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INTERNATIONAL SURGICAL  
ANATOMY TEACHING  
SERIES

A detailed anatomical illustration of a human torso, showing the ribcage, muscles, and internal organs. The illustration is rendered in a dark, textured style, possibly a woodcut or engraving, and is overlaid on a dark green background.

# ISATS HANDOUT 2024/25

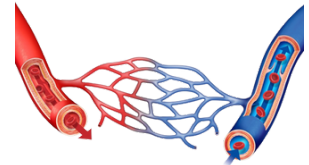
Vascular Anatomy

# VASCULAR ANATOMY

**Objectives:** Understand the path of the major arteries and veins within the body coupled with their respective branches. Apply anatomical knowledge in the context of a vascular emergency and the associated surgical treatment.

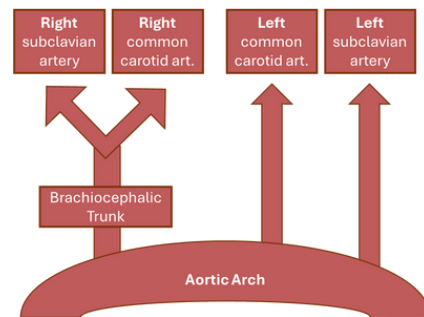
## Vessel layout

- Vascular network run from:  
**Arteries** → arterioles → capillaries → venules → **veins**
- Capillaries act to dissipate high arterial pressure into veins



## Aorta

- Outflow tract for left ventricle
- Three salient branches:
  - **Brachiocephalic** trunk, which branches into
    - Right subclavian artery
    - Right common carotid artery
  - Left **common carotid artery**
  - Left **subclavian artery**



## Vena cava

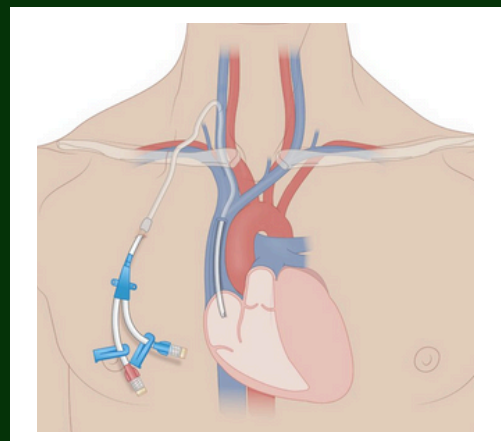
- Drains systemic venous blood into right atrium
- Two main inflows:
  - Superior vena cava
    - Tributaries are left and right **brachiocephalic** veins
  - Inferior vena cava

## Pulmonary trunk

- Transports deoxygenated blood from right ventricle to lungs.
- Bifurcates into left and right pulmonary arteries

## Tributaries of brachiocephalic veins

- Brachiocephalic veins begin with the confluence of the internal jugular vein (IJV) and subclavian veins
- IJV and subclavian vein junction known as the **venous angle**
  - **Right venous angle** facilitates drainage of right lymphatic duct
  - **Left venous angle** facilitates drainage of left thoracic duct
- Right brachiocephalic vein more vertically oriented than left counterpart



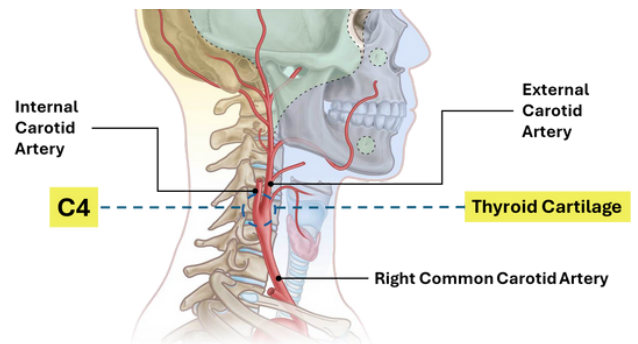
Right brachiocephalic vein's vertical orientation facilitates easier approach for *central line insertions*

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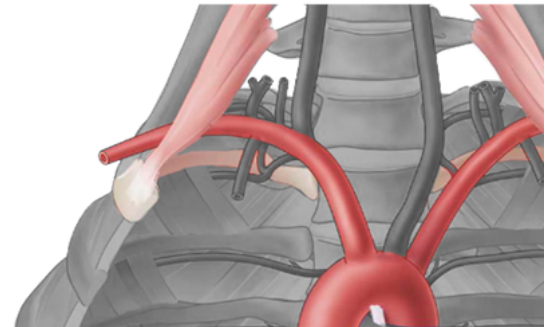
## Carotid arteries

- The common carotid artery (CCA) runs in **the carotid sheath**
- At the level of C4 (posteriorly) and laryngeal prominence (anteriorly), the CCA bifurcates into:
  - The internal carotid artery (ICA) -- continues to run inside the sheath
  - The external carotid artery (ECA) -- exits the sheath to supply the neck
- The common carotid **bifour**cates at **C4!**



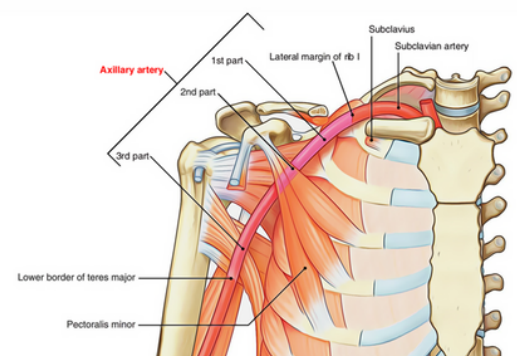
## Subclavian artery

- Split into three parts:
  - Part 1 – **Medial** to scalenus anterior
  - Part 2 – **Posterior** to scalenus anterior
  - Part 3 – **Lateral** to scalenus anterior, medial to 1st rib



## Upper limb arteries

- Axillary artery has three parts
  - Part 1 – 1st rib to pectoralis minor
    - Branch: Superior thoracic artery
  - Part 2 – Posterior to pectoralis minor
    - Branch: Thoracoacromial + Lateral thoracic artery
  - Part 3 – Pectoralis minor to teres major
    - Branch: Humeral circumflex artery (Anterior + Posterior) & subscapular artery



**Subclavian artery → Axillary artery → Brachial artery**

## Carotid endarterectomy

- Atheromatous plaque build-up in carotid arteries, specifically ICA, can lead to transient ischaemic attacks and cause 20% of strokes.
- Mechanical removal of carotid artery plaques is known as carotid endarterectomy.
- Associated with lower periprocedural stroke rate in patients > 70 years of age compared to carotid artery stenting

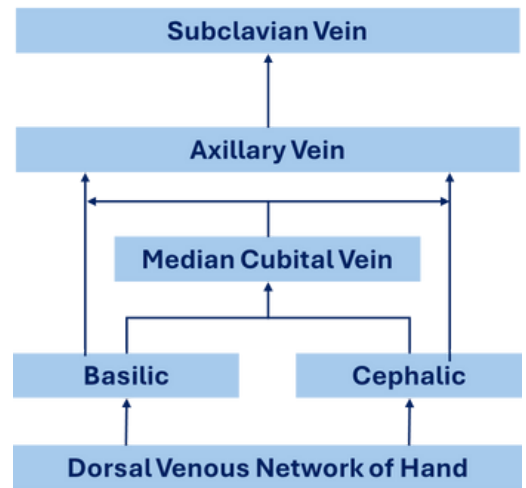
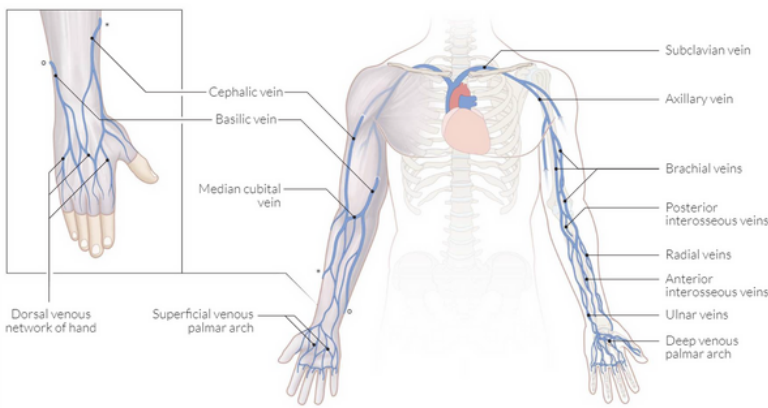


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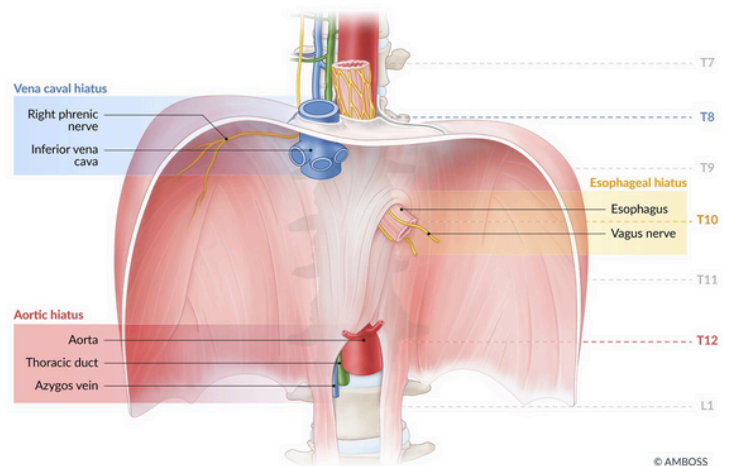
## Upper limb veins

- Median cubital vein common site for venesection



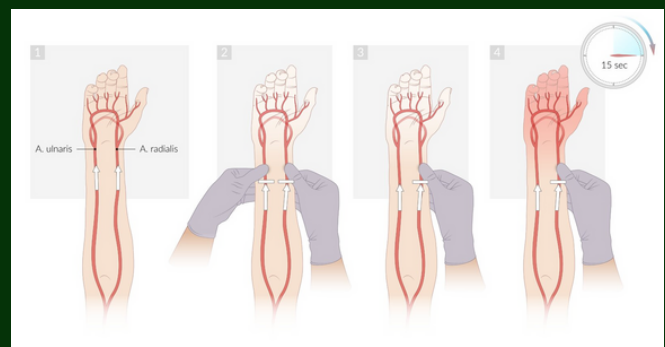
## Abdominal vessels

Mnemonic	Structure	Level
I Ate	Inferior Vena Cava	T8
Ten Oranges	Oesophagus	T10
At Twelve	Aorta	T12



## Allen's Test

- The brachial artery bifurcates to radial and ulnar arteries at the cubital fossa.
- The radial and ulnar arteries form a network of deep and superficial palmar arches, respectively.
- **Allen's test** is used to evaluate the patency of the collateral circulation to the hand through the radial and ulnar arteries.

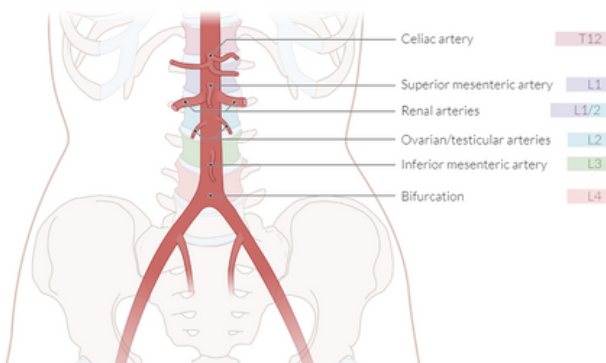


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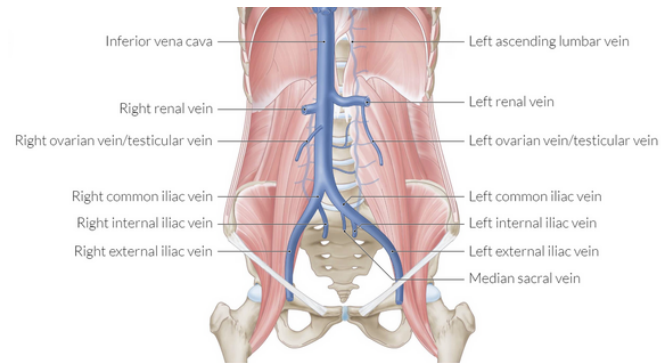
## Abdominal aorta

- Four main branches of abdominal aorta:
  - T12: **Coeliac trunk**
  - L1: **Superior mesenteric artery**
  - L3: **Inferior mesenteric artery**
  - L4: Aortic bifurcation



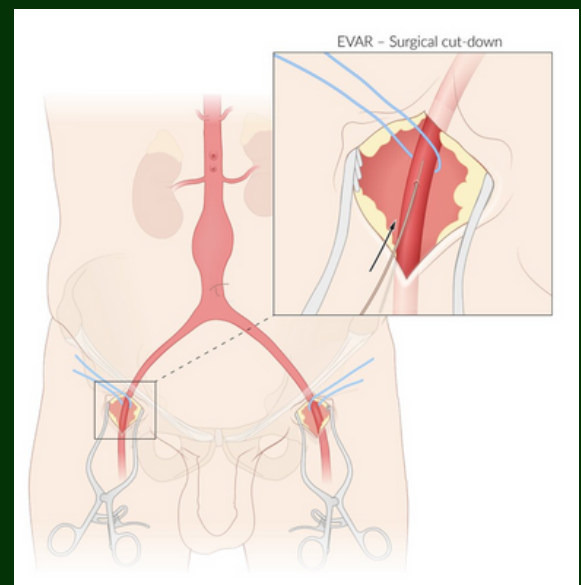
## Inferior vena cava

- Inferior vena cava has six tributaries:
  - Common **i**liac veins
  - **L**umbar veins
  - Right **r**enal vein
  - Right **s**uprarenal vein
  - **H**epatic veins (x3)



## Abdominal aortic aneurysm

- Full thickness focal dilatations of the blood vessel wall resulting in weakness in the vessel wall. This results in a risk of vessel wall rupture.
- The most common site for this to happen is **proximal to the L4 bifurcation of the aorta** (infrarenally). It can sometimes include the **common iliac arteries** and extend to the **renal arteries** above.
- The normal diameter of the aorta is **3cm**. An aneurysm in the aorta is defined as an enlargement of **1.5 times**.
- This aorta has to be monitored. If it increases in size or grows in size, it may be eligible for vascular surgical repair.
- Treatment is by **open or endovascular repair (EVAR)**



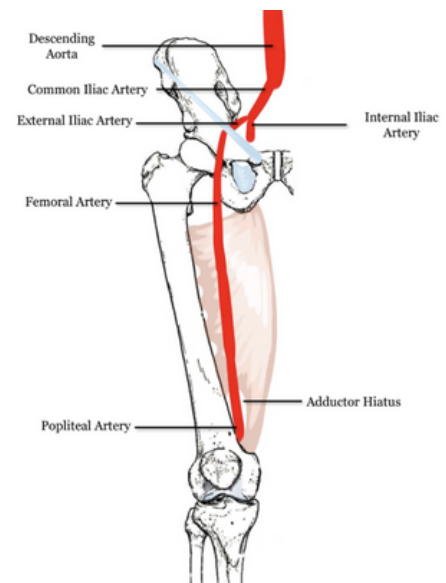
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Common iliac → (Internal &) External iliac artery → Femoral artery → popliteal artery

## Lower limb arteries

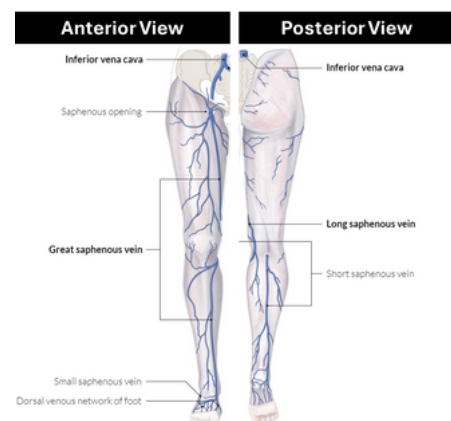
- (Under inguinal ligament) External iliac artery → femoral artery
- (Through adductor hiatus) Femoral artery → popliteal artery
- Femoral artery gives off **lateral** and **medial femoral circumflex artery**
- **Medial femoral circumflex artery** supplies 82% of femoral head (Dewar et al., 2016). Damage leads to avascular necrosis of femoral head.



Popliteal artery → anterior tibial artery + common peroneal artery + posterior tibial artery

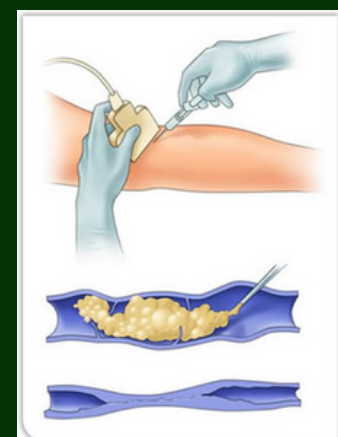
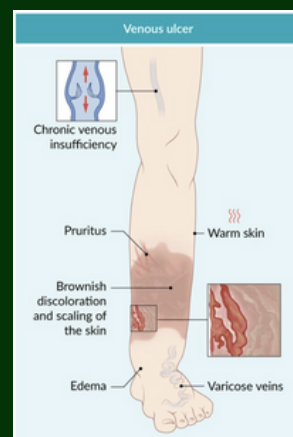
## Lower limb veins

- Dorsal venous arch drains bilaterally into:
  - **Greater saphenous vein** (Medially)
  - **Lesser saphenous vein** (Laterally)
- **Greater saphenous vein** joins femoral vein at *saphenofemoral junction*
- **Lesser saphenous vein** joins anterior and posterior tibial veins to form popliteal vein



## Chronic Venous Insufficiency

- Chronic venous insufficiency refers to the presence of dysfunctional venous valves in the superficial veins of the lower limbs
- Dysfunctional venous valves → stasis of blood → engorgement of veins → edema, stasis dermatitis, venous ulcers
- Interventional management includes **sclerotherapy** (chemical ablation).

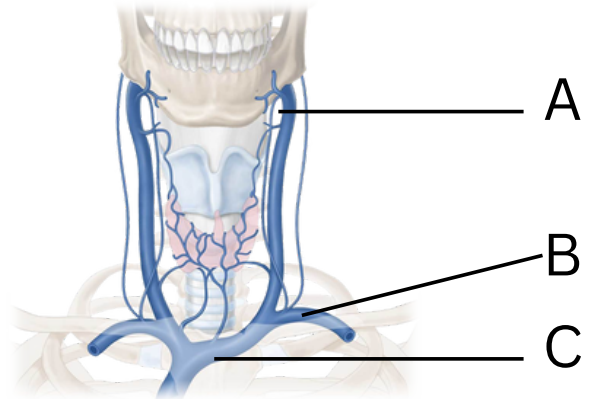


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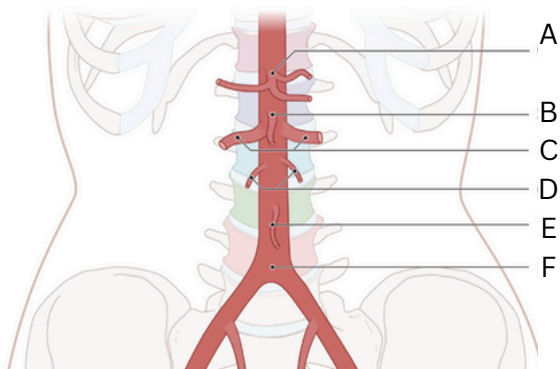
## Test yourself

1) Label the tributaries of the superior vena cava

- A .....
- B .....
- C .....

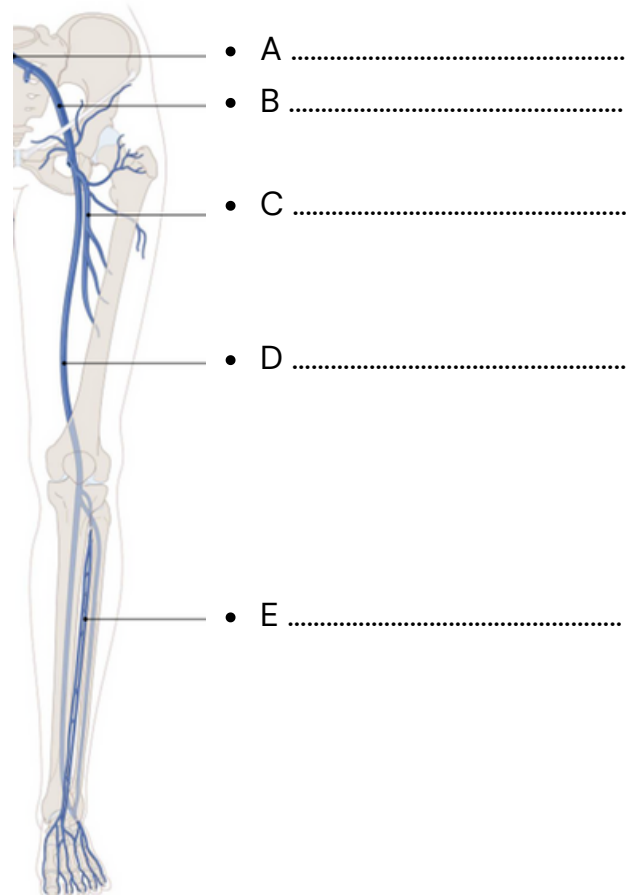


2) Label the branches of the abdominal aorta and mention their vertebral level



- A .....
- B .....
- C .....
- D .....
- E .....
- F .....

3) Label the deep veins of the lower limb (anterior view)



- A .....
- B .....
- C .....
- D .....
- E .....

# VASCULAR ANATOMY

## Test yourself

### MCQ 1

A 66-year-old female presents with a pulsatile mass in her abdomen, noticed during a routine check-up. She reports vague, intermittent lower back pain over the past few weeks but denies any trauma or acute injury. Which of the following is the most common site of developing abdominal aortic aneurysms?

- A. Infrarenal
- B. Suprarenal
- C. Pararenal
- D. Juxtarenal

### MCQ 3

Which of the following branches comes off of the third part of the subclavian artery?

- A. Thyrocervical trunk
- B. Dorsal scapular artery
- C. Costocervical trunk
- D. Thoraco-acromial artery

### MCQ 5

Which muscle serves as a landmark to indicate the transition from the axillary artery to the brachial artery?

- A. Pectoralis minor
- B. Pectoralis major
- C. Teres minor
- D. Teres major

### MCQ 2

Which of the following veins immediately drains into the superior vena cava?

- A. Internal jugular vein
- B. External jugular vein
- C. Brachiocephalic vein
- D. Subclavian vein

### MCQ 4

Following a motor vehicle accident, a 24-year-old male is admitted to the emergency department. The surgeons are concerned that the deep palmar arch is not receiving blood supply. What clinical test can be done to evaluate the patency of the collateral circulation to the hand?

- A. Phalen's test
- B. Finkelstein's test
- C. Allen's test
- D. Tinel's test

### MCQ 6

At what vertebral level does the abdominal aorta branch into the superior mesenteric artery?

- A. T12
- B. L1
- C. L2
- D. L3
- E. L4



# VASCULAR ANATOMY

## Test yourself

### OSCE Station – Case Based Discussion

A 45-year-old woman presents with complaints of aching and heaviness in her legs, particularly after standing for long hours. She also notices visible, bulging veins on her legs that have progressively worsened over the past few years. She denies any recent trauma or injury. Her medical history is significant for two pregnancies, and she has a family history of varicose veins. On examination, there are prominent, dilated, tortuous veins along the medial aspect of both legs, with mild pitting edema in the ankles.



- Q1. What risk factors in the history of this patient are contributing to her current condition?
- Q2. Describe the underlying pathophysiology behind the clinical finding in the attached image.
- Q3. What are the differential diagnoses in this patient?
- Q4. How would you confirm the diagnosis and assess the severity in this patient?
- Q5. What are the interventional management options for varicose veins?
- Q6. Discuss potential complications of untreated varicose veins.

Answers  
 MCQs. 1) A, 2) C, 3) B, 4) C, 5) D, 6) B  
 OSCEs: 1) Prolonged standing, pregnancy, family history, female sex, and age. 2) Dysfunctional venous valves → pooling of blood in the superficial veins of the lower limb → increased venous pressure, vein dilation, and tortuosity. 3) Deep vein thrombosis (DVT), chronic venous insufficiency without varicosities, lymphedema, cellulitis, and vasculitis. Q4) Clinical examination and duplex ultrasound. 5) Sclerotherapy, radiofrequency or laser ablation, and vein stripping. 6) Chronic venous insufficiency, venous ulcers, superficial thrombophlebitis, and bleeding from ruptured veins.