

Done by : Rama Alwraikat

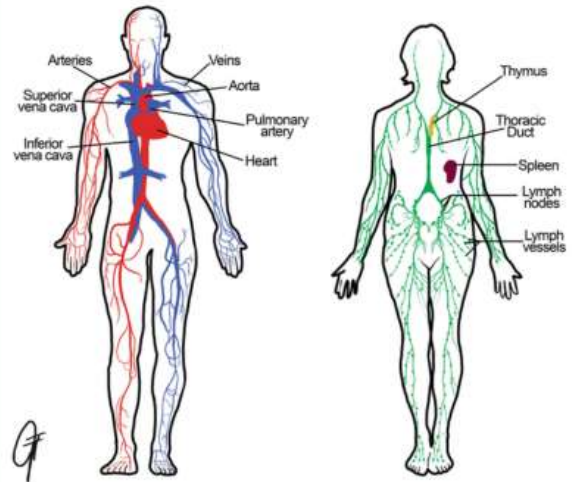
• Circulatory system is the system responsible for:

- Distributing nutrients and O_2 to all body tissues and removing wastes and CO_2 from all body tissues.
- Regulates body temperature.
- Defence against infections and diseases.

دفع

Can be divided into:

1. The cardiovascular system (CVS) → major
Heart and blood vessels
2. Lymphatic system
Lymphatic vessels and lymphatic organs
(one way from tissue to venous system)

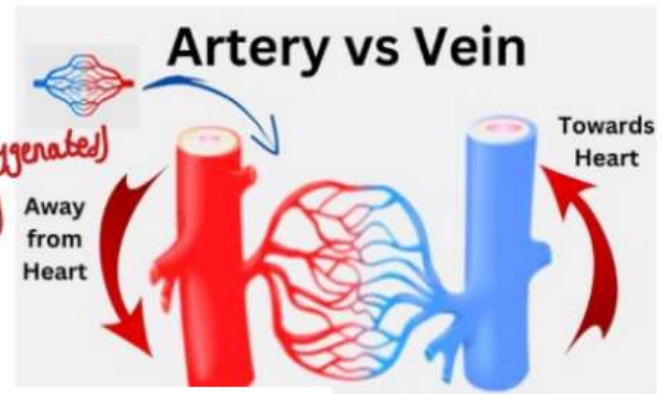


- Artery: carries blood away from heart. (oxygenated)
- Vein: carries blood towards the heart. (non)

لا يطلع من القلب

↑ إلى القلب

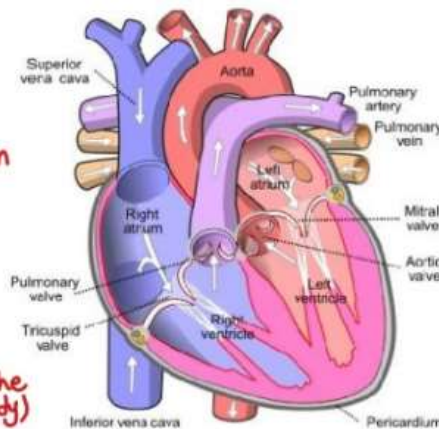
بعض الأثر من
of blood inside



The heart

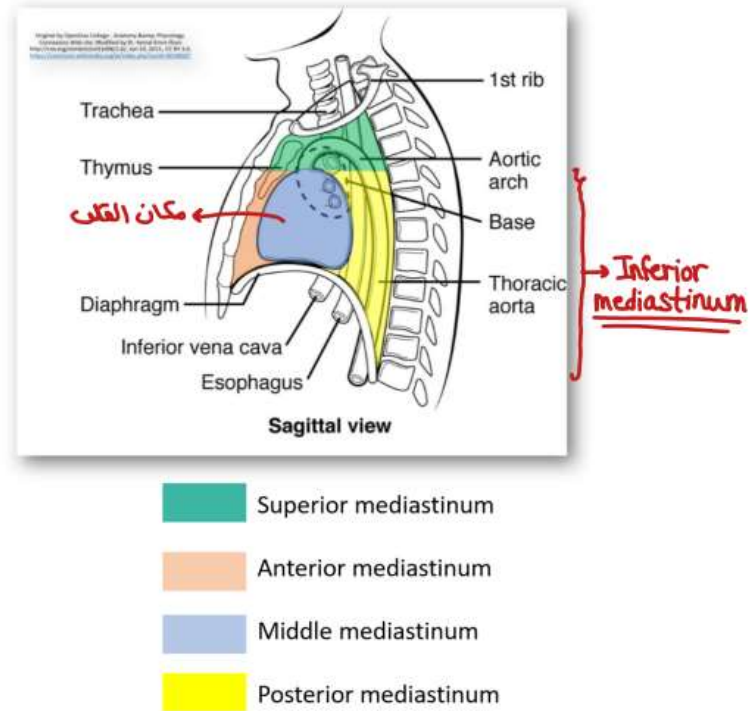
General characteristics:

- The first structure starts working in embryonic life (by the end of 4th week).
- An enlarged internally subdivided blood vessel, specialised for pumping. → originate from what?
- The heart is aligned obliquely in the thorax. منك
- Pumps blood through pulmonary circulation and systemic circulation (tissues all over the body) → through lungs
- Situated in the middle mediastinum and surrounded by pericardium



Location of heart

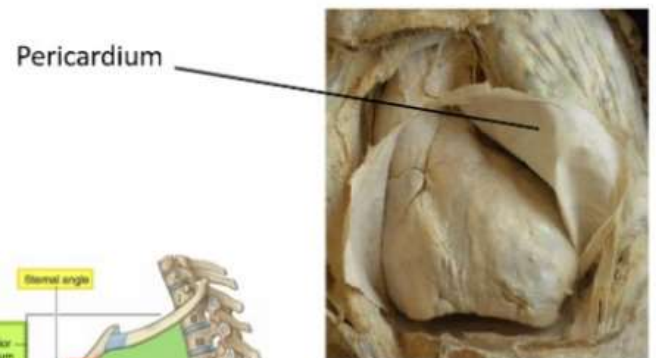
- **Mediastinum**, is a space in the thorax contains all the thoracic organs except the lungs
- Divided into two parts, **superior and inferior**, the inferior mediastinum is further divided into anterior, middle and posterior
- **Pericardium** is fibro-serous sac situated in the middle mediastinum.



Pericardium

- **Boundaries:**
 - Anteriorly: body of sternum and 2nd to 6th costal cartilages
 - Posteriorly: 5th to 8th thoracic vertebrae
 - Inferiorly: diaphragm
- **Functions of pericardium:**
 - Restrict excessive movements of the heart
 - Act as a lubricated container

because of fluid (ترطيب)



Pericardium

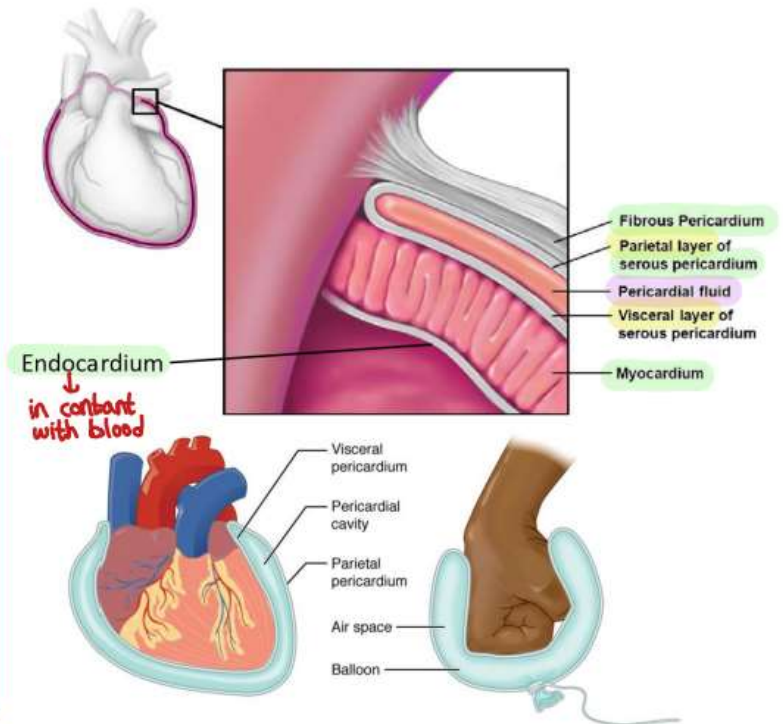
The pericardium is divided into:

- **Fibrous pericardium** (strong, outer layer), attached firmly to the diaphragm below and fuses with coat of main blood vessels.
- **Serous pericardium** lines the fibrous pericardium and divided into:
 - **Parietal pericardium**
 - **Visceral pericardium** (epicardium)

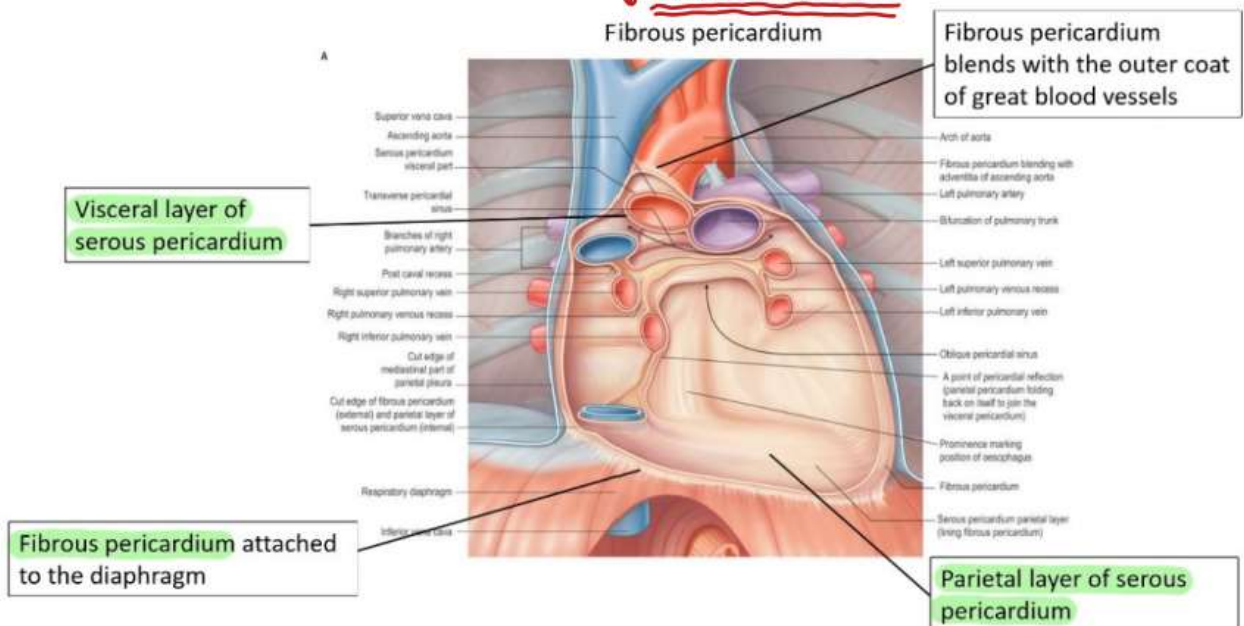
Between the parietal and visceral layers of the heart there is a thin film of fluid called **pericardial fluid** (50ml)

The pericardial fluid acts as a lubricant to facilitates the movements of the heart.

The parietal pericardium reflects around the roots of the large blood vessels to become **continuous** with the visceral pericardium that closely covers the heart.



↓ the heart is removed



Heart

4 chambers
2 Ventricles
2 Atria

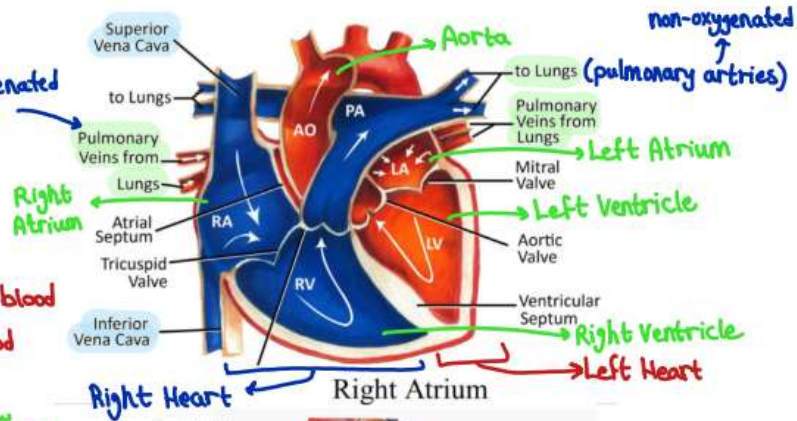
- The heart contains four chambers:
 - Two atria and two ventricles
- It has two functional circuits:
 - Right heart (or pulmonary circuit) → non-oxygenated blood
 - Left heart (or systemic circuit) → oxygenated blood
- The superior vena cava opens into the roof of RA, while the inferior vena cava opens into its inferoposterior part.
- The anterior wall of the Rt atrium is rough and muscular while the posterior wall is smooth.

جارات
بطين

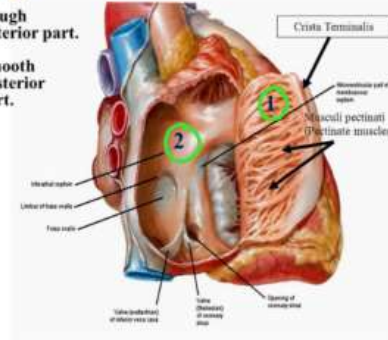
oxygenated blood

سفتين (الجزء الخلفي)

↳ inferior & superior Vena Cava

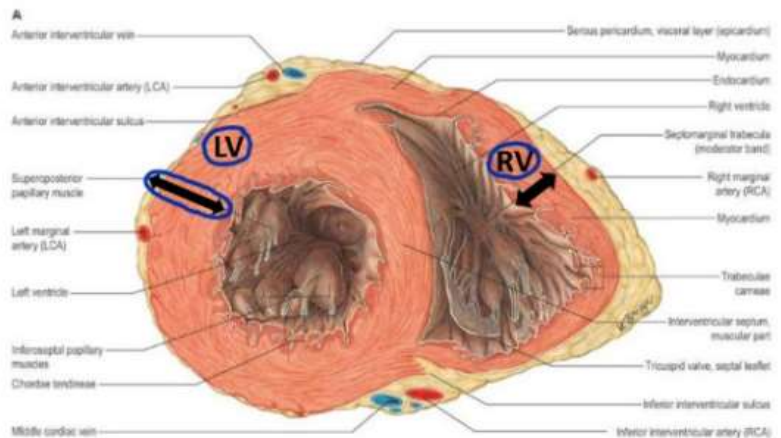
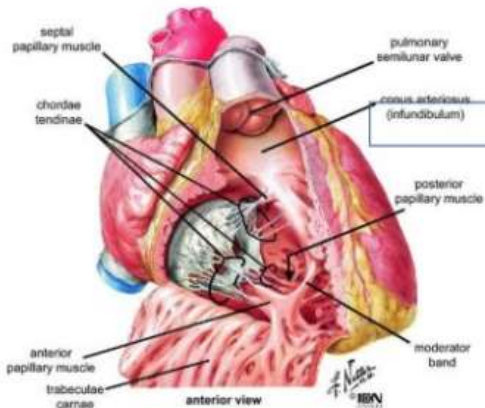


- Rough anterior part.
- Smooth posterior part.



- The Lt atrium receives the openings of the four pulmonary veins.
- The blood flows from Rt and Lt atria to the Rt and Lt ventricles, respectively.
- The outflow tract of the RV is called the infundibulum. In LV, the outflow tract is the area just below the aortic arch is named vestibule.
- LV is longer and narrower than RV
- LV walls are three times thicker (8–12 mm) than those of RV (black arrows) → because of pumping blood to all parts of the body

smooth part → لتكون خروجه
المسرعة أثناء contraction

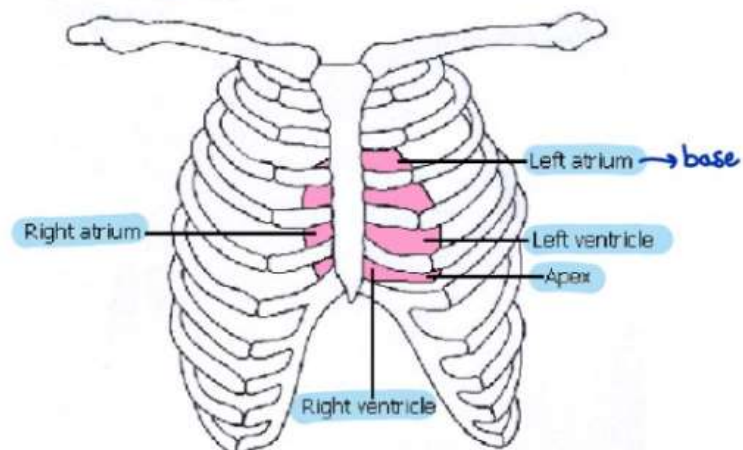
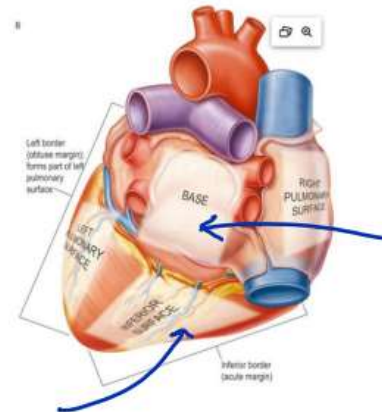
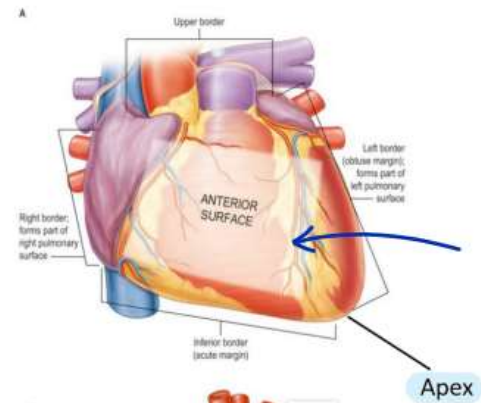


The orientation of heart

- The heart has **apex** and **base**
- **Apex**: pointed downward, forward and to the left, and is formed of the left ventricle.
- Lies at the level of the left fifth intercostal space. 9cm from the midline. → *to detect the pulse* ^{النبض}
- **Base** of the heart is directed upward and posteriorly, and is formed mainly of the left atrium.

- The heart has **two surfaces**; **anterior (sternocostal)**, **inferior (diaphragmatic)**, and **right and left pulmonary**
- **1. anterior (sternocostal) surface**: formed mainly by **right ventricle** ~2/3rd
- **2. Inferior (diaphragmatic) surface** is largely formed by **left ventricle**.

- And **four borders**; **superior, inferior, right and left**.
 - **Sup. Border** >>> the two atria
 - **Inf. Border** >>> two ventricles
 - **RT border** >>> right atrium
 - **LT border** >>> left ventricle and left auricle



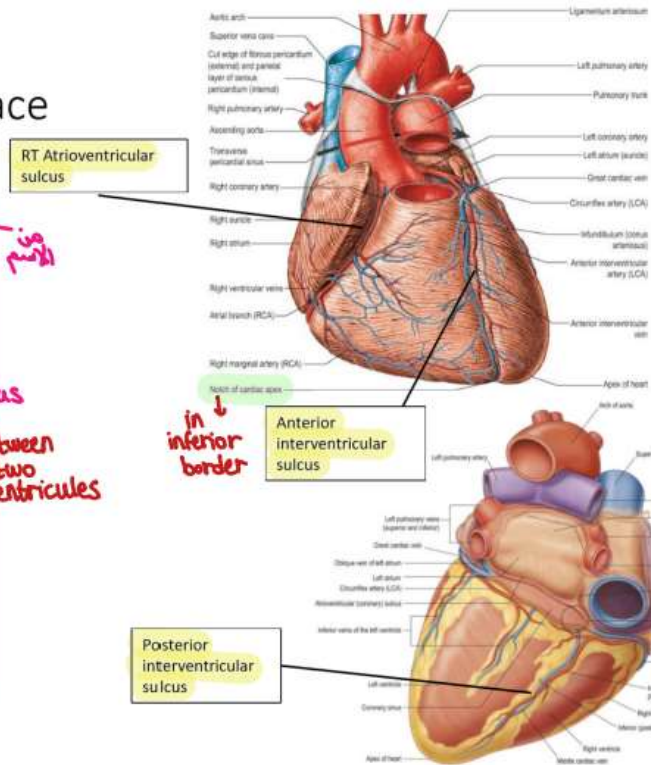
Sulci on the cardiac surface

- The **atrioventricular (coronary) sulcus** separates the atria from the ventricles and contains the main parts of the right and circumflex coronary arteries.

Right coronary artery → Right Sulcus
Circumflex coronary artery → left Sulcus

- The **interventricular sulci** extend from the atrioventricular sulcus to the notch of the cardiac apex on the inferior border.

between two ventricles



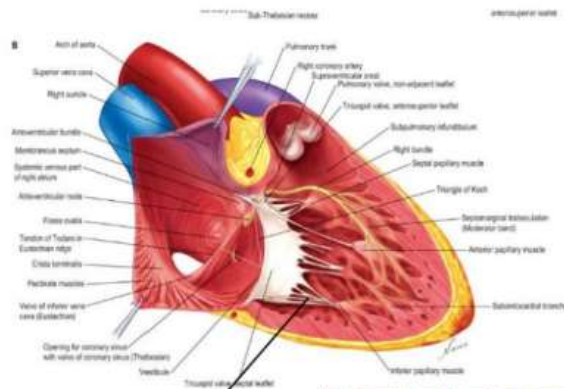
Valves of the heart → Two Types

1. Atrioventricular valves → *between Atrium & Ventricle*

- Right and left
- The **right** atrioventricular valve RAV is **tricuspid valve** (has **three cusps**) → *3 papillary muscles*
- The **left** atrioventricular valve LAV (Mitral valve) is **bicuspid valve** (has **two cusps**) → *2 papillary muscles*

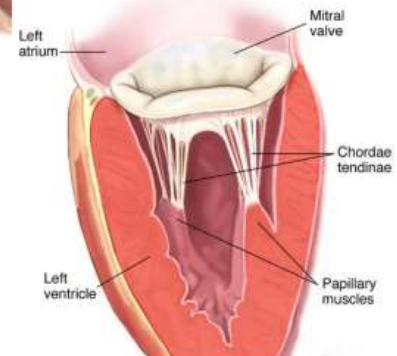
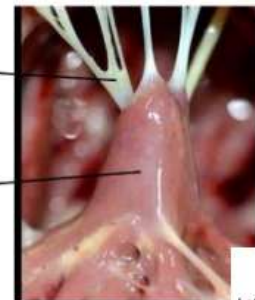
Chordae tendineae are fibrous collagenous structures that support the leaflets of the atrioventricular valves and connect them to the **papillary muscles**.

In most cases, the RAV valve has three papillary muscles while the LAV valve has two.



Chordae tendineae

papillary muscles



Valves of the heart

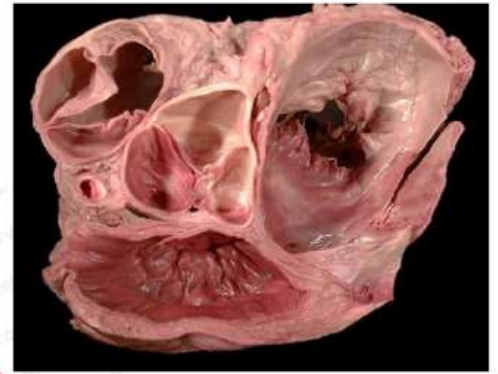
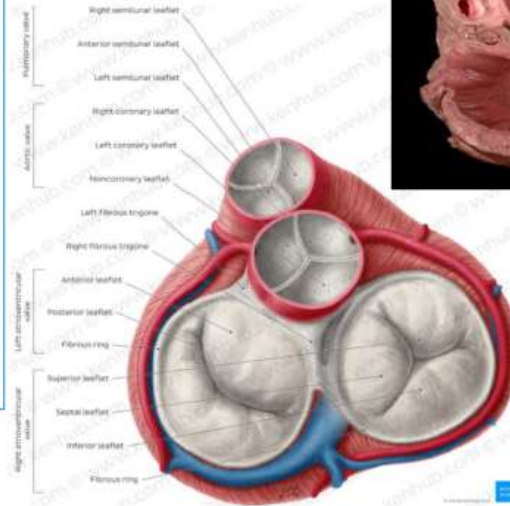
2. Semilunar valves

Formed of three cusps, with a hollow space above each cusp called **sinus**

- **Aortic valve**
- **Pulmonary valve**

Sinuses

No Chorda tendinea or papillary muscles are associated with semilunar valves.



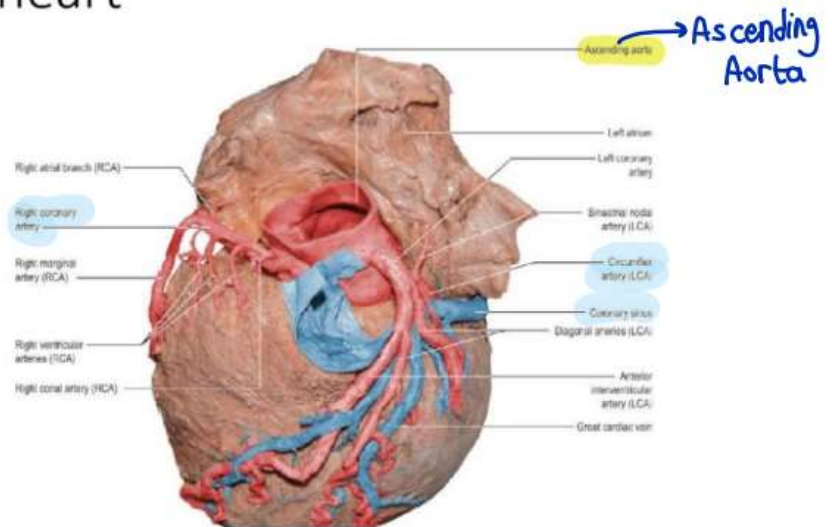
Blood supply of the heart

*Arterial supply

By the **coronary arteries** (Rt and Lt). Arise from the beginning of the ascending aorta.

*Venous drainage:

Through **small veins** that opens in the **coronary sinus** that empties in the **right atrium**



Coronary arteries are called **functional end arteries**

Collateral circulation is the anastomosis between the branches of the right and left coronary arteries.

The age is a key determinant of the collateral circulation development.

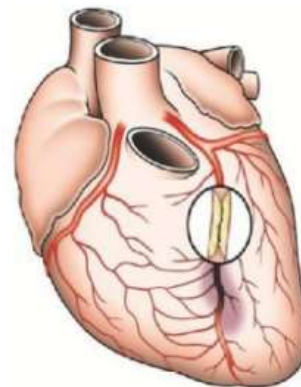
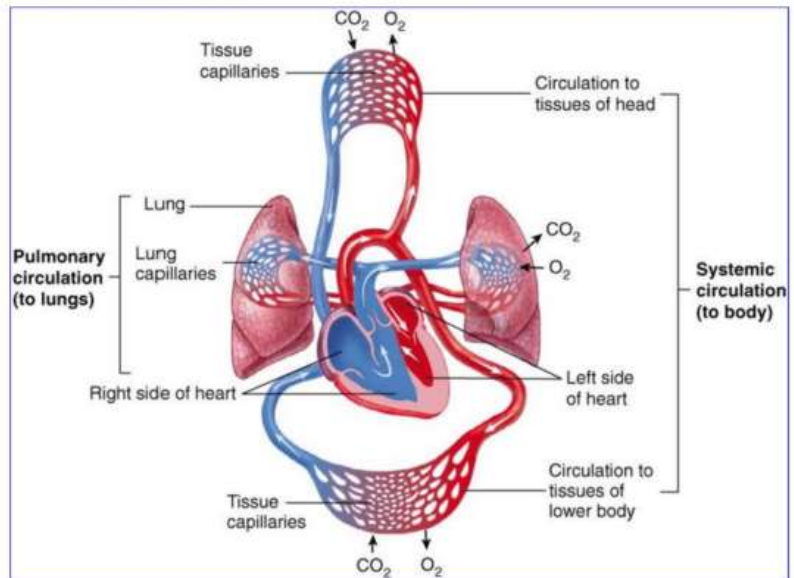


Figure 2

التحام عند الأعمار الأكثر من ٣٠
لذلك البطء عند الي أعمارهم أقل من ٣٠ يتكون معيقة

Types of blood circulations

- Pulmonary circulation
 - Systematic circulation
 - Portal circulation
- ↓
- liver

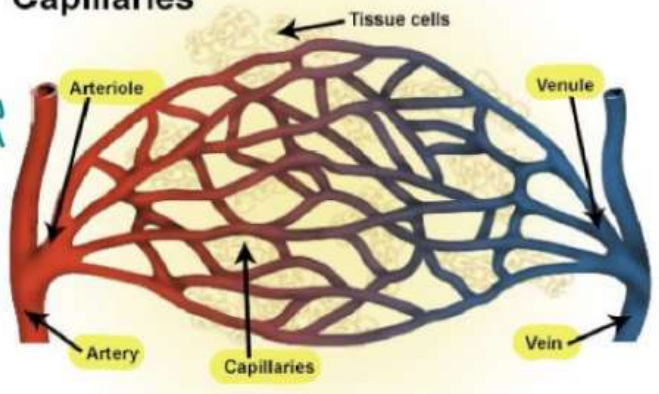


Types of blood vessels

60,000 miles of vessels → most of it → capillaries
 5-7 litres of blood

- **Arteries** → because of elastic fibers to increase elasticity
 ➤ large elastic and muscular arteries
 ➤ Arterioles microscopic arteries
- **Capillaries** (or in some tissues sinusoids)
- **Veins**
 ➤ Large veins (superior and inferior vena cava)
 ➤ Venules

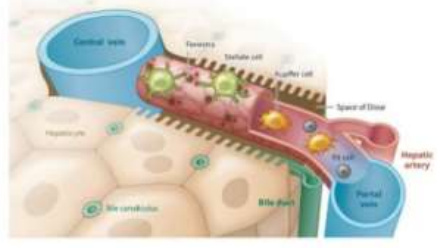
Capillaries



Gas and nutrients exchange occur at the capillaries

Sinusoids

- Sinusoids are a special type of capillary that have a wide diameter.
- ✗ **Fenestrated discontinuous capillaries**
- Found in the liver, spleen, lymph nodes, bone marrow and some endocrine glands.



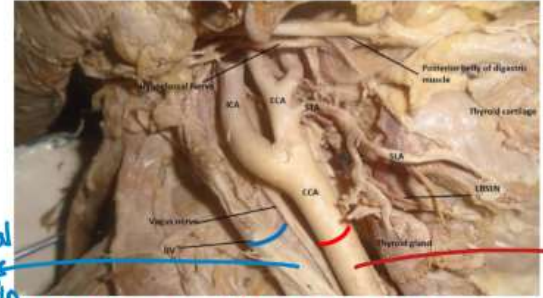
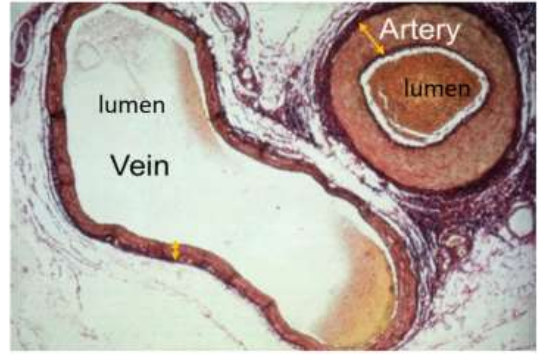
Acts as a physical platform for maximum gas exchange (O₂) from hepatic artery and nutrients from portal vein.

Artery vs Vein

Artery	Vein
Carry oxygenated blood Except: pulmonary artery	Carry non-oxygenated blood Except: pulmonary vein
Carry blood away from the heart	Carry blood towards the heart
No valves	Have valves (with exceptions)
Narrow lumen, thick wall	wide lumen, thin wall
Walls are rich with smooth muscles >>>non-compressible	Walls are poor with smooth muscles >>>compressible قابل للانقباض

Venous valves are important in moving blood toward the heart against the force of gravity.

ويستفيد من انقباض عضلات



internal jugular vein

Common Carotid Artery

لونها غليظ على Vein ما يرجع لشكله الطبيعي بسبب قلة العضلات smooth muscles

• **Capillaries**, the smallest and most numerous of the blood vessels, form the connection between the vessels that carry blood away from the heart (arteries) and the vessels that return blood to the heart (veins).

• The primary function of capillaries is the exchange of materials between the blood and tissue cells.

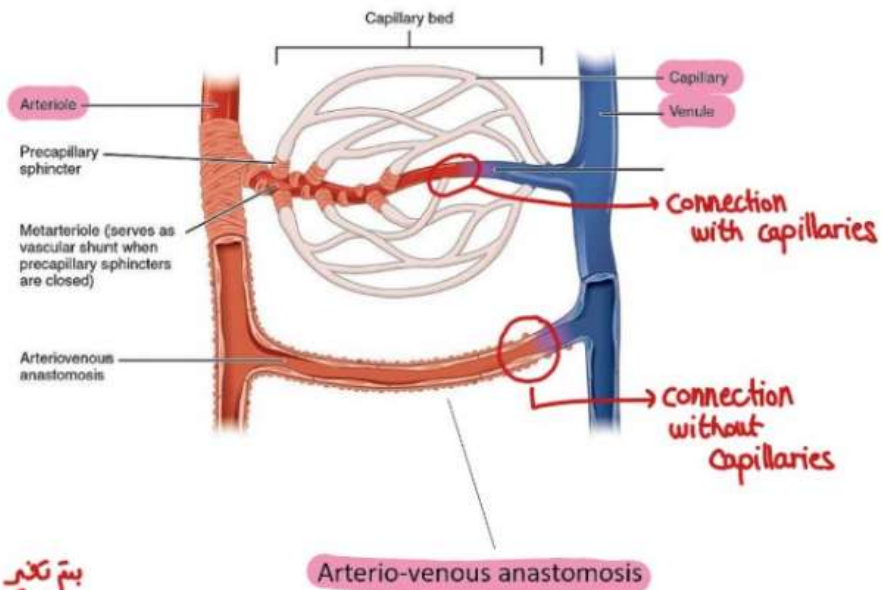
• **Direct Arterio-venous anastomoses** : is a direct connection between small arteries and small veins in certain tissues with NO capillary section between them.

- Regulation of blood flow
- Regulation of the body temperature

مثل intestine

بتم تكملة اتجاه الدم لأعضاء أخرى

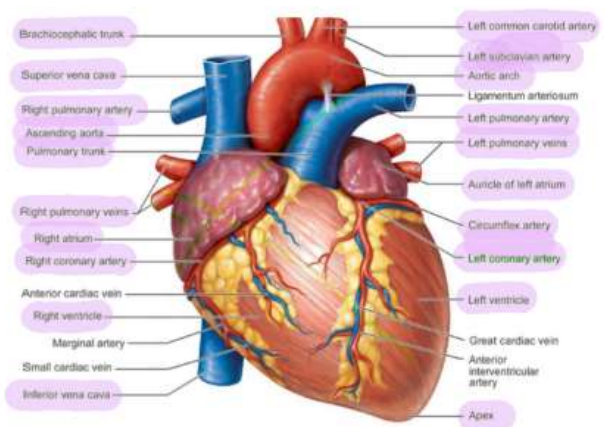
مثل عن اليد يصب constriction للاوعية → الدموع في اليد لتؤدي الطاقة لمرارة الجسم الداخلية



Arterio-venous anastomosis

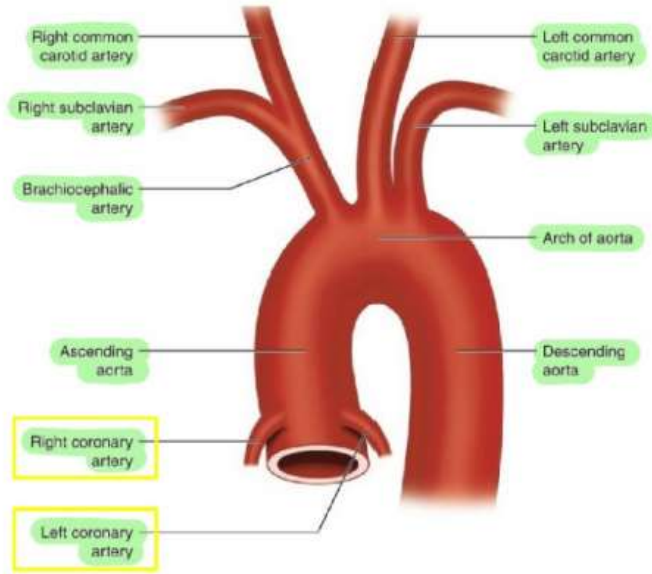
The main blood vessels in the human body

- The **aorta** and its largest **branches** (brachiocephalic, common carotid, and subclavian) are **large elastic arteries**.
1. **Pulmonary trunk** arises from **right ventricle**, and carries **de-oxygenated blood** to the lungs.
 2. **Aorta** consists of four segments
 - **Ascending aorta**
 - **Arch of aorta**
 - **Descending thoracic aorta**
 - **Descending abdominal aorta**

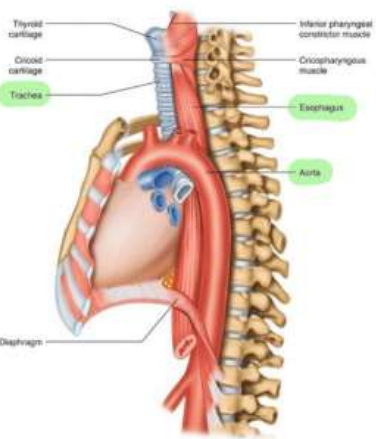


Segments of the aorta

1. **Ascending aorta** (about 5cm in length, lies within the **fibrous pericardium**, passes upward to the right).
- Branches:
 - Right coronary artery
 - Left coronary artery



The arch of aorta is anterior to the oesophagus and the trachea



2. **Arch of aorta**, continues from the ascending aorta and lies mainly within the **superior mediastinum**

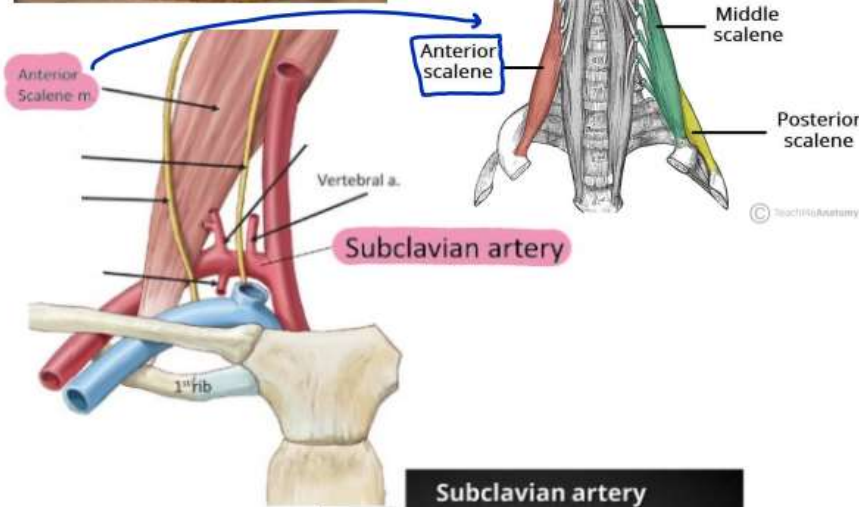
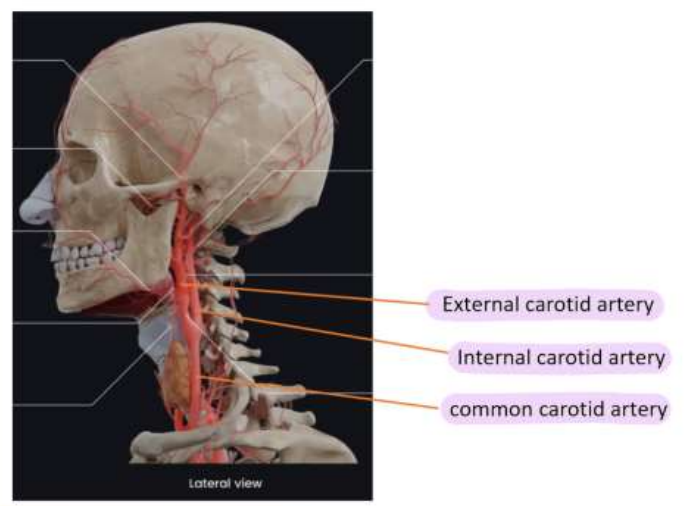
- Branches:
1. **Left subclavian artery**
↳ Under clavicle
 2. **Left common carotid artery** → to neck & head
 3. **Brachiocephalic artery** (or brachiocephalic trunk) is the largest branch in diameter. Divides into:
 - **Right subclavian artery** → to upper limb
 - **Right common carotid artery** → to head & neck

The right common carotid has only a **cervical part** whereas the left common carotid has **cervical and thoracic parts**.

Common carotid artery divides into:

1. **External carotid artery** which supplies the face and neck.
2. **Internal carotid artery** which provides main arterial blood supply to the brain.

Facial artery is a branch of the external carotid artery, it has tortuous route along the **nasolabial fold** towards the medial angle of the eye. This is important as muscles and organs of the face are **very movable**.

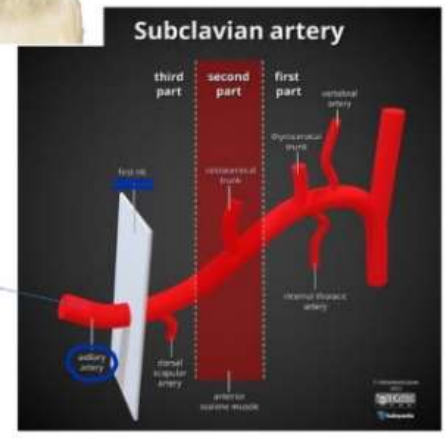


Subclavian arteries:
 The right subclavian artery is a branch of the brachiocephalic trunk, while the left subclavian is a direct branch of the aortic arch. → Two supply lower limb

Subclavian artery is divided into three segments:

1. First part from its origin to the **medial border of scalenus anterior**;
2. Second part **posterior to scalenus anterior**.
3. Third part from the **lateral margin of scalenus anterior to the outer border of the first rib**

Axillary artery
 يدخل الأخراب
 Axilla منطقة



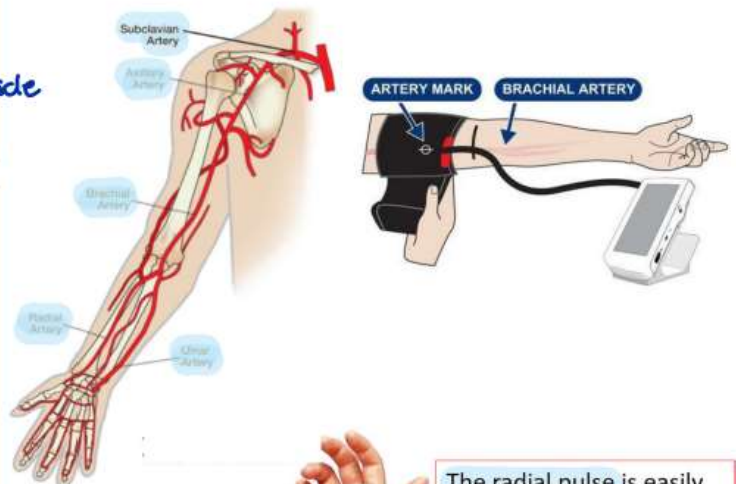
The **axillary artery**, a continuation of the subclavian artery, begins at the outer border of the first rib and ends at the inferior border of teres major, where it becomes the **brachial artery**

muscle

The **brachial artery** is a continuation of the axillary artery. It begins at the inferior border of the tendon of teres major and ends about a centimetre distal to the elbow joint (at the level of the neck of the radius) by dividing into the radial and ulnar arteries.

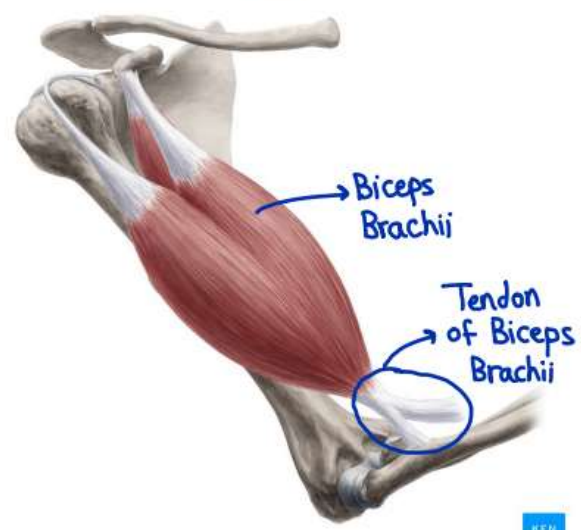
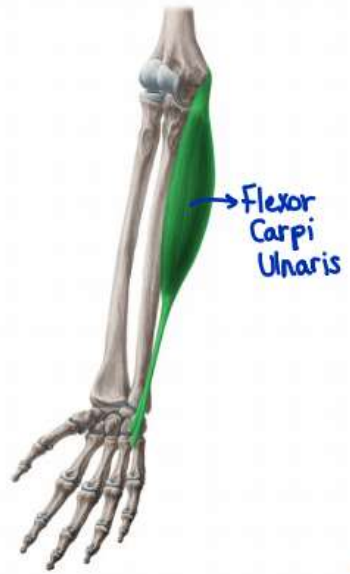
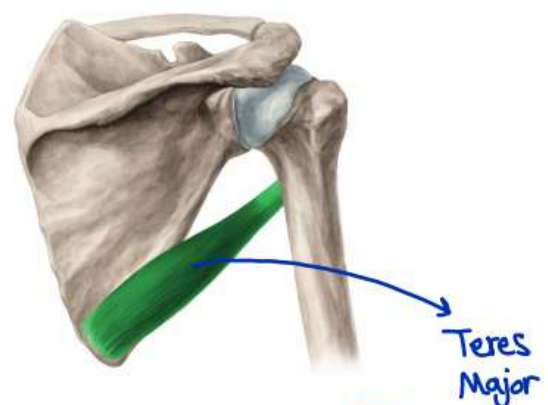
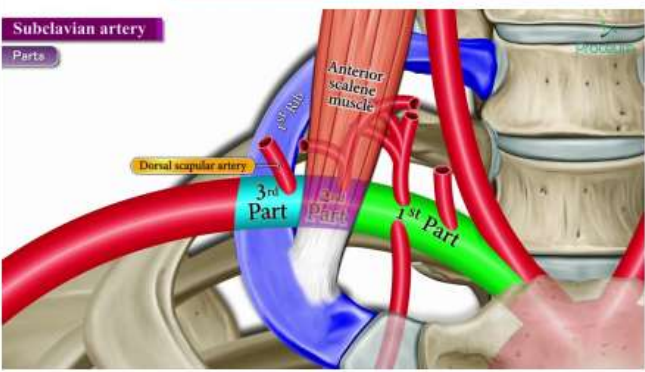
It's the artery used to measure your blood pressure medial to the tendon of biceps brachii.

Radial artery is at the lateral side of forearm while the **ulnar artery** is at the medial side.



The radial pulse is easily felt by the tip of the index and third fingers just lateral to the tendon of the flexors carpi radialis

#ADAM



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3. Descending thoracic aorta, lies within the posterior mediastinum.
 Extends between **T4-T12**.
thoracic vertebrae

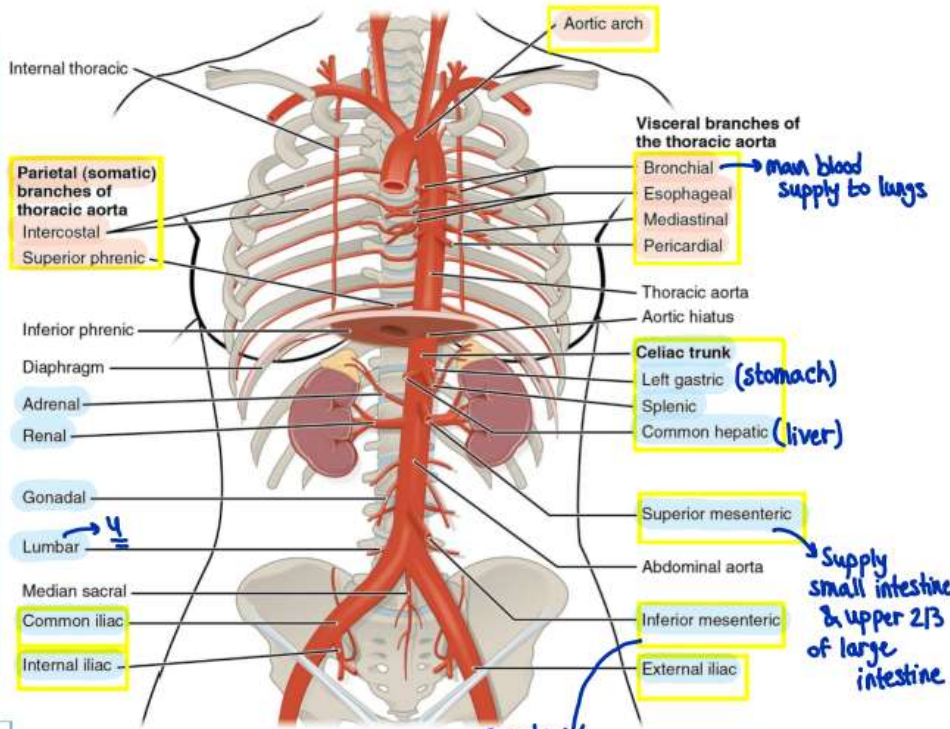
Main branches are divided into:

Visceral branches:

1. Pericardial branches
2. Bronchial arteries
3. Oesophageal arteries
4. Mediastinal arteries

Parietal branches:

1. Intercostal arteries
2. Superior phrenic



4. Descending abdominal aorta, starts at T12 and ends at L4, main branches are:
Lumbar vertebrae

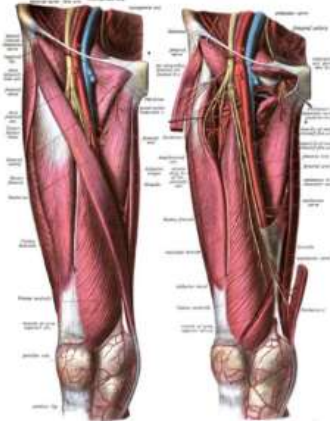
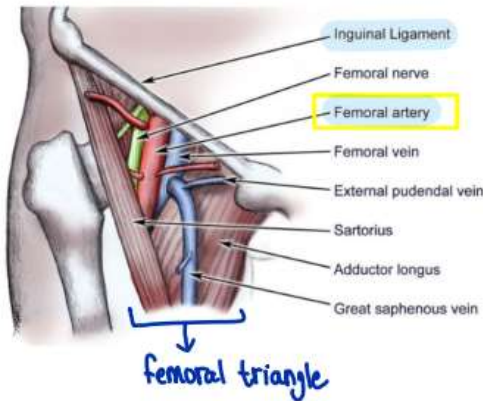
- Unpaired branches that arise from the anterior aspect:
 1. Celiac trunk
 2. Superior mesenteric artery
 3. Inferior mesenteric artery
- Paired branches arise from the lateral aspect
 1. Renal arteries
 2. Adrenal arteries
 3. Gonadal arteries
 4. Four lumbar arteries
- Terminal branches (two common iliac arteries)

* Gonadal arteries $\begin{matrix} \text{male} \\ \rightarrow 2 \text{ testicular arteries} \\ \text{female} \\ \rightarrow 2 \text{ ovarian arteries} \end{matrix}$

* Common iliac arteries $\begin{matrix} \rightarrow \text{Internal iliac} \rightarrow \text{to supply pelvic organs} \\ \rightarrow \text{External iliac} \end{matrix}$

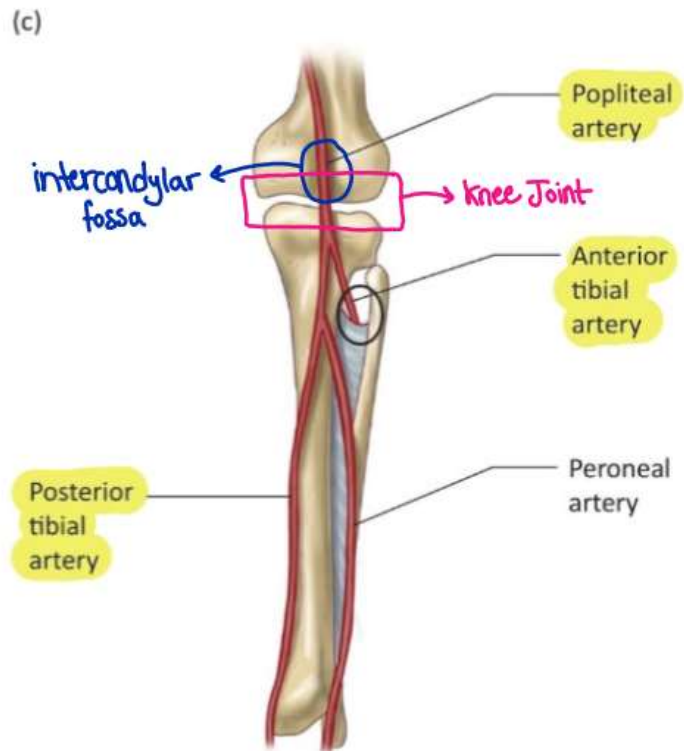
Arterial supply to the lower limb

The **femoral artery** is a continuation of the **external iliac artery** and provides the principal arterial supply to the lower limb. It begins posterior to the inguinal ligament, midway between the anterior superior iliac spine and the pubic symphysis, descends in **the femoral triangle**, enters and passes through the adductor canal, and becomes the **popliteal artery** as it passes through an opening in adductor magnus.



Arterial supply to the lower limb

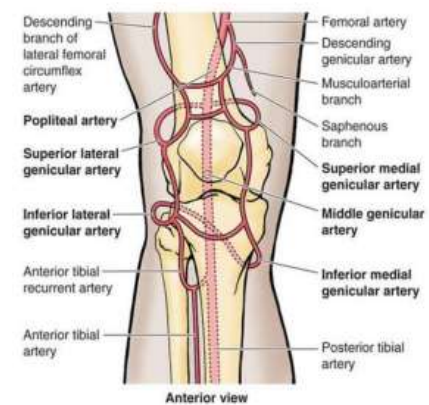
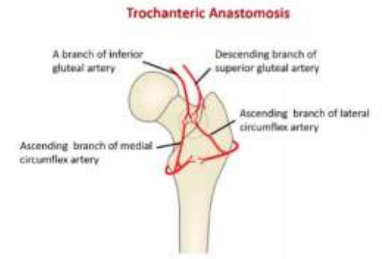
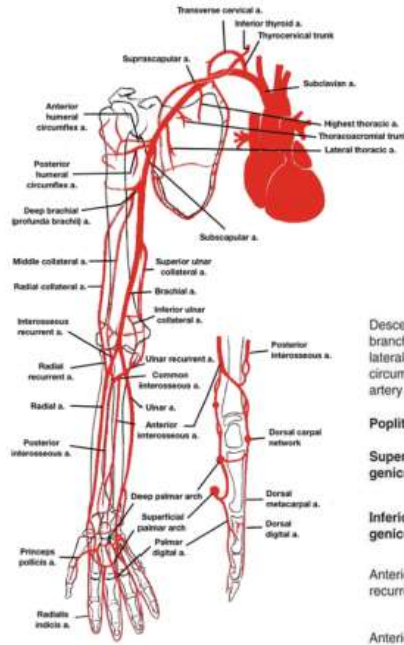
- **Popliteal artery** is the continuation of the **femoral artery** and **crosses the popliteal fossa**. It descends laterally from the opening in adductor magnus to the **femoral intercondylar fossa**. → posteriorly
- It gives two **branches** **the anterior and posterior tibial arteries**.



Collateral circulation

- Is a connection or (anastomosis) between the branches of adjacent arteries
- Back-up blood supply in case of blockages. *تجلبط أو كسر*
- Exists mainly around joints

يستكن عام موجوده الكثر وأقوى جزى Upper limb around sholder & Scapula



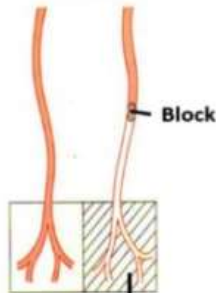
End arteries are arteries that do NOT anastomose

Can be classified to :

1. **Anatomical** end arteries, e.g. splenic, renal, central retinal and liver arteries
2. **Functional** end arteries, e.g. coronary arteries *شبكة الالين*

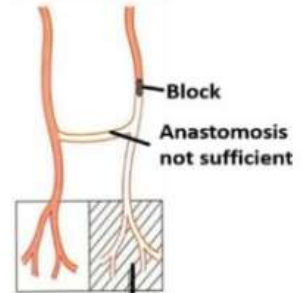
Functional end arteries could make anastomosis with adjacent arteries but these are NOT sufficient to provide blood supply.

Anatomic End Arteries

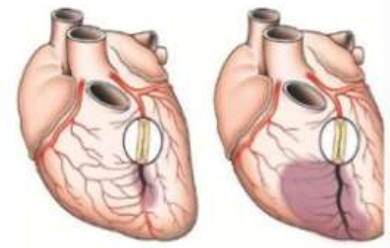
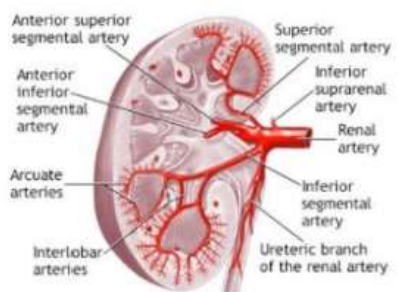


Area supplied by blocked artery undergoes Ischemic necrosis

Functional End Arteries

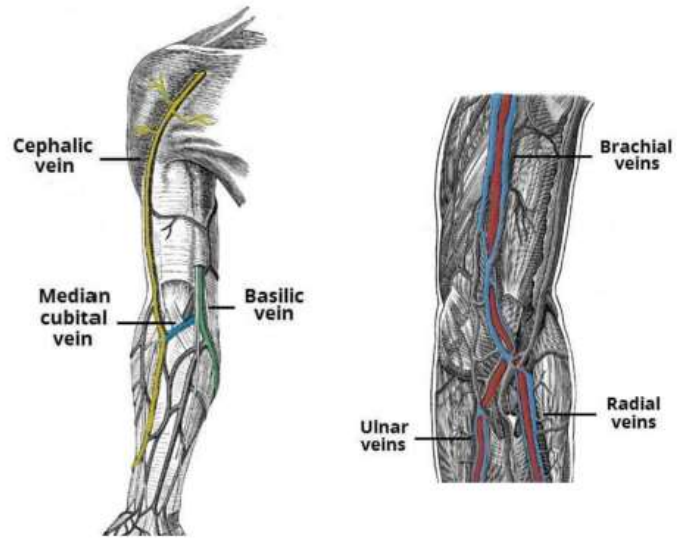


Area supplied by blocked artery undergoes Ischemic necrosis



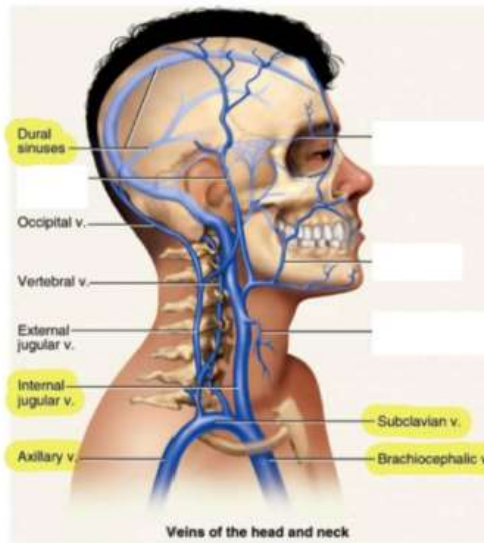
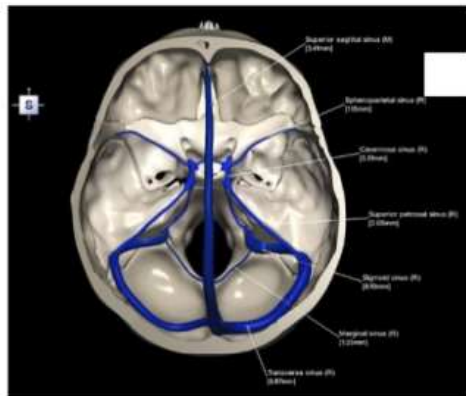
Venous drainage of the body

- There are two types of veins:
- 1. **Superficial veins:** beneath the skin
- 2. **Deep veins:** accompany the arteries, some arteries have **two** accompanying veins called **vena comitans**; one vein at each side of the artery.

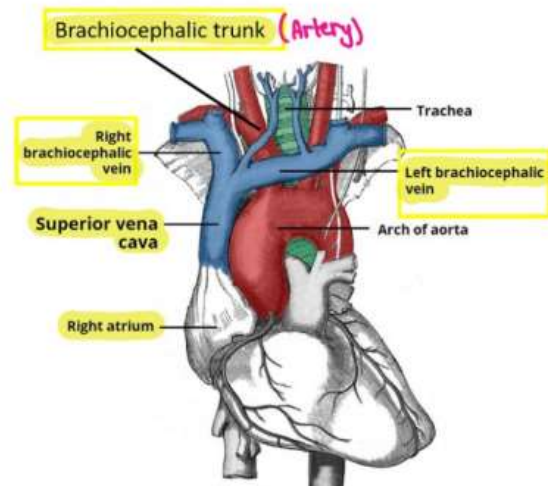


Venous drainage of the upper limb, head and neck

- Dural venous sinuses are **valveless**
- All **drain into the internal jugular vein** *يؤذي*
- Internal jugular vein joins subclavian vein to form **brachiocephalic vein**



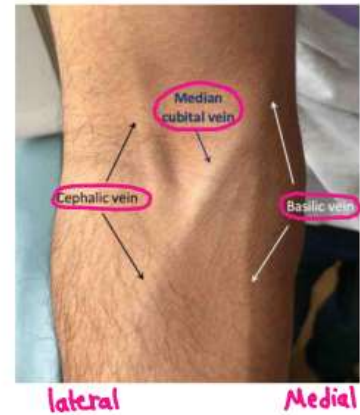
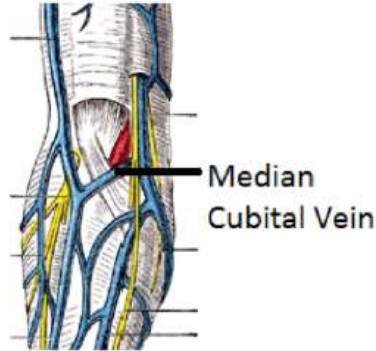
Notice here:
There are **right and left brachiocephalic veins**, but only one **brachiocephalic artery (trunk)** at the right side!



Venous drainage of the upper limb, head and neck

1. **Cephalic vein** starts at the lateral side of the dorsal venous arch
2. **Basilic vein** starts at the medial side of the dorsal venous arch

The median cubital vein is the most superficial vein in the body and connects the cephalic and basilic veins.



Large venous vessels

- **Superior vena cava**

Returns blood to the heart from the tissues above the respiratory diaphragm. About 7 cm in length and is formed by the junction of the left and right brachiocephalic veins.
→ Head & Neck Upper limb & thorax

- **Inferior vena cava**

The inferior vena cava returns blood to the heart from infra-diaphragmatic tissues.
→ Lower limb & Pelvis & Abdomen

