

# Heart

★ The heart is a **hollow muscular** organ which **pumps** the blood to the big vessels.

★ **Position:**

القلب في حوالبه

- It lies within the **pericardium** in the **middle mediastinum**.
- It behind the **body of the sternum** & 2-6 **costal cartilages**.
- **1/3** of the heart is to the **right** while its **2/3** is to the **left** of the median plane.

★ **Size and weight:**

- It is slightly larger than the size of **closed fist**, with an average weight of **250-300 gm**.
- In **living** the dimensions of the heart can be detected by **percussion** and **echocardiography**.

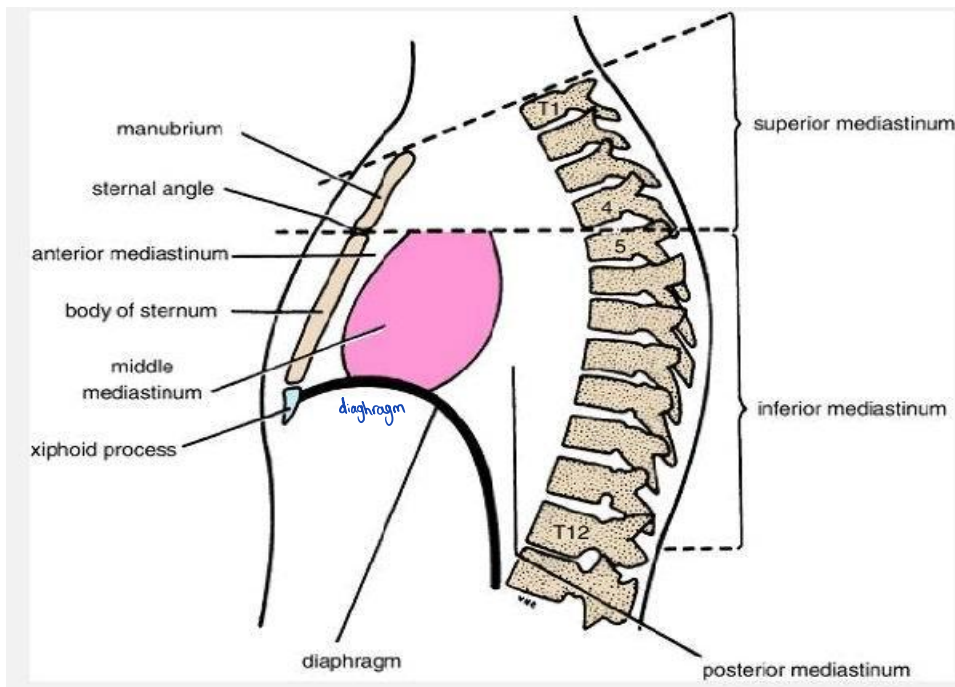
★ **Parts of the heart:** it has **4 chambers**; **2 atria** (right and left) and **2 ventricles** (right and left).

★ **Shape:** it is **conical** in shape, having the followings:

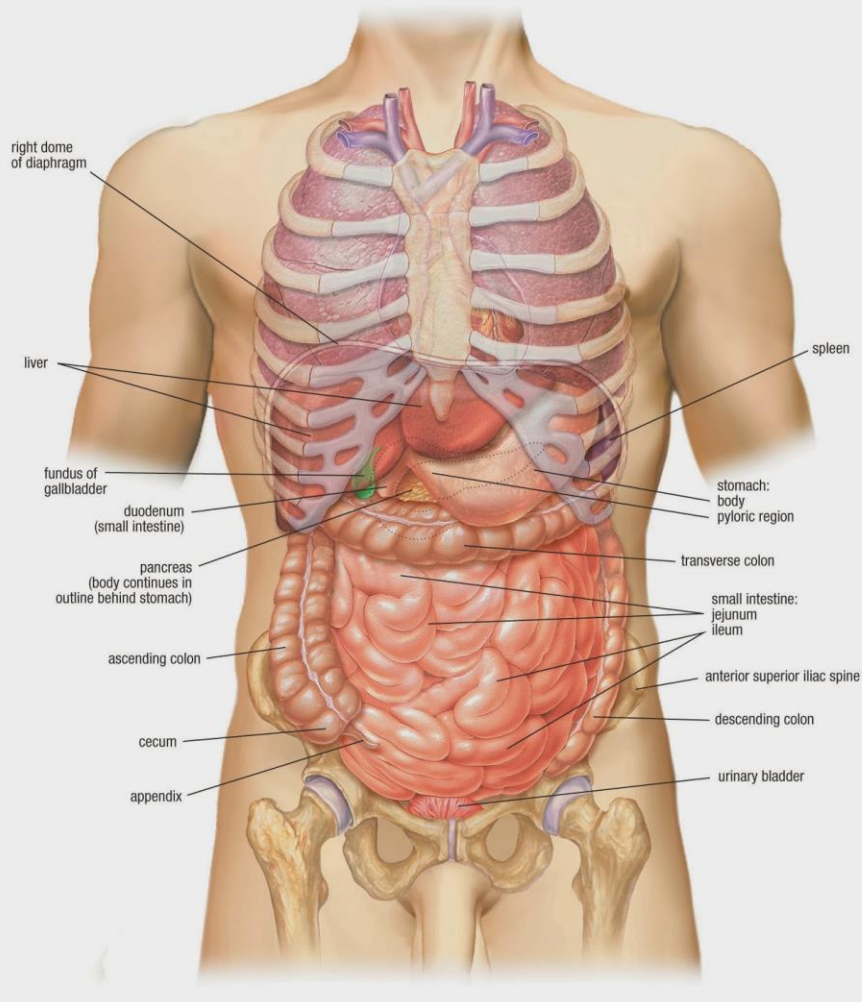
- A **base** (or posterior surface).
- An **apex**.
- The **axis** of the heart extends from the **base to the apex** is directed downwards, forwards and to the left.
- **2 surfaces:** sternocostal (or anterior) and diaphragmatic (or inferior)
- **4 borders:** superior, inferior, right and left.

# Anatomy of the Heart

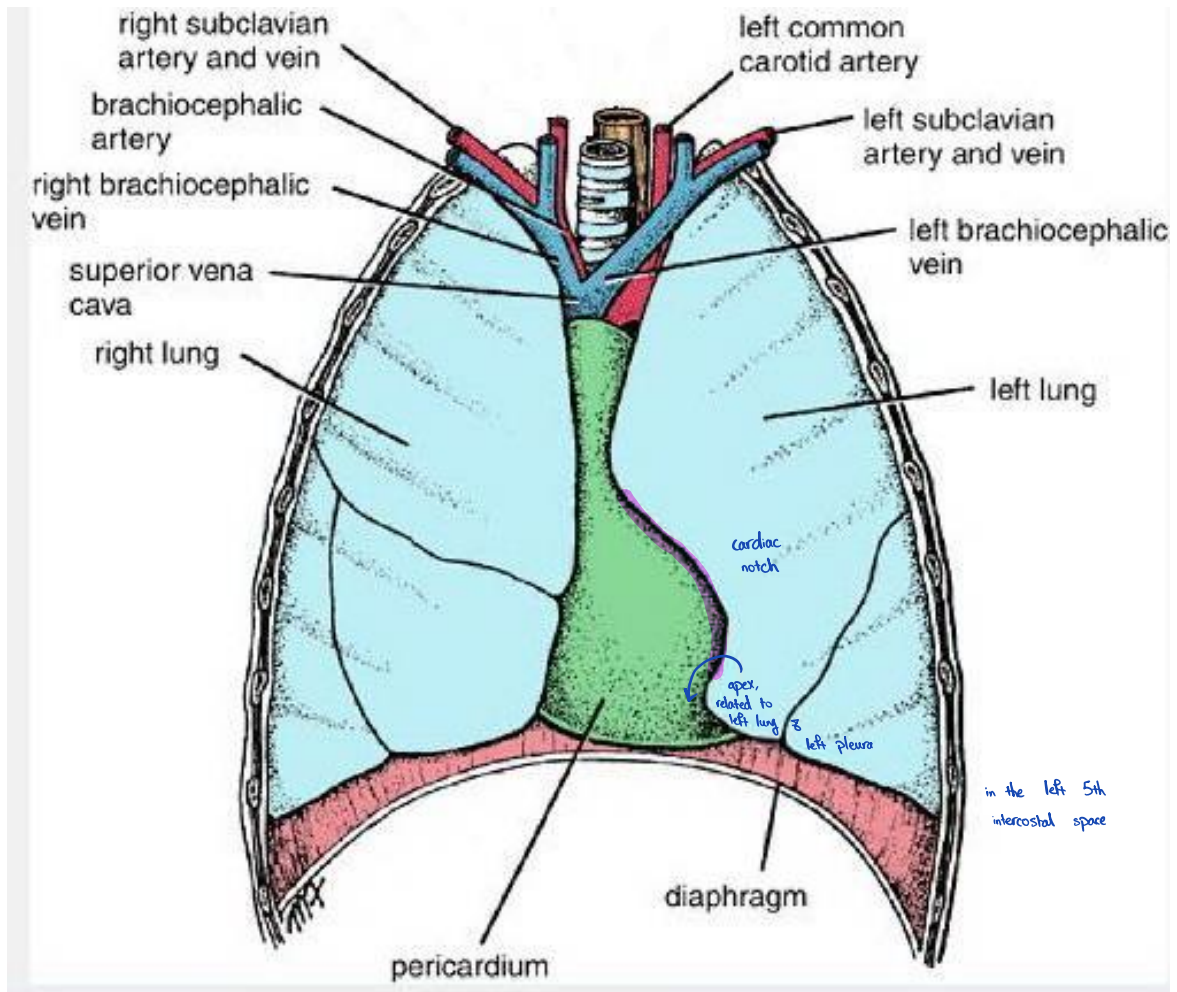
## Middle mediastinum



## ABDOMINAL VISCERA (ANTERIOR VIEW)

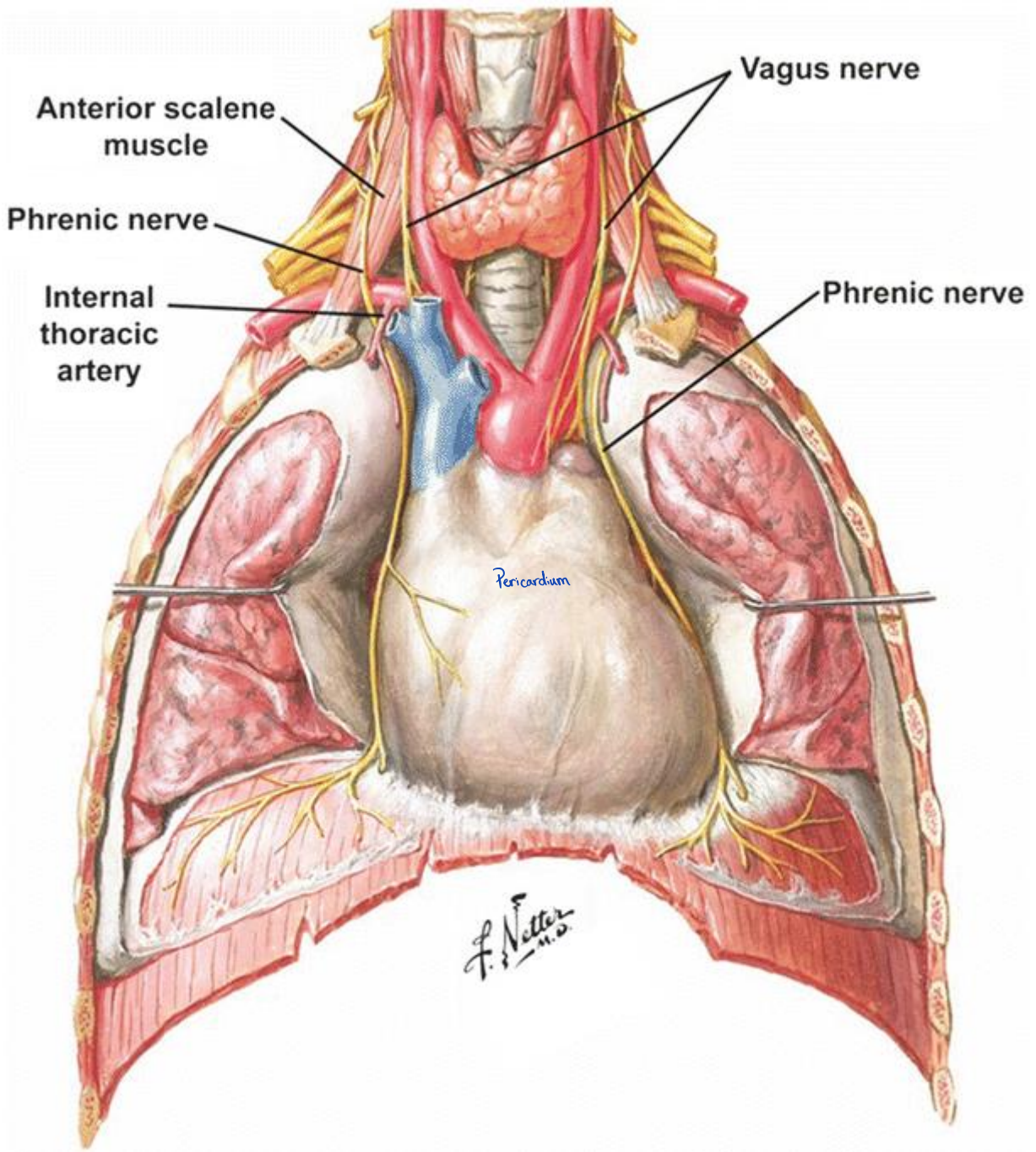


# Anatomy of the Heart



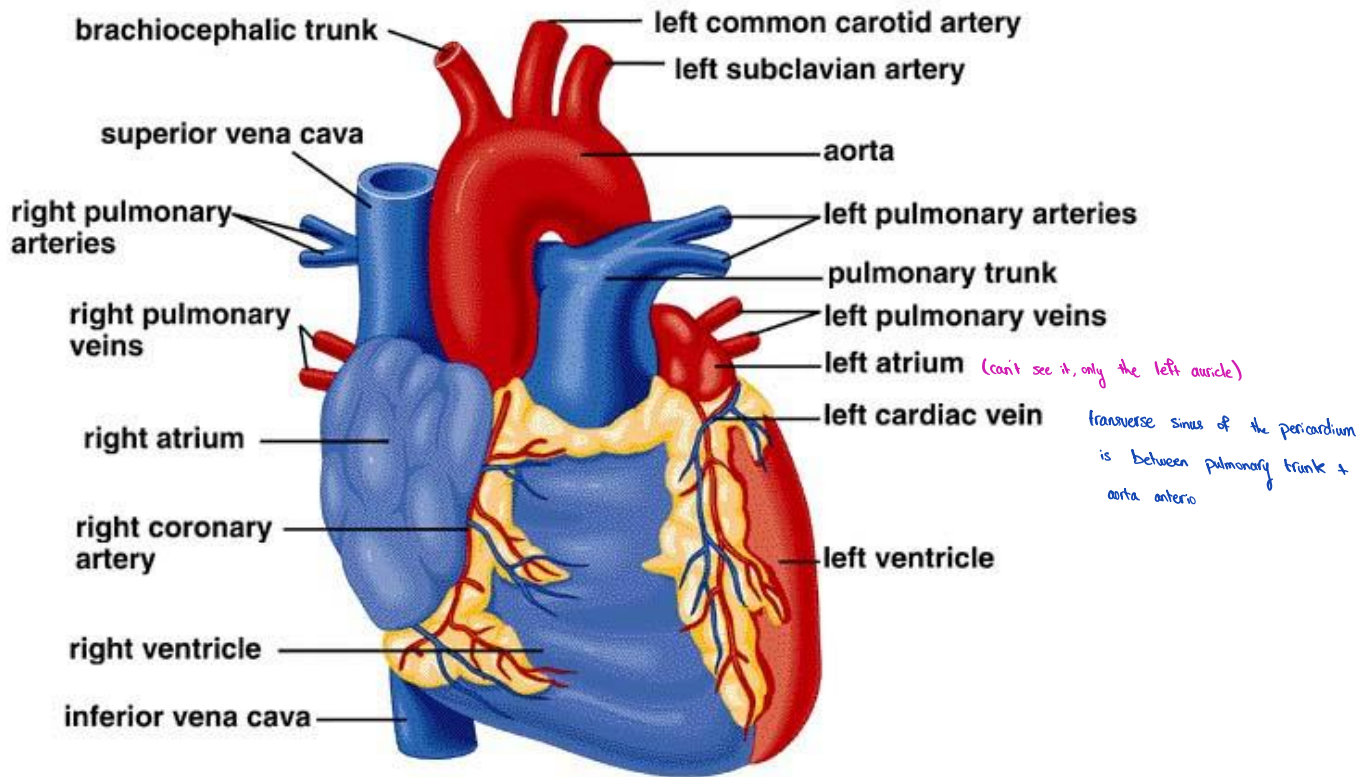
# Anatomy of the Heart

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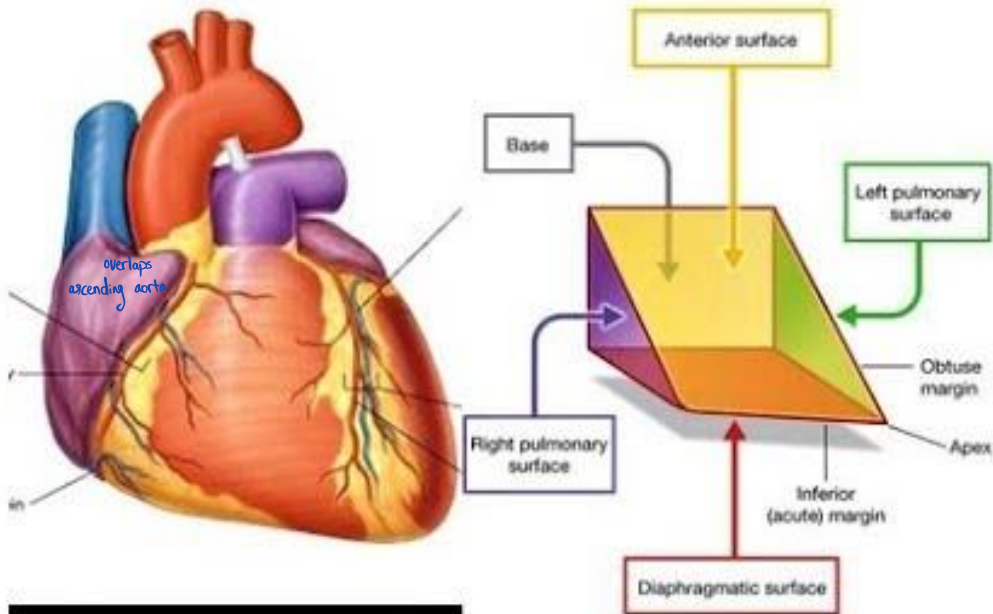


**Position of heart within the pericardium  
in the middle mediastinum**

# External Heart Anatomy



## Surfaces of heart



## Anatomy of the Heart

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### ★ External Features of the Heart :

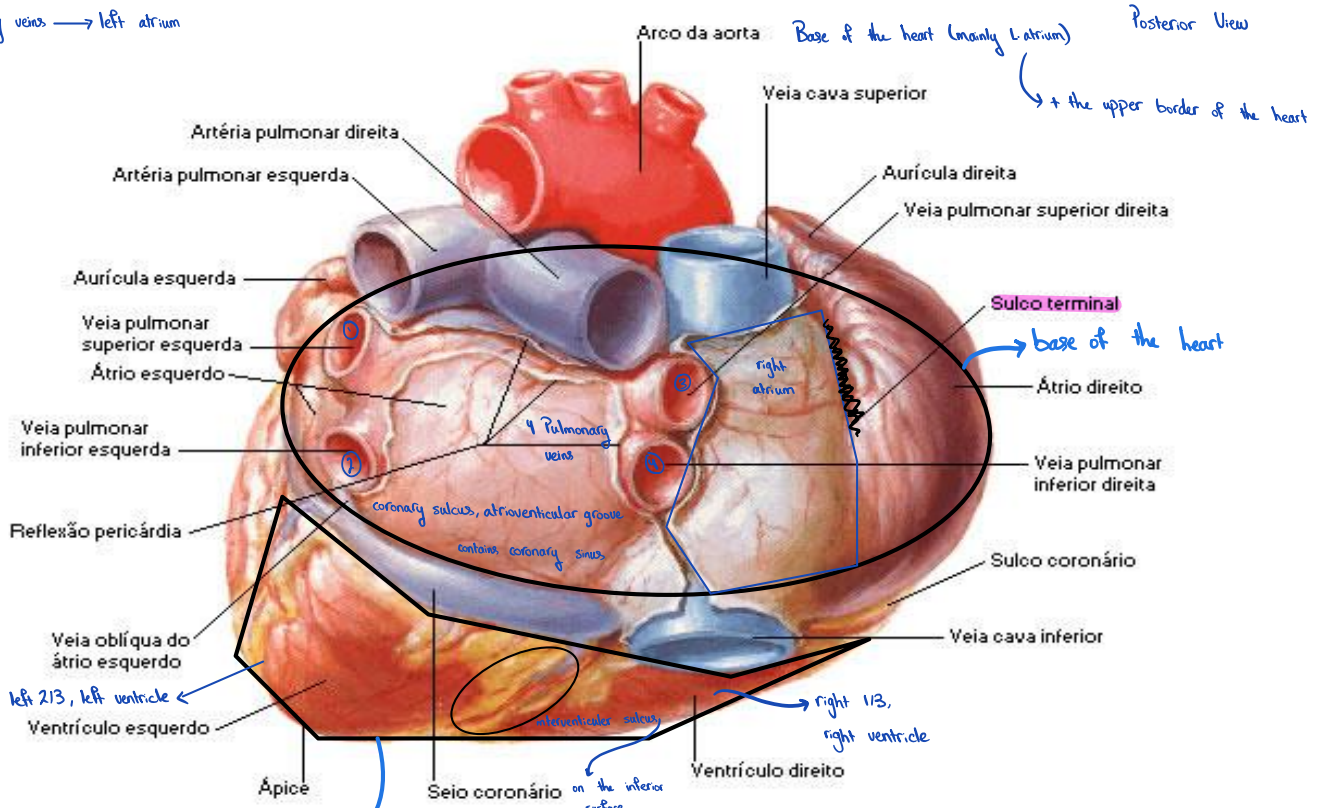
#### (A) Base and apex of the Heart:

##### 1- Base: (posterior surface)

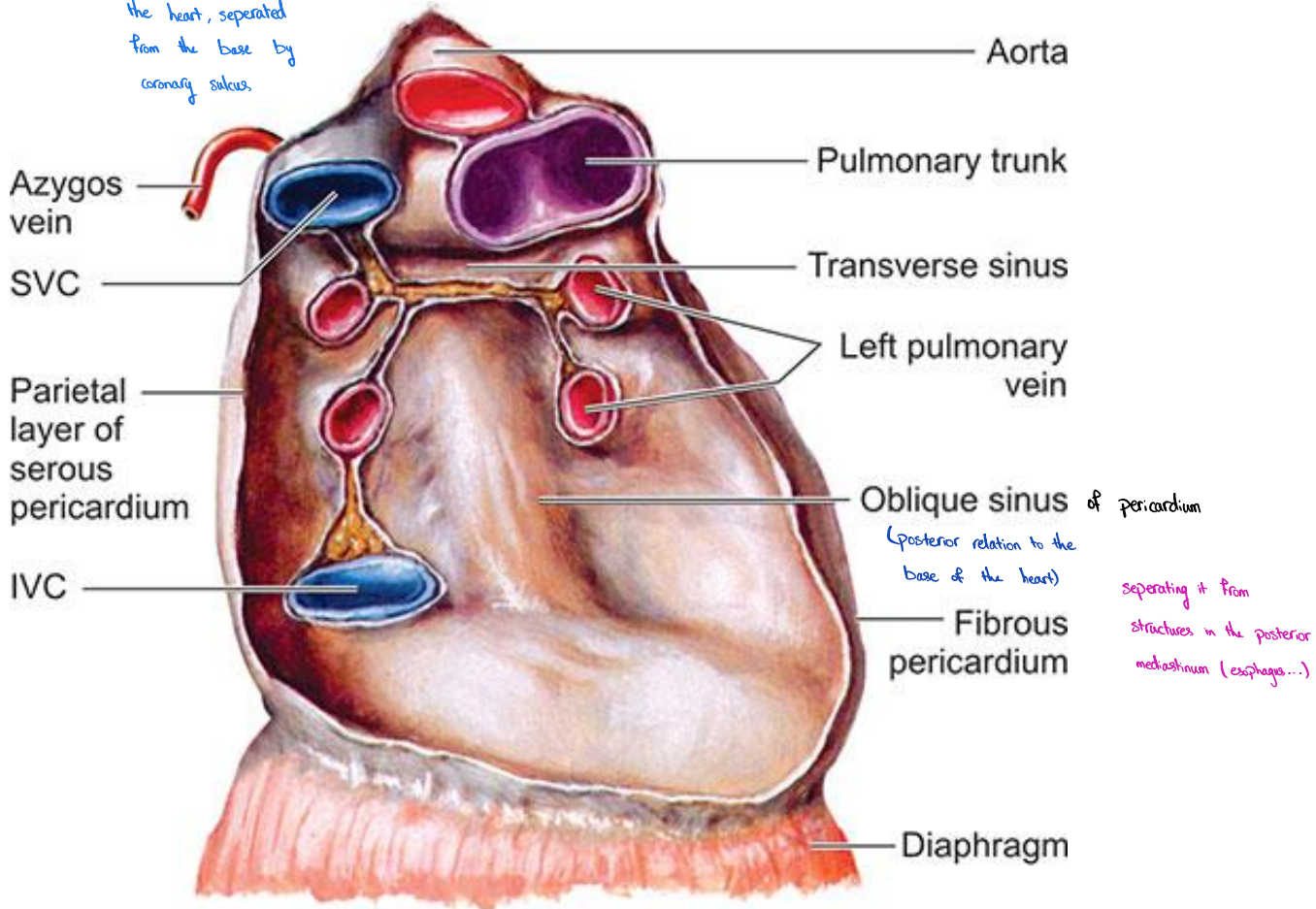
- It is the **posterior surface** of the heart.
- It is directed **backwards and to right**.
- It is **formed** of both atria (**mainly** by the **left** atrium).
- Right and left **pulmonary arteries** run along its **upper border**.  
branches of pulmonary trunk
- **Coronary sulcus** which contains coronary sinus and circumflex artery run along the **lower border**.
- The **SVC & the IVC** enter at the superior end & inferior end of the right atrium.
- It is related to the **middle 4 thoracic vertebrae** (5<sup>th</sup> to 8<sup>th</sup>), **separated** from them by:
  - a) Oblique sinus** of serous pericardium and posterior wall of **fibrous pericardium**.
  - b) The 2 left & 2 right pulmonary veins** enter at left & right sides of left atrium.
  - c) Oblique vein of left atrium**, in its way to open into coronary sinus.
  - d) Structures in the posterior mediastinum:** descending thoracic aorta, esophagus, azygos vein and thoracic duct.

# Anatomy of the Heart

Pulmonary veins → left atrium

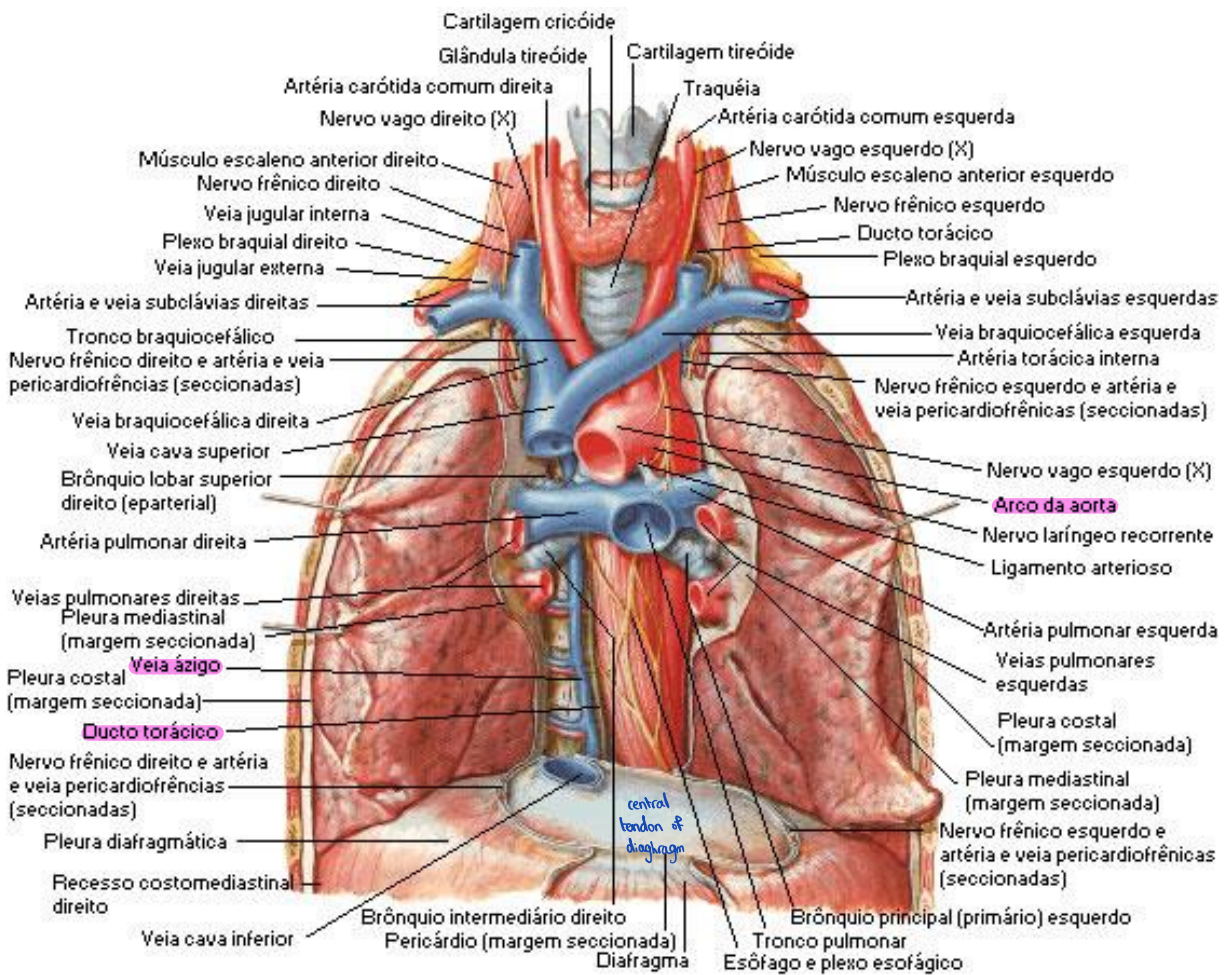
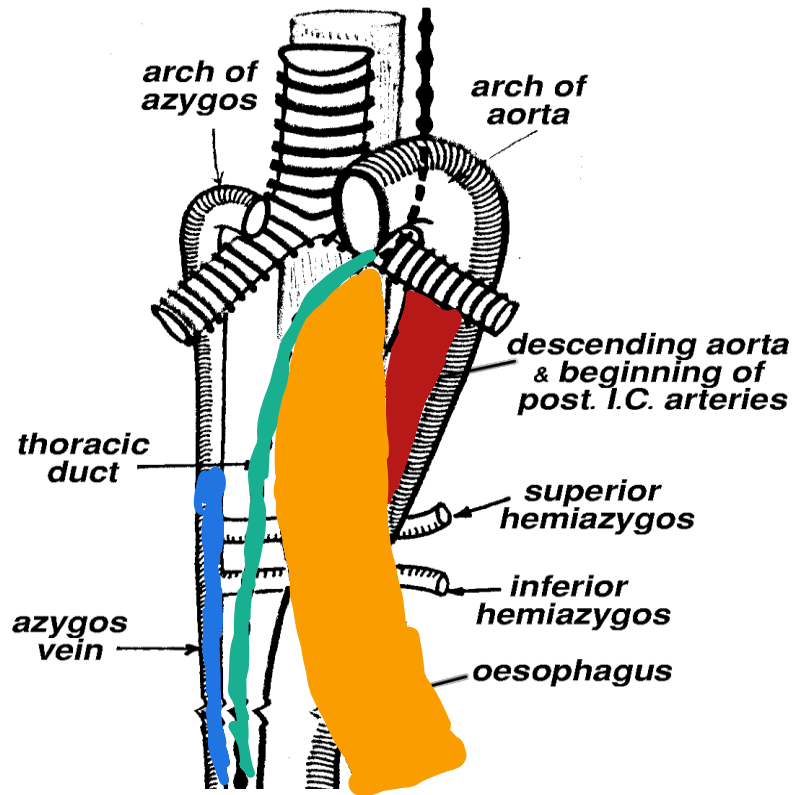


inferior surface of the heart, separated from the base by coronary sulcus



# Anatomy of the Heart

## Posterior mediastinum

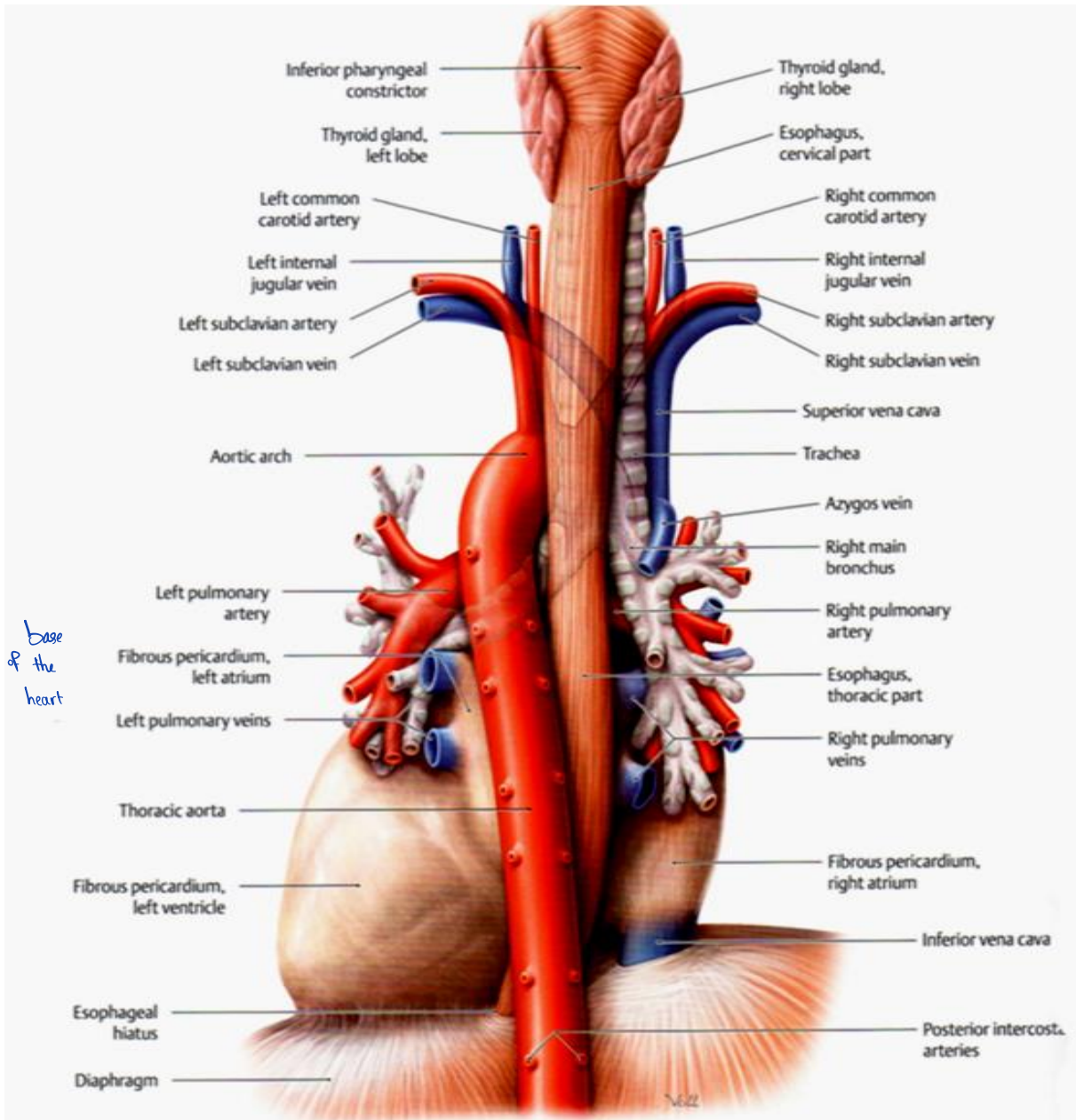




# Anatomy of the Heart

*Removed the vertebrae, posterior view*

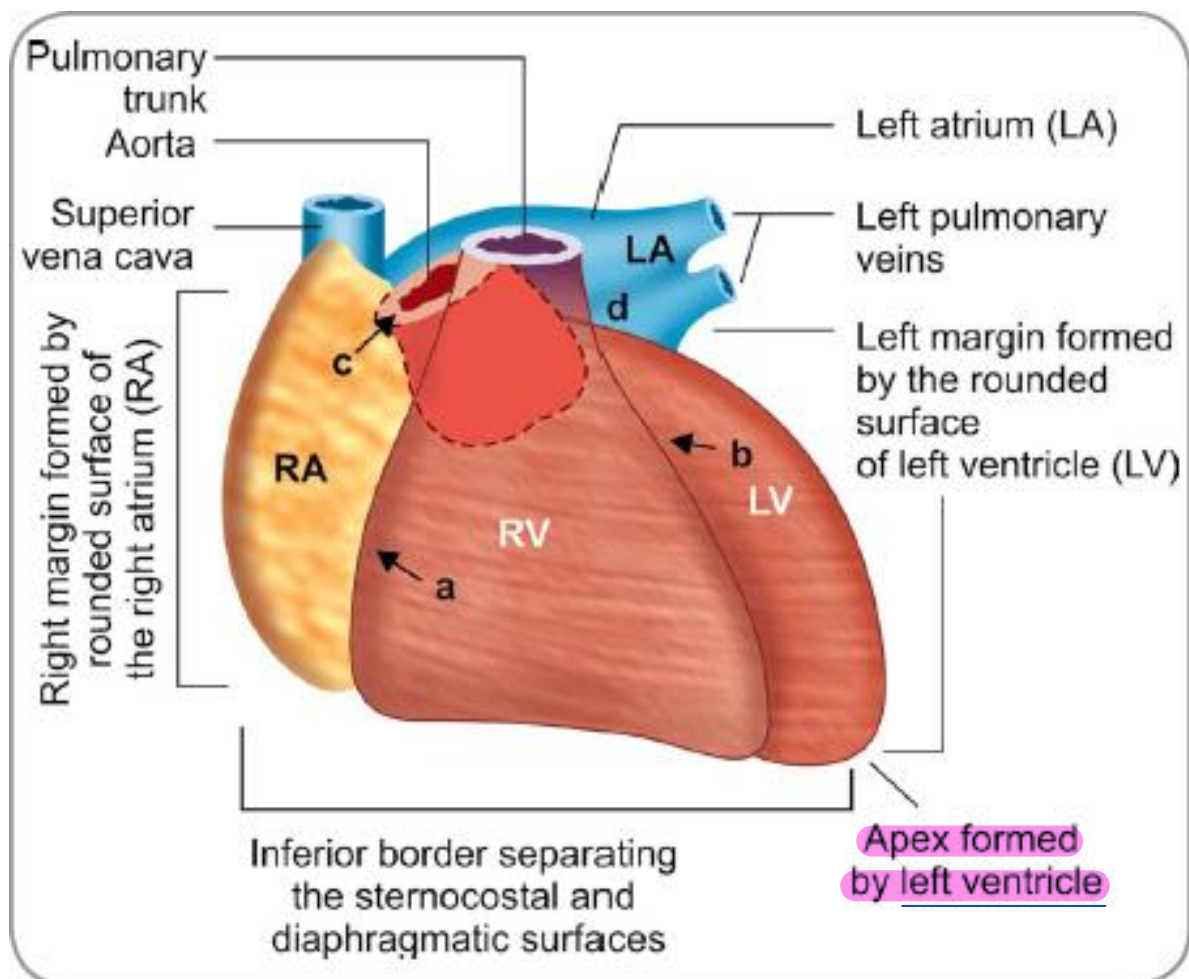
## Posterior mediastinum and base of the heart from behind



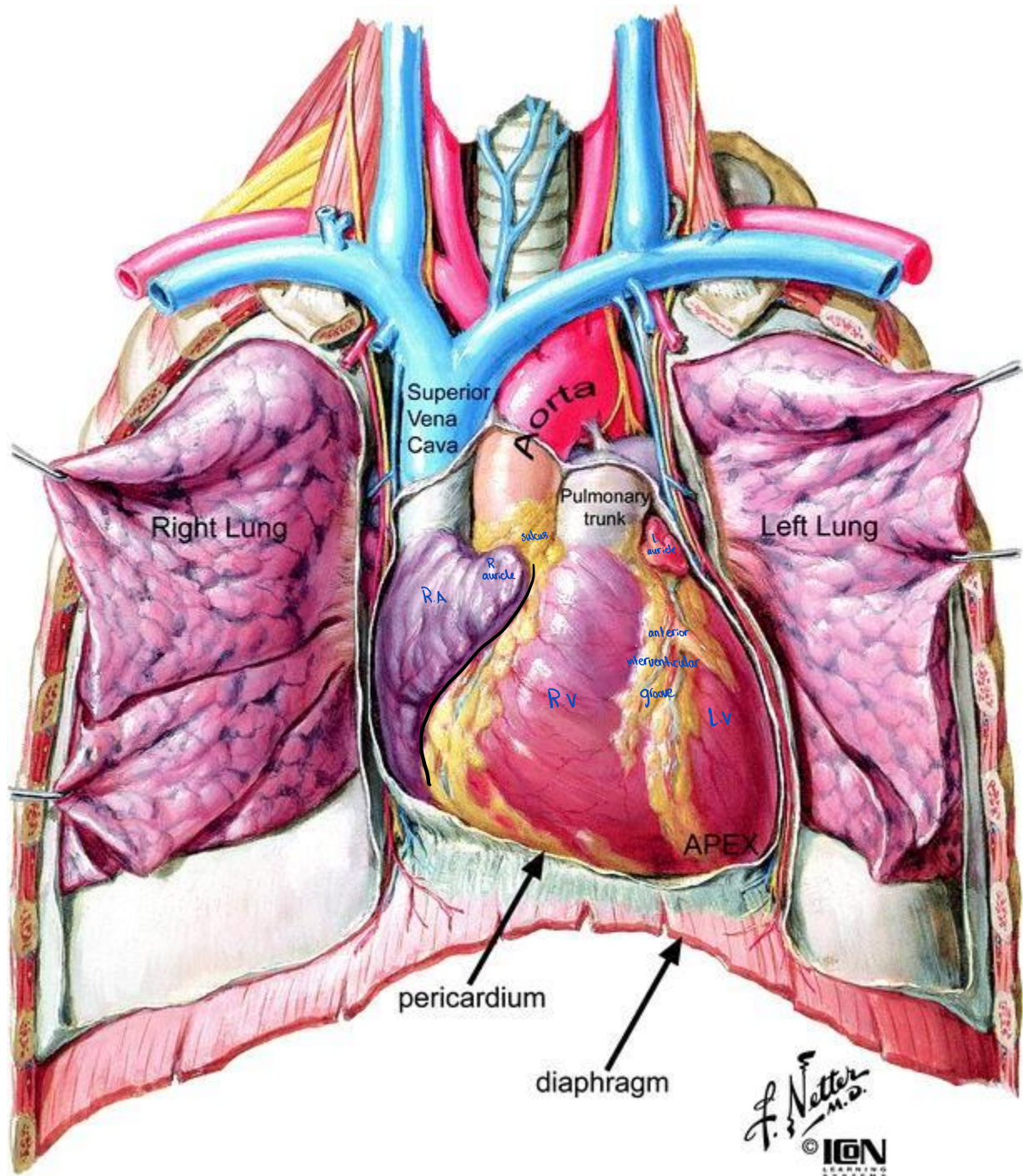
## Anatomy of the Heart

### 2- Apex:

- It is the **lower most** and **left most point** of the heart.
- It is **directed** downwards, forwards and to the left.
- It is **formed** only by the left ventricle.
- It **lies in** the left 5<sup>th</sup> intercostal space, just medial to the midclavicular line (about 3½ inches or 9 cm from the median plane).
- It is **related to** the left lung and pleura.



# Anatomy of the Heart



## (B) Surfaces of the Heart:

### 1- Sternocostal (anterior) surface:

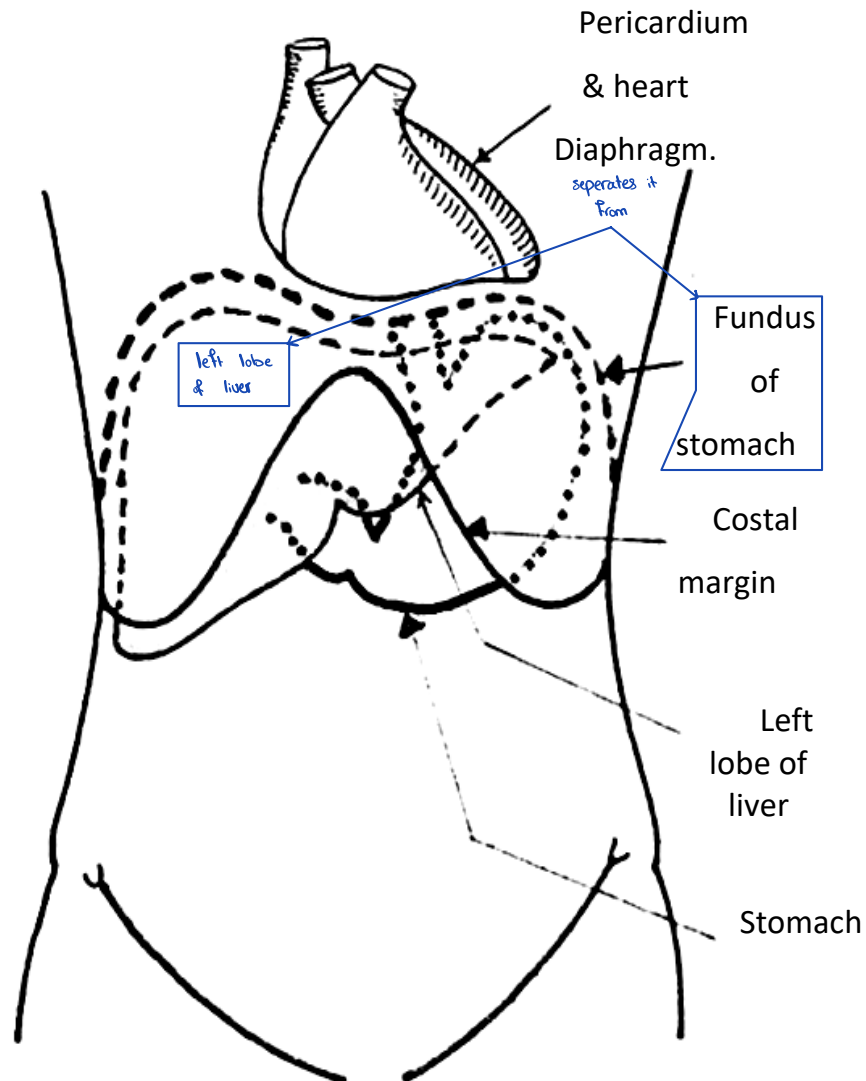
- It is **convex** bounded by the **4 borders** of the heart.
- This surface is formed **mainly by right ventricle**.

## Anatomy of the Heart

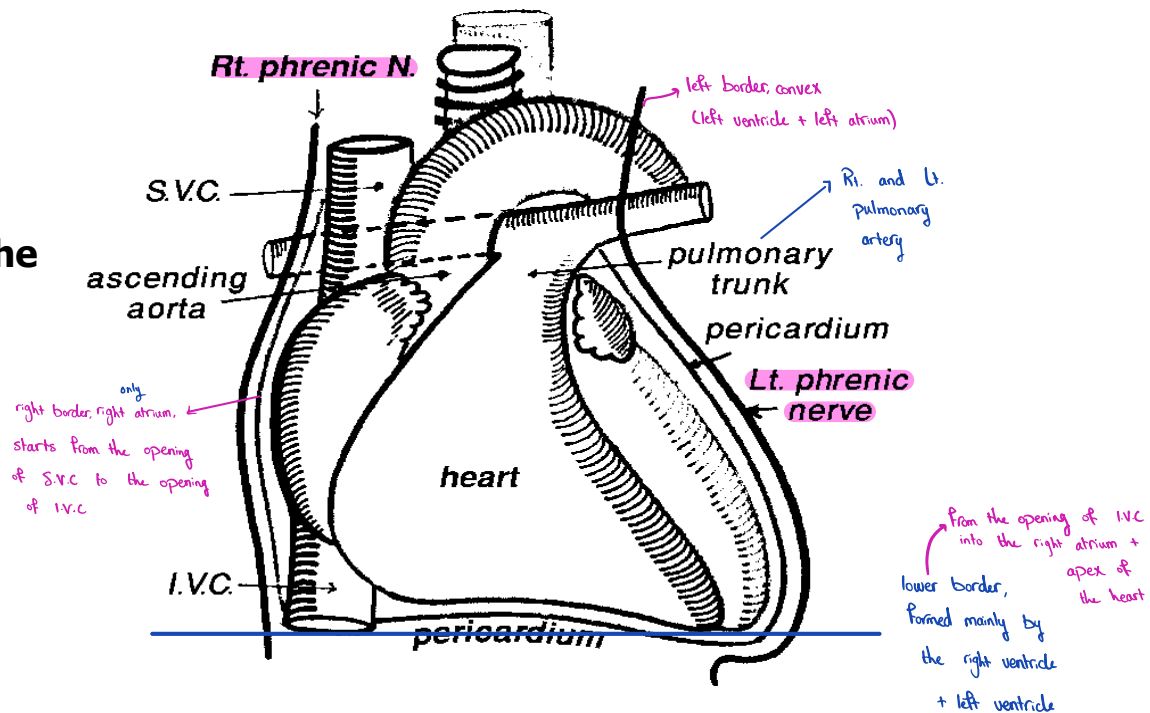
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- It is divided by **coronary (A-V) sulcus** into an **atrial part** (posterior & to the right) and a **ventricular part** (anterior & to the left).
  - The **atrial part** is formed of the right atrium & its auricle and left auricle (left atrium is hidden by pulmonary trunk & ascending aort).  
بنوته ه ورا ، الكور الأساس لل base
  - The **ventricular part**: Its **right 2/3** is formed of right ventricle and its **left 1/3** is formed of left ventricle.
- **This surface show 2 grooves:**
  - 1-**Atrioventricular** groove (**coronary** sulcus)
  - 2-**Anterior interventricular** groove
- It has the following relations, from **before backwards**:
  - a- Anterior thoracic wall**: sternum and 2-6 costal cartilages.
  - b- Anterior borders of the 2 pleurae and lungs**: separate it from the anterior thoracic wall **except** at the region of cardiac notch of the left lung (**bare area of pericardium**)
  - c- Contents of the anterior mediastinum.**
  - d- Pericardium.**
- **2- Diaphragmatic (inferior) surface:**
  - It rests on the central tendon of the **diaphragm**, and is **limited** posteriorly by the coronary sulcus.
  - Its left 2/3 is **formed** of left ventricle and its right 1/3 is formed of the right ventricle (the reverse of sternocostal surface).
  - The 2 ventricles are separated by the **inferior interventricular** groove.
  - This surface is related to base of **pericardium**, central tendon of **diaphragm** which separate the heart from underlying left lobe of **liver** and fundus of **stomach**.

## Relations of diaphragmatic surface



## Borders of the heart



## Anatomy of the Heart

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### (C) Borders of the Heart:

#### 1- The upper border:

- It is formed by 2 atria (**mainly by** the left atrium).
- It is **hidden anteriorly** by the roots of the ascending aorta and pulmonary trunk.
- The right and left **pulmonary arteries run along it**.

#### 2- The lower border:

- It is **formed by 2 ventricles: mainly** by the **right** ventricle and small part near the apex by the left ventricle.
- It **extends** from the opening of the **I.V.C.** into the right atrium to the **apex** of the heart.

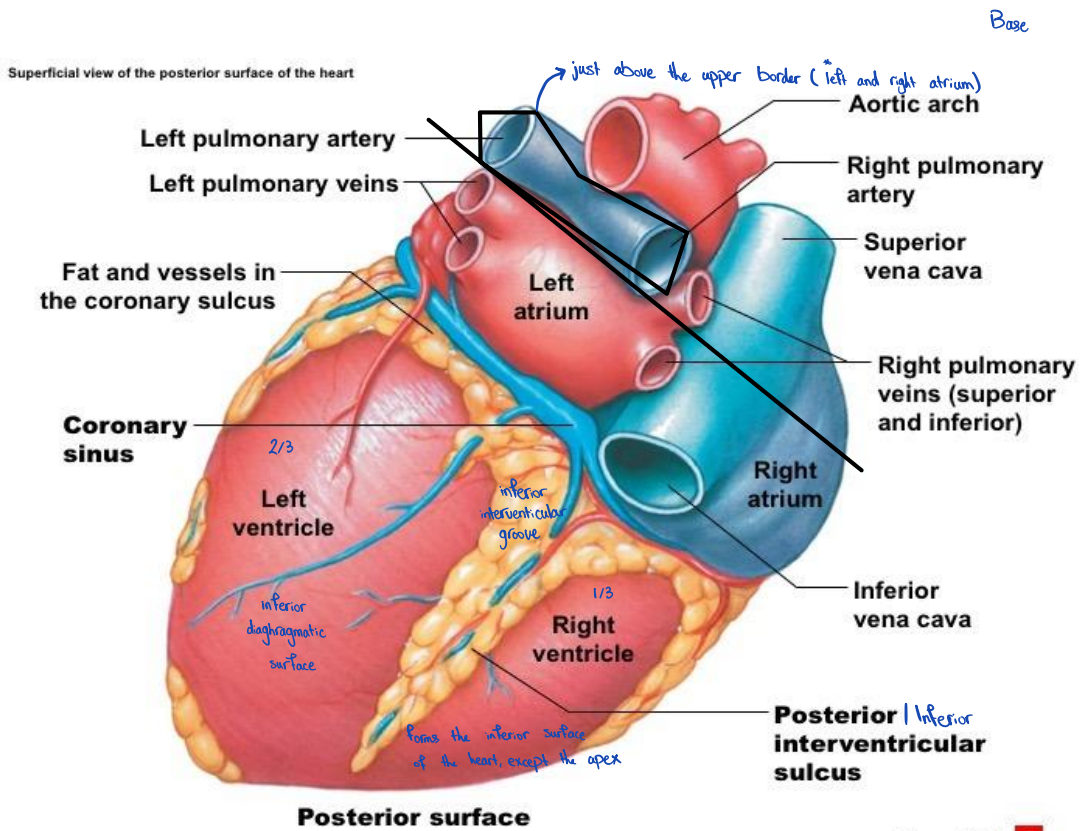
#### 3- Left border:

- It is slightly **convex**, and is **formed** in its **lower main part** by the **left ventricle** and in its **upper smaller part** by the **left auricle**.
- It is **related to** the pericardium, left phrenic nerve and pericardiaco-phrenic vessels which separate it from the left lung and pleura.

#### 4- Right border:

- It is slightly **convex**, and is **formed by the right atrium only**.
- It **extends** from the opening of the **S.V.C.** above to the opening of the **I.V.C.** below.
- It is **related** to the pericardium, right phrenic nerve and pericardiaco-phrenic vessels which separate it from the right lung and pleura.

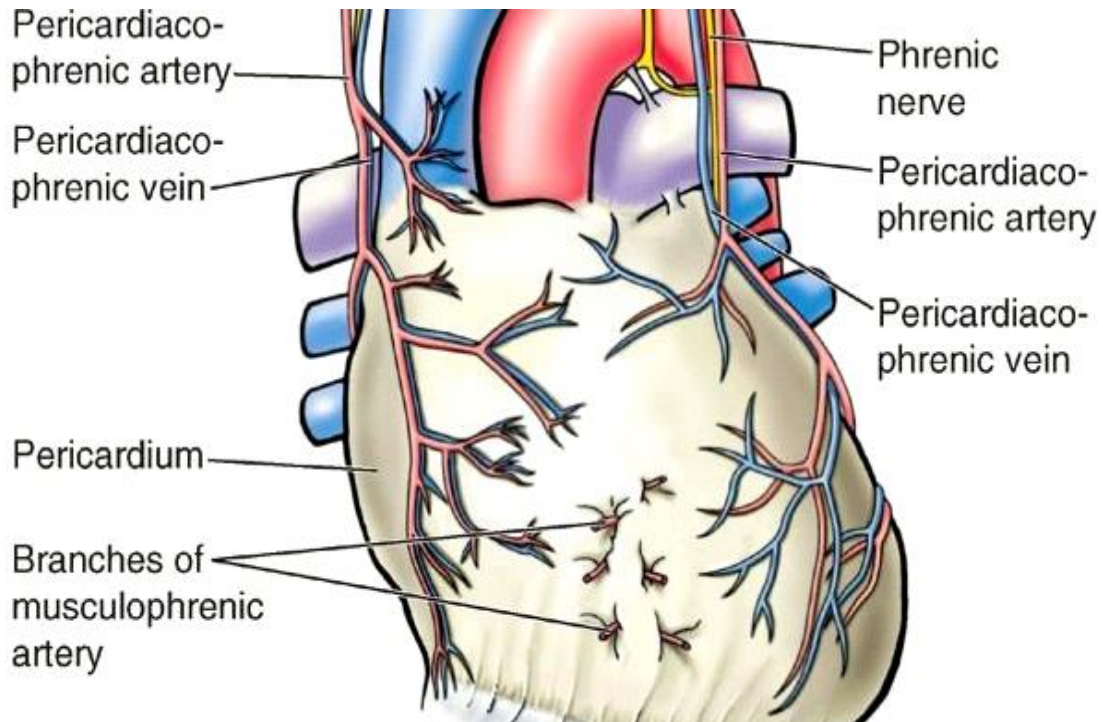
# Anatomy of the Heart



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Figure 19.4 2

separated by the pericardium  
from the central tendon of  
diaphragm



## **Anatomy of the Heart**

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★ **Grooves or Sulci:** The heart has the following grooves:

**1- Atrio-ventricular groove: (coronary groove)**

- It forms a circle around the heart separating the two atria (posterior and to right) from two ventricles (anterior and to left).

**2- The anterior and inferior interventricular grooves:**

- It separates the two ventricles from anterior and inferior surfaces respectively.



## Chambers of the heart

### I) The atria

- ★ **Thickness** of the atrial wall is about **3 mm**.
- ★ The 2 atria are separated by the **interatrial septum**.
- ★ Each atrium has an **auricle** projecting up and forwards.
- ★ **Different between right and left atria :**

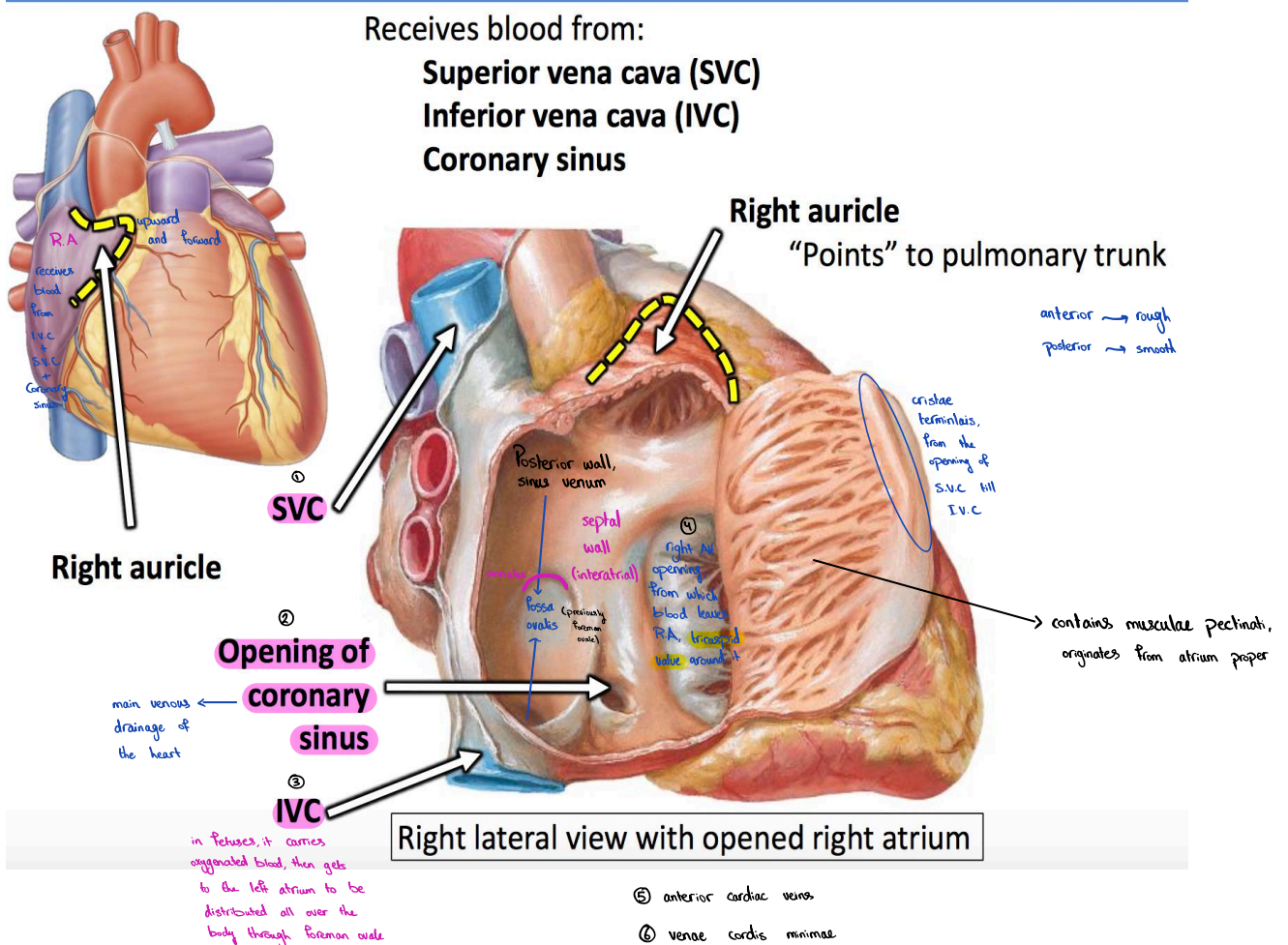
	1. Right atrium	2. Left atrium
Type of blood	<ul style="list-style-type: none"> <li>• It receives <b>non-oxygenated</b> blood from all parts of the body through IVC , SVC &amp; coronary sinus .</li> </ul>	<ul style="list-style-type: none"> <li>• It receives <b>oxygenated</b> blood from the lungs through <b>4 pulmonary veins</b>.</li> </ul>
Exit of blood	<ul style="list-style-type: none"> <li>• Through <b>tricuspid</b> valve which has <b>3 cusps</b>, admits <b>3 fingers</b> and leads to right ventricle.</li> </ul>	<ul style="list-style-type: none"> <li>• Through <b>mitral</b> valve which has <b>2 cusps</b>, admits <b>2 fingers</b> and leads to left ventricle.</li> </ul>
Site	<ul style="list-style-type: none"> <li>• It lies <b>anterior and to the right</b> to the left atrium.</li> </ul>	<ul style="list-style-type: none"> <li>• It lies <b>posterior and to the left</b> to the right atrium.</li> </ul>
	<ul style="list-style-type: none"> <li>• It forms <b>alone the right border</b> of the heart &amp; <b>small part</b> of the base and anterior surface.</li> </ul>	<ul style="list-style-type: none"> <li>• Forms <b>main</b> part of <b>upper border</b> &amp; main part of the <b>base</b>.</li> </ul>
Relations	<ul style="list-style-type: none"> <li>• <b>Anteriorly</b> and on the <b>right</b>: the right lung, pleura, pericardium, right phrenic nerve &amp; pericardio-phrenic artery.</li> <li>• <b>Posteriorly</b>: the left atrium and 2 right pulmonary veins.</li> <li>• <b>Left side</b>: it is related to the ascending aorta and pulmonary trunk.</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Anteriorly</b>: The <b>transverse sinus</b> of pericardium <b>separates</b> the left atrium from ascending aorta and pulmonary trunk.</li> <li>• <b>Posteriorly</b>: The <b>oblique sinus</b> of pericardium <b>separates</b> the left atrium structures in posterior mediastinum.</li> <li>• <b>N.B: The left atrium lies between the transverse and oblique sinuses of pericardium.</b></li> </ul>

## Anatomy of the Heart

<b>Auricle</b>	<ul style="list-style-type: none"> <li>• Its auricle overlaps the right aspect of ascending aorta.</li> </ul>	<ul style="list-style-type: none"> <li>• Its auricle overlaps left aspect of root of pulmonary trunk.</li> </ul>
<b>Cavity</b>	<ol style="list-style-type: none"> <li><b>1. The crista terminalis:</b> <ul style="list-style-type: none"> <li>• A thick muscular vertical ridge extends from the opening of SVC to the opening of IVC and marked on the outer surface by <b>sulcus terminalis</b>.</li> <li>• The crista terminalis divides the right atrium to <b>anterior and posterior</b> walls.</li> </ul> </li> <li><b>2. Anterior wall: (Atrium proper)</b> <ul style="list-style-type: none"> <li>• It forms the right auricle, <b>rough</b> due to the presence of <b>musculi pectinati</b> (muscular ridges <b>extend</b> from <b>crista terminalis</b> into the auricle to <b>prevents over distention</b> of the right atrium during diastole).</li> <li>• It is derived from the <b>foetal atrium</b>.</li> </ul> </li> <li><b>3. Posterior wall: (sinus venerum)</b> <ul style="list-style-type: none"> <li>• It is <b>smooth</b> with S.V.C., I.V.C. and the coronary sinus <b>open in this wall</b>.</li> <li>• It is derived from the <b>absorbed</b> right horn of <b>sinus venosus</b> of the embryo.</li> </ul> </li> <li><b>4. The septal wall: (The interatrial septum)</b> presents <ul style="list-style-type: none"> <li>• <b>The fossa ovalis:</b> in the lower part of the septum <b>above</b> the orifice of <b>IVC</b>. It is the remains of <b>foramen ovale</b> of the embryo.</li> <li>• <b>The annulus ovalis:</b> a <b>curved ridge</b> forms the anterior, posterior and superior margins of the <b>fossa ovalis</b>. It is the free lower border of <b>septum secundum</b> of the embryo.</li> </ul> </li> </ol>	<ul style="list-style-type: none"> <li>• <b>Smooth</b>, except its auricle which contains few musculi pectinati.</li> <li>• The <b>interatrial septum is smooth</b></li> </ul>

# Anatomy of the Heart

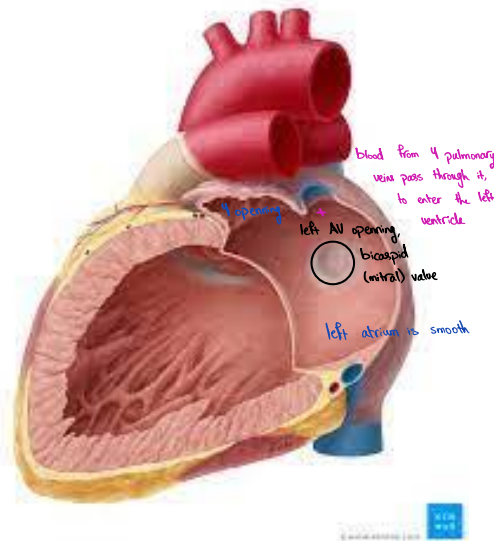
<b>Orifices</b>	<ol style="list-style-type: none"> <li><b>S.V.C. orifice:</b> has <b>no valve</b>, it lies in <b>superior</b> part of posterior wall.</li> <li><b>I.V.C. orifice:</b> opens in the <b>inferior</b> part of posterior wall, it has a small remnant embryological <b>valves</b> directs blood to foramen ovale to the left atrium.</li> <li><b>Coronary sinus orifice:</b> on the <b>left side</b> of the opening of I.V.C. <b>between</b> it and the tricuspid orifice. It is guarded by <b>valve</b>.</li> <li><b>Right atrioventricular opening</b> present in the <b>inferior part</b> of right atrium. It is guarded by the <b>tricuspid valve</b>.</li> <li><b>Orifices of venae cordis minimae and anterior cardiac veins.</b></li> </ol>	<ol style="list-style-type: none"> <li><b>Four pulmonary veins:</b> two from each side open into <b>upper</b> part of <b>posterior</b> surface.</li> <li><b>Left atrioventricular opening:</b> presents in the <b>inferior</b> part of left atrium. It is <b>guarded</b> by the the mitral valve.</li> </ol>
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\* left atrium → posterior and to the left

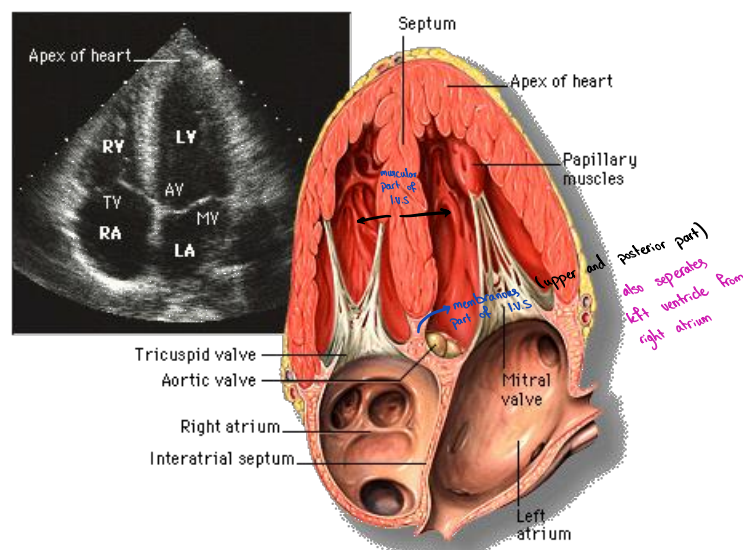
\* right atrium → anterior and to the right

# Anatomy of the Heart



## II) The ventricles

- ★ The two ventricles are separated from each other by the **interventricular septum** which is marked **on the surface** to the anterior and inferior **interventricular grooves**.
- ★ The **interventricular septum**: convex anterior and to the right and concave posterior and to the left. It's derived from 2 sources in embryo that is why it is formed of 2 parts:
  - 1. Membranous part**: thin, forms the **upper posterior** part of the septum. It **separates** the left ventricle from both right ventricle and right atrium.
  - 2. Muscular part**: thick, larger **lower part**. It **separates** the left ventricle from the right ventricle.



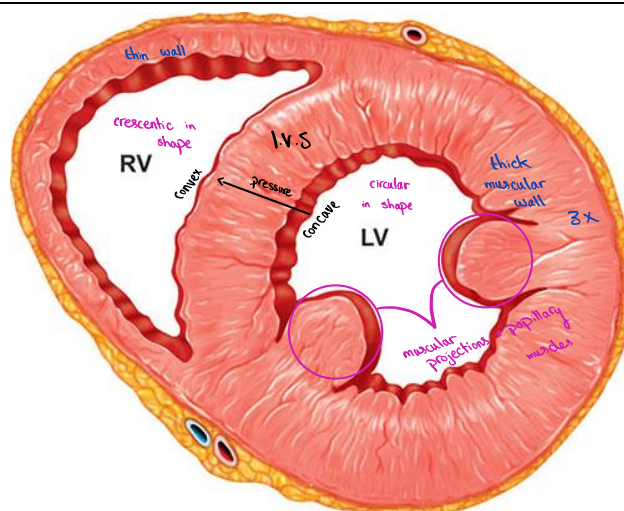
# Anatomy of the Heart

## ★ Different between right and left ventricles:

	1.Right ventricle	2.left ventricles
position	<ul style="list-style-type: none"> <li>Anterior and to the right of the left ventricle.</li> </ul>	<ul style="list-style-type: none"> <li>Posterior and to the left of the right ventricle.</li> </ul>
General features	<ul style="list-style-type: none"> <li>It has 3 walls:               <ol style="list-style-type: none"> <li><b>Anterior wall</b> forms main part of <b>sterno-costal</b> surface.</li> <li><b>Inferior wall</b> forms right 1/3 of <b>diaphragmatic</b> surface.</li> <li><b>Left (septal) wall</b> formed by the interventricular septum which is <b>convex</b> toward its cavity → this cavity appears <b>creseptic in cross section</b>.</li> </ol> </li> <li>It forms the main part of <b>lower border</b> of the heart except at apex.</li> </ul>	<ul style="list-style-type: none"> <li>It has 3 walls:               <ol style="list-style-type: none"> <li><b>Anterior wall</b> forms small left part of <b>sternocostal</b> surface.</li> <li><b>Inferior wall</b> forms left 2/3 of <b>diaphragmatic</b> surface.</li> <li><b>Right (septal) wall concave</b> towards its cavity → this cavity appears <b>circular in cross section</b>.</li> </ol> </li> <li>It <b>forms</b> most of <b>left border</b> &amp; part of lower border at the <b>apex</b> .</li> </ul>
Thickness	<ul style="list-style-type: none"> <li>9 mm</li> </ul>	<ul style="list-style-type: none"> <li>27 mm  i.e. 3 times thicker since it pushes blood in all parts of body.</li> </ul>
Cavity	<b>I) Inflow rough lower part</b> shows the following features :	
	<b>1.Trabeculae carnae</b> ( thick muscular ridges)	
	<ul style="list-style-type: none"> <li>Few and coarse.</li> </ul>	<ul style="list-style-type: none"> <li>Multiple and fine.</li> </ul>
	<b>2. Moderator band (Septomarginal trabecula)</b>	
	<ul style="list-style-type: none"> <li>Is thick muscle band between the IV septum and to the base of the anterior papillary muscle.</li> <li>It prevents over distention of the right ventricle</li> <li>It transmit the right branch of AV bundle .</li> </ul>	<ul style="list-style-type: none"> <li>Absent.</li> </ul>
<b>3.Papillary muscles:</b>		

# Anatomy of the Heart

	<ul style="list-style-type: none"> <li>• Are <b>conical</b> muscular projections.</li> <li>• The <b>apex</b> of each muscle is attached to <b>cordae tendinae</b> which connect them to the <b>free border</b> &amp; <b>ventricular surfaces</b> of A-V cusps.</li> </ul>		
	<table border="1"> <tr> <td> <ul style="list-style-type: none"> <li>• <b>3 papillary muscles:</b>  <b>a-Anterior</b> papillary muscle :(largest) attached to <b>anterior</b> wall.  <b>b- Posterior</b> papillary muscle: (smallest) attached to <b>inferior</b> wall.  <b>c- Septal</b> papillary muscles: <b>numerous</b> small projections which arise from the interventricular septum.</li> <li>• <b>Small</b> in size</li> </ul> </td> <td> <ul style="list-style-type: none"> <li>• 2 papillary muscles :  <b>Anterior &amp; posterior</b> attached to the anterior and inferior walls respectively &amp; their chordae tendinae are attached to <b>both cusps</b> of mitral valve</li> <li>• <b>Larger</b> in size.</li> </ul> </td> </tr> </table>	<ul style="list-style-type: none"> <li>• <b>3 papillary muscles:</b>  <b>a-Anterior</b> papillary muscle :(largest) attached to <b>anterior</b> wall.  <b>b- Posterior</b> papillary muscle: (smallest) attached to <b>inferior</b> wall.  <b>c- Septal</b> papillary muscles: <b>numerous</b> small projections which arise from the interventricular septum.</li> <li>• <b>Small</b> in size</li> </ul>	<ul style="list-style-type: none"> <li>• 2 papillary muscles :  <b>Anterior &amp; posterior</b> attached to the anterior and inferior walls respectively &amp; their chordae tendinae are attached to <b>both cusps</b> of mitral valve</li> <li>• <b>Larger</b> in size.</li> </ul>
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	<b>II) Outflow smooth upper part</b>		
	<table border="1"> <tr> <td> <ul style="list-style-type: none"> <li>• It lies just below pulmonary orifice and called <b>Infundibulum</b> (funnel shape) or conus arteriosus.</li> </ul> </td> <td> <ul style="list-style-type: none"> <li>• It lies just below aortic orifice and called <b>aortic vestibule</b>.</li> </ul> </td> </tr> </table>	<ul style="list-style-type: none"> <li>• It lies just below pulmonary orifice and called <b>Infundibulum</b> (funnel shape) or conus arteriosus.</li> </ul>	<ul style="list-style-type: none"> <li>• It lies just below aortic orifice and called <b>aortic vestibule</b>.</li> </ul>
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<b>Orifices</b>	<table border="1"> <tr> <td> <ul style="list-style-type: none"> <li>• Right atrio-ventricular (<b>tricuspid</b>) <b>orifices</b> is inlet orifice. It is guarded by the <b>tricuspid valve</b>.</li> <li>• <b>Pulmonary orifices</b> is the outlet orifice. It is guarded by the <b>pulmonary valve</b>.</li> </ul> </td> <td> <ul style="list-style-type: none"> <li>• Left atrio-ventricular (<b>mitral</b>) orifices is the inlet orifices. It is guarded by the <b>mitral valve</b>.</li> <li>• <b>Aortic</b> orifice is the outlet orifice. It is guarded by the <b>aortic valve</b>.</li> <li>• <b>Venae cordis minimi:</b> open by several small orifices</li> </ul> </td> </tr> </table>	<ul style="list-style-type: none"> <li>• Right atrio-ventricular (<b>tricuspid</b>) <b>orifices</b> is inlet orifice. It is guarded by the <b>tricuspid valve</b>.</li> <li>• <b>Pulmonary orifices</b> is the outlet orifice. It is guarded by the <b>pulmonary valve</b>.</li> </ul>	<ul style="list-style-type: none"> <li>• Left atrio-ventricular (<b>mitral</b>) orifices is the inlet orifices. It is guarded by the <b>mitral valve</b>.</li> <li>• <b>Aortic</b> orifice is the outlet orifice. It is guarded by the <b>aortic valve</b>.</li> <li>• <b>Venae cordis minimi:</b> open by several small orifices</li> </ul>
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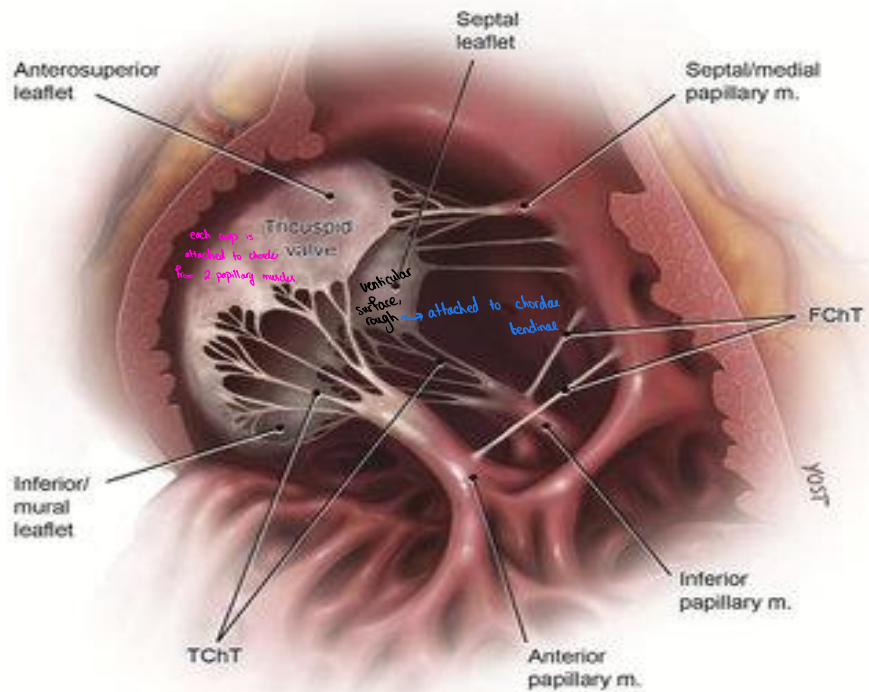
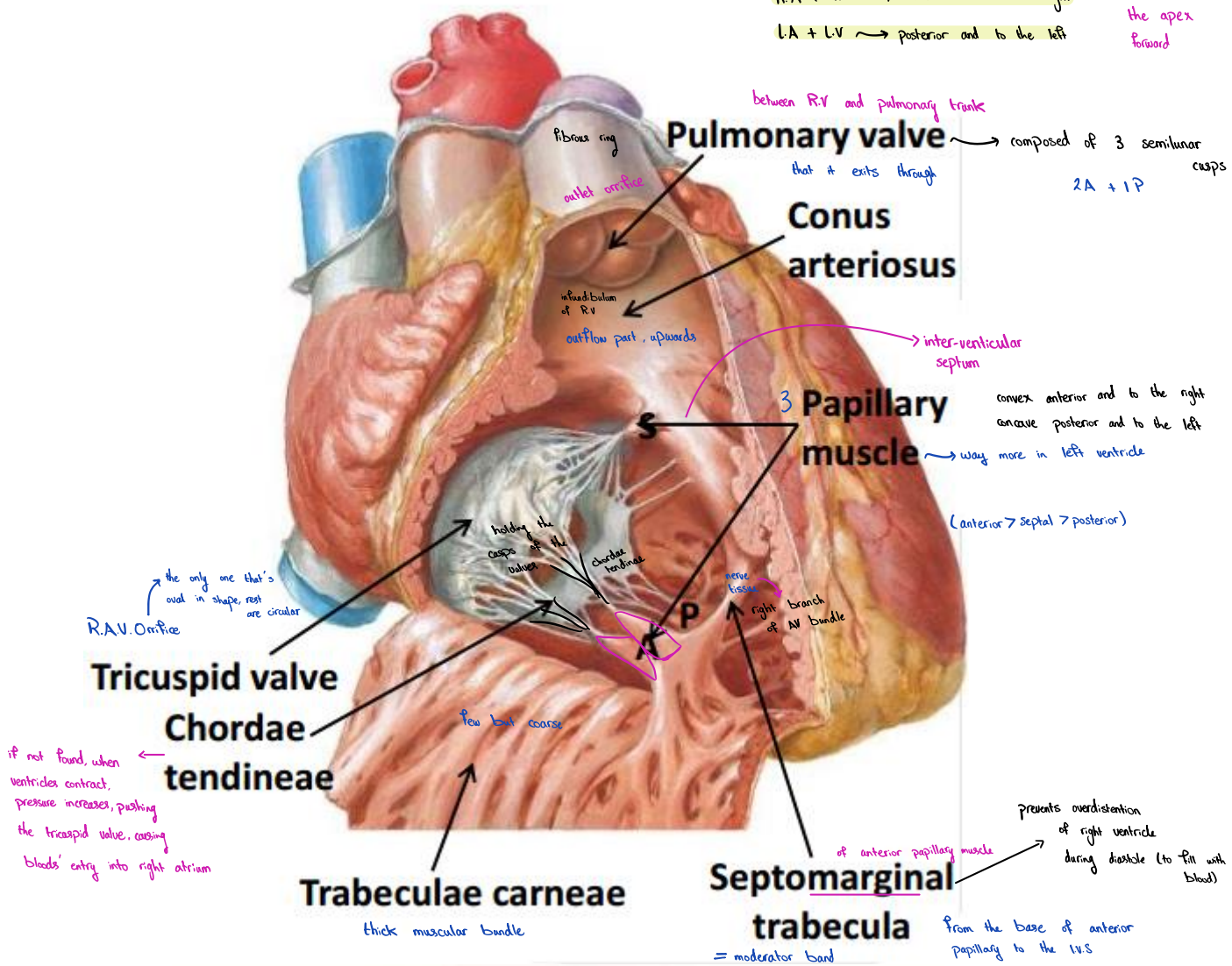


# Anatomy of the Heart

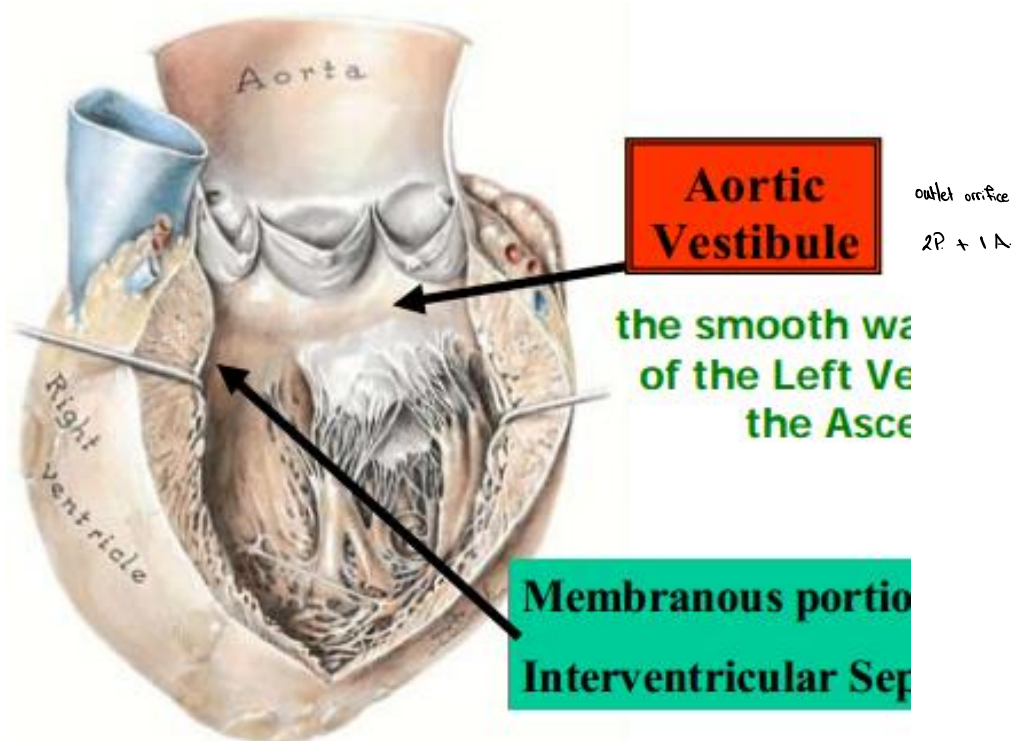
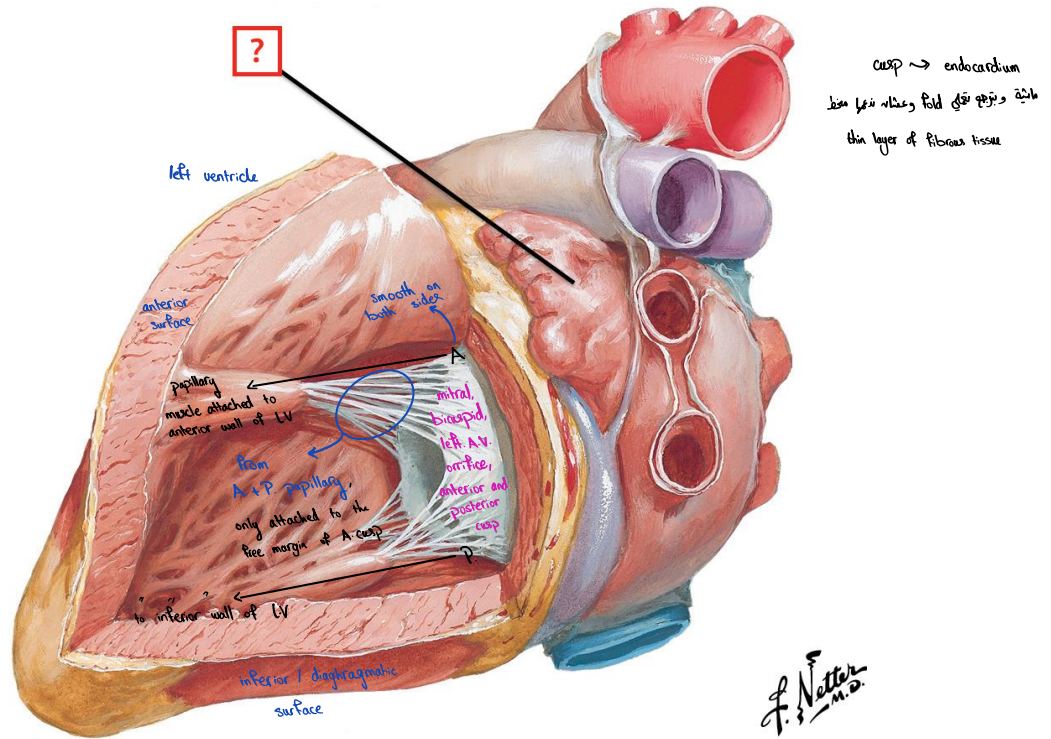
due to the rotation of the apex forward

RA + R.V → anterior and to the right

LA + LV → posterior and to the left



# Anatomy of the Heart

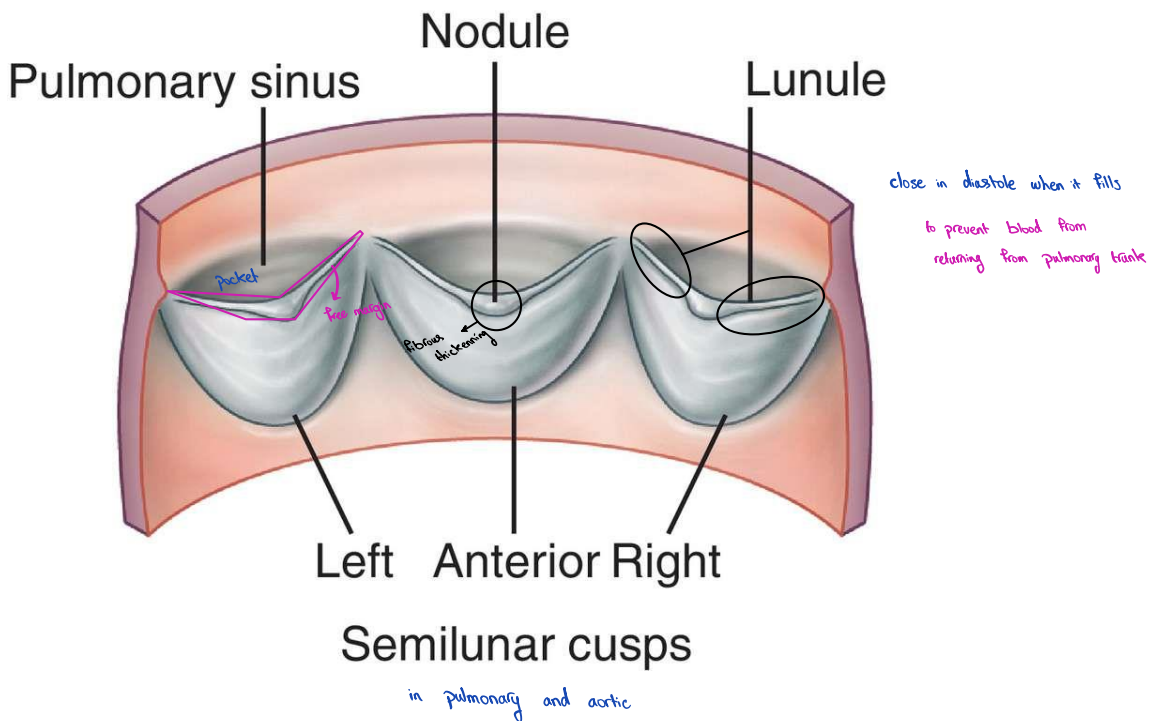
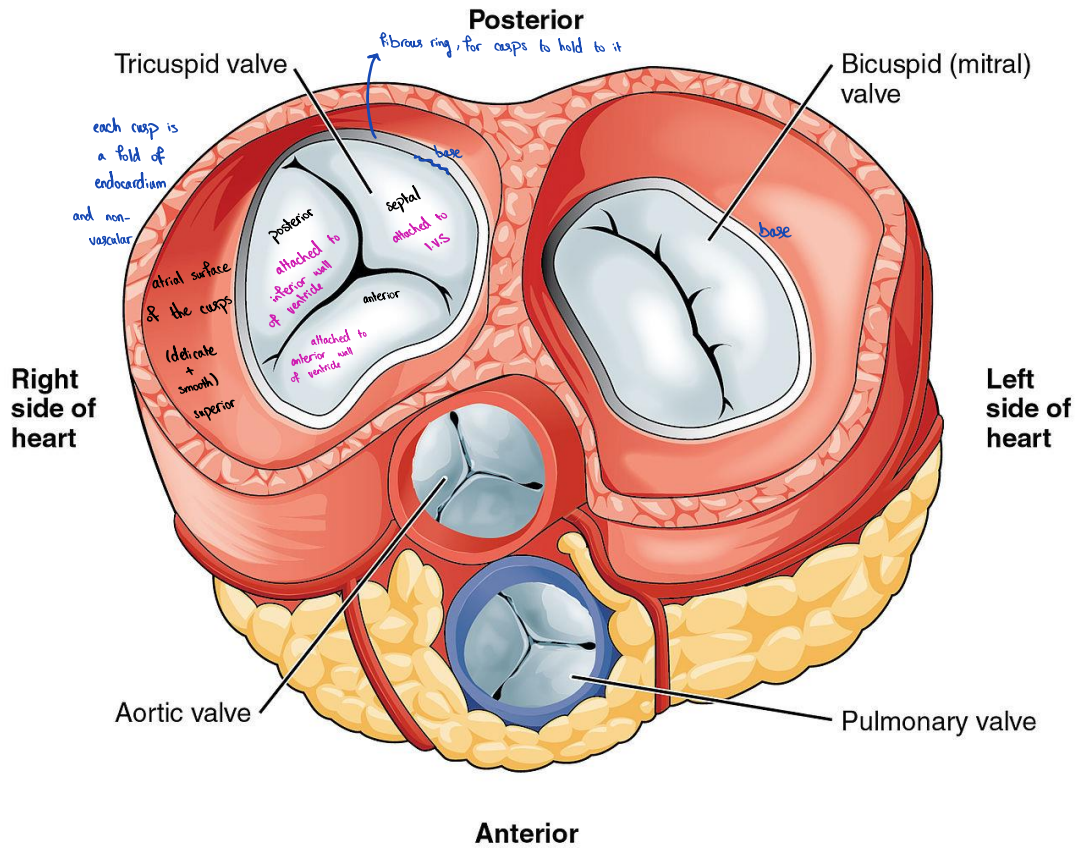




# Anatomy of the Heart

## ★ Orifices and Valves of the heart:

### I) Orifices and Valves of the atria: (see before)



## Anatomy of the Heart

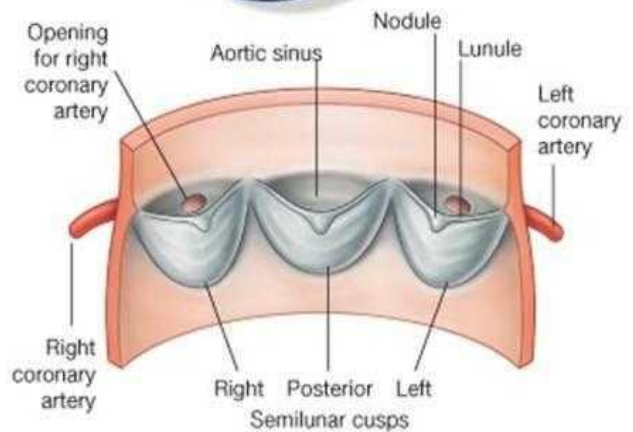
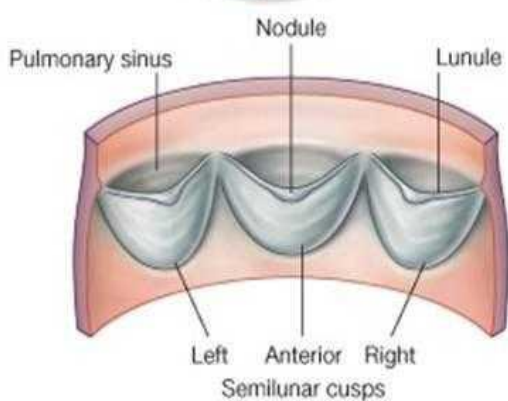
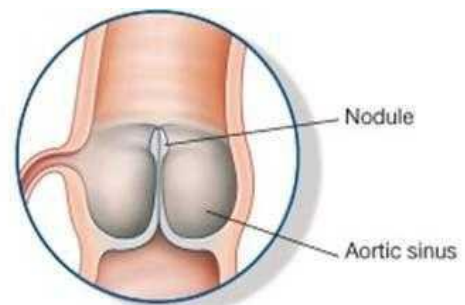
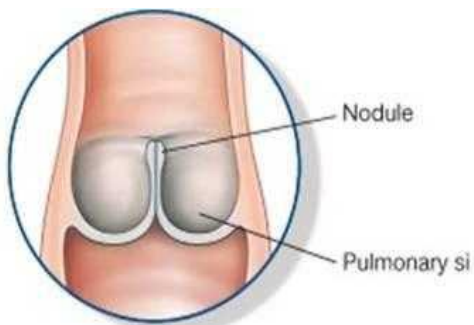
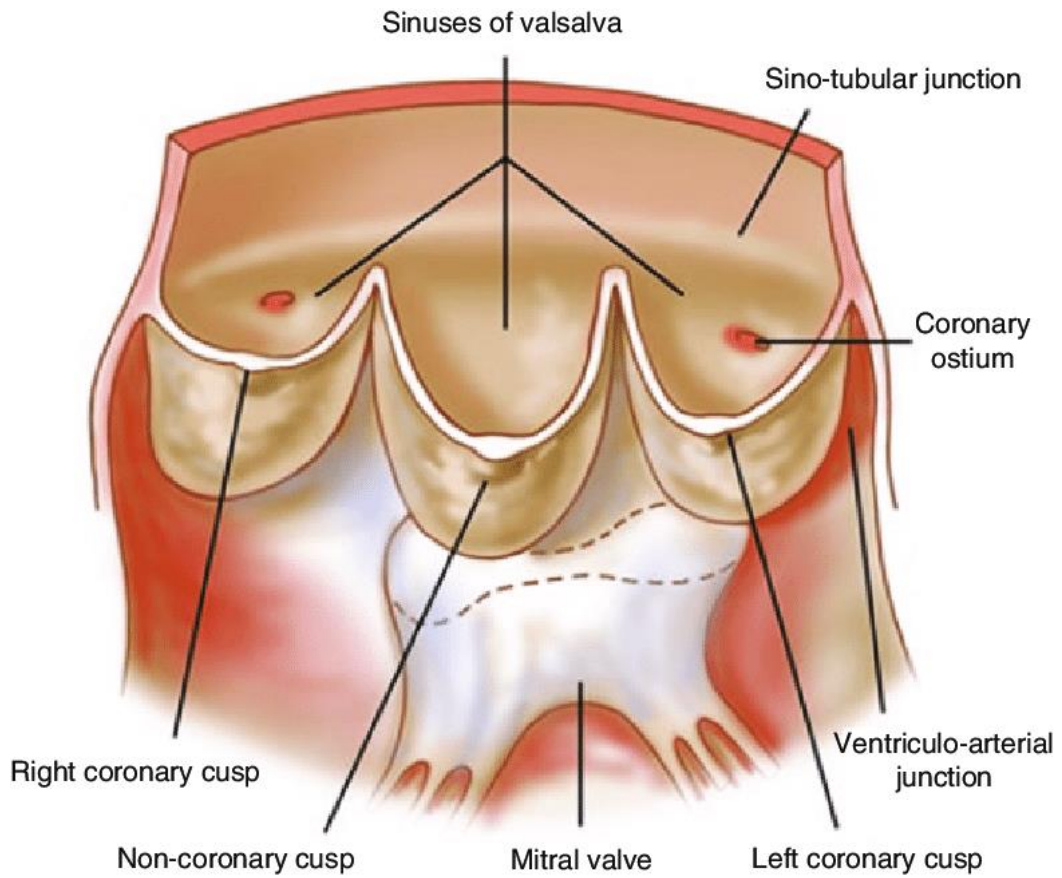
### II) Orifices and valves of the ventricles:

Orifices & Valves of right ventricle	Orifices & Valves of left ventricle
<b>A-Right atrioventricular (A-V) orifice:</b>	<b>A- Left atrioventricular (A-V) orifice:</b>
<ul style="list-style-type: none"> <li>It is an <b>oval</b> orifice.</li> </ul>	<ul style="list-style-type: none"> <li>It is a <b>circular</b> orifice.</li> </ul>
<ul style="list-style-type: none"> <li><b>Between</b> the right atrium and right ventricle.</li> </ul>	<ul style="list-style-type: none"> <li><b>Between</b> the left atrium and left ventricle.</li> </ul>
<ul style="list-style-type: none"> <li>Its plane is <b>vertical</b>.</li> </ul>	
<ul style="list-style-type: none"> <li>Directed forwards and to the left (<b>towards the apex</b> of the heart).</li> </ul>	
<ul style="list-style-type: none"> <li>It admits the tips of <b>3 fingers</b>.</li> </ul>	<ul style="list-style-type: none"> <li>It admits the tips of <b>2 fingers</b>.</li> </ul>
<ul style="list-style-type: none"> <li>Each <b>atrioventricular (A-V) orifice</b> is surrounded by a <b>fibrous ring</b> that gives attachment to the cusps of the corresponding A-V valve.</li> </ul>	
<b>B- Tricuspid valve:</b>	<b>B- Mitral (bicuspid) valve:</b>
<ul style="list-style-type: none"> <li>It consists of <b>3 cusps</b>:               <ol style="list-style-type: none"> <li><b>Anterior</b> cusp attached to the <b>anterior wall</b> of the ventricle.</li> <li><b>Posterior</b> cusp attached to the <b>inferior wall</b> of the ventricle.</li> <li><b>septal</b> cusp attached to the interventricular <b>septum</b>.</li> </ol> </li> </ul>	<ul style="list-style-type: none"> <li>It consists of <b>2 cusps</b>:               <ol style="list-style-type: none"> <li><b>Anterior cusp</b> is larger and attached to the <b>anterior wall</b> of the ventricle.</li> <li><b>Posterior cusp</b> attached to the <b>inferior wall</b> of the ventricle.</li> </ol> </li> </ul>
<ul style="list-style-type: none"> <li>Each cusp is <b>formed of a fold of endocardium</b> containing a thin layer of fibrous tissue. It is <b>non-vascular except</b> for the peripheral 2-3 mm.</li> </ul>	
<ul style="list-style-type: none"> <li>Each cusp has a <b>base</b> attached to the <b>fibrous ring</b> surrounding the A-V orifice, a <b>free border</b> that gives attachment to the <b>chordae tendinae</b> of the papillary muscles and <b>2 surfaces</b> (atrial &amp; ventricular surfaces).</li> </ul>	
<ul style="list-style-type: none"> <li>The <b>free margin</b> of each cusp receives chordae tendinae from the 2 of 3 papillary muscles in the right ventricle.</li> </ul>	<ul style="list-style-type: none"> <li>The free margin of each cusp receives chordae tendinae from the 2 papillary muscles in the left ventricle.</li> </ul>
<ul style="list-style-type: none"> <li>The <b>atrial surface</b> of each cusp is</li> </ul>	<ul style="list-style-type: none"> <li><b>Both surfaces</b> of the <b>anterior cusp</b></li> </ul>

## Anatomy of the Heart

<p><b>smooth</b> while its <b>ventricular surface</b> is <b>rough</b> as it gives attachment to the <b>chordae tendinae</b>.</p>	<p>are <b>smooth</b> (as it gives no attachment to chordae tendinae) .</p> <ul style="list-style-type: none"> <li>While <b>only the atrial</b> surface of the posterior cusp is <b>smooth</b> as its ventricular surface gives attachment to chordae tendinae.</li> </ul>
<b>C- Pulmonary orifice:</b>	<b>C- Aortic orifice:</b>
<ul style="list-style-type: none"> <li>It is a <b>circular</b> orifice.</li> </ul>	
<ul style="list-style-type: none"> <li>It is situated horizontally at the upper end of the <b>infundibulum</b></li> </ul>	<ul style="list-style-type: none"> <li>It is situated horizontally at the upper end of the aortic vestibule</li> </ul>
<ul style="list-style-type: none"> <li>It is <b>between</b> the right ventricle and the pulmonary trunk</li> </ul>	<ul style="list-style-type: none"> <li>It is <b>between</b> the leftt ventricle and the aort.</li> </ul>
<ul style="list-style-type: none"> <li>It is <b>surrounded</b> by a fibrous ring that gives <b>attachment</b> to the 3 <b>cusps</b> of the corresponding valve.</li> </ul>	
<b>D- Pulmonary valve:</b>	<b>D- Aortic valve:</b>
<ul style="list-style-type: none"> <li>It consists of <b>3 semilunar cusps</b>: 2 anterior and one posterior.</li> </ul>	<ul style="list-style-type: none"> <li>It consists of <b>3 semilunar cusps</b>; 2 posterior and one anterior.</li> </ul>
<ul style="list-style-type: none"> <li>The cusps form <b>pockets</b> with the wall of the pulmonary trunk.</li> </ul>	<ul style="list-style-type: none"> <li>The cusps form <b>pockets</b> with the wall of the ascending aorta.</li> </ul>
<ul style="list-style-type: none"> <li>The root of the pulmonary trunk presents <b>3 slight dilatations</b> opposite the cusps called <b>pulmonary sinuses</b>.</li> </ul>	<ul style="list-style-type: none"> <li>The root of the ascending aorta presents 3 slight dilatations opposite the cusps called <b>aortic sinuses</b>.</li> </ul>
<ul style="list-style-type: none"> <li>The <b>free margins</b> of the cusps are directed <b>upwards</b> into the <b>lumen</b> of the pulmonary trunk.</li> </ul>	<ul style="list-style-type: none"> <li>The free margins of the cusps are directed <b>upwards</b> into the <b>lumen</b> of the ascending aorta.</li> </ul>
<ul style="list-style-type: none"> <li>Each free border presents a <b>fibrous thickening</b> in the middle called <b>nodule</b> and 2 crescentic rims on either side called <b>lunules</b> (the 3 nodules provide central mechanical support for <b>proper closure</b> of the valve during diastole).</li> </ul>	

# Anatomy of the Heart



**pulmonary valve**

**aortic valve** [muhadharaty.com](http://muhadharaty.com)

### **Fibrous Skeleton of the Heart**

★ It is the fibrous **framework**, formed of **dense collagenous** bundles, which **surrounds the orifices** of the heart.

★ **Components of the fibrous skeleton:**

#### **1- Right and left atrioventricular rings:**

- The right ring surrounds the **right A-V orifice**, and is **larger** but **weaker** than the left ring.
- The 2 rings form together an **8-shaped** structure.
- They give **attachment to the bases of cusps** of the tricuspid and mitral valves respectively.

#### **2- Fibrous rings of the pulmonary and aortic orifices:**

- They **surround** the corresponding orifices and **give attachment** to the bases of cusps of the pulmonary and aortic valves.

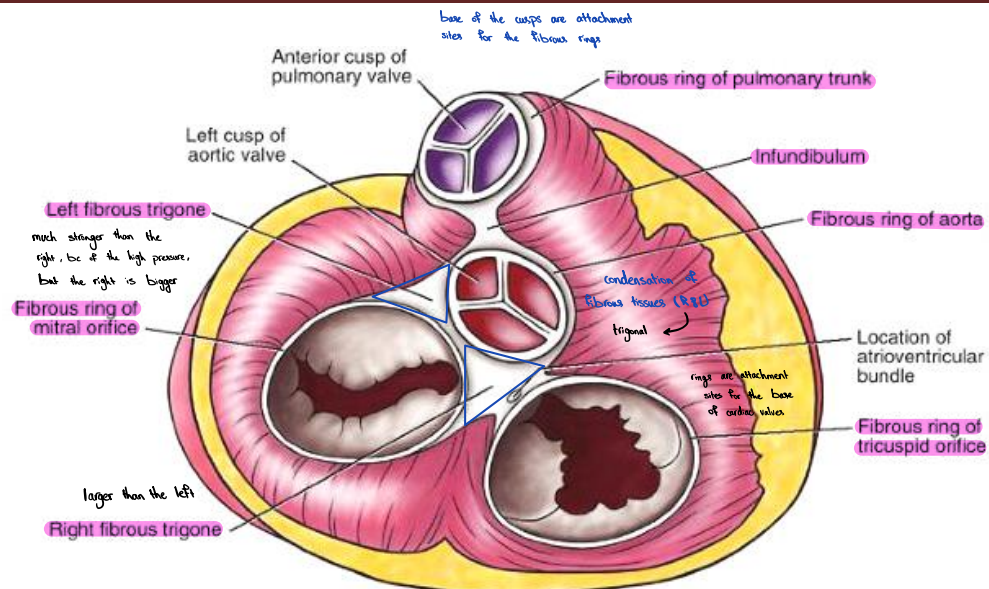
#### **3- Right and left fibrous trigones:**

- The **right** fibrous trigone is a **large** mass of fibrous tissue between the **aortic** and the **right A-V rings**, while the **left** fibrous trigone is a **small** mass of fibrous tissue between the **aortic** and the **left A-V rings**.

★ **Function of the fibrous skeleton:**

- 1- It gives **attachment** to the **myocardial** fibers.
- 2- It give attachment to the **cusps** of the valves.
- 3- It **prevents deformation** of the heart.
- 4- It acts as **electrical insulator** between the atria and ventricles (the conductivity between the atria and ventricles occurs only through the atrioventricular bundle)

# Anatomy of the Heart



## Fibrous Skeleton of the Heart Conducting System of the Heart

- ★ It is the system responsible for the **initiation and propagation of the electric rhythmic cardiac impulses** responsible for the coordinated contractions of each cardiac cycle.
- ★ It is formed of **specialized cardiac muscle** fibers (not nerve tissue).
- ★ **Components:**

### 1- Sino-atrial (S.A.) node:

- It is situated in the wall of the **right atrium** in the upper part of sulcus terminalis to the right of opening of the S.V.C.
- It is **crescentic** in shape, 10-20 mm long and 8 mm wide.
- It is the **pace maker** of the heart that initiates the excitation wave (impulse) in each cardiac cycle.
- It is under control of the **autonomic** nerves system.

### 2- Atrio-ventricular (A.V.) node:

- It is situated in the lower and posterior part of the **inter-atrial septum**, 10 mm above the orifice of the coronary sinus.
- It is oval in shape, 8 mm long.

## Anatomy of the Heart

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- It delay passage of impulses to the ventricles until full atrial contraction occurs.

### 3- Atrio-ventricular (A.V.) bundle (bundle of Hiss):

- It is the **only muscular connection** between the atria and the ventricles.
- It **transmits** the cardiac impulses from the A.V. node to the **ventricles**.
- It arises from the **A.V. node** and traverses the **fibrous skeleton** of the heart to reach the **interventricular septum**. Then, it descends along the **membranous** part of the septum to reach the **muscular** part where it **divides** into right and left branches.

### 4- Right branch of the A.V. bundle:

- Descends just deep to the **endocardium** covering the right side of the **septum**, close to the cavity of the right ventricle as far as the **moderator band**.
- Then it passes through moderator band to reach base of **anterior papillary** muscle where it **breaks** up into a network of **Purkinje** fibers.

### 5- The left branch of the A.V bundle:

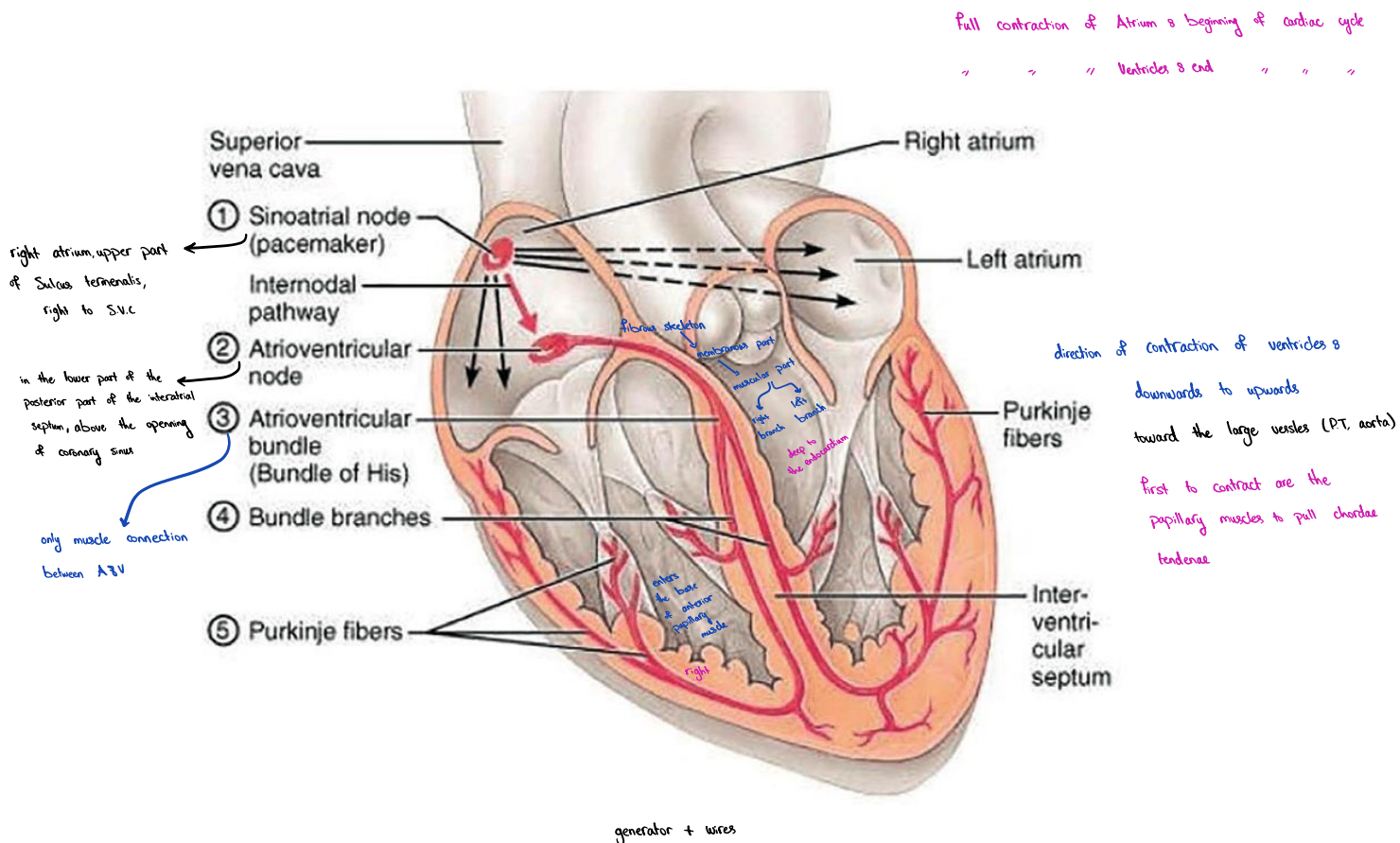
- It runs beneath the **endocardium** of the septum facing the cavity of the left ventricle towards the **apex** of the heart.

### 6- Purkinji Fibers:

- In each ventricle, they encircle the **bases of the papillary** muscles then ascend beneath the **endocardium** towards the base of the ventricle.

# Anatomy of the Heart

- This arrangement ensures that the **ventricles contract from below upwards** so that blood is pumped up through the **big arteries** and is not trapped in the ventricle.



## Conducting system of the heart

so it's more dangerous

★ The **right coronary artery** is the main arterial supply to the conducting system of the heart except left bundle branch which is supplied by the left coronary artery .

★ Please watch this video :

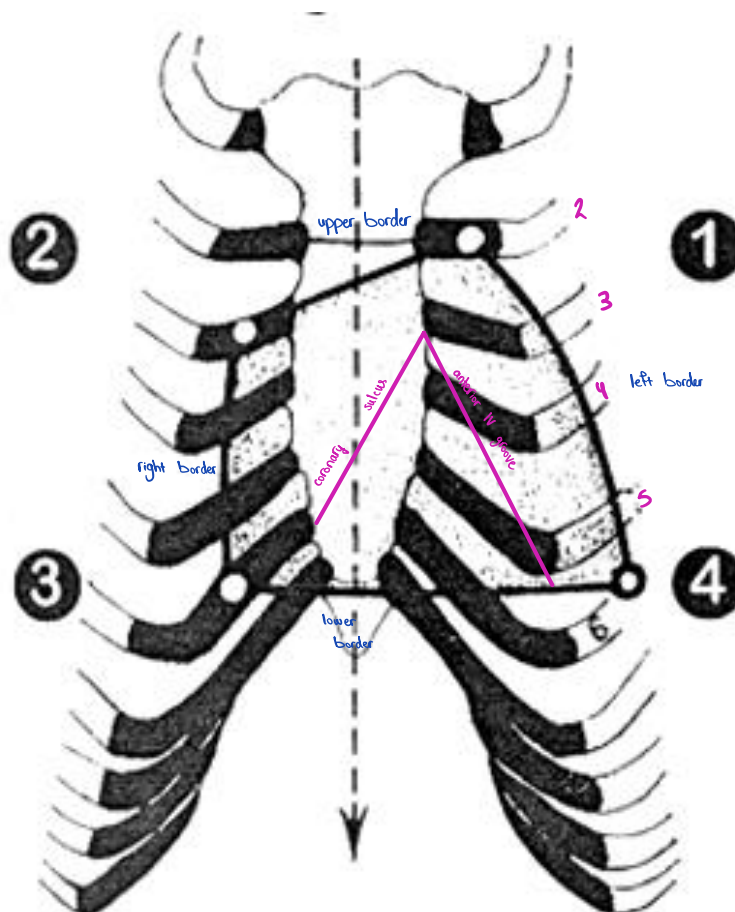
<https://www.youtube.com/watch?v=TnFoJ7Hhi-M>



## Surface Anatomy of the Heart

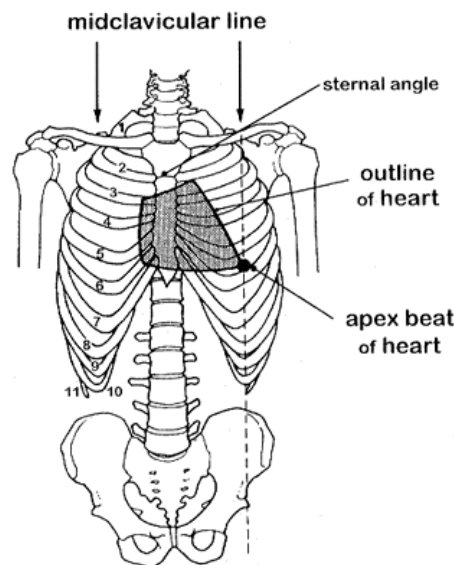
### [A] Borders of the heart:

- 1- **Upper border:** an oblique straight line from lower border of 2<sup>nd</sup> left costal cartilage 1.5 cm from sternal margin (**point 1**) to the upper border of 3<sup>rd</sup> right costal cartilage 1.5 cm from sternal margin (**point 2**)
- 2- **Right border:** a vertical line, slightly convex to the right, from **point 2** to 6<sup>th</sup> right costal cartilage 1.5 cm from sternal margin (**point 3**)
- 3- **Lower border:** an oblique straight line from **point 3** to 5<sup>th</sup> left intercostal space 9 cm from median plane (**point 4**)
- 3- **Left border:** a vertical line, slightly convex to the left, from apex of the heart (**point 4**) to **point 1**.



## Anatomy of the Heart

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### [B] Grooves of the Heart:

- 1- **Coronary or atrioventricular (A-V) sulcus:** an oblique line from the 3<sup>rd</sup> left to the 6<sup>th</sup> right sternocostal junctions.
- 2- **Anterior interventricular groove:** an oblique line from the 3<sup>rd</sup> left sternocostal junction to inferior border of the heart 1.5 cm from the apex.

### [C] Valves of the Heart:

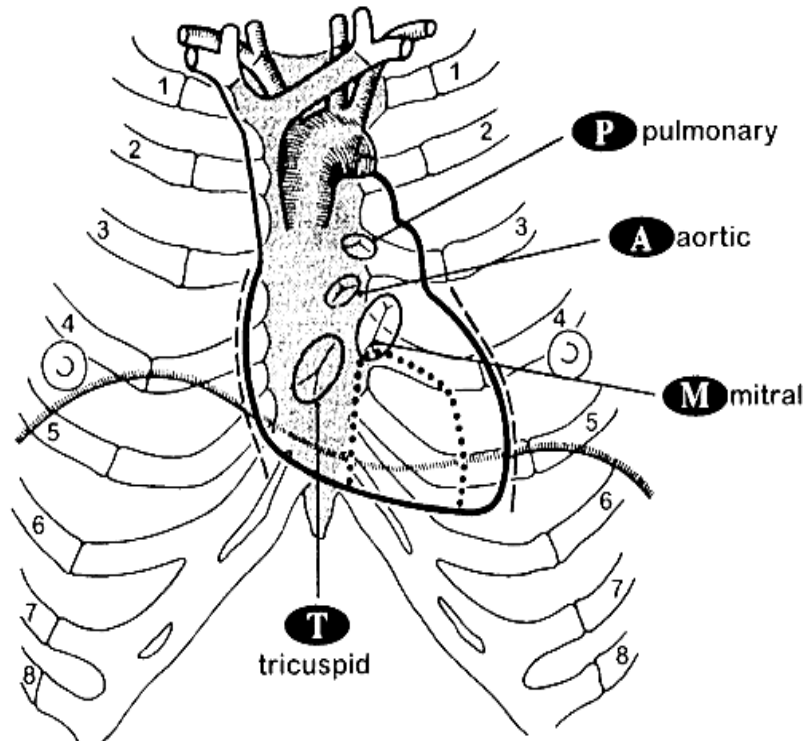
- 1- **Pulmonary valve:** lies behind the 3<sup>rd</sup> left sternocostal junctions.
- 2- **Aortic valve:** behind the left margin of the sternum opposite the 3<sup>rd</sup> left intercostal space.
- 3- **Mitral valve:** behind the left half of the body of the sternum, opposite the 4<sup>th</sup> left sternocostal junction.
- 4- **Tricuspid valve:** behind the center of the sternum opposite 4<sup>th</sup> intercostal space.

### [D] Auscultatory areas:

- The closure and opening of the cardiac valves produce the heart sounds. Because of the mechanics of propagation of sound, the

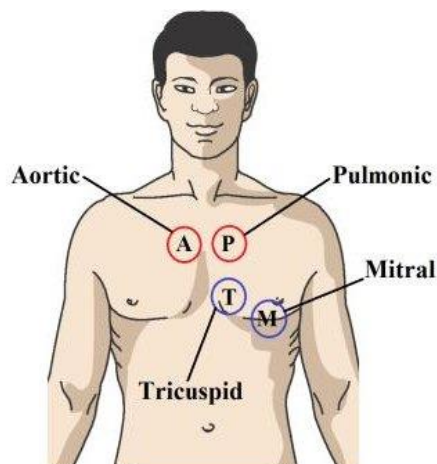
## Anatomy of the Heart

sounds of the valves are **not** heard best over their anatomical position, but at the auscultatory areas.



**Surface anatomy of the heart and its valves**

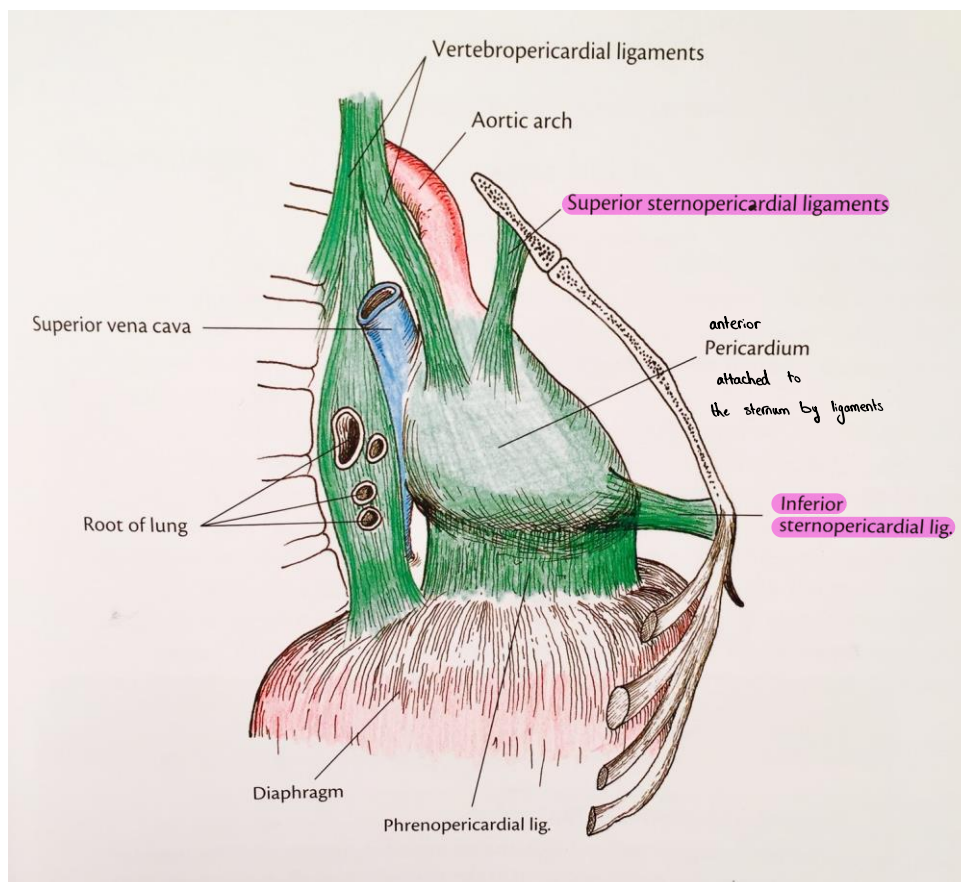
- **Clinically** the sounds of valves are best heard at the following sites:
  - 1. Pulmonary valve:** at 2<sup>nd</sup> left sternocostal junction.
  - 2. Aortic valve:** at 2<sup>nd</sup> right sternocostal junction.
  - 3. Mitral valve:** at the apex of the heart.
  - 4. Tricuspid valve:** at xiphisternal junction.



## Mechanism of Fixation of the Heart

a- Fixation of the pericardium to the surrounding structures.

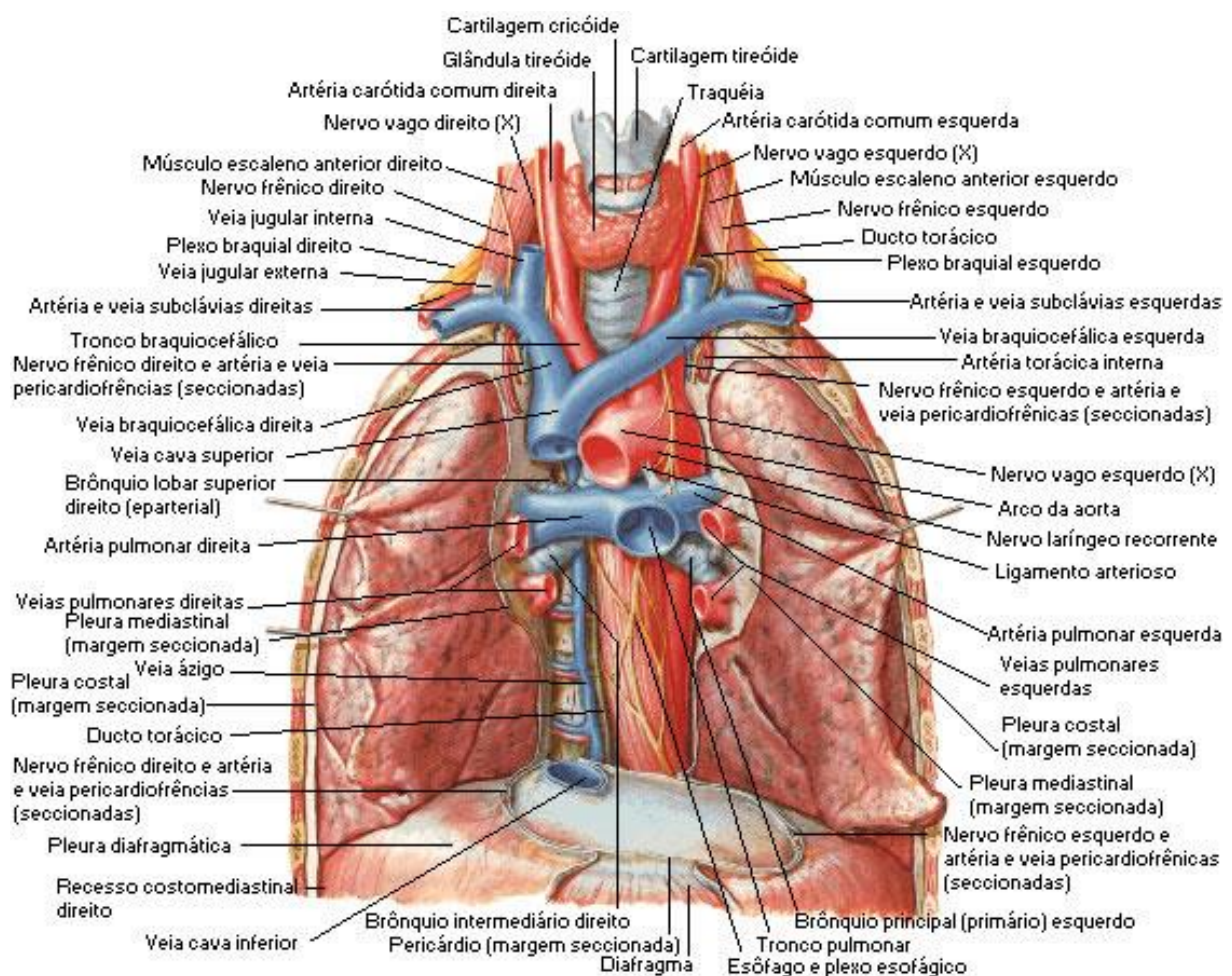
- **Anteriorly:** it is attached to the sternum by the superior and inferior **sterno-pericardial ligaments**.
- **Above:** it is continuous with the **pretracheal fascia** and **carotid sheath** thus becomes indirectly suspended to the **base of the skull**.
- **Below:** blends with the central tendon of the **diaphragm**.
- **On the sides:** blends with the mediastinal part of the parietal **pleura**.



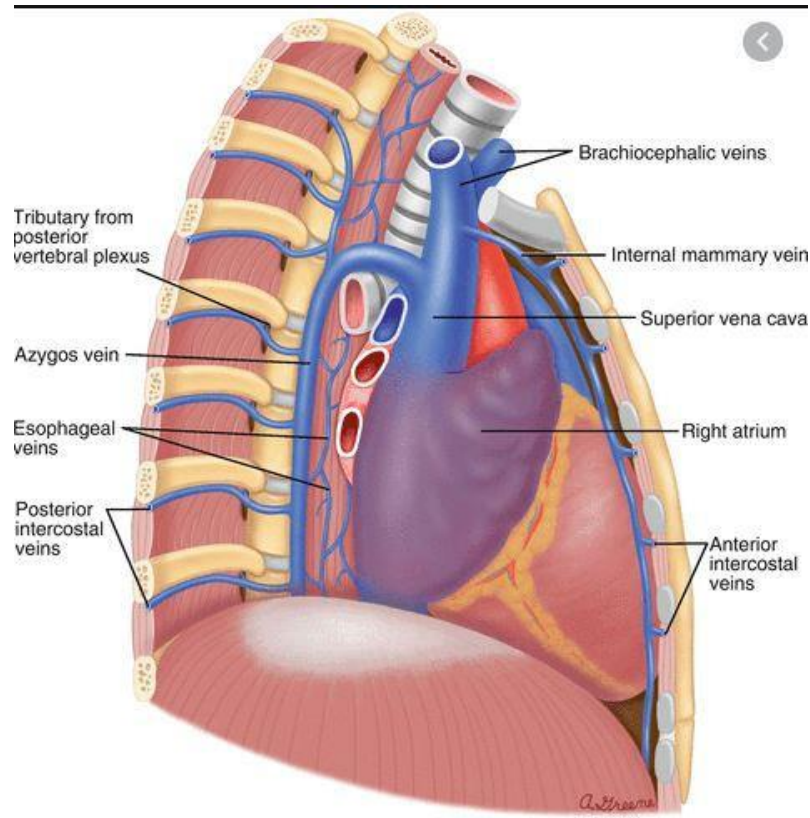
# Anatomy of the Heart

## b-Cardiac sling mechanism:

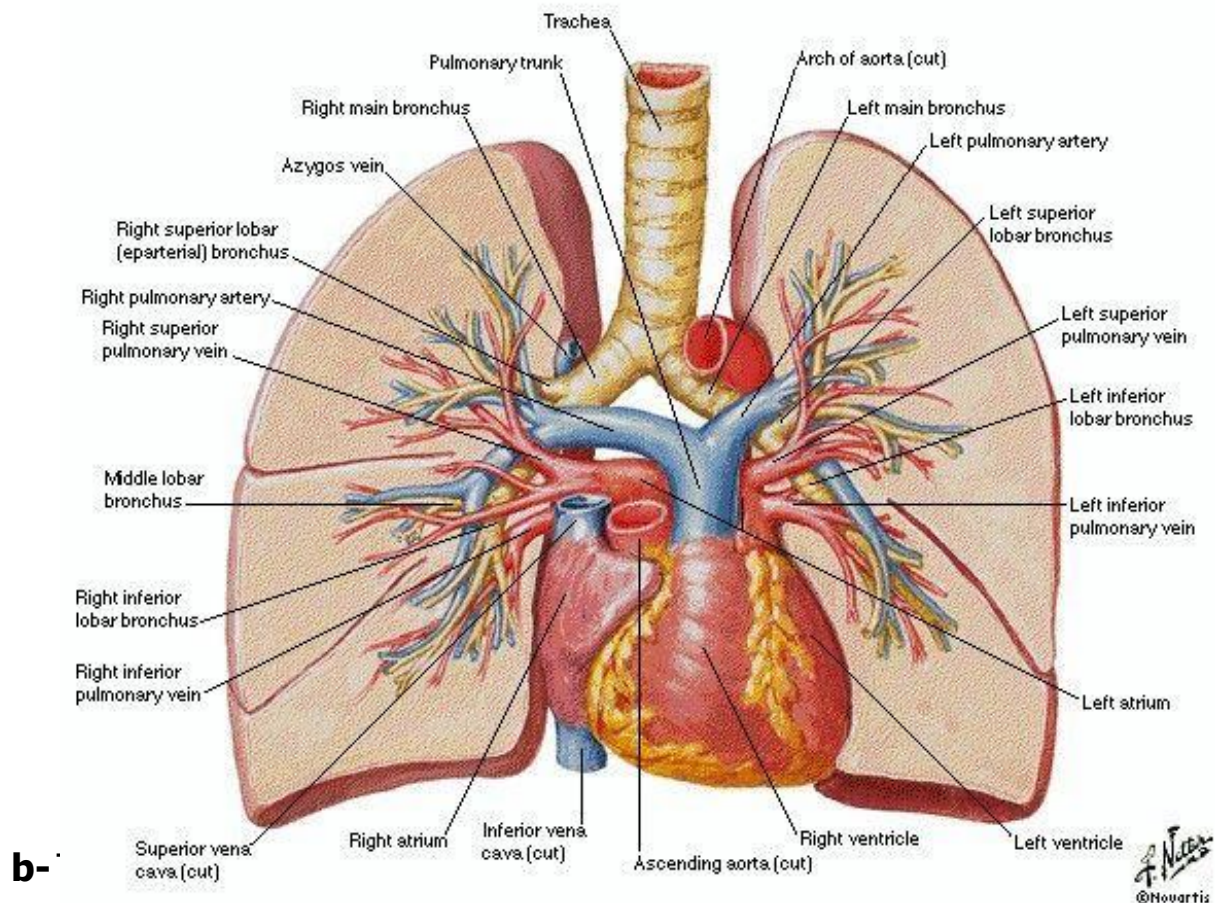
- It involves the **hooking of the great vessels** of the heart around thoracic structures.
- It includes:
  - a- Hooking of the **arch of the aorta and the left pulmonary artery** around the left principal bronchus
  - b- Hooking of the **arch of the azygos vein and right pulmonary artery** around the right principal bronchus
  - c- Hanging of the **subclavian vessels** across the 1<sup>st</sup> rib on each side at the thoracic inlet.



# Anatomy of the Heart



## Pulmonary Arteries and Veins



b-

## Anatomy of the Heart

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c- The diaphragm supports the heart from below.

### Nerve Supply of the Heart

- ★ The heart is supplied by **autonomic efferent fibers** which control the **rate** and **contractility of the heart**; the sympathetic nerves increase both while the parasympathetic decrease them.
- ★ The autonomic supply of the heart forms cardiac plexuses which contain also **afferent sympathetic fibers** which convey **pain** sensation from the heart to the spinal cord.
- ★ The autonomic nerves are **not** responsible for the **initiation or propagation of the cardiac impulse**; this is the function of the **S.A. node** and the other components of the **conducting system** of the heart.

#### ★ Origin of autonomic fibers:

**A- Parasympathetic supply:** derived from the 2 **vagi**.

- They are **preganglionic** parasympathetic fibers which arise from **vagal nuclei** in the medulla and pass in the following branches **cardiac branches**:

#### **a- In the neck:**

1. Right and left **upper** cervical cardiac branches of the 2 vagi.
2. Right and left **lower** cervical cardiac branches of the 2 vagi.

#### **b- In the thorax:**

1. Cardiac branches from the **right vagus** nerve.
  2. Cardiac branches from the **left recurrent laryngeal** nerve.
- These preganglionic fibers **relay** in parasympathetic ganglia in the wall of the heart.

## Anatomy of the Heart

### B- Sympathetic:

- Preganglionic fibers arise in the **lateral horn of the upper 5 thoracic segments** of the spinal cord.
- These fibers relay in the **3 cervical and upper 5 thoracic** sympathetic ganglia.
- The postganglionic fibres pass in the following branches from the sympathetic chains:

**a-In the neck:** Right and left **superior, middle and inferior** cervical cardiac branches of sympathetic chains.

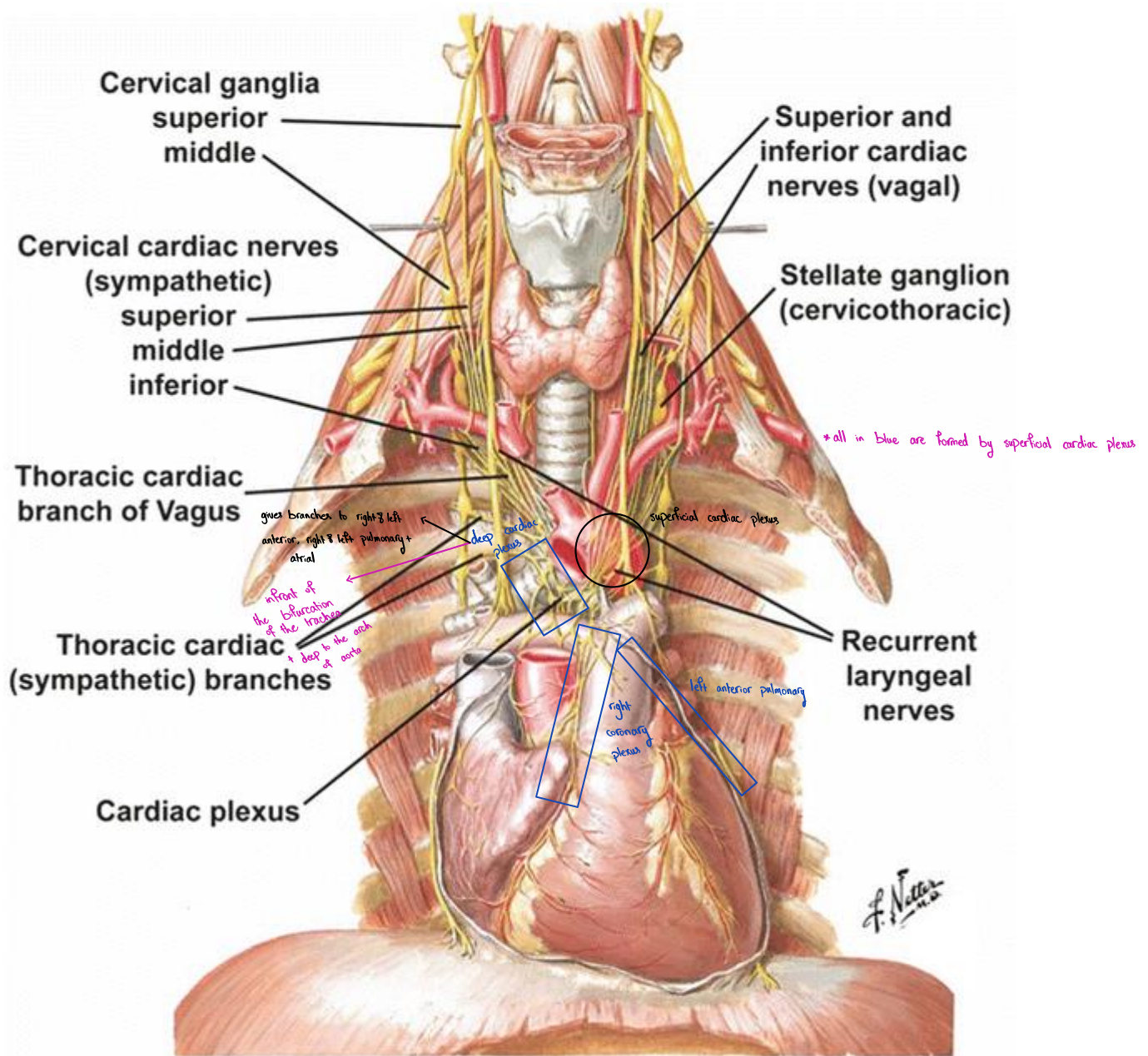
**b-In the thorax:** Right and left cardiac branches from the **2<sup>nd</sup>, 3<sup>rd</sup> and 4<sup>th</sup>** thoracic ganglia.

### ★ Cardiac Plexuses:

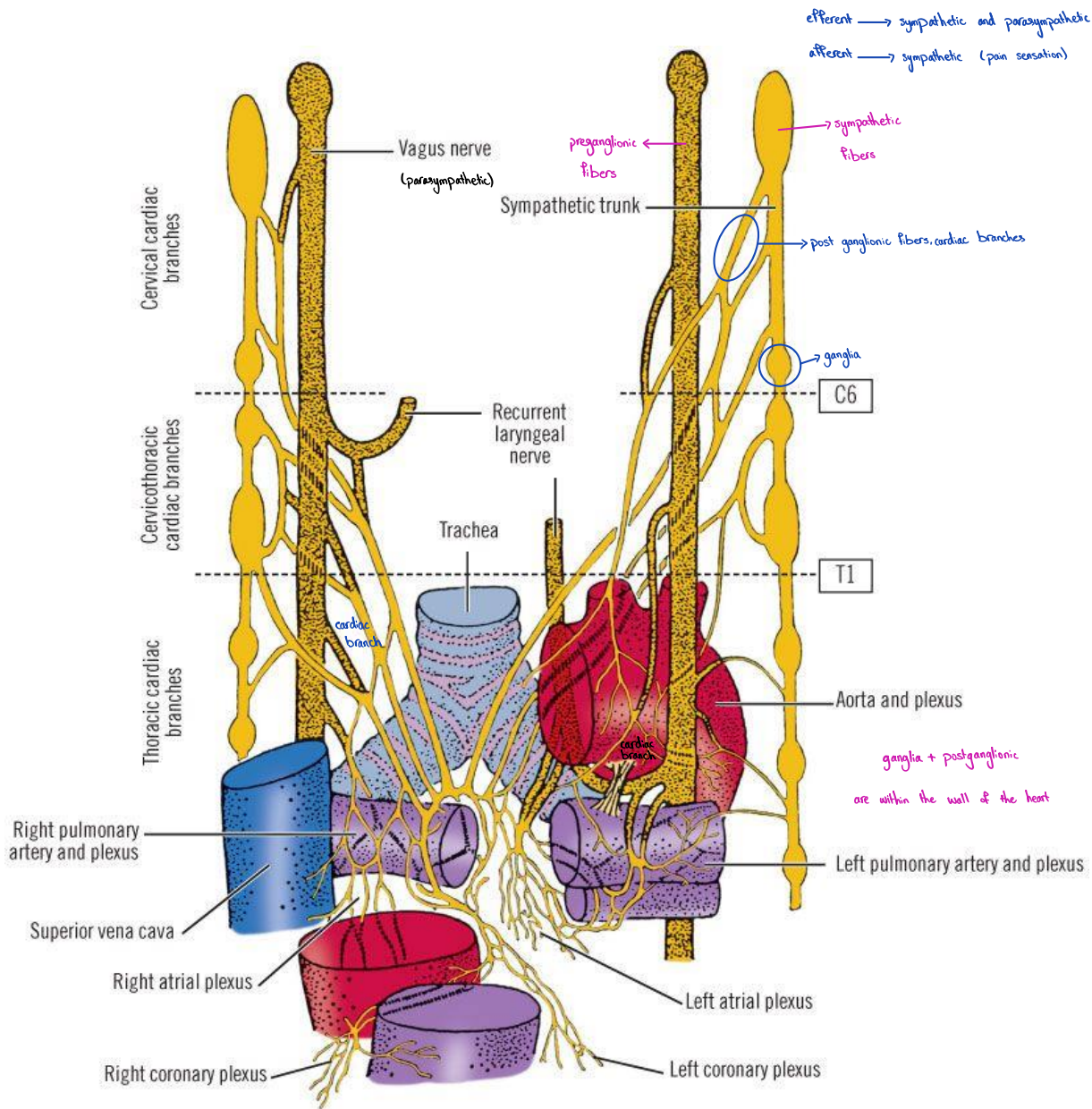
Plexus	Formation	Site	Distributions
▪ <b>Superficial cardiac</b>	<ul style="list-style-type: none"> <li>▪ <b>Superior cervical cardiac</b> branch of the <b>left sympathetic chain</b>.</li> <li>▪ <b>Inferior cervical cardiac</b> branch of the <b>left vagus</b> (parasympathetic).</li> </ul>	<ul style="list-style-type: none"> <li>▪ In the <b>concavity of arch of aorta</b>, anterior to ligamentum arteriosum.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Branches to:               <ol style="list-style-type: none"> <li>1-The deep cardiac plexus.</li> <li>2-The right coronary plexus.</li> <li>3-The left anterior pulmonary plexus.</li> </ol> </li> </ul>
▪ <b>Deep cardiac</b>	<ul style="list-style-type: none"> <li>▪ <b>all cardiac branches</b> of <b>2 sympathetic chains</b> and the <b>2 vagi</b> in the neck and thorax <b>except</b> those sharing in the superficial cardiac plexus.</li> </ul>	<ul style="list-style-type: none"> <li>▪ In front of <b>bifurcation of trachea</b>, deep to the aortic arch.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Branches to:               <ol style="list-style-type: none"> <li>1- <b>2 atria</b>.</li> <li>2-Right and left <b>coronary</b> plexuses.</li> <li>3-Right and left <b>anterior pulmonary</b> plexuses.</li> </ol> </li> </ul>



# Anatomy of the Heart



# Anatomy of the Heart



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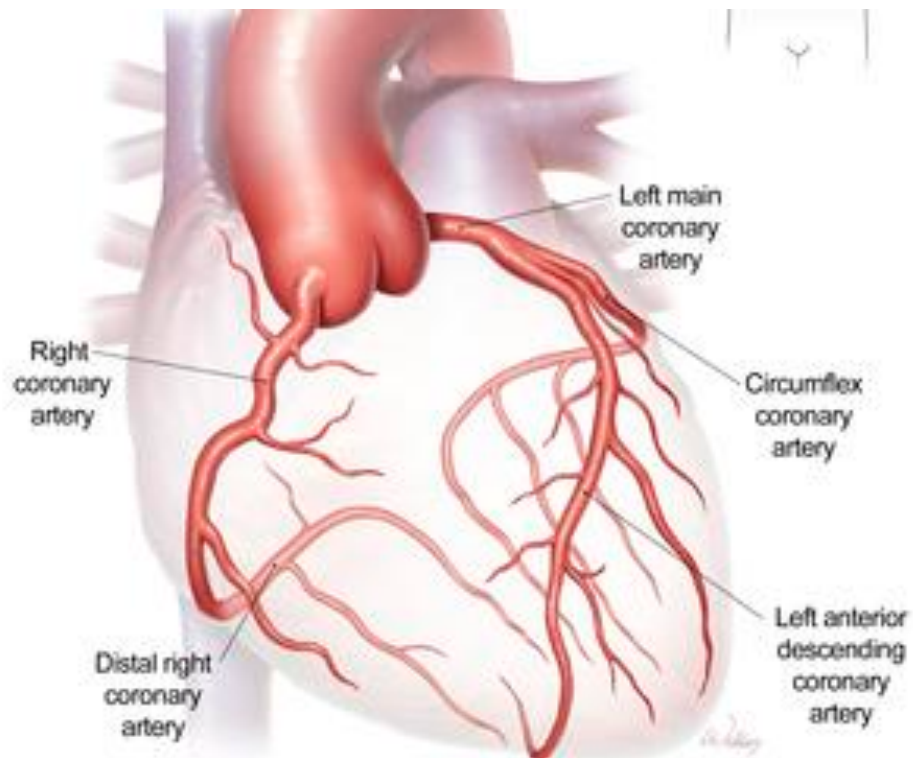
Sympathetic + parasympathetic  
 cardiac branches  
 form superficial + deep cardiac plexuses  
 in the concavity of arch of aorta, on the left, left sympathetic + left vagus [cervical] → superior cardiac branch  
 all cardiac branches of 2 vagi + sympathetic chains, except superior cervical sympathetic branch + inferior cervical vagal branch [they form the superficial plexus] → inferior cardiac branches  
 gives right and left anterior pulmonary plexus

# Blood supply of the heart

## A. Arterial supply

### (Coronary arteries)

- \* The heart is supplied by **two coronary arteries** (right and left) which run in the sulci of the heart **encircling** it like a ***crow*** and hence the name coronary.



# Anatomy of the Heart

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## 1. Right coronary artery:

- It **arises** from **anterior aortic sinus** of ascending aorta.
- It **passes between** the root of pulmonary trunk and right auricle.
- It **runs** downwards and to the right in the **coronary sulcus** directed till it reaches the point of **junction** of the right and inferior borders of the heart, here it **gives** the **right marginal** artery.
- Then it **turns** backwards to the left and **runs** in the posterior part of coronary sulcus where it **ends** by anastomosing with the circumflex branch of left coronary artery.

- **Branches of right coronary artery:**

- a. **Right marginal artery:**

- It runs **with** the small cardiac vein **along** inferior border to the apex of the heart.
    - It **supplies** the right ventricle.

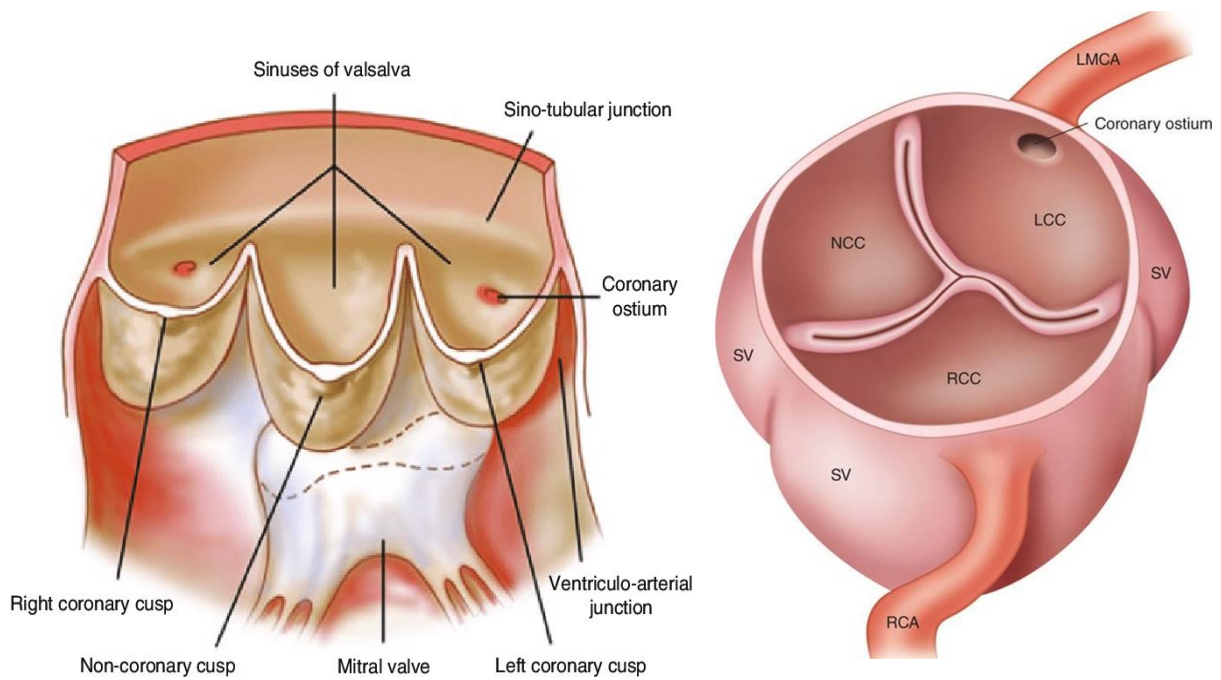
- b. **Inferior interventricular artery:**

- It **arises** near the termination of the right coronary artery.
    - It **passes** in the inferior interventricular groove **with** the middle cardiac vein
    - It **ends** near the apex by anastomosing with the anterior interventricular branch of left artery.
    - It **supplies** both ventricles and posterior 1/3 of interventricular septum.

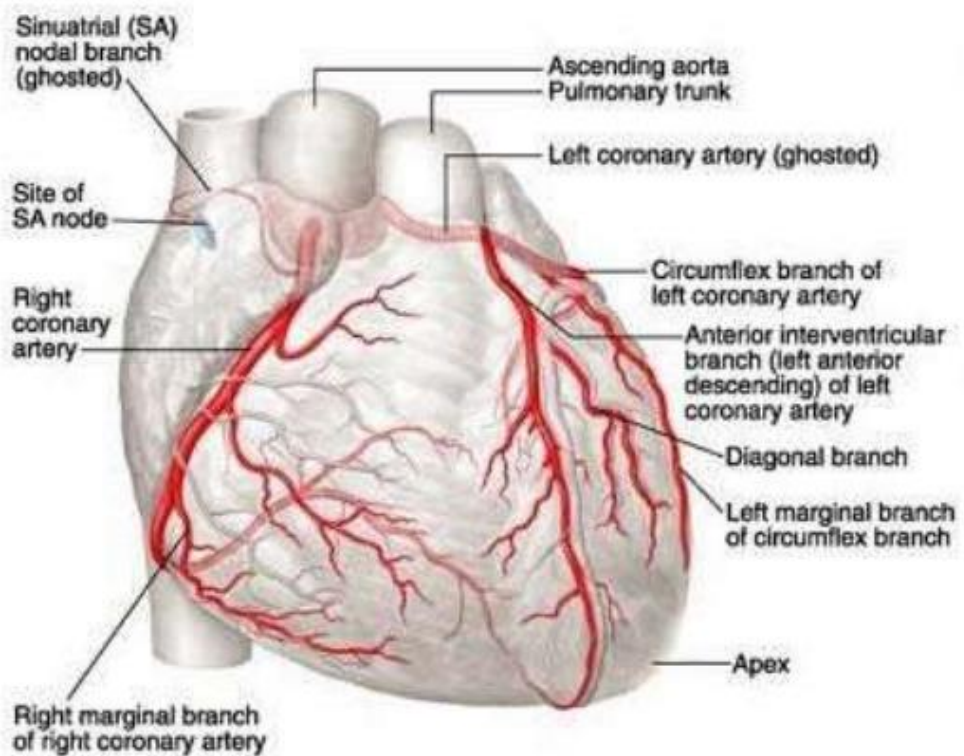
- c. **Small branches:**

- Right atrium
    - Right ventricle.
    - SA node (sino-atrial)
    - AV node (atrio-ventricular nodes).

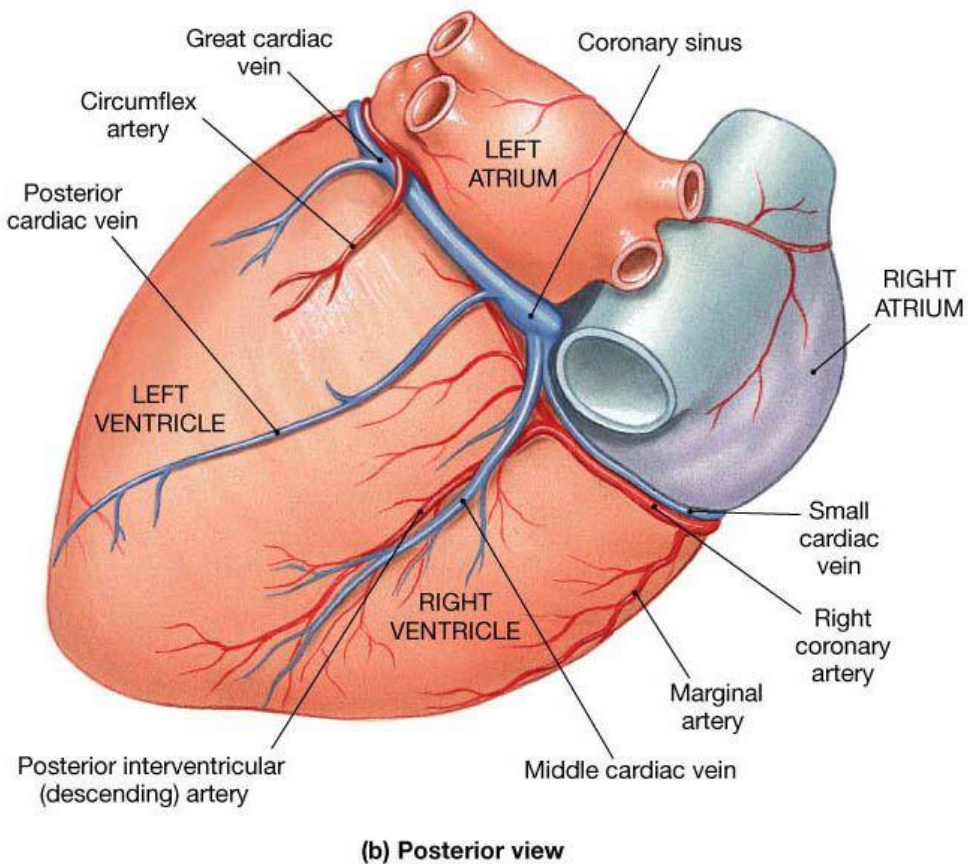
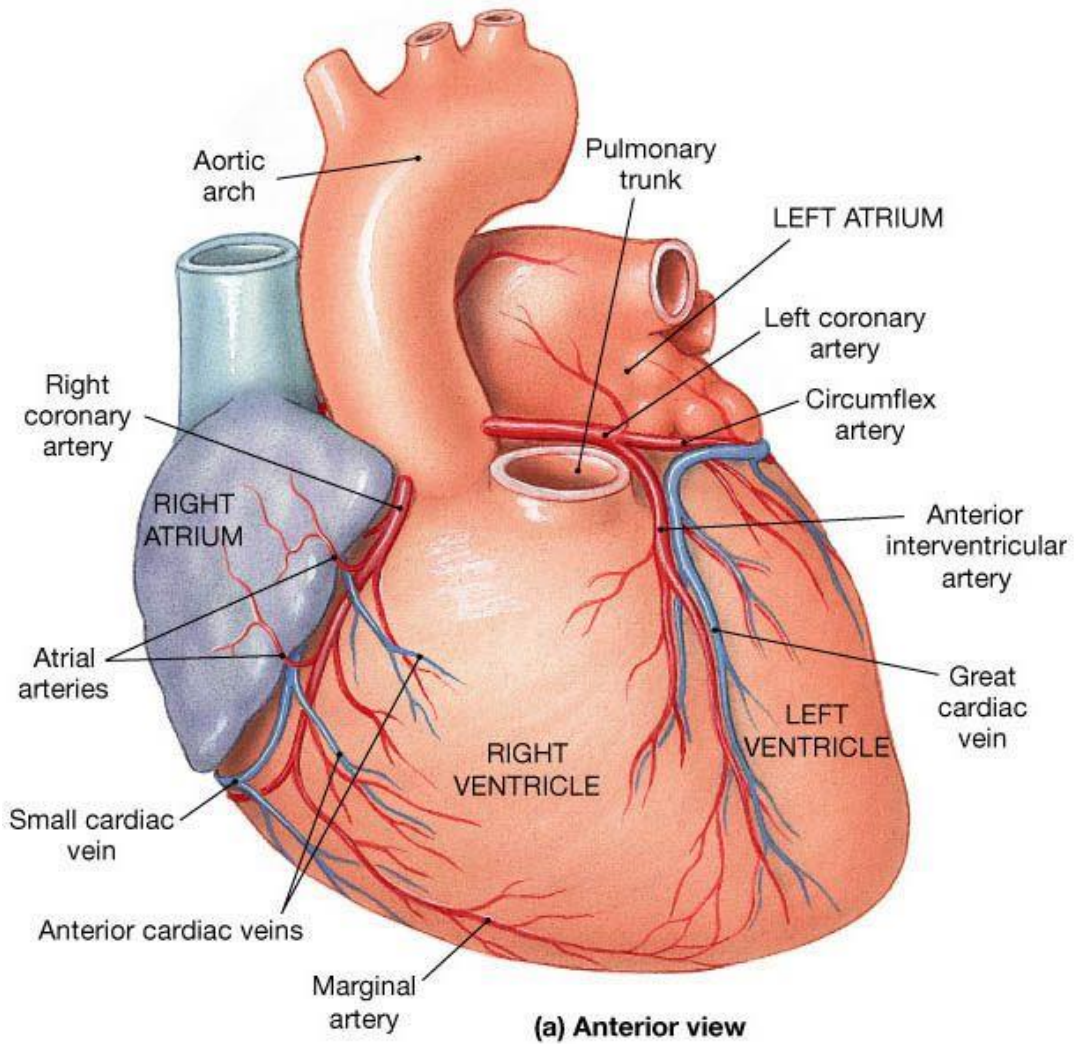
# Anatomy of the Heart



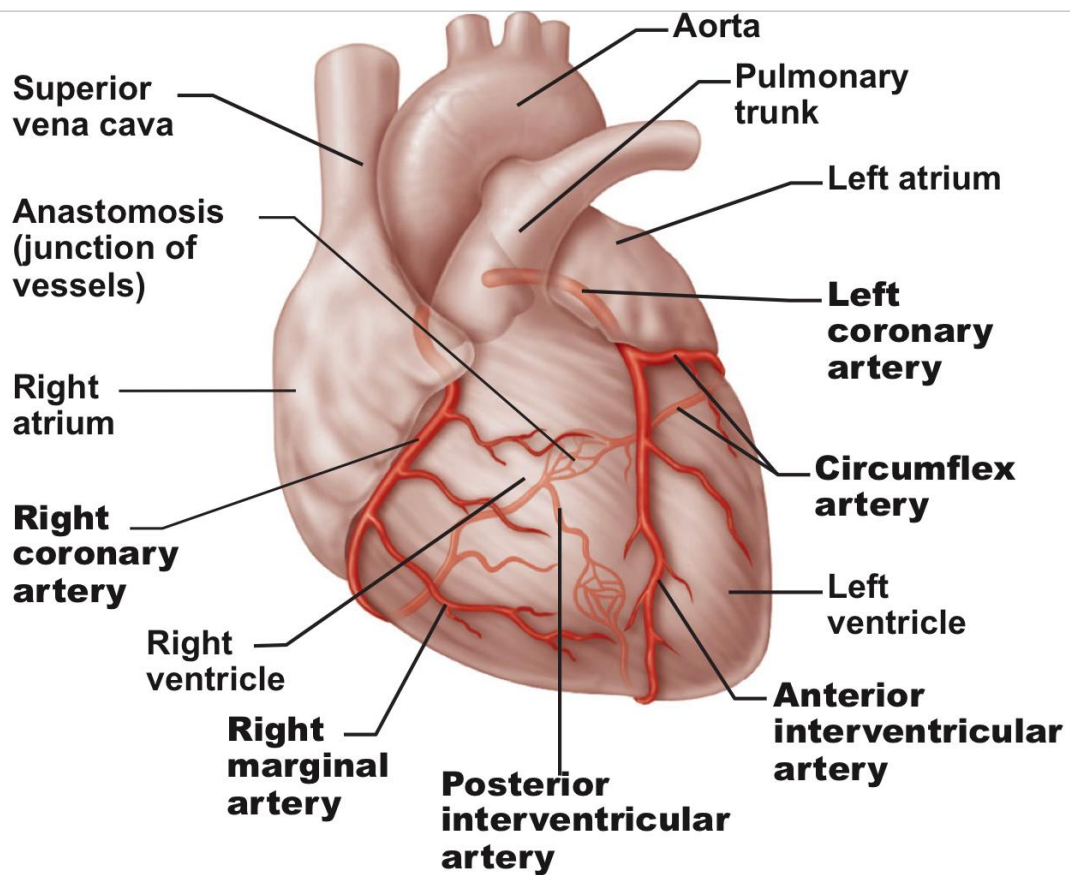
## A. Normal arterial pattern, anterior view



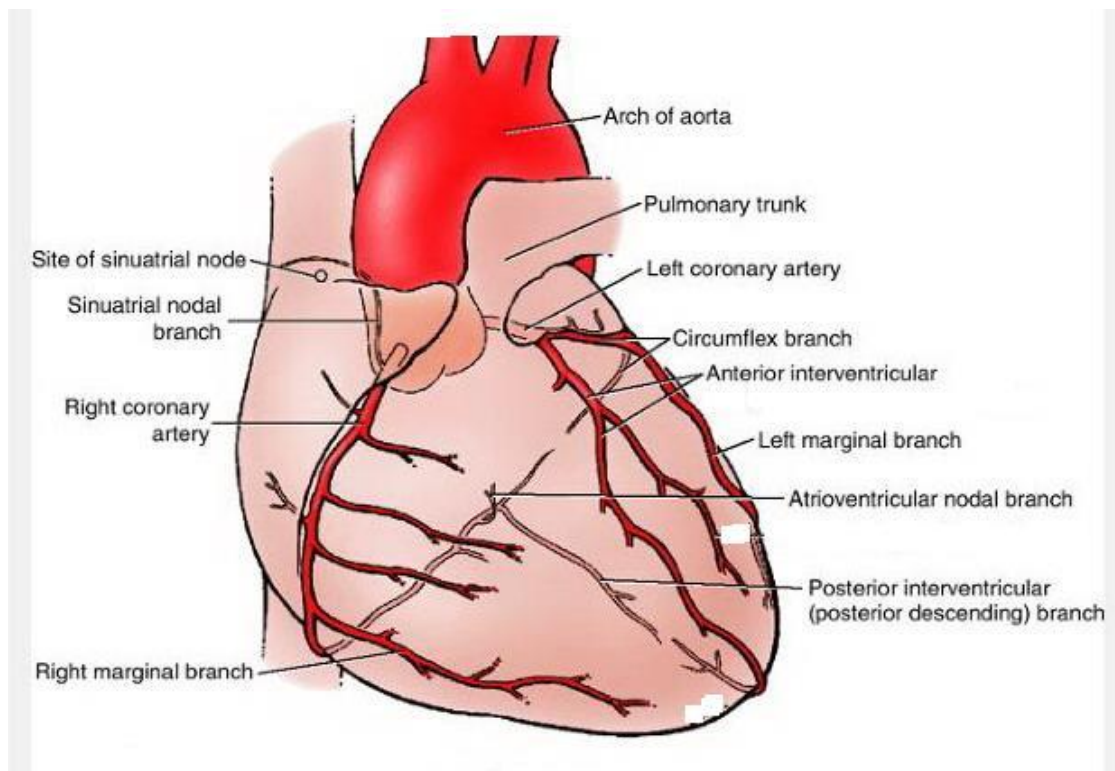
# Anatomy of the Heart



# Anatomy of the Heart



**(a) The major coronary arteries**



**Anterior view**

## **Distribution of the coronary arteries**

## Anatomy of the Heart

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### 2. Left coronary artery:

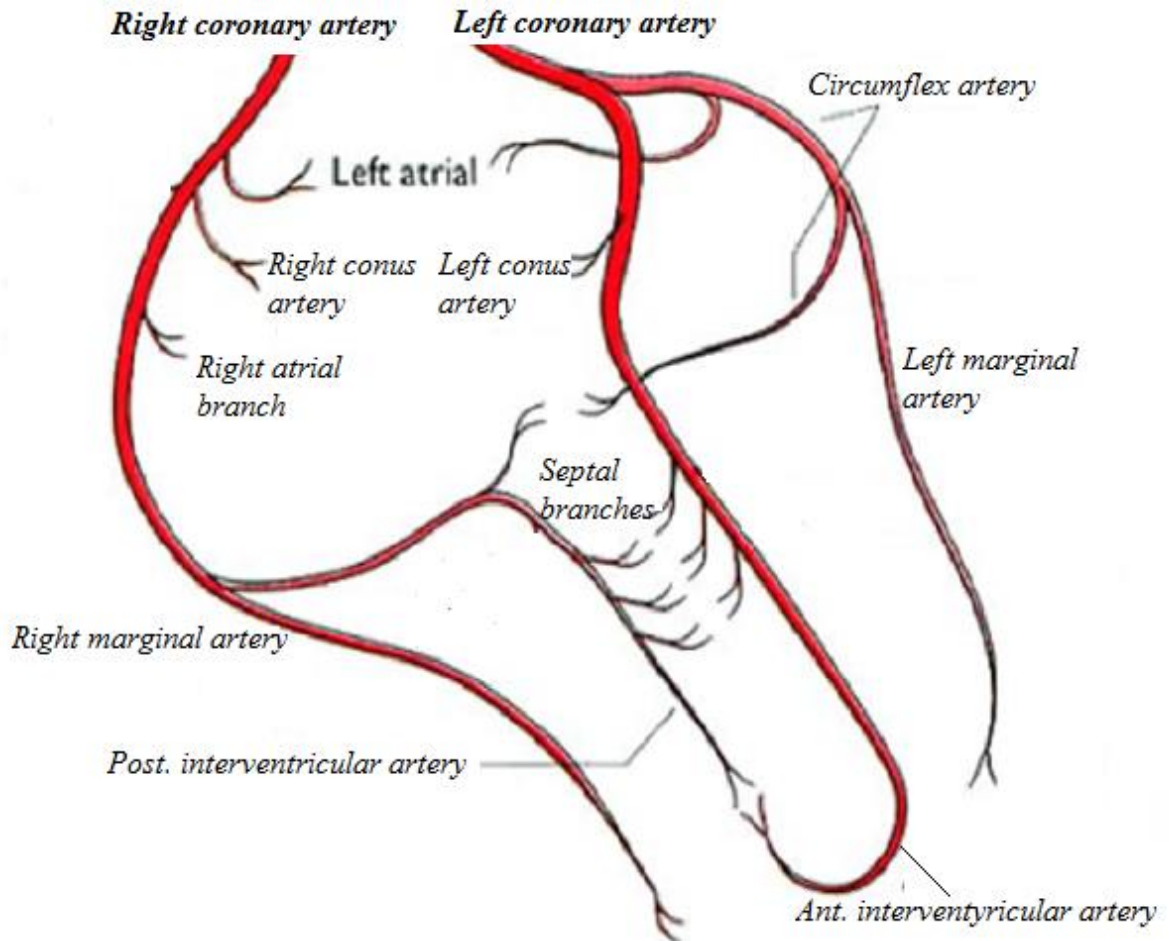
- It **arises** from **left posterior aortic sinus** of the ascending aorta.
- It is a very short artery **runs** forwards between the root of pulmonary trunk and left auricle to **reach** the upper end of anterior interventricular groove where it **ends** by dividing into two arteries: circumflex artery and artery anterior interventricular artery.
- **Branches:**
  - a. **Circumflex artery:**
    - It **passes** to the left in the coronary sulcus where it gives **left marginal** branch, then **turns** backwards around the left border of the heart and **continue** in the coronary sulcus with the coronary sinus to **end** by anastomosing with the right coronary artery.
    - It **supplies** the left atrium and left ventricle.
  - b. **Anterior interventricular artery:**
    - It **descends** with the great cardiac vein in the anterior interventricular groove to **reach** the inferior border of the heart near the apex, then **turns** to reach the inferior interventricular groove.
    - It **ends** by anastomosing with inferior interventricular artery.
    - It **supplies** the anterior surface of both ventricles and anterior 2/3 of interventricular septum.
  - c. **Small unnamed branches:**
    - Most of left atrium and left ventricle
    - Anterior 2/3 of the interventricular septum
    - Branch to SA node and AV bundle & its branches.



# Anatomy of the Heart

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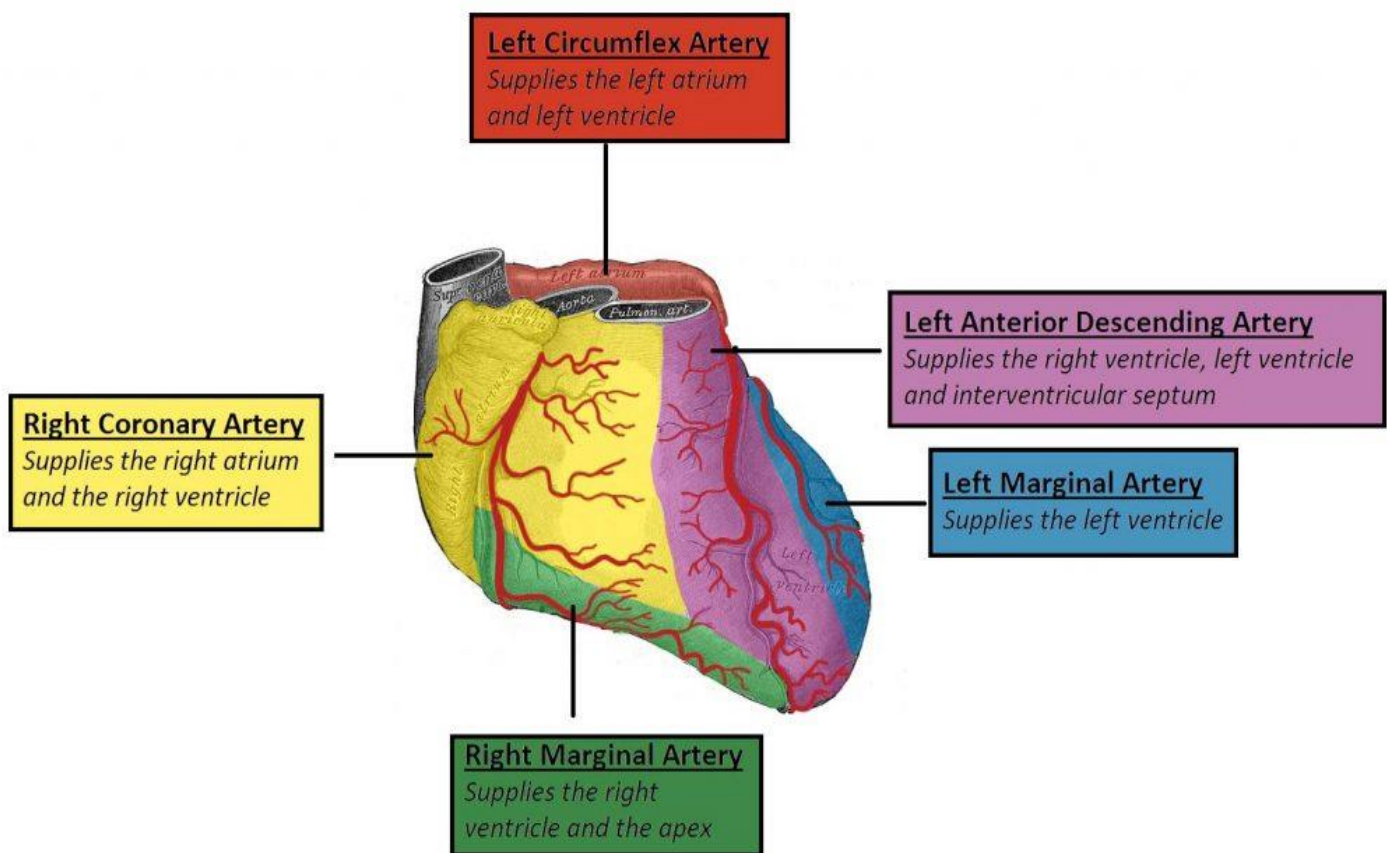
## Anastomosis between the branches of the coronary arteries



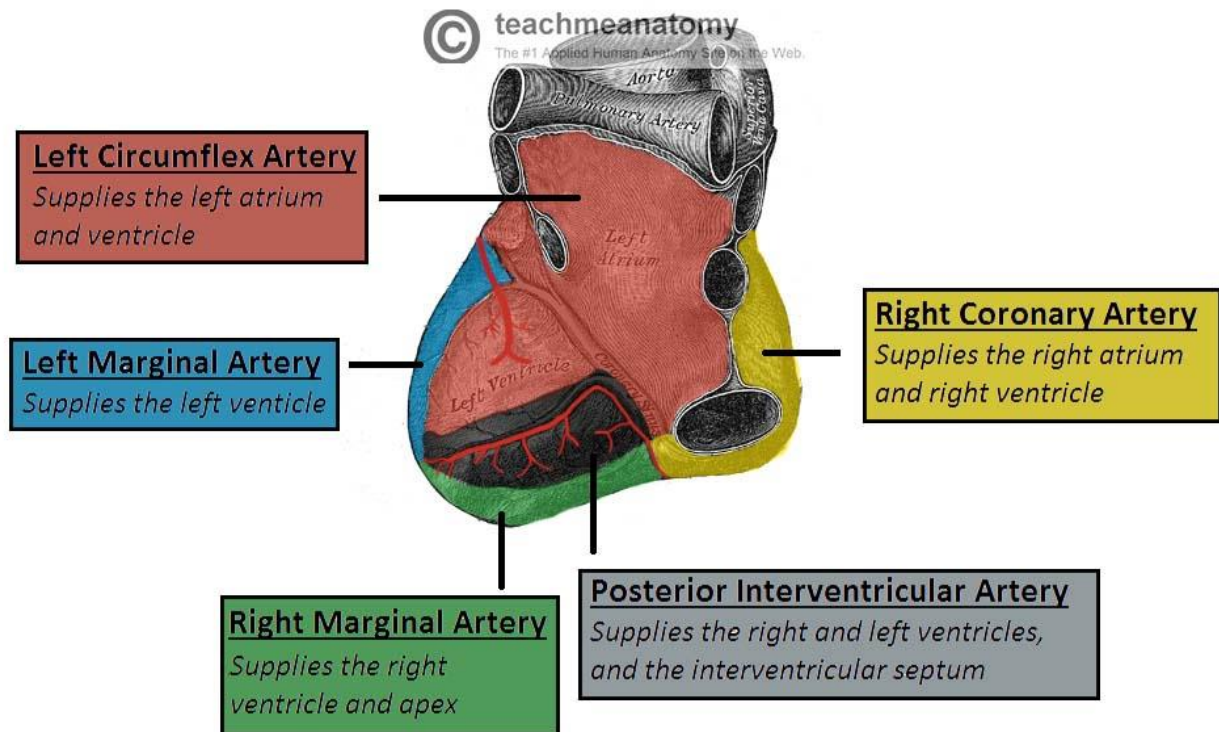
# Anatomy of the Heart

## Summary of arterial supply to the heart:

	Right coronary artery	Left coronary artery
<b>Right ventricle</b>	All of the right ventricle except small area .	small area related to the anterior interventricular
<b>Left ventricle</b>	Small area of inferior surface close to inferior interventricular sulcus.	All of the left ventricle except small area supplied by right coronary .
<b>Atria</b>	Right atrium and small area of left atrium.	Most of the left atrium.
<b>Interventricular septum.</b>	Posterior 1/3 of interventricular septum.	Anterior 2/3 of interventricular septum.
<b>Conductive system</b>	S.A node and A.V node	S.A node and AV bundle & its branches



# Anatomy of the Heart



## ★ Applied anatomy:

- **Anastomoses** between the branches of the right and left coronary arteries exist, but they are usually **poor except in athelets**.
- **Sudden occlusion** of one of the branches of coronary arteries usually leads to **myocardial infarction**, except in athelets.
- **Sudden occlusion** of one of the large branches of coronary arteries is a common cause of sudden death.
- **Visualization** of **left side** of heart or **coronary** arteries by **diagnostic cardiac catheter** (introduced from radial artery) and **angiography** .
- **Visualization of right side** of the heart **and pulmonary trunk** by diagnostic cardiac catheter (introduced from femoral vein) and angiography.
- Coronary occlusion is **treated by** stenting or coronary bypass operation.
- **Cardiomegaly** is enlargement of the heart.

## B. Venous drainage (Cardiac veins)

### I) Coronary sinus:

- It is a **wide short** venous channel 3 cm long, runs in the posterior part of **coronary groove**.
- It **ends** into the right atrium to the left side of the opening of the inferior vena cava and its opening is guarded by a small valve.

## Coronary Veins

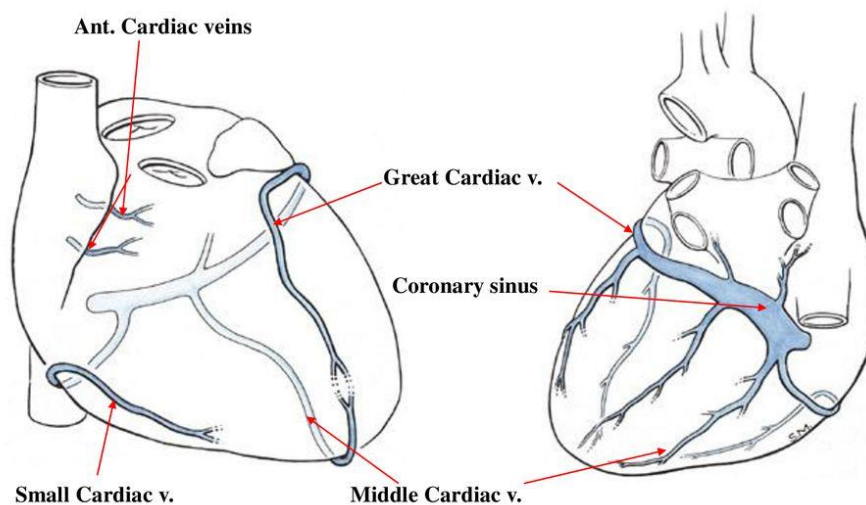
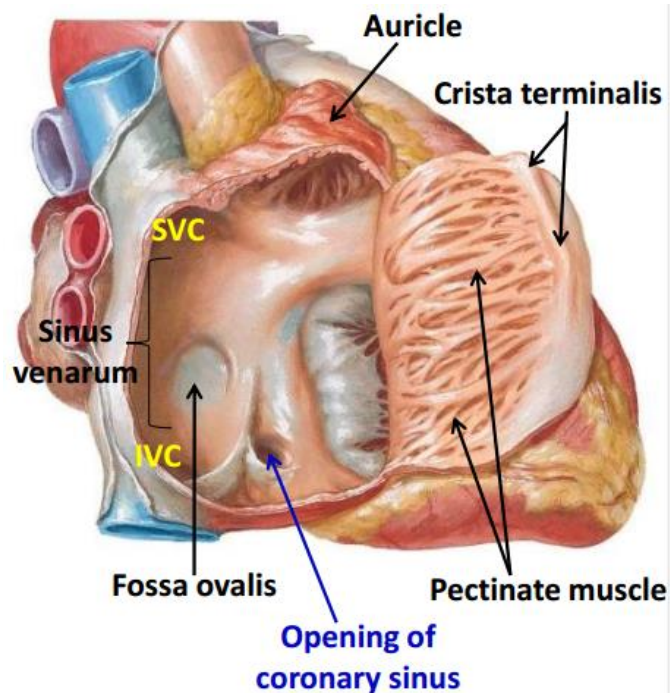


Fig. 1.52



## Anatomy of the Heart

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- **Tributaries:**

- 1-Great cardiac vein:**

- It **begins** near the apex and **runs** in the **anterior interventricular** sulcus **with** the anterior interventricular artery.
    - Then it follows the course of **circumflex artery** to **ends** in the left end of the **coronary sinus**.
    - It **receives** the **left marginal vein & veins mainly** from left atrium & ventricle.

- 2- Middle cardiac vein:**

- It **begins** near the apex of heart and **passes** in the inferior interventricular sulcus with **inferior interventricular** the artery,
    - It **ends** in the middle of the **coronary sinus**.
    - It **receives** the **veins** from the 2 ventricles.

- 3- Small cardiac vein:**

- It **begins** near the apex and runs with the right **marginal artery**, along the **lower border** of the heart till the **coronary sulcus** where it turns backwards with the **right coronary** artery.
    - It **ends** in near the right end of **coronary sinus**.
    - It **receives** the **right marginal vein & veins mainly** from right atrium & ventricle.

- 4- Oblique vein of left atrium:**

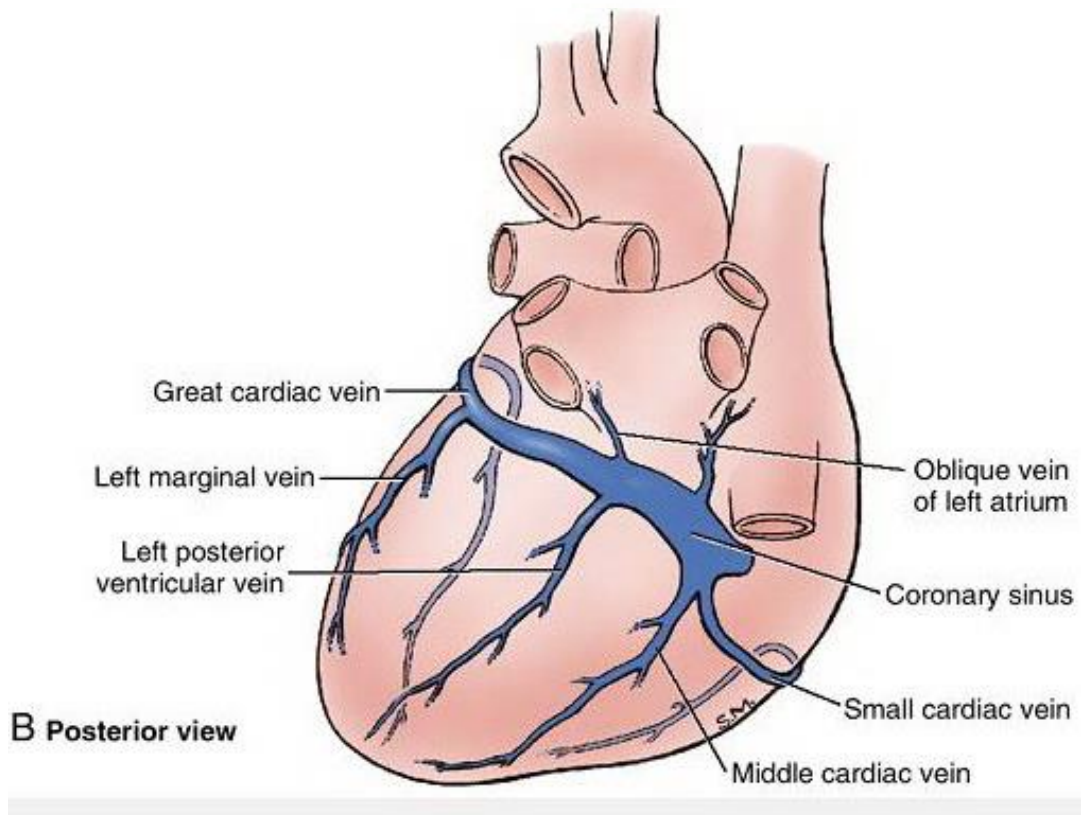
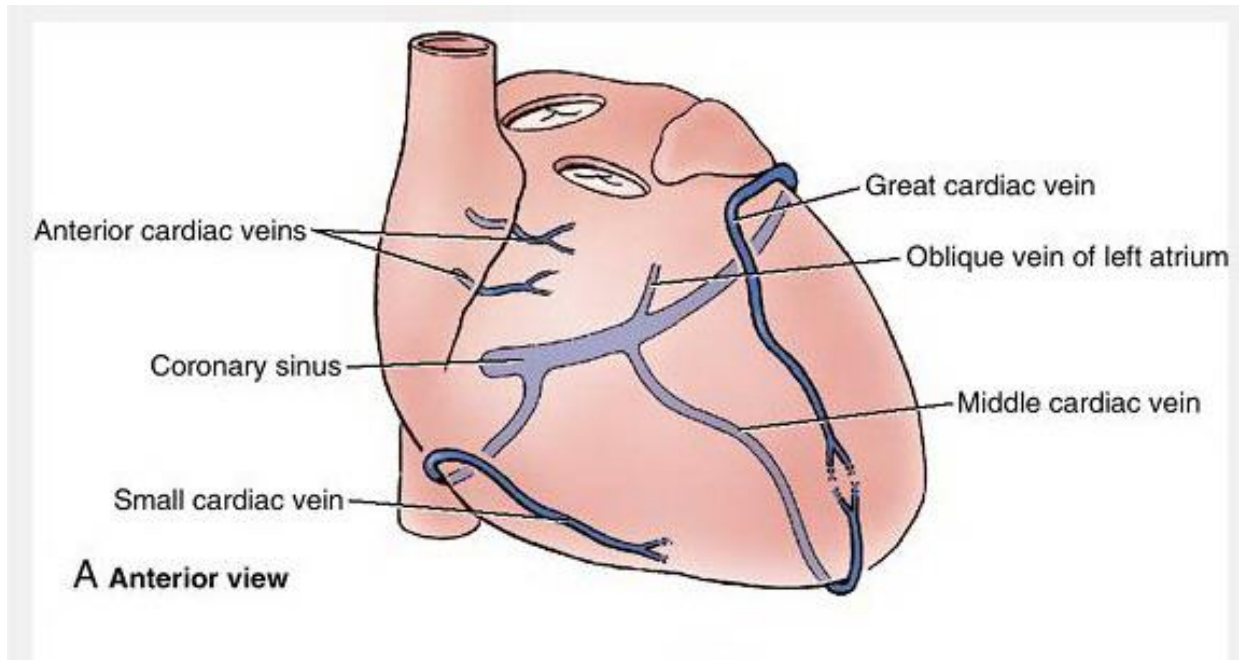
- **It** descends on the back of the atrium to end in the coronary sinus near its middle.

- 5- Posterior cardiac vein of left ventricle:** it runs on the left side of the middle cardiac vein and ends in the coronary sinus.

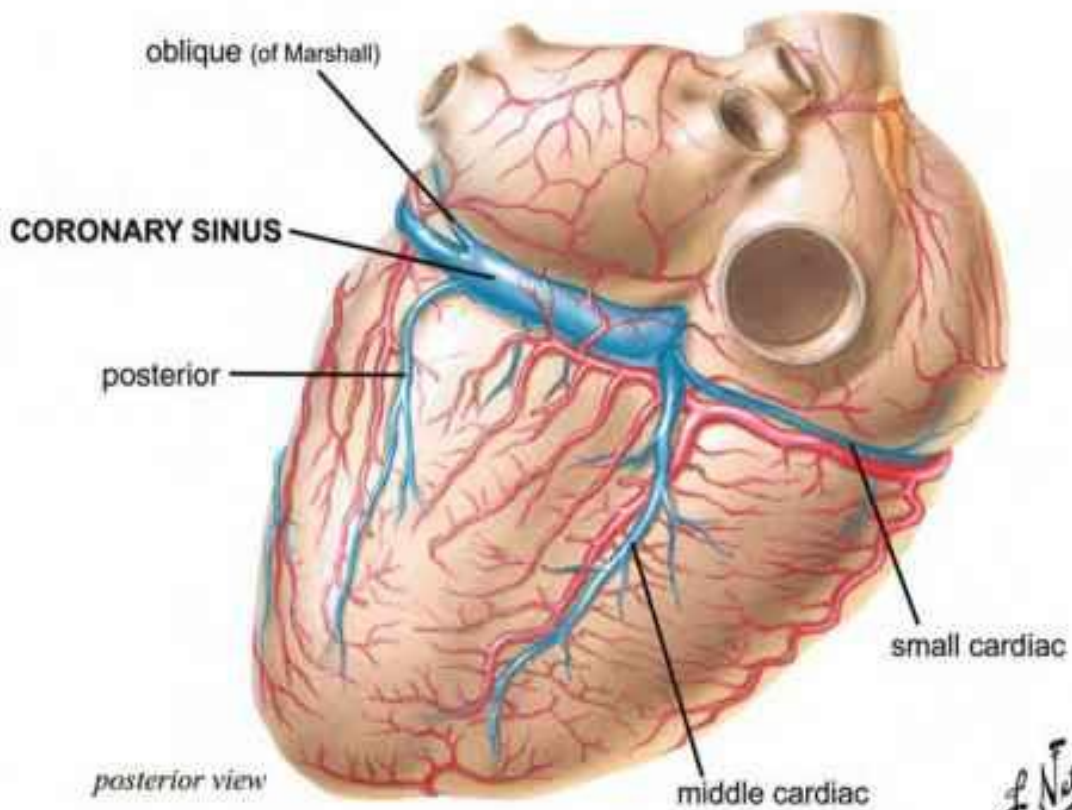
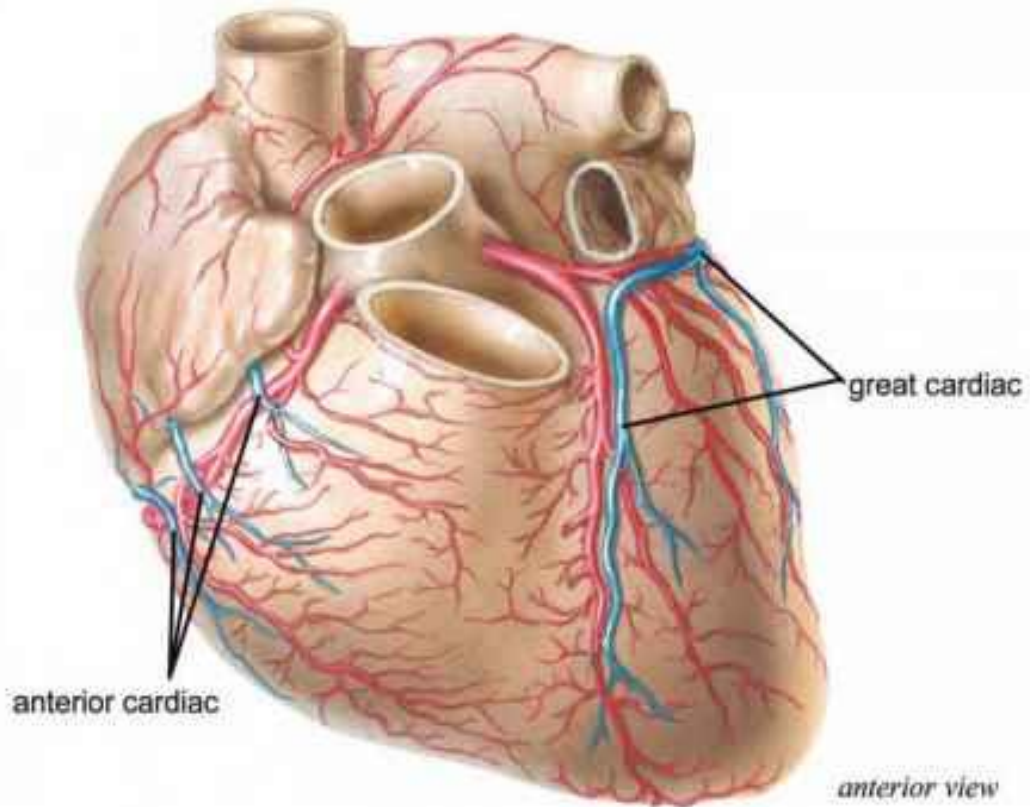
## Anatomy of the Heart

**II) Anterior cardiac veins:** 3 or 4 small veins run from anterior surface of right ventricle to open in the cavity of the right atrium.

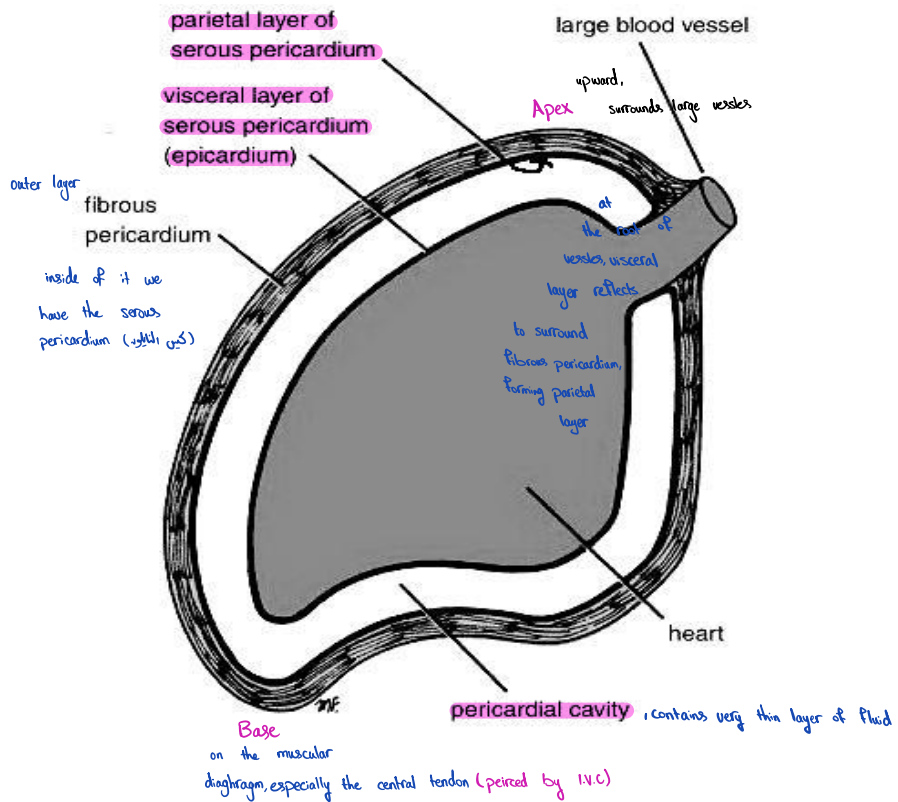
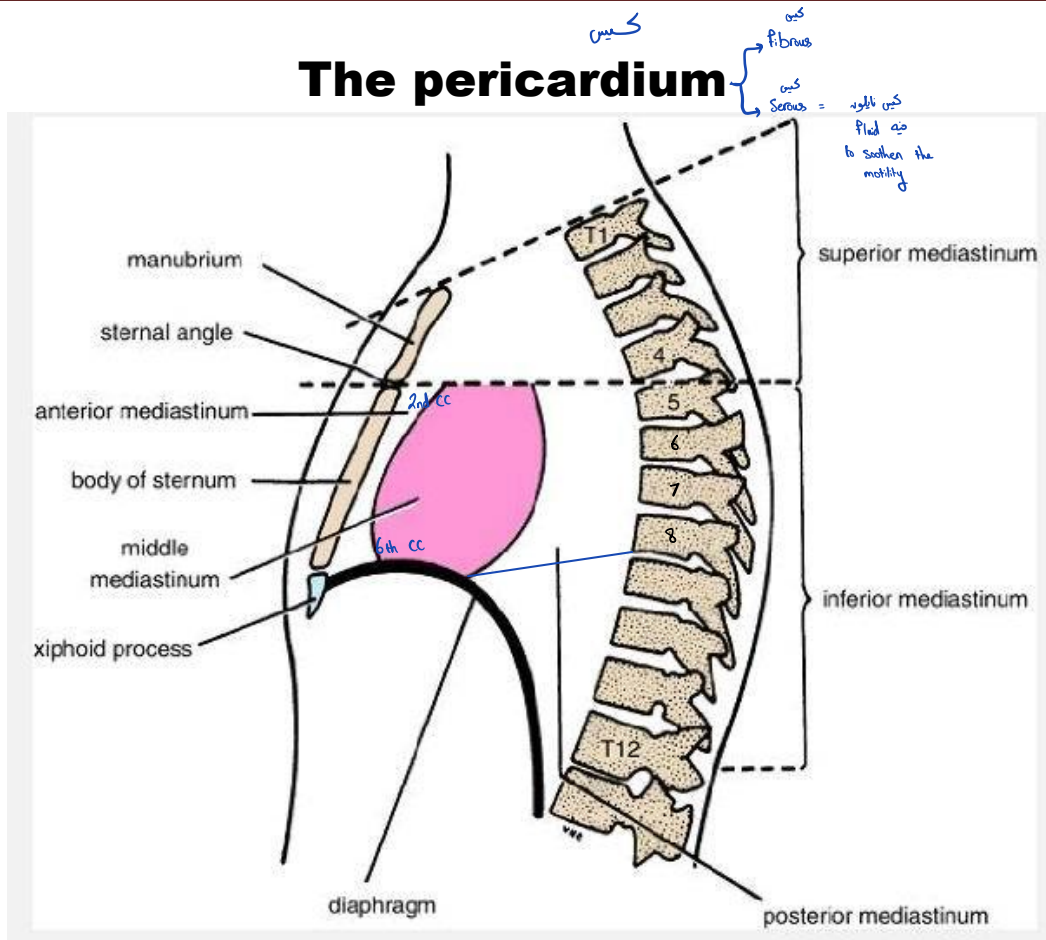
**III) Venae cordis minimae:** Minute veins present **within the myocardium** and open in all chambers mainly right atrium.



## Venous drainage of the heart



# Anatomy of the Heart



## Position and part of pericardium

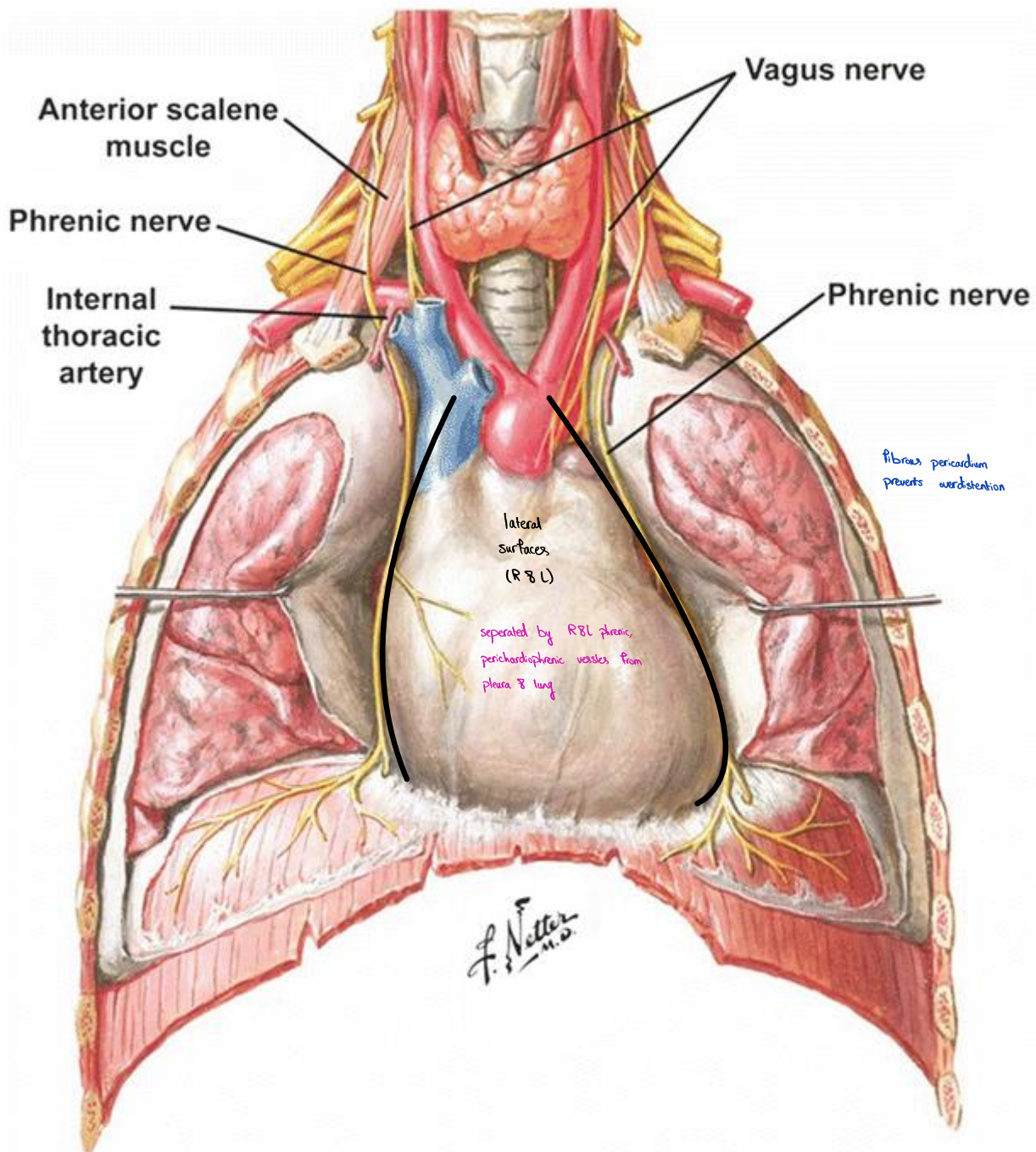


## Anatomy of the Heart

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- ★ The pericardium is a **fibro serous sac** which **surrounds** the heart and the roots of large vessels attached to it (ascending aorta, pulmonary trunk, lower ½ of SVC, terminal parts of IVC and 4 pulmonary veins).
- ★ It lies in the **middle mediastinum extending** from the plane of the sternal **angle of Louis** above, to the **diaphragm below**. In front, it extends from the **2<sup>nd</sup> to the 6<sup>th</sup>** costal cartilages. Behind, it lies opposite the **5<sup>th</sup> to the 8<sup>th</sup>** thoracic vertebrae.
- ★ It is **formed of** two parts:
  - A) An **outer** fibrous layer called "**fibrous pericardium**."
  - B) An **inner** serous sac known as "**serous pericardium**".
- ★ **Fibrous pericardium:**
  - It is formed of **tough, inelastic strong fibrous** tissue.
  - It forms the **boundaries of the middle mediastinum**.
  - **Shape:** It is **conical** having a base, an apex and four surfaces:
    - 1) **Base:**
      - It is directed **downwards** and attached the **central tendon of diaphragm**.
    - 2) **Apex:**
      - It is directed **upwards**.
      - It **surrounds and fuses** with the outer coats of the ascending aorta, pulmonary trunk and SVC.

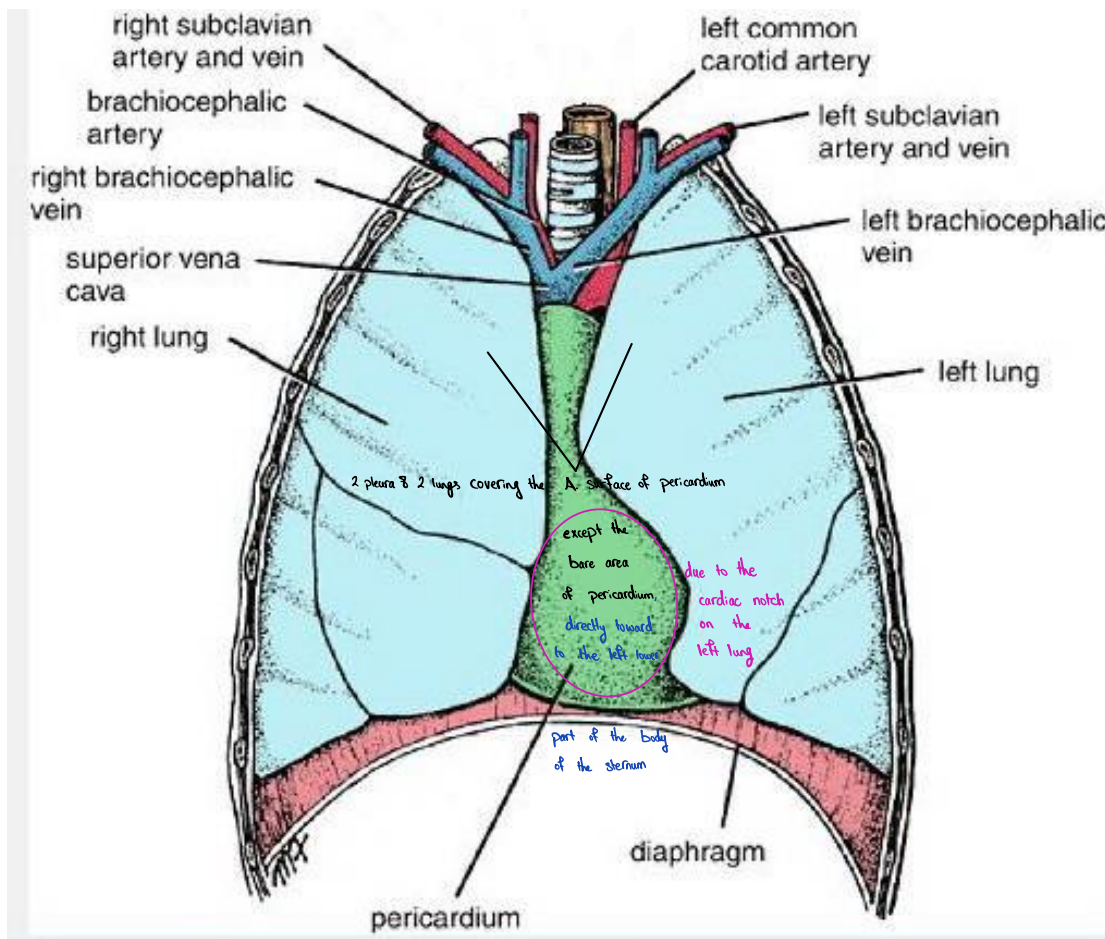
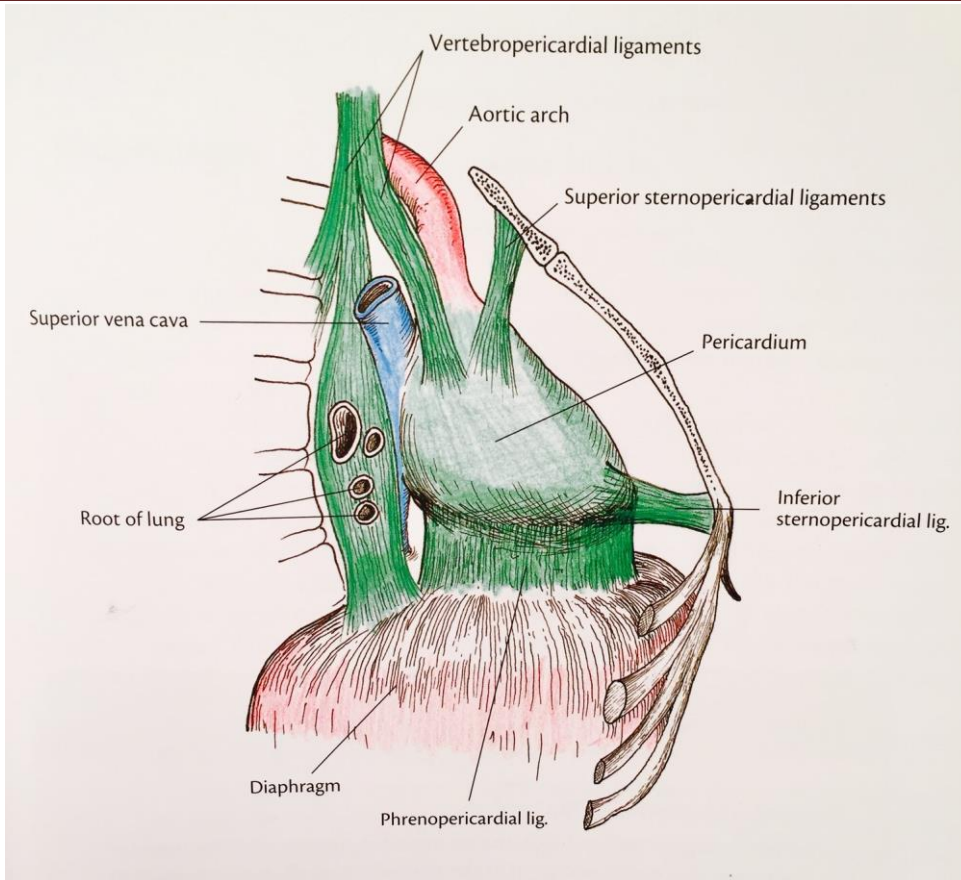
# Anatomy of the Heart



### 3) Anterior surface:

- It is connected to the body of the sternum by superior and inferior **sternopericardial ligaments**.
- The anterior borders of the **two pleurae and lungs** separate it from body of sternum **except** the lower left part of body of sternum which lies in direct relation to the pericardium (**bare area of pericardium**).

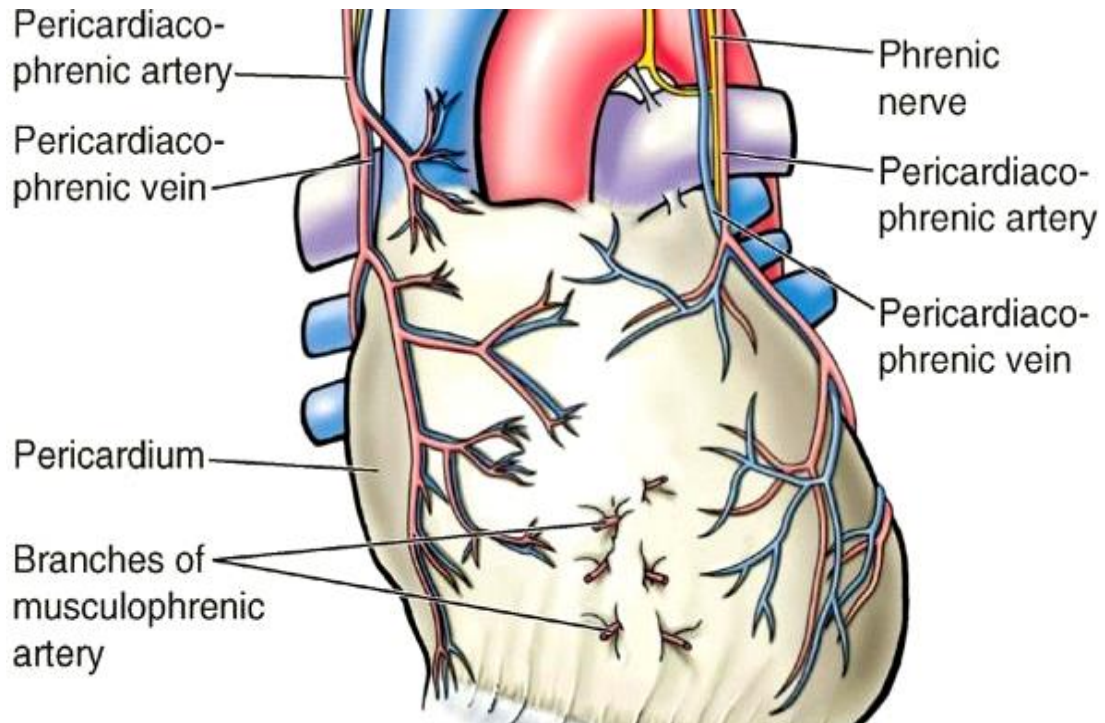
# Anatomy of the Heart



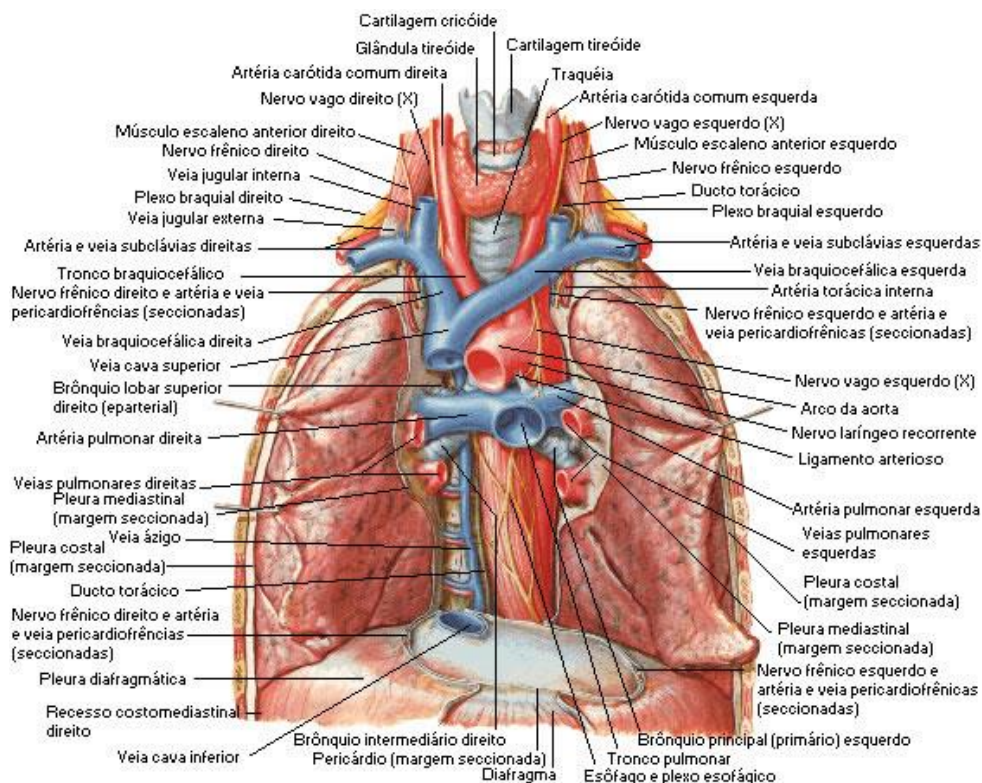
## Anatomy of the Heart

### 4) Two lateral surfaces:

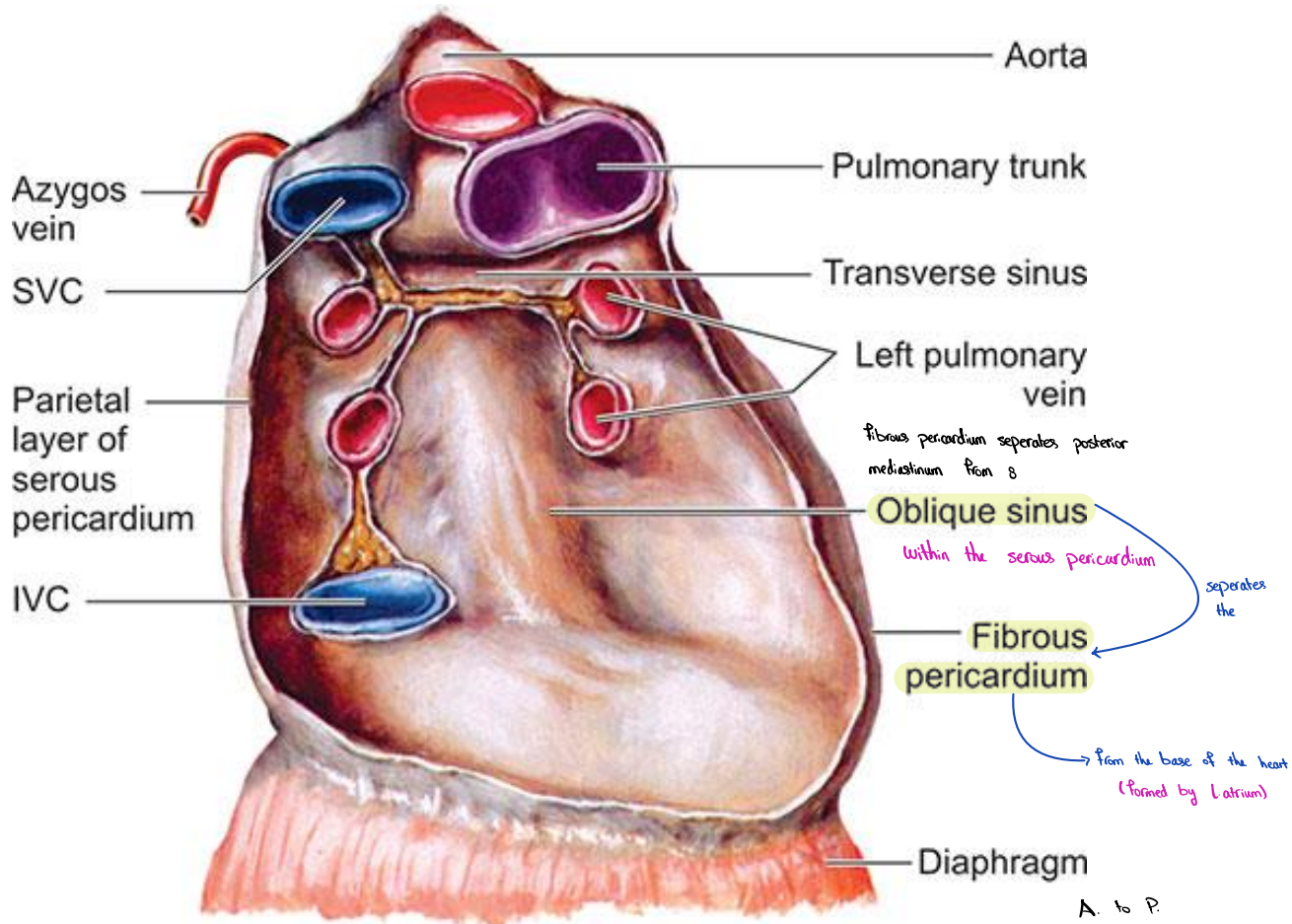
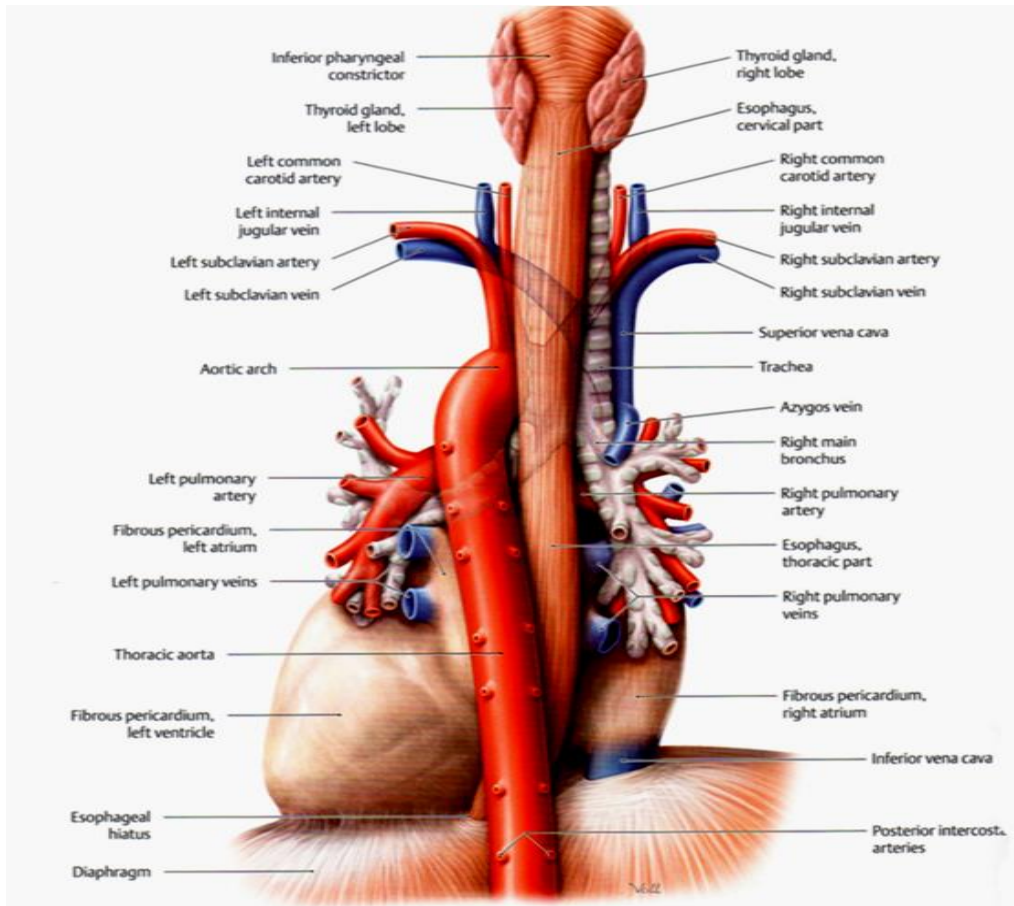
- Each surface is related mainly to the corresponding lung, pleura, phrenic nerve and pericardiophrenic vessels.



### 5) Posterior surface: related to oesophagus and descending aorta separating them from the oblique sinus & left atrium.



# Anatomy of the Heart



# Anatomy of the Heart

## ★ Serous Pericardium:

- It is a closed serous sac invaginated during fetal life from above and behind by the developing heart, so it is formed of 2 layers and a cavity:

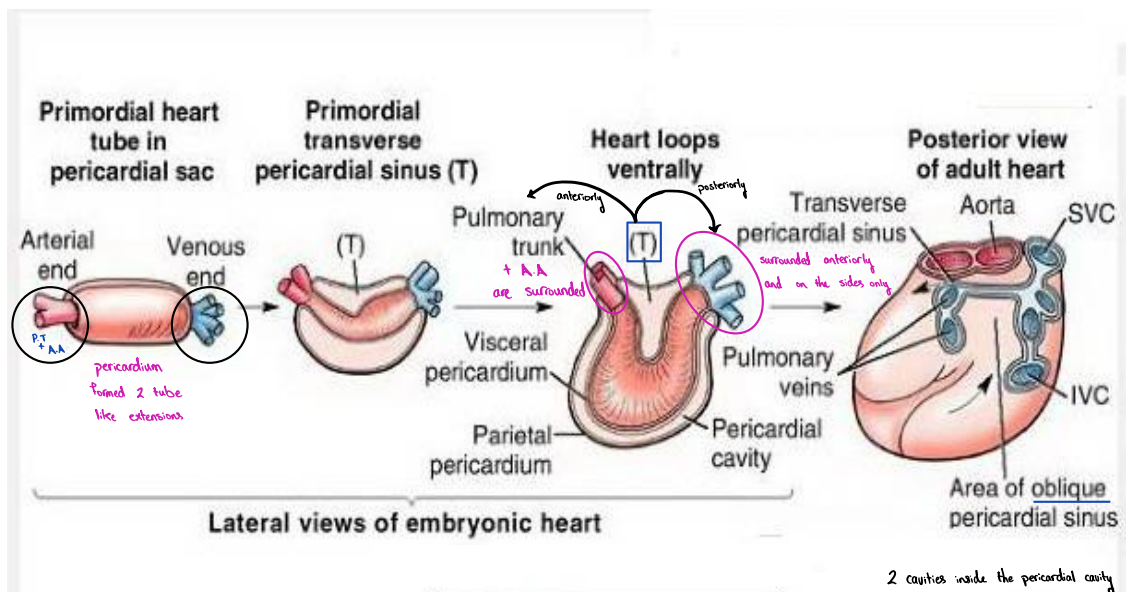
### a- Parietal layer:

- It lines the inner surface of the fibrous pericardium.
- It is reflected onto the heart and the roots of the great vessels.

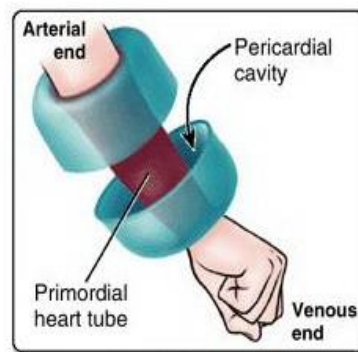
### b- Visceral layer:

- It covers and adherent to the heart forming the **epicardium**.

c-The potential space between the parietal and visceral layers is the **pericardial cavity**; it is empty except for a thin film of serous fluid.

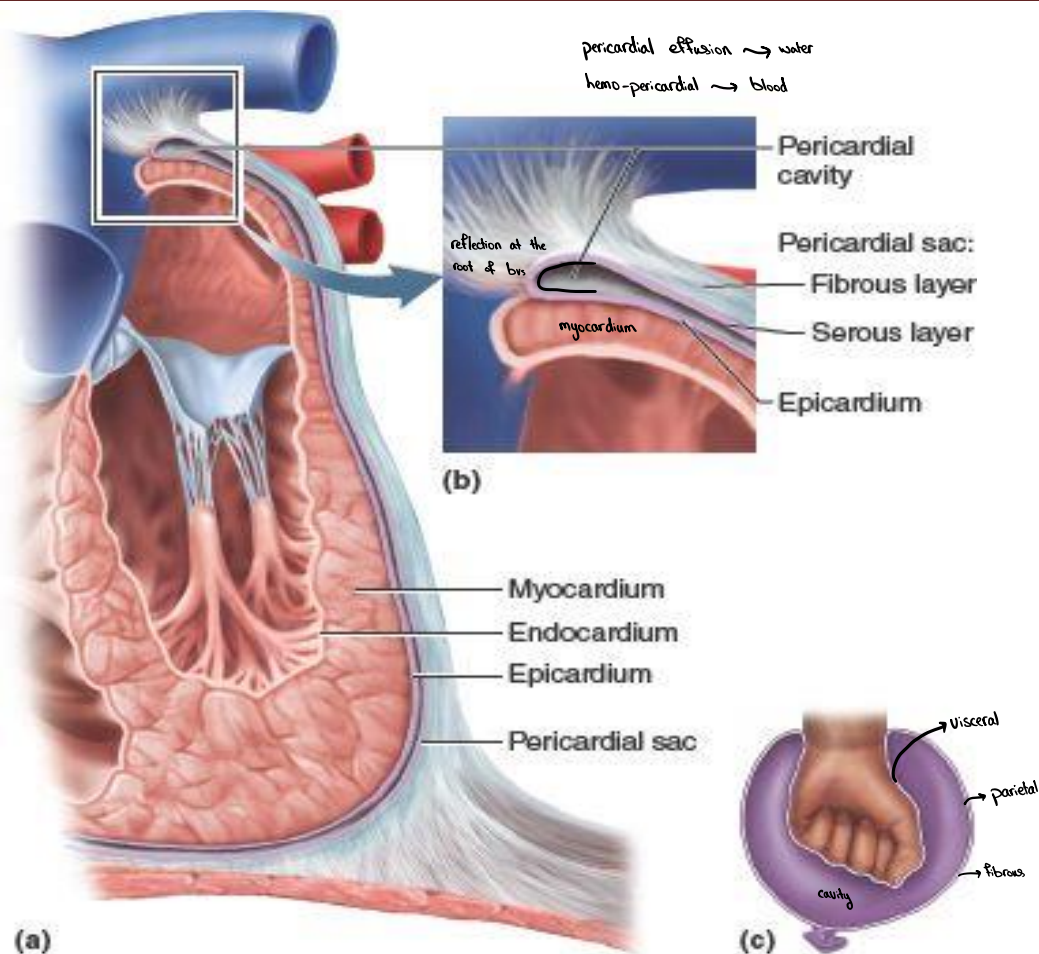


2 cavities inside the pericardial cavity  
oblique + transverse sinus



Schematic drawing of serous pericardium

# Anatomy of the Heart



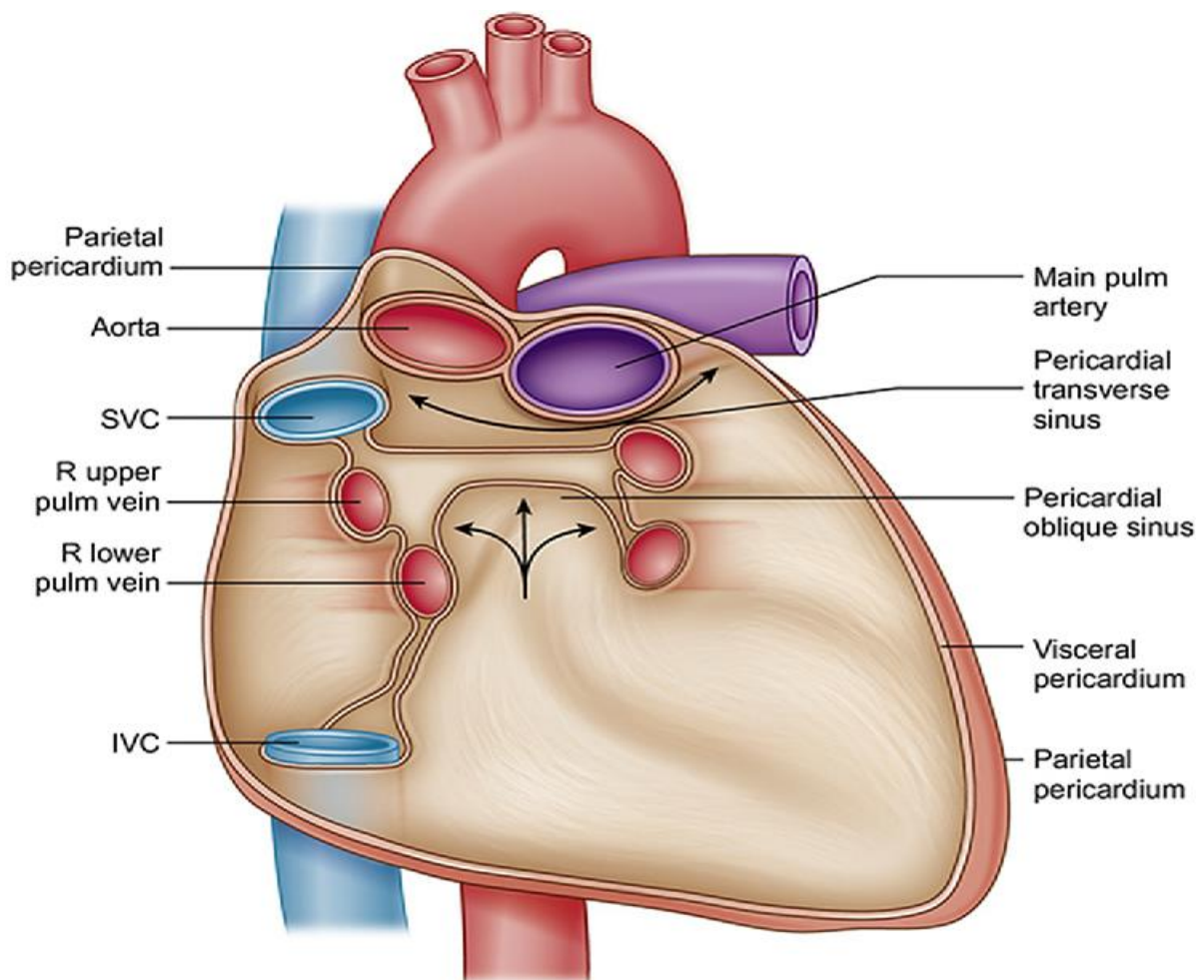
## ★ Sinuses of the Pericardium

- The visceral layer covering the heart (the epicardium) sends **2 tube-like extensions** to cover the roots of the great vessels:
  - a-** The **anterior tube** surrounds the **arterial end** of the heart enclosing completely the ascending aorta and the pulmonary trunk together (both were one vessel in the embryo).
  - b-** The **posterior tube** encloses the **venous end** of the heart covering anteriorly and the sides only of the lower 1/2 of S.V.C. and terminal parts of I.V.C. & the 4 pulmonary veins (Their posterior surfaces are bare and not covered by epicardium).
- There are **2 sinuses** related to the serous pericardium (inside the pericardial cavity):

# Anatomy of the Heart

## I) Transverse Sinus of Pericardium:

- A transverse passage between the arterial and the venous ends of the heart. I
- It **connects the right and left sides** of the pericardial cavity.
- **Boundaries:**
  - 1- Anterior:** ascending aorta and pulmonary trunk.
  - 2- Superior:** right pulmonary artery.
  - 3- Posterior:** lower part of S.V.C. and the 2 atria, mainly left.
  - 4- Inferior:** the 2 atria, mainly left.

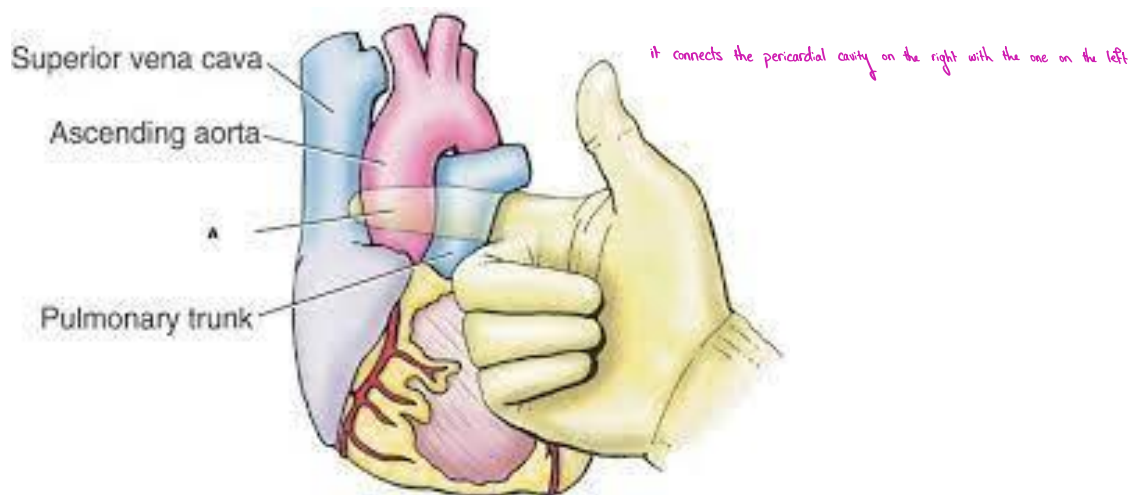
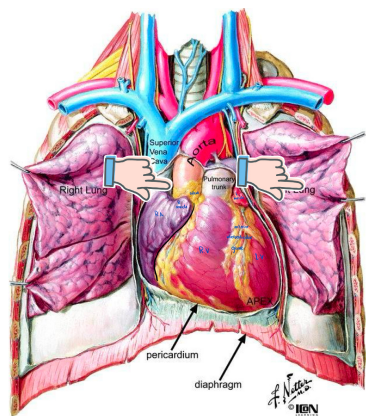




# Anatomy of the Heart

## ➤ How to reach:

- A finger is pushed from the right side in front of the lower part of the S.V.C. and behind the ascending aorta and pulmonary trunk.
- The finger will traverse the sinus and appear at its left end between the pulmonary trunk in front and the left auricle behind.



## II) Oblique Sinus of Pericardium:

- The visceral layer of serous pericardium passes on the diaphragmatic surface of the heart then ascends to cover the back of the left atrium and reflected on the fibrous pericardium to form the parietal layer of serous pericardium.
- Thus a blind recess in the pericardial cavity is formed between the left atrium (in front) and the fibrous pericardium (behind).
- **Boundaries:**
  - 1- Anterior:** back of the left atrium (i.e. base of the heart).
  - 2- Posterior:** parietal layer lining posterior fibrous pericardium separating the sinus from the structures in the posterior mediastinum (descending aorta and esophagus).

## Anatomy of the Heart

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**3-Superior:** the sinus is **closed** by the reflection of visceral layer of serous pericardium covering the back of the left atrium to the parietal layer of serous pericardium lining the posterior part of fibrous pericardium.

**4-On the right side:** reflection of serous pericardium onto the S.V.C., the 2 right pulmonary veins and the I.V.C. (from above downwards).

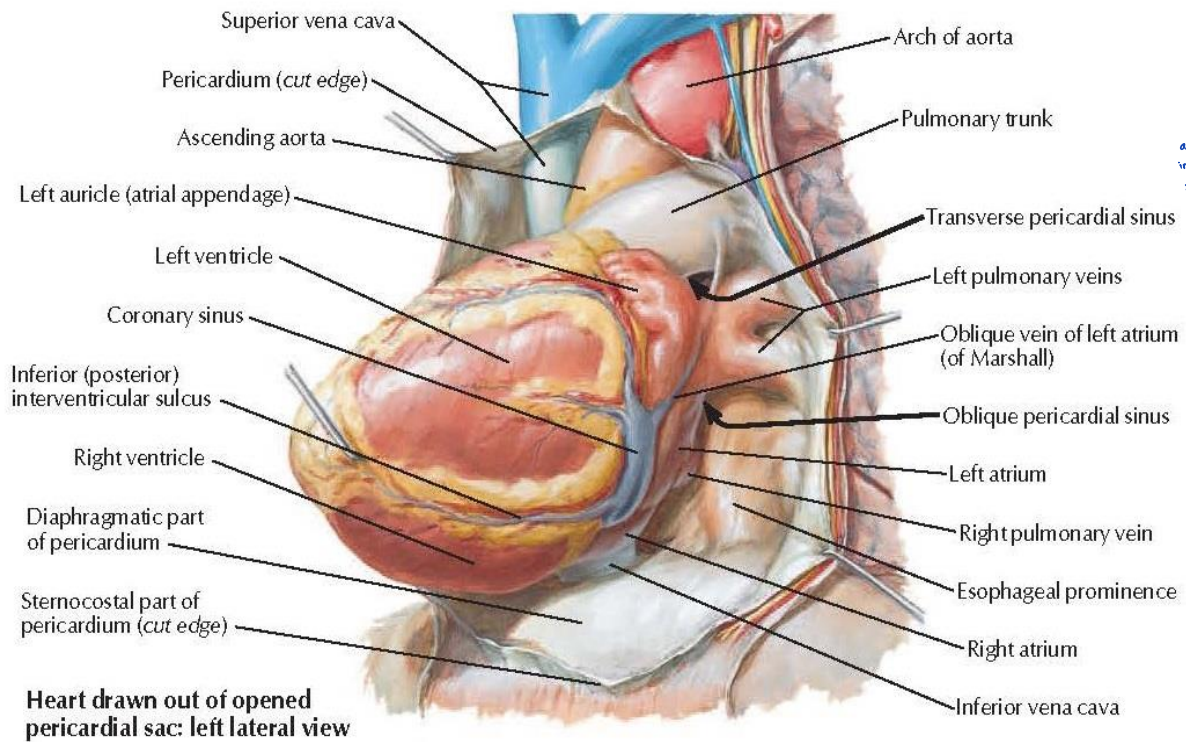
**5-On the left side:** reflection of serous pericardium onto the 2 left pulmonary veins (the left boundary is shorter than the right).

**6-Inferior:** the sinus is **open** into the main pericardial cavity. The **entrance** to sinus is bounded by I.V.C. (below and to right) and the lower left pulmonary vein (above and to left).

➤ **How to reach:**

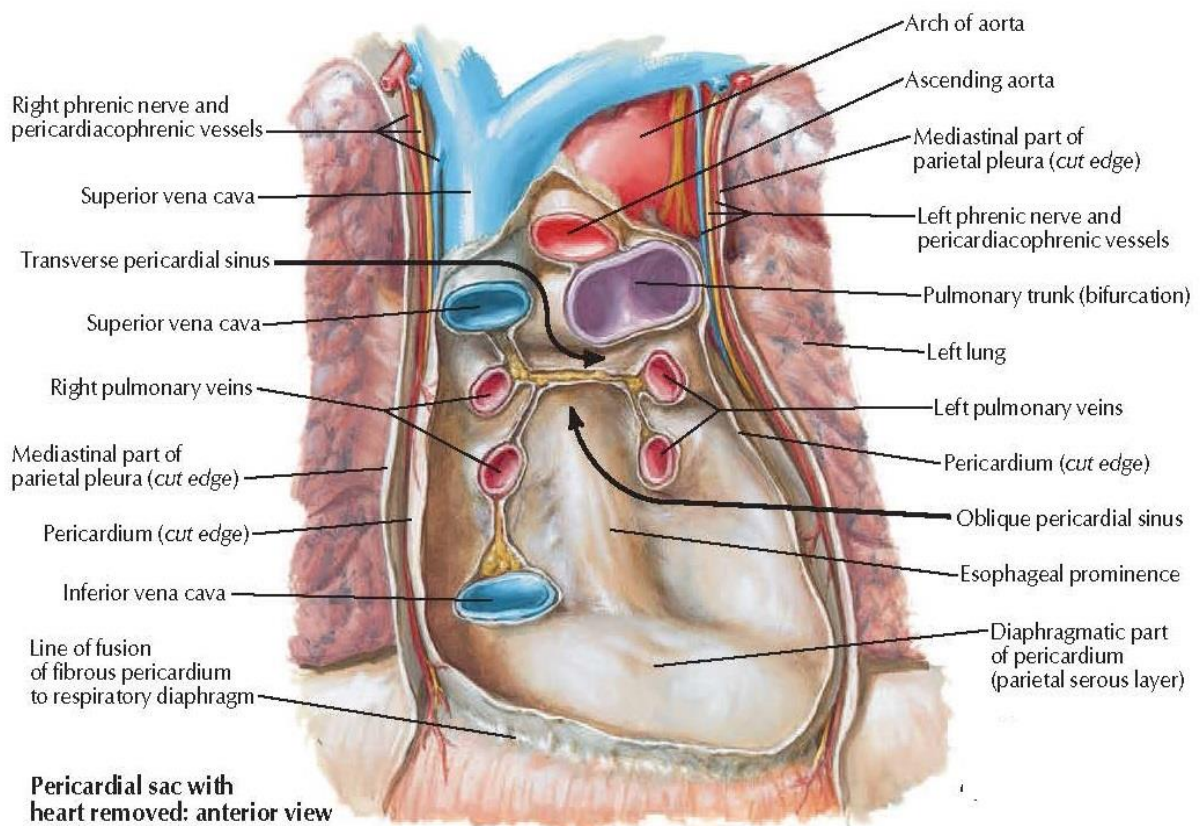
- The apex of the heart is lifted upwards and 3 fingers are placed behind the heart to the left of the I.V.C. then pushed upwards till they are stopped by the blind upper end of the sinus.
- The **upper border** of the left atrium separates the fingers in the oblique sinus from a finger put through the transverse sinus which lies just above and in front.

# Anatomy of the Heart



autonomic nerves are insensitive to pain but sensitive to ischemia

visceral layer on the inferior surface and left atrium is reflected to form the parietal layer



## Anatomy of the Heart

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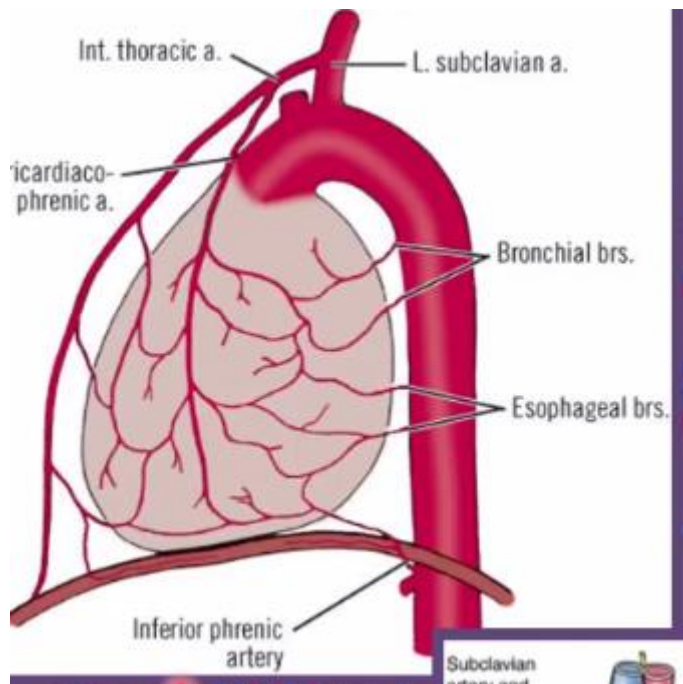
### ★ Blood supply of the pericardium:

#### a- Fibrous pericardium and parietal layer of serous pericardium:

- The **arterial** supply is from the **internal thoracic arteries** and their **pericardiophrenic** and **musculophrenic** branches and from descending **aorta**.
- The **venous** drainage is through the **azygos** venous system.

#### b- Visceral layer of serous pericardium:

- The epicardium has the same blood supply **as the heart**.
- It receives its arterial supply from the right and left **coronary arteries** and its venous drainage is via the **coronary sinus**.



## Anatomy of the Heart

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### ★ Nerve supply of the pericardium:

#### a- Fibrous pericardium and parietal layer of serous pericardium:

- It is supplied by the **phrenic** nerves (C<sub>3-5</sub>) which transmit somatic sensation; they are **sensitive to pain** (e.g. in pericarditis).

#### b- Visceral layer of serous pericardium:

- It is supplied, as the heart, by **autonomic** fibres (sympathetic and parasympathetic). It is **insensitive to pain** but sensitive to **ischaemia**.

### ★ Functions of Pericardium

#### a- The fibrous pericardium:

- **Protects** the heart, maintains its position and prevents its overdistension.
- Keeps the **mouth** of the large vessels open.

#### b- The serous pericardium:

- The **oblique sinus** acts as a **potential space** behind the left atrium allowing its **movements**. It also allows the **pulsation** of the descending thoracic aorta and the **expansion** of the esophagus during swallowing.
- The **transverse sinus** allows the **distension** of the great vessels, the ascending aorta and the pulmonary trunk, during systole.

### ★ Applied anatomy:

- 1. Pericarditis** is inflammation in the pericardium usually cause chest pain and pericardial rub on auscultation.
- 2.** Accumulation of clear serous fluid or pus in the pericardial cavity is called **pericardial effusion** leading to dullness around the normal cardiac dullness on percussion and distal heart sounds on

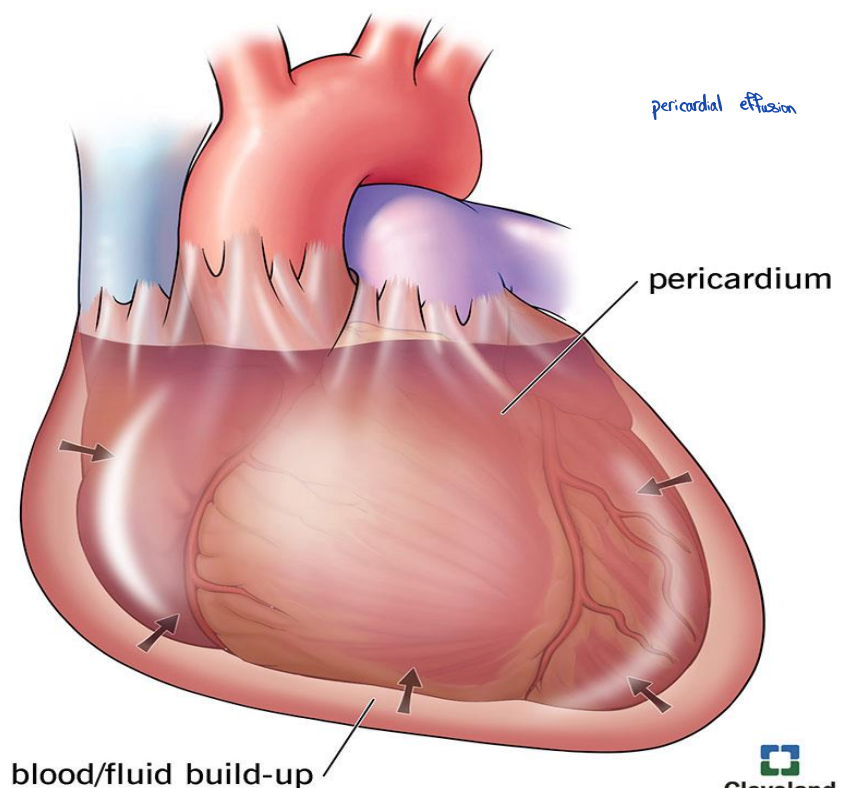
## Anatomy of the Heart

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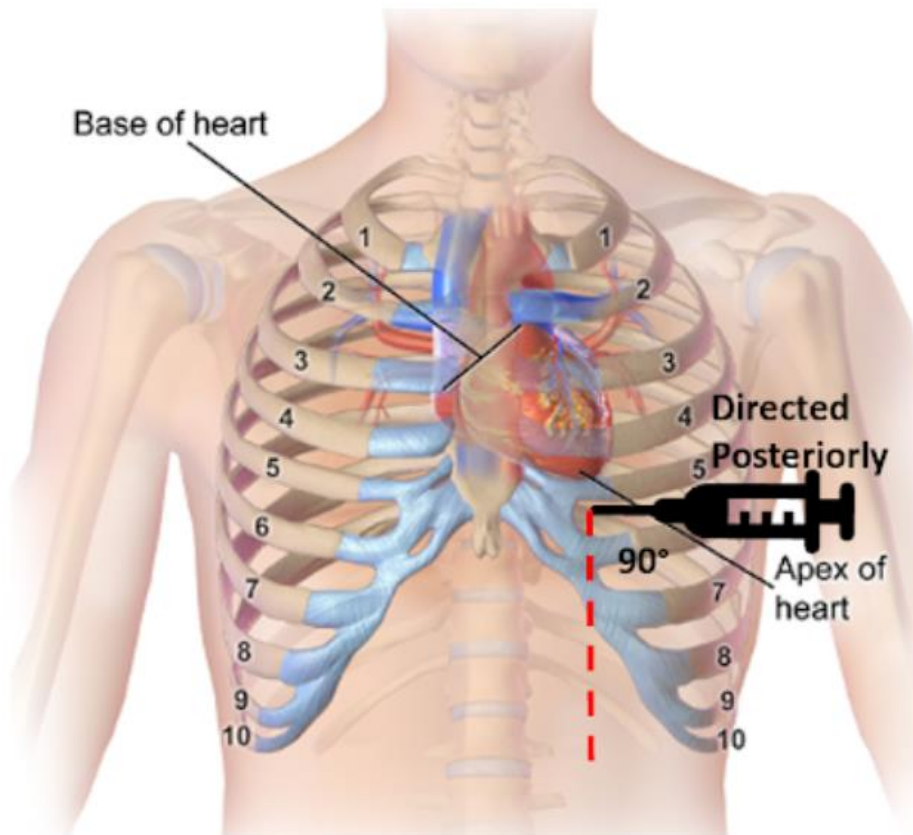
auscultation.

3. Accumulation of blood in the pericardial cavity is called **haemopericardium** (usually due to infarction, cardiac operation or cardiac trauma).
4. **Cardiac tamponate** is cardiac compression by haemopericardium usually lethal due to impairment of cardiac filling and cardiac output.
5. **Pericardiocentesis** is drainage of fluid from the pericardial cavity by a wide bore needle inserted parasternal in the left 5th. or 6th. intercostal space (i.e bare area of pericardium to avoid injury of left pleura, left lung and left internal thoracic vessels). The pericardial sac can also be reached via the left infrasternal angle by passing the needle postero-superior towards the left shoulder

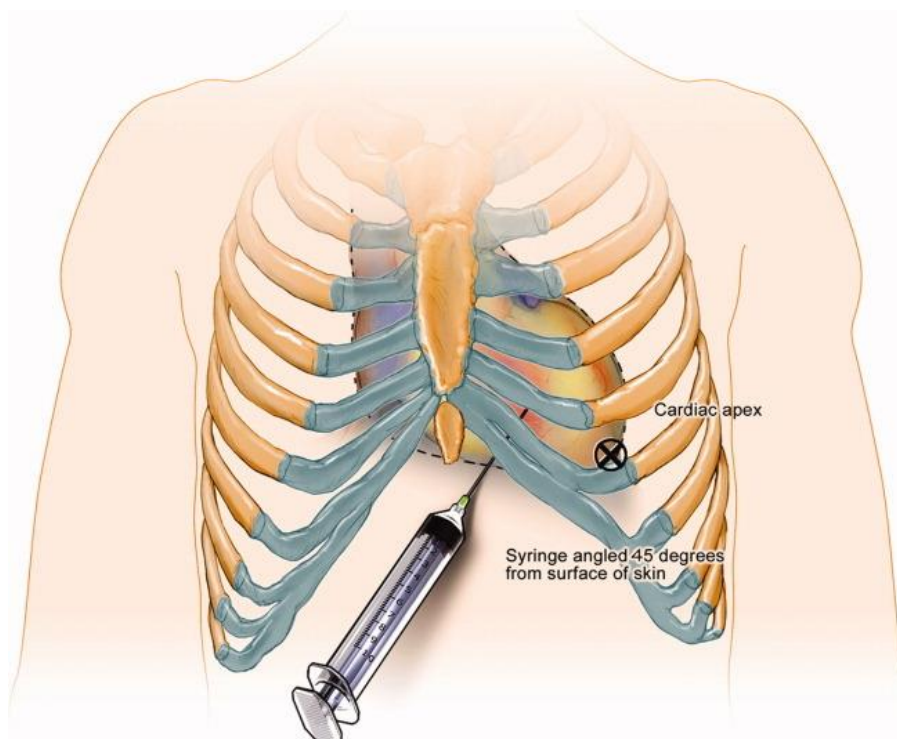
### Cardiac tamponade



# Anatomy of the Heart



**Parasternal**



**Sites of Pericardiocentesis**

## **Anatomy of the Heart**

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**6. During open heart surgery:** The transverse sinus of pericardium is used to pass a rubber catheter or clamp around the ascending aorta and pulmonary trunk to fix the heart or to divert the circulation to heart lung machine.