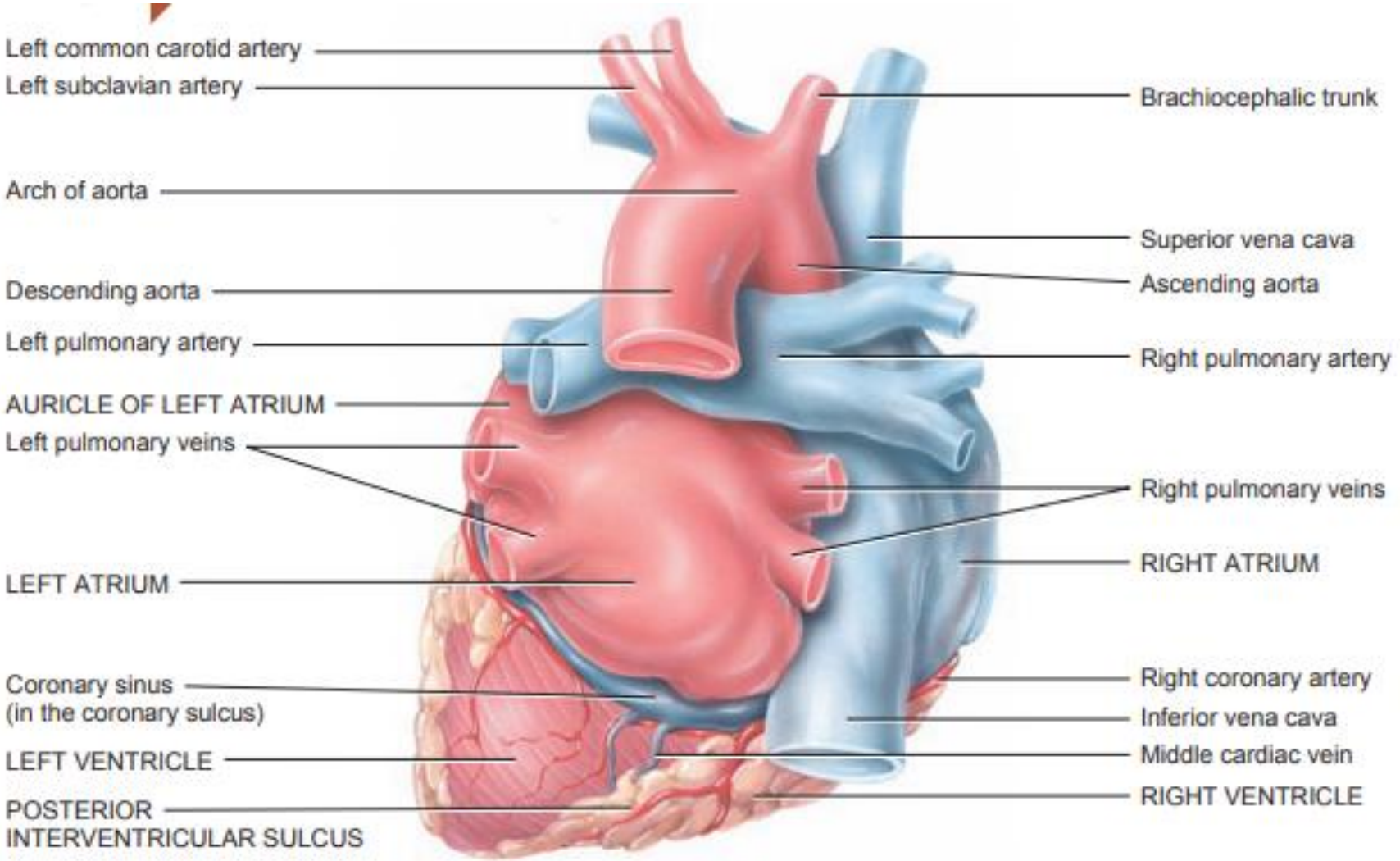
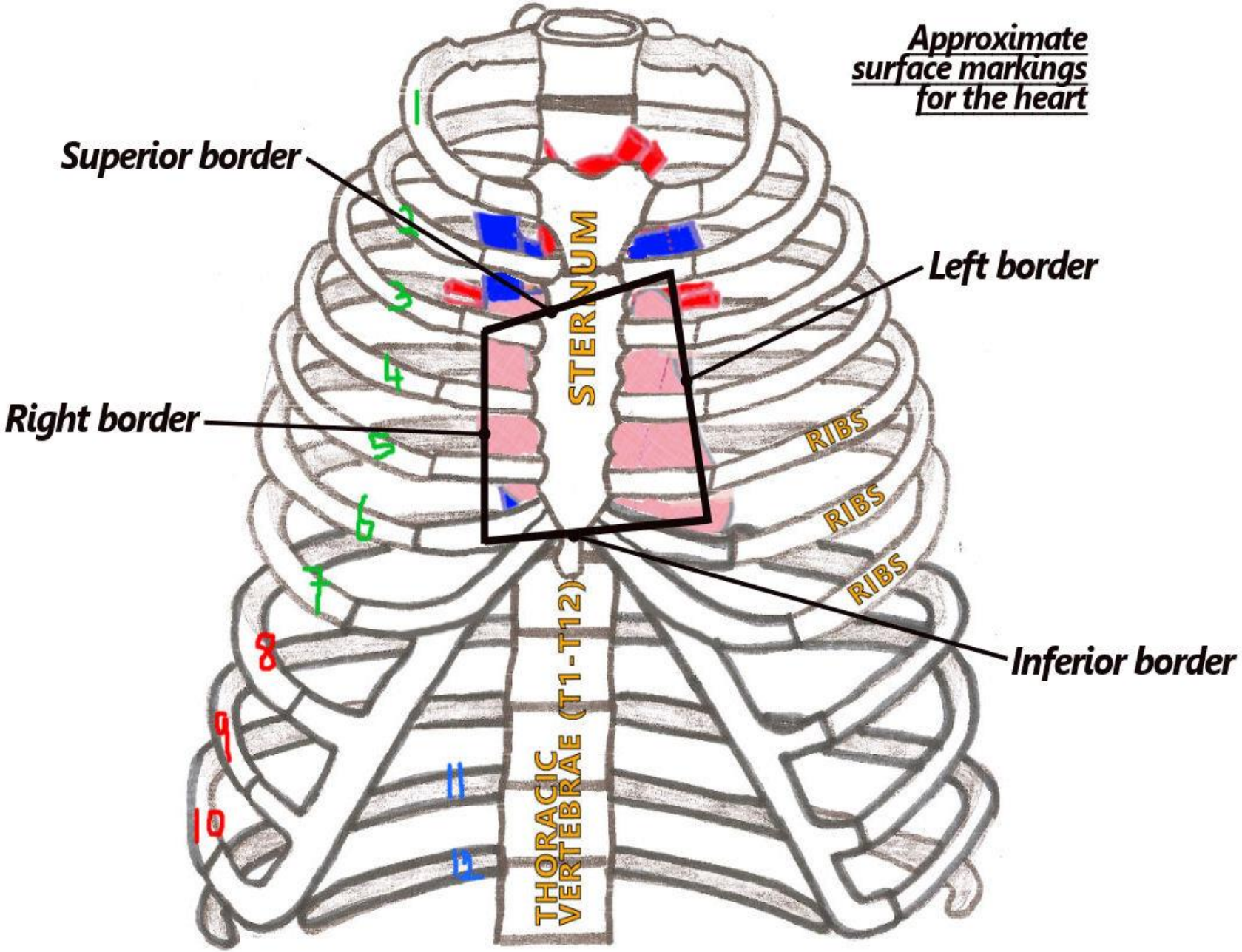
HEART



(c) Posterior external view showing surface features

- Location- **in the middle mediastinum, at the level of thoracic vertebrae T5-T8.**
- **Dimension-** about 12 cm long, 9 cm wide at its broadest point, and 6 cm thick,
- **Weight-** 250 g in adult females, 300 g in adult males.
- The heart rests on the diaphragm, near the midline of the thoracic cavity.
- About two-thirds of the mass of the heart lies to the left of the body's midline

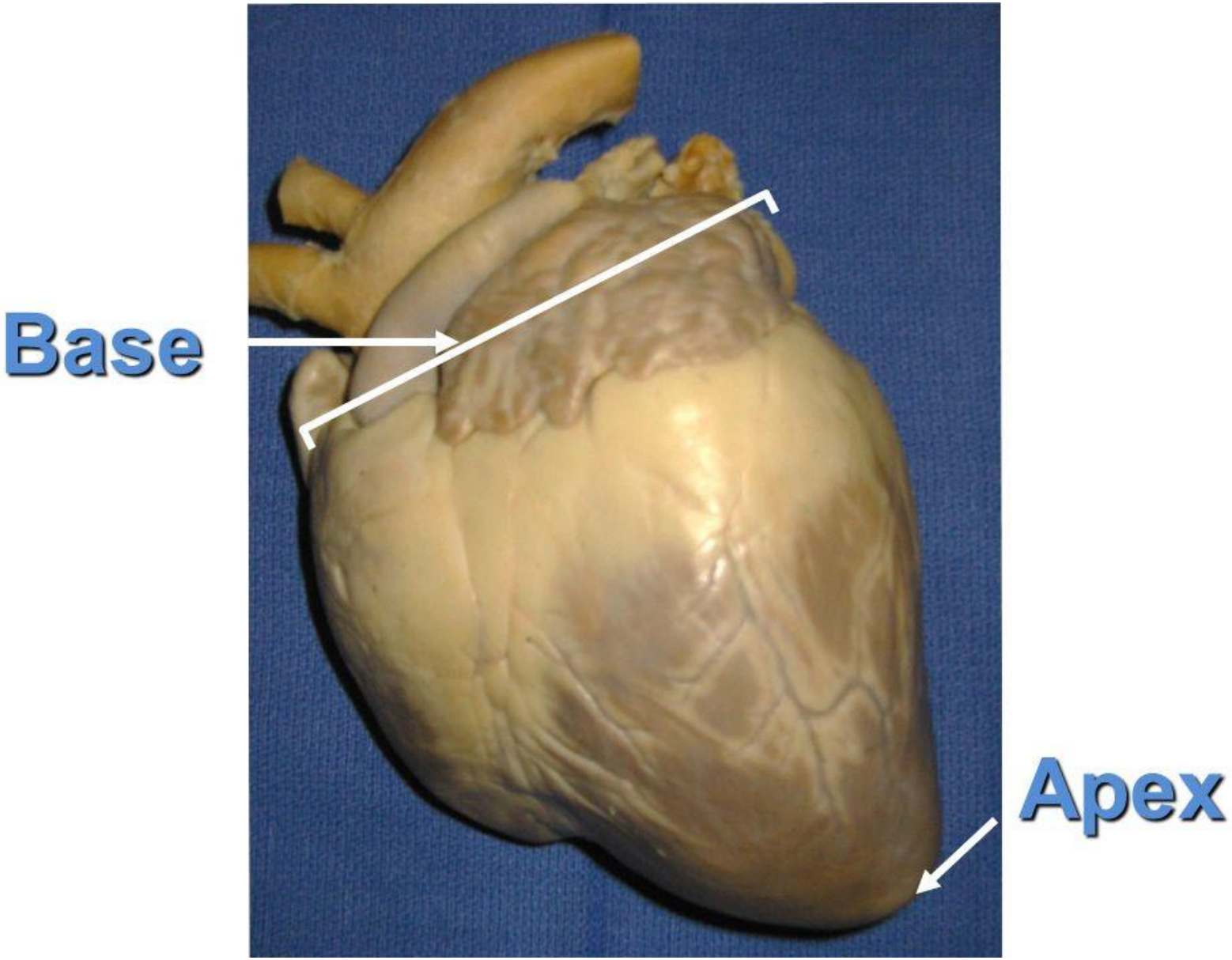

Approximate surface markings for the heart
Superior border
Left border
Right border
Inferior border
STERNUM
RIBS
RIBS
RIBS
THORACIC VERTEBRAE (T1-T12)
1
2
3
4
5
6
7
8
9
10
11
12

- **A double membraned sac called the pericardium surrounds the heart and attaches to the mediastinum.**
- **The back surface of the heart lies near the vertebral column, and the front surface sits behind the sternum and rib cartilages**
- **The heart is the attachment point for several large blood vessels – the venae cavae, aorta and pulmonary trunk.**

- **The upper part of the heart is located at the level of the third costal cartilage**

- **The lower tip of the heart, the apex, lies to the left of the sternum (9 cm from the midsternal line) between the junction of the fourth and fifth ribs near their articulation with the costal cartilages**

- **The heart is cone-shaped, with its base positioned upwards and tapering down to the apex.**

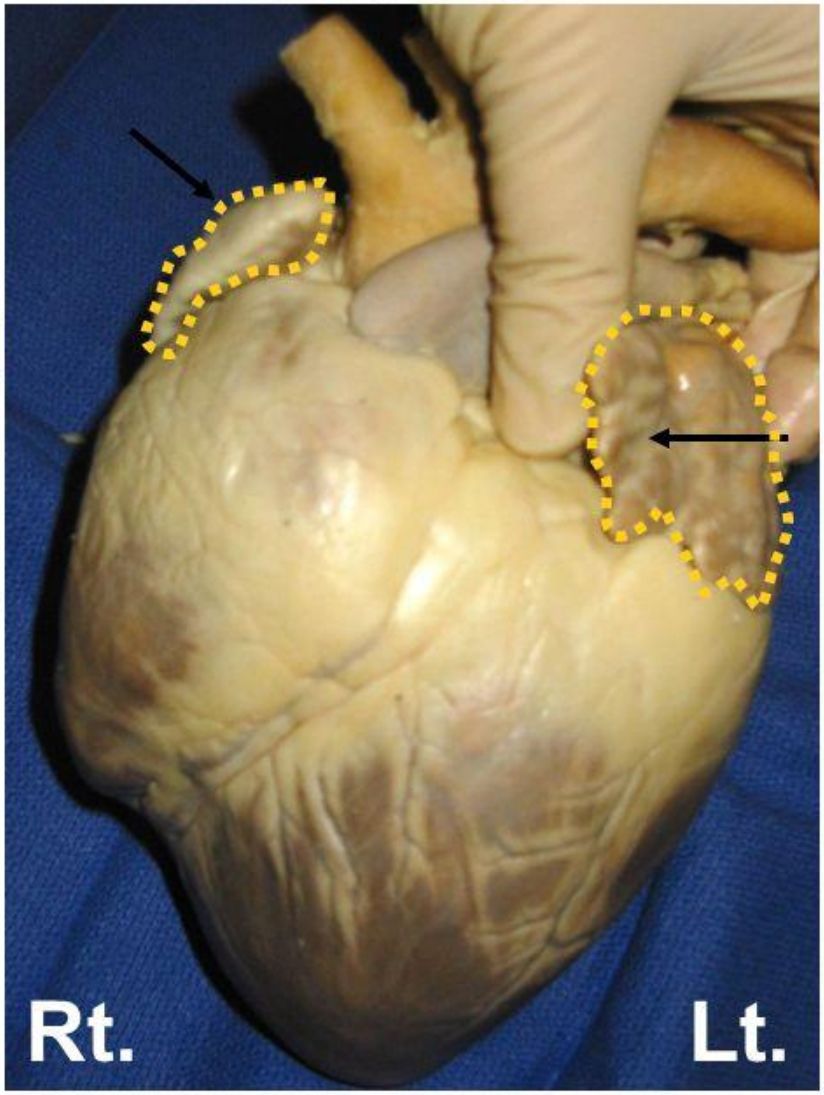

Base
Apex

Cardiac Chambers- 4

- The two superior receiving chambers are the atria, and the two inferior pumping chambers are the ventricles. On the anterior surface of each atrium is a wrinkled pouch-like structure called an auricle. Each auricle slightly increases the capacity of an atrium so that it can hold a greater volume of blood.

Auricles

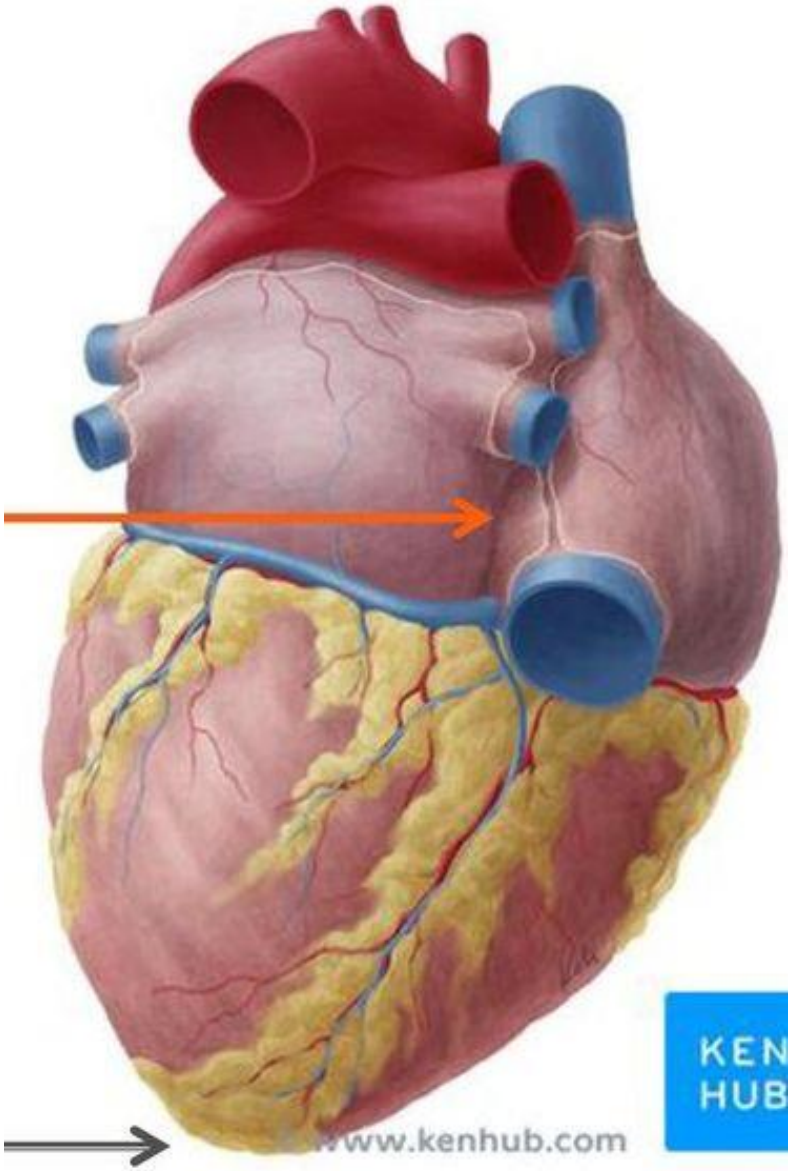
Ear-shaped extensions of the atria.



Sulci or groove

- **Atrioventricular sulcus-** the atria are separated from the ventricles by a circular sulcus called **coronary sulcus**
- It consist of ant. and post. Part
- The half part of ant. seen on the sternocostal surface and half part hidden from the pulmonary trunk and aorta.
- The posterior part of the sulcus lies at the diaphragmatic surface

- **Inter-atrial groove** is faintly visible post., While ant. hidden by the aorta and pulmonary trunk
- The **interventricular grooves** mark the position of attachment of the ventricular septum to the outer wall of the heart
- The ant. Interventricular groove separates the RT and LT ventricles
- The post. groove separates the same chambers on the diaphragmatic surface.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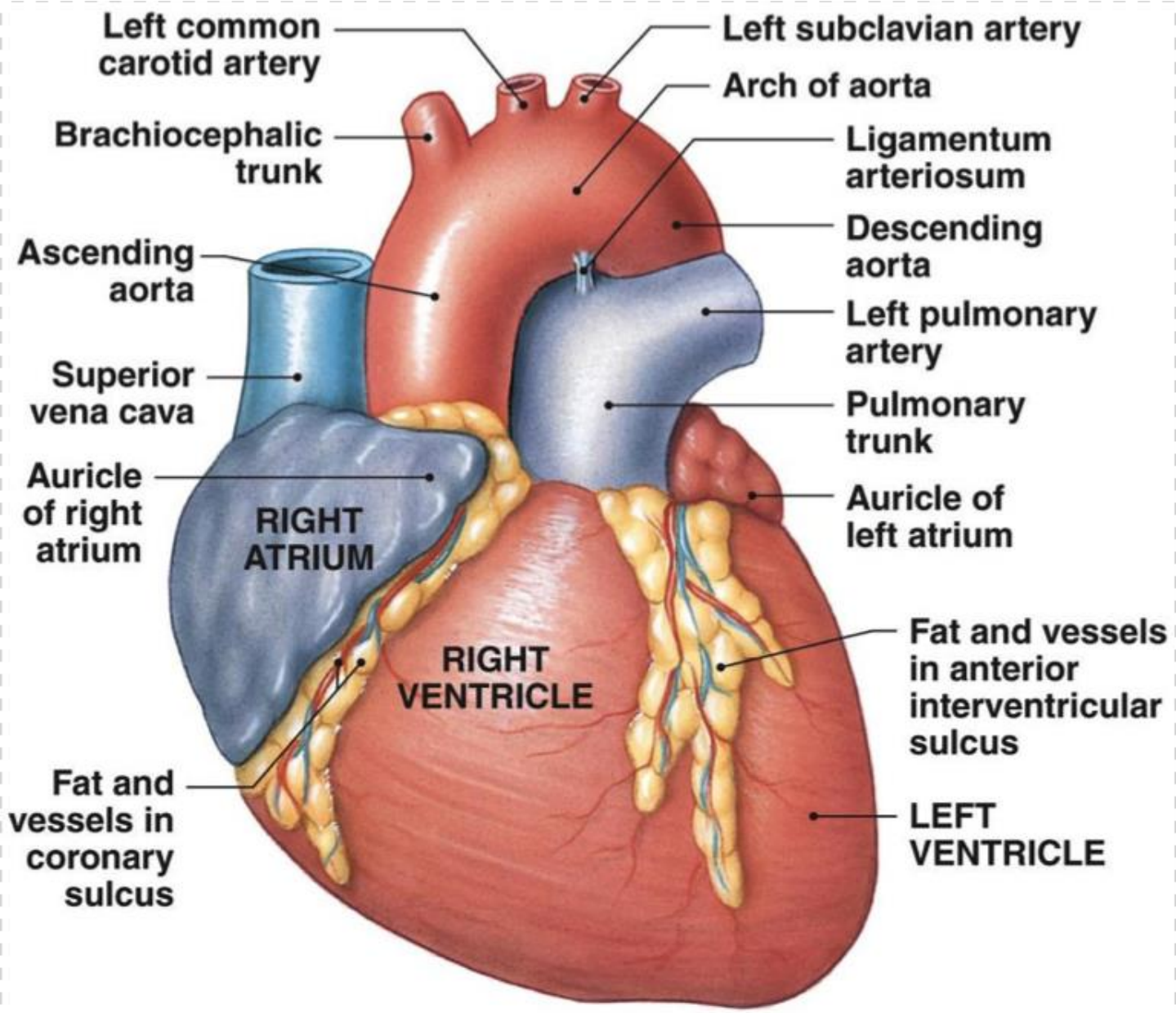
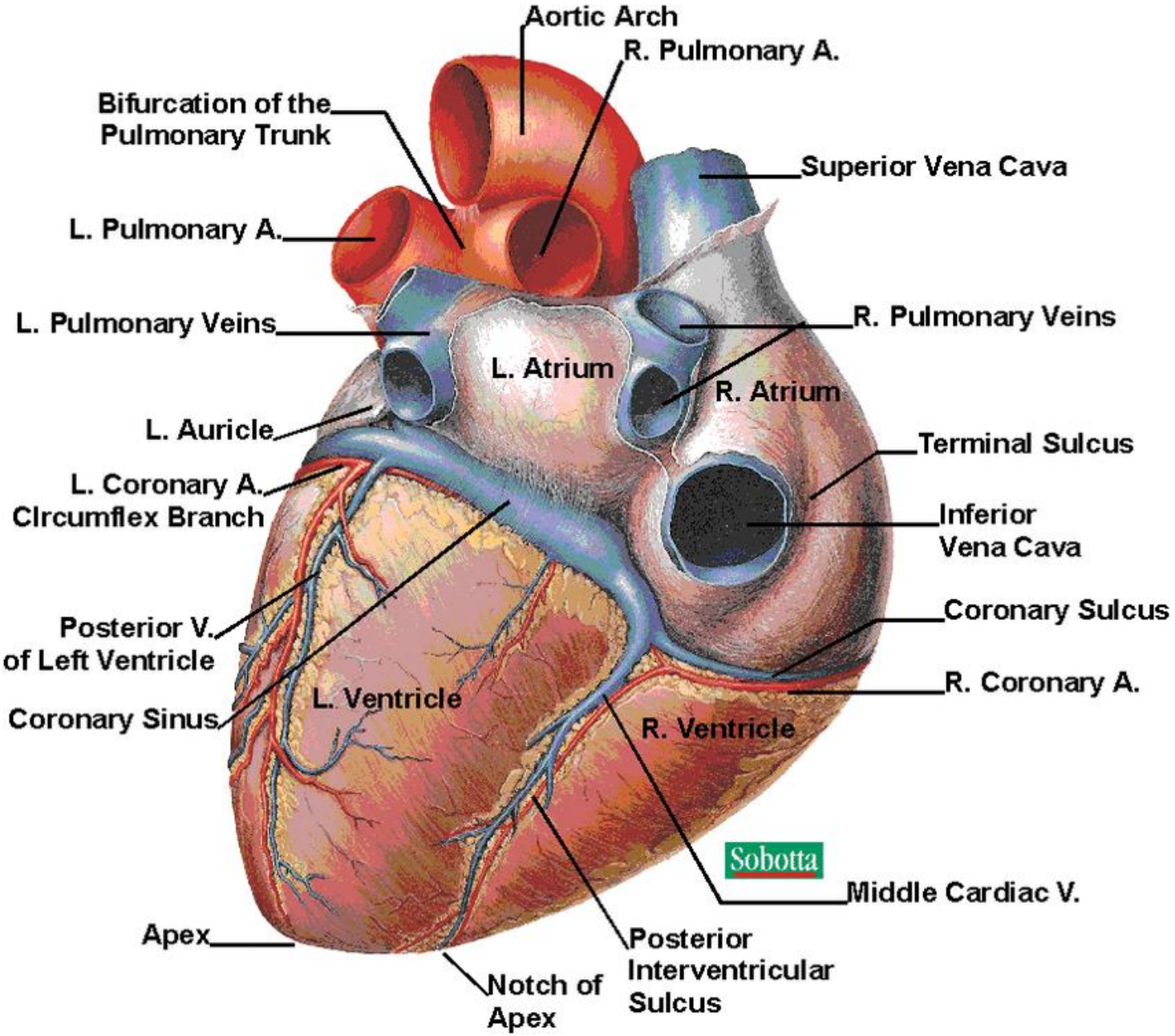


(a) Anterior (sternocostal) surface


Aortic Arch
R. Pulmonary A.
Bifurcation of the Pulmonary Trunk
Superior Vena Cava
L. Pulmonary A.
L. Pulmonary Veins
R. Pulmonary Veins
L. Atrium
R. Atrium
L. Auricle
Terminal Sulcus
L. Coronary A. CIrcumflex Branch
Inferior Vena Cava
Coronary Sulcus
Posterior V. of Left Ventricle
R. Coronary A.
L. Ventricle
Coronary Sinus
R. Ventricle
Sobotta
Middle Cardiac V.
Apex
Posterior Interventricular Sulcus
Notch of Apex

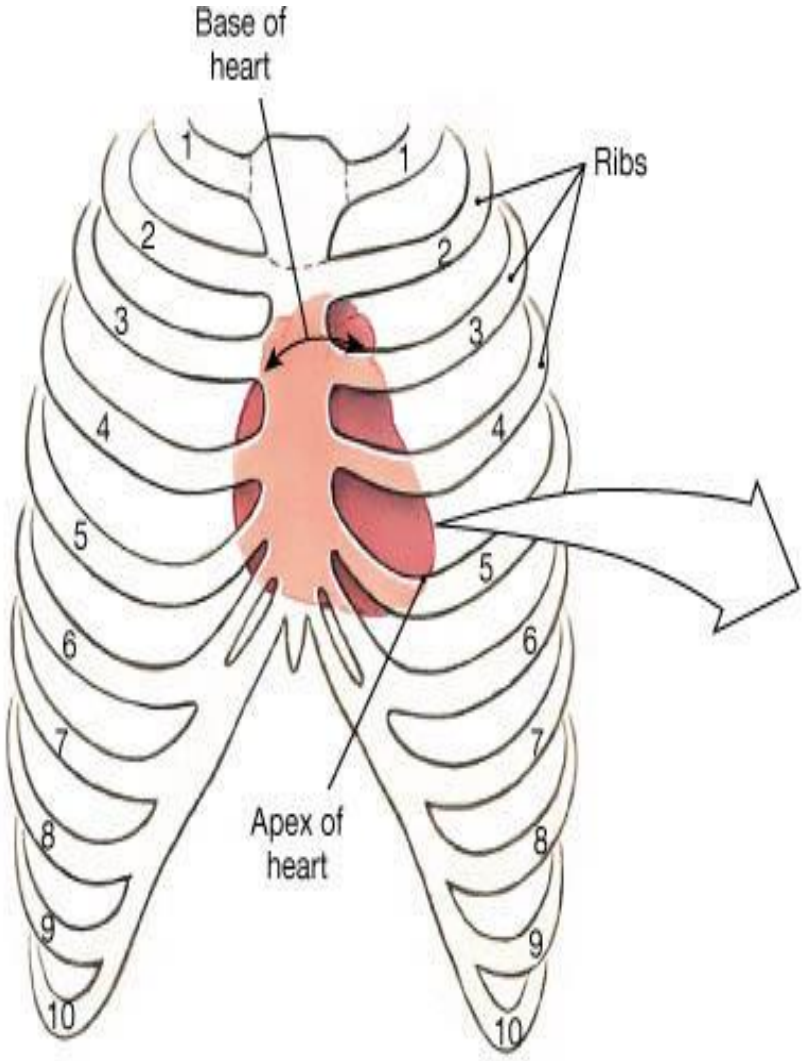
BORDER OF HEART

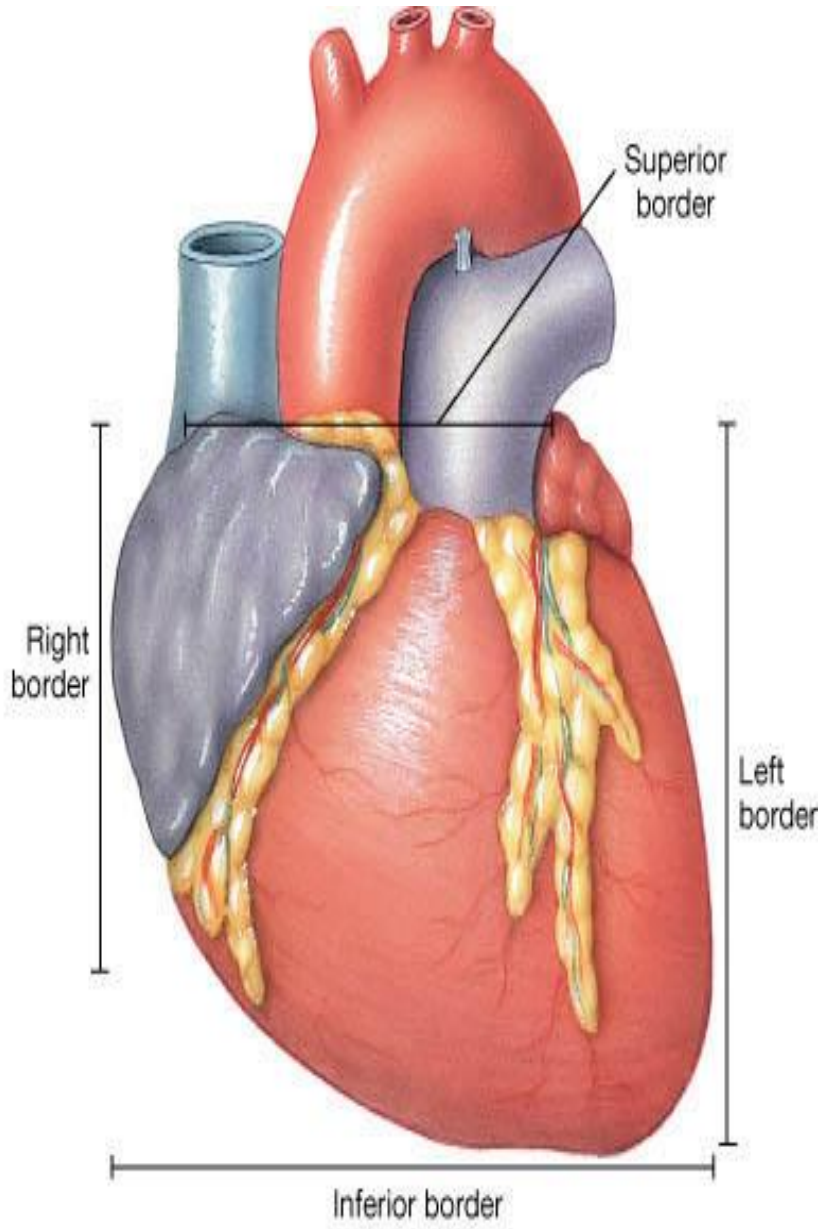
UPPER- mainly the left atrium

RIGHT- right atrium

INFERIOR- right ventricle and left ventricle

LEFT- left ventricle and left auricle


Base of heart
Ribs
Apex of heart
1
2
3
4
5
6
7
8
9
10


Superior border
Right border
Left border
Inferior border

Surface of heart

Anterior surface or sternocostal surface

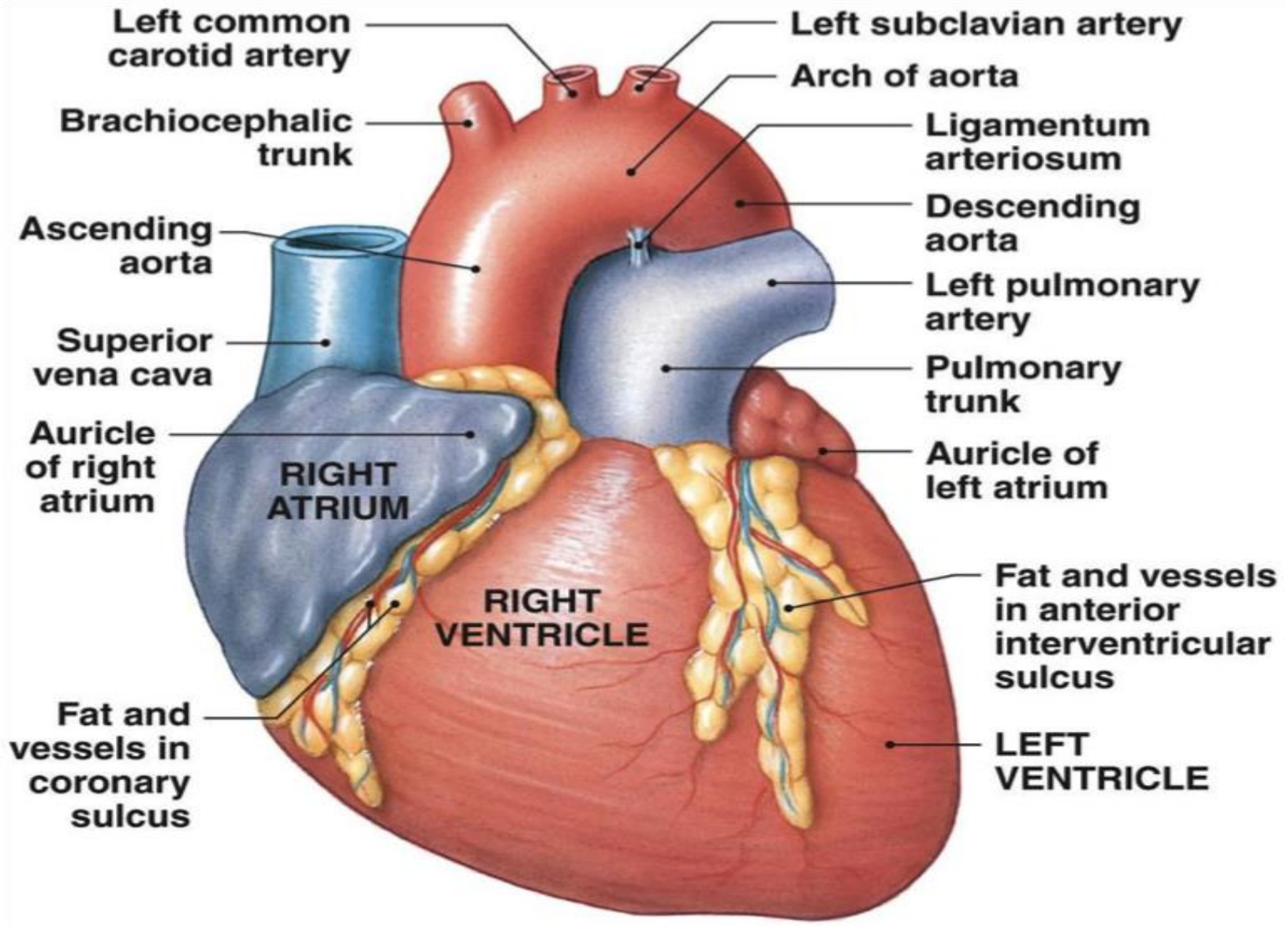
- Behind the sternum and ribs
- Right atrium and right ventricle

Inferior or diaphragmatic

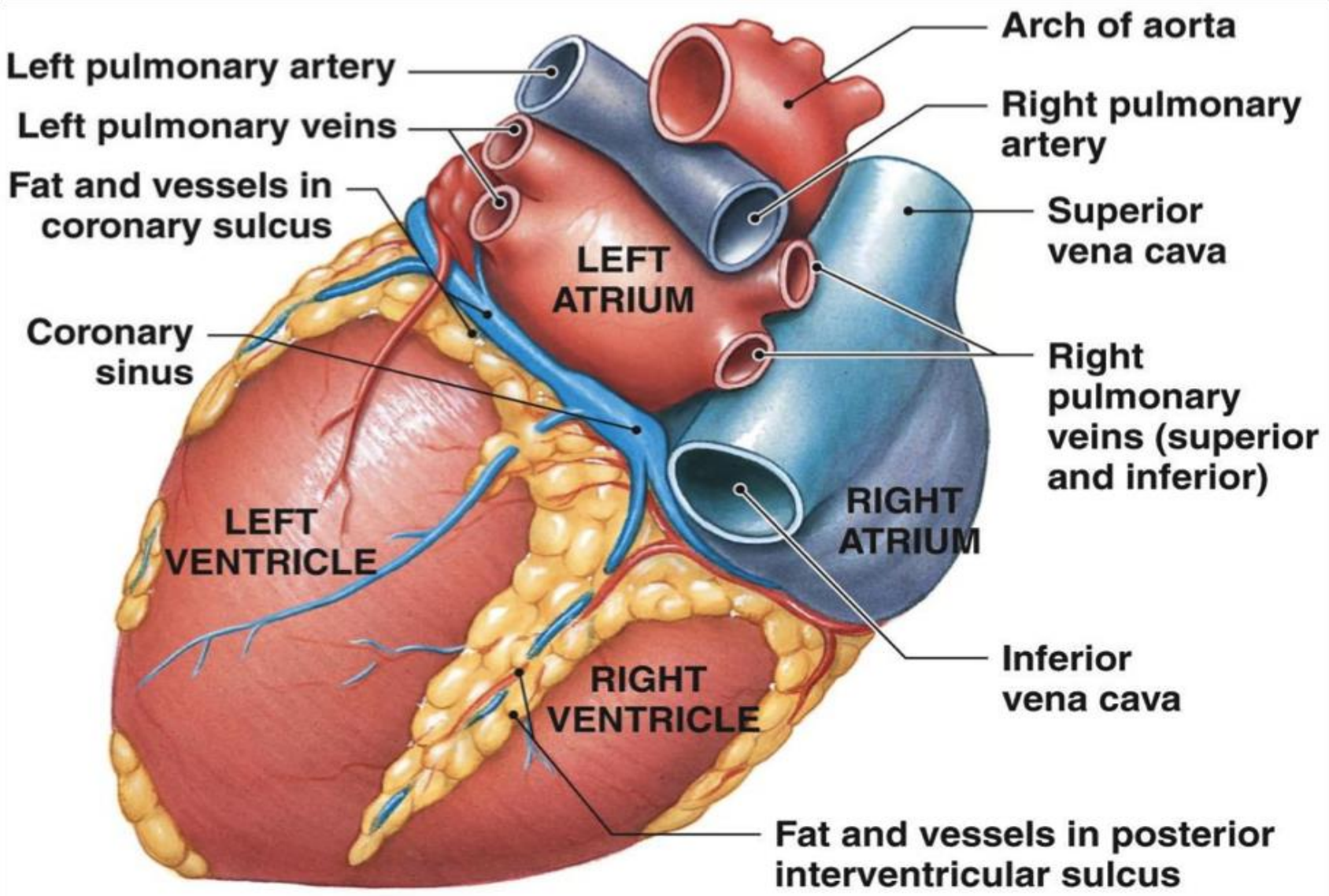
- Rest on cenral tendon of the diaphragm.
- It formed 2/3 part of left ventricle and 1/3 part of right ventricle

Left surface

- Mostly left ventricle and at the upper end by the left auricle



(a) Anterior (sternocostal) surface



(b) Posterior (diaphragmatic) surface

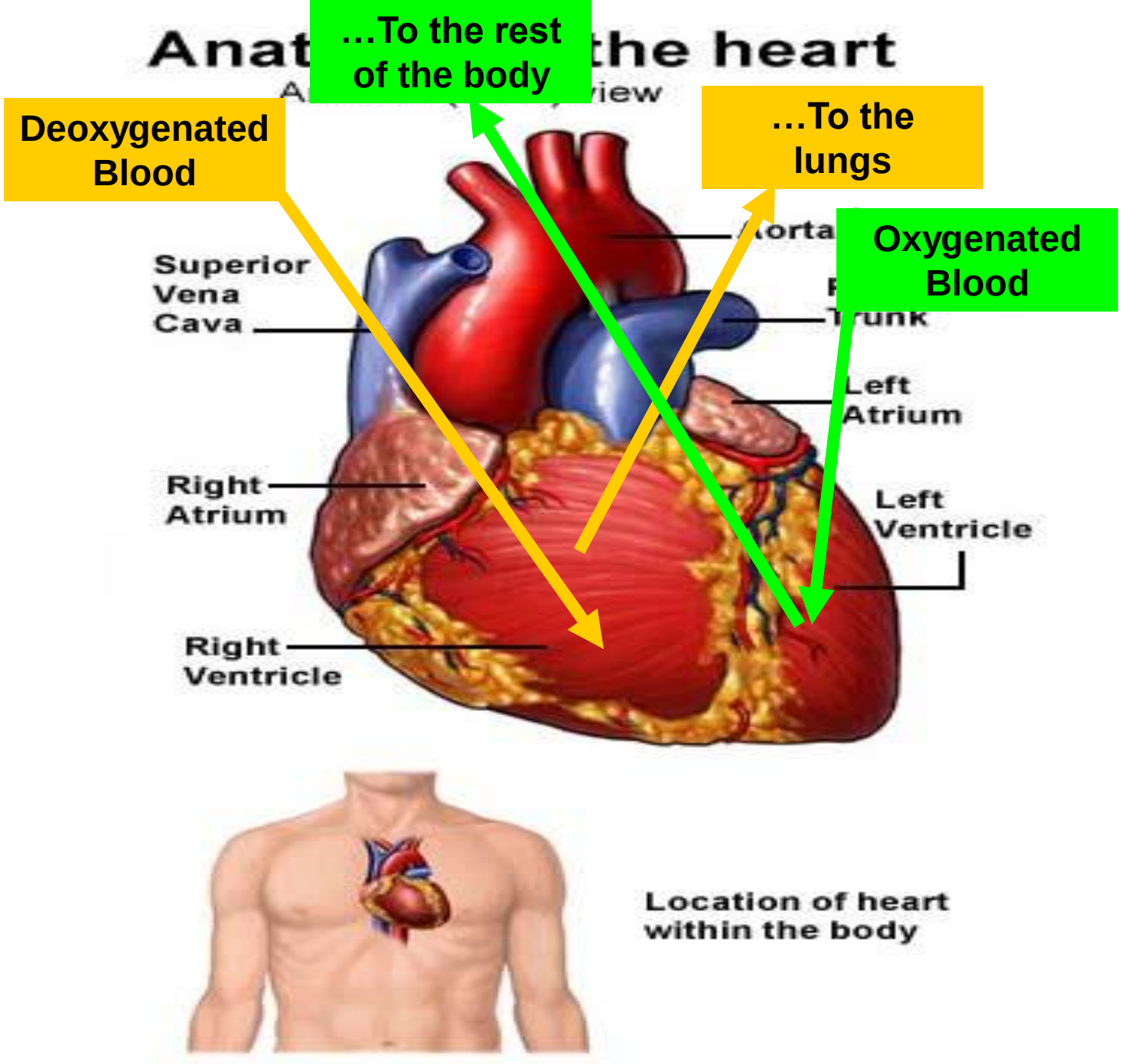
APEX

- It is directed downwards, forwards
- Formed mainly by the left ventricle
- It is situated in the 5th intercostal space 9 cm lateral to midsternal line

Base

- Base of heart is also called its posterior surface
- It is mainly by the left atrium and by a small part of the right atrium

Anat…the heart



Cardiac Tissues

- **Outermost = Pericardium & Epicardium**
  - **Epicardium** – visceral layer of the serous pericardium
  - Pericardium is a membrane anchoring heart to diaphragm and sternum
  - Pericardium secretes lubricant (serous fluid)
- **Middle = Myocardium**
  - Contains contractile muscle fibers
- **Innermost = Endocardium**
  - Lines Cardiac Chambers

Heart Valves

Mainly 4 valves

2 AV Valve + 2 semilunar valve

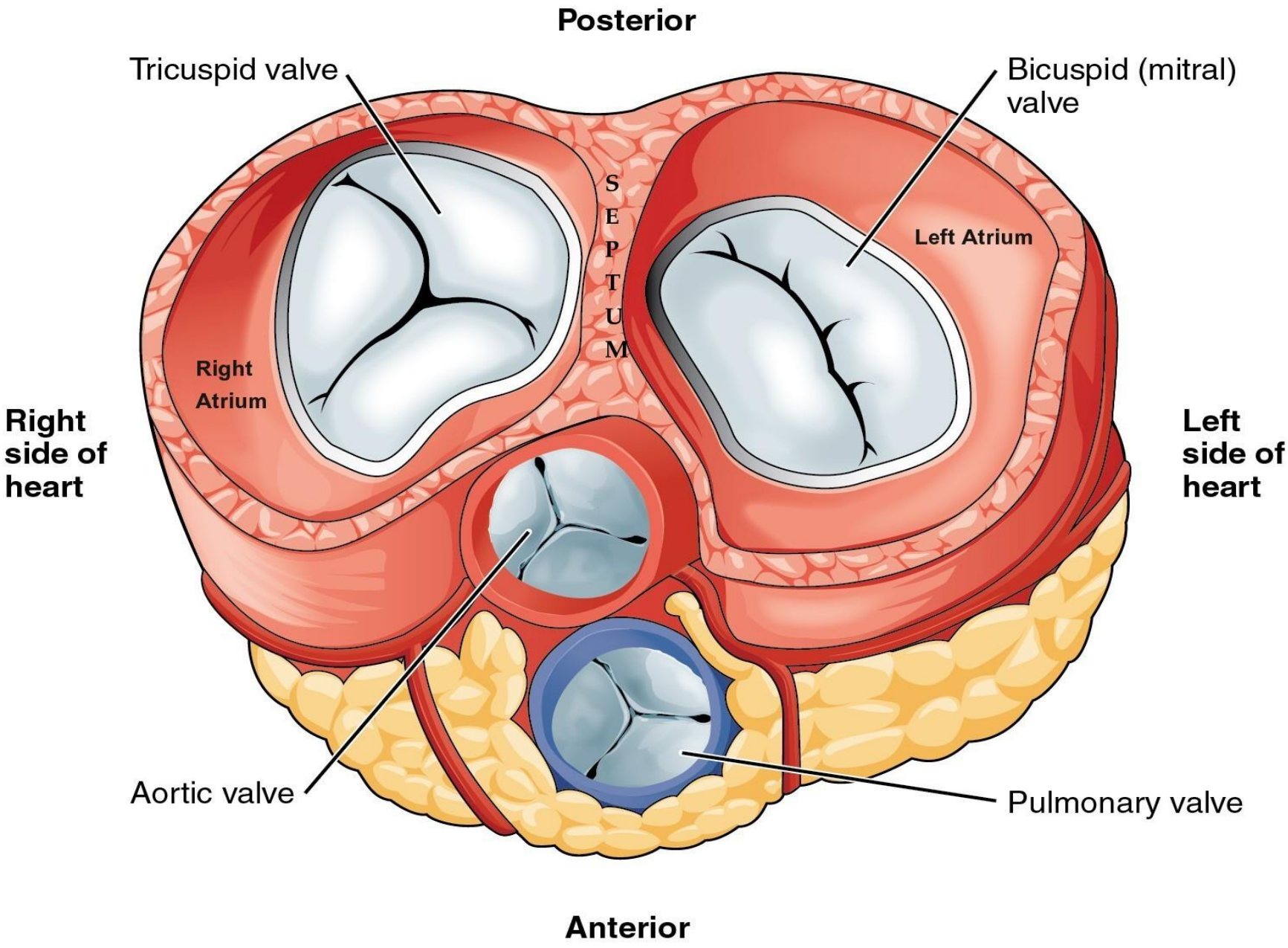
1. **Right AV valve or tricuspid valve**
2. **Left AV valve or bicuspid or mitral valve**
3. **Aortic valve**
4. **Pulmonary valve**

AV VALVE

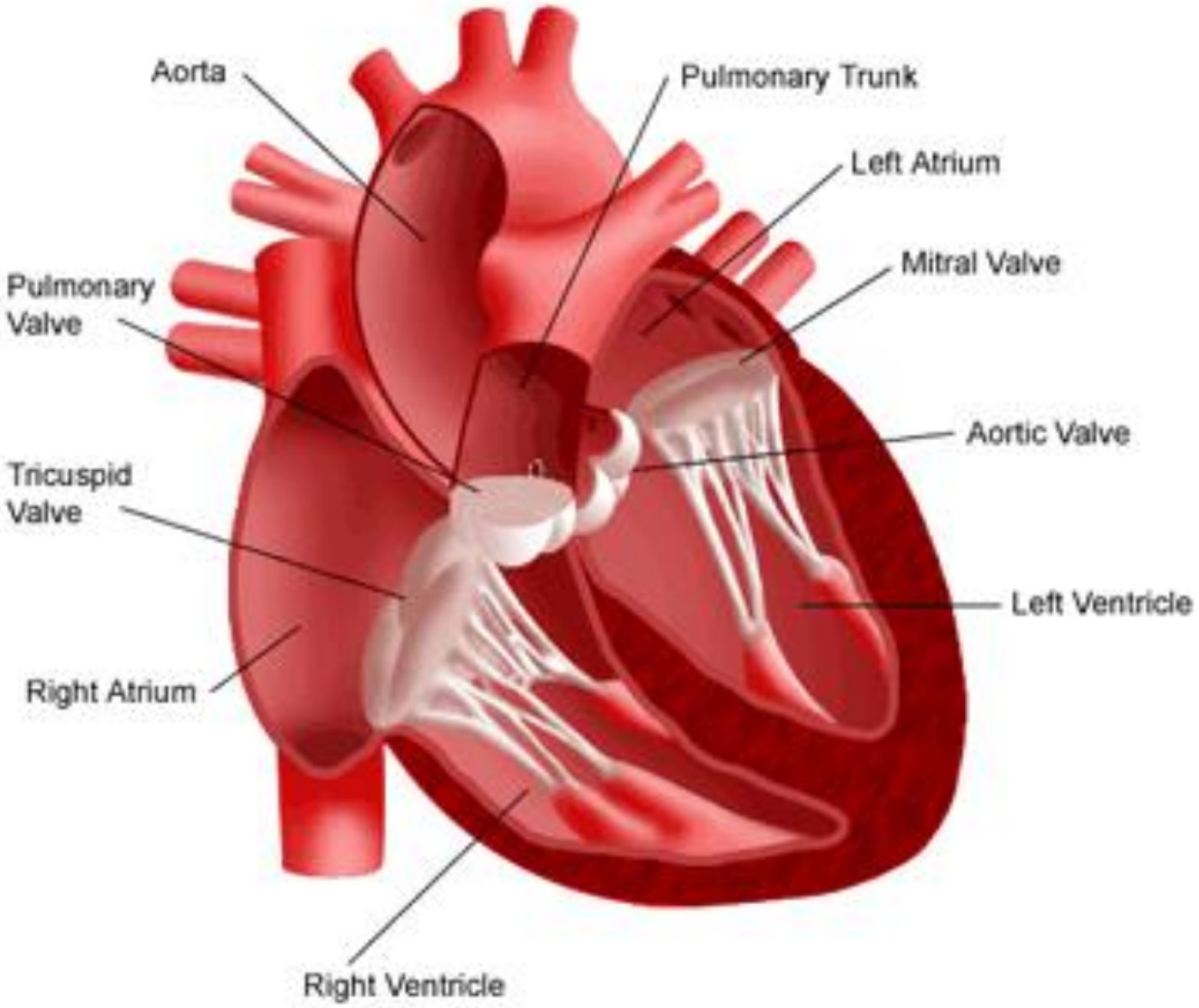
- Heart valves ensure unidirectional blood flow through the heart
- AV valves lie between the atria and the ventricles
- AV valves prevent backflow into the atria when ventricles contract
- RT AV Valve is known as the tricuspid valve because it has three cups
- LT AV valve is known as the bicuspid valve because it has two cups

SEMILUNAR VALVE

- **Semilunar valves prevent backflow of blood into the ventricles**
- **Aortic semilunar valve lies between the left ventricle and the aorta**
- **Pulmonary semilunar valve lies between the right ventricle and pulmonary trunk**


Posterior
Tricuspid valve
Bicuspid (mitral) valve
S E P T U M
Left Atrium
Right Atrium
Right side of heart
Left side of heart
Aortic valve
Pulmonary valve
Anterior

Valves of the Heart



RIGHT ATRIUM

- It receives venous blood from the whole body and pumps it to the right ventricle .
- The auricle arise from the upper part and is related to the ascending aorta

- Along the right border of right atrium a shallow vertical groove which passes from the SVC above and IVC below. This groove called **sulcus terminalis**
- It is produced by an internal muscular ridge called the **crista terminalis**
- The upper part of sulcus terminalis contains SA node which acts as the **pacemaker of heart.**

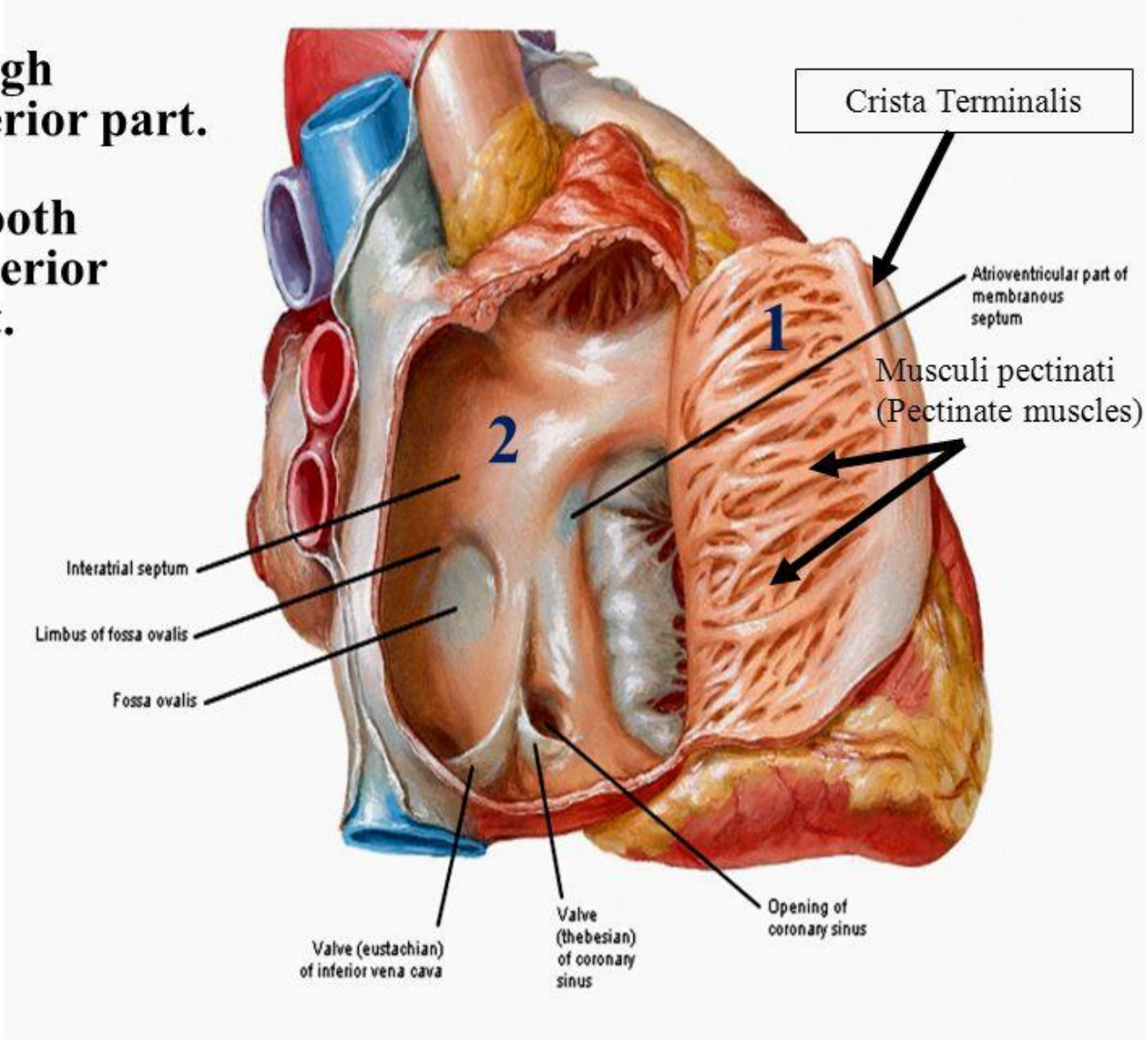
- The interior of Rt atrium divided into two main part.
  - A smooth, thin-walled posterior part (the sinus venarum), on which the SVC, IVC, and coronary sinus open, bringing poorly oxygenated blood into the heart;
  - The anterior part is rough due to the presence of muscular ridges called pectinate muscles, which also extend into the auricle.

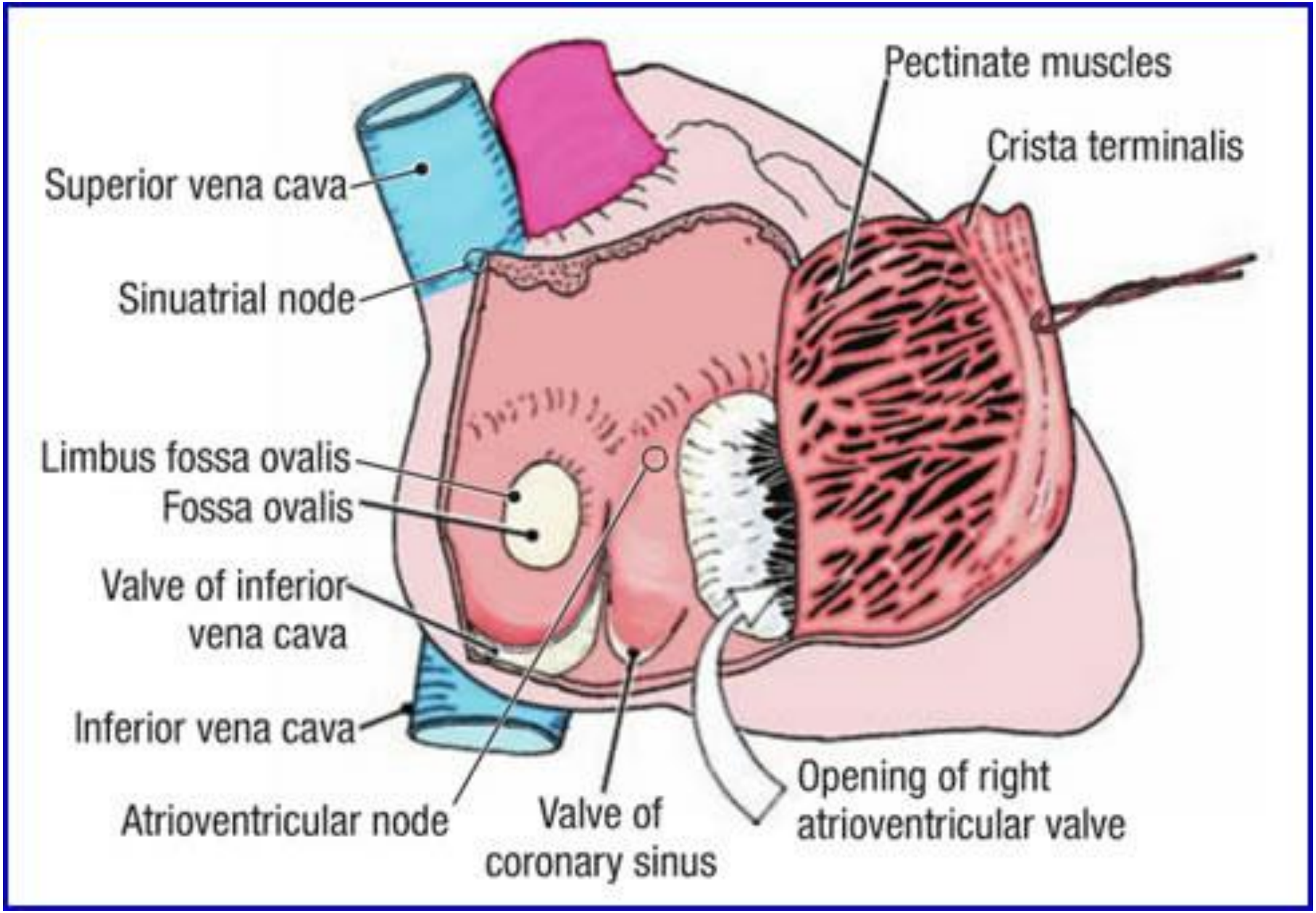
Opening of RT atrium

- SVC, IVC, coronary sinus, venae cordis minimi.

Right Atrium

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




Pectinate muscles
Crista terminalis
Superior vena cava
Sinuatrial node
Limbus fossa ovalis
Fossa ovalis
Valve of inferior vena cava
Inferior vena cava
Atrioventricular node
Valve of coronary sinus
Opening of right atrioventricular valve

Inter-atrial septum

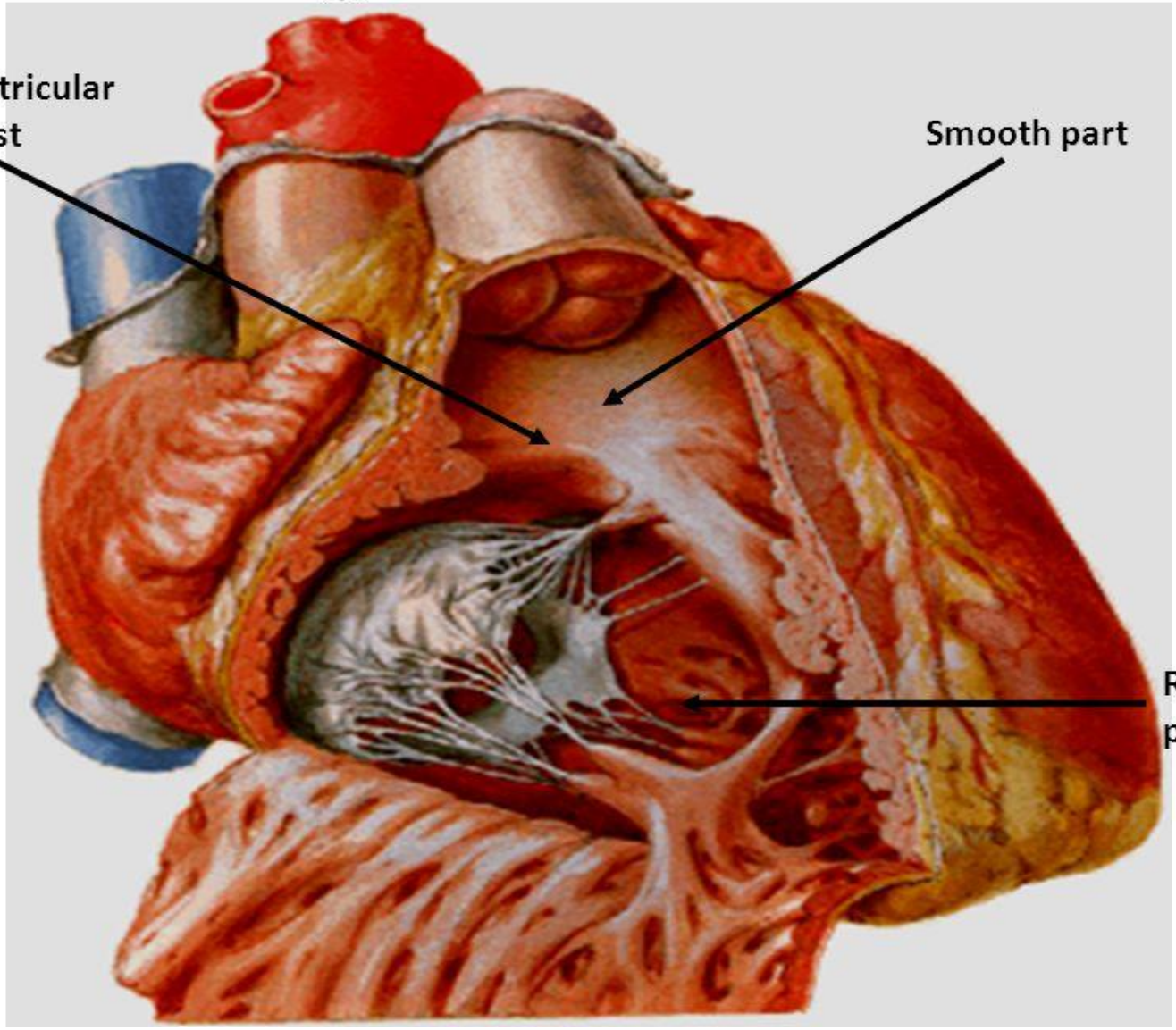
- The RT atrium separated from the LT atrium by the inter-atrial septum
- On its lower part, is an oval depression called the fossa ovalis
- The upper margin of the fossa is thickened to form curved ridge called limbus fossa ovalis
- The remains of the foramen ovale are occasionally present. It is normally closed after birth , but may some times persist.

Right Ventricle

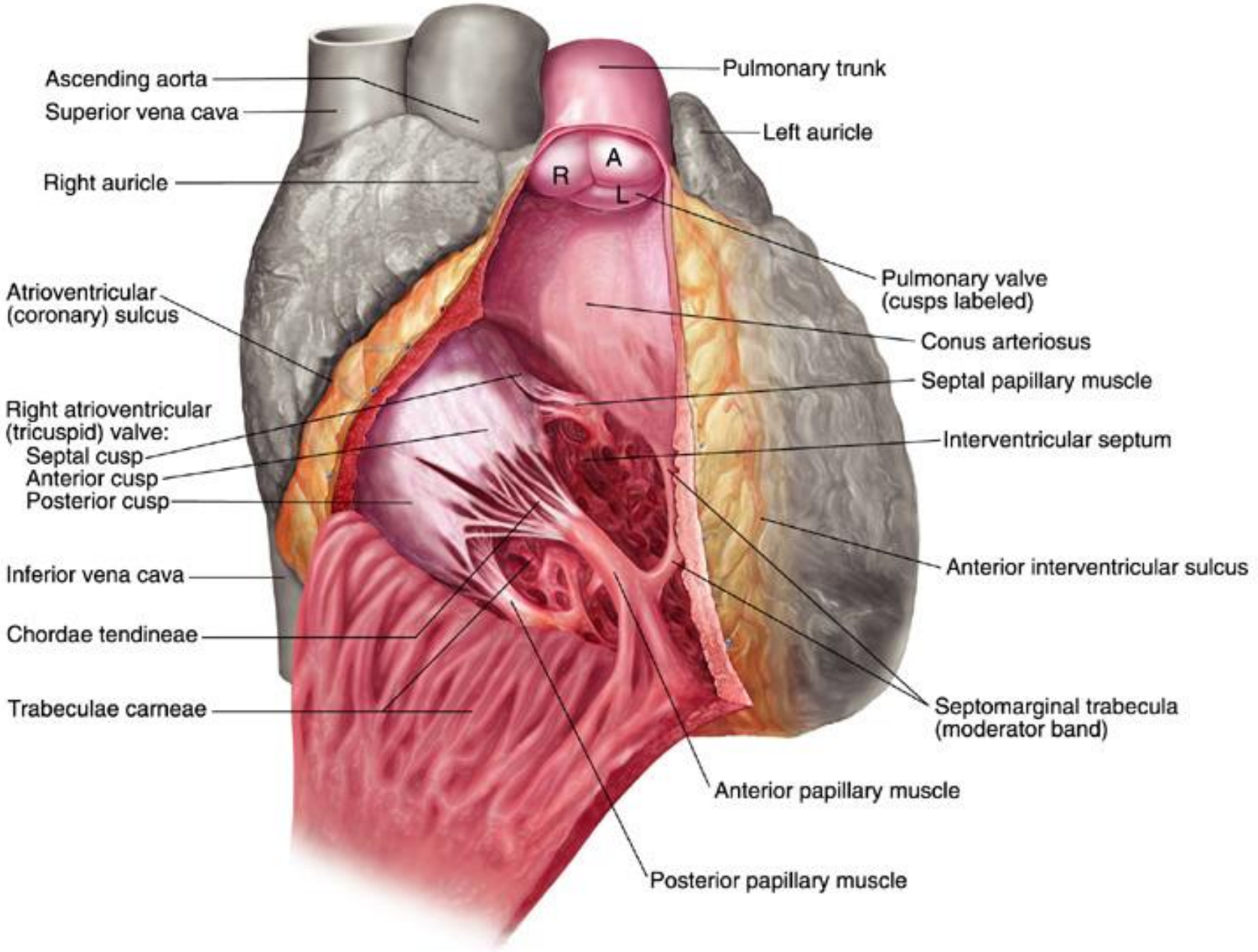
The interior of the right ventricle has irregular muscular elevations called **trabeculae carneae**. The cusps of the tricuspid valve are connected to tendon-like cords, the **chordae tendineae**, which in turn are connected to cone-shaped trabeculae carneae called papillary muscles.

- There are three papillary muscles (anterior, posterior, and septal) in the right ventricle that correspond in name to the cusps of the tricuspid valve. A thick muscular ridge, the supraventricular crest, separates the ridged muscular wall of the inflow part of the chamber from the smooth wall of the conus arteriosus or outflow part of the right ventricle.

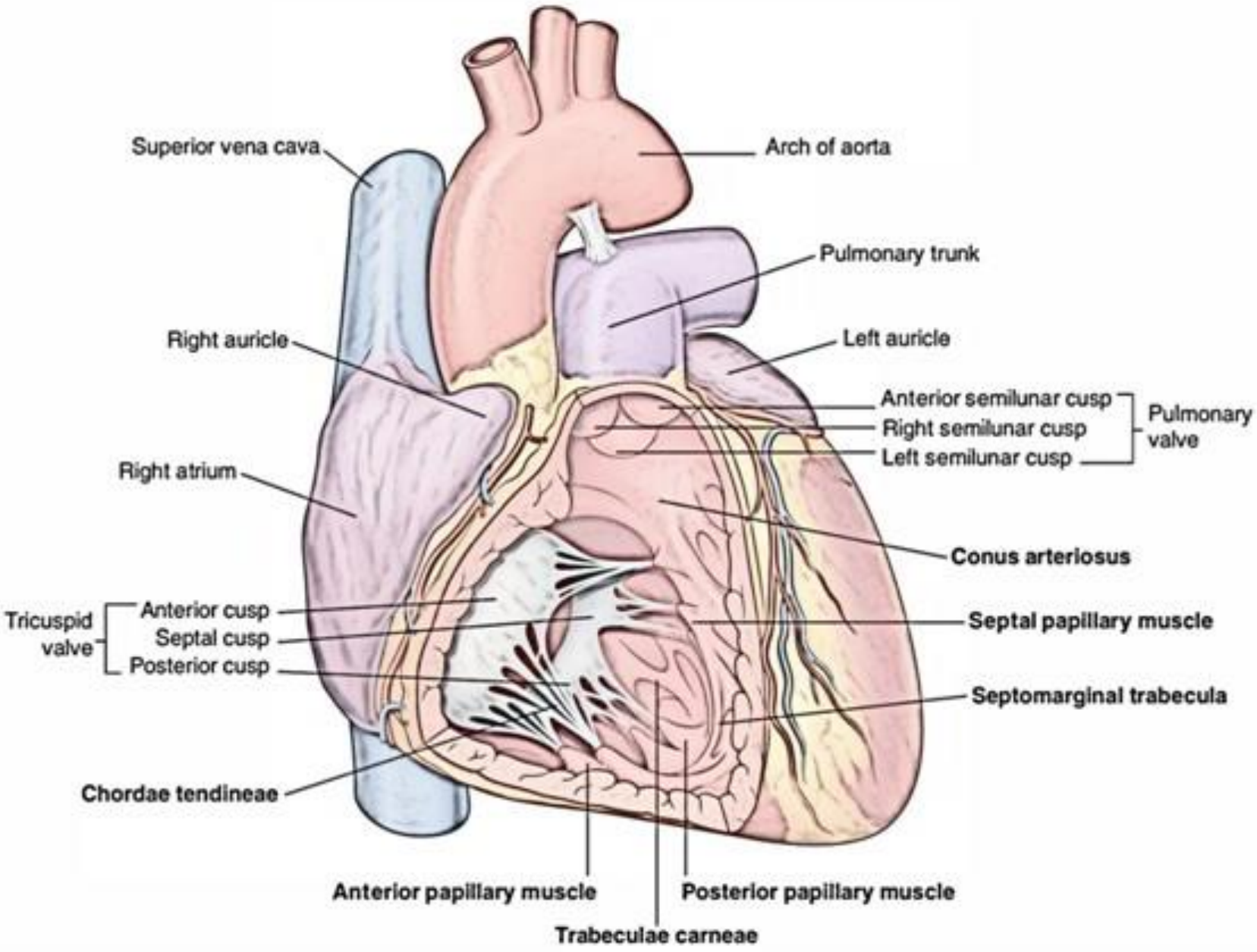
Right ventricle



- The inflow part of the right ventricle receives blood from the right atrium through the tricuspid orifice, located posterior to the body of the sternum at the level of the fourth and fifth intercostal spaces.

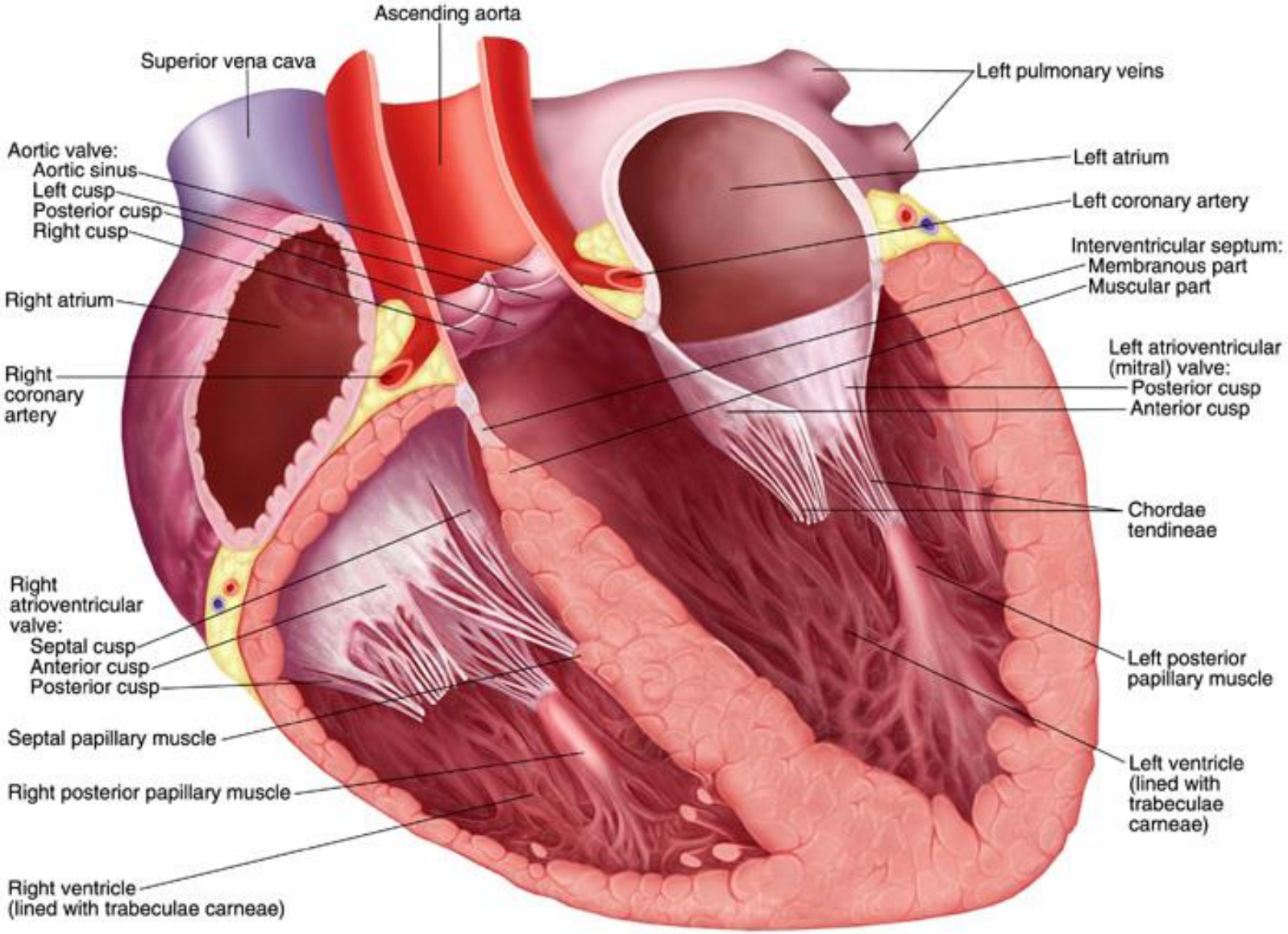


4-25 Heart, Internal Features, Right Chambers, C. Right Ventricle, Opened


Superior vena cava
Arch of aorta
Pulmonary trunk
Right auricle
Left auricle
Anterior semilunar cusp
Right semilunar cusp
Left semilunar cusp
Pulmonary valve
Right atrium
Conus arteriosus
Tricuspid valve
Anterior cusp
Septal cusp
Posterior cusp
Septal papillary muscle
Septomarginal trabecula
Chordae tendineae
Anterior papillary muscle
Posterior papillary muscle
Trabeculae carneae

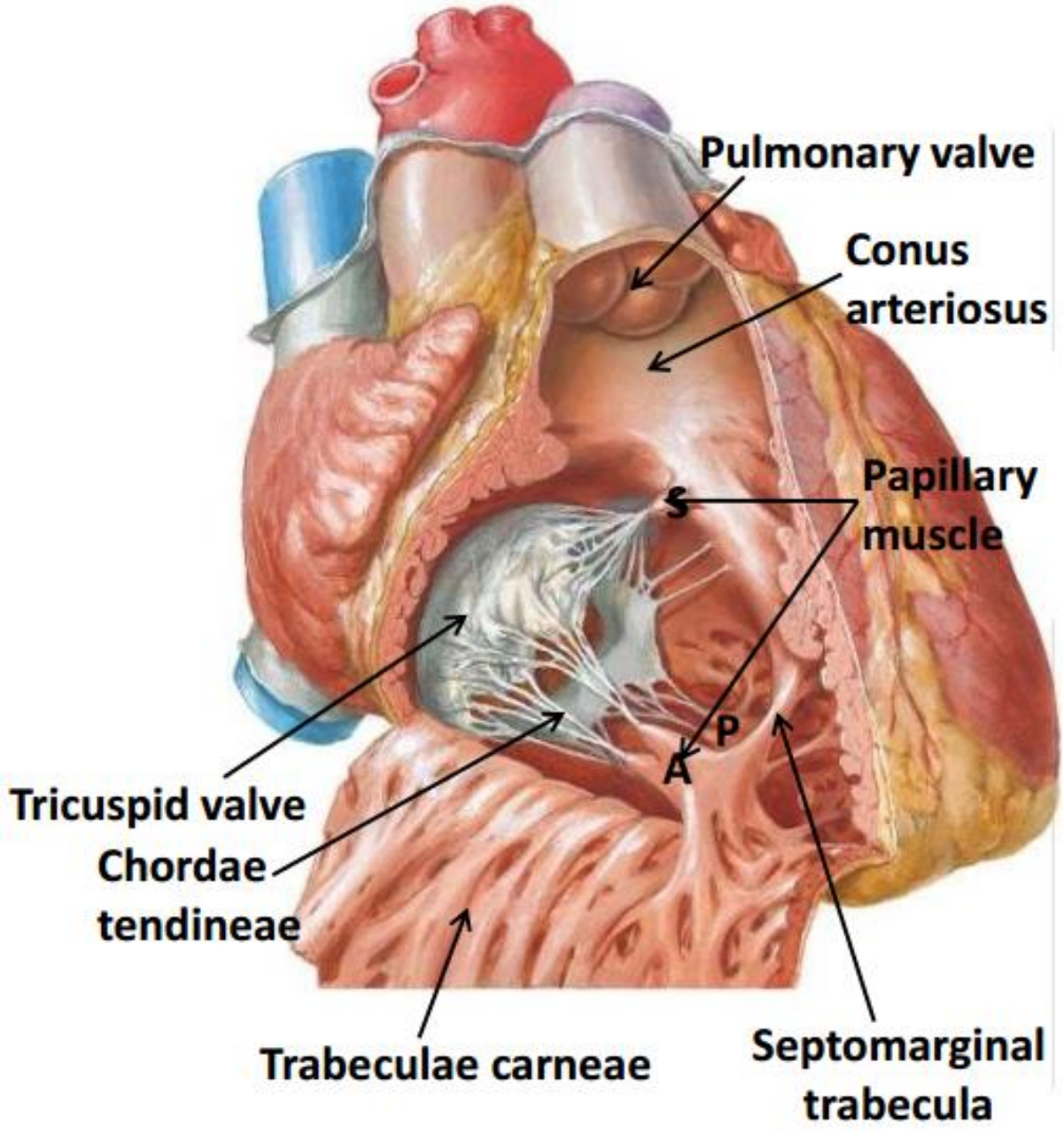
Interventricular septum

- It is composed of membranous and muscular parts, is a strong, obliquely placed partition between the right and the left ventricles.
- The superoposterior membranous part of the IV septum is thin. The muscular part of the IV septum is thick and bulges into the cavity of the right ventricle because of the higher blood pressure in the left ventricle.



4-27 Sectional View of the Heart
B. Section Through the Heart Showing the Posteroinferior Portion

- The septomarginal trabecula (moderator band) is a curved muscular bundle that runs from the inferior part of the interventricular septum to the base of the anterior papillary muscle. This trabeculum is important because it carries part of the right bundle branches of the AV bundle of the conducting system of the heart to the anterior papillary muscle.


Pulmonary valve
Conus arteriosus
Papillary muscle
S
P
A
Tricuspid valve
Chordae tendineae
Trabeculae carneae
Septomarginal trabecula

Left Atrium

The pairs of valveless right and left pulmonary veins enter the left atrium. The left auricle overlaps the pulmonary trunk.

The interior of the left atrium has: A larger smooth-walled part and a smaller muscular auricle containing pectinate muscles.

- Four pulmonary veins (two superior and two inferior) entering its posterior wall. A slightly thicker wall than that of the right atrium.

Left Ventricle

- The interior of the left ventricle has:

Walls that are two to three times as thick as that of the right ventricle.

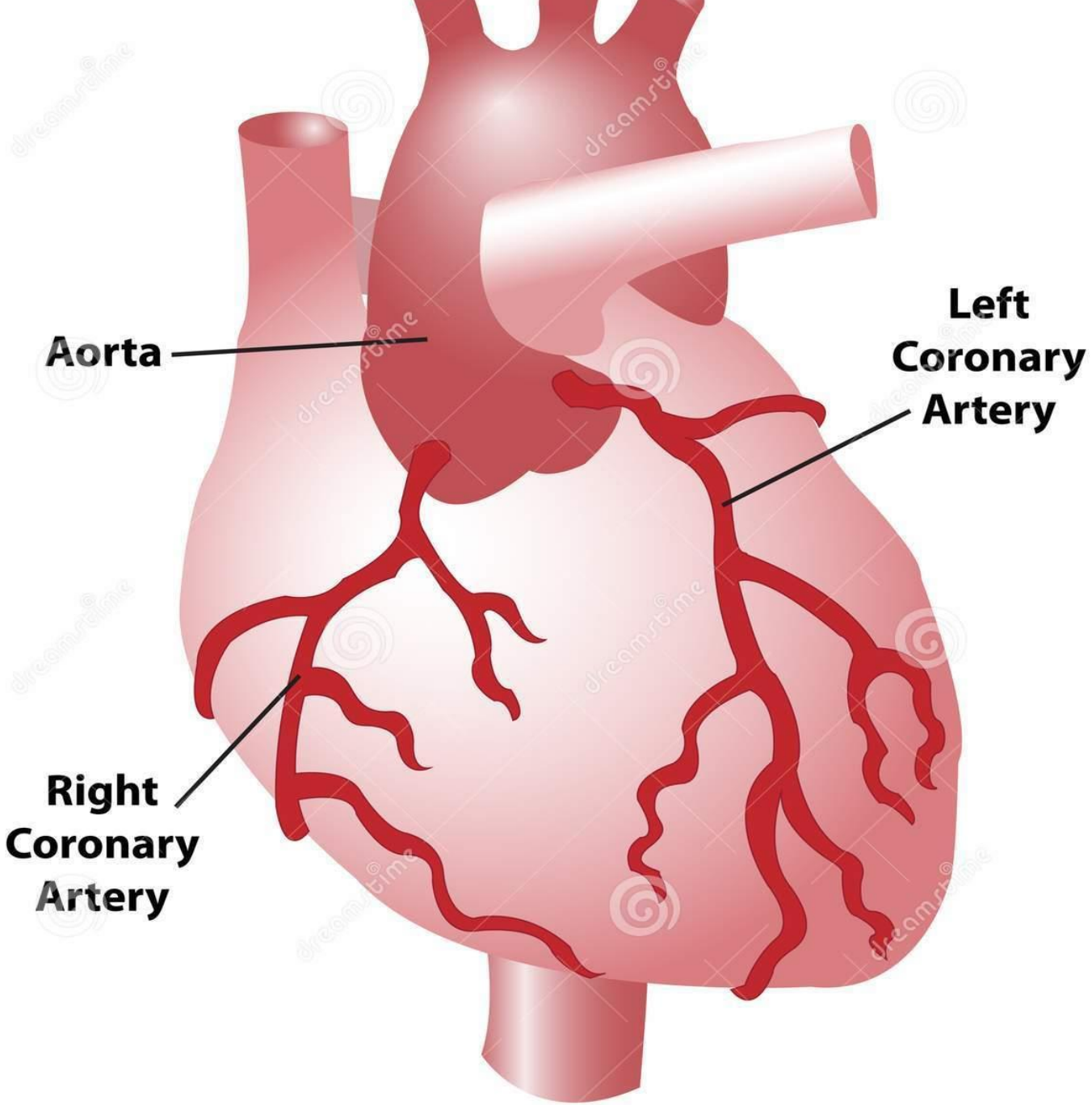
The mitral valve closing the orifice between the left atrium and left ventricle has two cusps, anterior and posterior.

The mitral valve is located posterior to the sternum at the level of the fourth costal cartilage.

- Each of its cusps receives tendinous cords from more than one papillary muscle.
- A conical cavity that is longer than that of the right ventricle.
- Trabeculae carneae are finer and more numerous than those in the right ventricle.
- Anterior and posterior papillary muscles that are larger than those in the right ventricle.

Anatomy of the Heart.mp4

ARTERIAL SUPPLY OF HEART



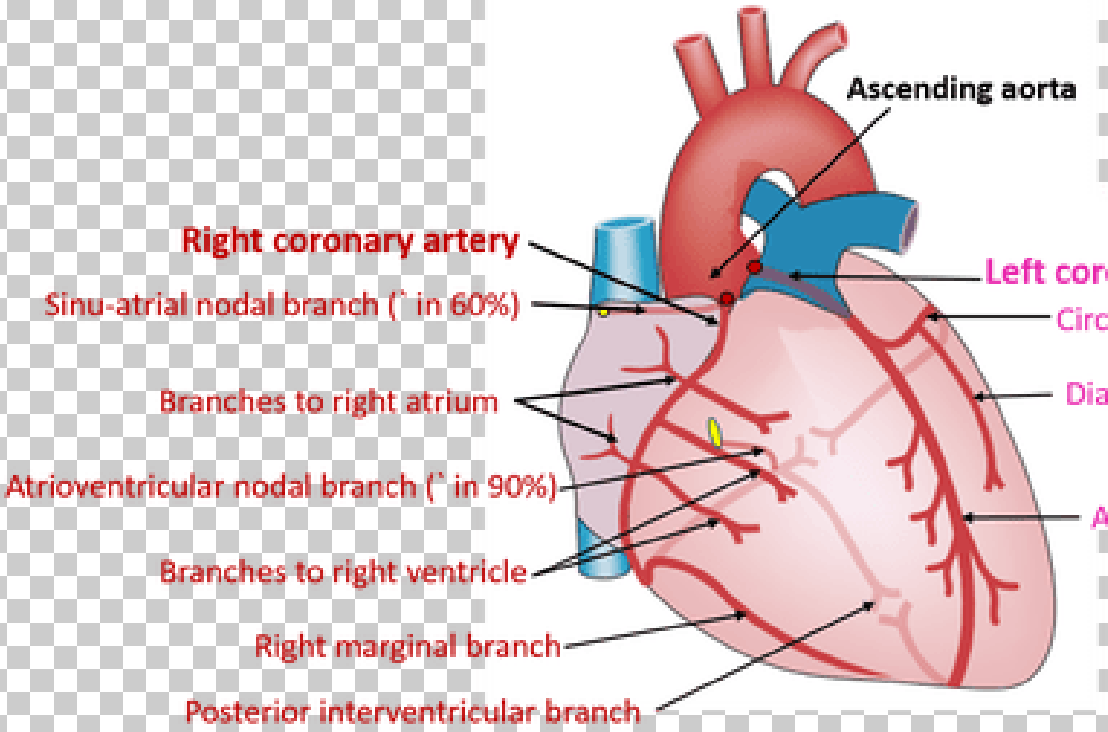
Right coronary artery-

- The right atrium
- Most of the right ventricle
- Part of the left ventricle (diaphragmatic surface)
- Part of the IV septum (usually the posterior third)
- The SA node (in approximately 60% of people)
- The AV node (in approximately 80% of people)

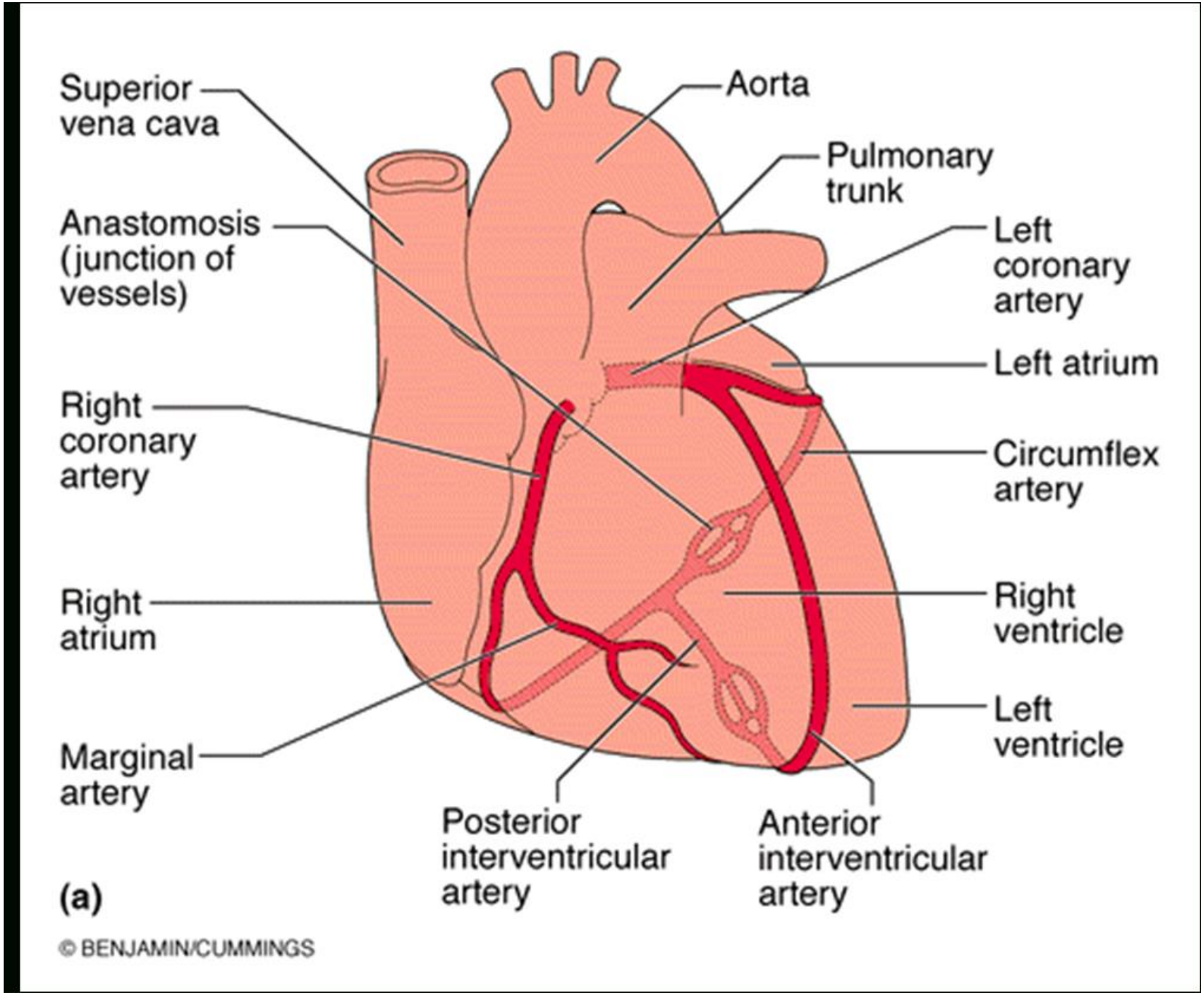
Branches of Rt coronary artery-

1. Sinu-atrial (SA) nodal branch
2. Right marginal branch
3. Posterior interventricular branch- 67%
4. Atrioventricular (AV) nodal branch

Arterial Supply of Heart-Coronary Arteries



LAD – left anterior descending branch


Superior vena cava
Aorta
Pulmonary trunk
Anastomosis (junction of vessels)
Left coronary artery
Left atrium
Right coronary artery
Circumflex artery
Right atrium
Right ventricle
Left ventricle
Marginal artery
Posterior interventricular artery
Anterior interventricular artery
(a)
© BENJAMIN/CUMMINGS

Left coronary artery-

- The left atrium.
- Most of the left ventricle.
- Part of the right ventricle.
- Most of the IV septum (usually its anterior two thirds), including the AV bundle of conducting tissue.
- The SA node (in approximately 40% of people).

- Branches of Lt coronary artery-

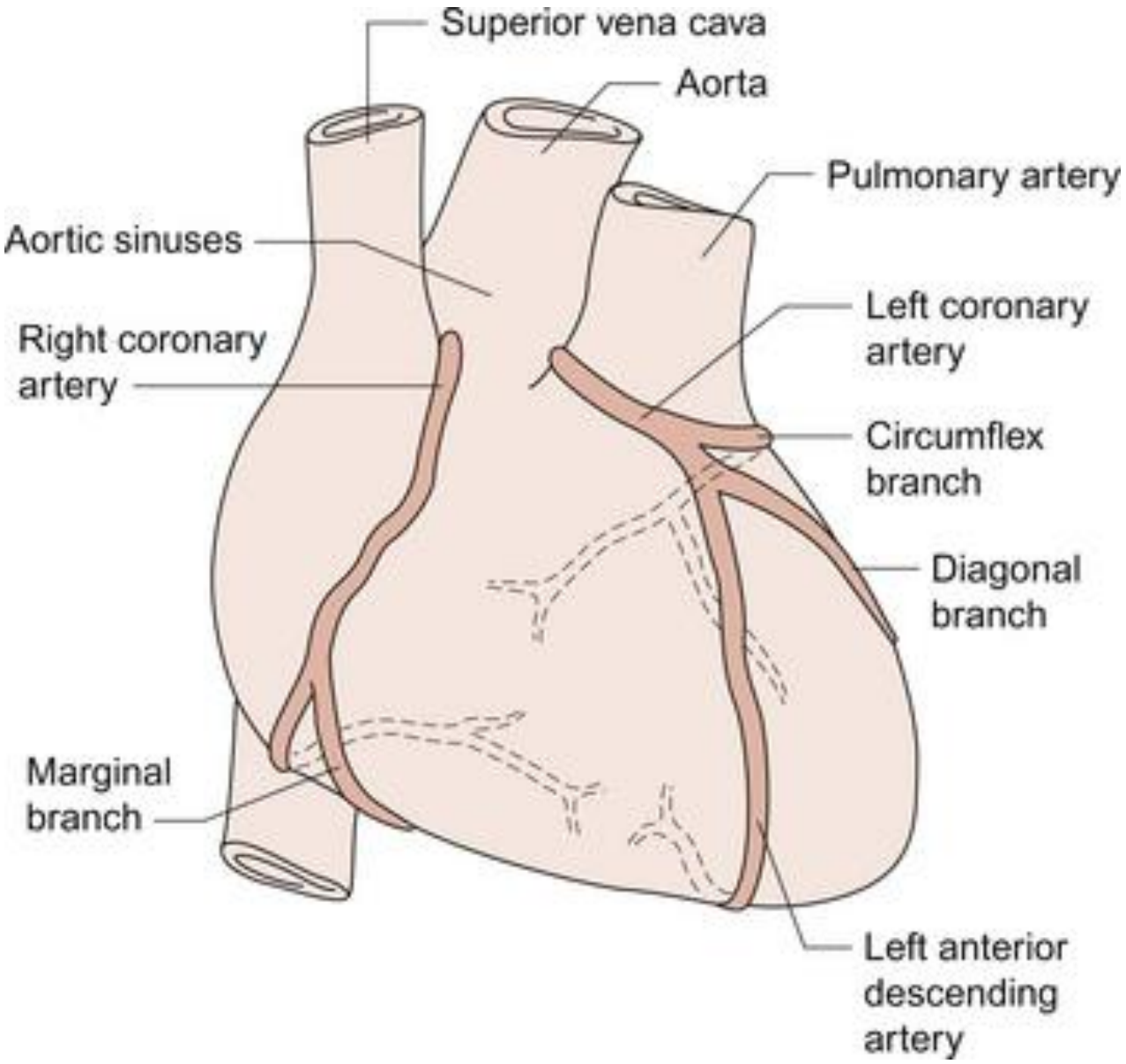
1 Anterior interventricular branch (LAD)

2. Circumflex

3. Left marginal

4. Posterior interventricular branch- 33%

5. Diagonal


Superior vena cava
Aorta
Pulmonary artery
Aortic sinuses
Left coronary artery
Right coronary artery
Circumflex branch
Diagonal branch
Marginal branch
Left anterior descending artery

VENOUS DRAINAGE OF HEART

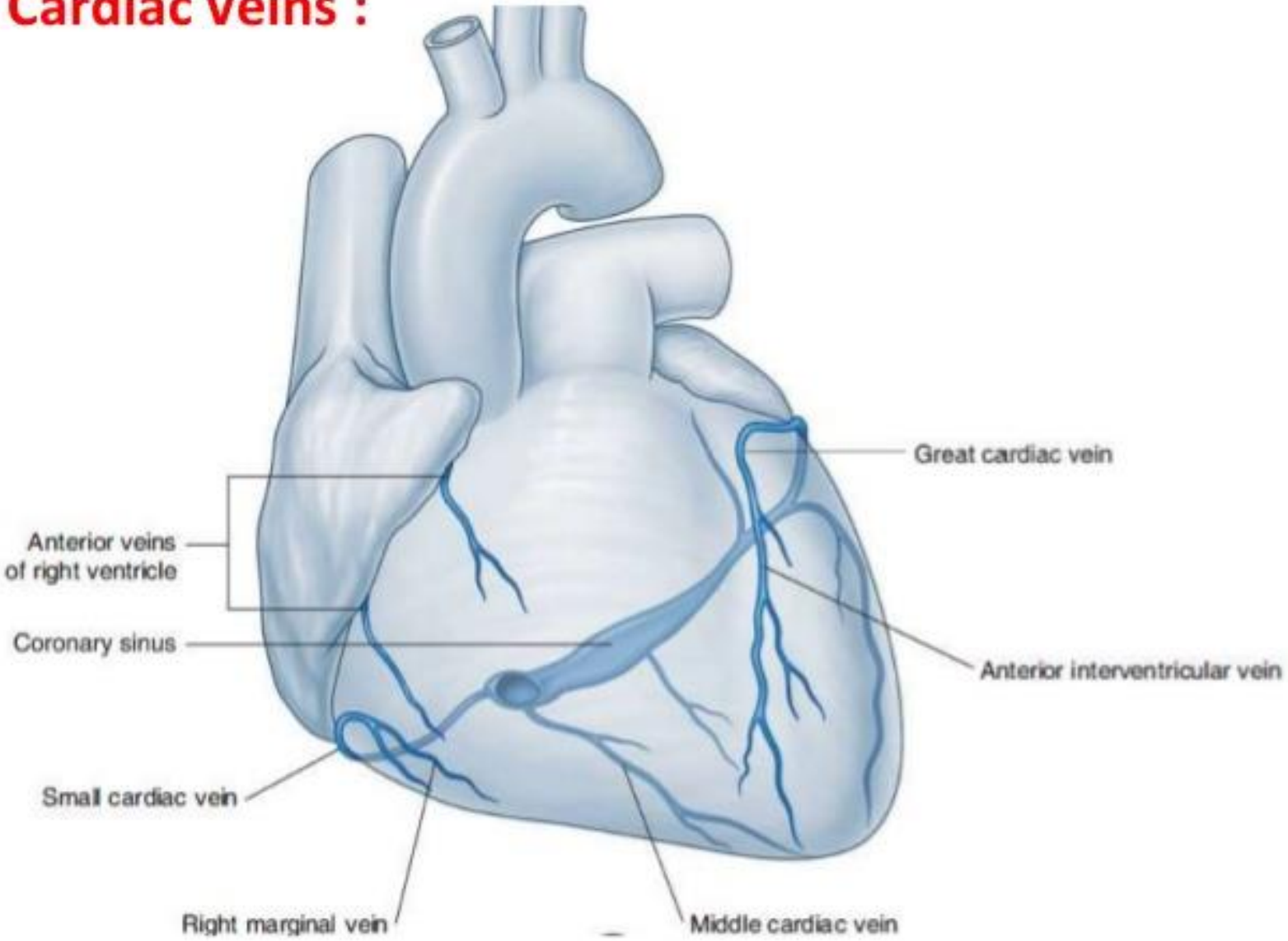
1. The coronary sinus, the main vein of the heart, empty directly into the chambers of the heart
2. great cardiac vein
3. middle cardiac veins
4. small cardiac veins
5. left posterior ventricular vein
6. left marginal vein

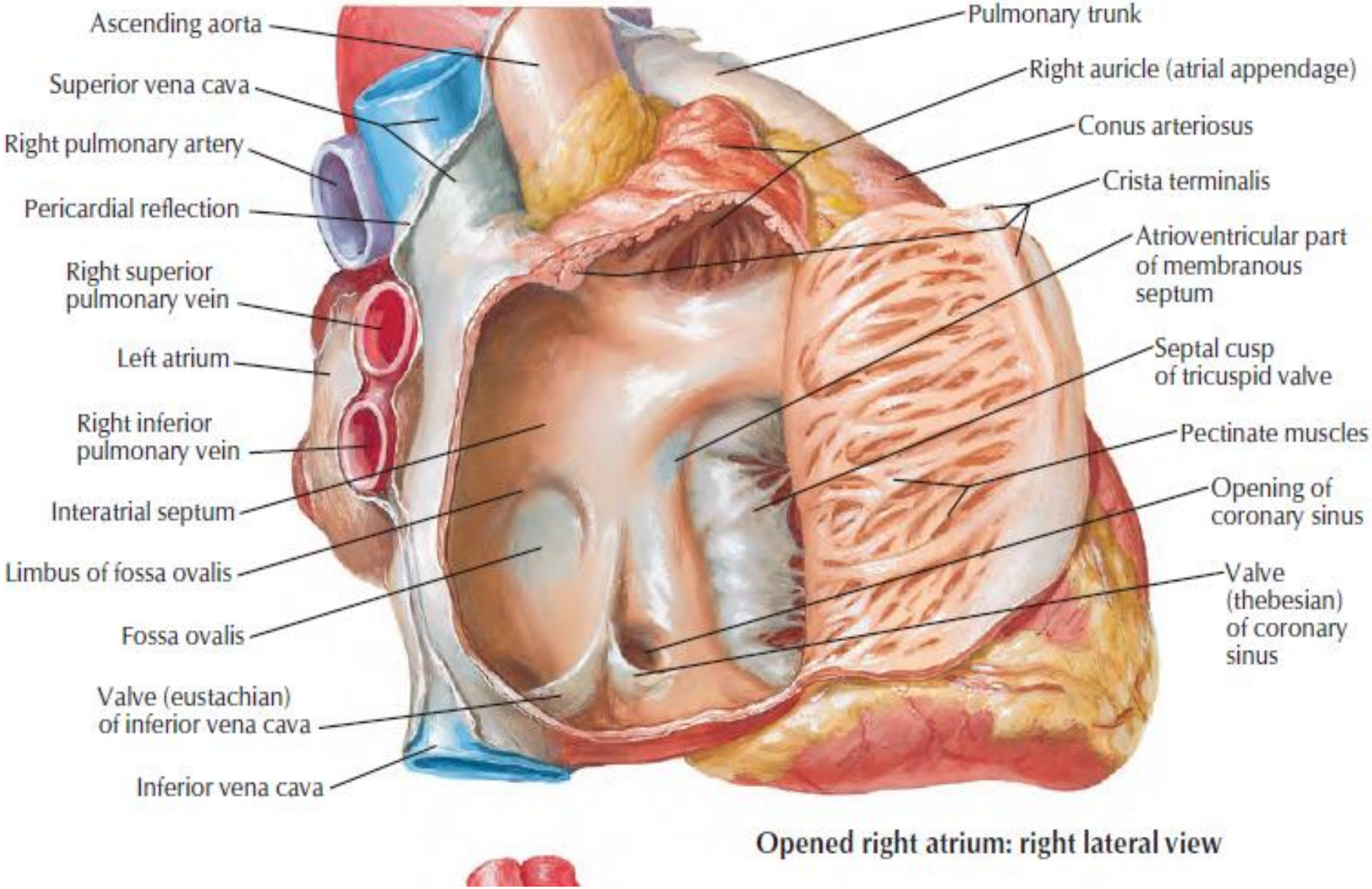
- 2-6 veins open into the coronary sinus.

7. anterior cardiac veins empty directly into the right atrium

8. venae cordis minimae- open directly into the chambers of the heart, chiefly the atria.

Cardiac veins :





Opened right atrium: right lateral view

LYMPHATIC DRAINAGE OF HEART

1. subepicardial lymphatic plexus
2. inferior tracheobronchial lymph nodes

INNERVATION OF HEART

- The heart is supplied by autonomic nerve fibers from superficial and deep cardiac plexuses. These nerve networks lie anterior to the bifurcation of the trachea and posterior to the ascending aorta.
- Sympathetic supply- T1-T5/T6
- Parasym- vagus nerve

CONDUCTING SYSTEM OF HEART

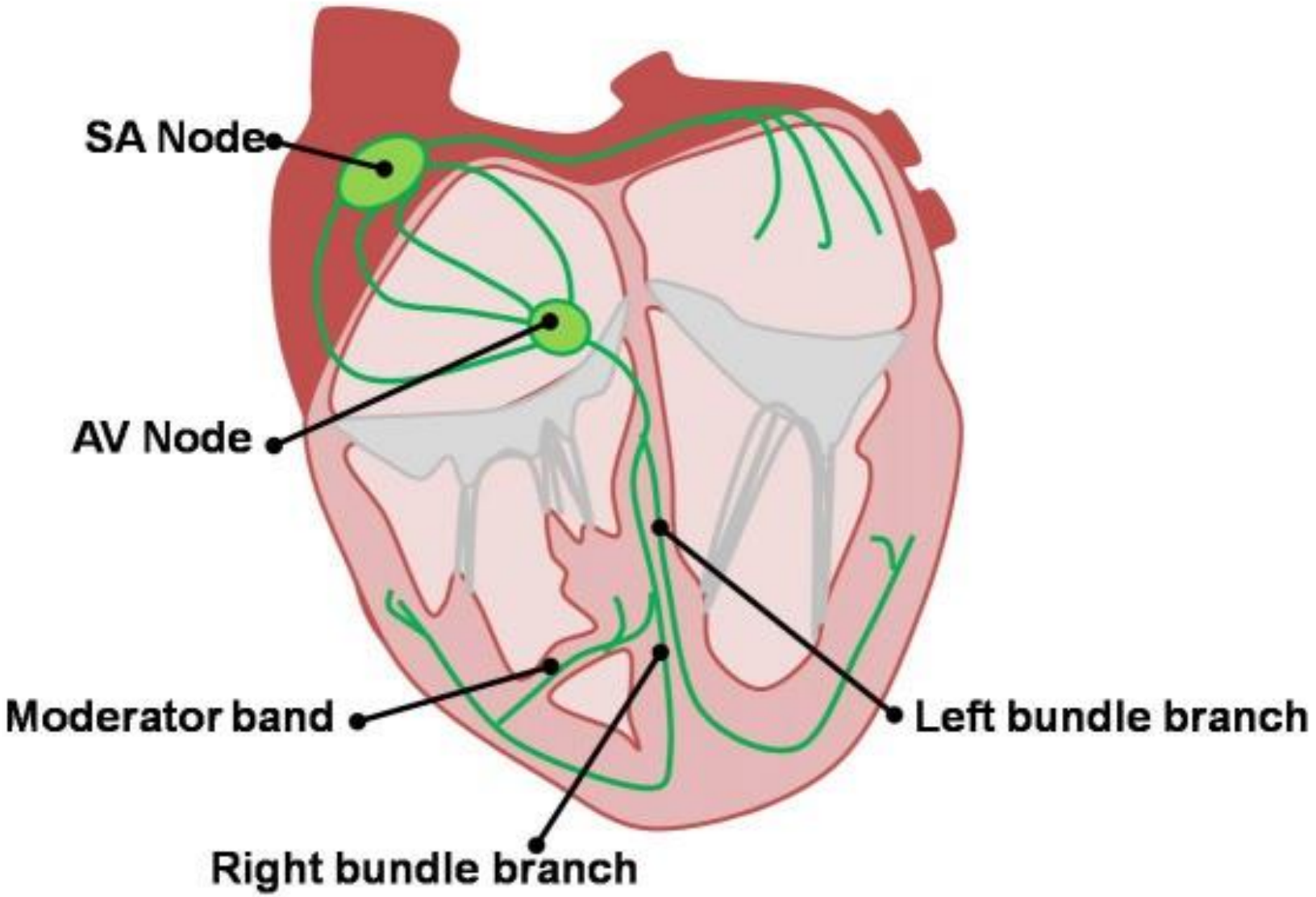
The SA node initiates and regulates the impulses for contraction, giving off an impulse about 70 times per minute in most people. The SA node, the pacemaker of the heart, is located anterolaterally just deep to the epicardium at the junction of the SVC and right atrium near the superior end of the sulcus terminalis.

- The AV node is a smaller collection of nodal tissue located in the posteroinferior region of the interatrial septum near the opening of the coronary sinus. The signal generated by the SA node passes through the walls of the right atrium, which transmits the signal rapidly from the SA node to the AV node.

- The AV node then distributes the signal to the ventricles through the AV bundle.
- The AV bundle, the only bridge of conduction between the atrial and the ventricular myocardium.
- At the junction of the membranous and muscular parts of the IV septum, the AV bundle divides into right and left bundle branches.

- The bundles proceed on each side of the muscular IV septum deep to the endocardium and then ramify into subendocardial branches (Purkinje fibers), which extend into the walls of the respective ventricles.

Cardiac Conduction System



SURFACE MARKING OF HEART

Superior border

2 point-

A- upper border of 3rd Rt costal cartilage about 1 cm from the sternal margin

B- lower border of 2nd Lt costal cartilage about 1 cm from sternal margin

These two points are joined by a straight line.

Inferior border-

2 points

C- 6th Rt costal cartilage about 1cm from sternal margin

D- 5th Lt intercostal space, medial to midclavicular line

Two points are joined by straight line

Right border-

- Point A and C are connected by a line which is convex to the right

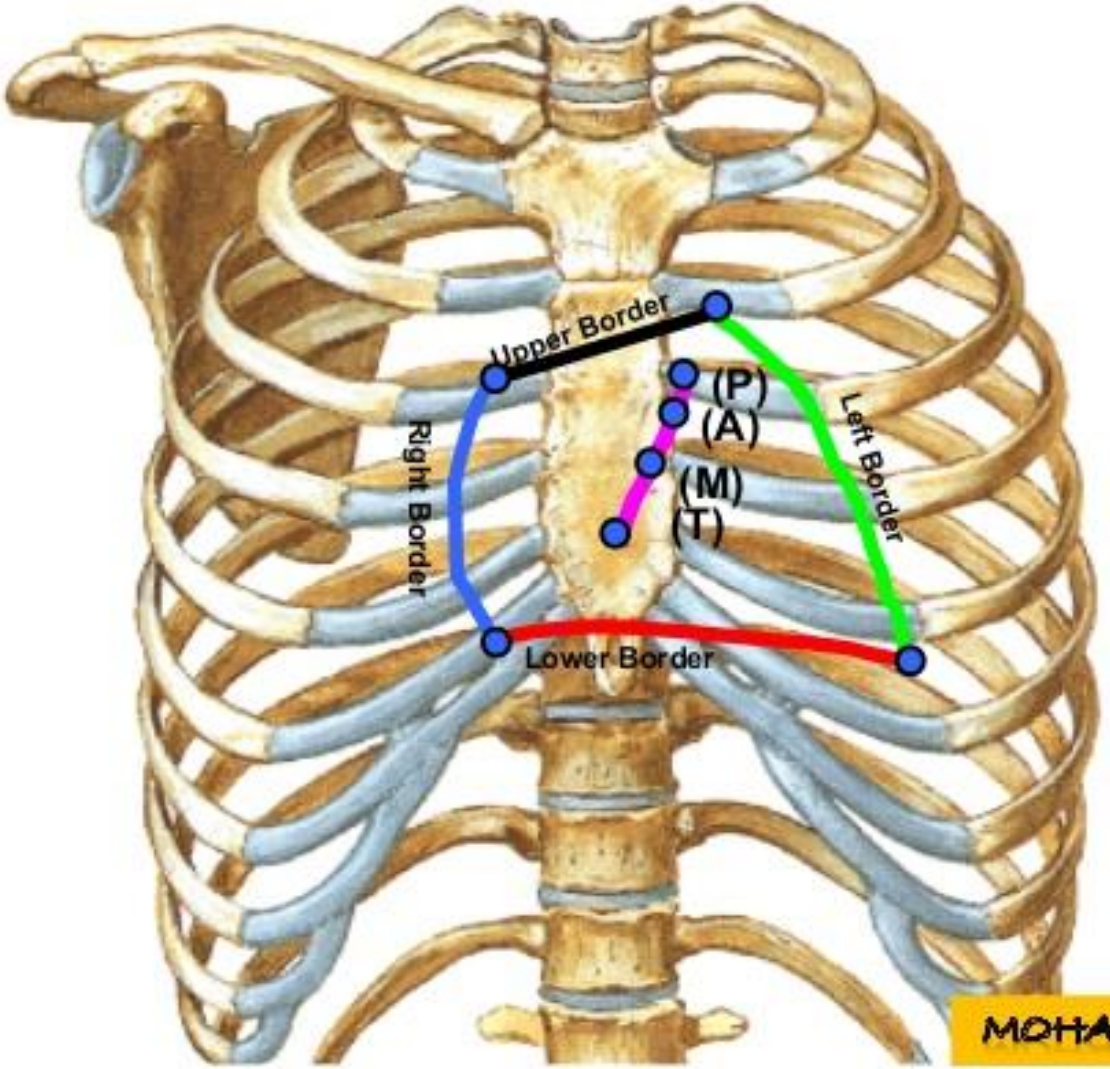
Left border-

Point B and D are connected by a line which is convex to the left

Apex of heart-

Marked on 5^{th} intercostal space, medial to midclavicular line

Surface Anatomy of the Heart



A- Borders

B- Apex

C- Coronary Groove

D- Valves

MOHAMED EL FIKY

- Valves of heart

1. Pulmonary valve- 2.5 cm broad, behind the Lt 3rd costal cartilage
2. Aortic valve- 2.5 cm broad, located behind the Lt. half of the sternum at the level of 3rd intercostal space.
3. Mitral valve- 3 cm wide, located behind the Lt. half of the sternum at the level of 4th intercostal space.
4. Tricuspid valve- 4 cm broad, behind the sternum, 4th costal cartilage level

Clinical aspect

1. **Myocardial Infarction**- With sudden occlusion of a major artery by an embolus, the region of myocardium supplied by the occluded vessel becomes infarcted and undergoes necrosis. The three most common sites of coronary artery occlusion are (1) the anterior IV (LAD) branch of the LCA, (2) the RCA, and (3) the circumflex branch of the LCA

2. **Coronary Atherosclerosis**- lipid deposits in the layer of the coronary arteries, begins during early adulthood and slowly results in stenosis of the lumina of the arteries. Insufficiency of blood supply to the heart may result in MI.

3. **Cardiac Referred Pain**

4. **Atrial Septal Defects**- Congenital anomalies of the interatrial septum — usually related to incomplete closure of the oval foramen.

5. **Ventricular septal defects**- common site junction of membranous part and muscular part of the IV septum.

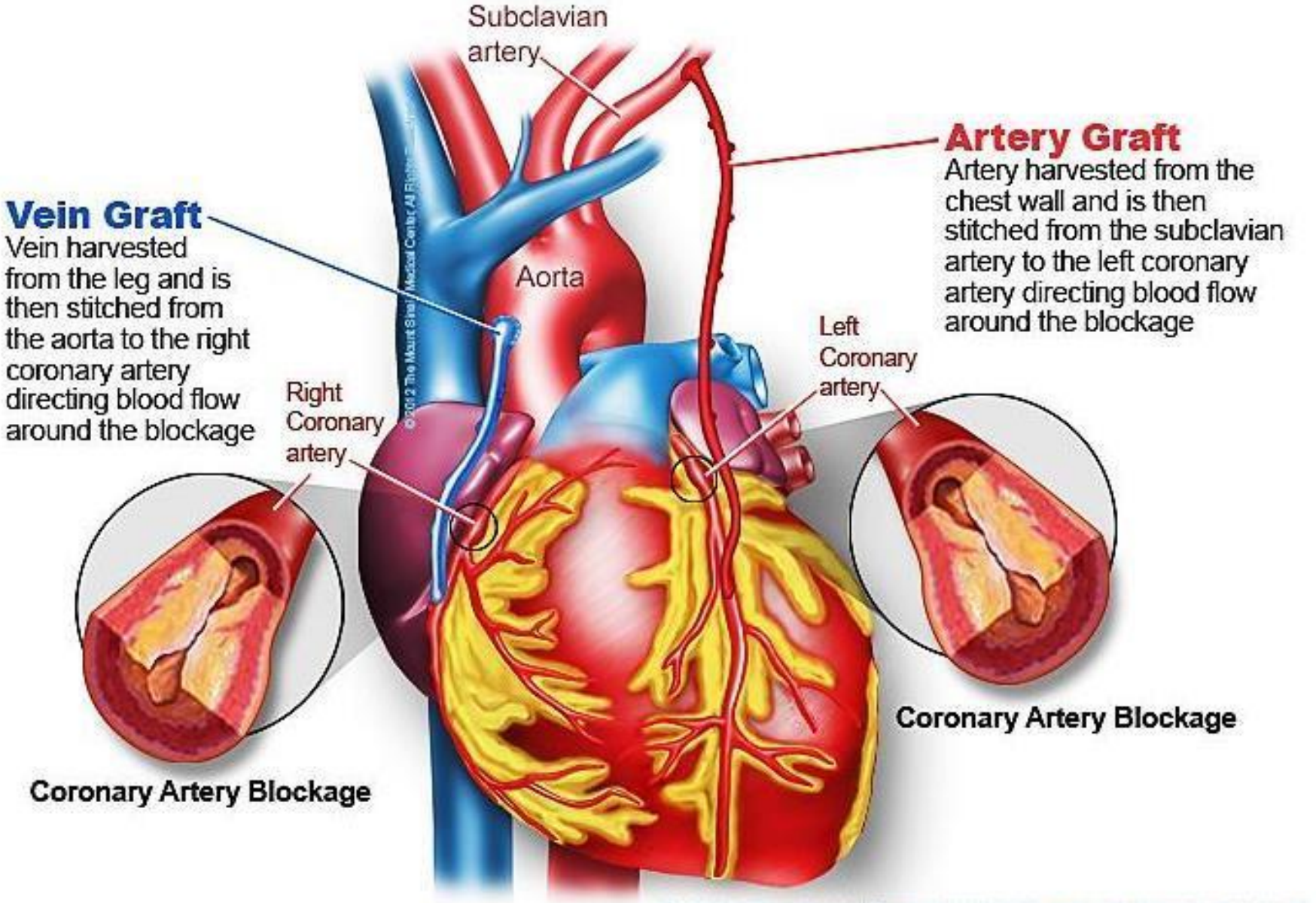
6. **Valvular Heart Disease**-

Stenosis is the failure of a valve to open fully, slowing blood flow from a chamber.

Valvular insufficiency or regurgitation is failure of the valve to close completely, This allows a variable amount of blood to flow back into the chamber

Percussion of Heart- Percussion is performed at the third, fourth, and fifth intercostal spaces

Coronary Bypass Graft- Patients with obstruction of their coronary circulation and severe angina may undergo a coronary bypass graft operation. A segment of an artery or vein is connected to the ascending aorta or to the proximal part of a coronary artery and then to the coronary artery distal to the stenosis. The **great saphenous vein** is commonly used for coronary bypass surgery


Subclavian artery
Artery Graft
Artery harvested from the chest wall and is then stitched from the subclavian artery to the left coronary artery directing blood flow around the blockage
Vein Graft
Vein harvested from the leg and is then stitched from the aorta to the right coronary artery directing blood flow around the blockage
Aorta
Left Coronary artery
Right Coronary artery
Coronary Artery Blockage
Coronary Artery Blockage
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Coronary Angioplasty

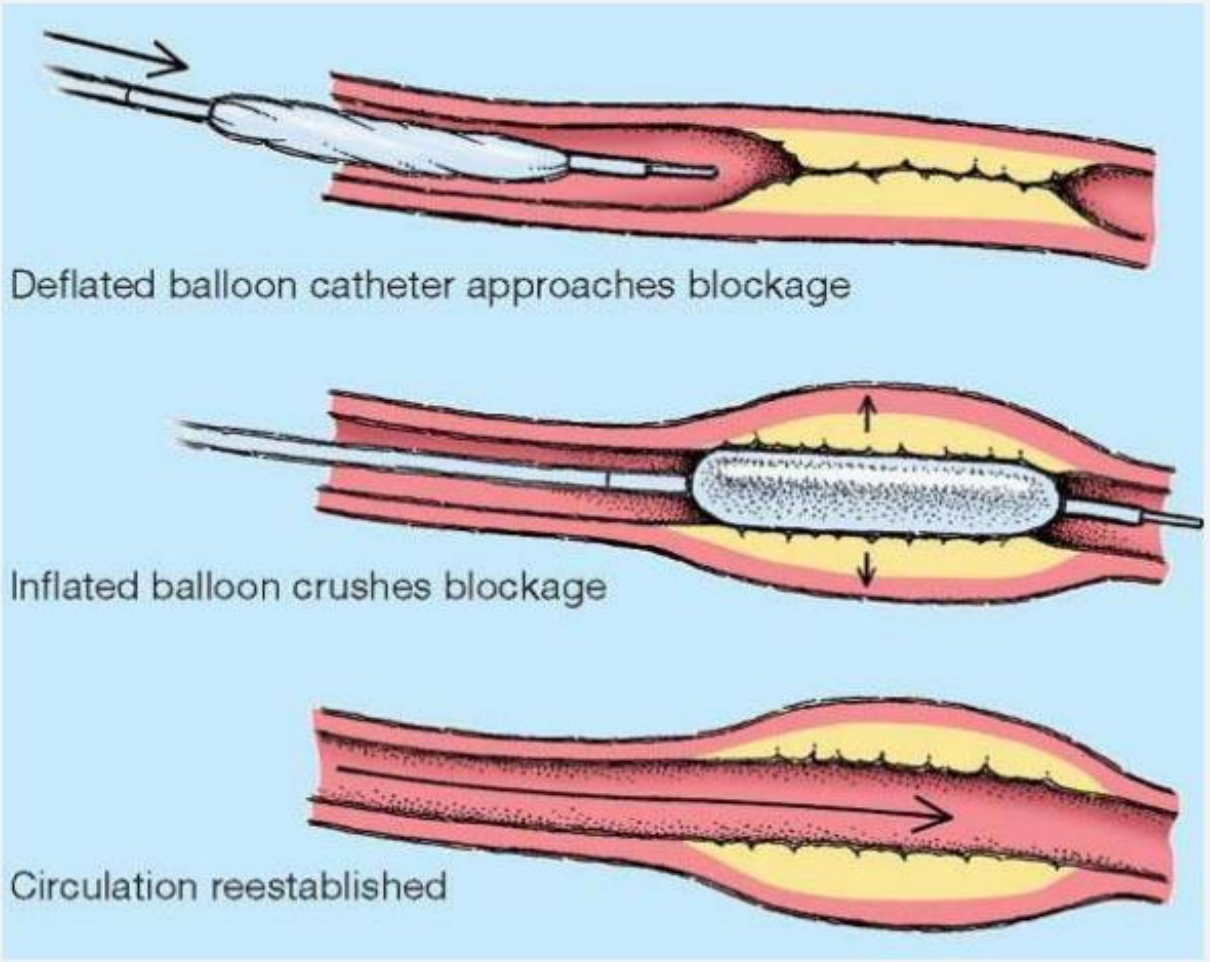

FIGURE B1.17. Percutaneous transluminal angioplasty.