ILOs

1. To describe the arrangement of conductive system of the heart and their function within the myocardium.
2. To describe the origin of the coronary arteries and their course, branches, distribution & sites of anastomosis between branches of coronary arteries.
3. To describe the normal variation in the course of the coronary arteries and their branches.
4. To describe the venous drainage of the heart and cardiac veins (their names, location and drainage areas).
5. To describe the location and termination of the coronary sinus and its tributaries.
6. To describe innervations of the heart and the principal of cardiac referred pain.

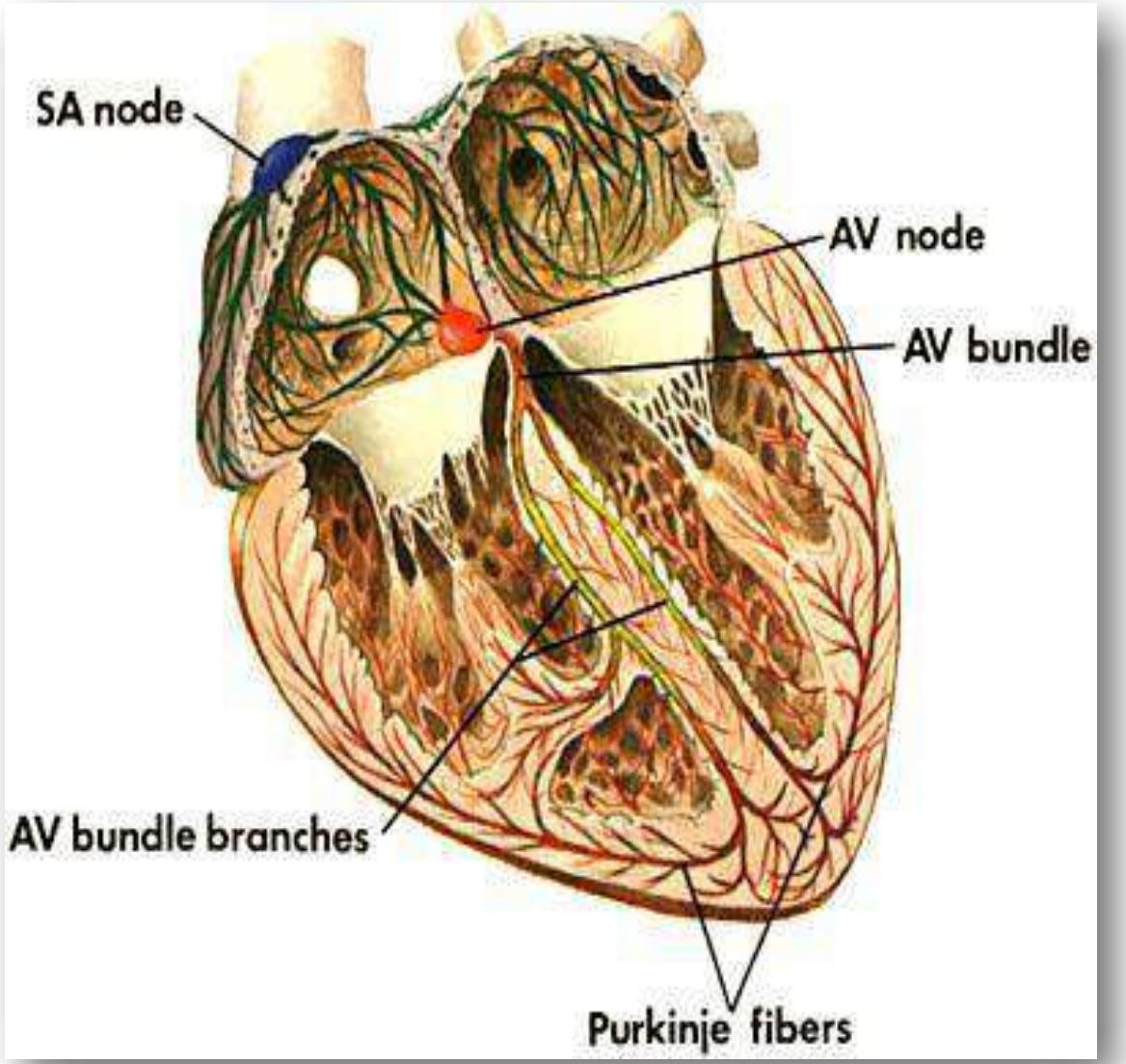
The right bundle branch (RBB):

- It **passes down** on the right side of the interventricular septum beneath the endocardium.

Subendocardiumly

- It **enters the moderator band,** to reach the anterior papillary muscle of the right ventricle.

- Then it divides profusely into fine sub-endocardial branches that surround the papillary muscles and distributed to the remaining ventricular walls. Here it **becomes continuous with** the fibers of the Purkinje plexus of the right ventricle.

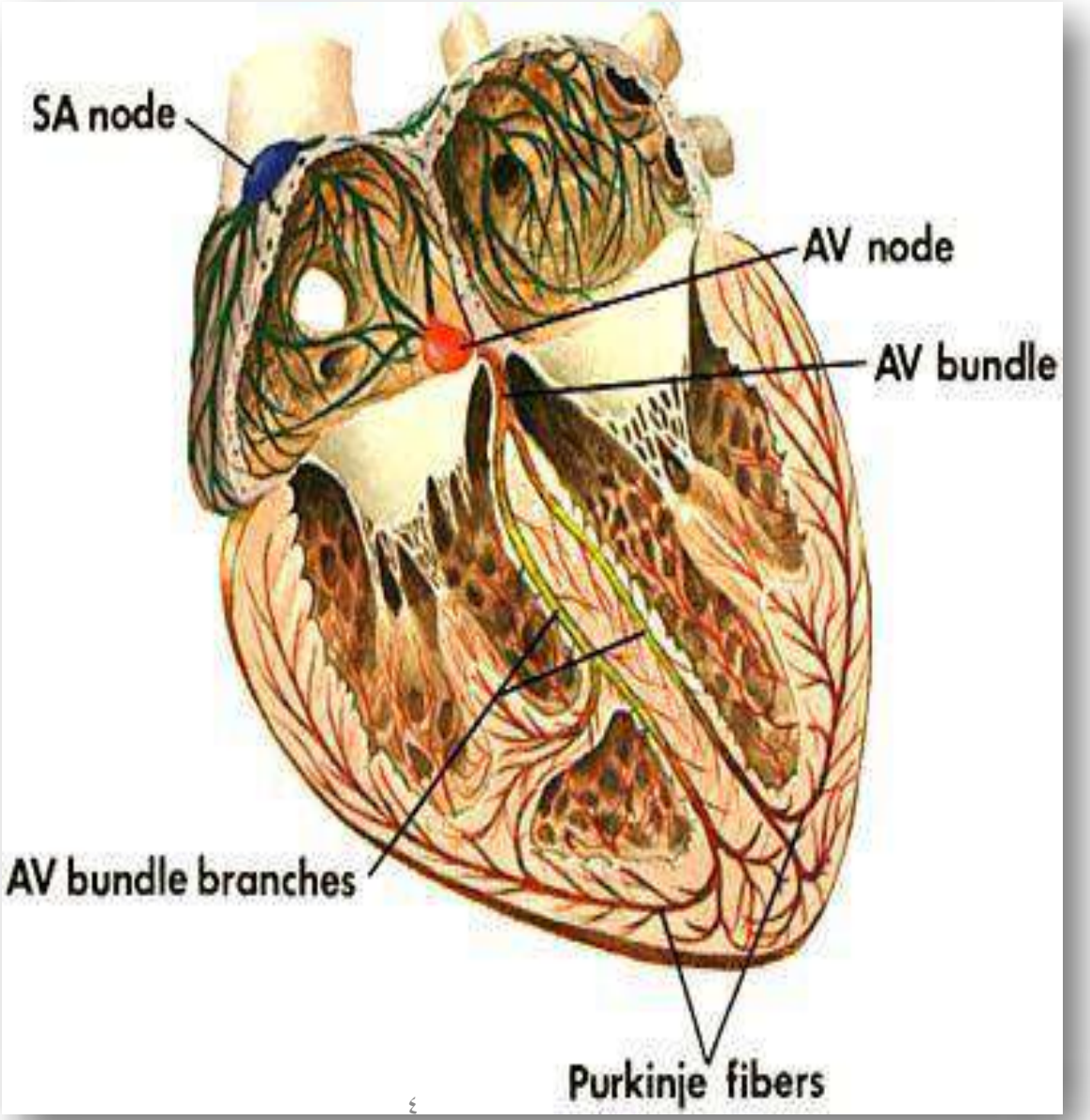


The left bundle branch (LBB):

- It **passes down on left side** of the interventricular septum beneath the endocardium.

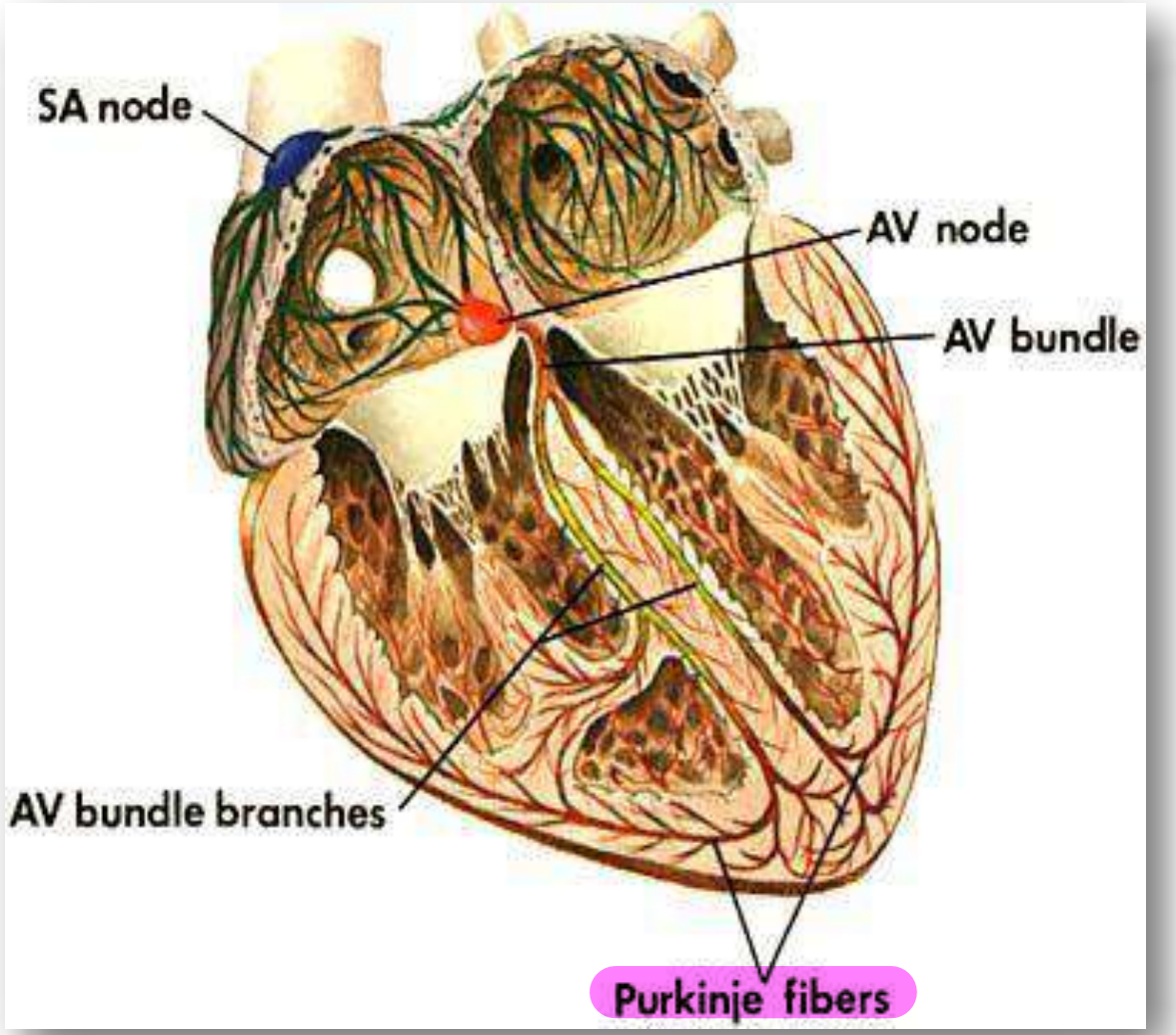
- It divides profusely into fine sub-endocardial branches, which first surround the papillary muscles and distributed to all parts of the ventricle, which **become continuous with the fibers of the** Purkinje plexus of the left ventricle.

→ Electrical Impulse reach the papillary muscles before the wall of the ventricles so contraction of the papillary muscles occurs firstly because papillary muscles cause closure to the Tricuspid Valve or Mitral Valve before contraction of the wall of the ventricles to push the blood through Pulmonary trunk or Aorta



Purkinje fibers: → Last part of the conducting system of the Heart

- Are **located in** ventricular walls of the heart, just beneath the endocardium. (NOT Atria) (Right & left AV bundle branches)
- The Purkinje fibers are specialized conducting fibers composed of electrically excitable cells. (All components of the conducting system of the Heart)
- Purkinje fibers **allow** the heart's conductive system to create synchronized (متزامن) contractions of its ventricles.



Blood supply of the heart

Arterial Supply

Venous Drainage

- The heart **is supplied by** two **coronary arteries (right and left)** which are branches of the **ascending aorta.**

- **It's drained by cardiac veins & Coronary sinus.**

- The coronary arteries and their major branches are distributed over the surface of the heart, lying within subepicardial connective tissue.

Right coronary artery:

Origin: from the right aortic sinus of the ascending aorta.

Course:

- It runs to the right in the coronary groove (anterior part of atrioventricular groove).
- Then it curves backwards to run in the posterior part of atrioventricular groove.

Termination: by anastomosing with the circumflex branch of the left coronary artery in the posterior part of the coronary groove.

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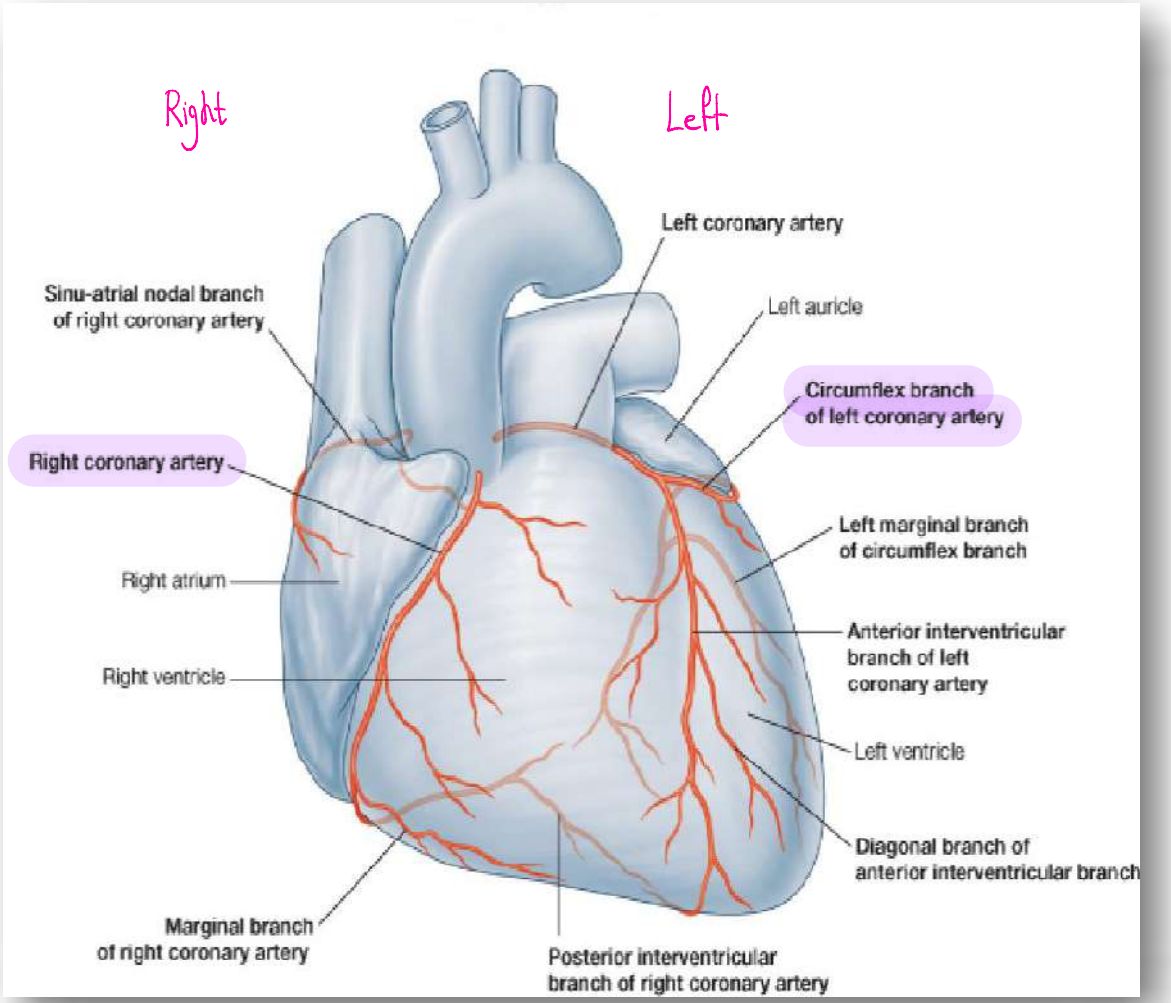


Termination of any Artery
- End Arteries → have a problem if it blocked
- or Anastomose with another artery
- or gives terminal branches

Branches of the right coronary artery:

1- Right conus artery: It supplies the anterior surface of the **pulmonary conus**. and the **upper part of the anterior wall of the right ventricle.**

2- Anterior ventricular branches: they supply the **anterior part of the right ventricle**.

3- Atrial branches: they supply the **right atrium**.

4- S.A. nodal artery: it arises from right coronary artery in 60% of individuals. it supplies the **sinoatrial node**.

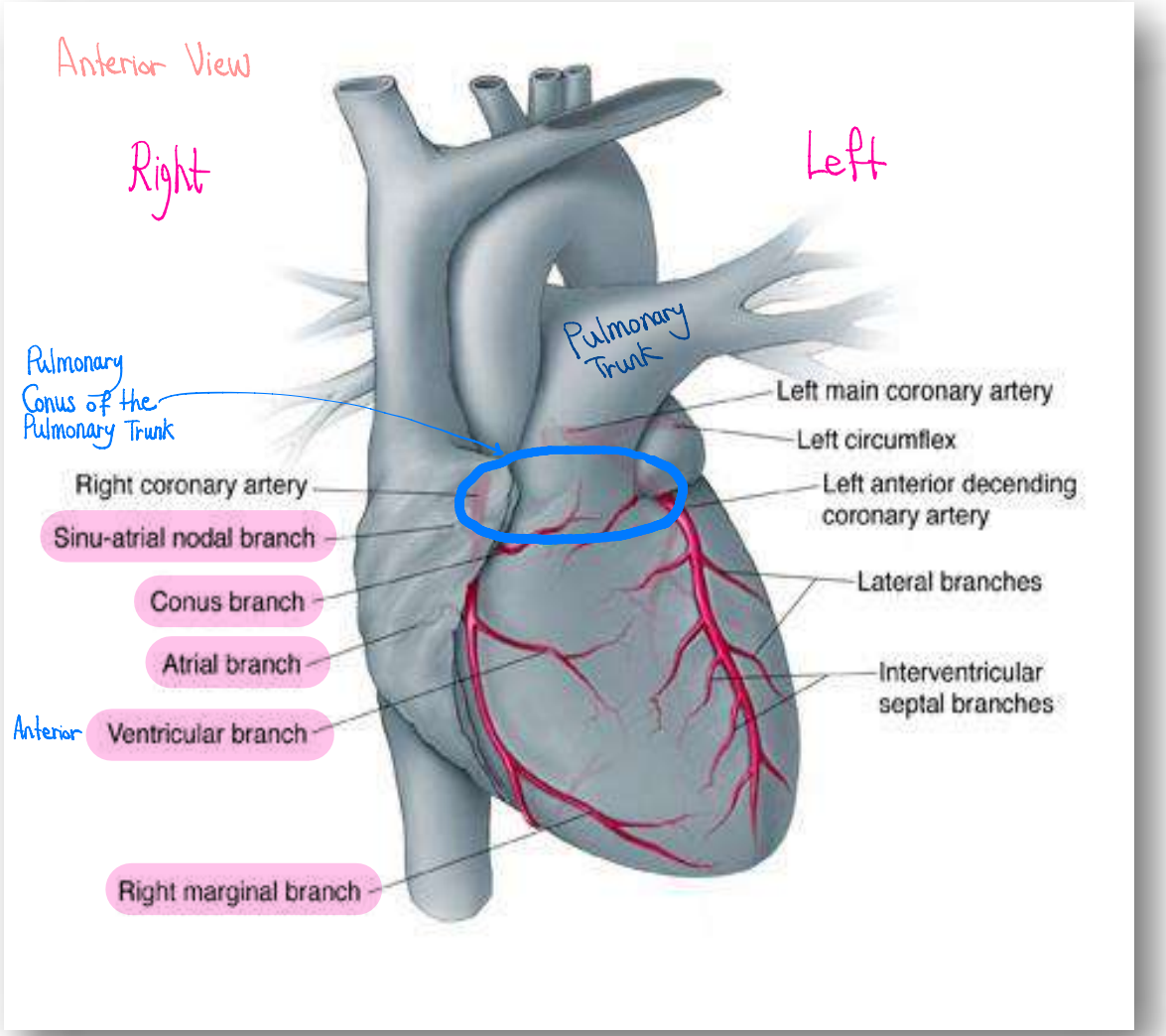
but 40% of individuals arise from left coronary artery

5- Right marginal branch: it runs along the lower margin of the heart.

Right Coronary Artery supplies the Right Atrium & Right Ventricle with exceptions in the Right Ventricle & Left Ventricle supplied by Left Coronary artery, supplied by right coronary artery

+

Left Coronary Artery supplies the Left Atrium & Left Ventricle

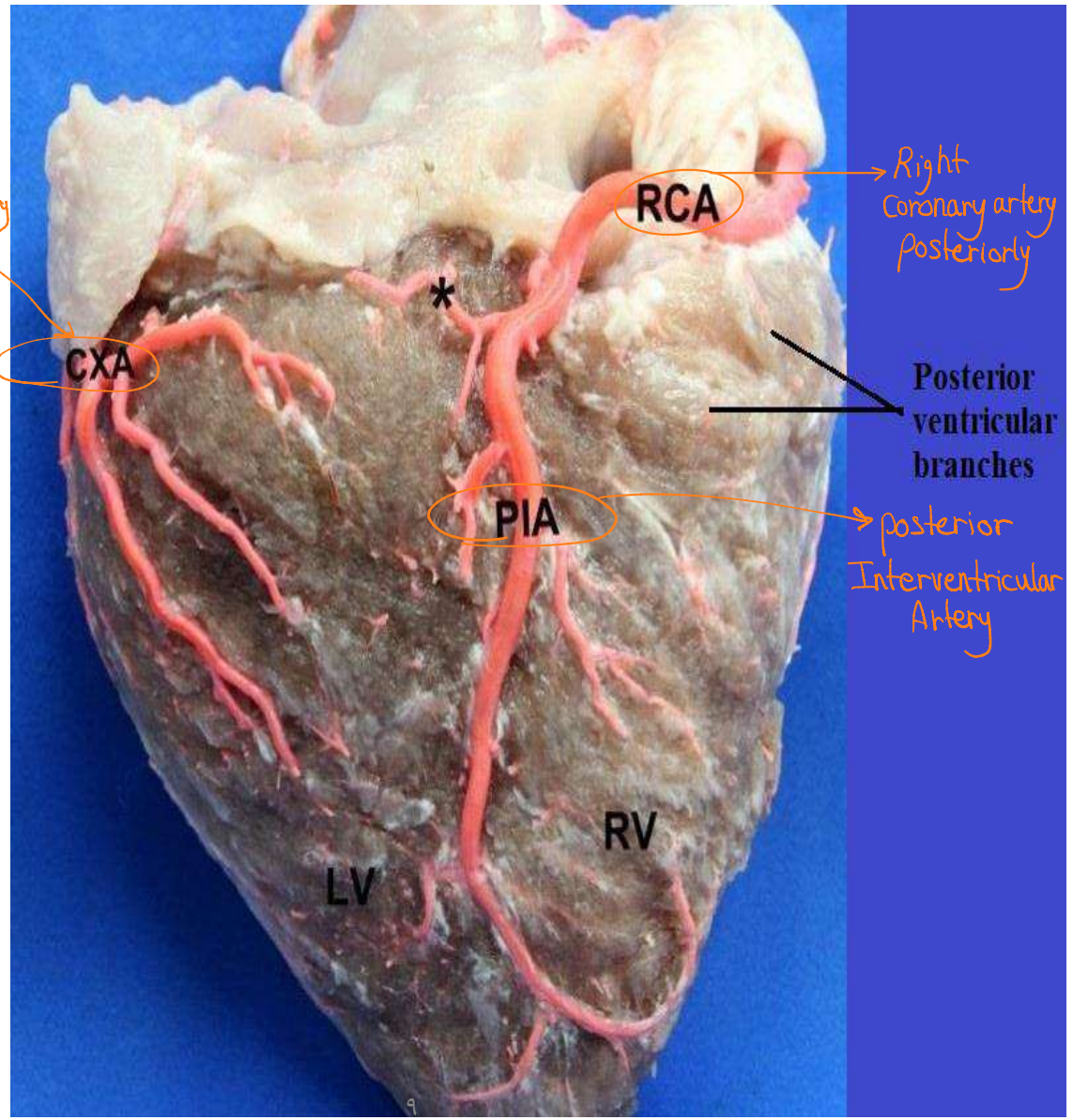


6- Posterior ventricular branches: they supply the **diaphragmatic part of the right ventricle**.

7- Posterior interventricular artery: (PIA)

- In 90% of individuals, arises from the right coronary artery. but 10% of individuals arises from the circumflex branch of the Left coronary artery
- It **passes** in the posterior interventricular groove.
- It **anastomose with** anterior interventricular artery near apex of heart. → branch form left coronary artery
- It **supplies parts of diaphragmatic surface of both ventricles** and also supplies **the posterior 1/3 of interventricular septum.** & Anterior Interventricular Artery supplies Anterior two thirds of the Interventricular Septum
- ↓ branch from it
- It **gives** AV nodal artery supplies the atrioventricular node. → which supplies the AV node

↓ Posterior View (Diaphragmatic Surface of the Heart)



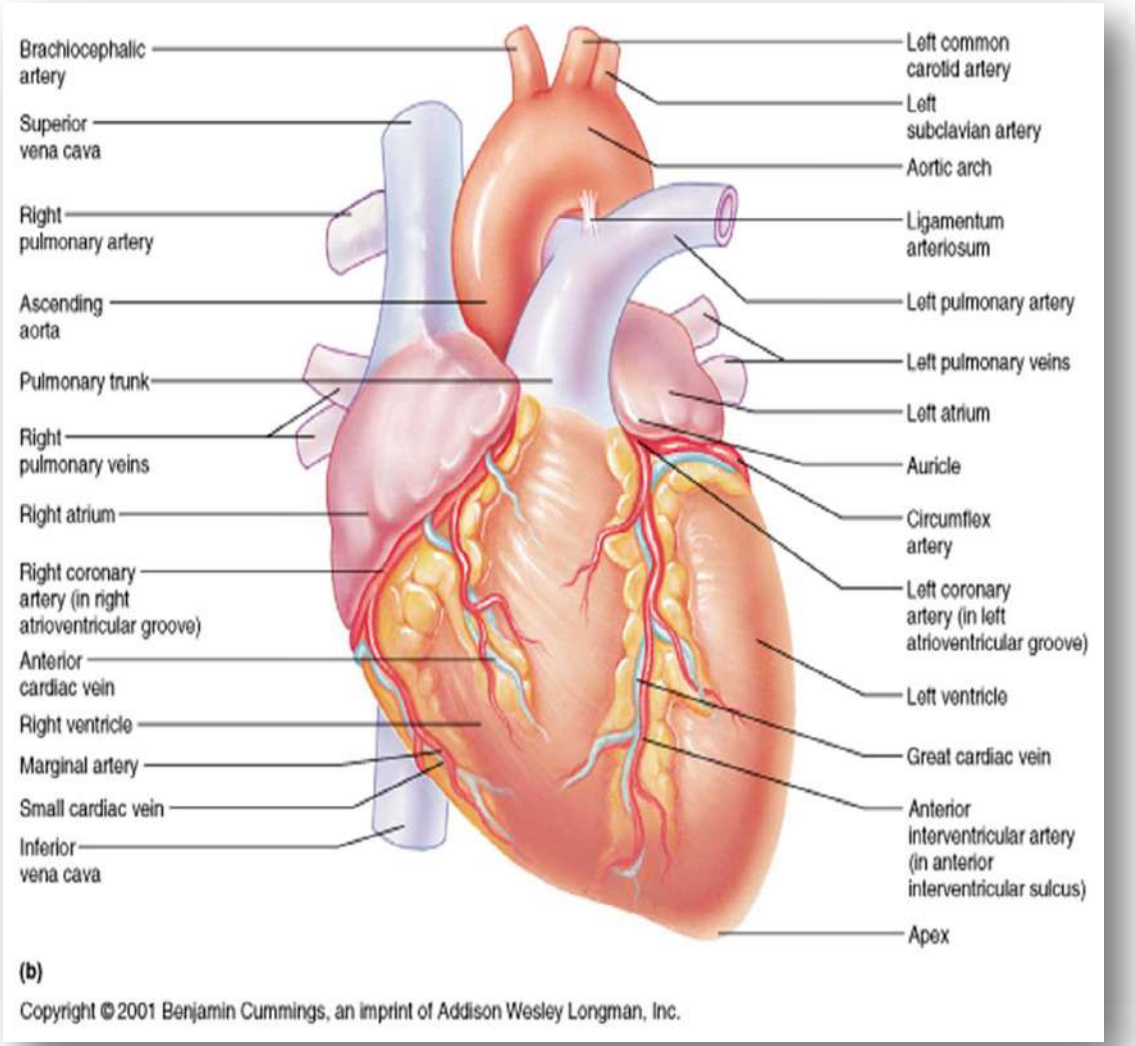
Left coronary artery:

The left coronary artery is **larger than** the right coronary artery.

Origin: From the **left aortic sinus** of the ascending aorta.

Course:

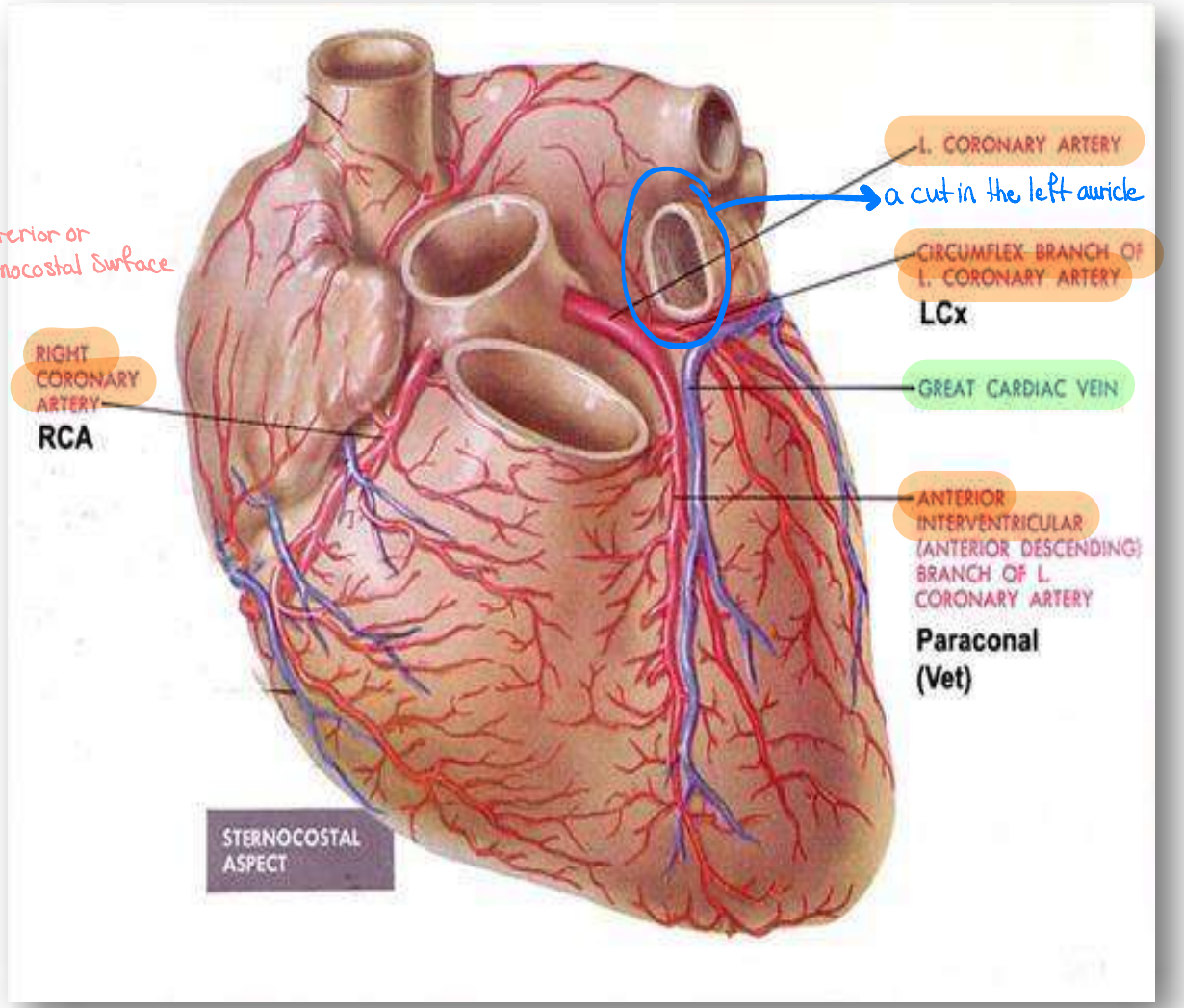
- It **passes** forward between the pulmonary trunk and the left auricle.
- It then **runs to** the left in the atrioventricular groove and **divides** into an anterior interventricular branch and a circumflex branch.



Branches of left coronary artery:

1-Anterior interventricular artery (AIA):

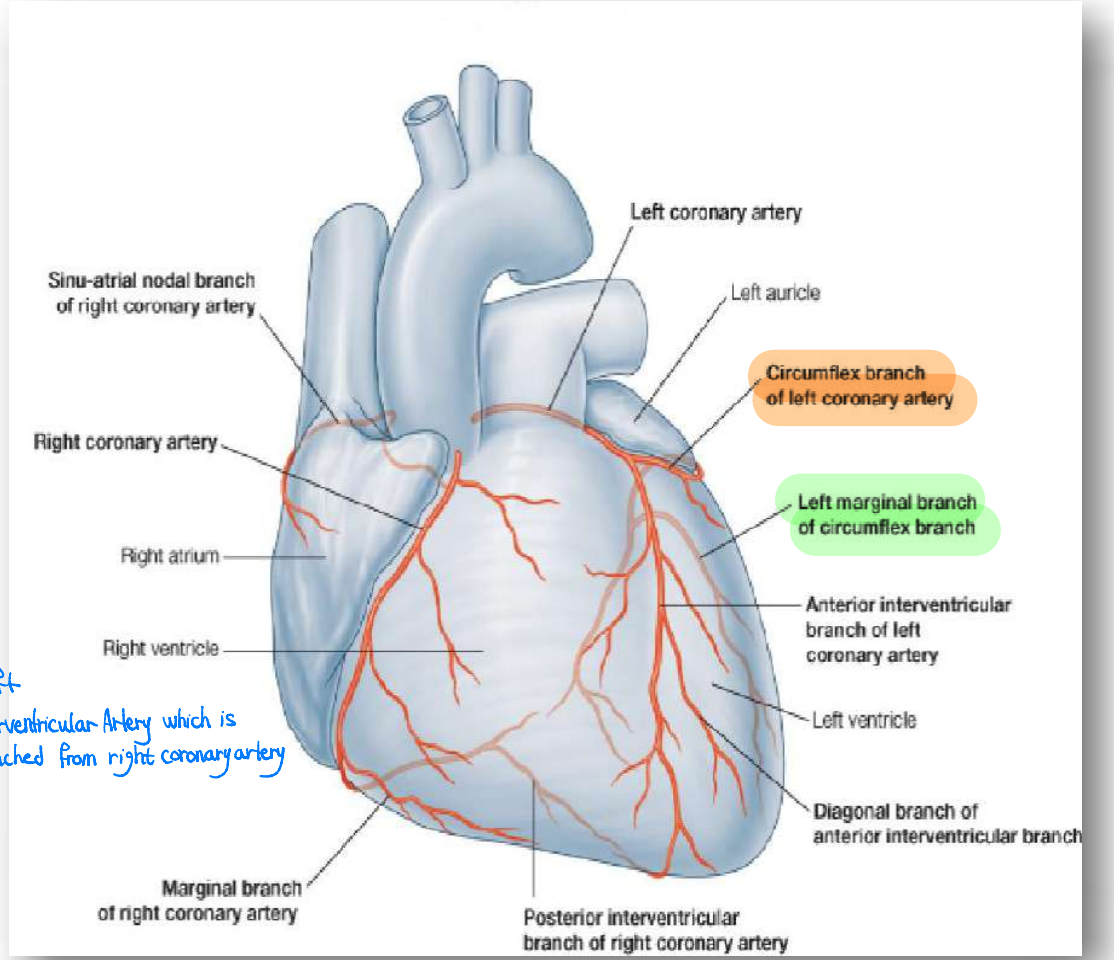
- **It runs** in the anterior interventricular groove. on the Anterior or Sternocostal Surface
- **It ends** by anastomosing with termination of (PIA). → Posterior Interventricular Artery near the apex of the heart
- **It supplies** the **anterior area** of both ventricles, (adjacent to anterior interventricular groove) and **anterior 2/3 of the interventricular septum.**
- **It supplies** the apex of the heart.
- A small **left conus artery** from anterior interventricular artery supplies the pulmonary conus.



2- Circumflex artery:

* The right atrium is completely supplied by branches of the Right Coronary Artery & The left atrium is completely supplied by circumflex branch of the left Coronary Artery

- It **runs to** the left in the atrioventricular groove, **continuing round** the left cardiac border and **runs into** the posterior part of the atrioventricular groove.
- It **ending by anastomosing** with the right coronary artery.



It gives the following branches:

1- Left marginal artery: supplies the left margin.

2-Posterior ventricular branches: supply part at the diaphragmatic surface of **left ventricle.** → not completely because there are some parts of the Diaphragmatic Surface of the Left Ventricle are supplied by branches of Posterior Interventricular Artery which is branched from right coronary artery

3-Atrial branches: Supply the **left atrium**. It give S.A nodal artery, supply SAN in 40% of individuals.

4-Posterior interventricular artery: in 10% of individuals (Lt coronary dominance) which give A.V. nodal artery, supply AVN.

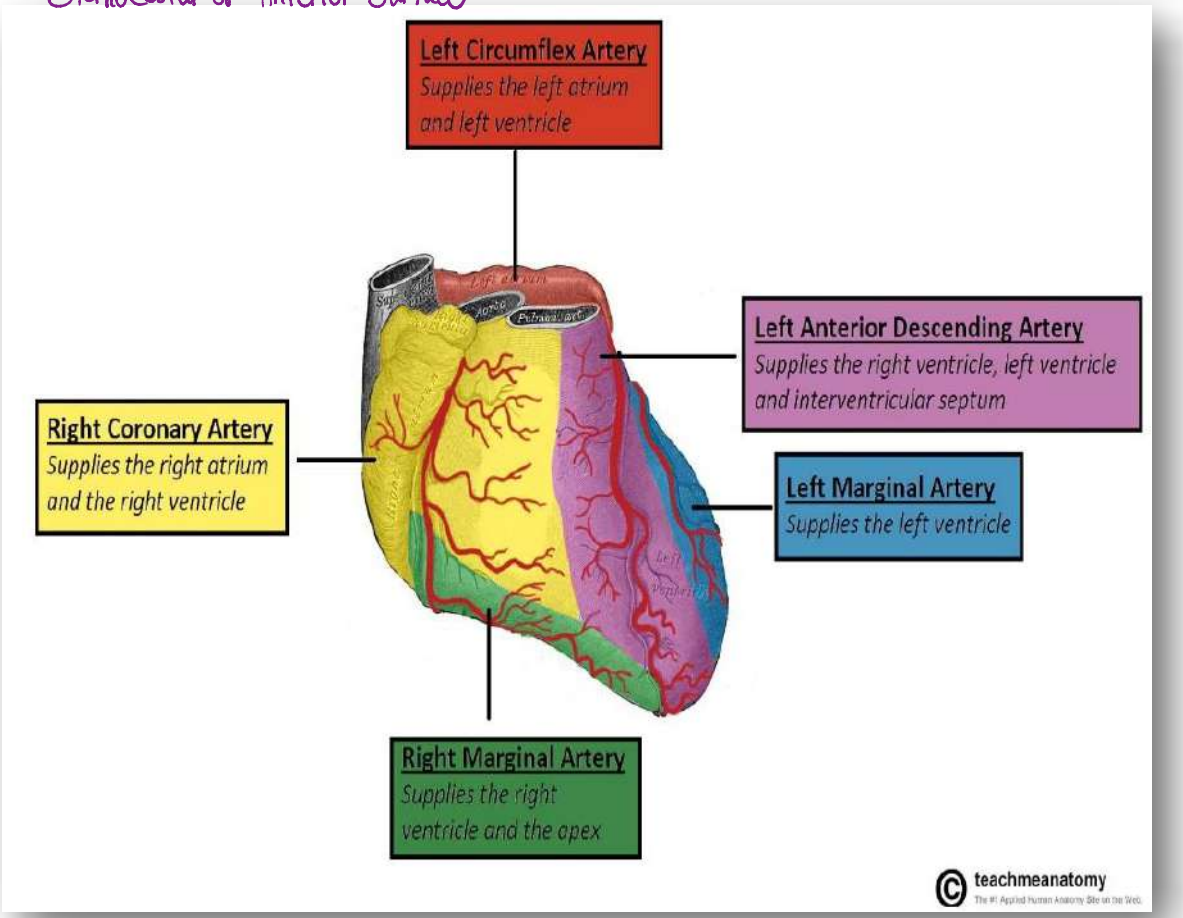
Coronary artery distribution:

Right coronary artery	Left coronary artery
Right atrium	Left atrium
Right ventricle except small area to the right of the anterior interventricular groove	Left ventricle except small area at diaphragmatic surface.
Small area of diaphragmatic surface of left ventricle (to the left of posterior interventricular groove).	Small area of anterior surface of right ventricle to the right of the anterior interventricular groove.
Posterior 1/3 of interventricular septum.	Anterior 2/3 of interventricular septum.
SAN in 60%.	SAN in 40% of individuals
AVN in 90%	AVN in 10% of individuals
Right bundle branch.	Left bundle branch

* if Mypcardial infarction occurs, any artery or branch is blocked ?
or
if Certain branch or artery is blocked, which area is infracted ?

Base & Diaphragmatic Surface

Sternocostal or Anterior Surface



Variations in the Coronary Arteries:

The posterior interventricular artery are variable. which define the dominance

In right coronary dominance;

- Posterior interventricular artery is a branch of the right coronary artery.
- It is present in most individuals (90%).

In left coronary dominance;

- Posterior interventricular artery is a branch of the circumflex branch of the left coronary artery.
- It is present in (10%) of individuals.

Coronary Artery Anastomoses:

- Anastomoses between the terminal branches of the right and left coronary arteries allow collateral circulation.
- But cannot rapidly provide collateral routes sufficient to sudden coronary obstruction. or block
  ما بتكفي تمنع لأنها بتيجي
- A sudden block of one of the larger branches of either coronary artery usually leads to myocardial death (myocardial infarction). to the area that is supplied by this branch
  so here coronary arteries are functionally end arteries ← يعني anastomoses بتكون normally في الحالة الطبيعية
- The functional value of such anastomoses appear to become more effective in slowly progressive pathological conditions (gradual block of one of the larger branches of either coronary artery). → anastomoses هنا تبدأ توسع بالتدريج
  "عند الموتى شكوى لكن ما بتوصل لـ "Myocardial infarction
- **Coronary arteries are essentially functional end arteries.** NOT anatomically

Venous Drainage of the heart

Most of the venous blood from the heart wall drains into the right atrium through **the coronary sinus.** → Deoxygenated blood ends in the right atrium

+ it's tributaries

Remainder of the venous blood is drained by:

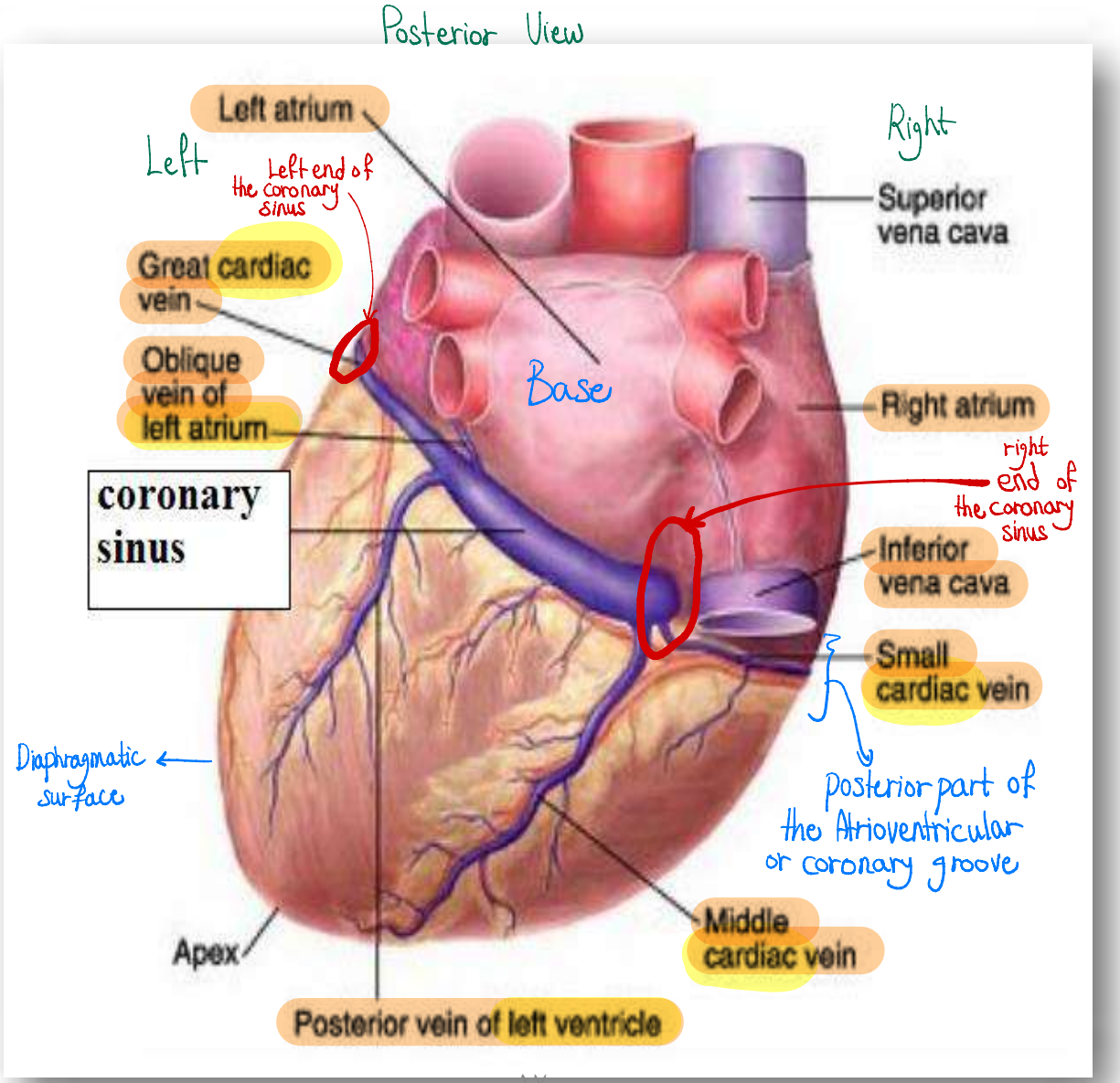
1- Anterior cardiac veins to the right atrium.

2- Small veins that open directly into the heart chambers.

Coronary sinus:

Site: Lies in left 1/2 of posterior coronary groove.

End: It opens into the posterior wall of the right atrium to the left of the inferior vena cava.



Tributaries of the coronary sinus (6):

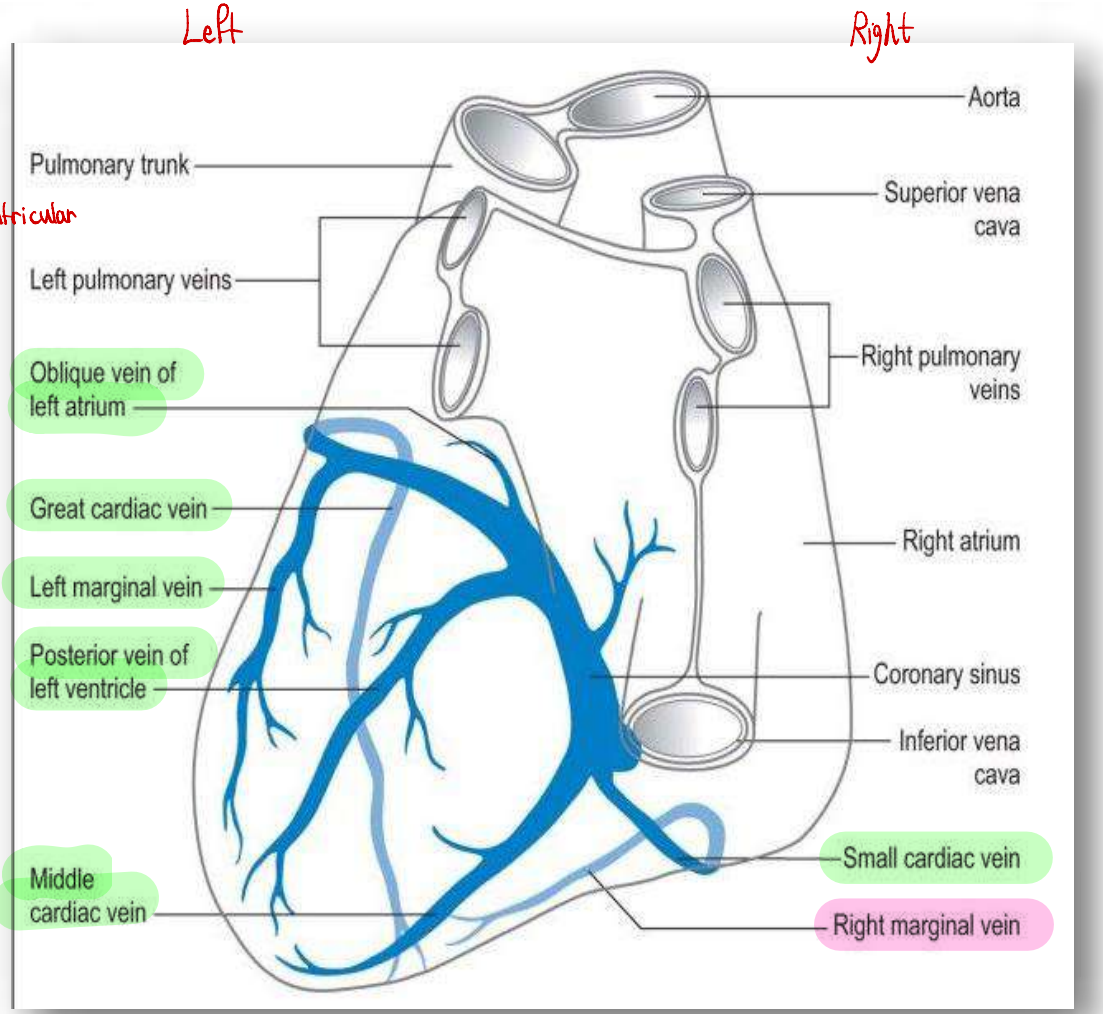
1- Great cardiac vein:

- It **begins** near the apex of heart and **ascend in** the anterior interventricular groove with (AIA). → Anterior Interventricular Artery
- **Ends in** the left end of the coronary sinus.
- It **receives** tributaries from the left atrium and both ventricles. (Right + Left)

2- Middle cardiac vein:

- It **begins** near apex of heart and **runs in** the posterior interventricular groove with (PIA). → posterior Interventricular Artery
- It **ends in** the coronary sinus near its termination. → Right end

↓ Posterior View



3- Small cardiac vein:

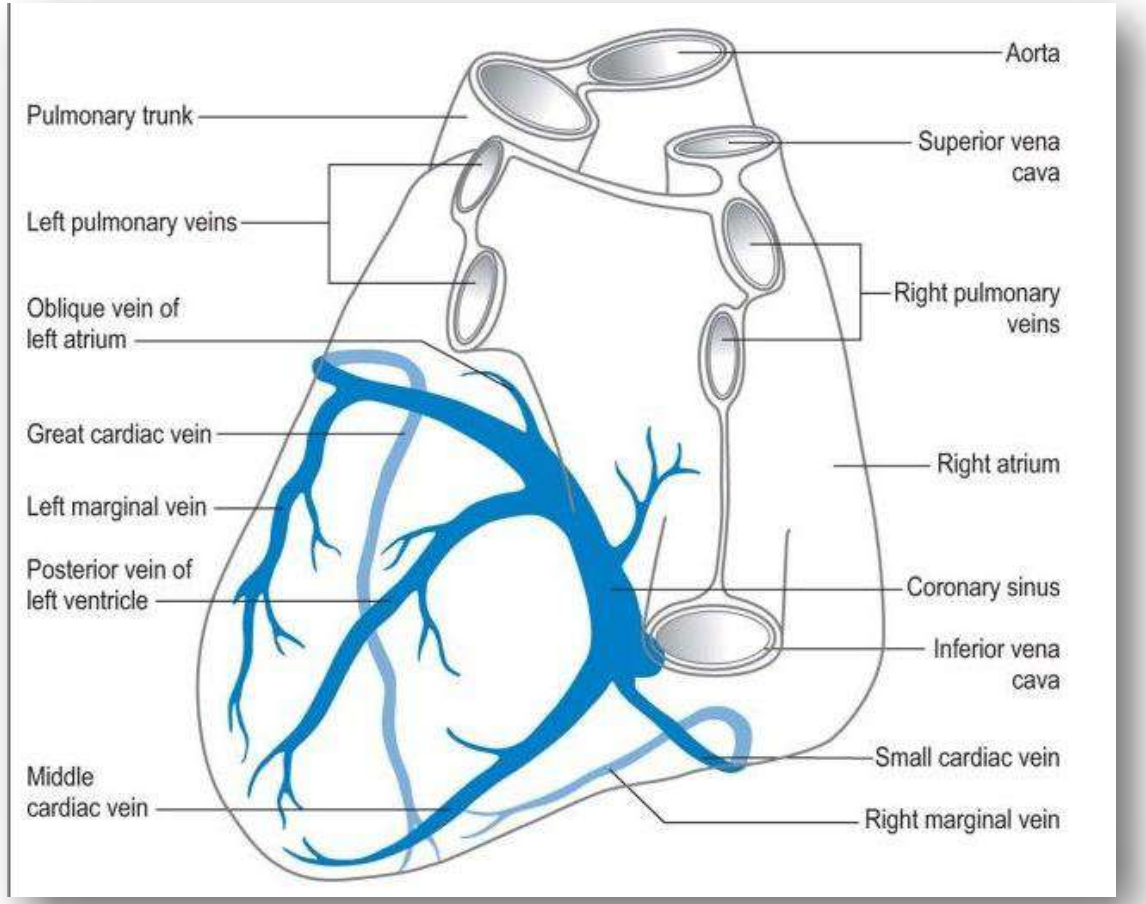
- **Lies in** the posterior part of coronary groove. in the right
- It **receives** blood from the posterior part of the right atrium and ventricle.

+ Right marginal vein ends in the small cardiac vein

4- Oblique vein of the left atrium.

5- Posterior vein of Left ventricle:

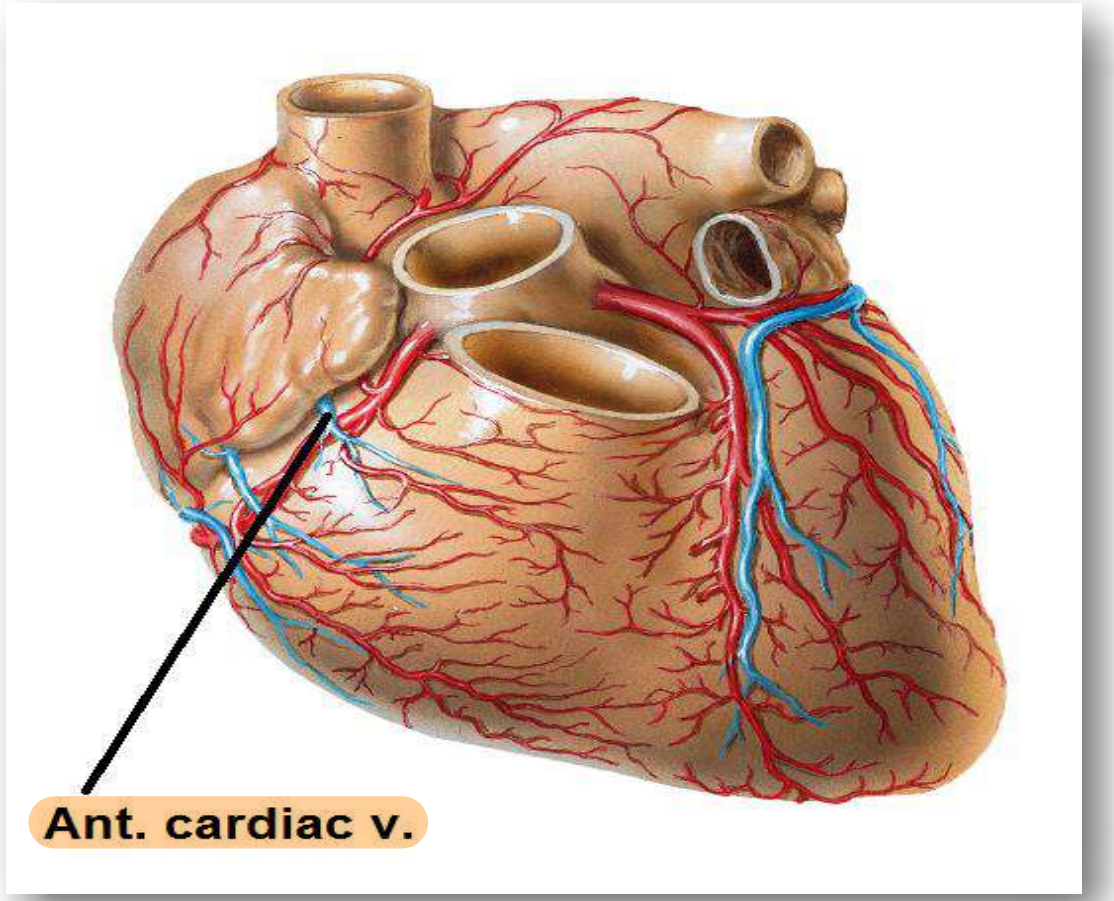
- It is **found on** the diaphragmatic surface of the left ventricle.



Remaining Parts not end in the coronary sinus

Anterior cardiac veins:

- Small veins run from the anterior surface of the right ventricle & right atrium **to open directly in the right atrium.** NOT in the coronary Sinus



Venae cordis minimae:

- Small veins open in all chambers of the heart.

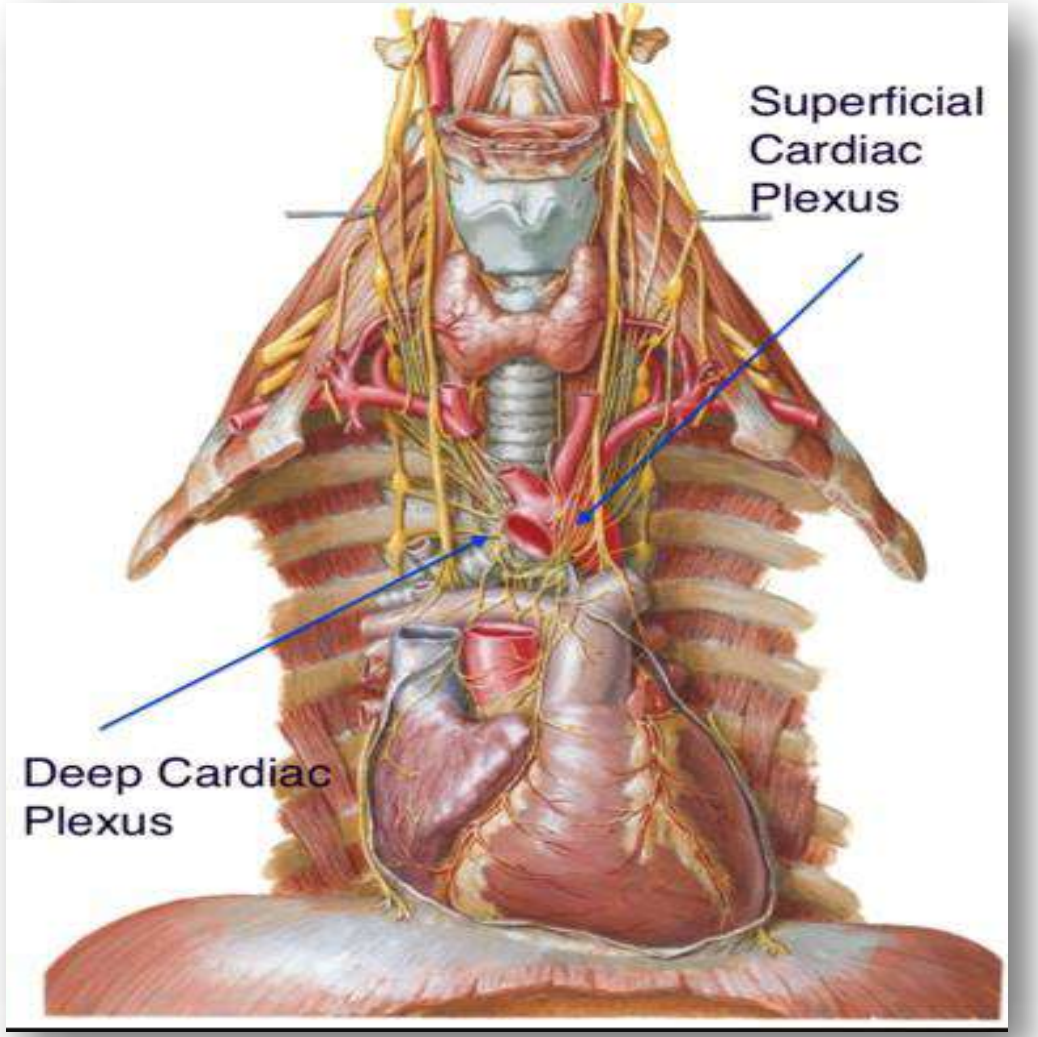
Nerve Supply of the Heart

- The heart is **innervated by** sympathetic and parasympathetic fibers via the cardiac plexuses. (Deep, Superficial)

- Sympathetic component of the cardiac plexus comes from **cardiac nerves**, which originate from the cervical and upper thoracic portions of the sympathetic trunk.

- Parasympathetic component of the cardiac plexus originates from the **cardiac branches of the vagus nerve.** (Cranial Nerve number 10)

- **Sympathetic & parasympathetic fibers terminate on:** the sinuatrial and atrioventricular nodes, on cardiac muscle fibers, and on the coronary arteries.



Cardiac Pain:

- Afferent pain fibers run in the sympathetic fibers to enter spinal cord segment T1-T4 especially on left side.
- **Pain originating in the heart as the result of:** acute myocardial ischemia.

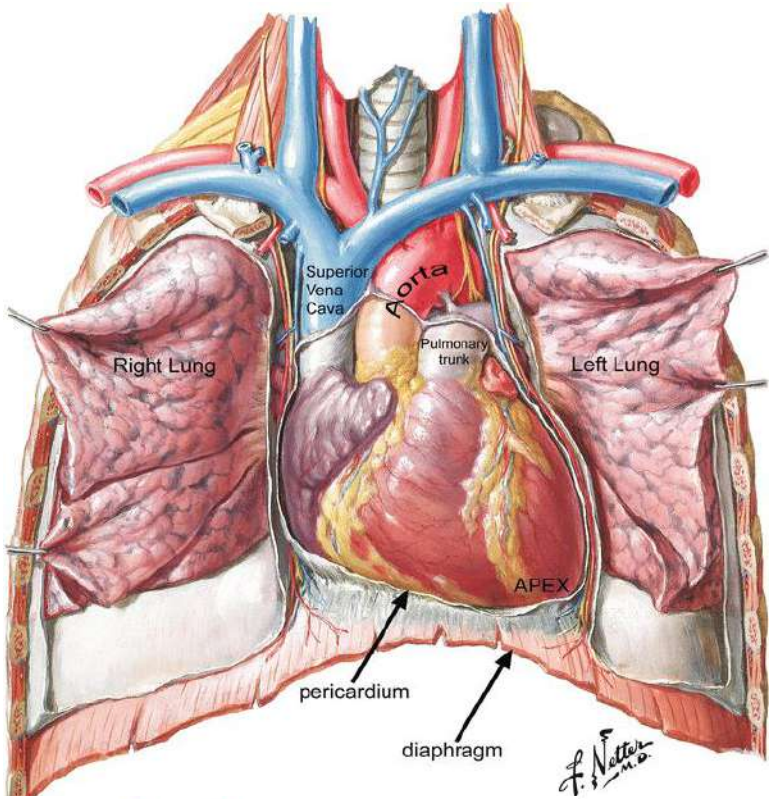
Referred cardiac pain

- It is **referred to** the skin areas that coincide with the dermatomes of somatic sensory fibers that enter the same spinal cord segment as afferent pain fibers coming from the heart.
- So cardiac pain is referred to the left side of chest (dermatome T3&T4) and medial aspect of left arm (dermatome T1&T2).

Great arteries of the heart

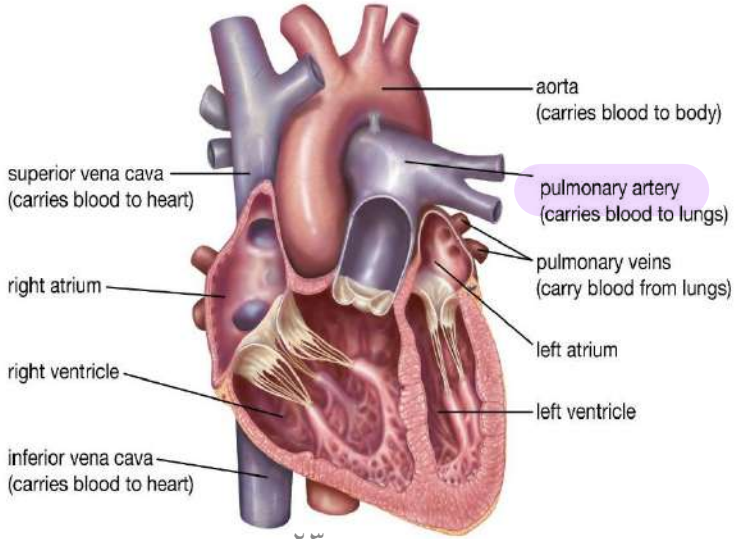
Pulmonary Trunk

- It leaves the upper part of the right ventricle and runs upward, backward, and to the left.
- It is about (5 cm) long.
- It terminates in the concavity of the aortic arch by dividing into right and left pulmonary arteries. → each artery carries blood into the corresponding lung
- Together with the ascending aorta, it is enclosed in the fibrous pericardium and a sheath of serous pericardium.



Branches

- **Right pulmonary artery;** Runs to the right behind the ascending aorta and superior vena cava to enter the root of the right lung.
- **Left pulmonary artery;** Runs to the left in front of the descending aorta to enter the root of the left lung.

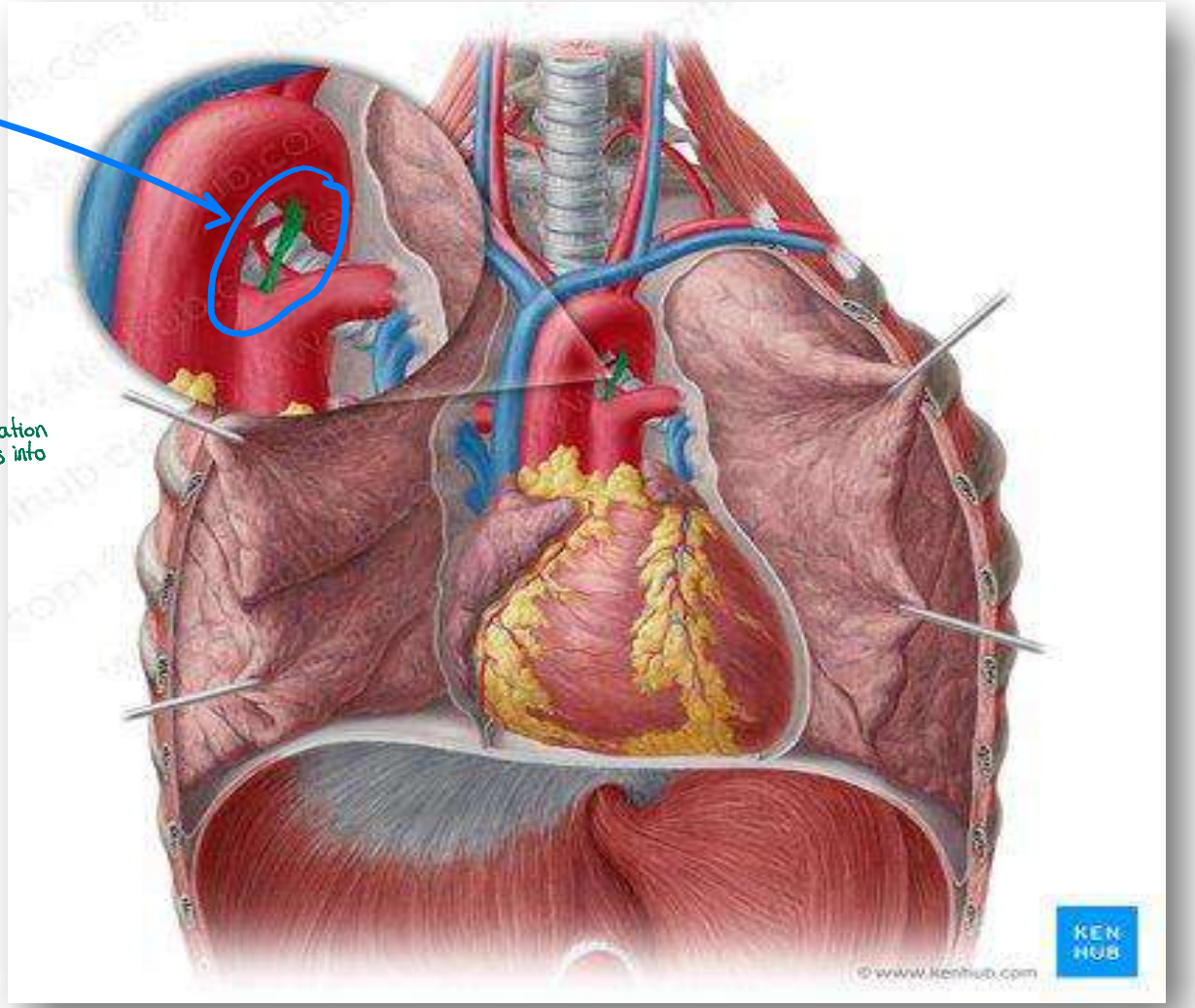


Ligamentum arteriosum:

باللون الأخضر

- Is a short fibrous band that connects the bifurcation (تشعب) of pulmonary trunk with the arch of the aorta.

- It is the remnant of the ductus arteriosus. → after birth, obliteration occurs & it transfers into Ligament



Ascending aorta

Origin:

- From the left ventricle at the level of **left 3rd costal cartilage.**
- At its origin, there were three outward bulges (sinuses of Valsalva), posterior (non-coronary), left and right aortic sinuses.

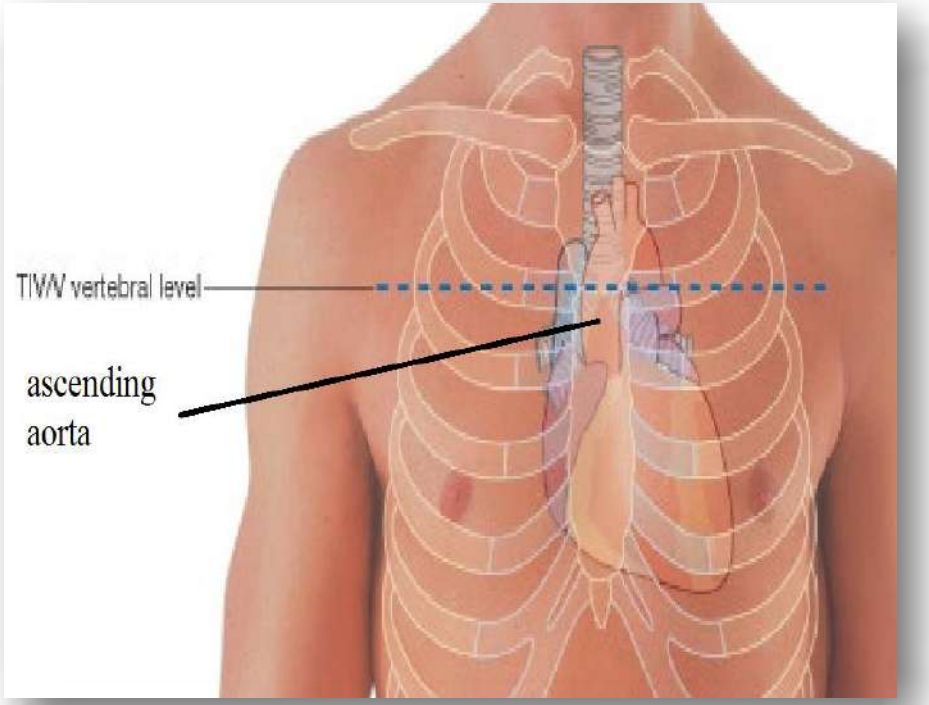
Course:

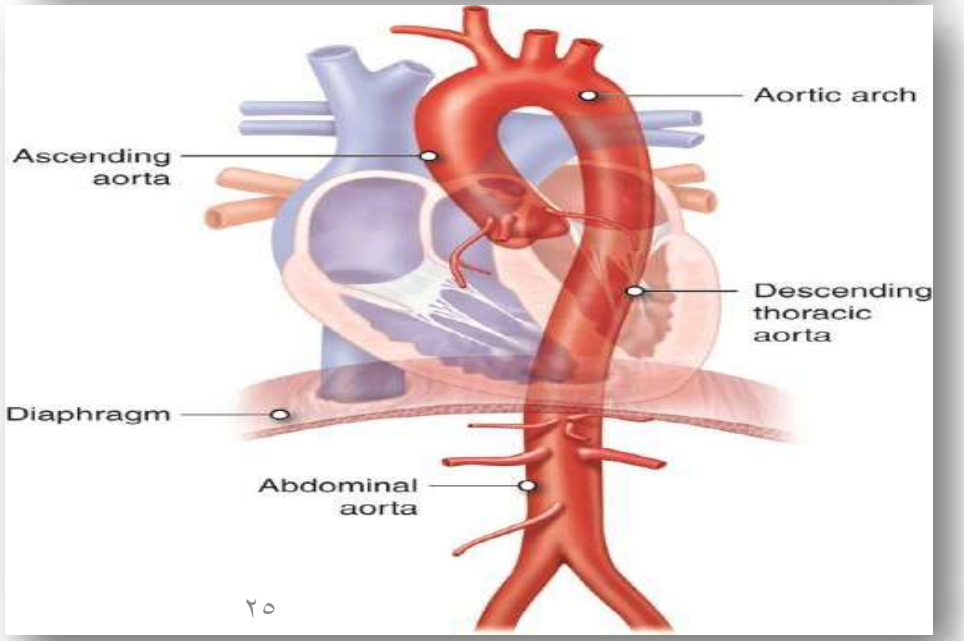
upward & r

It ascends obliquely to the right.

End:

- It ends at the level of the **right second costal cartilage,** where it becomes continuous with the arch of the aorta.





Relations of the ascending aorta

Anterior relations:

- Pulmonary trunk. firstly anterior & then to the left
- Right auricle.
- Right pleura& lung.

Posterior relations:

- Right pulmonary artery.

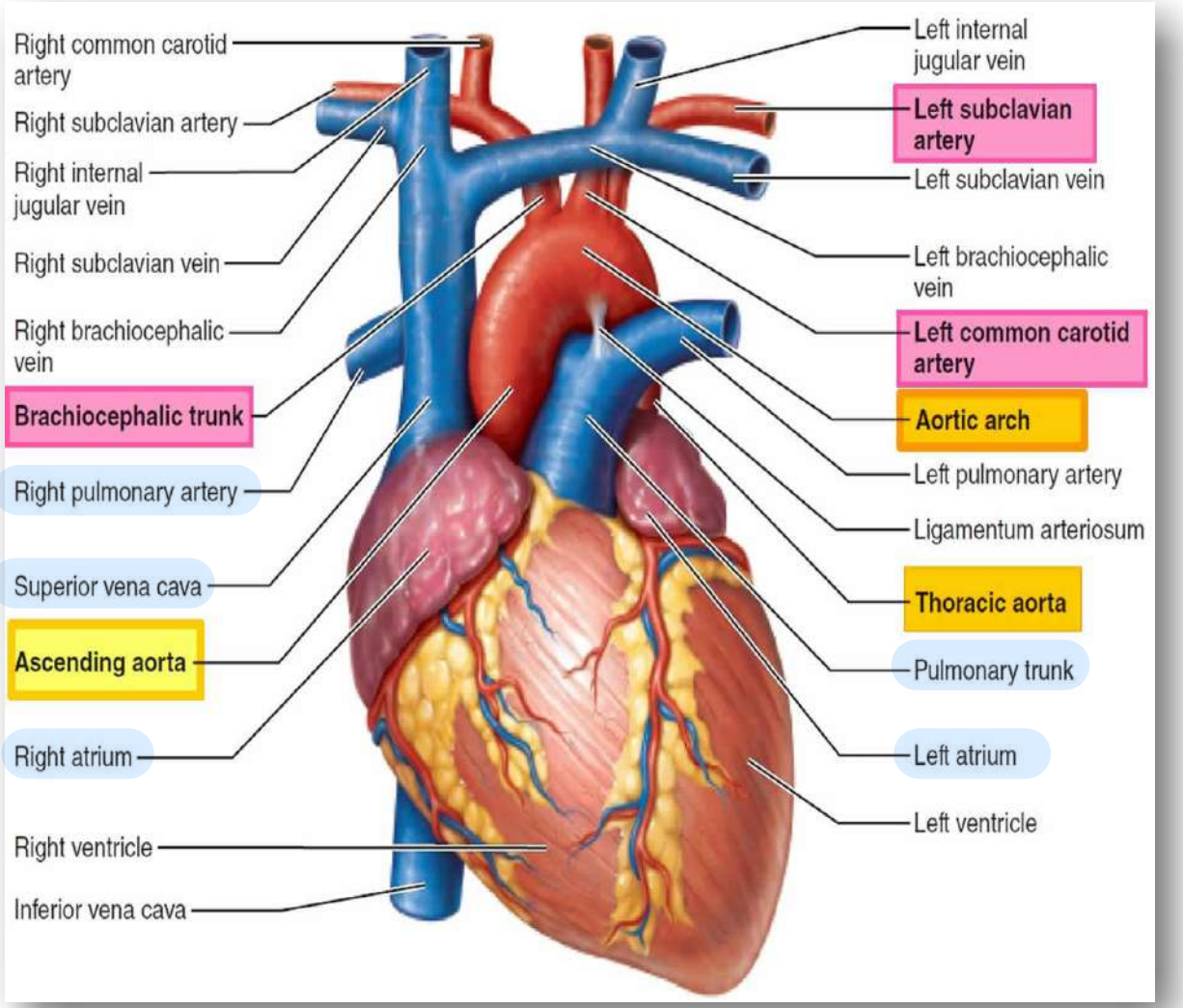
Right to it:

- Right atrium& SVC.

Left to it:

- Left atrium& Pulmonary trunk.

Branches: Right& Left coronary arteries.



Quiz

Coronary angiographs of a 44-year-old male patient reveal an occlusion of the anterior interventricular branch of the left coronary artery produces infarction in which one of the following areas?

A) The entire diaphragmatic surface of the left ventricle → near the posterior interventricular groove supplied by branch of Posterior interventricular artery & remaining is supplied by circumflex branch of the Left coronary artery

B) The anterior part of the interventricular septum.

C) The posterior wall of the left atrium. → supplied by Circumflex branch of the left coronary artery

D) The right auricle. or right atrium is completely supplied by Right Coronary Artery

Which of the following veins accompanies the posterior interventricular artery.

(A) Great cardiac vein → accompines with Anterior Interventricular artery

(B) Middle cardiac vein

(C) Anterior cardiac vein

(D) Small cardiac vein

(E) Oblique veins of the left atrium