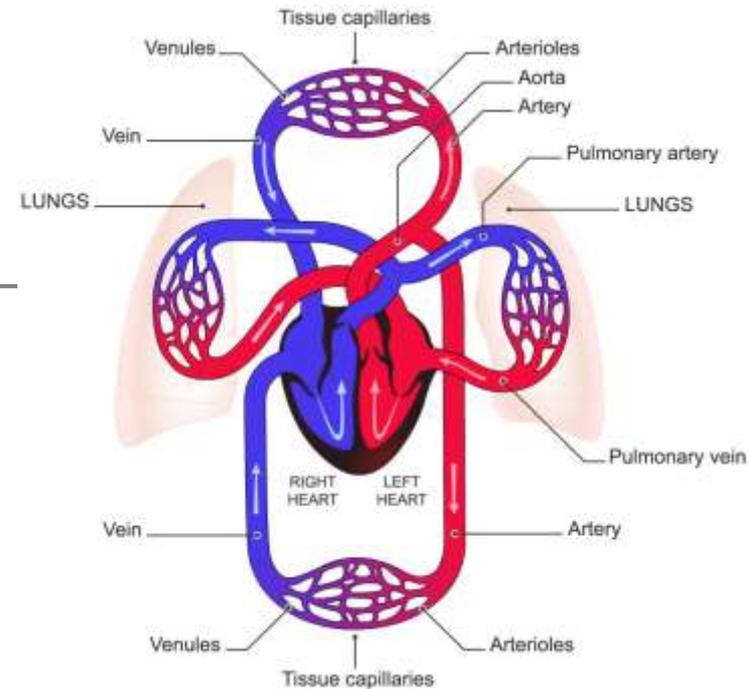


The Cardiovascular System

Dr. Mustafa Saad
(2021)

The Blood
The Heart
and The Vessels



Blood

↳ and lymph are fluid connective

- **Fluid connective tissue** → is differentiate in abundant ECM and cell
- **Extracellular matrix = plasma** → مائتة سائلة → solvent within solute
- **Cellular elements = Red blood cells, White blood cells and Platelets**

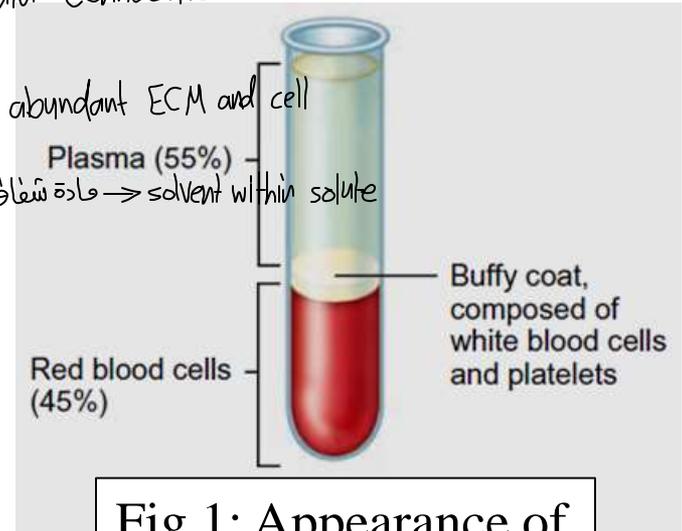


Fig.1: Appearance of centrifuged blood.

■ **Functions:**

1) **Transportation** → important function

- Gases, nutrients, hormones, waste products

2) **Regulation**

- pH, body temperature

3) **Protection**

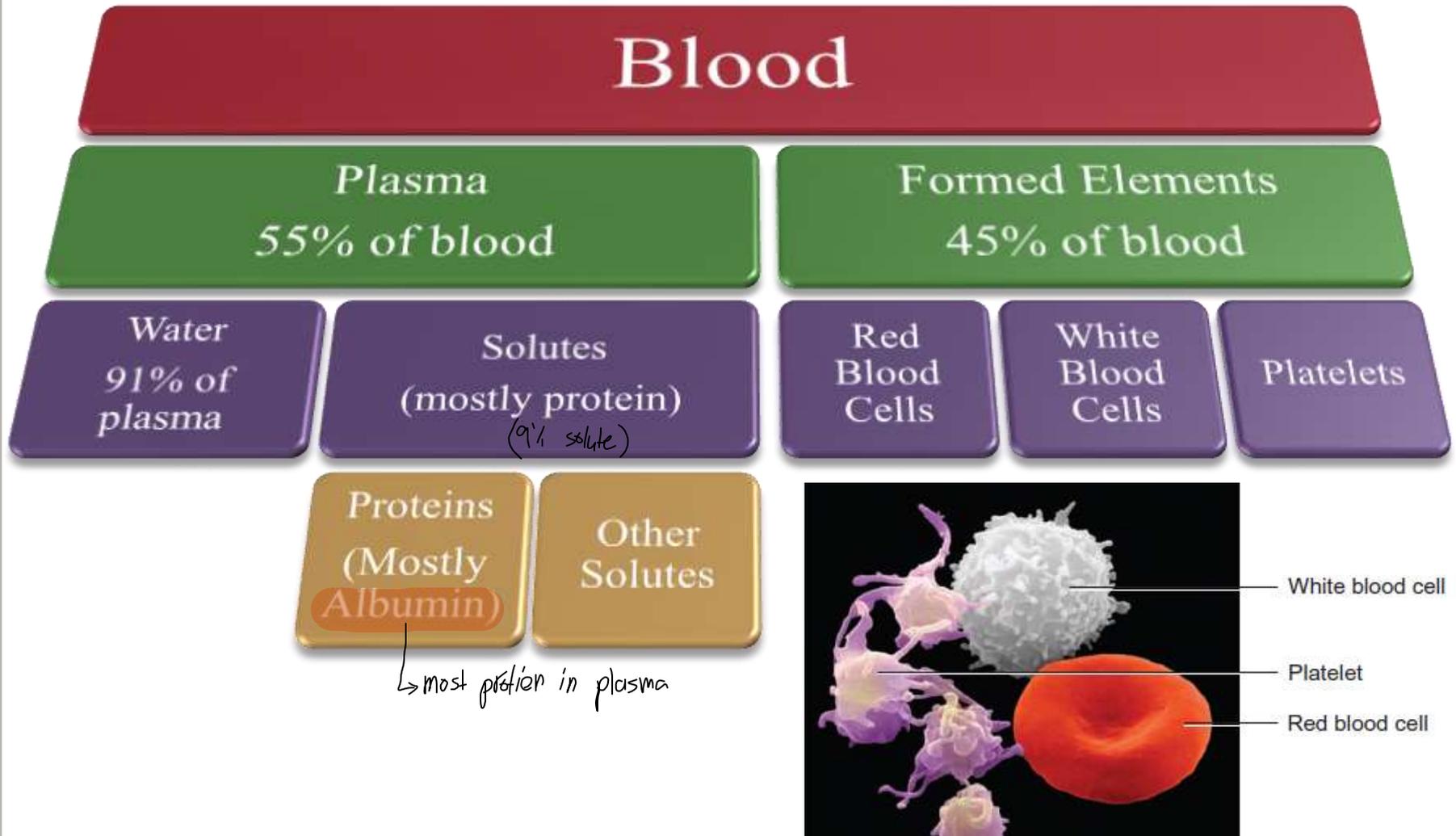
↳ by HCO_3^- → $\uparrow \text{HCO}_3^-$ increase basic (pH), $\downarrow \text{HCO}_3^-$ decrease (pH) → increase acidity

↳ attack from microorganism

- Clotting, white blood cells, proteins

↳ تخثر → by platelets

Components of Blood



Formed Elements of Blood

Ischemia (نقص التروية) = the red blood cell collect in small vessel (capillary) and cause severe pain and cause early death (doesn't infect in malaria)

Red Blood Cells/ Erythrocytes

- ↳ not present mitochondria (because it is trans O_2)
- **Biconcave disc** in shape. This **increases surface area**.
↳ قرص ثنائي التفرغ
- Lack nucleus and other organelles:
 - No mitochondria – doesn't use oxygen
↳ because it's pass through small capillary
- **Strong, flexible plasma membrane**. This allows the cell to change its shape without rupturing as it passes through narrow capillaries.
↳ لتفرغ
- Life span about **120 days**.
↳ دورة حياة خلية الدم (90-120) ←
- Cytoplasm filled with the oxygen-carrying protein **hemoglobin**.
↳ 2 α , 2 β
↳ هيموجلوبين ← حديد

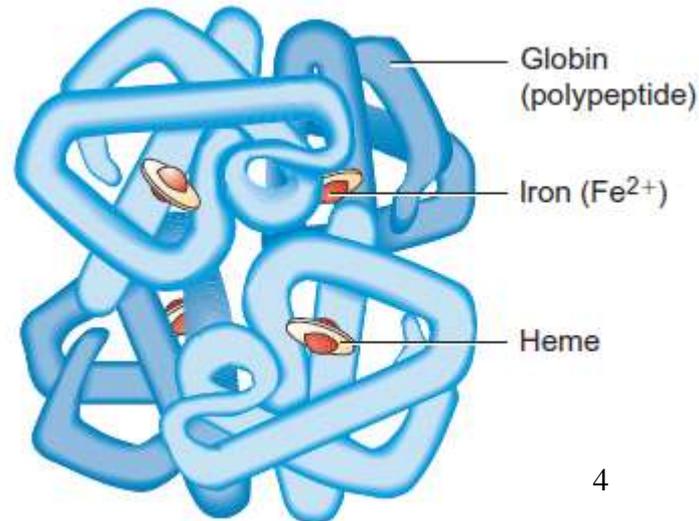
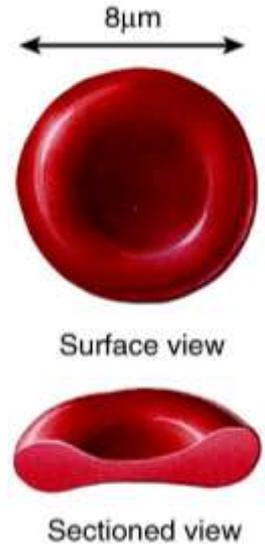


Fig.2: The shape of red blood cells and hemoglobin molecule.

Functions of the red blood cells ↪ three function

1) The hemoglobin in the **RBCs** functions in the transportation of: ↪ red blood cells

□ Oxygen – this is the main function of RBCs.

□ CO₂

□ Nitric Oxide (NO) – this gas is a vasodilator that helps in increasing blood flow. ↪ توسيع الأوعية الدموية ↪ increase blood pressure

← A ← B ← AB ← O ← not present

2) Glycolipids in plasma membrane are responsible for ABO and Rh blood groups. ↪ تعرفت

3) When RBCs are destroyed by some microorganism, they release substances that can kill these microorganism. ↪ قتل

White Blood Cells/ Leukocytes

↳ because they formed in bone marrow → blood → cell

❖ **Wandering cells:** formed in bone marrow, circulate in blood and enter tissues.

↳ all progenitor cell present inside bone marrow
↳ is stem cell (progenitor not happen inside if any) differentiation

❖ **Respond to local factors in inflammation.**

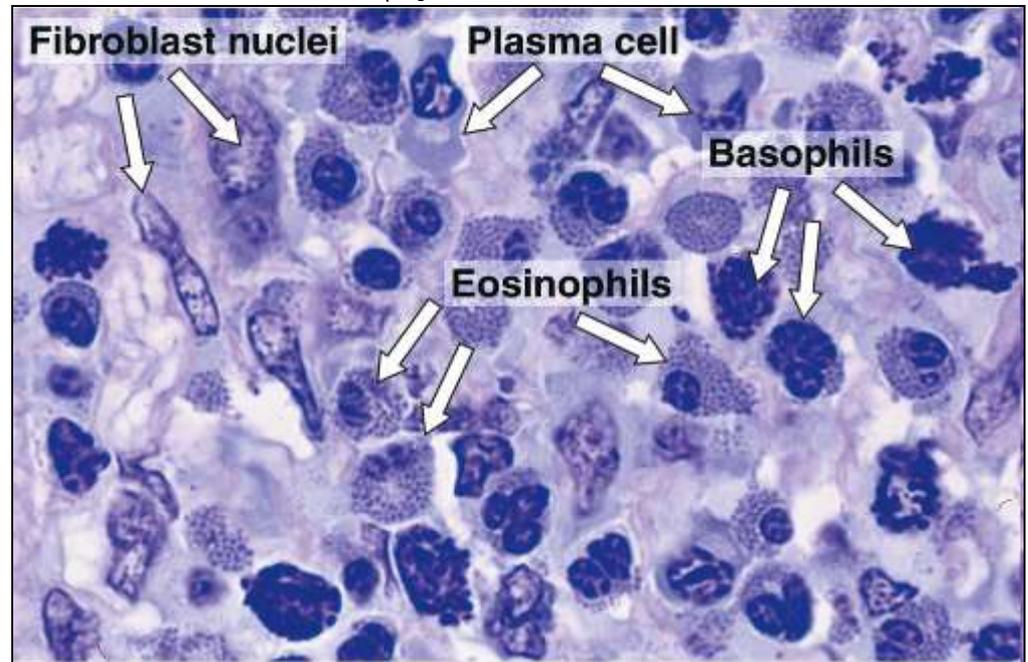
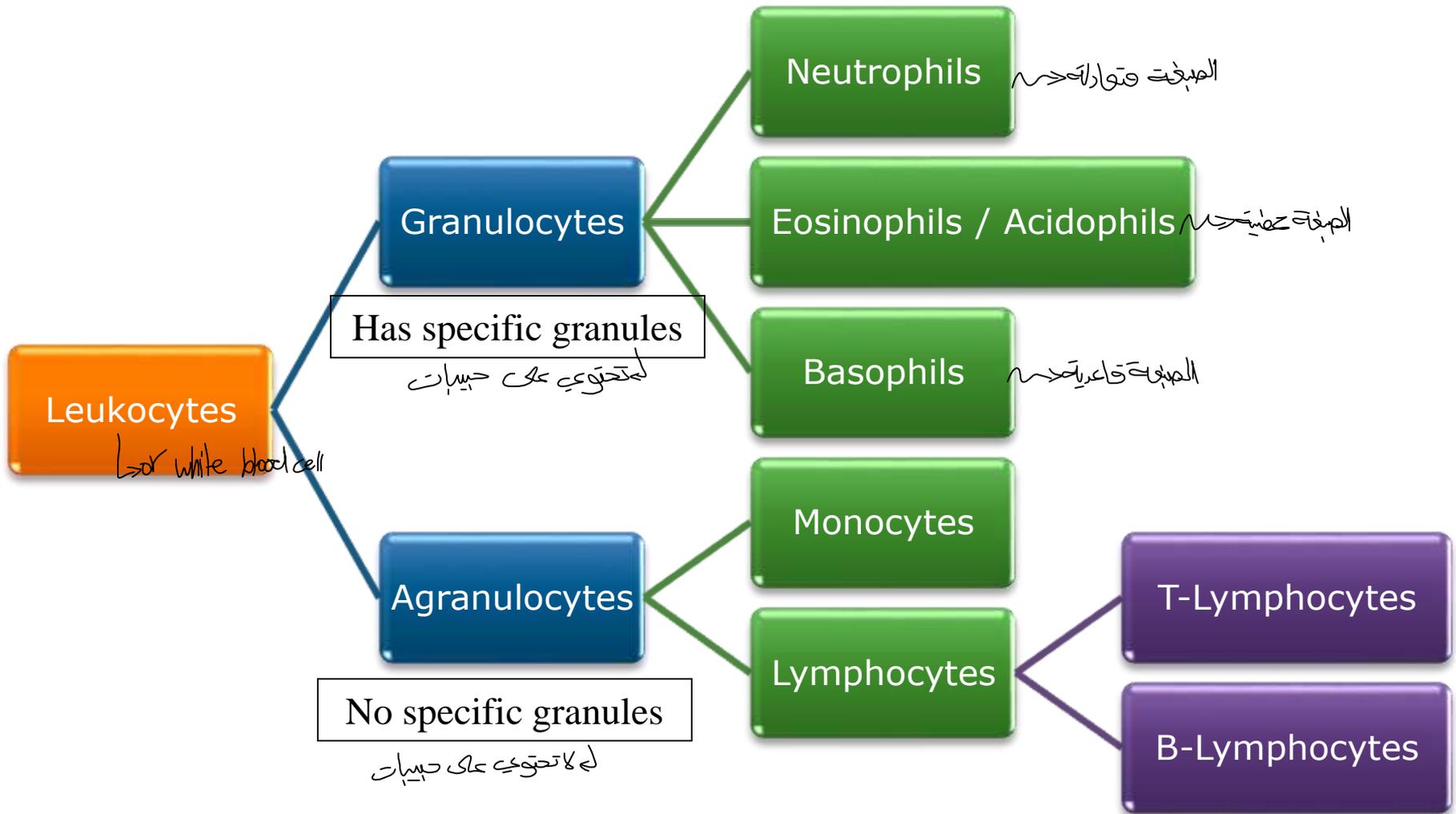


Fig.3: Leukocytes in inflamed tissue.

Classification of Leukocytes



cell blood counts (4060 - 11000) → increase on 11000 (infection)

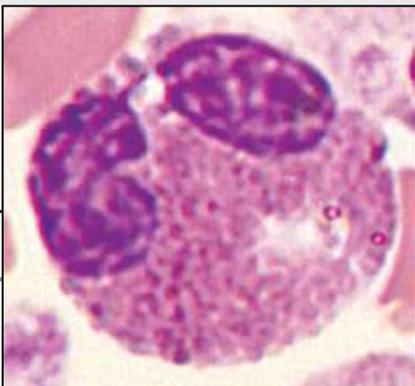
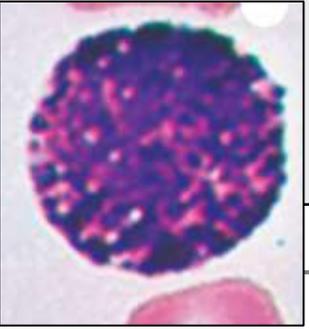
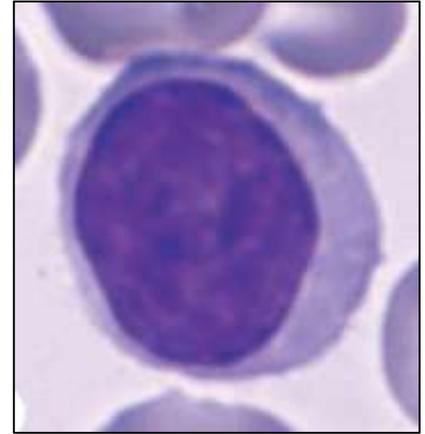
Granulocytes	Neutrophils	Eosinophils , acidophils	Basophils
Abundance (% of leukocytes)	<p>له أكثر نسبة Most common → زادت (40-45) → shifting</p>	<p>له أقل من neutrophils وأكثر basophils ⇒ parasite infection → ↑ Eosinophils</p>	<p>↳ increase → inflammation Least common</p>
Nucleus	<p>Multilobed له زىء الحبيبة</p>	<p>Bilobed له ذواتين</p>	<p>S shaped (obscured by granules) فقط ←</p>
Granules	<p>Sparse and stain variably له بقع متباينة</p>	<p>Large eosinophilic</p>	<p>Large basophilic</p>
Function	<p>Phagocytosis</p>	<ul style="list-style-type: none"> • Defense against parasitic infection • Allergic reactions 	<p>Release of inflammatory molecules</p>
<p>Fig.4: Granulocytes.</p>			

Fig.5:
Agranulocytes.

Agranulocytes:

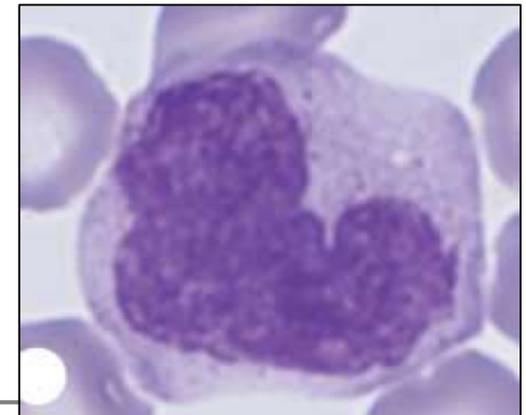
Lymphocytes:

- ❖ Variable in size.
- ❖ Nucleus very dark and occupies most of the cell. ← نوى
- ❖ Functions: T-cells → Cell mediated immunity.
B-cells → Antibody-mediated immunity.



Monocytes: → ربي حبة الطامبول

- ❖ Kidney or U-shaped nucleus.
- ❖ Cytoplasm basophilic. → more base
- ❖ Function: formation of macrophages.



Platelets/ Thrombocytes

← خلاصة

- Large cells in the bone marrow called **Megakaryocytes** send processes into blood vessels. These processes will **splinter** into small fragments called Platelets. ← تشقق
- This process continues until each **megakaryocyte** gives rise to about 2000 platelets. → (1000-3000) fragment of platelets
- Each platelet is a **disc-shaped** structure **surrounded by cell membrane** and **containing no nucleus but numerous vesicles containing blood-clotting promoting factors**. ↳ progenitor cell of platelets (from bone marrow) to blood vessel (but not pass from vessel, the cause size)
- **Short** life span: **5-9 days**. ↪ (حورة الظلقة)
- **Function:** Stops bleeding by the formation of **(1) platelet plug** and **(2) blood clot**. ← زئبق

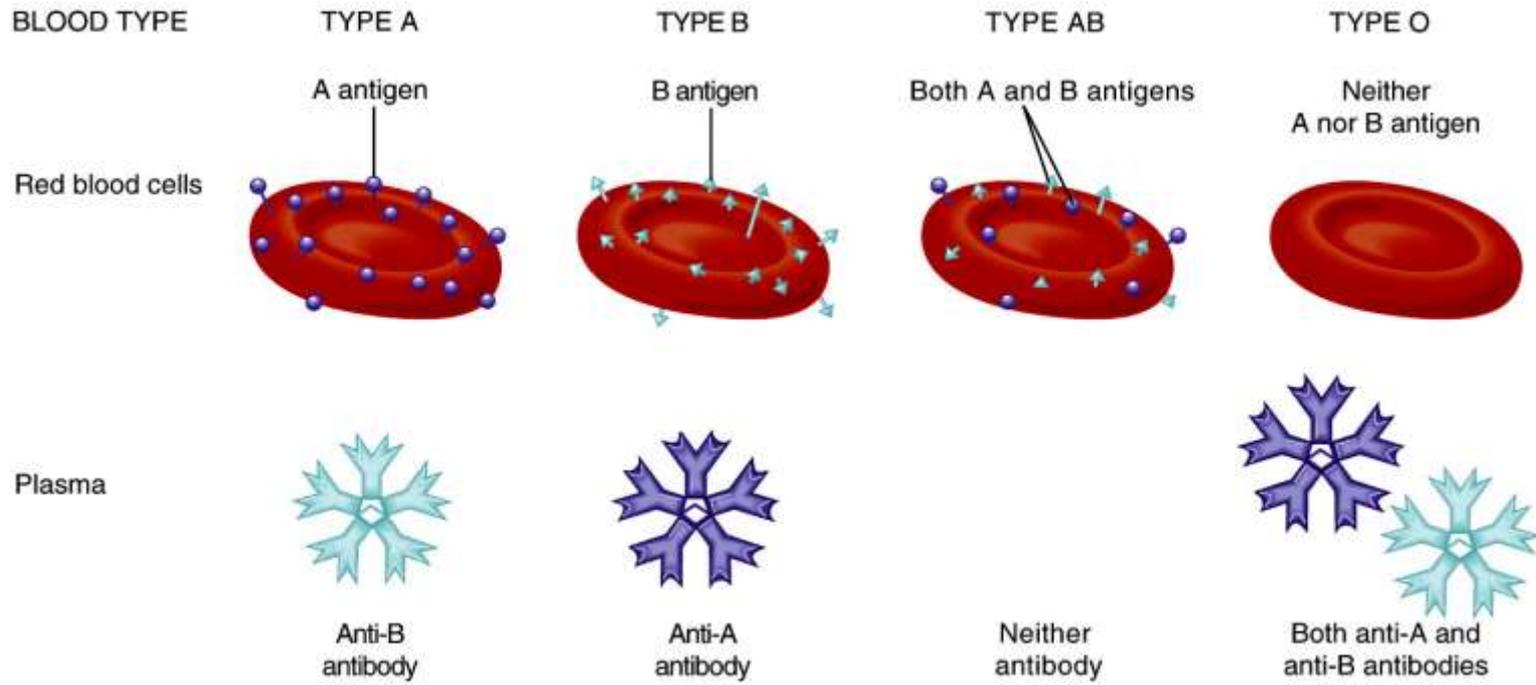
ABO Blood Group النوع الدم (on glycolipids)

- Blood group is type of blood designated to a person based on the presence/absence of an antigen on the surface of RBCs.
- The ABO blood groups are based on the A and B antigens.
- Reason for antibodies presence not clear.

لغير واضح → function? - fight when blood donation

Blood Type	Antigen on RBCs	Antibody in Plasma
<small>A ↗ O ↘</small> A	A	Anti-B
<small>B ↗ O ↘</small> B	B	Anti-A
<small>ياخذ من الكل</small> AB → universal recipient	A & B	None
<small>فقط O</small> O → universal donor	None	Anti-A & Anti-B

Fig.6: Antigens and antibodies in the different blood groups.



- Each blood group can give to itself
- **AB** is the **Universal Recipient**
- **O** Is the **Universal Donor**

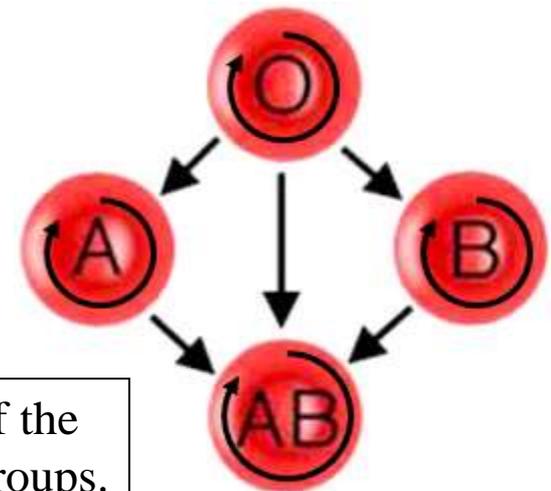


Fig.7: Relation of the different blood groups.

The Heart

↳ muscle → hollow from inside

A **hollow** **pyramidal** shaped **muscular organ** located **within the pericardium** in the **middle mediastinum** in the **thoracic cavity**.

↳ slice
cut from

The heart features:

- **3 surfaces** (anterior, inferior and posterior).
- **4 borders** (right, inferior, left and superior).
- **Apex.**
- **4 chambers** (right and left atria and ventricles).

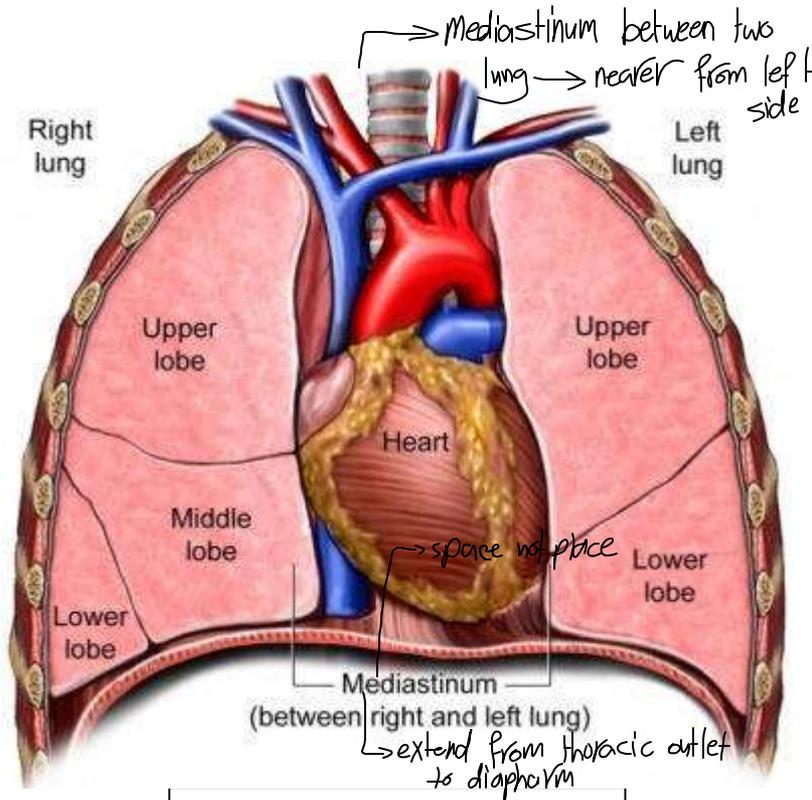


Fig.8: Position of the heart in the chest.

Thoracic (Chest) cavity:

A body cavity bounded by:

- ❑ **Anteriorly:** Sternum
- ❑ **Laterally:** Ribs, costal cartilages and contents of intercostal spaces
- ❑ **Posteriorly:** Thoracic vertebrae
- ❑ **Inferiorly:** Diaphragm
- ❑ **Superiorly:** The thoracic outlet, an oblique plane passing from the superior border of the sternum, between the two first ribs to the first thoracic vertebra

↳ axis, atlas

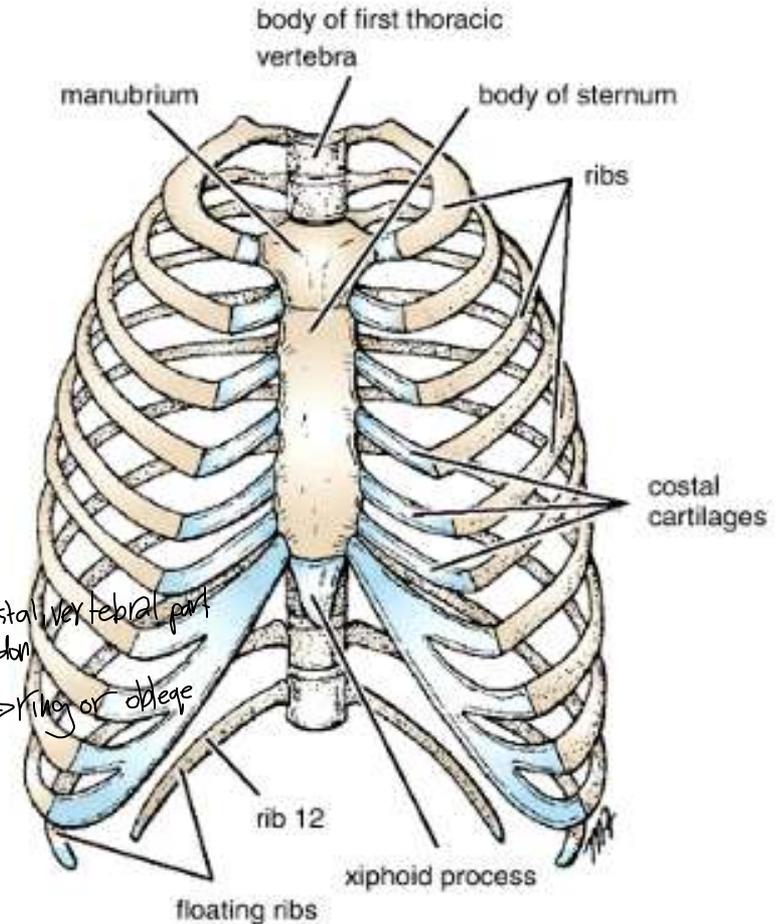


Fig.9: Boundaries of the thoracic cavity, anterior view.

Thoracic Outlet

Middle Scalene m.

Anterior Scalene m.

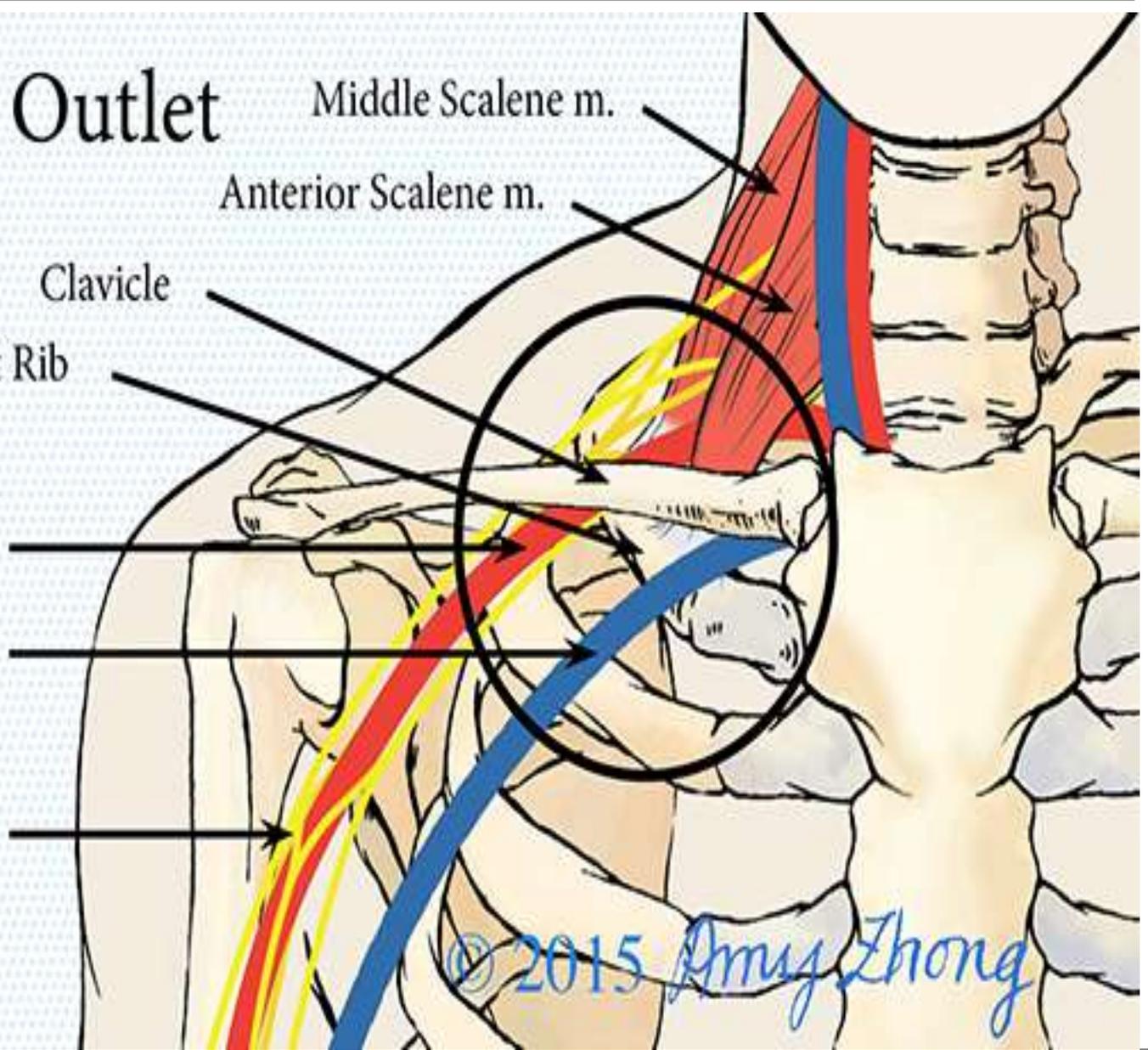
Clavicle

First Rib

Subclavian a.

Subclavian v.

Brachial Plexus



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The Mediastinum:

↳ space inside thoracic cavity

- A **midline region** that **extends** from the **thoracic outlet** to the **diaphragm**. It's bounded by:

- **Anteriorly:** Sternum

- **Posteriorly:** Thoracic vertebrae

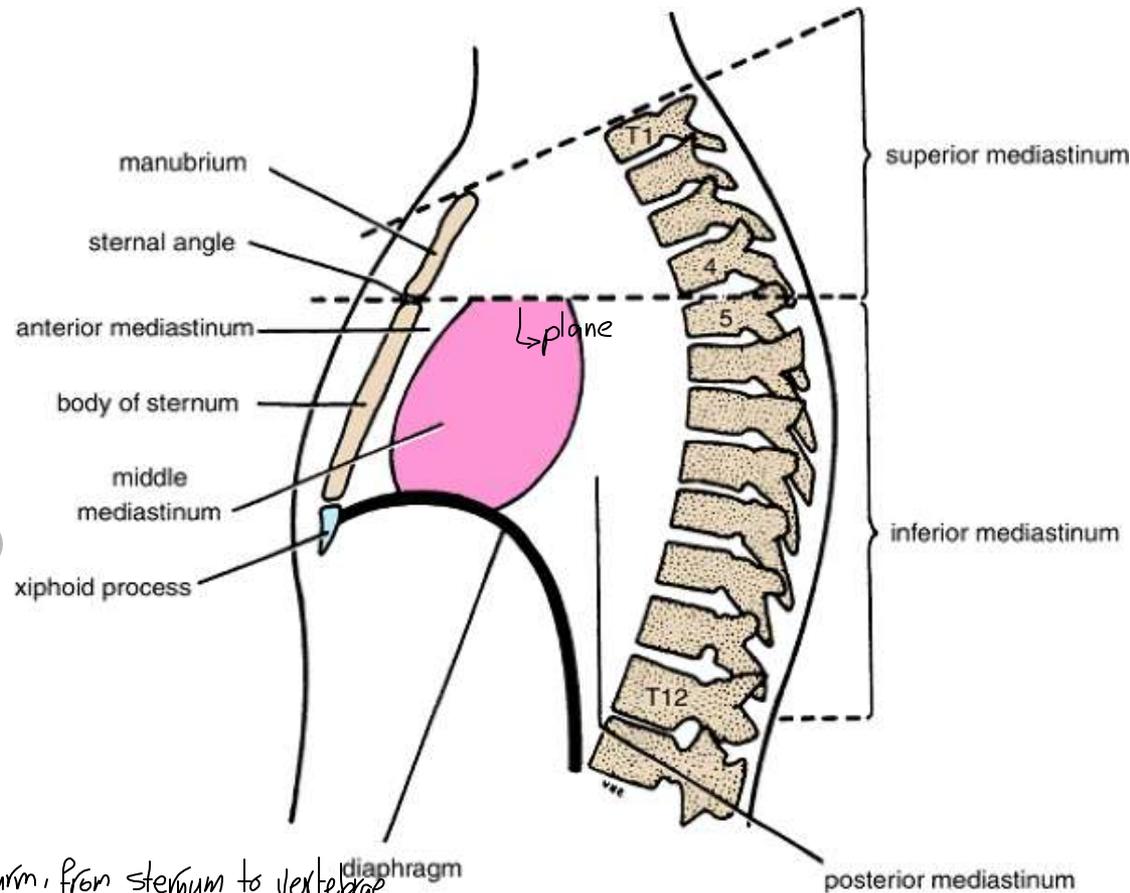
- **Laterally:** Lungs and pleurae

- **Inferiorly:** Diaphragm

↳ from thoracic outlet to diaphragm, from sternum to vertebrae

- The **mediastinum is divided into** superior and inferior parts by a plane passing from the sternal angle to the **lower** border of **T4**. The **inferior mediastinum is divided into** anterior, middle and posterior parts by the pericardium.

Fig.10: Lateral view of the mediastinum after removing the lung.



The Pericardium قسطور القلب

↳ surrounded the heart and anchor it

- Membrane surrounding and protecting the heart. Formed of 2 main parts:

- **Outer Fibrous pericardium:** قاس tough layer that function protects the heart and anchors it in place. band thick

- **Inner Serous pericardium** قسطور (simple squamous epithelium): thin more delicate membrane. Formed of the parietal layer fused to fibrous pericardium and the visceral layer which is the epicardium.

↳ two layer
 ↳ parietal layer :- outer part of serous, inner to fibrous
 ↳ visceral layer :- inner part of serous, attach with heart
 ↳ composed pericardial space (inside this space pericardial fluid) → reduce friction on the myocardium

- Between the two serous layers we have the pericardial cavity that's filled with the pericardial fluid to reduce friction.

↳ pericarditis disease :- occurs when pericardium thickens and stiffens, affecting the heart ability function normally

↳ وهذا النوع
يخفف الألم

Layers of the heart wall

- inner layer*

1. **Endocardium:** Inner layer of the heart. Lined by endothelium (simple squamous epithelium) continuous with that of the blood vessels. *wrapping the blood vessel from inside*
↳ as the serous pericardium
- middle layer*

2. **Myocardium:** The thickest layer of the heart. Formed of cardiac muscle cells. *muscle fiber*
- outer layer*

3. **Epicardium:** The outermost layer. The same as the visceral pericardium.

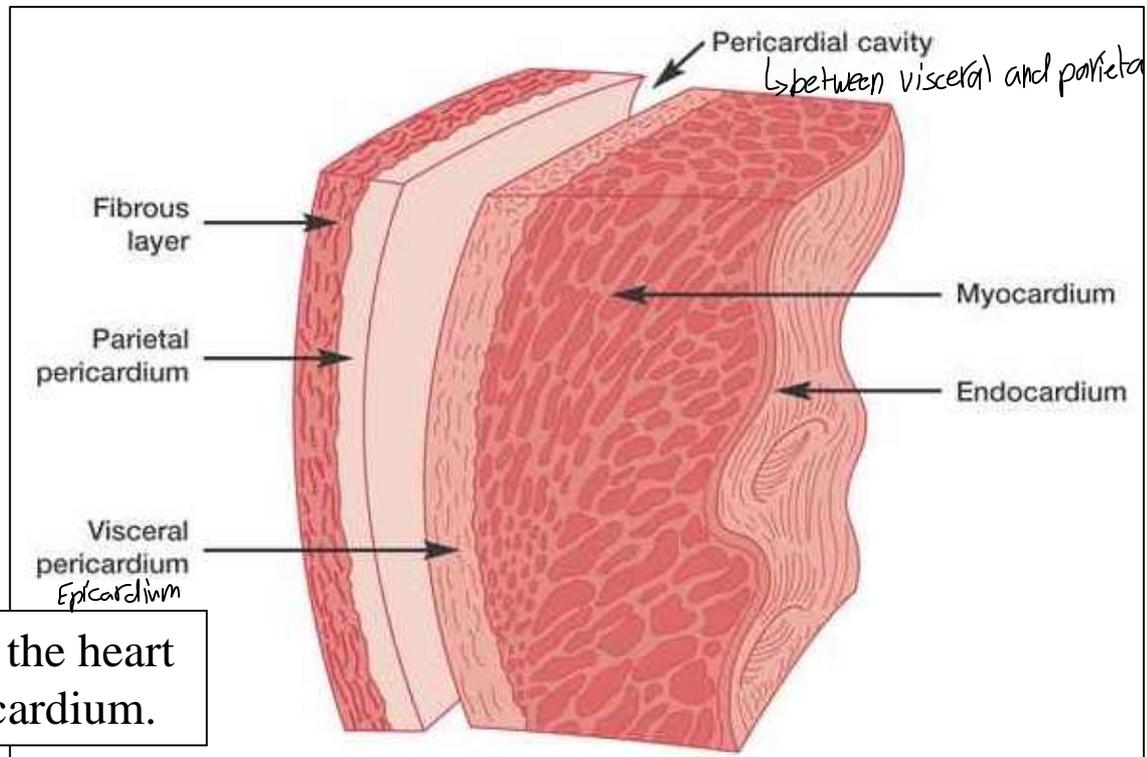


Fig.11: Layers of the heart wall and the pericardium.

Surfaces of the heart

Anterior Surface:

➤ Formed by the:

- Right atrium
- Right ventricle
- Left ventricle

➤ Related to the sternum. *→ nearest structure*

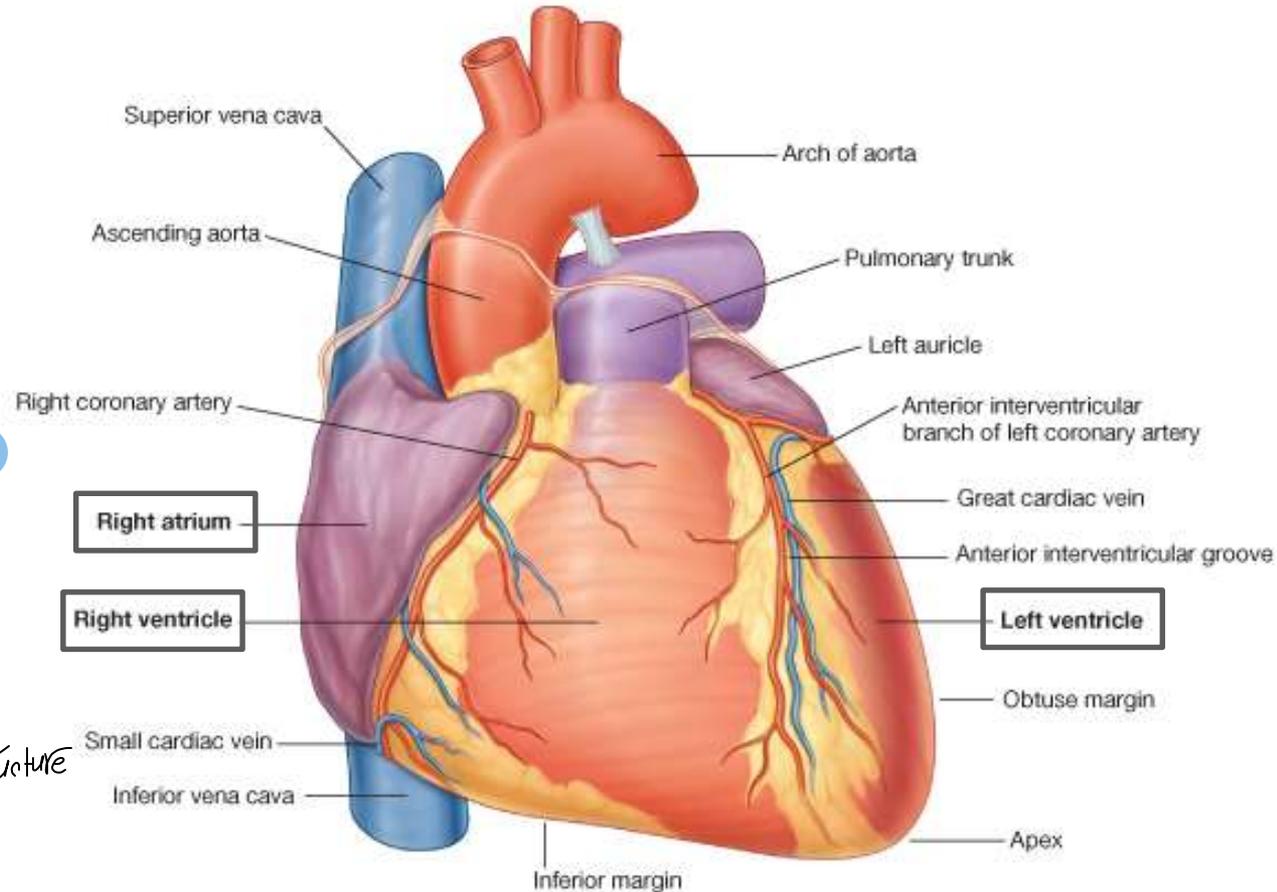


Fig.12: The anterior surface of the heart.

Fig.13: The posterior and inferior surfaces of the heart.

Posterior Surface

(Base):

➤ Formed by the:

- Left atrium

➤ Related to the

esophagus. ↳ nearest structure

لے قریب

Inferior Surface:

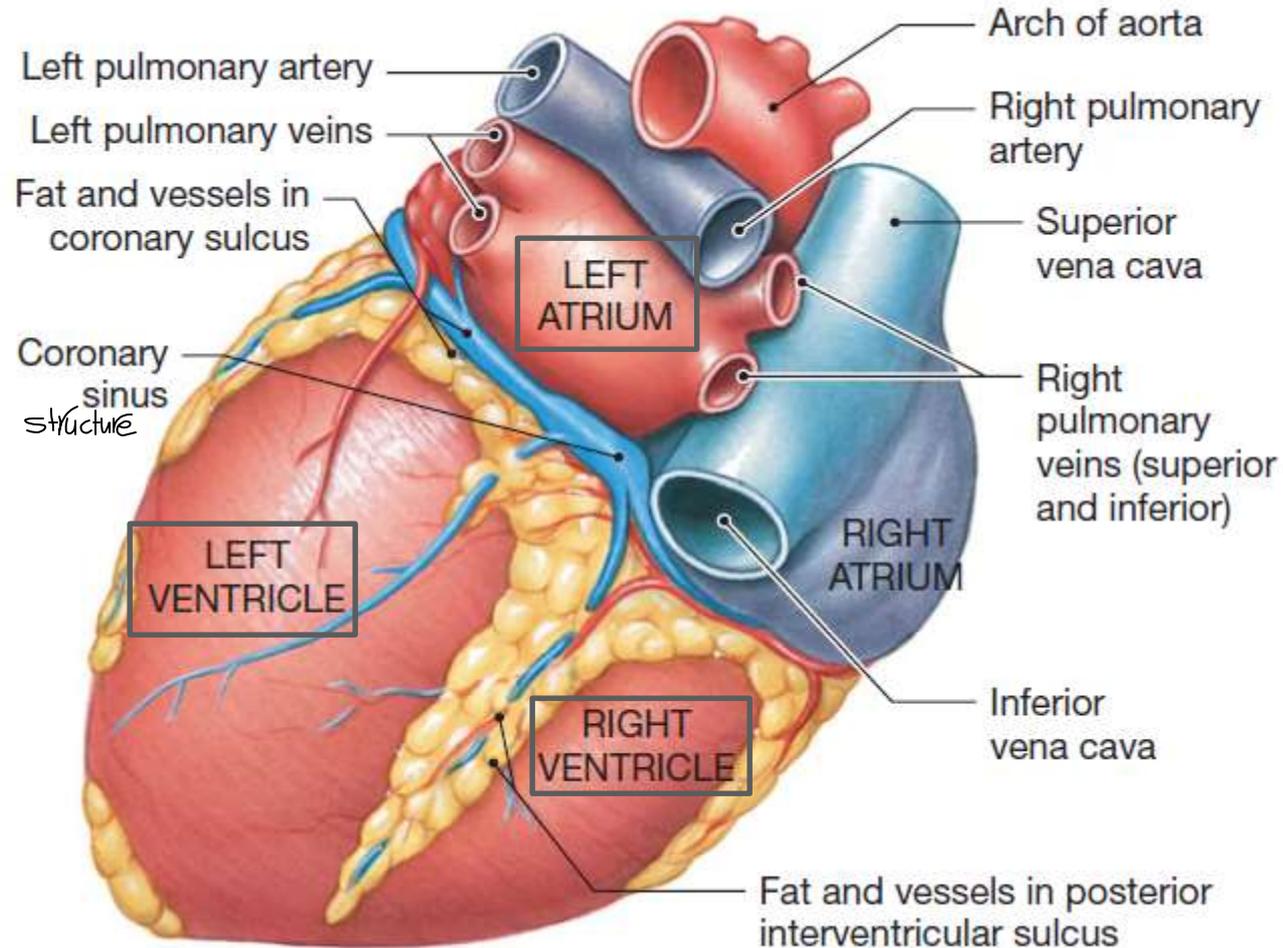
➤ Formed by:

- Right ventricle
- Left ventricle

➤ It's the surface upon which the heart rests on the diaphragm.

لے قریب

↳ nearest structure



Borders of the heart

They're very important to know and to understand X-rays of the heart.

- 1. Left border:** left ventricle, left atrium, pulmonary trunk and arch of aorta..
↳ From right ventricle
- 2. Inferior border:** right ventricle.
- 3. Right border:** IVC, right atrium, SVC.
↳ inferior vena cava
↳ superior vena cava
- 4. Superior border:** right and left atria, SVC, ascending aorta and pulmonary trunk.
↳ الجزء الصغرى
↳ left ventricle

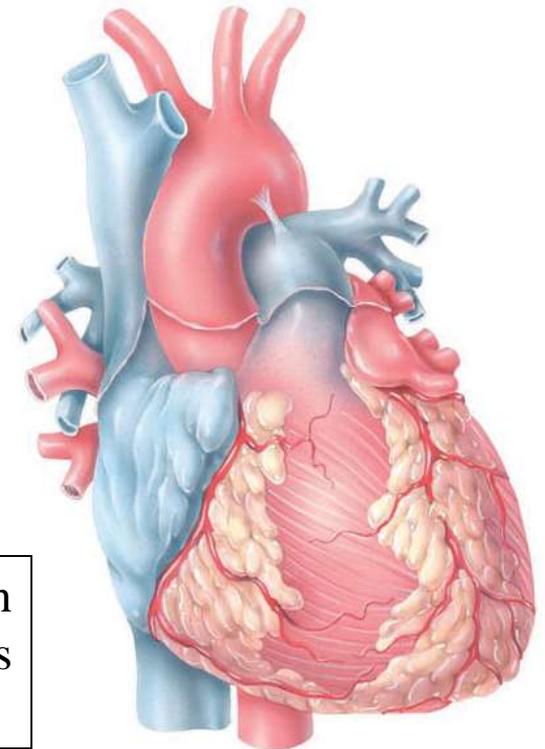
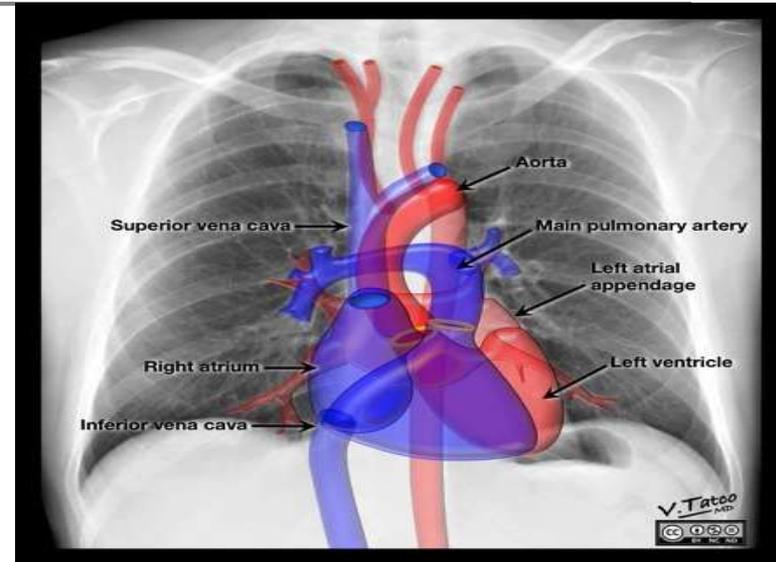


Fig.14: Boundaries of the heart as seen on an X-ray. Compare with the gross anatomy of the heart.

Apex of the heart

↳ pyramidal shape, inverted and possess angle

- ❑ Formed by the **left ventricle**. → in the end
- ❑ **Directed downwards, forwards and to the left.**
- ❑ **Located at the left 5th intercostal space 9cm from the midline.**
- ❑ **Can be felt by palpation.**

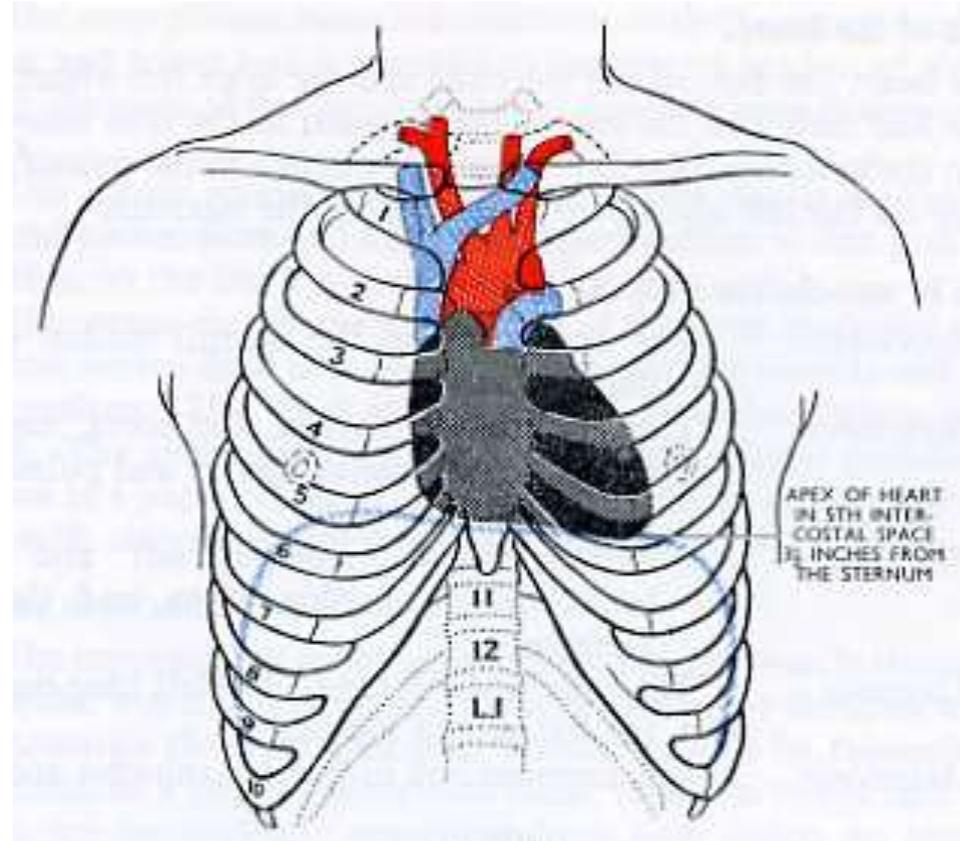


Fig.15: Location of the apex of the heart.

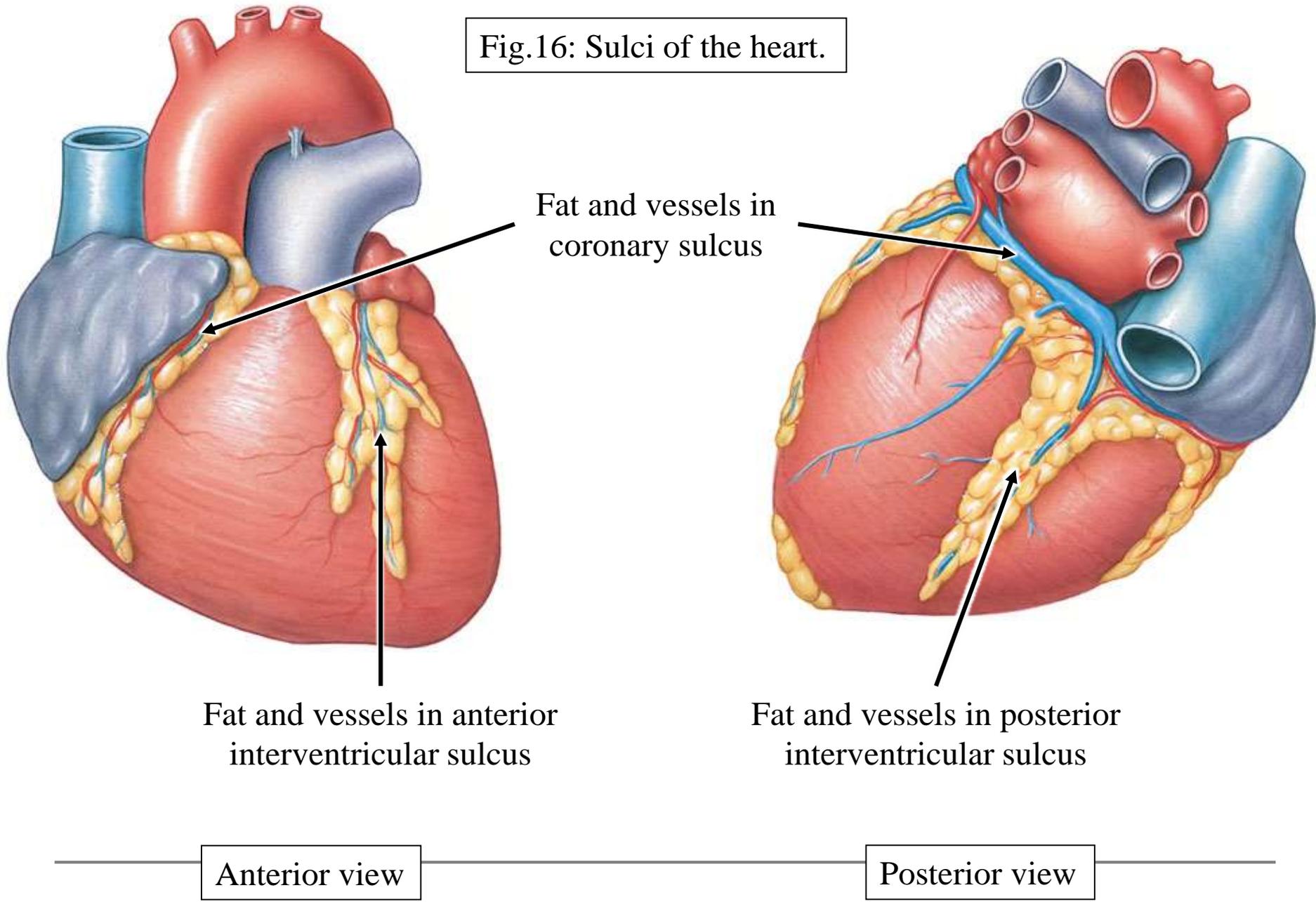
Chambers of the heart

- **2 atria** – receiving chambers → (الستقبل الدم) (area)
 - Auricle: small pouch that increase capacity of atria ← انتفاخ
- **2 ventricles** – pumping chambers → (مضخ الدم)
- **Sulci** – grooves on the surface of the heart that contain the coronary blood vessels. + fat → function = insulator, protection ← البعاجات للذئب

1. **Coronary sulcus**: separating the ^{two} atria from the ^{two} ventricles.
2. **Anterior interventricular sulcus**: between the two ventricles anteriorly.
3. **Posterior interventricular sulcus**: between the two ventricles posteriorly.

↳ but not present sulcus separate from two atria only

Fig.16: Sulci of the heart.



Anterior view

Posterior view

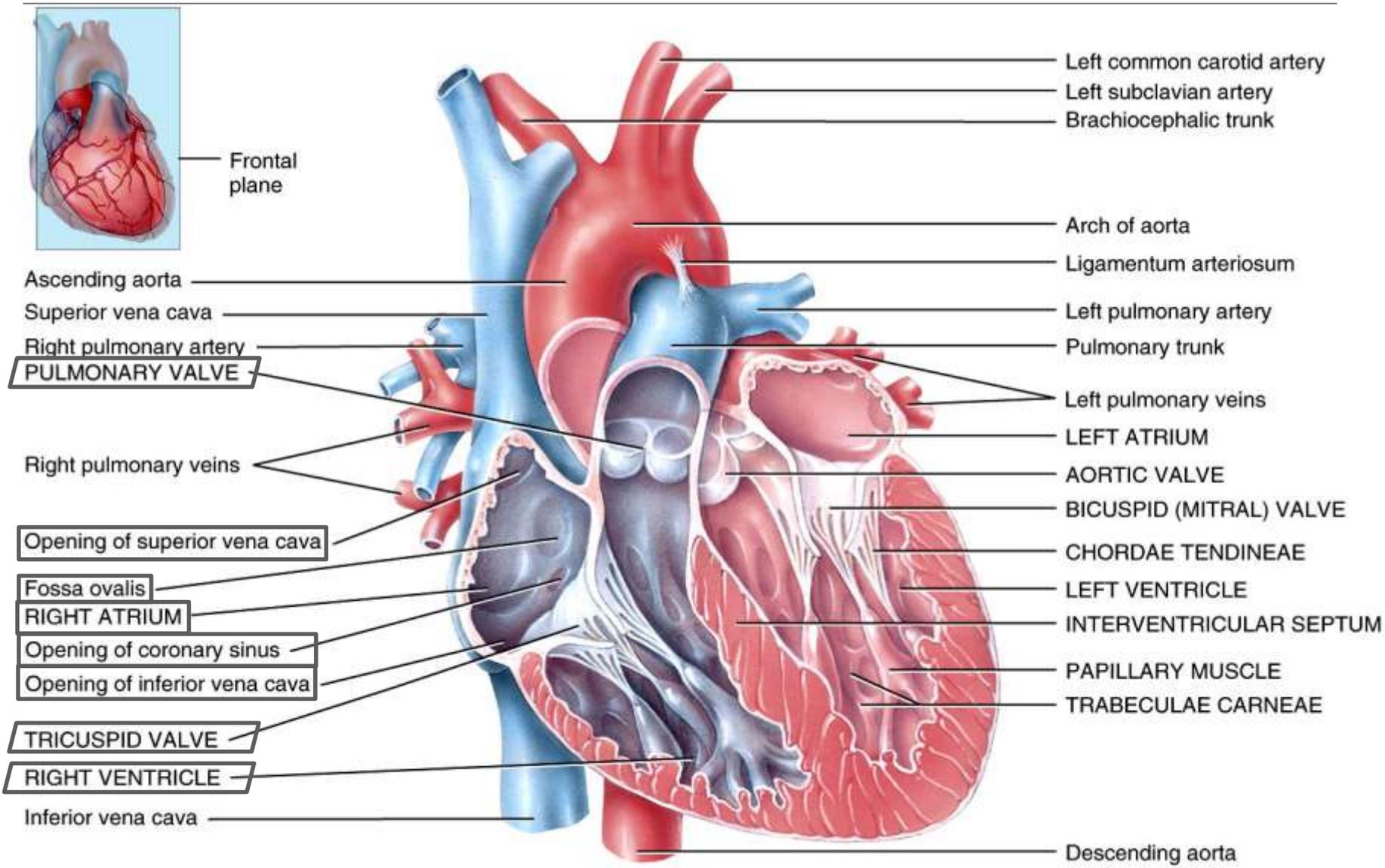
The Right Atrium (RA)

→ the place that allow to the mixing? ① foramen ovale
② ligamentum arteriosum
↪ between right and left atrium
↪ between pulmonary artery and aorta

- Receives blood from: (1) Superior vena cava, (2) Inferior vena cava, (3) Coronary sinus.
↪ deoxidative
↪ فتحة
- Interatrial septum has fossa ovalis (remnant of foramen ovale)
↪ إحد وكادة الجنين
↪ بقايا
↪ between right and left atrium
- Blood passes through the right atrioventricular orifice (which's guarded by the tricuspid valve) into right ventricle
↪ فتحة
↪ حروفين
↪ input the deoxidative blood to right atrium by coronary vein

The Right Ventricle (RV)

- Possess trabeculae carneae – raised bundles of cardiac muscle fiber.
↪ increase muscle area → increase contraction
- Cusps of the tricuspid valve are connected to chordae tendinae which are connected to papillary muscles (3 in number).
↪ right AV valve, right atrioventricular valve
↪ three papillary muscle → valve (open, close)
↪ the cusps articulate together in tricuspid valve
- Interventricular septum.
↪ between left and right ventricle (to prevent mixing between the oxide and not oxide blood)
- Blood leaves through pulmonary orifice which's guarded by the pulmonary semilunar valve into pulmonary trunk.
↪ pumping the blood into pulmonary trunk (lung)



(a) Anterior view of frontal section showing internal anatomy

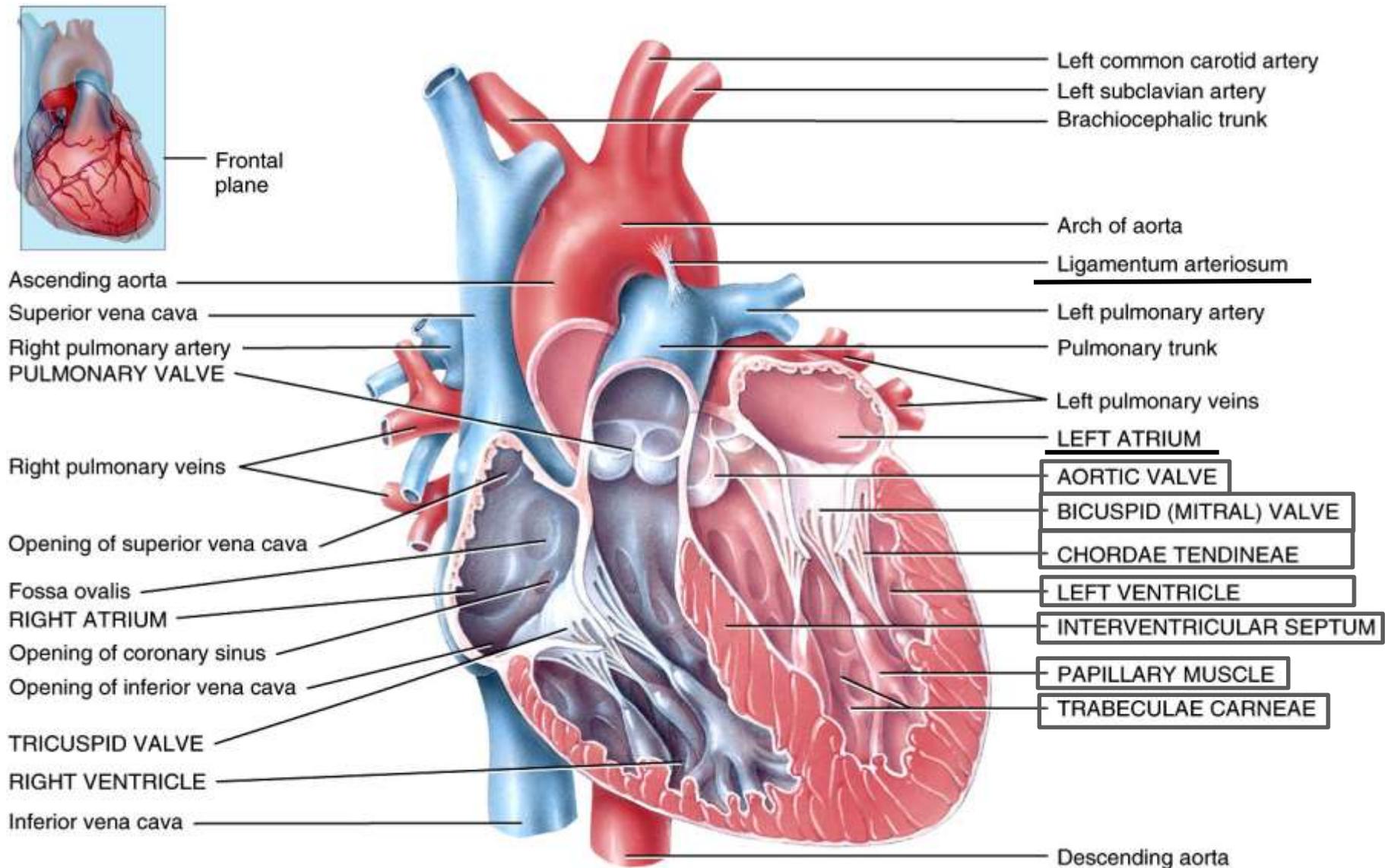
Fig.17: The left atrium and ventricle of the heart.

The Left Atrium (LA)

- About the same thickness as right atrium. → between left atrium and ventricle
- Receives blood from the lungs through pulmonary veins. → only vein that carries oxidation blood
- Blood Passes through the left atrioventricular orifice into the left ventricle. This orifice is guarded by the bicuspid/ mitral valve.
↳ because two papillary muscle between left atrium, ventricle

The Left Ventricle (LV)

- Thickest chamber of the heart.
- The cusps of the mitral valve are attached to chordae tendinae which are attached to papillary muscles (2 in number).
- Blood passes through aortic orifice into the aorta. This orifice is guarded by the aortic semilunar valve. → between left ventricle and aorta artery
- The interventricular septum is convex on the side of the RV making the cavity of the LV larger.
↳ right ventricle



(a) Anterior view of frontal section showing internal anatomy

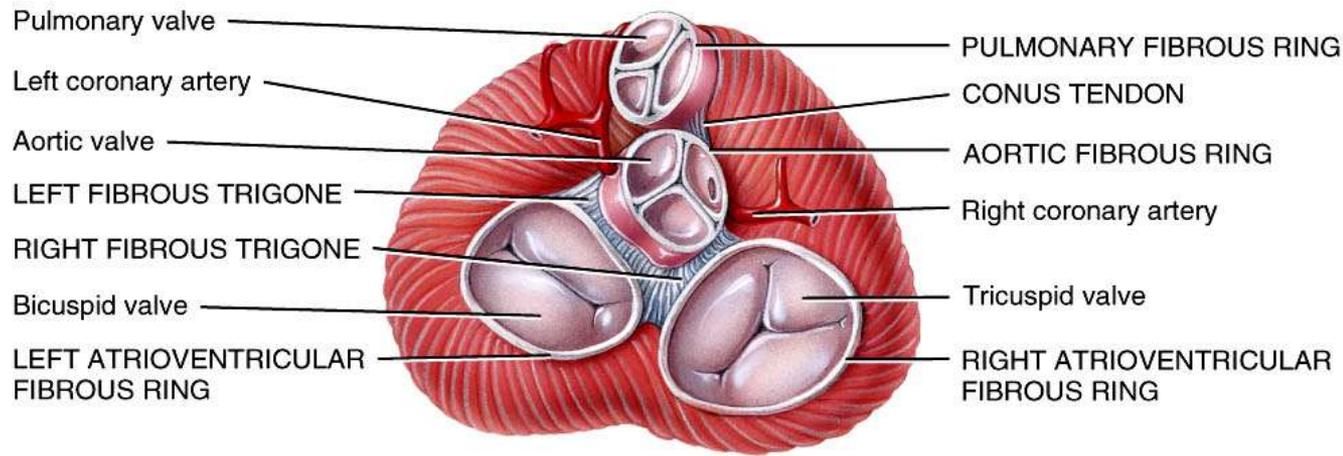
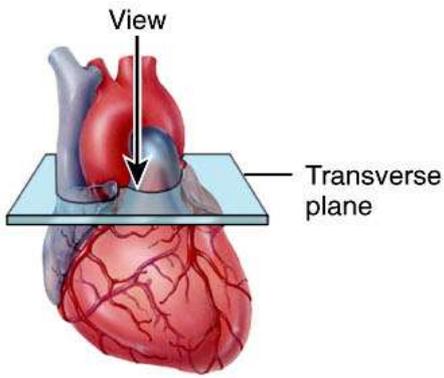
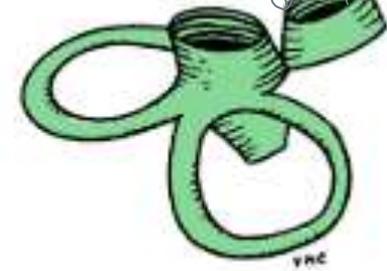
Fig.19: The right atrium and ventricle of the heart.

The Fibrous Skeleton of the heart

↳ places in heart contain fiber

- **Dense collagenous connective tissue** that forms (1) ^{thick ring} base for the valves, (2) point of insertion for cardiac muscles and (3) electrical insulator between atria and ventricles. *except AV node*

The valve is :-
 ① tricuspid valve
 ② bicuspid valve
 ③ pulmonary semilunar valve
 ④ aortic semilunar valve



Superior view (the atria have been removed)

Fig.20: The shape and position of the fibrous skeleton of the heart.

Valves: Atrioventricular Valves

⇒ valve between atrium and ventricle

↳ two valve

- Tricuspid (3 cusps) and bicuspid (2 cusps)

↳ right atrium and ventricle

↳ left atrium and ventricle

- Atria contract/ ventricles relaxed

↳ papillary muscle relaxed and chordae tendinae slack
opening valve and cusps projection when atria contract

- The higher pressure inside the atria pushes the cusps aside opening the valves and the cusps project into the ventricles

جانبا ←

↳ تنوء

- In the ventricles, papillary muscles are relaxed and chordae tendinae slack

↳ راحة

- Atria relax/ ventricles contract

pumping

↳ papillary muscle contract → tightening the chordae tendinae
closing the valve and drive the cusps toward the atria

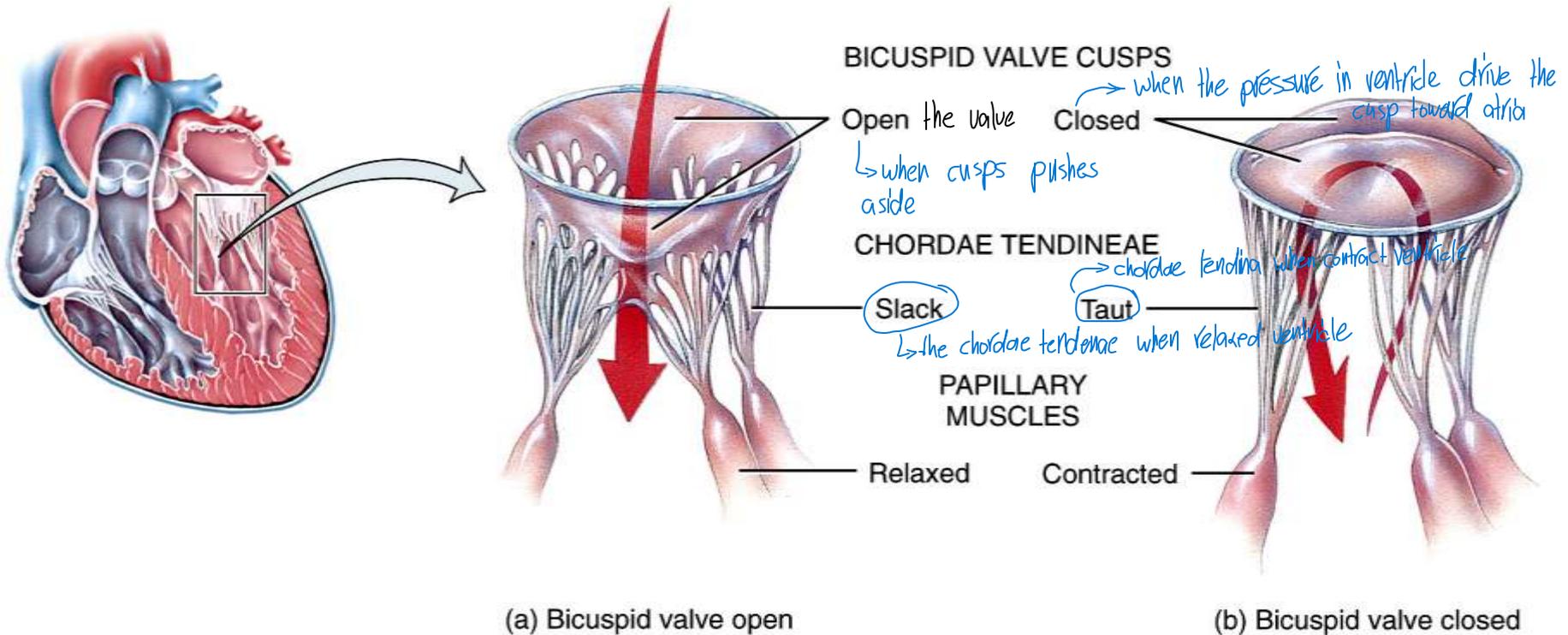
- Higher pressure in the ventricles drives the cusps towards the atria until edges of the cusps meet and close the valve

↳ حواف

- Papillary muscles contract tightening the chordae tendinae and preventing regurgitation

↳ شد

← الرجوع ← الرجوع الدم لـ atria



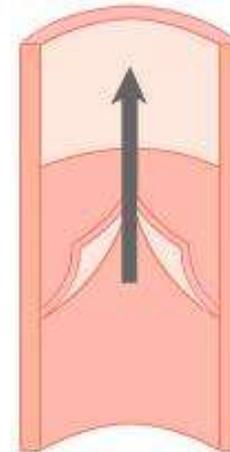
↳ between left atria and left ventricle → to pour the blood inside left ventricle → (contract left atrium, relaxed (filling) right ventricle)

Fig.21: How the atrioventricular valves function.

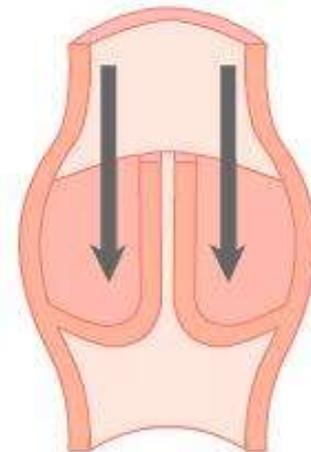
Valves: Semilunar Valves is two valve?

- between the left ventricle and aorta artery
 □ **Aortic** and **pulmonary** valves (each has 3 cusps).
→ between the right ventricle and pulmonary artery

- When ventricles contract the pressure in ventricles exceeds pressure in arteries **pushing the cusps aside and opening the valve.** → opposite the atrioventricular valve



Open



Closed

→ when ventricular contraction

- As ventricles relax, some blood flows back towards the ventricles, but blood fills the valve cusps closing them tightly. → as a result the cusp close to prevent the blood to back in the ventricle

- The aortic valve has openings for the coronary arteries into which blood flows when **LV relaxes.** → left and right (supply the cardiac muscle in oxygenated blood)

→ decrease the pressure in aorta artery → allow the blood to pass through the coronary artery (by special opening in the base of the aortic valve)

→ as a result the cusp close to prevent the blood to back in the ventricle

→ allow

Fig.22: Above, how the semilunar valves function. Below, opening of the coronary arteries.

The Conduction System of the heart

↳ cardiac myocyte cell, SA node → initiation electrical (action potential)
↳ pacemaker

Formed of specialized cardiac muscle fibers.

Nerve impulses from autonomic nervous system and hormones modify timing and strength of each heartbeat but do not establish fundamental rhythm.

→ sympathetic (fight) → secretion adrenalin that bind with B₁ (heart/kidney) increase heart rate
→ parasympathetic (rest and digested) → decrease heart rate

← ريثم بكل شيء إلا ريثم ←
rhythm

2 important functions of these specialized cells: (cardiac muscle fiber)

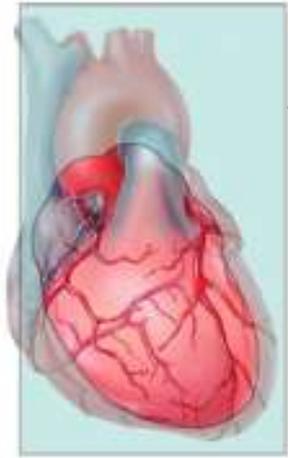
1. Act as pacemaker ~> only SA node

2. Form conduction system ~> need K^+ , Na^+ , Ca^{2+} because present repolarization plateau and depolarization

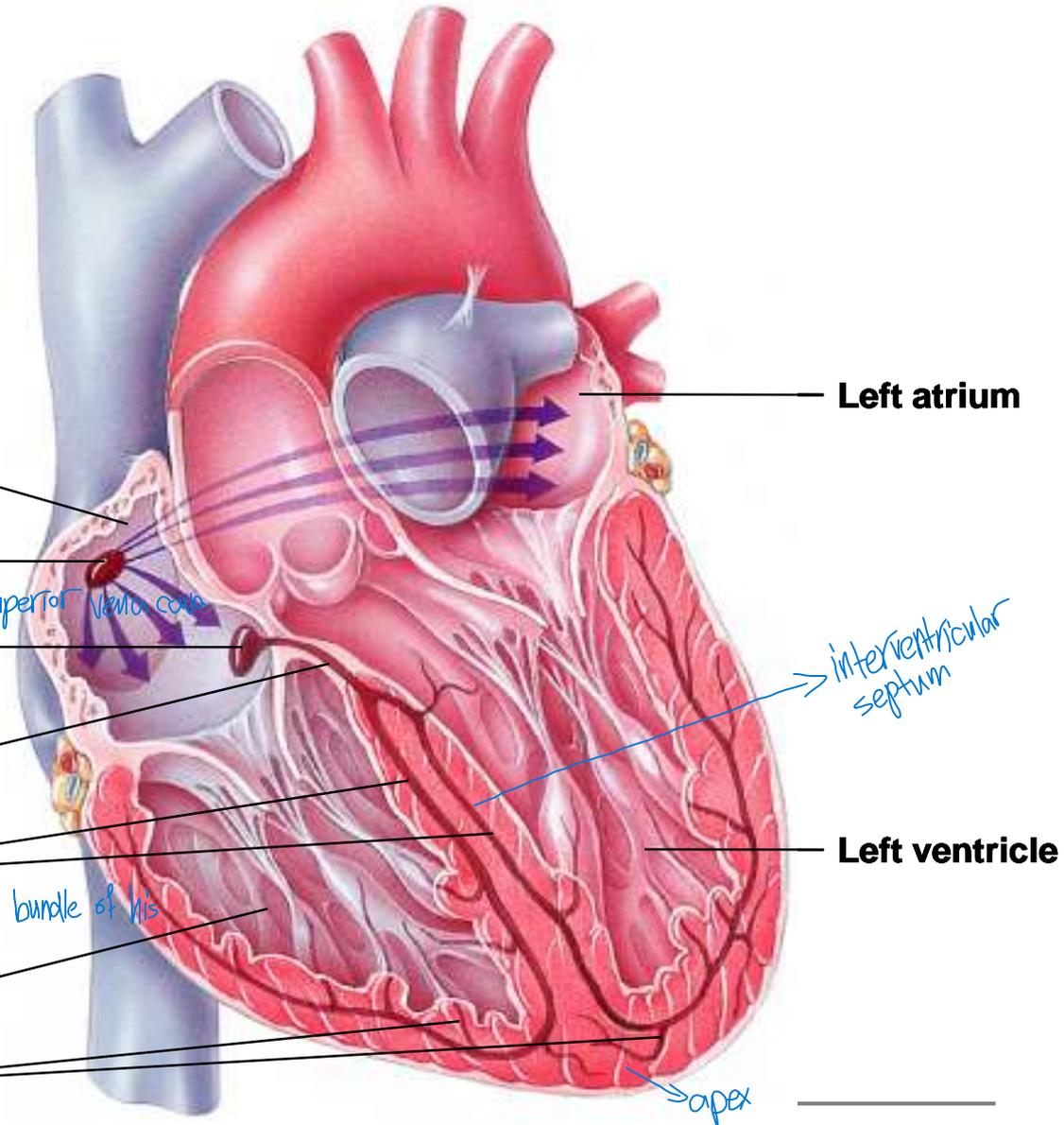
Conduction Pathway

→ In the end of superior vena cava → only can produce the action potential in the heart

1. Begins in **sinoatrial (SA) node** in **right atrial wall**
 - Propagates through atria **via gap junctions**
 - **Atria contract** → ^{left and right} the action potential propagate from right atrium to left atrium via gap junction ^{between left and right atria}
2. Reaches **atrioventricular (AV) node** in **interatrial septum** where it's delayed → the cause is (pass the AP via one way (bundle of His) to full contraction of atrium)
3. Enters **atrioventricular (AV) bundle (Bundle of His)**
 - Only site where action potentials can pass from atria to ventricles **due to fibrous skeleton** ^{البرق الوحيد الذي ينقل (AP) من أtria إلى ventricle}
4. Enters **right and left bundle branches** which **extends through interventricular septum towards apex**
5. Finally, ^{between left and right ventricle} large diameter **Purkinje fibers** **conduct action potential to remainder of ventricular myocardium**
 - **Ventricles contract** → full contraction of ventricle in end the purkijie fiber



Frontal plane



⇒ pathway the action potential?

1 SINOATRIAL (SA) NODE

↳ in opening of superior vena cava

2 ATRIOVENTRICULAR (AV) NODE

3 ATRIOVENTRICULAR (AV) BUNDLE (BUNDLE OF HIS)

4 RIGHT AND LEFT BUNDLE BRANCHES → branched bundle of his

Right ventricle

5 PURKINJE FIBERS

→ apex

Fig.23: The conduction system of the heart.

The Coronary Circulation

coronary vein → coronary sinus
coronary artery → via two septum

- The heart has its own network of blood vessels.
- Coronary arteries branch from ascending aorta.

two importance for these branches?

- Anastomoses provide collateral circuits
- Allows heart muscle to receive sufficient oxygen even if an artery is partially blocked

network from the blood vessel to nourish the heart

□ **Left Coronary Artery** → **Anterior Interventricular** and

② **Circumflex branches**

↳ the branches? ①
↳ تغذية 70% من القلب

↳ كافي
↳ of sulcus
↳ left anterior descending artery, LAD

□ **Right Coronary Artery** → **Marginal** and **Posterior Interventricular branches**, (sulcus)

↳ the branches?

□ **Coronary veins:** ↳ the branches?

■ Include the **Great, Anterior, and Middle cardiac veins**

■ Drain into **Coronary Sinus** (in the coronary sulcus)

↳ تصريف الدم

↳ that inter right atrium

↳ the location drain the blood from coronary vein.

The vessel formed vascular anastomosis mainly function as a collateral circulation to provide the heart in additional stored from the blood.

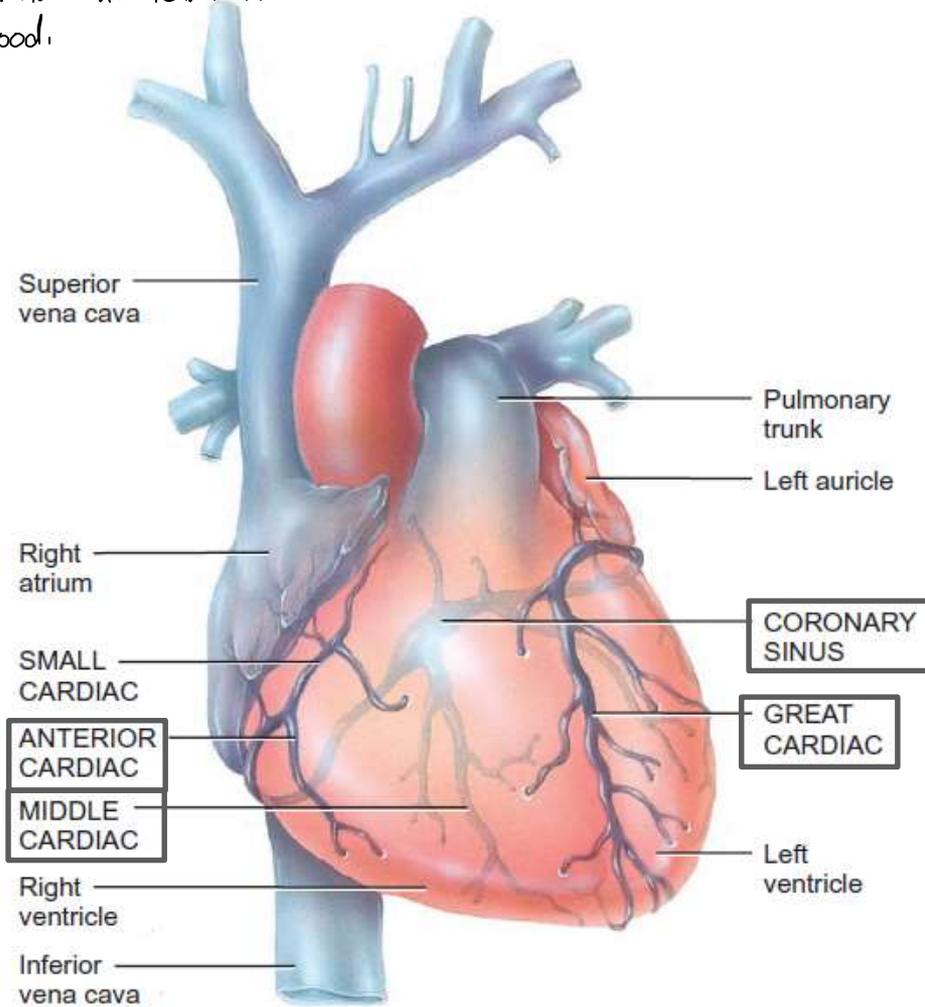
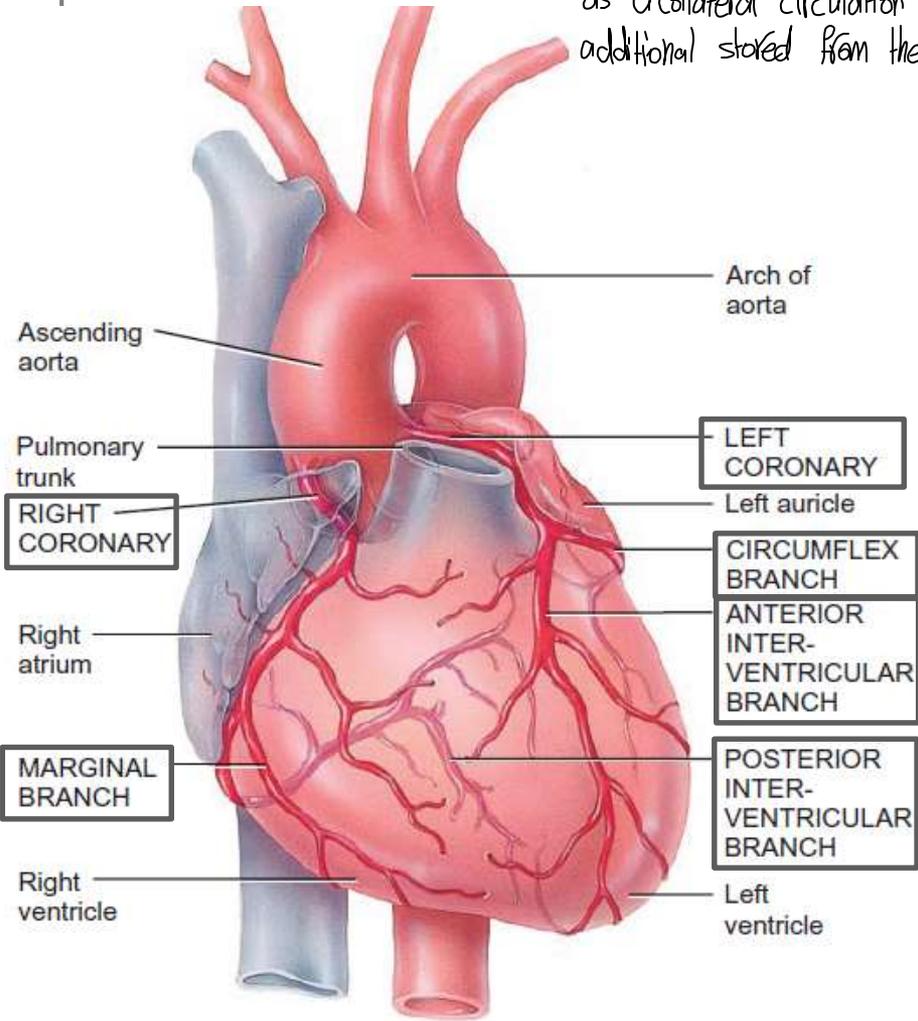


Fig.24: The coronary circulation.

The Blood Vessels

The blood vessel is?

- **Tube-like structures** through which **blood is carried**
- **5 main types:**
 - **Arteries** – **carry blood AWAY from the heart** (*deoxidation, oxidation*)
 - **Arterioles**
 - **Capillaries** – **site of exchange**
 - **Venules**
 - **Veins** – **carry blood TOWARDS the heart and they possess valves**

↳ (deoxidation, oxidation)

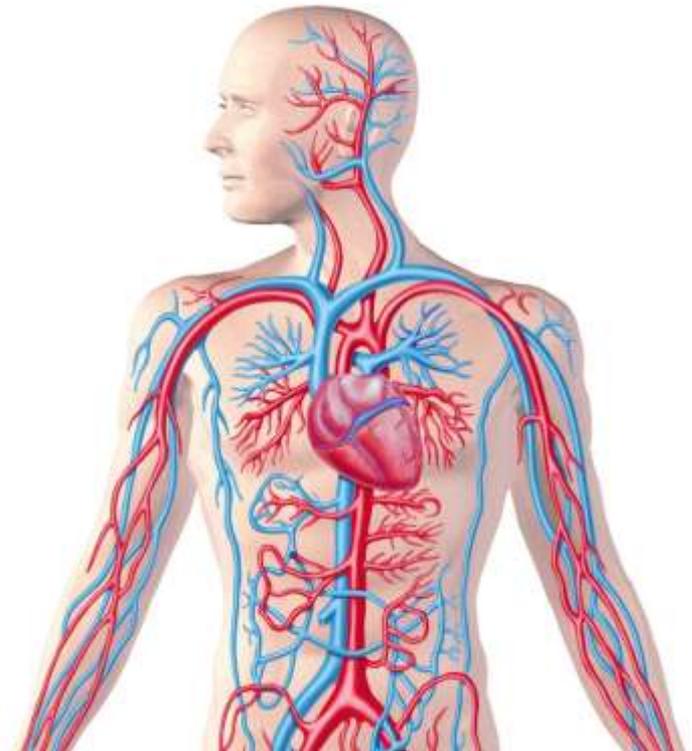


Fig.25: The blood vessels.

⑥ superior, inferior vena cava

Basic structure of the wall of blood vessels

■ **Tunica interna (intima)** → the inner layer

- Inner lining in **direct contact with blood**
- Endothelium continuous with **endocardial lining of heart**
↳ simple squamous epithelium as the heart

■ **Tunica media** → the middle layer

- **Muscular and connective tissue layer** → basement membrane that separate from intima and media layers
- **Greatest variation** among vessel types
← أكبر نوع
- **Smooth muscle regulates diameter of lumen** → the smooth muscle give elasticity to the blood vessel (allow the vessel to expansion and contraction)
↳ but not skeletal

■ **Tunica externa** → outside layer

- **Elastic and collagen fibers**
- **Vasa vasorum** (blood vessels that supply the blood vessel) or a small blood vessel that nourishes the large blood vessel in the blood.
- function? □ **Helps anchor vessel to surrounding tissue**
↳ تثبيت

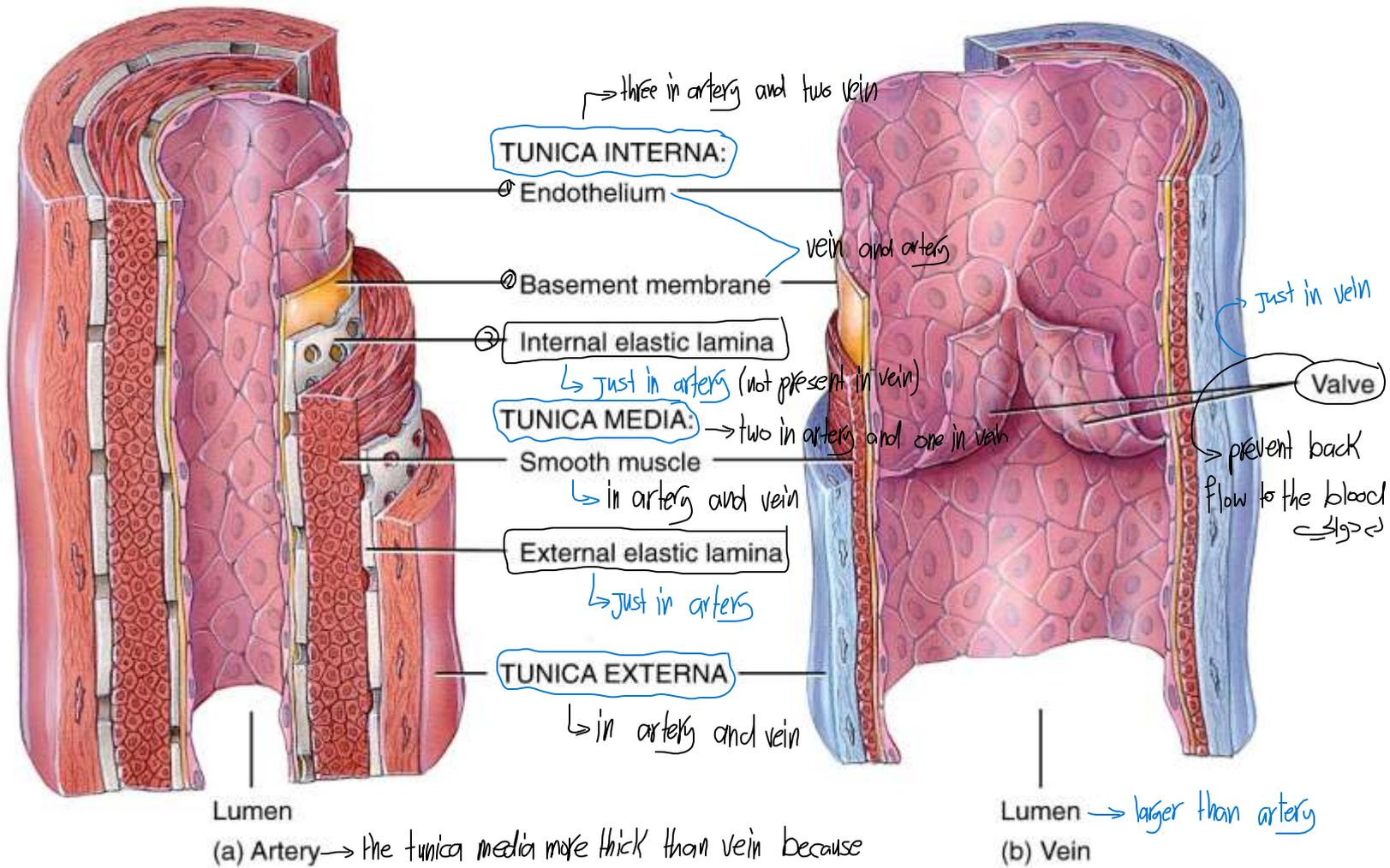
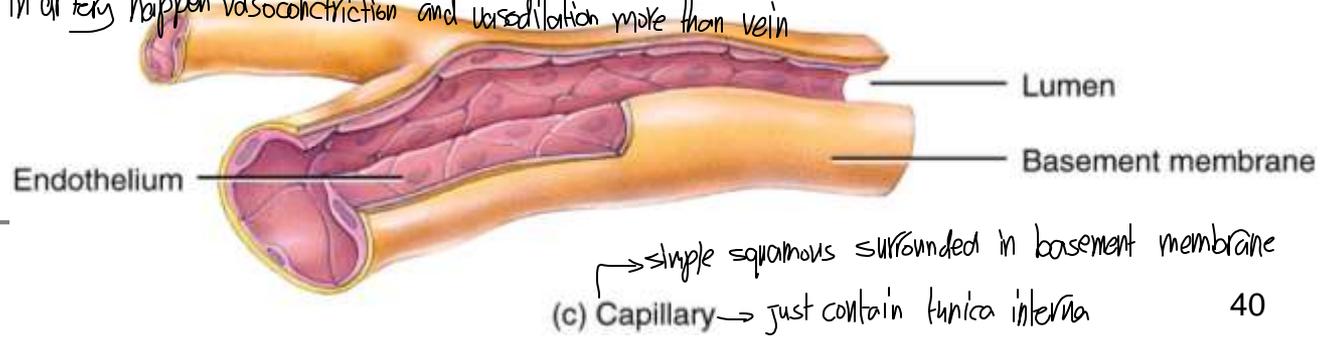


Fig.26: The difference between the walls of (a) large artery, (b) large vein, and (c) capillary.

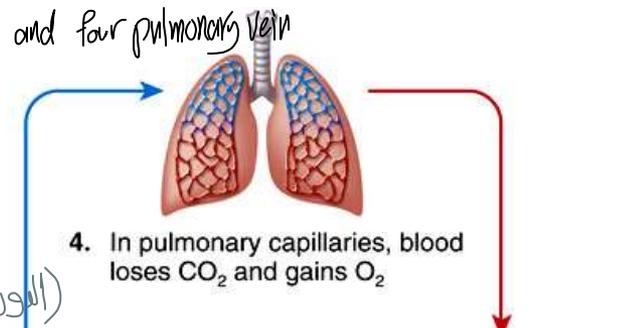


→ We have two pulmonary artery and four pulmonary vein

Pulmonary and Systemic Circulations

Two circuits in series

→ RA:- right atrium, RV:- right ventricle
 LA:- left atrium, LV:- left ventricle



4. In pulmonary capillaries, blood loses CO₂ and gains O₂

○ Pulmonary circulation

② RA receives deoxygenated blood from

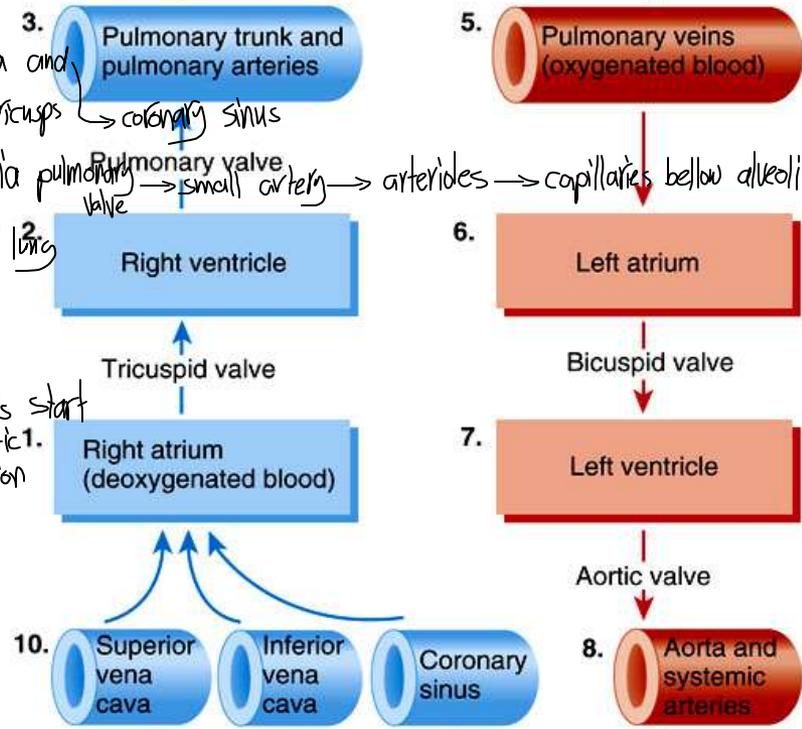
① systemic circulation → from superior, inferior vena cava and coronary sinus

• RA pumps blood into RV → via right (AV) orifice or tricusps

• RV ejects blood into pulmonary trunk → via pulmonary valve → small artery → arterioles → capillaries below alveoli then pulmonary arteries → is two from right and left lung

• Gas exchange in pulmonary capillaries in the lungs → is four from right and left lung

• Pulmonary veins take blood to LA → after this start systematic 1. circulation



○ Systemic circulation

② LA receives oxygenated blood from

① lungs

• LA pumps blood into LV

• LV ejects blood into aorta

• Systemic arteries, arterioles

• Gas and nutrient exchange in systemic capillaries

• Systemic venules and veins lead back

to RA → after this start pulmonary circulation

9. In systemic capillaries, blood loses O₂ and gains CO₂

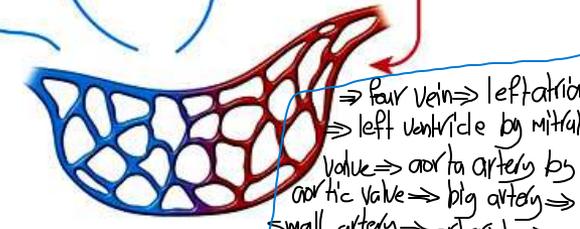


Fig.27: The two circulations.

Major Blood Vessels of the Thorax

The Major Arteries

The Aorta

❖ Is the largest artery in the body

❖ Arises from the LV

لـ يـشـأ

❖ Divided into 4 parts:

1. **Ascending aorta** → inside the ascending aorta two opening (exit from this opening left and right coronary artery)

2. **Arch of aorta** → تقوس

3. **Descending Thoracic aorta** بالصدر → (الجزء النازل)

4. **Abdominal aorta** بالبطن → same artery

↳ after the descending pass through diaphragm

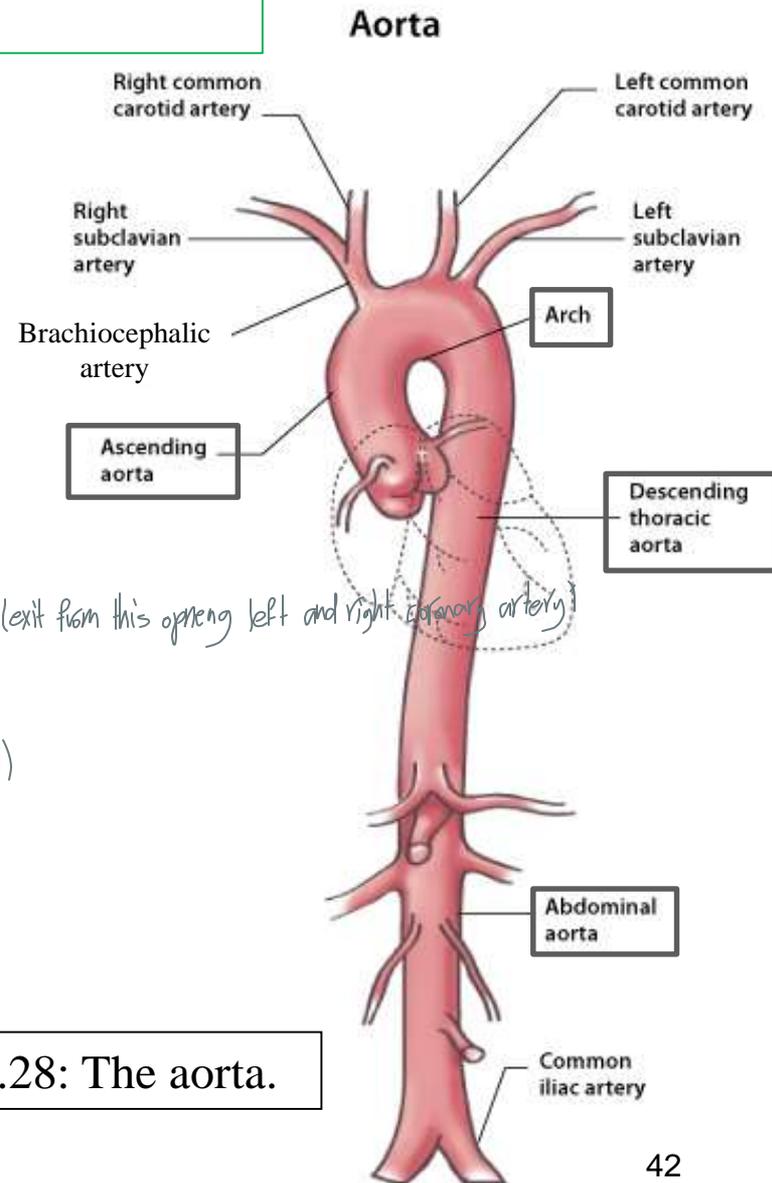


Fig.28: The aorta.

Important Branches (In the Thorax):

← أهم التفرعات في هذه المنطقة هي؟

○ Ascending Aorta:

1. Right Coronary artery
2. Left Coronary artery

○ Arch of aorta: → three main branches?

1. Brachiocephalic trunk (artery) → two branched
 - a. Right Subclavian artery
 - b. Right Common Carotid artery
2. Left Common Carotid Artery → head, neck
3. Left Subclavian Artery → الذراع اليسرى

⇒ subclavian artery (left, right) near from anterior scaleni muscle

○ Descending Thoracic Aorta:

Gives various branches to nearby structures

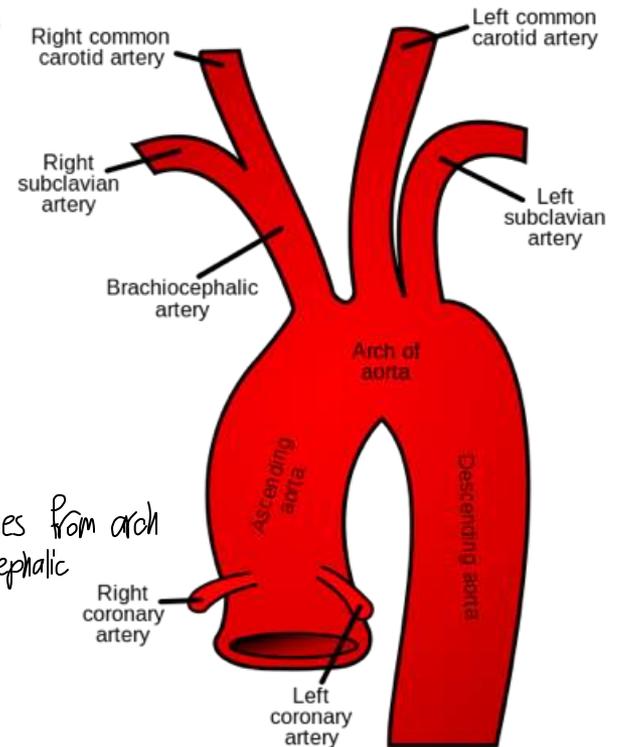


Fig.29: The ascending and the arch of aorta.

The Pulmonary Trunk

❖ Is the only artery in the body which carries

deoxygenated blood. → go to the lung

❖ Arises from the RV.

❖ Divides into the **Right and Left Pulmonary arteries**

which pass into the corresponding lung. ← *الربو*

❖ The pulmonary trunk is connected to the arch of aorta by the *ligamentum arteriosum*.

○ This is the remnant of the ductus arteriosus which shunted blood from the pulmonary trunk to the aorta during fetal life thus bypassing the lung. **During fetal life, the fetus does not need his lungs** because it **already receives oxygenated blood from the mother.** → why?

exit from the trunk two pulmonary artery (left and right) → after closing called *ligamentum arteriosum*
⇒ opening between pulmonary artery and aorta called *ductus arteriosus* the function make mixing the blood between aorta and pulmonary artery in the fetus.

↳ and the *foramen ovale* between right and left atrium make the same function

↳ and then after closing called *fossa ovalis*

→ in right and left lungs

Fig.30: Anterior view of the heart.

The Major Veins

- ❖ Blood from the thoracic region is collected by several veins that ultimately drain into the **azygos system** which shows considerable variation among people.
- ❖ The azygos vein eventually arches forwards to enter the superior vena cava.

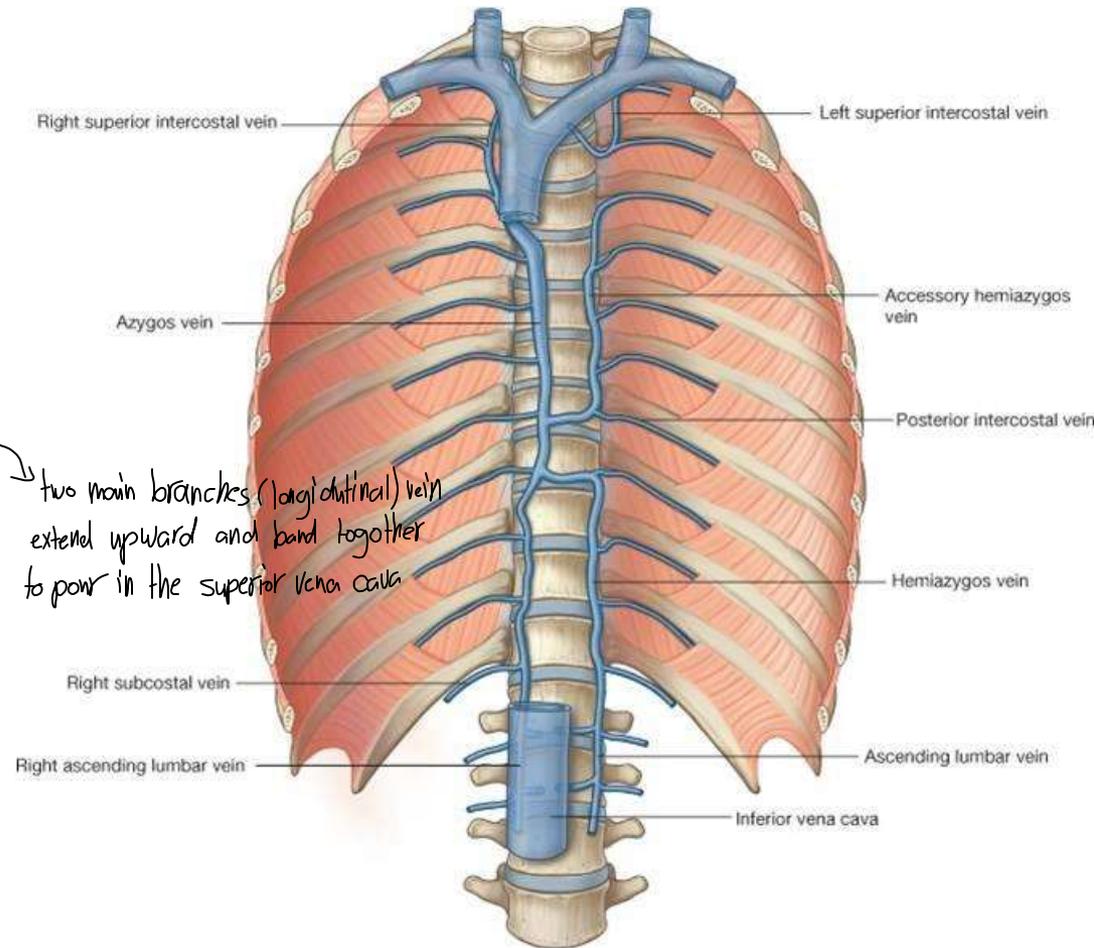


Fig.31: The azygos system of veins.

The Brachiocephalic → left and right

veins: → in figure 32

The right brachiocephalic vein is vertical, whereas the left is more horizontal. They **drain blood from the head, neck and upper limbs**. They **unite to form the Superior Vena Cava (SVC)** which opens into the **RA**.

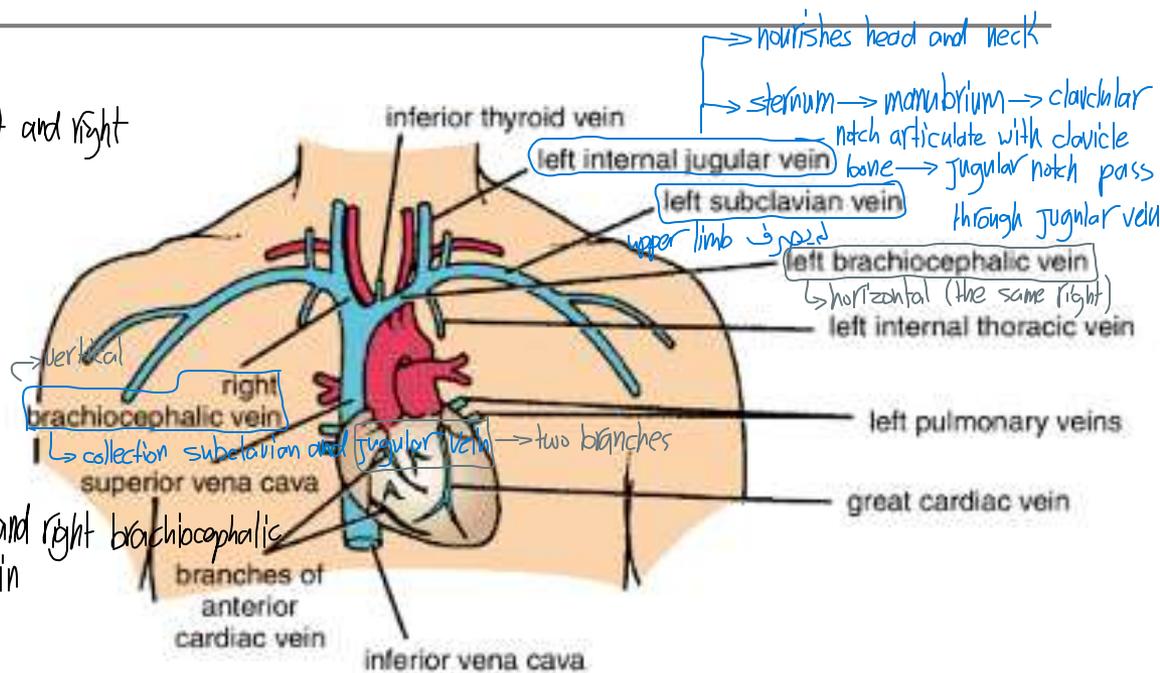


Fig.32: The major veins of the thorax..

The Pulmonary Veins: transfer the blood from lungs to left atrium

These are **4 veins (2 from each lung)** that **carry oxygenated blood** from the lung to the LA of the heart. **Only veins that carry oxygenated blood.**

The Inferior Vena Cava (IVC): → abdomen, viscera, lower limb → abdominal → thoracic → right atrium

This is formed in the abdomen and its terminal part enters the thorax (through the diaphragm) to open into the RA.

Major Blood Vessels of the Head and Neck

The Major Arteries

The Carotid Arteries ⇒ arch of aorta → brachiocephalic → right common carotid
→ left common carotid

the function of carotid artery?

- ❑ Responsible for **supplying blood to structures in the head and neck**. → externally or internally structure
- ❑ They ascend superiorly in the neck where they are closely related to the **internal jugular vein** and the **vagus nerve**. → when the carotid ascend related in this structure
(→ cranial nerve (10))
- ❑ About the level of the upper border of the **thyroid cartilage**, → cartilage followed to larynx
each artery divides into the
① **external** and ② **internal carotid arteries**. (this is where the carotid pulse can be felt). → when the artery reaches at the level upper border for thyroid cartilage is divide into two branches
→ supply the brain in the blood (inter inside skull)
→ supply the all part of neck and head in the blood except the brain

Fig.33: The carotid arteries.

part of brain? diencephalon, cerebrum, cerebellum, brainstem → are inferiorly (in the base) → supply the blood by network from artery called circle of willis

- ❑ The branches of the external carotid supply almost all structures in the head and neck except the brain.
- ❑ The **internal carotid** supplies the brain and various other structures.
- ❑ Branches from the **internal carotid** and the **subclavian arteries** form an arterial circle under the brain called the **Circle of Willis**. This provides blood to various parts of the brain.

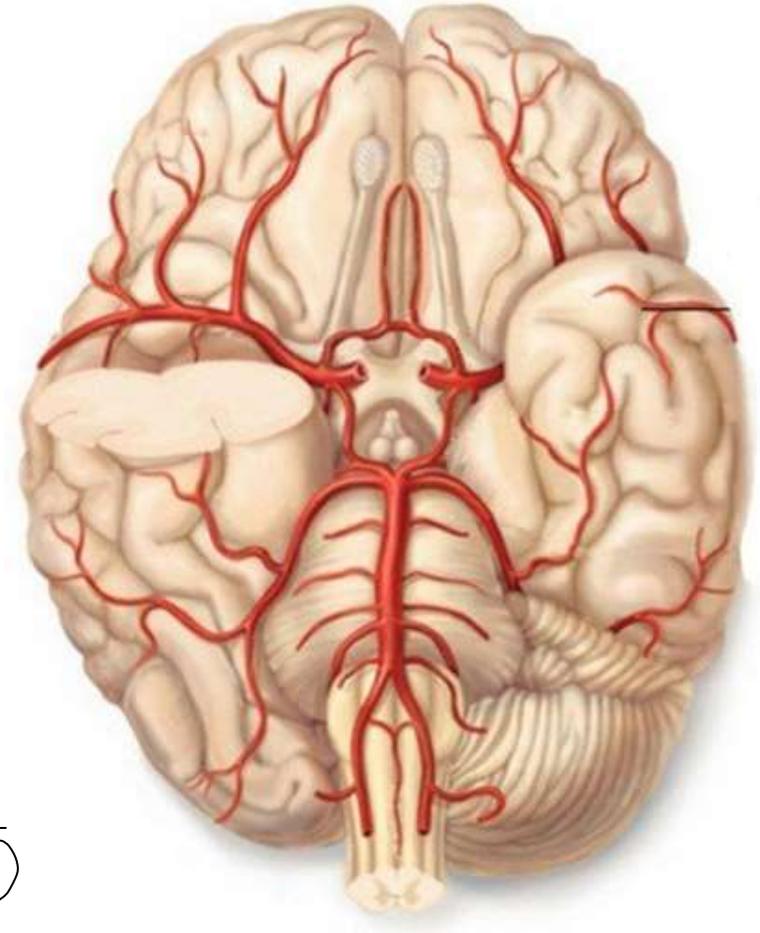


Fig.34: Inferior surface of the brain showing the circle of Willis.

⇒ which artery supply part of brain in the blood? internal carotid artery
⇒ which supply base of the brain? circle of willis composed from branches from the internal carotid and subclavian artery

The Subclavian Arteries

↳ supply the upper extremities in the blood

→ arch of aorta → left subclavian artery
 → brachiocephalic → right subclavian artery

- ❑ The right and left subclavian arteries arch **laterally** from their origins.
- ❑ At the **outer border of the first rib** they become the **axillary artery**.
- ❑ The **scalenus anterior muscle** is related to this artery.
 - ↳ subclavian artery once extends from the first ribs (is not branched from subclavian)
 - ↳ related with subclavian artery and vein and brachial plexus
- ❑ They give off several branches that supply various structure in the head, the neck, and even the **chest** →

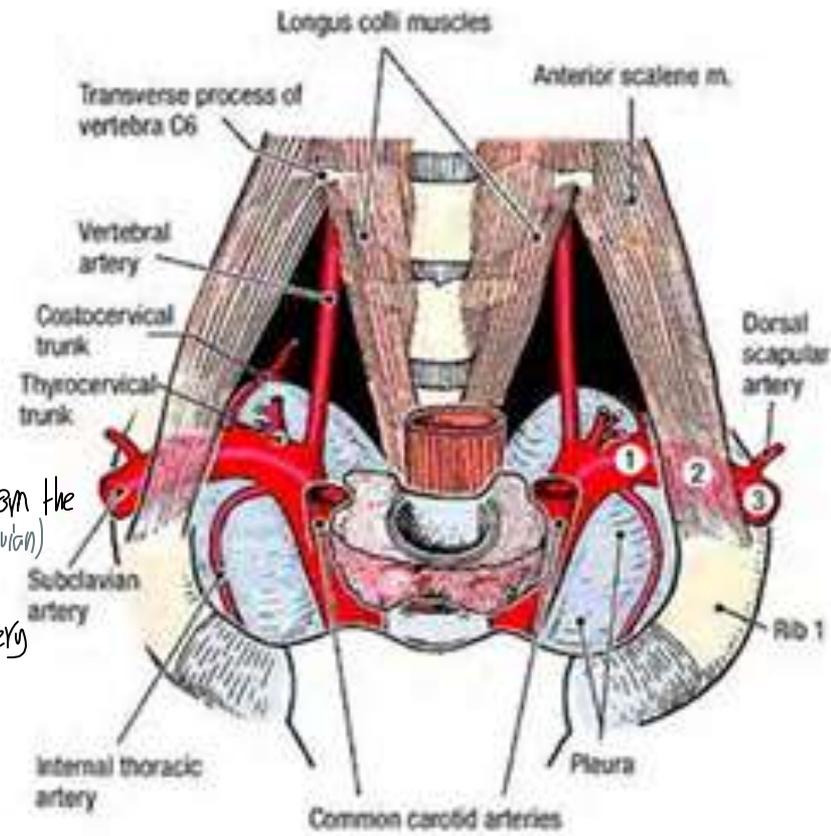


Fig.35: The subclavian arteries.

arch of aorta → brachiocephalic trunk → right subclavian artery → cervical trunk → thoraco-axillary artery → when reaches first ribs called axillary artery
 → internal mammary artery
 → right common carotid artery

The Major Veins

differ between carotid artery and jugular vein?
 not present common carotid (the internal and external jugular don't meet) ⇒ carotid artery, jugular vein / subclavian artery, subclavian vein / axillary artery, axillary vein

❑ All blood from the brain (and related structures) drains into **sinuses** (enlarged veins). These sinuses eventually drain into the **internal jugular vein (IJV)**.

↳ holes in the brain the deoxygenated blood pour inside it from different space.

❑ The IJV is formed inside the skull, leaves the skull by passing through the **jugular foramen** and descends through the neck in close relation to the **internal carotid** and **common carotid arteries**.

↳ pour the deoxygenated blood from sinuse to jugular and the jugular at the same level of the internal carotid artery

↳ internal jugular (left, right) leave the skull from this foramen

↳ the internal jugular before it passes thyroid cartilage is the same level internal carotid
 ↳ after passes through thyroid cartilage is the same level common carotid artery

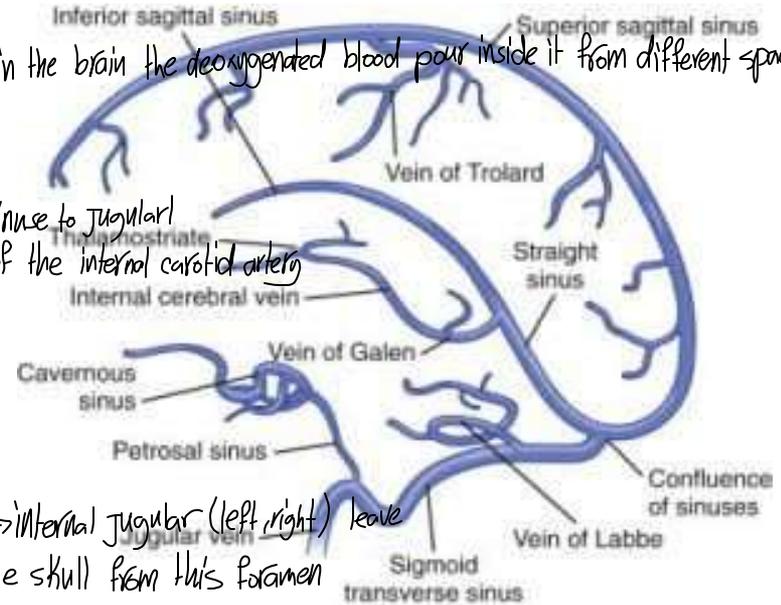
❑ Blood from the neck drain into IJV and the **external jugular vein**.

↳ carry deoxygenated blood from head and neck just into subclavian vein.

❑ The external jugular will drain into the subclavian vein. This vein will unite with the IJV to form the **brachiocephalic vein**.

↳ (subclavian vein, external jugular, internal jugular)

Fig.36: Venous sinuses of the brain.



↳ the internal jugular carry deoxygenated blood from brain, neck and head pours in the subclavian vein

↳ (left, and right) pour 50 in superior vena cava

Major Blood Vessels of the Upper Limb

The Major Arteries

The Axillary Artery \rightsquigarrow the subclavian artery when passes through lateral border of the first ribs

- ❖ It's the direct continuation of the subclavian artery when it passes the lateral border of the first rib.

- ❖ The **pectoralis minor muscle** divides the artery into 3 part.
 - \rightarrow before muscle (first part), during muscle (second part), after muscle (third part)
 - \rightarrow start from ribs (3-5) to the coracoid processes in the scapula
 - \rightarrow three region not three branches

- ❖ Its **several branches supply surrounding structures.** in the axilla (such as deltoid)

- ❖ At the lower border of the **teres major muscle**, it becomes the brachial artery.

\rightarrow posterior part in the shoulder

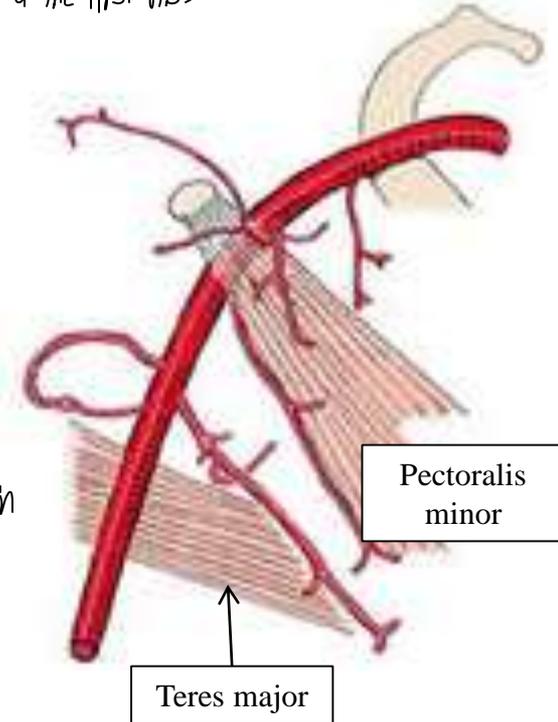


Fig.37: The axillary artery.

The Brachial Artery → supply all part in the arm (brachialis, brachioradialis, biceps, triceps)

- ❖ The direct continuation of the axillary artery when it passes the lower border of the teres major muscle. Its branches supply surrounding structures.
- ❖ It terminates at the **neck of the radius** by dividing into the radial and ulnar arteries.
- ❖ In the cubital fossa, the brachial artery passes medial to the tendon of the biceps muscle where it's superficial. This is the site for taking the brachial pulse and measuring the blood pressure.

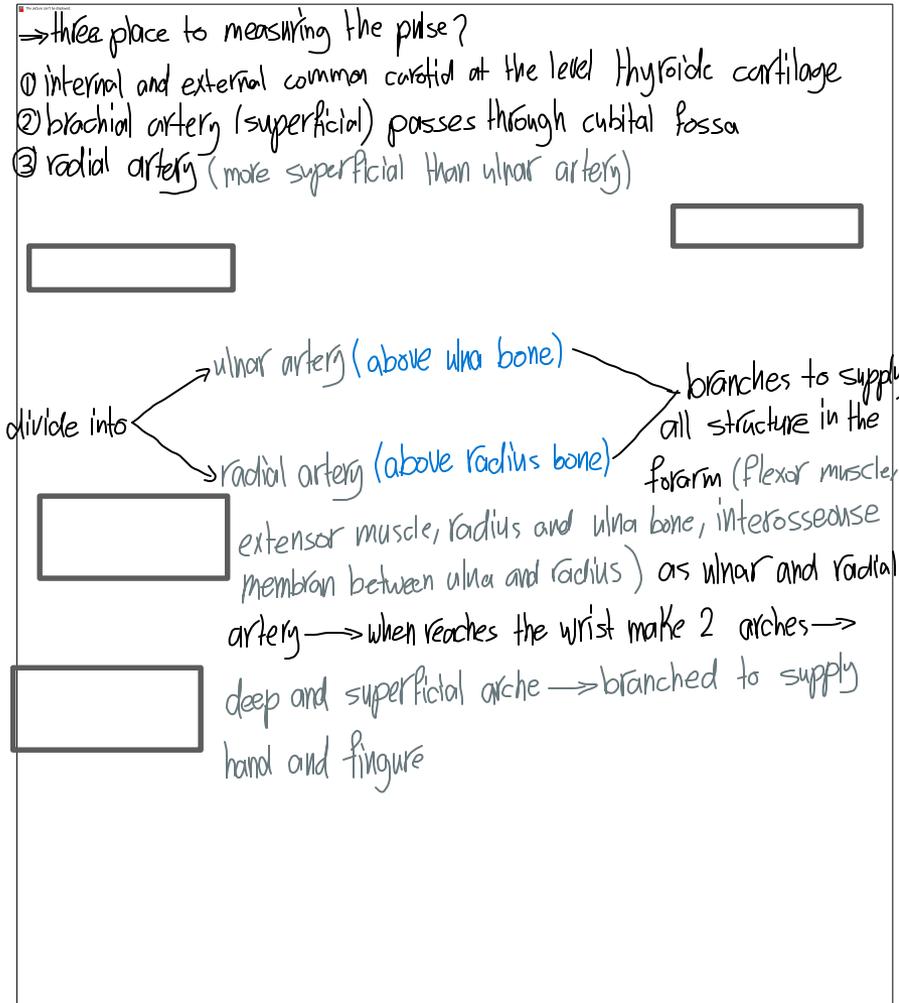


Fig.38: The brachial artery in the cubital fossa.

The Radial and Ulnar Arteries

⇒ in the slides 52

- ❖ The radial artery passes down on the lateral aspect of the forearm. The ulnar passes on the medial side. They enter the palm where they form the superficial and deep palmar arches. *→ when ulnar and radial artery inter palm*
- ❖ The radial and ulnar arteries supply structures in the forearm. The two palmar arches supply structures in the hand and fingers.
- ❖ The radial artery is superficial as it passes over the wrist. It's here that the radial pulse can be felt.

The Major Veins → collecting deoxygenated blood

□ In the upper limb, **we have superficial and deep veins**. The **superficial veins** run just under the skin. They start as a network on the dorsum of the hand. From this network the **cephalic and basilic** veins arise. These two superficial veins are connected at the elbow by the **median cubital vein**. Superficial veins are used to take blood samples.

□ Most of the ~~deep veins are in the form of two small veins that accompany the arteries (venae comitantes)~~.

□ The basilic vein unites with the venae comitantes of the brachial artery to form the axillary vein (a large deep vein accompanying the axillary artery). This receives the cephalic vein. Upon passing the outer border of the first rib, the axillary vein becomes the subclavian vein.

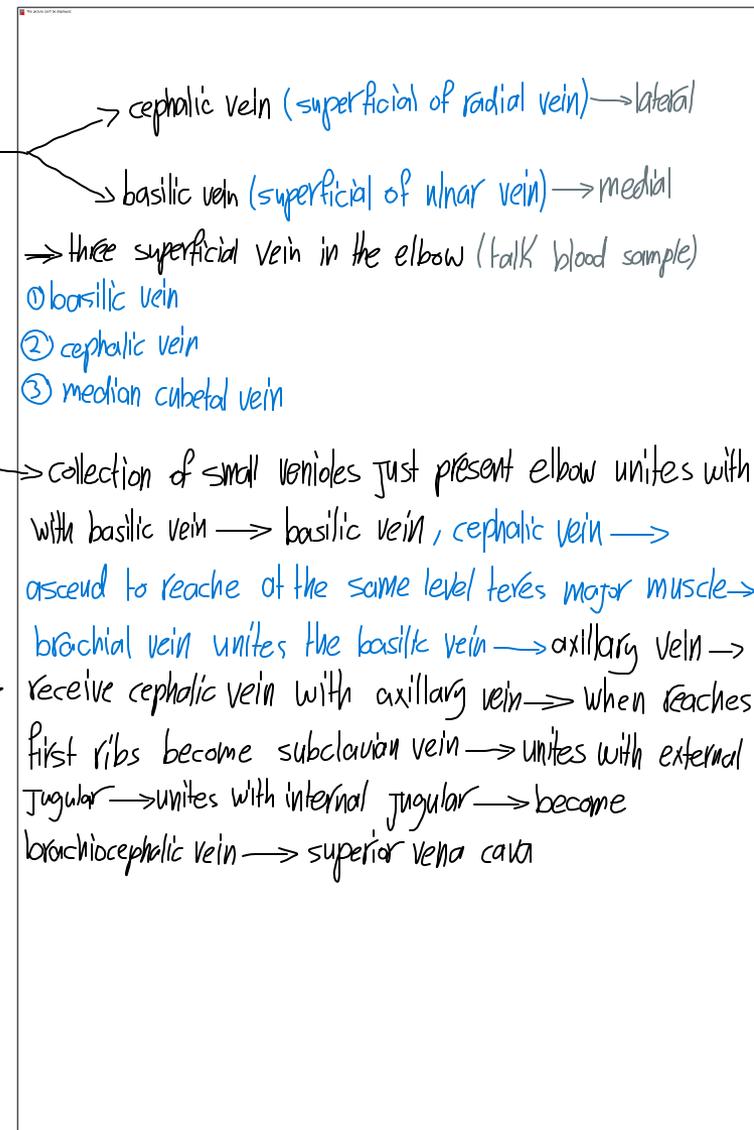


Fig.40: Veins of the upper limb.

Major Blood Vessels of the Abdomen

The Major Arteries

The Abdominal Aorta → ascending aorta → arch aorta → descending thoracic aorta → descending abdominal aorta
↳ supply the all structure in abdominal (digestive organ or non-digestive organ)

- ❑ The abdominal aorta is the continuation of the descending thoracic aorta. It **begins** where the aorta passes through the diaphragm to enter the abdominal cavity opposite **T12 vertebra**.

↳ abdominal aorta

- ❑ The abdominal aorta is closely related to the vertebral column and the IVC.

- ❑ It **terminates** opposite **L4** by dividing into the two Common Iliac Arteries.

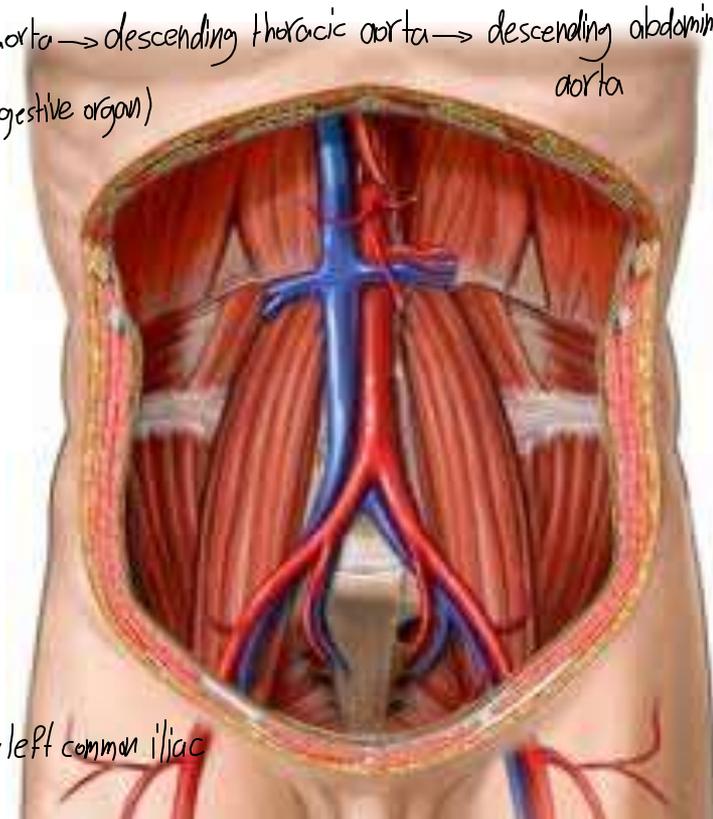


Fig.41: The abdominal aorta and the inferior vena cava.

Branches

- **Celiac trunk, superior mesenteric artery, and inferior mesenteric artery** which supply organs of the digestive system in the abdomen.

- **Suprarenal arteries** supply the **adrenal gland**.

- **Renal arteries** supply **kidneys**.

- Others.

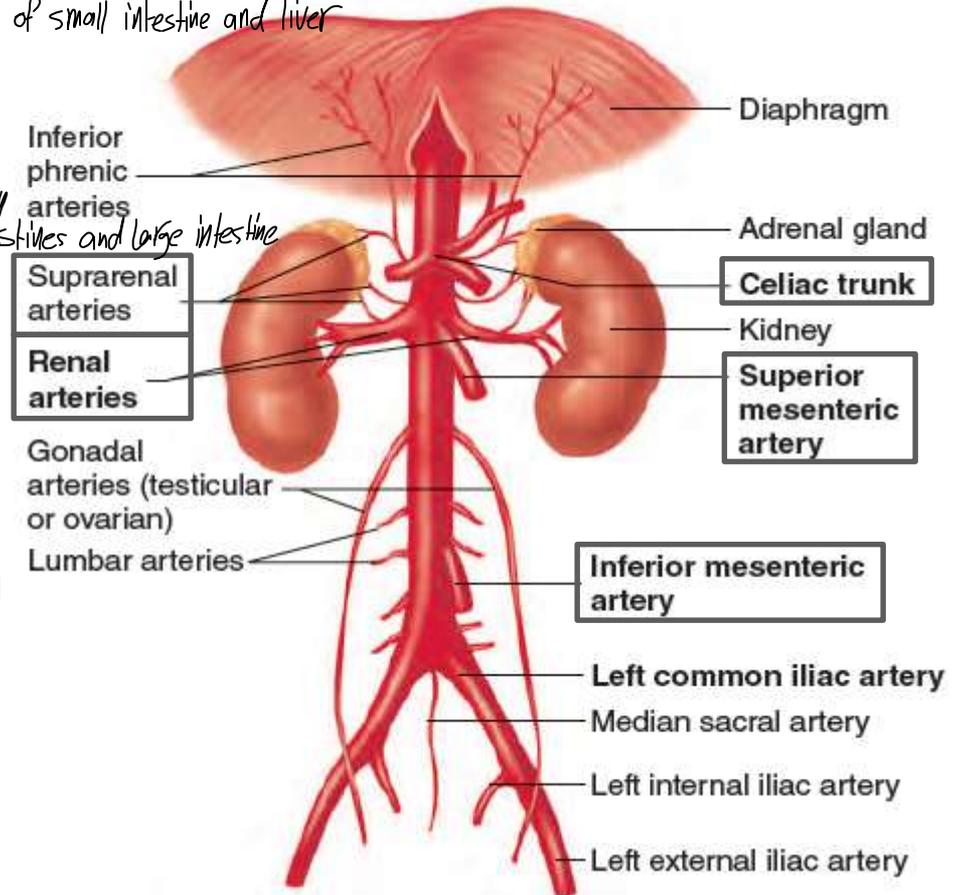


Fig.42: Branches of the abdominal aorta.

The Major Veins

- ❑ All Blood from the abdomen drains ultimately into the IVC. → pass diaphragm at the level T8 → right atrium
- ❑ The IVC passes upwards close to the abdominal aorta, then passes through the diaphragm at level of **T8** to enter the thorax where it opens into the RA.
- ❑ The blood from the **digestive organs** (esophagus, stomach, small and large intestines, liver, pancreas and spleen) drains first into the **Portal vein** then into the IVC.

↳ the blood of the organ in digestive system pour in this vein → liver (metabolism) → inferior vena cava

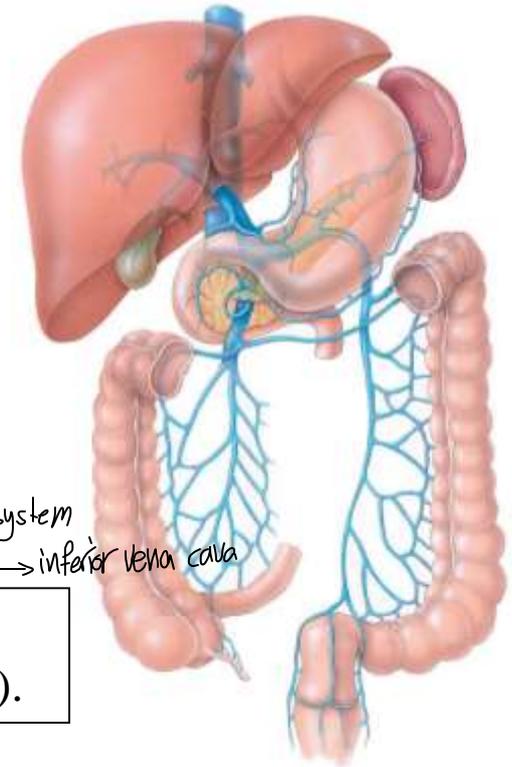
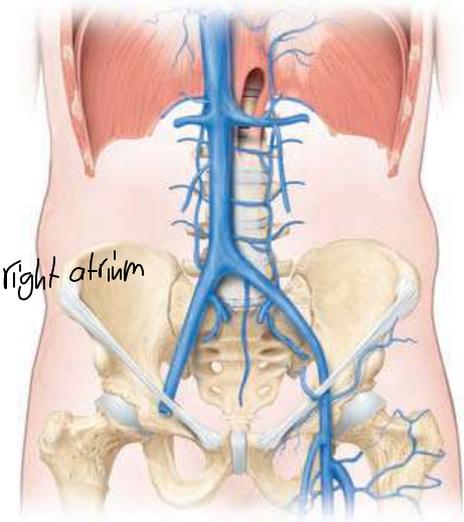


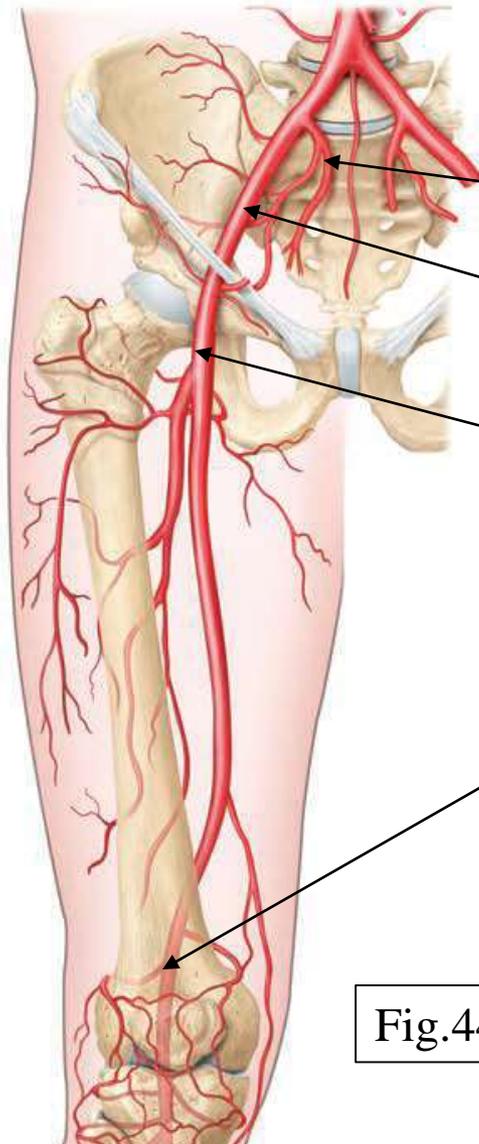
Fig.43: The inferior vena cava (above) and the portal vein (below).

Major Blood Vessels of the Lower Limb

The Major Arteries

abdominal aorta divide at level L4 to

- internal iliac artery (supply all organ in pelvis)
- external iliac artery → when reache thigh called femoral artery (at the same level of femur) supply the thigh and knee → when reaches knee called popliteal artery (femoral artery that pass the knee joint) supply the leg and foot



- Each common iliac artery soon divides to give the internal and external iliac arteries.
- The **internal iliac artery** supplies structures in the pelvis.
- The **external iliac artery** passes into the thigh where it becomes the femoral artery.
- The **femoral artery** gives branches that supply structures in the thigh and the knee joint.
- When this artery reaches the knee joint it becomes known as the **popliteal artery**. The branches of this artery supply structures in the leg and foot.

Fig.44: Major arteries of the lower limb.

The Major Veins

✓ Here we have **superficial and deep veins.**

✓ The ~~deep veins are venae comitantes. Some large deep veins correspond to the larger arteries.~~

✓ The superficial veins are:

a. The **Great Saphenous vein** which **drains into the femoral vein.**

→ use in open heart surgery

b. The **Small Saphenous vein** which **drains into the Popliteal vein.**

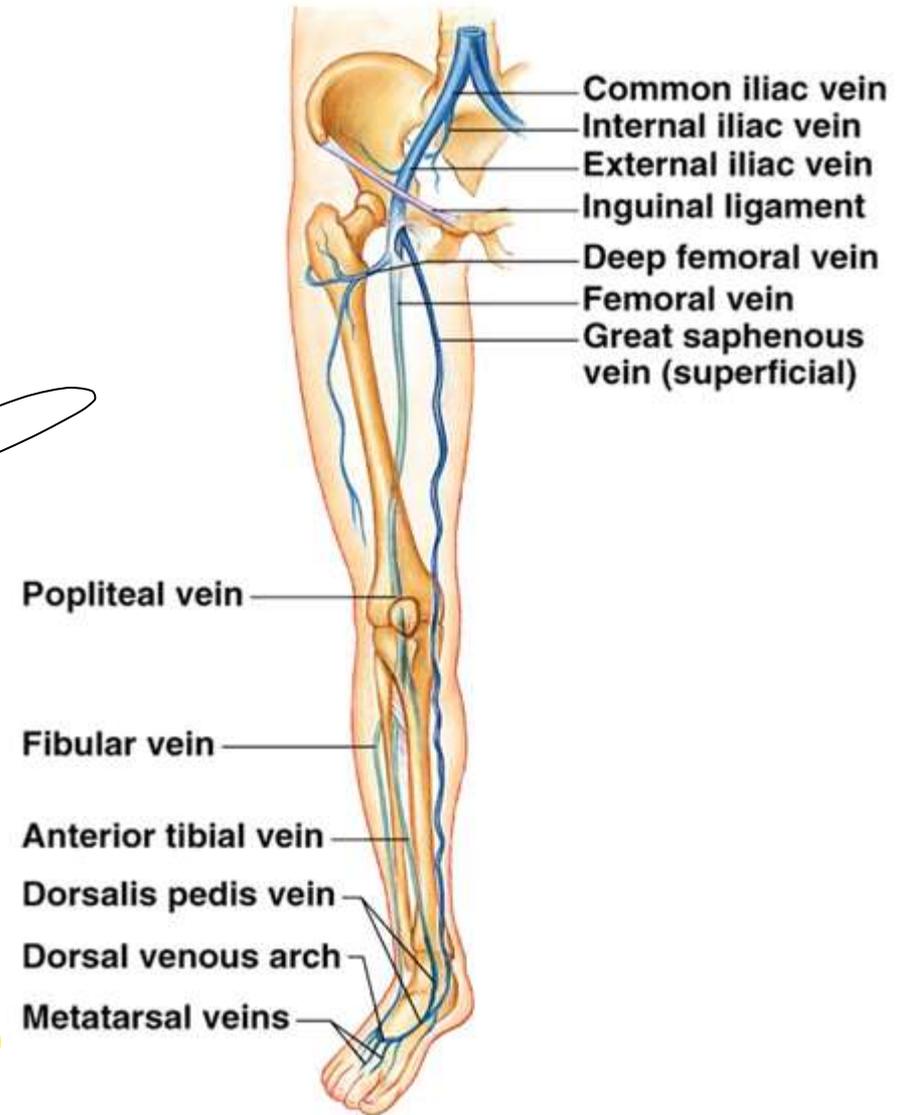


Fig.45: Major veins of the lower limb.