Anatomy & Embryology

Cardiovascular system (Part 1)

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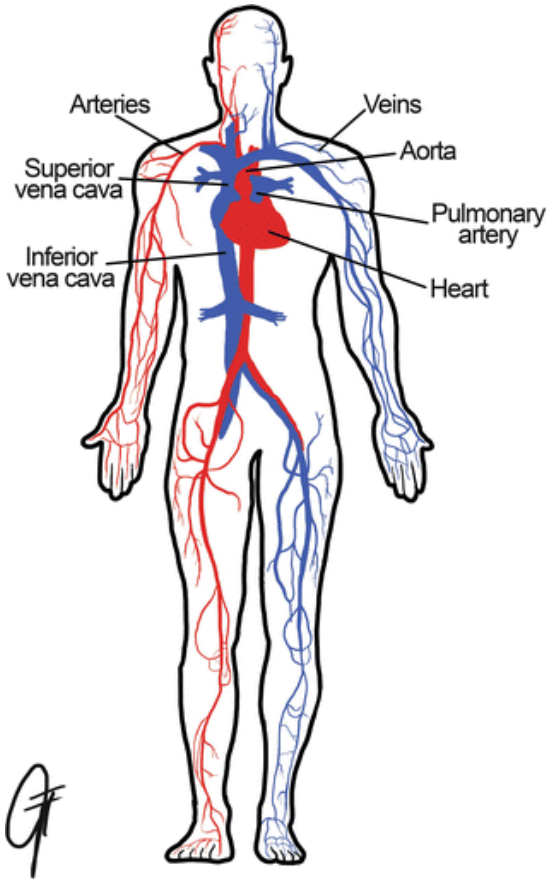
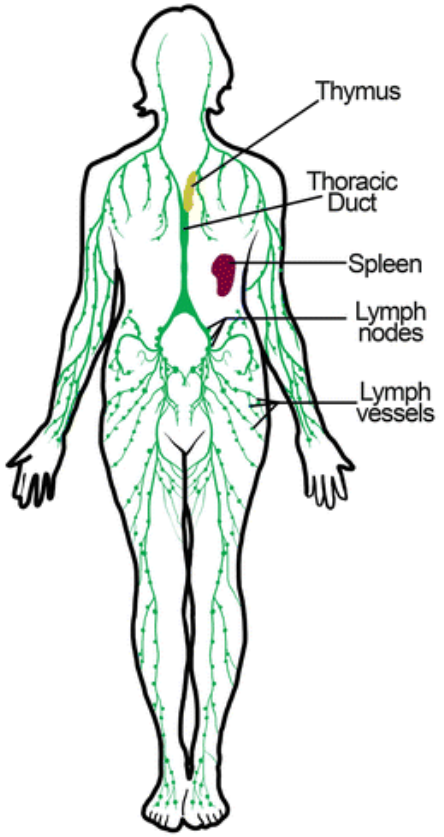
- **Circulatory system** is the system responsible for:

  - ➢ Distributing nutrients and O_2 to all body tissues and removing wastes and CO_2 from all body tissues.
  - ➢ Regulates body temperature.
  - ➢ Defence against infections and diseases.

Can be divided into:

1. The cardiovascular system (CVS)
   Heart and blood vessels
2. Lymphatic system
   Lymphatic vessels and lymphatic organs



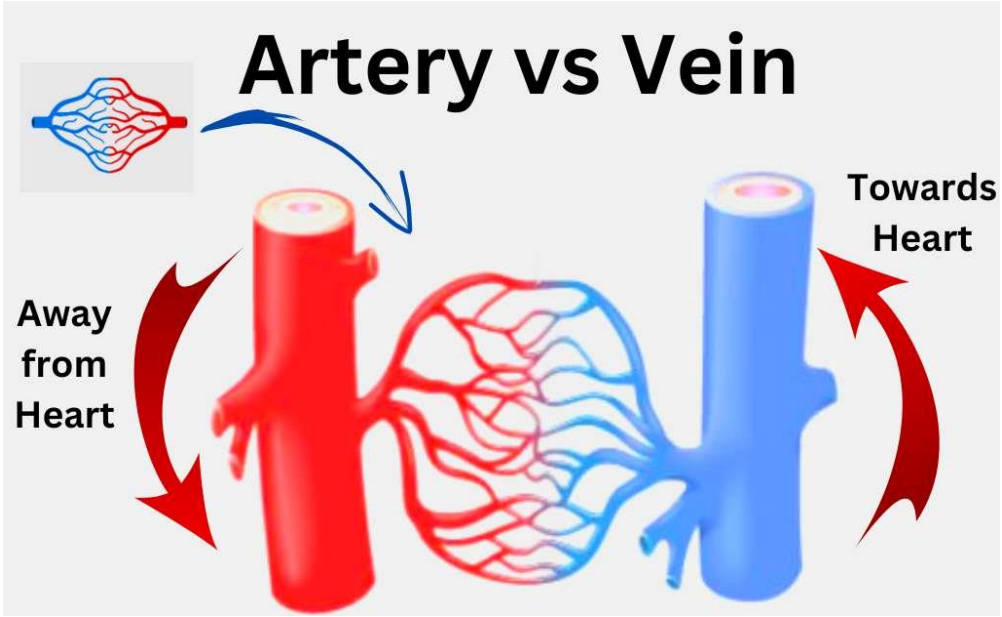


Arteries and Veins

- **Artery**: carries blood away from heart.
- **Vein**: carries blood towards the heart.

- Arteries always take blood away from the heart (a mnemonic to help you: **a**rtery=**a**way).

(Pulmonary artery & pulmonary veins)



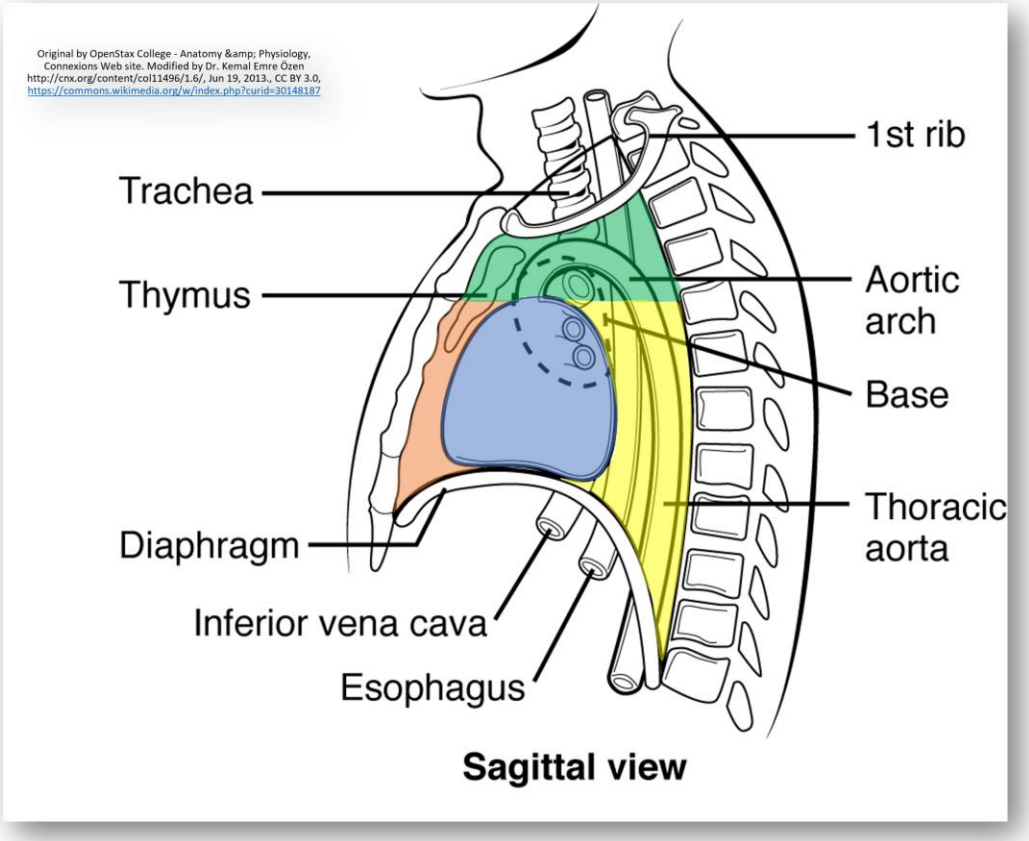
The heart

General characteristics:

- The first structure starts working in embryonic life (by the end of 4th week).
- An enlarged internally subdivided blood vessel, specialised for pumping.
- The heart is aligned **obliquely** in the thorax.
- Pumps blood through **pulmonary circulation** and **systemic circulation**
- Situated in the middle mediastinum and surrounded by **pericardium**

Location of heart

- **Mediastinum**, is a **space** in the thorax contains all the thoracic organs except the lungs.
- Divided into two parts, **superior and inferior**, the inferior mediastinum is further divided into anterior, middle and posterior
- **Pericardium** is **serous sac** situated in the middle mediastinum that surrounds and protects the heart.



Superior mediastinum

Anterior mediastinum

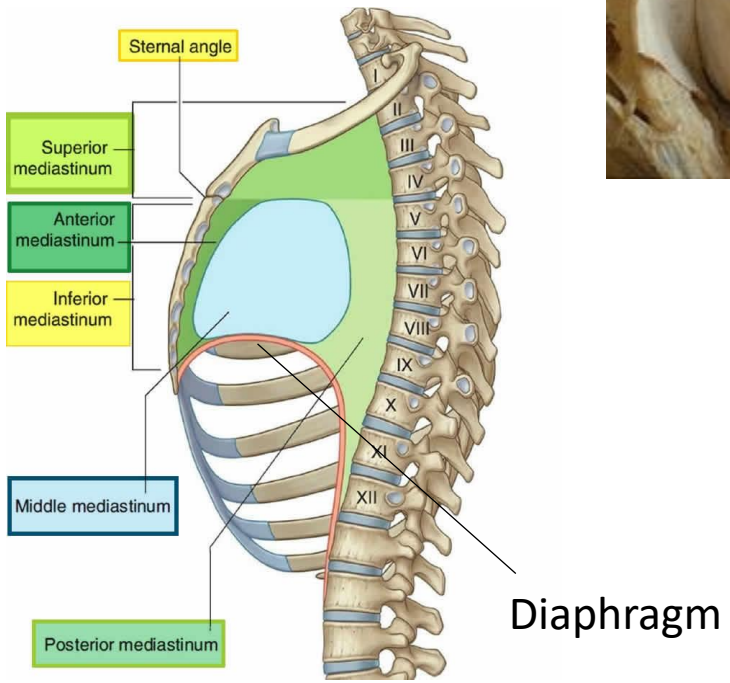
Middle mediastinum

Posterior mediastinum

Pericardium

- Boundaries:
  - Anteriorly: **body of sternum** and **2nd to 6th costal cartilages**
  - Posteriorly: **5th to 8th thoracic vertebrae**
  - Inferiorly: **diaphragm**

- Functions of pericardium:
  - Restrict excessive movements of the heart
  - Act as a lubricated container



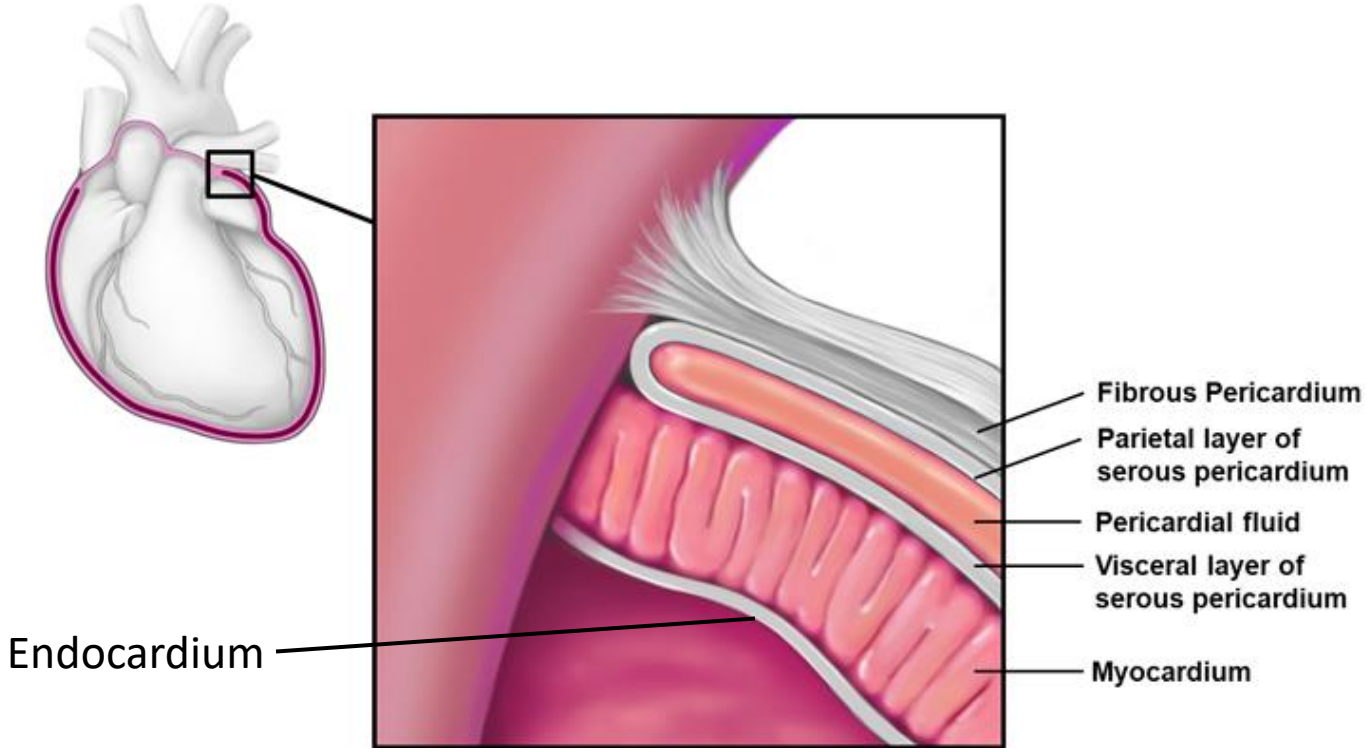
Pericardium

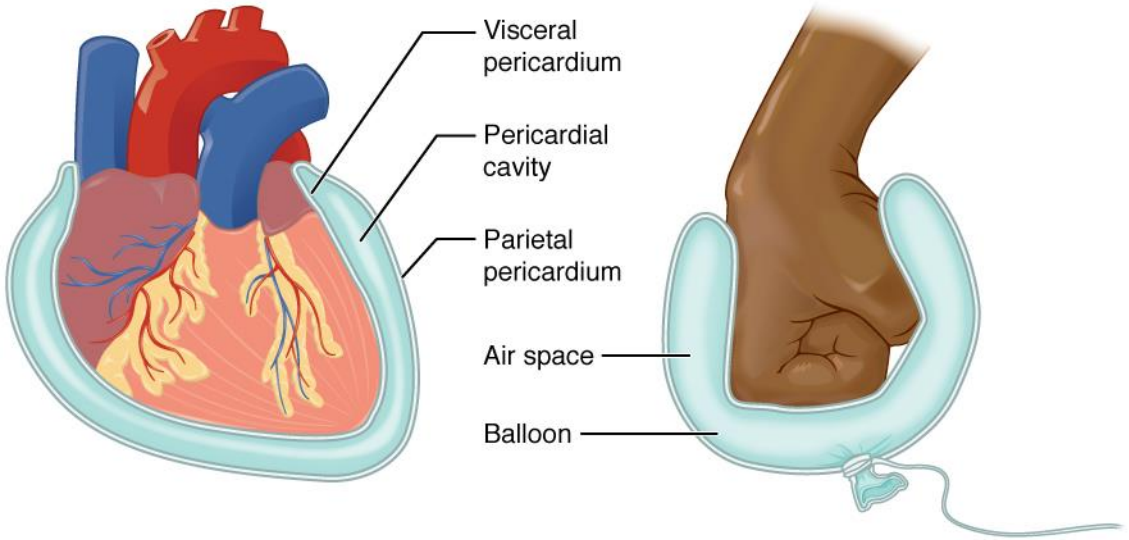
The pericardium is divided into:

- **Fibrous pericardium** (strong, outer layer), **attached firmly to the diaphragm below**

- **Serous pericardium** lines the fibrous pericardium and divided into:
  - **Parietal pericardium**
  - **Visceral pericardium** (epicardium)

Between the parietal and visceral layers of the heart there is a thin film of fluid called **pericardial fluid** (50ml)

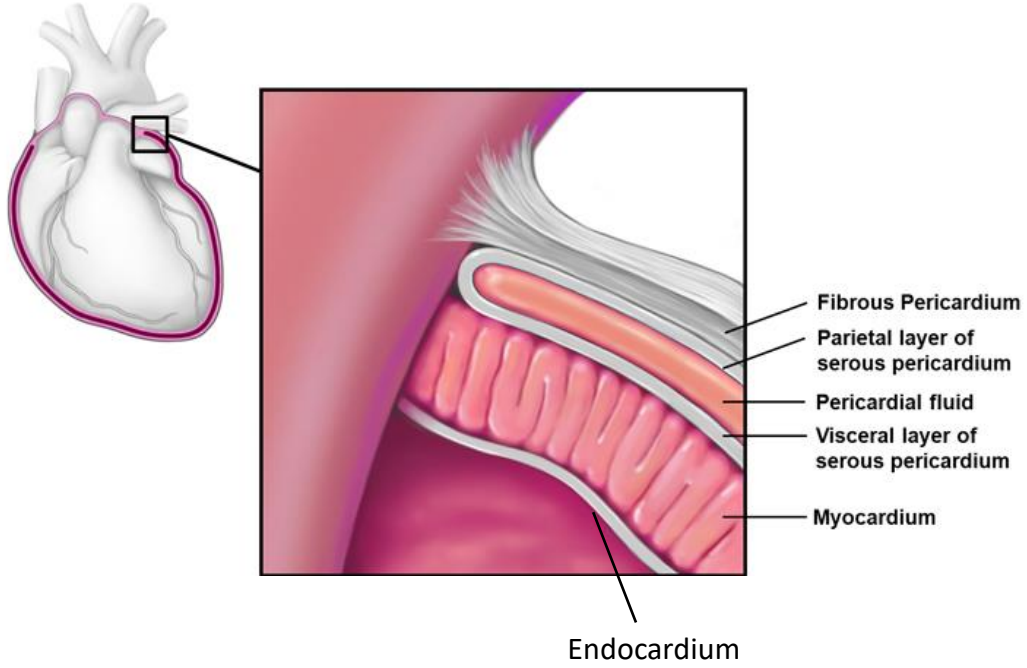


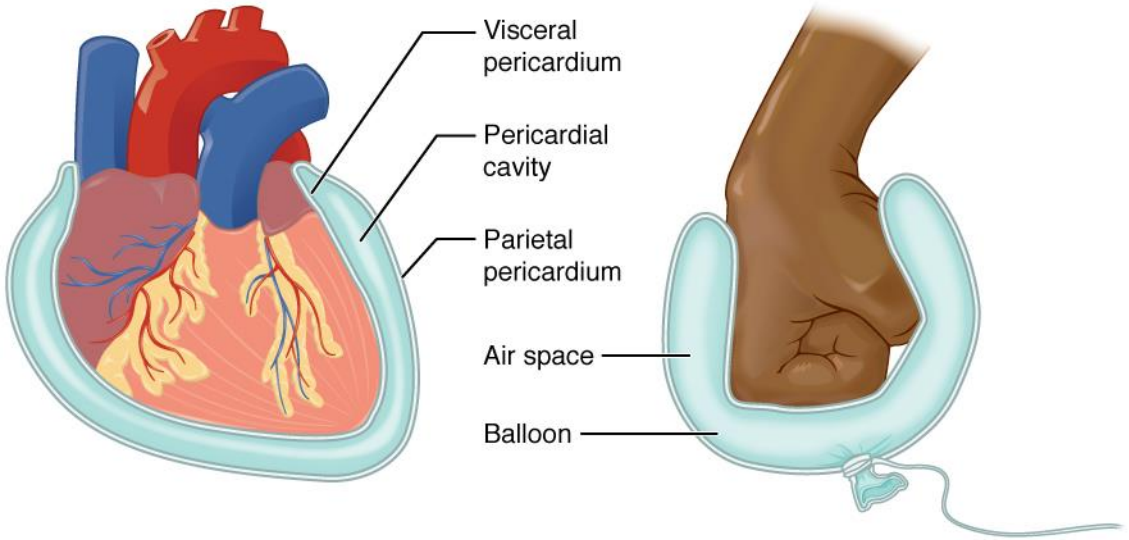


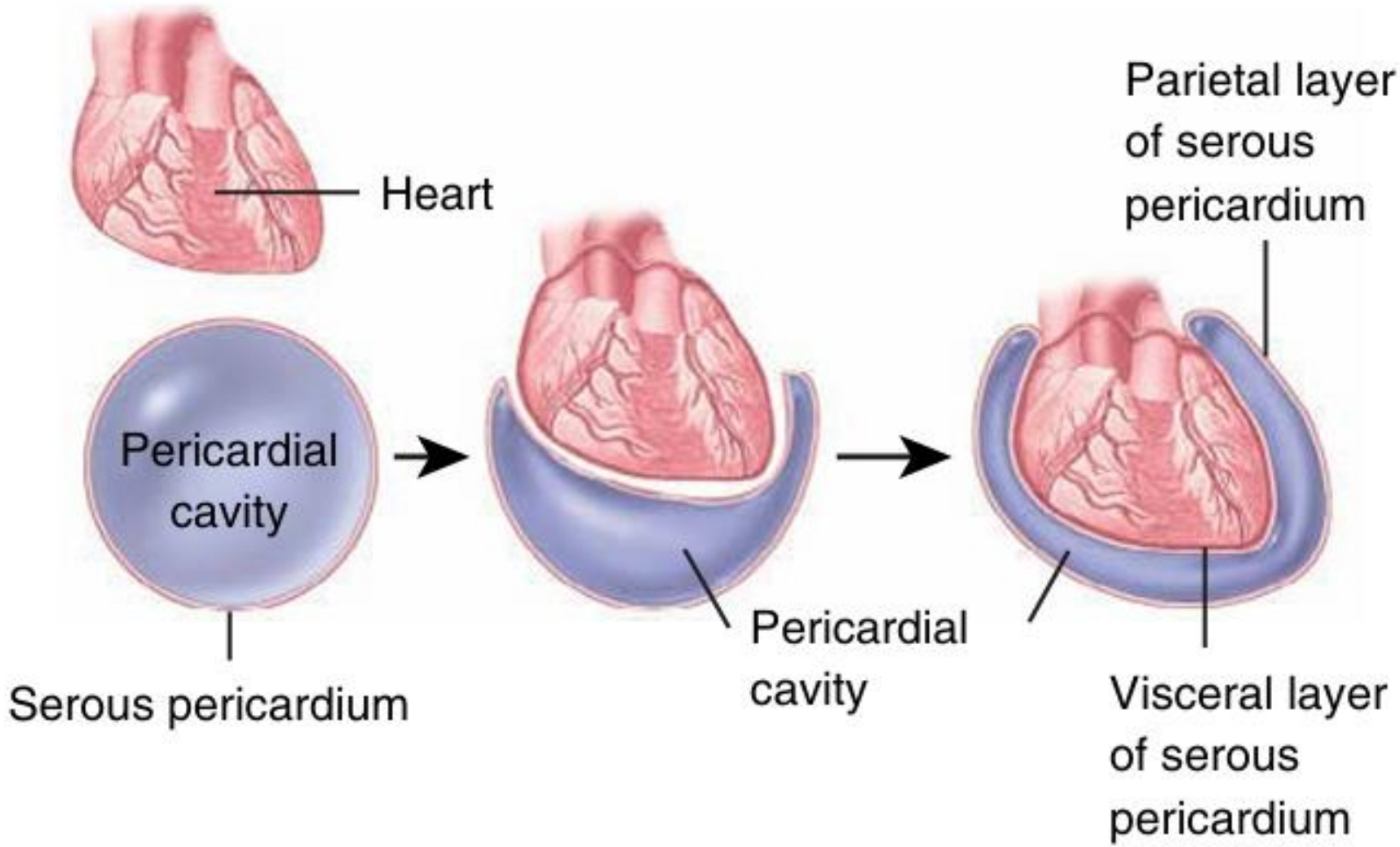
Pericardium

The pericardial fluid acts as a lubricant to facilitates the movements of the heart.

The parietal pericardium reflects around the roots of the large blood vessels to become continuous with **the visceral pericardium** that closely covers the heart.



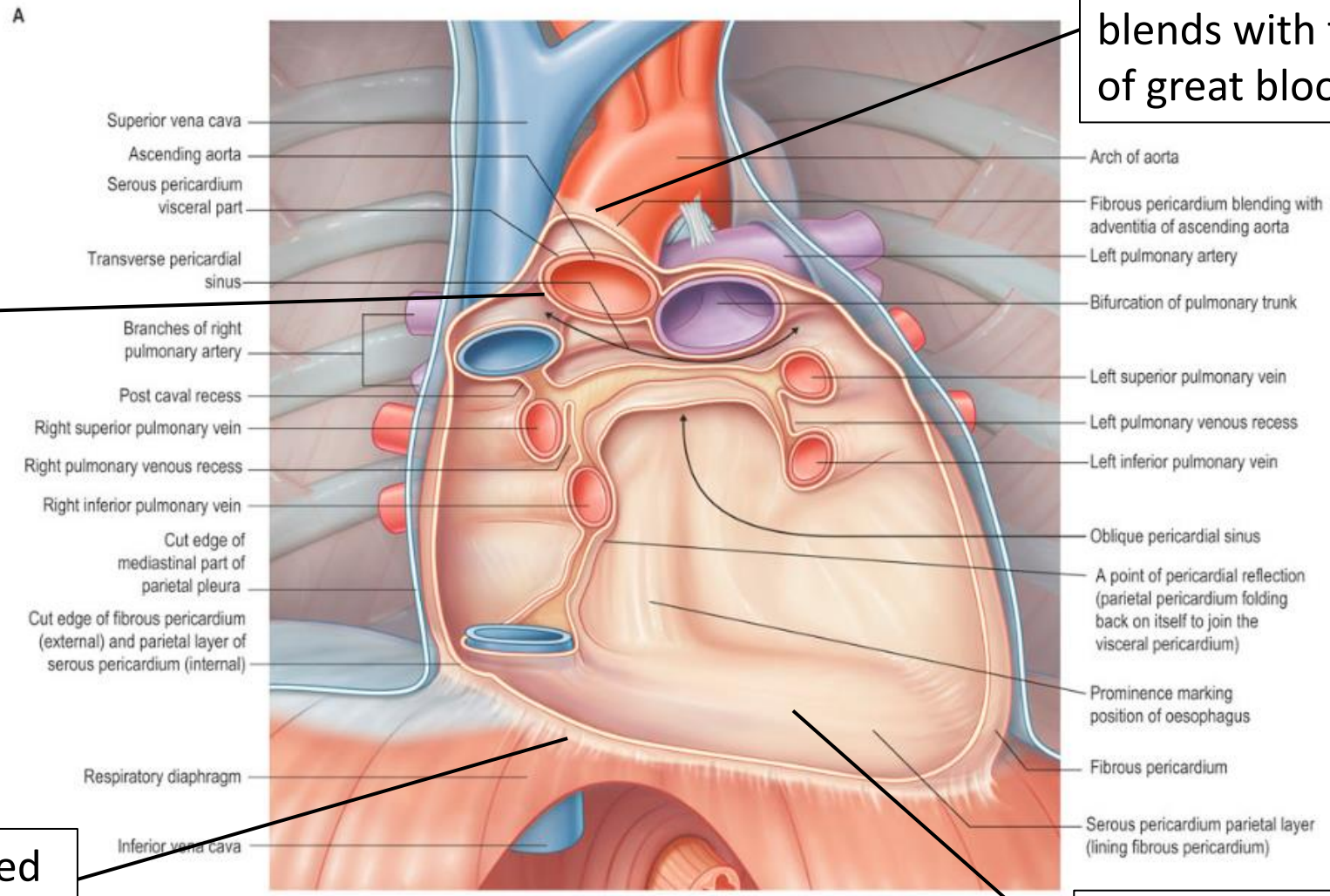



Heart
Parietal layer of serous pericardium
Pericardial cavity
Serous pericardium
Pericardial cavity
Visceral layer of serous pericardium

Fibrous pericardium

Fibrous pericardium blends with the outer coat of great blood vessels

Visceral layer of serous pericardium



Fibrous pericardium attached to the diaphragm

Parietal layer of serous pericardium

Chambers of the Heart

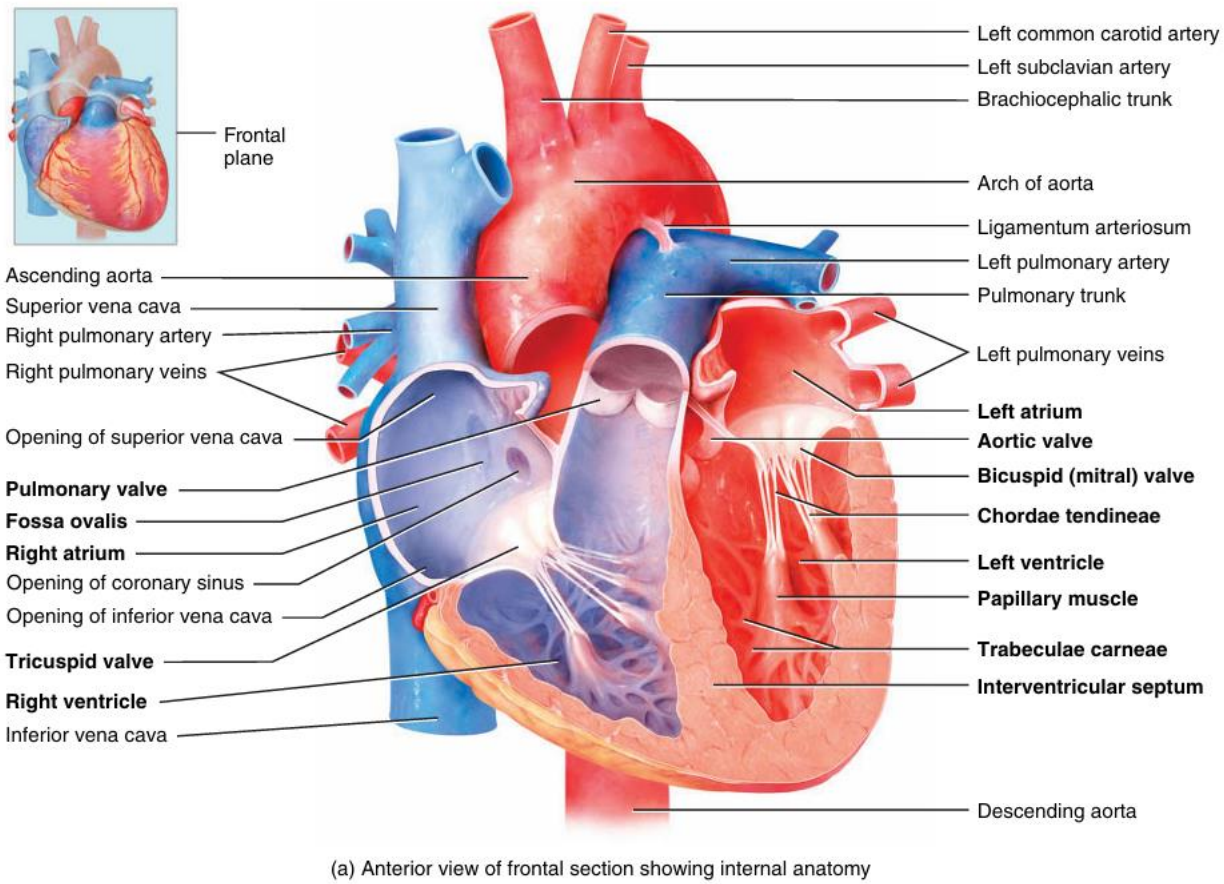
- The heart contains four chambers:

  ➢ **Two atria (atrium)** and **two ventricles**

  The blood flows from Rt and Lt atria to the Rt and Lt ventricles, respectively.

  RA+ RV (Right pump) Right heart (or pulmonary circuit)

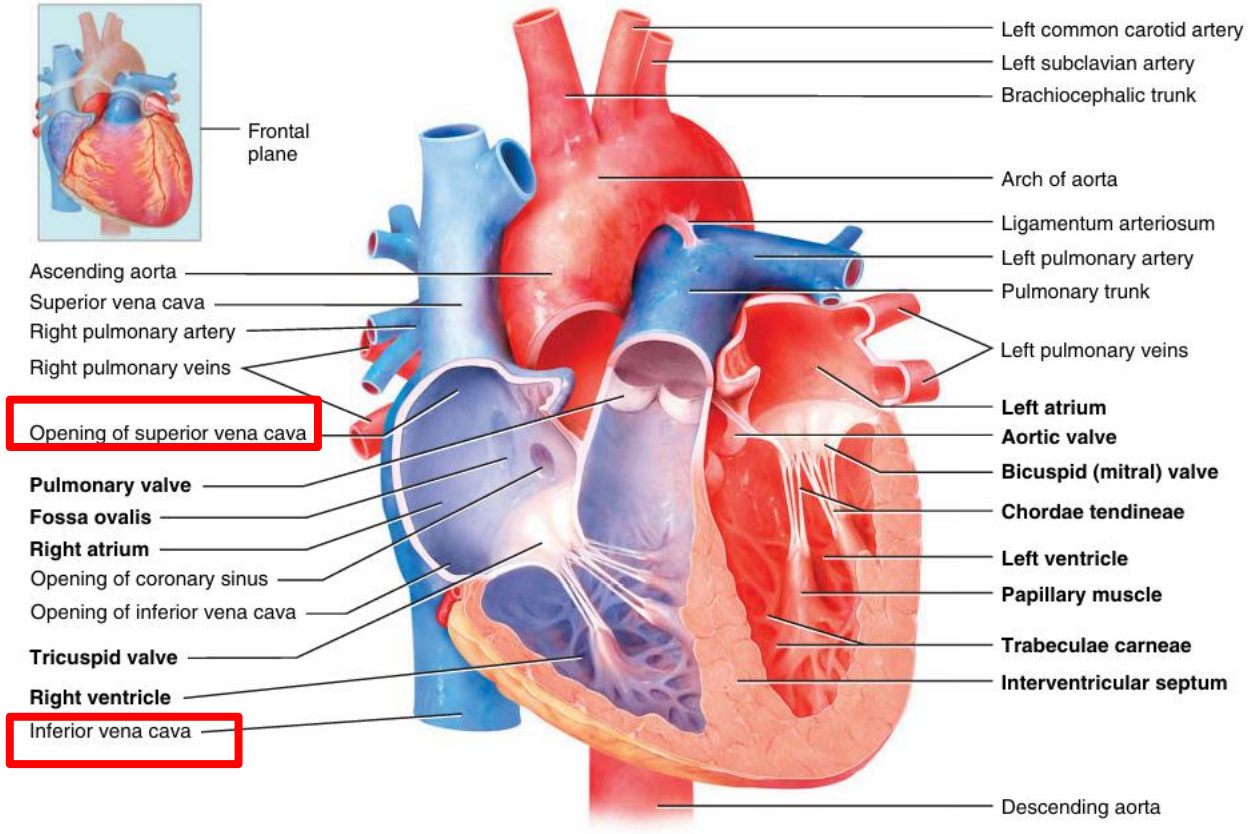
  LA + LV (left pump) Left heart (or systematic circuit)



(a) Anterior view of frontal section showing internal anatomy

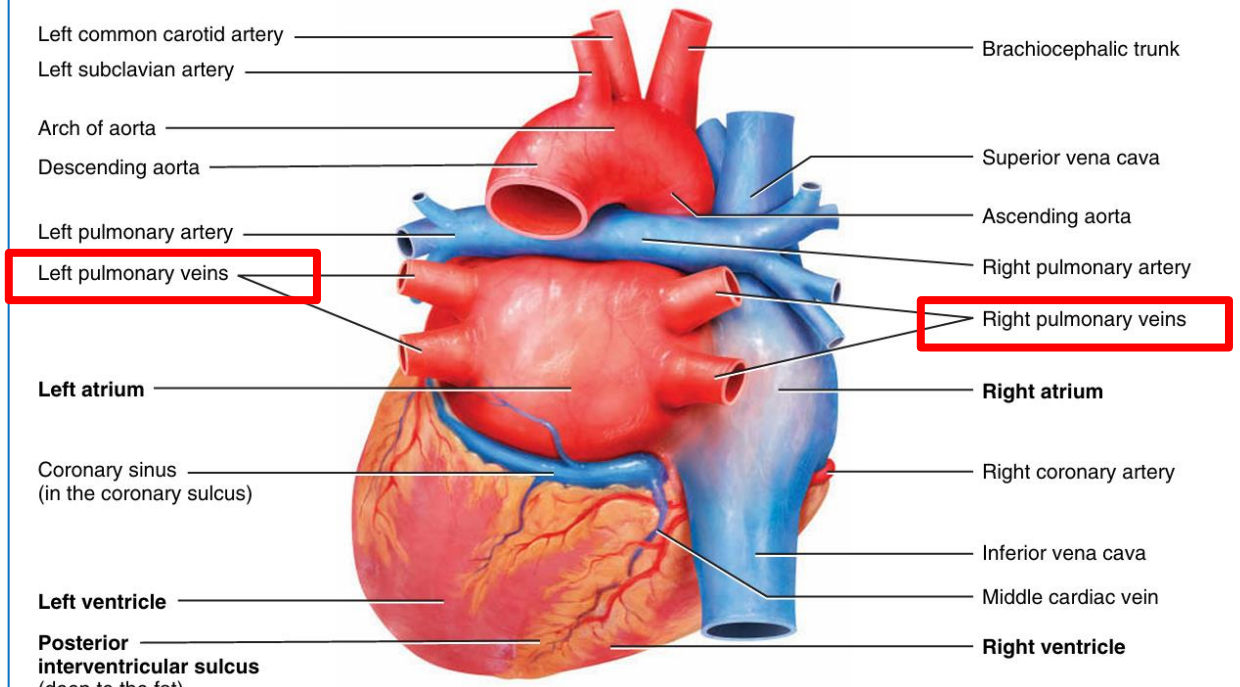
Chambers of the Heart

- The **Rt atrium** receives the openings of **superior vena cava** and **inferior vena cava.**
- The **Lt atrium** receives the openings of **the four pulmonary veins.**



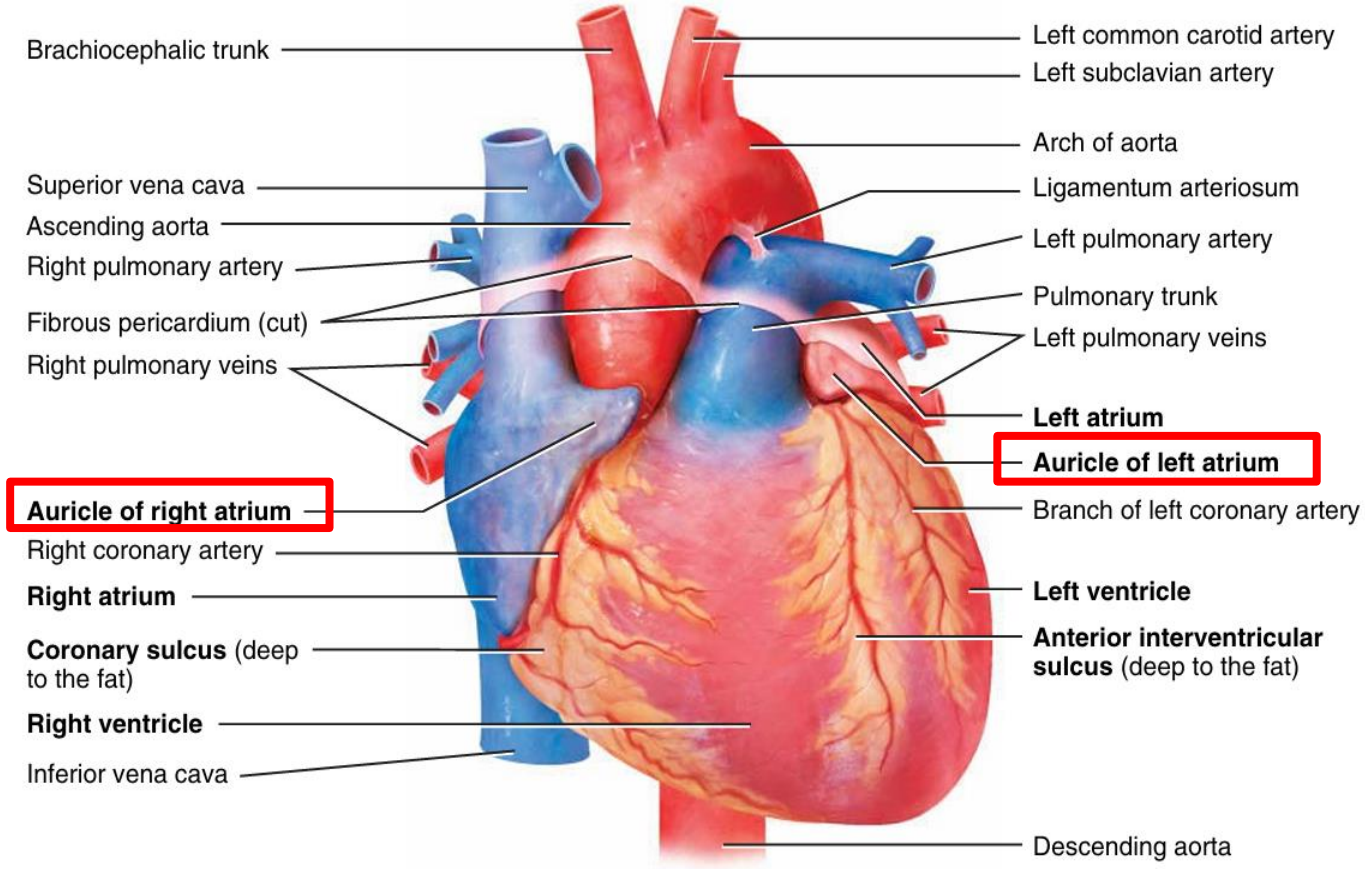
(a) Anterior view of frontal section showing internal anatomy

- The **Rt atrium** receives the openings of **superior vena cava** and **inferior vena cava.**
- The **Lt atrium** receives the openings of **the four pulmonary veins.**
- The outflow tract of the RV is called the **infundibulum. In LV,** the outflow tract is the area just below the aortic arch is named **vestibule**.



(c) Posterior external view showing surface features

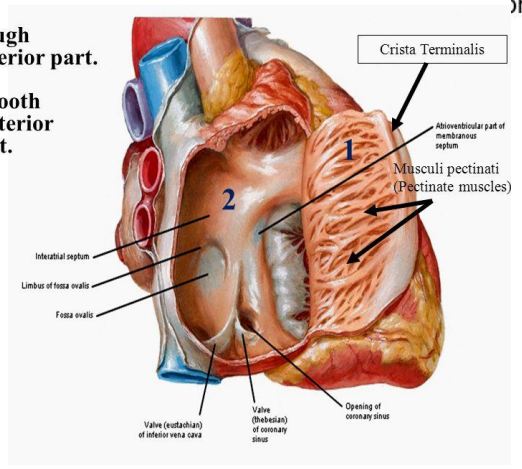
- On the anterior surface of each atrium is a wrinkled pouchlike structure called an **auricle**.
- The anterior wall of the Rt atrium is **rough** and muscular while the posterior wall is **smooth**.
- **Function**: increases the capacity of an atrium slightly so that it can hold a greater volume of blood.



Right Atrium

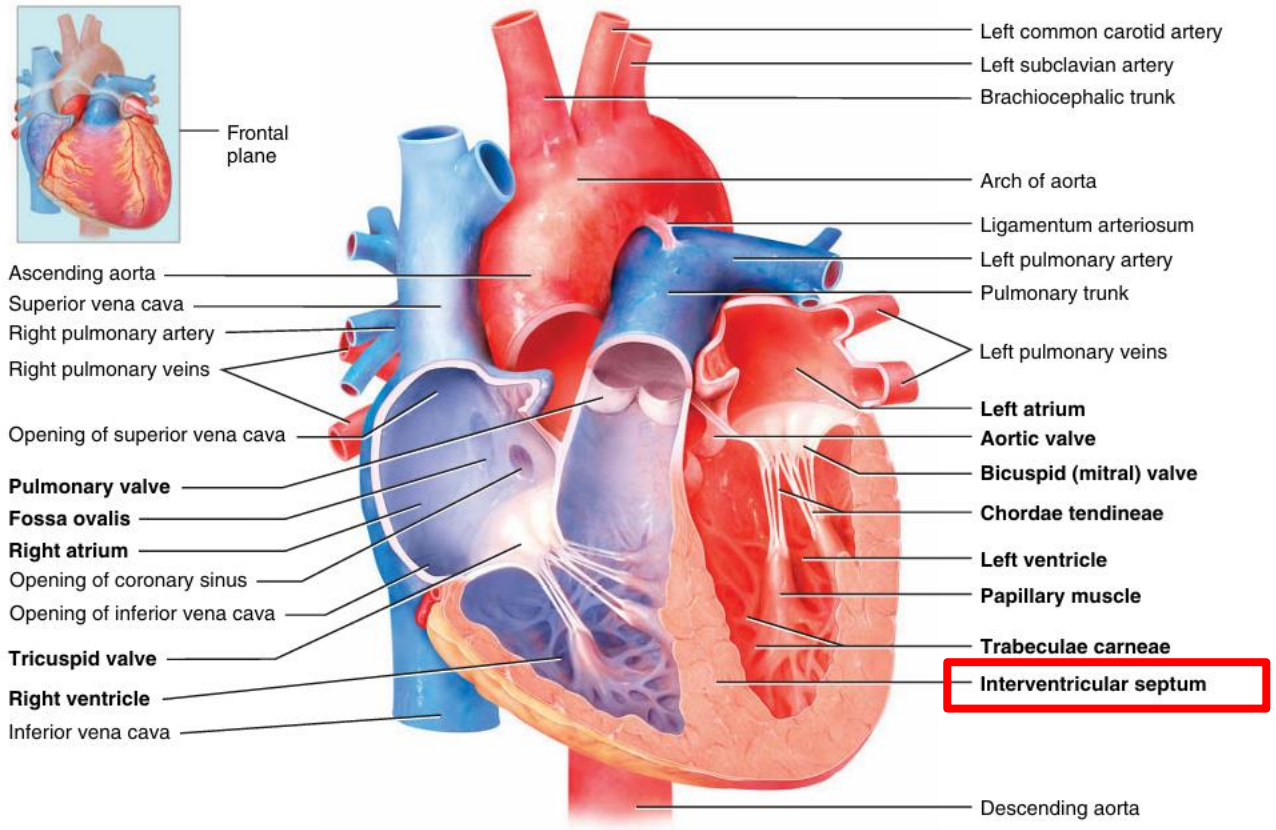
or external view showing surface features

1. **Rough anterior part.**
2. **Smooth posterior part.**



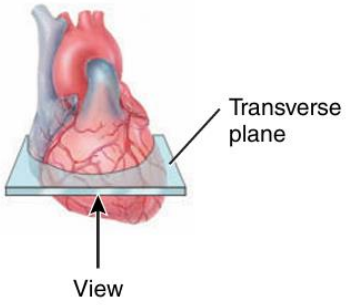
- Blood passes from the right ventricle into a large vessel called the **pulmonary trunk.** and from left ventricle into the largest artery of the body, **the ascending aorta**

- The right ventricle is separated from the left ventricle by a partition called the **interventricular septum.**
- The outflow tract of the RV is called the **infundibulum. In LV,** the outflow tract is the area just below the aortic arch is named **vestibule**.

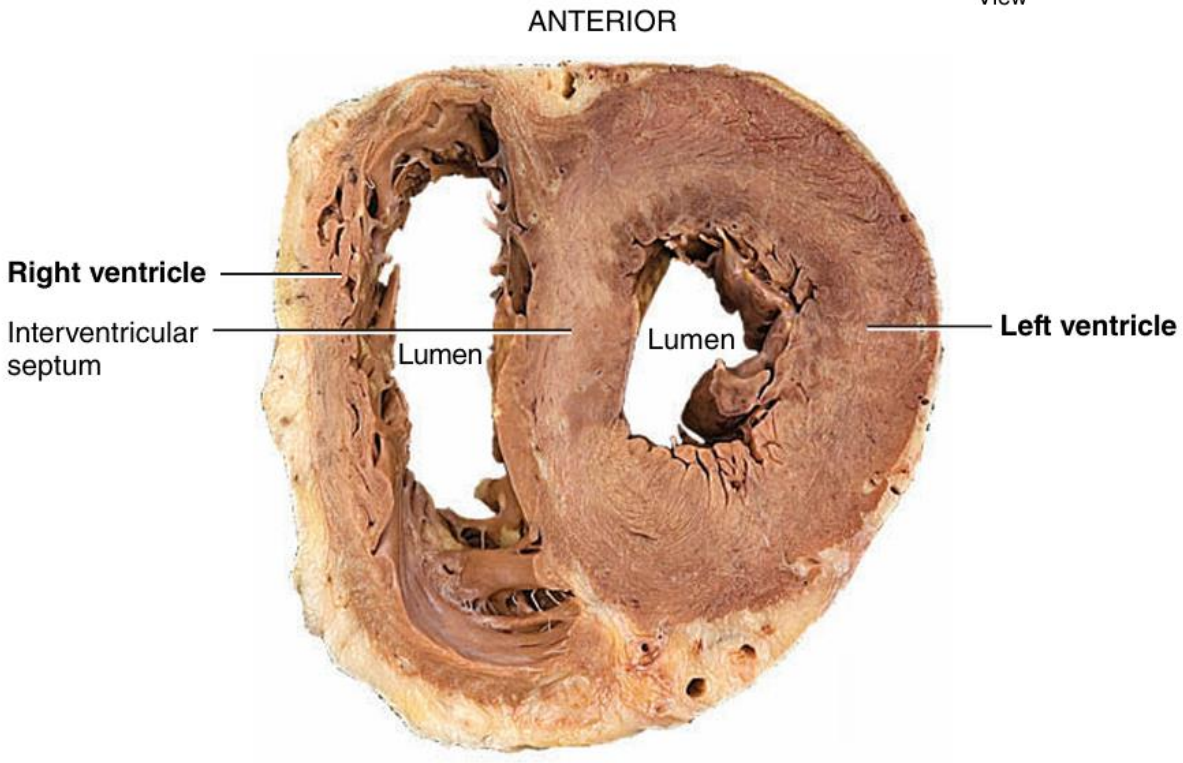


(a) Anterior view of frontal section showing internal anatomy

Anatomical differences between ventricles

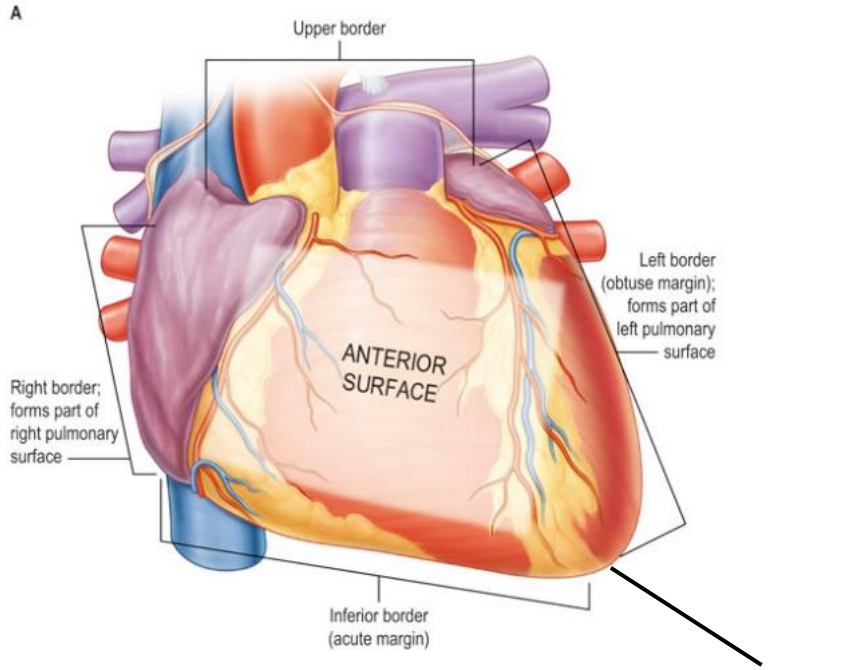


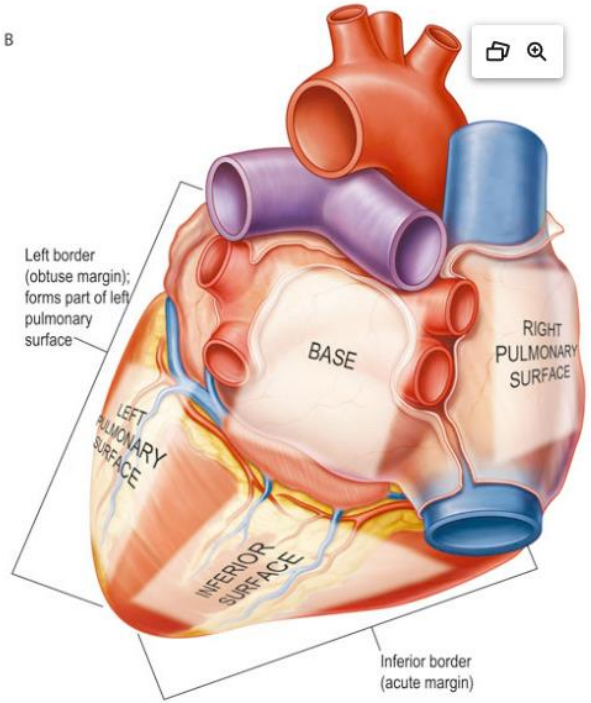
- Left ventricle is **longer and narrower** than right ventricle
- Walls of left ventricle are **three times thicker** (8–12 mm) than those of right ventricle



The orientation of heart

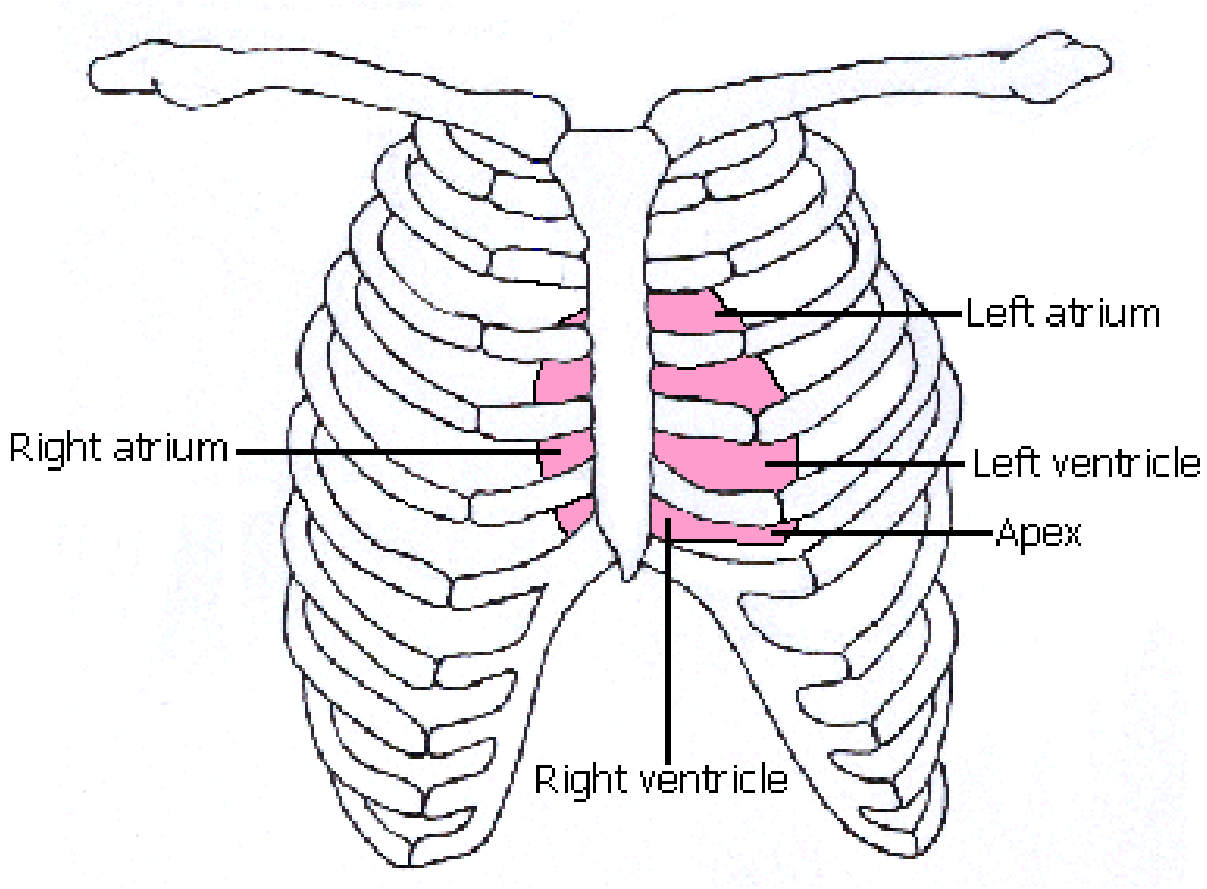
- About two-thirds of the mass of the heart lies to the left of the body's midline.
- The heart has **apex** and **base**
- **Apex**: the pointed tip of the heart directed downward, forward and to the left, and is formed of **the left ventricle.**
- **Base** of the heart (posterior aspect) is directed upward and posteriorly and is formed by the atria, mainly of **the left atrium**.





Apex of the heart

- Lies at the level of the **left fifth intercostal space.** 9cm from the midline.



Surfaces and borders of the heart

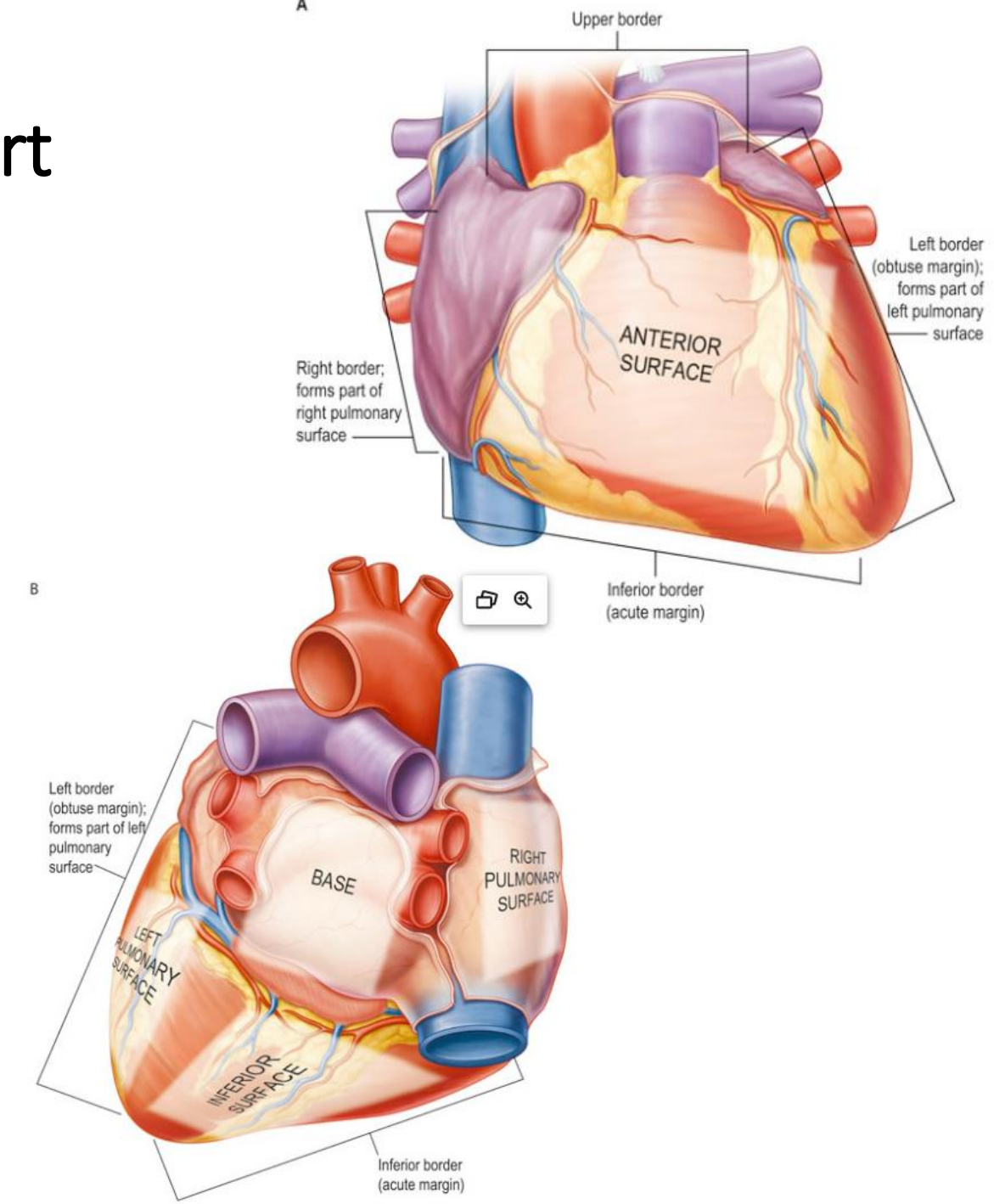
- The heart has several surfaces: **anterior (sternocostal)**, **inferior (diaphragmatic)**, and **right and left pulmonary**

1. Anterior (sternocostal) surface: formed mainly by **right ventricle ~2/3rd**

2. Inferior (diaphragmatic) surface is largely formed by **left ventricle.**

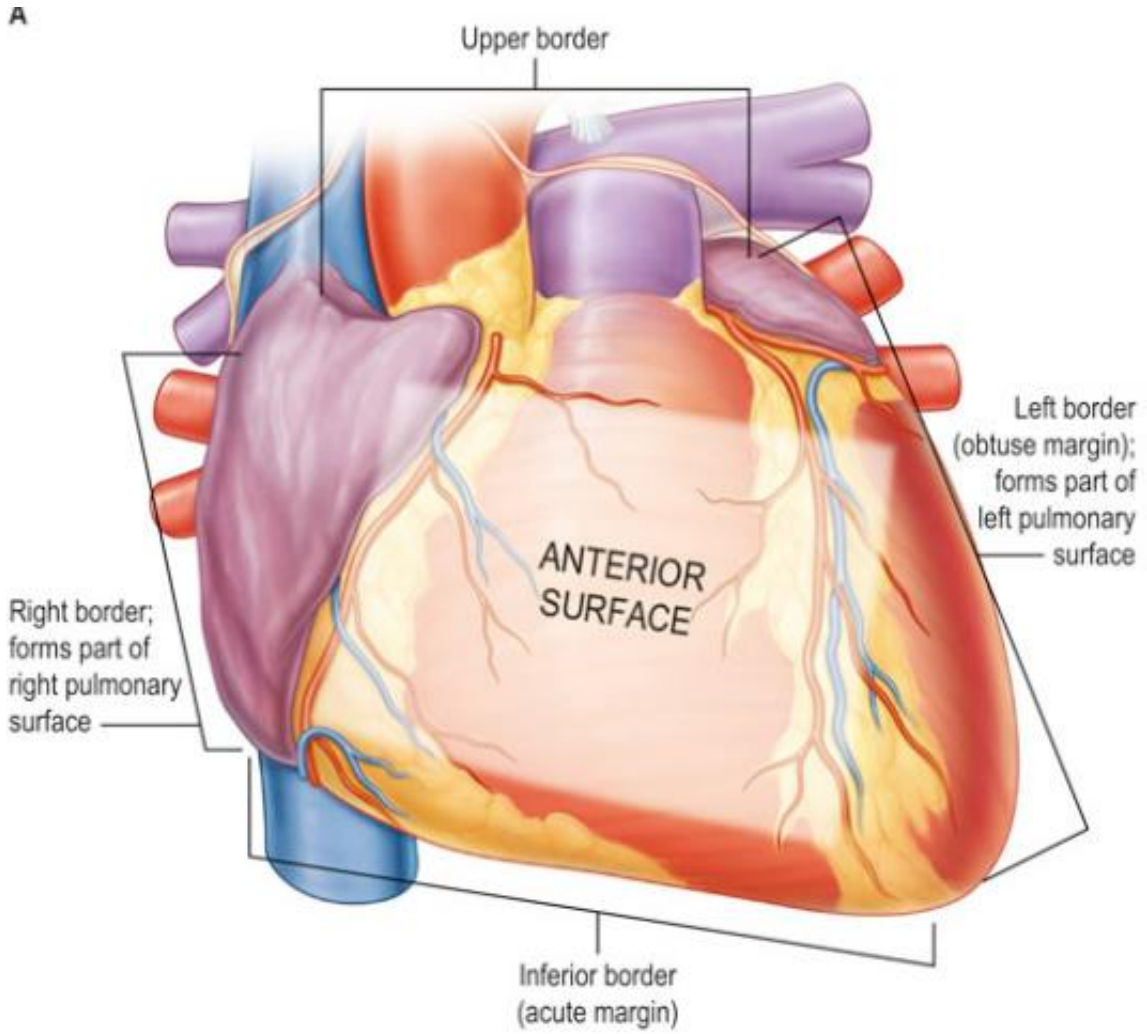
3. Right pulmonary faces right lung

4. Left pulmonary faces left lung



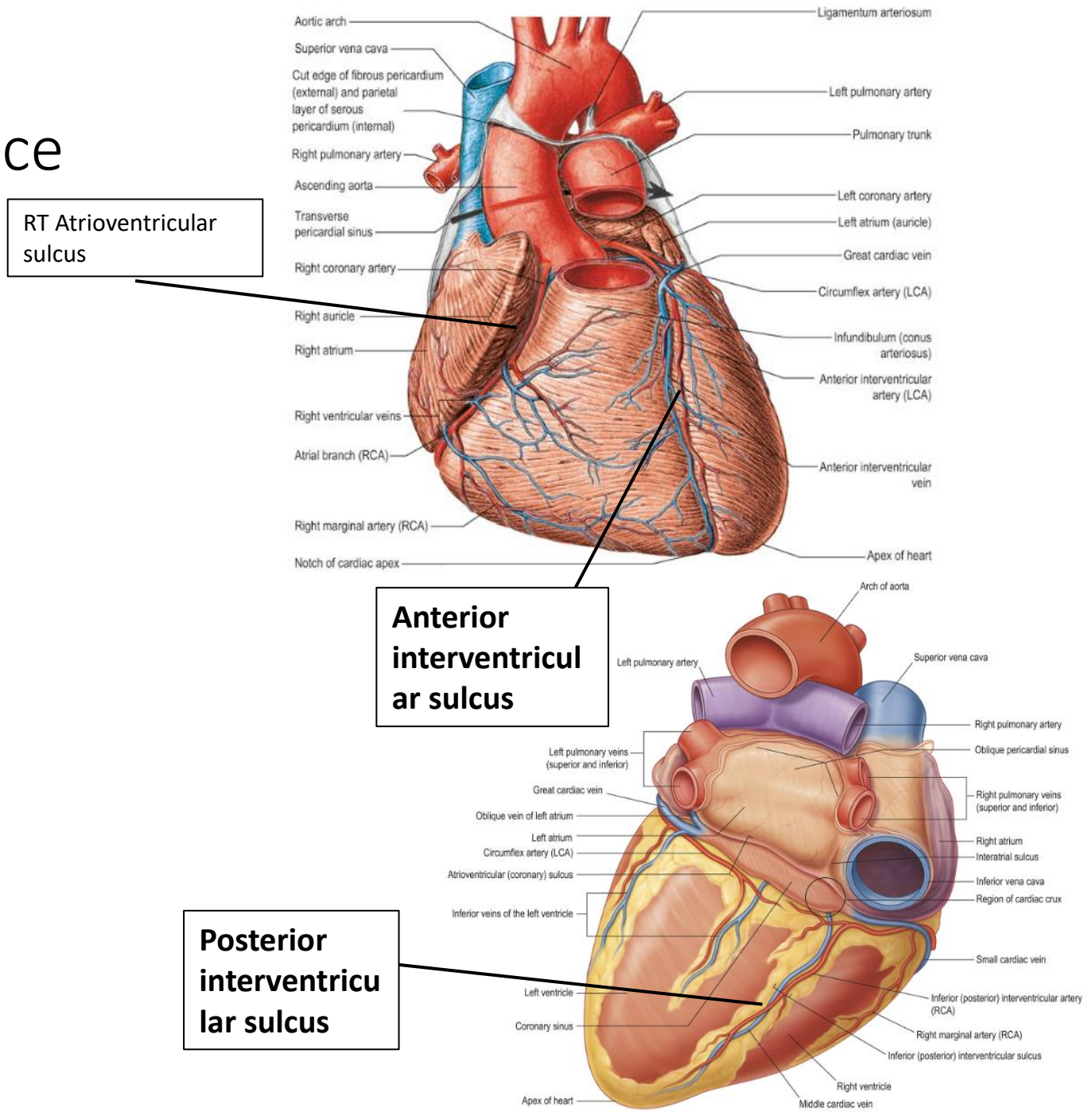
Surfaces and borders of the heart

- And four borders**; superior, inferior, right and left.**
  - **Sup. Border>>> the two atria**
  - **Inf. Border >>> two ventricles**
  - **RT border >>> right atrium**
  - **LT border >>> left ventricle and left auricle**



Sulci on the cardiac surface

- **The atrioventricular (coronary) sulcus** separates the atria from the ventricles and contains the main parts of the right and circumflex coronary arteries.
- **The interventricular sulci** extend from the atrioventricular sulcus to the notch of the cardiac apex on the inferior border.



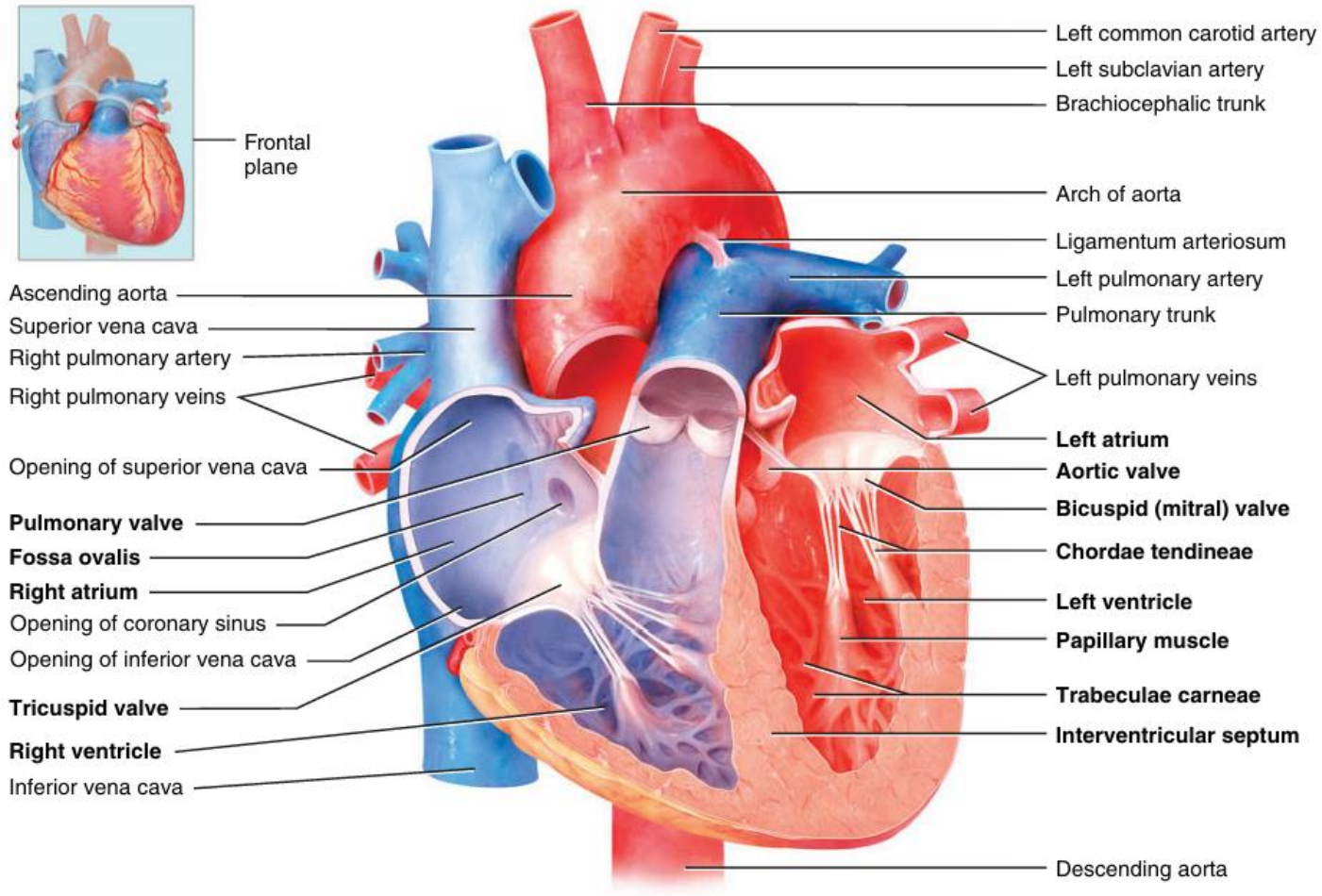
Valves of the heart

1. Atrioventricular valves

- Right and left

➢ The **right atrioventricular valve RAV** is tricuspid valve (has three cusps)

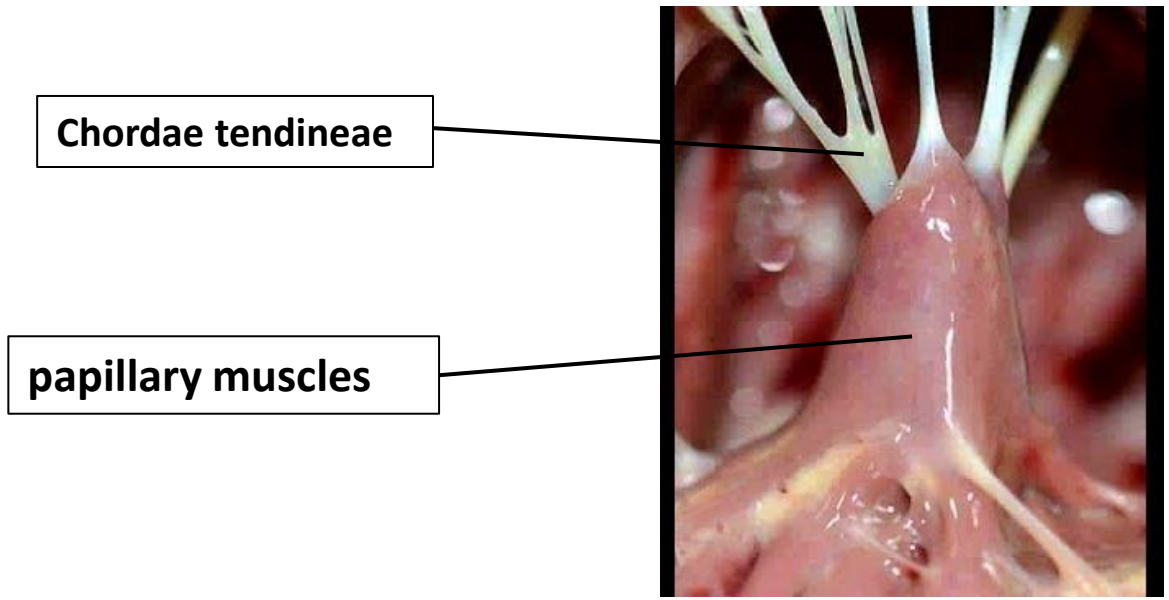
➢ The **left atrioventricular valve LAV** (Mitral valve) is bicuspid valve (has two cusps).



(a) Anterior view of frontal section showing internal anatomy

Chorda tendinea are fibrous collagenous structures that support the leaflets of the atrioventricular valves and connect them to the **papillary muscles**.

In most cases, the RAV valve has three papillary muscles while the LAV valve has two.



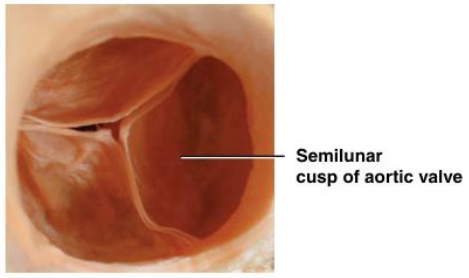
Valves of the heart

2. Semilunar valves

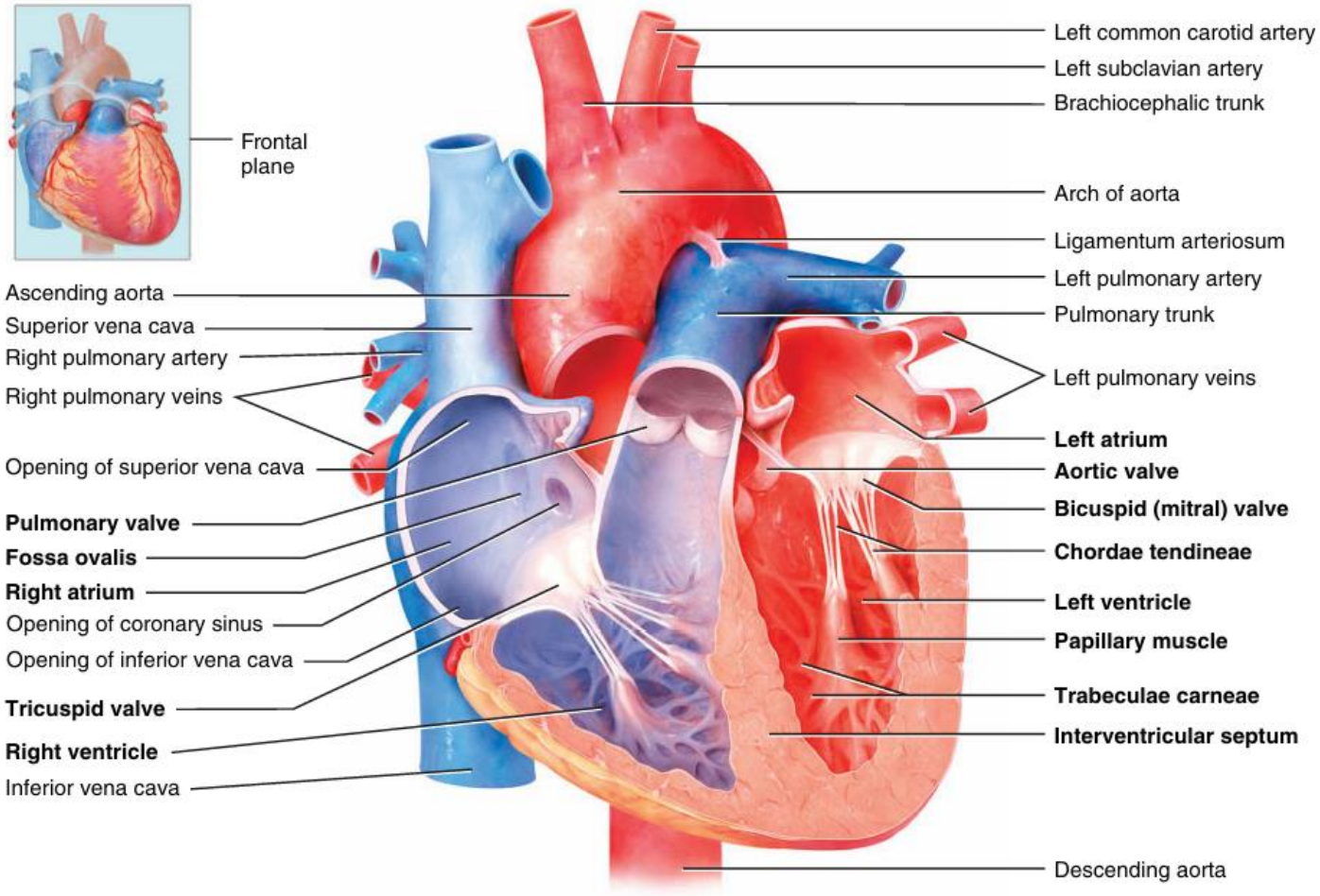
Formed of **three cusps**, with a hollow space above each cusp called **sinus**

- **Aortic valve**
- **Pulmonary valve**

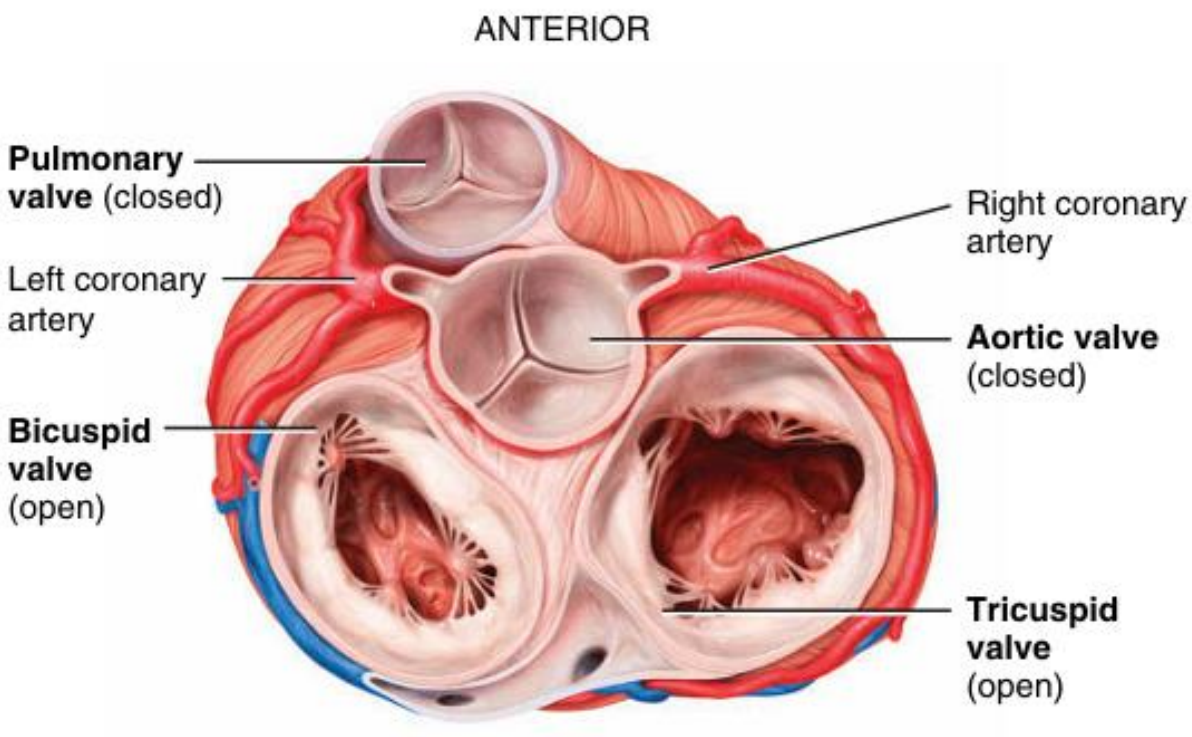
No Chorda tendinea or papillary muscles are associated with semilunar valves.

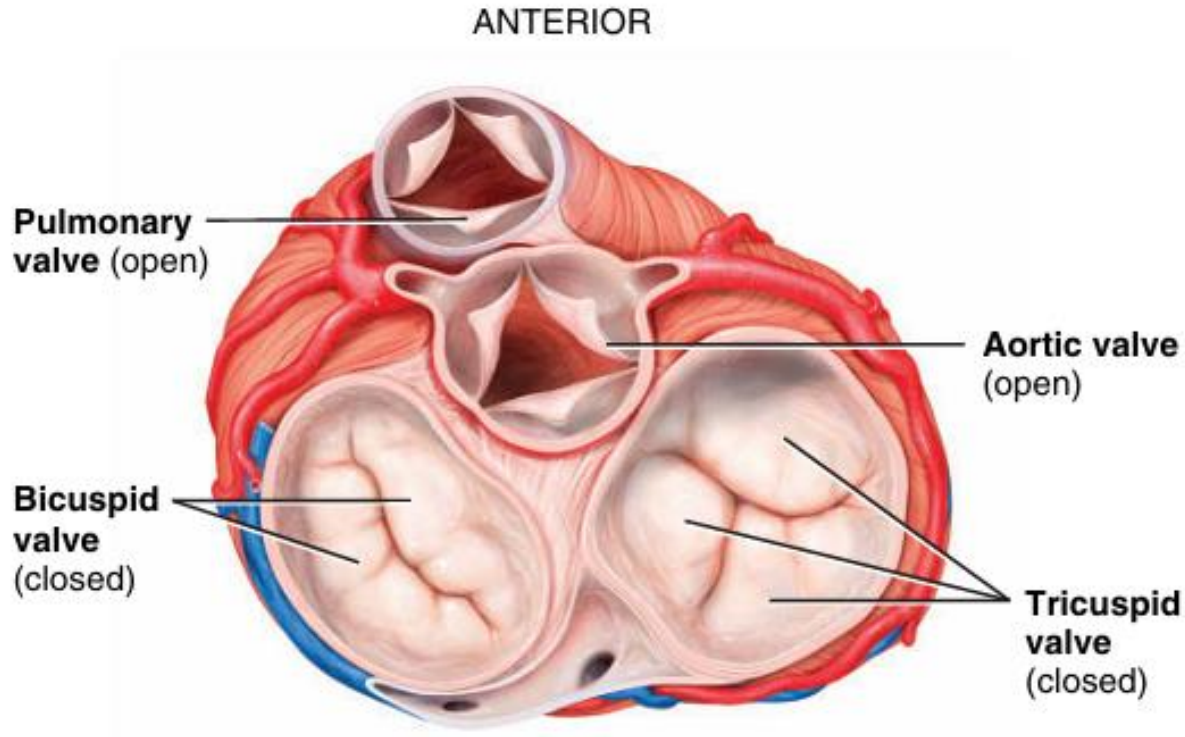


Dissection Shawn Miller, Photograph Mark Nielsen
(g) Superior view of aortic valve



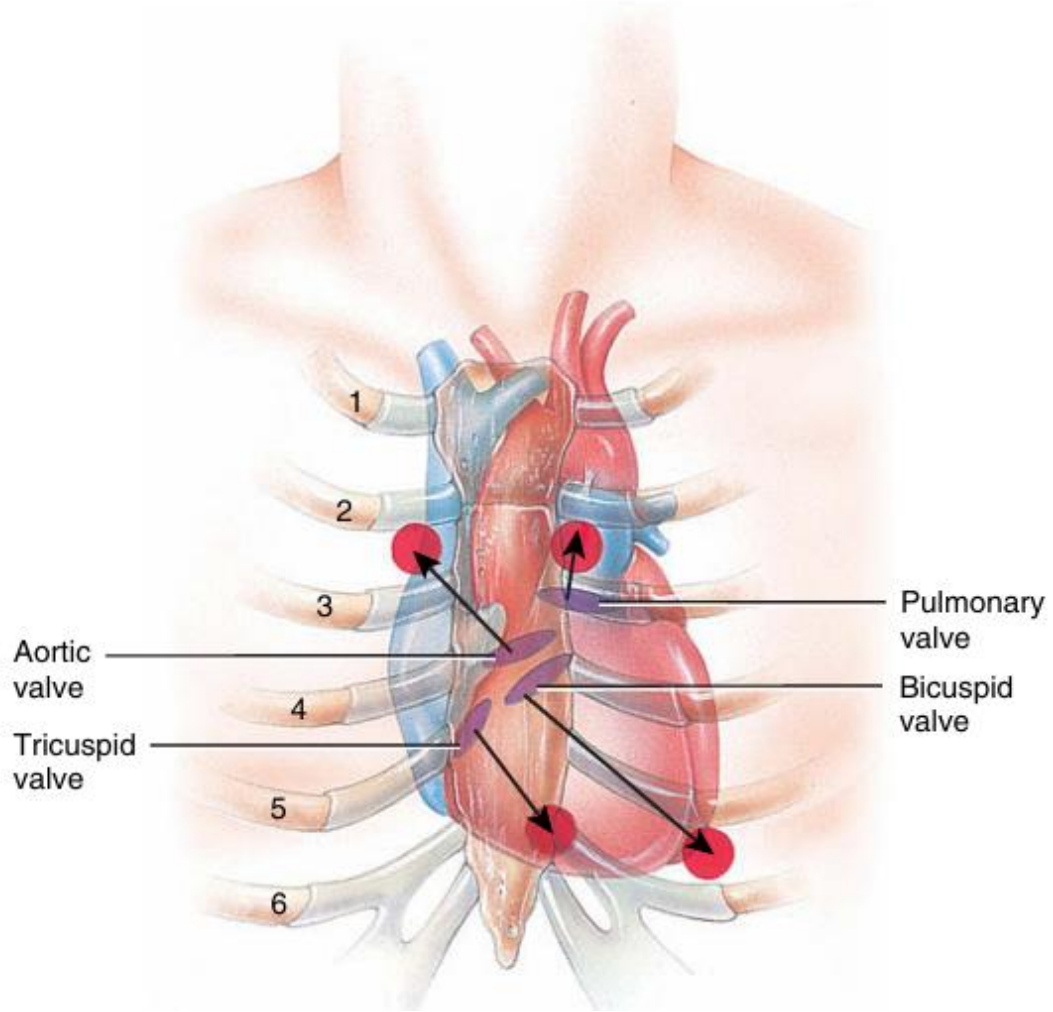
(a) Anterior view of frontal section showing internal anatomy


ANTERIOR
Pulmonary valve (closed)
Left coronary artery
Bicuspid valve (open)
Right coronary artery
Aortic valve (closed)
Tricuspid valve (open)


ANTERIOR
Pulmonary valve (open)
Bicuspid valve (closed)
Aortic valve (open)
Tricuspid valve (closed)

READ ONLY

Listening to sounds within the body is called auscultation; it is usually done with a stethoscope.



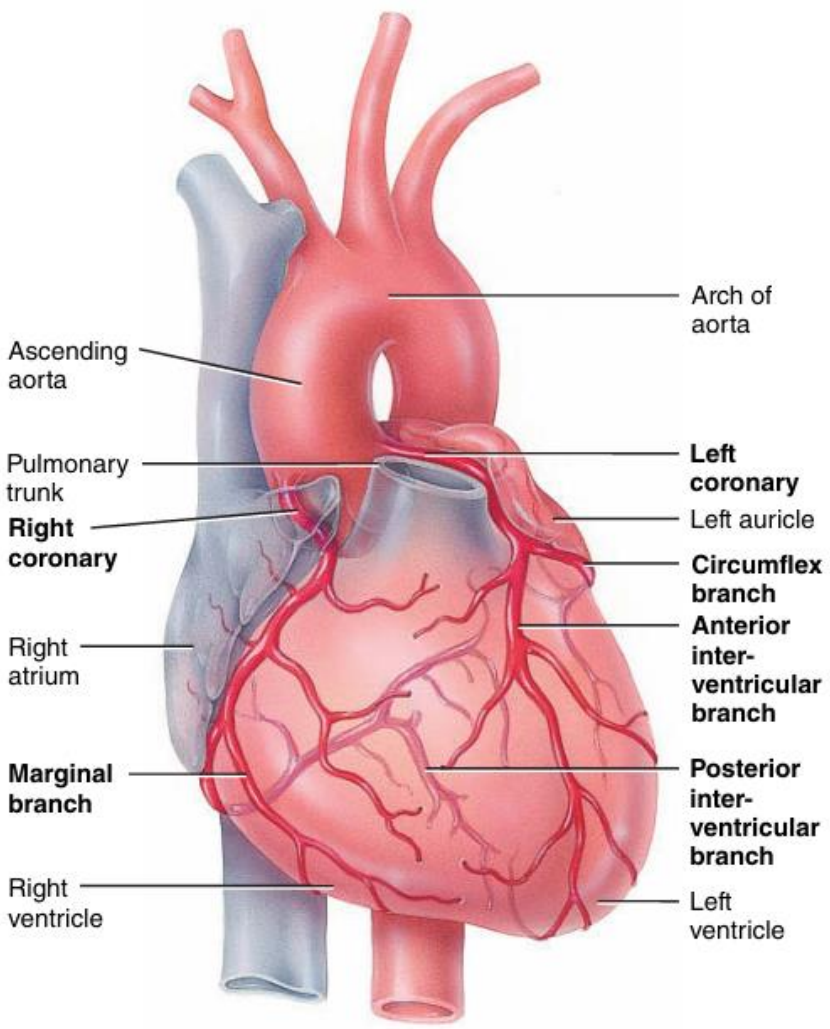
Blood supply of the heart

Arterial supply

By the **coronary arteries** (Rt and Lt). Arise from the beginning of the ascending aorta.

Venous drainage:

Through small veins that opens in the **coronary sinus** that empties in the right atrium



(a) Anterior view of coronary arteries

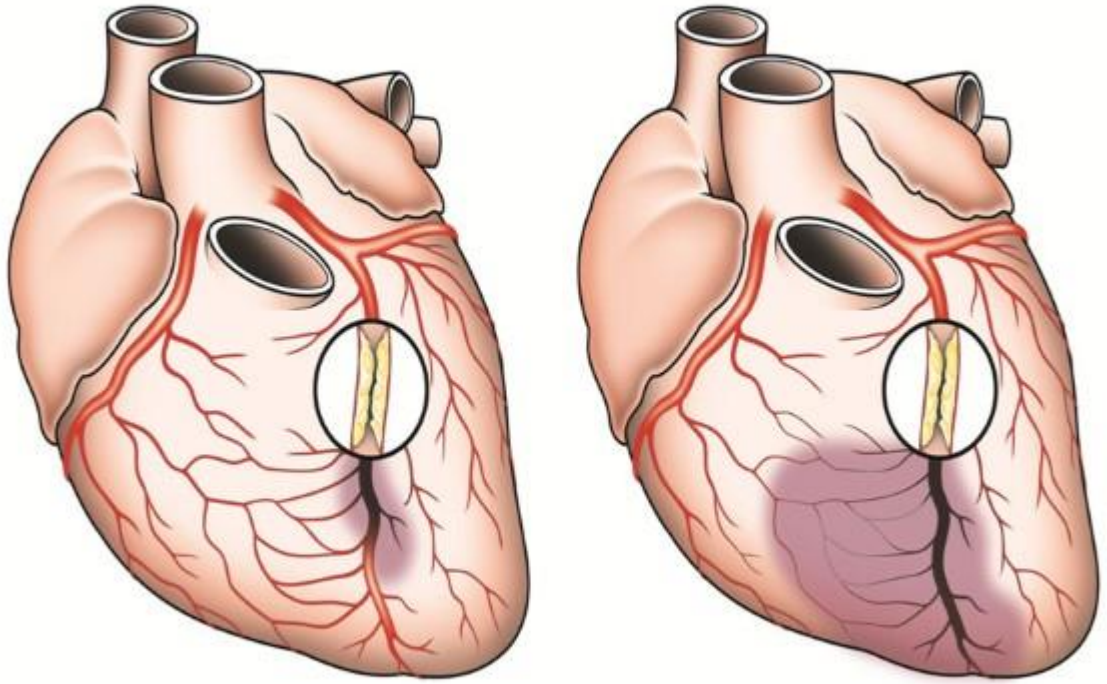
Blood supply of the heart

Collateral circulation is the anastomosis between the branches of the right and lef coronary arteries.

The alternative route of blood flow to a body part through an anastomosis

The age is a key determinant of the collateral circulation development.

Figure 1



Thank you!