대한뇌혈관내수술학회
SKEN
Society of Korean Endovascular Neurosurgeons

Theme: Vision & Sharing of Solutions for Endovascular Treatment of Intracranial Aneurysms

ASCENT 2018

대한뇌혈관내수술학회

일시 2018년 6월 15일(금)~16일(토)

장소 강릉 세인트존스호텔 그랜드볼룸

주최 : 대한뇌혈관내수술학회 Society of Korean Endovascular Neurosurgeons

주관 : 대한신경외과학연구재단 THE KOREAN NEUROSURGICAL SOCIETY

대한뇌혈관내수술학회 회원 여러분 안녕하십니까!

겨우내 고대했던 따뜻한 봄날도 잠시 스쳐가고 어느덧 무더운 여름이 우리 앞에 있습니다. 작년 제주에서 성황리에 진행했던 ASCENT가 올해는 아름다운 동해안의 강릉에서 6월 15–16일 양일간 개최됩니다. 이번 강릉에서 진행될 ASCENT 2018은 "Vision & Sharing of Solutions for Endovascular Treatment of Intracranial Aneurysms" 이란 테마로 진행됩니다. 그 동안 우리 회원들의 뇌동맥류 치료경험과 때로는 떠올리기도 싫었던 아픈 순간들을 공유함으로써 향후 치료에 있어서 길잡이로 삼고자 합니다.

또한 학회 첫째날 뇌동맥류치료의 새로운 컨셉으로 자리잡아가고 있는 flow diversion에 대해 호주의 Brooks 교수가 FRED를 이용한 뇌혈관내치료에 대해 특강을 준비하셨고 둘째날에는 일본의 Oishi 교수가 ATLAS 스텐트를 이용한 뇌동맥류코일 색전술에 대해 세미나를 가질 예정입니다. 마지막으로 현재 환자치료에 주로 사용되고 있는 코일과 스텐트들의 장단점을 공유하고 새롭게 런칭되거나 현재 개발중인 혈관내수술 기구들에 대해 전문가들로부터 조언을 듣는 시간도 마련했습니다.

회원 여러분께서 아시다시피 ASCENT는 학술 활동뿐만 아니라 회원상호간의 친교를 도모하는 시간과 장소 제공에도 초점을 맞추고 있습니다.

개최지 강릉의 지역적 특성을 고려하여 지역명사와 함께하는 시간을 가질 예정이고 젊고 열정적인 SKEN 회원들의 적극적인 참여가 이루어질 수 있도록 ASCENT–Travel Grant를 대폭 제공할 계획이며 발표하실 연제의 초록을 준비중인 회원들에게 그 혜택을 드리겠습니다. 또한 자유연제 발표자 중에서 우수한 몇 분을 선정하여 ASCENT–학술상도 수여할 예정이오니 좋은 발표 및 지원을 부탁 드립니다.

아울러 이번 ASCENT 2018은 기존에 운영해왔던 방식과는 달리 학회 둘째날 오전에 대한뇌혈관내수술학회 모든 회원들이 잠시 쉬면서 자연을 즐길 수 있는 몇 가지 프로그램을 준비하려고 합니다. 모든 회원들께서 진료와 연구를 위한 빠듯한 시간에서 잠시 벗어나 여유로운 순간을 만끽하시기를 기대합니다.

이번 ASCENT를 강릉에서 개최할 수 있도록 제안과 도움을 주신 유승훈 홍보이사님께 우선 감사 드리며 알찬 학술프로그램을 완성해주신 장철훈 학술이사님, 여러 가지 어려웠던 제반 문제들을 해결하시느라 고생하신 신승훈 총무이사님께도 감사 드립니다.

끝으로 이번 ASCENT 2018의 강릉개최를 위해 물심양면으로 지원해주신 여러 기업회원님들께도 심심한 감사의 말씀을 드립니다.

2018년 6월
대한뇌혈관내수술학회 회장 **고 준 석**

2018 대한뇌혈관내수술학회 임원진

명예회장

직 위	성 명	소 속
명예회장	백민우	인봉의료재단 뉴고려병원

회장

직 위	성 명	소 속
회장	고준석	강동경희대학교병원

상임이사

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보험	권현조	충남대학교병원
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감사	정준호	연세대학교 세브란스병원

2018 대한뇌혈관내수술학회 임원진

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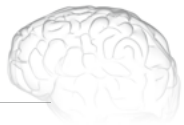
제4, 5대	권도훈	울산대학교 서울아산병원
제6대	안성기(작고)	(전) 한림대학교 성심병원
제7대	신용삼	가톨릭대학교 서울성모병원
제8대	권오기	분당서울대학교병원
제9대	김범태	순천향대학교 부천병원
제10대	성재훈	가톨릭대학교 성빈센트병원

프로그램 PROGRAM

6 / 15 Fri

13:00-13:20	등록		
13:20-13:30	인사말		3
13:30-14:40	**Free Paper I : "Difficult cases" session**	좌장 : 계명대 **이창영**, 연세에스병원 **정진영**	
	※Voting with live interaction during case presentation		
	Case 1. Stent-assisted coiling of paraclinoid aneurysms with wide neck and difficult geometry using LVIS Blue stent	계명대 **이창영**	10
	Case 2. Flow diverter as a rescue therapy for a post stent assisted coiling recurrence	연세대 **장창기**	11
	Case 3. Stent-assisted coil embolization on down-the-barrel view with spring-shaped microcatheter in patient with M1 ultrawide necked circumferential aneurysm	전북대 **박정수**	12
	Case 4. Intra-aneurysmal thrombosis during coiling for ruptured intracranial aneurysm: Treatment with intra-arterial tirofiban	대구가톨릭대 **곽영석**	13
	Case 5. Difficulties of endovascular coiling at very small basilar artery bifurcation aneurysm which is ruptured	한양대 **송대효**	14
	Case 6. Waffle cone in-stent technique for bifurcation aneurysms: A novel technique for inevitable cases	울산대 **유승훈**	15
	Case 7. Tailored endovascular treatment for anterior cerebral artery dissection presented with subarachnoid hemorrhage	가톨릭대 **김영우**	16
	Case 8. Microcatheter and stent-assisted endovascular coil embolization technique: Case report	차의과학대 **김태곤**	17
14:40-15:30	**Special Lecture I**	좌장 : 가톨릭대 **신용삼**	
	1. FRED for treatment in Aneurysm, Technology & Application Overview and Experience		20
	2. Sofia Intermediate Catheter for its Clinical Application and Experience	**Dr. Duncan Mark Brooks**	
		(Interventional Radiology, St.Vincent's Private Hospital, Austin Health, Melbourne, Australia)	
15:30-15:50	***Break***		
15:50-16:40	**Special Lecture II**	좌장 : 울산대 **유승훈**	
	차 한잔에 담긴 아름다움	(사)한국차인연합회 부회장 **정선화**	24
16:40-16:50	***Transfer***		
16:50-17:50	**Free Paper II : "My first cases" by young guns**	좌장 : 가톨릭대 **성재훈**	
	Case 1. Intraprocedural rupture during the coil embolization of ICA bifurcation aneurysm	성균관대 **정연구**	28
	Case 2. Coil embolization for a small ruptured aneurysm in fenestrated anterior communicating artery mimicking large aneurysm in CT	울산대 **박성철**	29
	Case 3. My first two coil embolizations cases: Coil embolization followed by decompressive craniectomy for MCA ruptured aneurysm, Intraprocedural rupture during coil embolization for Acom ruptured aneurysm	부산대 **신태희**	30
	Case 4. Successful removal of herniated whole coil mass using stentriever in anterior choroidal artery aneurysm	가톨릭대 **이동훈**	31
	Case 5. Coil embolization for a ruptured PcomA aneurysm: A maiden flight of young neurovascular surgeon	순천향대 **박종현**	32
	Case 6. The coil is not moved during coil embolization	참조은병원 **김현곤**	33
16:50-17:50 장소 Ballroom	**Satellite Symposium for Nurses & Technicians** Current Endovascular Treatment(EVT) for Intracranial aneurysm	좌장 : 울산대 **권순찬**	
	Current status of EVT for intracranial aneurysm in Korea	울산대 **권순찬**	36
	Medication (Pre, during & Post-)	연세대 **박근영**	44
	Technique of EVT for intracranial aneurysm	경희대 **신희섭**	51
	질의응답		
17:50-18:10	**총회**		
18:30-20:00	**Official Dinner / 공연**		



6 / 16 Sat

12:30-13:30	**Luncheon Seminar**	좌장 : 경희대 **고준석**	
	Experiences of Neuroform Atlas Stent for Intracranial Aneurysm Treatment	**Prof. Hidenori Oishi** (Neurosurgery, Juntendo University, Japan)	54
13:30-14:30	**Scientific Symposium (Debate Session)**	좌장 : 서울대 **권오기**	
	Coil vs Clip in treatment of intracranial aneurysm	부산대 **이재일**	58
	Optimal Tx. for ruptured fusiform ICA aneurysm in elderly patient	영남대 **정영진**	67
	Open vs Closed cell stent in peri-aneurysmal stenosis	계명대 **김창현**	74
	Streamline vs FRED for UIA	원광대 **김대원**	79
	Pipeline vs FRED for UIA	가톨릭대 **최재호**	83
14:30-15:10	**Scientific Session (Review of aneurysm coils)**	좌장 : 순천향대 **김범태**	
	Axium Prime Coil	가톨릭대 **김성림**	86
	Orbit Galaxy Coil	서울대 **강현승**	88
	Microvention Coil	순천향대 **박석규**	93
	Target Coil	아주대 **임용철**	99
15:10-15:30	***Break***		
15:30-16:00	**Introduction of new endovascular devices (by company)**	좌장 : 분당제생병원 **신승훈**	
16:00-17:00	**Free Paper III: "Complication cases" session**	좌장 : 순천향대 **윤석만**, 영남대 **장철훈**	
	Case 1. Three cases of LVIS blue deployment failure in blood blister-like aneurysm at the distal ICA	중앙대 **남택균**	104
	Case 2. Endovascular trapping of anterior cerebral artery occlusion caused by migration of entire coils after endovascular coil embolization	영남대 **김종훈**	105
	Case 3. A series of complications during endovascular treatment of a systemic lupus erythematosus patient with multiple aneurysms	부산대 **고준경**	106
	Case 4. Unexpected coil migration during coiling for regrowing ruptured Acom aneurysm	순천향대 **오재상**	107
	Case 5. Multimodality treatment for coil migration during coil embolization	을지대 **정승영**	108
	Case 6. P2 fusiform aneurysm treated with LVIS blue-assisted coil embolization after failed PED flex placement: A case report and literature review	가톨릭대 **장동규**	109
17:00~	**Closing Remark**		
17:30~	**Farewell Dinner**		

발표자 및 좌장 준수사항

발표자 준수사항

1. 한 연제당 발표시간은 아래와 같습니다. 활발한 토론을 위하여 시간을 엄수해 주시기 바랍니다.

Free Paper:

Difficult case: **한 연제당 8분(5분 발표, 3분 토론)**

My first case & Complication case: **한 연제당 10분(6분 발표, 4분 토론)**

Special Lecture: **한 연제당 50분**

Satellite Symposium for Nurses & Technicians: **한 연제당 15분**

Scientific Symposium (Debate Session): **한 연제당 12분**

Scientific Session (Review of aneurysm coils): **한 연제당 10분**

2. **사전에** (최소한 발표 30분 이전에 회의장으로) **발표하실 자료를 제출바랍니다.**

3. 발표 시 개인 노트북은 사용할 수 없습니다.

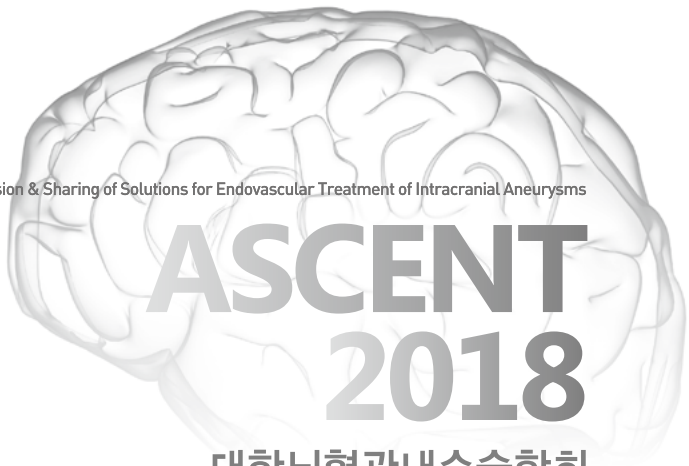
좌장 준수사항

1. 시간을 엄격히 지켜 주십시오.

2. 한두 사람에 의해 토론이 독점되지 않도록 진행하여 주십시오

3. 토론이 없을 경우를 대비하여 좋은 토론 내용을 미리 준비하시기 바랍니다.

4. 주제를 벗어난 부적절한 발언이나 토론 내용은 즉시 제지하여 주시기 바랍니다.



Theme: Vision & Sharing of Solutions for Endovascular Treatment of Intracranial Aneurysms

ASCENT 2018

대한뇌혈관내수술학회

Free Paper I : “Difficult cases” session

좌장 : 계명대 이창영, 연세에스병원 정진영

Case 1. Stent-assisted coiling of paraclinoid aneurysms with wide neck and diffi-cult geometry using LVIS Blue stent	계명대 **이창영**
Case 2. Flow diverter as a rescue therapy for a post stent assisted coiling recur-rence	연세대 **장창기**
Case 3. Stent-assisted coil embolization on down-the-barrel view with spring-shaped microcatheter in patient with M1 ultrawide necked circumferential aneu-rysm	전북대 **박정수**
Case 4. Intra-aneurysmal thrombosis during coiling for ruptured intracranial aneurysm: Treatment with intra-arterial tirofiban	대구가톨릭대 **곽영석**
Case 5. Difficulties of endovascular coiling at very small basilar artery bifurcation aneurysm which is ruptured	한양대 **송대효**
Case 6. Waffle cone in-stent technique for bifurcation aneurysms: A novel tech-nique for inevitable cases	울산대 **유승훈**
Case 7. Tailored endovascular treatment for anterior cerebral artery dissection presented with subarachnoid hemorrhage	가톨릭대 **김영우**
Case 8. Microcatheter and stent-assisted endovascular coil embolization tech-nique: Case report	차의과학대 **김태곤**

Case 1. Stent-assisted coiling of paraclinoid aneurysms with wide neck and difficult geometry using LVIS Blue stent

Chang-Young Lee

Department of Neurosurgery, Keimyung University School of Medicine

Objective: To describes stent-assisted coiling of paraclinoid aneurysms with wide neck and difficult geometry with LVIS Blue stent.

Methods: Stent-assisted coiling was performed using LVIS Blue for endovascular treatment of paraclinoid aneurysm with wide neck and difficult geometry, which was expected to be difficult to treat with other methods.

Result: The aneurysm was completely occluded and no procedure-related complications developed.

Conclusion: LVIS Blue stent may provide good wall apposition and high aneurysm neck coverage in endovascular treatment of wide-necked aneurysms in tortuous arteries

Case 2. Flow diverter as a rescue therapy for a post stent assisted coiling recurrence

Chang Ki Jang, Jae Whan Lee, Byung Moon Kim

Department of Radiology, Yonsei University College of Medicine

Objective: Flow diverting devices (FDDs) have revolutionized the treatment of morphologically complex intracranial aneurysms such as wide-necked, giant, or fusiform aneurysms and we did flow diverter for a post stent assisted coiling recurrence.

Result: A 21 years old female patient was admitted to our hospital with mild motor aphasia. Two weeks ago, she underwent stent assisted coiling in china for ruptured Lt distal internal cerebral artery aneurysm caused by motorcycle accident. MRI imaging demonstrated multi-focal small infarction in Lt hemisphere and wide cortical enhancement. Cerebral angiography demonstrated recurrence of coiling aneurysm. We decided immediately retreatment for that lesion because of previously ruptured aneurysm. First, we planned additional coiling through stent. But Excelsior SL-10 microcatheter navigated with traxcess microwire couldn't passed through stent strut, even though microwire was shaped as a loop in the sac. We decided to do flow diverter for rescue therapy. Successfully flow diverter was deployed across aneurysm neck. Final angiogram revealed prominent stagnation of intraluminal flow. Two weeks later, cerebral angiogram revealed no residual flow at the aneurysm and no in stent thrombosis.

Case 3. Stent-assisted coil embolization on down-the-barrel view with spring-shaped microcatheter in patient with M1 ultrawide necked circumferential aneurysm

Hyo Sung Kwak, Jung Soo Park, Eun Jeong Koh

Department of Neurosurgery, Chonbuk National University Hospital

Objective: We describe a technique for stent-assisted coil embolization with a spring-shaped microcatheter in a patient with an M1 ultrawide-necked circumferential aneurysm in the middle cerebral artery (MCA).

Methods: A 49-year-old man was referred for treatment of an incidentally detected M1 large-circumference aneurysm on magnetic resonance angiography. Subsequent digital subtraction angiography revealed an 18.2×16.5 mm ultrawide-necked circumferential aneurysm on the distal M1 portion of the left MCA, and we planned stent-assisted coil embolization using a spring-shaped microcatheter. After we deployed the stent, we performed coil embolization under the down-the-barrel view by pulling out the microcatheter little by little.

Result: Using this technique, we could fill the coil mass evenly into the aneurysmal sac around the stent. And there were no immediate or delayed complications after the procedure.

Conclusion: Stent-assisted coiling using a spring-shaped microcatheter may be a useful and safe technique for treating ultrawide-necked circumferential aneurysm or fusiform aneurysms.

Case 4. Intra-aneurysmal thrombosis during coiling for ruptured intracranial aneurysm: Treatment with intra-arterial tirofiban

Youngseok Kwak, JaeHoon Cho

Department of Neurosurgery, Daegu Catholic Medical Center

Objective: Spontaneous thrombosis of the aneurysm during attempting the first coil is rare. Some reports described recanalization of a spontaneous occluded ruptured aneurysm. We report a case of intra-aneurysmal thrombosis during coil embolization that was solved by intra-arterial tirofiban infusion.

Methods: 78 years old female presented with subarachnoid hemorrhage due to rupture of the superior cerebellar artery(SCA) aneurysm. Cerebral angiography revealed the small left SCA aneurysm with a narrow neck. During attempting the first coil, thrombosis occurred in the entire aneurysm and in the left SCA. We injected tirofiban near the aneurysm using another microcatheter. After injection of 0.75mg tirofiban, the left SCA and aneurysm neck were partially recanalized. We injected 0.25mg tirofiban further and inserted a small coil into the neck of the aneurysm.

Result: There was no change in neurological symptoms after procedure. On next day, diffusion weighted imaging revealed a few embolisms in the SCA territory. On 10 days, follow-up cerebral angiography showed minor recanalization of the aneurysm neck. She discharged without neurological deficit. We plan to perform follow-up angiography 2 months later.

Conclusion: Intra-arterial tirofiban infusion can be possible options for intra-aneurysmal thrombosis during coil embolization.

Case 5. Difficulties of endovascular coiling at very small basilar artery bifurcation aneurysm which is ruptured

Dae-Hyo Song, Hyeong-Joong Yi, Kyu-Sun Choi

Department of Neurosurgery, Hanyang University Medical Center, Seoul, Korea

Objective: Very small basilar artery bifurcation aneurysm ruptured cases reported, not a few. These cases have some difficulties of endovascular coiling. So, Intraprocedural rupture rate is higher than other aneurysms.

Methods: We described two cases of intraprocedural ruptured very small basilar artery bifurcation aneurysm during coiling. A 56-year-old man presented with severe headache due to subarachnoid hemorrhage. Preprocedural Hunt and Hess scale is grade 2 and modified Fisher scale is grade 4. In DSA, the aneurysm at basilar top was lobulated, and about 3.6x2.5mm. The patient underwent endovascular coiling in emergency. In the procedure, the aneurysm was ruptured during 2nd coil insertion. We continued more coil insertion. Three coils (Micrusphere 2.5/3.3, Target 360 US 2/6, Nano 1.5/2) are inserted without stent and two coils (Target 360 Nano 2/4, Deltaplush 1.5/3), failed. Finally, the patient discharged without neurologic deficit. A 78-year-old woman presented with moderate headache due to subarachnoid hemorrhage. Preprocedural Hunt and Hess scale is grade 2 and modified Fisher scale is grade 3. In first DSA, we judged the aneurysm has a deformed shape. In follow up DSA after 3 days, the aneurysm size and shape were changed. The aneurysm was about 1.6x2.5mm of daughter sac and broad-neck at the shoulder aspect of Lt BA-PCA P1. In the coiling procedure, stent (Enterprise stent 4/23 assisted coiling was performed in jail technique. Intraprocedural rupture during 1st coil (Target 360 Nano 2/4) insertion. So we continued to insert three more coils (Target 360 Nano 2/3, 2/3, 2/3) and the aneurysm could be completely obstructed. Repeated VA angiogram showed no evidence of contrast leakage. This patient discharged without neurologic deficit, like a previous patient.

Result: There are several reasons that very small aneurysm ruptured SAH coiling is difficult. First, Protrusion to the parent artery during coiling often occur due to that very small aneurysm has relatively wide neck. And during coiling, very small space in aneurysm increases friction against aneurysmal wall.

Conclusion: Strategy of very small ruptured aneurysm in coiling is necessary. There are considering of more soft and shortest coil (reshape), considering stent or balloon assisted (Wide neck, unstable coil position), and location of microcatheter on the aneurysmal neck.

Case 6. Waffle cone in-stent technique for bifurcation aneurysms: A novel technique for inevitable cases

Seung-Hoon You, Seong-Cheol Park, Su-Hee Cho

Department of Neurosurgery, Gangneung Asan Hospital, College of Medicine, Ulsan University

Objective: Aneurysms at bifurcation are difficult to treat with endovascular methods, in general. We report a novel technique, so called Waffle cone in-stent, for stent-assisted coil embolization for bifurcation aneurysm in which one or both branches are originated at the side wall of the aneurysm.

Methods: We have treated two cases of bifurcation aneurysms with Waffle cone in-stent technique. First case is Basilar tip aneurysm in which Lt PCA was not difficult to engage with wire and catheter, but we could not access Rt PCA. Therefore, we had no choice but to deploy stent to Lt PCA first and then did partial embolization with two-catheter technique. Three months after first session, we tried to deploy stent from the sac to mid basilar artery in which previously stent was deployed. And then it was possible to fill the sac compactly without compromise of Rt PCA. Second case is AComA aneurysm with same situation. We did stenting to Lt ACA first and then stenting from the sac to Lt A1 subsequently. And we could fill the sac compactly without any compromise of both ACA.

Result: All two cases were treated successfully and no peri-procedural untoward events occurred with the Waffle cone in-stent technique.

Conclusion: Although its performance seems to be complex and difficult, this technique may be a very useful method in certain conditions, such as inaccessible branch, suitable sac size, and inevitable needs for endovascular treatment of bifurcation aneurysms.

Case 7. Tailored endovascular treatment for anterior cerebral artery dissection presented with subarachnoid hemorrhage

Young Woo Kim

Department of Neurosurgery, Uijeongbu St. Mary's Hospital, The Catholic University of Korea

Objective: Intracranial dissection in the anterior circulation is relative rare, especially in the anterior cerebral artery (ACA), In addition, only several cases of ACA dissection that underwent endovascular treatment have been reported. Here we present a case of ACA dissection causing subarachnoid hemorrhage, successfully treated by tailored endovascular treatment (stent-protecting parent artery occlusion).

Methods: A 37-year-old man was admitted with sudden bursting headache which was followed by stuporous mentality. Computed tomography revealed subarachnoid hemorrhage and cerebral angiography showed fusiform dilatation from the right A1 to right A2, suggesting intracranial dissection.

Result: Both carotid arteries were catheterized with two guiding catheters through bilateral transfemoral puncture under general anesthesia. First, one microcatheter through the left guiding catheter (Prowler select plus) was navigated from left A1 to right A2 and the stent (Enterprise 4mm x 30mm) was placed to protect A-com and right A2. The other microcatheter through right guiding catheter (Excelsior SL-10) was navigated into the dissected right A1 segment. The aneurysm along with the parent vessel (right A1) was occluded 10 coils. Angiography performed immediately after the procedure showed occlusion of the parent vessel with no filling of the aneurysm with patent flow of right A2. No ischemic complications were seen in the diffusion-weighted image. The two-month follow-up angiography did not show any recanalization.

Conclusion: To prevent ischemia in the territory fed by specific artery, tailored endovascular treatment, based on individual anatomic variation or lesion, should be considered and might be superior to simple parent artery occlusion.

Case 8. Microcatheter and stent-assisted endovascular coil embolization technique: Case report

Tae Gon Kim1, Sang Heum Kim2, Dong Ik Kim2

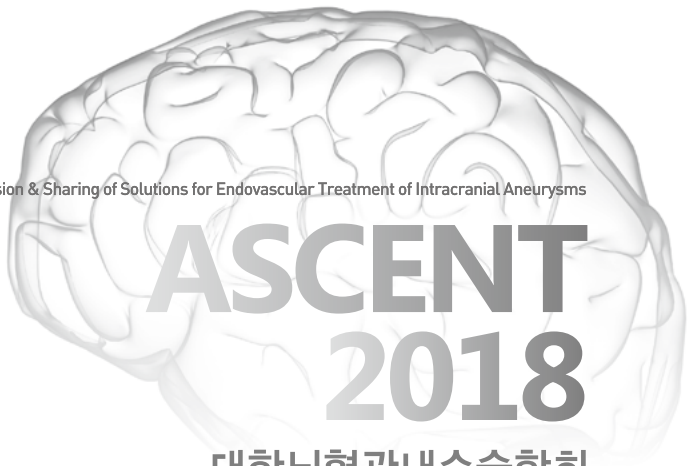
Department of 1Neurosurgery, 2Neuroradiology, CHA Bundang Medical Center,
CHA University School of Medicine

Objective: This report describes a case of patient with a ruptured internal carotid artery-posterior communicating (IC-Pcom) artery aneurysm, which was successfully treated using microcathter and stent-assisted endovascular coil embolization technique.

Methods: An 80-year-old woman was admitted to our hospital complaining of severe headache and mental deterioration. She suffered from hypertension for 20 years, which has been well controlled. In neurological examination, she showed deep stupor mental state and Lt. hemiplegia. Her brain CT scan showed diffuse subarachnoid hemorrhage and right sylvian hemorrhage. Brain CT angiography and conventional cerebral angiography revealed the ruptured Rt. IC-Pcom aneurysm, which shape was irregularly saccular and the size was about 20 mm. The gap between right distal internal cerebral artery and right IC-Pcom was too wide.

Result: We performed microcather and stent-assisted endovascular coil embolization using 23 coils and the aneurysmal occlusion was totally complete. After the coiling, stereotactic catheter insertion and hematoma drainage was performed.

Conclusion: We successfully performed microcathter and stent-assisted endovascular coil embolization in the patient with ruptured IC-Pcom aneurysms. In the case of aneurysm with the complicated shape and geometry, it may be helpful to get assistance from various instruments.



Theme: Vision & Sharing of Solutions for Endovascular Treatment of Intracranial Aneurysms

ASCENT 2018

대한뇌혈관내수술학회

Special Lecture I

좌장 : 가톨릭대 신용삼

1. FRED for treatment in Aneurysm, Technology & Application Overview and Experience

2. Sofia Intermediate Catheter for its Clinical Application and Experience

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Dr. Duncan Mark Brooks

Interventional Radiology, St.Vincent's Private Hospital, Austin Health, Melbourne, Australia

Duncan Mark Brooks

Interventional Radiology, St. Vincent's Private Hospital,
Austin Health, Melbourne, Australia

Current appointments:	Commenced August 1995 Radiologist, Austin Health Commenced January 2005 Interventional radiologist Warringal Private Hospital Commenced Nov 2010 Interventional radiologist, interventional neuroradiologist St Vincents Hospital Melbourne Commenced Nov 2010 Interventional radiologist, interventional neuroradiologist, St Vincents Private Hospital Melbourne
Secondary Education	1974 – 1979 Scotch College, Melbourne HSC in Physics, Chemistry, Pure and Applied Mathematics, English
Tertiary Education	1980 – 1985 Monash University, Melbourne
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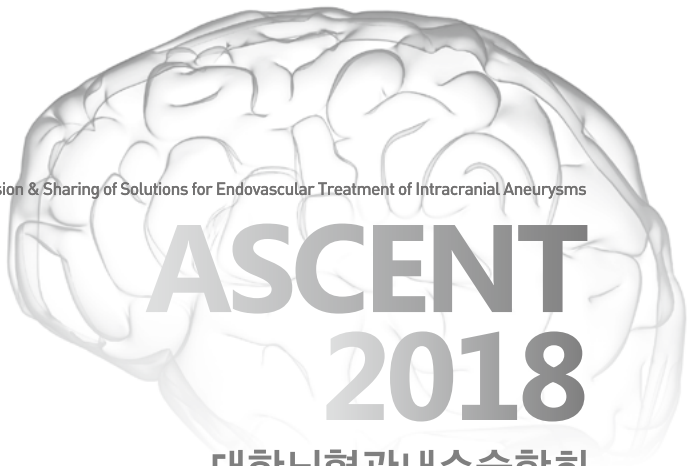
Email	mark.brooks@austin.org.au
Memberships	RANZCR, IRSA, ANZSNR
Clinical Posts Held	Jan 1986 – 1987 Internship, Alfred Hospital, Melbourne Jan 1987 – 1988 Resident Medical Officer, Alfred Hospital, Melbourne Jan 1988 – 1989 Resident Medical Officer, Caulfield Hospital, Melbourne
Radiology Posts Held	Jan 1989 – 1994 Radiology Registrar, Austin Hospital, Melbourne Jan – March 1994 Locum Radiologist, Mercy Hospital for Women, Melbourne March – June 1994 Locum Radiologist, Radclin Medical Imaging, Cabrini and John Faulkner Hospitals, Melbourne July 1994 – 1995 Cook Research Fellow in Interventional Radiology, Hammersmith Hospital, London. Honorary senior registrar Royal Postgraduate Medical School. June 2005 – June 2011 Interventional Radiologist Northern Hospital, Epping Feb 2009 – Feb 2010 Fellow in Interventional Neuroradiology Monash Medical Centre, Melbourne
Interventional Radiology Teaching	Training workshop in Interventional Neuroradiology (INR) – 2017, VascuLab Melbourne Training workshop in Interventional Radiology (IR) – 2017, VascuLab Melbourne Training workshop in Interventional Radiology (IR) – 2017, VascuLab Melbourne
Professional Interests	Interventional Neuroradiology technical and clinical aspects. Acute stroke intervention Branched and Fenestrated Stent Grafts. TIPS and alternative treatments for portal hypertension. Clinical and technical developments in interventional radiology

1. FRED for treatment in Aneurysm, Technology & Application Overview and Experience
2. Sofia Intermediate Catheter for its Clinical Application and Experience

Duncan Mark Brooks

Interventional Radiology, St. Vincent's Private Hospital, Austin Health, Melbourne, Australia



Theme: Vision & Sharing of Solutions for Endovascular Treatment of Intracranial Aneurysms

ASCENT 2018

대한뇌혈관내수술학회

Special Lecture II

좌장 : 울산대 유승훈

차 한잔에 담긴 아름다움

(사)한국차인연합회 부회장 **정선화**

정 선 화

(사) 한국차인연합회 부회장

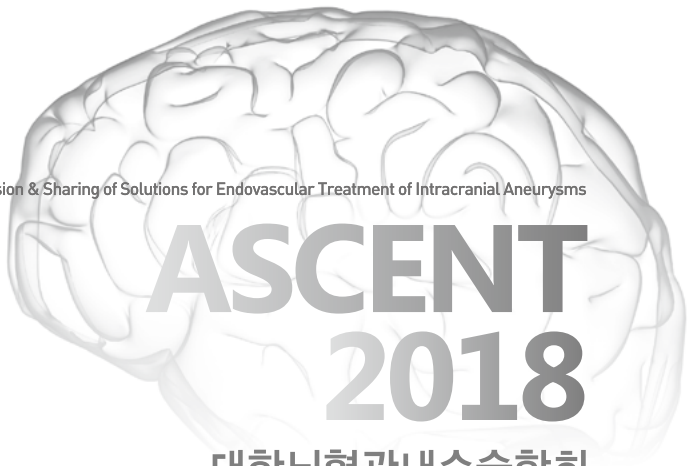
경력

한국불교차인중앙회 재무
강릉문화원 다도 전임교수
강릉문인협회 이사
(사)강릉다연다례원 원장
전통다실 다생다연 운영

차 한잔에 담긴 아름다움

정선화

(사)한국차인연합회 부회장



Theme: Vision & Sharing of Solutions for Endovascular Treatment of Intracranial Aneurysms

ASCENT 2018

대한뇌혈관내수술학회

Free Paper II : "My first cases" by young guns

좌장 : 가톨릭대 **성재훈**

Case 1. Intraprocedural rupture during the coil embolization of ICA bifurcation aneurysm	성균관대 **정연구**
Case 2. Coil embolization for a small ruptured aneurysm in fenestrated anterior communicating artery mimicking large aneurysm in CT	울산대 **박성철**
Case 3. My first two coil embolizations cases: Coil embolization followed by de-compressive craniectomy for MCA ruptured aneurysm, Intraprocedural rup-ture during coil embolization for Acom ruptured aneurysm	부산대 **신태희**
Case 4. Successful removal of herniated whole coil mass using stentriever in anterior choroidal artery aneurysm	가톨릭대 **이동훈**
Case 5. Coil embolization for a ruptured PcomA aneurysm: A maiden flight of young neurovascular surgeon	순천향대 **박종현**
Case 6. The coil is not moved during coil embolization	참조은병원 **김현곤**

Case 1. Intraprocedural rupture during the coil embolization of ICA bifurcation aneurysm

Yeongu Chung1, Yu Sam Won1, Myeongho Roh2

Department of 1Neurosurgery and 2Radiology, Kangbuk Samsung Hospital,
Sungkyunkwan University School of Medicine

Objective: The incidence of periprocedural complications during the coil embolization is about 6.9%. Among them, intraprocedural rupture is one of the most dangerous complication and makes the beginner endovascular surgeon panic.

Methods: This report describes author's first case of intraprocedural rupture of ICA bifurcation aneurysm. A 36-year-old man was admitted to our hospital complaining of severe headache. Neurological examination showed no focal neurologic deficits. A brain CT angiography showed the small amount of subarchnoid hemorrhage on basal cistern and sylvian fissure with suspicious ruptured ICA bifurcation aneurysm with a size of 8.2mm x 6.2mm which had a relatively good dome-to-neck ratio (neck 2.6mm).

Result: We planned to perform a coil embolization due to favorable dome-to-neck ratio and small amount of subarachnoid hemorrhage. After insertion of frame coil, parent artery was preserved and confirmed the patency. However, during the insertion of third coil, coil loop was escaped from the aneurysmal sac inferolaterally and contrast media leakage was occurred. Fortunately, additional two coil were inserted and contrast leakage was stopped after about 3 minutes. Finally, total seven coils packing was performed successfully with double microcatheters.

Conclusion: Intraprocedural rupture is relatively common complication to endovascular neurosurgeon and always makes the operator panic. To avoid this complication, preprocedural review of 3-dimensional angiographic imaging was needed. Above all, selection of proper microcatheter and stabilization of microcatheter in the aneurysmal sac would be the most important considerations.

Case 2. Coil embolization for a small ruptured aneurysm in fenestrated anterior communicating artery mimicking large aneurysm in CT

Seong-Cheol Park, Su Hee Cho, Seung-Hoon You
Department of Neurosurgery, Gangneung Asan Hospital, University of Ulsan College of Medicine

Objective: A ruptured aneurysm case in fenestrated a-com was reported. This aneurysm was embolized by endovascular technique.

Methods: A 53 years old female visited ER with acute loss of consciousness and vomiting. Light reflex was 3mm/3mm sluggish/sluggish and GCS score was E1M4V1. CT showed a large aneurysm with 5 x 10 mm size in a-com protruded to left frontal lobe. Fisher grade was IV. In follow-up CT, contrast leakage from CT angiography was found. In angiogram, a small 1.5 mm sized aneurysm in proximal portion of fenestrated a-com in left side was found.

Result: Aneurysm was approached through left A1. Aneurysm was selected with S-shape microcatheter and embolized with a single coil of 1mm/2 size. After embolization, the catheter moved and the aneurysm could not be selected. No blood flow into the aneurysm was observed. Two weeks after the procedure, the patient recovered with neurologic deficit. In the post-procedure 6-month angiography, the aneurysm was occluded without blood flow into the aneurysm.

Conclusion: Small size aneurysm may mimic a large aneurysm when an active bleeding is present. A small a-com aneurysm embolization case was reported.

Case 3. My first two coil embolization cases: Coil embolization followed by decompressive craniectomy for MCA ruptured aneurysm: Intraprocedural rupture during coil embolization for Acom ruptured aneurysm

신태희1, 황보리2, 김수희1, 이재일1, 고준경1, 이태홍2

부산대학교병원 신경외과1, 영상의학과2

Objective: This presentation describes what beginner felt when he had endovascular operations for the first time.

Methods: The endovascular operations have been carried out recently by beginner.

Result: Case 1 A 65 years-old female patient visited our hospital in a semi-coma. She performed unruptured Pcom aneurysm clipping 10 years ago. Non-enhanced Brain CT showed SAH with temporal lobe ICH. We performed coil embolization for MCA ruptured aneurysm with two catheter technique. Then decompressive craniectomy was done. Case 2 A 57 years-old male patient visited our hospital in a drowsiness accompanying severe headache. Brain CT showed typical SAH without ICH. We performed coil embolization for Acom ruptured aneurysm. During procedure, intra-procedural rupture occurred by microcatheter penetrated the aneurysmal wall. We carried out this problem properly. Post operative CT showed frontal lobe ICH that previously nonexistent. Luckily, he discharged without deficit.

Conclusion: There is much consideration doing endovascular operations performed by beginner.

Case 4. Successful removal of herniated whole coil mass using stentriever in anterior choroidal artery aneurysm

Dong Hoon Lee, Jae Hoon Sung, Min Hyung Lee

Department of Neurosurgery, St. Vincent's Hospital, The Catholic University of Korea

Objective: Forty-years-old female presented with burst headache. Initial Computerized tomography shows subarachnoid hemorrhage (SAH). Digital subtraction angiography (DSA) showed the saccular aneurysm at left posterior communicating artery (PCOM, neck x width x depth 2.1 x 3.9 x 2.1 mm) and left anterior choroidal artery (AChA, 2.47 x 3.43 x 2.00 mm). Endovascular intervention was planned for treatment of these aneurysms.

Methods: After uneventful embolization of the AChA artery aneurysm, the PCOM aneurysm was selected with an Excelsior SL-10, pre-shaped 90° microcatheter over a Traxcess 14 microwire. Embolization was initiated using Target Nano coil of 3 mm x 4 cm. Following the placement of the second Target nano coil with a size of 2.5 mm × 4 cm, the left AchA was not visualized immediately. Concerns about neurological deficit, we planned intra-arterial thrombolysis using a Tirofiban for recanalization. Placing the microcatheter as close as possible to the AChA for injecting Tirofiban, microcatheter pushed the coils and moved to inside the AChA aneurysm. Concurrently the whole coils rolled out the aneurysm and the occluded AChA was visible.

Result: After deliberation, the Solitaire FR (6x40mm) retriever used in an attempt to retrieve the coil. The stent retriever has been deployed adjacent to the errant, rolled out coils. After confirming that the stent captured the coil, the stent retriever is pulled from the intracranial circulation with coil engaged, past the existing coil mass. The coil is successfully removed, without disruption of the remaining coil within the PCOM aneurysm. The AchA aneurysm was selected again and embolization was concluded using Target nano coil of 2.5 mm x 4 cm and following the second Microplex VFC coil with a size of 1 mm × 3 cm. The mild to moderate left MCA vasospasm on TCD persisted for 18 days after the procedure, but examination at the time of discharge showed the patient to be neurologically intact with no deficits in vision and strength discrepancy between the right and left side.

Conclusion: Herniated whole coil mass which is not migrated distally can be successfully removed using stentriever in selected cases of cerebral aneurysm.

Case 5. Coil embolization for a ruptured PcomA aneurysm: A maiden flight of young neurovascular surgeon

Jong-Hyun Park, Dong-Sung Shin, Bum-Tae Kim

Department of Neurosurgery, Soonchunhyang University Bucheon Hospital

Objective: We report the first case of the coil embolization with a ruptured posterior communicating artery aneurysm performed by young neurovascular surgeon.

Methods: On days 10 after an elective cesarean section, a 38-year-old woman developed sudden-onset severe headaches followed by generalized seizures. CT scan demonstrated subarachnoid hemorrhage in bilateral sylvian fissure and basal cistern. Her cerebral angiogram showed the right posterior communicating artery aneurysm sized 7.4mm X 4.71 mm with luminal irregularity of distal ICA

Result: Numerous treatment options were considered, including microsurgery, but we felt that she would benefit from the coil embolization. After the microwire and microcatheter were positioned uneventfully, we finished deployment of the initial framing coil. We then deployed four additional coils with special attention directed towards avoiding encroachment of the coils at the origin of the ICA. Immediate angiogram demonstrated full patency of the ICA and occlusion of the aneurysm. Follow up MRI and MRA scan demonstrated excellent apposition of the coil, patency of the ICA, and no untoward findings

Conclusion: Endovascular treatment for a ruptured posterior communicating artery aneurysm is challenging for young neurovascular surgeon. With the coming up of endovascular coiling as a standard therapy for treatment of cerebral aneurysms, more effort for progress in gaining experience is required for young neurovascular surgeon

Case 6. The coil is not moved during coil embolization

Hyun Gon Kim, Jae Heung Ahn

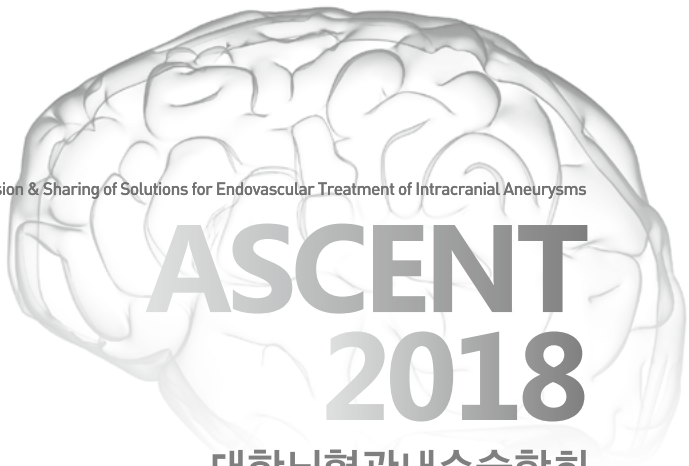
Department of Neurosurgery, Chamjoeun Hospital

Objective: Endovascular coiling should be considered when ruptured aneurysms were found. Consequently, the use of coiling for ruptured intracranial aneurysms has been increasing. Early rebleeding after coil embolization of ruptured intracranial aneurysms is not common, however high mortality and morbidity have been reported. There are many complications during coiling procedure, so I want to share the advices.

Methods: A 48-year-old man excercised push-up and presented with severe headache suddenly one days before outpatient clinic. Brain computer tomography(CT) revealed intracerebral hematoma(ICH) in right frontal lobe with small subarachnoid hemorrhage(SAH). Brain CT angiography (CTA) and cerebral angiography revealed anterior communicating artery aneurysm ruptured. The aneurysm had anterior direction and maximum diameter of 12.4mm, neck diameter of 5mm, height diameter of 8mm.

Result: Endovascular coiling was performed immediately. 13 target detachable coils(TDCs) were used, last TDC 3D 3mmx 8cm was used and aborted. Last TDC about 1cm was inserted, but not moved. It was tried to recapture coil for 1 hours. Microcatheter (Excelsior SL-10 preshape 45) and wire(Synchro) was pushed and pulled several times.

Conclusion: Fortunately, the patient had no neurologic deficit without headache. The previous ICH was expanded slightly on post-op brain CT. In beginner, I experience many problems during procedure, I want to share information with seniors.



Theme: Vision & Sharing of Solutions for Endovascular Treatment of Intracranial Aneurysms

ASCENT 2018

대한뇌혈관내수술학회

Satellite Symposium for Nurses & Technicians

Current Endovascular Treatment(EVT) for Intracranial aneurysm

좌장 : 울산대 **권순찬**

Current status of EVT for intracranial aneurysm in Korea	울산대 **권순찬**
Medication (Pre, during & Post-)	연세대 **박근영**
Technique of EVT for intracranial aneurysm	경희대 **신희섭**

권 순 찬

울산대학교병원 신경외과

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Editorial Board	Journal of Cerebrovascular and Endovascular Neurosurgery (JCEN) Review Board Journal of Korean Neurosurgical Society (JKNS)
Honors and Awards	2015.04. 봉생학술상 2017.02. 남천학술상

Current status of EVT for intracranial aneurysm in Korea

권순찬

울산대학교병원 신경외과

Current Status of EVT for Intracranial Aneurysm in Korea

KWON, SoonChan M.D., Ph.D.

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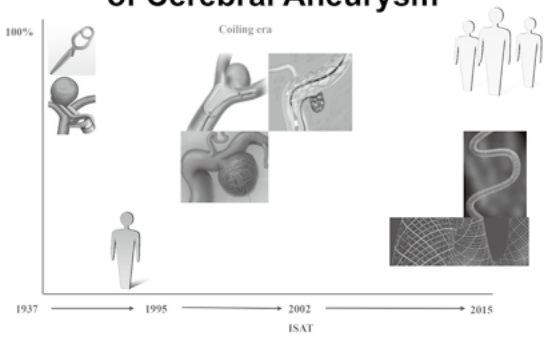
Trend of endovascular treatment of Cerebral Aneurysm



Endovascular Coil Embolization for Cbr. Aneurysm

The Rise of Endovascular Treatment of Cerebral Aneurysms

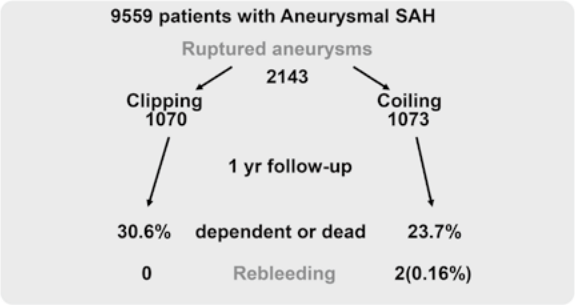
❖ The Guglielmi "detachable" coil

- Developed in the 1980s
- First use in a human brain An. in 1990
- FDA approval in 1995
- KFDA approval in 1996

Initial Recommendation for Aneurysm Coiling by FDA

- Very high risk for management by traditional neurosurgical techniques
- Inoperable

ISAT Report (Lancet, 2002)



Generally Accepted Concepts for Endovascular Coiling

- Protective against subsequent re-hemorrhage
- Many Ans. were not completely occluded by coiling.
  - Potential risks of delayed recurrence
  - the need for retreatment
  - the possibility of new SAH

Guidelines for the Management of Intra-cranial Aneurysms

Guidelines for the Management of Intra-cranial Aneurysms

1. European Stroke Organization Guidelines for the Management of Intracranial Aneurysms and Subarachnoid Haemorrhage. (Steiner T, et al., Cerebrovasc Dis. 2013; 35: 93-112)

2. Treatment of Cerebral Aneurysms-Surgical Clipping or Endovascular Coiling: The Guiding Principles. (Shivashankar R, et al., Semin Neurol. 2013; 33(5): 476-487)

3. Clinical Practice Guideline for the Management of Intracranial Aneurysms. (Jeong HW, et al., Neurointervention. 2014; 9: 63-71)

4. Guidelines for the Management of Patients With Unruptured Intracranial Aneurysms: A Guideline for Healthcare Professionals From the Americal Heart Association/American Stroke Association. (Thompson BG, et al., Stroke. 2015; 46: 2368-2400)

Guidelines for the Management of Intra-cranial Aneurysms

- Determination of aneurysm treatment should be a multidisciplinary decision based on characteristics of the patient and the aneurysm.
- Both surgical clipping and endovascular coiling for cerebral aneurysm is recommended to be performed at higher-volume center.
- For the aneurysms to be technically amenable to both coiling and clipping, endovascular coiling should be considered.

Guidelines for the Management of Intra-cranial Aneurysms

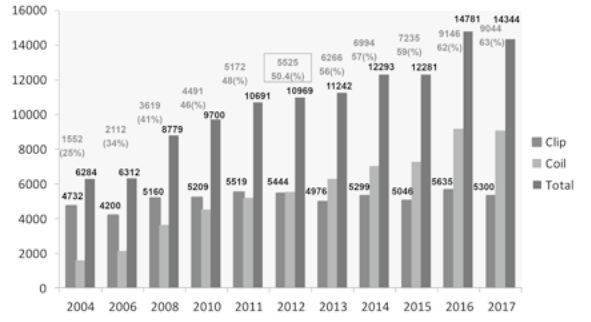
❖ Surgical clipping has slightly more effectiveness over endovascular coiling (Class I, LOE B vs. Class IIa, LOE B).

❖ Endovascular coiling is associated with a reduction in procedural morbidity and mortality over surgical clipping in selected cases, but has an overall higher risk of recurrence.

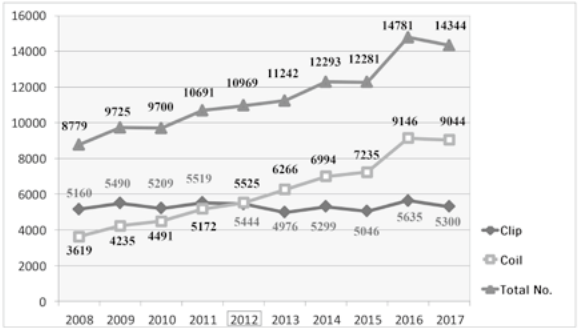
Recent Trend in Treatment of Intracranial Aneurysms in Korea: Clipping vs. Coiling

Data from the national health-claim database by the Korean Health Insurance Review & Assessment Service (HIRA)

Cbr. Ans. in Korea: Clipping vs. Coiling

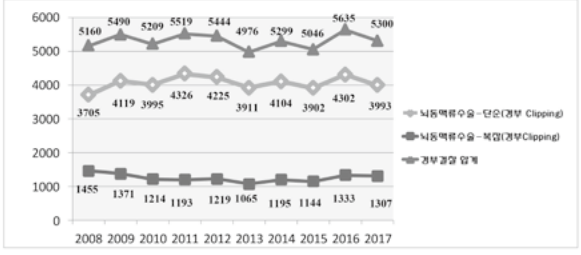


Cbr. Ans. in Korea: Clipping vs. Coiling



Clipping for Cbr. Ans. in Korea

❖ 2008년부터 2018년까지 경부결찰술은 2.7% 증가 (연평균 0.3%)
❖ 단순 Code 비중이 증가하며, 복잡 Code는 steady



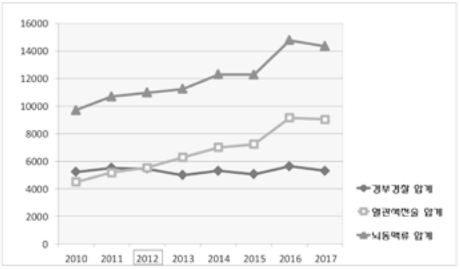
Coiling for Cbr. Ans. in Korea

❖ 2008년부터 2018년까지 색전술은 149.9% 증가(연평균 16.7%)
❖ 기타(단순, Simple), 보조물 지지(복잡) code 모두 증가세

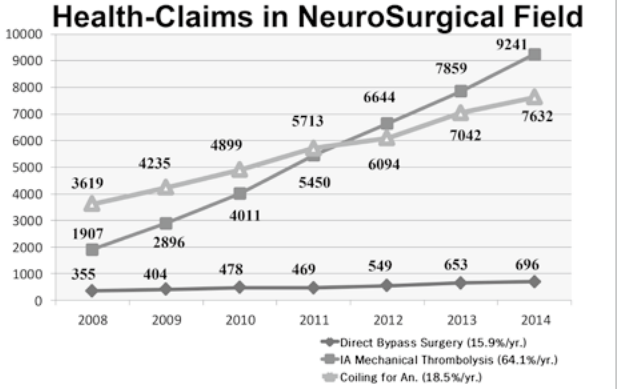
Management of Cbr. Ans. in Korea

❖ 전체동맥류 – 치료건수 연평균 6.8%증가세 / 치료비용 연평균 8.8% 증가세

경부결찰술 – 치료건수 연평균 0.2% 증가세 / 치료비용 연평균 10.5% 증가세
열관색전술 – 치료건수 연평균 14.5% 증가세 / 치료비용 연평균 13.0% 증가세

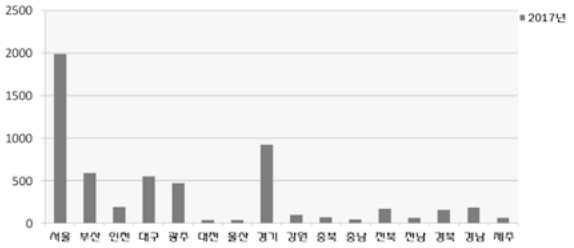


Recently Increasing Items of National Health-Claims in NeuroSurgical Field



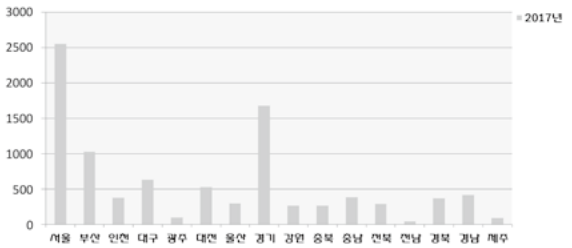
Cerebral Aneurysm

❖ 경부결찰술, 2017년 전국분포
❖ 서울/경기 집중 비율: 54.8% (2904/5300)



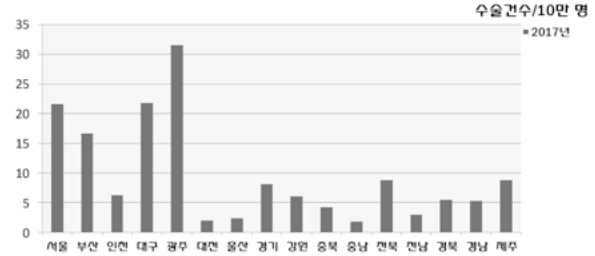
Cerebral Aneurysm

❖ 코일색전술, 2017년 전국분포
❖ 서울/경기 집중 비율: 46.7% (4223/9044)
: 경부결찰술에 비해 시도간 차이가 적음??



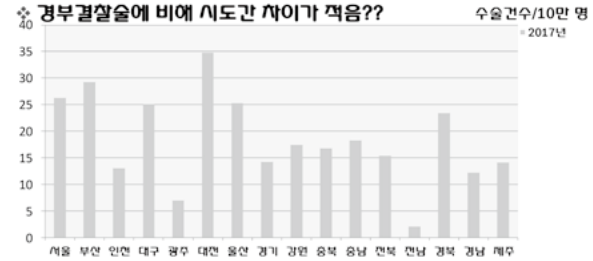
Cerebral Aneurysm

❖ 경부결찰술
❖ 2017년 전국분포: 수술건수/10만 명
❖ 서울/경기 집중 비율: 19.3% (29.7/153.9)



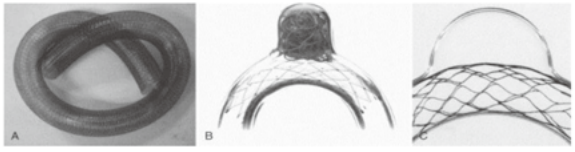
Cerebral Aneurysm

❖ 코일색전술
❖ 2017년 전국분포: 수술건수/10만 명
❖ 서울/경기 집중 비율: 13.8% (40.5/294.4)
❖ 경부결찰술에 비해 시도간 차이가 적음??



Flow Diverting Technique

❖ Concepts of endo-luminal flow diverters
: stent-like devices with high metal surface-area coverage (low porosity, 30 - 35% metal surface area)
cf. usual SEIM: 6.5 - 9%



Flow Diverting Technique

❖ Limitations

- technical difficulty including navigation & deployment
- possibility of ischemic stroke due to perforating artery occlusion
- delayed aneurysm rupture
- unknown antiplatelet medication

Why Endo-luminal Technique (Flow Diversion)?

❖ Sometimes, Endosaccular techniques are far more technically challenging, esp. in cases of the larger and /or more complex aneurysm neck, which can encompass > 180 degrees of the cross sectional vessel circumference.

❖ Collectively, incomplete coiling & recurrence represent serious limitation of the endosaccular methods.
- Even though new coil technologies including bioactive coils

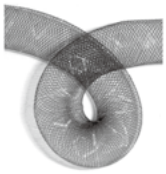
Why Endo-luminal Technique?

❖ Endosaccular method is limited to therapeutic attack upon the aneurysmal sac.
: An angiographically normal-appearing parent artery may suffer from a more widespread mural deficiency.

❖ Theoretically primary parent artery reconstruction looks more physiologic and biologic.

What is the Flow Diverter?

❖ Pipeline Embolization Device (PED, PED Flex)
Silk, FRED, Surpass etc.



❖ Microcatheter delivered
❖ Flexible
❖ Radio-opaque
❖ Allows anatomical reconstruction of the vessel

Flow Diverters

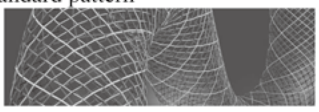
1) Silk (Balt, Montomercy, France)
2) PED & PED FLEX (Medtronic, Irvine, CA)
3) Surpass (Stryker, Fremont, CA)
4) FRED (Microvention, Tustin, CA)

5) NeuroEndoGraft (Stryker, Fremont, CA)
6) Derivo (Acandis, Pforzheim, Germany)
7) P64 (phenox, Bochum, Germany)

What is the Flow Diverter?

❖ Pipeline Embolization Device (PED, PED Flex)

- Flexible self-expanding mesh-like device
- Bi-metallic self expanding braid designed
- Balance visibility & radial strength
  25% platinum tungsten
  75% cobalt chromium
- 48 strands interwoven in standard pattern
- 30-35% surface coverage



❖ Korean Indication for Flow Diverter

Ⅲ. 기료재료

5. 중재적시술료

제 목	세부인정사항
Flow-diverter를 이용한 뇌동맥류 색전술용 색전 기구(Embolization Device)의 급여기준	Flow-diverter를 이용한 뇌동맥류 색전술시 사용하는 색전 기구(Embolization Device)의 인정기준은 다음과 같음. - 다 음 - 가. 적응증 (1) 직경 15mm이상의 비파열성 뇌동맥류 (2) 직경 15mm미만의 비파열성 뇌동맥류 중 다음의 경우 사례별로 인정 - 내경동맥 원위부의 수포성 뇌동맥류 - 방추형 뇌동맥류 - 척추동맥의 박리형 뇌동맥류 나. 인정개수 : 1개 다만, 환자의 상태나 동맥류의 해부학적 특성 등으로 불가피하게 인정개수를 초과하여 사용하는 경우에는 의사소견서 및 진료기록부 등 관련 자료를 첨부하여야 하며 제출된 관련 자료를 참조하여 요양급여를 인정함. 다. 뇌동맥류 색전술용 Micro Coil과의 별품사용은 인정하지 아니함.

❖ Why Flow Diverter???

ORIGINAL RESEARCH
INTERVENTIONAL

International Retrospective Study of the Pipeline Embolization Device: A Multicenter Aneurysm Treatment Study

D.F. Kallmes, R. Hanel, D. Lopes, E. Boccardi, A. Bonafé, S. Cekirge, D. Fiorella, P. Jabbour, E. Levy, C. McDougall, A. Siddiqui, I. Sirokora, H. Woo, F. Albuquerque, H. Bozorgchami, S.K. Dashti, J.E. Delgado Almandoz, M.E. Kelly, R. Turner IV, B.K. Woodward, W. Brinjikji, G. Lanzino, and P. Lylyk

ABSTRACT

BACKGROUND AND PURPOSE: Flow diverters are increasingly used in the endovascular treatment of intracranial aneurysms. Our aim was to determine neurologic complication rates following Pipeline Embolization Device placement for intracranial aneurysm treatment in a real-world setting.

MATERIALS AND METHODS: We retrospectively evaluated all patients with intracranial aneurysms treated with the Pipeline Embolization Device between July 2008 and February 2015 in 31 centers worldwide. We defined 4 subgroups: internal carotid artery aneurysms of ≥10 mm, ICA aneurysms of <10 mm, other anterior circulation aneurysms, and posterior circulation aneurysms. Neurologic complications included spontaneous rupture, intracranial hemorrhage, ischemic stroke, permanent cranial neuropathy, and mortality. Comparisons were made with *t* tests or ANOVA for continuous variables and the Pearson χ^2 or Fisher exact test for category variables.

RESULTS: In total, 793 patients with 956 aneurysms were included. The neurologic morbidity and mortality rate was 8.4% (67/793), highest in the posterior circulation group (16.4%, 9/55) and lowest in the ICA <10-mm group (4.8%, 14/294) ($P = .19$). The spontaneous rupture rate was 0.6% (5/793). The intracranial hemorrhage rate was 1.4% (9/793), ischemic stroke rates were 4.7% (37/793), highest in patients with posterior circulation aneurysms (7.3%, 4/55) and lowest in the ICA <10-mm group (2.7%, 8/294) ($P = .36$). Neurologic mortality was 3.8% (30/793), highest in the posterior circulation group (9.9%, 6/55) and lowest in the anterior circulation ICA <10-mm group (0.4%, 4/294) ($P < .19$).

CONCLUSIONS: Aneurysm treatment with the Pipeline Embolization Device is associated with the lowest complication rates when used to treat small ICA aneurysms. Procedure-related morbidity and mortality are higher in the treatment of posterior circulation and giant aneurysms.

ABBREVIATIONS: IntraPED = International Retrospective Study of Pipeline Embolization Device; IPH = intraparenchymal hemorrhage; PED = Pipeline Embolization Device

Result

End point	Value	significant meaning for each end point
Rupture	0.6%	giant 4.5% within 30 days
IPH	2.4%	no difference 14/19 within 30days
Ischemic stroke	4.7%	giant 14.5% (vs. small 2.8%) posteriaor7.3% (vs. ICA <10mm 2.7%)
Stenosis	0.3%	acceptable comparing coil assistant coiling
Neuropathy	0.3%	no difference
Mortality	3.8%	giant 9.6% (vs. small 1.8%) posterior 10.9% (vs. ICA <10mm 1.4%) ruptured 10.8%
M&M	7.4%	giant 25.8% (vs. small 5.4%) posteriaor16.4% (vs. ICA <10mm 4.8%)
Multi PED	34.2%	ICA ≥ 10mm 40.6%

❖ Problems / Complications with flow diverter we can NOT solve / understand

- Decrease in Mass Effect is not predictable.
- Delayed Rupture
- Delayed ipsilateral hemorrhage
- Peri-aneurysmal Inflammation

Delayed Aneurysm Rupture

ORIGINAL RESEARCH

Intra-Aneurysmal Thrombosis as a Possible Cause of Delayed Aneurysm Rupture after Flow-Diversion Treatment

AJNR Am J Neuroradiol. 2011 Jan; 32(1): 20-25

- ❖ Clinical: 11 of 13 were symptomatic pts.
- ❖ Location: - cavernous 2
  - supraclinoid 8
  - basilar 3
- ❖ Size: mean diameter of 22mm
- ❖ FDs alone may modify hemodynamics in ways that induce extensive aneurysm thrombosis. Under specific conditions, aggressive thrombus-associated autolysis of An. wall may result in delayed rupture.

Flow-diverting devices, such as the Pipeline stent

Flowdiverters are potentially useful devices for certain giant, complex, & dissecting aneurysms, but their limitation & indication are not fully understood.

There is a learning curve.

Using them as an initial approach or instead of an established treatment is NOT indicated.

Thank you for your attention.

박 근 영

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2011–2013 국민건강보험공단 일산병원 전문의
2013–현재 연세대학교 의과대학 신경외과 임상조교수

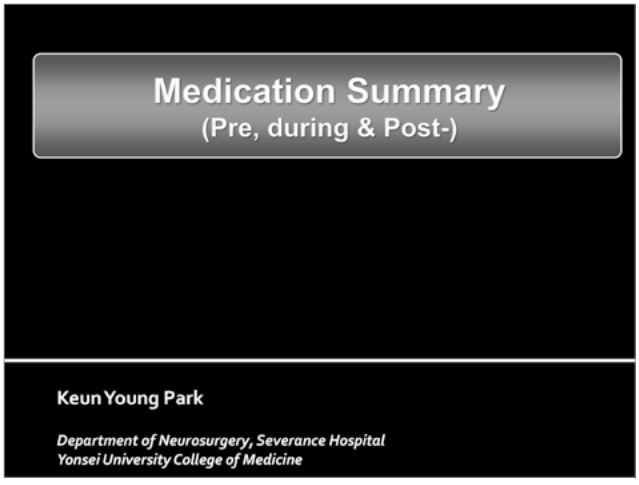
학회활동

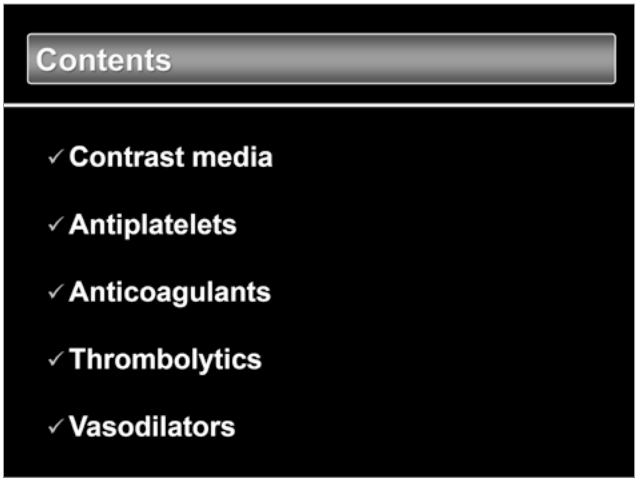
대한신경외과학회 정회원
대한뇌혈관외과학회 정회원
대한뇌혈관내수술학회 정회원
대한신경중재치료의학회 정회원 및 교육 이사
대한뇌졸중학회 정회원

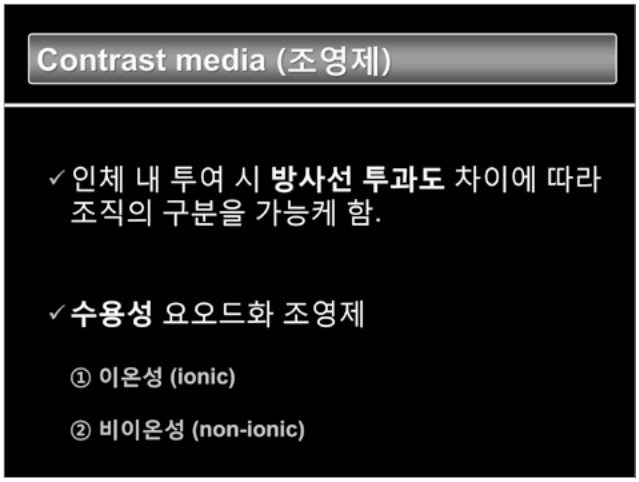
Medication (Pre, during & Post-)

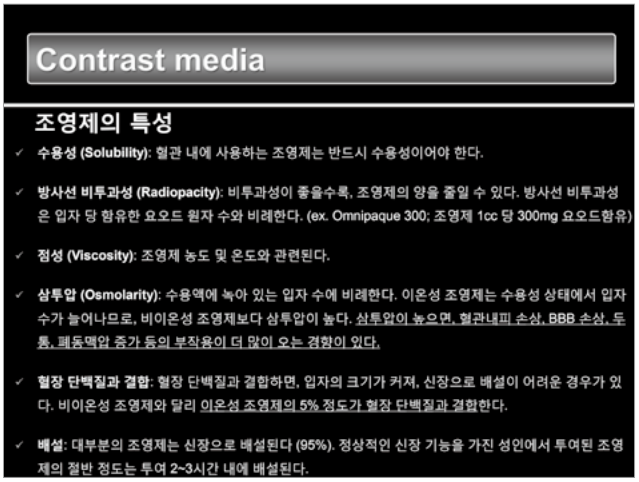
박 근 영

연세대 세브란스병원 신경외과









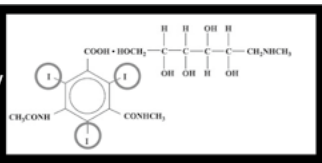
Contrast media

좋은 조영제의 요건

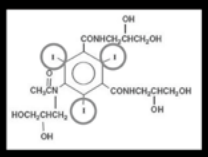
- ✓ 수용성 (Solubility)
- ✓ 방사선 비투과성 (Radiopacity) ↑
- ✓ 점성 (Viscosity) ↓
- ✓ 삼투압 (Osmolarity) ↓
- ✓ 혈장 단백질과 결합 X

Better visualization & Less side effect!!
→ Non-ionic contrast

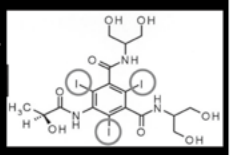
Conray



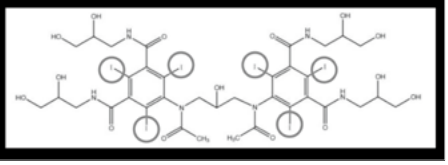
Omnipaque



Pamiray



Visipaque



Contrast media 스펙

구조	입자비(요오드/입자)	상품명	요오드 농도	삼투압	점도 (37도 기준)
Inonic(ionic) monomer	1,5 (3/2)	Conray	370	1500	3
		Isopaque		2100	
		Telebrix		1500	5,2
Inonic dimer	3 (6/2)	Hexabrix	370	580	6
Noninonic monomer	3 (3/1)	Omnipaque	300	672	6,3
		Pamiray		620	4,7
		Ultravist		607	4,8
		Optiray		651	5,5
		Xenetix		695	6
		Iomeron		520	4,5
Noninonic dimer	6 (6/1)	Visipaque	320	290	11,4
		Isovist	240	300	3,9

뇌혈관외과학 1판.

Side Effect

Hypersensitivity (≠Allergy)

: 2~5%. (비이온성 조영제의 경우)

Sx. urticaria, skin rash, mucosal edema, bronchospasm, anaphylaxis

Tx.

① 예방이 최선. 병력 청취가 중요.
이전 조영제 과민반응.
해조류/어패류 알러지와는 명확한 관련성 없음.

② 경한 증상에서는 항히스타민제가 도움. 중증 증상의 예방을 위해서는 procedure 6시간 전 스테로이드 사용이 도움.

Side Effect

- ✓ **Contrast-induced nephropathy**

정의: 조영제 사용 3일 이내에, 특별한 이유 없이 serum Cr level이 baseline보다 25% 이상 오르거나, serum Cr>1.5mg/dL. (위험인자: DM nephropathy, old age, dehydration…)

Tx.

① 조영제 사용의 최소화
② Metformin(당뇨약제) 혼합 사용은 유산산증(mortality 50%)의 우려가 있어 병용 금지된다.
③ N-acetylcystein (Mucomyst): free-radical scavenger, PO 600mg BID * 2 days (저술전, 당일)
④ Visipaque>Omnipaque
⑤ IV hydration

- ✓ **Transient global amnesia**

3) 이 약을 비구아니드계 혈당강하제(염산메트포민, 염산부포민 등)와 병용투여 시에는 유산산증을 일으킬 수 있으므로, 이를 예방하기 위해 조영제를 투여하기 전에 메트포민의 복용을 중단하고, 혈청크레아티닌을 측정하여, 충분한 수분공급을 해야 합니다.
① 정상 신기능 환자 : 조영제를 투여할 시점에 비구아니드계 약물의 복용을 중단하고 조영 검사를 마치고 48시간 후 또는 신기능이 정상화 된 후 복용을 재개합니다.
② 비정상 신기능 환자 : 비구아니드계 약물의 복용을 중단하고 48시간 이후에 조영 검사를 합니다. 신기능(혈청크레아티닌)에 변화가 없을 때에만 복용을 재개합니다.
③ 신기능이 비정상이거나 이확인된 응급상황의 환자 : 조영제 사용의 유익성과 위험성을 고려하여 주의깊게 사용해 주

Antiplatelets Preparation

Effect of antiplatelet therapy on thromboembolic complications of elective coil embolization of cerebral aneurysms.

Yamada NK, Cross DT 3rd, Pilgram TK, Moran CJ, Derdeyn CP, Dacey RG Jr

Author information

Abstract

BACKGROUND AND PURPOSE: Thromboembolic events are the most common complications of elective coil embolization of cerebral aneurysms. Administration of oral clopidogrel and/or aspirin could lower the thromboembolic complication rate.

MATERIALS AND METHODS: Records over a 10-year period were reviewed in a retrospective cohort study. For 369 consecutive elective coil embolization procedures, 25 patients received no antiplatelet drugs, 86 received antiplatelet drugs only after embolization, and 258 received antiplatelet drugs before and after embolization.

RESULTS: Symptomatic thromboembolic complications (transient ischemic attack or stroke within 60 days) occurred in 4 (16%) of 25 when no antiplatelet drugs were given, in 2 (2.3%) of 86 when antiplatelet drugs were administered only after embolization, and in 3 (1.5%) of 258 when antiplatelet drugs were administered before and after embolization. The lower symptomatic thromboembolic complication rate in the patients who received any antiplatelet therapy was statistically significant (P = .004). Clots were visible intraprocedurally in 5 (4.5%) of 111 when no antiplatelet drugs were administered before procedures and in 4 (1.6%) of 258 when they were (P value not significant). None of the 9 was symptomatic postprocedurally, but 7 were lysed or mechanically disrupted. Extracerebral hemorrhagic complications occurred in 0 (0%) of 25 when no antiplatelet drugs were given and in 11 (3.2%) of 344 when they were (P value not significant).

CONCLUSION: Oral clopidogrel and/or aspirin significantly lowered the symptomatic thromboembolic complication rate of elective coil embolization of unruptured cerebral aneurysms. There were trends toward a lower rate of intraprocedural clot formation in patients given antiplatelet drugs before procedures and a higher hemorrhagic complication rate in patients given antiplatelet drugs. Benefits of antiplatelet therapy appear to outweigh risks.

Antiplatelets preparation is mandatory, especially in SAC.

Antiplatelets

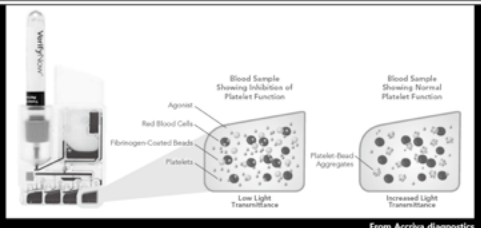
	Aspirin	Clopidogrel (Plavix)	Ticlopidine	Prasugrel	Abciximab (ReoPro)	Tirofiban (Aggrastat)	Cilostazol (Pletaal)	Triflusal (Disgren)
COX-1	v							v
P2Y12		v	v	v				
GPIIb-IIIa					v	v		
PDE							v	v

✓ **Aspirin : PO 100mg/T, GI irritation/bleeding, Bronchospasm, Reye's syndrome (children)**

✓ **Clopidogrel: PO 75mg/T (식사관계없이), Resistance, PPI 제재와 병용시 효과 감소.**

- GI hemorrhage: clopidogrel 2.0%, aspirin 2.7%
- Intracranial hemorrhage: clopidogrel 0.4%, aspirin 0.5%

P2Y12 resistance test (VerifyNow)



From Accriva diagnostics

<Test Timing>

Clopidogrel	75mg	≥7 days on maintenance
	300mg	≥8 hours post bolus
	600mg	≥6 hours post bolus

P2Y12 resistance test (VerifyNow)

✓ **P2Y12 Reaction Units (PRU)** - indicate the amount of ADP-mediated aggregation specific to the platelet P2Y12 receptor.

✓ **BASE (Base PRU)** - indicates the amount of mediated aggregation specific to the platelet PAR-1 and PAR-4 receptors. The BASE result is normalized to report units that are equivalent to baseline (pre-drug) PRU values.

✓ **Percent (%) P2Y12 Inhibition** - is the percent change from baseline aggregation, and is calculated from the PRU result and the BASE result.

P2Y12 resistance

✓ 약물 종류: Prasugrel < Clopidogrel

✓ 투여 기간

✓ 약물 상호 작용: PPI

✓ 환자의 유전적 요인: CYP2C19 polymorphism

Antiplatelets

	Aspirin	Clopidogrel (Plavix)	Ticlopidine	Prasugrel	Abciximab (ReoPro)	Tirofiban (Aggrastat)	Cilostazol (Pletaal)	Triflusal (Disgren)
COX	v							v
P2Y12		v	v	v				
GPIIb-IIIa					v	v		
PDE							v	v

✓ **Prasugrel : PO. ADP receptor anatagonist (P2Y12)**

* Acute Coronary Syndrome에서 승인.
* 뇌에서 사용은 허가외 사용 신청이 필요. (Low dose: 20mg loading, 5mg maintain)
* PPI 제재와의 interaction 이 적음.
* Effectiveness and Safety 면에서 dual antiplatelets 보다 우수할 것으로 사료.

Antiplatelets

	Aspirin	Clopidogrel (Plavix)	Ticlopidine	Prasugrel	Abciximab (ReoPro)	Tirofiban (Aggrastat)	Cilostazol (Pletaal)	Triflusal (Disgren)
COX	v							v
P2Y12		v	v	v				
GPIIb-IIIa					v	v		
PDE							v	v

✓ **Cilostazol : PO 100mg/T (200mg/day, 식전투여), Headache, Diarrhea, heat intolerance, palpitations**

✓ **Disgren: PO 300mg/T (300~900mg/day, 가급적 식중 투여)**

Antiplatelets

	Aspirin	Clopidogrel (Plavix)	Ticlopidine	Prasugrel	Abciximab (ReoPro)	Tirofiban (Aggrastat)	Cilostazol (Pletaal)	Triflusal (Disgren)
COX	v							v
P2Y12		v	v	v				
GPIIb-IIIa					v	v		
PDE							v	v

- ✓ **Abciximab : IV(/IA). Monoclonal Ab. Half-life 10~30 min. However, its effect on platelet for 48 hours.**
  - * Bolus : 0.25mg/kg
  - * Maintenance: 0.125μg/kg/min (~12시간)
- ✓ **Tirofiban : IV(/IA). Small molecule. Half-life 2 hours. However, its effect on platelet for 4~8 hours.**
  - * 0.9% 염화나트륨 수용액 또는 5% 포도당 수용액 250ml에서 50ml를 제거하고, 이 약 50ml (1 vial)을 채워넣는다.
  - * Bolus : 25μg/kg
  - * Maintenance: 0.15μg/kg/min (12~24시간)

Antiplatelets Modification

High incidence of P2Y12 receptor antagonist poor-responder in Asia

Table 3. Primary and Secondary Outcomes of the Standard and Modified Preparation Groups

Variable	Modified Preparation, No. (%)	Standard Preparation, No. (%)	Crude Risk Difference, % (95% CI)	Adjusted Risk Difference, % (95% CI)[a]	P Valu
Thromboembolic event, d					
≤7	1/63 (1.6)	7/63 (11.1)	−9.5 (−17.9 to −1.2)	−11.7 (−21.3 to −2.0)	.02
≤30[b]	1/63 (1.6)	7/63 (11.1)	−9.5 (−17.9 to −1.2)	−11.7 (−21.3 to −2.0)	.02
Bleeding event	6/63 (9.5)	4/63 (6.3)	3.2 (−6.2 to −12.6)	5.6 (−4.2 to −15.4)	.26

JAMA Neurol. 2015.

The thromboembolic event rate was low in the modified preparation group (1 of 63 [1.6%]) compared with the standard preparation group (7 of 63 [11.1%]; adjusted risk difference, −11.7% [95%CI, −21.3%to −2.0%]; *P* = .02).

Antiplatelets Modification

- ✓ **How Modification?**
- **1. Dose Up**
- **2. Triple**
- **3. Prasugrel**

Table 5: Comparison of platelet function test results using VerifyNow P2Y12 assay

Test	CPG	PSG	*P* Value
BASE	311.8 ± 41.1	313.7 ± 41.6	.753
PRU	242.7 ± 69.8	125.7 ± 79.4	<.001
Percentage inhibition (%)	22.1 ± 19.7	60.2 ± 24.7	<.001

Note:—BASE indicates platelet reactivity to isothrombin receptor–activating peptide.

AJNR. 2016.

In terms of P2Y12 resistance, Prasugrel can be more effective comparing with Clopidogrel.

Antiplatelets Modification

Interv Neuroradiol. 2017 Feb;23(1):52-59. doi: 10.1177/1591019916680090. Epub 2016 Oct 22.

Prasugrel versus clopidogrel in stent-assisted coil embolization of unruptured intracranial aneurysms.

Segal J[1], Chau Y[1], Gaudart J[2], Sachet M[1], Beuil S[3], Lonjon M[4].

Author information

Abstract

Background Thromboembolic complications are the main problem in stent-assisted coil embolization of unruptured intracranial aneurysms. The combination of aspirin and clopidogrel is generally used to decrease these complications, but some patients do not respond to clopidogrel and have a higher risk of stent thrombosis. In cardiology, clinical trials have shown that prasugrel reduced the incidence of ischaemic events in patients with acute coronary syndrome compared with clopidogrel but, according to several authors, prasugrel would produce an increased risk of cerebral haemorrhagic complications. Objective The purpose of this study was to determine whether prasugrel would be more effective than clopidogrel in reducing procedural events in patients with an unruptured aneurysm treated endovascularly with coils and stent. Materials and methods Two hundred consecutive patients with intracranial aneurysms were treated using coiling and stenting procedures. The first 100 patients were administered a dual antiplatelet of aspirin and clopidogrel, while the remaining 100 patients were administered a dual antiplatelet of aspirin and prasugrel. In each group data were collected on procedural and periprocedural haemorrhagic and ischaemic complications. Results Aneurysmal occlusion and haemorrhagic complications rates were identical in both groups. The number of thromboembolic events observed in the two groups of our study did not differ significantly, but the prasugrel group included more wide-neck aneurysms and more flow-diverted stents. Moreover, complications in the prasugrel group were more benign, explaining the significant difference in clinical outcomes between the two groups on Day 30. Conclusions Prasugrel reduces the clinical consequences of thromboembolic complications of endovascular treatment with stenting and coiling of unruptured intracranial aneurysms.

In stent-assist coiling, Prasugrel group may be more safe comparing with Clopidogrel group.

Multiple Antiplatelets: How long?

- ✓ **Undefined in Neurovascular Field**
- ✓ **Experience in Coronary**

Incidence of cerebral ischemic events after discontinuation of clopidogrel in patients with intracranial aneurysms treated with stent-assisted techniques

Clinical article

James D. Rossen, M.D.,[1] Nohra Chalouhi, M.D.,[1] Shaftik N. Wassef, M.D.,[1,3,4] Jacob Thomas, B.S.,[1] Taylor J. Abel, M.D.,[1] Pascal M. Jabbour, M.D.,[1] David K. Kung, M.D.,[2] and David M. Hasan, M.D.[1]

Departments of [1]Neurosurgery and [2]Internal Medicine, Division of Cardiovascular Medicine, University of Iowa, Iowa City, Iowa; [3]Department of Neurological Surgery, Thomas Jefferson University Hospital, Philadelphia, Pennsylvania; [4]McConnell Brain Imaging Centre, Montreal Neurological Institute and Hospital; and [5]Department of Neurology and Neurosurgery, McGill University, Montreal, Quebec, Canada

SAC under dual Tx.

↓

Clopidogrel D/C at 6 weeks

↓

Delay Thromboembolic event : 5%

J Neurosurgery. 2012.

Multiple Antiplatelets: How long?

J Stroke Cerebrovasc Dis. 2014 Apr;23(4):771-7. doi: 10.1016/j.jstrokecerebrovasdis.2013.07.008. Epub 2013 Aug 15.

Onset Time of Ischemic Events and Antiplatelet Therapy after Intracranial Stent-assisted Coil Embolization.

Matsumoto Y[1], Nakai K[2], Tsutsumi M[2], Iko M[2], Nii K[3], Narita S[3], Eto A[3], Mitsutake T[3], Aikawa H[3], Kazekawa K[3].

Author information

Abstract

BACKGROUND: Stent-assisted coil embolization is effective for intracranial aneurysms, especially wide-necked aneurysms; however, the optimal antiplatelet regimens for ischemic events that develop after coil embolization have not yet been established. We aimed to determine the onset time of such postoperative ischemic events and the relationship between these events and antiplatelet therapy.

METHODS: We performed coil embolization using a vascular reconstruction stent for 43 cases of intracranial aneurysms and evaluated the incidence of postoperative ischemic events in these cases.

RESULTS: Nine patients showed postoperative ischemic events during the follow-up period (13 ± 7 months). Two patients developed cerebral infarction within 24 hours. Five patients developed transient ischemic attack within 40 days while they were receiving dual antiplatelet therapy. In addition, 1 patient showed cerebral infarction 143 days postoperatively during single antiplatelet therapy, and a case of transient visual disturbance was reported 191 days postoperatively (49 days after antiplatelet therapy had been discontinued). We increased the number of antiplatelet agents in 4 of these patients. The other 5 patients were under strict observation with dual antiplatelet therapy. All these patients were shifted to single antiplatelet therapy 3-13 months postoperatively. No recurrence of ischemic events was noted.

CONCLUSIONS: Postoperative ischemic events are most likely to occur within 40 days postoperatively. For patients with postoperative ischemic events, additional ischemic events can be prevented by increasing the number of antiplatelet agents; subsequently, they can be shifted to single antiplatelet therapy after the risk of recurrence has decreased.

Multiple Antiplatelets: How long?

Radiology. 2014 Oct;273(1):194-201. doi: 10.1148/radiol.14140070. Epub 2014 Jun 11.

Delayed ischemic stroke after stent-assisted coil placement in cerebral aneurysm: characteristics and optimal duration of preventative dual antiplatelet therapy.

Hwang G*, Kim JG, Song KS, Lee YJ, Villavicencio JB, Surpto NS, Park NM, Park SJ, Jeong EA, Kwon OK.

Author information

Abstract

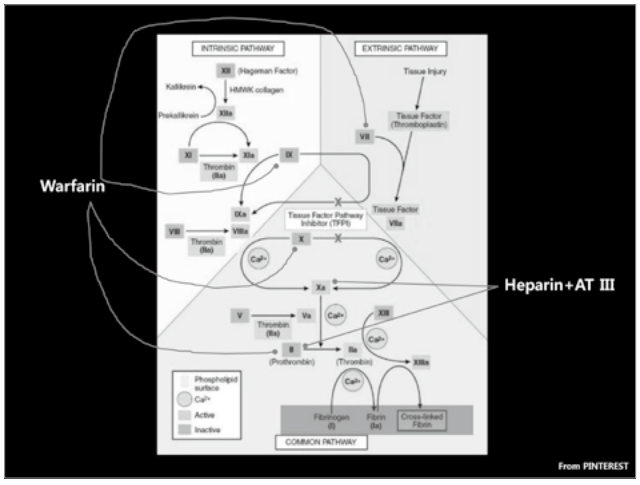
PURPOSE: To evaluate characteristics of delayed ischemic stroke after stent-assisted coil placement in cerebral aneurysms and to determine the optimal duration of dual antiplatelet therapy for its prevention.

MATERIALS AND METHODS: This retrospective study was approved by the institutional review board, and the requirement to obtain written informed consent was waived. Of 1579 patients with 1661 aneurysms, 395 patients (25.0%) with 403 aneurysms (24.3%) treated with stent-assisted coil placement were included and assigned to groups stratified as early (126 patients [31.9%]; 3 months of coil placement), midterm (160 patients [40.5%]; 6 months), or late (109 patients [27.6%]; ≥ 9 months), according to the time points of switching dual antiplatelet therapy to monotherapy from coil placement. Cumulative rates of delayed ischemic stroke in each group were calculated by using Kaplan-Meier estimates that were compared with log-rank tests. Risk factors of delayed ischemic stroke were identified by using Cox proportional hazard analysis.

RESULTS: Delayed ischemic stroke occurred in 3.5% of all cases (embolism, 3.0%; thrombotic occlusion, 0.5%) within 2 months following the switch. Late switch yielded no delayed ischemic stroke, unlike early (seven of 126 patients [5.6%]; P = .013) or midterm (seven of 160 patients [4.4%]; P = .028) switch. Incomplete occlusion (hazard ratio, 6.68 [95% confidence interval: 1.490, 29.900]) was identified as a risk factor.

CONCLUSION: Delayed ischemic stroke after stent-assisted coil placement is caused by embolism from or thrombotic occlusion of stent-containing vessels after switching from dual antiplatelet therapy to monotherapy. The stent-containing vessel with incomplete aneurysm occlusion presents as a long-term thromboembolic source. Therefore, dual antiplatelet therapy for more than 9 months and late switch to

Bleeding: 1%



Anticoagulants

- ✓ **Heparin**: AT-III dependent anticoagulants (Factor II, Xa inhibition), IV
  - * During endovascular Tx.: IV bolus 3000 IU, then 1000 IU on every hour , Flushing line
  - * Monitoring: aPTT/ACT (Therapeutic range: aPTT 60~80 sec)
  - * Antidote: Protamine sulfate 1mg/100 IU
  - * Heparin-induced thrombocytopenia
- ✓ **Warfarin**: Vitamin K antagonist (Factor II, VII, XI, X inhibition), PO
  - * Monitoring: PT INR (Therapeutic range: INR 2.0~3.0)
  - * Warfarin-toxicity and Intracranial hemorrhage (약 8~11배 ICH 발생률이 높다)
  - * Reversal: PCC > FFP > vitamin K

<Anticoagulation bridging>
출혈이 예상되는 elective surgery 시, 입원 당일 저녁부터 와파린을 끊고 heparin으로 대체한다. 2-3일 후 PT INR이 1.5 이하가 되면 수술이 가능하며, 헤파린은 술전 6-8시간에 stop 한다.

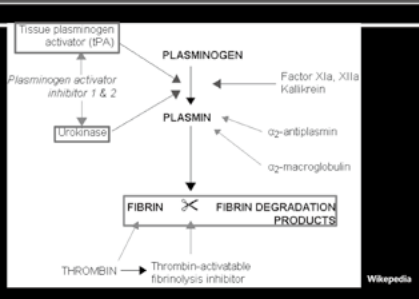
Anticoagulants

- ✓ **NOACs** (Novel Oral Anticoagulants): monitoring X, lower bleeding risk, short acting time
  - * Dabigatran (Pradaxa) : direct thrombin inhibitor
    Antidote: Idarucizumab
  - * Rivaroxaban (Xarelto) : direct factor Xa inhibitor
  - * Apixaban (Eliquis) : direct factor Xa inhibitor

Heparin-induced Thrombocytopenia

- ✓ Heparin —> 5~14일 사이 IgG for heparin 생성. 약 3달간 지속.
- ✓ IgG binds to the platelet receptor and activates platelet.
- ✓ 1~5% in patients with heparin usage
- ✓ Platelet consumption and thrombocytopenia
- ✓ Symptom: Asymptomatic, Thrombosis, rare hemorrhage
- ✓ Treatment
  - • Discontinue heparin
  - • Do NOT use heparin family and Vit-K antagonist (Warfarin necrosis)
  - • Do NOT transfuse platelet (Thrombosis 악화, rare case of severe thrombocytopenia)
  - • Alternative medication: Danaproid, bivalirudin, argatroban

Thrombolytics



- ✓ Recombinant Tissue plasminogen activator (rt-PA)
- ✓ Urokinase (UK)
- ✓ Streptokinase

rt-PA

✓ **Alteplase :** FDA approved for acute ischemic stroke (IV, 0.9mg/kg, maximum dose 90mg)

* NINDS study (NEJM, 1995)

✓ Within 3 hours of symptom onset (Class I, LOE A)
✓ Within 3 ~ 4.5 hours of symptom onset (Class I, LOE B)

Urokinase

✓ Plasminogen activator
✓ Urokinase was originally isolated from human urine.
✓ FDA approved for pulmonary embolism (IV)

"Urokinase is marketed as Abbokinase or Kinlytic and competes with recombinant tissue plasminogen activator (e.g., alteplase) as a thrombolytic drug in infarction. However, urokinase is not very selective for clot-bound plasminogen, unlike tissue plasminogen activator (tPA) which preferentially interacts with clot-bound plasminogen."

✓ 과거 Chemical thrombolysis에 많이 사용. (IA, Off-Label)

1세대: IA chemical thrombolysis
↓
2세대: IA mechanical thrombectomy
- Merci
- Penumbra
↓
3세대: IA stent retriever

Vasodilators

✓ Papaverine : *Papaver (양귀비).*
✓ *Antispasmodic effect. Unclear mechanism.*

- 내장평활근 경련
- 급성 관상동맥 증후군
- 말초혈관 연축 (뇌혈관 연축)
- 발기부전

Vasodilators

✓ Nimodipine: Ca^{2+}-channel blocker (PO, IV)
- 처음에는 고혈압 약제로 개발.
- 현재는 윤일하게 효과가 입증된 post-SAH vasospasm 치료제 (neuroprotective effect)

- SAH 후 96시간 이내 사용, 최대 21일 사용.

✓ Nicardipine (Perdipine): Ca^{2+}-channel blocker (PO, IV) - 고혈압 약제로 사용.
IA therapy for vasospasm 연구 중.

Conclusions

✓ **Endovascular Procedure:**
시술 전,중,후의 medical treatment 가 매우 중요합니다.

✓ **따라서, 중환자실 혹은 병동뿐만 아니라, 혈관촬영실에서의 medication 점검은 환자 치료에 critical 합니다.**

신 희 섭

강동경희대학교병원 신경외과

학력 및 경력

경희대학교 의과대학 졸업 (학사) 및 동대학원 졸업 (석사, 박사)
경희대학교병원 신경외과 전임의
강동경희대학교병원 신경외과 전임의
강동경희대학교병원 신경외과 임상조교수
강동경희대학교병원 신경외과 조교수

학회활동

대한신경외과학회 정회원
대한뇌혈관외과학회 정회원
대한뇌혈관내수술학회 정회원 및 인증전문의
대한신경중재치료의학회 정회원 및 인증전문의
대한노인신경외과학회 정회원

Technique of EVT for intracranial aneurysm

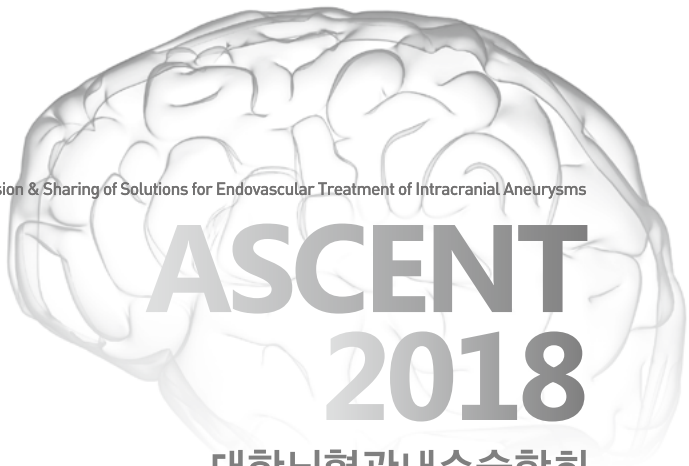
신희섭

경희대학교 의과대학/의학전문대학원 강동경희대학교병원 신경외과

두개강내 동맥류에 대한 뇌혈관내 수술는 1990년 대 후반 Guglielmi Detachable Coil (GDC) 이 뇌동맥류 치료에 적용되기 시작한 이후 점차 치료 영역을 확대하여 지금은 뇌동맥류 치료에 중요한 한 축을 담당하고 있다. 2016년 발간된 대한뇌혈관내수술학회 (SKEN) 연보에 의하면 1년간 SKEN 회원들이 뇌혈관내 수술로 치료한 뇌동맥류는 7,729례 이었다. 20여년간 뇌혈관내수술 치료 기법의 발달과 치료 기구의 발전으로 뇌혈관내 수술의 치료 성적은 개두술을 통한 클립결찰술과 대등한 수준이 되었으며, 오히려 더 좋은 치료 성적을 거두었다는 연구 결과들도 있다.

두개강내 동맥류에 대한 뇌혈관내 수술의 주요 기법은 코일을 이용한 뇌동맥류 색전술이 주요 기법이다. 코일 색전술은 새로운 intracranial stent 와 balloon 의 개발과 기술 발전으로 wide necked aneurysm 에도 안정적이고 성공적인 치료 결과를 보이고 있고, double or triple catheter technique과 stent와 microcatheter를 이용한 다양한 치료 technique의 개발과 경험 축적으로 이전에는 치료가 불가능하였던 complexed aneurysm 에도 치료 영역을 넓혀나가고 있다. 최근에는 코일 색전술로 치료가 까다로운 giant aneurysm에 대한 flow diverter device 들이 개발되어 성공적인 치료 효과를 보이고 있어 새로운 치료 paradigm을 제시하였다.

두개강내 동맥류에 대한 뇌혈관내 수술의 치료 기법과 새로운 치료 도구는 놀라운 속도로 발전하고 있어 뇌동맥류에 대한 뇌혈관내 수술의 치료 영역과 치료 효과는 더욱 발전할 것으로 기대된다.



Theme: Vision & Sharing of Solutions for Endovascular Treatment of Intracranial Aneurysms

ASCENT 2018

대한뇌혈관내수술학회

Luncheon Seminar

좌장 : 경희대 고준석

Experiences of Neuroform Atlas Stent for Intracranial Aneurysm Treatment

Prof. Hidenori Oishi
Neurosurgery, Juntendo University, Japan

Hidenori Oishi

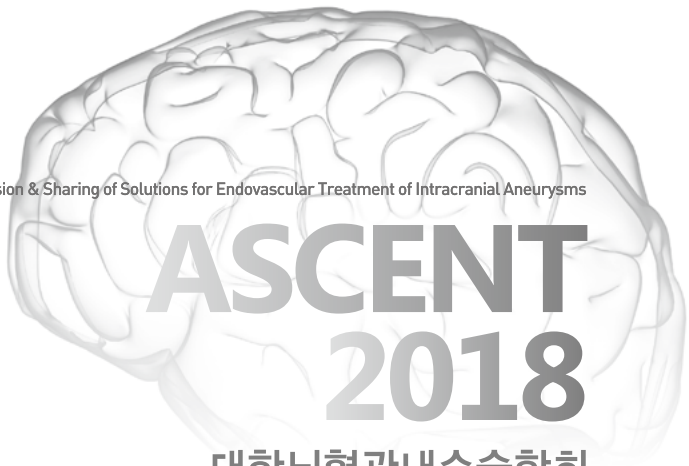
Department of Neurosurgery and Neuroendovascular Therapy,
Juntendo University School of Medicine, Tokyo, Japan

Education	1991 MD, Juntendo University School of Medicine, Tokyo, Japan 2002 PhD, Juntendo University School of Medicine, Tokyo, Japan
Postgraduate Career	1991/6-1993/5 Resident, Juntendo University Hospital, Tokyo, Japan 1993/6-1997/8 Clinical Fellow in Neurosurgery, Juntendo University Hospital 1997/9-1998/7 Assistant Professor in Radiology, Juntendo University Hospital 2000/11-2003/3 Assistant Professor in Neurosurgery, Mito National Hospital 2007/4-2012/10 Assistant Professor in Neurosurgery, Juntendo University Hospital 2012/11-Present Chairman in Neuroendovascular Therapy, Juntendo University Hospital Professor in Neuroendovascular Therapy, Juntendo University Hospital
License and Certificates	1991 Japanese National Medical License 1997 Board Certificated Member of the Japan Neurosurgical Society 2002 Board Certificated Member of the Japan Society for Neuroendovascular Therapy 2005 Board Certificated Member of the Japan Stroke Society
Appointments	Academic: Chairman in Neuroendovascular Therapy, Juntendo University Hospital Professor in Neuroendovascular Therapy, Juntendo University Hospital Hospital: Chief, Section of Neuroendovascular Therapy, Juntendo University Hospital

Experiences of Neuroform Atlas Stent for Intracranial Aneurysm Treatment

Hidenori Oishi

Department of Neurosurgery and Neuroendovascular Therapy,
Juntendo University School of Medicine, Tokyo, Japan



Theme: Vision & Sharing of Solutions for Endovascular Treatment of Intracranial Aneurysms

ASCENT 2018

대한뇌혈관내수술학회

Scientific Symposium (Debate Session)

좌장 : 서울대 **권오기**

Coil vs Clip in treatment of intracranial aneurysm	부산대 **이재일**
Optimal Tx. for ruptured fusiform ICA aneurysm in elderly patient	영남대 **정영진**
Open vs Closed cell stent in peri-aneurysmal stenosis	계명대 **김창현**
Streamline vs FRED for UIA	원광대 **김대원**
Pipeline vs FRED for UIA	가톨릭대 **최재호**

이 재 일

부산대병원 신경외과

학력 및 경력

부산대학교 의과대학 졸업
부산대학교 의과대학 박사과정 수료
현, 부산대학교 신경외과 기금 부교수
부산시 의사협회 사회참여이사
국민연금관리공단 장애심사 자문의사
심평원 자문의사

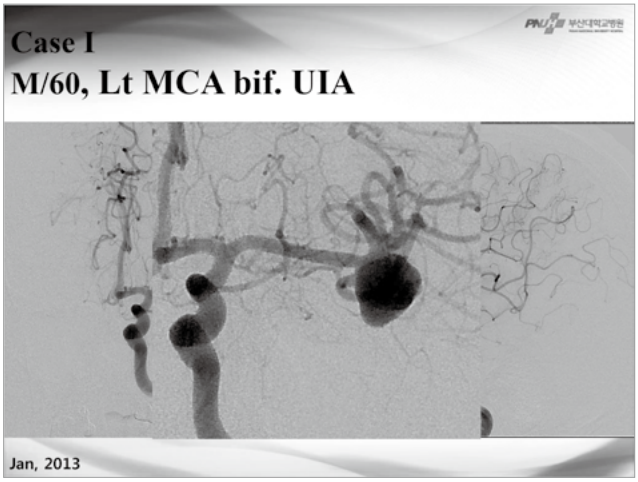
학회활동

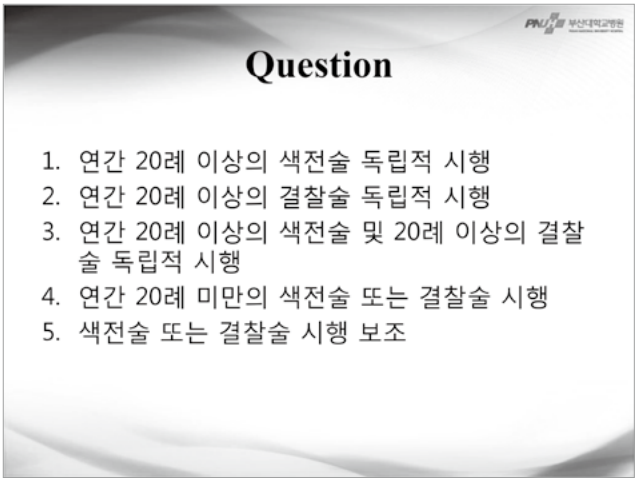
대한 뇌혈관내수술학회 혈관내 수술 인증의
대한 신경중재치료의학회 혈관내 수술 인증의
대한뇌혈관외과학회 정회원, 실행이사
대한뇌혈관내수술학회 정회원, 학술위원
대한신경중재치료의학회 정회원
대한뇌졸중학회 정회원

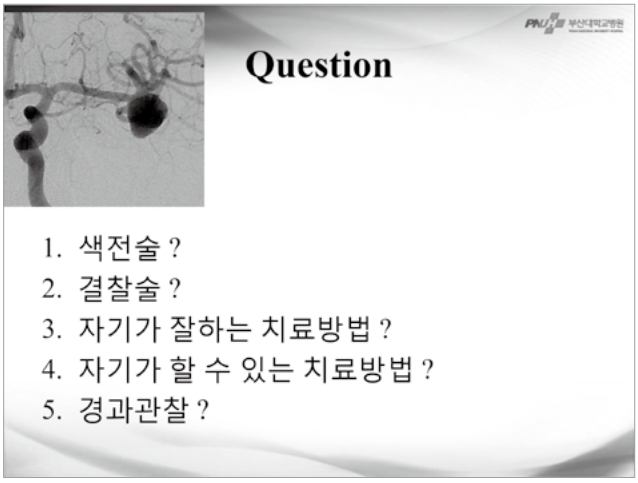
Coil vs Clip in treatment of intracranial aneurysm

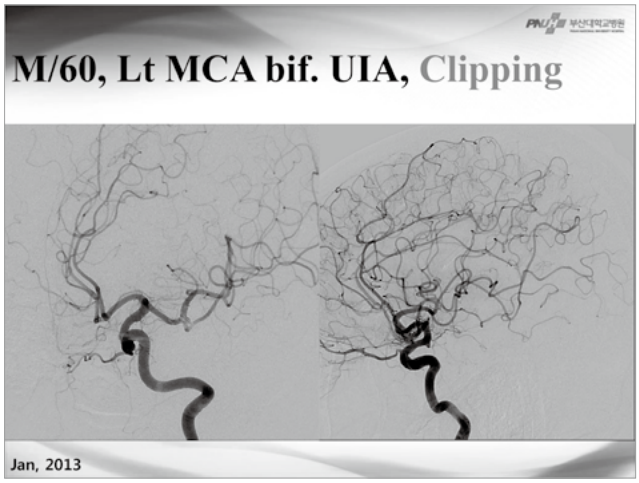
이재일

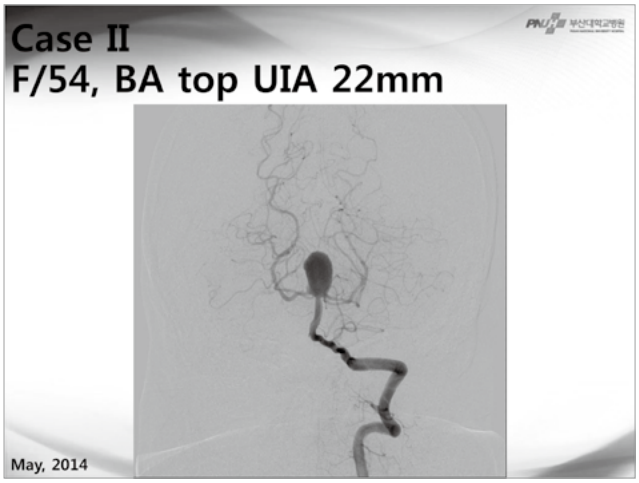
부산대병원 신경외과

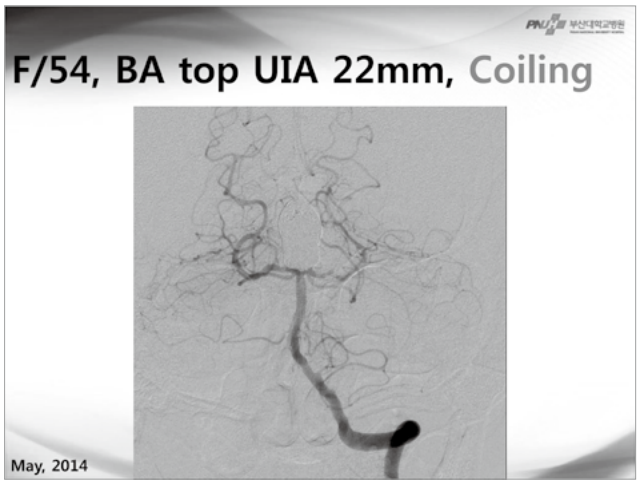




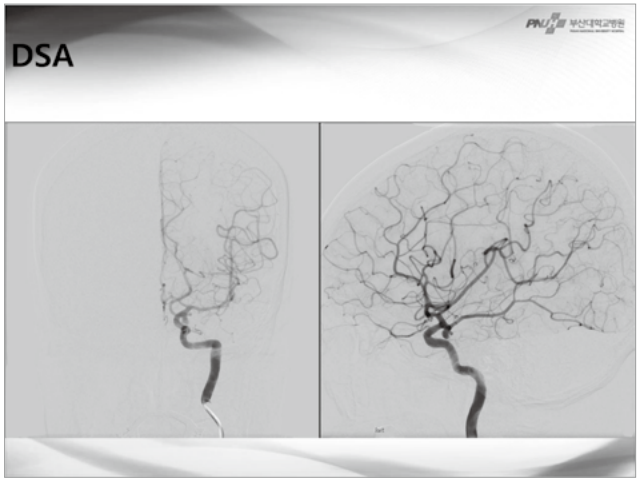


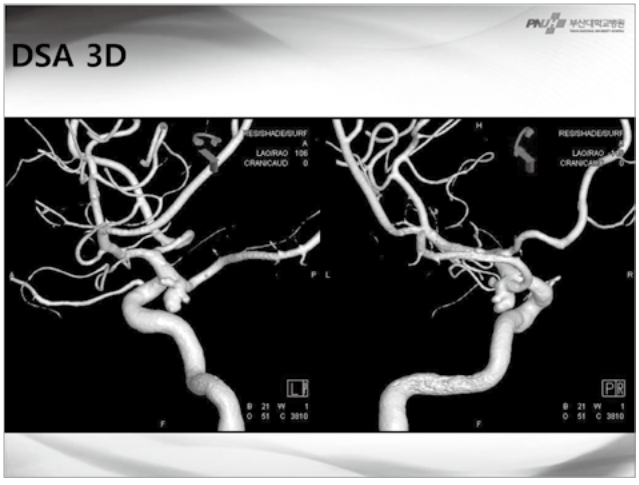

M/60, Lt MCA bif. UIA, Clipping
Jan, 2013


Case II
F/54, BA top UIA 22mm
May, 2014


F/54, BA top UIA 22mm, Coiling
May, 2014


Case III
F/57, SAH, H-H :2


DSA

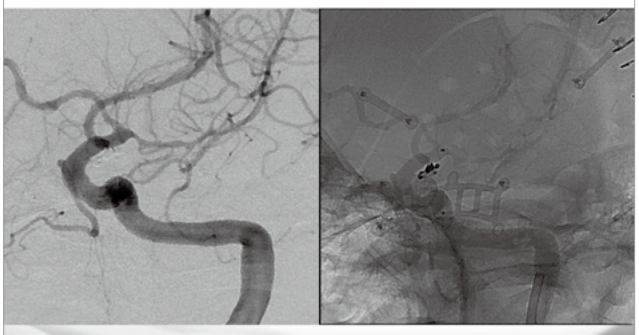

DSA 3D

DSA 3D

Question

1. 색전술 ?
2. 결찰술 ?
3. 자기가 잘하는 치료방법 ?
4. 자기가 할 수 있는 치료방법 ?
5. 경과관찰 ?

F/57, SAH, H-H :2 Clipping



Guidelines for the Management of Patients With Unruptured Intracranial Aneurysms

A Guideline for Healthcare Professionals From the American Heart Association/American Stroke Association

The American Academy of Neurology affirms the value of this guideline as an educational tool for neurologists.

Endorsed by the American Association of Neurological Surgeons, the Congress of Neurological Surgeons, and the Society of NeuroInterventional Surgery

Surgical Clipping: Recommendations

1. Several factors, including patient age and aneurysms location and size, should be taken into account when considering surgical clipping as the mode of treatment for a UIA *(Class I; Level of Evidence B).*
2. Imaging after surgical intervention, to document aneurysm obliteration, is recommended given the differential risk of growth and hemorrhage for completely versus incompletely obliterated aneurysms *(Class I; Level of Evidence B).*

Stroke, 2015

3. Long-term follow-up imaging may be considered after surgical clipping given the combined risk of aneurysm recurrence and de novo aneurysm formation. Long-term follow-up may be particularly important for those aneurysms that are incompletely obliterated during initial treatment *(Class IIb; Level of Evidence B).*

4. Surgical treatment of UIA is recommended to be performed at higher- volume centers (eg, performing >20 cases annually) *(Class I; Level of Evidence B).*

5. The use of specialized intraoperative tools and techniques for avoiding vessel compromise or residual aneurysms may be considered to reduce the adverse outcomes seen with operative management of UIAs *(Class IIb; Level of Evidence C).*

Endovascular Treatment: Recommendations

1. Endoluminal flow diversion represents a new treatment strategy that may be considered in carefully selected cases *(Class IIb; Level of Evidence B).* Other emerging technologies to treat unruptured cerebral aneurysms, such as liquid embolic agents, represent new treatment strategies that may be considered in carefully selected cases *(Class IIb; Level of Evidence C).* The long-term effects of these newer approaches remain largely unknown. Strict adherence to the US Food and Drug Administration's indications for use is probably indicated until additional trial data demonstrate an incremental improvement in safety and efficacy over existing technologies *(Class IIa; Level of Evidence C).*

2. Use of coated coils is not beneficial compared with bare-metal coils *(Class III; Level of Evidence A).*
3. Endovascular treatment of UIAs is recommended to be performed at high-volume centers *(Class I; Level of Evidence B).*
4. The procedural risk of radiation exposure should be explicitly reviewed in the consent process for endovascular procedures *(Class I; Level of Evidence C).*

Comparative Efficacy of Clipping Versus Coiling :

Recommendations

1. Surgical clipping is an effective treatment for UIAs that are considered for treatment *(Class I; Level of Evidence B).*
2. Endovascular coiling is an effective treatment for select UIAs that are considered for treatment *(Class IIa; Level of Evidence B).*
3. Patients with UIAs who are considered for treatment should be fully informed about the risks and benefits of both endovascular and microsurgical aneurysm clipping *(Class I; Level of Evidence B).*
4. Endovascular coiling is associated with a reduction in procedural morbidity and mortality over surgical clipping in selected cases but has an overall higher risk of recurrence *(Class IIb; Level of Evidence B).*

Guidelines for the Management of Aneurysmal Subarachnoid Hemorrhage

A Guideline for Healthcare Professionals From the American Heart Association/American Stroke Association

Surgical and Endovascular Methods of Treatment of Ruptured Cerebral Aneurysms: Recommendations

1. Surgical clipping or endovascular coiling of the ruptured aneurysm should be performed as early as feasible in the majority of patients to reduce the rate of rebleeding after aSAH *(Class I; Level of Evidence B).*
2. Complete obliteration of the aneurysm is recommended whenever possible *(Class I; Level of EvidenceB).*
3. Determination of aneurysm treatment, as judged by both experienced cerebrovascular surgeons and endovascular specialists, should be a multidisciplinary decision based on characteristics of the patient and the aneurysm *(Class I; Level of Evidence C).*

Stroke, 2012

Surgical and Endovascular Methods of Treatment of Ruptured Cerebral Aneurysms: Recommendations

4. For patients with ruptured aneurysms judged to be technically amenable to both endovascular coiling and neurosurgical clipping, endovascular coiling should be considered *(Class I; Level of Evidence B).*
(Revised recommendation from previous guidelines)
5. In the absence of a compelling contraindication, patients who undergo coiling or clipping of a ruptured aneurysm should have delayed follow-up vascular imaging (timing and modality to be individualized), and strong consideration should be given to retreatment, either by repeat coiling or microsurgical clipping, if there is a clinically significant (eg, growing) remnant *(Class I; Level of Evidence B).*
(New recommendation)

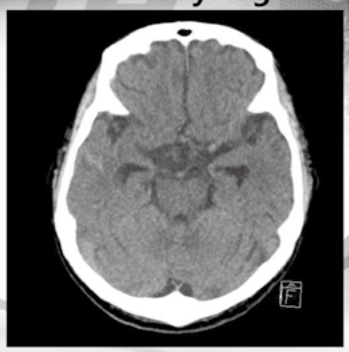
Surgical and Endovascular Methods of Treatment of Ruptured Cerebral Aneurysms: Recommendations

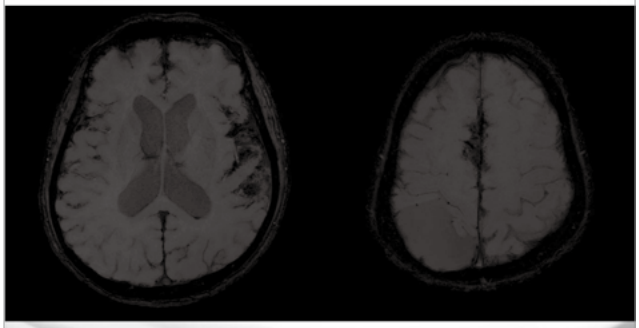
6. Microsurgical clipping may receive increased consideration in patients presenting with large (>50 mL) intraparenchymal hematomas and middle cerebral artery (MCA) aneurysms.

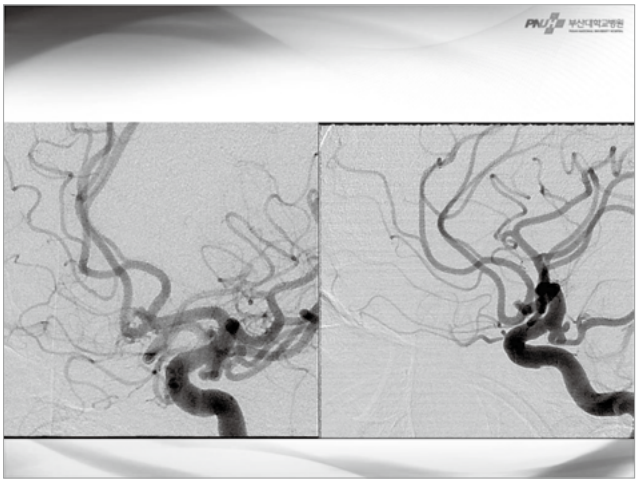
Endovascular coiling may receive increased consideration in the elderly (70years of age), in those presenting with poor-grade classification(IV/V) aSAH, and in those with aneurysms of the basilar apex *(Class IIb; Level of Evidence C).*
(New recommendation)

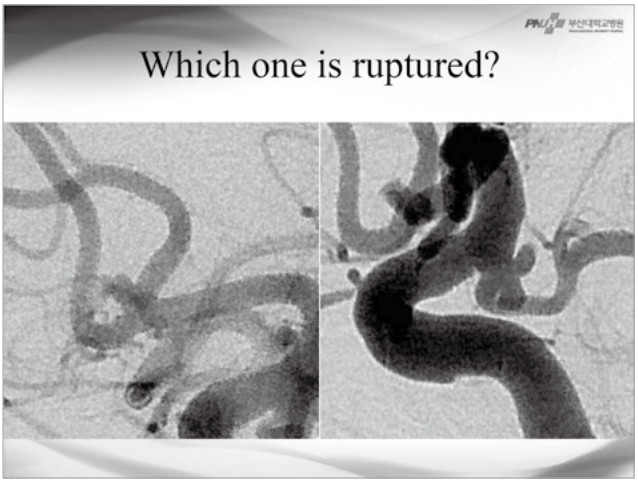
7. Stenting of a ruptured aneurysm is associated with increased morbidity and mortality, and should only be considered when less risky options have been excluded *(Class III; Level of Evidence C).*
(New recommendation)

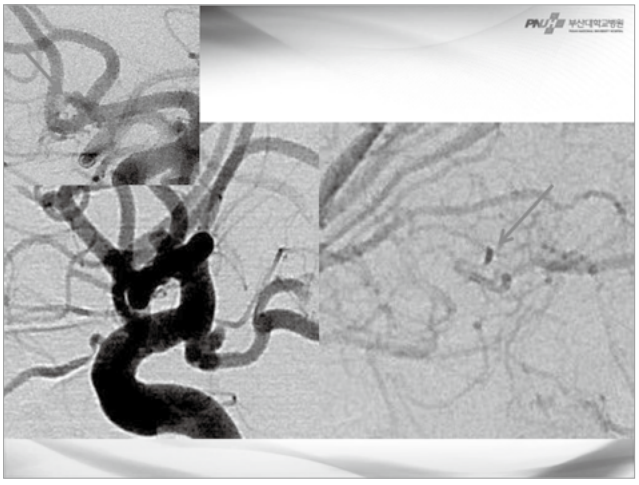
Case IV
M/77, Headache 5 days ago

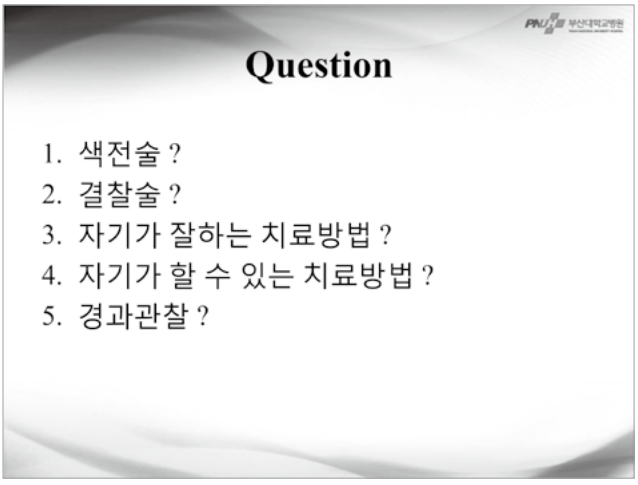


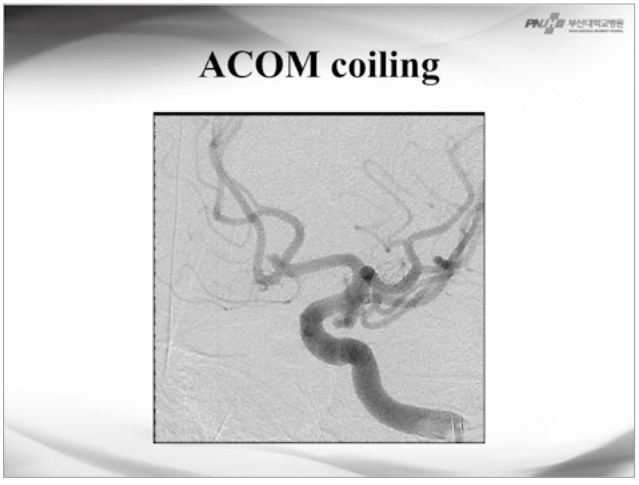


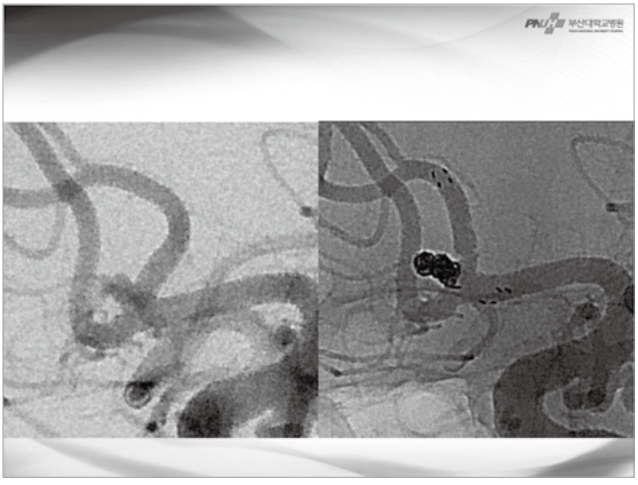


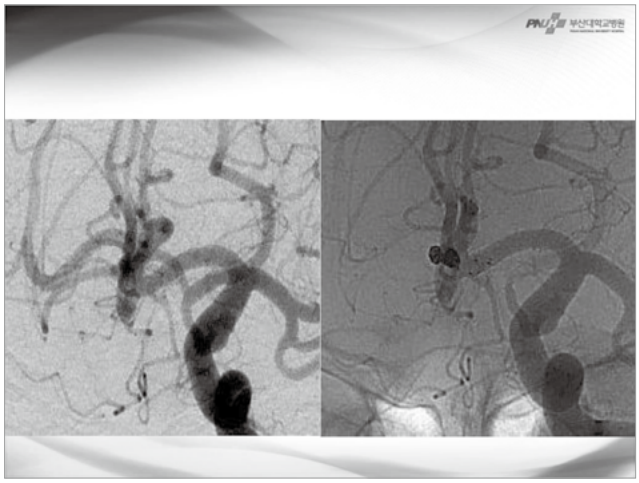

Which one is ruptured?

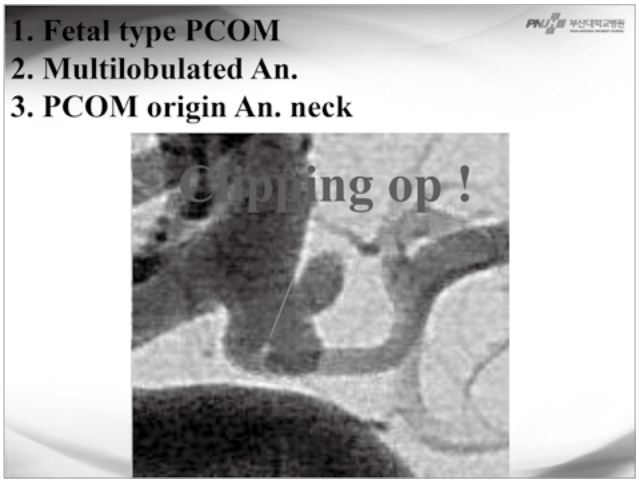


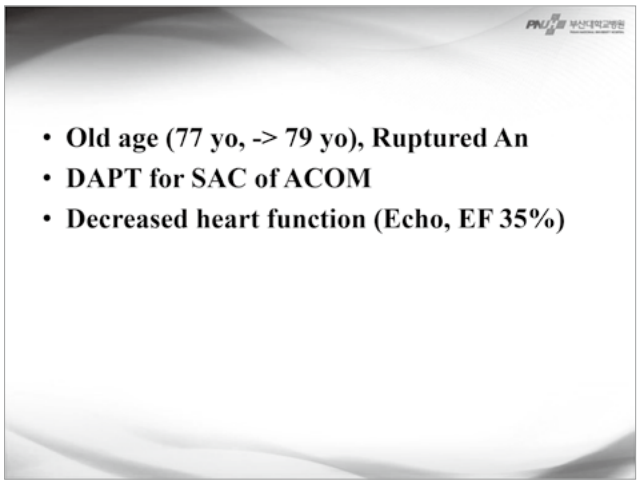

Question
1. 색전술 ?
2. 결찰술 ?
3. 자기가 잘하는 치료방법 ?
4. 자기가 할 수 있는 치료방법 ?
5. 경과관찰 ?


ACOM coiling





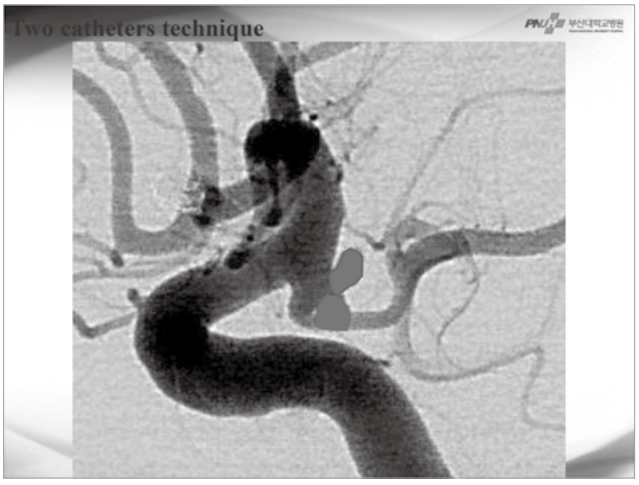

1. Fetal type PCOM
2. Multilobulated An.
3. PCOM origin An. neck
Clipping op !

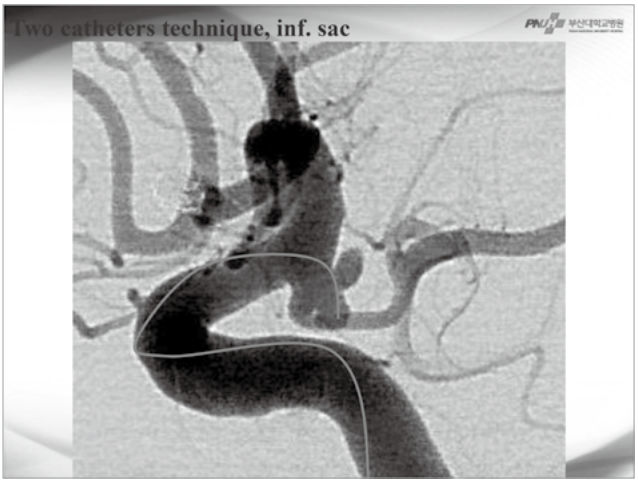

• Old age (77 yo, -> 79 yo), Ruptured An
• DAPT for SAC of ACOM
• Decreased heart function (Echo, EF 35%)

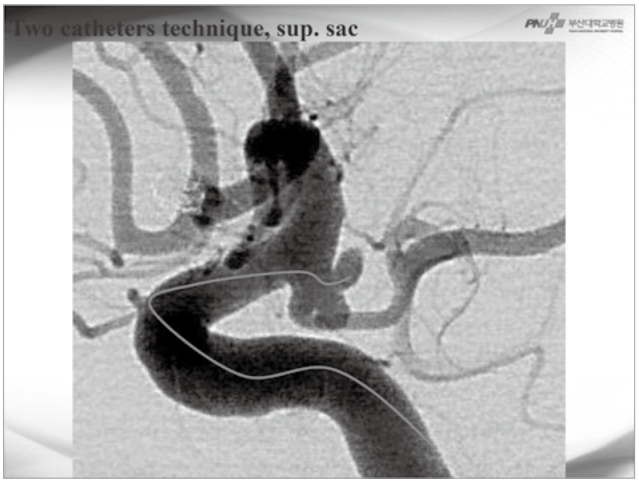

SAC (ICA)

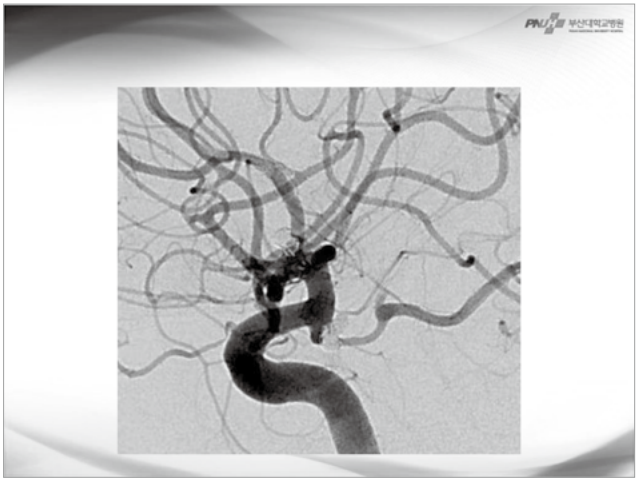

SAC (PCOM to ICA)

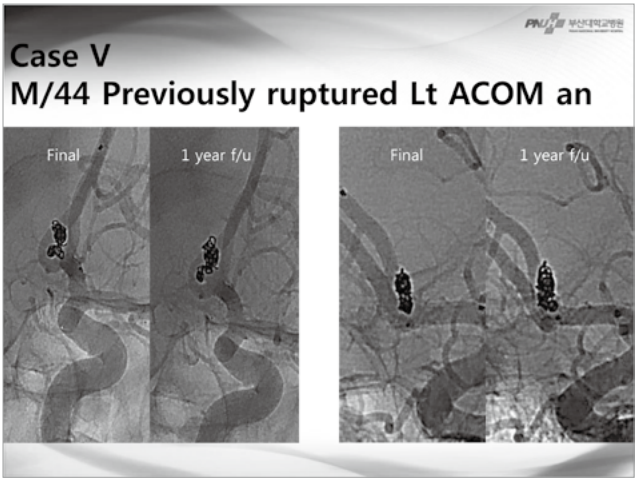

SAC (Modified Waffle corn)


Two catheters technique

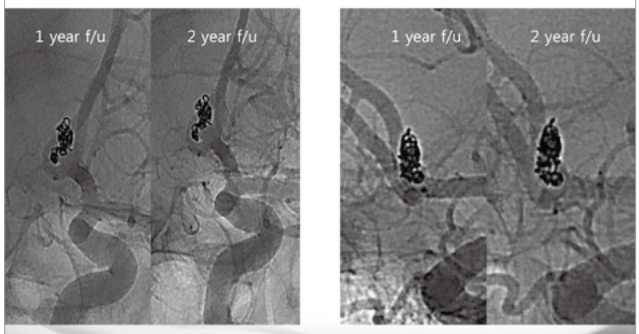

Two catheters technique, inf. sac

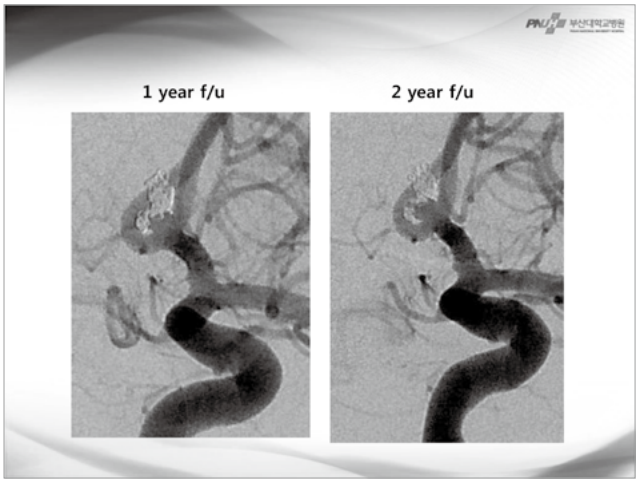

Two catheters technique, sup. sac




Case V
M/44 Previously ruptured Lt ACOM an
Final
1 year f/u
Final
1 year f/u

2 year follow up



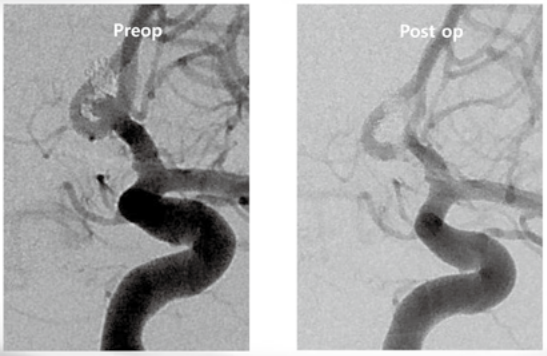


Question

1. 경과관찰?
2. 색전술
3. 결찰술 ?
4. 자기가 잘하는 치료방법?
5. 자기가 할 수 있는 치료방법?

Regrowthed coiled ACOM clipping

Post op DSA



Thank you for your attention!

정 영 진

영남대병원 신경외과

학력 및 경력

2001 영남의대 졸업
2002 영남대학교 의과대학 부속병원 인턴
2006 영남대학교 의과대학 부속병원 레지던트
2010 영남대학교 의과대학 부속병원 전임의
2011 서울 아산병원 전임의
2017 미국 에모리 대학 교환교수
2018 영남대학교 의과대학 부속병원 신경외과학교실 조교수

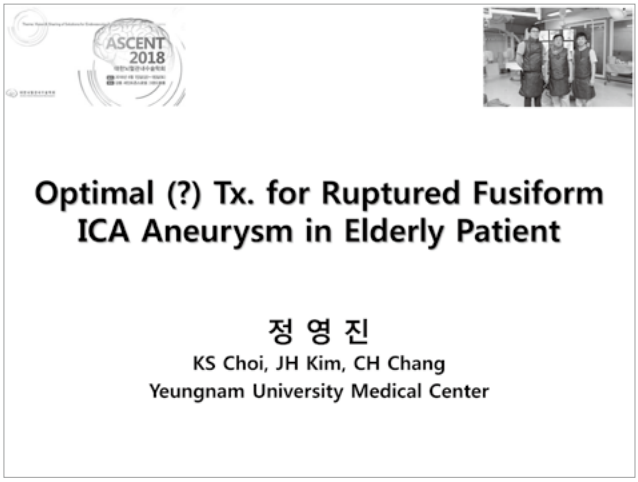
학회활동

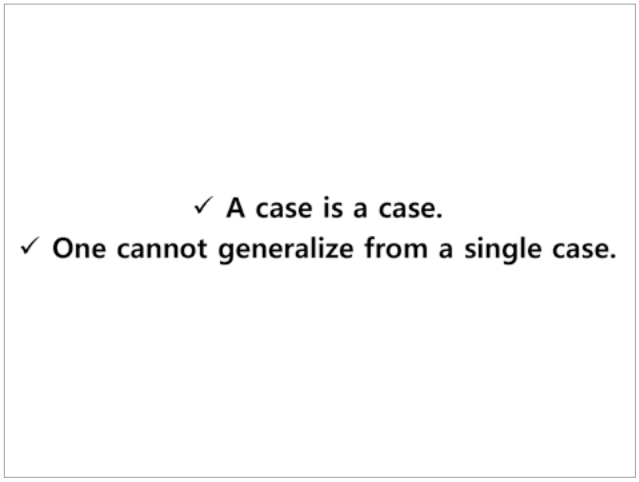
대한의학협회
대한신경외과학회
대한뇌혈관외과학회
대한뇌혈관내수술학회
대한뇌졸중학회

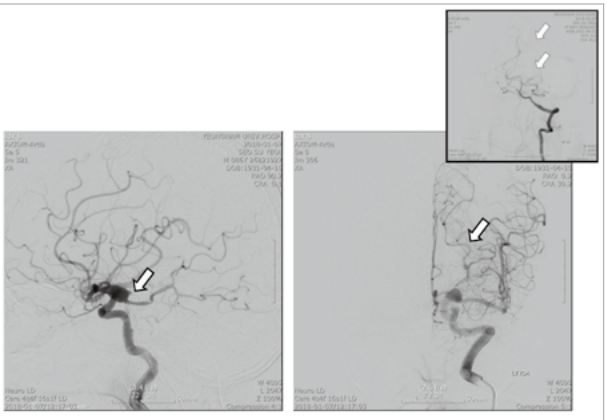
Optimal Tx. for Ruptured Fusiform ICA Aneurysm in Elderly Patient

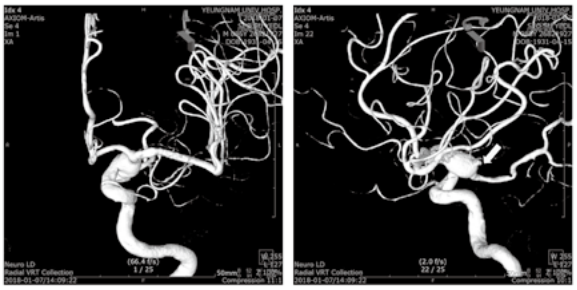
Young-Jin Jung, Kyungsik Choi, Jong-Hoon Kim, Chul-Hoon Chang

Department of Neurosurgery, Yeungnam University Medical Center









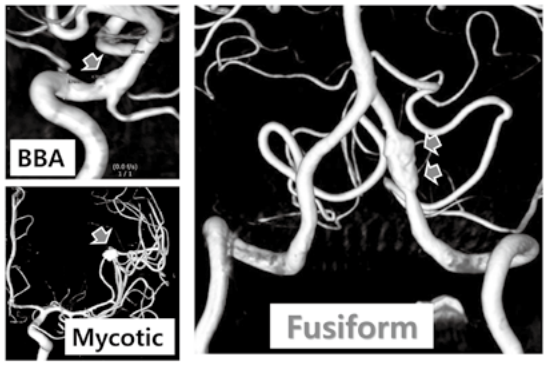
Question?

- 가장 합당한 진단명은?
  - 1. SAH d/t ruptured **Saccular** PcomA An.
  - 2. SAH d/t ruptured **BBAn**.
  - 3. SAH d/t ruptured **ICA Fusiform** An.
  - 4. SAH d/t ruptured **Mycotic** An.
  - 5. **Others.**

Aneurysm

- **Saccular**
  - thin-walled protrusions from the intracranial arteries that are composed of a very thin or absent tunica media, and an absent or severely fragmented internal elastic lamina
- Fusiform
  - **enlargement or dilatation of the entire circumference** of the involved vessel that may in part be formed due to **atherosclerosis**
  - entire circumference of the distal ICA &
  - origin Pcom, AchoA from the dilated segment
- **Mycotic**
  - usually result from infected emboli due to infective endocarditis
- **Blood blister-like**
  - arterial lesions from non-branching sites (dorsal or anterior wall) on the internal carotid artery

Aneurysm



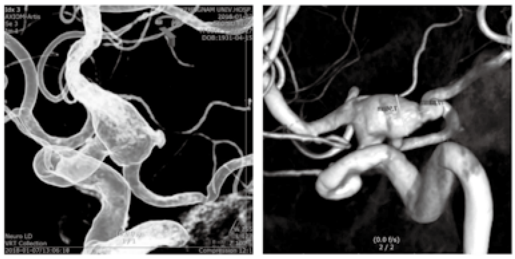
aSAH d/t ruptured Aneurysm

- **Personal Cases 217 Cases (From, 2012.08)**
- **EVT in YUMC, 2017**

Disease	Cases
UIA	136
aSAH	114
IS (iA Thrombectomy)	30+NM
CAS	15
Total	**295**

Ruptured Fusiform ICA Aneurysm (?)

- Only 1 cases, my entire experience

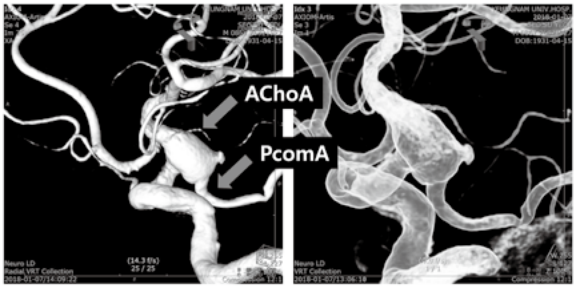


F/86 F/83, Prof. JH KIM

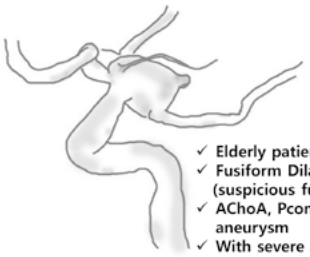
Ruptured Fusiform ICA Aneurysm

- Fusiform An. in anterior circulation
  - rare
  - mainly, posterior circulation
- Treatment modality
  - Difficulty & Controversial
  - Relationship with AchoA, PcomA
  - Vascular reconstruction
    - trapping, proximal occlusion with bypass etc.

SAH maybe
d/t Ruptured Fusiform Aneurysm (Dissecting Aneurysm ?)
with Daughter Sac (Rupture Point ?)



Schematic Illustration



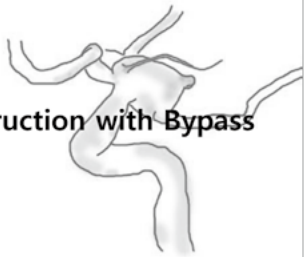
- ✓ Elderly patient (F/ 86)
- ✓ Fusiform Dilatation (suspicious fusiform an.)
- ✓ AChoA, Pcom originated form the aneurysm
- ✓ With severe atherosclerotic change
- ✓ Small bleb (suspicious rupture point)
- ✓ No Acom, P1

Question ?

- Treatment Plan ?
  - 1. Microsurgery
  - 2. Endovascular treatment
  - 3. Others
  - 4. Transfer (?)

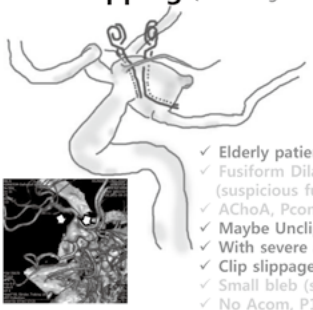
Q. Microsurgery

- 1. Direct Clipping
- 2. Vascular Reconstruction with Bypass
- 3. Others



Surgical Clipping

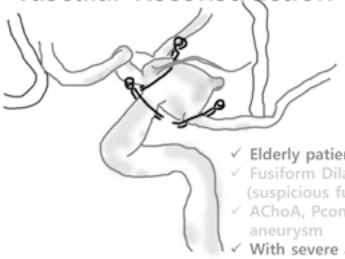
- Direct Clipping (Preserving AchoA and PcomA)



- ✓ Elderly patient (F/ 86)
- ✓ Fusiform Dilatation (suspicious fusiform an.)
- ✓ AChoA, Pcom originated form the aneurysm
- ✓ Maybe Unclippable d/t
- ✓ With severe atherosclerotic change
- ✓ Clip slippage (feat. poor surgical technique)
- ✓ Small bleb (suspicious rupture point)
- ✓ No Acom, P1

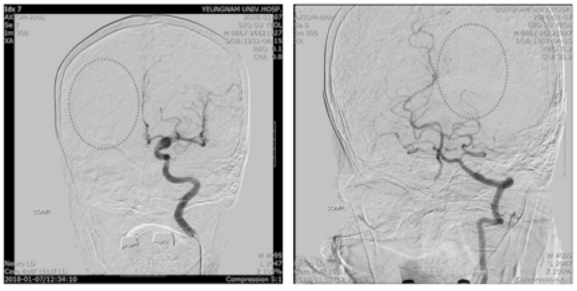
Surgical Clipping

- Vascular Reconstruction with Bypass



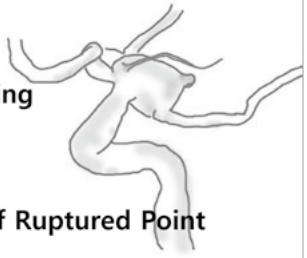
- ✓ Elderly patient (F/ 86)
- ✓ Fusiform Dilatation (suspicious fusiform an.)
- ✓ AChoA, Pcom originated form the aneurysm
- ✓ With severe atherosclerotic change
- ✓ Small bleb (suspicious rupture point)
- ✓ Poor surgical technique (feat. I CAN'T)
  - ✓ ACA-ACA, STA-PCA bypass
  - ✓ Preserving AchoA

Mata's/ Allcock Test



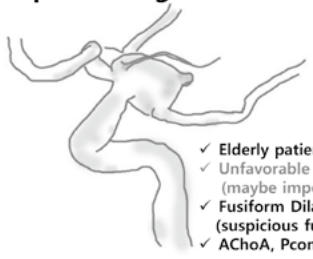
Q. Endovascular Tx.

- 1. Simple Coiling
- 2. Stent assisted Coiling
- 3. Flow Diversion
- 4. Selective Coiling of Ruptured Point
- 5. Others



Endovascular Treatment

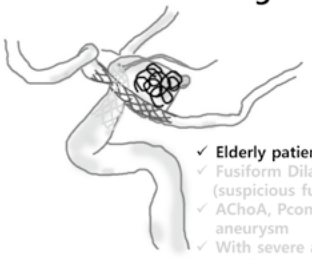
- Simple coiling



- ✓ Elderly patient (F/ 86)
- ✓ Unfavorable for simple coiling (maybe impossible)
- ✓ Fusiform Dilatation (suspicious fusiform an.)
- ✓ AChoA, Pcom originated form the aneurysm
- ✓ With severe atherosclerotic change
- ✓ Small bleb (suspicious rupture point)
- ✓ No Acom, P1

Endovascular Treatment

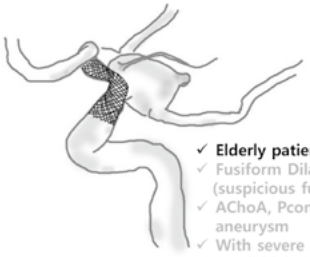
- Stent Assisted Coiling



- ✓ Elderly patient (F/ 86)
- ✓ Fusiform Dilatation (suspicious fusiform an.)
- ✓ AChoA, Pcom originated form the aneurysm
- ✓ With severe atherosclerotic change
- ✓ Small bleb (suspicious rupture point)
- ✓ Difficult or Impossible Proper Stent Delivery d/t No Acom, P1

Endovascular Treatment

- Flow Diversion



- ✓ Elderly patient (F/ 86)
- ✓ Fusiform Dilatation (suspicious fusiform an.)
- ✓ AChoA, Pcom originated form the aneurysm
- ✓ With severe atherosclerotic change
- ✓ Small bleb (suspicious rupture point)
- ✓ No Acom, P1
- ✓ No Premedication of Dual Antiplatelet
- ✓ No Medical Insurance

Endovascular Treatment

- Selective Coiling

- ✓ Elderly patient (F/ 86)
- ✓ Fusiform Dilatation (suspicious fusiform an.)
- ✓ AChoA, Pcom originated form the aneurysm
- ✓ With severe atherosclerotic change
- ✓ Small bleb (suspicious rupture point)
- ✓ No Acom, P1
- ✓ Lack of Evidence
- ✓ No long term result

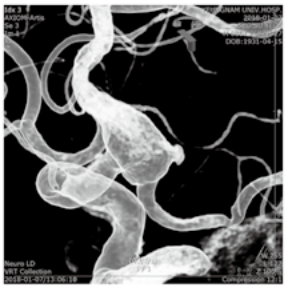
We Planned,

✓ Selective Coiling of the Suspicious Ruptured Point,

✓ with Double MC Technique

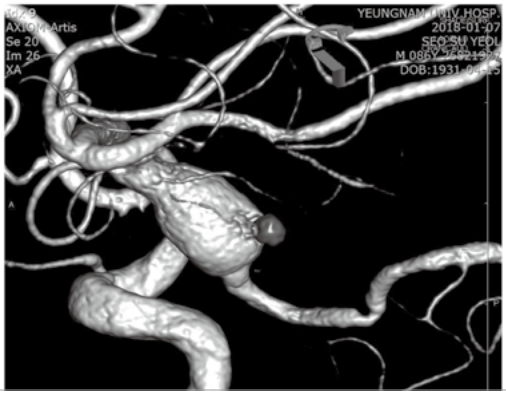
Selective Coiling

Ruptured Small Aneurysm N/H/W (2.51/1.81/2.56)



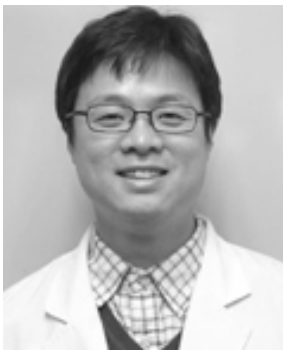
Double MC Technique

Result



Conclusion

- **Treatment of ruptured fusiform aneurysms**
  - vascular reconstruction/ proximal occlusion/ trapping with bypass
- **Selective coiling suspected rupture point**
  - could be alternative treatment option



김 창 현

계명대 동산병원 신경외과

학력 및 경력

2012.7- : Assistant Professor, Department of Neurosurgery, Keimyung University, Dongsan Medical Center
2011.3-2012.6: Staff, Department of Neurosurgery, Cerebro-vascular Center, Dong-Rae Bongseng Hospital
2009.3-2011.2: Clinical Research Instructor, Department of Neurosurgery, Stroke Center, Yonsei University College of Medicine, Gangnam Severance Hospital
2008.3-2009.2: Clinical Fellowship, Brain Tumor and Skull Base Section, Samsung Medical Center
2007.3-2008.2: Clinical Fellowship, Cerebro-Vascular Section, Samsung Medical Center
2003.3-2007.2: Resident Ship, Kyung-Pook National University Hospital
2002.3-2003.2: Internship, Kyung-Pook National University Hospital

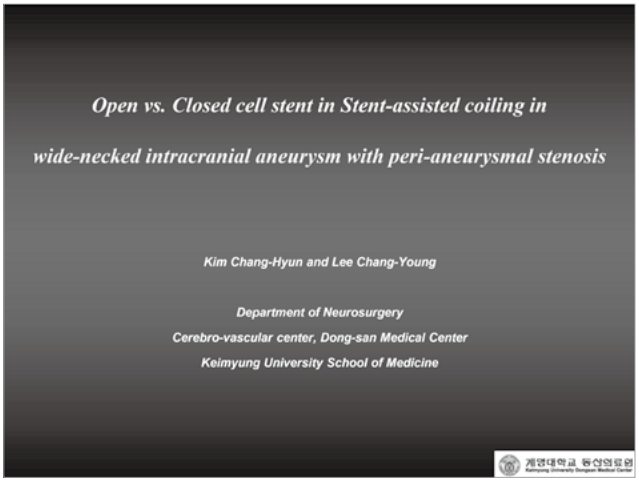
학회활동

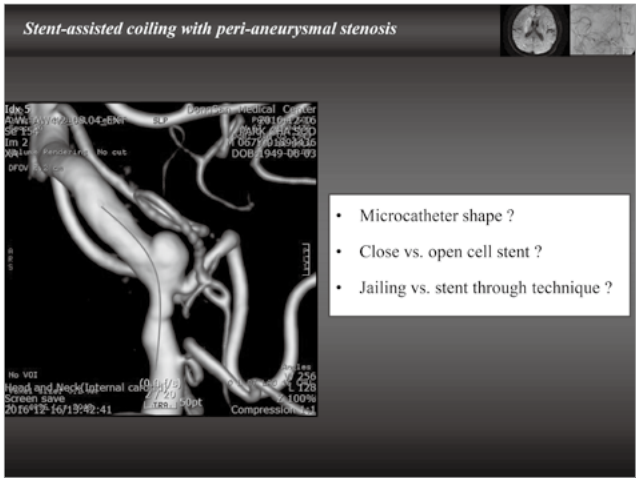
2013.4 - Present Korean Society of Cerebro-vascular Surgeons: Multi-institutional clinical trial member
2012.3 – Present Korean Society of Cerebro-vascular Surgeons: Insurance Institution Association Member
2012.3 – Present Journal of Cerebro-vascular and Endovascular Neurosurgery: journal reviewer
2009 – Present Member, Korean Society of Interventional Neuroradiology
2009 – Present Member, Society of Korean Endovascular Neurosurgeons
2007 - Present Member, Korean Society of Cerebro-vascular Surgeons

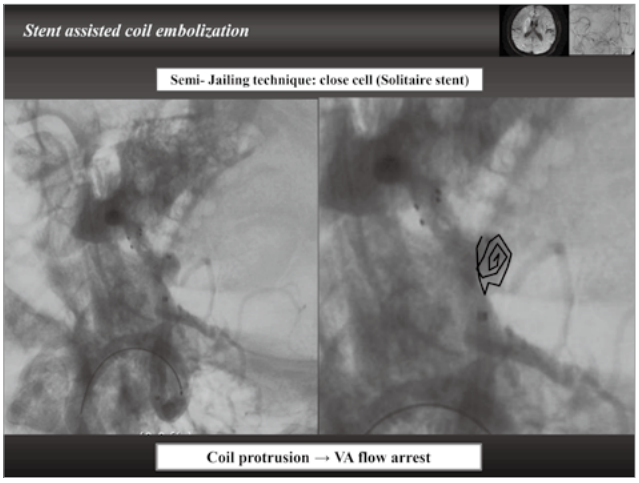
Open vs. Closed cell stent in Stent-assisted coiling in wide-necked intracranial aneurysm with peri-aneurysmal stenosis

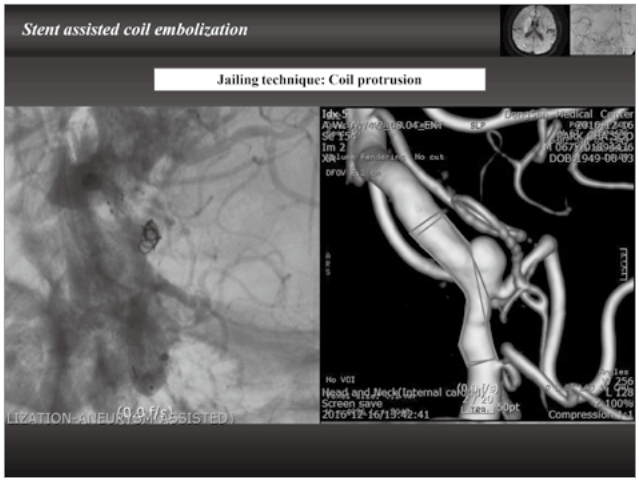
Kim Chang-Hyun, Lee Chang-Young

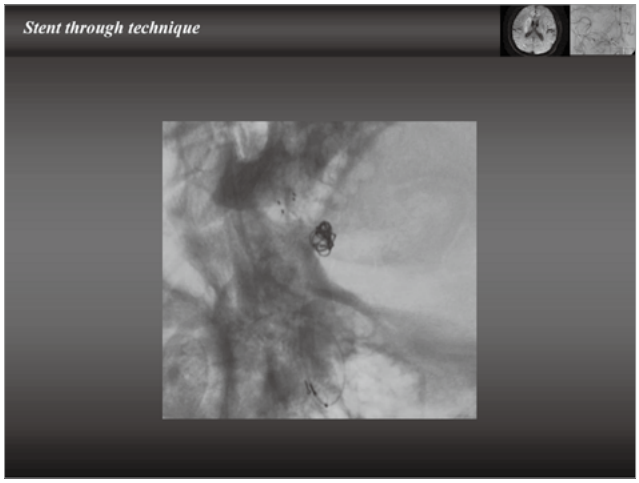
Department of Neurosurgery Cerebro-vascular center, Dong-san Medical Center
Keimyung University School of Medicine

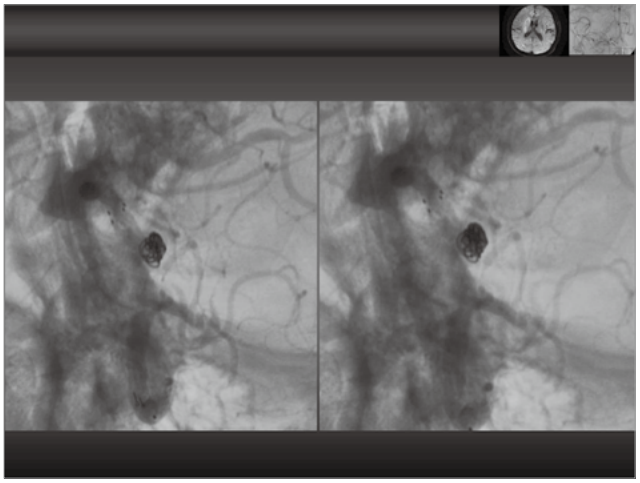


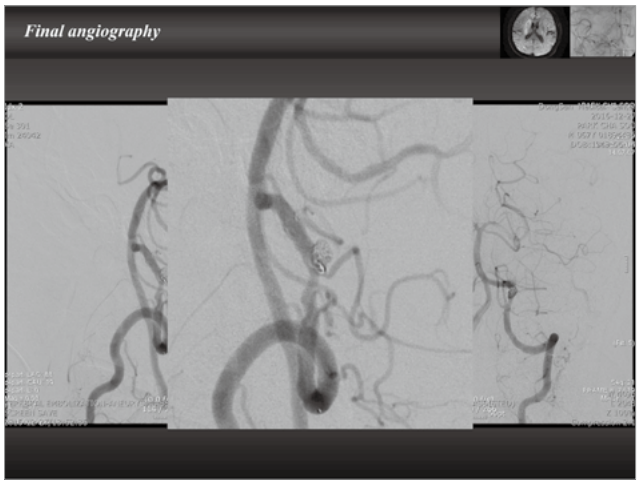


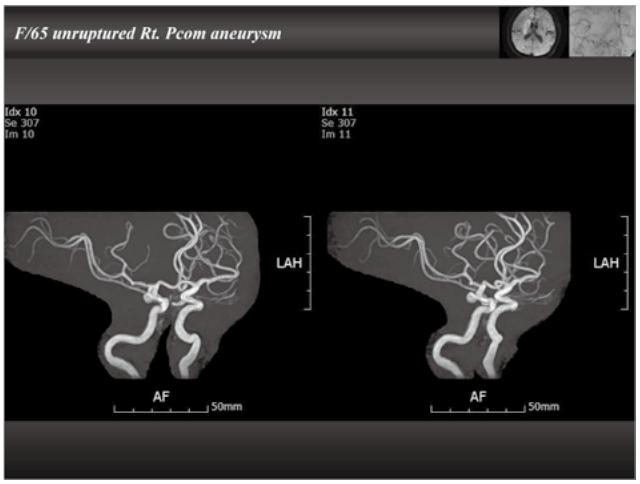


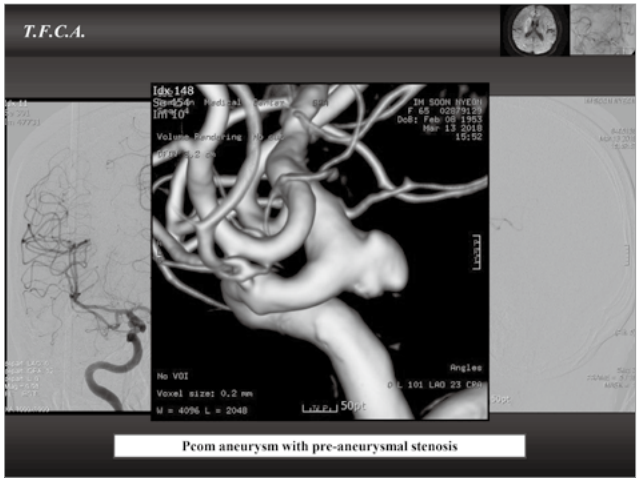


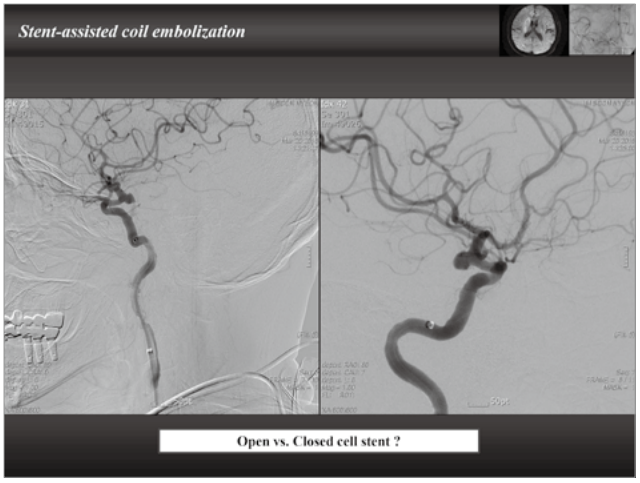

Stent through technique

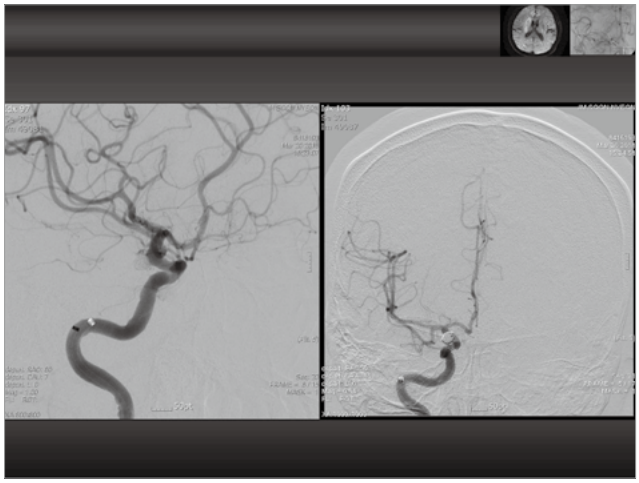



Final angiography

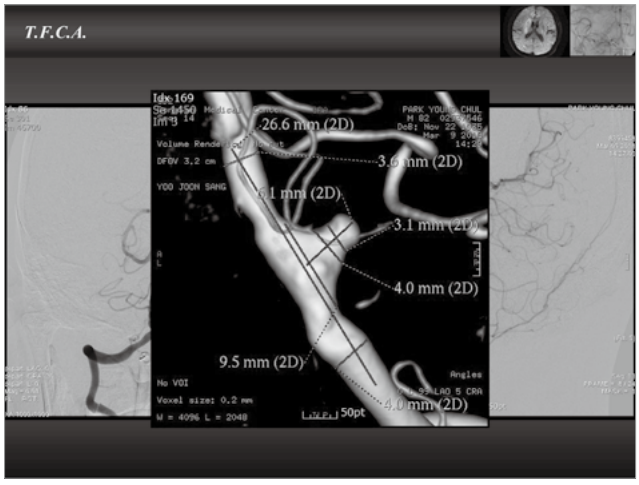

F/65 unruptured Rt. Pcom aneurysm
Idx 10
Se 307
Im 10
Idx 11
Se 307
Im 11
LAH
LAH
AF
50mm
AF
50mm

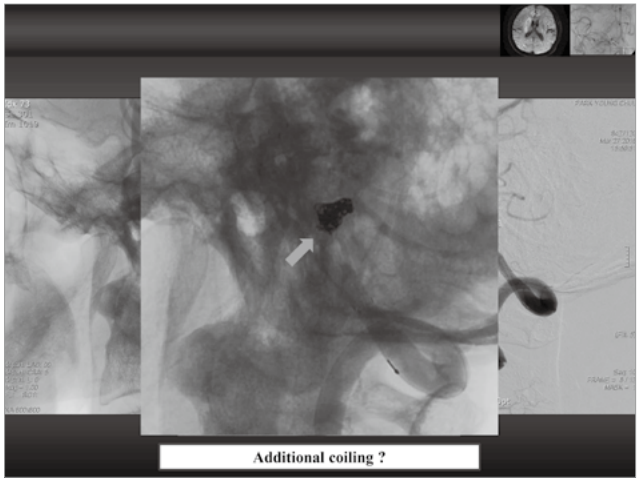

T.F.C.A.
Idx 148
Voxel size: 0.2 mm
Angles
Pcom aneurysm with pre-aneurysmal stenosis


Stent-assisted coil embolization
Open vs. Closed cell stent ?

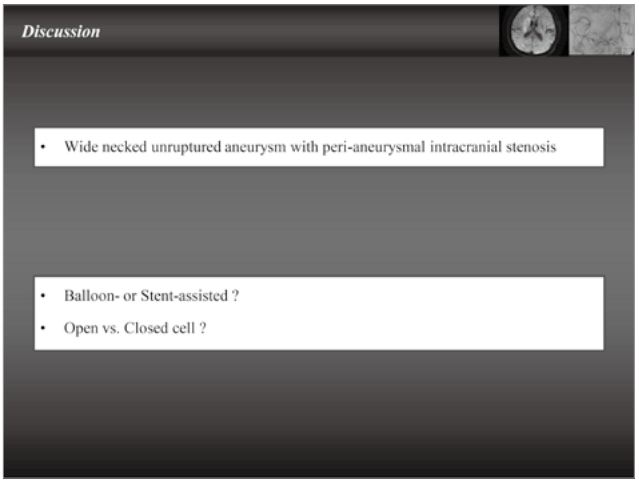



M/82 unruptured VA aneurysm with peri-aneurysmal stenosis
LAF
PF
50mm


T.F.C.A.
26.6 mm (2D)
3.0 mm (2D)
3.1 mm (2D)
4.0 mm (2D)
9.5 mm (2D)
4.0 mm (2D)
50pt


Additional coiling ?


Try Stent-through technique ?
50pt


Discussion
• Wide necked unruptured aneurysm with peri-aneurysmal intracranial stenosis
• Balloon- or Stent-assisted ?
• Open vs. Closed cell ?


Thank you for your attention !!!

김 대 원

원광대병원 신경외과

학력 및 경력

원광대학교 의학과 학사
원광대학교 의학과 석사
전북대학교 의학과 박사

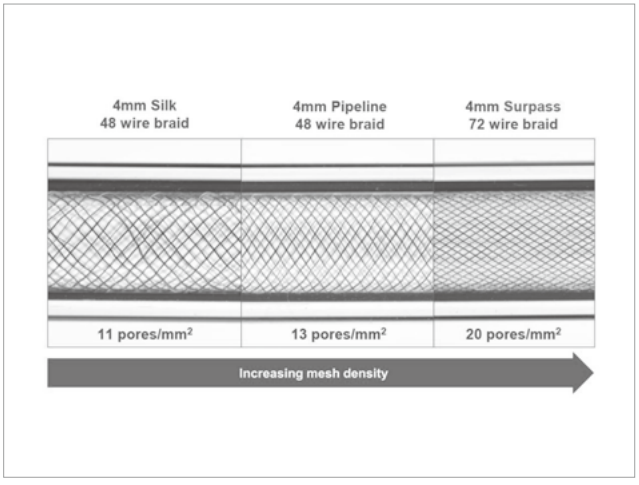
학회활동

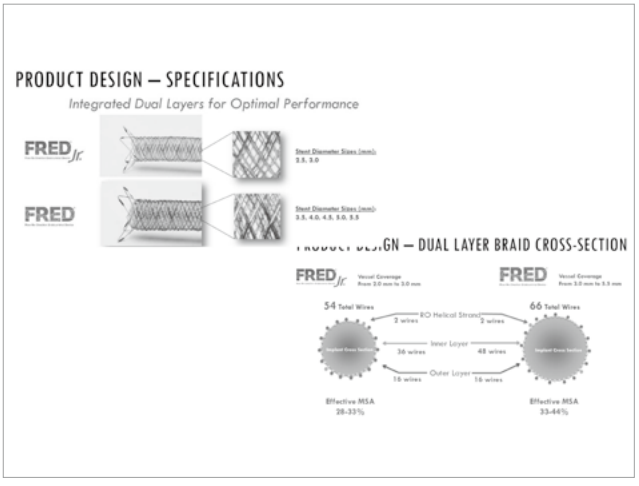
대한 신경외과학회 정회원
대한 뇌혈관외과학회 정회원
대한 뇌혈관내수술학회 정회원

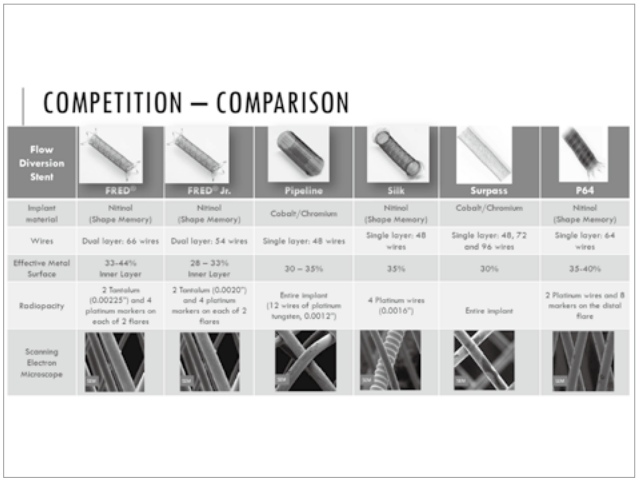
Streamline vs FRED for UIA

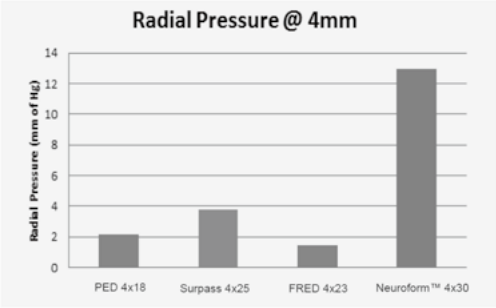
김대원

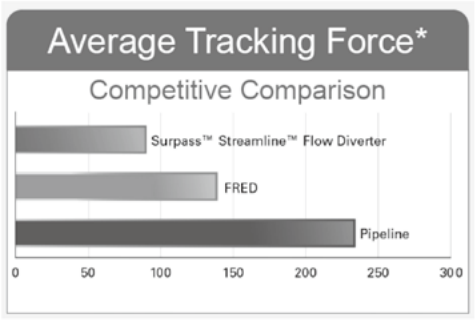
원광대병원 신경외과

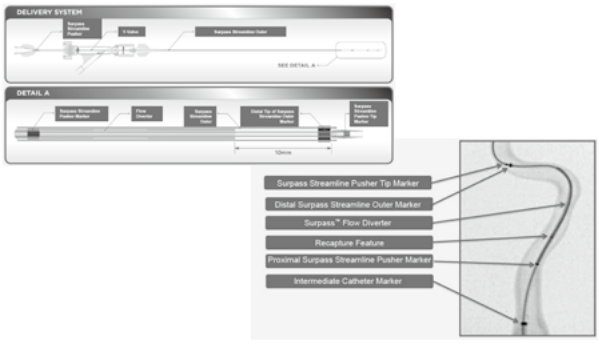


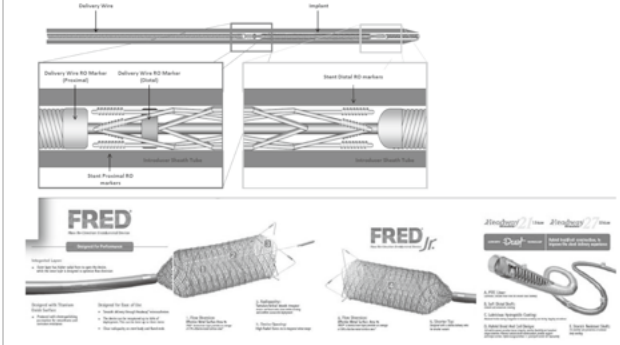












Intermediate Catheters

System	ID (in)	Prox. OD (in)	Dist. OD (in)	Clearance w/ 6F Shuttle (.087)	Performance	Compatibility	CI Friendly
Surpass	-	0.053	-	-	-	-	-
Navien	0.058	0.070	0.070	0.017	**	****	****
5 Max/DDC	0.054	0.080	0.065	0.007	**	*	**
DAC™	0.057	0.068	0.068	0.019	*	**	**
Fargo	0.055	0.079	0.064	0.008	*	**	**

FRED System and Catheter Set-up

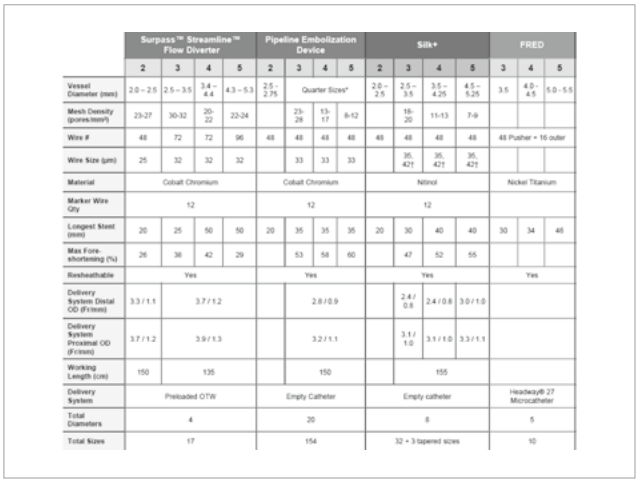
FRED
Flow Re-Direction Endoluminal Device

A 6F Guiding Sheath (ID ≥ 0.071")
B Sofia® Distal Access Catheter (5F)
C Headway® 27 Microcatheter
D FRED® Flow Re-Direction Endoluminal Device

CATALOG INFORMATION – FRED®

Length (mm)	Diameter: 2mm	Diameter: 3mm	Diameter: 4mm	Diameter: 5mm
12mm	✔			
15mm	✔	✔	✔	
20mm	✔	✔	✔	✔
25mm		✔	✔	✔
30mm			✔	✔
40mm			✔	✔
50mm			✔	✔

Never shorter than its labeled length after deployment



	Surpass™ Streamline™ Flow Diverter				Pipeline Embolization Device				Silk+				FRED		
	2	3	4	5	2	3	4	5	2	3	4	5	3	4	5
Vessel Diameter (mm)	2.0 – 2.5	2.5 – 3.5	3.4 – 4.4	4.3 – 5.3	2.5 - 2.75	Quarter Sizes*			2.0 – 2.5	2.5 – 3.5	3.5 – 4.25	4.5 – 5.25	3.5	4.0 - 4.5	5.0 - 5.5
Mesh Density (pores/mm²)	23-27	30-32	20-22	22-24		23-28	13-17	8-12		18-20	11-13	7-9			
Wire #	48	72	72	96	48	48	48	48	48	48	48	48	48 Pusher + 16 outer		
Wire Size (µm)	25	32	32	32		33	33	33		35, 42†	35, 42†	35, 42†			
Material	Cobalt Chromium				Cobalt Chromium				Nitinol				Nickel Titanium		
Marker Wire Qty	12				12				12						
Longest Stent (mm)	20	25	50	50	20	35	35	35	20	30	40	40	30	34	46
Max Fore-shortening (%)	26	38	42	29		53	58	60		47	52	55			
Resheathable	Yes				Yes				Yes				Yes		
Delivery System Distal OD (Fr/mm)	3.3 / 1.1	3.7 / 1.2				2.8 / 0.9				2.4 / 0.8	2.4 / 0.8	3.0 / 1.0			
Delivery System Proximal OD (Fr/mm)	3.7 / 1.2	3.9 / 1.3				3.2 / 1.1				3.1 / 1.0	3.1 / 1.0	3.3 / 1.1			
Working Length (cm)	150	135				150				155					
Delivery System	Preloaded OTW				Empty Catheter				Empty catheter				Headway® 27 Microcatheter		
Total Diameters	4				20				8				5		
Total Sizes	17				154				32 + 3 tapered sizes				10		

최 재 호

가톨릭대 서울성모병원 신경외과

학력 및 경력

가톨릭대학교 의과대학 학사
가톨릭중앙의료원 인턴
가톨릭중앙의료원 신경외과 전공의 수료
현)가톨릭대학교 서울성모병원 신경외과 임상조교수

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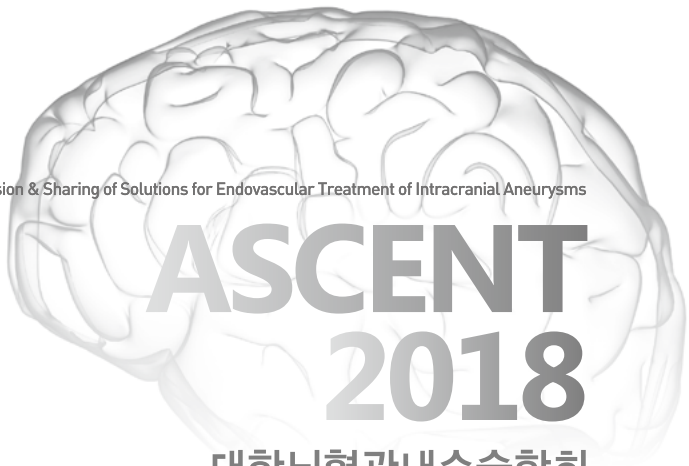
대한신경외과학회 정회원
대한뇌혈관학회 정회원
대한뇌혈관내수술학회 정회원
대한신경중재영상의학회 정회원

FRED versus PED for very large and giant unruptured intracranial aneurysms

Jai Ho Choi, Yong Sam Shin

Department of Neurosurgery, Seoul St Mary's Hospital, The Catholic University of Korea

Flow redirection endoluminal device(FRED, Microvention) is new flow diverter that is intended for endovascular embolization of intracranial aneurysms. FRED is also braided stent like Pipeline embolization device (PED), but it has a specific structure composed of integrated dual layers. Here, we compared the characteristics between FRED and PED, and introduced our experience of FRED for very large and giant unruptured intracranial aneurysms(UIA). We have experienced 4 FREDs deployments in 3 patients since December, 2017. One giant UIA involving MCA showed complete obliteration on digital subtraction angiography(DSA) 3 months later. We have not yet performed follow-up DSA of the other two UIAs. Additional balloon angioplasty was needed due to inappropriate wall apposition in one case. There was no procedural related and delayed complication. FRED has a unique outer layer with flared ends, which improves device opening due to high radial force and has a high anchoring force. FRED is a type of flow diverter similar to PED, but it has some different characteristics and advantages compared to PED.



Theme: Vision & Sharing of Solutions for Endovascular Treatment of Intracranial Aneurysms

ASCENT 2018

대한뇌혈관내수술학회

Scientific Session (Review of aneurysm coils)

좌장: 순천향대 **김범태**

Axium Prime Coil	가톨릭대 **김성림**
Orbit Galaxy Coil	서울대 **강현승**
Microvention Coil	순천향대 **박석규**
Target Coil	아주대 **임용철**

김 성 림

가톨릭대 부천성모병원 신경외과

학력 및 경력

1988.03 ~ 1994.02	가톨릭대학교 의과대학
2004.09 ~ 2007.08	가톨릭대학교 의과대학원 의학 박사
1994.02 ~ 1997.04	공중보건의
1997.05 ~ 1998.02	가톨릭대학교 성모병원 인턴
1998.03 ~ 2002.02	가톨릭대학교 성모병원 레지던트
2002.03 ~ 2004.02	가톨릭대학교 성모병원 임상강사
2004.03 ~ 현재	가톨릭대학교 부천성모병원
2007.08 ~ 2009.01	해외연수, University of Pittsburgh
2012.03 ~ 2017.09	가톨릭대학교 부천성모병원 신경외과 중환자실장
2012.09 ~ 2015.02	가톨릭대학교 부천성모병원 신경외과 과장
2017.09 ~ 현재	가톨릭대학교 부천성모병원 수련교육부장

학회활동

2004 - 현재	International Member, American Association of Neurological Surgeons
2009 - 현재	Invited Faculty, TCTAP Angioplasty Summit
2010.01–현재	대한뇌혈관내수술학회 간행이사
2013 Invited Faculty, WFNS 2013	
2015.03 - 현재	Editor–in–Chief, Journal of Cerebrovascular & Endovascular Neurosurgery
2015.03 - 현재	대한뇌혈관외과학회 간행이사

Axium Prime Coil

김성림

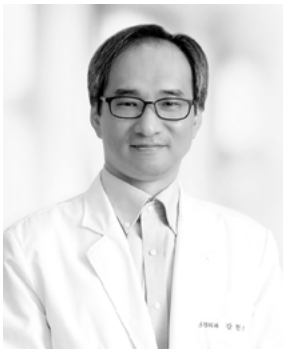
가톨릭대 부천성모병원 신경외과

The evolution of technology has braodened the scope of endovascular treatment of intracranial aneurysms. Coils play a determinant role in this treatment. The virtues of a good coil include framing, packability, avoidance of stetching and minimization of kick-back of microcatheter.

In this session, merits and demerits of the axium prime coil will be discussed and clinical experiences be exemplified.

강 현 승

서울대병원 신경외과



학력 및 경력

1988.3 ~ 1990.2 서울대학교 자연대학 의예과 수료
1990.3 ~ 1994.2 서울대학교 의과대학 졸업(의학사)
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1994.3 ~ 1995.2 서울대학교병원 수련의 수료
1995.3 ~ 1999.2 서울대학교병원 신경외과 전공의 수료(신경외과 전문의)
1999.2 ~ 2002.4 육군 군의관 (대위)
2002.5 ~ 2003.2 서울대학교병원 신경외과 전임의수료 (뇌혈관)
2003.3 ~ 2005.2 서울대학교병원 영상의학과 전임의수료 (신경중재)
2003.3 ~ 2008.3 건국대학교 의과대학 전임강사, 조교수
2008.4 ~ 현재 서울대학교 의과대학 교수

학회활동

대한신경외과학회 회원
대한뇌혈관학회 회원
대한신경중재치료학회 회원
대한뇌혈관내수술학회 회원

Orbit Galaxy Coil

강현승

서울대병원 신경외과

ASCENT 2018 2018/6/15 ~ 6/16 강릉세인트존스호텔

TrufillOrbit/Galaxy coils

서울의대 강현승

SNUH experiences

- As of Dec 2017
- TrufillOrbit or Galaxy coil as a initial frame coil, **48%** (2923/6094)

TrufillOrbit-Galaxy coil for Framing

- Standalone; *random* action
- Soft
- High packing density (OD.012")
- Longer length – Galaxy

- Hydraulic release

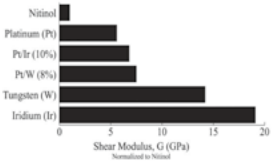
- *Re-sheathing* problem

Spring constant, *K*

$$k = \frac{D_1^4 G}{8 D_2^3 n} = Stiffness \propto \frac{D_1 G}{D_2 n}.$$

- **D1,** diameter of primary platinum wire
- **D2,** coil diameter e.g., .010", .012" etc.

- *G*, shear modulus (metal strength)
- *n*, number of wraps per unit distance

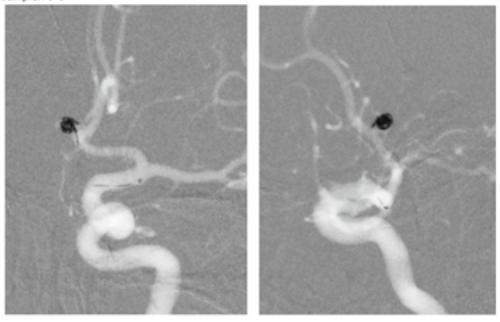


White et al. 2008 AJNR

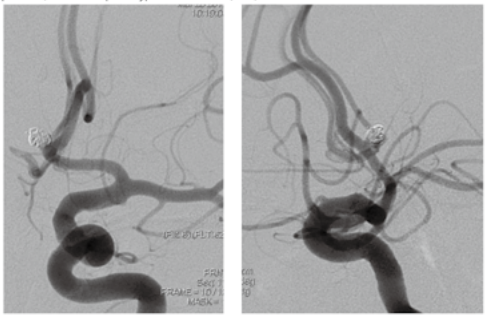
M80 LeeYH DM HT H/H 5 Rebleeding during CT → **intubation & EVD**

Headway, twisted S steam shaping; Galaxy complex 3-8

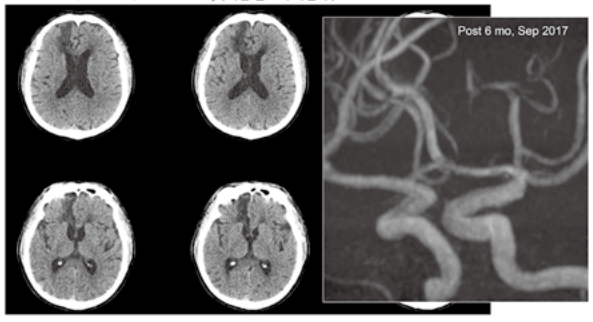
Galaxy complex 3-8



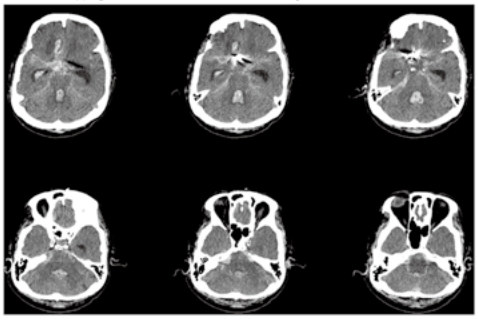
Galaxy complex 3-8, then Microplex Hypersoft 3D 1.5-4, 1-3, 1-2 Mar 2017

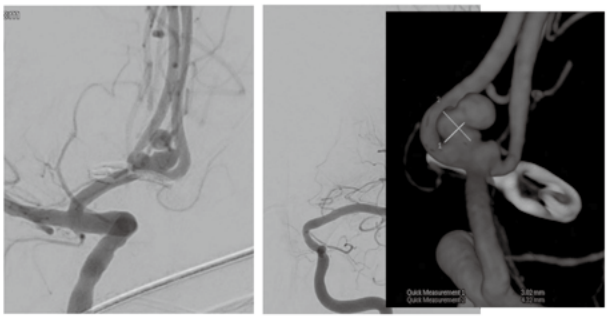


Post ictus 3mo, Jun 2017; Good recovery ('나물 뜯으러 다닌다')

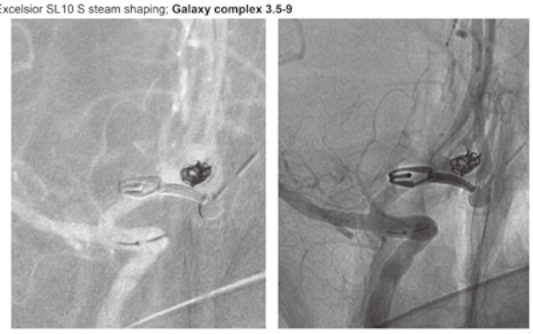


F68 Jung SD 1997 SAH Clipping; DM ESRD on HD **Altered mentality** E2M2Ve → EVD Jun 2017

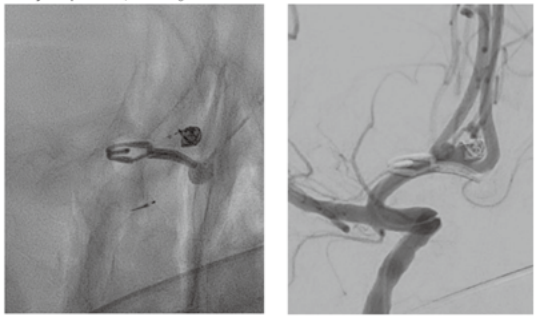




Excelsior SL10 S steam shaping; **Galaxy complex 3.5-9**

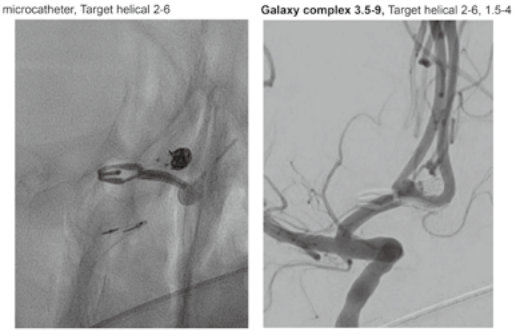


Galaxy complex 3.5-9, *re-framing*

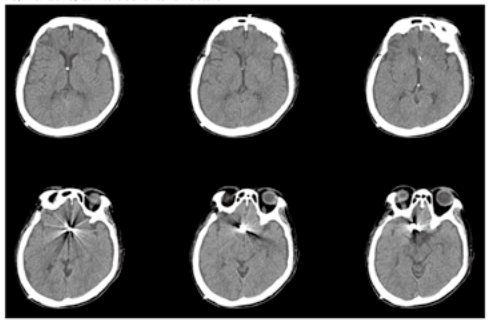


2nd microcatheter, Target helical 2-6

Galaxy complex 3.5-9, Target helical 2-6, 1.5-4



Post 9 mo, Mar 2018; Lt intertrochanteric fracture

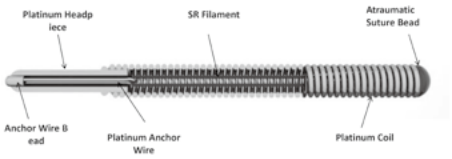


Random Loop, Complex Coil Design

Unique Design

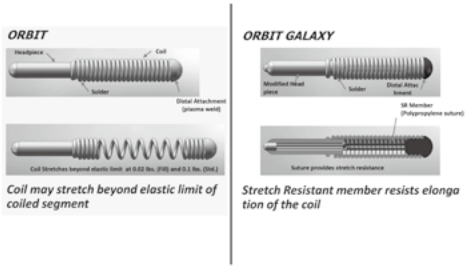
- Random loops – Random breaks
- Various Sized Loops
- Does not cross center of aneurysm

Anatomy of an ORBIT GALAXY Coil



17

Design Comparison



Coil may stretch beyond elastic limit of coiled segment

Stretch Resistant member resists elongation of the coil

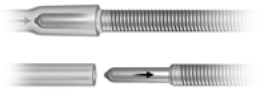
18

Gentle, Hydraulic Release

- Blue Zone = Purge
- Orange Zone = Coil Placement
- Green Zone = Detachment
- Red Line = Alternative Detachment

Increase pressure: rotate clockwise
Decrease pressure: rotate counterclockwise

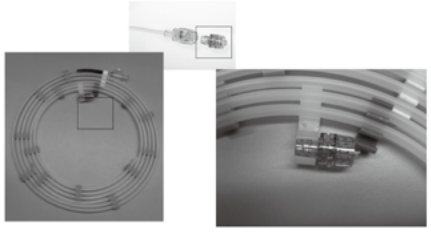
NOTE:
The introduction of air emboli may occur during embolic coil detachment if all air is not removed from the syringe during syringe preparation.



19

Luer Activated Valve

enables syringe removal during coil placement to reduce system length and enhance ease of use. ***One LAV is packaged sterile in the pouch with every coil.***



CERENOVUS introduces GALAXY G3 MINI Coil for treatment of cerebral aneurysms

January 30, 2018

GALAXY G3™ MINI Coil is the Smallest and Softest Finishing Coil the Company Has Ever Produced

CERENOVUS, part of the Johnson & Johnson Medical Devices Companies, today announced the launch of the GALAXY G3™ MINI Coil, its smallest and softest embolic finishing coil, for use in the endovascular treatment of cerebral aneurysms and hemorrhagic stroke. The company received 510 (k) clearance for the device from the U.S. Food and Drug Administration (FDA) in late September 2017.

GALAXY G3™ MINI Coils are about 25 percent softer than the GALAXY G3™ XSFT Coils, the company's other finishing coil and have an ultra-low coil profile with a primary wind diameter of 0.009-inches, the lowest available in the CERENOVUS SPECTRA™ Family of Coils.

박 석 규

순천향대 서울병원 신경외과

학력 및 경력

1995년 순천향대학교 의과대학 의학사
1997년 순천향대학교 대학원 의학석사
2008년 순천향대학교 대학원 의학박사
1995년 ~ 2000년 순천향대학교병원 인턴 및 신경외과 전공의
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2010년 ~ 현재 순천향대학교 부속 서울병원 신경외과 교수

학회활동

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대한뇌혈관내수술학회 정회원 및 뇌혈관내수술 인증의
대한뇌혈관외과학회 종신회원
대한중환자의학회 종신회원 및 중환자의학 세부전문의
대한신경중환자의학회 정회원
대한방사선수술학회 정회원

Microvention Coil

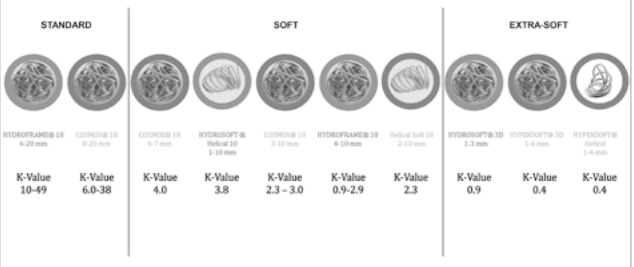
박석규
순천향대 서울병원 신경외과

Review of Aneurysm Coils
Microvention Coil

Overview
Featuring HydroFrame 10 & HydroSoft 3D

박석규
순천향대학교 부속 서울병원

Complete Line of MicroVention Coils



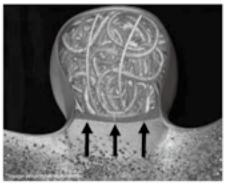
HYDROGEL BACKGROUND

What is Hydrogel?

Inert Hydrogel provides a uniquel y stable and permanent platform f or blood stasis, thrombus organiz ation and neointima formation

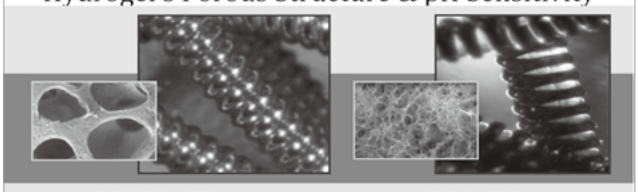
Bare Platinum Coil[1]

Hydrogel Coil[1]



Neointima Formation

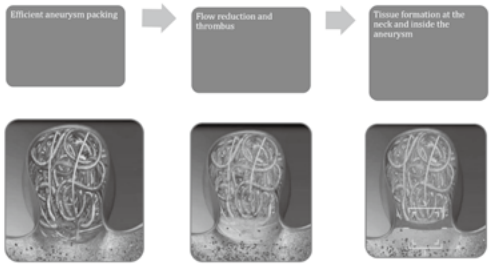
Hydrogel's Porous Structure & pH Sensitivity



DEHYDRATED
Porous hydrogel provides an excellent substrate for neointima formation and smooth muscle cell migration.

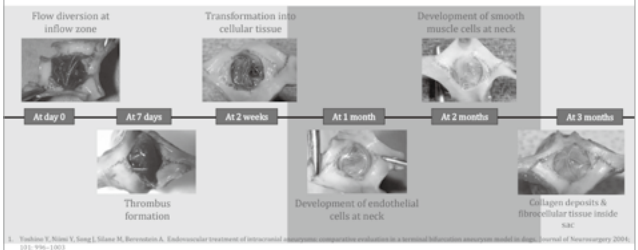
HYDRATED
Hydrogel expands when in contact with blood. Blood components (proteins, etc) are absorbed into hydrogel during the expansion process.

Hydrogel Objectives



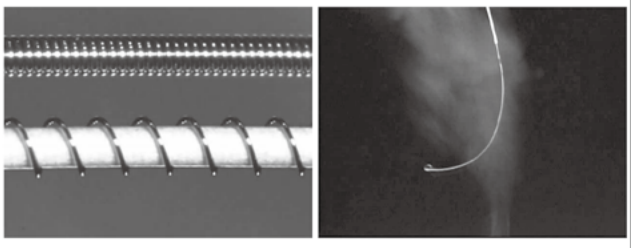
Hydrogel's Role in Aneurysmal Healing

In-vivo animal studies show that Hydrogel acts as a stable and permanent mechanical platform for natural tissue proliferation

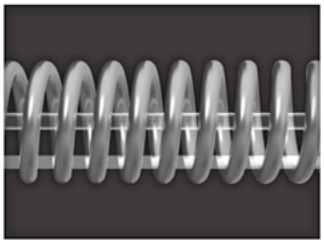


1. Yoshino Y, Niimi Y, Song J, Silane M, Berenstein A. Endovascular treatment of intracranial aneurysms: comparative evaluation in a terminal bifurcation aneurysm model in dogs. Journal of Neurosurgery 2004; 101: 996–1003
2. Tsumoto T, Niimi Y, Berenstein A. Evaluation of the new HydroSoft® coil in a canine model of bifurcation aneurysm. J Neurosurg 2009.

1st Generation HydroCoil® System



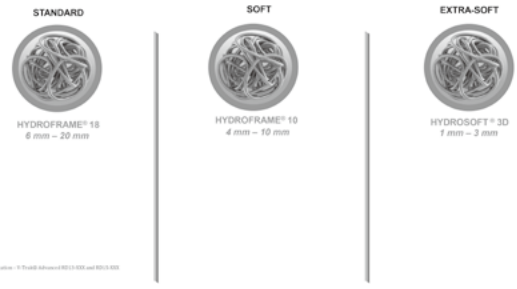
2nd Generation HydroSoft® System



Hydrogel Portfolio is....

- Complete
- Progressively soft
- As easy to use as pl atinum

Start-to-Finish Treatment with Hydrogel Technology



Primary Wind and Filament

MicroVention Coil Brand	Coil Diameter (mm)	Outer Diameter (in)	Filament Thickness
HydroSoft 3D	1-2.5x6, 3x4, 3x6	0.0120	0.00150
HydroSoft 3D	2.5x8, 3x8, 3x10	0.0130	0.00175
HydroFrame 10	4x5-4x10	0.0130	0.00175
HydroFrame 10	4x15-6	0.0135	0.00200
HydroFrame 10	7-10	0.0135	0.00225

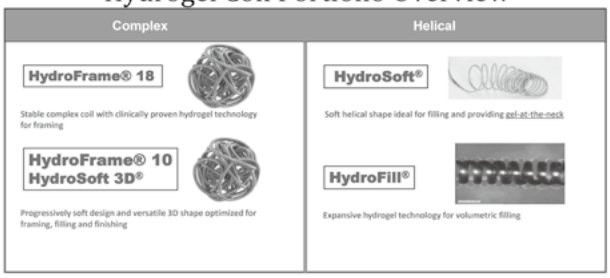
Complete, Progressively Soft, Easy to Use

Increasing stability for framing

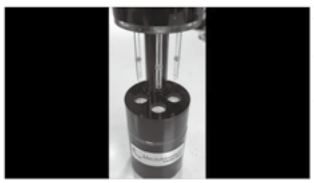
Coil Name	Diameter (mm)	Length (cm)
HydroSoft 3D	1	2, 3,
	1.5	2, 3, 4
	2	2, 3, 4, 6, 8
	2.5	4, 6, 8
	3	4, 6, 8, 10
HydroFrame 10	4	5, 8, 10, 15
	5	10, 15, 20
	6	12, 19
	7	15, 28
	8	17, 33
	9	31
	10	36

Increasing softness for filling and finishing

Hydrogel Coil Portfolio Overview



Hydrogel Flow Reduction



Drip Model Experiment:

- 30% packing volume
- Hydrogel (middle) provide MORE reduction vs. 0.020" (left) and 0.010" (right) outer diameter platinum coils

Evolution of Questions Explored by Hydrogel Studies

Are hydrogel coils.....

HELPS
PRET I & II

GEL-THE-NEC

GREAT
HYBRID
HEAT

RAGE

Strong Clinical Evidence for Hydrogel

Safe & Effective for Finishing[1]

GEL-THE-NEC[1]

HydroSoft® coils shown to be safe & effective for finishing at the neck in ruptured and unruptured aneurysm

- 89% complete/near complete occlusion at follow-up
- Low 3.4% retreatment rate
- Low complication rate (1.8% procedure related major morbidity and mortality)

More Effective than Platinum[2]

GREAT[2]

HydroFrame® and HydroSoft® coils have lower composite adverse outcomes than bare platinum coils in medium size aneurysms

- Less recurrence (12 vs. 18%)
- Less retreatment (3 vs. 6%)
- Less composite adverse events *(met primary endpoint with statistical significance)*

HEAT & HYBRID

Results pending

Especially Effective for Ruptured Aneurysms[3]

HELPS[3]

Statistically significantly reduced major recurrence vs platinum coils for medium sized ruptured aneurysms (1st generation hydrogel coils)

GREAT

Subgroup analysis on-going

RAGE

Pending initiation (Ruptured aneurysm study)

1. Brinjikji et al, JNIS 2017
2. Taschner, C. GREAT – Second Generation Hydrogel-coated Coils for the Endovascular Treatment of Intracranial Aneurysms: Final Results of a Randomized Controlled Trial. 2017 International Stroke Conference Abstract Presentation and Stroke on Demand.

Summary of Hydrogel Studies post HELPS

Study Name	Study Type	Pub Date	PI	Journal Ref	Region	# Patients	% Gel by length	Recan Rate	Retreat Rate
PRET I & II	RCT Large, Recurrent Aneurysms	2017	Raymond, Canada	*Raymond J et al. AJNR 2017*	USA, Can, UK, Fra, Chile, JP	447	Min 66% required	Plat: 30% Gel: 28%	Plat: 10% Gel: 11%
GEL-THE-NEC	Pro Reg, Gel for finishing	2017	Kallmes, USA	Brinjikji et al, JNIS 2017	USA	599	43%	11%	3.4%
GREAT	RCT, Med size	2018	Taschner, Germany		Fra, Ger	513	83%	Plat: 18% Gel: 12%	Plat: 6% Gel: 3%
HEAT	RCT		Bendock, USA		USA	600	90%		
HYBRID	RCT		Sakai, JP		JP	431			
RAGE	Pro Reg		Arthur, Fiorella		USA	1000	90%		

2nd Gen

GREAT Study[1]

A Randomized Endovascular Aneurysm Trial

Prof. Christian Taschner – Principal Investigator
Freiburg University Hospital, Freiburg, Germany

- Study Aim: Establish whether 2nd generation Hydrogel coils improve outcomes compared to bare platinum coils.
- Randomized 1:1 in two arms
  - At least 50% hydrogel coils (HydroFrame®, HydroSoft®) by length
  - ANY bare platinum coils
- 513 patients from 22 centers France and Germany

Actual % hydrogel coil length in hydrogel arm = 83%

1. Taschner, C. GREAT – Second Generation Hydrogel-coated Coils for the Endovascular Treatment of Intracranial Aneurysms: Final Results of a Randomized Controlled Trial. 2017 International Stroke Conference Abstract Presentation and Stroke on Demand.

GREAT Trial Design[1]

Study Endpoints

Primary Endpoint	Secondary Endpoints
Adverse composite endpoint: 1. Major aneurysm recurrence on follow-up at 18 month 2. Re-treatment for major recurrences within 18 months 3. Morbidity (mRS = 3 to 5) that prevented angiographic follow-up 4. Any death (mRS = 6)	• Angiographic outcome at baseline and at 6 months • Clinical outcome at 6 months measured by mRS • Total coil length deployed • Packing density obtained

1. Taschner, C. GREAT – Second Generation Hydrogel-coated Coils for the Endovascular Treatment of Intracranial Aneurysms: Final Results of a Randomized Controlled Trial. 2017 International Stroke Conference Abstract Presentation and Stroke on Demand.

GREAT Trial Primary Outcome Results[1]

Primary Composite Endpoint

		Hydrogel	Bare platinum
1	Major recurrence	12% (28/243)	18% (42/241)
2	Re-treatment	3% (7/243)	6% (14/241)

Hydrogel is EFFECTIVE

		Hydrogel	Bare platinum
3	mRS 3 to 5 (prevented angiographic follow-up)	1% (3/243)	0% (0/241)
4	mRS 6 (any death)	3% (7/243)	4% (10/241)

Hydrogel is as SAFE as bare platinum

1. Taschner, C. GREAT – Second Generation Hydrogel-coated Coils for the Endovascular Treatment of Intracranial Aneurysms: Final Results of a Randomized Controlled Trial. 2017 International Stroke Conference Abstract Presentation and Stroke on Demand.

GREAT Trial Safety Results[1]

No statistical difference in procedural adverse events

	Hydrogel	Bare platinum
Thromboembolism	3% (8/243)	5% (12/241)
Aneurysm rupture	1.2% (3/243)	3% (7/241)
Vessel occlusion	Less than 1% (1/243)	1.2% (3/241)
Vessel perforation	1	1
Vessel dissection	0	0

Hydrogel coils are safe
No reports of hydrocephalus in either study group

1. Taschner, C. GREAT – Second Generation Hydrogel-coated Coils for the Endovascular Treatment of Intracranial Aneurysms: Final Results of a Randomized Controlled Trial. 2017 International Stroke Conference Abstract Presentation and Stroke on Demand.

GREAT Trial Safety Results[1]

No statistical difference in clinical outcomes at 18 months in *all patients*

	Hydrogel	Bare platinum
mRS = 0	85% (198/243)	86% (202/241)
mRS = 1 and 2	9% (20/243)	9% (20/241)
mRS = 3 to 5	3% (7/243)	1% (3/241)
mRS = 6	3% (7/243)	4% (10/241)

Hydrogel coils are as safe as platinum
No reports of hydrocephalus in either study group

1. Taschner, C. GREAT – Second Generation Hydrogel-coated Coils for the Endovascular Treatment of Intracranial Aneurysms: Final Results of a Randomized Controlled Trial. 2017 International Stroke Conference Abstract Presentation and Stroke on Demand.

GREAT Trial Technical Results[1]

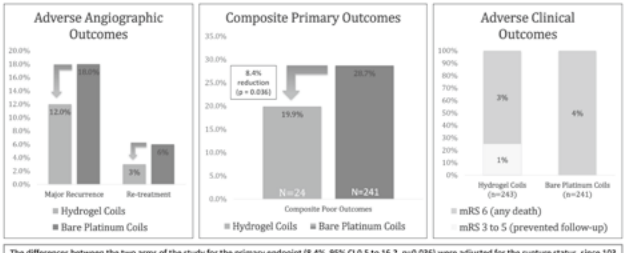
Technical outcome

	Hydrogel	Bare platinum
Coil volume	0.041 cm^3	0.038 cm^3
Mean packing density	39%	31%
Coil length	51.2 cm	61.6 cm
# of implanted coils	6.5	7.0

Mean packing density 8% higher with Hydrogel (p = 0.0001)

1. Taschner, C. GREAT – Second Generation Hydrogel-coated Coils for the Endovascular Treatment of Intracranial Aneurysms: Final Results of a Randomized Controlled Trial. 2017 International Stroke Conference Abstract Presentation and Stroke on Demand.

GREAT Trial Primary Outcome at 18 months[1]



The differences between the two arms of the study for the primary endpoint (8.4%, 95% CI 0.5 to 16.2, p=0.036) were adjusted for the rupture status, since 103 patients (42%) in the hydrogel arm and 105 patients (44%) in the bare platinum arm were treated for ruptured aneurysms.

1. Taschner, C. GREAT – Second Generation Hydrogel-coated Coils for the Endovascular Treatment of Intracranial Aneurysms: Final Results of a Randomized Controlled Trial. 2017 International Stroke Conference Abstract Presentation and Stroke on Demand.

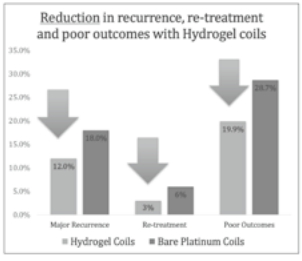
GREAT Primary Endpoint at 18 months[1]

Key points:

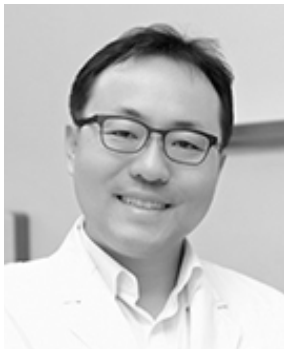
Compared to bare platinum coils, hydrogel coils show:

- Less major recurrence
- Less retreatment
- Less adverse composit outcomes

Statistically Significant
P=0.036



1. Taschner, C. GREAT – Second Generation Hydrogel-coated Coils for the Endovascular Treatment of Intracranial Aneurysms: Final Results of a Randomized Controlled Trial. 2017 International Stroke Conference Abstract Presentation and Stroke on Demand.



임 용 철

아주대병원 신경외과

학력 및 경력

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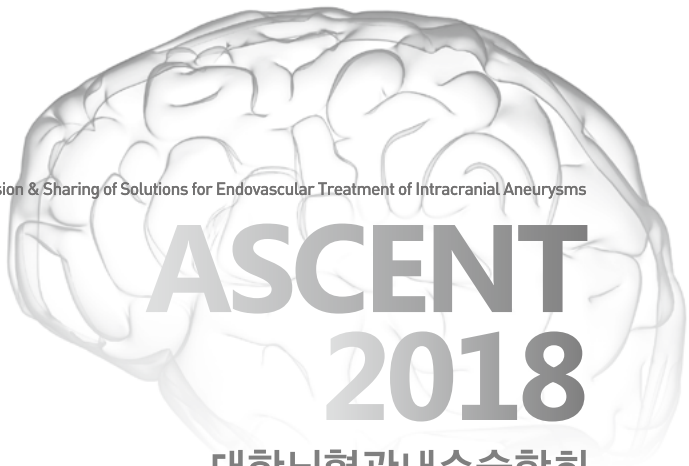
2006 아주대 대학원 의학과 의학 석사

2005 아주대 의과대학 신경외과 연구강사
아주대 의과대학 진단방사선과 연구강사
2008–2013 아주대 의과대학 신경외과 조교수
2014–현재 아주대 의과대학 신경외과 부교수

Target Coil

임용철
아주대병원 신경외과



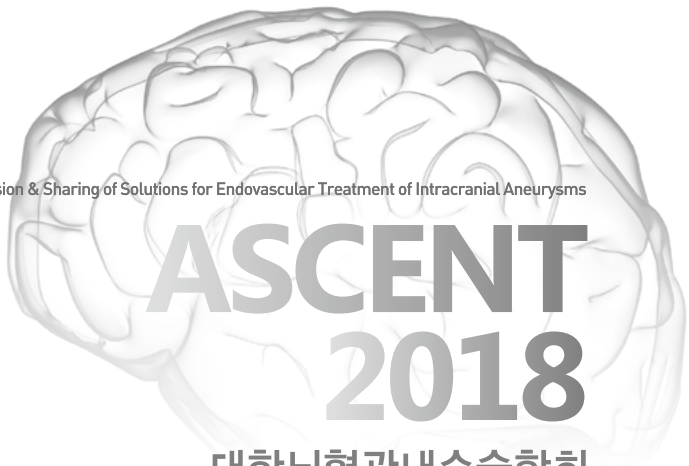
Theme: Vision & Sharing of Solutions for Endovascular Treatment of Intracranial Aneurysms

ASCENT 2018

대한뇌혈관내수술학회

Introduction of new endovascular devices (by company)

좌장 : 분당제생병원 신승훈



Theme: Vision & Sharing of Solutions for Endovascular Treatment of Intracranial Aneurysms

ASCENT 2018

대한뇌혈관내수술학회

Free Paper III: "Complication cases" session

좌장 : 순천향대 **윤석만**, 영남대 **장철훈**

Case 1. Three cases of LVIS blue deployment failure in blood blister-like aneurysm at the distal ICA	중앙대 **남택균**
Case 2. Endovascular trapping of anterior cerebral artery occlusion caused by migration of entire coils after endovascular coil embolization	영남대 **김종훈**
Case 3. A series of complications during endovascular treatment of a systemic lupus erythematosus patient with multiple aneurysms	부산대 **고준경**
Case 4. Unexpected coil migration during coiling for regrowing ruptured Acom aneurysm	순천향대 **오재상**
Case 5. Multimodality treatment for coil migration during coil embolization	을지대 **정승영**
Case 6. P2 fusiform aneurysm treated with LVIS blue-assisted coil embolization after failed PED flex placement: A case report and literature review	가톨릭대 **장동규**

Case 1. Three cases of LVIS blue deployment failure in blood blister-like aneurysm at the distal ICA

Taek-Kyun Nam1, Hyun Ho Choi1, Woong Jae Lee2, Jun Soo Byun2

Department of 1Neurosurgery, 2Radiology, Chung-Ang University Hospital

Objective: Intracranial blood blister-like aneurysm (BBA) is a type of aneurysm that lacks both the intima and media, and tends to rupture. It remains a demanding task to find a safe and effective approach to eliminating this lesion because of the fragility of artery wall. Nowadays, there are several options to repair BBA, such as microsurgical clipping or wrapping, endovascular coiling with balloons or stents, flow diverter such as pipeline embolization device, and covered stents. We reported technical complications occurred in the treatment with the LVIS blue stent for three ruptured BBAs.

Methods: Case 1: A 39-year-old male visited the emergency center with a sudden severe headache. Brain CT revealed SAH in basal and bilateral Sylvian fissure. In cerebral angiography, a BBA in Lt. distal ICA was suspected. Stent-assisted coil embolization was done with LVIS blue 4.5/23. The stent mid-portion was collapsed at cavernous genu portion without flow disturbance and thromboembolism. Case 2: A 48-year-old female with a sudden severe headache was transferred to our hospital. Brain CT revealed SAH and cerebral angiography showed BBA in Rt. supraclinoid ICA (dorsal wall). Emergent stent-assisted coil embolization was done. LVIS blue 4.5/23 and Enterprise 4/16 were deployed. During the inflation of Sceptor XC for collapsed Enterprise stent, rebleeding was developed. Rt. ICA was trapped at the cavernous portion. Case 3: A 47-year-old male with stuporous consciousness was transferred to our hospital. Brain CT and cerebral angiography showed SAH with BBA at the Rt. ICA dorsal wall. Emergent stent-assisted coil embolization was done with LVIS blue 4.5/18. The stent mid-portion was collapsed and thromboembolic complication developed.

Result: - Case 1: the outcome of the patient was mRS 0. Follow up angiography at 5 months revealed no change of minimal contrast filling at neck and focal collapsed stent at ophthalmic segment with patent blood flow. - Case 2: In the second case, the outcome was mRS 4 (alert, hemiplegia). Follow up angiography at 2.5 months revealed hypoplastic change of Rt. cervical ICA, Rt. ophthalmic artery supplied by hypoplastic ICA, no BBA recurrence, Rt. MCA supplied by Rt. PCA-Pcom channel, and Rt. ACA supplied by Lt. Acom channel. - Case 3: In the third case, the outcome was mRS 5 (vegetative state). Follow up angiography at 2 weeks showed near-total Rt. ICA occlusion distal to the ophthalmic artery, no change of the collapsed stent, and Rt. ACA supplied by Lt. Acom channel.

Conclusion: When using the LVIS blue stent, it is necessary to have sufficient experience with other stents, pre-practice on the LVIS blue stent, and a good angiography equipment. Otherwise, the use of LVIS blue stent may be a disaster rather than a treatment. We should find a way to treat it more easily and more safely.

Case 2. Endovascular trapping of anterior cerebral artery occlusion caused by migration of entire coils after endovascular coil embolization

김종훈, 최경식, 정영진, 장철훈

영남대학교병원 신경외과

Objective: We report a rare case of endovascular trapping of anterior cerebral artery occlusion caused by migration of entire coils after endovascular coil embolization.

Methods: On April 17, 2018, a 50-year-old male patient with the chief complaint of headache was referred to our hospital. Brain CTA and digital subtraction angiography(DSA) showed a unruptured anterior communicating artery aneurysm (neck:2.49mm, height:2.92mm, width:3.36mm). And we decided to treat the aneurysm.

Result: The patient underwent endovascular therapy under monitored anesthesia care using dexmedetomidine. A 7 French sheath was placed in the right femoral artery and a guiding catheter was placed in the petrous segment of left internal carotid artery. A single microcatheter technique was applied. After first frame coil insertion (3D 2.5x4), additional 3 coils were inserted. At the end of procedure, final DSA showed complete obliteration of the aneurysm. There were no specific events. However, a few minutes later, the brain CT showed suspicious coil migration. DSA was performed immediately, and showed migration of coils to ACA (left proximal A2). So, we performed the aneurysm occlusion and Lt. ACA trapping to prevent distal embolic event. Fortunately, the patient did not have any neurological symptom. The patient was discharged at 1 week after the procedure, with no neurological deficit.

Conclusion: Coil migration into the parent artery during endovascular coil embolization is a rare, but life-threatening complication, which can induce thromboembolism and result in poor outcome. Therefore, we must do our best to prevent coil migration during endovascular coil embolization.

Case 3. A series of complications during endovascular treatment of a systemic lupus erythematosus patient with multiple aneurysms

Jun Kyeung Ko

Department of Neurosurgery, Medical Research Institute, Pusan National University Hospital

Objective: Although prior reports suggest that intracranial aneurysms are more prevalent in systemic lupus erythematosus (SLE) patients than the general population, larger and more recent studies have found that the overall incidence is comparable. However, SLE patients bear a worse prognosis, with higher incidence of subarachnoid hemorrhage (SAH), increased mortality, and worse Hunt and Hess grades on presentation. The main underlying pathology of intracranial aneurysm and its rupture is presumed to be lupus vasculitis and fragility of blood vessels due to prolonged use of steroid.

Methods: For these reasons, surgical or endovascular intervention for the treatment of intracranial aneurysm can complicate the situation, especially due to bleeding tendency. On the other hand, given the possibility that SLE may predispose to growth and rupture, early intervention may be more beneficial than in the general population.

Result: Here I would like to report on various complications that occurred during endovascular treatment of a SLE patient with multiple aneurysms. The complications include an intraprocedural rupture of unruptured aneurysm, coil stretching, contrast-induced encephalopathy, and delayed ipsilateral intraparenchymal hemorrhage after stent-assisted coiling.

Conclusion: Our unique case highlights that SLE patients with intracranial aneurysm had a higher risk of endovascular procedure-related complications which might be due to the increased bleeding tendency and fragility of blood vessels.

Case 4. Unexpected coil migration during coiling for regrowing ruptured Acom aneurysm

Jae-Sang Oh, Jae-Min Ahn, Jae-Sung Han, Seok-Mann Yoon

Department of Neurosurgery, Soonchunhyang University Cheonan Hospital

Objective: 48 years old man had admitted via ER for severe headache. Brain CT showed the thick subarachnoid hemorrhage on basal cistern and the intraventricular hemorrhage. And cerebral angiography showed the two aneurysms on anterior communicating artery with two different directions. The shape of these aneurysms was unusual that it had two aneurysmal sacs superoposterioly and anterioinferiorly on anterior communicating artery. One of them was irregular shape and they could not admit the Acom trapping because contralateral A1 was hypoplasia. I decided that these two aneurysms were treated with stent-assisted coilings with one procedure. Despite thromboembolic event was occurred during that procedure, the patient recovered well without any morbidity.

Methods: After one year, follow up angiography showed the superoposterior directed aneurysm of two aneurysms was partial recanalized on neck portion. I decided the retreatment for this regrowing aneurysm with Y stenting assisted coiling. However, this treatment could not be regarded as an easy case for me because the neck of aneurysm was not located on right direction to A1 or Acom and it was located on A2. In addition, A1-A2 axis was also acute angle to select the microcatheter to A2 for additional stenting. During second procedure, ipsilateral A2 selection for additional stenting was very difficult and was spent many times. So I changed the plan to simple coiling.

Result: After selection on neck portion of regrowing aneurysm using one microcatheter, first frame coil was packed the regrowing neck portion of aneurysm without difficulty. However, first frame coil was suddenly fallen into the parent artery (A2) during second filling coil insertion. Eventually, frame coil got totally fallen into the parent artery of A2 and then finally frame coil migrated to the A4 segment of ACA. As a lucky misfortune, selection of ipsilateral A2 parent artery was successfully done at that time. And stenting was done with attachment a migrated coil to the A3 located no branch. Finally, Y stent-assisted coiling was done for regrowing Acom aneurysm according to the original plan and migrated coil was taken on ACA without any flow limitation. Post-operative DWI showed no significant emboli and the patient had no neurological deficit.

Conclusion: Sometimes we could meet the situation of migrated coil or any complication in any time. At that time, we should keep the several options of solution in mind and maintain the peace of mind in unstable situation. Fortunately, my case was finished well and the patient was remained without any morbidity. But I think, as a neurosurgeon, I always ready to move and run for avoiding the worst case with composure.

Case 5. Multimodality treatment for coil migration during coil embolization

Seung Young Chung, Se Hun Chang, Moon Sun Park

Department of Neurosurgery, Eulji University Hospital

Objective: Distal coil migration is a rare, but potentially morbid complication of intracranial aneurysm embolization. The consequences of coil migration vary significantly from asymptomatic to as severe as large territory cerebral infarction. At present, there is no established standard of surgical or endovascular evacuation of migrated coil and in particular, no consensus on the optimum time for such intervention. We report our positive experiences with multimodality treatment for coil migration during coil embolization.

Methods: Uncontrolled coil occurred in 5 (0.91%) of approximately 550 patients treated between 2013 and 2017 in our series. We report 2 cases of endovascular retrieval performed with snare technique and 1 with retrieval stent technique, and 1 with microsurgical extraction, and 1 with observation.

Result: All of cases, removal of migrated coil were performed immediately following the migration event without hesitation. In all cases, there was no obstruction of blood flow in angiography after removal of migrated coil, and no infarction was observed in f/u MRI. After treatment, low molecular weight heparin was used as a short term, all patients were discharged with no deficit.

Conclusion: In our study, we performed three cases of endovascular retrieval and one case of surgical retrieval of migrated coil. In such urgent situation, operator should consider the retrieval of migrated coil and the consequences following the event such as intracranial hemorrhage or cerebral infarction both. Decision between surgical or endovascular retrieval of migrated coil should lead to avoid devastating consequences. In addition, we also emphasize the capability of operator both in endovascular technique and surgical technique since operator must be prepared for unexpected situations in all times.

Case 6. P2 fusiform aneurysm treated with LVIS blue-assisted coil embolization after failed PED flex placement: A case report and literature review

Dong-Kyu Jang1, Byung-Hoo Moon1, Sang-Kyu Park1, Young-Min Han3, Yong-Sam Shin2, Byung-Rae Cho1, Kyung-Sool Jang1

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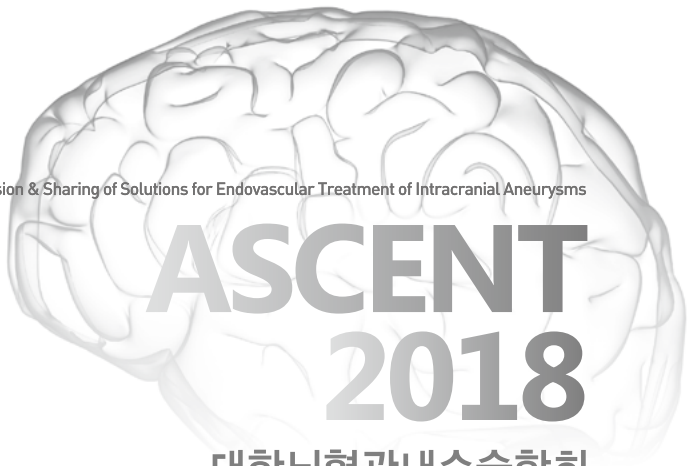
Objective: A progressing posterior cerebral artery (PCA) P2 fusiform aneurysm is a challenging lesion to treat with surgical or endovascular methods. We report an agony case treated with LVIS Blue (Microvention, Aliso Viejo, California) -assisted coil embolization after failure of Pipeline Embolization Device (PED; Medtronic Inc, Dublin, Ireland) Flex placement.

Methods: A 50-year-old female patient presenting with severe headache and left side sensory change was diagnosed with right large partially thrombosed unruptured P2A fusiform aneurysm. The patient wanted to be treated conservatively initially due to improved symptoms. At the 6-year follow-up, she revisited at our clinic with sudden bursting headache. As the aneurysm got more enlarged, flow-diversion with PED Flex was planned.

Result: Due to severe tortuosity of proximal PCA, PED Flex was failed to be deployed. In sequence, LVIS Blue stent was delivered to cover the aneurysm with unintentional foreshortening and subsequent coil embolization was performed. Brain stem infarction and subarachnoid hemorrhage occurred postoperatively. Eventually, complete occlusion of the aneurysm was achieved with her modified Rankin Scale of 1 at the 7-month follow-up.

Conclusion: Large partially thrombosed P2 fusiform aneurysm is still risky to treat. Flow diverters can be used to treat this lesion in selective cases very cautiously. Braided stents should be deployed considering the estimated stents-covering margins due to foreshortening.



Theme: Vision & Sharing of Solutions for Endovascular Treatment of Intracranial Aneurysms

ASCENT 2018

대한뇌혈관내수술학회

Poster Session

1. Ruptured basilar artery perforator aneurysm (BAPA) mimicking superior cerebellar artery (SCA) aneurysm

Jong Young Lee

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Objective: Basilar artery perforator aneurysms (BAPA) are rare lesions. Due to small diameter of basilar artery perforator, visualization by angiographic imaging is difficult and uncertain. In most cases of BAPA, contrast filling of aneurysm sac is usually visualized without parent artery. We report a case of ruptured BAPA initially diagnosed as superior cerebellar artery (SCA) aneurysm.

Methods: A 46-female patient presented with Hunt and Hess grade 2 subarachnoid hemorrhage. Initial imaging study, including digital subtraction angiography (DSA), revealed no vascular lesions. Two-week after admission, DSA revealed an aneurysm arising from the left SCA. Endovascular coil embolization was planned first. However, aneurysm selection using microcatheter was failed. Then, surgical approach was done via pre-temporal ("Half-and-Half") approach.

Result: We identified SCA, but there was no aneurysm. Further dissection revealed an aneurysm arising from basilar artery perforator, which was overlapped by SCA. The parent artery of the aneurysm arose from juxtaproximal to the orifice of left SCA, and crossed SCA at the juxtadistal to the aneurismal sac. Clipping was performed with perforator patency confirmed on direct inspection and indocyanine green videoangiography (ICGA). After the surgery, the patient suffered diplopia without extraoccular movement limitations. Postoperative magnetic resonance image showed no evidence of brainstem stroke. Two-month after the surgery, she was fully recovered without any neurologic deficits.

Conclusion: Almost of posterior circulation aneurysm could be treated by endovascular technique. However, surgical approach should be considered in case of unexplained failure via endovascular approach to treat posterior circulation aneurysm.

2. Hybrid procedure to treat ruptured PICA aneurysm

Jong Young Lee

Department of Neurosurgery, Kangdong Sacred Heart Hospital, Hallym University College of Medicine

Objective: The vicinity of brainstem and cranial nerves as well as the limited operative working space make clip ligation of posterior inferior cerebellar artery (PICA) aneurysms challenging. The small caliber of the PICA and the broad neck often associated with these aneurysms also create challenges in preserving this artery during treatment. This case presents a ruptured PICA aneurysm treated using hybrid procedure.

Methods: 63-year old female patient was presented with Hunt and Hess grade 4 subarachnoid hemorrhage. Digital subtraction image showed triangular shaped, wide-necked aneurysm at the proximal segment of the left PICA. The lesion was associated with PICA stenosis at the juxtadistal segment of the aneurysm. Due to a shape of the lesion, endovascular treatment seemed to be impractical. Surgical approach was thought to be dangerous because of ruptured lesion, and perilesional stenosis.

Result: We performed a OA-PICA bypass, and subsequent endovascular trapping in hybrid OR. Surgical exposure of the aneurysm was not required, and we can avoid extensive bone work. After the patency of PICA was guaranteed, the aneurysm could be easily trapped via endovascular technique.

Conclusion: Hybrid procedure is feasible, safe and effective treatment for difficult ruptured PICA aneurysms.

3. Two cases report of failing to select the ICA dorsal wall aneurysm with various shaped microcatheters

Jaesung Han, Jaesang Oh, Seokmann Yoon

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Objective: Endovascular treatment of ICA (internal carotid artery) dorsal wall aneurysm is known to be difficult because aneurysm selection is often difficult or microcatheter tends to be unstable during coil packing, resulting in incomplete embolization. Particularly, when the carotid siphon is closed, aneurysm selection can be more difficult, or impossible.

Methods: We experienced two cases of ICA dorsal wall aneurysm in which microcatheter selection was impossible for aneurysm coiling. A 50 year-old women was presented with small unruptured ICA dorsal wall aneurysm. The aneurysm direction was superior. A 56-year-old woman visited outpatient clinic for treatment of small unruptured aneurysm. The aneurysm was arising from the dorsal wall of left ICA. Aneurysm direction was supero-lateral.

Result: We tried to select the aneurysms using various shapes of microcatheter and microwires but eventually failed to insert coils into the aneurysm, even after stent placement in both patients. In 2nd patient we deployed overlapping stent for flow diversion effect.

Conclusion: In rare instance, ICA dorsal wall aneurysm cannot be treated with endovascular coiling.

4. Endovascular treatment of a ruptured posterior communicating artery aneurysm with associated pseudoaneurysm as called

최종욱, 오지웅, 김종연

원주세브란스기독병원 신경외과

Objective: Intracranial pseudoaneurysm formation due to ruptured non-traumatic saccular aneurysm is extremely rare. We ‘probably’ experienced one case of pseudoaneurysm formation due to rupture of a saccular aneurysm.

Methods: A 75-year-old woman presented with drowsy mentality with posterior communicating artery (P-com) aneurysm ruptured SAH a Brain computed tomography angiography (CTA). Endovascular treatment was chosen for right-sided P-com aneurysm. After diagnostic TFCA, we can see delayed multiplecontrast filling at adjacent P-com aneurysm.

Result: First of all, we tried to find origin of delayed filling sac. Under microselection of anterior choroidal artery and posterior communicating artery, there was no dye filling into the pseudo sac. So, we treated the P-com aneurysm on simple coiling. And then, there were delayed that multiple contrast filling. After 1 week, TFCA was not revealed delayed filling sac.

Conclusion: Intracranial pseudoaneurysm formation due to rupture of a saccular aneurysm is extremely rare, but if angiography discloses the characteristics of the so-called ghost aneurysm, has special radiological characteristics that should be promptly recognized to offer the best treatment.

5. Recapture of Neuroform Atlas stent after failure of deployment

Minwook Yoo, Jung-Soo Kim, Sung-Chul Jin

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Objective: To assess the clinical characteristics of the Neuroform Atlas stent in stent assisted coil embolization of intracranial aneurysms.

Methods: Stent-assisted coil embolization was performed on the aneurysm of ophthalmic artery. The Neuroform Atlas stent was deployed with the jailing technique, and when partially deployed, the stent marker tip was misexpanded into the aneurysm. Even though it is an open cell stent but not fully deployed, we could pull the stent wire back into the catheter and then deploy the stent again in the correct area.

Result: Because of the he characteristics of the open cell stent, it cannot be restored when deployed. However, like this case, if it is not fully expanded, the recapture should be considered again.

Conclusion: The Neuroform Atlas stent can be deployed afer after recapture

6. Thromboembolic complication following double-stenting for ruptured internal carotid artery dorsal wall aneurysm

Dae Han Choi, Myeong Jin Kim, Chan Jong Yoo

Department of Neurosurgery, Gachon University Gil Medical Center

Objective: A 48-year-old woman admitted to our emergency room because of loss of consciousness. Brain CT showed diffuse SAH, and DSA confirmed the rupture of left internal carotid artery dorsal wall aneurysm. Endovascular treatment was performed simultaneously.

Methods: After administration of dual antiplatelet agents via nasogastric tube, we attempted the stent-assisted coil embolization for dorsal wall aneurysm. However, coil deployment at the rupture point was failed, so double stents (Enterprise 2, 4x16mm) were deployed instead. After second stent deployment, in-stent thrombosis was occurred with preserved patency. Because of the fear of rebleeding, antithrombotic agent was not given, and I finished the procedure.

Result: Postoperatively, the patient was alert, but the strengths of left side extremities were decreased to grade 3/5 and DW-MRI showed multiple embolic infarctions in left hemisphere. In postoperative 1-week DSA, in-stent thrombosis was resolved, and aneurysm was not recurred, but occlusion of distal branches of right MCA inferior trunk were detected. The fear of rebleeding obstructed the additional administration of antithrombotic agents. Further neurologic deficit was not occurred fortunately.

Conclusion: Decision making to use of anticoagulants or thrombolytic agents is difficult in the situation of unobliterated ruptured aneurysm.

7. Waffle cone technique coil embolization using solitaire stent in 3 small aneurysms

Hyon-Jo Kwon, Hyehwa Jung, JungBoo Yu, JeongWook Lim, Hyeon-Song Koh

Department of Neurosurgery, Chungnam National University Hospital

Objective: Solitaire stent is the only stent with the ability to be fully retrievable. Especially in coil embolization, the waffle cone technique using this stent is widely known in which the distal end is placed on the aneurysm neck. We report three cases of this method in which other stent deployment technique was not applicable.

Methods: We retrospectively reviewed the operative images and medical records of 3 small aneurysms in 2 patients undergoing coil embolization using the Waffle cone technique using the distal end of the Solitaire stent.

Result: The first patient had an aneurysm at the origin of the Lt M1 early frontal branch with daughter sac. The second patient had two small adjacent aneurysms at the distal ACA. The first patient had a tiny neck remnant immediately after surgery, but showed complete occlusion at 18 months' follow-up. In the second patient, one solitary stent was used to coil two small aneurysms.

Conclusion: When other methods are difficult or unapplicable, small aneurysms can be embolized effectively with the waffle cone technique using a Solitaire stent.

8. Combined antegrade and retrograde approach for protecting the parent artery using coil in endovascular treatment of posterior communicating artery aneurysm: A Case Report

Hak Cheol Ko, Seung Hwan Lee, Jun Seok Koh, Hee Sup Shin

Department of Neurosurgery, Kyung Hee University Hospital at Gangdong,
College of Medicine, Kyung Hee University

Objective: The traditional endovascular approach to a cerebral aneurysm is antegrade. In special cases, however, the parent artery is located between the aneurysmal neck and dome, so that conventional, stent or balloon-assisted coil embolization of the aneurysm via antegrade approach is impossible, because it could not protect the parent artery. We present a case of a ruptured posterior communicating artery (PcomA) aneurysm treated with coil embolization via antegrade approach and protection of parent artery using coil via retrograde approach.

Methods: A 49-year-old woman presented with severe bursting headache. Computed tomography showed diffuse subarachnoid hemorrhage and digital subtraction angiography revealed an irregular shaped left PcomA aneurysm with daughter sac, incorporating the origin of PcomA.

Result: We successfully treated the PcomA aneurysm while protecting the parent artery through ante- and retrograde approach. The aneurysm was superselected using the double catheter technique through antegrade approach, and then the origin of PcomA was selected with another microcatheter through PcomA retrograde via vertebrobasilar system. We could maintain the PcomA patency during coil embolization of PcomA aneurysm while protecting the origin of PcomA using coil.

Conclusion: In PcomA aneurysm, incorporating the origin of PcomA, it is possible safely and effectively access an aneurysm via a retrograde approach for protecting the parent artery.

9. Recurrent stroke event due to innominate artery aneurysm: A case report

Hyun Joo Baek, In Soo Kim, Jun Suk Huh

Department of Neurosurgery, Kimpo Woori Hospital

Objective: Transient ischemic attack (TIA) is very common symptom of cerebrovascular event and the epidemiology and causes are also well known. Among many causes of ischemic stroke, brachiocephalic artery aneurysm also known as aneurysm of innominate artery (AIA) is one of rare disease entity with the prevalence of 1% in all aneurysm.1) We report a case of pontine infarction and symptom of TIA due to calcified brachiocephalic unruptured aneurysm.

Case Report: 57-years-old male patient admitted for subjective left hemiparesis. His initial brain magnetic resonance diffusion image showed small pontine infarction. Brain magnetic resonance image, magnetic resonance angiography (MRA), carotid MRA and cardiac evaluation revealed no pathogenic lesion. Cerebral vascularity and carotid artery was within normal range without significant stenosis or arteriosclerotic degeneration. Transthoracic echo and 24hours-holter evaluation was within normal range. His symptom improved within 48 hours of admission and was discharged with antiplatelet agent. One month later, the patient admitted to emergency department with sudden onset of left hemiparesis. To evaluate cryptogenic stroke, cerebral angiography was performed. It revealed calcified aneurysm of innominate artery which probably was the source of small embolism that caused repeated cerebral infarction.

Discussion: Only 1-3% of all peripheral aneurysms involve the subclavian and innominate arteries. Known etiology of AIAs are atherosclerosis, trauma, thoracic outlet syndrome, rarely congenital connective tissue disorder, and infection such as mycobacterial, syphilic and bacterial. Variety of neurologic symptoms can occur due to microembolic phenomena or flow reduction and reversal including hemispheric symptoms, ocular deficit, or vertebrobasilar syndrome. Treatment option of AIAs are surgical approach, endovascular repair using graft stent and endovascular-surgical hybrid procedure with the mortality rate of 5% in elective surgery, 13% in an emergency setting and 5% mortality with 28% rate of complication and 40% of stent graft occlusion in endovascular procedure.

Conclusion: Despite the infrequency of innominate artery lesion as a cause of neurologic deficit, the consequence may be permanent and disabling. When evaluating recurrent episode of TIA or cryptogenic stroke, visualization of the arch and great vessels in diagnostic evaluation of stroke symptoms and TIA should not be undertaken.

10. Staged embolization of dissecting aneurysm using enterprise stents and LVIS blue stents

Wonki Yoon

Department of Neurosurgery, Guro Hospital, Korea University Medical Center

Objective: Blood blister like aneurysm or ruptured dissecting aneurysm has very vulnerable wall easy to rupture even with minimal hemodynamic change. Treatment of those vascular diseases is challenging.

Methods: Here we introduce two cases of successfully treated ruptured ICA dorsal wall blood-blister-like aneurysm and ruptured vertebral dissecting aneurysm.

Result: Both aneurysms were treated with staged embolization strategy. First procedure was performed in acute phase using multiple Enterprise stents and coil embolization. Early follow-up angiography revealed recurrent or residual aneurysm sac without rebleeding. Additional procedure with multiple LVIS blue stents was performed. Their clinical and radiological outcome was excellent.

Conclusion: In spite of small number of cases, the excellent results provide a glimpse for an effective and safe treatment strategy for this challenging disease.

11. Endovascular coiling for a wide-neck bifurcated aneurysm with anterograde horizontal stenting via microcatheter looping: A technical case report

Hong Jun Jeon, Jong Hwa Park, Jong Young Lee, Byung Moon Cho

Department of Neurosurgery, Kangdong Sacred Heart Hospital, Hallym University College of Medicine

Objective: Technical advances with devices such as catheters, balloons, and stents have widened the indications for endovascular coiling for unfavorable aneurysms. The authors report two cases of coil embolization for a wide-neck bifurcated aneurysm with anterograde horizontal stenting via microcatheter looping.

Methods: Two women, aged 56 and 38 years, respectively, had an undertall- and overwide-neck aneurysm with bifurcated branches at the basilar bifurcation and middle cerebral bifurcation, respectively. The delivery microcatheter was steamed so that it could be looped deliberately to the opposite vessel. The enterprise stent was first anchored to the vessel of the posterior cerebral artery on one side. The remaining portion was spanned into a looped microcatheter to the opposite branch while pushing the stent. The Neuroform Atlas stent was passed directly through the looped segment of the microcatheter at the M2 branch and spanned horizontally by unsheathing.

Result: Under horizontal stenting, complete coil embolization was achieved without immediate or delayed complications in both cases.

Conclusion: This novel technique presents a viable option for stent-assisted coiling within an optimal anatomy.

12. Traumatic carotid cavernous fistula with a connection between the supraclinoid internal carotid artery and cavernous sinus via a pseudoaneurysm presenting with delayed life-threatening epistaxis

Soo Hee Kim, Jun Kyeung Ko
Department of Neurosurgery, Pusan National University Hospital

Objective: Traumatic carotid cavernous fistula (CCF) presents most commonly as a direct connection between the cavernous segment of internal carotid artery (ICA) and cavernous sinus (CS), and often accompanies basal skull fracture (BSF). The most frequently reported signs and symptoms are proptosis, chemosis, and bruit. Epistaxis is uncommon symptom of CCF

Methods: A 63-year-old man with a history of BSF due to blunt head trauma eight months previously was referred to our emergency room for massive epistaxis. Cerebral angiography demonstrated a high-flow CCF with a connection between the supraclinoid portion of left ICA and CS via a pseudoaneurysm, suggesting the life-threatening epistaxis had been caused by high-flow shunting, through the gap created by the BSF.

Result: After the complete obliteration of the pseudoaneurysm arising from the supraclinoid ICA by stent-assisted coil embolization, the CCF was no longer evident and epistaxis ceased.

Conclusion: To the best of our knowledge, this is the first case of a traumatic CCF with a connection between the supraclinoid ICA and CS via a pseudoaneurysm, presenting with delayed life-threatening epistaxis.

13. A case report of cerebral infarction associated with cerebral angiography before coil embolization of a basilar artery bifurcation unruptured aneurysm with diplopia

In Ho Oh, Sun Ju Lee, Hee Il Kang

Department of Neurosurgery, VHS Medical Center

Objective: Basilar artery bifurcation unruptured aneurysm with diplopia is rare, which necessarily requires treatment. Vertebral artery and basilar artery in elderly patients are often tortuous, and the risk of cerebral infarction caused by microcatheters when approaching the aneurysm is high, which requires much cautions. We'd like to report a case of cerebral infarction associated with cerebral angiography in coil embolization of a basilar artery bifurcation unruptured aneurysm with Diplopia.

Methods: A 76-year-old male patient visited our neurology department with diplopia. The patient had prostate cancer and CKD, and there were no other neurologic findings. Brain MRA performed at the neurology department revealed a 6mm unruptured aneurysm in the basilar artery bifurcation. After that, he was transferred to the neurosurgery department and transfemoral cerebral angiography was done. After the transfemoral cerebral angiography, confused mental status and visual disturbance occurred and diffusion MRI we took showed acute cerebral infarction. Conservative treatment for acute cerebral infarction was done. Dual anti-platelet therapy was used for 2 weeks and then, we did coil embolization for the aneurysm.

Result: There was no occlusion of vessels in cerebral angiography taken during coil embolization. Coil embolization was done without any problem. Neurological findings of the patient are not changed. However, on post-operative Brain CT scans, high density over the territory of the acute cerebral infarction were observed with perilesional brain edema was suspected. The HFU of the high signals of the patient was different from the HFU of ordinary cerebral hemorrhages. No surgical intervention was done additionally because there were no signs of brainstem compression. The patient discharged without any neurological changes.

Conclusion: The risk of cerebral infarction during cerebral angiography before coil embolization requires much cautions. If coil embolization is performed under the condition that dual anti-platelet therapy is necessary, hemorrhagic transformation may occur due to reperfusion. However, there is a possibility of a change in signals due to the contrast agent. So when the decide treatment plan, it is necessary to consider the continuous usage of the antiplatelet drugs and determine the operation after observing patient's neurologic changes.

14. Intraprocedural retrieval of migrated-coil during endovascular aneurysm treatment with the solitaire stent

Sun Joo Lee, In Ho Oh, Ji Hye Lee, Tae Wan Kim

Department of Neurosurgery, VHS Medical Center

Objective: With the rapid development of surgical techniques, there is an increase in the number of treatments, and complications are also inevitably increased. Coil migration during endovascular treatment of intracranial aneurysms occurs in 2-6% of cases. Coil masses that escape from the aneurysm are highly thrombogenic and interfere with blood flow of the parent artery and can cause cerebral infarction in a large area, leading to neurological morbidity in some cases. Therefore, it is very important to remove the migrated coil mass quickly and safely.

Methods: An 80-year-old man with unruptured 4 ×4mm, anterior communicating artery aneurysm with irregular -shaped daughter sacs was referred for endovascular treatment. During coiling with the single catheter technique, the second coil mass came out of the aneurysm and flowed into the left anterior cerebral artery.

Result: We used Solitaire stent devices (Medtronic, USA) to successfully retrieve the migrated coils, and the remaining aneurysm embolization was completed. On postoperative MRI, small multiple focal infarctions were observed in the left anterior cerebral artery territory but the patient was discharged without any symptoms.

Conclusion: Since there is not yet a definite treatment guideline to remove the migrated-coil, it is entirely dependent on the retrospective review of published reports and expert opinion. We present a unique and effective method for endovascular retrieval of displaced coils using a Solitaire Stent device.

15. Fusiform aneurysm arising from distal portion of the superior cerebellar artery treated with intra-aneurysmal embolization together with parent artery occlusion: Reports of 2 cases

Kyungsik Choi, Jonghoon Kim, Chulhoon Chang, Youngjin Jung

Department of Neurosurgery, College of Medicine, Yeungnam University

Objective: SAH due to ruptured aneurysms arising from the distal portion of the superior cerebellar artery (SCA) are very rare. In acute phase microsurgical treatment may be difficult owing to their inaccessibility and to the frequent inability to preserve the involved parent artery because the lesions commonly are fusiform. As an alternative, aneurysmal obliteration with parent artery occlusion may be performed relatively easily. We describe 2 cases of cortical SCA aneurysm that was treated successfully with endovascular coil trapping.

Methods: Two patients (49-year-old female patient with two people) admitted to our institution because of loss of consciousness. Radiological examination revealed subarachnoid hemorrhage caused by ruptured of the aneurysm located at the hemispheric branch of the SCA. We performed trapping of SCA using coils.

Result: Follow up MR images of two patients showed small infarctions on the cerebellar hemisphere. Clinically, one patient's neurological status was restored as drowsy conscious level. And the other patient gradually recovered nearly completely and able to look after own affairs without assistance and walking without assistance

Conclusion: Endovascular coil embolization of the distal SCA aneurysm with parent occlusion may be performed in cases with good collateral circulation and the aneurysm is distal to the perforating branches to the brainstem. We think it could be an effective, easy and safe alternative method in these rare lesions.

16. Recanalization after endovascular occlusion of a dissecting aneurysm of the vertebral artery – A case report and review of the literature

Won Joo Jeong, Seok Keun Choi, Byung Duk Kwun, Sung Ho Lee

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Objective: There have been few reports regarding antegrade recanalization in the vertebral artery (VA) after internal trapping. We reported a patient with an unruptured growing VA dissecting aneurysm that was treated by internal trapping of the aneurysm and parent artery using detachable coils with subsequent antegrade recanalization of occluded VA during the follow-up period. Possible mechanisms and management for the antegrade recanalization of the occluded VA are also discussed.

Methods: A 48-year-old female with a history of gradually developed headache, dysarthria, swallowing difficulty, numbness of right face and left upper extremity and right VA dissecting aneurysm was admitted to our hospital. The dissecting aneurysm and affected right VA were completely occluded by coil embolization with preservation of the right posterior inferior cerebellar artery. The 26 months follow-up angiography showed recanalization of the occluded right VA without recurrence of dissecting aneurysm. We concluded that no further intervention was needed because the dissecting aneurysm was considered to be stabilized and dissection of the right VA had not deteriorated. At the last clinical follow-up 58 months after initial treatment, MR angiography showed no signs of right VA dissection or the recanalization of the aneurysm.

Result: There are four possible mechanisms of recanalization: 1) Occlusion of the false lumen with the aneurysm rather than true lumen, 2) Coil compaction and displacement due to loose packing or effect of blood pressure, 3) False lumen which has both an entrance and exit, 4) Short trapping length or incomplete obliteration of the entry zone of a dissecting aneurysm because of the proximity of PICA origin to aneurysm. Recanalization has been most commonly observed within first 6 months after treatment in previously published reports. Extent of arterial wall injury, neointimal proliferation and fibrous change of vascular wall during the healing process of dissecting aneurysm may influence the timing of parent artery recanalization Additional coil embolization is recommended if the recanalization of the aneurysm or development of a dissection is suspected. Otherwise, further treatment is unnecessary during the chronic stage.

Conclusion: Even after successful internal trapping of a dissecting aneurysm, careful follow-up with angiography is crucial because antegrade recanalization of parent artery may occur. And if recanalization is confirmed, the additional treatment should be planned based on each patient`s angiographic findings of the affected arteries.

17. Endovascular treatment of iatrogenic vertebral artery pseudoaneurysm with basilar artery thrombosis during anterior cervical spine surgery: A case report

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Objectives: To report a case of vertebral artery pseudoaneurysm with basilar artery thrombosis during anterior cervical spine surgery.

Summary of Background Data: Vertebral artery injuries during anterior cervical spine surgery are rare, with a reported incidence of 0.3% to 0.5%, but serious complications. Without immediate recognition and management, it may have disastrous consequences. The spine surgeon should be aware of the detailed surgical anatomy and be prepared to manage of the vertebral artery injury.

Methods: A 71-year-old male underwent anterior cervical discectomy and fusion (ACDF) C4-5-6. When a drilling on the medial side of C5-6 uncovertebral joint, the right vertebral artery injured and massive bleeding was noted. So, topical hemostatic agent and gauze packing and manual compression were done. After the hemostasis and ACDF C4-5-6, immediate postoperative angiography was performed. The right vertebral artery occlusion and basilar artery thrombosis was noted on 4-vessel angiography. The basilar artery thrombectomy using Solitaire FR revascularization device via left vertebral artery was done. After 3 days the right vertebral artery recanalization and 7mm sized pseudoaneurysm was observed on follow up 4-vessel angiography. And then the patient discharged with anti-platelet medication. After a month the pseudoaneurysm size up to 15mm checked on CT angiography. So, endovascular treatment was done for coil embolization of pseudoaneurysm and right VA trapping.

Results: Three month after endovascular treatment, the right vertebral artery total occlusion by coil trapping and coil embolization of pseudoaneurysm was observed on CT angiography. The patient suffered no neurological deterioration.

Conclusions: In case of vertebral artery injury during anterior cervical spine surgery, the immediate angiography has to be checked. And if necessary, endovascular management was performed. Although bleeding control by hemostatic packing, there remains a risk of delayed hemorrhage from pseudoaneurysm. Postoperative vertebral angiography is helpful to avoid life-threatening complications. Endovascular treatment can be a good treatment of vertebral artery injury.

18. Early postoperative angiography after clipping of intracranial aneurysms: Clinical value of angiography and predisposing factors for aneurysm remnants

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Department of Neurosurgery, Yonsei University, Gangnam Severance Hospital

Objective: Aneurysm remnants after microsurgical clipping have a risk of regrowth and rupture and have not been validated in the era of 3-dimensional angiography. Although computed tomography angiography (CTA) is currently preferred for evaluating aneurysmal clipping results, it cannot completely rule out postoperative remnant occurrence. Furthermore, there is no concrete evidence supporting its superior accuracy to digital subtraction angiography (DSA). Therefore, this study aimed to (1) evaluate the clinical value of angiography in diagnosing remnants, (2) determine the rate of remnants, and (3) identify the predictors for remnants after microsurgical clipping.

Methods: Between January 2014 and May 2017, 200 aneurysms in 154 patients, treated via microsurgical clipping, were considered eligible for the present study. Among them, 139 aneurysms in 106 patients were finally selected for evaluation. The results of microsurgical clipping were evaluated within 7 days to predict the remnant development risk using DSA based on the classification, and clinical features of the patients and characteristics of treated aneurysms.

Result: The rate of aneurysm remnants, including intentional remnants, was 29.5%, and retreatments were needed in 6.5% of such cases. Neck size (cut-off: 5.68 mm; sensitivity, 66.7%; specificity, 96.2%) and maximum diameter (cut-off: 7.03 mm; sensitivity, 66.7%; specificity, 89.2%) of aneurysms were independent predisposing factors for the occurrence of aneurysm remnants that need retreatment (OR: 2.30; $p < 0.001$; OR: 1.38; $p < 0.001$, respectively).

Conclusion: Postoperative DSA may identify remnants after microsurgical clipping. Aneurysms with larger neck size and maximum diameter have a higher risk of aneurysmal remnants after clipping.

19. Y-stent assisted coil embolization for unruptured MCABF aneurysm

Jae Seong Kang, Tae Hyung Kim, Seung Hun Sheen

Department of Neurosurgery, Bundang Jesaeng General Hospital

Objective: Stent-assisted coiling (SAC) is increasingly being performed as intervention for wide-neck intracranial aneurysms. Treatment of bifurcation intracranial aneurysms is technically challenging. Sometimes it is necessary to pass a microcatheter through the aneurysm sac to navigate. the microcatheter to a branch originating from the aneurysm sac. The NeuroForm Atlas Stent (CE-marked; Stryker, Kalamazoo, Michigan) is relatively new to evaluate the effectiveness and safety of NeuroForm Atlas SAC for intracranial aneurysms in the first such study.

Methods: A 52-year-old female patient was treated for an unruptured middle cerebral artery bifurcation aneurysm Lt.at May 30, 2018. It was favorable clinical outcomes and successful aneurysm occlusion. stent-assisted coiling technique with an Atlas stent was used for endovascular treatment. The stent was deployed carefully between the M2 segment superior, inferior division branch across MCABF aneurysm sac.

Result: Endovascular treatment of bifurcation intracranial aneurysms is well performed No clinical problem and hemorrhagic complications were observed.

Conclusion: NeuroForm Atlas SAC is a feasible way to treat ruptured and unruptured wide-neck aneurysms that are not amenable to conventional coiling or clipping. Aneurysm occlusion and favorable clinical outcome are consistent with previously reported cases for SAC of wide-neck aneurysms with other devices.

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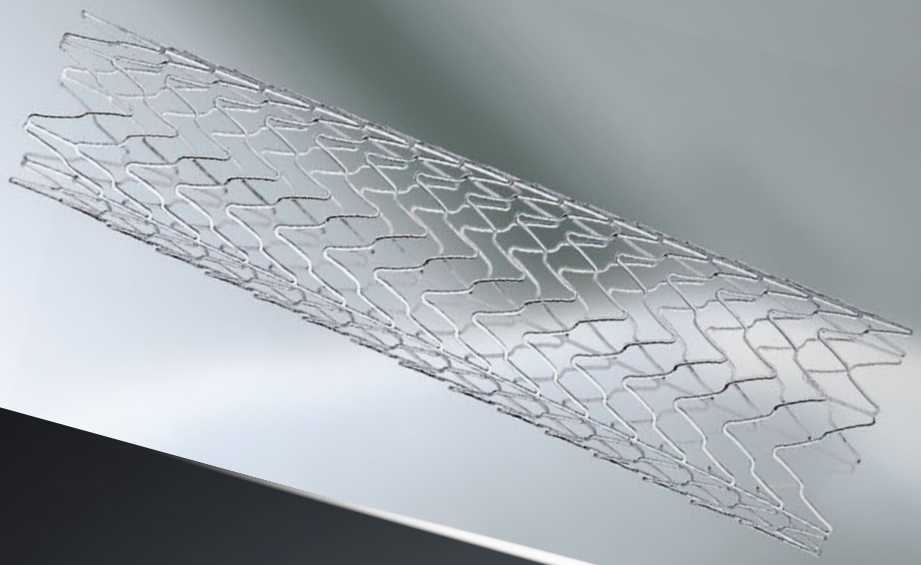

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Reference
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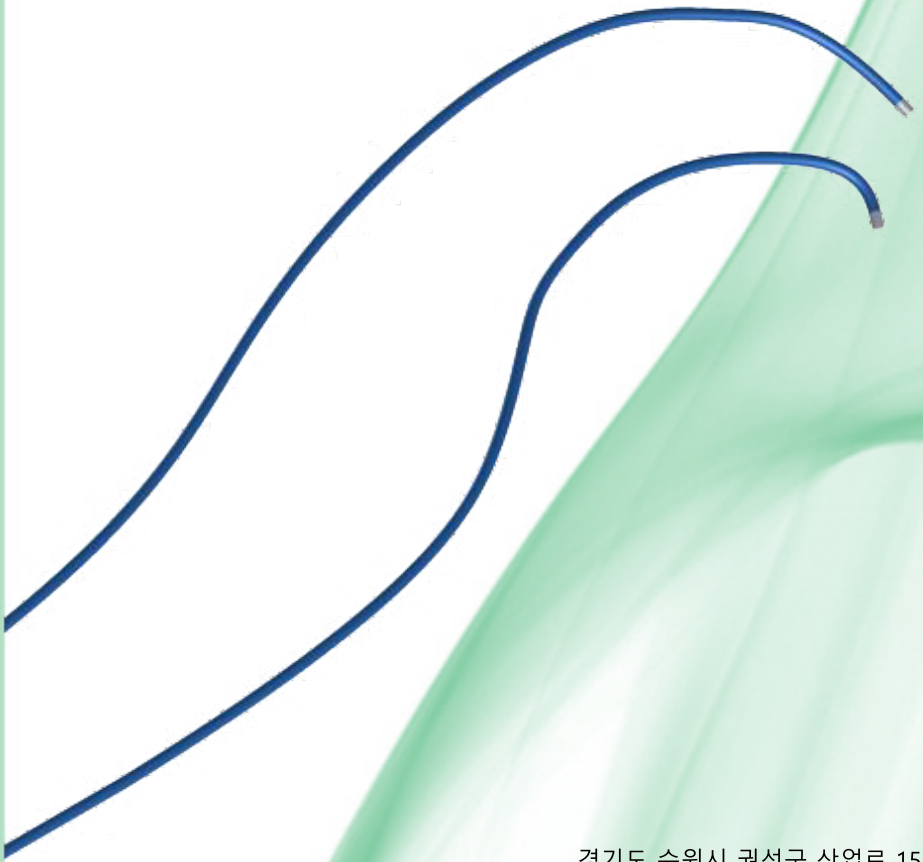

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