

Techniques and Complications of EndoVascular Aortic Repair



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- **TEVAR**
 - **Indications & contraindications**
 - **Procedure & technical tips**
 - **Hybrid TEVAR (debranching techniques)**
- **EVAR**
 - **Indications & contraindications**
 - **Procedure & technical tips**
 - **Advanced techniques (Chimney, Sandwich, coiling, plugging)**
- **Complications in (T)EVAR**

Definition..!!!!



- **Aneurysm**

Diameter > 50%, all 3 layers (intima, media, adventitia)

- **Pseudoaneurysm**

Disruption of arterial wall with extravasation
Blood contained by periarterial connective tissue
(not by the arterial wall)

- **Ectasia**

Arterial dilatation < 150%

- **Aortic dissection**

Disruption of the media layer
Bleeding within and along the wall of the aorta

- Acute aortic dissection
- Chronic aortic dissection
- Subacute aortic dissection

TEVAR



TEVAR (Thoracic EndoVascular Aortic Repair)

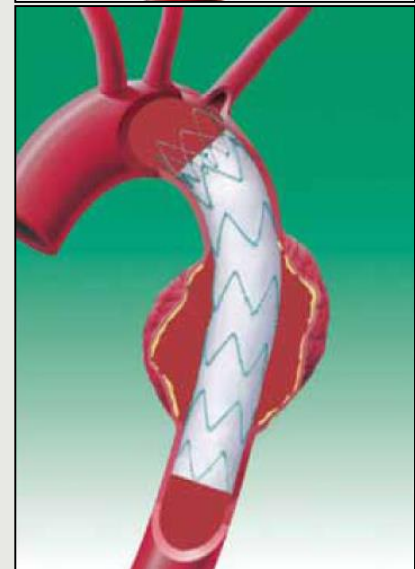
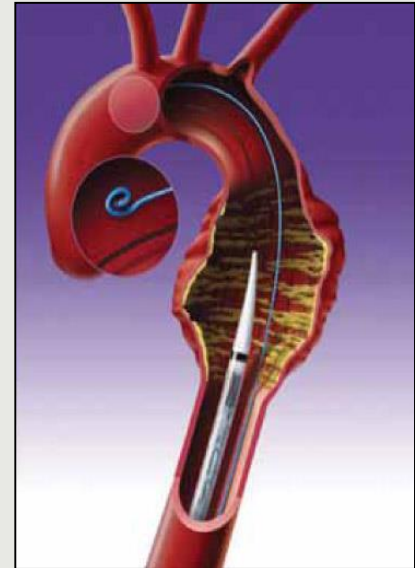


- **Indication**

- Aortic aneurysm (>6.0cm, 1cm/yr, symptomatic)
- Aortic dissection (ex. Complicated type B AoD)
- Traumatic aortic injury

- **Contraindication**

- Hypersensitivity in stent-graft
- Condition that threatens to infect the graft

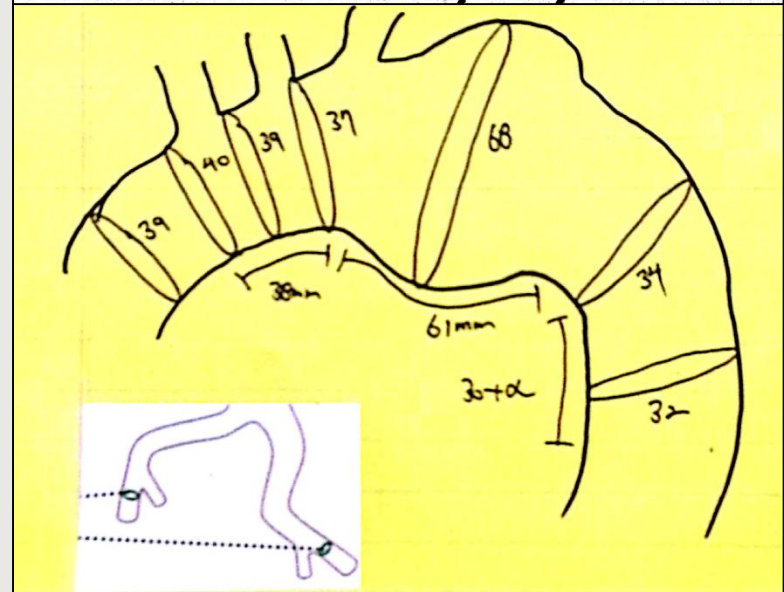
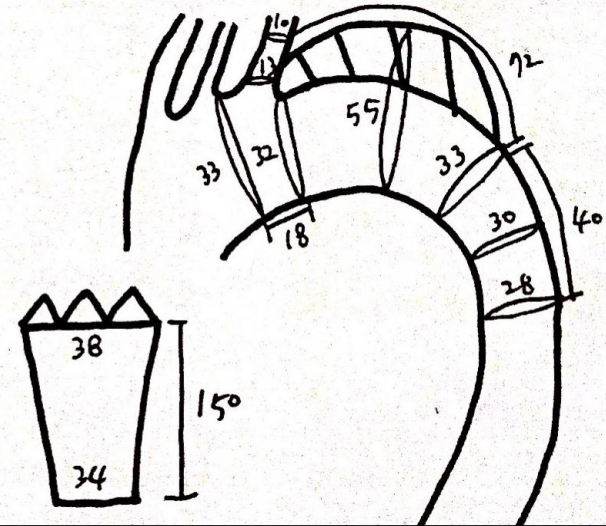


Planning

- Condition of access vessel
 - Iliofemoral artery & abd aorta
 - Tortousity & stenosis
- Proximal and distal landing zone
 - Angle & length
- Size of stent-graft
 - >10-15% than native aorta
 - Tapered vs straight
 - Etiology
 - aneurysm, dissection, shock



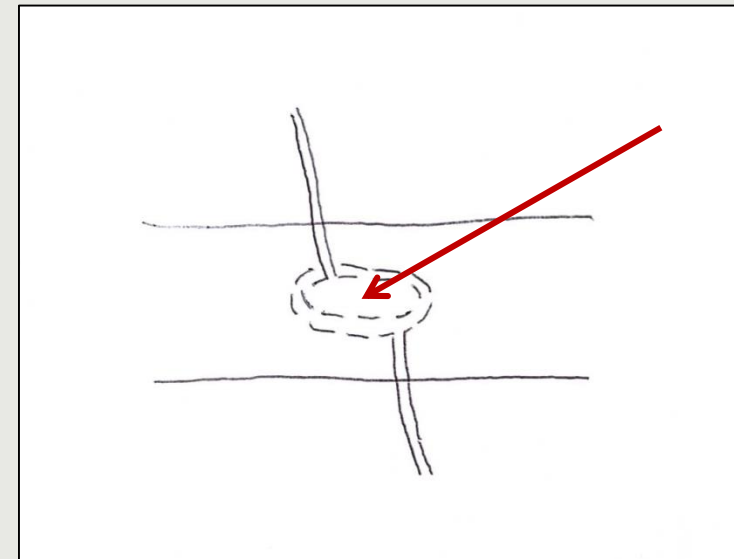
Drawing / Remarks



Approach

- **Percutaneous**
 - Preclosing with Perclose devices
 - Learning curve, costs....

- **Exposure**
 - Small incision
 - Purse-string suture (Prolene 5-0, x2)



Guidewire & catheter insertion in TEVAR



- **Approach**

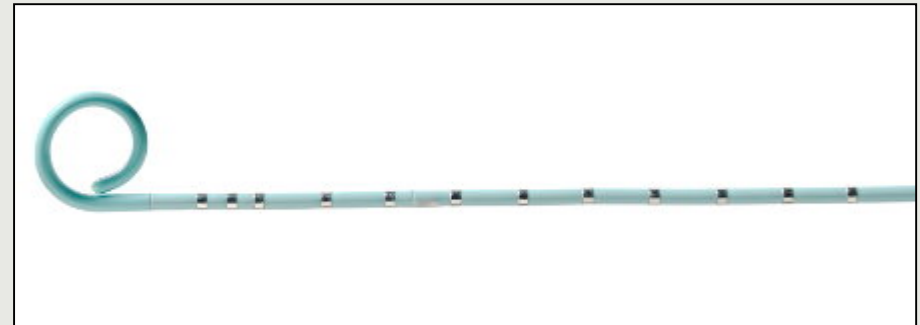
- 5Fr sheath insertion
- Open vs. pre-closing

- **5Fr sheath**

- Soft wire (260mm) → pig-tail catheter (for angio & sizing)

- **Open vs. pre-closing**

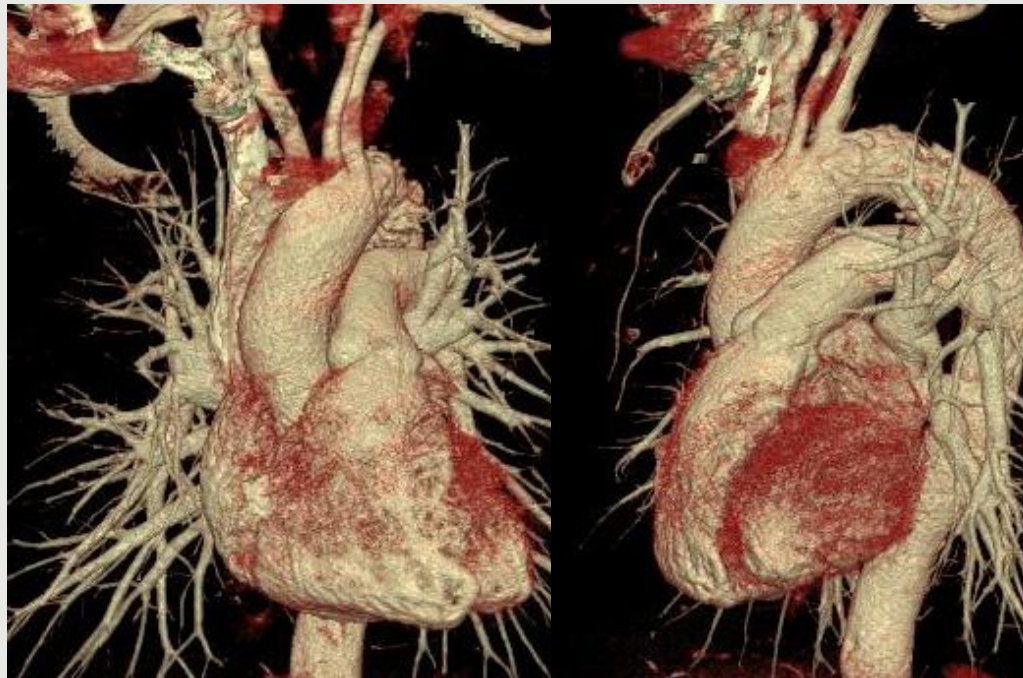
- Soft wire (260mm) → long catheter (ex. DAV) → super-stiff wire (260mm, ex. Lunderquist) → stent-graft deployment



Initial aortography



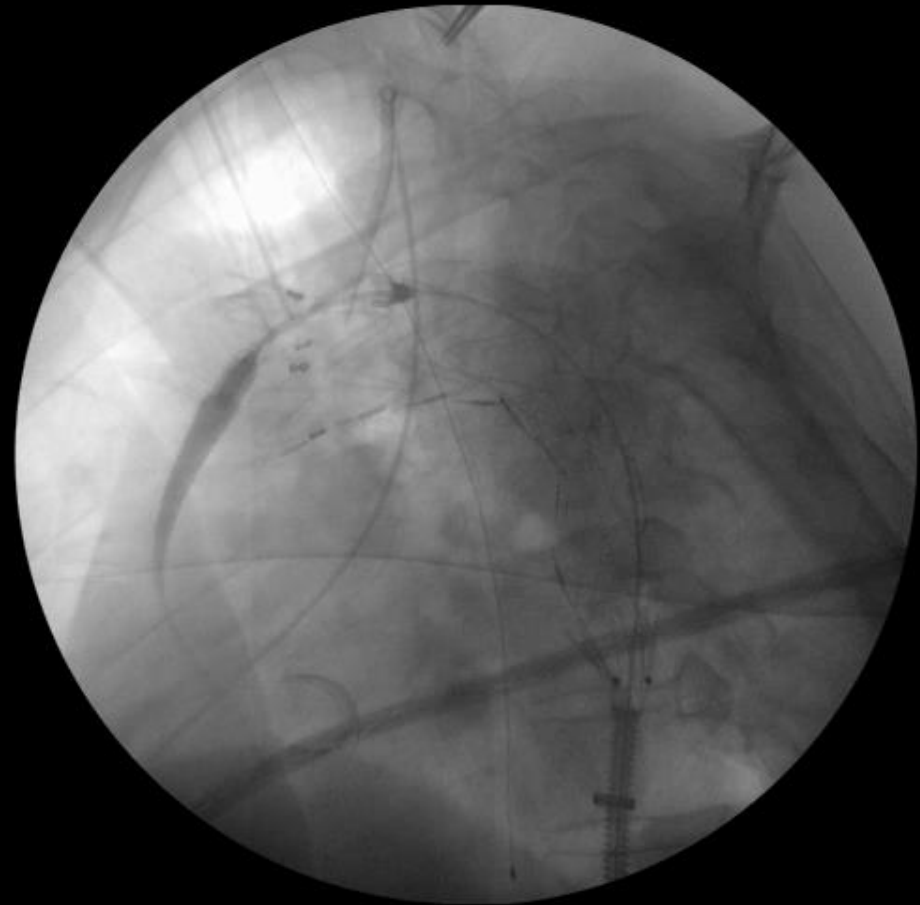
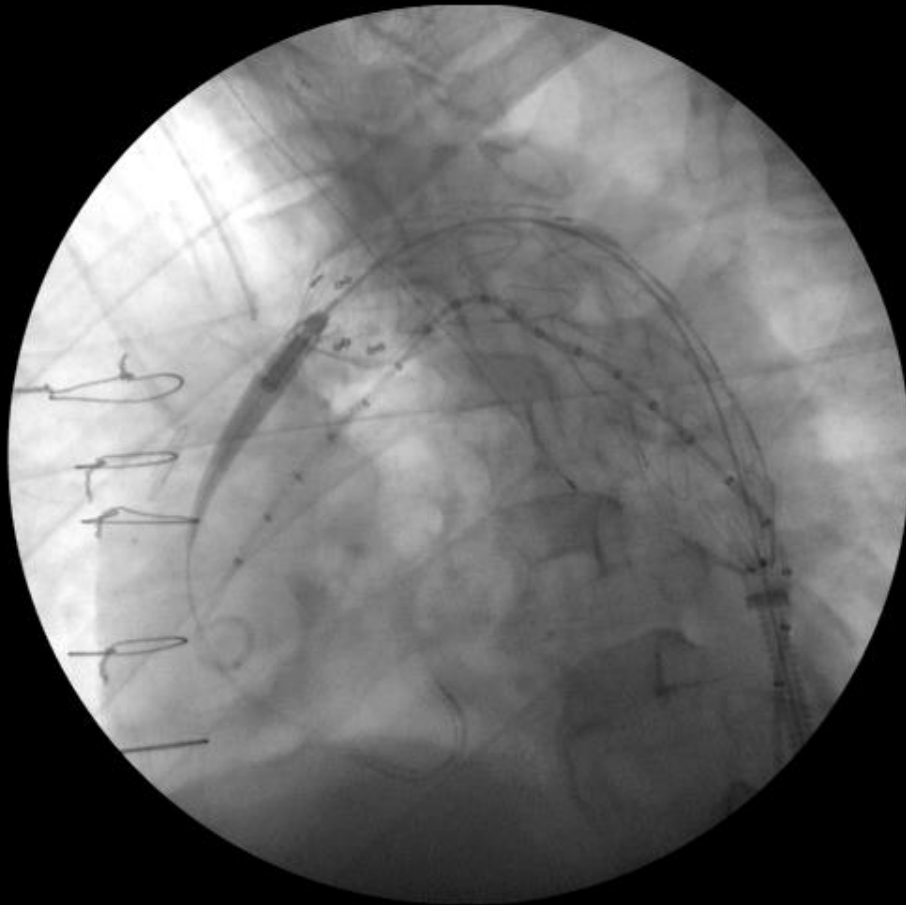
- Angle 을 맞추는 것이 가장 중요!!
 - LAO vs RAO
 - cranial vs caudal



Stent-graft deployment



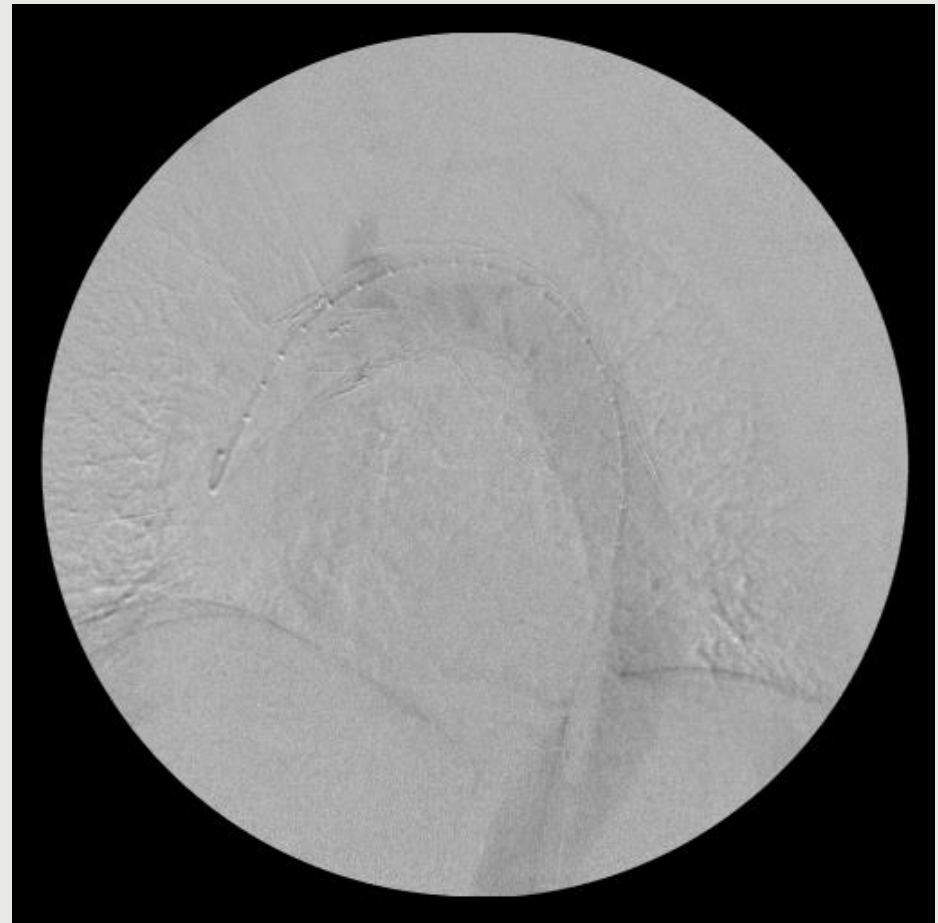
- **Alignment of radiopaque markers!!**



Stent-graft deployment



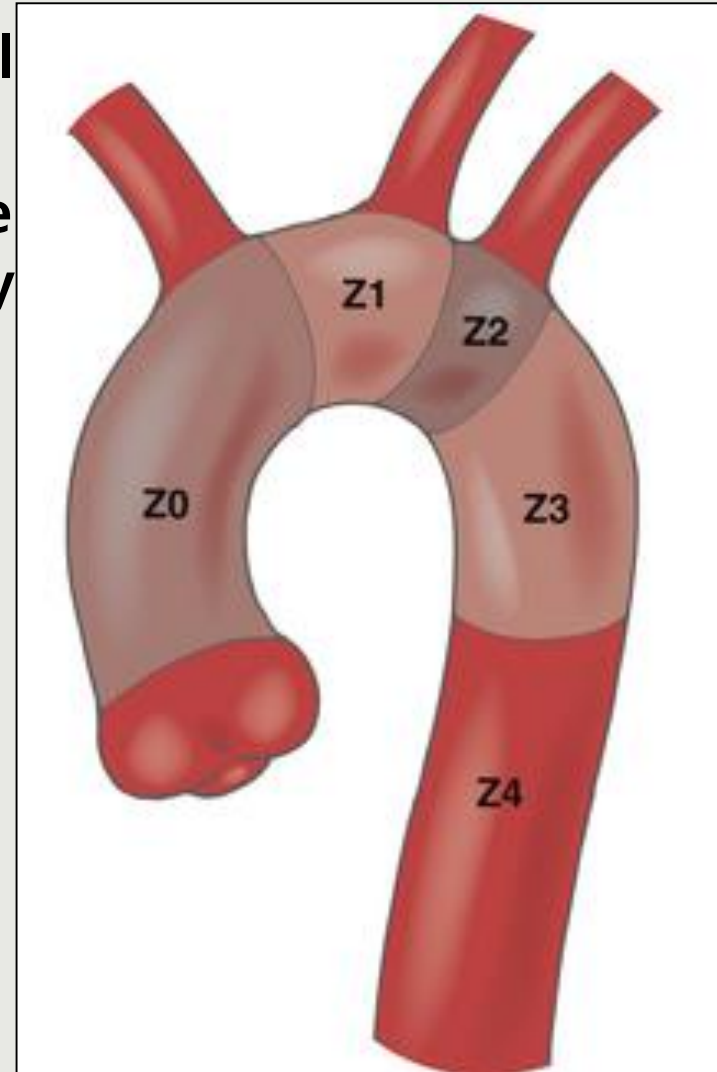
- **Prevent migration of stent-graft!!**
 - Fixation of left hand
 - Lower blood pressure
 - Rapid ventricular pacing
- **Final angiography**
 - Stiff wire 는 가능한 제거한 후 보는 것이 원칙이다



Hybrid TEVAR – proximal landing zone

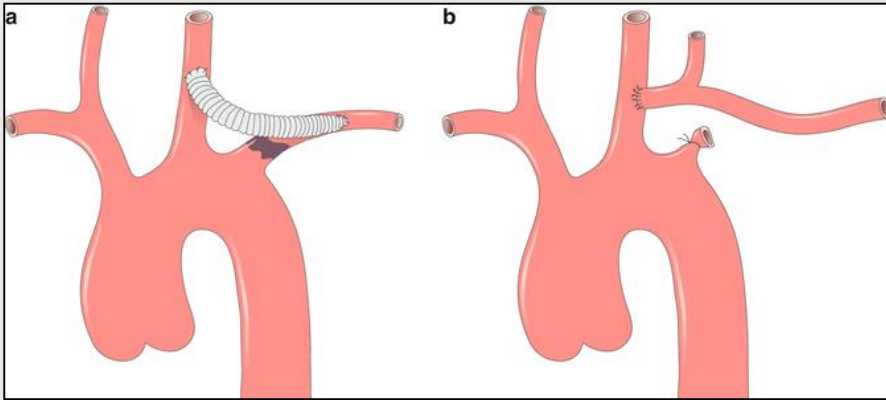


- **Zone 0:** ascending aorta and proximal arch to innominate artery
- **Zone 1:** segment between innominate artery and left common carotid artery
- **Zone 2:** segment between left common carotid and left subclavian arteries
- **Zone 3:** segment beyond left subclavian along curved portion of distal arch
- **Zone 4:** straight portion of descending thoracic aorta starting at level of the 4th thoracic vertebra

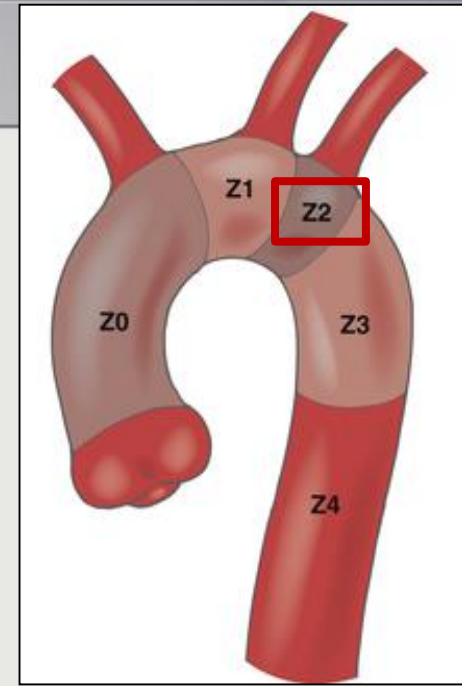


Zone 2 TEVAR

- LCCA-LSCA bypass or LSCA transposition

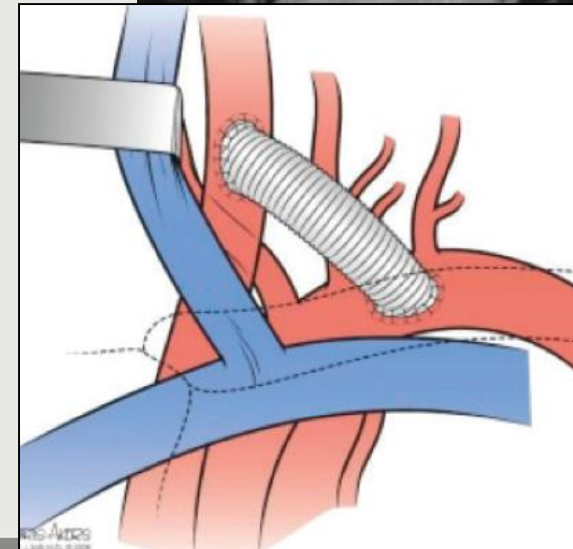


- Proximal LSCA ligation vs plugging vs coiling



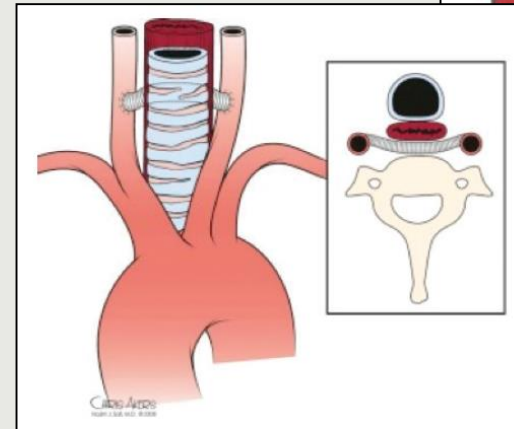
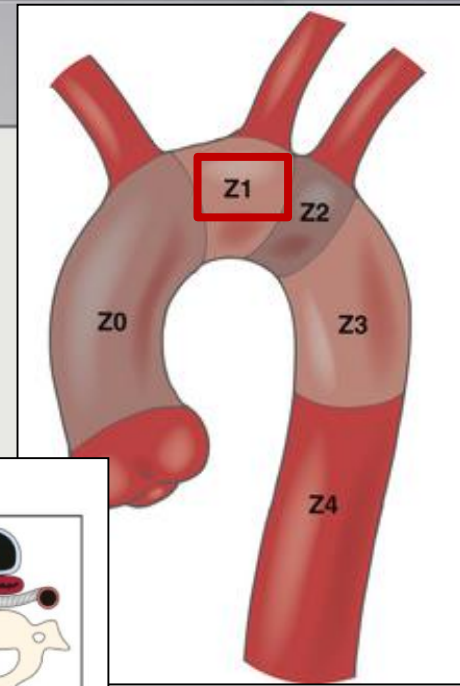
Consideration for zone 2 TEVAR

- **LSCA bypass or not..??**
 - **Indication of LSCA revascularization**
 - LIMA bypass
 - left vertebral dominance
 - isolated left brain hemisphere
 - left upper extremity dialysis access
 - Younger or left-handed patients
- **LCCA-LSCA bypass**
 - **Supraclavicular incision**
 - **Not difficult..!!!!**

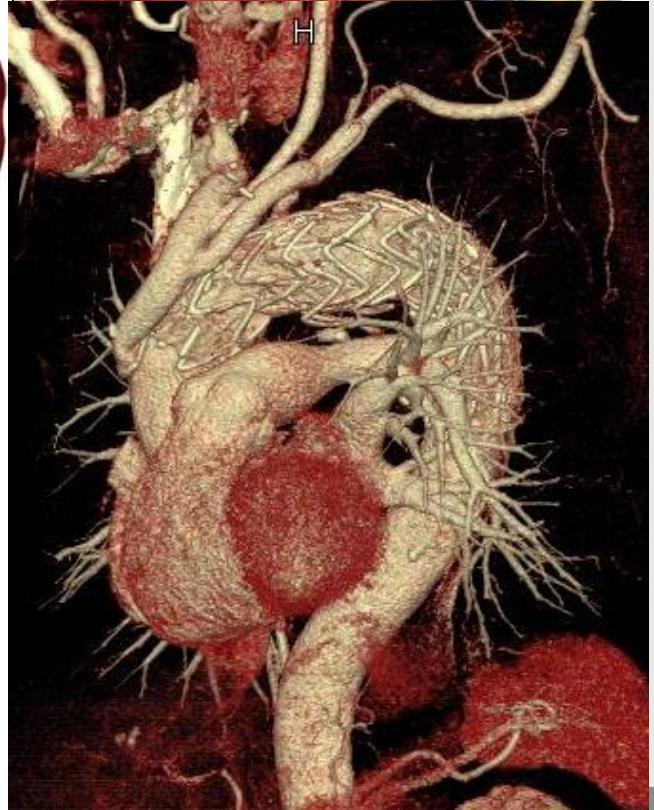
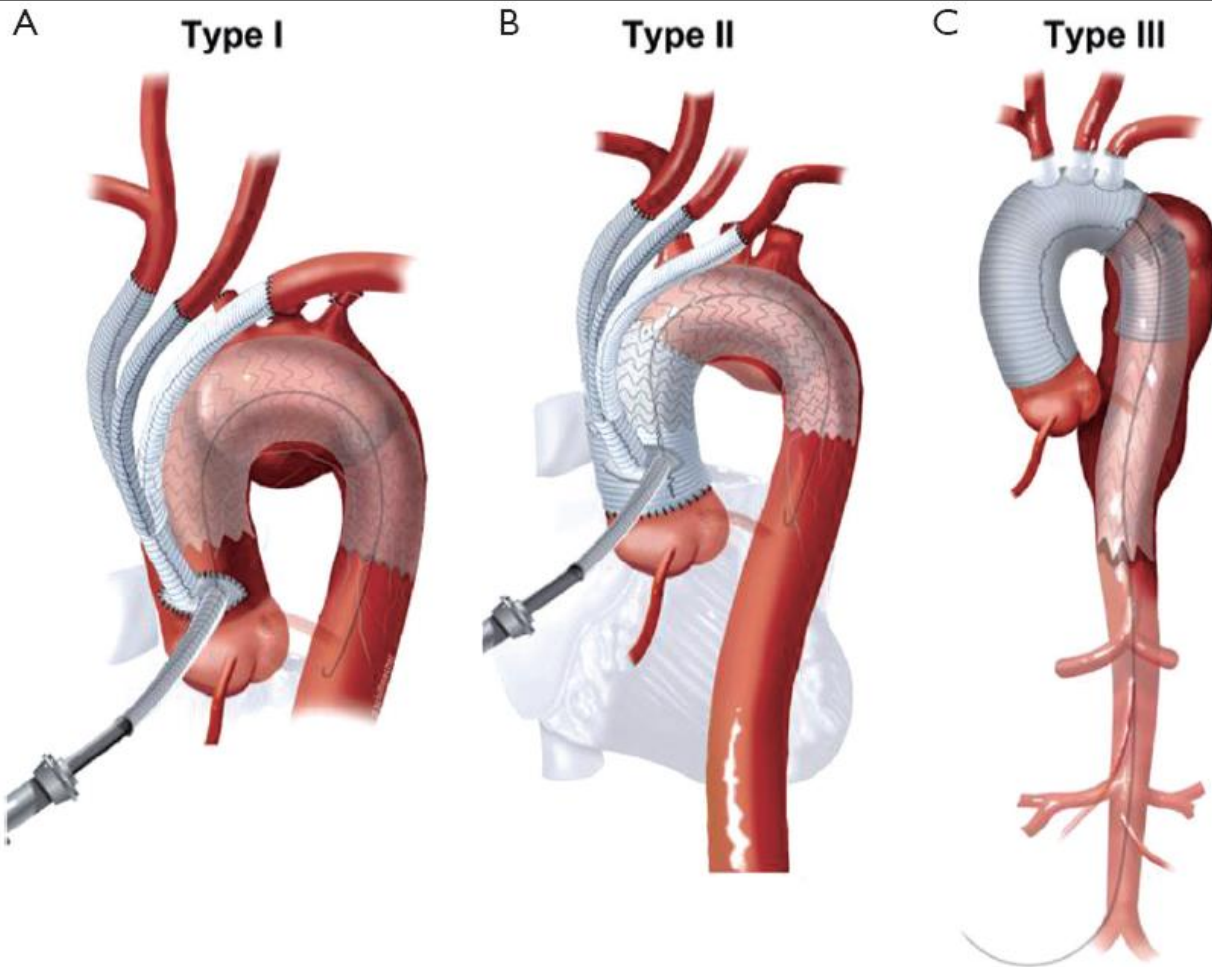
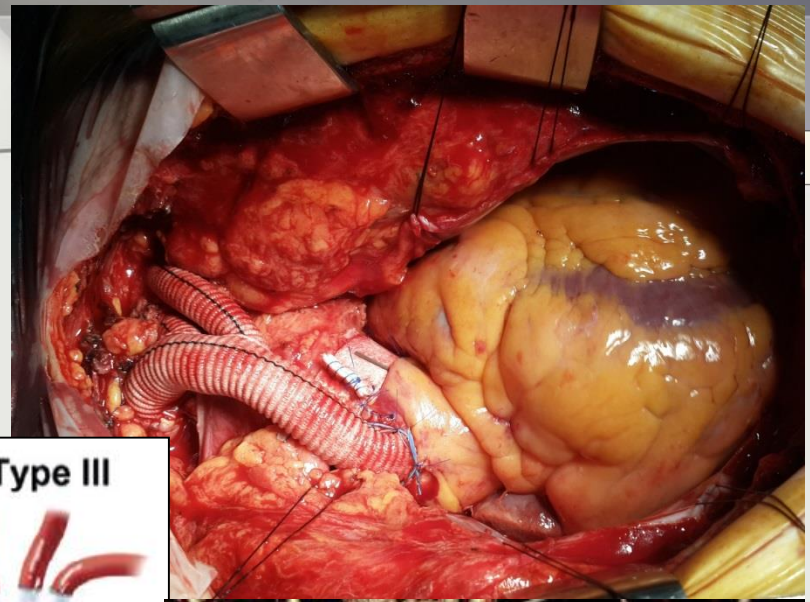


Zone 1 TEVAR

- Carotid-carotid bypass
 - Retropharyngeal route
 - Subcutaneous route
- IA-LCCA-LSCA bypass
 - Upper partial sternotomy



Zone 0 TEVAR



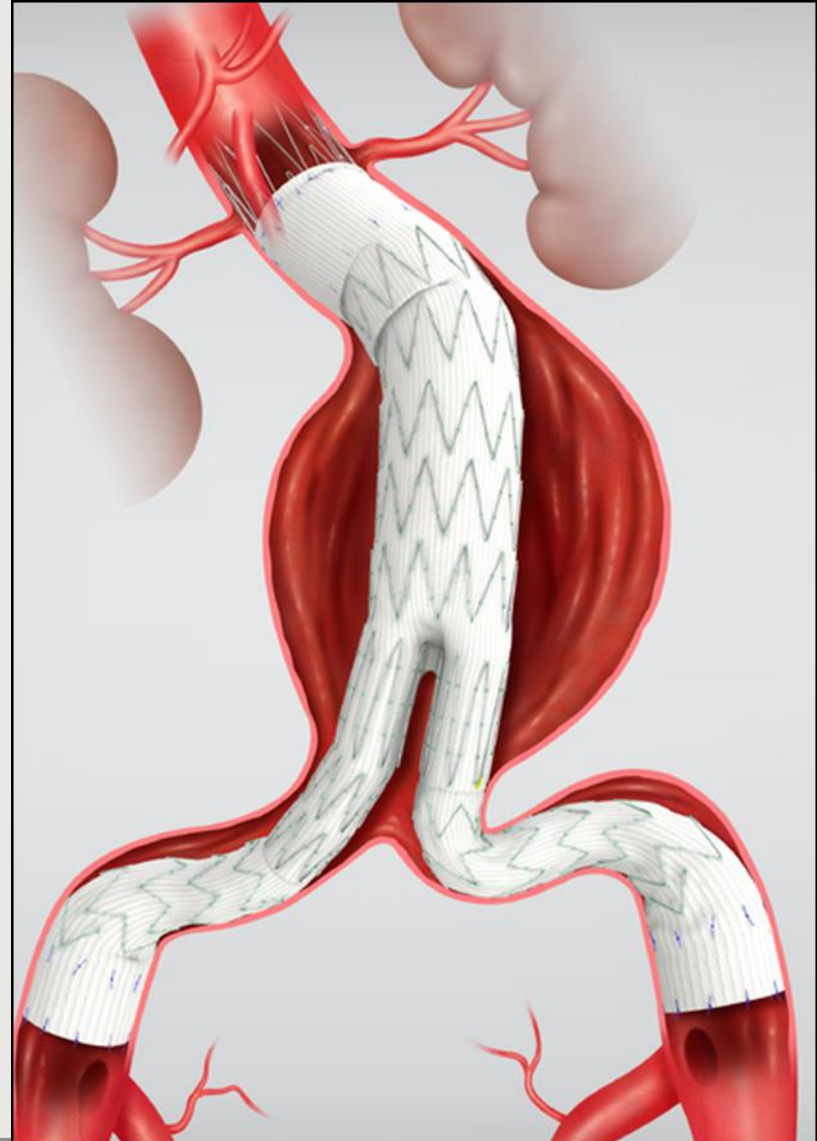
EVAR



Surgical / Endovascular indication for AAA

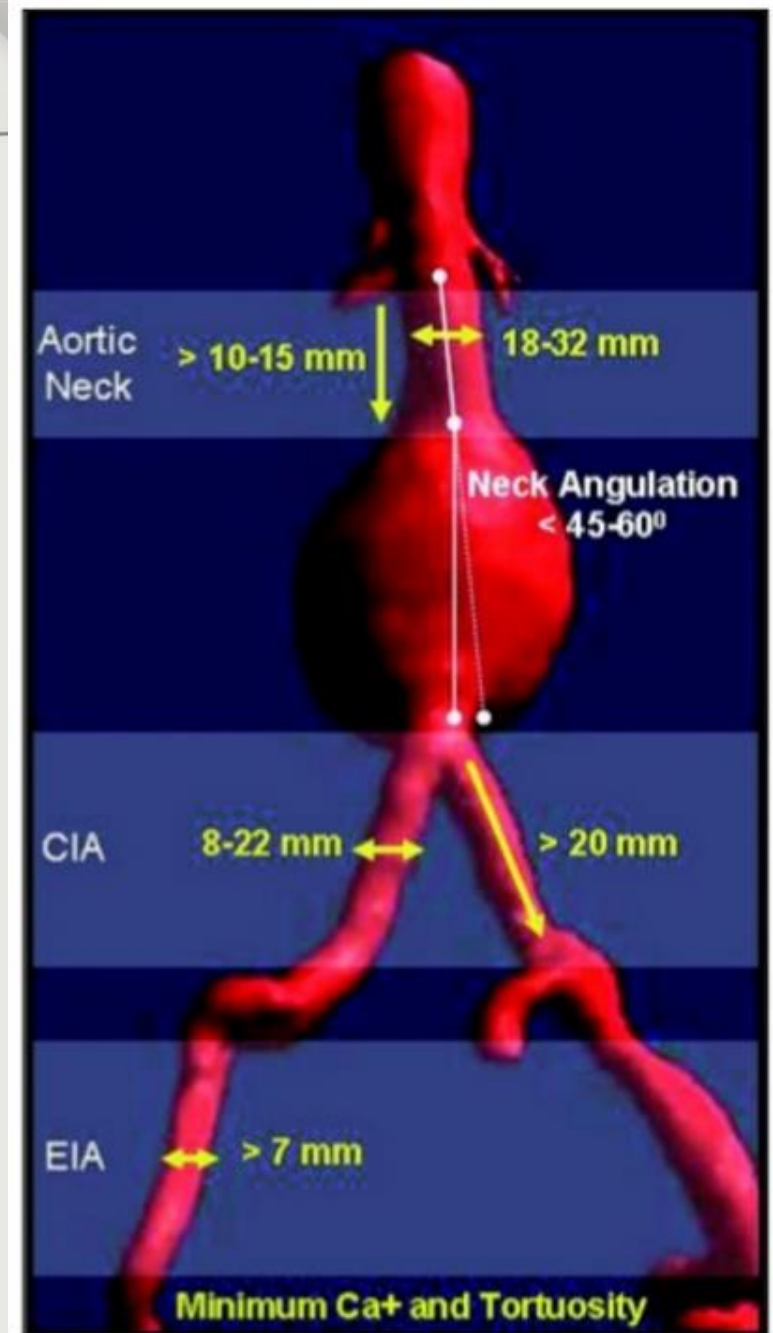


- **Symptomatic or ruptured AAA**
- **Diameter > 50mm**
- **Rapid growing (>5mm for 6mo)**
- **Saccular aneurysm**



Patient selection for EVAR

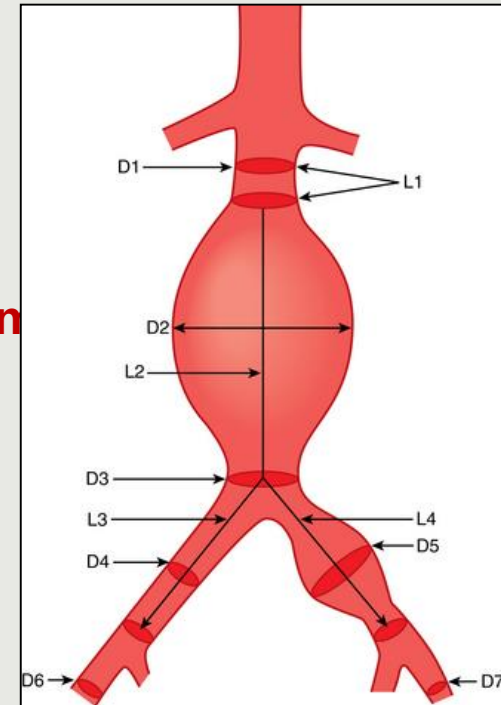
- Proximal landing zone
 - Diameter / Length
 - Shape (conical)
- Distal landing zone
 - Diameter / CIA length
- Angulation
 - Proximal neck / Iliac
- Ilio-femoral condition
(for access)



Patient selection

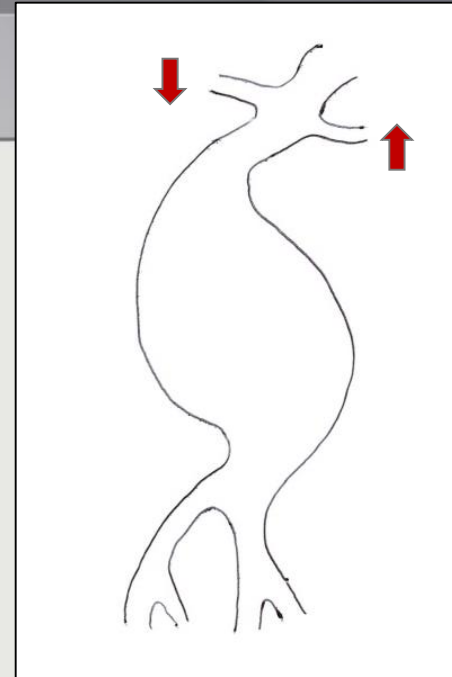
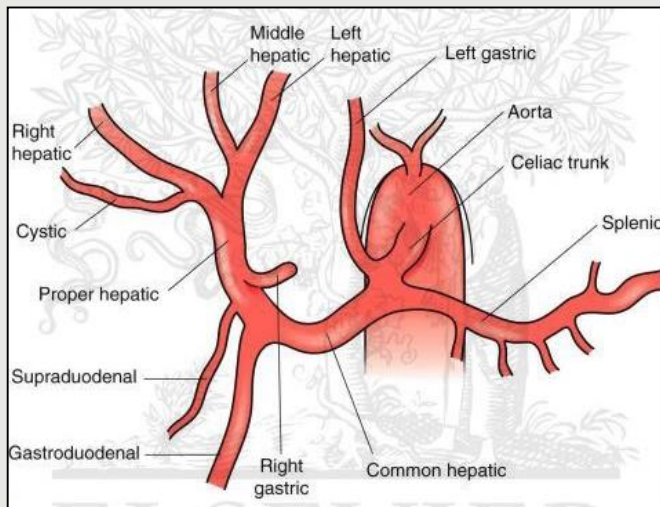


- IFU (Indication For Use) : *ex. OOO stent-graft*
 - Adequate iliac/femoral access that is compatible with vascular access techniques, devices and/or accessories
 - Proximal neck length of ≥ 10 mm
 - Infrarenal neck angulation of $\leq 60^\circ$
 - Aortic neck diameters with a range of 19 to 32 mm
 - Distal fixation length(s) of ≥ 15 mm
 - Iliac diameters with a range of 8 to 25 mm
 - Morphology suitable for aneurysm repair



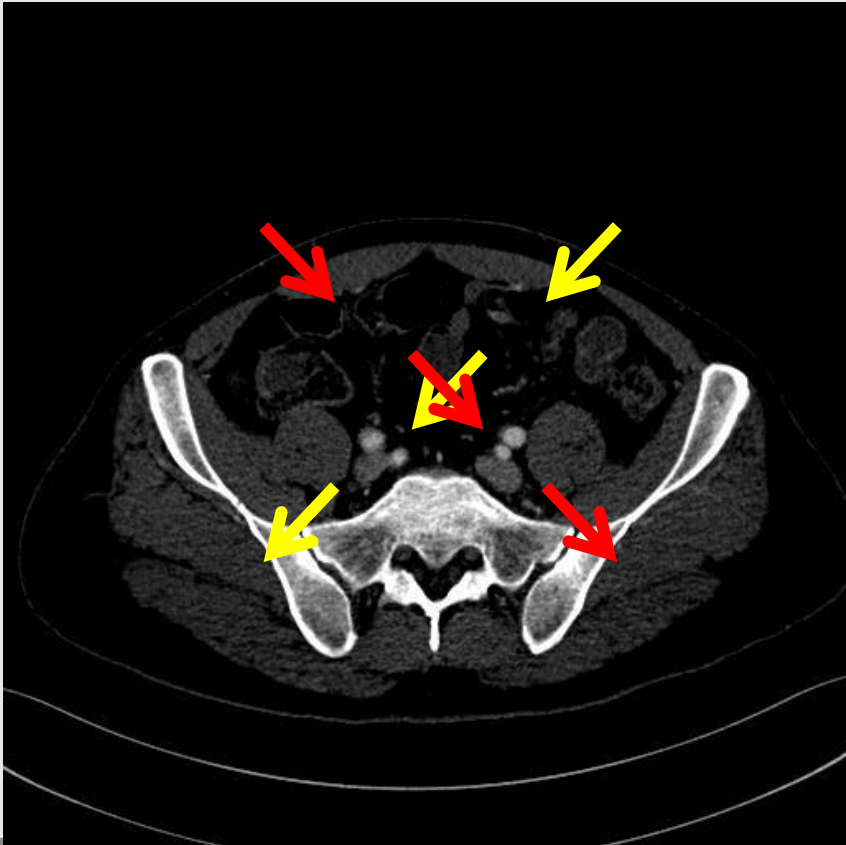
Initial aortography (1)

- **Renal arteries**
 - Usually between L1 & L2
 - Should check the lowest renal artery
 - Should not be confused celiac trunk (common hepatic a & splenic a)

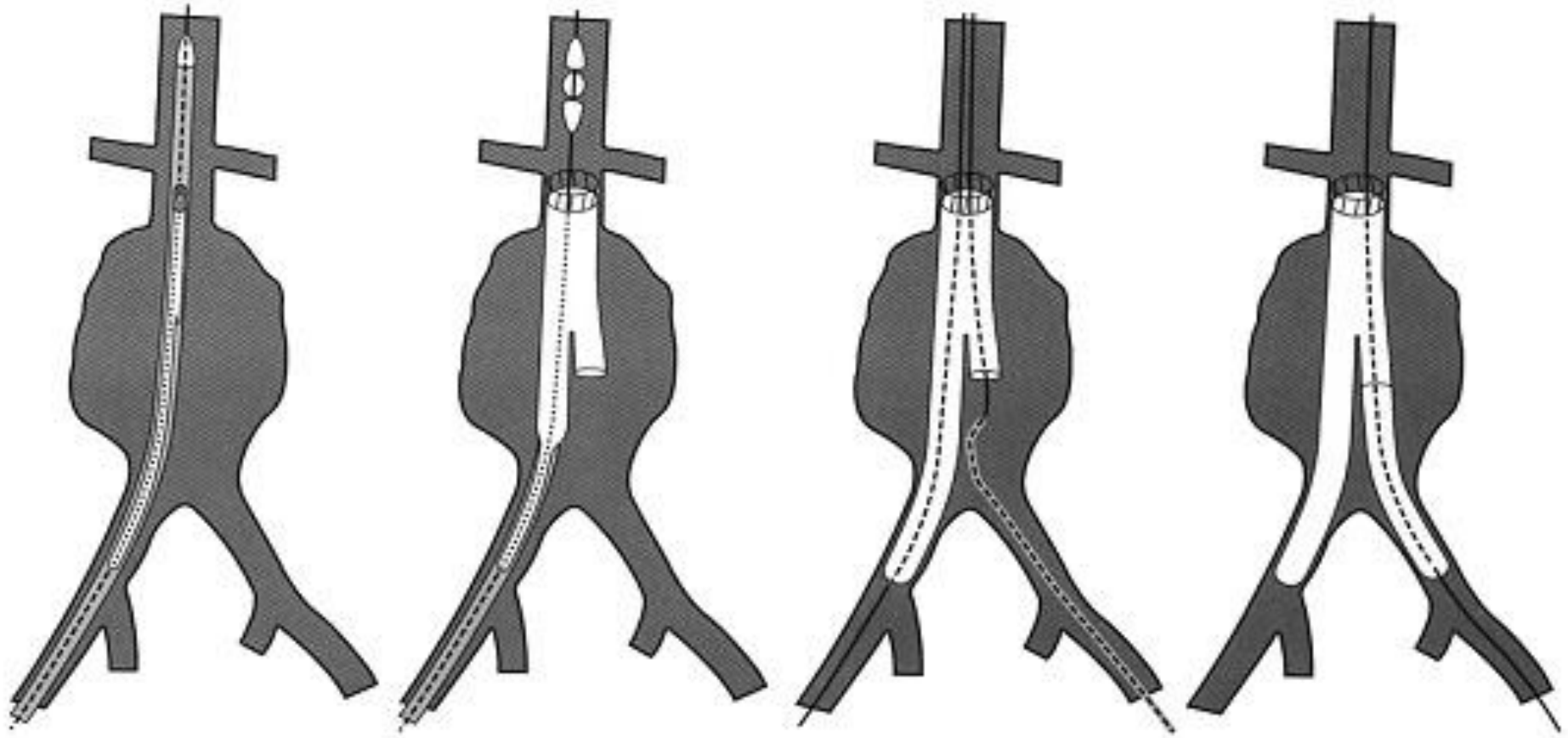


Initial aortography (2)

- Iliac bifurcation
 - LAO (Rt.) / RAO (Lt.) view



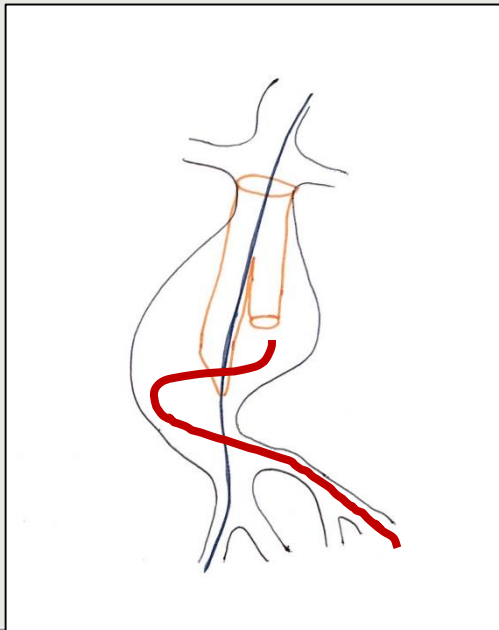
Procedure



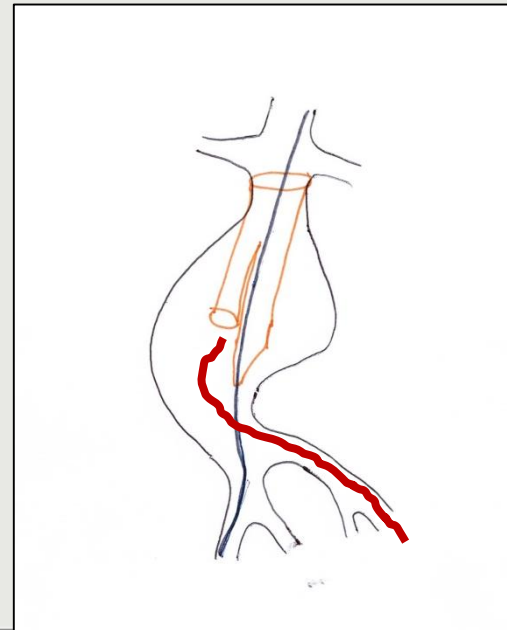
Main body deployment



- **Contralateral limb의 방향이 매우 중요..!!!!**
 - 등쪽이 아닌 배쪽으로 contralateral limb 이 펼쳐져야 한다
 - Iliac artery의 주행에 따라 정방향으로 할지, Ballerino position으로 할지 결정한다



vs.

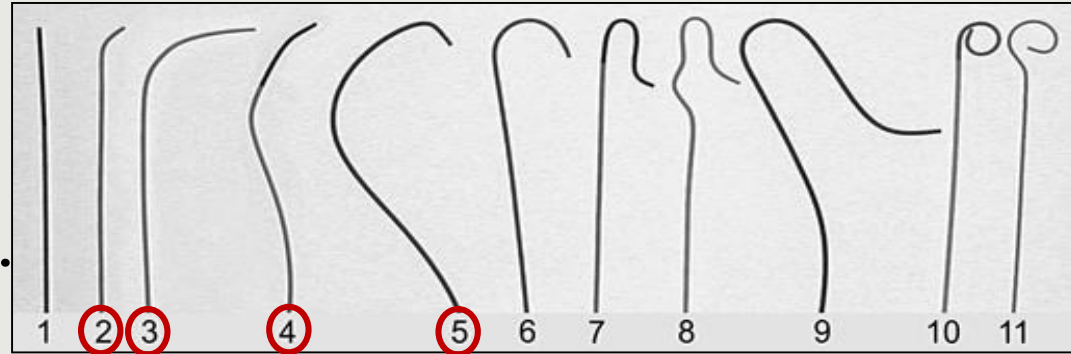


Contralateral limb selection



- **Catheter**

- Cobra, Davis /MP, H1



- **Main body 내부에 guidewire 가 위치하는지 반드시 확인한다**

- 360도 C-arm을 돌려본다
- Main body 안에서 contrast injection 을 해본다
- Main body 안에서 pigtail cath를 돌려본다
- Balloon을 중간에 해서 snowman을 만들어본다

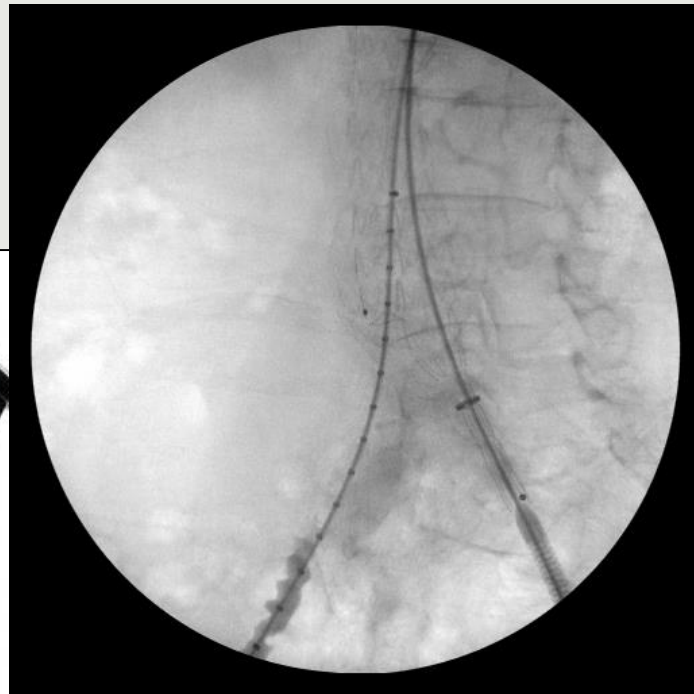
Iliac tortuosity



- Severe angulated & calcified iliac artery
→ rupture risk ↑ ↑

- Super-stiff wire 를 사용하였을 때
straightening 이 일어난다

– Accordion effect



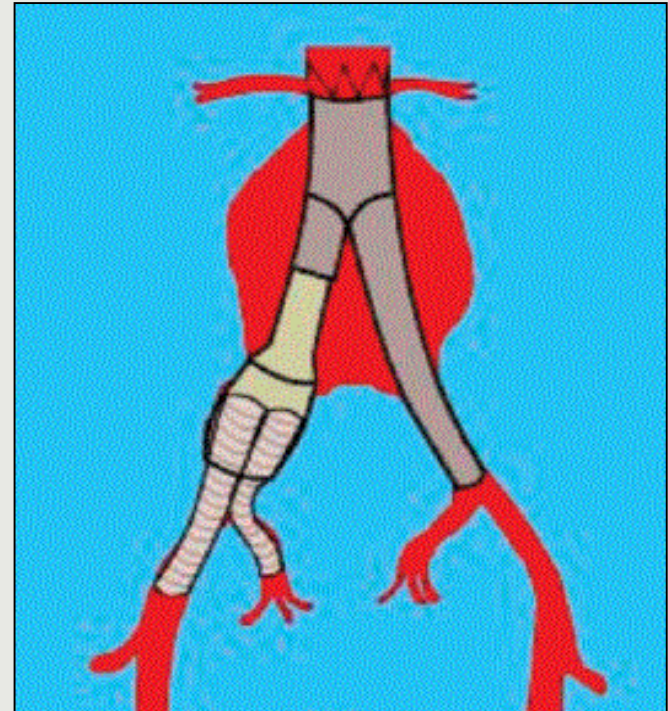
Iliac tortuosity - case



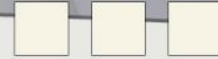
Advanced procedure



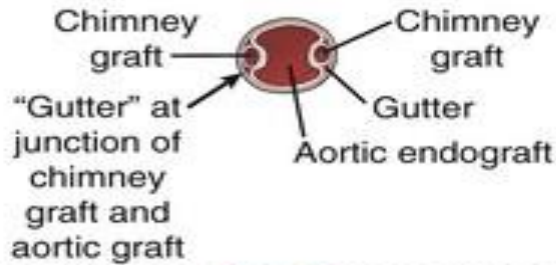
- Chimney technique / Sandwich technique
 - Stent-graft 가 필요 (ex. Viabahn, Lifestream stent-graft)



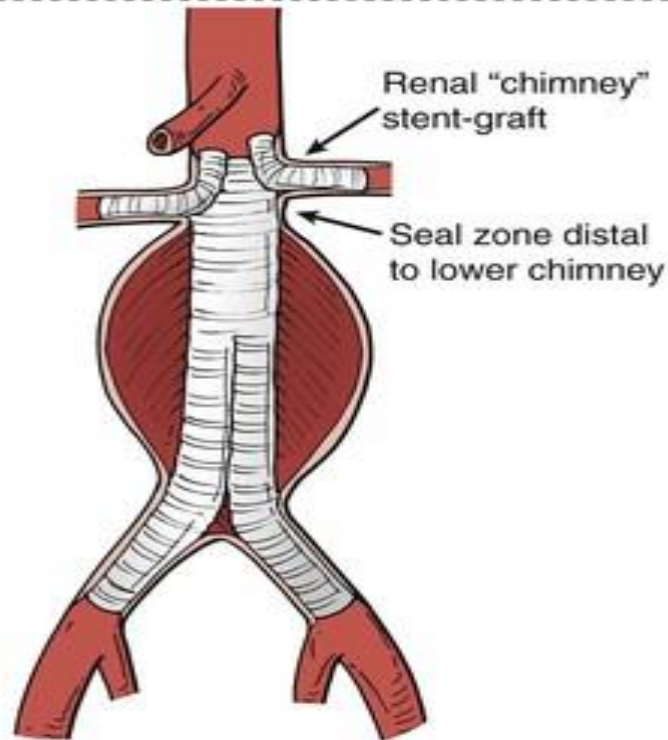
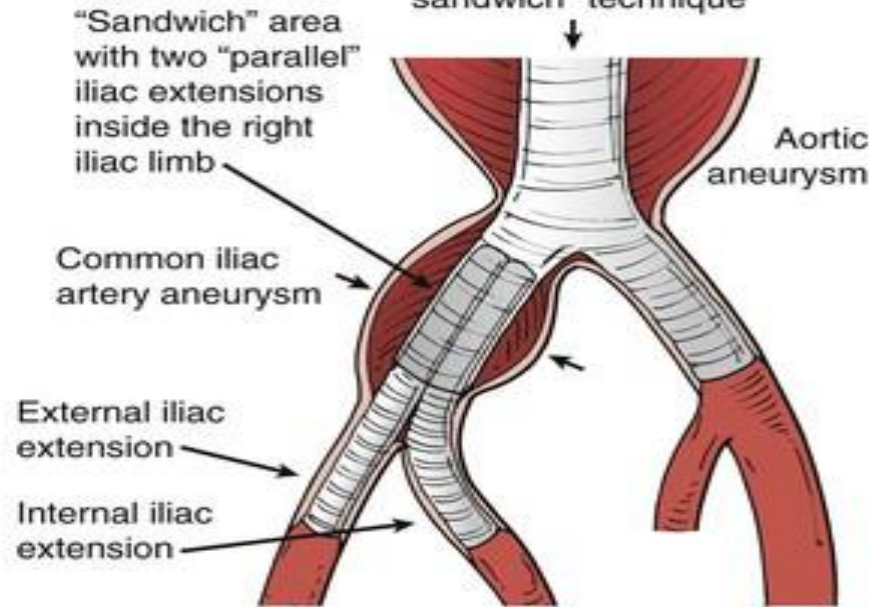
Chimney technique / Sandwich technique



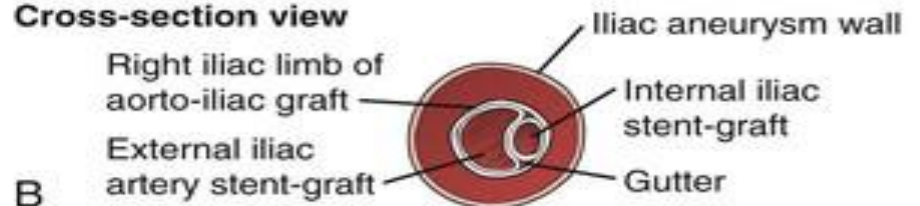
Cross-section view



Aorto-bi-iliac bifurcated endograft with right iliac limb used for "sandwich" technique



Cross-section view



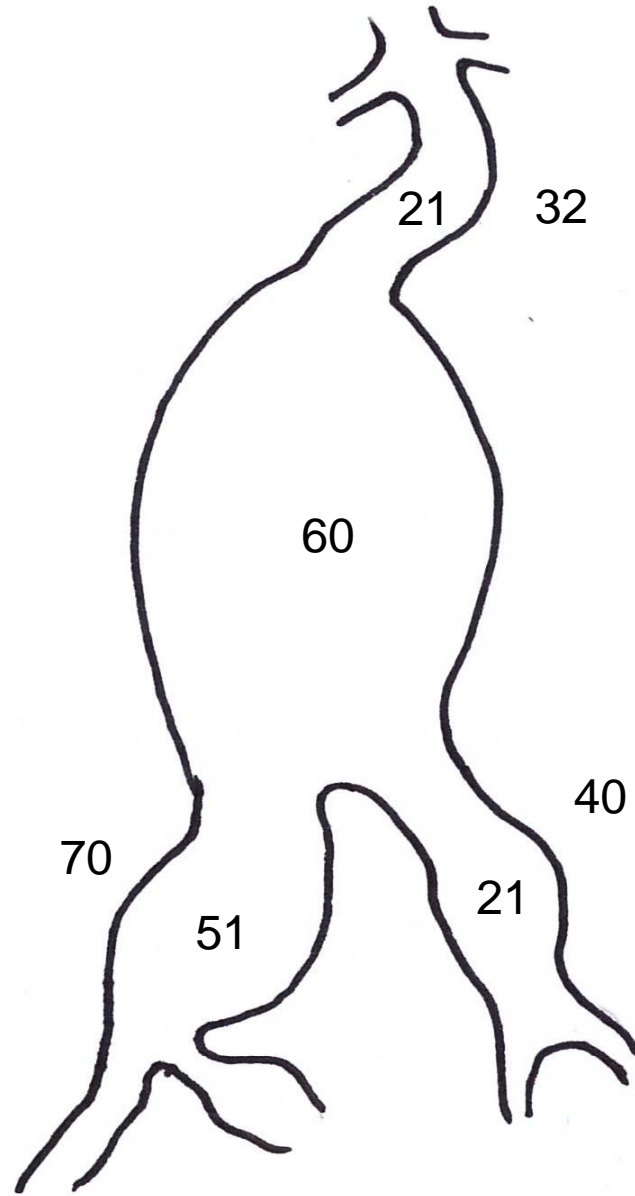
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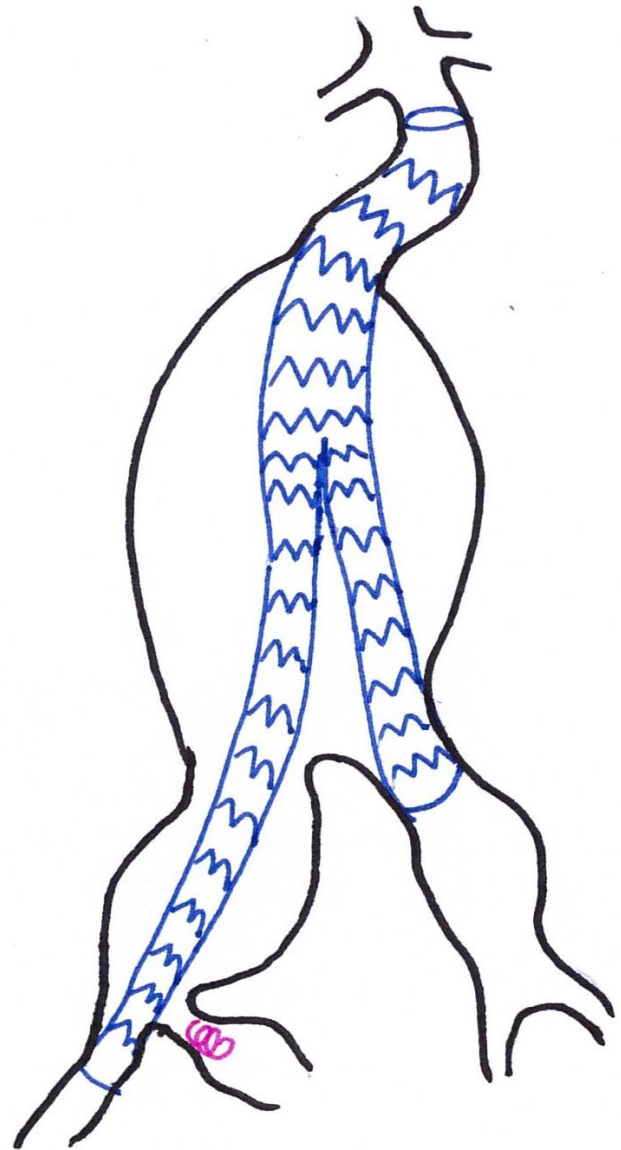
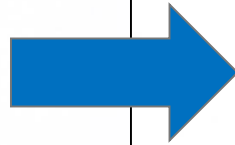
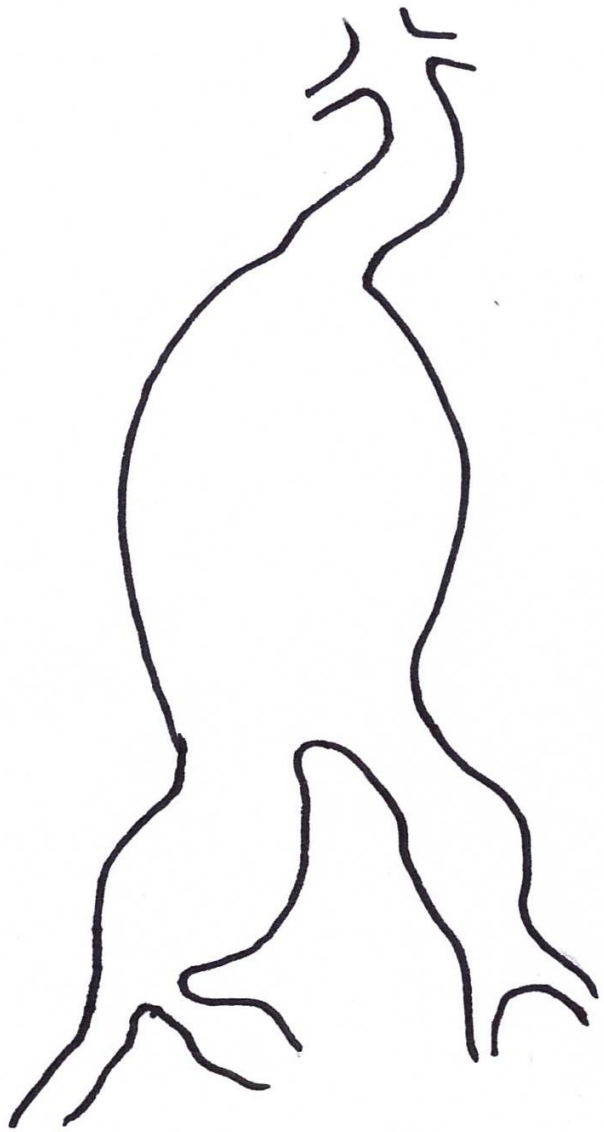
B

Case



(mm)





Iliac artery embolization

- Coiling vs plugging
- Buttock or thigh claudication
- Sexual dysfunction (impotence)
- Bowel ischemia
- Spinal cord ischemia
- Avoid bilateral internal iliac artery..!



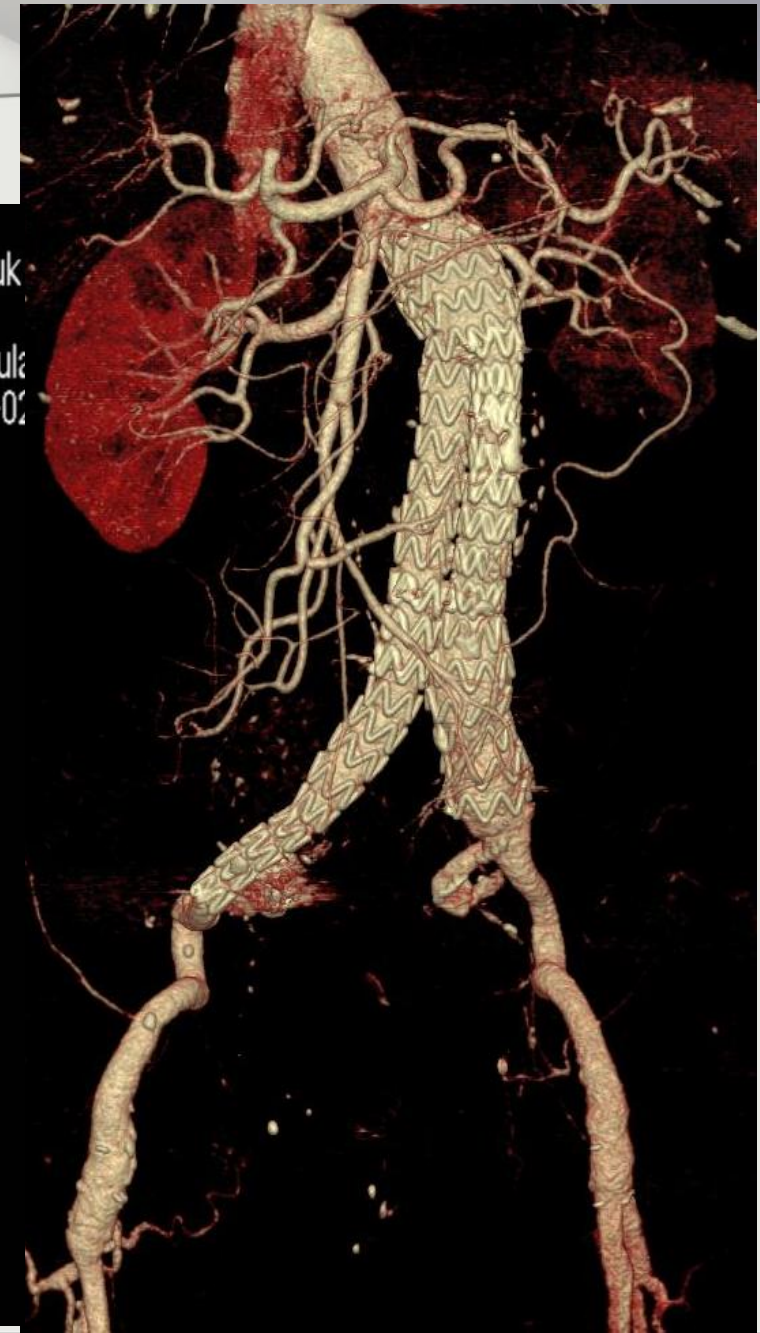
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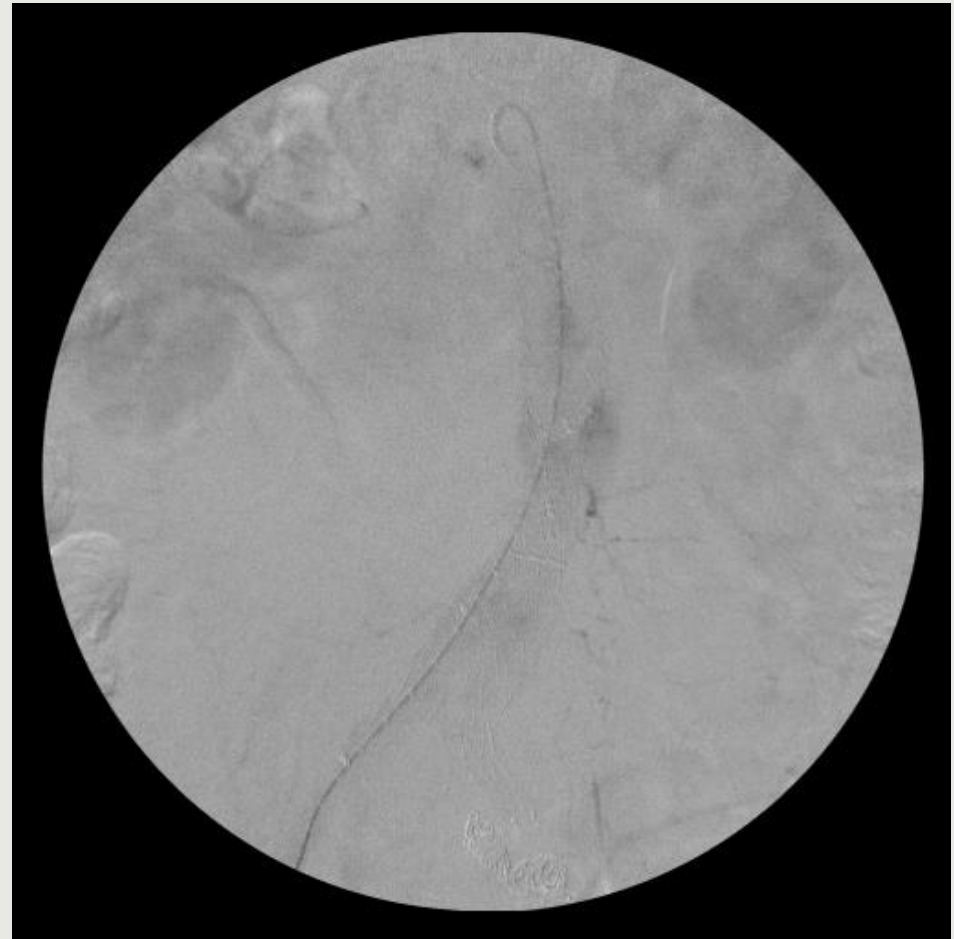
Vascular
2014-01



Final angiography

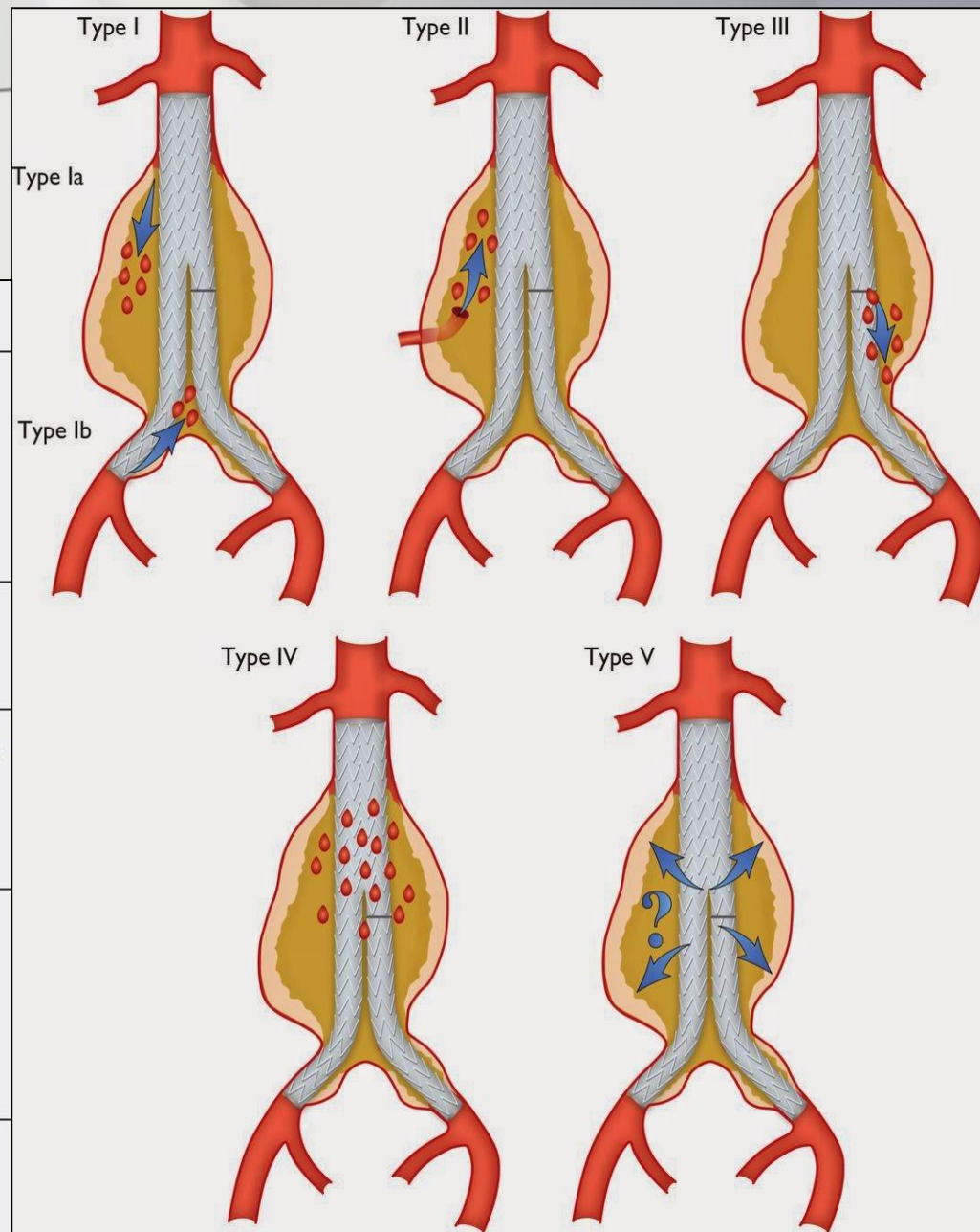


- 원칙적으로는 super-stiff wire를 제거한 후 최대한 오래 촬영해야 한다.
- Endoleak : type 1 ~ 5



Endoleak

Type	Definition
Type I	Persistent filling of the aneurysm sac due to incomplete seal or ineffective seal at the proximal (type IA) or distal (type IB) end of the stent graft
Type II	Persistent filling of the aneurysm sac due to retrograde branch flow from collateral vessels
Type III	Blood flow into the aneurysm sac due to inadequate or ineffective sealing of overlapping graft joints or rupture of the graft fabric
Type IV	Blood flow into the aneurysm sac due to the porosity of the graft fabric, causing blood to pass through from the graft and into the aneurysm sac
Type V	Aneurysm sac expansion without clear evidence of endoleak origin



Type 1a endoleak



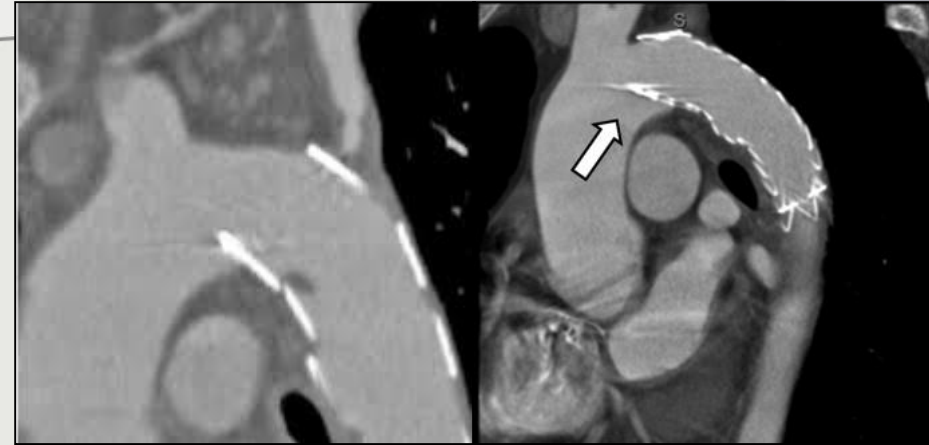
Complications (1)



- **Device related**
 - Graft migration, kinking, endoleak
- **Procedure related**
 - Dissection, malpositioning,
 - renal failure, thromboembolism, ischemic colitis, paraplegia
 - Groin hematoma, wound infection
- **Systemic complications**
 - Contrast induced nephropathy (CIN)
 - Post-implantation syndrome (PIS)

Complications (2) - TEVAR

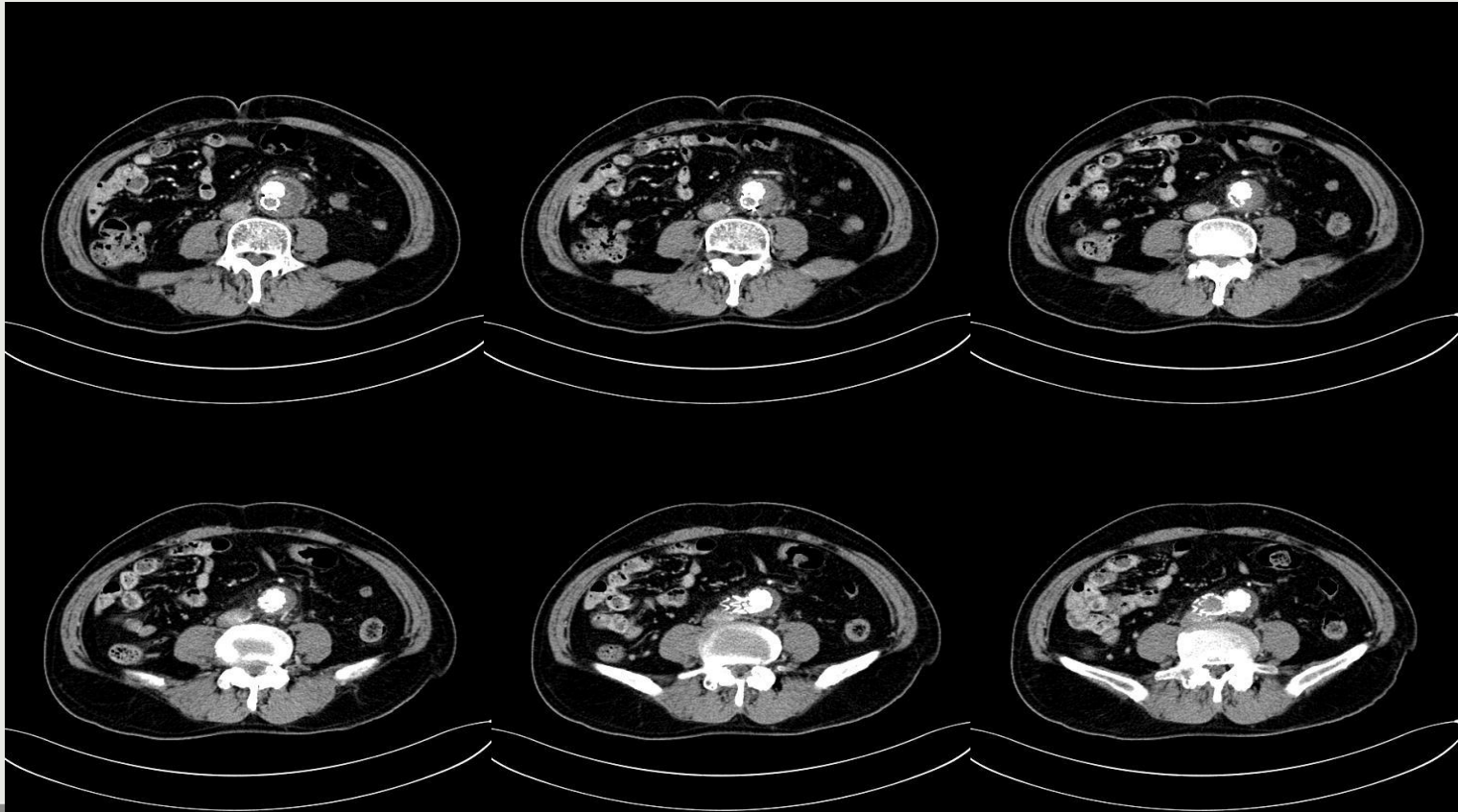
- Bird-beak appearance
 - d/t Aortic arch curvature
- SINE (stent-graft induced new entry)
 - In aortic dissection



Complications (3) - EVAR

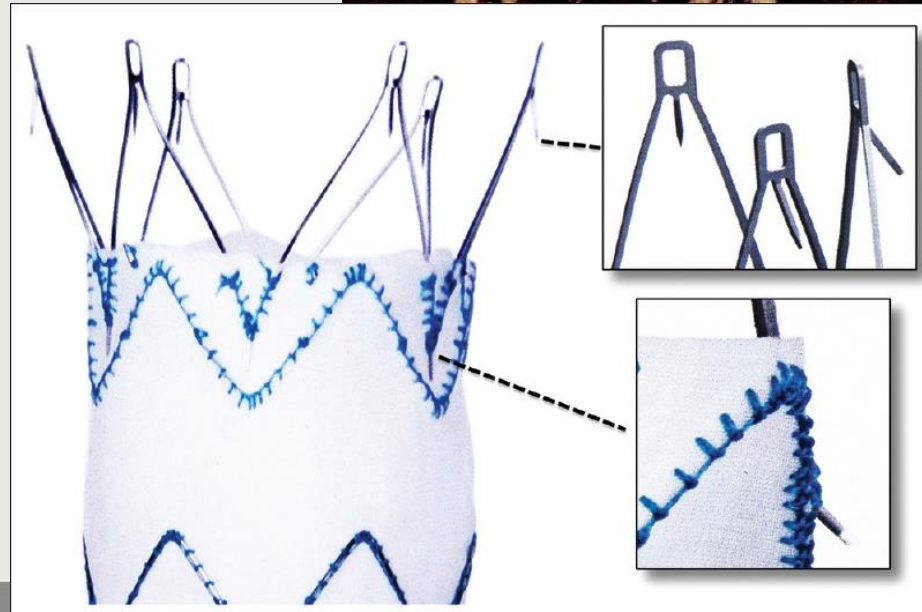


- **Limb occlusion**
 - **Small & angulated aortoiliac anatomy**



Open surgery after EVAR

- 무리하게 stent-graft 를 제거하려 하지 말 것..!!
 - Stent-graft 위 또는 아래에 clamping 은 어렵다.
 - Barb (hook) 로 인하여 aortic wall injury를 줄 수 있다.
 - Stent-graft 의 strut을 cutting 한 후에 aortic wall 과 함께 suture 하면 된다.



What approach..?



- **(T)EVAR**
 - Minimal incision
 - No aortic cross clamping
 - No extracorporeal circulation
 - Lower operative mortality rate
 - Lower morbidity rate
 - Lower hospital stay
 - Good choice for patients with important comorbidities
 - *.. But not for everyone..*
 - *.. Long term results..??*
- **Open surgery**
 - No suitable proximal and distal landing zones
 - No suitable stent-grafts
 - Lack of vascular access
 - Connective tissue disorders