

Basic NeuroEndovascular Training Course 1 (BNET Course)

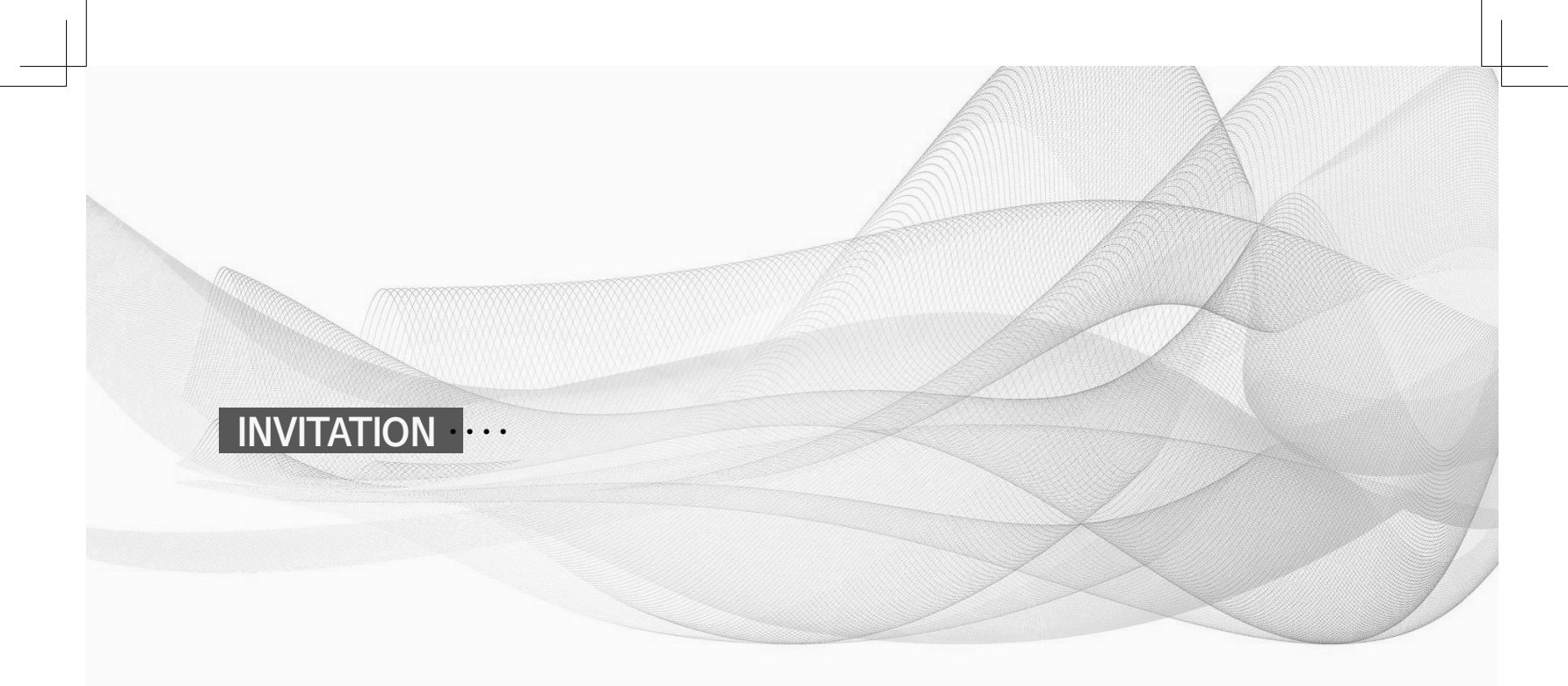
BNET 1st : General aspects of neuroendovascular approaches

일시 : 2023년 3월 11일(토)

장소 : 대웅제약본사 별관 베어홀 (지하1층)
(서울 강남구 봉은사로 644)

주최 : 대한뇌혈관내치료의학회

주관 : 대한신경외과학연구재단



INVITATION ···

회원 여러분 안녕하십니까?

2020년에 시작된 Basic NeuroEndovascular Training Course (BNET Course)를 2023년에도 이어가려고 합니다.

이 분야를 시작한지 얼마 되지 않은 회원님들(전임의 및 Junior staff)을 대상으로 하고 있으므로, 아주 기본적인 내용으로 구성하였습니다.

총 3번의 코스를 계획하고 있으며, 다음과 같이 구성하였습니다.

세 코스 모두 신청 혹은 부분 신청 가능합니다.

1. General aspects of neuroendovascular approaches
2. Aneurysmal coiling
3. Carotid stenting and Mechanical thrombectomy

병원 업무로 바쁘시겠지만, 이번 베이직 코스에 꼭 참여하여 지식을 습득하고 기본 술기를 향상시키는 계기가 되기를 기원합니다.

감사합니다.

2023년 3월 11일
대한뇌혈관내치료의학회 회장 장철훈
부회장 권순찬
총무이사 김영우
수련교육이사 김태곤, 박중철

PROGRAM

일시 : 2023년 3월 11일(토)

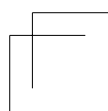
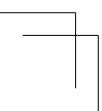
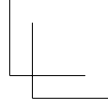
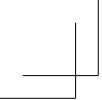
장소 : 대웅제약본사 별관 베어홀

08:30-08:50	Registration			
08:50-09:00	Course Introduction	박중철	울산대 서울아산병원	
	Welcome Address	장철훈	KoNES 회장	
09:00-09:30	Endovascular suite: Angiography Equipment and Frame rate	김태곤	차의과학대 분당차병원	07
09:30-10:00	Angiographical Contrast Media	김정재	연세대 세브란스병원	27
10:00-10:30	Angiographical Devices - sheath, guiding catheter, intermediate catheter, guiding wire, microcatheter, microwire, etc	김소연	가톨릭관동대 국제성모병원	33
10:30-11:00	Performing cerebral angiography and related cerebral arterial anatomy	신동성	순천향대 부천병원	45
11:00-11:30	Closing devices and techniques	유민욱	창원파티마병원	57
11:30-12:00	Lunch			
12:00-13:00	Hands-on (Closing device)		All	
	Closing & Photo time	김영우	KoNES 총무이사	

Endovascular suite: Angiography Equipment and Frame rate

김 태 곤

차의과학대 분당차병원



Endovascular suite: Angiography Equipment and Frame rate

Tae Gon Kim, M.D.

Vice-President, Director of Big Data Center,
Director of Cerebrovascular Center,
Chief & Head professor of Neurosurgery department,
Bundang CHA Medical Center
CHA University, School of Medicine



Angiography Equipment

- Since the discovery of X-rays in 1895, technology using them has developed very rapidly, with minimally invasive angiography and endovascular intervention at the apex of this application.
- The cerebral angiography and endovascular interventions using X-rays are very routine procedures, and for good imaging and better results, it's important to be familiar with angiography machine based on X-rays.
- In this chapter, the technologies on the angiographic imaging system, including C-arm, foot switch, monitor console, table and control panel and other imaging techniques such as pulsed fluoroscopy, digital subtraction angiography, collimation, etc will be introduced.

Angiography Equipment

- Interventional suites may be equipped
 - : a stationary fluoroscopic imaging system
 - : a mobile fluoroscopic imaging system
- The common features of these systems
 - : a C-arm
 - : an angiographic procedure table
 - : console or computer system (to process and project the images for viewing on a screen)



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Angiography Equipment



Angiography Equipment



Angiography Equipment

- **C-arms**
: consists of a C shaped metal mount equipped with an X-ray generator at one end and an X-ray receptor(Detector) at the opposite end of the C-arm.
- **Procedure table**
: The patient is placed on a radiolucent procedure table
: between the X-ray tube and the receptor



Angiography Equipment



Angiography Equipment

- A stationary fluoroscopy system
 - : consists of a ceiling or floor mounted C-arm
 - : ceiling mounted monitors
 - : floor mounted procedure table
- The entire set up is fully mechanized and the patient is positioned within the fluoroscopy field by either moving the motorized procedure table or the C-arm.
- Stationary system usually has a larger generator that can provide higher image resolution and has the advantage of maximal C-arm mobility for multiple views.





Angiography Equipment

X-ray receptor
(Detector)



X-ray generator

Angiography Equipment



Angiography Equipment



Angiography Equipment



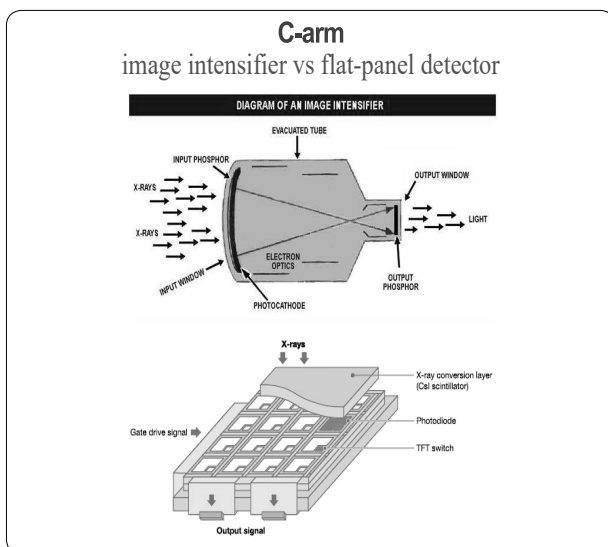
Angiography Equipment

- A mobile fluoroscopy system
 - : a portable C-arm
 - : monitor that can be moved from room to room.
 - : The angiographic procedure table is usually stationary and the radiographer manually positions the C-arm over the area of intervention.
- They are generally less expensive and have smaller X-ray generators and lower heat capacity compared to the stationary systems.



C-arm

- An X-ray generator : the x-ray beam is generated
- An X-ray receptor : is captured by the receptor which can be either an image intensifier or a digital flat-panel detector.
 - : higher radiation dose vs lower radiation dose
 - : longer size vs shorter size
 - : lower image quality vs higher image quality
 - : lower cost vs higher cost
 - : more service and parts vs less service and parts
- The current that is required to generate x-rays is measured in milliamperes/second (mAs), usually 0.5–5 mAs for fluoroscopy
- The current determines the density of the image.



C-arm

- Peak kilo-voltage (kVp), which is a measure of the potential difference across the anode and cathode, determines the maximum kinetic energy of the X-ray beam.
- The kinetic energy of the X-ray beam impacts the penetrability of the X-ray beam and the contrast of the image.
- In an automated system, the interaction between the mAs and kVp is determined by the computer to provide the best image quality at the lowest radiation dose to the patient.



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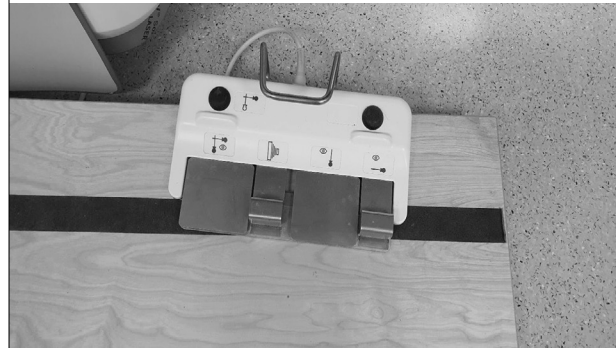
Foot Switch

- A foot switch control is used to start the generation of X-rays by the C-arm.
- The pedals are programmed to begin imaging using fluoroscopy or digitally subtracted angiography when depressed respectively.

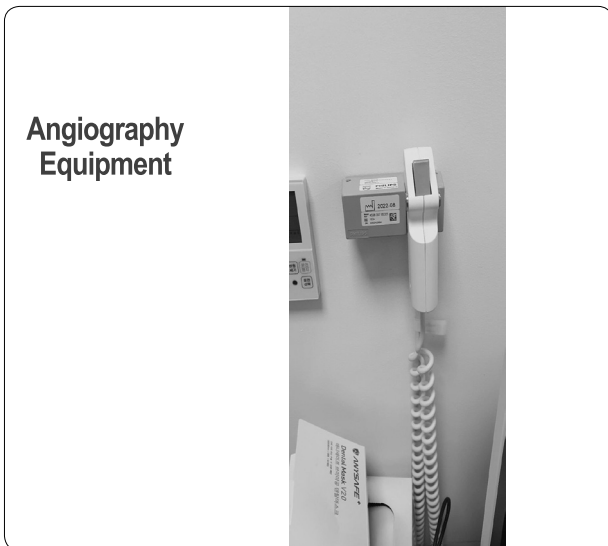




Angiography Equipment



Angiography Equipment



Monitor

- The monitor console usually has two or more computer screens to display the images.
- The screen on the left shows the “active” or “live” images while the one on the right can be used to display the last recorded image frame or replay the image sequences.



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Angiography Equipment



Angiography Equipment

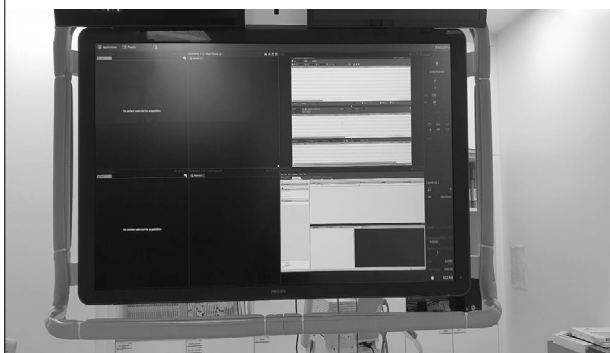


Table and Control Panel

- The procedure table is made of carbon fiber to allow for easy penetration of the X ray beam.
- In the stationary system, along with the control panel located within the control room, another set of control panel can be found on the side of the procedure table.



Table and Control Panel

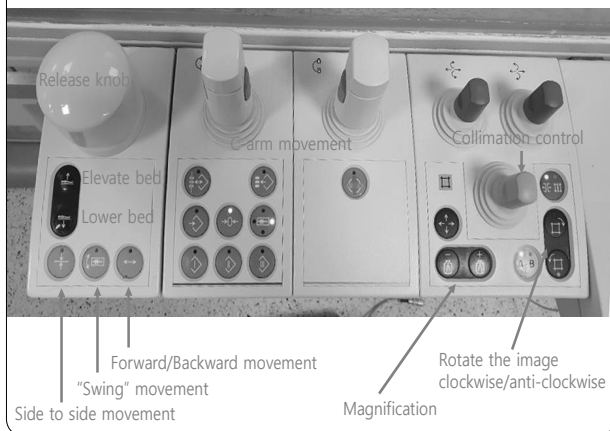
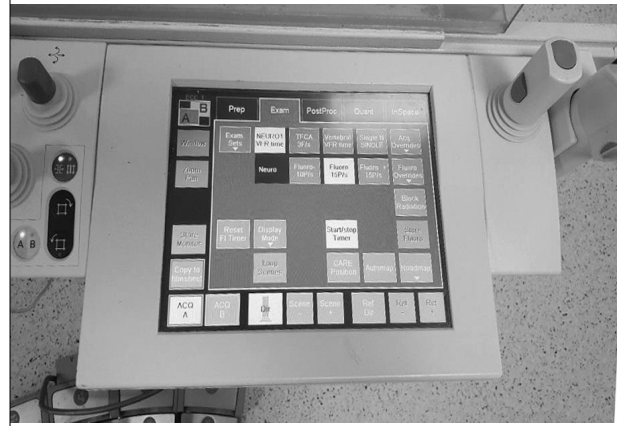
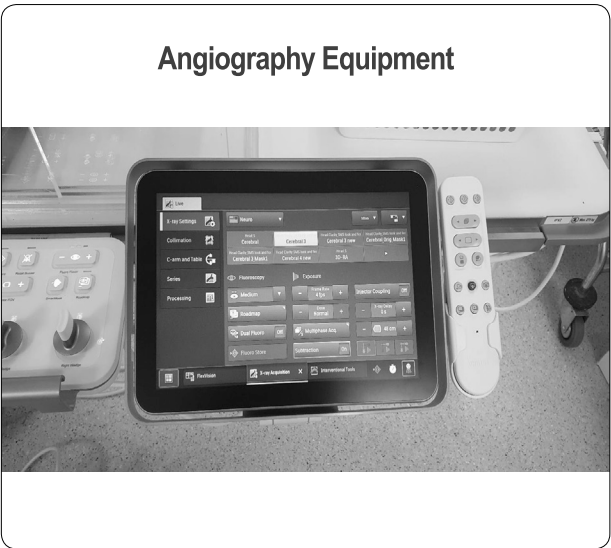
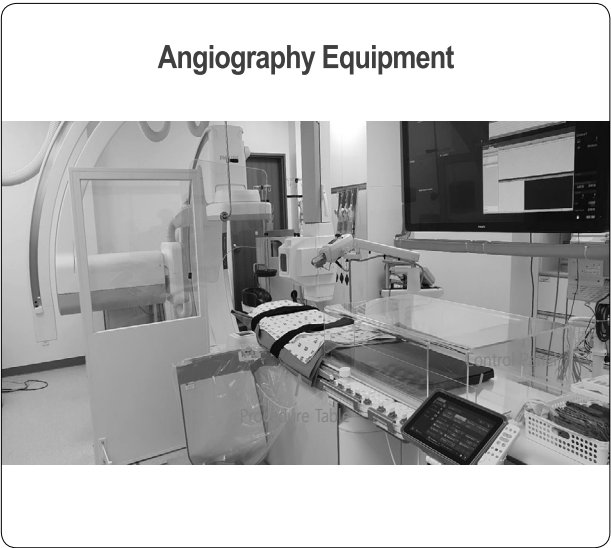


Table and Control Panel



Basic NeuroEndovascular Training Course 1 (BNET Course)



Angiography Equipment



Angiography Equipment



Angiography Equipment



Angiography Equipment



Angiography Equipment



Angiography Equipment



Basic NeuroEndovascular Training Course 1 (BNET Course)



Contrast Injection

- **Flow rate**
: unit – ml/seconds
: $\propto$ velocity of blood flow, vessel diameter
: ICA, VA – 4-5, ECA – 3-3.5, CCA – 6
- **Volume**
: target total volume
: ICA, VA – 5-6, ECA – 4-4.5, CCA – 9
- **Injection duration**
: determined by flow rate & volume



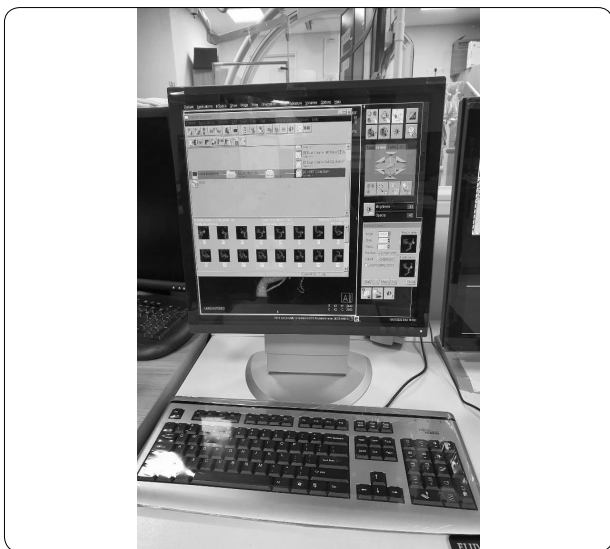
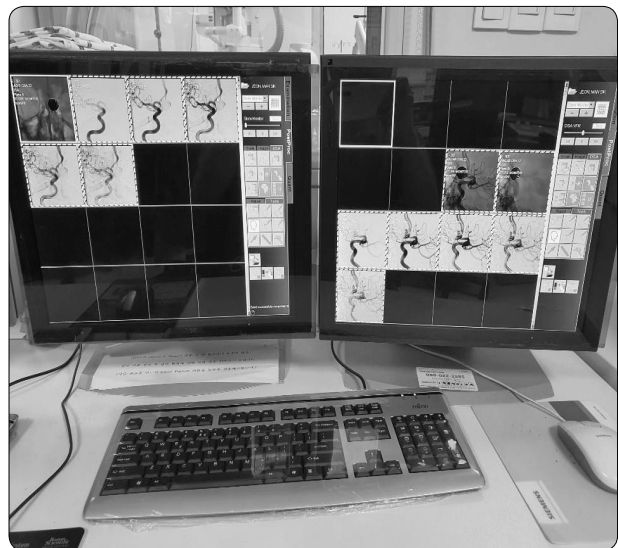
Angiography Equipment



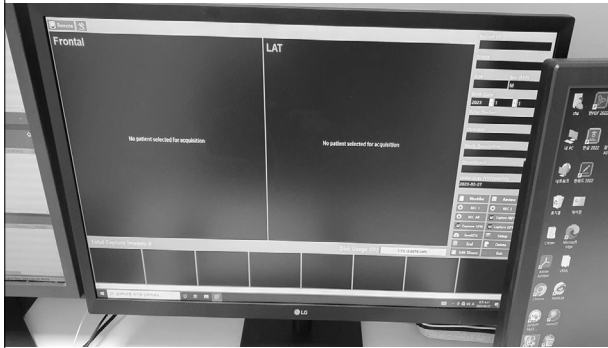
Basic NeuroEndovascular Training Course 1 (BNET Course)



Angiography Equipment



Angiography Equipment



Imaging Options - Pulsed Fluoroscopy -

- Variable rate pulsed fluoroscopy is an important feature on digital angiographic imaging system.
- In pulsed mode, the X ray beam is not generated continuously but delivered intermittently in synchrony with image display to produce the appearance of a smooth continuous image.
- The use of pulsed fluoroscopy can significantly reduce X-ray dose but “flickering” of images can occur when it is set too low. The default setting in our center is 15 pulses per second although in general.
- The X ray dose at 30 pulses per second is equivalent to that of continuous fluoroscopy.

Imaging Options - Fluoroscopy vs Digital Subtraction Angiography -

- In standard fluoroscopy, electron dense objects such as bones and iodinated contrast materials absorb more energy and appear white on a black background.
- This is usually reversed digitally such that bone and contrast will appear black on a white background.
- In digital subtraction angiography (DSA), a “mask” of the area of interest is first taken and used as a reference to digitally remove or subtract the “background” tissues or structures from the images that are subsequently acquired during contrast material administration. Vessels that are filled with the contrast material appear black on a “white out” background. Subtraction angiography improves contrast resolution of the image



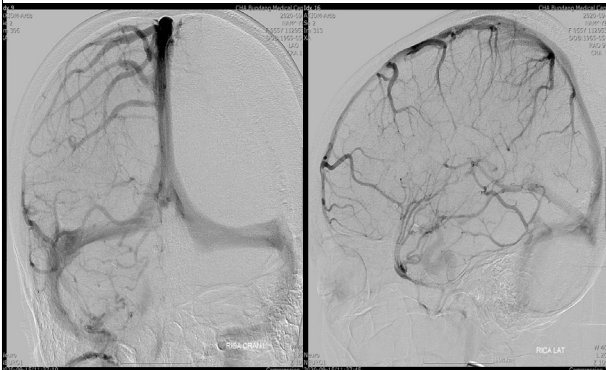
Imaging Options - Fluoroscopy vs Digital Subtraction Angiography -



Imaging Options - Fluoroscopy vs Digital Subtraction Angiography -



Imaging Options - Fluoroscopy vs Digital Subtraction Angiography -



Imaging Options - Fluoroscopy vs Digital Subtraction Angiography -

- Acquisition of DSA images is described in “frames per second”.
- The image acquisition frame rate can be adjusted in accordance to the target vasculature. While a slow acquisition frame rate may not be able to capture the flow of contrast material adequately, a high frame rate may be unnecessary and may result in high radiation dose.
- In general, 4 frames per second is sufficient when imaging the cerebral arteries while 3 frames per second is adequate for hand injection angiography.



Angiography Equipment



Contrast Injection

• Inject Delay

: 3-4 frame (reference for DSA for about 1.5 -2 seconds) → x-rays
+ dye injection
therefore, injection delay (for about 1.5 - 2 seconds)

cf) 1 seconds – 2 frame/sec
4 seconds – 4 frame/sec
the last – 1 frame/sec

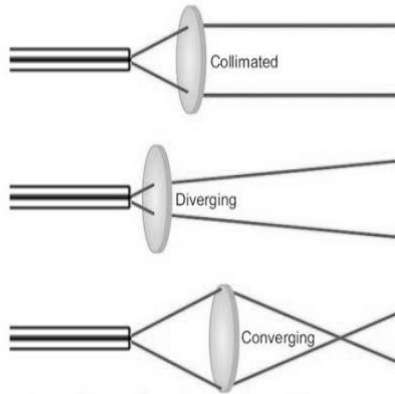
Contrast Injection

• X-ray Delay

1. regular 3D (no DSA) – before coiling
: dye injection (filling for the vessel for about 1.6 – 2 seconds)
→ 180° circulation – x-rays → contrast 조절을 통해서 vessel image
cf) bone과 contrast media의 density에는 차이가 있음.

2. 3D using DSA – after coiling
: 180° circulation (reference for DSA) → dye injection (filling the vessel for about 1.6 – 2 seconds) → 180° circulation – x-rays
: reference image에서 contrast 조절을 통해서 coil image를 얻음. → dye injection image에서 vessel image 얻음 → 둘의 합성
cf) bone과 coil에도 density에도 차이가 있음.

Collimation Versus Magnification



Collimation Versus Magnification

- Collimation is used to limit the size of the field of view to the area of interest.
- It helps to decrease the radiation dose to the patient and improve image quality by reducing scattered radiation.
- Magnification is used to magnify or enlarge the area of interest.
- Magnification results in an increase in the radiation dose to the patient and should be used only when fine detail is needed.

Optimizing Image Quality

1. Minimize the distance between the X-ray detector and the patient. This improves image quality and decreases scatter radiation.
2. Remove radio-opaque objects such as oxygen tubing and ECG leads from the field of view
3. Minimize patient movements to decrease movement artifacts, e.g., breath holding during imaging of the central veins will help improve image quality
4. Position the patient and x ray detector before starting imaging.
5. Keep the area of interest in the center of the image

Optimizing Image Quality

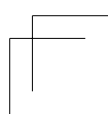
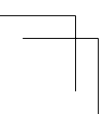
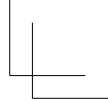
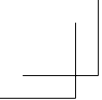
6. Use collimation to “remove” unnecessary area.
7. Use magnification to see details in a specific area when necessary.
8. Increase the number of pulses per second or frames per second where necessary.
9. Use full strength iodinated contrast material rather than diluted contrast material, especially when imaging the proximal or central vessels.
10. Oblique views may be necessary to delineate overlapping vessels and detecting eccentric vascular disease.

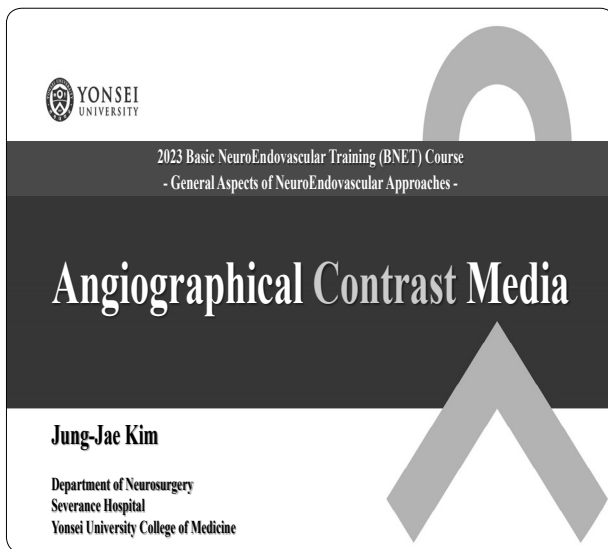
MEMO //////////////////////////////////////

Angiographical Contrast Media

김 정 재

연세대 세브란스병원





Contrast media

Substance used to enhance the visibility of structures in the body
Attenuation difference of X-ray between objects and surrounding structures

Binding energy of K-shell of Iodine: 33.2KeV
 ~ mean energy level of polychromatic radiation using general X-ray generators
 → Increasing attenuation compared with surrounding tissue.



Classification of Contrast media

Based on Ionicity and Molecular Structure

1. Ionic monomer (high-osmolar contrast media; HOCM)
2. Ionic dimer (low-osmolar contrast media; LOCM)
3. Nonionic monomer (LOCM)
4. Nonionic dimer (iso-osmolar contrast media; IOCM)

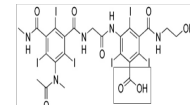
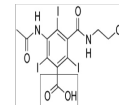


Classification of Contrast media

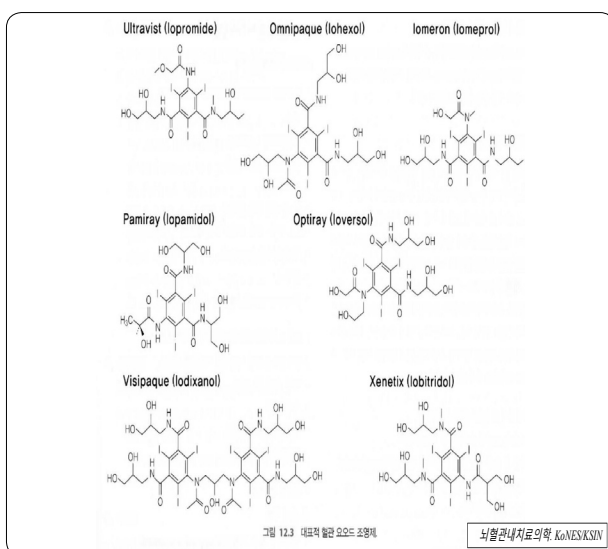
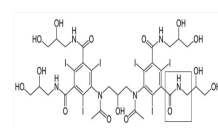
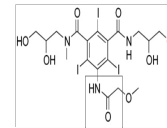
Monomer

Dimer

Ionic (carboxyl)
 R-COOH



Non-ionic (amide)
 R-CONH



Classification of Contrast media

Ionic monomer



High-osmolality contrast media (HOCM)

Very Hyperosmolar

Ionic dimer



Low-osmolality contrast media (LOCM)

Nonionic monomer



Hyperosmolar

Nonionic dimer



Iso-osmolality contrast media (IOCM)

Iso-osmolar



Injection Rate

Roadmap!!
 → Glance through the vessel
 → Caliber, rate of flow, distal run-off, catheter position
 (4F cath, 10cc syringe → forceful injection ≈ 5cc/sec)

1 psi = 51.7149 mmHg
 Rise time → unstable catheter

주사용 요오드화 조영제 및 MRI용 가돌리늄 조영제 요해반응에 관한 한국 임상진료지침

[2016년 제2판]

- Immediate reaction
 - < 1 hour, 0.7-2%
 - Anaphylactoid reaction
- Delayed reaction: skin rash (70%)

표 2. 요오드화 조영제 급성 유해반응의 분류

	과민반응	생리적 반응(기타 유해반응)
경증	국소적인 두드러기-가려움증 국소적인 피부 부종 목(인후두) 가려움 코 충혈, 재채기, 콧물, 결막염	경미한 메스꺼움-구토 일시적인 화끈거림-열감-오한 두통, 이질러움, 발한, 맛의 변화 경증 고혈압 지혈로 중단되는 혈관미주신경성긴 반응
중등증	광범위한 두드러기-가려움증 광범위한 홍반 안면부종 목이 붓거나 험 저산소증이 없는 천명, 기도수축	지속되는 메스꺼움-구토 홍통 고혈압성 긴급증(hypertensive urgency) 치료가 필요한 혈관미주신경성긴 반응
중증	효율기관을 동반한 심한 부종과 안면부종 저혈압을 동반한 심한 홍반 그림기림/저산소증을 동반한 후두부종 심한 저산소증이 있는 천명, 기도수축 아나필락시스 쇼크	부정맥 경련 고혈압성 응급증(hypertensive emergency) 치료를 필요하지 않는 천명, 기도수축 아나필락시스 쇼크

Management for adverse reaction

급성 유해반응 종류	치 료	아나필락시스 쇼크
구토/구토	• 경구/정맥, 필요 시 항구토제 고려	
두드러기/발적	• 경증: 경구항염, 필요 시 항히스타민제 • 중등증: 중등 항히스타민제, 경구/정맥 항히스타민제, 필요 시 전신 스테로이드제 사용	• 빠른 속도로 수액 공급 • 계속 천명 시 11,000 에피네프린 0.01 mg/kg 근육, 5~15분마다 반복하여 용량: 성인 0.5 mg, 6~12세 0.3 mg, 6세 미만 0.1 mg, 근육 투여는 반응이 없을 경우 11,000 에피네프린을 서서히 정맥으로 투여할 수 있음 • 2차 치료: 항히스타민제, 전신 스테로이드제, 속효성 기관지 확장제 (salbutamol) 등
안면 또는 후두부종	• 기도 확보 • 산소포화도 유지(성인 90% 이상, 소아 95% 이상) • 혈액정류 실시 • 항히스타민제, 필요 시 전신 스테로이드제 사용 • 심한 안면부종 혹은 경구 후두부종: 에피네프린 0.01 mg/kg 근육, 5~15분마다 반복 (최대 용량: 성인 0.5 mg, 6~12세 0.3 mg, 6세 미만 0.15 mg)	• 조영 장기 • 기도 확보, 혈액정류와 산소포화도 유지(성인 90% 이상, 소아 95% 이상), 저산소증을 경구 산소 공급 • 경구/정맥 항히스타민제, 필요 시 전신 스테로이드제 사용 • 디아제팜 5 mg, 미다졸람 0.5~1 mg, 로라제팜 2~4 mg 서서히 정주 • 가능한 한 신장 전연의 자궁 요통
기관지수축	• 기도 확보, 혈액정류와 산소포화도 유지(성인 90% 이상, 소아 95% 이상), 저산소증을 경구 산소 공급 • 속효성 기관지 확장제(salbutamol) 흡입: 정량식 흡입기 혹은 연무기 • 항히스타민제, 필요 시 전신 스테로이드제 사용 • 계속 천명 시 에피네프린 0.01 mg/kg 근육, 5~15분마다 반복 (최대 용량: 성인 0.5 mg, 6~12세 0.3 mg, 6세 미만 0.15 mg)	• 기도 확보, 혈액정류와 산소포화도 유지(성인 90% 이상, 소아 95% 이상), 저산소증을 경구 산소 공급 • 이노베이트/루로세이드 20~40 mg 2분마다 정주 • 혈관미주신경성긴 반응 • 기도 확보, 혈액정류와 산소포화도 유지(성인 90% 이상, 소아 95% 이상), 저산소증을 경구 산소 공급 • 스크레치 • 경구/정맥 항히스타민제, 필요 시 전신 스테로이드제 사용 • 빠른 속도로 수액 공급 • 필요 시 아트로핀(0.5 mg/mL) 0.5~1 mg 천천히 용액(3~5분 간격으로) 반복 투여, 최대 누적 투여량 3 mg
아나필락시스 쇼크	• 기도 확보 • 산소포화도 유지(성인 90% 이상, 소아 95% 이상) • 혈액정류 실시 • 스크레치 • 경구/정맥 항히스타민제	

Risk factors for adverse reaction

- History of acute adverse effects, anaphylaxis
- History of allergy (≥ 4) and asthma
- Cardiac status: angina or congestive heart failure
- Hyperproteinemia (e.g. multiple myeloma)
- Pheochromocytoma
- Sickle cell anemia
- Myasthenia gravis
- Renal insufficiency

Premedication for adverse reaction

Skin test for screening, test injection are not recommended.

ACR/ESUR recommendation

- H1 blockers, 1 hour before examination
- Corticosteroids
 - Prednisolone – 50 mg by mouth at 13 hours, 7 hours, and 1 hour before contrast media injection
 - Methylprednisolone (Medrol®) – 32 mg by mouth 12 hours and 2 hours before contrast media injection

Contrast-induced nephropathy (CIN)

A sudden deterioration in renal function
 Occurs within 72 hours following the IV iodinated contrast medium

- Absolute serum creatinine increase ≥0.5 mg/dL (>44 μmol/L)
- A percentage increase in serum creatinine ≥25% (≥1.25-fold above baseline)

- 11% of hospital acquired renal insufficiency
- 3rd most common cause of renal failure (0.6-2.3%)

Contrast-induced nephropathy (CIN)

Prevention of CIN Tolerable volume of 300 nonionic contrast = $\frac{\text{Weight (kg)} \times 5 \text{ (adult) or } 4 \text{ (child)}}{\text{Serum creatinine (mg/dL)}}$

1. High-risk patients → avoid iodinated contrast as possible
2. Renal impairment patients: hydration (diuresis, volume expansion, HCO₃)
 - Normal saline (1-1.5ml/kg/hr) for 6hr
 - Sodium bicarbonate (3ml/kg/hr, 1hr before; 1ml/kg/hr, 6hr)
3. Limited evidence of any pharmacological intervention
e.g. acetylcysteine



주식회사 의료정보 유해성평가 한국응용영상학회 2018년 제1회

Summary

1. Iodinated contrast has characteristic properties and is classified, based on ionicity and its structure.
2. Powered injection of contrast: rate, volume, rise time, pressure limit.
3. Adverse reaction of contrast including contrast-induced nephropathy (CIN): prevention and management.
4. Minimization of contrast load.



Key Points

- New fellows in our room are often nonplussed as to why we **only** have two CDs for our music system. One of these is "The Greatest Hits of Marty Robbins" and we never play the other one. The point this detail makes is that neuroangiography is safest when practiced in a methodical, repetitive, consistent manner. Every angiogram is executed through the exact same steps, as much as possible. Certainly, there are many days when creativity, ingenuity, and improvisation are in great demand, but these moments are often best avoided and forgotten. The purpose of the music is not entertainment but providing a familiar ambiance. The priority in the room is safety.
- Safe technique can only come about through absolutely consistent practice of safe habits. In most patients, most of the time, such scrupulousness is redundant, but these habits are not aimed at the majority of cases. They are aimed at those rare, unforeseen circumstances when they will make a big difference.

REVIEW THE PREVIOUS STUDIES

The importance of this preliminary step cannot be overemphasized. Relying on typed reports of what was seen on the previous studies, which side the findings were on, and the like, is a recipe for oversight, omission, or worse.

- Cerebral angiography는 진단과 치료의 결과를 본다는 면에서 endovascular procedure의 시작이자 끝이라 생각합니다.
- Complication rate of cerebral angiography:
 - Neurologic Cx. 2.63% (19826, 1981-2003, Mayo clinic, *Radiology* 2007)
 - 0.30% (3636, 2001-2007, Fifi JT et al. *J Vasc Interv Radiol* 2009)
- Complication is always painful!!
- Angiography = Safe habits

Pearse Morris, "Practical Neuroangiography", 3rd ed.



YONSEI UNIVERSITY
COLLEGE OF MEDICINE

THANK YOU FOR YOUR
ATTENTION!!

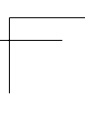
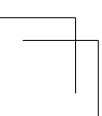
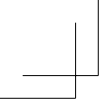


Angiographical Devices

- sheath, guiding catheter, intermediate catheter, guiding wire, microcatheter, microwire, etc

김 소 연

가톨릭관동대 국제성모병원



가톨릭관동대학교 국제성모병원
CATHOLIC KWANGWON UNIVERSITY INTERNATIONAL St. MARY'S HOSPITAL

Angiographic devices

- Guiding catheter to microwire

국제성모병원
김소연



목차

1. Basic concepts
2. Sheath
3. Guiding catheter
4. Guidewire
5. Intermediate catheter
6. Microcatheter
7. Microwire



1. Basic Concepts

1. Basic Concepts

Unit

- Outer Diameter(OD): French system (Fr)
- Inner Diameter(ID): Inches (inch/")
 - 3 Fr = 1 mm
 - 1 Fr = 0.33 mm

$$1 \text{ mm} = 3 \text{ Fr} = 0.0394 \text{ inch} = 19 \text{ G}$$

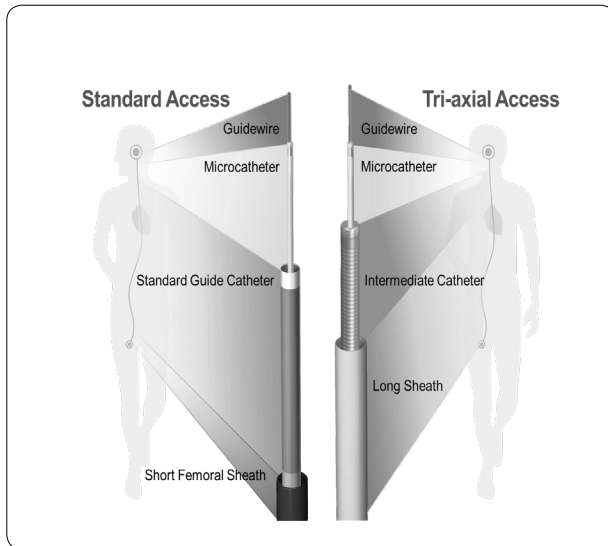
- 5 Fr diagnostic catheter (100cm length)
 - 0.066 inch outer diameter (1.65 mm/5Fr)
 - 0.038 ~ 0.45 inch inner diameter (0.97 ~ 1.2 mm)
- Guidewire: 0.035 inch (0.89mm) angled tip wire, 150 cm length

french	mm	in	french	mm	in
3	1	0.039	12	4	0.158
4	1.35	0.053	13	4.3	0.170
5	1.67	0.066	14	4.7	0.184
6	2	0.079	15	5	0.197
7	2.3	0.092	16	5.3	0.210
8	2.7	0.105	17	5.7	0.223
9	3	0.118	18	6	0.236
10	3.3	0.131	19	6.3	0.249
11	3.7	0.144	20	6.7	0.263

• Aneurysm coiling

	OD	ID
6Fr Guiding	8Fr	0.087"
6Fr Intermediate	084"	070"
10 microcatheter	1.7Fr	017"
014 microwire	014"	

- Guiding 은 ID 개념, 그 외는 OD 개념
- 5Fr Angio catheter

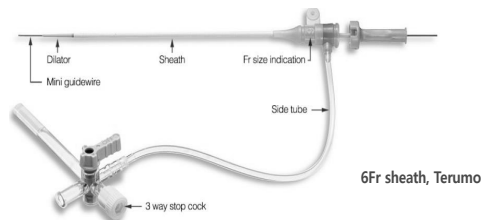


2. Sheath

2. Sheath

1. Regular sheath / Terumo

- Artery로의 접근 용이, flushing line 연결 가능
- Length 10~25cm
- Dilator 포함,
- 구불구불한 혈관부위를 지나 곧은 부위까지 도달할 수 있도록



2. Sheath

	Length (cm)	ID (Fr/mm)	Guidewire length (cm)	Guidewire (Inch)
4 Fr	10	1.45	45	0.035"
5 Fr	10	1.78	45	0.035"
6 Fr	10	2.10	45	0.035"
7 Fr	10	2.45	45	0.035"
8 Fr	10	2.78	45	0.035"
9 Fr	10	3.14	45	0.035"
11 Fr	10	3.82	45	0.035"
5 Fr long	25	1.78	80	0.038"
6 Fr long	25	2.10	80	0.038"
7 Fr long	25	2.45	80	0.038"
8 Fr long	25	2.78	80	0.038"
9 Fr long	25	3.14	80	0.038"

2. Sheath

2. Flexor® Shuttle Guiding Sheath / Cook

- Sheath + Guiding catheter 동시 가능
 - hydrophilic-coated braided sheath
- excellent stability during the procedures

Flexor® Shuttle guiding sheath paired with a specially designed coaxial selective catheter.

	Length (cm)	ID	Dilator OD
6 Fr	90 / 80	2.21mm / 0.087"	0.038"
7 Fr	90 / 80	2.54mm / 0.100"	0.038"
8 Fr	90 / 80	2.87mm/0.113"	0.038"



Shuttle Guiding Sheath System

FLEXOR SHUTTLE

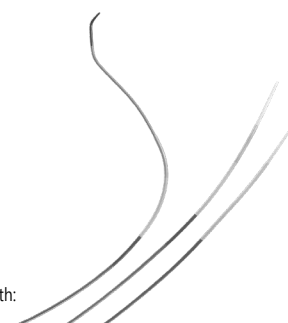
G30009	KSAW-5.0-18/38-90-RB-SHTL-HC
G13539	KSAW-6.0-38-80-RB-SHTL-HC
G13264	KSAW-6.0-38-90-RB-SHTL-HC
G13338	KSAW-7.0-38-80-RB-SHTL-HC
G12835	KSAW-7.0-38-90-RB-SHTL-HC
G12836	KSAW-8.0-38-90-RB-SHTL-HC

FLEXOR SHUTTLE SELECT

G31133	KSAW-5.0-38-90-RB-SHTL-FLEX-HC
G31138	KSAW-6.0-38-90-RB-SHTL-FLEX-HC

Flexor® Shuttle Select guiding sheath:

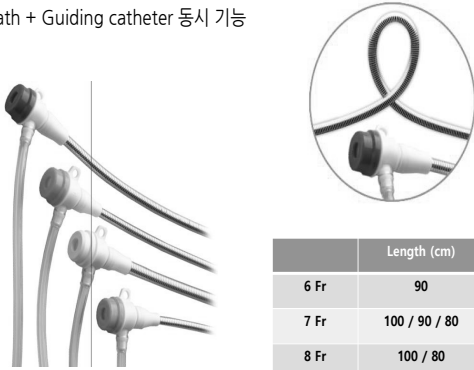
- Softer Distal Tip
- Stiffer Proximal Shaft



2. Sheath

3. Arrow-Flex® Sheath Introducer / Teleflex

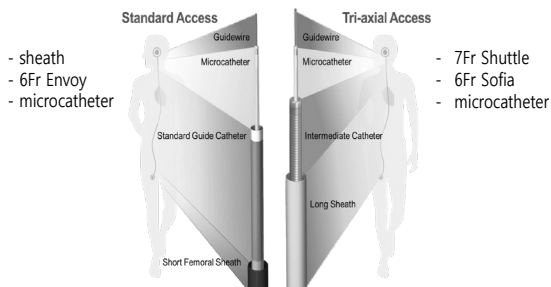
- Sheath + Guiding catheter 동시 기능



3. Guiding catheter

3. Guiding catheter

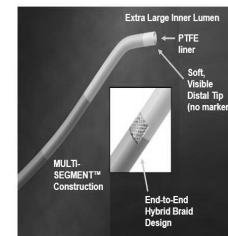
- Guiding catheter back up force가 제품마다 다르고 또 Fr 에 따라 달라진다
- Co-axial system으로 사용하면 장단점을 보완할 수 있다



3. Guiding catheter

1. Envoy / Cerenovous

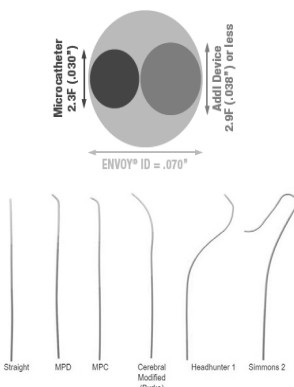
- **Soft atraumatic tip section**
 - Braid-free soft tip
- **Large ID**
 - Improved injections, ability to road map
 - Accommodates variety of interventional devices
- **Lubricious PTFE inner liner**
 - Enhances mobility of devices
- **Radiopaque shaft**
 - Provides visibility of body and tip
- **Four segment construction**
 - Varies firmness and flexibility from hub (stiffest) to tip (softest)



	OD	ID	Length
Envoy 5F	5F	0.056"	90/100 CM
Envoy 6F	6F	0.070"	90/100 CM
Envoy 7F	7F	0.078"	90/100 CM

3. Guiding catheter

1. Envoy / Cerenovous



- 5Fr Envoy : single microcatheter but difficult DSA
- 6Fr Envoy : double catheter
- 7Fr Envoy : balloon catheter

	OD	ID	Length
Envoy 5F	5F	0.056"	90/100 CM
Envoy 6F	6F	0.070"	90/100 CM
Envoy 7F	7F	0.078"	90/100 CM

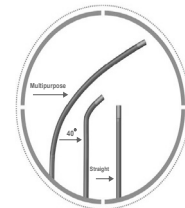
3. Guiding catheter

2. Guider Softip™ XF Guide Catheter / Stryker

- The Boston Scientific Guider Softip® XF Guide C catheters are intended to facilitate the placement of interventional devices into the neurovascular system.

Designed for support

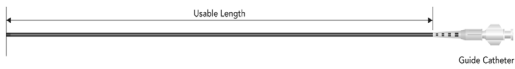
- Braided multi-durometer shaft for proximal support with distal flexibility
- **Atraumatic soft tip** available in three configurations



	Guider soft tip
Outer Diameter (F)	5,6,7,8
Inner Diameter (in)	.053/.064/.073/.086
Usable length (cm)	90,100
Tip shape	Straight 40 MP

3. Guiding catheter

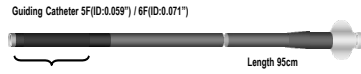
3. Fubuki Guiding catheter / Asahi



ASAHI FUBUKI	Tip Shape	Hydrophilic Coating	Inner Diameter	Outer Diameter	Usable Length
6Fr GC	Angle	150mm	1.80mm (0.071")	2.09mm (6Fr)	90cm, 100cm
7Fr GC	Angle	150mm	2.05mm (0.081")	2.40mm (7Fr)	90cm, 100cm
8Fr GC	Straight	50mm	2.28mm (0.090")	2.70mm (8Fr)	80cm, 90cm

3. Guiding catheter

4. Chaperon Guiding catheter / Microvention



Size	ID	Catheter Length	Distal Flexible Length	Distal Tip Shape
5F (1.73mm)	0.059" (1.50mm)	95cm	7cm	STR/MP1/MP2/BUR
6F (2.06mm)	0.071" (1.80mm)	95cm	7cm	STR/MP1/MP2/BUR

Key Feature	Supportive Function	Key Benefit
Soft Inner Catheter with Tenumo Glide Technology	Soft atraumatic distal shaft contains no braiding Hydrophilic coating distal in 15 cm	Improved vessel access safety and superior trackability
Largest ID of 0.071" for 6F, 0.059" for 5F	Thin PTFE inner layer	Enhanced work space for parallel use of Balloon and Microcatheter with less friction (6F)
Unique Shaft Materials	Polyester outer layer	Sustainable device supportability with lower water absorption rate
High Rigidity Stainless Flat Braid	Appropriately controlled metal composition to the plastic materials	Optimized torque control and high kink resistance

3. Guiding catheter

5. FLOWGATE Balloon Guiding Catheter / Stryker

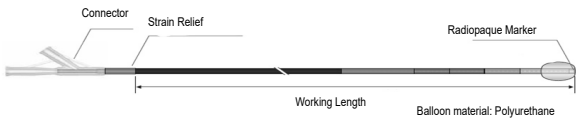


DESIGN FEATURE	INTENDED DESIGN BENEFIT	INTENDED CLINICAL BENEFIT
Inner Shaft	• Flexibility profile	• Optimal distal flexibility affects deliverability and stability in the vessel
Outer Jacket	• Bonded to the inner shaft and hub to create the coaxial lumen; outer blend of materials provides optimal proximal stability	• Coaxial lumen allows for reliable inflation and deflation • Optimal proximal stability affects pushability and stability in the vessel
Compliant Balloon	• Conforms to the vessel when inflated	• Proximal flow control = less distal emboli during clot retrieval

FlowGate2 8F	
OD	8Fr
ID	0.084"
Tip length	2.5 mm
Effective length	85, 95 cm
Balloon length	10 mm

3. Guiding catheter

6. Optimo Balloon Guiding Catheter



- ① Tip less Design in Balloon Dilatation
- ② Largest Inner Lumen in same category
- ③ Balloon material made of Polyurethane
- ④ Shaft transition design for good conformability
- ⑤ Optimized balloon deflation time

O/D	I/D	CM
9Fr	0.093inch	90cm
8Fr	0.085inch	95cm
8Fr	0.085inch	90cm





4. Guidewire

- Hydrophilic coating: smooth, rapid movement
- Nitinol or stainless core: resists kinks
- Core: torquability and steerability

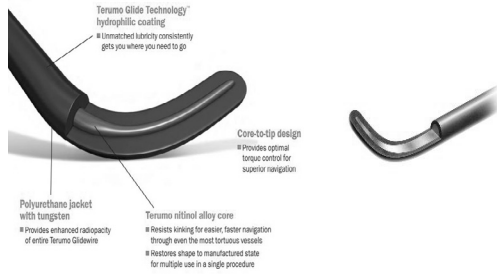
	Diameter	Length (cm)	Flexible tip length (cm)
Angled	0.035"/0.89mm	150	3
STIFF angled	0.035"/0.89mm	150	3
Shapeable	0.035"/0.89mm	150	3
Straight	0.035"/0.89mm	150	3
STIFF exchange	0.035"/0.89mm	260	3
Angled exchange	0.035"/0.89mm	260	3

- Stiff
- Shapable
- Exchange

4. Guidewire

1. Radifocus® Guide Wire / Terumo

- Highly flexible, tapered tip for atraumatic and controlled navigation through vessels
- M Coat hydrophilic coating for low friction endovascular steerability and trackability
- Radiopaque polyurethane jacket for good fluoroscopic visibility and controlled navigation
- One-piece construction with one-to-one torque transmission for predictable navigation
- Rounded, atraumatic tip for the prevention of vessel trauma and low friction guidewire insertion



4. Guidewire

2. Roadrunner UniGlide / Cook

- Hydrophilic guide wire



Features	Benefits
Nitinol core	Kink resistance and elasticity
Hydrophilic coating	Lubricity, durability and quality
Radiopaque polymer jacket	Visibility
Construction	Torque control and trackability
Free torque device	Convenience and cost savings
Wire inserter	Ease of use



5. Intermediate catheter

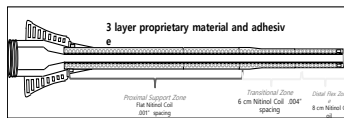
5. Intermediate catheter

- Guiding catheter와 microcatheter 사이의 유격을 줄여 주고 microcatheter를 좀 더 distal까지 delivery 하기 용이하도록 도와 줌
- For further delivery & better control
- Guiding catheter와의 병용사용만 인정
- Intermediate catheter 2개 사용 불가

5. Intermediate catheter

1. Navien / Medtronic

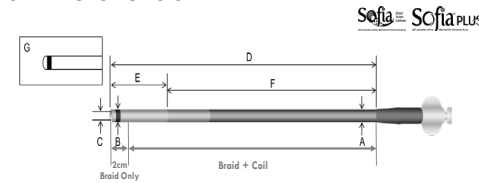
- More kink resistance
- 5f - 0.058 Lowest ovalization rates
- 6f - 0.072 Increased flow rates for better visualization from better contrast injections
- Increased aspiration rates
- More device compatibility/flexibility



Product Catalog Number	Maximum Outer Diameter (F/In)	Inner Diameter (In)	Length (cm)	Tip Shape	Max Wire Compatibility (In)	Flexible Distal Length (cm)
RFK058-115-08	5 / 0.070	0.058	115	Straight	0.038	8
RFK058-125-08	5 / 0.070	0.058	125	Straight	0.038	8
RFK058-130-08	5 / 0.070	0.058	130	Straight	0.038	8
RFK072-105-08MP	6 / 0.084	0.072	105	Multi-Purpose 25°	0.038	8
RFK072-115-08MP	6 / 0.084	0.072	115	Multi-Purpose 25°	0.038	8

5. Intermediate catheter

2. Sofia / Microvention



Product Code	Name	Catheter Size (French)	Proximal OD (Inch/mm)	Distal OD (Inch/mm)	ID (Inch)	Working Length (cm)	Distal Length (cm)	Proximal Length (cm)	Distal Tip Shape
DA5115ST	Sofia DAC	5	0.068/1.7	0.067/1.7	0.055	115	17	98	Straight
DA5125ST	Sofia DAC	5	0.068/1.7	0.067/1.7	0.055	125	17	108	Straight
DA6115ST	Sofia DAC	6	0.0835/2.1	0.0815/2.1	0.070	115	17	98	Straight
DA6125ST	Sofia PLUS	6	0.0835/2.1	0.0815/2.1	0.070	125	19	106	Straight
DA6131ST	Sofia PLUS	6	0.0835/2.1	0.0815/2.1	0.070	131	19	112	Straight

5. Intermediate catheter

3. Envoy DA, DAXB / Cerenovus

• Distal Segment Flexibility

- 8 cm의 Flexible distal segment

• Soft Distal Tip

- Braid-free distal tip with excellent fluoroscopic visibility

• Large .071" Lumen Diameter

• End-to-End Braided Construction

- support 증가

Soft Distal Tip with Excellent Visibility

Distal Segment Flexibility

Large .071" Lumen Diameter

Hydrophilic Coating

End-to-End Braided Construction

Improved Back-Up Support

Distal Access G/c	OD	ID	Length	Distal soft segment	Shape
Envoy DA	6F	0.071"	95/105 CM	8CM	STR/M PD
Envoy DA XB	6F	0.071"	95/105 CM	8CM	STR/M PD

5. Intermediate catheter

4. Penumbra ACE 68(Reperfusion)

Ultimate Tracking:
Advancements from Hub to Tip

6F (1.63mm) 2.03mm 132 cm 6F (1.63mm) 2.03mm

Extended flexible distal shaft
Allows improved tracking through tortuosity

Construction resistant to compressive pressure
Maintains lumen integrity and reduces risk of collapse under aspiration

Large .068" lumen
Optimises clot engagement and maximises aspiration

Beveled tip
Improves navigation

Ultimate Tracking:
Advancements from Hub to Tip

Unique coil winding geometry
Advances pushability for navigation while maintaining kink resistance

16 transitions
Enables smooth force transmission and minimises kinking

Optimized PTFE liner
Increases shaft flexibility

On-Tip
LSD Lighting
Imagined Coil/Catheter
Dist. Inside Design

Penumbra ACE68
with support zone

ACE Plus

5. Intermediate catheter

5. Penumbra Neuron Max 088(Intermediate Guiding)

Neuron MAX 088 | 80 / 90 / 100 cm

6F .088" (2.24 mm) ID 7 cm 8 cm 8 cm

Support Zone Transition Zone Distal Flexible Zone

Neuron MAX 088 vs. Cook® Shuttle®

Click to hear

Optimal Proximal Support

• 75% more proximal support than Cook® Shuttle®

Measuring Distal Flexibility

• 3x softer than Cook® Shuttle®

• 9x softer than Terumo® Destination®

Distal Shaft Softness (gF)

Proximal Shaft Softness (gF)

5. Intermediate catheter

6. Catalyst 5 / Stryker

Designed for Distal Support and Smooth Navigation

Proximal Support

The key to responsive pushability & control

• Stainless steel tight pitch coil

• Thick walled, high durometer shaft

Smooth Force

Transmission

12 transitions

• Outer jacket durometer

• Coil pitch transitions

Distal Flexibility

Access more distal tortuosity

• 5cm distal flex zone

• Variable pitch Nitinol flatwire coil

AXIS Catalyst 5

Outer diameter proximal/distal (F) 5.6/5.3

Outer diameter proximal (in) 0.073

Inner diameter (in) 0.058

Usable length (cm) 115

Tip Shape Straight

Minimum guide catheter /sheath clearance 0.078 in

Transition zones 13

5. Intermediate catheter

7. Catalyst 6 / Stryker

Stroke Catheter – Optimized for Trevo

Proximal Support

The key to responsive pushability & control

• Stainless steel tight pitch coil

• Thick walled, high durometer shaft

Smooth Force Transmission

15 transitions

• Outer jacket durometer

• Coil pitch

Distal Flexibility

Access more distal tortuosity

• 14cm distal flex zone

• Variable pitch Nitinol flatwire coil

AXIS Catalyst 6

Outer diameter proximal/distal (F) 6.0/5.4

Outer diameter proximal (in) 0.079

Inner diameter (in) 0.060

Usable length (cm) 132

Tip Shape Straight

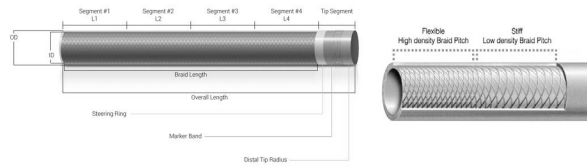
Minimum guide catheter /sheath clearance 0.084 in

Transition zones 16

CKU

6. Microcatheter

- **Hydrophilic coating**
- **Polyethylen, polyamide, polyurethane, polyester, silicone, teflon**
- **Braiding(stainless steel, nitinol, platinum) - kinking 과 굴곡이 심한 혈관을 지나갈 때 카테터의 내경이 좁아지는 문제를 방지, pushability 유지 역할**



6. Microcatheter

1. Excelsior microcatheter family / Stryker

Feature	Intended Benefit
Steam-shapeable distal tip	Enhances vessel selectivity and helps maintain position in aneurysm during coil delivery
PTFE lined inner lumen	Enhances manipulation of devices within the Microcatheter
Kink resistant shaft construction	Designed to provide excellent kink resistance for challenging anatomy
Ultra-lubricious hydrophilic coating	Facilitates advancement and negotiation through challenging anatomy
Precisely placed radiopaque markerbands	Facilitates proper Target®, Matrix® and GDC® coil detachment
Transparent hub	Allows direct visualization of coil and guidewire introduction



	Excelsior 1018	Excelsior SL-10	Excelsior XT-17
Outer diameter proximal/distal (F)	2.6/2.0	2.4/1.7	2.4/1.7
Inner diameter proximal/distal (F)	0.019	0.0155	0.017
Usable length (cm)	150	150	150
Distal Flexibility (cm)	6	6	15
Number of RO markers	1 or 2	1 or 2	2
Tip Shapes	45°, 90°, J.S.C., Straight	45°, 90°, J.S.C., Straight	45°, 90°, J., Straight

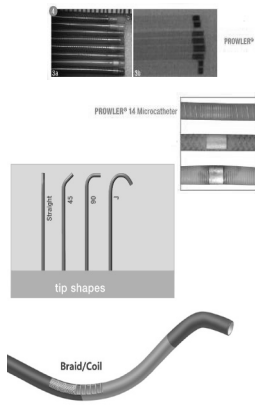
	Excelsior XT-27
Outer diameter proximal/distal (F)	2.9/2.7
Inner diameter(in)	0.027
Usable length (cm)	135, 150
Distal Flexibility (cm)	6
	18
Number of RO markers	1

6. Microcatheter

2. Prowler / Cerenovus

- **Braid+Coil construction**
 - Proximal Support & Distal Flexibility
- **Accurate tip position**
- **Widest choice**
 - 0.015", 0.0165", 0.021" & 4 pre-shaped tips
- **TruLumen Technology**
 - In-line Marker로 타사제품 대비 Marker 부분에서도 ID가 변함없이 동일

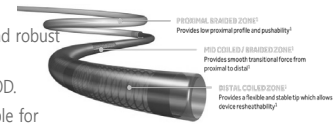
Microcatheter	OD (Proximal/Distal)	ID	Length	Distal Length
Prowler 10	2.3F/1.7F	0.015"	150cm	50cm
Prowler 14	2.3F/1.9F	0.0165"	150cm	50cm
Prowler Select LP-ES	2.3F/1.9F	0.0165"	150cm	5cm
Prowler Plus	2.8F/2.3F	0.021"	150cm	20cm
Prowler Select Plus	2.8F/2.3F	0.021"	150cm	5cm



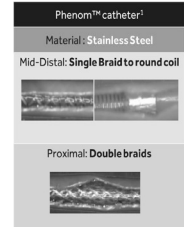
6. Microcatheter

3. Phenom / Medtronic

- 3 Performance zones with progressive flexibility
- A proximal microcatheter Stable and robust to a tip flexible and control.
- With a large ID & small proximal OD.
- Phenom27 engineered to be durable for device delivery & recapturing.



	CATHETER ID	PROXIMAL OD	DISTAL OD	TIP SHAPE	Length
Phenom™ 17	0.017"(0.43mm)	0.029"(2.2F)	0.024"(1.8F)	STRAIGHT	150cm
				J CURVE	150cm
				45° CURVE	150cm
Phenom™ 21	0.021"(0.69mm)	0.034"(2.6F)	0.030"(2.3F)	STRAIGHT	160cm
				STRAIGHT	150cm
Phenom™ 27	0.027"(0.69mm)	0.040"(3.1F)	0.036"(2.8F)	STRAIGHT	160cm



6. Microcatheter

4. Rebar / Medtronic

- The REBAR™ REINFORCED MICRO CATHETERS are designed to deliver a wide variety of pharmacologic, diagnostic and therapeutic agents, including detachable coils and the Onyx™ liquid embolic system.



REBAR™ 18 REINFORCED MICRO CATHETER				
Product Catalog Number	Outer Diameter (F)	Inner Diameter (In)	Usable Length (cm)	Max. Guidewire (In)
105-5081-153	2.7-2.4	.021	153	0.018

REBAR™ 27 REINFORCED MICRO CATHETER				
Product Catalog Number	Outer Diameter (F)	Inner Diameter (In)	Usable Length (cm)	Max. Guidewire (In)
105-5082-130	2.8-2.6	.027	130-145	0.021

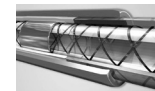
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6. Microcatheter

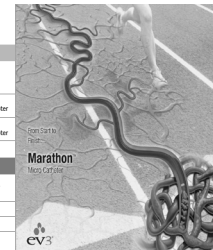
5. Apollo / Marathon / Medtronic

- **APOLLO™** - Marathon™ 에 detachable tip version
- **MARATHON™** - for Onyx™ delivery



APOLLO™ ONYX™ DELIVERY MICRO CATHETER							
Product Catalog Number	Proximal Outer Diameter (F)	Distal Outer Diameter (F)	Inner Diameter (In)	Total Length (cm)	Tip Length (cm)	Tip Shape	Wire Compatibility (In)
105-1005-000	2.7 / 0.036	1.5 / 0.020	0.013	165	1.5	Straight	0.026 & 0.020 hydrophilic
105-1006-000	2.7 / 0.036	1.5 / 0.020	0.013	165	3.0	Straight	0.026 & 0.020 hydrophilic

MARATHON™ FLOW DIRECTED MICRO CATHETER					
Product Catalog Number	Style	Outer Diameter (F)	Inner Diameter (In)	Usable Length (cm)	Distal Length (cm)
105-5055	With	2.7-1.5	.015-0.013	165	25
105-5056	Without	2.7-1.5	.015-0.013	165	25



6. Microcatheter

6. Echlon / Medtronic

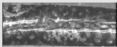
- Better proximal pushability, stability and support
- Shape retention
- Kink resistance and less ovalization
- Fatigue resistance
- Softness via graduated zones and transition point



Echelon™ 10/14 catheter¹

Material: Annealed Nitinol

Mid-Distal: Progressive flat braid



Proximal: Progressive flat braid



Echelon™ 10 MICRO CATHETER					
Product Catalog Number	Outer Diameter (F)	Inner Diameter (in)	Usable Length (cm)	Max. Guidewire (in)	Tip Configuration
105-5095-150	2.3-1.7	.017	150	0.014	Straight
145-5095-150	2.3-1.7	.017	150	0.014	45°
190-5095-150	2.3-1.7	.017	150	0.014	90°

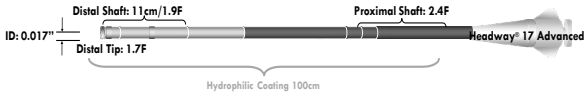
Echelon™ 14 MICRO CATHETER					
Product Catalog Number	Outer Diameter (F)	Inner Diameter (in)	Usable Length (cm)	Max. Guidewire (in)	Tip Configuration
105-5092-150	2.4-1.9	.017	150	0.014	Straight
145-5092-150	2.4-1.9	.017	150	0.014	45°
190-5092-150	2.4-1.9	.017	150	0.014	90°

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6. Microcatheter

7. Headway family / Microvention



Product	Tip Markers	Strain Relief	Shape	Usable Length (cm)	OD Proximal / Distal (F)	ID (inch)
Headway17	2	Dark Green	STR	150	2.4/1.7	0.017
Headway27	2	Dark Green	STR	156	3.1/2.6	0.027

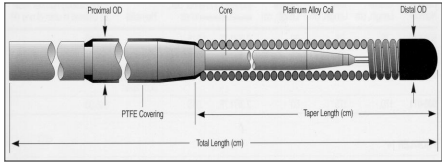
Product	ID (inch)	Distal Length	Total Length	Hydrophilic Coating Length	Entry OD	Distal OD	Proximal OD	Distal Tip Shape	Tip Markers
Headway21	0.021"	15cm	150cm	100cm	2.0F	2.2F	2.5F	STR	2



Headway DUO	1.6F / 156cm	1.3F / 167cm
Proximal / Distal OD	2.1F/1.6F	2.1F/1.3F
Proximal / Distal ID	0.0165" / 0.0165"	0.0165" / 0.013"
Guidewires Compatibility	0.014" and smaller	0.014" / 0.012" and smaller
Distal Tip End	No Taper	Tapered
Distal Progressively Soft Length	30cm	30cm
Total Length	Longest length of any coil compatible catheter 156cm	Longer liquid embolic delivery catheter length 167cm
Markers	2	1
Delivery Compatibility: Liquid Embolics / Coils		
DMSO Compatible	Yes	Yes
Dead Space	0.34cc	0.35cc
Burst Pressure	700psi	700psi



7. Microwire



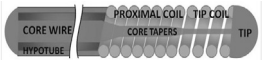
Core: Platinum, Tungsten, stainless steel

Torque control

Tip shape and retention

Tapered core; length of transition

Length of distal floppy segment



7. Microwire

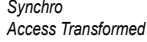
1. Transend & Synchro family

Transend® Guidewire:

- Features Scitanium™ Alloy
- Corewire construction designed for enhanced torque transmission and distal support

Synchro® Guidewire:

- Employs a microfabricated nitinol hypotube technology with a pattern of machined slots; Variations in the slot profiles determines the support and flexibility characteristics of the distal segment



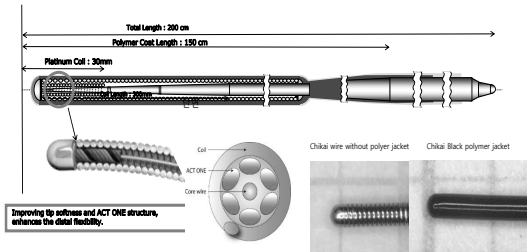
• Designed for Torque Control

• Intended for reliable Stability and Flexibility

	Synchro 10	Synchro 14	Synchro ²	Synchro ² Support	Synchro SELECT
Wire diameter proximal/distal (F)	0.012/0.010	0.014/0.014	0.014/0.014	0.014/0.014	0.014/0.014
Length (cm)	200, 300	200, 300	200, 300	215, 300	215, 300
Core Material	Microfabricated nitinol hypotube, stainless steel core	Microfabricated nitinol hypotube, stainless steel core	Microfabricated nitinol hypotube, stainless steel core	Microfabricated nitinol hypotube, stainless steel core	Microfabricated nitinol hypotube, stainless steel core
Flexibility options		Standard Soft	Standard Soft	Support	Soft Standard Support
Shape options	Shapeable tip	Shapeable tip	Straight Pre-shaped	Straight Pre-shaped	Straight Pre-shaped

7. Microwire

2. Chikai black / Asahi



	Usable length	Distal/Proximal OD	Polymer Jacket Length	특징
CHIKAI Black 14 soft tip	200cm	0.014" (0.36mm)	150cm	Polymer Jacket type
CHIKAI wire	200cm	0.014" (0.36mm)	None	Bare coil type

7. Microwire

3. Agility & Neuroscout / Cerenovus

Agility

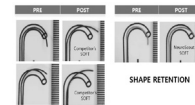
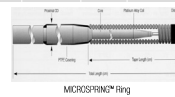
- Soft Tip : Safe navigation, min. risk rupture
- Shapeable Tip : Vessel access
- Flexible Lateral Profile : Vessel conformability
- MICROSPRING™ Ring : Torque response
- Platinum/Tungsten Coil : Radiopacity

Neuroscout

- Good Shapeability : procedural flexibility
- Tip Re-shapeability : re-shaping without wire kinking
- Tip Shape Retention : minimize shape loss over time

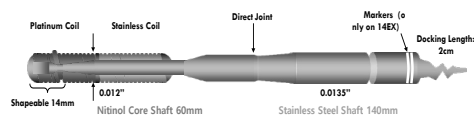
Guidewire	Description	OD	Length	Tapered length
Agility 10	Standard	0.010"	195cm	36cm
	Soft	0.010"	195cm	38cm
Agility 14	Standard	0.014"	205cm	42cm
	Soft	0.014"	205cm	45cm
	Standard XL	0.014"	350cm	42cm

Guidewire	Description	OD	Length	Tapered length
Neuroscout 14	Standard	0.014"	205cm	42cm
	Soft	0.014"	205cm	43cm



7. Microwire

4. Traxcess / Microvention



Product	Total Length	Nitinol Core Length	Stainless Coil Length	Platinum Coil Length	Stainless Coil Length	Shapeable Length	Hydrophilic Coating Length	Proximal Diameter	Distal Diameter	PTFE Coating
Traxcess 14	200cm	60cm	140cm	3cm	37cm	1.4cm	40cm	0.014"	0.012"	133cm
Traxcess 14EX	200cm	60cm	140cm	6cm	34cm	1.4cm	40cm	0.014"	0.012"	133cm

My favorite

- Diagnostic angio
 - : 5Fr short sheath + 5Fr Davis + Terumo wire
- Coil
 - : 6Fr Shuttle + 6Fr Navien + SL-10 m/c + coil
- IA thrombectomy
 - : 8Fr long sheath + 8Fr Optimo + 5Fr Sofia + Rebar m/c + stent retriever

감사합니다

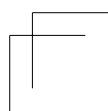
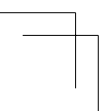
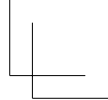
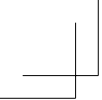


MEMO //////////////////////////////////////

Performing cerebral angiography and related cerebral arterial anatomy

신 동 성

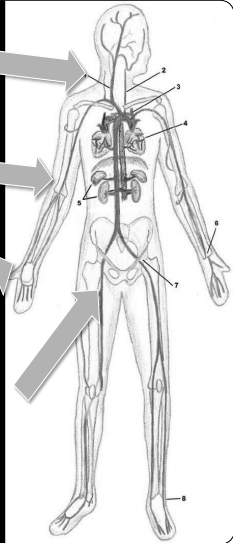
순천향대 부천병원



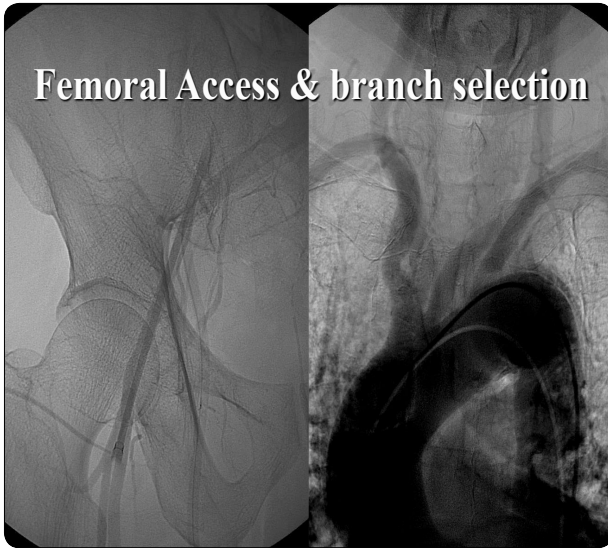
Performing cerebral angiography and related cerebral arterial anatomy

순천향 부천병원
신경외과
신동성 이호준 김범태

Carotid a.
Brachial a.
Radial a.
Femoral a.
Access route

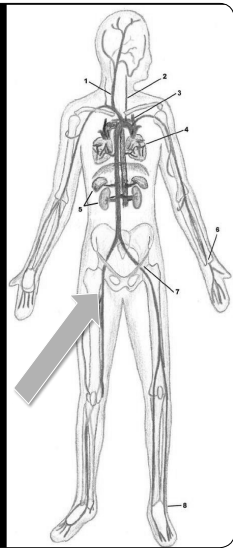


Femoral Access & branch selection



Complication

2~10%
Bleeding, hematoma(6~10%)
Pseudo-aneurysm(1~6%)
A-V fistula
laceration
Acute occlusion
Retroperitoneal hemorrhage
infection
(>1%)



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Abstract
A Morphometric Study on Cadaveric Aortic Arch and Its Major Branches in 25 Korean Adults : The Perspective of Endovascular Surgery
Bum-Tae Kim, MD, Dong-Seong Shin, MD
Department of Neurosurgery, Soonchunhyang University Bucheon Hospital, Bucheon, Korea

Objective : To understand the anatomic characteristics of the aortic arch (AA) and its major branches to build a foundation toward performing neuroendovascular surgery safely.

Methods : A total of 25 formalin-fixed Korean adult cadavers were used. The authors investigated anatomical variations of the AA and its branches, coordinates of the AA, distance from the mid-vertebral line to the origin of the major branches, distance from the origin of the common carotid artery (CCA) to the origin of the subclavian artery (SCA), and the angle of the CCA to the SCA.

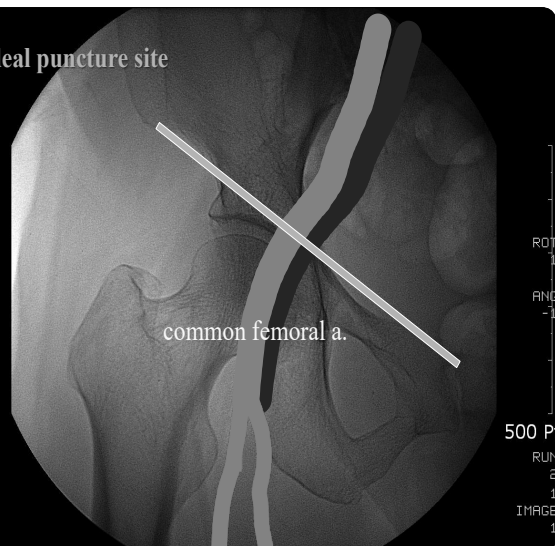
Results : The three major branches directly originated from AA in 21 (84%) of the cadavers. In two (8%) of remaining four cadavers, left ICA was slightly above the level of BCT. In remaining two (8%) cadavers, the left vertebral artery (VA) was directly originated from AA, averaging at AA coordinate in the coronal plane was 42.2 degrees. BCT averaged 102 mm on the right of the mid-vertebral line, CCA and CCA line from 12.3 mm and 22.3 mm on the left of the mid-vertebral line. Mean distance from the origin of the BCT to the origin of the RCA was 32 mm, distance from the origin of the CCA to the origin of the VA was 38.8 mm. Average angles at which the major branches arise from AA were 65.3, 46.8 and 43.8 degrees. The safe zone for arterial puncture is considered to be 0-20 mm above the BCTH on a fluoroscopic view. This study may provide comprehensive anatomical information to catheterize AA and its branches for safely performing transfemoral neuroendovascular approach.

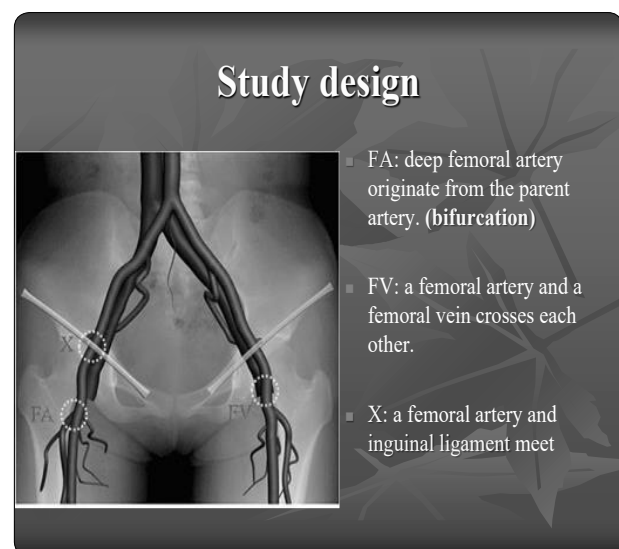
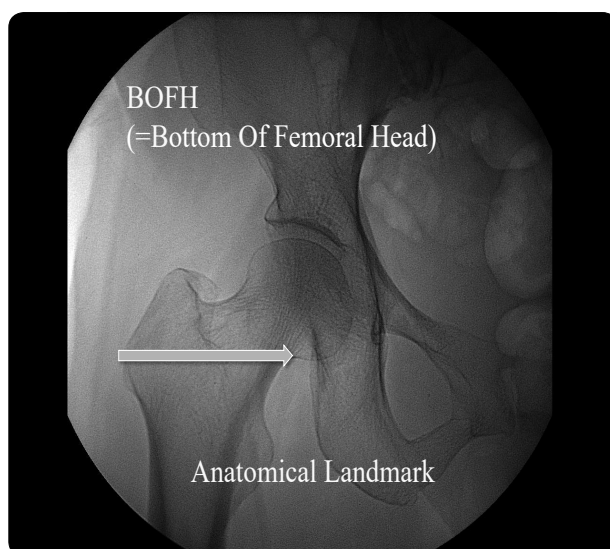
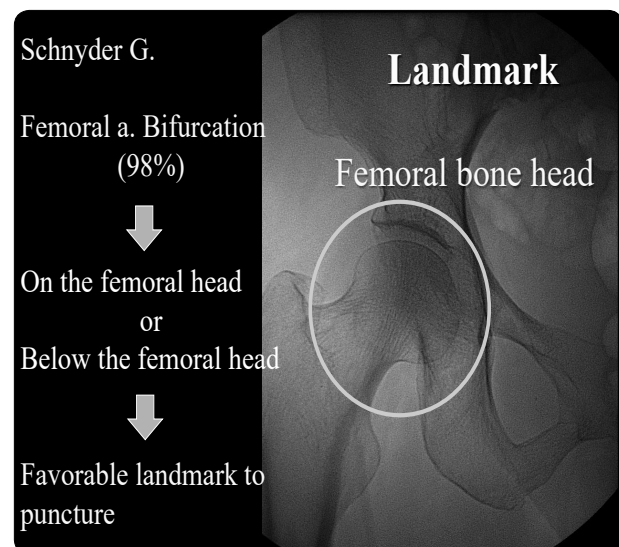
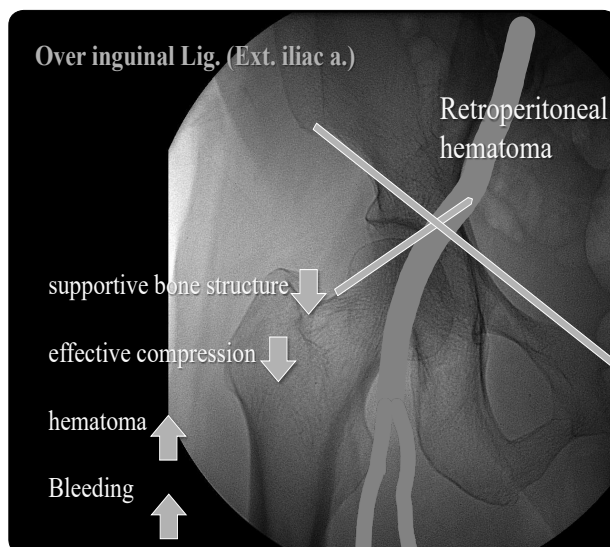
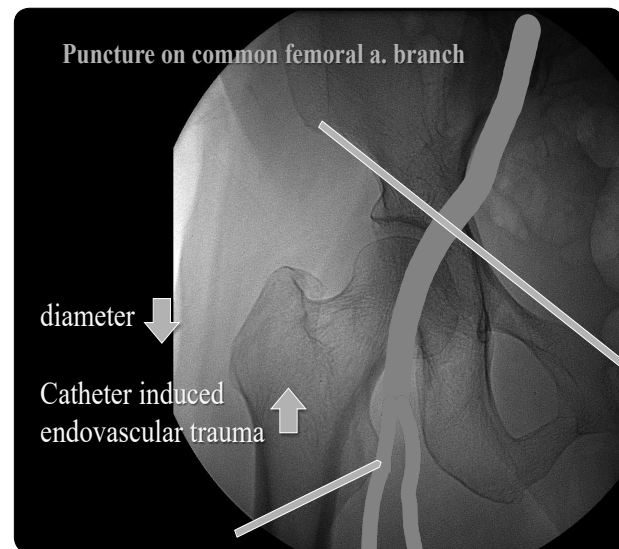
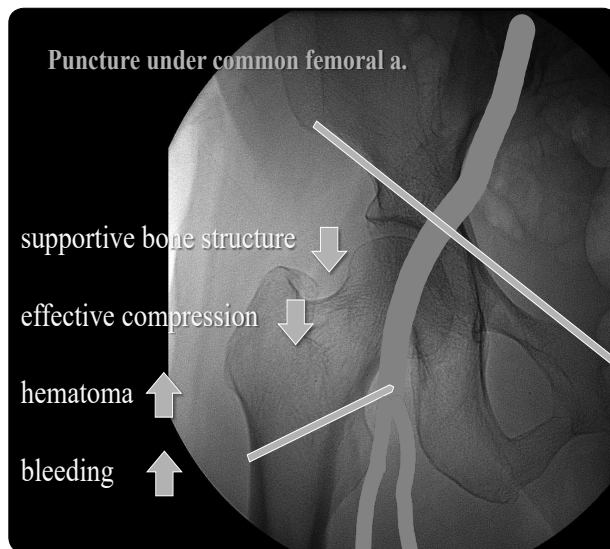
Key Words : Aorta; Femoral artery; Anatomy

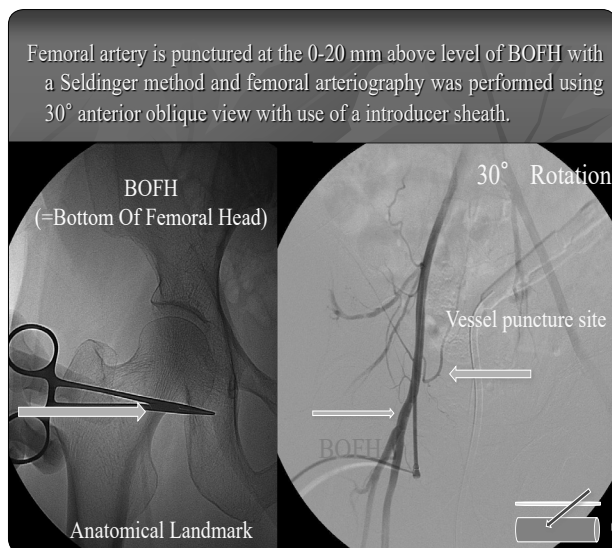
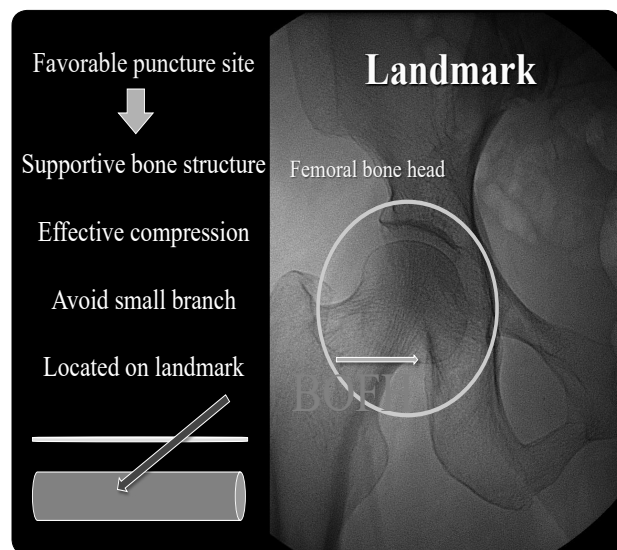
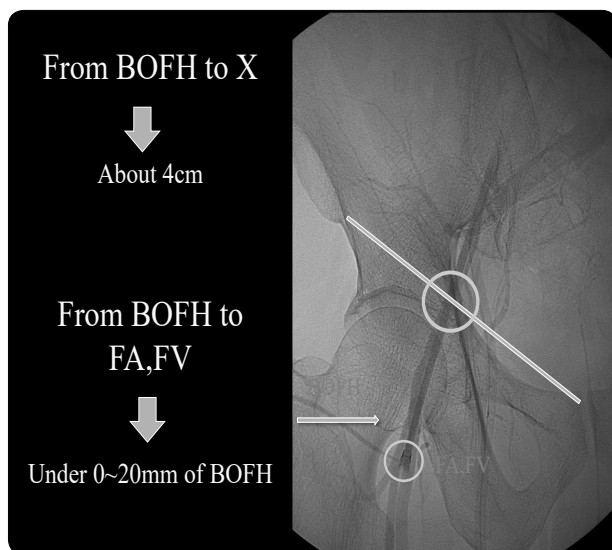
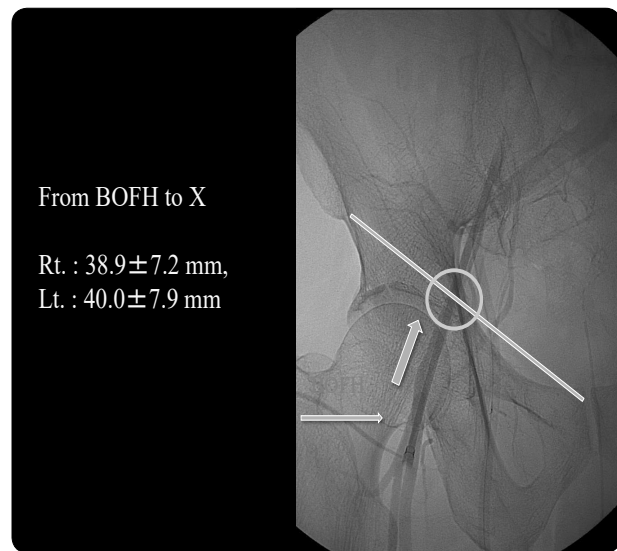
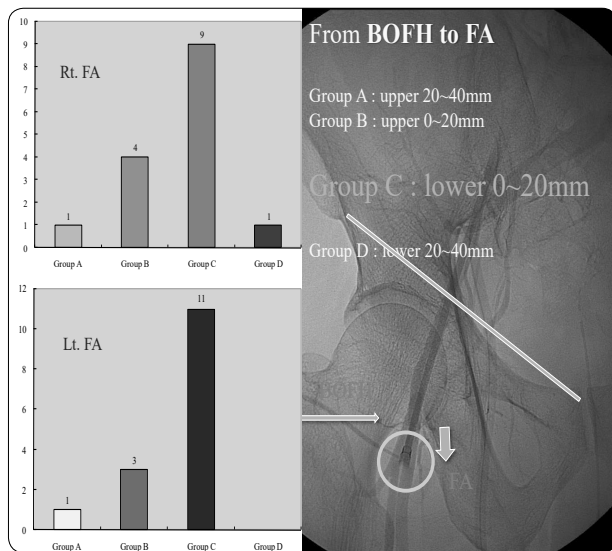
Journal of Korean Neurosurgical Society
Print ISSN 2095-3711 On-line ISSN 1598-7878
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Abstract
Morphological Assessment of Cadaveric Radial, Brachial and Subclavian Arteries : A Neurointerventional Approach
Ali Yilmaz, M.D., Ayca Ozkul, M.D., Dong Seong Shin, M.D., Soe-Bin Im, M.D., Seok-Mann Yoon, M.D., Bum-Tae Kim, M.D.
Department of Neurosurgery, Ankara University Faculty of Medicine, Ankara, Turkey
Department of Neurosurgery, Soonchunhyang University Bucheon Hospital, Bucheon, Korea
Department of Neurosurgery, Soonchunhyang University Chonan Hospital, Chonan, Korea

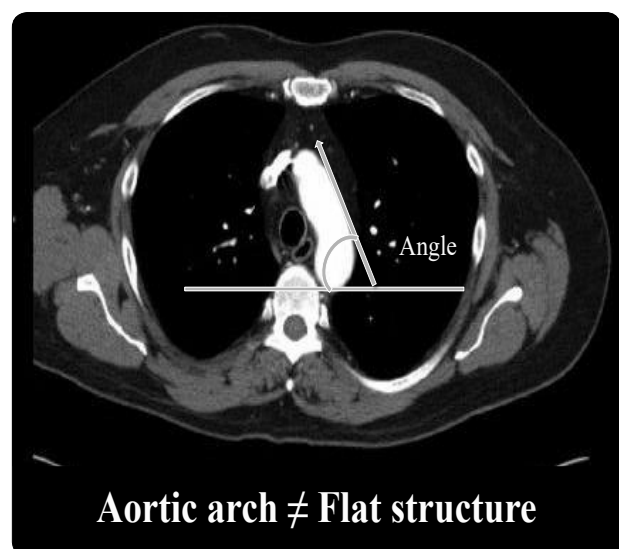
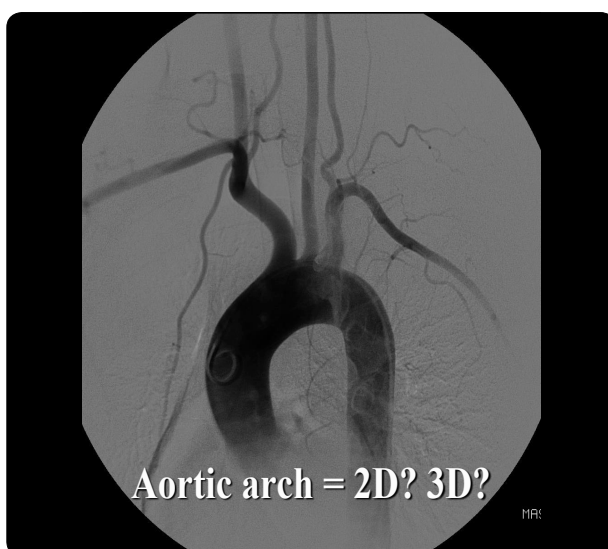
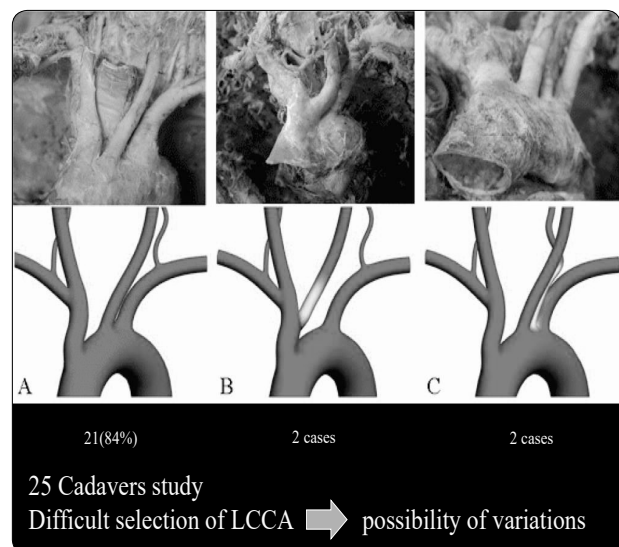
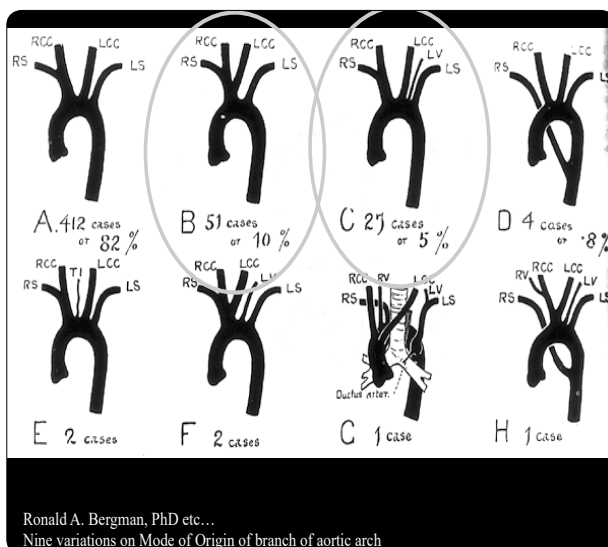
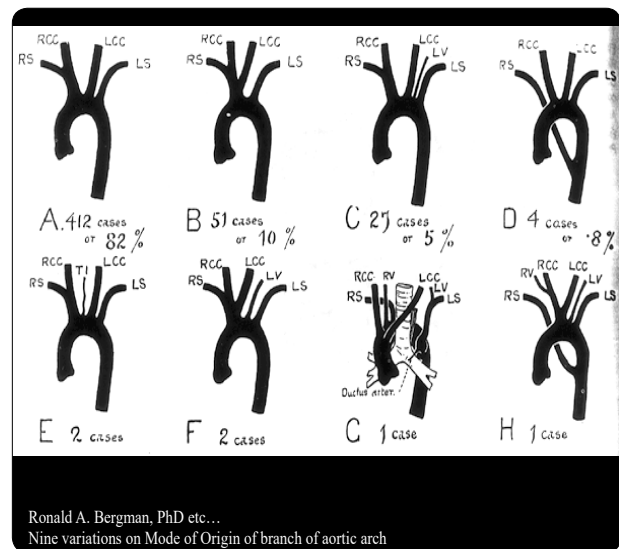
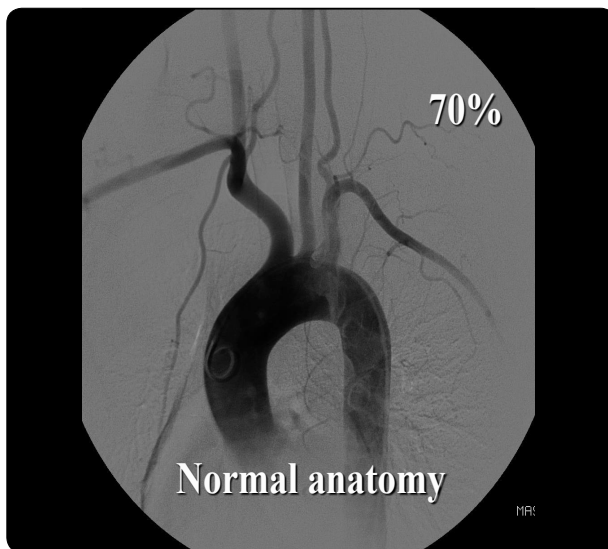
Ideal puncture site
common femoral a.

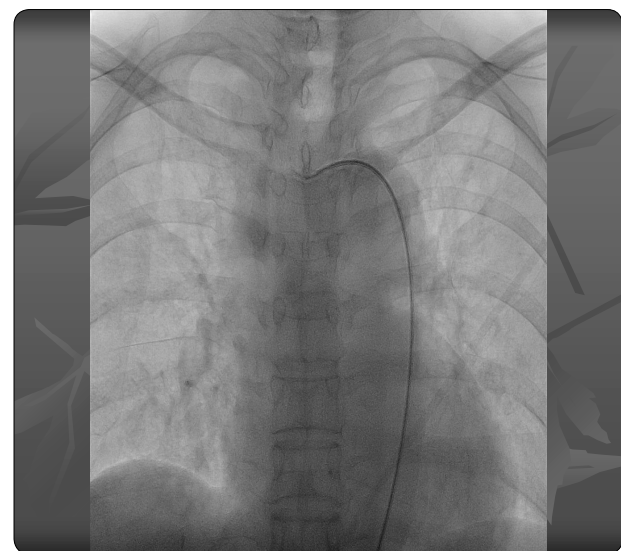
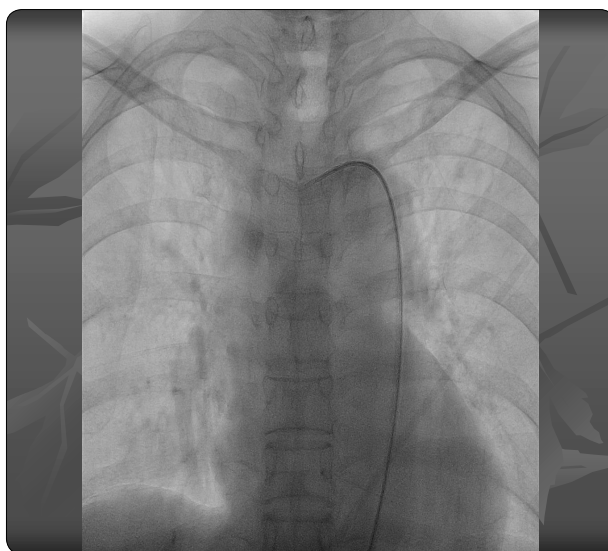
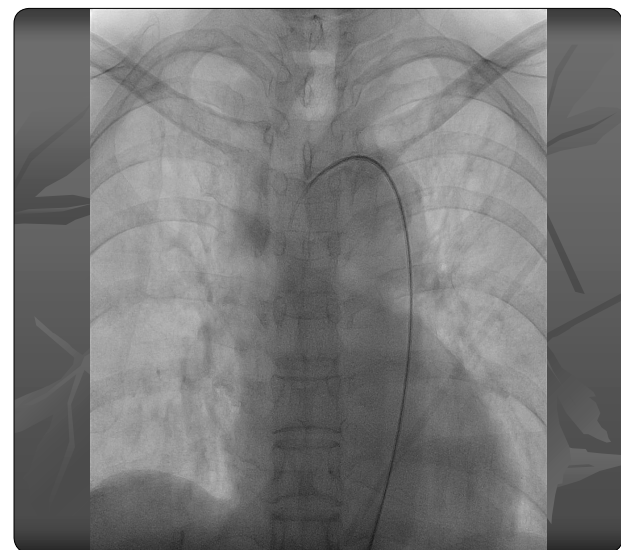
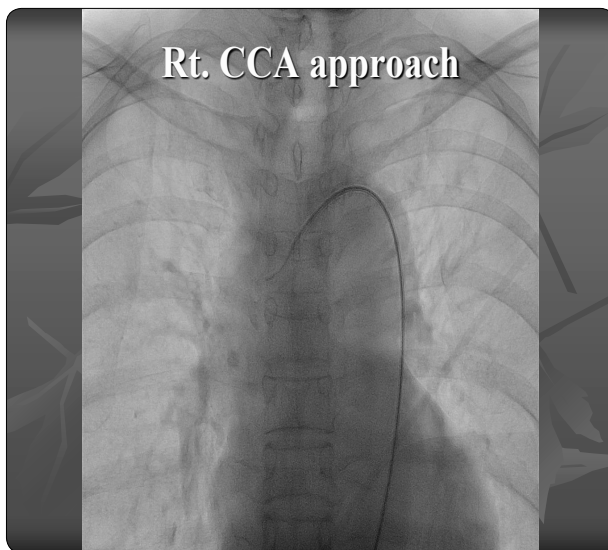
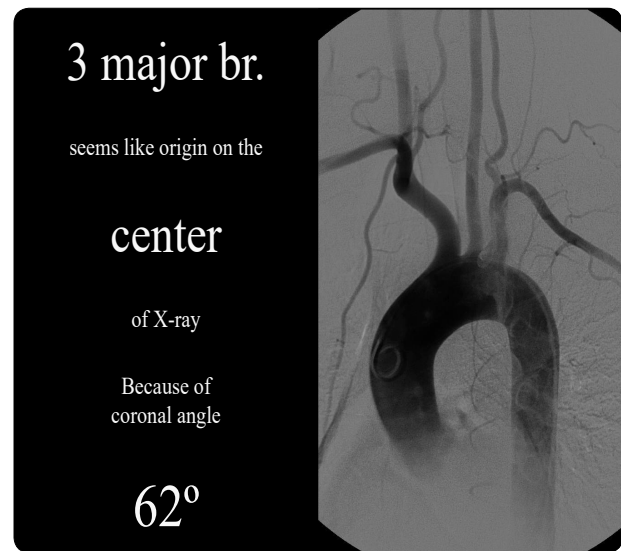
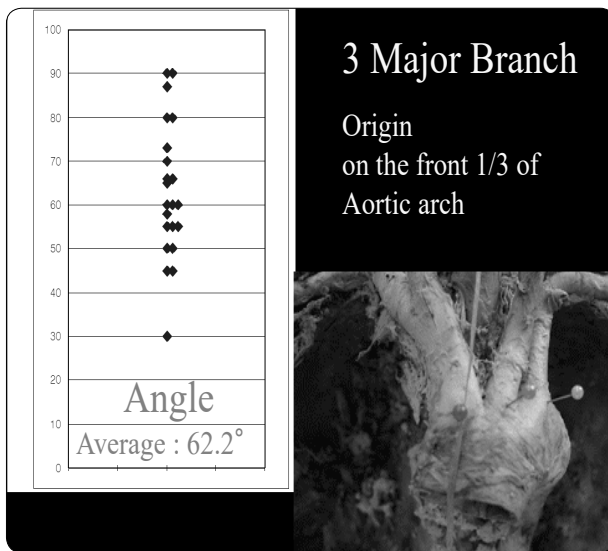


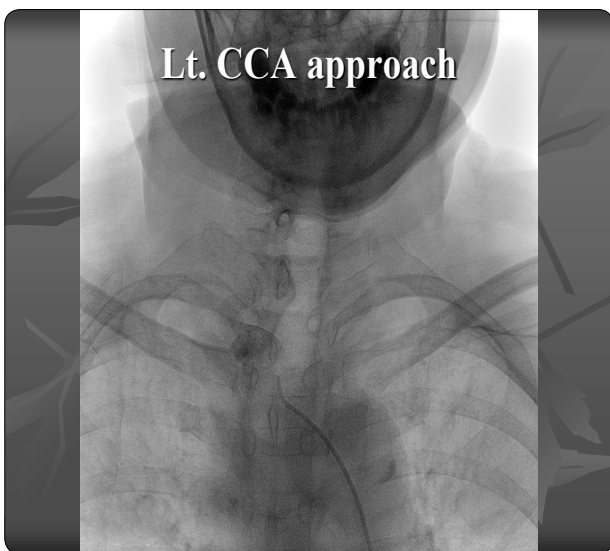
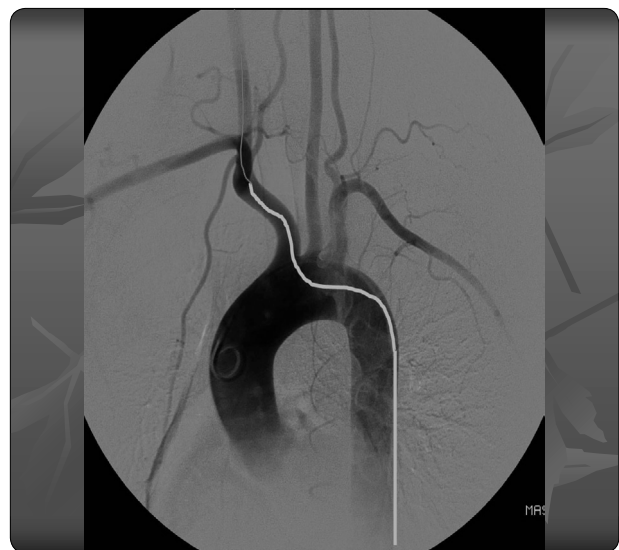
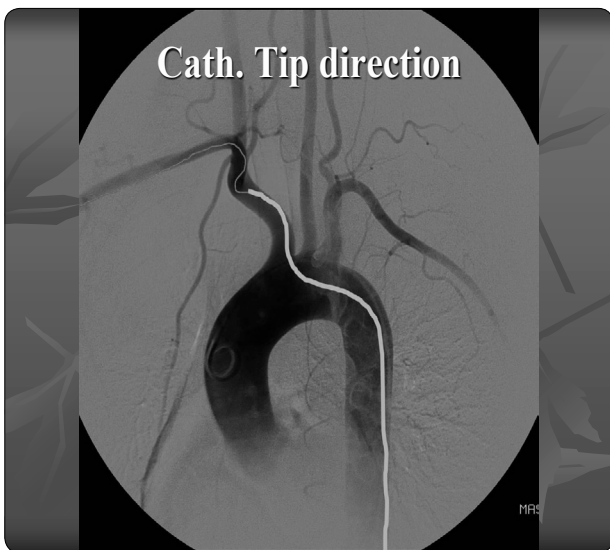
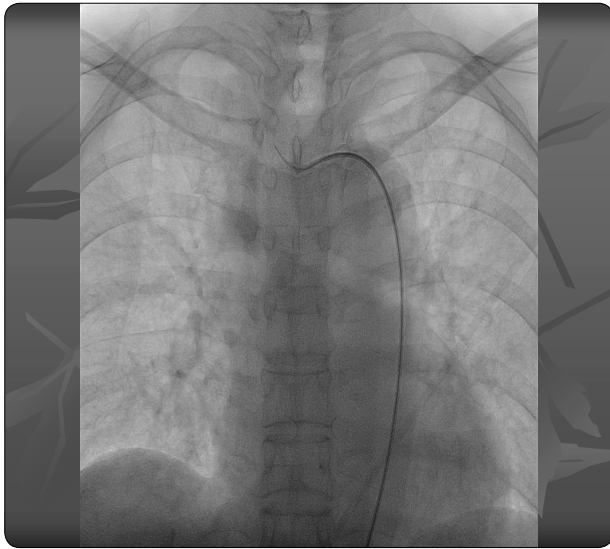


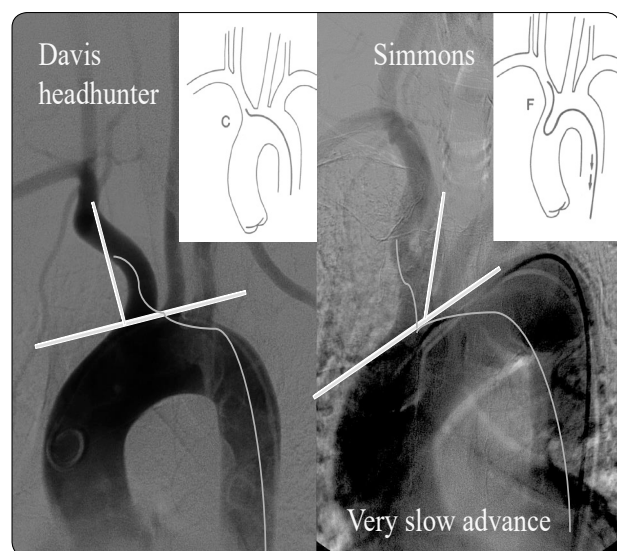
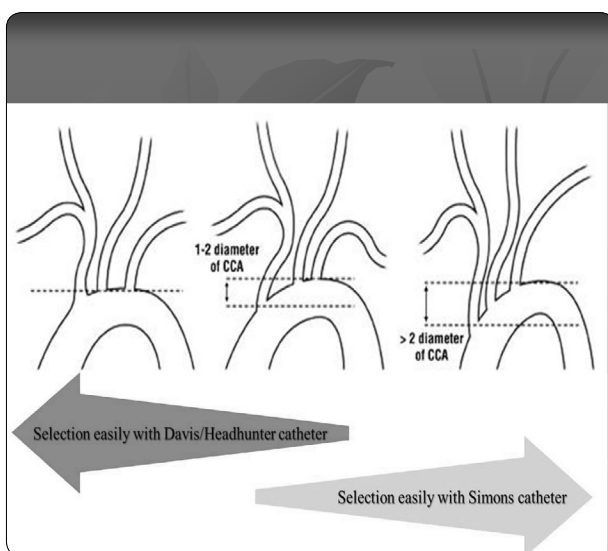
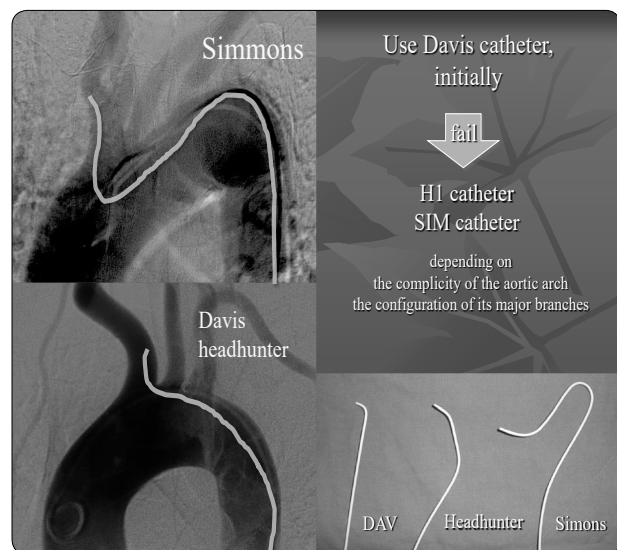
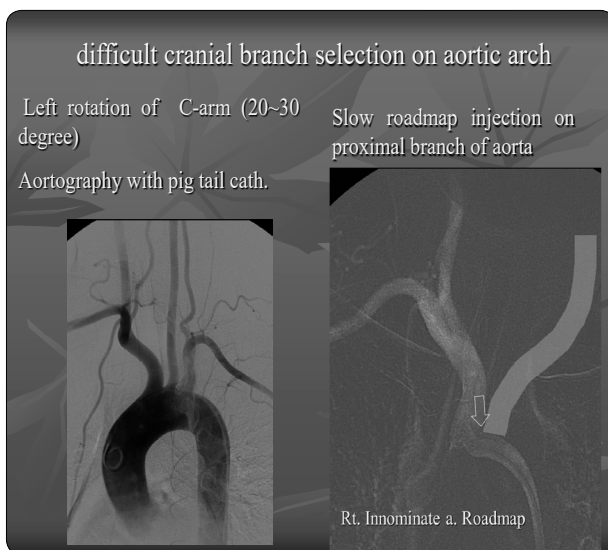
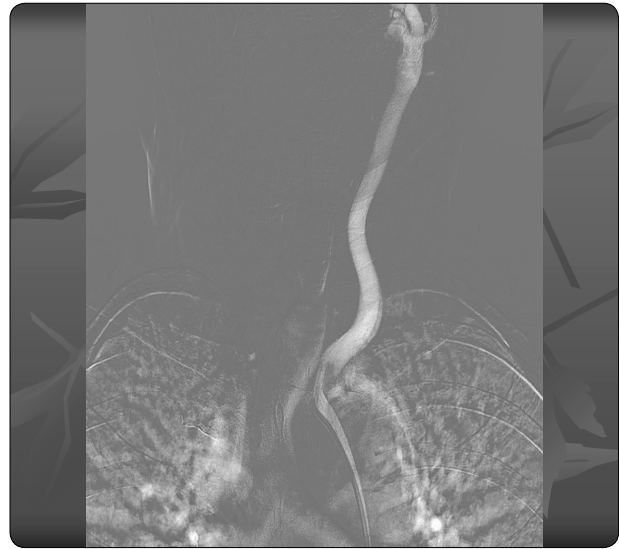
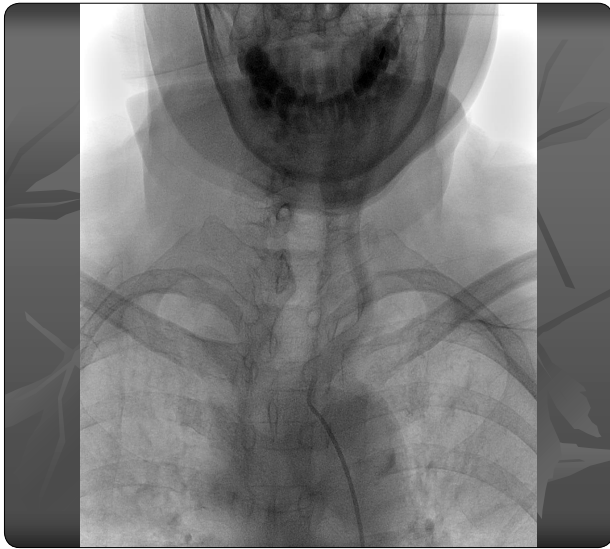


- USG is very useful for inguinal anatomy, puncture point
- A 5 French catheter is used for a adult and a 4 French is used under the age 10.
- The catheter techniques is done as gentle as possible like doing microneurosurgery.
- The selective catheterization of the carotids (internal and/or external), vertebral, or subclavian arteries was usually done.

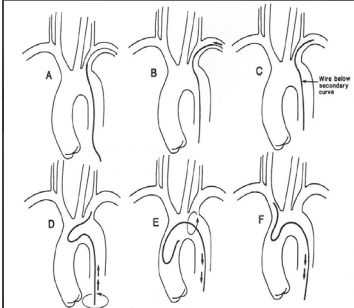




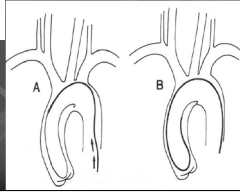




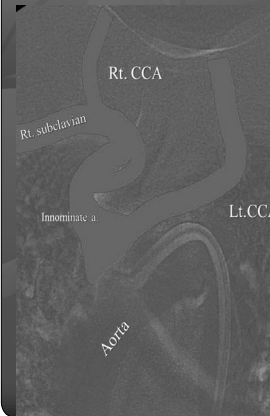
SIM cath. Set up



Initially, you have to make U-shape for vessel selection



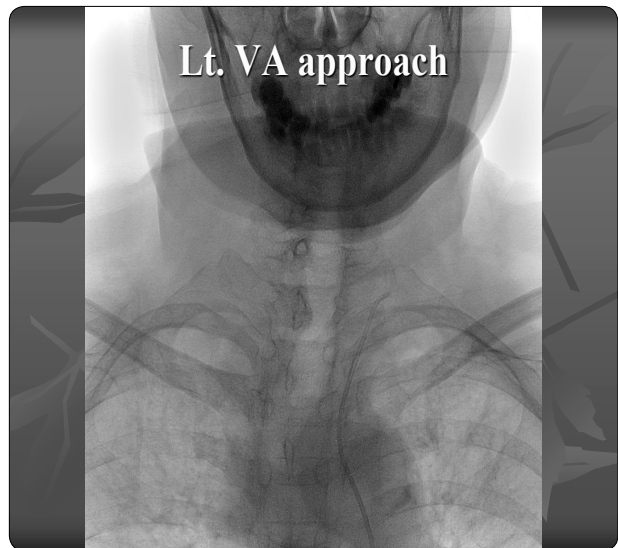
Failure of cranial vessel approach

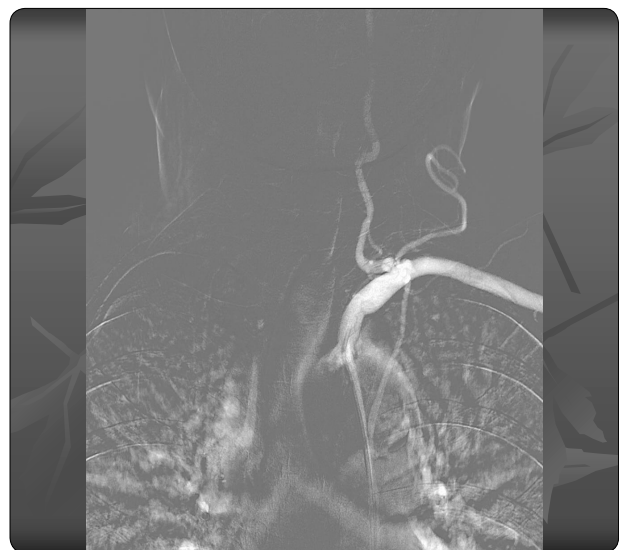


Angiography performed on proximal cranial vessels



Lt. VA approach



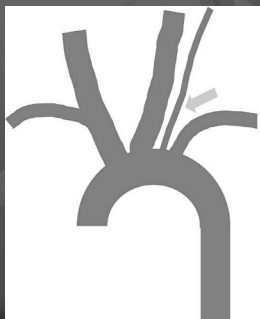


Invisible Lt. VA

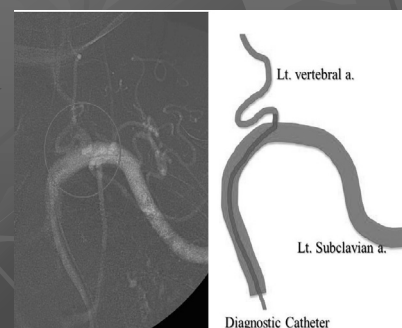
Lt. VA originated from aorta directly
Chronic occlusion of Lt. VA

Aortography

Rt. VA angiography with cath. Advance distally, (distal VA angiography)



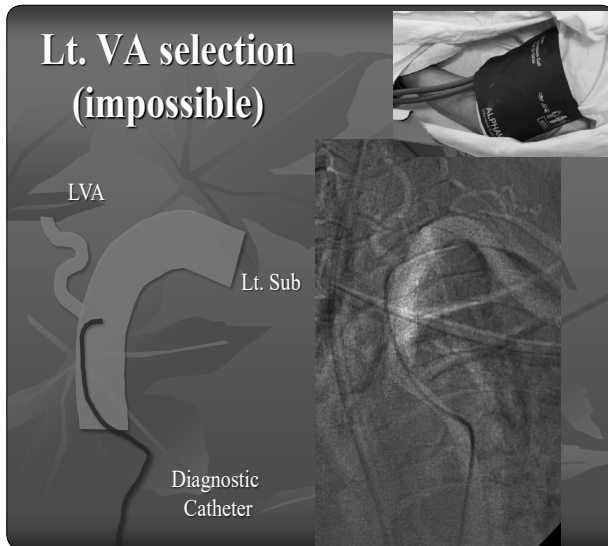
Complicated case of Lt. VA selection



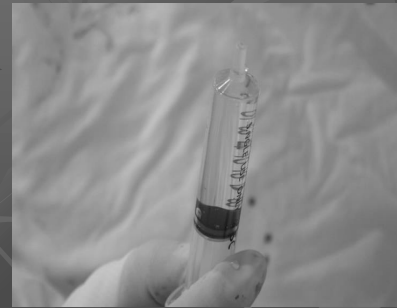
Proximal selection and angiography

Slow speed syringe dye injection angiography (No regurgitation of dye injector)

Lt. VA selection (impossible)



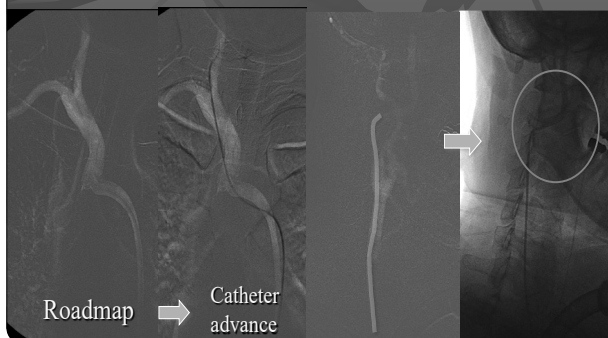
Others principle of TFCA



Operator always check air-bubble in the syringe when perform injection work.

Road map image should set it up essentially, before Catheterization

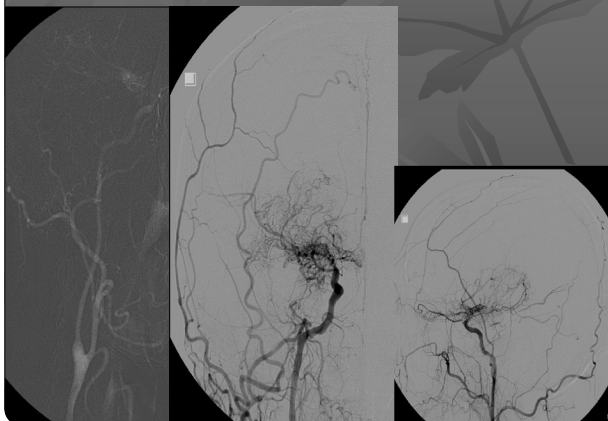
Test injection was performed by hand before connect injector line



We try to position the catheter as proximal level as possible (that is, in the large caliber of the selected artery) within the range of adequate diagnosis.

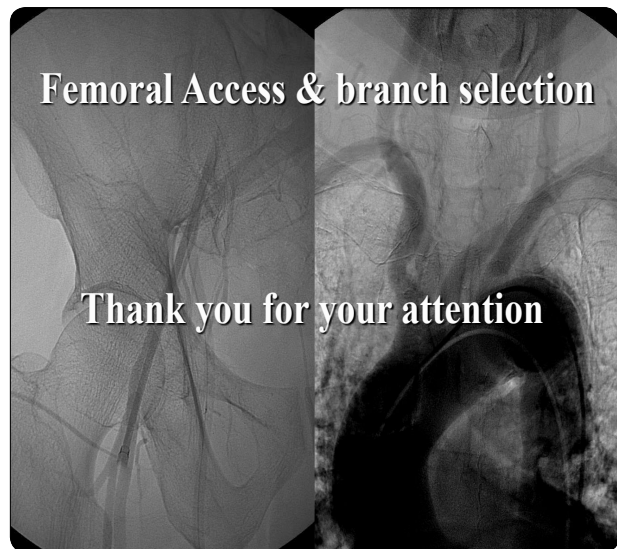


Exceptionally, we have selected common carotid and used the reduced volume of contrast in the moyamoya disease patients.



Femoral Access & branch selection

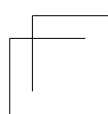
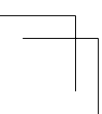
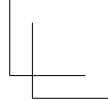
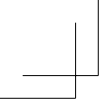
Thank you for your attention



Closing devices and techniques

유민욱

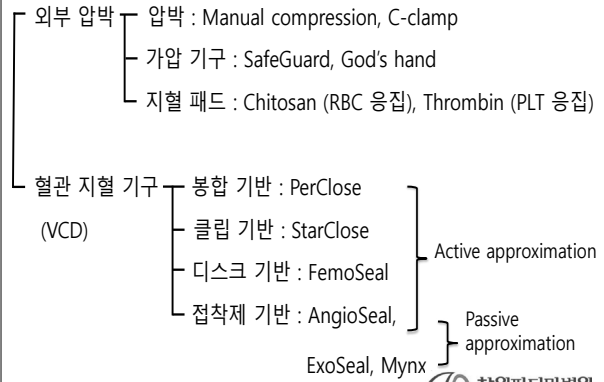
창원파티마병원



Vascular Closing Devices

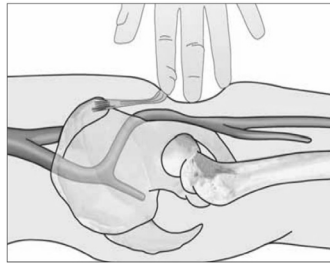


지혈 방법의 종류



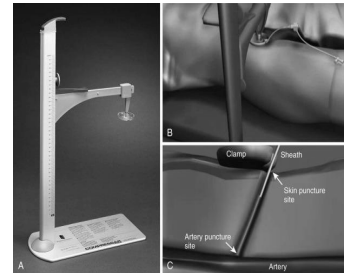
압박 – Manual compression

- 동맥 천자부위를 압박
(피부 천자 부위 2cm 위)
- 15~20분간 지혈
- 6~8시간 동안 침상 안정
- 지혈 기구 실패 시 다음단계는 '손으로 압박' 하기
- Manual compression은 천자부위 지혈의 'Gold standard'



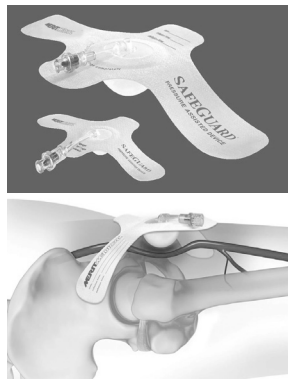
압박 – Compression Clamp

- 퇴원 전 천자 부위의 출혈, 혈종, distal flow, 및 청진 시 잡음 (pseudo-aneurysm 및 fistula 등을 확인하기 위하여) 을 확인함



가압 기구 - SafeGuard

- 1회용 공기 압박 기구
- 주사기로 7~40cc의 공기를 주입
- 손으로 누르는 시술자의 힘과 시간을 줄이는 효과가 있으나, 손으로 누르는 것을 완전히 대체하지 못함
- 장시간의 풍선 압박으로 인한 욕창을 포함한 합병증의 발생도 보고된 바 있음



가압 기구 – God's hand

- SafeGuard와 같은 1회용 공기 압박 기구로, 원리 및 기구의 사용 방법은 유사
- 다만 풍선 내로 공기를 100~150cc 주입하여, 지혈까지 걸리는 압박 시간 및 침상 안정 시간을 반으로 단축
- 손으로 누르는 것을 완전히 대체하지 못하며 장시간의 풍선 압박이 합병증을 일으킬 수 있음



지혈 패드

- 응고를 촉진할 수 있는 물질이 도포된 패드로, 천자 부위를 손으로 눌러서 지혈 시 더 빠르게 지혈을 시킬 수 있는 보조제

- ① Zeolite는 수분을 흡수하여 응집을 촉진 (QuickClot)
- ② Chitosan or Poly-prolate는 RBC의 응집을 촉진 (ChitoSeal, Clo-Sur PAD, HemCon)



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지혈 패드

③ PLT의 응집을 촉진 (D-Stat)

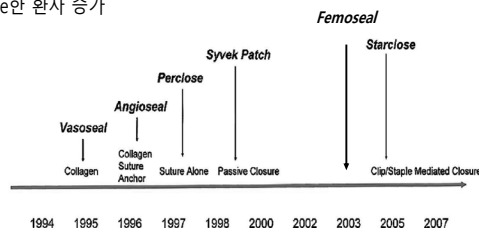
- 제품간의 차이는 크지 않으며, 단순히 손으로 눌러서 지혈하는 것보다 평균적으로 약 3분 가량 시간을 단축 시켰으나 지혈 후 보행까지 걸리는 시간은 단축 시키지 못함
- 지혈 패드 역시 손으로 누르는 것을 완전히 대체하지 못함



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혈관 지혈 기구 - 배경

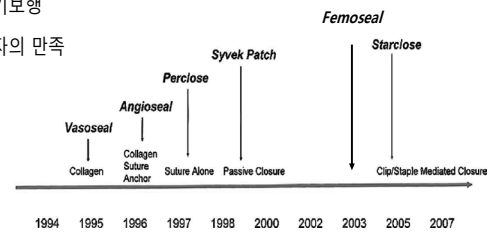
- 시술이 점점 더 복잡해짐에 따라 Larger introducing sheath 사용
- 항 응고제 사용 증가
- Obese한 환자 증가



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혈관 지혈 기구 - 결과

- 높은 성공률
- 지혈시간 단축
- 조기보행
- 환자의 만족



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혈관 지혈 기구 - 증명

- 30개의 randomized trial에 대한 meta-analysis
- ① 지혈 시간 : 평균 17분 단축
- ② 침상 안정 시간 : 10.8시간 감소 (95% CI, 8.5~13.1hrs)
- ③ 병원 입원 기간 : 0.6일 감소 (95% CI, 0.1~1.1days)

Arterial Puncture Closing Devices Compared With Standard Manual Compression After Cardiac Catheterization Systematic Review and Meta-analysis

Context: Arterial puncture closing devices (APCDs) were developed to replace standard compression at the puncture site and to shorten bed rest following percutaneous coronary intervention.

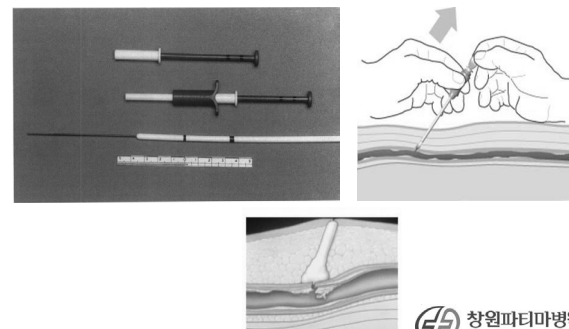
Objective: To assess the safety and efficacy of APCDs (Angioseal, VasoSeal, Duett, Perclose, Vascular Prostar) compared with standard manual compression in patients undergoing coronary angiography or percutaneous vascular interventions.

JAMA. 2004;291:350-357

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혈관 지혈 기구 - VasoSeal

- 1st FDA approved VCD at 1995



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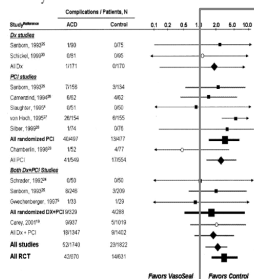
혈관 지혈 기구 - Vasoseal

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ISSN 0735-1017/04/\$18.00
doi:10.1016/j.jacc.2004.06.008

Vascular Complications Associated With Arteriotomy Closure Devices in Patients Undergoing Percutaneous Coronary Procedures A Meta-Analysis

- 2004년 합병증 보고
- 2006년 시판 중단



창원파티마병원
CHANGWON FATIMA HOSPITAL

혈관 지혈 기구 - 종류

종류	기구	회사	재료	최대 sheath 크기	지혈 성공률	지혈 시간	보형 가능 시간	합병증 발생률
봉합 기반	PerClose®	Abbott vascular	Polypropylene monofilament	8F (Single) 21F (Double)	89~100%	6~20 min	1.8~7.1 hour	0.8~3.6%
클립 기반	StarClose®	Abbott vascular	Nitinol clip	7F	86.8~94.1%	1.46 +/- 4.5 min	2.7±1.8 hour	1.1~4.8%
디스크 기반	FemoSeal™	Terumo	Polymer disc	7F (8F)	93.6%	1 min	1.5±0.6 hour	1.11%
접착제 기반	AngioSeal™	Terumo	Bovine collagen	8F 25F (Manta)	92~98.5%	1~18 min	1.4~9 hour	0.8~3.6%

창원파티마병원
CHANGWON FATIMA HOSPITAL

봉합 기반 – PerClose (8F 이하)

- PerClose는 천자 부위에서 동맥을 봉합하여 지혈
- 장점
 - ① 매듭이 묶여지고 즉각적으로 막힘
 - ② 다시 동맥 천자가 쉽다
 - ③ 혈관 안으로 남는 물질은 없다
 - ④ Polypropylene monofilament 봉합사 자체의 염증 반응이 적음
- 단점
 - ① 다른 지혈 기구와 비교하여 사용방법이 비교적 복잡

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봉합 기반 – PerClose (8F 이하)



창원파티마병원
CHANGWON FATIMA HOSPITAL

봉합 기반 – PerClose (8F 이상)

- 8F 이상의 동맥 천자에서는 두 개의 PerClose®제품을 사용하여 서로 엇갈리게 봉합하여 지혈
- 최대 21F까지 지혈 가능



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봉합 기반 – PerClose (8F 이상)



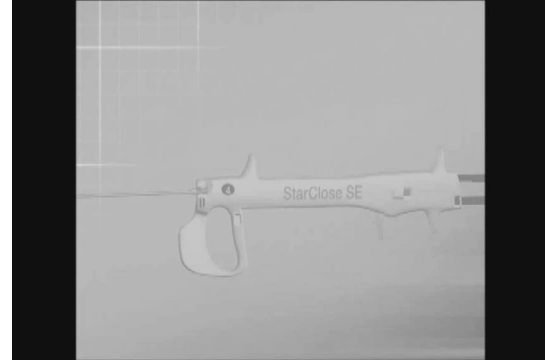
창원파티마병원
CHANGWON FATIMA HOSPITAL

클립 기반 - StarClose

- StarClose는 천자 부위를 혈관 밖에서 니켈 합금으로 된 클립을 이용하여 지혈
- 금속 클립은 3 Tesla MRI 에서도 안전하게 사용 가능
- 장점
 - ① 사용은 빠르고 쉬우며, 보통 48초 이내 사용이 끝남
 - ② 접착제를 사용하는 기구와 비교 시 염증 반응은 작음
- 단점
 - ① 재 천자 시 기존의 클립을 뚫을 수 있고, 이를 다시 StarClose로 지혈 시, 또 다른 클립과 기존의 클립이 간섭할 수 있는 가능성이 존재 (이에 대한 안전성 여부는 담보되지 않음)



클립 기반 - StarClose

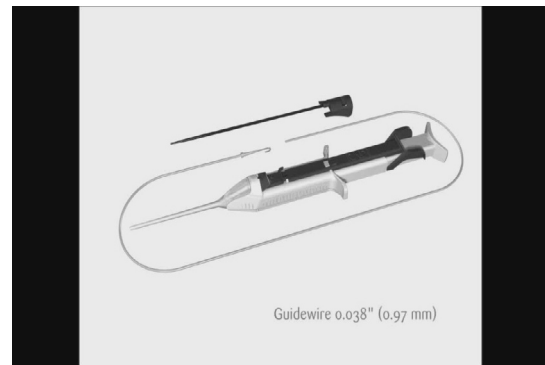


디스크 기반 - FemoSeal

- 두 개의 흡수성 디스크를 천자 부위의 안쪽과 바깥쪽에서 붙여 지혈
- 디스크는 90일 뒤 가수분해되어 흡수
- 주의
 - ① 사용시 혈관 안쪽으로 디스크가 남기 때문에, 천자 부위를 통한 조영 시 혈관의 협착이 없는 경우 시행하는 것이 안전
 - ② 한번 디스크가 펼쳐지면, 다시 회수할 수 없다



디스크 기반 - FemoSeal



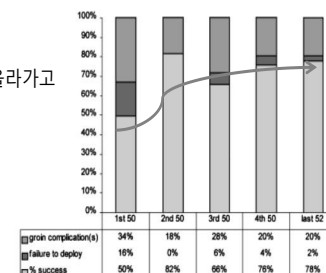
접착제 기반 - AngioSeal

- 지혈제가 흡수성 Dexon에 의해 직사각형의 1x2x10mm의 plate에 붙어있는 형태로 이루어져 있다. 천자 부위를 동맥 안에서 흡수성 plate가 anchor 역할도 하고, 밖에서 지혈제가 붙어서 샌드위치처럼 안과 밖에서 눌러서 지혈
- ExoSeal과 다른점
 - ① 대퇴동맥 sheath를 제거한 뒤 시술을 할 수 있음
 - ② 지혈제로 플라스젠 (PLT 응집 촉진, 면역반응 가능) 을 사용 (60~90일 이내 흡수)
- 장점
 - ① 짧은 learning curve로 쉽게 사용 가능 (미국 기준으로 50% 이상의 시장 점유율)
 - ② Aorta, carotid artery, subclavian artery 같이 다른 혈관 부위 에서도 사용 가능
- 단점
 - ① 혈관 안쪽의 판에 의한 embolus가 발생할 수 있는 가능성이 있으며 4mm 이상의 혈관에서만 사용하는 것이 추천



접착제 기반 - AngioSeal

- 첫 50case만 넘으면
 - ① 성공률은 빠르게 올라가고
 - ② 실패는 낮아지며
 - ③ 합병증은 적어짐



Predictors of Complications and Learning Curve Using the Angio-Seal™ Closure Device Following Interventional and Diagnostic Catheterization

Benjamin S. Warren,¹ Stafford G. Warren,^{2*} and Scott D. Miller²

Catheterization and Cardiovascular Interventions 48:162-166 (1999)



접착제 기반 - AngioSeal



현재는 AngioSeal Evolution -> AngioSeal VIP 으로 upgrade

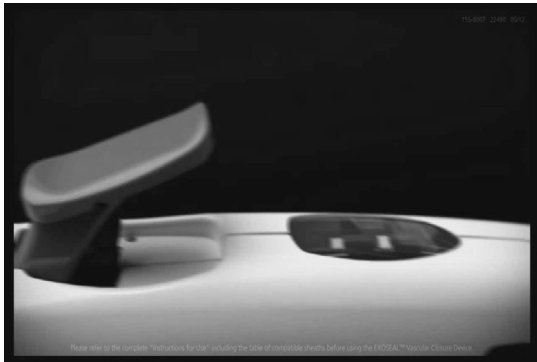


접착제 기반 - ExoSeal

- 지혈제는 약 60~90일 이내에 가수분해 되어 흡수
- AngioSeal과 다른점
 - ① 기존의 대퇴동맥 sheath를 제거하지 않고 sheath 안으로 기구를 삽입하여 봉합
 - ② 지혈제로 비 콜라겐 계열인 polyglycolic acid (PGA) 를 사용
- Mynx와 다른점
 - ① 지혈제의 위치를 잡기 위해 Mynx는 풍선을 사용하였으나 ExoSeal은 금속(nitinol) 와이어 링을 사용하는 점이 다름
 - ② 혈액의 분출과 계기판을 통하여 기구 끝부분의 위치 확인이 가능

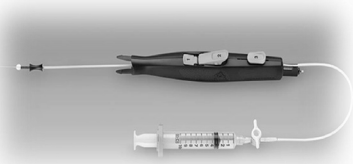


접착제 기반 - ExoSeal



접착제 기반 - Mynx

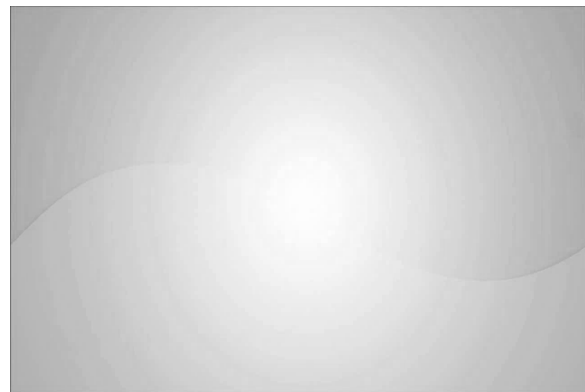
- 지혈제로 비 콜라겐 계열인 polyethylene glycol (PEG)를 사용
- 지혈제는 30일 이내 가수분해되어 흡수
- 지혈제의 위치를 잡기 위해서 천자 부위 안쪽에서 걸어주는 anchor 으로 풍선을 사용한다.



접착제 기반 - Mynx

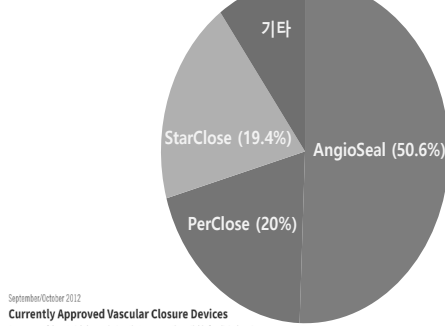


접착제 기반 - MANTA



혈관 지혈 기구 - 점유율

2010년 Global market share



September/October 2012
Currently Approved Vascular Closure Devices
A summary of the arterial closure devices that are currently available for clinical use in the United States.
By Ronald R. Caputo, MD, FACC, FSCAI

창원파티마병원
CHANGWON FATIMA HOSPITAL

혈관 지혈 기구 - 특징

- | | |
|---|--|
| <ul style="list-style-type: none"> • PerClose <ul style="list-style-type: none"> ① 혈관 안쪽에 남는 것이 없이 지혈 ② 사용 방법이 어렵다 • StarClose <ul style="list-style-type: none"> ① 빠르고 확실한 지혈 ② Re-puncture가 어렵다 | <ul style="list-style-type: none"> • FemoSeal <ul style="list-style-type: none"> ① 직관적인 사용법 ② 혈관 안쪽으로 디스크가 남음 • AngioSeal <ul style="list-style-type: none"> ① 높은 지혈 성공률 ② 지혈제로 인한 잠재적 감염 가능 |
|---|--|

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혈관 지혈 기구 - 합병증

- 지혈 기구와 손으로 누르는 경우 간에 합병증 발생률의 차이가 이전 보다 나아진 결과를 보여주고 있다.
- 혈관 지혈 기구 사용시 기구에 의한 색전을 제외한다면 손으로 누르는 경우와 거의 차이가 없다는 보고도 있다.
- 그러나 감염, 폐색, 동정맥류, 및 출혈을 동반하는 가상 동맥류 등은 반복되는 동맥 천자와 연관된 합병증으로 남아있다.

Angiographic Access Site Complications in the Era of Arterial Closure Devices

Shari L. Meyerson, MD, Ted Feldman, MD,* Tina R. Desai, MD, Jeffrey Leef, MD, Lewis B. Schwartz, MD, and James F. McKinsey, MD, Chicago, IL

Vascular and Endovascular Surgery Volume 36, Number 2, 2002

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혈관 지혈 기구 - 합병증

- 항 응고제를 복용하는 경우, 혈관 지혈 기구 사용 시 합병증 발생률이 손으로 누르는 경우와 비슷하다는 보고가 많음
- 그러나, 후 복강 내 혈종이나 천자 부위 감염과 같은 경우는 항 응고제를 복용하는 경우 지혈 기구 사용시 더 많다고 보고되고 있다.
- 대퇴동맥의 경우 약 5% 정도의 환자에서 5cm 이상의 큰 혈종이 생길 수 있다.
- 천자 시 동맥과 정맥 모두 뚫려 손상이 발생한 경우 동정맥류가 생길 수 있으며, 초음파를 포함한 검사가 필요할 수 있다.

Cardiac Catheterization Vol. 40, No. 1, 2002
ISSN 0735-1097/02/0201924-1
P1 80735-1097/02/01924-1
Vascular Closure Devices in Patients Treated With Anticoagulation and IIb/IIIa Receptor Inhibitors During Percutaneous Revascularization
Robert J. Applegate, MD, FACC; Mark A. Gatzert, MD; William C. Little, MD, FACC; Timothy C. Smith, MD; Michael W. Jones, MD; Robert R. Kohn, MD, FACC; Gregory A. Braden, MD, FACC; Kevin M. Rankin, MD, FACC; Michael A. Kessler, MD, FACC; Winston Salas, MD; Caroline and Nicholas J. Tancos

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혈관 지혈 기구 - 합병증 분류

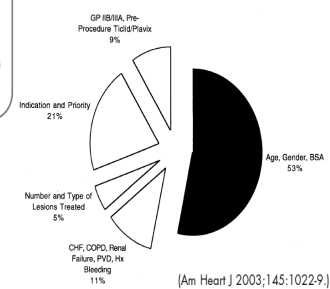
- 허혈
 - ① Artery의 stenosis
 - ② 디스크 기반 혈관 지혈 기구
- 출혈
 - ① 고령
 - ② 혈관의 석회화
 - ③ 기저질환 : ESRD
 - ④ In-complete closing : pseudo-aneurysm으로 진행가능
 - ⑤ 혈관 후벽 천자
- 감염
 - ① 점착제 기반 혈관 지혈 기구
 - ② Re-puncture

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혈관 지혈 기구 - 합병증 위험 요소

- ① 나이 (70세 이상)
- ② 여성
- ③ Body Surface Area (BSA) < 1.6m²
- ④ Emergent procedure
- ⑤ Cr > 2mg/dL
- ⑥ Glycoprotein IIb/IIIa inhibitor (Tirofiban)
- ⑦ Plavix
- ⑧ Multi-lesion

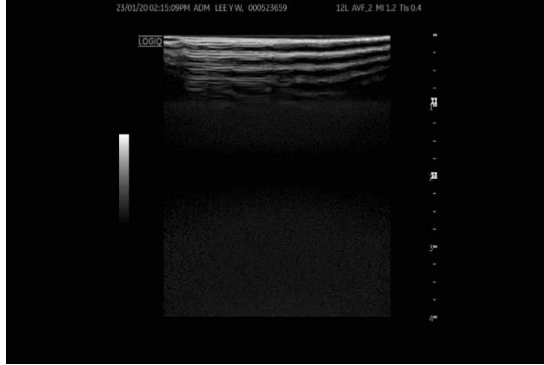
Predicting vascular complications in percutaneous coronary interventions



창원파티마병원
CHANGWON FATIMA HOSPITAL

합병증 예방 방법

- 혈관의 후 벽을 뚫지 않는다.



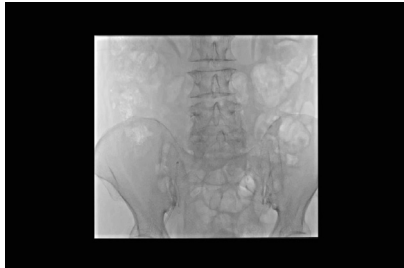
합병증 예방 방법

- Femoseal의 Tip 부위는 생각처럼 부드럽지 않다.
- Soft wire를 그 모양 그대로 따라 올라가지만 반드시 그렇지만은 않음.
- Femoral artery가 tortuous 하거나 고령으로 탄력이 없는 경우 wire를 물고 artery를 뚫을 수 있음.



합병증 예방 방법

- Femoseal set 안에 있는 wire 보다는 stiff wire를 쓰는 것도 한 방법
⇒ 그러나 stiff wire는 다른 혈관에 걸린 경우, 잘못 밀면 혈관 손상 가능성 soft wire 보다 높음



합병증 예방 방법

- 찢어지는 느낌이 있는 경우 rupture point를 바로 손으로 눌러야 함
- Rupture point로 의심되는 부위에 기구를 대서 point를 확인 후 손으로 누른 뒤, 충분히 지혈된 후 Angio 장비를 이용해서 CT를 촬영할 수 있음 바로 확인한다.



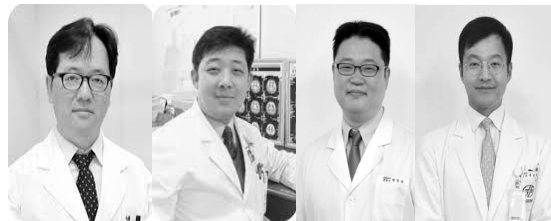
결론

- 전 세계적으로 모든 동맥 천자 후 약 30~50%는 지혈 기구를 사용하여 지혈되는 것으로 알려져 있다.
- 손으로 눌러서 지혈하는 것과 비교하여 최근에 나오고 있는 지혈기구는 유의미하게 합병증은 낮아지고 사용자 편리성은 더 높아지고 있다.
- 천자 부위의 직경, 환자의 나이 및 기저 질환, 지혈을 위한 시간적 제약 등이 지혈 기구 사용을 결정하는 중요한 요인
- 많은 지혈 기구가 모두 효과적이며 그 합병증의 발생은 큰 차이를 보이지 않는다.
- 다만 사용방법에 따른 사용자의 숙련도 여부와 재 천자 여부 등이 어떤 지혈 기구를 사용할 지를 결정하게 할 것이다.

감사합니다

각각의 사진과 동영상에 대한 저작권은 Abbott, Terumo, Cordis, Teleflex 회사에 있습니다.

문의 : a01066941279@gmail.com



MEMO //////////////////////////////////////

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- 최적화된 수산화마그네슘 용량 복합으로 정제 크기 소형화⁸⁾

* UBIST Data: 2021년 누적 원외처방금액 기준 [※ UBIST Data : 의약품 통계 정보 서비스로 의료기관에서 발행된 원외 처방전을 통해 조제된 약국의약품 조제 내역 데이터]

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- 2) Lee YJ, Kwak MK, Eom JH, et al. Optimal regimen and period for the treatment of patients with laryngopharyngeal reflux disease. *Korean J Otorhinolaryngol-Head Neck Surg.* 2014;57(57): 698-702.
- 3) Scheiman JM, Yeomans ND, Talley NJ, et al. Prevention of ulcers by esomeprazole in at-risk patients using non-selective NSAIDs and COX-2 inhibitors. *Am J Gastroenterol.* 2006;101(4):701-710.
- 4) Xin Y, Manson J, Govan L, et al. Pharmacological regimens for eradication of Helicobacter pylori: an overview of systematic reviews and network meta-analysis. *BMC Gastroenterol.* 2016;16(1):80.
- 5) Data on file. HM-ESOM-101.
- 6) Data on file. HM-ESOM-103.
- 7) Data on file. HM-ESOB-101. 에소메졸플러스 40/350mg 최고혈중농도 도달시간 : 약 20분
- 8) Data on file. 수산화마그네슘 양 선정근거자료.

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Reference

1. González-Contreras J. et al. NutrHosp. 2012;27(6):1900-7 2. Braga M et al., Clinical Nutrition 2009;28:378-386

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