



Vascular investigations

Objectives:

Not included :(

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

Resources:

- Davidson's.
- Dr.Abdulmajeed Altuwaijri's slides.
- 435' team work.

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COLOR INDEX:

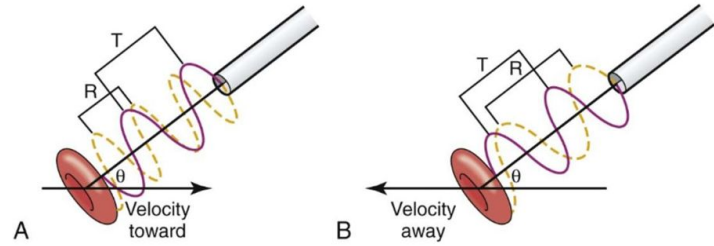
NOTES , IMPORTANT , EXTRA , DAVIDSON'S

[EDITING FILE](#)

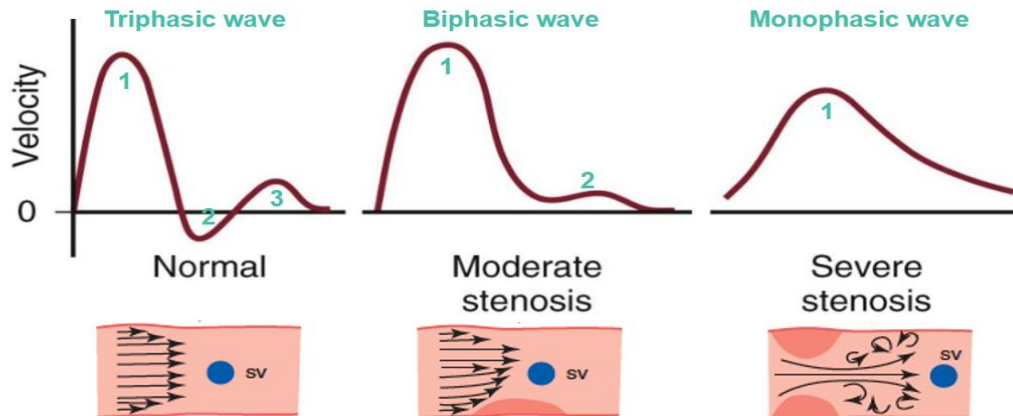
[FEEDBACK](#)

◆ Handheld Doppler: (sound only)

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.



- Normal Peripheral Arterial Doppler signal: Triphasic arterial signal.



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

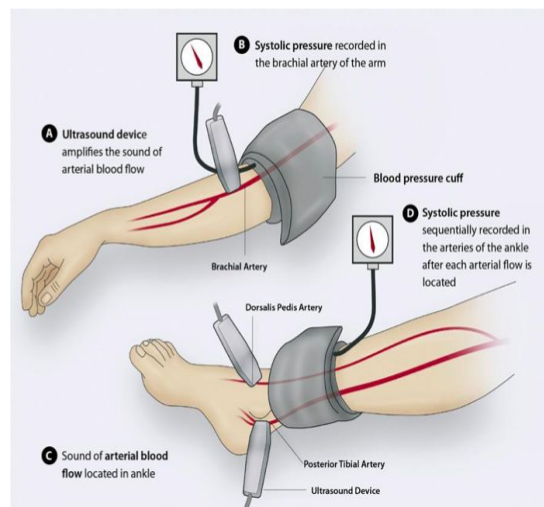
*Severe stenosis is similar to venous flow sound which is continuous with no pulsation (Veins are not pulsatile).

◆ Ankle Brachial Index (ABI): Interpretation is important

The severity of ischaemia in the leg can be simply estimated by determining the ratio between the ankle and brachial blood pressures. It 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.

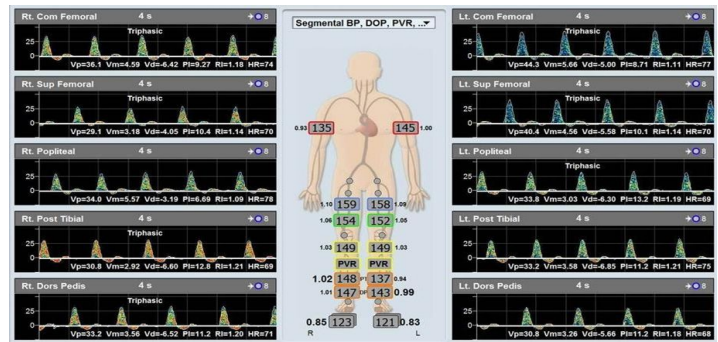
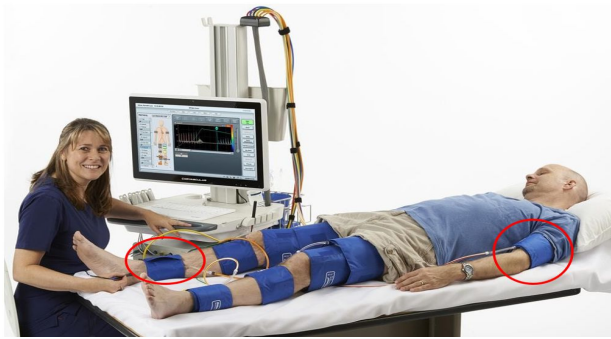
$$ABI = \frac{\text{Ankle systolic pressure (dorsalis pedis or posterior tibial artery)}}{\text{Arm systolic pressure (brachial artery)}}$$

Interpretation of ABI (accepted as normal: 0.9 – 1.30)	
> 1.30	Non-compressible: considered as a false reading, specially in patients with diabetes. Because their lower limb vessels are severely calcified so the cuff cannot close the artery to read the pressure. So we don't use ABI in these patients.
1.00 – 1.29	Normal
0.91 – 0.99	Borderline (equivocal)
0.41 – 0.90	Mild to moderate peripheral arterial disease: Chronic limb ischemia only with claudication.
0.00 – 0.40	Severe peripheral arterial disease: Chronic limb ischemia with rest pain, gangrene and tissue loss.



In healthy people, ABI should be at least 1; the pressure at the ankles should be at least as high as that in the arms. However, a difference of 10-15 mmHg is borderline and considered normal.

❖ **Segmental pressure:** Not important.



-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.

❖ **Ankle Brachial Index (ABI):** Also Segmental pressure and doppler.

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

❖ **Duplex ultrasound:** B - mode¹ + Color Doppler

Called duplex because it combines both ultrasound (B-mode) for anatomy, and doppler for physiology. It shows the anatomy of vessels, the disease and the flow velocity.

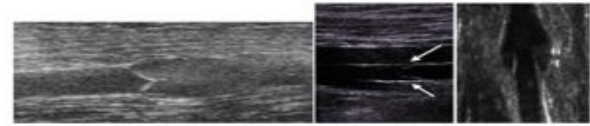
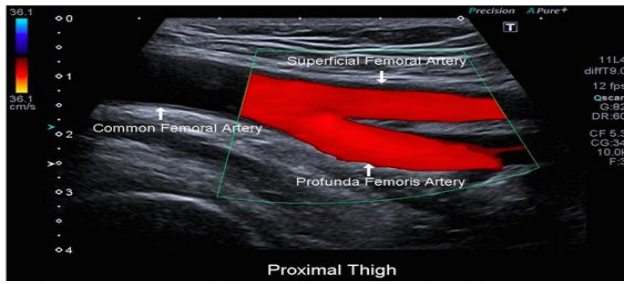
Normal velocity is up to 120, **increase** in velocity means that there is **stenosis**. And too low velocity means that there is occlusion.

When we get a duplex ultrasound image we check for 3 things:

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

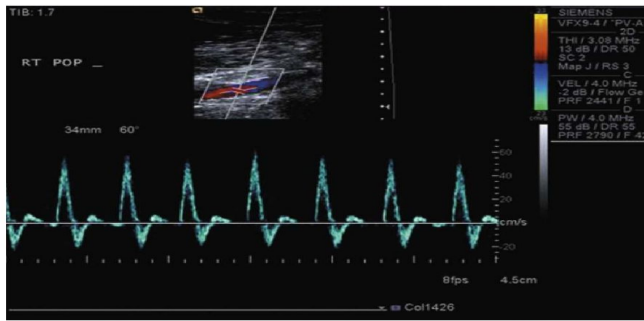
Sensitive	Operator dependent	Toxic	Therapeutic
✓✓✓ More sensitive than ABI because duplex gives you the exact site and severity of stenosis. While ABI gives you only about the nature but not the exact site or how severe it is)	✓✓✓	×	×

¹ B-mode (brightness mode) ultrasound, More commonly known as 2D mode now.

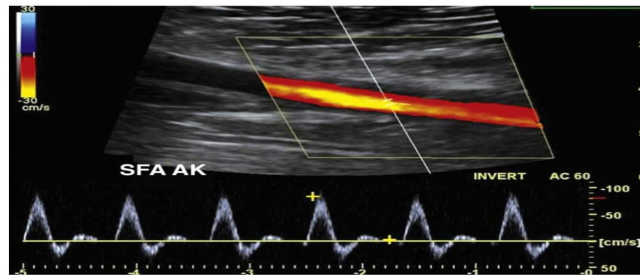
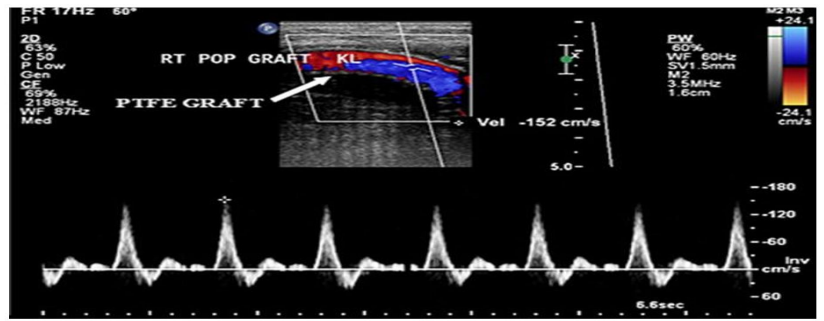


Normal anatomy of a vein how do we know it's a vein? Presence of valves

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



Triphasic wave + velocity 50 = normal flow



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

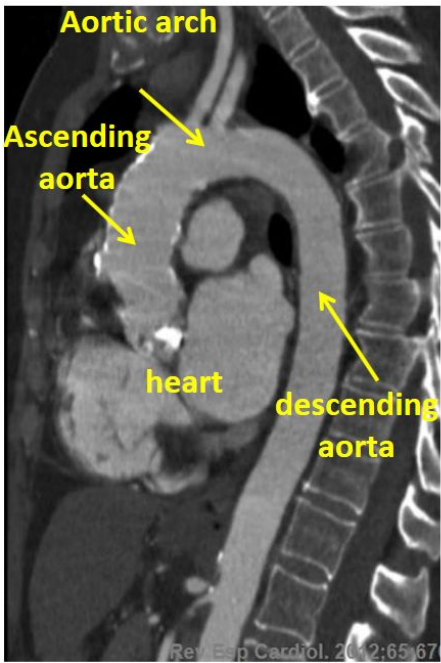
The difference between CT angiogram and CT venogram is the timing. The dye goes this way: veins > heart > arteries. Thus an early CT will show veins, and a late CT will show arteries. "

Due to the use of contrast:

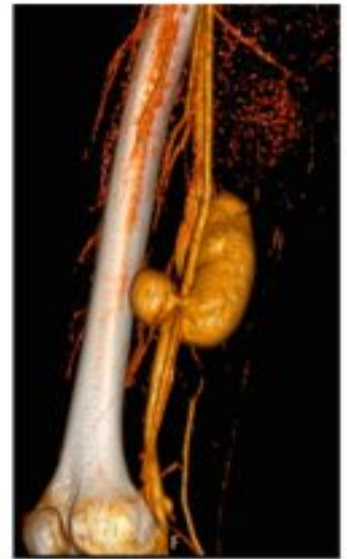
- DM pts on metformin have to stop it at least 2 days before doing a CT angiogram because it may cause lactic acidosis.
- If the patient has renal failure (on dialysis) it's okay to use contrast, because the kidney is not functioning anyway and the pt is on dialysis. But the problem is in pts with borderline 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 <u>anatomically</u> than duplex. Shows the exact location of the abnormality and the type of abnormality.</p>	<p>×</p> <p>The operator only injects the contrast.</p>	<p>✓✓✓</p> <p>-Contrast allergy (especially in patients with iodine sensitivity)</p> <p>- Renal injury (borderline creatinine must do dialysis after it)</p> <p>-Radiation²</p>	<p>×</p>

² mostly affecting gonads, thyroid, and eye (cataract)



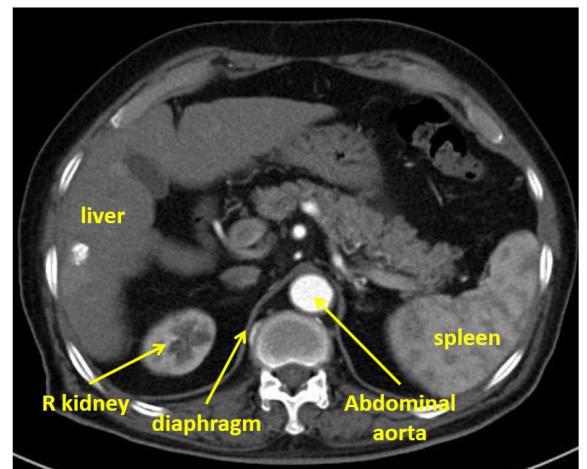
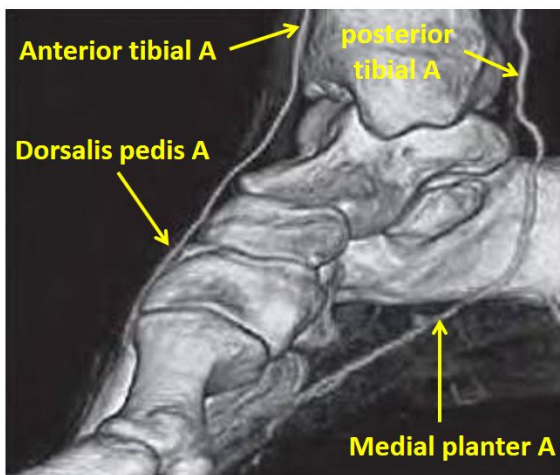
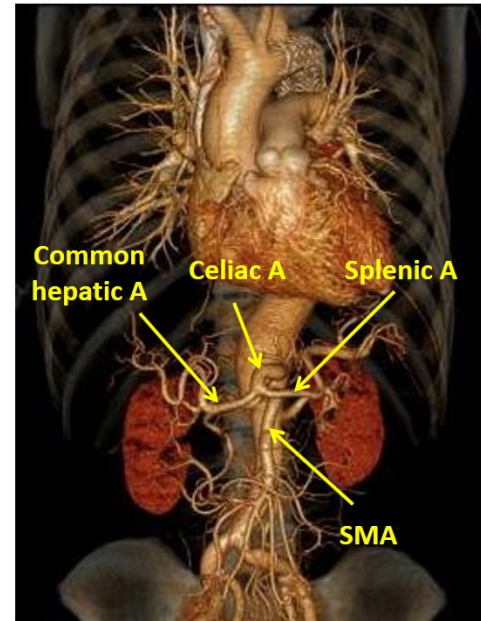
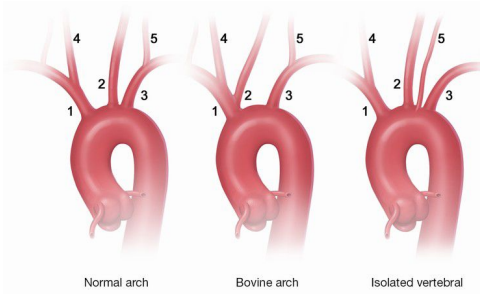
Abnormal calcification of the Aorta



Superficial femoral A aneurysm



Extra picture:

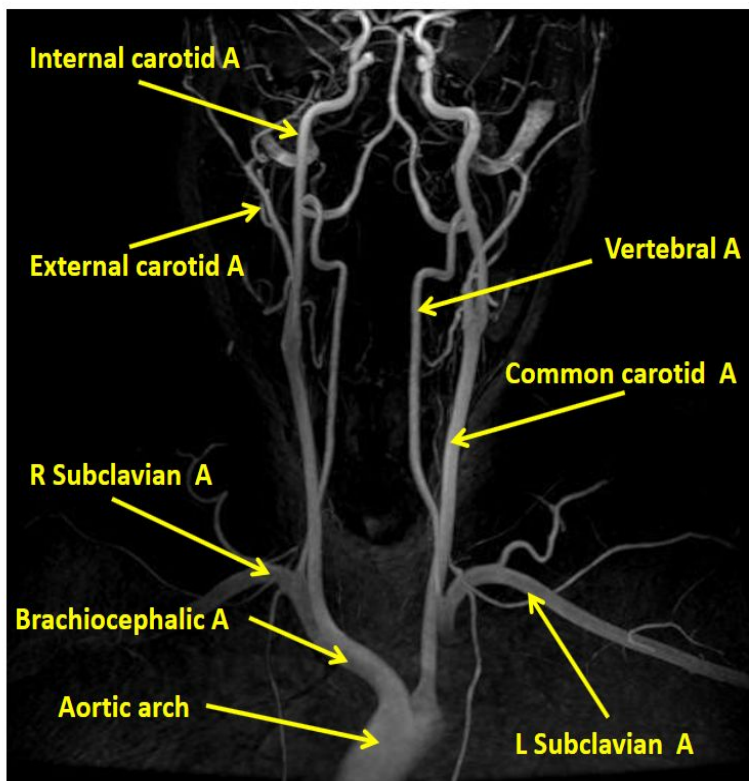


◆ MR Angiogram (Magnetic Resonance Angiogram):

MRA is so helpful in soft tissue disease, such as popliteal entrapment syndrome³. But it's expensive, not available everywhere. And it depends on the machine in terms of clarity.

Sensitive	Operator dependent	Toxic	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 pt.	×

MRA of the neck:



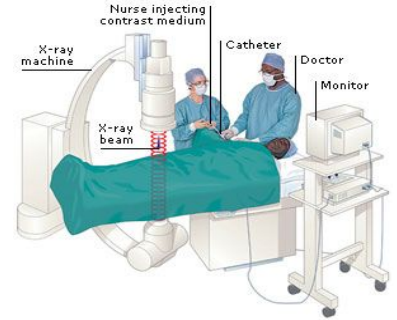
³ The popliteal artery may be compressed behind the knee, due to congenital deformity of the muscles or tendon insertions of the popliteal fossa.



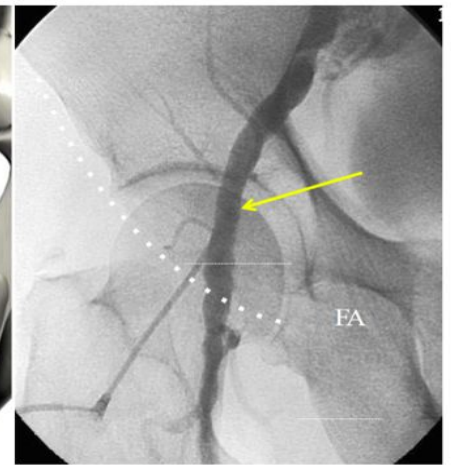
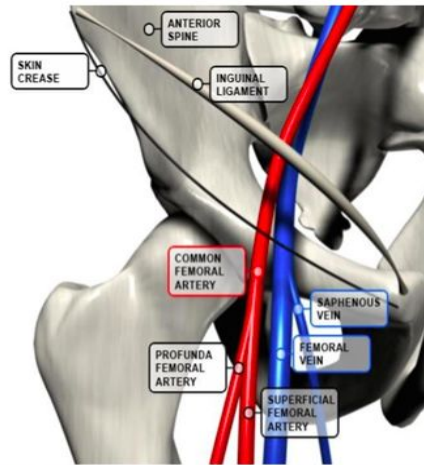
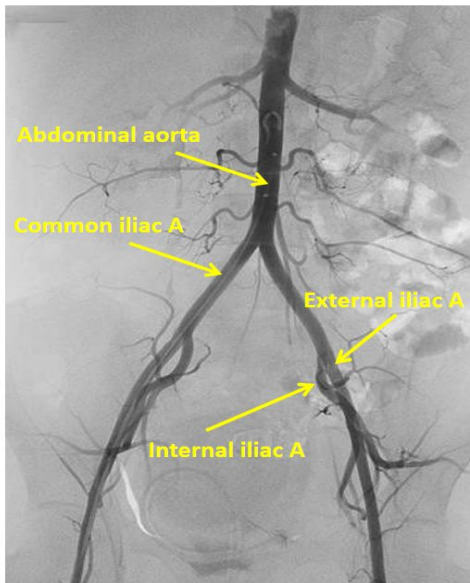
Angiography: x-ray + dye.

30 years ago, angiography was to 99% to diagnose, but nowadays it's 95% therapeutic but not used to diagnose, because there are other easier non-invasive methods.

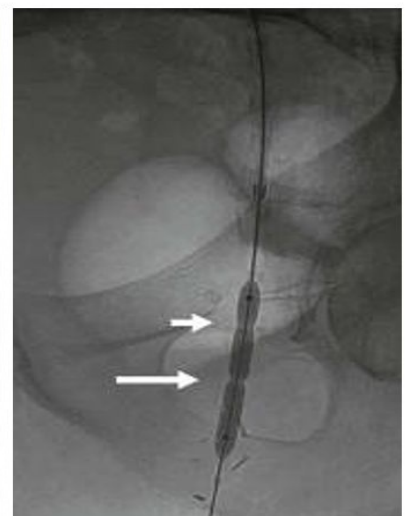
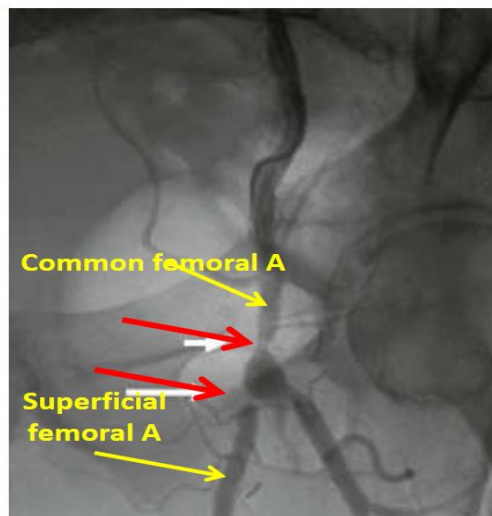
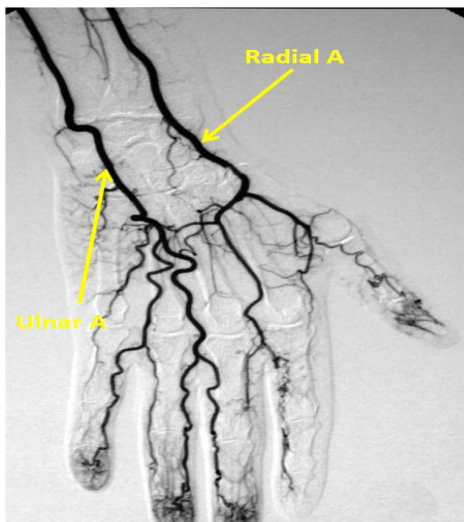
Conventional angiogram: you puncture the artery > go inside and inject the dye > take an x-ray, it's like the cardiac angiogram.



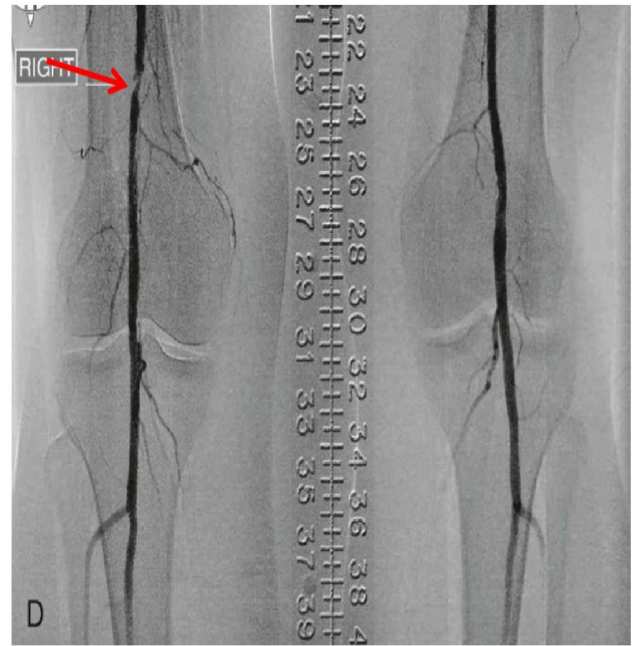
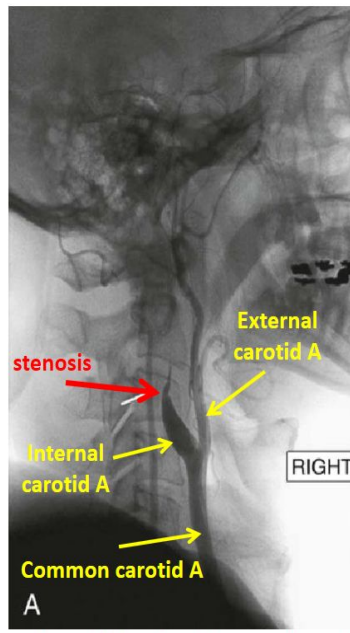
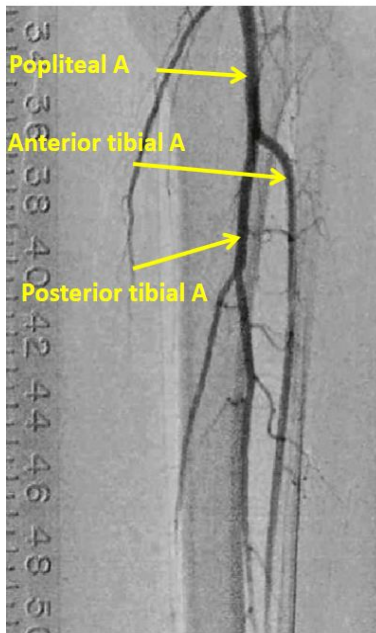
Sensitive	Operator dependent	Toxic	Therapeutic ⁴
✓✓✓✓✓	×	✓✓✓✓ -Contrast allergy and radiation. -Less contrast than CT because it's selective. -Renal failure. -Access/puncture complications like bleeding or hematoma.	✓✓✓✓ The <u>only</u> therapeutic investigation. So we can balloon or stent to treat the underlying pathology.



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.



⁴ Stenosis: angioplasty + stent
 Aneurysm: endovascular repair (instead of open surgery)



Before and after treatment of stenosis.

*IMPORTANT CLINICAL NOTE: It's important to know the land mark of the common femoral artery (which is the femoral head) to not puncture the external iliac (بيصير يلعب كذا بالأيومين وينزف), superior femoral and deep femoral arteries; because we cannot introduce strong pressure on these arteries as they are not very close to the bones. If they're punctured, this will lead to hematoma and bleeding after the removal of the sheath.

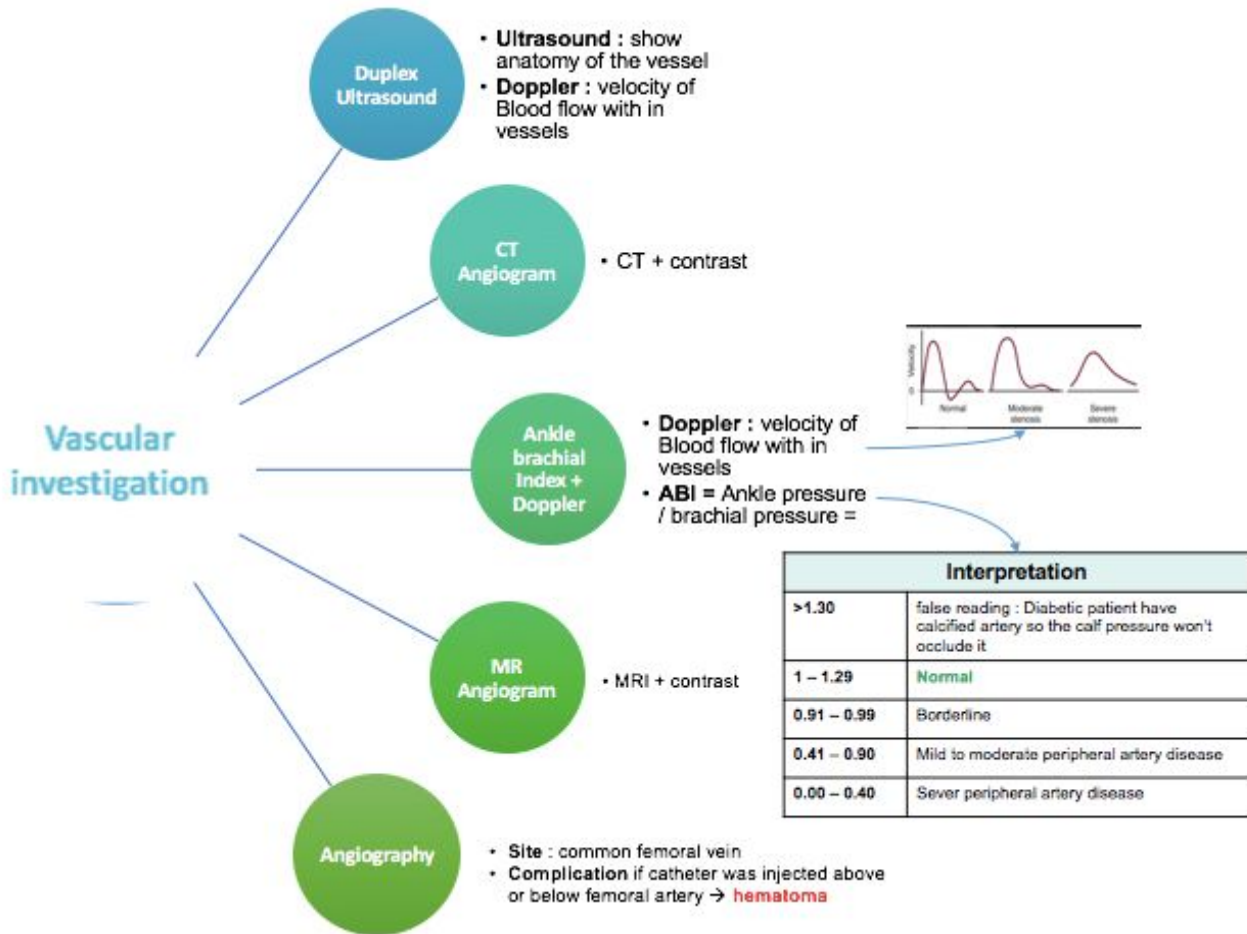
Another way to spot the site of common femoral artery:

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

*The test of choice depends on the abnormality.

Summary of the modalities: Special thanks to 435 team!

Modality	Sensitive	Operator dependent	Toxic	Therapeutic
Handheld doppler	✓	✓✓✓	✗	✗
Duplex ultrasound	✓✓✓	✓✓✓	✗	✗
CT Angiogram	✓✓✓✓✓	✗	✓✓✓	✗
MR Angiogram	✓✓✓✓	✗	✓✓✓	✗
Angiography	✓✓✓✓✓	✗	✓✓✓	✓✓✓ The only therapeutic investigation





Questions

Q1: A 65 year old patient presented to the clinic with resting calf pain, upon physical examination you noticed that he has an ulcer and tissue loss in his foot. What do you expect his ABI to be?

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

Ans: B

Q2: For the same patient in Q1, you performed a Duplex ultrasound and it revealed a flow with a speed of 300. What is most likely the abnormality?

- A. Common femoral artery stenosis.
- B. Thrombus occluding the flow to the lower limb.
- C. Aneurysm.
- D. Normal finding.

Ans: A

Q3: A 91 year old patient presented with acute limb ischemia, you wish to confirm the diagnosis and treat the condition, which investigation of the following would be best to perform?

- A. Angiography.
- B. CT angiogram.
- C. MR angiogram.
- D. Duplex US.

Ans: A

Q4: You were asked to perform an angiography, where exactly would you puncture?

- A. Superficial femoral.
- B. Common iliac.
- C. Common femoral.
- D. None of the above.

Ans: C

Q5: Which of the following is most sensitive:

- A. CT angiogram.
- B. ABI.
- C. Doppler.
- D. Duplex US.

Ans: A

Best of luck!