

Lecture # 3

**CLINICAL ANATOMY AND OPERATIVE SURGERY
OF THE CHEST WALL, MEDIASTINUM, THE
PERICARDIUM & HEART**

Plan of lecture

1. Clinical Anatomy of the Thoracic wall.
2. Clinical Anatomy of the Pleural cavity and Lungs.
3. Clinical Anatomy of the Mediastinum.
4. Clinical anatomy of the Pericardium and Heart.

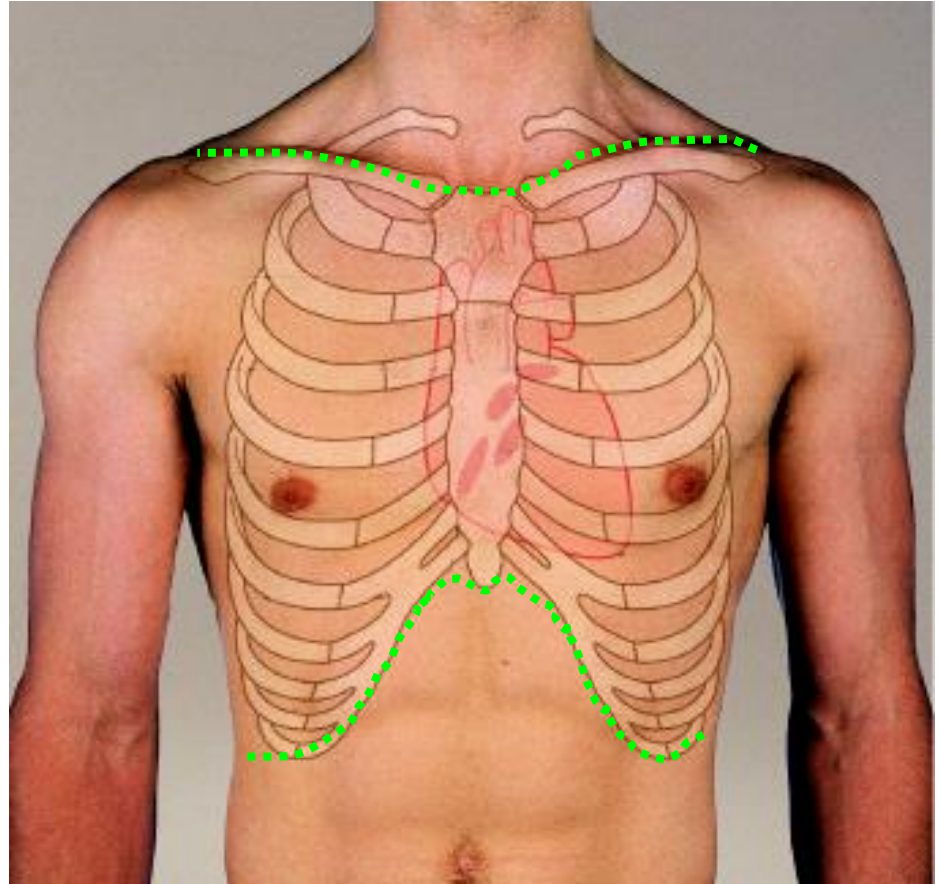
Parts and regions of the thorax

Boundaries

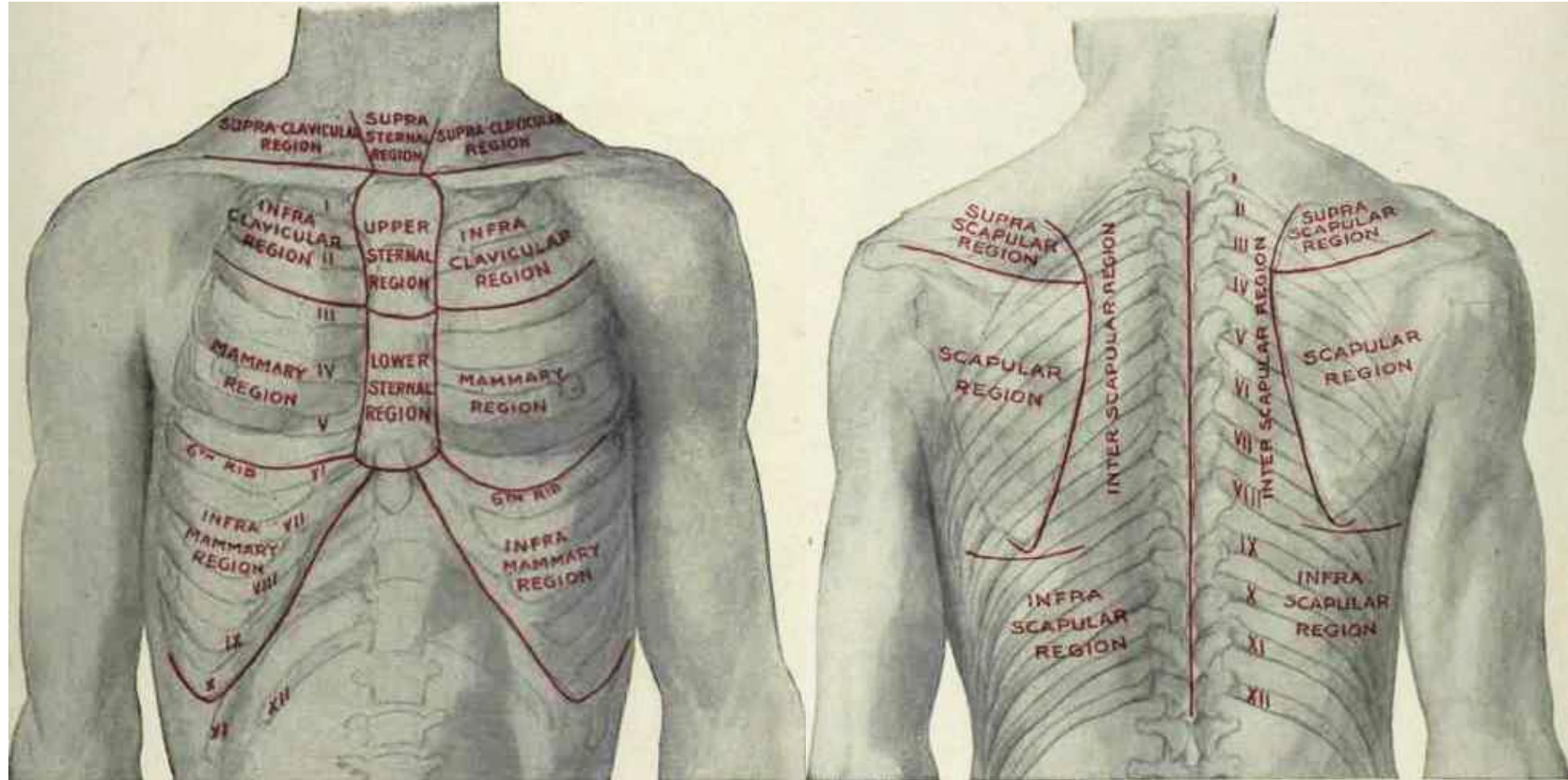
- ❑ Superiorly—jugular notch, sternoclavicular joint, superior border of clavicle, acromion, spinous processes of C7
- ❑ Inferiorly—xiphoid process, costal arch, 12th and 11th ribs, vertebra T12

Regions

- ❑ Thoracic wall
- ❑ Thoracic cavity

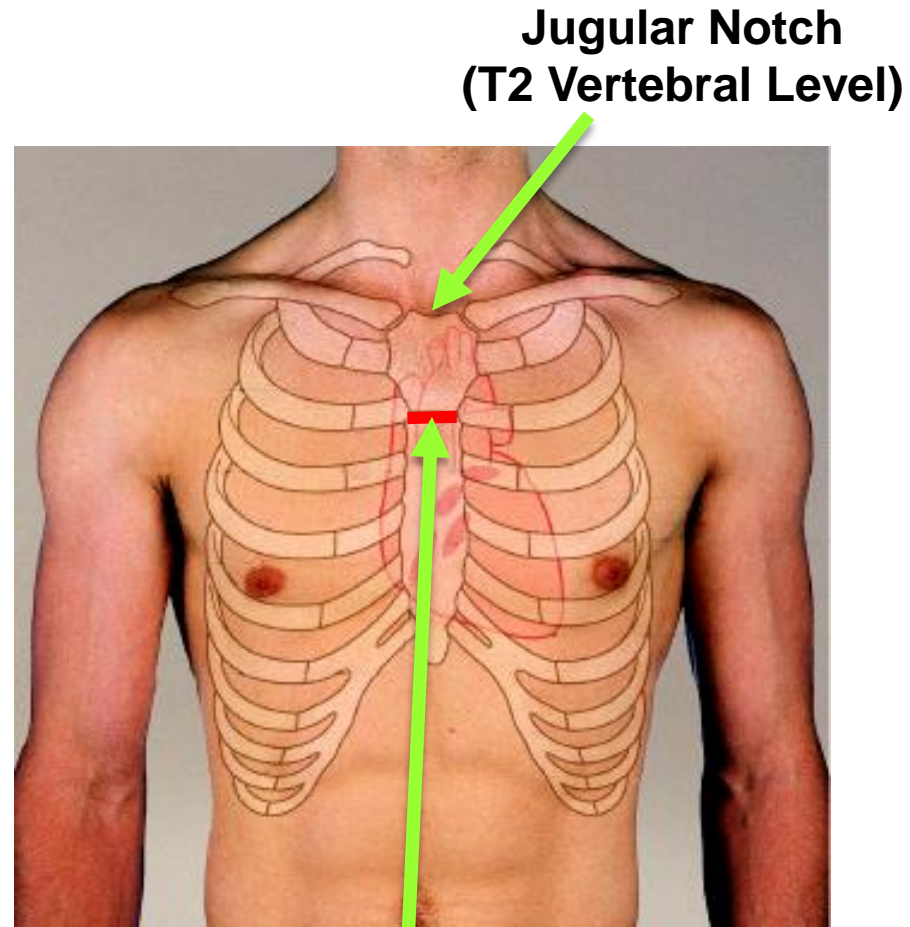


Surface anatomy & regions of the chest



Landmarks of thorax

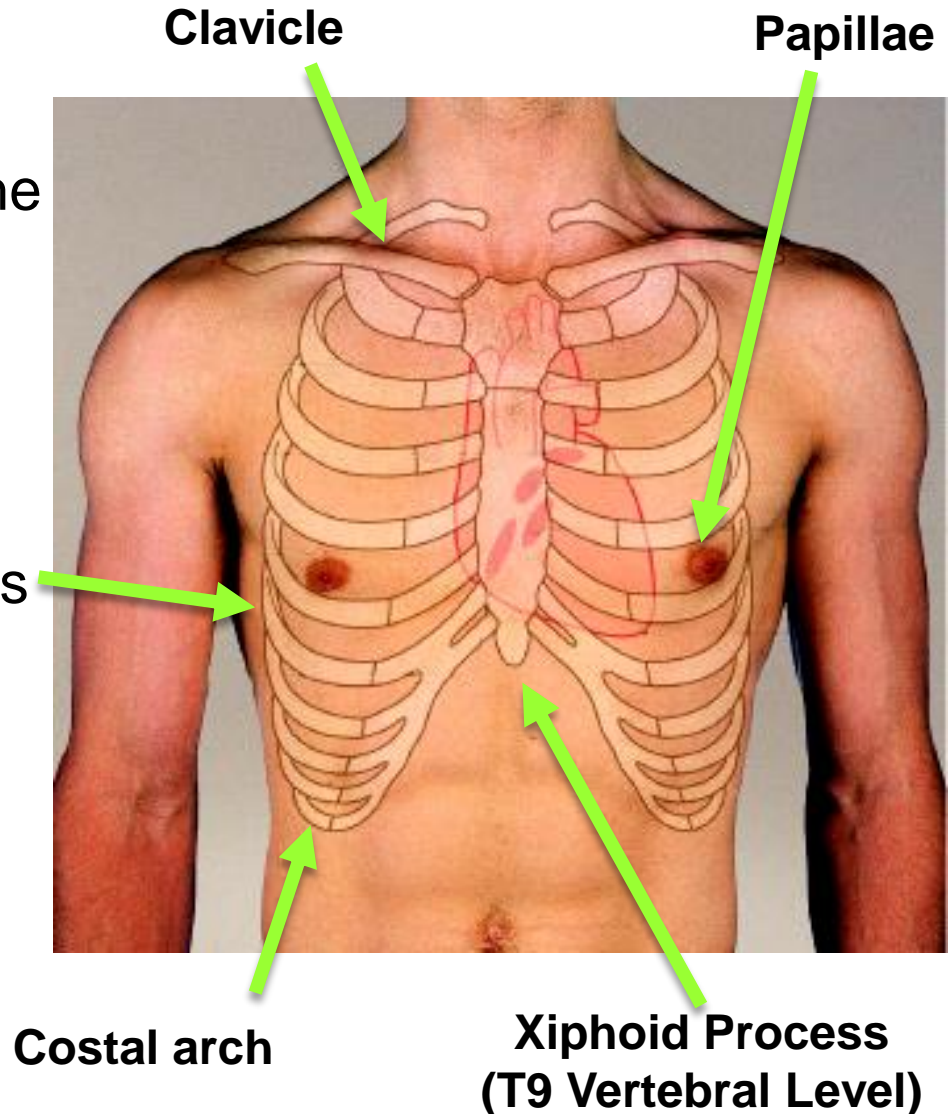
- ❖ **Jugular notch** corresponds with
The 2th thoracic vertebra
- ❖ **Sternal angle** corresponds with
 - Connects 2nd costal cartilage laterally
 - The lower border of 4th thoracic vertebra
 - The bifurcation of trachea in the adult
 - The beginning of aortic arch which ends posteriorly at the same level
 - The esophagus is crossed by the left main bronchus



Sternal Angle
(T4 Vertebral Level)

Landmarks of thorax

- ❑ Xiphoid process—
xiphisternal synchondrosis
lies opposite the body of the
9th thoracic vertebra
- ❑ Clavicle
 - Inferior fossa of clavicle
 - Coracoid process
- ❑ Ribs and intercostal spaces
- ❑ Costal arch
 - Infrasternal angle
 - Xiphocostal angle
- ❑ Papillae



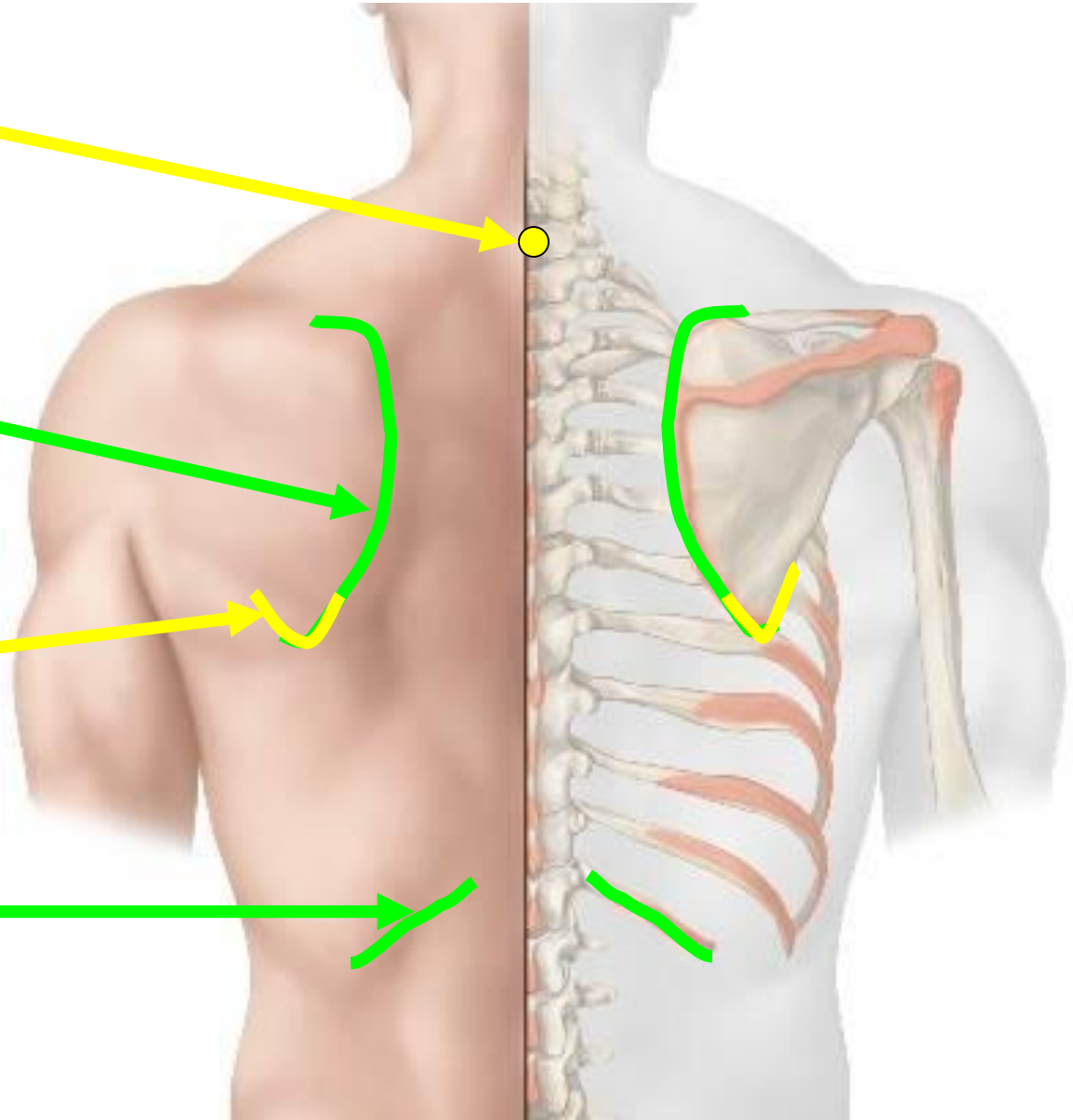
Surface Anatomy of the Posterior Thoracic Wall

C7 Spinous Process
(Vertebra Prominens)

Vertebral Border
of Scapula

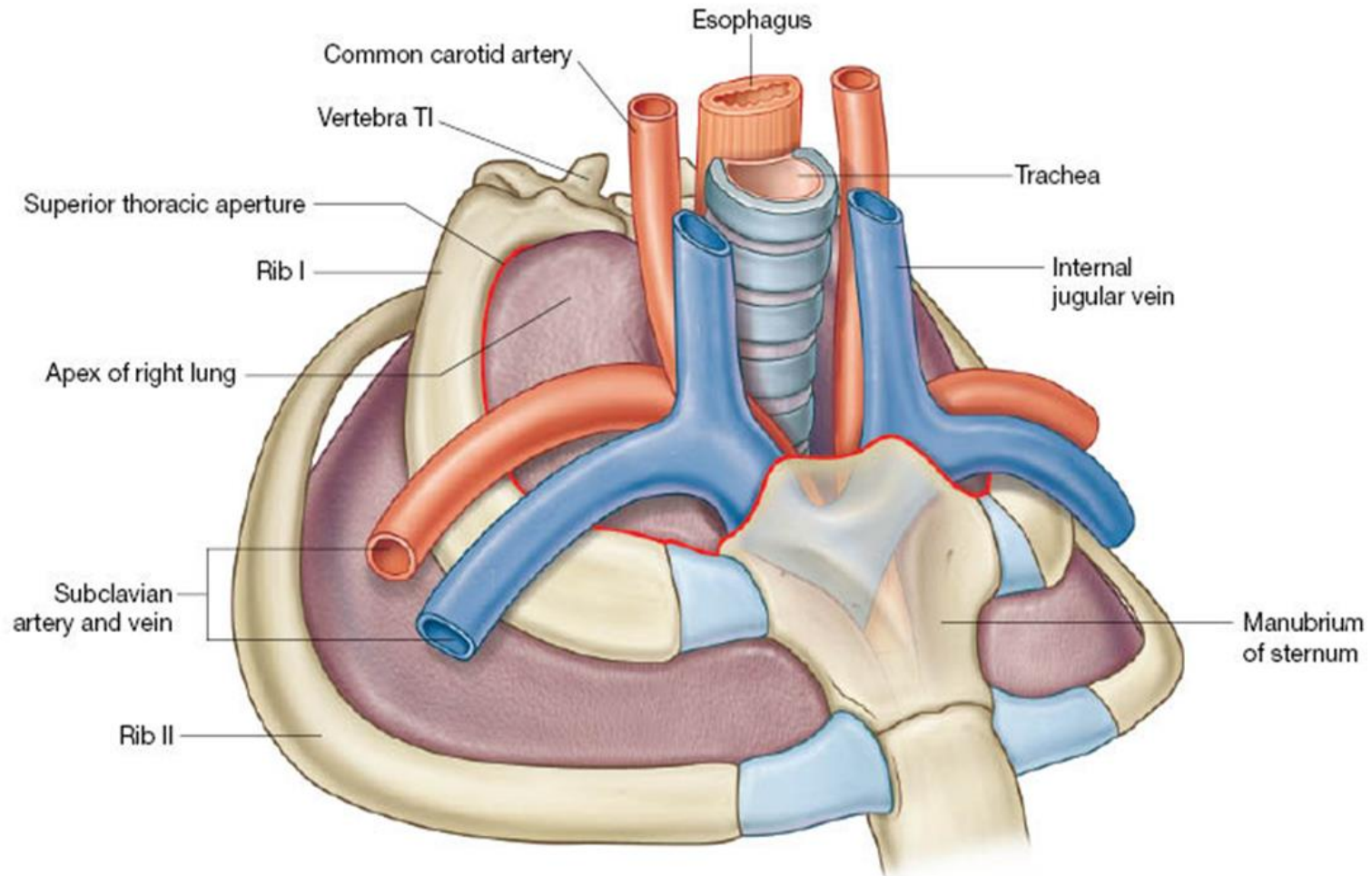
Inferior Angle
of Scapula

12th Rib



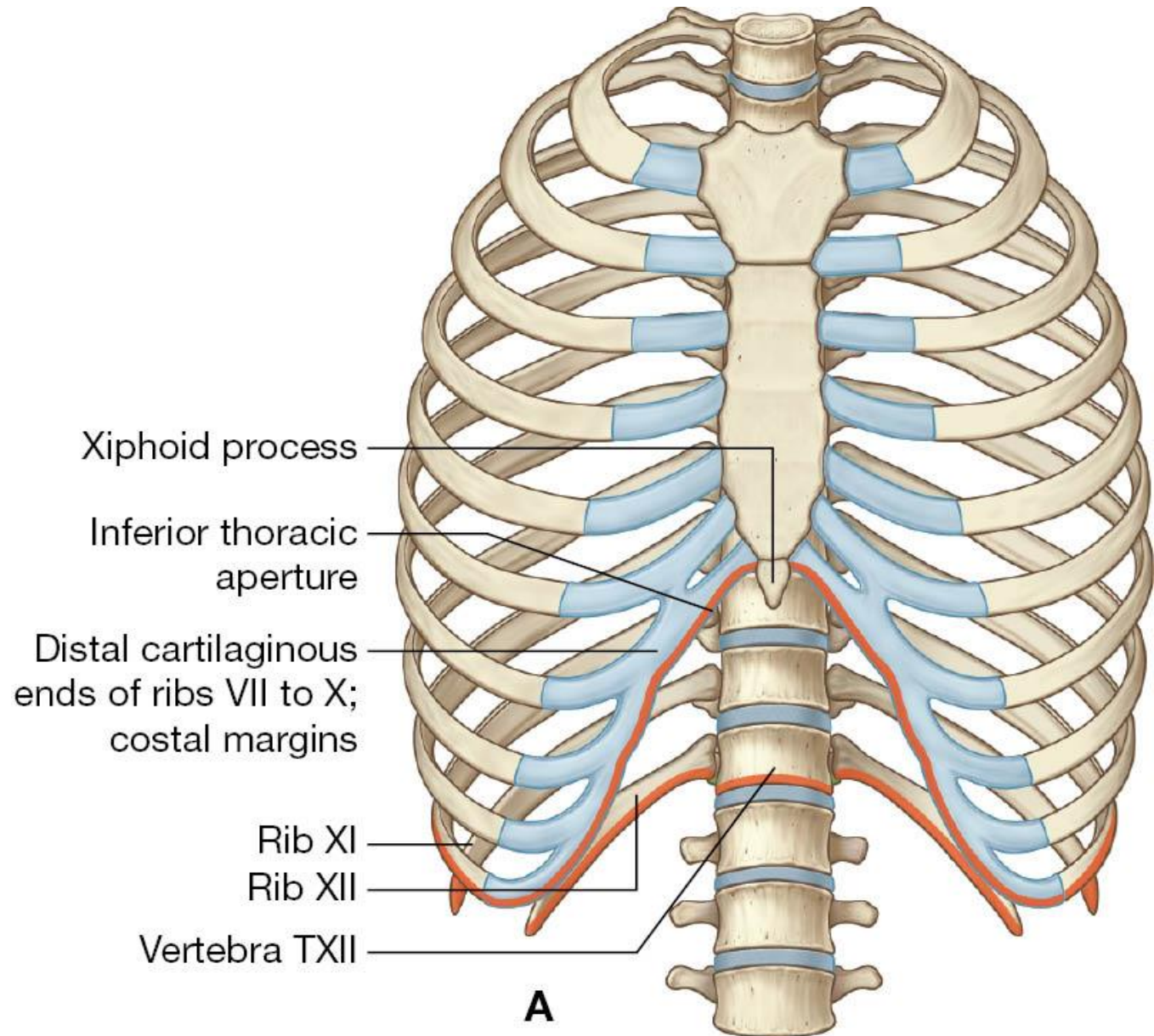
Superior Thoracic Aperture (Thoracic Outlet)

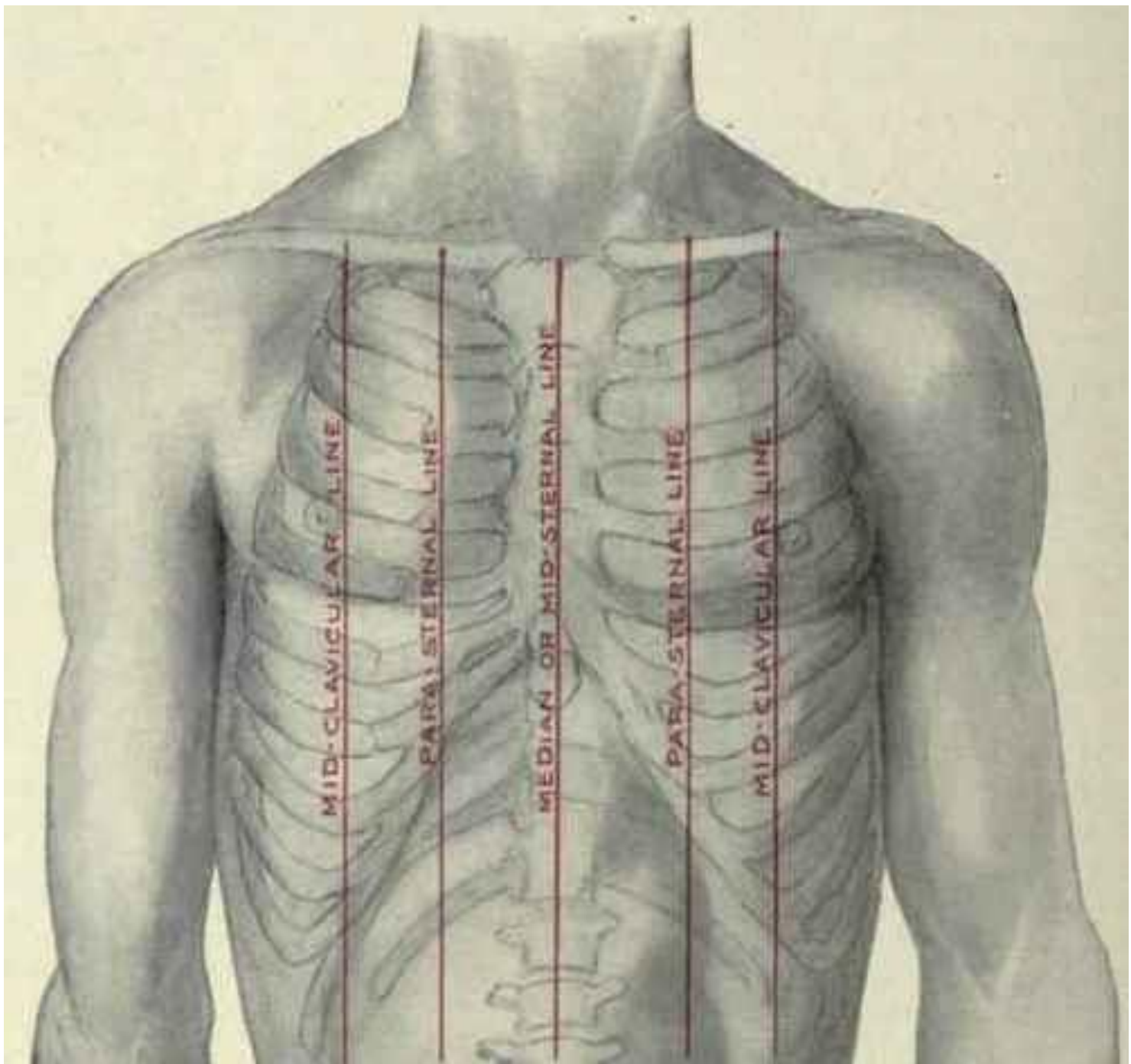
The apex of the each lung extends above the first rib.



Inferior Thoracic Aperture

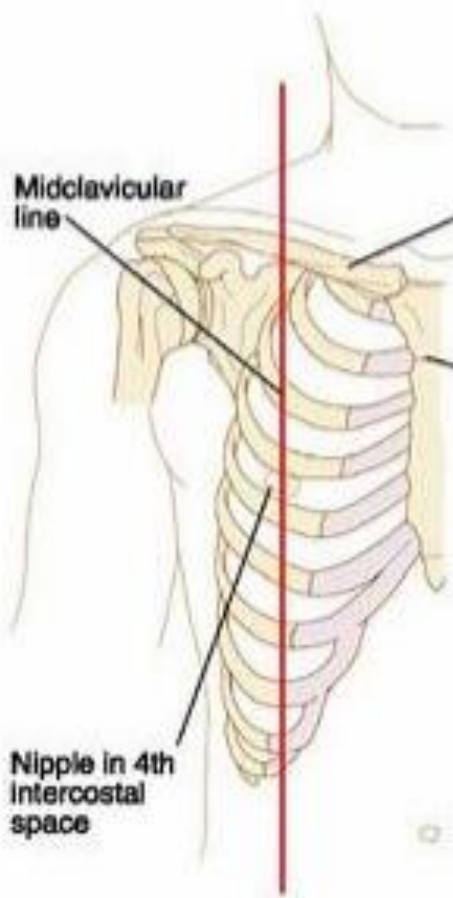
The diaphragm attaches at the inferior border of the ribs, sternum and the body of vertebra T12.



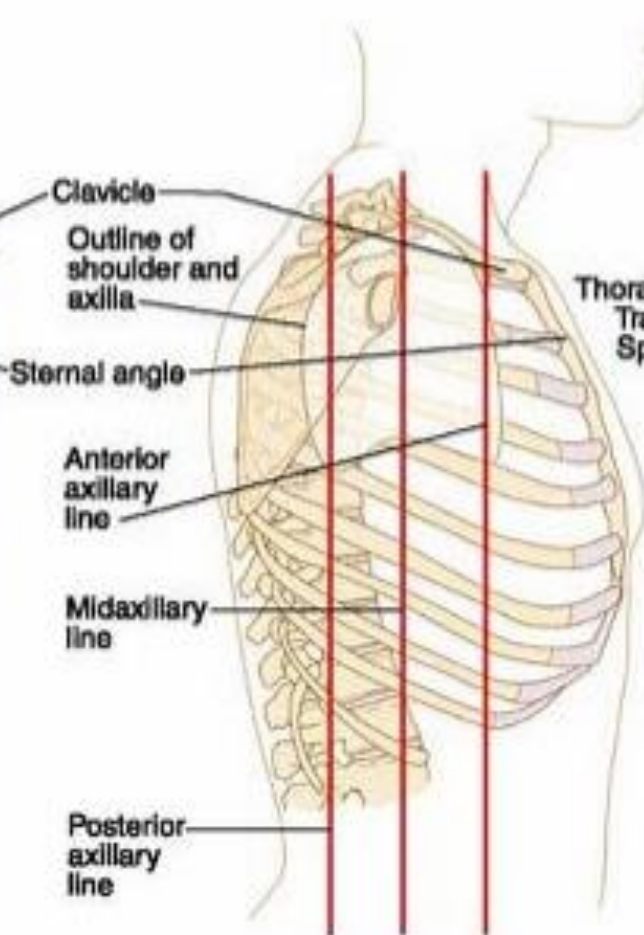


Lines of the Thorax

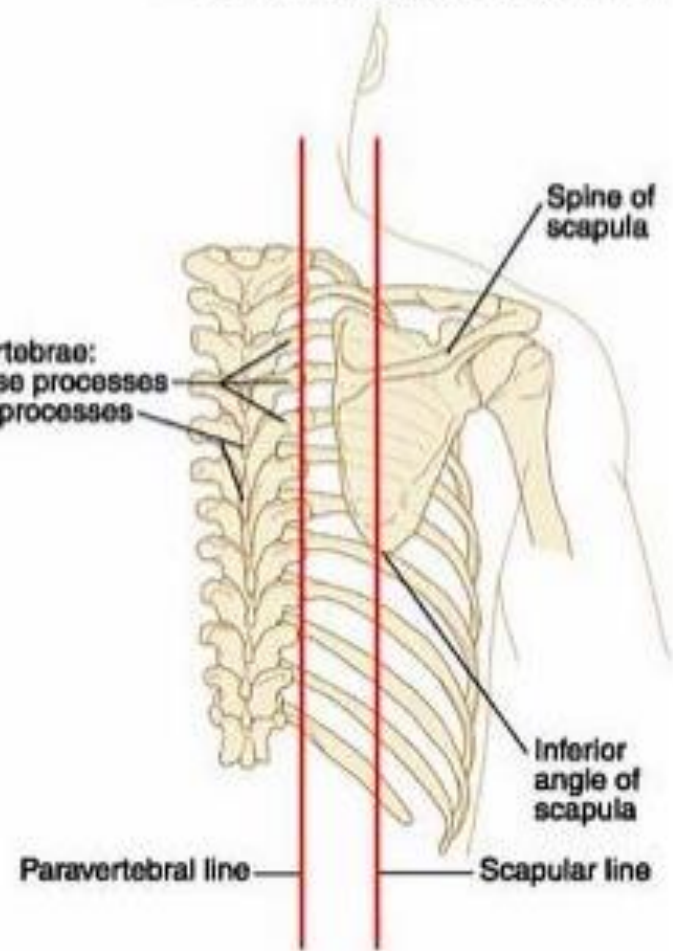
Landmarks, anterior view



Landmarks, lateral view

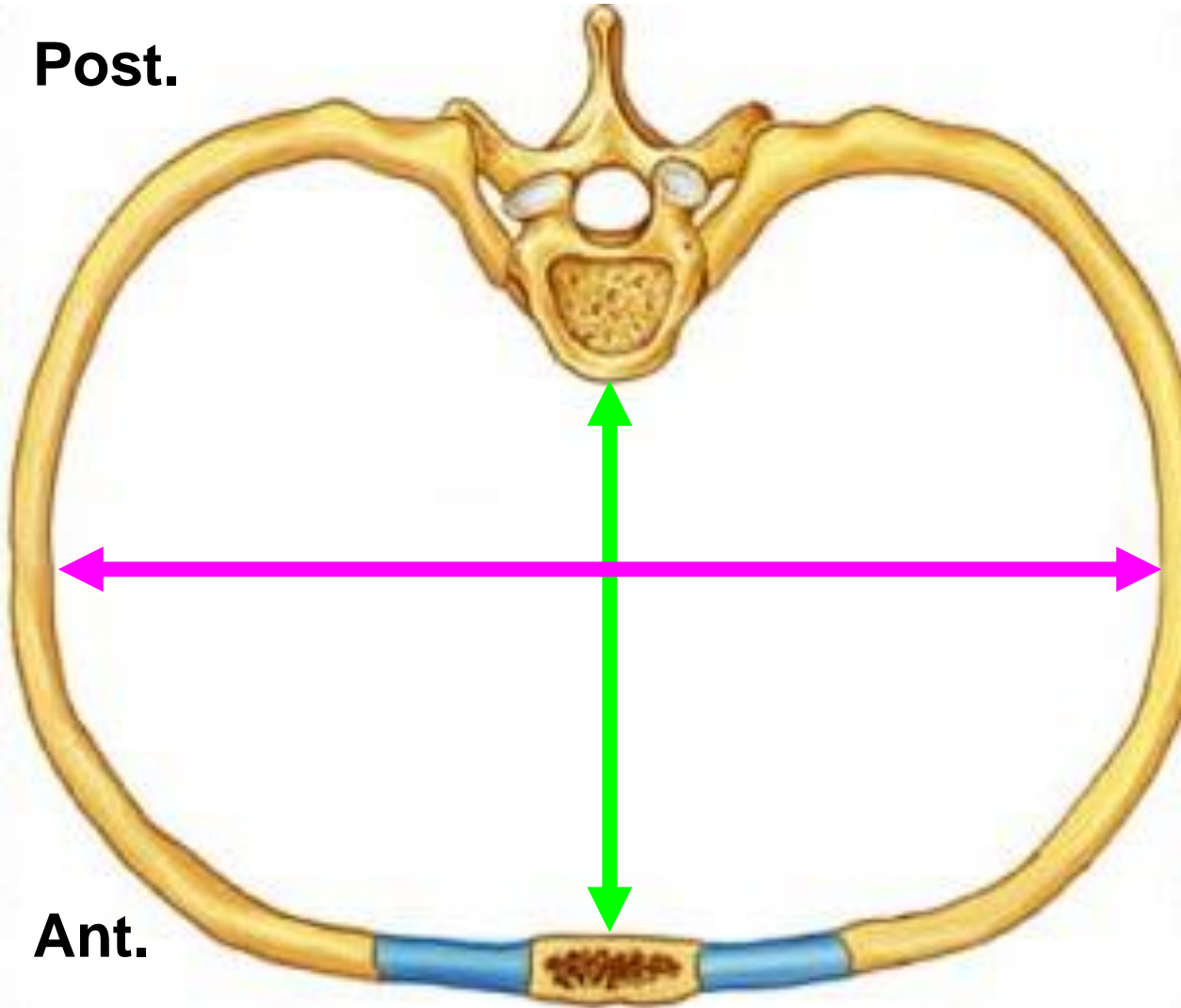


Landmarks, posterior view



Ratio of Anterior-Posterior Diameter : Transverse Diameter

Post.



Ant.

Children
(< 6 yrs old)

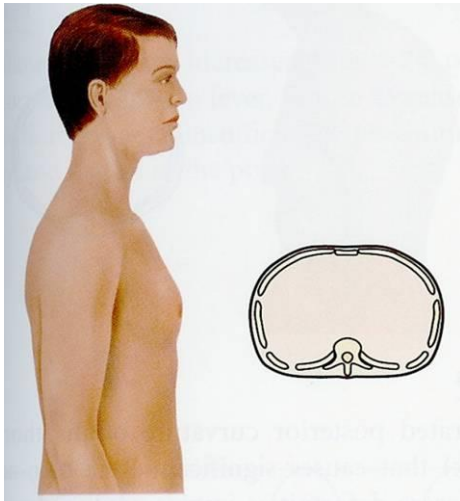
1:1

Adults
(> 6 yrs old)

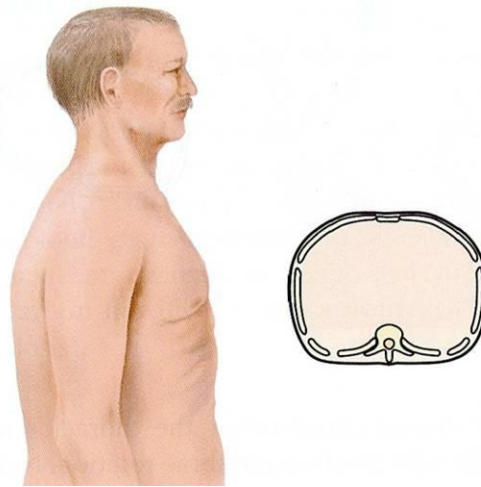
Between

1:1.4 - 1:2

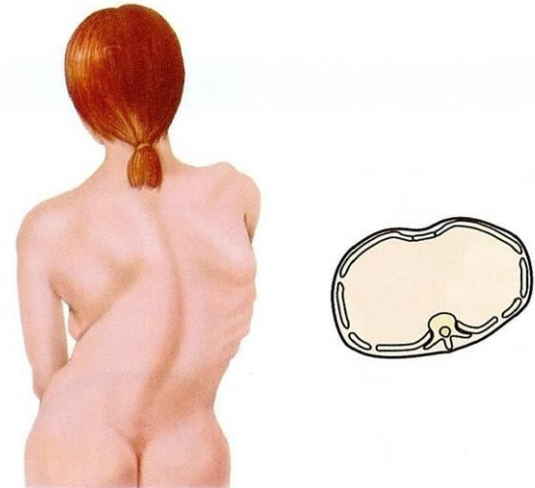
Normal



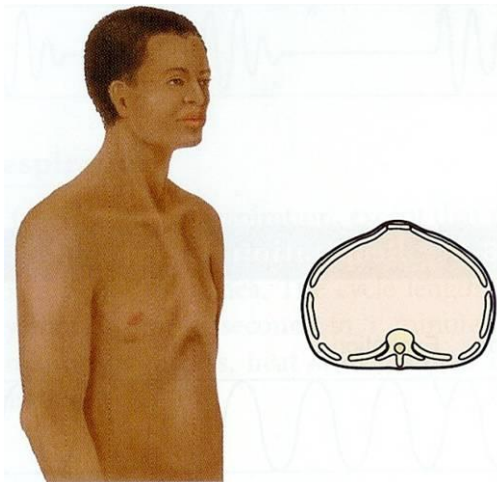
Barrel Chest



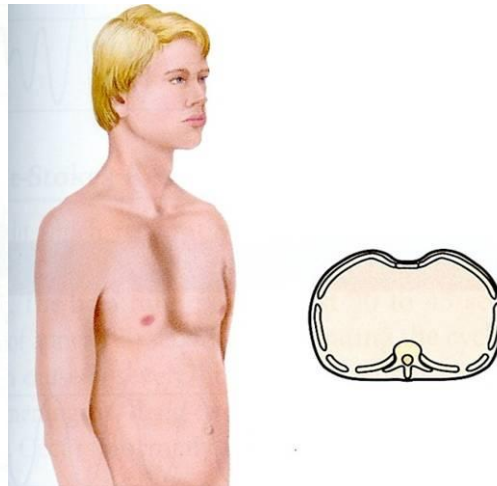
Scoliosis



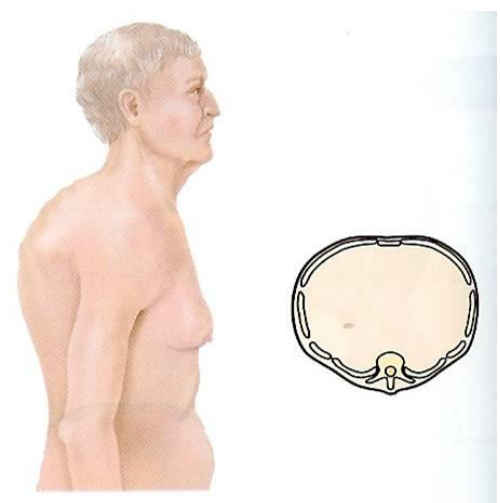
Pectus Carinatum



Pectus Excavatum



Kyphosis

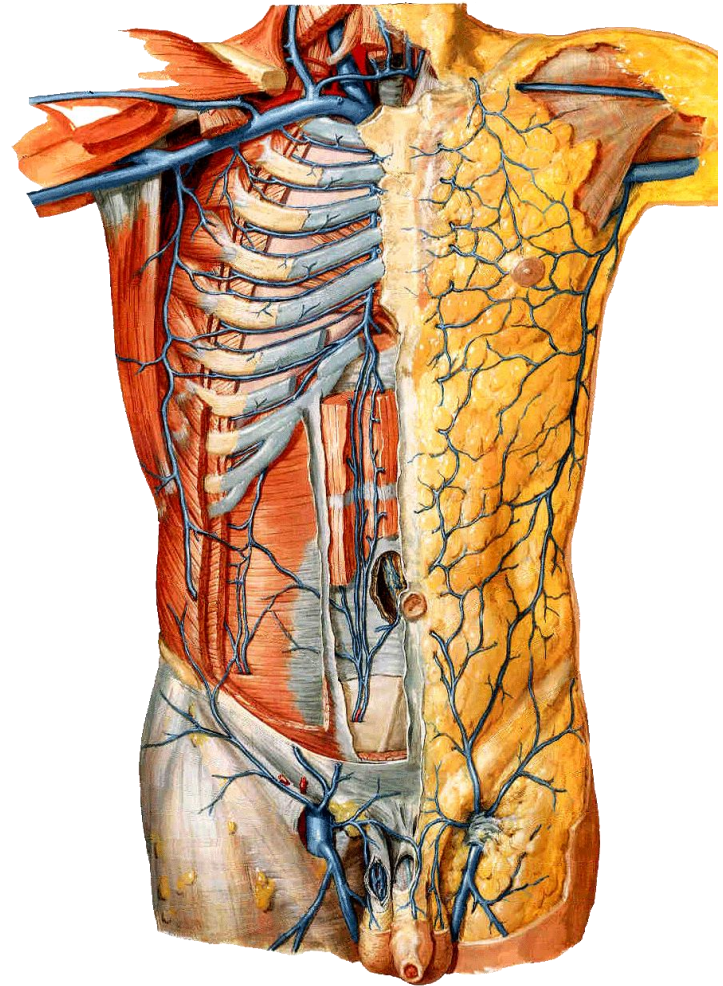


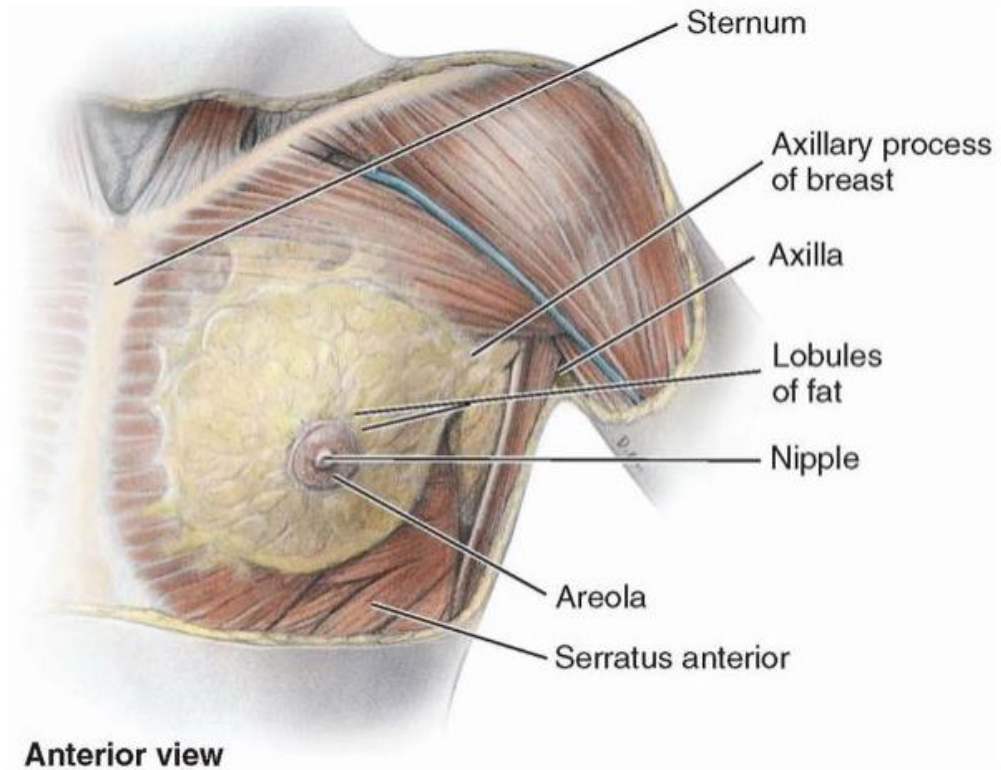
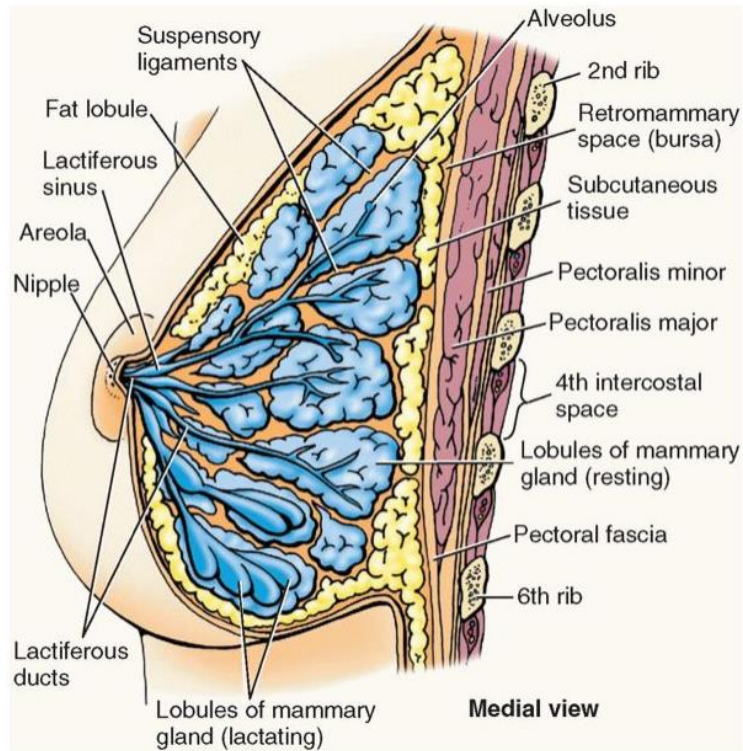
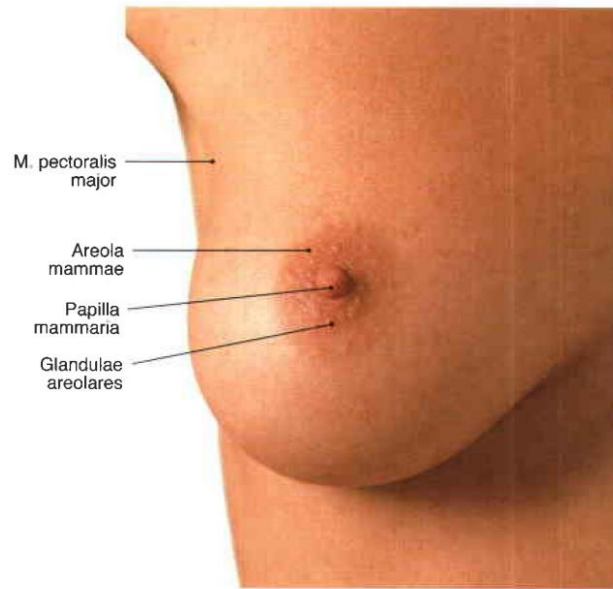
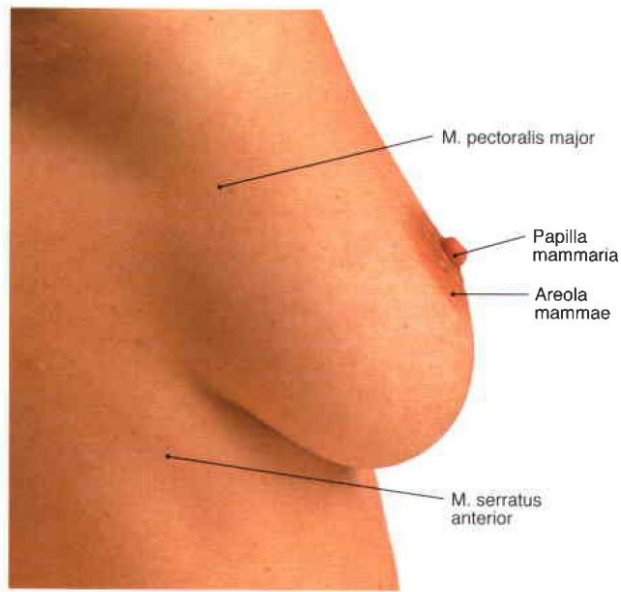
Thoracic wall

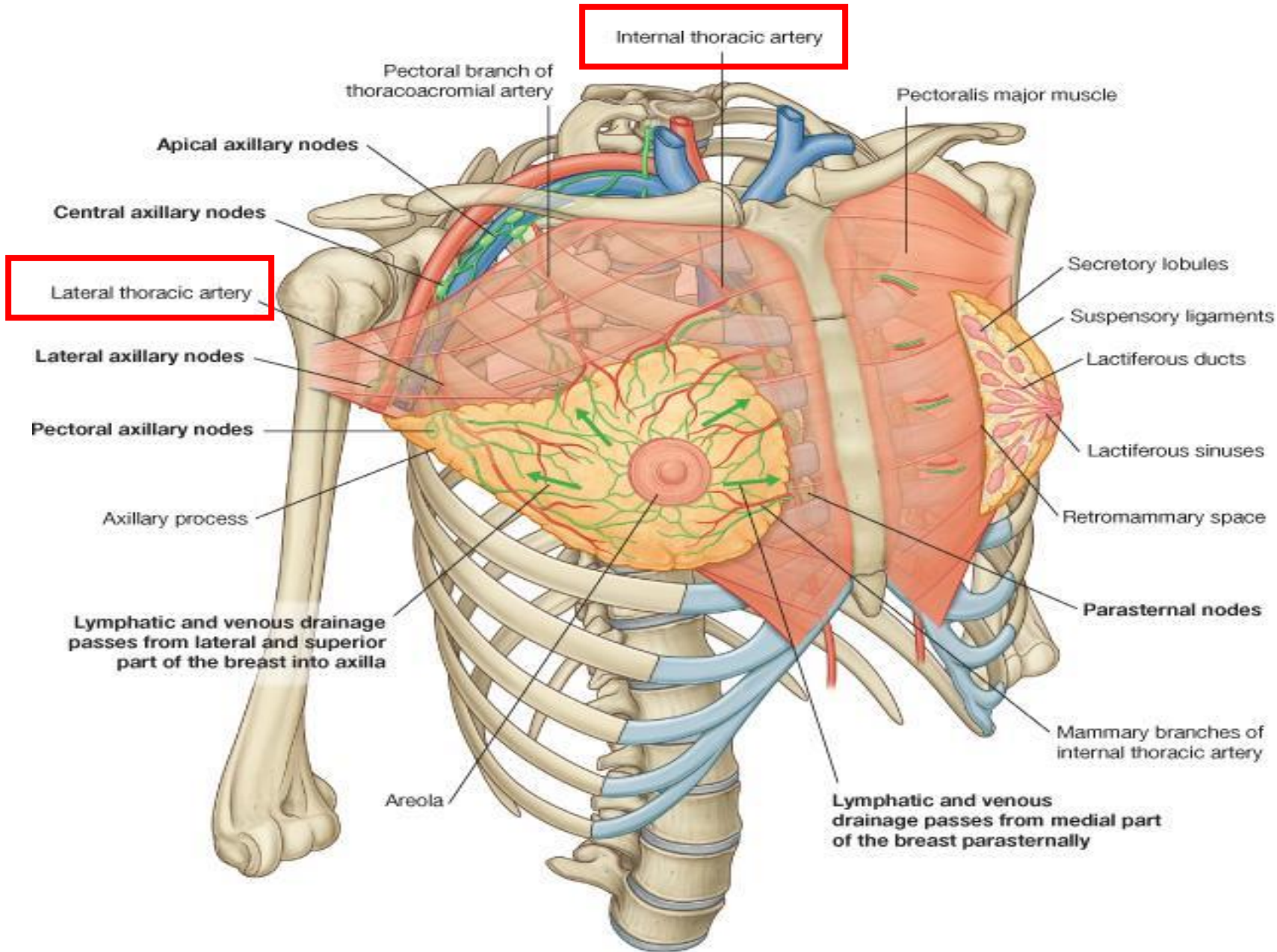
Superficial structures

- Skin
- Superficial fascia
 - Superficial aa.
 - Superficial vv.
 - Thoracoepigastric v.
 - Lateral thoracic v.
 - Superficial nn.
 - Supraclavicular n.
 - Anterior and lateral cutaneous branches of intercostal n.

Superficial fascia covers a breast.

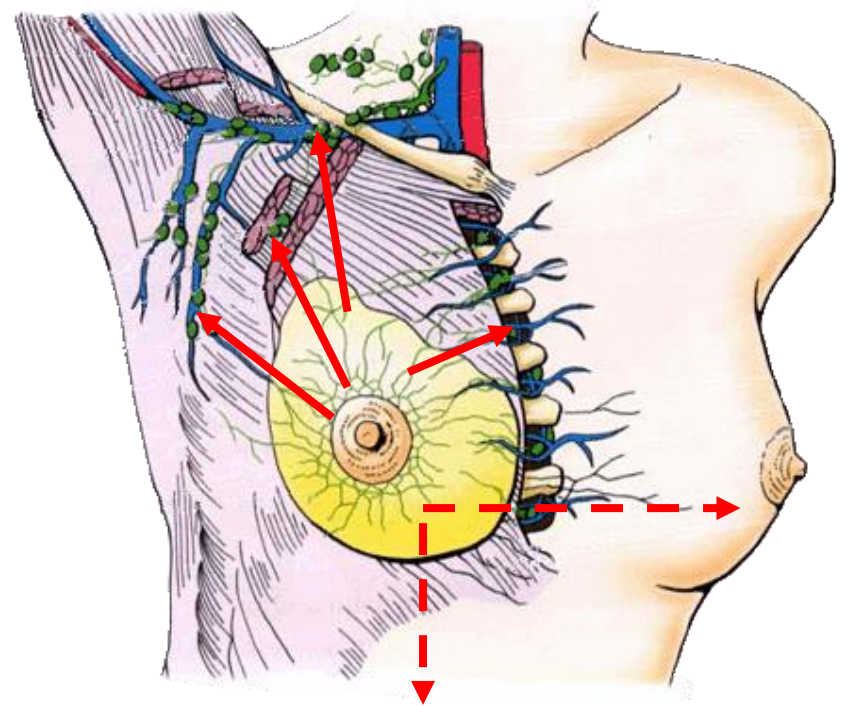


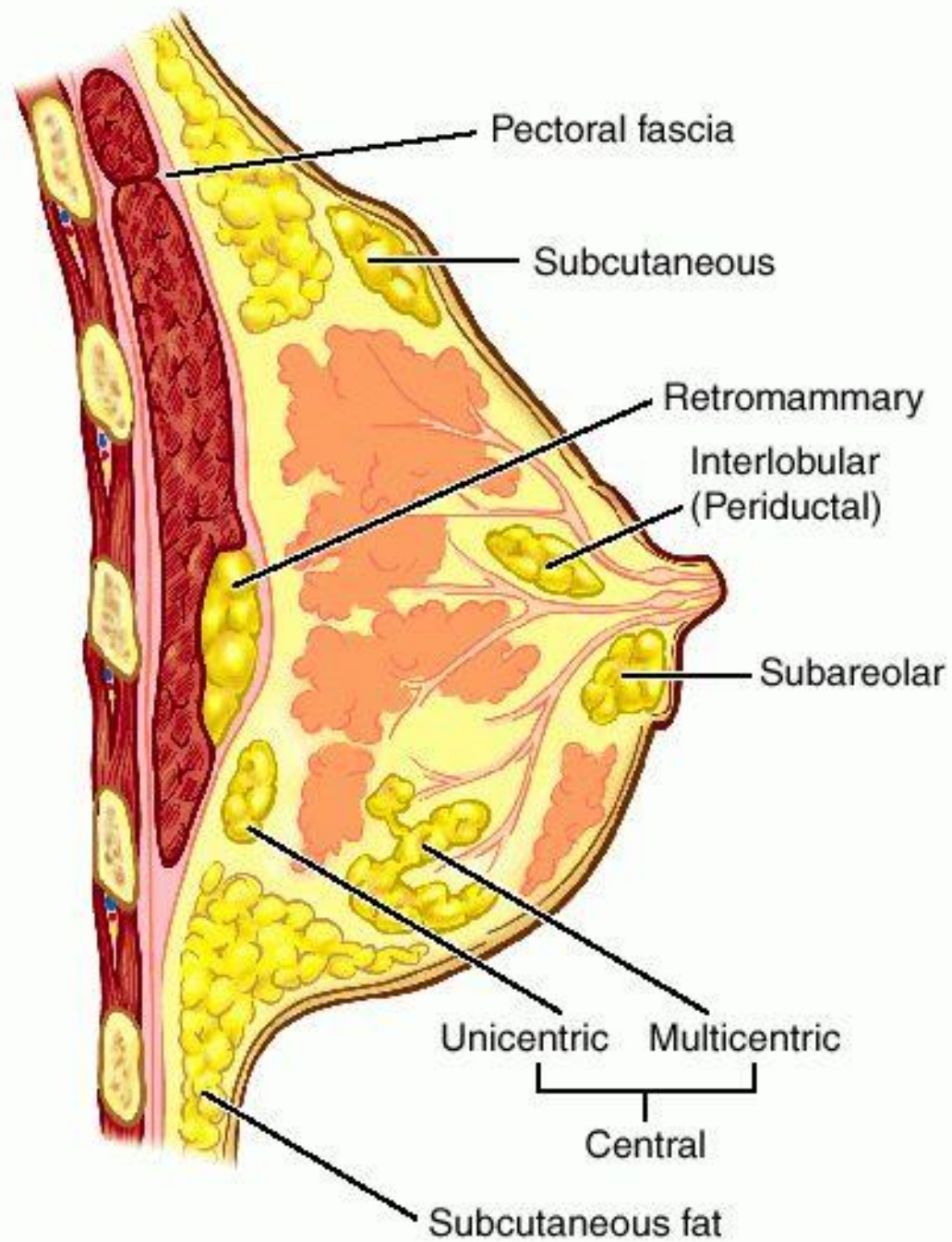


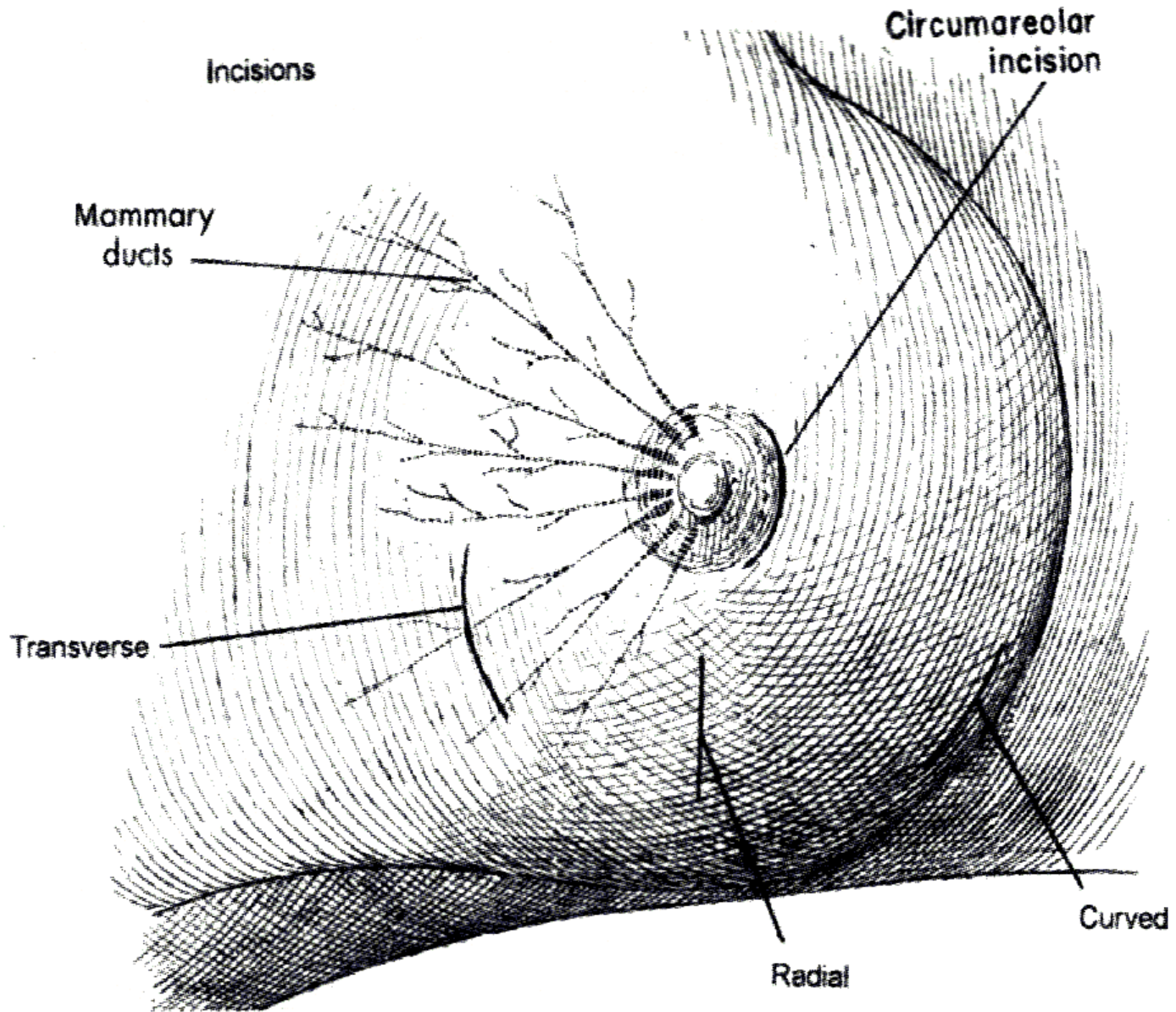


Lymphatic drainage of a breast

- ❑ Into pectoral In. from lateral and central parts of breast
- ❑ Into apical and supraclavicular In. from superior part of breast
- ❑ Into parasternal In. from medial part of breast
- ❑ Into interpectoral In. from deep part of breast
- ❑ The lymphatic capillaries of breast form an anastomosing network which is continuous across the midline with that of the opposite side and with that of the abdominal wall



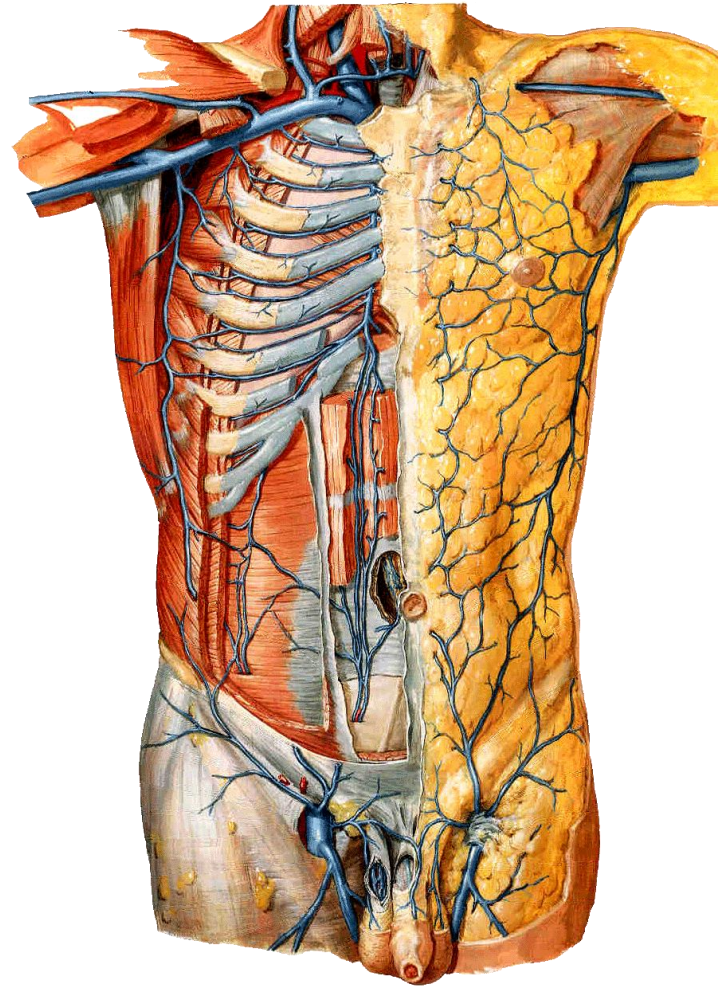




Thoracic wall

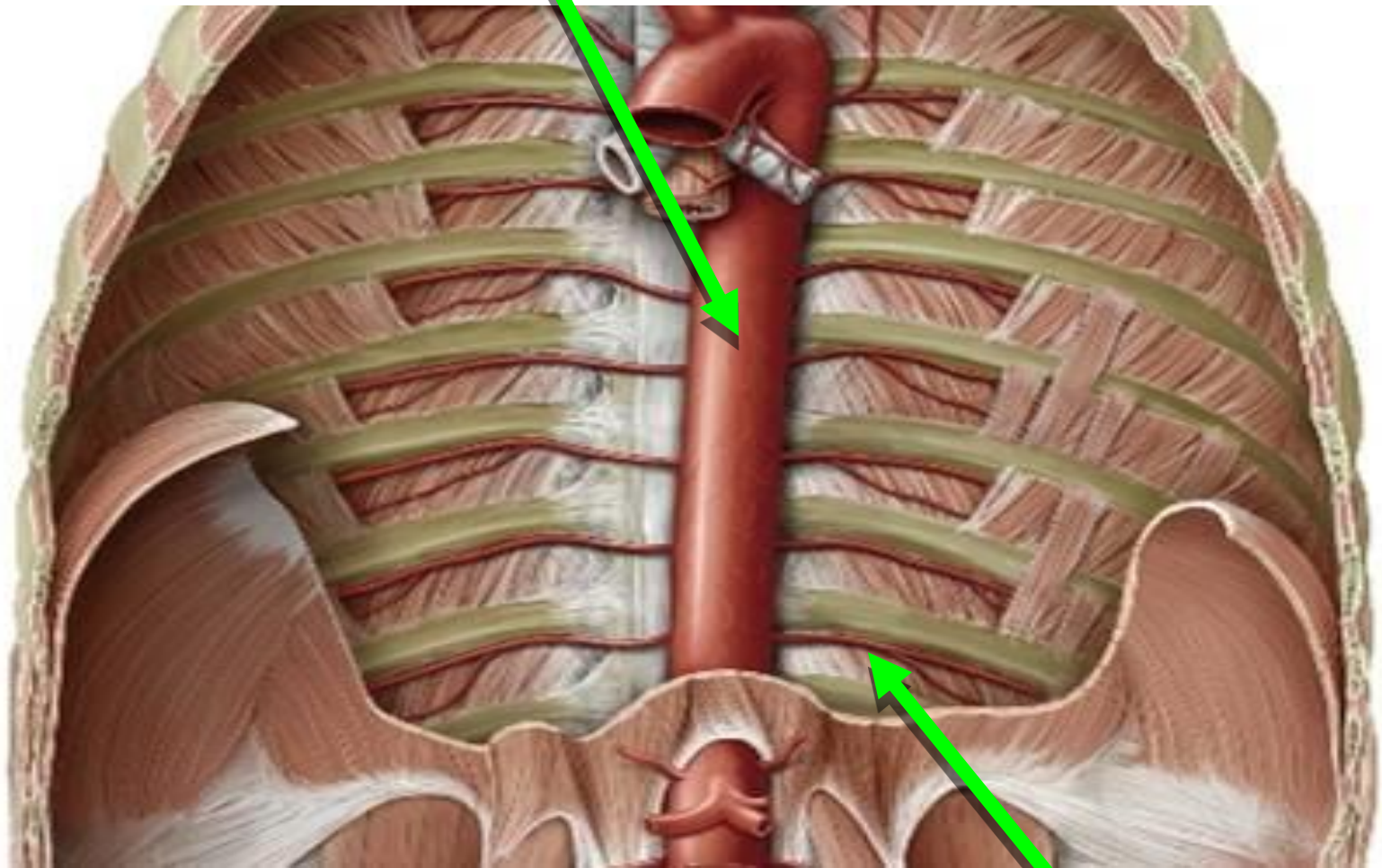
Deep structures

- Deep fascia
 - Superficial layer
 - Deep layer—clavipectoral fascia
- Muscles of thorax
 - Subclavius
 - Pectoralis major
 - Pectoralis minor
 - Serratus anterior
 - Intercostales externi
 - Intercostales interni
 - Intercostales intimi
- Endothoracic fascia

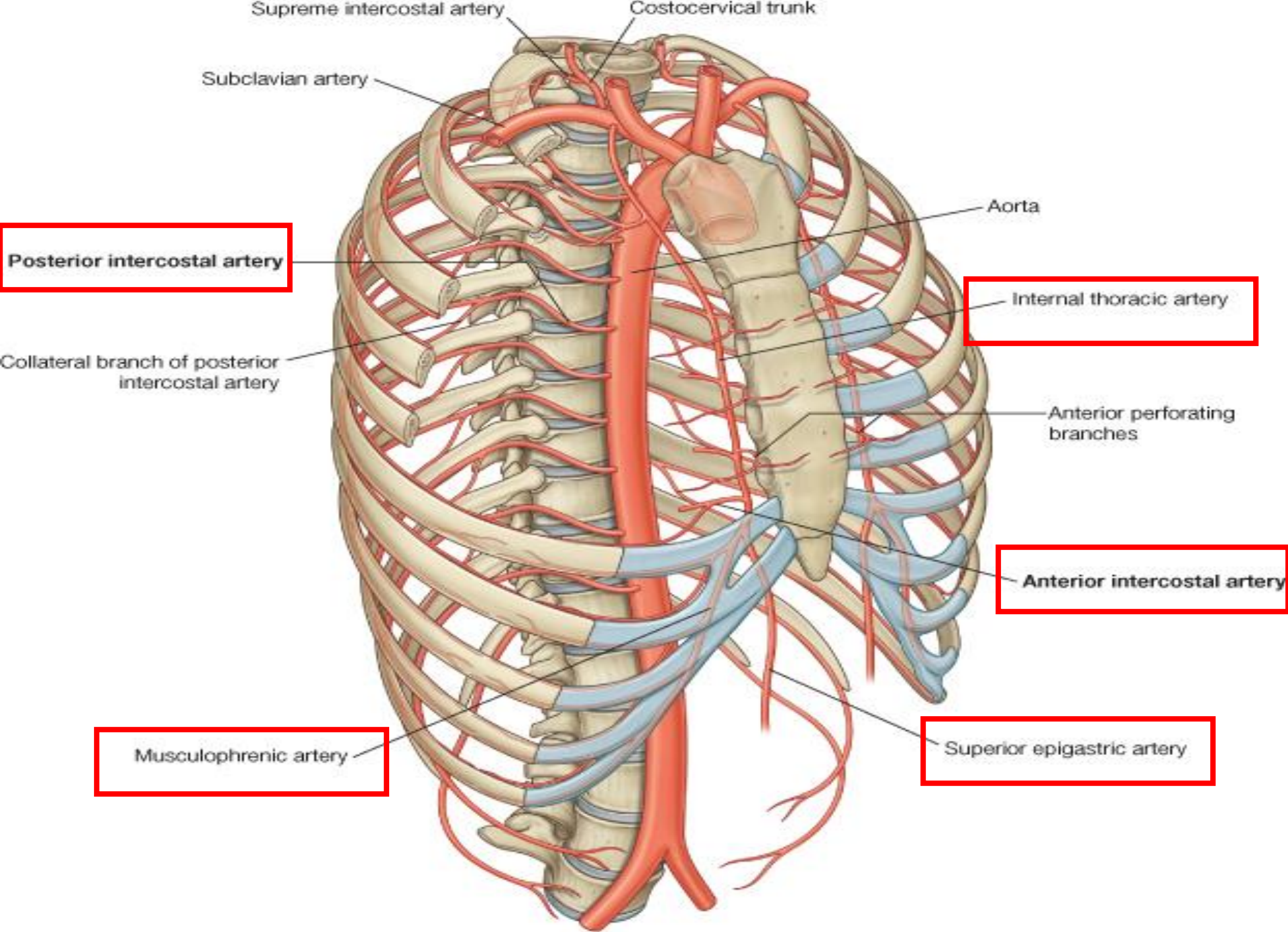


Arteries of the Posterior Thoracic Wall

Thoracic aorta



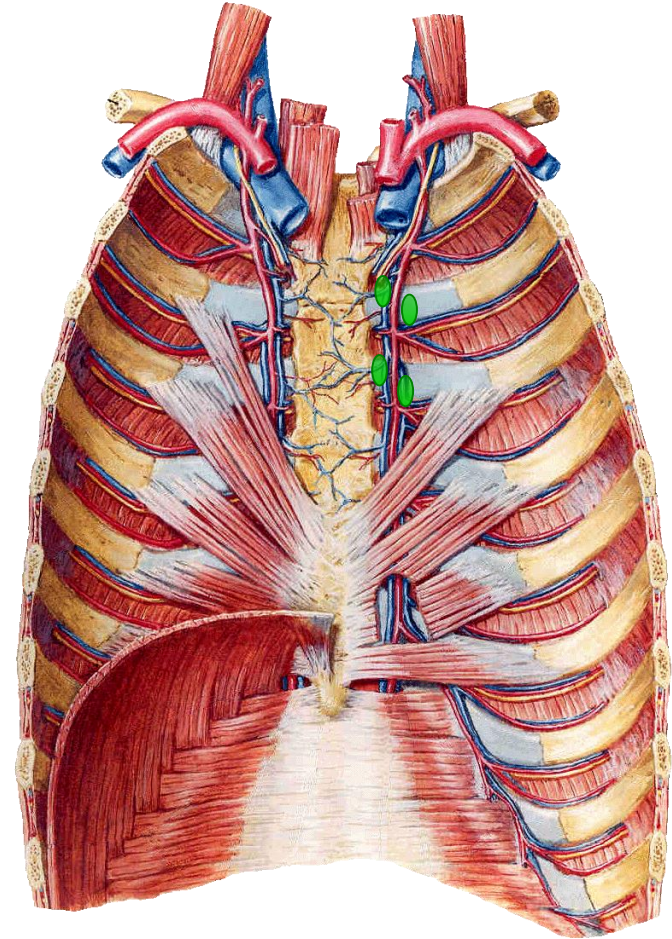
Intercostal arteries



Internal thoracic vessels

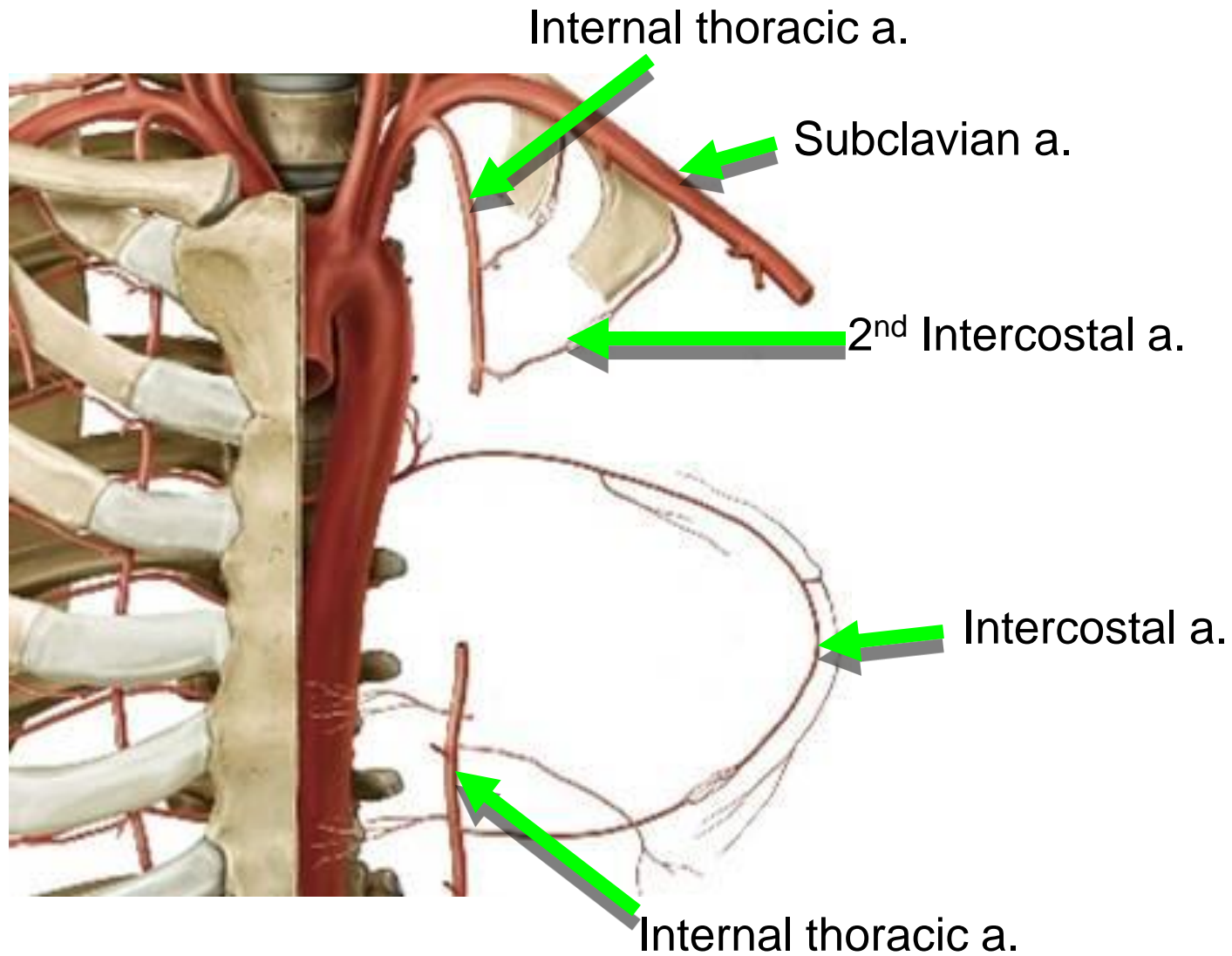
Internal view

- **Internal thoracic a.&v.**
 - Descends into thorax 1.2cm lateral to edge of sternum
 - Ends at the sixth costal cartilage by dividing musculophrenic and superior epigastric arteries
- **Parasternal In.**

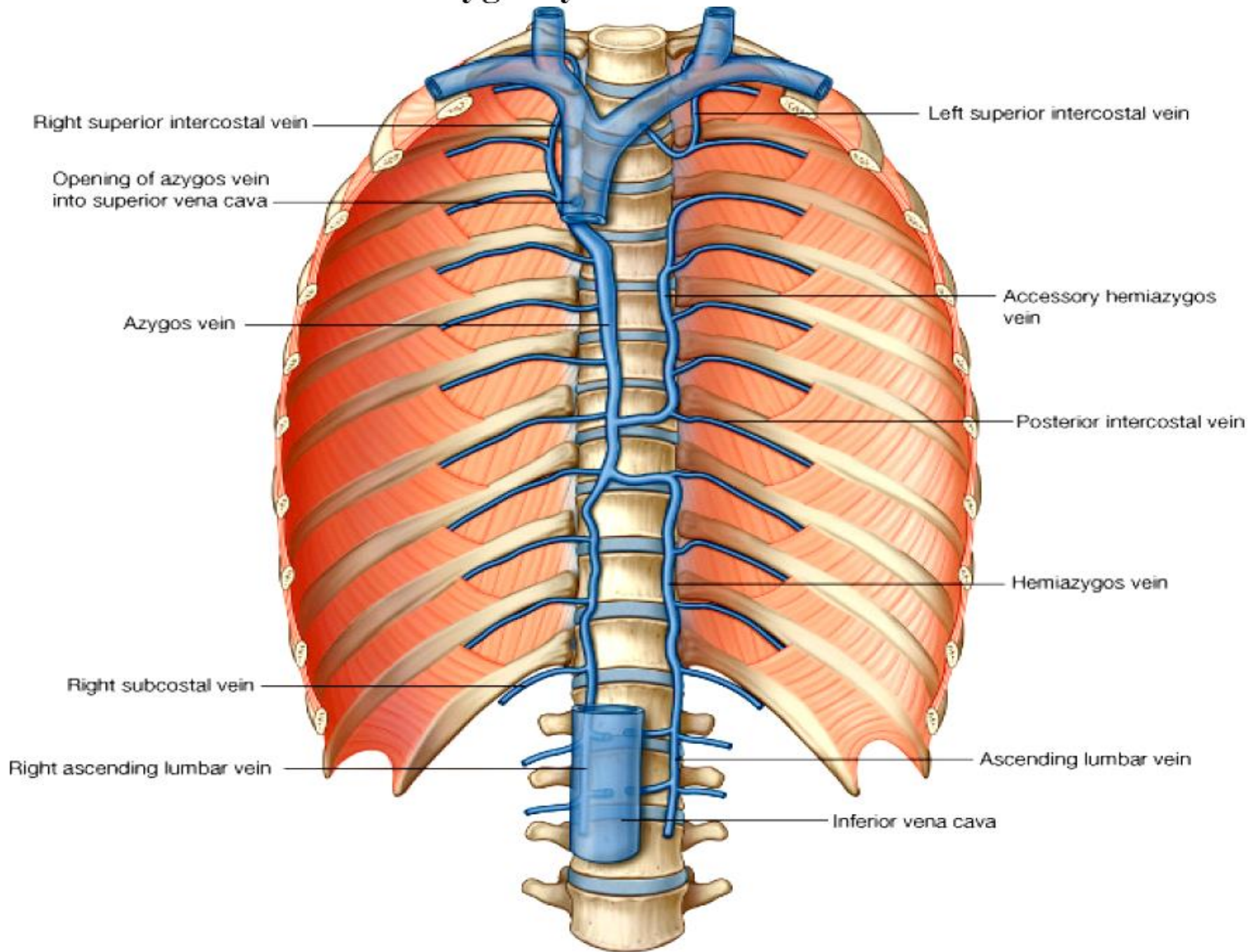


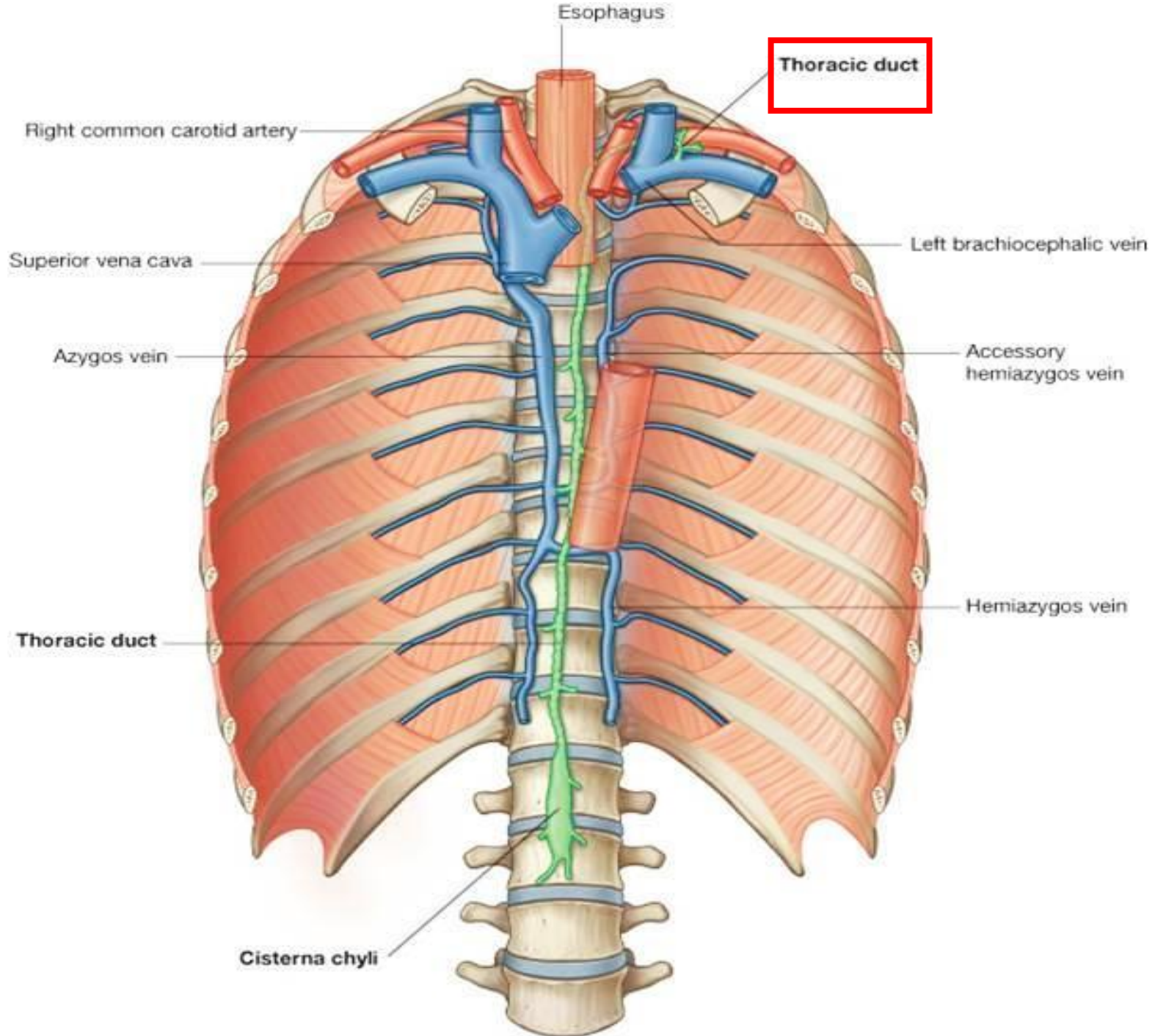
Arteries of the Thoracic Wall

External view

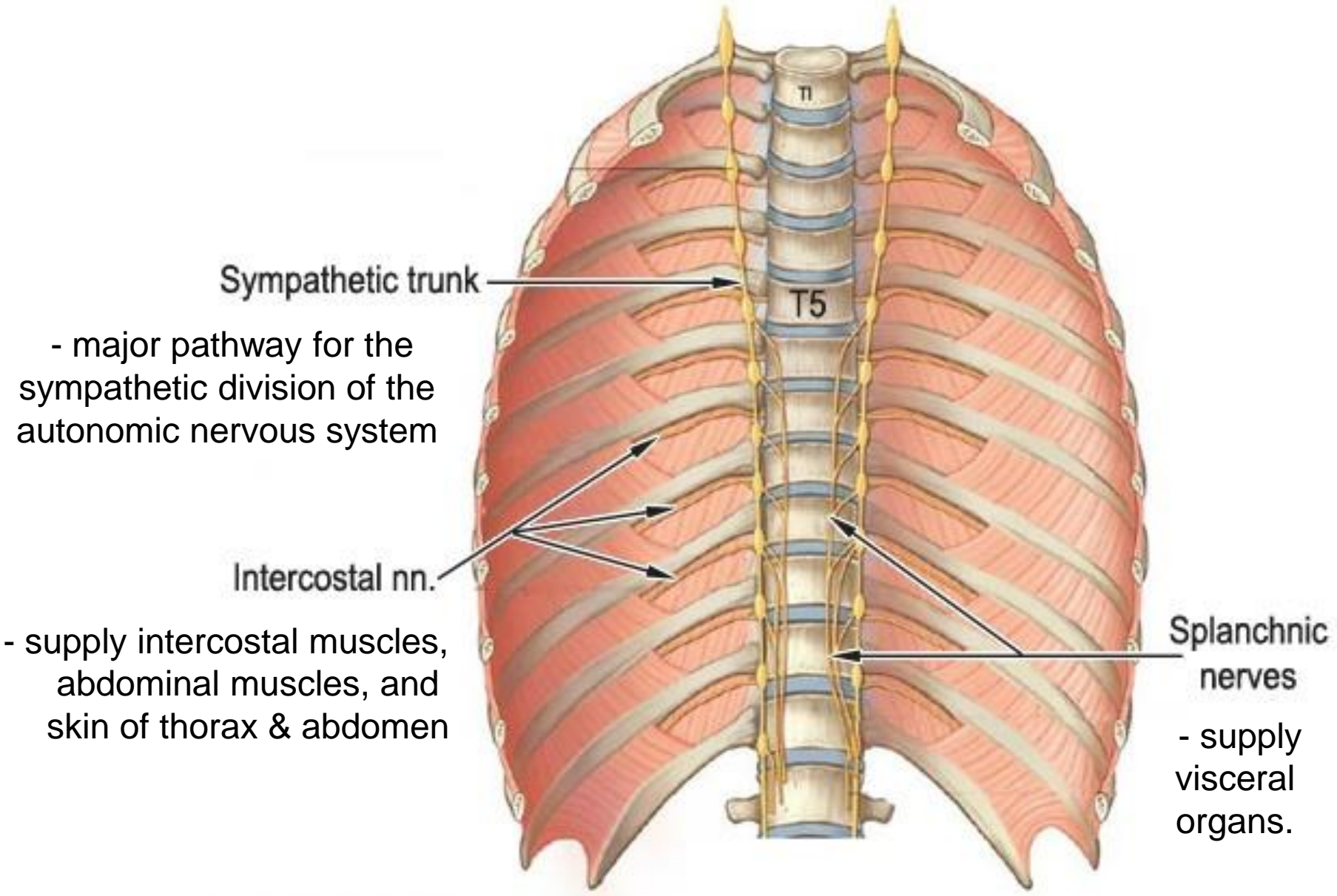


Azygos system of veins.





Nerves of the Posterior Thoracic Wall



Sympathetic trunk

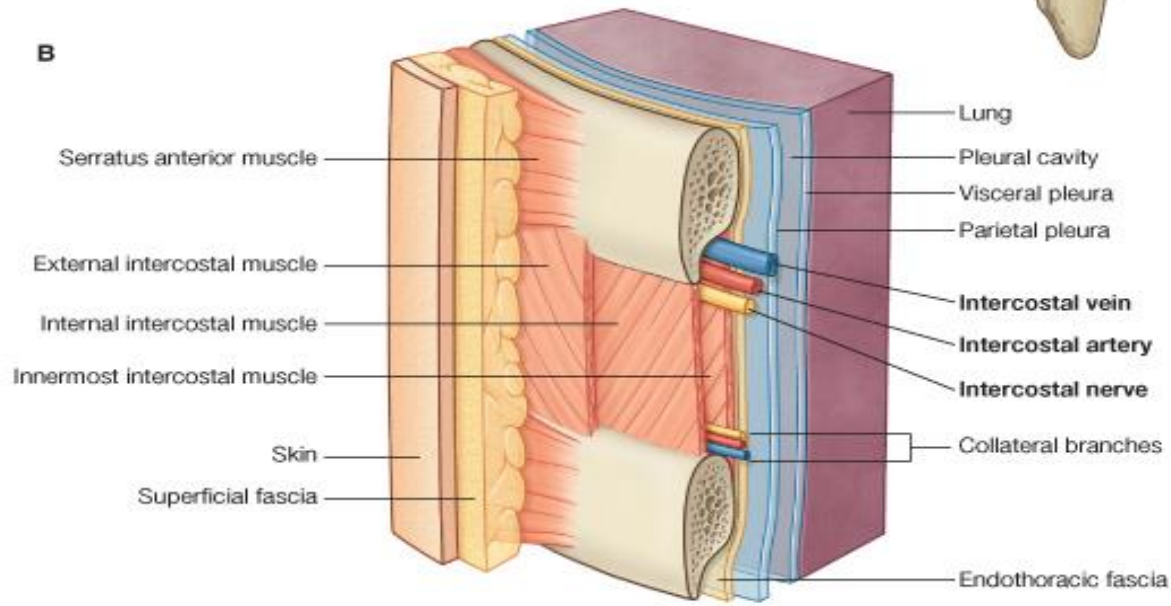
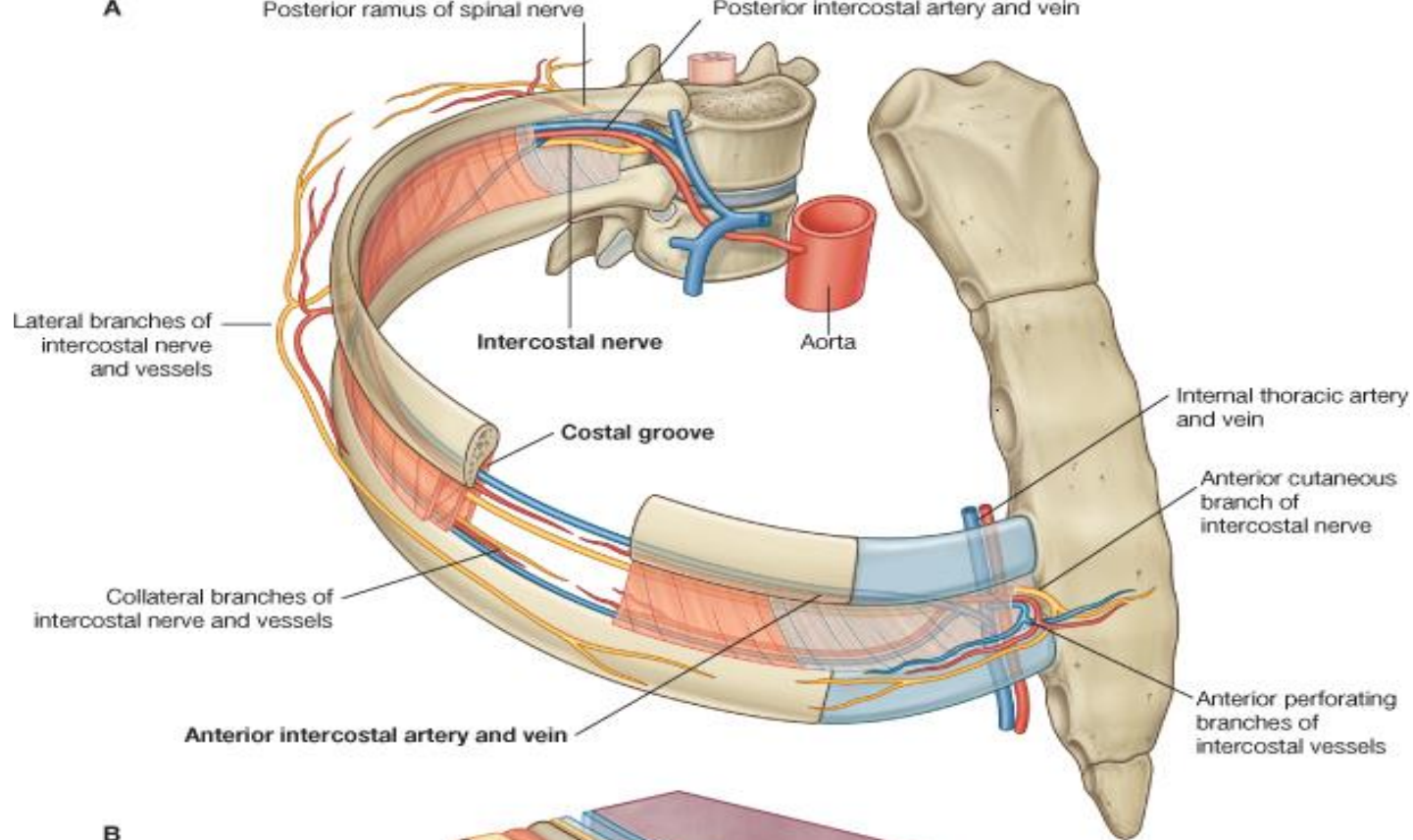
- major pathway for the sympathetic division of the autonomic nervous system

Intercostal nn.

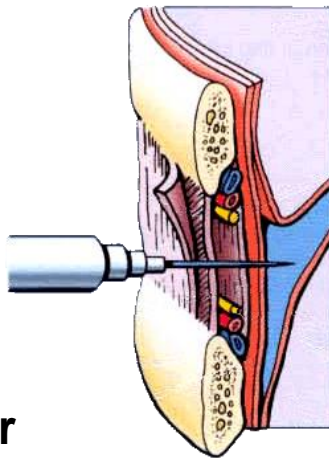
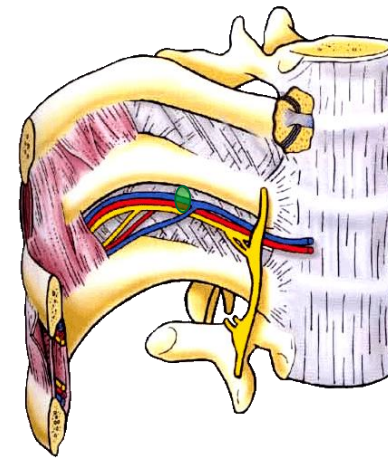
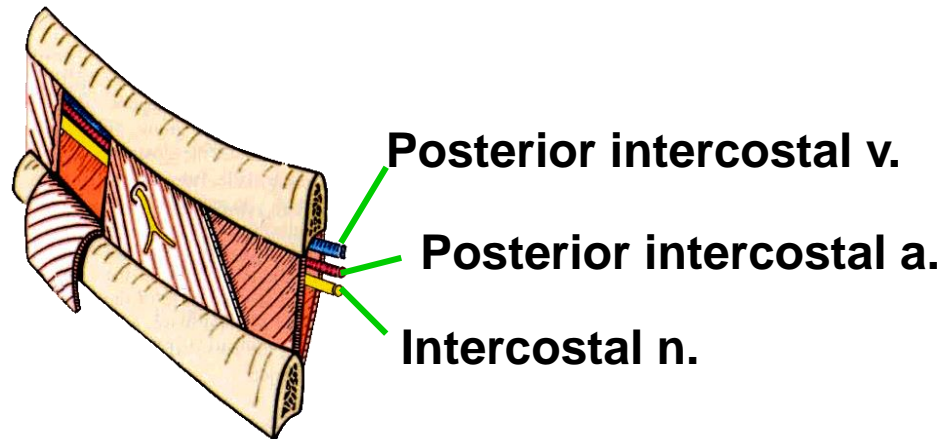
- supply intercostal muscles, abdominal muscles, and skin of thorax & abdomen

Splanchnic nerves

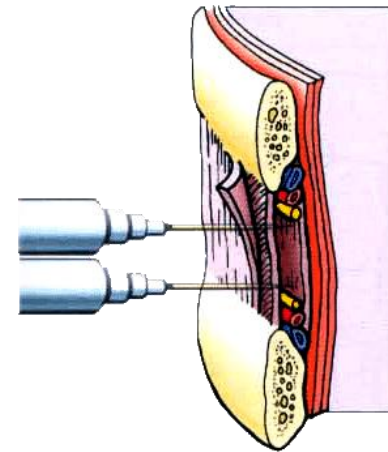
- supply visceral organs.



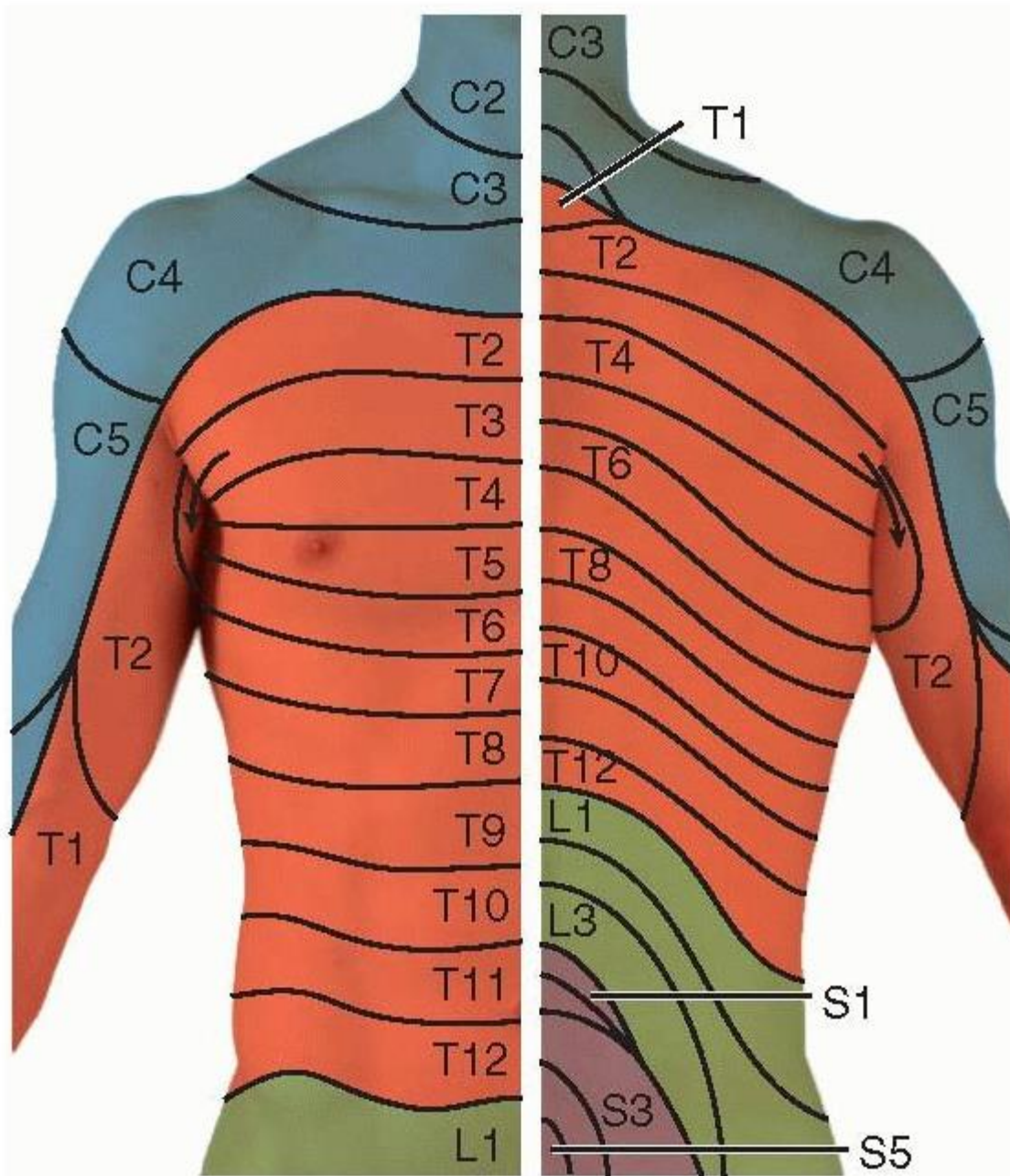
Intercostal space



**Technique for
thoroacocentesis
(in midaxillary line)**

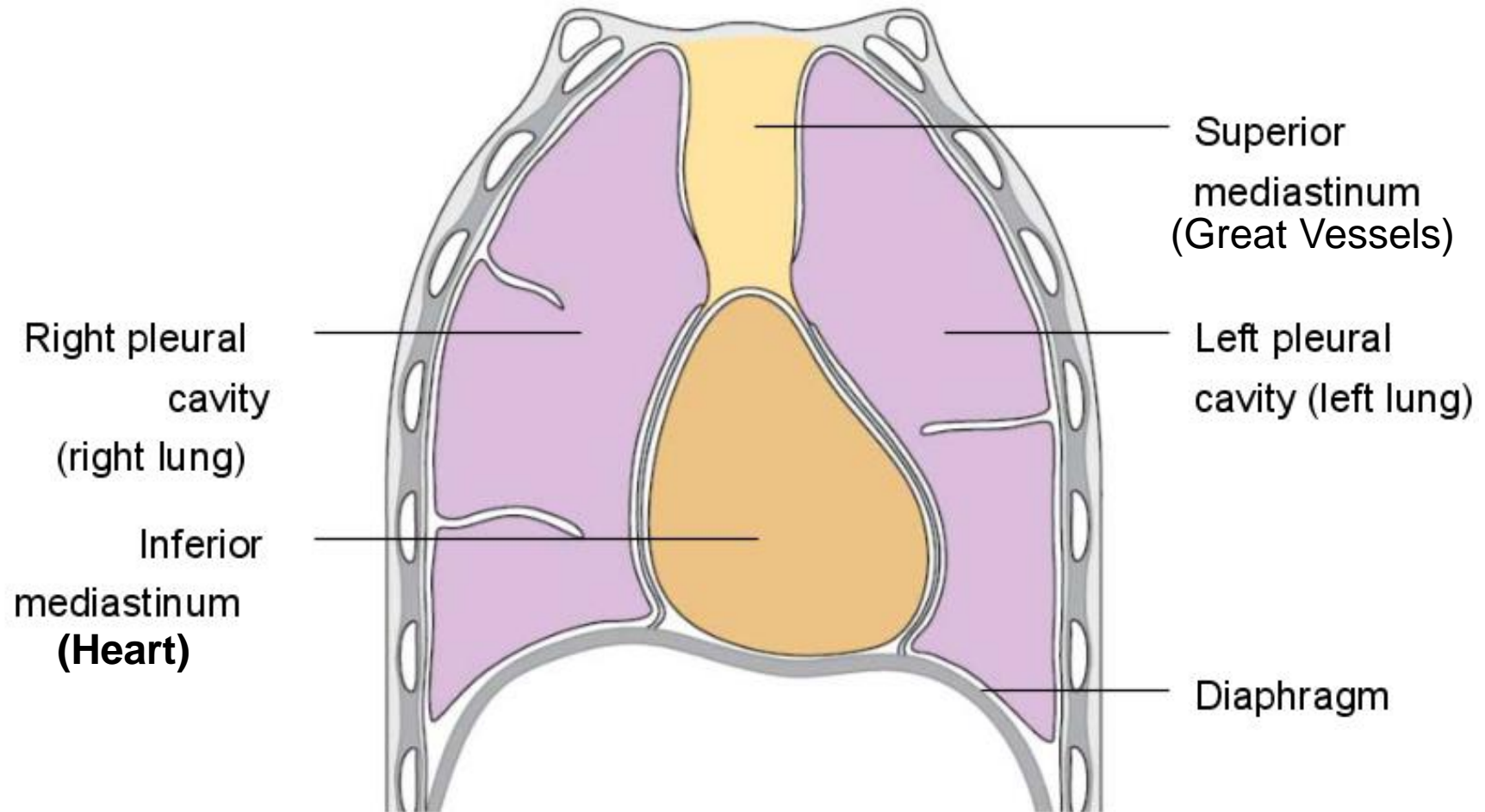


Intercostal nerve block

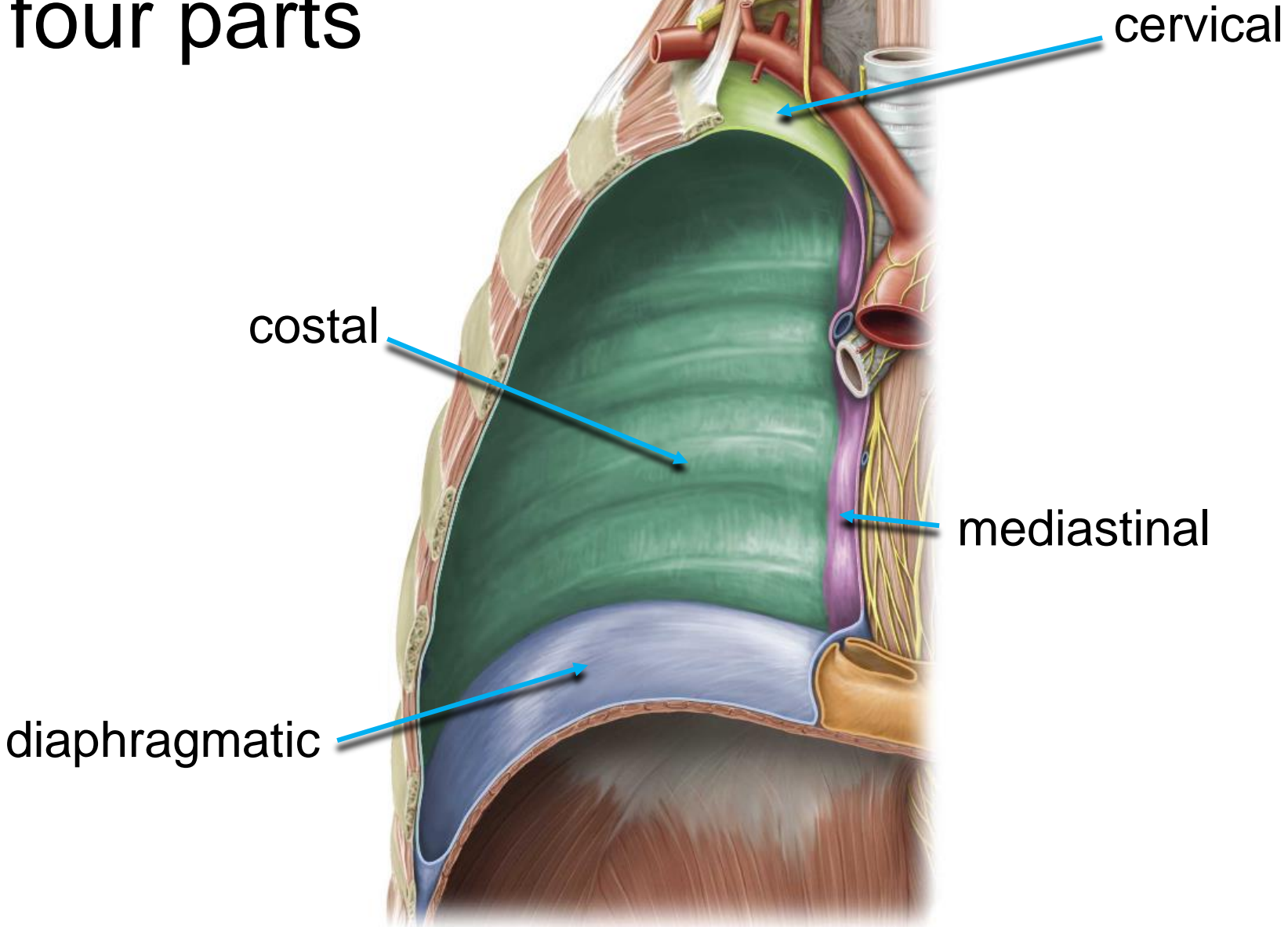


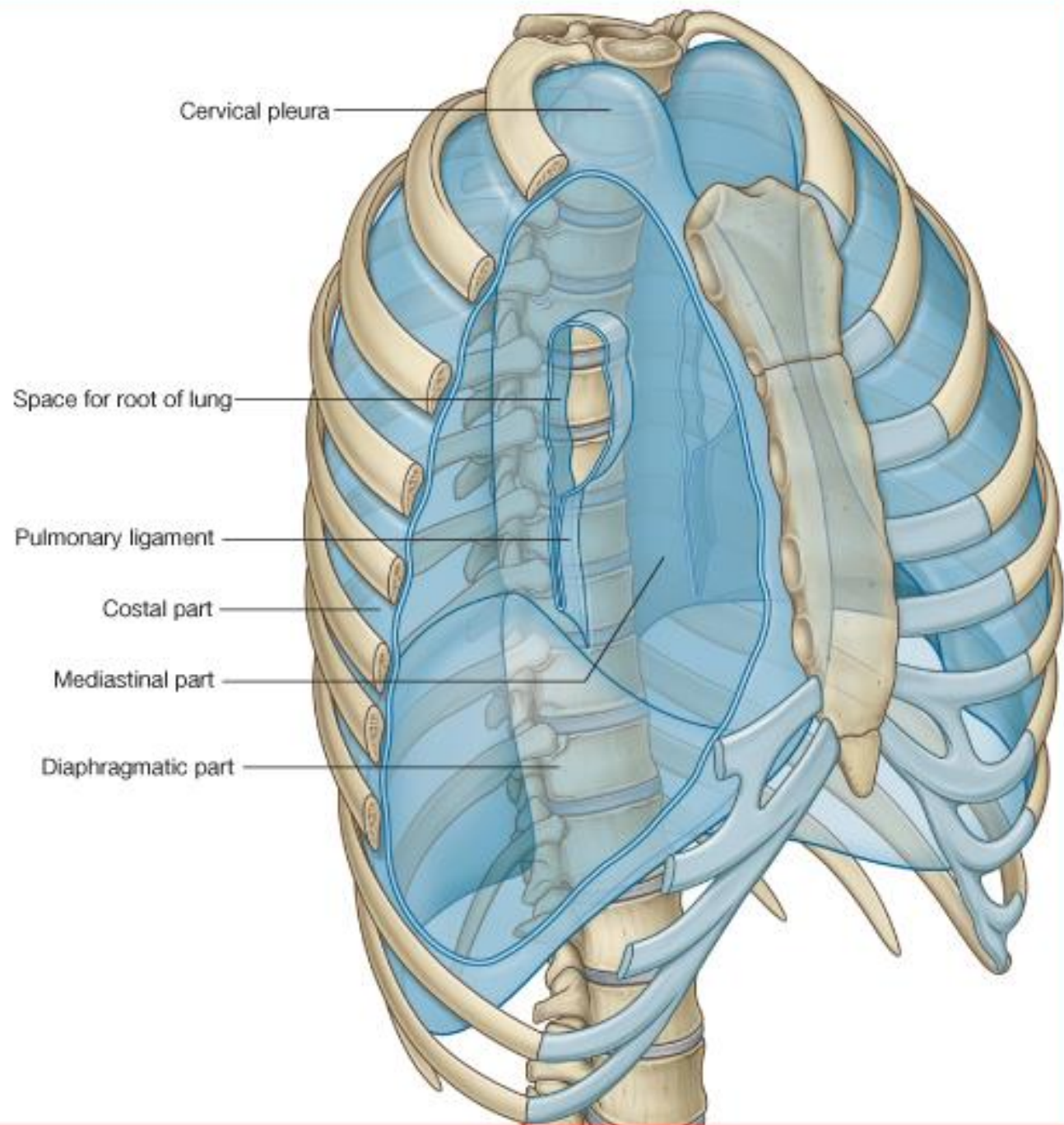
Anterior view Posterior view

3 Compartments of the Thorax



Parietal Pleura: four parts





Pleural Membranes

Secrete serous fluid

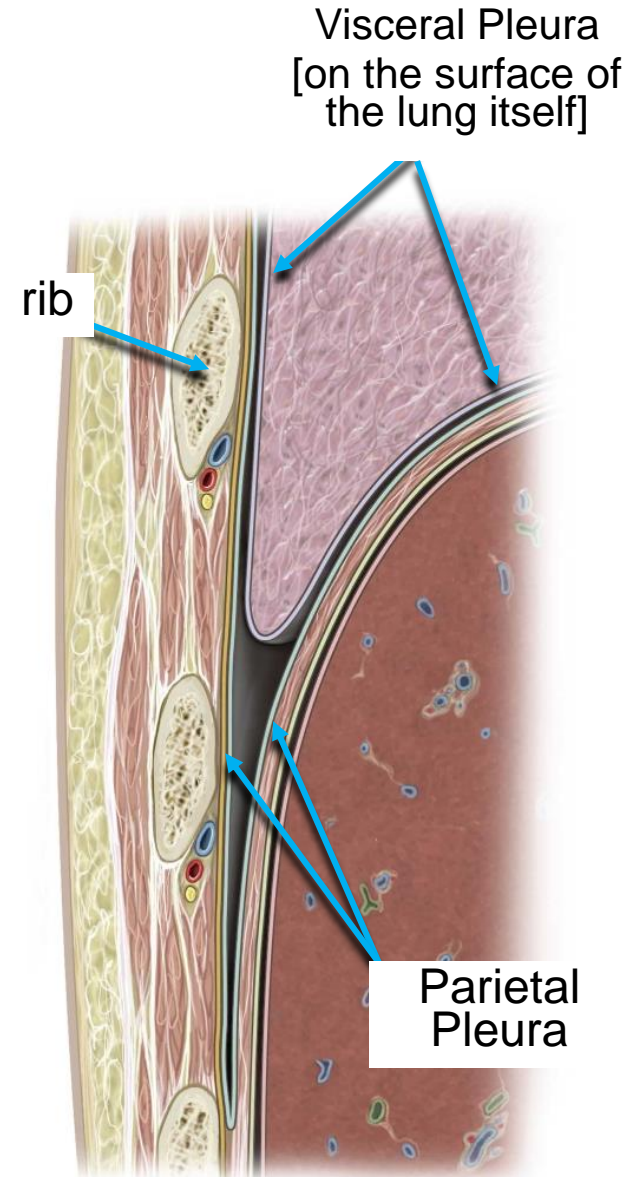
- Allows for smooth breathing

Pleural cavity

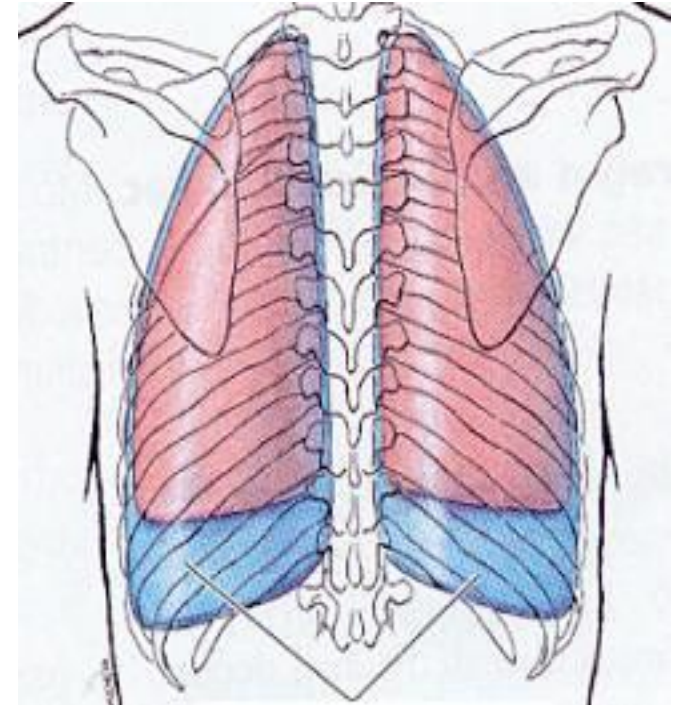
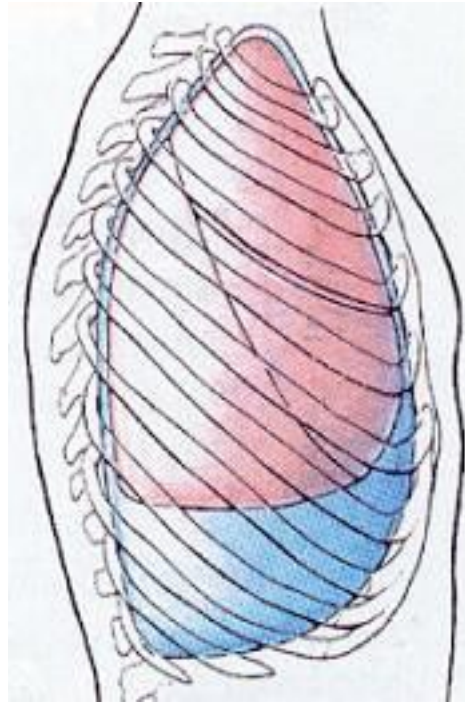
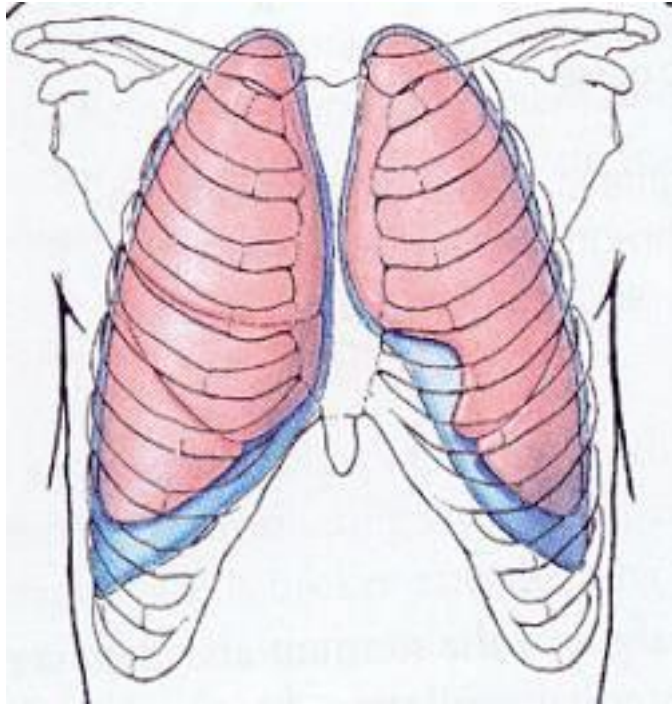
Potential space between the visceral and parietal pleurae

Surface Tension between parietal and visceral pleura keeps the lungs 'stuck' to the thoracic wall during respiration

- Necessary for proper ventilation



At the edges of the thoracic cavity the pleura extend lower than the lungs to form the **Pleural Gutter**



	Midclavicular	Midaxillary	Paravertebral
Lung	6 th rib	8 th rib	10 th rib
Pleura	8 th rib	10 th rib	12 th rib

Wounds of the chest

Wounds of the chest can be opened and closed (penetrative and nonpenetrative)

Complications of penetrative wounds:

- Haemothorax (blood is in the pleural cavity)
- Pneumothorax is produced by presence of air in the pleural cavity.

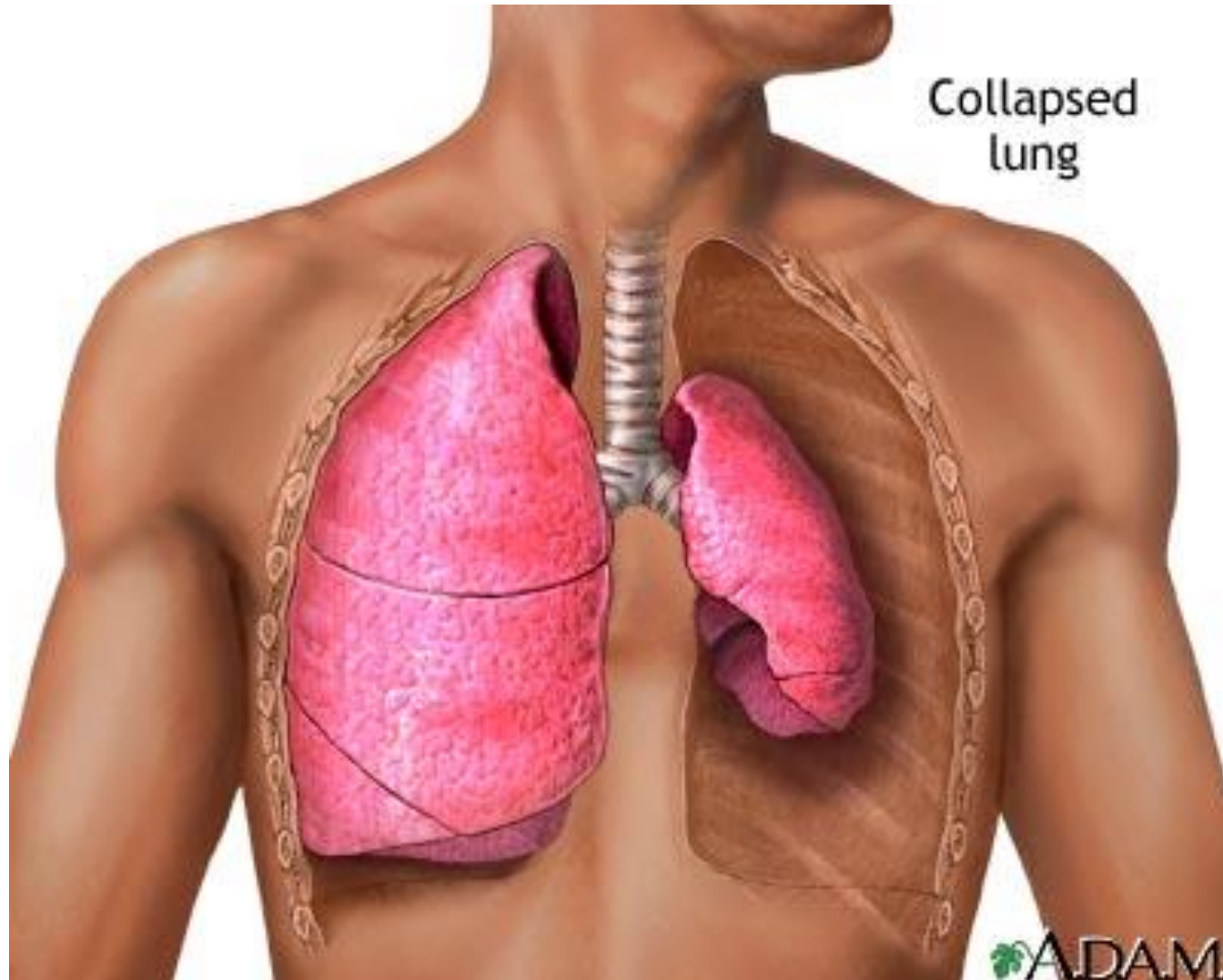
Hemothorax is accumulation of blood in the cavity of pleura. If the poured blood out occupies sinus only, there is small hemothorax, if the level of blood comes to the lower corner of shoulder-blade is middle hemothorax, a blood is higher than the corner of shoulder-blades is large hemothorax.

Wounds of the chest

Types of pneumothorax :

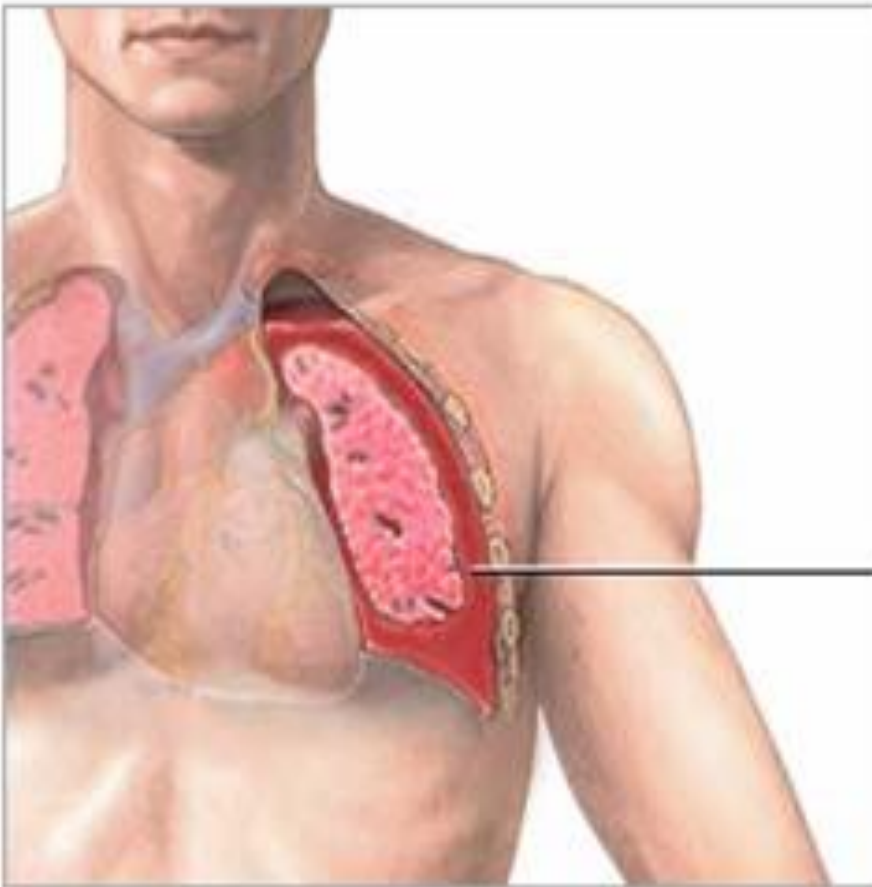
1. Opened
2. Closed
3. Valvular

Pneumothorax can cause the affected lung to collapse leading to difficulty breathing, cyanosis, and possible shifting the placement of the heart.



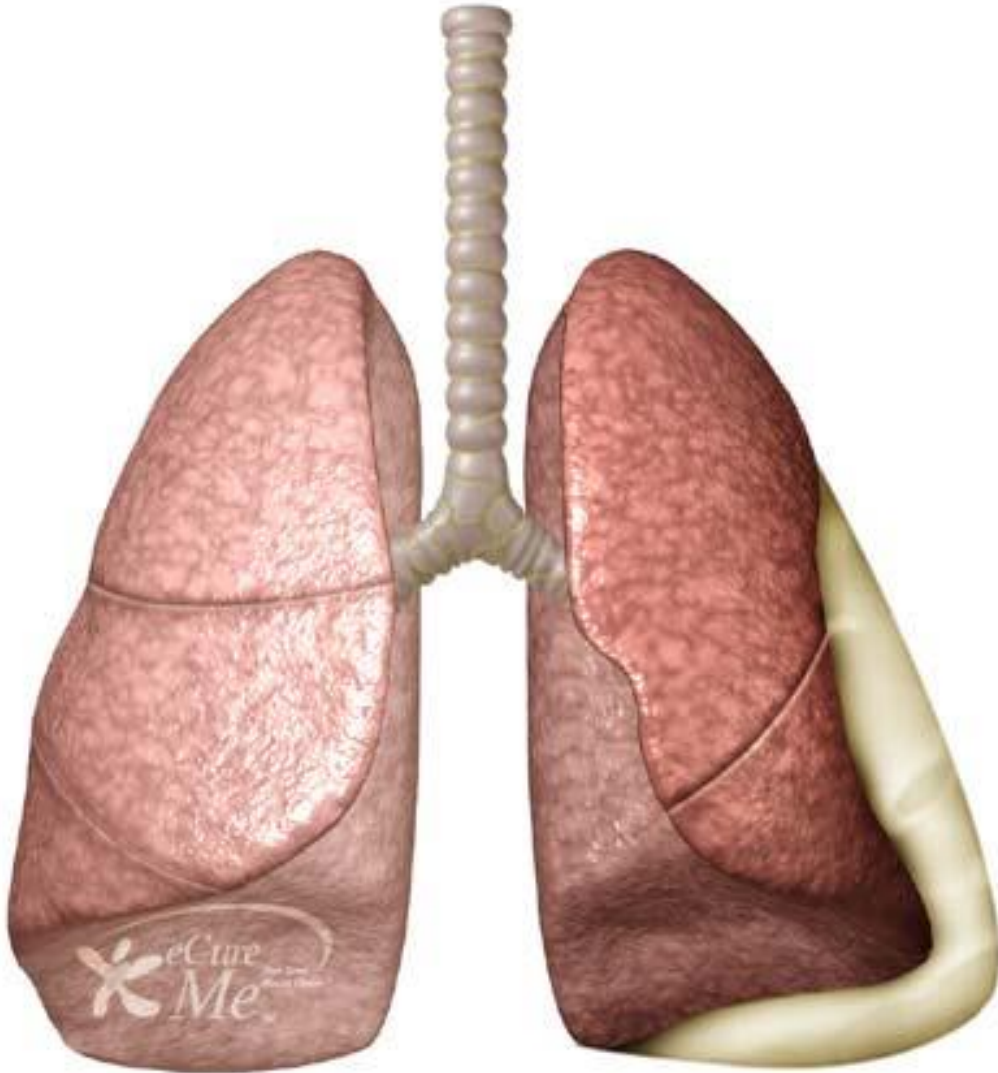
Hemothorax - Blood in the pleural cavity

- difficult ventilation
- painful breathing, cyanosis, tachycardia
- causes – trauma resulting in rupture of pleura
- treatment — remove source of bleeding, drain blood, thrombolytic agents



Blood in
pleural space

Pleurisy (Pleuritis) – Inflammation of the pleura

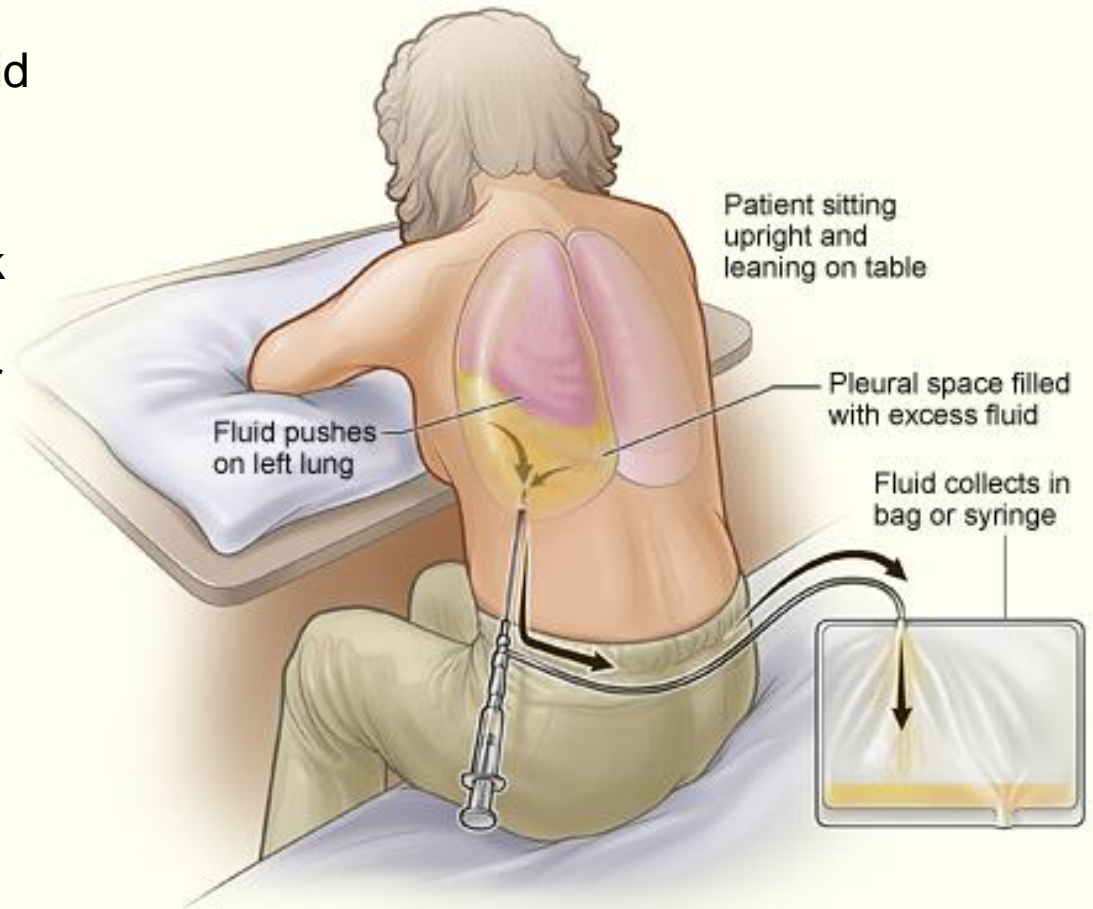


- painful breathing, cough, fever, chills
 - causes: infection, heart surgery, autoimmune, cancer
 - treatment: drain fluid, anti-inflammatory, antibiotics, cancer treatment

Thoracentesis

Procedure to remove excess fluid from the pleural space

Most easily done from the back where the pleural gutter is deepest and the neurovascular bundle is closer to the inferior edge of the rib.

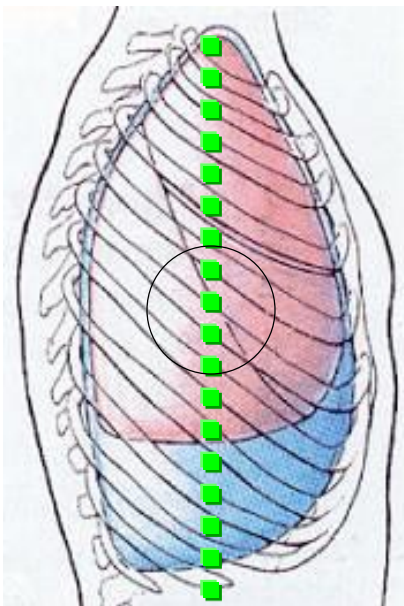


Chest Tube Placement

To remove air or large amounts of fluid from the pleural space.

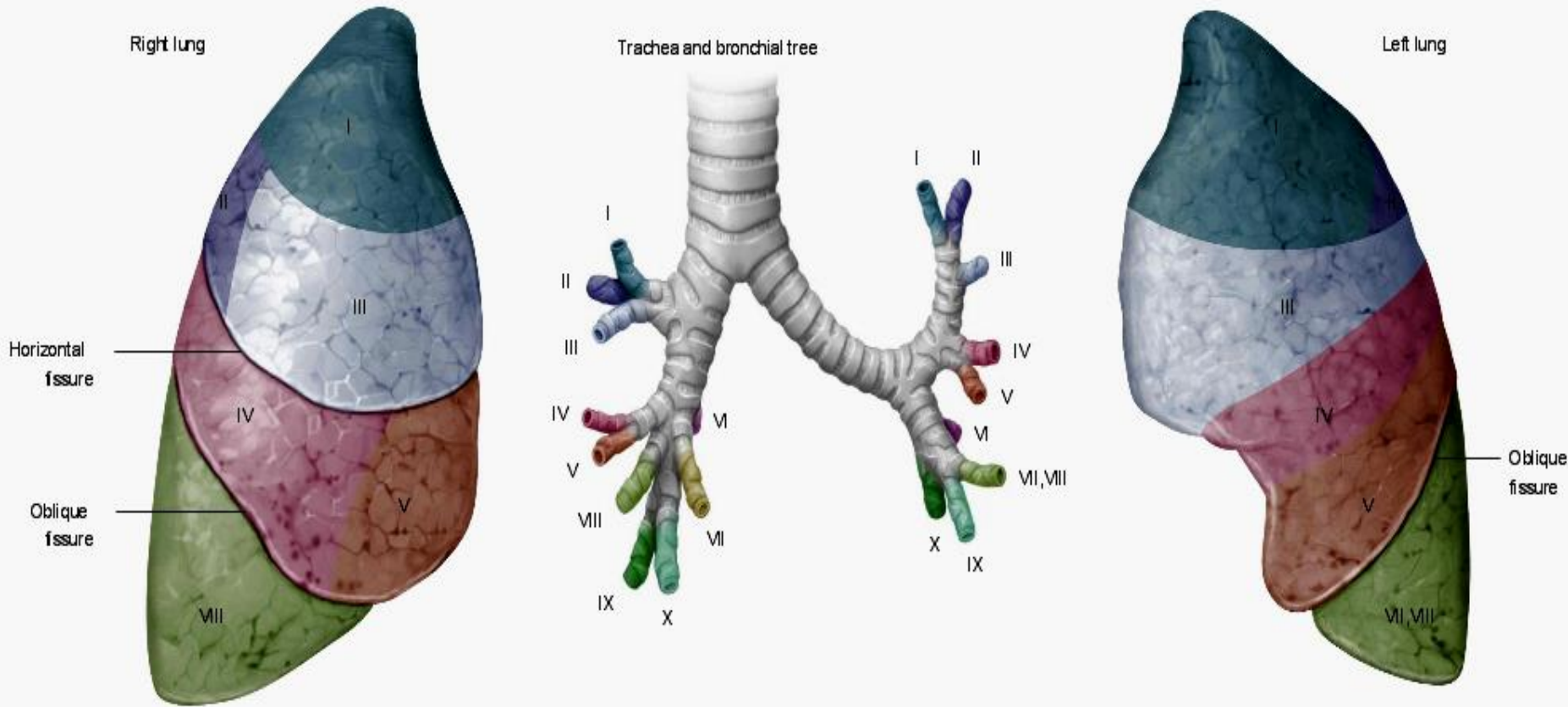
Common emergency procedure

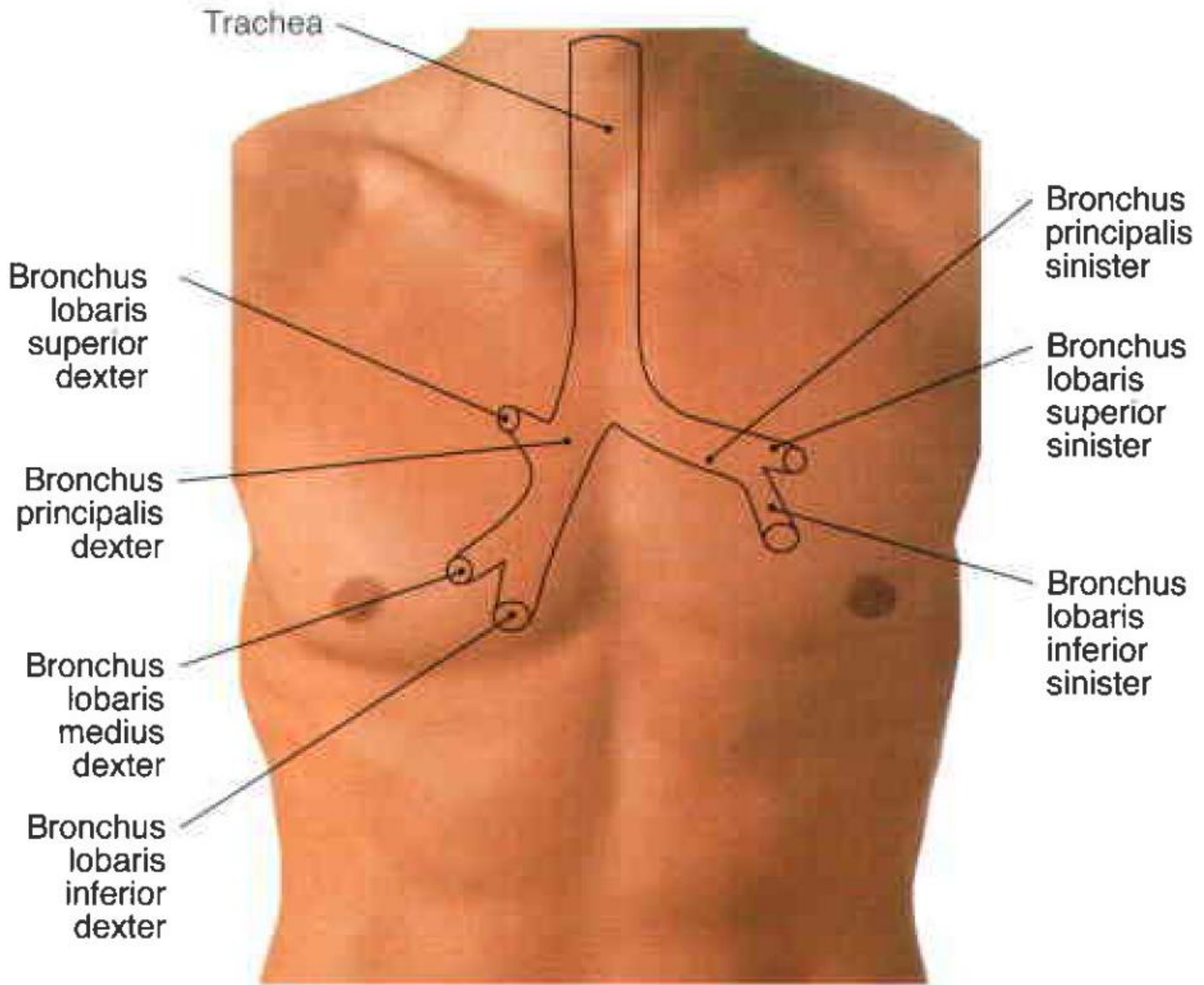
Most commonly done along the mid-axillary line between the 4th and 5th ribs

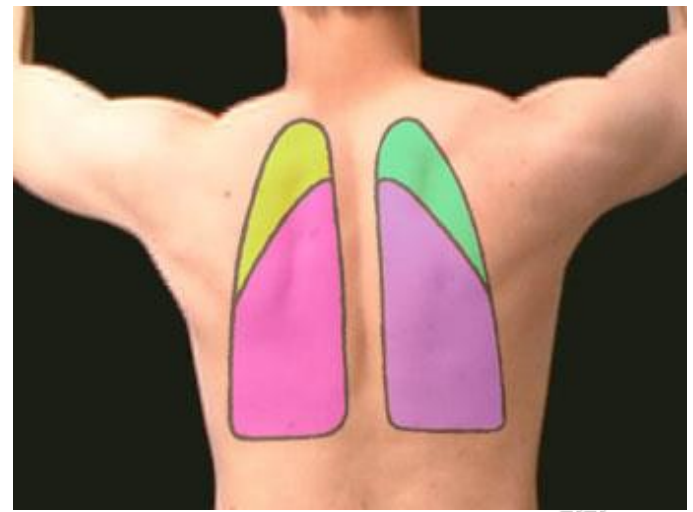
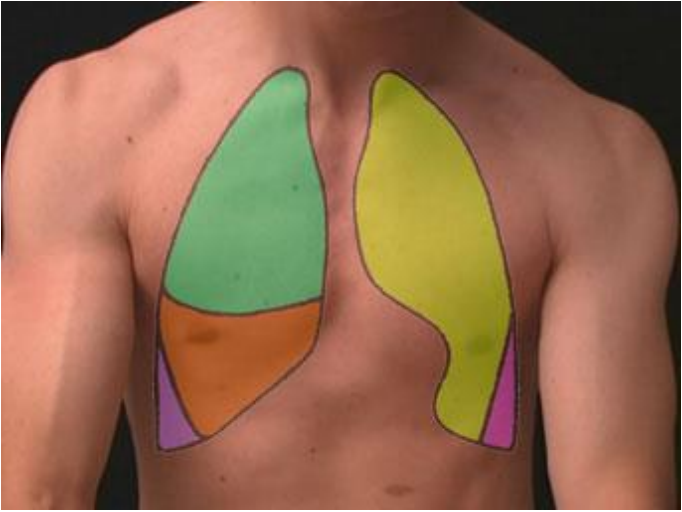
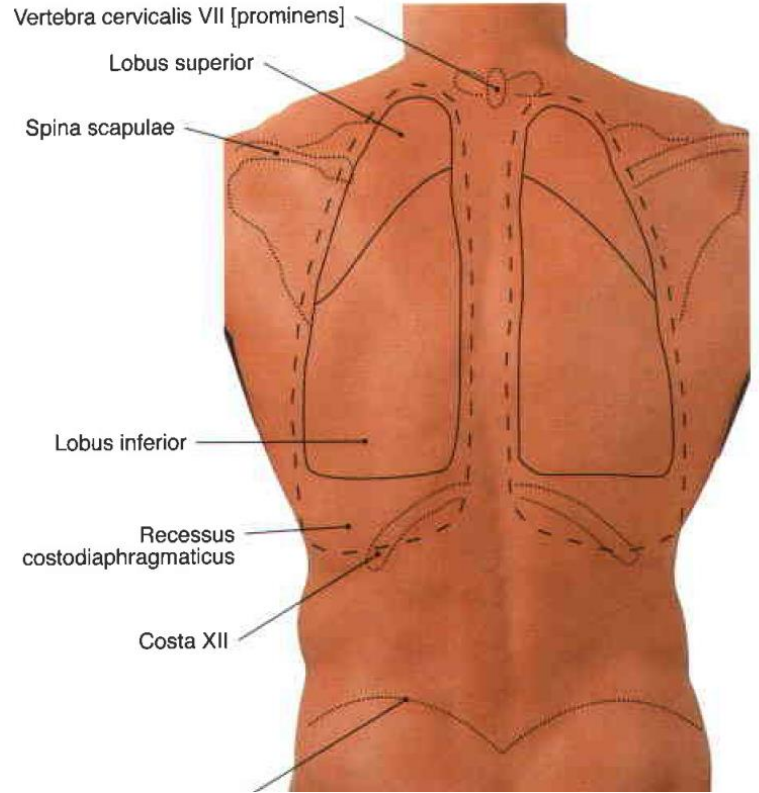
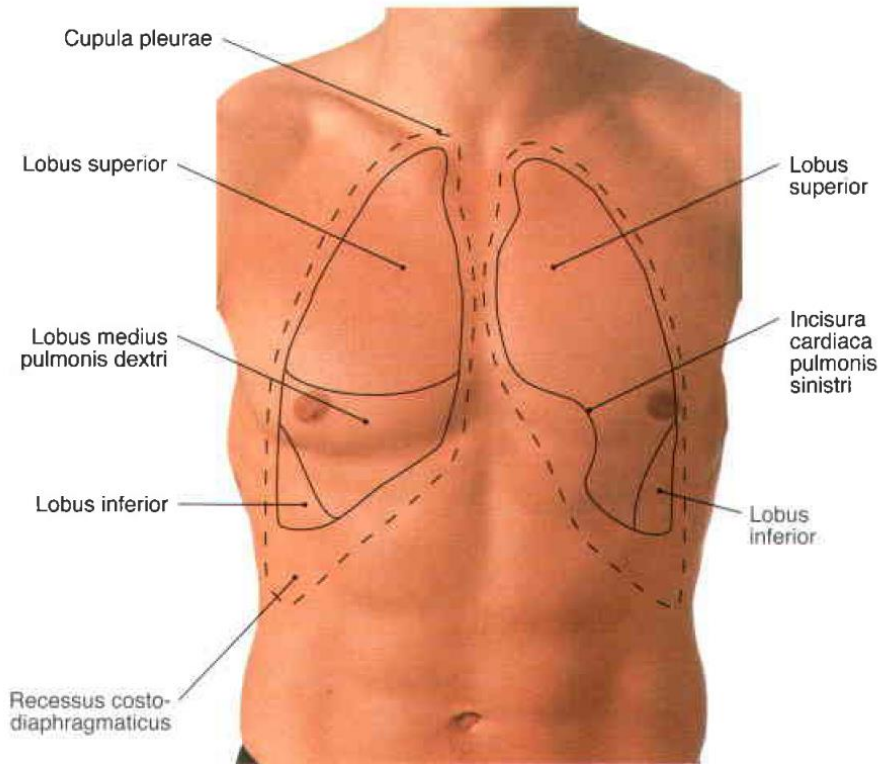


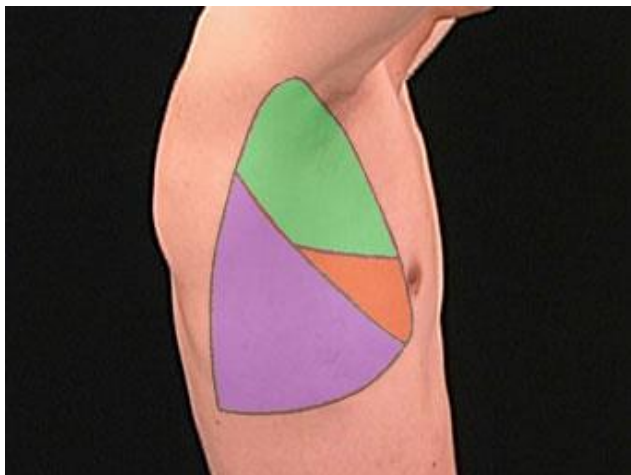
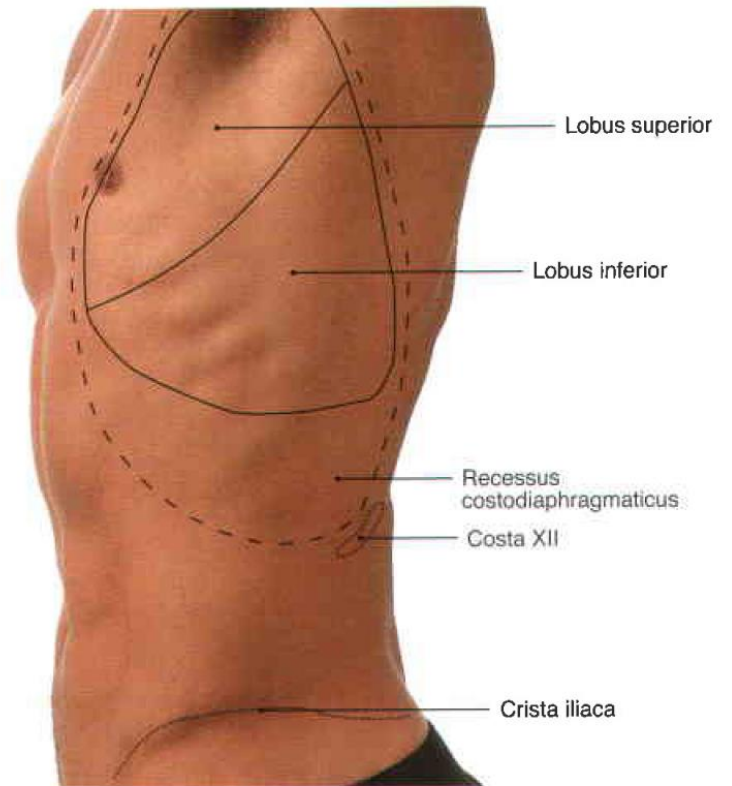
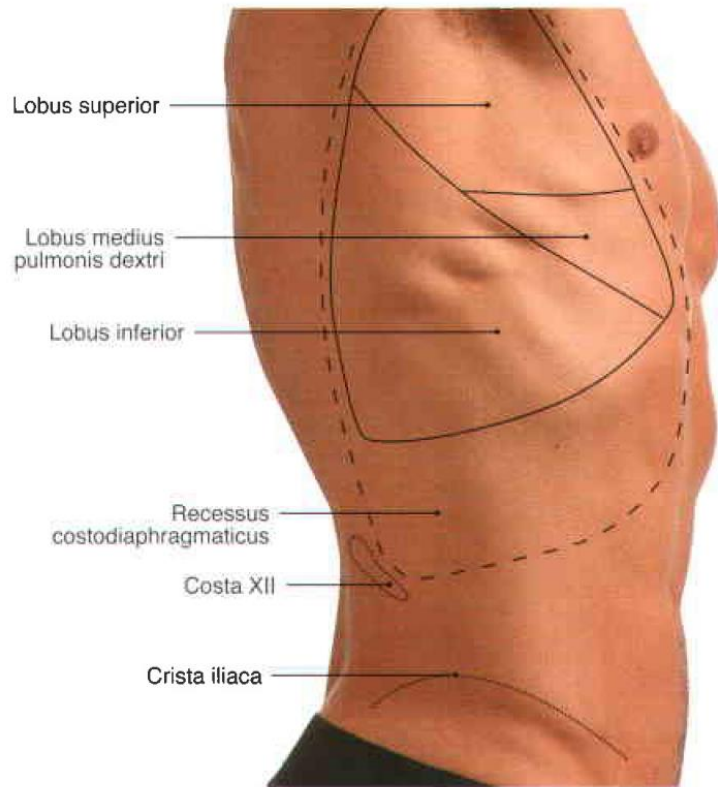
Lobes Divided into 10 Bronchopulmonary Segments on each Side

Don't need to name them individually



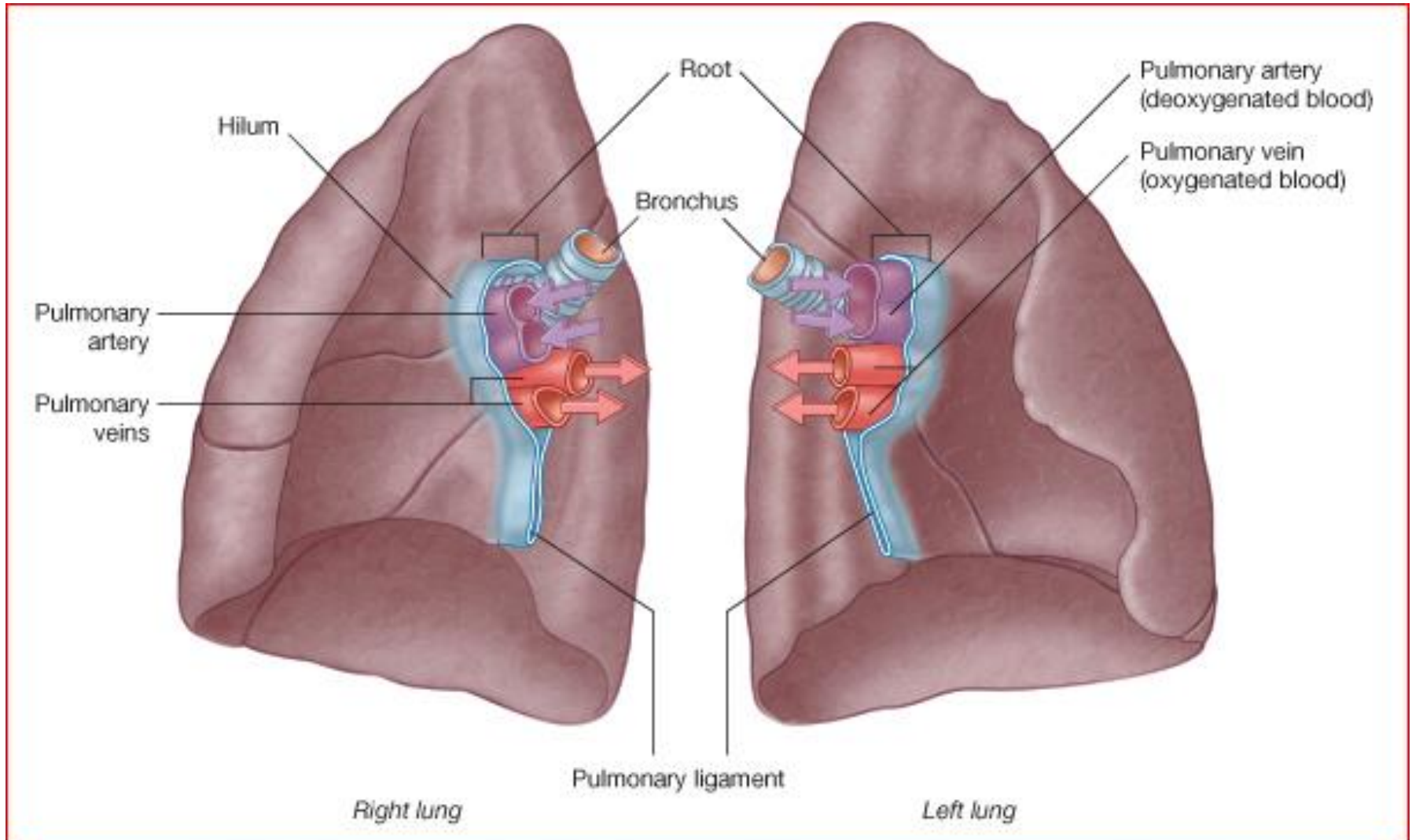




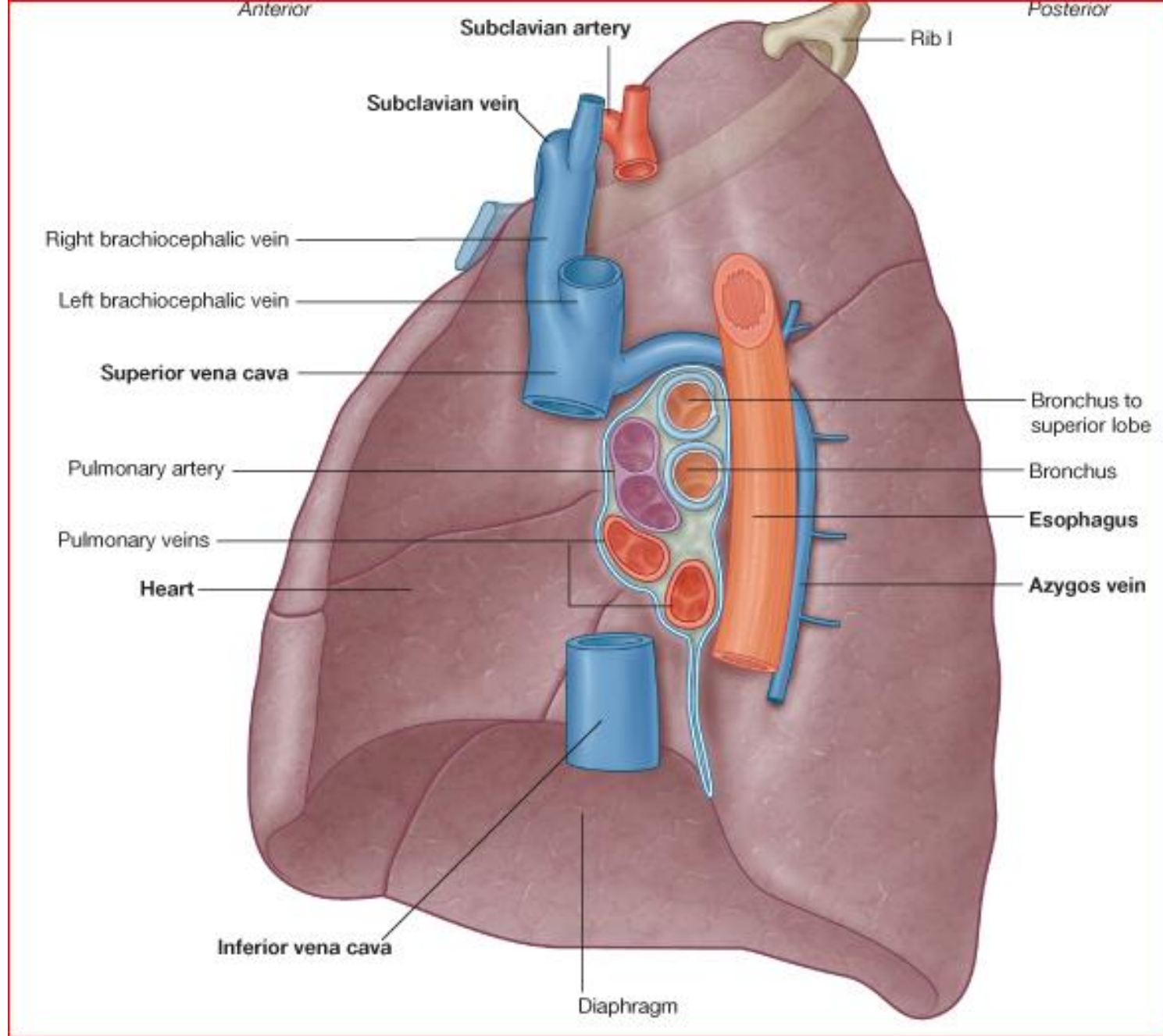


Hilum—where air and blood enter and leave

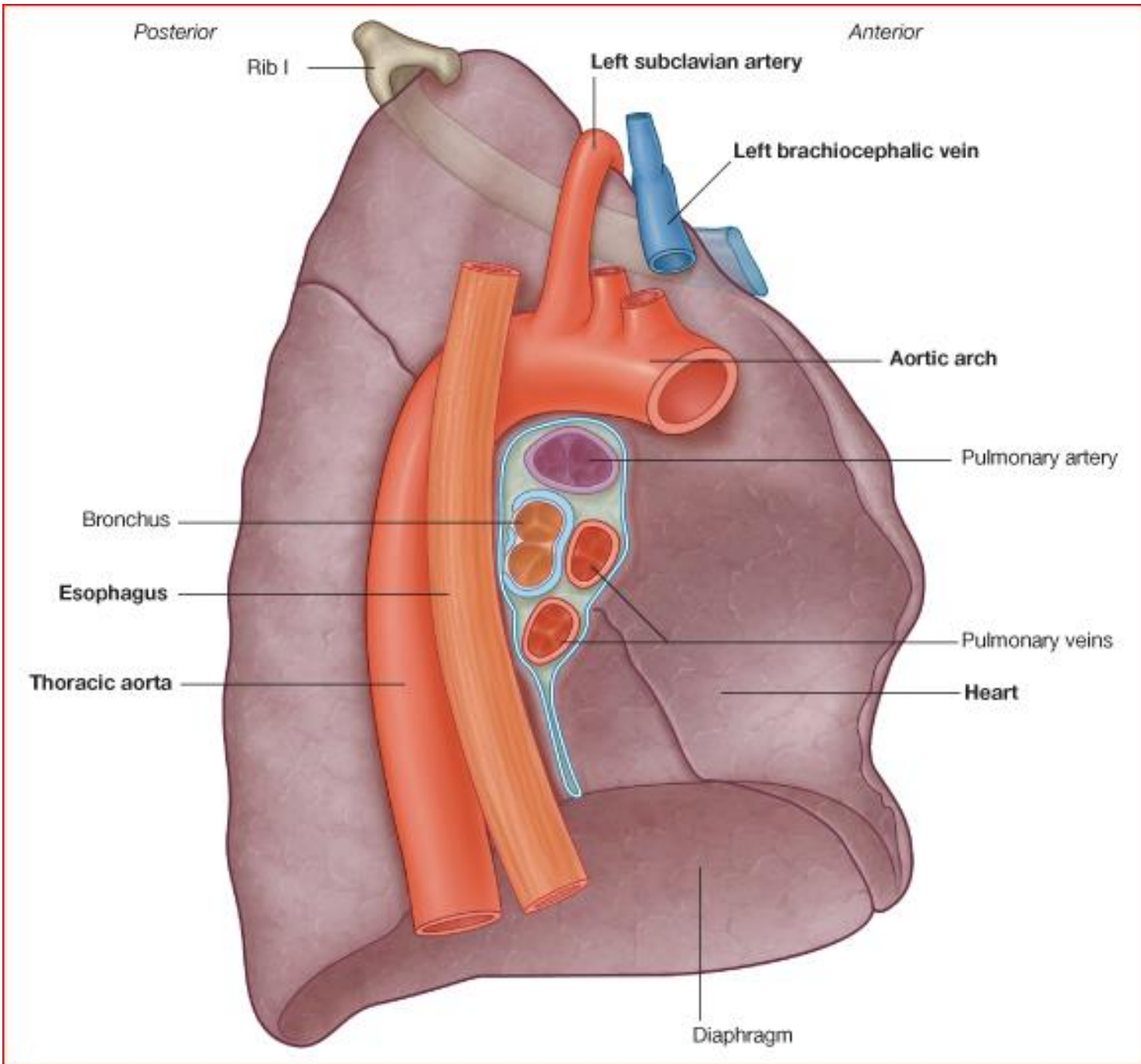
Arteries are up high. Bronchi are posterior and near the top. Veins tend to be more anterior and inferior.



Right lung - related structures



Left lung - related structures

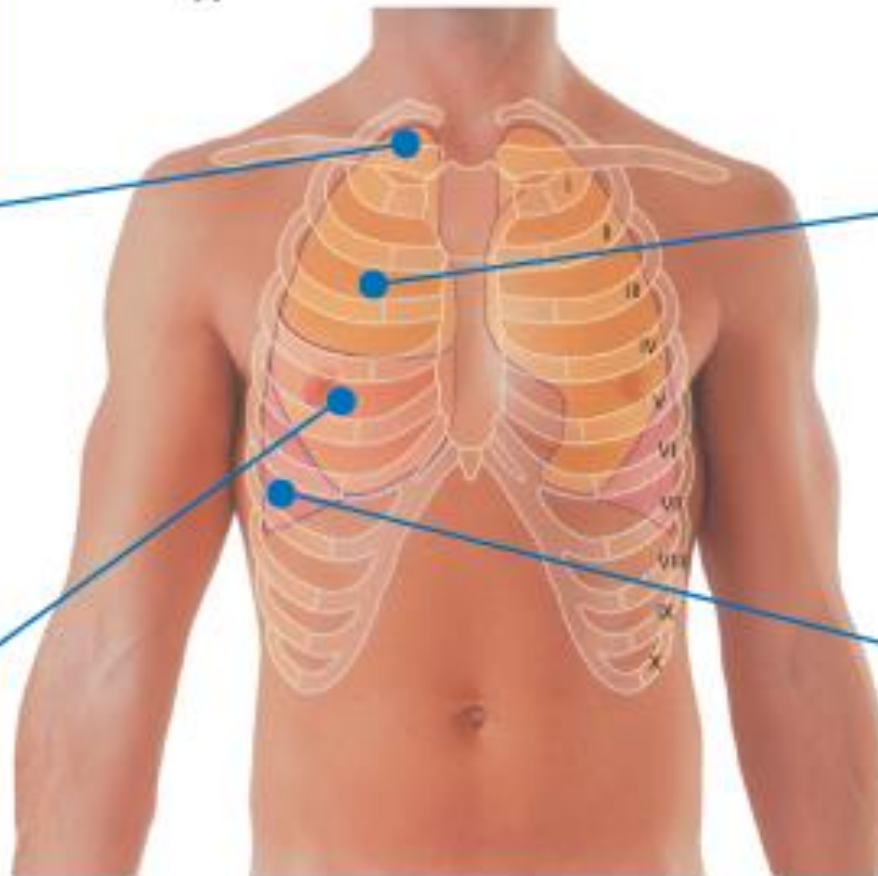




Apex of right lung



Superior lobe of right lung

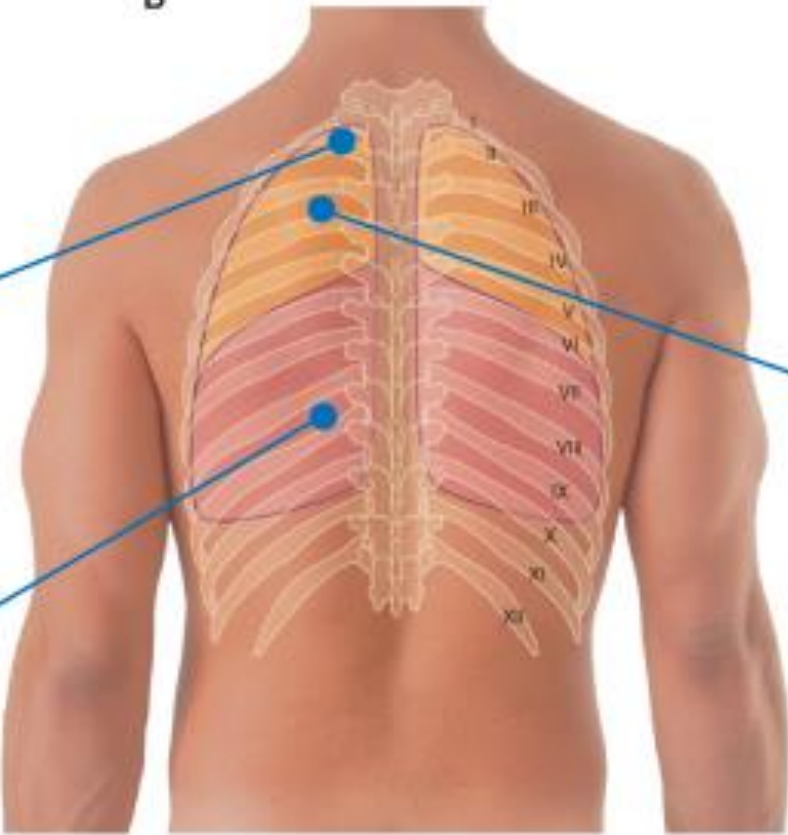


Middle lobe of right lung



Inferior lobe of right lung

B



Apex of left lung



Superior lobe of left lung

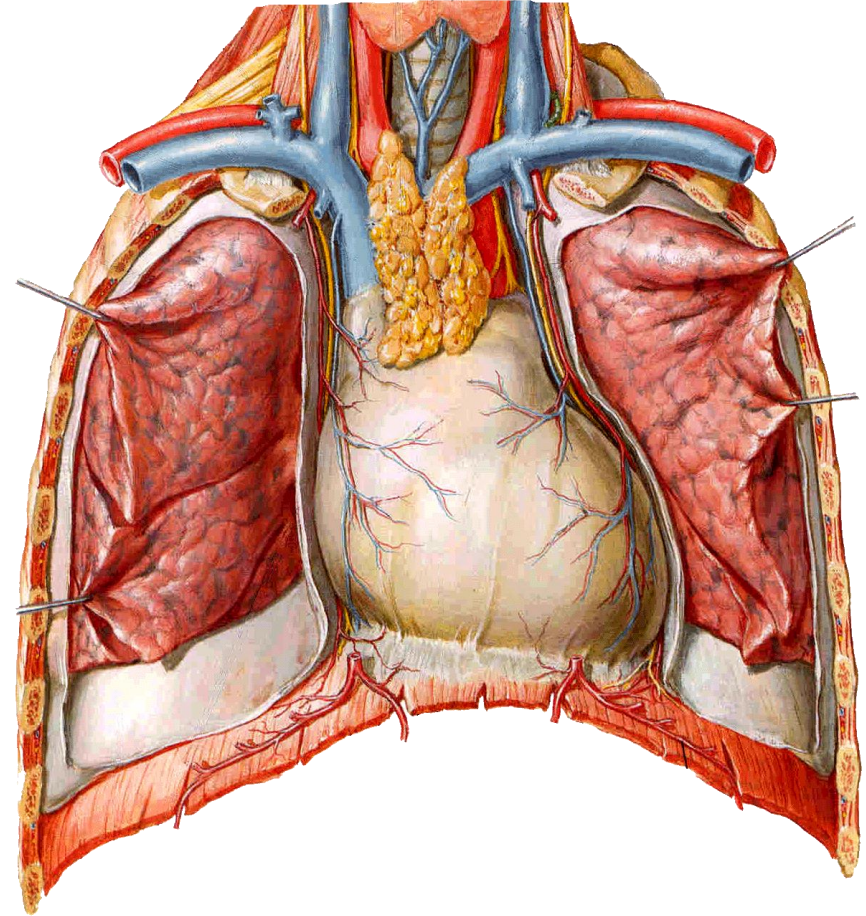


Inferior lobe of left lung

The Mediastinum

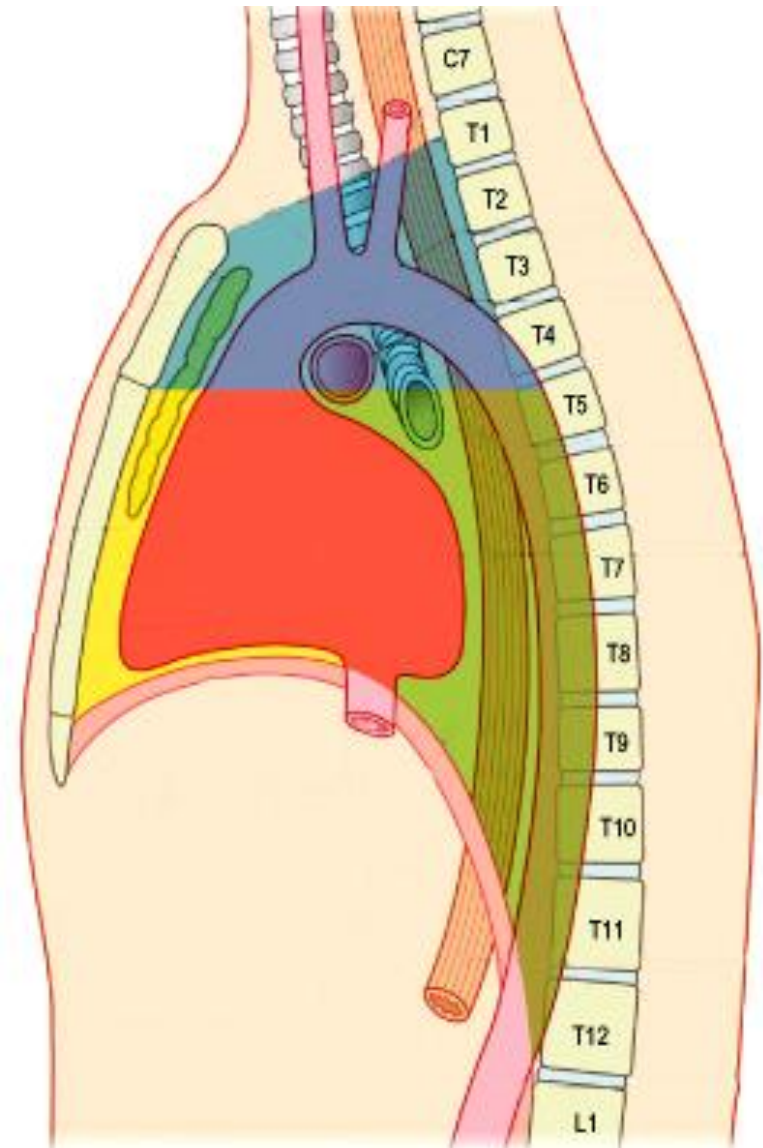
Concept

- All of organs between the left and right mediastinal pleurae is called mediastinum.
- It extends from the sternum in front to the vertebral column behind, and from the thoracic inlet above to the diaphragm below.

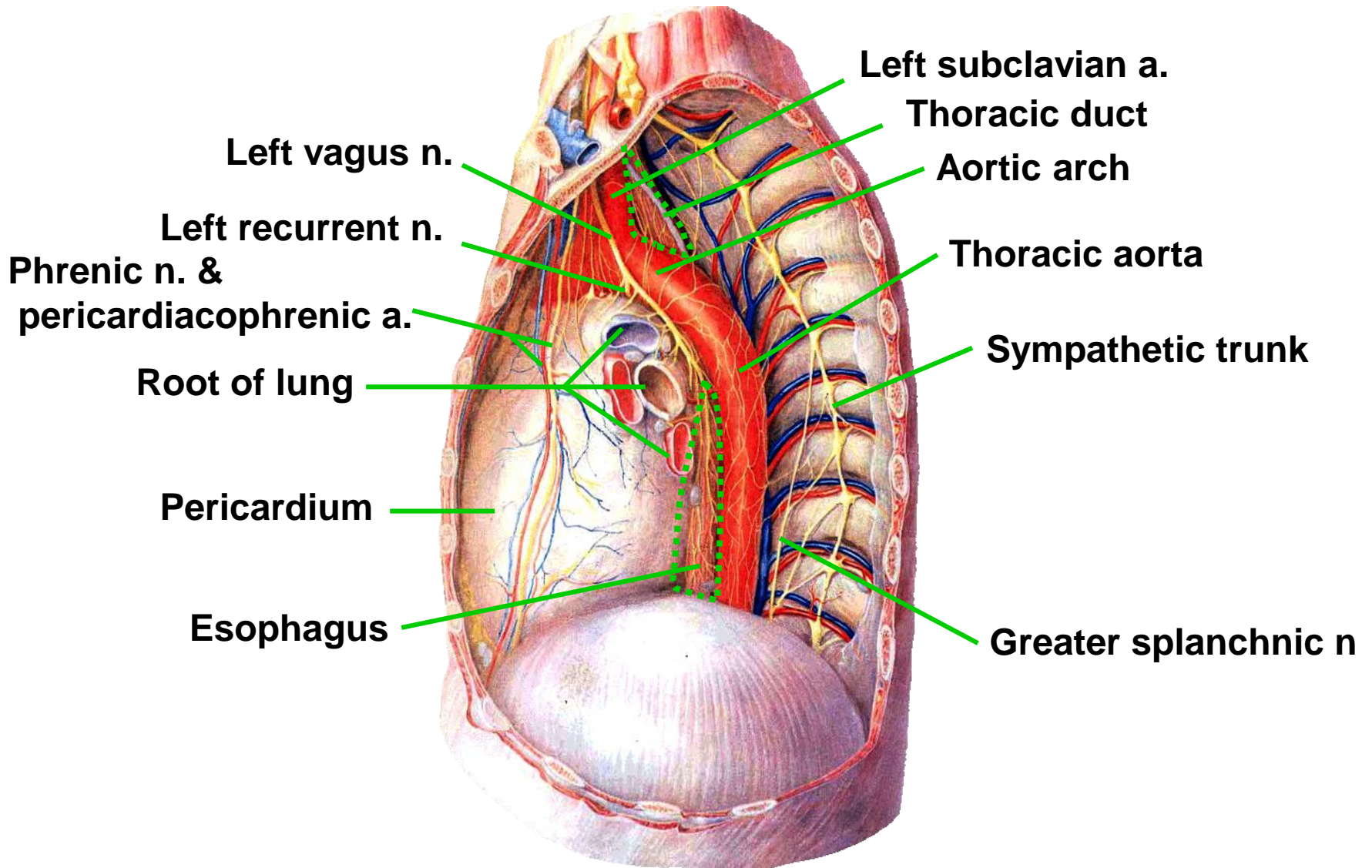


Subdivisions of mediastinum

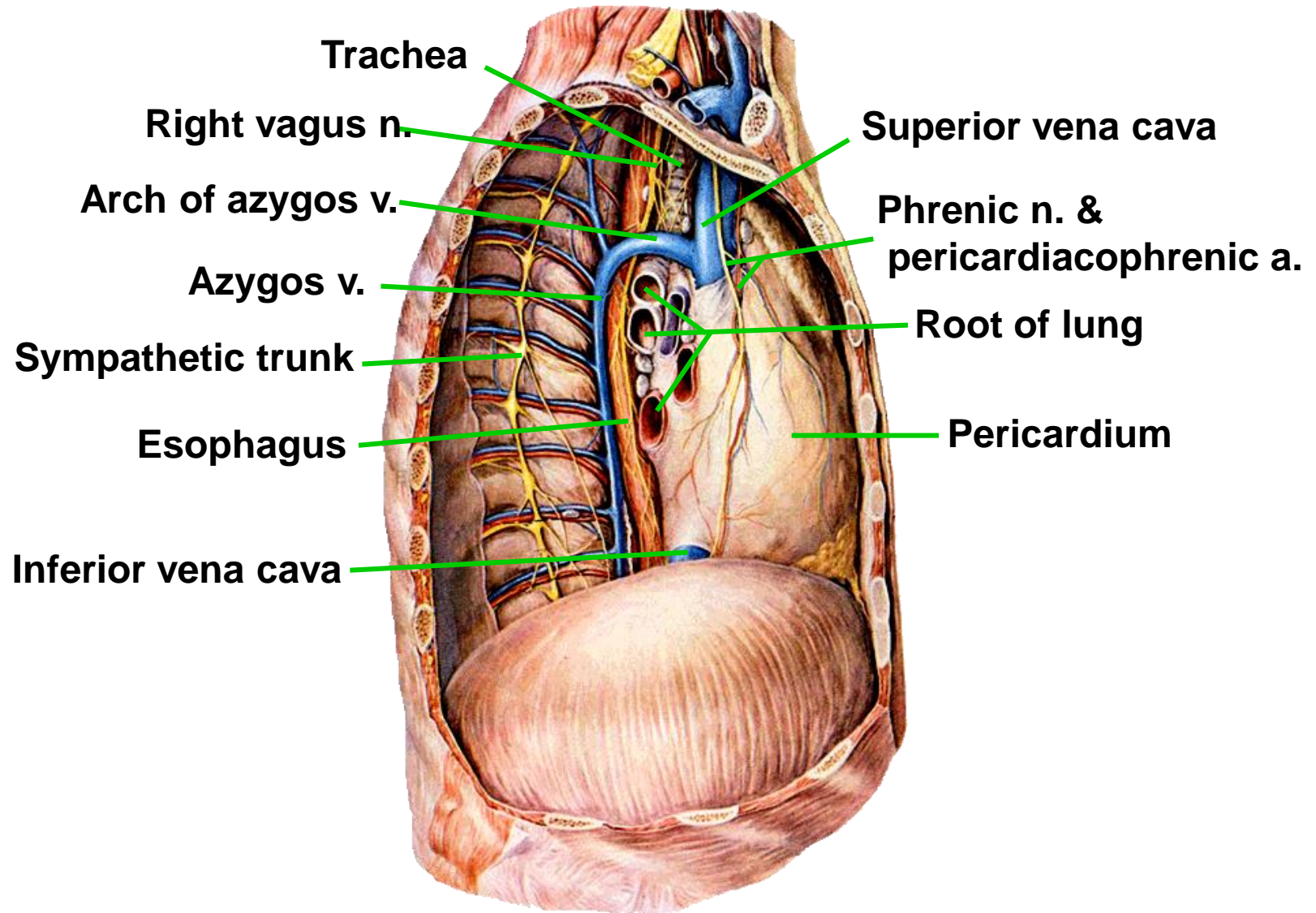
- **Superior mediastinum**
- **Inferior mediastinum**
 - Anterior mediastinum
 - Middle mediastinum
 - Posterior mediastinum



Left side of mediastinum



Right side of mediastinum

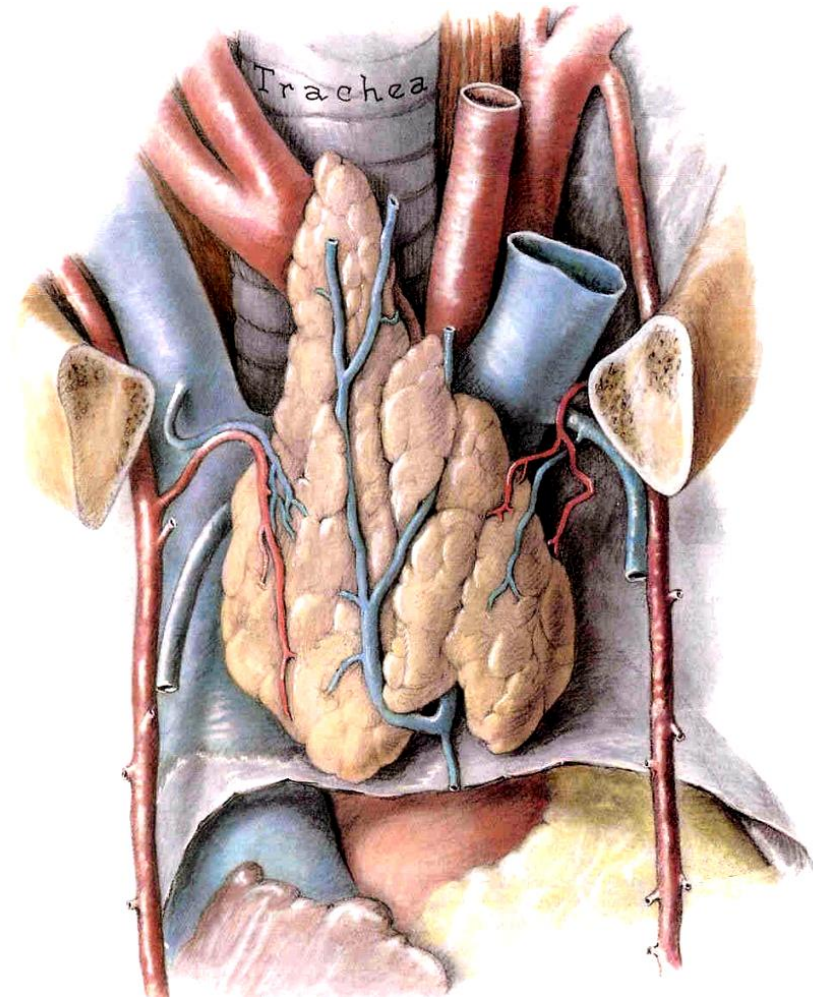


Superior mediastinum

Locating — from inlet of thorax to plane extending from level of sternal angle anteriorly to lower border of T4 vertebra posteriorly

Contents

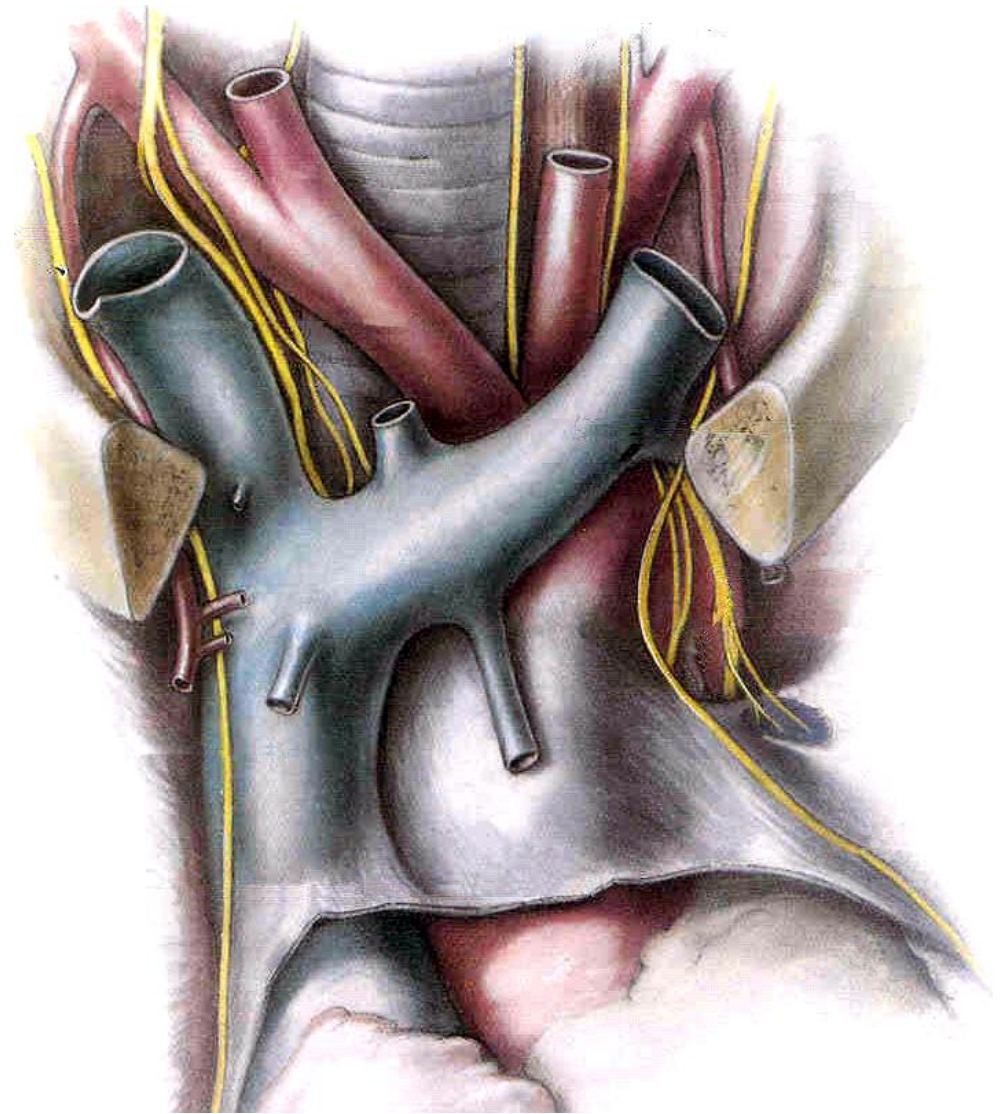
- Superficial layer
 - Thymus
 - Three veins
 - Left brachiocephalic v.
 - Right brachiocephalic v.
 - Superior vena cava



Superior mediastinum

Contents

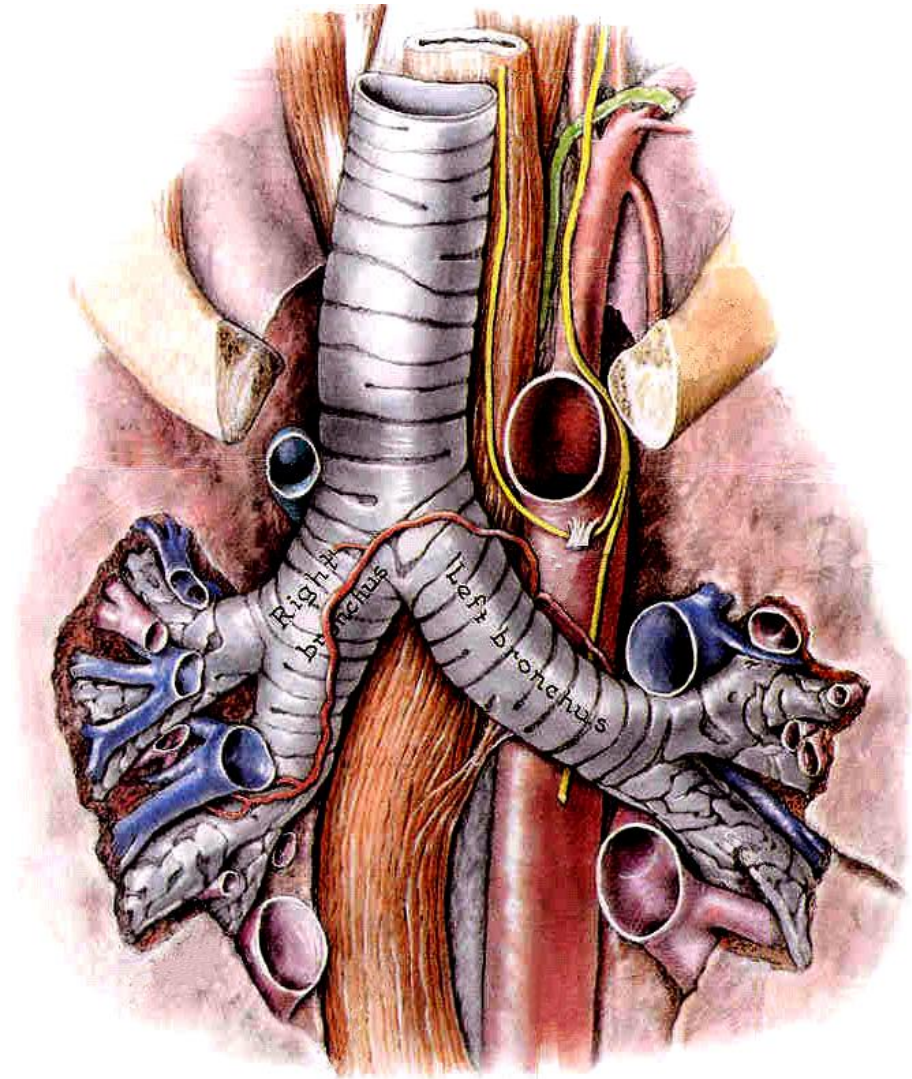
- Middle layer
 - Aortic arch and its three branches
 - Phrenic n.
 - Vagus n.



Superior mediastinum

Contents

- Posterior layer
 - Trachea
 - Esophagus
 - Thoracic duct



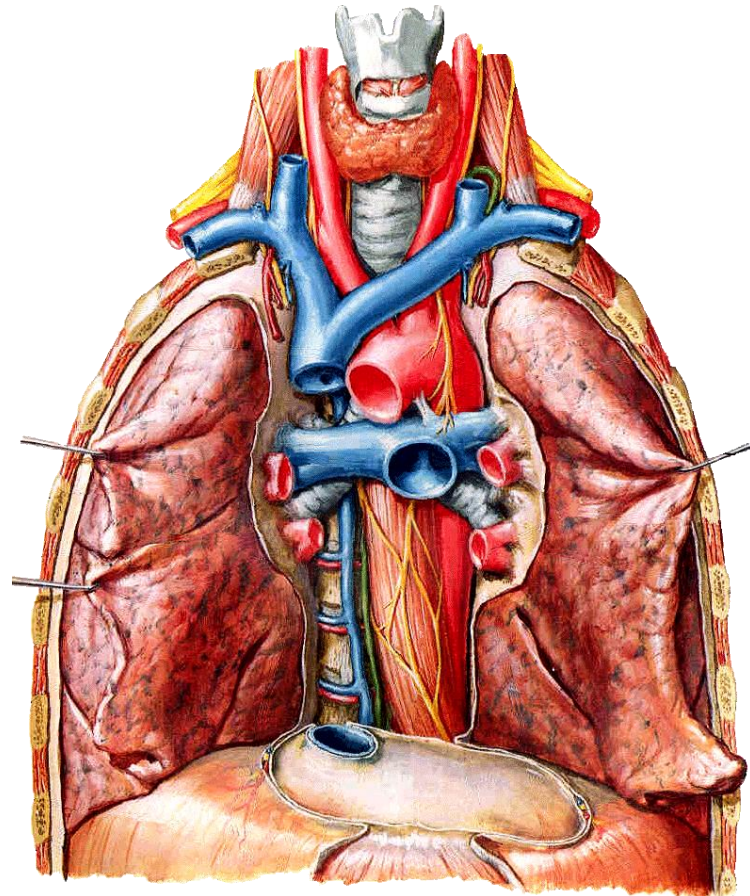
Relations of aortic arch

□ Superiorly

- Its three branches
- Left brachiocephalic v.
- Thymus

□ Inferiorly

- Pulmonary a.
- Arterial ligament
- Left recurrent n.
- Left principal bronchus
- Superficial cardiac plexus



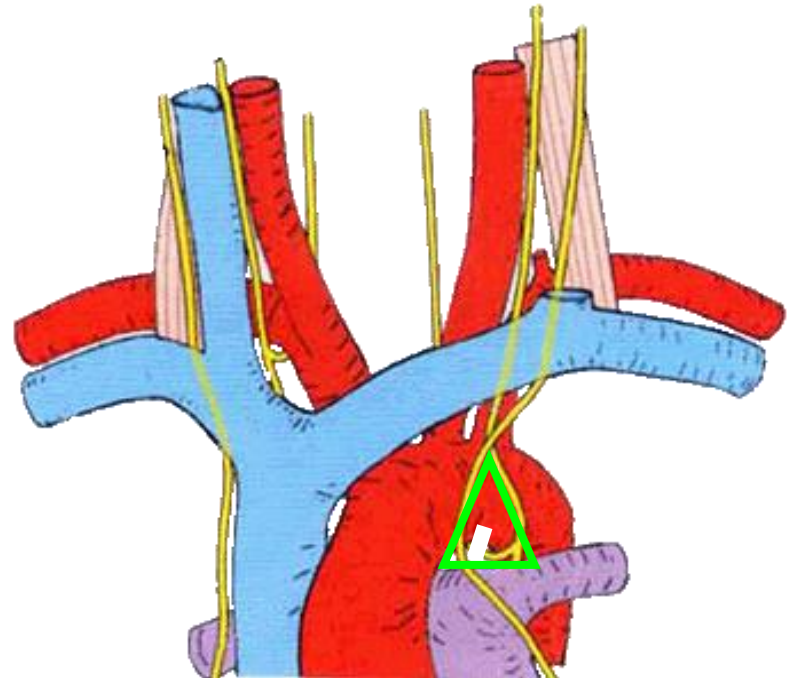
Triangle of ductus arteriosus

□ Boundaries

- Phrenic n.
- Left vagus n.
- Left pulmonary a.

□ Contents

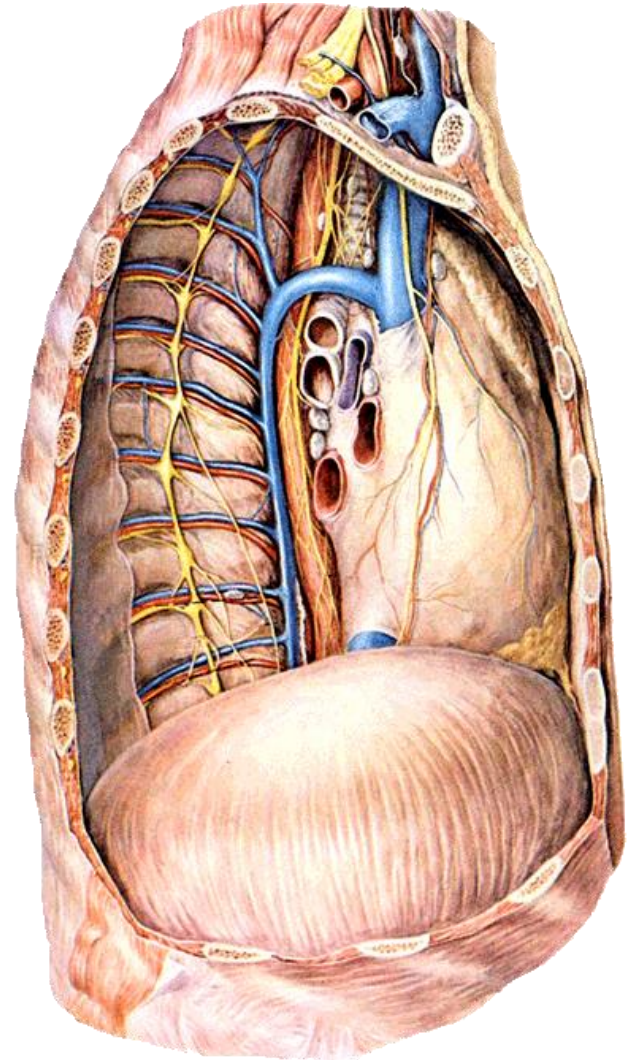
- Arterial ligament
- Left recurrent n.
- Superficial cardiac plexuses



Inferior mediastinum

Anterior mediastinum

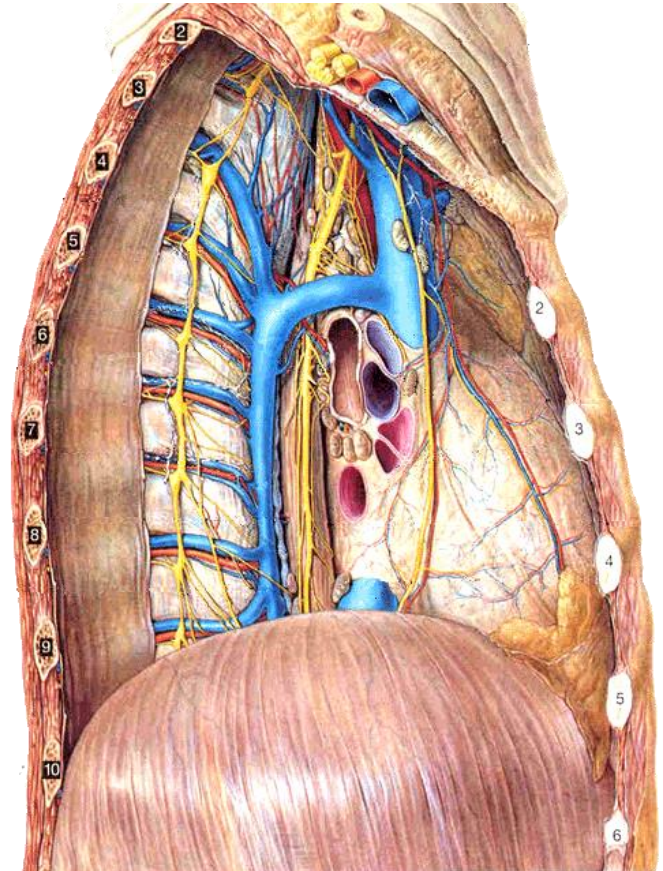
- ❑ **Location** — posterior to body of sternum and attached costal cartilages, anterior to heart and pericardium
- ❑ **Contents**
 - Fat
 - Remnants of thymus gland
 - Anterior mediastinal lymph nodes



Inferior mediastinum

Middle mediastinum

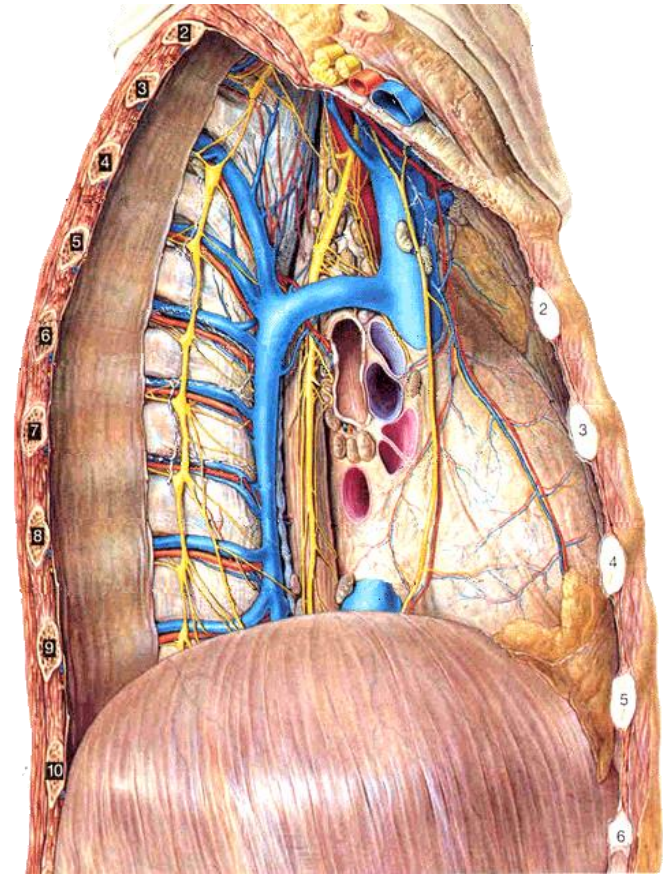
- ❑ **Location** — between anterior mediastinum and posterior mediastinum
- ❑ **Contents**
 - Heart and pericardium
 - Beginning or termination of great vessels
 - Phrenic nerves
 - Pericardiophrenic vessels
 - Lymph nodes



Inferior mediastinum

Posterior mediastinum

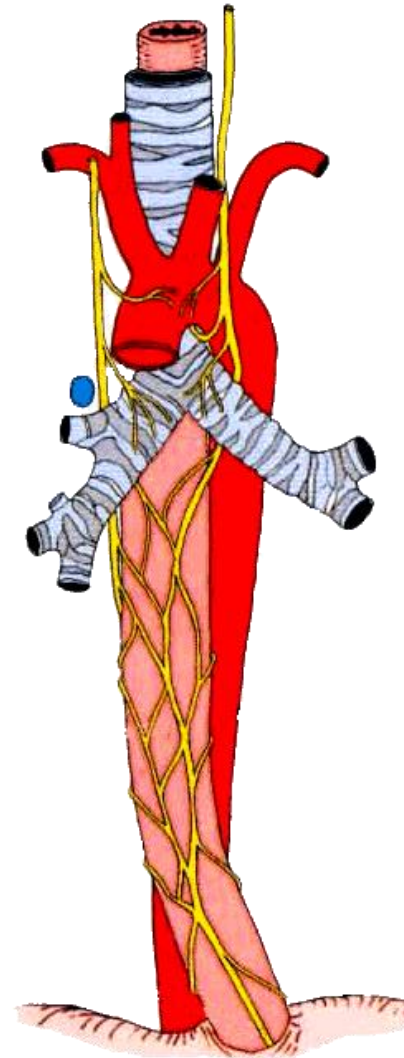
- Location—posterior to heart and pericardium, anterior to vertebrae T5—T12
- Contents:
 - Esophagus
 - Vagus n.
 - Thoracic aorta
 - Azygos system of veins
 - Thoracic duct
 - Thoracic sympathetic trunk
 - Posterior mediastinal lymph nodes



Relations of esophagus

□ Anteriorly

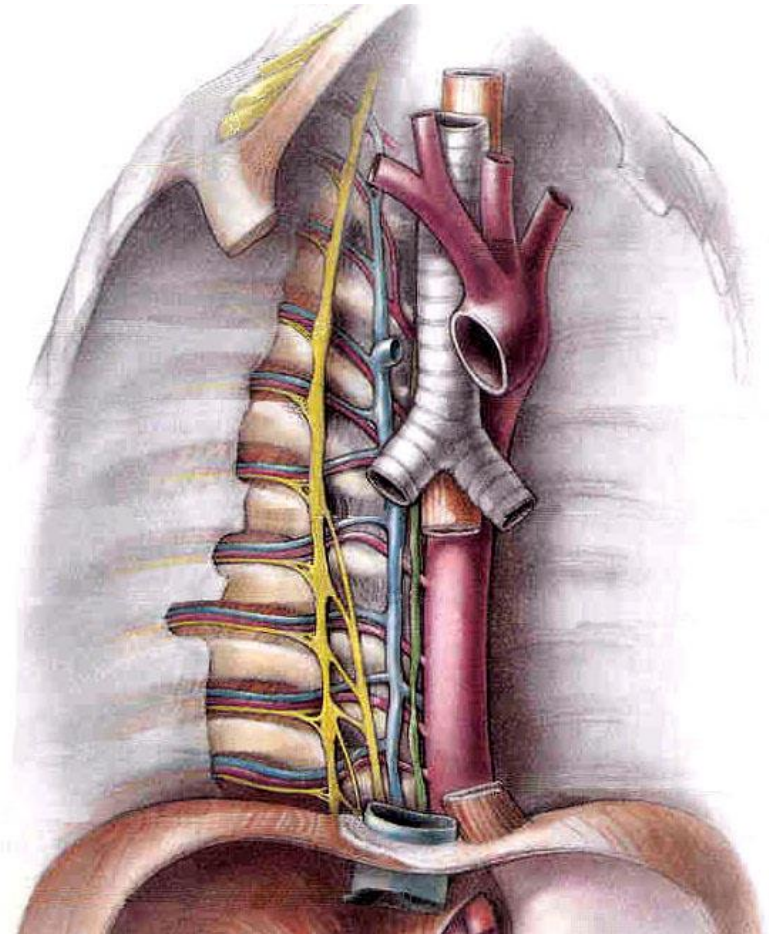
- Trachea
- Bifurcation of trachea
- Left principal bronchus
- Left recurrent n.
- Right pulmonary a.
- Anterior esophageal plexus
- Pericardium
- Left atrium
- Diaphragm



Relations of esophagus

□ Posteriorly

- Posterior esophageal plexus
- Thoracic aorta
- Thoracic duct
- Azygos v.
- Hemiazygos v.
- Accessory hemiazygos v.
- Right posterior intercostal v.



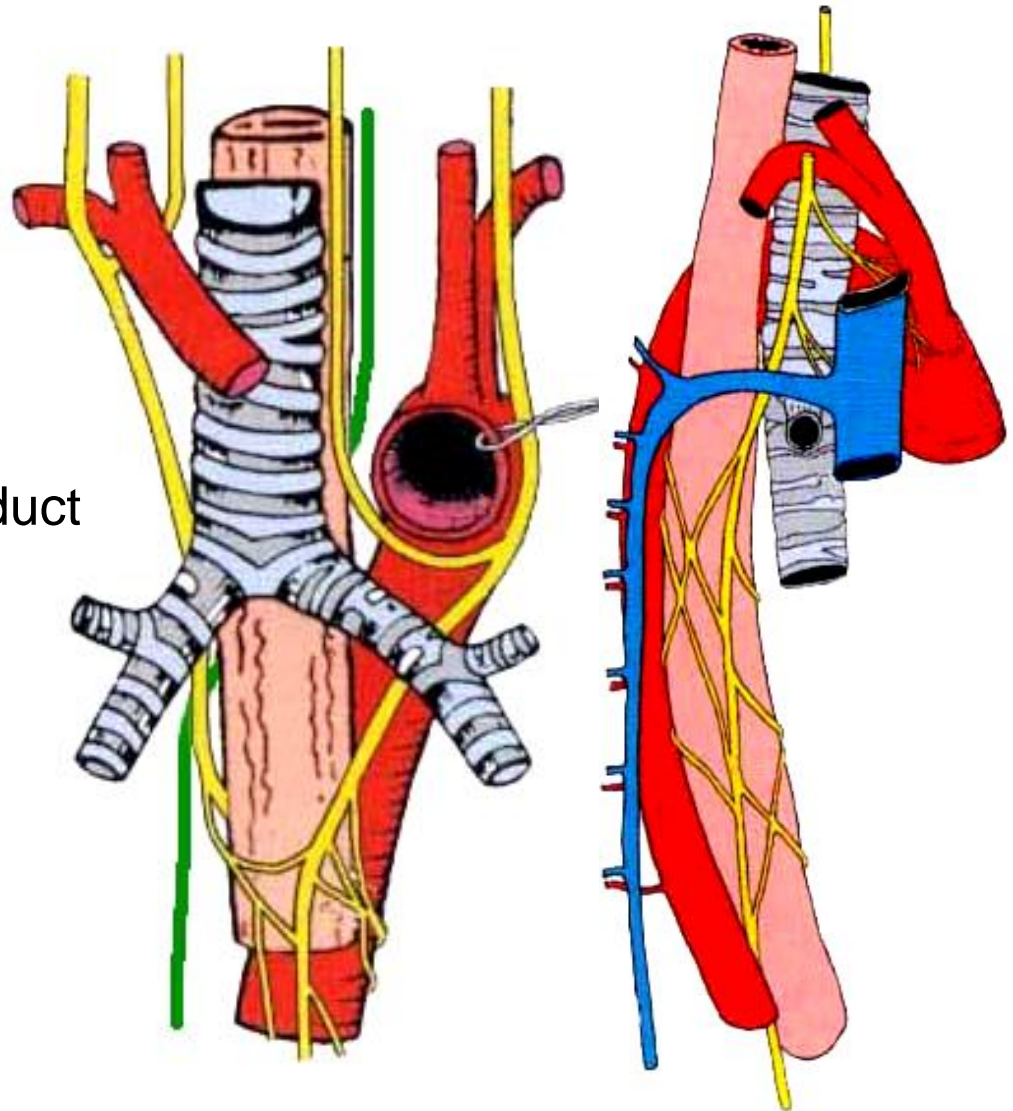
Relations of esophagus

□ Left

- Left common carotid a.
- Left subclavian a.
- Aortic arch
- Thoracic aorta
- Superior part of thoracic duct

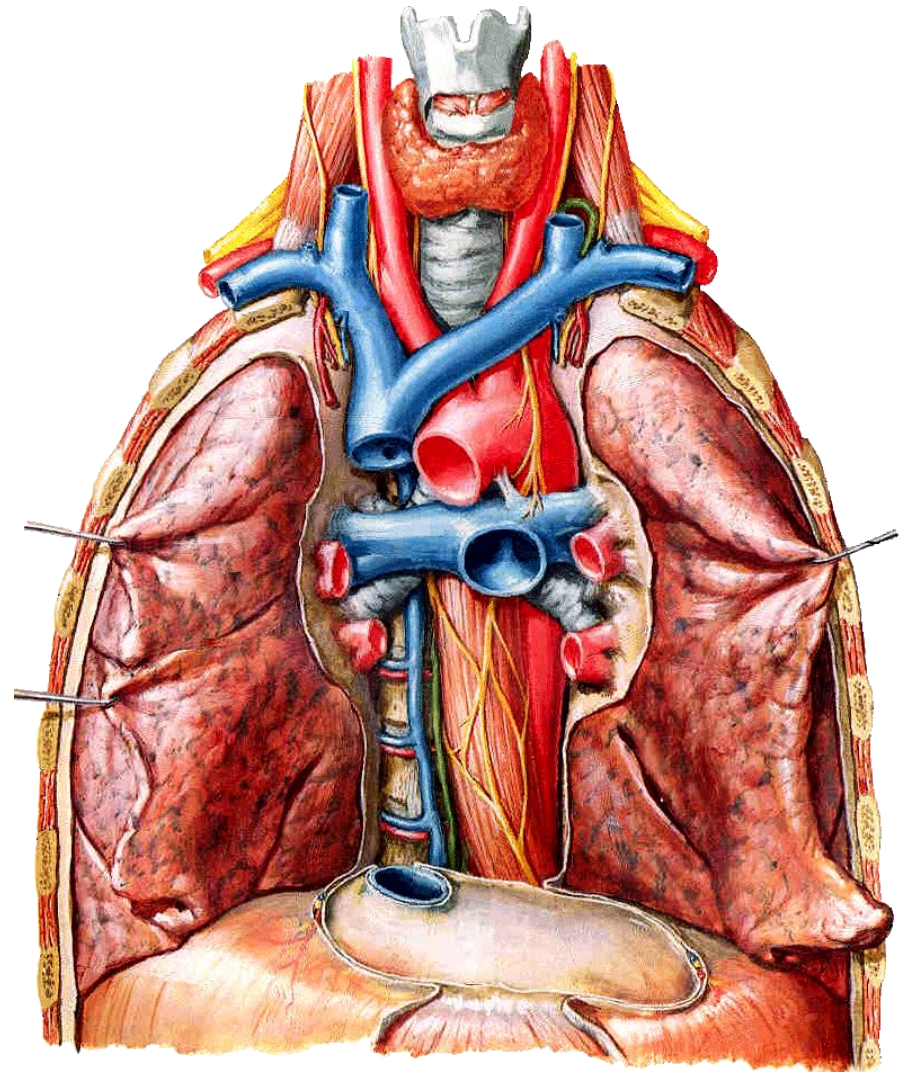
□ Right

- Arch of azygos v.



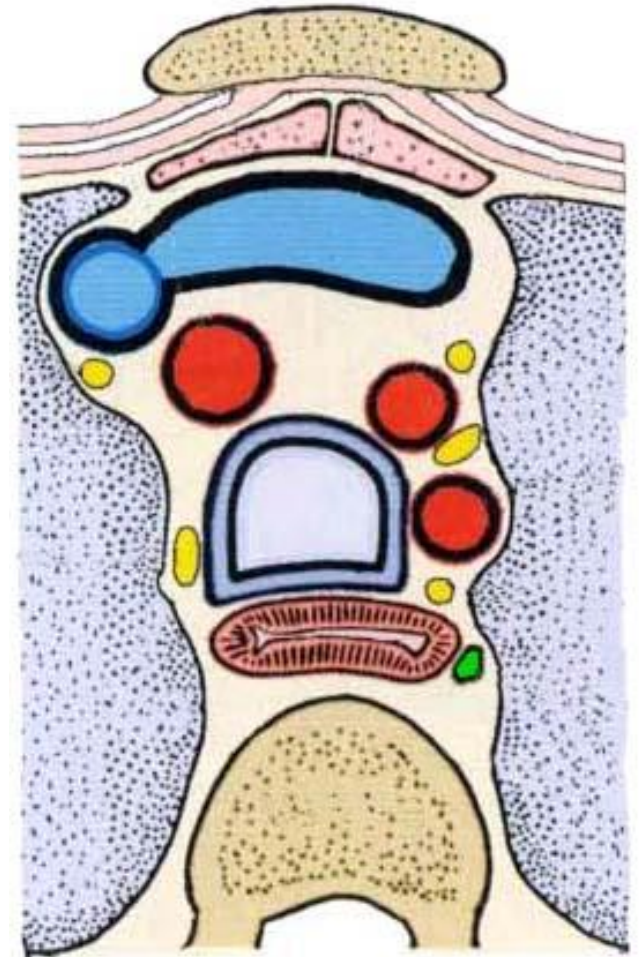
Relations of thoracic aorta

- ❑ **Anteriorly**
 - Left root of lung
 - Pericardium
 - Esophagus
- ❑ **Posterior**
 - Hemiazygos v.
 - Accessory hemiazygos v.
- ❑ **Right**
 - Azygos v.
 - Thoracic duct
- ❑ **Left**—mediastinal pleura

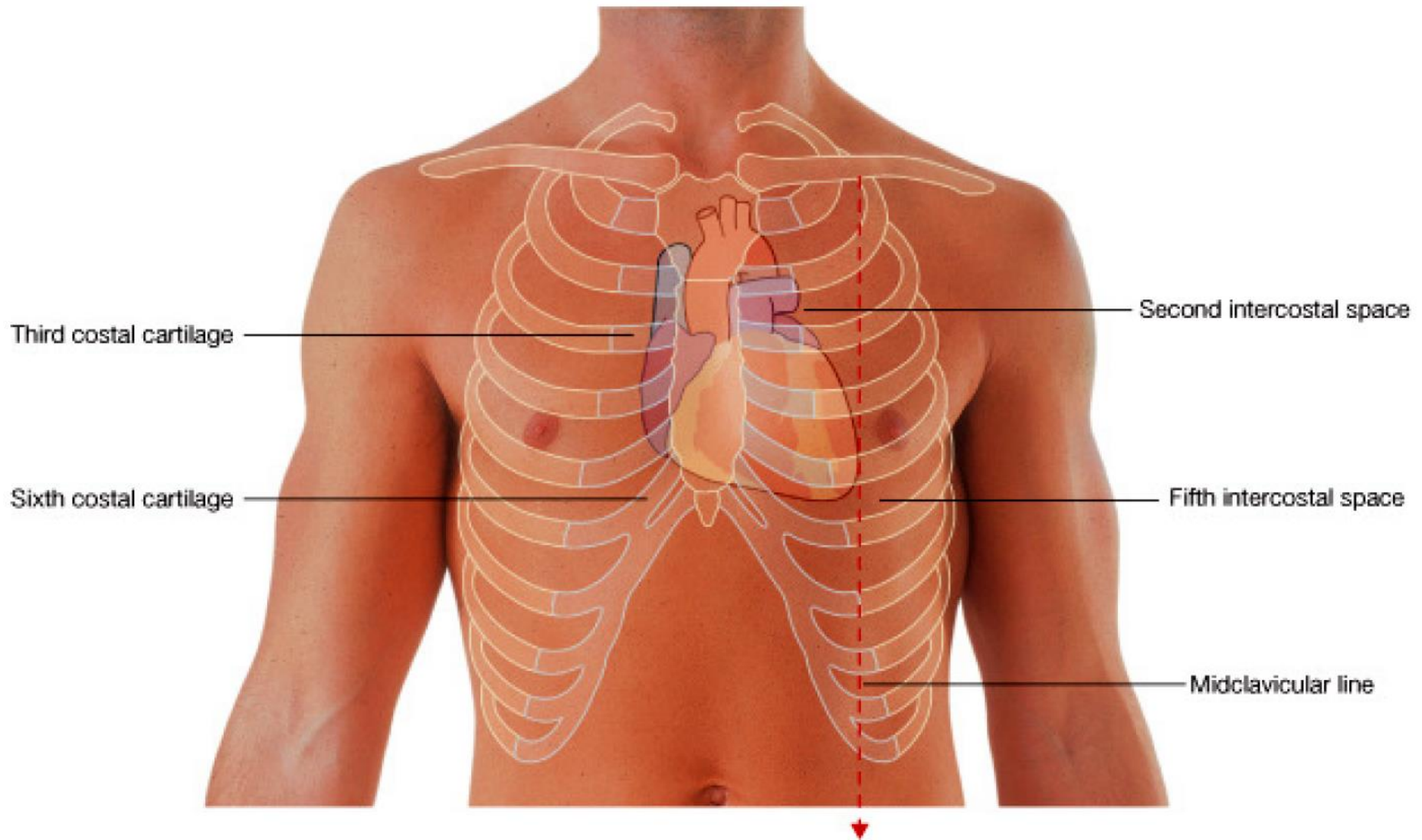


Mediastinal spaces

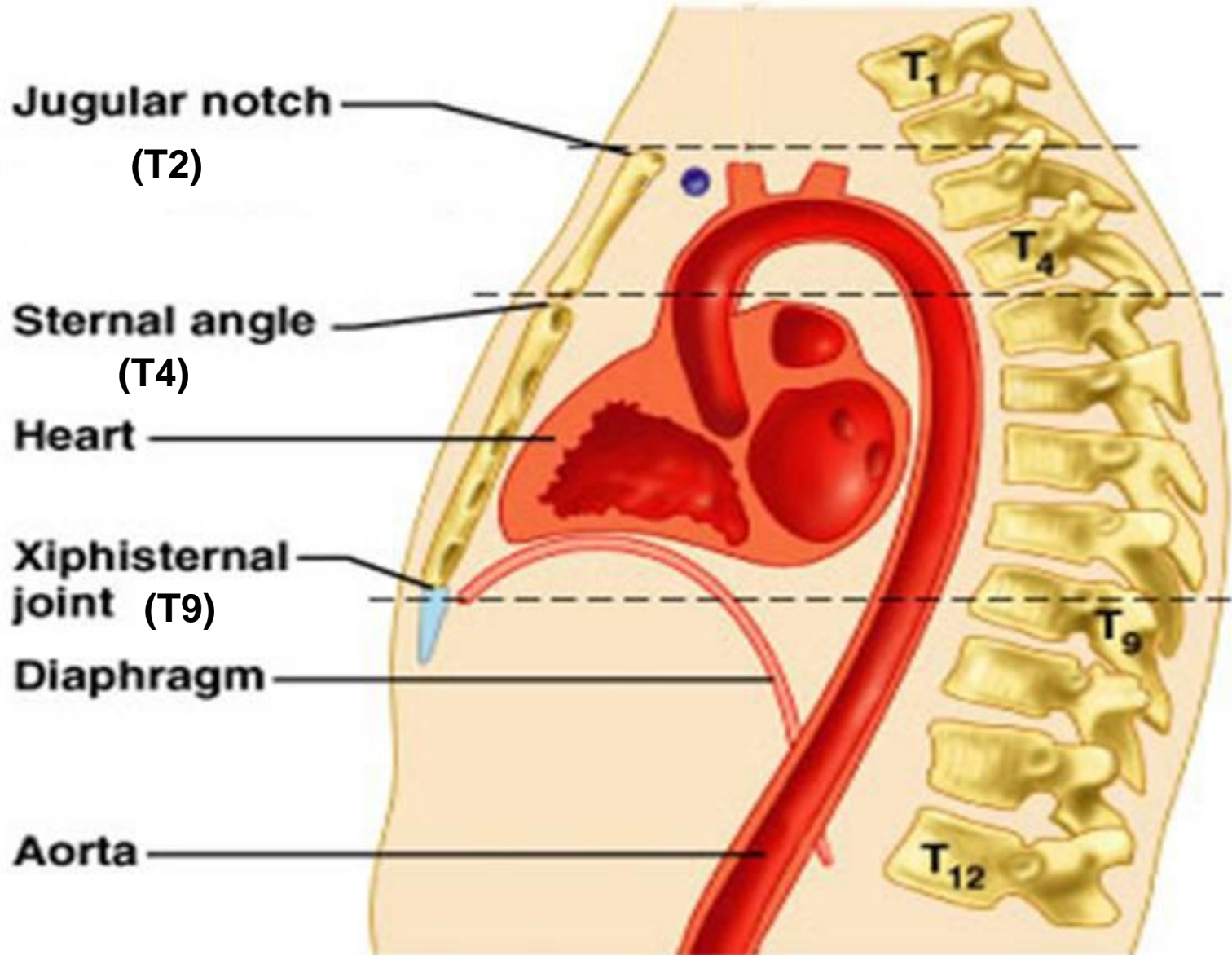
- ❑ **Retrosternal space** lies between sternum and endothoracic fascia
- ❑ **Pretracheal space** lies within superior mediastinum, between trachea, bifurcation of trachea and aortic arch
- ❑ **Retroesophagus space** lies within superior mediastinum, between esophagus and endothoracic fascia



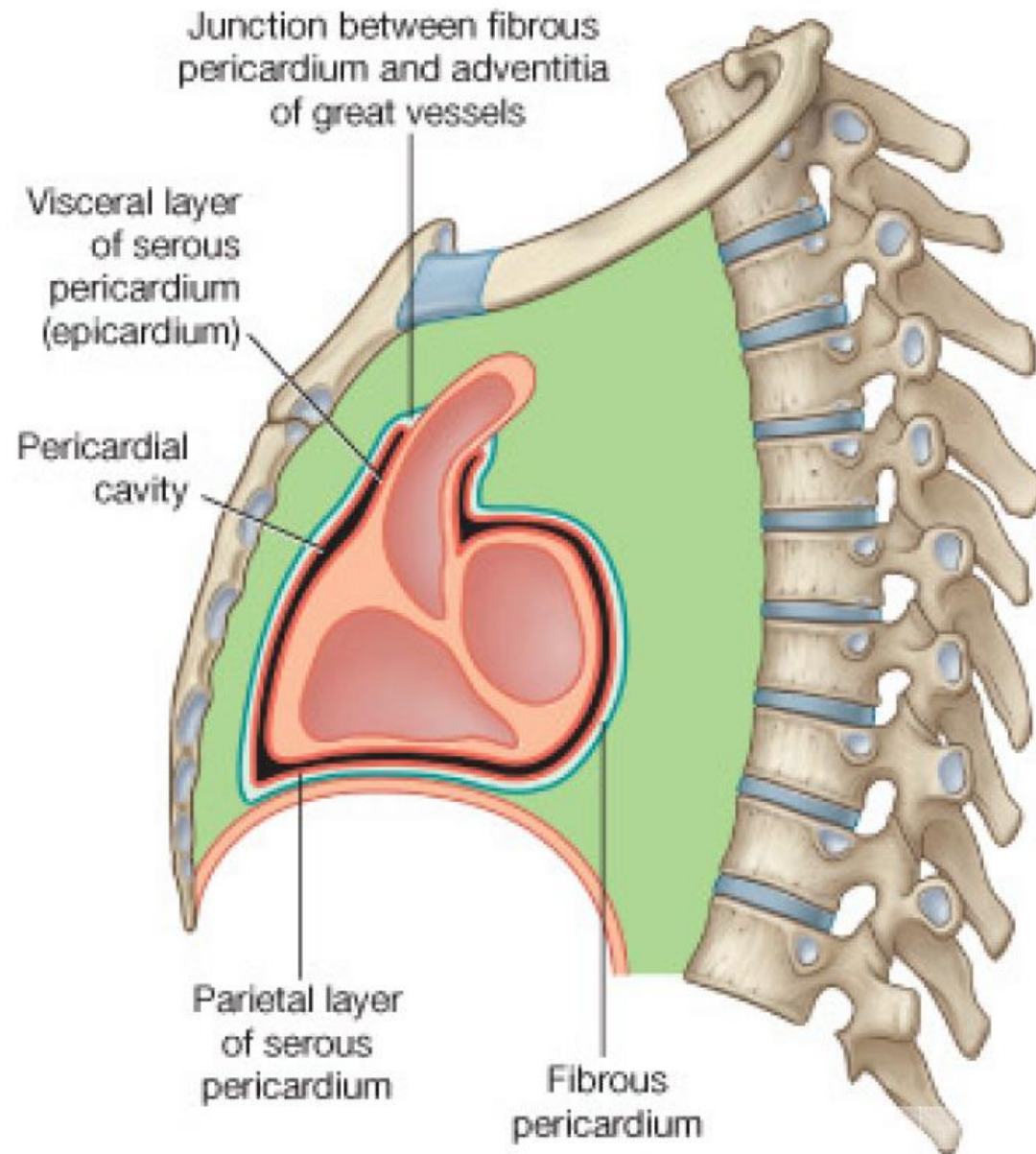
Surface anatomy of the heart



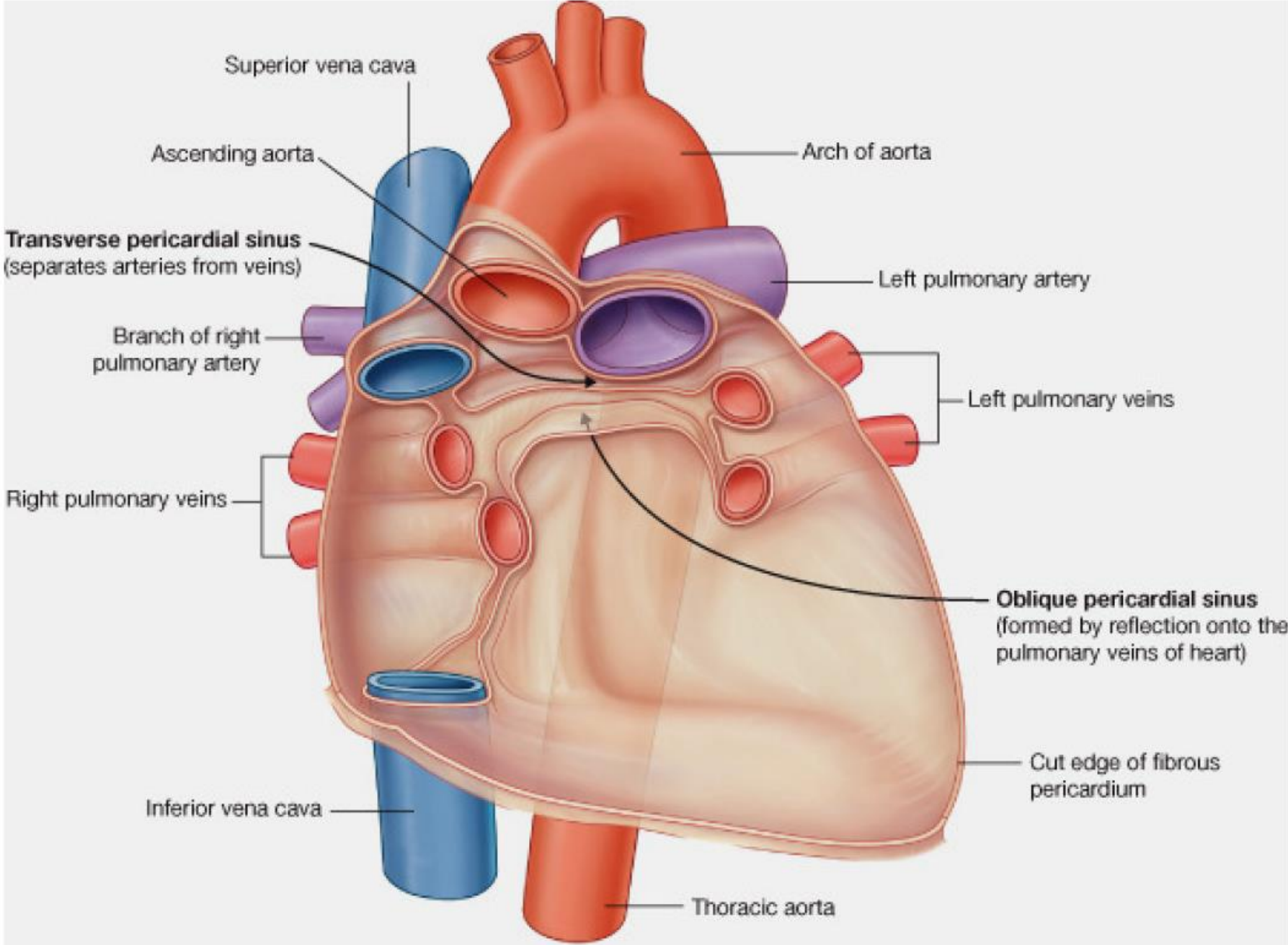
Vertebral Levels of Thoracic Landmarks



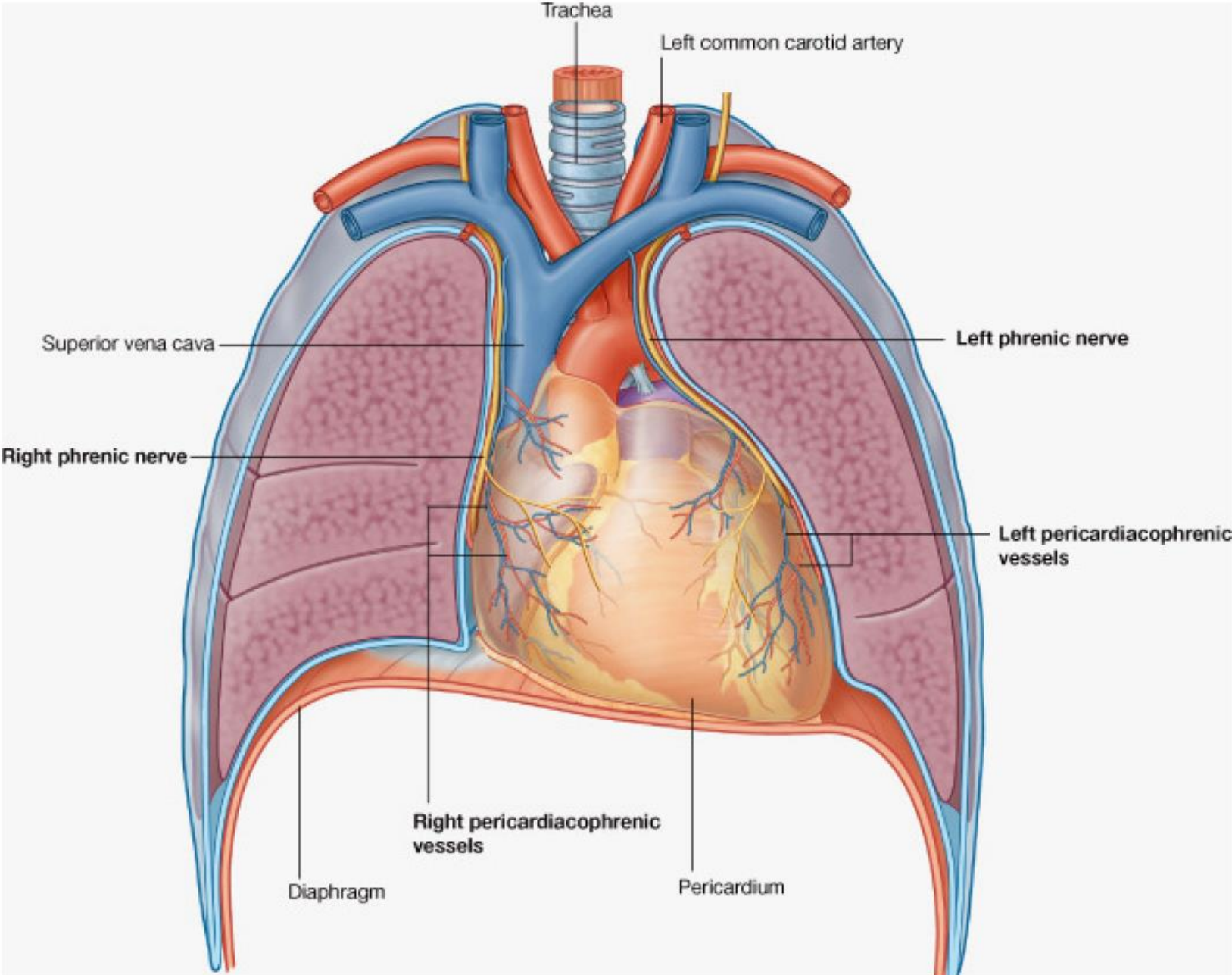
Pericardium



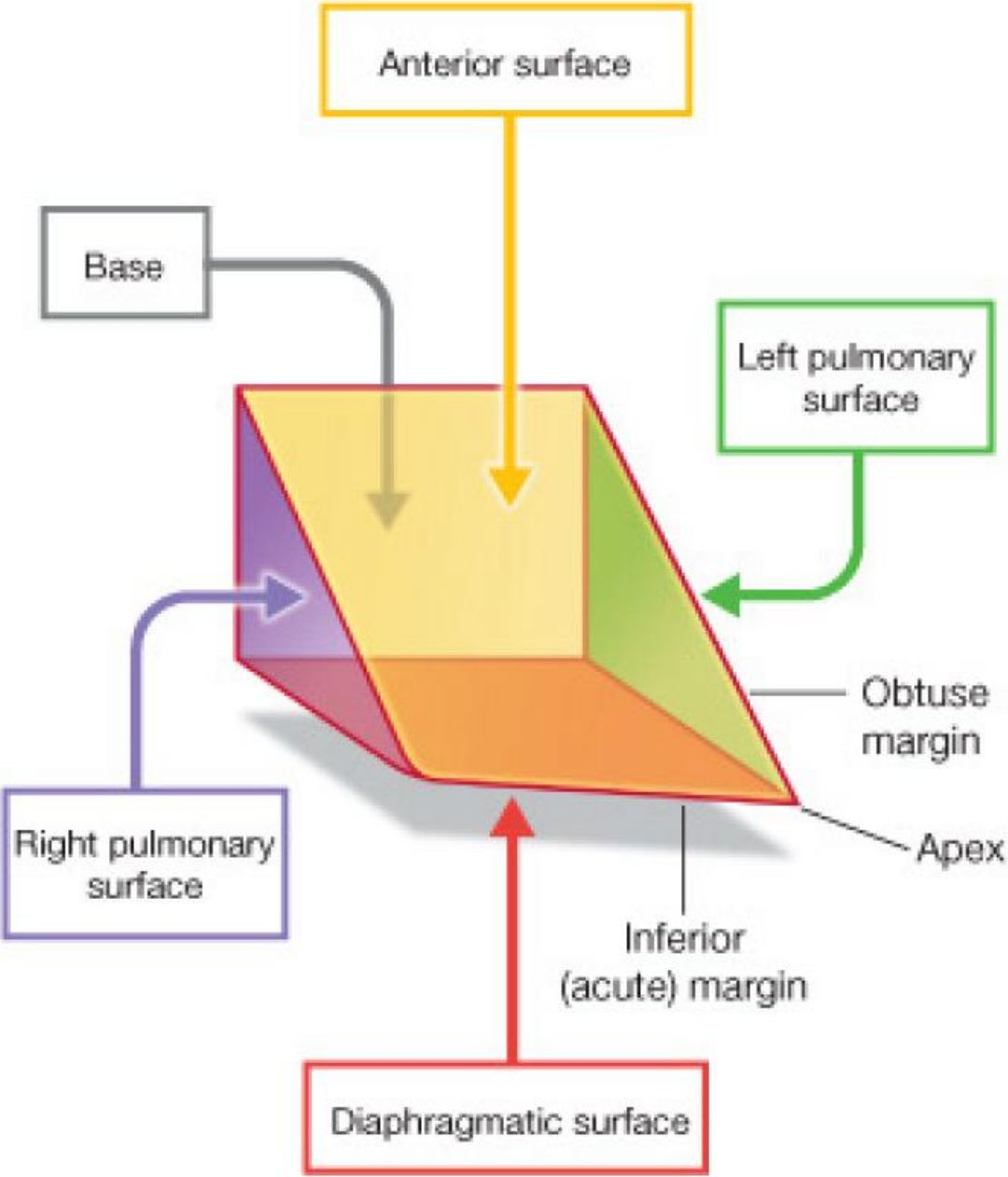
Posterior portion of pericardial sac showing reflections of serous pericardium



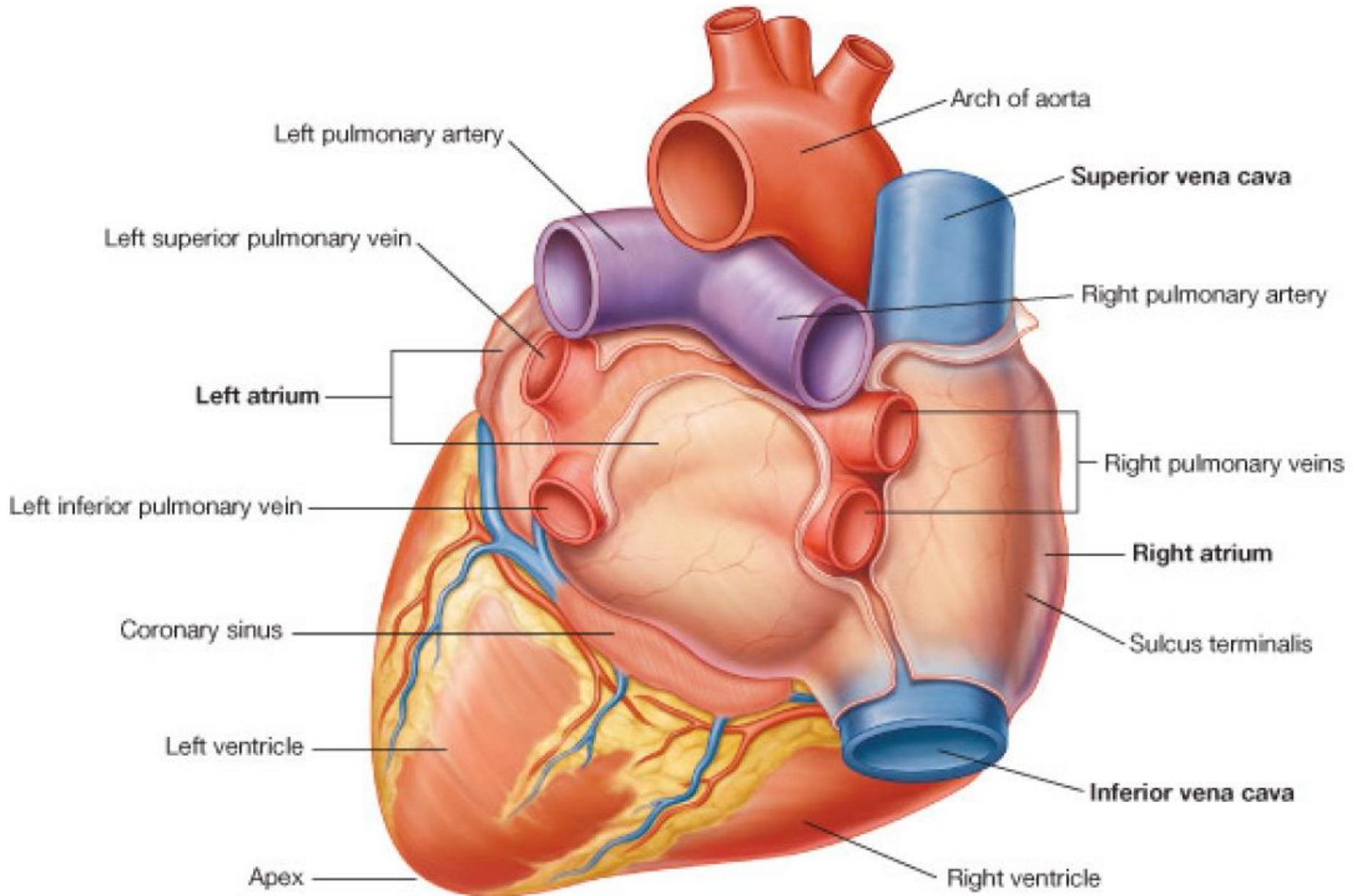
Phrenic nerves and pericardiophrenic vessels



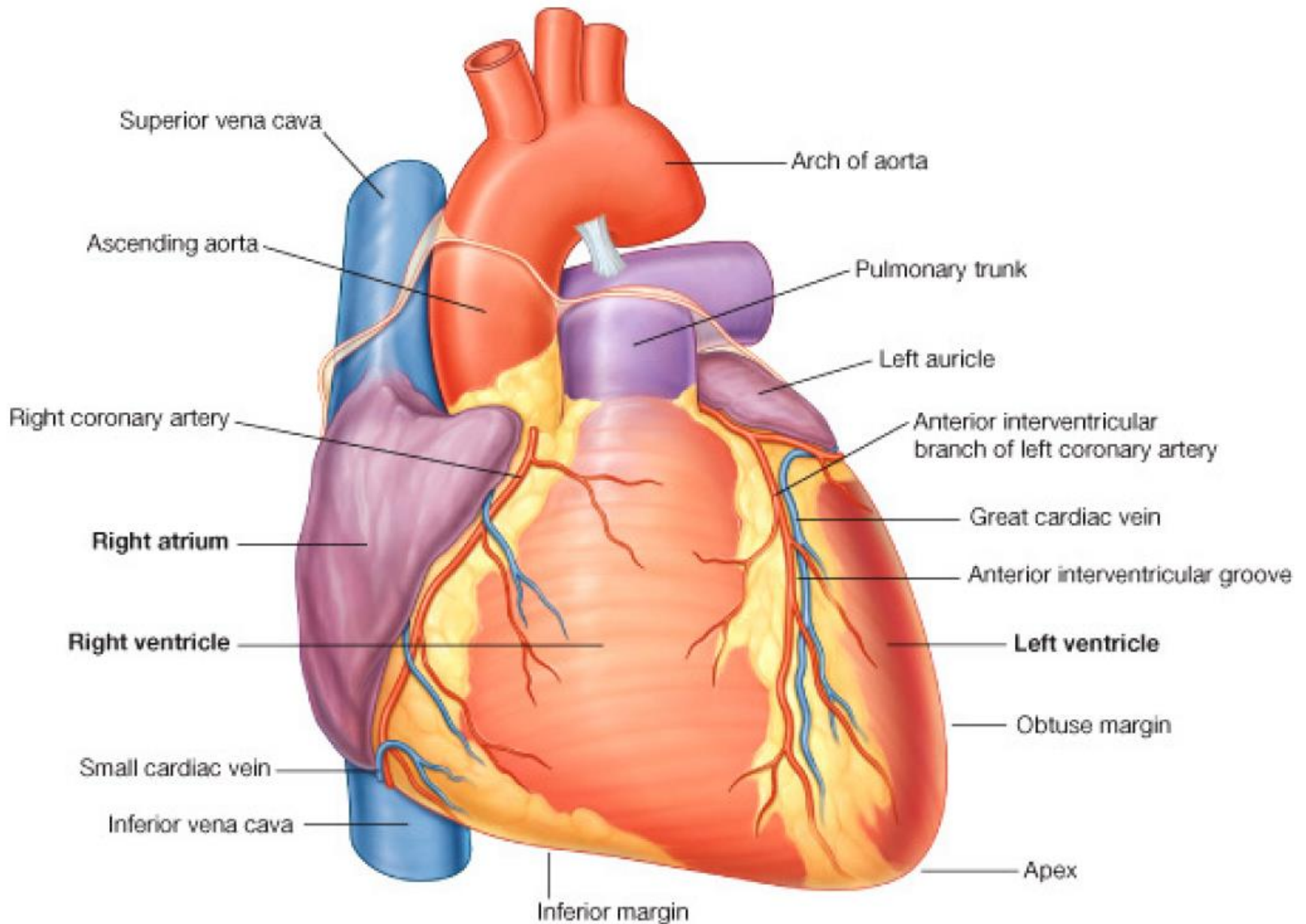
Schematic illustration of the heart showing orientation, surfaces and margins.



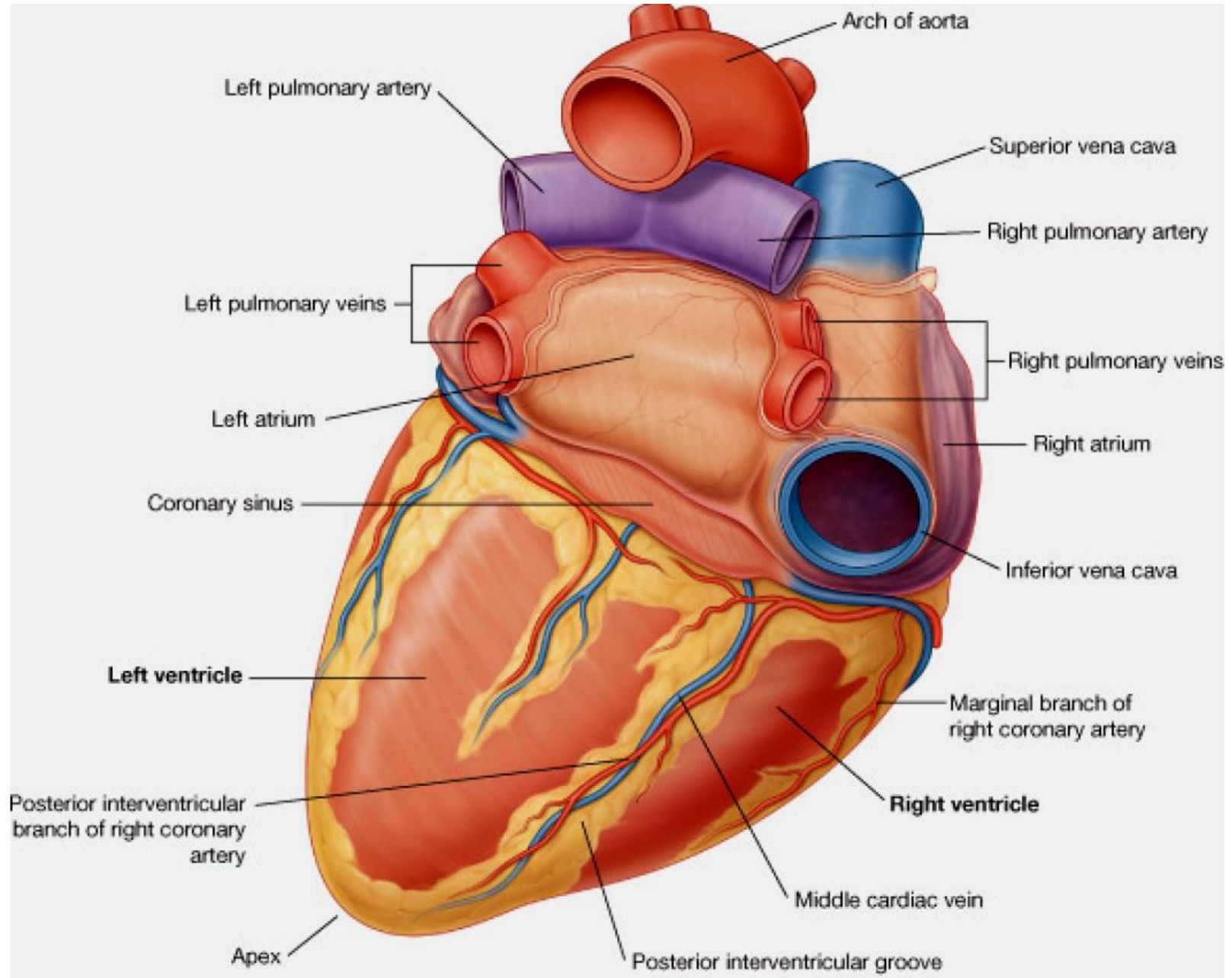
Base of the Heart



Anterior surface of the Heart

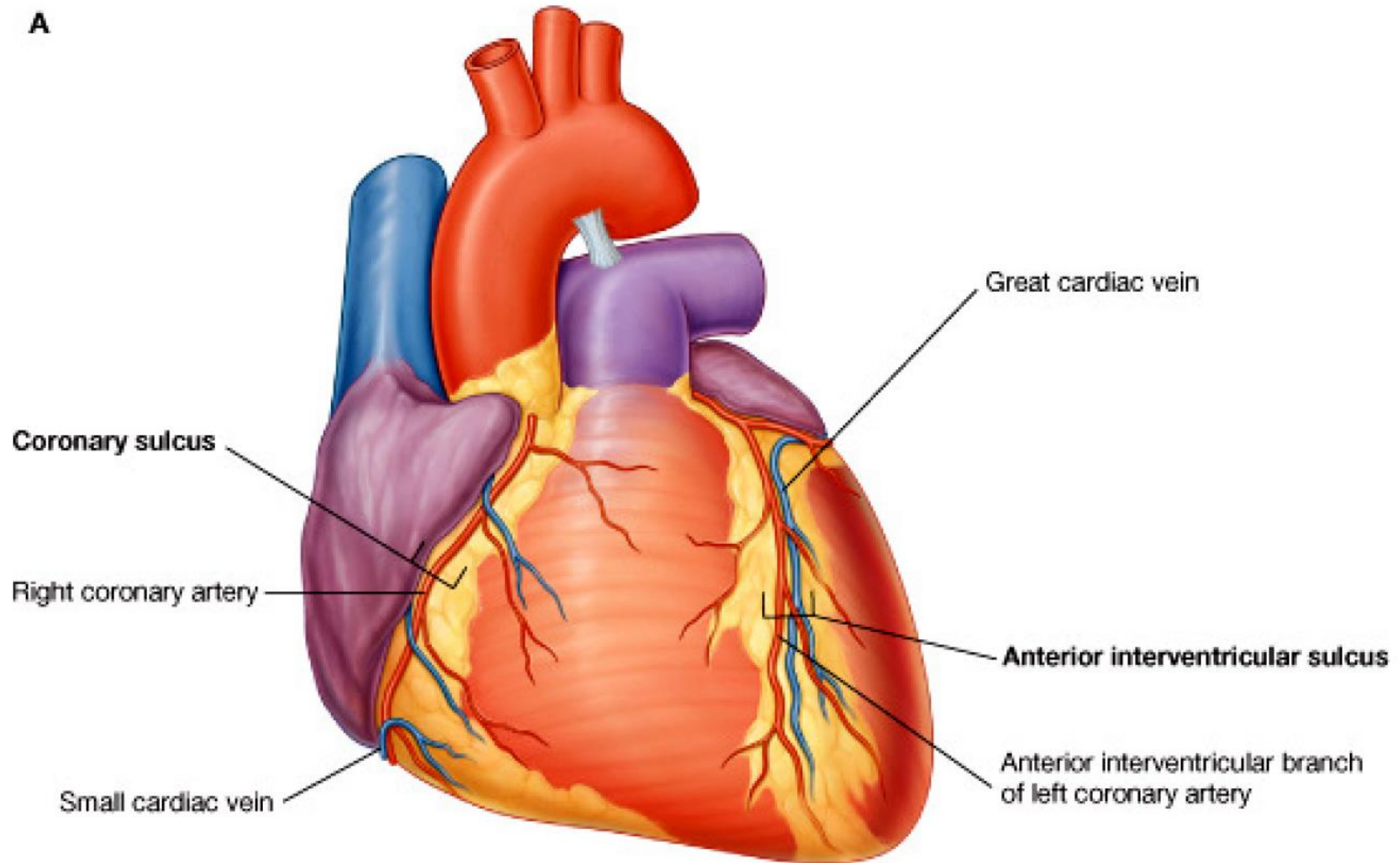


Diaphragmatic surface of the Heart

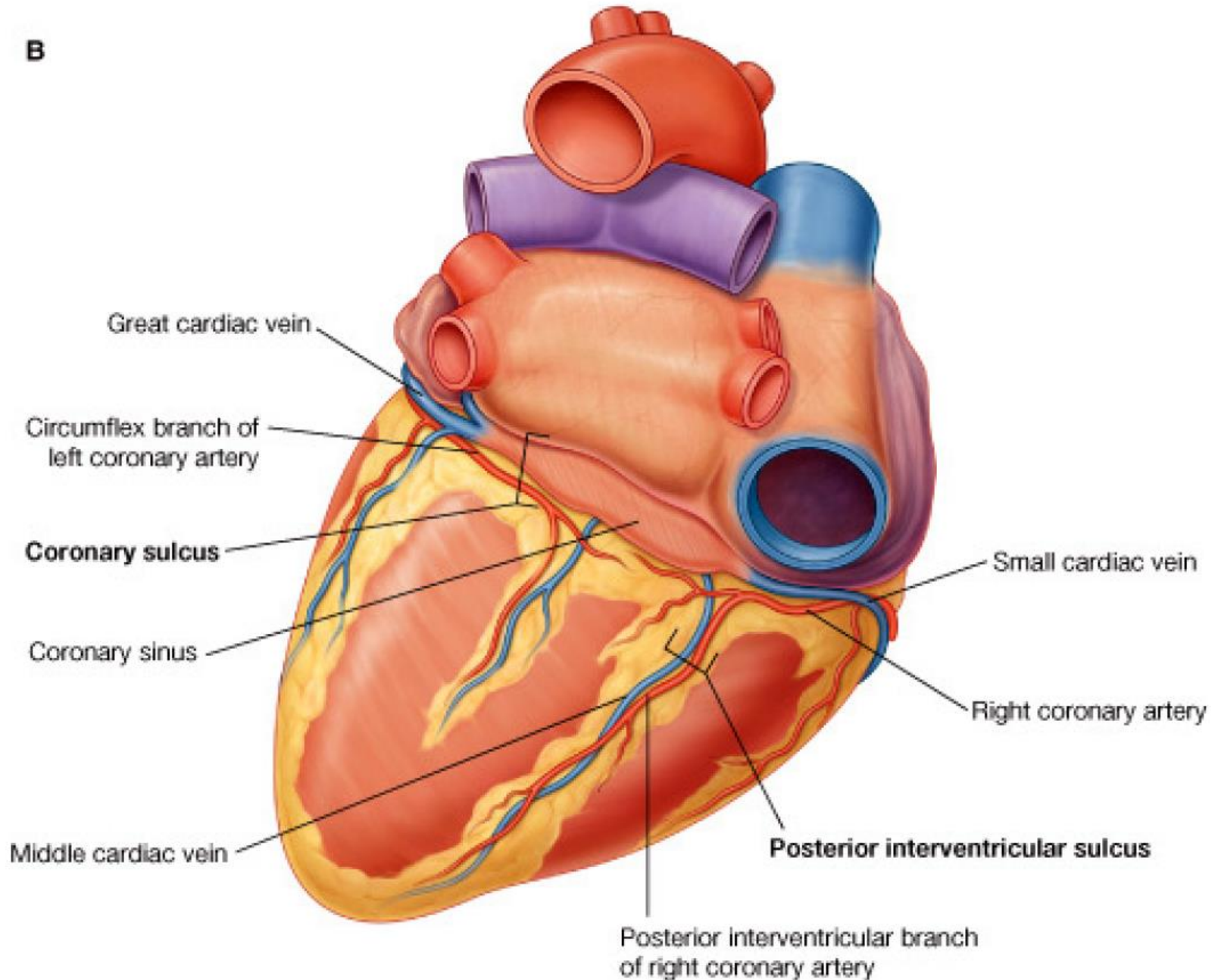


Sulci of the heart. A. Anterior surface of the heart.

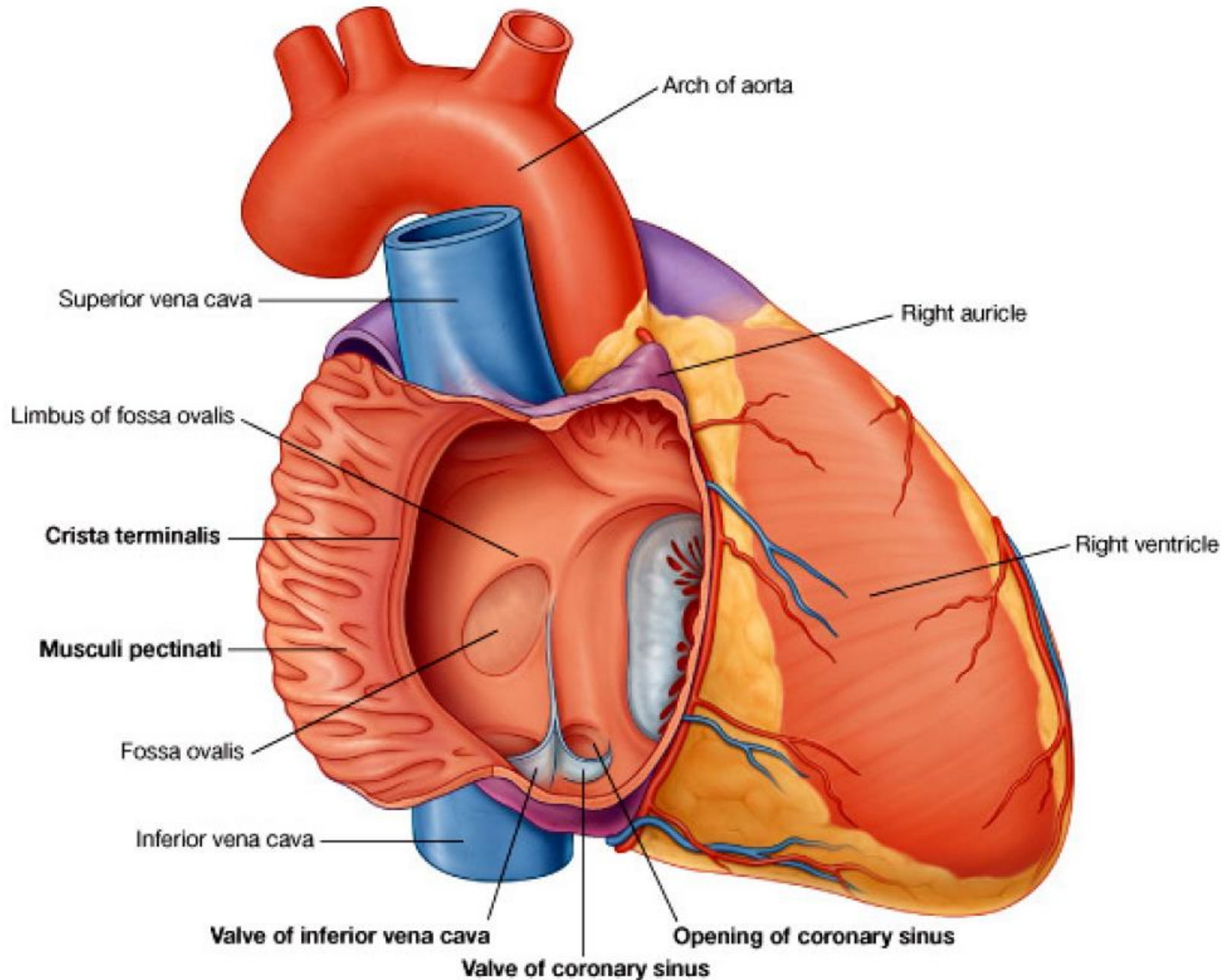
A



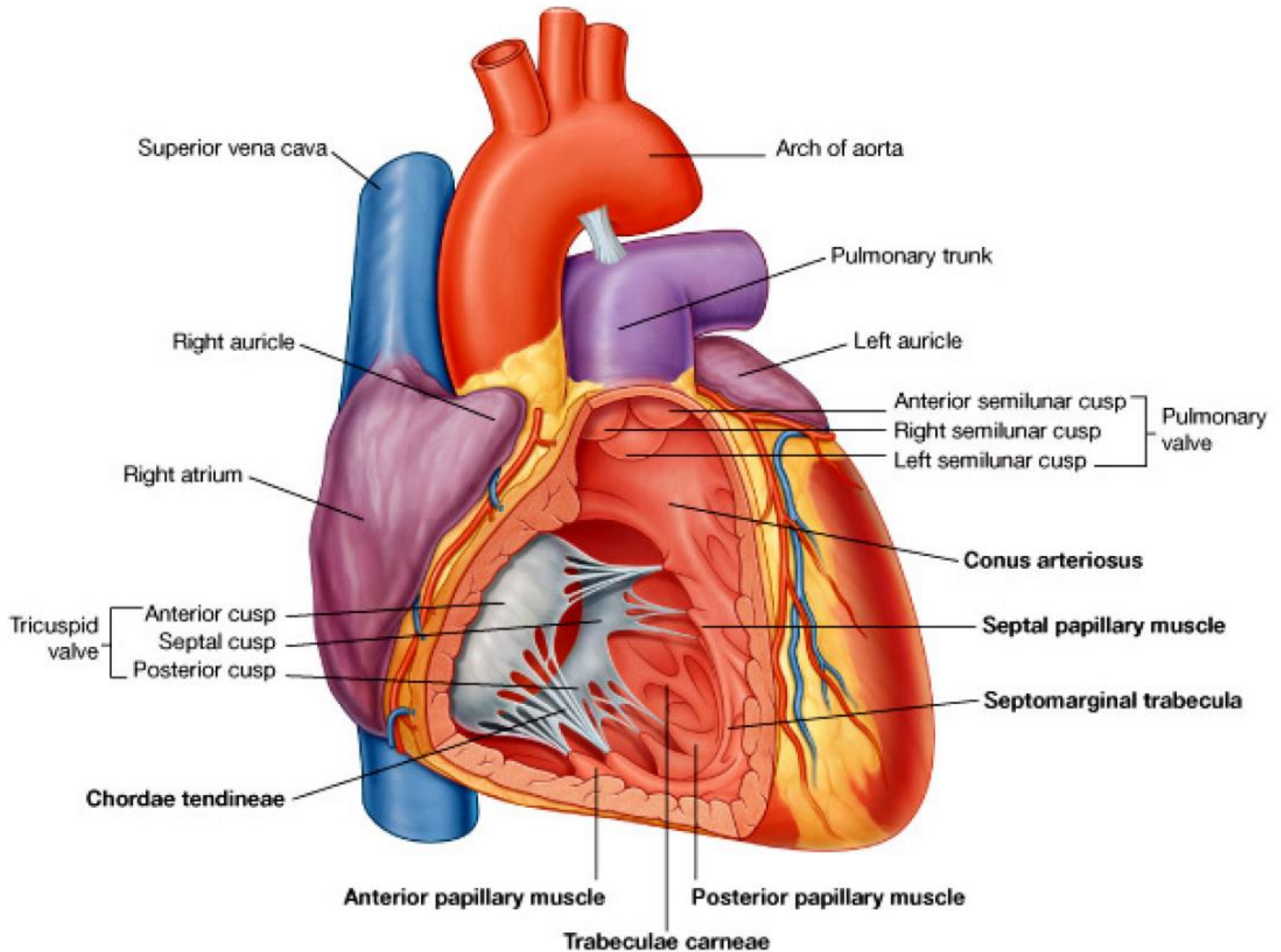
Sulci of the heart. B. Diaphragmatic surface and base of the heart.



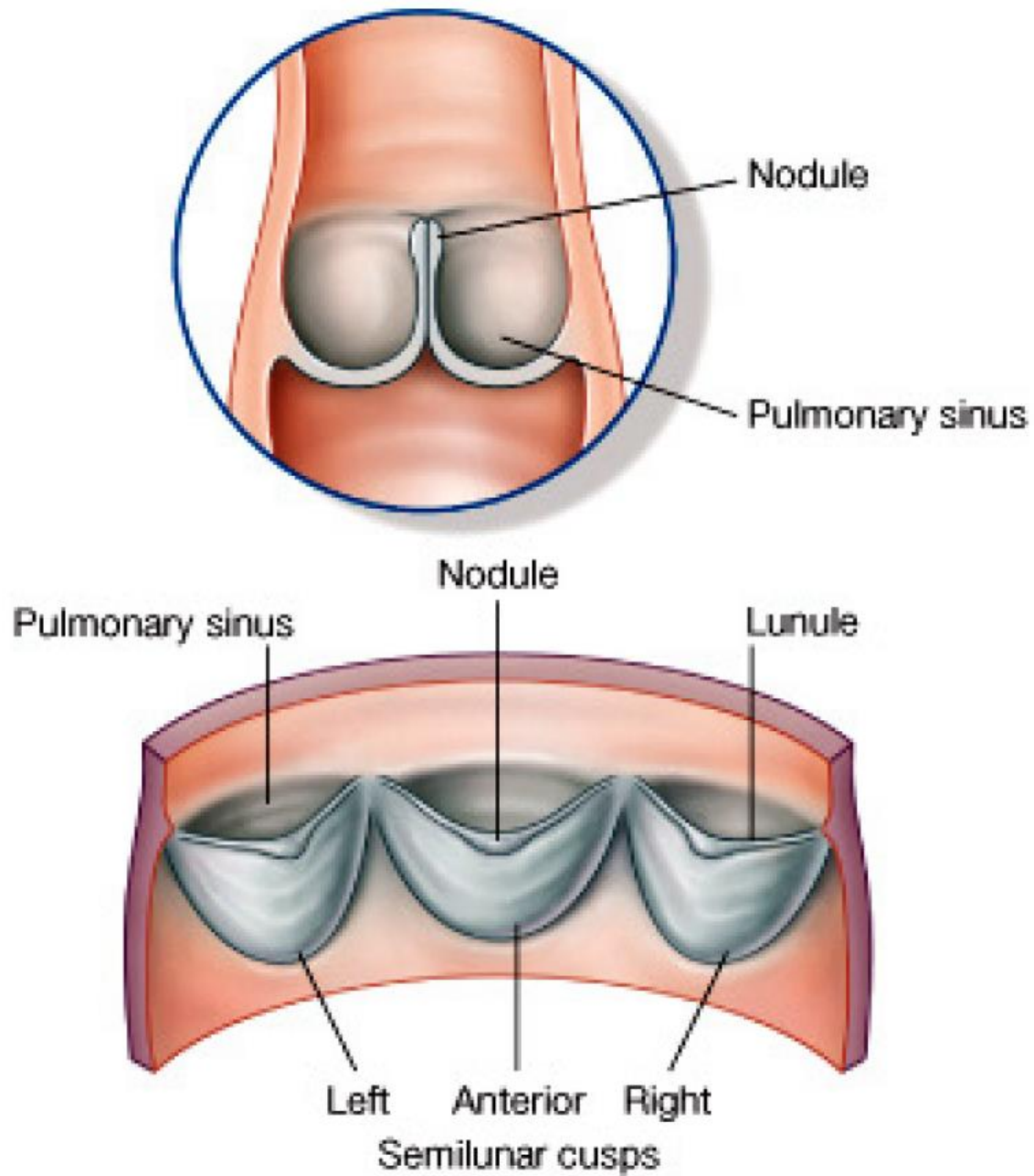
Internal view of right atrium.



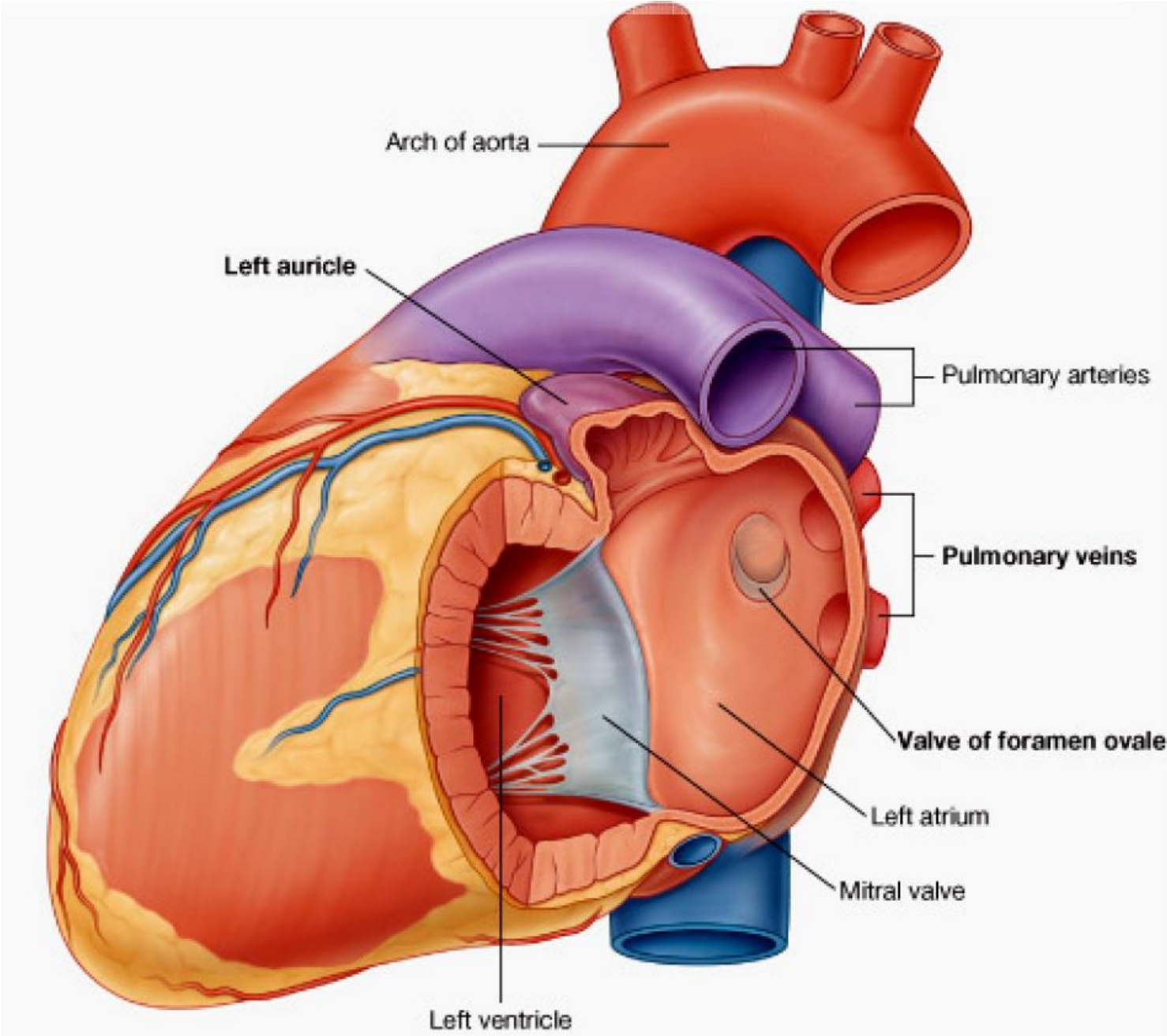
Internal view of right ventricle.



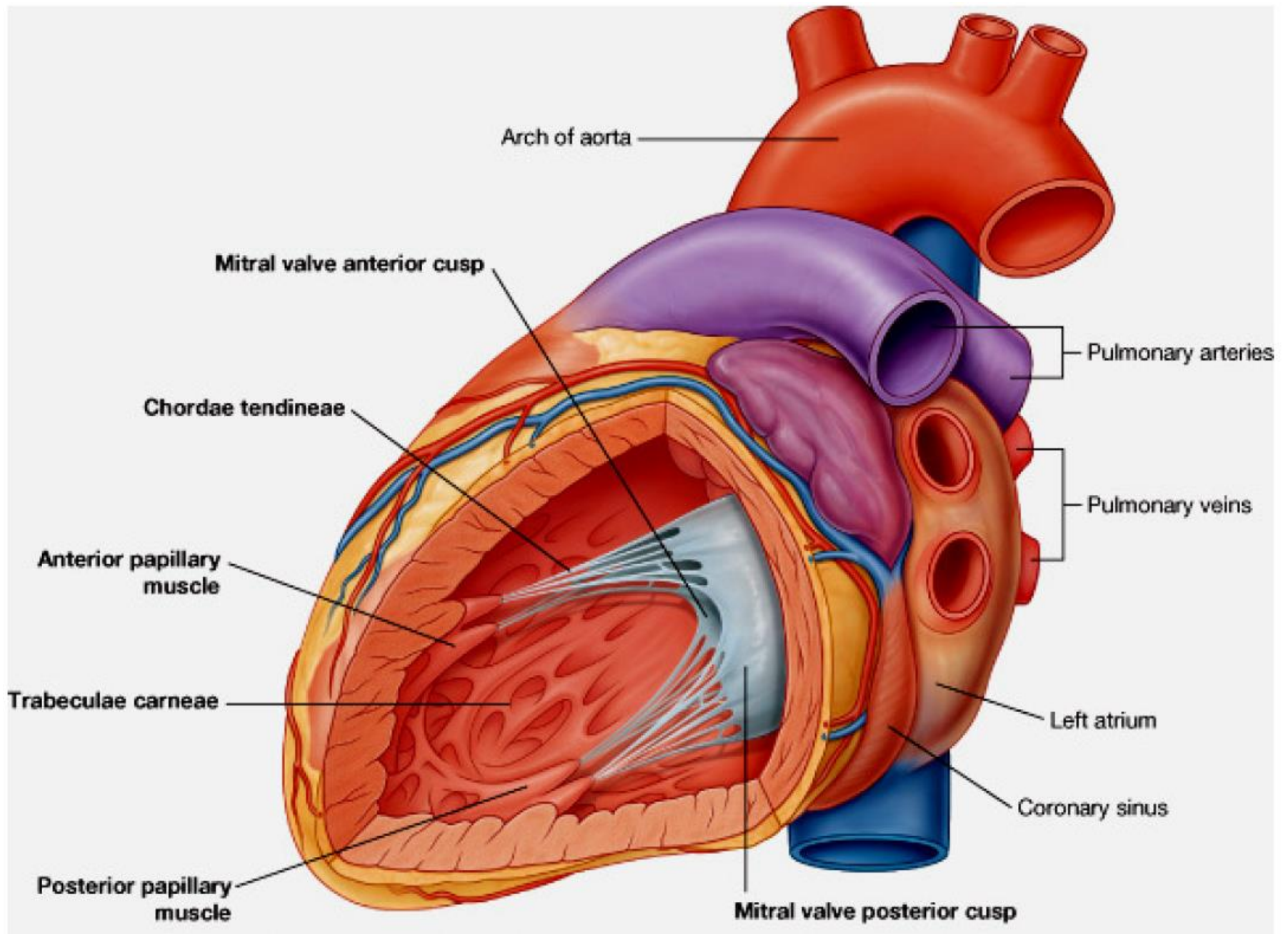
Posterior view of the pulmonary valve.

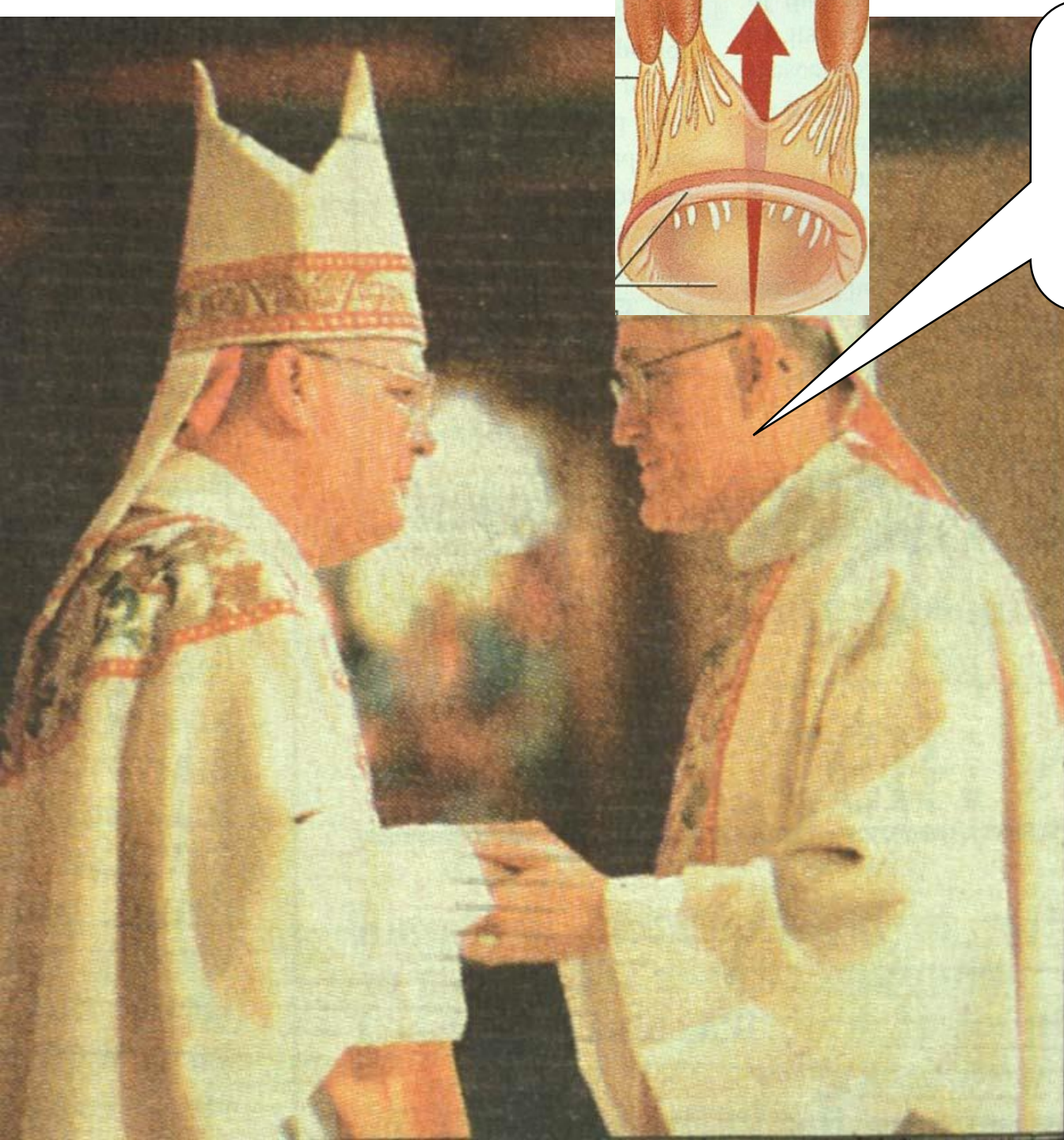


Internal view of left atrium.



Internal view of left ventricle.

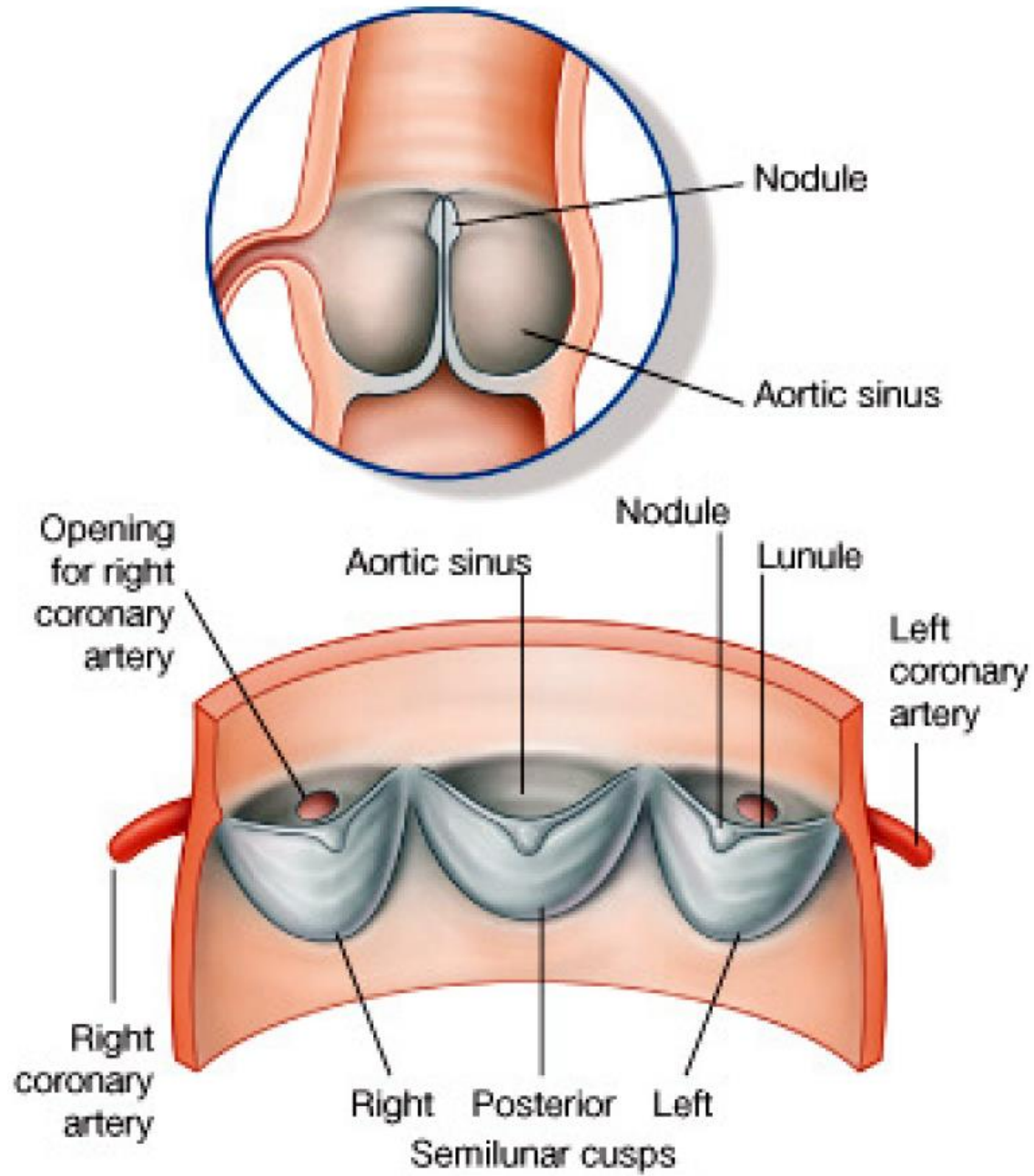




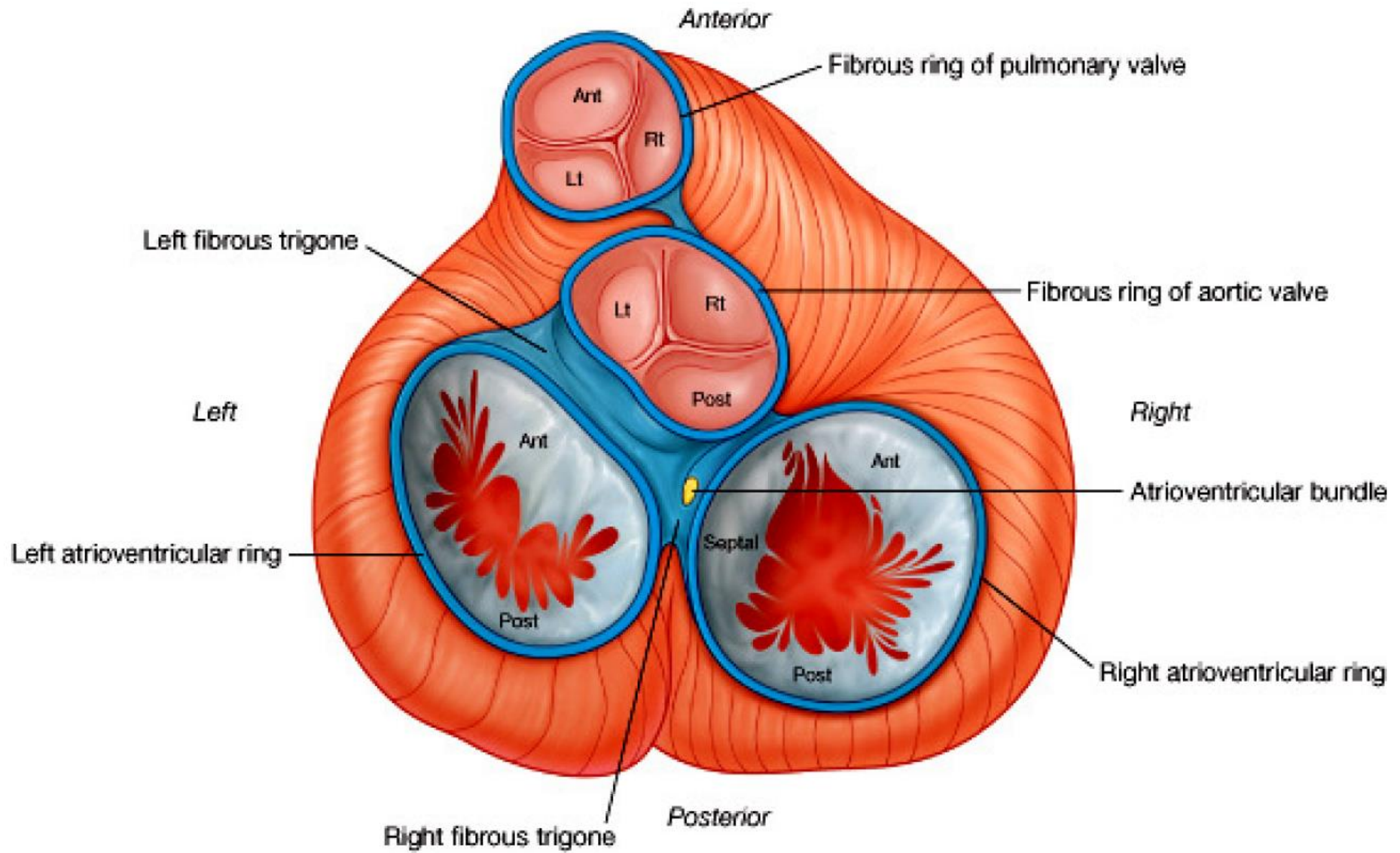
Did you hear?
They named a
heart valve
after our
mitres!

The left AV valve
(bicuspid valve) is
also called the
mitral valve
because it
resembles a
bishop's hat, or
mitre.

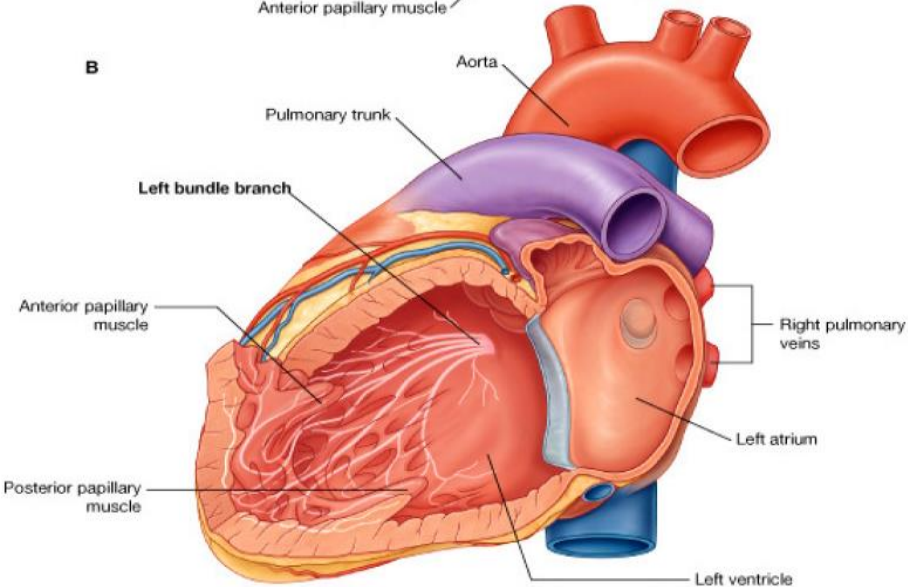
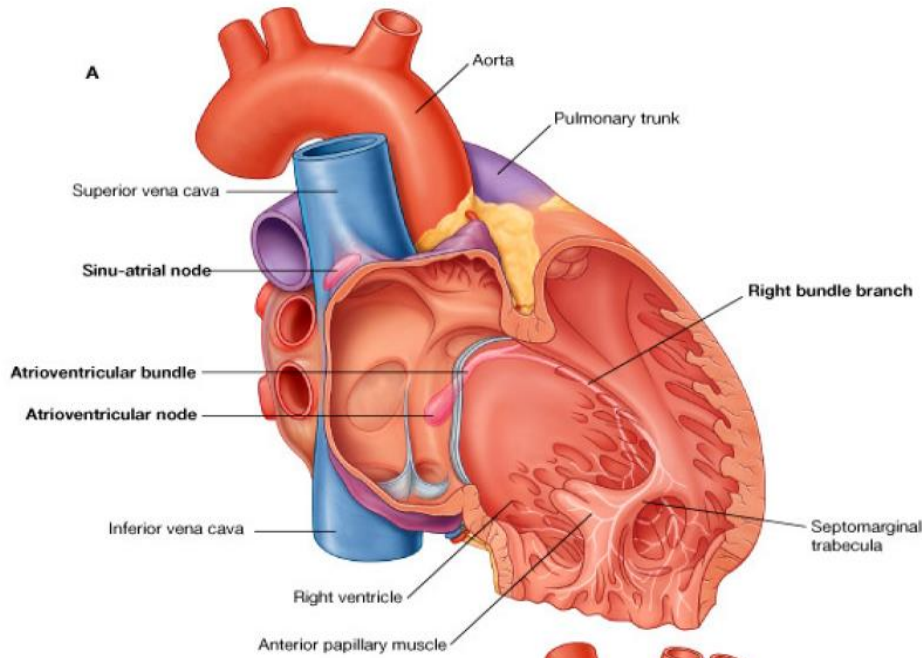
Anterior view of the aortic valve.



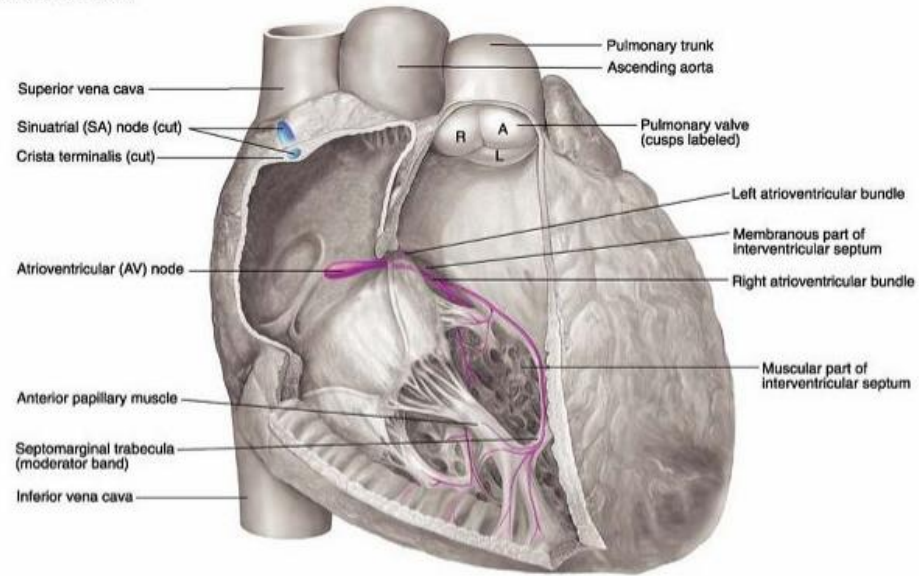
Cardiac skeleton (atria removed).



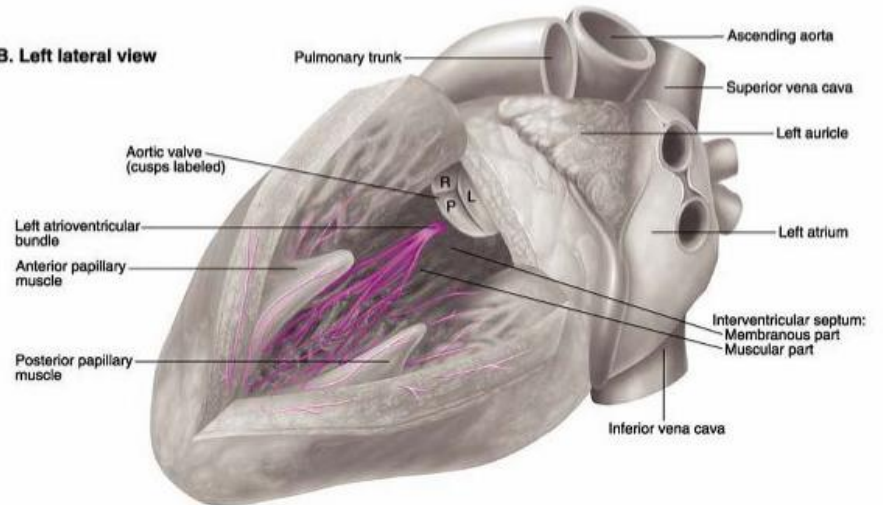
Conduction system of the heart. A. Right chambers. B. Left chambers.



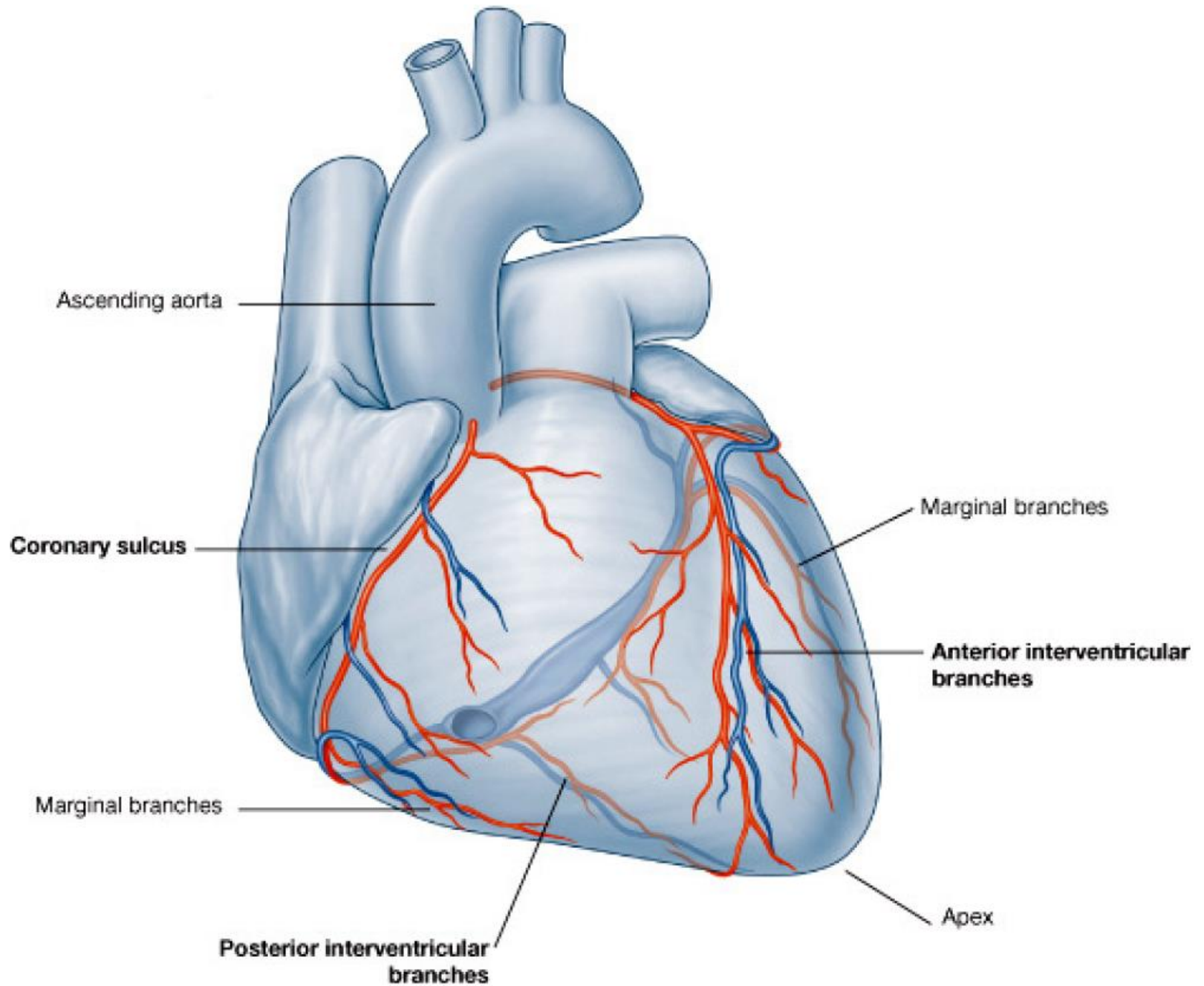
A. Anterior view



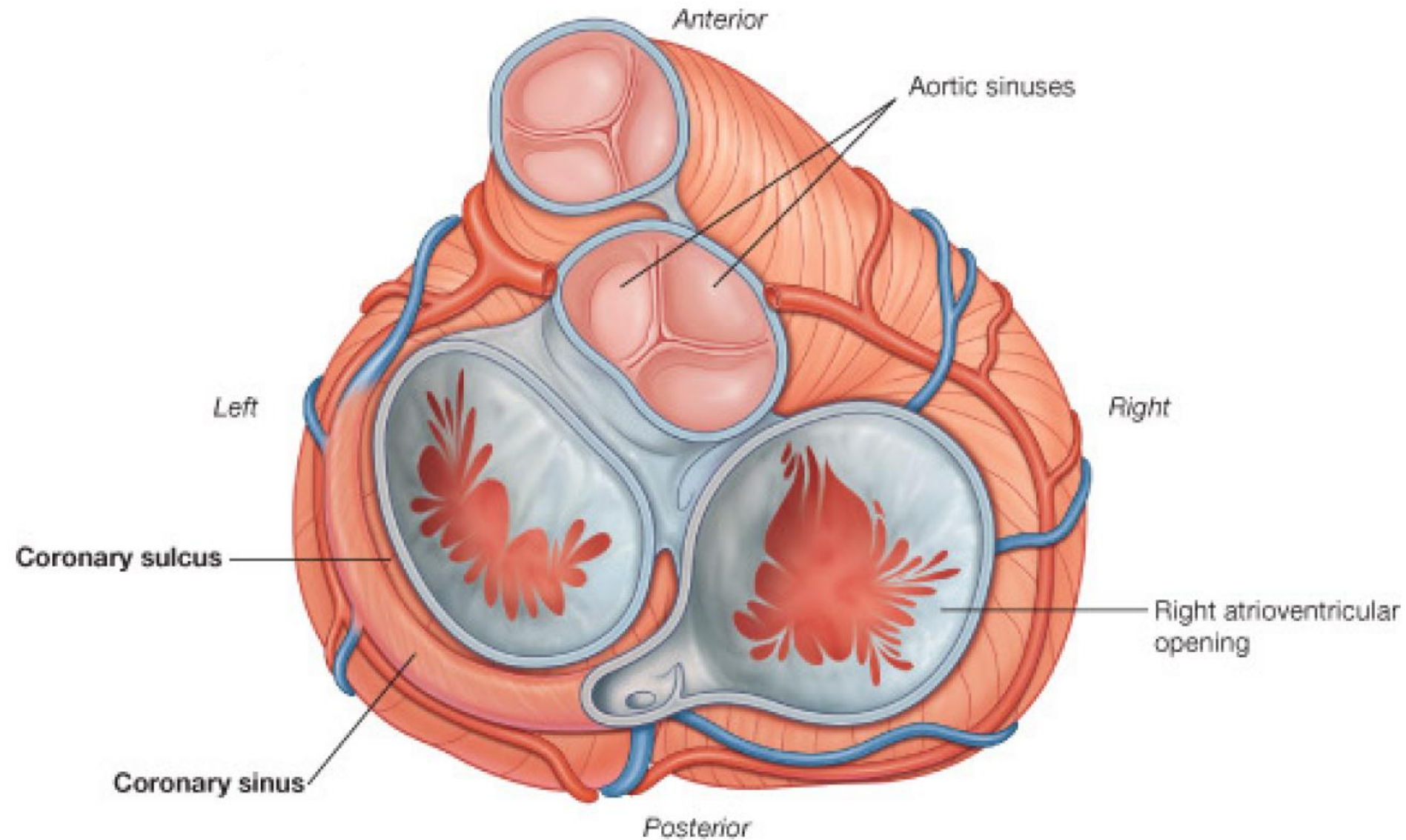
B. Left lateral view



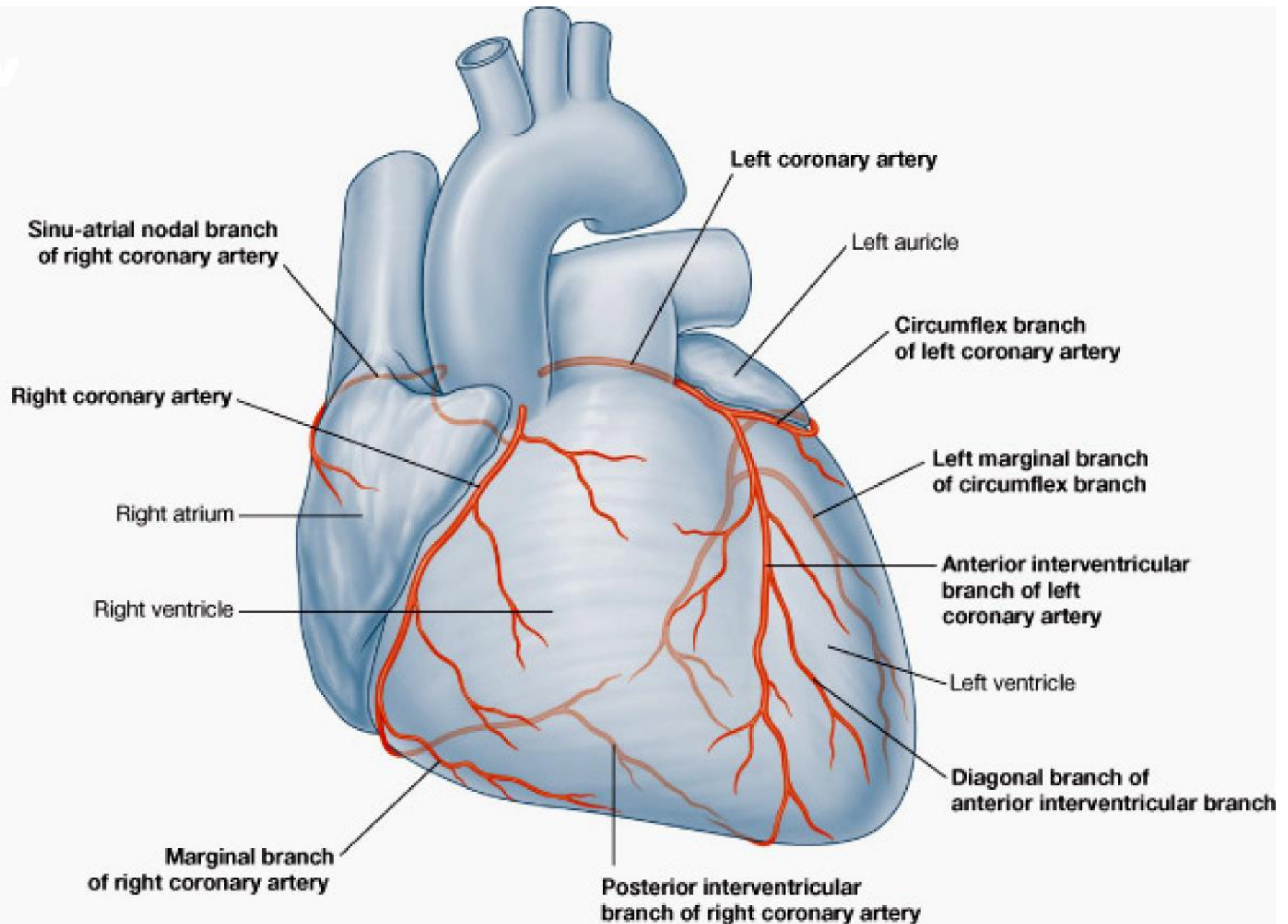
Cardiac vasculature. Anterior view.



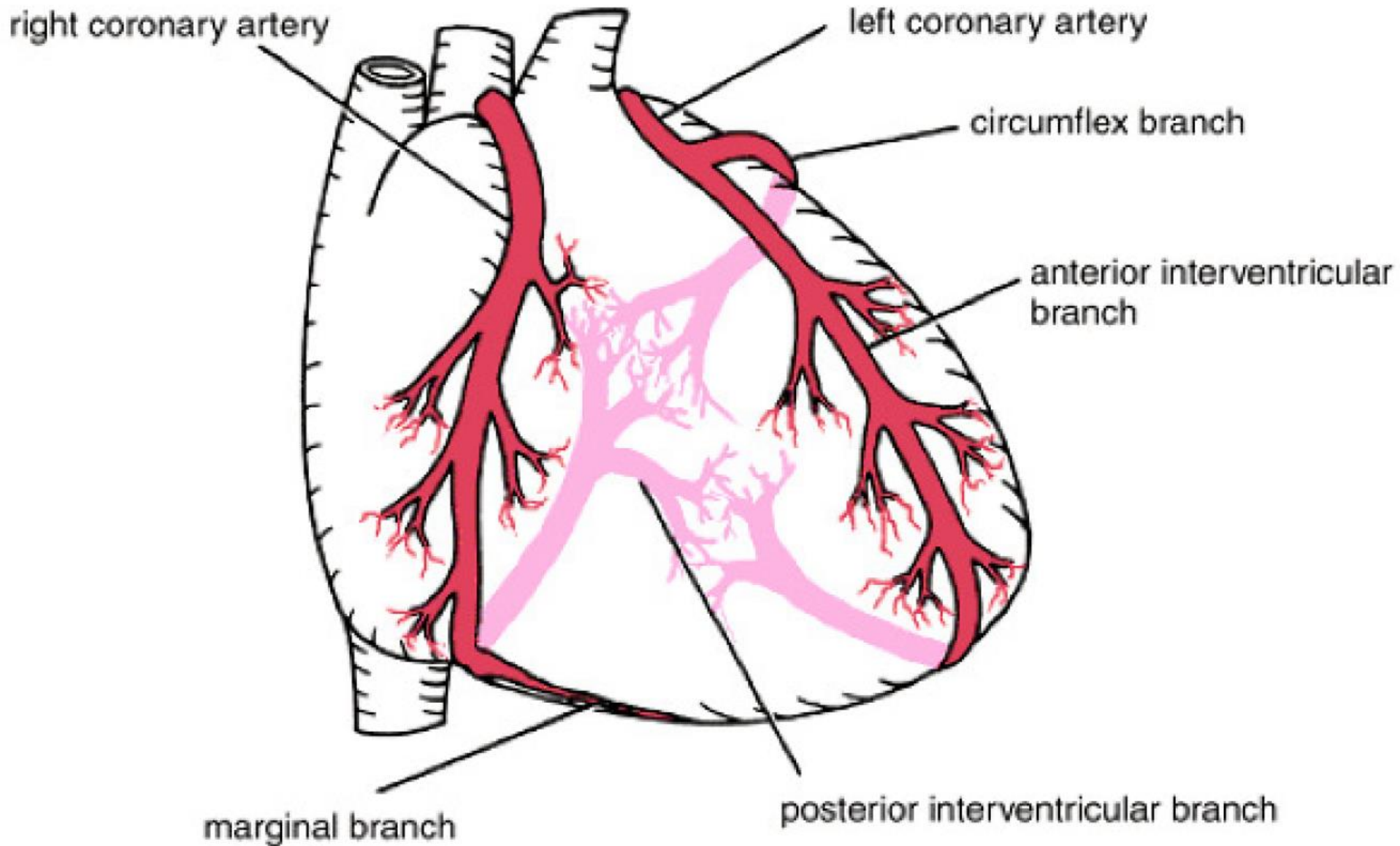
Cardiac vasculature. Superior view (atria removed).



Anterior view of coronary arterial system.



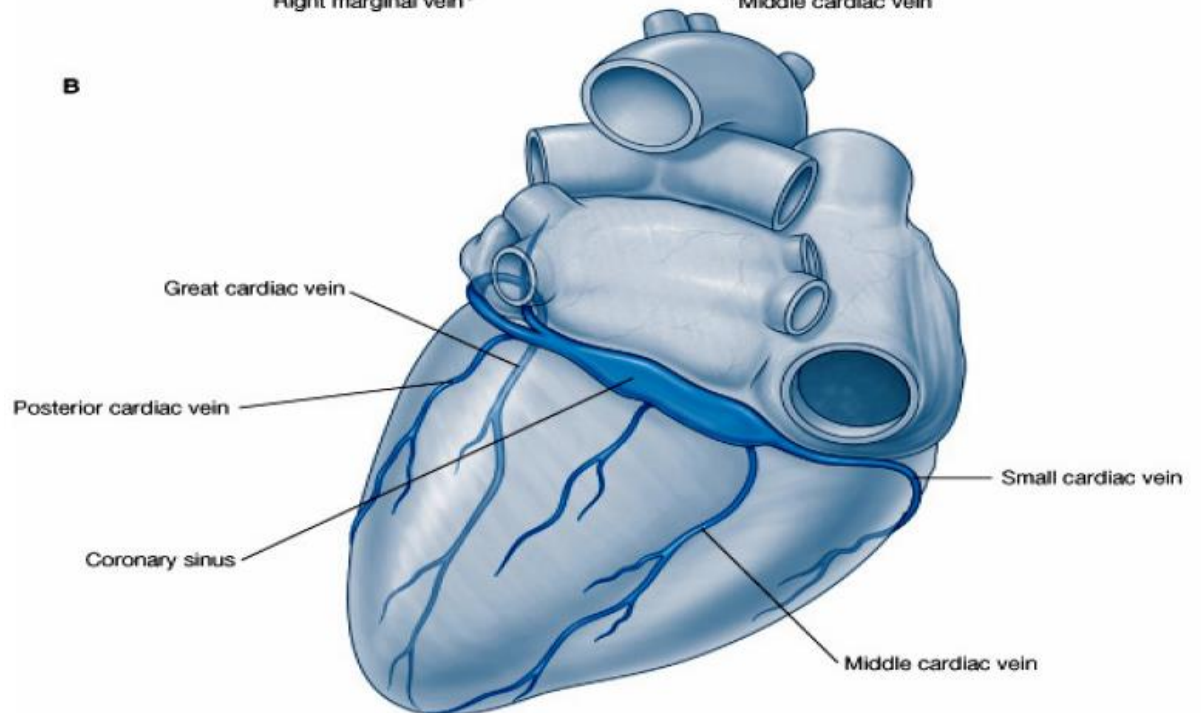
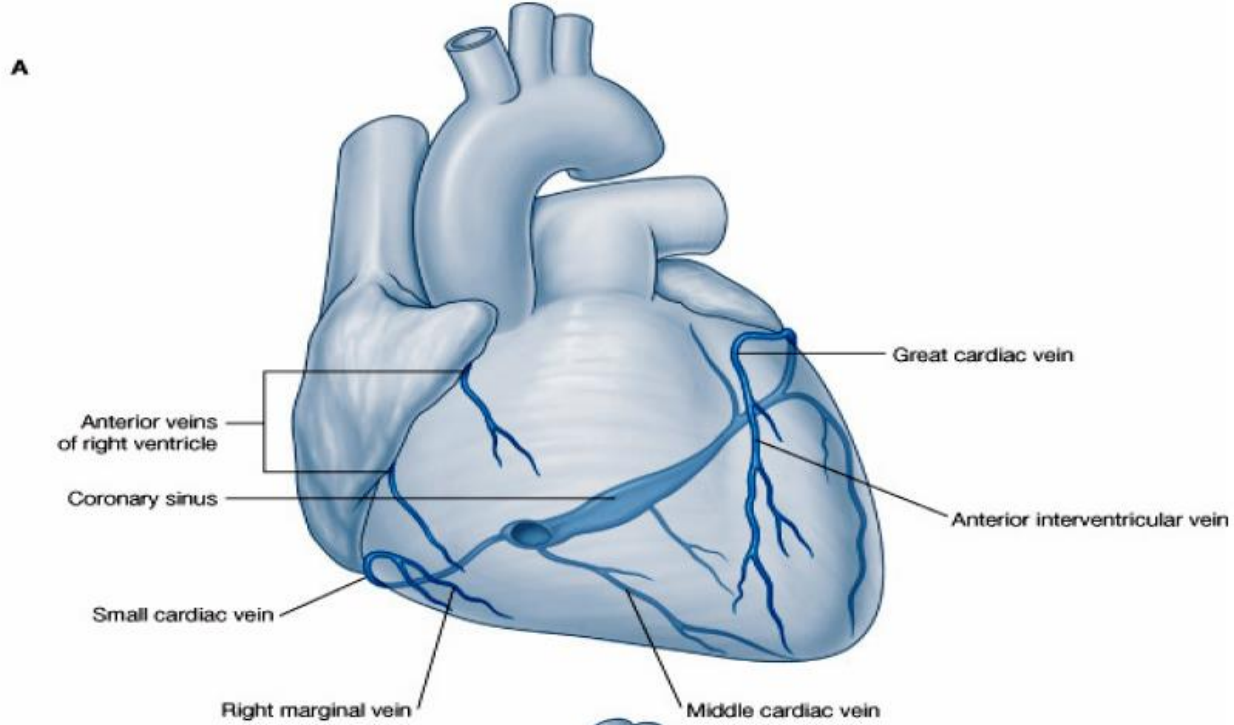
Coronary arteries



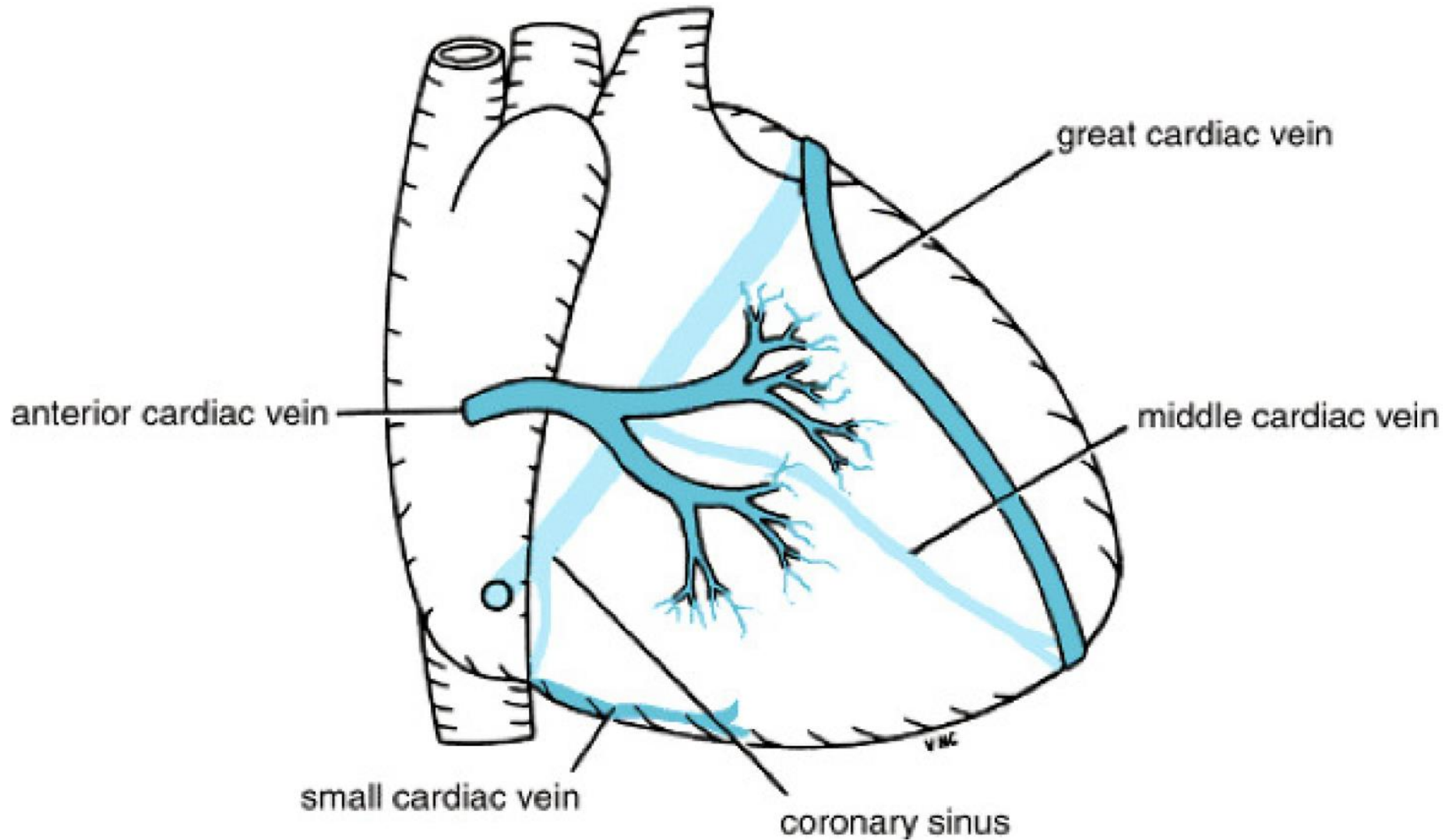
Major cardiac veins.

A. Anterior view of major cardiac veins.

B. Posteroinferior view of major cardiac veins.



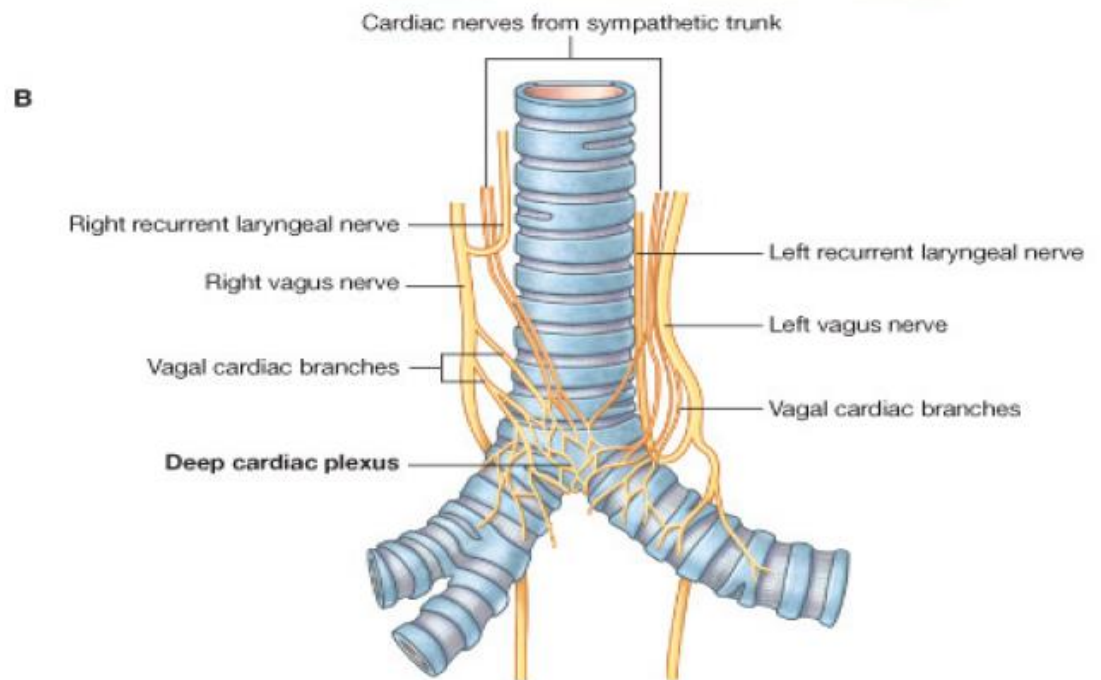
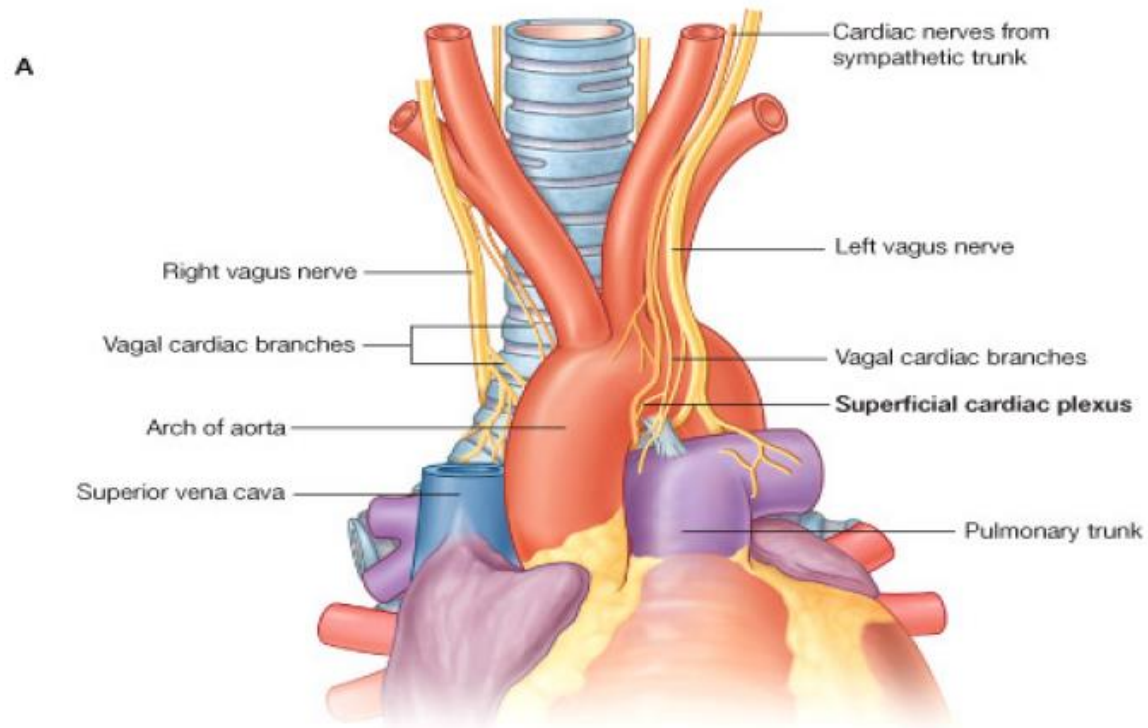
Cardiac veins



Cardiac plexus.

A. Superficial.

B. Deep.



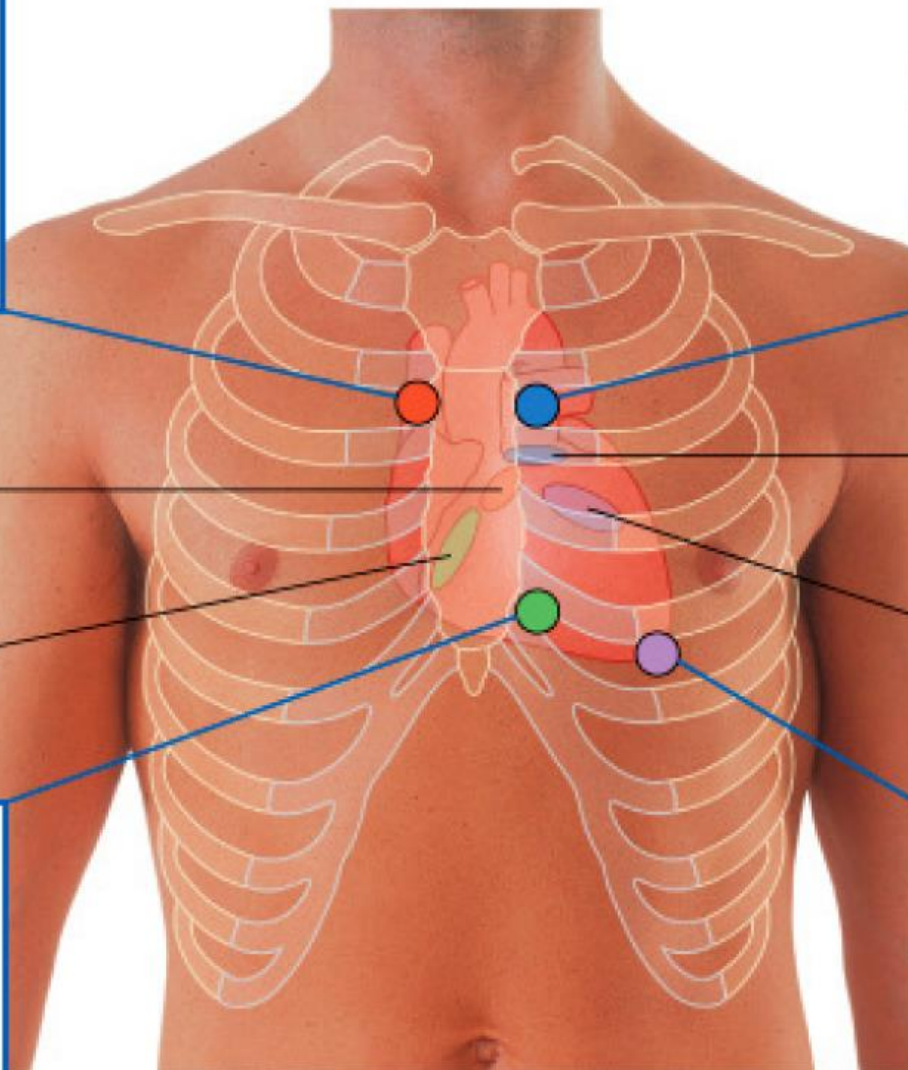
Where to listen for heart sounds?



Auscultation position for aortic valve



Auscultation position for pulmonary valve



Aortic valve

Pulmonary valve

Tricuspid valve

Mitral valve

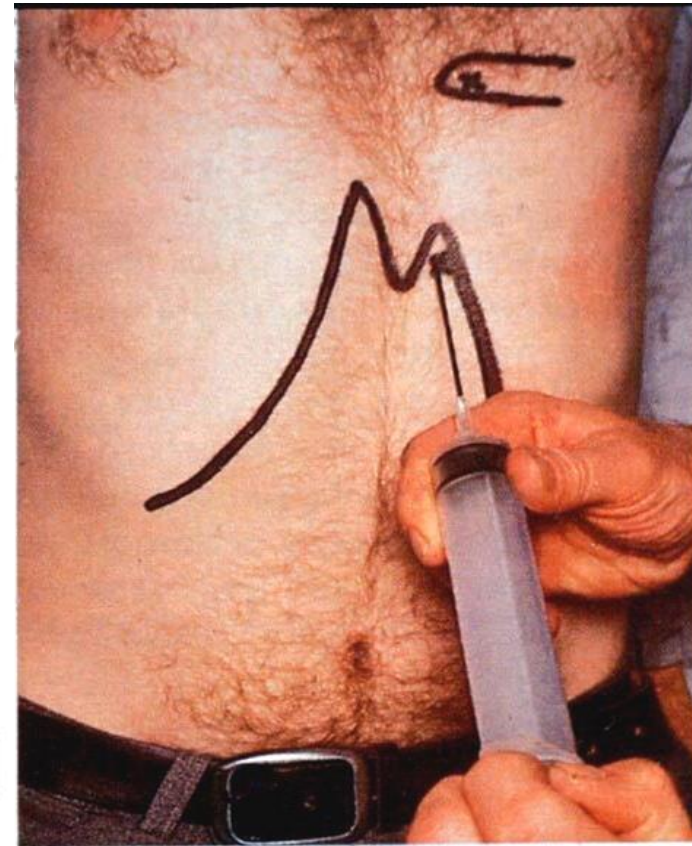
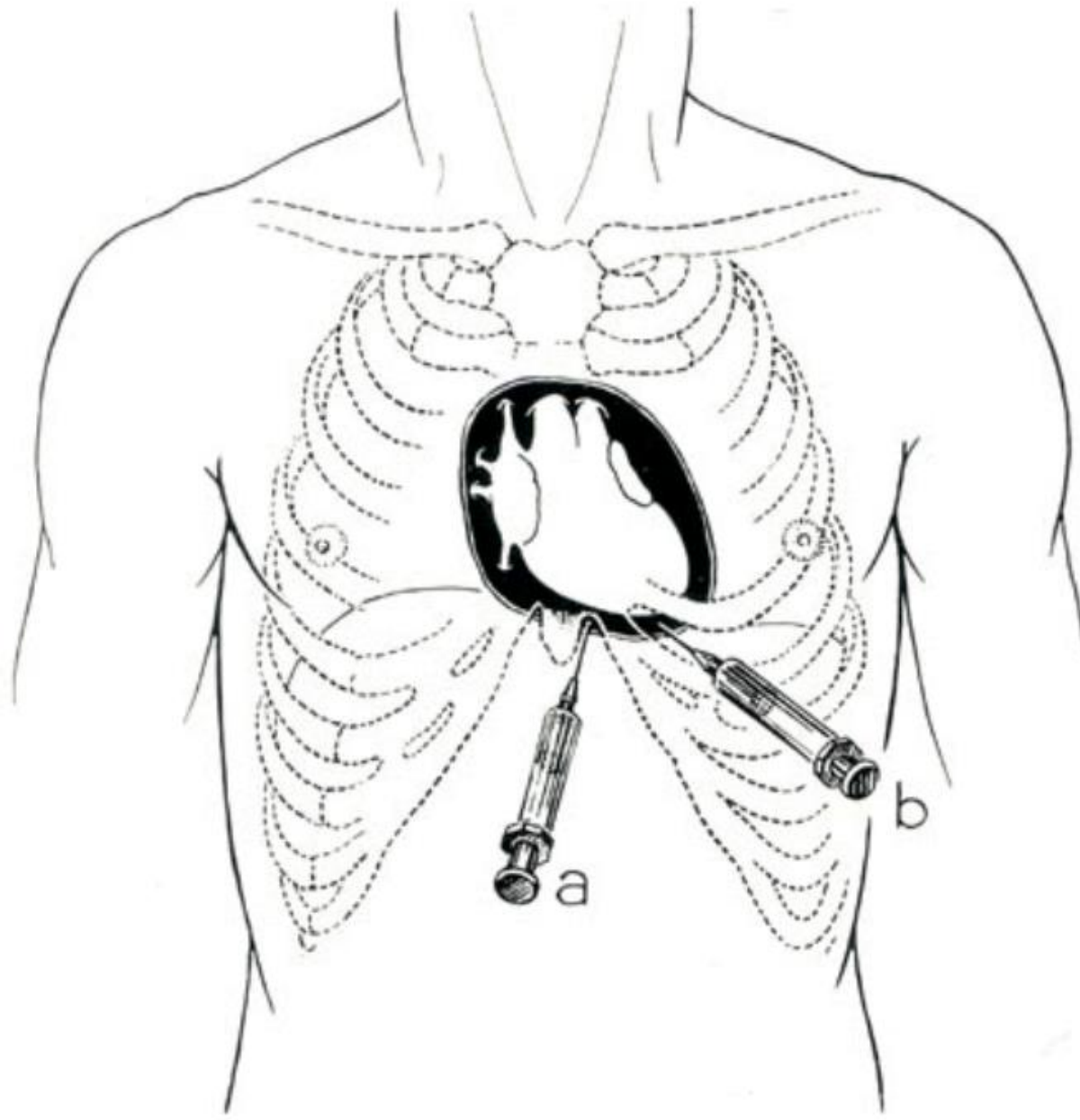


Auscultation position for tricuspid valve



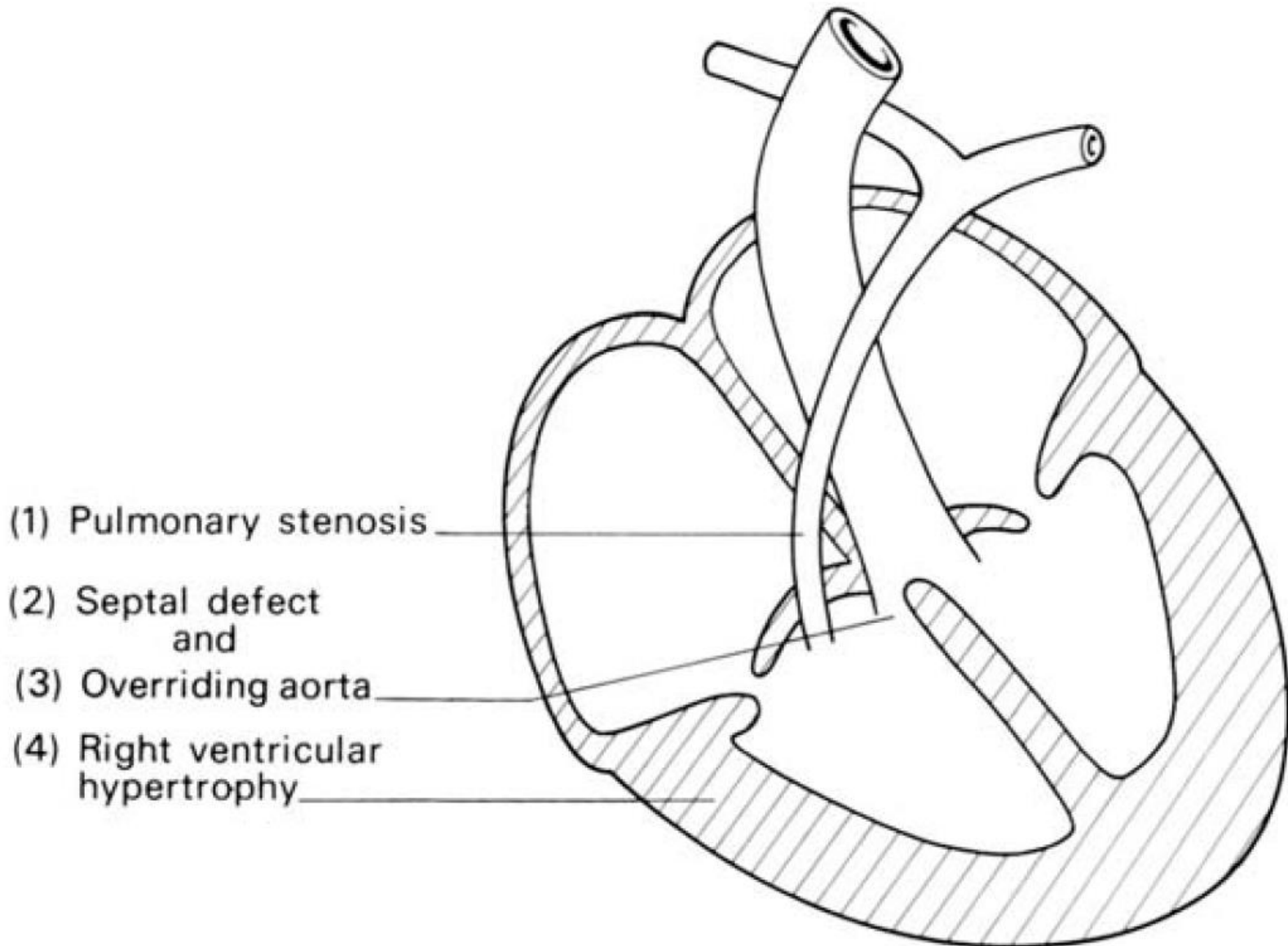
Auscultation position for mitral valve

A common treatment for **cardiac tamponade** is to carefully insert a needle through the parietal pericardium and aspirate off some of the excess fluid to relieve the pressure on the outside of the heart.



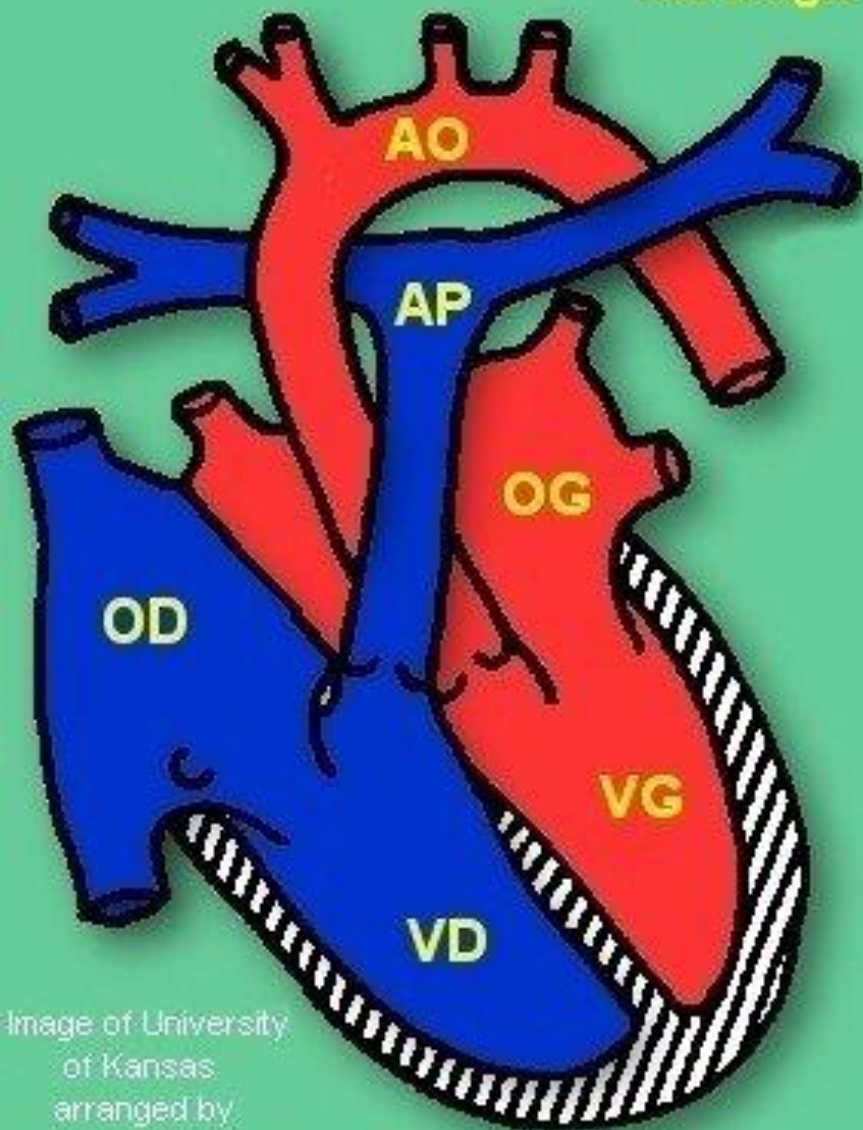
Management of cardiac tamponade by aspiration: Substernal transdiaphragmatic aspiration (a), and left lateral aspiration (b).

The tetralogy of Fallot

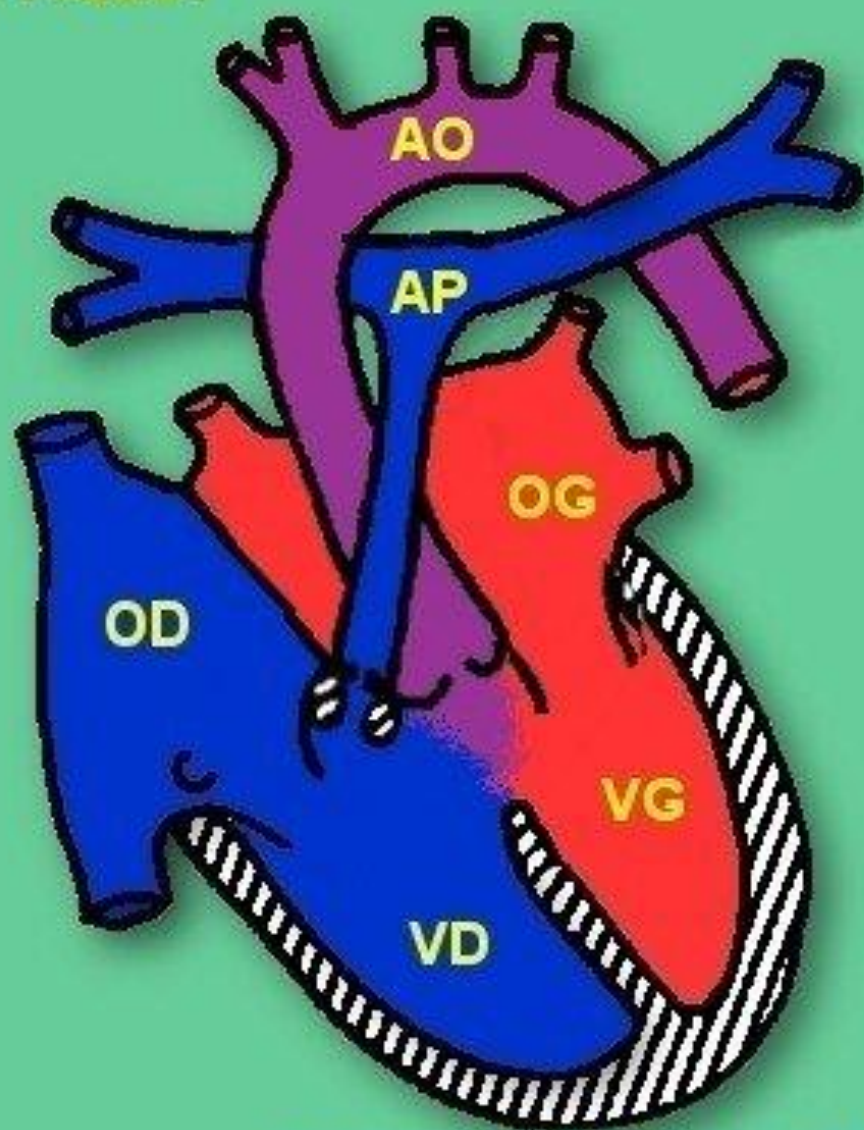


TETRALOGIE de FALLOT

Tetralogie of FALLOT



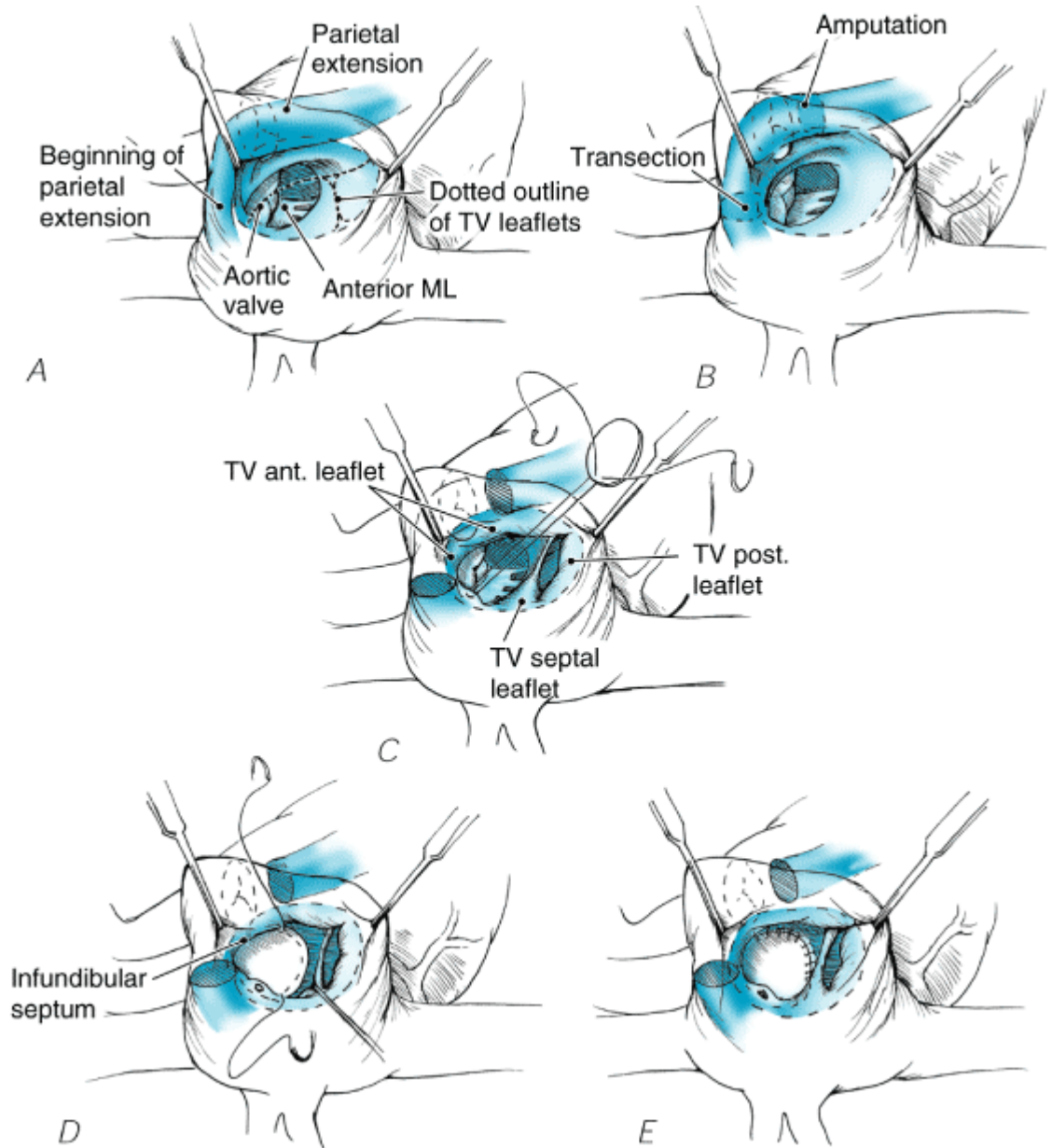
Normal



TETRALOGIE de FALLOT

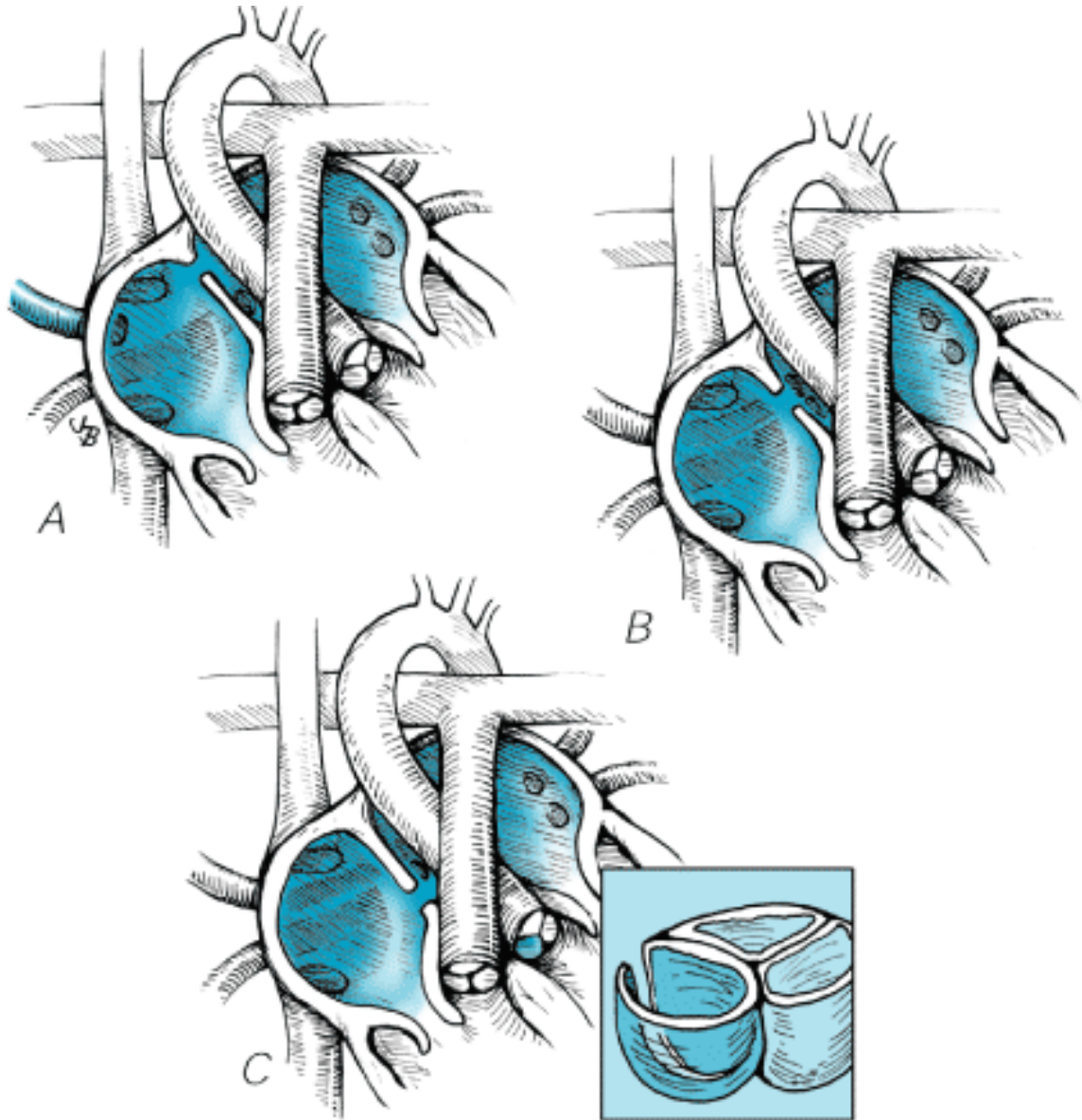
Tetralogy of Fallot

The anatomy from the perspective of the right atrium approach, shown as if the right atrial free wall and tricuspid valve were translucent. The free edge of the tricuspid leaflets is shown by dashed lines. **A.** Right ventricle perspective. **B.** The same perspective without the outline of the tricuspid valve leaflets. **C.** A pledgetted mattress suture is placed between septal and tricuspid leaflets. **D.** The suturing is continued onto the parietal extension and infundibular septum. **E.** The repair of the ventricular septal defect is completed.



Atrial Septal Defect

The anatomy of atrial septal defects. In the sinus venosus type **(A)**, the right upper and middle pulmonary veins frequently drain to the superior vena cava or right atrium. **B.** Secundum defects generally occur as isolated lesions. **C.** Primum defects are part of a more complex lesion and are best considered as incomplete atrioventricular septal defects.



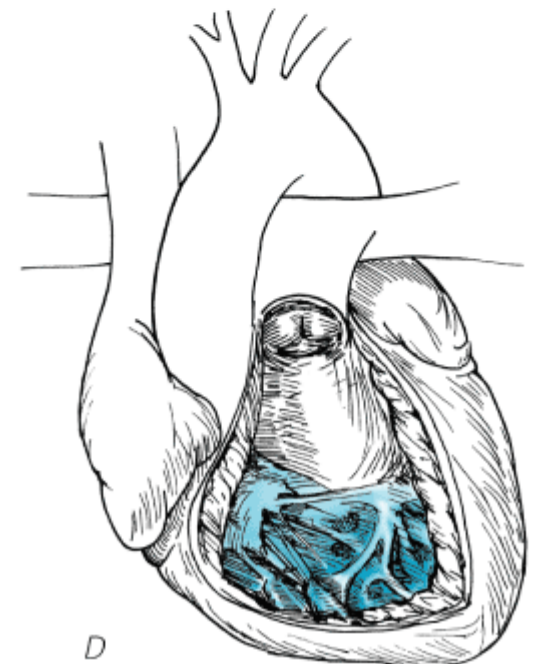
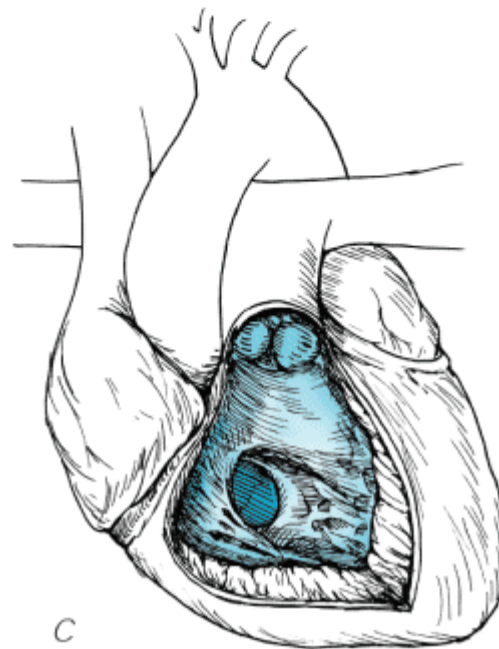
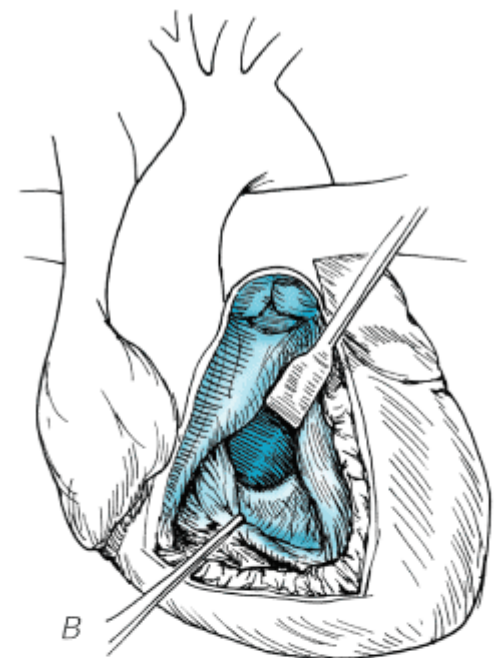
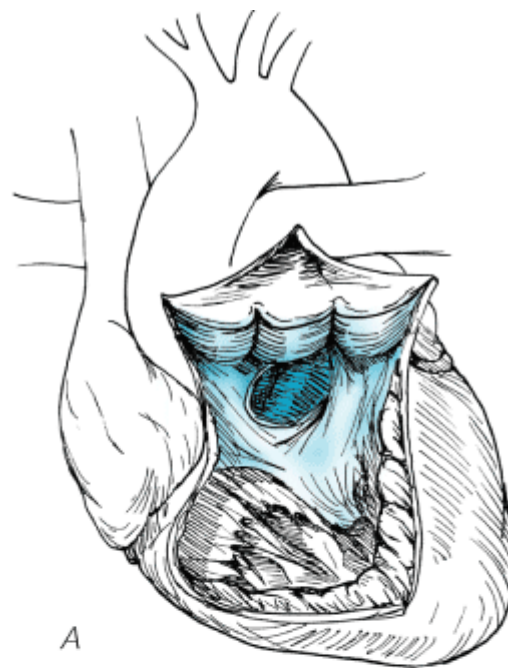
Ventricular septa defect

Classic anatomic types of ventricular septal defect (VSD). **A.** Type I (conal, infundibular, supracristal, subarterial) VSD;

B. type II or perimembranous VSD;

C. type III VSD (AV canal type or inlet septum type);

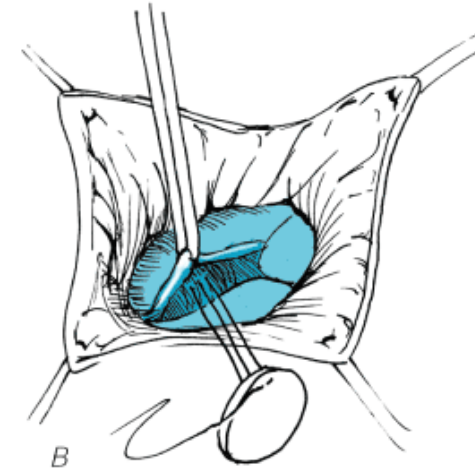
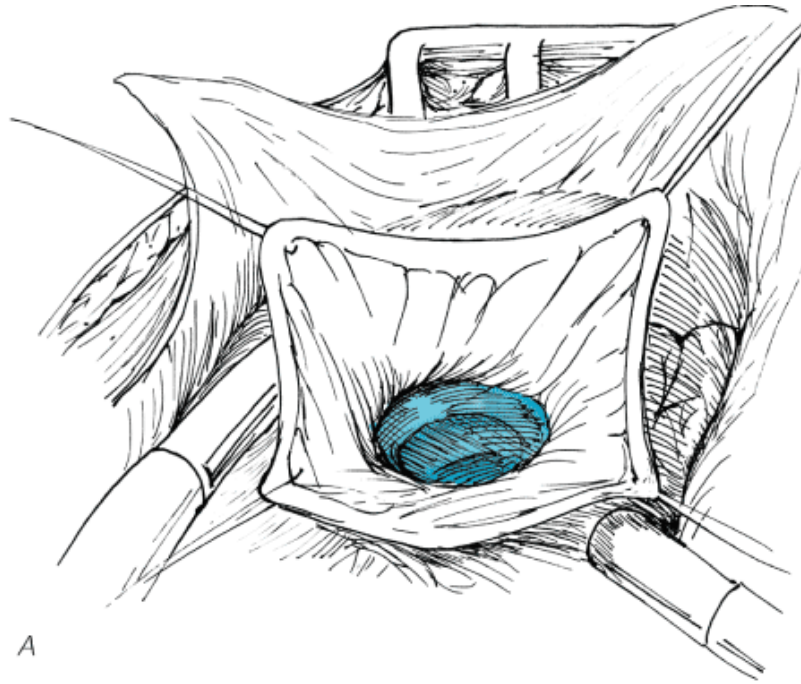
D. type IV VSD (single or multiple).



Ventricular septa defect. Treatment

A. Right atrial incision and exposure of perimembranous ventricular septal defect (VSD) in the region of the tricuspid anterosseptal commissure.

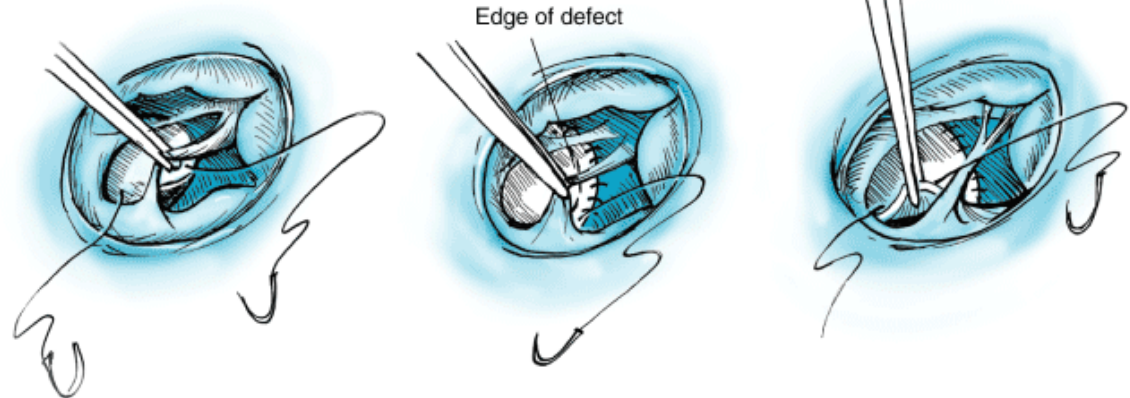
B and C. The repair of the perimembranous VSD is completed with use of a slightly oversized Dacron patch, taking care to place stitches 3 to 5 mm away from the edge of the defect itself to avoid injury to the conduction system.



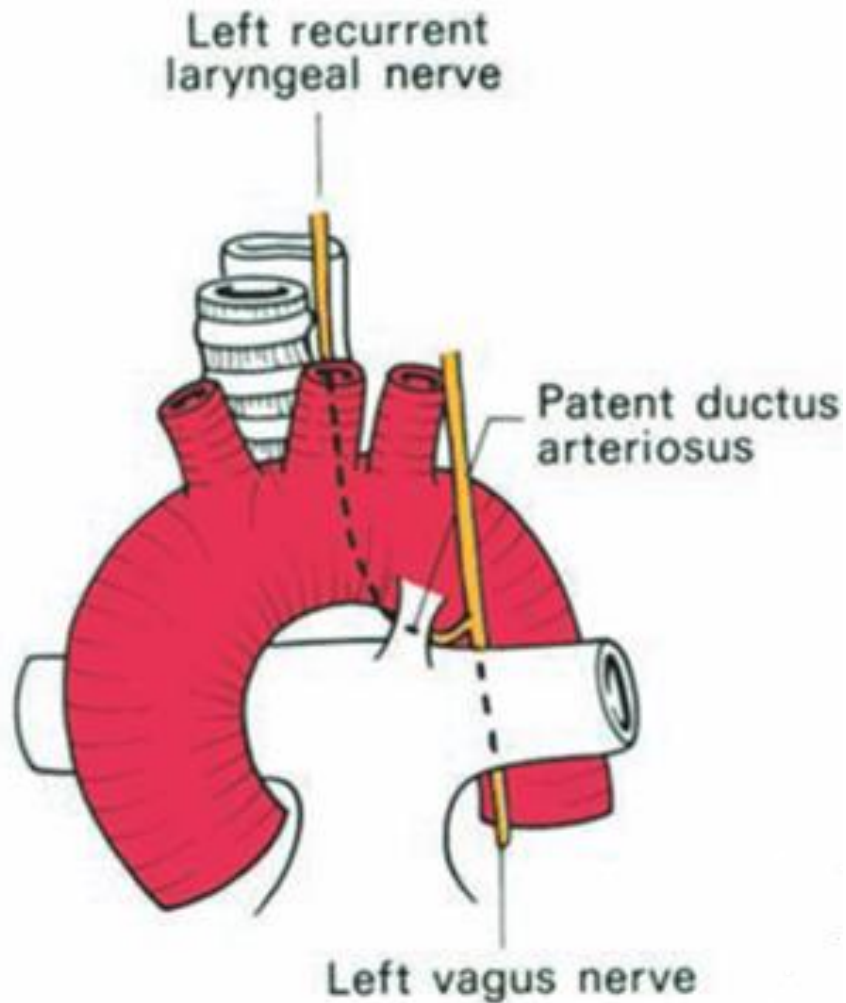
A

B

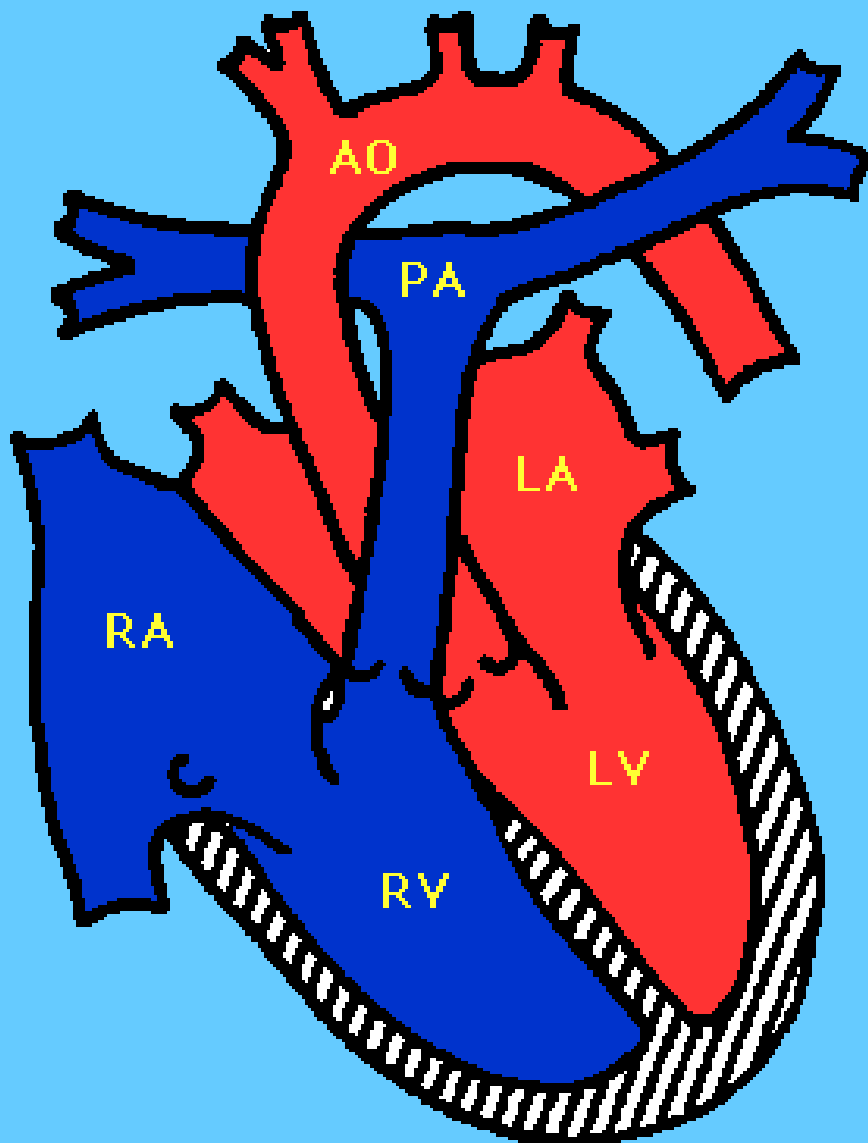
C



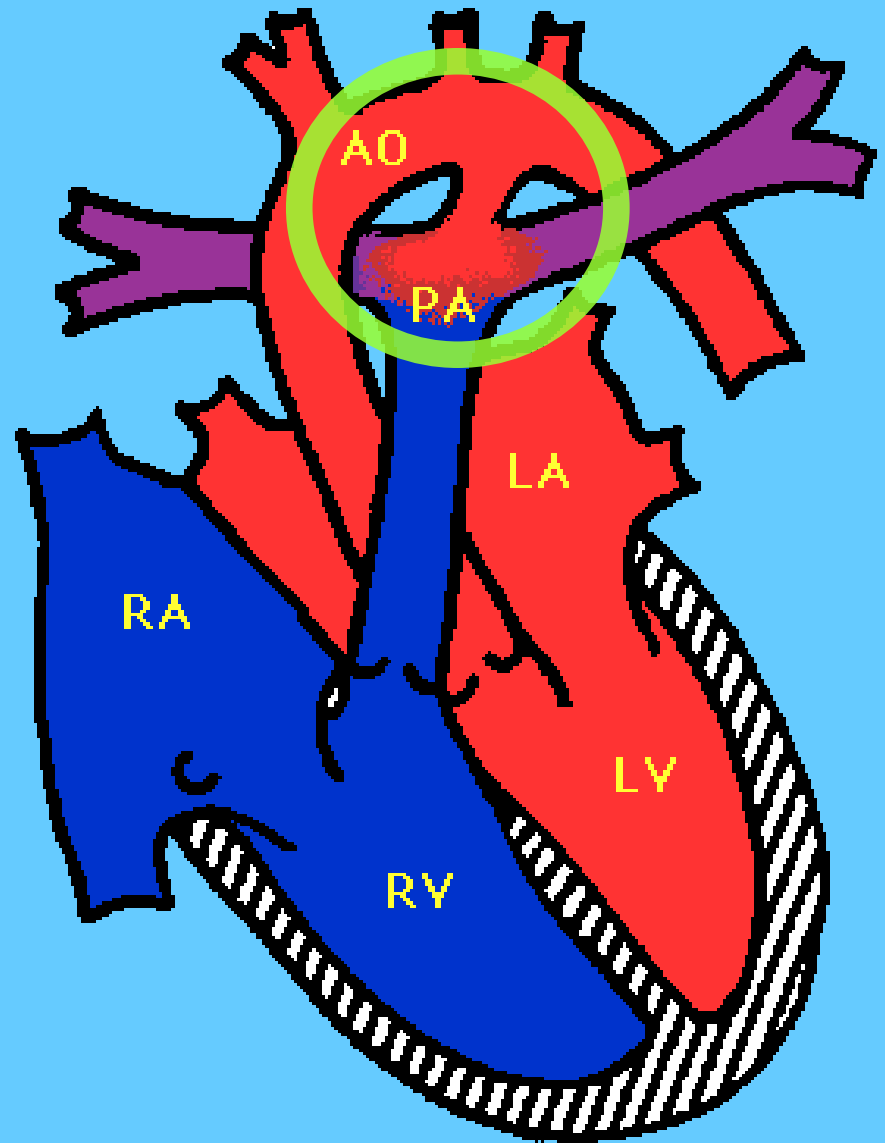
Persistent ductus arteriosus - showing its close relationship to the left recurrent laryngeal nerve.



Patent Ductus Arteriosus

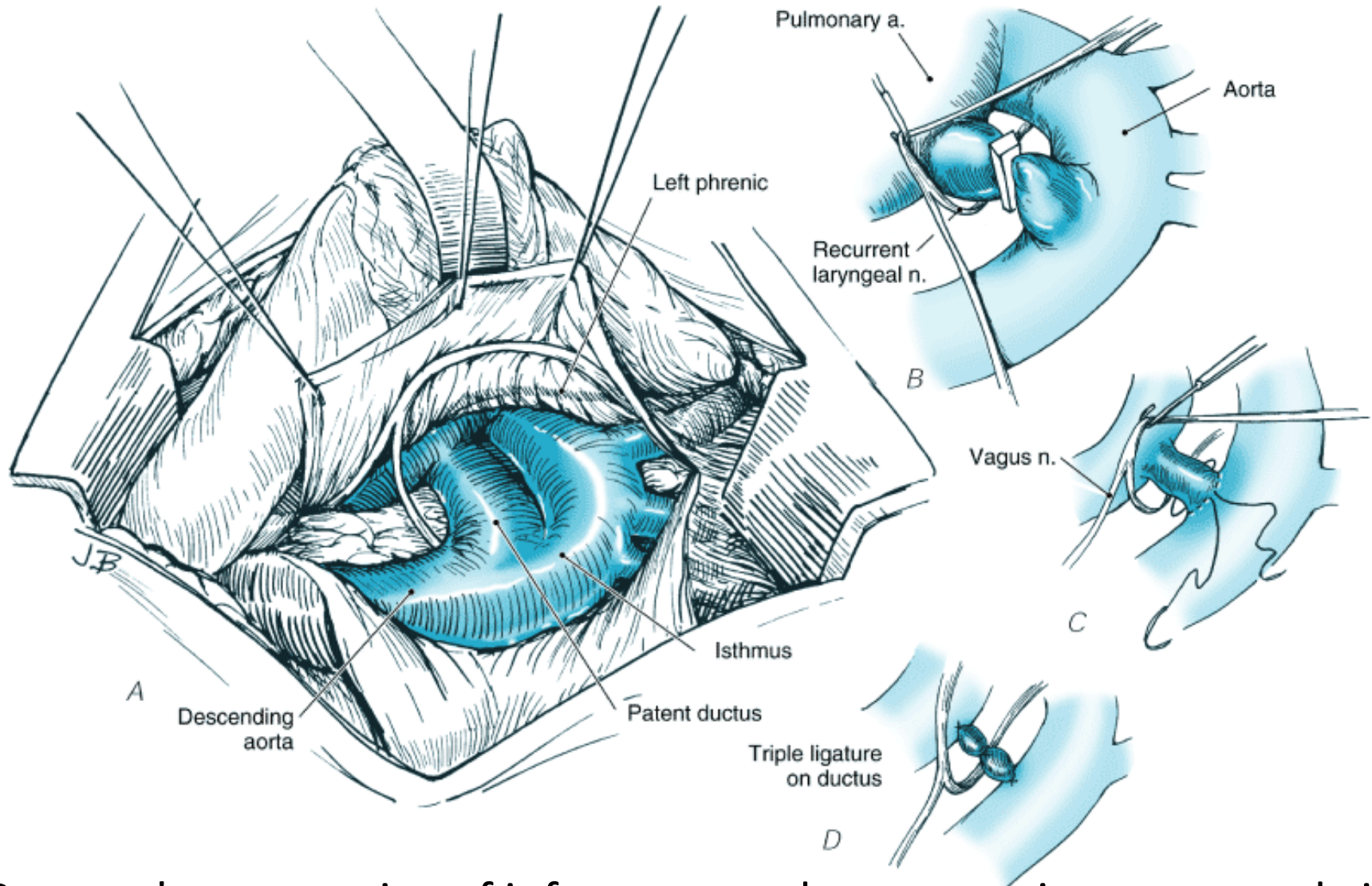


Normal



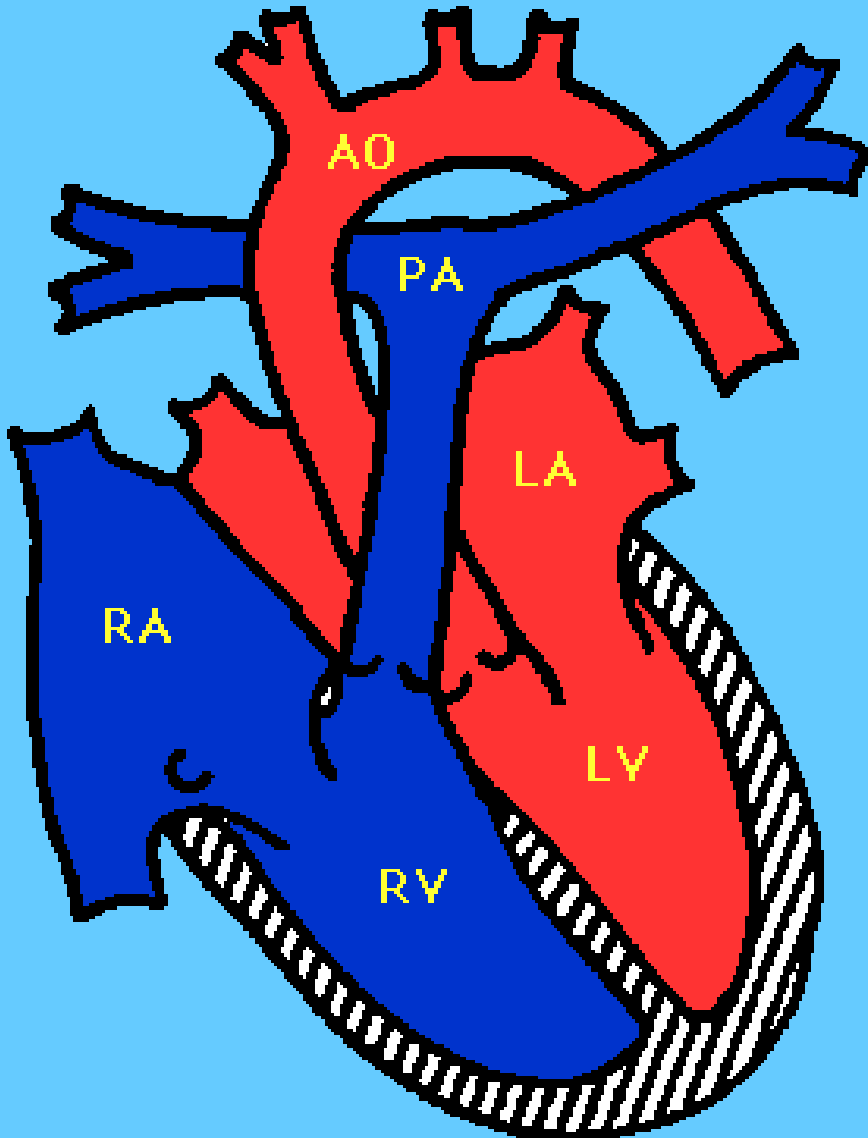
Patent Ductus Arteriosus

Patent Ductus Arteriosus

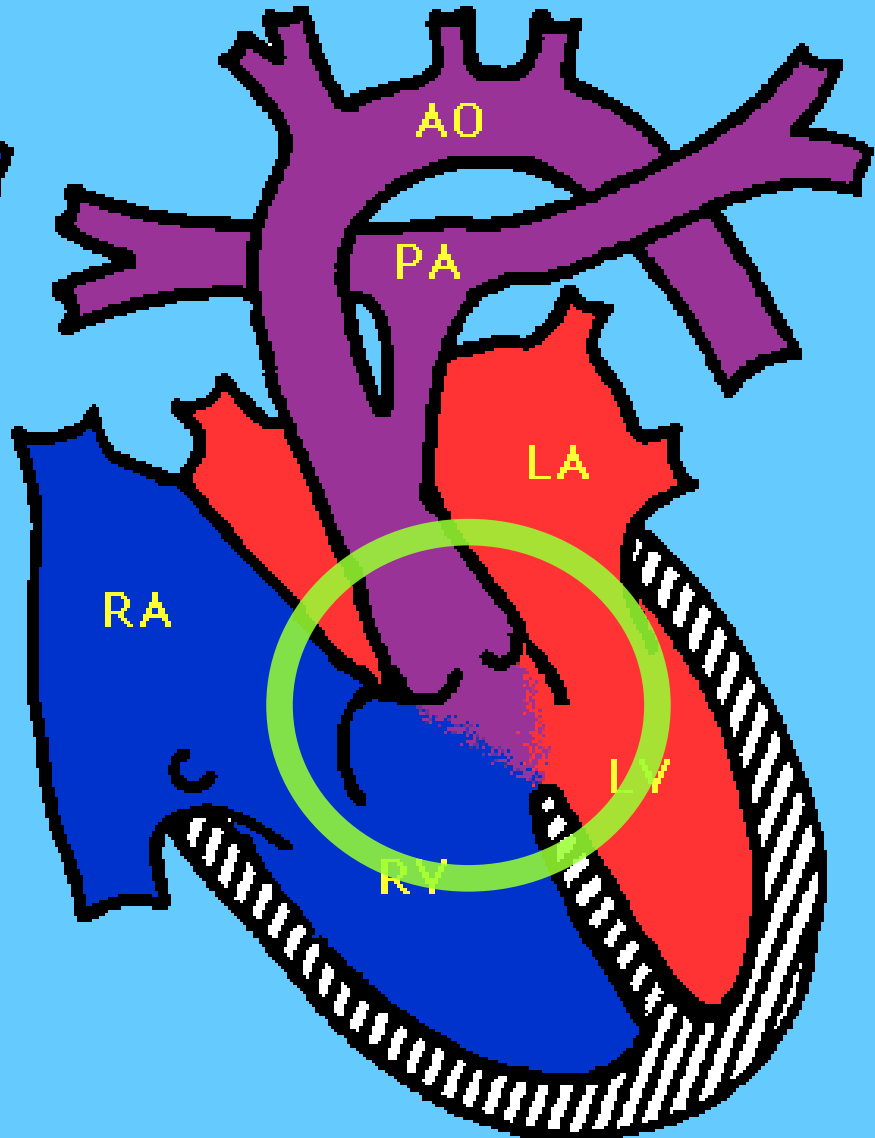


A. Surgeon's perspective of infant patent ductus arteriosus exposed via a left thoracotomy. **B.** The pleura over the aortic isthmus is incised and mobilized. **C and D.** Technique of triple ligation.

Truncus Arteriosus

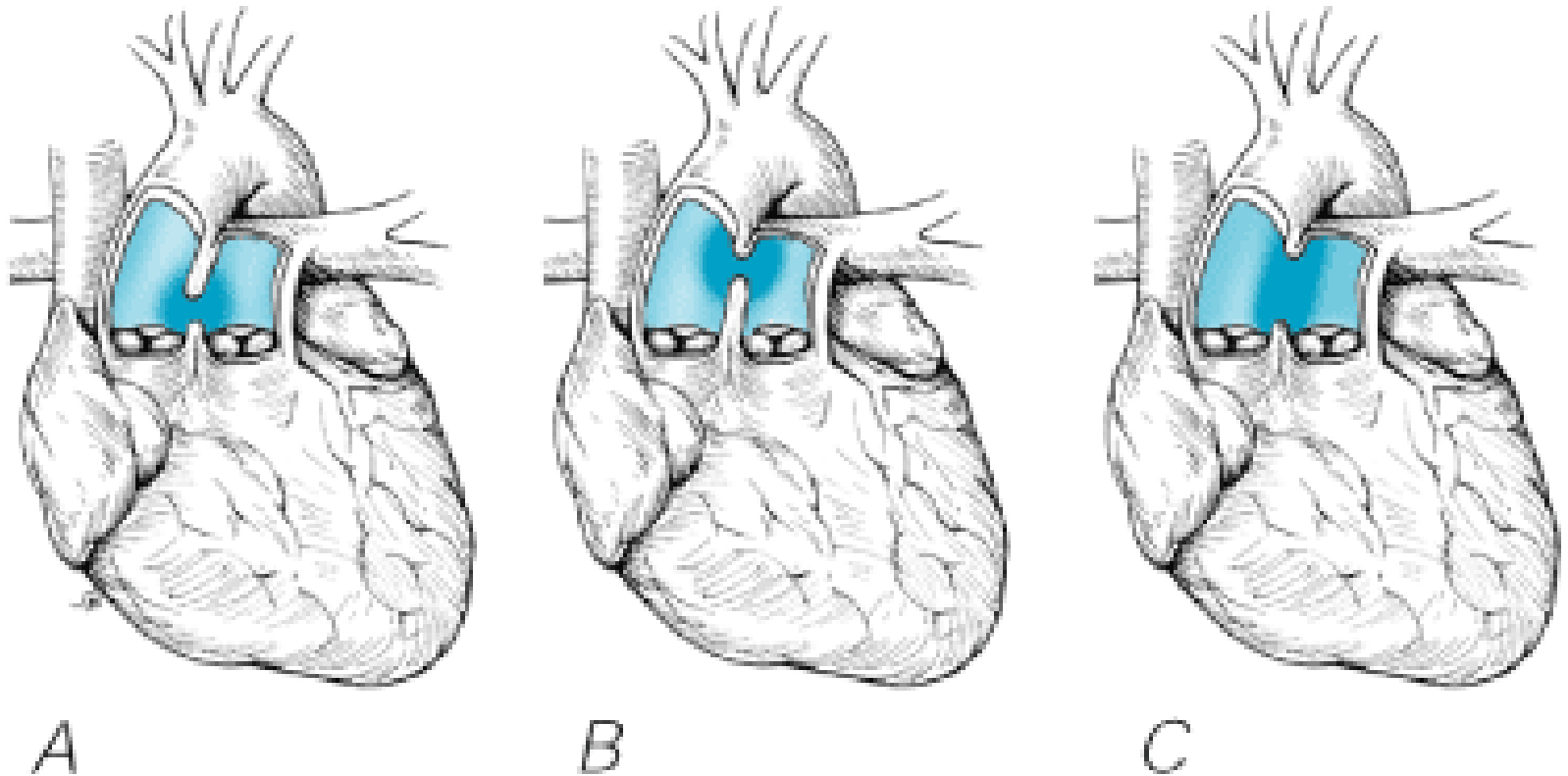


Normal



Truncus Arteriosus

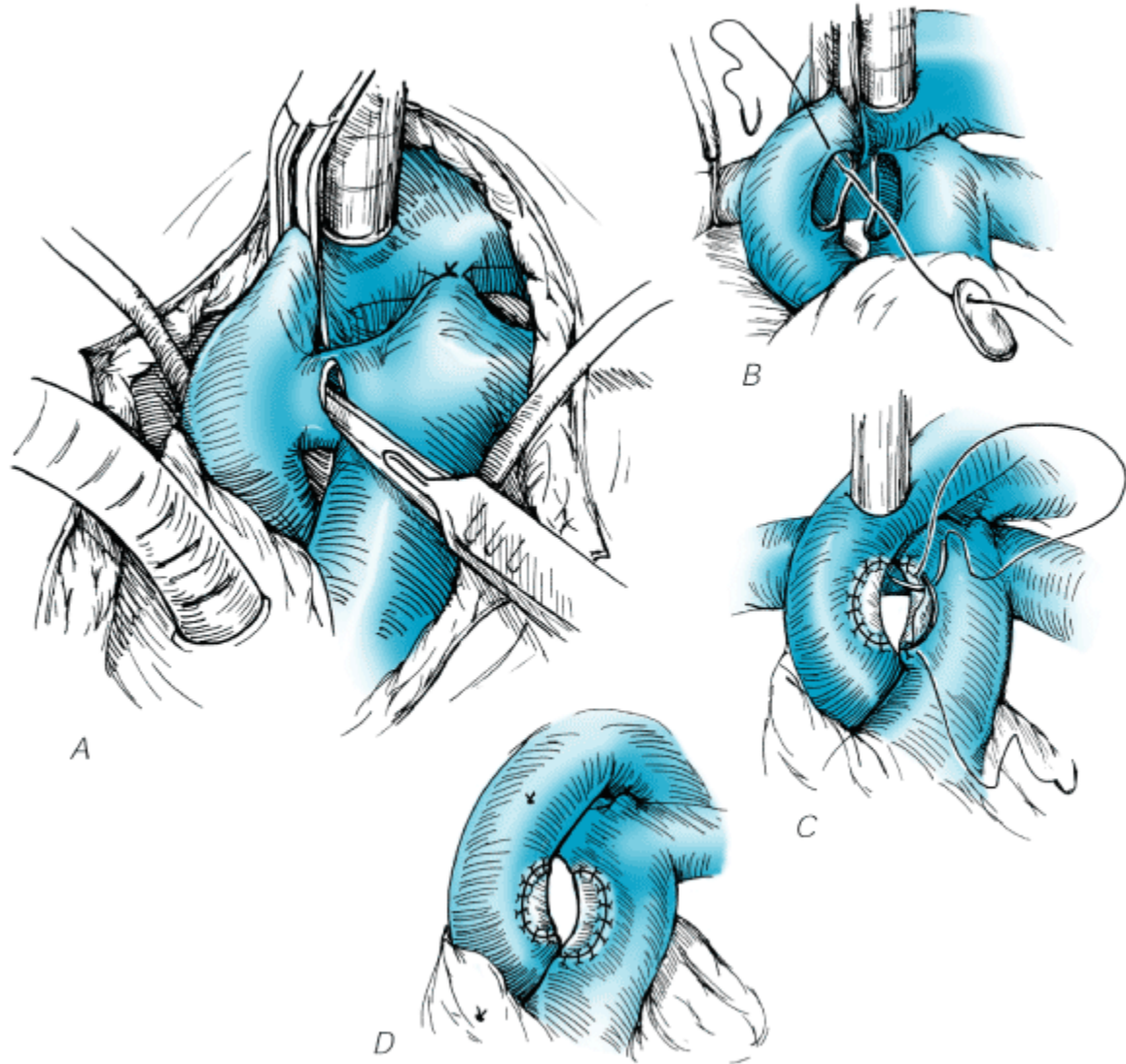
Aortopulmonary Window



Classification of aortopulmonary window. **A.** Type I proximal defect; **B.** Type II distal defect; **C.** Type III total defect.

Aortopulmonary Window

Two-patch repair of aortopulmonary window. **A.** The aorta and right atrium are cannulated through a median sternotomy, and once the patient is on cardiopulmonary bypass, the right and left pulmonary arteries are occluded with snares. **B.** A piece of previously prepared pulmonary homograft material is used to patch the aortic defect. **C.** Once the aortic portion of the defect has been safely repaired, the aortic cross-clamp may be removed to restore perfusion to the heart. **D.** At the completion of repair the patient is easily weaned from cardiopulmonary bypass and the cannulas are removed.



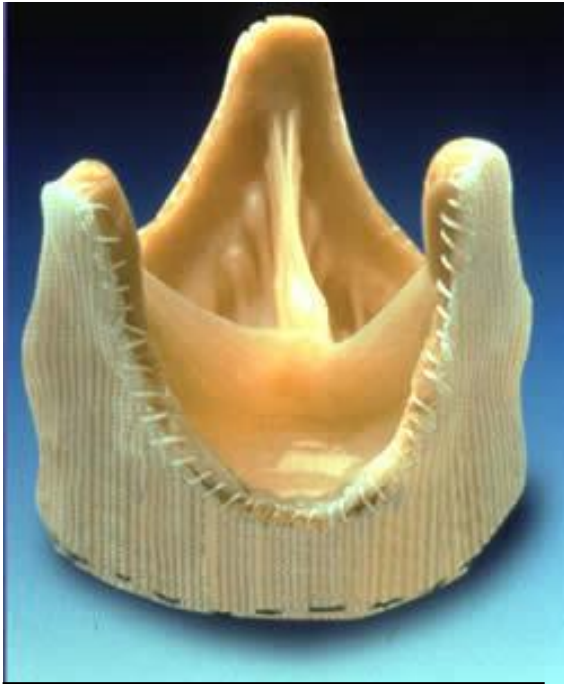
**Valvular Heart
Disease**



Mechanical valve



Cow pericardium valve



Pig tissue valve



Human cadaver valve

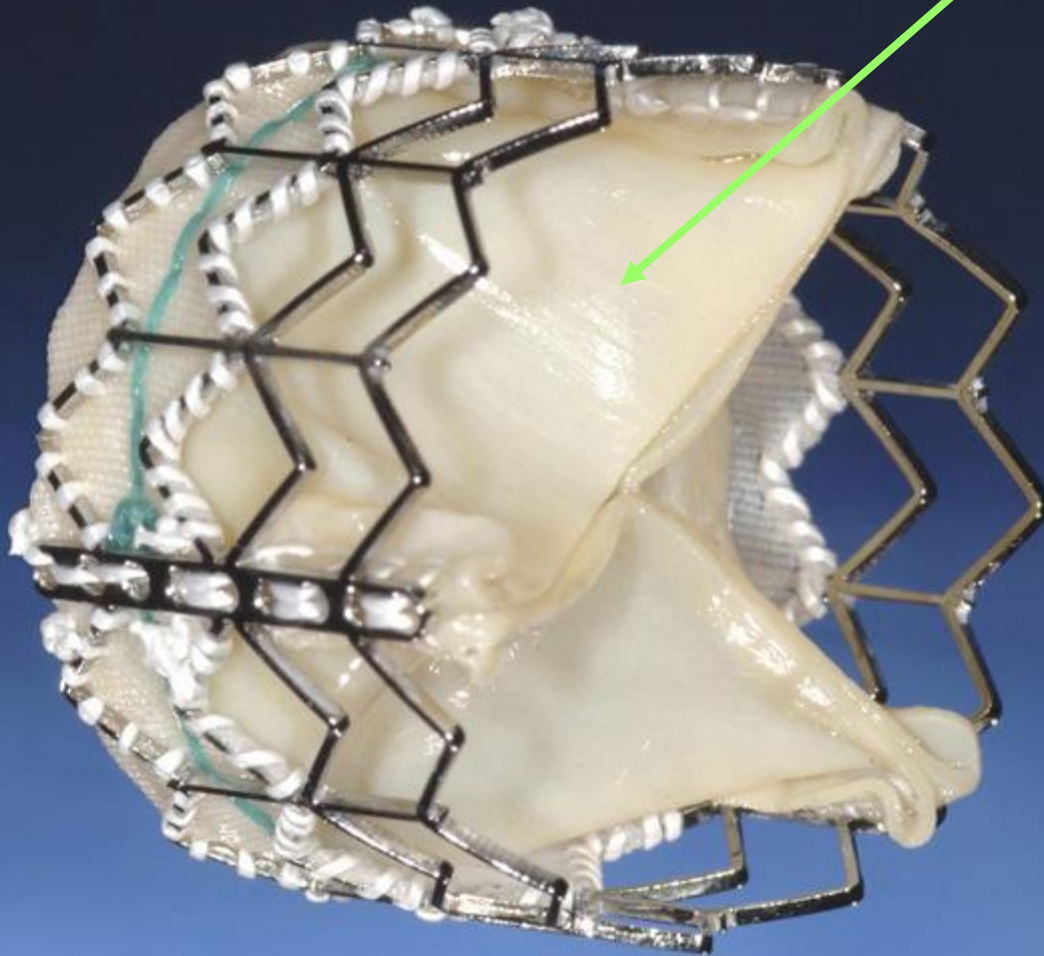


New option: put valve in with a stent (old valve is dilated but left in place).

The Cribier-Edwards percutaneous heart valve is crimped down to the diameter of a pencil onto a balloon catheter for insertion into the patient's artery.



Equine pericardium!



When open it is about the diameter of a quarter

