

INTERNATIONAL SURGICAL
ANATOMY TEACHING
SERIES



ISATS HANDOUT 2023/24

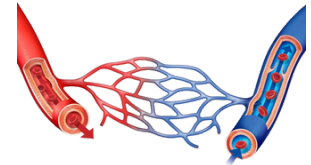
Vascular Anatomy

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.

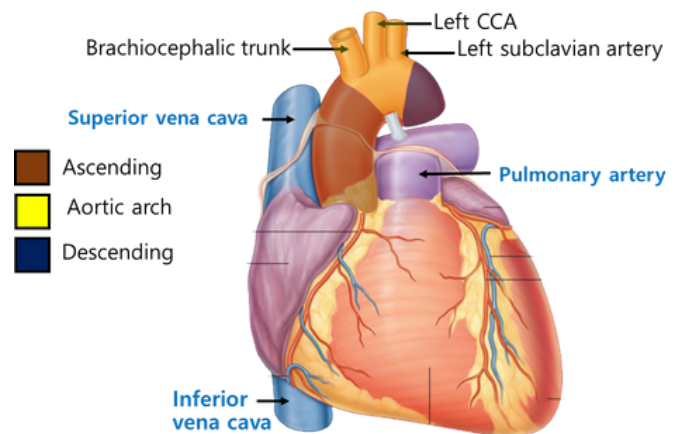
Vessel layout

- 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

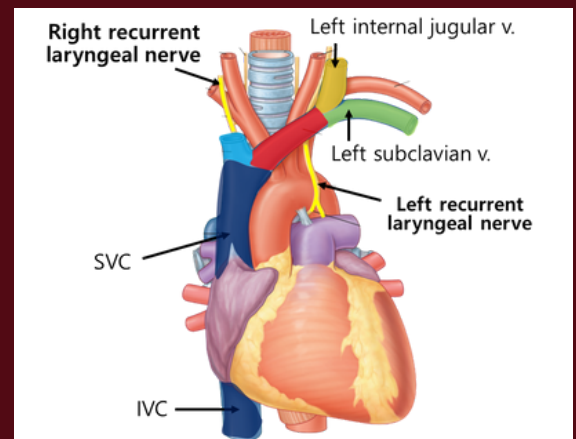
- Drains systemic venous blood into right atrium
- Two main inflows:
 - Superior vena cava
 - Tributaries are left and right **brachiocephalic** veins
 - Inferior vena cava

Pulmonary trunk

- Transports deoxygenated blood from right ventricle to lungs.
- Bifurcates into left and right pulmonary arteries
- Aorta + pulmonary arteries separated from superior vena cava by **transverse pericardial sinus**

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

- Common carotid arteries **bifurcate** into internal carotid artery (ICA) and external carotid artery (ECA) around C4
- Laryngeal prominence (Tip of thyroid cartilage) approximates 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

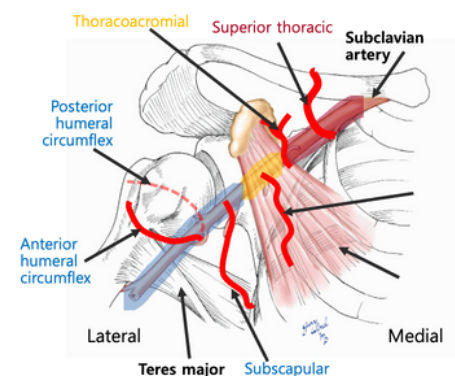
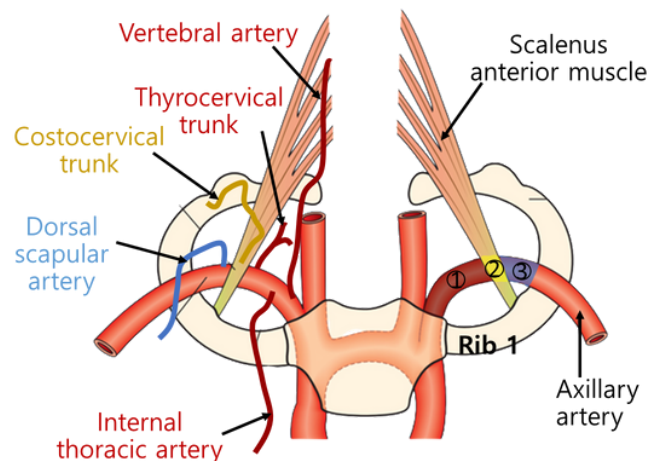
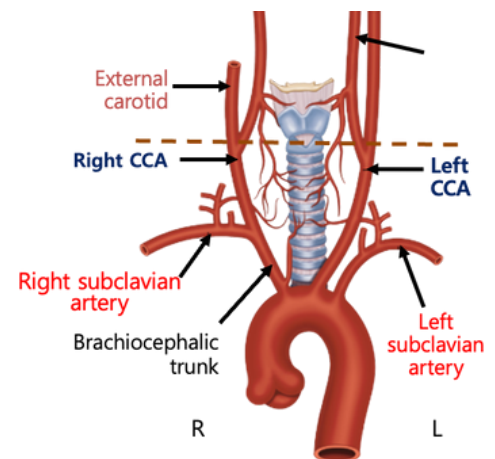
MNEUMONIC - V.I.T C.D

- Important distal branches:
 - Thyrocervical trunk → inferior thyroid artery
 - Internal thoracic artery → musculophrenic + superior epigastric artery

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.
- Post-operative stroke incidence falls to 2% after successful procedure (Meškauskienė et al., 2011) PMID: 21956139.

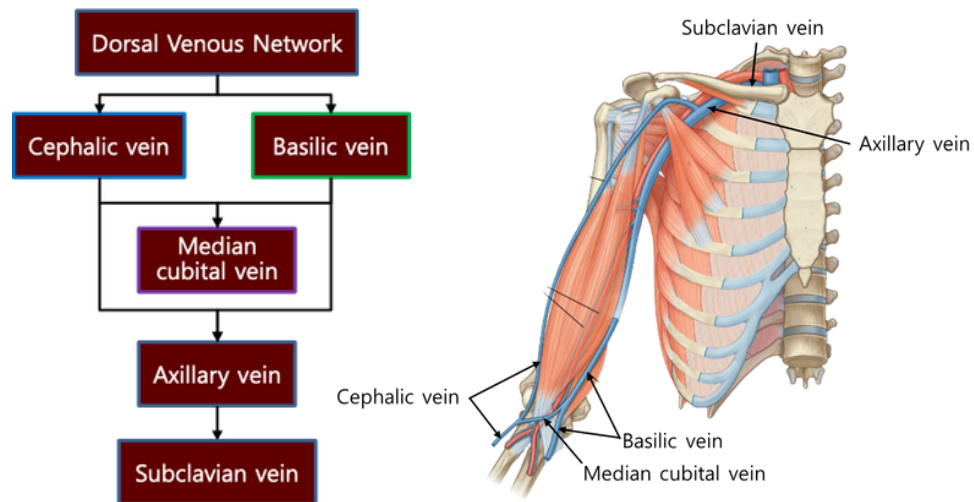


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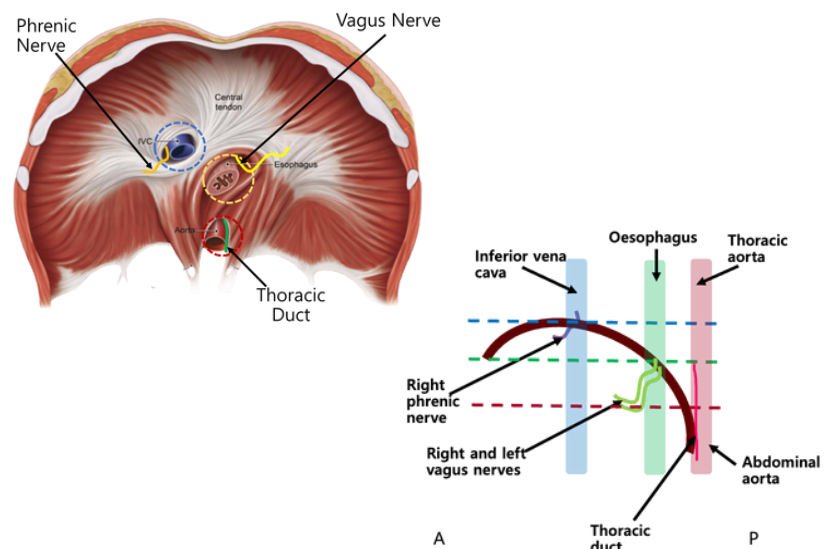
Upper limb veins

- Originates from hand
- Median cubital vein common site for venesection
- Subclavian vein joins internal jugular vein to form superior vena cava bilaterally



Abdominal vessels

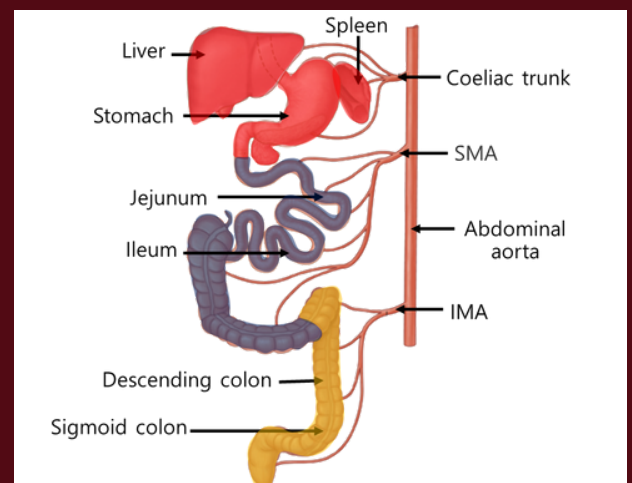
- **T8: Inferior vena cava** pierces tendinous part of diaphragm
 - Right phrenic nerve accompanies IVC
- **T10: Oesophagus** passes muscular diaphragm (Covered by crura)
 - Vagus nerve accompanies oesophagus
- **T12: Abdominal aorta** passes aortic hiatus (Covered by crura)
 - Accompanied by **thoracic duct**



Gastrointestinal (GI) tract:

- GI tract is divided into:
 - **Foregut** - Mouth to duodenum (2nd part, D2)
 - **Midgut** - D2 to Proximal 2/3rd transverse colon
 - **Hindgut** - Distal 2/3rd transverse colon to anus
- Each division has respective blood supply:
 - **Foregut** → **Coeliac trunk**
 - **Midgut** → **Superior mesenteric artery**
 - **Hindgut** → **Inferior mesenteric artery**

Segmentation of GI tract facilitates differentiation in absorption, e.g. protein and fat absorption by midgut vs. water reabsorption by hindgut

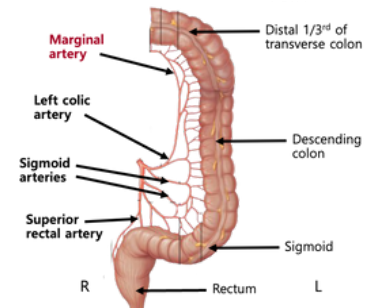
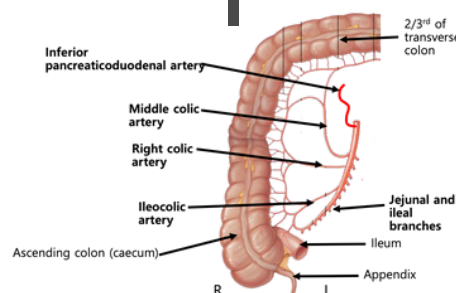
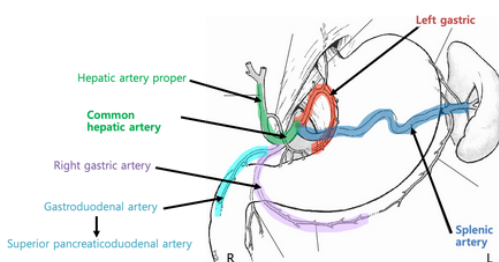
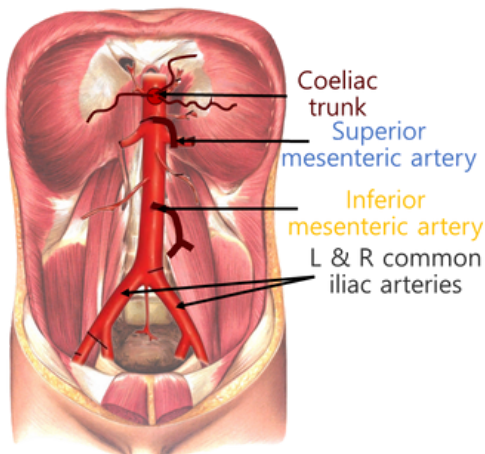


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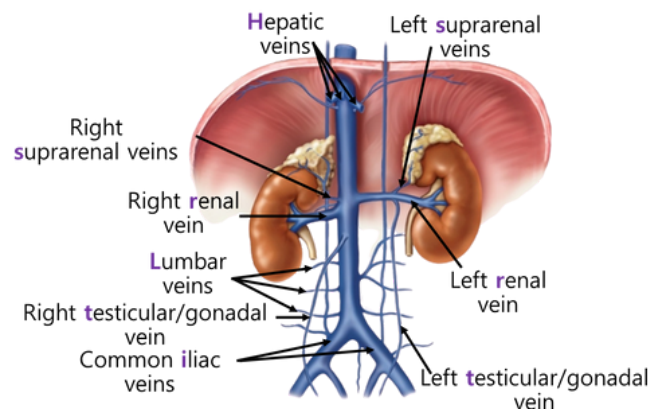
Abdominal aorta

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



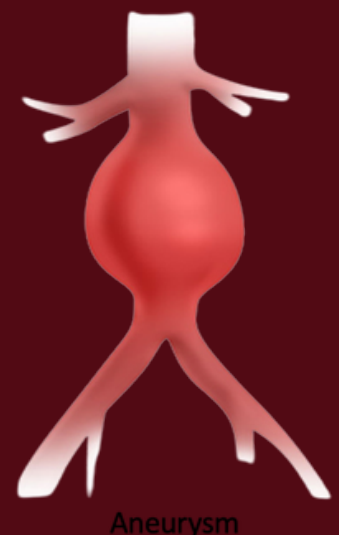
Inferior vena cava

- Inferior vena cava has six tributaries:
 - Common **iliac** veins
 - **Lumbar** veins
 - Right **renal** vein
 - Right **suprarenal** vein
 - **Hepatic** 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 abdominal aorta this often occurs just **proximal to the L4 bifurcation of the aorta**. 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)**



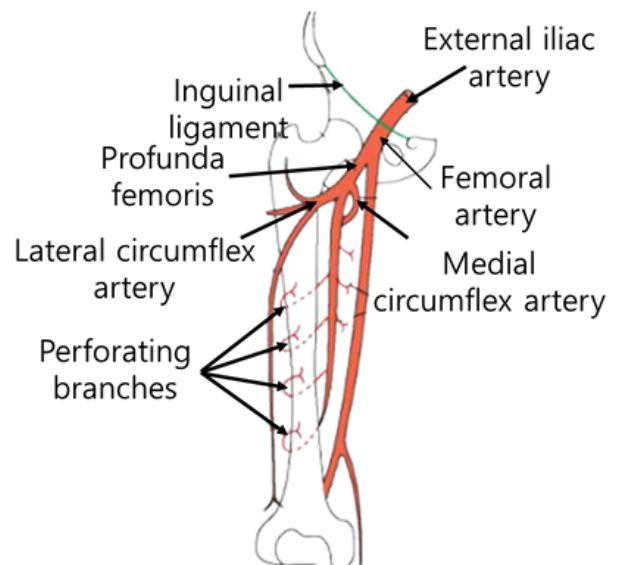
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Common iliac → (Internal &) External iliac artery → Femoral artery → popliteal artery

Lower limb arteries

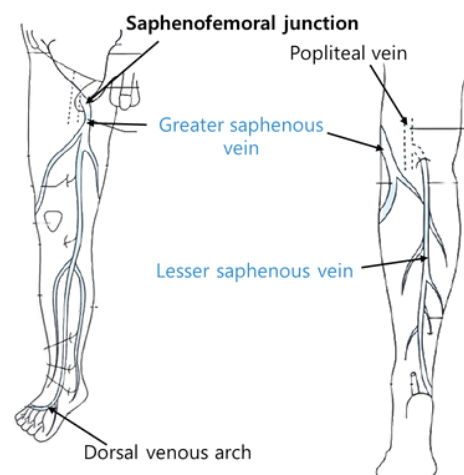
- (Under inguinal ligament) External iliac artery → femoral artery
- (Through adductor hiatus) Femoral artery → popliteal artery
- Femoral artery gives off **lateral** and **medial femoral circumflex artery**
- **Medial femoral circumflex artery** supplies 82% of femoral head (Dewar et al., 2016). Damage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



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

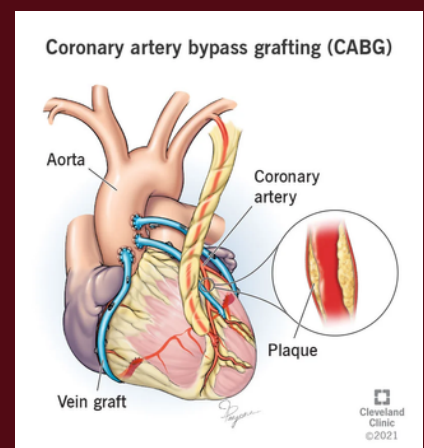
Lower limb veins

- 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



Coronary artery bypass graft (CABG):

- CABG procedures are performed for patients with severe myocardial infarctions
 - *Triple vessel disease*
 - *Severe left main stem stenosis*
 - $\geq 70\%$ LAD and proximal left circumflex artery stenosis
- *Greater saphenous vein is frequently harvested for graft*
- *Greater saphenous vein graft permits arterial blood to bypass blockage/atheromatous plaque and reach cardiac tissue*

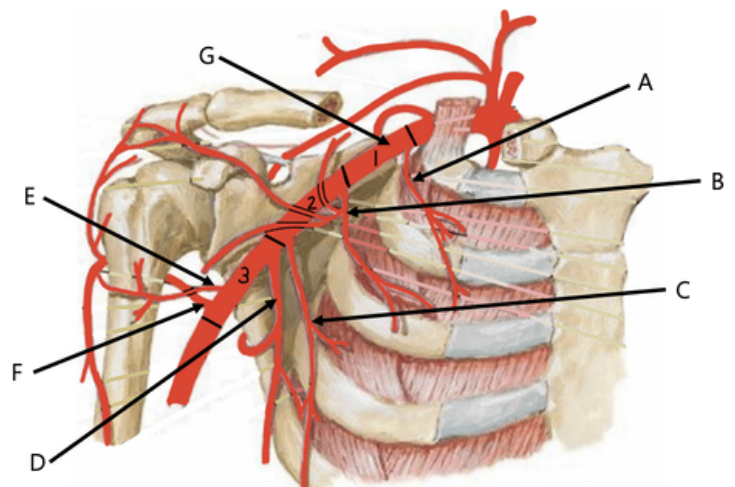


VASCULAR ANATOMY

Test yourself

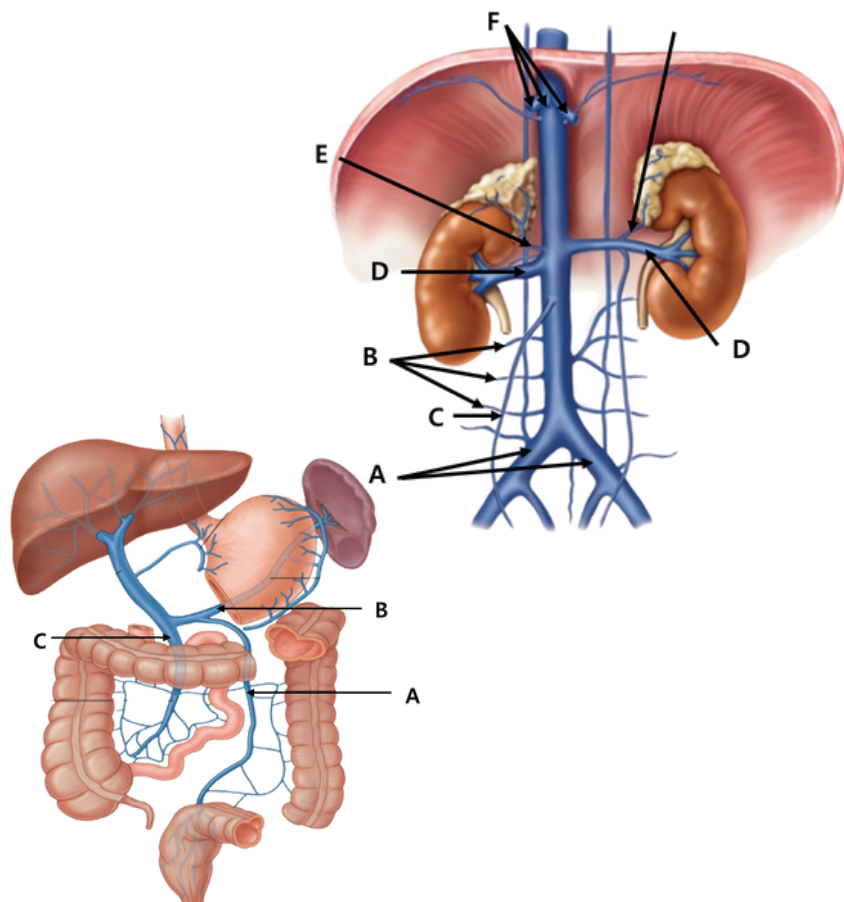
1) Label the branches of the axillary artery

- A
- B
- C
- D
- E
- F
- G



2) Label the venous tributaries of the inferior vena cava:

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



3) Label the venous tributaries of the hepatic portal vein:

- A
- B
- C

VASCULAR ANATOMY

Test yourself

MCQ 1

A 68 year old female is undergoing a coronary artery bypass graft surgery. She will need venous access for the delivery of drugs during the surgery. Which vascular structure should the anaesthetist aim to put the central venous catheter into?

- A. Brachiocephalic trunk
- B. Right common carotid artery
- C. Left brachiocephalic vein
- D. Superior vena cava
- E. Inferior vena cava

MCQ 3

A 60 year old female arrives in A&E after having a traumatic fall. Radiology confirms the injury as a Colles fracture (radial fracture). The surgeons are concerned that the deep palmar arch is not receiving blood supply. Which artery is most likely damaged?

- A. Ulnar artery
- B. Radial artery
- C. Brachial artery
- D. Superficial palmar arch
- E. Basilic artery

MCQ 5

Which vascular structure delivers the most blood to the liver within the portal venous system?

- A. Hepatic portal vein
- B. Hepatic veins
- C. Splenic vein
- D. Superior mesenteric vein
- E. Inferior mesenteric vein

MCQ 2

Which structure passes directly adjacent to the inferior vena cava as it passes through the diaphragm?

- A. Vagus nerve
- B. Thoracic duct
- C. Left phrenic nerve
- D. Right phrenic nerve
- E. Inferior vena cava

MCQ 4

A 55 year old male patient with extensive history dyslipidaemia and hypertension experiences a transient ischaemic attack which caused visual disturbances and temporary left sided upper limb weakness. Which vessel is likely contains the plaque which caused the attack?

- A. Maxillary artery
- B. Superior thyroid artery
- C. Ophthalmic artery
- D. External carotid artery
- E. Internal carotid artery

MCQ 6

Which of the following statements regarding the carotid artery is false?

- A. The external carotid artery has 6 extracranial branches
- B. The common carotid artery bifurcates into the internal + external carotids at C4
- C. The middle meningeal artery is a distal branch of the external carotid artery
- D. The internal carotid artery has no extracranial branches
- E. The left common carotid artery arises directly from the aortic arch

VASCULAR ANATOMY

Test yourself

OSCE Station – Case Based Discussion

A 50-year-old male diabetic smoker presents with leg pain on exertion for 6 months. He notes bilateral calf cramping with walking. He states that it is worse on his right calf than his left and that it goes away when he stops walking. He has noticed that distance is more limited on an incline or if stairs are present.



- Q1. What is important to identify from the history?
- Q2. What are the potential differential diagnoses for this patient?
- Q3. Which investigations will be useful in confirming a diagnosis?
- Q4. How will you manage this patient?
- Q5. What is the most common pathological cause of peripheral arterial disease?
- Q6. What are the potential complications of femoral endarterectomies?

Answers
 MCQs. 1) D, 2) D, 3) B, 4) E, 5) A, 6) A
 OSCEs: 1) Rule out vascular emergencies such as acute limb ischaemia. The classic 6 signs of acute limb ischaemia which are pain, paralysis, paraesthesia, pulselessness, poikilothermia, and pallor. 2) Critical limb ischaemia, acute limb ischaemia, spinal stenosis, venous claudication, arthritis 3) Ankle-brachial index (ABI) in someone with suspected peripheral arterial disease (PAD). An ABI ≤ 0.9 is diagnostic for the presence of PAD. Q4) Antiplatelet therapy with aspirin, control risk factors such as high cholesterol and smoking, and encourage exercise. If lifestyle-limiting symptoms consider revascularisation. 5) Atherosclerosis 6) Leg swelling, chronic pain, numbness or weakness in the leg, venous thromboembolism.