

# PLEURAL SPACE AND THYMUS

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# PLEURA

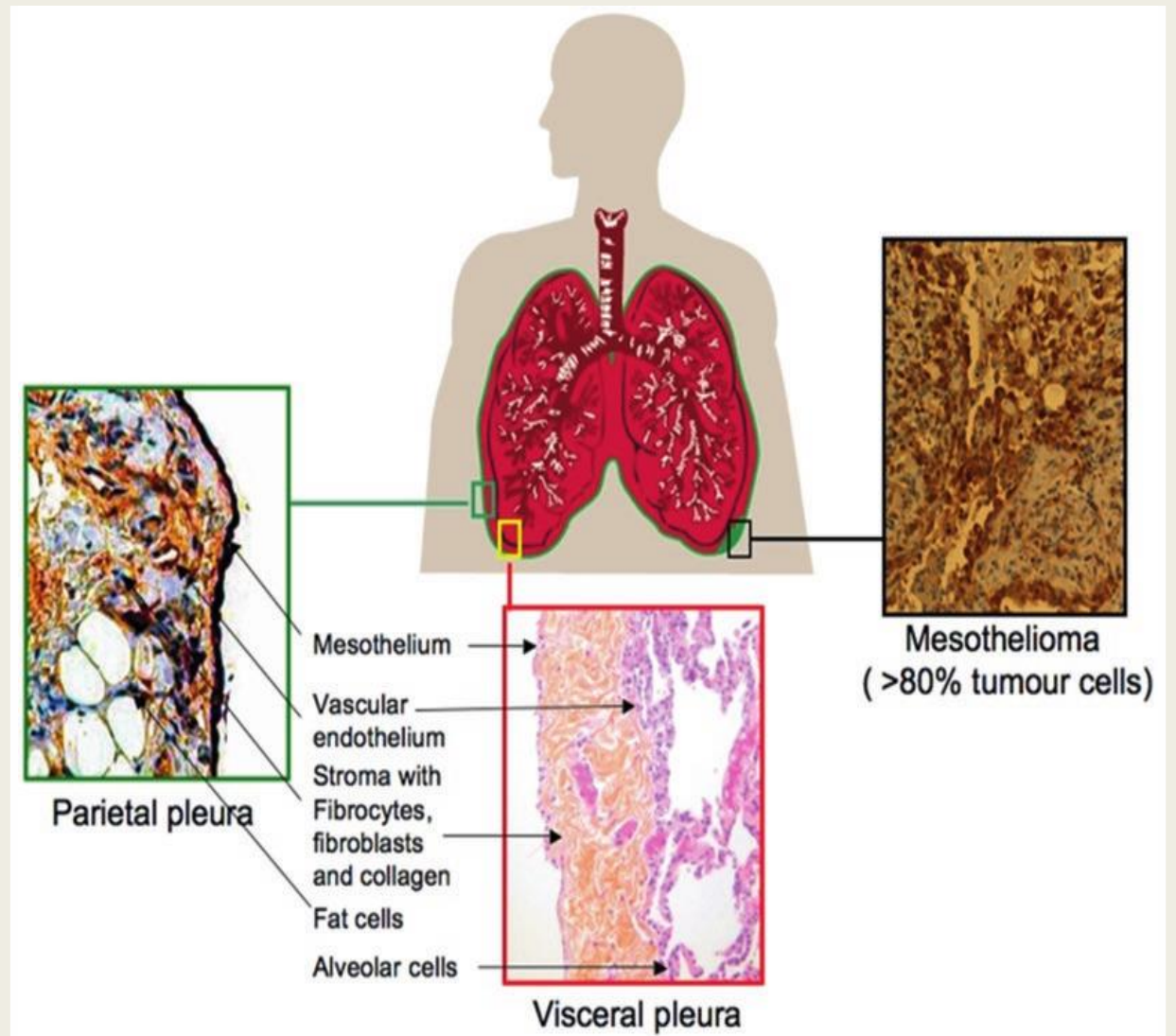
Surfaces of the thoracic cavity are covered by pleura that is a thin *serous membrane* formed from a layer of squamous mesothelial cells tightly attached by a network of dense connective tissue containing elastic and collagenous fibers

The sub-mesothelial layer comprises dense connective tissues, blood vessels, and lymphatics:

- **VISCERAL PLEURA** covers lung and the extends into fissures
- **PARIETAL PLEURA** covers the inside of rib cage, diaphragm, and mediastinum

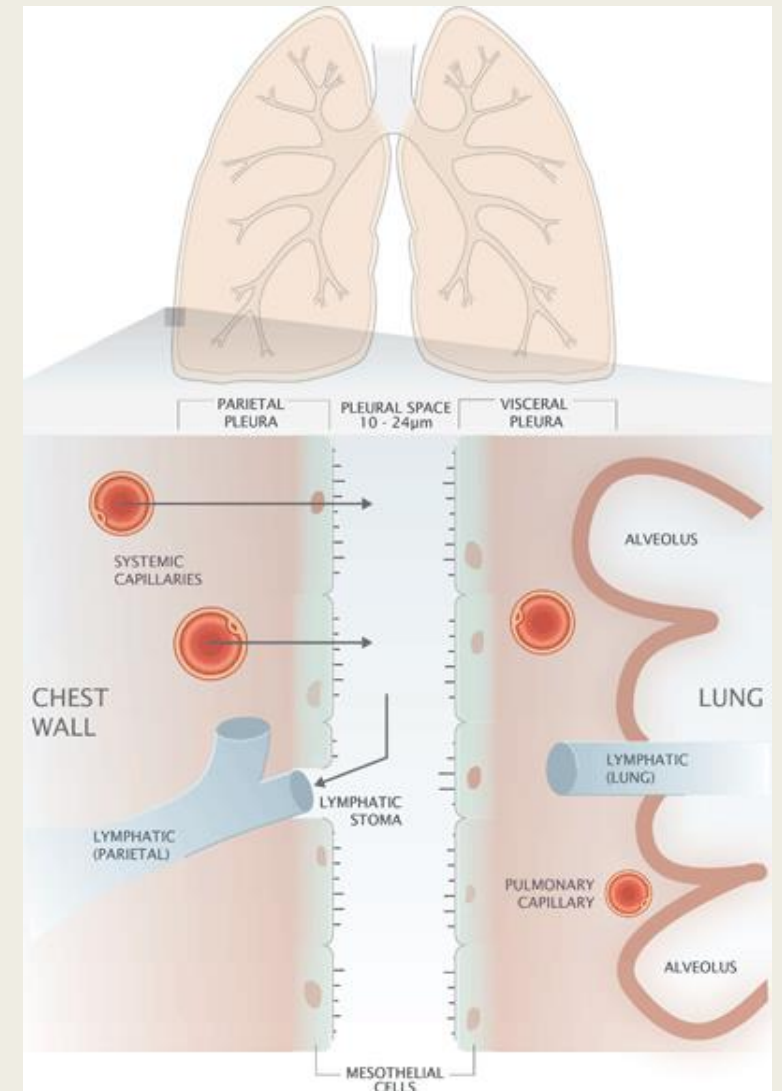
VISCERAL PLEURA covers the entire surface of lungs, infiltrating into fissures between the lobes, tightly attached to the pulmonary fibroelastic network

PARIETAL PLEURA has some differences from visceral pleura. It is made up from only one layer of cuboidal mesothelial cells sustained by loose connective tissue (1-4 $\mu$ m)



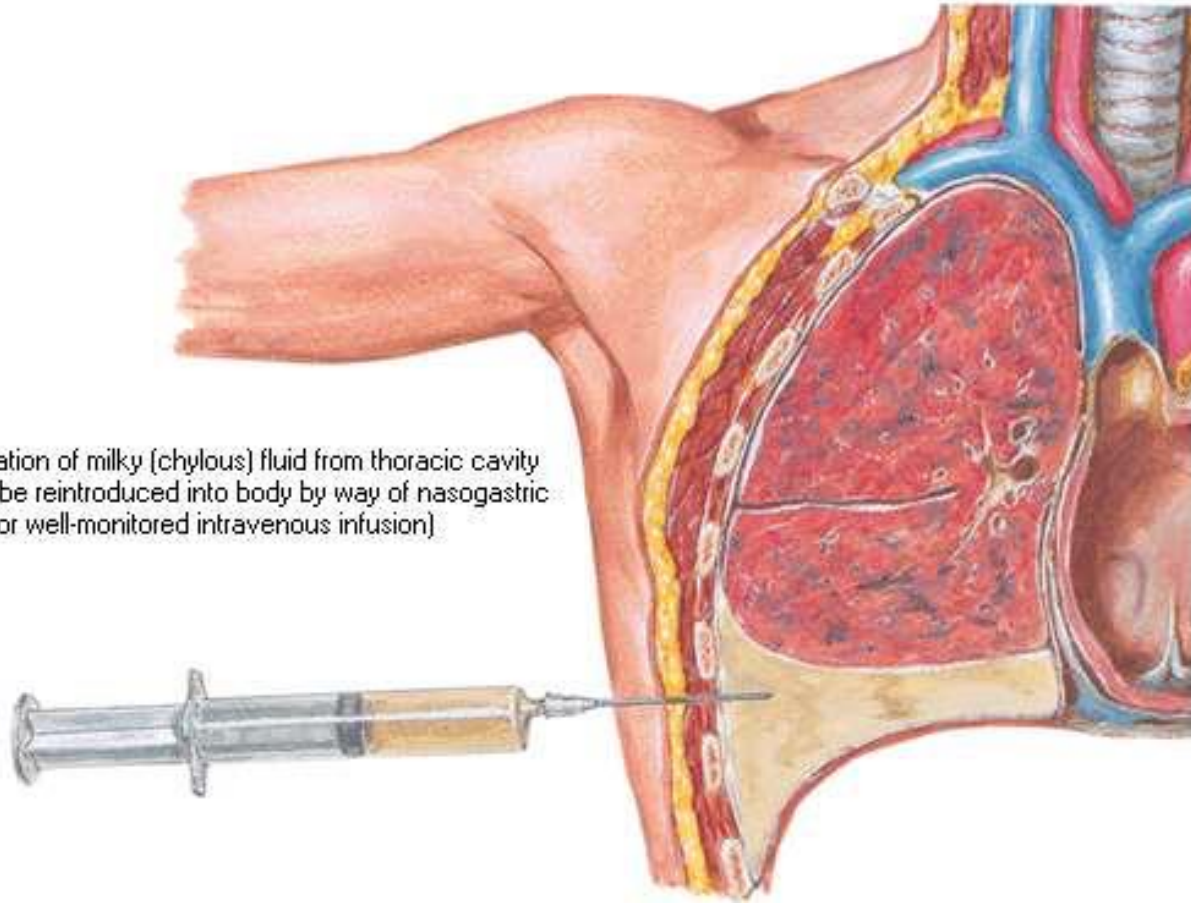
PARIETAL PLEURA is connected to the endothoracic fascia, adheres to the periostum of ribs and the fascia of intercostal muscles

The space between the pleurae is called the PLEURAL CAVITY and is filled with fluid Pleural fluid contributes to breathing by acting as a lubricant



## Chylothorax Diagnosis

Aspiration of milky (chylous) fluid from thoracic cavity  
(may be reintroduced into body by way of nasogastric  
tube or well-monitored intravenous infusion)





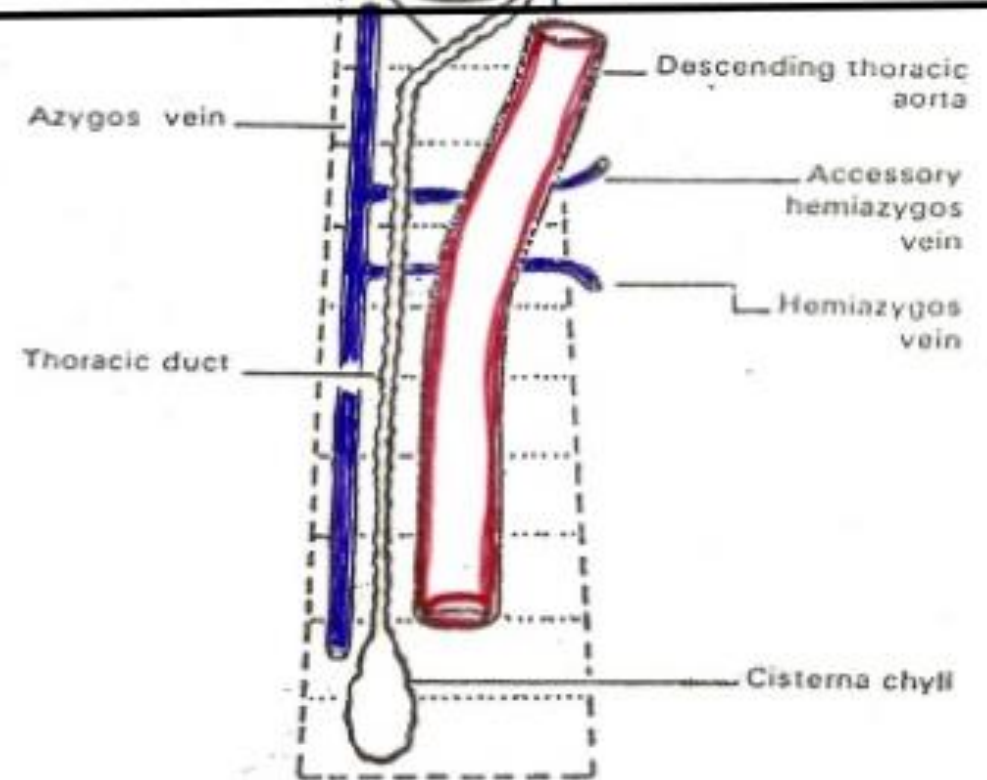
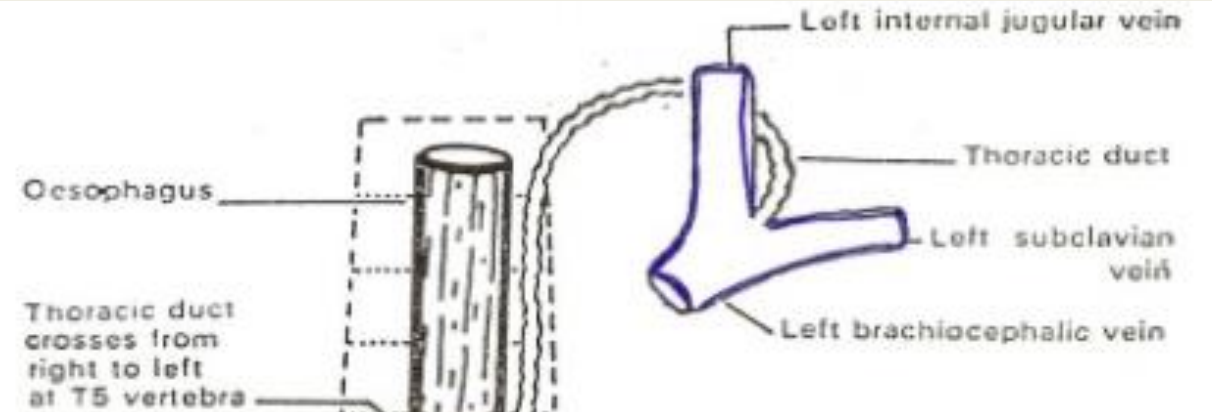
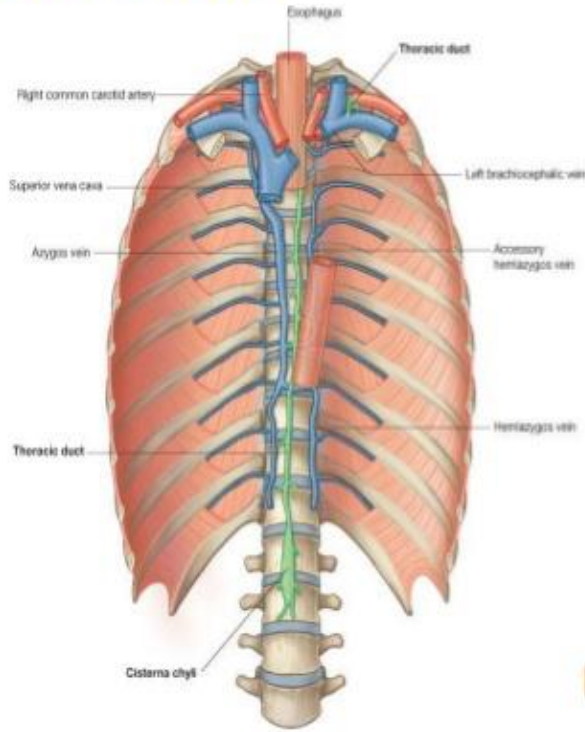
# Thoracic duct

- Is the largest lymphatic trunk which drains chyle (product of fat digestion) & most lymph of body.

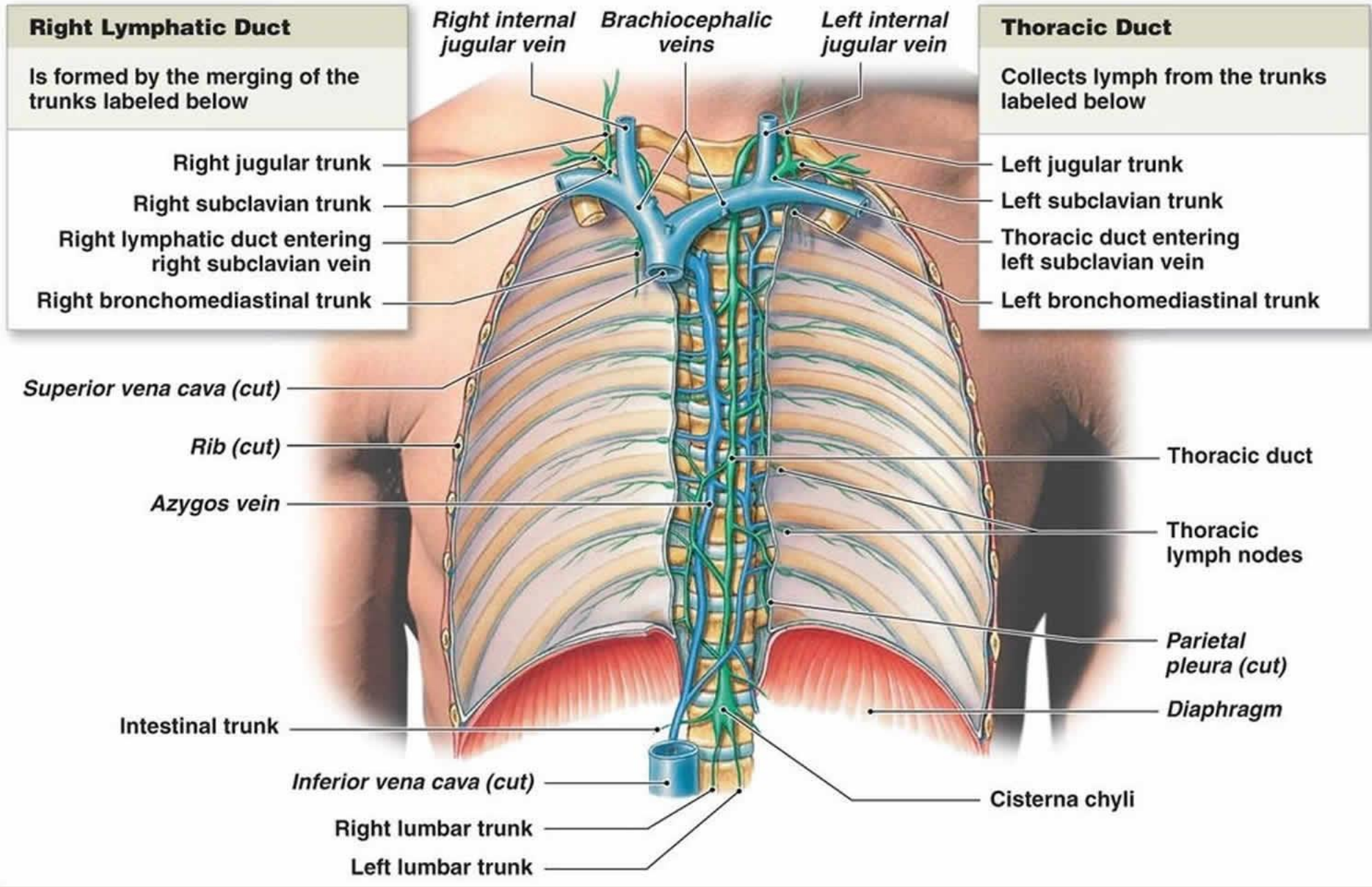
- **Extent**- Upper abdomen at lower border of T12 to lower part of neck, crossing post & sup mediastinum

- 45cms long & 0.5cms wide

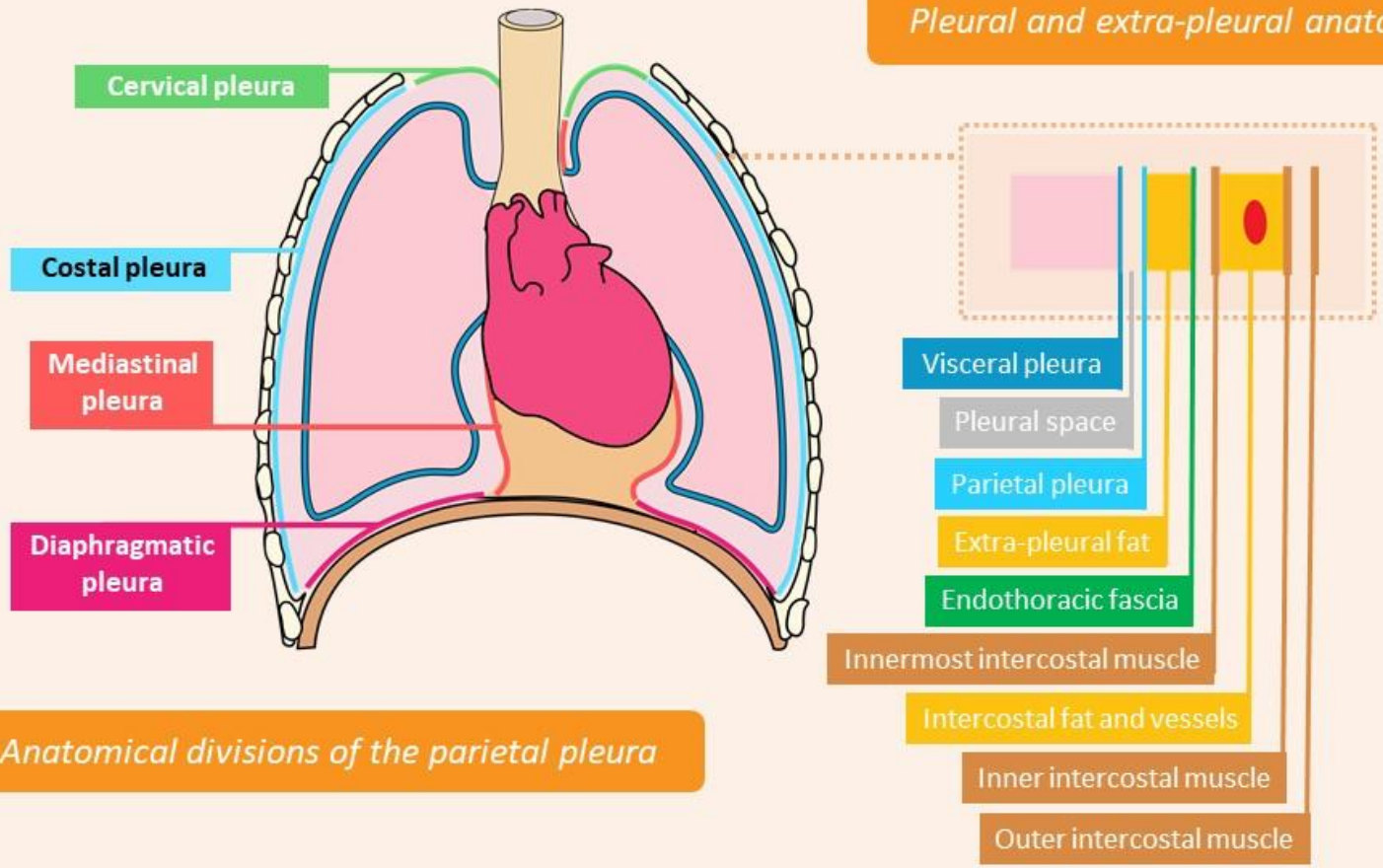
- Appears Beaded due to presence of many valves in its lumen



The relationship between the right lymphatic and thoracic ducts and the venous system

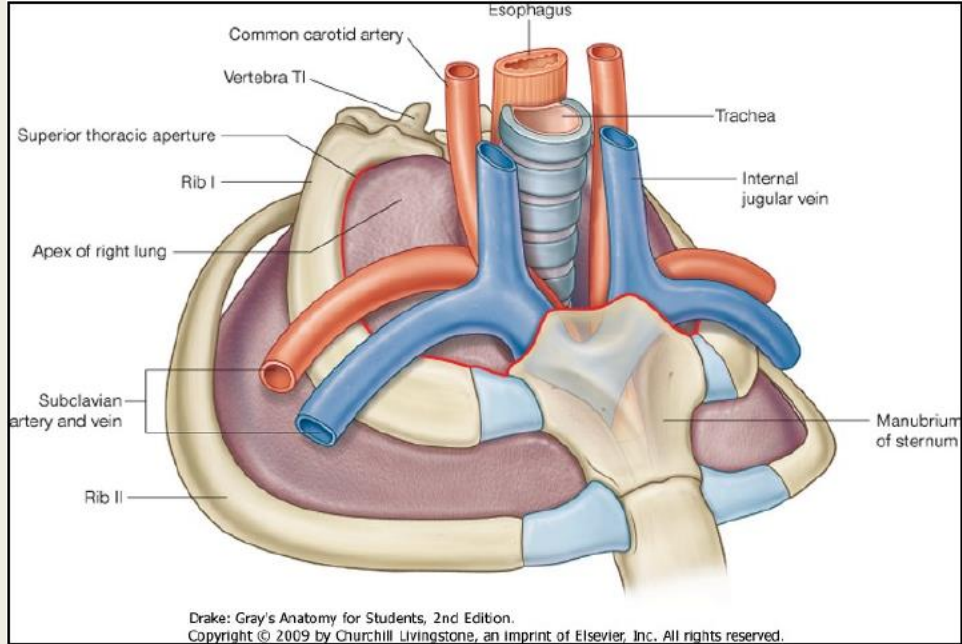


*Pleural and extra-pleural anatomy*

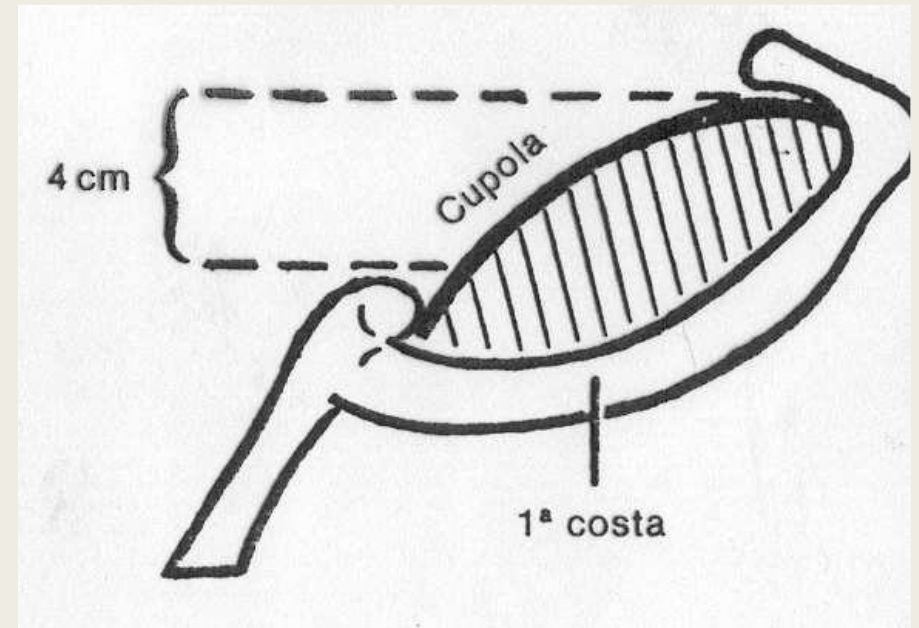
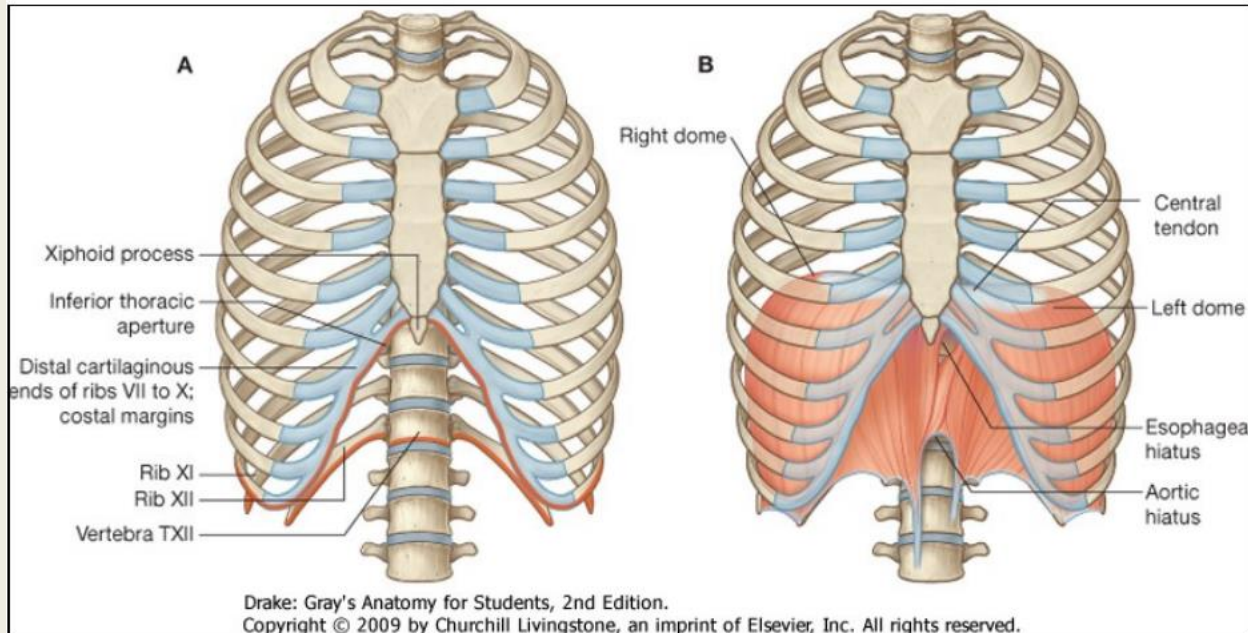


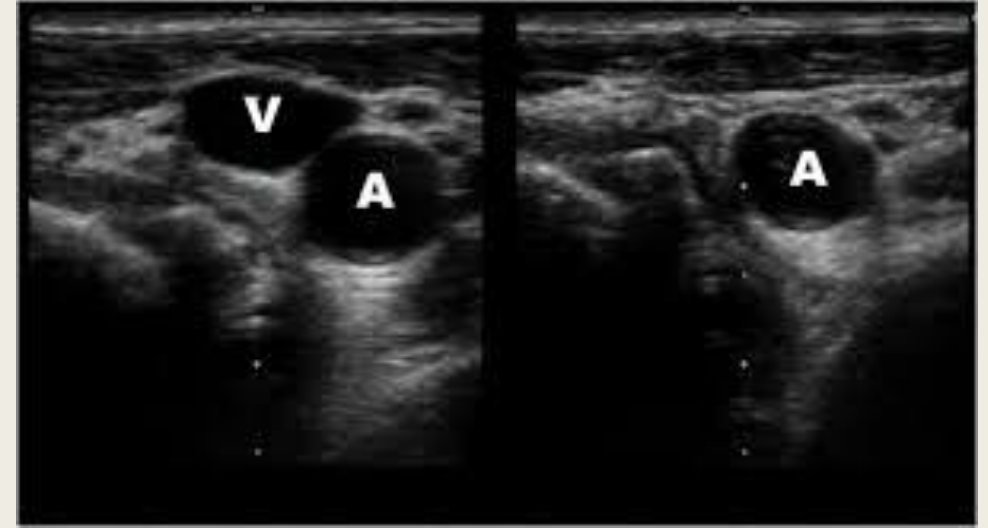
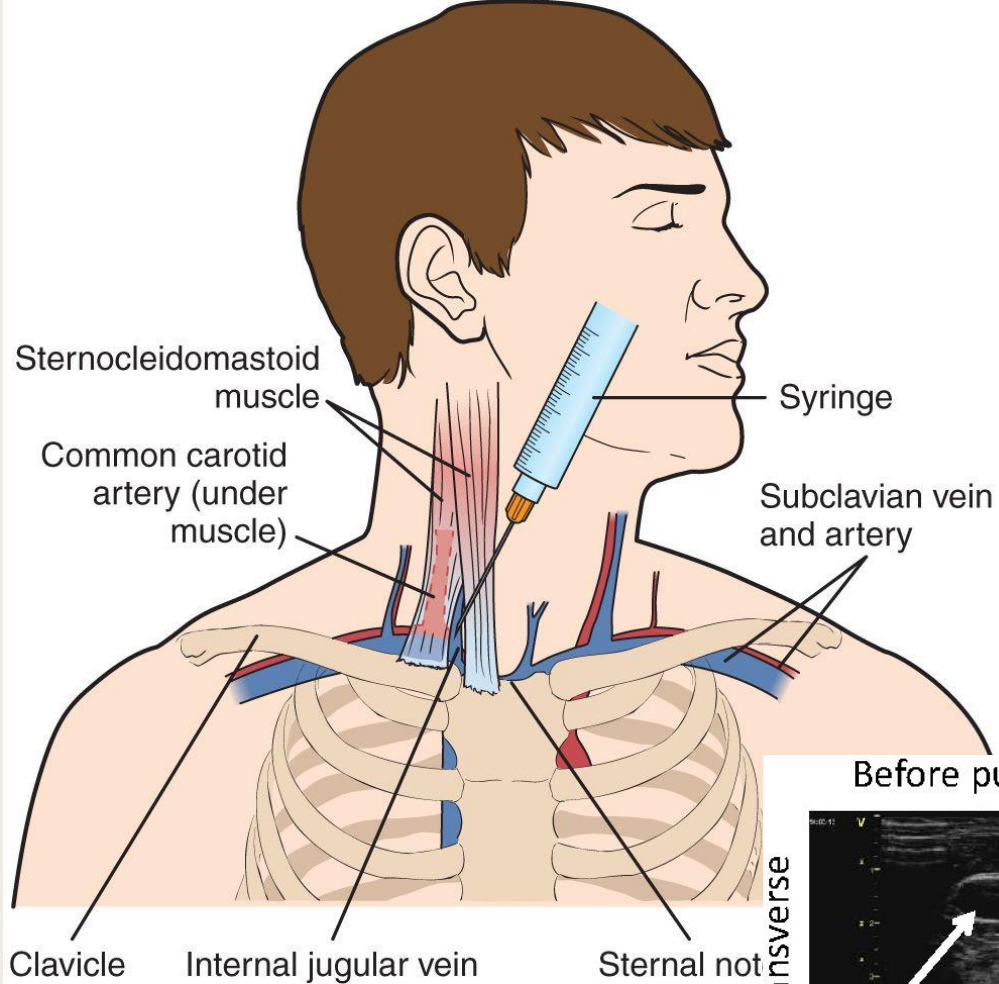
*Anatomical divisions of the parietal pleura*





the upper portion of the parietal pleura protrudes above the 1st rib, forming the **PLEURAL DOME** and covering the apex of the lung





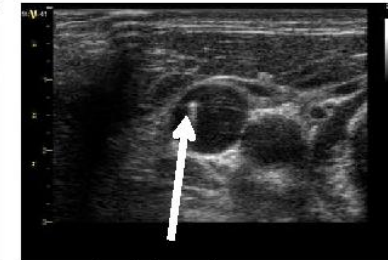
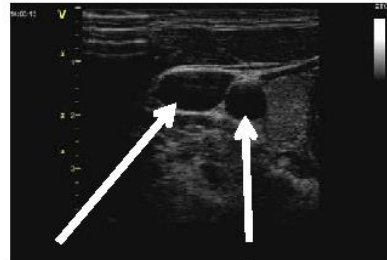
Before puncture

During puncture

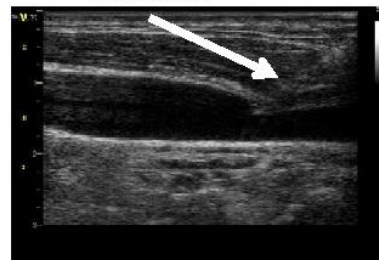
Guidewire

Catheter

Transverse



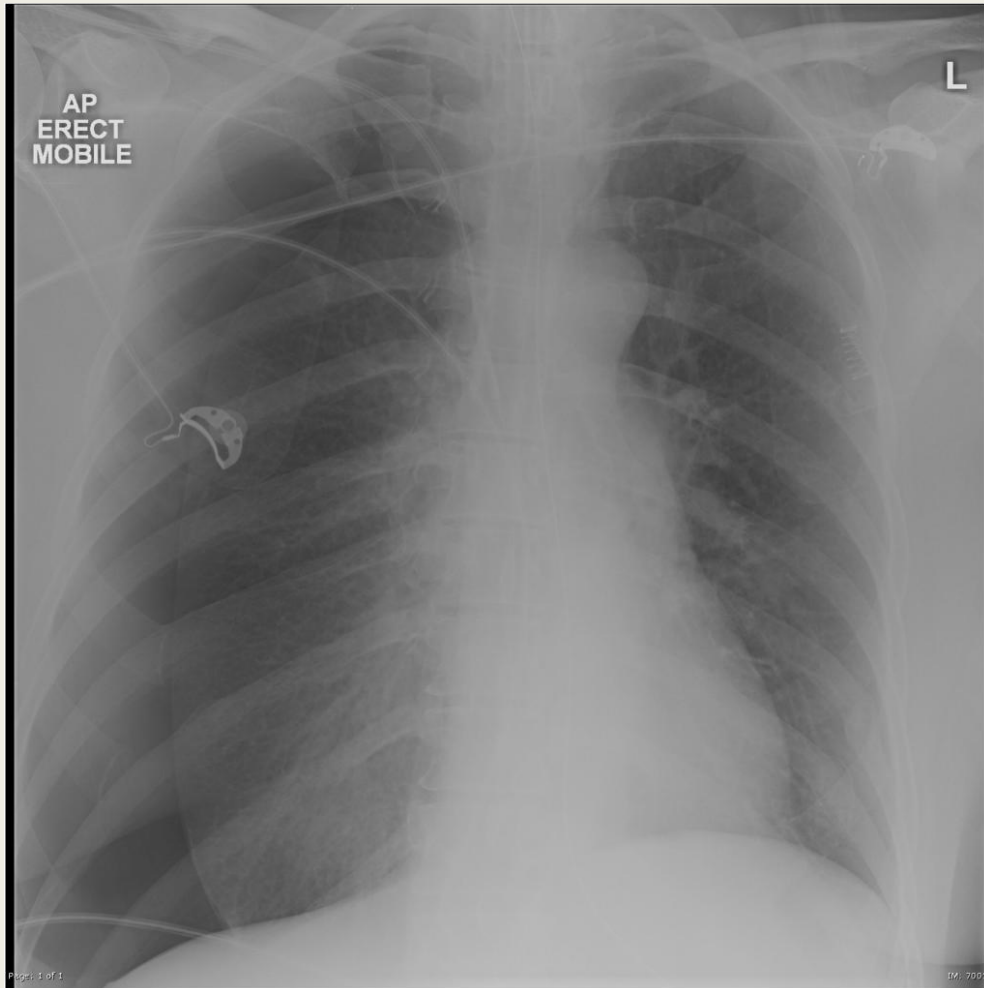
Longitudinal



# Central Venous Catheterization

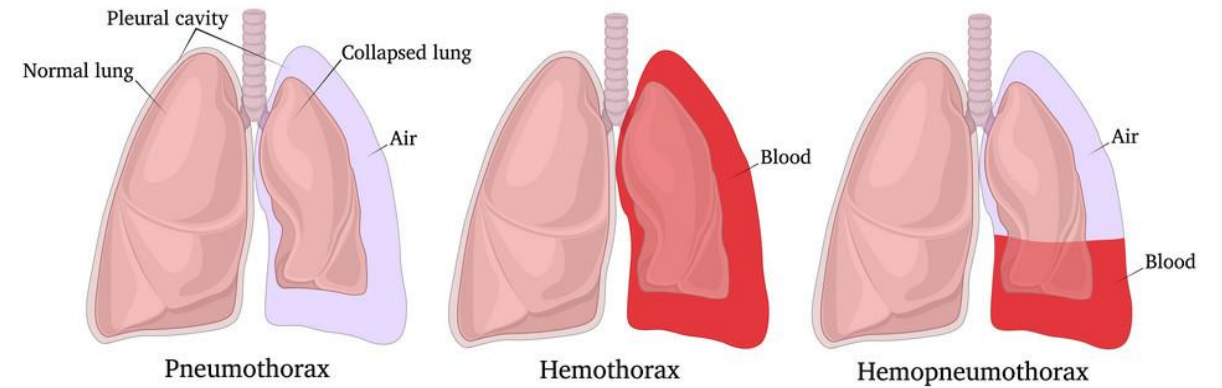


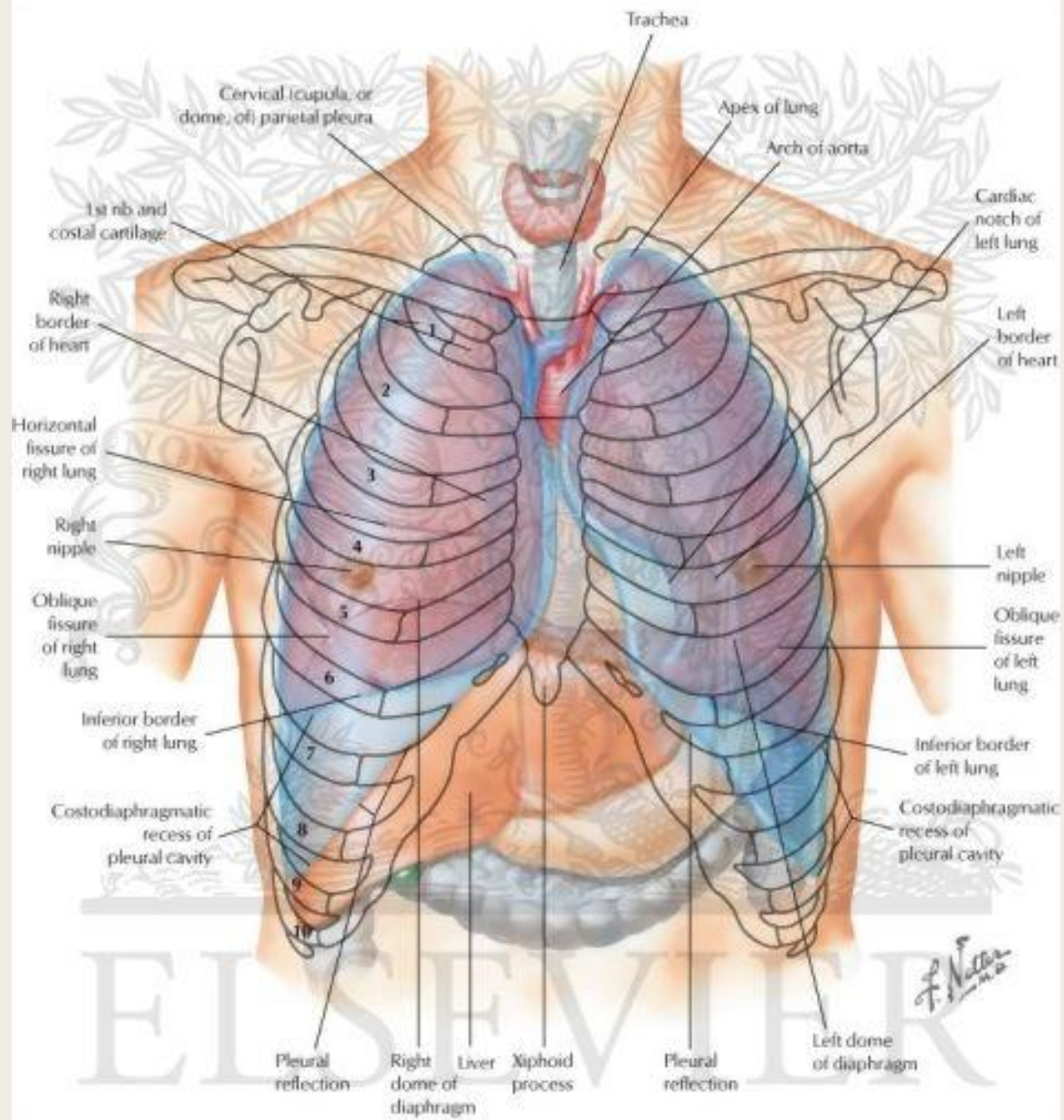
# ...Possible complications



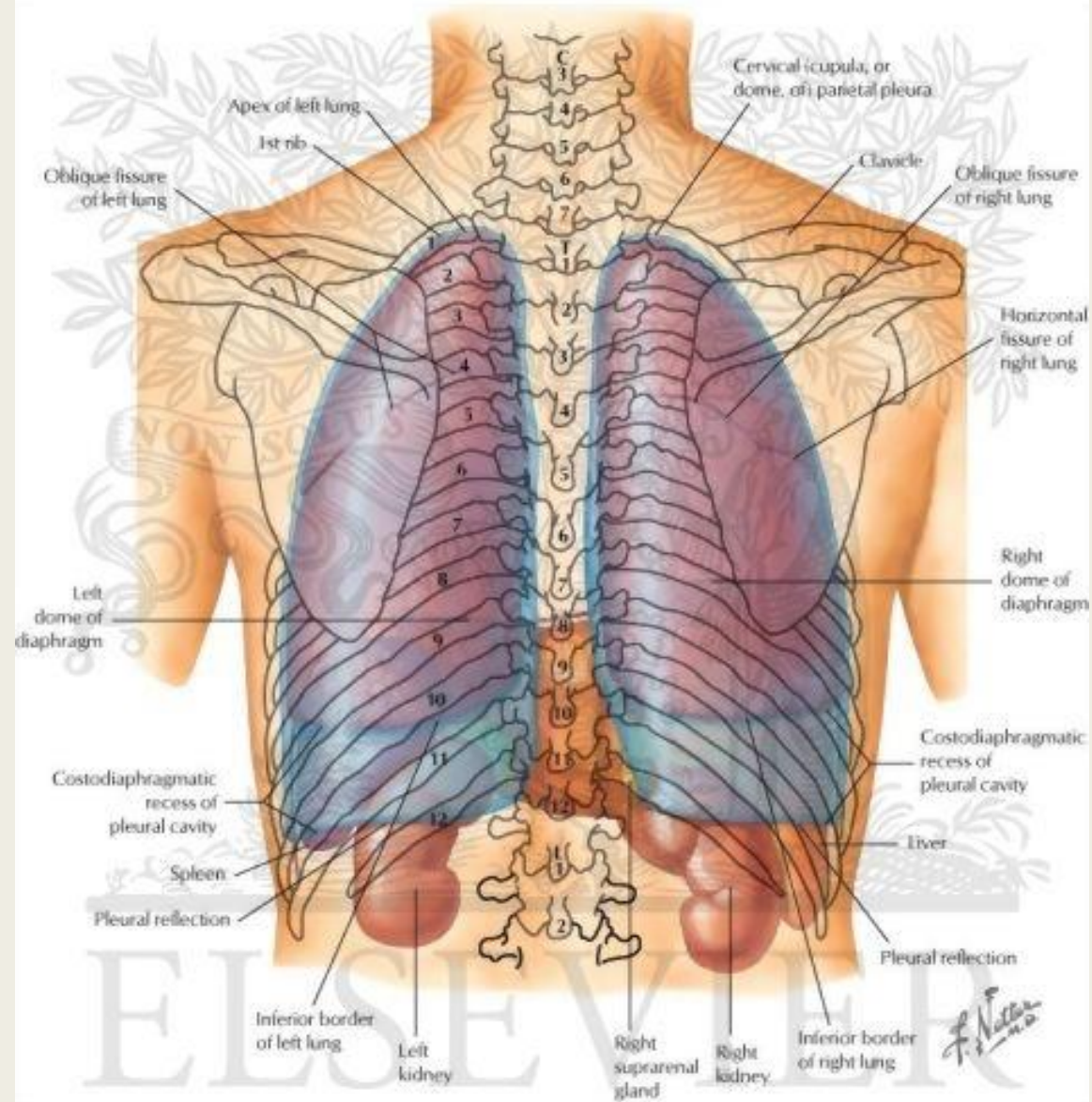
## Pneumothorax

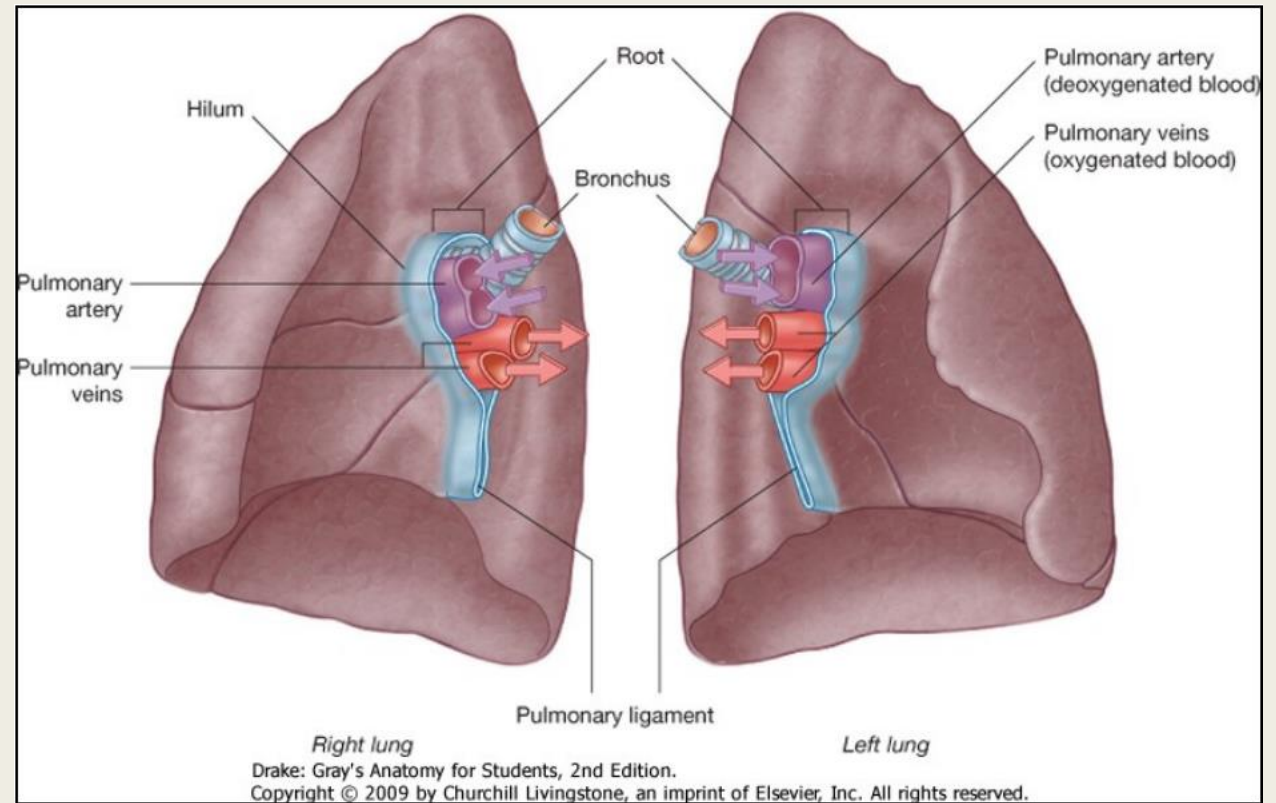
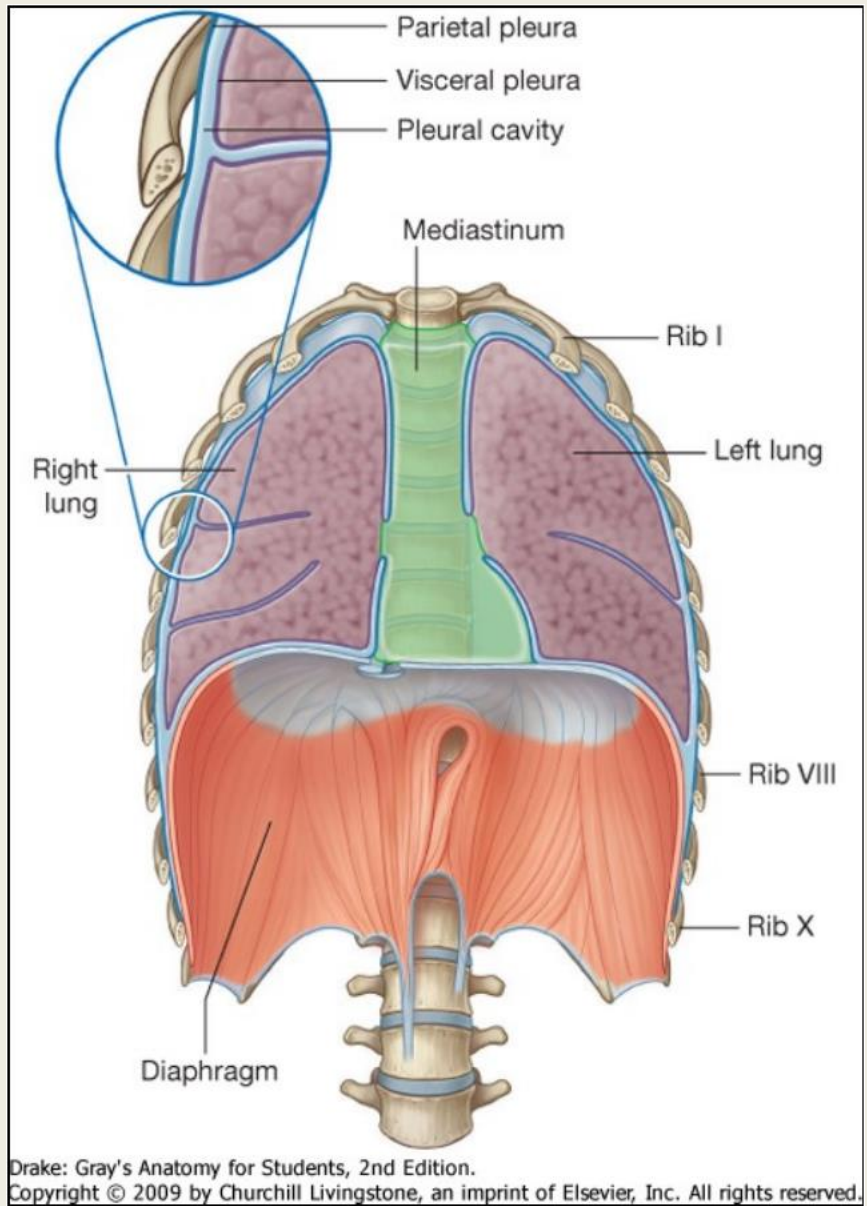
## Pneumothorax, Hemothorax and Hemopneumothorax





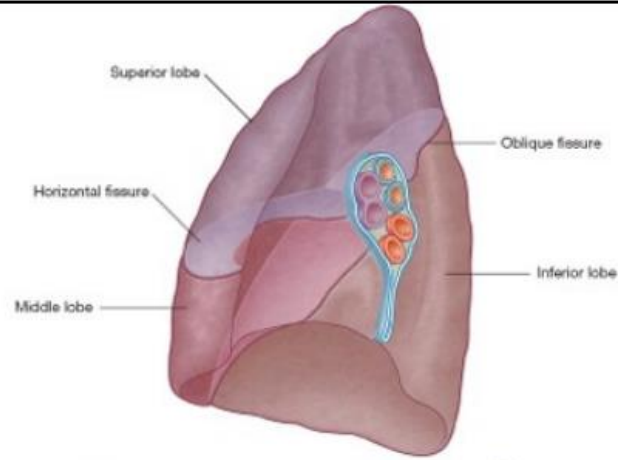




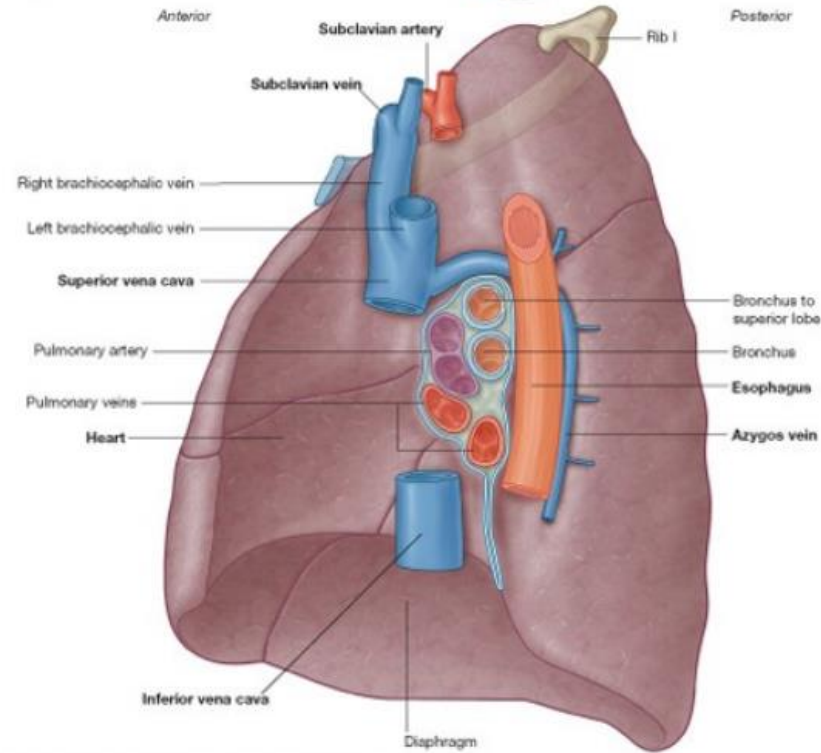


**PULMONARY LIGAMENT** stabilizes the position of the inferior lobe and may also accommodate the down and up translocation of structures in the root during breathing

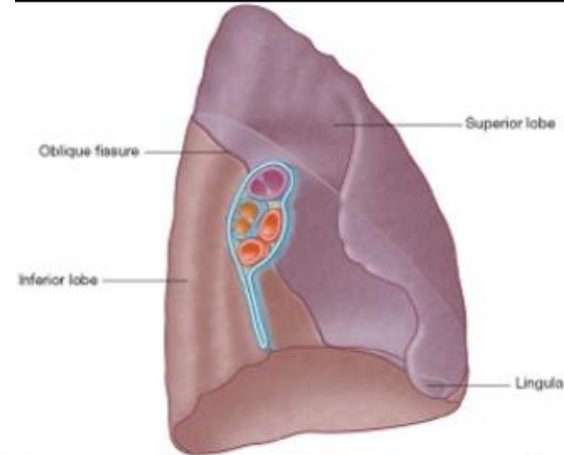
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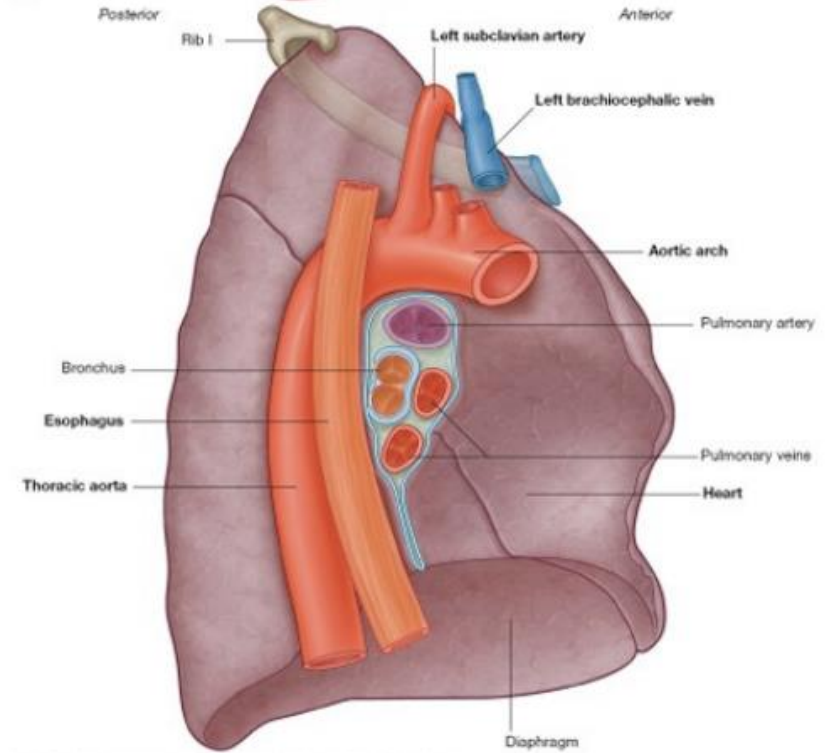
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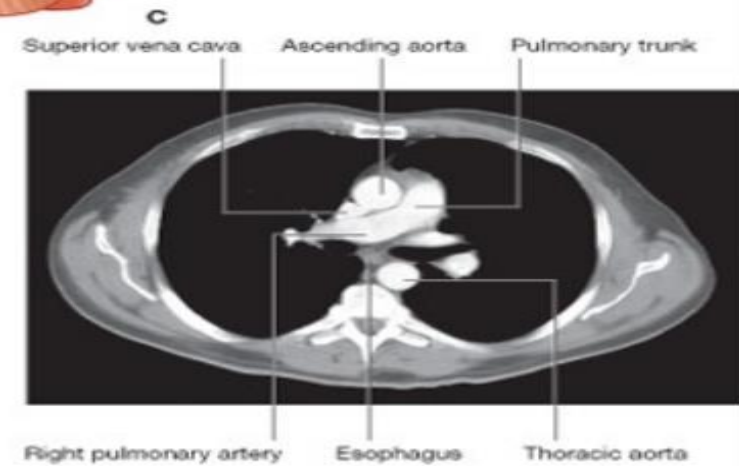
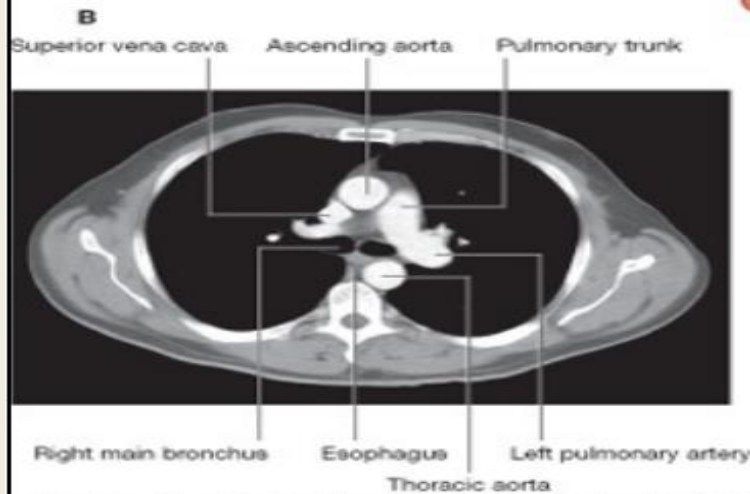
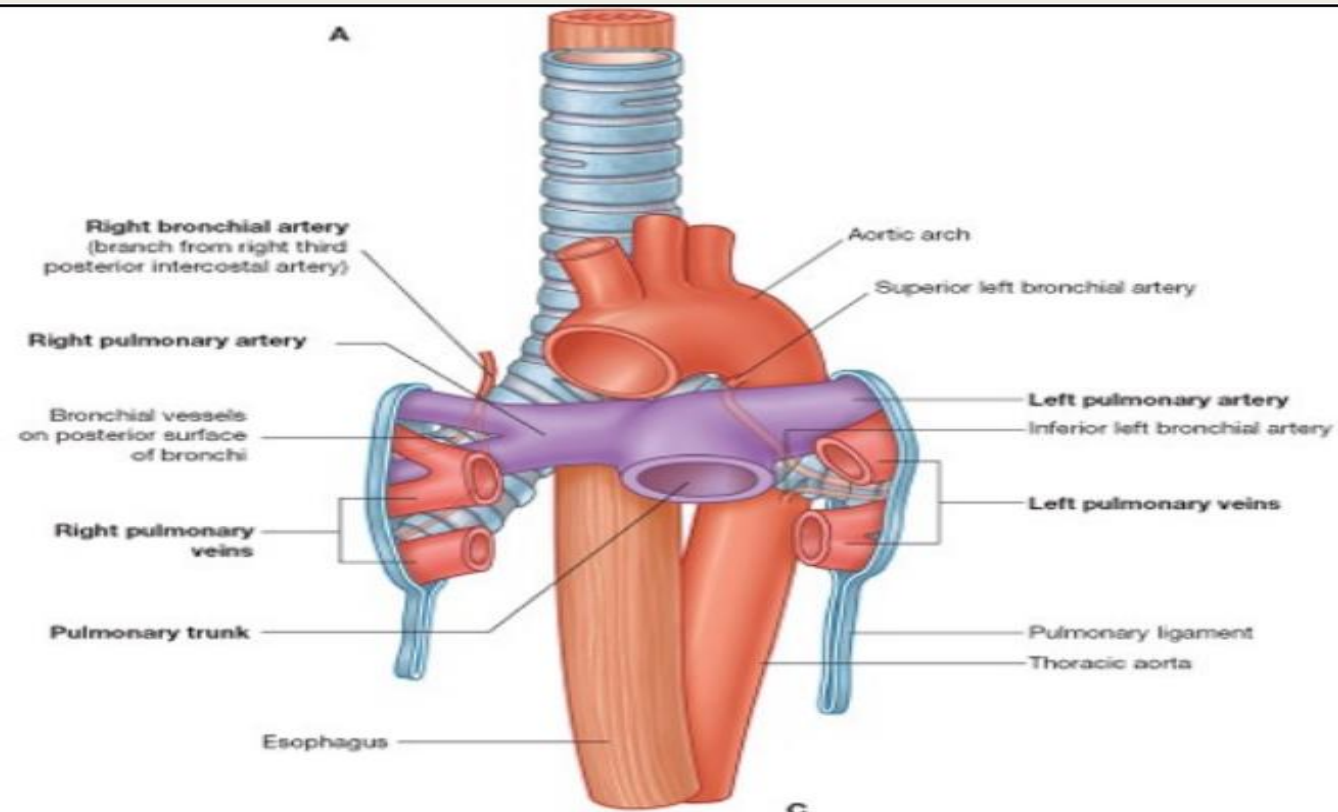


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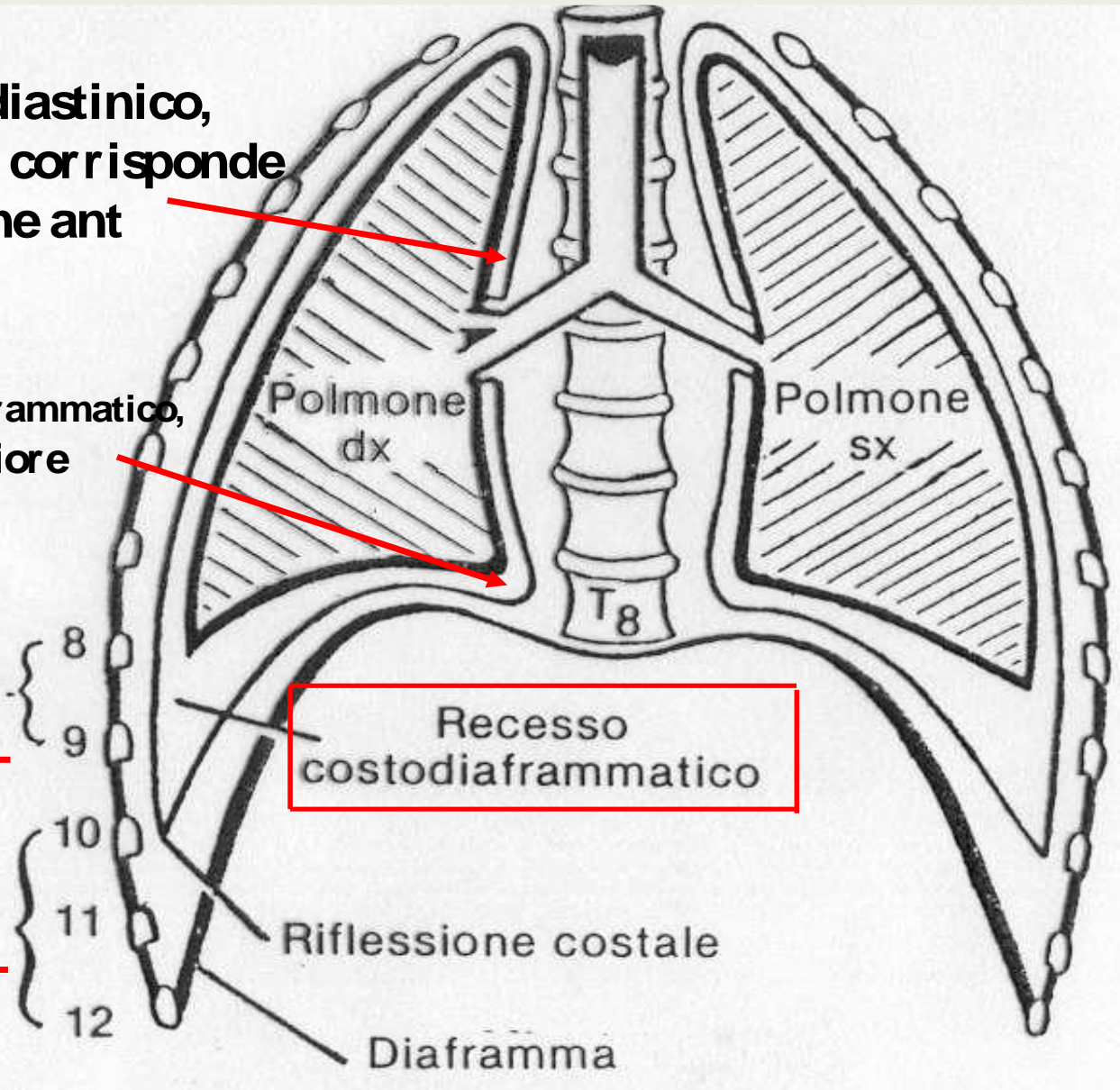


**Costomediastinico,  
Verticale, corrisponde  
Al margine ant**

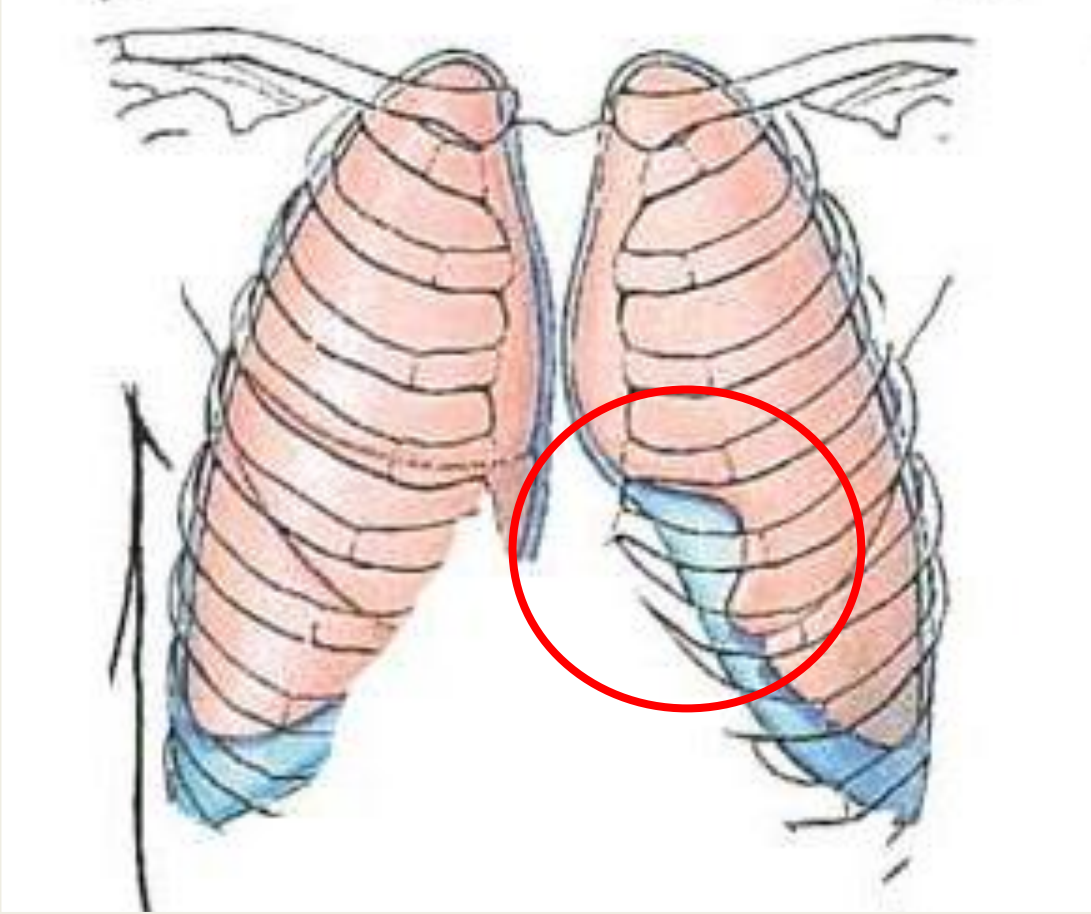
**Mediastinodiaframmatico,  
Antero posteriore**

**Assenza del  
polmone**

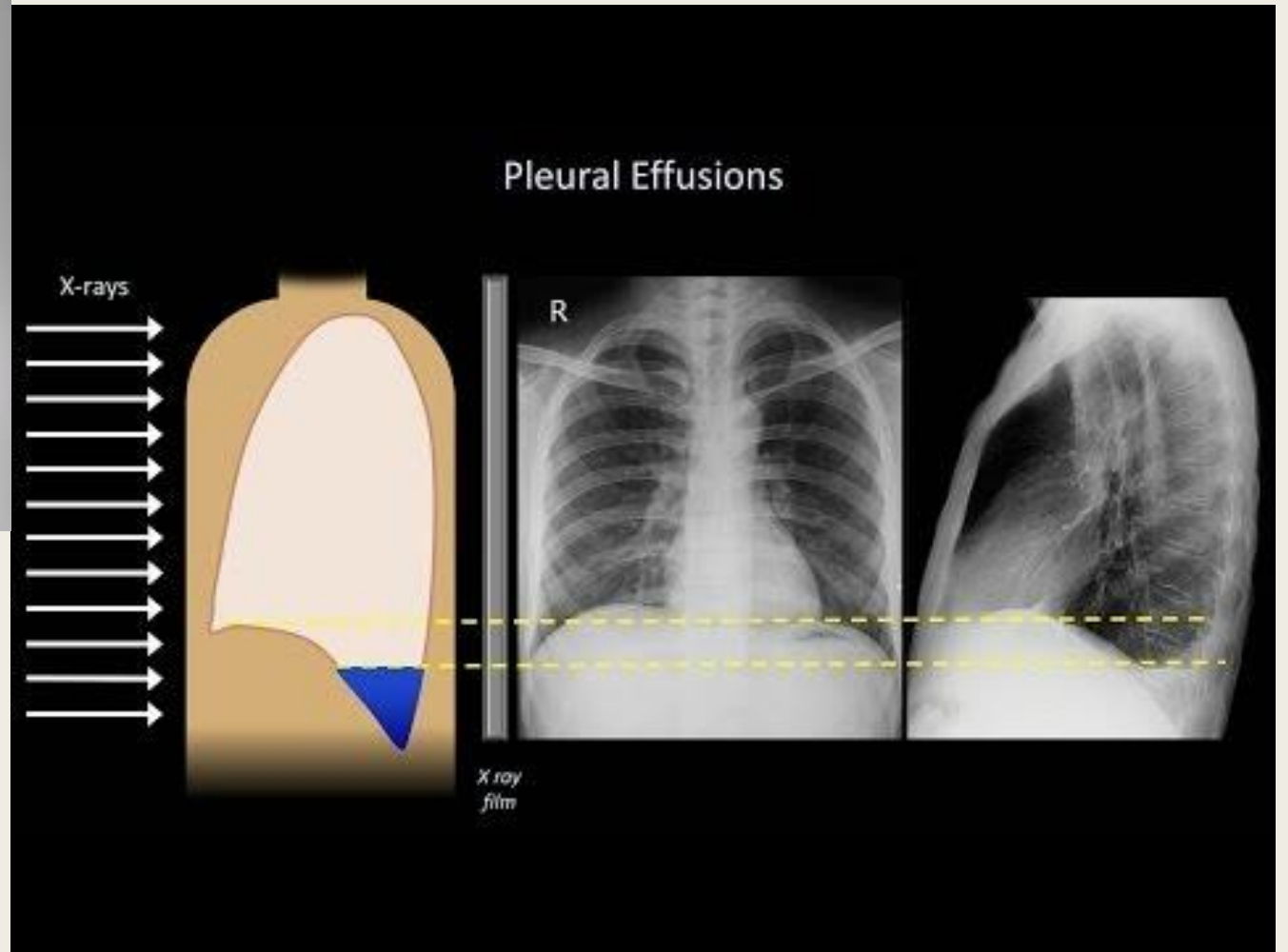
**Assenza  
della pleura**



The three parts of the parietal pleura continue into each other at the sinuses or PLEURAL RECESSES



The costomediastinal sinus is wider on the left due to the presence of the cardiac notch

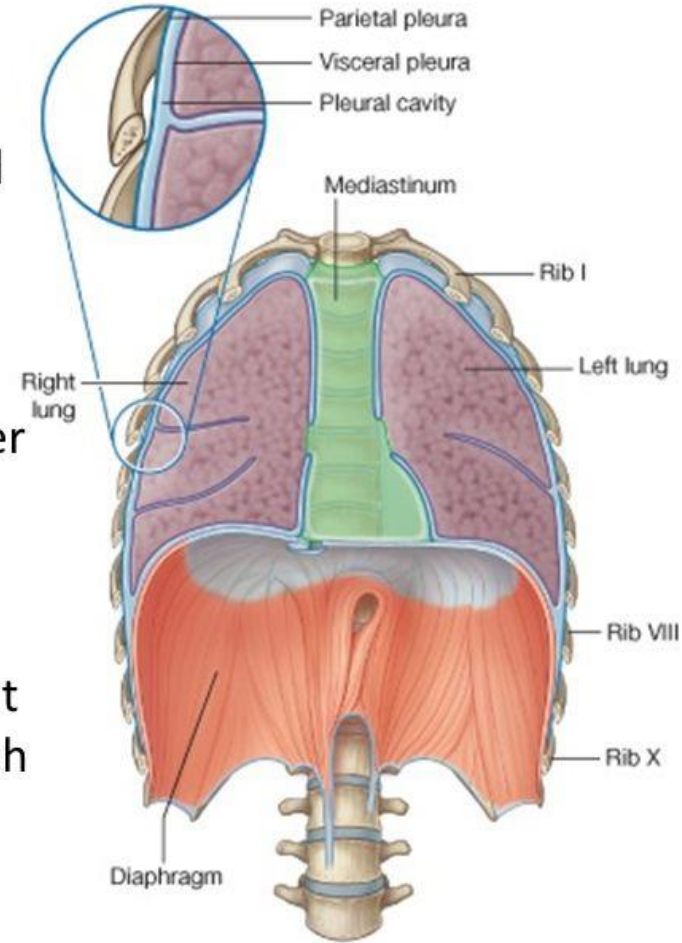


# Nerve Supply of Pleura

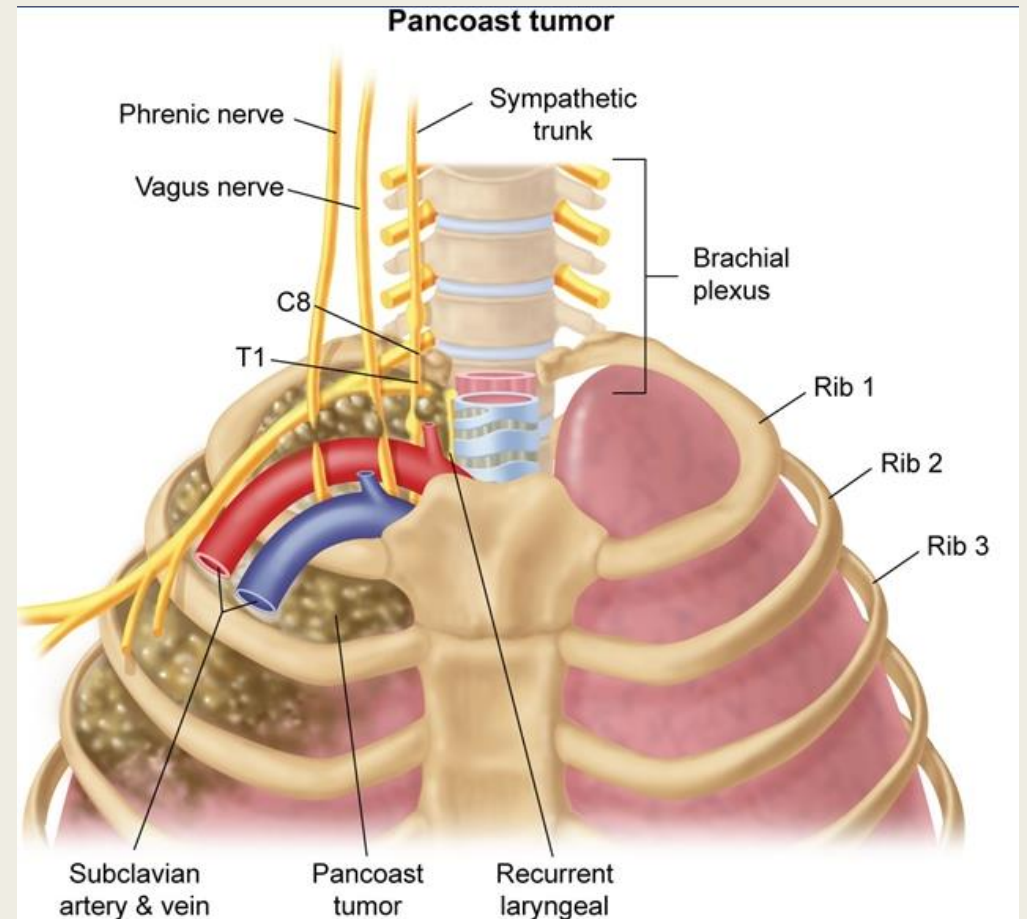
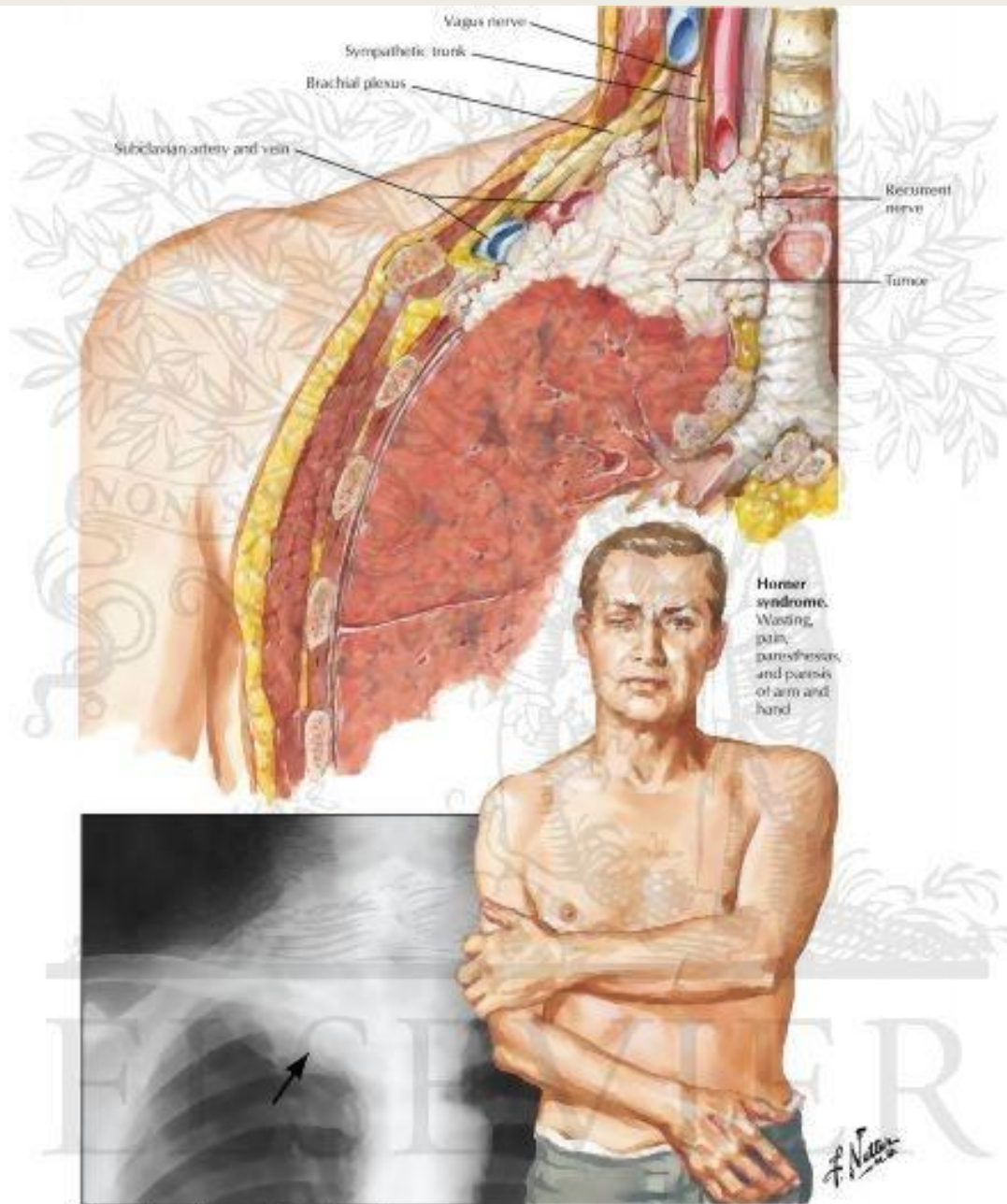
**Parietal pleura** is sensitive to pain, temperature, touch, and pressure:

- **Costal pleura** is segmentally supplied by intercostal nerves.
- **Mediastinal pleura** is supplied by phrenic nerve.
- **Diaphragmatic pleura** is supplied over the domes by phrenic nerve and around periphery by lower six intercostal nerves.

**Visceral pleura** is sensitive to stretch but is insensitive to common sensations such as pain and touch. It receives an autonomic nerve supply from the pulmonary plexus.



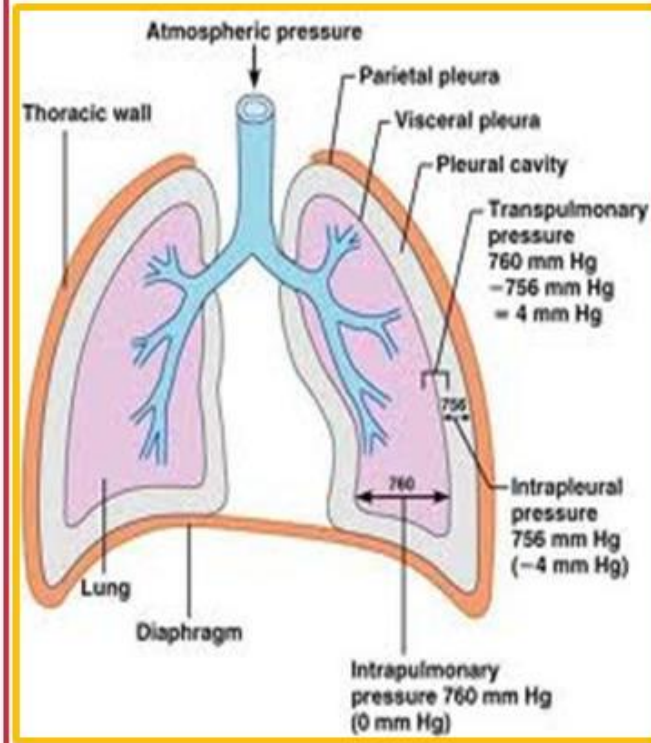




# Pancoast TUMORS

### □ Intrapulmonary pressure

-the pressure within the alveoli  
-as the chest expands on inspiration the intrapulmonary pressure becomes more negative, which causes air to be sucked into the lungs.



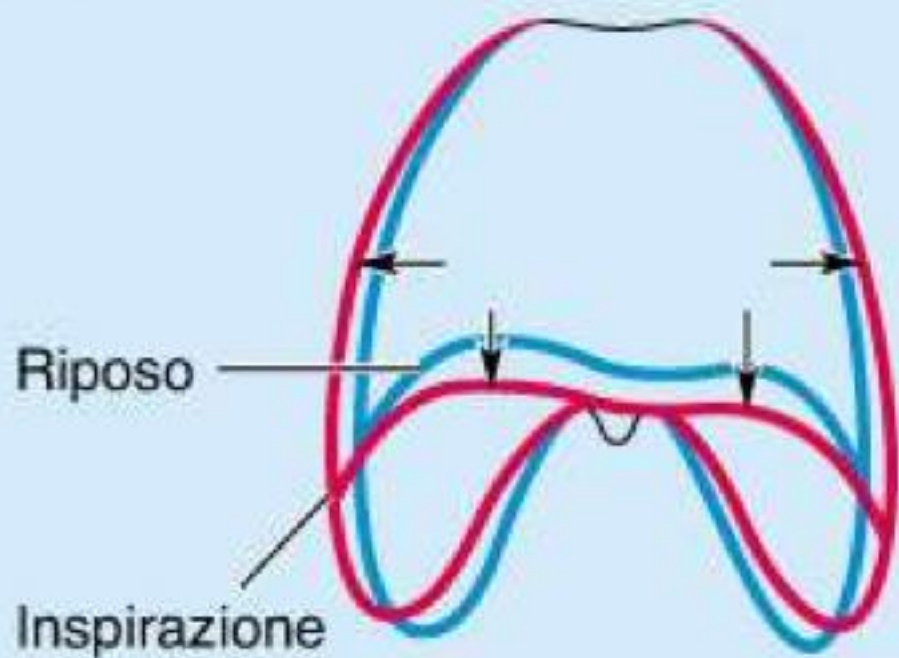
### □ Intrapleural pressure

-Negative pressure is created in the pleural space as the thoracic cage enlarges and the lungs recoil during normal inspiration  
-negative pressure may be lost if fluid collects in the pleural space, making the lung unable to expand fully.

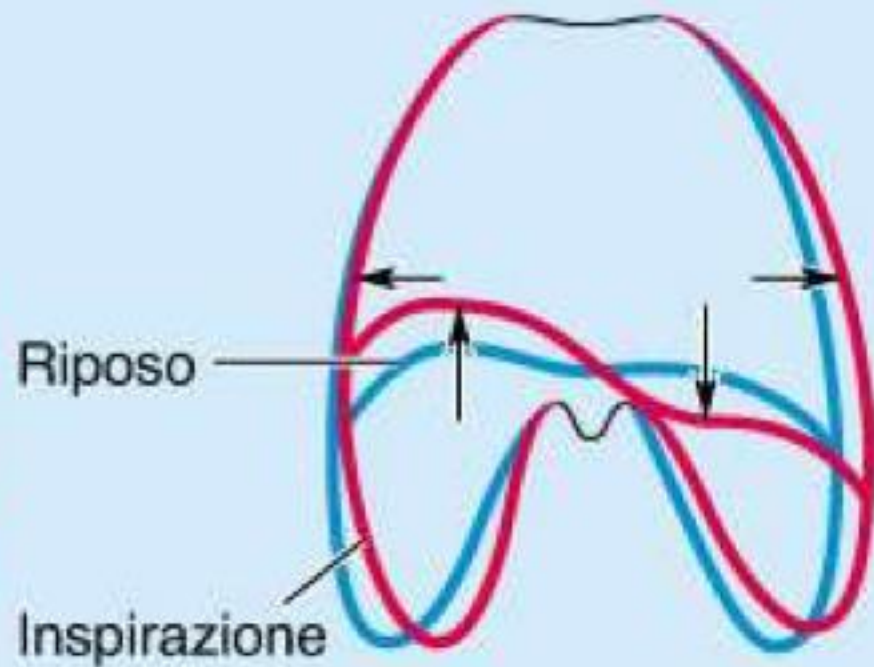
Another important function of the pleura is linked to the negative pressure that exists inside its cavity.



■ Inspirazione   ■ Espirazione



**(A) Inspirazione normale**



**(B) Paralisi dell'emidiaframma destro**

# THYMUS

- Primary lymphoid organ.
- Encapsulated, soft & bilobed
- Site - Superior Mediastinum
- Two parts are joined in the midline by connective tissue that merges with the capsule of each lobe





## FUNCTION...

Organ is important for...

- Development of immunocompetent T-cells,
- Proliferation of clones of of mature T-cells,
- Developing immunological self-tolerance,
- Secretion of hormones for T-cell development. (thymosin, thymulin and thymopoietin )
- Hormones are produced by reticular epithelial cells in the cortex.

# Inferior mediastinum:

## Third part: Anterior Mediastinum

### □ Boundaries:

- **Superior:** Horizontal plane
- **Inferior:** Diaphragm
- **Anterior:** Body & xiphoid of sternum
- **Posterior:** Heart
- **Lateral:** Lungs & pleurae

### □ Contents:

- **Thymus gland**
- **Lymph nodes**

Note: lymph nodes present in all mediastinum region

**IMPORTANT NOTE:** There are six structure present in more than one region in mediastinum

**Three** in superior and posterior mediastinum:

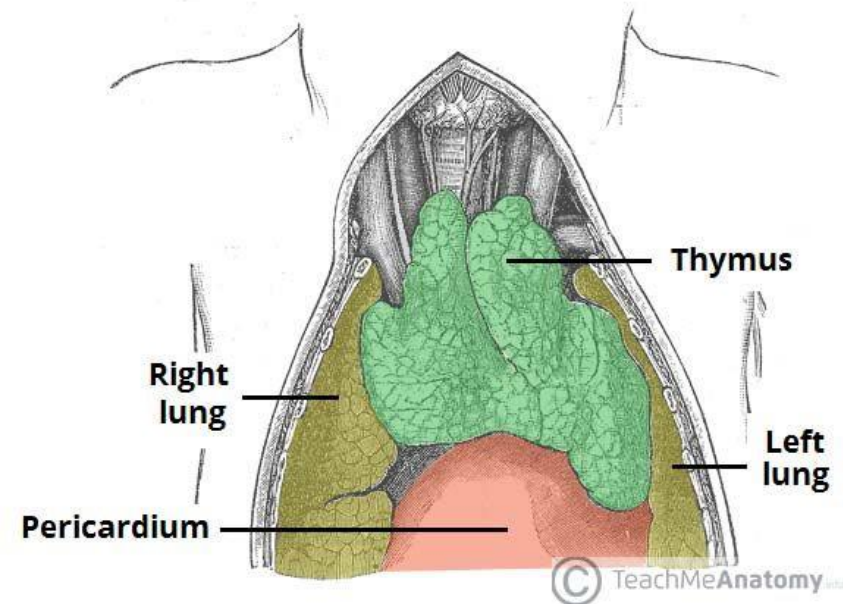
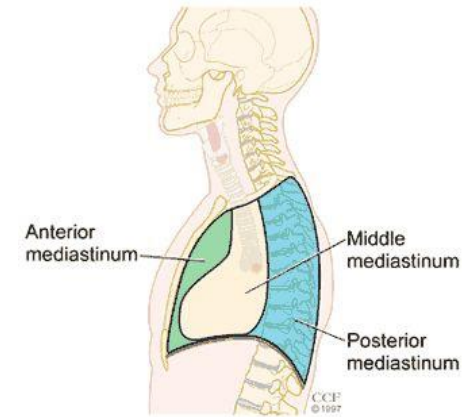
- Thoracic duct, Esophagus, vagus nerves

**Two** in superior and middle mediastinum:

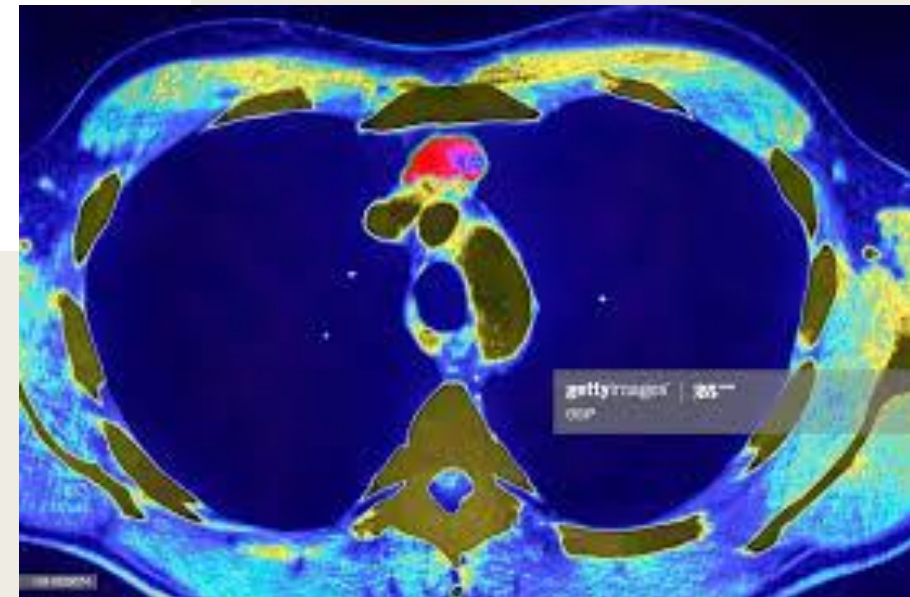
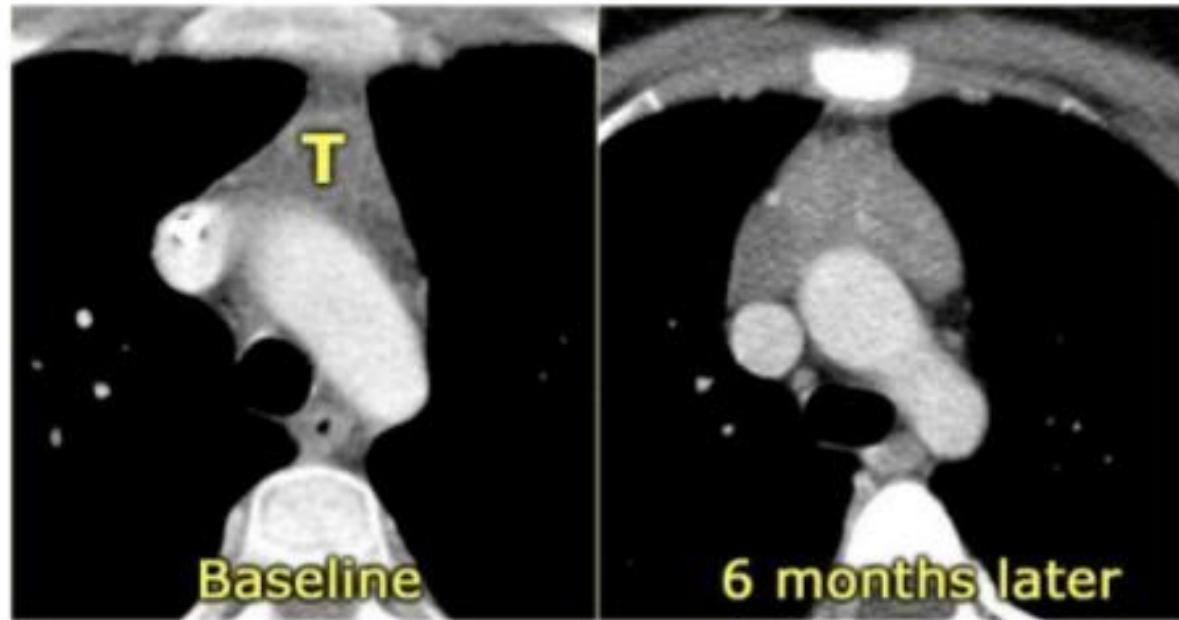
- phrenic nerves, superior vena cava

**One** in superior and anterior mediastinum:

- Thymus gland

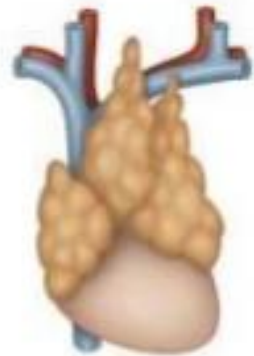


- Capsule may adhere to the fibrous pericardium, which is thinner superiorly
- **Visible on CT and MRI**





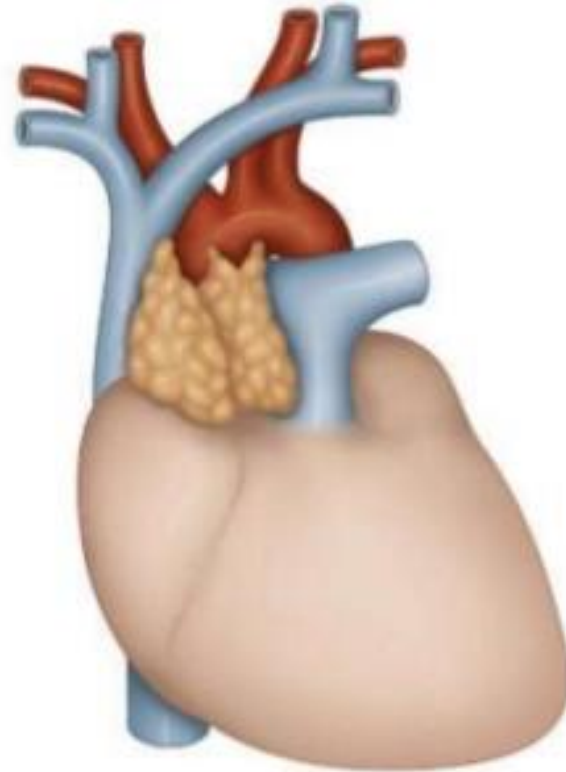
## AGE RELATED CHANGES...



Thymus in a newborn.



Thymus in a 2-year-old child.



Thymus in an adult

Fibroadipose involution with age

- Largest in the early part of life, particularly around puberty,
- Persists actively into old age
- As age advances **fibrofatty degeneration** (hiding the existence of persistent thymic tissue.
- Greater part of the thymus lies in the **superior and anterior mediastinum**;
- Inferior aspect of the thymus reaches the level of the **fourth costal cartilages**

- Reaches to the inferior poles of the thyroid gland or even higher
- Connected to the thyroid gland by **thyrothymic ligament.**
- Shape is largely moulded by adjacent structures.
- Inferiorly, the right lobe commonly lies between the right side of the ascending aorta and the right lung, anterior to the superior V. cava.



From superior to inferior...

- Sternohyoid and sternothyroid,
  - Cervical fascia,
  - Manubrium sterni,
  - Internal thoracic vessels,
  - Upper three costal cartilages,
  - Pleurae lie laterally
  - Phrenic nerves are anterolateral and inferior;
- (Last 2 structures may be injured during thymectomy)

ANTERIOR BORDERS

- Lies in contact with the vessels/Viscera of the superior mediastinum...
  - Left brachiocephalic vein.
  - Inferior thyroid veins .
  - Superior part of the thoracic trachea.
  - Anterior cardiac surface (right atrium and ventricle).

POSTERIOR BORDERS

## ECTOPIC THYMUS...

Often found...

- Scattered around the gland
- In unusual mediastinal locations.
- Accessory nodules may occur in the neck
- Representing separated portions, detached during embryological descent.
- Sometimes reaching more superiorly than the **thyroid cartilage**.
- **Ectopic intrathyroidal thymi** have been reported in children.





## VASCULAR SUPPLY...

- **Thymic branches** originating from...
  - **Internal thoracic,**
  - **Inferior and**
  - **Superior thyroid arteries.**
- As no definite hilum exists
- Arterial branches either travel along the interlobar septa before entering the thymus at the junction of the cortex and medulla
- Reach the thymic tissue directly through the capsule.

## VENOUS DRAINAGE...

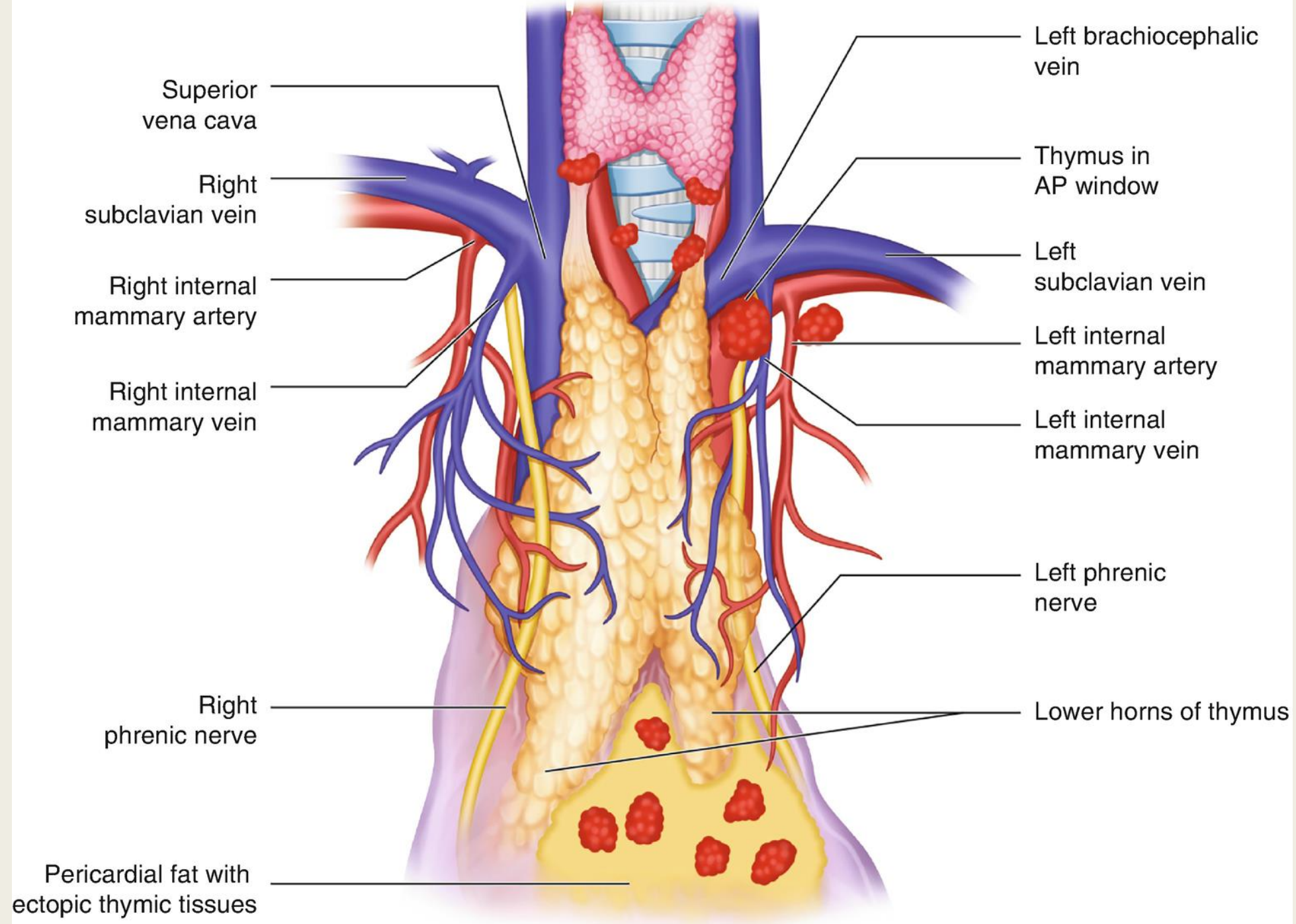
*Thymic veins* drain to ...

➤ *Left brachiocephalic v.,*

➤ *Internal thoracic v.and*

➤ *Inferior thyroid veins,* and occasionally directly into the *superior vena cava.*

- One or more veins often emerge medially from each lobe of the thymus to form a common trunk opening into the *left brachiocephalic v\**.



## LYMPHATIC DRAINAGE...

- *No afferent lymphatics.*
- **Efferent lymphatics** arise from the medulla and corticomedullary junction,
- Drainage through the extravascular spaces, accompany the supplying arteries and veins, d
- Drained in...
  - *Brachiocephalic,*
  - *Tracheobronchial*
  - *Parasternal nodes.*



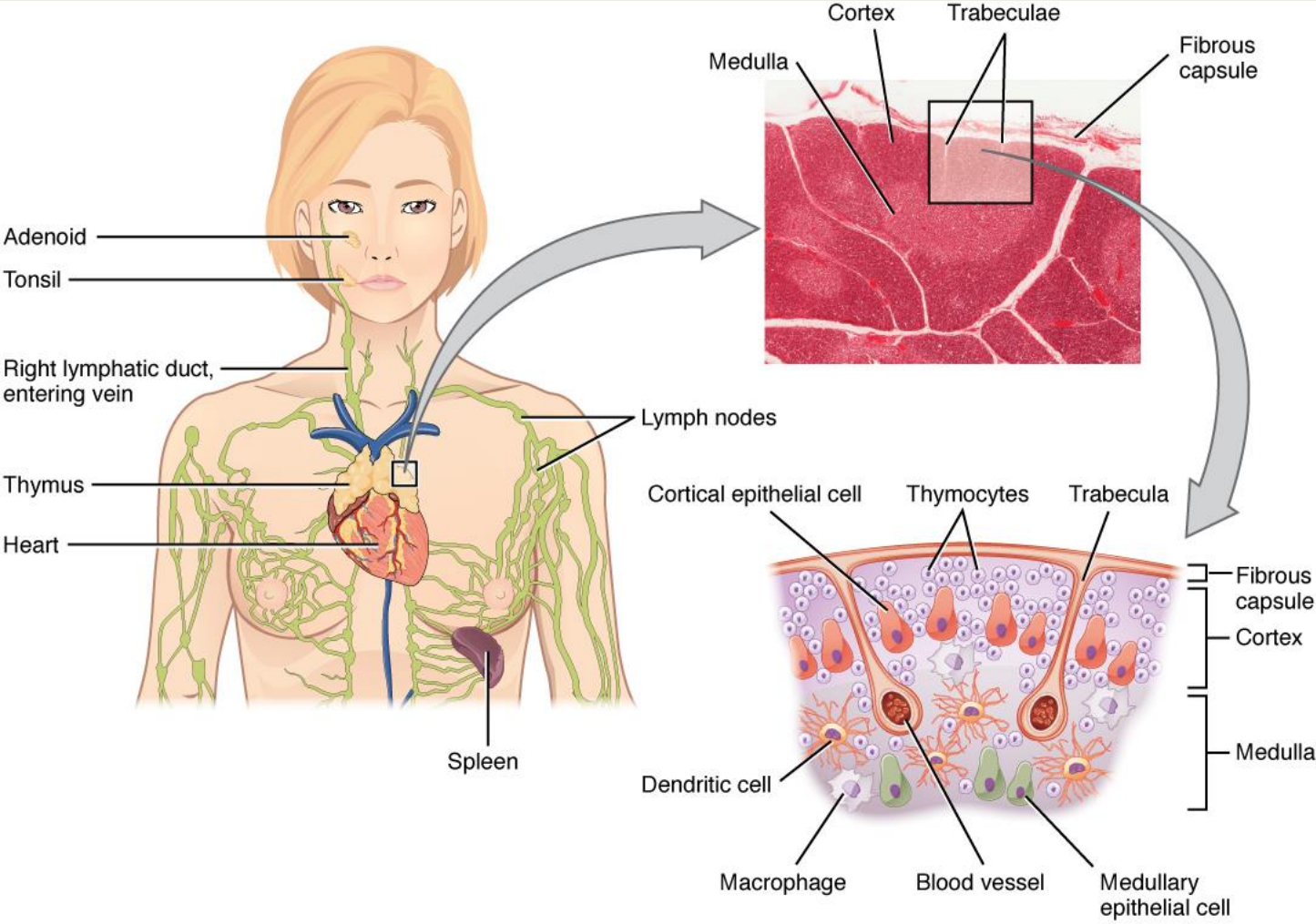
## INNERVATION...

### **Sympathetic -**

- Cervicothoracic (stellate) ganglia or ansa subclavia
- Branches from the **phrenic** and descending cervical nerves (inferior roots of the ansa cervicalis) are distributed mainly to the capsule.

### **Parasympathetic - Vagi.**

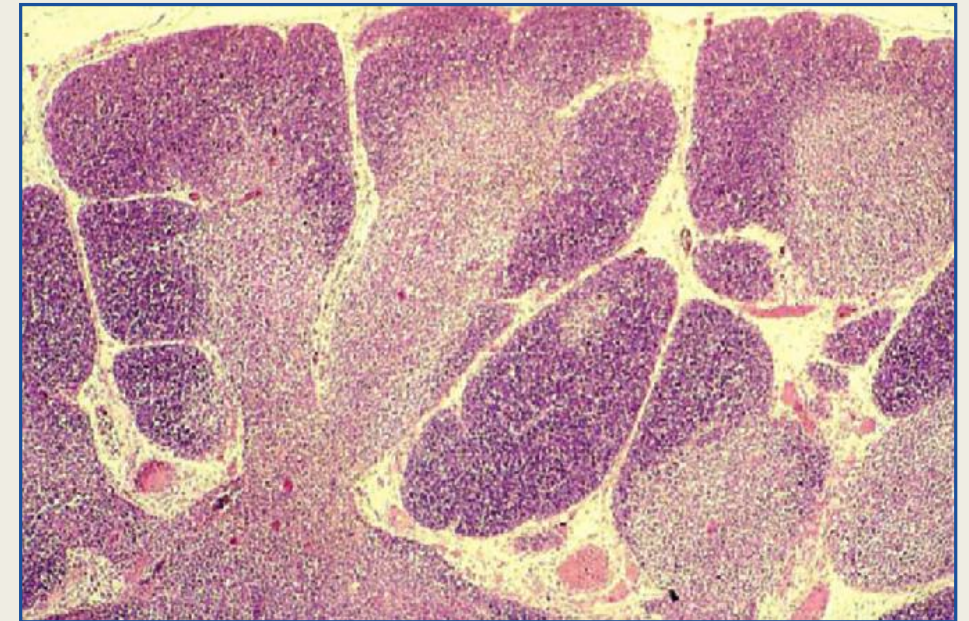
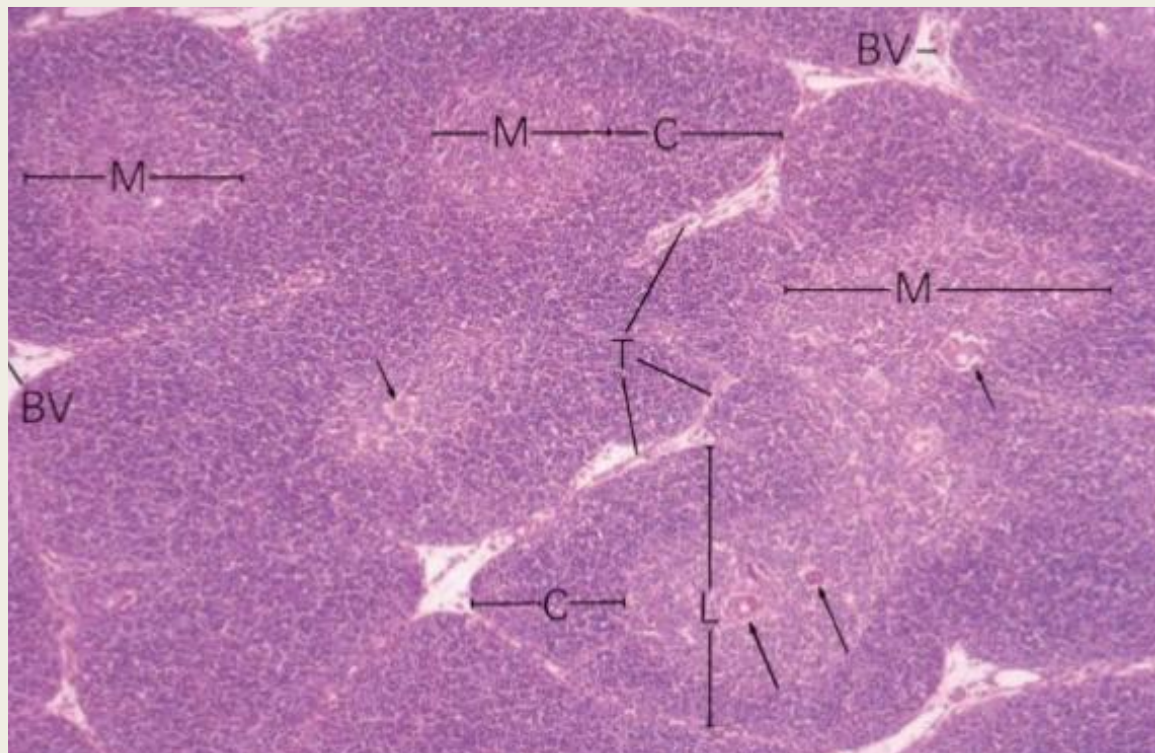
- Two lobes are innervated separately through their dorsal, lateral and medial aspects.



# Microscopic anatomy 1

- Two lobes divided up into many incomplete lobules.
- **CORTEX** - outer, more darkly staining region is the cortex, and this is **highly cellular**.
- **MEDULLA** - inner lighter staining region, less cellular.
- An outer connective tissue capsule and septa divides organ into incomplete lobules.





**Fig. 2.1** Light micrograph of neonatal human thymus showing its lobular architecture. In each lobule a pale medullary core appears to be surrounded by a dark stained cortex. Note the higher cellular density in the cortex with respect to the medulla. Haematoxylin-Eosin stain (specimen prepared by the Department of Anatomy and Histology of University of Modena and Reggio Emilia)

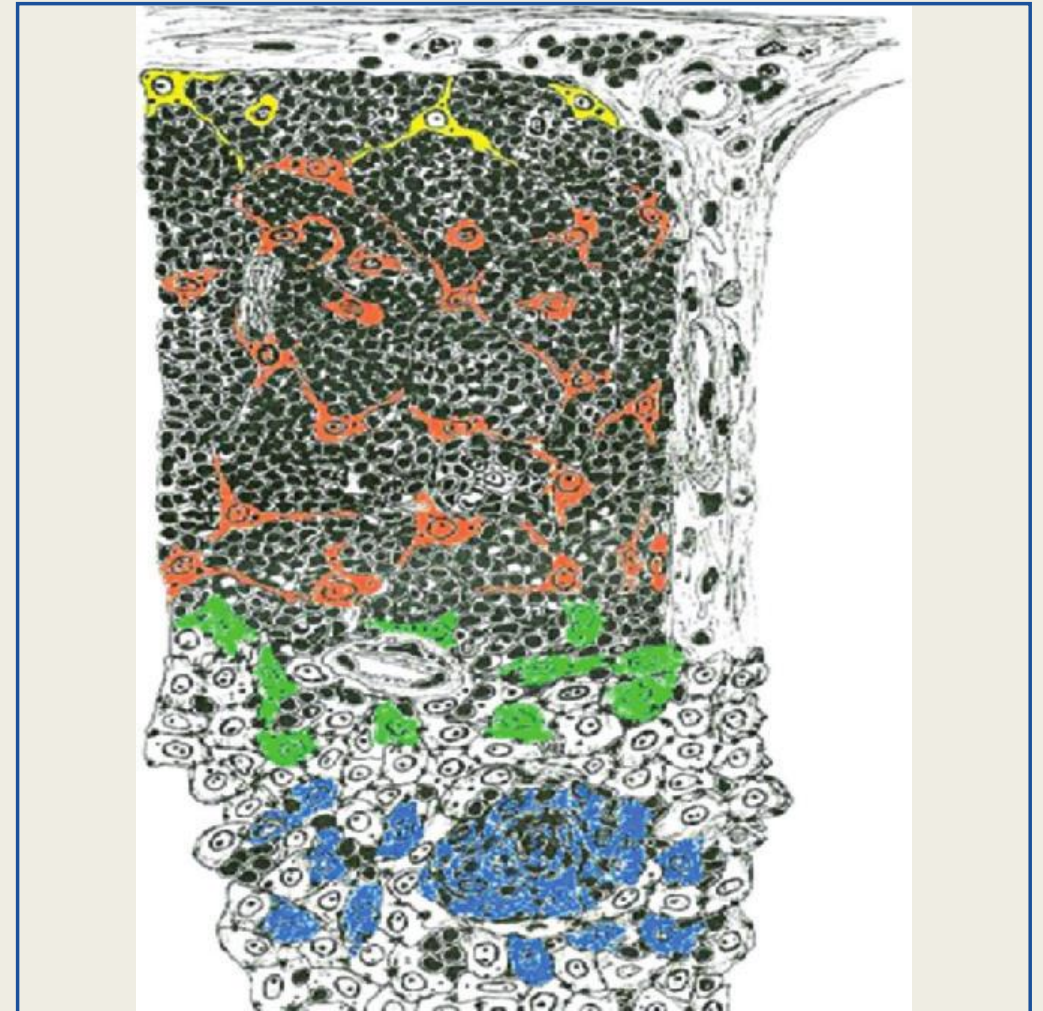
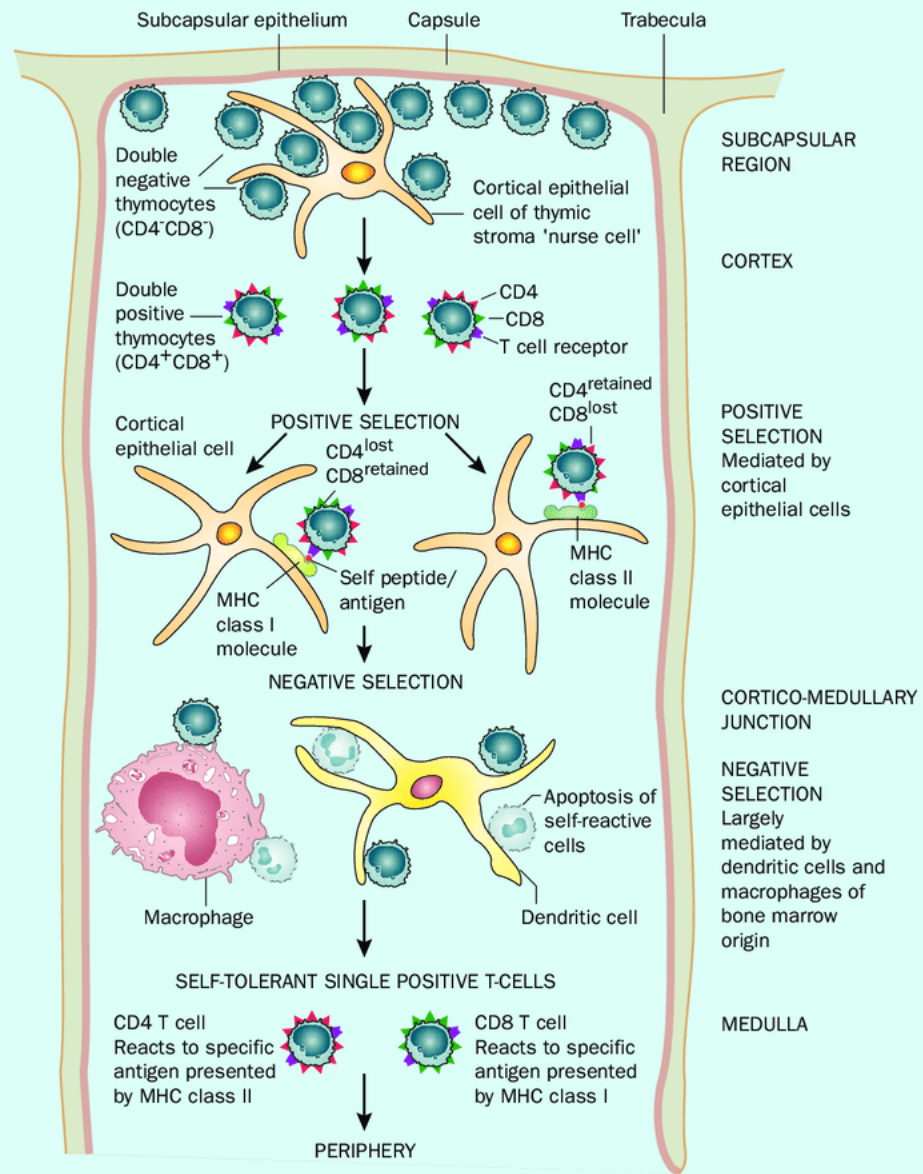
# Microscopic anatomy 2

## CAPSULE AND TRABECULAE

Contain ...

- Blood vessels...
- Efferent (but not afferent) lymphatic vessels
- Nerves.
- Collagen fibers and fibroblasts,
- Variable numbers of plasma cells, granulocytes, lymphocytes, mast cells, adipose cells, and macrophages.





**Fig. 2.2** Schematic drawing showing the location of the various types of epitheliocyte in the thymic parenchyma. Type 1 epitheliocytes in *yellow*, type 2-4 epitheliocytes in *orange*, type 5 epitheliocytes in *green*, type 6 epitheliocytes in *blue*

# Thymic Epithelia Cells

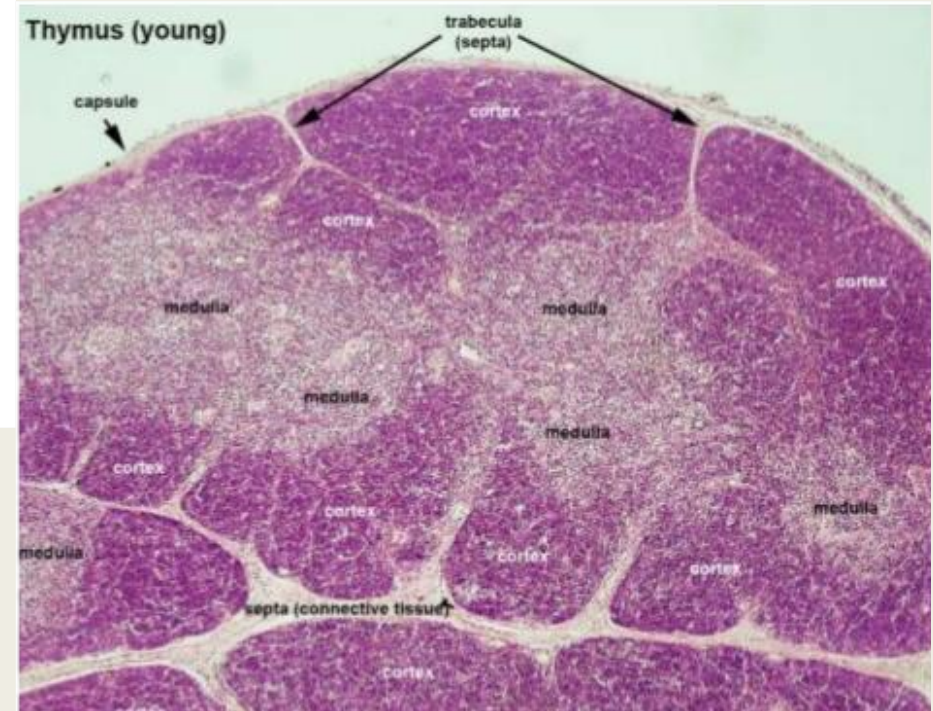
- **mTECs** are indispensable in the establishing central tolerance with the expression of autoimmune regulator gene and in the promoting the development of CD4 T regulatory and natural killer (NK) T cells
- While **cTECs** are involved in positive and negative selection
- TECs are known to be a dynamic population with rapid turnover
- Crosstalk between T-cells and TEC for maturation and positive or negative selection



## CORTEX...

- Outer portion of the parenchyma,
- Markedly **basophilic** in (H&E) preparations because of the **closely packed developing T lymphocytes** with their intensely staining nuclei.

*Thymic parenchyma contains developing T cells in an Extensive meshwork formed by epithelioreticular cells.*



➤ **Desmosomes,**

➤ **Intermediate filament protein keratin is**

- Stains more darkly (**basophilic**) as it contains more lymphocytes than the medulla.
- Epithelial cell network is **more finely branched** than in the medulla - and this gives this network the name '**reticular**'.
- Epithelial cells are connected to each other by

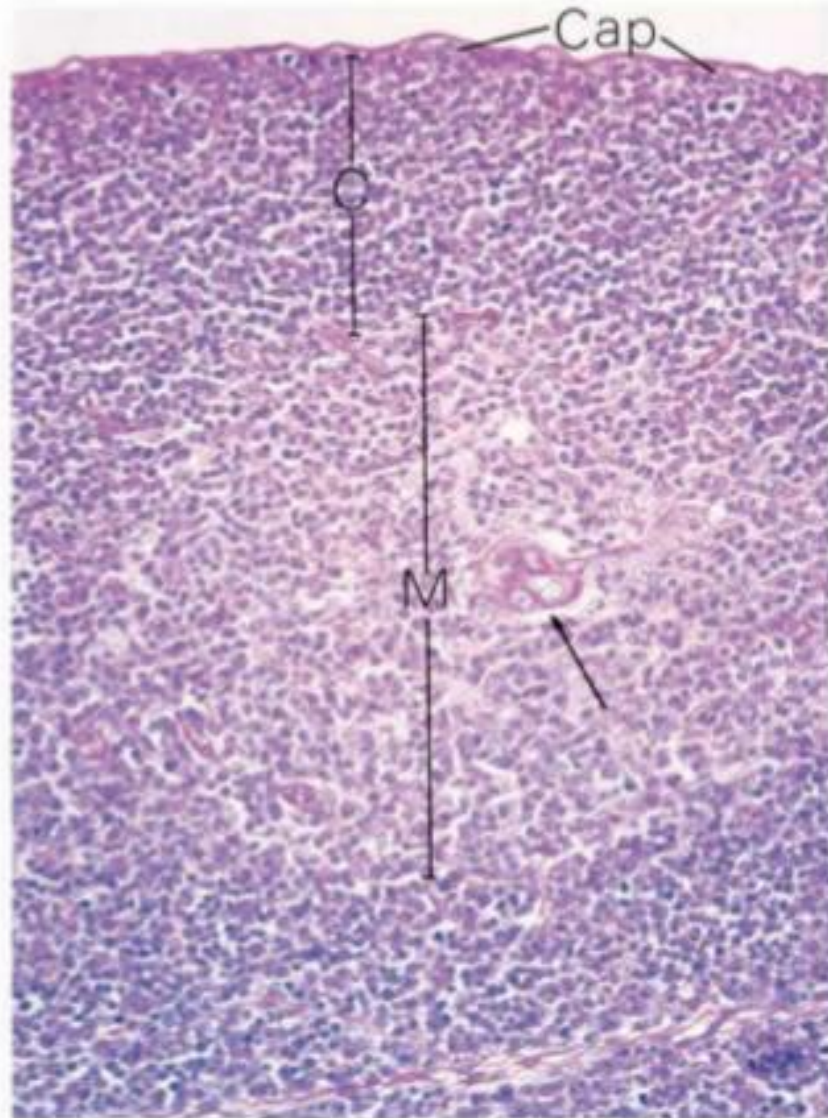
➤ **Desmosomes,**

➤ **Intermediate filament protein keratin is** present in their cytoplasm.

## **EPITHELIORETICULAR CELLS**

- Have features of both epithelial and reticular cells.
- Provide a framework for the developing T cells;
- Correspond to the reticular cells and their associated reticular fibers in other lymphatic tissues and organs.
- Reticular connective tissue cells and their fibers, however, are not present in the thymic parenchyma.
- Cells exhibit characteristic of epithelium such as intercellular junctions and intermediate filaments.





## CORTEX VS MEDULLA

- Lymphocytic Population
- Staining Properties Of Nuclei

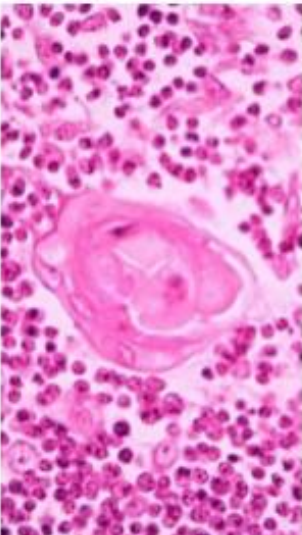
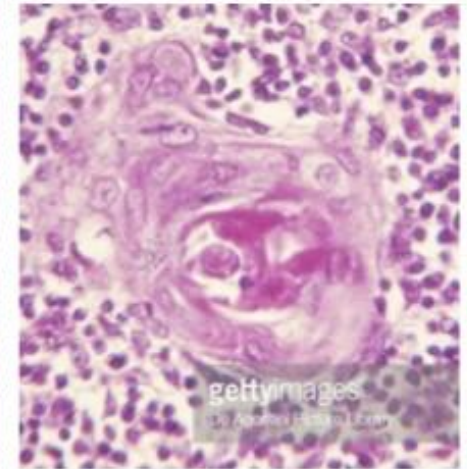
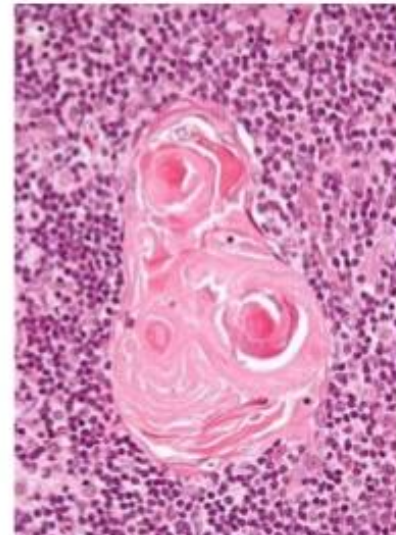
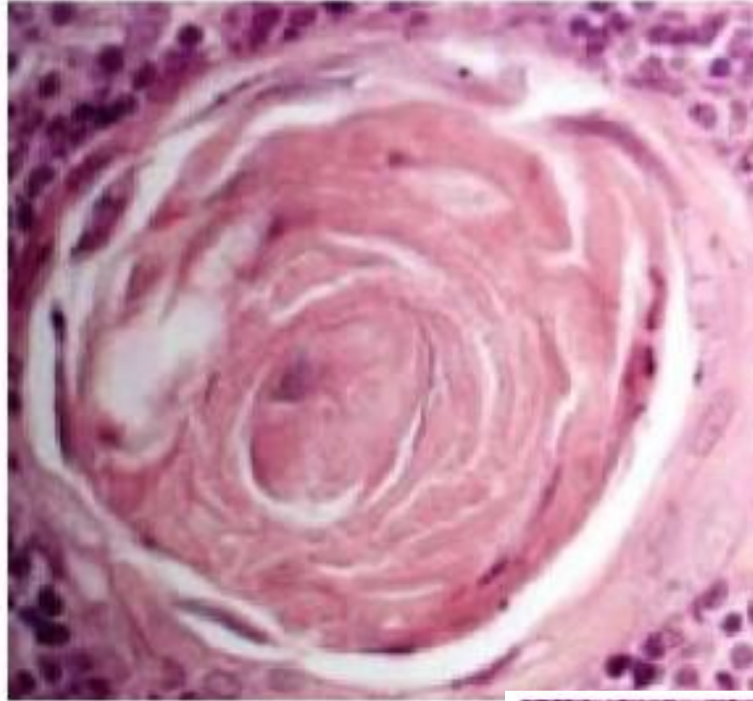
### **Medulla -**

- Less cellular,
- Eosinophilic
- Presence of **Hassal's corpuscles**



## MEDULLA- HASSAL'S CORPUSCLES

- Present in the medulla.
- Made up of **flat non-secreting epithelial cells (type 6 reticuloepithelial cells)** arranged in a concentric layers that have keratinised.
- Only found in the thymus.



# BLOOD THYMUS BARRIER

