

Venous Diseases

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Color Index:

● Important

● Doctor's Notes

● Extra

● Davidson's

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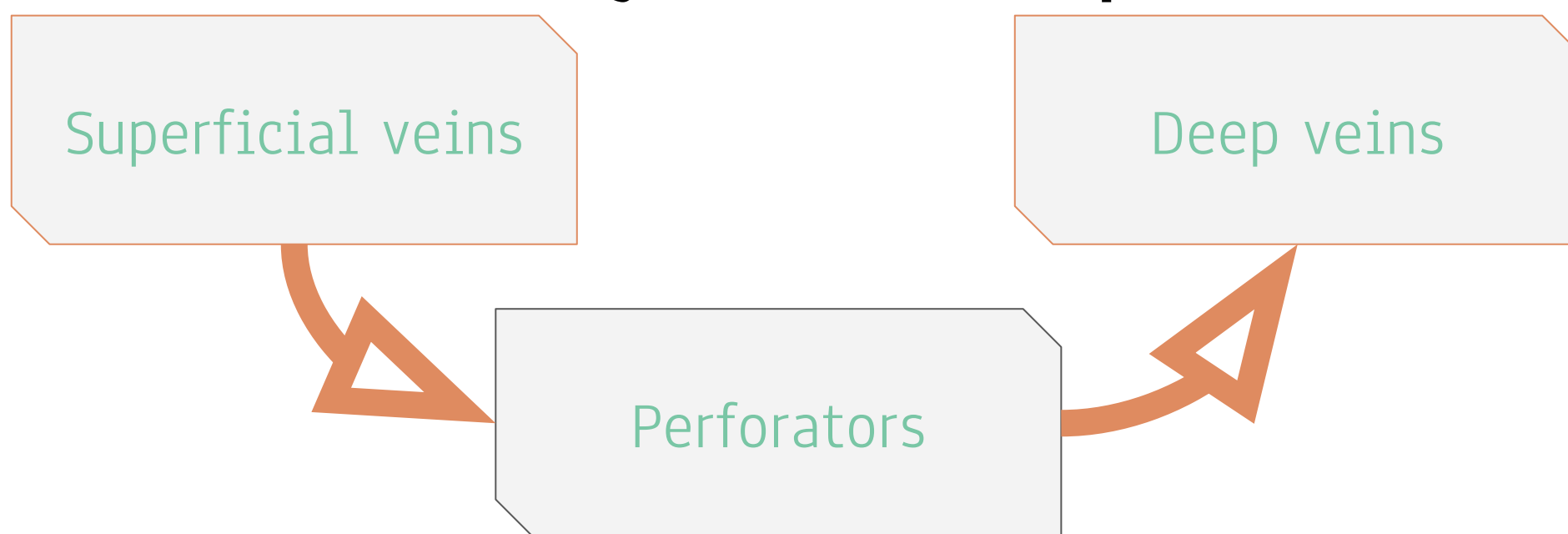


Anatomy of Venous System

Introduction:

- The vascular system is made up of arterial and venous systems (in this lecture our focus is on venous).
- In this lecture we will be discussing chronic, not acute, disorders.
- We have to keep in mind that in the venous system the blood flows from down to up and out to in (From superficial vein to deep vein).
 - The biggest challenge to the venous system is overcoming gravity to deliver the blood, especially in the lower limb.

Lower Limb Venous System is composed of :

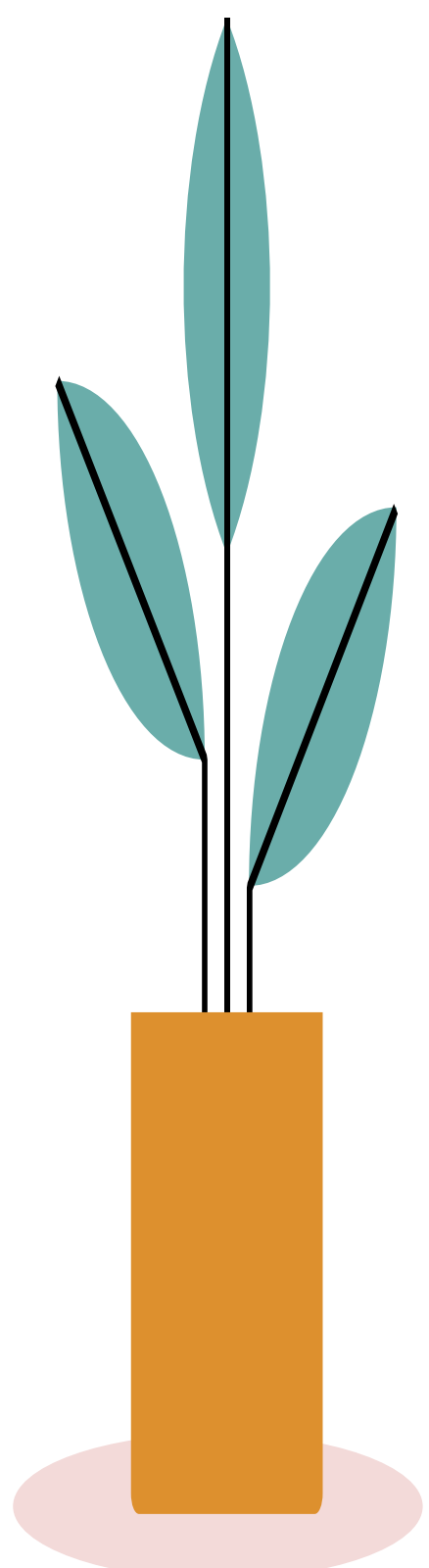
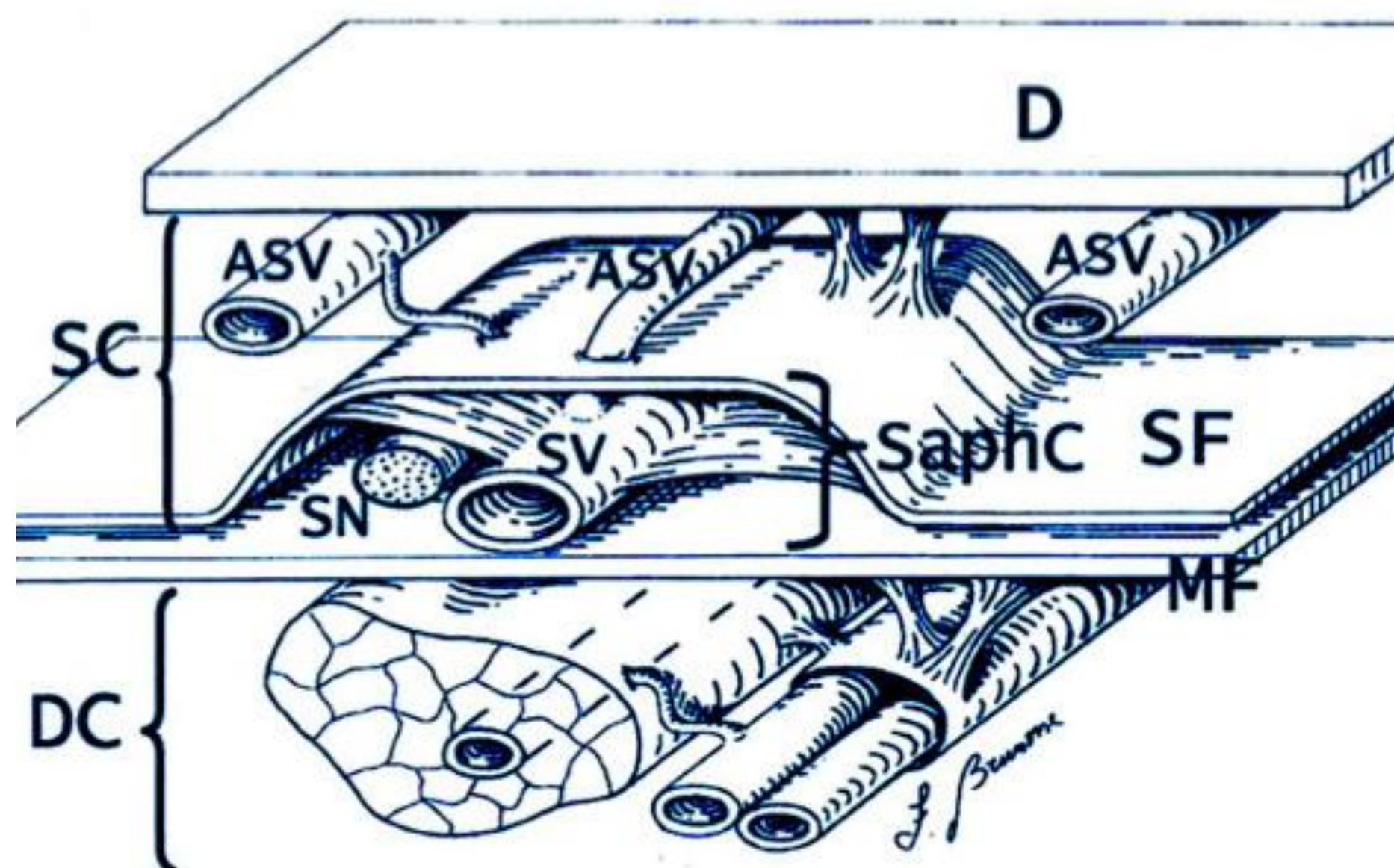
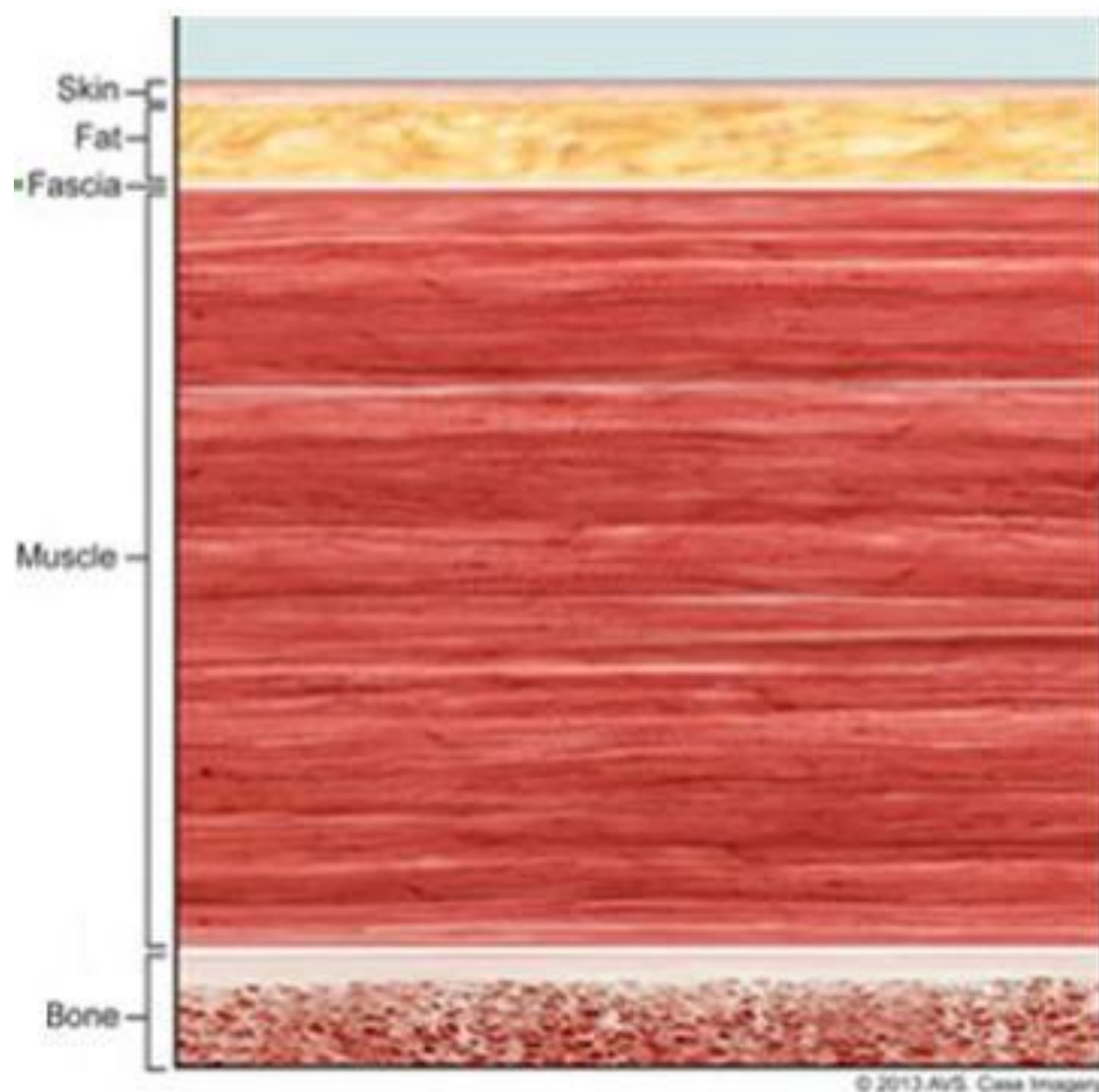


*The different layers of the lower limb are:

1. Skin, 2. Fat 3., Fascia 4. Muscle, 5. Bone.

-Veins above or outside the fascia are called superficial veins.

-Veins inside or below the fascia are called deep veins.



Anatomy of Venous System

1- Superficial veins:

- They lie just beneath the skin, and they have valves that make the blood go upward.
- Like great (long) saphenous vein (GSV) and lesser (short) saphenous vein (LSV).
- The saphenous veins and their tributaries lie outside the deep fascia and in healthy individuals carry about 10% of the venous return from the limb.

GSV	LSV
<ul style="list-style-type: none"> • originates from the medial end of the dorsal arch • then it goes in front of the medial malleolus to ascends to the medial thigh • then it joins the common femoral vein at the Saphenofemoral junction (SFJ) in the groin. 	<ul style="list-style-type: none"> • originates from the lateral end of the dorsal arch • then it passes posteriorly to the lateral malleolus to ascend to the back of the leg • then it joins the popliteal vein at the Sapheno-popliteal junction then the popliteal vein will continue as femoral vein.

2- Deep veins:

- They lie deeply within the muscles and they also accompany arteries (usually have the same names example: popliteal vein, femoral vein). Their valvular system allows the blood to travel upward.

3- Perforators:

- They connect the superficial and deep veins together. Their valvular system allows the blood to move inward. The flow is normally from the **superficial to the deep** veins.
- Perforators veins are also called mid-thigh perforators and calf perforator (**because of their location**)

The veins contain valves which allow the blood to flow in only one direction in 2 movements: down to up (i.e upward) and out to in (i.e inward)!
 What are valves? Single layer leaflets of endothelial cells that contain one way valves that prevent blood from flowing backwards. "Folds within the vein"

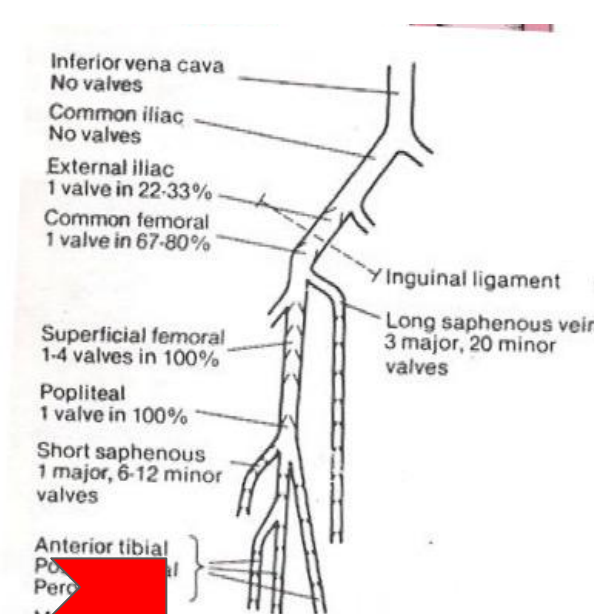
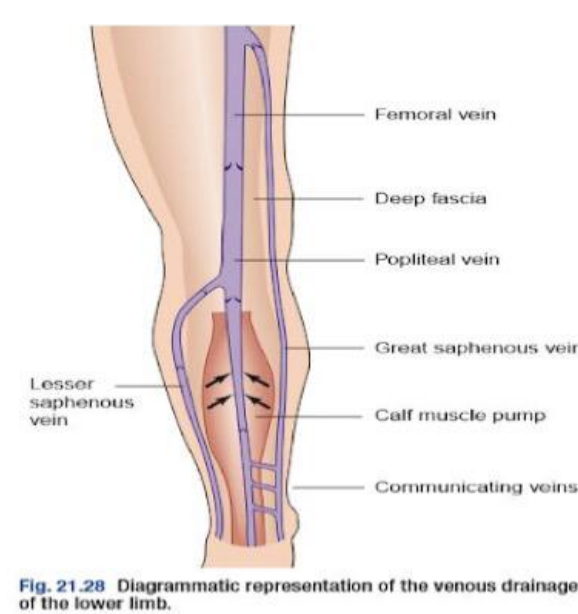
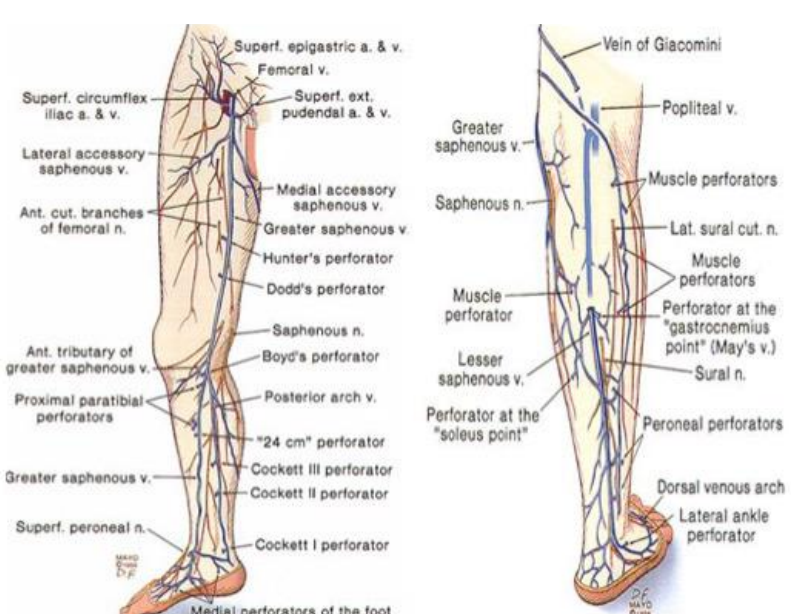
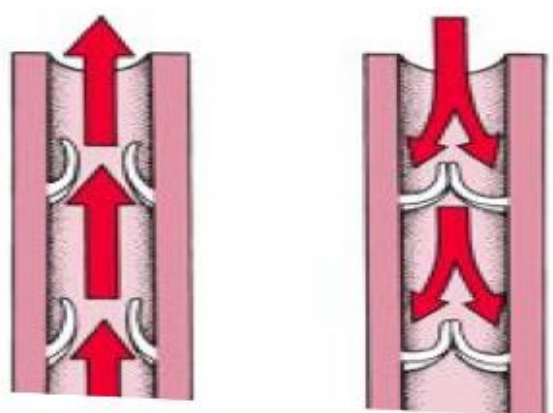


Fig. 21.28 Diagrammatic representation of the venous drainage of the lower limb.



Physiology of Venous System

Pressure acting on blood vessels: (for your understanding)

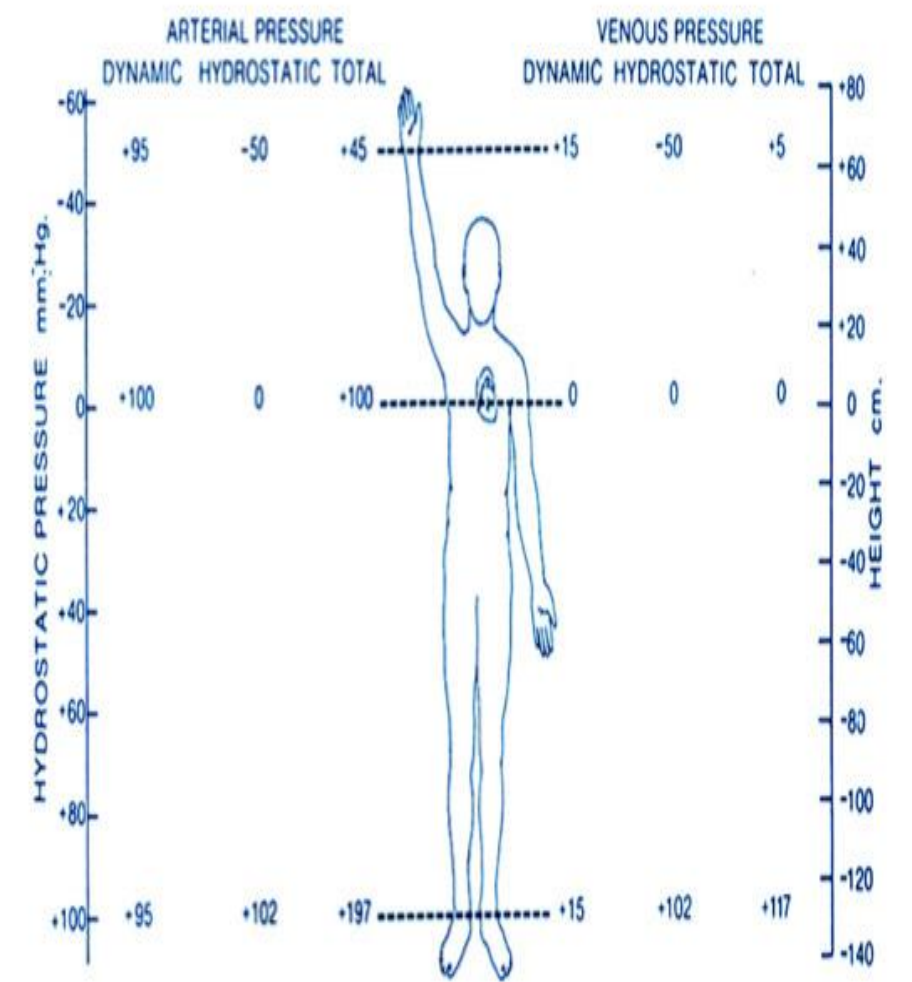
Any tube column containing fluid has pressures acting on it:

1- Hydrostatic “atmospheric” pressure (from the blood/fluid itself) and the pressure becomes higher the further we go down due to gravity:

- It equals zero at the level of the heart (because the veins empty there immediately), and is negative above it (that's why it's rare to see venous insufficiency disease in the upper limb) and positive below it (due to gravitational weight of the blood).
- The pressure in the artery = vein (both contain blood).

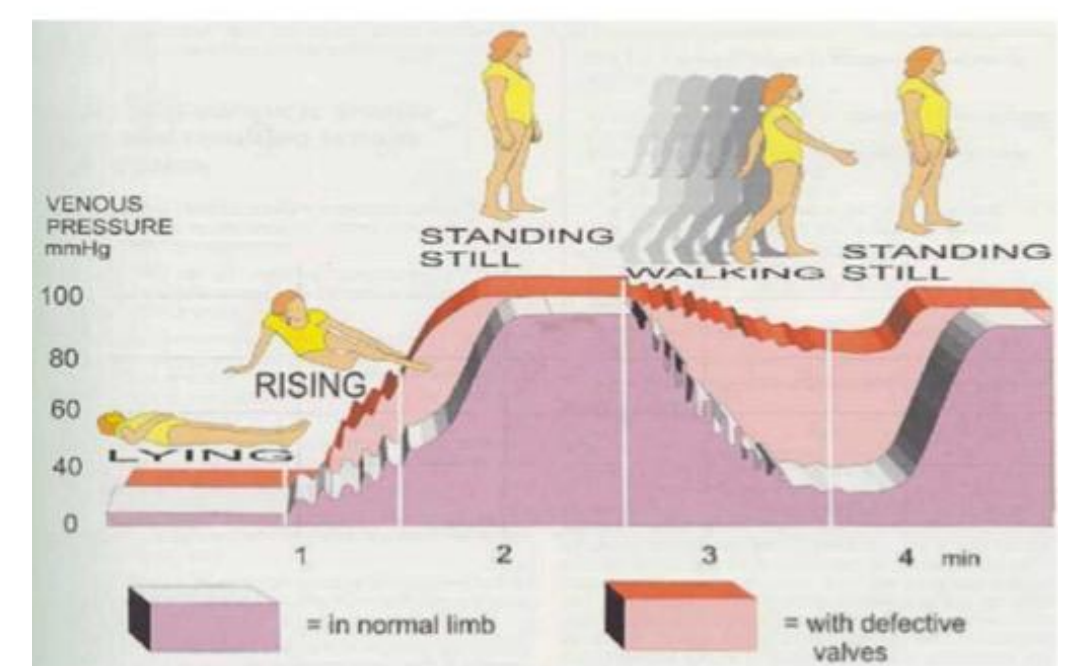
2- The dynamic pressure “whatever brings the fluid inside the tube” (example: osmotic or oncotic pressure)

- In arteries, this pressure is from the heart and it is usually around 95.
- This pressure in the veins of LL is around 100, so the total venous pressure in the lower limb is almost more than 120 (it is such a challenge to bring up that we need “another heart”)

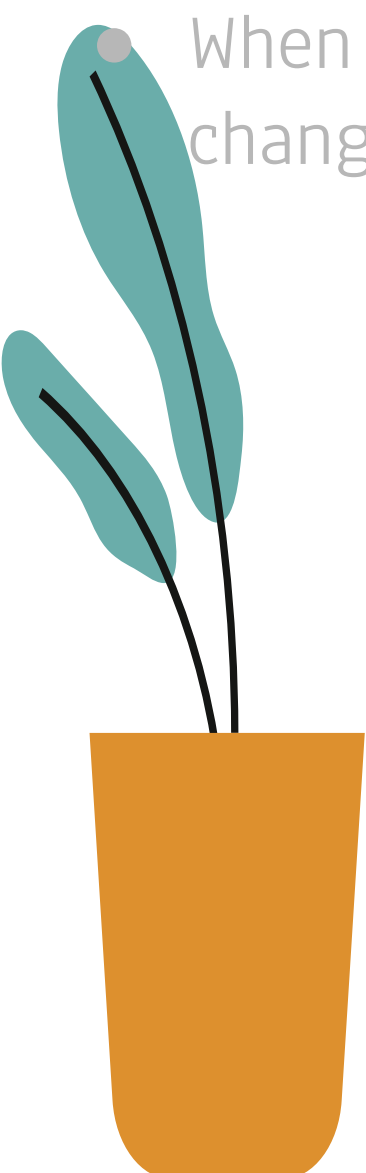


Ambulatory Venous Pressure (AVP)

- Ambulate = to walk
- It is the minimal pressure in foot veins when walking due to the mechanisms of venous return
- In supine position → AVP is around 10 mmHg
- Standing still → AVP rises to 90 mmHg
- Upon walking, it falls to 25 mmHg (7 steps = max effect)
- The purple graph depicts the normal rise and fall of venous pressure according to body positioning and gravitational effect.



- When there is pathology or hypertension in the veins these numbers will change (will be discussed later)



Physiology of Venous System



Pressure acting on blood vessels:

- How does the blood travel through the body? Arteries have more smooth muscles that can pump the blood, but the veins do not have enough smooth muscles and they rely on other mechanisms:

1- Respiratory pump (in brief breathing sucks the blood up):

- Pressure changes induced in thoracic cavity by breathing sucks blood upward toward the heart.
- When we inhale, the pressure becomes negative in the thorax and (يشغل) abdomen the in positive so the blood will go from the abdomen to thorax.
- When we exhale, the abdominal pressure decreases and it receives blood from lower limbs.

2- Leg (Calf) muscle pump:

Some veins (example soleal plexus) are inside the muscle, and when the muscle contracts it pushes the blood up (it can only go up, it can't go out or down because the valves are closed).

Then when it relaxes the sponge effect occurs: after pushing the blood up the vein are empty and this space has negative pressure so it sucks blood from out to in (via the perforators) and from down to up. (so it refills)

This cooperation between valves and muscles creates "a second heart".

In summary: when walking each leg has a cycle of two phases:

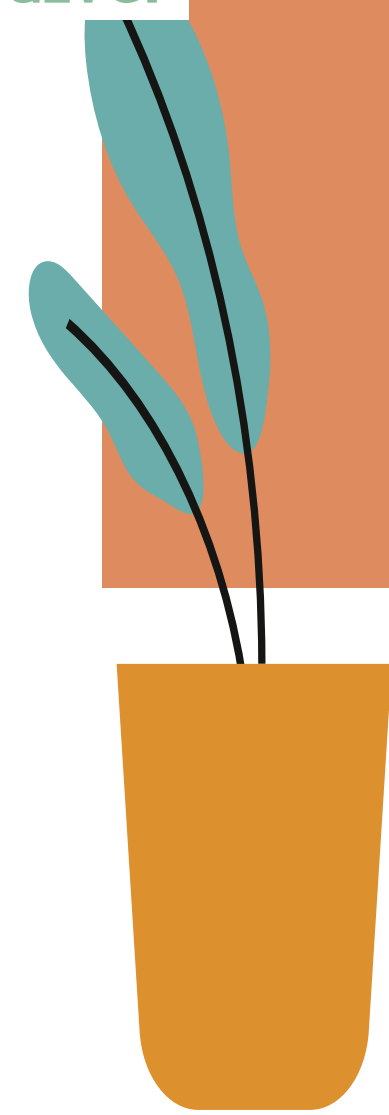
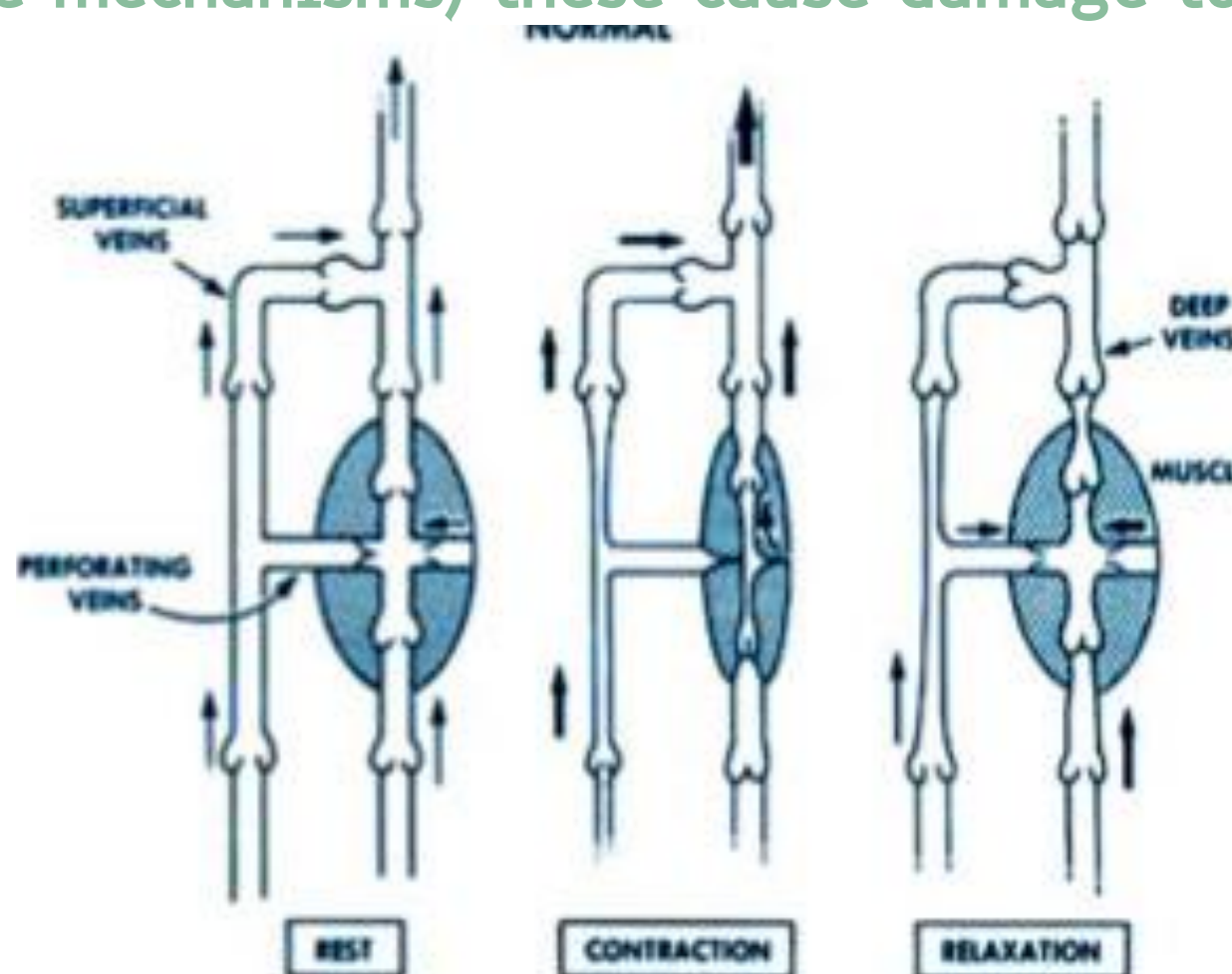
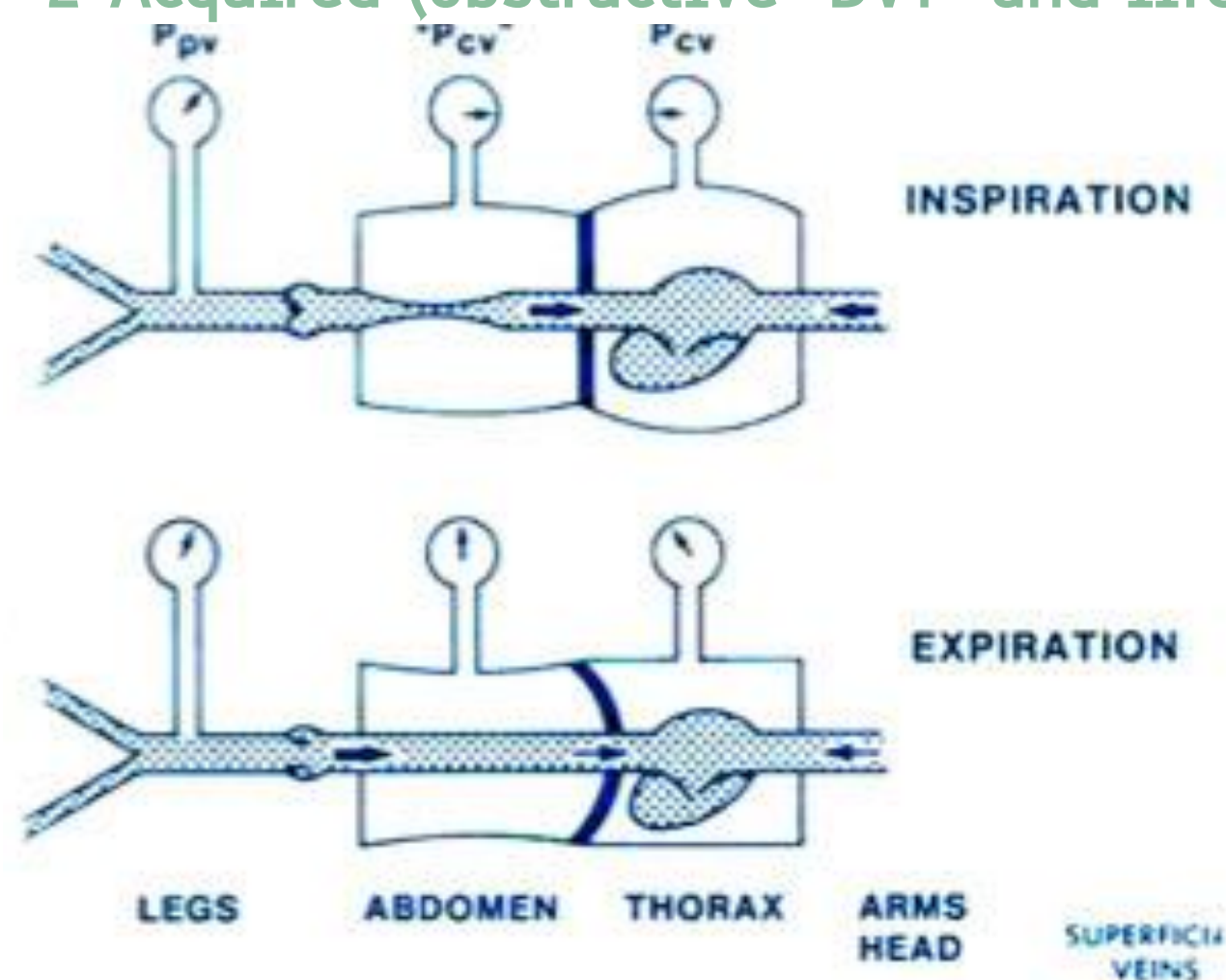
- I. Pushing off leg → **Contractions** of muscles → propels **blood up** towards heart
- II. Lifting leg → **Relaxation** of muscles → draws blood from **superficial to deep veins** during relaxation. Valves are responsible for preventing blood from going backwards.

3. The unidirectional **valves** (they do not pump the blood but they support the other mechanisms by preventing the blood from going backward)

The most failing part of the venous system is the valve and that due to many reasons, mainly:

1-Congenital (Absence of the valve)

2-Acquired (obstructive "DVT" and life style mechanisms) these cause damage to the valve."



Venous Disorders






Varicose veins

Chronic Venous Insufficiency

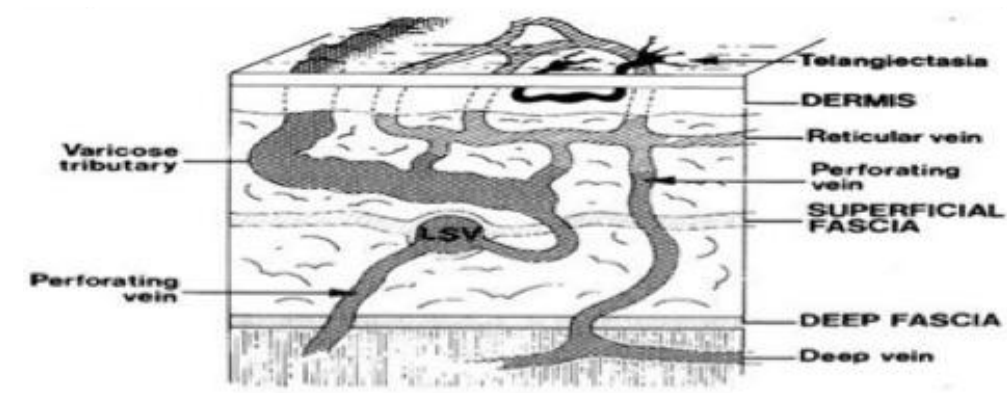
Venous Ulcer

I) Varicose Veins:-

- Most common vascular disorder and pregnancy consider as a risk factor
- A great majority of individuals with varicose veins are **asymptomatic**, and seek treatment for cosmetic purposes.
- Only a portion of patients with varicose veins go on to develop the complications of chronic venous insufficiency.
- Classification:

Varicose veins	Reticular veins	Telangiectasia
Subcutaneous dilated, palpable, elongated, tortuous veins greater than 3 mm involving saphenous veins, saphenous tributaries or non saphenous tributaries	Dilate bluish tortuous subdermal viens 1-3 mm in diameter, impalpable	Also called spider and thread veins, confluence of dilated intradermal venules less than 1 mm in diameter, impalpable
		
Extra pic	Extra pic	Extra pic

An image illustrating the layers of skin where each of the varicose veins' classifications is found.



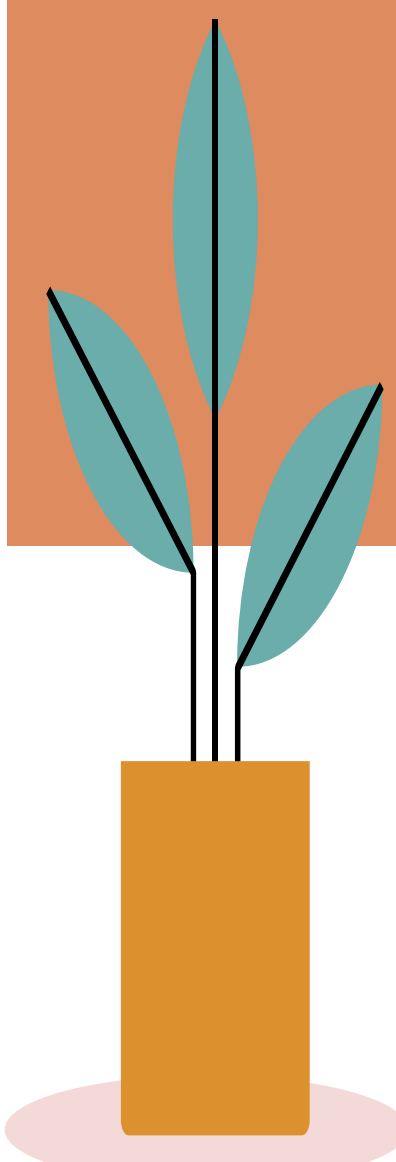
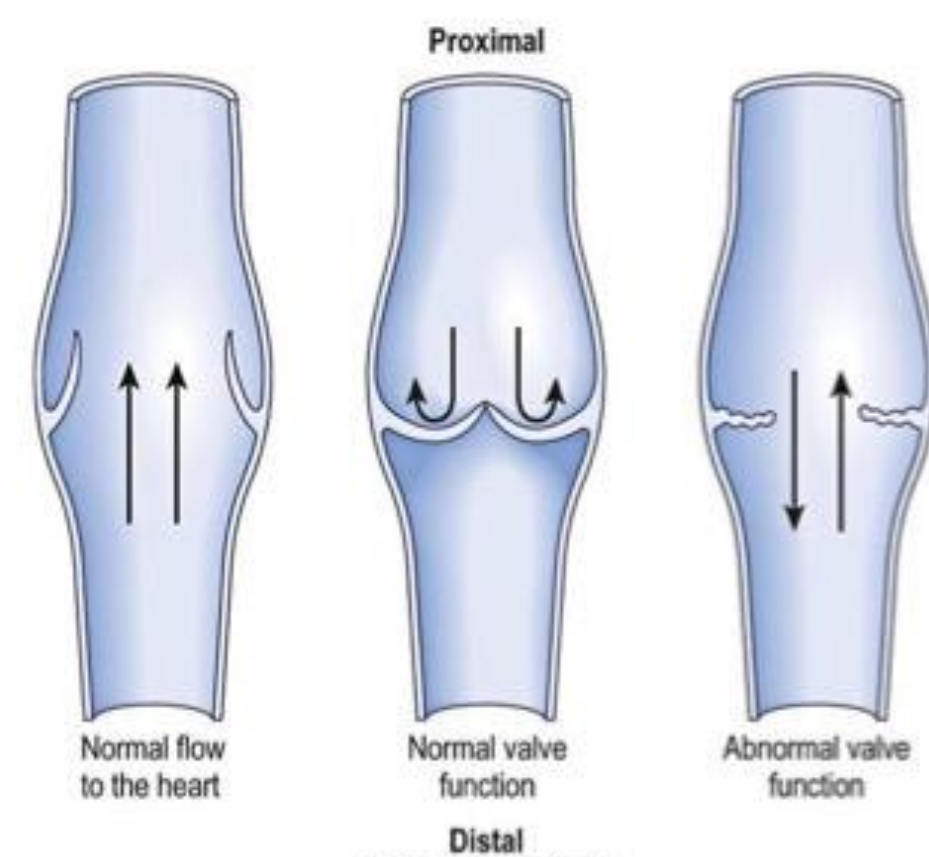
II) Chronic Venous Insufficiency:-

- The presence of **(irreversible) skin damage** (such as **eczema, lipodermatosclerosis=skin changes**) in the lower leg as a result of sustained ambulatory venous hypertension.
- It may be due to reflux 90% or an obstruction 10% and it can cause ulcer.
- CVI collectively describes the manifestations of impaired venous return mainly due to failure of valves that leads to continued reflux of blood.

● The underlying causes can classified into:

- ❑ Primary (floppy valve): valvular incompetence for unknown reason.
- ❑ Secondary: due to other factors that increase the load on veins leading to dilation of the veins (obesity, pregnancy, mass, deep vein thrombosis, obstruction)

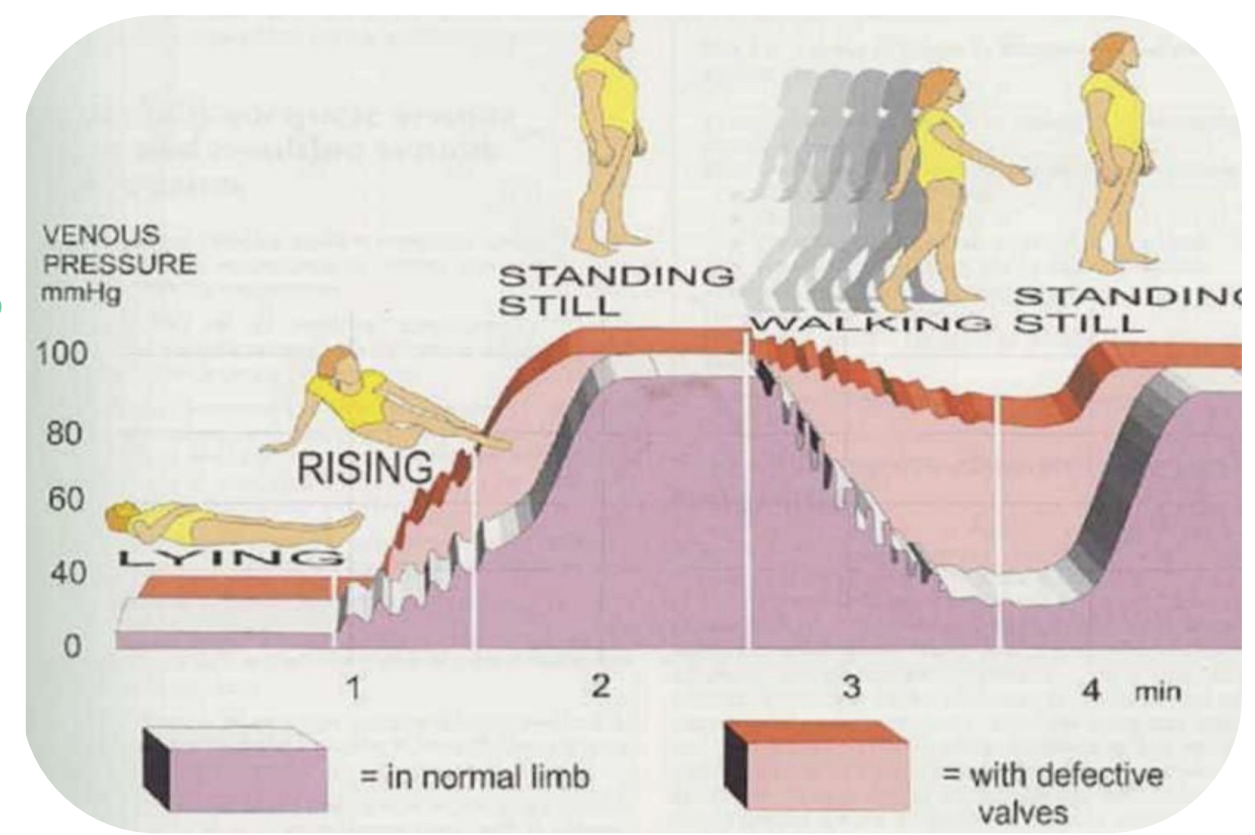
- Main defect may be in Superficial, Deep or Perforating vein:
- Increased Ambulatory Venous Pressure (ambulatory venous hypertension)



Venous Disorders

Ambulatory Venous Hypertension:

- It's caused by failure of venous return mechanisms.
- In the image, compare the venous pressure changes in normal limb and in the one with defective valves
- Normally in the supine position the venous pressure is around 0 to 10 then when we stand up it increases gradually to around 100 mmHg, then as we walk, it falls back down to roughly 20 - 40 mmHg.
- But in a defective valve, or in ambulatory venous hypertension, as we stand up there is a sharp increase in the pressure and as we walk it only slightly decreases (to about 90 mmHg).



III) Venous Ulcer:

- Why does venous ulcer happen?
- They occur primarily in the **gaiter area (above medial malleolus)**: this is the area of the highest pressure because **the greater saphenous is starting here**.
- Also this area has another problem: **the skin is directly on the bone** (no muscles) so when there is venous failure and leakage of proteins and toxins they directly affect the skin and an ulcer occurs.
- **Approximately 70% of all leg ulcers are venous in aetiology.**
- Painful ulcers near ankle, which starts as brownish pigmentation.
- There might also be: Lipodermatosclerosis, Bleeding, and Superficial thrombophlebitis.

This table is EXTRA from davidson:

Clinical features	Arterial ulcer	Venous ulcer
Gender	Men > women	Women > men
Age	Usually presents > 60 years	Typically develops at 40–60 years but patient may not present for medical attention until much older; multiple recurrences are the norm
Risk factors	Smoking, diabetes, hyperlipidaemia and hypertension	Previous DVT, thrombophilia, varicose veins
Past medical history	Most have a clear history of peripheral, coronary and cerebrovascular disease	More than 20% have a clear history of DVT; many more have a history suggestive of occult DVT, i.e. leg swelling after childbirth, hip/knee replacement or long bone fracture
Symptoms	Severe pain is present unless there is (diabetic) neuropathy; pain may be relieved by dependency	About a third have pain, but it is not usually severe and may be relieved on elevation
Site	Normal and abnormal (diabetics) pressure areas (malleoli, heel, metatarsal heads, 5th metatarsal base)	Medial (70%), lateral (20%) or both malleoli and gaiter area
Edge	Regular, 'punched-out', indolent	Irregular, with neo-epithelium (whiter than mature skin)
Base	Deep, green (sloughy) or black (necrotic) with no granulation tissue; may involve tendon, bone and joint	Pink and granulating but may be covered in yellow-green slough
Surrounding skin	Features of severe limb ischaemia	Lipodermatosclerosis, varicose eczema, atrophe, blanche
Veins	Empty, 'guttering' on elevation	Full, usually varicose
Swelling	Usually absent	Often present

(you have to know how to examine ulcers either arterial or venous the doctor said it will come in your OSCE, Cheek PAD lecture)

Evaluation

A. History

B. Physical examination (clinical evaluation):

Clinical aspect of **CEAP classification**:

- C0 - no signs of venous disease
- C1 - Telangiectasia & Spider veins (non bulging veins)
- C2 + varicose veins
- C3 + edema due to venous disease
- C4 + skin changes (called Lipodermatosclerosis)
- C5 + Healed ulcer
- C6 + Active ulcer



C. Investigations: we will talk about them briefly; they will be discussed in more detail in the next lecture.

Non Invasive

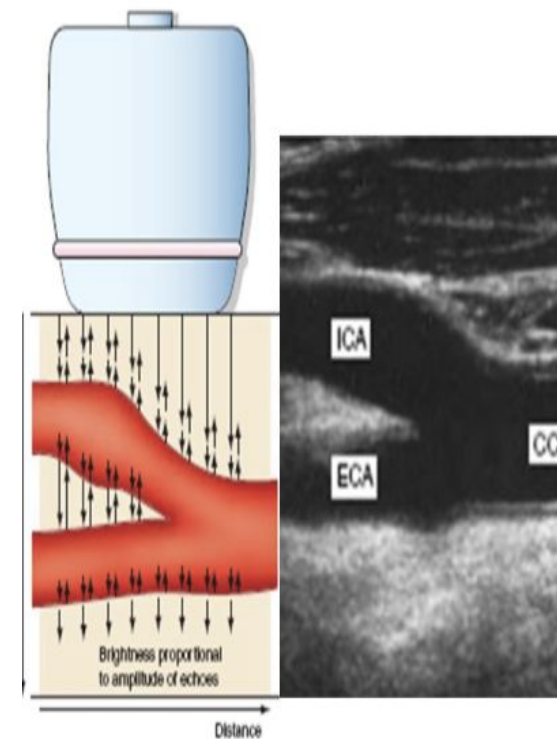
1. Doppler

- A Doppler is like a microphone, it records the sound of the blood flow
 - (sounds like bruit). It can be a component of US.
 - How does this help us? To assess if there is failure of valves.
 - How? If there is failure there will be reflux and bidirectional flow.
- Does not give anatomic information (you don't know which veins you're assessing)



2. Duplex scan

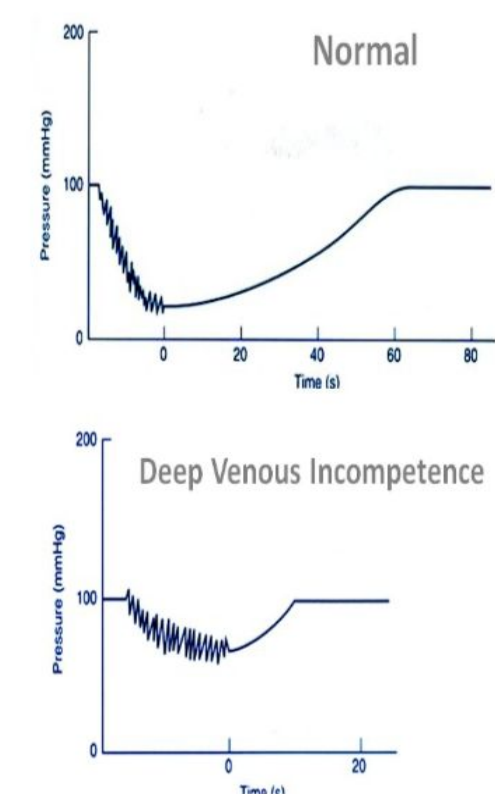
- All patients must undergo duplex US to define the nature and distribution of superficial and deep venous disease, as this has an important bearing on both treatment and prognosis.
- It comprises a high technology **B-mode ultrasound and a Doppler**.
- Duplex scan helps us assess the anatomy of the valve, direction (toward or away) and the speed of the flow.
- **The test of choice in venous diseases!**



Invasive

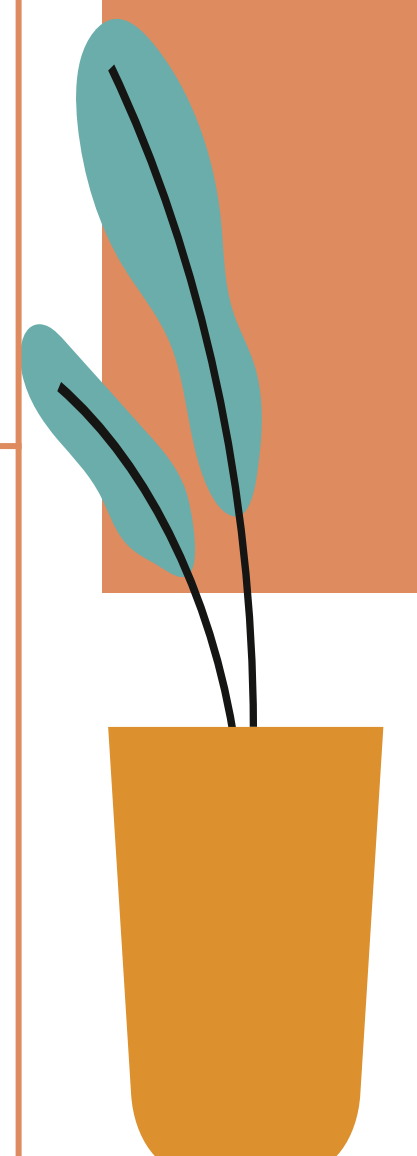
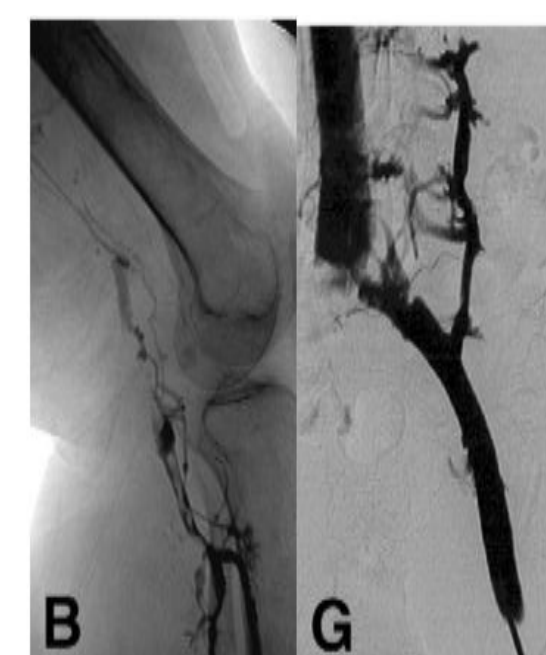
3. AVP (these were mentioned in the slides but the doctor skipped them)

- 20-21 gauge Butterfly Needle in
- Superficial Dorsal Vein (foot) or ankle vein
- Standing and heel raised and then we measure AVP
- Interpretation:
 - Normal: less than 80-90 mmHg to 20-30 mmHg or >50% drop. Venous Refill Time (VRT): $\geq 20s$
 - Abnormal:
 - I. Lack of sufficient drop in pressure with ambulation (<50%)
 - II. Short VRT (<20s)



4. Phlebography (venography) there were some images in the slides doctor focused on it [click to see it](#)

- Shows us the anatomy from inside the vein (the contrast fills inside).
- **Not used to diagnose only because it is invasive and has complications, but its used when there are therapeutic purposes.**



Treatment

- Treatment depends on what's wrong with the patient.
- If the failure is secondary, treat the underlying cause
 - **Main concept of treatment is ablation (obstruction or removal of the problematic vein) because the vein isn't working & may fail the other veins.**
- A contraindication of ablation is DVT
- We have 4 types/methods:
 1. **Physical** ablation → compression stocking
 2. **Chemical** ablation → sclerotherapy
 3. **Thermal** ablation → laser (EVLT)
 4. **Surgical** ablation

1- Compression stockings (physical or mechanical ablation)

- The point of the stocking is to apply external pressure and close the superficial veins to make sure that blood doesn't return to them. Or at least bring the valves closer to each other.
- Difficulties:
 - Interrupted treatment: whenever the patient takes them off their effect is lost.
 - **Compliance** (uncomfortable) &
 - Elderly patients may have difficulty in putting them on.

It is vitally important to **exclude peripheral arterial** disease before compression is applied, because if there is arterial disease and you apply pressure you will cause ischemia and eventually necrosis.

- First investigation before compressing is checking the pulse (Dorsalis pedis pulse).
- Keep in mind that there is another type of stockings used for DVT prevention called TED stocking, they are NOT the same as compression stockings (has greater graded pressure)!!



Fig. 21.33 Graded elastic compression for venous ulcer. (A) Compression from the base of the toes to the thigh tuberosity usually suffices. (B) Extensive necrosis in a patient treated with compression for a venous ulcer in the presence of significant arterial disease. Above-knee amputation was required.

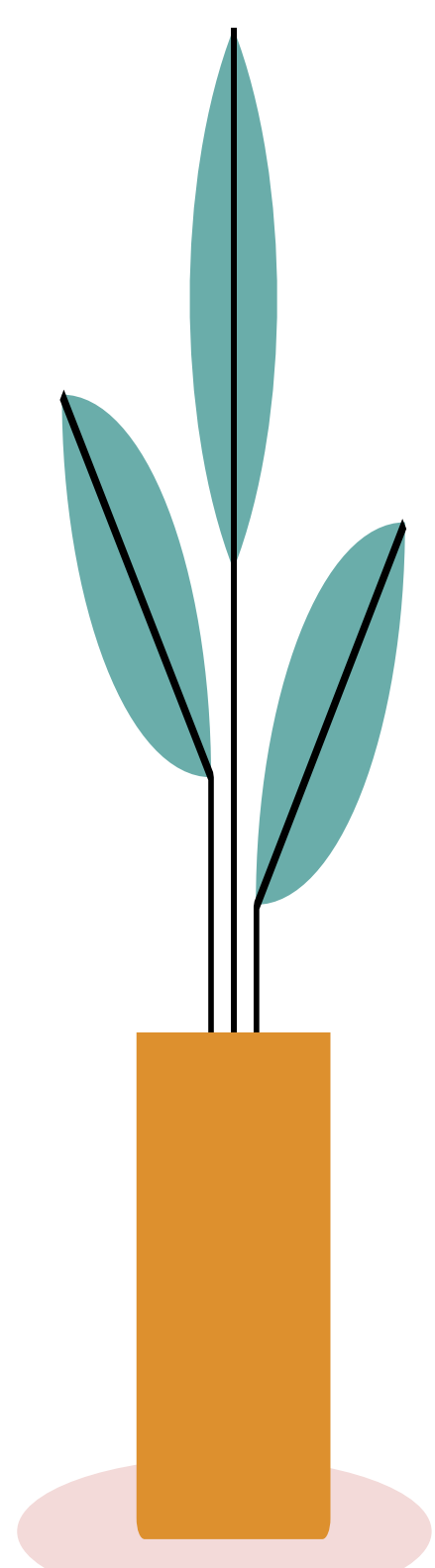
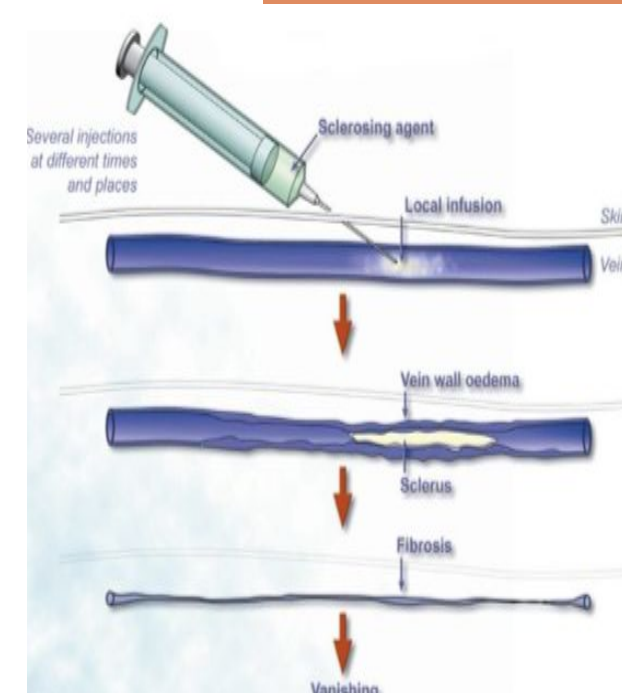
2- Sclerotherapy (chemical ablation):

- Sclerotherapy is the injection of a sclerosing (thrombosing) agent into a vein, causing an inflammatory reaction in the endothelium of the vein wall. The vein walls adhere together under compression and form a scar (fibrotic tissue) that is absorbed by the body.
- Inject → thrombosis → fibrosis → closure
- Only applicable in small superficial veins can't use it in deep (since they require large toxic doses).
- Usually used for cosmetic purposes.

The Dr skipped the table of the side effect

Solution	Pigmentation	Allergic reaction	Necrosis	Pain
Sodium morrhuate	++	++	+++*	+++
Sodium tetradecyl sulfate	++	+	+++*	+
Ethanolamine oleate	+	++	+++*	+
Polidocanol	+	+	++	0
Hypertonic saline	+	0	+++*	+++
Sclerodex (10% saline + 5% dextrose)	+	0	+	++
Chromated glycerin	0	+	0	++
Polyiodinated iodine	++	+	+++*	+++

0, Minimal; +, moderate; ++, significant.
*Concentration dependent.

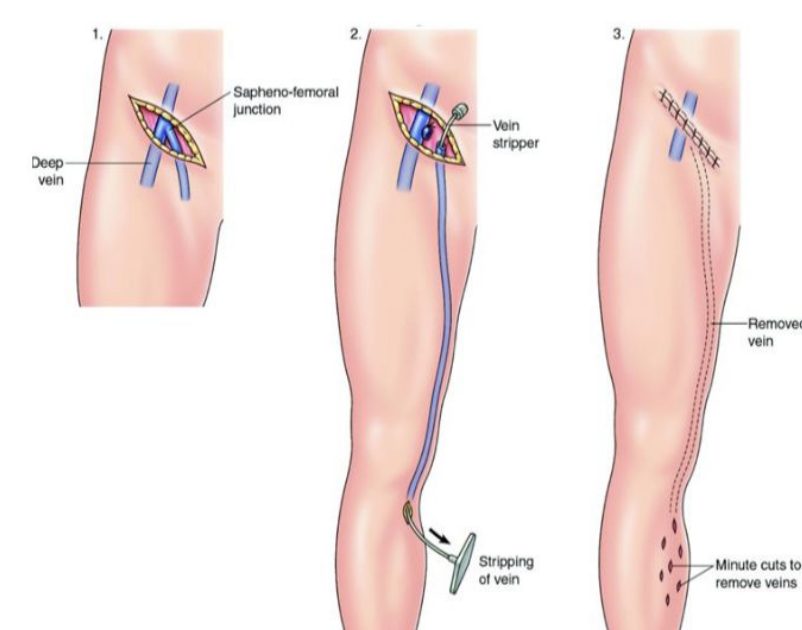
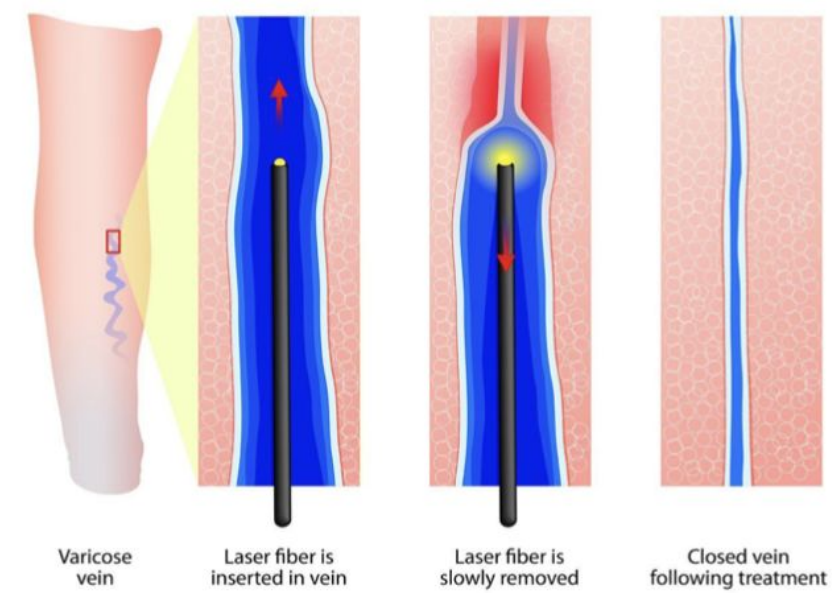


Treatment

3- EndoVenous Laser Therapy [EVLT] :

- Catheter with that can beam laser at its end that heats and destroys veins from inside which leads to thrombosis and finally fibrosis.
- Process: Denaturation of vein wall collagen → Contraction → Fibrous Obliteration
- **Treatment of choice.** (although it is the treatment of choice some people prefer conservative treatment with stockings and that's fine.)
- Before we do the procedure **we have to check that the deep system is functioning! By doing duplex US** Because if it is not functioning, and I remove the superficial system, the blood will have nowhere to go.
- **Contraindication:** deep system failure (example: DVT, mechanical failure, etc).

ENDOVENOUS LASER TREATMENT



4- surgery (surgical ablation):

- **Not used** anymore because it is invasive and very painful.

Extra but its important to know DVT for your OSCE:

Definition of DVT: Deep Venous Thrombosis—a clot forming in the pelvic or lower extremity veins.

Signs and symptoms: Lower extremity pain, swelling, tenderness, Homan's sign, PE
Up to 50% can be asymptomatic!

Diagnosis: duplex ultrasound.

Homan's sign?

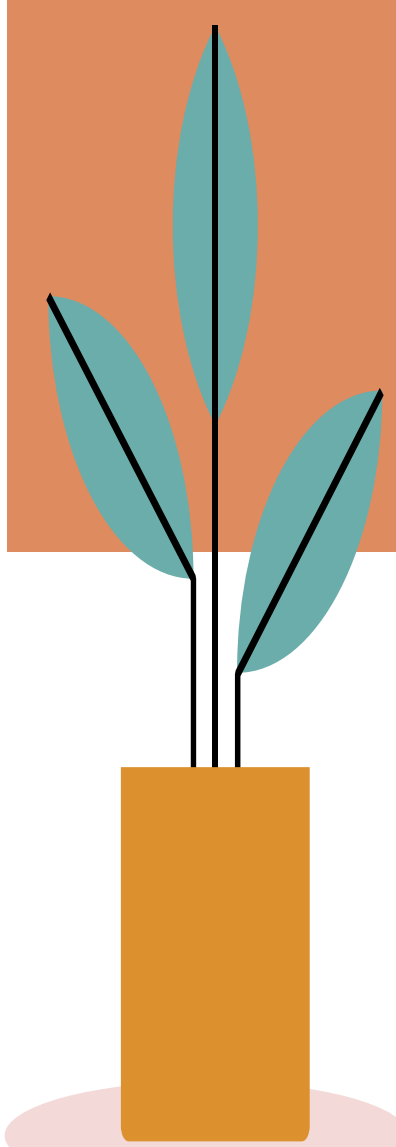
Calf pain with dorsiflexion of the foot classically seen with DVT,

Summary of treatment depending on condition: (doctor skipped it)

- 1- Telangiectasia and Reticular vein: Stocking and/or Sclerotherapy (Sclero-Rx)
- 2- Varicose veins:
 - a. Stocking
 - b. UltraSound Guided Sclerotherapy (USG-Sclero-Rx)
 - c. EVLT/Surgery
- 3- Edema or Cutaneous Ulcer or Local wound:
 - a. Stocking
 - b. USG-Sclero-Rx
 - c. ELVT/Surgery

REMEMBER:

- **TEST OF CHOICE IN VENOUS DISEASE IS ULTRASOUND WITH DUPLEX.**
- **IF A SCENARIO SHOWED THAT THE VALVULAR FAILURE IS SECONDARY TO SOMETHING ELSE, OUR ATTENTION GOES TO THE UNDERLYING CAUSE!**
- **CONTRAINDICTION OF EVLT IS DEEP SYSTEM FAILURE**



Venous diseases summary

Varicose veins	Varicose veins	Subcutaneous dilated, elongated, tortuous veins greater than 3mm. Involving: saphenous veins, saphenous tributaries or non saphenous tributaries.
	Reticular veins	Dilate bluish tortuous subdermal veins 1-3mm in diameter.
	telangiectasia	Confluence of dilated intradermal venules less than 1mm in diameter.
Chronic venous insufficiency (CVI)	<p>Overview:</p> <ul style="list-style-type: none"> ● Skin damage in lower limbs as a result of ambulatory venous hypertension. ● Impaired venous return mainly due to failure of valves that leads to continued reflux of blood. ● It may manifest as reflux 90% or an obstruction 10%. ● The underlying causes can be classified into: <ul style="list-style-type: none"> ○ Primary (floppy valve): valvular incompetence for unknown reason. ○ secondary: due to other factors that increase the load on veins (obesity, pregnancy, mass, deep vein thrombosis). 	<p>Evaluation:</p> <ol style="list-style-type: none"> 1. History. 2. Physical examination: <ul style="list-style-type: none"> ● C0: no signs of venous disease. ● C1: telangiectasia & spider veins. ● C2: varicose veins. ● C3: edema due to venous disease. ● C4: skin changes (called lipodermatosclerosis) ● C5: healed ulcer. ● C6: Active ulcer. 3. Investigation: <ol style="list-style-type: none"> a. Non-invasive: <ul style="list-style-type: none"> ● Doppler examination: to assess if there is bidirectional flow (reflux). Does not give anatomic information. ● Duplex scan: shows if there is movement or not + direction and speed of flow. Direct detection of vascular efflux. b. Invasive: <ul style="list-style-type: none"> ● Ambulatory venous pressure (AVP). ● phlebography.
	<p>Treatment:</p> <ol style="list-style-type: none"> 1. Sclerotherapy (chemical ablation): introducing toxins to damaged veins > thrombosis > fibrosis and closure. 2. Compression therapy (mechanical ablation): <ul style="list-style-type: none"> ● Stockings that compress on legs with high pressure. ● Hemodynamic effect: compress the superficial veins to make sure that blood doesn't go through them. 3. Endovenous laser therapy (thermal ablation): catheter with beam laser at its end that heats and destroys veins from inside which leads to: denaturation of vein wall collagen > contraction > fibrous obliteration. 4. Surgery (surgical ablation). 	

1. Which of the following occur in gaiter areas:

- A. Skin tags.
- B. Venous ulcers.
- C. Cellulitis.

2. A patient develops valvular failure due to deep vein thrombosis. What should our initial management be aimed at:

- A. Treating the valvular failure with EVLT.
- B. Treating the DVT.
- C. Prescribe analgesic and send home.

3. What is the main difference between veins(superficial and deep) and perforators:

- A. Superficial and deep veins allow blood to move upward, while perforators allow blood to move inward.
- B. Superficial and deep veins allow blood to move upward, while perforators allow blood to move upward.
- C. Superficial and deep veins allow blood to move upward, while perforators allow blood to move downward.

4. AVP (Ambulatory Venous Pressure) is raised when:

- A. Walking.
- B. Supine.
- C. Standing still.

5. When lifting your leg, calf muscles and valves relax allowing blood to draw from:

- A. Deep to superficial veins.
- B. Superficial to deep veins.
- C. Capillaries.

6. Which of the following is the most common vascular disease:

- A. Varicose vein.
- B. Venous ulcer.
- C. Arteriovenous malformation.

7. Which of the following is used in therapeutic procedures:

- A. Ambulatory venous pressure.
- B. Phlebography.
- C. Duplex scan.

8. Which of the following is contraindicated in EndoVenous Laser Therapy (EVLT):

- A. Heart failure.
- B. COPD.
- C. DVT.

9. What is the test of choice for the diagnosis of venous disease:

- A. Doppler examination.
- B. US and duplex scan.
- C. Ambulatory venous pressure.

10-The main goal of treatment is to:

- A. To remove problematic vein.
- B. To introduce a new functioning vein in the same area.
- C. To exclude secondary causes by physical examination.

- 1. B
- 2. B
- 3. A
- 4. C
- 5. B
- 6. A
- 7. B
- 8. C
- 9. B
- 10. A