

Heart Valves and Heart blood supply

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VALVES OF THE HEART

Atrioventricular valves

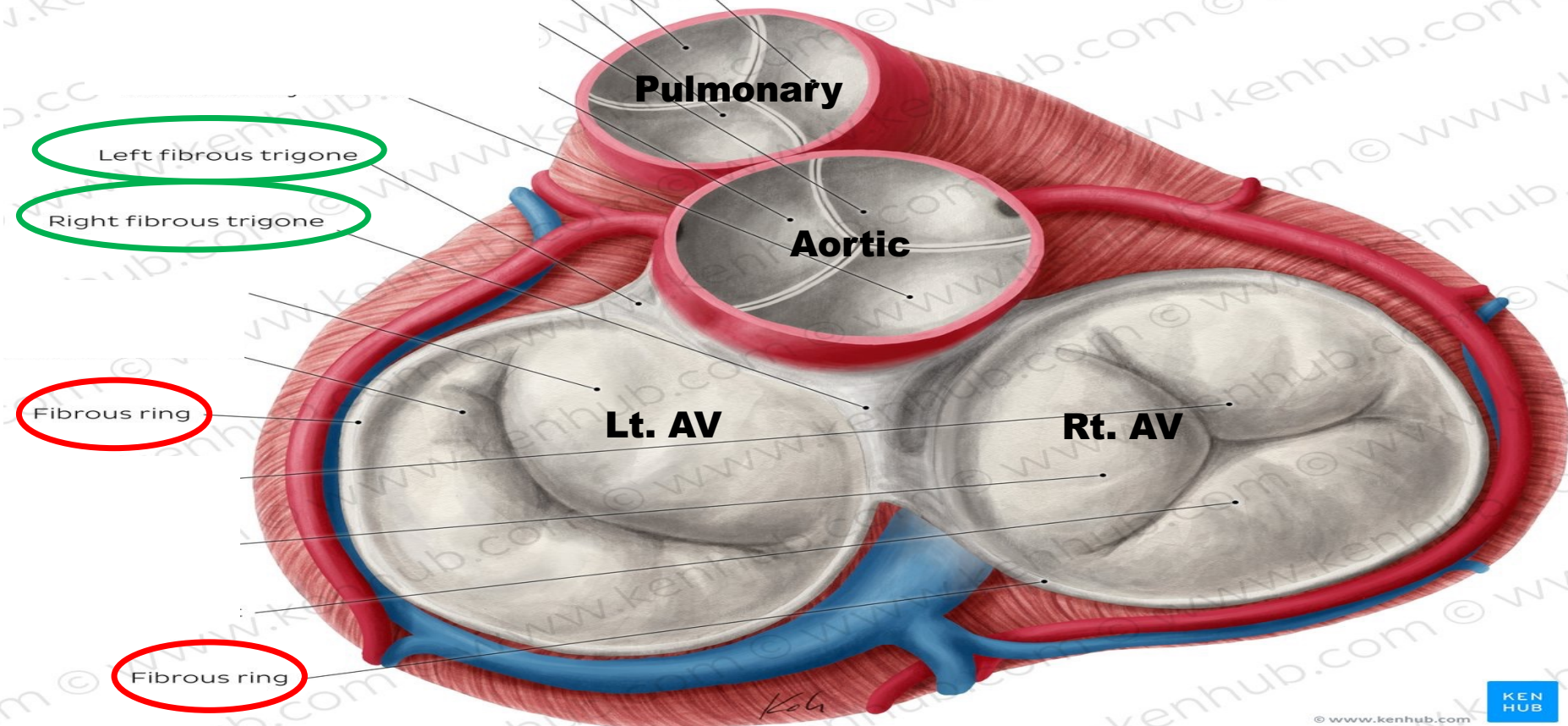
Semilunar valves

Tricuspid valve:
Between right atrium and right ventricle

Mitral or Bicuspid valve:
Between left atrium and left ventricle

Pulmonary valve
Between right ventricle and pulmonary artery

Aortic valve
Between left ventricle and Aortic artery

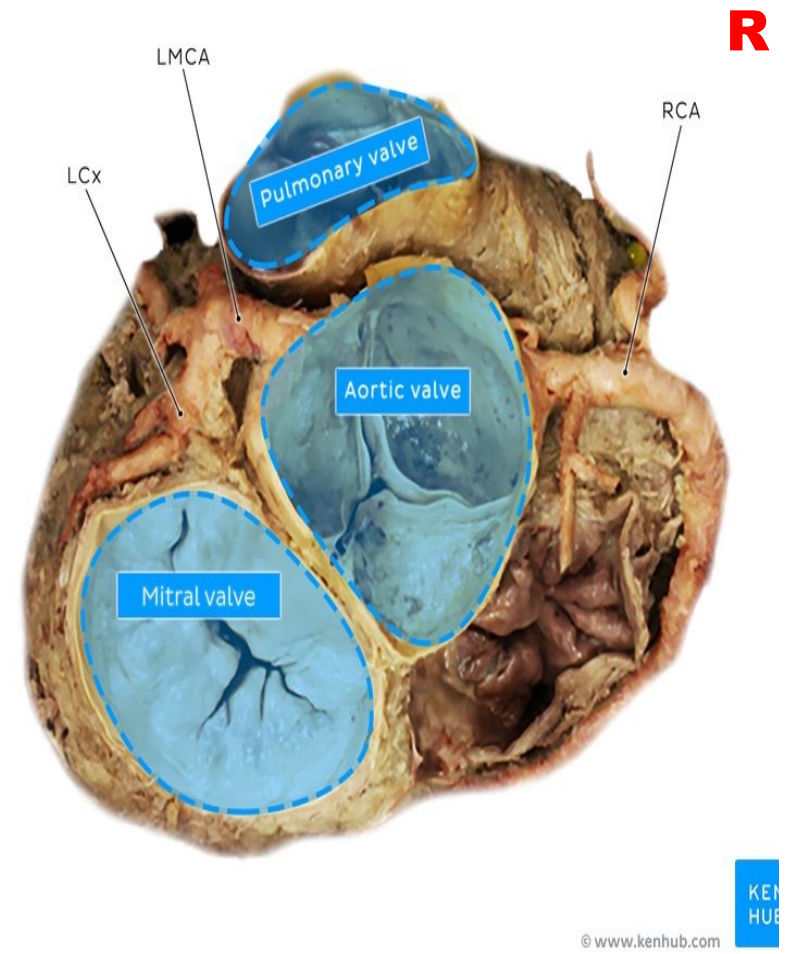
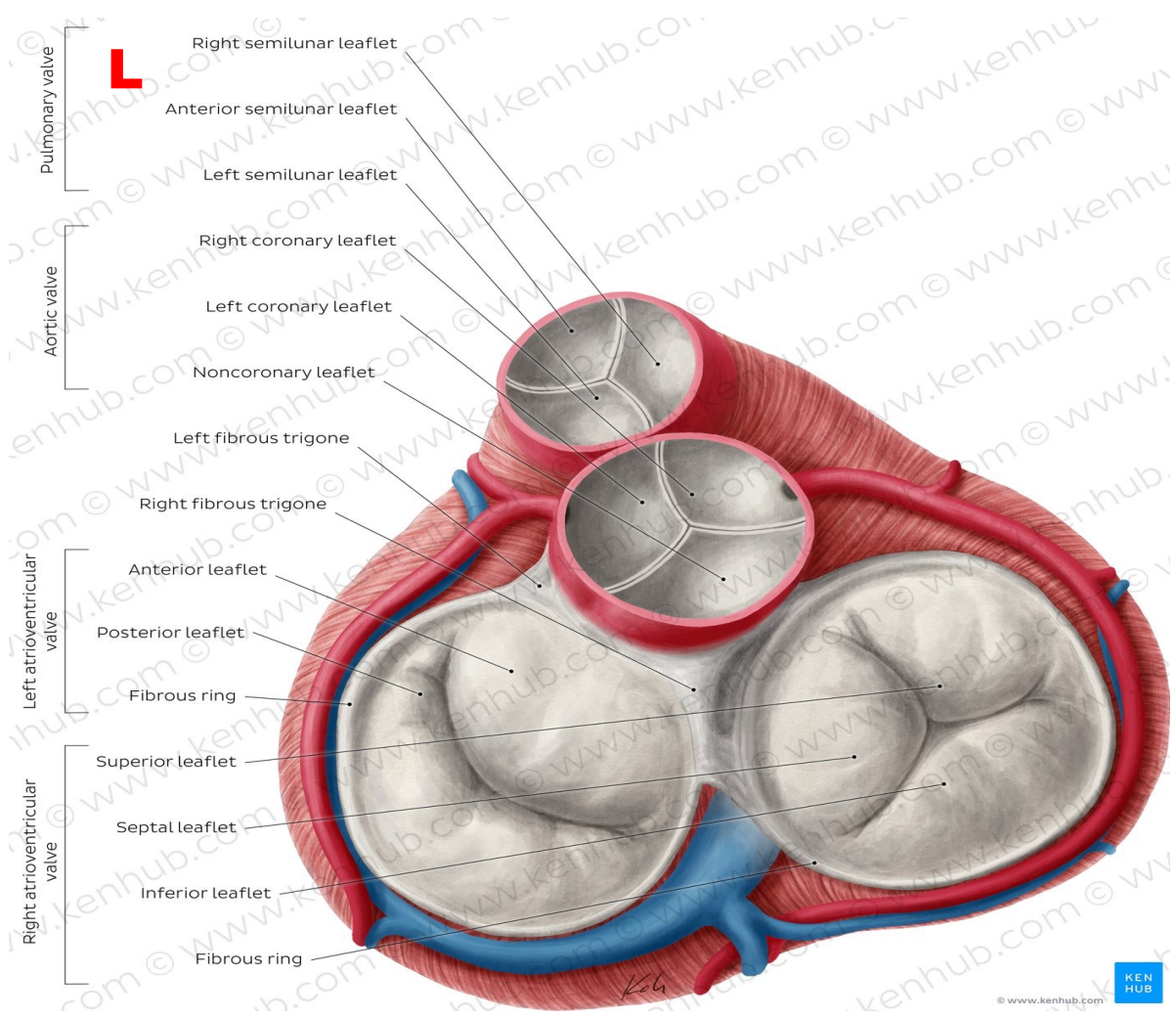




Fibrous ring of left atrioventricular valve



Fibrous ring of right atrioventricular valve



Tricuspid valve

It guards the right Atrioventricular orifice

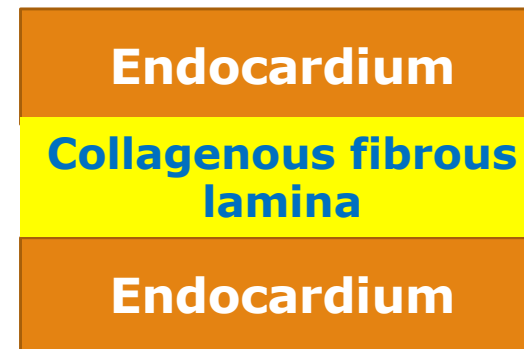
It composed of :

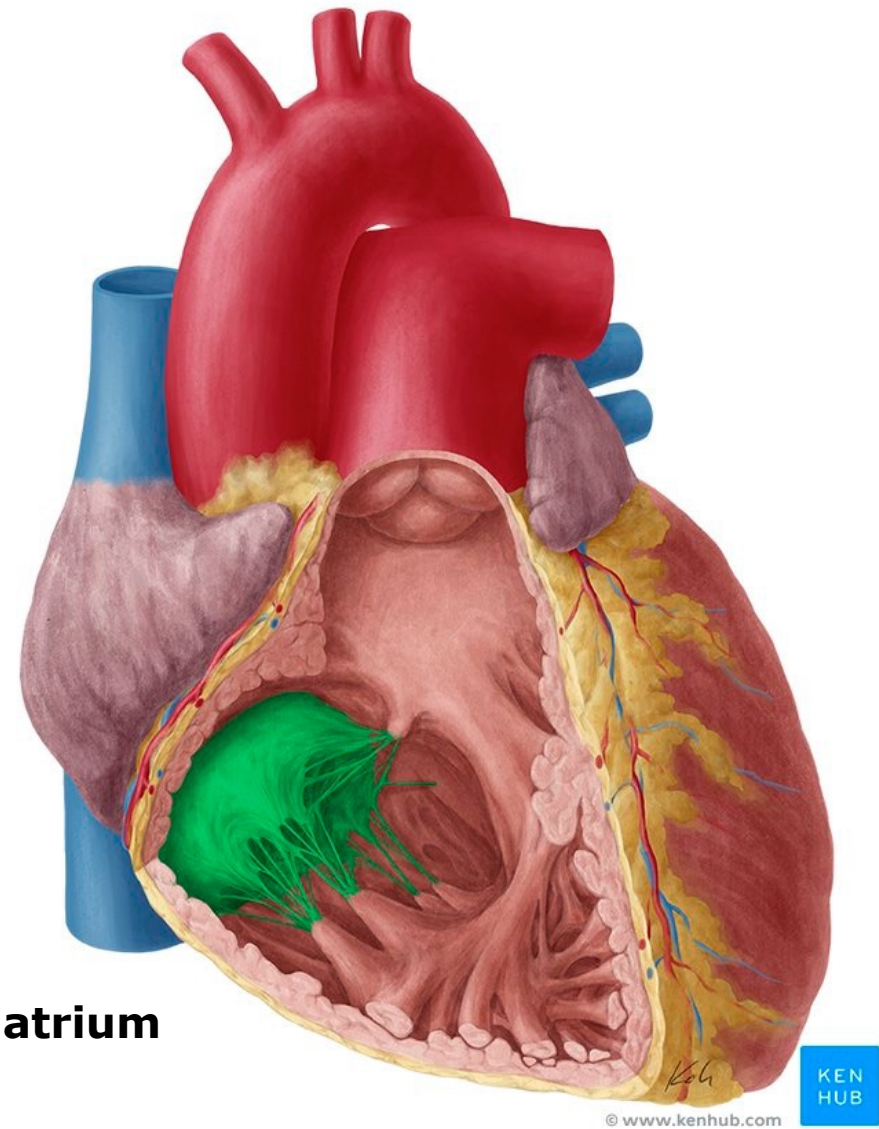
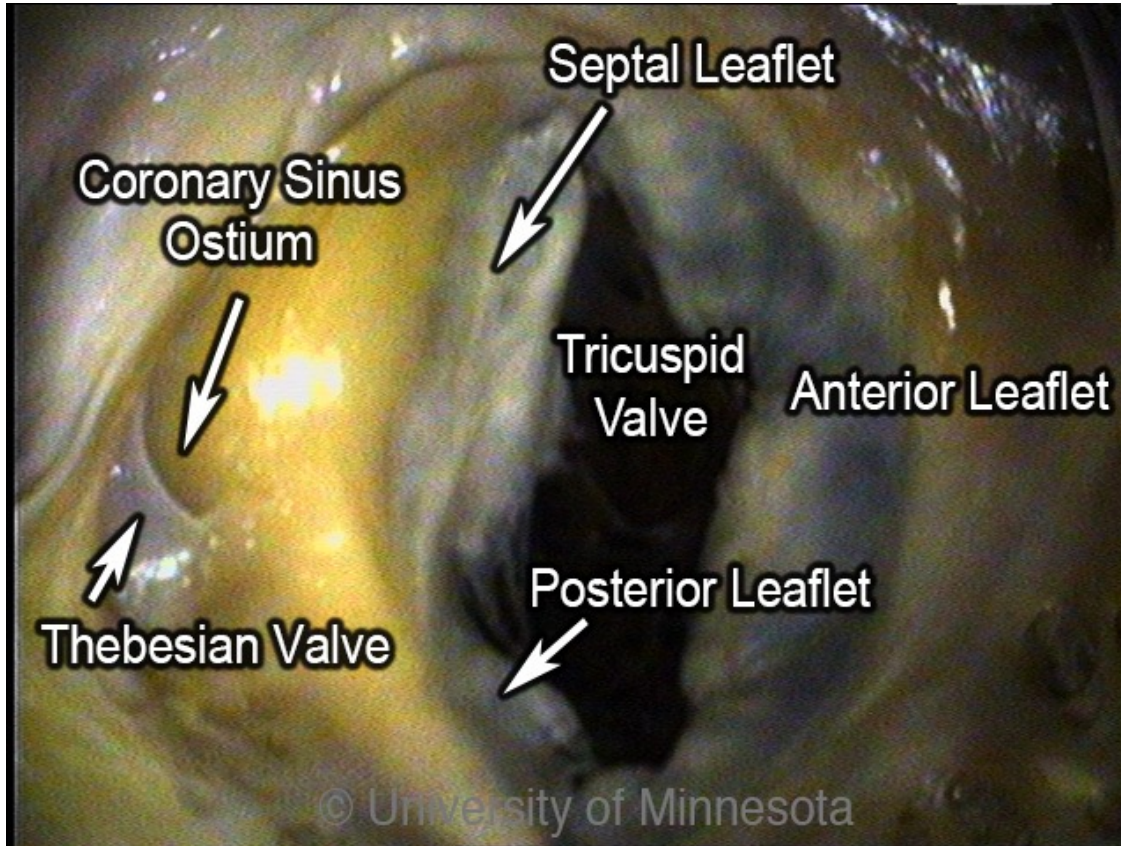
1-Tricuspid valve orifice and annulus

- The orifice is surrounded by the tricuspid valve annulus which is a collagenous fibrous ring
- It gives attachment to the cusps or leaflets of the tricuspid valve.
- The fibrous ring keeps the caliber of the orifice constant, large enough to admit the tips of three fingers

2- Tricuspid valve cusps (leaflets)

- Three in number: anterior, posterior and septal.
- The base of the cusps are attached to the tricuspid fibrous annulus of the heart skeleton
- The margins of the cusps are fused together forming valve commissures.
- Each cusp or leaflet is formed of a double layer of endocardium enclosing a collagenous fibrous lamina.
- The anterior cusp is the largest while the septal one is the smallest.





A human tricuspid valve viewed from the right atrium

3- Chordae tendineae

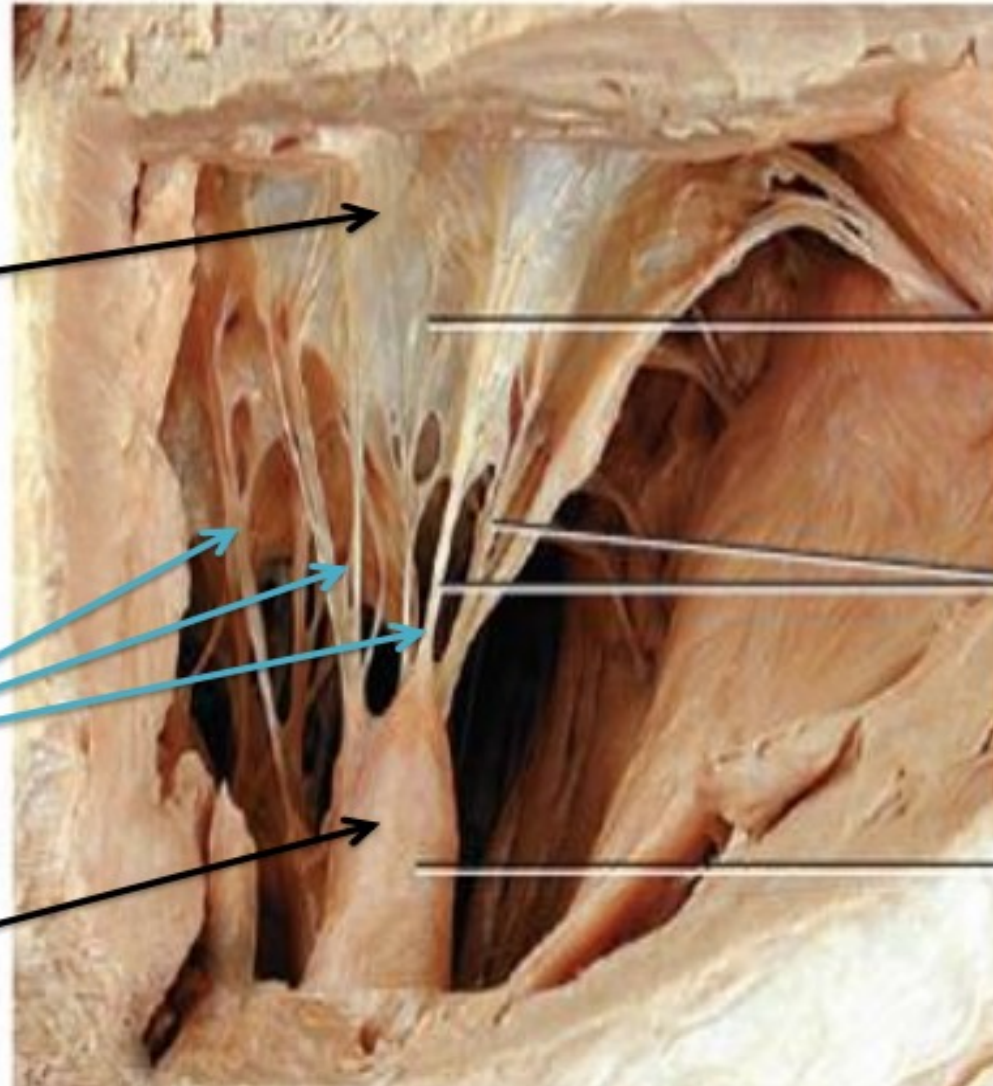
- These are strong collagenous fibrous threads which spring from the apical parts of the papillary muscles or directly from the septal wall.
 - They get attached to the margins and ventricular surfaces of the leaflets of the tricuspid valve.
 - Each papillary muscle sends its chordae tendineae to two adjacent leaflets
-
- ❑ **Anterior papillary muscles** their chordae tendineae are attached to the adjacent parts of the anterior and posterior leaflets.
 - ❑ **Posterior papillary muscles** their chordae tendineae are attached to the adjacent parts of the posterior and septal leaflets.
 - ❑ **Septal papillary muscles**: their chordae tendineae are attached to the adjacent parts of the septal and anterior leaflets.

The Tricuspid Valve

The cusps

The chordae tendineae.

papillary muscles



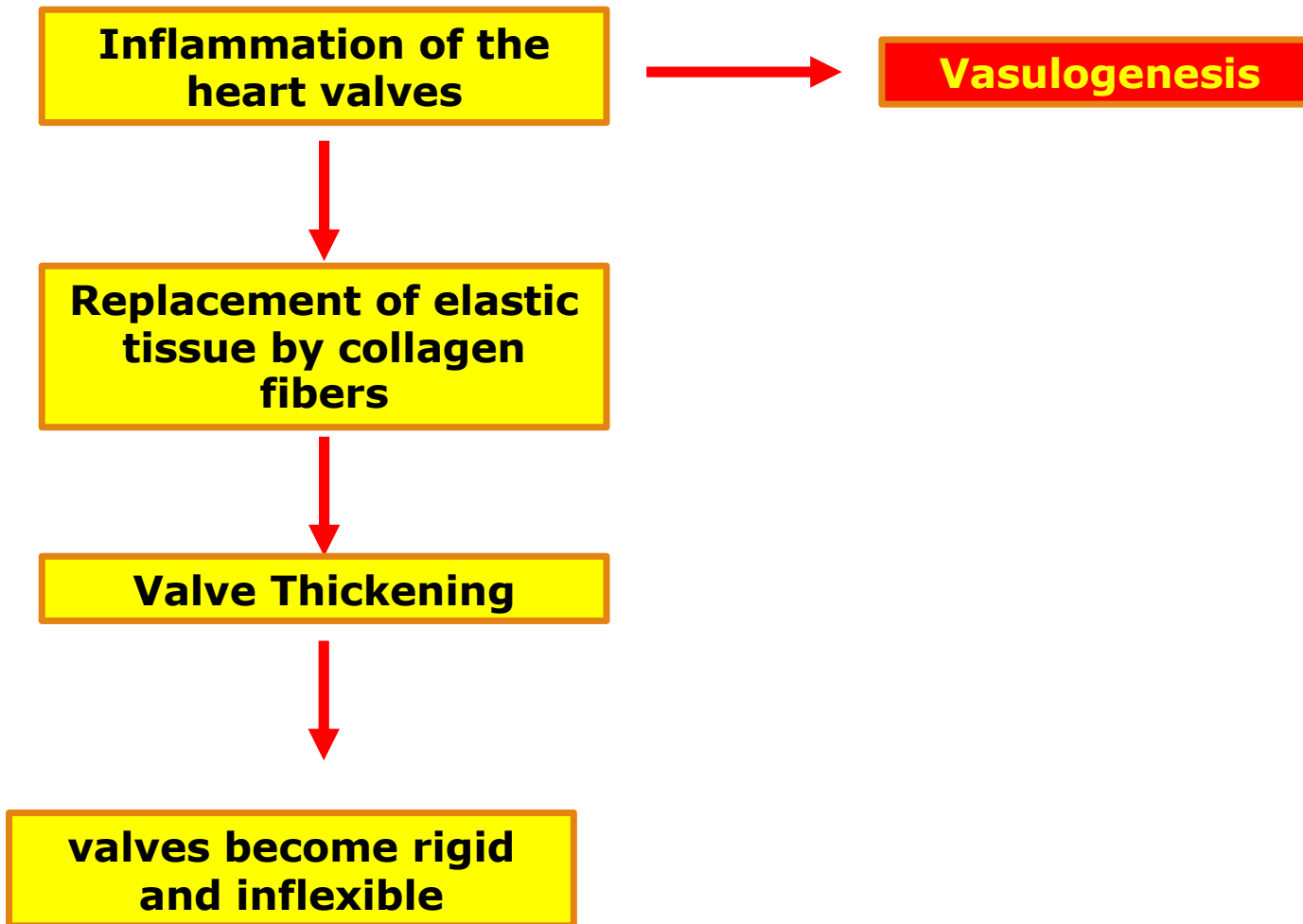
Cusp of tricuspid valve

Chordae tendineae

Papillary muscle

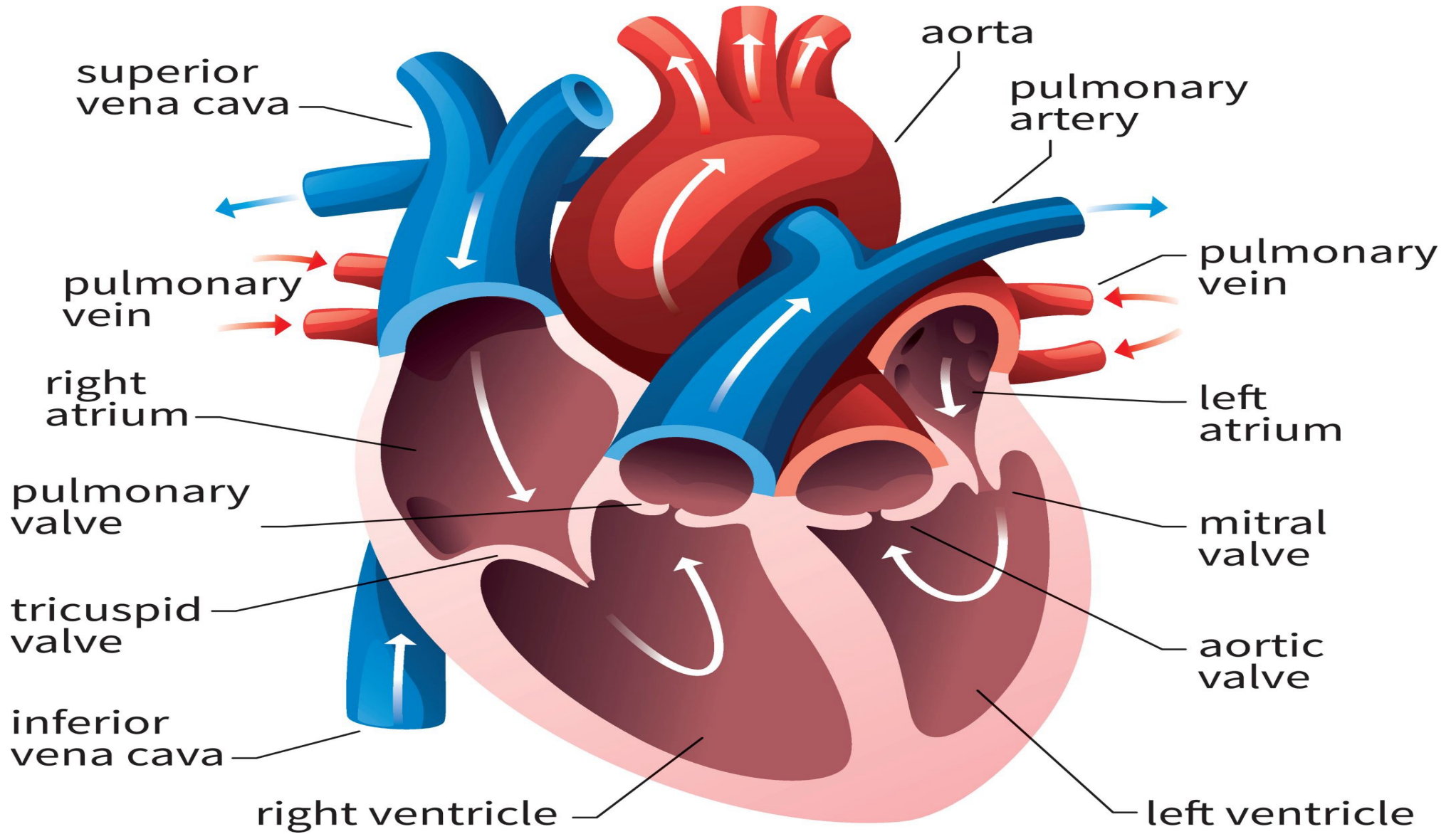
Blood supply of the cusps

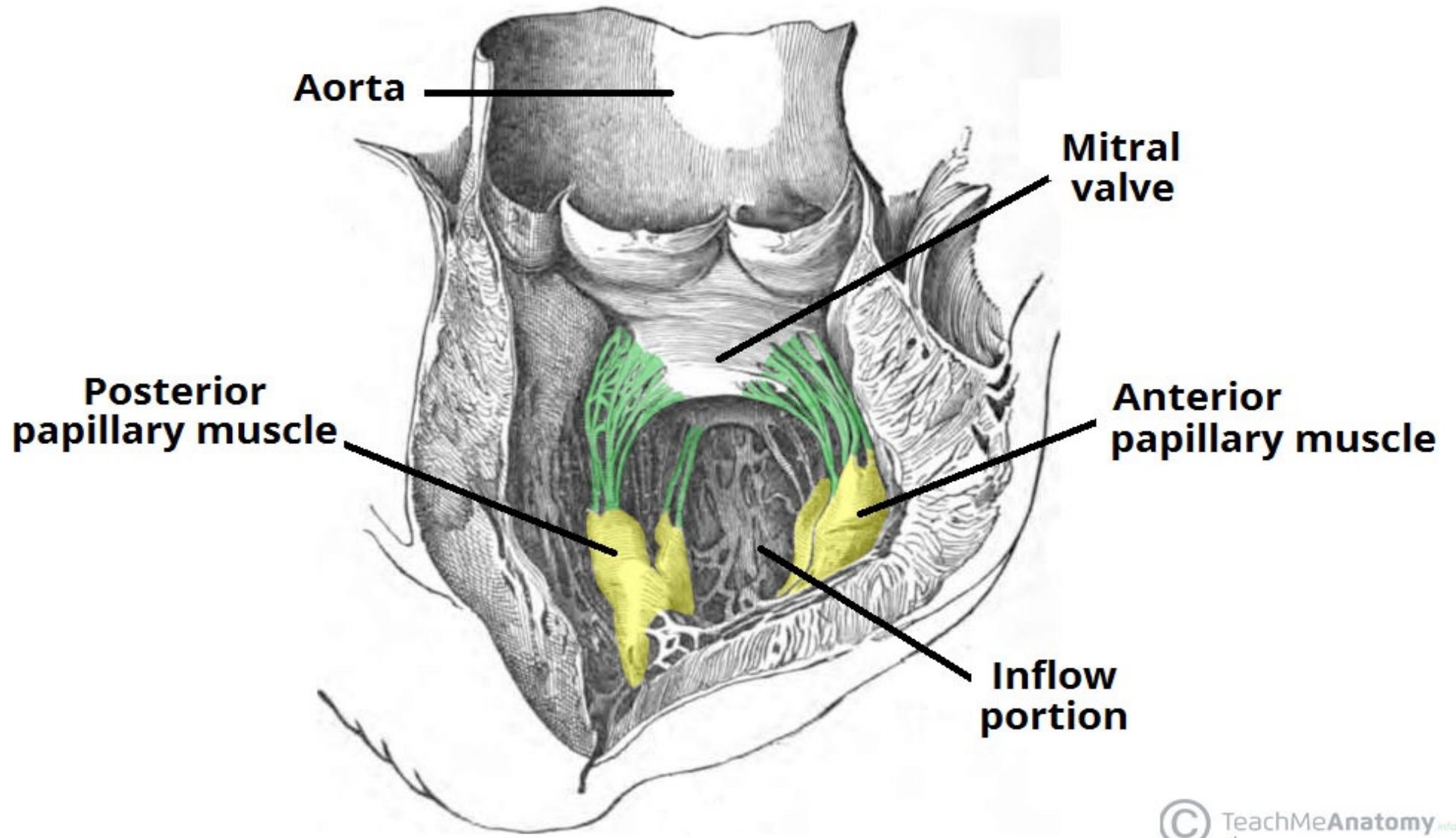
- ❖ Valve cusps are normally avascular
- ❖ Small blood vessels and smooth muscle can be found only in the base of the cusp.
- ❖ The surfaces of the valve are exposed to blood, and the cusps are thin enough to allow nutrients and oxygen to diffuse from the blood
- ❖ Rheumatic fever causes inflammation of the heart valves (valvulitis)
- ❖ Inflammation induces angiogenesis in the valve and vascularization in the normally avascular layers of the valve.
- ❖ This inflammation can lead to progressive replacement of elastic tissue by irregular masses of collagen fibers, causing the valve to thicken.
- ❖ The valves become rigid and inflexible, which affects their ability to open and close



Mitral Valve

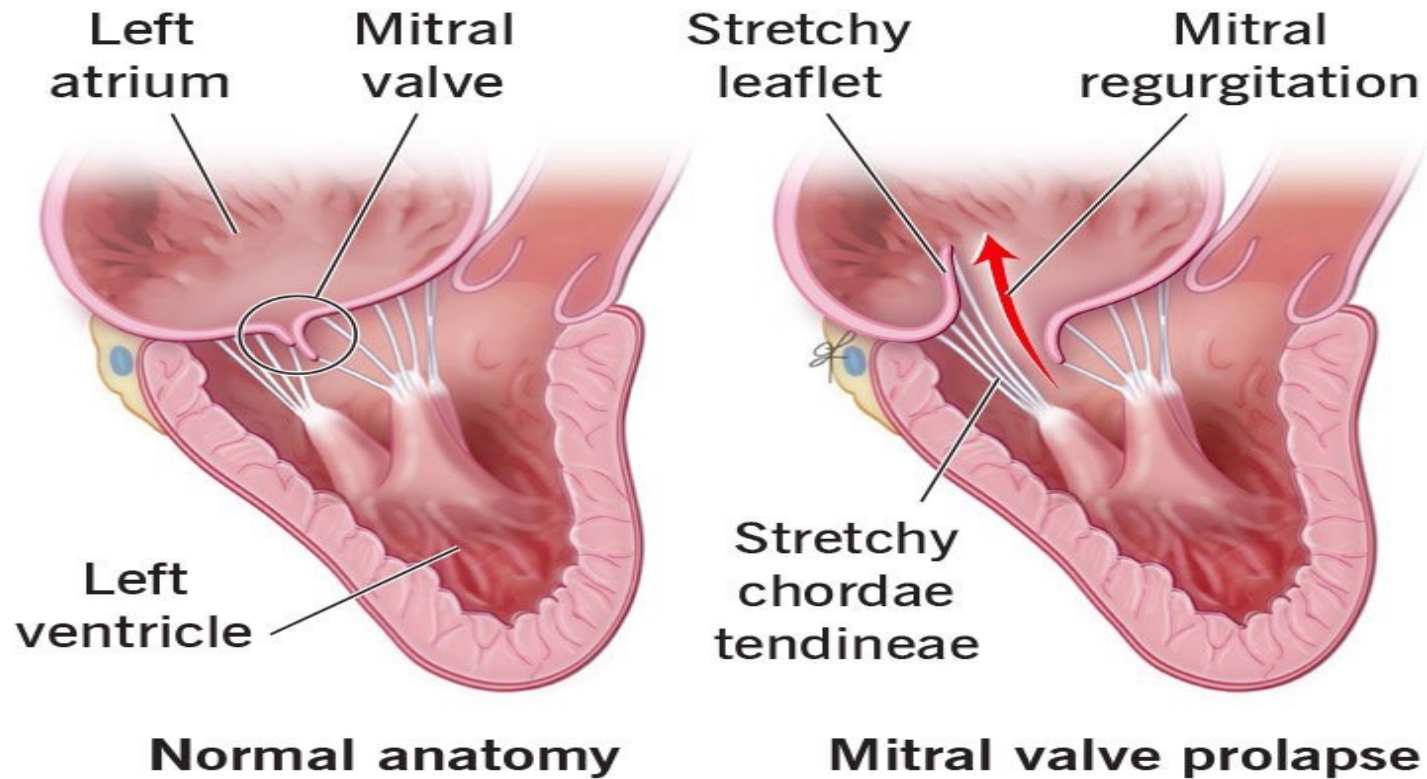
- It guards the left atrioventricular orifice between left atrium and left ventricle
- The mitral orifice is narrower than tricuspid orifice
- It has two cusps :
 - The anterior is larger and directed anterior and to the right
 - The posterior is smaller and directed posterior and to the left





Mitral Valve Prolapse

Floppy valve syndrome



How the atrioventricular valves work

- ✓ When the ventricle contracts, the papillary muscles contract and prevent the cusps from being forced into the atrium and turning inside out as the intraventricular pressure rises
- ✓ To assist in this process, the chordae tendineae of one papillary muscle are connected to the adjacent parts of two cusps
- ✓ On closure of an AV valve, the narrow border between the free edge of each cusp presses against that of the next, resulting in a secure, watertight closure

- ❑ Papillary muscles begin to contract before contraction of the right ventricle, tightening the tendinous cords and drawing the cusps together.
- ❑ Because the cords are attached to adjacent sides of two cusps, they prevent separation of the cusps and prevent prolapsing (being driven into the right atrium) as ventricular pressure rises.
- ❑ Thus, regurgitation of blood (backward flow of blood) from the right ventricle back into the right atrium is blocked during ventricular systole by the valve cusps.

Semilunar valves

- Each consists of three pocket like cusps of approximately equal size
- The arterial wall has three dilated pouches called sinuses or Valsalva (The aortic sinuses pulmonary sinuses)
- The blood in the sinuses and the dilation of the wall prevent the cusps from sticking to the wall of the vessel, which might prevent closure
- At the center of the free margin of each cusp is a small fibrous nodule called the **nodulus Arantii**
- Along the entire free edge of the cusp, on each side of the nodules of Arantius there is a thin, halfmoon-shaped area called the lunula

1- The pulmonary valve

It guards the orifice between right ventricle and pulmonary artery.

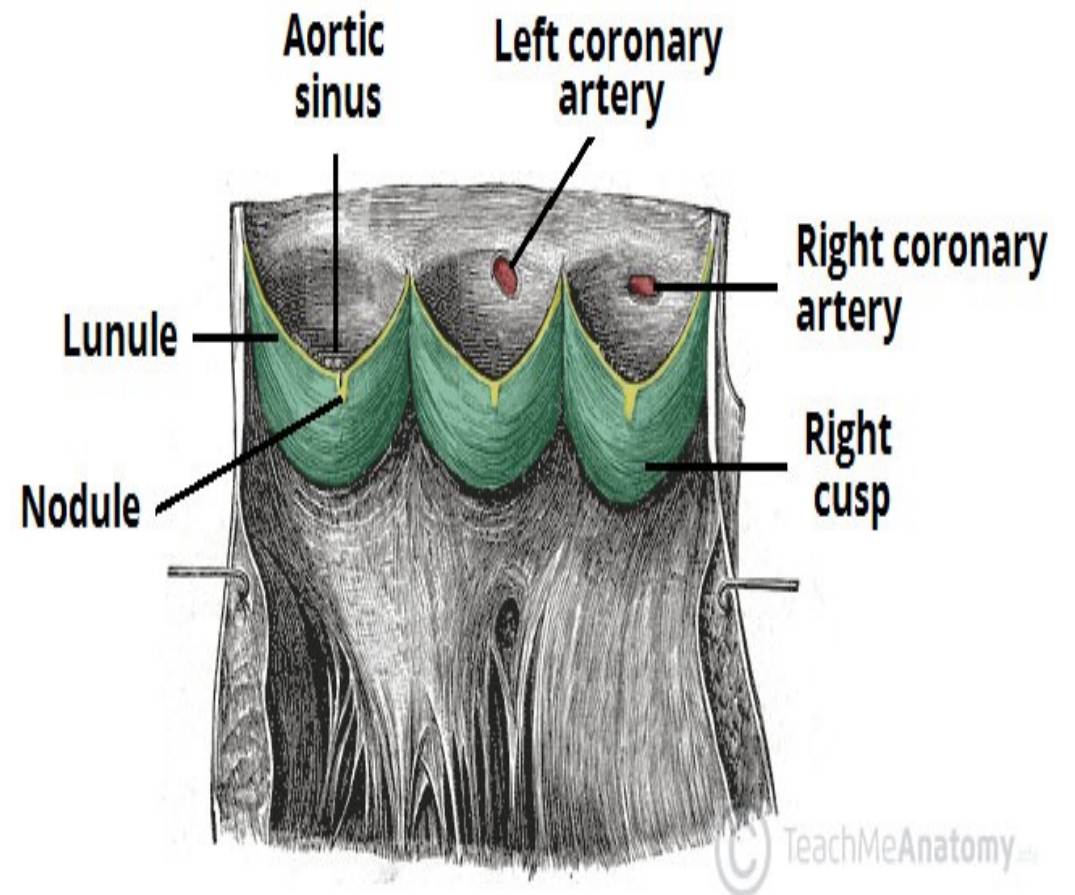
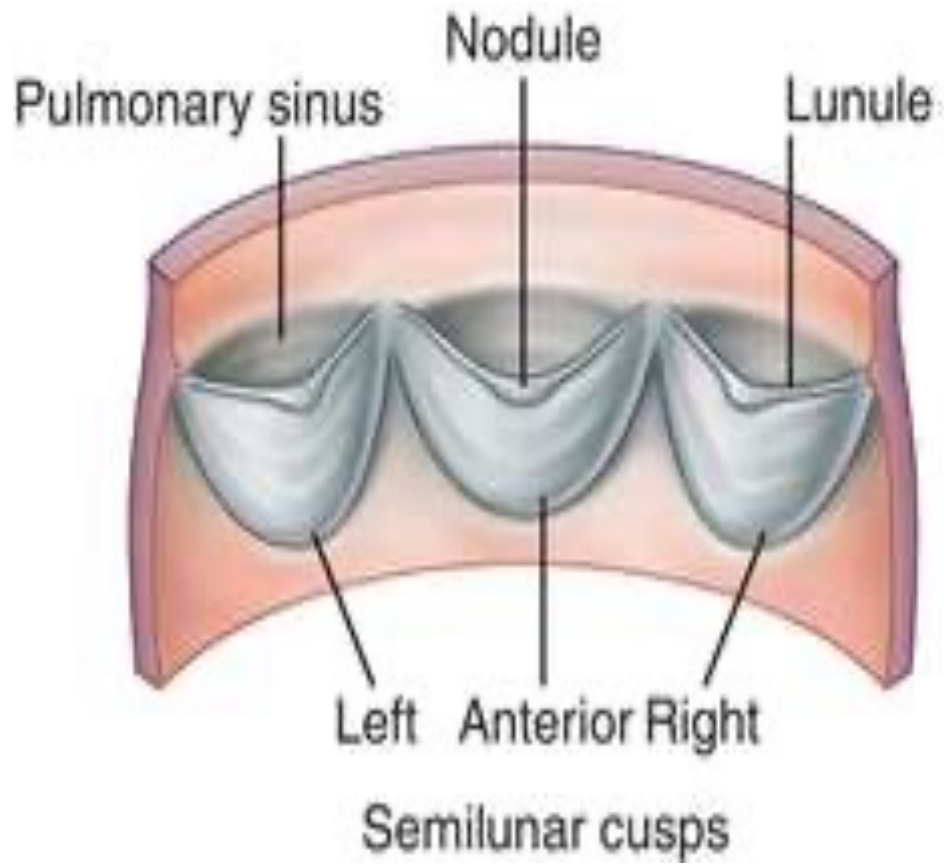
It consists of three semilunar cusps (Anterior , right and left)

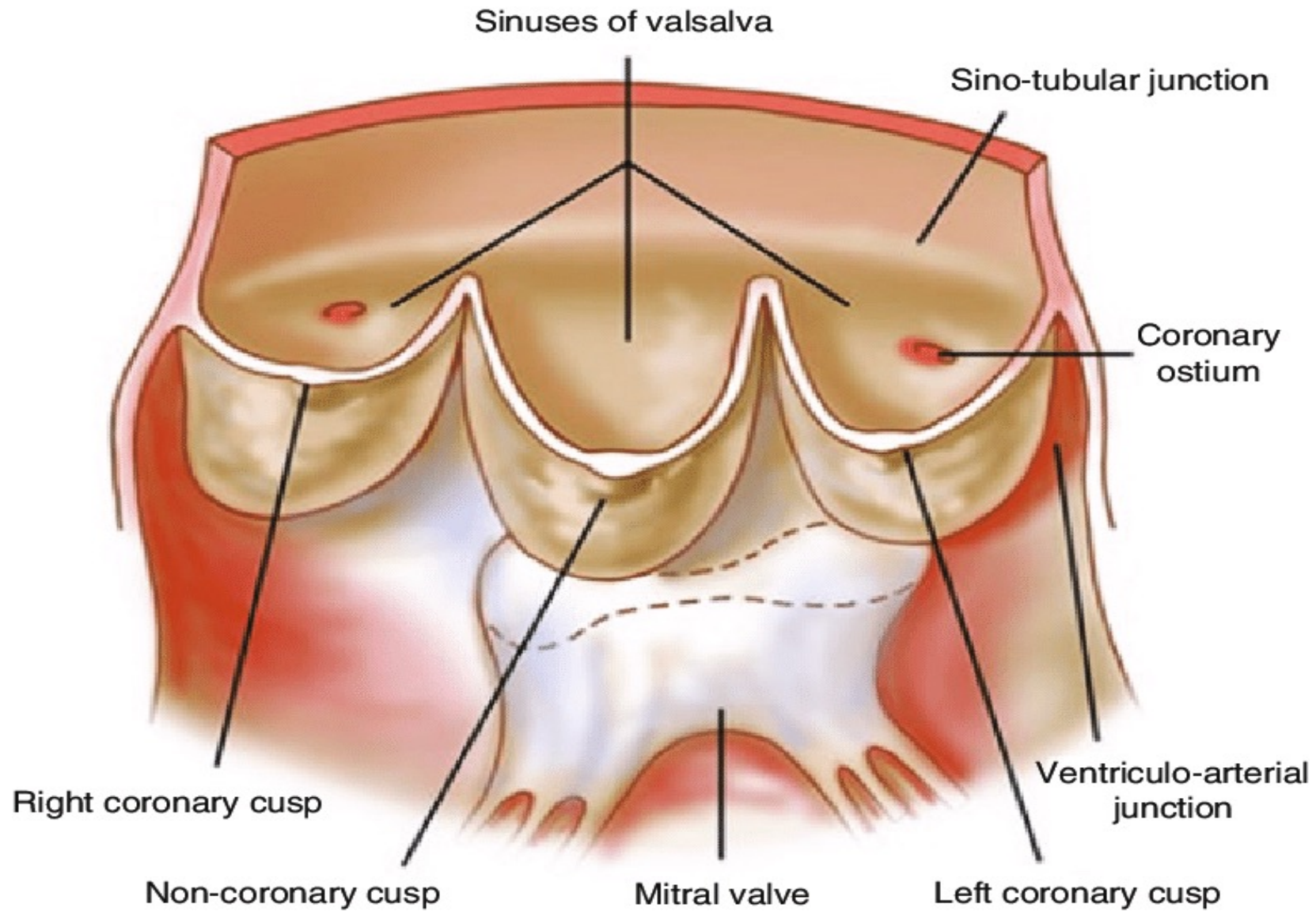
2-The Aortic valve

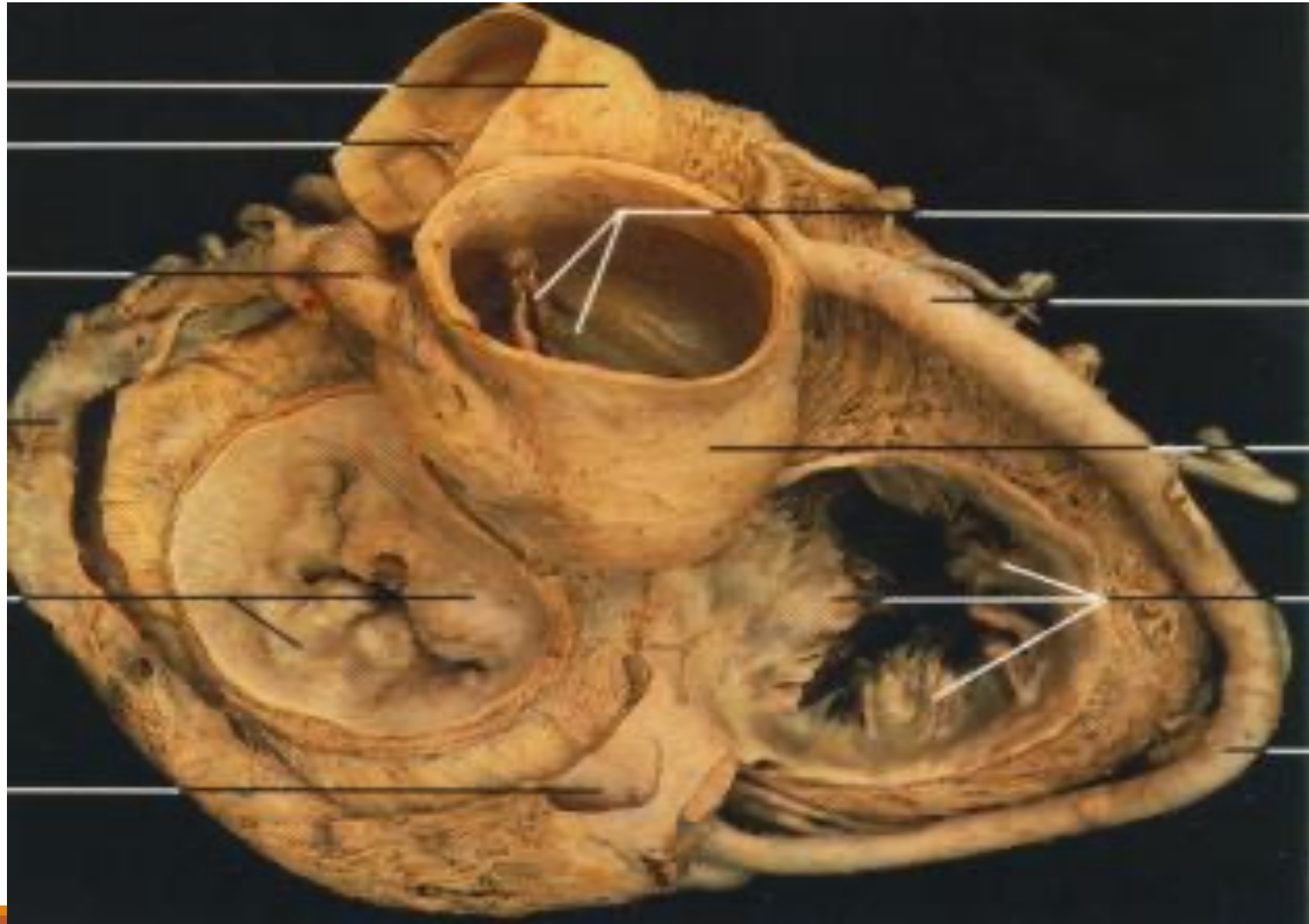
It guards the orifice between left ventricle and aorta

It consists of three semilunar cusps (Posterior right and left)

Just superior to right and left cusps in the aortic sinus there are the openings of the right and left coronary arteries, respectively



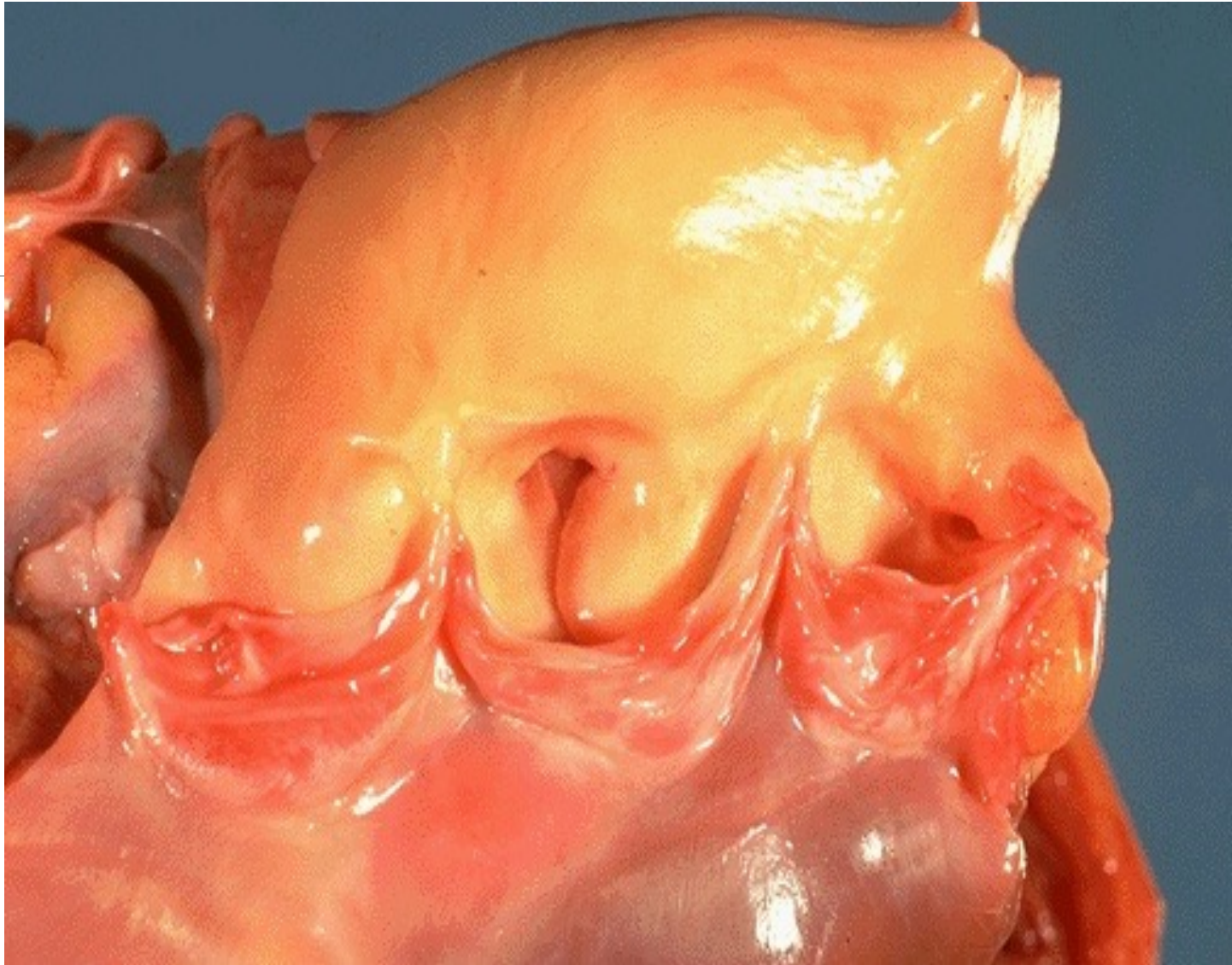




DR.AHMED SALMAN



Semilunar valves



Mechanism of Heart Valves

Watch this video from Minute 2

<https://www.youtube.com/watch?v=hNAwT3QDM28>

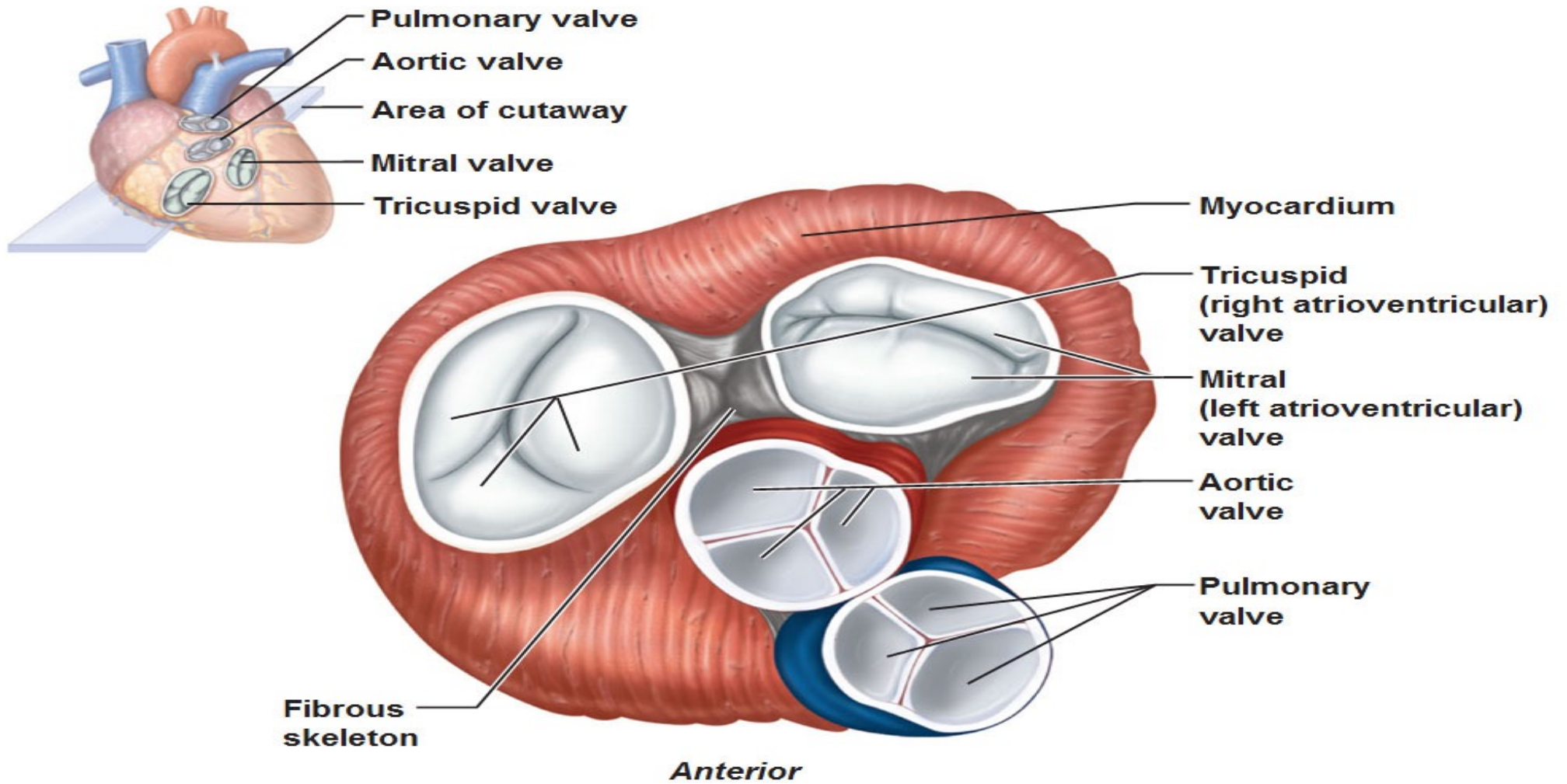
The Atrioventricular (AV) Valves

- 1) When the ventricles contract, forcing blood against atrioventricular valve cusps
- 2) Papillary muscles contract and , tightening the tendinous cords and drawing the cusps together and preventing valve flaps from everting into atria
- 3) Because the cords are attached to adjacent sides of two cusps, they prevent separation of the cusps and their inversion when tension is applied to the tendinous cords

The Semilunar Valves

- 1) As ventricles contract and intra ventricular pressure rises, blood is pushed up against semilunar valves, forcing them open.
- 2) After relaxation of the ventricle (diastole), the elastic recoil of the wall of the pulmonary trunk or aorta forces the blood back toward the heart.
- 3) The blood filling the cusps of semilunar valves and forcing them to close
- 4) They come together to completely close the orifice and preventing any blood from returning to the ventricle

Heart Valves and the Fibrous Skeleton (dense CT)

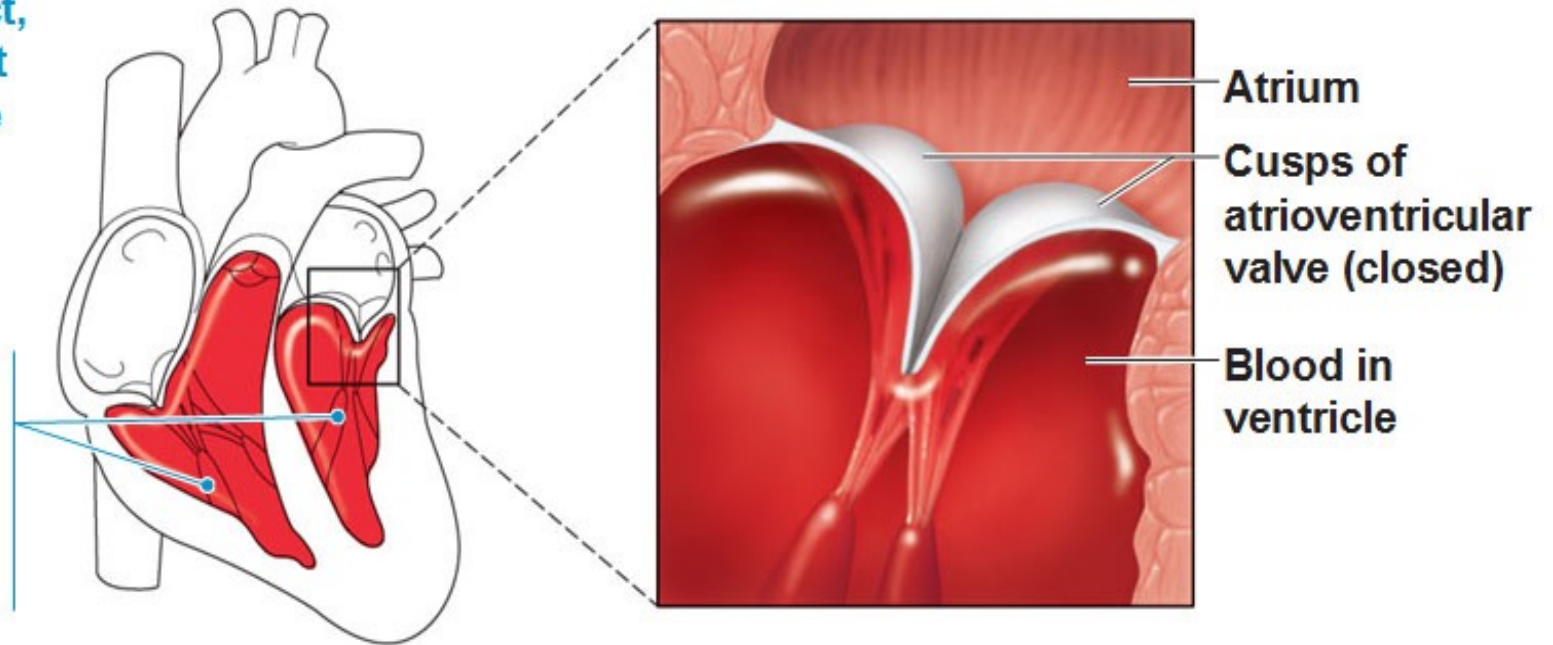


Function of the Atrioventricular Valves

At this point, you hear the first heart sound, with the mitral sound slightly before the tricuspid

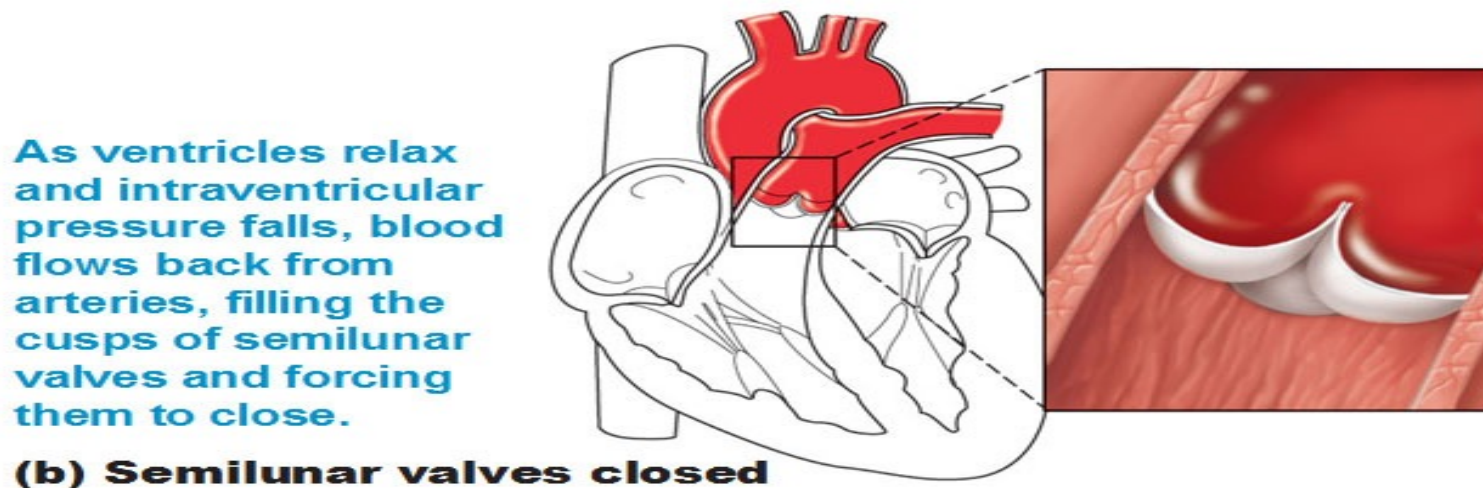
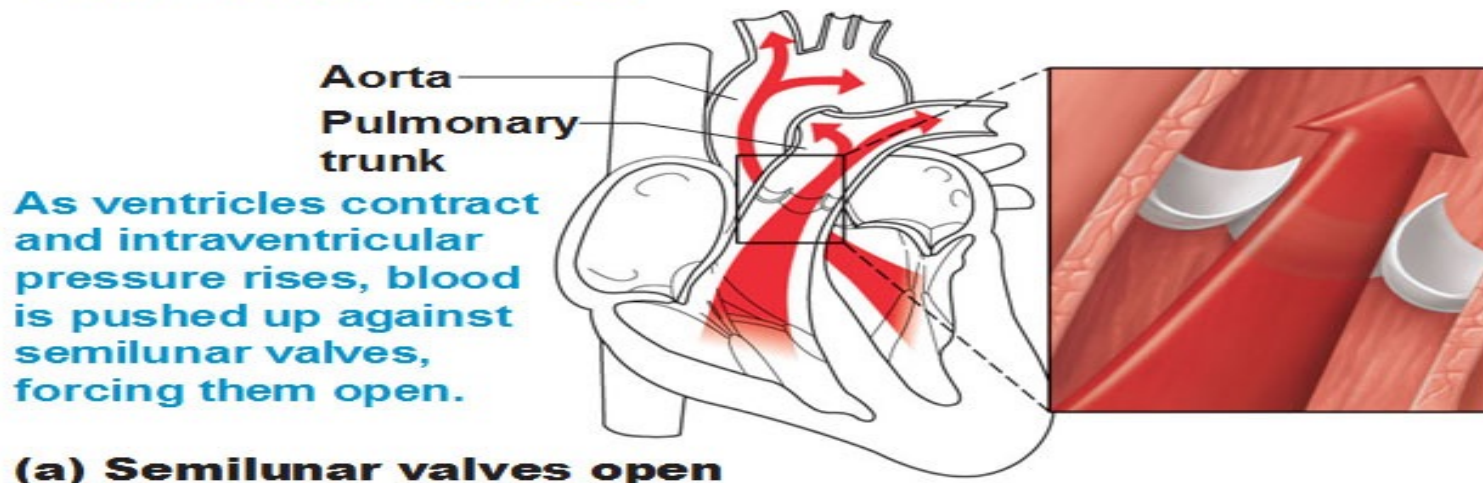
(b) AV valves closed; atrial pressure less than ventricular pressure

- ① Ventricles contract, forcing blood against atrioventricular valve cusps.
- ② Atrioventricular valves close.
- ③ Papillary muscles contract and chordae tendineae tighten, preventing valve flaps from everting into atria.



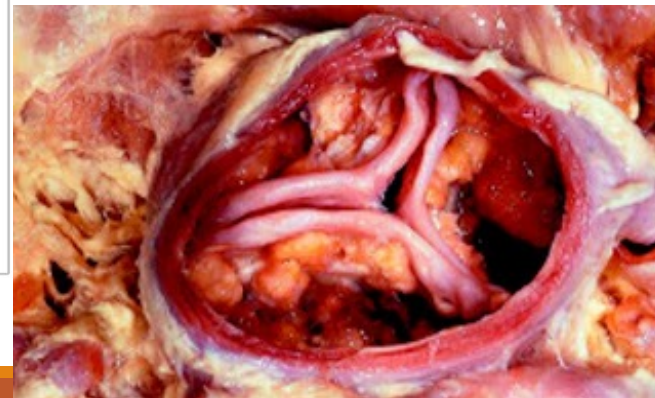
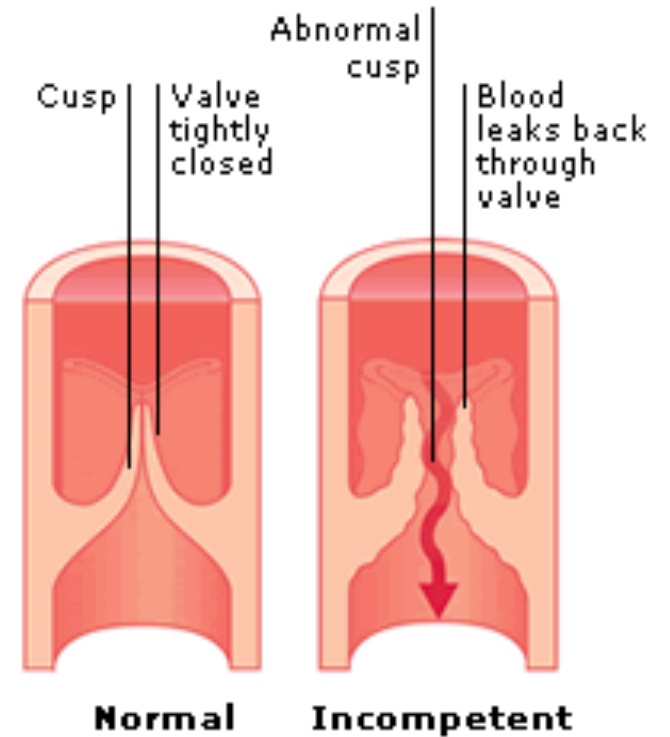
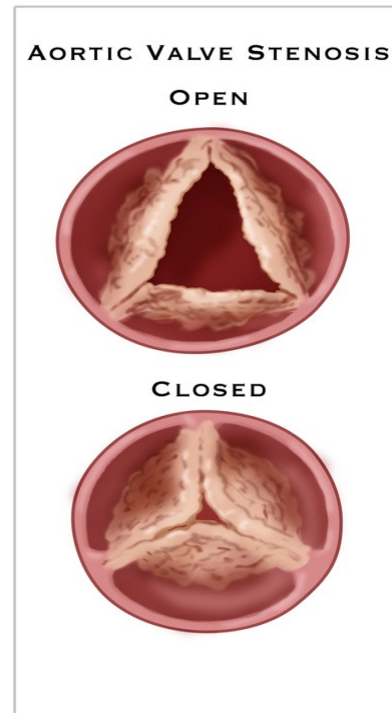
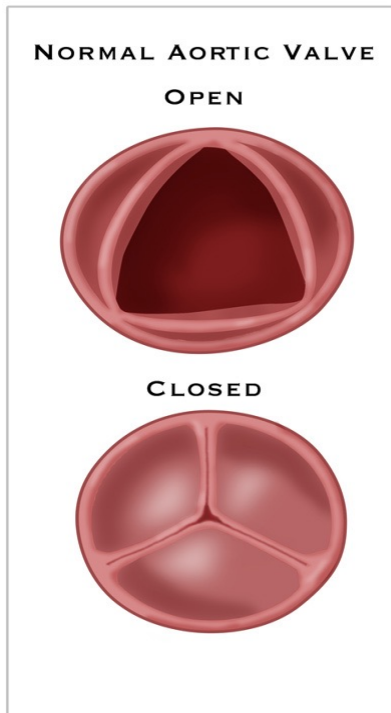
Function of the Semilunar Valves

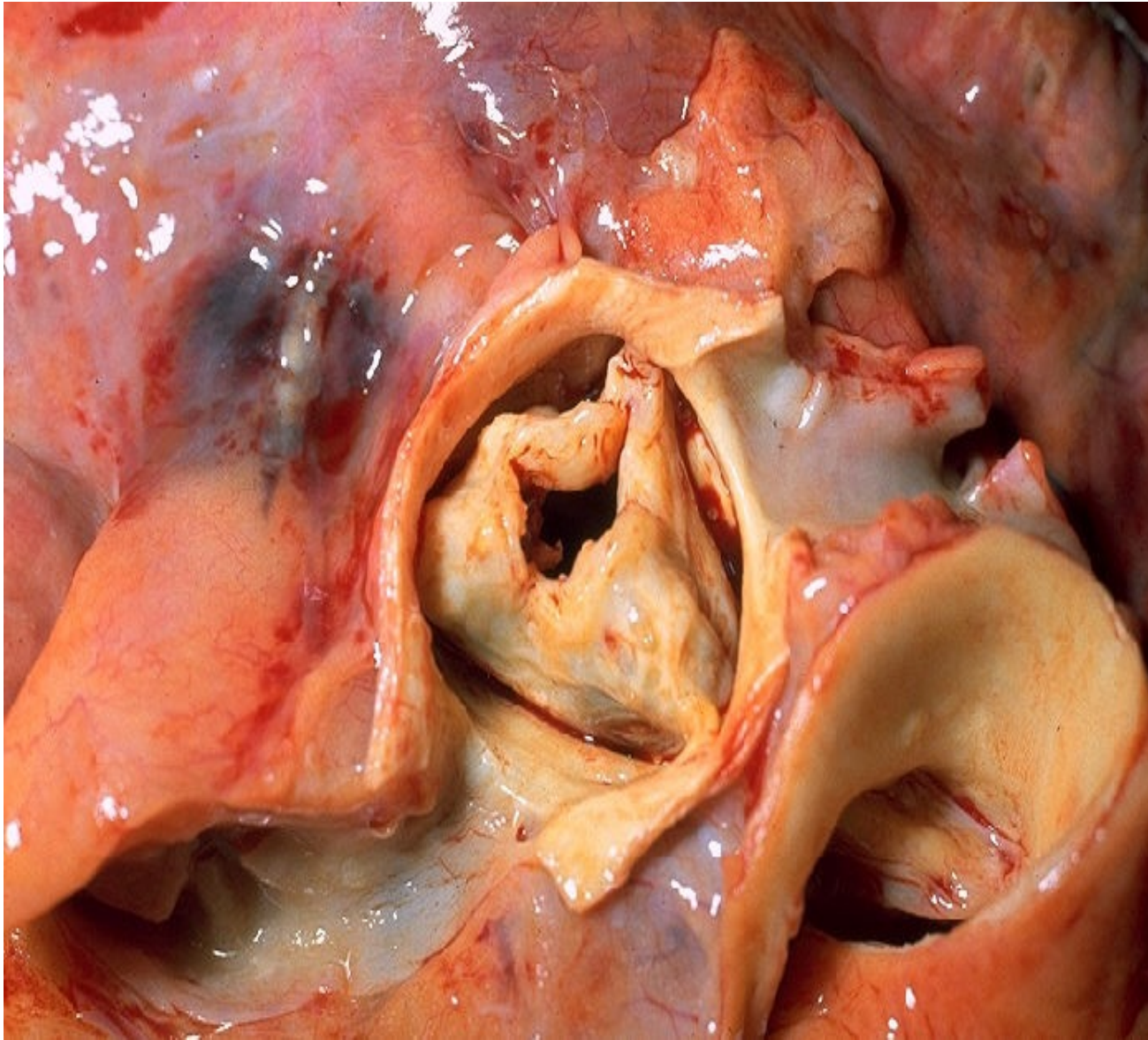
When semilunars close, you hear 2nd heart sound, with aortic slightly before pulmonary



Clinical Anatomy

Incompetent valve leads to regurgitation of blood
Stenosis of the valve leads to heart over load





Aortic stenosis, secondary to rheumatic heart disease. The aorta has been removed to show thickened, fused aortic valve leaflets and opened coronary arteries from above.

Wear your headphones and ENJOY

Mitral stenosis

<https://www.youtube.com/watch?v=5oCptZo4pUY>

Mitral valve prolapse

https://www.youtube.com/watch?v=sH_KmHIHR70

Aortic regurgitation

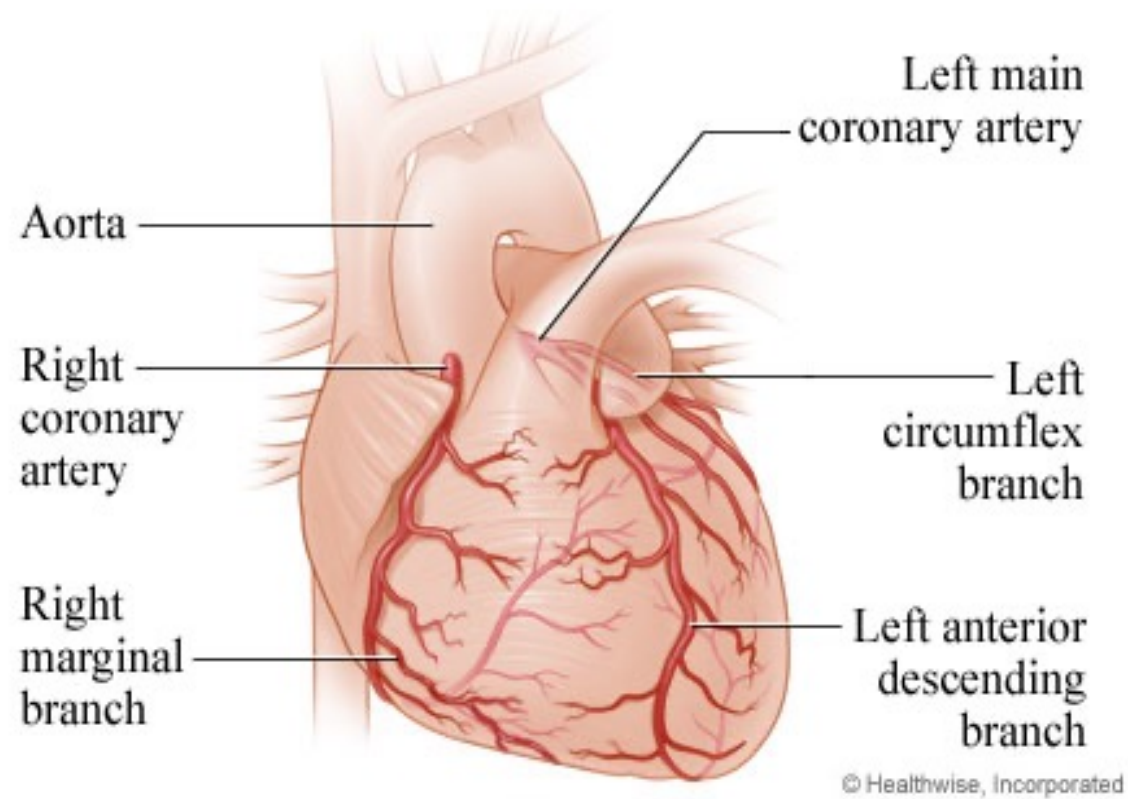
<https://www.youtube.com/watch?v=uZysrKXHJMM>

Aortic stenosis

<https://www.youtube.com/watch?v=pgDWz1JybzE>



Blood Supply of heart



Blood Supply of the heart

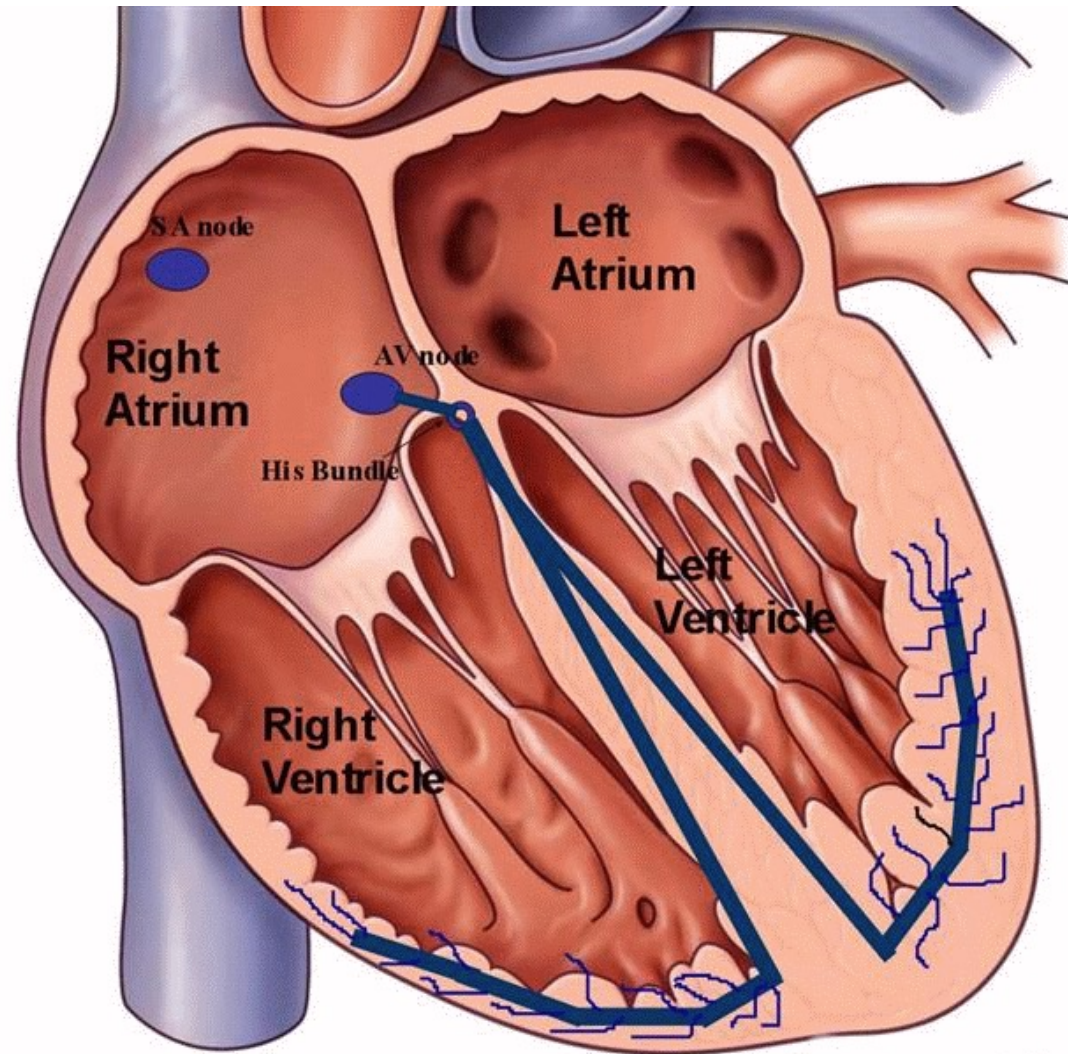
Arterial

Venous

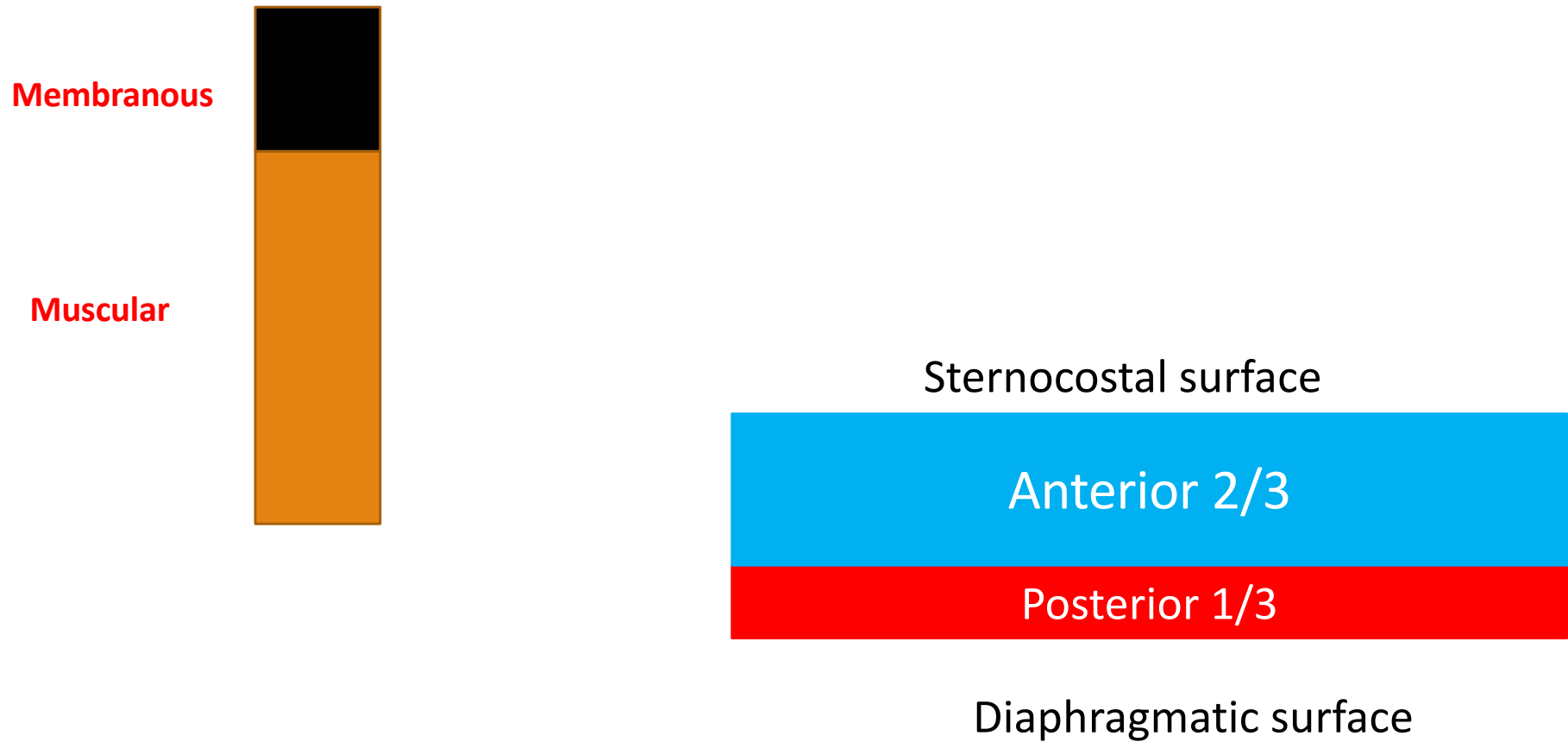
**Right
coronary**

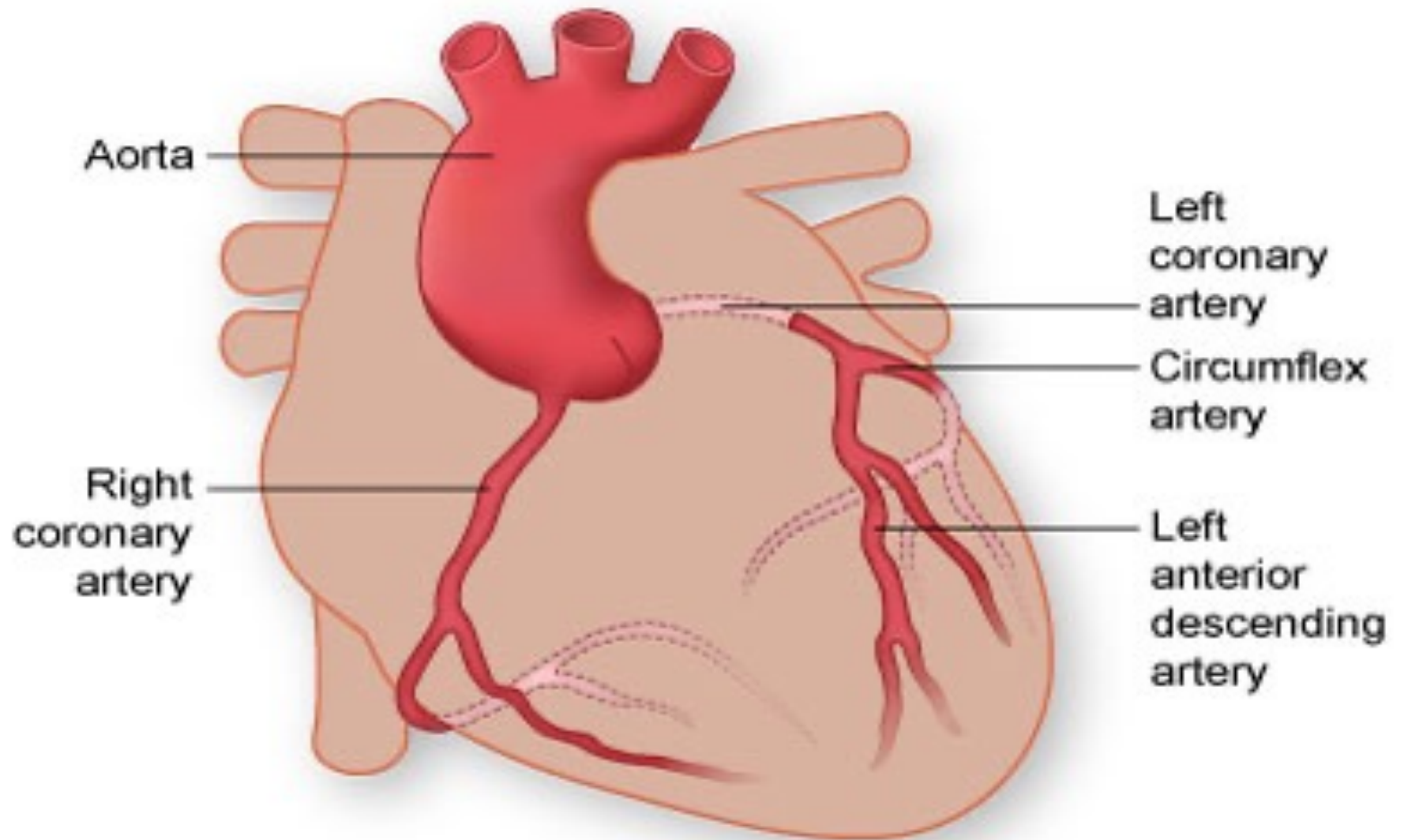
**Left
coronary**

**Cardiac
sinus**



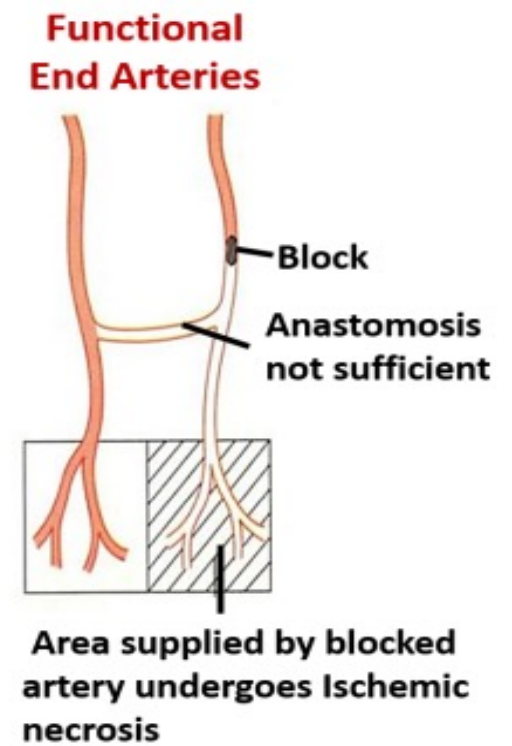
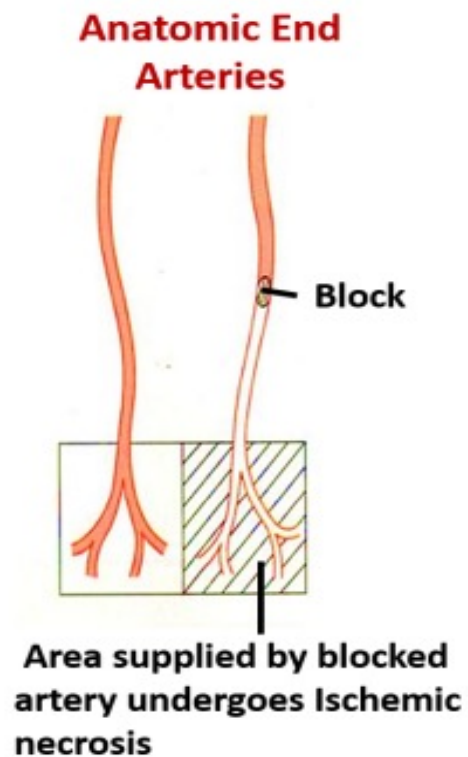
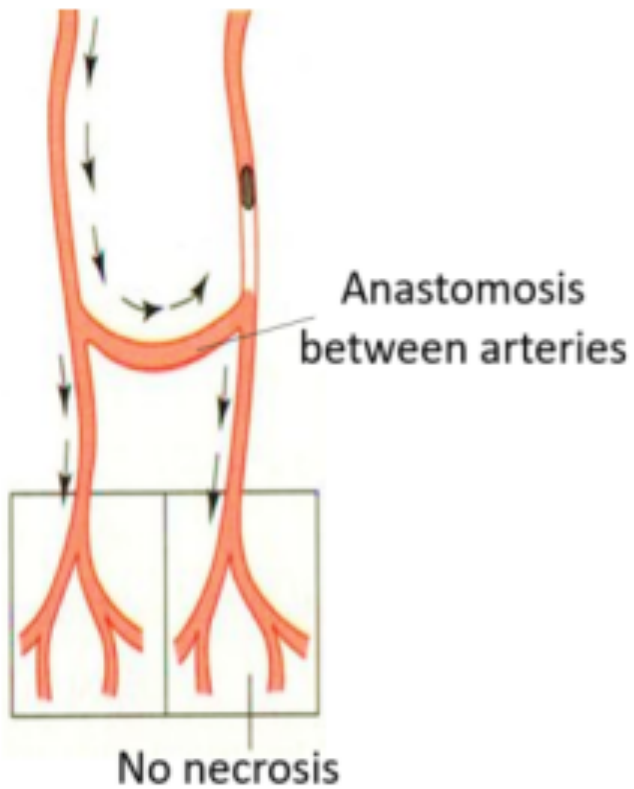
Interventricular septum





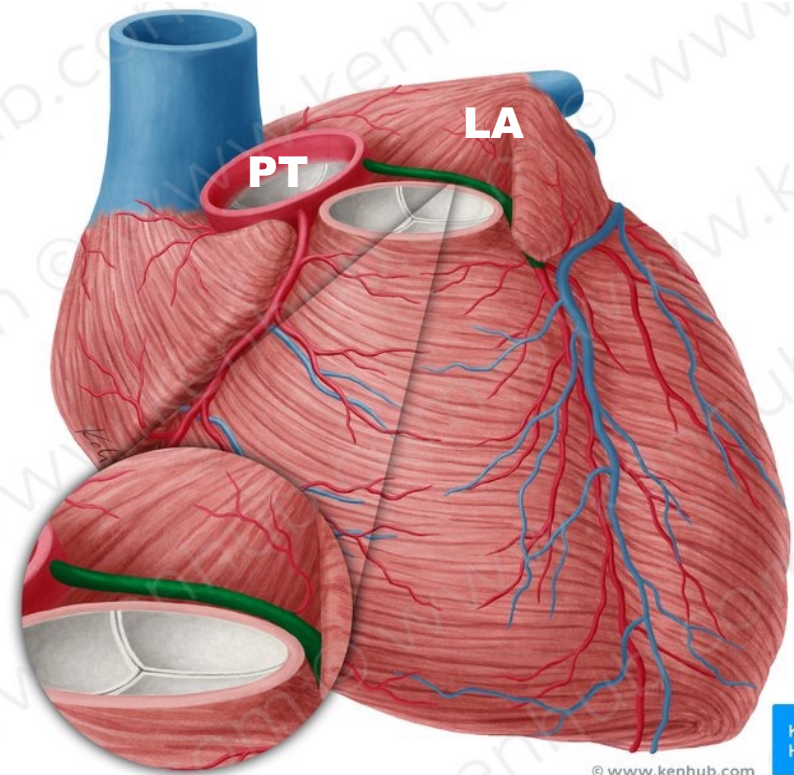
Coronary arteries

- The branches of the coronary arteries are generally considered to be functional end arteries
- So, arteries that supply regions of the myocardium lacking sufficient anastomoses from other large branches to maintain viability of the tissue when occlusion occurs
- The endocardium and some subendocardial tissue located immediately external to the endocardium receive oxygen and nutrients by diffusion or microvasculature directly from the chambers of the heart



The left coronary artery (LCA)

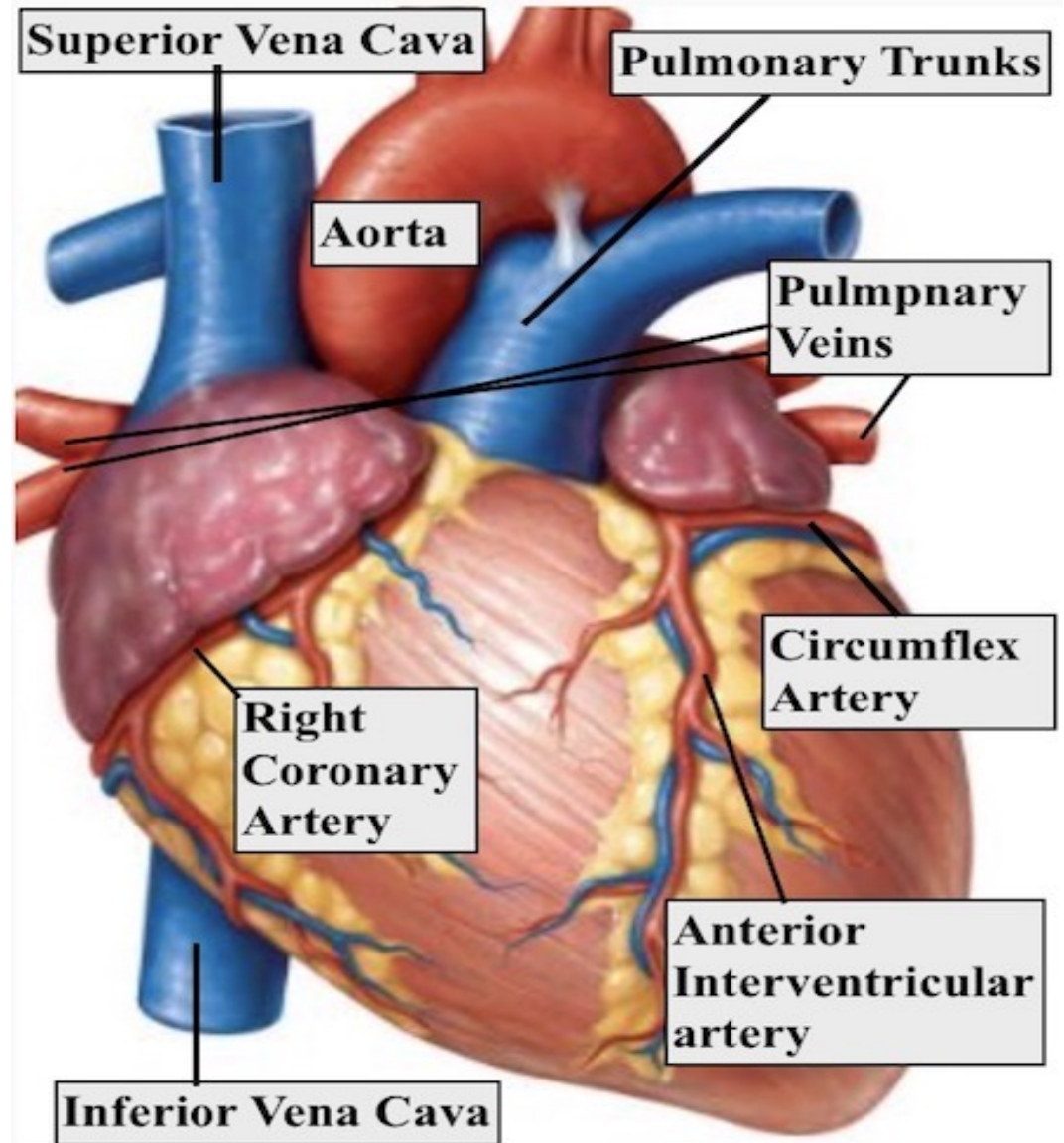
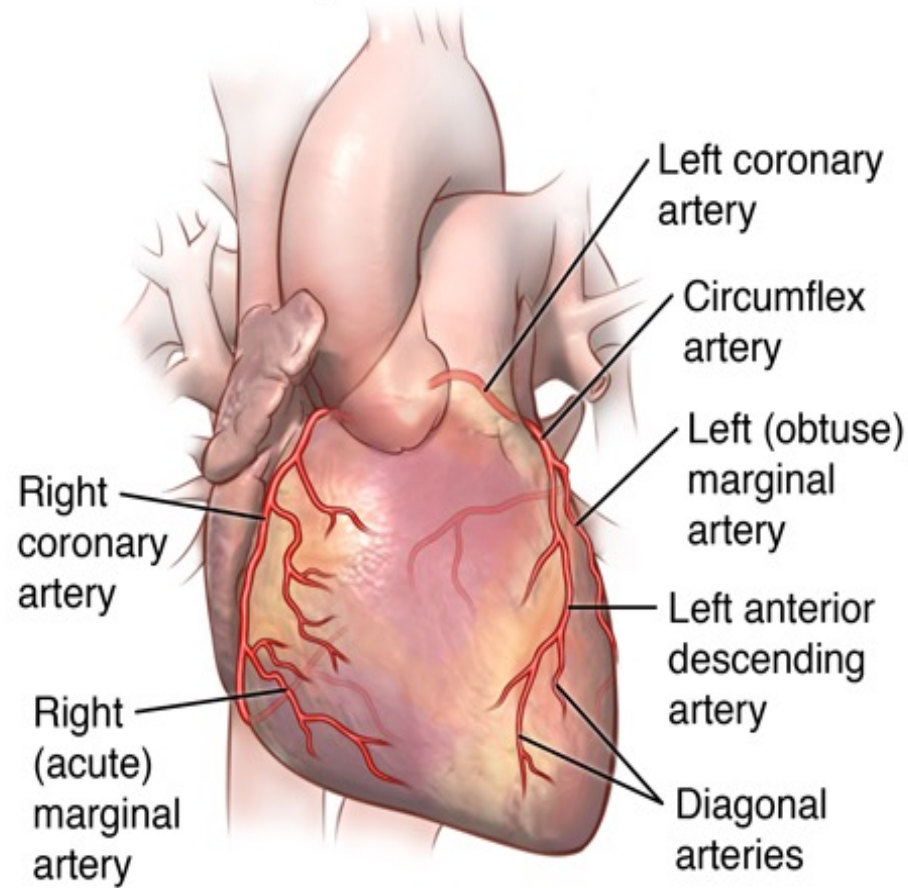
- ✓ It originates from the **left aortic sinus** of the ascending aorta
- ✓ It passes between the left auricle and the left side of the pulmonary trunk
- ✓ It has short stem ,the it divided into the anterior interventricular or left anterior descending (LAD) and circumflex artery

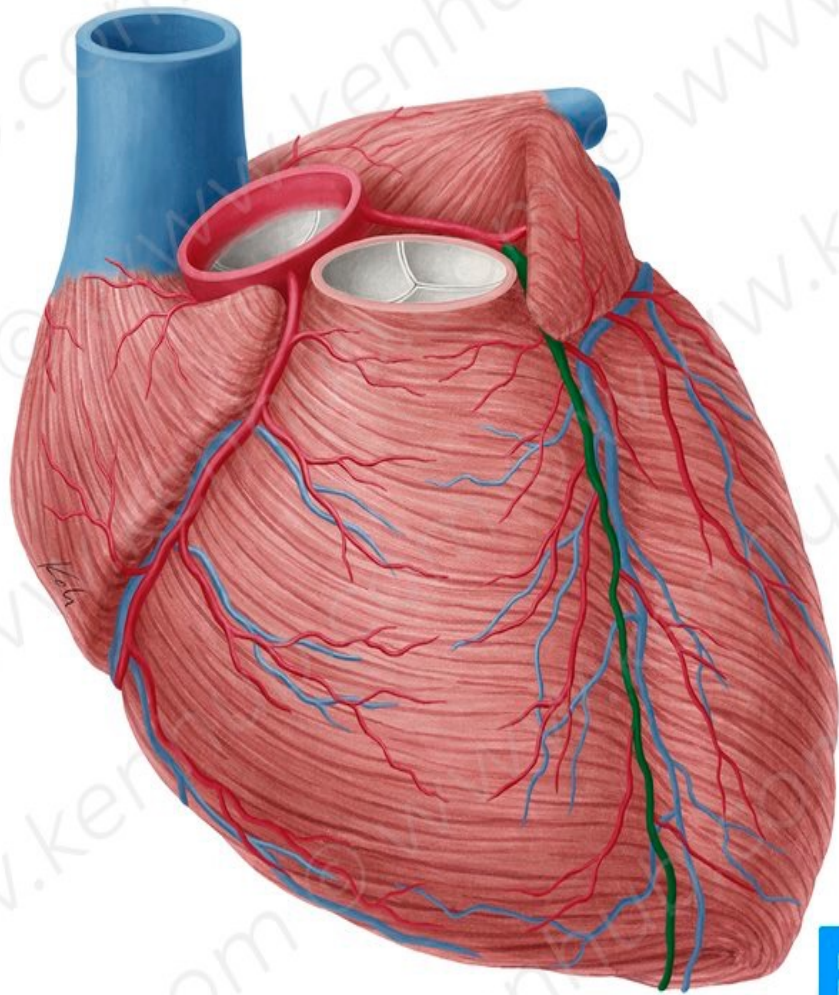


1-Anterior interventricular artery (IV)

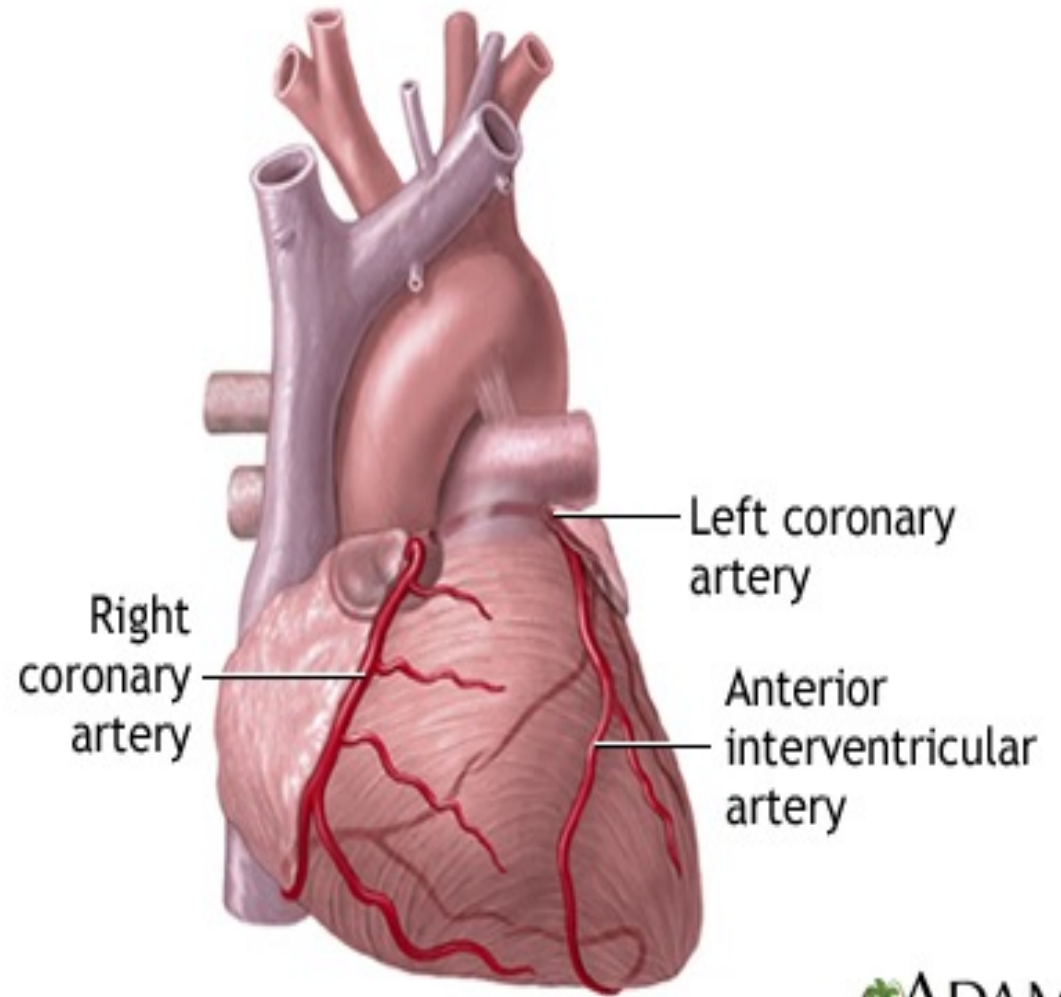
- A. Clinician name it as **left anterior descending (LAD)**
- B. It runs downward in the anterior interventricular groove to the apex of the heart ,then it passes around the apex of the heart to enter the posterior interventricular groove and anastomoses with the terminal branches of the right coronary artery.
- C. In one third of individuals it ends at the apex of the heart
- D. The anterior IV branch supplies adjacent parts of both ventricles and the anterior two thirds of the IVS via IV septal branches
- E. In many people, the anterior IV branch gives rise to a lateral branch (diagonal artery), which descends on the anterior surface of the heart

Coronary arteries of the heart





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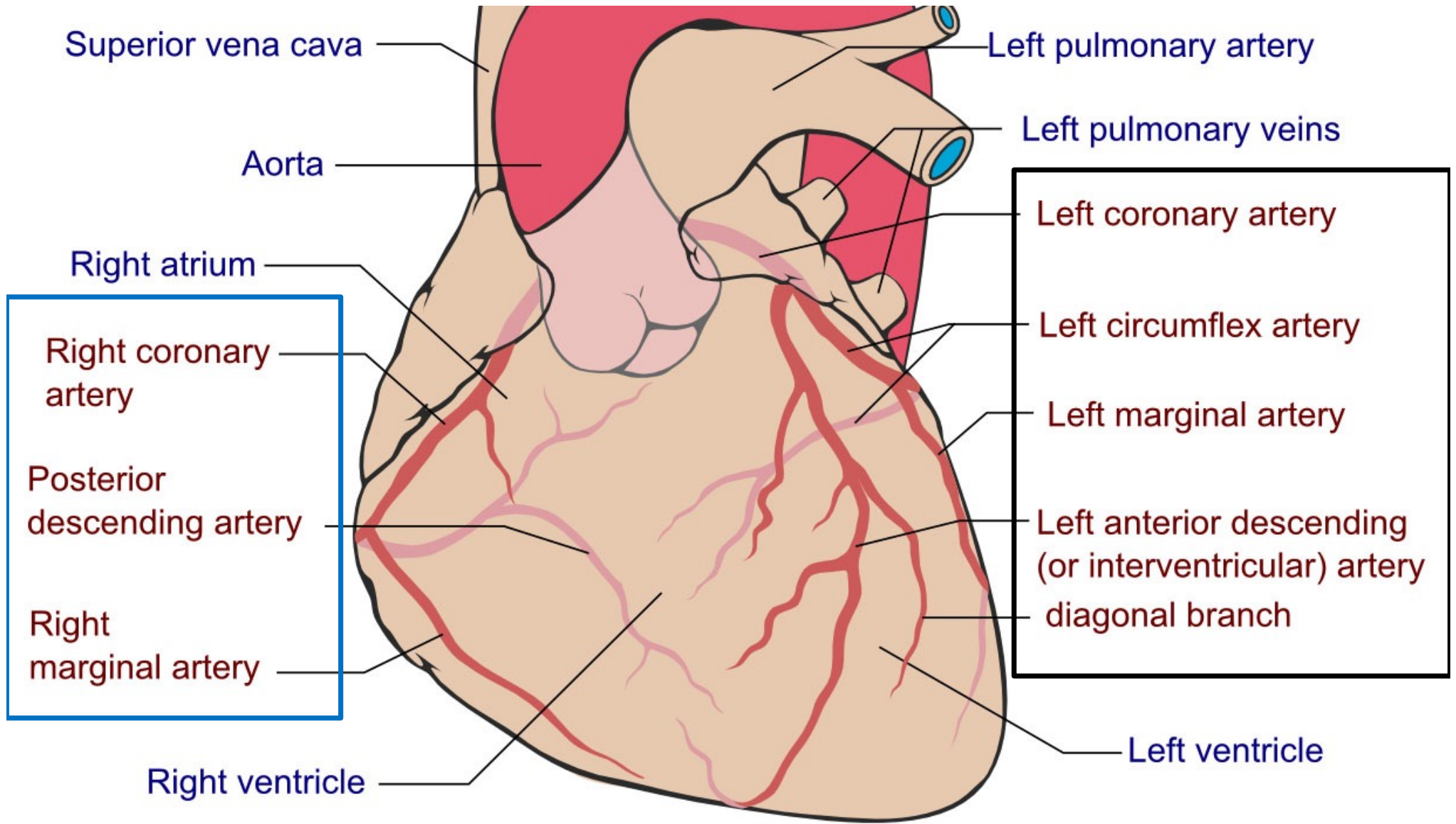
Anterior interventricular artery

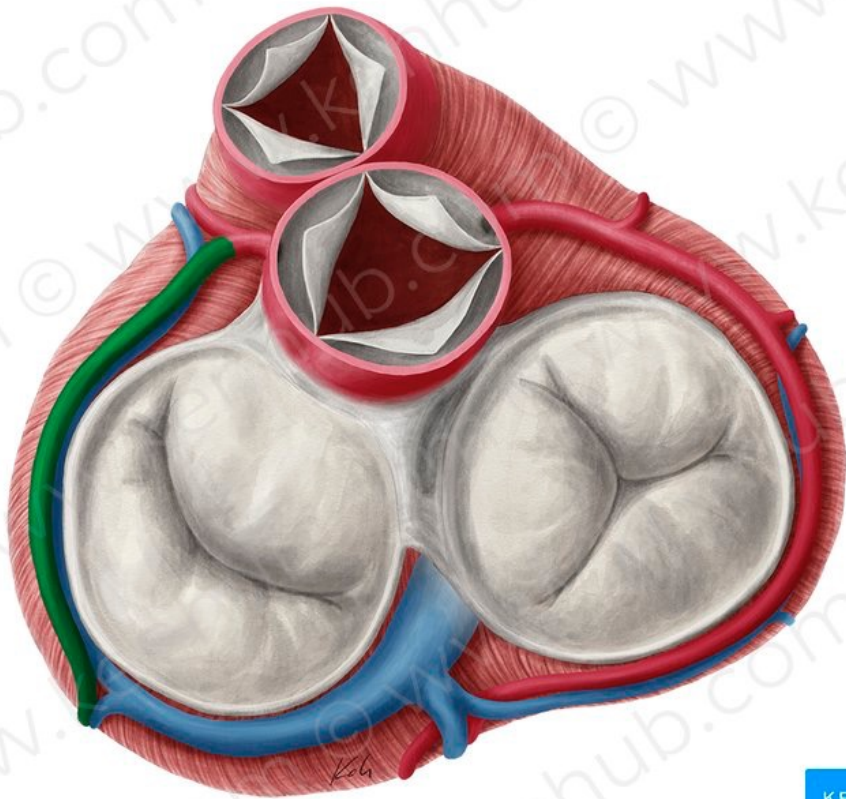
The circumflex artery

- A. It is the same size as the anterior interventricular artery
- B. It winds around the left margin of the heart in the atrioventricular groove.

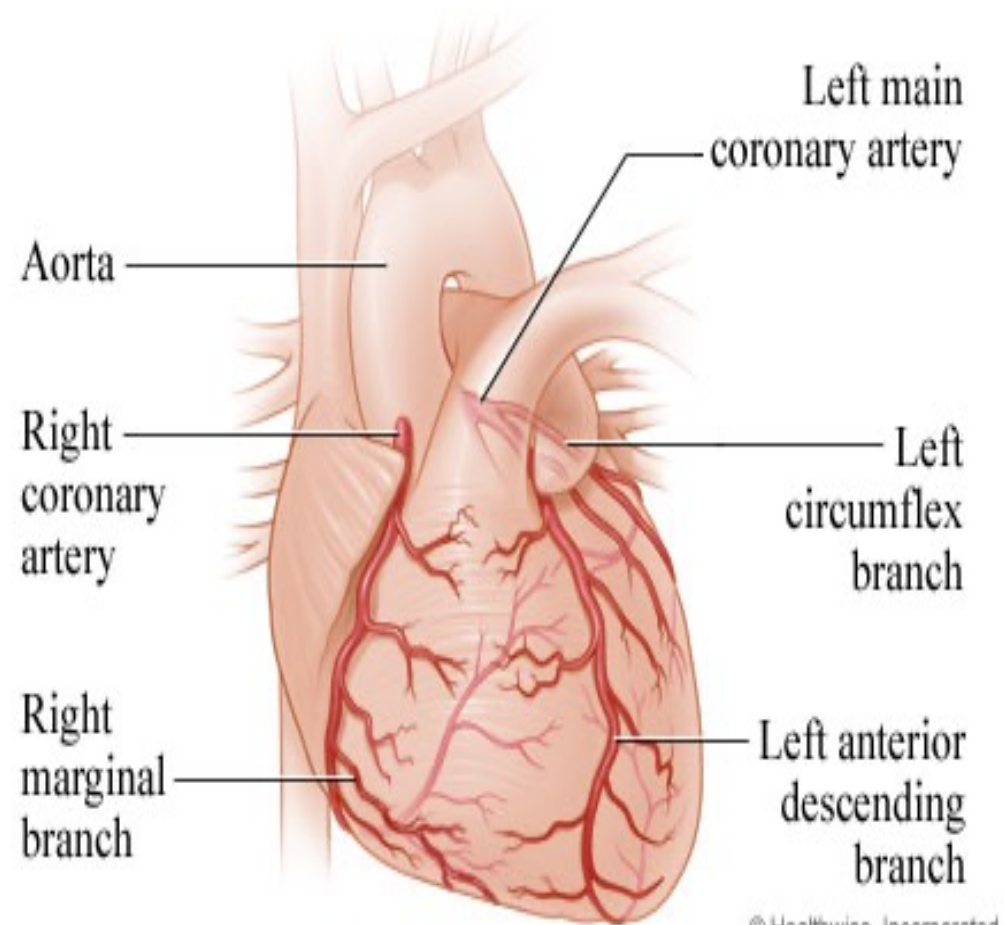
Branches

- ❖ Left marginal artery , is a large branch that supplies the left margin of the left ventricle down to the apex.
- ❖ Anterior ventricular and posterior ventricular branches supply the left ventricle.
- ❖ Atrial branches supply the left atrium





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The circumflex artery

The LCA supplies :

1. The left atrium.
2. Most of the left ventricle.
3. Part of the right ventricle.
4. Most of the IVS (usually its anterior two thirds), including the AV bundle of the conducting system of the heart, through its perforating IV septal branches.
5. The SA node (in approximately 40% of people)
6. Right Bundle Branch
7. Left Bundle Branch

The right coronary artery (RCA)

Arises from The right aortic sinus of the ascending aorta
It runs along the right AV sulcus, embedded in fat.

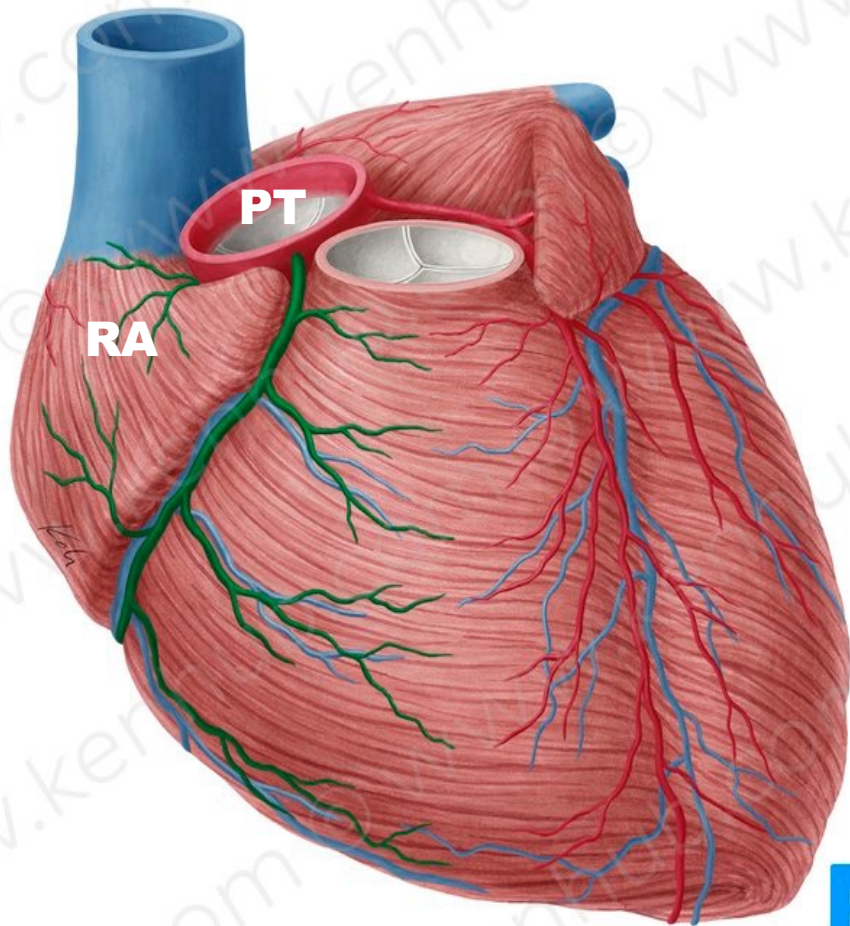
Branches

1-Sinoatrial (SA) nodal artery : It encircles the base of SVC to supply SA node

2-Atrioventricular (AV) nodal artery :It supplies AV node

3-Inferior (Posterior) interventricular branch, which descends in the posterior IV groove toward the apex of the heart.

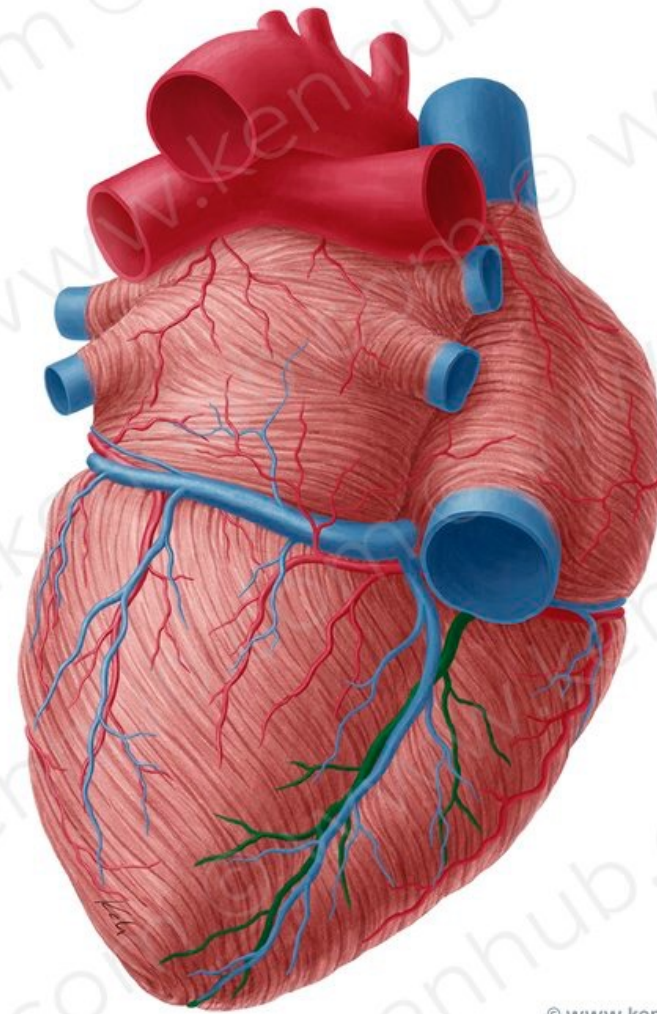
This branch supplies adjacent areas of both ventricles and posterior third of IV septum .



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Right coronary artery



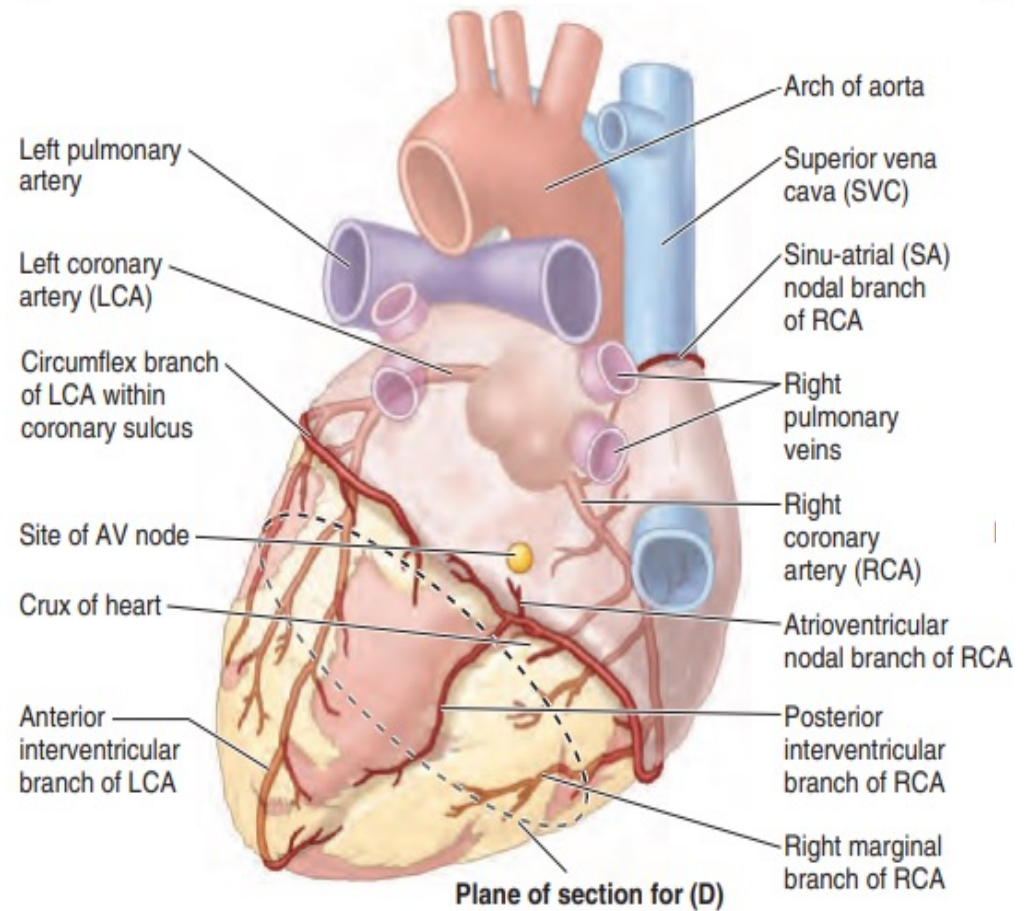
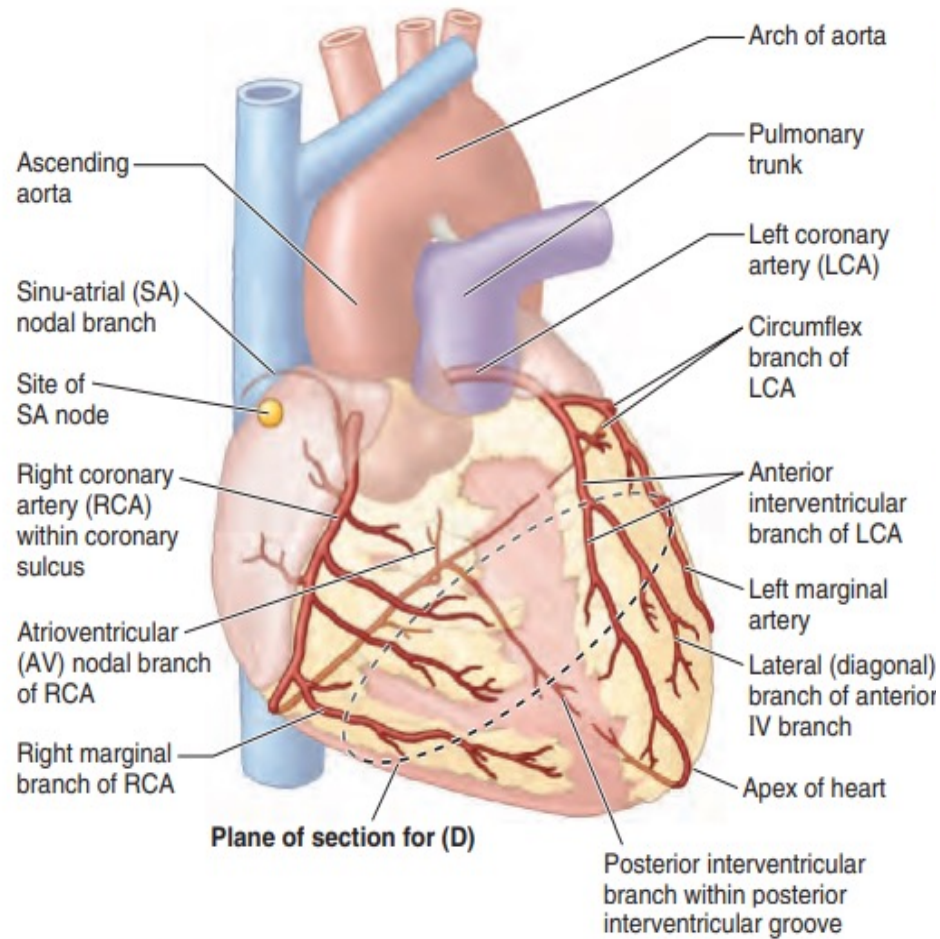
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Inferior interventricular branch

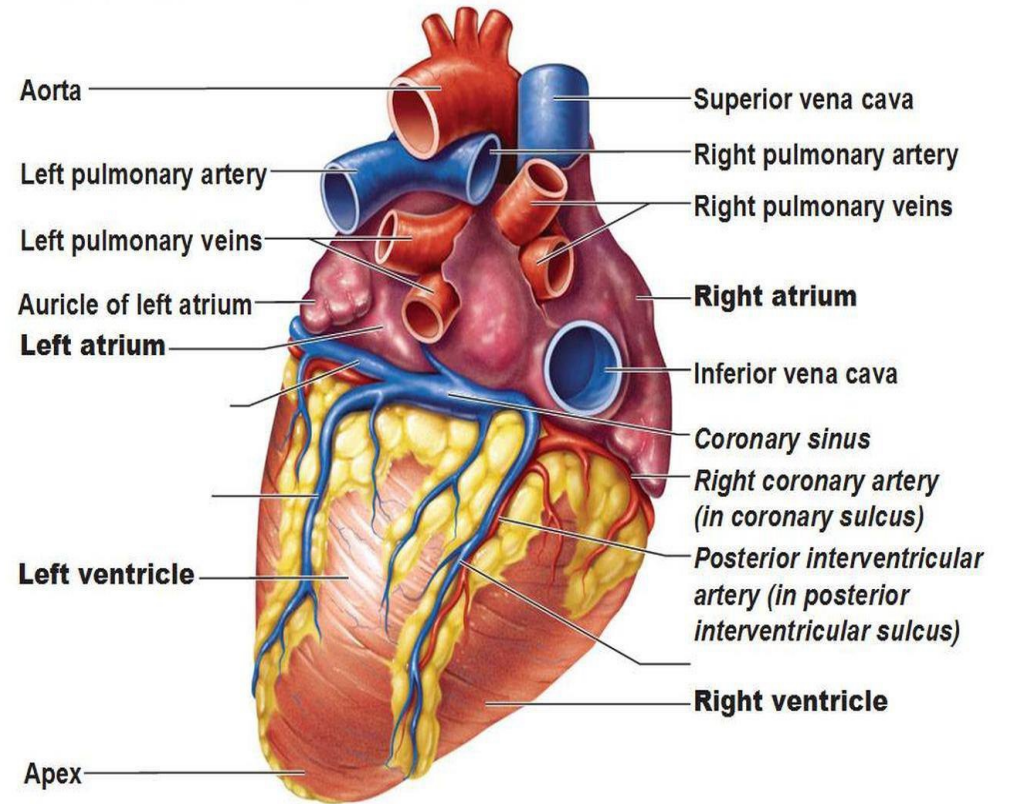
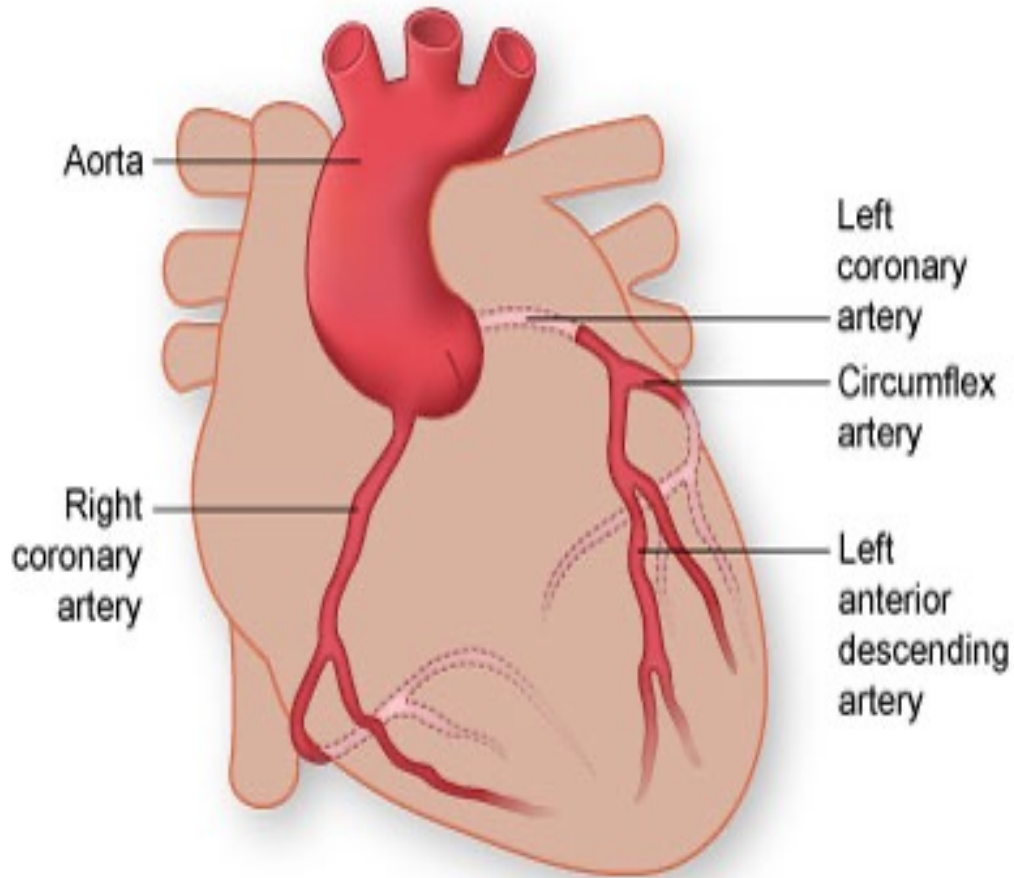
The RCA supplies :

1. The right atrium.
2. Most of right ventricle.
3. Part of the left ventricle (the diaphragmatic surface).
4. Part of the IV septum, usually the posterior third.
5. The SA node (in approximately 60% of people).
6. The AV node (in approximately 80% of people)
7. The LBB also receives small branches.



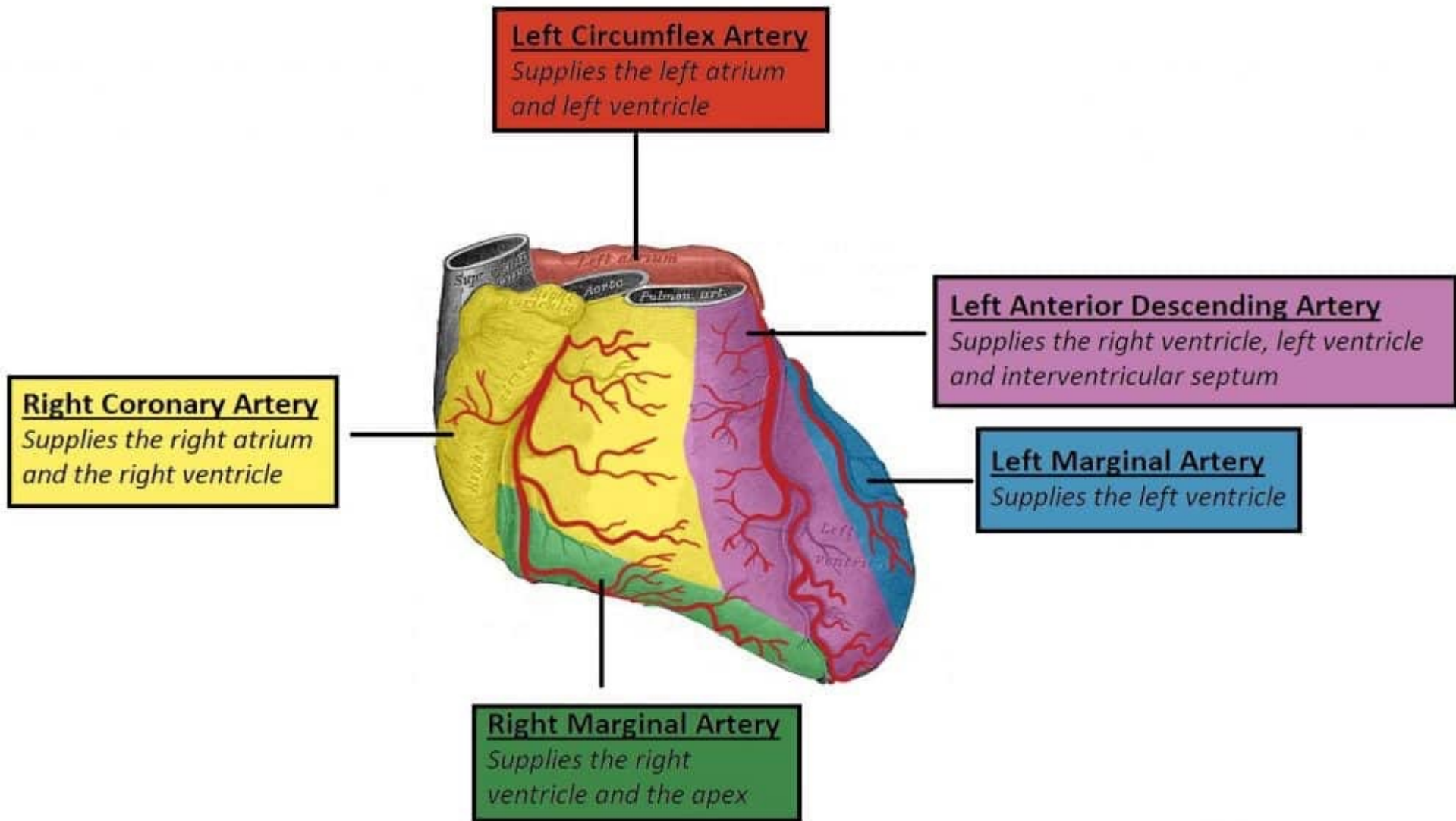
(B) Postero-inferior view

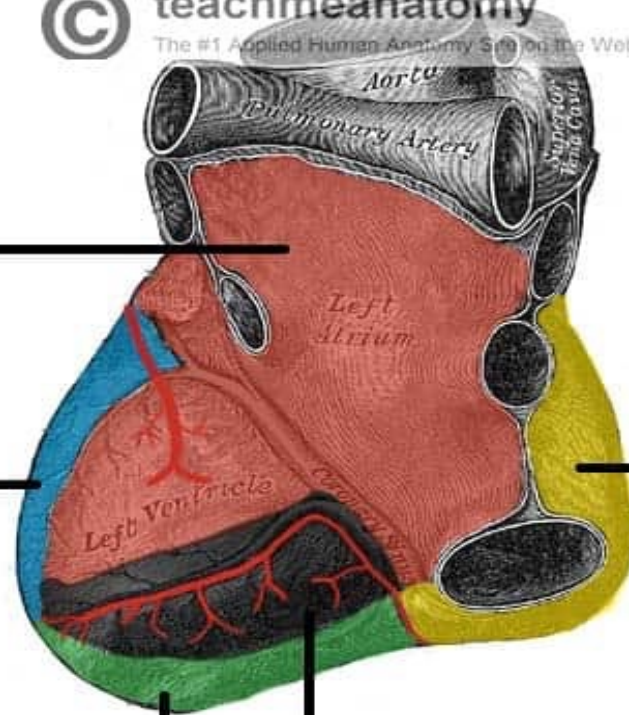
Inferior View of the Heart (“Inferior” because this surface lies on diaphragm) surface shown rests on the diaphragm.



Arterial Supply to the Conducting System

- **The sinuatrial node (SA)** is usually supplied by the right but sometimes by the left coronary artery.
- **The atrioventricular node (AV)** is supplied by the right coronary artery.
- **The RBB** of the atrioventricular bundle is supplied by the left coronary artery
- **The LBB** is supplied by the right and left coronary arteries





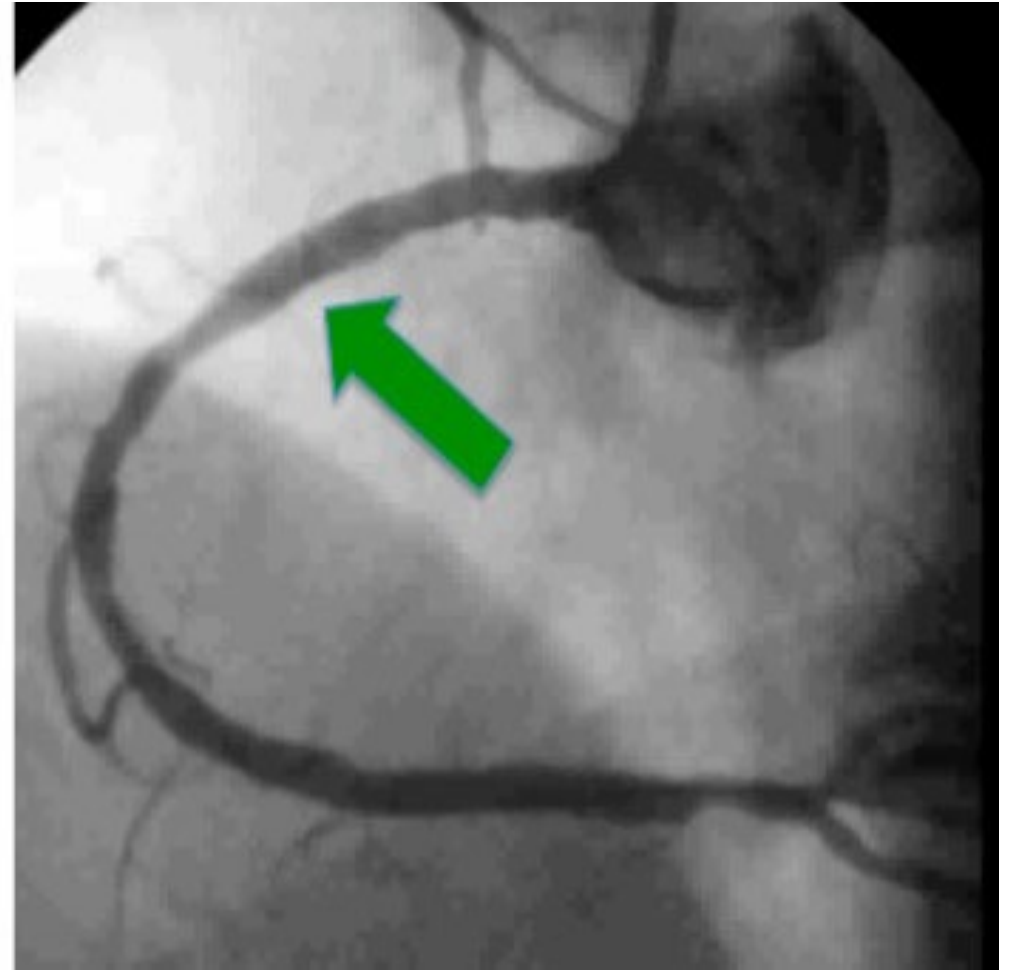
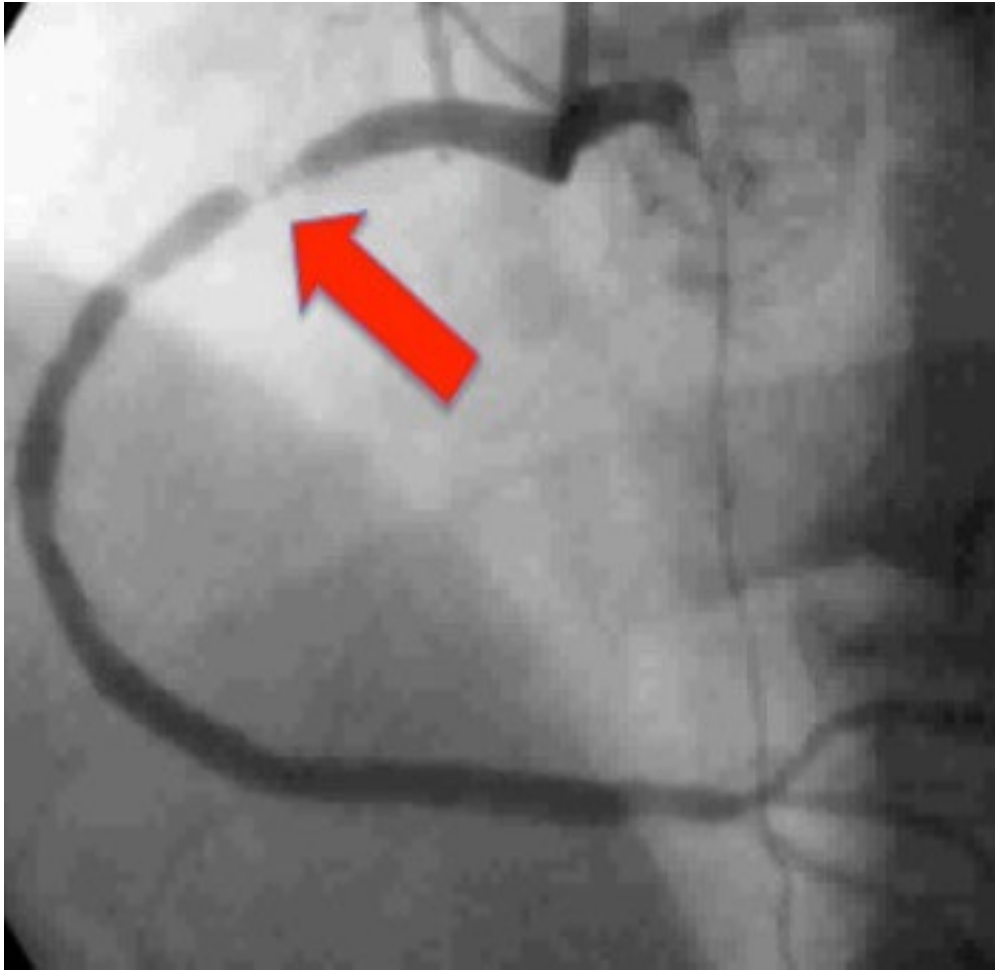
Left Circumflex Artery
Supplies the left atrium and ventricle

Left Marginal Artery
Supplies the left ventricle

Right Coronary Artery
Supplies the right atrium and right ventricle

Right Marginal Artery
Supplies the right ventricle and apex

Posterior Interventricular Artery
Supplies the right and left ventricles, and the interventricular septum



Example of coronary angiogram of a 55 year old gentleman with chest pain. Image on the left shows the right coronary artery with a severe narrowing (red arrow). Image on the right was taken after angioplasty and stenting showing resolution of the narrowing.

variations in the Coronary Arteries

Variations in the blood supply to the heart do occur, and the most common variations affect the blood supply to the diaphragmatic surface of both ventricles. Here the origin, size, and distribution of the posterior interventricular artery are variable. In right dominance, the posterior interventricular artery is a large branch of the right coronary artery. Right dominance is present in most individuals (90%). In left dominance, the posterior interventricular artery is a branch of the circumflex branch of the left coronary artery (10%).

Coronary Artery Anastomoses

Anastomoses between the terminal branches of the right and left coronary arteries (collateral circulation) exist, but they are usually not large enough to provide an adequate blood supply to the cardiac muscle should one of the large branches become blocked by disease. A sudden block of one of the larger branches of either coronary artery usually leads to myocardial death (myocardial infarction), although sometimes the collateral circulation is enough to sustain the muscle.

Venous drainage of the heart

The heart is drained mainly by veins that empty into the coronary sinus and partly by small veins that empty directly into the right atrium

Veins of the heart are

1. Coronary sinus
2. Anterior cardiac veins (drain the upper part of the anterior surface of the right ventricle . These veins empty directly into the right atrium
3. Venea cordis minimi (Thebesian veins)

It drain subendocardial portion of myocardium into heart chambers

A. The coronary sinus

Is the main vein of the heart, is a wide venous channel

It runs from left to right in the posterior part of the coronary sulcus

It runs between left atrium and ventricle.

It receives :

1-Great cardiac vein:

- ❑ It begins at the apex of the heart and ascends in the anterior interventricular groove
- ❑ It receives left marginal vein which ascends on the left border of the heart.

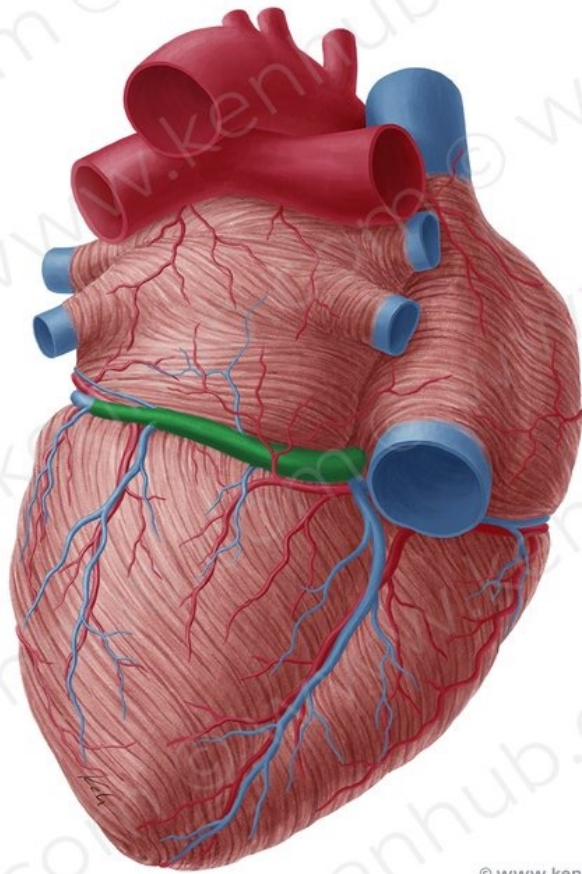
2-Middle cardiac vein:

It also begins at the apex of the heart and runs in the posterior (inferior) interventricular groove

3-Small cardiac vein

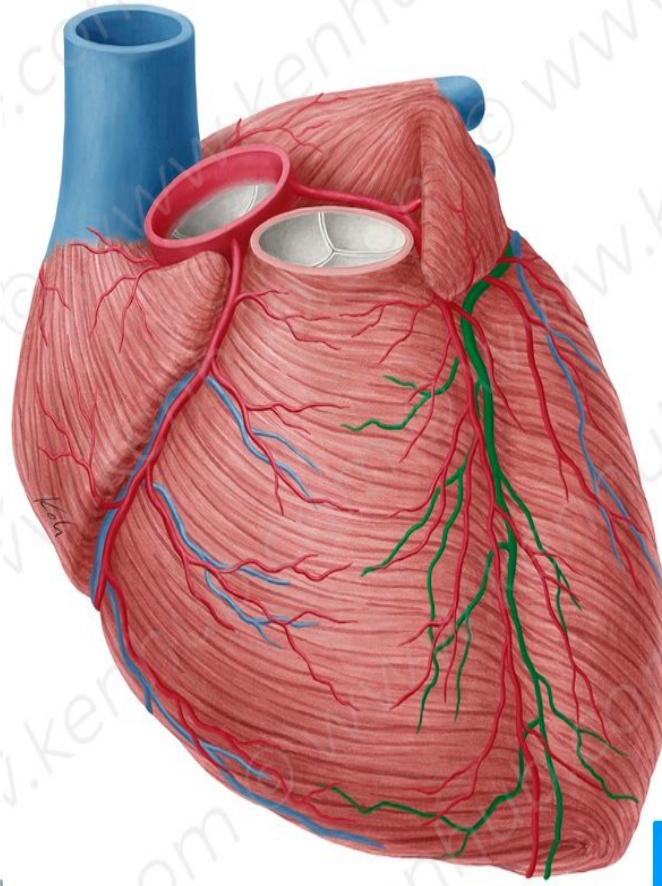
4-Posterior vein of left ventricle

5-Oblique vein of the left atrium



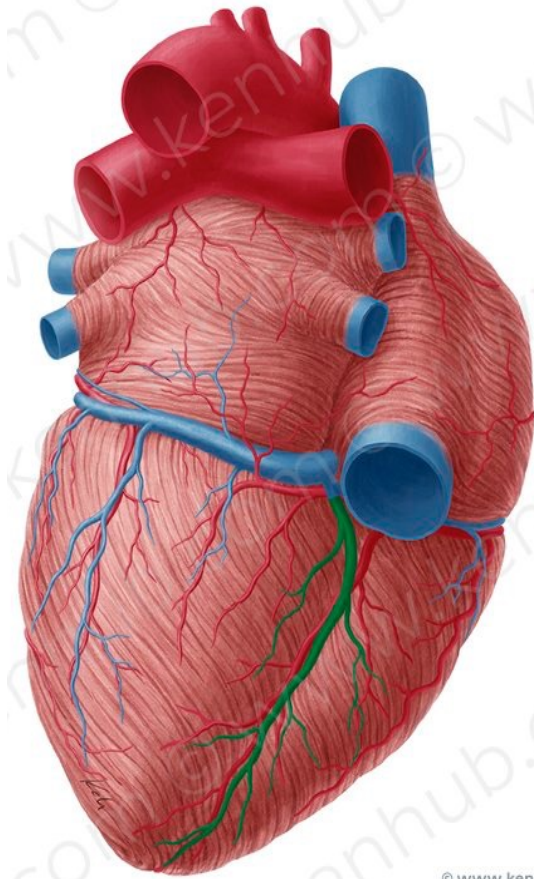
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Coronary sinus



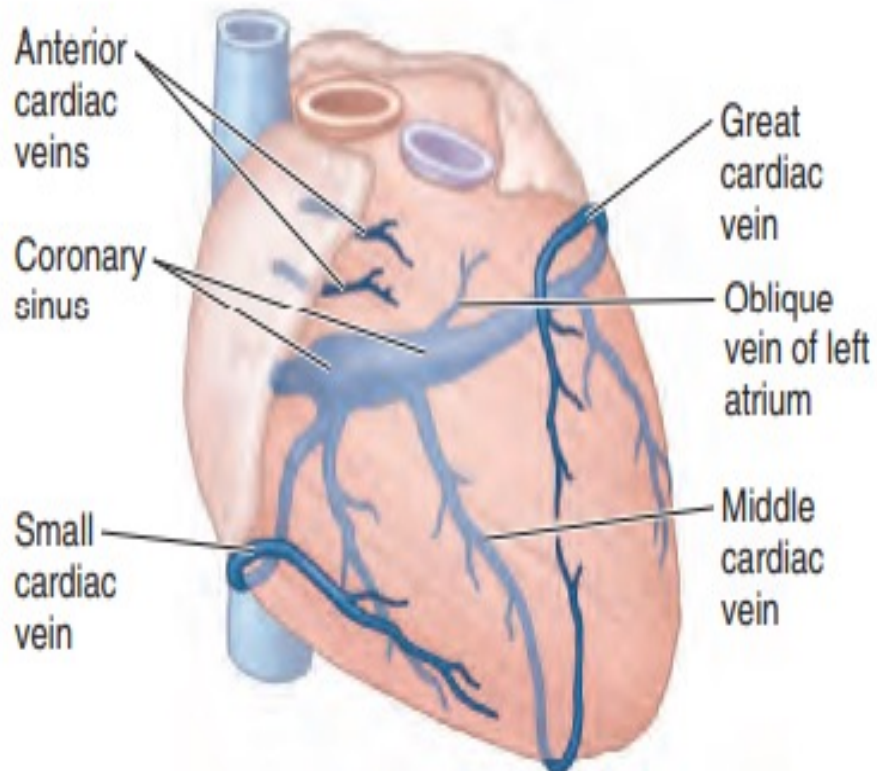
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Great cardiac vein

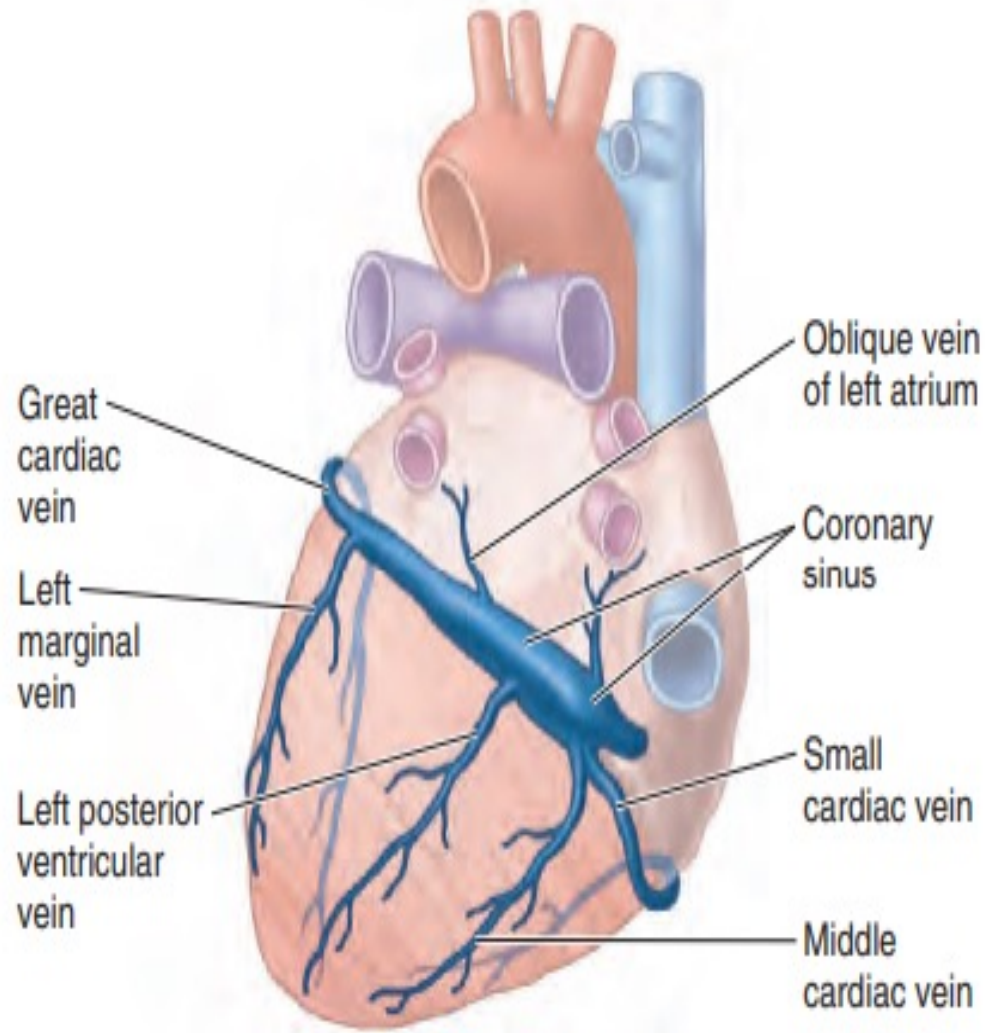


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Middle cardiac vein



Anterior view



Postero-inferior view

