Introduction to Interventional Radiology

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INTERVENTIONAL RADIOLOGY

A subspecialty in radiology which provides minimally invasive procedures using imaging modalities to diagnose and treat different conditions ,its has many different advantages such as.

- Minimally invasive
- Local anesthesia
- Early recovery

TYPES

1_ Percutaneous Example biopsy or abcess drainage .

2-endovascular such arterial angioplasty or tumour embolization

VASCULAR IR

- Endovascular aneurysm repair
- Peripheral arterial angioplasty and stenting
- Thrombectomy and thrombolysis
- Venous thrombolysis
- IVC filter insertion
- Peripherally inserted central catheter
- Embolization
- Transjugular Intrahepatic Portosystemic Shunt
- Uterine fibroid embolization

Bone & Lungs → can't do U/S guided - biopsy

PERCUTANEOUS NON-VASCULAR IR

- Abscess drainage
- Percutaneous gastrostomy
- Percutaneous biliary drainage and biliary stent insertion
- Percutaneous nephrostomy
- Image-guided biopsy
- Transcatheter arterial chemoembolization
- Embolization of hypervascular metastases
- Transforaminal nerve root block

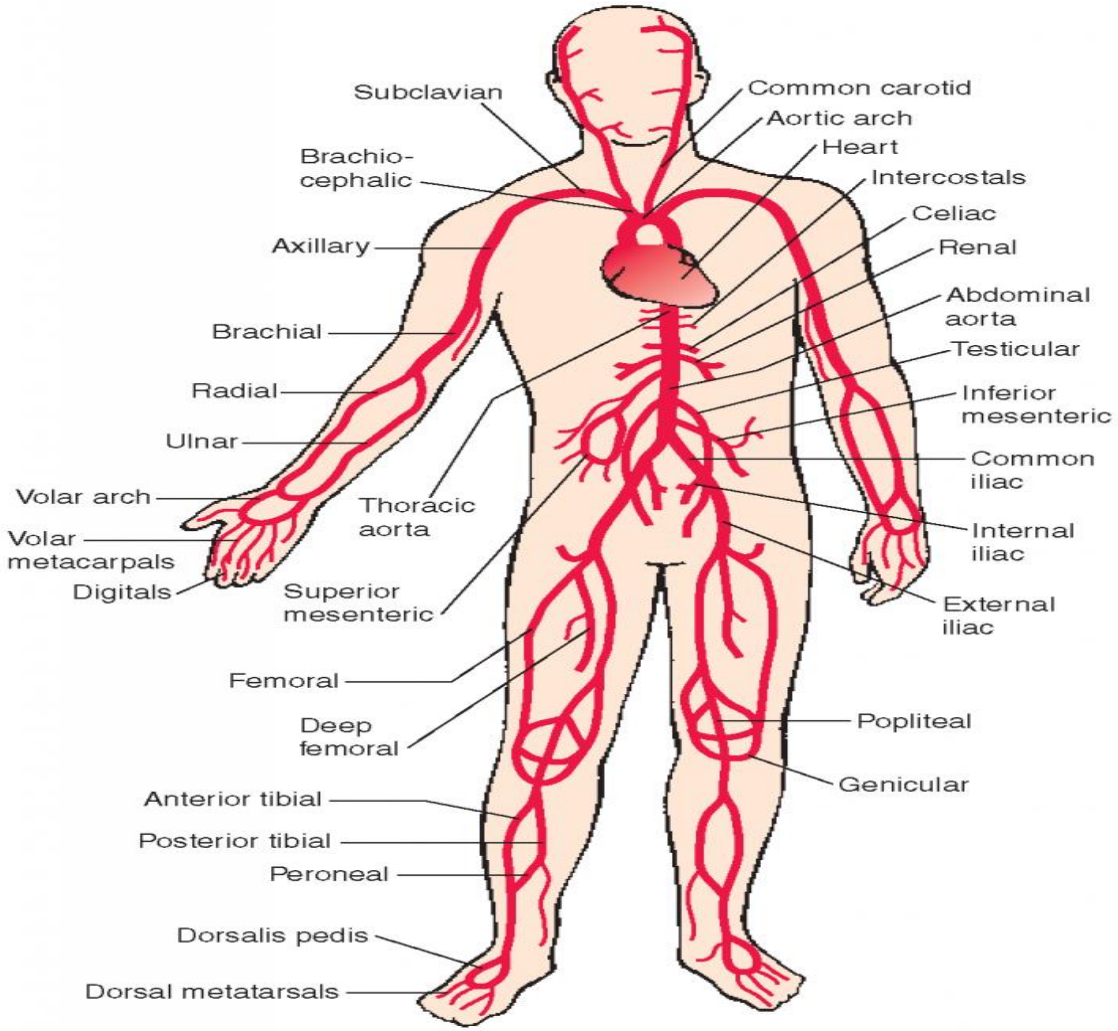
Types Of Vascular Imaging

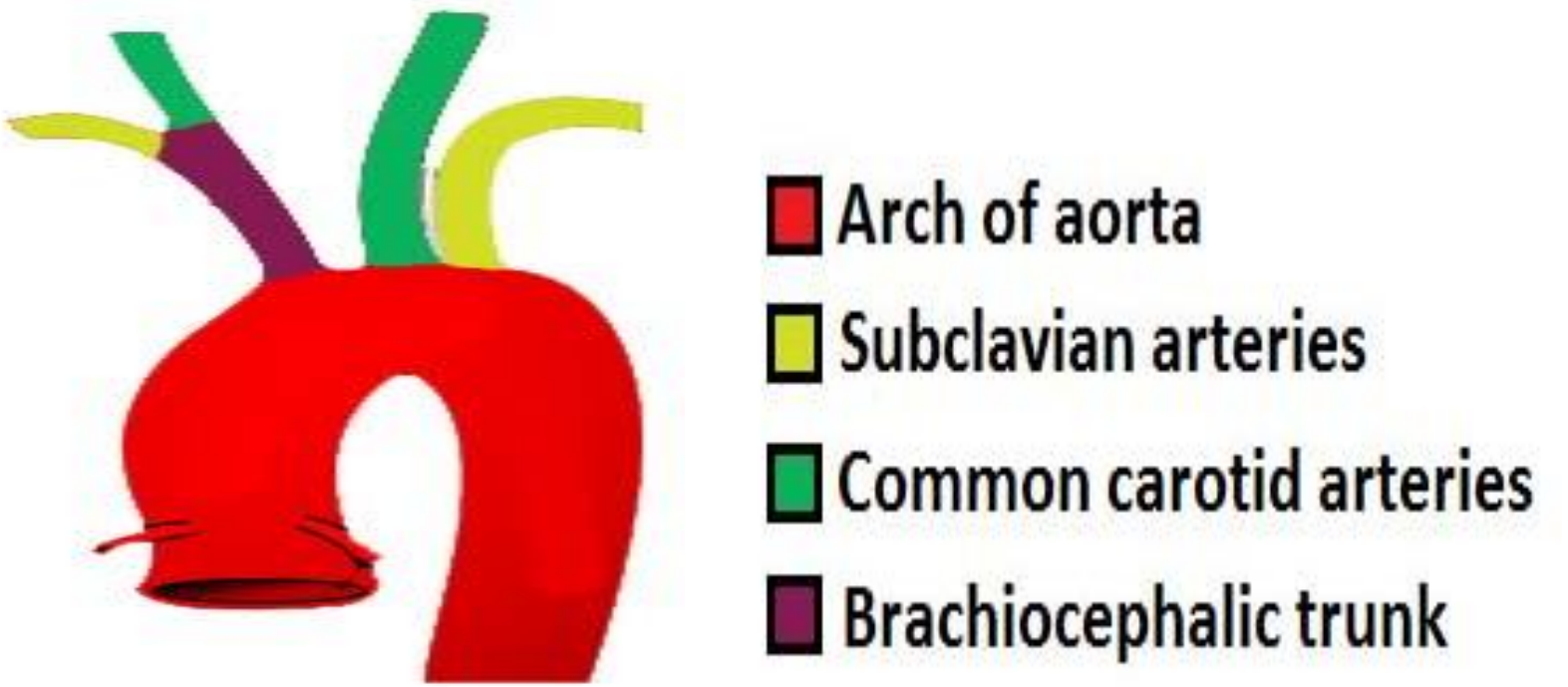
Doppler Ultrasound	Digital subtraction	CT angiography	MR angiography
	X-ray	CT spiral ~	↑Cost - ↑Tim - ↓availability

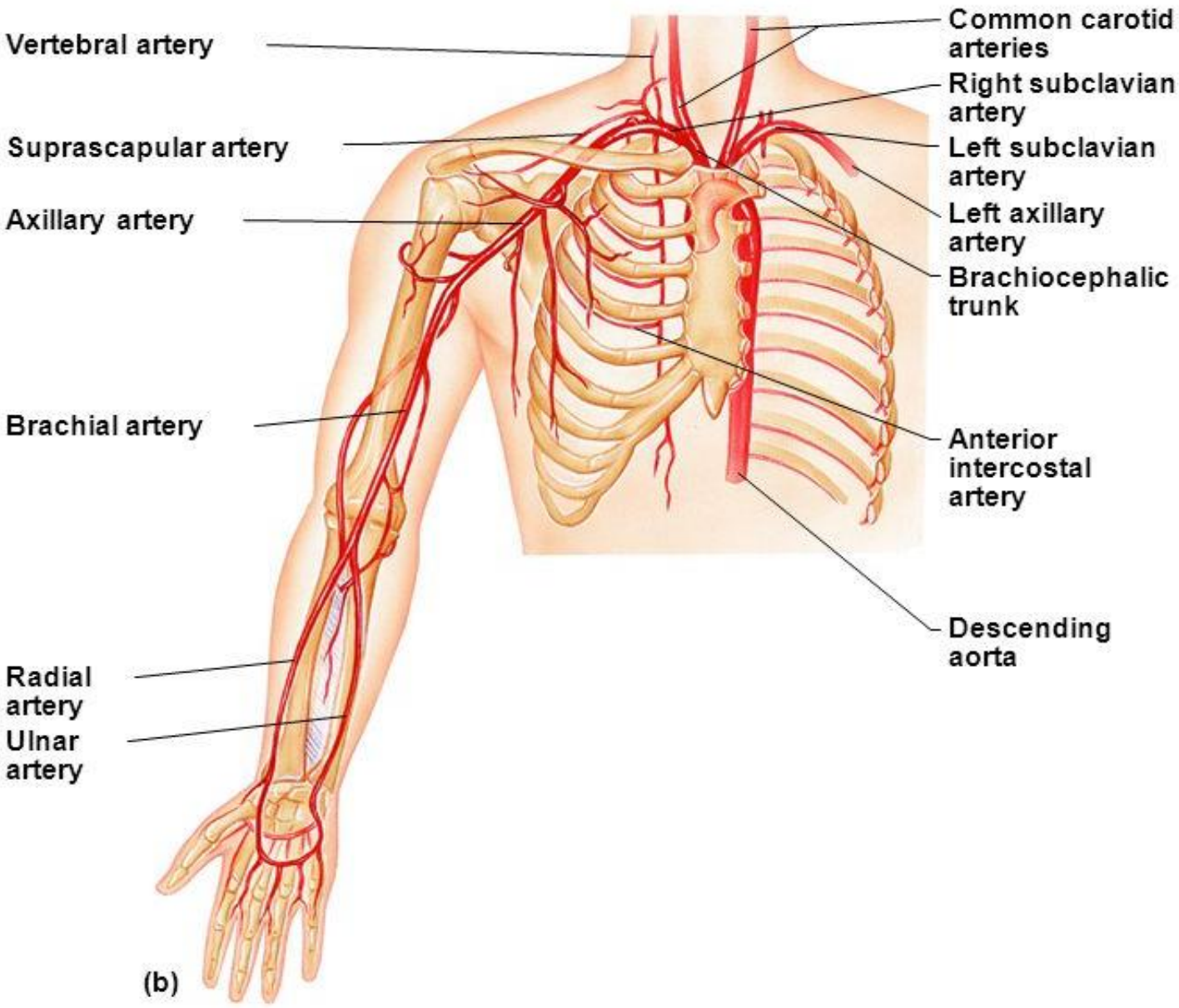
TYPES OF ANGIOGRAPHY

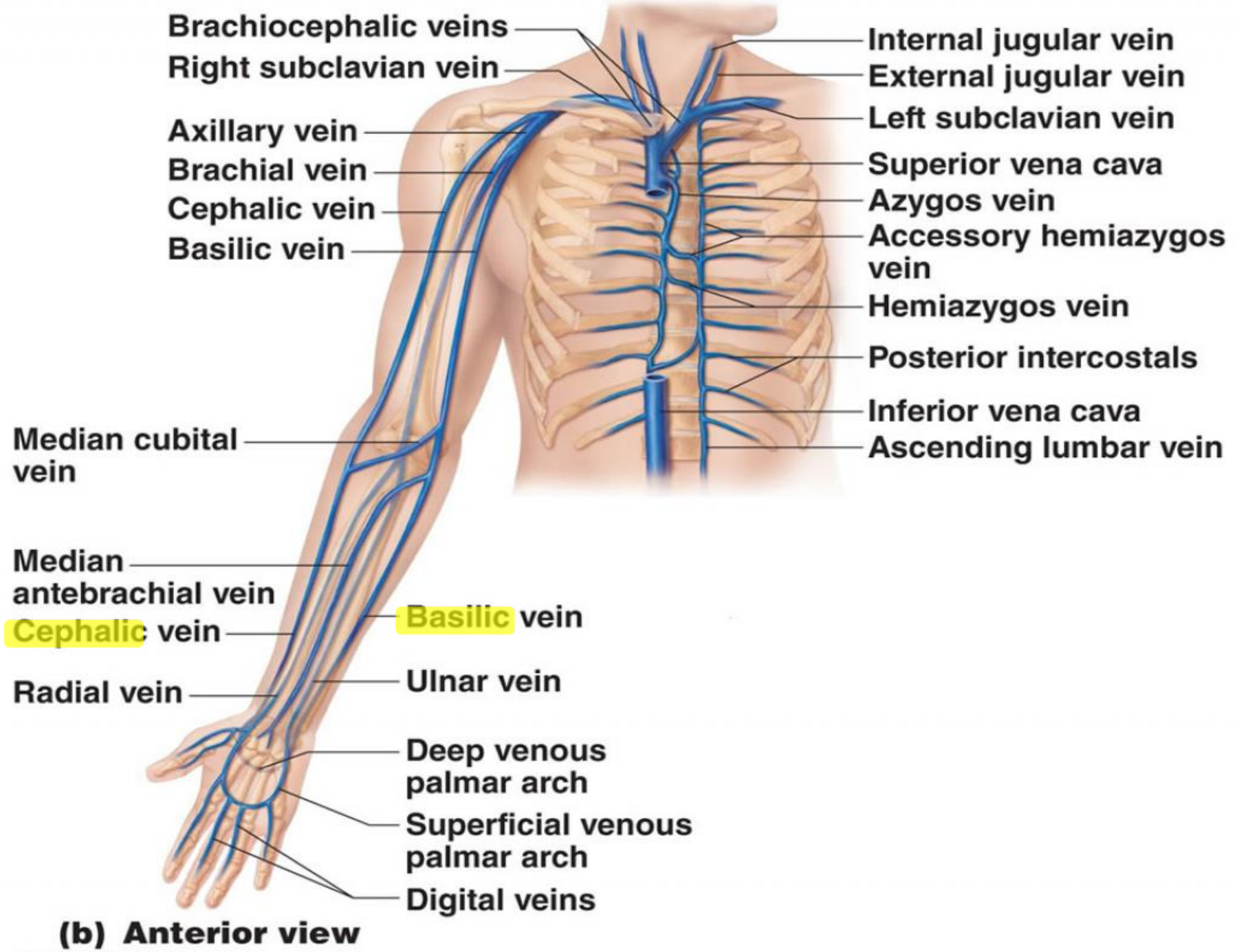
- Advanced US, CTA and MRA techniques made conventional angiography limited to therapeutic purposes.

NORMAL ANATOMY

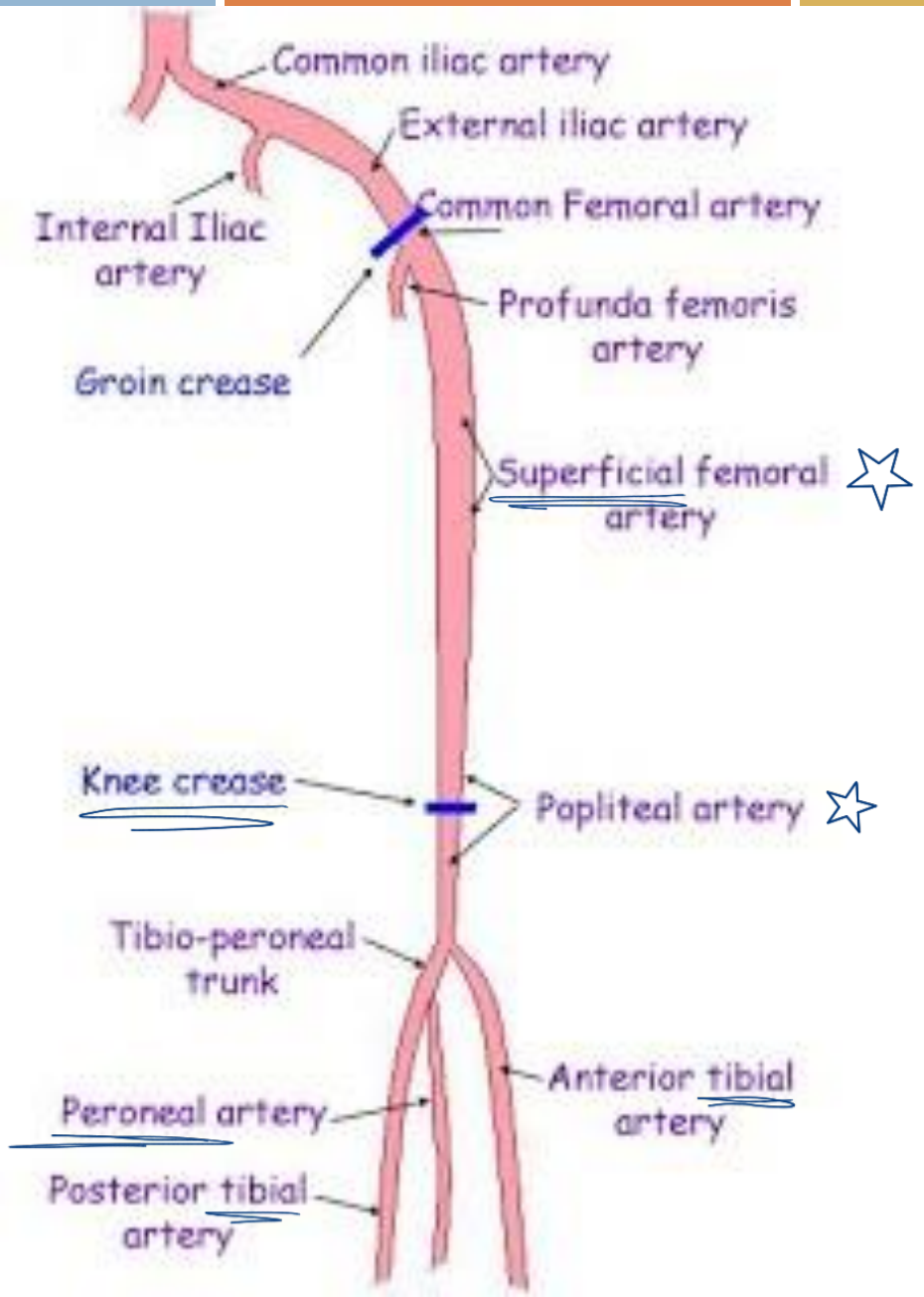



Arch of aorta
Subclavian arteries
Common carotid arteries
Brachiocephalic trunk

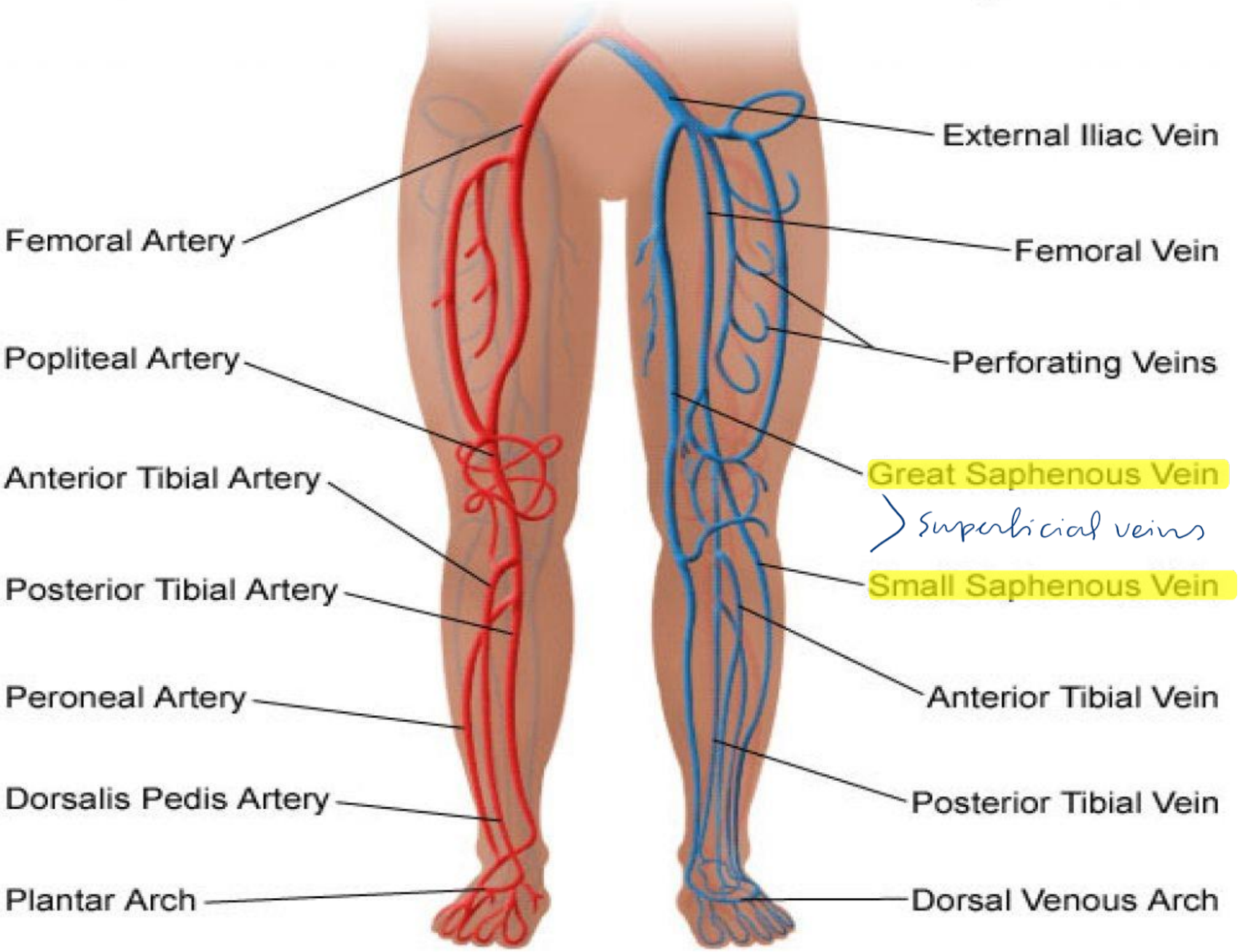

Vertebral artery
Suprascapular artery
Axillary artery
Brachial artery
Radial artery
Ulnar artery
(b)
Common carotid arteries
Right subclavian artery
Left subclavian artery
Left axillary artery
Brachiocephalic trunk
Anterior intercostal artery
Descending aorta



(b) Anterior view


Common iliac artery
External iliac artery
Internal Iliac artery
Common Femoral artery
Profunda femoris artery
Groin crease
Superficial femoral artery
Knee crease
Popliteal artery
Tibio-peroneal trunk
Anterior tibial artery
Peroneal artery
Posterior tibial artery

Arterial and Venous Circulation of the Legs



> superficial veins

ANGIOGRAPHY

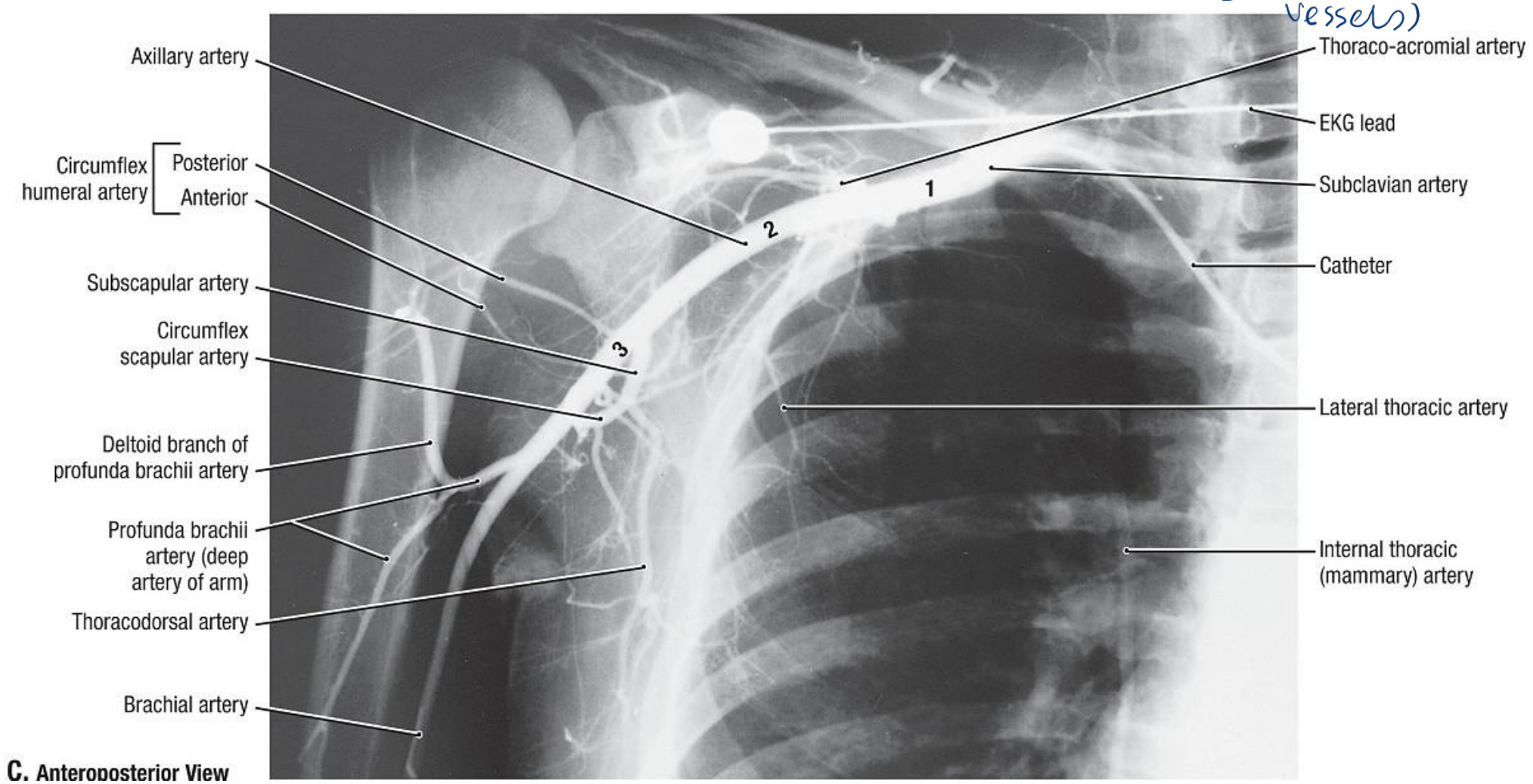
Definition

- It is an x-ray examination.
- The blood vessels are opacified by the iodine-containing contrast medium

Angiograms:

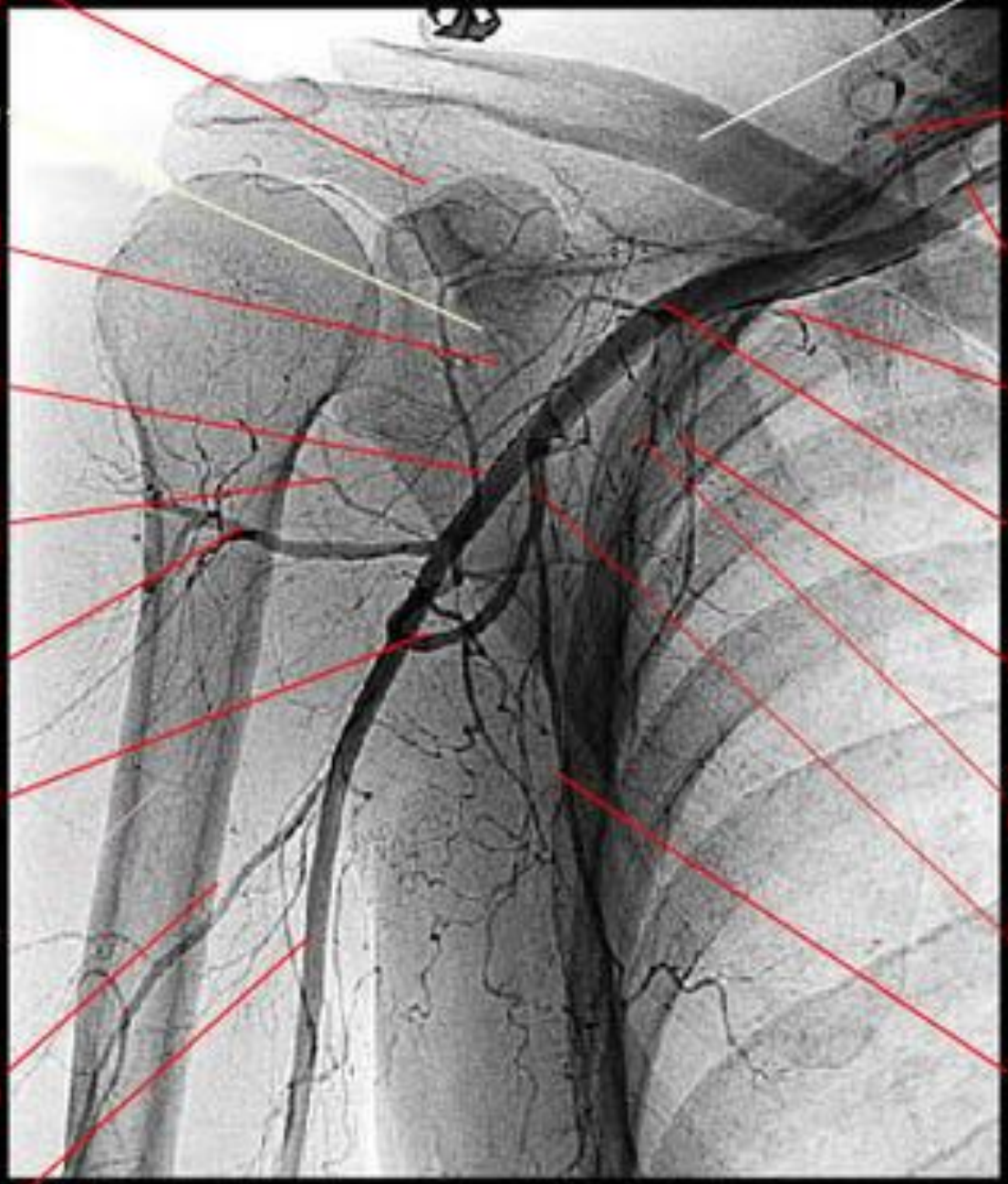
1. Arteriograms
2. LIMITED Venograms Replaced by U/S

Convential arteriogram (x-ray + can see vessels) ↱ Can see bone



C. Anteroposterior View

Angiogram



Thoracoacromial artery (Acromial branch)

Scapula

Thoracoacromial artery (Deltoid branch)

Axillary artery

Anterior circumflex humeral artery

Posterior circumflex humeral artery

Circumflex scapular artery

Humerus

Profunda brachii artery; Deep artery of arm

Brachial artery

Clavicle

Dorsal scapular artery

Subclavian artery

Superior thoracic artery

Thoracoacromial artery

Lateral thoracic artery

Thoracoacromial artery (Pectoral branches)

Subscapular artery

Thoracodorsal artery

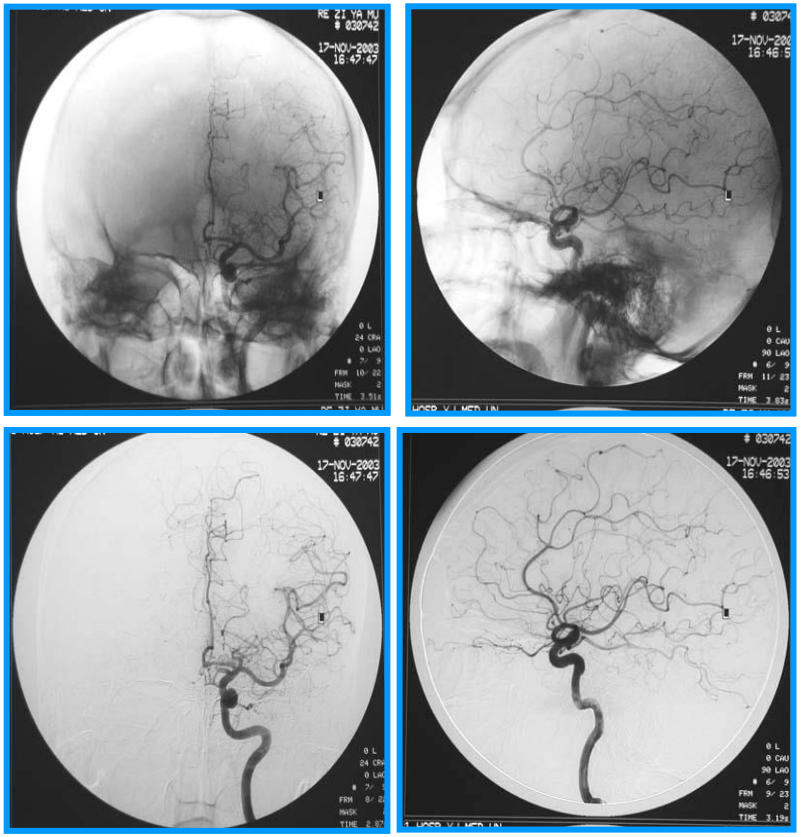
DSA

(*Digital subtraction angiography*)

Removing bone shadows

Principle

Subtract the shadows that are present on the plain films from the films taken after the contrast has been injected for the angiogram, the result is an image containing details of the opacified structures only, such as arterial system .



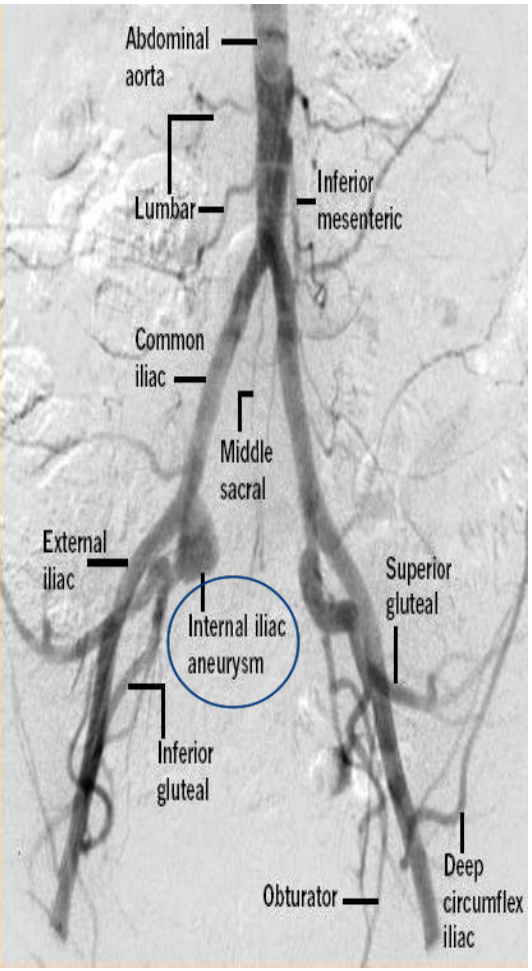
Digital vascular imaging

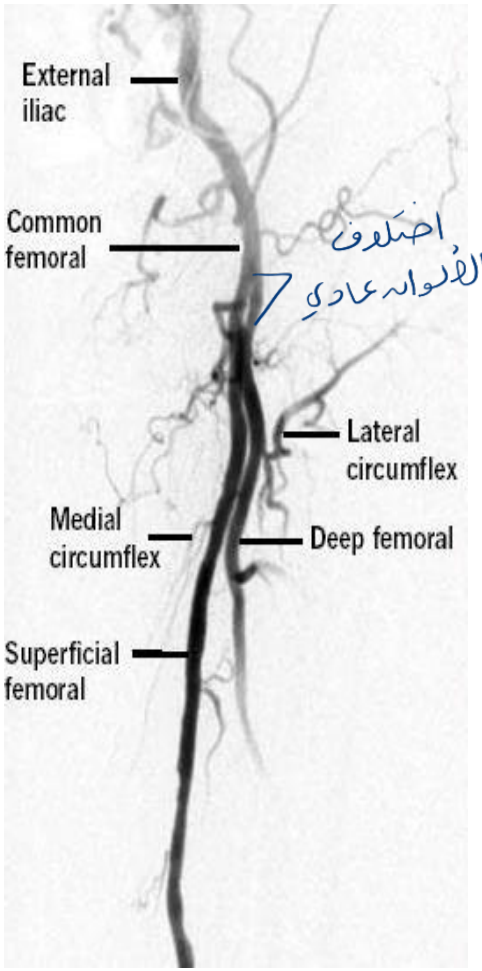
(2D DSA)

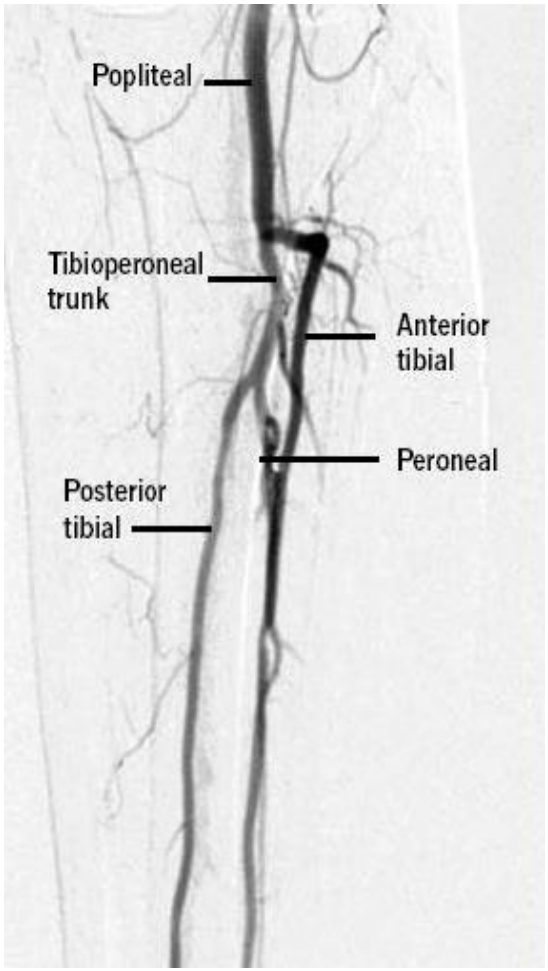
Three dimensional Imaging

(3DDSA)

Digital Subtraction arteriogram







Patient Preparation

Most imp Labs: Coag profile + KFT (contrast-induced nephropathy)

- Appointment time
- Nil orally 4-6 hrs.
- On trolley
- In hospital gown
- Groin shave
- Records
- Coagulation profile

✡ PTI

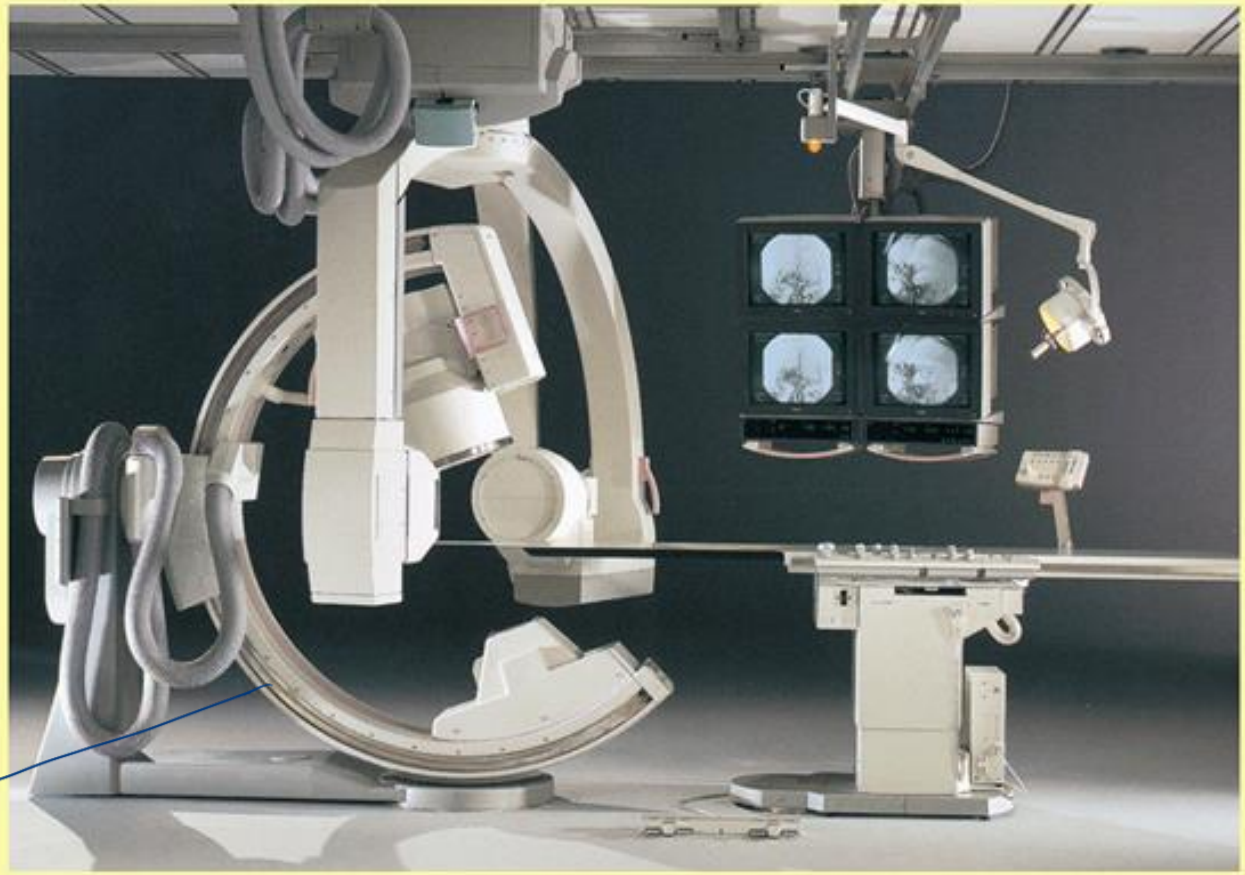
- Should be well hydrated.
- Should void before procedure.
- Peripheral pulses marked.
- I.V line in place.
- Informed consent

Contrast allergy: absolute CI

Another allergy: Give Steroids (Prednisolone) bf the Procedure

Asthmatic pts: Give steroids..

EQUIPMENTS



General angiographic room with biplane C-arm digital imaging

SELDINGER TECHNIQUE

- Site cleaned, area draped, local anesthetic given.
- The needle is introduced into the target artery or vein .

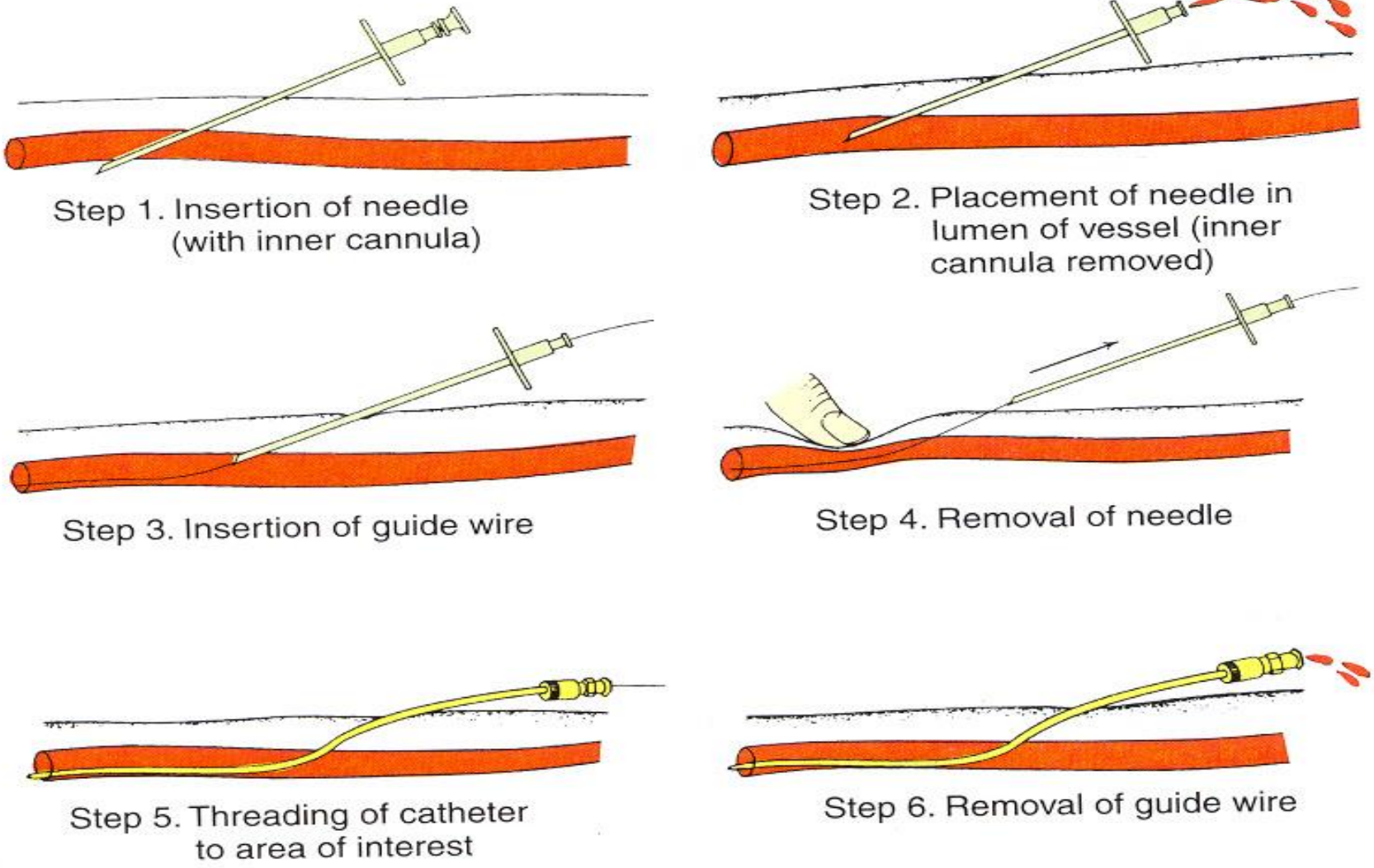


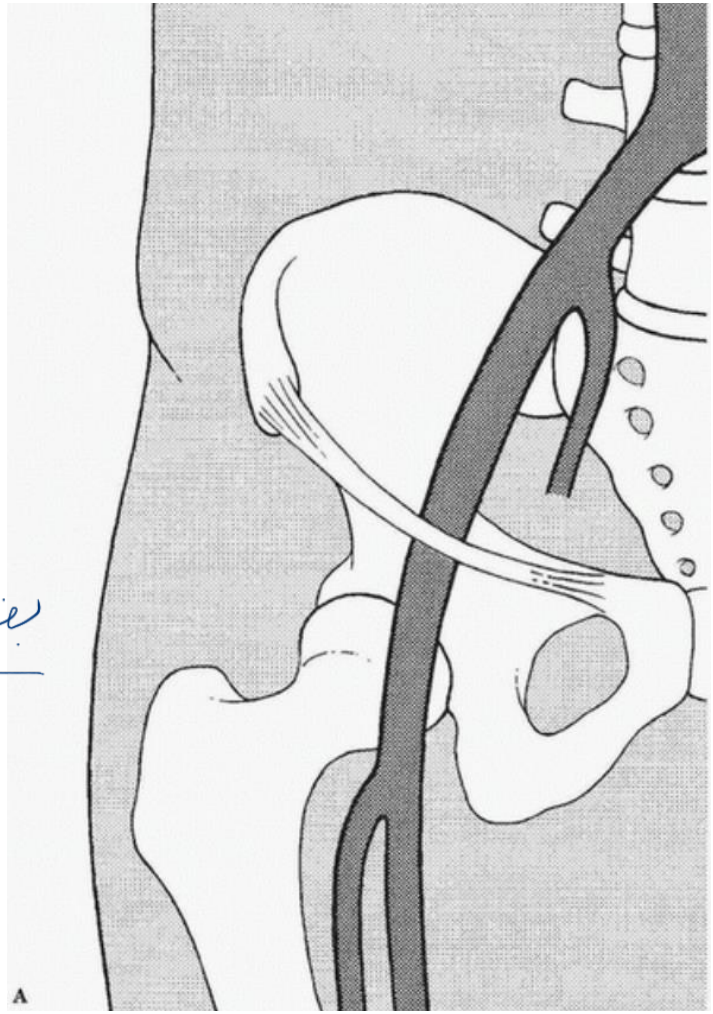
Fig. 21-36. Six steps of Seldinger technique.

SELDINGER TECHNIQUE

- A guide wire is inserted through the needle.
- With guide wire in vessel, needle is removed.
- Catheter is threaded onto the guide wire.
- Under fluoroscopy, the catheter is then advanced and the guide wire is removed.

Femoral Artery Approach

- Easily accessible.
- Large caliber vessel
- Well defined land marks exist.
  - has bony structures behind it
- Low complication rate.



Post procedural Care

- After the catheter is removed **compression** is applied to the puncture site.
- The patient is asked for **bed rest** for a minimum of 4 hours
- During rest patient is monitored **and vital signs** like peripheral pulses distal to Puncture are regularly checked
- The extremity is also checked for warmth, color, numbness to **ensure circulation** has not been disrupted.

CONTRA-INDICATIONS

- Contra-indications to contrast media

1. Allergy (allergy to CM is an absolute contraindication)
2. Impaired renal function
3. Medications

- Blood- clotting disorders/ Anti coagulant medication

- Unstable cardio pulmonary/ neurological status

COMPLICATIONS

- 0.16% major complication rate:

1. **Local complications:** hematoma, vessel laceration, dissection, peudoaneurysm, AV fistula.
2. **Systemic complications:** contrast reactions, fever, sepsis, dehydration, death.
3. **Therapy related complications** (ex: **CNS bleeding during thrombolysis**)

- Peripheral Vascular Disease
- Aneurysms
- Stenosis

Arterial Occlusive Disease

- Acute VS chronic.

Acute Arterial Occlusion

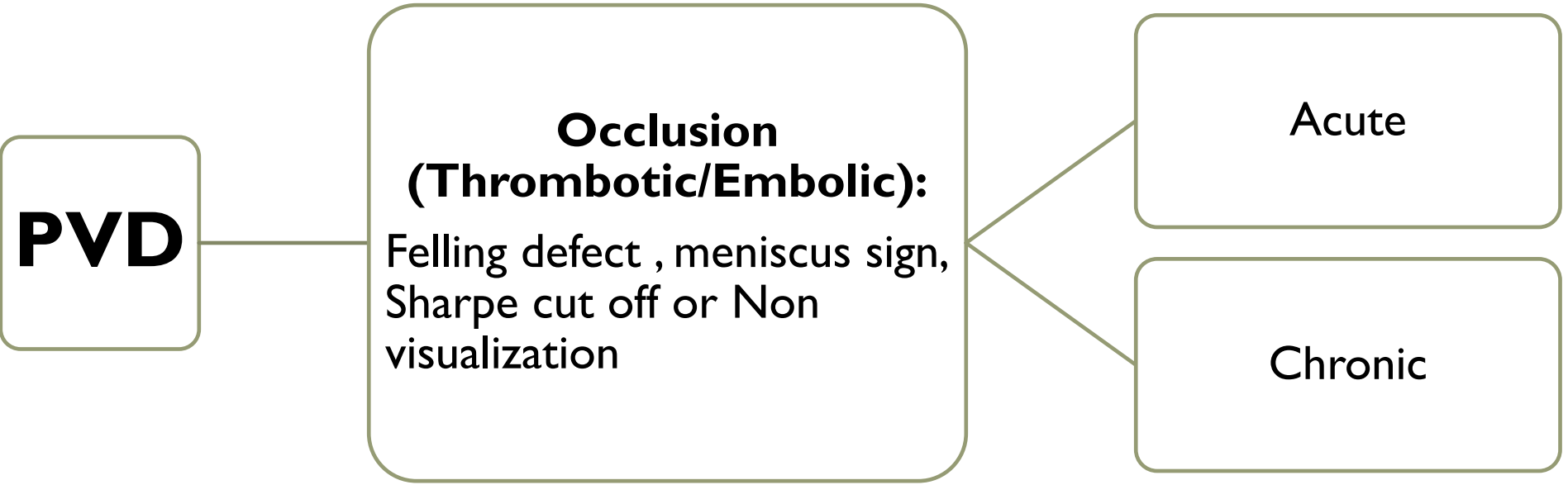
- Embolus is the most common cause
- Other etiologies are dissections of the arterial wall, external compression , spasm or hemodynamic problems.
- Immediate intervention needed to prevent loss of extremity

Acute Embolic Occlusion

- Cardiac origin : recent MI or A-fib
- Emboli get trapped at arterial bifurcations and cause further thrombosis by apposition or stagnation of blood flow
- Most frequent location of arterial emboli is the common femoral artery (46 %)

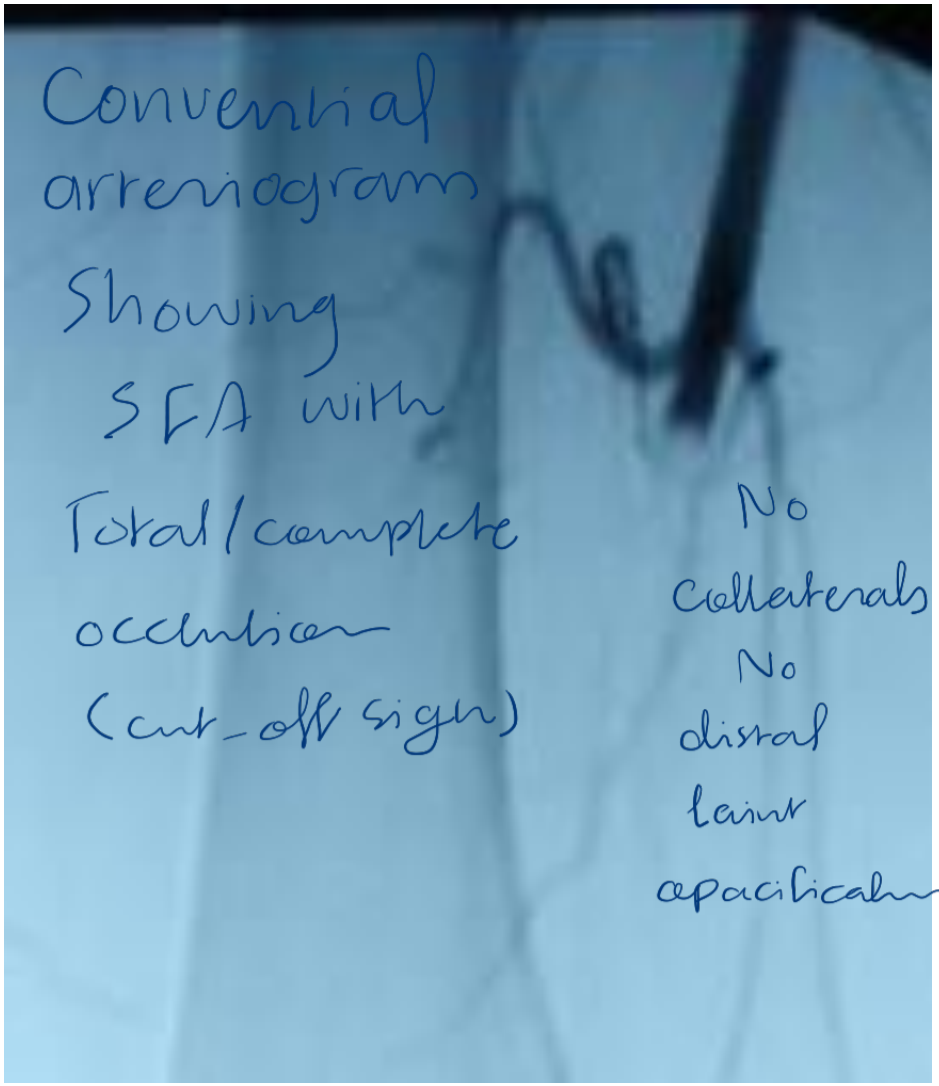
Acute Thrombotic Occlusions

- Caused by atherosclerosis in over 90%.
- The clinical signs are less severe than with acute embolic disease.


PVD
Occlusion (Thrombotic/Embolic):
Felling defect , meniscus sign, Sharpe cut off or Non visualization
Acute
Chronic

→ Distal subtraction arteriogram

Still there's a contrast rim
(∵ filling defect → Almost complete occlusion)

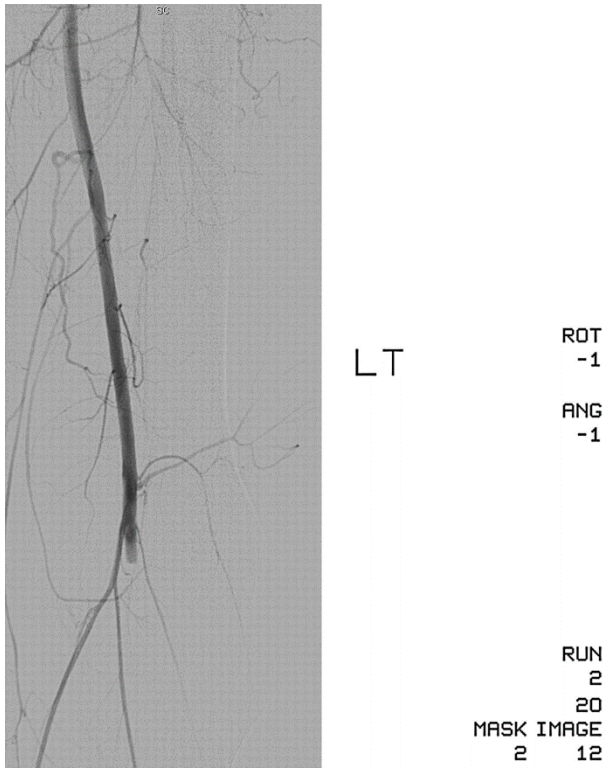


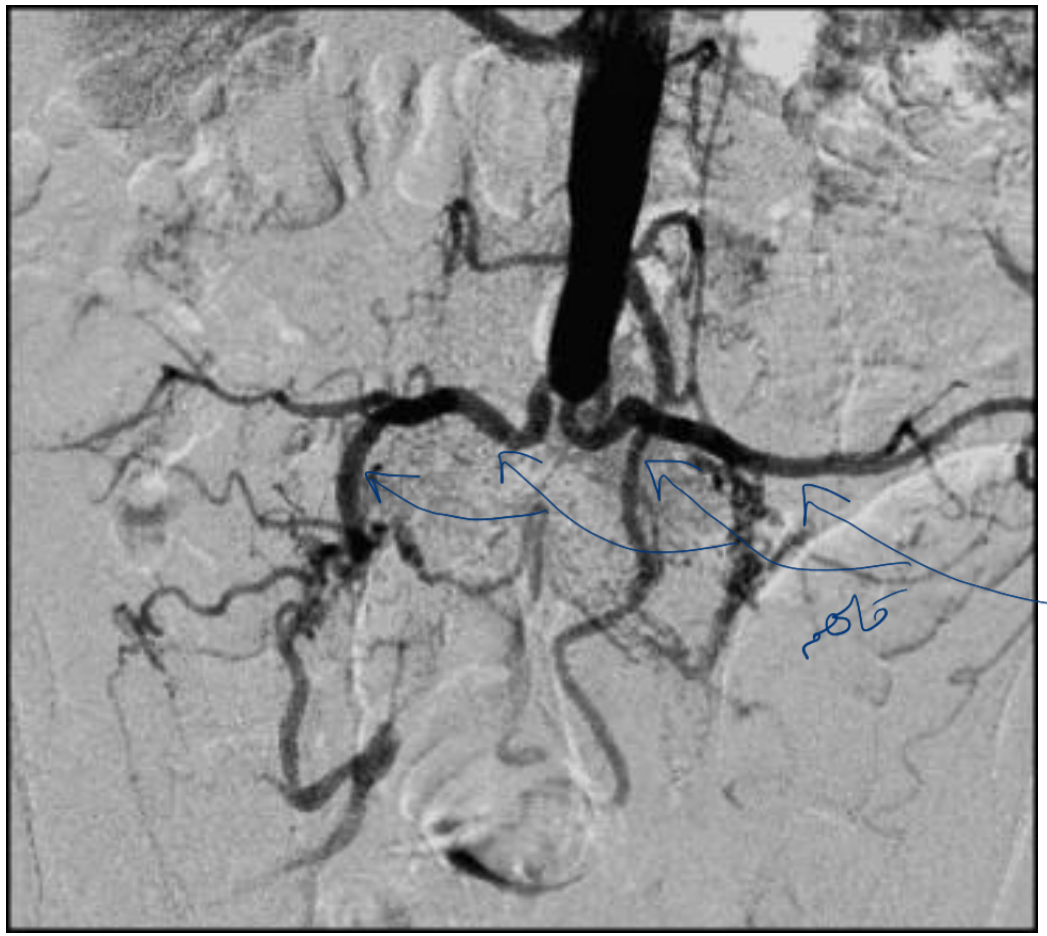
→ No collaterals

Acute occlusion

Acute Occlusions

- On arteriography an acute thrombotic occlusion may show a relative **sharp cut-off** of the contrast column





Digital Sub. arterio. Showing Abd. aorta with Comp. occlusion at aortoiliac bifurcation.

↓

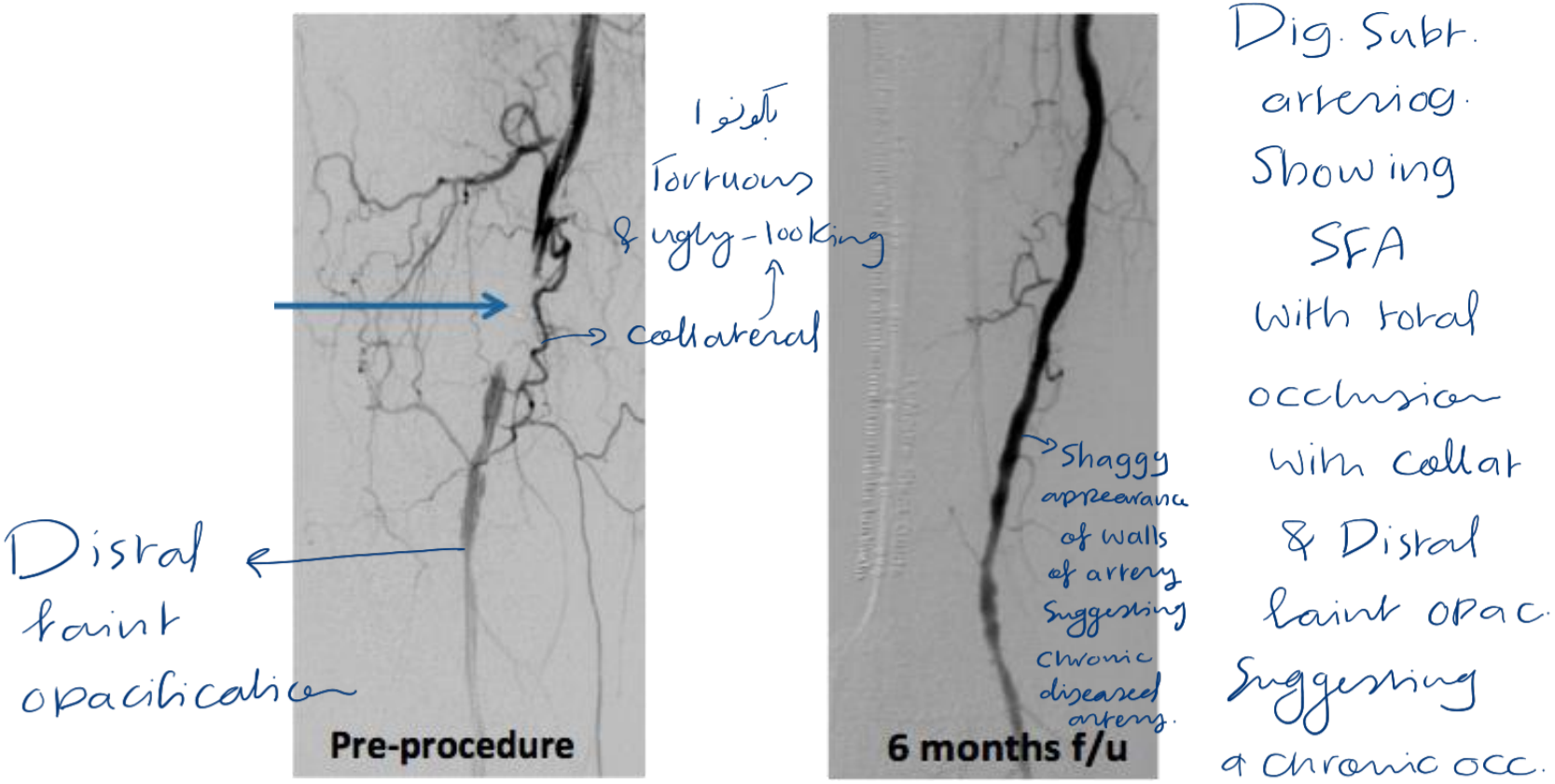
There's collaterals

↓ ∴

Chronic occlusion

Aortoiliac Occlusive Disease, Also Known As Leriche's Syndrome

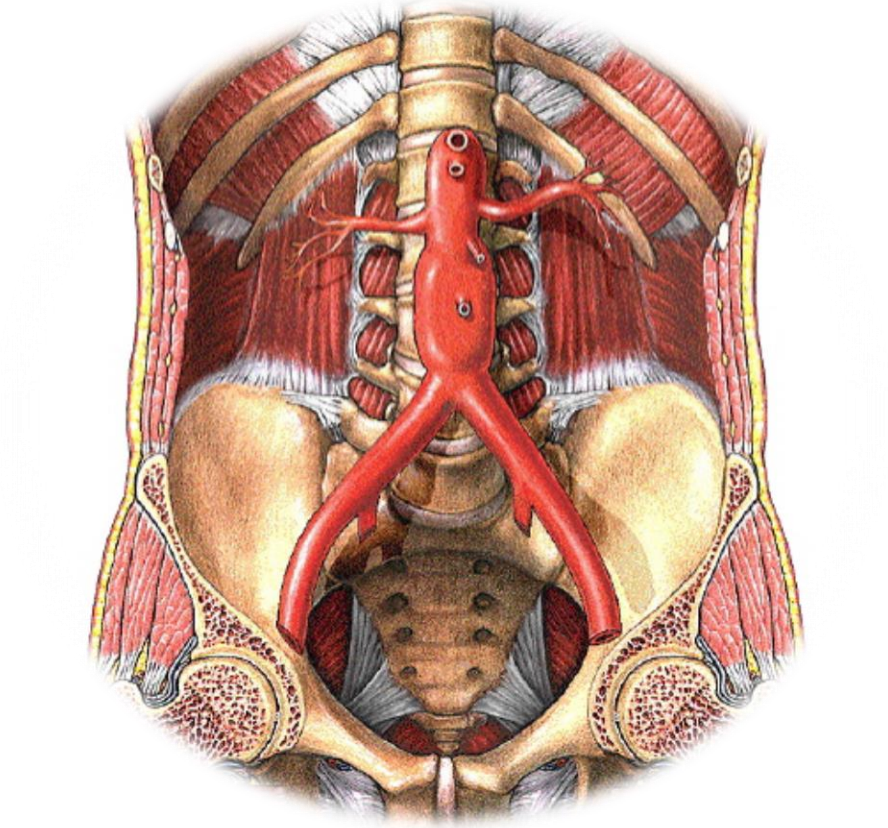
↳ Triad : No distal pulses
Claudication
impotence



Angioplasty and stenting of superficial femoral artery

Ballooning OR Stent.

ANEURYSMS



ANEURYSMS

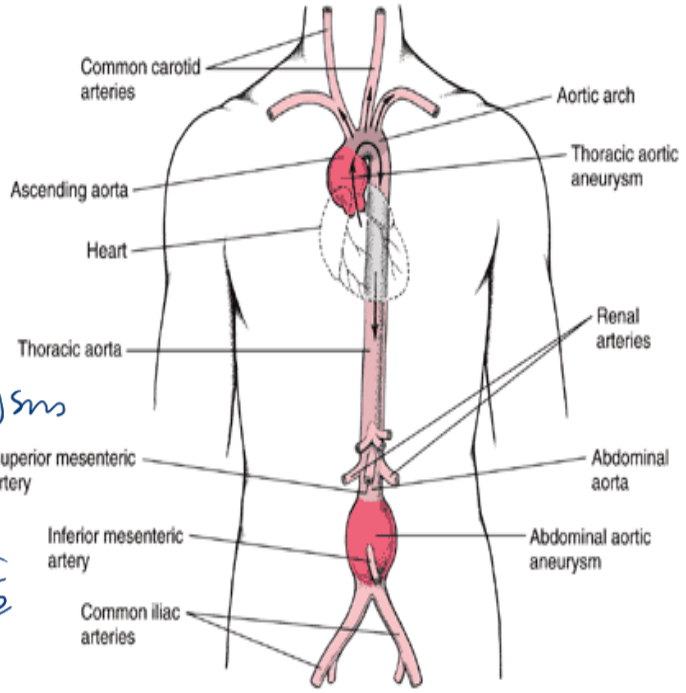
Dilation of an artery:

1. Fusiform or saccular
2. True or false

Aorta :

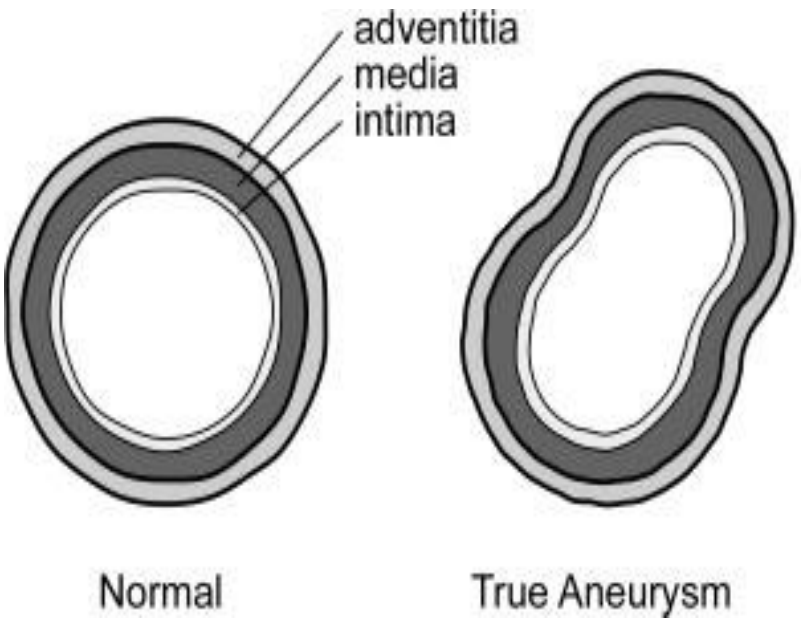
- Thorax › 4cm. normally ≤4 cm (×1.5 = aneurysm)
- Abdomen › 3cm. normally ≤3 cm (×1.5)

eg: 3.5 cm Abd aorta → ectasia, not aneurysm. (>3 but <4.5)

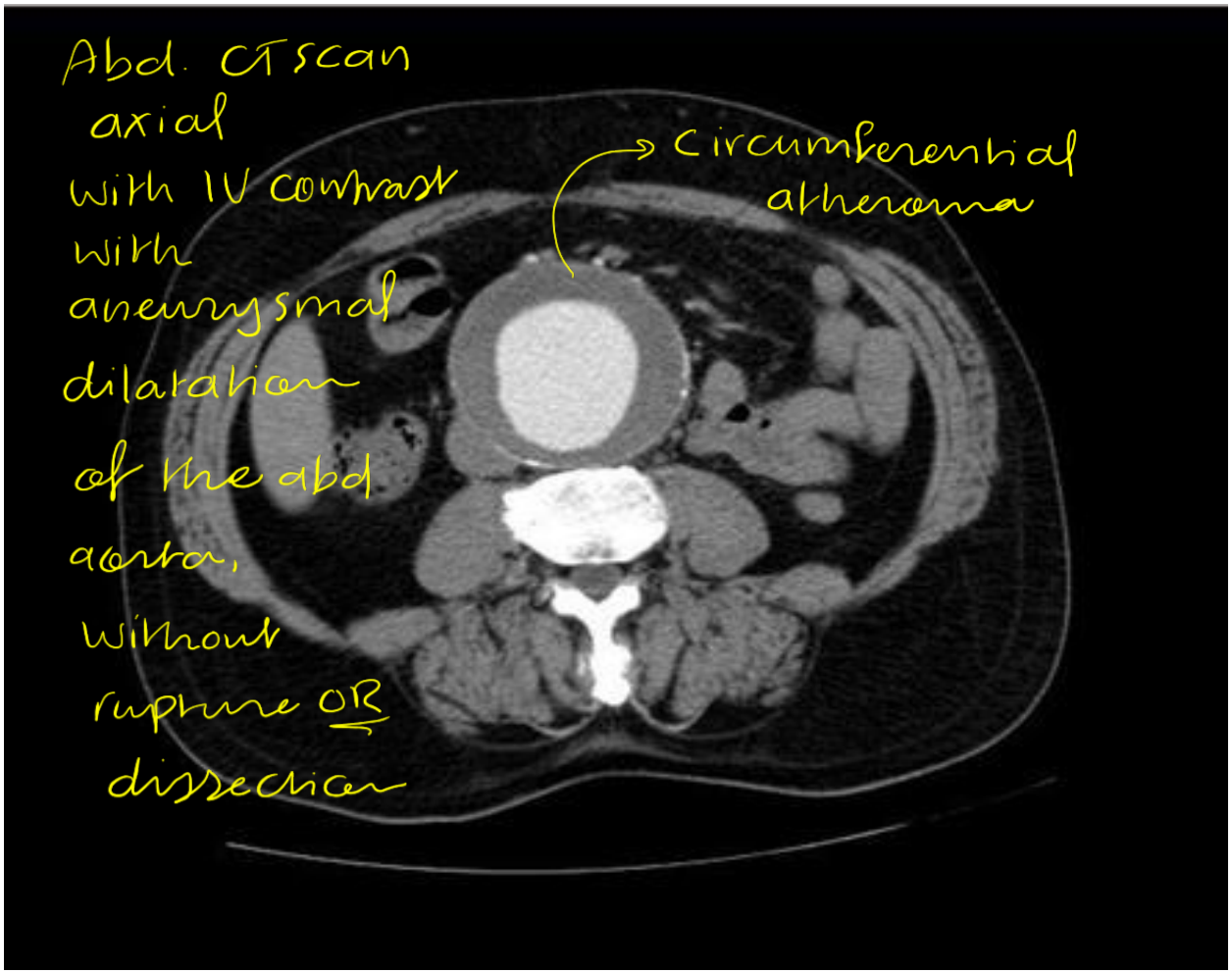


TRUE ANEURYSMS

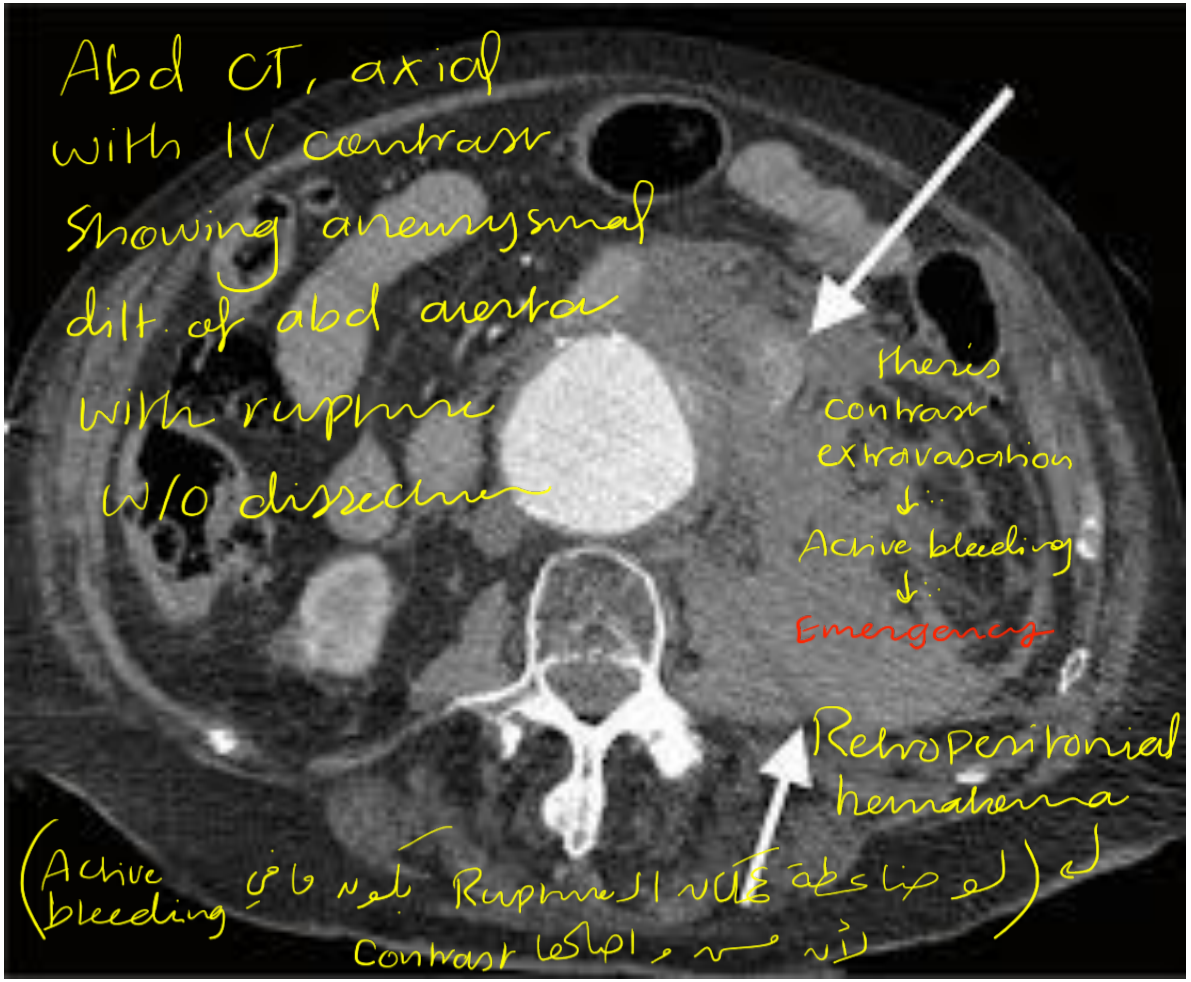
- localized outpouchings, spindle shaped which involve all three layers of the arterial wall.
- The pathogenesis is mainly a degeneration of the media
- The etiology is atherosclerosis in 70% to 80%.



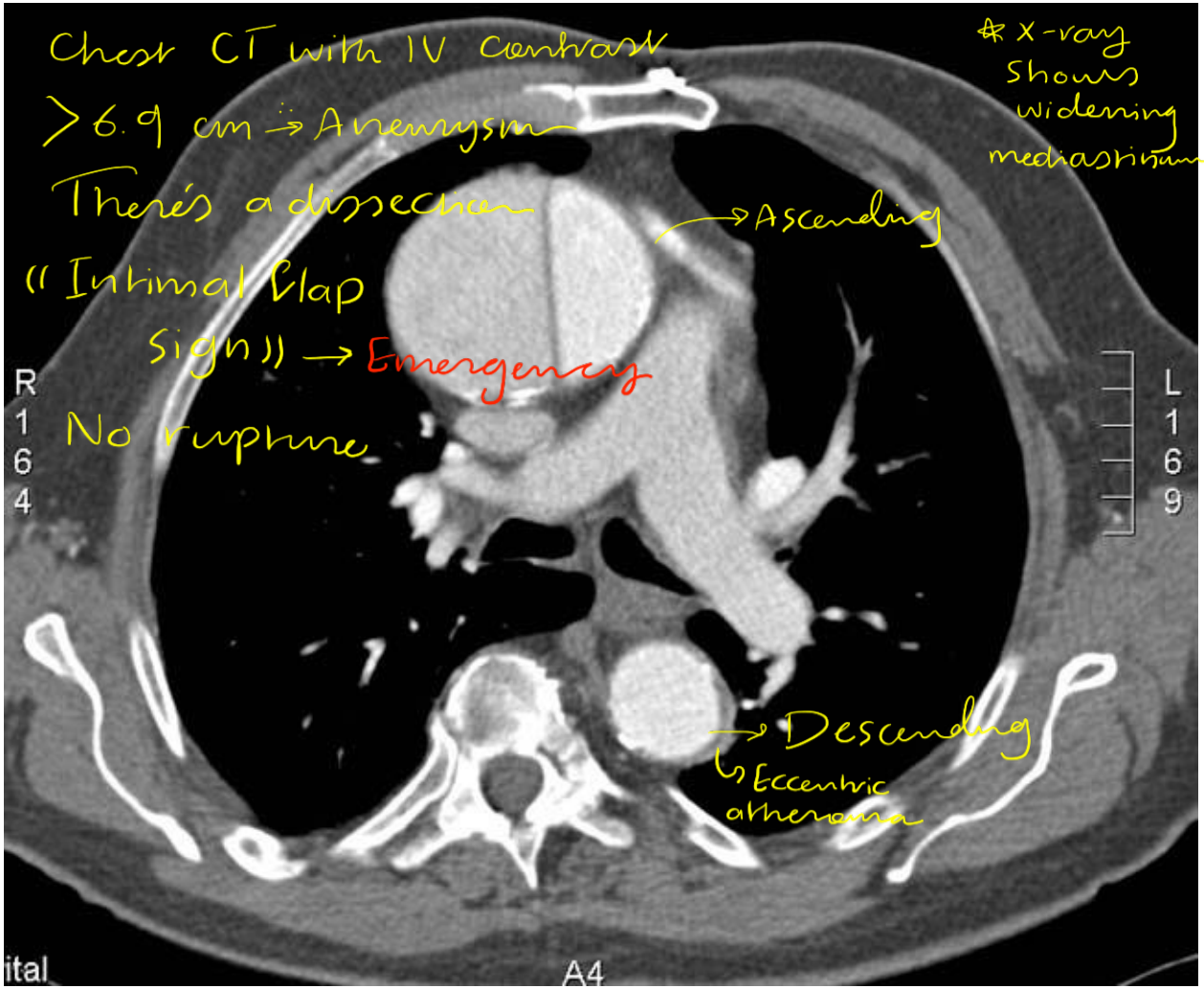
ANEURYSMS


Abd. CT scan
axial
with IV contrast
with
aneurysmal
dilatation
of the abd
aorta,
without
rupture OR
dissection
circumferential
atheroma

RUPTURED ANEURYSM



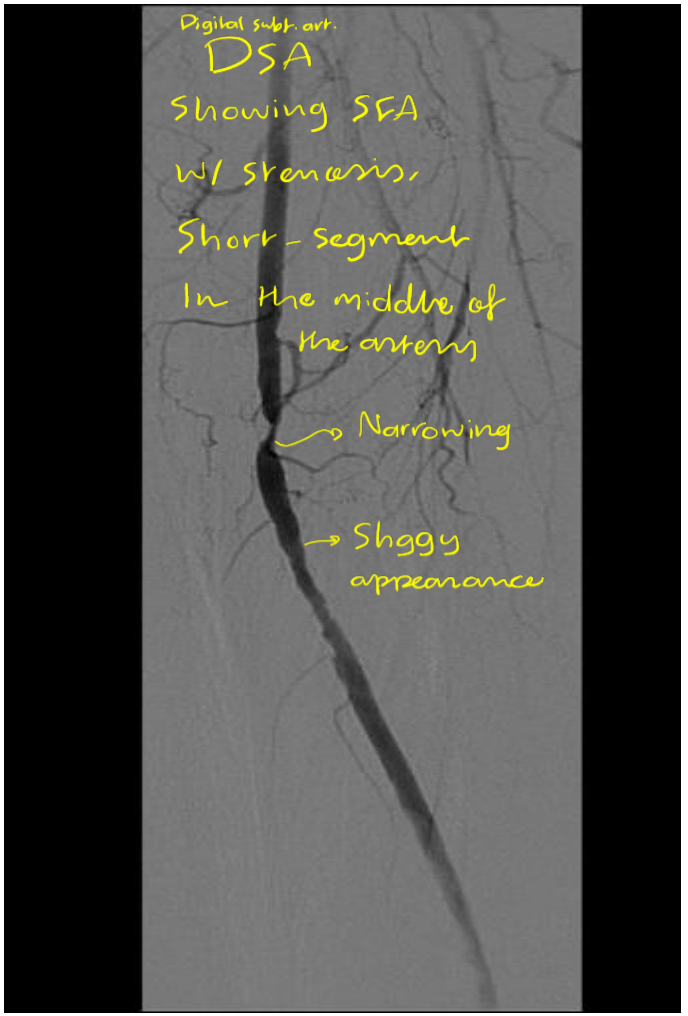
Dissecting Aneurysms



Arterial Stenosis

Artery stenosis may be caused by several pathological processes:

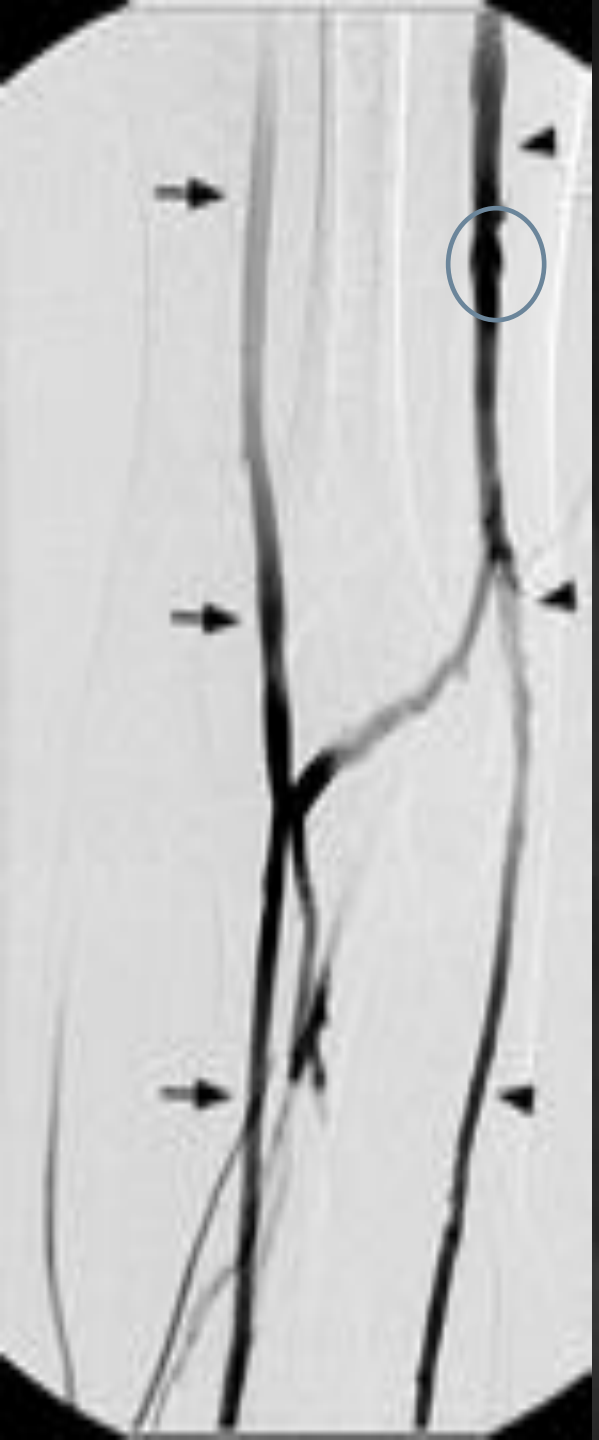
- Atherosclerosis (~75% of cases).



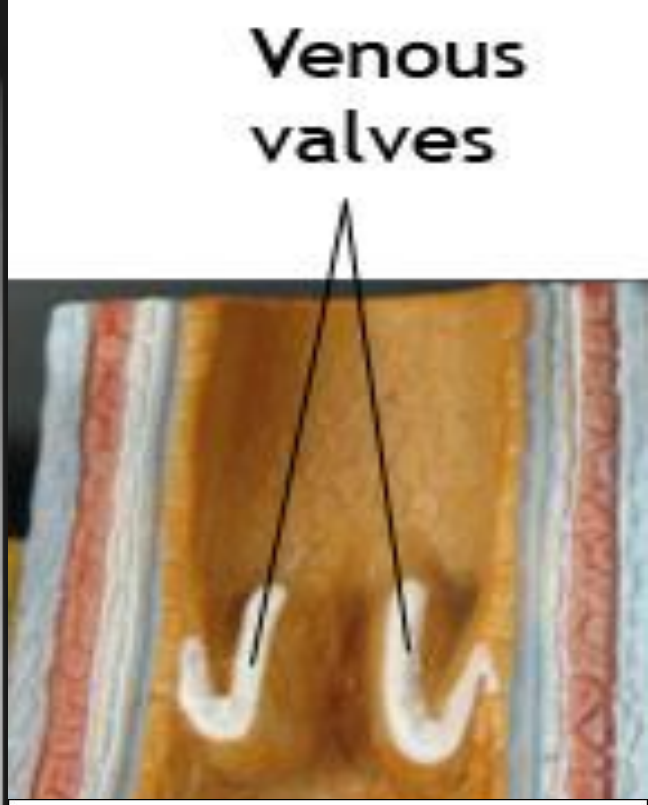
VENOGRAPHY

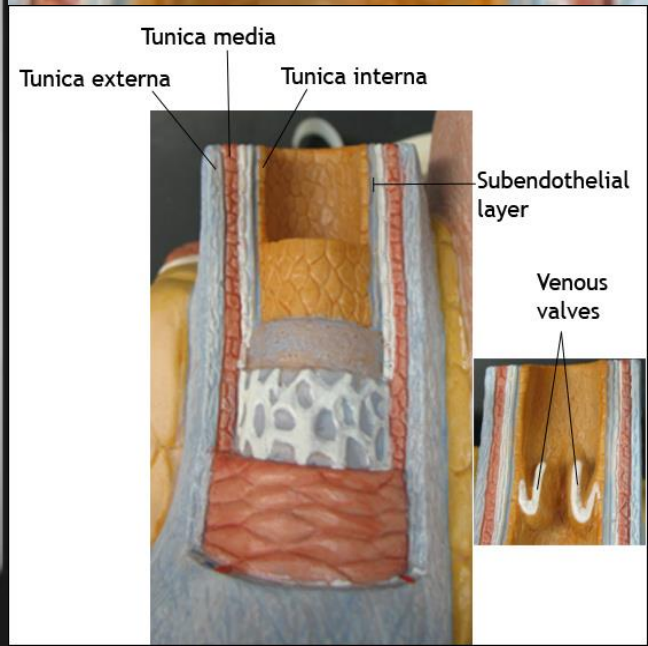
- Technique

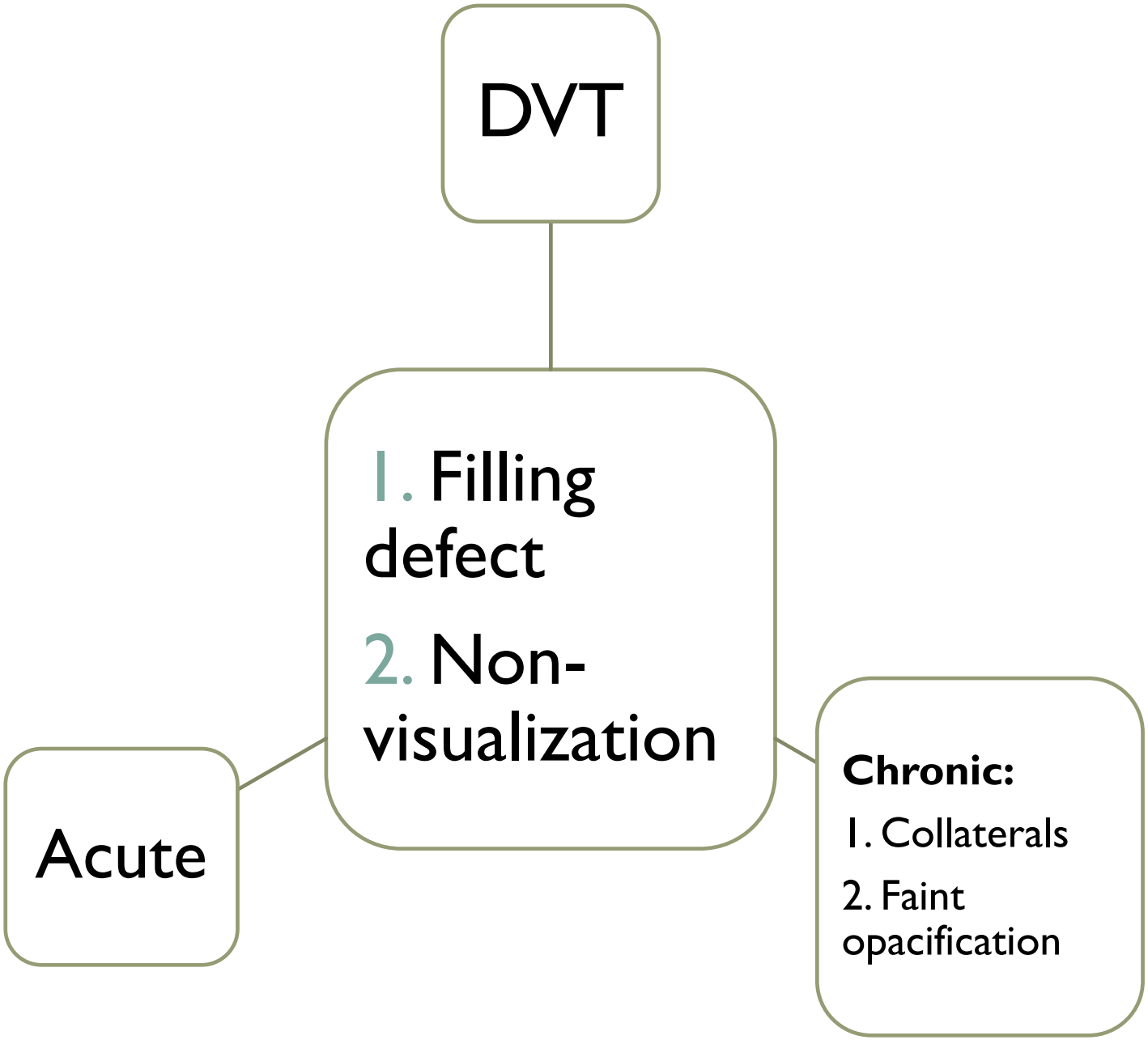
contrast medium is injected into a small vein in the dorsum of the hand or foot.

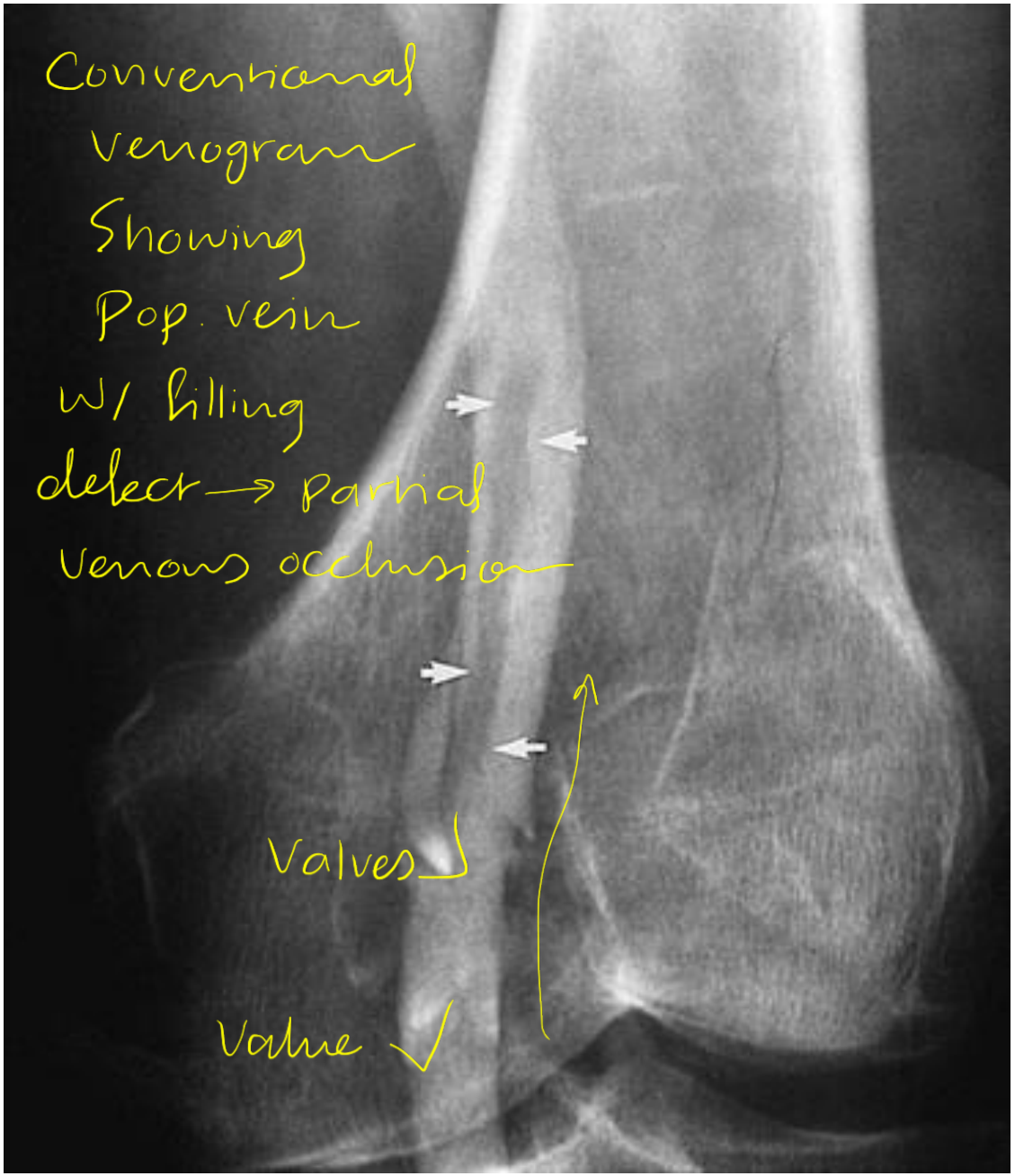


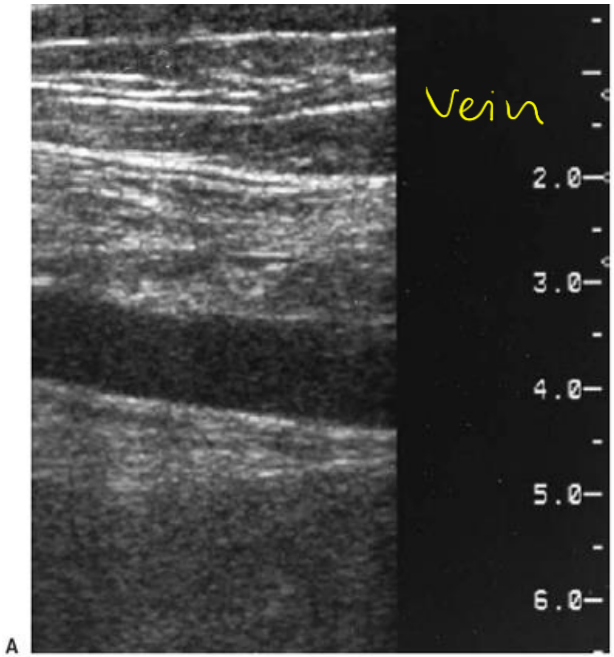

∧
inverted 7
sign → valve

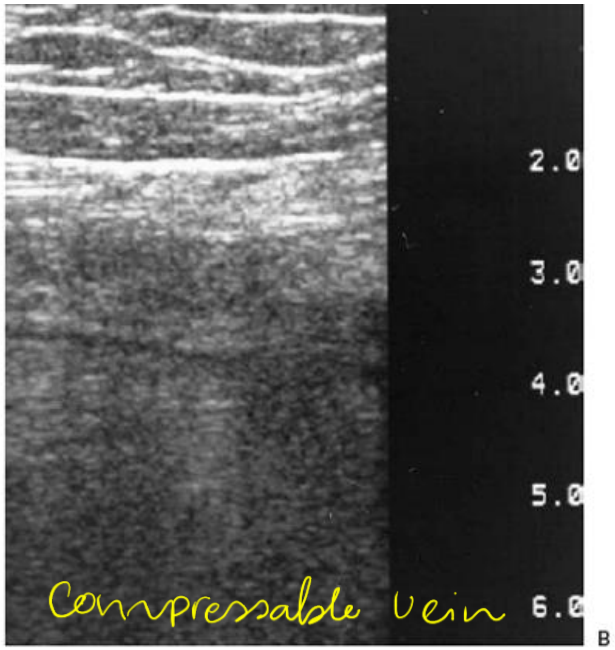

Venous
valves

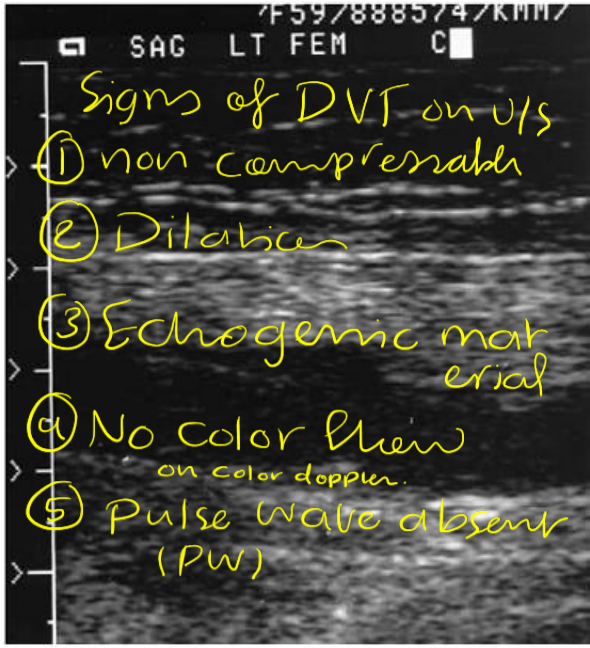

Tunica media
Tunica externa
Tunica interna
Subendothelial
layer
Venous
valves

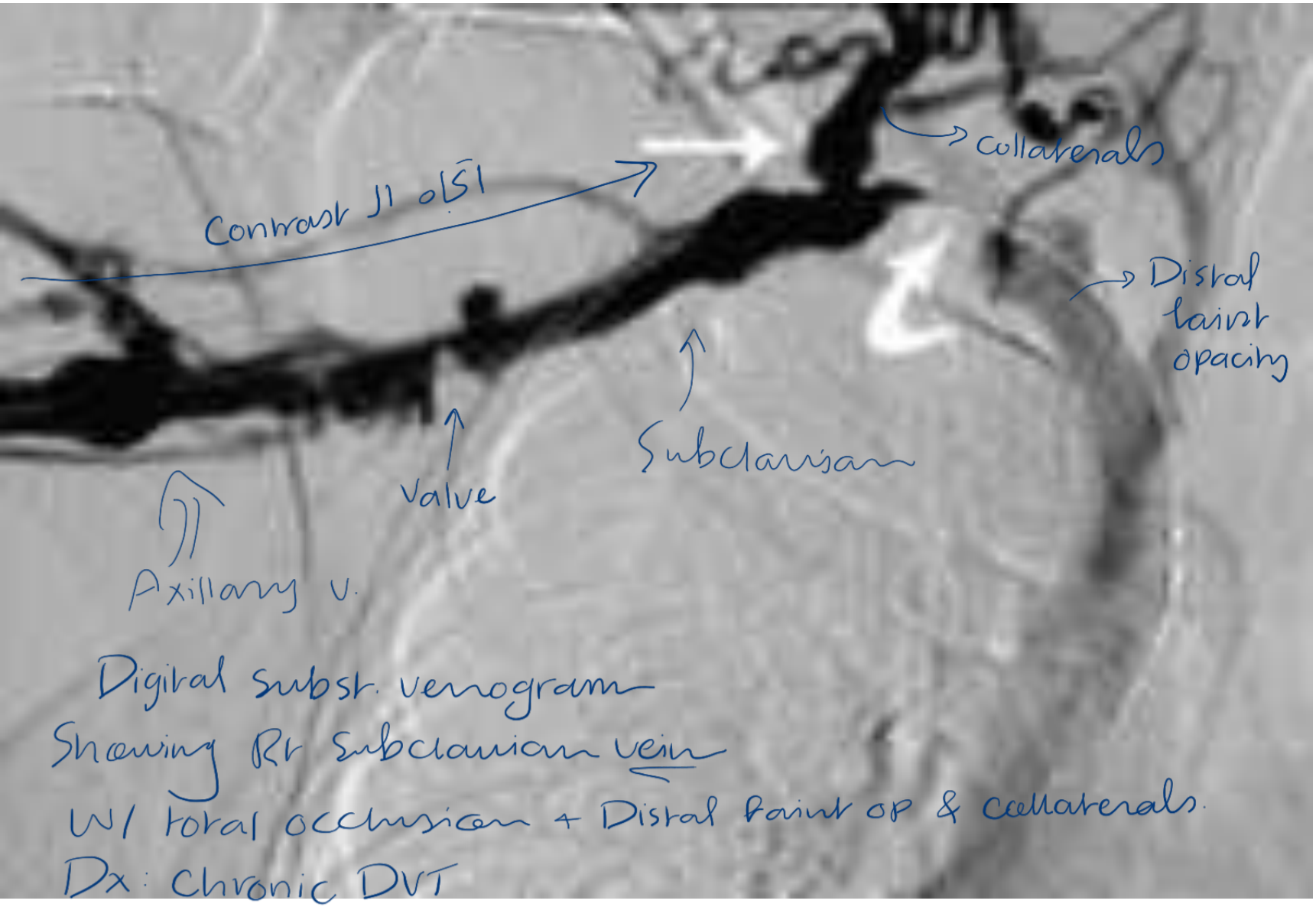

DVT
1. Filling defect
2. Non-visualization
Acute
Chronic:
1. Collaterals
2. Faint opacification


Conventional
Venogram
Showing
Pop. vein
W/ filling
defect → partial
Venous occlusion
Valves
Valve


Vein
2.0
3.0
4.0
5.0
6.0
A


2.0
3.0
4.0
5.0
Compressable Vein
6.0
B


SAG LT FEM
Signs of DVT on U/S
① non compressable
② Dilation
③ Echogenic material
④ No Color flow
on color doppler.
⑤ Pulse wave absent
(PW)
C



Digital subst. venogram
Showing Rt Subclavian vein
W/ total occlusion + Distal faint op & collaterals.
Dx: Chronic DVT

Interventional Radiology

- **The interventional radiologist uses per-cutaneous techniques under imaging control to guide small instruments through the blood vessels or other pathways to treat disease.**
- **These procedures are typically much less invasive and cause much less discomfort.**
- **Imaging modalities:**

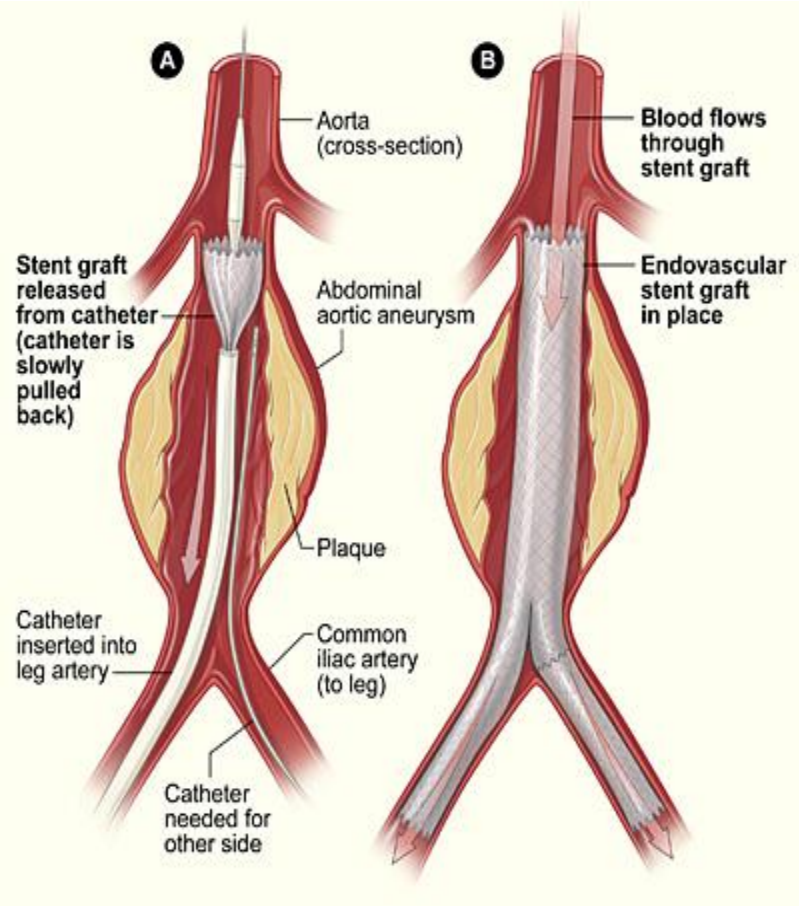
1. **X-ray /fluoroscopy/DSA**
2. **CT**
3. **US**
4. **MRI**

Basic Interventional Techniques

1. Endovascular Aneurysm Repair
2. Angioplasty
3. Vascular Stents And Filters
4. Therapeutic Embolization
5. Percutaneous Needle Biopsy
6. Percutaneous Abcess drainage or aspiration

1. Endovascular Aneurysm Repair

- For high risk surgery patients
- Before aneurysm reaches diameter for elective surgery
- Inserted through femoral artery
- Decreased length of stay in hospital
- Still need monitoring for complications



2. Angioplasty

Technique

During the procedure a balloon catheter is placed across the lesion and the balloon is inflated and the lesion is compressed. The result is a wider vessel lumen and increased blood flow.

Indications

Short vascular stenosis or occlusion in the legs or arms, kidneys, brain or elsewhere in the body.

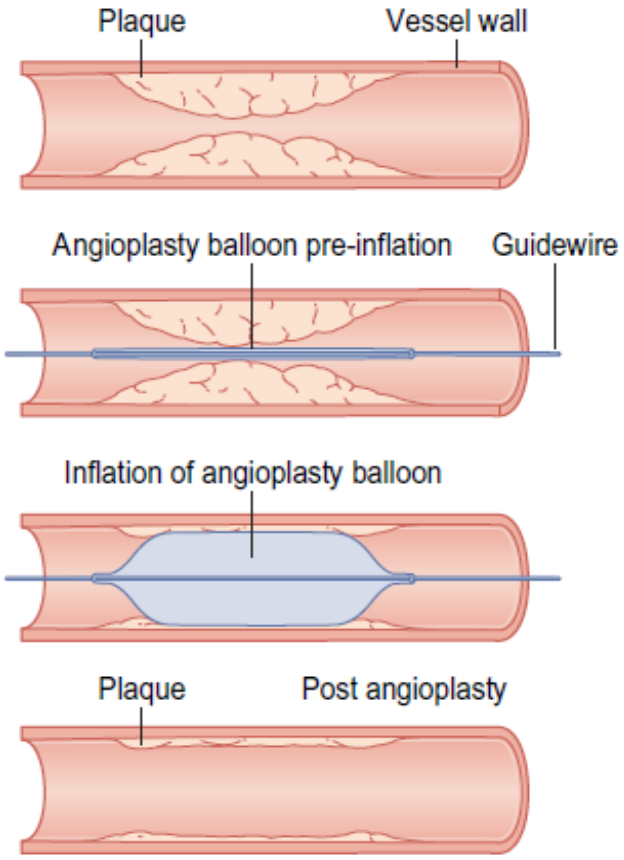
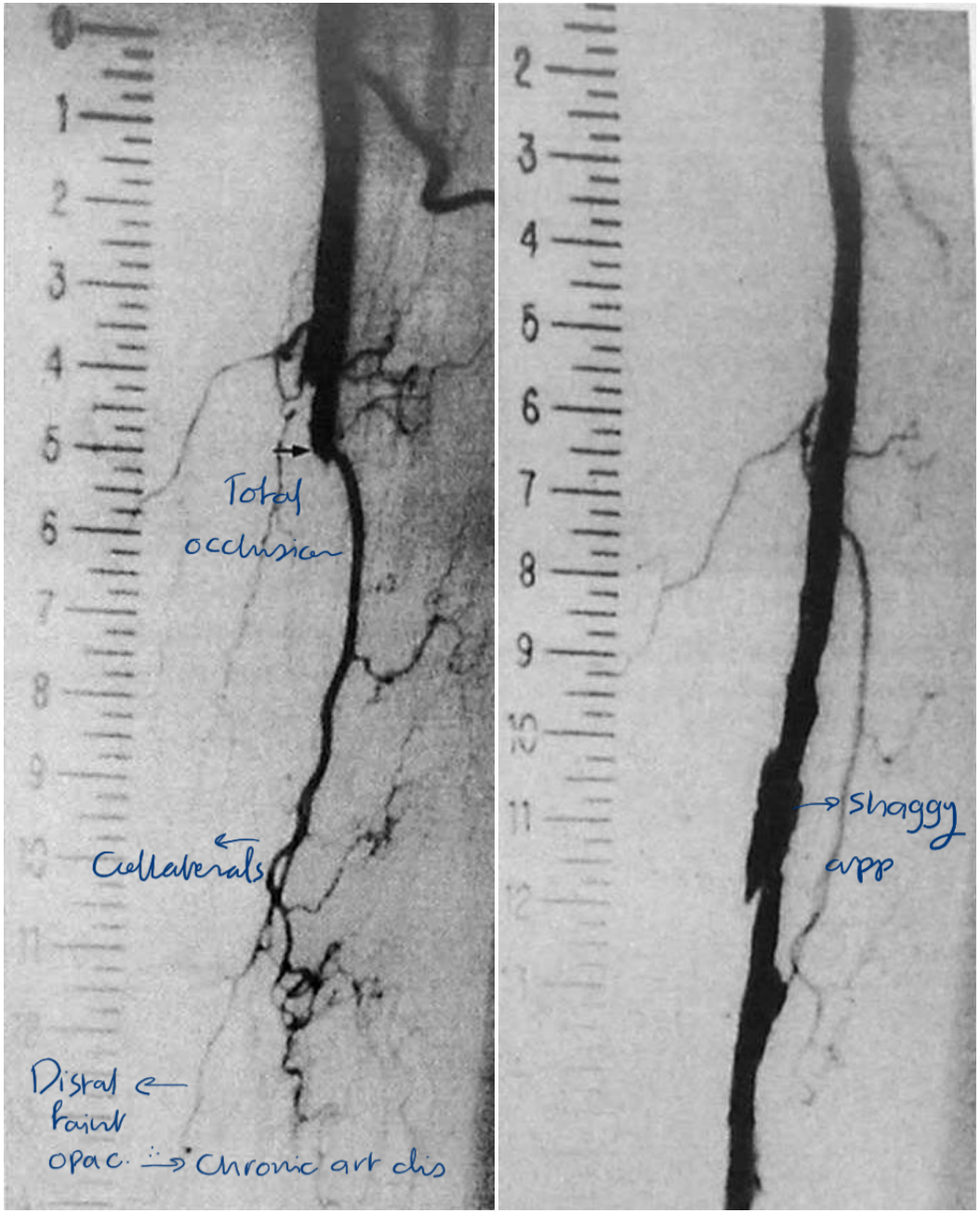


Diagram of angioplasty



Angioplasty of left femoral artery

3. Vascular Stents

Technique

Stents are expandable metal cylinders that can be embedded in plastic and collapsed to enable them to be inserted through an artery or vein. Stents help hold the artery open, which improves blood flow and relieves symptoms caused by the blockage.

Indications

Vascular stenosis in peripheral vascular

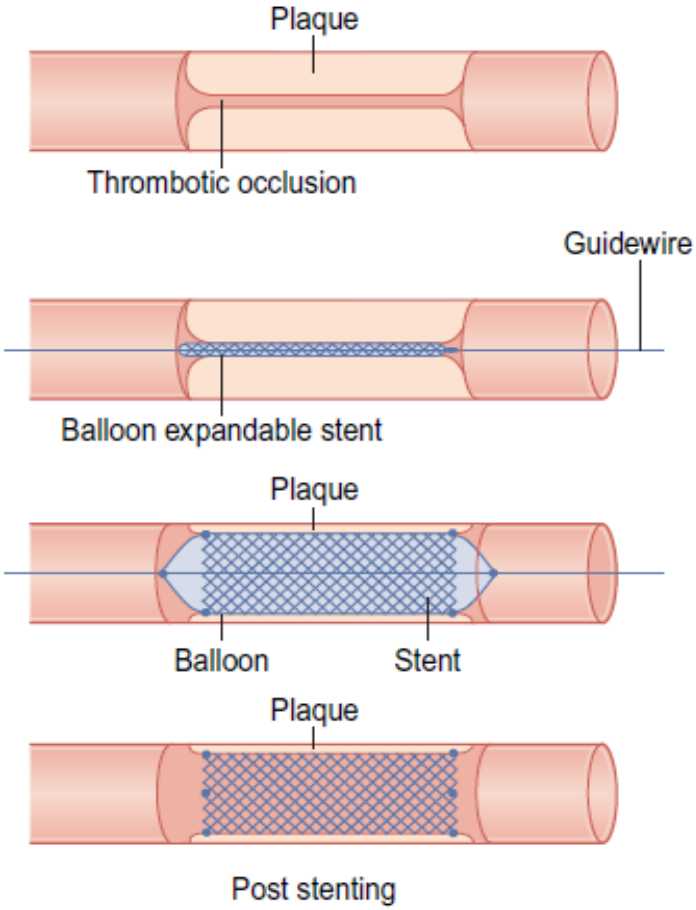
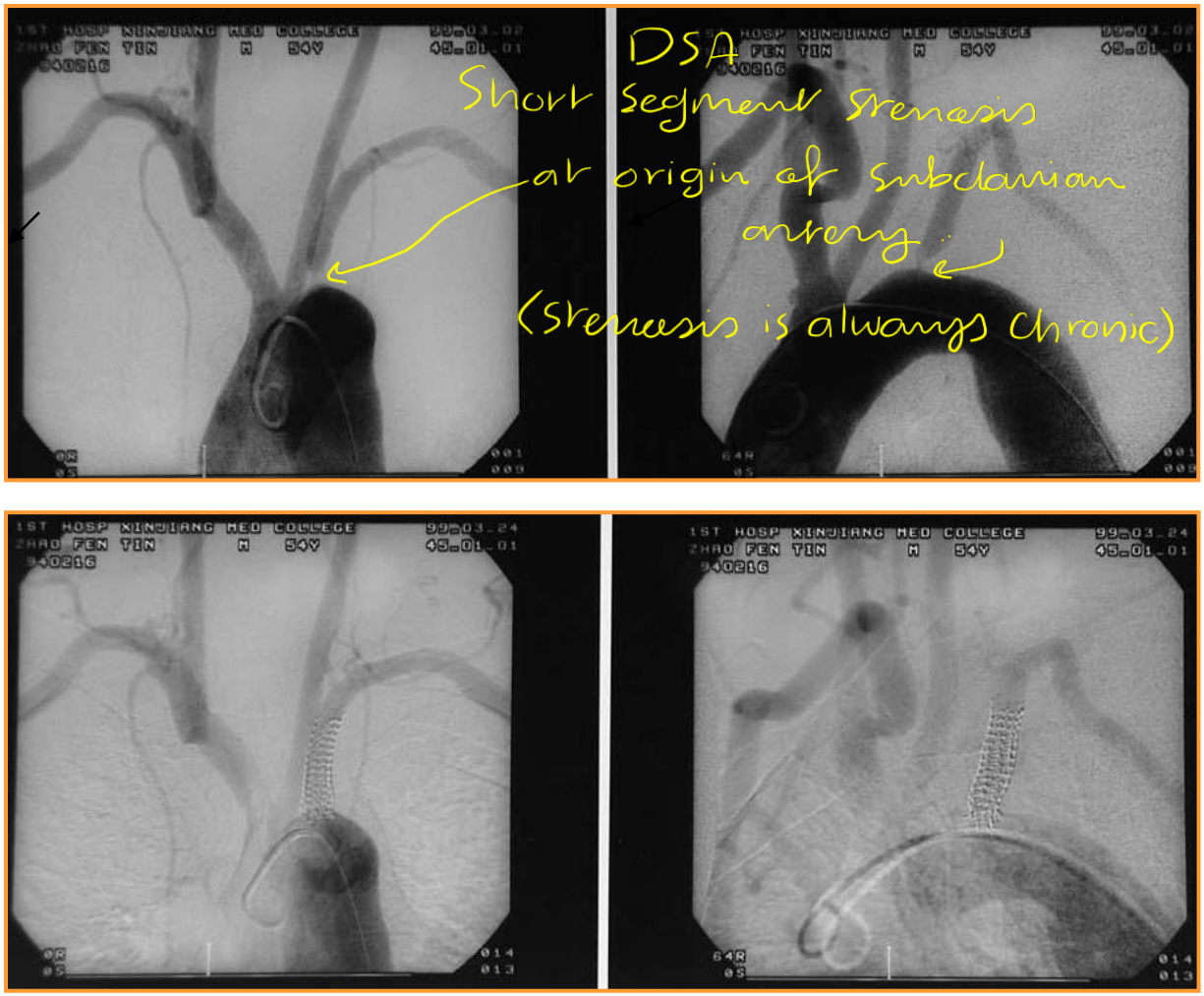


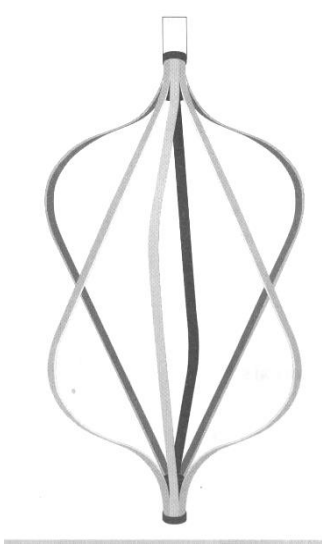
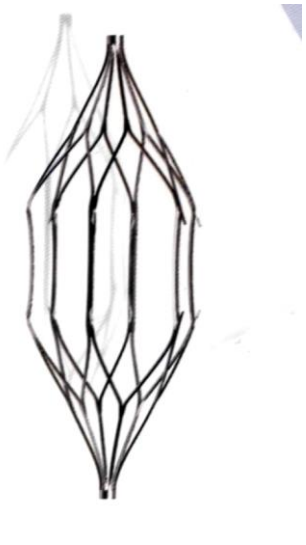
Diagram of stenting

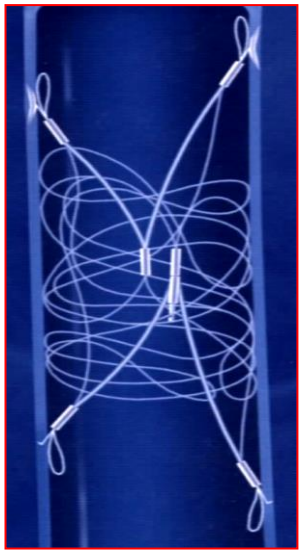
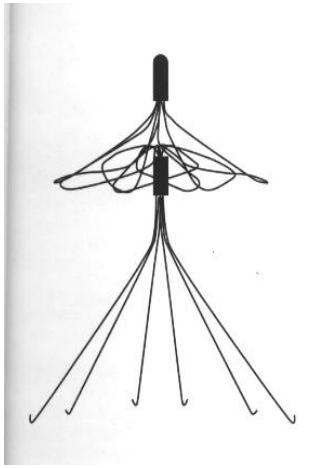
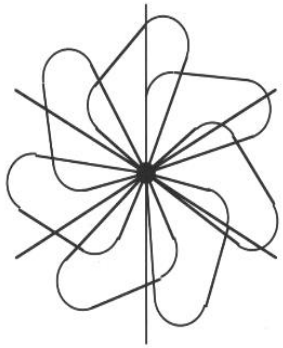
Indications For Stents In Revascularization Procedures:

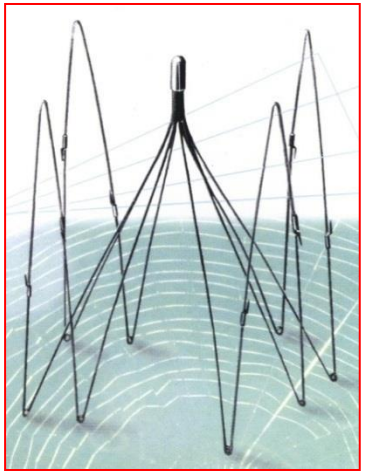
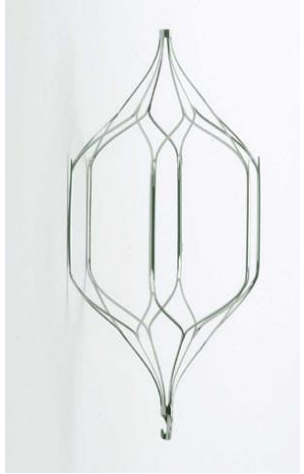
- Unsuccessful PTA (percutaneous transluminal angioplasty)
- Recurrent stenosis after angioplasty.
- Long segment stenosis.
- Total occlusion.
- Hard calcified or ulcerated plaque.
- Renal osteal lesions.



Angioplasty of left subclavian artery

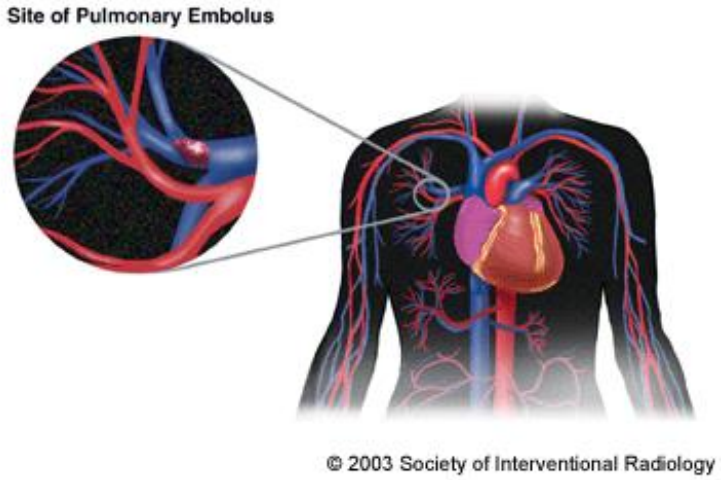





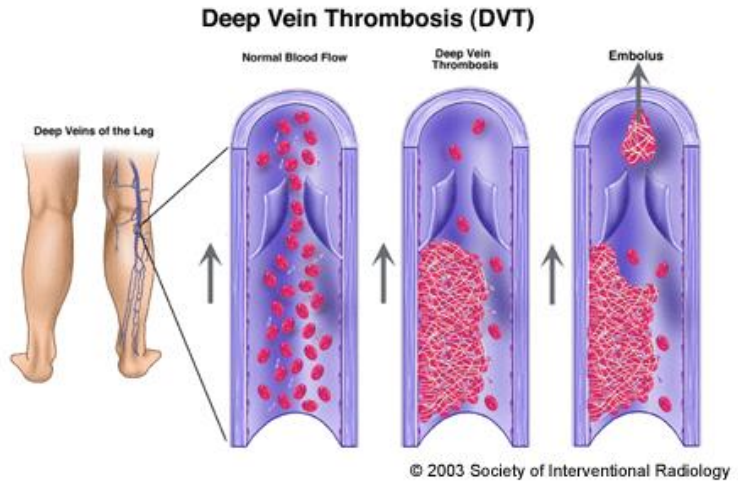



I V C Filters

Inferior Vena Caval Filters

- Inferior vena caval filters can be introduced percutaneously through the femoral vein.
- The filters trap emboli originating from leg or pelvic vein thrombi.
- They are used in patients who are at risk of pulmonary embolism.





Indications For IVC Filters:

DVT and/or PE and one of the following:

1. Contraindication to anticoagulation.
2. Failure of anticoagulation.
3. Complication of anticoagulation.

Technique:

- Through right femoral vein.
- Because caval thrombosis is a complication of filter placement, filters are usually placed below the renal veins.

Complications:

- Filter migration.
- Filter failure (recurrent PE).
- IVC thrombosis
- Groin complications.
- PE after IVC filter may be due to filter thrombosis, collaterals, upper extremity DVT.

Inferior Vena Caval Filters



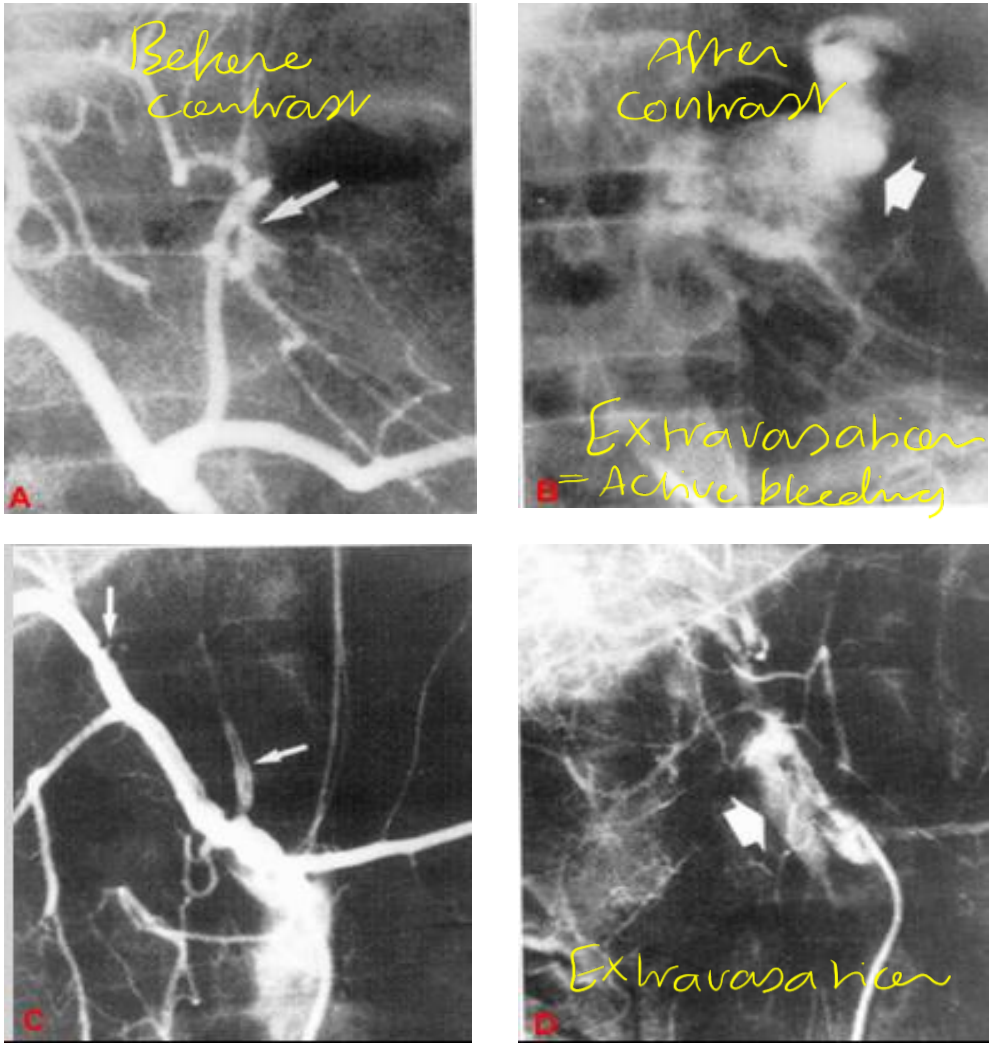
4. Therapeutic Embolization

Technique

Introducing a variety of materials through a catheter selectively placed in the vessel.

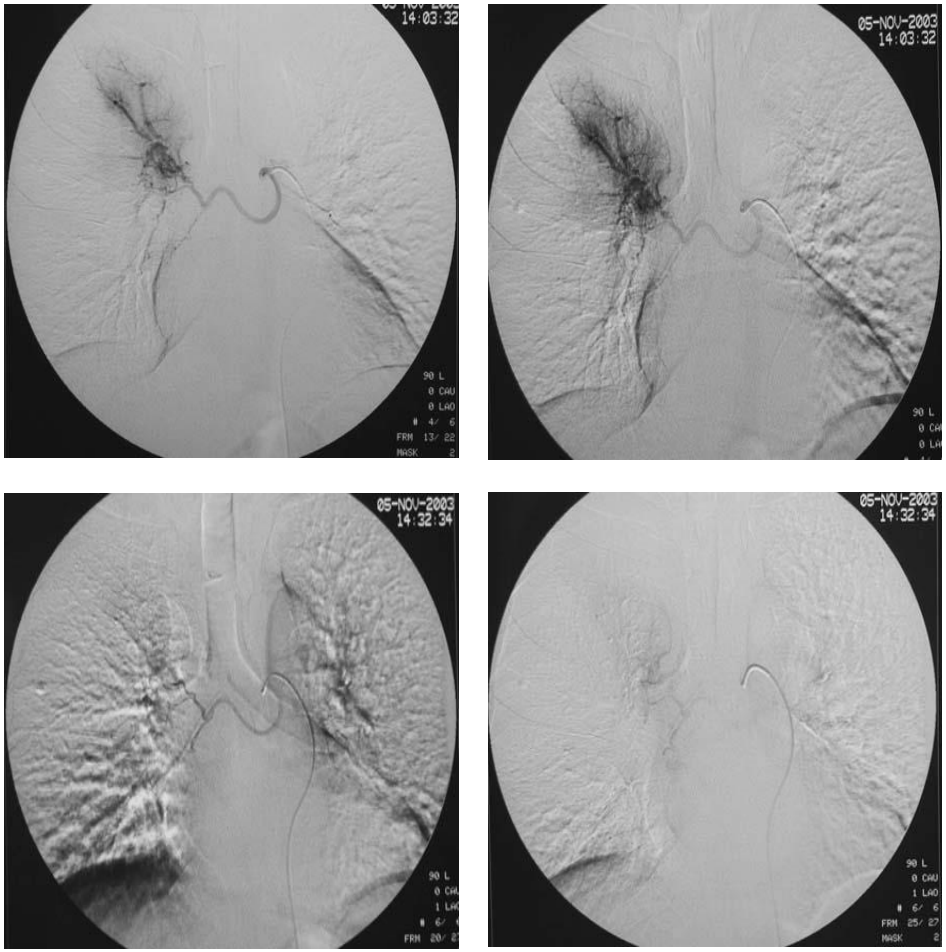
Indications

1. Bleeding
2. Tumors
3. Aneurysms
4. Arteriovenous malformations



Gastrointestinal (GI) tract bleeding

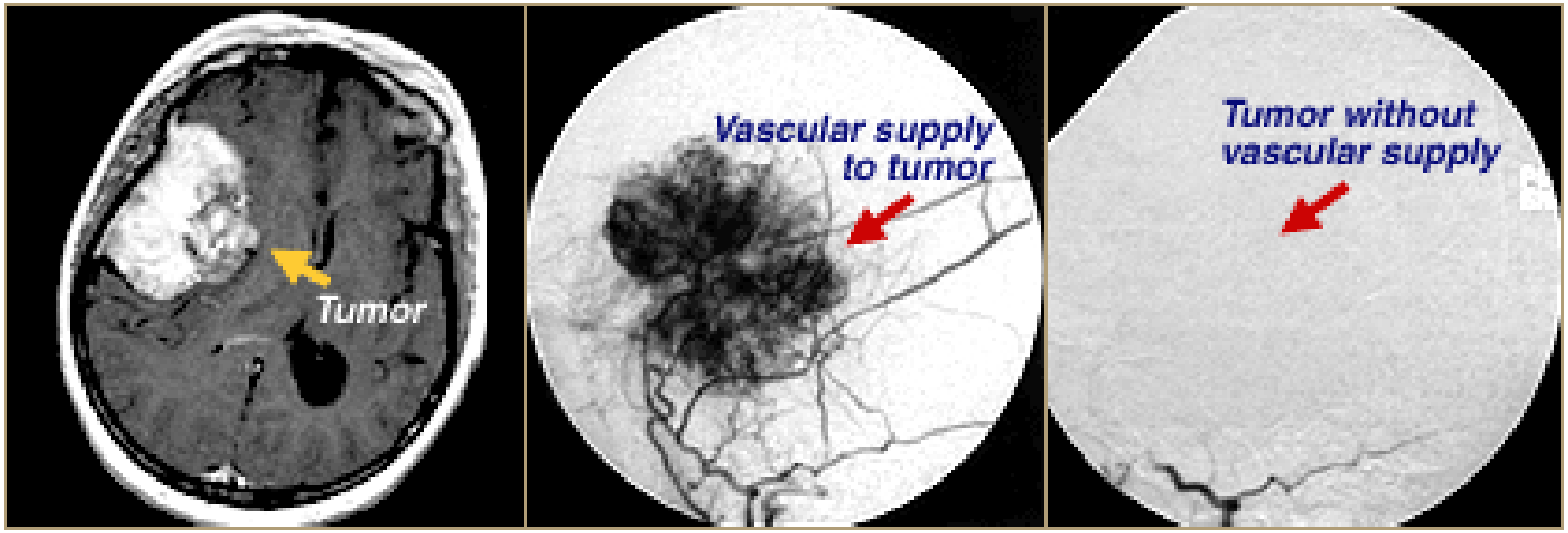
Angiography demonstrated the bleeding site at left gastric artery.



Hemoptysis

1. The extravasation of contrast medium, local hypervascularity and shunting of contrast from bronchial arteries to pulmonary artery are demonstrated in angiography of bronchial arteries

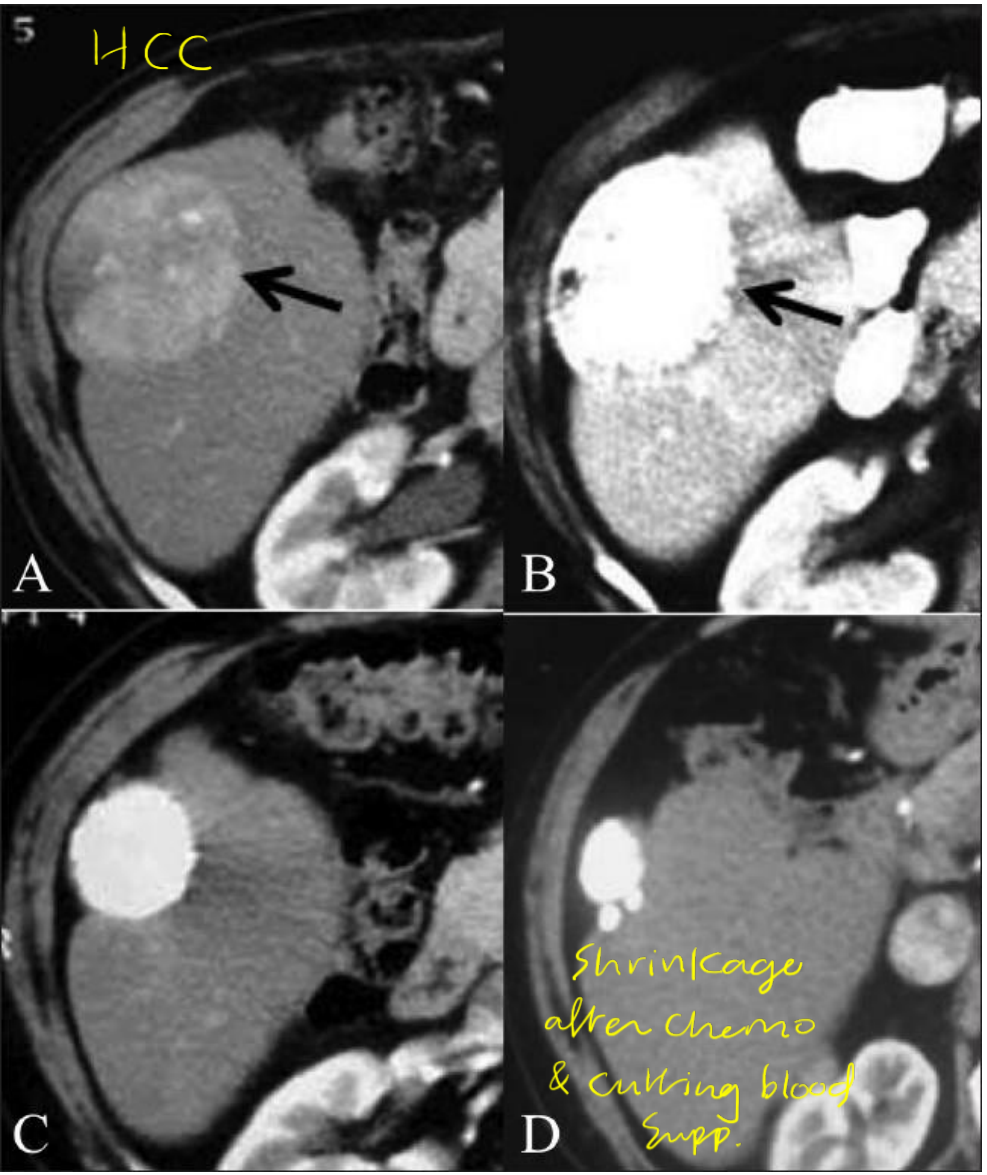
2. Following embolization with gelatin foam, the bronchial artery is occluded.



(A) Right frontal meningioma (tumor); (B) Arteriogram showing blood supply to tumor prior to embolization; (C) Arteriogram after embolization of blood supply to tumor.

Preoperative tumor embolization

- Many tumors such as meningiomas and renal cell metastases are hypervascular thus making surgical resection more difficult and time consuming.
- Embolization of the tumor preoperatively with gelatin foam, particles, coils, and alcohol can make resection easier and faster.



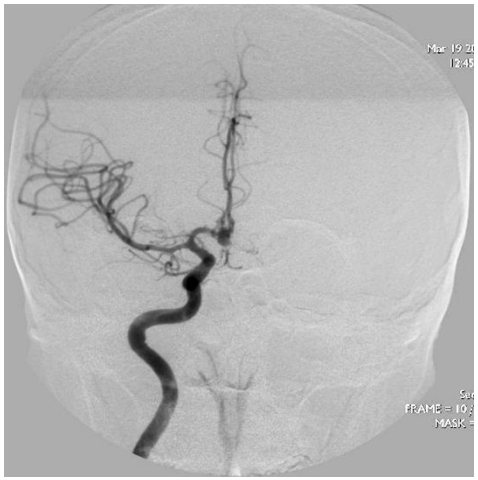
Transarterial chemoembolization

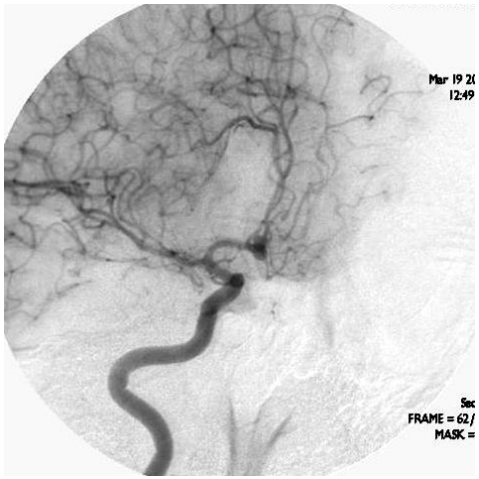
Technique

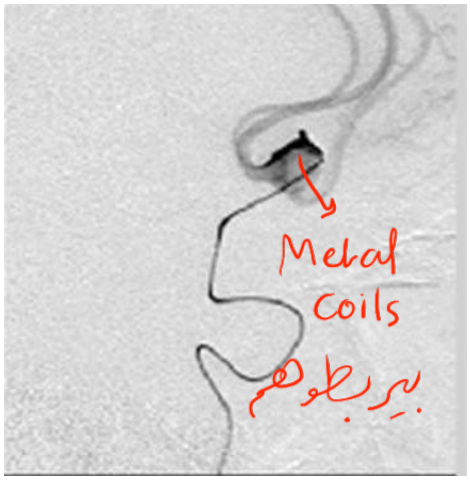
- Chemotherapeutic agents are usually combined with embolic particles to achieve chemoembolization of hepatic tumors.
- The aim is to cause ischemia and prolonged contact of the chemotherapeutic agent with the tumor.
- Such mixtures can dramatically increase the local concentration of the chemotherapeutic agent.
- The systemic drug levels is lower, thus reducing toxicity.

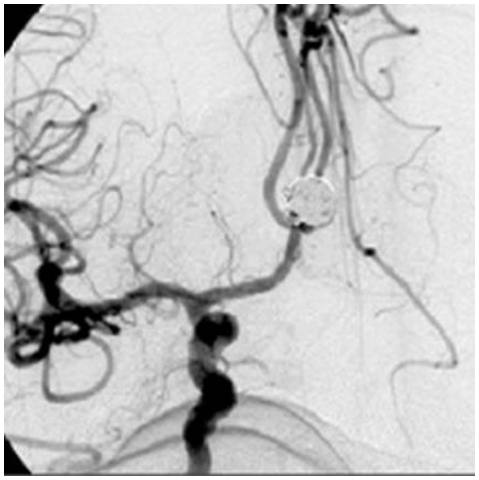
Survival

- The probability of cancer recurrence and/or metastatic dissemination was lower after TACE than after surgery.









Cerebral aneurysms

Carotid angiogram shows an aneurysm located in the Acom A.

The embolization of aneurysm with metal coils is well demonstrated.

Complications Of Embolization:

- Post-embolisation syndrome (fever, elevated WBC).
- Infection of embolised area (prophylactic antibiotics).
- Reflux of embolic material (non targeted embolization).
- Alcohol can cause skin, nerve and muscle necrosis .

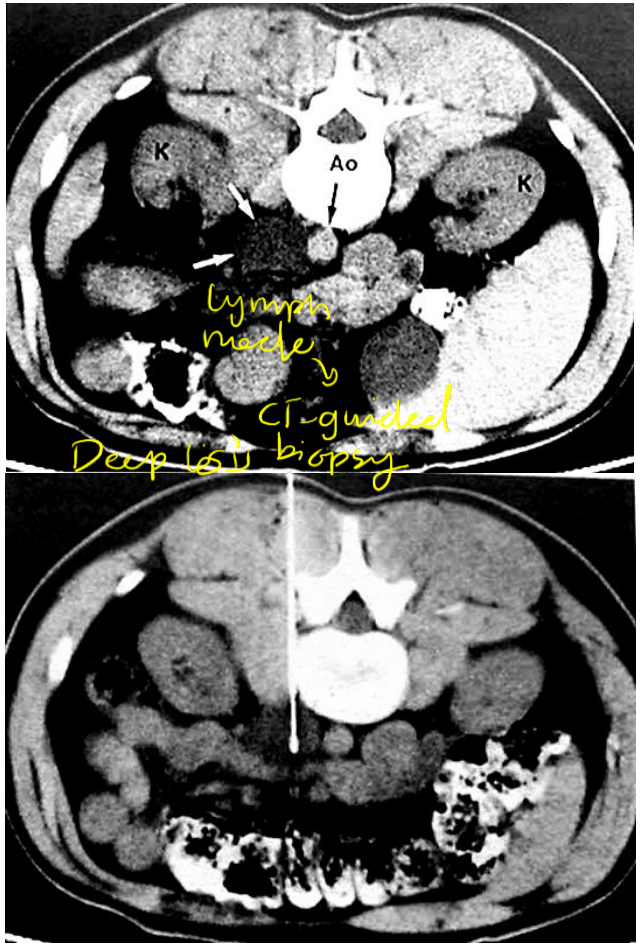
5. Percutaneous Needle Biopsy

Technique

- A needle is passed into the desired site and a small amount of tissue is removed.
- With a fine needle(20-22 gauge for aspiration, 14-18 gauge for soft tissues,
- 10-13 gauge for bone.

Indications

- Diagnostic test for breast, lung and other cancers
- An alternative to surgical biopsy.



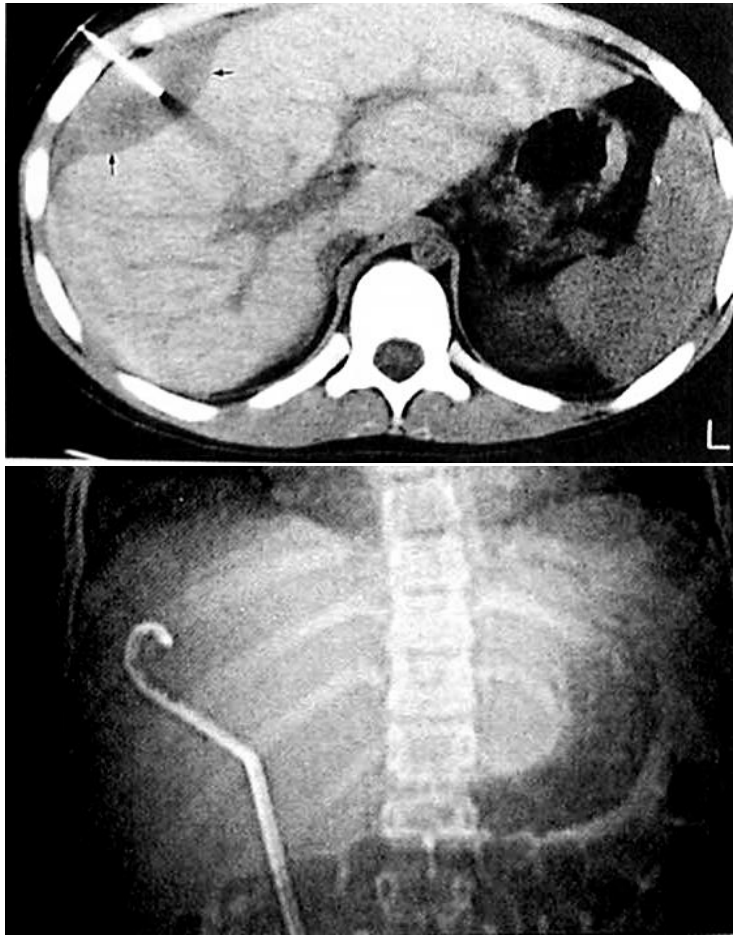
6. Percutaneous Drainage Of Abscesses And Other Fluid Collections

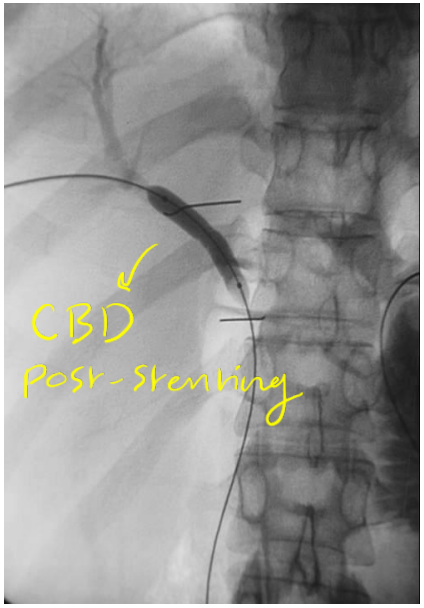
Technique

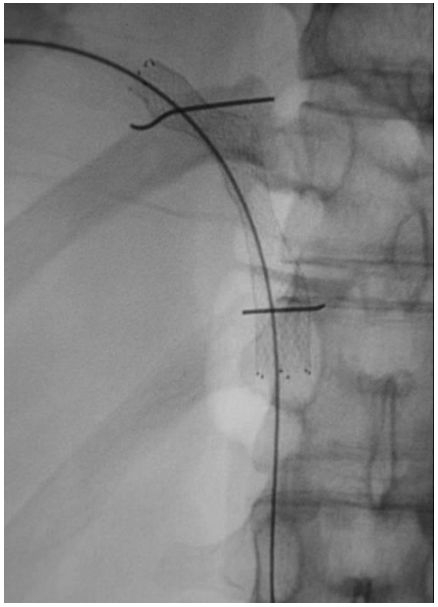
- Specially designed drainage catheters can be introduced percutaneously into abscesses allowing the pus to drain for several days.

Indications

- Intra abdominal abscesses







Percutaneous Insertion Of billary Stent To Bypass An Obstruction In The billary Ducts

Thank You !