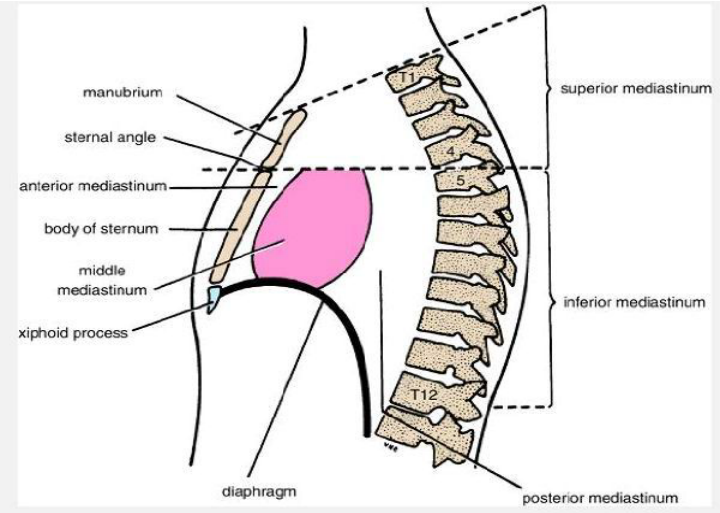
HEART

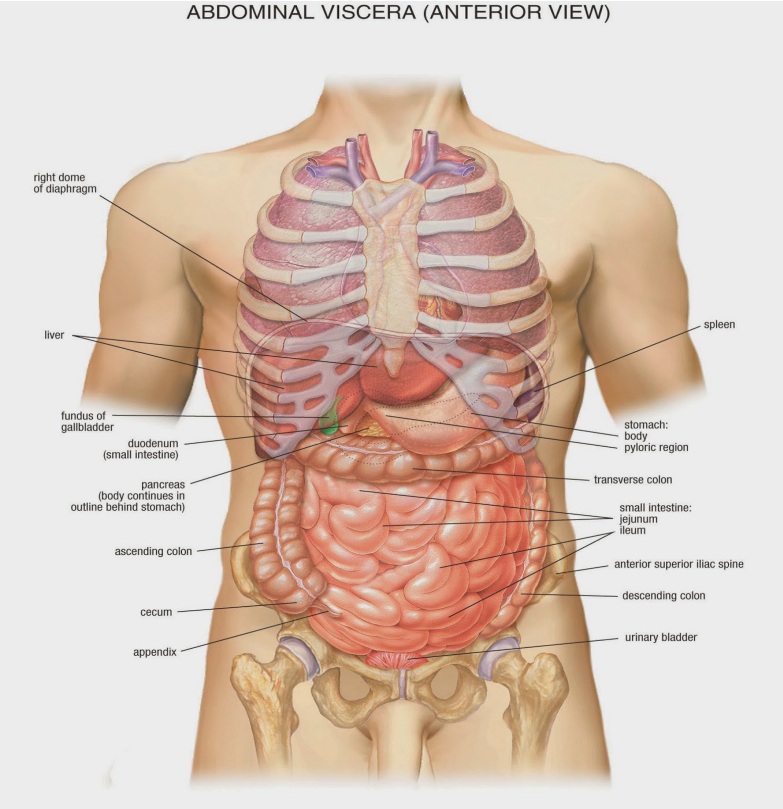
External features

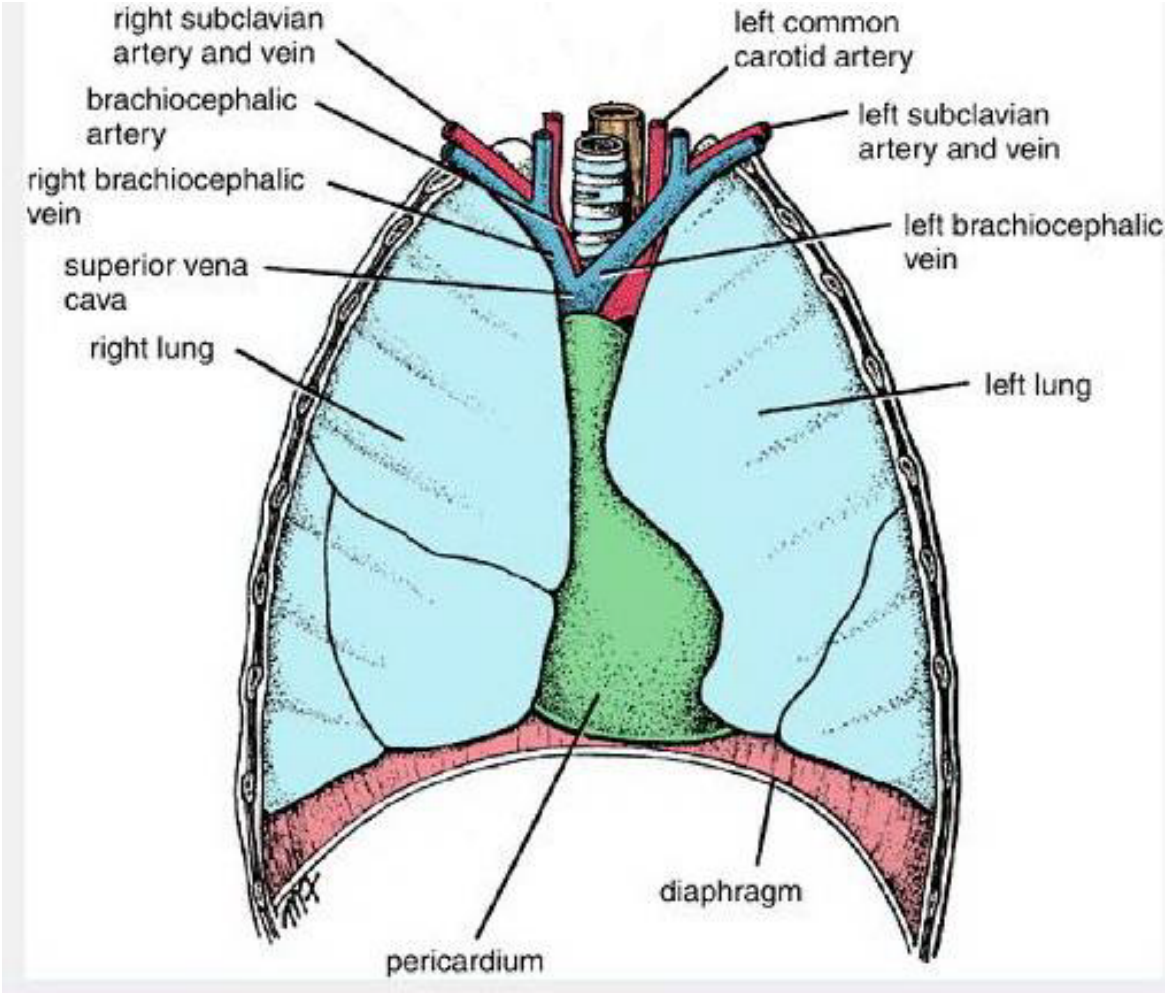
★ Position:

- 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.

Middle mediastinum







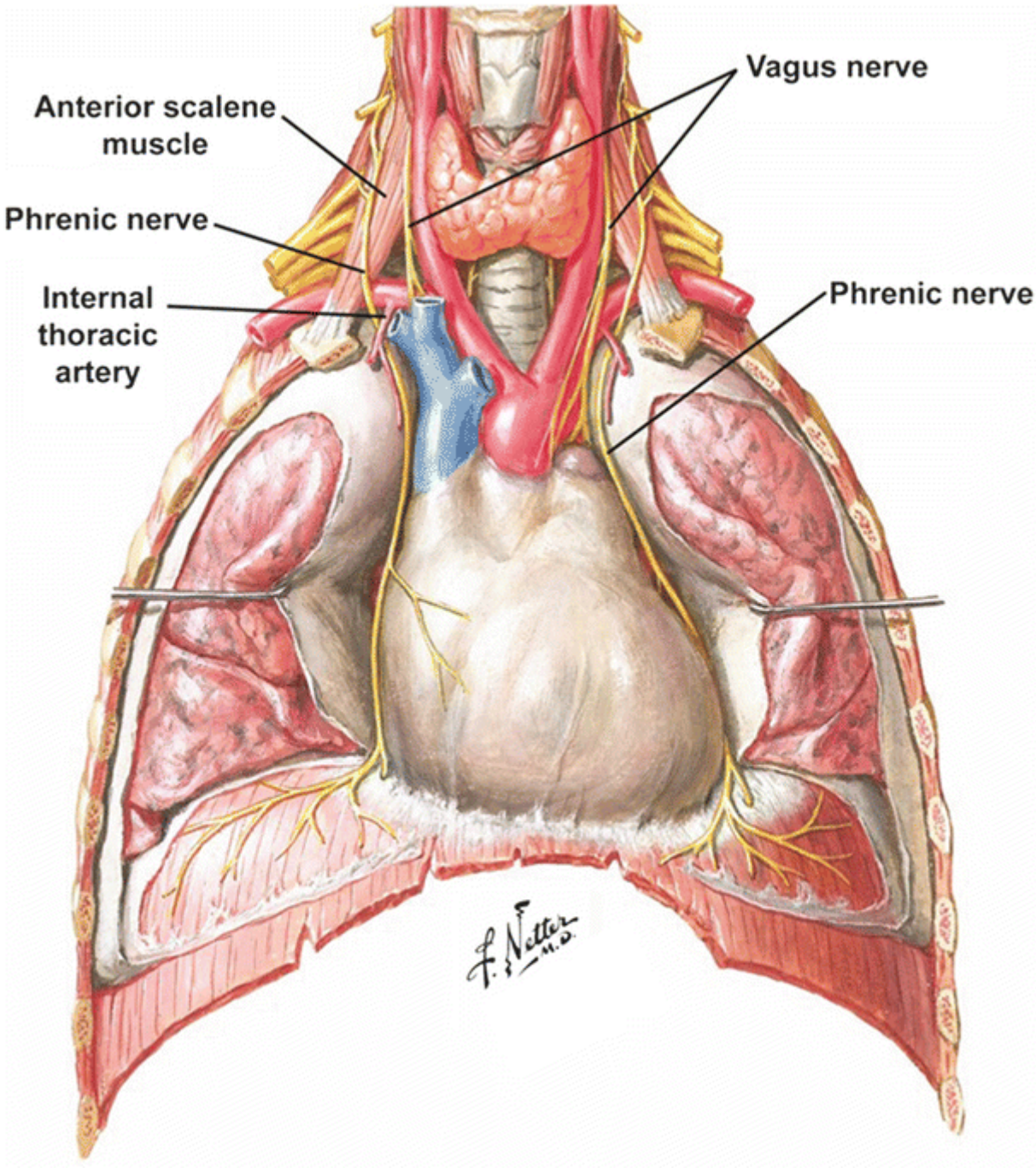
★ **Size and weight:**

- It is slightly larger than the size of **closed fist.**

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

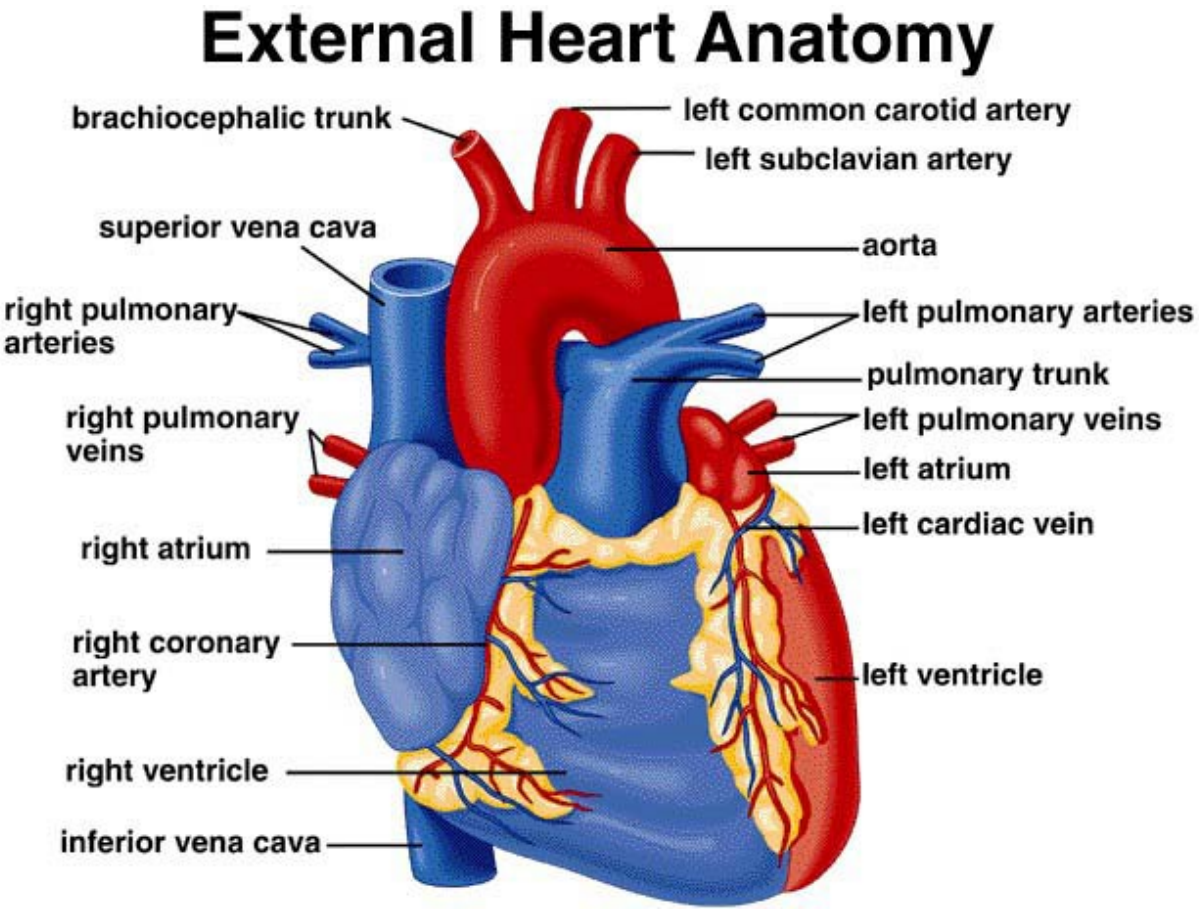
★ **Shape:** it is **conica**l in shape, having the followings:

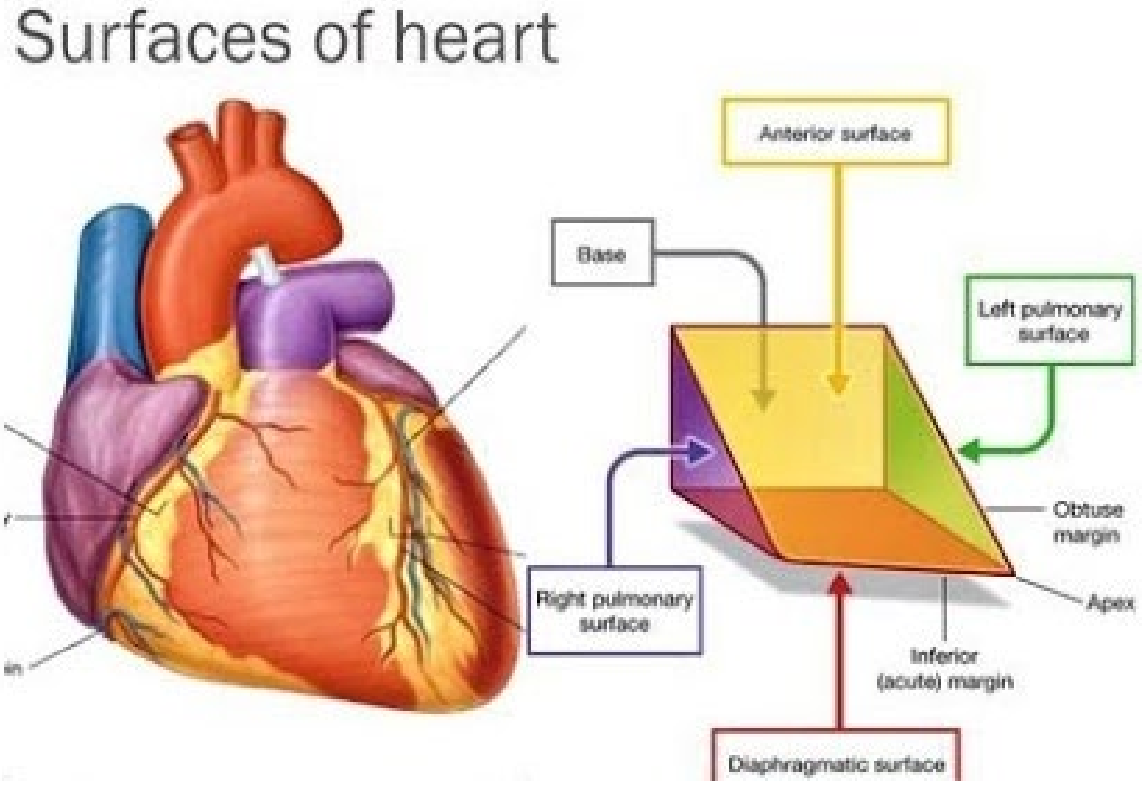
- A **base** (or posterior surface).
- An **apex.**
- The **axis** of the heart extends from the **base to the apex** is directed downwards, forwards and to the left.
- **5 surfaces**: sternocostal (or anterior), posterior surface (base), diaphragmatic (or inferior),right and left pulmonary boders
-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



Position of heart within the pericardium

in the middle mediastinum


External Heart Anatomy
brachiocephalic trunk
left common carotid artery
left subclavian artery
superior vena cava
aorta
right pulmonary arteries
left pulmonary arteries
pulmonary trunk
right pulmonary veins
left pulmonary veins
left atrium
left cardiac vein
right atrium
right coronary artery
left ventricle
right ventricle
inferior vena cava


Surfaces of heart
Anterior surface
Base
Left pulmonary surface
Obtuse margin
Right pulmonary surface
Apex
Inferior (acute) margin
Diaphragmatic surface

★ External Features of the Heart:

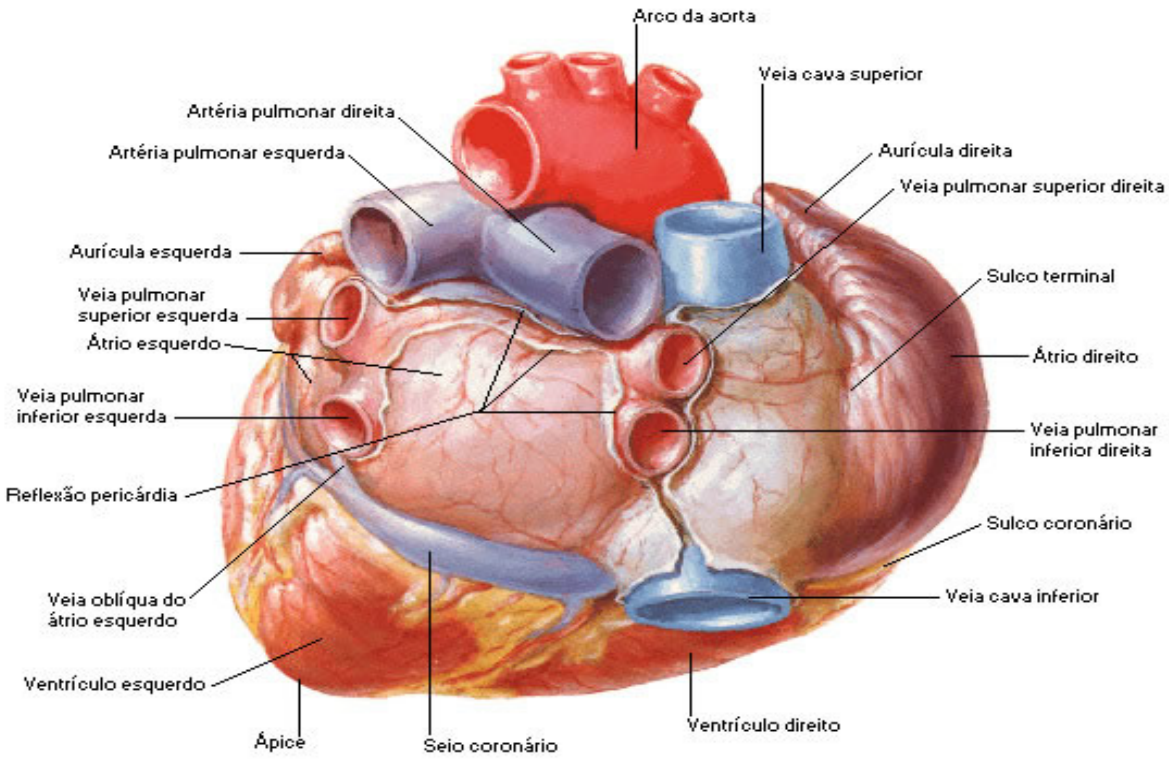
(I) Base: (posterior surface)

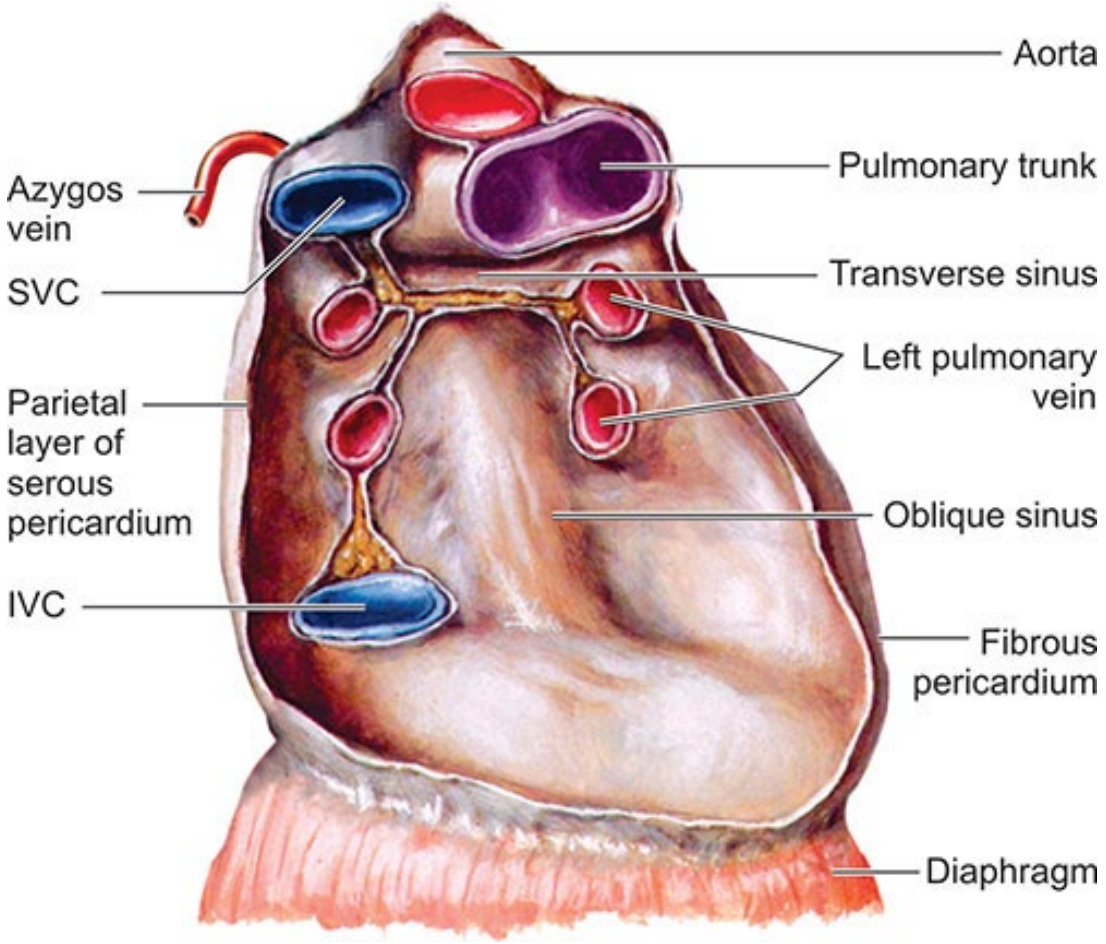
- It is the **posterior surface** of the heart.
- It is directed **backwards and to right.**
- It is **formed** of both atria (**mainly** by the **left** atrium).
- Right and left **pulmonary arteries** run along its **upper border**.
- **Coronary sulcus** run along the its **lower border.**
- The **SVC & the IVC** enter at the superior end & inferior end of the right atrium.
- It is related to the **middle 4 thoracic vertebrae** (5^{th} to 8^{th}), **separated** from them by:

  a) Oblique sinus of serous pericardium and posterior wall of **fibrous pericardium.**

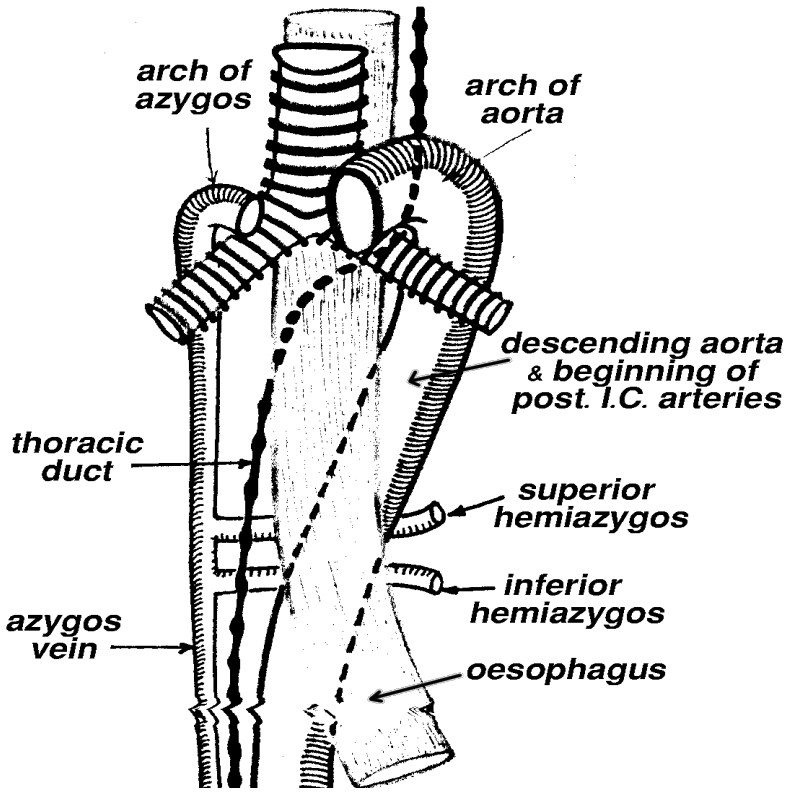
  b) The 2 left & 2 right pulmonary veins enter at left atrium

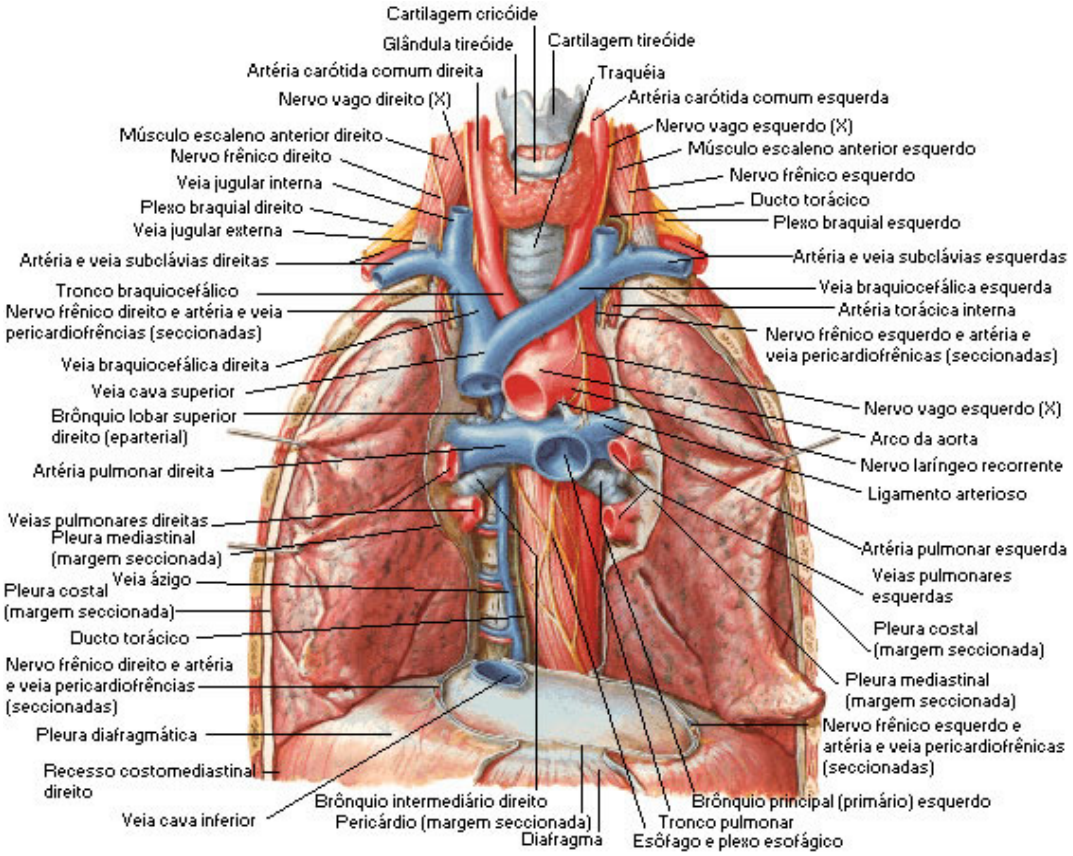
  c) Structures in the **posterior mediastinum**: descending thoracic aorta, esophagus, azygos vein and thoracic duct.



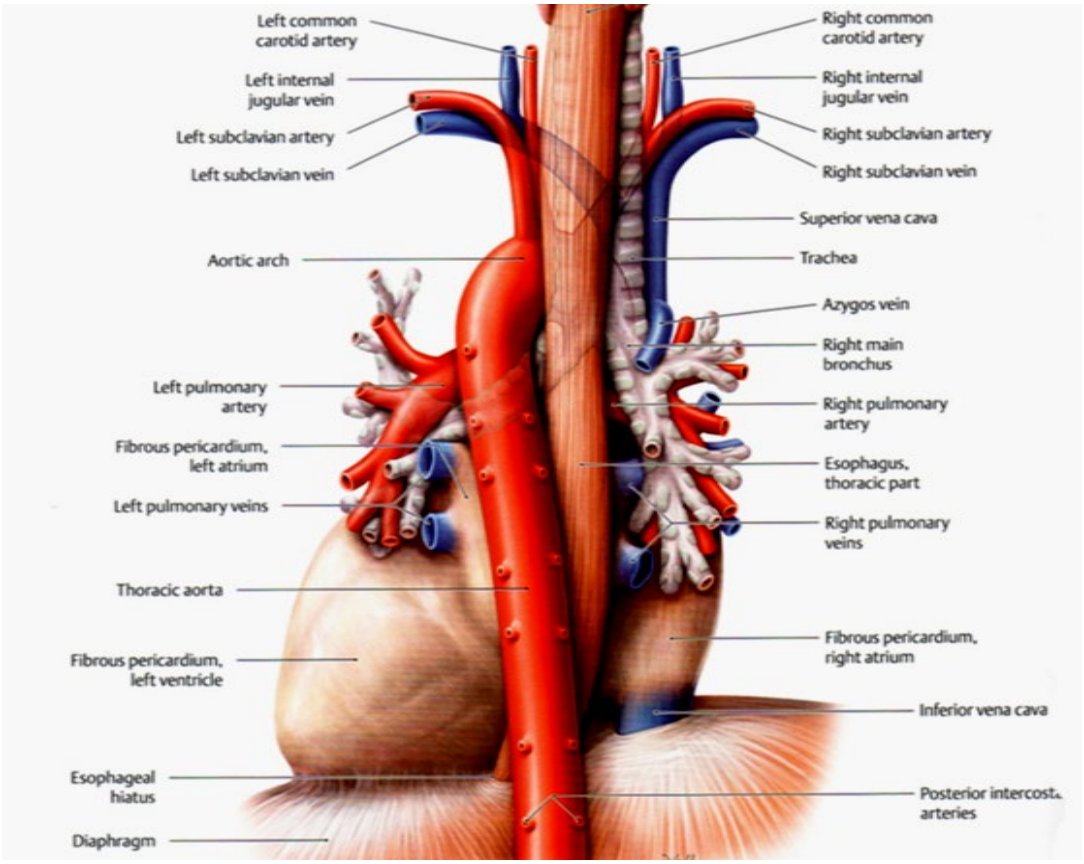


Posterior mediastinum



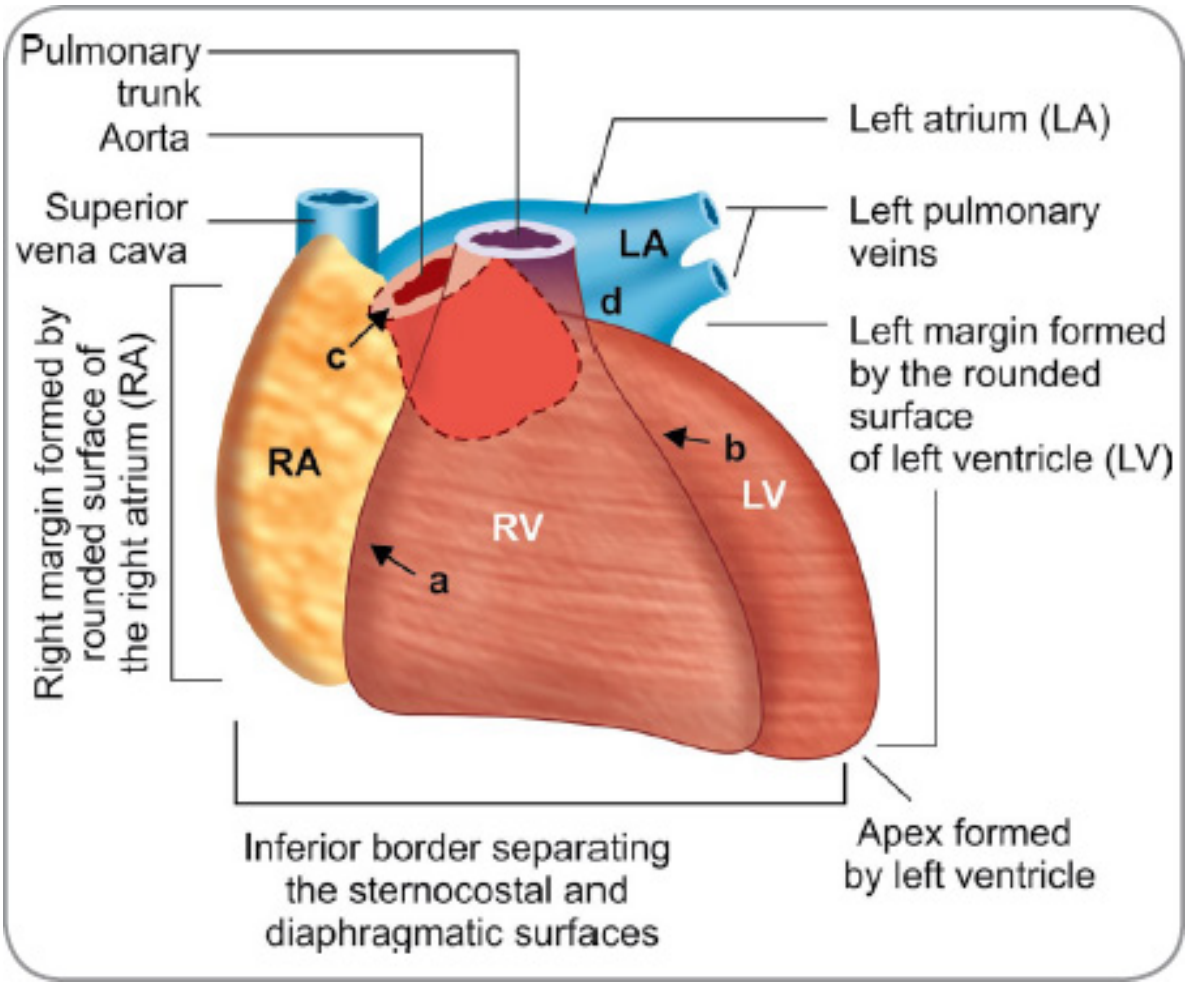


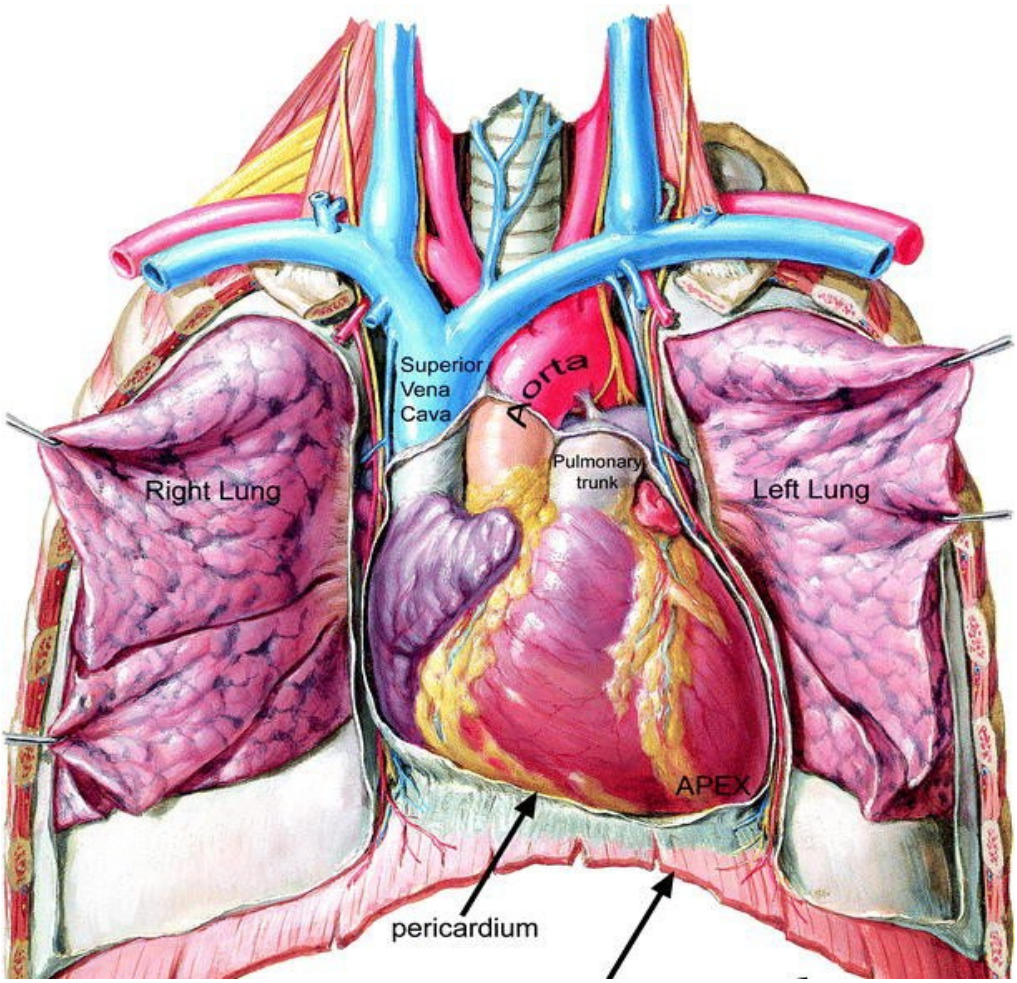
Posterior mediastinum and base of the heart from behind



II) Apex:

- It is the **lowest and most 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 5th 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.





III) Surfaces of the Heart:

1- Sternocostal (anterior) surface:

- It is bounded by the **4 borders** of the heart.
- This surface is formed **mainly by right ventricle** and parts of other chamber.
- 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 aorta).
  - 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** (A-V) groove (or **coronary** sulus)

  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)**

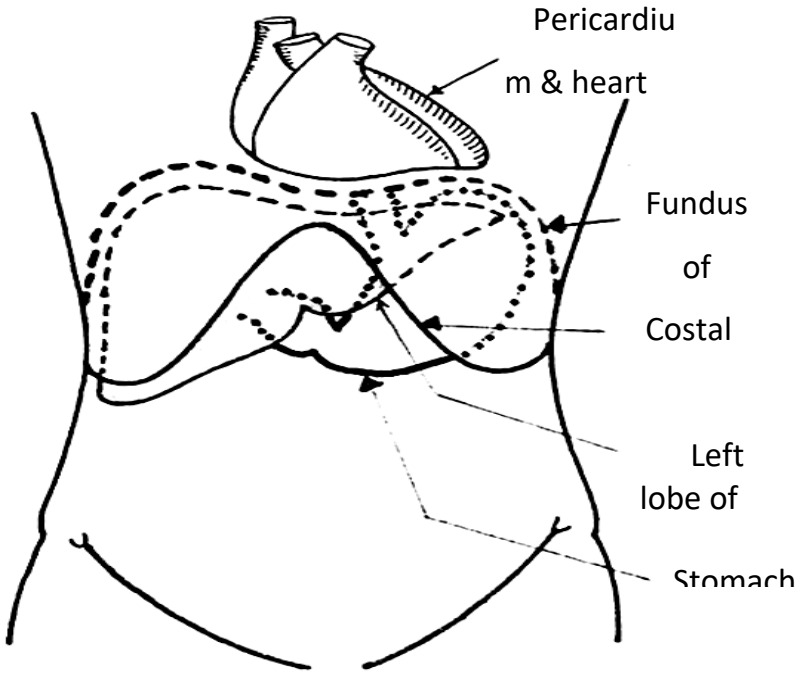
  c- Contents of the anterior mediastinum.

  d- Pericardium.

2- Posterior surface (Base).

3-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, c**entral tendon of **diaphragm** which separate the heart from underlying left lobe of **liver** and fundus of **stomach.**



Relations of diaphragmatic surface

4 &5- Right and left pulmonary surfaces: related to corresponding pleura and lung.

IV) Borders of the Heart:

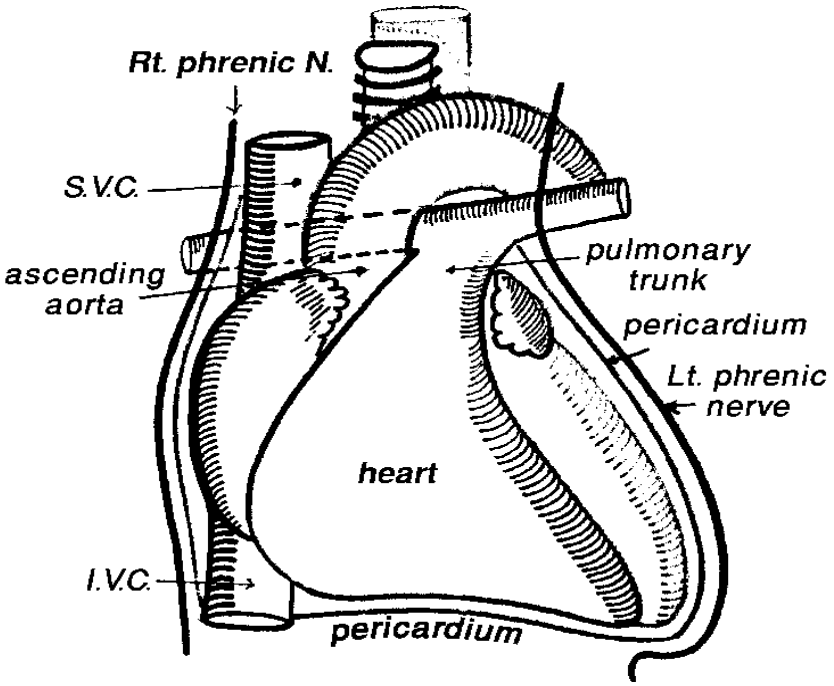
1- The upper border:

- It is formed by 2 atria (**mainly by** the left atrium i.e. like the base).
- 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.

Borders of the heart

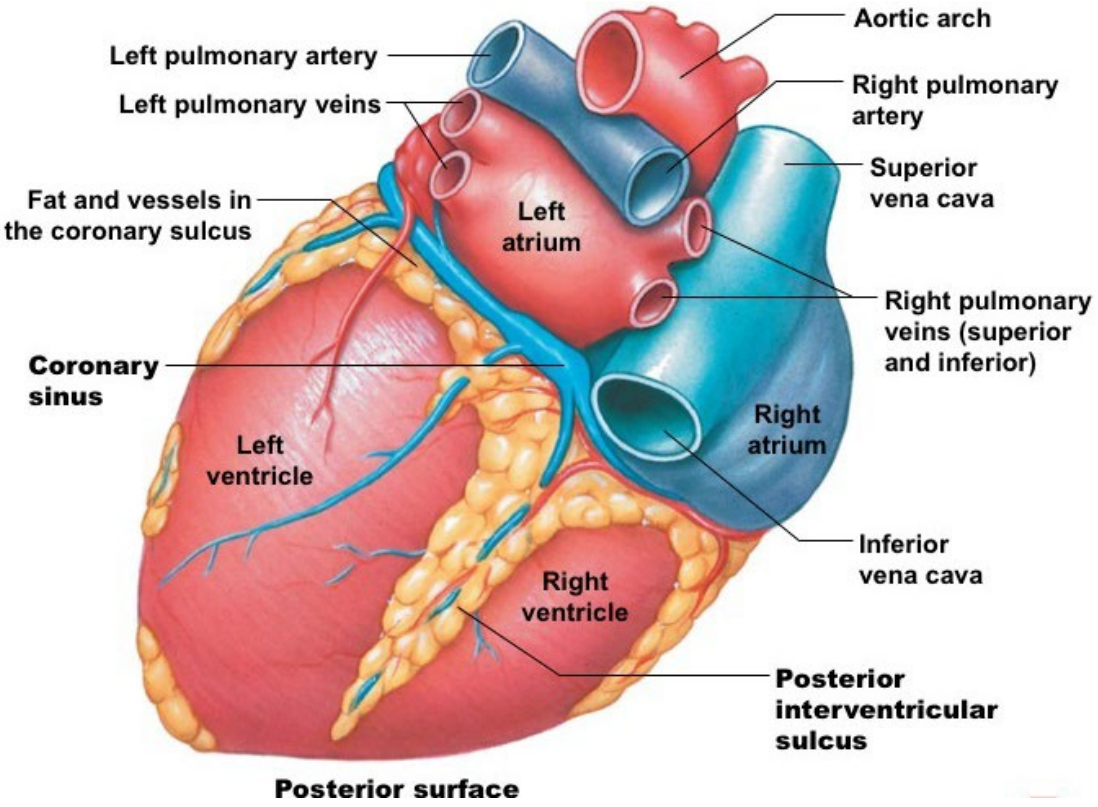


3- Left border:

- It 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 and left phrenic nerve which separate it from the left lung and pleura.

4- Right border:

- It 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 and right phrenic nerve which separate it from the right lung and pleura.



★ **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.

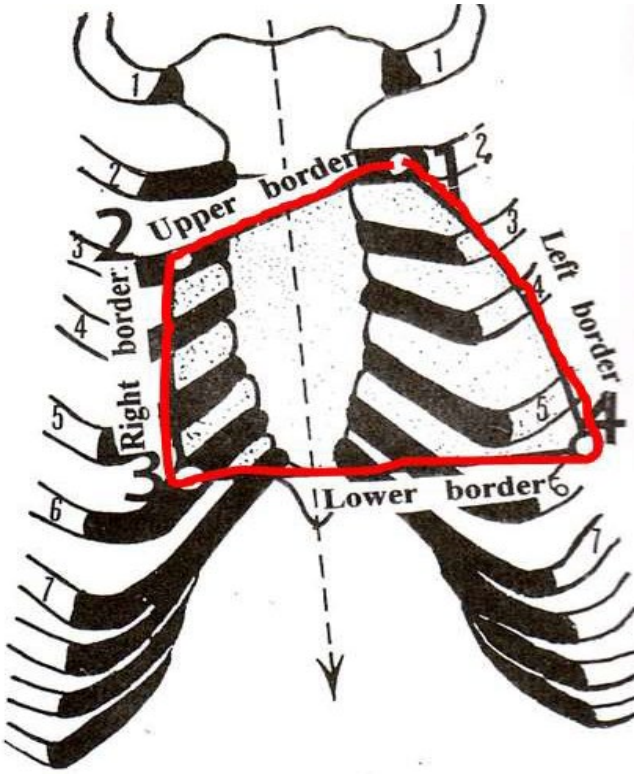
★ **Surface Anatomy of the borders of the heart:** (remember **2365**)

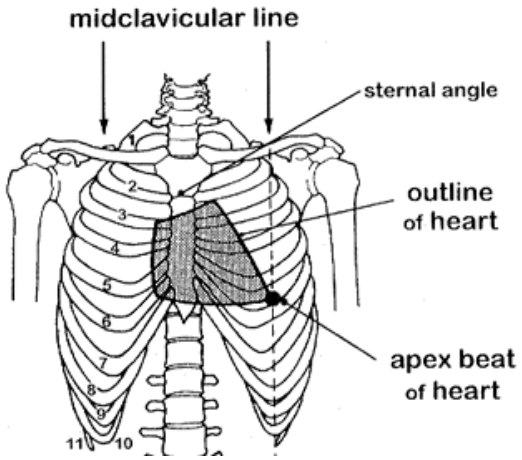
1- Upper border: from lower border of 2nd left costal cartilage 1.5 cm from sternal margin (**point 1**) to the upper border of 3rd right costal cartilage 1.5 cm from sternal margin (**point 2**)

2- Right border: from **point 2** to 6th right costal cartilage 1.5 cm from sternal margin (**point 3)**

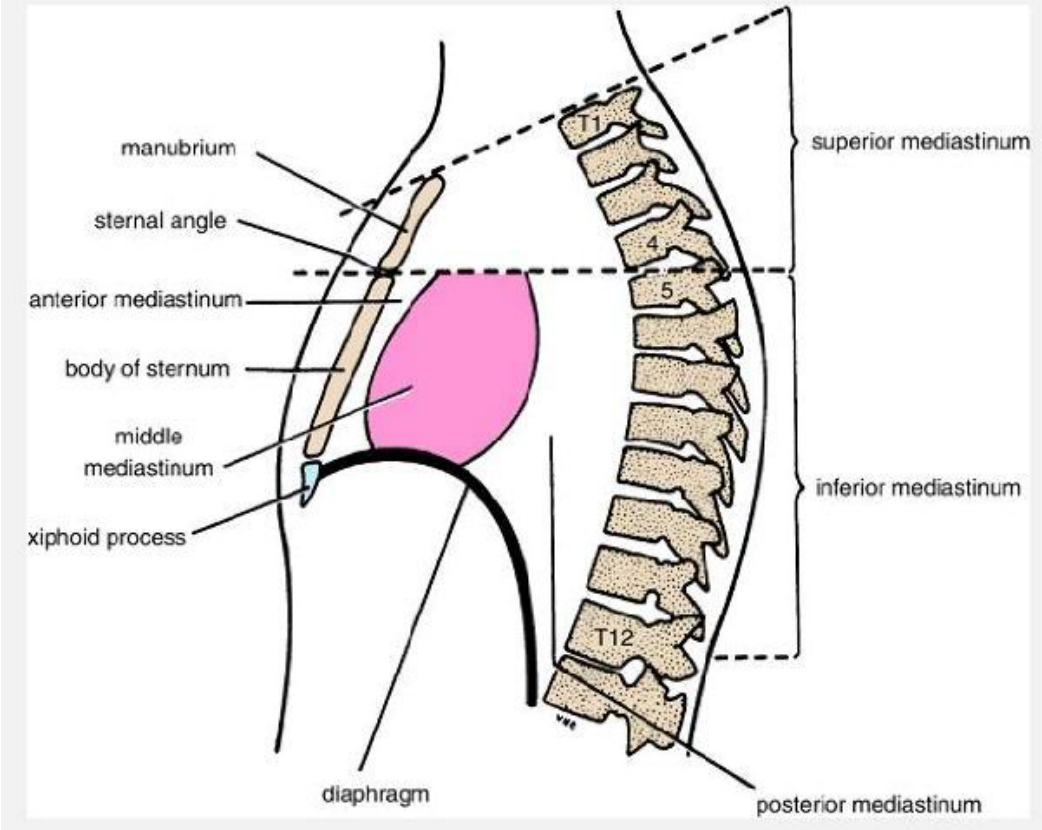
3- Lower border: an oblique straight line from **point 3** to 5th left intercostal space 9 cm from median plane (**point 4**)

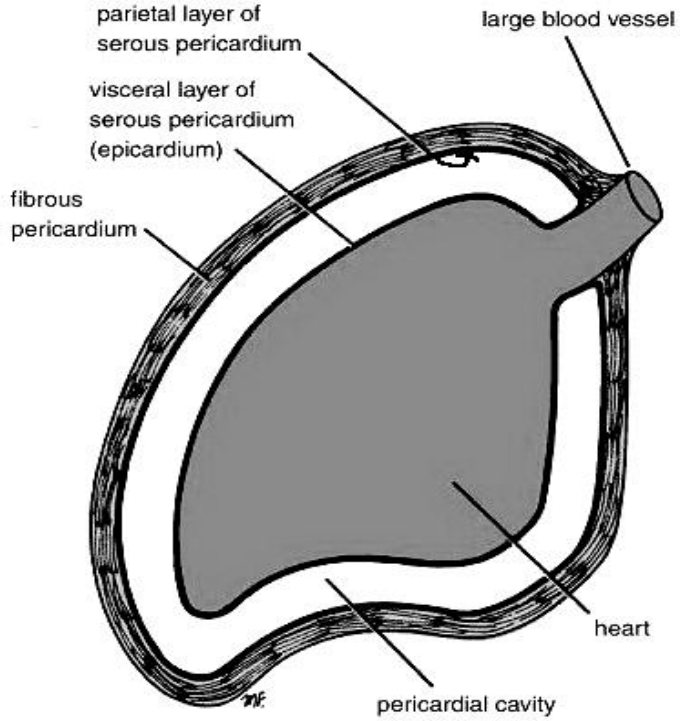
3- Left border: from apex of the heart **(*point 4*) to *point 1*.**





THE PERICARDIUM





Position and part of pericardium

★ The pericardium is a **fibro-serous sac** which **surrounds** the heart and the roots of large vessels attached to it (ascending aorta, pulmonary truck, 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 **sternum** and **2nd to the 6th** costal cartilages. Behind, it lies opposite the **5th to the 8th** 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"**.

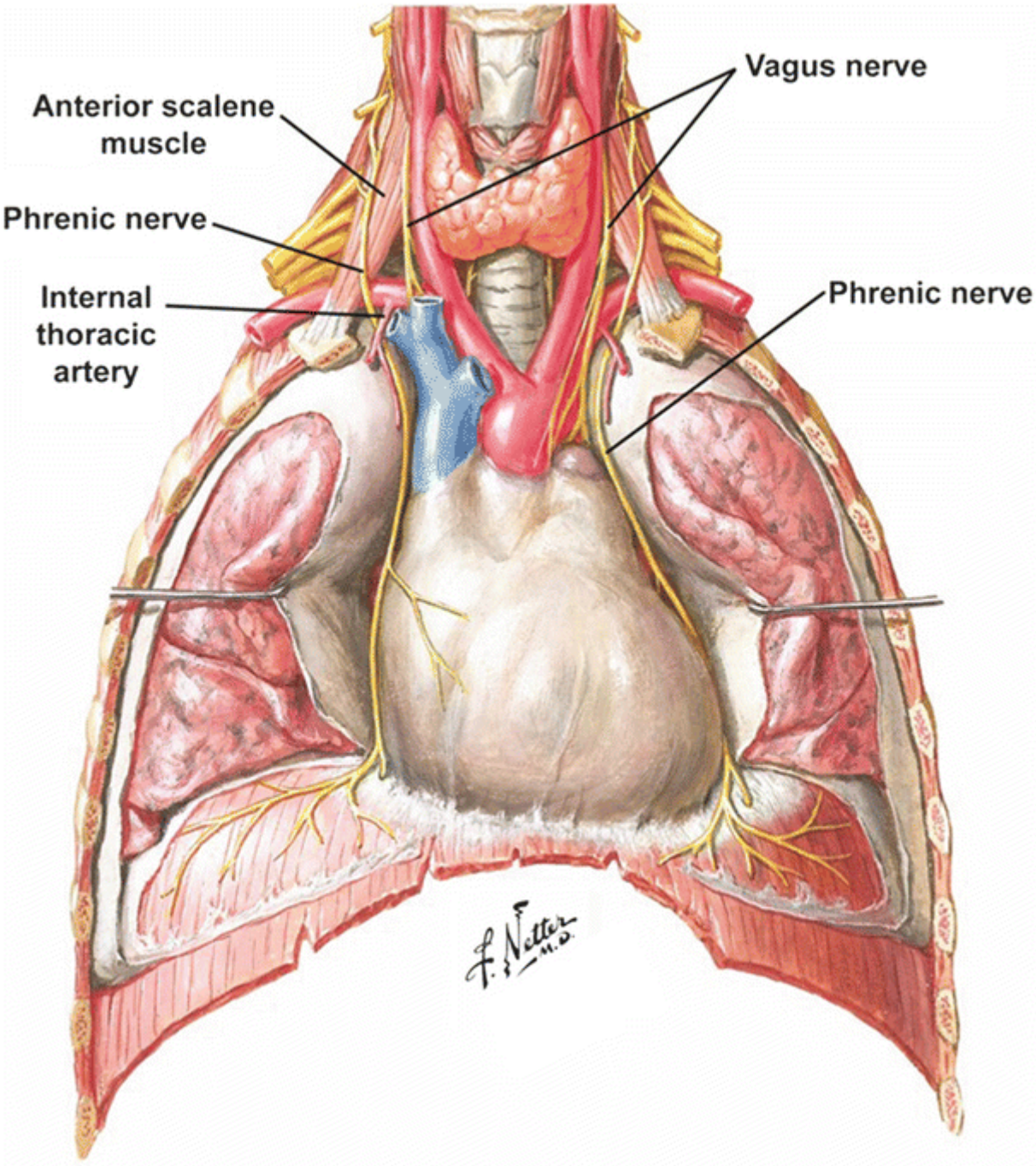
★ **Fibrous pericardium:**

- It is formed of **strong fibrous** tissue.
- It forms the **boundaries of the middle mediastinum**.
- **Shape:** It is **conical** having a base below, apex above and four surfaces:

1) **Base:** It is directed **downwards** and attached the **central tendon of diaphragm.**

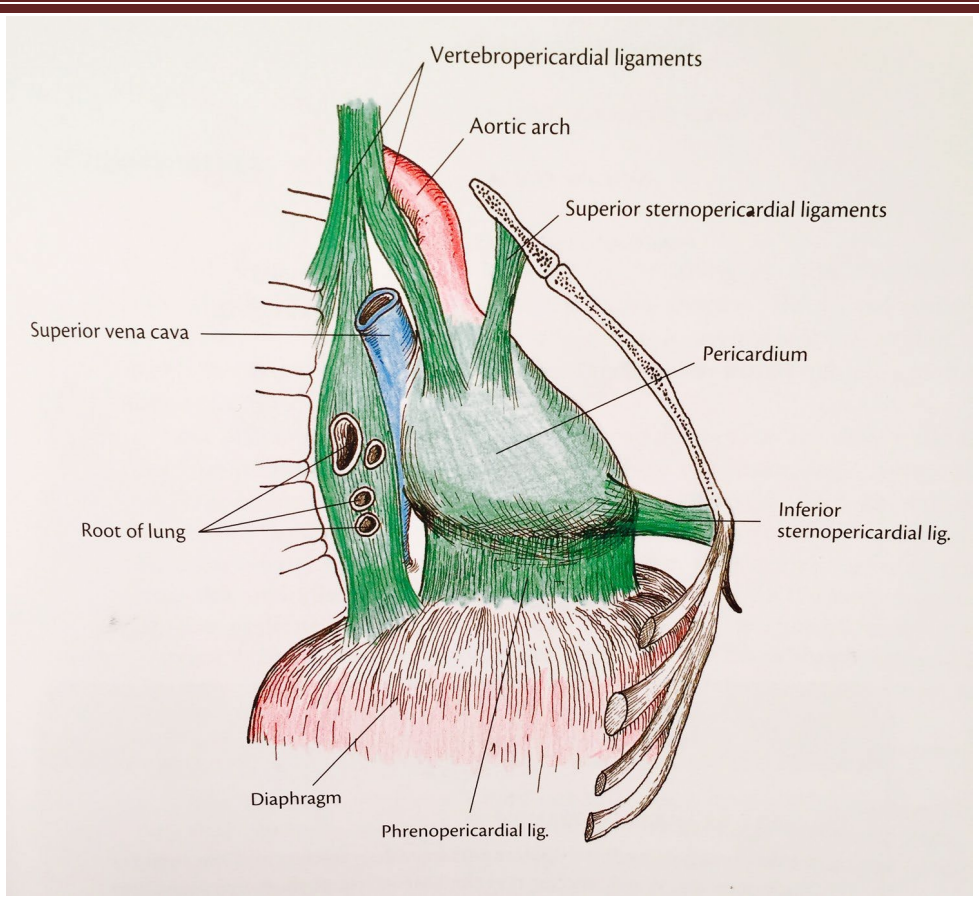
2) **Apex:**

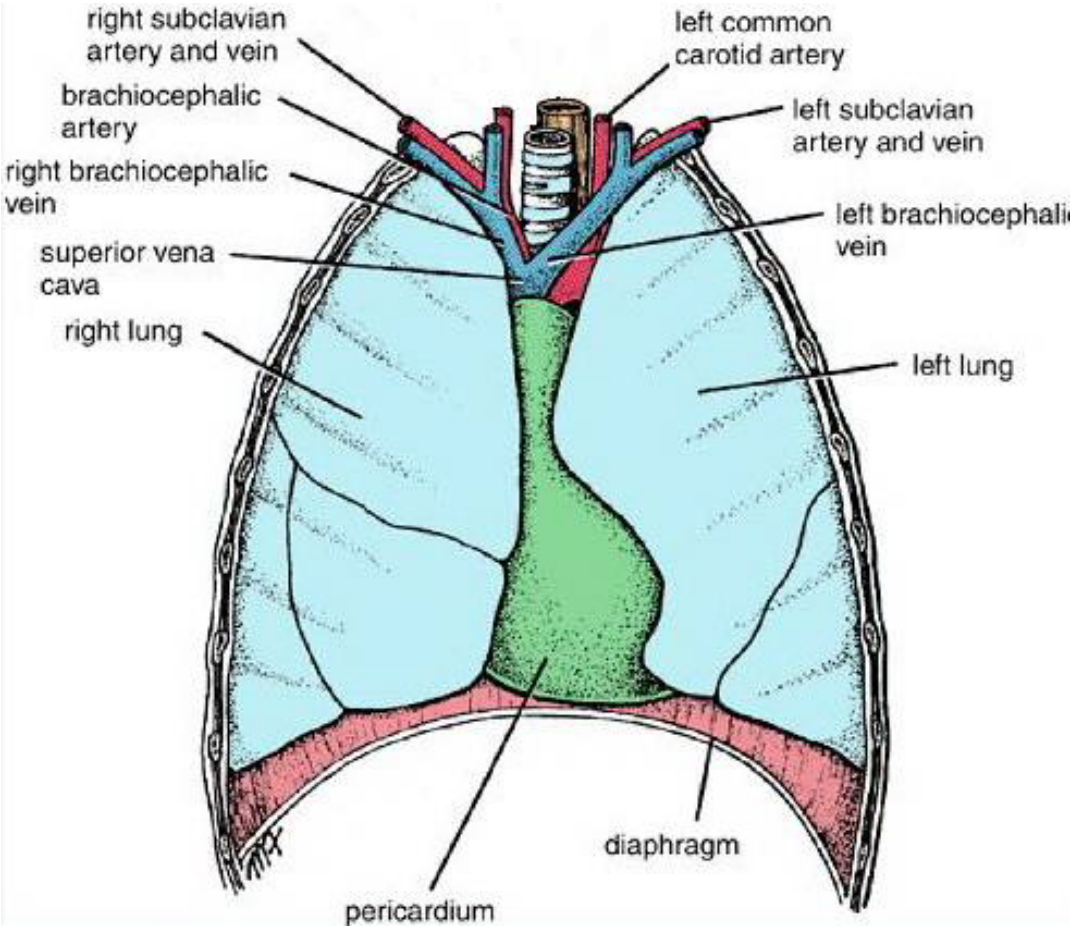
   - It is directed **upwards**.
   - It **surrounds and fuses** with the outer coats of the ascending aorta, pulmonary trunk and SVC.



3) **Anterior surface**:

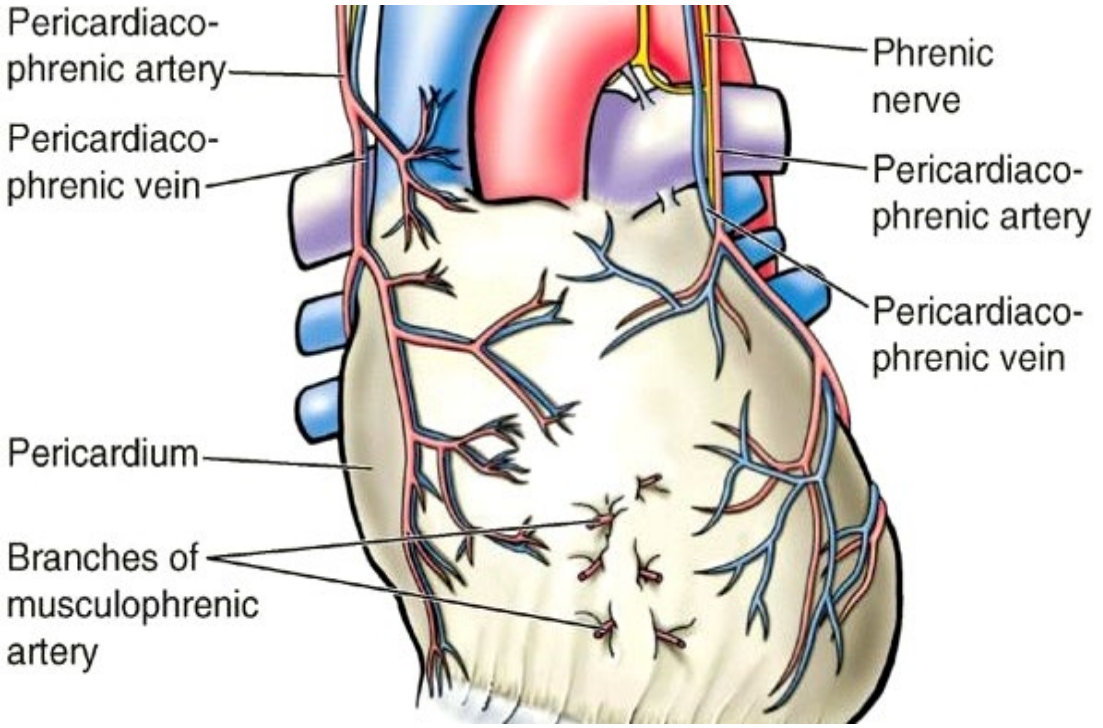
- It is connected to the body of the sternum by superior and inferior **sterno-pericardial ligaments**.
- The anterior borders of the **two pleurae and lungs** separate it from body of sternum **except** the lower left part of body of sternum which lies in direct relation to the pericardium (**bare area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


Vertebropericardial ligaments
Aortic arch
Superior sternopericardial ligaments
Superior vena cava
Pericardium
Root of lung
Inferior sternopericardial lig.
Diaphragm
Phrenopericardial lig.

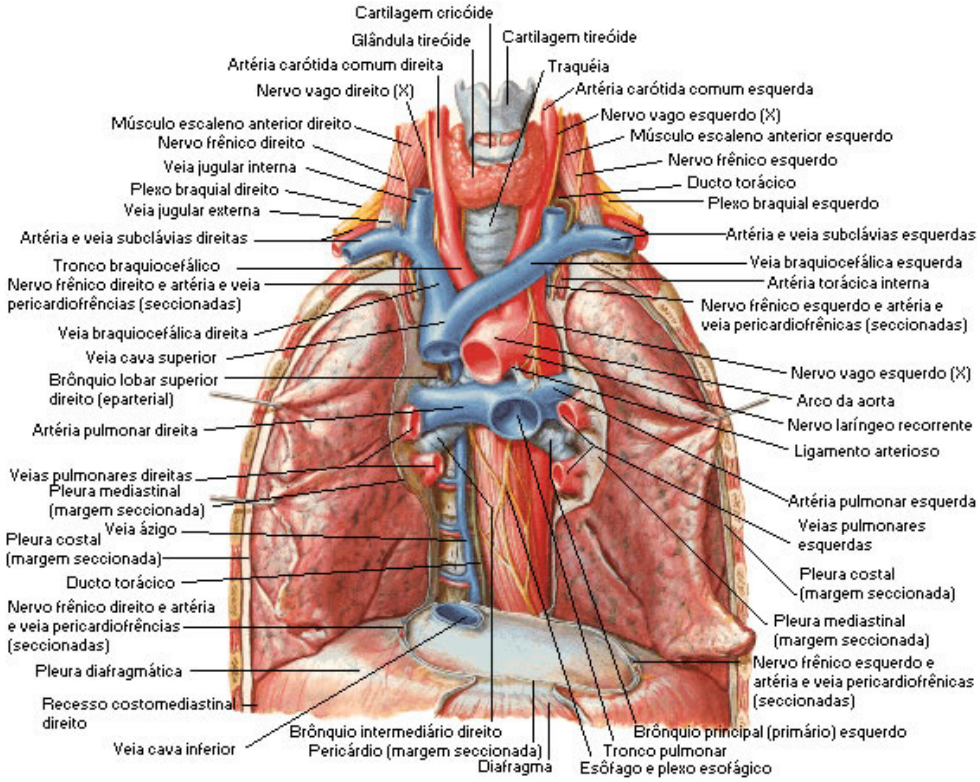

right subclavian artery and vein
left common carotid artery
brachiocephalic artery
left subclavian artery and vein
right brachiocephalic vein
left brachiocephali vein
superior vena cava
right lung
left lung
diaphragm
pericardium

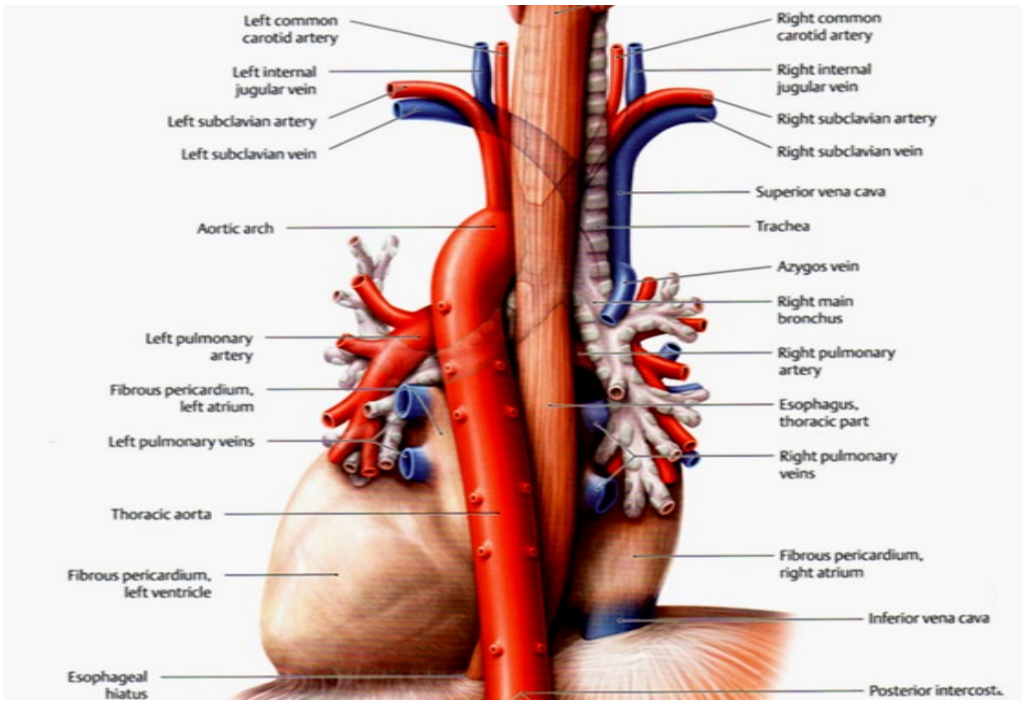
4) **Two lateral surfaces:**

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



5) **Posterior surface:** related to oesophagus and descending aorta.





★ 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:

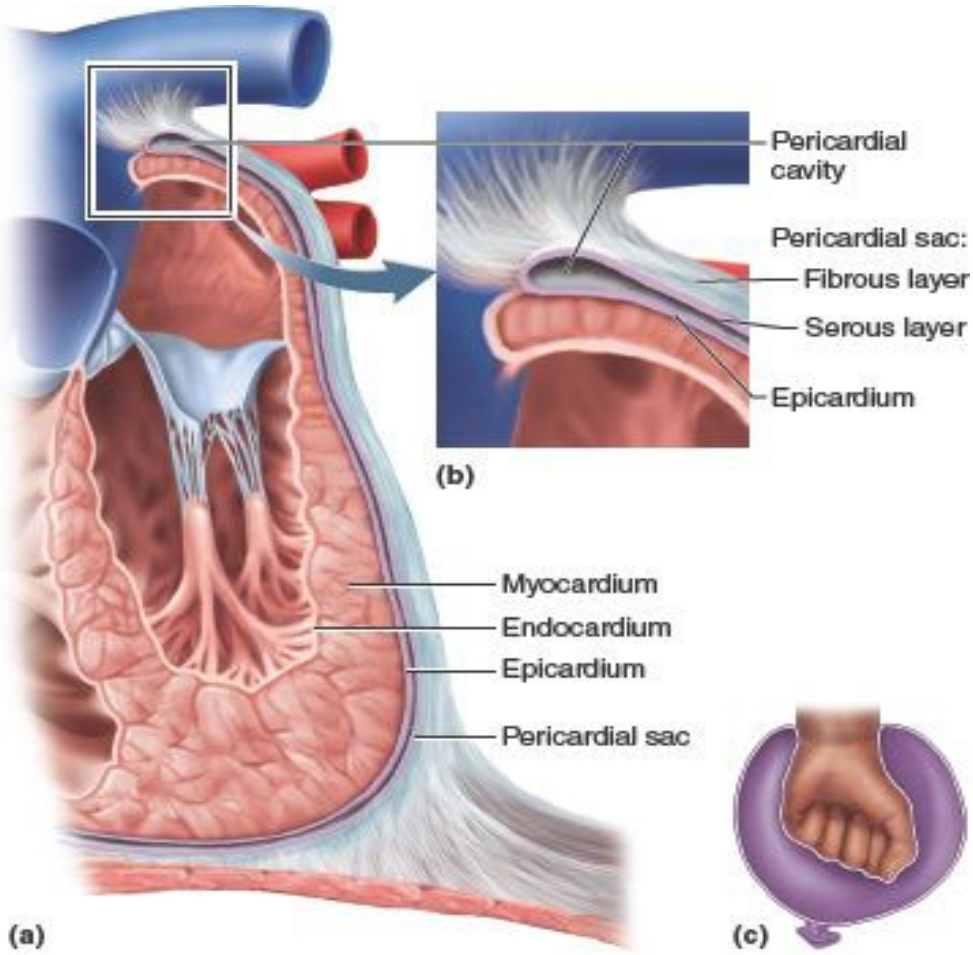
a- Parietal layer:

- 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.



★**Sinuses of the Pericardium:** There are **2 sinuses** related to the serous pericardium (inside the pericardial cavity):

I) Transverse Sinus of Pericardium:

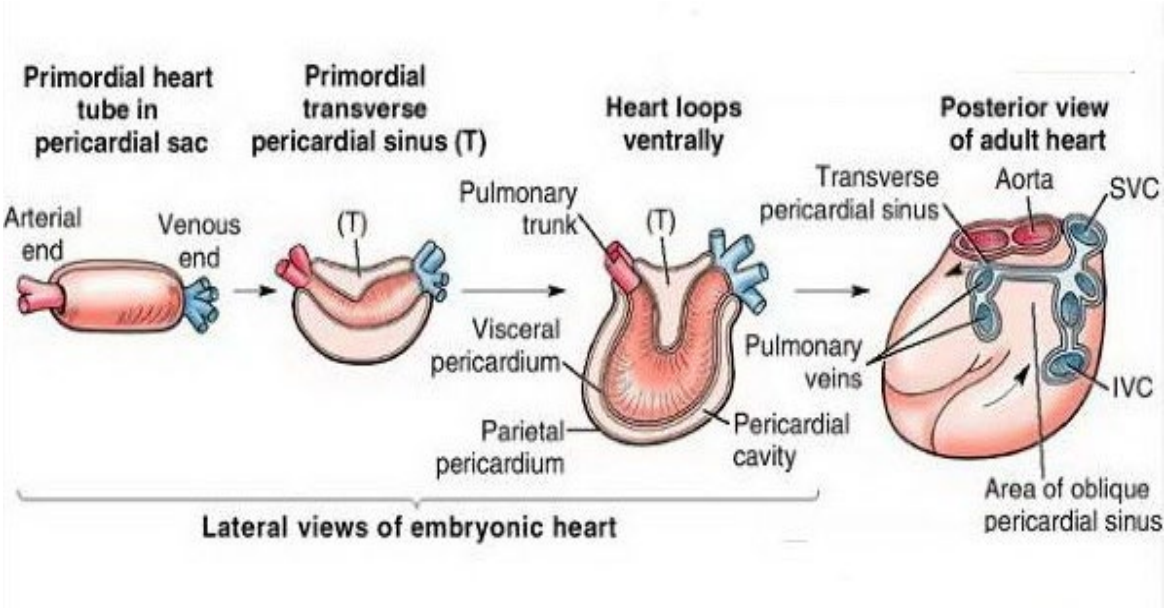
- A **transverse passage** between the arterial and the venous ends of the heart. I
- It **connects the right and left sides** of the pericardial cavity**.**
- **Boundaries:**

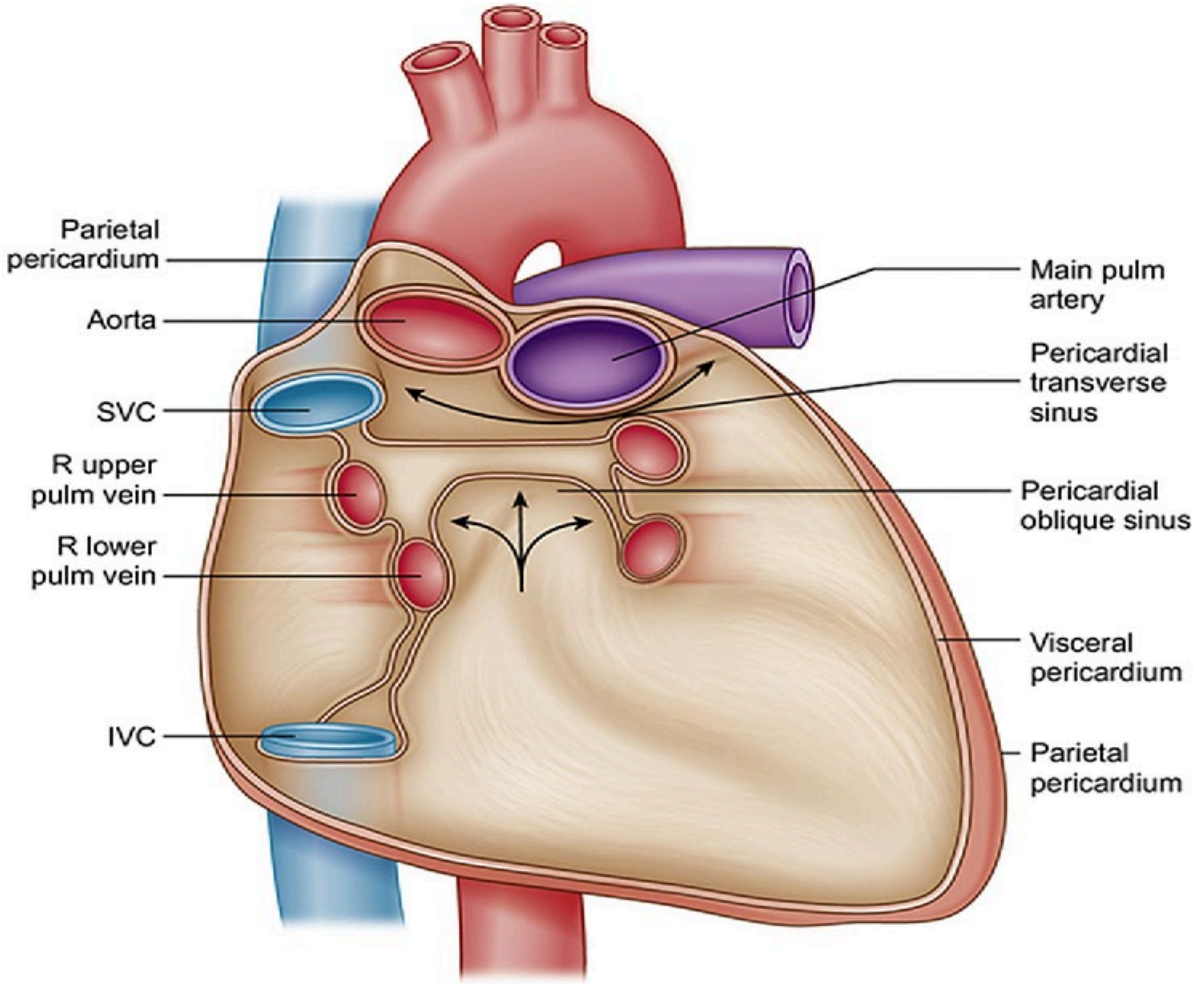
1- Anterior: ascending aorta and pulmonary trunk.

2- Superior: right pulmonary artery.

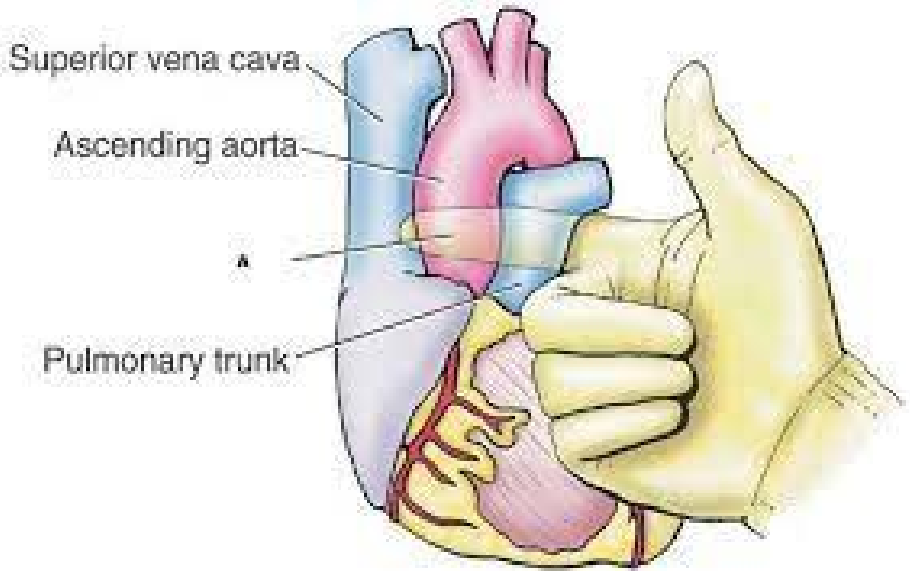
3- Posterior: lower part of S.V.C. and the 2 atria, mainly left.

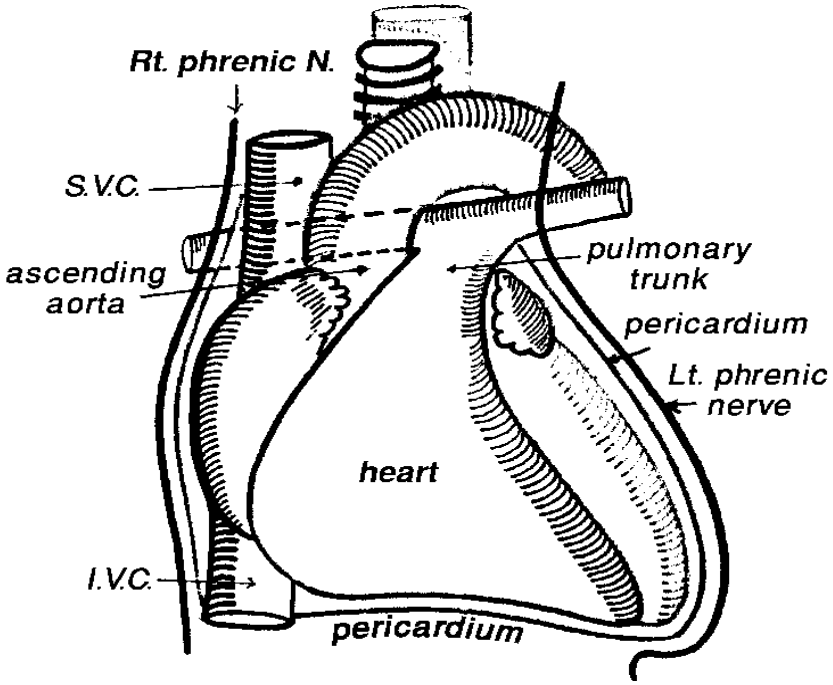
4- Inferior: the 2 atria, mainly left.





- **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**.

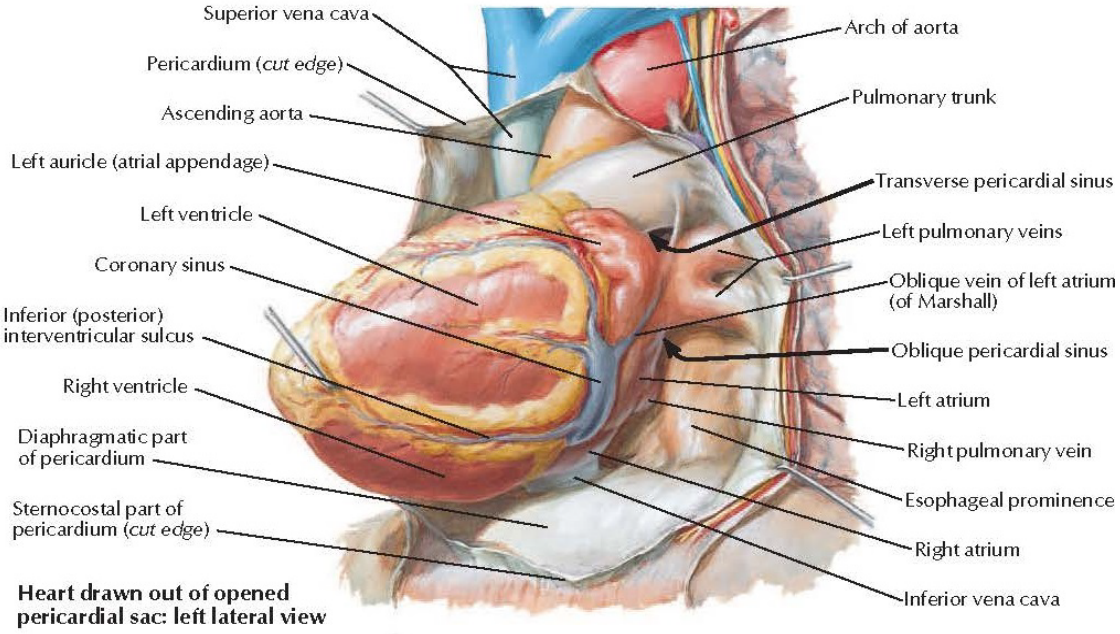




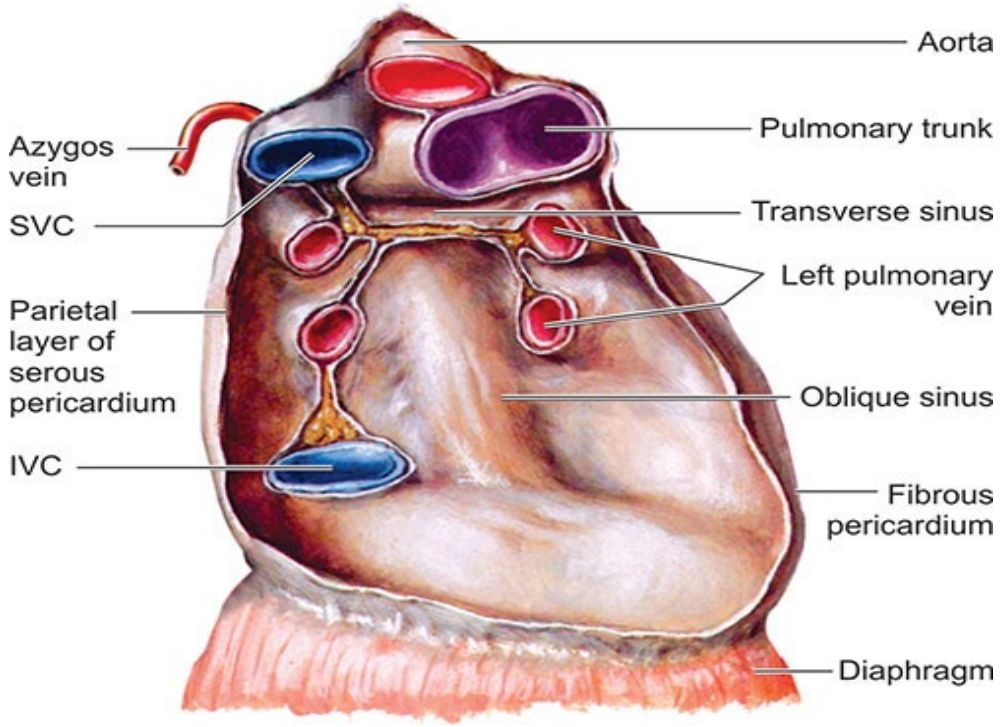
II) Oblique Sinus of Pericardium:

- The visceral layer of serous pericardium passes 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).
  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.
- **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.



Heart drawn out of opened pericardial sac: left lateral view



Transverse sinuous

Oblique sinuous

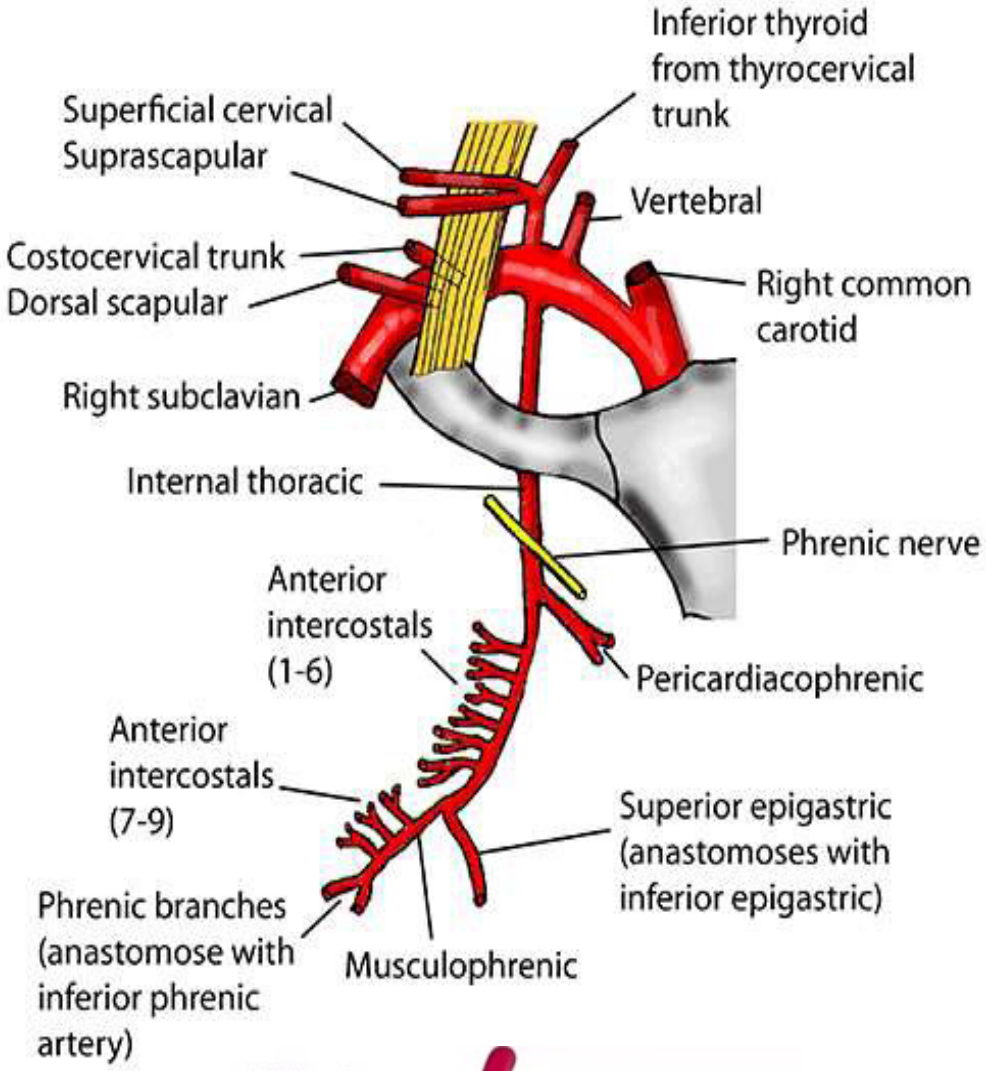
★ **Blood supply of the p1ericardium:**

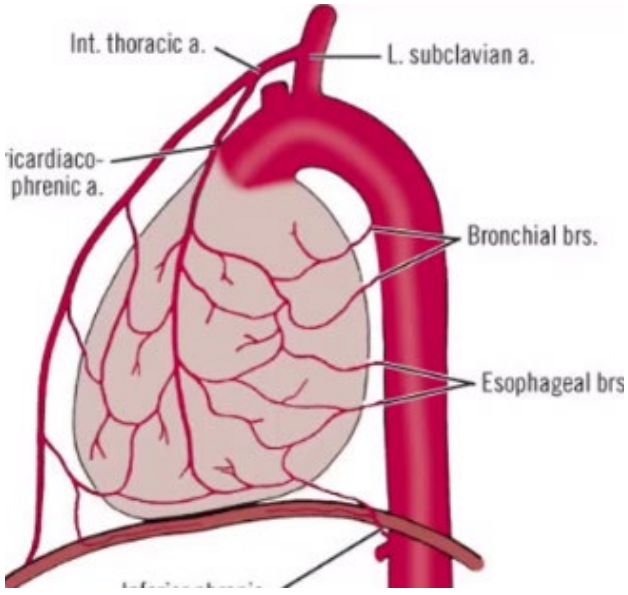
a-Fibrous pericardium and parietal layer of serous pericardium:

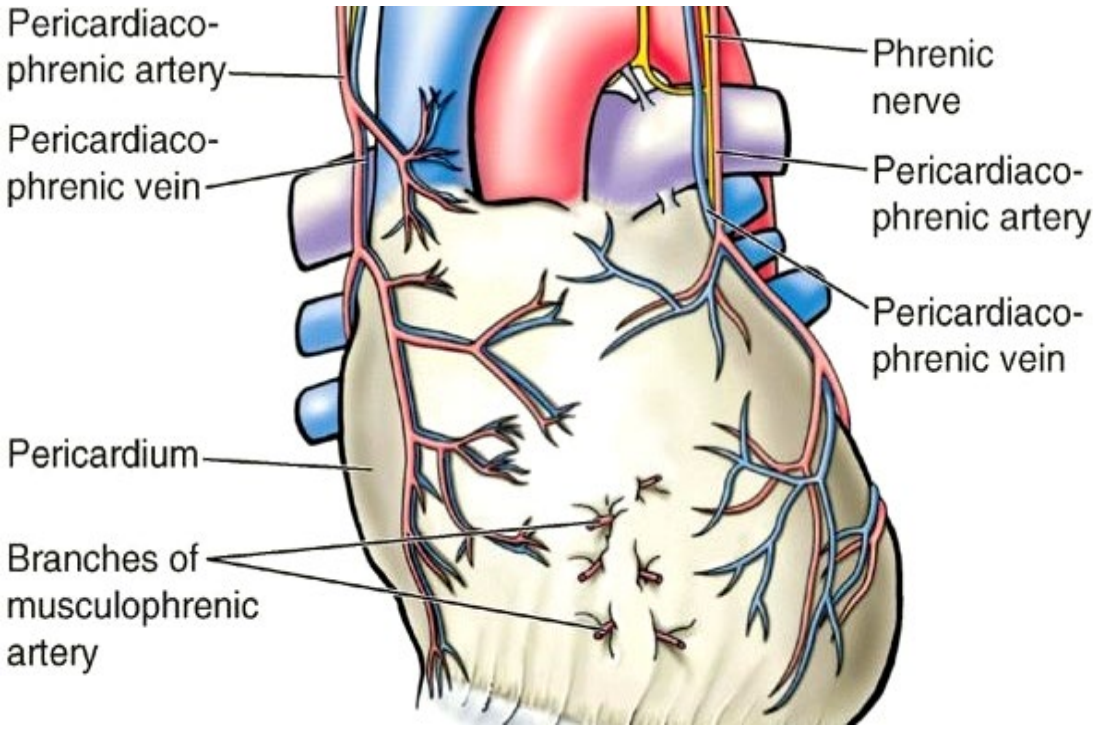
- The **arterial** supply is from the **internal thoracic arteries** and their **pericardiacophrenic** and **musculophrenic** branches and from descending **aorta**. In addition arterial blood from **bronchial** and **esophageal** arteries.
- The **venous** drainage is through the **azygos** venous system.

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.**


Inferior thyroid from thyrocervical trunk
Superficial cervical
Suprascapular
Vertebral
Costocervical trunk
Dorsal scapular
Right common carotid
Right subclavian
Internal thoracic
Phrenic nerve
Anterior intercostals (1-6)
Pericardiacophrenic
Anterior intercostals (7-9)
Superior epigastric (anastomoses with inferior epigastric)
Phrenic branches (anastomose with inferior phrenic artery)
Musculophrenic


Int. thoracic a.
L. subclavian a.
icardiaco-
phrenic a.
Bronchial brs.
Esophageal brs



★ **Nerve supply of the pericardium:**

a- Fibrous pericardium and parietal layer of serous pericardium:

- It is supplied by the **phrenic** nerves (C_{3-5}) 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 trunk and vagus). It is **insensitive to pain** but sensitive to **ischaemia**.

★ **Functions of Pericardium**

a- The fibrous pericardium:

- **Protects** & maintains position of the heart and prevents its over-distension.
- Keeps the **mouth** of the large vessels open.

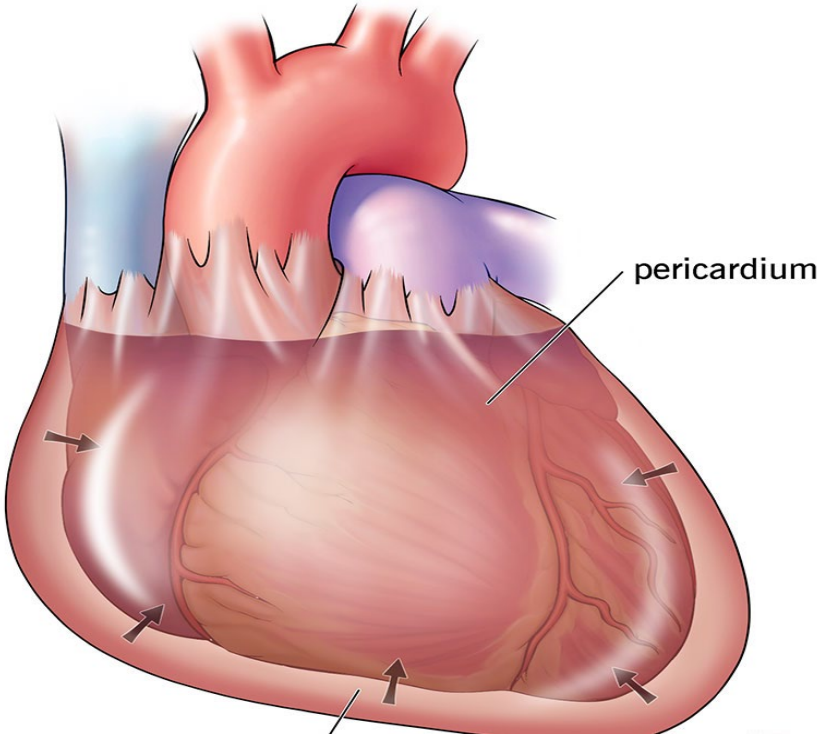
b- The serous pericardium:

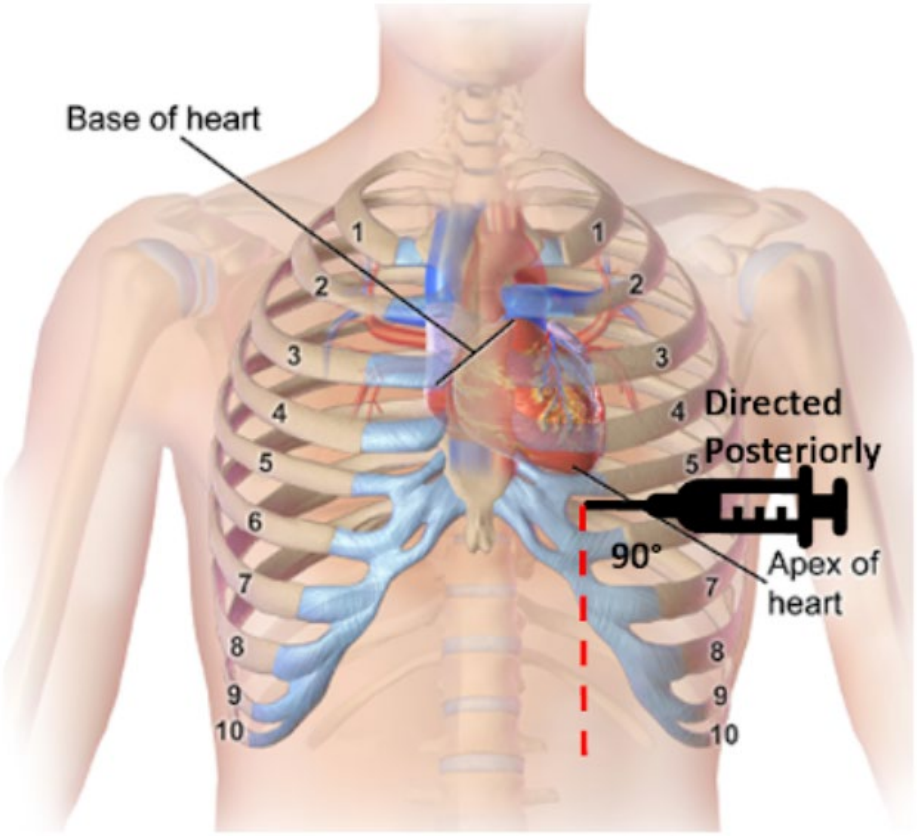
- It allows **free movements** of the heart during systole and diastole
- The **oblique sinus** acts as a **potential space** behind the left atrium allowing its **movements**. It also allows the **pulsation** of the descending thoracic aorta and the **expansion** of the esophagus during swallowing.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

★ **Applied anatomy:**

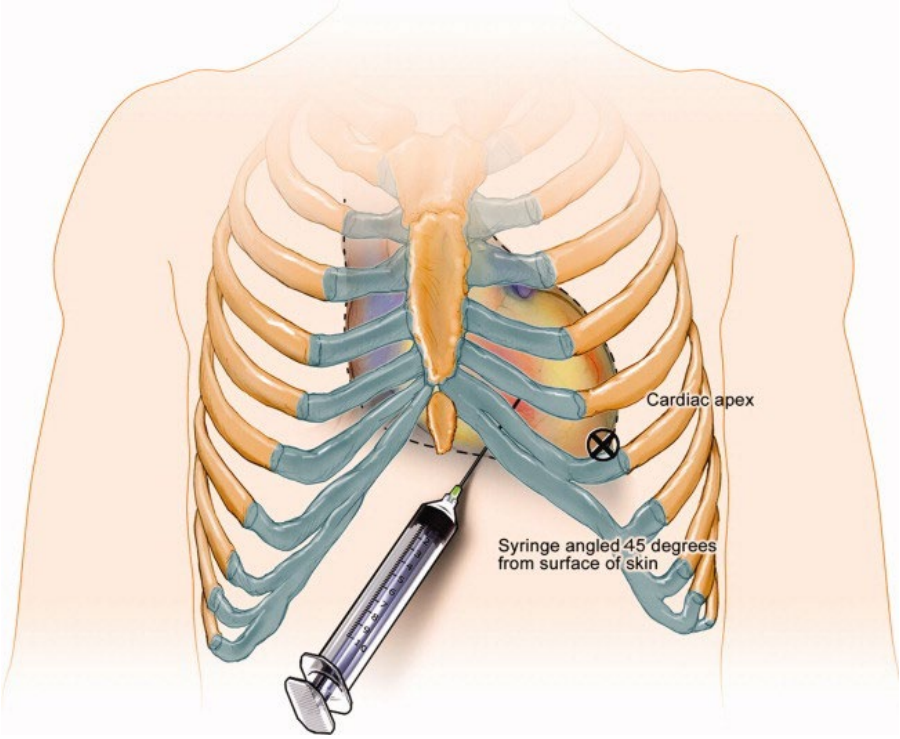
1. **Pericarditis** is inflammation in the pericardium usually cause chest pain and pericardial rub on auscultation.
2. Accumulation of fluid in the pericardial cavity is called **pericardial effusion** leading to dullness around the normal cardiac dullness on percussion and distal heart sounds on auscultation.
3. Accumulation of blood in the pericardiac cavity is called **haemo-pericardium** (usually due to infarction, cardiac operation or cardiac trauma).
4. **Cardiac tamponate** is cardiac compression by haemo-pericardium usually leathal due to impairment of cardiac filling and cardiac output.
5. **Pericrdiocentesis** 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 infrastenal angle** by passing the needle postero-superior towards the left shoulder.

Pericardial effusion





Parasternal



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