



CVS....

Lecture (2)

# Anatomy of the Heart

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# ILOS

1. To describe the internal features of each chamber of the heart.
2. To describe the fibrous skeleton of heart.
3. To identify papillary muscles and describe their locations and importance.
4. To describe the atrioventricular, semilunar (pulmonary and aortic) valves, their position, functional importance, surface marking and ideal sites for their auscultation.
5. To describe different parts of the conductive system of the heart.

# Interior of the right ventricle

## Cross section

- Has a semilunar cavity.
- **Its wall:** 1/3 thickness of the wall of the left ventricle.

## A- Has 2 openings:

Tricuspid & Pulmonary.

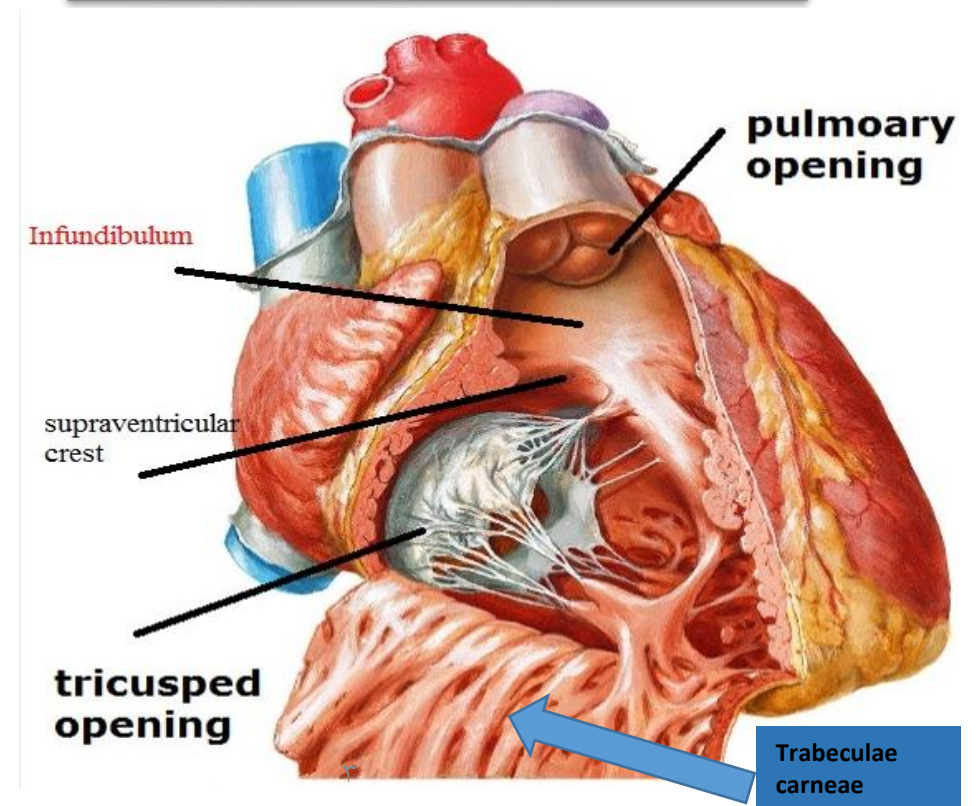
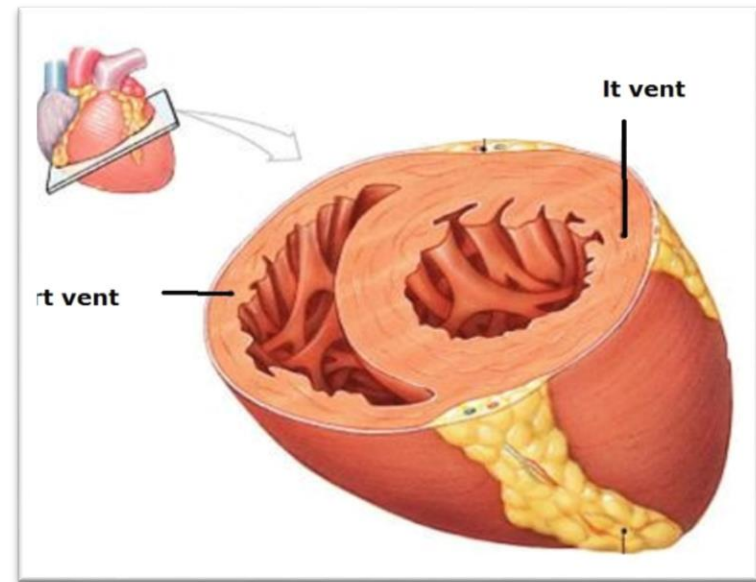
## B- Has smooth (outflow) part:

- **Infundibulum of pulmonary trunk;** funnel shaped part of right ventricle toward the pulmonary orifice, separated from inflow part by supraventricular crest.

## C- Rough (inflow) part: shows (3 features)

### 1-Trabeculae carneae:

Muscular ridges that freely intercross.



**2-Papillary muscles:** three in number

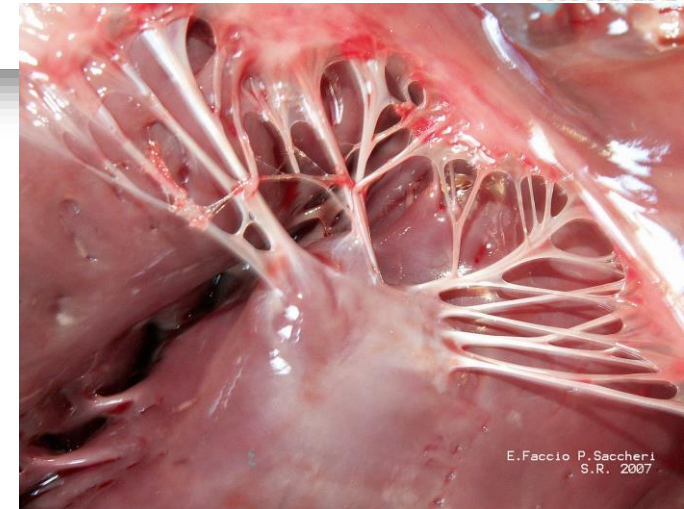
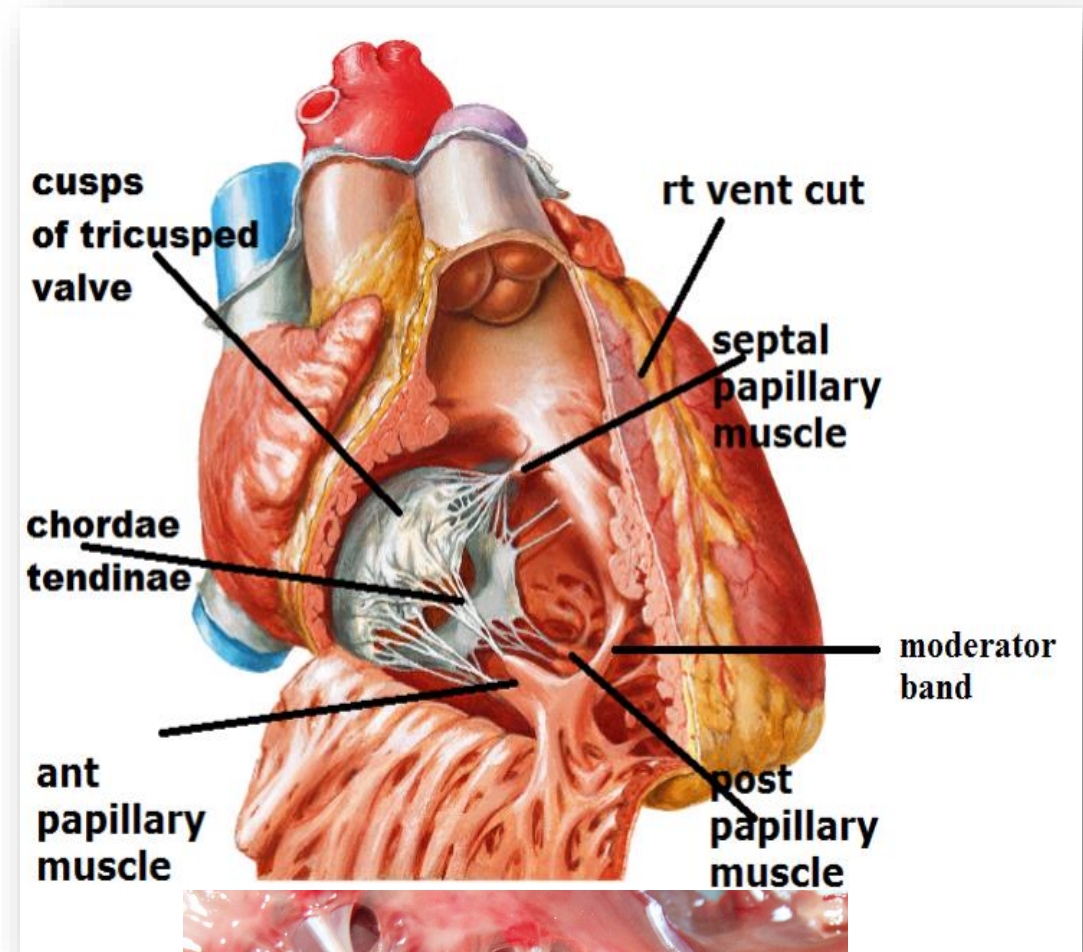
**Anterior, posterior & septal** papillary muscles

**Shape:** conical has:

- **Base:** attached to the ventricular wall.
- **Apex:** gives chordae tendinae that attached to the margins & ventricular surface of cusps of the tricuspid valve.
- **Function:** they prevent prolapse of cusps (eversion to the atrium), holding them in a closed position.

**3-Moderator band:**

- It is a trabecula from the interventricular septum to the base of anterior papillary muscle.
- **Function:** Transmits the right bundle branch.



# Interior of the left Ventricle

## Cross section:

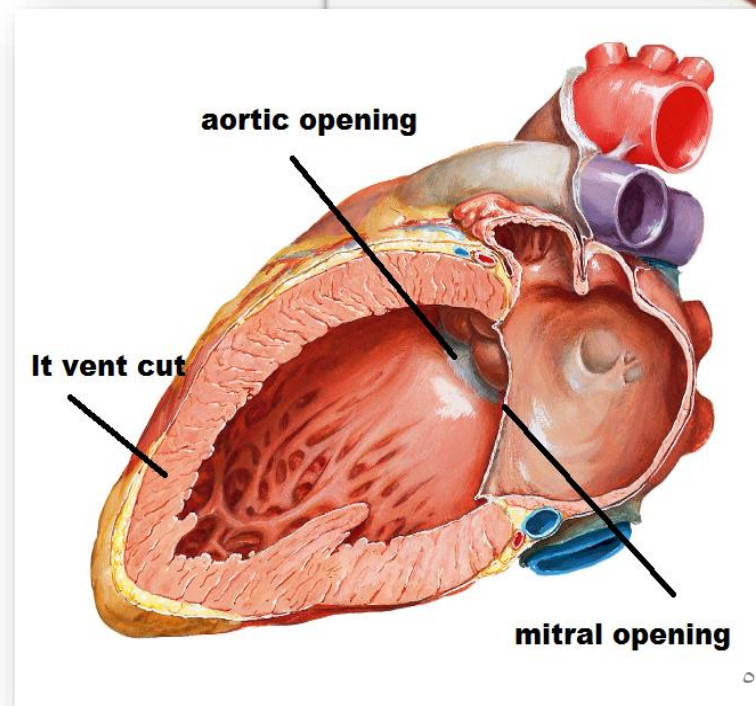
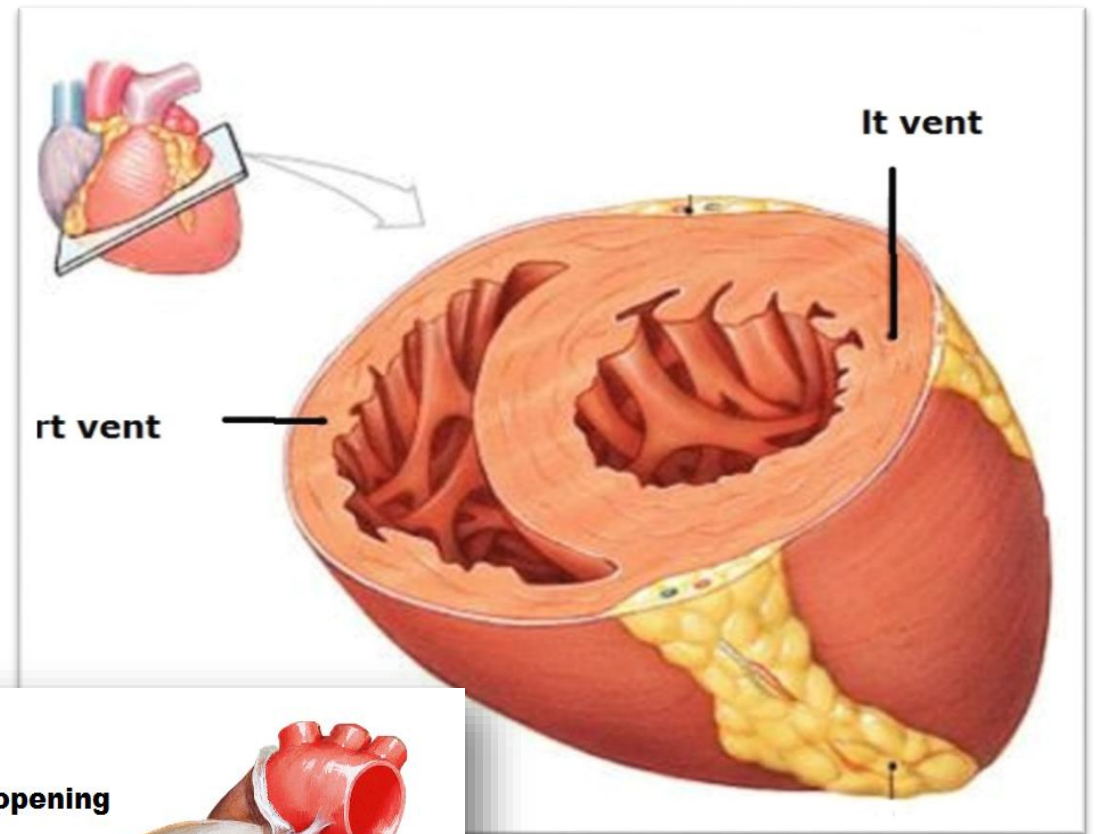
- Has circular cavity.
- **Its wall:** three times thickness of the wall of the right ventricle.

## **A- Has 2 openings:**

Mitral & Aortic.

## **B- Smooth (outflow) part:**

**Aortic vestibule**, below the aortic opening.



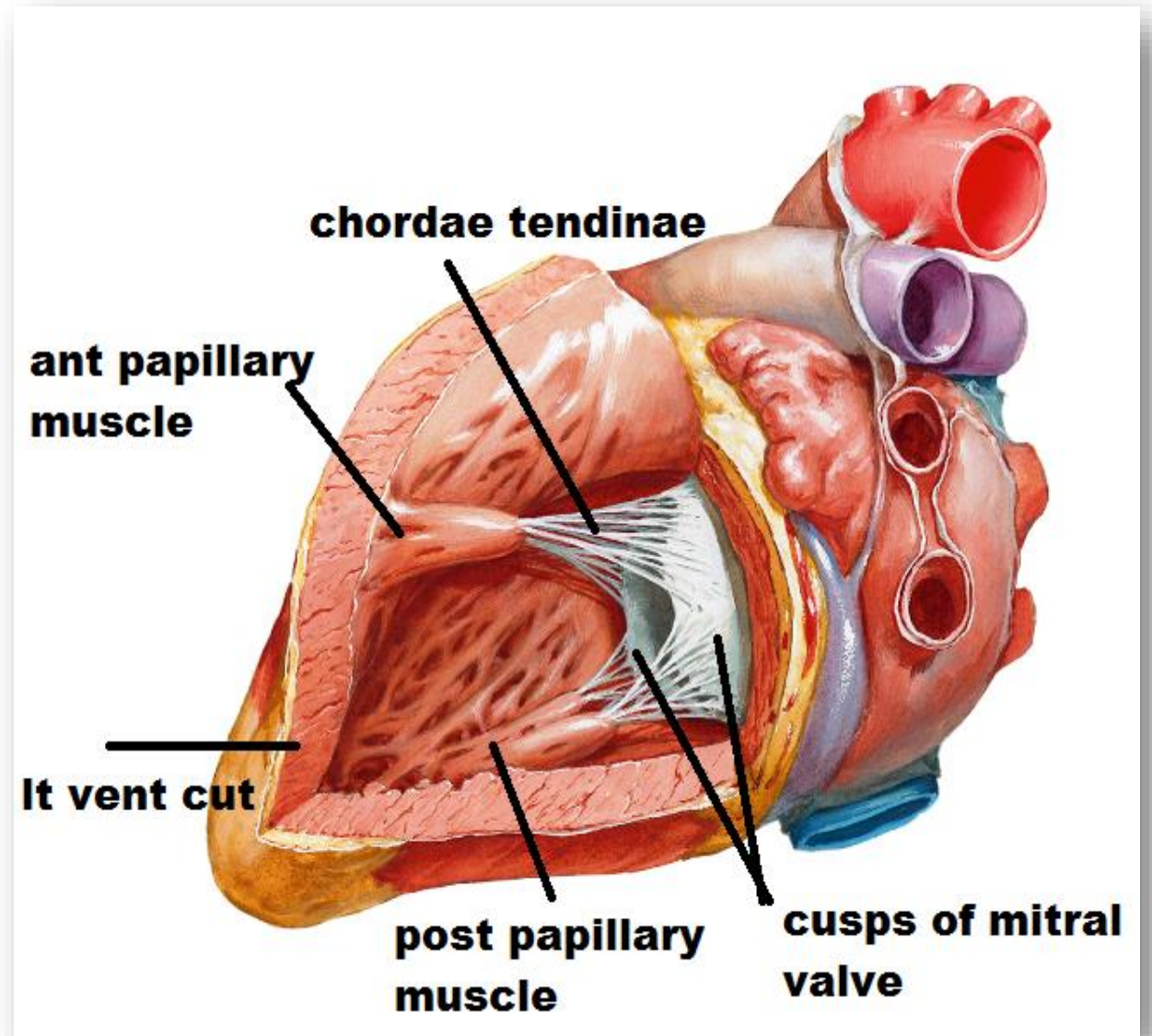
**C- Rough (inflow) part, shows:**

**1-Trabeculae carneae.**

**2- Papillary muscles:** two in number,  
**Anterior & posterior** papillary muscles.

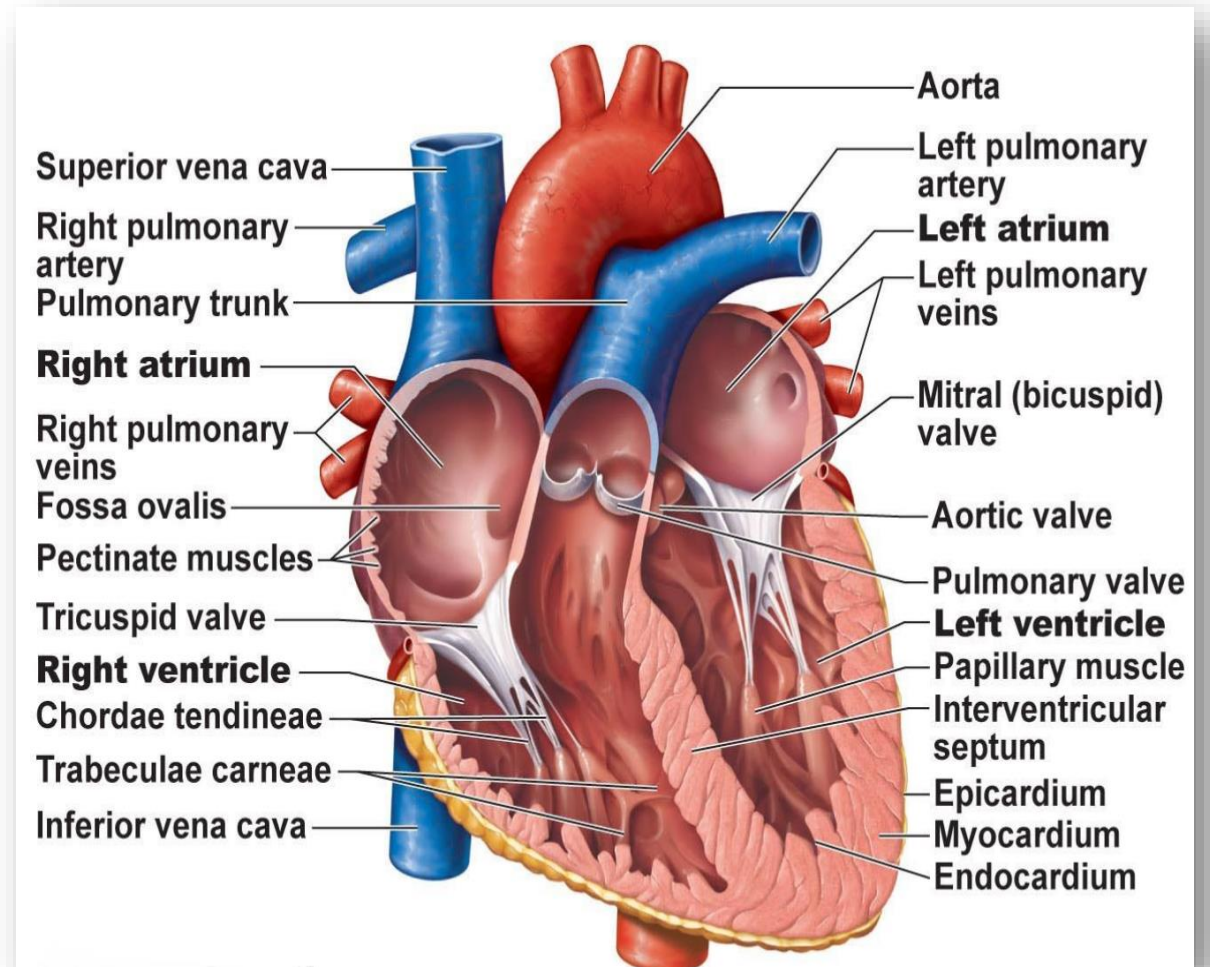
**Shape:** larger than that of the right ventricle,  
chordae tendinae are attached to margins &  
ventricular surface of cusps of the mitral valve.

**3- Has no moderator band.**



# Interventricular septum

- **The right ventricle** is anterior & to the right of the septum.
- **The left ventricle** is posterior & to the left of the septum.
- The septum is **convex towards** the right ventricle.
- **Consists of 2 parts** (Lower muscular & upper membranous parts).



# Fibrous skeleton of the heart

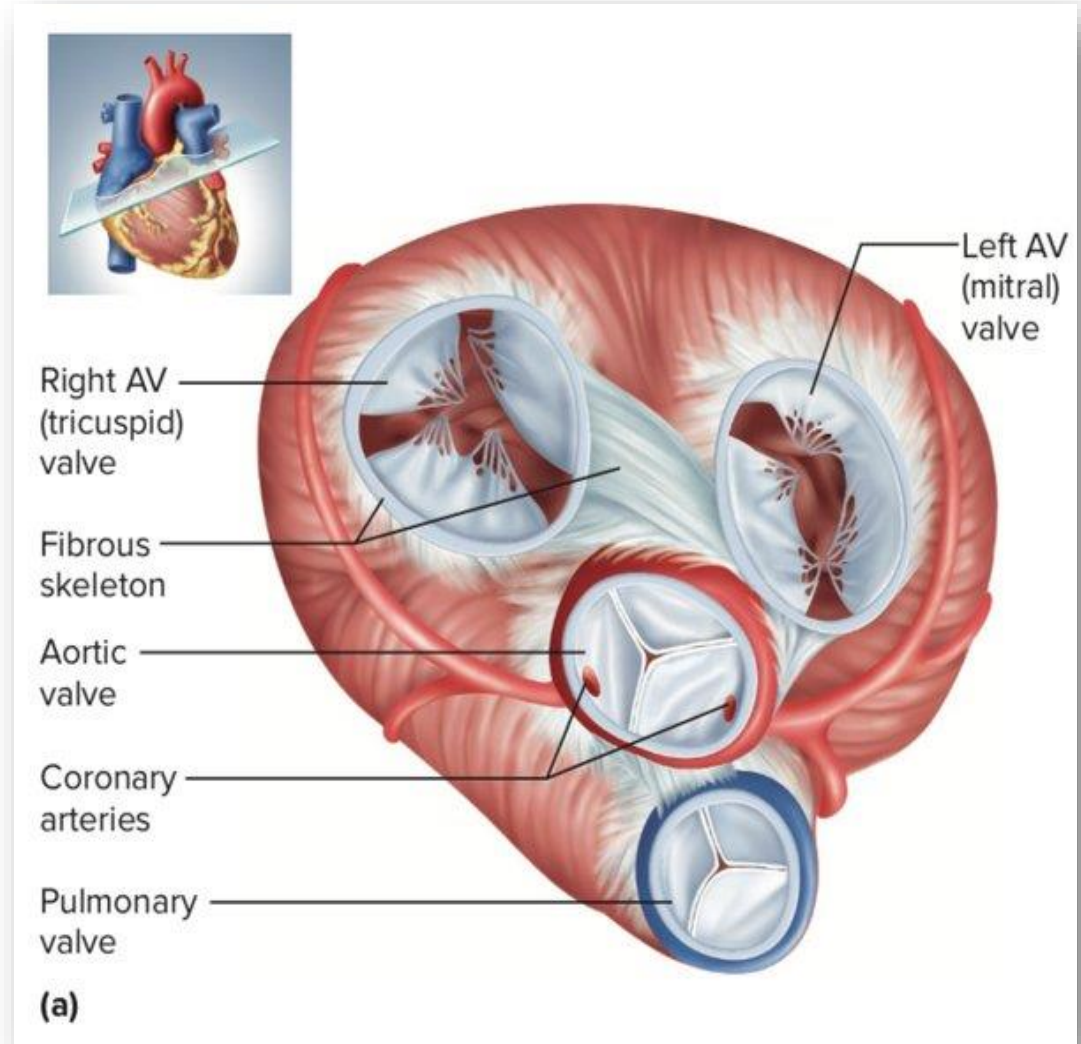
**Definition:** A rigid framework of dense regular connective tissue located between the atria and the ventricles.

## **Components:**

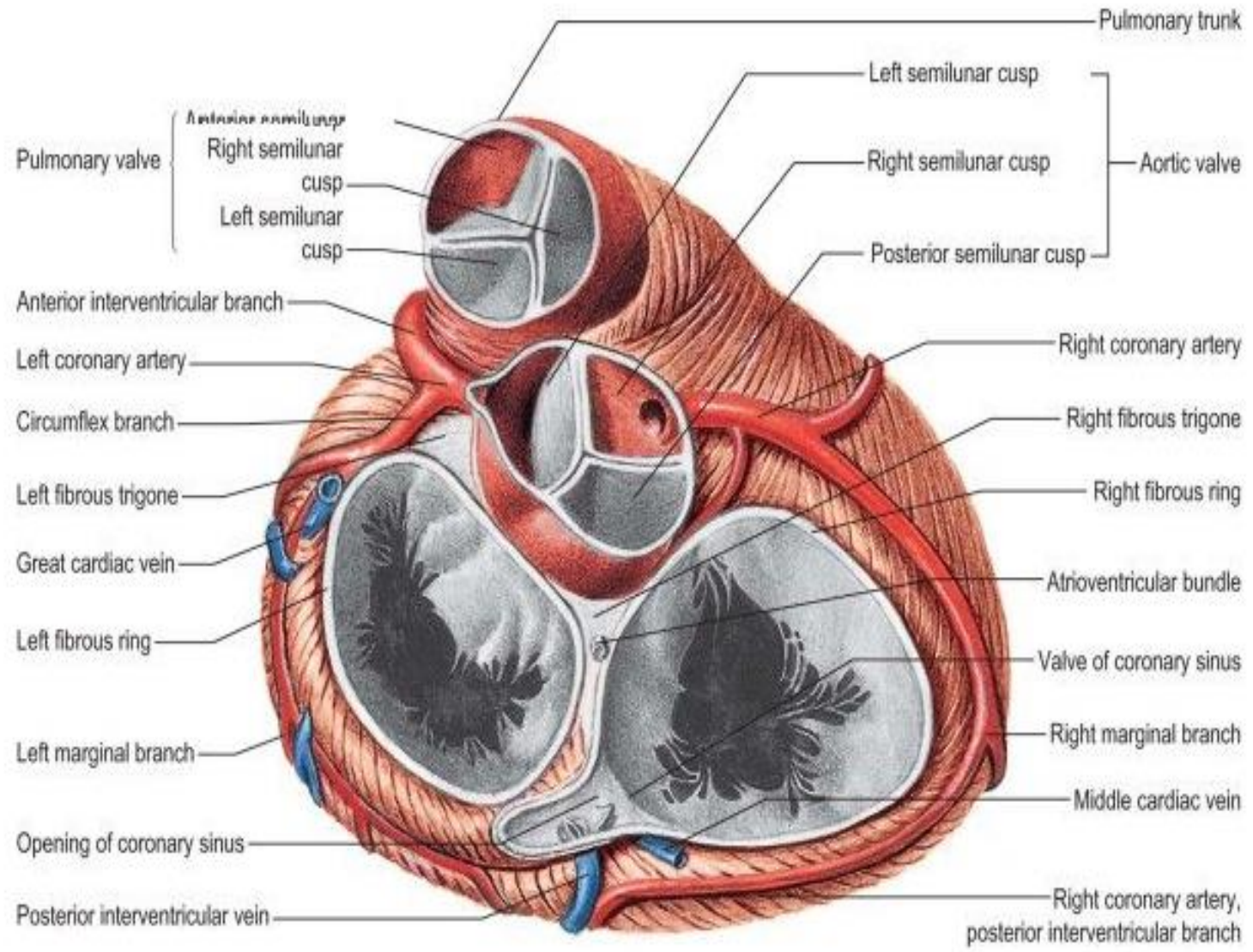
- **Four fibrous rings.** 1-tricusped ring. 2-mitral ring. 3-aortic ring. 4-pulmonary ring.
- Right and left **fibrous trigones.**
- **Membranous parts** of the interatrial, interventricular septum.

## **Functions:**

- Maintains **valve orifices open.**
- Provides **attachment** for valve cusps & myocardial fibers
- Acts as **an electrical insulator** between the atria and ventricles except at the site of penetration of the atrioventricular bundle.







# Orifices at the right side of the heart

## 1-Right atrio-ventricular (inlet) orifice:

### Tricuspid orifices:

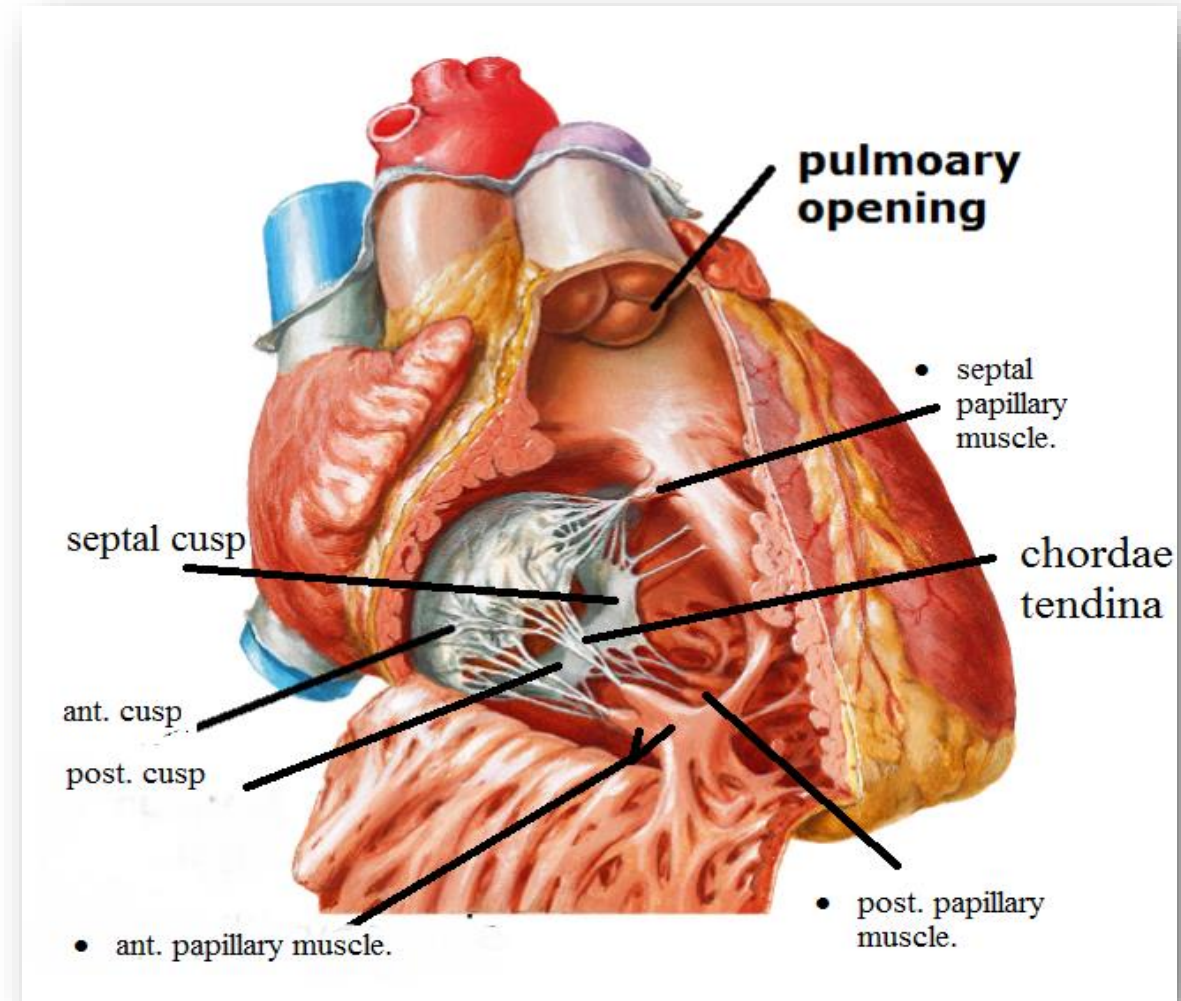
- Guarded by **Tricuspid Valve**.
- Surrounded by a fibrous ring, which gives attachment to **3 cusps (anterior, posterior & septal) of tricuspid valve**.

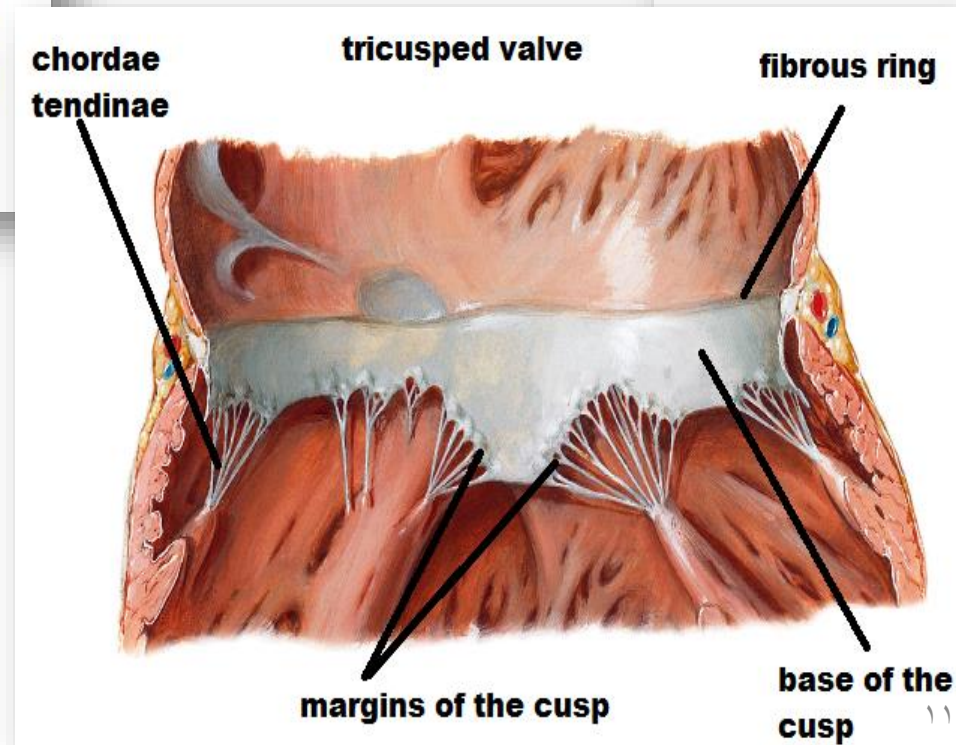
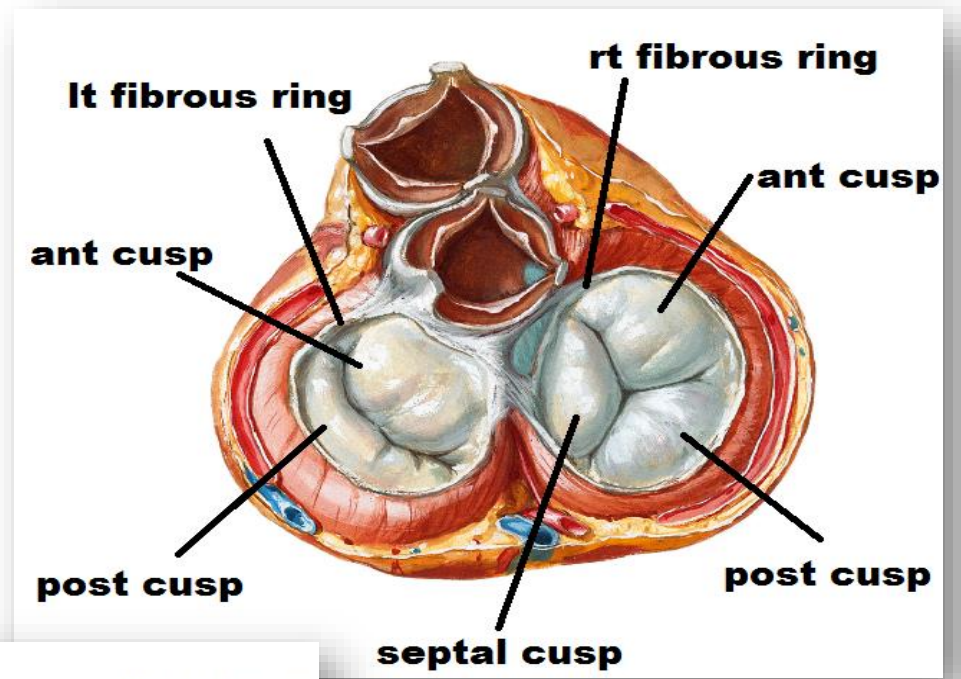
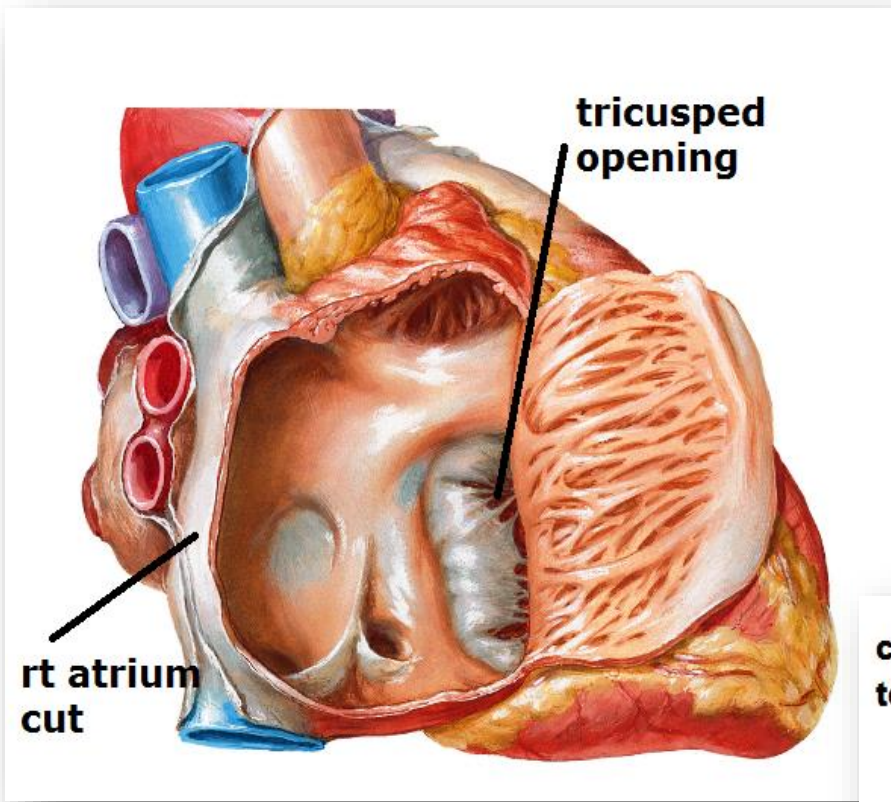
**Each cusp;** is a reduplication of endocardium.

**Each cusp;** is triangular in shape, has:

- **Two surfaces;** smooth atrial & rough ventricular.
- **Base;** attached to fibrous ring.
- **Apex & margin;** Chordae tendinae attached to them.

\*Also Chordae tendinae attached to ventricular surfac.





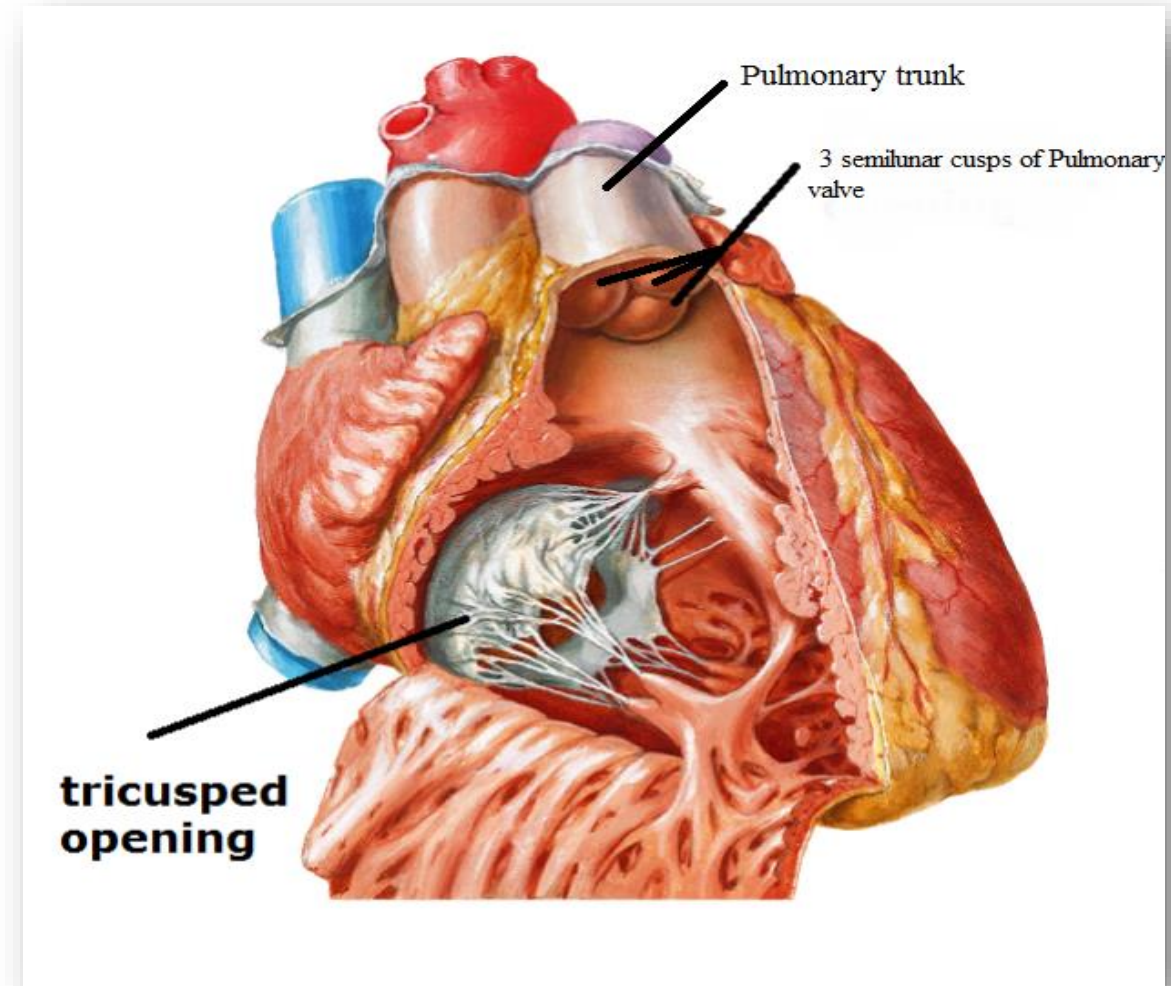
## 2-Outlet orifice of the right ventricle: Pulmonary orifice:

- Guarded by Semilunar (valve).
- Surrounded by a fibrous ring, which gives attachment to **3 semilunar cusps (anterior, right & left) of pulmonary valve.**

**Each cusp:** formed by folds (reduplication) of endocardium.

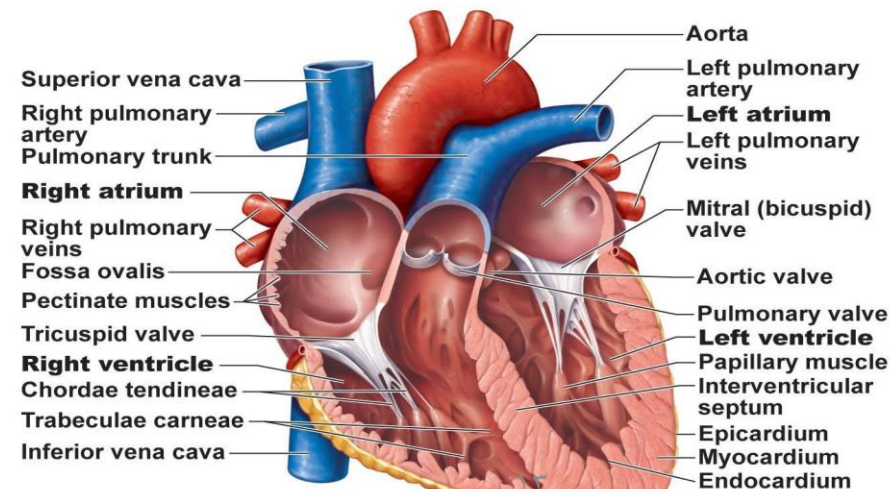
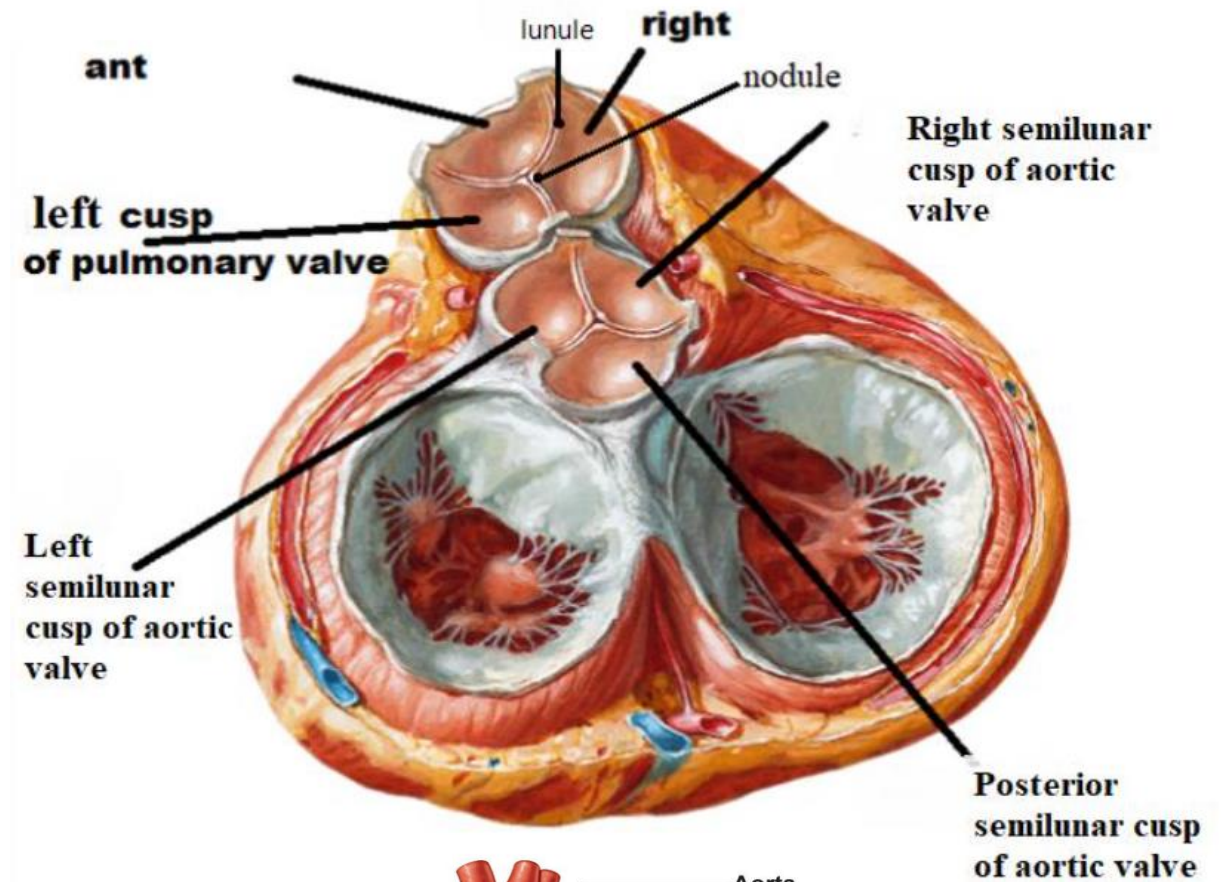
**Each cusp:** semilunar & has:

- **Concave** upper surface (open mouths) & **convex** lower (ventricular) surface.
- **Upper margin (free);** shows **thickened nodule** in the middle & **thin lunule** on the sides.
- **Lower margins & sides;** are attached to the arterial wall.



## Pulmonary valve:

- No chordae tendinae or papillary muscles are associated with these valve cusps.
- The attachments of the sides of the cusps to the arterial wall prevent the cusps from prolapsing into the ventricle.
- At the root of the pulmonary trunk are three dilatations called the sinuses.
- During the ventricular systole, the cusps of the valve are pressed against the wall of the pulmonary trunk by the out-rushing blood.
- During diastole, blood flows back toward the heart and enters the sinuses, the valve cusps fill and come into apposition in the center of the lumen, and close the pulmonary orifice.



(e) Frontal section

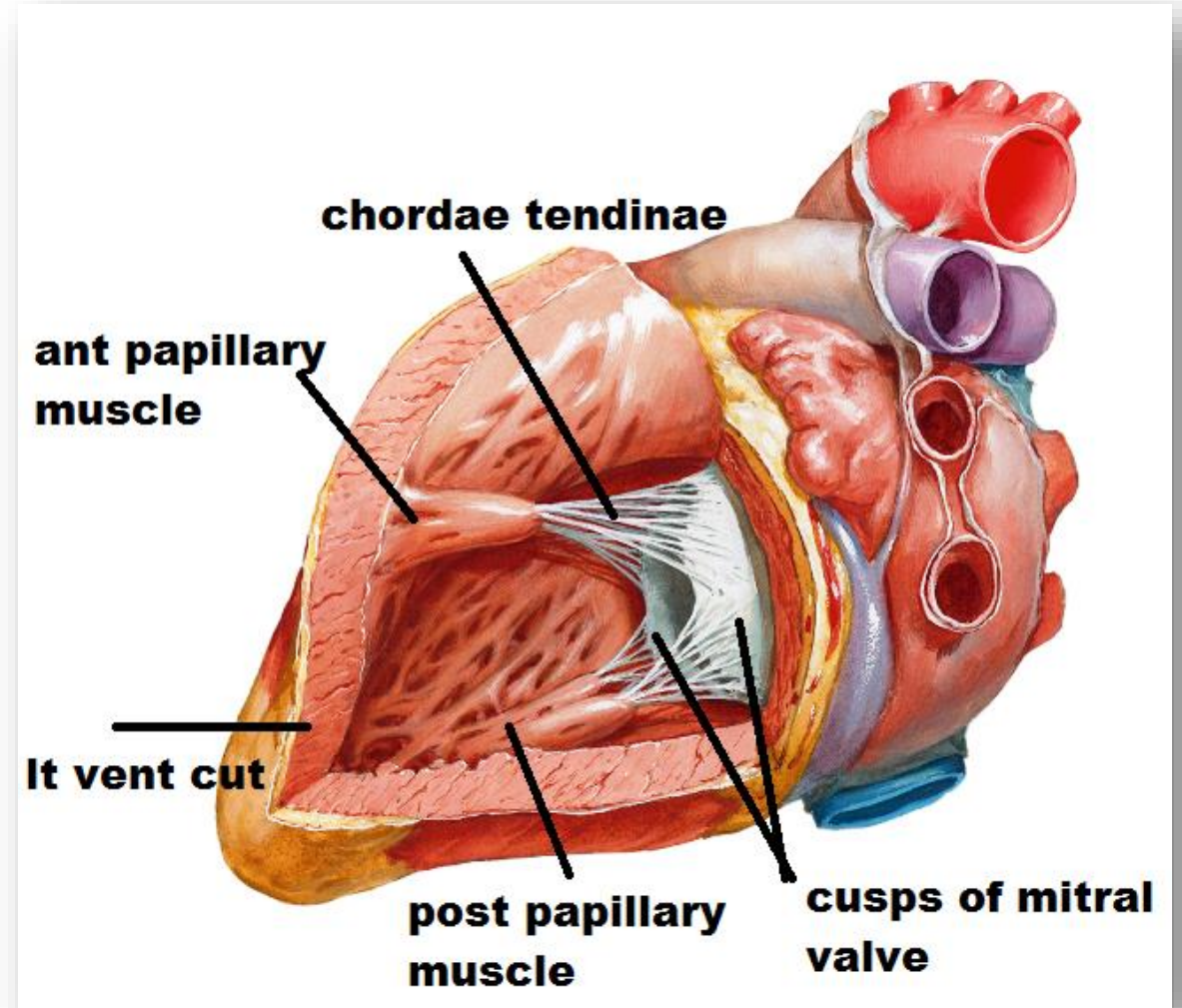
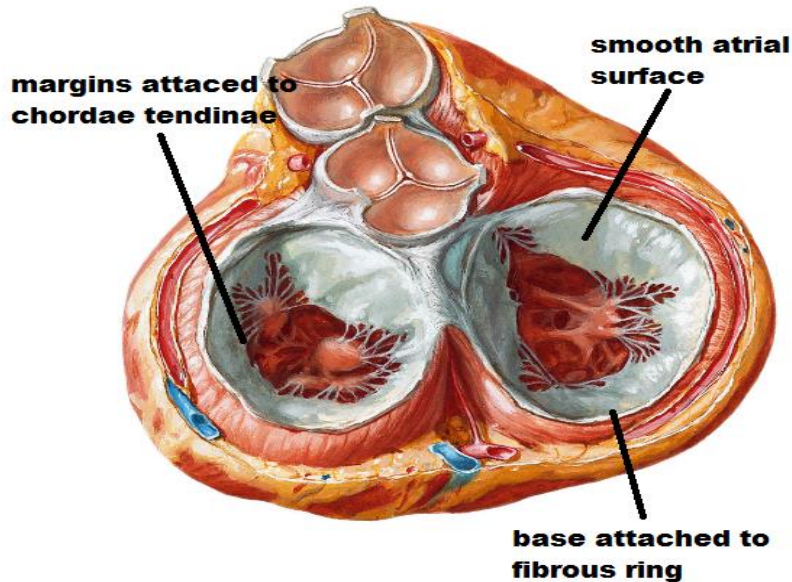
# Orifices of the left ventricle

## 1-Left atrio-ventricular ( inlet):

### Mitral orifice

- Guarded by the **Mitral Valve**.
- Surrounded by a fibrous ring, which gives attachment to **2 cusps (anterior & posterior)** of mitral valve.

**The same description of the tricuspid cusps.**



## 2- Outlet orifice; Aortic orifice.

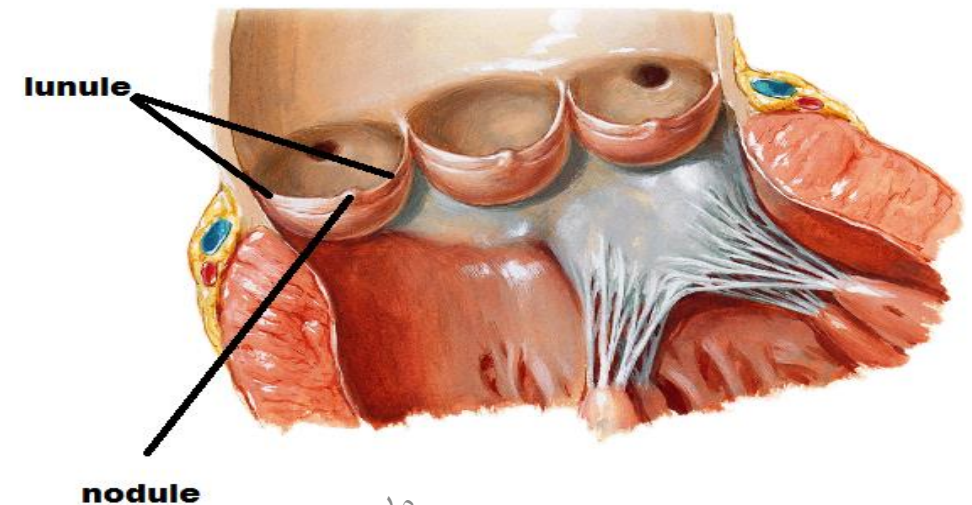
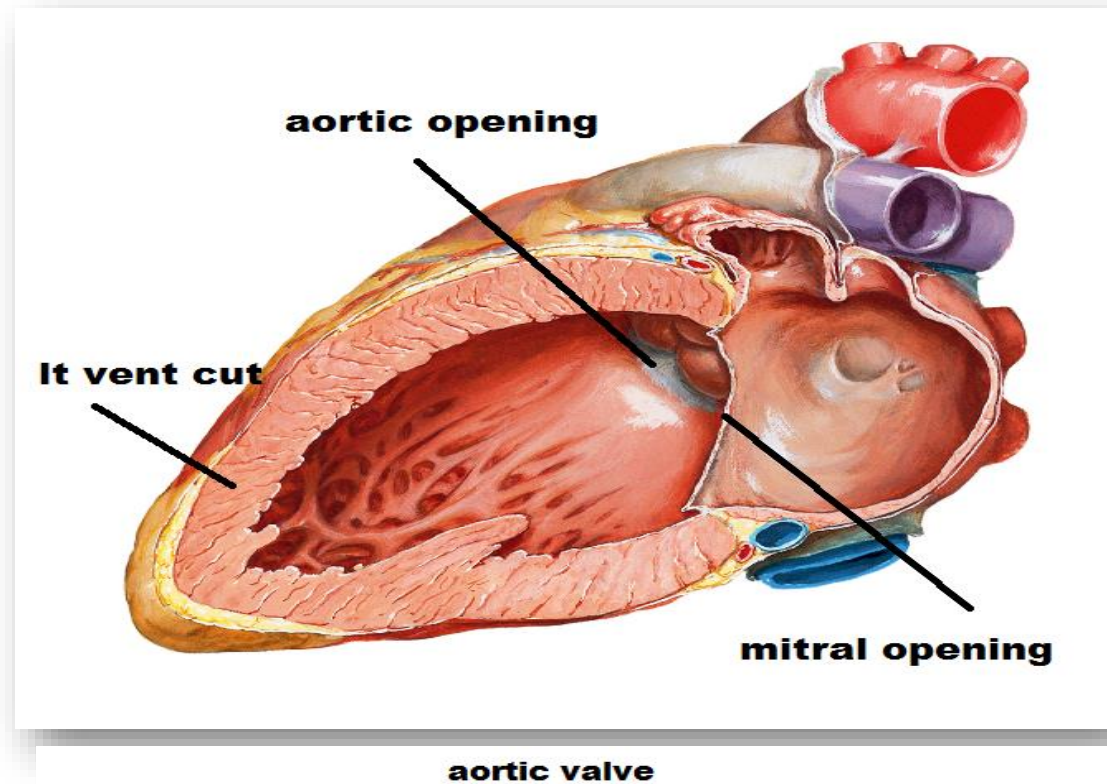
- Guarded by the semilunar valve.
- Surrounded by a fibrous ring, which gives attachment to **3 semilunar cusps (posterior, right & left)** of the aortic valve.

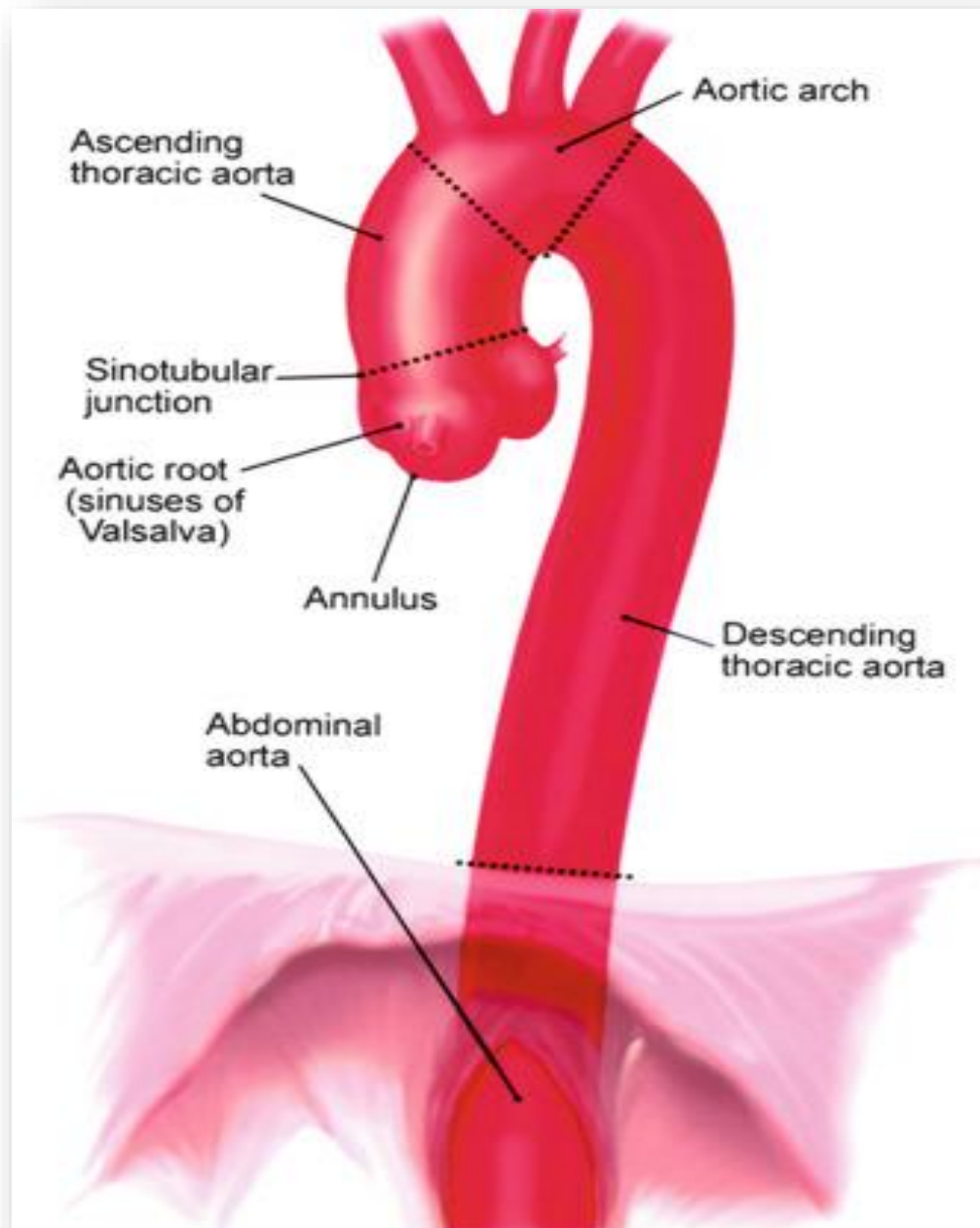
**Each cusp:** formed by folds of endocardium.

**Each cusp:** semilunar & has:

**The same description of the pulmonary cusps.**

- **Aortic Sinuses:** slight dilatation above each cusp.







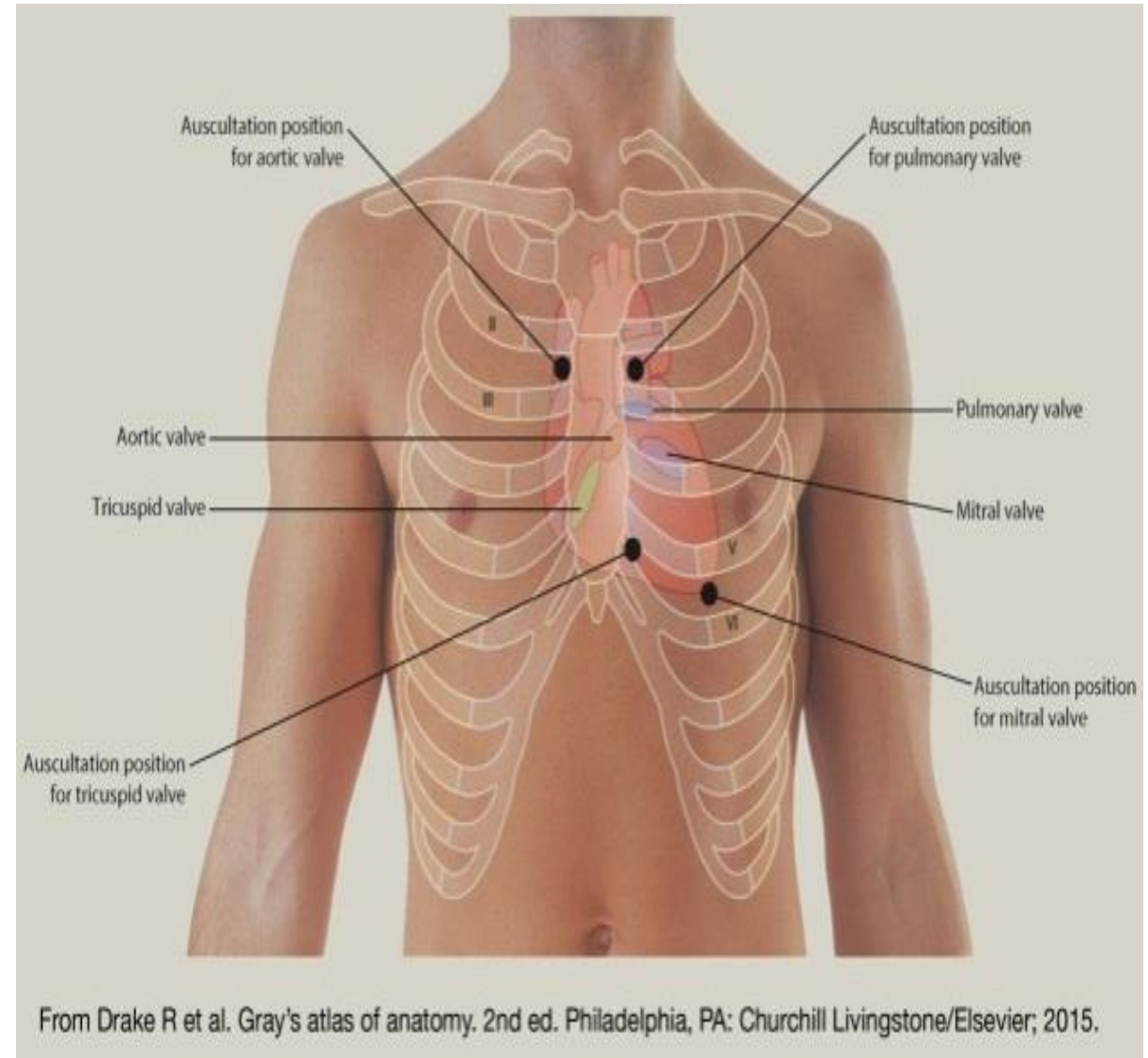
# Surface anatomy of the valves of the heart

**Pulmonary valve:** Left 3<sup>rd</sup> costal cartilage, close to the sternal margin.

**Aortic valve:** level of Left third intercostal space, behind the left 1/2 of sternum.

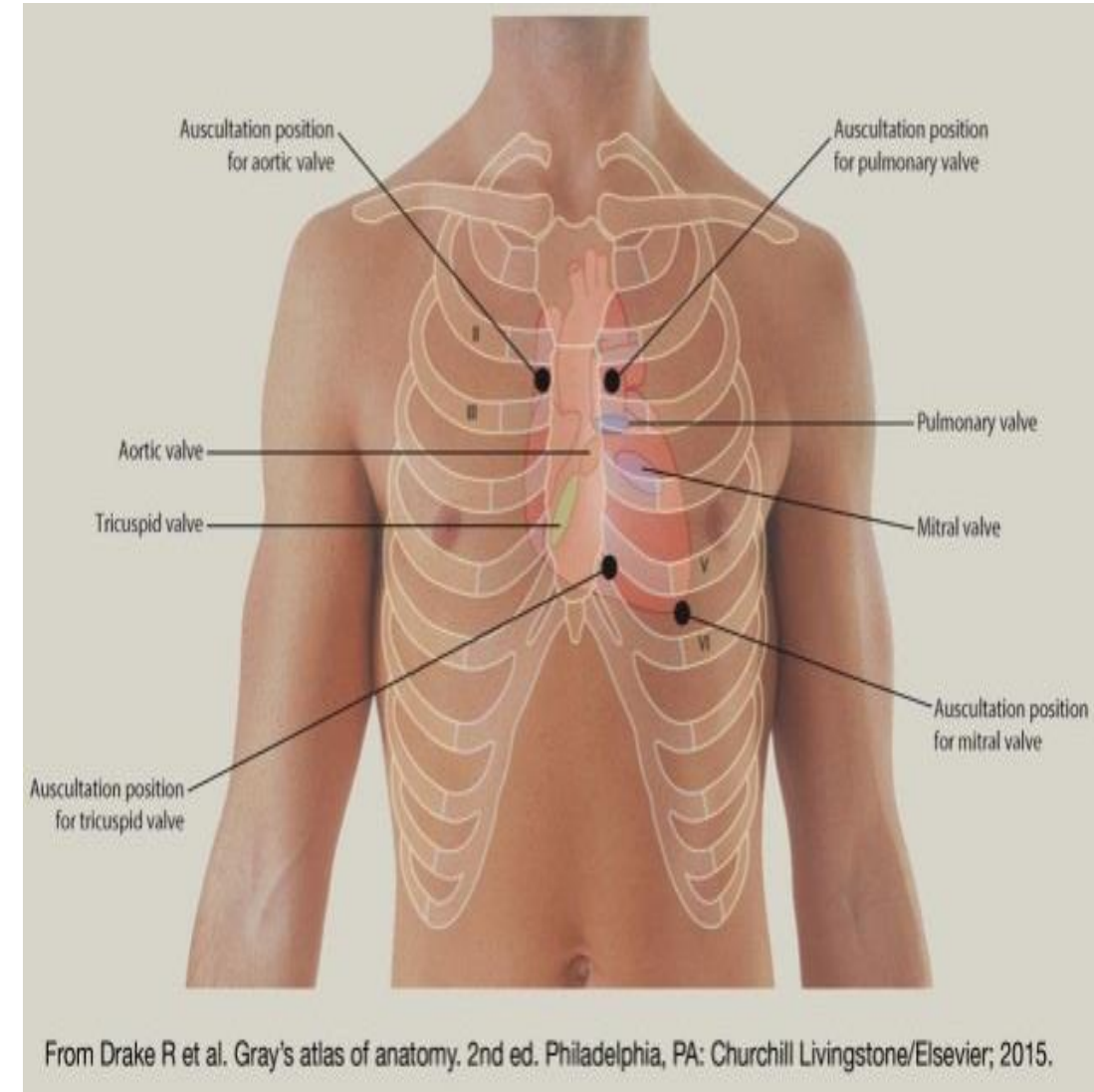
**Mitral valve:** Left fourth costal cartilage close to the sternal margin.

**Tricuspid valve:** level of fourth intercostal space, behind the right half of the sternum.

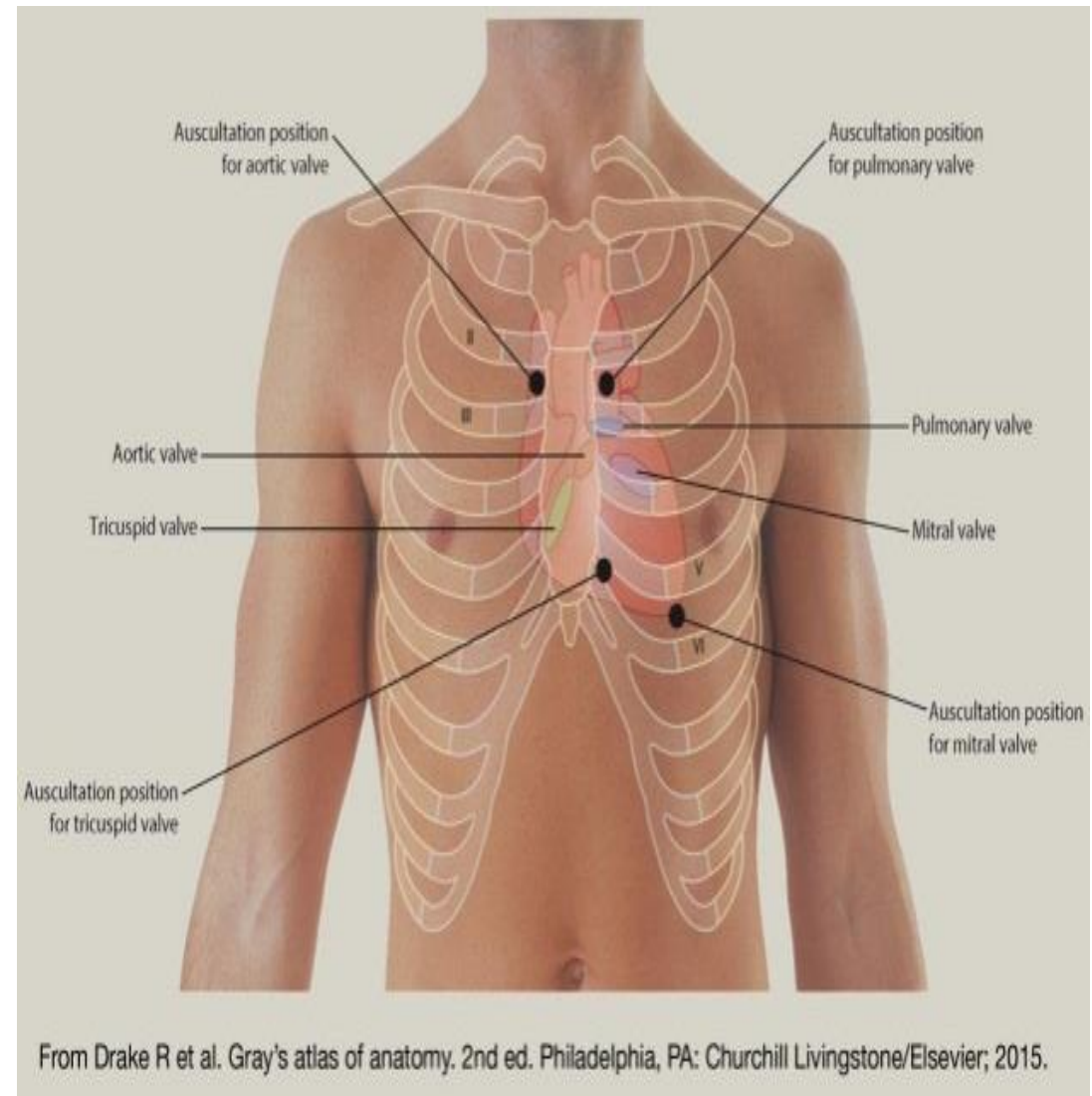


# Auscultation of the valves of the heart

- There are two normal heart sounds, often described as a *lub* and a *dub* that occur in sequence with each heartbeat.
- **First heart sound ( $S_1$ )** produced by the closing of the atrioventricular valves.
- **Second heart sound ( $S_2$ )**, produced by the closing of the semilunar valves.
- It is important for a physician to know where to place the stethoscope on the chest wall to be able to hear sounds produced at each valve with the minimum of distraction.

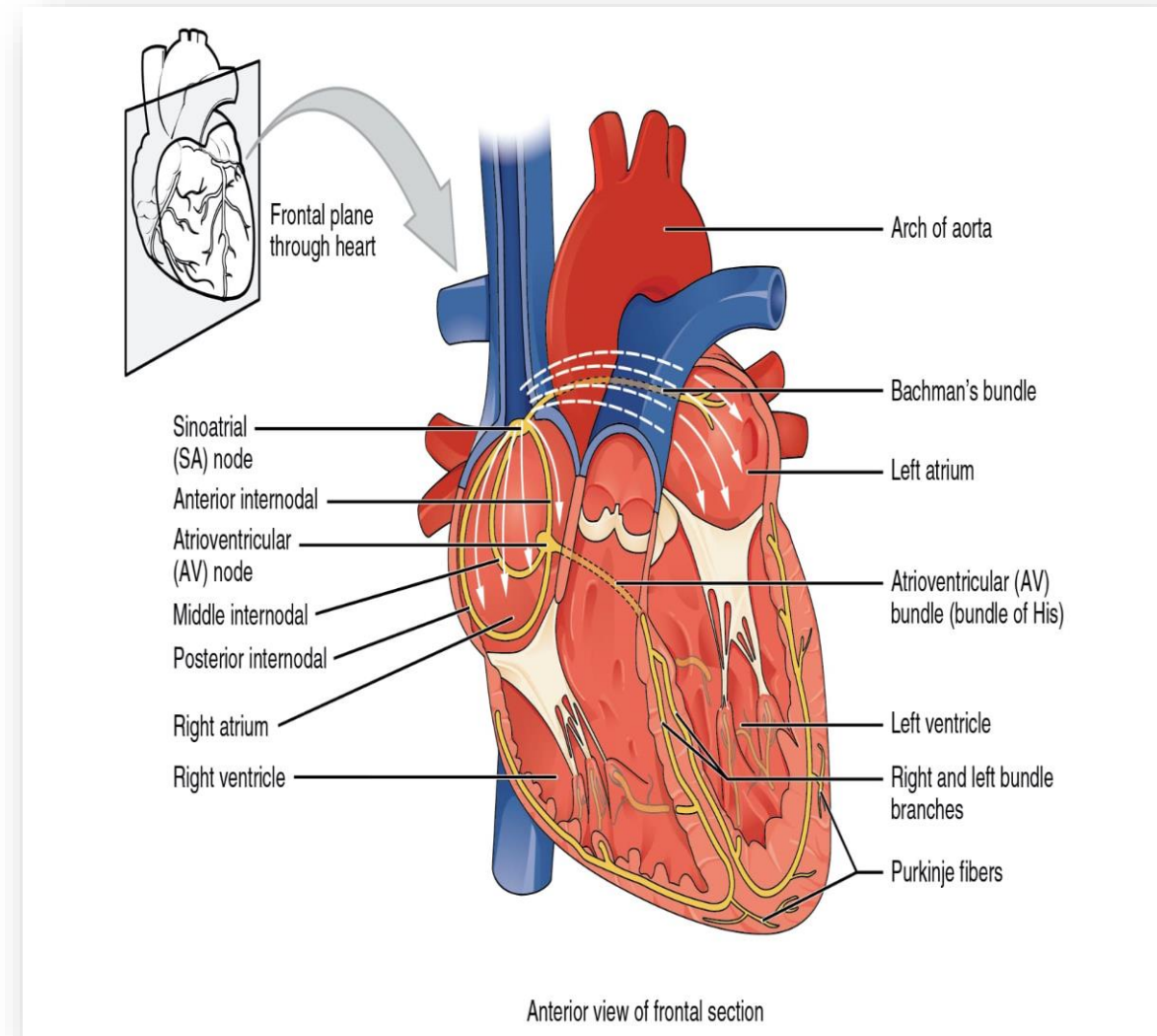


- **Pulmonary valve area** is best heard over the **left second intercostal space**, near the sternal border.
- **Aortic valve area** is best heard over the **right second intercostal space**, near the sternal border.
- **Mitral valve area** is best heard **over the apex of the heart**.
- **Tricuspid valve area** is at **fourth & fifth intercostal space**, near the left sternal border.



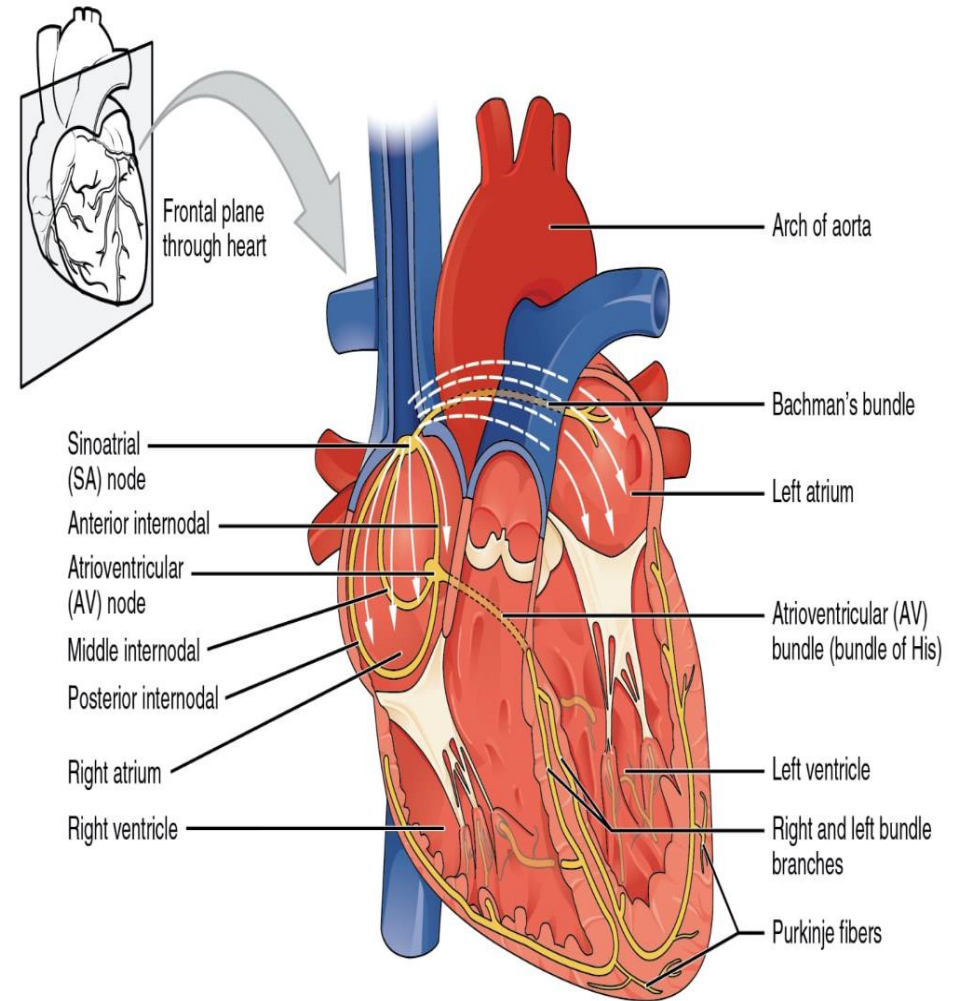
# Conductive System of the Heart

- The normal heart contracts rhythmically at about 70 to 90 beats/ minute in the resting adult.
- **The rhythmic contractile process** originates spontaneously in the conducting system and the impulse travels to different regions of the heart, so the atria contract first and together, to be followed later by the contractions of both ventricles together.
- The slight delay in the passage of the impulse from the atria to the ventricles allows time for the atria to empty their blood into the ventricles before the ventricles contract.



The specialized cardiac muscle fibers that form the conductive system of the heart, **represented in:**

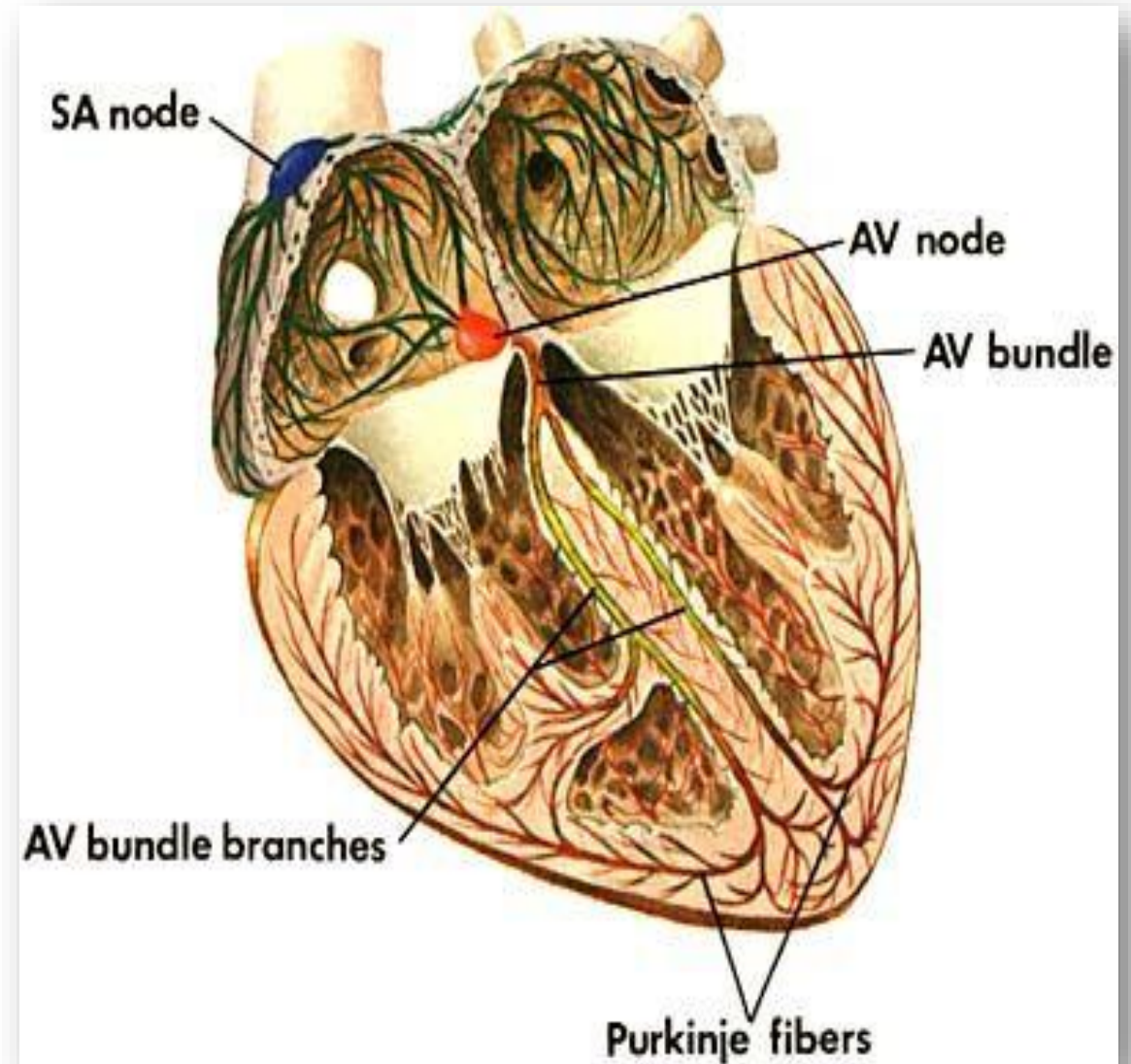
- Sinuatrial node (**SAN**)
- Atrioventricular node (**AVN**)
- **Atrioventricular bundle** and its right and left terminal branches.
- Subendocardial plexus of **Purkinje fibers**.



Anterior view of frontal section

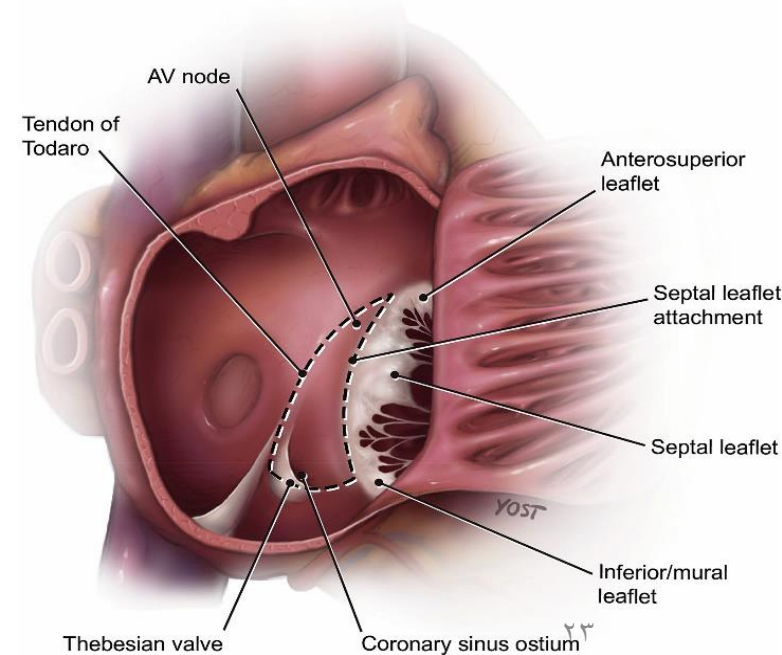
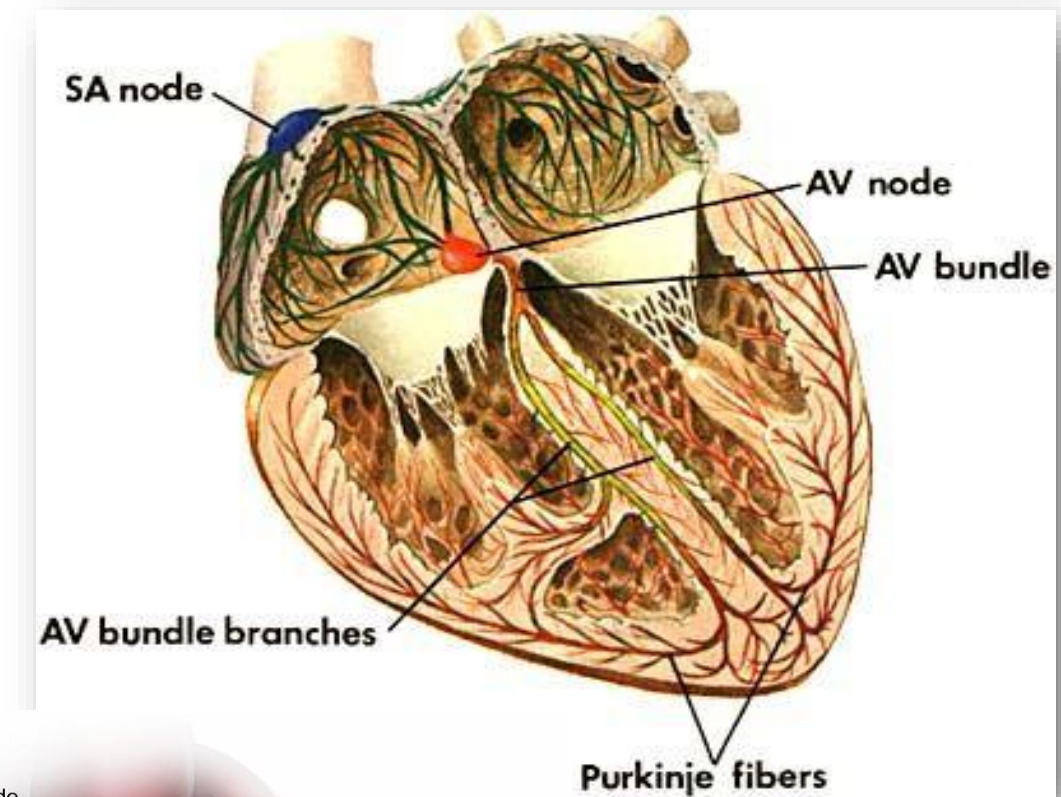
# Sinoatrial node (SAN)

- It is the **pacemaker of the heart**, initiates the impulse of contraction.
- The sinoatrial node is an **elliptical structure, 10–20 mm long**.
- **Site:** is located in the wall of the right atrium in the upper part of the sulcus terminalis, subepicardially, just to the right of the opening of the superior vena cava
- The node **spontaneously gives origin** to rhythmic electrical impulses that spread in all directions through the cardiac muscle of the atria and cause the muscles to contract.



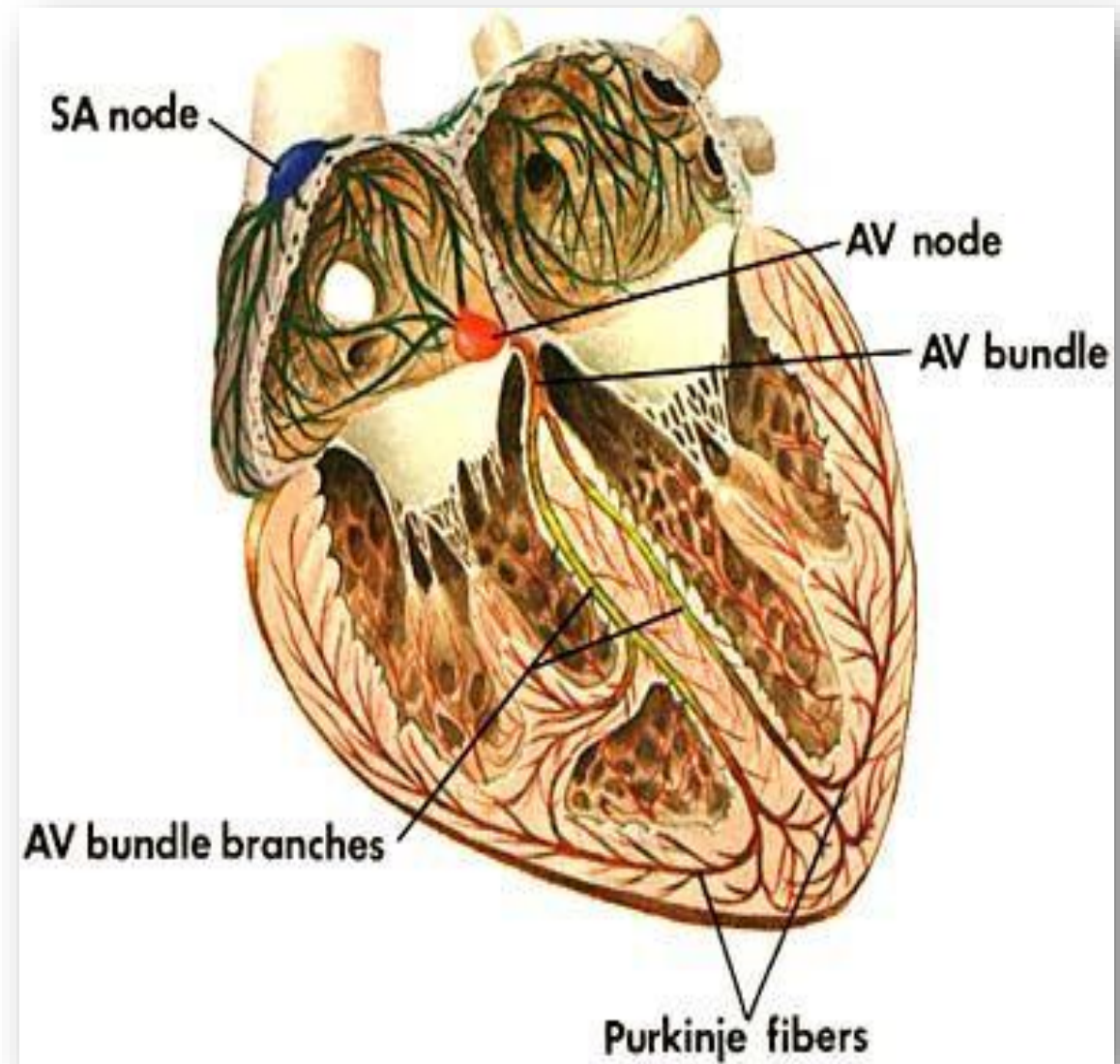
# Atrioventricular Node (AVN)

- **Site:** It is located within the **triangle of Koch** (at its apex)- above the attachment of the septal cusp of the tricuspid valve.
- Triangle of Koch is a region located at the right atrium defined by the following landmarks: the coronary sinus ostium, tendon of Todaro (tT), and the septal leaflet of the tricuspid valve (TV).
- The atrioventricular node is **stimulated by** the excitation waves as it pass through the atrial myocardium.
- **From it** the cardiac impulse is conducted to the ventricles by the atrioventricular bundle.

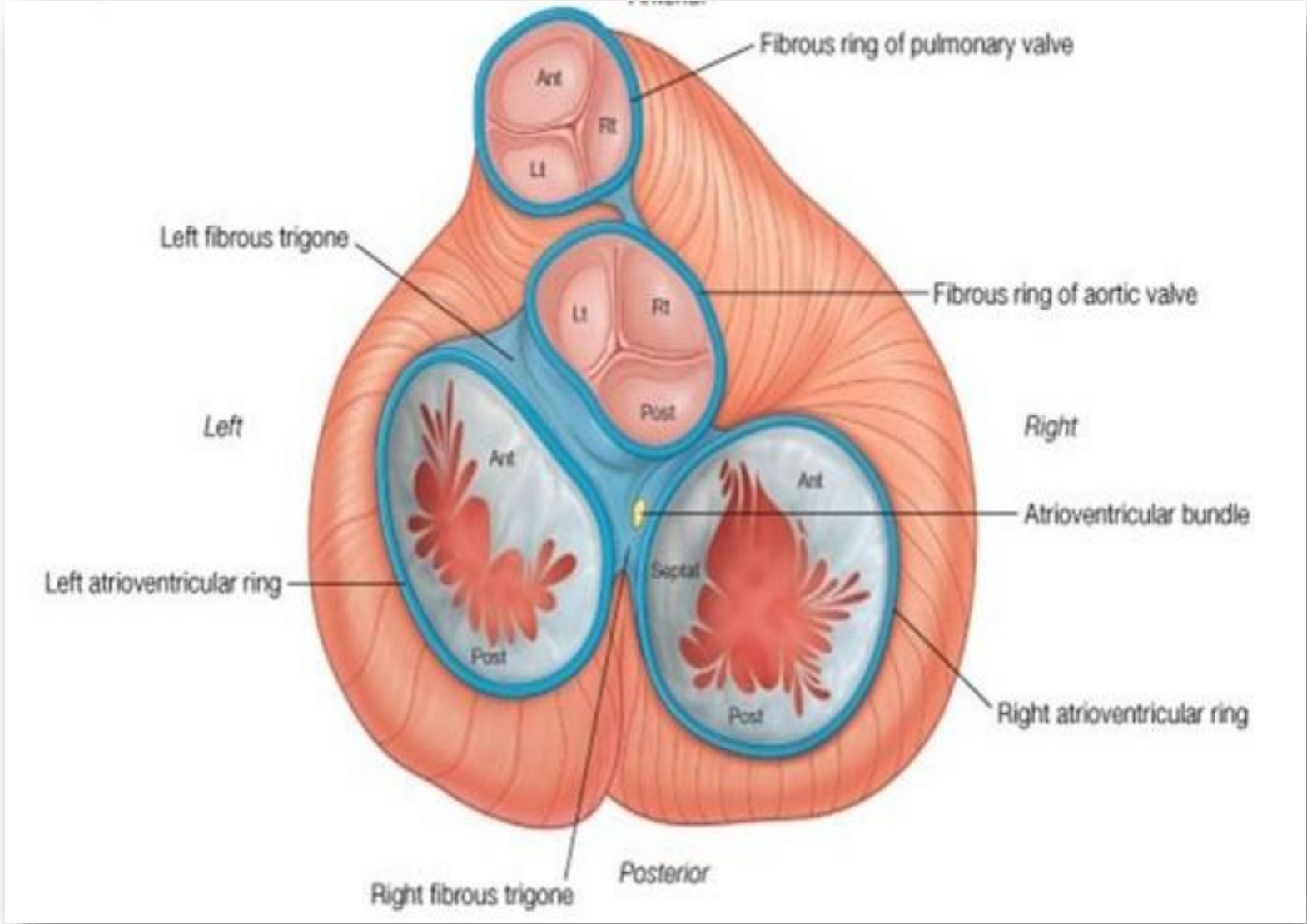


## Atrioventricular Bundle:

- The atrioventricular bundle (**bundle of His**) it is the only bundle of cardiac muscle that **connects** the myocardium of the atria and the myocardium of the ventricles.
- So it is thus the **only route** along which the cardiac impulse can travel from the atria to the ventricles.
- **Course:** The bundle **descends** through the fibrous skeleton of the heart, **then descends** behind the septal cusp of the tricuspid valve to reach the membranous part of the ventricular septum.
- **End:** At the upper border of the muscular part of the ventricular septum **it divides into** two branches, one for each ventricle, **Right & left bundle branches.**







# Quiz

**A 57-year-old patient has a heart murmur resulting from the inability to maintain constant tension on the cusps of the atrioventricular (AV) valve. Which of the following structures is most likely damaged?**

- (A) Crista terminalis
- (B) Moderator band.
- (C) Chordae tendineae
- (D) Pectinate muscle.

**Which of the following sequences correctly represents the conduction of an impulse through the heart?**

- A) SA node, AV node, AV bundle, bundle branches
- B) SA node, AV bundle, AV node, bundle branches
- C) AV node, SA node, AV bundle, bundle branches
- D) SA node, bundle branches, AV node, AV bundle
- E) AV node, AV bundle, SA node, bundle branches

*Thank  
you*

