




Objectives:

Not included

Pictures are not included in the MCQs but can be asked in the OSCE

Vascular Investigations

 Team leaders: Alanoud Almansour, Ghaida Al Musma , Moath Alhamoud and Mohammed Alqwaifli

 Done by: Hussam Alhajlh, Omar Alfawzan, Nouf Alotaibi, Ghada Alhaidari and Esraa Alnazzawi

 Revised by: Aseel Badukhon

Color Index:

● Important

● Doctor's Notes

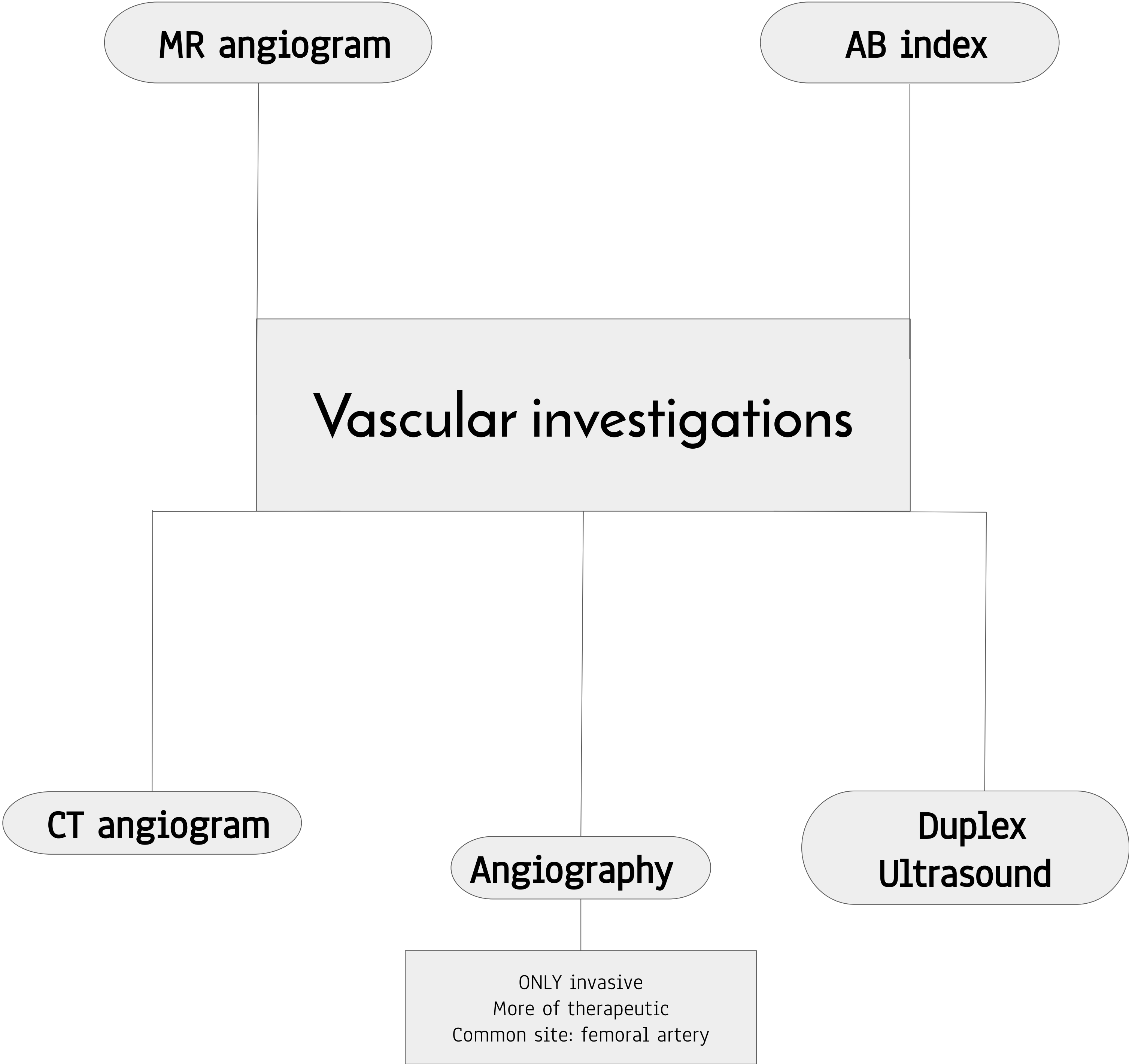
● Extra

● Davidson's

[Editing File](#) / [Feedback](#)



Overview



Handheld Doppler (sound only)

Doppler is not used for investigation, it just helps you to examine your patient when you are not able to feel the pulse, it's Used to hear the arterial flow and the velocity (speed of RBCs) when you don't hear a pulse in the patient, so you can see the signals that reflect the blood flow

Ankle Brachial Index (ABI):

The ABI has limited use in evaluating calcified vessels that are not compressible as in diabetes (gives high values). So you measure the pressure at ankle and brachial and divide them.

- It is sensitive because it tells us if there is a disease or not and also the severity

$$ABI = \frac{\text{Ankle systolic pressure (dorsalis pedis or posterior tibial artery)}}{\text{Arm systolic pressure (brachial artery)}}$$

| | |
|-------------|--|
| >1.30 | Non compressible : considered as false limb reading, specially in patients with diabetes. Because their lower limb vessels are severely calcified so the cuff cannot close the artery to read pressure. So we don't use ABI in these patients. |
| 1.00 - 1.2 | Normal |
| 0.91 - 0.99 | Borderline (equivalent) |
| 0.41 - 0.90 | Mild to moderate peripheral arterial disease: Chronic limb ischemia only with claudication |
| 0.00 - 0.40 | Severe peripheral arterial disease : critical limb ischemia with rest pain, gangrene and tissue loss. |

| Sensitive | Operator dependent | Toxic | Therapeutic |
|--|--|---|---|
|  Limited sensitivity |  الي يسويه ممكن يغلط بمكان البروب وممكن يعطينا false reading , and you can't depend on the results unless you trust the .operator |  |  |

Also Segmental pressure and doppler.

Segmental pressure

“just to know”

-You will measure the blood pressure between two segments, and if there is a difference it means there is stenosis between the two areas. For example, if you measured the pressure above the knee and it was normal, then you measured it below the knee and it was abnormal, it means there's a stenosis in between.

-While measuring the blood pressure, we use the doppler to reflect the sound of blood flow on a paper to check for normal blood flow.

-Simple, non invasive, gives us an indication if there is a decrease in the blood flow or not, but doesn't tell us what's the disease if it's complete occlusion or stenosis.

Duplex ultrasound

B - mode* + Color Doppler

*B-mode (brightness mode) ultrasound, More commonly known as 2D mode now. Called duplex because it combines: ultrasound (B-mode) for anatomy + doppler for physiology. It shows the anatomy of vessels, the disease and the flow velocity. Normal velocity is up to 120, **increase** in velocity means that there is **stenosis**. And too low velocity means that there is occlusion. When we get a duplex ultrasound image we check for 3 things:

- Waveform (normal: triphasic wave).
- Velocity (up to 120).
- Anatomically clear.

| Sensitive | Operator dependent | Toxic | Therapeutic |
|---|--------------------|----------|-------------|
| <p>✓✓✓</p> <p>More sensitive than ABI because duplex gives you the exact site and severity of stenosis. While ABI gives you only about the nature but not the exact site or how severe it is)</p> | <p>✓✓✓</p> | <p>✗</p> | <p>✗</p> |

CT Angiogram

(CT with contrast injected into peripheral veins, if it's only CT blood vessels would appear black) NON INVASIVE

- If the patient has renal failure (on dialysis) it's okay to use contrast, because the kidney is not functioning anyway and the pt is on dialysis. But the problem is in pts with **borderline kidney function**; they may develop renal failure from the contrast, so in this case we check creatinine level. If elevated, we hydrate the pt with IV normal saline 6 hours before CT contrast.

| Sensitive | Operator dependent | Toxic | Therapeutic |
|---|--|--|-------------|
| <p>✓✓✓✓✓</p> <p>More sensitive anatomically than duplex. Shows the exact location of the abnormality and the type of abnormality.</p> | <p>✗</p> <p>The operatory only injects the contrast.</p> | <p>✓✓✓</p> <p>-Contrast allergy (especially in patients with iodine sensitivity) - Renal injury (borderline creatinine must do dialysis after it) -Radiation)*</p> | <p>✗</p> |

MR Angiogram

MRA is mainly used in soft tissue diseases, such as popliteal entrapment syndrome (A disease where the popliteal artery is compressed behind the knee, due to congenital deformities of the muscles or tendon insertion of the popliteal fossa)

Disadvantages: 1- Expensive 2- Not available everywhere 3- The clarity depends on the machine type.

| Sensitivity | Operator dependency | Toxicity | Therapeutic |
|-------------|---------------------|--|-------------|
| ✓✓✓✓ | × | ✓✓✓ Gadolinium contrast (different than that of CT contrast) In renal failure can cause Nephrogenic systemic fibrosis, so there is toxicity but a bit different from CT angiogram in some patients | × |

30 years ago, angiography was used solely to diagnose. But now, it's 95% therapeutic and not diagnostic since there are better non-invasive methods.

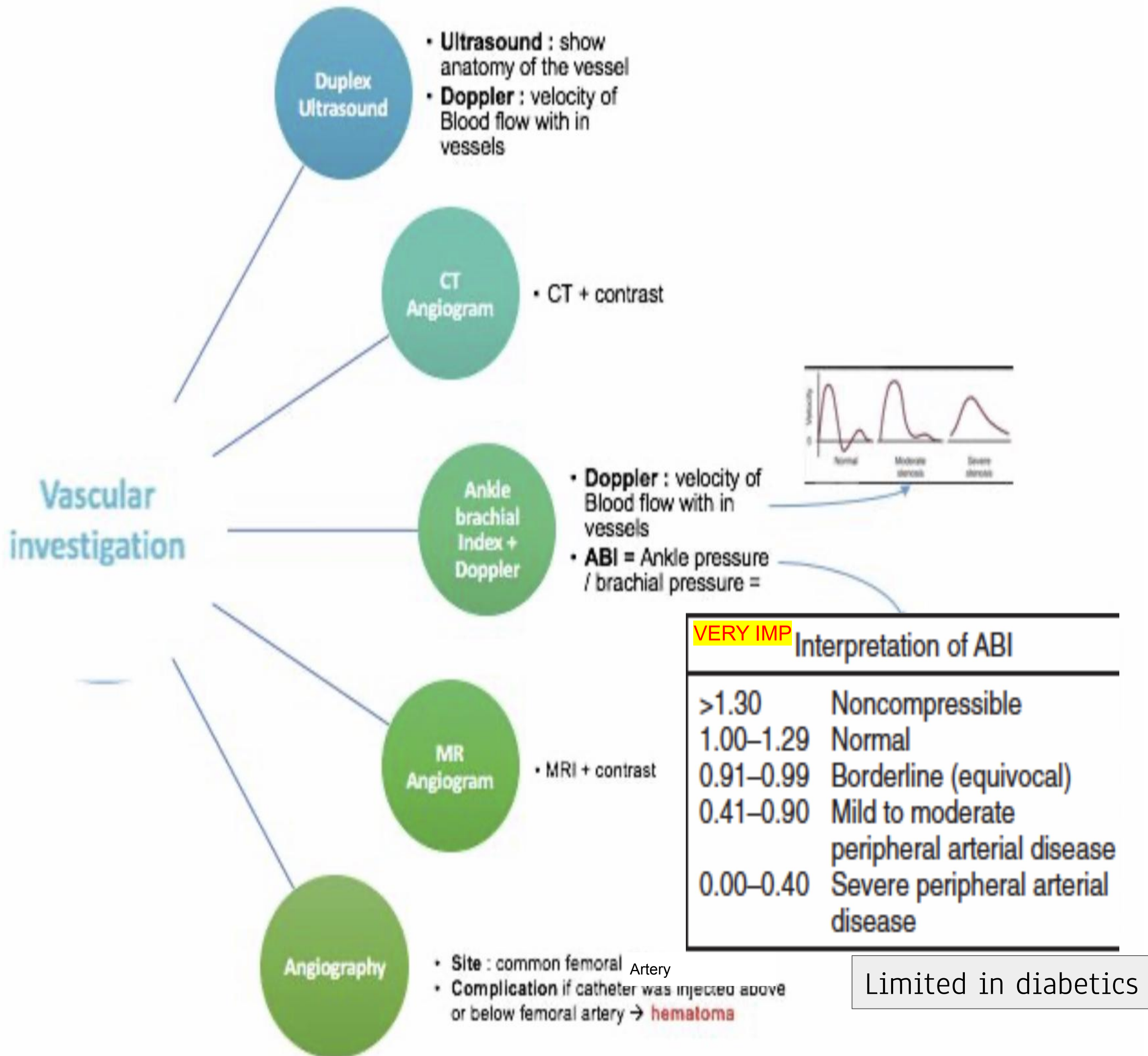
Conventional angiography (similar to cardiac angiogram): invasive!

Puncture the artery → Inject the dye → take an x-ray

Angiography : (X-ray + dye)

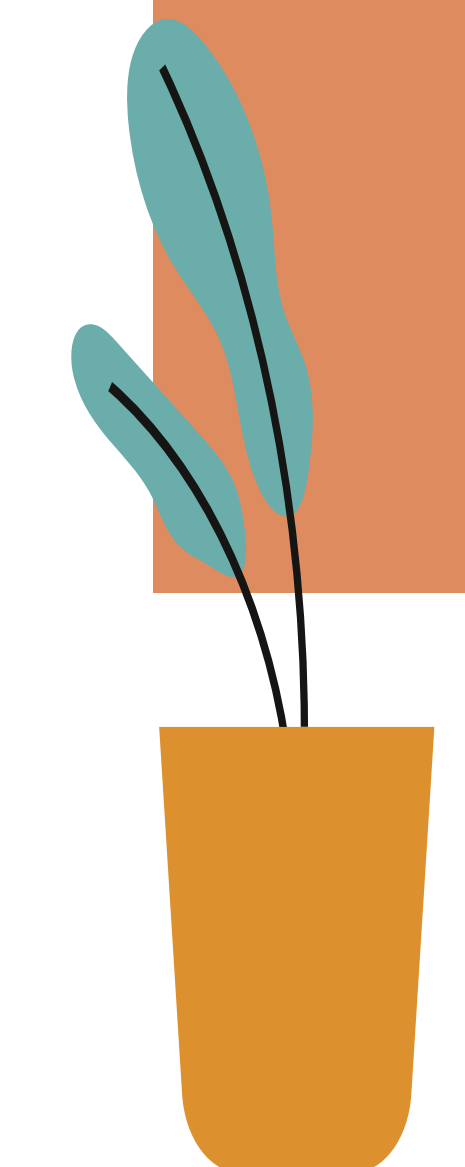
| Sensitivity | Operator dependency | Toxicity | Therapeutic |
|-------------|---------------------|--|--|
| ✓✓✓✓ | × | ✓✓✓ - Contrast allergy and radiation - Less contrast than CT because it's selective - Renal failure - Access complications like bleeding or hematoma pseudoaneurysm | ✓✓✓ The only therapeutic investigation. We can balloon or stent to treat the pathology |

Summary



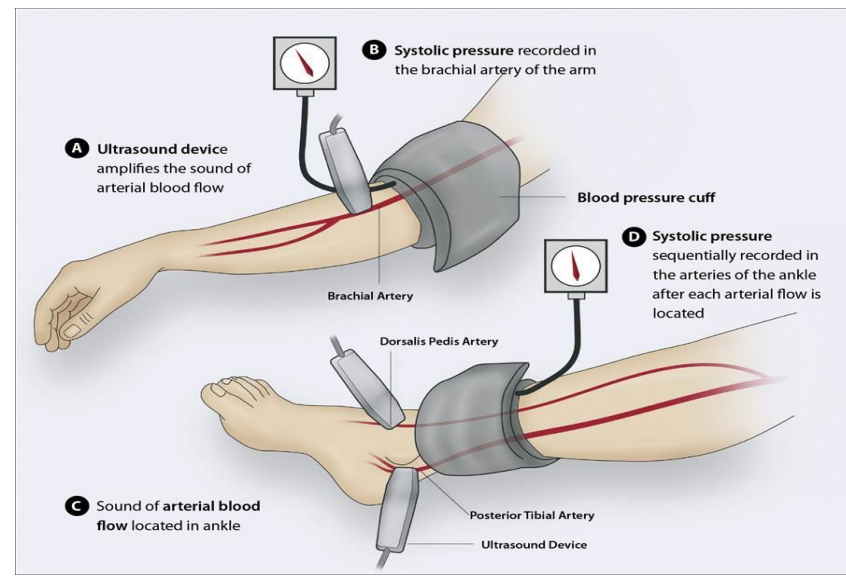
435 summary

| Modality | Sensitivity | Operator dependent | Toxicity | Therapeutic |
|-------------------|-------------|--------------------|----------|---|
| Handheld doppler | ✓ | ✓✓✓ | × | × |
| Duplex ultrasound | ✓✓✓ | ✓✓✓ | × | × |
| CT angiogram | ✓✓✓✓✓ | × | ✓✓✓ | × |
| MR angiogram | ✓✓✓ | × | ✓✓✓ | × |
| Angiography | ✓✓✓✓✓ | × | ✓✓✓ | ✓✓✓ The only therapeutic investigation |

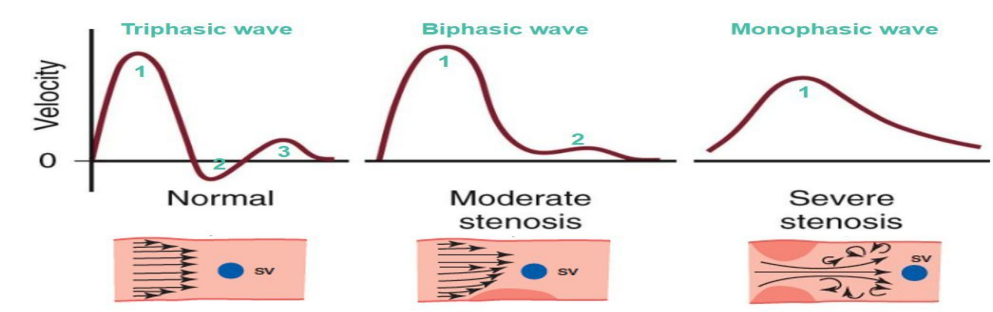


Pictures are not included in the MCQs but can be asked in the OSCE

Ankle brachial index(ABI)

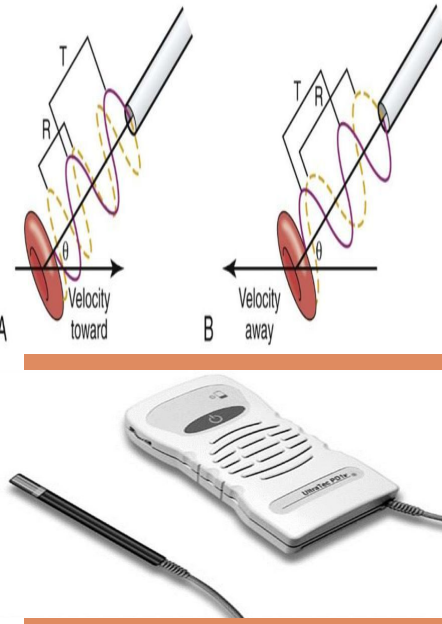


Handheld Doppler

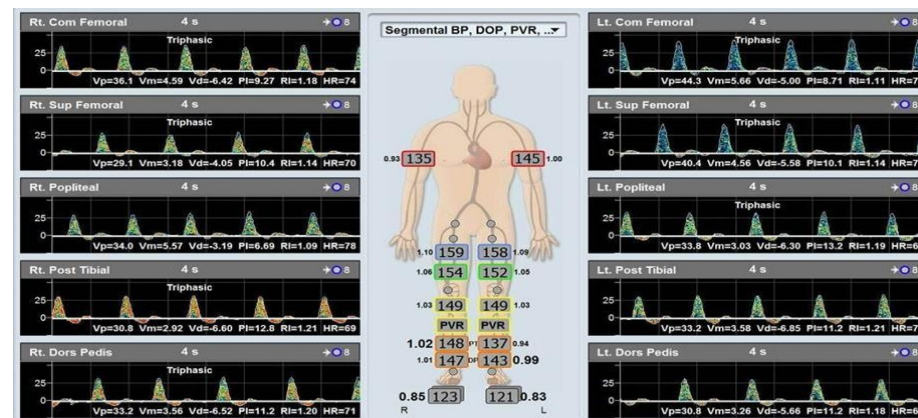


*Stenosis means that the blood flow to the limb is not enough.

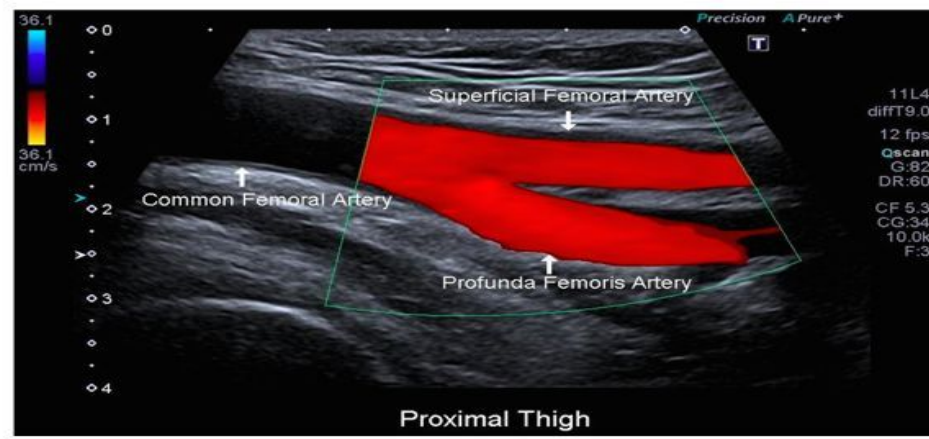
*Severe stenosis is similar to venous flow sound which is continuous with no pulsation (Veins are not pulsatile).



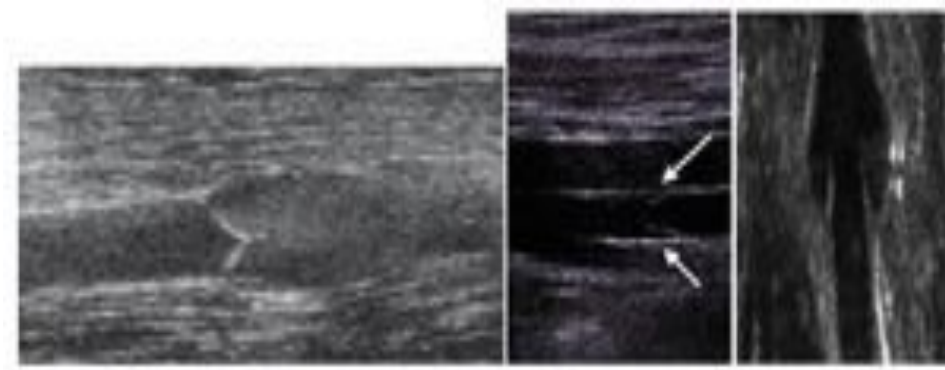
Segmental pressure:



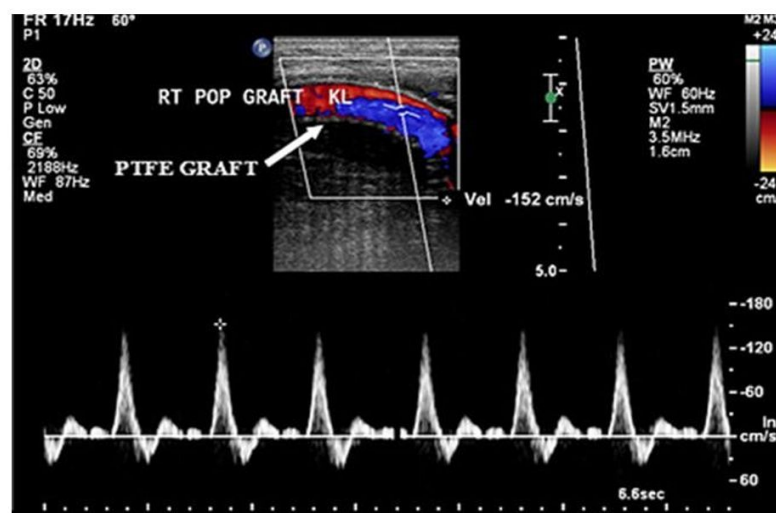
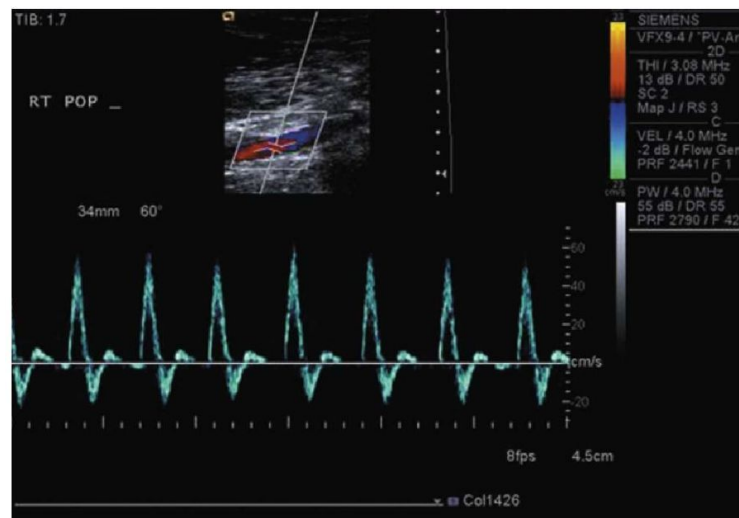
Duplex ultrasound:



This is an ultrasound, you can see the anatomy: The common femoral artery bifurcates to Superficial And Profunda (deep) femoral artery.

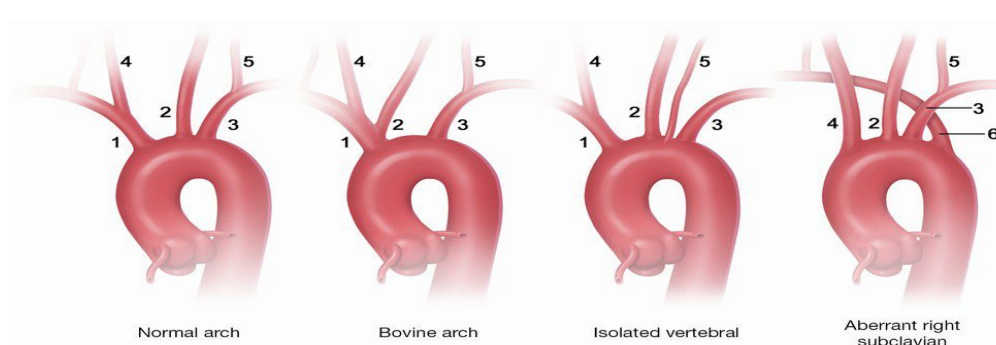
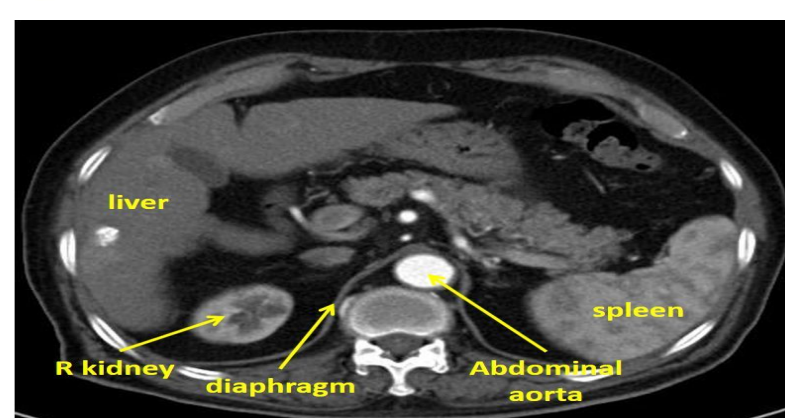
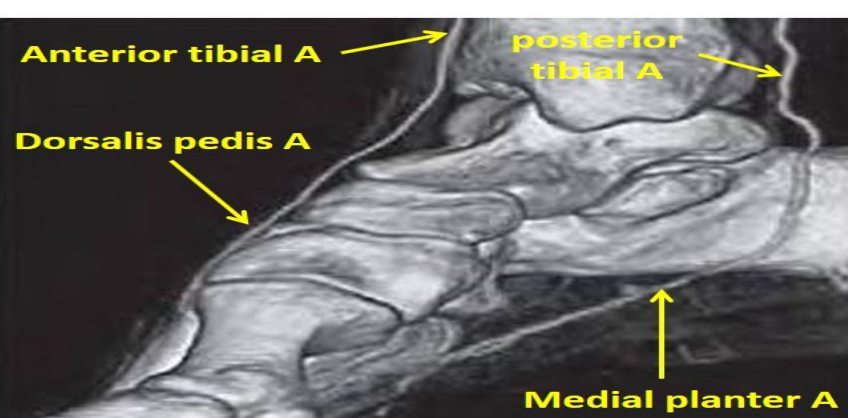
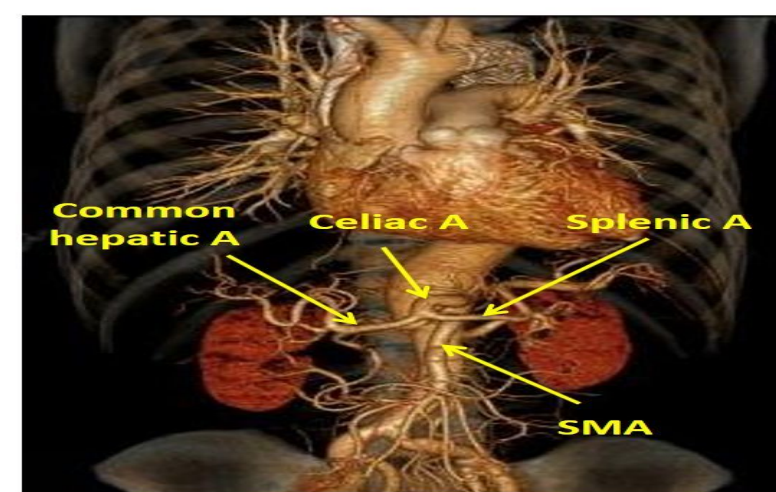
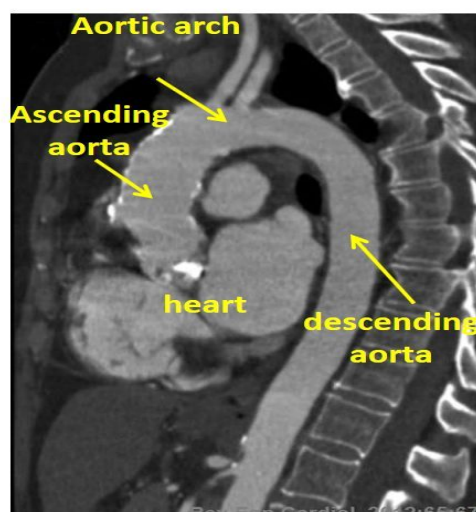


Normal anatomy of a vein how do we know it's a vein? Presence of valves



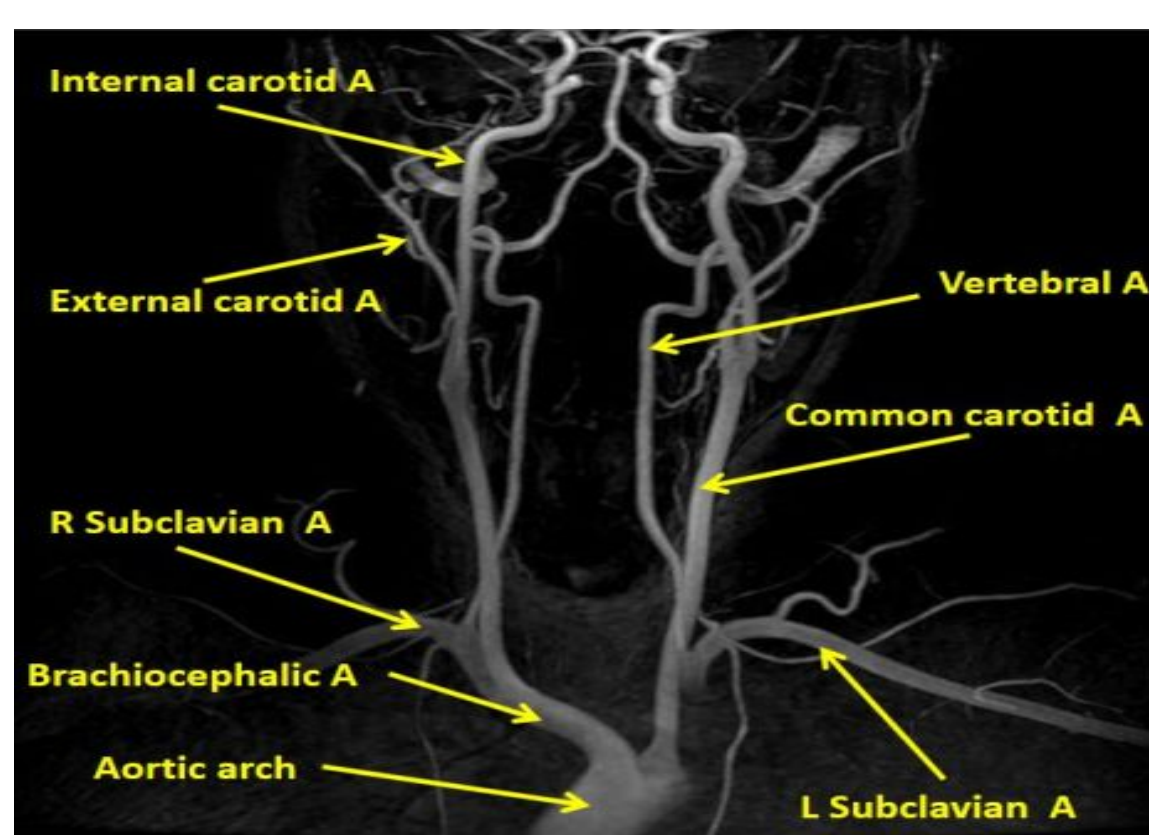
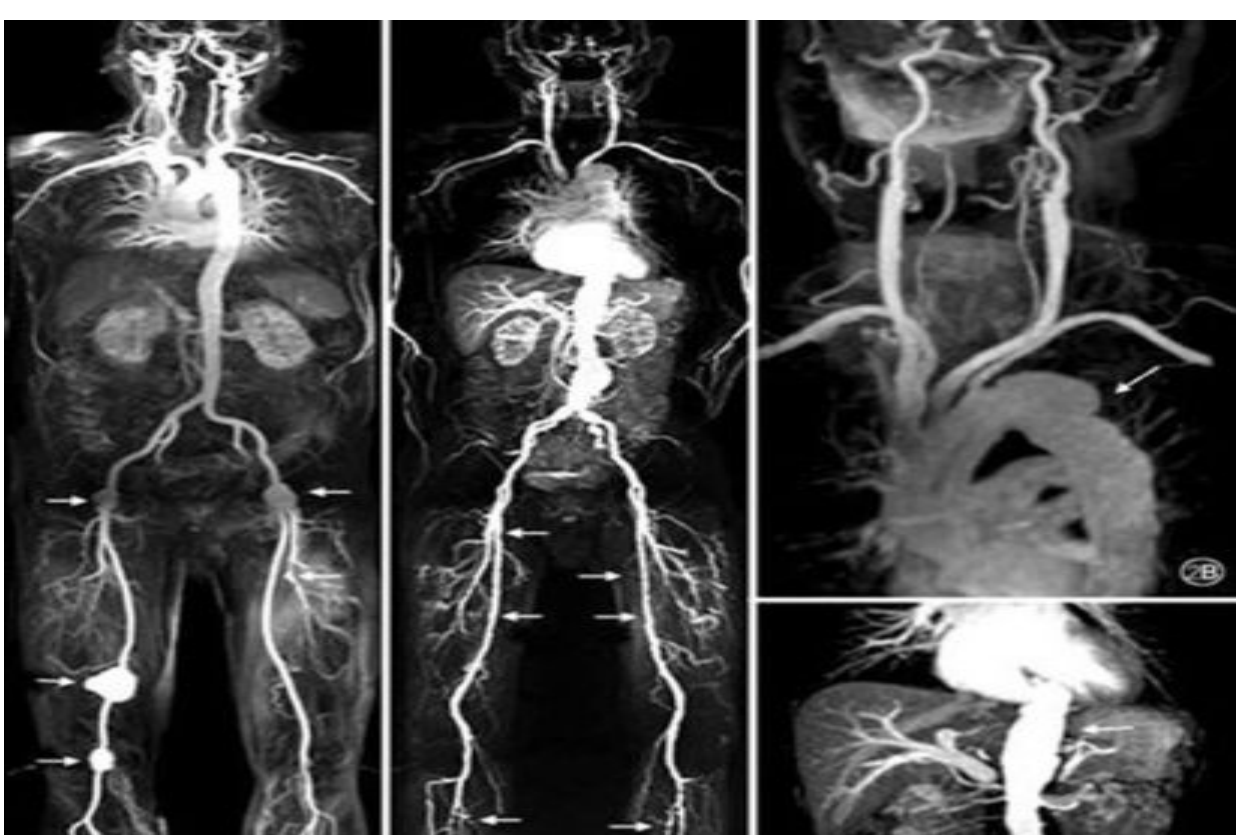
These are doppler bc you can see the anatomy + velocity (doc said don't memorize the velocity numbers)

CT Angiogram:

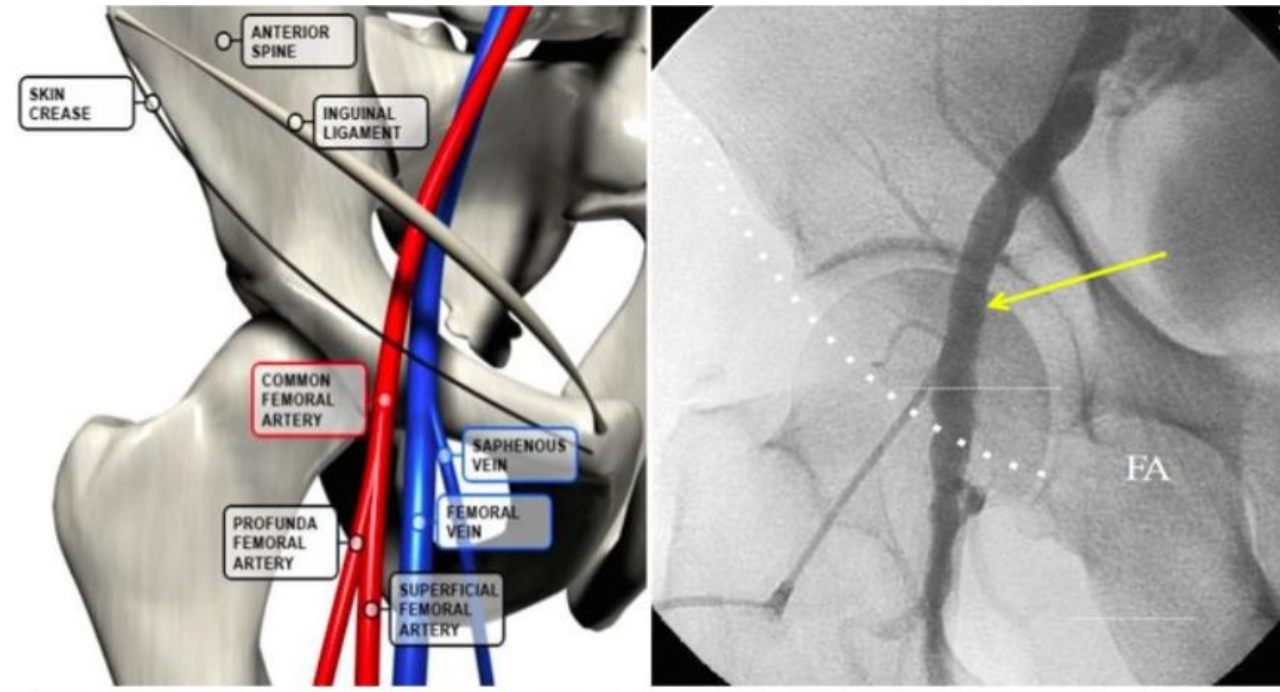
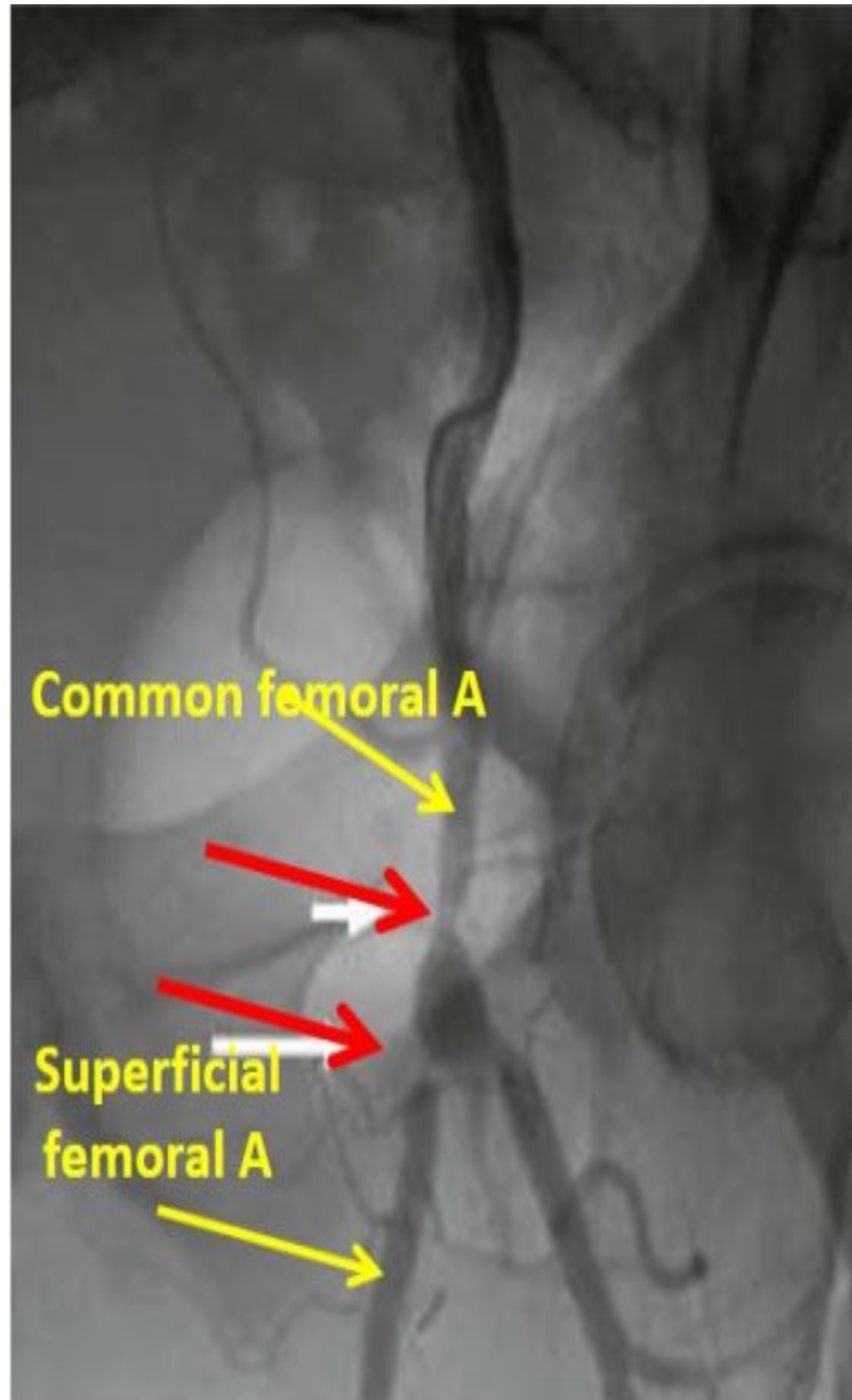
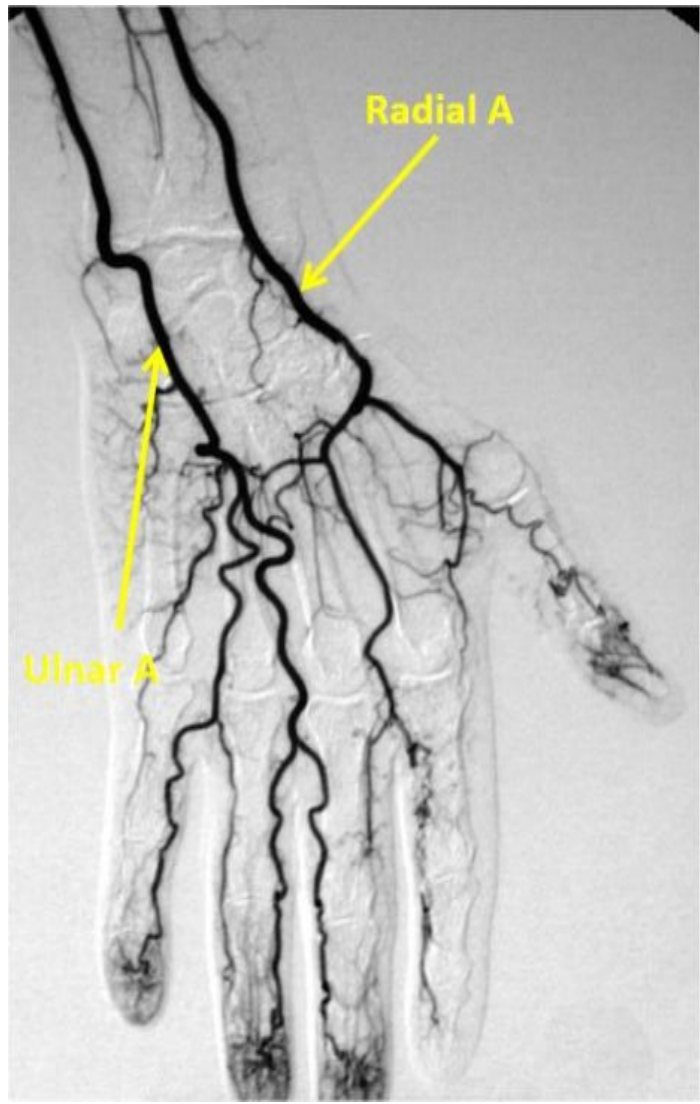


Extra Picture:

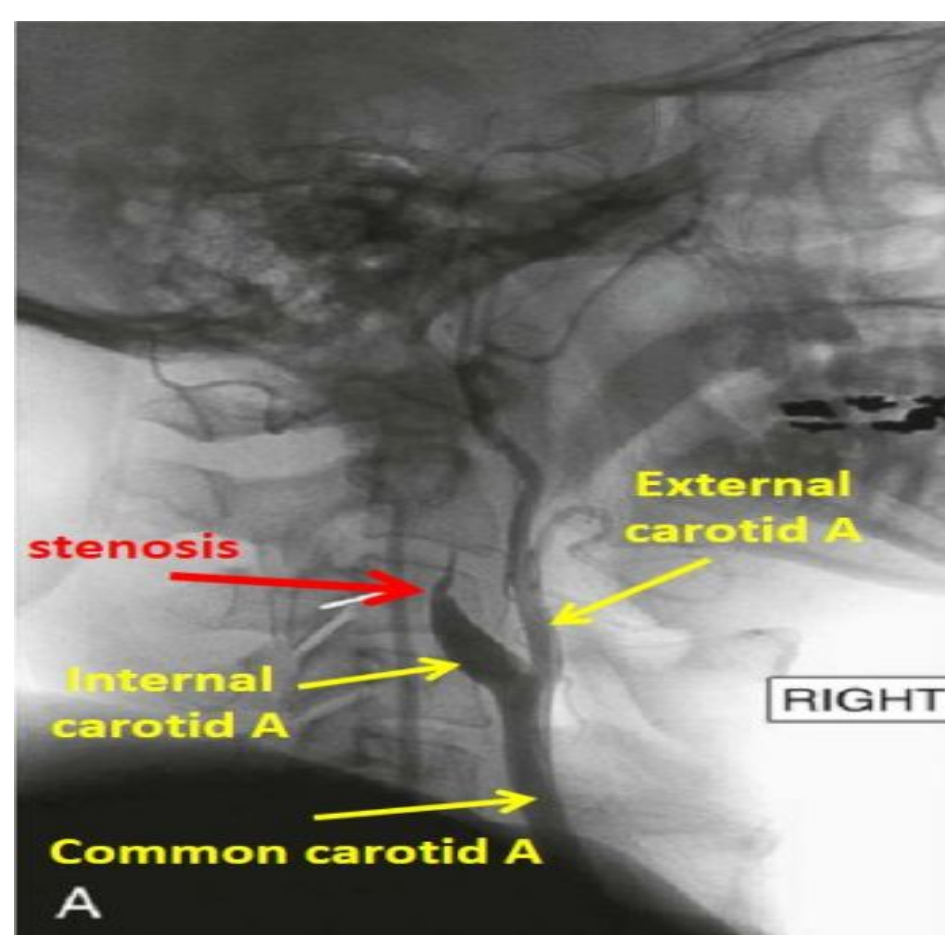
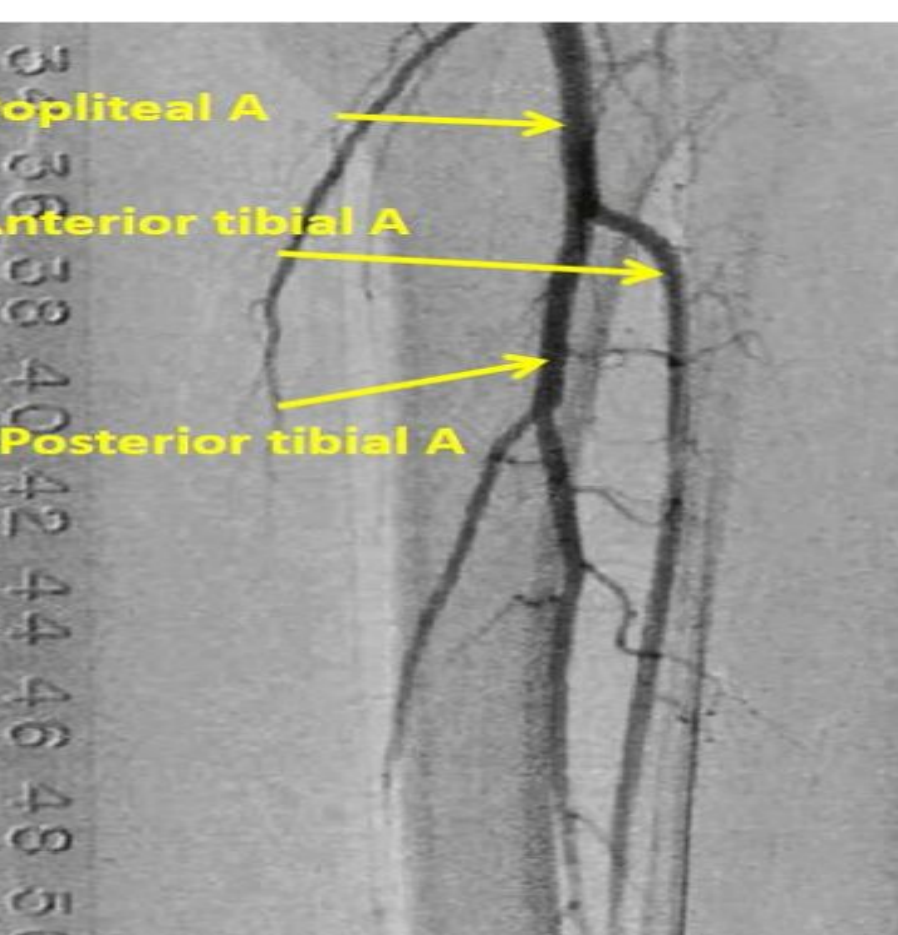
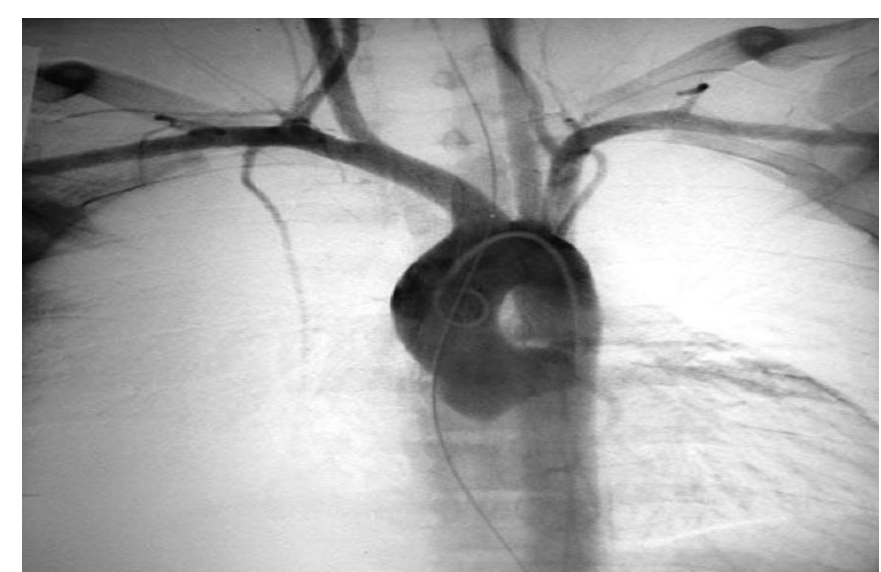
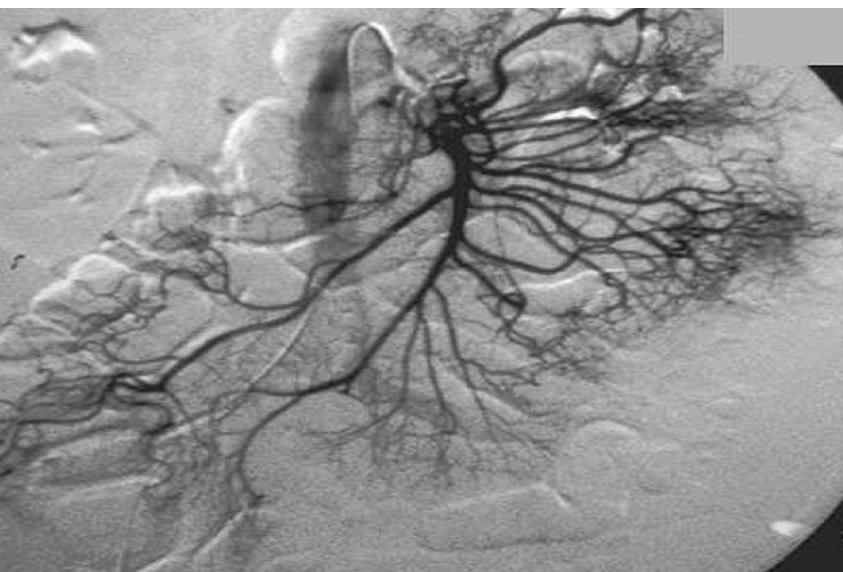
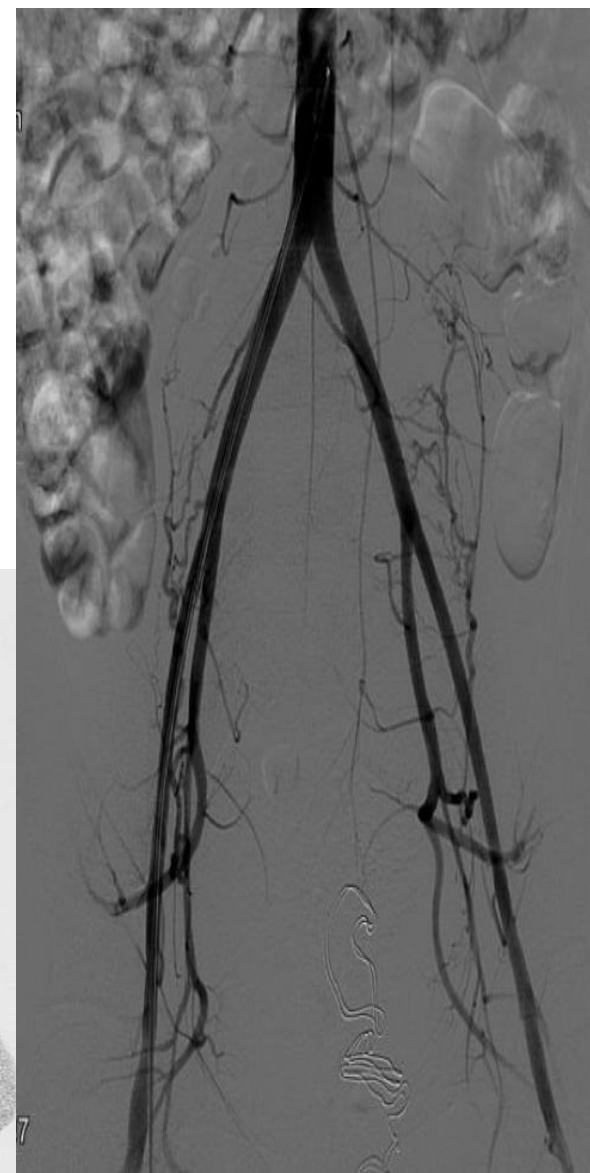
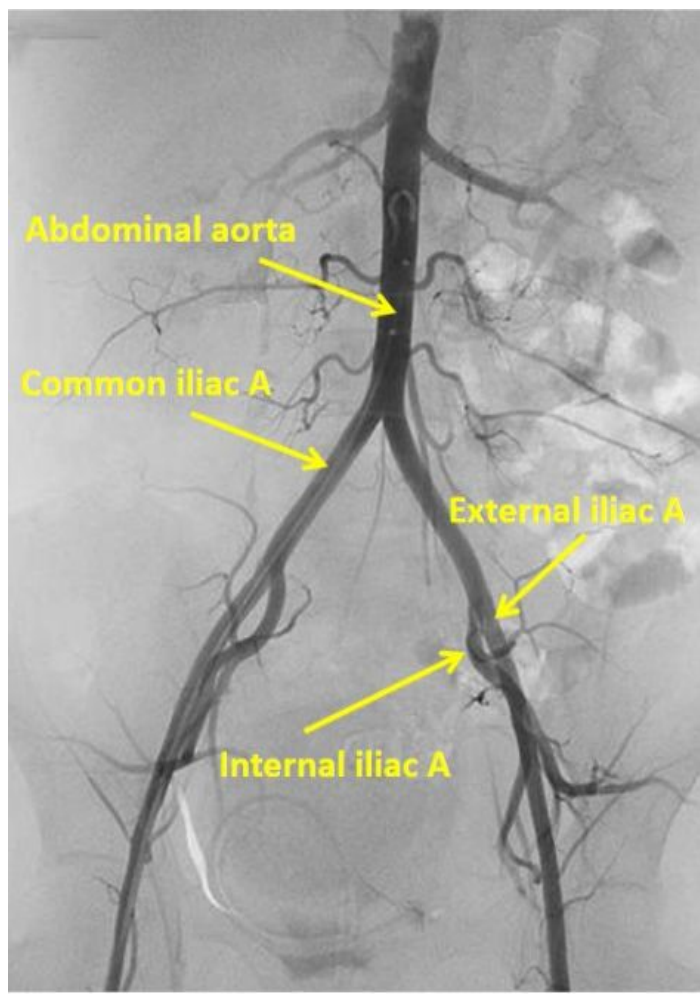
MR Angiogram:



angiography



The most common artery to puncture is the common femoral artery, why? Because it lies on the femoral head so it's easier to compress on it after the procedure; to prevent bleeding.



Before and after treatment of stenosis

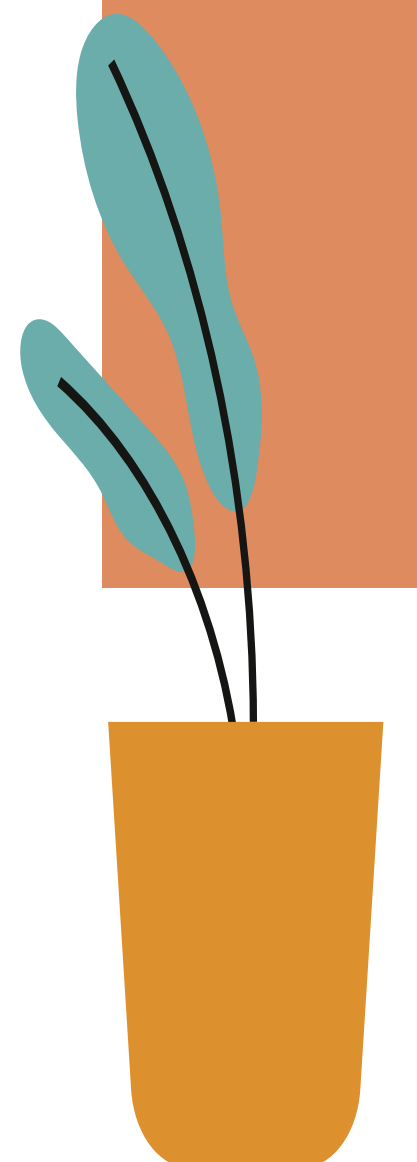
Important clinical note: it's important to know the landmarks of the common femoral artery to not puncture the external iliac, superior femoral and deep femoral arteries; since we can't introduce strong pressure on these arteries as they are not very close to the bone.

If they're punctured, this will lead to hematoma and bleeding after the removal of the sheath.

Another way to spot the site of common femoral artery:

- Fluoro-guidance puncture (x-ray with contrast).
- Ultrasound guidance

Which to choose depends on the abnormality



Extra

Surgical Recall

what is the ABI?

- Ankle to Brachial Index (ABI); simply, the ratio of systolic blood pressure at the ankle to the systolic blood pressure at the arm (brachial artery) A:B; ankle pressure.
- taken with Doppler; the ABI is noninvasive

What ABI are associated with normal, claudicators, and rest pain?

- Normal ABI: ≥ 1.0
- Claudicator ABI: < 0.6
- Rest pain ABI: < 0.4

What gets false ABI reading?

- Patients with calcified arteries, especially those with diabetes.

What are PVRs?

- Pulse Volume Recordings; pulse waveforms are recorded from lower extremities representing volume of blood per heart beat at sequential sites down leg .
- Large wave form means good collateral blood flow
- (Noninvasive using pressure cuffs)

Prior to surgery for chronic PVD, what diagnostic test will every patient receive?

- A-gram (arteriogram: dye in vessel and x-rays) maps disease and allows for best treatment option (i.e., angioplasty vs. surgical bypass vs. endarterectomy) - Gold standard for diagnosing PVD



Quiz

1-How to avoid toxicity because of CT angio contrast in patients with high creatinine or patients with high risk of renal failure?

- A. we don't use CT angio
- B. Admit patient and hydrate for 8-12 h (normal saline, bicarb)
- C. Angiography instead

2- patient with Critical limb ischemia who has a tissue loss in his foot
What do you expect his AB index to be?

- A. 0.4-0.9
- B. 0.0-0.4
- C. 0.5-0.8
- D. 1.0-1.3

3- Patient came with resting calf pain, upon investigations ABI result was 0.4,
duplex found a lesion in SFA 9 cm long

How do you confirm your diagnosis?

- A. CT angiogram.
- B. ABI.
- C. Angiography.
- D. DuplexUS.

4-If you had the same scenario in Q3 BUT Duplex showed a LONG lesion that is most likely won't be treated with balloon or stent do you do angiography?

5-What happens when we puncture the femoral bifurcation ?

- A. Stroke
- B. Emboli
- C. Femoral dissection

6- ABI limited use in? Why? When AB is?

- A. diabetics, calcified vessels not reliable, >1.3
- B. Diabetics, calcified vessels, 0.99
- C. Critical limb ischemia patients, tissue loss, 0.4

you need to know:

- the definitions of
 1. Critical : Rest pain, tissue loss, gangrene
 2. Chronic: PADH Claudication
 3. Acute : complete decrease in flow usually thrombus or emboli (sudden)
- Difference between IC and critical limb ischemia.(progression)

- 1) B
- 2) B
- 3) C
- 4)
No,CT
angio
to confirm
then
surgery
- 5) C
- 6) A