for ST patients, CT-Angiography at 6 months for EVT patients and Duplex scanning for both groups every year.
Results: Fourty-seven EICAA in 42 patients were treated, 28 ST (59.6%), and 19 (40.4%) EVT. Overall, the aetiology of carotid lesions was nonspecific atherosclerosis in 18 cases (38.3%); fibromuscular dysplasia in 13 (27.7%); post-traumatic in 13 (27.7%) and postoperative after carotid artery surgery in 3 cases (6.4%). Neurologic symptoms were present in 13 patients (27.7%) preoperatively. Surgical techniques included aneurysm excision followed by internal carotid artery re-anastomosis in 10 cases (35.7%); internal to external carotid artery transposition in 1 case (3.6%); interposition graft in 12 cases (42.9%); aneurysmorrhaphy in 5 cases (17.9%). EVT was performed in 11–58% post-traumatic cases; 7–37% atherosclerotic; 1–5% post-operative after carotid artery surgery with either bare metal (16-84.2%) and covered stents (3 -15.8%). Treatment was performed electively in 92.8% STs and 100% EVTs, with 0% mortality rate in both groups. Postoperative stroke rate was 7.2% (2 cases) in ST and 0% in EVT group (P = .03). Two cases (7.2%) required surgical emergent treatment for ruptured aneurysm, with 1 peri-operative death. Cranial nerve lesions occurred in 7 cases of ST group (all transient, resolved within 6 weeks) and in 0 cases of EVT group (P = .006). Mean follow-up was 62 months for both groups (range 4–240 months). All EVT procedures led to complete aneurysm exclusion. In the ST group, 4 late complications occurred: 2 vein graft complications, 1 late transient ischaemic attack, 1 recurrent aneurysm. In the EVT group, 1 case of asymptomatic bare metal stent thrombosis occurred 12 months after the procedure, with no neurological sequelae. Overall complication rate was not significantly different in the two groups (14.3% vs 5.3%; P = .63).
Conclusion: EICAA is an infrequent vascular disease which can be effectively treated either by ST or EVT, however EVT seems advantageous in terms of early outcome. Larger experience is needed to definitively assess the best approach and technical details of EICAA treatment.
Keywords: Carotid, Aneurysms, Treatment

P 093

TREATMENT OF PSEUDOANEURYSM OF INTERNAL MAXILLARY ARTERY RESULTING FROM NEEDLE INJURY – CASE REPORT

JW Choi[1], JY Kim[1] and YM Koo[1]
[1]Wonju Severance Christian Hospital, Wonju, SOUTH KOREA

Purpose: Pseudoaneurysm of internal maxillary artery (IMA) after trauma is rare, and most cases reported are caused by maxilla-facial blunt trauma. Pseudoaneurysm is discontinuity in the vascular wall leading to an extravascular hematoma that freely communicates with the intravascular space producing pulsatile hematoma rapidly. Therefore, prompt treatment is necessary as soon as it occurs. We described a case of pseudoaneurysm of IMA after the masticatory muscle reduction using needle injection in dentistry.
Materials and Methods: A 44-years-old woman presented with a pulsatile swelling and pain in the left parotid region. She underwent the masticatory muscle reduction using needle injection in dentistry one month ago. The left facial pulsatile swelling developed after the procedure immediately and uncontrolled bleeding occurred on the day of visit to our institution. We performed emergency angiography and diagnosed pseudoaneurysm of left IMA.
Results: We treated by embolization with Histoacryl Glue through left IMA. IMA total occlusion was confirmed by angiography and symptoms improved after procedure. She had not any other complication after procedure.
Conclusion: Pseudoaneurysm following blunt trauma of the face have been reported but are few. Furthermore, there is no report of IMA pseudoaneurysm due to direct injury by needle. Recently, many cosmetic surgery procedures using injection techniques have been performed, and it is necessary to pay attention to the direct vessel injury by the needle. And endovascular therapies can give early recovery with minimal morbidity and avoids injury to the facial nerve and its branches.
Keywords: pseudoaneurysm, IMA injury

P 094

ENDOVASCULAR TREATMENT OF EXTRACRANIAL PSEUDOANEURYSM BY FLOW DIVERTION TECHNIQUE

F Petra[1], A Aguado[2], G Caballero[3], J Lizundia[4], M Grana[5] and L Parra[6]
[1]Hospital Santa Isabel De Hungria, Mendoza, ARGENTINA
[2]Hospital Santa Isabel De Hungria, Mendoza, ARGENTINA
[3]Hospital Santa Isabel De Hungria, Mendoza, ARGENTINA
[4]Hospital Santa Isabel De Hungria, Mendoza, ARGENTINA
[5]Hospital Santa Isabel De Hungria, Mendoza, ARGENTINA
[6]Hospital Santa Isabel De Hungria, Mendoza, ARGENTINA

Purpose: Extracranial carotid dissecting or traumatic pseudo-aneurysm (ECDTP) is an infrequent pathological presentation, The risks of aneurysm rupture are associated with high morbidity and mortality rate. We aim to show the safety and utility of high mesh flow diverter (FD) stents for the treatment of these lesions.
Materials and Methods: Between May 2015 and March 2017 12 patients were admitted in our center presenting ECDTP, and treated after multidisciplinary work, though FD device deployment.
Results: Median ECDTP size was 28 mm (12 mm–58mm), In 9 cases it was necessary only one device, in 2, two devices and in 1 patient it was necessary to use a no flow diverter stent associated with a FD as anchoring technique. No coilling or other filling technique was associated to improve results. Angiographic complete occlusion was seen in 10/12 (83%) aneurysms at a median follow-up of 18 months. Two patients gone through a second procedure were one FD

was deployed to secure the pseudoaneurysm, and total occlusion was obtained at 6 months follow up angiogram. The third patient with incomplete occlusion didn't go any therapy and was followed up trough no invasive imaging, with no changes in pseudo aneurysm volume. None patient presented neurological symptoms or signs of ECDTP rupture during follow up (mRanking Score of 0–1).

Conclusion: High Mesh flow diverter stentdeplyent in extracranial carotid artery pseudo-aneurysms is safe, feasible, and showed high occlusion rates and favorable clinical outcomes.

Keywords: Flow Diverter Device, Extracranial, Pseudoaneurysm

P 095

STENT ASSISTED ANEURYSM COILING IN ACUTE SUBARACHNOID HEMORRHAGE

A Kumar[1], M Joshi[2], V Bhatia[3], S Vyas[4] and C Ahuja[5]
[1]PGIMER, Chandigarh, INDIA
[2]PGIMER, Chandigarh, INDIA
[3]PGIMER, Chandigarh, INDIA
[4]PGIMER, Chandigarh, INDIA
[5]PGIMER, Chandigarh, INDIA

Purpose: Use of stent in setting of acute SAH is associated with many question marks due to risk of thromboembolic complications associated with stent and haemorrhagic complications associated with antiplatelet drug use. The situation being made worse by the acute SAH inducing inflammatory response and causing coagulation disturbances. However at times use of stent in these cases comes as a compulsion when other options for treatment and decision of delaying treatment carries more risk.

Materials and Methods: A retrospective and prospective study was conducted including the cases of stent assisted coiling done in setting of acute SAH in our institute from Jan 2010 to Oct 2016. Both radiological and clinical data at the time of procedure and at follow up was collected and evaluated.

Results: Total 69 patient were taken for SAC in acute SAH in study period, one of which failed technically. Among rest of technically successful 68 patients intra-procedure technical complications were encountered in 10(14.7%), none of which was clinically significant. Thromboembolic complication were encountered in 18(26.5%), one of which was clinically significant (transient). Haemorrhagic complications were seen in 18(26.5%) patients and were cause of mortality in 6 patients. Overall 62.7% patients had good clinical outcome (mRS 0–2).

Conclusion: Stent assisted coiling is a viable option for treatment of otherwise difficult to treat ruptured aneurysms with safety reasonably comparable to other endovascular and surgical treatment modalities in terms of intracranial haemorrhagic and thromboembolic complications. Systemic haemorrhagic complications, which may be attributed to antiplatelet agent or heparin use needs to be addressed aggressively to prevent fatal complications.

Keywords: Stent, SAH, Coiling

P 096

A RADIOLOGIC AND CLINICAL COMPARISON OF NEUROFORM ATLAS AND LVIS JR STENT ASSISTED COIL EMBOLIZATION FOR UNRUPTURED CEREBRAL ANEURYSMS IN DISTAL SMALL BRANCHES

JW Baek[1], HW Jeong[1], ST Kim[2], YG Jeong[2], JH Seo[3], SC Jin[4] and OK Kwon[5]
[1]Inje University Busan Paik Hospital – Department of Radiology, Busan, SOUTH KOREA
[2]Inje University Busan Paik Hospital – Department of Neurosurgery, Busan, SOUTH KOREA
[3]Inje University Busan Paik Hospital – Department of Neurology, Busan, SOUTH KOREA
[4]Inje University Haeundae Paik Hospital – Department of Neurosurgery, Busan, SOUTH KOREA
[5]Seoul National University Bundang Hospital – Department of Neurosurgery, Seongnam, SOUTH KOREA

Purpose: To compared the radiological and clinical outcome of coil embolization for un-ruptured cerebral aneurysms which located in A-com, MCA bifurcation and their distal branches using the Neuroform Atlas and LVIS Jr stents and compared the follow-up radiological results.

Materials and Methods: From January 2017 to September 2018, 56 un-ruptured cerebral aneurysms at A-com, MCA bifurcations and their distal branches were treated with stent-assisted coil embolization using Neuroform Atlas or LVIS Jr. (Neuroform Atlas: 31, LVIS Jr: 25) at three institutions. Three cases of fusiform aneurysm which treated with multiple stents insertion only were excluded. Accordingly, 53 un-ruptured cerebral saccular aneurysms were included in our study (Neuroform Atlas: 31, LVIS Jr: 22). Demographic data, characteristics of the aneurysm, periprocedural and postprocedural complications, initial and follow up radiologic outcome were evaluated.

Results: There was no significant difference in aneurysm location, size and coil packing density between the two groups. Initial and follow up radiological outcome, which classified with Raymond occlusion criteria show no significant difference in two groups. But, symptomatic complications – one borderzone infarction, one intraprocedural rupture – were observed only in LVIS Jr group. Two minor recanalizations were observed only in Neuroform Atlas group, but there was no statistically significant difference.

Conclusion: This multicenter retrospective study shows that two stents – Neuroform Atlas & LVIS Jr – did not show statistically significant differences in outcome of stent-assisted coil embolization for A-com, MCA bifurcation, or their distal branches.

Keywords: stent assisted, Neuroform Atlas stent, LVIS Jr

P 097

RESCUE STENTING USING THE NEUROFORM ATLAS STENT DURING COIL PROTRUSION FOR RUPTURED INTRACRANIAL ANEURYSMS

V Semeraro[1], MP Ganimede[2], S Vidali[1], E Lozupone[3], NM Lucarelli[2], V Gisone[2], M Resta[2] and N Burdi[2]
[1]Policlinico Tor Vergata, Roma, ITALY
[2]Ospedale Ss. Annunziata, Taranto, ITALY
[3]Policlinico A. Gemelli, Roma, ITALY

Purpose: Endovascular coiling represents an effective therapeutical option for ruptured intracranial aneurysms. Despite the growing operators' experience and quality of tools and the consequent improved efficacy of endovascular cerebral aneurysms' treatment, procedure-related complications are still reported. Purpose of this study is to report an experience of rescue stenting treatments using Neuroform Atlas (NA) open-cell stent, to manage loops herniation during coiling of ruptured intracranial aneurysms.
Materials and Methods: Between April 2016 and April 2018, 18 consecutive coil protrusions, occurred during ruptured aneurysms' coil embolizations, were treated with NA stenting. All patients received intra-procedural Tirofiban and underwent 24 h CT scan re-evaluation. Follow-up after procedure was performed with initial MR-angiography (MRA) at 1 month and MRA plus standard digital subtraction angiography (DSA) at 11–13 months.
Results: Technical success was achieved in 100% of patients. No complication related to device delivery or release was observed. Initial MRA showed aneurysm complete occlusion (CO) and patency of parent vessels in 18 out of 18 cases. 11–13 months MRA and DSA, documented 15 CO and 2 Partial Occlusion (PO) 1 death occurred during hospital stay, due to initial subarachnoid hemorrhage (SAH).
Conclusion: NA stent represents a valid rescue treatment option for coil protrusion during ruptured intracranial aneurysms embolization, being effective in terms of parent vessels patency restoration and being associated to minimal intra-procedural and post-procedural thromboembolic adverse events.
Keywords: Rescue Stenting, Coil Protrusion, Ruptured Aneurysms

P 098

THE USE OF BARE STENT IN LESS THAN 2.0 MM CEREBRAL ARTERY FOR ANEURYSM TREATMENT

H Yoshioka[1], T Uno[1], A Kambe[1], H Takeuchi[2], M Sakamoto[1] and M Kurosaki[1]
[1]Tottori university, Yonago, JAPAN
[2]Nojima hospital, Kurayoshi, JAPAN

Purpose: The cerebral aneurysms involving small diameter arteries are difficult to treat, in according to technical difficulty of insertion of microcatheter and patency of reconstructive vessel. However new generation of self-expandable microstents (LVIS Jr. and ATRAS) have possibility of suitable for microvessel (less than 2.0 mm).
Materials and Methods: Aneurysms treated with LVIS Jr., ATRAS, Neuroform EZ, and Enterprise stent in vessels less than 2.0 mm between April 2013 and January 2019 were included. Periprocedural adverse events, occlusion rates in each follow-up period are reported.
Results: A total of 15 patients with 15 aneurysms were included. Fourteen aneurysms were unruptured (93.3%) and one was ruptured (6.7%). The reconstructive vessel size ranged from 1.12 to 1.94 mm; mean 1.44 mm. Location of the aneurysms was as follows; Four aneurysms at anterior communicating artery (A Com), two at the A1 anterior cerebral artery (ACA), three at the distal A2 ACA, one at the posterior communicating artery (P Com), one at the distal M2 middle cerebral artery (MCA), one at the superior cerebellar artery (SCA), one at the vertebral artery – posterior inferior cerebellar artery (VA-PICA), one at the VA. Aneurysms ranged from 2.98 to 12.18 mm in maximum diameter; mean 6.58 mm. One periprocedural thrombosis, one postprocedural parent artery occlusion was occurred. Angiographic follow-up was available in all patients, follow period mean 32.4 month. Angiography showed nine complete aneurysm occlusions, five neck remnants (remained unchanged or decreased), one parent artery occlusion in a ruptured patient.
Conclusion: Our preliminary result show that stenting with low-profile stent allowed us to treat complex intracranial aneurysms with involved vessel diameter of less than 2.0 mm with acceptable safety profile, but limited to unruptured aneurysm.
Keywords: Stent Assisted Coil Embolizati, Small Vessel, Low Profile Stent

P 099

ANTIPLATELET THERAPY FOR STENT-ASSISTED COIL EMBOLIZATION OF CEREBRAL ANEURYSMS

H Fukumoto[1], Y Horio[2], K Fukuda[3], M Iwaasa[4], K Nii[5], T Inoue[6] and T Higashi[7]
[1]Department of Neurosurgery, Fukuoka University Hospital, Fukuoka, JAPAN
[2]Department of Neurosurgery, Fukuoka University Hospital, Fukuoka, JAPAN
[3]Department of Neurosurgery, Fukuoka University Hospital, Fukuoka, JAPAN
[4]Department of Neurosurgery, Fukuoka University Hospital, Fukuoka, JAPAN
[5]Department of Neurosurgery, Fukuoka University Chikushi Hospital, Chikushino, JAPAN
[6]Department of Neurosurgery, Fukuoka University Hospital, Fukuoka, JAPAN
[7]Department of Neurosurgery, Fukuoka University Chikushi Hospital, Chikushino, JAPAN

Purpose: Although the efficacy and the safety of stent-assisted coil embolization (SAC) for cerebral aneurysms have already proved, there is not enough consensus regarding the usage of antiplatelet therapy (APT). We performed a retrospective analysis on the regimen for APT with SAC.
Materials and Methods: We reviewed prospectively collected database. Data were collected from 136 out of 172 SAC cases with over 6 months follow-up. Generally, dual antiplatelet therapy (DAPT) was initiated seven days prior to SAC. The anatomical site, implanted stent, duration of DAPT, duration of single antiplatelet therapy (SAPT) were studied.
Results: Average age was 59.0 years (30-82), 111 female and 25 male. Anatomical sites of aneurysm were 60 paraclinoid, 38 other internal carotid, 16 vertebral, 8 basilar, 9 anterior communicating, 3 middle cerebral, and 2 posterior cerebral arteries. Implanted stents were 69 Enterprise, 7 Enterprise 2, 32 Neuroform, 11 Neuroform Atlas, 9 LVIS Jr., and 8 LVIS stents. The average duration of DAPT was 135.2 days and SAPT was terminated after 810.8 days in 90 cases (66.2%). Cases from the latter half period terminated APT (68 cases, 512.1 days) earlier than the first half period (68 cases, 1029.9 days). And cases with internal carotid aneurysms terminated APT (98 cases, 742.3 days) earlier than those of other aneurysms (38 cases, 1216.7 days). There were nine ischemic events during the chronic period (3 asymptomatic, 2 TIA, 4 minor stroke).
Conclusion: Appropriate APT in the perioperative and follow-up period is mandatory for the safe SAC. Although it is possible to terminate the APT in many cases, a tailor-made regimen is necessary for selected cases to prevent the chronic ischemic event.
Keywords: Coil Embolization, Stent Assist, Anti Plated Therapy

P 100

A CASE OF SYMPTOMATIC MULTIPLE CEREBRAL ENHANCING LESIONS AFTER STENT-ASSISTED COIL EMBOLIZATION OF UNRUPTURED CEREBRAL ANEURYSM

M Katayama[1], M Murase[1], S Suga[1] and S Suga[1]
[1]Tokyo Detal College Ichikawa General Hospital, Ichikawa, Chiba pref, JAPAN

Purpose: We report multiple cerebral enhancing lesions with perilesional edema and magnetic susceptibility developed in the vascular territories of the cerebral aneurysm following stent-assisted coil embolization.
Materials and Methods: A 69 year-old female underwent stent-assisted (neuroform atlas) coil embolization of unruptured right middle cerebral aneurysm. The patient suffered from left-sided weakness and left homonymous hemianopsia 40 days later. MRI revealed multiple enhancing lesions, with perilesional edema and magnetic susceptibility in the vascular territories of the treated aneurysms. Symptoms worsened gradually.
Results: Oral methylprednisolone administration from post-operative day55 resulted in improvement of symptoms. All neurologic symptoms resolved in 2 weeks. MRI showed reduction of the enhancing lesions, resolution of perifocal edema, while prolonged magnetic susceptibility in 6 weeks.
Conclusion: Symptomatic multiple cerebral enhancing lesions are reported following stent-assisted embolization of unruptured middle cerebral artery aneurysm. Methylprednisolone administration improved symptoms, but magnetic susceptibility lesions remained. Long term follow-up should be done because long term result remains unknown.
Keywords: Aneurysm, Stent, Granuloma

P 101

TREATMENT OF UNRUPTURED INTRACRANIAL ANEURYSMS USING THE PIPELINE EMBOLIZATION DEVICE: A SINGLE-CENTER EXPERIENCE WITH SHORT-TERM FOLLOW-UP RESULTS

M Zhou[1], H Lu[1], G Li[1] and H Zhang[1]
[1]Department of Neurosurgery – Xuanwu Hospital Capital Medical University, Beijing, CHINA

Purpose: To present the short-term safety and efficacy results in treating unruptured intracranial aneurysm with pipeline embolization device(PED)
Materials and Methods: A prospective analysis was done in Neurosurgery department of Xuanwu Hospital. Clinical data of 42 patients who underwent endovascular treatment with PED in our department from Oct. 2014 to Jun. 2016 were retrieved to investigate its short-term safety and efficacy.
Results: 42 patients with 44 intracranial aneurysms were treated with PED during the study period. Rtention of contrast agent in the aneurysm cavity was detected by immediate radiography in 42 aneurysms. Perioperative complications were seen in 4 patients. Follow-up study of 2–12 months(mean 6.6 months) were done in 32 aneurysms of 31 patients.75.0 percents of aneurysms(24/32) showed complete occlusion on angiography, while 18.8 percents aneurysms(6/32) showed angiographic evidence of sub-complete occlusion.
Conclusion: Use of PED offers a safe and effective treatment strategy for unruptured intracranial aneurysm, with a high occlusion rate at 6 months. Larger prospective studies are needed to further confirm these observations.
Keywords: Pipeline embolization device, Flow diverter, Intracranial aneurysm

P 102

A SINGLE-CENTER EXPERIENCE WITH FLOW-DIVERTER DEVICES FOR INTRACRANIAL UNRUPTURED ANEURYSM TREATMENT

TK Jee[1] and P Jeon[1]
[1]Samsung Medical Center, Seoul, SOUTH KOREA

Purpose: Flow diversion now offers a new treatment alternative for large or giant intracranial aneurysms. The aim of this study was to assess the efficacy and safety of flow diverter treatment for unruptured aneyrusms larger than 15 mm in maximal diameter.
Materials and Methods: We retrospectively reviewed all patients with large or giant aneurysms treated by flow diverters in our institution between December 2014 and October 2018. Baseline characteristics and procedural data were collected to determine clinico-radiological outcomes based on CTA, TFCA, and MRI after 6 months. All patients were premedicated with dual antiplatelet agents, which ware modified based on the results of VerifyNow testing.
Results: Forty-four patients with 44 unruptured large or giant aneurysms were treated by flow diverters during the study period. The mean size of aneurysms was 19 mm and 30 of the 44 aneurysms (68%) were located in the anterior circulation. Two patients had recurrent aneurysms after clipping or coiling. During the mean follow-up of 15 months, angiographic obliteration was confirmed in 20 patients (45%) and half of them showed decrease in aneurysm size (n = 10). However, persistent filling of the treated aneurysm were found in 24 patients. Total five patients underwent repeated treatment due to increased aneurysm size (n = 3) or uncovered neck caused by flow diverter shortening or migration during follow up period (n = 2). Additionally, two patients suffered from delayed intracerebral hemorrhage.
Conclusion: Flow diversion appeared to be a reasonable option in the treatment of large or giant unruptured aneurysms.
Keywords: Aneurysm, Flow diverter, Large aneurysm

P 103

EFFICACY AND SAFETY OF FLOW DIVERTER STENTS IN THE TREATMENT OF CEREBRAL ANEURYSMS LESS THAN FIVE MM

E Akgul[1], HB Onan[2], HT Balli[2], Z Gungoren[1] and EH Aksungur[2]
[1]Istanbul Medipol University, Istanbul, TURKEY
[2]Cukurova University, Adana, TURKEY

Purpose: In this study, we evaluated the safety and efficacy of the flow diverters (FDs) in the treatment of intracranial aneurysms a less than 5 mm.
Materials and Methods: We treated 68 aneurysms in 43 patients with aneurysms less than 5 mm in size. Of the patients included in the study, 29 were females and the other 14 were males (mean age: 50.2 years). Headache was the most frequent symptom. Aneurysms in 7 patients were ruptured but they were not treated in acute stage. In 10 patients the aneurysms were recanalized and those had been treated with only coils or stent-assisted coiling. All aneurysms were in the anterior circulation. One of Silk, Pipeline, Derivo or FRED FDs were used in the treatment. Intracranial stent medication (double antiaggregation) was accomplished in all patients. All patients were evaluated one day later for any new ischemic lesion with DWI. The first follow-up angiograms were planned to be performed after 3–6 months.
Results: In all patients, the treatment was successful. Minor complications occurred in three patient (7%). In one patient, thrombus inside SILK was seen and it is relieved with tirofiban. But some asymptomatic acute focal small ischemic lesions were seen on follow-up MRI. Second patient bled from the right common femoral artery entrance and she was operated on. In the third patient, complications were technical. No hemorrhagic complication was seen on CT performed immediately following the procedure. All patients were discharged without any neurological deficit. Mean follow-up period was 26 (6-52) months. Of the aneurysms, 66 (97.1%) were completely closed.
Conclusion: The FDs are effective and safe in the treatment of intracranial, anterior circulation small aneurysms less than five mm in size.
Keywords: Cerebral Aneurysm, Endovascular Treatment, Flow Diverter

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FLOW-DIVERTER STENTS IN ANEURYSMAL SUBARACHNOID HEMORRHAGE

A Alexandre[1], F Giubbolini[1], G Garignano[1], I Valente[1], E Lozupone[1], F D'argento[1], C Colosimo[1] and A Pedicelli[1]
[1]Fondazione Policlinico Universitario A. Gemelli IRCCS, Roma, Italia. UOC Radiologia e Neuroradiologia., Roma, ITALY

Purpose: We report our preliminary experience in the use of flow-diverter stenting after acute subarachnoid aneurysmal hemorrhage, caused by different type of lesions (blood blister-like aneurysms, microaneurysms and dissecting aneurysms).
Materials and Methods: Retrospective evaluation of patients treated in our center with a flow-diverter stent in case of acute subarachnoid hemorrhage cause by an intracranial aneurysm. Four patients presenting with blister-like aneurysms (2 patients), microaneurysm (1 patient) and a fusiform aneurysm (1 patient). All patients were treated with a glycoprotein IIb/IIIa receptor antagonist with the standard dose, followed by a dual antiplatelet therapy until the sixth month after the procedure. Immediate and mid-term clinical and angiographic results of the interventions were assessed. The radiological follow-up protocol included DSA

after 1, 6 and 12 months and MR and MRA or CT and CTA at 1 and 2 years.
Results: There were no intra- or post-procedural major complications. At DSA control (1, 6 and 12 months after the procedure) the aneurysm was not filled anymore in the 3 patients who survived the acute bleeding. One patient died for other causes 10 days after the treatment. From the neurological point of view the 3 patients were stable immediately after the treatment and at 2 years follow-up.
Conclusion: In our experience flow-diverter stent in acute subarachnoid hemorrhage is safe and effective. Different type of aneurysms can be efficaciously treated with an easy endovascular technique avoiding complex, risky and inefficacious endovascular or surgical approaches. Further prospective studies, as well as long term results, are needed to confirm and validate these results.
Keywords: flow-diverter stents, ruptured cerebral aneurysms, blister-like aneurysms

P 105

SINGLE CENTER EXPERIENCE IN MINI FLOW-DIVERTER ANEURYSM EMBOLIZATION

N Marotti[1], U Rozzanigo[1], G Luppi[1], A Comai[2], F Ferro[2], G Nano[2], M Bonatti[2] and B Petralia[1,2]
[1]Ospedale Santa Chiara – Azienda Provinciale Servizi Sanitari della Provincia Autonoma di Trento, Trento, ITALY
[2]Ospedale San Maurizio – Azienda Sanitaria dell'Alto Adige, Bolzano, ITALY

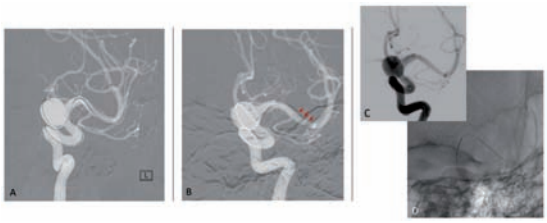
Purpose: To evaluate safety and efficacy of mini flow-diverter stents in prossimal and distal intracranial artery aneurysms.
Materials and Methods: In Trentino – Alto Adige Region we treated nine aneurysms in seven patients with Silk Vista Baby (balt) flow-diverter stent. Six aneurysms were ruptured, three were occasional. Aneurysm distribution: two of anterior communicating artery, two of basilar artery, one of pericallosal artery, one of middle cerebral artery, two of vertebral artery, one of superior cerebellar artery. Mean age of the patients were 59 years.
Results: Preliminary results were evaluated with angiogram control and angio-CT scan at discharge and with angiogram control within six months. All aneurysms showed immediate exclusion or flow stagnation. No complication were related to stent positioning.
Conclusion: Mini flow-diverter stents seems a feasible and safe tool to exclude hemorrhagic or occasional intrracranial aneurysms, even in distal cerebral vessels.
Keywords: Mini Flow-Diverter Stent, Aneurysm, Embolization

P 106

STENTRIEVER ANCHOR TECHNIQUE DURING ANEURYSMS EMBOLIZATION WITH FLOW-DIVERTER

G Garignano[1], E Lozupone[1], A Alexandre[1], F D'argento[1], I Valente[1] and A Pedicelli[1]
[1]Fondazione Policlinico Universitario A. Gemelli IRCCS, Rome, ITALY

Purpose: To assess whether the use of Stentriever could help to reduce the microcatheter's loop within a cerebral aneurysm during embolization with flow diverter.
Materials and Methods: Summary of cases. Three patients with an unruptured wide-neck brain aneurysm were treated with a flow diverter device. Endovascular treatment of these aneurysms with flow diverter can be technically challenging. One of the main difficulties is reaching the distal vessel arising from the aneurysm; to obtain the distal access, the microcatheter occasionally needs to be looped inside the sac because of the distorted anatomy of the aneurysm, of the stenosis or the kinking of the parent artery. In our cases, a coil-microcatheter (0.016 inches) was looped inside the sac in order to reach the distal emerging vessel; therefore, stentriever was deployed and used as a distal anchor to resolve the loop by pulling the microcatheter back. Subsequently, the 0,027'' microcatheter was delivered over the pushing wire of the stentriever. The stentriever was then resheated and the flow diverter was correctly deployed.



Results: -
Conclusion: Stentriever may represent an alternative tool in the treatment of wide-neck cerebral aneurysm in which a microcatheter loop inside the sac is necessary to reach the distal vessel for the deployment of a flow-diverter.
Keywords: Stentriever, Aneurysm embolization, Flow diverter

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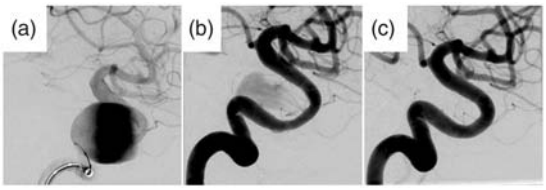
DELAYED HIGH JET FLOW INTO AN ANEURYSM AFTER FLOW DIVERTER PLACEMENT

R Nakae[1], T Takigawa[2], Y Kawamura[2], Y Tanaka[2], M Nagaishi[2], A Hyodo[2], K Suzuki[2] and H Yokota[1]
[1]Nippon Medical School, Department of Emergency and Critical Care Medicine, Tokyo, JAPAN
[2]Dokkyo Medical University Saitama Medical Center, Department of Neurosurgery, Saitama, JAPAN

Purpose: High jet flow into an aneurysm sac immediately following flow diverter (FD) treatment is an assumed cause of delayed aneurysmal rupture. The significance of high jet flow occurring months after FD treatment is unknown.
Materials and Methods: A 76-year-old woman with a large intracranial aneurysm measuring 23.0×18.1 mm in the cavernous segment of the right internal carotid artery was treated with placement of a single FD (Pipeline Embolization Device [PED]®, Covidien, Irvine, CA, USA).
Results: Post-procedure digital subtraction angiography (DSA) demonstrated flow stagnation inside the aneurysm dome (A). The patient was discharged 9 d post-procedure without new neurological deficits. A 6-month followup DSA demonstrated high jet flow into the aneurysm sac (B). Although she was scheduled for additional PED placement because of concern for aneurysmal rupture, the operation was not conducted due to an interim motor vehicle accident. Oral treatment with aspirin (100 mg/d) and clopidogrel (75 mg/d) was continued during her recovery. A DSA performed 12 months post-procedure showed that the aneurysm had completely thrombosed (C).
Conclusion: Our findings suggest that delayed high jet flow into an aneurysm may form part of the normal clinical course post-FD placement, and may not preclude eventual thrombosis of the aneurysm. Further studies are needed to determine whether more frequent followup DSAs and watchful waiting are suitable in such cases.



Keywords: Intracranial Aneurysm, Flow Diverter, Pipeline

P 108

OPEN VERSUS FLOW DIVERSION TREATMENT OF SMALL UNRUPTURED CAROTID-OPHTHALMIC ANEURYSMS: A SISTEMATIC REVIEW

E Paschoal[1], CR Orocha[2], AC Pires[2], L Lobato[2], FLA Tobelem[2], L Msantos[2], M Isr[2], A Ldcosta[2], F Mpaschoaljr[2], R Mrburbano[3], J Rnbrito[3], J Srogerio[3], R-Dos-Santos[4], J Aslima[3] and A De M. Lima Neto[3]
[1]Unidade Neuromuscular do Complexo Hospitalar da UFPA/EBSERH, Belém, BRAZIL
[2]Grupo de Pesquisa Amazônia Neurovascular UFPA CNPq, Belem, BRAZIL
[3]Instituto Neurologico do Hospital Ohpir Loyola, Belem, BRAZIL
[4]Laboratorio de Genetica Humana da UFPA, Belem, BRAZIL

Purpose: We performed a systematic review to compare angiogram and clinical outcomes between clipping and flow diverter stenting for small unruptured cerebral aneurysm at ophtalmic segment of the internal carotid artery.
Materials and Methods: A systematic search of Medline, Cochrane Central Register of Controlled Trials, LILACS and EMBASE data bases was conducted Proportional meta-analyses and relative risk of death before five years were assessed between patient groups.
Results: The literature search yielded 209 articles, of which 11 met the inclusion criteria. All of the studies were retrospective case series.
Conclusion: Our study suggests that treatment of small unruptured carotid-ophthalmic aneurysms with flow-diverter devices is feasible and effective with lower rates of procedure-related morbidity and mortality, high complete occlusion rates and good neurologic outcomes.
Keywords: Intracranial aneurysm, Clipping, Flow diverter stent

P 109

FACTORS ASSOCIATED WITH IPSILATERAL DISTANT SUBARACHNOID HEMORRHAGE AFTER FLOW DIVERTER PLACEMENT

T Kikuchi[1], A Ishii[1], M Okawa[1], Y Yamao[1], H Nishi[1], I Ono[1] and S Miyamoto[1]
[1]Department of Neurosurgery, Kyoto University Graduate School of Medicine, Kyoto, JAPAN

Purpose: Localized subarachnoid hemorrhage (SAH) sometimes can be seen at the distal territory of the artery on which flow diverter (FD) was placed for intracranial aneurysm. Although most of the phenomena usually resolve spontaneously, it may provide important suggestion in considering periprocedural management. This study was aimed to clarify the relationship between ipsilateral distant subarachnoid hemorrhage (iSAH) after FD placement and other factors such as preoperative platelet function indicators, ischemic lesions and other clinical informations.
Materials and Methods: This is a retrospective cross sectional study in single institute. Patients who received FD placement for intracranial aneurysm between April 2016 and April 2019 in our institute were included.
Results: 67 patients were eligible for this study. One patient was excluded because of SAH caused by vessel perforation during procedure. Ipsilateral distant SAH was seen in 5 patients and all were asymptomatic. Magnetic resonance imaging acquired post-procedural day 1 or 2 revealed that all the iSAH was co-localized with DWI hyperintensity spots except for one patient. iSAH was seen significantly more ($p = 0.0261$) in patients with PRU equal to or below100 (4/14), compared to the patients with PRU > 100 (3/52), while ipsilateral intraparenchymal hemorrhage was equally seen in both group.
Conclusion: Ipsilateral distant SAH has possible relationship with ischemic lesion after FD placement. iSAH might have ischemia in its background and be helpful in considering pre- and post procedural antiplatlet management.
Keywords: Flow diverter, Ischemia, Subarachnoid hemorrhage

P 110

DELAYED RUPTURE OF IC CAVERNOUS LARGE ANEURYSM AFTER PED TREATED BY TRANSARTERIAL COIL/ONYX EMBOLIZATION

I Nakahara[1], S Matsumoto[1], Y Suyama[1], J Oda[1], A Hasebe[1], T Suzuki[1], J Tanabe[1], S Watanabe[1] and K Suyama[1]
[1]Department of Comprehensive Strokology, Fujita Health University School of Medicine, Toyoake, JAPAN

Purpose: A successful case of transarterial, trans-PED embolization of delayed rupture of IC cavernous large aneurysm treated by Pipeline FX using coils and ONYX is presented.
Materials and Methods: A 72 years-old gentleman underwent Pipeline Flex treatment of an asymptomatic but progressively enlarging left IC cavernous aneurysm measuring 15 mm in diameter. Treatment was uneventfully finished using a single Pipeline FX (4.75mmx16mm) with excellent wall adaptation and immediate eclipse sign. He was discharged home on Day 7. In the evening of that day, he was suffered a sudden onset headache and pulsatile tinnitus and came back to us.
Results: Angiography revealed direct carotid cavernous fistula due to rupture of the aneurysm. Several therapeutic options were discussed including 1) additional PEDs, 2) transvenous embolization (cavernous sinus/aneurysm), 3) transarterial embolization (TAE), 4) parent artery occlusion. As occlusion tolerance of ICA without EC-IC bypass was insecure and rupture point was obscure, TAE was selected. Complete obliteration of the aneurysm was obtained by trans-PED access using dual distal access guiding system / CTO wire, and intra-aneurysmal ONYX embolization (ONYX-34 4.63 ml over 60 minutes) after coil embolization.
Conclusion: TAE with trans-PED access and ONYX may be an alternative for delayed rupture of IC cavernous aneurysm after PED treatment.
Keywords: PED, delayed rupture, ONYX

P 111

IN VIVO ANEURYSM PRESSURE TRANSITION FOR SEVERAL HOURS AFTER PLACEMENT OF A PIPELINE EMBOLIZATION DEVICE

H Chihara[1], A Ishii[2], T Kikuchi[2], H Ikeda[2], D Arai[2] and S Miyamoto[2]
[1]Kokura Memorial Hospital, Kitakyushu, JAPAN
[2]Kyoto University, Kyoto, JAPAN

Purpose: A pipeline embolization device (PED) is one of the most frequently used flow diverters for intracranial aneurysms; PEDs have been improved (second-generation PED Flex), and flow diversion has been increasingly used to treat smaller and/or more distal aneurysms. However, the issue of delayed rupture of aneurysms, unique to flow diverters, has not been completely resolved. To examine the mid-term intra-aneurysmal pressure changes after flow diverter placement, intra-aneurysmal pressure was measured in a rabbit aneurysm model.
Materials and Methods: Six elastase-induced aneurysms were created in New Zealand white rabbits. Intra-aneurysmal pressure measurements were performed with a dual-sensor guidewire.
Results: The mean size of the induced aneurysms was 8.0 mm (4.3-14 mm), and the mean size of the aneurysmal necks was 5 mm (2.2-10.2 mm). One animal that received Pipeline Flex placement had a wide neck in which the stent was not long enough, and two stents were placed using a telescoping technique. In the other four animals, one Pipeline Flex device was placed. Blood pressure and intra-aneurysmal pressure were measured before and up to six hours after placement in all six animals, including one animal that did not receive Pipeline Flex placement. Intra-aneurysmal pressure decreased immediately after Pipeline Flex placement. Although this difference then disappeared temporarily, intra-aneurysmal pressure decreased significantly again four hours after placement.
Conclusion: The present study showed that intra-aneurysmal pressure decreased after several hours. This finding is useful in the clinical setting for postoperative management to prevent delayed rupture in patients undergoing flow diverter placement.
Keywords: flow diverter, intra-aneurysmal pressure, PED

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APPLICATION OF 3D FUSION IN PIPELINE APPOSITION EVALUATION

Y Liu[1]
[1]Department Of Neurosurgery, Tangdu Hospital, Xian, CHINA

Purpose: To observe the effectiveness and availability of 3D fusion technique in the evaluation of Pipeline apposition.
Materials and Methods: 6 patients with Pipeline Flex blood flow guidance device implantation were compared with 3D fusion technique and dilution contrast medium method.
Results: 48 development wires distribute in the whole Pipeline stents, which makes the whole body development effect realized. The shape and structure of Pipeline and its adhesion in circuitous blood vessels could be clearly displayed by using double volume fusion technique. Compared with the dilution contrast medium method, the double volume fusion technique can save the contrast time and has a higher success rate. At the same time, the imaging effect is also obviously better than the dilution method. Furthermore, the section view is clearer and we can easily realize the stereoscopic multi-angle observation.
Conclusion: The whole body development characteristics of: Pipeline Flex blood flow guidance device have inherent advantages in observing adherent. In general, diluted contrast medium will be used for non-subtraction radiography during operation, and the adherent condition will be observed and evaluated from multiple angles. The emergence of 3D fusion technology can further give full play to

the development advantages of Pipeline, clearly observe the shape of the stent and its relative position with the vessel wall, and evaluate the adhesion. The correct selection of appropriate reconstruction mode and reconstruction method is an important guarantee for the effect of operation.

Keywords: Aneurysm,3D fusion technique, Pipeline apposition

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OCCLUSION RATE OF FLOW DIVERTER DEPENDS ON ANEURYSM MORPHOLOGY

T Sunohara[1], N Sakai[1], H Imamura[1], S Tani[1], H Adachi[1], R Fukumitsu[1], N Fukui[1], Y Oomura[1], T Akiyama[1], T Fukuda[1], S Kajiura[1] and M Shigeyasu[1]

[1]Kobe City Medical Center General Hospital, Kobe, JAPAN

Purpose: Flow diverter is IVR device, and its treatment strategy of flow diversion for intracranial aneurysm is different from coil embolization. Although some previous authers reported factors related to complication rate, factors to occlusion rate, especially on molphologic factors are not clear. Here we investigated factors affecting occlusion rate of aneurysm treated by Pipeline Flex.

Materials and Methods: a total of 55 aneurysms in 51 patients treated by pipeline flex flow diverter system in our institute between July 2015 and September 2018 and observed >6 months were included. Occlusion rate was analyzed using O'Kelly-Marotta grading scale at the 6-month follow-up digital subtraction angiography. The factors involved in occlusion rate were assessed.

Results: In all aneurysms ($n = 55$), 5 (9.1%) were C, 37 (67.3%) were B, and 13 (23.6%) were A immediately after the procedure. At 6-month digital subtraction angiography, 26 (47.3%) were D, 19 (34.5%) were C, 8 (14.5%) were B, and 2 (3.6%) were A. There were significant differences in aneurysm type ($p < 0.01$), aneurysm dome diameter ($p < 0.05$), aneurysm neck diameter ($p < 0.05$), between OKM grade D and A to C.

Conclusion: Occlusion rate of flow diverter depends on aneurysm type and size, and neck length. Thus, strategy such as multiple stent use should be adjusted depending on aneurysm type.

Keywords: Flow diverter, aneurysm, single institute

P 114

NEUROINTERVENTIONAL MANAGEMENT OF LARGE OR GIANT ANEURYSM IN THE CIRCLE OF WILLIS BY USING PHYSIOLOGIC FLOW DIVERSION

B Kwon[1], Y Song[1], J Ryu[1] and DC Suh[1]

[1]Department of Radiology, Asan Medical Center, University of Ulsan College of Medicine, Seoul, SOUTH KOREA

Purpose: The circle of Willis is a common area in development of aneurysm. By using a reciprocal flow via the circle of Willis, we developed physiologic flow diversion technique in the treatment of aneurysm.

Materials and Methods: Physiologic flow diversion technique uses the concept that occlusion of the origin of the vessel induces increased flow via the opposite direction. We applied the technique in two large or giant aneurysm at the P-com or basilar tip. Aneurysm were occluded a staged fashion to induce increased flow in the circle of Willis. Follow-up magnetic resonance angiography and patient status were evaluated.

Results: We successfully treated two patients with large or giant aneurysms. Follow-up magnetic resonance angiography showed obliteration of aneurysm and enlargement of P1 or posterior communicating artery due to the increased flow. There was no ischemic lesion on MRI and no neurological event during or after procedure.

Conclusion: Induction of increased flow from the opposite direction via the circle of Willis contributed to the complete occlusion of the aneurysm and prevented recurrence.

Keywords: Large Or Giant Aneurysm, Circle Of Willis, Physiologic Flow Diversion

P 115

COMPARISON OF HEMODYNAMIC STRESS OF HEALTHY SIDE ARTERY IN PARENT ARTERY OCCLUSION AND FLOW DIVERTER STENT TREATMENT FOR LARGE INTERNAL CAROTID ARTERY ANEURYSM WITH 3D CINE PCMR ANALYSIS

T Tsukada[1], T Izumi[1], M Nishihori[1], R Ooshima[1], T Kawaguchi[1], K Ootawa[1], A Kropp[1], S Gotou[1], M Ikezawa[1], H Isoda[2,3] and T Wakabayashi[1]

[1]Department of Neurosurgery, Nagoya University Hospital, Nagoya, JAPAN

[2]Brain & Mind Research Center, Nagoya University, Nagoya, JAPAN

[3]Department of Brain & Mind Sciences, Nagoya University Graduate School of Medicine, Nagoya, JAPAN

Purpose: Large internal carotid artery (ICA) aneurysms are difficult to treat, and parent artery occlusion (PAO) has been the treatment of choice. However, in recent years there has been a shift towards flow diverter stent (FD) treatment, which can preserve the parent artery. It has been reported that post-PAO, de novo aneurysms tend to develop on the healthy vessel side. It is speculated to be caused by the increase in hemodynamic stress in the remaining blood vessels. We used 3D cine phase-contrast MRI (3D PCMR) to measure and compare hemodynamic stress in healthy side vessels before and after surgery in PAO and FD groups.

Materials and Methods: Seventeen patients who underwent MRI including 3D PCMR imaging before and after surgery for large ICA aneurysms from May 2015 to March 2018 were

enrolled in this study. There were 5 cases in the PAO group and 12 cases in the FD group. Segmentation of vascular structure was created from TOF MRA date, and blood flow volume data was obtained from 3D PCMR as the boundary condition. The ratio of postoperative data to preoperative data was compared between PAO and FD groups for flow volume of healthy side ICA and wall shear stress (WSS) in C1 part of healthy side ICA.

Results: The site of aneurysm was ICPC in one case in PAO group and remaining 16 cases were between cavernous and petrous portion. The mean maximum diameter of the aneurysm was 30.5 mm in the PAO group and 21 mm in the FD group. After 1 to 2 months of treatment, the flow volume of the healthy side ICA was 1.24 times ($n = 5$) in the PAO group, and 1.07 times in the FD group ($n = 12$) compared with those before the surgery. After 6 months to 1 year of treatment, the flow volume was 1.3 times ($n = 5$) greater in the PAO group, and 1.05 times ($n = 9$) in the FD group. In the PAO group, WSS in the C1 part of ICA was increased by an average of 1.3 times at 1 to 2 months and 6 months to 1 year after treatment, but no increase was observed in the FD group.

Conclusion: Postoperatively, the flow volume in the healthy blood vessel has increased and the WSS in C1 part of healthy side ICA has significantly increased in PAO, which is considered to contribute to the formation of de-novo aneurysm after PAO.

Keywords: large internal carotid artery,3D cine PCMR, hemodynamic stress

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MEGA GIANT PARTIALLY THROMBOSED ANEURYSM OF THE ANTERIOR COMMUNICATING ARTERY: AN ASTONISHING SURGICAL TREATMENT AND CLINICAL OUTCOME

C Bombardieri[1], C Ceccotti[2], K Pardatscher[3] and T Fukushima[4]

[1]University Hospital, Catanzaro, ITALY
[2]Neurosurgery Department, Pugliese-Ciaccio Hospital, Catanzaro, ITALY
[3]University, Catanzaro, ITALY
[4]Carolina Neuroscience Institute, Raleigh, USA

Purpose: Giant cerebral aneurysms are > 25 mm in greatest diameter. They represent a small portion (~5%) of all brain aneurysms and, if untreated, they have a high risk of rupture. These aneurysms may manifest with SAH or signs/symptoms of mass effect.

Materials and Methods: A 61-year-old man presented with a 30-day history of right severe visual deficits and apathy. An examination revealed poor visual acuity and a field defect in the right eye. He rapidly underwent brain MRI (Figure 1A) and MRA exams, CT scan and digital angiography. He was a heavy smoker (40 cigarettes a day) at the moment of the diagnosis in 2011. His aneurysm presents a dimension major of 5.2 cm and a vascularized bilobar portion of almost 3 cm size. The patient had consultations in many universities and institutions but no one could achieve the treatment and also on endovascular consult they failed to offer any definitive management. So, finally, the patient was referred to Professor Takanori Fukushima for repair of this aneurysm. Professor Fukushima made a bifrontal craniotomy (~12 cm square), bilateral superficial temporal artery harvest and connection from the right superficial temporal artery proximal over the right calvarium down to the interhemispheric fissure to right A3 bonnet bypass, radical resection of the mega giant thrombosed aneurysm, aneurysmorraphy with 7-0 stitches and application of 2 titanium clips. This procedure was made on 25 May 2012 and it has taken 18 hours.

Results: The patient was awake on the second postoperative day, on the fourth day he started to have per os intake. In the postoperative course the patient had a CT scan, MRI and DSA (Figure 1B) to demonstrate the patency of the bypass and the aneurysm repair. Postoperative angiogram finding was excellent. The patient was discharged on postoperative day 12, in good clinical conditions, ambulating, no weakness, no new neurological deficits except short-term memory disturbance. His right vision is pretty much recovered from near blindness to fairly good vision. Brain MRI and MRA exams confirmed the aneurysm repair and the patency of the bypass 18 months after the surgery. Over a 7 year follow-up period the man is in good clinical conditions.

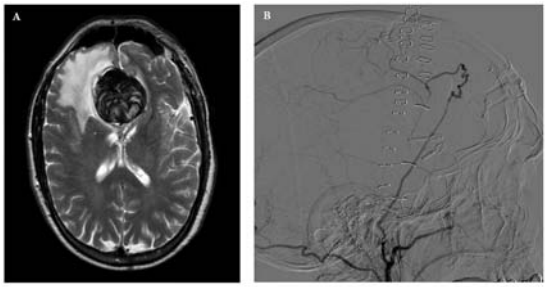

Figure 1 – A) Axial T2-weighted MRI demonstrates a mega giant anterior communicating artery aneurysm with intramural hemorrhage and perilesional edema. B) – Postoperative angiogram showing the patency of the bypass from right superficial temporal artery to the A3 segment of the right anterior cerebral artery.

Conclusion: The management of these complex aneurysms represents a real challenge for both Neurosurgeon and Neurointerventional Radiologist. Flow diverters have emerged as a considerable tool to treat complex aneurysms but perhaps a very experienced neurosurgeon can achieve fine results, just better than endovascular technique at the moment.

Keywords: Mega Giant Aneurysm, Bonnet Bypass, Anterior Communicating Artery

P 117

A SINGLE-CENTER EXPERIENCE IN THE ENDOVASCULAR TREATMENT OF CAROTID SIPHON ANEURYSMS USING THE WILLIS COVERED STENT

C Fang[1], L Ma[1], J Xu[1], S Yan[1] and H Feng[1]
[1]Shanghai Tongji Hospital, Tongji University School of Medicine, Department of Interventional Radiology, Shanghai, CHINA

Purpose: To report the clinical results and initial clinical experience of endovascular isolation with the Willis covered stent for carotid siphon aneurysms.

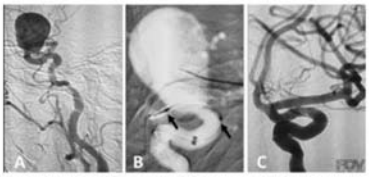

Figure 1 Carotid siphon aneurysm treated with the Willis covered stent. (A) Pre-procedural digital subtraction angiography image shows a wide-necked giant aneurysm on the anterior wall of the left C6 segment. (B) The Navien support catheter was positioned in the C4 segment of the internal carotid artery by the coaxial technique. The Willis covered stent (4.0×16 mm) was successfully deployed with proximal and distal ends of the stent covering the neck of the aneurysm (4 mm) on both sides (arrows). (C) Cerebral angiogram immediately after stent placement demonstrates complete occlusion of the aneurysm with patency of the parent artery.

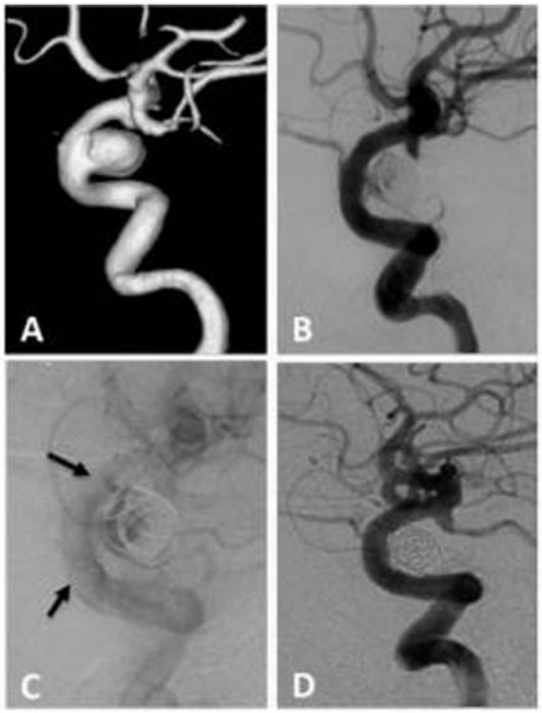

Figure 2 Carotid siphon aneurysm treated with the Willis covered stent plus coils. (A) Pre-procedural three-dimensional rotational view shows a wide-necked large aneurysm on the C4 segment of the internal carotid artery. (B) Cerebral angiogram immediately after stent-assisted coil embolization shows near total occlusion of the aneurysm with mild endoleak. (C) The Willis covered stent can be clearly seen in the plain film after stent placement (arrows). (D) Follow-up angiogram at 12 months shows complete disappearance of the aneurysm with patency of the parent artery.

Table 1 Baseline characteristics of the 57 patients with carotid siphon aneurysms

Characteristics	No of patients
Sex	
Male	26
Female	31
Median age	67 (19–72)
Location	
C6	19
C6+C5C4	14
C4–C5	6
C4+C2C4	18
Aneurysm size	
<3 mm	17
3–10 mm	16
10–25 mm	24
Aneurysm morphology	
Saccular aneurysm	44
Pseudoaneurysm	10
Dissection	3
Ruptured aneurysms	30
Unruptured aneurysms	27
Clinical symptoms	
Subarachnoid hemorrhage	22
Hunt and Hess grade	
I	8
II	13
III	1
Epistaxis	8
Headache	12
Decreased visual acuity/diplopia	9
Pituitary dysfunction	1
Pituitary operation-related hemorrhage	3
Paranasal sinus operation-related hemorrhage	2
Strategy	
Covered stent	41
Double covered stent	2
Covered stent plus coils	11
Double covered stent plus coils	3
Outcome	
Complete occlusion	48
Endoleak	9
Adverse events/outcome	
Acute stent thrombosis	1/recovery
Intracranial hemorrhage	1/dead
Stent displacement	1/endoleak
Modified Rankin Scale score	
0–2	56
>2	1

Materials and Methods: Between November 2013 and December 2016, a total of 57 patients who presented with carotid siphon aneurysms were treated with the Willis covered stent. Results of the procedures, technical events, and complications were recorded. Clinical and imaging follow-ups were performed at 3 months following the endovascular procedures.

Results: Placement of the Willis covered stent was successful in all patients. Immediate angiography revealed complete exclusion of aneurysms in 48 patients (84%), while endoleak occurred in nine patients (16%). Procedure-related complications occurred in three cases, including displacement of the covered stent in one patient, acute in-stent thrombosis in one patient, and microwire-related intracranial

aneurysms, they may be benign and should simply be monitored.

Keywords: Cerebral Aneurysm, Fusiform Aneurysm, Vertebral Artery

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BILATERAL VERTEBRAL ARTERY DISSECTING ANEURYSM: COMPRESSING BRAIN STEM, HIDDEN ANEURYSM

K Chae[1], Y Choo[1] and S Lee[1]

[1]Bongseng Memorial hospital, Busan, SOUTH KOREA

Purpose: Most of unruptured vertebral artery dissecting aneurysm(VADA) have good prognosis. However, large aneurysm that have a mass effect can cause symptoms and sometimes lead to rupture, so these cases may require treatment. I would like to introduce a case that bilateral VADA compressed brain stem which was not observed initially.

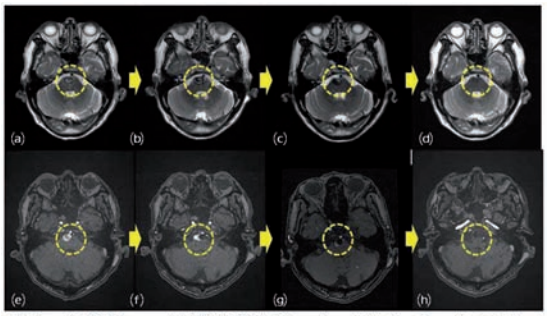

Fig.1 serial MRI image (a) initial T2WI, (b) post embolization 3month, (c) after 2months of 2nd embolization, (d) after 18months follow up, (e) initial TOF, (f) partial occlusion and enlargement of Rt. Aneurysm sac, (g) decreased size of aneurysm, (h) disappeared aneurysm

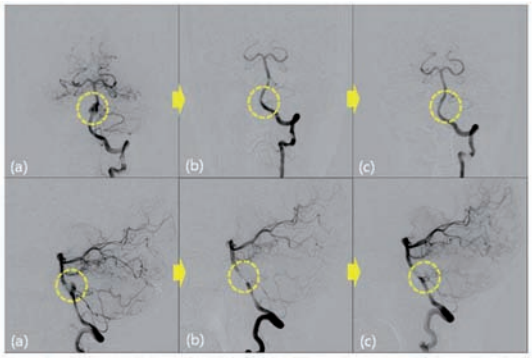

Fig.2 Angiography follow up, (a) initial Lt. VA angiography, (b) 3months follow up : coil embolization state, (c) 12months follow up : no visible aneurysm

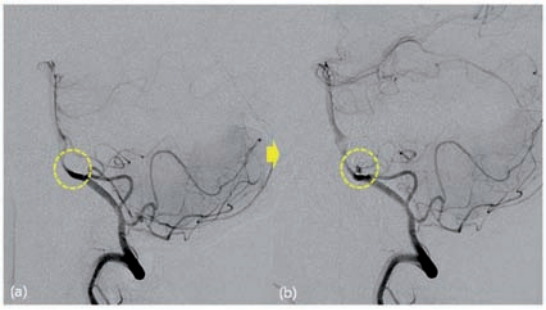

Fig.3 Angiography follow up, (a) initial Rt. VA angiography, (b) newly visible aneurysm on 3month follow up angiography

hemorrhage in one patient. Angiographic follow-ups were done in 49 patients, with complete exclusion of aneurysms in 47 patients. Endoleak was present in two patients. No aneurysm recurrence occurred. Forty-four patients showed good parent artery patency, while the other five patients showed mild to moderate asymptomatic in-stent stenosis. During the follow-up period, no ischemic or hemorrhagic event occurred. The modified Rankin Scale scores at follow-up were 0–2 in 56 patients and >2 in one patient.

Conclusion: The treatment of siphon aneurysms with Willis covered stent implantation resulted in satisfactory clinical outcomes. The Willis covered stent seems safe and feasible for the treatment of siphon aneurysms, which still needs to be confirmed by longer follow-up periods and controlled studies with larger samples.

Keywords: carotid siphon aneurysm, Willis covered stent, endovascular treatment

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LONG-TERM FOLLOW-UP OF INTRACRANIAL FUSIFORM ANEURYSMS OF VERTEBRAL ARTERIES

S Kohyama[1], S Iihoshi[1], S Kasakura[1], S Yoshikawa[1], E Tsukagoshi[1] and F Yamane[2]

[1]Saitama Medical University International Medical Center – Department of Endovascular Neurosurgery, Saitma, JAPAN

[2]Teikyo University School of Medicine – Department of Neurosurgery, Tokyo, JAPAN

Purpose: Intracranial fusiform aneurysms in the vertebral arteries (VAs) are often detected incidentally by magnetic resonance imaging. The difference in prognosis of fusiform aneurysms and saccular or dolichoectatic aneurysms is not known. The objective of this study is to determine the risk of progression and progression rate of intracranial fusiform aneurysms in the VAs for better understanding of effective treatment.

Materials and Methods: Clinical data of 117 patients with 128 intracranial fusiform aneurysms in the VAs were retrospectively retrieved from a medical records database. Fusiform aneurysms extending to the basilar artery and dolichoectatic aneurysms were excluded. Because 11 aneurysms detected in 10 patients were treated soon after diagnosis, 117 intracranial fusiform aneurysms in the VAs in 107 patients were evaluated. Analysis of risk factors for aneurysm growth was performed using the Mann-Whitney test for continuous variables and the chi-square or Fisher exact test for categorical variables.

Results: During a mean follow-up of 45 months (range, 3–185 months), only three aneurysms enlarged. One patient was treated with an endovascular procedure, and two of the aneurysms remained stable after more than three years of follow-up. Any aneurysms did not become symptomatic. Statistical analysis did not reveal any significant risk factor for progression.

Conclusion: Asymptomatic intracranial fusiform aneurysms in the VAs were not progressive regardless of size, shape, or presence of thrombosis. Unlike saccular or dolichoectatic

Materials and Methods: A 63-year-old male patient visited the emergency room due to dizziness and gait disturbance. In brain MRI and MRA, a large aneurysm which compressed the brain stem was observed in the left vertebrae artery and edema was observed around the brain stem. An angiography was done and a thrombosed aneurysm from the left dominant VA was observed. We performed coil embolization with double stent, and he discharged without any problem. After three months, brain MRI was checked, but aneurysm compressing brain stem was not changed and brain swelling was still observed, so we checked angiography. The previously treated left VA aneurysm was completely cured, but a new aneurysm was observed in right vertebral artery just opposite side of previous aneurysm. That was not seen on initial angiography. It was also thrombosed aneurysm, so we performed occlusion of distal VA with coils.
Results: Two months later, the size of the thrombosed aneurysm that was compressing the brain stem decreased and there was no aneurysm on angiography 6 months later. After 18 months, MRI showed that thrombosed portion was almost absorbed and the symptoms of the patient improved.
Conclusion: In rare cases, we must observe carefully after treatment of large VADA because there is a possibility of bilateral VADA.
Keywords: Dissecting Aneurysm, Vertebral Artery, Stem Copression

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LATERAL MEDULLARY INFARCTION AFTER DISTAL VERTEBRAL ARTERY TRAPPING FOR MANAGEMENT OF DISSECTING ANEURYSM

JW Choi[1], YS Seo[1], DH Kim[1] and JY Kim[1]
[1]Wonju Severance Christian Hospital, Wonju, SOUTH KOREA

Purpose: Endovascular coil trapping is a useful treatment option for prevent bleeding or infarction from a intracranial vertebral artery dissection. And lateral medullary infarctions that occur after successful embolization are rare. We report a case of lateral medullary infarction, which developed after endovascular distal vertebral artery trapping for management of dissecting aneurysm in a 46-year-old woman.
Materials and Methods: A 46-year-old woman who had no specific previous medical history was admitted with a headache for 2 weeks. Magnetic resonance image (MRI) and cerebral angiography showed a left vertebral artery dissecting aneurysm that did not involve the origin of the posterior inferior cerebellar artery (PICA).
Results: We treated this aneurysm by endovascular coil trapping of the vertebral artery distal to the PICA. There was no specific symptom at the immediate postoperation, however, 16 hours after embolization, left facial anhidrosis, left upward gaze limitation and left upper extremity ataxia symptoms were developed and MRI showed infarction in the right posterior superior cerebellum. The symptoms did not progress, and improved, though she still had residual symptoms of diplopia and left side sensory change at discharge.
Conclusion: Although this case is relatively uncommon, it is complication that should be considered in treating unruptured dissecting aneurysm. Further investigations to identify risk factors and medullary infarct mechanisms are needed in order to reduce such a complication.
Keywords: VA dissecting aneurysm, Lateral medullary infarction

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ENDOVASCULAR TREATMENT WITH STENTS FOR RUPTURED DISSECTING ANEURYSMS

A Ito[1], Y Suzuki[3], Y Oyama[1], K Uno[1], M Miyamoto[1], K Hoya[2], F Yamane[1] and A Matsuno[1]
[1]Teikyo University School of Medicine, Tokyo, JAPAN
[2]Teikyo University Chiba Medical Center, Ichihara, JAPAN
[3]Fujii Neurosurgical Hospital, Utsunomiya, JAPAN

Purpose: Intracranial dissecting aneurysms (DAs) are well-known as one of the causes of subarachnoid hemorrhage (SAH). Recently, there are some reports about reconstructive stent therapy in unusual cases in which conventional endovascular treatment of parent artery occlusion was not feasible. However, the indication and timing of stent treatment for ruptured aneurysms remain controversial. The purpose of this presentation is to evaluate the efficacy and safety of stent therapy for intracranial ruptured DAs.
Materials and Methods: Among patients with SAH caused by intracranial DAs, only patients who underwent stnet therapy were included in this study. Between January 2016 and March 2019, 8 patients underwent stent therapy. 3 out of 8 patients underwent overlapping multiple stents therapy, and 5 underwent stent therapy with coil embolization. Safety, technical feasibility, clinical, and imaging follow-up data were retrospectively evaluated.
Results: Stent deployments for DAs were successfully performed in all 8 DAs without any procedure-related complication. Among the patients, 7 patients showed clinical improvement without new symptoms, one patient had neurological worsening because of the clinical vasospasm. All 8 patients showed near normalization on follow-up angiogram within 3 months after the procedure, including 3 patients who underwent overlapping multiple stents therapy without coil embolization.
Conclusion: The stent therapy for ruptured dissecting aneurysm was considered to be safe and effective alternative method in unusual cases in which conventional endovascular treatment was not feasible and surgical treatment was contraindicated.
Keywords: dissection, stent, subarachnoid hemorrhage

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DELAYED DEVELOPMENT OF DE NOVO CONTRALATERAL VERTEBRAL ARTERY DISSECTING ANEURYSM AFTER ENDOVASCULAR TREATMENT (2 CASES)

J Cho[1] and Y Kwak[1]
[1]Daegu Catholic Medical Center, Daegu, SOUTH KOREA

Purpose: Vertebral artery dissecting aneurysm (VADA) can induce cerebral ischemia, subarachnoid hemorrhage (SAH), other symptoms such as headache or mass effect. Usually, endovascular management or open surgery is required. Interestingly, the development of contralateral VADA after initial treatment has been reported sporadically. Most of them were developed during short-term F/U period. We present two cases of a de novo contralateral VADA after endovascular treatment (Trapping of a ruptured VADA & Stent-assisted coiling of an unruptured VADA) during long-term F/U period. Postoperative hemodynamic stress after trapping was suggested as the possible causative factor in several reports. We hypothesize about the possible mechanism(s) of these aneurysms.
Materials and Methods: 1) Case 1: A 49-year-old woman with lupus nephritis received endovascular trapping for a ruptured VADA on Rt. Side. F/U MRA (30 months) revealed no evidence of recurrence or newly developed lesion. 4 months later, she complained of sudden headache and lost her consciousness. Brain CT revealed diffuse SAH and hydrocephalus and F/U TFCA revealed a de novo VADA on the contralateral side (Lt.). 2) Case 2: A 50-year-old woman with occipital headache after mild head trauma received double stents assisted coiling for an unruptured VADA on Lt. side. F/U MRA (5 year) revealed a newly developed VADA on the Rt. side.
Results: 1) Case 1: The patient received double stents assisted coiling for the ruptured Lt. side VADA & extraventricular drainage. The patient showed a good postoperative course without any neurologic deficits. 2) Case 2: The patient received single stenting only because of several perforators arising from the involved vertebral artery. F/U TFCA (10 months) revealed more irregularly-enlarged VADA and we performed additional stent assisted coiling for the lesion. F/U MRA (12 months) after SAC showed stable condition.
Conclusion:
1. Increased hemodynamic stress may lead to the development of a dissecting aneurysm. After trapping for the treatment of a VADA, long term F/U study is necessary for the detection of any change. (Case 1)
2. Uncertain factor(s) except increased hemodynamic stress may be involved in the development of de novo VADA. (Case 2)
Keywords: Delayed, De nove, Contralateral

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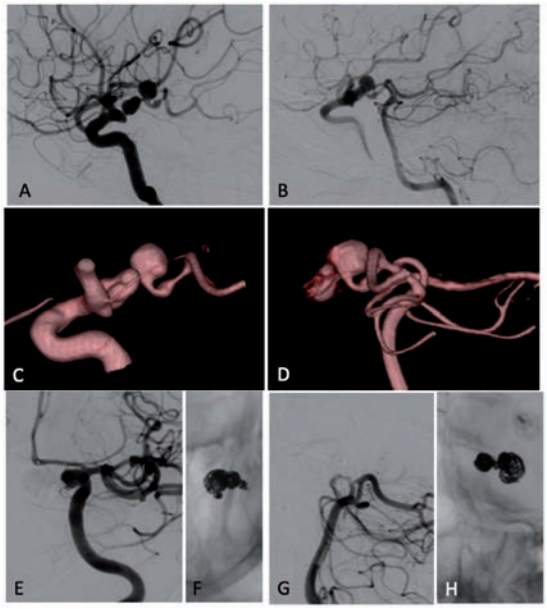
ENDOVASCULAR TREATMENT OF DISSECTING ANEURYSM OF THE POSTERIOR COMMUNICATING ARTERY

T Kataoka[1] and K Takahira[1]
[1]Hokkaido Ohno Memorial Hospital, Sapporo, JAPAN

Purpose: Dissecting aneurysms occurring in the posterior communicating artery are very rare. We report a case of posterior communicating artery dissecting aneurysm onset with thalamic infarction. It was slowly increased. We treated dissecting posterior communicating artery aneurysm with internal trapping.



Materials and Methods: Case: 64-year-old male. Onset at 56 years old, with left thalamic infarction. MRA showed tortuous and dilated left posterior communicating artery. Conservative therapy was selected because the onset was non-bleeding. Three months later, completely spontaneous occlusion of the posterior communicating artery and dissecting aneurysm was confirmed on cerebral angiography and MRA. Three years later, recanalization of the dissecting aneurysm was observed on MRA. Follow-up MRA showed a gradual increase of the size of the dissecting aneurysm. Six years after onset, coil embolization was performed.
Results: Guiding catheters were placed into the internal carotid artery and vertebral artery. Micro-catheters were inserted into dissecting aneurysms from both the internal carotid artery and basilar artery via P1 segment of posterior cerebral artery. And Coils were placed into the dissecting aneurysm from both catheters. The dissecting aneurysm was completely occluded without any complications. Two years after embolization, recurrence has not been observed on MRA.
Figure.
A: Left Internal carotid artery angiogram lateral view. Posterior communicating artery is tortuous and enlarged.

B: Right Vertebral artery angiogram lateral view with left carotid retery compression.
C: Left Internal carotid artery 3D angiogram.
D: Right Vertebral artery 3D angiogram.
E: Post treatment Left Internal carotid artery angiogram A-P view. It shows complete obliteration of the dissecting posterior communicating artery.
F: Skull XP of A-P view(same as E).
G: Post treatment Rite vertebral artery lateral oblique view. It shows complete obliteration of the dissecting posterior communicating artery.
H: Skull XP of lateral oblique view(same as G).
Conclusion: Like the other sites of the dissecting aneurysm, internal coil trapping of posterior communicating artery considered a safe and useful treatment. It was considered important to insert micro-catheters from both the internal carotid artery and the basilar artery before starting coil insertion.
Keywords: Posterior communicating artery, dissecting aneurysm, internal trapping

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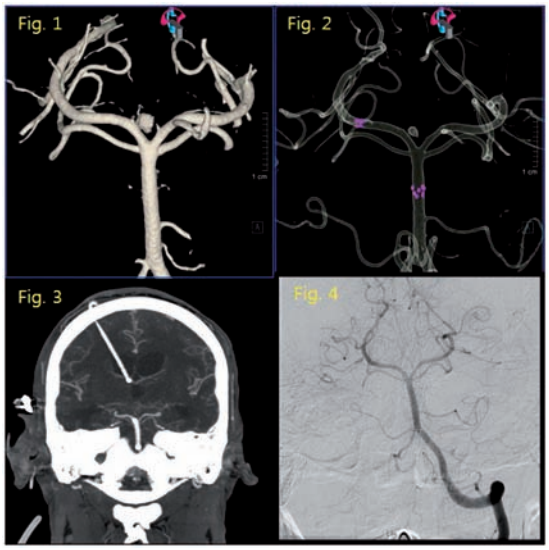
A CASE OF EARLY MIGRATION OF INTRACRANIAL STENT AFTER DISSECTION ANEURYSM TREATMENT

J Cho[1], S Kim[1], K Cho[1], Y Na[1], M Kang[1], Y Na[1] and Y Lee[2]
[1]Catholic Kwandong Univerisry, Incheon, SOUTH KOREA
[2]Ilsan Hospital, Ilsan, SOUTH KOREA

Purpose: As development of stent material, the use of stent during neurointervention is increasing. For these circumstance, it is essential to understand the properties of these stents to determine their role and implications in endovascular treatment of cerebral aneurysms. Here we present a case of early migration of intracranial stent during dissecting aneurysm treatment.



Materials and Methods: A 57 year-old female presented to emergency department with sudden headache and CT shows subarachnoid hemorrhage secondary to a proximal posterior cerebral artery (PCA) aneurysm. (Fig 1)
Results: Two Enterprise stent (4.5 × 14 mm) was deployed in the PCA across the neck of the aneurysm.(Fig 2) CT angiogram 2 days later showed significant stent migration toward basilar artery. (Fig 3) But there was no filling of previous noted PCA dissecting aneurysm. Repeated angiography after one week also showed complete occlusion of the PCA aneurysm and no further stent migration comparing previous CT angiogram. (Fig 4) Patient discharged 3 weeks later with no neurological deficit.
Conclusion: This is an unequivocal case of early spontaneous migration of a self-expanding intracranial stent. We think that when there is significant discrepancy in luminal diameter and suboptimal wall apposition, the physician should be aware of possibility of the stent migration. Early imaging following stent deployment may be indicated in these cases.
Keywords: stent, migrastion, dissection

P 125

A RUPTURED RECURRENCE ANEURYSM OF POSTERIOR INFERIOR CEREBELLAR ARTERY ASSOCIATED WITH PERSISTENT PRIMITIVE HYPOGLOSSAL ARTERY

T Naito[1], T Hasegawa[1], T Kato[1], T Tanei[1], K Ishii[1] and E Tsukamoto[1]
[1]Komaki City Hospital, Komaki, JAPAN

Purpose: case presentation.
Materials and Methods: Persistent primitive hypoglossal artery (PPHA) represents the second most common carotid-vertebrobasilar anastomosis, with a reported incidence of 0.027-0.26%. A 38 years old female presented with a subarachnoid hemorrhage (SAH) originated from proximal posterior inferior cerebellar artery (PICA) aneurysm associated with PPHA. The patient was treated by aneurysmal neck clipping. Postoperative course was uneventful, and she had full recover favorably without any neurological deficit. She was admitted in our institute at department of obstetrics with normal spontaneous delivery at 3 year after aneurysm neck clipping. Sudden conscious disturbance occurred in childbirth. She was coma. A brain CT scan showed SAH. The CT angiogram examination showed PICA aneurysm recurrence.
Results: We performed coil embolization for this recurrence aneurysm. This aneurysm was treated successfully by coil embolization.
Conclusion: We experienced a case of aneurysm associated PPHA with direct and endovascular surgery.
Keywords: PPHA, aneurysm, coiling

P 126

CLINICAL AND ANGIOGRAPHIC OUTCOME OF RUPTURED BLOOD BLISTER-LIKE ANEURYSMS OF THE INTERNAL CAROTID ARTERY WITH STENTS – ASSISTED COIL EMBOLIZATION: SINGLE CENTER EXPERIENCE

YK Ihn[1], JH Sung[1], DH Lee[1], HJ Lee[1] and JH Shin[1]
[1]St. Vincent's hospital, Suwon, SOUTH KOREA

Purpose: BBA(Blood blister like aneurysm) are arterial lesion from non-branching sites (dorsal or anterior wall) on the internal carotid artery (ICA). This lesion is typically diagnosed after bleeding because of there small size and carry a high rate of morbidity and mortality. It is very challenging to treat surgically as well as endovascularly. The optimal treatment method for BBAs has not been defined. Therefore, we present a single center experience in treating ruptured BBAs with stents-assisted coil embolization and its clinical outcome.
Materials and Methods: From January 2007 to April 2019, 14 consecutive patients with ruptured BBAs underwent treatment using reconstructive endovascular treatment. We reviewed all of relevant imaging studies and records pertaining to the diagnosis and treatment. Reconstructive endovascular treatment using stents with or without coiling, was primarily considered due to the poor collateral blood supply, extremely proximity of the BBA to the origin of the anterior choroidal artery, or both. Stents assisted coil embolizations were performed under general anesthesia. Variable techniques were used for coil embolizaton after stent placement. (Jailing or coil-through technique). Additional multiple stents were placed for flow diversion.
Results: complete occlusion of BBAs at the first treatment for 6 of 14 patients (42 %). Stable state of BBAs without additional treatment were achieved 9 patients of 14 patients (64%). Complementary treatment was required in five patients, including coil embolization or additional stent placement. 11 patients survived and had good outcomes during clinical follow-up period (0-2 mRS scale outcome, mean 48 months, range 36 –112 months).
Conclusion: In our institution, stent-assisted coil embolization effectively prevented rebleeding and regrowing of BBA without sacrifice of the ICA. However, as early regrowth /re-rerupture remains a problem, importance of early angiographic follow-up should be considered.
Keywords: Blood blister-like aneurysm, Internal carotid artery, Subarachnoid hemorrhage

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COMPLEMENTARY FUNCTIONS OF OPEN SURGERY AND ENDOVASCULAR TREATMENT IN RUPTURED INTERNAL CAROTID ARTERY DORSAL WALL ANEURYSM (2 CASES)

J Cho[1] and Y Kwak[1]
[1]Daegu Catholic Medical Center, Daegu, SOUTH KOREA

Purpose: Owing to the focal wall defect covered with thin fibrous tissues, a ruptured aneurysm arising from the dorsal wall of the internal carotid artery (ICA) is difficult to manage either surgically or endovascularly. Unfortunately, the definitive treatment modality of such highly risky aneurysm has not yet been demonstrated. Upon encountering the complex intracranial pathophysiology of such a highly precarious aneurysm, a treatment team would be faced with a challenge to decide on an optimal approach.
Materials and Methods: Case 1: This is a case of multiple paraclinoid aneurysms including the ICA dorsal wall aneurysm, presented with spontaneous subarachnoid hemorrhage (SAH) in a 56-year-old woman. Initially, endovascular intervention was chosen because of uncertainty of the ruptured aneurysm in multiple aneurysms. Follow-up angiography revealed the enlargement of ICA dorsal wall aneurysm on the Rt. side. Direct clipping with a Sundt graft clip was performed after multiple endovascular interventions had failed.
Case 2: A 47-year-old woman with sudden bursting headache with nausea revealed SAH (H-H grade II). Initially, the patient received surgical clipping with a Sundt graft clip for ruptured ICA dorsal wall aneurysm on Lt side. F/U angiography (POD #6) for the evaluation of vasospasm revealed small aneurysmal bulging with the Sundt clip. The small aneurysmal bulging was significantly increased in F/U angiography (POD #15). Stent assisted coiling was done successfully.
Results: Case 1: The patient improved gradually with a hemiparesis on the left side (grade III, arm and grade IV, leg). F/U angiography (5 months and 7 years) after the clipping demonstrated unchanged good condition.
Case 2: F/U TFCA (4 & 16 months) revealed no any recurrence of Lt ICA dorsal wall aneurysm.
Conclusion: 1. Surgical approach can be a treatment modality for a blood blister-like aneurysm (BBA) even after failed endovascular intervention(s). (Case 1) 2. Endovascular intervention can be selected as an alternative management even in surgically clipped ICA dorsal wall aneurysm. (Case 2)
Keywords: Complementary function, Open surgery and intervention, Dorsal wall aneurysm

P 128

RE-RUPTURE OF A ''SUCCESSFULLY TREATED'' DISSECTING ICA ANEURYSM

UM Ciochon[1], G Gal[2] and G Benndorf[3]
[1]Department of Diagnostic Radiology, Rigshospitalet, Copenhagen, DENMARK
[2]Department of Radiology, Odense University Hospital, Odense, DENMARK
[3]Department of Diagnostic Radiology, Rigshospitalet, Copenhagen, DENMARK

Purpose: Dissecting intracranial aneurysms are a rare and underdiagnosed cause of subarachnoid and intracerebral hemorrhage. Unstable by nature, they may present with aggressive clinical behaviour requiring urgent management. Optimal treatment can be a challenging task due to lacking randomized trials and only small observational studies being reported so far.
Materials and Methods: We report the case of a 44-year-old female that presented with a severe subarachnoid hemorrhage (SAH) caused by a right dissecting internal carotid artery (ICA) aneurysm. Despite initially successful endovascular treatment using stent-assisted coiling (SAC) with an angiographic ''complete occlusion'', the patient presented 8 weeks later with a recurrent SAH and an enlarging pseudoaneurysm. A second treatment attempt caused another re-rupture with high intracranial pressures (ICPs) and temporary circulation arrest. Two days later, a third treatment attempt was undertaken, this time successful with occlusion of the enlarging pseudoaneurysm. The patient was discharged to rehabilitation after 4 weeks of slow and delayed postprocedural recovery.
Results: During a subsequent 3 months follow-up (FU) visit the patient had remarkably improved with only minor deficit and a small recurrence at the aneurysm neck. In a subsequent 4th treatment session an additional flow diverting device was deployed which resulted in stabilization of the pseudoaneurysm and no further clinical sequalae.
Conclusion: The highly unpredictable nature of dissecting ICA aneurysms requires short term repeat DSA within 4–10 days to establish proper diagnosis. In addition, close post-procedure follow-up imaging using DSA or CTA with a maximum interval of 4 to 6 weeks after treatment appears advisable. Angiographic ''complete occlusions'' are no guarantee for long-term durability. While no endovascular technique has proven truly reliable so far, flow diverters are growing in popularity in treating this pathology. They do require dual or at least single antiplatelet therapy carrying a risk of a fatal hemorrhage.
Keywords: Dissecting aneurysms, Flow diverters, Treatment complications

P 129

EFFECTIVENESS OF PARENT ARTERY OCCLUSION WITH NBCA AND COILS FOR PERIPHERAL CEREBRAL ARTERY ANEURYSM

S Fujita[1], M Hayashi[1], R Suzuki[1], N Hirai[1], Y Hiramoto[1], H Nakayama[1], N Saito[1], K Ito[1], K Aoki[1] and S Iwabuchi[1]
[1]Department of Neurosurgery, Toho University Ohashi Medical Center, Tokyo, JAPAN

Purpose: Peripheral cerebral artery aneurysms are rare and difficult to treat surgically. Furthermore, the treatment strategy whether parental artery occlusion (PAO) or selective aneurysm occlusion (SAO) is important. We report the angiographic results and the clinical outcomes for the patients be performed PAO with n-Butyle-2-cyanoacrylate (NBCA).
Materials and Methods: In two years, four patients with peripheral cerebral artery aneurysms were treated endovascularly. These patients were all women with a mean age of 57 years (range, 38–61 years). Two patients presented with subarachnoid hemorrhage, one intracranial hemorrhage, one asymptomatically. The aneurysms were six, located middle cerebral artery in five, posterior cerebral artery in one.
Results: Case1 61-years-old woman was diagnosed as infective endocarditis(IE). Head CT showed high-density area in left temporal lobe, and CTA showed two small aneurysms at M3 and P3. The bigger aneurysm was performed in PAO with NBCA 33% and one coil, because the parent artery was so small, and the other one with two coils. After the procedure she could be discharged with no neurological deficit. Case2 52-years-old woman complained sever headache, head MRI showed a massive lesion in right parietal lobe. After three days, the symptom was worsening and left hemiparesis was revealed. Head CT showed intracranial hemorrhage and aneurysm at M4. First we performed endovascular therapy for aneurysm to control the blood flow. The parent artery was so big that to sacrifice, we selected SAO with ten coils. After that craniotomy hematoma removal surgery was performed. However the blood flow of aneurysm still remained, and it was raptured. We clipped and removed the aneurysm. After that she could be discharged with no deficit in one month. Case 3 38-years-old woman was taken with sever coma. Head CT showed left intracranial hemorrhage with midline shift. First we underwent a decompression surgery. An aneurysm at M2 was performed PAO with NBCA 33% and two coils. After that craniotomy was underwent, and the blood flow of aneurysm was obviously decreased. After the procedure she transferred hospital to receive rehabilitation. Case 4 60-years-old woman presented subarachnoid hemorrhage with right MCA spasm with two small aneurysms at M4. We performed PAO with NBCA and coil. She was diagnosed as IE. After the procedure she could be discharged with no deficit.
Conclusion: Our results suggest that peripheral aneurysms can be treated safely with endovascular PAO with NBCA and coils. If the parent artery could not be preserved, the

leptomeningeal anastomosis supplies the blood without neurological deficits.
Keywords: peripheral aneurysm, parent artery occlusion, infective endocarditis

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INTRACRANIAL MYCOTIC ANEURYSMS CAUSED BY AN EXTREMELY RARE BACTERIUM, CORYNEBACTERIUM DIPHTHERIAE IN DEVELOPING COUNTRY

E Chanthanaphak[1], V Suraratdecha[1], S Chaovorawinyoo[1] and M Apirakkan[1]
[1]Ramathibodi hospital, Bangkok, THAILAND

Purpose: To demonstrate intracranial mycotic aneurysms caused by an extremely rare bacterium, Corynebacterium diphtheriae in developing country.
Materials and Methods: A retrospective review of a case report.
Results: A 7-year-old girl with history of Tetralogy of Fallot and incomplete Tdap vaccination, presented with fever and dyspnea for few days. She was investigated for echocardiogram demonstrating moderate tricuspid regurgitation and vegetation at anterior and septal leaflet of tricuspid valve. She was diagnosed infectious endocarditis. Then, blood culture was done and shown Corynebacterium diphtheriae. Proper intravenous antibiotics were given. After that, computed tomography angiography (CTA) brain was done for screening mycotic aneurysm. It showed two intracranial mycotic aneurysms. The first aneurysm appeared saccular type and located at the superior M2 division of right middle cerebral artery (MCA), size = 5.3×4.8 mm with 2.3-mm neck. The latter located at the distal cortical branch of posterior temporal branch of left posterior cerebral artery (PCA), size = 2×2 mm with 0.8-mm neck. When CTA brain was follow-up in 1 week later, the aneurysms were not significantly changed. Due to plan for cardiac surgery with long-term anticoagulant, endovascular treatment was initiated to eradicate the aneurysms for prevention of rupture. A 5Fr soft tip guiding catheter was navigated into the right internal carotid artery. Then, a 1.9-Fr headway microcatheter was used for coiling in the right MCA mycotic aneurysm with detachable coils 4 mm,3mm,2.5 mm – total length 18 cm. Control angiogram showed nearly total obliteration of the aneurysm. Then, a 5Fr soft tip guiding catheter was moved to the left vertebral artery and a 1.2Fr Magic microcather was inserted to the left PCA. A mixture of 1-ml N-butyl cyanoacrylate and 1-ml lipiodol was injected to close the left PCA mycotic aneurysm with complete obliteration of the aneurysm. No immediate complication was occurred. A 3-month follow-up MRA brain demonstrated no residual, regrowth or new mycotic aneurysms.
Conclusion: Corynebacterium diphtheriae can be a causative bacterium of intracranial mycotic aneurysms in endemic area particularly in patient with incomplete vaccination.
Keywords: Mycotic aneurysm, Endovascular treatment, Diphtheria

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UNUSUAL PRESENTATION OF INFECTIOUS INTRACRANIAL ANEURYSM WITH SEQUENTIAL HEMORRHAGIC AND ISCHEMIC COMPONENTS

JH Ko[1], JW Chung[1] and JS Ahn[2]
[1]Department of Neurosurgery, College of Medicine, Dankook University, Dankook University Hospital, Cheonan, SOUTH KOREA
[2]Department of Neurosurgery, College of Medicine, Ulsan University, Asan Medical Center, Seoul, SOUTH KOREA

Purpose: Infectious intracranial aneurysm (IIA), a rare type of cerebral aneurysm, is often observed in patients with infective endocarditis. Hemorrhage or infarction often occurs; however, the presentation of both hemorrhagic and ischemic components is rare.
Materials and Methods: A 41-year-old man with progressive motor weakness, dysarthria, and the severe headache was admitted to our hospital. Brain computed tomography scan revealed a scanty subarachnoid hemorrhage (SAH), and diffusion magnetic resonance imaging confirmed acute cerebral infarction around the external capsule and insular lobe. A digital subtraction cerebral angiogram revealed obstruction in the middle cerebral artery (MCA). The patient's neurological symptoms improved remarkably on the fifth day, and a follow-up angiogram revealed recanalized MCA with pseudoaneurysm, which was not observed on the previous angiogram. A blood culture result confirmed bacteremia, and the patient was then diagnosed with infective endocarditis.
Results: The pseudoaneurysm was treated with anastomosis of the superficial temporal artery and MCA with trapping of the parent artery. He was discharged with no neurological deficits.
Conclusion: We present a patient with IIA, who sequentially developed SAH and cerebral infarction, and underwent extracranial-intracranial bypass with trapping of the parent artery. Although the treatment strategy for IIA is controversial, the treatment plan should be cautiously discussed with the patient. In addition, the assessment of an underlying infectious disease is required.
Keywords: Infectious cerebral aneurysm, subarachnoid hemorrhage, cerebral infarction

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SMALL ANEURYSMS MAY GROW FAST

N Fujumura[1], S Nakashima[1], T Aoki[2], R Sakamoto[1], Y Okamoto[3] and M Morioka[2]
[1]Department of Neurosurgery, Saiseikai Futsukaichi Hospital, Chikushino, JAPAN
[2]Department of Neurosurgery, Kurume University School of Medicine, Kurume, JAPAN
[3]Department of Neurosurgery, Saiseikai Yahata General Hospital, Kitakyushu, JAPAN

Purpose: Usually, small aneurysms (<5 mm in size) show a very low rupture rate. However, the risk of rupture is >18% in patients with growing aneurysms. We performed a 10-year follow-up study at our hospital and observed 7 aneurysms, which increased in size during the study period. All 7 aneurysms were small in size. We aimed to describe the clinical feature of such aneurysms.
Materials and Methods: We retrospectively reviewed the magnetic resonance (MR) angiography and computed tomography (CT) angiography records obtained from the database of our hospital. We identified 7 patients with unruptured aneurysms that increased in size between January 2008 and December 2018.
Results: Mean age of patients was 58.6 years (range 46–68 years) with female predominance. Aneurysms were located along the internal carotid-posterior communicating artery (IC-PC) (n = 3) and the middle cerebral artery (MCA) (n = 4). Mean size of aneurysms was 2.5 mm (range 0.5–4 mm). Six patients underwent surgical and 1 patient underwent endovascular treatment. The duration from initial diagnosis until treatment was 1–10 years (mean 4.1 years). Notably, 5 aneurysms increased in size within 3 years of follow-up and 1 of these 5 caused subarachnoid hemorrhage (SAH). The mean size of aneurysms in the rapid growth cohort was 2.3 mm (range 0.5–3.4 mm) and in the slow growth cohort was 3.2 mm (range 2.3–4 mm). Among the 7 patients with aneurysms, 3 reported a family history of SAH, 2 reported a history of smoking and 2 reported no risk factor. All patients showed good postoperative outcomes.
Conclusion: Small IC-PC and MCA aneurysms, particularly in patients with risk factors such as a family history of SAH or a personal history of smoking, are associated with a risk of increasing in size. Results showed that ultra-small aneurysms (<3.5 mm) grow rapidly within a short period and require careful follow-up.
Keywords: aneurysm, growth, natural history

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VESSEL WALL IMAGING OF UNRUPTURED INTRACRANIAL ANEURYSMS

T Matsushige[1], K Shimonaga[1], T Mizoue[1], H Takahashi[1], Y Hashimoto[1], M Kaneko[2], C Ono[3], S Sakamoto[4] and K Kurisu[4]
[1]Hiroshima City Asa Citizens Hospital – Department of Neurosurgery AND Interventional Neuroradiology, Hiroshima, JAPAN
[2]Hiroshima City Asa Citizens Hospital – Department of Pathology, Hiroshima, JAPAN
[3]Hiroshima City Asa Citizens Hospital – Department of Radiology, Hiroshima, JAPAN
[4]Graduate School of Biomedical and Health Sciences, Hiroshima University – Department of Neurosurgery, Hiroshima, JAPAN

Purpose: It remains a challenge to predict unruptured intracranial aneurysms (UIAs) that are prone to rupture. Vessel wall imaging (VWI) is a current topic whether it might suggest unstable aneurysms. The purpose of this study was to investigate the clinical relevance of VWI findings with exploring histopathologic aneurysm wall architectures.
Materials and Methods: A total of 157 UIAs were investigated by VWI from April 2017 through March 2019. The presence of aneurysm wall enhancement (AWE) was evaluated. Univariate analysis was performed to assess the correlation between VWI findings and patient demographics as well as aneurysm morphologic risk factors. A total of 15 UIAs were available for histopathological examination.
Results: AWE was identified in 52 of 157 UIAs (33%). Aneurysmal maximum diameter (6.5 ± 0.6 versus 4.5 ± 0.1, $p < 0.001$), irregular shape (75% versus 35%, $p < 0.001$) and the PHASES score (8.4 ± 0.4 versus 7.0 ± 0.2, $p = 0.002$) were significantly associated with AWE. All UIAs > 10 mm maximum in size showed AWE. Among 60 UIAs with serial follow-up over 2-years, aneurysm growth with daughter sac formation was significantly associated with AWE ($p < 0.01$). Histopathological studies revealed that wall thickening accompanied by atherosclerosis, neovascularization, and abundant macrophage infiltration corresponded to AWE. The thicken wall was characterized by loss of mural cells and mucinous degeneration as well. On contrary majority of UIAs without AWE were characterized by well-cellularized wall structure without wall inflammation.
Conclusion: In the present study, approximately one-third of UIAs showed AWE. Vessel wall imaging could not provide rupture risk estimation beyond the PHASES score at this moment, however, it could visualize aneurysmal wall status.
Keywords: Unruptured Aneurysm, Vessel Wall Imaging, Gadolinium

P 134

3D HR MR VWI (3-DIMENSIONAL HIGH RESOLUTION MAGNETIC RESONANCE VESSEL WALL IMAGING) FOR THE EVALUATION AND MANAGEMENT OF CEREBRAL ANEURYSMS

S Suh[1], W Yoon[2], H Roh[2], H Bae[2] and T Kwon[2]
[1]Section of neuroradiology/neurointervention, Department of Radiology, Korea Univ. Medicine, Guro Hospital, Seoul, SOUTH KOREA
[2]Department of Neurosurgery, Korea Univ. Medicine, Guro Hospital, Seoul, SOUTH KOREA

Purpose: HR VWI, especially 3D method, has been applied as an innovative and promising imaging technique for evaluation of intra- and extracranial arteriopathy such as atherosclerotic disease, moyamoya disease etc. We introduce the clinical experience of HR MR VWI with advanced imaging technique in patients with cerebral aneurysms.
Materials and Methods: We collected the imaging data from our HR VWI study for intracranial arterial pathology, more than 700 study from 2013 July to 2019 March. Among them, we evaluated the imaging findings and clinical management in patients with the cerebral aneurysms as follows: unruptured saccular or fusiform aneurysm, ruptured saccular aneurysms, thrombosed aneurysms, dissecting aneurysms, and blood-blister like aneurysm in the intracranial circulation. The imaging protocol of HR MR VWI for cerebral aneurysms is as followed: 1) 3T scanner (Skyra, Prisma: Siemens, Erlangen, Germany); 2) T2 WI, pre and post gadolinium enhanced T1 WI sagittal images by isotropic 3D SPACE sequences with blood suppression; 3) multi planar reconstruction for coronal or axial acquisition; 4) advanced imaging technique since 2017 such as DANTE (delay alternating with nutation for tailored excitation) for flow suppression and CAIPRINA (controlled aliasing in parallel imaging results in higher acceleration) for rapid acquisition.
Results: We present the imaging findings of HR MR VWI for the radiologic diagnosis and the clinical decision marker of the management for various cerebral aneurysms.
Conclusion: HR VWI, especially 3D acquisition with advanced imaging technique, can be considered as an adjunctive useful tool for the evaluation and management of the cerebral aneurysms.
Keywords: Cerebral Aneurysm, MR vessel wall imaging, Diagnosis and management

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ANEURYSM WALL ENHANCEMENT A BIOMARKER OF ANEURYSM PROGRESSION?

E Paschoal[4], L Batista[1], M Piani[2] and GA Lien[3]
[1]Ophir Loyola Hospital, Belém, BRAZIL
[2]Ophir Loyola Hospital, Belém, BRAZIL
[3]Ophir Loyola Hospital, Belém, BRAZIL
[4]Ophir Loyola Hospital, Belém, BRAZIL

Purpose: Evaluate the aneurysm wall enhancement (AWE) as a biomarker of rupture risk for intracranial aneurysm.
Materials and Methods: We performed a literature research of AWE and its role as an inflammation biomarker on the NCBI database.
Results: Management of unruptured aneurysms traditionally relies on its geometric features, as size, size ratio, aspect ratio, non-sphericity index, hemodynamic aspects, and PHASES score. Anatomopathological analyses have suggested that aneurysm progression and rupture risk is mediated by inflammation on aneurysm wall triggered mainly by hemodynamic pressures, atherosclerotic plaques, and intraluminal thrombus. Aneurysm inflammation leads to aneurysm remodeling through increased cellular activity and vasogenic edema favoring daughter sacs formation, growth and consequently rupture. Inflammation seems to be the main mechanism of AWE upon contrast infusion. Another mechanism associated to AWE might be related to increased vasa vasorum through angiogenesis on focal ischemic islands. Sequential analyses on MRI and histopathology have showed correspondence between the point of rupture and the focal enhancement on MRI and related to the fresh thrombus formation. Furthermore, accentuated atherosclerotic plaques poses to a challenging an open clipping approach since it can reduce clip closing and favor bleeding, making evaluation of plaque activity in MRI an essential point in treatment planning. There is among literature evidence for association of increased rupture risk depicted by traditional markers with AWE. Sequential studies of MRI and surgical treatment have showed a ubiquitous presence of AWE in rote aneurysm. Nonetheless, AWE might have an especial role in clinical guidance of aneurysm that are traditionally classified as low risk, in which an AWE might trend the clinical decision towards a surgical approach to a traditionally conservative aneurysm. Regardless of the implicated mechanism on AWE all of them encloses an active process of aneurysm wall degeneration through inflammation. Denoting the needed to closely watch this aneurysm progression due to its dynamic wall remodeling and prompt treatment if increased bleeding risk. Thus, AWE is probably a better markers of aneurysm rupture risk due to its dynamicity than a stationary geometric classification, which might indicate risk but does not predict evolution.
Conclusion: AWE demonstrates an active inflammation on the aneurysm wall leading to a wall remodelling increasing aneurysm rupture risk. Thus, it might be reasonable to treat aneurysm in the primitive sings of evolution rather than on the verge of rupture. Such use might also be of great value on small aneurysm which at the lower spectrum of rupture risk.
Keywords: Aneurysm Wall Enhancement, MRI vessel imaging, Inflammation

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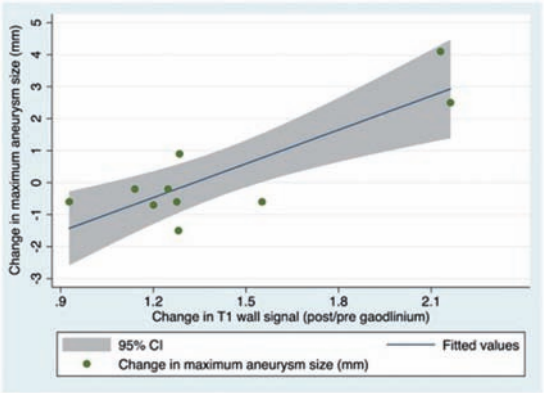
QUANTITATIVE WALL ENHANCEMENT OF UNRUPTURED ANEURYSMS ON VESSEL WALL IMAGING MRI IS ASSOCIATED WITH GROWTH ON DELAYED ANGIOGRAPHY

M Alexander[1], A De Havenon[1], J Mcnally[1], A Elkhatali[1], D Parker[1], S Kim[1], P Taussky[1] and R Grandhi[1]
[1]University of Utah, Salt Lake City, UT, USA

Purpose: Vessel wall MRI (vwMRI) techniques allow for improved characterization of cerebral aneurysms. Prior studies describe association between enhancement in aneurysm walls on vwMRI and aneurysm growth, but these studies utilized suboptimal qualitative determination of enhancement. To further clarify this association, this study quantitatively measured aneurysm wall enhancement on vwMRI to assess association with subsequent growth.



Materials and Methods: According to an IRB-approved protocol, vwMRI studies performed to investigate unruptured cerebral aneurysms at a major academic medical center were retrospectively reviewed. Patients who also underwent repeat digital subtraction angiography (DSA) >120 days after the vwMRI study were identified. Among this cohort, the medical record was queried to record patient demographic and clinical data. vwMRI studies were performed on a Siemens Prisma 3T MRI scanner, and images were scored by a board-certified neuroradiologist, recording maximum signal in the aneurysm wall on T1-weighted SPACE with DANTE images before and after the administration of gadolinium contrast. For each variable measured, the mean of three data points was computed after obtaining the maximum single-voxel intensity values at each site of interest. The primary outcome was change in maximum diameter of the aneurysm between the initial and follow up imaging. The primary predictor was change in signal intensity in the aneurysm wall (deltaWS) between pre- and post-contrast sequences. Linear regression was employed to assess this association, adjusting for the potential confounders of smoking, hypertension, and aneurysm location.
Results: Ten patients met inclusion criteria. Mean time between initial imaging and follow up DSA was 294 (±270) days. Mean change in maximum aneurysm diameter was 0.31 mm (−1.5–4.1, ±1.73). In univariate analysis, DeltaWS was associated with change in maximum aneurysm diameter (β coefficient = 3.53, 95% CI = 1.70–5.36, p = 0.002), which is illustrated in Figure 1. In the final multivariate regression model, deltaWS remained associated with change in maximum aneurysm diameter (β coefficient = 3.65, 95% CI = 1.05–6.25, p = 0.015).
Conclusion: vwMRI techniques can effectively characterize unruptured cerebral aneurysms and aid in management decisions. Using quantitative techniques that improve upon prior methodologies of vwMRI analysis, this study confirmed the previously reported association between enhancement in aneurysm walls and growth on subsequent imaging. Such an association can equip treating physicians to better counsel patients on the need for treatment of these lesions.
Keywords: Vessel Wall Imaging, Aneurysm Growth, MRI

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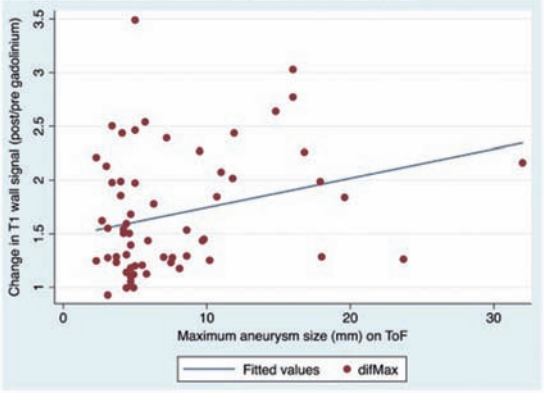
QUANTITATIVE WALL ENHANCEMENT INCREASES WITH SIZE OF UNRUPTURED ANEURYSMS ON VESSEL WALL IMAGING MRI

M Alexander[1], A De Havenon[1], J McNally[1], A Elkhatali[1], D Parker[1], S Kim[1], P Taussky[1] and R Grandhi[1]
[1]University of Utah, Salt Lake City, UT, USA

Purpose: Vessel wall MRI (vwMRI) techniques have provided new tools for evaluation of cerebrovascular disease by allowing visualization of vessel walls themselves. Such techniques can be used in the evaluation of intracranial aneurysms. Enhancement in particular can be helpful in evaluation, with prior studies demonstrating an association between aneurysm enhancement and growth. Prior reports have also shown that aneurysm size correlates with post-contrast wall enhancement on vwMRI, but these have been limited by qualitative approaches to enhancement that are inherently subjective and susceptible to bias. To further evaluate this association, this study employed quantitative approaches to determine the enhancement characteristics of aneurysm walls on vwMRI.

Variable	β coefficient	95% CI	p-value
Ethnicity	-0.349	-0.509 — -0.19	<0.001
Tobacco	0.268	0.0311—0.505	0.028
Max Size	0.045	0.0264—0.0638	<0.001



Materials and Methods: Prospectively maintained records were queried to identify patients undergoing vwMRI for analysis of unruptured cerebral aneurysms at a major academic medical center. Patient demographic and clinical data were tabulated. All images were acquired on a Siemens Prisma 3T MRI scanner. A board-certified neuroradiologist identified the maximum signal in the aneurysm wall on T1-weighted SPACE with DANTE images both before and after the administration of gadolinium contrast. For each variable measured, the mean of three data points was computed after obtaining the maximum single-voxel intensity values at each site of interest. The primary outcome was the change in signal intensity of the aneurysm wall between pre- and post-contrast imaging (deltaWS) expressed as a ratio. The primary predictor was the maximum diameter of the aneurysm on 3D time of flight MRA. Linear regression was used to correlate the outcome and predictor variables and adjusted for potential confounders, which were chosen using a backwards stepwise selection for variables with $p < 0.1$.

Results: Thirty six vwMRI studies were performed during the evaluation of 23 patients with 27 unruptured cerebral aneurysms (7 fusiform, 20 saccular). Mean deltaWS was 1.55 ($\pm$0.46), and mean maximum aneurysm measurement was 7.36 mm ($\pm$6.09). Results from the multivariable model are shown in Table 1. Figure 1 demonstrates deltaWS plotted against maximum aneurysm dimension.

Conclusion: vwMRI techniques are effective in the evaluation of cerebral aneurysms. This study confirmed previous findings of an association between enhancement in the aneurysm wall on vwMRI and aneurysm size, augmenting prior research with more quantitative metrics less prone to bias. When evaluating cerebral aneurysms, lesion size should be taken into consideration to properly interpret the impact of enhancement on vwMRI.

Keywords: Vessel Wall Imaging, Aneurysm, MRI

P 138

PERSISTENT ENHANCEMENT OF UNRUPTURED CEREBRAL ANEURYSM FOLLOWING ENDOVASCULAR TREATMENT COMPARED TO UNTREATED ANEURYSMS

M Alexander[1], A De Havenon[1], J McNally[1], A Elkhatali[1], D Parker[1], S Kim[1], P Taussky[1] and R Grandhi[1]

[1]University of Utah, Salt Lake City, UT, USA

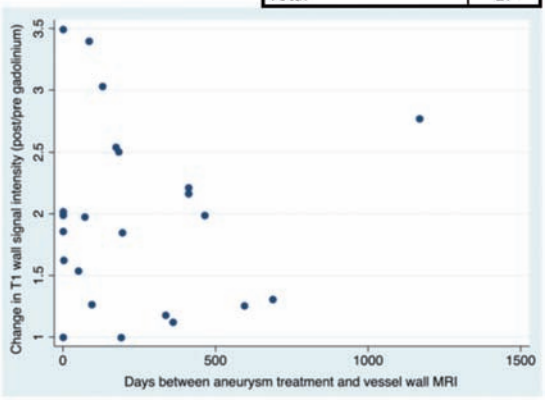
Purpose: Vessel wall MRI (vwMRI) studies can enhance investigation of cerebral aneurysms. To better characterize the effect of treatment on enhancement patterns this study quantitatively measured aneurysm wall enhancement, comparing patients treated with embolization against those that were not treated.

Table 1: Aneurysm Location

ICA/Pcomm	10
AComm	2
Vertebrobasilar	3
PICA	1
PCA	1
Total	17

Table 2: Embolization Technique

Coiling	1
Balloon-Assisted Coiling	5
Stent-Assisted Coiling	1
Flow Diversion	6
Flow Diversion + Coiling	3
Vessel Sacrifice	1
Total	17



Materials and Methods: According to an IRB-approved protocol, retrospective analysis was performed of vwMRI studies conducted for evaluation of unruptured cerebral aneurysms at a major academic medical center. vwMRI studies were performed on a Siemens Prisma 3T MRI scanner. Studies were evaluated by a board-certified neuroradiologist. Maximum signals in the aneurysm wall on T1-weighted SPACE with DANTE images before and after the administration of gadolinium contrast were noted. For each variable measured, the mean of three data points was computed after obtaining the maximum single-voxel intensity values at each site of interest. The change in signal intensity in the aneurysm wall (deltaWS) between pre- and post-contrast sequences was noted, and bidirectional student's t-test was performed to compare these values between the treated and untreated groups. Additionally, linear regression was performed to assess for association between deltaWS and time since treatment.

Results: Twenty three vwMRI studies were performed to evaluate 17 aneurysms in 17 patients. Aneurysm locations and treatment modalities are summarized in tables 1 and 2, respectively. deltaWS was significantly higher in treated versus untreated aneurysms (1.91 ± 0.68 vs. 1.50 ± 0.41, $p = 0.039$). For treated aneurysms, deltaWS was not associated with number of days between aneurysm treatment and vwMRI acquisition ($n = 23$, $p = 0.912$). These data are plotted in Figure 1. When controlling for thrombosis status among the treatment group, no change was noted.

Conclusion: vwMRI techniques can enhance evaluation of cerebral aneurysms. This study characterizes persistent enhancement of previously treated lesions, in some cases with enhancement visualized years after embolization and in some lesions with confirmed post-treatment occlusion. As such, persistent enhancement following aneurysm embolization should be considered a normal finding and does not appear to reflect presence of residual aneurysm or risk of recurrence.

Keywords: Vessel Wall Imaging, Aneurysm Embolization, MRI

P 139

CREATION OF ELASTASE-INDUCED ANEURYSMS IN RABBITS

Y Zhang[1], Y He[1] and T Li[1]
[1]Zhengzhou University People's Hospital, Zhengzhou, CHINA

Purpose: New Zealand white rabbits have been widely used for creation of right common carotid artery (RCCA) elastase-induced aneurysms. The aim of this study is to create an elastase-induced aneurysm model. And in this study several modifications had been made to the aneurysm model to make the model ideal for evaluating endovascular devices in aneurysmal therapy.
Materials and Methods: This study was performed in 12 New Zealand white rabbits. Elastase-induced aneurysms were created in 10 New Zealand rabbits, and 2 underwent a control procedure. The RCCA was surgically exposed and temporarily occluded the origin of the RCCA with a Fogarty Catheter in all New Zealand white rabbits. In the aneurysm creation procedure, elastase was infused into the lumen of the trapped RCCA segment and the isolated segment is infused with elastase for 30 minutes. Then the RCCA was ligated distally. And in the control procedure, the isolated RCCA was ligated with no elastase. Rabbits underwent aneurysm creation procedures were followed up with angiography and sacrificed at 4 weeks ($n = 2$), 8 weeks ($n = 4$) and 12 weeks ($n = 4$) after aneurysm creation. At the same time histology was obtained. And both two rabbits underwent control procedures were sacrificed at 4 weeks ($n = 2$).
Results: Elastase-induced aneurysms were successfully created by the intravascular approach. Aneurysms formed in ten of the Twelve rabbits. Both two rabbits that underwent control procedures showed no aneurysm. The elastase-induced aneurysms had a mean width of 3.9 mm (range, 2.3–5.9 mm) and a mean length of 7.5 mm (range, 5.5–9.2 mm). Histologic evaluation revealed thinned elastic lamina and destruction of the normal elastin layers, which allowed the artery to become aneurysmal.
Conclusion: These elastase-induced aneurysms were reliably created in New Zealand white rabbits. The creation of the aneurysms was rapid, reproducible and reliable. The elastase-induced aneurysm model can be readily applied to evaluating endovascular devices for aneurysmal therapy.
Keywords: Aneurysm, Rabbit Model, Elastase

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THE USE OF CHITOSAN GEL AS AN EMBOLIC AGENT IN EXPERIMENTAL ANEURYSM MODELS OF RABBITS: A FOCUS ON ANGIOGRAPHIC AND HISTOPATHOLOGIC FINDINGS

DH Hwang[1], KJ Lee[1], ST Park[2], CW Hur[3], J Hur[3], MJ Lee[4] and BK Kwack[4]
[1]Seoul PAIK Hospital, Seoul, SOUTH KOREA
[2]Seoul Soonchunhayng Hospital, Seoul, SOUTH KOREA
[3]Myung Ji Saint Mary Hospital, Seoul, SOUTH KOREA
[4]Chungang University Hospital, SOUTH KOREA

Purpose: For the purpose of overcoming anatomic and biological limitations, such as difficulty in filling completely and little organized thrombus in large cerebral aneurysms treated with the Guglielmi detachable coils (GDCs), biological modifications to the platinum coil or the use of liquid polymer which has potential to fill the entire aneurysm cavity have been investigated as an alternative method for treating aneurysms. The purpose of this study is to evaluate the feasibility of endovascular treatment of experimental aneurysms of rabbits using chitosan gel as an embolic agent, in the hope of giving clues to overcome these facing problems.
Materials and Methods:. As the first step, activated clotting times (ACTs) were compared between the pure blood group and the chitosan gel-blood mixture group in 17 patient's blood in vitro study. Additionally, ACTs were compared between the heparinized blood group and the chitosan gel-heparinized blood mixture group. As a main experiment, an aneurysm was created in the proximal common carotid artery in 13 rabbits and embolized with chitosan gel in 10 rabbits (3 controls with non-embolized aneurysms and 10 embolized aneurysms). These were evaluated by serial follow-up intravenous digital subtraction angiography (IV-DSA) on 1 week ($n = 13$), on 2 weeks ($n = 12$), on 4 weeks ($n = 10$) and on 6 weeks ($n = 8$) after embolization. Then histopathologic evaluation was also done on 3 days ($n = 2$), 1 week ($n = 1$), 2 weeks ($n = 1$), 3 weeks ($n = 1$), 4 weeks ($n = 2$), 6 weeks ($n = 1$), and 8 weeks ($n = 1$) after embolization.
Results: The results of in vitro study revealed a much faster ACT in the chitosan gel-blood mixture and chitosan gel-heparinized blood mixture groups than in the pure and heparinized blood groups. On follow-up of the IV-DSA study of aneurysms with embolization, in 7 rabbits, more than 75% decreased aneurysm size was noted, 75%–50% decrease in 2 rabbits, and less than 50% decrease in 1 rabbit. Histopathologic findings showed well organization thrombus and neointima formation in the aneurysmal sac.
Conclusion: The results of this study suggest that chitosan gel may be a possible gel embolic agent that can be used in human aneurysms by not only a mechanical embolization effect but also a biological effect for eliciting or promoting fibrosis and neointima formation. Further studies are needed to overcome the technical difficulty of injecting the chitosan gel through the microcatheter and to develop a new endovascular delivery system of chitosan gel.
Keywords: Aneurysm, Kitosan, Rabbit model

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SPONTANEOUS INTRACRANIAL HYPOTENSION AS A RARE COMPLICATION OF ANEURYSMAL SUBARACHNOID HEMORRHAGE

A Rustici[1], L Cirillo[2,3], M Dall'olio[2], C Princiotta[2] and M Cellerini[2]

[1]Università degli Studi di Ferrara, Ferrara, ITALY
[2]IRCCS – Istituto delle Scienze Neurologiche di Bologna, Bologna, ITALY
[3]Università degli Studi di Bologna, Bologna, ITALY

Purpose: Spontaneous Intracranial Hypotension (SIH) is an important cause of headache caused by Cerebrospinal Fluid (CSF) volume depletion, nearly always from spontaneous CSF leak. The CSF leak location is usually complex to find, but more frequently occurs in the spine or in the skull base, while other locations are rare. SIH can be associated to preexisting areas of dural weakness or meningeal diverticula. The radiological manifestations of SIH are broad, including the presence of CSF along the neural sleeves, diffuse pachymeningeal enhancement, and/or venous engorgement. However, these characteristics are only qualitative and do not allow to confirm the diagnosis. We present a case of SIH consequent to an aneurysmal subarachnoid hemorrhage (SAH).
Materials and Methods: Case Presentation.
Results: A 71-year old female with no history of trauma or medical therapy presented an intense headache and was admitted to the Emergency Department. Emergency CT scan showed a SAH due to a 10 mm PcomA aneurysm, which was immediately treated with coiling. The patient awaked immediately after the procedure without neurological deficit, but the day after the patient experience another intense headache associated to lumbar pain. A CT scan and a DSA were performed for the suspect of re-bleeding, but no evidence was found. Following CT scan and MRI demonstrated the presence of a lumbar subdural hematoma, brain ventricle size reduction and parietal hygroma. Even if no evidence of meningeal enhancement on MRI was found, a SIH was suspected. For the good clinical condition of the patient and spontaneous recovery of the headache and lumbar pain, a conservative treatment was chosen with demonstration of reduction of the lumbar subdural hematoma and of parietal hygroma.
Conclusion: We have reported a case of SIH presented after aneurysmal SAH. SIH is a potential diagnostic pitfall and careful attention should be given to its clinical and radiological manifestations, due to the possibility of neurological deterioration into a coma or even death. In case of aneurysmal SAH the most common cause of recurrence headache is the rebleeding, but other conditions have to be taken into account, as SIH. The physiopathological mechanism of SIH after a SAH is not clear, but a possible explanation could be that, as suggested by the Monro-Kellie theory, SAH can cause transient changes in the intracranial pressure, because of the introduction of blood into the subarachnoid space, causing possible CSF leak in preexisting areas of dural defect in patients with peculiar risk factors.
Keywords: Intracranial Hypotension, Rebleeding, CSF leak

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GLOBAL MIRNA EXPRESSION PROFILE REVEALS NOVEL MOLECULAR PLAYERS IN ANEURYSMAL SUBARACHNOID HAEMORRHAGE

E Paschoal[1], FM Paschoaljr[1], V Apabastos[2], E B-S-Shu[2] and R-Dos-Santos[2]

[1]Unidade Neuromuscular do Complexo Hospitalar da UFPA EBSERH, Belem, BRAZIL
[2]Grupo de Pesquisa Amazônia Neurovascular UFPA CNPq, Belem, BRAZIL
[3]Laboratorio de genetica Humana da UFPA, Belém, BRAZIL

Purpose: The molecular mechanisms behind aneurysmal subarachnoid haemorrhage (aSAH) are still poorly understood. Expression patterns of miRNAs may help elucidate the post-transcriptional gene expression in aSAH. Here, we evaluate the global miRNAs expression profile (miRnome) of patients with aSAH to identify potential biomarkers.
Materials and Methods: We collected 33 peripheral blood samples (27 patients with cerebral aneurysm, collected 7 to 10 days after the haemorrhage, when usually is the cerebral vasospasm risk peak, and six controls). Then, were performed small RNA sequencing using an Illumina Next Generation Sequencing (NGS) platform. Differential expression analysis identified eight differentially expressed miRNAs. Among them, three were identified being up-regulated, and five down-regulated. miR-486-5p was the most abundant expressed and is associated with poor neurological admission status.
Results: In silico miRNA gene target prediction showed 148 genes associated with at least two differentially expressed miRNAs. Among these, THBS1 and VEGFA, known to be related to thrombospondin and vascular endothelial growth factor. Moreover, MYC gene was found to be regulated by four miRNAs, suggesting an important role in aneurysmal subarachnoid haemorrhage.
Conclusion: 15 novel miRNAs were predicted being expressed only in aSAH, suggesting possible involvement in aneurysm pathogenesis. These findings may help the identification of novel biomarkers of clinical interest.
Keywords: miRNA, Subarachnoid hemorrhage, Intracranial Aneurysm

SESSION: Vasospasm

P 143

EARLY DETECTION OF CEREBRAL VASOSPASM OR DELAYED CEREBRAL ISCHEMIA AFTER SUBARACHNOID HEMORRHAGE: A META-ANALYSIS

E Paschoal[1], F Mtuji[2], AP Lobo[3], F Mpaschoaljr[1], R Mrburbano[2], V Apabastos[2], A R-Dos Santos[2], J Srogerio[2], AO Barbosa[2] and E B-S-Shu[2]

[1]Unidade Neuromuscular do Complexo Hospitalar da UFPA EBSERH, Belem, BRAZIL
[2]Instituto de neurologia do Hospital OphirLoyola, Belem, BRAZIL
[3]Grupo de Pesquisa Amazonia Neurovascular, Belem, BRAZIL

Purpose: Cerebral vasospasm and delayed cerebral ischemia are common in patients suffering from aneurysmal subarachnoid hemorrhage (aSAH) and lead to increased morbidity and mortality. The purpose of this study is to compare two methods, transcranial Doppler (TCD) and computed tomography perfusion (CTP), for early detection of vasospasm because both are more accessible than angiography and have excellent results for this pathology.
Materials and Methods: Searches were performed in three databases; 695 articles were initially retrieved, and five articles were included, of which three examined TCD (cluster A) and two examined CTP (cluster B). Using the selection criteria established by the authors, a total of 436 patients were included.
Results: The articles in cluster A did not indicate significant differences; the area under the ROC curve was equivalent to a qui quadrate value of 1.70. A similar result was found for cluster B, in which qui quadrate = 0.12A similar result was found when comparing the two methods, as qui quadrate = 0. Thus, we determined that the two methods studied were not significantly different.
Conclusion: No significant difference was observed for the prediction of vasospasm between TCD and CTP, which is an important result for public health and the favorable evolution of the patients because these methods are cheaper and more accessible than angiography.
Keywords: Cerebral Vasospasm, Inatracranial Aneurysm, Transcranial Doppler

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EARLY DETECTION OF VASOSPASM USING CT PERFUSION AFTER ANEURYSMAL SUBARACHNOID HEMORRHAGE

SY Kim[1], KC Cho[1] and JM Cho[1]

[1]International St. Mary's Hospital, Department of Neurosurgery, Incheon, SOUTH KOREA

Purpose: This study was conducted to evaluate efficacy of CT perfusion (CTP) studies for early detection of vasospasm-related cerebral infarction after aneurysmal subarachnoid hemorrhage (aSAH).
Materials and Methods: A prospectively collected database of patients who treated for aSAH between January 2017 and June 2018 were reviewed. In 34 patients, a CTP and CT angiography studies were routinely performed in post-operative Day 3 and post-operative Day 7 to evaluate vasospasm. Transcranial Doppler sonography (TCD) was also checked every-other-day before postoperative Day 14.
Results: Early Day 3 CTP defects were found in 11 patients (32.4%) and late Day 7 CTP defects were found in 16 patients (47.1%). Among 11 patients who had early CTP defects, 5 patients (45.5%) were suffered with delayed neurologic deficits and 4 patients (36.4%) developed cerebral infarction with statistically significant correlation ($P = 0.037$ and 0.014, respectively). In 16 patients (47.1%) who had late CTP defects, 7 patients (43.8%) had delayed neurologic deficits and 5 patients (31.3%) developed cerebral infarction with statistical significance ($p = 0.009$ and 0.01, respectively). On the other hand, early Day3 CT angiography was not correlated with delayed neurologic deficits nor cerebral infarction, and so did late Day7 CT angiography and cerebral infarction. Only late Day 7 CT angiography showed clinical correlation to delayed neurologic deficits ($p = 0.014$). TCD did not contribute to detect vasospasm in this study.
Conclusion: Early and late CTP studies are sensitive and reliable methods to identify vasospasm-related delayed neurologic deficits and cerebral infarction. Late CT angiography also gives us useful information about delayed neurologic deficits.
Keywords: vasospasm, delayed neurologic deficit, CT perfusion

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DUAL ANTIPLATELET THERAPY ASSOCIATED WITH REDUCED RISK OF CLINICAL VASOSPASM IN ANEURYSMAL SUBARACHNOID HEMORRHAGE

D Kim[1]

[1]Wonkwang University School of Medicine and Hospital, Iksan, SOUTH KOREA

Purpose: Clinical vasospasm is one of serious complication of aneurysmal subarachnoid hemorrhage (aSAH). Several theories involving platelet activation have been postulated as potential explanations of the development of clinical vasospasm. However, the effects of dual antiplatelet therapy (DAPT; aspirin and clopidogrel) on clinical vasospasm have not been widely investigated. The objective of this study was to evaluate the effects of DAPT on clinical vasospasm in aSAH patients.
Materials and Methods: Analysis of patients treated for aSAH during the period from 2009 to 2018 was performed in a single-institution retrospective study. Patients were divided into 2 groups: patients who underwent stent-

assisted coiling requiring DAPT (DAPT group) and patients who underwent coiling or clipping only without DAPT (control group). The frequency of symptomatic clinical vasospasm was compared between the 2 groups.
Results: Total 744 patients were included in the analysis (68 patients in the DAPT group, 676 patients in the control group; clipping – 569, coiling – 107). In the 3 different treatment modality (clipping, coiling, DAPT) groups, the incidence of clinical vasospasm was 8.6, 10.3 and 1.5%, respectively. The risks of clinical vasospasm was significantly lower in patients receiving DAPT ($p = 0.03$).
Conclusion: The use of DAPT was associated with a lower risk of clinical vasospasm in patients treated for aSAH.
Keywords: clinical vasospasm, dual antiplatelet therapy, subarachnoid hemorrhage

P 146

INTRA-ARTERIAL INJECTION OF FASUDIL HYDROCHLORIDE FOR CEREBRAL VASOSPASM SECONDARY TO BACTERIAL MENINGITIS

T Ishikawa[1], K Yamaguchi[2], T Funatsu[3], S Eguchi[4], Y Omura[5], T Nonaka[6] and T Kawamata[7]
[1]Tokyo Women's Medical University, Tokyo, JAPAN
[2]Tokyo Women's Medical University, Tokyo, JAPAN
[3]Tokyo Women's Medical University, Tokyo, JAPAN
[4]Tokyo Women's Medical University, Tokyo, JAPAN
[5]Tokyo Women's Medical University, Tokyo, JAPAN
[6]Tokyo Women's Medical University, Tokyo, JAPAN
[7]Tokyo Women's Medical University, Tokyo, JAPAN

Purpose: The occurrence of cerebral vasospasm secondary to bacterial meningitis is relatively rare. Further, there is no specific treatment. Endovascular treatment may be essential for cases with advanced clinical course. Balloon angioplasty or intra-arterial injection of verapamil, nicardipine, or nitroglycerin has been previously reported. We experienced successful treatment using intra-arterial infusion of fasudil hydrochloride. To our knowledge, this is the first case to report the intra-arterial injection of fasudil hydrochloride for treating cerebral vasospasm secondary to bacterial meningitis.
Materials and Methods: A 37-year-old female who presented with dizziness had a right cerebellar tumor that was excised and diagnosed as glioblastoma. On postoperative day 10, Streptococcus oralis meningitis was detected. On postoperative day 20, the patient developed right hemiparesis with a severe vasospasm of the bilateral middle cerebral artery and anterior cerebral artery.
Results: Intra-arterial fasudil hydrochloride injection was performed for 3 days, following which the patient's symptoms improved.
Conclusion: Symptomatic cerebral vasospasm secondary to bacterial meningitis is relatively rare and difficult to treat; in selected cases, intra-arterial fasudil hydrochloride injection was an effective treatment for cerebral vasospasm secondary to bacterial meningitis.
Keywords: meningitis, angioplasty, fasudil hydrochloride

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ARTERIAL SPIN LABELING MAGNETIC RESONANCE IMAGING TO DIAGNOSE CONTRAST-INDUCED VASOSPASM AFTER INTRACRANIAL STENT EMBOLIZATION

G Frauenfelder[1], R Saponiero[2], G Locatelli[2], A Siani[2], S Tartaglione[2] and DG Romano[2]
[1]Università Campus Bio Medico, Roma, ITALY
[2]AOU San Giovanni e Ruggi d'Aragona, Salerno, ITALY

Purpose: Contrast-induced encephalopathy (CIE) is a rare and misdiagnosed complication of intravascular injection of contrast, responsible for arterial vasospasm and neurologic effects. Conventional radiologic findings are not in themselves specific for cerebral vasospasm diagnosis. We present a case in which arterial spin labeling (ASL) perfusion magnetic resonance imaging (MRI) was useful in early diagnosis of CIE.
Materials and Methods: A 56-year-old woman was admitted for elective flowdiverter embolization of a recanalized left supra-ophthalmic internal carotid artery aneurysm; at 4 hours postprocedure, she acutely developed sensitive aphasia and right arm paresis. Although no-contrast computed tomography and MRI with fluid-attenuated inversion recovery and diffusion-weighted imaging sequences did not demonstrate acute ischemic/hemorrhagic cerebral foci or cortical edema, ASL showed decreased cerebral blood flow (CBF) in the insulartemporal-parietal anterior lobe, suspected for hypoperfusion due to vasospasm, which was not confirmed by subsequent emergent digital subtraction angiography.
Results: At 16 hours, because of worsening symptoms, patient underwent an additional MRI, which showed slight insular cortical edema on fluid-attenuated inversion recovery and corresponding slight restricted diffusion-weighted imaging with a severe reduction in CBF value; at this time, emergent digital subtraction angiography demonstrated distal arterial vasospasm of left middle cerebral artery, and vasospasm therapy was started. Within 48 hours of symptom onset, the patient gradually improved to a complete neurologic recovery, with normalization of CBF values in the concerning cerebral region.
Conclusion: CIE should always be considered in patients with focal neurologic deficits after iodinate contrast exposure. ASL perfusion MRI with CBF maps could be a promising tool for prompt, early confirmation of underlying vasospasm, as cortical edema and distal vasospasm could not be detected on conventional radiologic imaging.
Keywords: Arterial spin labeling (ASL), Contrast-induced encephalopath, Intracranial vasospasm

SESSION: AVM

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SILENT MRA; ARTERIAL SPIN LABELING MAGNETIC RESONANT ANGIOGRAPHY WITH ULTRA-SHORT TIME ECHO ASSESSING CEREBRAL ARTERIOVENOUS MALFORMATION

N Arai[1], T Akiyama[1], H Fujiwara[2], M Jinzaki[2] and K Yoshida[1]
[1]Neurosurgery department, Keio University, Tokyo, JAPAN
[2]Radiology department, Keio University, Tokyo, JAPAN

Purpose: Cerebral arteriovenous malformations (CAVMs) have little evidence to determine the standardized therapy. Treatment policy for each CAVM depends on its clinical course and vascular complexity. TOF MRA which is a most commonly-used modality for CAVM has been demonstrated to be insufficient to assess some certain groups of CAVMs. Silent MRA being newly developed MRI software, have potential vantages over TOF MRA because they employ the combination of arterial spin labeling method and ultra-short time echo. We compared TOF MRA and silent MRA focusing on the goodness of visualization for CAVM.
Materials and Methods: Consecutive 27 CAVM patients diagnosed by CT-DSA or DSA, who underwent both TOF MRA and silent MRA from August 2015 to August 2018 in Keio University Hospital (Tokyo, Japan) was enrolled. Two experienced interventional neurosurgeons independently assessed the silent and TOF images of CAVMs patients without any information from DSA or CT-DSA. The detection of lesions, Spetzler-Martin Grading (S-M Gr.) of CAVMs and visibility scoring of the components (feeder, nidus and drainer) using subjective 5 points scales; Grade1, not visible (no signal at all); Grade2, slightly visible (can be detected but highly blurring or artifacts); Grade3, acceptable (enough to discern the diagnostic information with moderate image quality); Grade4, good (can give clinicians good quality diagnostic information with slight blurring or artifacts); Grade5, excellent (the visuality is very high without few artifacts) were performed respectively and they are compared in use of statistical software R. The value $p < .05$ was statistically significant.
Results: The sensitivity for detecting CAVMs was 79% in TOF MRA and 100% in silent MRA respectively. In TOF MRA image, both observers could not detect 6 micro AVMs in 10 cases. The accuracy rates for AVM grading of TOF MRA and silent MRA imaging were 69% (20/29) and 93% (27/29) respectively, which was of significant difference ($p = 0.04$) between them. As for visibility, the mean score of the feeder, nidus, and drainer were 3.48 ± 1.00, 2.07 ± 0.84 and 1.86 ± 1.06 by TOF MRA and 3.93 ± 0.91, 4.24 ± 0.72 and 3.17 ± 1.47 by silent MRA, respectively. There was not significantly difference of feeder visibility between the TOF MRA and silent MRA ($p = 0.07$). By contrast, the visibility of the other components; nidus and drainer were significantly different between the modalities, with both P values being < 0.001.
Conclusion: Silent MRA can more clearly visualize variously directional flow of AVM components than 3D TOF-MRA. Especially for nidus and drainer, there are significantly huge differences of visuality between those modalities.
Keywords: Arterial Spin Labeling, Ultra Short UE, silent MRA

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CURE OF CEREBRAL ARTERIOVENOUS MALFORMATION AFTER PARTIAL EMBOLIZATION IS JUST A CHANCE OR A HEMODYNAMIC PROCESS

A Sultan[1], TI Metwally[1] and T Hassan[1]
[1]Neurosurgery Department, Alexandria University, Alexandria, EGYPT

Purpose: angiographic cure of brain AVMs is the main aim of endovascular treatment to prevent future rupture. Partial embolic occlusion can fortunately lead to angiographic obliteration of the nidus. This phenomenon is observed in some of our cases.
Materials and Methods: Among 160 patients underwent embolization for pial AVMs, eighteen patients after incomplete nidal embolization had complete angiographic obliteration during follow up angiography.
Results: the eighteen patients twelve females and 6 males. Their age ranged from 7 to 43 years old. Fifteen patients presented with hemorrhage. The AVM grade was 2 in eight patients and grade 3 in eight patients. Ten patients were treated by n-Butyl Cyanoacrylate and 8 patients were treated with Onyx. Follow up angiography was done from 2 to 6 months after embolization. Fourteen patients were embolized once, three patients required 2 sessions and one patient was treated in 3 sessions. The components of the nidus disappeared completely on the follow up digital subtraction angiography. In most patients the draining vein was delayed to the late arterial phase or early venous phase. Two patients had intraoperative leak during superselective microcatheter navigation without postoperative sequelae. Two had patients had transient weakness. No permanent deficits or death related to the embolization procedure occurred.
Conclusion: Partial embolization may sometimes lead to angiographic cure of the cerebral arteriovenous malformations. This can be expected when the draining vein appeared in the late arterial or venous phases. Excessive infusion of the embolic agents could be stopped when the venous phase is delayed especially when there is excessive reflux. Partial embolization to cure can decrease excessive infusion of onyx or excessive microcatheter navigation in cases of NBCA and related complications.
Keywords: arteriovenous Malformations, partial embolization, angiographic cure

P 150

POSTERIOR FOSSA ARTERIOVENOUS MALFORMATIONS: A REVIEW OF NATURAL HISTORY AND PATIENT OUTCOME IN SIRIRAJ HOSPITAL

A Potigumjon[1], A Churojana[1], T Aurboonyawat[1], E Chankaew[1], D Songsaeng[1], B Sangpetngam[1] and P Withyasak[1]
[1]Siriraj, Bangkok, THAILAND

Purpose: Posterior fossa arteriovenous malformations (AVMs) accounted for only 7–15% of all brain AVMs but can cause hemorrhage as high as 75–92%, with high risk of recurrent bleeding and high mortality rate. However in our experience we found that most of our posterior fossa AVMs had good clinical outcome (MRS 0–2) even though they presented with hemorrhage. The purpose of this study is to evaluate the natural history and clinical outcome of posterior fossa AVM in Siriraj hospital.
Materials and Methods: A retrospective review of patients with diagnosis of posterior fossa AVM in Siriraj hospital between August 2013 and March 2019 was performed. The baseline characteristics, clinical presentations, angioachitectures, method of treatment and clinical outcome were collected.
Results: The posterior fossa AVMs accounted for 17% of all brain AVMs (31/183 patients) in Siriraj hospital, with the mean age at 37 years and male at 64%. The ruptured AVMs occurred at 77%. The angio-architecture of ruptured AVMs were associated significantly with low spetzler martin grade ($P = 0.014$) and tended to relate with presentation of intra-nidal or flow related aneurysms ($P = 0.065$). Of 31 patients, 87% underwent treatment, 58% had endovascular approach alone, 19.4% had combined embolization with either surgery or radiotherapy. Complete obliteration of AVMs was achieved at 26% (7/27) of treated patients, with 57% (4/7) cured by embolization alone. Good clinical outcome was found in 80%, however, 80% of patients with good outcome had incomplete AVM obliteration. Of the six patients with poor outcome, 3 had embolization complication and the others had initially high MRS score.
Conclusion: Posterior fossa AVMs were frequently presented with rupture, despite low spetzler martin grade, and tended to associated with intranidal or flow related aneurysms. Even rupture, patients still had good clinical outcome regardless of treatment with incomplete obliteration. Although embolization can cure the posterior fossa AVMs, it should be weight against the treatment complications. It is not necessary to achieve complete obliteration of a posterior fossa AVM in order to have good clinical outcome.
Keywords: Posterior fossa, AVM, Natural history

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PRELIMINARY EXPERIENCE WITH NOVEL LIQUID EMBOLISING AGENT: PRECIPITATING HYDROPHOBIC INJECTABLE LIQUID (PHIL)

A Kumar[1] and V Bhatia[2]
[1]PGIMER, Chandigarh, INDIA
[2]PGIMER, Chandigarh, INDIA

Purpose: To describe our preliminary experience in treating cerebral arterio-venous malformations (AVMs) and dural arterio-venous fistulas (AVFs) using Precipitating Hydrophobic Injectable Liquid (PHIL).
Materials and Methods: Between Jul 2015 and Aug 2016, six patients, with four brain AVMs, one Vein of Gallen Malformation (VOGM) and one dural AVF were treated with PHIL. Clinical presentation, location of the vascular malformation, injecting microcatheter used, volume of PHIL injected, complications if any, immediate angiographic data, modified Rankin scale (premorbid and at discharge) and neurologic deficit post procedure, if any were recorded.
Results: Six patients were successfully treated with complete or near complete occlusion of the AVM/AVF. One large pericallosal AVM was treated with more than 50% occlusion of the nidus with subsequent referral for Gamma Knife Surgery (GKS). One patient had intra-procedural rupture of AVM with minimal hemorrhage, however no neurological deterioration occurred. No other procedural or technical complication was noted.
Conclusion: The novel liquid embolization agent PHIL appears to be an excellent, safe and effective alternative agent as compared to other options available in the market, in our initial experience.
Keywords: PHIL, AVM, Embolisation

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THE ENDOVASCULAR MANAGEMENT OF BRAIN ARTERIOVENOUS MALFORMATIONS BY ETHANOL SCLEROTHERAPY

Y He[1], W Bai[1] and T Li[1]
[1]Cerebrovascular Division, Interventional Center, Henan Provincial People's Hospital, Zhengzhou University, Zhengzhou, CHINA

Purpose: To explore the safety of the endovascular management of brain arteriovenous malformations(bAVMs) by ethanol obliteration.
Materials and Methods: Between September and November 2018, the clinical and imaging data of 12 patients with bAVMs treated by endovascular embolization with ethanol were collected. Rotational 3D angiography with volumetric reconstruction were generated to identify the exact location of target embolization, which included aneurysms or arteriovenous fistulas. Different concentrations of mixture of ethanol and iohexol 320 were injected based on different

angioarchitecture of targets. All perioperative adverse events related to procedure were recorded.
Results: Twelve patients underwent endovascular ethanol sclerotherapy through 19 artery pedicles. Thirteen target aneurysms and 6 arteriovenous fistulas were obliterated, in which 15 targets were cured with only ethanol embolization, 2 with ethanol and Onxy injection. One patient was cured of the bAVMs with ethanol combined with transvenous embolization. One target aneurysm was still slightly opacified on control angiography. There were 8 patients suffered encephaledema, and 5 of them had cerebral infarction after operation, however, only one patient, who remained worsen till discharge than preoperative state.
Conclusion: Endovascular ethanol sclerotherapy seems feasible and safe for bAVMs, which still needs to be verified by more and further studies.
Keywords: AVM, Ethanol sclerotherapy, Intracranial

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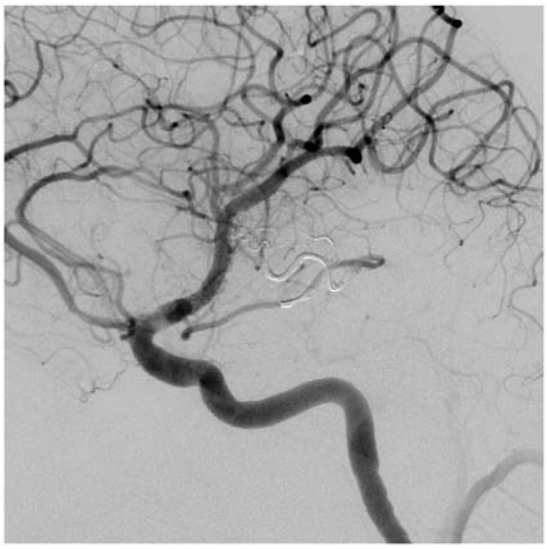
MICROCATHETER RUPTURE DURING AVM EMBOLIZATION AND MANAGEMENT IN ANTERIOR CHOROIDAL ARTERY: A CASE REPORT

TY Kim[1] and DW Park[2]
[1]Hanyang University Guri Hospital, Department of Radiology, Guri, SOUTH KOREA
[2]Hanyang University Guri Hospital, Department of Radiology, Guri, SOUTH KOREA

Purpose: We report a case with Onyx leakage due to microcatheter rupture, during embolization of a bled periventricular AVM via anterior choroidal artery.



Materials and Methods: A 20-year-old woman was admitted to our hospital due to ruptured recurrent AVM at left posterior periventricular white matter and dorsomedial nucleus of thalamus, with intracerebral hemorrhage and intraventricular hemorrhage. Conventional angiography showed 5.8 cm sized nidus, feeder from intra ventricular segment of left anterior choroidal artery, drainage to internal cerebral vein via thalamostriate vein, and 8.3 mm sized intranidal aneurysm. We performed micro-guidwire assisted selection of anterior choroidal artery due to acute and reverse angled origin. The Onyx was slowly injected to embolize AVM nidus including intranidal aneurysm through microcatheter. When almost total occlusion of AVM nidus was done, the microcatheter rupture was happened at catheter mid portion. Small amount of Onyx leakage was seen at just after plexal point of anterior choroidal artery.
Results: To avoid risk of microcathter entrapment and excessive leakage of the Onyx, we removed the microcatheter immediately. It was difficult to remove of Onyx fragment using stent retriever due to small caliber, angulation at plexal point and origin of anterior choroidal artery. We decided to maintain saline flushing or angiography to make thin strand of leaked Onyx and to prevent occlusion of anterior choroidal artery. The blood flow of left anterior choroidal artery was well maintained after 30 minutes flushing, but mild to moderate stenosis was seen at leakage point. There was no visible anterior choroidal artery territorial acute infarct on post procedural diffusion weighted images.
Conclusion: Increased injection pressure of Onyx sometimes can result in microcatheter rupture. Prompt removal of ruptured microcatheter and continuous saline injection can prevent acute occlusion of vessel by leaked Onyx, when stent retriever is not available and the leakage is small amount.
Keywords: microcatheter rupture, Onyx leakage, AVM

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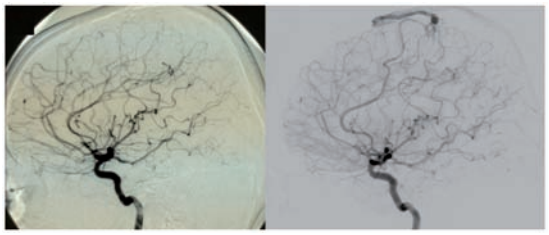
DE NOVO AVM IN ASYMPTOMATIC ADULT PATIENT

L Milonia[1], E Lozupone[1], P Trombatore[1], F D'argento[1], A Alexandre[1], I Valente[1], C Colosimo[1] and A Pedicelli[1]
[1]Catholic University of Sacred Heart, Gemelli Hospital, Rome, ITALY

Purpose: The pathogenesis of cerebral arteriovenous malformations (AVMs) is currently unknown; although AVMs have been traditionally considered to be congenital anomalies of vasculogenesis, an increasing number of reports in the literature is challenging this statement, suggesting a more dynamic developmental process. We report a rare case of de novo AVM and present an extensive review of the literature.



Materials and Methods: An asymptomatic 35-years-old woman underwent a cerebral DSA to investigate a vascular abnormality of the left intracranial ICA, previously detected at an MRI scan. 10 years later she performed a follow-up

DSA that confirmed the vascular abnormalities of the left intracranial ICA and demonstrated a small cortical AVM of the pre-rolandic area, retrospectively absent on the previous DSA imaging. Review of the literature was conducted on PUBMED. Inclusion criteria were English language and reliable imaging like MRI or DSA previous to the appearance of the AVM (article prior to 1990 and with non-digital subtracted angiography were excluded).

Results: Thirty-four patients (median age 26; 17 F, 16 M) with de novo AVM were found in the review of the literature. 21 patients performed an MRI as a negative previous exam (64%), while in 12 cases (36%), a DSA was performed. The first imaging investigation was conducted for different brain pathology: 19 patients (58%) presented condition of vascular nature (hemorrhage, ischemic stroke, moya-moya disease, HHT, venous thrombosis), 5 patients (15%) suffered from epilepsy, 3 (9%) had a brain tumor, 2 (6%) a head trauma, and the remaining (12%) suffered from other congenital or acquired conditions. In 30% of cases the AVM developed within or adjacent to the region of preexisting pathology. In 21 patients, the de novo AVM was symptomatic while in the remaining cases its identification was incidental. 8 patients (38% of symptomatic) showed an intracranial hemorrhage due to the AVM, 9 (43%) presented with seizure, 3 (14%) with headache and 1 (5%) with pulsatile tinnitus.

Conclusion: Increasing evidences supports the hypothesis that probably not all AVMs are congenital. The appearance of de novo AVM has always been observed in patients with a history of brain disease and its location often corresponds to that of the previous insult. This led to hypothesize a congenital vascular vulnerability of these patients in which the cerebral pathology act as a trigger with a ''second hit'' mechanism and the AVM develops as an abnormal vascular response to injury.

Keywords: De novo avm, case report, literature review

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THE VALUE OF INTRAOPERATIVE ANGIOGRAPHY FOR EXCISION OF BRAIN ARTERIOVENOUS MALFORMATION

P Lueangapapong[1], C Kobkitsuksakul[2] and S Pongpech[2]

[1]Division of Neurosurgery, Department of Surgery, Ramathibodi Hospital, Mahidol University, Bangkok, THAILAND

[2]Division of Interventional Neuroradiology, Department of Radiology, Ramathibodi Hospital, Mahidol University, Bangkok, THAILAND

Purpose: Microsurgery of brain arteriovenous malformation (bAVM) is one of the high-risk operations. Post-operative bleeding can cause severe morbidity and mortality especially in patients with residual bAVMs. These patients have high long-term rupture risk and require reoperations. To confirm complete treatment, hybrid operating room was implemented to provide intraoperative angiography and confirm the residual malformations, which can be found postoperatively up to 5–10% of the patients according to previous studies including those from high-volume centers. We aimed to report the results of bAVMs removal under intraoperative angiography.

Materials and Methods: In our hospital, we selected the bAVMs with high potentialities to have postoperative residuals such as diffuse-type, in small size or adjacent to eloquent areas. They were performed craniotomy with excision the bAVMs. Intraoperative angiography was done until the bAVM was cured.

Results: Five patients with bAVM were selected for hybrid surgery. Mean age was 13.6 years. The bAVM located at left parietal area in 3 patients, right parietal area in 1 patient and right medial temporal area in 1 patient. According to intraoperative angiography, one patient was cured after the first operation. Two patients had residual bAVMs after the first angiography and was confirmed cured in the second angiography. The other two cases had three angiograms with residual small draining veins. All of them didn't have any perioperative bleeding and were discharged within 4 days postoperatively without any new neurological deficits.

Conclusion: Intraoperative angiography for the excision of bAVM is helpful to confirm the completeness of removal. It could reduce postoperative bleeding complications and perioperative morbidity and mortality rates. Moreover, we think that this procedure may preserve normal brain parenchyma better than previous operative methods because surgeons can confirm the completeness of removal without entailing extensive brain parenchymal excision.

Keywords: AVM, Surgery, Hybrid

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PATIENTS EYE LENS DOSE DURING BRAIN ARTERIOVENOUS MALFORMATION (AVM) INTERVENTIONAL NEURORADIOLOGY (INR) PROCEDURE

R Wongsung[1], R Thana[2], J Tantivatana[2] and A Krisanachinda[2]

[1]Department of Radiology, King Chulalongkorn Memorial Hospital, Bangkok, THAILAND

[2]Faculty of Medicine, Chulalongkorn University, Bangkok, THAILAND

Purpose: The aim is to investigate the patient eye lens dose and other dose indicators such as Air KERMA and KERMA Area Product, KAP, in brain arteriovenous malformation (bAVM) during INR procedure to comply with the threshold absorbed-dose inducing eye lens opacities and cataracts of 0.5 Gy and the threshold of skin reaction at 2.0 Gy (ICRP, 2012).

Materials and Methods: 48 bAVM patients including 26 therapeutics and 22 diagnostics who underwent INR procedures were studied using a biplane X-ray system, between January and December 2018 at King Chulalongkorn Memorial Hospital, Bangkok Thailand. Cumulative dosimetric and

exposure parameters related to acquisition protocol such as kVp, mAs, frame rates, number of images, KERMA area product (KAP), Air kerma (AK), total exposure time, source-image receptor distance are recorded. The size and site of bAVM lesion and experience of interventional neuroradiologists are recorded.

Results: Of 26 therapeutics, the average cumulative KAP of both X-ray tubes was 143.65 (23.76–507.83) Gycm2, the average cumulative AK of PA X-ray tubes was 1.80 (0.50–5.17) Gy, and lateral X ray tube was 1.26 (0.38–2.98) Gy. The average exposure time was 66.06 (20.16–186.56) minutes. The correlation between KAP and eye lens dose had been referred to this study by the average eye lens dose of the left and right eye were 60.41 (17.88–111.70) mGy and 26.65 (11.63–56.81) mGy respectively. The average patient left eye lens dose was higher than the right eye according to the large lesion size, the prolonged exposure time and repeat irradiation to the same interest area. The beam collimation, frame rate, angular and rotation of X-ray tube, the complexity index of the procedure influenced the patient eye lens dose.

Conclusion: The average patient eye lens dose in a single procedure was not exceed 0.5 Gy, the threshold dose of eye lens opacities and cataracts and the average AK was 1.8 Gy which was less than the threshold of the skin injury at 2.0 Gy. The awareness in using proper exposure parameters such as collimated irradiation area, reduce frame rate, and the short distance from flat panel detector to patient have been carefully selected and optimization procedures were considered, especially in patients requiring multiple procedures.

Keywords: Eye lens dose, Brain arteriovenous malforma, Interventional neuroradiology

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RELATIONSHIP BETWEEN NOTCH4 GENE POLYMORPHISM AND BRAIN ARTERIOVENOUS MALFORMATION DEVELOPMENT: A SYSTEMATIC REVIEW

E Paschoal[1], F Mpaschoal Jr[1], VA.PA Bastos[2], RMR Burbano[2], FM Tuji[2], E B-S-Shu[2] and R-Dos-Santos[3]

[1]Unidade Neuromuscular do Complexo Hospitalar da UFPA/EBSERH, Belém, BRAZIL

[2]Grupo de Pesquisa Amazônia Neurovascular UFPA/CNPq, Belém, BRAZIL

[3]Laboratorio de Genetica e Humana da UFPA, Belém, BRAZIL

Purpose: Background: Brain arteriovenous malformations (BAVM) are a cause of intracranial hemorrhage (ICH). The basic morphology of BAVM consists of a tangle of abnormal and dilated channels with intervening gliosis, that directly shunts blood circulation between the arteries and veins without a true capillary bed. Some gene polymorphisms have been shown to play an important role in the prediction of the BAVM, in this case, the NOTCH4 gene polymorphism. Objectives: The aim of this study was to review systematically and critically previous studies of the clinical prevalence of NOTCH4 gene polymorphism as a risk factor for the Brain Arteriovenous Malformations development.

Materials and Methods: A systematic literature search was performed using PubMed and Scielo. Selected articles had to describe a study that provided a prevalence and/or incidence number for the population with NOTCH4 gene polymorphism and brain arteriovenous malformation.

Results: A total of 85 articles were found, but only thirteen studies reporting the relationship between the NOTCH4 polymorpohism and brain arteriovenous malformations met the inclusion criteria. In most of them (approximately 50%), the authors suggest NOTCH4 polymorphism and the NOTCH signaling pathway as a factor involved in the brain arteriovenous malformations development.

Conclusion: Although the literature on the prevalence and incidence of NOTCH4 gene polymorphism is limited, there is a general consensus that this kind of polymorphism can be considered as possible genetic risk factor in brain arteriovenous malformation development. In addition, large studies are still needed that can prove the relationship between NOTCH4 and BAVM, so that therapeutics can be created to prevent clinical manifestations of this kind of disease.

Keywords: Single Nucleotid Polymorphisms, Genetic, Arteriovenous Malformatiion

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RELATIONSHIP OF SPECIFIC GENETICS POLYMORPHISMS AS A RISK FACTORS FOR THE BRAIN ARTERIOVENOUS MALFORMATIONS DEVELOPMENT: A SYSTEMATIC REVIEW

E Paschoal[1], LM Santos[4], VA.PA Bastos[4], FM Paschoaljr[1], VFR Farias[4], CRO Rocha[4], AC Pires[4], ALD Costa[4], JRN Brito[3], GALR Andrade[4], FLA Tobelem[4], RMR Burbano[3], MIS Rocha[4], E B-S-Shu[4], EG Figueiredo[4] and R-Dos-Santos[2]

[1]Unidade Neuromuscular do Complexo Hospitalar da UFPA/EBSERH, Belém, BRAZIL

[2]Laboratório de Genética Humana e Médica da UFPA, Belém, BRAZIL

[3]Instituto de Neurologia do Hospital Ophir Loyola, Belém, BRAZIL

[4]Grupo de Pesquisa Amazônia Neurovascular UFPA CNPq, Belém, BRAZIL

Purpose: The aim of this study was to review systematically and critically previous studies of the clinical prevalence of specific genetics polymorphisms as a risk factors for the Brain Arteriovenous Malformations (BAVM) development.

Materials and Methods: A systematic search of Medline, Cochrane Central Register of Controlled Trials, LILACS and EMBASE data bases was performed to identify all published studies reporting the clinical prevalence of specific genetics polymorphisms as a risk factors for the Brain Arteriovenous Malformations development. Information was extracted through a data extraction protocol in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-

Analyses guidelines. From each selected study, information such as gene involved, gene character (inflammatory or pro-angiogenesis), age most affected, sex most affected, size of AVM and relation between owning the gene and having AVM were obtained.

Results: The literature search yielded 208 articles, of which 11 met the inclusion criteria. All of the studies were case-control studies. The most affected age group was in the range between 35 and 40 years. AVMs, in general, presented with a mean size of 3 to 6 cm. Of the analyzed polymorphisms, all had a direct relationship between having the polymorphism and being an AVM. We found studies that highlighted the greater role of inflammatory genes in the pathophysiology of this disease, so that the most involved genes were Notch4, IL-6, TGF, VEGF, TNF-alpha, MMP-9 and ANGPTL4. And, of the more present clinical manifestations, the hemorrhage was highlighted.

Conclusion: Although the literature on the prevalence and incidence of genetic polymorphism is limited, there is a general consensus that this kind of polymorphisms can be considered as possible genetics risk factors in brain arteriovenous malformation development. In addition, large studies are still needed that can prove the relationship between genetic polymorphisms and BAVM development, so that therapeutics can be created to prevent clinical manifestations of this kind of disease.

Keywords: Single Nucleotid Polymorphisms, Arteriovenous Malformation, Hemorrhage

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MIRNAS PROFILE IN PATIENTS WITH BRAIN ARTERIOVENOUS MALFORMATION

E Paschoal[1], GS J-A-Liem[2], VN Yamaki[5], JA Doss. Lima[2], FM Paschoaljr[1], JRN Brito[2], JS Rogerio[2], JM De Jesus[2], R MR Burbano[4], FM Tuji[4], VA.PA Bastos[4], LM Santos[1], V FR Farias[1], CRO Rocha[1], AC Pires[1], EG Figueiredo[5], E B.-S.-Shu[5] and R-Dos-Santos[3]

[1]Unidade Neuromuscular – Complexo Hospitalar UFPA EBSERH, Belém, BRAZIL

[2]Instituto Neurológico do Hospital Ophir Loyola, Belém, BRAZIL

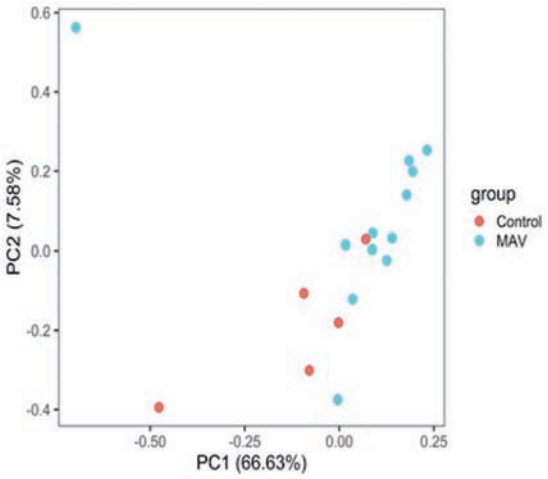
[3]Laboratório de Genética Humana e Médica da UFPA, Belém, BRAZIL

[4]Grupo de Pesquisa Amazônia Neurovascular CNPQ/UFPA, Belém, BRAZIL

[5]Universidade de São Paulo, São Paulo, BRAZIL

[6]Laboratório de Biologia Molecular do HOL, Belém, BRAZIL

Purpose: Background: Brain arteriovenous malformations (BAVM) are vascular lesions described as anomalous tangle of vessels in which arteries and veins are directly connected without an intervening capillary system and normal brain tissue. When its presentation comes with vascular disrupt leads to serious neurological impairment or death. This feature can be directly associated to a biological molecular expression which can change the natural history of AVM. From this way a special focus on miRNA and its profile can explain the metabolic route to trace a diagnostic or a therapeutic biomarker. Purposes: The authors showed up the epigenetic profile of BAVM in an Amazon folk as a hallmark to contribute to explain the main phenomena enrolled to celular, molecular and physiological processes in this disease.



Materials and Methods: We studied 22 patients (15 unruptured BAVM and 7 ruptured BAVM). The samples were analysed by Ultradeep Miseg platform (Ilumina) to achieve the study step-by-step in a sequence for small RNA. The reading was analysed using a packing DESq2 (program R) to appraise a distinguish expression of each miRNA. An analyzed was performed in garner sample using tools as: Target compare, miRtabase e TargetScan to establish the identity target genes from differential expressed miRNA.

Results: We identify 7 differential expressed miRNA (p adjusted < 0.05 and ILog2 [FoldChange]i > 2), between normal controls and patients with brain AVM. From these miRNAs two were upregulated and 5 were downregulated. Of all miRNA found the most upregulated was hsa-miR-486-5p and hsa-miR-18a. Two miRNAs like as hsa-miR-17 and hsa-miR-19a-3p showed up a metabolic pathway influence regulating so many target genes such as: ANGTTL4, HMGA2, CASP3, KRAS, VEGFA, NOTCH4 and ENG. These genes are related to vascular remodeling, including angiogenesis and vasculogenesis (figure 1). Also these genes achieve into extracellular matrix remodeling which is critical to pathophisiological mechanisms to Arteriovenous Malformation.

Conclusion: These is the first study which are outlined the Global miRNA profile about ruptured Brain AVM using a new generation of sequence research. This research showed up 7 new and discriminated miRNAs into ruptured brain AVM, suggesting a new enrollment.

Keywords: Epigenetics, miRNA, Arteriovenous Malformatiion

SESSION: AVF

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DIPLOIC ARTERIOVENOUS FISTULAS. REPORT OF 2 CASES

R Anxionnat[1], S Bracard[1], R Tonnelet[1], AL Derelle[1], L Liao[1] and B Gory[1]
[1]Université de Lorraine -Hopital Central-department of neuroradiology, Nancy, FRANCE

Purpose: to report two cases of unusual arteriovenous fistulas located within the diploic space.
Materials and Methods: we describe clinical presentation, MRA diagnosis, angiographic features, endovascular treatment and follow-up of intradiploic arteriovenous fistulas in 2 patients, aged 59 and 63 years old, revealed by pulsatile tinnitus spontaneously occurring in the first case and following minor head traumatism in the second case.
Results: MRA with 3D TOF sequence confirmed the diagnosis of arteriovenous fistula in the 2 cases but failed to assess the precise location of the arteriovenous shunt. The intradiploic arteriovenous shunt was nicely shown on cone beam CT reformation from 3D angiography. In case 1 arteriovenous shunt appeared as an occipital intradiploic poach fed by multiple transosseous branches from both right and left occipital arteries and draining through the inner table of the occipital bone to reach the right transverse sinus. Endovascular occlusion with coils was easily performed by venous road. Clinical result was good and MRA at 3 months confirmed angiographic cure. In case 1 multiple bilateral feeders from middle meningeal and superficial temporal arteries communicated with large intradiploic channels within the frontal bone with a reflux towards the superior sagital sinus. After an uncessfull attempt of arterial embolization the arteriovenous shunt was reached using a direct puncture through the vault and occluded with onyx. There was complete regression of the tinnitus after embolization but the tinnitus reappeared spontaneously 4 years later on the other side and MRA showed a new diploic arteriovenous fistula on the opposite side of the first one. There was no angiographic confirmation as the patient declined any treatment.
Conclusion: Diploic arteriovenous fistulas are rare. Precise location of the arteriovenous shunt is best assessed by subtracted angiography with cone beam CT reformation from 3D. Endovascular treatment is usually possible.
Keywords: dural AV fistulas, diploic, embolization

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NEURONAVIGATION SYSTEM MIGHT BE USEFUL FOR DIRECT PUNCTURE OF THE TARGETED VENOUS SINUS IN EMBOLIZATION OF DURAL ARTERIOVENOUS FISTULA

Y Nakagawa[1], Y Mine[1], H Kagami[1] and M Inaba[1]
[1]Saiseikai Yokohamashi Tobu Hospital, Yokohama-shi, JAPAN

Purpose: Transvenous embolization is effective in the treatment of the intracranial dural arteriovenous fistula (dAVF). Although transvenous approach by femoral route can be used for closure in the vast majority of cases, access to the fistula may be limited by associated dural sinus thrombosis, unsuitable anatomy or angioarchitecture. A transcranial approach has been developed for venous embolization in such a situation. The authors report two cases with the use of neuronavigation system to access the sinus by direct puncture through single burr hole.
Materials and Methods: Two patients with dAVFs underwent embolization procedures through burr hole in which direct sinus puncture was performed. Two dAVFs drained directory into a sinus with secondary reflux into leptomeningeal veins.
Results: The position of burr hole was decided by using neuronavigation system and dAVFs were successfully embolized using coils.
Conclusion: The correct location of the burr hole is essential for success to be achieved using this technique. To achieve this, our solution is to decide the position of the burr hole by using neuronavigation system. This allows simple and safe catheterization of the dAVF and venous embolization.
Keywords: dural arteriovenous fistula, transcranial approach, neuronavigation system

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INITIAL EXPERIENCE OF STEERABLE MICROCATHETER FOR THE SELECTIVE TVE OF DURAL AVFS

K Tokuyama[1], H Kiyosue[2], Y Hori[3], H Nagatomi[3] and M Okahara[4]
[1]Nanaki medical centre, Saiki, JAPAN
[2]Oita university faculity of medicine, Yufu, JAPAN
[3]Nagatomi neurosurgical Hospital, Oita, JAPAN
[4]Shinbeppu hospital, Beppu, JAPAN

Purpose: Selective transvenous embolization (TVE) is an effective technique for the treatment of dural arteriovenous fistulas (DAVF). A Steerable microcatheter (SM) is recently available of which the tip angle can be controlled at hand. We present our initial experience of using the SM for selective catheterization and TVE of DAVF.
Materials and Methods: Twelve consecutive cases of DAVF that underwent TVE using SM between October 2016 and October 2018 were reviewed. The SM were used for selective catheterization for targeted pouch, isolated sinus, sinus or cortical vein and embolization. Locations of DAVF were 8 transvers-sigmoid sinus, 3 cavernous sinus, and one superior petrosal sinus. In the one case, SM was used for catheterization to the isolated sinus. We evaluated the maneuverability of the SM and success of selective catheterization into the target legions and results of endovascular treatments.
Results: The SM of high-flow type was used as coaxial system with a 1.6 or 1.9F microcatheter in 10 cases, and

that of selective type was used in two cases. There was no difficulty to use the SM. In 26 of 28 target legions, successful selective catheterization was achieved. Ten cases were achieved complete occlusion, in the remaining 2 cases showed reduction of DAVFs. Procedure-related complication of sinus thrombosis with asymptomatic cerebral hemorrhage was observed in one case. There were no cases of recurrence or exacerbation during 5.25 months of mean fllow-up periods.

Conclusion: The SM is a useful tool for selective catheterization for target lesion during selective TVE of DAVF.

Keywords: DAVF, transvenous embolizatiion, steerable microcatheter

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ANGIOARCHITECTURE OF CRANIAL VENTRAL TYPE DURAL ARTERIOVENOUS FISTULAS: EMBRYOLOGICAL, ANATOMICAL, AND CLINICAL CONSIDERATIONS

N Toma[1], Y Suzuki[1], Y Miura[1], M Shiba[1] and H Suzuki[1]
[1]Mie University Hospital, Tsu, JAPAN

Purpose: The authors examined characteristics of angioarchitecture of cranial ventral type dural arteriovenous fistula (DAVF), i.e. DAVF around cavernous sinus (CS) and hypoglossal canal (HC), and discussed embryology and anatomy of cranial base and clinical characteristics.

Materials and Methods: Seventeen cases of cranial ventral type DAVF, 10 cases of CSDAVF and 7 cases of HCDAVF, were retrospectively analyzed their feeding arteries and location of fistula using 3D-RA and cone beam CT. CSDAVF were categorized into 2 subtypes based on involvement of shunted flow in CS. Five cases of diffuse type showed whole CS filled with shunted flow, and 5 cases of restrictive type showed shunted flow into restricted compartment of partially occluded CS.

Results: Five cases of diffuse type CSDAVF demonstrated primary fistulas located on intraosseous venous pouches in the dorsum sellae, supplied from a number of osseous branches of the ascending pharyngeal artery (APA). Diffuse shunt from numerous feeding arteries around CS from the branches of the maxillary artery and ophthalmic artery were also observed. Three of 5 cases of restricted type CSDAVF demonstrated exclusive intraosseous fistulous pouches in the dorsum sellae, and the other 2 cases had primary fistulous pouch along the superior or lateral wall of the CS with converging multiple feeding arteries, although small intraosseous venous pouches were also observed in the dorsum sellae. In 7 cases of HCDAVF, shunted flow was also primarily supplied from osseous branches of the APA in all cases and the occipital artery in 3 cases. Meningeal branches of the APA were rarely involved in the fistula. All cases demonstrated intraosseous fistulous pouches adjacent to the hypoglossal canal and connection with the anterior condylar vein.

Conclusion: This study demonstrated that intraosseous fistulous pouch supplied from the APA is distinct characteristics of cranial ventral type DAVF. Therefore, topography of cranial ventral type DAVF is basically chondrocranium derived from mesoderm, especially around basisphenoid and basioccipital bone, suggesting a close relationship with embryonic midline structure, notochord. The nature of intraosseous fistula can explain similar characteristics of CSAVF and HCAVF, such as benign clinical course and less cortical venous reflux. 3D-RA and the cone beam CT are useful for identification of intraosseous fistulous pouch and selective embolization of the pouch via transvenous route is essential for the treatment of cranial ventral type DAVF.

Keywords: dural arteriovenous fistula, angioarchitecture, embryology

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CLINICAL SIGNIFICANCES OF DURAL ARTERIOVENOUS SHUNTS WITH RETROGRADE CORTICAL VENOUS ECTASIAE

F Yamane[1], S Kohyama[2], M Miyamoto[1], K Uno[1], A Itou[1] and A Matsuno[1]
[1]Department of Neurosurgery, Teikyo University School of Medicine, Tokyo, JAPAN
[2]Department of Endovascular Neurosurgery, Saitama Medical University International Medical Center, Saitama, JAPAN

Purpose: In cases with dural arteriovenous shunts (dAVS) with retrograde cortical venous ectasiae (RCVE) are known to be related to so-called aggressive type. To investigate the clinical significances of the presence of RCVE in dAVS, we retrospectively studied clinical presentations, shunt structures and results of interventional managements.

Materials and Methods: From January 2009 to the February 2019, 30 operations for 26 cases underwent endovascular therapy to dAVS with RCVE at our institute and the related hospital. F:M = 10:16, average age 69.5 yrs. Initial presentations were hemorrhage in 5 cases (20%), convulsions 2 cases, dementia one, dizziness one, headache one and one in visual fields deficits. Eleven cases (40%) were no symptoms and incidentally found on MRI. We evaluated structures of shunts and venous outlets to ectasiae in the use of CT with contrast enhancements, cone-beam CT, and DSA with 3D-RA. Clinical course and results of interventions were reviewed with medical records at the institutes.

Results: Ten cases (19.6%) were observed in transvers sigmoid sinus (TS), 9 cases (42.8%) tentorial sinus (tentorial), 2 cases (33.3%) anterior cranial fossa (AF), 2 cases (20%) in superior sagittal sinus (SSS), 2 cases (4.7%) cavernous sinus (CS), and one in other locations. Fourteen cases were non-sinusal type, 12 cases were sinus type. Draining patterns can be divided into two categories: diffuse and simple type. In diffuse type, ectasia and cerebral venous drainage were observed in wide area, in simple type those were distributed

in limited area. Twenty cases were done via transarterial embolization (TAE), 6 cases underwent transvenous embolization (TVE), and 2 cases via direct punctures. Outcome of the interventions were, no shunts in 20 cases (84%) and shunt remained in 11 cases. In these shunts remained cases, 5 patients became no shunts and those cases were diffuse type. Hemorrhagic complications were observed in 2 cases and one in blindness. Common sites of dAVS with RCVE were tentorial and anterior cranial fossa. In interventional managements if flow reduction might be achieved with venous sides penetrations even if partially occluded with flow reductions, shunt residual can be no shunts.

Conclusion: Clinical significances of dAVS with RCVE is unclear, however diffuse and simple type can be distinguished. In patients with dAVS with RCVE, hemorrhagic events were commonly found in cases of nonsinus type and shunts with cortical branch feeders.

Keywords: dural arteriovenous shunt, venous ectasia, cortical branch feeder

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A CASE OF ETHMOIDAL DAVF TREATED WITH TRANSARTERIAL EMBOLIZATION

M Yokota[1], T Oshima[2], R Kawaguchi[1], N Matsuo[1] and S Miyachi[1,2]

[1]Department of Neurosurgery, Aichi Medical University, Nagakute, JAPAN

[2]Neuroendovascular Therapy Center, Aichi Medical University, Nagakute, JAPAN

Purpose: Ethmoidal dural arteriovenous fistula (DAVF) accounting for 4–6 % of all DAVFs has been usually treated with surgical occlusion of the shunt point under the frontbasal craniotomy. Endovascular approach is considered difficult because of the risk of unexpected occlusion of retinal artery and of incomplete result with remaining shunt via external carotid system or from contralateral side. We encountered a patient with an ethmoidal DAVF supplied by the branches from both ophthalmic arteries, and successfully treated with transarterial embolization under the flow control using balloon catheter.

Materials and Methods: The patient, 70 year-old male, took brain check-up, and an abnormal vascular lesion at the right anterior cranial base was pointed out. Angiogram showed ethmoidal DAVF fed with both anterior ethmoidal arteries draining into superior sagittal sinus via frontal cortical veins. Both ophthalmic arteries were found to coil at their origin, particularly with tortuous course on the left side. Although the access seemed to be difficult because of this anatomical disadvantage, we decided endovascular approach because the patient strongly refused the craniotomy.

Results: A microcatheter (MarathonTM Medtronic) was advanced to just proximal to the shunt point of right anterior ethmoidal artery, where far distal from the origin of central retinal branch, and balloon catheter (TransformTM 4*10 mm, Stryker) was placed at the origin of ophthalmic artery in the left internal carotid artery. After balloon was inflated and the stop of left ophthalmic flow was confirmed, very diluted glue (17% NBCA + Lipiodol mixture) was meticulously injected from Marathon and was penetrated to the drainers. Post-angiogram of both carotid arteries showed complete occlusion of DAVF. There were no visual complications, and postoperative course was uneventful.

Conclusion: Non-sinus type of DAVF is usually treated with surgical trapping of the shunt because endovascular approach is often difficult due to the tortuous access and high risk of ischemic complications with the migration of embolic material into normal branches or of impairment of nerve nutrition. The catheterization to the sufficiently distal and slow injection of diluted glue not to reflux and not to migrate to the anastomotic branches enables safer endovascular occlusion of the shunt. Although sufficient penetration of glue can be obtained with the bilateral approach of both ophthalmic arteries, the tortuous course of left ophthalmic artery did not allow the catheterization in this patient. In such a case flow control with balloon may be one of the substitute useful options to perform the complete embolization.

Keywords: ethmoidal DAVF, transarterial embolization, flow control

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DURAL ARTERIOVENOUSFISTULA WITH VEIN OF GALEN DILATATION MIMICKING VEIN OF GALEN MALFORMATION IN ADULT

JW Choi[1] and JY Kim[1]

[1]Wonju Severance Christian Hospital, Wonju, SOUTH KOREA

Purpose: Vein of Galen malformation is an uncommon intracranial vascular abnormality, and this malformation is caused by the persistence of a cerebral arteriovenous fistula of the median prosencephalic vein–a precursor of the vein of Galen at 6–11 weeks gestational age. Most of the cases are found during the neonatal or childhood period; in contrast, it is rarely found in adult patients. The clinical manifestations include headache, seizure, hydrocephalus, calcified pineal mass, and subarachnoid or intracerebral hemorrhage. We described a case of duralarteriovenousfistula with vein of galen dilatation by endovascularembolizationthat patient with headache that presented vein of galen dilatation in imaging study.

Materials and Methods: A 49-year-old woman presented with headache and nausea during 1 month. She had no significant medical illness history. No neurologic deficit was found. Computed tomography of the brain showed mass like lesion around third ventricle. Further computed tomography angiography showed the presence of a large dilatated vein of galen involving with multiple feeder on both side. Conventional cerebral angiography showed arteriovenous fistula around vein of galen supplied by both internal and external carotid artery and right vertebral artery

drained to straight sinus. Vein of galen was presented early arterial phase in dilatated appearance.
Results: We treated with Onyx embolization through left superficial temporal artery. Total 3cc injected. Then, postoperative conventional angiography was not showed arteriovenous fistula and arterial phase venous structure. She had not any clinical symptom after procedure.
Conclusion: Endovascular embolization has considerably improved outcomes in patients with duralarteriovenousfistula(dAVF). In the past, mostly dAVF with dilatated vein of galen was misunderstand vein of galen malformation. For successful treatment, there were considered to be exact diagnosis. The results of therapeutic options chosen allcontribute to the body of information to be referencedwhen treating similar patients in thefuture.
Keywords: Dural AVF, Vein of Galen malformation

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ANGIOARCHITECTURE AND ENDOVASCULAR TREATMENT RESULTS OF TENTORIAL DURAL ARTERIOVENOUS FISTULAS: FOUR DIFFERENT LOCATIONS

H Kiyosue[1], S Ide[1], Y Hori[2], K Tokuyama[2] and M Okahara[3]
[1]Oita University Faculty of Medicine, Yufu, JAPAN
[2]Nagatomi Neurosurgical Hospital, Oita, JAPAN
[3]Shiinbeppu Hospital, Beppu, JAPAN

Purpose: Tentorial dural arteriovenous fistulas (TDAVFs) are relatively rare, but can cause fatal hemorrhage. Although transarterial embolization has been widely applied for the TDAVFs in recent years, its safety and efficacy may depends upon angioarchitecure of the lesion which would be related to the location. We retrospectively investigated angioarchitecture and treatment results of TDAVFs in four different locations.
Materials and Methods: From 2011 to 2017, 11 consecutive patients with TDAVFs treated in our department were retrospectively reviewed. There were 10 males and one female with age ranging from 41 to 81 years. Symptoms included cerebral hemorrhage ($n = 5$), conscious disturbance ($n = 1$), ataxia ($n = 1$), progressive myelopathy ($n = 1$), and no symptom ($n = 3$). Locations of TDAVFs were divided into 4 areas including anterolateral (petrous portion, $n = 1$), posterolateral (paratransverse sinus, $n = 5$), posteromedial (falx cerebelli, $n = 3$), and anteromedial (Galen, $n = 2$). Angioarchitectures (main feeding arteries, and dranage vein) and treatment results of TDAVFs in each location were investigated.
Results: Anterolateral TDAVFs were mainly fed by petrosal branch of the middle meningeal artery (MMA), posterior branch of the accessory meningeal artery, and tentorial artery of the inferolateral trunk, and were drained via the petrosal vein to the brain stem and cerebellar veins. Posterolateral TDAVFs were mainly fed by the posterior convexity branch of the MMA, and transosseous branch of the occipital artery and drained into the temporal cortical vein. In one case, the TDAVF was mainly fed by pial arteries. Posteromedial TDAVFs were mainly fed by posterior convexity branch of the MMA, and artery of falx cerebelli from the ascending pharyngeal artery, and the dural branch of the superior cerebellar artery, and drained into the cerebellar cortical veins. Anteromedial TDAVFs were fed by dural branches of the posterior cerebral artery and the superior cerebellar artery, posterior convexity branch of the MMA, posterior meningeal artery of the vertebral artery, and tentorial artery from the internal carotid artery, and drained into the vein of Galen. All but one TDAVFs were disappeared by endovascular treatments including transarterial glue embolization ($n = 9$) and transvenous coil embolization ($n = 1$). There was one asymptomatic complication of SAH probably due to stretching of the pial feeding artery during withdrawing a microcatheter after glue injection. Clinical outcomes were good in 9 but one patient died due to initial brain damage due to hemorrhage.
Conclusion: TDAVFs showed different angioarchitecture based on their locations. Embolization using appropriate approaches and/or adequate target artery based on angioarchitecture is essential for successful treatmentof TDAVFs.
Keywords: dural arteriovenous fistula, tentorial arteriovenous fistul, arteriovenous shunt

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DIAGNOSIS AND TREATMENT OF DURAL ARTERIOVENOUS FISTULAS WITH SUPERIOR PETROSAL VEINS

Y Cheng[1], Y Ma[1], H Zhang[1] and F Ling[1]
[1]Xuanwu Hospital, Beijing, CHINA

Purpose: To investigate the clinical manifestations and imaging features of dural arteriovenous fistulas with super petrosal venous drainage.
Materials and Methods: From May 2013 to September 2014, 9 patients with petrosal vein drained dural arteriovenous fistula at Xuanwu Hospital, Capital Medical University and Beijing Haidian Hospital were enrolled retrospectively. The patients were treated with endovascular embolization or microsurgery, and the MRI and DSA examinations were applied, and the scores of the modified Aminoff&Logue scale (mALS) were performed before and after treatment.
Results: In the 9 patients, there were 3 females and 6 males. They all had different degrees of limb sensory and motor abnormalities,7 patients also had urination and / or bowel disorders,4 had cranial nerve dysfunction, including hoarseness, bucking, hiccup, and paralysis. 6 patients received embolization treatment,3 received microsurgery. All the patients achieved anatomic cure. The preoperative mALS score was 6.0 ± 2.7, and the score at 3 months after procedure was 2.8 ± 1.7. There was significant difference between before and after treatment ($P < 0.05$).
Conclusion: The dural arteriovenous fistulas involving petrosal veins are kinds of rare cerebrovascular malformations.

The lesion involves a wide range. The clinical manifestations are severe. Both endovascular embolization and microsurgery can achieve a more ideal therapeutic effect. If the vascular condition is permitted, the interventional embolization treatment should be preferred.

Keywords: Dural Arteriovenous Fistulas, Superior Petrosal Veins, Diagnosis and Treatment

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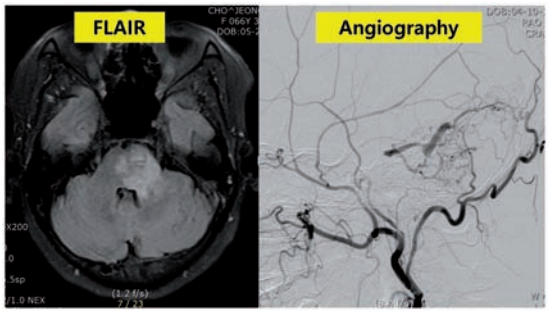
INTRACRANIAL DURAL ARTERIOVENOUS FISTULA MIMICKING PONTINE GLIOMA

YW Kim[1]

[1]Uijeongbu St. Marys Hospital, The Catholic University of Korea, Neurosurgery, Uijeongbu, SOUTH KOREA

Purpose: Intracranial dural arteriovenous fistulas (DAVFs) are rare lesion. We present a patient with DAVFs, revealed by radiological features that mimicked pontine glioma.



Materials and Methods: A 66-year-old woman with no previous medical history presented with a 1-week history of rapidly progressive right hemiparesis, vertigo, and dysphasia. Brain MRI showed a confluent T2/FLAIR hyperintensity in the pons (mainly left side) and left middle cerebellar peduncle, isointense on T1-weighted images, petechial and elongated dark signal intensities in the left cerebellum on SWI with punctiform contrast enhancement. Brainstem glioma was suspected. However, the possibility of a vascular underlying lesion was brought up because of repaid progression of neurological symptoms, and CTA was performed. CTA showed tortuous and elongated enhancing veins in the left cerebellum with nonvisualized left transverse and sigmoid venous sinuses; thus, cerebral angiography was performed. A cerebral angiography revealed DAVFs with arterial supply via branches of the occipital artery drained into the petrosal sinus with reflux into the pontomesencephalic and left transverse pontine veins.

Results: Complete obliteration of the fistula was achieved via transarterial Onyx embolization. The patient's symptoms improved progressively after the embolization, and Follow-up brain MRI performed 2 weeks after the embolization showed decreased extent of confluent T2WI high signal intensity in the pons and left middle cerebellar peduncle.

Conclusion: Careful radiological studies, based on the history of neurological symptoms, is necessary in the workup of an infiltrating pontine lesion to rule out intracranial dural arteriovenous fistula.

Keywords: Dural arteriovenous fistula, Pontine glioma, Onyx

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PROGNOSIS OF THE PATENT DURAL ARTERIOVENOUS FISTULAS IN THE SIGMOID SINUS

T Akiyama[1], **T Horiguchi**[1], **S Takahashi**[1] **and K Yoshida**[1]

[1]Keio University, Tokyo, JAPAN

Purpose: The shunted pouches of the dural arteriovenous fistula in the transverse-sigmoid sinuses are sometimes multiple and diffusely located. Treatment for these lesions by trans-arterial embolization using liquid or trans-venous embolization using coils or liquids, sometimes results in incomplete obliteration in order to avoid potential risks. Thus, it is important to investigate the prognosis of the residual lesions or untreated lesions of this area.

Materials and Methods: We analyzed 53 cases of transvers-sigmoid sinus dural arteriovenous fistula who had been treated by the first author endovascularly, surgically or conservatively. Prognosis of the residual or untreated lesions of the dural arteriovenous fistula located at the sigmoid sinus and sigmoid-jugular junction was evaluated.

Results: Twenty-five out of 53 cases had arteriovenous shunts within sigmoid sinus and sigmoid-jugular junction. Twenty-one cases had patent arteriovenous shunts in sigmoid or sigmoid-jugular junction including cases under observation without treatment or with residual lesions after treatment. During follow-up (mean: 39.6 months), two cases showed spontaneous regression of the shunts, and two cases developed new AV shunts at other locations and no cases showed development of cortical venous reflux nor clinical deterioration including bleeding.

Conclusion: Dural arteriovenous fistulas in sigmoid sinus or sigmoid-jugular junction seem to be benign with compared to the lesions in the transverse-sigmoid junction. Extensive trans-arterial embolization of jugular bulb or inferior sigmoid sinus bears substantial risk to occlude functional arteries such as ascending pharyngeal artery or vertebral artery. In conclusion, as the lesions are benign, we should avoid excessive embolization of these areas.

Keywords: dural arteriovenous fisutula, sigmoid sinus, prognosis

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SUPERSELECTIVE TRANSVENOUS COIL EMBOLIZATION FOR DURAL AVF AT HYPOGLOSSAL CANAL

H Ohta[1], K Saitou[1], K Yokogami[1] and H Takeshima[1]
[1]Department of Neurosurgery, Division of Clinical Neuroscience, Faculty of Medicine, University of Miyazaki, Miyazaki, JAPAN

Purpose: We report two dural arteriovenous fistula (dAVF) cases located at hypoglossal canal which were treated with superselective transvenous coil embolization.
Materials and Methods: Case 1 was 67-year-old woman presented with sudden left proptosis, chemosis, and diplopia. MRI and CT scan revealed left hypoglossal canal dAVF with the drainage toward the inferior petrosal sinus (IPS) to cavernous sinus. The 3D-DSA revealed the fistulas point in the hypoglossal canal, and we performed the superselective TVE with Target coils. Case 2 was 60-year-old man presented with left tongue atrophy prolonged for 6 months. MRI and CT scan revealed left hypoglossal canal dAVF with the venous pouch and drained toward the left IPS to cavernous sinus. After we checked the fistulas point, superselective TVE with Target coils was performed.
Results: All two cases were cured after the TVE, and 6 months follow-up MRI revealed no recurrence of dAVF. There were no new neurological deficits.
Conclusion: Superselective TVE with coils for hypoglossal dAVF was effective to avoid the new hypoglossal nerve palsy caused by coil over packing. Preoperative 3D-DSA was useful to detect the fistulas point, and make the treatment strategy.
Keywords: dural AVF, hypoglossal canal, TVE

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ARTERIOVENOUS FISTULAS AT THE CRANIOCERVICAL JUNCTION

L Xu[1], Y Ma[1], H Zhang[1], M Li[1], G Li[1] and L Sun[1]
[1]Xuanwu Hospital, Capital Medical University, Beijing, CHINA

Purpose: The arteriovenous fistulas at the craniocervical junction are rare. We performed a retrospective review of 50 such patients to describe the clinical and angiographic characteristics.
Materials and Methods: We reviewed 50 cases with arteriovenous fistulas at the craniocervical junction between April 2002 and January 2015 in Beijing Xuanwu Hospital, China. Clinical presentation, angiographic characteristics, treatment and outcomes were assessed.
Results: There were 46 males and 4 females; the mean age was 54.1 (range from 27 to 75). Among them 23 had subarachnoid hemorrhage (SAH) and 25 presented with venous hypertensive myelopathy (VHM). There was one patient just suffering from dizziness while another one being diagnosed occasionally. Angiography revealed that 43 patients had dural arteriovenous fistulas (DAVF), whereas 2 patients had perimedullary arteriovenous fistulas (PMAVF), 5 patients had both DAVF and PMAVF. All of the cases shared the medullary veins as a main drainage route. 22 cases, with single or main ascending venous route into the intracranial vein, included 18 with SAH, 3 with VHM and 1 just suffering from dizziness. 28 cases, with single or main descending draining vein, included 22 with VHM, 5 with SAH and 1 without any symptom. 3 patients were treated by endovascular embolization. 43 patients were treated by microsurgical interventions. 2 patients were treated by surgical interventions combined with endovascular embolization firstly and there were 2 patients rejecting to accept any operation. 41 of the 48 patients received follow-up angiographs which indicated the fistulas disappeared, whereas the other 7 patients didn't undertake any follow-up angiographs.
Conclusion: The arteriovenous fistulas at the craniocervical junction should be classified as three types: the DAVF, the PMAVF and concurrent type. The risk for SAH or VHM is related to the direction of the main drainage veins, there is an increased risk of SAH if the fistulas manifest an ascending venous route while that of VHM is just the reverse.
Keywords: Arteriovenous fistulas, Craniocervical Junction, Classification

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TRANSARTERIAL N-BUTYL-2 CYANOACRYLATE EMBOLIZATION FOR DURAL ARTERIOVENOUS FISTULA OF THE SINUS OF THE LESSER SPHENOID WING

R Kikuchi[1], T Akiyama[2], A Nakamura[1] and H Miyazaki[1]
[1]Department of Neurosurgery, Hiratsuka City Hospital, Hiratsuka, JAPAN
[2]Department of Neurosurgery, Keio University School of Medicine, Tokyo, JAPAN

Purpose: Dural arteriovenous fistulas (DAVFs) of the sinus of the lesser sphenoid wing (SLSW) are extremely rare. We report a patient with a DAVF of the SLSW with leptomeningeal drainage.
Materials and Methods: A 76-year-old man consulted department of neurosurgery regarding further examination because abnormal venous ectasia of frontal cortical vein which was accidentally found on magnetic resonance imaging. Angiography showed DAVF of the left SLSW; the fistula was supplied by the recurrent meningeal artery via the ophthalmic artery (OphA) and the inferolateral trunk (ILT) from the left internal carotid artery. There were also multiple feeders from the left external carotid artery, such as the artery of the foramen rotundum (AOR), the accessory meningeal artery (AMA), and the middle meningeal artery (MMA). The fistula drained into the deep middle cerebral vein via the uncal vein and the frontal cortical vein via the superficial

middle cerebral vein. The frontal cortical vein had a varix and finally flowed into the superior sagittal sinus.
Results: Patient hoped endovascular treatment and transarterial embolization (TAE) was done. The recurrent meningeal artery, ILT, and AOR were occluded with platinum coils. AMA was obliterated with n-butyl-2-cyanoacrylate (NBCA). The fistula was completely embolized via MMA with NBCA. There was no adverse event and the fistula was successfully obliterated at a half years after intervention. There are a few reports for treatment of DAVFs of the SLSW. Almost cases were treated with TAE and open surgery, or open surgery alone. Few reports demonstrated TAE alone with Onyx. In this case, we performed TAE alone with NBCA and coils. NBCA embolization are high thrombogenicity and relatively low risks of cranial nerve palsies compared to Onyx. Because the SLSW has connection to ophthalmic artery or ILT, NBCA and coil embolization may be effective treatment option in this lesion.
Conclusion: DAVFs of the SLSW are rare, and TAE with NBCA is useful treatment in this lesion.
Keywords: sinus of lesser sphenoid wing, dural arteriovenous fistula,n-butyl-2-cyanoacrylate

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TRIGEMINO-CARVERNOUS FISTULA TREATED BY BALLOON EMBOLIZATION

V Suraratdecha[1] and M Apirakkan[1]
[1]Ramathibodi hospital, Mahidol university, Bangkok, THAILAND

Purpose: To show a rare case of Trigemino-cavernous fistula which successfully treat with balloon embolization.
Materials and Methods: Retrospective review of clinical information and imaging findings.
Results: A 56-year-old woman with double vision, and pulsatile tinnitus. Her physical examination demonstrated only sixth cranial nerve palsy on right side without chemosis or conjunctival injection. Then, MR angiography (MRA) was performed and showed appearance of a right carotid-cavernous sinus fistula (CCF) with a distended ipsilateral cavernous sinus (CS) drained by a dilated superior ophthalmic vein (SOV). So, we initially misdiagnosed her presentation as a carotid-cavernous fistula. After that, we performed digital subtraction angiography for a definitive diagnosis and treatment. Her DSA showed an arteriovenous fistula involving the right cavernous sinus and an ipsilateral persistent trigeminal artery. Balloon embolization was done. Control angiogram showed complete obliteration of trigemino-cavernous fistula. At follow-up at 3 months after treatment, her diplopia was improved.
Conclusion: Diagnosis of the trigemino-cavernous fistula with the non invasive imaging and clinical context is challenged and can be misdiagnosed as a carotid-cavernous fistula. Treatment of the trigemino-cavernous fistula can be done with balloon embolization.
Keywords: Persistent trigeminal artery, Trigeminal cavernous fistula, Balloon embolization

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CORTICAL DAVF MIMICKING A CAVERNOUS SINUS FISTULA OBSCURED BY MRI

R Holmboe Dahl[1], V Eskesen[2] and G Benndorf[1,3]
[1]University Hospital Rigshospitalet, Department of Radiology, Copenhagen, DENMARK
[2]University Hospital Rigshospitalet, Department of Neurosurgery, Copenhagen, DENMARK
[3]Baylor College of Medicine, Department of Radiology, Houston, USA

Purpose: Arteriovenous fistulas (AVFs) involving the cavernous sinus (CS) usually become clinically apparent due to eye symptoms including diplopia, proptosis and eye redness. Although rare, the same symptoms can be associated with AVFs located remote from the CS when draining into its tributaries. We report the unusual case of a dural AVF where such communication was not immediately obvious from the diagnostic angiogram.
Materials and Methods: Clinical history: A 61-year-old male presented with increasing lid swelling, proptosis and redness of the right eye for 1 month. Examination of the eye showed dilated and tortuous conjunctival, episcleral, and retinal vessels. MRI revealed a right-sided proptosis with superior ophthalmic vein (SOV) dilatation and enlarged parietal cortical veins over the right hemisphere but failed to demonstrate an arteriovenous shunt involving the CS. Digital subtraction angiography (DSA) showed no evidence for a cavernous sinus fistula (CSF) but revealed a DAVF between the middle meningeal artery (MMA) and the vein of Trolard with direct shunting and two ectasias. The main drainage was directed towards the right transverse sinus, and from here towards the jugular bulb. The AVF also drained into several smaller veins one of which coursed towards the middle cranial fossa and was identified as the superficial middle cerebral vein (SMCV). Only very late venous phase images eventually revealed faint opacification of the right CS and SOV.
Results: Procedure: Endovascular treatment was performed by a transfemoral access using a triaxial catheter system with a 6-Fr Neuron™ MAX, 5-Fr Sofia®, and 1.3-Fr Headway® Duo navigated into the right external carotid artery. The microcatheter was advanced into the distal MMA until the fistula site was reached. Here a total of 2.55cc PHIL 25% was injected until cessation of the AV shunting was observed. Control runs showed complete occlusion of the AVF and flow reversal in the right SMCV, CS, and SOV. The patient's postoperative course was uneventful with clinical improvement within 1 week.
Conclusion: Summary: DAVFs involving parietal cortical veins may cause atypical symptoms suggesting a CSF due to rerouted venous drainage. MRI exclusion of a CSF in a patient with eye redness and proptosis is insufficient

diagnostic. Due to its superior temporal resolution, DSA allows to identify even ''angiographically obscured'' slow flow communications between a remote AV shunt and the CS. Understanding venous anatomy and drainage pattern between cortical veins and the CS system helps to correlate vascular pathology and clinical symptoms, and thus allows efficient and safe treatment.

Keywords: Cavernous sinus fistula, Vein of Trolard, Cortical DAVF

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ENDOVASCULAR THERAPY FOR CAROTID-CAVERNOUS SINUS DURAL ARTERIOVENOUS FISTULA WITHOUT CORTICAL VENOUS REFLUX PRESENTING WITH SEVERE RETRO-ORBITAL PAIN

T Funatsu[1], T Ishikawa[1], S Eguchi[1], K Yamaguchi[1] and T Kawamata[1]

[1]Department of Neurosurgery, Tokyo Women's Medical University, Tokyo, JAPAN

Purpose: Endovascular therapy was generally admitted to the treatment of carotid-cavernous sinus dural arteriovenos fistula (CSDAVF). CSDAVF with cortical venous reflex (CVR) is proactively treated to avoid aggressive symptoms including intracranial hemorrhage. While, without CVR often take benign courses, it is controversial for the indication of surgical intervention. We report two cases of endovascular treatment for CSDAVF without CVR presenting with intolerable retro-orbital pain.

Materials and Methods: Case 1 was 71 year-old man initially presenting with right retro-orbital pain, and two months after initial symptom occurrence, right abducens nerve palsy was also appeared. Case 2 was 71 year-old man initially presenting with left retro-orbital pain and transient left chemosis, and one months later, left ocular nerve and abducens nerve palsy was also appeared. Both cases demonstrated CSDAVF without CVR on angiography. We performed trans-venous embolization for the cases.

Results: The procedures was completed without complication, and shunt flow was almost disappeared in each cases. Postoperatively, retro-orbital pain worsened in all cases, but the pain disappeared in the subacute phase.

Conclusion: We experienced two cases of endovascular treatment for CSDAVF without CVR presenting with intolerable retro-orbital pain, and the pain was disappeared after the procedure. Treatment indications should be considered in cases of CSDAVF without CVR with severe symptoms.

Keywords: carotid-cavernous sinus, dural arteriovenous fistula, retro-orbital pain

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SELECTIVE TRANSVENOUS EMBOLIZATION COMBINED WITH BALLOON ANGIOPLASTY OF OCCLUDED INFERIOR PETROSAL SINUS FOR THE TREATMENT OF CAVERNOUS SINUS DURAL ARTERIOVENOUS FISTULAS

S Ide[1], H Kiyosue[1], K Tokuyama[2], Y Hori[2], M Okahara[3], R Shimada[1], Y Hisamitsu[4] and T Kubo[4]

[1]Department of Radiology, Oita university hospital, Yufu, JAPAN

[2]Department of Radiology, Nagatomi neurosurgery hospital, Oita, JAPAN

[3]Department of Radiology, Shinbeppu hospital, Beppu, JAPAN

[4]Department of Neurosurgery, Oita university hospital, Yufu, JAPAN

Purpose: Abgioplasty of the dural sinus has been rarely performed for the treatment of cavernous sinus dural arteriovenous fistulas. We evaluate efficacy of selective transvenous embolization (TVE) combined with balloon angioplasty of the occluded inferior petrosal sinus (IPS) for the treatment of cavernous sinus dural arteriovenous fistulas (CSDAVFs).

Materials and Methods: Consecutive 5 patients with CSDAVFs with occlusion of the IPS treated by selective TVE with balloon angioplasty of the IPS from July 2018 to January 2019 were retrospectively review. There were 3 females and 2 males with age average 74 years. All patients showed ocular symptoms. Angiography showed cortical venous reflux in 4 cases, and localized shunted pouches at the medial portion of the cavernous sinus, intercavernous sinus, or the laterocavernous sinus. Selective TVE was performed via the occluded IPS with bilateral femoral venous approaches, and the occluded IPS was reconstructed by angioplasty with 2–3 mm diameter balloon during or after selective TVE.

Results: CSDAVFS were disappeared immediately after treatment and the occluded IPSs were successfully reconstructed with re-establishment of normal antegrade venous flow in all cases. No complication was observed, and symptoms resolved within 2 weeks after treatment. During 1–6 months follow-up periods, no cases showed recurrence of CSDAVFS.

Conclusion: Selective TVE combined with balloon angioplasty of the occluded IPS is safe and effective for the treatment of CSDAVFs with re-establishement of normal venous circulation in selected cases with localized shunted pouches.

Keywords: dural arteriovenous fistula, IPS, PTA

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THE SO CALLED ''OCCULT'' INFERIOR PETROSAL SINUS

R Holmboe Dahl[1] and G Benndorf[1,2]
[1]Department of Radiology, University Hospital Rigshospitalet, Copenhagen, DENMARK
[2]Department of Radiology, Baylor College of Medicine, Houston, USA

Purpose: The ''non-feasibility'' of the IPS approach to access the cavernous sinus (CS) for endovascular treatment of dural cavernous sinus fistulas (DCSFs) is increasingly observed in reports of more aggressive techniques, such as the direct puncture of the superior ophthalmic vein (SOV), or the CS, or surgical exposure of a cortical vein. This decision-making is usually made based on evaluation of cerebral arteriograms obtained by arterial injections observing an ''occult IPS''. The aim of this study is to analyze and compare the angiographic visualization of the IPS-IJV junction obtainable by arterial and venous contrast injections (arterial DSA and jugular phlebography).
Materials and Methods: In 19 patients with DCSFs presenting a so-called ''occult IPS'', a 2D ''large volume'' phlebogram was obtained and used to evaluate the venous anatomy at the level of the IPS-IJV junction. A 6F-guiding catheter was placed at the level of the jugular bulb just below the expected level of entry of the IPS. A 20 cc syringe was used for manual injection of non-diluted contrast in 11 patients. In 6 patients a power injector was used with 2.5 cc/sec and 28 cc of contrast (300 mg) and in 2 patients an additional 10 sec. rotational phlebogram was performed.
Results: When compared to the arterial injections of the standard cerebral DSA, jugular phlebograms revealed far superior opacification of the IPS and its adjacent structures. Venous structures, commonly not visualized on arterial injections, such as the inferior petroclival vein, the internal carotid venous plexus and the anterior condylar confluence are frequently detectable on phlebograms. In cases of arteriographically ''occult IPS'', 2D and 3D-phlebography documented the sinus as either fully or at least partially patent, allowing for navigation of a microcatheter into the CS in all such cases. In addition, 3D anatomy of the IPS-IJV junction if obtainable improved visualization and understanding of the venous anatomy significantly.
Conclusion: Image analysis of the IPS-IJV junction based on DSA images obtained by arterial injections only is insufficient for complete understanding of the anatomy and for planning of transvenous occlusion of DCSFs. The use of additional jugular phlebography, including rotational 3-dimensional data, if obtainable, appears mandatory as it provides significantly more anatomical information for proper decision making and thus, in the vast majority of cases, facilitates transvenous catheter navigation to the CS and successful transvenous occlusion of DCSFs making more aggressive and potentially harmful approaches unnecessary even in most cases of the so called ''occult IPS''.

Keywords: Inferior petrosal sinus, Dural cavernous sinus fistula, Jugular phlebography

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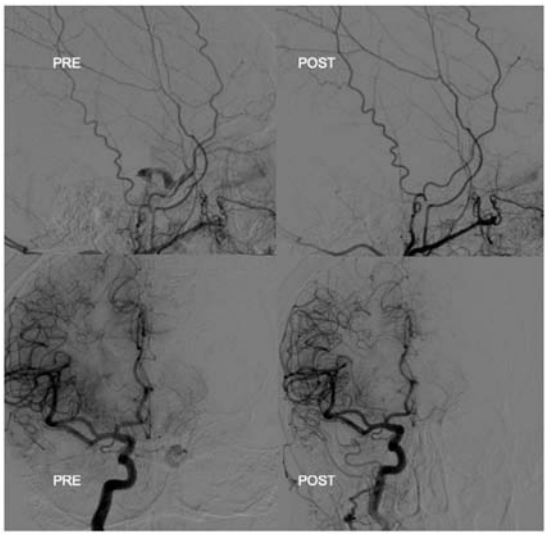
CAVERNOUS SINUS DURAL FISTULA IN A PATIENT WITH GRAVES OPHTALMOPATHY: COMPLETE RESOLUTION AFTER MEDICAL TREATMENT

N Cavasin[1], E Cagliari[1], M Cazzagon[1], M Bellamio[1] and T Scaravilli[1]
[1]Ospedale dell'Angelo, Department of Neuroradiology, Mestre-Venezia, ITALY
[2]Ospedale dell'Angelo, Department of Neuroradiology, Mestre-Venezia, ITALY
[3]Ospedale dell'Angelo, Department of Neuroradiology, Mestre-Venezia, ITALY
[4]Ospedale dell'Angelo, Department of Neurology, Mestre-Venezia, ITALY
[5]Ospedale dell'Angelo, Department of Neurology, Mestre-Venezia, ITALY

Purpose: Graves ophtalmopathy is usually related to hyperthyroid autoimmune disease but can seldom be found in euthyroid patients. There are scarse reports about the association of cavernous sinus dural fistulas and Graves ophtalmopathy. Dural fistulas are usually successfully treated with a transvenous or transarterial endovascular approach. We present a case of a cavernous sinus dural fistula completely treated with medical therapy.
Materials and Methods: We present the case of a 68 yo female that was referred to our institution for an asymmetric proptosis with conjunctival chemosis, diplopia and retroorbital pain. She had previously been diagnosed with euthyroid Hashimoto's thyroiditis and was not therefore receiving hormone replacement. The asymmetric signs of the disease and the euthyroid state of the patient led to further investigations and a cavernous sinus dural fistula was found with feeders from dural branches of the ipsilateral maxillary artery and the contralateral carotid syphon.



An endovascular transvenous approach was attempted but we couldn't negotiate the venous pouch and couldn't access the thin 'en passage' arterial feeders either. Assuming that the extrinsic muscle hypertrophy might be the cause of the venous congestion a we tried to administrate weekly intravenous methylprednisolone at high levels (total of 12 administrations) as the consensus for the treatment of dysthyroid optic neuropathy.

Results: The dural fistula progressively decreased in size and occluded after the end of the medical treatment. The patient recovered completely and is still free of symptoms.

Conclusion: To our knowledge there are to date no publications that report the complete disappearance of a dural fistula with the sole medical therapy. Our case may suggest the secondary nature of the dural fistula in patients with Graves.

Keywords: Graves ophtalmopathy, Cavernous sinus dural fistula, Medical treatment

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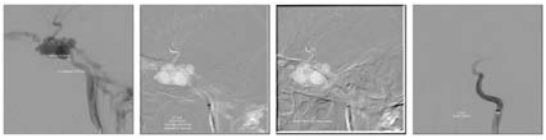
TREATMENT OF CAROTID-CAVERNOUS FISTULA PRESENTING WITH CONTRALATERAL EXOPHTHALMOS; SEVERAL EXPERIENCES OF GRAFT STENT

SY Chung[1], MS Park[1] and SH Chang[1]
[1]Department of Neurosurgery, Eulji UNiversity Hospital, Daejeon, SOUTH KOREA

Purpose: Endovascular detachable balloon occlusion and coil occlusion have been well-established options for the treatment of carotid cavernous fistulas (CCFs). Sporadic treatment of CCFs with covered stent grafting is recently proving an excellent result not only in successful treatment of fistula but also preserving patency of parent artery. In this study, we experienced CCF of a patient who underwent the contralateral exophthalmos in addition to 5 CCF with ipsilateral symptoms treated by graft stent.

Materials and Methods: A 64-year old female presenting with left-sided decreased vision, exophthalmos, injection, and periorbital bruit was found to have a right-sided carotid-cavernous fistula. In addition, we experienced 6 consecutive patients with CCFs underwent the graft stent placement alone at our department during 4 years. Two were direct CCFs with a symptom triad and 4 were indirect CCFs with diplopia or exophthalmos. These patients had periodic clinical follow-up examinations (at 0–29 months) and angiographic follow-up examination (at 0–15 months).

Results: Covered stent placement was technically successful in all 6 patients. Immediate post-procedural complete exclusion of the fistula was achieved in 3 and near complete exclusion with small endo-leak was observed in 3 after stent placement. ICA patency was preserved in all. Symptoms related to CCFs regressed within14 days in all patients after treatment without thromboembolic events. There was no mortality and no immediate post-procedural morbidity related to the procedure. Follow-up cerebral angiography showed complete exclusion in all with previous small endo-leak. However, one who had complete exclusion immediately recur the filling during follow-up. This patient treated with re-dilation of the stent using balloon. Final follow-up angiography showed complete exclusion of all CCFs and revealed good stent patency of the ICA without intra-stent stenosis.



Patient sex / age (years)	Sings/symptoms	Stent sizes	Post-procedural angiographic results	Final angiographic FU
F/73	Proptosis, Visual disturbance	Graftmaster 3.5 X 16 mm	Radioanatomic cure without complications	Stable CCF occlusion with ICA patency
M/28	Conjunctival injection, Mild proptosis	Graftmaster 4.5 X 16 mm	Small endoleak was observed	Stable CCF occlusion with ICA patency
M/65	Proptosis, Visual loss	Graftmaster 4mm X 12 mm	Radioanatomic cure without complications	Stable CCF occlusion with ICA patency
M/58	Visual disturbance, bruit	Graftmaster 4.8 X 16mm	Radioanatomic cure without complications	Stable CCF occlusion with ICA patency

Conclusion: Graft-stents should be considered as an alternative option of treating CCFs and preserving the parent artery by arterial wall reconstruction especially in patients with a fistula that cannot be successfully occluded with detachable balloons or coils. Although a larger sample and expanded follow-up are needed, our series shows that covered stents can be used in the treatment of CCFs with symptomatic relief as experience.

Keywords: CCF, graft stent, contralateral exophthalmus

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COMPARISON OF RADIOSURGERY AND ENDOVASCULAR TREATMENT OUTCOMES FOR CAVERNOUS SINUS DURAL ARTERIOVENOUS FISTULAS

C Luo[1], C Lin[1], H Yang[2], W Guo[1], H Wu[1] and W Chung[2]
[1]Department of Radiology, Taipei Veterans General Hospital and School of Medicine, National Yang-Ming University, TAIPEI [2]Department of Neurosurgery, Taipei Veterans General Hospital and School of Medicine, National Yang-Ming University, TAIPEI

Purpose: Endovascular treatment (EVT) and stereotaxic gamma-knife radiosurgery (GKRS) can both effectively treat cavernous sinus dural arteriovenous fistulas (CSDAVFs). Here, we compare the prognostic factors and treatment effectiveness of GKRS and EVT for different CSDAVF types.

Materials and Methods: The charts of 200 patients undergoing GKRS and 105 patients undergoing EVT were reviewed for data on symptoms (orbital, cavernous, ocular, and cerebral). We classified CSDAVFs into proliferative, restrictive, and late restrictive types. We evaluated prognostic factors for complete obliteration (CO) in both the GKRS and EVT groups and measured the latent period to CO. Chi-square

tests were used to compare final CO rates for EVT and GKRS across the three CSDAVF types.
Results: EVT and cavernous symptoms were significant independent predictors of CO. The CO rate after EVT (97.9%) was significantly higher than that after GKRS (63.5%) for restrictive CSDAVFs ($P < 0.001$), but not for proliferative or late restrictive types. In the GKRS group, cavernous symptoms (Hazard ratio [HR]:.557) and target volume (HR:.853) predicted CO, but only target volume remained significant in multivariate analysis. In the EVT group, the latent period to CO was shortest for restrictive CSDAVFs (3.2 ± 1.6 months, $P = 0.05$).
Conclusion: Angioarchitecture did not affect treatment outcomes. Cavernous symptoms were strongly associated with lower complete obliteration rates in the GKRS but not the EVT group. EVT remains the treatment of choice, especially for restrictive CSDAVFs. However, compared to EVT, GKRS had lower complication rates and similar therapeutic effects for proliferative type fistulas.
Keywords: arteriovenous fistula, cavernous sinus, endovascular treatment

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A CASE OF TRAUMATIC CAROTID-CAVERNOUS FISTULA ASSOCIATED WITH PERSISTENT PRIMITIVE TRIGEMINAL ARTERY SUCCESSFULLY TREATED BY IN-STENT COIL EMBOLIZATION

R Kawaguchi[1], T Oshima[2], N Matsuo[1] and S Miyachi[1.2]
[1]Department of Neurosurgery, Aichi Medical University, Nagakute, JAPAN
[2]Neuroendovascular Therapy Center, Aichi Medical University, Nagakute, JAPAN

Purpose: Persistent primitive trigeminal artery (PPTA) is the most common type of fetal carotid-basilar persisting communication into adulthood; however, carotid-cavernous fistulas (CCFs) associated with PPTA are rare. Herein we present a case of traumatic CCF associated with PPTA in an elderly woman who was successfully treated with in-stent coil embolization.
Materials and Methods: An 84-year-old woman presented with traumatic CCF associated with PPTA manifesting as vascular bruit. Transarterial embolization was performed. Although a detachable coil was deployed at the fistula point, it was easy to migrate into the cavernous sinus because of the high-flow shunt.
Results: Angiogram showed typical CCF with the rupture of PPTA. The fistula point was a little shifted to the ICA side, which was clearly demonstrated on the color fusion image with anterior and posterior circulation angiograms. Since the shunt flow through the rupture hole was too big to place coils not to flow out to the cavernous sinus, we planned in-stent internal trapping. Neuroform Atlas stent TM was deployed to cover whole length of PPTA and coils were placed inside the stent with bilateral approach from ICA and BA. Some coils were still herniated at the rupture hole, but the stent played a role of fence to avoid the migration of coils. Totally 15 coils were placed and resulted in complete occlusion of CCF.
Conclusion: Internal trapping with stent-bridge is useful to occlude the fistula for saving coils and for avoiding massive cavernous packing. This technique is also available for the internal trapping for giant carotid cavernous aneurysm. However the stent apposition is important in this maneuver. Cases with high discrepancy of luminal diameter between distal and proximal parent arteries or tortuous course at the fistula part may have a high risk of endoleak through the outer space of the stent.
Keywords: PPTA, traumatic CCF, stent

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FIRST EXPERIENCE OF ENDOVASCULAR TREATMENT OF POST-TRAUMATIC CAROTID-CAVERNOUS FISTULAS OF FLOW-DIVERTER STENTS USING

A Sufianov[1], S Karasev[1], R Khafizov[1], R Rustamov[1] and R Sufianov[2]
[1]Federal Center of Neurosurgery, Tyumen, RUSSIA
[2]First Moscow State Medical University named after I.M. Sechenov Ministry of Health of the Russian Federation, Moscow, RUSSIA

Purpose: To evaluate the results of the treatment of post-traumatic direct carotid-cavernous fistula type A with flow-diverter stents according to the ''telescope'' technique.
Materials and Methods: In our clinical case, patient V. is represented., Male, 30 years old. Diagnosis: Post-traumatic carotid-cavernous fistula type A on the internal carotid artery. Condition after endovascular occlusion of the sinus of the carotid-cavernous fistula with coils. Complications of the main diagnosis: Moderate right-sided exophthalmos. Ischemic optic neuropathy of the right eye. In order to determine further treatment tactics, the patient underwent selective cerebral angiography and revealed a carotid-cavernous type A fistula according to classification Barrow at al. Given the nature of the lesion, it was decided to implant a flow-diverter stent. Under the endotracheal anesthesia, a puncture of the right femoral artery was performed. Through the Introducer 6F, angiographic catheter Headhunter 5F catheterized right internal carotid artery (ICA). A carotid-cavernous fistula of type A was detected, the distal blood flow was preserved. Considering the presence of a preserved distal blood flow and a defect in the vascular wall of the ICA of a large size, we decided to implant two flow-diverter stents according to the ''telescope'' technique. The angiographic catheter is replaced with a guide catheter. A microcatheter is precisely positioned in the lumen of the right ICA, and the flow-diverter FRED (MicroVention) 4.5x34 mm, 5.0x35 mm stents are implanted in turn by the 'telescope' – stenting technique.
Results: On the control angiography, the complete restoration of the ICA lumen is determined with no discharge into

the cavernous sinus, the trunk and distal vessels are passable. Microcatheter removed without technical difficulties. Endovascular instrumentation extracted. Hemostasis, bleeding. A pressure bandage was applied to the puncture site. The early postoperative period was without complications. Neurological status of the patient without features. Was discharged in good condition on the 3rd day after the intervention. In the long-term period, three months after the intervention, a significant decrease in exophthalmos, conjunctival chemosis, and scleral injections is determined. A satisfactory aesthetic and clinical result of the operation is noted. The patient notes improvement in vision.

Conclusion: A clinical case has shown the efficacy and safety of applying flow-diverter stents in this pathology.

The use of a telescopic technique for implanting flow-diverter stents allows for a good recovery of the vessel lumen with complete shut-off of the fistula from the bloodstream, preserving the lateral branches.

Keywords: Carotid-cavernous fistulas, flow – diverter stents, telescope technique stenting

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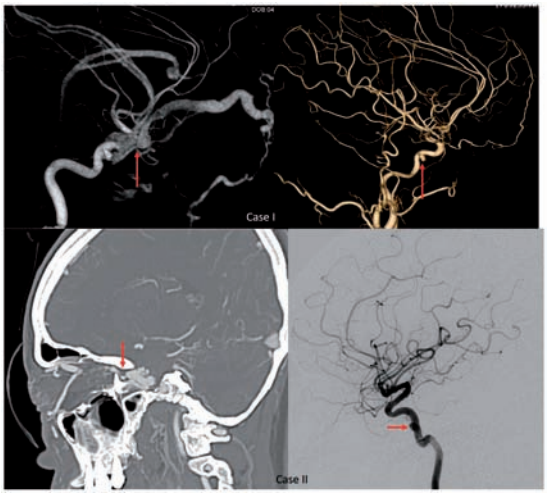
SPONTANEOUS RESOLUTION TRAUMATIC CAROTID CAVERNOUS FISTULA ASSOCIATED WITH VENOUS OUTLET STENOSIS: TWO CASES REPORT

M Apirakkan[1]

[1]Diagnostic and Therapeutic Radiology Department, Ramathibodi Hospital, Bangkok, THAILAND

Purpose: We present our direct carotid cavernous fistula (CCF) cases that have spontaneous resolution with the factor that we observed and may related to this condition.



Materials and Methods: Two cases of direct CCF scheduled for transarterial detachable balloon embolization by our institute. We observed the similar factor that may related to spontaneous resolution of the hi-flow shunt in our cases. Previous published articles were also reviewed.

Results: Case 1: A 43-year-old woman with history of severe head injury about a year. Her CTA suspected direct CCF. We performed cerebral angiogram, which showed bilateral direct carotid cavernous fistula, then transarterial detachable balloon embolization of the left CCF was performed, the right CCF showed delayed contrast stasis in the right superior ophthalmic vein (SOV) and right cavernous sinus with venous outlet narrowing between SOV and cavernous sinus. Thus, we stop the operation and schedule for the next cerebral angiogram on a few days later. During the second operation, no abnormal AV shunt of the cavernous ICA detected, leaving small venous pouch at cavernous ICA. Case 2: A 48 year-old woman presents with right eye proptosis after severe head injury about 2 months. Her CTA suspected direct CCF. We observed venous outlet stenosis between the cavernous sinus and confluence of ophthalmic vein in the CTA. Because of her orbital symptom is not severe, the intra-occular pressure is borderline and no malignant venous drainage in the CTA. Thus, we wait and schedule for angiogram with balloon embolization in the next 2 weeks. In the week before the operation, her symptom gradually improved and the intra-occular pressure becoming normal. We performed cerebral angiogram and showed that no abnormal AV shunt detected. However, small venous pouch at the cavernous ICA is seen.

Conclusion: The previous published paper confirmed that low-flow and small-sized fistula, hypotension, severe ocular manifestations, dissections or spasm of carotid artery, and increased intracranial pressure probably be the factors related to spontaneous thrombosis of the direct CCF. The other factors including contrast media reaction, single venous drainage, absence of posterior drainage, manual carotid compression, and stop anticoagulant drug are still inconclusive. We observed that structural stenosis of the venous outlet of the shunt especially between the cavernous sinus and SOV-IOV conjugation visualized in our two cases as well as the previous published data probably be another additional factor accompany with the factor aforementioned, resulting in spontaneous thrombosis of the TCCF.

Keywords: Spontaneous resolution TCCF, Venous stasis TCCF, venous outlet stenosis TCCF

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ANGIOGRAPHIC CHANGE ON TIME INTERVAL IN TRAUMATIC-DIRECT CAROTID CAVERNOUS FISTULA WITHOUT VENOUS REFLUX, AND TREATMENT WITH LVIS STENT ALONE

CY Lee[1]

[1]Konyang University Hospital, Daejeon, SOUTH KOREA

Purpose: Traumatic carotid cavernous fistula (CCF) is usually high flow, direct type and typically manifested by venous hypertension and reflux, therefore it can lead to various neurologic deficit as well as severe ophthalmic symptoms including exophthalmos, congestion and visual disturbance. On the contrary, in traumatic-direct CCF without high flow that causes venous hypertension and/or reflux, the natural clinical course is obscure, and the diagnosis may be

difficult. The treatment has not been well documented in detail. We are reporting on sequential angiographic change on time interval in traumatic-direct CCF without venous hypertension and/or reflux, and experience of treatment using LVIS stent.

Materials and Methods: A 45-year-old male was transferred to our hospital after a penetrating injury by a steel rod while working and 63-year-old male was transferred to our ER with complaints of drowsy consciousness after a Motor vehicle accident.

Results: In one patient had multiple skull fracture, intracerebral hemorrhage in the left temporal lobe with central skull base fracture, especially a lateral wall fracture of the sphenoid sinus. There was no enlargement of ophthalmic vein nor ocular symptoms suggesting CCF, but conventional angiogram defined a very low flow, small leakage from cavernous portion of ICA, but there was no reflux into the draining vein such as the ophthalmic vein. Initially, active management was not considered. In follow up angiogram one week later, flow velocity had increased and the amount of leakage was more aggravated. Over time, the lesion was thought to be worse, and active treatment was considered., LVIS stent was used to expect hemodynamic change. After 10 min, complete occlusion of fistula was achieved. Flow diversion effect had occurred with the stent alone. In the other patient In the follow up angiograms after 1 week, the flow velocity as well as the amount of leakage had decreased markedly. One week thereafter, there was spontaneous complete occlusion as seen on the cerebral angiogram.

Conclusion: In traumatic-direct CCF with very small outflow opening and low flow, we have experienced one case that healed spontaneously and another that required intervention. In cases of traumatic-direct CCF with favorable angiographic characteristics, without overt symptoms, close sequential observation and short term follow-up may be important option. Progressively worsening symptoms and hemodynamic change will require repeated angiograms and definite endovascular treatment. LVIS stents with small cell size and more coverage device may be helpful in CCF with low flow and small opening.

Keywords: Dural fistula, LVIS stent

SESSION: Pediatric

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ENDOVASCULAR TREATMENT OF COMPLEX PEDIATRIC INTRACRANIAL UNRUPTURED ANEURYSMS

L Jiang[1], G Zeng[1], X Zhi[1], J Li[1] and H Zhang[1]
[1]Xuanwu Hospital, Capital Medical University, beijing, CHINA

Purpose: To illustrate the feasibility and safety of stent-assisted embolization of complex pediatric intracranial unruptured aneurysms.

Materials and Methods: case illestration and follow-up data analysis.

Results: This was a 5 year old boy presented with visual acuity decrease of bilateral eyes and abnormal movement of left eye for 2 years. The CTA and DSA confirmed giant aneurysms of cavernous segments of bilateral internal carotid artery and left dissecting aneurysm of vertebral artery, accompanied with right internal carotid artery occlusion. Because of the difficulty in treating this complex aneurysm, the original strategy was observation. Then stent-assisted embolization of left cavernous segment was performed after the usage of Lvis stent was relatively matured 2 years latter. During follow-up, this aneurysm enlarged, and second embolization and occlusion the parent was performed.

Conclusion: stent-assisted embolization of pediatric intracrania aneurysm is feasible and safe for strictly selected pediatric patients. Long time follow-up is needed to evaluate the effecacy.

Keywords: intricranial aneurysm, pediactric, complex

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SUCCESSFUL TREATMENT OF RUPTURED BASILAR MYCOTIC ANEURYSM IN AN INFANT WITH ENDOVASCULAR PARENT ARTERY OCCLUSION

K Somboonnithiphol[1], E Chantanaphak[1] and S Pongpech[1]
[1]Department of diagnostic and therapeutic radiology, Ramathibodi Hospital, Mahidol University, Bangkok, THAILAND

Purpose: To demonstrate a rare case of ruptured basilar mycotic aneurysm in an infant which successfully treated with endovascular parent artery occlusion.

Materials and Methods: We reviewed clinical information, imaging findings and endovascular treatment of an 8-month-old infant referred to our institute with bacterial meningitis and ruptured basilar mycotic aneurysm.

Results: A previous healthy 8-month-old female infant was admitted to another hospital with prolong fever without organ specific symptoms. A cerebrospinal fluid (CSF) examination showed pleocytosis and meningitis was diagnosed. Empiric treatment with Cefotaxime and Acyclovir was administered. A computerized tomography (CT) of the brain with contrast medium revealed mild communicating hydrocephalus without space-occupying lesion or gross aneurysm. Despite treatment with antibiotics and antiviral agent, her condition worsened with drowsiness and high-grade fever. Repeated CSF examination showed worse CSF profiles and previous CSF culture grew Pseudomonas aeruginosa, so antibiotics was promptly changed to Meropenem. On the next day, the patient suddenly developed seizure and alteration of consciousness. The non-contrasted CT of the brain demonstrated diffuse subarachnoid hemorrhage (SAH) with intraventricular hemorrhage, then she was referred to our institute. After admission to our hospital, she experienced seizure again and further decreased level of consciousness.

Repeated CT and CT angiography of the brain revealed progression of SAH and communicating hydrocephalus with a newly developed lobulated fusiform aneurysm (8 mm in maximal diameter and 13 mm in length) at proximal basilar artery, suspected re-ruptured mycotic aneurysm. The cerebral angiography demonstrated the aneurysm at proximal basilar artery without antegrade flow to basilar trunk, however retrograde flow to distal basilar artery from anterior circulation via bilateral posterior communicating arteries was depicted. Endovascular treatment with disrupted inflow of the aneurysm was done by coiling to occlude the vertebrobasilar junction. No antegrade contrast filling of the aneurysm from vertebral arteries was noted. After endovascular intervention, her clinical symptoms gradually improved. The patient was discharged after complete 4-week course of antibiotics. At 6-week follow-up, appropriate motor, language and social skills of the patient were observed.

Conclusion: Management of intracranial mycotic aneurysm in an infant should be individualized depending on clinical presentation, anatomical location and the expertise available. Endovascular treatment is an effective and life-saving method for management of ruptured intracranial mycotic aneurysm.

Keywords: Mycotic aneurysm, Endovascular treatment, Parent artery occlusion

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ENDOVASCULAR TREATMENT OF DURAL SINUS MALFORMATION WITH AV SHUNT IN INFANTS; A CASE REPORT

M Mitsuhito[1], Y Nishikawa[1] and N Aihara[1]

[1]Department of Neurosurgery, Nagoya City University Graduate School of Medical Sciences, Nagoya, JAPAN

Purpose: Dural sinus malformation (DSM) is a rare vascular malformation with high mortality in newborns and infants. DSM sometimes associates with sinus thrombus and AV shunt. We present a case with DSM with AV shunt treated endovascularly and followed up more than 9 years with good prognosis, and discussed the prognosis based on the literature.

Materials and Methods: The patient was born on 3D + 40w and had mild heart failure (CTR 70%). MRI (day 1) showed the right temporal intracerebral hemorrhage and enlargement of dural sinus including confluence with AV shunt mainly fed from bilateral middle meningeal arteries (MMA). The heart failure was improving medically.

Results: After 2.5 months, we performed angiography for the diagnosis and trans-arterial embolization (TAE). The shunt point from the left MMA was occluded by coil and 25% of NBCA. The right MMA is occluded by 50% MMA. After the TAE, brain circulation improved significantly although small shunt remained from the left occipital artery. Now, the patient is nine years old with appropriate development and growth without any neurological deficits. MRI shows no recurrence of the shunt.

Conclusion: In this case, enough flow reduction of the shunt by TAE resulted in spontaneous disappearance of lesions without recurrence. We note that a part of patients with DSM with AV shunt have good prognosis after appropriate shunt reduction.

Keywords: dural sinus malformation, arterial venous shunt, prognosis

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A CASE OF PEDIATRIC DURAL ARTERIOVENOUS FISTULA TREATED WITH TRANSVENOUS EMBOLIZATION USING NBCA

M Okawa[1]

[1]Kyoto University, Kyoto, JAPAN

Purpose: We reported a case of pediatric dural arteriovenous fistula treated with transvenous embolization using low-concentrate NBCA.

Materials and Methods: A 10-year-old healthy girl complained headache. She had no tinnitus. MR angiogram showed the trasverse-sigmoid sinus (TSS) at right side. Neither cerebral hemorrhage nor venous infarctions were found on MRI. Cerebral angiogram revealed the isolated sinus of the right TSS and apparent cortical venous drainage. Endovascular treatment was performed.

Results: Guiding catheter was led to contralateral jugular vein, then the microcatheter was penetrated into the occluded sinus. The inner structure of isolated sinus was complicated, suspicious to developmental failure. The several platinum coils placed the orifice of Labbe's vein and superior petrosal sinus to prevent unpredictable distal migration of glue cast. NBCA was mixed with lipiodol and adjusted concentration of 12.5%. Glue was injected within the isolated sinus with 'plug and push technique ' like Onyx. Most parts of the affected sinus were occluded. After TVE, additional TAE via occipital artery was performed for residual shunt at medial side. AVF was completely diminished, and she improved headache and had no neurological deficit.

Conclusion: Dural arteriovenous fistula of pediatric case was very rare. Some are classified into dural sinus malformation, infantile dural arteriovenous shunt, and adult DAVS. Our case showed configration of vasculature was homologous to acquired dural arteriovenous fistula, while inner structure was reticular and complicated, which was suspicious to developmental problem. Transvenous liquid embolization could be feasible for sinus packing with the complicated sinus.

Keywords: dural arteriovenous fistula,nBCA, transvenous embolization

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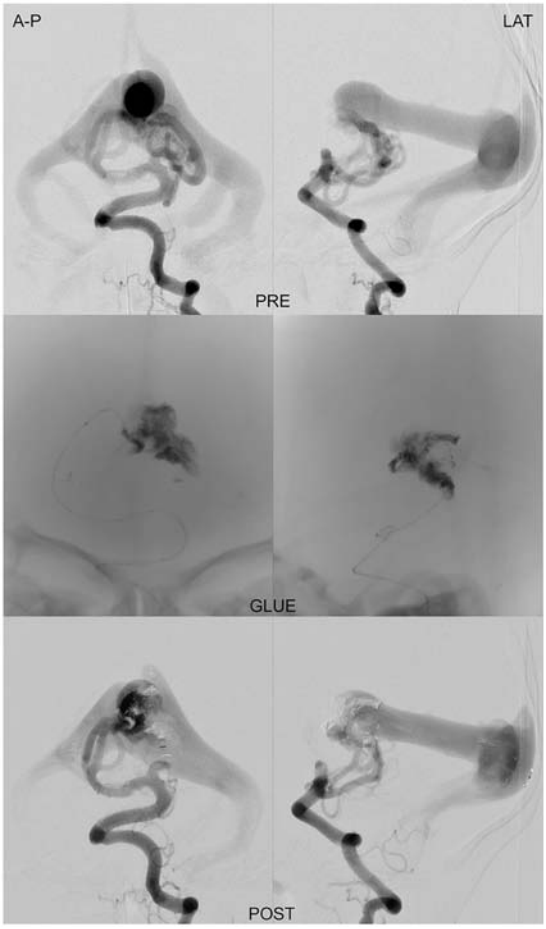
VEIN OF GALEN MALFORMATIONS IN NEONATES: MULTIDISCIPLINARY APPROACH AND NEUROENDOVASCULAR TREATMENT

T Shigematsu[1], A Berenstein[1], J Fifi[1] and R De Leacy[1]
[1]Mount Sinai Health System, Department of Neurosurgery, New York, USA

Purpose: When the vein of Galen aneurysmal malformation (VGAM) baby develops heart failure symptoms during the neonatal period, the mortality rate is almost 100% without endovascular treatment. Therefore, multidisciplinary comprehensive management for VOGM neonates is important, and it is necessary to immediately proceed endovascular treatment and reduce the arteriovenous shunt flow, if the heart failure is refractory to medical treatment. Here, we review and report our neonatal management and endovascular treatment for children with VGAM for the last 5 years, to evaluate the outcomes of modern management of neonates with refractory heart failure from VGAMs.



Materials and Methods: We retrospectively reviewed 38 consecutive patients with VGAM or vein of Galen aneurysmal dilatation (VGAD) who started to receive medical management at our hospital from January 2014. The only VGAD patient was presented in her toddler Of these, 11 babies were born in our hospital and managed in the neonatal period, 8 babies were born in outside hospitals and transferred to us in neonatal period for evaluation and management. The remaining 19 cases were referred to us in their infant period or later. During the neonatal period, MRI brain study was performed to evaluate the parenchymal damage and vascular structure, and cardiac echo was performed to evaluate the heart function and amount of shunt, in every patient. Bicetre neonatal evaluation score was not used to decide indication of endovascular treatment.
Results: Of the 19 VGAM neonates managed in our neonatal intensive care unit (NICU), 15 cases required endovascular treatment. Of the 15 cases, 9 cases were diagnosed with VGAM antenatally, and 6 cases led to the diagnosis of VGAM through work up of heart failure after birth. All 15 cases underwent embolization with nBCA with transumbilical approach except one transferal approach. An average of 1.75 sessions of treatment was required to control heart failure. Of the 15 cases, 8 cases are currently achieving normal development, 4 cases with slight impairment, but 3 cases with failure to rescue. In addition, there were 4 cases that were evaluated and managed medically in our NICU and did not require endovascular treatment.
Conclusion: VGAMs that cause heart failure in the neonatal period are extremely severe. Though neuroendovascular treatment for them is still challenging, it improves their outcome. And comprehensive management in NICU with neonatal intensivists, pediatric cardiologists, pediatric anesthesiologists, pediatricians, and pediatric neuroendovascular surgeons.
Keywords: vein of Galen malformation, transarterial embolization, neonate

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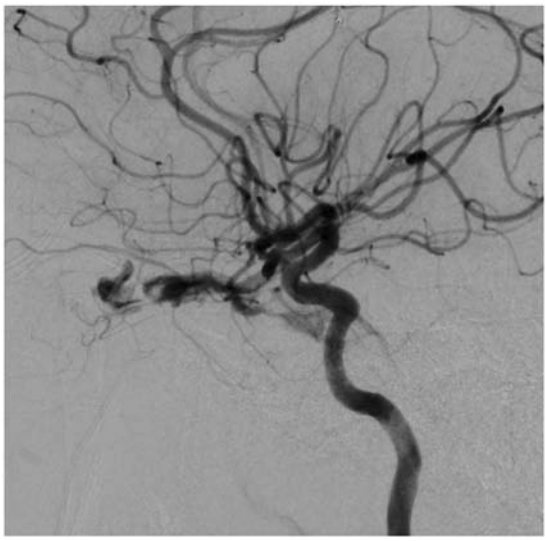
ORBITAL ARTERIO-VENOUS SHUNT (AVS) CO-EXISTING WITH VENO-LYMPHATIC MALFORMATIONS (VLM) OF THE RIGHT ORBIT IN A 11 YEAR OLD BOY: A CASE REPORT OF OUR THERAPEUTIC EXPERIENCE FROM RAMATHIBODI HOSPITAL

P Jiarakongmun[1], E Chantanaphak[2], M Apirakkarn[3] and K Somboonnithiphol[4]
[1]INR section, Ramathiobodi Hosp, Bangkok, THAILAND
[2]INR section, Ramathiobodi Hosp, Bangkok, THAILAND
[3]INR section, Ramathiobodi Hosp, Bangkok, THAILAND
[4]INR section, Ramathiobodi Hosp, Bangkok, THAILAND

Purpose: Venolymphatic malformation (VLM) is a common congenital condition of the orbit, with multiple low flow veno-lymphatic vessels, present with bulging eye. However, orbital arteriovenous shunt can has same sign and orbital imaging, with different treatment strategy and prognosis.



Materials and Methods: We retrospectively review our case of 11 years old boy, who presented with acute proptosis and dropped visual acuity. CECT showed multiple lobulated veno-lymphatic channels in the retro-orbital space, causing moderate right exophthalmos, with clinical decreased visual equity. And MRI also shows multiple low flow VLM, with mild compression of right optic nerve with bulging or exophthalmos.
Cerebral angiogram showed multiple AVS with early draining venous routes, to right cavernous sinus and inferior petrosal vein to systemic jugular vein. Therefore, additional diagnosis has been made as right orbital AVS on pre-existing VLM, and treatment changed to venous disconnection using multiple fibered coils, following by NBCA embolization of residual fast flow AVS. And the patient underwent surgical removal of the VLM of the right orbit, with clinical improvement.
Results: Orbital VLM is a common congenital vascular disease of the eye with multiple connecting bulbous channels of low flow veno-lymphatic vessels, presenting in children and young adult, with rapid progressive and repeating bulging of the eye globe or exophthalmos, from increased orbital pressure with mass effect due to intralesional hemorrhage or veno-lymphatic congestion, during active veno-lymphatic activity from head and neck infection, minute trauma or hormonal disturbance. And diagnostic pathognomonic imaging is calcified phleboliths in low flow veno-lymphatic channels. However, orbital arteriovenous shunt is less common condition, which can present after thrombosis of the intra-orbital venous channels from vascular injury or other conditions, with same clinical presentation of exophthalmos and orbital vascular bruit, but treatment strategy can be totally different from simple VLM, and definite diagnosis prior to treatment is mandatory for treatment outcome. Non-invasive imaging of the patient presented with acute proptosis, should be done with contrast-enhanced CT scan and dynamic CTA, or contrasted MRI and MRA orbits, or conventional angiogram, to distinguish slow flow VLM and secondary AVS with early draining vein, before definite treatment.
Conclusion: Before direct puncture treatment for sclerosing therapy of orbital VLM, it is important to exclude the fast flow vascular condition i.e. AVS or AVMs of the orbit, from simple low flow orbital VLM, for patient safety and treatment outcome. Dynamic contrasted CTA, or MRA or conventional diagnostic angiography of the orbit are sufficient to exclude the condition.
Keywords: orbital VLM, Direct sclerosing injection, secondary AVFs

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ENDOVASCULAR MANAGEMENT OF PIAL FISTULA IN INFANCY

M Mahmoud[1], R Nader[1] and M Farid[1]
[1]INR unit Ain Shams University, Cairo, EGYPT
[2]INR unit Ain Shams University, Cairo, EGYPT
[3]INR unit Ain Shams University, Cairo, EGYPT

Purpose: Cerebral Pial fistula is a rare vascular pathology with few number of cases have been reported. Most cases reported in infancy were published as case reports. Due to its high flow, its occurrence in this age group carries potential risk of heart failure, chronic venous hypertension, seizures and less frequently cerebral hemorrhage. We present two cases of pial fistulae in infancy treated by endovascular embolisation. A review of English literature was performed for this age group with special emphasis to ruptured cases.
Materials and Methods: Two cases of Pial fistula has been treated using N-butyl cyanoacrylate Lipiodol mixture. Twenty two month old patient presented with seizures and a thirty nine week old baby presented with intra parenchymal hematoma. Both have been treated by endovascular way through an arterial route.
Results: Both patients recovered with no neurological changes. The first patient showed normal school performance after 4 years and is seizures free. Control angiography has been performed after one year for the second patient revealing complete angiographic cure.
Conclusion: Pial fistula in infants and neonates is a serious condition necessitating prompt intervention. Preoperative radiological investigations are important in identifying risk factors, i.e. flow-dependent aneurysms or venous outflow stenosis. Early endovascular treatment may prevent disability or death.
Keywords: Pial fistula, cerebral hemorrhage, Vascular malformation

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PREOPERATIVE SUPERSELECTIVE ENDOVASCULAR EMBOLISATION HELPS IN COMPLETE ENDOSCOPIC EXCISION OF JUVENILE NASOPHARYNGEAL ANGIOFIBROMA

S Kumar[1] and K Bhavana[1]
[1]All India Institute of Medical Sciences Patna, Patna, INDIA

Purpose: Endoscopic excision of juvenile nasopharyngeal angiofibroma (JNA) is an alternate to open surgery, however the reduced field of vision can cause incomplete excision especially due to hypervascular tumor character. We aimed to decrease the intraoperative bleeding by performing preoperative superselective embolisation thus improving chances of complete excision of the tumors.
Materials and Methods: Retrospective chart review of cases performed between April 2015 to Nov 2018 was done. All patients were embolised under local anesthesia after a 6 vessel cerebral DSA in the same sitting, using a 5Fr guide catheter placed in the parent arteries, a 2.7 Fr Progreat microcatheter (Terumo Interventional systems) tracked distally in the feeder vessels and embolised using 300 micron size polyvinyl alcohol (PVA) particles (COOK Medical). Surgery was done next day of the embolisation. A contrast CT study was done within 48 hours of surgery to look for any residue. The embolisation procedural details, patient characteristics, operative details, blood loss, post operative tumor residue, complications were tabulated and descriptive analysis done.
Results: Total of 20 patients with mean age 12.5 years (9-24 years) were treated during the review period. The tumors were Radwoski IIB (n = 4), IIC (n = 5), IIIA (n = 11), with mean size 5.5 cm(+ /-1.8 cm, range 3.5 cm to 11.5 cm). Patients has presented with recurrent epistaxis (n = 20) since mean 1.5 years (2 months-4.5 years), change in voice (n = 11), vision problems (n = 3), altered/decreased smell (n = 13), headache (n = 7). DSA showed bilateral feeders from internal maxillary artery (IMA) branches, mainly the sphenoplatine artery (SPA) in 12, unilateral feeders from IMA branches in 8; additional significant supply from ascending pharyngeal artery was seen in 9 cases. Five cases had additional supply from Internal carotid artery (ICA) branches. ICA branches were not embolised. Procedure completion could be done in all cases, defined as > 90% devascularisation of tumor (excluding the ICA supply). No complication occurred. All children complained of pain during the procedure and were given fentanyl or tramadol. Two patients had fever, lasting two days, and managed medically, subsequently operated after three days of embolisation. Surgical excision was complete in 19/20 cases. One case had 1.5 cm sized residue and underwent reoperation with subsequent complete tumor removal. Blood loss was 270 ml (+/−70 ml, range 100–800 ml). No surgical complications were noted.
Conclusion: Superselective preoperative particle embolisation of JNA is a technically sound and safe technique to achieve high rate of complete excision using endoscopic surgical technique.
Keywords: Nasopharyngeal angiofibroma, Embolisation, PVA aprticle

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SUPERSELECTIVE INTRA-ARTERIAL CHEMOTHERAPY (SIAC) FOR RETINOBLASTOMA A SAFETY TECHNIQUE: 9 YEARS EXPERIENCE

F Villasante[1], F Navarro[2], E Loncharic[3], M Varela[4], P Schaiquevich[5], G Chantada[6], A Fandiño[7] and A Ceciliano[8]
[1]Hospital Universitario Austral, Buenos Aires, ARGENTINA
[2]Hospital Universitario Austral, Buenos Aires, ARGENTINA
[3]Hospital Universitario Austral, Buenos Aires, ARGENTINA
[4]Hospital Universitario Austral, Buenos Aires, ARGENTINA
[5]Conicet Hospital Nacional De Pediatria J. Garrahan, Buenos Aires, ARGENTINA
[6]Hospital Universitario Austral, Buenos Aires, ARGENTINA
[7]Hospital Universitario Austral, Buenos Aires, ARGENTINA
[8]Hospital Universitario Austral, Buenos Aires, ARGENTINA

Purpose: To show our complications in superselective intra-arterial chemotheray (SIAC) for advance Retinoblastoma (RTB) in 9 years of experience.
Materials and Methods: Retrospective review of our database of all children with RTB treated with SIAC chemosurgery at our institution.
Results: 621 intra-arterial infusions were performed in 211 eyes over 133 patients (71 female). Bilateral RTB were 78 patients (59%). In 35% of IAC the procedure were performed via external carotid artery (MMA). Complications were divided in periocular complicactions: periocular erythema (4), madarosis (1), neuritis III CN (1), transient IV CN paresia (1); extraocular complications: hemodinamic inestability and bronchospasm (5), neutropenia (3), transient femoral occlusion (2), allergic reaction due contraste media (2), neutropenia (2), hemodinamic inestability (1), bronchospasm (1). Respiratory reactions consist in acute decrease in lung compliance appearing at catheterization of the carotid cavernous siphon or the ophthalmic artery.
Conclusion: Severe complications of IAC for retinoblastoma are very rarely, but the team must be trained in fast detection and treatment.
Keywords: retinoblastoma, intra arterial chemotherapy, complications

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COMBINATION OF STENT + PTA + BYPASS SURGERY IN AN EVOLUTIVE MCA FINALLY STENOSIS LEADING

M Bergui[1], B Siri[1], P Saracco[1] and A Lanterna[2]
[1]University Of Turin, Torino, ITALY
[2]Ospedale Papa Giovanni 23Bergamo, Bergamo, ITALY

Purpose: To describe a young patient with progressive arteriopaty finally leading to a moyamoya, and to discuss results of endovascular and surgical treatment.
Materials and Methods: Review of the case.
Results: A 7 Y old boy presented with left hemiparesis. MRA showed bilateral stenosis of MCA. In the following months, stenosis progressed in both MCA and ACA, with parallel development of moyamoya type collateral circulation. Steroids and immunosuppressive drugs, given on suspect of vasculitis, were unable to stop progression of the disease. Several PTA and stenting of left MCA were done, while intra-extra cranial bypass was done on the right side. Disease finally stopped progressing 8 months later. Genetic, immunologic and methabolic studies were unconclusive.
Conclusion: Disease remains undefinied; PTA and stenting and bypass surgery were successful to maintain perfusion of brain hemispheres and to avoid major deficits.
Keywords: Moyamoya, Pta Stent, Bypass Surgery

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SCREENING OF FINDINGS OF COMPUTED TOMOGRAPHY FOR MINOR BLUNT HEAD TRAUMA AMONG PAEDIATRICS IN ALEXANDRIA UNIVERSITY EMERGENCY DEPARTMENT, A CENTER EXPERIENCE

K Saad'[1], E Gaber[1], T Ibrahim[1], A El Kafafy[1] and W Foad[1]
[1]Alexandria University Hospitalas, Alexandria, EGYPT

Purpose: Investigating the abuse of head CT scan to detect CITBI after isolated head trauma in paediatric patients presented to the Emergency Department (ED) especially in a medium income country with limited facilities, based on personal clinical judgement to rule out the need for CT.
Materials and Methods: We conducted a prospective observational study and used a specific inclusion and exclusion criteria to enroll 50 paediatric patients (2-18 years) diagnosed with isolated head trauma presented within 24 hours to the ED. CT was performed on all patients. Interpretations were confirmed with the attending neurosurgeon and all patients were followed up during their stay until referral to another department or discharge. The measured outcome was the presence of CITBI in the CT findings. Personal clinical judgement of the emergency physician and the Paediatric Emergency Care Applied Research Network (PECARN) decision rule were used as prediction methods to determine if the use of CT was necessary in these patients. We carried out extensive statistical analysis including Chi-Square, Fisher Extract and Student t tests.
Results: Out of our 50 patients, 34 were found to have unremarkable CT findings and ciTBI was detected in 16 patients. Personal clinical judgement alone was associated with 30% increase in using CT scans in all enrolled patients, whilst the PECARN tool was associated with only 2% increase. Regarding the ability to rule out the need for brain CT scan, personal clinical judgement was not a statistically significant tool ($p = 0.574$). PECARN rule was a statistically significant excellent tool to rule out the need for CT showing good sensitivity (88.2%) and specificity (97.0) with a negative predictive value of 94.1%.
Conclusion: The role of CT for the assessment of isolated head trauma in children aged 2–18 years is currently abused subjecting them to a danger of unnecessary radiation. The PECARN prediction rule may serve as a better tool than personal clinical judgement to rule out the need for brain CT. Thus, we recommend against the use of personal clinical judgement alone but a combination of both prediction methods to select the paediatric patients for CT is more reliable.
Keywords: Neurotruma, Pediatrics, ct Brain

SESSION: Spine

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SPONTANEOUS REGRESSION OF THE HERNIATED LUMBAR DISC: CLINICAL AND IMAGING PREDICTORS

A Sultan[1], A Elwany[1], D Mokhtar[2] and A Alnagar[1]
[1]Neurosurgery Department, Alexandria University, Alexandria, EGYPT
[2]Department of Radiodiagnosis, Alexandria, EGYPT

Purpose: Lumbar disc herniation is a common health problem which may present with variable symptoms according to the level of the herniated disc. Different management techniques are present, however conservative treatment with spontaneous resolution of the disc has been described. Aim of the study: was to assess the role of imaging to predict the possibility of spontaneous disc regression.
Materials and Methods: The study included 30 patients with disc herniation who showed spontaneous regression after conservative treatment.
Results: Thirty patients were included in the study, 15patients were male, age ranged from 24 to 61 years, 50% occurred in L5-S1 level, 45% L4-L5, and 5% L1-L2. 80% presented with unilateral sciatica, 20% bilateral, size of herniated disc ranged from 4 to 20 mm, 70% were more than 10 mm. 60% of the prolapse were horizontal in direction, 23% were down and 17 % were up. In 70% of cases the prolapse was posterolateral. The canal was stenotic in only 15 % of cases. The original disc was degenerated in all cases, 40% of cases had moderated disc degeneration and 60% had high grade of degeneration. Only 15% of cases had grade 2 Modic changes of adjacent vertebral bodies.
Conclusion: The regression of herniated lumbar disc is highly suspected in cases with posterolateral herniation, absence of canal stenosis, high degrees of disc degenerative changes, and absence of Modic changes. Also migrated hernias, trans-ligamentous herniations, L4-5 level herniations and massive disc herniation. However a larger number of cases and a comparative study is needed to confirm these observations. Also patients with high pain threshold early clinical improvement had high possibility

of spontaneous regression. Complete disc regression is observed more in cases of migrated, sequestrated, and extruded disc.

Keywords: Disc prolapse, spontaneous regression, predictive factors

P 198

PRESURGICAL TRANS-ARTERIAL EMBOLIZATION OF HYPERVASCULARIZED SPINAL TUMORS: A REVIEW OF THE TECHNIQUE AND RESULTS IN NINE-HUNDRED-SEVENTY-TWOPATIENTS

F Taglialatela[1], S Isceri[1], C Barbara[1], S Bandiera[2], A Gasbarrini[2] and L Simonetti[1]

[1]IRCCS Istituto delle Scienze Neurologiche di Bologna – Neuroradiology Unit Ospedale Maggiore, Bologna, ITALY
[2]Spine Surgery Oncologic and Degenerative, Rizzoli Orthopaedic Institute, Bologna, ITALY

Purpose: The prognosis of tumours of the spine, particularly in aggressive lesions, has recently been improved by the application of ''en bloc'' resection techniques. Local and systemic disease control depends on complete intra-lesional resection including removal of the tumour's pseudocapsule (''extracapsular excision''). However, extracapsular intralesional surgery is often hampered or prevented by severe tumoural haemorrhage. From this point of view, the techniques of preoperative embolization of hypervascular spinal tumourscan be an essential prerequisite to surgery, making resection possible and minimizing the risks. The purpose of this study was to analyze the technique and to evaluate the safety and value of preoperative transarterial embolization of hypervascular spinal tumours.

Materials and Methods: From 2001 to 2018, 1172 patients with hypervascular spinal tumours underwent transarterial embolization prior to surgery. The lesions were located between the upper cervical and sacral spinewith a preponderance of the thoracic and lumbar spine and of metastatic pathology. The material used to embolize the neoplasms was polyvinyl alcohol (PVA) particles (n = 868), acrylic glue (n = 269), balloon (n = 3), and coils (n = 32). The criteria adopted to assess the success of theendovascular treatment were: degree of bleeding during surgery and the extent of the radical extracapsular resection.

Results: Tumour embolization was total in 740 patients, subtotal in 328, and partial in 104. There were 3 symptomatic neurological complications associated with embolization. The average blood loss during surgery was considered by the surgeons asremarkably milderthan the norm, particularly in the patients treated with acrylic glue or with mixed technique particles/acrylic glue. The reduction of bleeding allowed radical resection of the macroscopically visible tumour and its pseudocapsule.

Conclusion: Preoperative embolization of hypervascular spinal tumoursis effective and safe in the vast majority of cases. It can make complete resection of a tumour possible and an unresectable tumor resectable. An accurate diagnostic study with super selection or flow control is necessary to achieve effective devascularization and to avoid complications.

Keywords: Embolization, Spinal Tumors, Preoperative

P 199

HEMANGIOBLASTOMA OF FILUM TERMINALE MIMICKING WITH A SPINAL ARTERIOVENOUS SHUNT

N Uransilp[1] and M Apirakkan[1]

[1]Ramathibodi hospital, Bangkok, THAILAND

Purpose: – To demonstrate a rare case of hemangioblastoma of filum teminale which non-invasive imaging can mimic a spinal arteriovenous shunt. – To demonstrate the role of spinal angiography for diagnosis and treatment in patients with hemangioblastoma of filum terminale.

Materials and Methods: We reviewed clinical information, non-invasive imaging and spinal angiography of a patient that refer to our hospital for treatment hemangioblastoma of filum teminale that mimicking a spinal dural arteriovenous shunt.

Results: Sporadic hemangioblastoma of the spinal cord is rare and account for 1–5% of all spinal cord tumor, especially in filum terminale is extremely rare. We report a 64-year-old male presented with progressive radiculopathy without weakness. A lumbosacral magnetic resonance imaging at the regional hospital showed intradural mass at L3 spinal level with serpentine flow voids around the cord and congestion of spinal cord, differential diagnosis was hypervascular mass with intratumoral shunt or spinal dural arteriovenous shunt with cauda equina tumor. The patient was sent to Ramathibodi hospital for treatment. A spinal angiography revealed a hypervascular mass with diffuse homogenous capillary stain and slowly draining into perimedullary veins. The hypervascular mass was fed by the artery of the filum terminale, hemangioblastoma was suspected from angiography. The patient underwent an L3-4 laminectomy with tumor removal. Pathologic examination of the tumor revealed highly vascular, foamy stromal cells and perivascular pseudorosette formation, compatible with hemangioblastoma WHO grade 1. Post-operative lumbosacral CT confirmed that the spinal hemangioblastoma had been removed. A Clinical symptom was improved after surgical removal of the tumor.

Conclusion: Spinal hemangioblastoma of filum terminale is rare and non-invasive imaging can mimic a spinal dural arteriovenous shunt. Spinal angiography has the benefit of combining diagnosis in this case.

Keywords: spinal hemangioblastoma, filum terminale, arteriovenous shunt

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4D DSA FOR SPINAL CORD VASCULAR MALFORMATIONS EXPLORATION: PRELIMINARY EXPERIENCE

F Clarençon[1], S Lenck[1], E Shotar[1], A Boch[1], K Premat[1], J Chiras[1] and N Sourour[1]
[1]Pitié-Salpêtrière Hospital, Paris, FRANCE

Purpose: Spinal vascular malformations (SVMs) are aggressive diseases that may lead to neurological deficit due to spinal venous engorgement or secondary to hemorrhage. The endovascular treatment of such SVMs may be challenging with a significant risk of failure and/or a risk of severe neurological complications in case of spinal cord vascular supplies compromising. The precise understanding of the angio-architecture of SVMs is of tremendous importance to reduce the risk of treatment failure and the treatment-related complication risk. 4D DSA (Siemens Healthcare) is a recently developed technology that has shown its potential for a better understanding of brain AVMs. The purpose of our study was to evaluate the potential of 4D DSA in spinal vascular malformations' exploration.
Materials and Methods: Four consecutive patients (3 males, 1 female, mean age: 49 ± 17 y) with 5 spinal vascular malformations (spinal dural arteriovenous fistula [sDAVF]: n = 2, spinal pial arteriovenous fistula [sPAVF]: n = 1 and spinal arteriovenous malformations [sAVMS]: n = 1; one patient had 2 synchronous pial fistulas) had a spinal DSA including 4D DSA acquiiqisition. All the spinal DSA acquisitions were performed under general anesthesia. 4D DSA acquisitions were acquired with the protocol: ''12sDSA Dyna4D Neuro''. 12 ml of Iodixanol 320 mg of I/ml were injected via a 5 F catheter at 1 ml/s during the 12 s of the 4D DSA acquisition. The following criteria were evaluated in consensus by two reviewers:
- overall quality of the acquisition
- number of arterial feeders
- location of the primary shunt point
- venous drainage pattern: ascending, descending or both.

Results: In 4/5 of the cases (2 dural AV fistulas; 2 pial AV fistulas), the quality of the acquisition was graded good or fair. Satisfactory concordance between 4D DSA and the selective microcatheterization was observed in these 4 cases for the number of arterial feeders, the location of the shunt point and the venous drainage pattern. In one case of cervical spine AVM, the 4D DSA quality was graded poor and the angio-architecture could not be satisfactorily analysed.
Conclusion: 4D DSA acquisition may be helpful for a better understanding of spinal vascular malformations' angio-architecture. Larger series are warranted to confirm these first promising results.
Keywords: 4D DSA, Spine vascular malformation, Angioarchitecture

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SPINAL EPIDURAL ARTERIOVENOUS FISTULA CO-EXISTING WITH SPINE TUMOR, THE CHALLENGING DIAGNOSIS

U Wongkhum[1] and C Kobkitsuksakul[1]
[1]Ramathibodi Hospital, Mahidol University, Bangkok, THAILAND

Purpose: To demonstrate a rare case of iatrogenic spinal epidural arteriovenous fistula co-existing with Spine tumor which is challenging for diagnosis.
Materials and Methods: A case report by reviewing the clinical presentation and image study of the patient.
Results: Spinal epidural arteriovenous fistula is a rare type of spinal arteriovenous shunt (AVS). This type of AVS is the connection among the branches of the paraspinal or paravertebral arterial system and the epidural venous plexus. Clinical manifestation varies resulting from venous pouch compression or venous reflux congestive myelopathy. We present a case report and literature review of a 56-year-old woman who presents with progressive back pain and neurogenic claudication. Her initial MRI of the lumbar spine showed epidural mass at the L5-S1 level. She underwent laminectomy and posterior spinal fusion aiming to remove the tumor. Immediate post-operation, she had bleeding and needed second look operation to control bleeding. Even though the hemostasis was obtained, the patient had new progressive paraparesis and paraplegia. At our institute, new postoperative MRI proceeded, and the spinal arteriovenous fistula was diagnosed. In the retrospective review of the pre-operative MR imaging from the outside institute, few abnormal dilated intramedullary vessels with subtle conus medullaris edema are found co-existing with the spine tumor. The spinal angiogram has confirmed the existence of the spinal AVS; therefore, she was successfully treated by N-butyl cyanoacrylate (N-BCA) embolization. Three months follow up; her symptoms have gradually improved. Follow up Spinal MRI reveals profoundly decrease spinal cord congestion.
Conclusion: Occasionally, the striking abnormality/ pathology has been identified; the radiologist fails to continue to search and overlook another abnormality. The co-pathology or co-existing abnormality, particularly subtle one, is potentially missed. This error is common in the radiology so-called '' the satisfaction of search; SOS.'' Meticulous detecting is crucial for the clinical radiologist, and the radiologist should keep this erroneous in mind. In the treatment perspective, we successfully treated the epidural spinal AVS by N-butyl cyanoacrylate (N-BCA) embolization; however, the embolic agent selection depends on the angioarchitecture and the familiarity of the interventionist.
Keywords: spinal epidural fistula, satisfaction of search, embolization

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SPINAL EPIDURAL ARTERIO-VENOUS MALFORMATIONS – AN INSTITUTIONAL EXPERIENCE

LJD Sebastian[1], J Nadarajah[1], M Gupta[1], A Garg[1], SB Gaikwad[1] and NK Mishra[1]
[1]All India Institute of Medical Sciences, New Delhi, INDIA

Purpose: Spinal epidural arterio venous malformations (SEAVM) are uncommon, complex spinal vascular lesions with varying clinical presentations and include osseous and non osseous epidural fistulae and more complex metametric lesions with epidural components. Although difficult to cure completely, these can be managed by endovascular means with reasonable functional outcome. Objective of this study is to review the consecutive cases of spinal epidural fistulae in a single center and analyze their clinical presentation, imaging findings, angioarchitecture, endovascular management and outcome.
Materials and Methods: From our institutional data base, we retrospectively reviewed all cases of spinal vascular malformation from January 2005 to May 2019 and identified 23 cases of SEAVM. Demographic details, clinical presentation, imaging findings, digital subtraction angiographic pattern, immediate and long-term functional outcome following endovascular treatment were analyzed.
Results: Major presenting symptoms were back pain (100%) followed by motor weakness. Epidural hematoma with acute presentation was noted in two. Of the 23 cases, 14 were male. Mean age at presentation was 28.8 years (12–68 years). In majority of the patient's fistulae were noted in dorsal level with venous pouches were ventral in location. In DSA cervical malformations were predominantly fed by vertebral artery and dorsal fistulae were fed by D8 segmental artery. Intradural venous reflux was noted in one patient with isolated epidural fistulae. Complex metameric malformation with epidural fistulae were noted in 6 patients. In one of the cases RMA was seen arising form feeding artery to fistula. Of these 23 cases, endovascular treatment was done 18 cases. In all cases trans arterial route was preferred. Transvenous approach was attempted in two case without success. Glue was used in all cases except one patient with cervical epidural fistula fed by right vertebral artery treated with stent graft followed by parent vessel occlusion. None of the cases had any major complication. One patient had glue embolization into pulmonary vasculature who developed transient dyspnea and recovered with supportive care. Of the treated cases 15 had improved outcome,1 had clinical stabilization and 2 had progressive worsening of symptoms.
Conclusion: Understanding angioarchitecture is the key in the management of these complex lesions and avoiding complications. Though these lesions are difficult to cure completely, targeted embolization of large extradural venous pouches can yield dramatic clinical improvement by relieving compressive myelopathy. Hematomyelia in patients with metameric malformations is often consistent with poor clinical course.
Keywords: Spinal Epidural, Metameric, Spinal AVM

P 203

AN ADULT CASE OF NONVERTEBRAL PARASPINAL ARTERIOVENOUS FISTULAS ALONG THE SEGMENTAL NERVE WITH PERIMEDULLARY REFLUX: A CASE REPORT AND A DESCRIPTION OF NOVEL TECHNIQUE IN TREATMENT OF HIGH-FLOW LARGE FISTULAS

T Asano[1], K Ozaki[1], S Kubota[1], K Kado[1], S Mitsuhashi[1], I Yamakami[1] and Y Kageyama[1]
[1]Chiba Medical Center, Chiba, JAPAN

Purpose: Nonvertebral paraspinal arteriovenous fistula (AVF) along the segmental nerve is an extremely rare subtype of spinal arteriovenous shunts characterized by large direct fistulas located in the vicinity of thoraco-lumbar neural foramen. This type of lesions were previously reported only in the pediatric population with minimum or no neurological symptom. We report a case of an adult nonvertebral paraspinal AVFs along the segmental nerve caused progressive myelopathy and describe novel embolization technique for treating high-flow large fistula.
Materials and Methods: A 46-years-old male presented with slowly progressive paraparesis and urinary dysfunction. Selective angiography revealed direct fistulas located in the left L4/5 intervertebral foramen draining into both the intervertebral venous plexus and the perimedullary veins. The placement of ''pre-detached'' detachable coil in the venous side was performed before the transarterial NBCA injection.
Results: Although complete obliteration of the fistulas and clinical improvement were achieved after the 1st embolization, a new epidural AVF developed at the another site of initial AVFs was recognized with 1 year follow-up angiography and 2nd transarterial embolization was needed.
Conclusion: Though the nonvertebral paraspinal AVFs along the segmental nerve are thought to occur during younger age with minimum symptoms, they can cause perimedullary reflux in later period. To minimize the length of obliterated vessels and avoid migration of embolic materials, transarterial glue injection in combination with ''pre-detached'' detachable coil placement in the venous side is a feasible technique in the treatment of high flow lesions.
Keywords: AVF, spinal, embolization

SESSION: Miscellaneous

P 204

DAY-HOSPITAL AS A FEASIBLE SETTING FOR CEREBRAL DIGITAL SUBTRACTION ANGIOGRAPHY

I Valente[1], F D'argento[1], A Alexandre[1], E Lozupone[1], G Garignano[2], A Romi[2], A Bartolo[2] and A Pedicelli[1]
[1]Fondazione Policlinico Universitario A. Gemelli IRCCS, Roma, ITALY
[2]Università Cattolica del Sacro Cuore, Roma, ITALY

Purpose: To evaluate whether Day-hospital is a safe and feasible setting to perform digital subtraction angiography (DSA) on patients with cerebro-vascular pathologies. To evaluate whether Day-hospital for cerebral DSA offers an economical advantage over the In-hospital setting.
Materials and Methods: We retrospectively reviewed clinical and radiological data of 145 patients who underwent Day-hospital DSA between August 2016 and February 2019. Procedural complications and clinical condition at patient's discharge were analyzed. An economic evaluation on costs and revenues of this type of management was carried out.
Results: All 145 patients underwent cerebral DSA without any major complication; only one patient experienced a small hematoma of the puncture site that required a one-night hospitalization. The economic evaluation showed a direct saving for the National health system estimated in the 82% and an indirect loss of earnings for the Hospital of the 90,8%.
Conclusion: Day-hospital is a safe and feasible setting for cerebral DSA. In comparison with In-hospital setting, DH offers an easier scheduling of the procedures, a greater patient adherence and cost reduction with equal complications rate.
Keywords: DSA, Day Hospital, Aneurysms

P 205

THE ANGIOGRAPHIC QUALITY IN TERM OF RADIOLOGIST SATISFACTION USING THE DIFFERENT PERCENTAGE OF THE CONTRAST MEDIA CONCENTRATION

P Thomya[1], P Poonkarun[1] and N Rodiead[1]
[1]Faculty of Medicine Ramathibodi Hospital, Mahidol University, Bangkok, THAILAND

Purpose: Our study aims to compare the angiographic quality in term of radiologist satisfaction emphasis on the internal carotid artery angiogram using the different percentage of the contrast media concentration.
Materials and Methods: This was the analytic prospective study. Two radiologists analyzed the angiographic quality of the 100 internal carotid angiography using Hexabrix 320 (Guerbet, France). The prospect patients were divided into 4 groups of 25 without acknowledging the contrast media concentration. Contrast media were diluted by 0.9% normal saline solution in different concentration i.e. 70%, 80% and 90% contrast media concentration. Diluted or non-diluted contrast media was used about 8 ml injection with flow rate in 4 ml/sec. 5Fr Bern (Boston scientific, USA) was applied for angiography. The data were collected regarding i) vascular contrast density divided in 3 groups as over density, good density and poor density, ii) adequacy of image interpretation divided in 2 groups as adequate and inadequate. User's satisfication was analyzed and classified as satisfied when good / over vascular contrast density and adequate imaging interpretation and non-satisfied when poor vascular contrast density and inadequate imaging interpretation.
Results: Good vascular contrast density were 100% in various diluted contrast concentration group while non-diluted contrast medium group showed 72% of good vascular contrast density. 28% of the latter group demonstrated over density images. Image interpretation in either diluted or non-diluted groups were adequate (100%). All angiographic quality (100%) were satisfied by the radiologists in both diluted and non-diluted groups.
Conclusion: Hexabrix320 contrast media can be diluted various concentration (70% in lowest concentration) being great angiographic quality i.e.vascular contrast density, adequacy of image interpretation and user's satisfaction that increased amount of contrast media usage in low body weight or pediatric patients.
Keywords: Angiographic Quality, Contrast media, Concentration

P 206

INVESTIGATION OF PUNCTURE SITE HEMATOMA AFTER NEUROENDOVASCULAR SURGERY

R Oshima[1], T Izumi[1], M Ikezawa[1], S Gotoh[1], A Kropp[1], M Otawa[1], T Kawaguchi[1], T Tsukada[1], M Nishihori[1] and T Wakabayashi[1]
[1]Nagoya University, Aichi, JAPAN

Purpose: Puncture site hematoma after neuroendovascular surgery is not a rare complication and can even result in death due to massive bleeding. Despite the use of vascular closure device, hematoma can be frequently seen. We sought to define the risk profile for puncture site hematoma after neuroendvascular surgery.
Materials and Methods: A retrospective review of consecutive patients who underwent neuroendovascular surgery between April 2014 and December 2017 in our institution was conducted. Patient characteristics, operation time, preoperative use of antiplatelet drugs, final intraoperative ACT, sheath size, and management of access sites such as manual compression, Exoseal® or Angioseal® were examined.
Results: A total of 566 patients underwent neuroendovascular surgery, and puncture site hematoma was observed in 36 (6.3%) patients. In univariate analysis, the hematoma rate was significantly different between patients receiving antiplatelet drug (8.5%) to those without (2.5%). The incidence

rate was significantly different between final ACT <300 (4.2%) and >300 (12.1%), sheath size (<7Fr (4.2%) and >7Fr (9.6%)) as well as in management of access site with manual compression 5.9%, Exoseal® 1.4%, and Angioseal® 10.1%. On the other hands, the procedural failure rate was significantly different among manual compression (2.9%), Exoseal® (7.7%), and Angioseal® (2.9%). Multivariate analysis indicated that final ACT > 300 (hazard ratio [HR], 2.16; P = 0.027) and Angioseal® (HR 3.9; P = 0.007) were significant factors for puncture site hematoma.

Conclusion: The final ACT of 301 and more is a significant risk factor for puncture site hematoma, and proper reversal of heparinization is necessary. The use of Angioseal® is also a significant risk factor for hematoma rates, but the use of Exoseal® has a significantly higher failure rate. Therefore, a different review of device dominance is nescessary.

Keywords: puncture site hematoma, neuroendovascular surgery, vascular closure device

P 207

EXTRACRANIAL AND INTRACRANIAL ANASTOMOSIS AND ITS CLINICAL IMPLICATIONS IN THERAPEUTIC NEUROINTERVENTIONS

V Bhatia[1] and A Kumar[2]
[1]PGIMER, Chandigarh, INDIA
[2]PGIMER, Chandigarh, INDIA

Purpose: ICA and ECA anastomosis are commonly seen in day-to-day diagnostic and therapeutic cerebral angiographies. A thorough knowledge of these anastomosis is required to avoid untoward complications during the procedures especially in particulate/liquid embolizations.

Materials and Methods:

I. Brief revision regarding essential neuro vascular anatomy of the intracranial and extracranial vessels.

II. Important anastomosis ECA and ICA that should be looked for specifically during embolization procedures.

III. Illustrative examples including cross sectional imaging and angiography images.

IV. Clinical implications and complications that could be encountered if there is inadverant embolizations to non targeted sites.

V. Examples showing ICA-ECA anastomosis as alternative pathways for accessing the target sites.

Results: The ICA-ECA anastomosis can be developmental in nature or develop secondary to underlying pathology – eg: Arteriovenous fistulas, dural tumors like meningioma. These arterial anastomosis open up in two situations 1> due to sump effect secondary to underlying high flow malformation 2> as a collateral pathway when there is occlusion / flow limitation of the main vessel supplying a particular artery. Many a times, these anastomosis play important role in gaining access to the site of pathology.

Conclusion: The diagnostic angiography runs should be thoroughly studied and reviewed before the intervention.

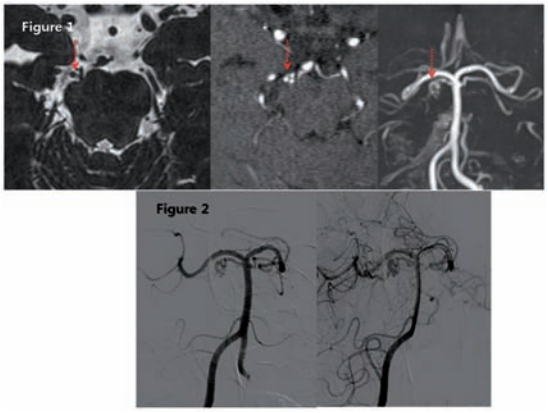
Keywords: EC-IC, anastamosis, neurointervention

P 208

ISOLATED TROCHLEAR NERVE PALSY IN A PATIENT WITH SUPERIOR CEREBELLAR RETE MIRABILE

EJ Kim[1], Y Shin[2], CW Ryu[2], KM Lee[1], EK Yeon[1] and JS Lee[1]
[1]Kyung Hee University Hospital, Seou, SOUTH KOREA
[2]Kyung Hee University Hospital at Gangdong, Seou, SOUTH KOREA

Purpose: Rete mirabile is an arterial or arteriolar meshwork formed by branches from one or more arteries that converges into a single artery. It is a very rare vascular malformation and superior cerebellar artery (SCA) rete mirabile is not reported previously. We report a new case of rete mirabile of SCA initially detected by MRI and digital subtraction angiography(DSA).



Materials and Methods: This report illustrates the case of a 58-year-old man who presented with vertical diplopia since 10 days with aggravating severity; this was relieved when he tilted his head to the left. Brain MR(Figure 1) revealed clustered tortuous signal void in the right crural cistern on T2-weighted images, and abnormal vascular meshwork on magnetic resonance angiography (MRA). 3D VISTA brain MRI demonstrated that the cisternal segment of the ipsilateral trochlear nerve compressed by this vascular malformation. MRI revealed no abnormal ischemia/hemorrhage or tumors. DSA was done to evaluate this vascular abnormality.

Results: DSA(Figure 2) with 3D rotational angiography of cerebral vessels DSA revealed a network of small abnormal vessels arising from the proximal portion of the right SCA. The right SCA was divided into a tangle of small dysplastic vessels which reunited to form a single dominant trunk of the distal SCA supplying the upper cerebellar hemisphere. The right SCA had slightly decreased caliber. The DSA showed no veins draining the vascular lesion, suggesting arteriovenous shunting or malformation. These findings indicated the presence of rete mirabile from the SCA.a rete mirabile of SCA. We assumed that his cranial nerve palsy was caused by the rete mirabile of the right SCA. During the 8-week, the patient was observed and symptom was relieved spontaneously.

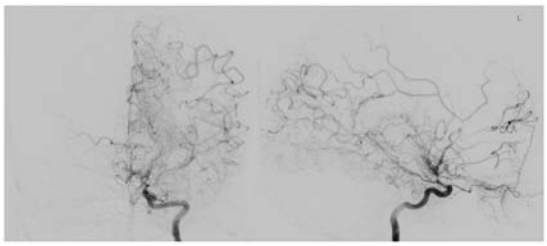
Conclusion: We provide a first report in the literature of rete mirabile involving the SCA and suggest a descriptive knowledge of rete mirabile for clinicians during decision making of treatment.
Keywords: Rete Mirabile, Superiro Cerebellar Artery, Variation

P 209

A RARE CASE OF POSTINFECTIOUS MOYAMOYA SYNDROME: CASE REPORT AND REVIEW OF THE LITERATURE

P Trombatore[1], E Lozupone[1], S Gaudino[1], L Milonia[1], A Alexandre[1], F D'argento[1], I Valente[1], C Colosimo[1] and A Pedicelli[1]
[1]Fondazione Policlinico Universitario A. Gemelli IRCCS Università Cattolica del Sacro Cuore, Roma, ITALY

Purpose: Postinfectious Moyamoya syndrome is a rare vasculopathy that can follow a bacterial meningitis. Few cases have been described in the literature related to different microorganisms such as M. Tuberculosis, S. Pneumoniae, H. Influence and T. Pallidum. We present a unique case of Moyamoya syndrome following a bacterial meningitis caused by A. Fumigatus and E. Coli and we reviewed all cases of Moyamoya syndrome post-meningitis in the literature.



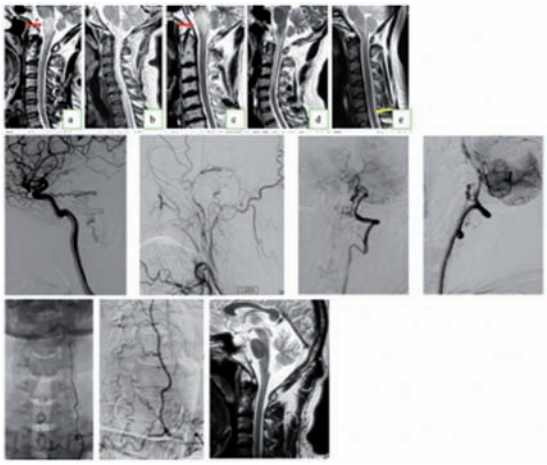
Materials and Methods: A 41 years-old man developed meningitis due to A. Fumigatus and E. Coli infection 4 days after neurosurgery for subependymoma of the fourth ventricle. Two years later, the patient presented with acute headache and mild left hemiparesis. The CT scan and the MRI revealed two acute ischemic lesions in the right centrum semiovale associated to bilateral chronic watershed cerebral ischemic lesions. Bilateral severe stenosis of distal ICA and the M1 segments of MCA were disclosed at the MR-angiography. The cerebral DSA showed a typical Moyamoya pattern with occlusion of both the distal ICA, the M1 segments, the A1 segments and the presence of tangle of tiny vessels (''puff of smoke'') along the course of lenticulo-striatal arteries; leptomeningeal and transdural collateral circulation was also detected. Posterior circulation was spared from the disease. The cases of the review were identified through research on PUBMED and additional articles were considered basing on their references.
Results: 9 cases of Moyamoya syndrome following a bacterial meningitis were found after reviewing the literature. The Mycobacterium tuberculosis was isolated in 4 patients, the Streptococcus pneumoniae in 3 patients, the Treponema pallidum and the Haemophilus influenzae type C in one case each. Time between meningitis and onset of Moyamoya pattern was extremely variable. In 1 patient Moyamoya pattern developed after 30 days, in 5 patients between 6–12 months, and in 4 patients after one year; in the latter group, the infectious agent involved was the Mycobacterium tuberculosis. All cases showed bilateral involvement of the anterior cerebral circulation. Involvement of posterior circulation was present in 7 cases, 3 of which were consequent to Streptococcus pneumoniae meningitis. All patients were medically treated.
Conclusion: Clinicians should be aware of vascular complications such as Moyamoya syndrome which can follow bacterial meningitis. Imaging is essential for diagnosis and to exclude other causes of late neurological symptoms in these patients.
Keywords: Moyamoya syndrome, meningitis, vasculopathy

P 210

DIAGNOSIS AND TREATMENT OF BRAIN STEM VENOUS HYPERTENSIVE CONGESTION

L Yan[1], YJ Ma[1], GL Li[1], T Hong[1], LY Sun[1] and HQ Zhang[1]
[1]Xuanwu Hospital Capital Medical University, Beijing, CHINA

Purpose: Brain stem venous hypertensive congestion are uncommon, we present our 5 cases with brain stem venous hypertensive congestion due to spinaldural arteriovenous fistula-(S)DAVF, present our experience of diagnosis and treatment of this rare kind of vascular disease.



Materials and Methods: The data of five cases of patients with brain stem congestion treated in Xuanwu Hospital between August 2014 and August 2015 were reviewed retrospectively, including their clinical history, neuroimagings, treatment and follow-up data.
Results: The five cases included 2 superior petrosal sinus DAVF, 1 hypoglossal canal DAVF, 1 cranio-cervical junction DAVF and a cervical SDAVF. 4 patients underwent microsurgical treatment while 1 got embolization. Postoperative DSA

confirmed the obliteration of the fistulas and MRI indicated remission of the congestion. All patients had clinical improvement.

Conclusion: The brain stem venous hypertensive congestion is a kind of vascular lesion caused from (S)DAVFs. The clinical symptoms are not specific, MRI and DSA are of great value for diagnosis.

Keywords: Venous hypertension, Brain stem congestion, Arteriovenous fistula

P 211

NEUROVASCULAR MANIFESTATIONS OF NFI- A PICTORIAL ESSAY BASED ON OUR CASES

LJD Sebastian[1], J Nadarajah[1], M Gupta[1], A Garg[1] and SB Gaikwad[1]

[1]All India Institute of Medical Sciences, New Delhi, INDIA

Purpose: Neurofibromatosis type 1 is an autosomal dominant systemic disorder affecting 1 in 3000 individuals. This disease is known to affect medium and large sized arteries with reported prevalence of 2.5-6%. Although majority are asymptomatic, can present with ischemic stroke secondary to vascular stenosis or occlusion or major hemorrhages due to aneurysm or fistulae. Here we illustrate myriad of vasculopathies in NF1 patients and its management implications.

Table:1. Neurofibromatosis -1 Cases with neurovascular presentations

Cases	Demographic details	Clinical presentation	Angiographic findings	Management	outcome
1	30-year-old, Male Diagnosed case of NF-1, positive family history	left upper limb weakness with tingling sensation	Left Vertebral artery-Venous epidural high flow fistula	Stent graft	Complete clinical improvement
2	34-year-old, Male diagnosed case of NF-1 with positive family history	Progressive neck swelling and Brule	Left ICA giant ruptured aneurysm with vertebra venous fistula	Parent vessel occlusion with trapping	Neck swelling reduced
3	34- year old, Male Diagnosed case of NF-1 with positive family history	Progressive quadriparesis with restricted neck movement	Dissecting ICA aneurysm with Vertebro venous Fistula	Parent vessel occlusion for VVF	Able to walk with improved neck mobility
4	22 -year old Male Not diagnosed at the time of DSA	Progressive vision loss	Fusiform ectasia of cavernous ICA with segmental venous dysgenesis of superior sagittal sinus	Conservative management	Asymptomatic for vasculopathies. Vision loss is due to bilateral optic nerve lesions

Materials and Methods: From our institutional data base, we retrospectively reviewed all cases of Neurofibromatosis patients underwent Digital subtraction angiography from January 2005 to May 2019 and identified 4 cases with vasculopathies. Demographic details, clinical presentation, imaging findings, digital subtraction angiographic pattern, immediate and long-term functional outcome following endovascular treatment were documented.

Results: Shown in the attached table.

Conclusion: Although rare, NF 1 may be associated with complex, high flow vascular lesions as described this pictorial review. Endovascular management although challenging, it is safe and effective in majority of cases. In all these cases, priority should be given to preserve the affected vessel irrespective of underlying vascular lesion as these subjects are at risk of developing future vasculopathies in uninvolved vessels. Hence its is important to keep high threshold for parent vessel sacrifice at all cost.

Keywords: Neurofibromatosis 1, High Flow Fistula, Dissecting Aneurysm

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CEREBRO VASCULAR MANIFESTATIONS OF NEUROFIBROMATOSIS TYPE I- A PICTORIAL REVIEW

N Jain[1], M Gupta[2], J Nadarajah[3], L Deverajan[4] and S Gaikwad[5]

[1]Artemis Hospital, Gurugram, INDIA
[2]All India Institute of Medical Sciences, New Delhi, INDIA
[3]All India Institute of Medical Sciences, New Delhi, INDIA
[4]All India Institute of Medical Sciences, New Delhi, INDIA
[5]All India Institute of Medical Sciences, New Delhi, INDIA

Purpose: Neurofibromatosis type 1 is an autosomal dominant systemic disorder affecting 1 in 3000 individuals. This disease is known to affect medium and large sized arteries with reported prevalence of 2.5-6%. Although majority are asymptomatic, can present with ischemic stroke secondary to vascular stenosis or occlusion or major hemorrhages due to aneurysm or fistulae. Here we illustrate myriad of vasculopathies in NF1 patients and its management implications.

Cases	Demographic details	Clinical presentation	Angiographic findings	Management	outcome
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3	34- year old, Male Diagnosed case of NF-1 with positive family history	Progressive quadriparesis with restricted neck movement	Dissecting ICA aneurysm with Vertebro venous Fistula	Parent vessel occlusion for VVF	Able to walk with improved neck mobility
4	22 -year old Male Not diagnosed at the time of DSA	Progressive vision loss	Fusiform ectasia of cavernous ICA with segmental venous dysgenesis of superior sagittal sinus	Conservative management	Asymptomatic for vasculopathies. Vision loss is due to bilateral optic nerve lesions

Materials and Methods: From our institutional data base, we retrospectively reviewed all cases of Neurofibromatosis patients underwent Digital subtraction angiography from January 2005 to May 2019 and identified 4 cases with vasculopathies. Demographic details, clinical presentation,

imaging findings, digital subtraction angiographic pattern, immediate and long-term functional outcome following endovascular treatment were documented.
Results: added in table 1.
Conclusion: Although rare, NF 1 may be associated with complex, high flow vascular lesions as described this pictorial review. Endovascular management although challenging, it is safe and effective in majority of cases. In all these cases, priority should be given to preserve the affected vessel irrespective of underlying vascular lesion as these subjects are at risk of developing future vasculopathies in uninvolved vessels. Hence its is important to keep high threshold for parent vessel sacrifice at all cost.
Keywords: Neurofibromatosis, Arterio venous fistula, aneurysms

P 213

EXTRACRANIAL VERTEBRAL ARTERIOVENOUS FISTULA IN A PATIENT WITH NEUROFIBROMATOSIS TYPE 1

T Nakazawa[1], A Tsuji[1], Y Yoshimura[1], K Tsuji[1] and K Nozaki[1]
[1]Department of Neurosurgery, Shiga University of Medical Science, Otsu, JAPAN

Purpose: Neurofibromatosis type 1(NF 1) is well known an inherited disease, but NF-1 related vascular anomalies are rare. In addition, a vertebral arteriovenous fistula (VAVF) caused by ruptured vertebral artery aneurysm with NF1 is extremely rare. Although the treatment options are various, the endovascular approach has become the first choice. On the other hand, the large mass of coils produced as a result of tight packing in the large vertebral aneurysm might migrate through the skin with the late adverse effect. We present a patient of NF 1 harboring extracranial vertebral aneurysms with the VAVF.
Materials and Methods: A 51-year-old woman with maternal family history of NF1 was referred to our hospital for growing pulsatile subcutaneous mass in the right-side upper neck. Three-dimensional CT angiography revealed multiple extracranial vertebral aneurysms and one of them was approximately over 35 mm in width. The right vertebral angiogram demonstrated a VAVF between paravertebral venous plexus and the large anerysm at level of C2/C3.A microcatheter was advanced into the large aneurysm from the right vertebral artery and coinstantaneously another microcatheter was navigated into the same aneurysm from the left vertebral artery beyond the vertebral artery union. Subsequently, internal trapping of the large aneurysm was performed with platinum coils with rough packing of the aneurysm and the distal and proximal normal vertebral arteries of the aneurysm were completely occluded with coils and glue.
Results: Although the fistula remained slight flow recruited by the deep cervical artery, Follow-up angiography performed 1 year after procedure confirmed complete obliteration of the right VAVF without new additional symptoms.
Conclusion: Extracranial VA aneurysm sometimes causes the ischemic stroke and if the aneurysm has ruptured, cervical hematoma, dyspnea, and hemothorax may occur leading to the devastating disaster. Considering to fragility of arterial wall with NF1, the aneurysms might be tear easily and lead to poor prognosis. Although there is no long-term result for endovascular treatment of ruptured or non-ruptured extracranial vertbral aneurysm with NF 1, especially in association with the arteriovenous fistula, the lesion should be treated promptly.
Keywords: neurofibromatosis type 1, vertebral aneurysm, vertebral AVF

P 214

INFILTRATED EMBOLIZATION OF MENINGIOMA WITH DILUTE CYANOACRYLATE GLUE

O Hiroyuki[1], T Kenkichi[1], M Kenichi[1], K Yuji[1], K Yoshihiro[1] and O Hideyuki[1]
[1]Ohnishi Neurological Center, Akashi, JAPAN

Purpose: Meningiomas are often embolized before their surgical resection to reduce blood loss during surgery. We have used low concentration n-butyl cyanoacrylate(NBCA) since 2011. We report the efficacy and technical aspect of infiltrated preoperative embolization for meningiomas with the penetration of very-diluted glue.
Materials and Methods: In this method 13% NBCA-lipiodol mixture is extremely slow injected from the middle meningeal artery like a plug and push injection of Onyx after the tortuous side feeders are proximally embolized. The glue is infiltrated into small tumor arteries and extends to the inaccessible feeders from pial artery or deep meningeal arteries. If the careful embolization not to reflux too much and migrate the glue into the normal arteries is achieved, this method is very useful to get the extremely effective devascularization on surgical extirpation, and also may applicable to the surgically untreatable meningiomas as a semi-radical treatment option.
Results: Since 2011, 66 cases preoperatively diagnosed with meningioma were embolized with this technique. Intratumoral embolization was possible in 59 cases(92.0%), and more than 50% reduction of contrast area in T1 Gd was achieved in 40 cases(62.5%). 4 cases achieved complete devascularisation, showing a remarkable shrinkage in tumor size after embolization.
Conclusion: Preoperative embolization of meningioma with the penetration of very- diluted glue was useful. We assessed the extent of intratumoral embolization and its effect on tumor removal.
Keywords: meningioma, transarterial embolization, NBCA

P 215

PREOPERATIVE EMBOLIZATION VIA NON INTERNAL CAROTID ARTERY FOR INTRACRANIAL MENINGIOMA OR SOLITARY FIBROUS TUMOR IS A SAFE AND USEFUL METHOD

J Suenaga[1], N Shimizu[1], T Ogura[1], S Matsumoto[1], K Fujii[1], A Ohshima[1], T Nakamura[1], N Ikegaya[1], M Sato[1], K Tateishi[1], H Murata[1] and T Yamamoto[1]

[1]Yokohama City University – Department of Neurosurgery, Yokohama, JAPAN

Purpose: Surgery is the best way for meningioma. But we sometimes encounter the hyper vascular tumor and suffer from the maneuver of attachment, and tumor bleeds much in such cases. We perform preoperative embolization if proper feeder is obvious within 7 days before surgery. Purpose of this study is to evaluate the safety and efficacy of embolization by single expert surgeon in single institute retrospectively.
Materials and Methods: There were 41 patients, 45 embolization (4 are staged embolization). M:F = 1:2, mean 55 years old (median 57). Meningioma 38 (grade 2 was 1), solitary fibrous tumor 3 (grade 2 was 1, grade 3 was 2). Location was 24 skull base (5 sphenoid ridge, 4 petroclival, 3 sphenoorbital, 3 cerebellopontine angle, 2 middle fossa, 2 olfactory, 2 foramen magnum, 1 cavernous sinus, 1 cerebellar tent, 1 paraclinoid), and 17 non skull base (7 convexity, 7 parasagittal, 2 posterior convexity, 1 trigone). Tumor size was 20–120 mm (mean 43 mm). The most frequent feeder was middle meningeal artery (MMA), following occipital artery, accessory meningeal artery (AMA), superficial temporal artery, artery of foramen rotundum, sphenopalatine artery, ascending pharyngeal artery, posterior choroidal artery, and superior cerebellar artery. Embolization via ICA wasn't performed. As for embolization material, combination of 100–500 μm particle plus coil was 16, 10–20% NBCA was 15, and other combination was utilized.
Results: Targeted artery embolization was achieved in all cases. The reduction rate of vascularity was average 70% (30-95%). Provocation test was negative in 16, but positive in 8 cases, that is 2 oculomotor palsy via petrosal branch of MMA, 5 facial numbness via AMA, that had all recovered. There was no simultaneous complication concerning the maneuver. In 70 mm paraclinoid meningioma embolized via bilateral external carotid artery (ECA), acute thrombogenic stroke was occurred after 6 hr and acute thrombectomy was performed. The patient's modified Rankin Scale (mRS) was 2 after 3 months. And in other middle fossa meningioma case, immediate after via ECA embolization, multiple scattered NBCA casts was observed in bifrontal region on CT scan. This patient was no symptom.
Conclusion: Embolization via non ICA by expert surgeon was effective and safe reducing the intraoperative hemorrhage and facilitating the extent of resection.
Keywords: Enbolization, NBCA, Meningioma

P 216

COMBINED MANAGEMENT OF HYPERVASCULAR BRAIN TUMORS IN HYBRID OPERATING ROOM

R Mori[1], I Kan[1], T Kodama[1], T Ishibashi[1], Y Akasaki[1] and Y Murayama[1]

[1]The Jikei University School of Medicine, Tokyo, JAPAN

Purpose: Surgical resection of hyper-vascular intracranial brain tumors often presents difficult hemostasis and risks of ischemia or congestion. Hemangiopericytomas and solid type hemangioblastomas are typical hyper-vascular tumors with feeding arteries arising from the anterior or posterior circulations. To reduce intra- and postoperative complications, blood loss and surgical time, preoperative tumor embolization can been performed. We report our experience of resecting such tumors in the hybrid operating suite with preoperative embolization.
Materials and Methods: We reviewed the medical records of patients with hypervascular brain tumors who were treated in our institution from 2015 to 2018. We focused on the estimated blood loss, blood transfusion and complications.
Results: Four patients, 2 hemangiopericytomas and 2 solid hemangioblastomas, underwent tumor resection with preoperative tumor embolization. Hemangiopericytomas were mainly located supratentorially and main feeders were middle meningeal artery and posterior cerebral artery respectively. Tumors were resected on the following day of the feeding artery coil embolization. Hemangioblastomas were located in the cerebellar hemisphere and vermis, supplied by the posterior inferior cerebellar arteries (PICA). Both patients showed hydrocephalus due to cerebellar edema or obstruction of the 4th ventricle outlet, thus tumors were resected immediately after PICA embolization in the hybrid operating room in a single session. Intraoperative bleeding was well controlled in all cases and surgeries ended uneventfully without blood transfusion.
Conclusion: Endovascular embolization of the feeding arteries contributes to blood flow reduction in the tumor, surgical time decrease, and lower intraoperative blood loss. The hybrid operating room allows simultaneous, rapid and urgent management for complex pathologic conditions requiring both endovascular and microsurgical procedure.
Keywords: hybrid operating room, hypervascular brain tumor, tumor embolization

P 217

PARENT ARTERY OCCLUSION FOR TRAUMATIC VERTEBRAL ARTERY INJURY

Y Matsunaga[1], Y Morofuji[1], N Horie[1], T Izumo[1], T Anda[1] and T Matsuo[1]

[1]Department of Neurosurgery, Nagasaki University Graduate School of Biomedical Sciences, Nagasaki, JAPAN

Purpose: Traumatic vertebral artery injury (TVAI) due to cervical spine injury is known to be a potentially severe complication, especially embolic posterior circulation ischemic stroke. The treatment for TVAI is controversial. Our hospital has experienced a TVAI case of severe embolic stroke after posterior cervical fusion (PCF) in the past, now in our institute, the basic treatment policy for TVAI needed to perform PCF is parent artery occlusion of injury vessels before the cervical procedure. We examined the validity of this treatment.
Materials and Methods: We reviewed the clinical and angiographic features of 11 traumatic injuries of the vertebral artery during the 5-year period. All patients received endovascular treatment (parent artery occlusion: PAO) before performed PCF, and we used balloon guiding catheter to the prevention of embolic stroke as possible, and we performed PAO using a combination of detachable coil and pushable coil.
Results: The cause of injury included traffic accident in 6 patients, falls in 3 patients and slipping in 2 patients. All patients appreciated following spinal bone injury; upper cervical fracture, facet fracture, dislocation, and body fracture. The endovascular intervention resulted in immediately total occlusion in all patients. Postoperative cerebral infarction was noted in two patients, but these patients showed transient ataxia and no permanent deficits. There were no additional surgical procedures for the vascular lesion.
Conclusion: In the results of our case series, we suggest that PAO for TVAI before PCF might be a useful procedure to reduce the risk of severe posterior circulation ischemic stroke.
Keywords: trauma, vertebral artery injury, parent artery occlusion

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THE ALGORITHM AND THE RESULTS OF THE TREATMENT FOR CHRONIC SUBDURAL HEMATOMA IN OUR HOSPITAL, AND IDENTITY OF THE FEEDER EMBOLIZATION BY THE INTERVENTION

Y Makoto[1]
[1]Takeda General Hospital, Kyoto, JAPAN

Purpose: The complete cure rate by first burr hole operation (BHO) for chronic subdural hematoma is reported with 80–90%. Many recurrence factors are reported, and the treatment guidelines and tips depend on operators or institutions, so the algorithm is various. We will report on the clinical and cost effectiveness of the middle meningeal artery embolization (MMaE) for this disease.
Materials and Methods: From January, 2011 to May, 2017, 203 cases and 257 BHO. Uniformly, we did not stop the antiplatelet drugs, a single burr hole and irrigate the cavity under the local anesthesia. The MMaE was performed under the local anesthesia to 9 intractable cases.
Results: The operation times until cure, 1st/2nd/3rd = 163/31/9. The complete cure rate, 1st/2nd/3rd = 80.3%/77.5%/100%. After MMaE, all cases don't have further recurrence and perioperative complication.
Conclusion: It was difficult to distinct whether the cure was natural course or was the effectiveness of MMaE, but the contribution for the intractable cases was suggested. When MMaE by only glue without coil capping of feeder proximal, it became cost effectiveness more than additional BHO. We often seems MMaE invasive compared with BHO, but in the easy access cases, the MMaE is low risk and finish quickly. And, it led skill-up especially glue technique of IVR. We recommend aggressive MMaE for easy recurrence cases.
Keywords: chronic subdural hematoma, feeder embolization, algorithm of the treatment

P 219

REGULATORY SCIENCE ASPECT OF POST-MARKET SURVEILLANCE OF NEURO-ENDOVASCULAR DEVICES IN JAPAN

C Sakai[1], N Sakai[2], H Imamura[2], A Ishii[3], Y Matsumaru[4] and S Yoshimura[1]
[1]Hyogo Medical College, Nishinomiya, JAPAN
[2]Kobe City Medical Center General Hospital, Kobe, JAPAN
[3]Kyoto University, Kyoto, JAPAN
[4]Tsukuba University, Tsukuba, JAPAN

Purpose: To review post market surveillance (PMS) of neuroendovascular devices (NED) in Japan based on regulatory science aspect.
Materials and Methods: We evaluate all approved NEDs since current regulation of medical device established in 2005, including 3 stents for carotid artery, 5 embolic protection devices (EPD) for CAS, 5 neck-bridge stents for aneurysm (AN), 1 flow diverter (FD) for AN, 1 stent for intracranial atherosclerosis (ICAD), 6 devices for acute ischemic stroke (AIS), 1 liquid material for AVM and dAVF, 1 particle for tumor and dAVF and several detachable coils for AN and access devices.
Results: Detachable coils and access devices don't have PMS. All stents and EPDs for CAS, 2 of 3 neck bridge stents for AN, 5 of 6 AIS devices, 1 FD, 1 stent for ICAD, 1 liquid material for AVM, and 1 particle material have PMS with GPSP regulation. 1 AIS device and 1 liquid material for dAVF have physician control PMS. Only 1 neck-bridge stent for AN doesn't have PMS. Number of cases (120–3000), duration of enrollment (1–3 years), follow-up periods (90 days-3 years) and involved sites (all or selected) are different in each PMSs, but basically endpoint with pivotal study of each devices, severe adverse events, and device failures were same. However, no PMS have publication, and most of PMSs haven't been disclosed as assessment reports. Few PMS have been reported timely for physician.
Conclusion: Most of approved devices, except for detachable coil and access device, have PMS. Regulatory department of health, industry, and medical society should collaborate for timely and effectively utilization of PMS.

Keywords: post market surveillance, endovascular device, approval

SESSION: Etmint

PE: 1

ANALYSIS OF FEASIBILITY AND SAFETY OF ENDOVASCULAR RECANALIZATION OF CHRONIC OCCLUSION OF LARGE INTRACRANIAL ARTERY

S Li[1] and L Jiao[2]
[1]Interventional radiology center, Xuanwu Hospital Capital Medical University, Beijing, CHINA
[2]Department of neurosurgery, Xuanwu Hospital Capital Medical University, Beijing, CHINA

Purpose: To investigate the feasibility and safety of endovascular recanalization of chronic occlusion of large intracranial artery.
Materials and Methods: From January 2009 to January 2017, 15 patients with chronic occlusion of large intracranial artery were admitted to the Department of Interventional radiology?Xuanwu Hospital Capital Medical University for endovascular recanalization. Their clinical and imaging data was analyzed retrospectively. 12 of them had arterial occlusions at V4 segment of vertebral artery and 3 at intracranial segment of internal carotid artery. Whole brain digital subtraction angiography (DSA) was performed preoperatively to assess the length and location of occlusion. High-resolution magnetic resonance imaging (MRI) was used to evaluate the nature of occlusion and the feasibility of recanalization. Bilateral femoral artery sheath placement was conducted in 13 cases?and one of the two sheath was used for recanalization and stenting?while the other was used to opacify the distal segment of occlusion through collaterals in the order to create a reference road map?so that increased the possibility of recanalization. According to the TICI grades after procedure, the prograde flow after recanalization was systematically evaluated, and grade?2b was defined as successful recanalization.
Results: The median time from the first onset of symptoms to recanalization was 50 (18–365) days. Recanalization was successful in 13 cases and failed in 2 cases with occlusions at intracranial segment of vertebral artery. Among the 13 successful cases?the prograde flow after recanalization were TICI grade 3 in 12 cases?and TICI 2b in 1 case; symptoms were improved in 7 cases?did not change in 4 cases?and aggravated in 2 patients who developed transient ischemic attack or stroke after procedures. 11 patients were followed up for a median of 39 (3–89) months?the median mRS score was 1 (0-2).
Conclusions: For recanalization of chronic large intracranial artery occlusion?preoperative high? resolution magnetic resonance imaging evaluation and intraoperative bilateral sheath placement technique maybe helpful for increasing recanalization rate and reducing perioperative complications.

PE: 2

MANAGEMENT AND NURSING FOR CAROTID ARTERY STENTING RELATED HEMODYNAMIC DEPRESSION

Z Wang[1], J Hou[2] and L Jiao[3]
[1]Interventional radiology center, Xuanwu Hospital Capital Medical University., Beijing, CHINA
[2]department of neurosurgery, Xuanwu Hospital Capital Medical University, Beijing, CHINA
[3]School of nursing, Capital Medical University, Beijing, CHINA

Purpose: To review the epidemiological features, risk factors, correlations with postoperative complication and intraoperative managements of hemodynamic depression (HD) related to carotid artery stenting (CAS), so as to provide a reference for the nursing cooperation during operation.
Materials and Methods: Literatures on CAS-related HD were reviewed.
Results: HD was generally defined as systolic blood pressure (SBP)? 90 mmHg or heart rate (HR)? 60 beats/min. HD lasting for more than 1 hour after CAS was defined as persistent HD. Most HD happened intraoperatively and 12–24 h after operation. The overall incidence of CAS-related HD was 39.4%, with that of persistent HD is 19.2%. The risk in patients of older than 78 years is 5.25 times to the patients of younger than 78 years. Hypertension, coronary artery disease, diabetes mellitus, history of myocardial infarction and occlusion of contralateral carotid artery are other risk factors of CAS-related HD. Persistent HD increases the risk of stroke, arrhythmia, myocardial infarction. During the operation, nurses should pay attention the change of blood pressure and accelerate the fluid infusion when necessary. Atropine and dopamine should be prepared by nurses before inflation of balloon and deployment of stent. Other measures include intentional cough and transcutaneous temporary cardiac pacing.
Conclusions: CAS-related HD, especially the persistent HD, should be avoided in both intra- and post-operative period. Nurses should be familiar with the risk factors and managements of CAS-related HD, and try to avoid the persistent HD.

PE: 3

NURSING COORDINATION FOR HYBRID RECANALIZATION OF OCCLUDED CAROTID ARTERY

H Zhang[1], Z Wang[1], H Tang[1], W Li[1], M Sun[1] and L Jiao[2]
[1]Interventional radiology center, Xuanwu Hospital Capital Medical University, Beijing, CHINA
[2]Department of neurosurgery, Xuanwu Hospital Capital Medical University, Beijing, CHINA

Purpose: To summarize the nursing cooperation experiences in the hybrid recanalization surgery of internal carotid artery occlusion.

Materials and Methods: Experience on nursing cooperation were summarized from 71 cases of internal carotid artery occlusion treated by hybrid technique that combines traditional carotid endarterectomy and interventional procedure.
Results: The key points are listed as followings. 1) According to the results of preoperative cerebral angiography, surgery supplies were prepared in advance. 2) Equipment in the operating room should be organized rationally to avoid repeated movement of the instrument. 3) Be clear about proper patient positioning and aseptic area. 4) Be familiar with the catheter fixation and care. 5) Be familiar with usage of catheters and vascular sheaths in the consideration of thrombosis prevention. 6) Observation the dose of heparin sodium during surgery. 7) Be cautious on intraoperative complications and be clear about corresponding nursing measures.
Conclusions: The flexible, efficient and comprehensive cooperation of surgical nurses is of great significance to the hybrid recanalization of internal carotid artery occlusion.

PE: 4

NURSING COORDINATION FOR HYBRID RECANALIZATION OF 44 SYMPTOMATIC VERTEBRAL ARTERY OCCLUSION PATIENTS

H Tang[1], L Jiao[2], Q Xiao[1], F Feng[1], G Li[1] and Z Wang[1]
[1]Interventional radiology center, Xuanwu Hospital Capital Medical University, Beijing, CHINA
[2]department of neurosurgery, Xuanwu Hospital Capital Medical University, Beijing, CHINA

Purpose: To explore the methods of nursing cooperations in hybrid operations for posterior circulation diseases and provide reference to clinical practice.
Materials and Methods: Expetiences of 44 cases of vertebral artery occlusion treated by hybird recanalization from October 2014 to February 2019 were summarized.
Results: 1) nurses should communicate with doctors before surgery to understand the surgical plan and procedures so as to develop a pre-arranged nursing plan. 2) Prepare special implements and instruments according to results of Digital Subtraction Angiography (DSA). 3) Be familiar with intraoperative anticoagulation and nursing of blood clots. 4) Arrange the instruments in the operation room reasonably to avoid repeated movement.
Conclusions: The flexible, efficient and comprehensive cooperation of surgical nurses is of great significance to the hybrid recanalization of vertebral artery occlusion. Good cooperation of the surgical team is important to the safety of patients.

PE: 5

RECANALIZATION OF LONG SEGMENTAL OCCLUSION AT EXTRACRANIAL VERTEBRAL ARTERY BY HYBRID TECHNIQUE: CASE REPORT

Q Song[1], Y Ma[2] and L Jiao[2]
[1]Interventional radiology center, Xuanwu Hospital Capital Medical University, Beijing, CHINA
[2]Department of neurosurgery, Xuanwu Hospital Capital Medical University, Beijing, CHINA

Purpose: To report a case of refractory vertebrobasilar insufficiency associated with long segmental occlusion at extracranial vertebral artery (VA), who was successfuly treated by recanalization with hybrid technique.
Materials and Methods: Patient is a male, 72 years old. He suffered from paroxysmal vertigo and persistent unstable walking for more than 3 months. Serial cranial MRI suggested repeated bilateral Cerebellar and cerebral infarction. He was treated by dual antiplatelets and statin for more than 3 months, but his symptoms persisted. Physical examination found clear consciousness, fluent speech, normal high-level intelligent activities, normal cranial nerves function. Muscle strength of all limbs were grade V, muscular tension was normal. Angiography suggested that the V1-V2 segment of right VA was occluded, and a muscular collateral from thyrocervical trunk connected to the V2 segment and supplied the distal VA. The left VA was thin. Contrast-enhancement high-resolution MRI (HR-MRI) suggested that the segment distal to the occlusion of right VA was purely thin, without atheromatous plaque. MRI non-invasive optimal vessel analysis (NOVA) suggested that the V3 segment and basilar artery blood flow in the right VA was very low.
Results: Under general anesthesia, the patient was placed in a supine position with a small pillow under the right shoulder and turn the neck 10° to the left. In open surgery, the V1 segment of right VA was carefully exposed. After intravenous injection of 40 mg heparin, use vascular forceps and aneurysm clip to temporarily block the proximal and the distal of the subclavian artery (SubA), as well as internal thoracic artery. As the initial segment of right VA was tortuous, it was transected at 1 cm distal to its origin from the SubA. The distal VA was found to be filled with white thrombus with very low blood reflux. The thrombus in the lumen was removed by the valgus method. An aneurysm clip was used to temporarily blocked the distal end of right VA. Transposition of right vertebral artery origin was performed by VA-SubA end-to-side anastomosis. Control angiography showed that the V2 segment of the VA was thin, and the contrast passed slowly, suggesting there was still residual thrombus in the lumen. After the true lumen of the distal VA was confirmed by angiography, two Apollo balloon-expandable stents (3.0×23.0 mm at the distal, 3.5×18.0 mm at the proximal, Microport, China) was deployed. Control angiography showed good blood flow without significant residual stenosis. After operation, patient's vertigo disappeared. Postoperative MRI was scanned in 24 hours, and

no fresh cerebral infarction was found. And NOVA suggested that the velocity of blood flow of right V3 segment and the basilar artery were significantly higher than before. 4 days after operation, he was discharged. Dual antiplatelets was changed to aspirin only after 3 months. CT angiography (CTA) after 8 months showed mild restenosis of right VA, but no significant progression in the 1-year-CTA. At the follow-up of 6, 12, and 18 months, patient kept asymptomatic.
Conclusions: Recanalization of long segmental occlusion at extracranial vertebral artery by hybrid technique can be safe and effective for occlusion-related refractory vertebrobasilar insufficiency.

PE: 6

NURSING COOPERATION IN THE HYBRID SURGERY OF COMPLEX SPINAL VASCULAR MALFORMATION: EXPERIENCES FROM 111 CASES

Q Qin[1], Y Tang[1], X Chen[2], X Niu[1], Z Wang[1] and B Han[2]
[1]Interventional radiology center, Xuanwu Hospital Capital Medical University, Beijing, CHINA
[2]nursing department, Xuanwu Hospital Capital Medical University, Beijing, CHINA

Purpose: To summarize the critical nursing essentials in the hybrid surgery of complex spinal vascular malformation.
Materials and Methods: The nursing experiences of 111 cases (73 males and 38 females) of spinal vascular malformation were summarized.
Results: Our nursing experiences were summarized as followings.?Before operation?nurses should be familiar with all of the surgical protocols?and anticipate special items which might be used during surgery according to location and size of vascular malformation.?Nurses should understand all of the medical test results, which are important considerations for intraoperative medication.?Before anesthesia induction, nurses should evaluate patients' physical functions, which are the preconditions of postoperative comparisons?? Layout of all medical instruments in the operating room should be reasonable?while repeated movement should be avoided.? Patients' body positions should meet the requirements of both surgery and body function.? Measures of preventing pressing injuries should be taken according to patient's body position.? Connect the vessel sheath and catheter to the high pressure injector properly to prevent thrombogenesis.? The inside-body length and outside-body length of the vessel sheath should be determined according to patients' body positions and locations of lesions.
Conclusions: Good nursing cooperation can improve quality of hybrid surgery of complex spinal vascular malformation.

PE: 7

DURAL ARTERIOVENOUS FISTULAS INVOLVING THE SUPERIOR PETROSAL VEINS: CASE SERIES

T Jie[1], M Yongjie[1], Z Hongqi[1], L Feng[1] and L Guilin[1]
[1]Department of Neurosurgery, Xuanwu Hospital Capital Medical University, Beijing, CHINA

Purpose: To investigate the clinical manifestations and imaging features of dural arteriovenous fistulas with super petrosal venous drainage.
Materials and Methods: From May 2013 to September 2014, 9 patients with petrosal vein drained dural arteriovenous fistula at Xuanwu Hospital, Capital Medical University and Beijing Haidian Hospital were enrolled retrospectively. The patients were treated with endovascular embolization or microsurgery, and the MRI and DSA examinations were applied, and the scores of the modified Aminoff&Logue scale (mALS) were performed before and after treatment.
Results: In the 9 patients, there were 3 females and 6 males. They all had different degrees of limb sensory and motor abnormalities,7 patients also had urination and / or bowel disorders,4 had cranial nerve dysfunction, including hoarseness, bucking, hiccup, and paralysis. 6 patients received embolization treatment,3 received microsurgery. All the patients achieved anatomic cure. The preoperative mALS score was 6.0 ± 2.7, and the score at 3 months after procedure was 2.8 ± 1.7. There was significant difference between before and after treatment ($P < 0.05$).
Conclusions: The dural arteriovenous fistulas involving petrosal veins are kinds of rare cerebrovascular malformations. The lesion involves a wide range. The clinical manifestations are severe. Both endovascular embolization and microsurgery can achieve a more ideal therapeutic effect. If the vascular condition is permitted, the interventional embolization treatment should be preferred.

PE: 8

HYBRID OPERATION FOR STYLOCAROTID ARTERY SYNDROME: A CASE REPORT AND LITERATURE REVIEW

F Zhu[1] and L Jiao[2]
[1]Interventional radiology center, Xuanwu Hospital Capital Medical University, Beijing, CHINA
[2]department of neurosurgery, Xuanwu Hospital Capital Medical University, Beijing, CHINA

Purpose: To report a case of stylocarotid artery syndrome, which is a rare condition resulted from compression of the internal or external carotid artery by the styloid process of temporal bone, successfully treated by hybrid operation.

Materials and Methods: Patient was presented with left limbs weakness, then compression of the right carotid artery by elongated styloid process was found. He was treated by styloid process truncation with hybrid technique.
Results: After operation, compression of carotid artery was relieved. No arterial perforation or dissection happened.
Conclusion: This case demonstrated treatment of carotid artery stylocarotid syndrome with hybrid operation that combines endovascular techniques, radiological imaging and surgical resection can be safe and effective and minimally invasive.

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The congress takes place at **Palacongressi**, inside Mostra d'Oltremare
Address: J.F. Kennedy, 54 – 80125 – Napoli – Italy

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Free Wifi access is provided in the exhibition area and meeting rooms.
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English is the official language of the Congress.

REGISTRATION AND INFORMATION DESK

The Registration desk is located at the main entrance, ground floor of Palacongressi.

The Registration desk is operating in the following hours:

Sun 20th October	14.00–19.00
Mon 21st October	7.00–19.00
Tue 22nd October	7.00–19.00
Wen 23rd October	7.00–19.00
Thu 24th October	7.00–17.00

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The **15th WFITN** Congress has been accredited by the European Accreditation Council for Continuing Medical Education (EACCME) with **27** European CME Credits (ECMEC's). Each medical specialist should claim only those hours of credit that he/she actually spent in the educational activity.

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The information desk of WFITN's Secretariat will be available throughout the Congress to provide information about WFITN, membership, new applications, INR journal, payment of membership fee (etc.)

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The speaker ready room is located on the 1st floor in Room Corsica.

All presentations must be uploaded at least two hours before their session.

Audiovisual technicians will be at your service to assist with uploading your presentation.

Please note that presentation using personal laptops will not be allowed during the sessions.

Operation hours:

Mon 21st	7.00–18.30
Tue 22nd	7.00–18.30
Wen 23rd	7.00–18.30
Thu 24th	7.00–16.00

PLEASE NOTE: in compliance with CME requirements, all Speakers are requested to include a slide disclosing conflicts of interest at the beginning of their presentation. For detailed information about

instructions for Speakers please visit the website page: http://www.wfitn2019.com/index.php/scientific-program/presentation-information/.

POSTER EXHIBITION

E-poster boards are located in the E-Poster Area inside the tensostructure, located in front of the main entrance of Palacongressi, after the registration desks.

You will be able to consult all the cases selected by the Scientific Committee for poster on the large E-poster monitors.

MOBILE APPLICATION

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The application includes all information regarding the event (detailed program, keynote speakers, exhibitors, general information, maps etc.)

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During the Plenary session in the Auditorium, it will be possible to interact with the speakers through the software "Post It" which allows to send questions on a post it format.

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REFRESHMENT BREAKS and LUNCH

Coffee/tea and water/soft drinks will be served during the coffee breaks and an easy working lunch will be served in lunch breaks.

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WFITN is pleased to invite you to a welcome cocktail on Monday (October, 21st) from 19.00 at Esedra Fountain (just outside Palacongressi).

CURRENCY, EXCHANGE, CREDIT CARDS

The official currency in Italy is **EURO (€).** Exchange facilities are offered to participants at the airport, in hotels, at the exchange desk of the banks. All major credit cards are accepted in hotels, restaurants and city stores. However, please be aware that American Express might be not accepted.

We recommend to ask or look for the logo before ordering. There is an ATM Machine inside Mostra d'Oltremare.

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Taxis are white in Napoli. We suggest that you use only authorized taxis equipped with license number and taximeter. Beware of private cabs, especially those without a taximeter.

Before the taxi starts the ride, please ask the driver for the pre-fixed rate.

The pre-fixed fares include all extras as night fare, luggage, pets, overcharge airport and does not depend on the number of passengers. Naples motorway toll is not included. Radio-taxi call is not included.

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Electricity in Italy, as in the rest of Europe, comes out of the wall socket at 220 volts alternating at 50 cycles per second.

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Shops in Napoli are open from 10.00-13.00 and from 16.00-20.00 (Monday to Saturday).

Shops are closed on Sundays. Big shopping centres around the city are open all day from 9.00 to 21.00, also on Sundays.

SMOKING

Smoking is not permitted inside the conference building or at the venues for the social activities. Smokers are required to smoke outdoors in the designated areas.