

Introduction to Interventional Radiology

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INTERVENTIONAL RADIOLOGY

A subspecialty which provides minimally invasive techniques with the help of imaging modalities to diagnose or treat a condition.

- Minimally invasive
- Local anesthesia
- Early recovery



INTERVENTIONAL RADIOLOGY

Interventional radiology has exploded as a specialty in recent years and there is now a huge range of procedures that can be performed with imaging guidance by radiologists, for diagnosis and therapy of diseases.



Endovascular IR

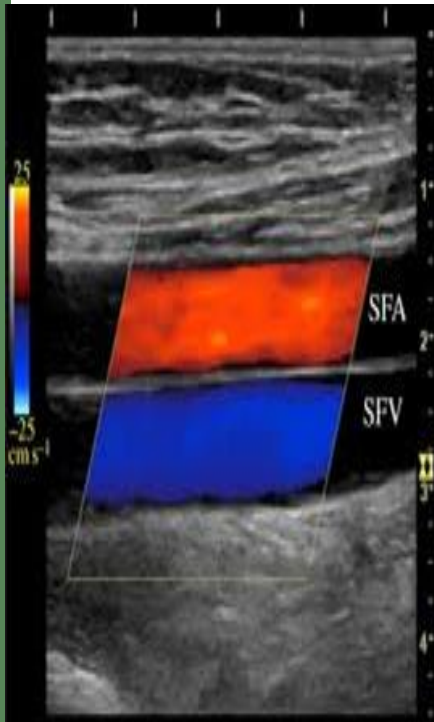
- Endovascular aneurysm repair
- Peripheral arterial angioplasty and stenting
- Thrombectomy and thrombolysis
- Venous thrombolysis
- IVC filter insertion
- Peripherally inserted central catheter
- Embolization
- Transjugular Intrahepatic Portosystemic Shunt

Percutaneous IR

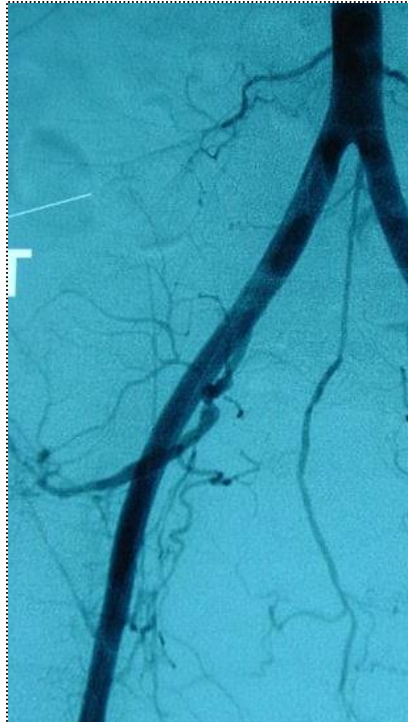
- Abscess drainage
- Percutaneous gastrostomy
- Percutaneous biliary drainage and biliary stent insertion
- Percutaneous nephrostomy
- Image-guided biopsy
- Pain control (nerve root block)

Modalities

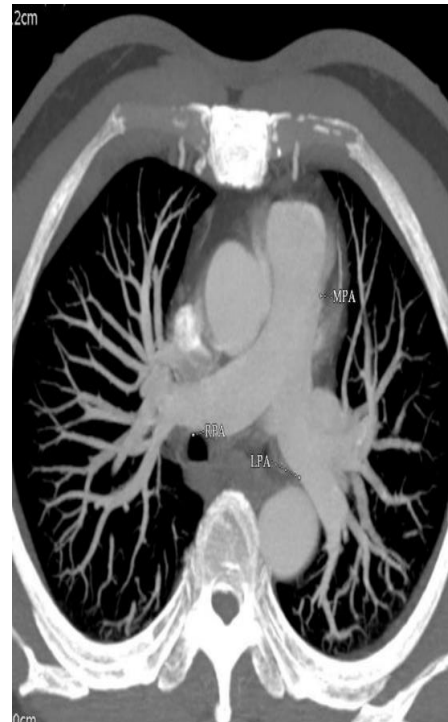
**Doppler
Ultrasound**



**Digital
subtraction**



**CT
angiography**



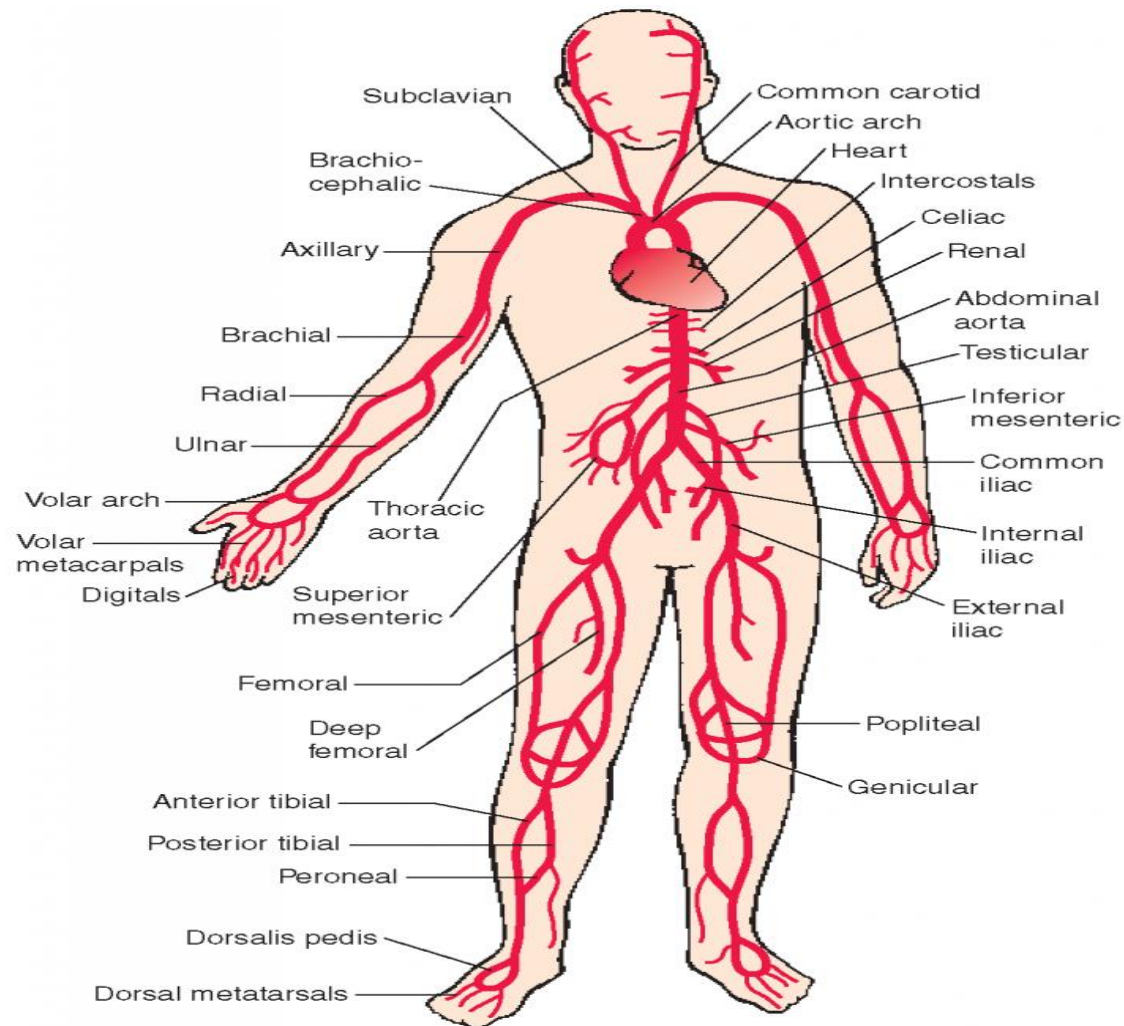
**MR
angiography**

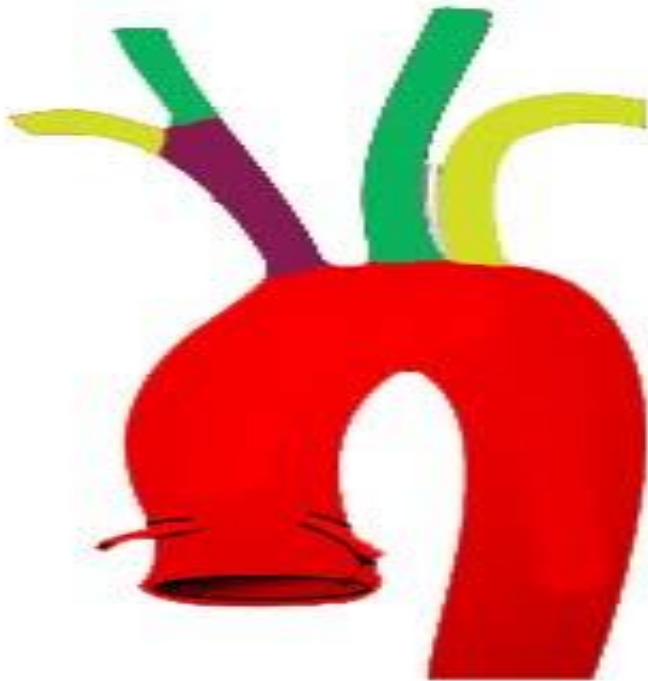


Types Of Angiography

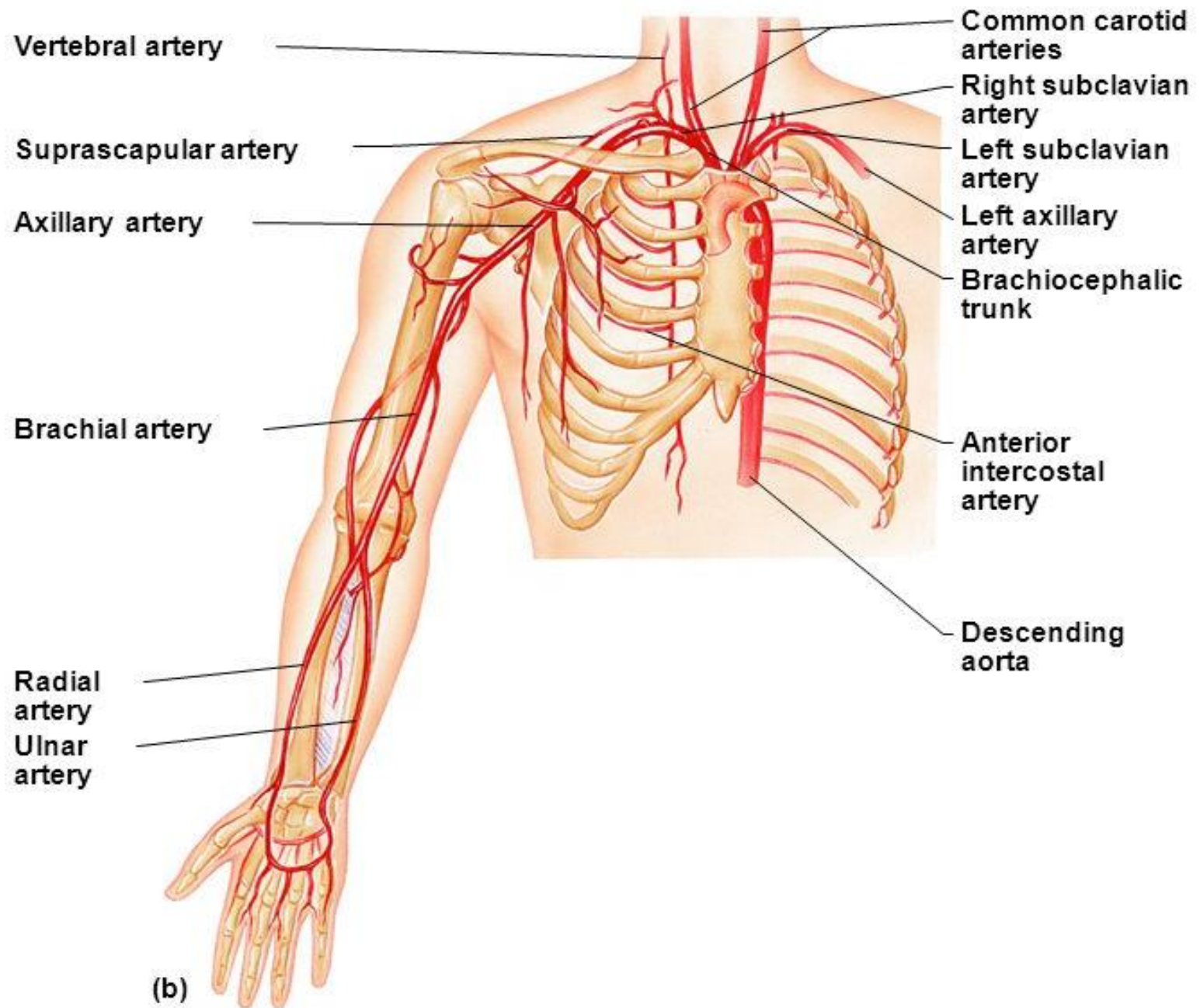
- **Advanced US, CTA and MRA techniques made conventional angiography limited to therapeutic purposes.**

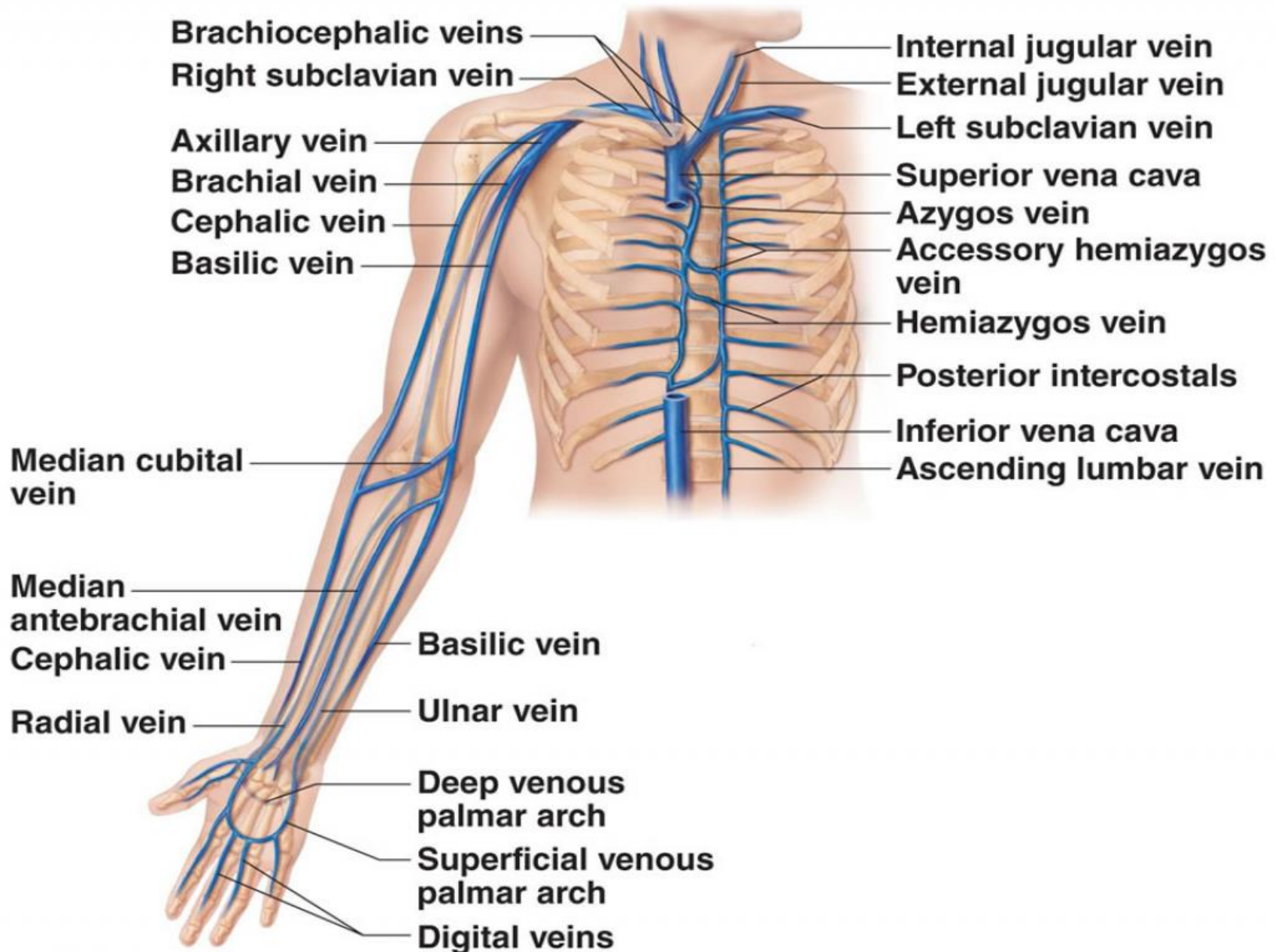
Normal Anatomy



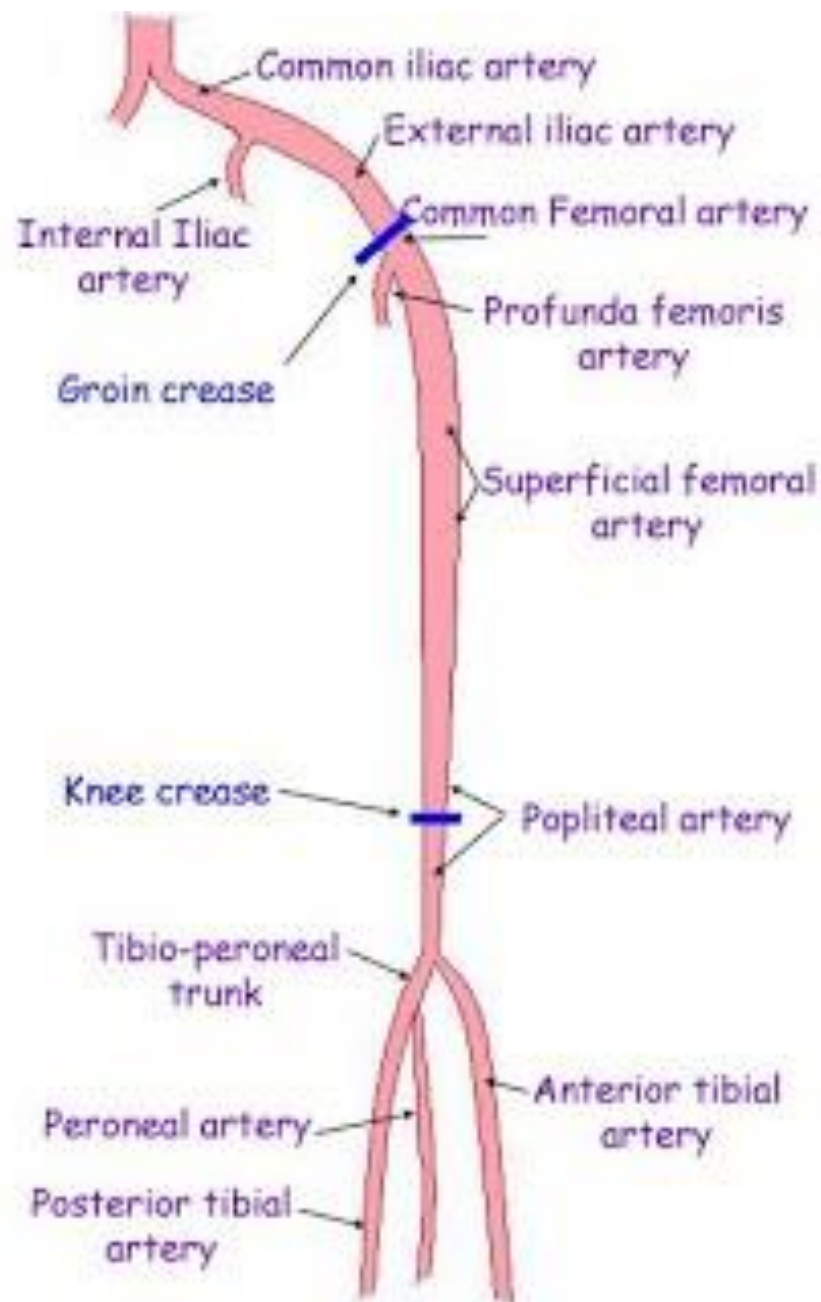


- Arch of aorta
- Subclavian arteries
- Common carotid arteries
- Brachiocephalic trunk

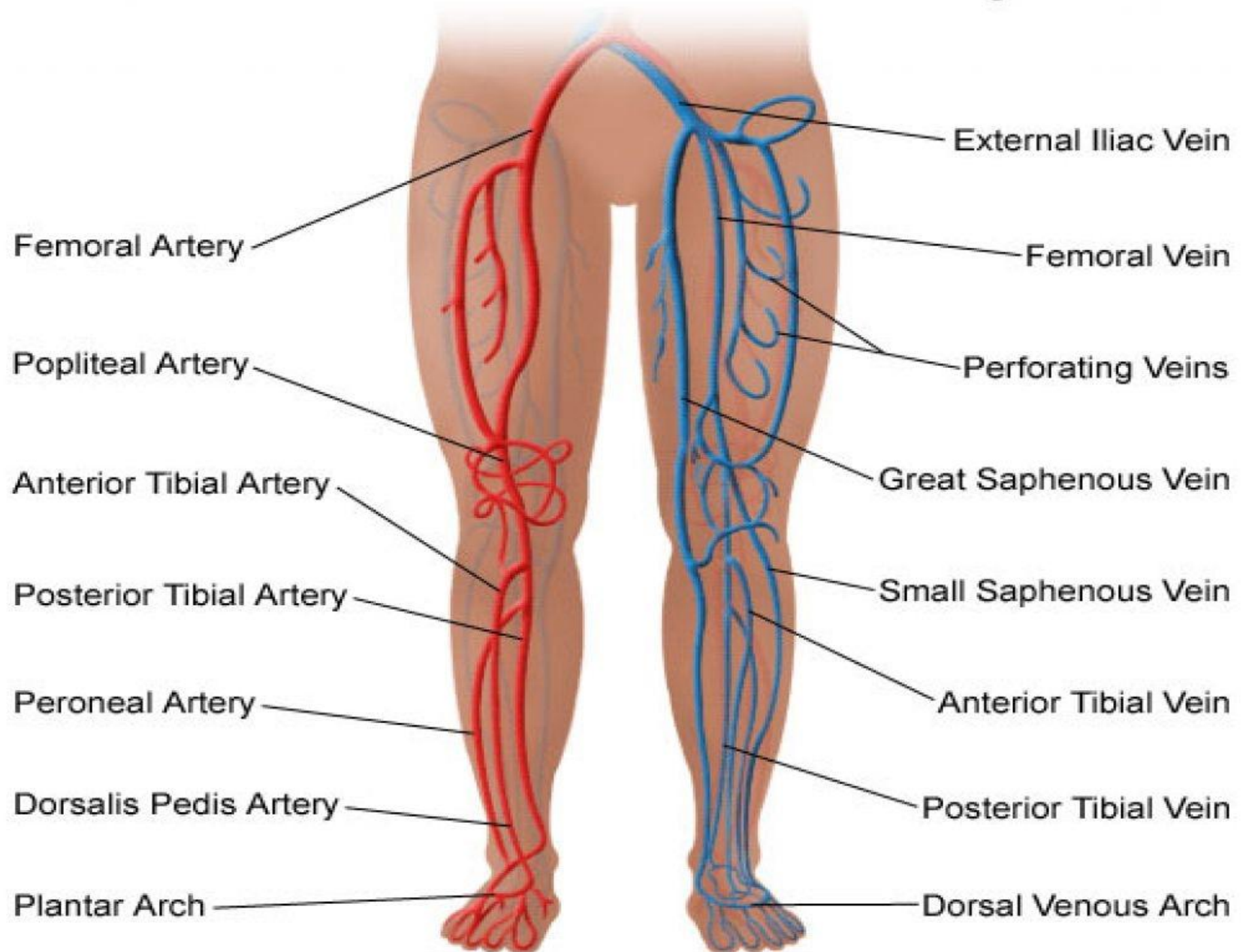




(b) Anterior view



Arterial and Venous Circulation of the Legs



Angiography

Definition

- An examination that utilizes contrast media to opacify blood vessels.

Angiograms:

1. Arteriograms
2. Venograms

LIMITED



EQUIPMENT

Angiographic Imaging Equipment



General angiographic room with biplane C-arm digital imaging

Patient Preparation

- Appointment time
- Nil orally 4-6 hrs.
- On trolley
- In hospital gown
- Groin shave
- Records
- PTI
- Should be well hydrated.
- Should void before procedure.
- Peripheral pulses marked.
- I.V line in place.
- Informed consent is a must

SELDINGER TECHNIQUE

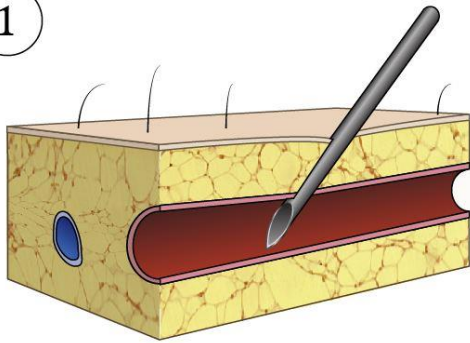
- Site cleaned, area draped, local anesthetic given.
- The seldinger needle is introduced into the artery.

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 fluoro, the catheter is then advanced and the guide wire is removed.

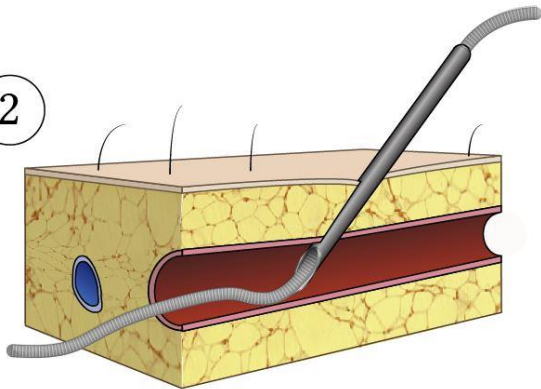


1



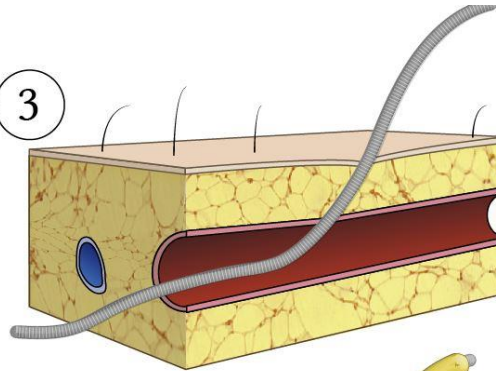
The artery is punctured with a hollow needle

2



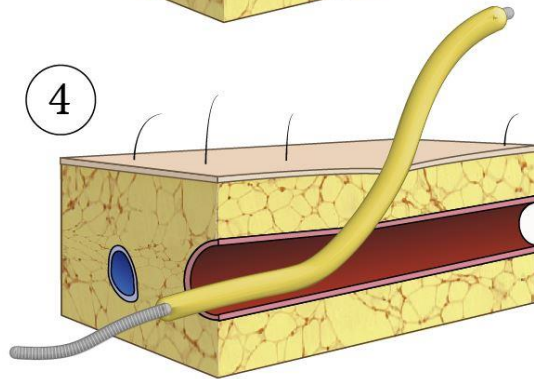
A flexible guidewire is introduced through the needle

3



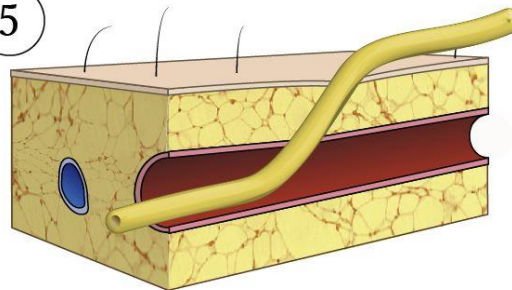
The needle is withdrawn, leaving the guidewire in the artery

4



The arterial catheter is introduced over the guidewire

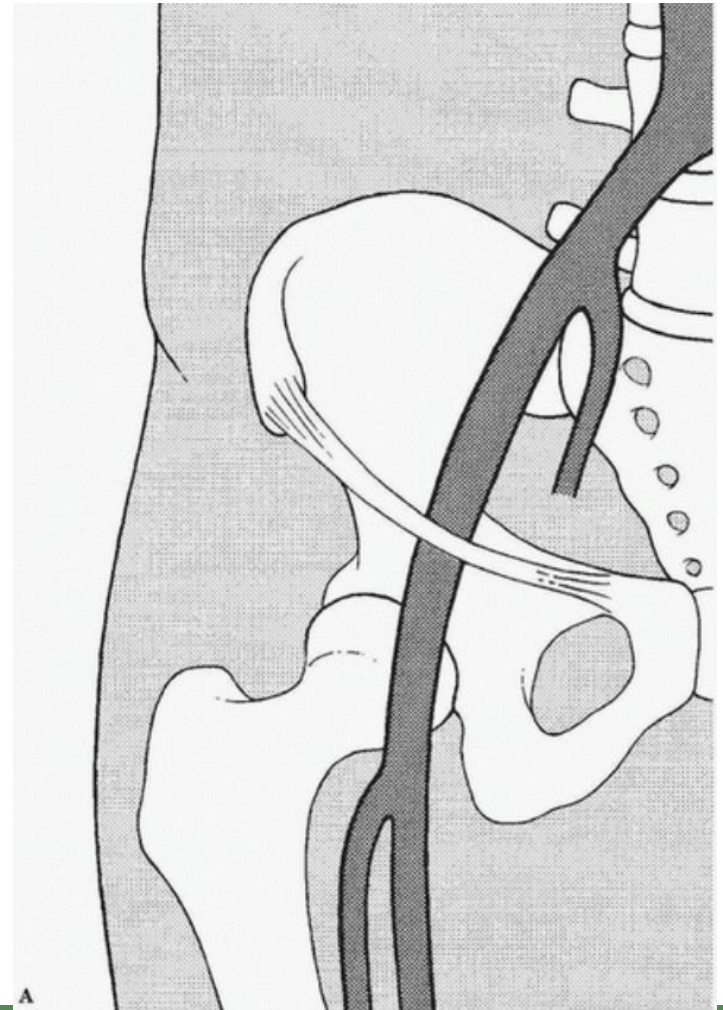
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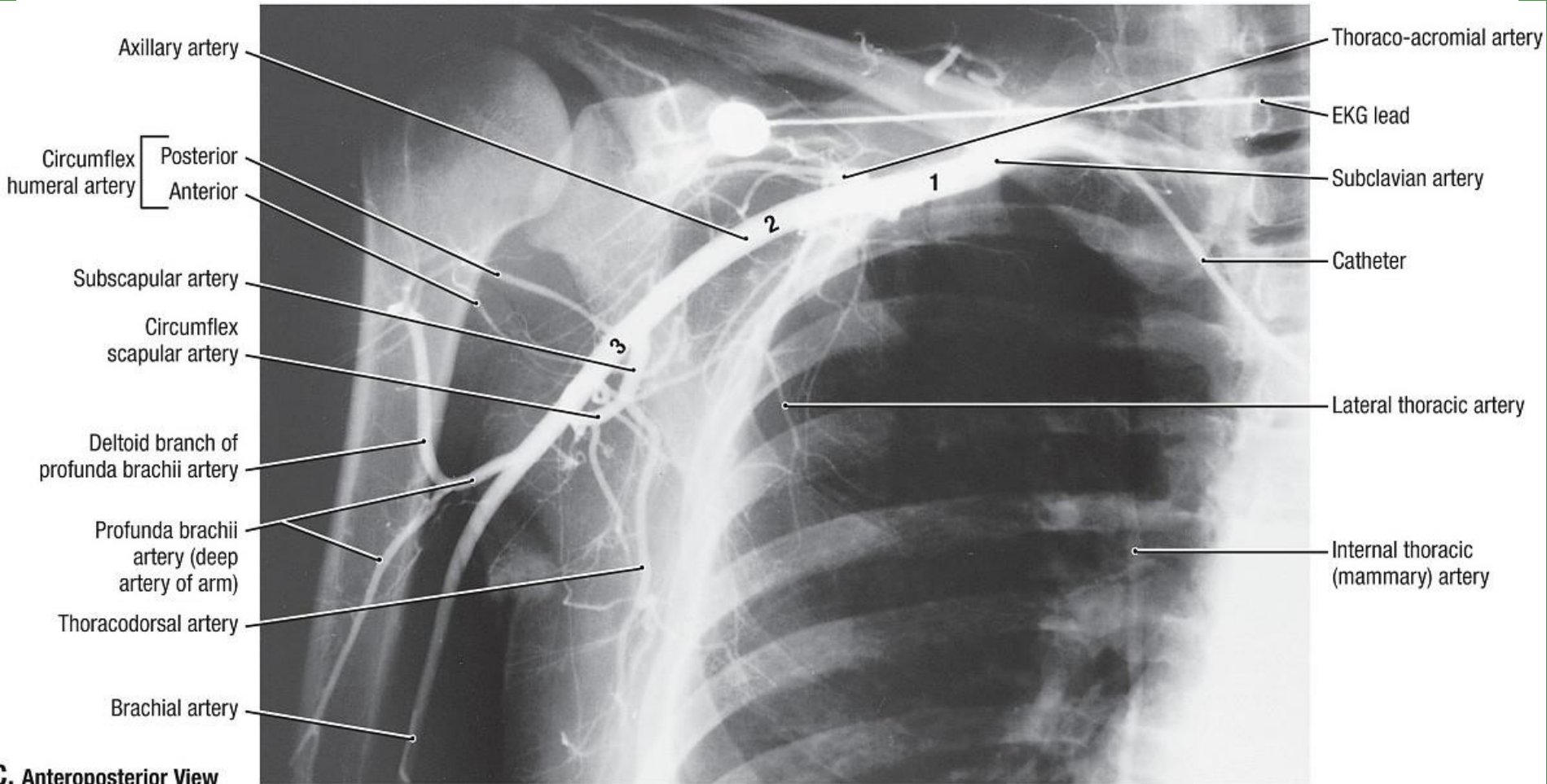


The guidewire is removed and the catheter remains in the vessel

Femoral Artery Approach

- Easily accessible.
- Large caliber vessel
- Well defined land marks exist.
- Low complication rate.





C. Anteroposterior View

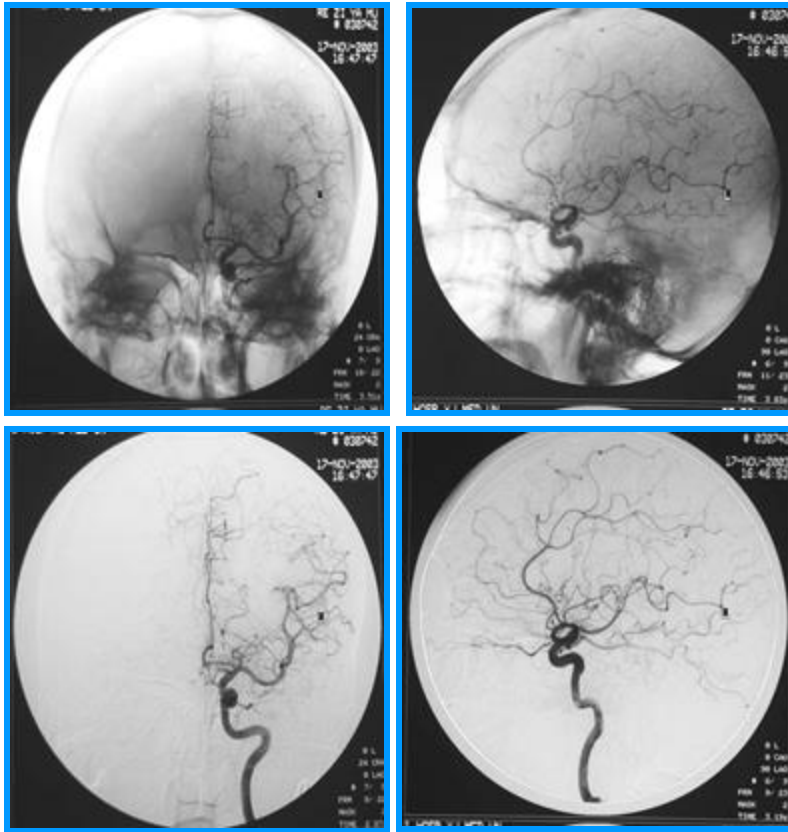
DSA

(digital subtraction angiography)

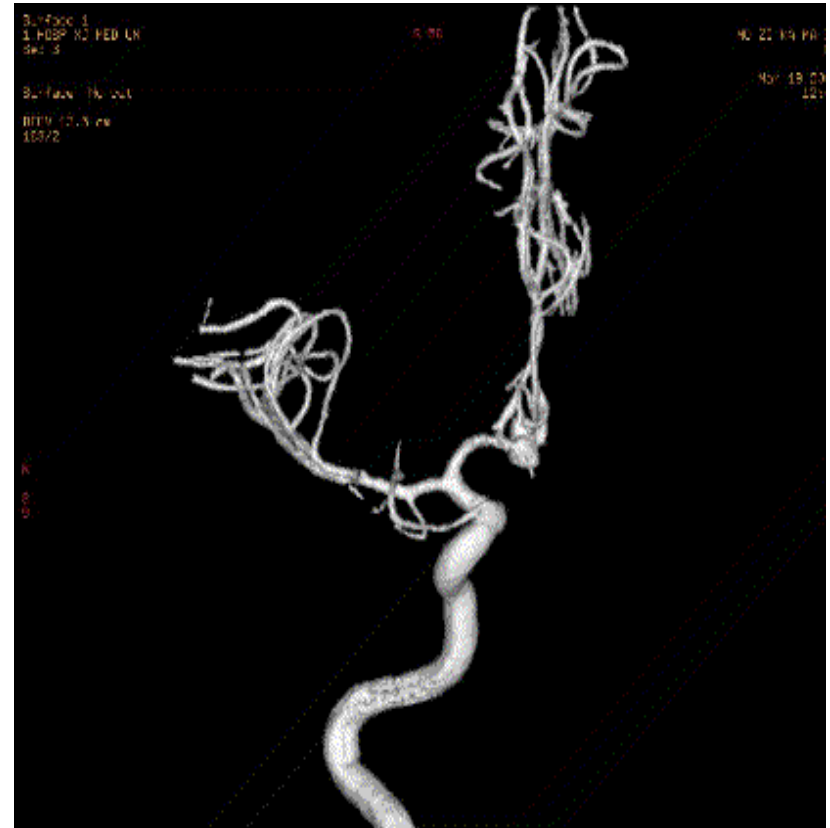


Principle:

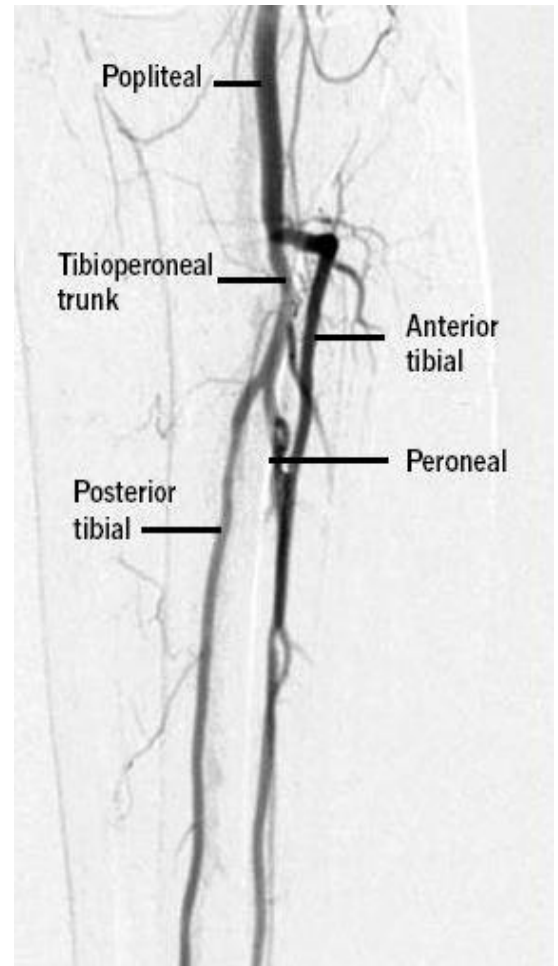
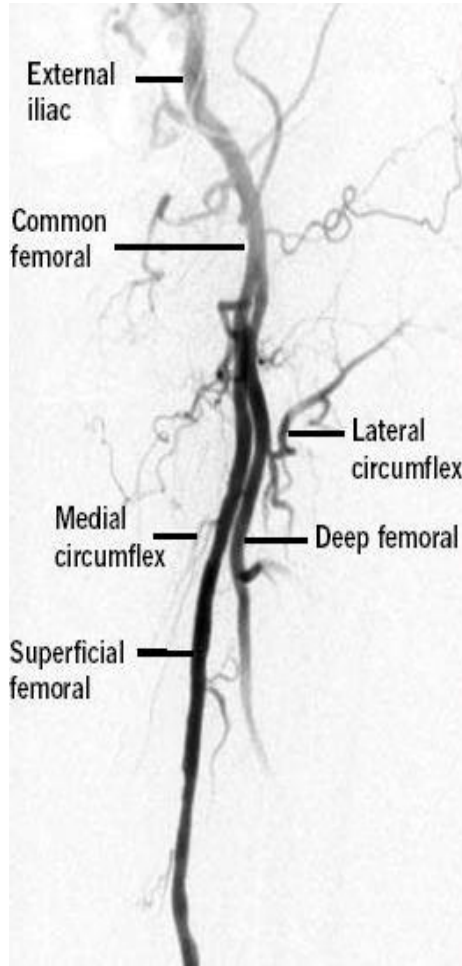
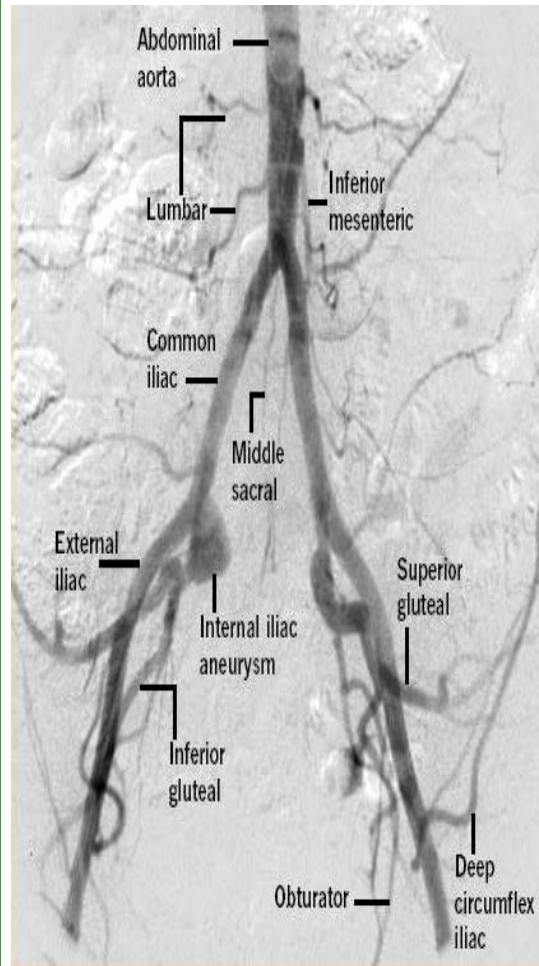
Subtract the shadows that are present on the plain films from the films taken after the contrast has been injected for the angiogram, the result is an image containing details of the opacified structures only.



Digital vascular imaging
(2D DSA)



Digital vascular imaging
(3D DSA)



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 the puncture site 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, pseudoaneurysm, AV fistula.
2. Systemic complications: contrast reactions, fever, sepsis, dehydration, death.
3. Therapy related complications (ex: CnS bleeding during thrombolysis)

Pathology

- **Peripheral Vascular Disease/Occlusions**
- **Aneurysms**
- **Stenosis**

Arterial Occlusive Disease

- Acute vs chronic.

Acute Arterial Occlusion

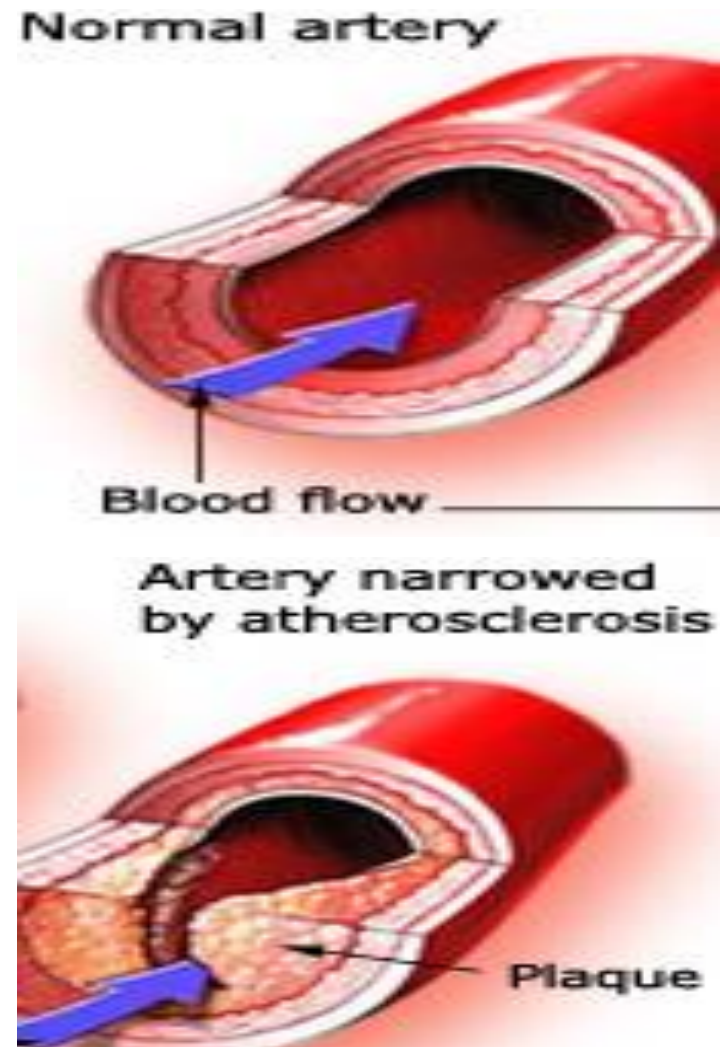
- **Embolus** is the most common cause
- Other etiologies are thrombosis, dissections of the arterial wall, external compression , spasm or hemodynamic problems.
- **Immediate intervention** needed to prevent loss of extremity

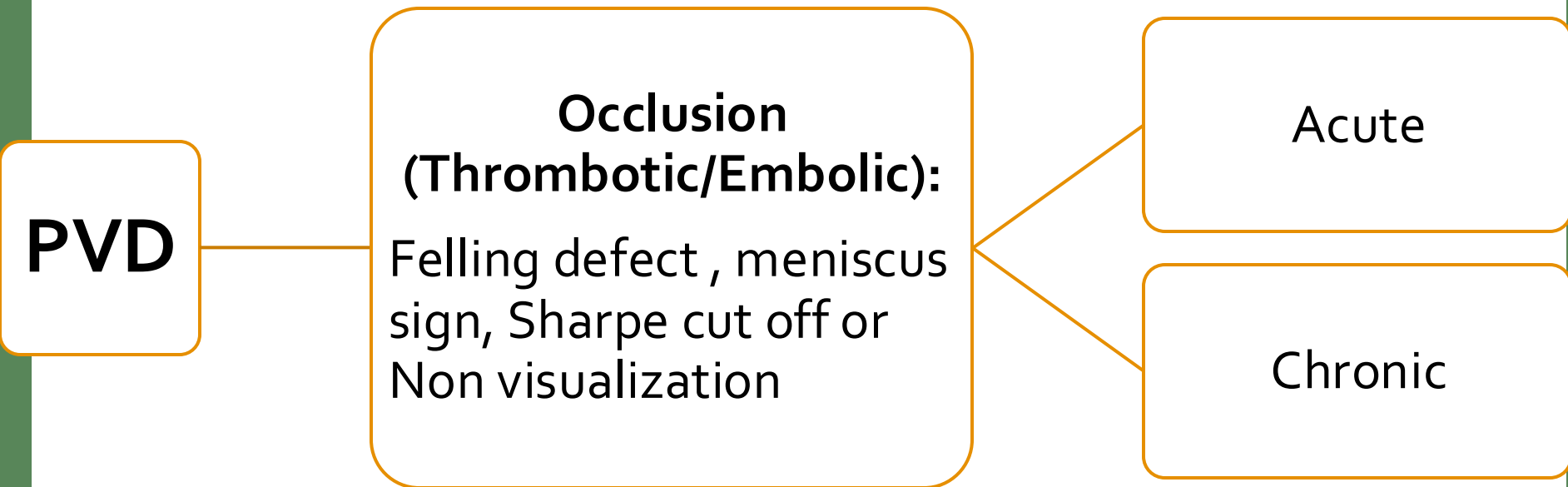
Acute Embolic Occlusion

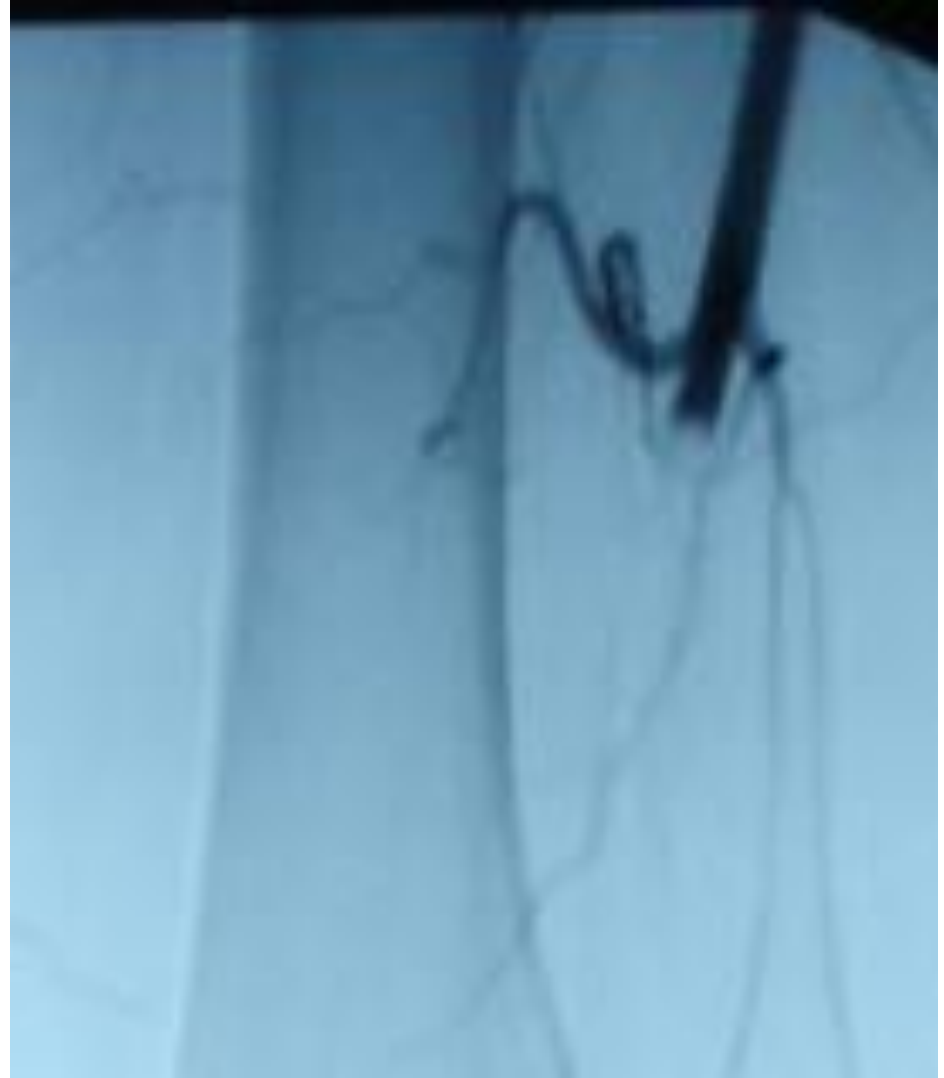
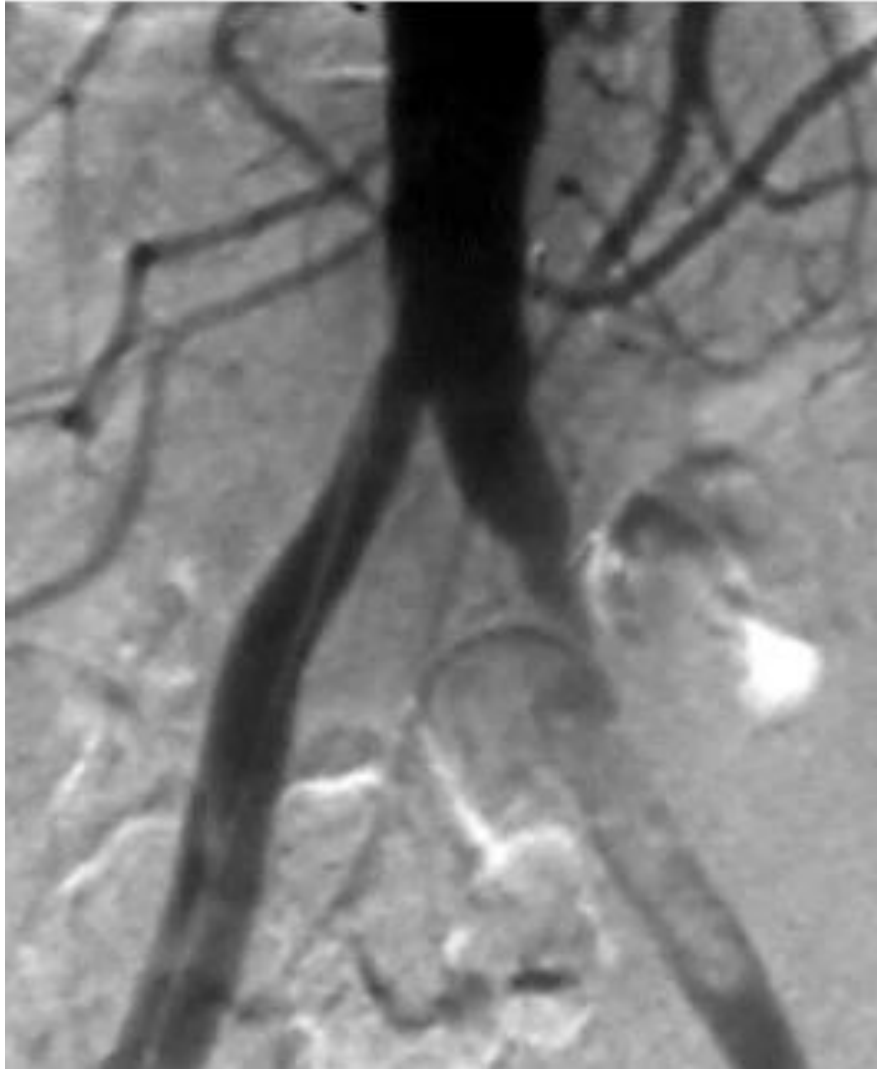
- Cardiac origin : recent MI or a-fib
- Lower limb origin: DVT
- Emboli get trapped at **arterial bifurcations** and cause further thrombosis by apposition or stagnation of blood flow
- Most frequent location of arterial emboli is **the common femoral artery (46 %)**
- Another common site are the pulmonary arteries (PE)

Acute Thrombotic Occlusions

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



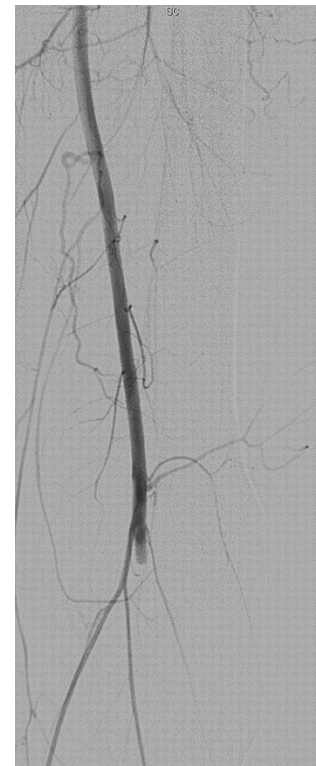




Acute occlusion

Acute Occlusions

- On arteriography an acute embolic occlusion may show a relative **sharp cut-off** of the contrast column with the embolus being described as a **filling defect**



LT

ROT
-1

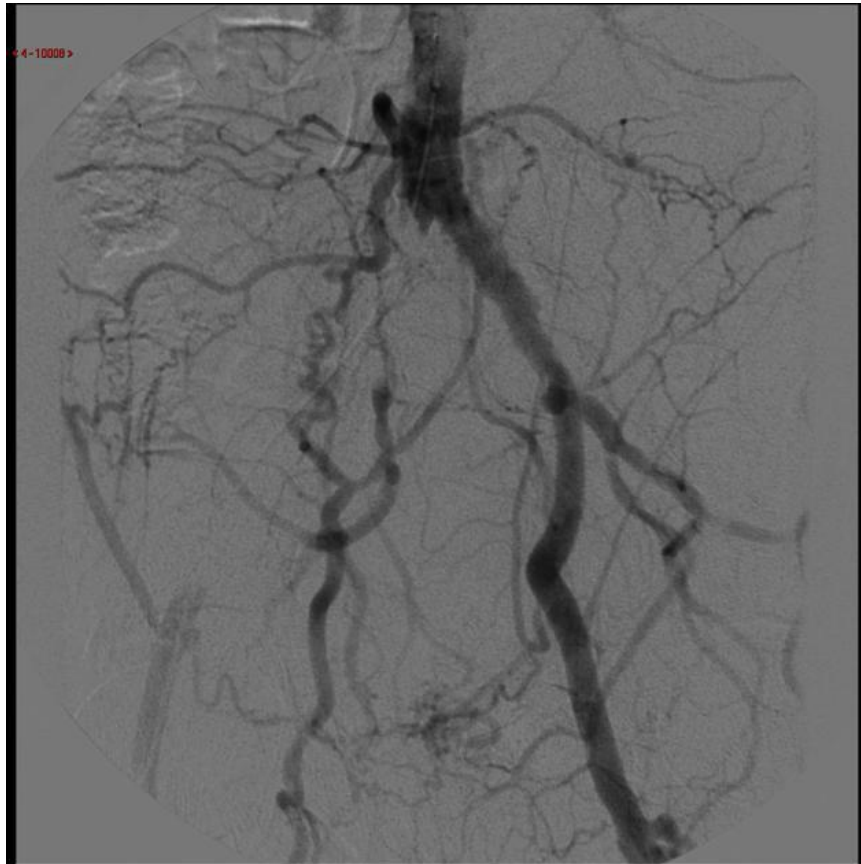
ANG
-1

RUN
2

20

MASK IMAGE
2 12

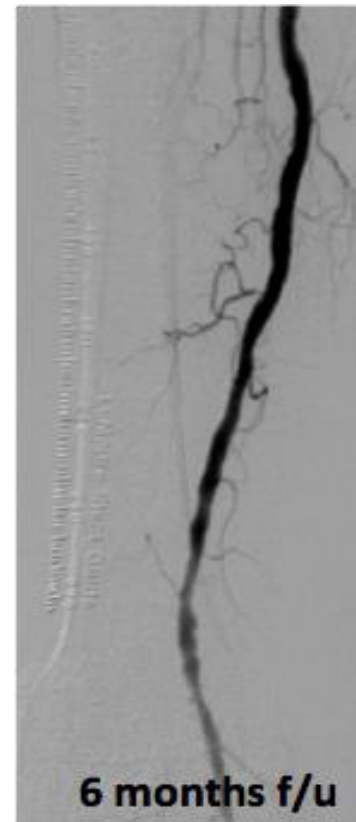
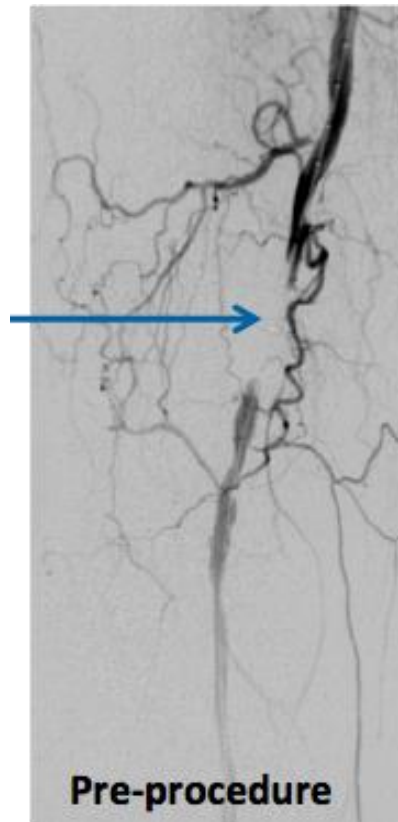
Chronic Occlusions



Chronic occlusions can be differentiated from acute occlusions due to the presence of **collaterals** and **faint distal opacification**.

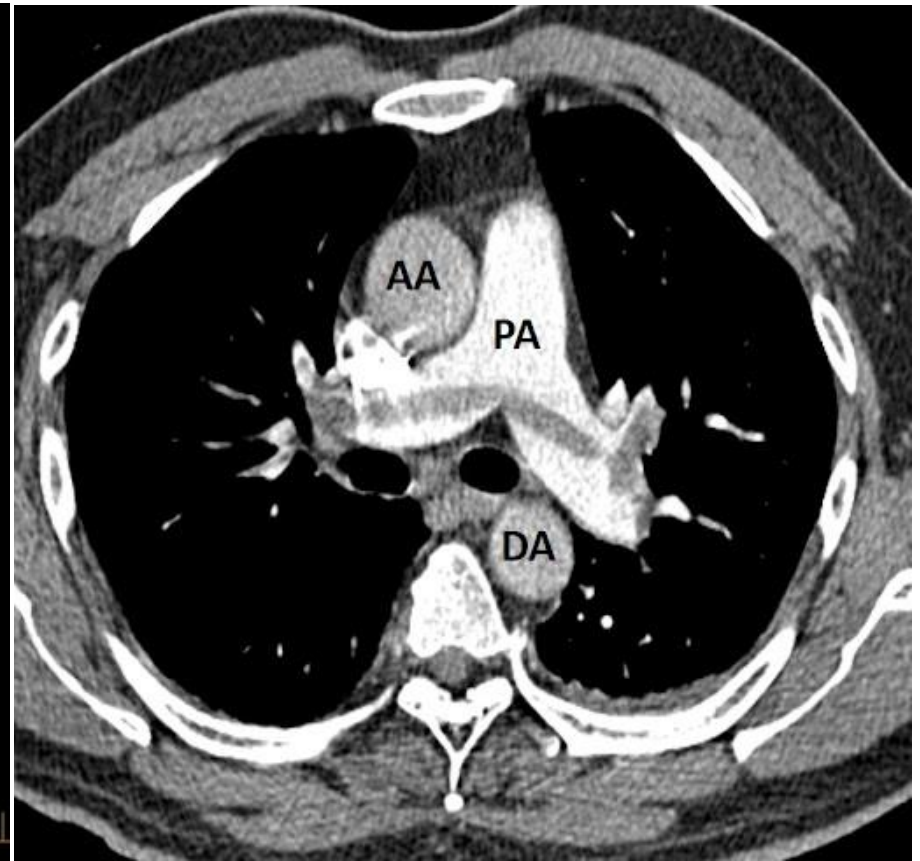
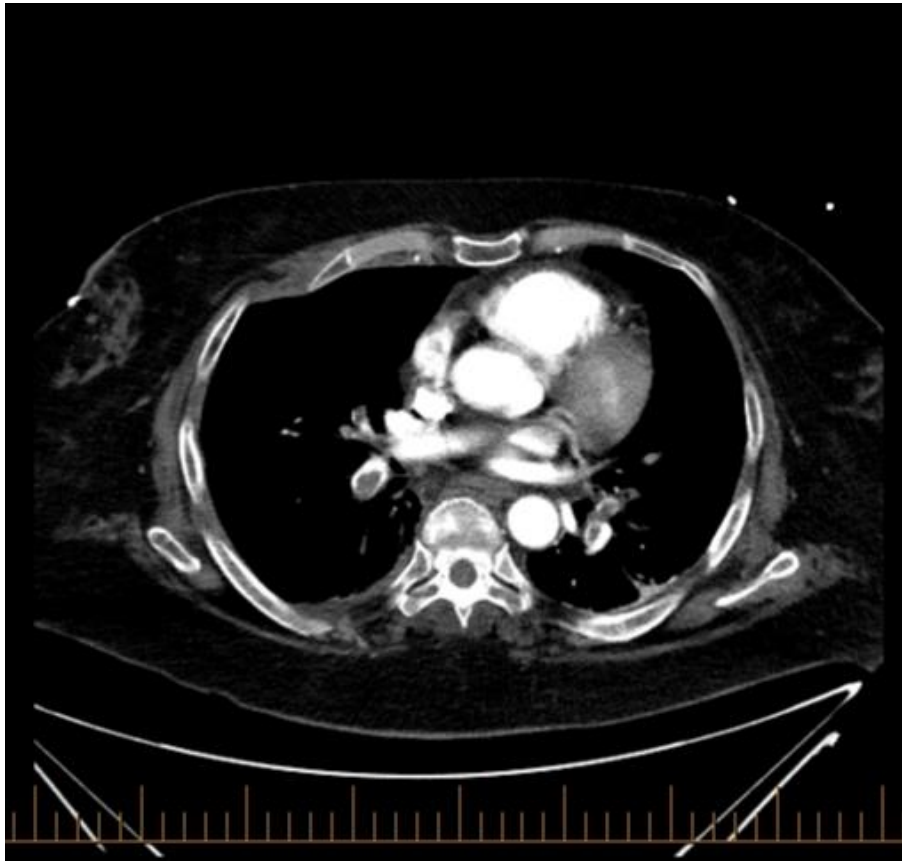


**Aortoiliac Occlusive Disease, Also Known As
Leriche's Syndrome**



Angioplasty and stenting of superficial femoral artery

Pulmonary Embolus

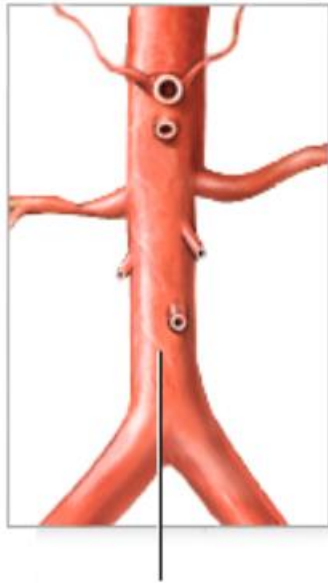


Arterial Stenosis

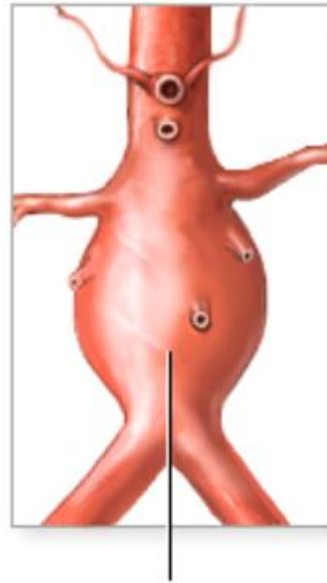
Artery stenosis may be caused by several pathological processes the most common being atherosclerosis (~75% of cases).



Aneurysms



Normal aorta



Aorta with large
abdominal aneurysm

Aneurysms

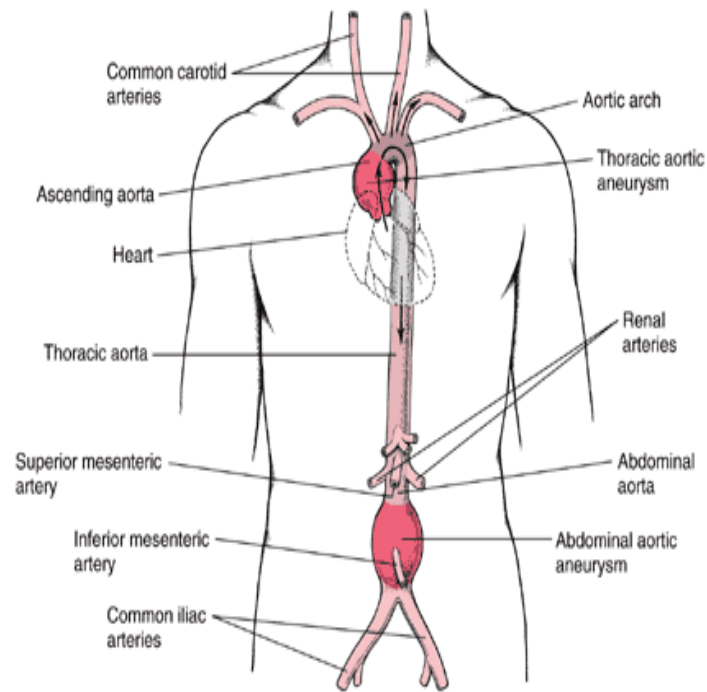
Dilation of an artery:

1. Fusiform or saccular
2. True or false

Aorta :

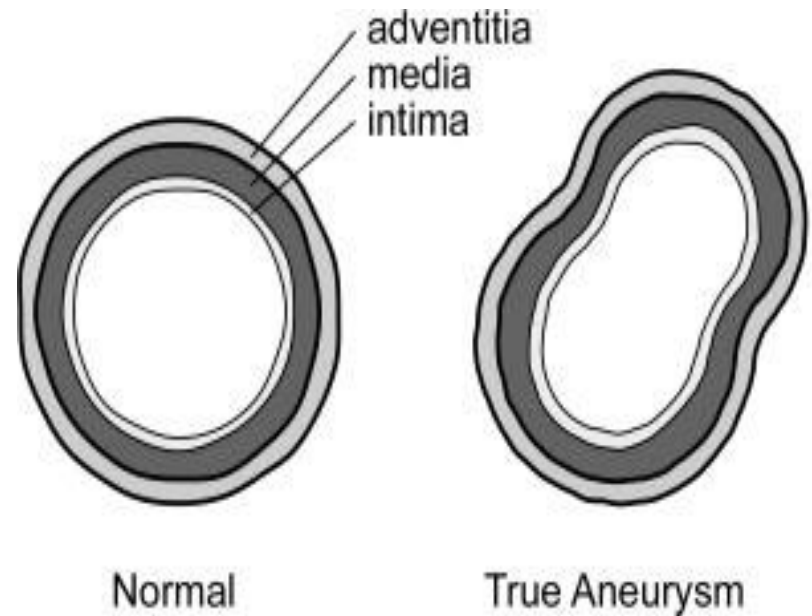
■ Thorax > 4cm.

■ Abdomen > 3cm.



True aneurysms

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



Aneurysms



Ruptured Aneurysm



Dissecting Aneurysms



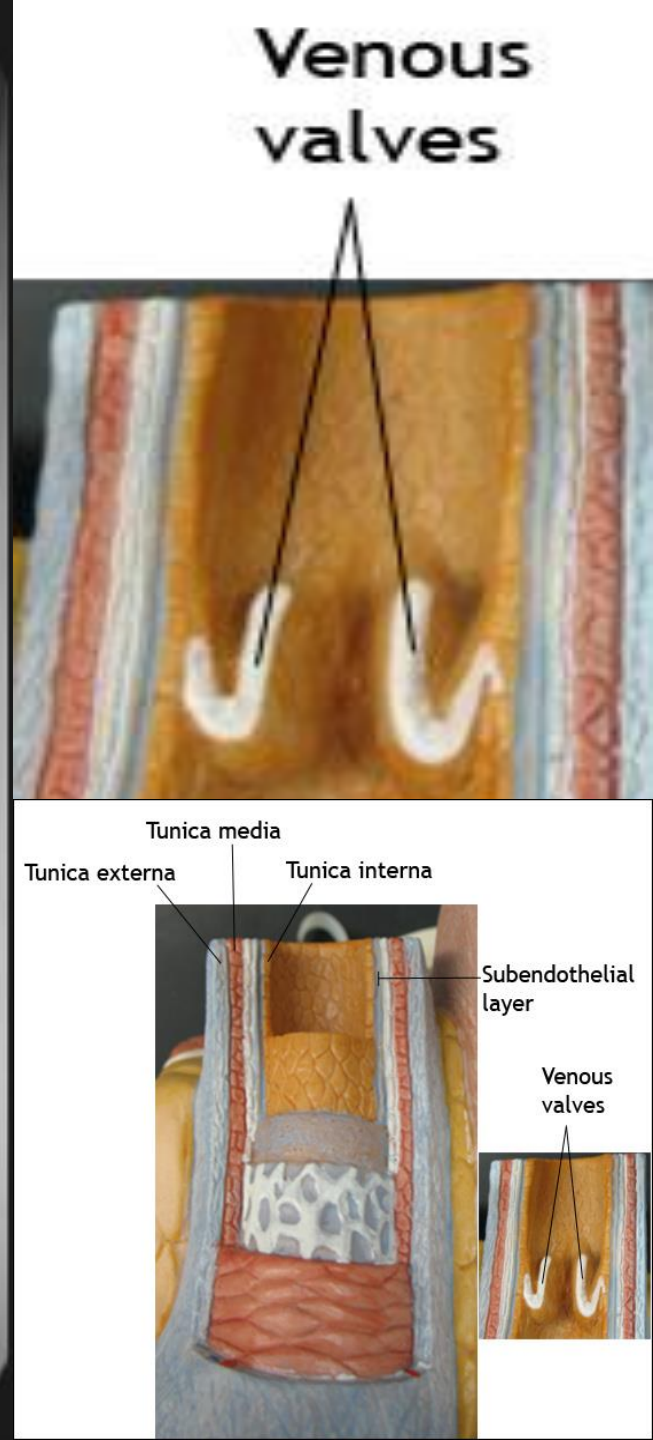
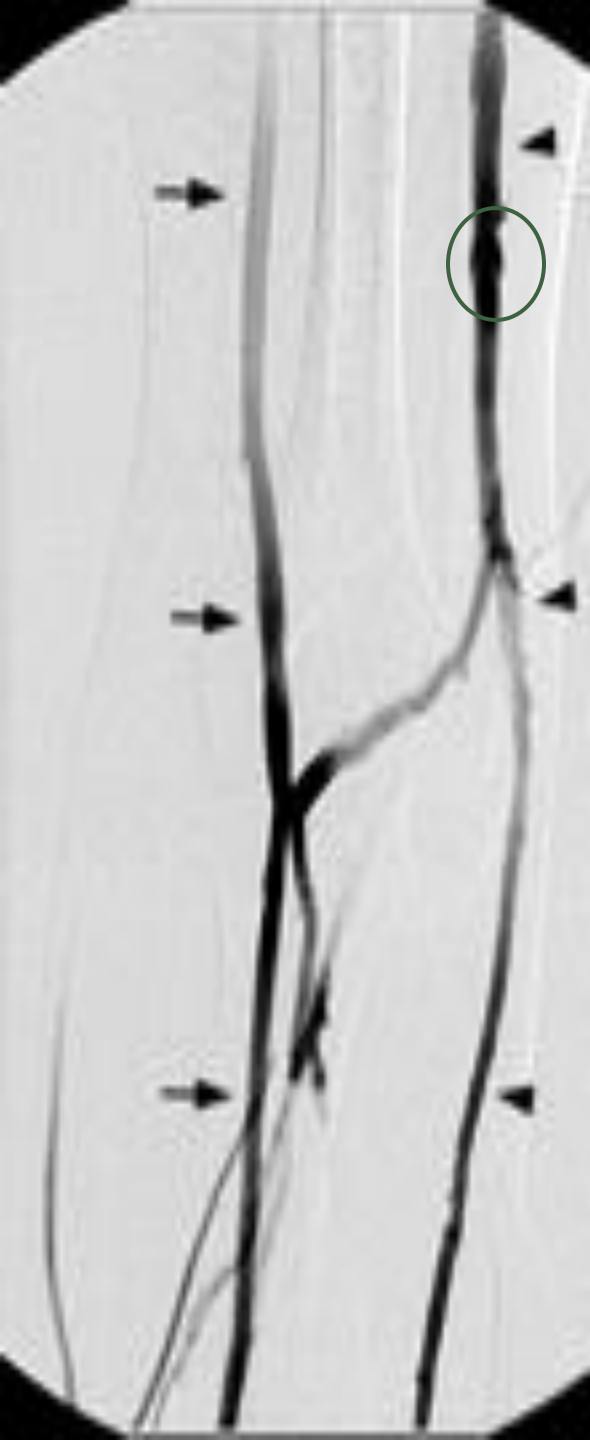
Venography

- Technique

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

LIMITED





DVT

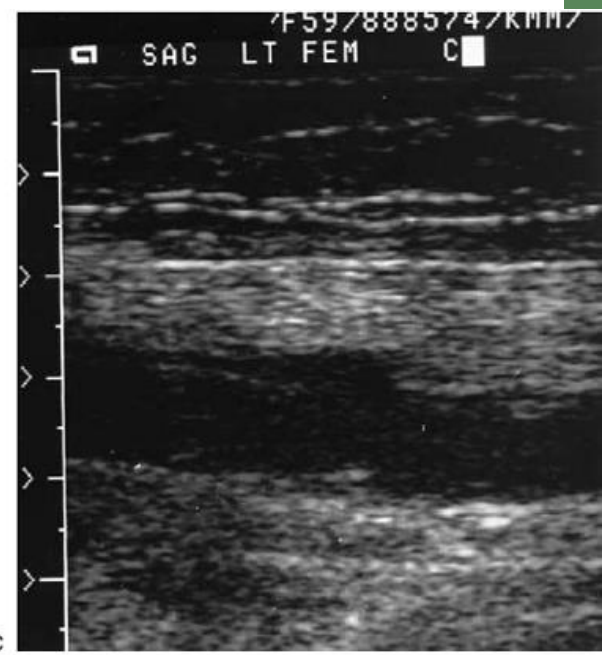
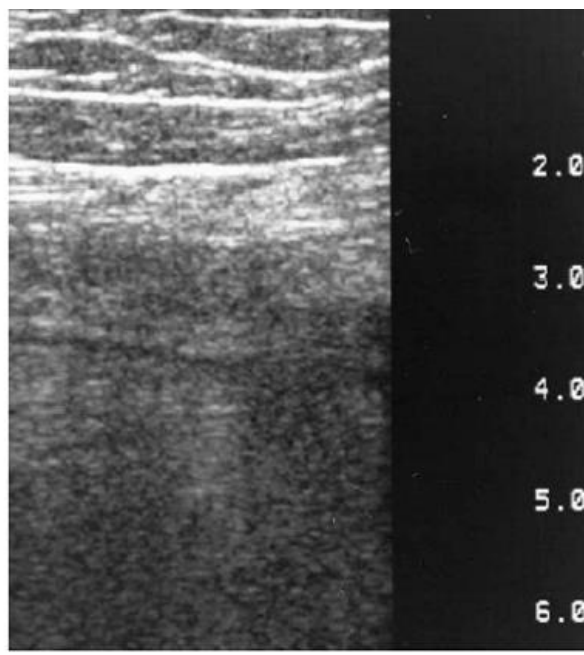
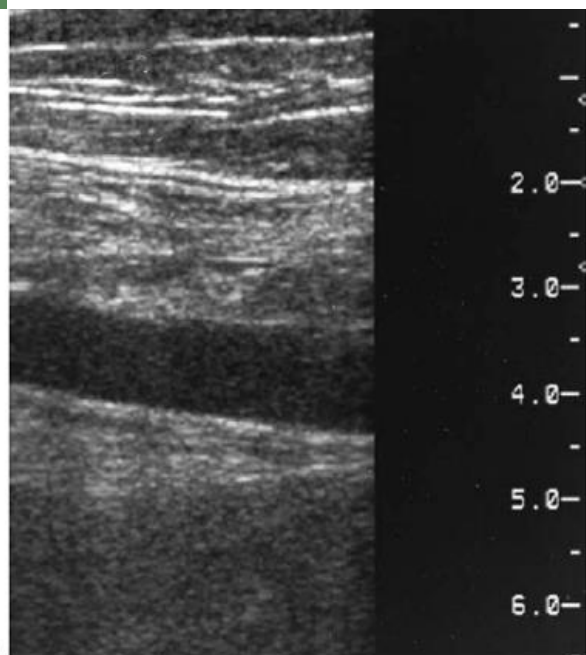
1. Filling defect

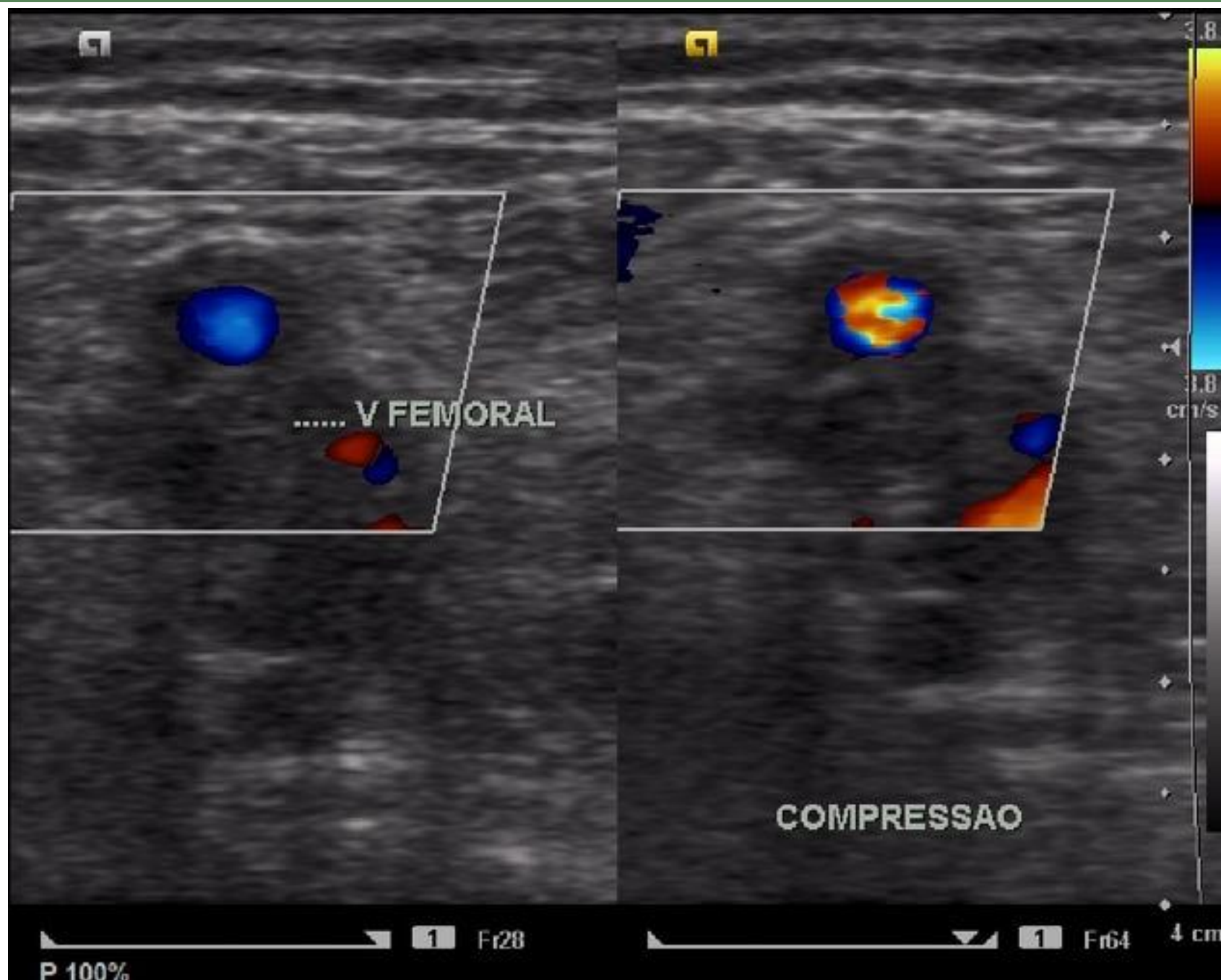
2. Non-visualization

Acute

Chronic:

1. Collaterals
2. Faint opacification





Interventional Radiology

- Radiologists use 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.
- Imaging modalities:
 1. X-ray/fluoroscopy/DSA
 2. CT
 3. US
 4. MRI (limited)

Basic Interventional Techniques

Endovascular IR:

- Aneurysm Repair

- Angioplasty

- Vascular Stents And Filters

- Therapeutic Embolization

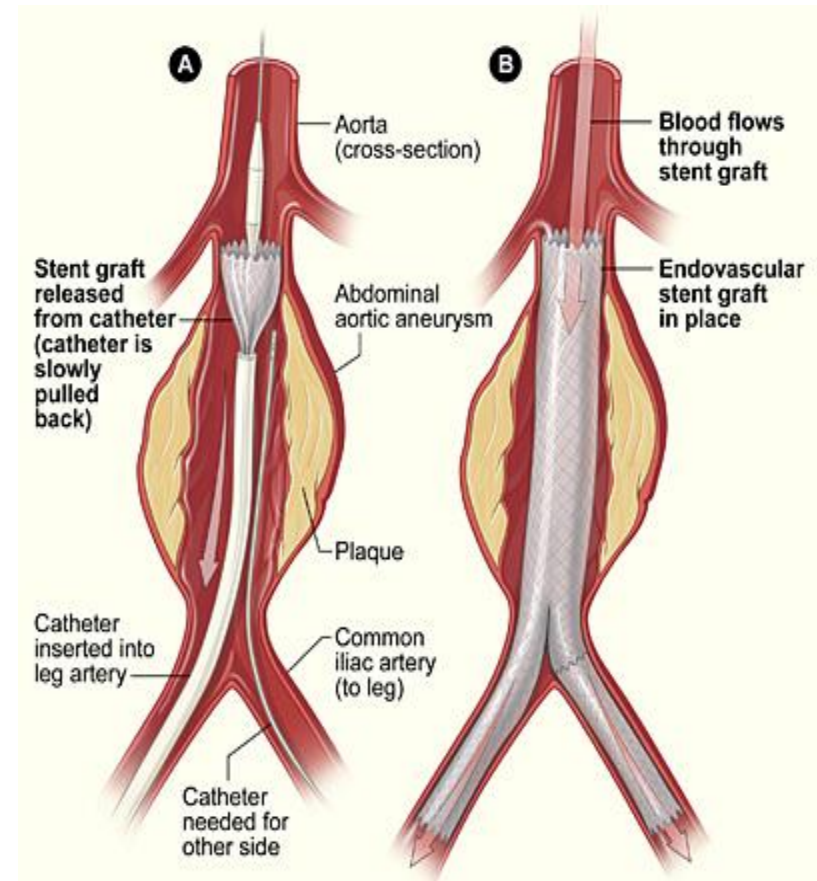
Percutaneous IR:

- Percutaneous Needle Biopsy

- Percutaneous Puncture/Drainage

Endovascular Aneurysm Repair

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



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.

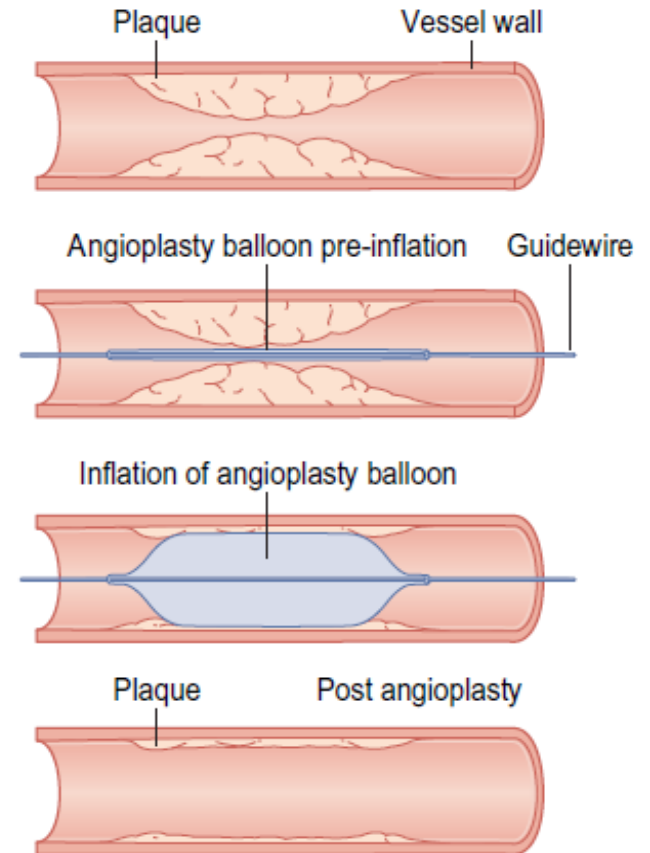
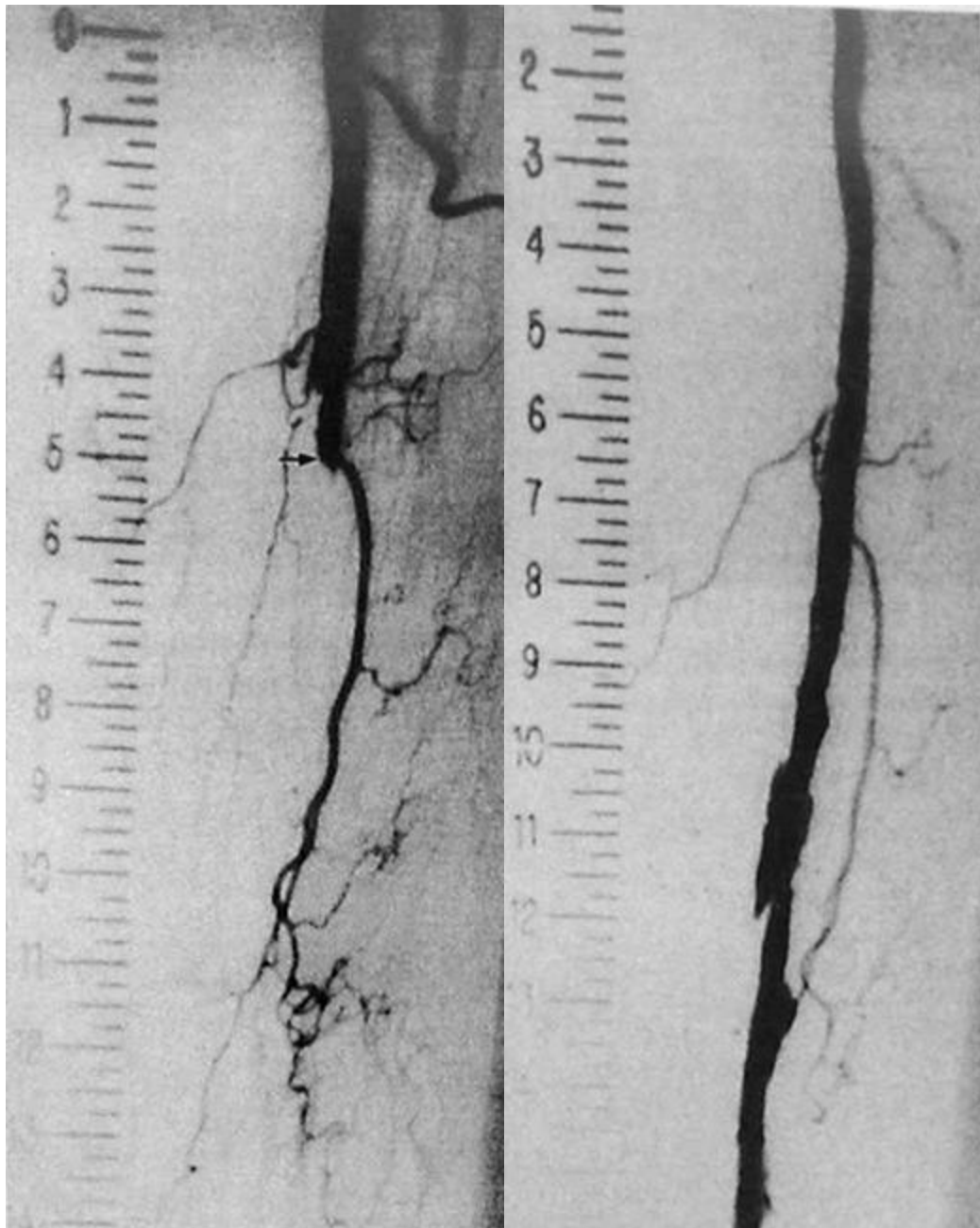


Diagram of angioplasty



**Angioplasty of left
femoral artery**

Vascular Stents And Filters

■ 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 to **hold the artery open**, which improves blood flow and relieves symptoms caused by the blockage.

■ Indications

Vascular stenosis or occlusion

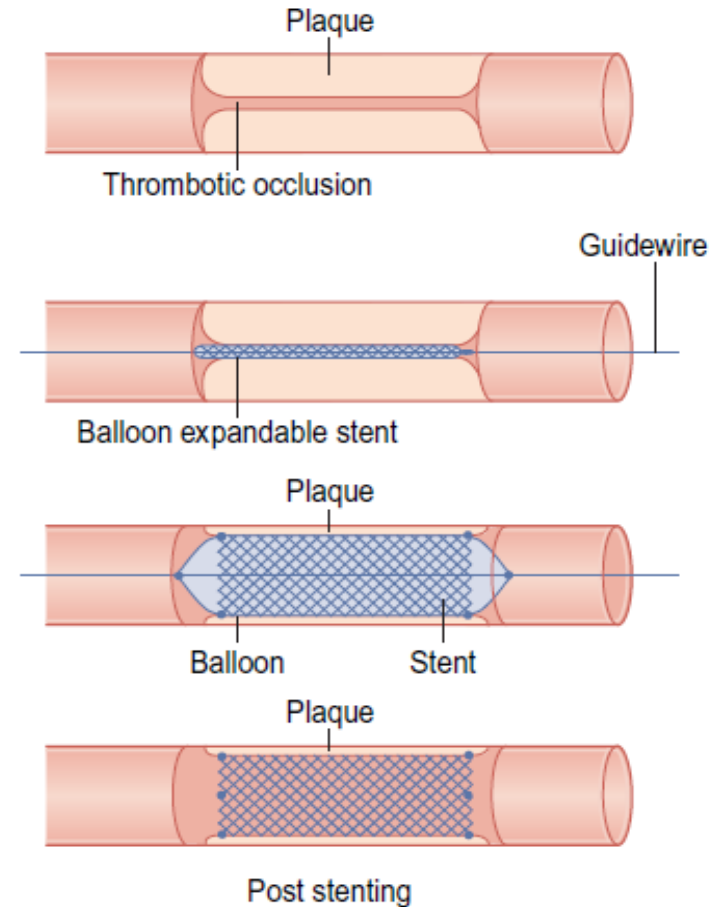


Diagram of stenting

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.

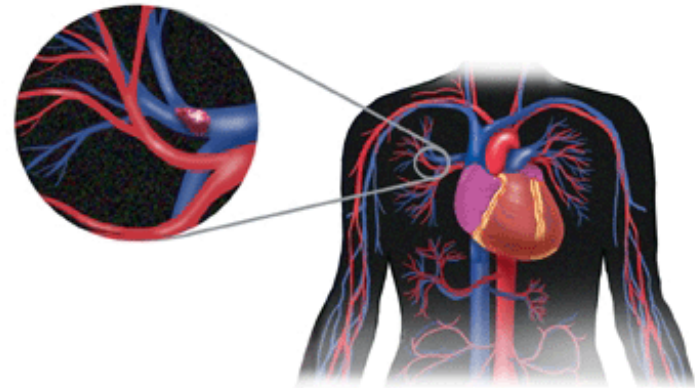


Angioplasty of left subclavian artery

Inferior Vena Cava Filters

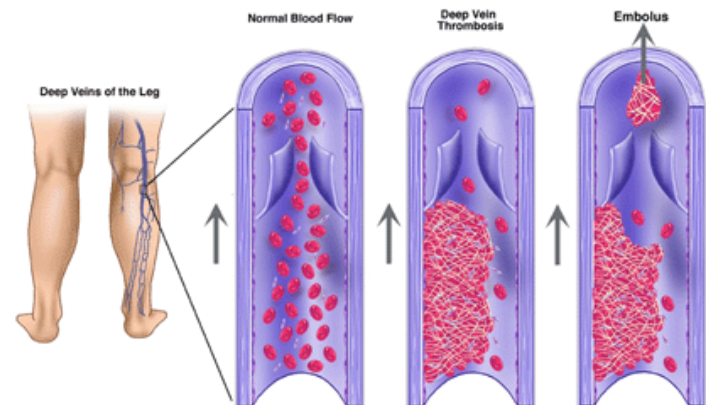
- Inferior vena cava filters can be introduced percutaneously through the femoral vein.
- The filters trap emboli originating from leg or pelvic vein thrombi.
- They are used in patients who are at risk of pulmonary embolism.

Site of Pulmonary Embolus

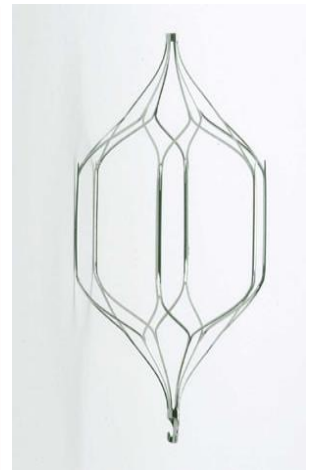
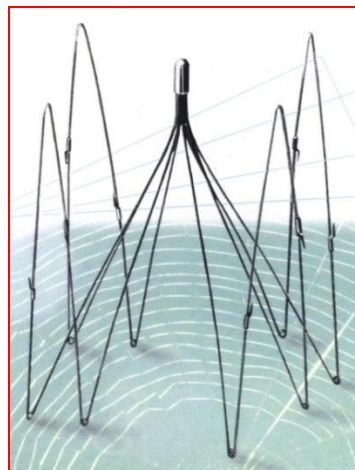
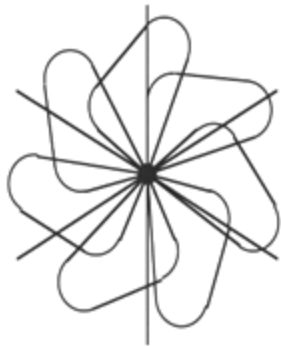
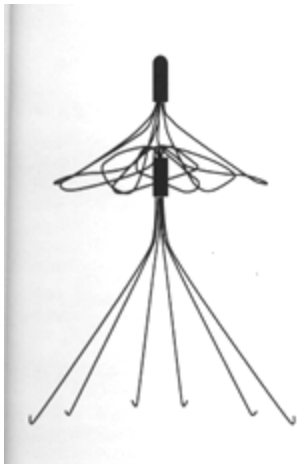


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Deep Vein Thrombosis (DVT)



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Indications For IVC Filters:

1. DVT and/or PE and one of the following:
2. Contraindication to anticoagulation.
3. Failure of anticoagulation.
4. Complication of anticoagulation.

Because IVC 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.

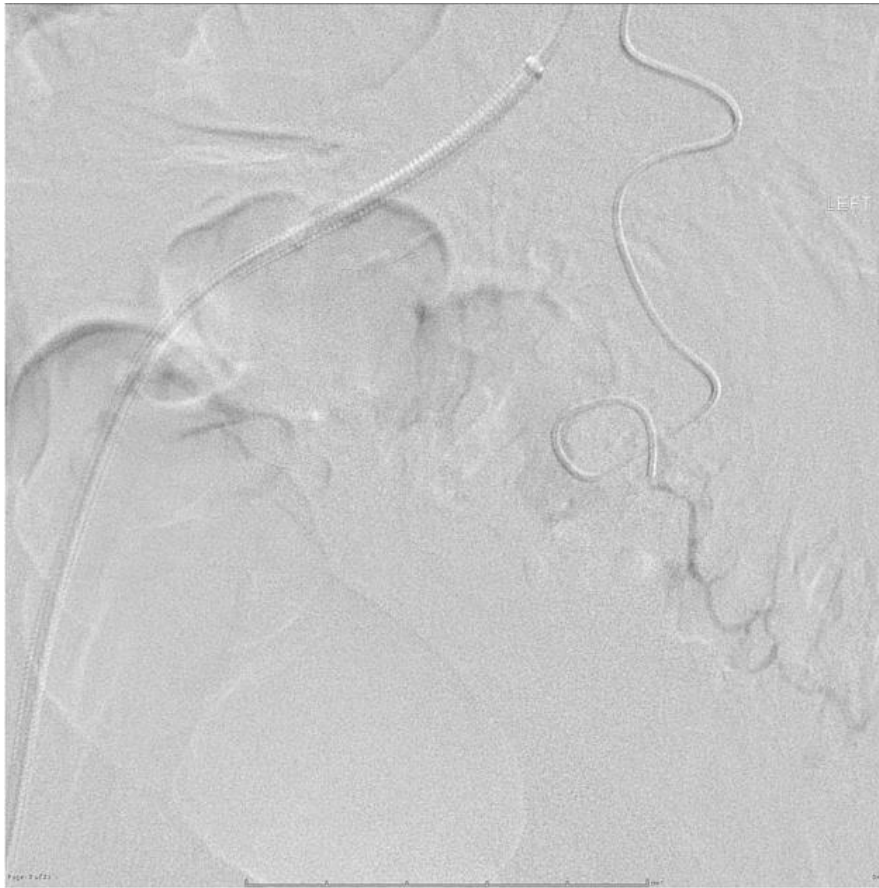
Therapeutic Embolization

Technique:

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

Indications

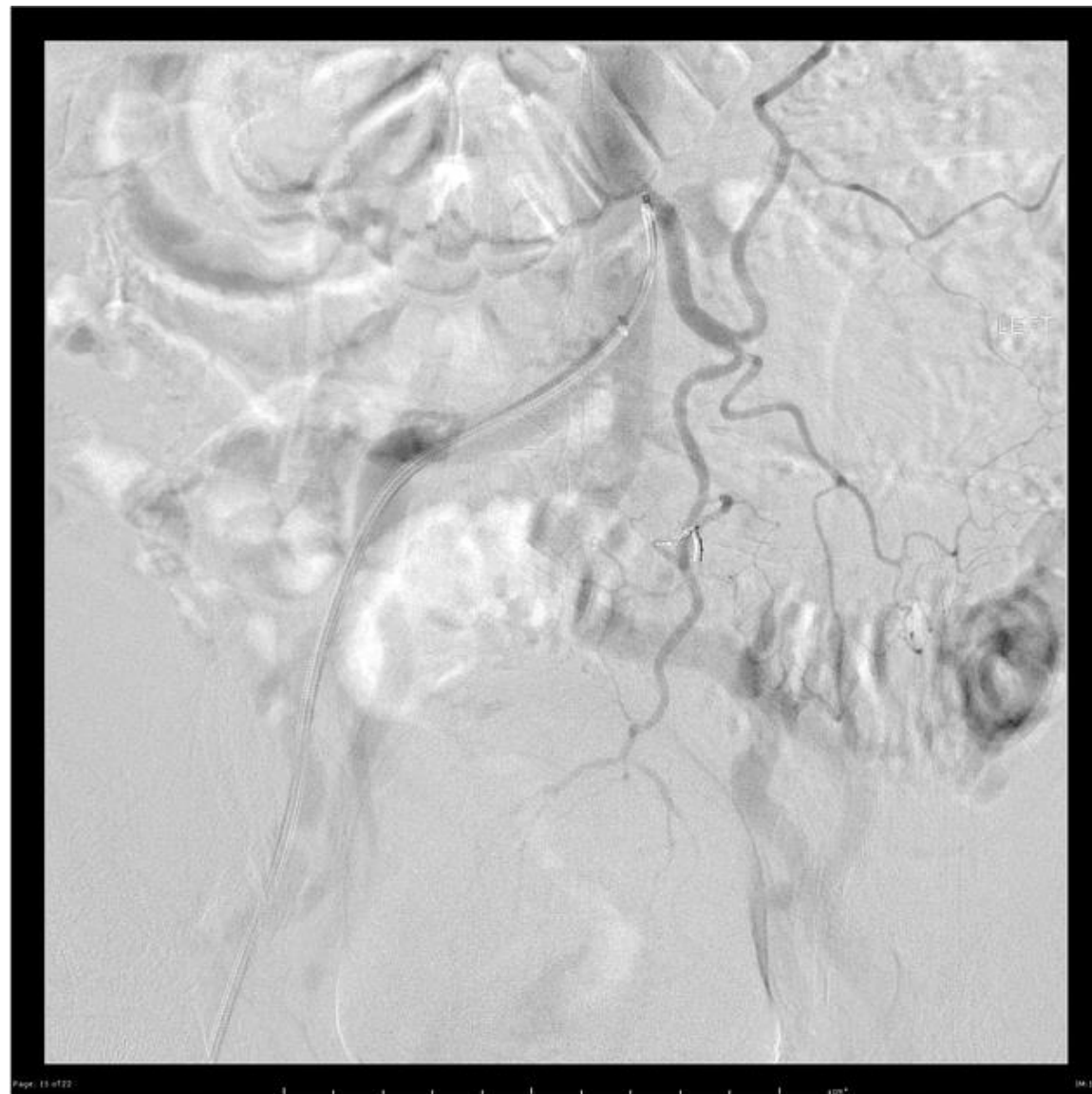
1. Bleeding
2. Tumors
3. Aneurysms
4. Arteriovenous malformations

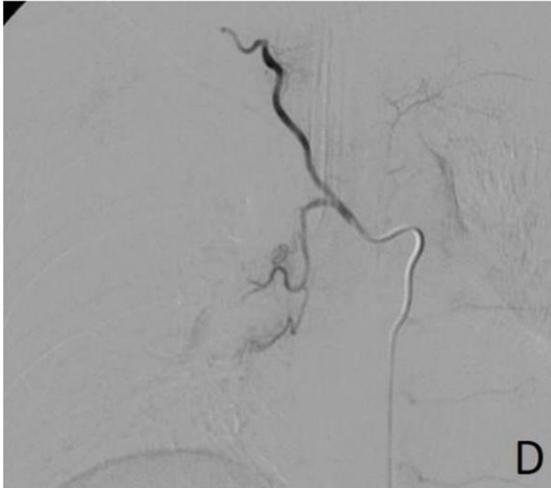
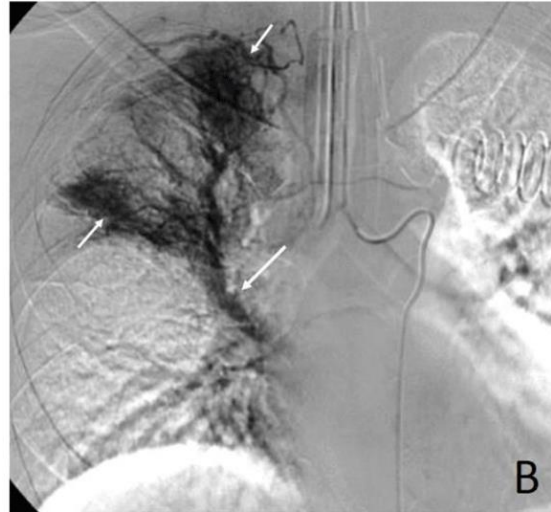


Gastrointestinal (GI) tract bleeding

Angiography demonstrated the bleeding site at a middle sigmoid branch of the IMA.

Post embolization





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 bleeding bronchial artery is occluded



Preoperative tumor embolization

- Many tumors such as meningiomas, and renal cell carcinoma 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.

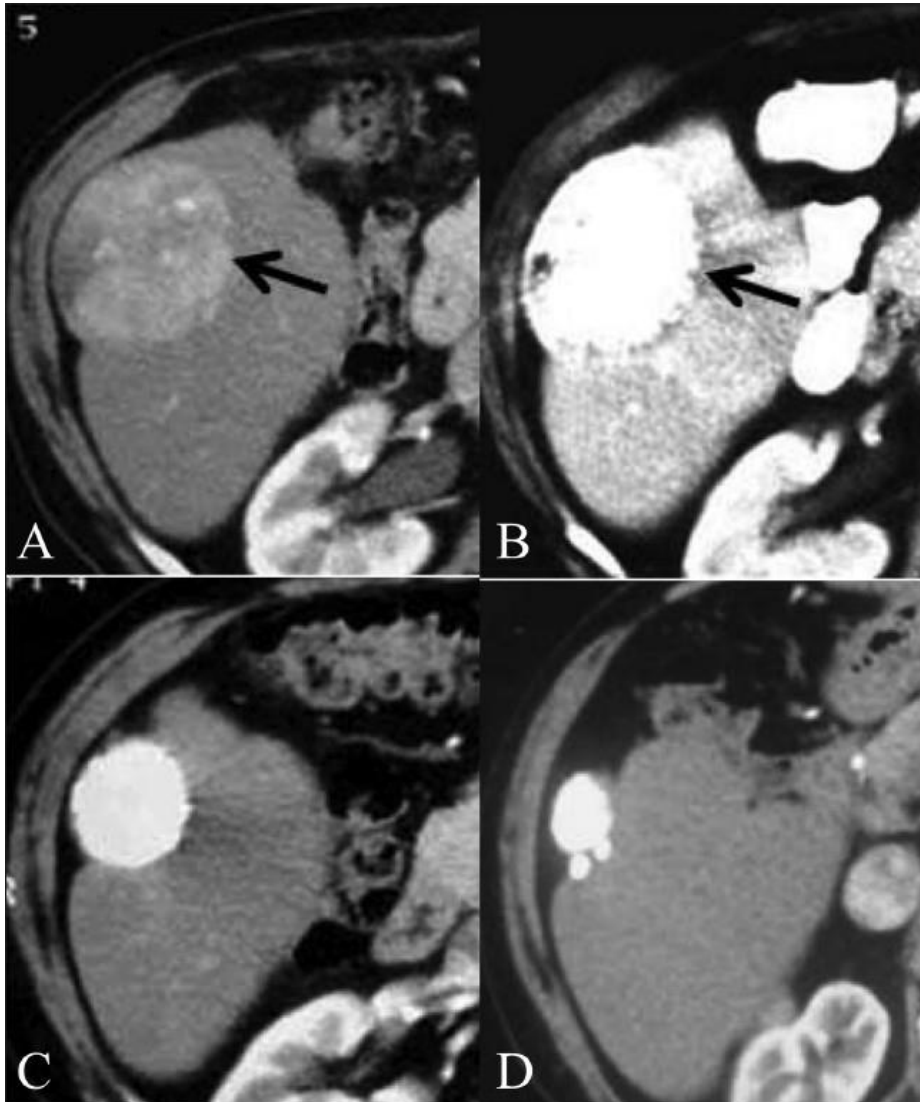
Transarterial Chemoembolization

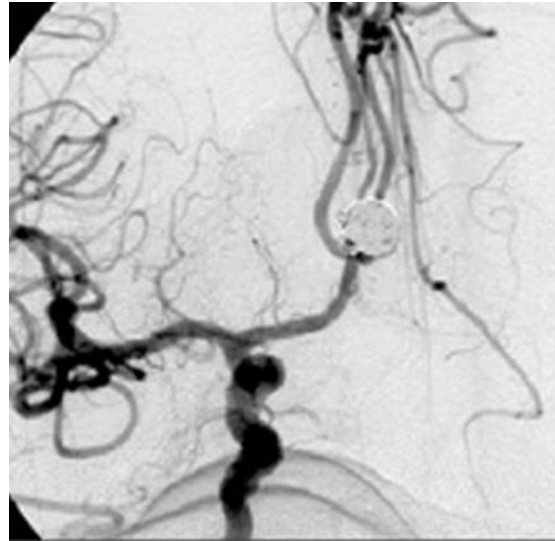
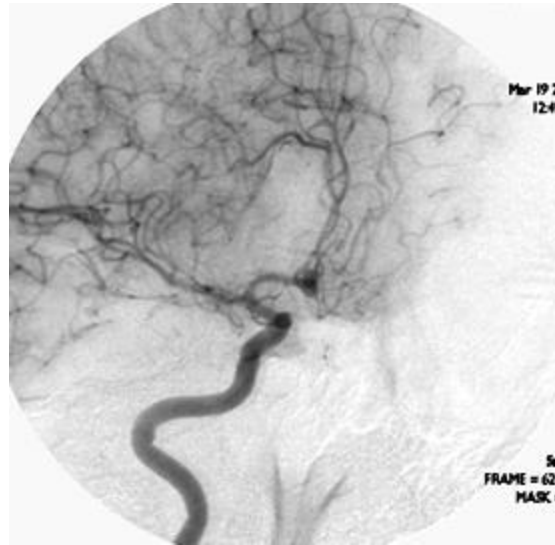
Technique

- 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 showing an aneurysm located in the AComA.

The embolization of aneurysm with metal coils is well demonstrated.

Percutaneous Needle Biopsy

Technique

- A needle is passed to 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)
- material can be obtained for cytology.

Indications

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



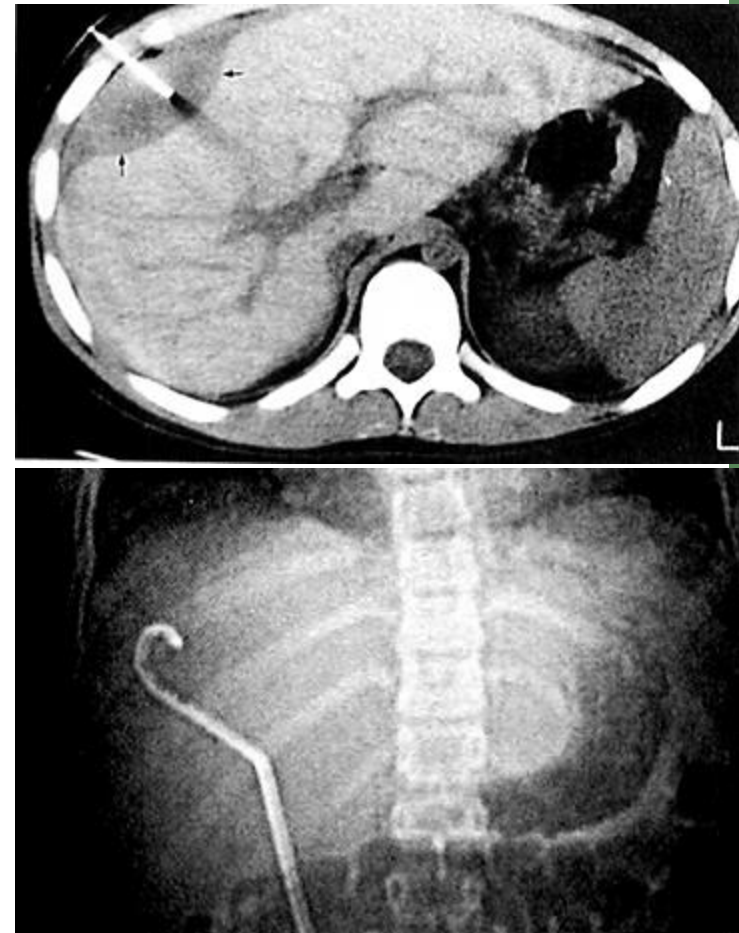
Percutaneous Drainage Of Abscesses And Other Fluid Collections

Technique

- The specially designed drainage catheters can be introduced percutaneously into abscesses avoiding the vital organ and allow the pus to drain for several days.

Indications

- Abdominal abscesses



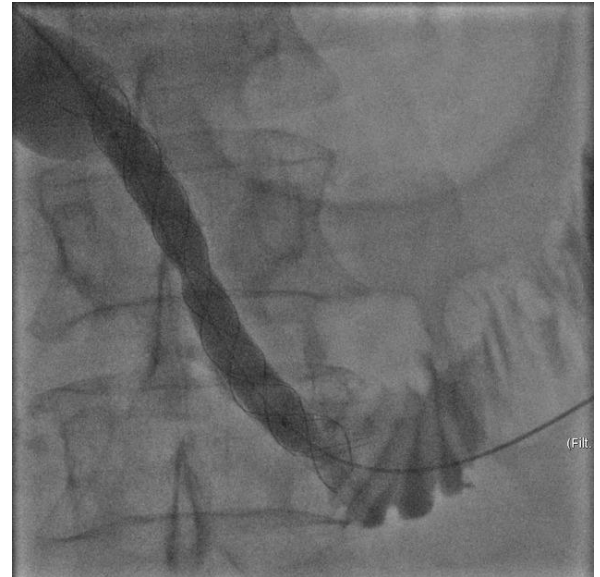
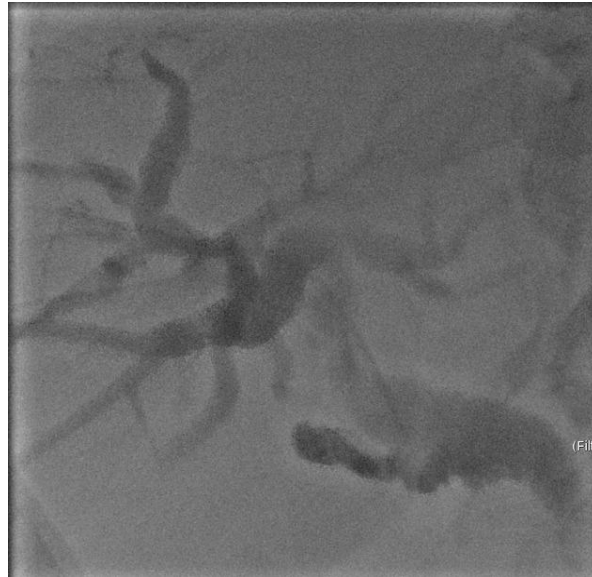
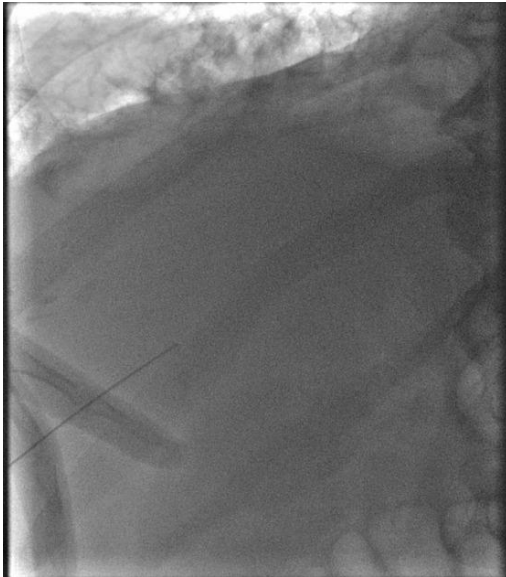
Drainage Of The Biliary System

Technique

- Uses a stent (small mesh tube) to open up blocked ducts and allow bile to drain from the liver.
- Stent helps to hold the bile duct open, which improves biliary flow and relieves symptoms caused by the obstruction.

Indications

- An obstructed biliary system due to tumors or stones



Percutaneous Insertion Of A Stent To Bypass An Obstruction In The Common Biliary Duct



Thank You !