

The 12th Annual Summer Conference Endovascular Neurosurgical Therapy

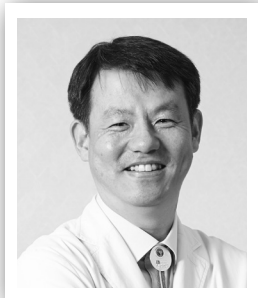
ASCENT 2017

"Consider, Communicate and Conquer"

일시 : 2017. **6. 16**(금)~**17**(토)

장소 : 메종 글래드 제주





안녕하십니까?

금년에는 우리학회의 중요 학술모임인 ASCENT가 제주에서 개최됩니다. 탁 트인 바다와 이국적인 경치가 회원 여러분의 업무 스트레스를 조금이라도 해소시켜 드릴 것으로 믿습니다.

이번 모임의 논제 (theme)는 ‘우리의 업무를 간결하게 표현해 주는 단어는 없을까?’ 라는 질문의 답을 이것저것 찾아 본 끝에, 생각 (consider), 소통 (communicate), 극복 (conquer) 이라는 세 단어로 요약해 보았습니다.

시술을 시작하기 전 사진을 면밀하게 검토하고 머릿속에서 시뮬레이션 하는 생각 (consider)은 기초공사에 해당하는 가장 기본적이면서 중요한 단계라 생각합니다. 또한 저희는 뇌혈관촬영실에서 동고동락하는 팀원 모두와 끊임없이 정보를 교환하고, 수정 보완하는 단계를 거쳐야만 합니다. 소통 (communication)의 가치는 회원 여러분께서 너무나도 잘 알고 계실 것입니다.

최종적으로 실제 시술이라는 실전에서는 예기치 못하였던 상황이 벌어질 수도 있고, 끊임없는 가혹한 판단을 요구합니다. 우리 모두는 이들을 잘 극복 (conquer)할 수 있도록 날마다 새롭게 업데이트되는 최신지견과 다양한 기구에 눈과 귀를 열고 있어야만 합니다.

저희는 이 논제에 맞추어 1) 다양한 증례와 합병증의 치료경험, 2) 방사선사 및 간호사 회원을 위한 교육세션 및 3) 최신 보고, 기구 핵심정리 등을 최대한 상호 교수법 (interactive teaching) 을 적극 활용하여 함께 공유하고자 합니다.

항상 새로운 시도와 접근을 시도함으로써 우리 학회가 추구하는 변화와 도전이라는 가치에 부합하고자 하는 저희의 노력을, 모든 회원분들의 날카로운 눈으로 평가해 주시기 바랍니다.

물론, 친교와 우정의 무대가 될 제주의 밤에 대한 기대는 풍성한 덤으로 보답해 드리겠습니다.

감사합니다.

2017년 6월

대한뇌혈관내수술학회 회장 성재훈



2016~2017 대한뇌혈관내수술학회 임원진

회장

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상임이사

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총무	유승훈	울산대학교 강릉아산병원
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지회대표(부산/울산/경남)	권순찬	울산대학교병원
감사	권현조	충남대학교병원
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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

운영위원

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학술	이재일	부산대학교병원
	박근영	연세대학교 세브란스병원
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	신희섭	경희대학교 강동병원
	최종일	한림대학교 강남성심병원
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	이종영	한림대학교 강동성심병원
수련교육	윤원기	가톨릭대학교 성바오로병원
	최재형	동아대학교병원
보험	정준호	연세대학교 강남세브란스병원
	김창현	계명대학교 동산의료원
전산정보	신동성	순천향대학교 부천병원
	김명진	가천대학교 길병원
다기관연구	심유식	인하대학교병원

6월 16일(금)

11:00-12:30	Symposium for nurses and technicians	좌장 : 울산대 유승훈
	1) Anatomy of cerebrovascular structure	울산대 유승훈 · 10
	2) History of endovascular surgery	순천향대 윤석만 · 21
	3) Medication summary during endovascular treatment	연세대 박근영 · 27
13:30-13:50	등록	
13:50-14:00	인사말	회장 성재훈
14:00-15:50	The “Difficult case” session	좌장 : 가톨릭대 신용삼
	Voting with live interaction during case presentation Unruptured Internal Carotid Artery Aneurysms	
	Case 1. Vein of Galen in adult	연세대 원주세브란스 최종욱 · 35
	Case 2. Y-stent retriever technique at BA occlusion	한림대 동탄성심 박정현 · 36
	Case 3. Endovascular treatment for ruptured basilar aneurysm	가천대 김명진 · 37
	Case 4. SSS dAVF	계명대 이창영 · 39
	Case 5. Ethmoidal dAVF	계명대 김재현 · 40
	Case 6. Technical option for difficult aneurysm	영남대 김종훈 · 41
	Case 7. Reversible cerebral vasoconstriction syndrome	가톨릭대 성빈센트 이민형 · 42
	Case 8. Partially thrombosed giant ACA aneurysm	인제대 김성태 · 43
	Case 9. Symptomatic vertebrobasilar stenosis	가톨릭대 부천성모 박강혁 · 45
15:50-16:10	Coffee break	
16:10-16:50	Stryker symposium	좌장 : 서울대 권오기
	Proximal control BGC and specially FlowGate 2 on the Stent retriever thrombectomy procedure	Dr. Jordi Blasco · 50 (Hospital Clinico Y Provincial De Barcelona)
16:50-17:30	The “Complication case” session	좌장 : 순천향대 김범태
	Case 1. Embolic complication after stent assist coil for basilar tip aneurysm	차의대 김태곤 · 52
	Case 2. Basilar artery dissecting aneurysm	양산부산대 김영수 · 53
	Case 3. VA dissecting aneurysm	동래봉생 성승언 · 54
	Case 4. Thromboembolic complication during IAT	가톨릭대 대전성모 김상욱 · 55
	Case 5. Coil stretch during the embolization	가톨릭관동대 김소연 · 56
	Case 6. Iatrogenic vessel injury caused by wire tip of neuroform stent delivery system during endovascular coiling	인제대 진성철 · 57
17:30-18:00	총회	
18:30-20:00	만찬	

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6월 17일(토)

08:00-08:40	The "Debate" session: panel discussion with live audience interaction	좌장 : 한림대 이호국
	패널 : 윤석만, 박석규	
	Intraoperative neurophysiological monitoring during endovascular procedure	가톨릭대 인천성모 장동규 • 61
	1) Case presentation: IOM	순천향대 오재상 • 63
	2) Cerebral oximetry	순천향대 신동성 • 69
08:40-09:10	"My first case" by the young guns	좌장 : 가톨릭대 성재훈
	Case 1. LVIS junior stent migration during embolization	인하대 오세양 • 72
	Case 2. Stent assisted coil embolization for ruptured Pcom aneurysm	안동성소 김성묵 • 73
	Case 3. Angioplasty for MCA stenosis	분당제생 조광천 • 74
	Case 4. Stent retriever thrombectomy combined with distal aspiration for acute MCA occlusion	울산대 강릉아산 조수희 • 76
	Case 5. My first coil embolization	동국대 최현호 • 77
	Case 6. My first case: 1) ICA aneurysm 2) ICA stenosis with MCA occlusion	건국대 박동선 • 78
09:10-09:30	Coffee break	
09:30-10:30	My technical tips and tricks: mechanical thrombectomy	좌장 : 계명대 이창영
	1) Stent retriever thrombectomy for acute major arterial occlusion	계명대 김창현 • 82
	2) Combined IAT strategy based on manual clot aspiration	경북대 강동훈 • 91
10:30-11:00	Introduction of new devices (by company)	학술이사 정진영
11:00-11:10	맺음말	

The 12th Annual Summer Conference Endovascular Neurosurgical Therapy

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"Consider, Communicate and Conquer"

Symposium for nurses and technicians

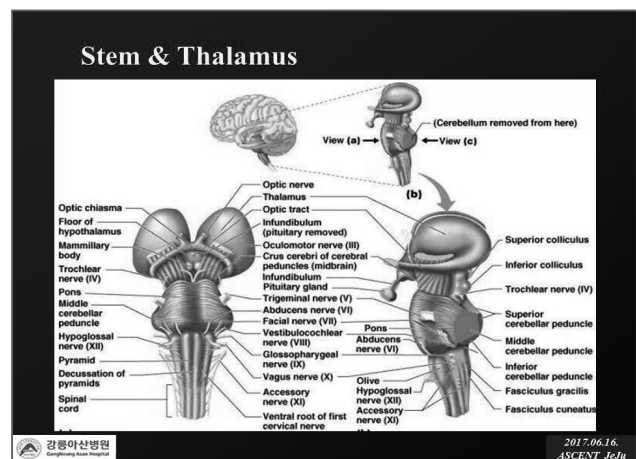
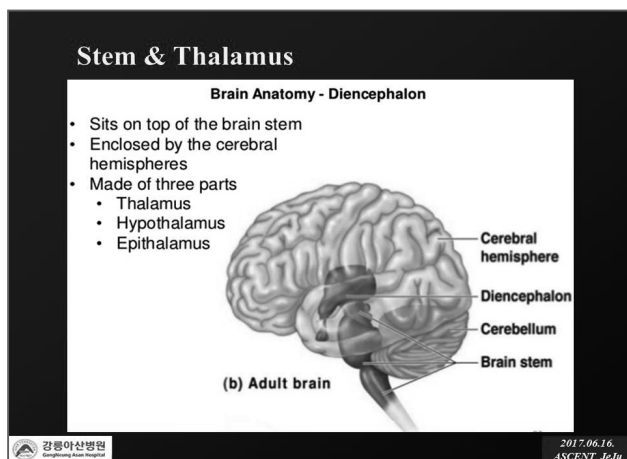
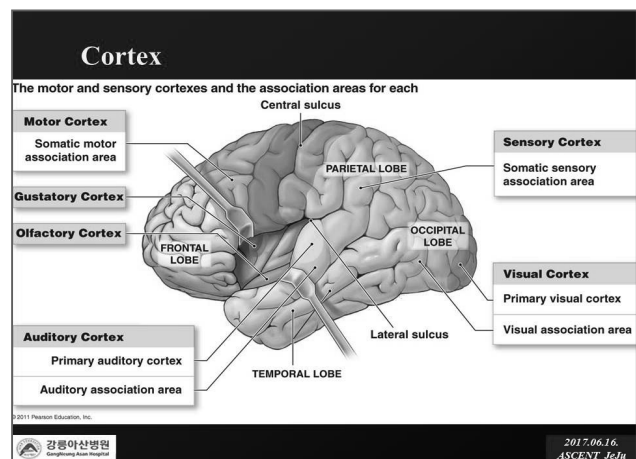
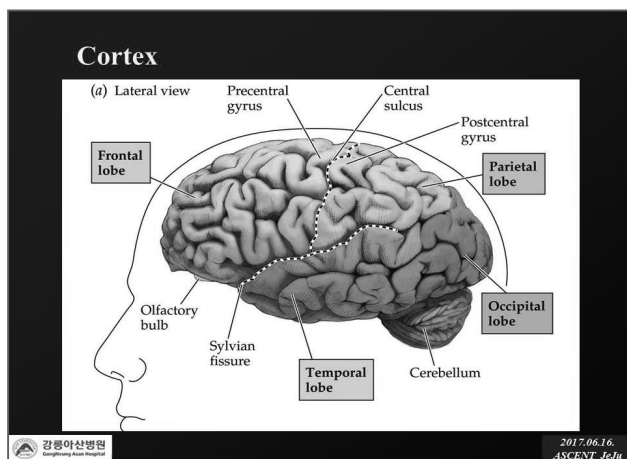
좌장 : 울산대 유승훈



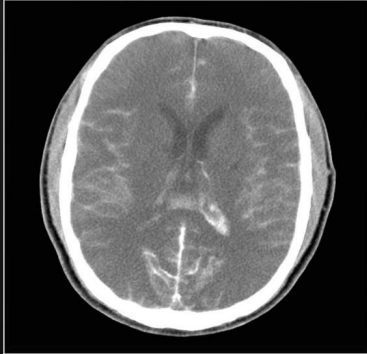
1) Comprehensive Brain Anatomy: A Introduction

유 승 훈

울산대 강릉아산병원 신경외과



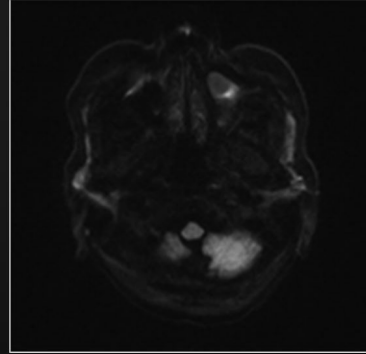
Subarachnoid Space



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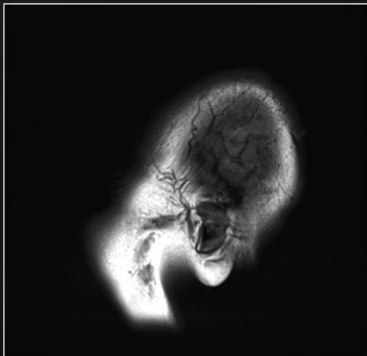
Axial Section



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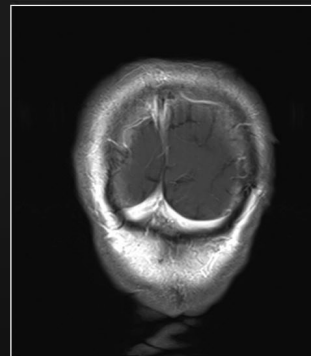
Sagittal Section



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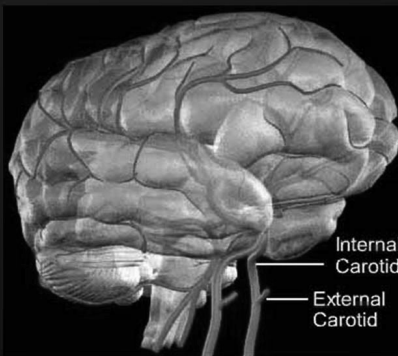
Coronal Section



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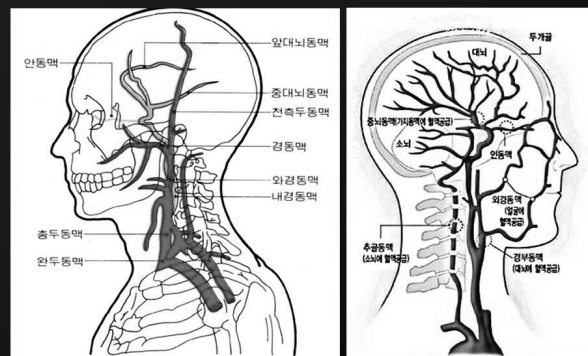
Cortex



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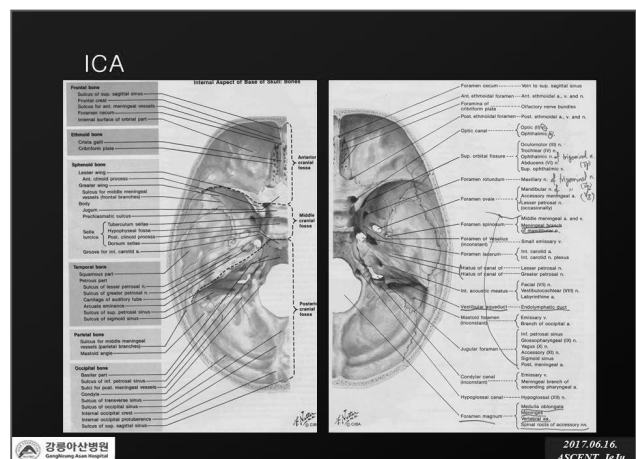
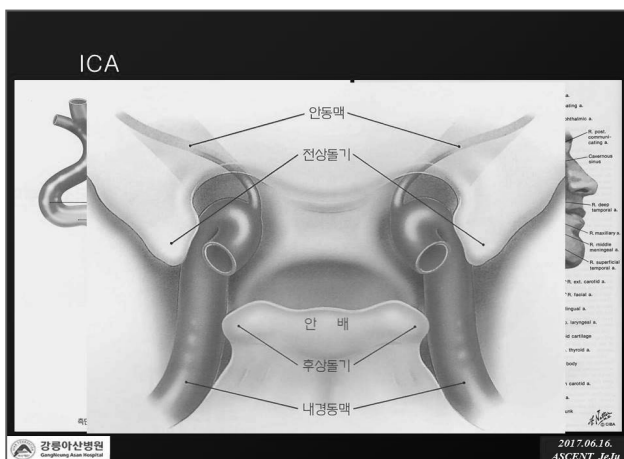
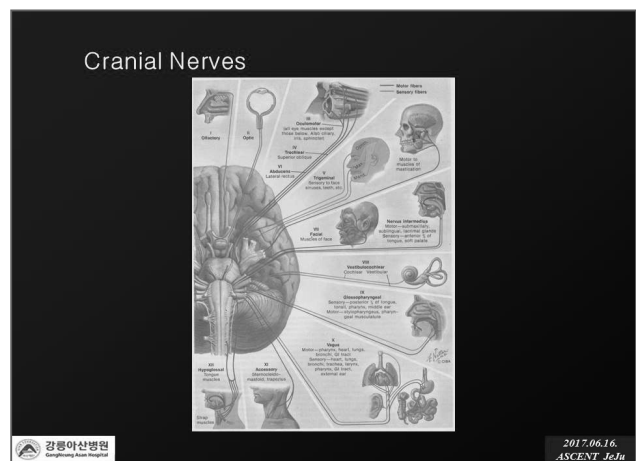
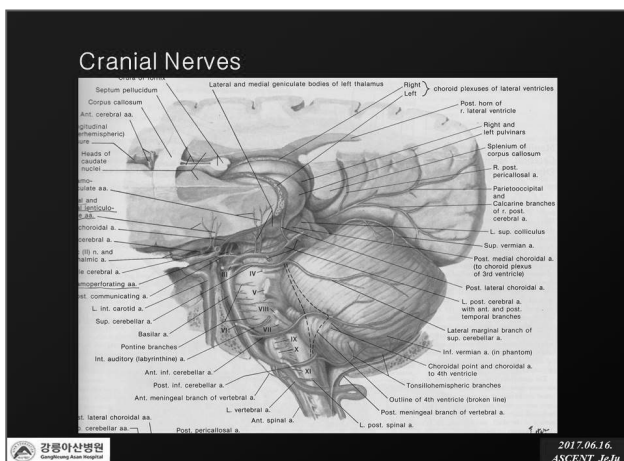
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Cortex

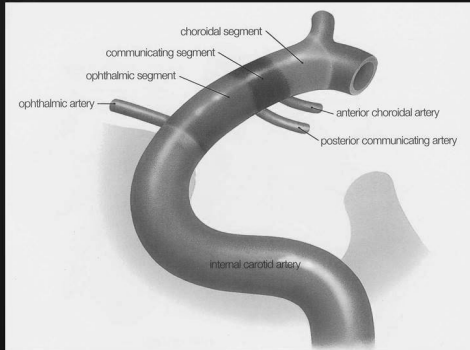


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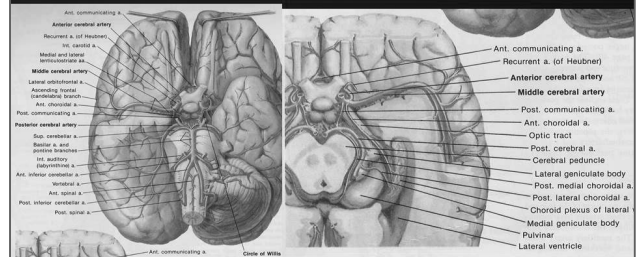
ICA



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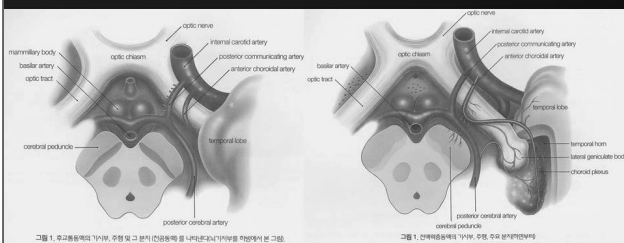
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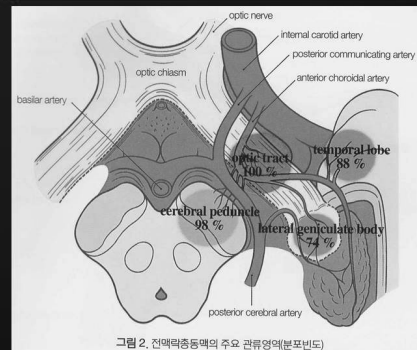
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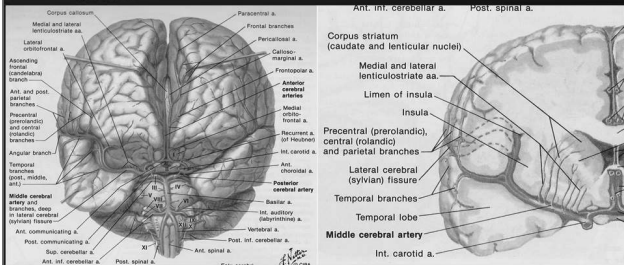
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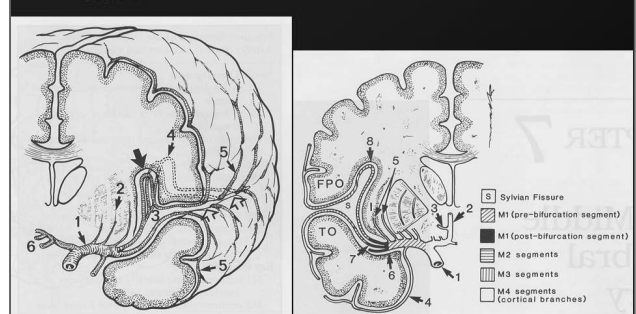
MCA



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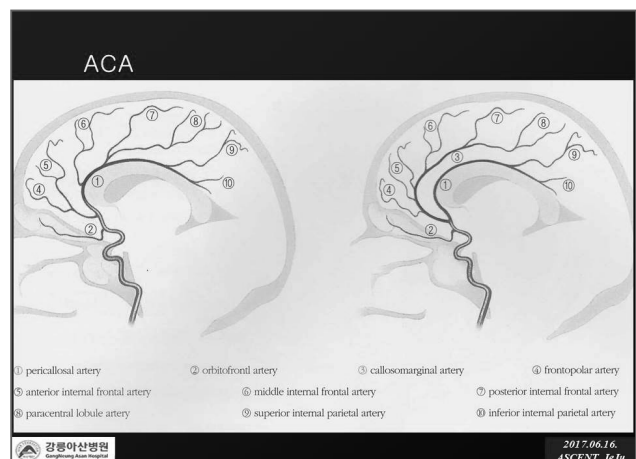
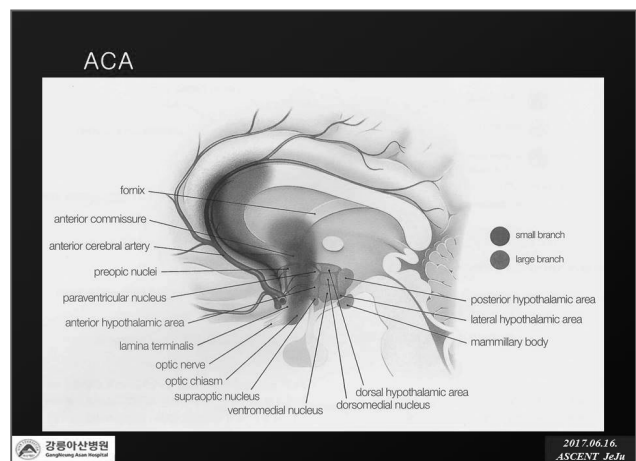
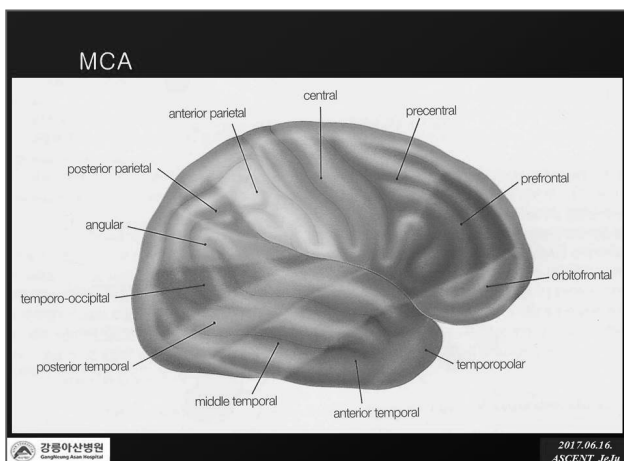
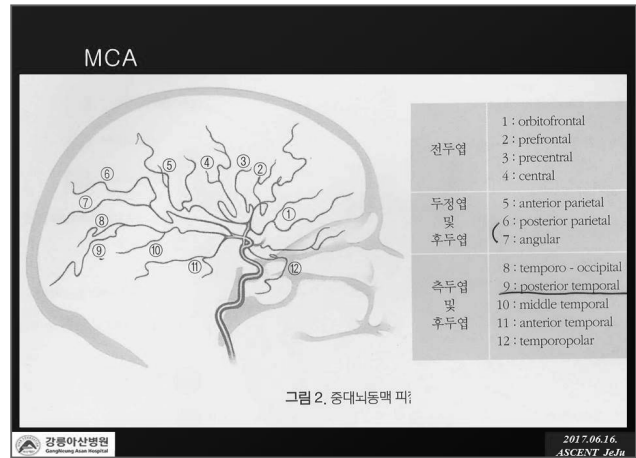
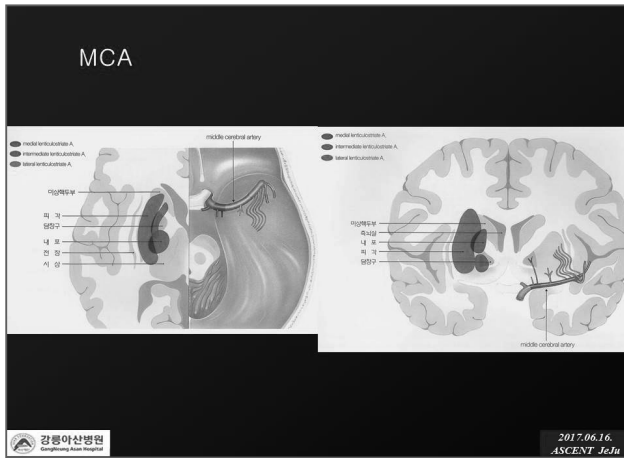
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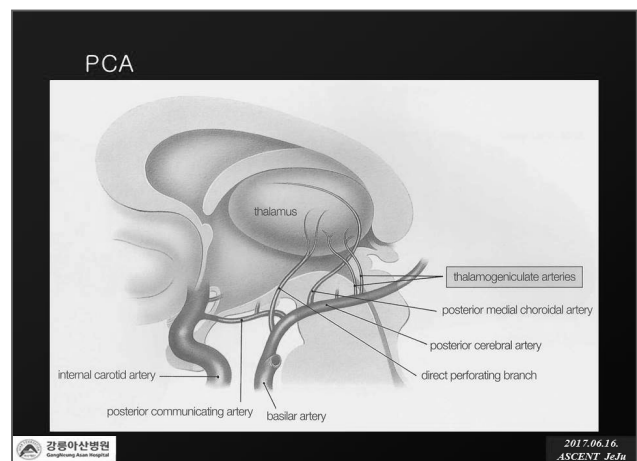
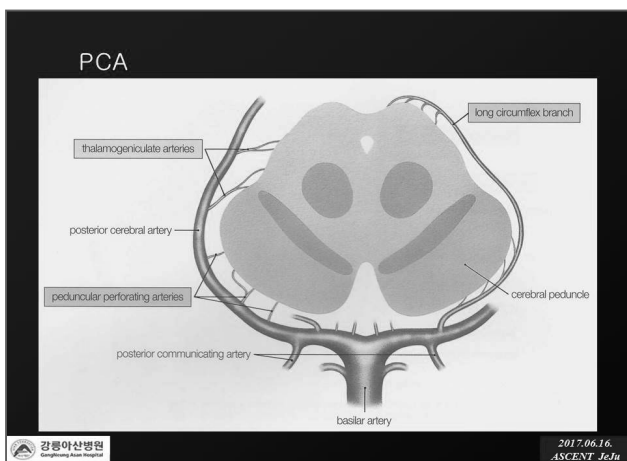
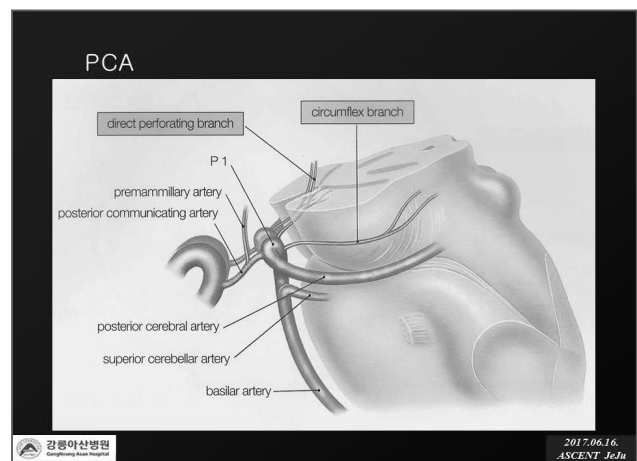
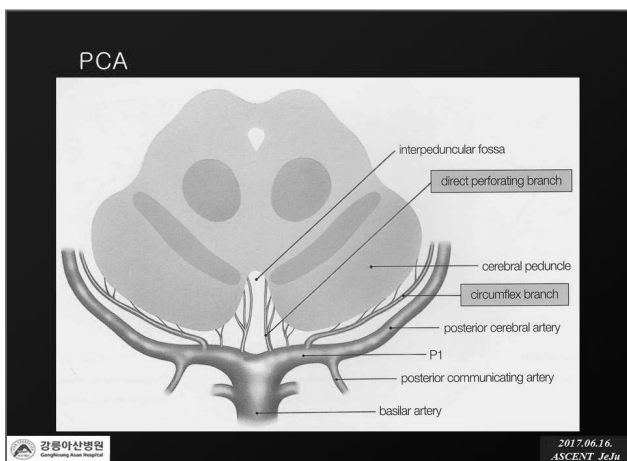
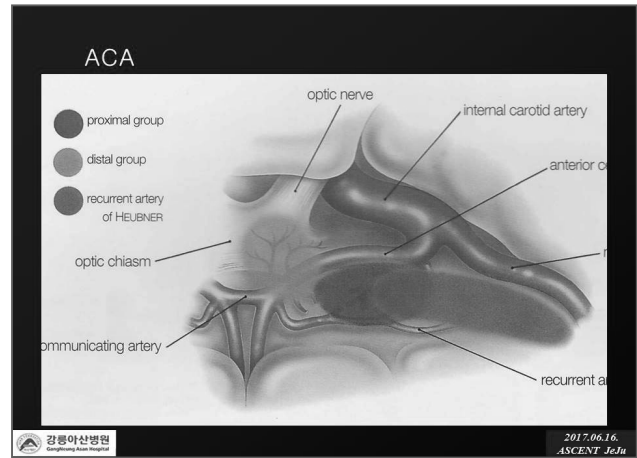
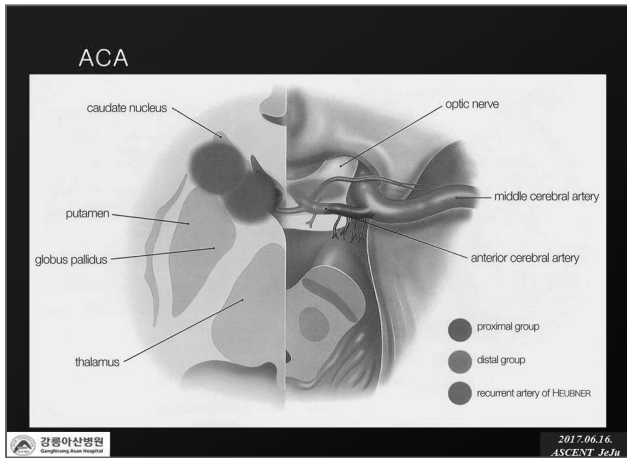
MCA

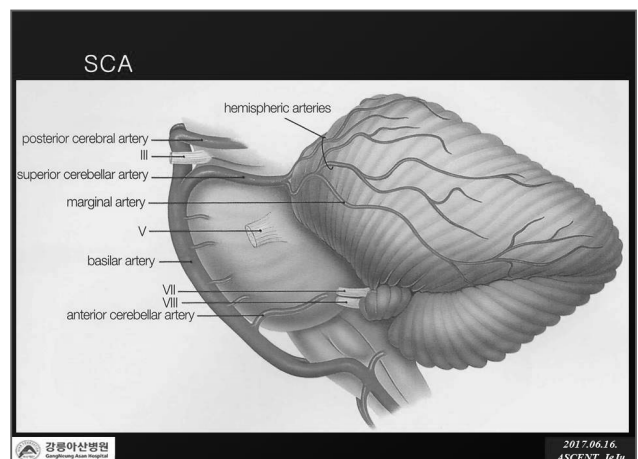
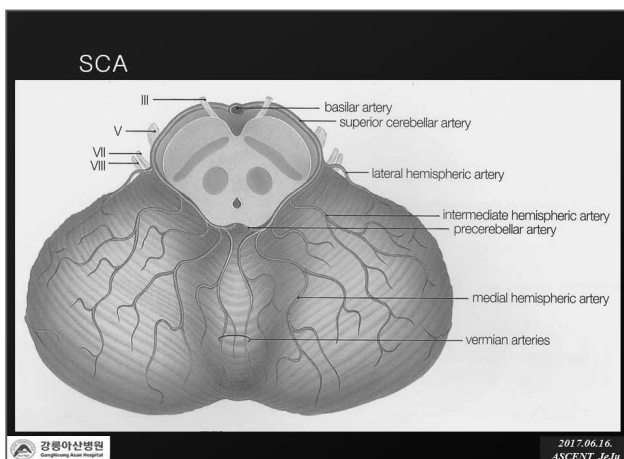
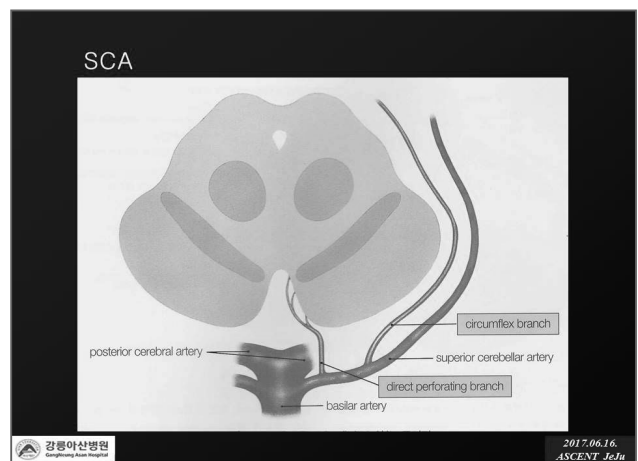
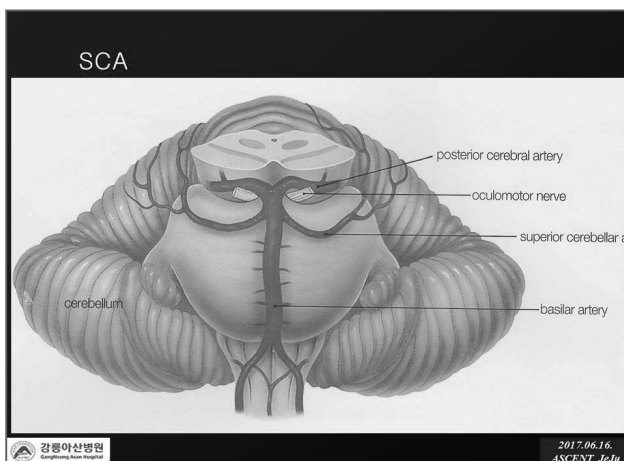
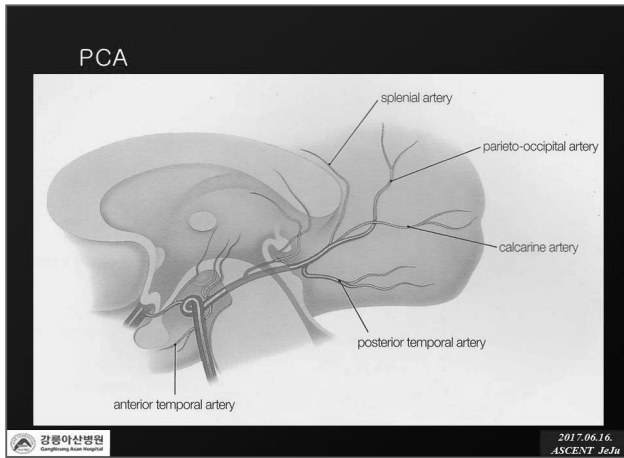


강릉아산병원
 Gangneung Asan Hospital

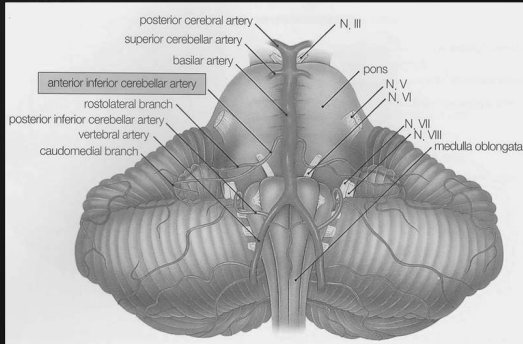
2017.06.16
 ASCENT JeJu







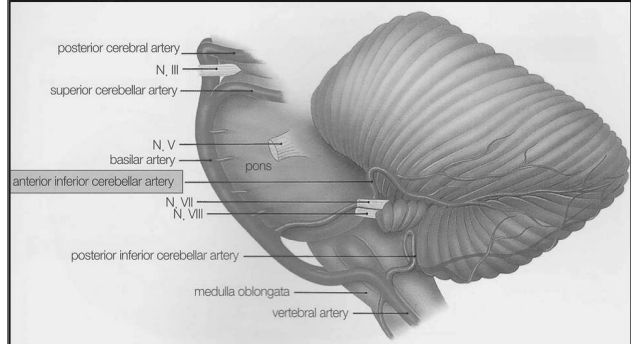
AICA



강릉아산병원
Gangneung Asan Hospital

2017.06.16
ASCENT JeJu

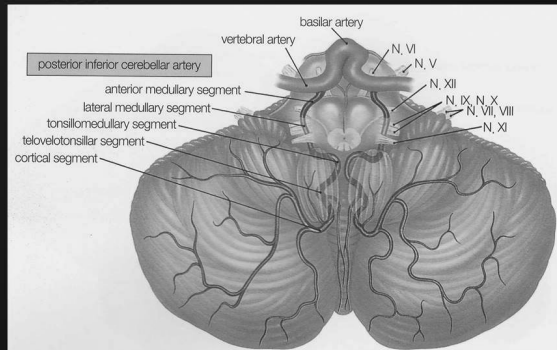
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Gangneung Asan Hospital

2017.06.16
ASCENT JeJu

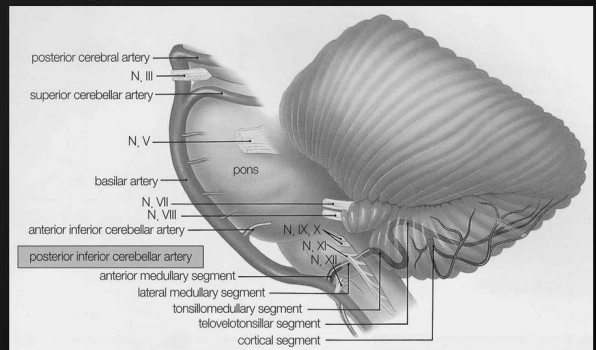
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Gangneung Asan Hospital

2017.06.16
ASCENT JeJu

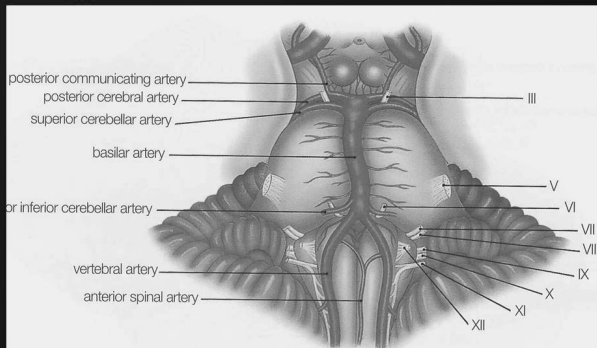
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강릉아산병원
Gangneung Asan Hospital

2017.06.16
ASCENT JeJu

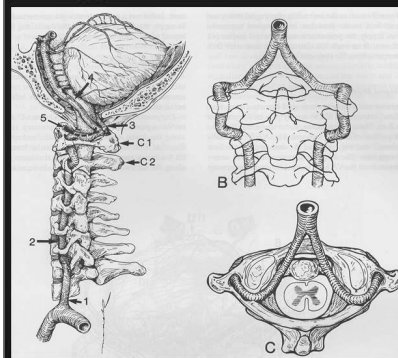
BA



강릉아산병원
Gangneung Asan Hospital

2017.06.16
ASCENT JeJu

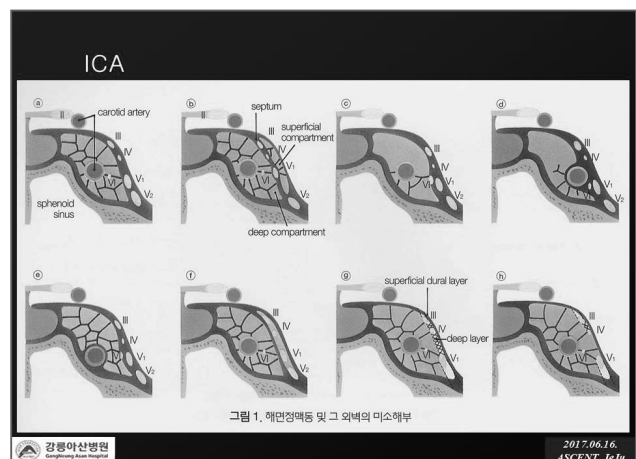
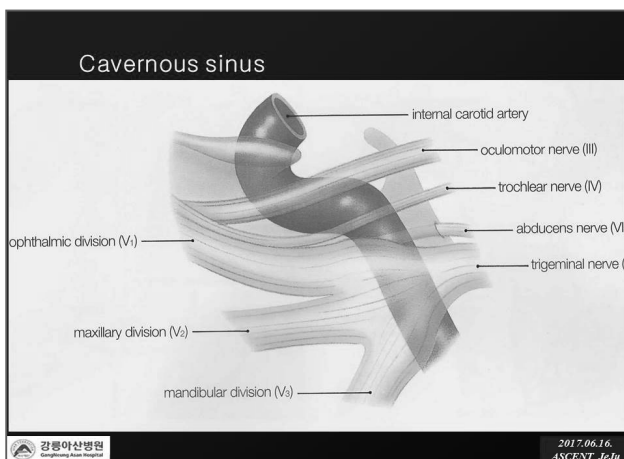
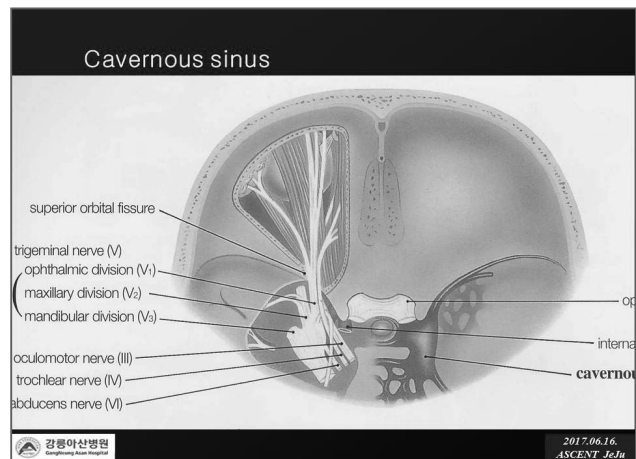
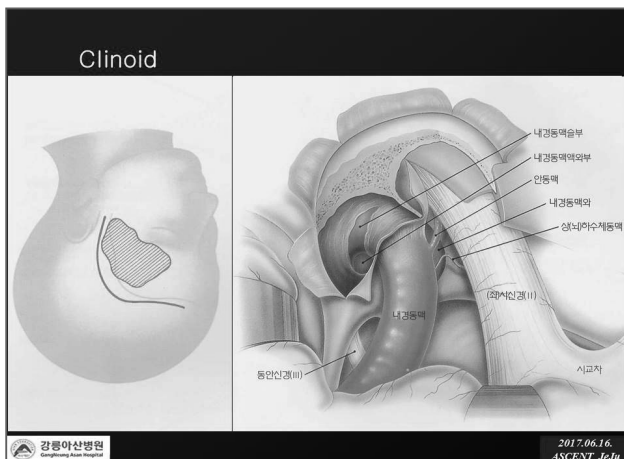
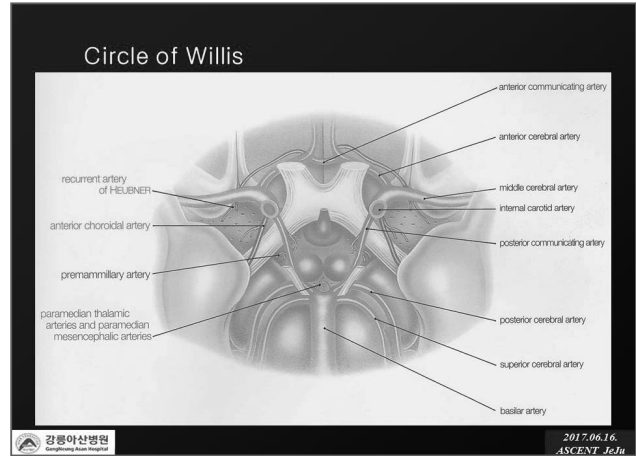
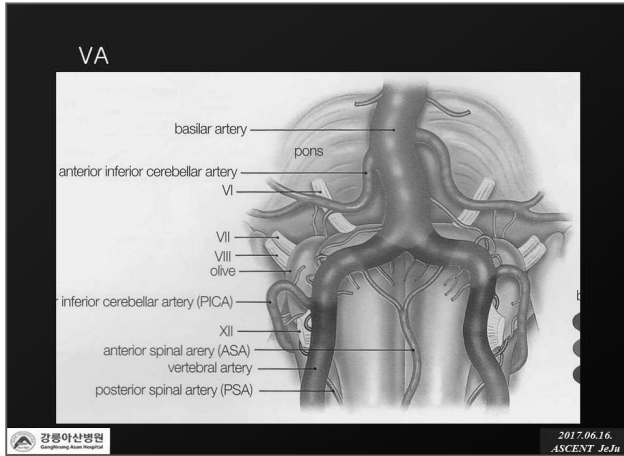
VA



- 1, Extracranial (V1) segment
- 2, Foraminal (V2) segment
- 3, Extraspinal (V3) segment
- 4, Intracranial (V4) segment
- 5, Approximate position of occipital condyle

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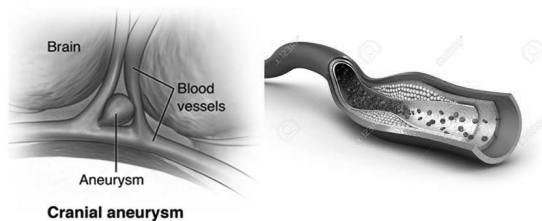


2) History of endovascular surgery

윤 석 만

순천향대 천안병원 신경외과

뇌혈관질환



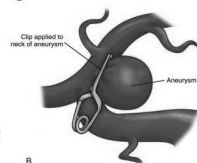
혈관내치료의 역사적 배경

1. X-ray: Wilhelm Röntgen (독) in 1895
2. contrasted x-ray cerebral angiography-- Egas Moniz (포) in 1927
3. Seldinger technique in 1953 스위스
4. Cerebral angiogram: main diagnostic tool in 1960s



뇌동맥류의 치료

1. Dandy in 1937, first aneurysm clipping



2. Yasargil in 1980s, Microsurgery 저술
--clipping수술의 보편화

뇌동맥류의 치료

- 1941 Werner, 최초의 뇌동맥류 색전술

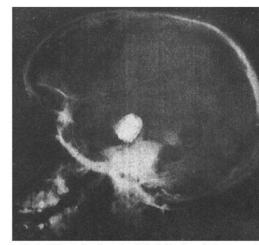


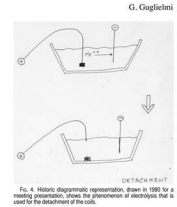
FIG. 1. Plain skull radiograph obtained after 8 m of silver-enamelled wire had been inserted into an aneurysm of the ICA by puncturing the aneurysmal wall. This procedure was performed in 1941 by Werner and colleagues. The image shows an impressive resemblance to what can be achieved today using detachable coils (an aneurysm filled with a metallic wire).

뇌동맥류의 혈관내치료

1. Lussenhop & Velasquez in 1964
 -- first catheterize intracranial vessel via ECA
2. Frei, in 1960년대 중반
 POD, para-operational device
 -- microcatheter tip에 micromagnet 부착,
 자기장을 걸어 catheter조정
3. Electrothrombosis
 - 전기를 흘려 동맥류에 혈전이 생기도록 치료

Electrothrombosis

- Mullan in 1960s
- Burhole을 통해 fine needle puncture of aneurysm neck stereotactically, 전류 흘리니 thrombosis발생
- 1mA for 5min, 30분 간격으로 검사, 동맥류 막힐 때까지
- 49/61례 에서 성공적

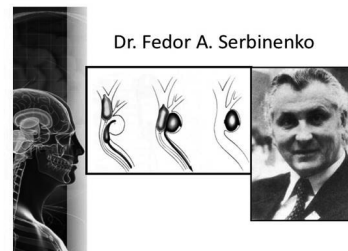


Iron microsphere

- Alksne & Smith in mid-1970s
- Stereotactic placement of magnetic probe against the aneurysm sac
- Injection of iron microsphere into aneurysm sac by puncturing
- 철이 aneurysm sac을 채우고 thrombus가 차서 막히도록 유도
- Methylmethacrylate와 철가루를 혼합해서 사용
- 16/22 return to work

Balloon embolization

- Fedor Serbinenko (러) -1974년 최초
 balloon으로 aneurysm을 300례 이상 치료



Balloon embolization

- 1980s – 수술로 치료가 어려운 동맥류를 Balloon embolization하는 것이 대세, but, poor outcome
- Higashida 등은 1990년 84명의 수술이 어려운 동맥류를 balloon 으로 치료, 18% 사망률, 11% 이환율 보고
- Balloon은 aneurysmo-plasty를 시키므로 위험성 존재
- 코일 시도 1989 Hilal, pushable coil, nonretrievable

Invention of GDC

Guido Guglielmi
 4th April 2016 • 2401



Invention of GDC

- 1988년 말- Dr. Guido Guglielmi arrived at UCLA to join Dr. Fernando Vinuela, GDC 연구 시작
- March 6, 1990: First clinical use of Guglielmi Detachable Coil
- FDA approval in 1995

First Detachable Coil (GEM)



Fig. 5. Photograph of a detachable coil. This particular coil was one of the first coils used in 1989 and was one of the first ever built.



Fig. 8. Historic photograph of the first (handmade) current generator used to detach the coils in 1989.



1990년대 초반

- 1991-1995 – 수술 위험이 매우 높은 환자를 대상으로 시행
- 1995 – FDA approval for the GDC coils
- 1998-1999 – UCLA에서 200 aneurysms를 코일로 치료, 전세계적 확산

3D rotational angiography

Am J Neuroradiol. 1993 May;4(3):289-91.

Rotational cerebral angiography: procedure and value.

Thoen A, VloedK.

Abstract

Rotational cerebral angiography provides continuously changing projections and correspondingly excellent visualization of aneurysms or other vascular malformations requiring special or oblique views. Rotation angiography as part of the routine angiography gives a three-dimensional impression with one injection and series of films. Although additional subtraction technique is not possible and the injection time has to be prolonged, the technique is nevertheless advantageous compared with magnification angiography and angioplastomy in the preoperative evaluation of cerebral vascular malformations.

PMID: 6410723

[Indexed for MEDLINE]



Cerebral : 대뇌의, 뇌의, 지각의, 지성에 호소하는, 사색적인

Interventional Neuroradiology 6: 85-94, 2000

3D Rotational Angiography: Recent Experience in the Evaluation of Cerebral Aneurysms for Treatment

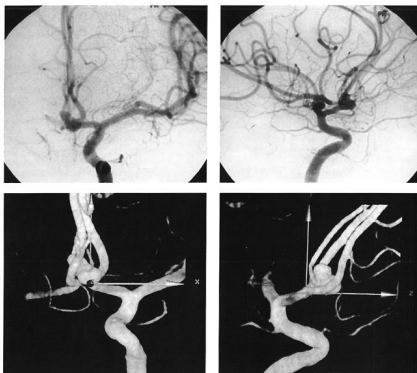
S. ISHIIHARA*, I.B. ROSS**, M. PIOTIN, A. WEILL, H. AERTS***, J. MORET

Department of Interventional Neuroradiology, Fondation Ophthalmologique Rothschild, Paris, France

*** Department of Neurosurgery, National Defense Medical College, Suita, Osaka, Japan*

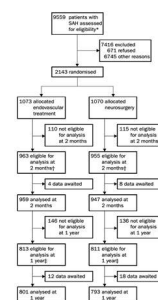
**** Department of Surgery, University of Manitoba, Winnipeg, Canada,*

***** Philips Medical Systems, Best, Netherlands*



International Subarachnoid Aneurysm Trial (ISAT) of neurosurgical clipping versus endovascular coiling in 2143 patients with ruptured intracranial aneurysms: a randomised trial

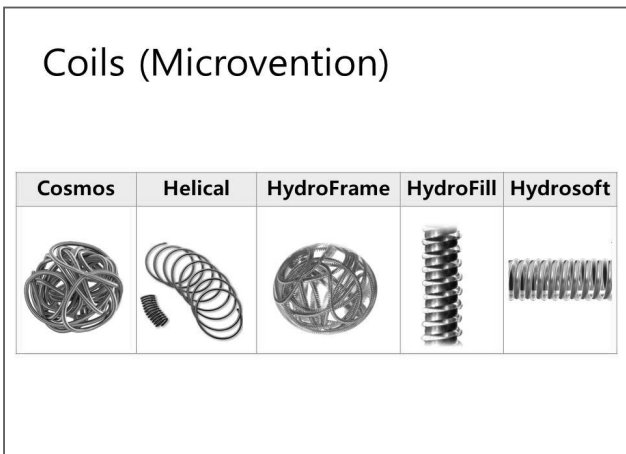
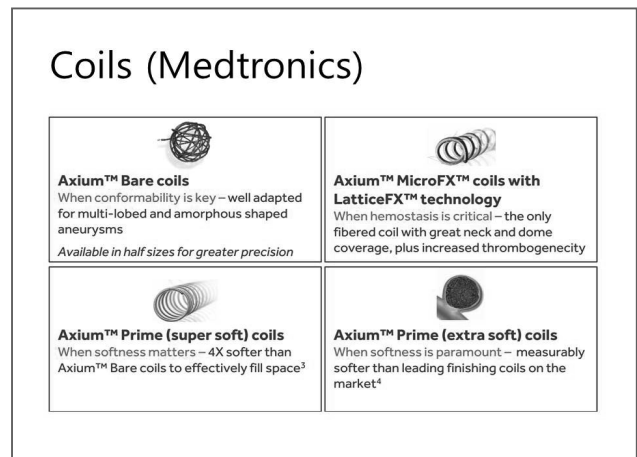
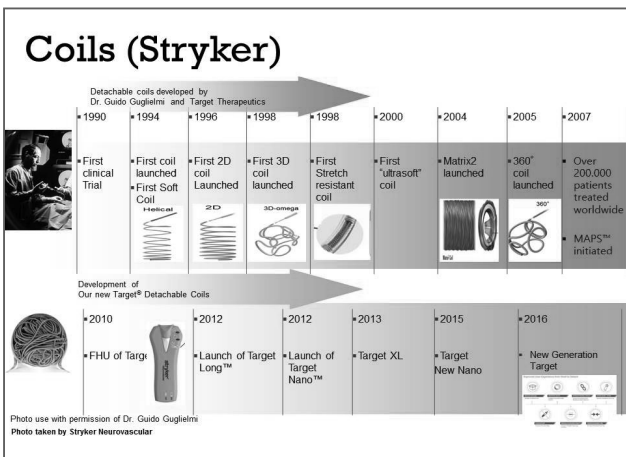
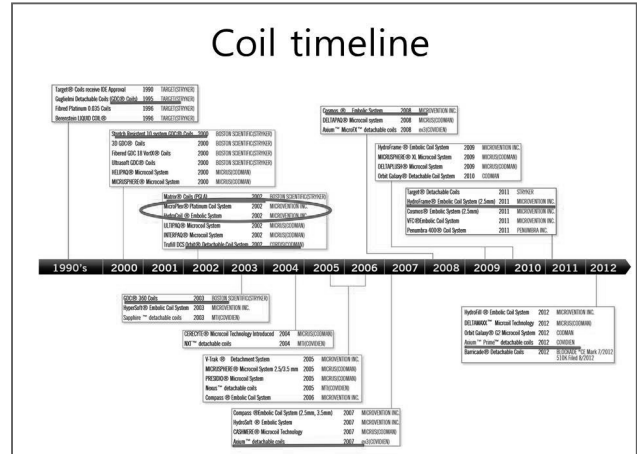
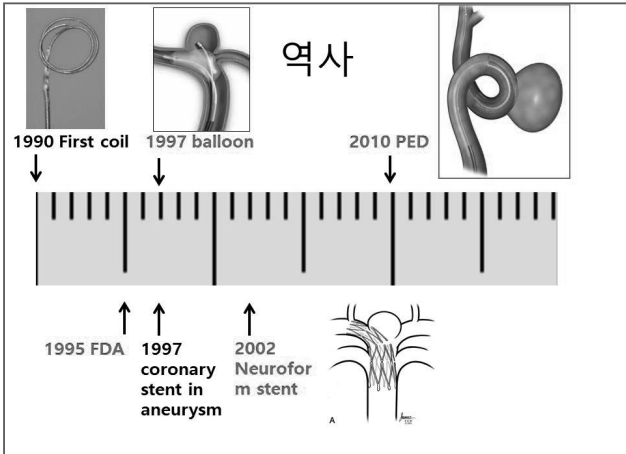
International Subarachnoid Aneurysm Trial (ISAT) Collaborative Group*

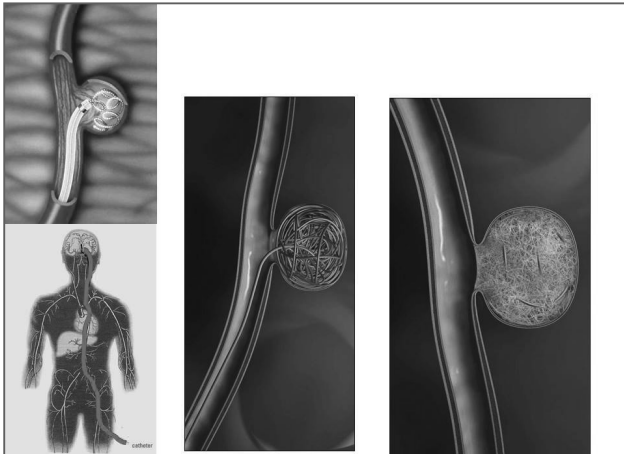


Findings 190 of 801 (23.7%) patients allocated endovascular treatment were dependent or dead at 1 year compared with 243 of 793 (30.6%) allocated neurosurgical treatment ($p=0.0019$). The relative and absolute risk reductions in dependency or death after allocation to an endovascular versus neurosurgical treatment were 22.6% (95% CI 8.9–34.2) and 6.9% (2.5–11.3), respectively. The risk of rebleeding from the ruptured aneurysm after 1 year was two per 1276 and zero per 1081 patient-years for patients allocated endovascular and neurosurgical treatment, respectively.

Interpretation In patients with a ruptured intracranial aneurysm, for which endovascular coiling and neurosurgical clipping are therapeutic options, the outcome in terms of survival free of disability at 1 year is significantly better with endovascular coiling. The data available to date suggest that the long-term risks of further bleeding from the treated aneurysm are low with either therapy, although somewhat more frequent with endovascular coiling.

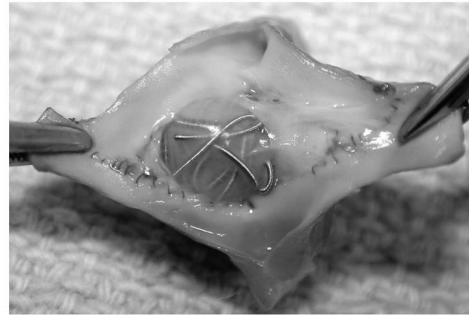
Lancet 2002; **360**: 1267–74



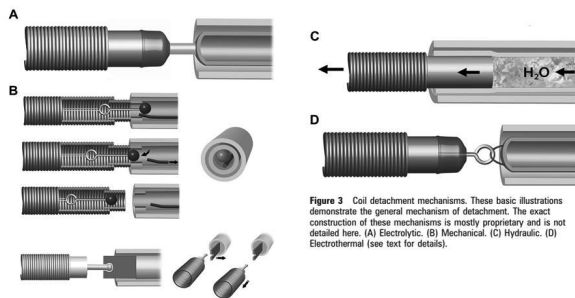


HydroCoil® Endothelialization

3-month Follow Up

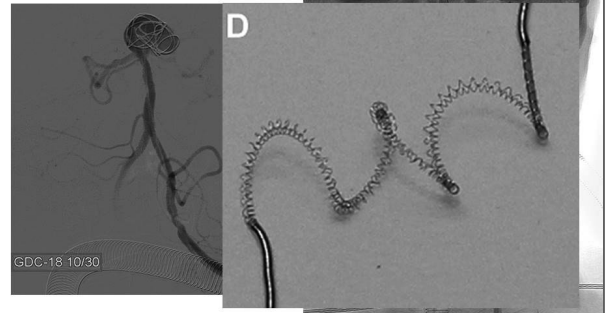


Detach methods

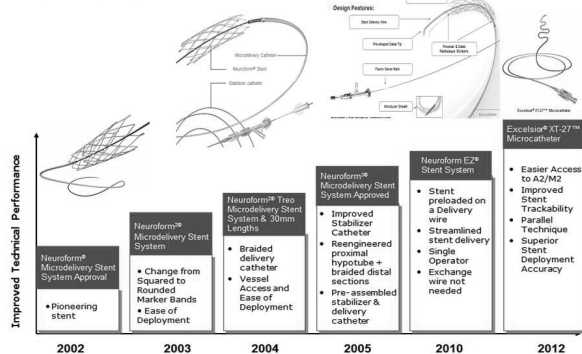


Coil stretch

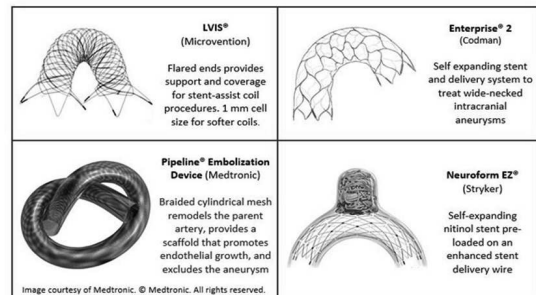
2007.08.09, Jung ID



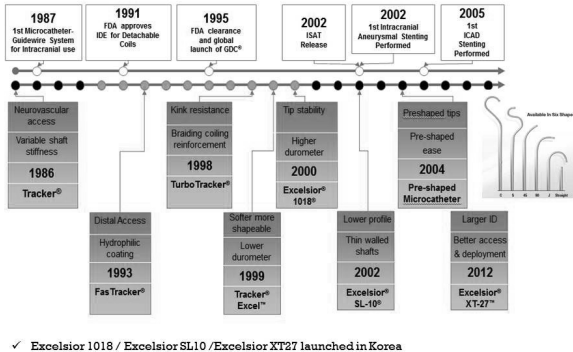
Neuroform



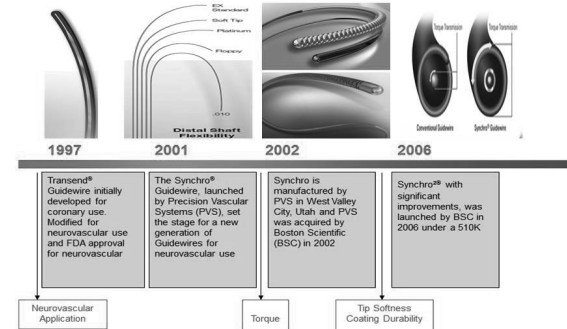
Neurovascular Stents



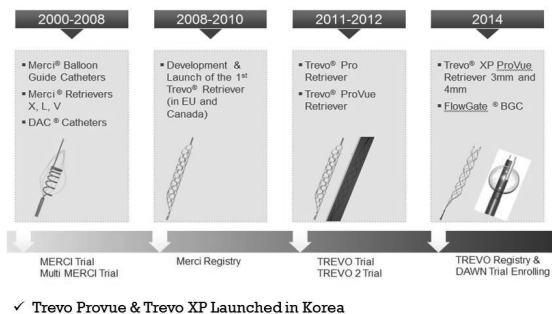
Microcatheter



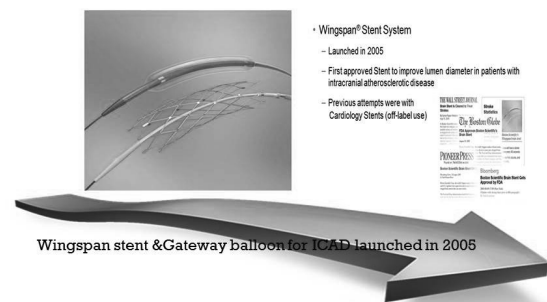
Guidewire



AIS



Wingspan&Gateway



요약

- Neurosurgeon과 Neuroradiologist가 초기에 수술이 어려운 병변에 대한 less invasive Tx로 출발하였으나, 컴퓨터, device, technique 발전으로 말미암아 뇌동맥류 치료의 주류가 되었다.
- 뇌혈관질환의 혈관내 치료시 각 device, material의 장, 단점을 사전에 충분히 숙지하고 빠른 속도로 변화하는 지식과 기술발전에 뒤처지지 않도록 지속적인 교육과 훈련이 필요할 것이다.

3) Medication summary during endovascular treatment

박 근 영

연세대 세브란스병원 신경외과

Contents

- ✓ Contrast media
- ✓ Antiplatelets
- ✓ Anticoagulants
- ✓ Thrombolytics
- ✓ Vasodilators

Contrast media

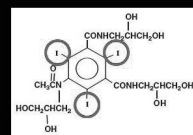
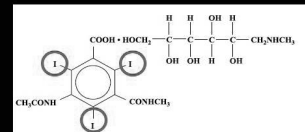
- ✓ 인체 내 투여 시 방사선 투과도 차이에 따른 조직의 구분을 가능케 함.
- ✓ 수용성 요오드화 조영제
 - ① 이온성 (ionic)
 - ② 비이온성 (non-ionic)

Contrast media

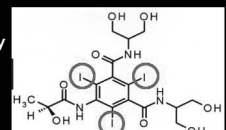
조영제의 특성

- ✓ **수용성 (Solubility):** 혈관내에 사용하는 조영제는 반드시 수용성이어야 한다.
- ✓ **방사선 비투과성 (Radiopacity):** 비투과성이 좋을수록, 조영제의 양을 줄일 수 있다. 방사선 비투과성은 입자 당 함유한 요오드 원자 수와 비례한다.
- ✓ **점성 (Viscosity):** 조영제 농도 및 온도와 관련된다.
- ✓ **삼투압 (Osmolarity):** 수용액에 녹아 있는 입자 수에 비례한다. 이온성 조영제는 수용성 상태에서 입자수가 늘어나므로, 비이온성 조영제보다 삼투압이 높다. 삼투압이 높으면, 혈관내피 손상, BBB 손상, 두통, 패동맥압 증가 등의 부작용이 더 많이 오는 경향이 있다.
- ✓ **혈장 단백질과 결합:** 혈장 단백질과 결합하면, 입자의 크기가 커져, 신장으로 배설이 어려운 경우가 있다. 비이온성 조영제와 달리 이온성 조영제의 5% 정도가 혈장 단백질과 결합한다.
- ✓ **배설:** 대부분의 조영제는 신장으로 배설된다 (95%). 정상적인 신장 기능을 가진 성인에서 투여된 조영제의 절반 정도는 투여 2~3시간 내에 배설된다.

Conray

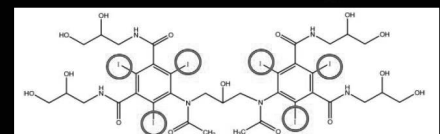


Pamiray



Omnipaque

Visipaque



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

Contrast media

구조	입자비(오모드/입자)	상품명	오모드 농도	삼투압	점도 (37도 기준)
Ionic (ionic) monomer	1.5 (3/2)	Conray	370	1500	3
		Isopaque		2100	
		Telebrix		1500	5.2
Ionic dimer	3 (6/2)	Hexabrix	370	580	6
		Omnipaque		672	6.3
Nonionic monomer	3 (3/1)	Pamiray	300	620	4.7
		Ultravist		607	4.8
		Optiray		651	5.5
		Xenetix		695	6
		Iomeron		520	4.5
		Visipaque		290	11.4
Nonionic dimer	6 (6/1)	Isosvist	240	300	3.9

뇌혈관외과학 1판.

Side Effect

Hypersensitivity (≠Allergy): 2~5%. (비이온성 조영제의 경우)

Sx. urticaria, mucosal edema, bronchospasm, anaphylaxis
Tx.

① 병력 청취가 중요.

이전 조영제 과민반응. 해산을 알려지라는 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.

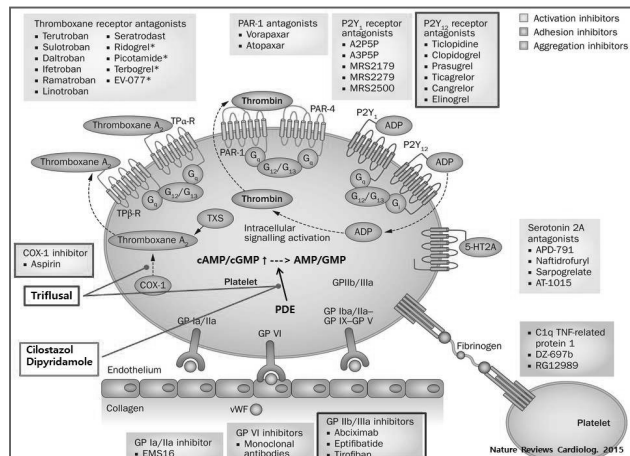
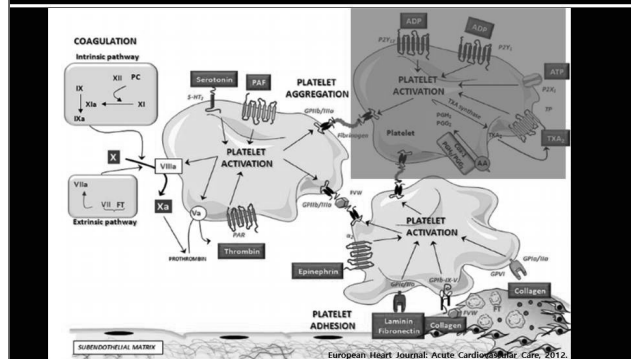
Tx.

- ① 조영제 사용의 최소화 (Maximal dose of iodine = Total 80 gm or 2000 mg/kg)
- ② Metformin(당뇨약제)와의 혼합 사용은 유산산증(mortality 50%)의 우려가 있어 병용 금지된다.
- ③ N-acetylcystein (Mucomyst): free-radical scavenger, PO 600mg BID * 2 days
- ④ Visipaque>Omnipaque
- ⑤ IV hydration

✓ Transient global amnesia

3) 이 약을 비-이온성 조영제라고 하지만, 염산으로 된 용액이며, 이는 유산산증을 일으킬 수 있으므로, 이를 예방하기 위해 조영제를 투여하기 전에 해독효소의 복용을 중단하고, 혈청크레아티닌을 측정하여, 충분한 수분 공급을 해야 합니다.
① 정상 신기능 환자: 조영제를 투여할 시점에 비-이온성 조영제의 복용을 중단하고 48시간 후 검사를 마치고 48시간 후 또는 신기능이 정상화된 후 복용을 재개합니다.
② 비정상 신기능 환자: 비-이온성 조영제의 복용을 중단하고 48시간 이후에 조영 검사를 합니다. 신기능을 완전히 회복하기 전까지는 조영제 복용을 중단합니다.
③ 신기능이 비정상적이거나 이미 확인된 만성 신장 질환의 환자는 조영제 사용의 유익성과 위험성을 고려하여 주의 깊게 사용됩니다.

Coagulation cascade and Platelet pathway



Antiplatelets

호중구강소증 뇌혈관 미승인

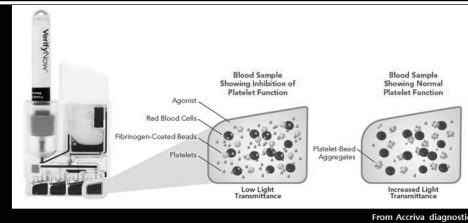
	Aspirin	Clopidogrel (Plavix)	Ticlopidine	Prasugrel	Abciximab (ReoPro)	Tirofiban (Agrastat)	Cilostazol (Pletaal)	Triflusal (Disgren)
COX	V							V
P2Y12		V	V	V				
GPIIb-IIIa					V	V		
PDE							V	V

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

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

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

P2Y12 resistance test (VerifyNow)



<Test Timing>

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

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 (Agrastat)	Cilostazol (Pletaal)	Triflusal (Disgren)
COX	V							V
P2Y12		V	V	V				
GPIIb-IIIa					V	V		
PDE							V	V

✓ Abciximab : IV/(IA). 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). Half-life 2 hours. However, its effect on platelet for 4~8 hours.

* 0.9% 열화나트륨 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)

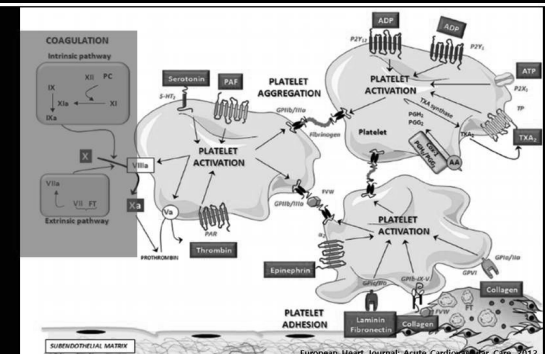
Antiplatelets

	Aspirin	Clopidogrel (Plavix)	Ticlopidine	Prasugrel	Abciximab (ReoPro)	Tirofiban (Agrastat)	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, heat intolerance, palpitations

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

Coagulation cascade and Platelet pathway





Anticoagulants

- * During endovascular Tx: IV bolus 3000 IU, then 1000 IU on every hour
- * Monitoring: aPTT/ACT (Therapeutic range: aPTT 60–80 sec)
- * Antidote: Protamine sulfate 1mg/100 IU
- * Heparin-induced thrombocytopenia

- * 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

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.

- * Dabigatran (Pradaxa) : direct thrombin inhibitor
- * Rivaroxaban (Xarelto) : direct factor Xa inhibitor
- * Apixaban (Eliquis) : direct factor Xa inhibitor

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)

- **심박전: 폐색전증**
 - **심방의 혈전증**
 - 1. 급성심방전증
 - 2. 만성심방전증
 - **심방의 혈전증**
 - 1. 급성심방전증
 - 2. 만성심방전증
 - **심방의 혈전증**
 - 1. 급성심방전증
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- **심방전증**
 - **심방전증**
 - 1. 급성심방전증
 - 2. 만성심방전증
 - **심방전증**
 - 1. 급성심방전증
 - 2. 만성심방전증
 - **심방전증**
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- **심방전증**
 - **심방전증**
 - 1. 급성심방전증
 - 2. 만성심방전증
 - **심방전증**
 - 1. 급성심방전증
 - 2. 만성심방전증
 - **심방전증**
 - 1. 급성심방전증
 - 2. 만성심방전증

- ✓ 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 Kinytic 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)



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 유일하게 효과가 입증된 post-SAH vasospasm 치료제 (neuroprotective effect)

III 적응증 (Indications)	
식약처 허가받은 적응증	→ IV/PO 병합
동맥류성 자궁외동맥류의 뇌혈관경련에 의한 허혈성 신경장애의 예방 및 치료	
FDA 승인 적응증	→ Only PO
1. 거미막밑출혈 (Subarachnoid Hemorrhage)	

- 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.

The 12th Annual Summer Conference Endovascular Neurosurgical Therapy

ASCENT 2017

"Consider, Communicate and Conquer"

The "Difficult case" session

좌장 : 가톨릭대 신용삼

Voting with live interaction during case presentation



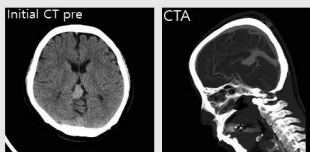
Case 1. Vein of Galen in adult

최종욱, 김종연

연세대 원주세브란스기독병원

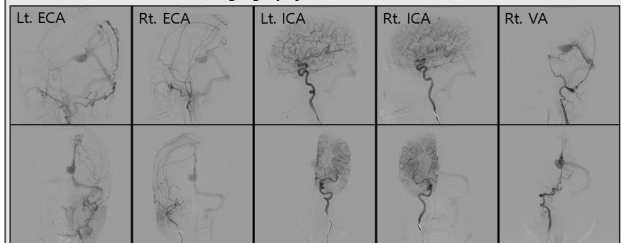
49/F

- Chief complains
 - Headache, Dizziness
- Duration
 - About 5-6 years
- No specific medical past history



R/O Vein of Galen malformation
Planned DSA for further study

Under Distal subtraction angiography

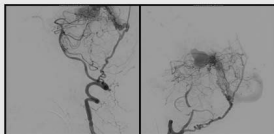


Under 6 vessels angiography, 5 vessels was supplied by direct fistula into the VGM, except Lt. VA

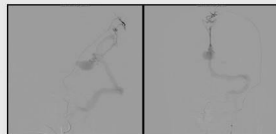
Treatment option?

- Embolization using Onyx, Glue, Coil
 - Single stage?
 - Multi stage?
 - Which route?
- Embolization and Radiosurgery

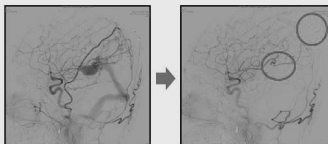
Planning Onyx embolization



1st micro-catheter insertion was tried via
Rt. VA route ⇒ Failed (d/t tortuous vessel)



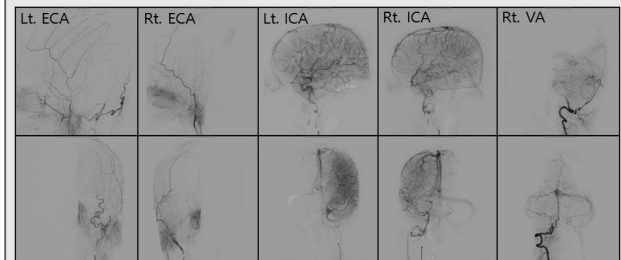
2nd micro-catheter insertion was tried via
Lt. ECA route (using STA) ⇒ Success



Onyx embolization was done using Lt. STA
Total Onyx amount : 3cc

Nearly total occlusion!!

Final Distal subtraction angiography



Conclusions

- Fortunately, well occlusion case

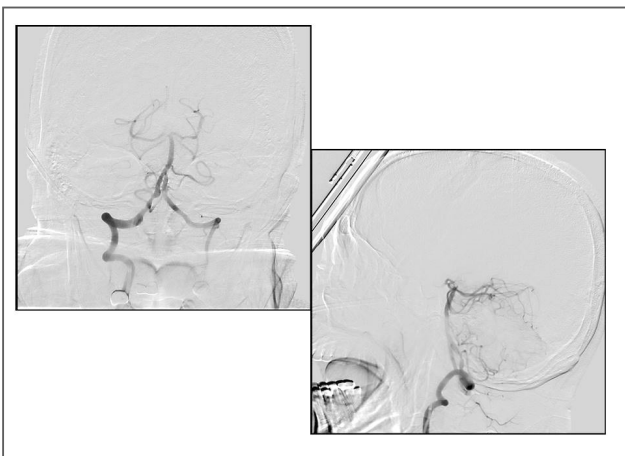
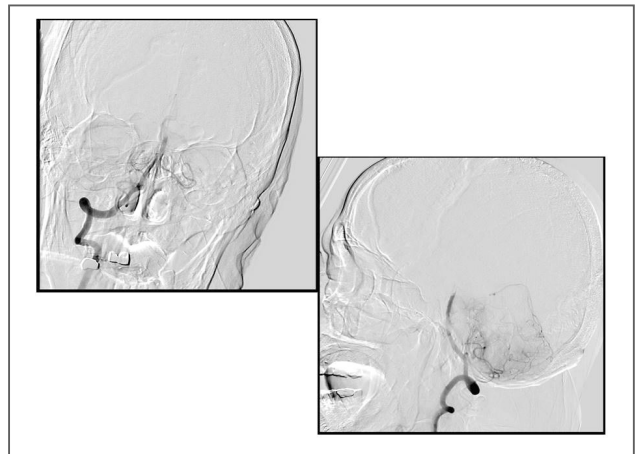
Case 2. Y-stent retriever technique at BA occlusion

박 정 현

한림대 동탄성심

75 Y.O / Male

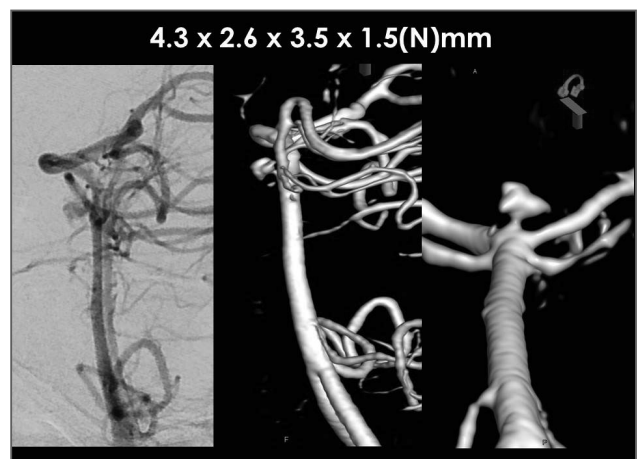
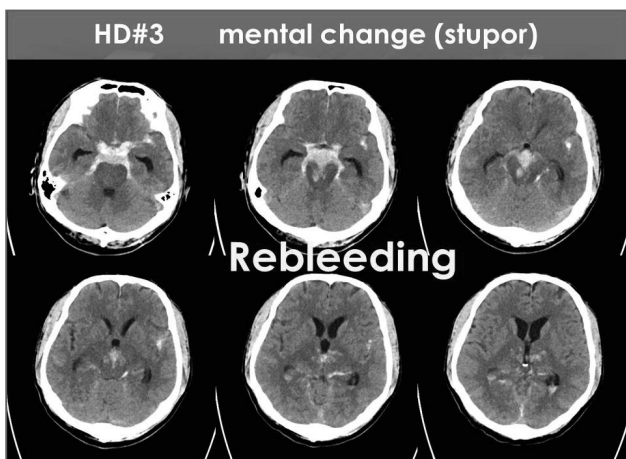
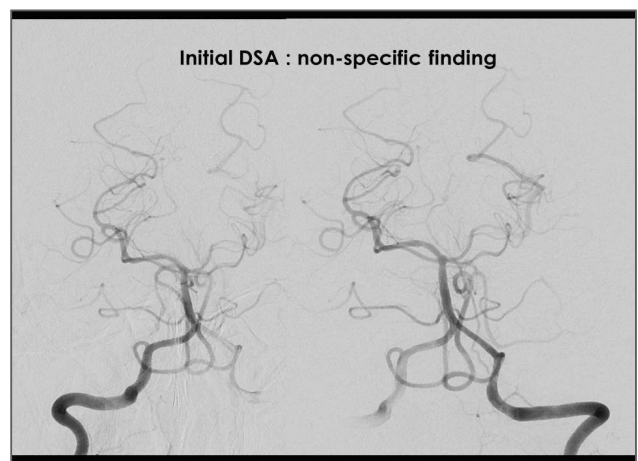
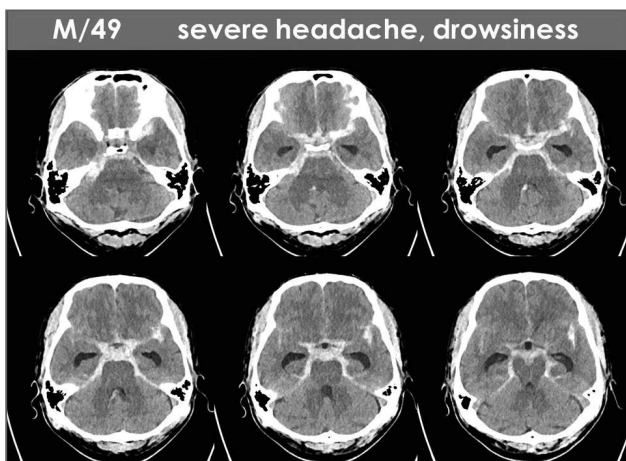
- Distal BA occlusion
- PCA 로 stent 위치 후 retrieval 시행하였으나, thrombus 가 engagement 되지 않아 Rt. PCA 통한 retrieval 시 Lt. PCA occlusion (Rt. 는 recanalization)
- Lt. PCA 통한 retrieval 시 Rt. PCA occlusion (Lt. 는 recanalization) 됨.
- Both PCA 로 Y-stent retrieval 시행함.



Case 3. Endovascular treatment for ruptured basilar aneurysm

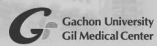
김 명 진

가천대



Tx options?

- 1. Surgical clipping**
- 2. Coil embolization**
- 3. Stent-assisted coil embolization**
- 4. Multiple stenting**
- 5. Flow diverter**



Case 4. SSS dAVF

이 창 영

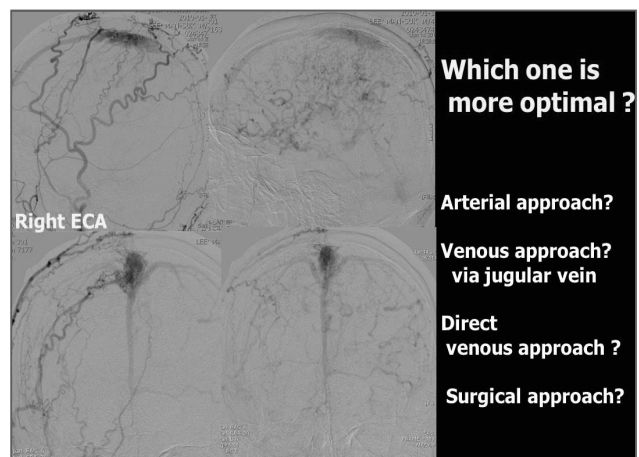
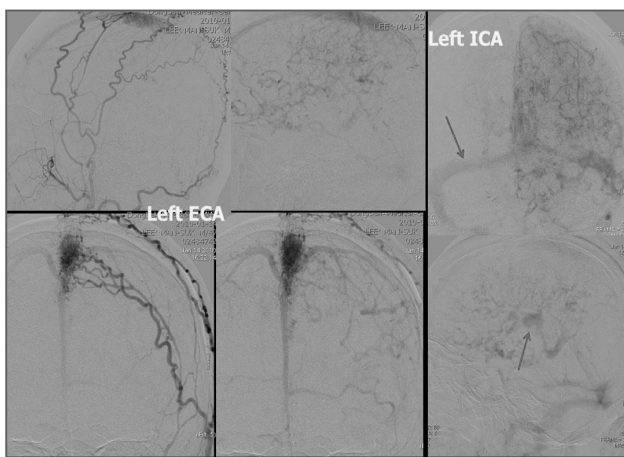
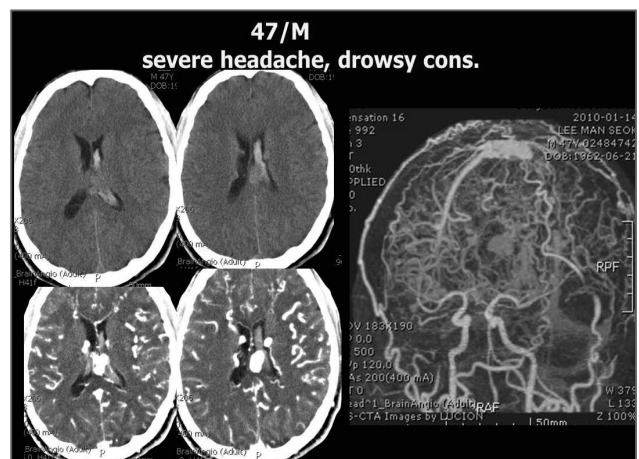
계명대

Case presentation (SSS dural AVFs)

In this paper, the author presents the case of a SSS dural AVFs causing IVH, treated in an endovascular manner.

Chang-Young Lee, M.D.

Department of Neurosurgery, Keimyung University
School of Medicine, Daegu, Korea



Case 5. Ethmoidal dAVF

김재현, 김창현, 이창영

계명대

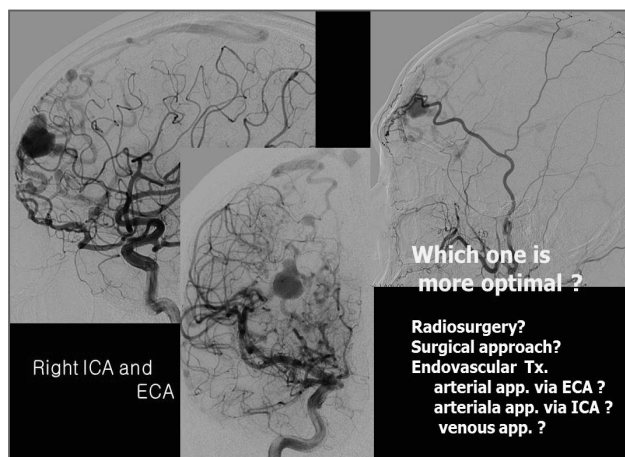
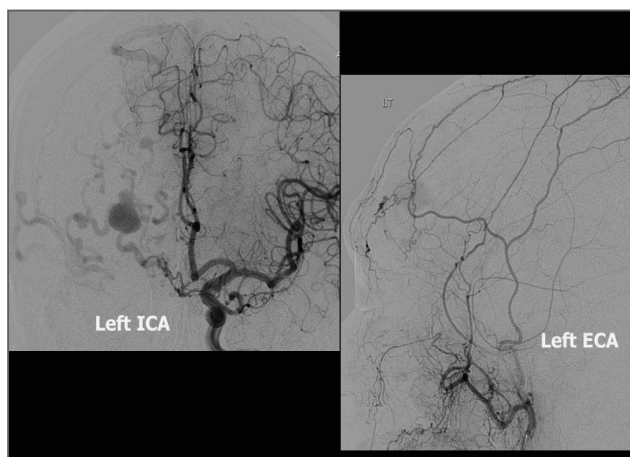
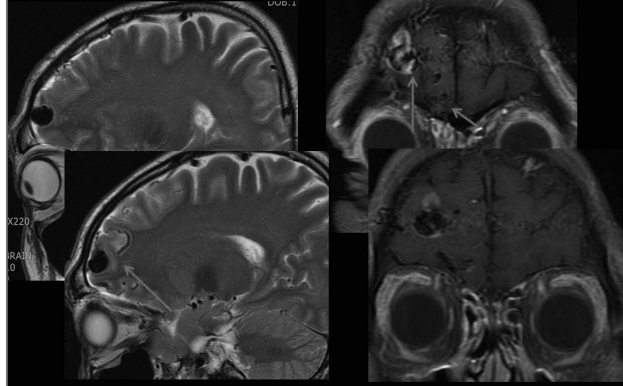
Case presentation (ethmoidal dural AVFs)

In this paper, the authors present the case of an ethmoidal AVFs found incidentally, treated in an endovascular manner.

Jae-Hyun Kim, M.D., Chang-Hyun Kim, M.D., Chang-Young Lee, M.D.

Department of Neurosurgery, Keimyung University
School of Medicine, Daegu, Korea

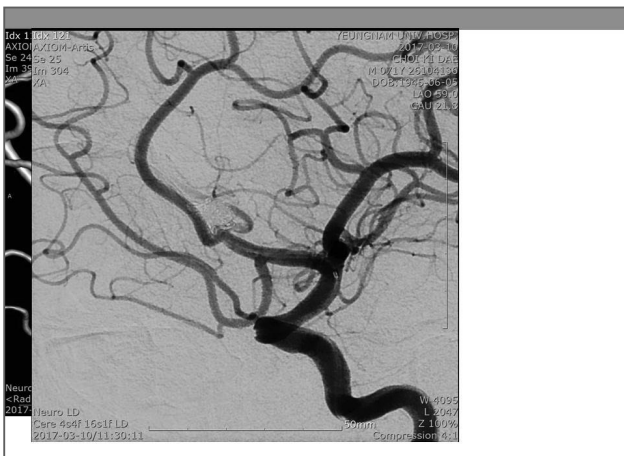
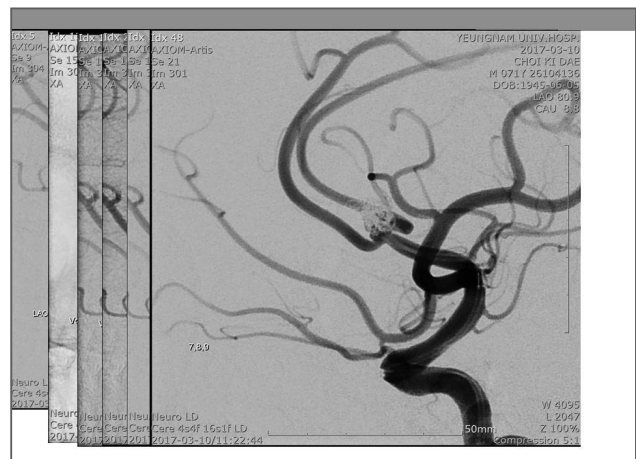
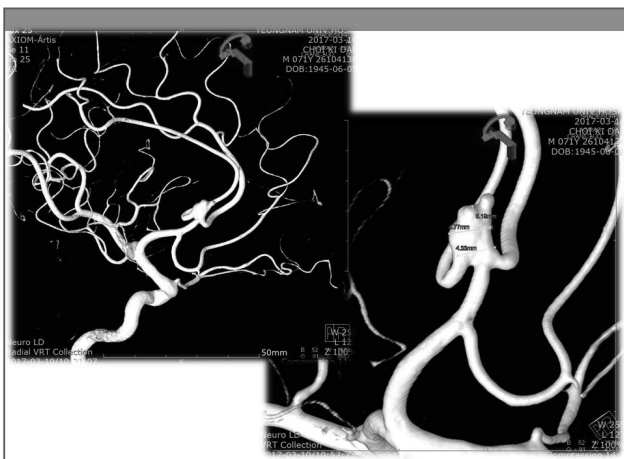
54/M
on the medical check-up (asymptomatic).



Case 6. Difficulties in coil selection when using the double catheter technique

김종훈, 정영진, 장철훈

영남대



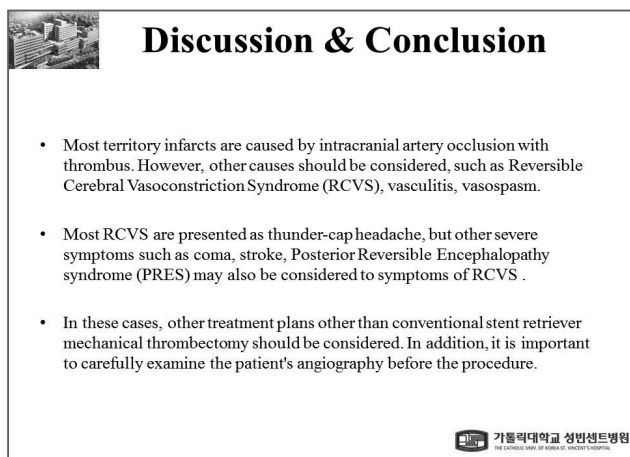
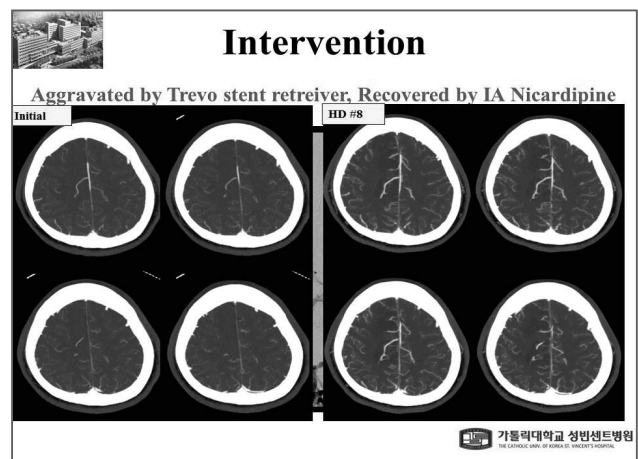
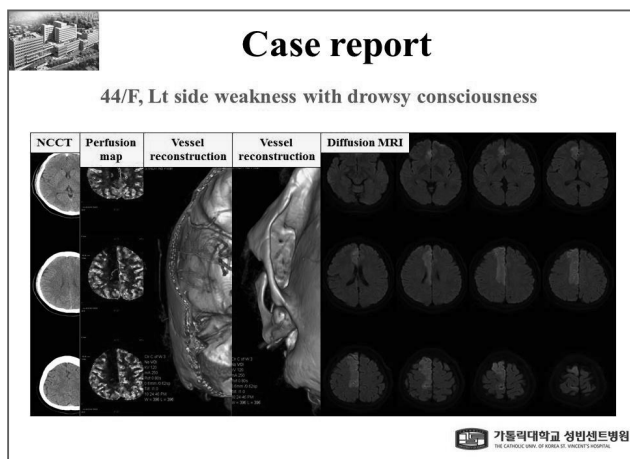
Stent를 사용하지 않고 double cath. Technique을 사용할 때 고민되는 부분..

1. Sac의 size에 따라 coil의 size를 각각의 catheter에 어떤 것을 선택할 것인가..?
2. 360 coil을 선택할 것인가? 또는 helical coil을 선택할 것인가?
3. 양쪽 branch로 coil이 내려오지 않도록 frame을 튼튼하게 잡아주기 위해 어떤 brand의 coil을 쓸 것인가? 과연 brand 별로 frame을 튼튼하게 할 때 유리한 것 or filling 할 때 유리한 것이 있는지..?

Case 7. Territory infarction is always associated with a intracranial artery occlusion? Or other considerations : Reversible Cerebral Vasoconstriction Syndrome

이민형, 성재훈, 이호준, 이동훈, 이상원

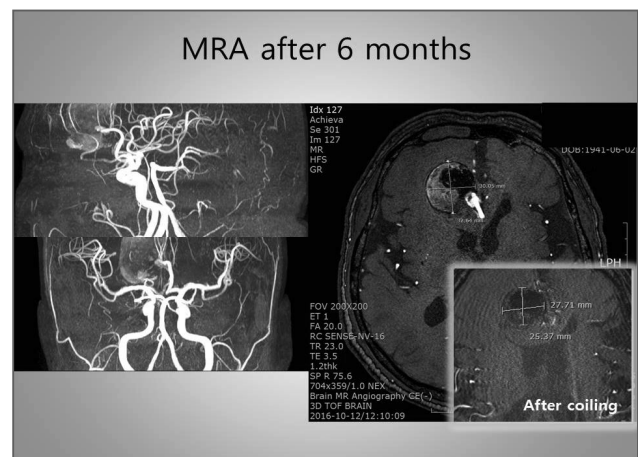
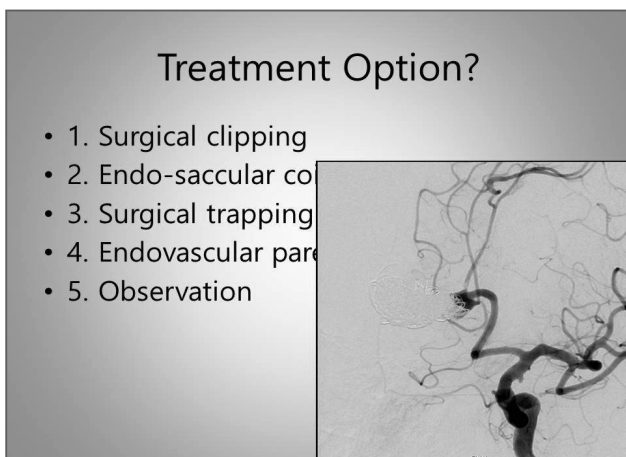
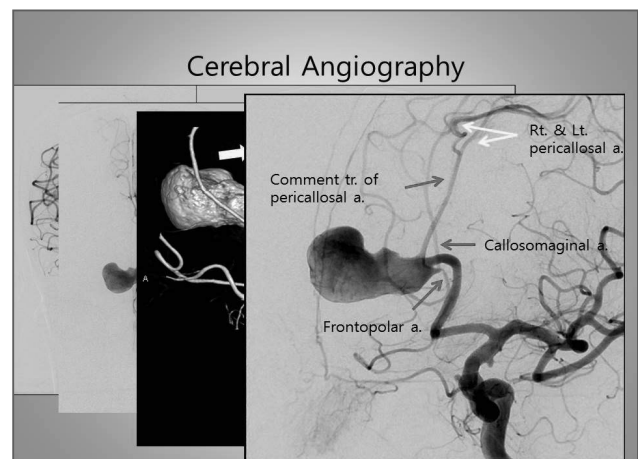
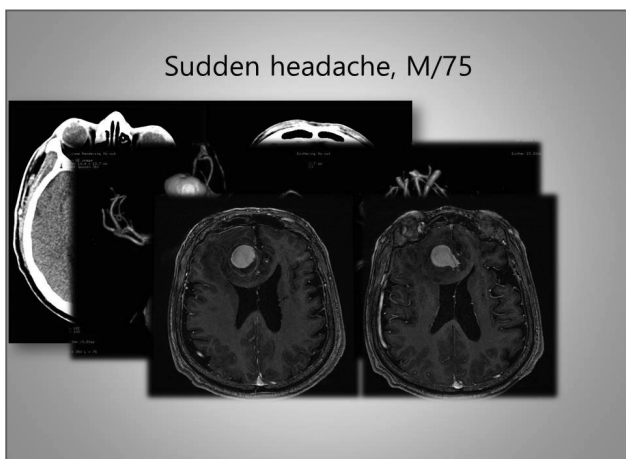
가톨릭대 성빈센트



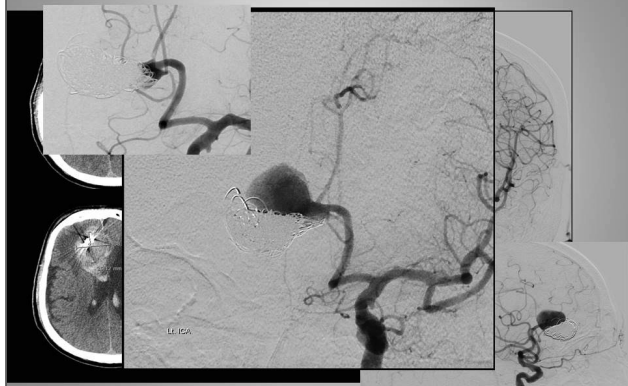
Case 8. Surgical Treatment of a Re-ruptured Partially Thrombosed Giant Aneurysm in the Anterior Cerebral Artery

김성태, 김병진, 박정현, 정해웅, 정영균

인제대



After 1 month



Treatment option?

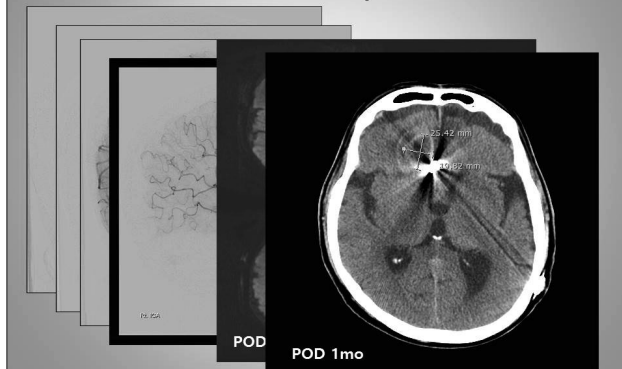
- 1. Surgical clipping
- 2. Additional endo-saccular coiling
- 3. Surgical trapping and bypass
- 4. Endovascular parent artery occlusion
- 5. Observation

Attempt to clip neck
 - if needed, bypass using STA and RA.

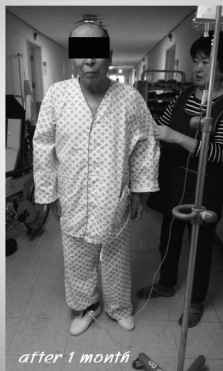
Uni. AIH Lt.



Post op



경청해주셔서 감사합니다.



after 1 month

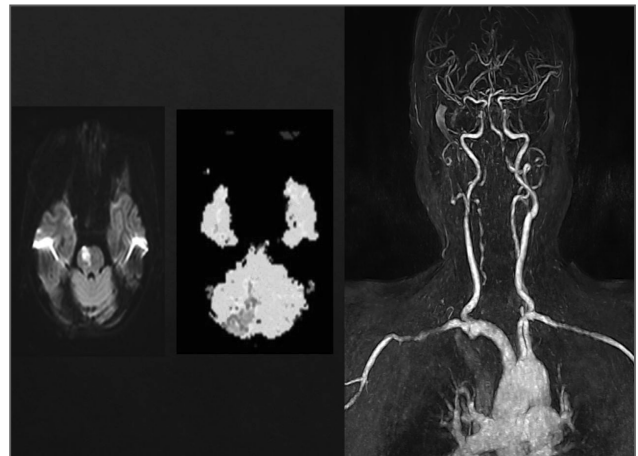
Case 9. Symptomatic vertebrobasilar stenosis

박 강 혁

가톨릭대 부천성모

76/F

- ◇ Dysarthria, Lt.hemiparesis GIV – 7days ago
NIHSS 1
- ◇ DM/HTN/Dyslipidemia (+/+/-)
- ◇ Smoking (-)
- ◇ F/Hx) mother - stroke



- ◇ TC/TG/HDL/LDL - 192/308/31/121
- ◇ Echo – Grade II LV diastolic dysfunction
- ◇ 24 hrs Holter – RSR
- ◇ Tx : dual antiplatelet (Aspirin 100mg + clopidogrel 75mg)
statin (Rosuvastatin 10mg)

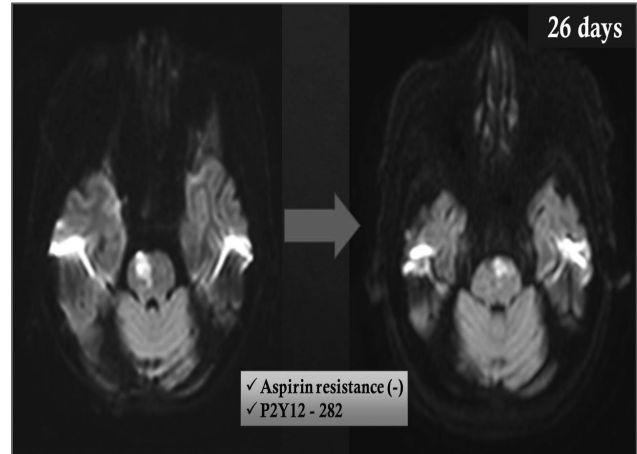


HD 3

2nd attack (26 days later)

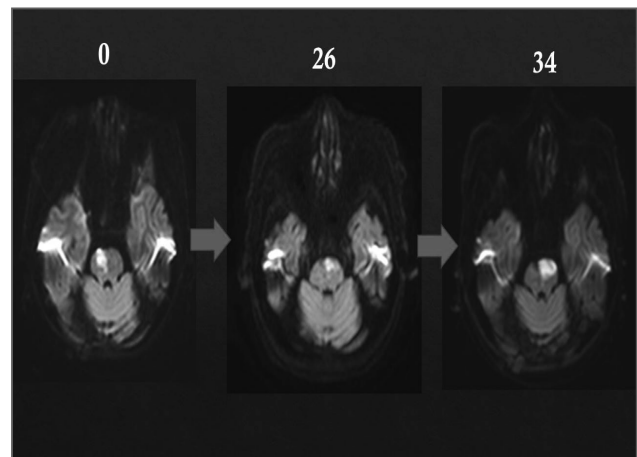
◆ Aphasia, Rt.hemiplegia

◆ NIHSS 13



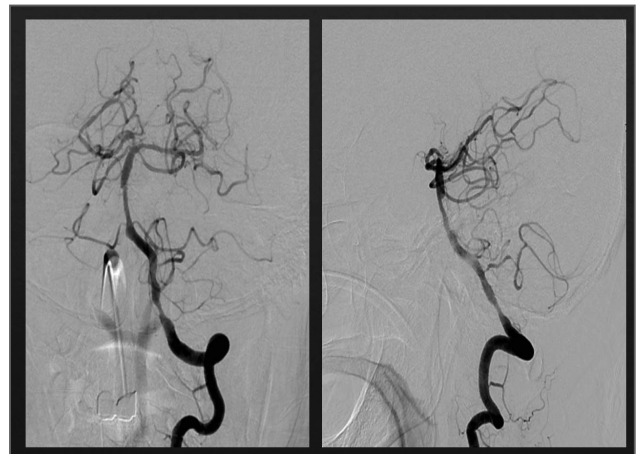
Next step ?

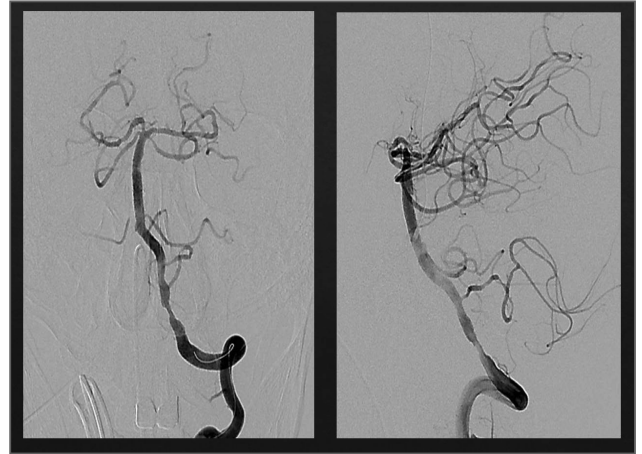
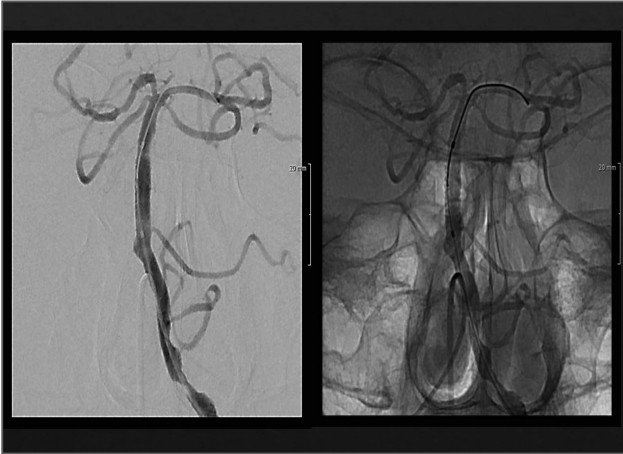
- 1) Dual antiplatelet (Aspirin + Cilostazol)
- 2) Triple antiplatelet (Aspirin + Clopidogrel + Cilostazol)
- 3) Antiplatelet + Anticoagulant
- 4) Intracranial stenting



Next step ?

- 1) Triple antiplatelet (Aspirin + Clopidogrel + Cilostazol)
- 2) Antiplatelet + Anticoagulant
- 3) Intracranial stenting
- 4) Destiny





The 12th Annual Summer Conference Endovascular Neurosurgical Therapy

ASCENT 2017

"Consider, Communicate and Conquer"

Stryker symposium

좌장 : 서울대 권오기

Proximal control BGC and specially FlowGate 2 on the
Stent retriever thrombectomy procedure

Dr. Jordi Blasco

Hospital Clinico Y Provincial De Barcelona



Jordi Blasco Andaluz

Contact country : Spain

Contact aut. region/reg. : Catalonia

Contact city : Barcelona

Current professional situation

Employing entity : HOSPITAL CLINICO Y PROVINCIAL DE BARCELONA

Previous positions and activities

01/05/1998 Especialist, Hospital Casa Maternitat

01/02/1998 Especialist, CAP Numancia

01/01/1994 Resident, HOSPITAL CLINICO Y PROVINCIAL DE BARCELONA

University education

1st and 2nd cycle studies and pre-Bologna degrees

University degree : Doctorate

Name of qualification : Licenciado en Medicina y Cirugía

Degree awarding entity : Universitat de Barcelona

Doctorates

Doctorate programme : doctor en medicina

Degree awarding entity : Universitat de Barcelona

The 12th Annual Summer Conference Endovascular Neurosurgical Therapy

ASCENT 2017

"Consider, Communicate and Conquer"

The "Complication case" session

좌장 : 순천향대 김범태



1) Embolic complication after stent assist coil for basilar tip aneurysm

김 태 곤

차의대

2) Basilar artery dissecting aneurysm

김 영 수

양산부산대

3) VA dissecting aneurysm

성 승 언

동래봉생

4) Thromboembolic complication during IAT

김 상 욱

가톨릭대 대전성모

5) Coil stretch during the embolization

김 소 연

가톨릭관동대 국제성모

6) Iatrogenic vessel injury caused by wire tip of neuroform stent delivery system during endovascular coiling

진 성 철

인제대

ASCENT 2017

"Consider, Communicate and Conquer"

The "Debate" session: panel discussion with live audience interaction

좌장 : 한림대 이호국

패널 : 윤석만, 박석규

Intraoperative neurophysiological monitoring during endovascular procedure

가톨릭대 인천성모 장동규

1) Case presentation: IOM

순천향대 오재상

2) Cerebral oximetry

순천향대 신동성



Reversible cerebral vasoconstriction syndrome

장 동 규

가톨릭대 인천성모

Intraoperative neurophysiological monitoring (IOM) has an important role for many neurosurgical procedures. IOM has been used to minimize neurological injury during operation, to identify important neural structures in the operative field, and so to avoid significant postoperative impairment. IOM modalities are motor evoked potential (MEP), somatosensory evoked potential (SSEP), electroencephalography (EEG), electromyography (EMG), brainstem auditory evoked potential (BAEP), and visual evoked potential (VEP). Multimodal IOMs have been used during neurosurgical operation such as carotid endarterectomy, cerebral aneurysm clipping, AVM operation, brain tumor, and spine surgery. On the contrary, thromboembolic complications and intraprocedural bleeding are the most common causes of morbidity or mortality following neuroendovascular procedures. The risk of intraprocedural thrombosis during aneurysm coiling or AVM embolization is reported to occur in 4% to 15% of cases. However, IOM has not been used in neurointerventional procedure as often as in neurosurgical operation. Therefore, a brief review regarding basic IOM concept, technical aspect, and case series in our hospital was conducted mainly about cerebral aneurysm coiling and AVM embolization.

1) Sensitivity of MEP For early detection of complications during Aneurysm Coiling

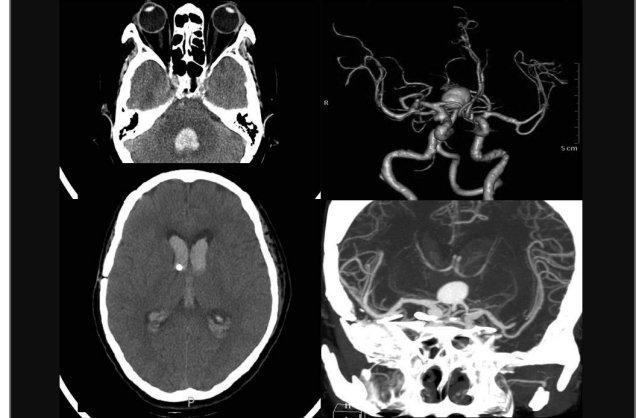
오재상, 윤석만

순천향대

Case 1

- 54/F
- Drowsy consciousness
- GCS 3/3/6
- Previous SAH hx (+)
- 2003. S-SAH d/t Rt. Pcom An. Rupt. / Rt. MCA UIA -> clip
- 2007. B-MRA 상 basilar tip UIA size 증가 -> TFCA -> F/U loss
- HTN (+) : aspirin
- V/S stable

Brain CTA 상 S-SAH d/t Ruptured Basilar tip

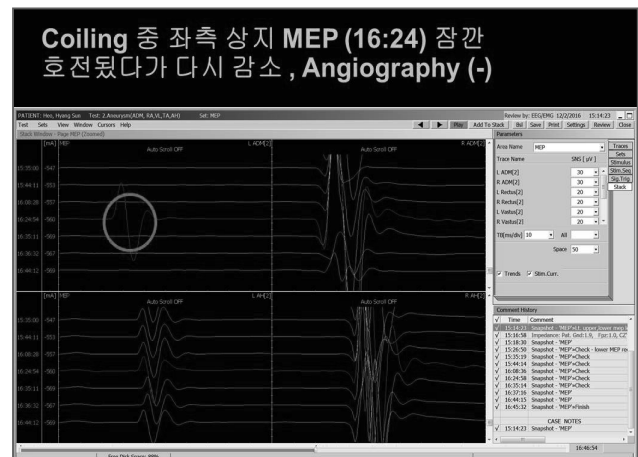
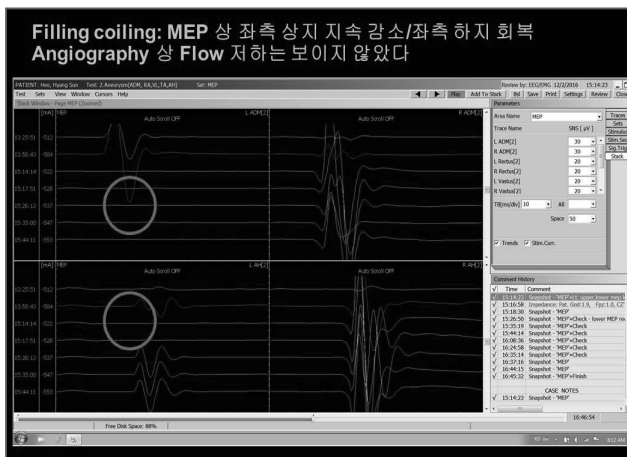
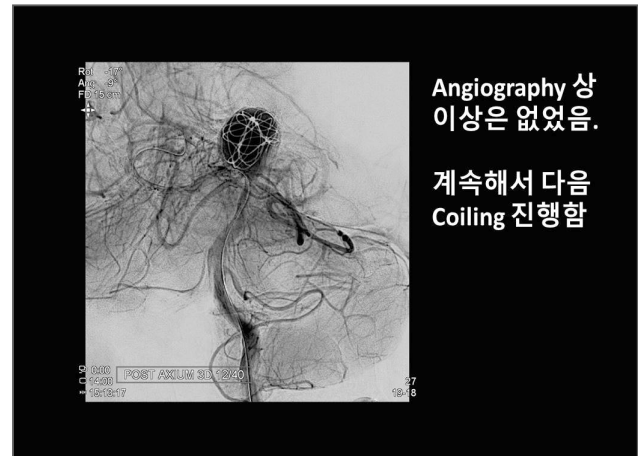
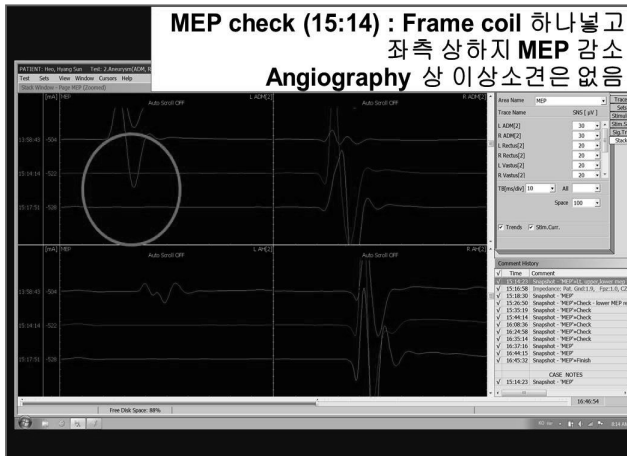


TFCA



Coil embolization Frame coil



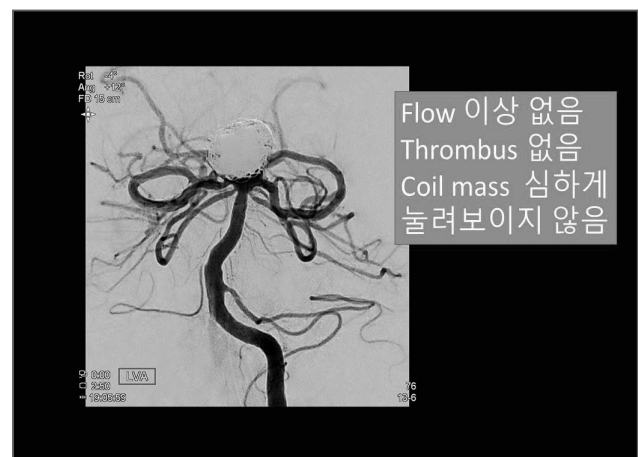


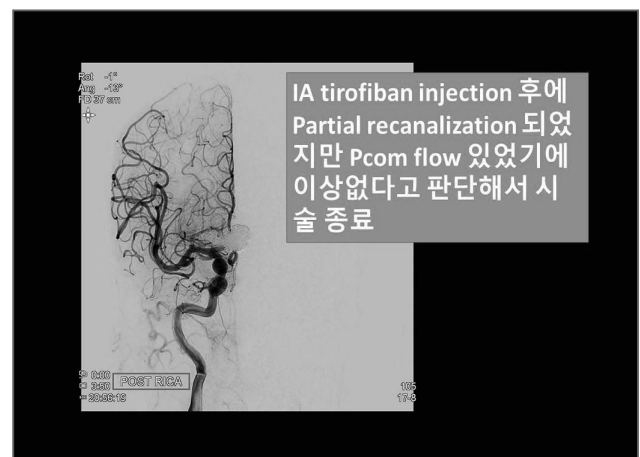
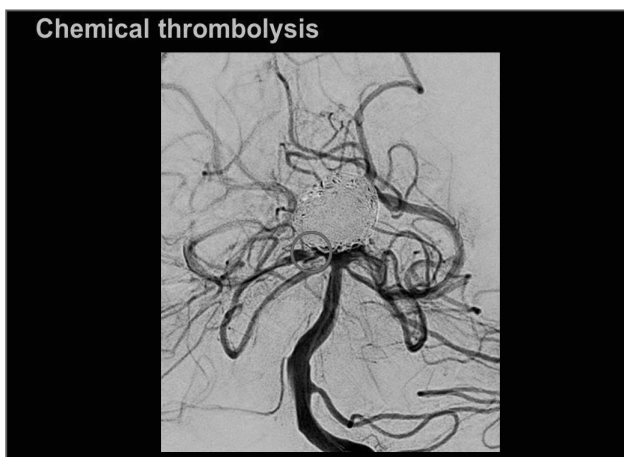
시술후 1시간째..

“Left hemiparesis 2.”

TE 발생이라고 생각 후

다시 전신마취 하고 TFCA 시행함.





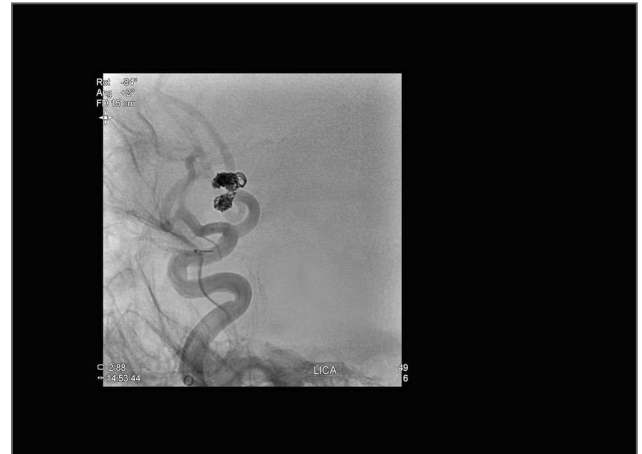
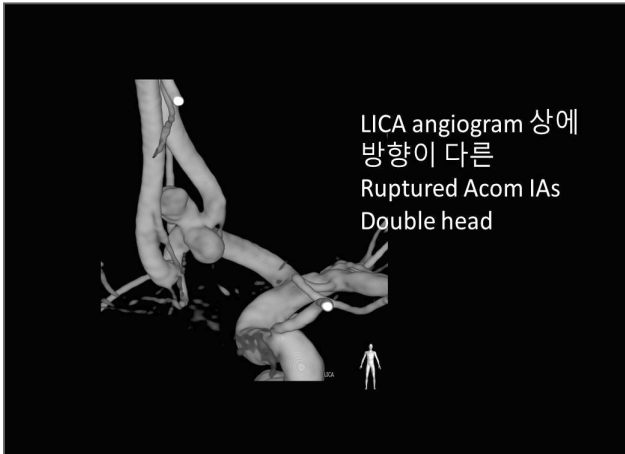
Question...?

- 시술 중 원인을 알기 힘든 MEP 만의 큰 저하
→ 임상적으로 의미가 있었던 걸까..
- 만약 그렇다면...
→ 시술을 마치기 전에 Complication 을 예상해서 꼭
Rescue therapy 를 꼭 추가로 하고 나왔어야 했을까...

Case 2

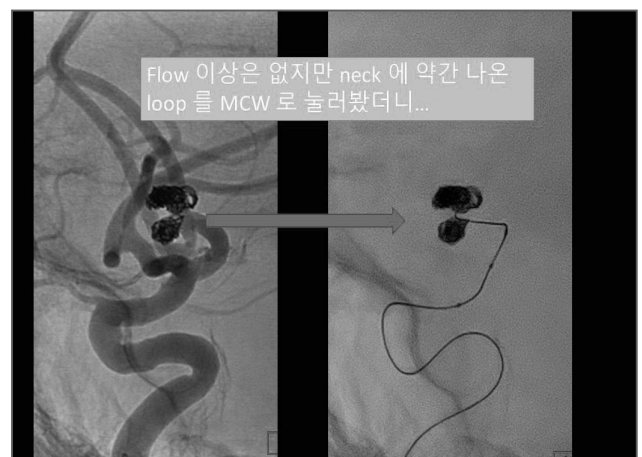
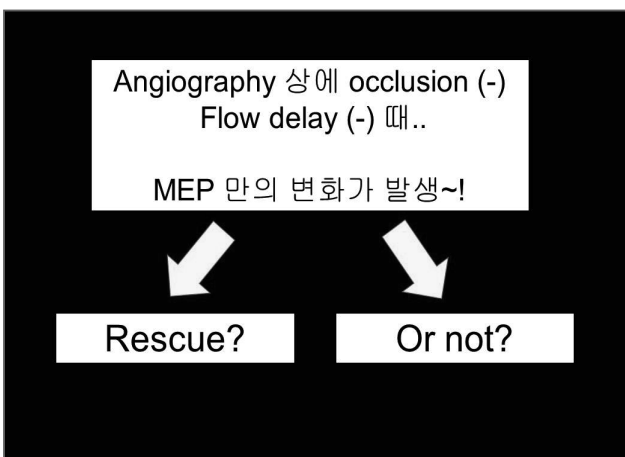
- 44/M
Drowsy consciousness (GCS 3/5/6)
- HTN (+)

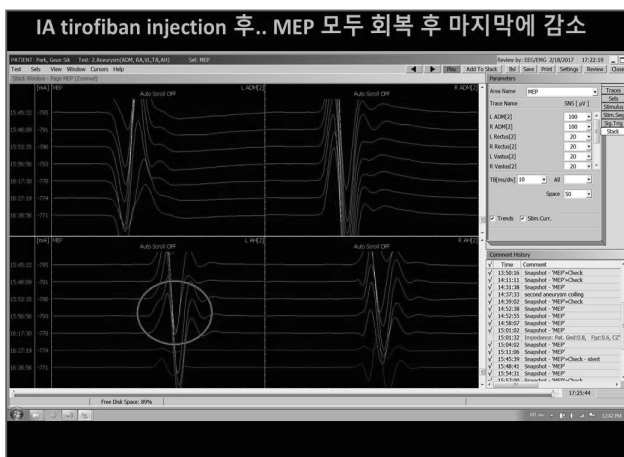
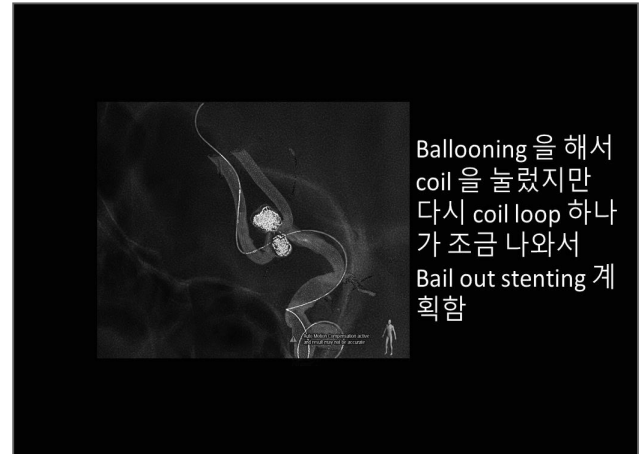
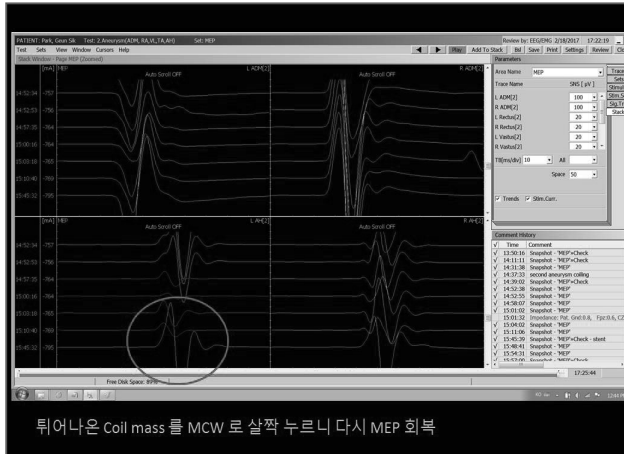




좌측 하지 MEP 만 50% 이하로 감소했습니다~!

...Coil mass extrusion ? 때문일까?
 ... Thrombus 가 발생했나?





- Immediately Post op
–No neurologic deficit
- POD # 10
– Vasospasm treatment
- Discharge
mRS 0

Key Point~!

- Coil 시술중, Angiography 상 이상이 없는 MEP만의 변화가 발생시에 Rescue therapy 를 해야 하는 것일까?
- Ruptured SAC 에서 Stenting 같은 Rescue 가 TE complication 을 유발할 가능성이 높음에도 MEP 를 회복하기 위해 시행해야할까?
- IOM 이 Endovascular procedure 에 필수적
- → 보험 관련 문제 해결 필요할것으로 판단됨

2) Cerebral oximetry

신 동 성, 박 종 현, 김 범 태

순천향대

Cerebral cortex hypoxemic insults can be occurred in the neuro-endovascular procedures. It would be related with guide catheters vasospasm, microcatheters or embolic devices. Sometimes general anesthesia(GA) also disturbs cerebral hemodynamics. However, no definite proved monitoring devices for the cerebral hemodynamics exists.

We are using the cerebral oximeter during endovascular procedure under the GA. This device is an inexpensive, non-invasive oximeter. It has been shown to be effective in identifying changes in cerebral oxygenation induced by hypoxemia and in detection of clinically relevant levels of desaturation. The technique of near infrared spectroscopy(NIRS) is based on the principle of light attenuation by the chromophores oxyhaemoglobin, deoxyhaemoglobin and cytochrome oxidase. Changes in the detected light levels can therefore represent changes in concentrations of these chromophores. The clinical availability of non-invasive NIRS-based cerebral oximetry devices represents a potentially important development for the detection of cerebral ischemia. Medical fee for this monitoring device can be compensated by National Health Insurance.

The 12th Annual Summer Conference Endovascular Neurosurgical Therapy

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"Consider, Communicate and Conquer"

"My first case" by the young guns

좌장 : 가톨릭대 성재훈



Case 1. LVIS junior stent migration during embolization

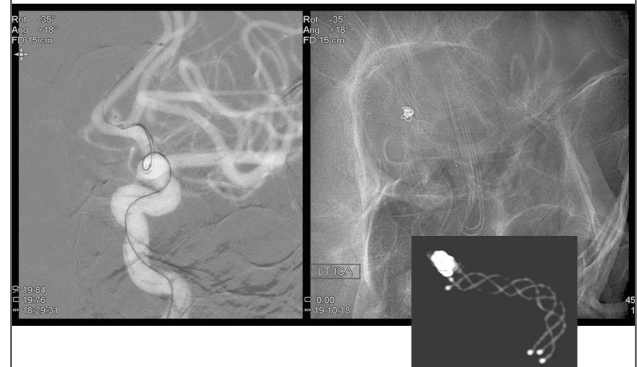
오 세 양

인하대

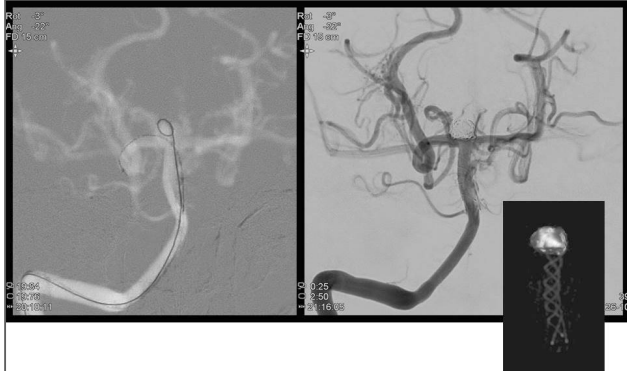
My First case session : 인하대병원 오세양

- 제목 : LVIS junior stent 사용 중 발생한 stent migration
- 요약 :
 - 제가 시행한 총 5례의 LVIS junior stent 이용한 시술 중 첫번째와 두번째 시술입니다.
 - LVIS junior stent를 이용하여 Acomm aneurysm (Case 1)과 basilar top aneurysm (Case 2)를 coil embolization 계획
 - Stent deploy 과정에서 stent가 proximal로 migration되었으나 다행히 waffle-cone 형태로 stent가 deploy되어 coil은 잘 마쳤습니다.
 - 다른 선생님들의 경험에서 LVIS junior stent가 유독 deploy 과정에서 migration이 잘 되는지 혹은 제가 시도한 방법에 다른 문제는 없었는지 궁금하여 case들을 소개합니다.

Case 1



Case 2

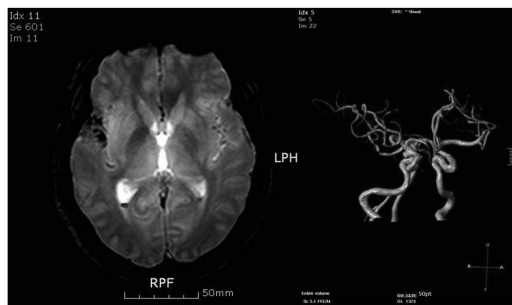


Case 2. My First stent-assisted coil embolization case of Right posterior communicating artery ruptured aneurysm

김성묵, 류성주

안동성소

F/78(2017.4), dizziness,



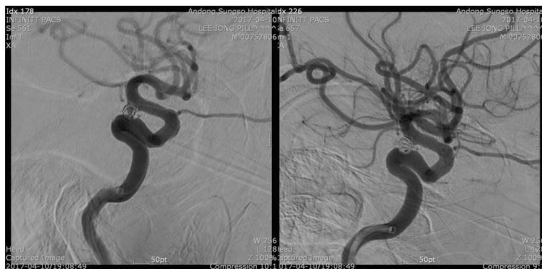
DSA



Rt Pcom ruptured an.

Coiling? Clipping?

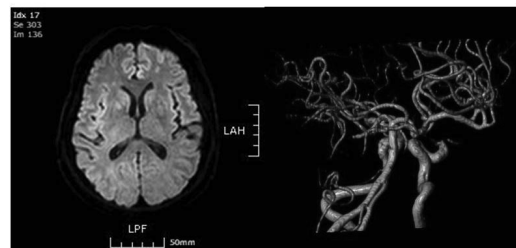
Stent-assisted coil embolization



Catheter shaping?

Semi-jailing? Jailing?

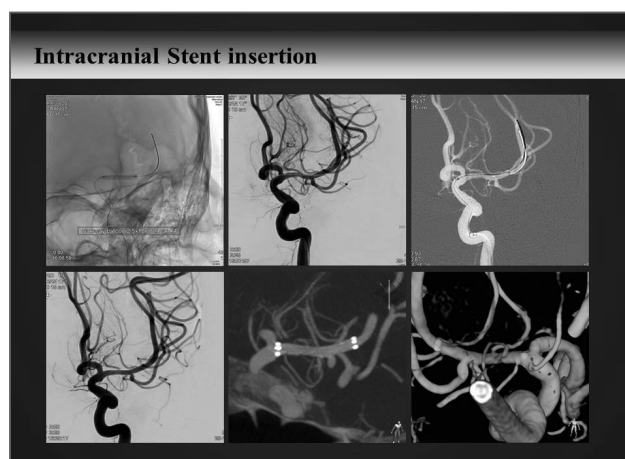
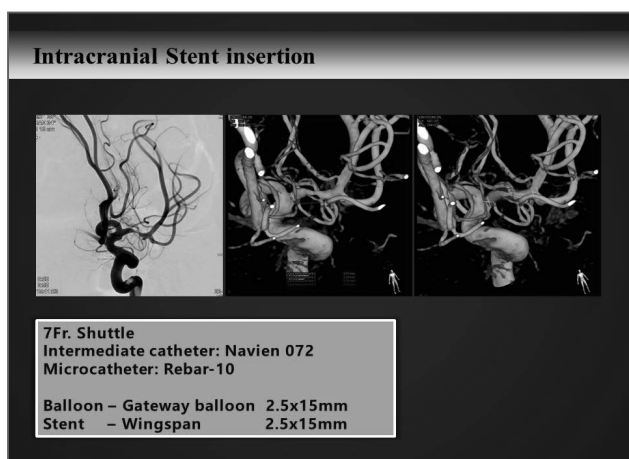
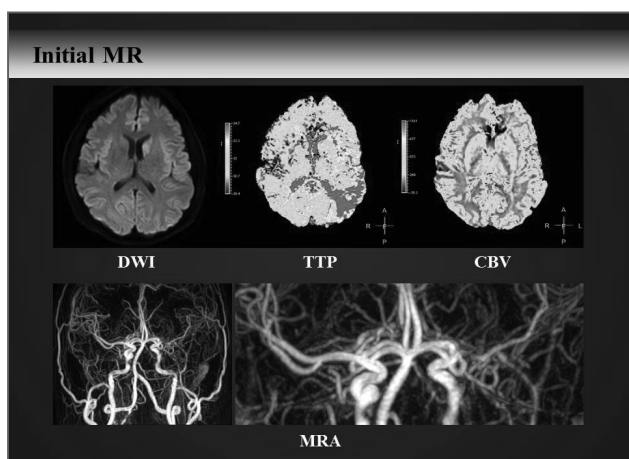
Postop DWI, MRA

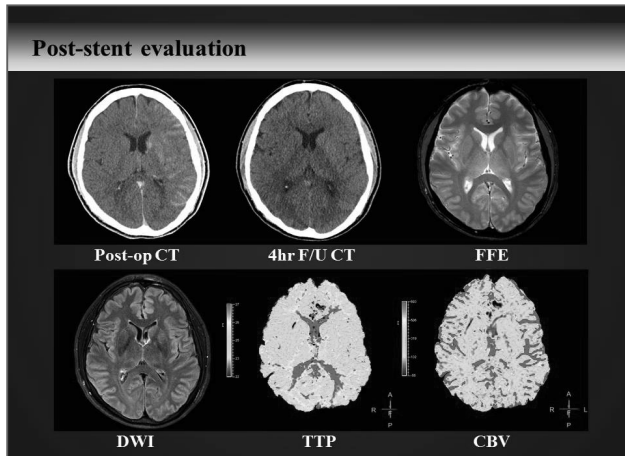


Case 3. First Intracranial Stent Insertion

조 광 천

분당제생





Case 4. Stent retriever thrombectomy combined with distal aspiration for acute MCA occlusion

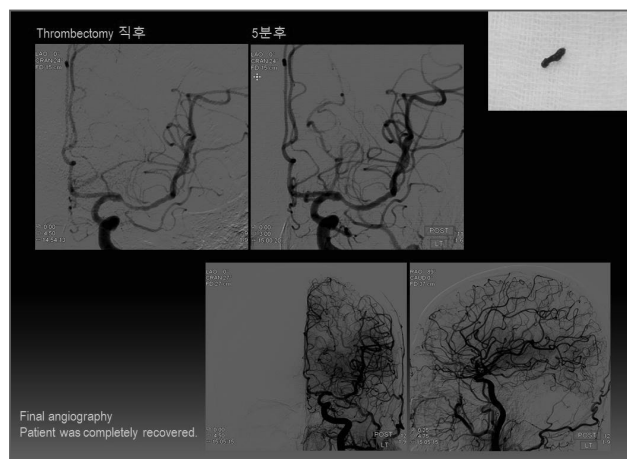
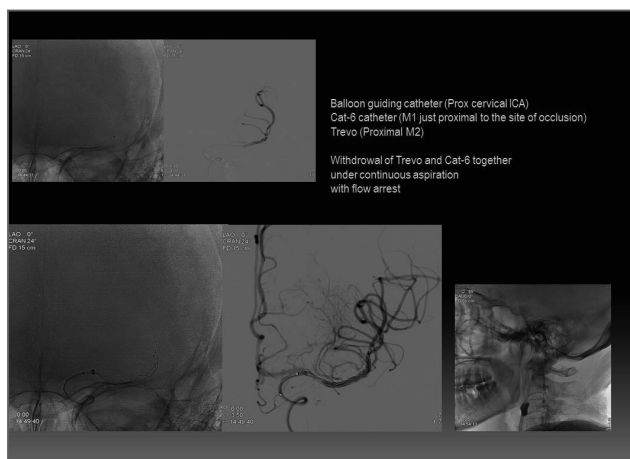
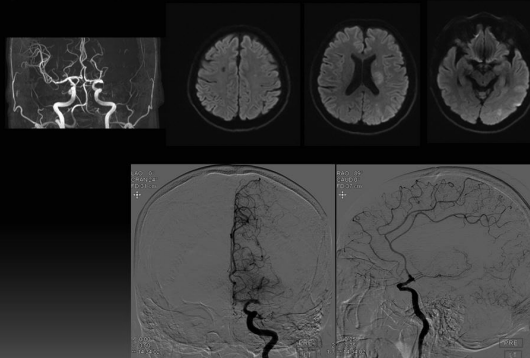
조 수 희

울산대 강릉아산

Stent retriever thrombectomy combined with distal aspiration for acute MCA occlusion

- Speaker: 조수희, Cho Su Hee (강릉아산병원, Gangneung Asan Hospital)
- My first case session
- Discussion point
 - technical detail
 - advantage and disadvantage

56/M
right side weakness (onset: 1 HA)



Case 5. My first coil embolization

최 현 호

동국대

dongguk
UNIVERSITY
MEDICAL CENTER

일산 동국대 병원 신경외과 최현호

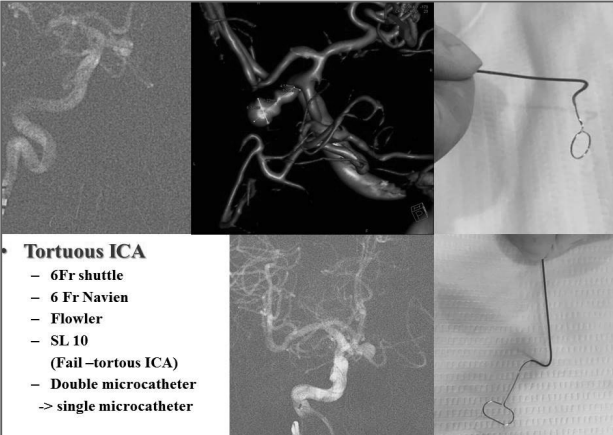
My First case_coil embolization

- First case에 대한 기대
 - Old age
 - Poor grade
 - Day time
 - Coil embolization > surgical clipping
 - 첫 케이스에 대한 부담감을 덜고 주변의 도움을 받고 싶다.
 - 내가 무리하지 않았다는 위안감과
환자에게 피해를 끼치지 않았다는 안도감

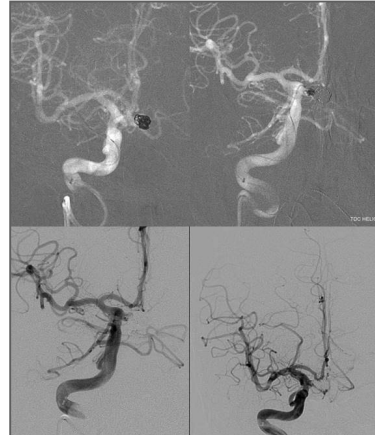
➡ 드디어 찾아온 첫번째 기회

CASE

- F/51
 - Known HTN
 - GTC Seizure, LOC
 - GCS E3M6V5 (ER)
 - Rt. paraclinoid An.
 - Friday night (PM11)
- First case에 대한 기대
 - Old age (X)
 - Poor grade (X)
 - Day time (X)
 - Coil embolization > surgical clipping (O)

- Tortuous ICA
 - 6Fr shuttle
 - 6 Fr Navien
 - Fowler
 - SL 10
(Fail -tortuous ICA)
 - Double microcatheter
-> single microcatheter



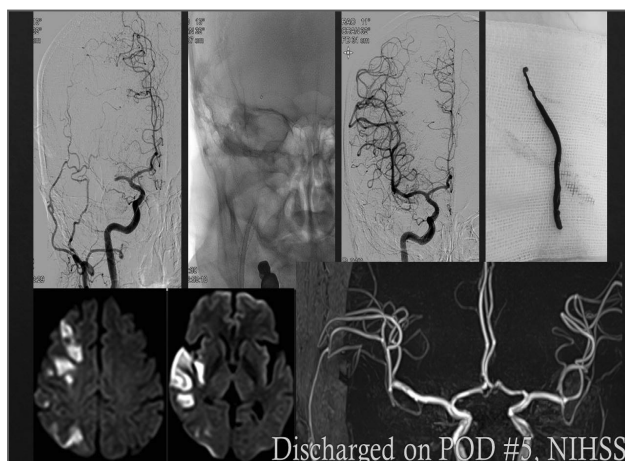
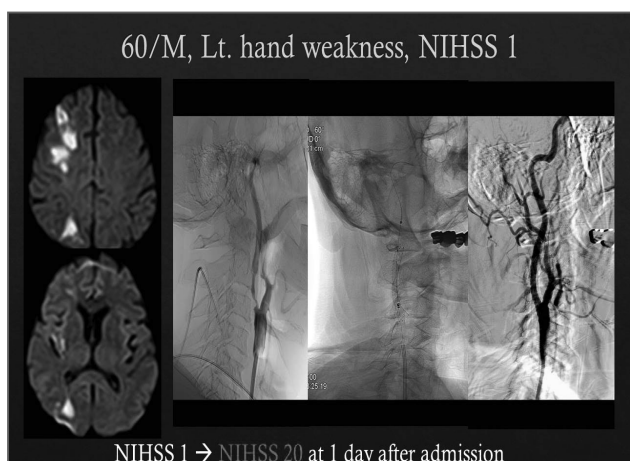
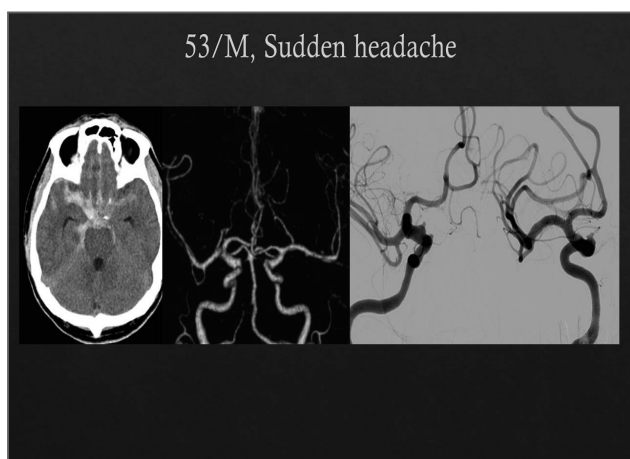
dongguk
UNIVERSITY
MEDICAL CENTER

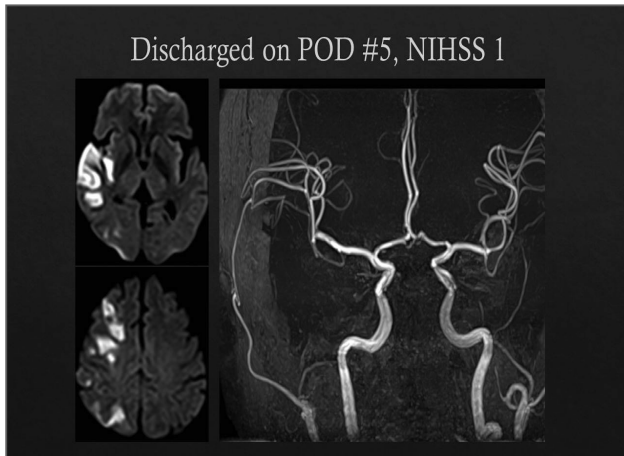
- Alert, oriented
 - TDC 360 SOFT 6/20
 - AXIUM PRIME 3D 6/15
 - AXIUM PRIME 3D 5/10
 - TDC 360 ULTRA 5/10
 - AXIUM PRIME 3D 4/8
 - TDC HELICAL NANO 3/6
 - TDC HELICAL NANO 3/4
 - TDC HELICAL NANO 2.5/3
 - AXIUM PRIME 3D 3/6
 - TDC HELICAL NANO 2.5/3
 - TDC HELICAL NANO 2.5/4
 - TDC HELICAL NANO 2.5/4
- Take home message
 - Senior staff 의 감시 하에
진행하는 것이 좋겠다.

Case 6. My first case: 1) ICA aneurysm 2) ICA stenosis with MCA occlusion

박 동 선, 이 증 곤

건국대





ASCENT 2017

"Consider, Communicate and Conquer"

My technical tips and tricks: mechanical thrombectomy

좌장 : 계명대 이창영

1) Stent retriever thrombectomy for acute major arterial occlusion

계명대 김창현

2) Combined IAT strategy based on manual clot aspiration

경북대 강동훈



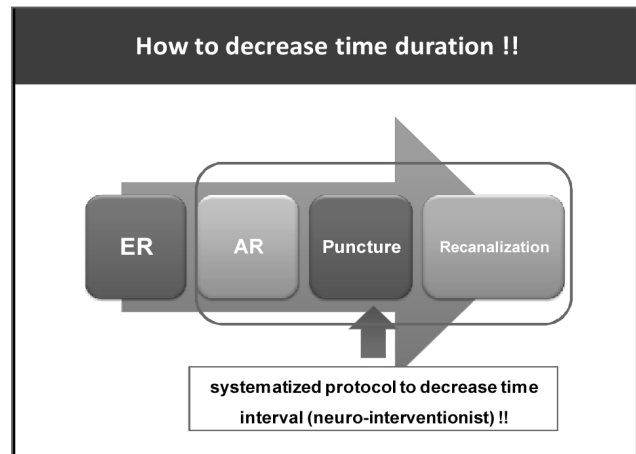
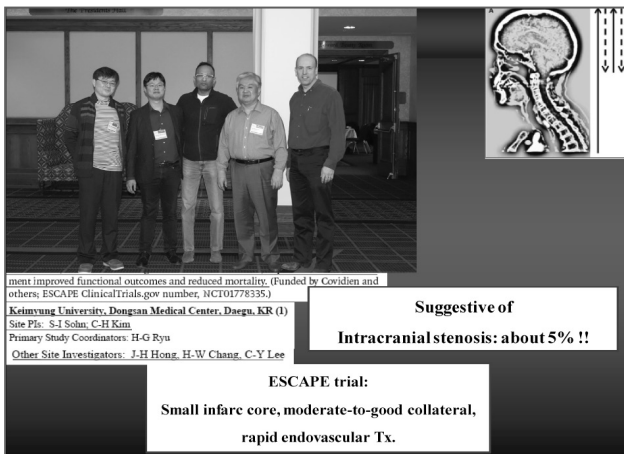
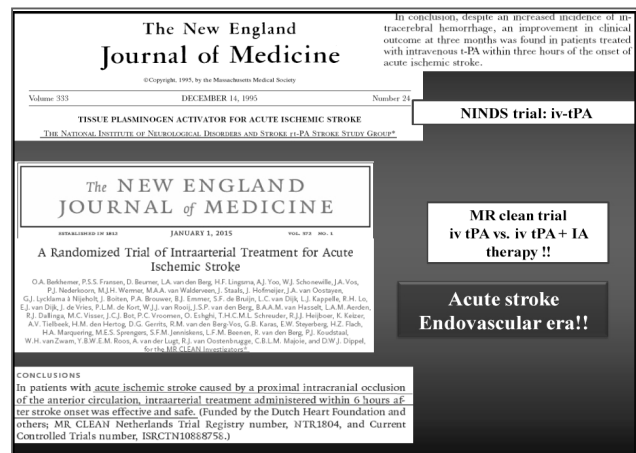
1) Stent retriever thrombectomy for acute major arterial occlusion

김창현¹, 손성일², 홍정호², 이창영¹

계명대 동산의료원 신경외과¹, 신경과²

Treatment strategies of Acute Ischemic Stroke

SWIFT 및 TREVO trial 이 후 acute ischemic stroke with major intra-arterial occlusion 에 대해서 mechanical thrombectomy 의 safety 와 effectiveness 에 대해서 언급이 된 이 후로, 최근 ESCAPE 및 MR-CLEAN study 의 등장으로 이제는 acute ischemic stroke 의 치료에 endovascular treatment 가 꼭 필요한 치료 방법의 하나가 되고 있습니다. 외국과 우리 나라의 여러 문헌이 있지만, door-to-recanalization에 걸리는 time interval 을 최소화 하는 것이 환자의 예후 및 recanalization 성공 여부에 중요한 요소인 것으로 생각합니다. 1) door-to-puncture 까지 time interval 을 줄이기 위한 systemic protocol, 2) puncture-to-recanalization 까지 time interval 을 줄이기 위한 endovascular technique 및 preparation 과 3) Asian people에 게 더 흔한 intracranial stenosis가 의심되는 상황에서 recanalization rate 를 증가시키기 위한 방법 등에 대해서 저희 뇌혈관센터의 경험 (Tips and tricks) 에 대해서 발표하려고 합니다.



Treatment strategies of acute ischemic stroke !!

1. Puncture - to - recanalization: endovascular protocol !!
2. Door - to - angiogram, angiogram - to - puncture: systemic protocol !!
3. Suggestive of In - situ intracranial stenosis: treatment methods !!
4. The role of endovascular neurosurgeon: what ?

1. Puncture - to - recanalization: endovascular protocol !!

SWIFT trial

Solitaire flow restoration device versus the Merci Retriever in patients with acute ischaemic stroke (SWIFT): a randomised, parallel-group, non-inferiority trial

Interpretation The Solitaire Flow Restoration Device achieved substantially better angiographic, safety, and clinical outcomes than did the Merci Retrieval System. The Solitaire device might be a future treatment of choice for endovascular recanalisation in acute ischaemic stroke.

	Solitaire (n=31)	Solitaire (randomly allocated, n=58)	Merci (randomly allocated, n=55)	Odds ratio (95% CI) for comparison between randomised groups	Non-inferiority p-value for comparison between randomised groups	Superiority p-value for randomised comparison
Successful recanalisation without symptomatic intracerebral haemorrhage (primary endpoint)	55% (16/29)	61% (34/56)	24% (13/54)	4.87 (2.16-11.30)	<0.0001	0.0001
Angiographic efficacy endpoint	63% (17/27)	69% (37/54)	30% (16/53)	5.03 (2.22-11.35)	<0.0001	0.0001
Successful recanalisation with study device (assessed by core laboratory)	77% (24/31)	83% (49/54)	48% (26/54)	5.38 (2.21-13.15)	<0.0001	0.0002
Successful recanalisation with study device (assessed at study site)	77% (24/31)	83% (49/54)	44% (24/55)	0.34 (0.15-0.77)	<0.0001	0.015
Use of rescue treatment*	23% (7/31)	21% (12/58)	44% (24/55)	3.89 (1.41-10.78)	<0.0001	0.030
Successful recanalisation at end of procedure (assessed at study site)	94% (29/31)	89% (48/54)	67% (37/55)			

Solitaire stent Recanalization rate: 81 – 94%

Unsuccessful recanalization: 6 – 11%

(I) and (II) - Strategies after failed thrombectomy

Failed recanalization or re-occlusion after thrombectomy (Penumbra or Solitaire)

- previous intracranial stenosis or hard thrombus: **How ?**

IA tirofiban

What amount of tirofiban ? tight stenosis ?

Stenting + post-balloon

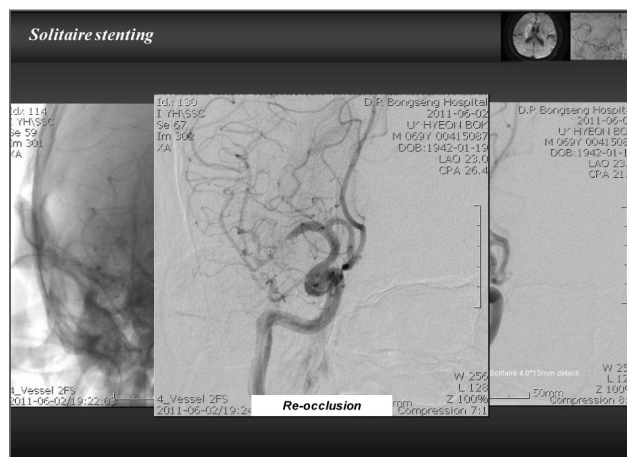
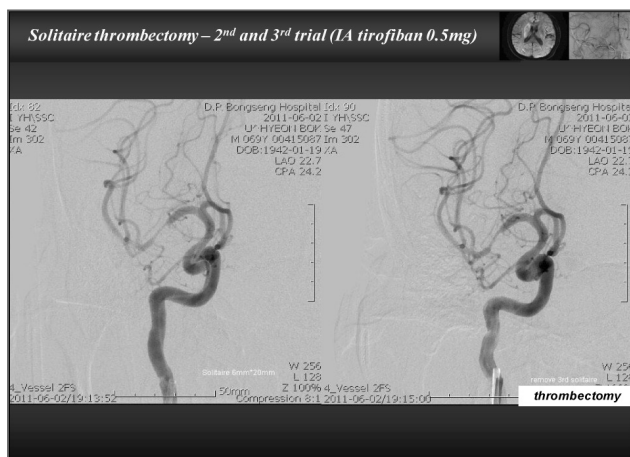
Rupture ? In-stent thrombosis ? What kind of stent ?

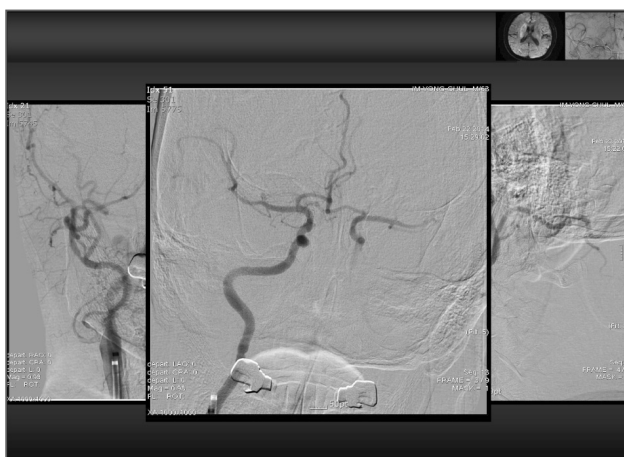
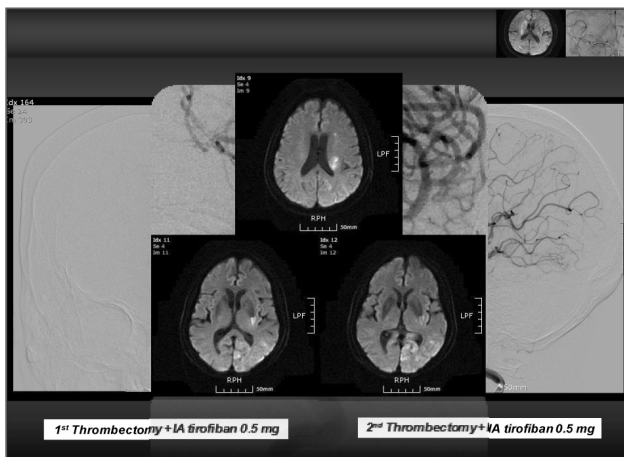
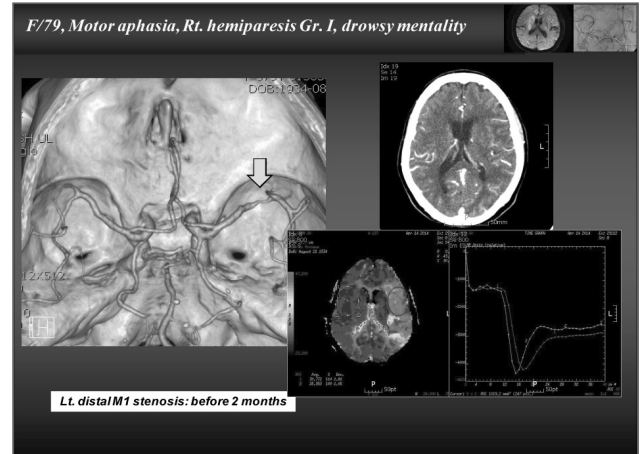
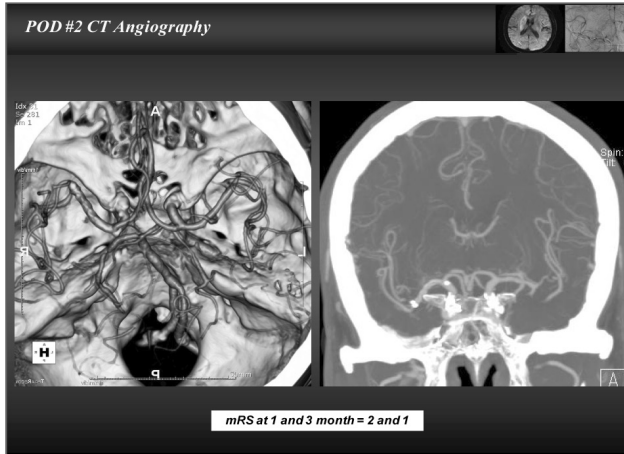
M/69, Stuporous, Rt. hemiparesis Gr. II

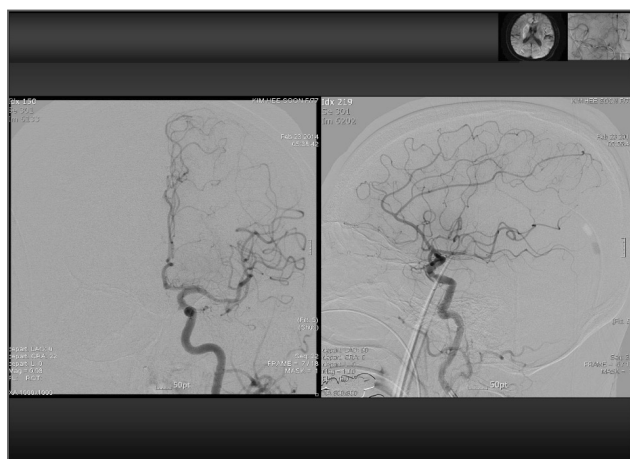
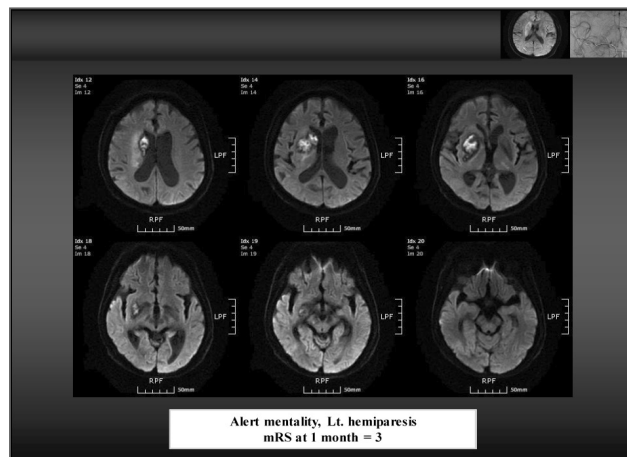
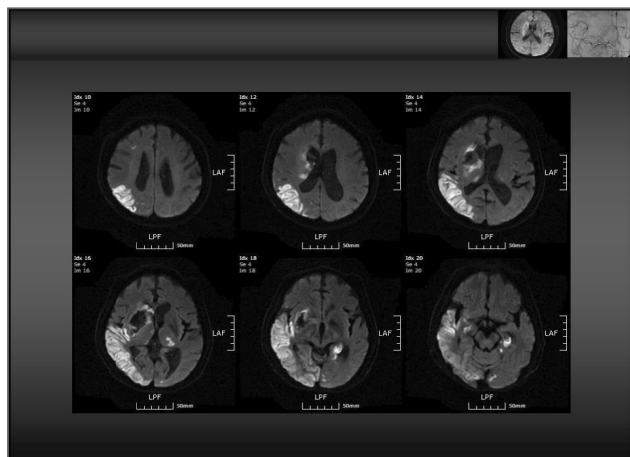


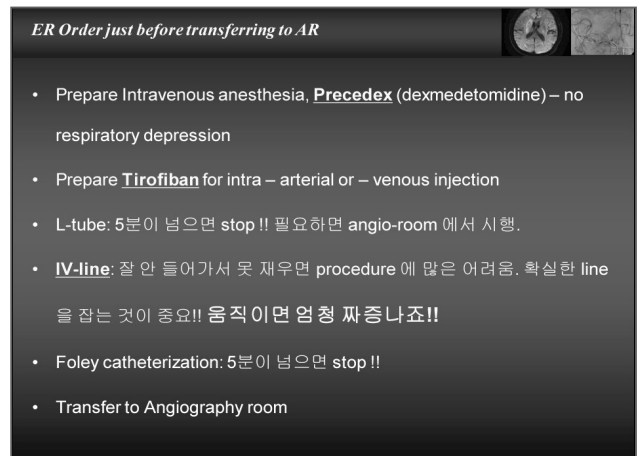
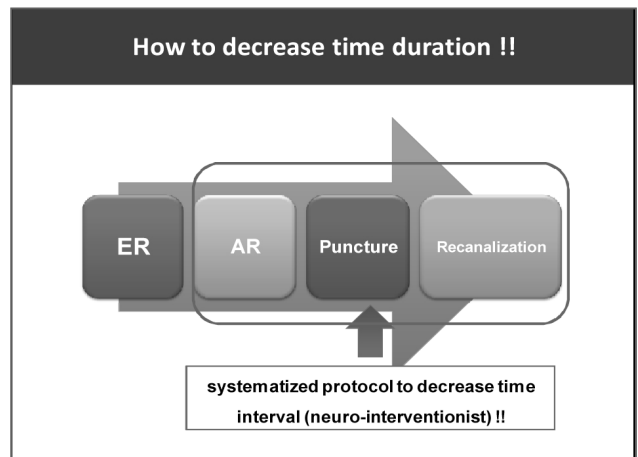
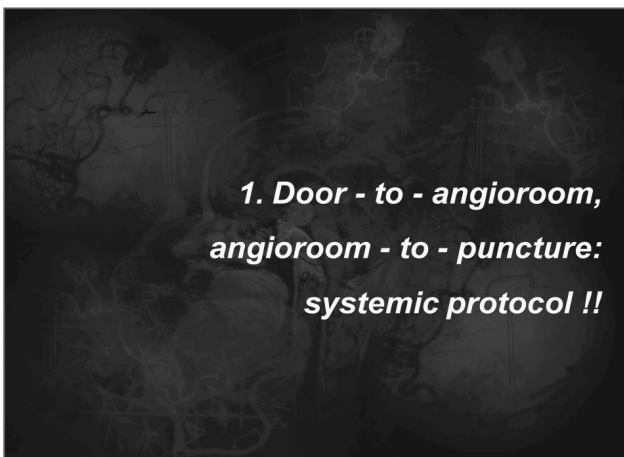
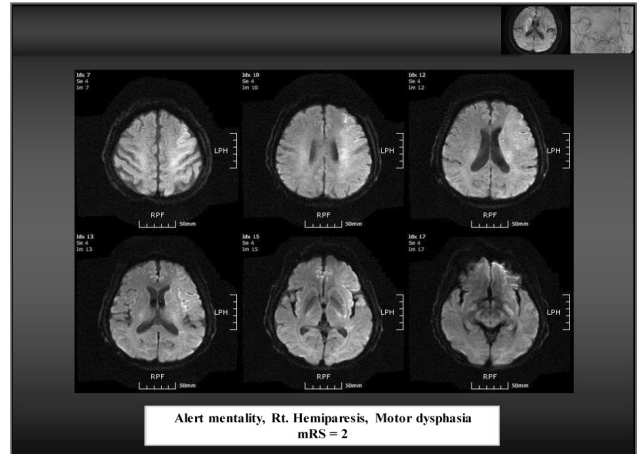
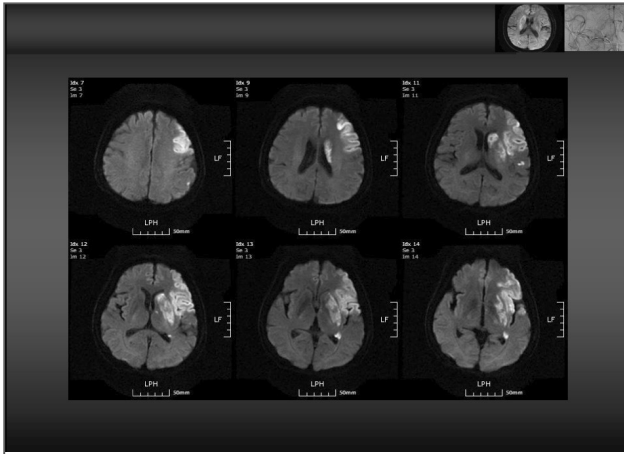
T.F.C.A. (Rt. ICA system)

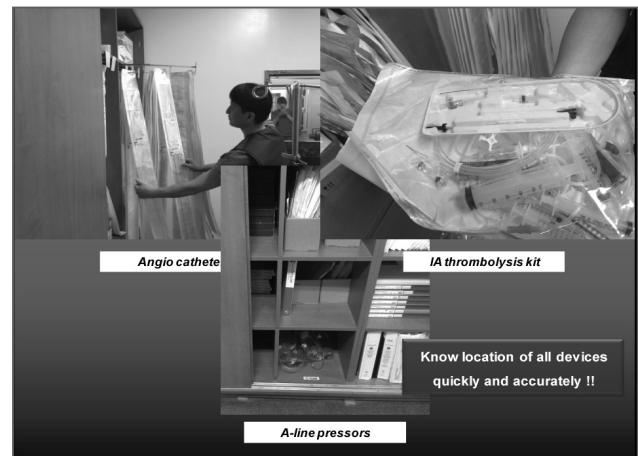
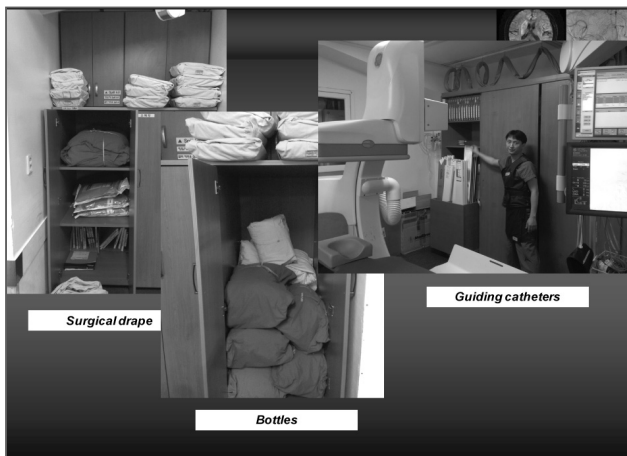
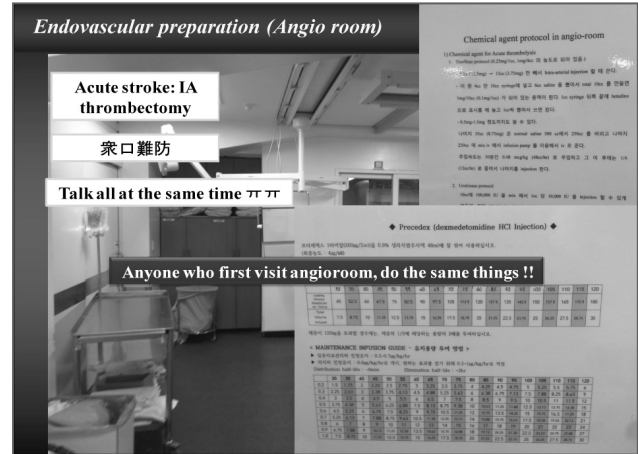


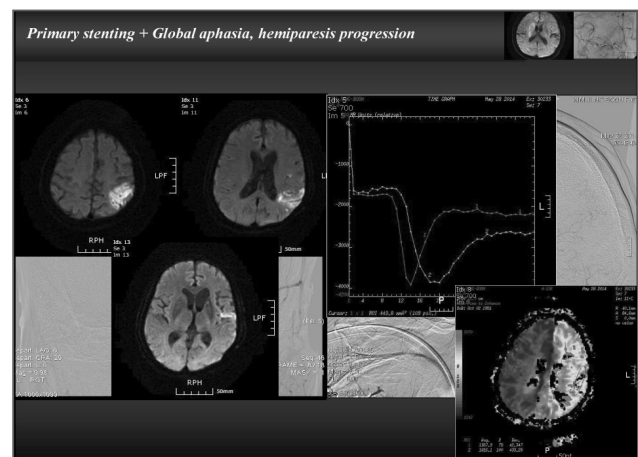
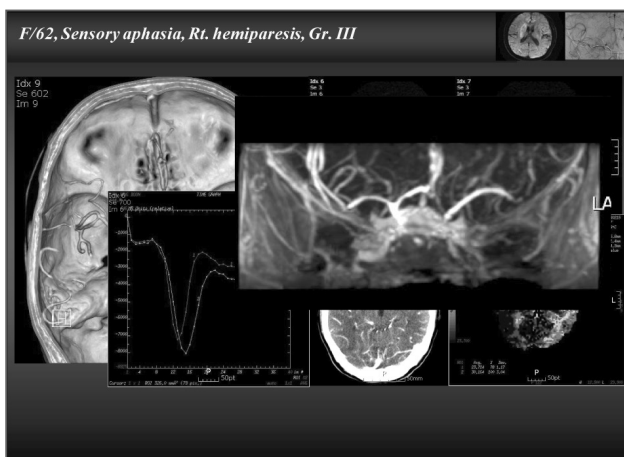
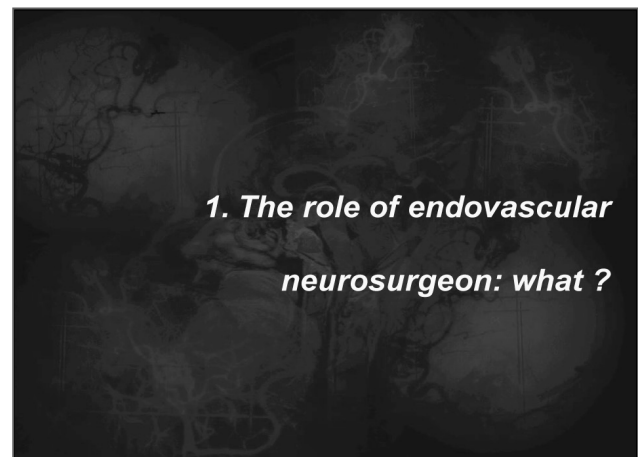
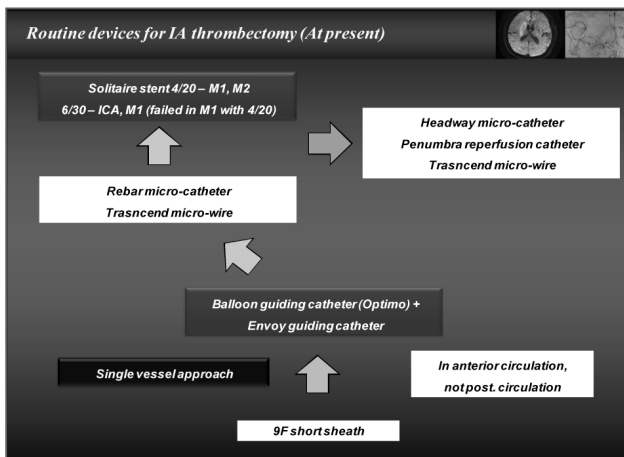
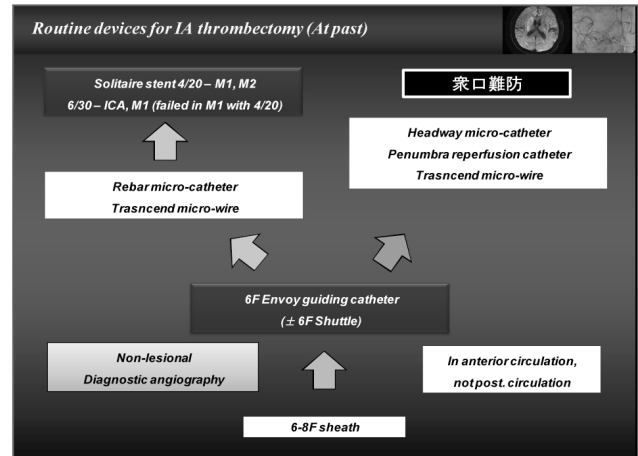


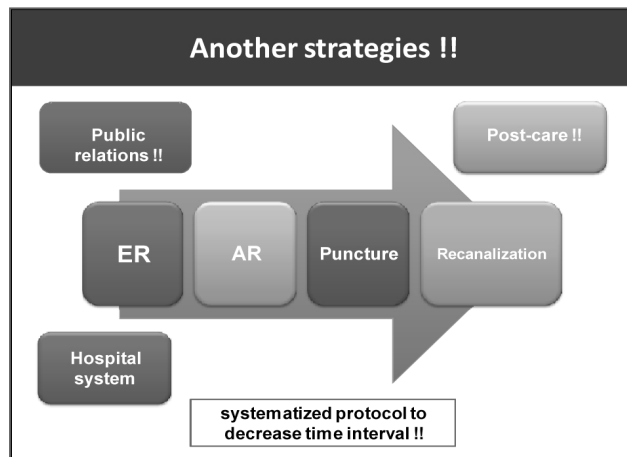
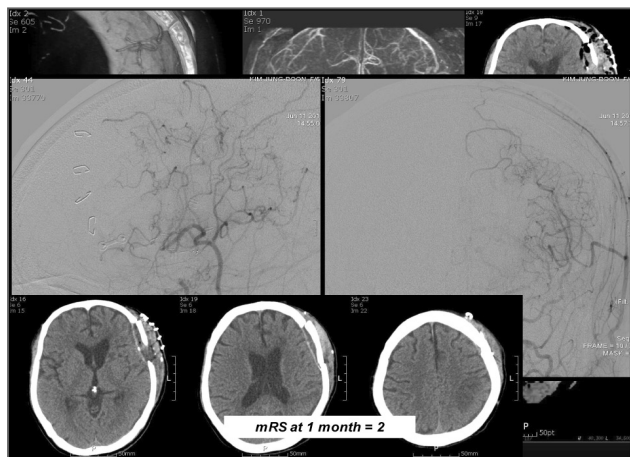












2) Combined IAT strategy based on manual clot aspiration

강 동 훈

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Evolution of IA thrombectomy technique

IA drip
Wire & Cath
Merci
Penumbra
Stent retriever
Solubra etc

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Study	Treatment modality Endovascular vs Control	Time window	Vascular age	Stroke size (ml)	Onset to treatment (min)	CT to groin (min)	CT to groin (min)	mRS 90-93 mo (Endovascular vs Control)	Symptomatic ICH (Endovascular vs Control)	Mortality at 90 mo (Endovascular vs Control)
IMS III (2013)	IV rPA + IA any approved device (50% stent retriever) vs IV rPA	6 hrs to IAT	Non-stroke CT only	434/222	69	208 ± 47	41	1% vs 6% (p=0.03)	6.0% vs 5.9% (p=0.83)	19% vs 22% (p=0.52)
SYNEXP (2013)	IA any approved device vs IV rPA	6 hrs to IAT	Non-stroke CT only	434/222	69	208 ± 47	41	42% vs 40% (p=not reported)	4.9% vs 5.9% (p=0.03)	0% vs 1% (p=0.03)
MR RESCUE (2013)	rPA + IA mechanical (Merci or Penumbra System) vs IV rPA	8 hrs to IAT (stop by 9 hrs)	Non-stroke CT only	434/222	69	208 ± 47	41	Used mean mRS comparison 3.9 vs 3.9 (p=0.99)	5% vs 4% (p=0.24)	19% vs 24% (p=0.75)
MR CLEAN (2015)	IV rPA + IA any approved device (50% stent retriever) vs IV rPA	6 hrs to IAT	CT CTA MRA	233/267	66	269 [10-31]	58.7%	33% vs 19% (RR 1.7, 1.2-2.3)	7.7% vs 6.4% (p=NA)	27% vs 22% (RR 1.6, 0.7-1.3)
ESCAPE (2015)	IV rPA + IA any approved device (70% stent retriever) vs IV rPA	12 hrs to randomization	CT CTA	165/150	71	Onset to CT 134 [77-247] CT to groin 51 [39-68]	72.4%	53% vs 29% (RR 1.8, 1.2-2.4)	3.8% vs 2.7% (p=0.75)	10% vs 19% (RR 0.5, 0.3-1.0)
SWIFT PRIME (2015)	IV rPA + IA stent retriever vs IV rPA	6 hrs to IAT	CT CTA ± CTP or MRI	98/98	65	224 [165-275]	88%	60% vs 35% (RR 1.8, 1.1-2.8)	0% vs 3.1% (p=0.12)	9% vs 12% (RR 0.8, 0.1-1.7)
EXTEND-IA (2015)	IV rPA + IA stent retriever vs IV rPA	6 hrs to IAT	CT CTA CTP	35/35	69	224 [165-275]	86%	71 vs 40% (RR 1.8, 1.1-2.8)	0% vs 5.7% (p=0.49)	9% vs 20% (RR 0.4, 0.1-1.5)
REVASCAT (2015)	IV rPA + IA stent retriever vs IV rPA	8 hrs to IAT	CT CTA ± CTP or MRI	109/109	66	269 [101-340]	66%	44% vs 20% (RR 1.8, 1.1-2.3)	1.9% vs 1.9% (p=1.00)	10% vs 18% (RR 1.2, 0.6-2.2)

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Endovascular thrombectomy after large-vessel ischaemic stroke: a meta-analysis of individual patient data from five randomised trials

Mayank Goyal, Bijoy K Menon, Wim H van Zwam, Diederik W J Dippel, Peter J Mitchell, Andrew M Demchuk, Antoni Dávalos, Charles B L M Majoie, And van der Lugt, Maria A de Miquel, Geoffrey A Donnan, Yoo B W E M Roos, Alain Bonafé, Reza Jahan, Hans-Christoph Diener, Lucie A van den Berg, Elad Levy, Olvert A Berkhemer, Vitor M Pereira, Jeremy Kemp, Monica Millán, Stephen M Davis, Daniel Roy, John Thornton, Luis San Roman, Marc Ribó, Debbie Beumer, Bruce Stouch, Scott Brown, Bruce CV Campbell, Robert J van Oostembroke, Jeffrey L Saver, Michael D Hill, Tudor G Jovin, for the HERMES collaborators

Summary
Background In 2015, five randomised trials showed efficacy of endovascular thrombectomy over standard medical care in patients with acute ischaemic stroke caused by occlusion of arteries of the proximal anterior circulation. In this meta-analysis we, the trial investigators, aimed to pool individual patient data from these trials to address remaining questions about whether the therapy is efficacious across the diverse populations included.

Methods We formed the HERMES collaboration to pool patient-level data from five trials (MR CLEAN, ESCAPE, REVASCAT, SWIFT PRIME, and EXTEND IA) done between December, 2010, and December, 2014. In these trials,

Interpretation Endovascular thrombectomy is of benefit to most patients with acute ischaemic stroke caused by occlusion of the proximal anterior circulation, irrespective of patient characteristics or geographical location. These findings will have global implications on structuring systems of care to provide timely treatment to patients with acute ischaemic stroke due to large vessel occlusion.

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WHAT we HAVE

Learn about what we have.

Two Main Techniques

- Clot aspiration
 - FAST = Forced Arterial Suction Thrombectomy**
 - ADAPT = A Direct Aspiration first Pass Technique**
- Penumbra Max/ACE
 - Catalyst
 - Sofia/Sofia-plus
 - Arc
- Stent retriever
 - Solitaire FR
 - Trevo XP
 - Eric

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How to achieve effective and quality recanalization?

Clot Aspiration Thrombectomy

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Forced Arterial Suction Thrombectomy (FAST) with Penumbra catheter: M1 occlusions

- 6F Sheath (Shuttle, NEURON 088 MAX)
- 9F Balloon guiding catheter (OPTIMO, M)
- Penumbra 054/041 (SMAX ACE/4MAX)
- Manual syringe aspiration or Aspiration pump

F:51, F:AT 4hrs, NIHSS 24, Lt M1 occlusion, CF: FAST 041 Penumbra: Single shot TIC1 3

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AINRI Am J Neurosurg 32:283-87 | Feb 2011 | www.ajnr.org

Direct Thrombus Retrieval Using the Reperfusion Catheter of the Penumbra System: Forced-Suction Thrombectomy in Acute Ischemic Stroke

ORIGINAL RESEARCH

D.-H. Kang
Y.-H. Hwang
Y.-S. Kim
J. Park
O. Kwon
C. Jung

BACKGROUND AND PURPOSE: Although the PS has been the most promising mechanical thrombectomy device in terms of recanalization rates, even the PS cannot recanalize all cases of occlusion. Under such circumstances, we simply modified the PS, identified certain advantages, and applied this modification as a primary technique for recanalization. Here we describe and discuss the technical details and results of our preliminary experience.

MATERIALS AND METHODS: This study included 22 consecutive patients with acute ischemic stroke secondary to large-artery occlusion who underwent modified thrombectomy by using the PS for recanalization. Direct wedging between the tip of the reperfusion catheter and the proximal part of the clot followed by forceful suction by using a 20- or 50-mL syringe is a unique feature of this technique. What is distinctive is that this does not require use of a separator or aspiration pump.

RESULTS: All treated vessels (100%) were successfully recanalized. A TIC1 scale of 2b or 3 was achieved in 81.8% of patients. A 3-month favorable functional outcome (mRS score, 0-2) was achieved in 45.5% of patients. The only procedural complication was a transient dissection of the proximal ICA, which developed while advancing the guide catheter.

CONCLUSIONS: Forced-suction thrombectomy is a simple modification of the PS. On the basis of our data, this technique allows safe and effective recanalization in acute large-vessel occlusion. Thus, for achieving the best outcome, the modified PS technique is proposed as a viable option for acute stroke management, either by itself or in conjunction with other devices or drugs.

ABBREVIATIONS: BA = basilar artery; ECASS = European Cooperative Acute Stroke Study; HI = hemorrhagic infarction; ICA = internal carotid artery; ICH = intracranial hemorrhage; Lt = left; MCA = middle cerebral artery; mRS = modified Rankin scale; NIHSS = National Institutes of Health Stroke Scale; PH = parenchymal hemorrhage; Post = after; Pre = before; PS = Penumbra System; Rt = right; rPA = recombinant tissue plasminogen activator; TIC1 = Thrombolysis in Cerebral Infarction

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Forced Arterial Suction Thrombectomy (FAST) with Penumbra Catheter: ICA T occlusions

- 6F Sheath (Shuttle, NEURON 088 MAX) or 9F Balloon guiding catheter (OPTIMO, Merci BGC)
- Penumbra 054/041 (SMAX ACE/4MAX)
- Manual syringe aspiration or Aspiration pump

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J Neurointerv Surg 2012; doi:10.1136/neurintsurg-2012-010777

Outcome of forced-suction thrombectomy in acute intracranial internal carotid occlusion

Yang-Ha Hwang,^{1,2} Dong-Hun Kang,^{2,3} Yong-Won Kim,^{1,2} Yong-Sun Kim,^{2,3,4} Sung-Pa Park,^{1,2} Chung-Kyu Suh^{1,2,3}

ABSTRACT
Objective: Ischemic stroke from acute intracranial distal internal carotid artery (ICA) occlusion usually carries a poor prognosis. Despite the intra-arterial recanalization therapies, the results are still unsatisfactory. The aim of this study was to compare the outcomes between two endovascular techniques, the modified Penumbra System (mPS) and mechanical clot disruption (MCD), and to confirm the influence of recanalization on the outcomes.

Methods: In a retrospective review of 39 consecutive cases of acute distal ICA occlusion, the recanalization rates and functional outcome at 3 months of the two intra-arterial techniques during two consecutive periods (March 2009 to February 2010; MCD technique [n=19] vs March 2009 to August 2010; mPS technique [n=20]) were compared. Univariate and multivariate analyses were performed to determine the predictors of a favorable functional outcome.

Results: The rate of successful recanalization (Thrombolysis in Cerebral Infarction score 2 or 3) was significantly higher in the mPS group than in the MCD group (89% (17/20) vs 32% (6/19); p=0.001). Favorable outcomes at 3 months (modified Rankin Scale score 0-2) were achieved in 92% and 31% in the mPS and MCD groups, respectively (60% vs 16%; p=0.046). Binary logistic regression analysis showed that younger age and successful recanalization were independent predictors of a favorable functional outcome.

Conclusions: Forced-suction thrombectomy using the mPS technique may be a viable option for acute distal ICA occlusion and could result in more successful recanalization and a more positive clinical outcome.

FAST (Penumbra, Alameda, California, USA), respectively.^{1,2} However, the clinical outcome in ICA occlusion is still disappointing—no data, only one-quarter of patients achieve a good outcome.³

Used early 2009 our main recanalization technique in acute ischemic stroke included the multidistal method, mainly mechanical clot disruption (MCD) with or without adjunct IV and IA thrombolytic agents, with a recanalization rate approaching 60%. Since then we have used the modified Penumbra System (mPS), so-called "forced-suction thrombectomy", which has been shown to be safe and effective in the recanalization of major intracranial vascular occlusions.⁴ The aim of the present study was to compare the clinical outcome with MCD and the mPS and to ascertain the influence of recanalization on the clinical outcome, focusing especially on patients with acute distal ICA occlusion.

MATERIALS AND METHODS
Patient selection
The subjects were selected retrospectively from a prospectively enrolled acute stroke registry at our center. They had applied for IA recanalization therapies for acute intracranial distal ICA occlusion with clot extending to the middle cerebral artery and anterior cerebral artery or the middle cerebral artery only. Inclusion criteria for IA treatment were as follows: (1) acute ischemic stroke attributable to ICA occlusion on time-of-flight MR angiography (TOF MRA) or CT angiography; (2) extent of infarct volume on diffusion-weighted imaging

Rate of whole-thrombus retrieval is about 50% within 3 attempts of FAST

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Step 1. Advance 6F Sheath/9F BGC to prox ICA

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Step 2. Advancement of Penumbra 5 MAX (ACE) to M1 mostly easy: recent aspiration catheter is highly trackable!

Only with 014 wire Only 5 Max without wire

Step 2. Advancement Penumbra 5 MAX (ACE) to M1 - sometimes difficult (d/t Siphon curve, OphA, Athero)

How can we overcome this obstacle ??

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1) Steam shaping of the catheter tip: 45, 90, and J

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2) Coaxial advancement technique: Inner microcatheter to reduce gap

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Step 3. Manual clot aspiration using 50cc syringe

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IAT Protocol in KNUH stroke center

Period 1 ~2009.4	Period 2 ~2010.11	Period 3 ~2016.8	Period 4 2016.9~
MCD	FAST Penumbra catheter (1G) No BGC → BGC	FAST to SRT FAST using Penumbra catheter → SRT [Solitaire FR / Trevo XP]	FAST to m-Solumbra FAST using Penumbra catheter → m-Solumbra [Trevo XP / Solitaire FR / ERIC through the aspiration catheter]

Steps to Reperfusion

in a sequence, in organized fashion

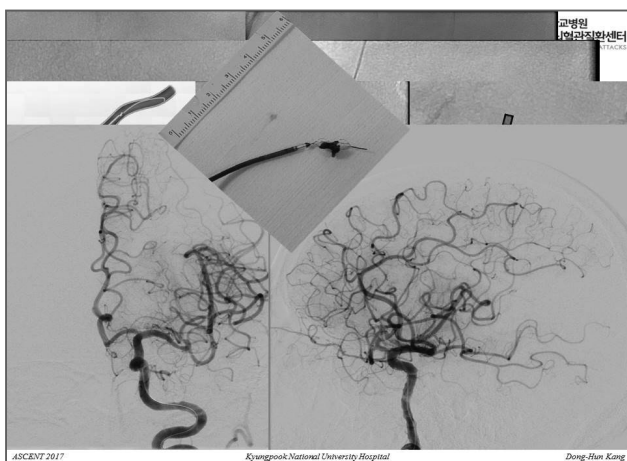
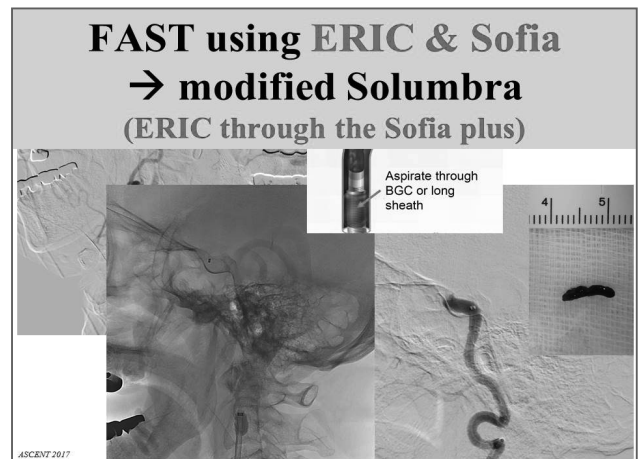
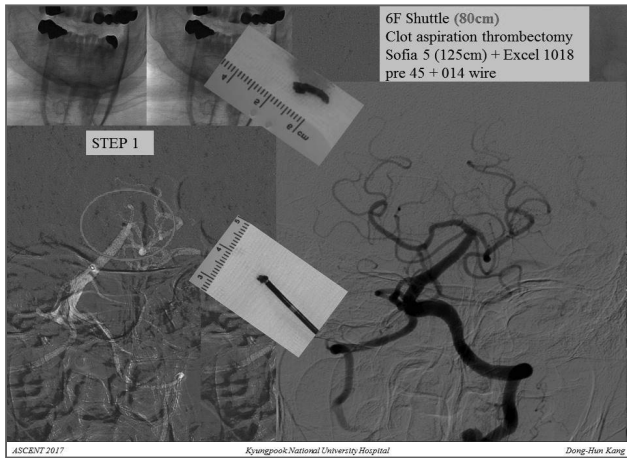
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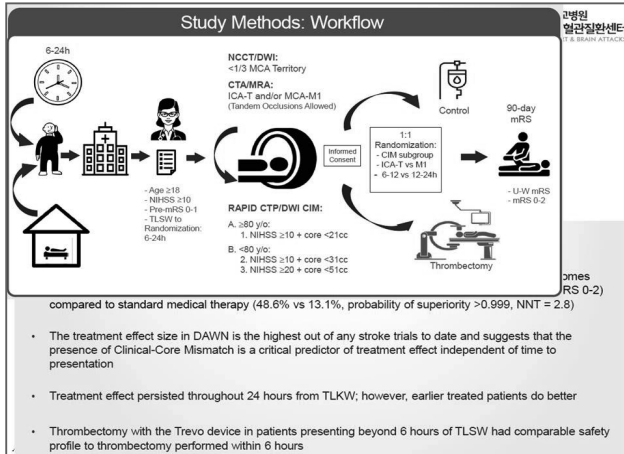
Switch to SRT / m-Solumbra = How I do 3 times of aspiration

F/79 b-NIHSS 18
6F Chaperon (95cm) +

Stent retrieval thrombectomy
Trevo XP 4x20

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Evolution of IA thrombectomy technique

The Present Questions ???

시대의 변화를 거스를 수가 없다.
어차피 환자는 계속 증가할 것이고 빨리 잘 개통하는 것만이
내 삶의 질을 유지하는 유일한 방법이다.
어떻게 잘 개통할 것인가?

IA technique과 device는 계속 진화해 나갈 것이다.

1) 그렇다면 둘 중 어떤 방법이 더 좋을까?
 2) 현재의 트렌드는 무엇인가?

Solumbra etc

구식보다는 신식의 방법이 더 좋다!!!

INIS

Outcome of forced-suction thrombectomy in acute intracranial internal carotid occlusion

Yang-Ha Hwang, Dong-Hun Kang, Yong-Won Kim, et al.

J Neurointerv Surg 2013; 5: 181-184 originally published online April 27, 2012
 doi: 10.1136/neurintsurg-2012-010277

Table 2 Angiographic and clinical outcomes

	IA revascularization technique MCD (N=19)	mPS (n=20)	p Value
Successful recanalization (TICI 2-3), n (%)	6 (31.6%)	17 (85%)	0.001
Complete recanalization (TICI 2b-3), n (%)	1 (16.7%)	11 (64.7%)	0.043
Mean-SD puncture to recanalization time, min	77.8 ± 24.9	62.7 ± 29.8	0.278
Ancillary carotid stent, n (%)	1 (5.3%)	4 (20%)	0.169
Use of IA thrombolytics, n (%)	8 (42.1%)	1 (5%)	0.006
Favorable functional outcome (mRS 0-2), n (%)	3 (15.8%)	9 (45%)	0.048
Mortality at 3 months (mRS 6), n (%)	2 (10.5%)	0 (0%)	0.136
Intracerebral hemorrhage (ICH)	9 (47.4%)	9 (45%)	0.882
PHI/PHZ, n (%)	6 (31.6%)	8 (40%)	0.584
PHI/PHZ, n (%)	3 (15.8%)	1 (5%)	0.267
Symptomatic ICH, n (%)	2 (10.5%)	3 (15%)	0.676

in a sequence,

한가지에 매달리는 것보다 섞어 쓰는 게 더 좋다!

Stroke

Switching Strategy for Mechanical Thrombectomy of Acute Large Vessel Occlusion in the Anterior Circulation

Dong-Hun Kang, MD; Yong-Won Kim, MD; Yang-Ha Hwang, MD; Jacchan Park, MD; Jeong-Hyun Hwang, MD; Yong-Sun Kim, MD

Background and Purpose—We introduce the concept of a switching strategy for mechanical thrombectomy with period-to-period analysis. In period 1, forced arterial suction thrombectomy with a Penumbra aspiration catheter was performed, even in difficult cases; in period 2, forced arterial suction thrombectomy was initially performed, with switching to Solitaire in difficult cases.

Methods—We analyzed 135 consecutive patients treated with mechanical thrombectomy with acute large vessel occlusion in the anterior circulation, 61 from period 1 and 74 from period 2. We defined difficult case for both periods as 23 failed attempts at recanalization.

Results—Period 2 showed a trend for better angiographic outcome of Thrombolysis in Cerebral Infarction 2b-3 (73.8%, period 1 versus 85.1%, period 2; $P=0.10$). In interperiod subgroup analysis of difficult cases, switching significantly outperformed non-switching in Thrombolysis in Cerebral Infarction 2b-3 recanalization (52.7% versus 82.9%, $P=0.000$). Differences in puncture-to-recanalization time, symptomatic intracranial hemorrhage incidence, and procedure-related complications were not statistically significant.

Conclusions—A switching strategy using 2 mechanical thrombectomy techniques (forced arterial suction thrombectomy to Solitaire) may harbor better angiographic outcomes than a 1 technique only strategy (forced arterial suction thrombectomy). (*Stroke*, 2013; 44:3577-3579.)

in a sequence,

한가지에 매달리는 것보다 섞어 쓰는 게 더 좋다!

ORIGINAL RESEARCH

Outcomes of manual aspiration thrombectomy for acute ischemic stroke refractory to stent-based thrombectomy

Seul Kee Kim,¹ Woong Yoon,¹ Sung Min Moon,¹ Man Seok Park,² Gwang Woo Jeong,¹ Heoung Keun Kang¹

ABSTRACT

Background and purpose The optimal treatment for patients with acute stroke refractory to stent-based thrombectomy (SBT) is unclear. This study aimed to report clinical outcomes of manual aspiration thrombectomy (MAT) for the treatment of acute ischemic stroke refractory to SBT.

Methods We retrospectively analyzed clinical and angiographic data of 30 patients who underwent MAT with a Penumbra aspiration catheter because of failure of SBT. The primary outcome was recanalization rate defined by a lack of successful recanalization (defined as Thrombolysis in Cerebral Infarction 2b-3) after the initial attempt. A good outcome was defined as a modified Rankin scale score of ≤ 2 at 3 months.

Results Successful recanalization was achieved in 83.3% (25/30) of the patients who underwent MAT after failed SBT. There was no intracranial hemorrhage or symptomatic intracranial hemorrhage. Two patients died of a new arterial territory and two patients died of a new venous territory. The overall good outcome rate was 66.7% (20/30) at 3 months.

Conclusions This study suggests that MAT with the Penumbra aspiration catheter can further increase the recanalization rate without serious complications in patients with acute stroke with refractory occlusions after SBT with a Solitaire stent.

KEYWORDS acute ischemic stroke, manual aspiration thrombectomy, stent-based thrombectomy, Penumbra aspiration catheter, Solitaire stent.

Take home messages

그렇다면 둘 중 어떤 방법이 더 좋을까?
 -- 무엇이든 나에게 익숙한 방법, 내가 더 잘 개통할 수 있는 방법
 -- 더 중요한 것은 두 가지 방법을 충분히 잘 시행할 수 있어야 한다는 것
 -- 상황에 따라 더 안전하고 좋은 방법을 적용할 수 있어야 한다는 것

현재의 트렌드는 무엇인가?
 -- 무엇이든 나에게 익숙한 방법, 내가 더 잘 개통할 수 있는 방법
 -- 오로지 시각하고 나만의 기준을 갖고 그 다음 방법을 적용하는 것
 ex. FAST to SRT, FAST to m-Solumbra, SRT to FAST, SRT to m-Solumbra

THE EVOLUTION OF COMMUNICATION

Stent retriever
Solumbra etc

The 12th Annual Summer Conference Endovascular Neurosurgical Therapy

ASCENT 2017

"Consider, Communicate and Conquer"

Introduction of new devices (by company)

학술이사 정진영



