

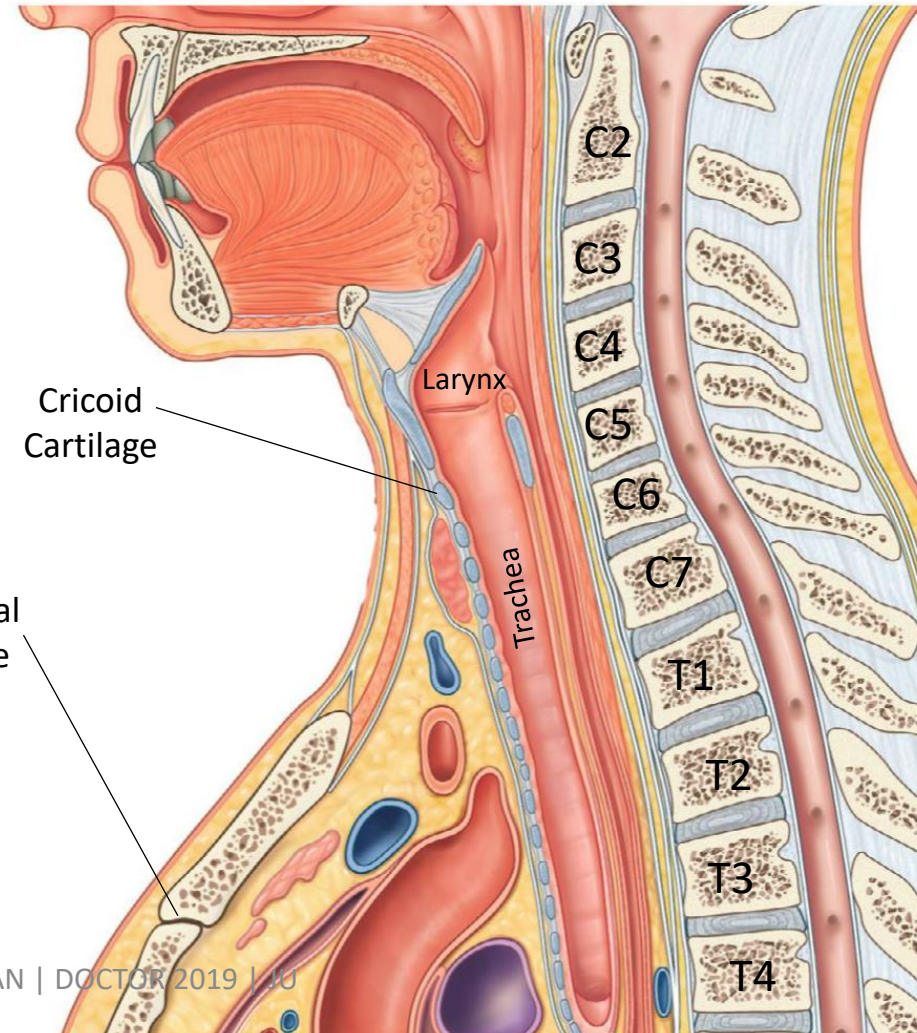
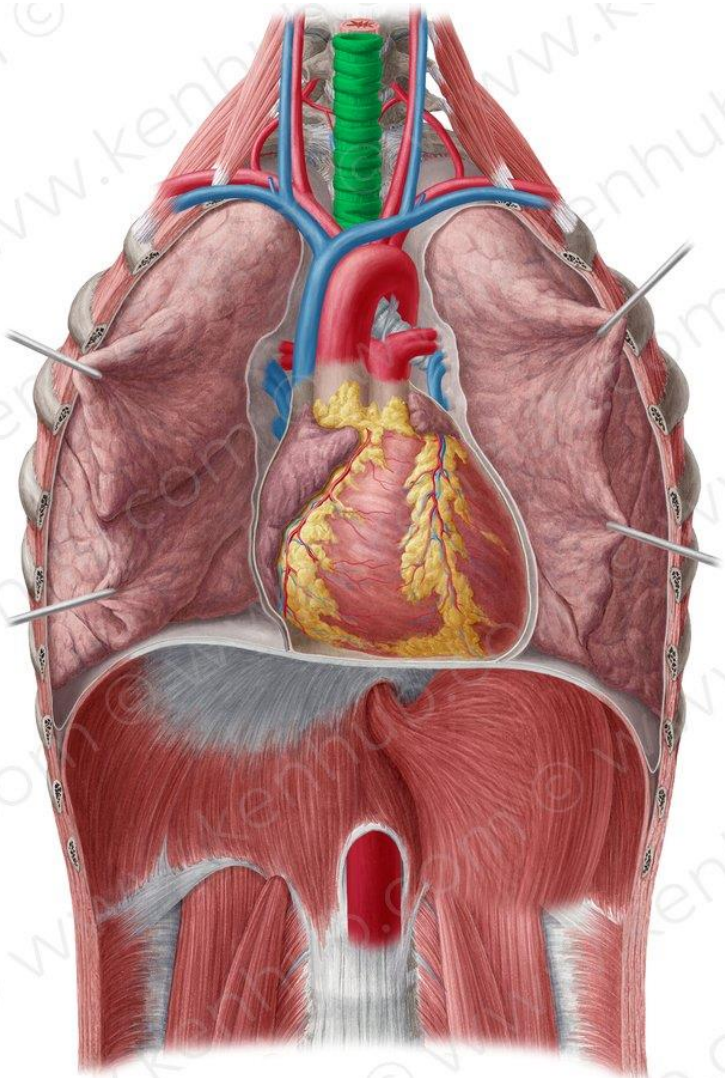
بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

# The Trachea, Bronchial Tree, Lungs and Pleurae.

Done by: Ahmad Ayma

# THE TRACHEA

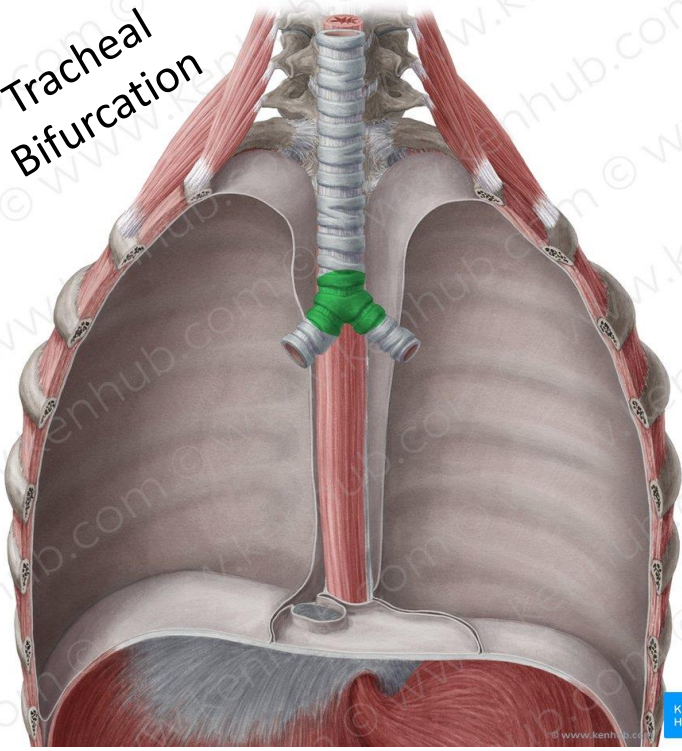
The trachea is a flexible tube that extends from vertebral level C6 ( inferior border of the cricoid cartilage) in the lower neck to vertebral level T4/5 ( this is the level of the sternal angle, angle of louis of as was Dr. Amjad saying: “the imaginary plane”).



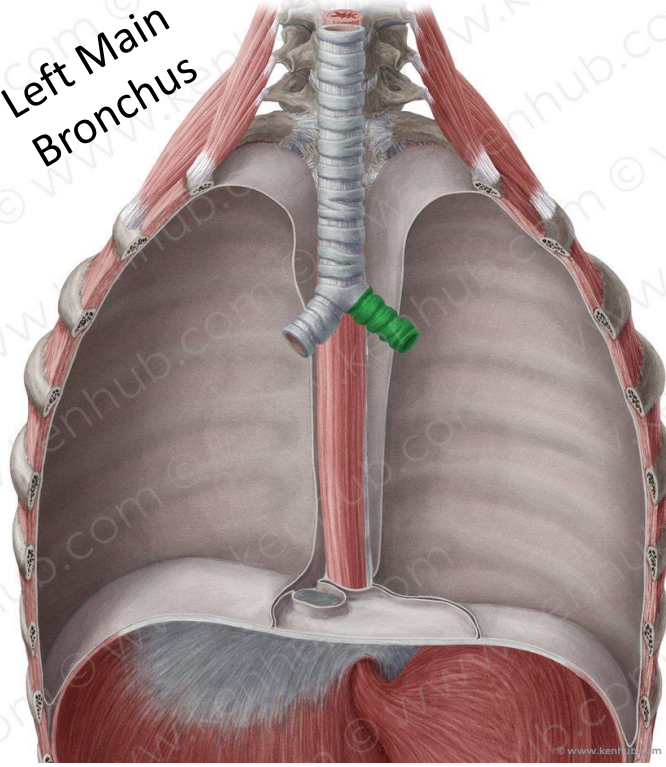


- The trachea bifurcates a right and a left main bronchus at the level of sternal angle.
- In adults the trachea is about 4½ in. (11.25 cm) long and 1 in. (2.5 cm) in diameter (almost the diameter of index finger).
- In children, the diameter of the trachea is too narrow (almost as the diameter of the pencil), so it can easily get obstructed upon respiratory infections, also it is very difficult to preform a tracheostomy in children.
- The trachea widens and lengthens slightly with each inspiration, returning to its resting size with each expiration.

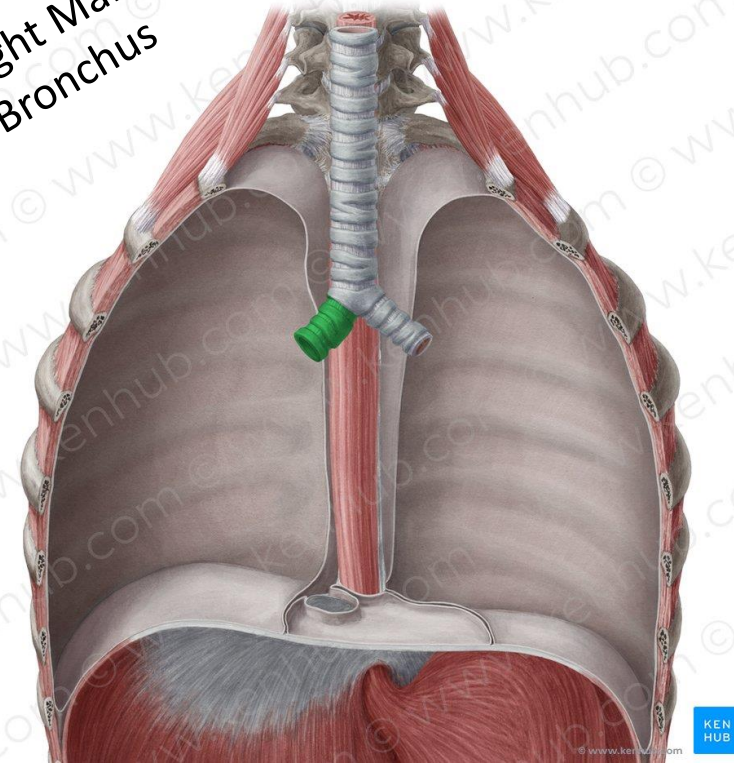
Tracheal  
Bifurcation



Left Main  
Bronchus



Right Main  
Bronchus





- The trachea is held open by **C-shaped hyaline cartilaginous rings that are 16-20 in number** embedded in its wall, with the open part of the 'C' facing posteriorly.
- The posterior wall of the trachea is composed mainly of smooth muscle and connective tissue, so the smooth muscle part faces the esophagus which lies posterior to the trachea, this smooth muscle part maintains the airway during esophageal peristalsis that occurs when ingesting a food bolus, contraction of trachealis muscle further helps opening the food bolus, however, if there were a cartilage posteriorly, it would interfere with esophageal peristalsis and embed the food bolus. (note: the smooth muscle of the trachea is referred to as the trachealis muscle).

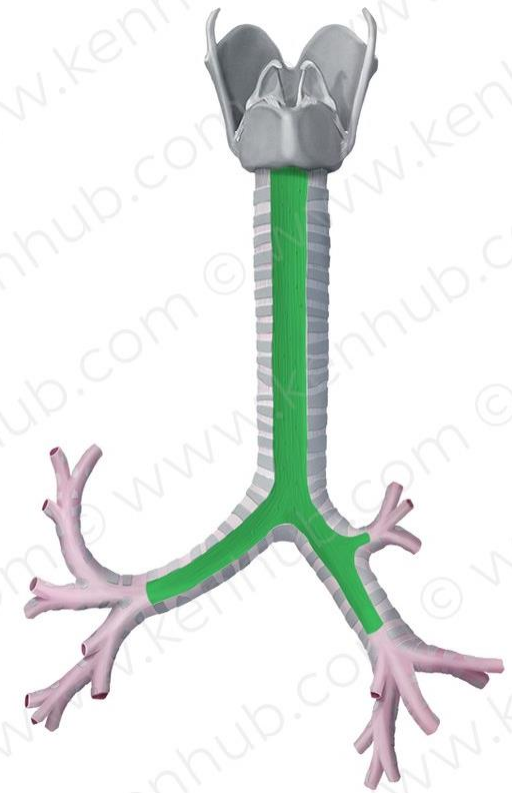
Tracheal Cartilaginous Rings  
(Anterior View)



Tracheal Cartilaginous Rings  
(Posterior View)



Trachealis muscle.

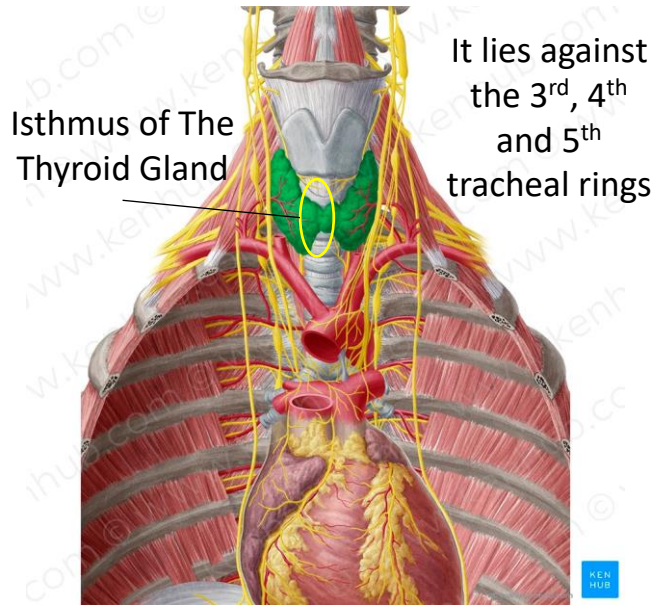


- The **carina** is a cartilaginous ridge within the trachea that runs anteroposteriorly between the two primary bronchi at the site of the tracheal bifurcation (which lies at the level of T4-T5).
- The mucous membrane of the carina is the most sensitive area of the trachea and larynx for triggering a cough reflex.
  - In deep inspiration, the carina descends to the level of T6.



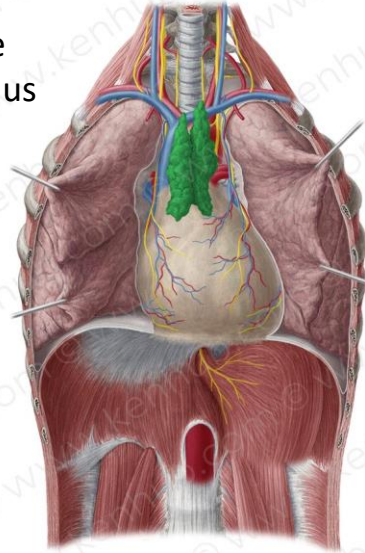
Note: touching the carina from the inside would send afferent impulses to the brain, which would respond by stimulating muscles that close the laryngeal inlet, thus trapping air within the lungs, then stimulating contraction of expiratory muscles, thus increasing pressure greatly pressure inside the lungs, then opening the laryngeal inlet opens suddenly resulting in an explosion that is the cough.

# RELATIONS OF THE TRACHEA



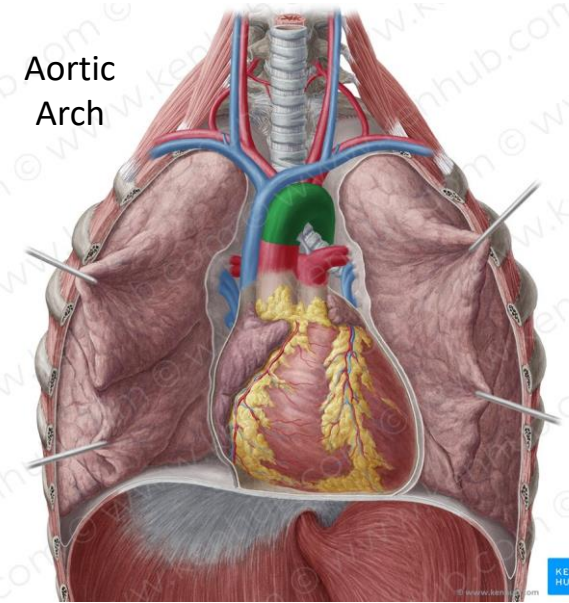
Anteriorly:

The Thymus

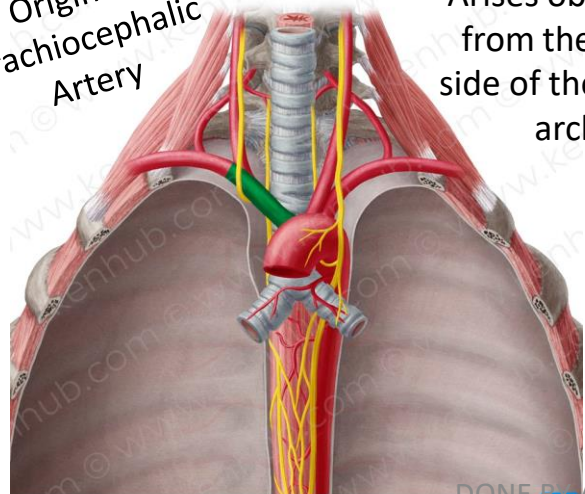


Note: in adults, there is no thymus and only its remnants (fat) are in front of the trachea.

Aortic Arch

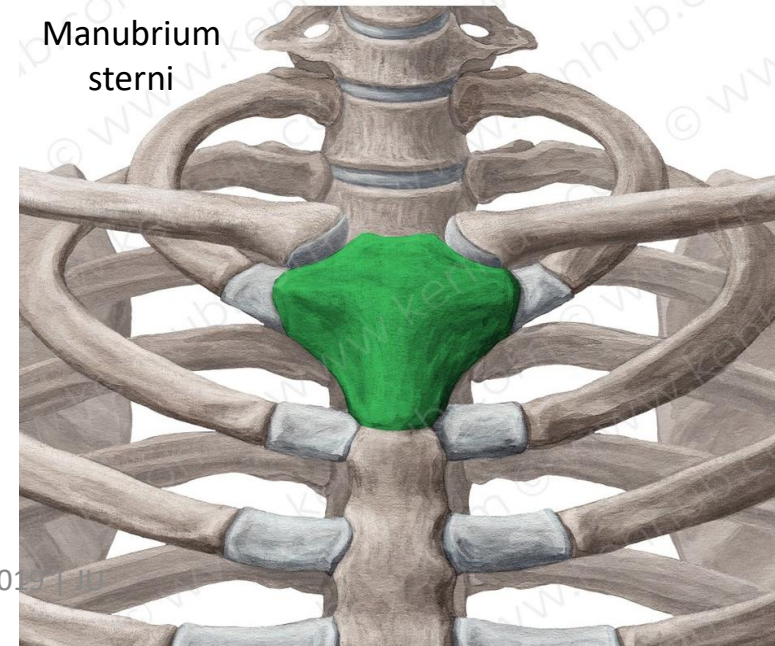


Origin of Brachiocephalic Artery



Arises obliquely from the right side of the aortic arch

Manubrium sterni

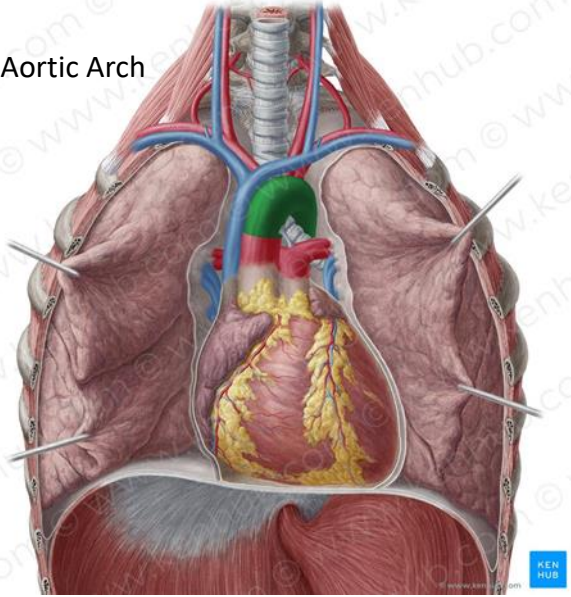


It encloses all these structures.

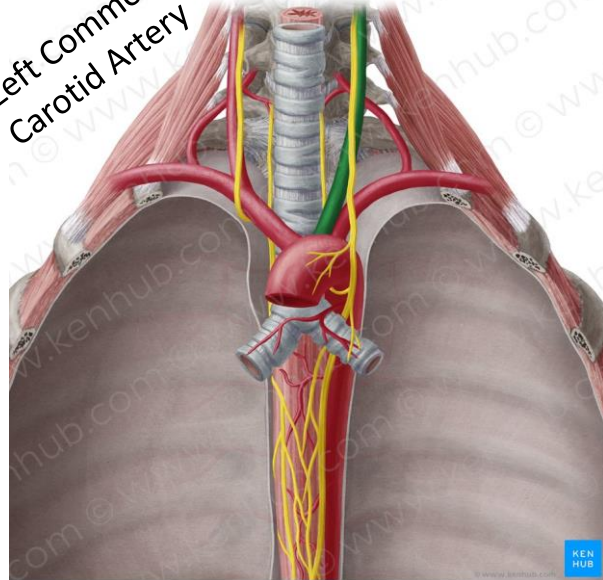


To the left:

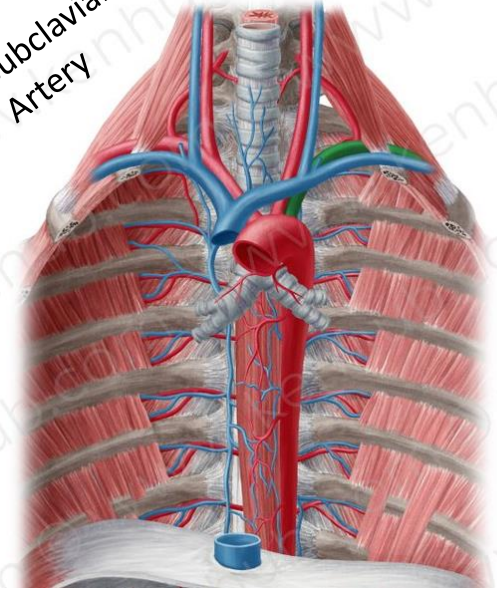
Aortic Arch



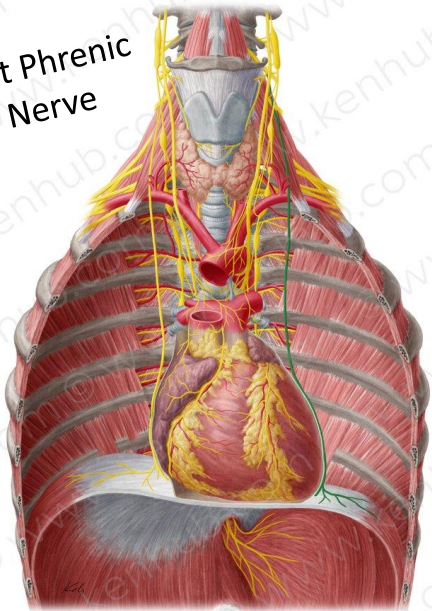
Left Common Carotid Artery



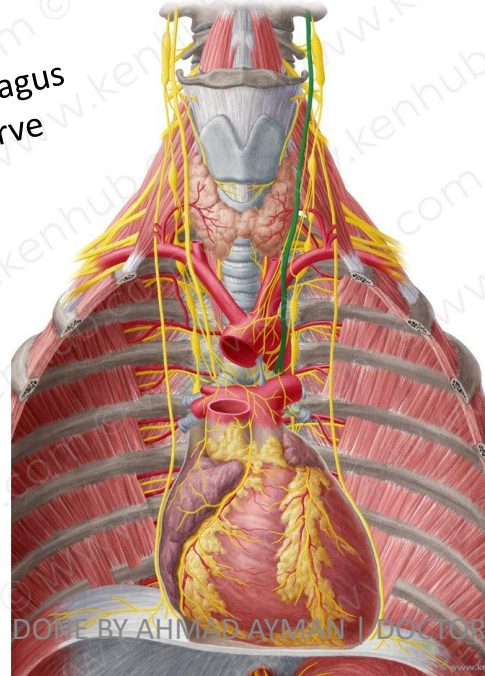
Left Subclavian Artery



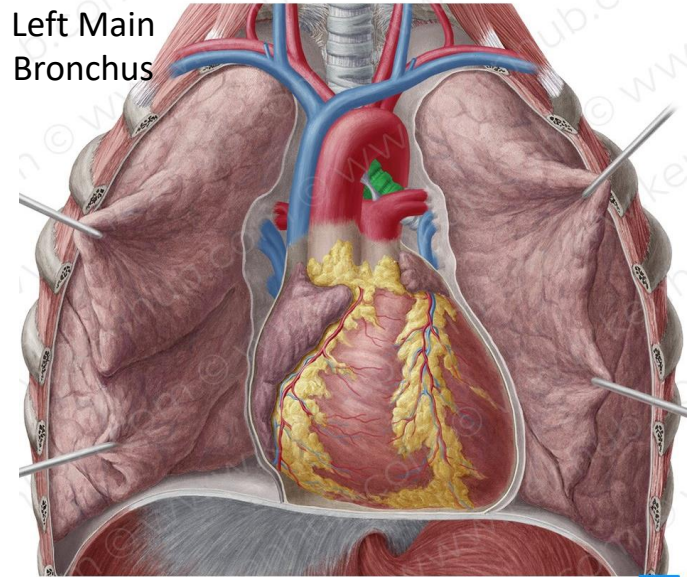
Left Phrenic Nerve



Left Vagus Nerve



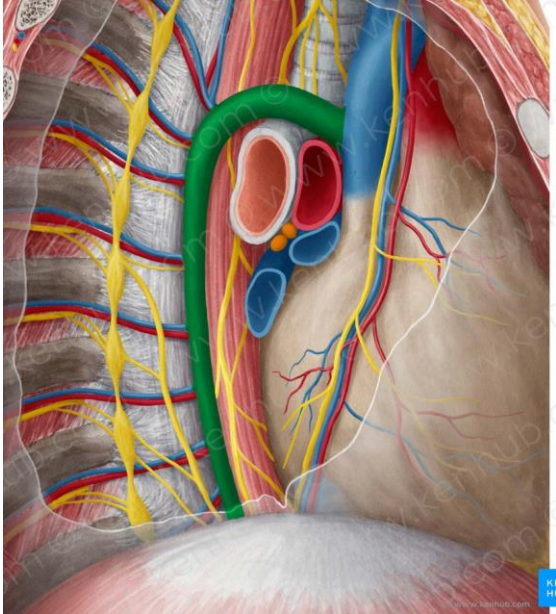
Left Main Bronchus



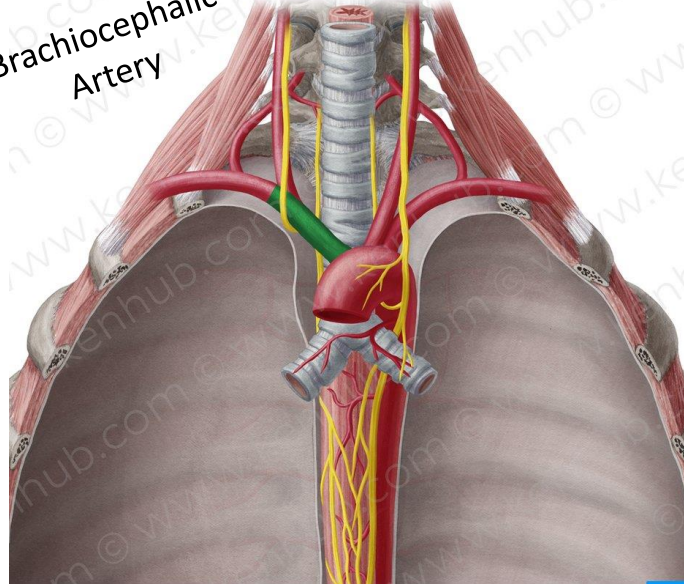


# To The Right:

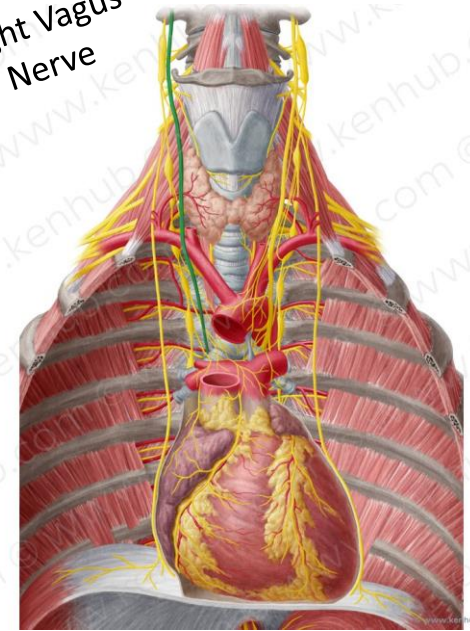
Arch of Azygous Vein



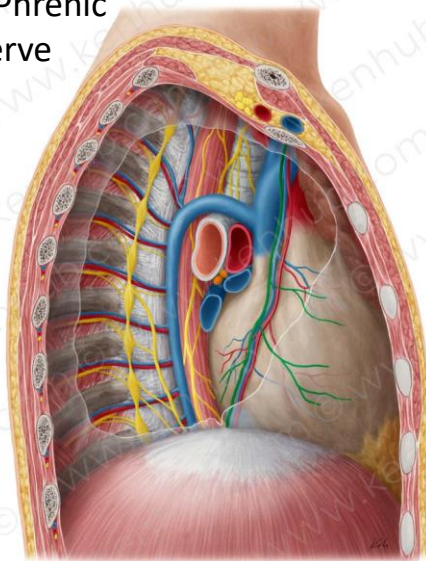
Brachiocephalic Artery



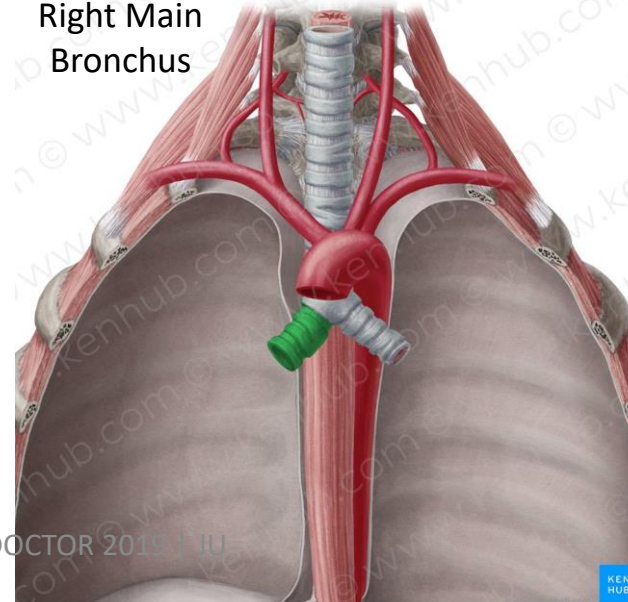
Right Vagus Nerve



Right Phrenic Nerve



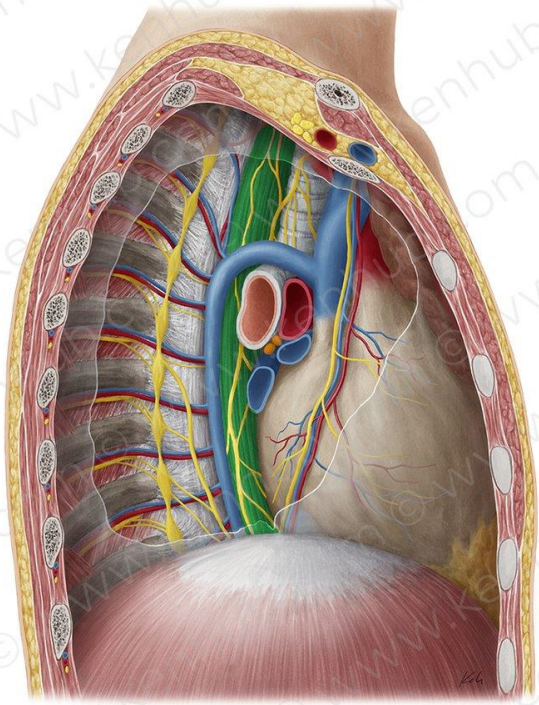
Right Main Bronchus



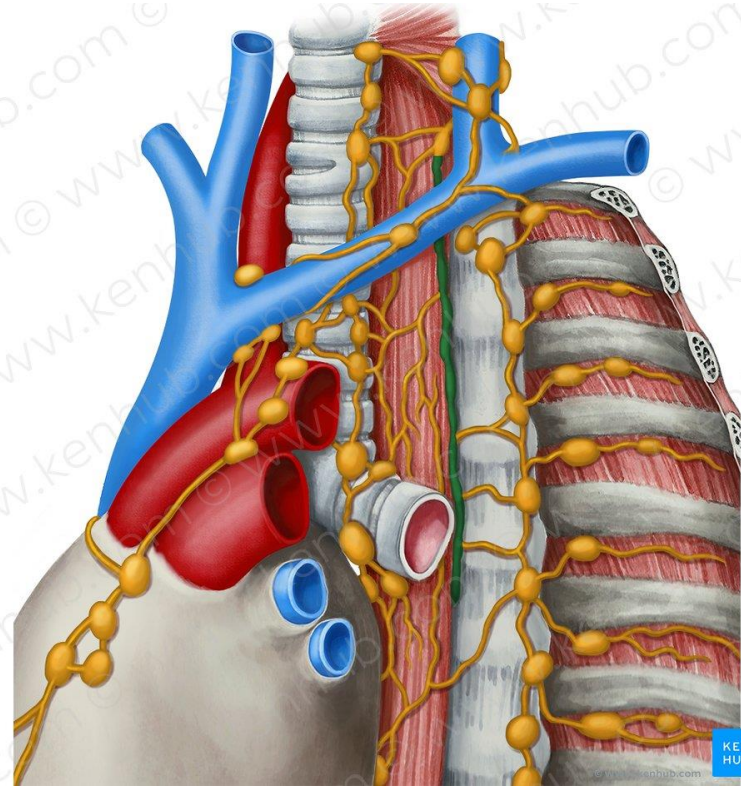
Note: the phrenic nerves lie anterior to the main bronchi while the vagus nerves lie posterior



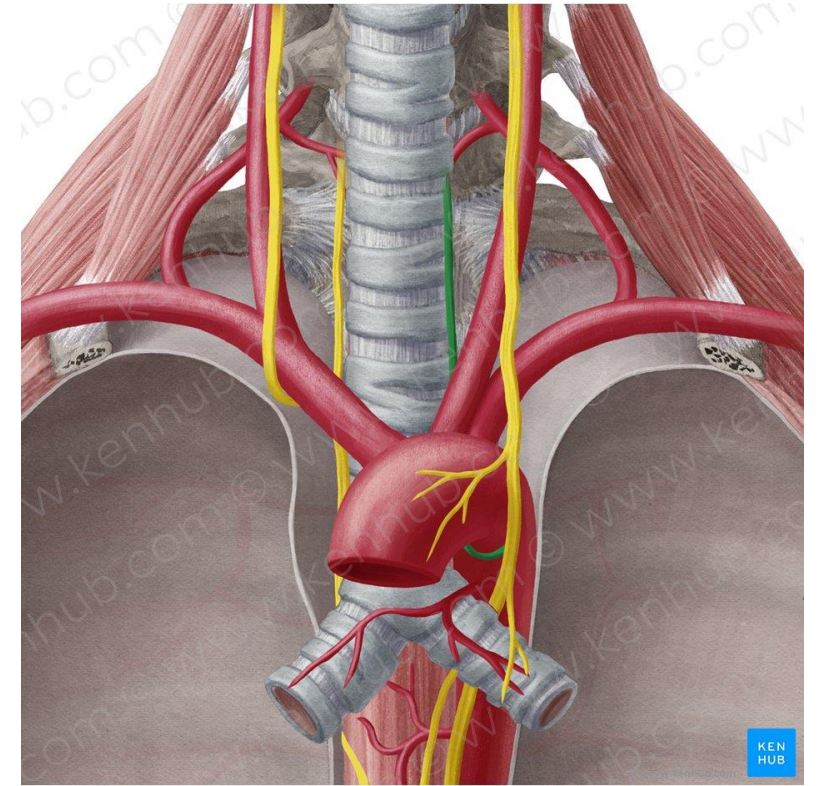
Posteriorly:



The Esophagus



The Thoracic Duct



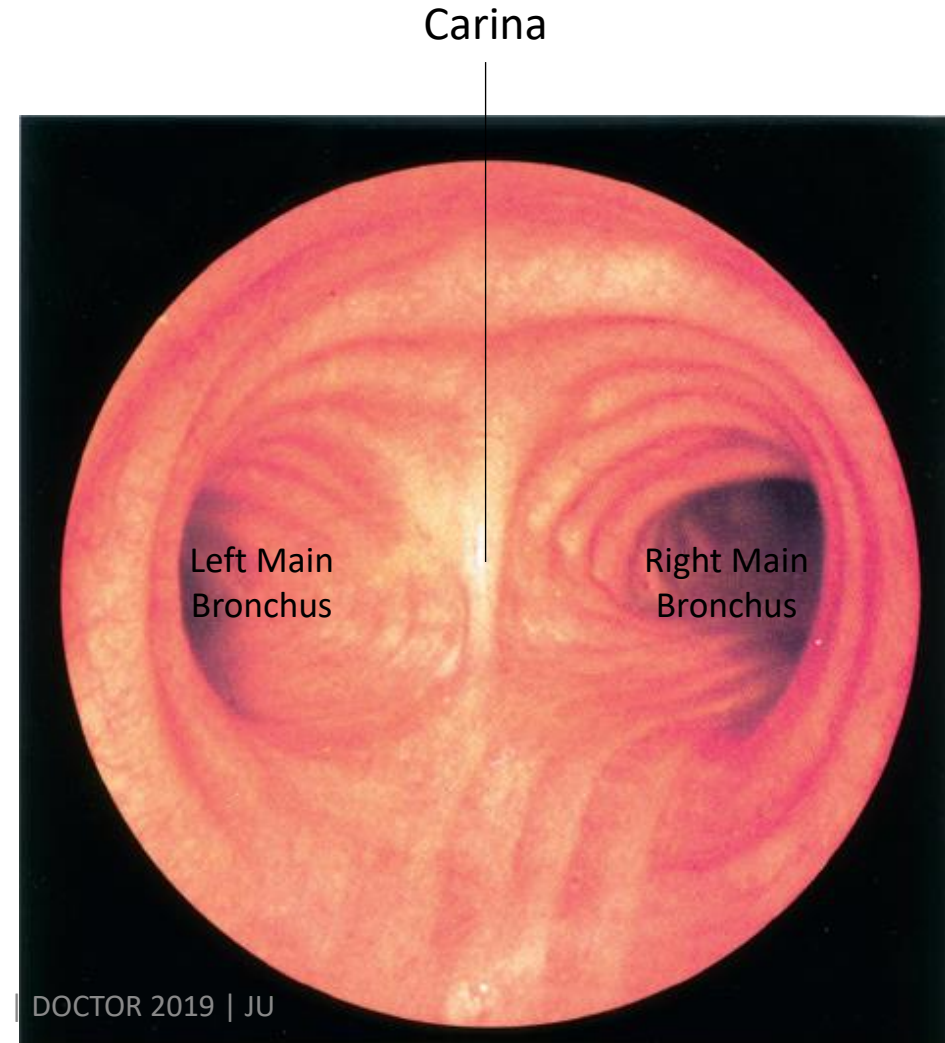
The Left Recurrent Laryngeal Nerve

Remember the issue of trachealis muscle.



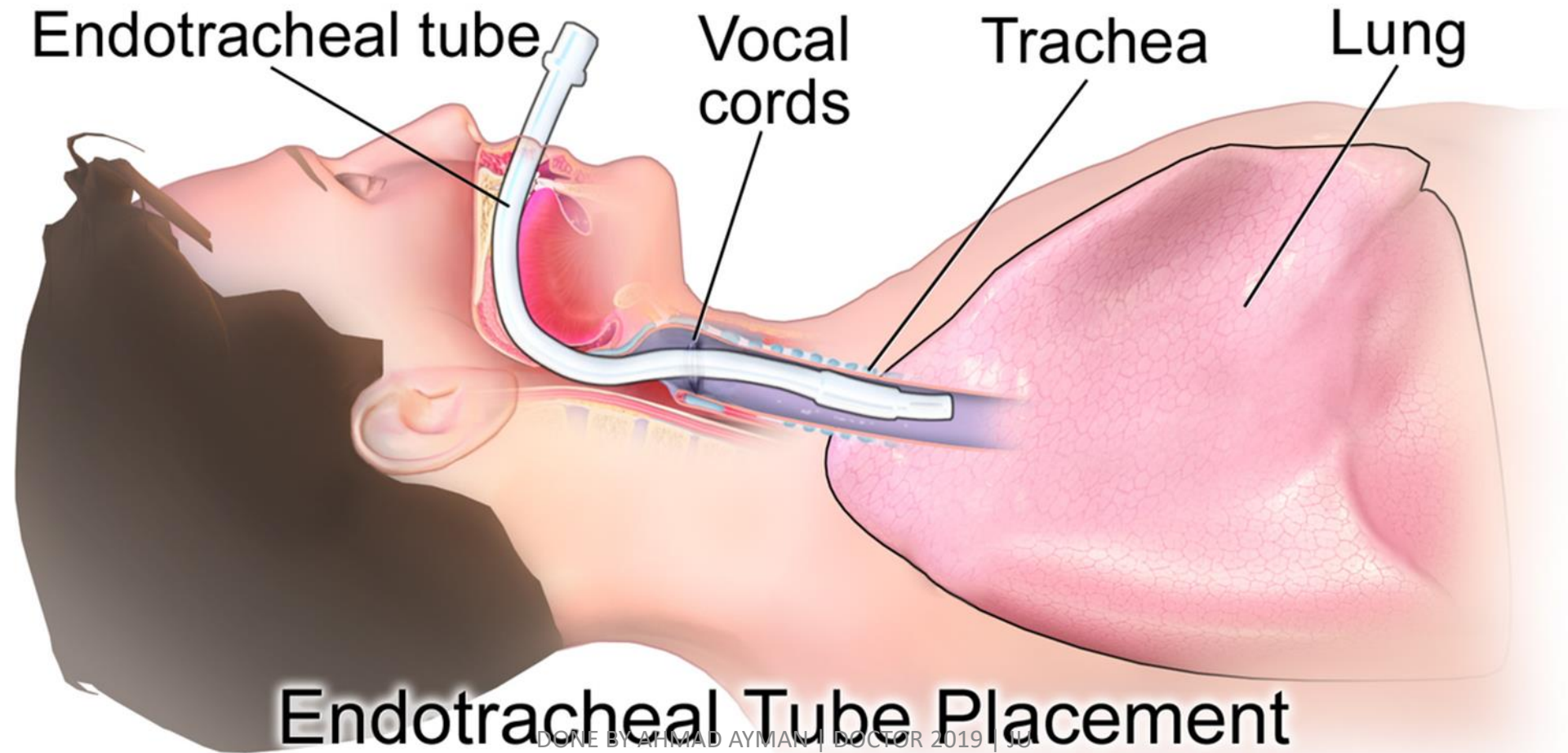
# BRONCHOSCOPY

Pulmonologists use an instrument known as the bronchoscope, this instrument is sort of an endoscope that is inserted through the oral cavity into the oropharynx, laryngopharynx, the laryngeal inlet then into the trachea and the bronchi to visualize these structures for diagnostic and/or therapeutic benefits, the pulmonologists must make sure that this instrument mustn't touch the carina.



# ENDOTRACHEAL INTUBATION

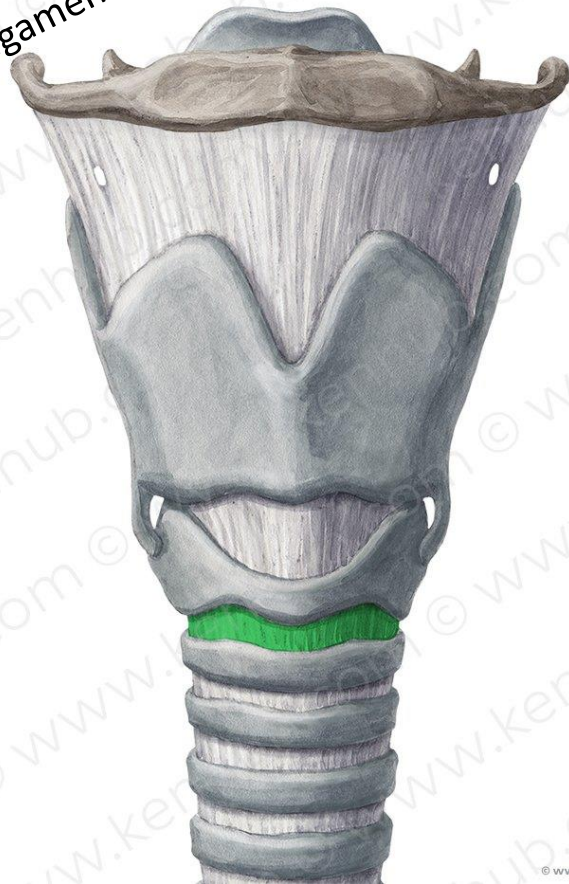
- In endotracheal intubation, the tube is inserted through the mouth or nose and push aside any flexible obstruction, any mucous clogging can be suctioned through the tube.
- Endotracheal tubes are commonly used by anesthesiologists, be used by anesthesiologists during surgical operations, this tube is inserted in the oral cavity, oropharynx, laryngopharynx, laryngeal inlet, laryngeal cavity and then the trachea, this is because general anesthesia might result in adduction of the vocal cords.



# TRACHESTOMIES (TRACHEOTOMIES)

- Tracheostomy (tracheostomy is a synonym for tracheotomy ☺) can be high or low tracheostomy.
- high tracheostomy is usually preformed during surgical operations, like when there is mistakenly a bilateral partial section of the recurrent laryngeal nerve, high tracheostomies are done in the cricotracheal ligaments usually.
- Note: both tracheostomy and endotracheal intubation are used to reestablish airflow past a tracheal obstruction, but if the obstruction is superior to the larynx, a tracheotomy may be performed

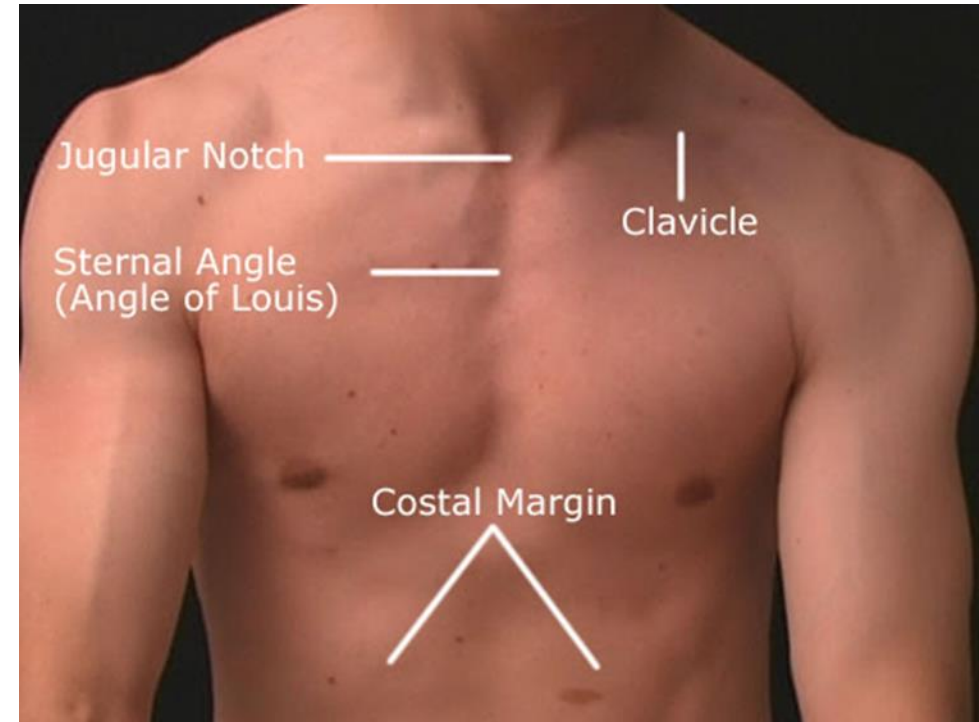
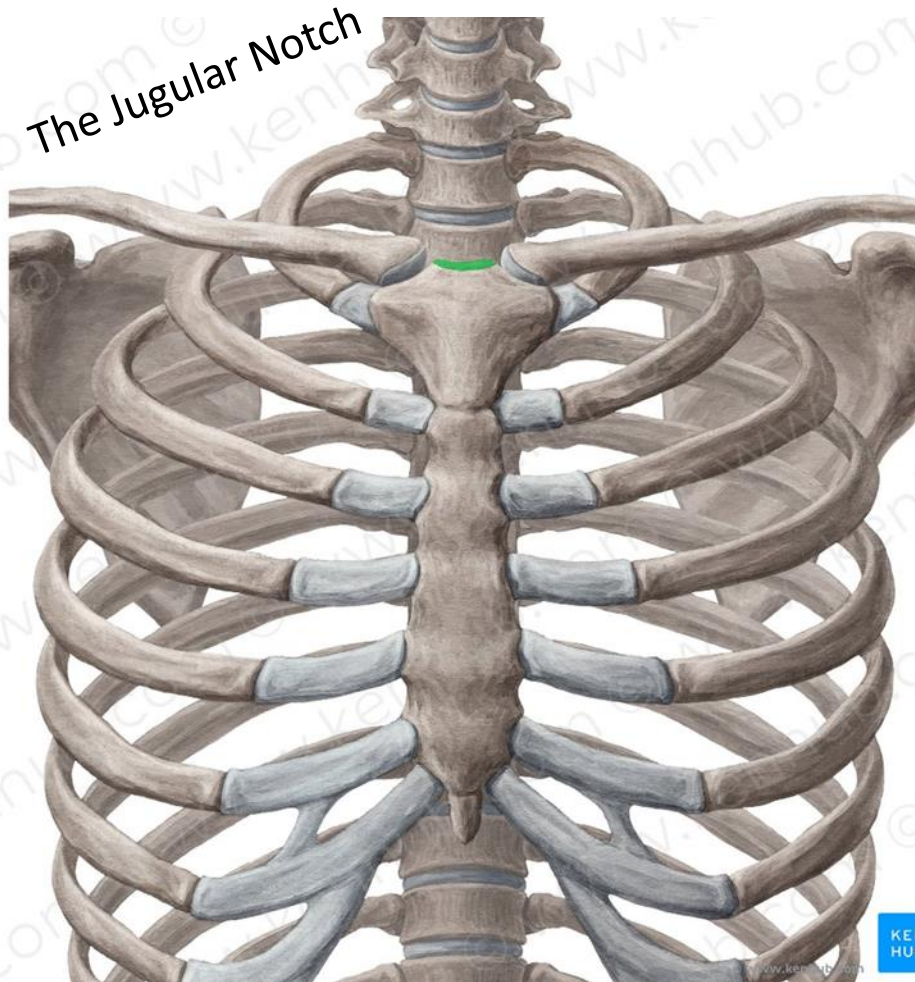
Cricotracheal Ligament



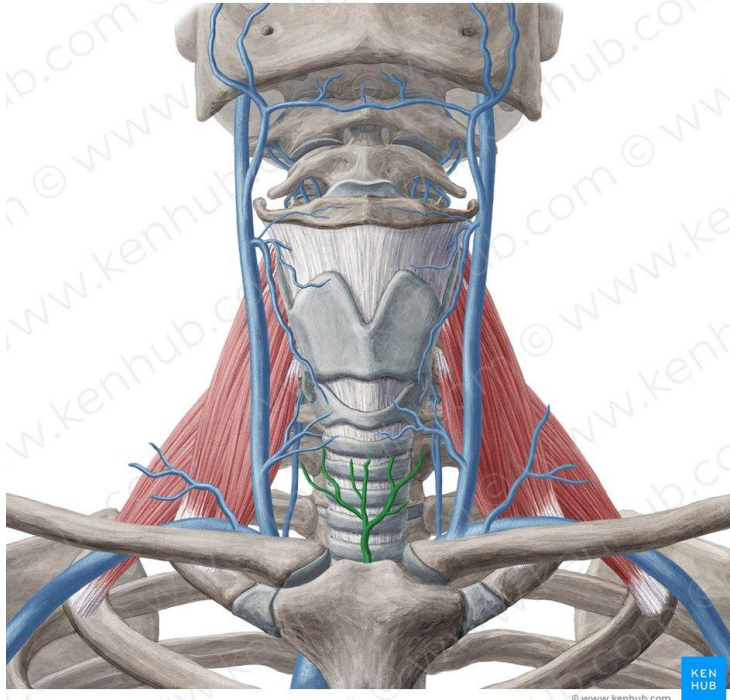
Cricotracheal Ligament



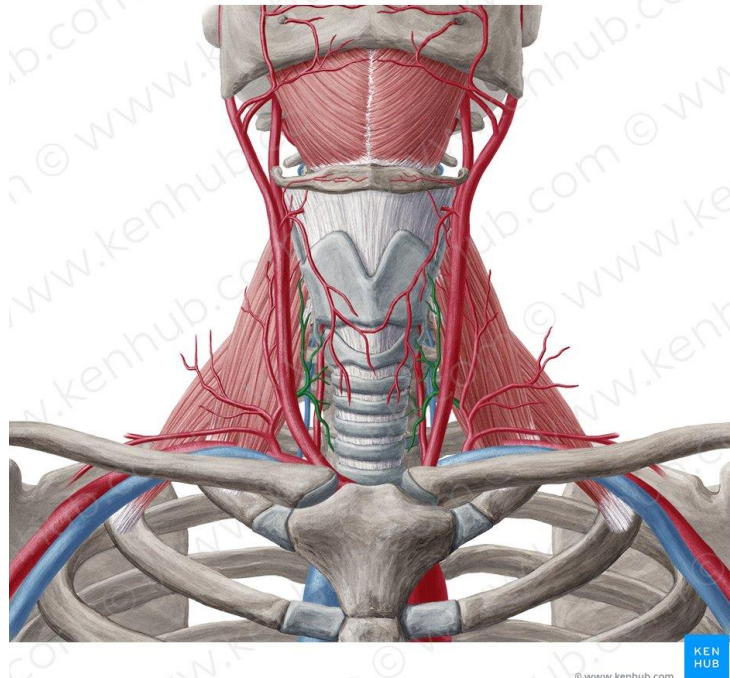
In contrast to high tracheostomies, low tracheostomies are performed in the trachea at the level of the jugular notch, this usually done in emergencies when you are not in a medical facility, you use any sharp object to open the trachea.



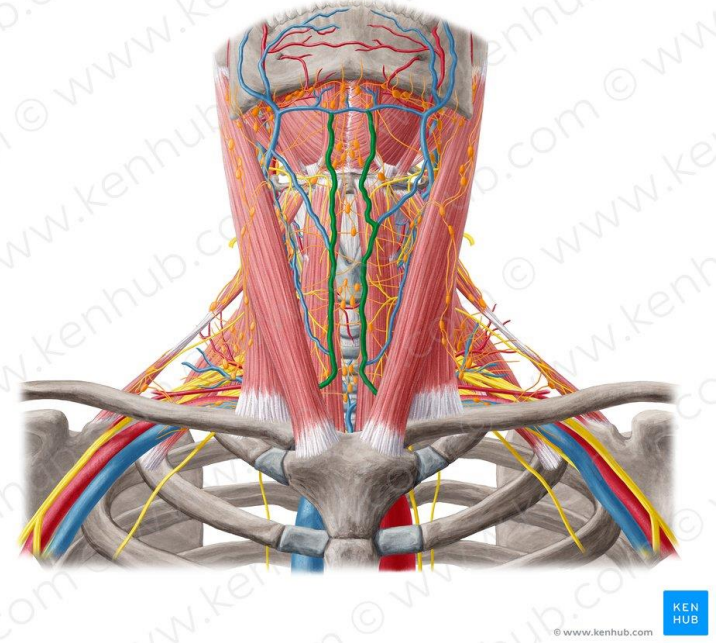
# STRUCTURES TO AVOID INJURY DURING LOW TRACHEOSTOMY



Inferior Thyroid Vein

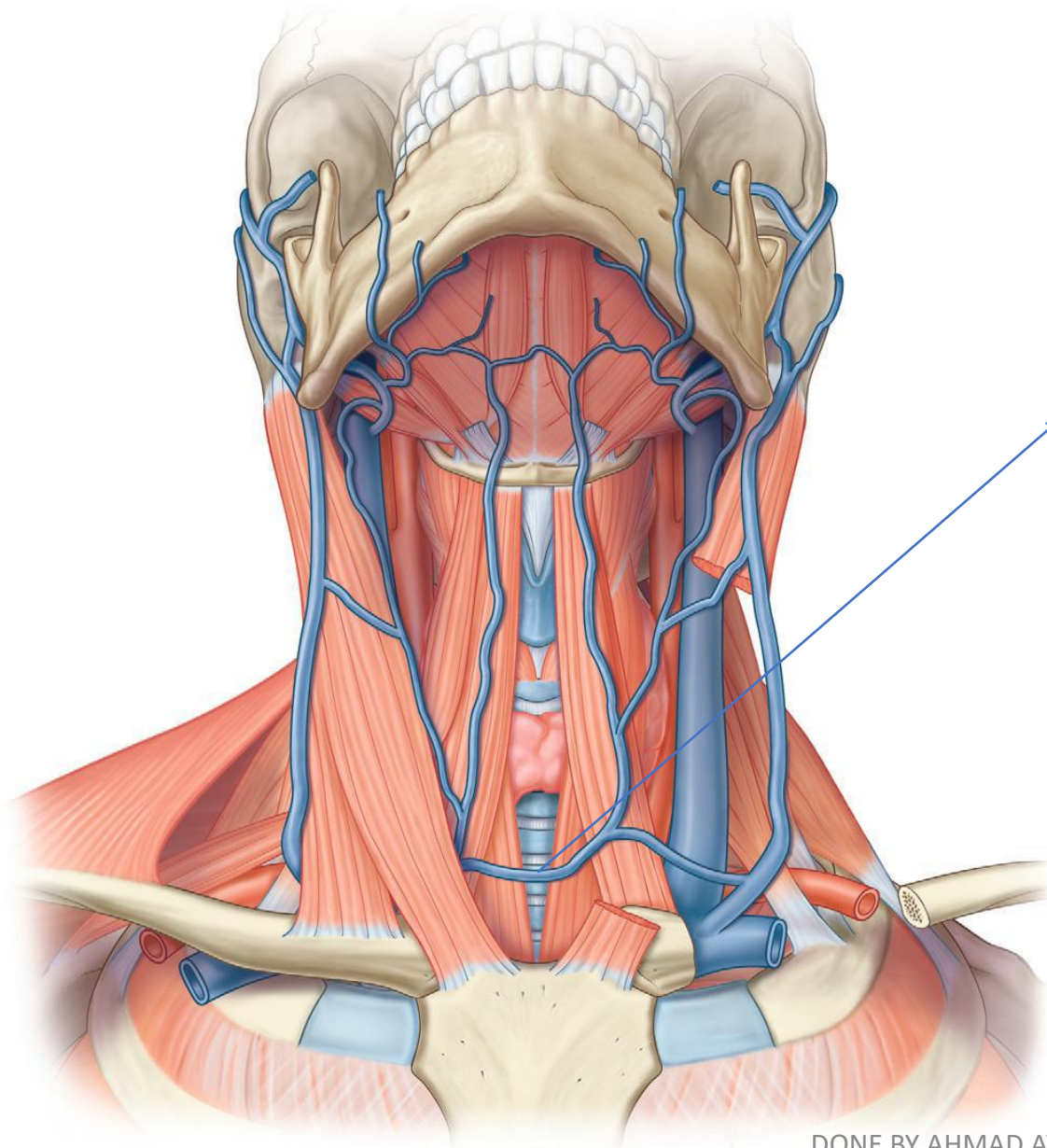


Inferior Thyroid Arteries



Anterior Jugular Veins





Jugular  
venous  
arch

In addition, you must be careful not to injure the thyroid Ima artery, which is an artery that arises from the brachiocephalic trunk and presents in only 15% of people.

Please do not get feared while performing a low tracheotomy if you injured one of these structures and minimal bleeding occurred, preserving oxygen supply to the brain is more important than a minimal bleeding 😊



# TRACHEOSTOMY TUBES

- A tracheostomy tube is a permanent prosthetic implant, it is inserted through an incision in the trachea, it is used in people whose larynges are nonfunctional anymore, like people who undergo laryngectomy (surgical removal of the whole larynx) due to laryngeal cancer, this tube must be cleaned regularly.



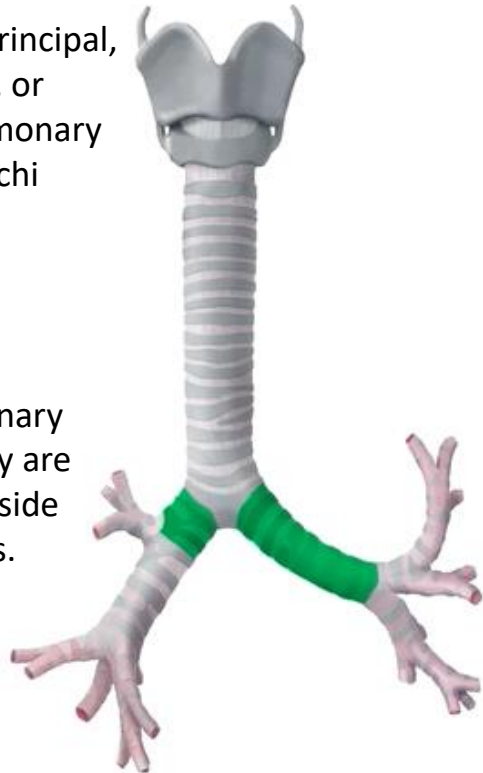
إذا عندك وقت افتح هذا الرابط و رح تلاقي فيه قصة جميلة عن ال  
☹️ ☹️ tracheostomy tube

<https://web.facebook.com/204934119643350/posts/899521953517893/? rdc=1& rdr>

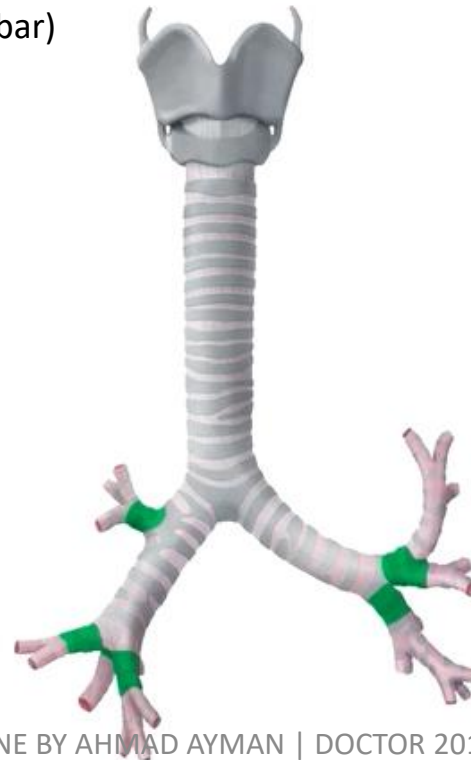
# ORGANIZATION OF THE BRONCHIAL TREE.

- Each main bronchus enters the root of a lung and passes through the hilum into the lung itself, The main (also called primary, principal or extrapulmonary) bronchus divides within the lung into lobar bronchi (also called secondary bronchi), each of which supplies a lobe.
- The lobar (Secondary) bronchi further divide into segmental bronchi (tertiary bronchi), which supply bronchopulmonary segments.
- So each main (principal, primary, or Extrapulmonary bronchus) supplies a lung, each secondary (lobar) bronchus supplies a lobe of a lung and each tertiary (segmental) bronchus supplies a bronchopulmonary segment.

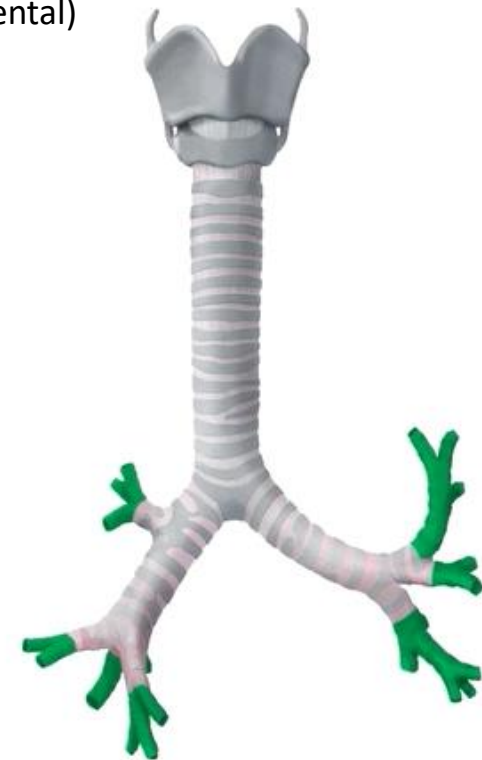
Primary, Principal, main, or Extrapulmonary Bronchi



Secondary (Lobar) Bronchi



Tertiary (segmental) Bronchi

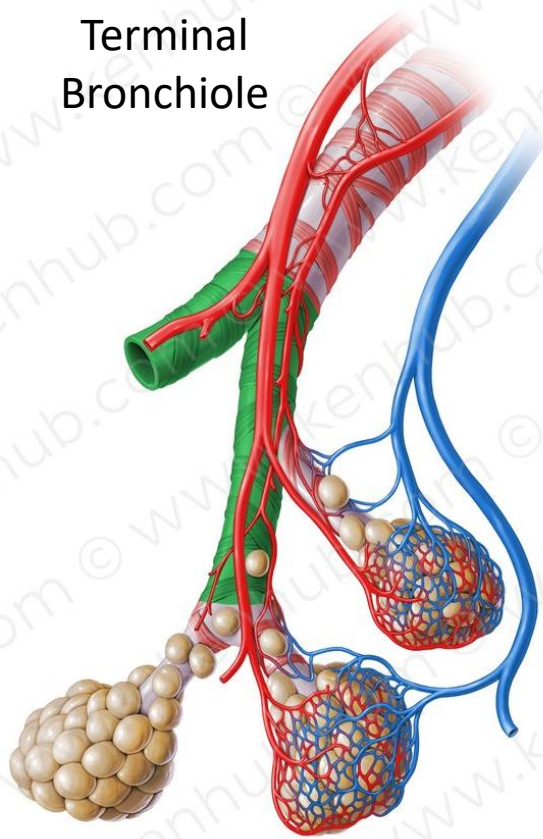


Called extrapulmonary because they are located outside the lungs.

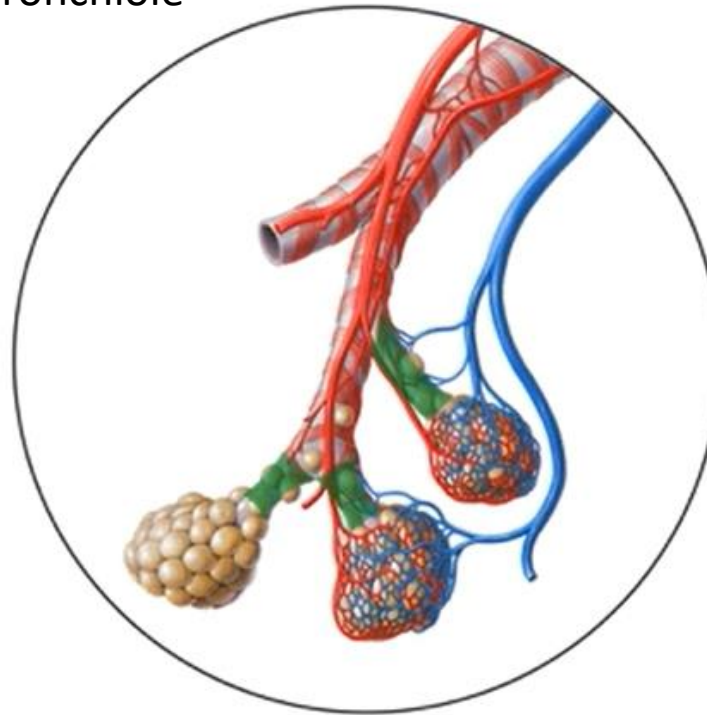


- Tertiary (segmental) bronchi further divide into terminal bronchioles and these into respiratory bronchioles which end in the pulmonary unit .
- Pulmonary units consist of alveolar ducts, atria, air sacs and pulmonary alveoli.
- The walls of the bronchi are held open by discontinuous elongated plates of cartilage, but these are not present in bronchioles, bronchioles are devoid of cartilage, rather, they contain smooth muscle.

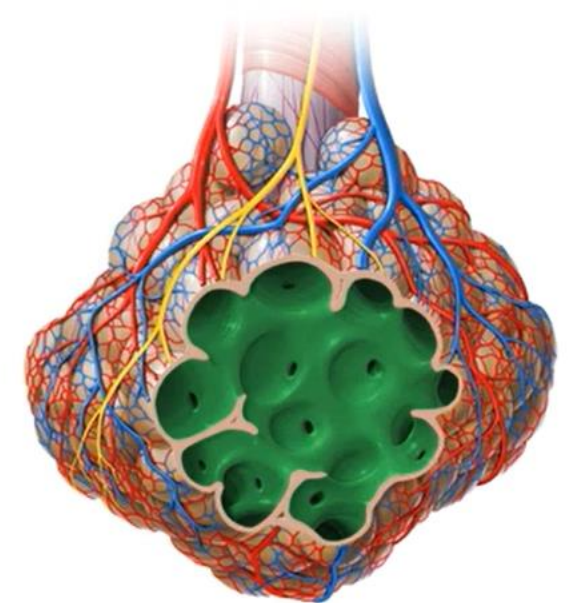
Terminal  
Bronchiole

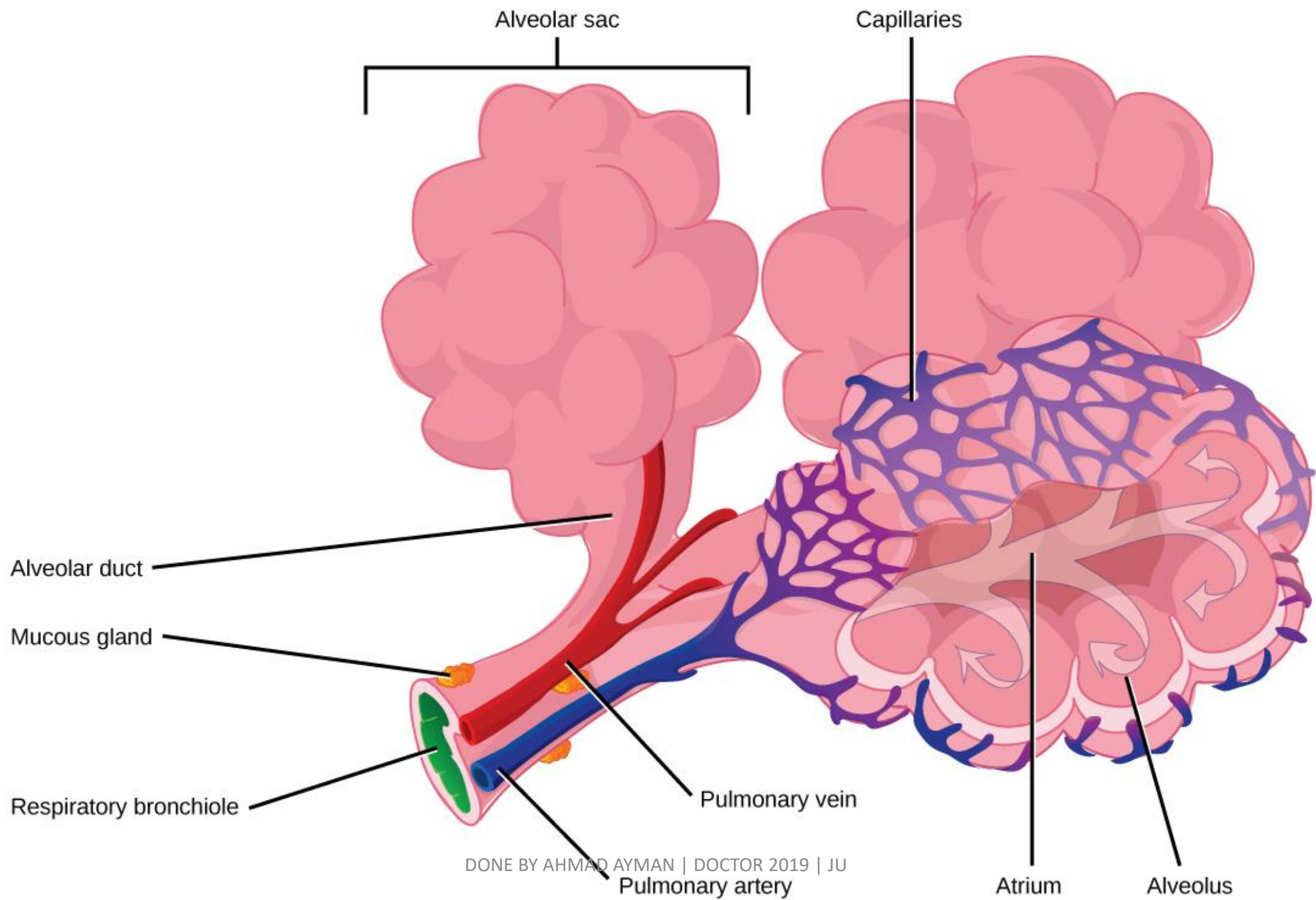


Respiratory  
Bronchiole



Alveolar  
Sac





DONE BY AHMAD AYMAN | DOCTOR 2019 | JU

# THE RIGHT MAIN BRONCHUS

- The right main bronchus is wider than the left main bronchus, and it takes a more vertical course and is about 1 inch (2.5 cm).
- The right principal bronchus divides upon entering the hilum of the right lung into eparterial and hyparterial bronchi, the eparterial is the right superior lobar (Secondary) bronchus, while the hyparterial bronchus divided within the right lung into right middle lobar (secondary) bronchus and right inferior lobar (secondary) bronchus.
  - The eparterial and hyparterial bronchi are named according to their position relative to right pulmonary artery.

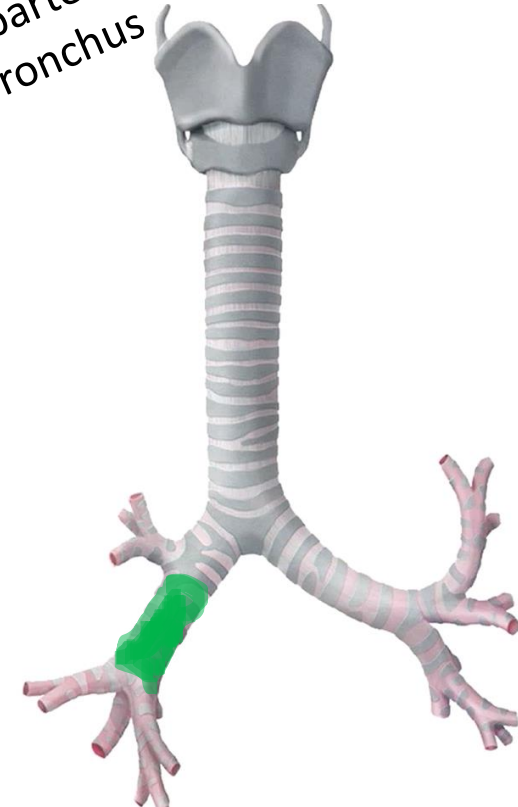
Right Main  
Bronchus



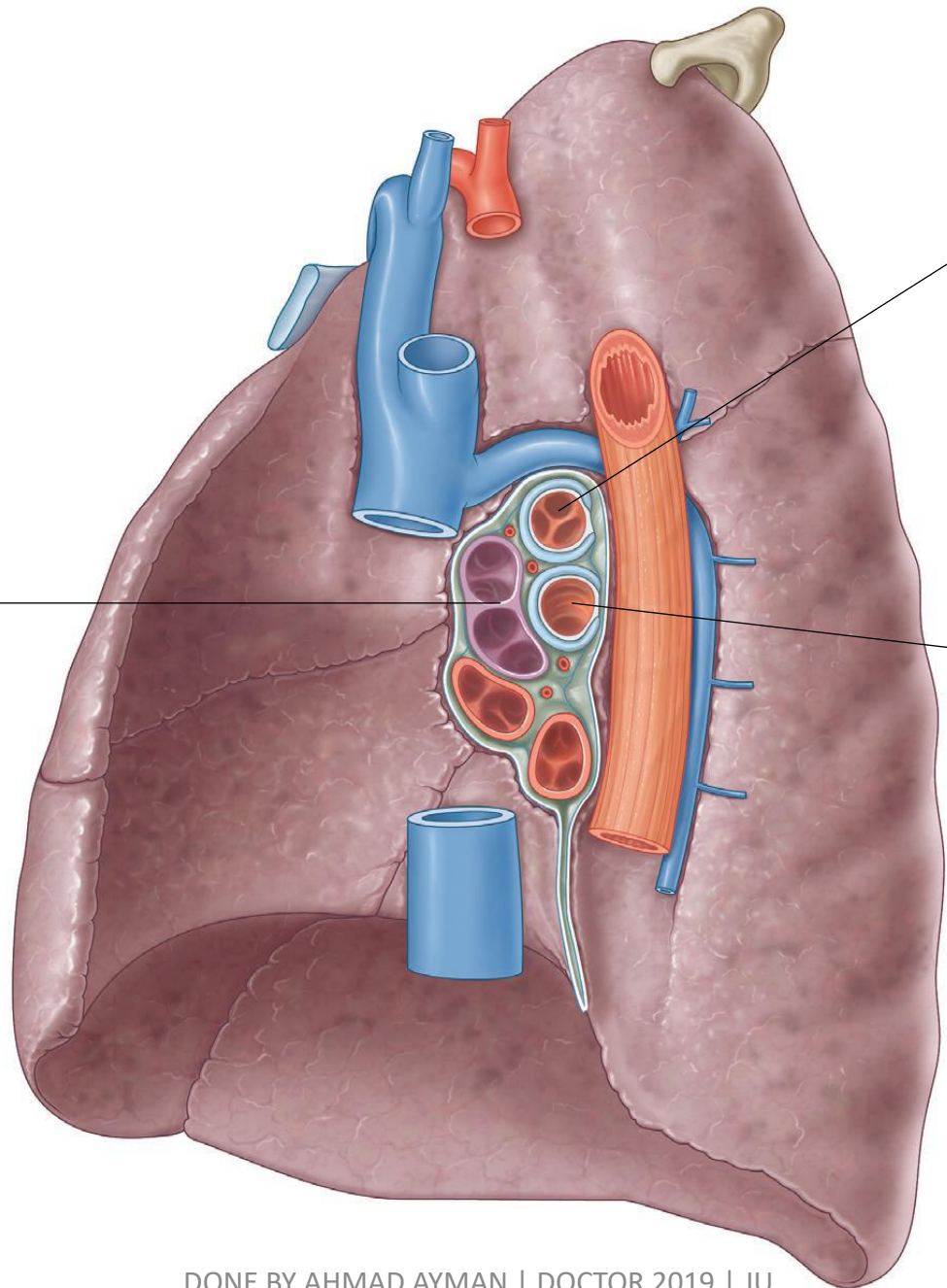
Eparterial  
Bronchus



Hyparterial  
bronchus







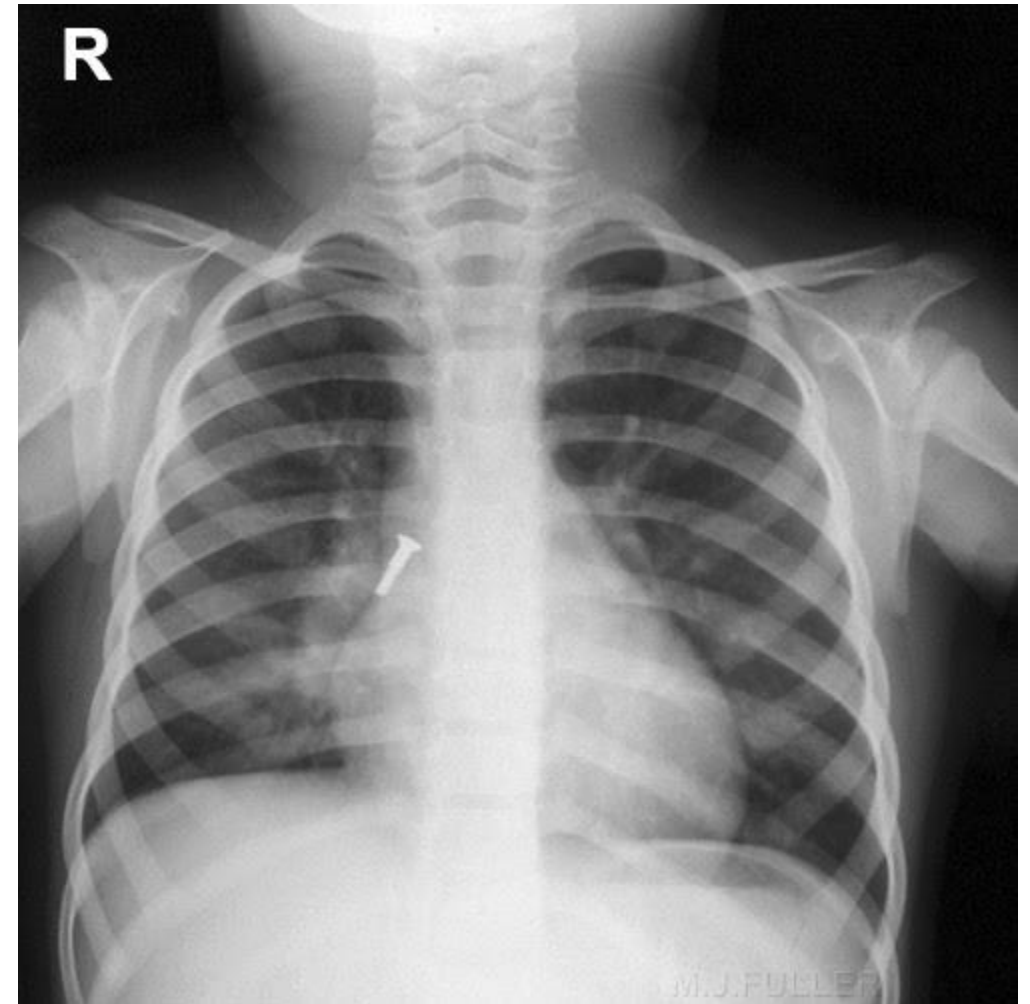
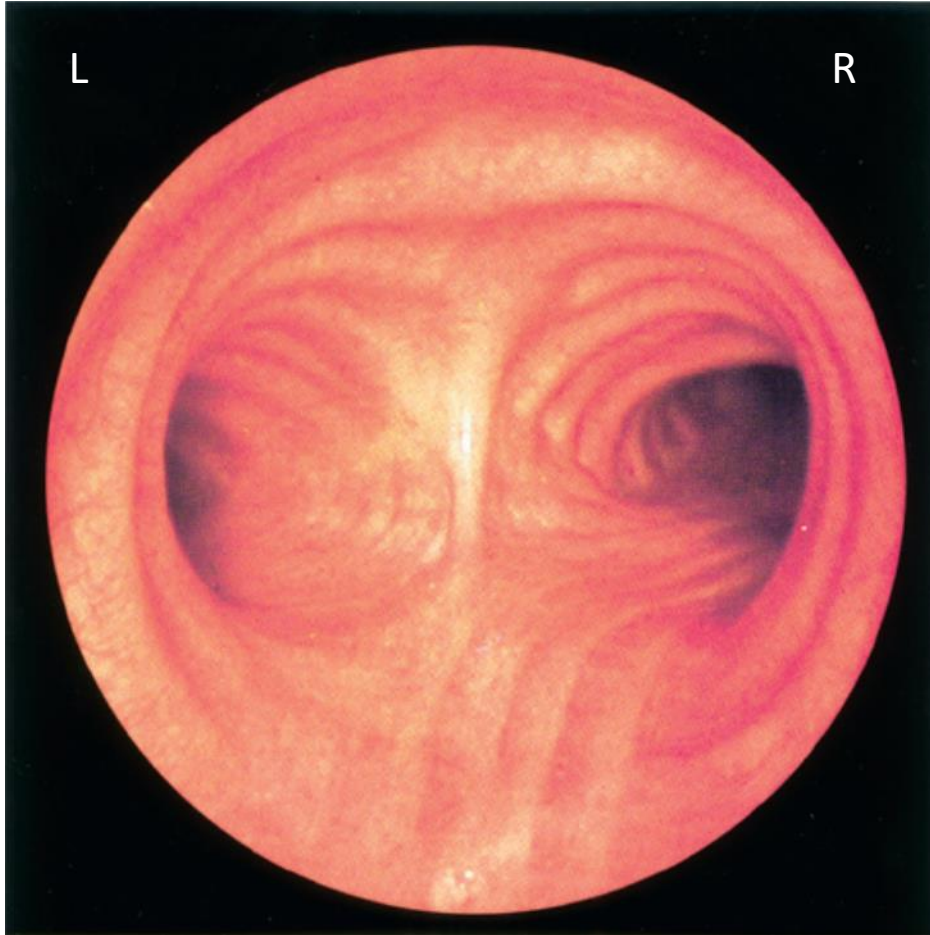
Eparterial (right superior lobar) bronchus

Hyparterial bronchus, divides into right middle and right inferior lobar bronchus

Right Pulmonary Artery

Because of this organization, the lobar bronchus to the superior lobe is the only secondary bronchus to originate within the root of the lung rather than inside the lung.

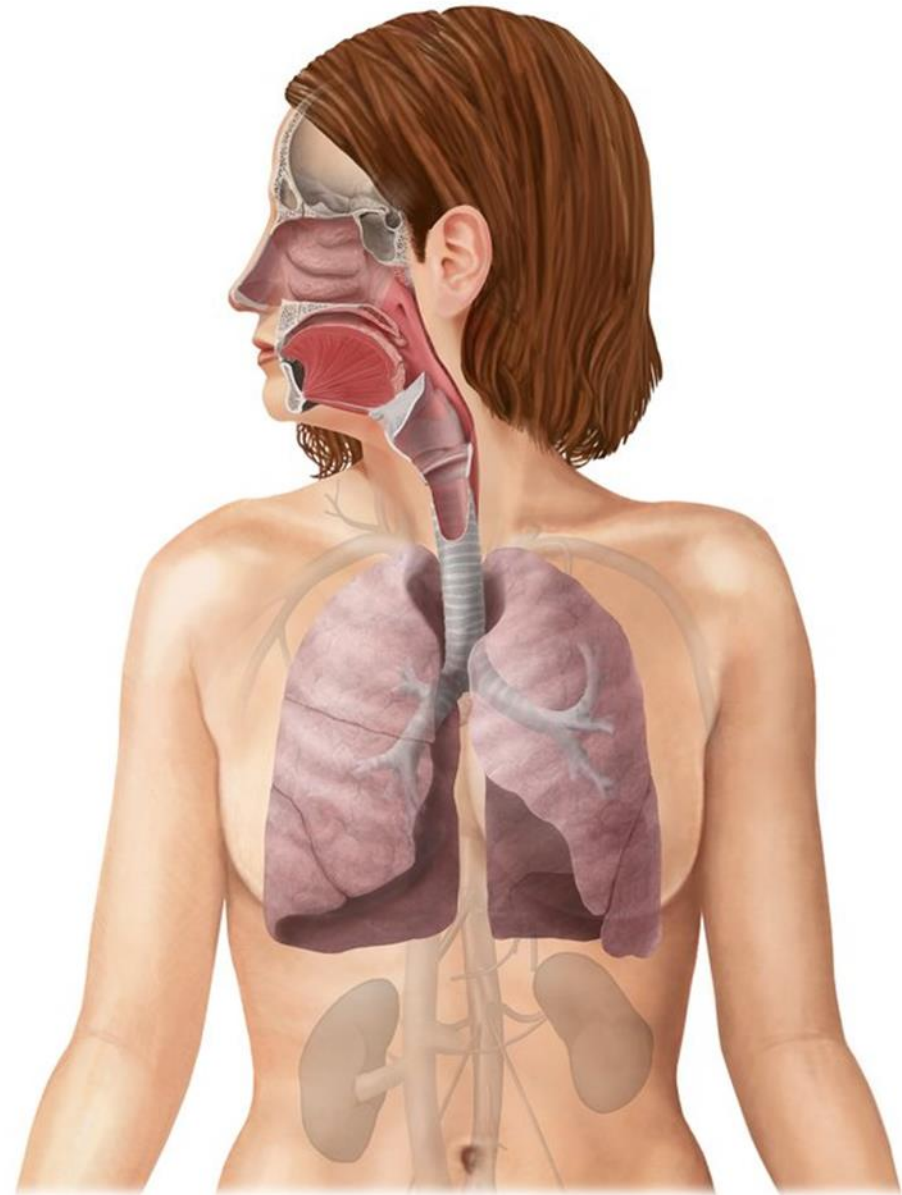
**Clinical note:** because the right main bronchus is more vertical (عمودي) and wider, inhaled foreign bodies (like fish bone or a child who had swallowed a coin or whatever) tend to lodge more frequently within the right lung.



Notice that we can see deeper in the right main bronchus because it is more vertical

# THE LUNGS

- The lungs are the organs of respiration, they lie on either side of the mediastinum.
- They are surrounded by the right and left pleural cavities.
- The lungs are spongy in architecture and grey in color, they become darker as we age due to accumulation of dust particles.
- a single lung weights 600-800 gm, 90% of its weight is air and 10% is tissue.

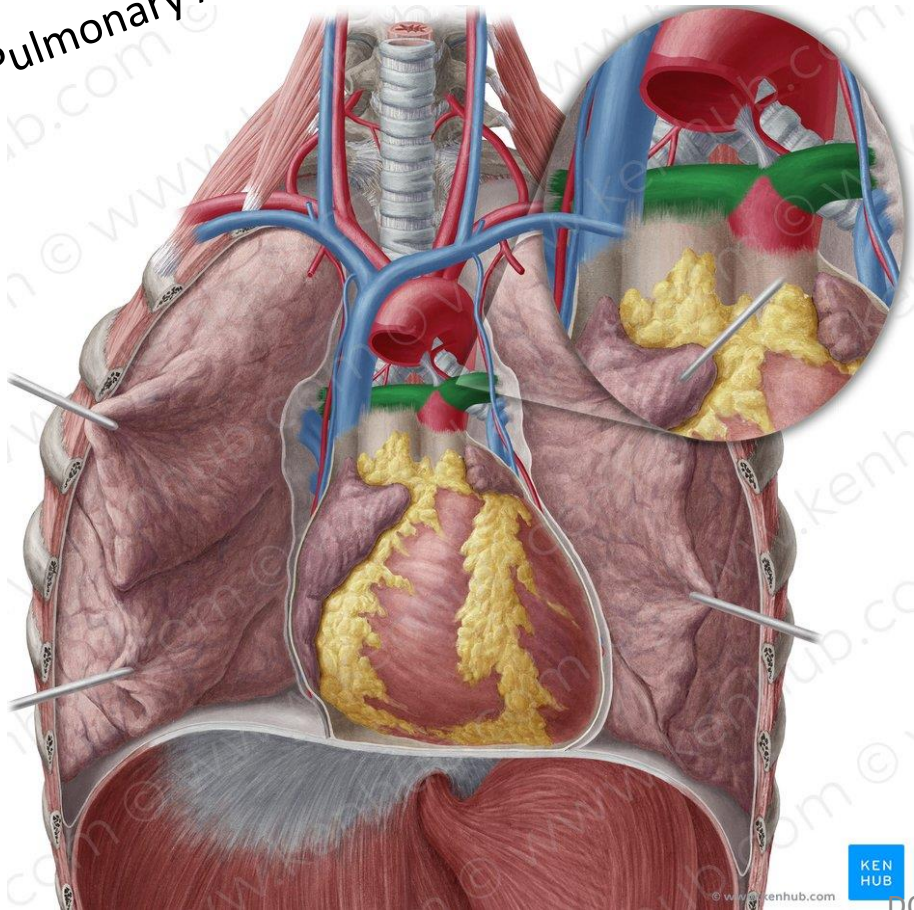




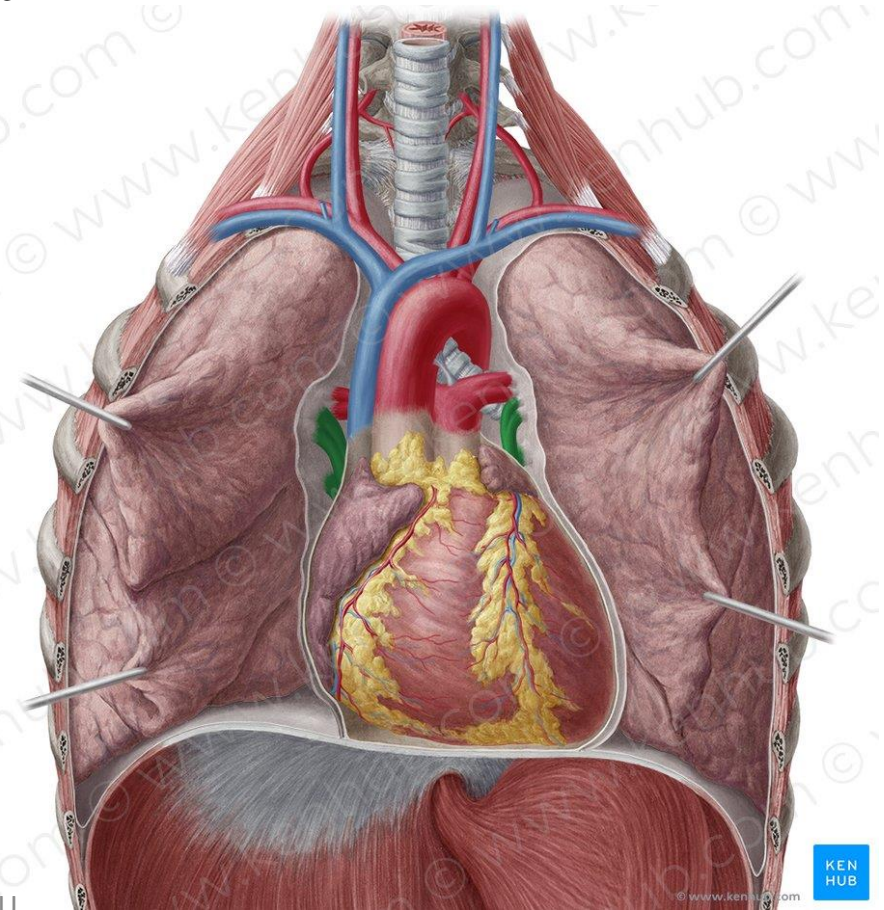
# THE PULMONARY CIRCULATION

- The **pulmonary arteries** deliver deoxygenated blood to the lungs from the **right ventricle of the heart**.
  - Oxygenated blood returns to the **left atrium** via the **pulmonary veins**.

Pulmonary Artery

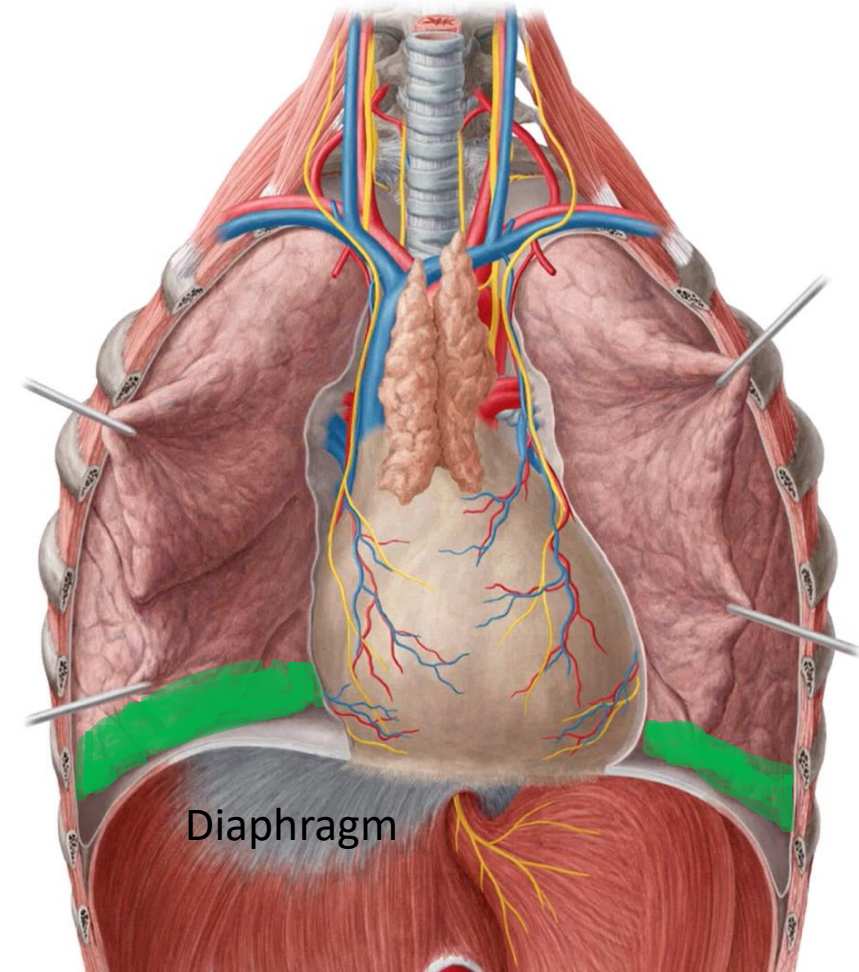
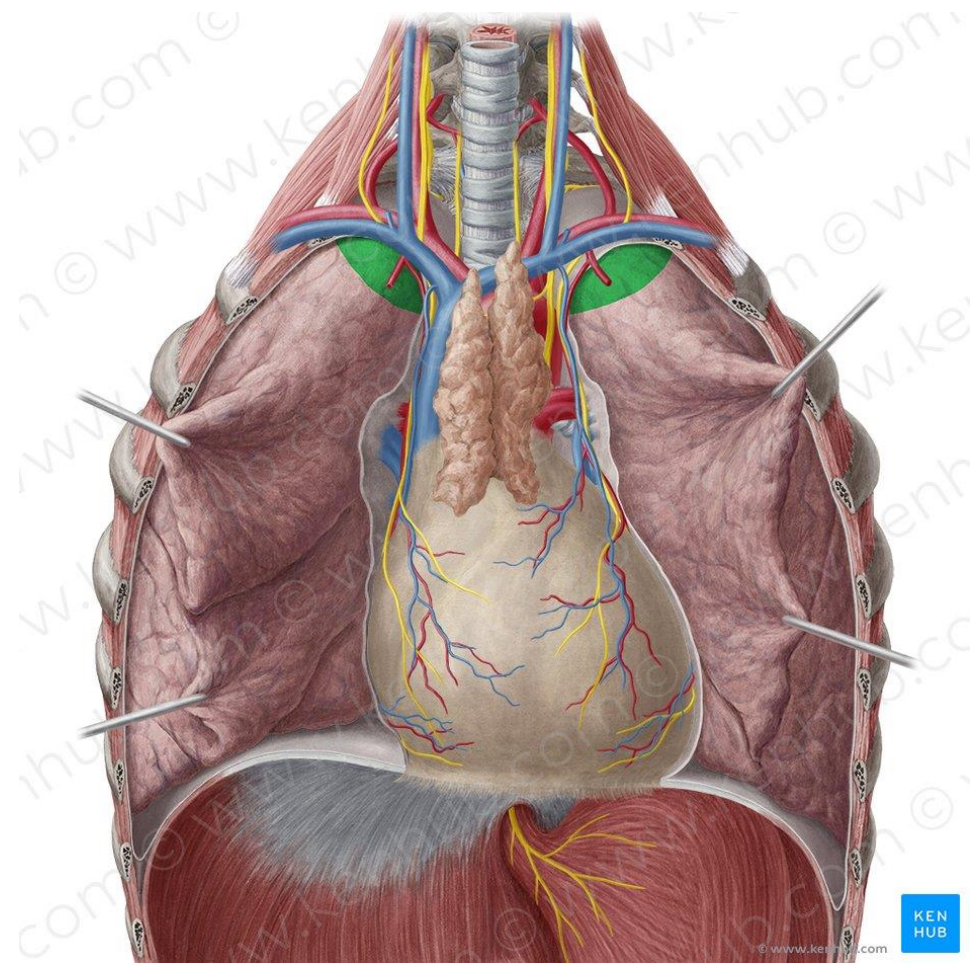


Pulmonary Vein





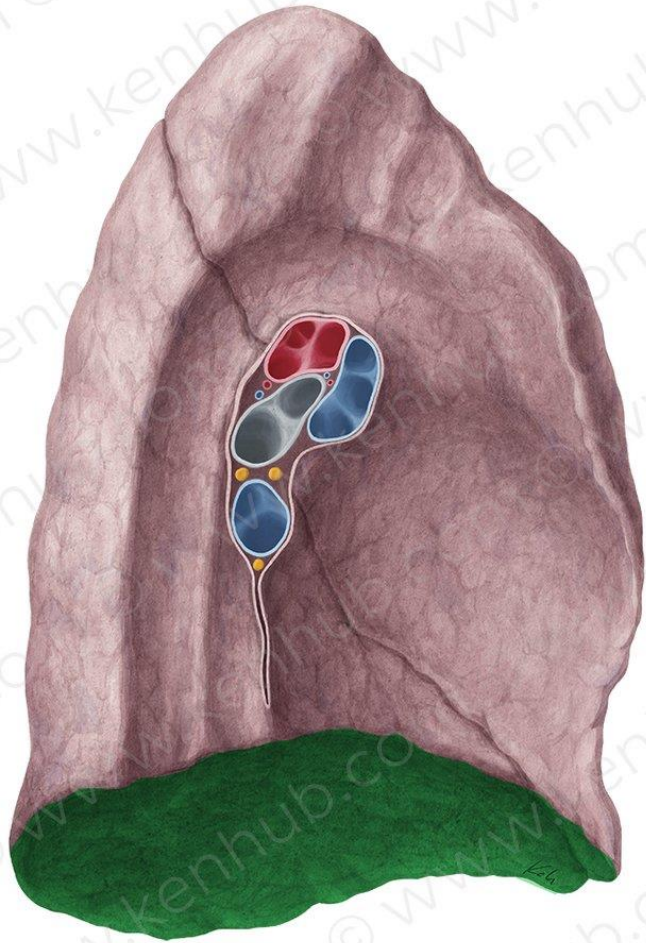
- Each lung is half-cone **نصف مخروط** in shape.
- Each lung has a base, an apex, two surfaces (costal and mediastinal surfaces) and three borders (anterior, posterior and inferior borders).



The apex of the lung projects above the 1<sup>st</sup> rib into the root of the neck, the apex extends 2.5 cm above the medial third of the clavicle and 3-4 cm above the 1<sup>st</sup> costal cartilage, the apex is covered by the suprapleural membrane\*.

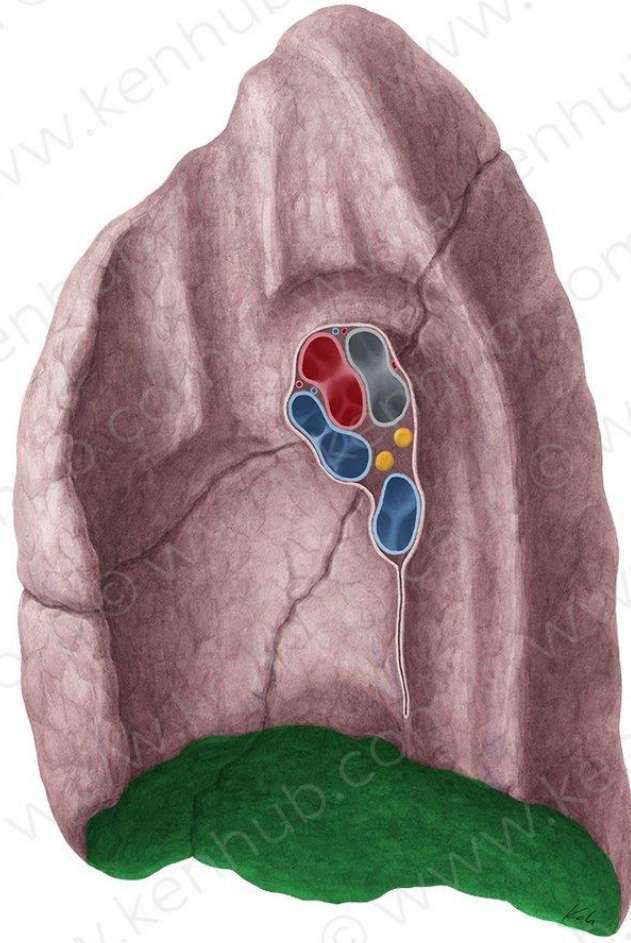
The base of the lung sits on the diaphragm.





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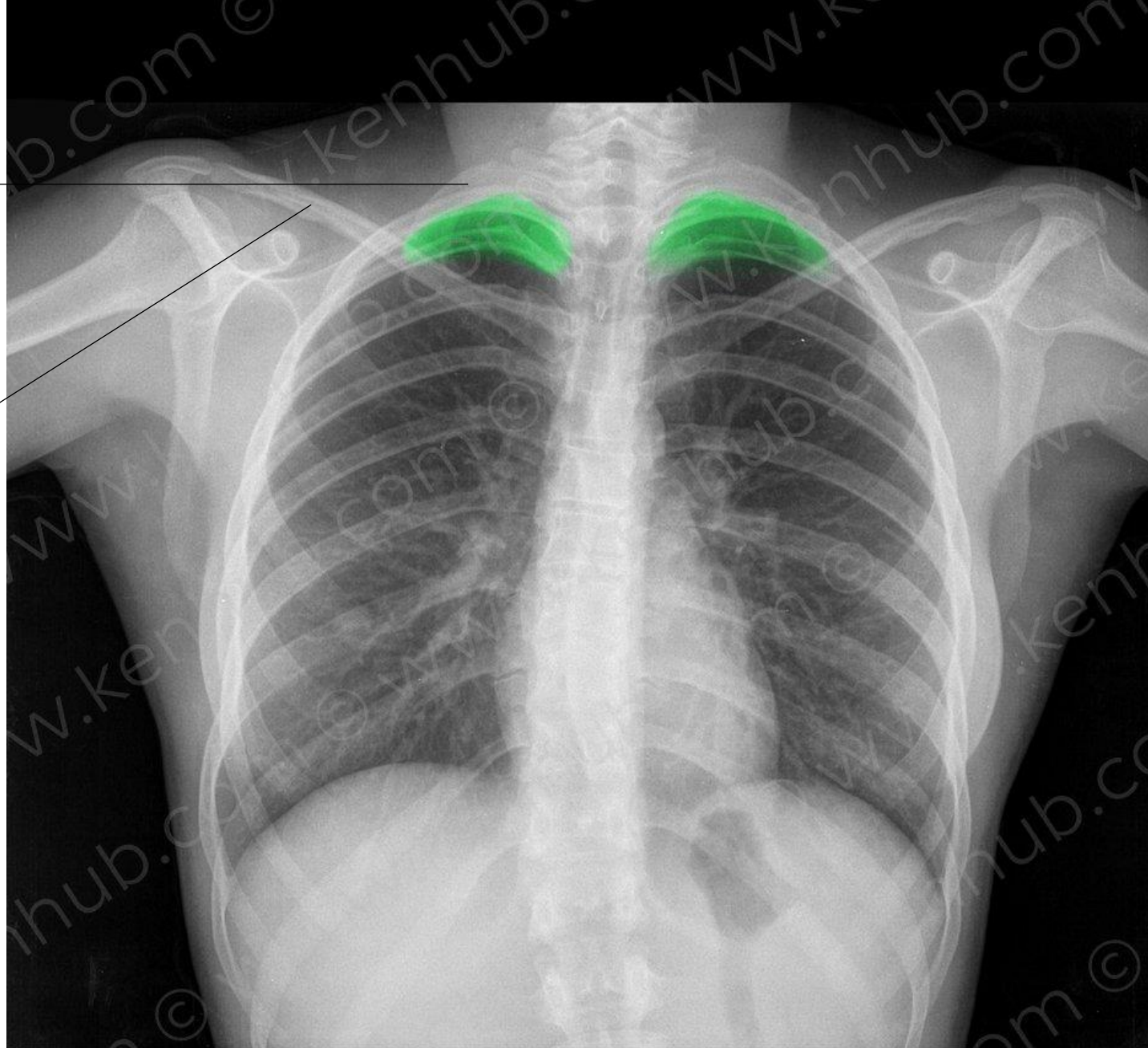
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Note: The bases of the lungs are also referred to as the diaphragmatic surfaces 😊.

1<sup>st</sup> rib

Clavicle



The pulmonary apex is highlighted in green

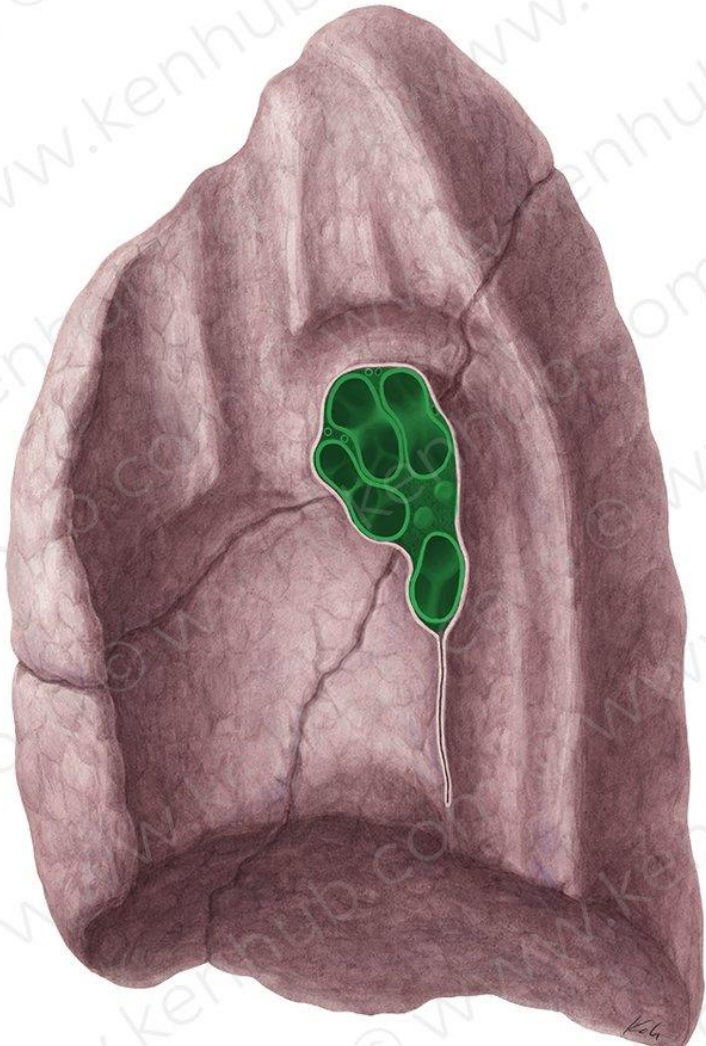


Note: the right lung is wider, shorter and bigger, while the left one is narrower, small and lighter, this is because the right lung is compressed by the liver which extends up to the level of the 5<sup>th</sup> rib, while the left lung is occupied by the heart which is deviated to the left.



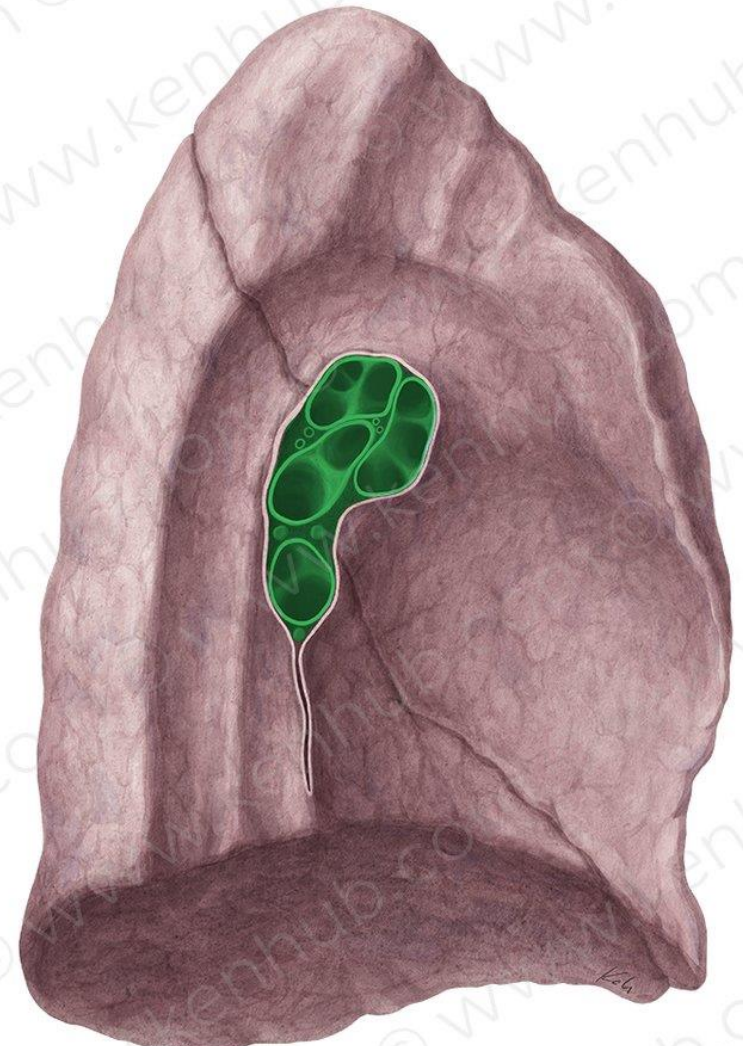
The **costal surface** lies immediately adjacent to the ribs and intercostal spaces.  
Notice that the ribs have impressions on this surface.

The **mediastinal surface** of the lungs lies against the mediastinum anteriorly and the vertebral column posteriorly.



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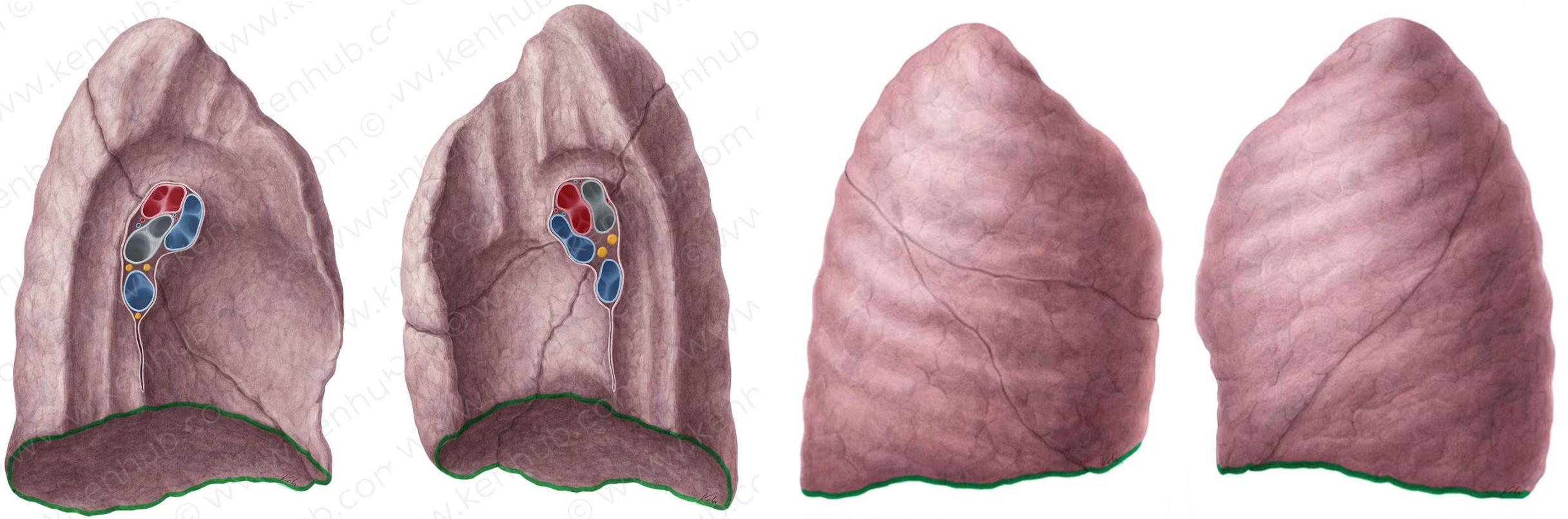
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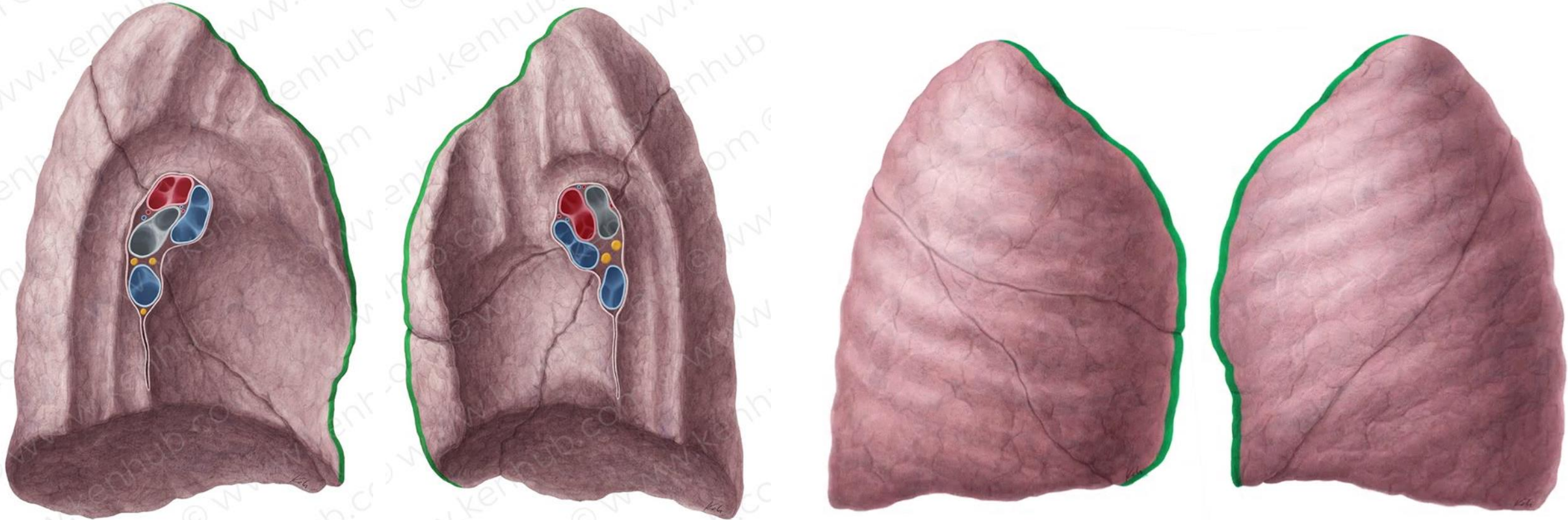
The mediastinal surface contains the comma-shaped **hilum of the lung** through which structures enter and leave.



The inferior border of the lung is sharp and separates the base from the costal surface.

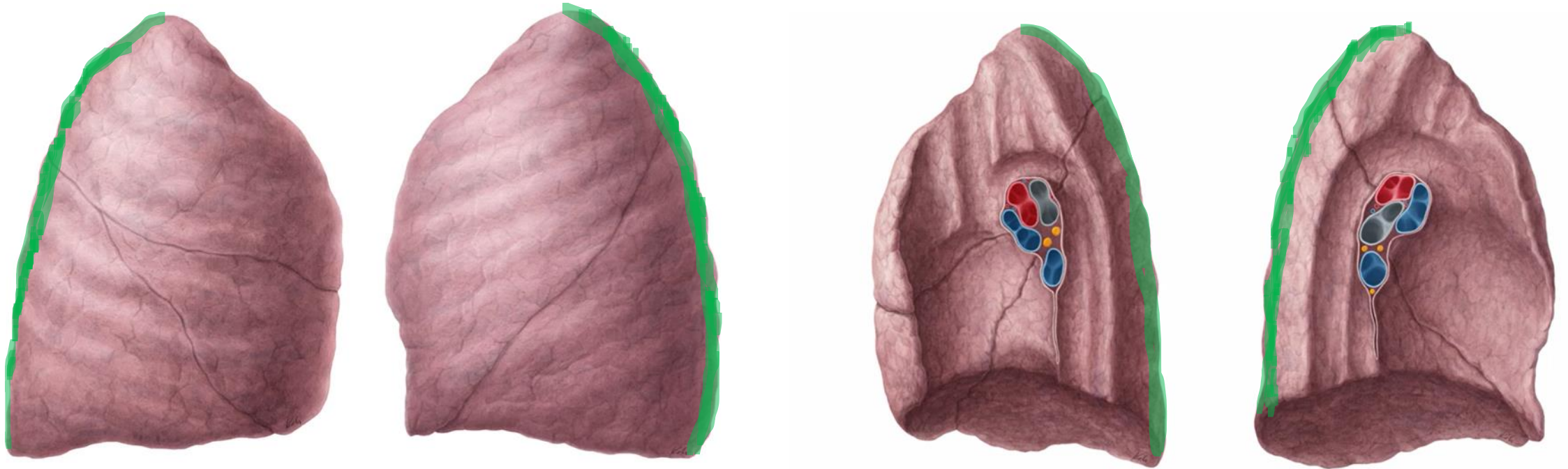


The anterior border is sharp and it separates the costal surface from the mediastinal surface.



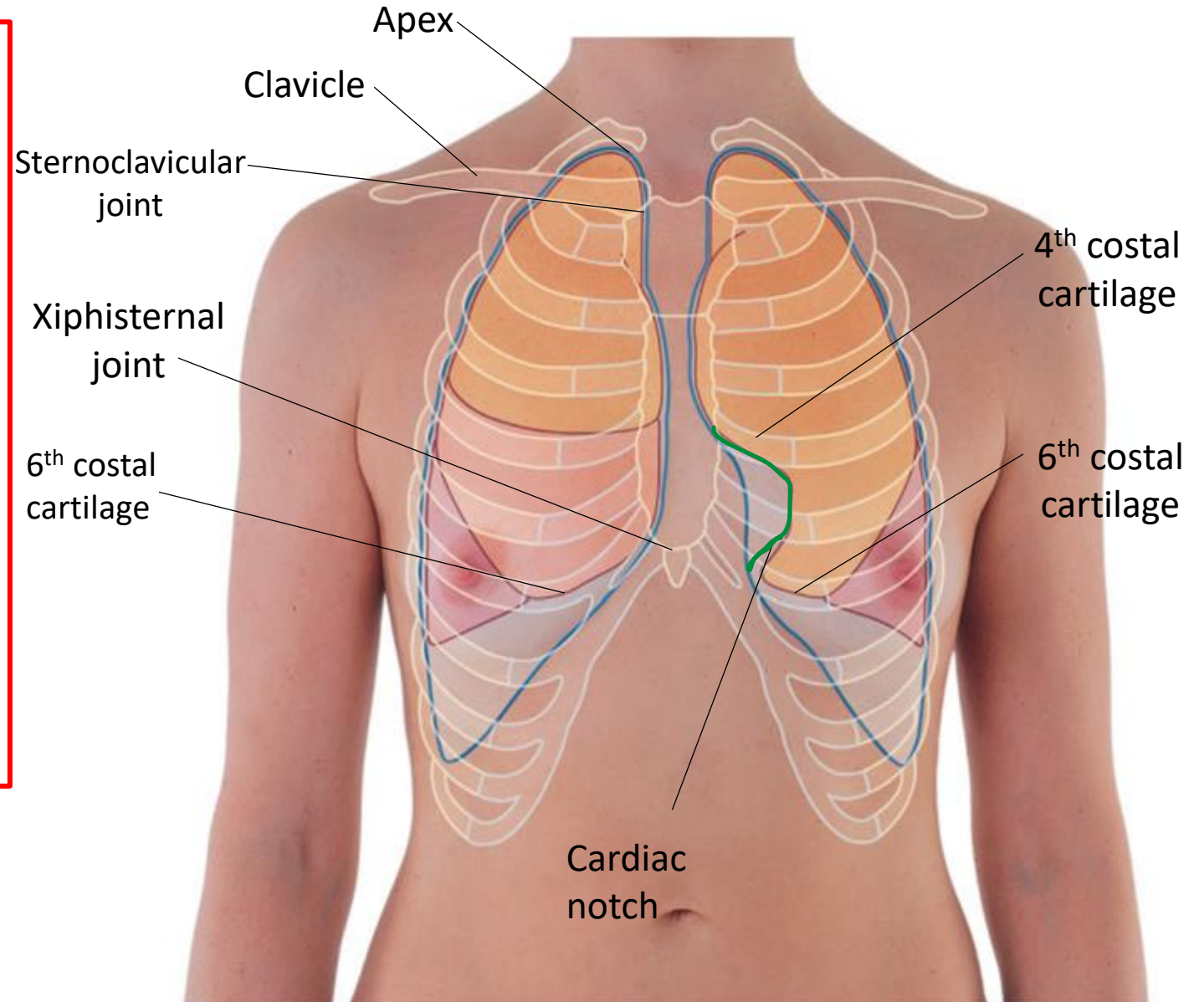


The posterior border is smooth and rounded, it separates the costal surface from the mediastinal surface.



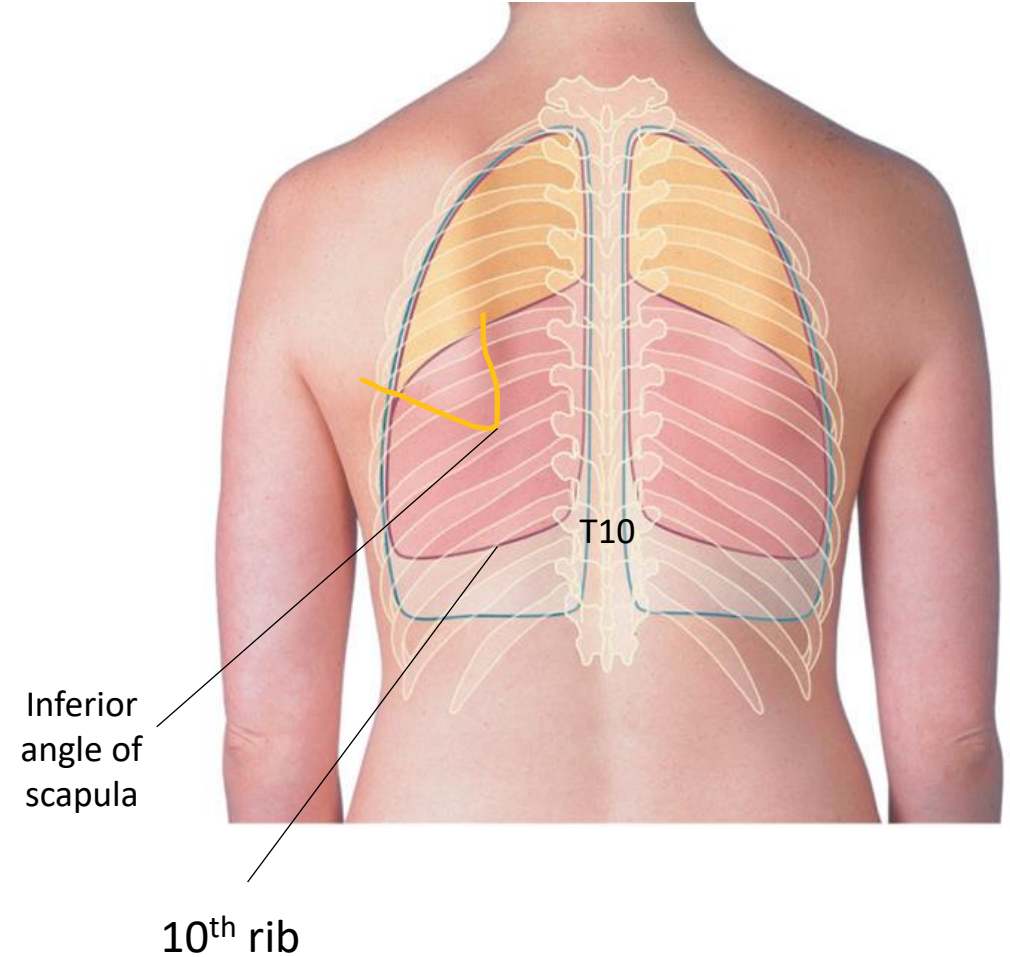
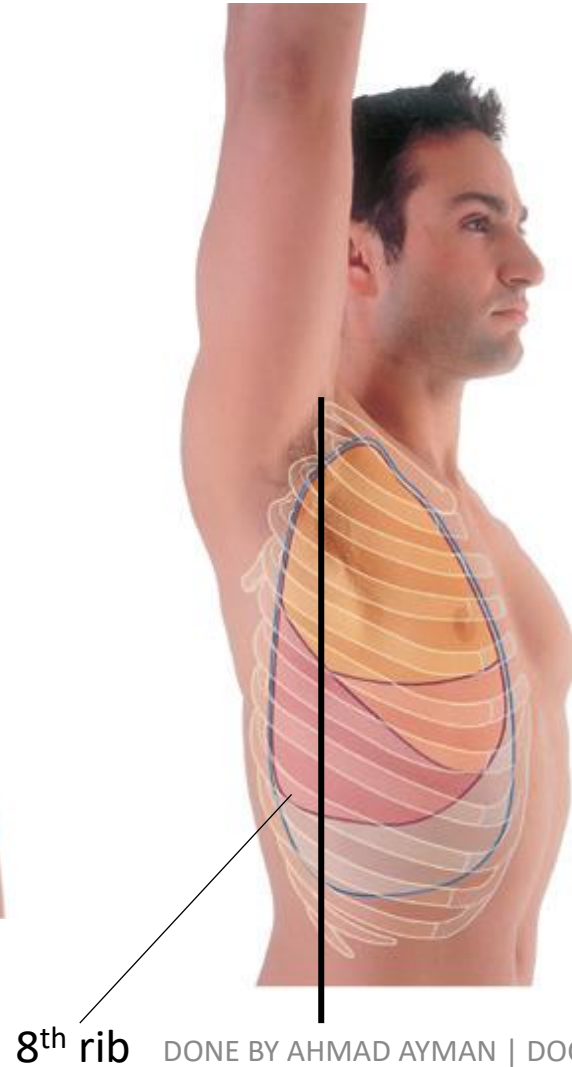
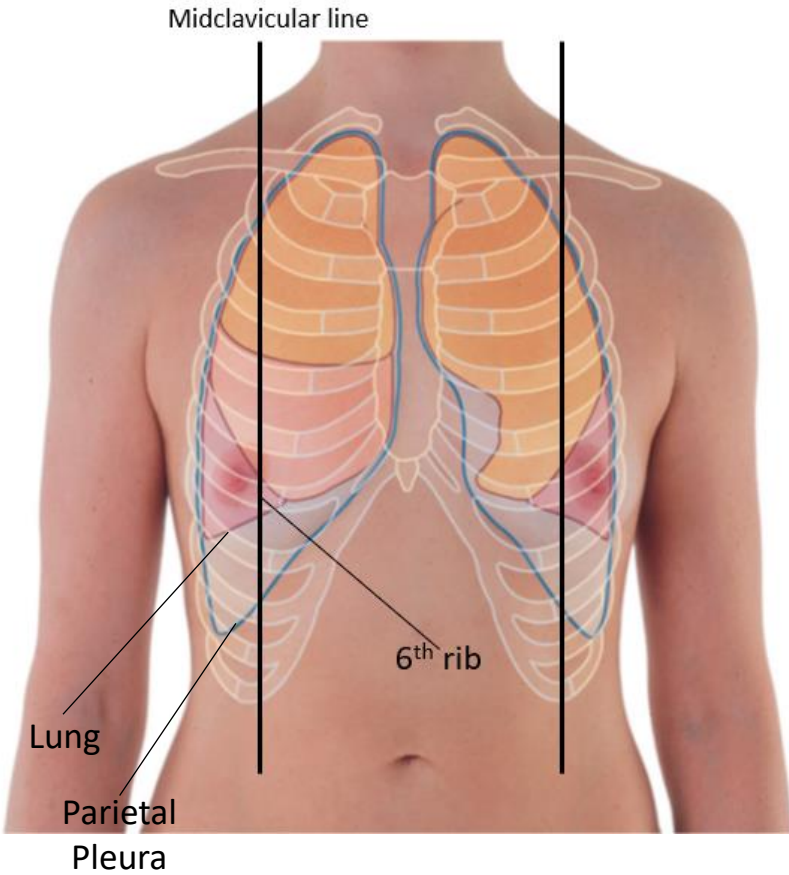
# SURFACE ANATOMY OF THE BORDERS OF THE LUNG

- The anterior border of the lung begins at the apex of the lung 2.5 cm (1 inch) above the clavicle, then it descends to cross the sternoclavicular joint and the angle of Louis (Sternal Angle) and descends until the xiphisternal joint, at the level of the 6<sup>th</sup> costal cartilage.
- the anterior border of the left lung is special in that it has the cardiac notch which extends between the 4<sup>th</sup> and 6<sup>th</sup> costal cartilage and we can imagine as a semicircle whose diameter is 1 inch.





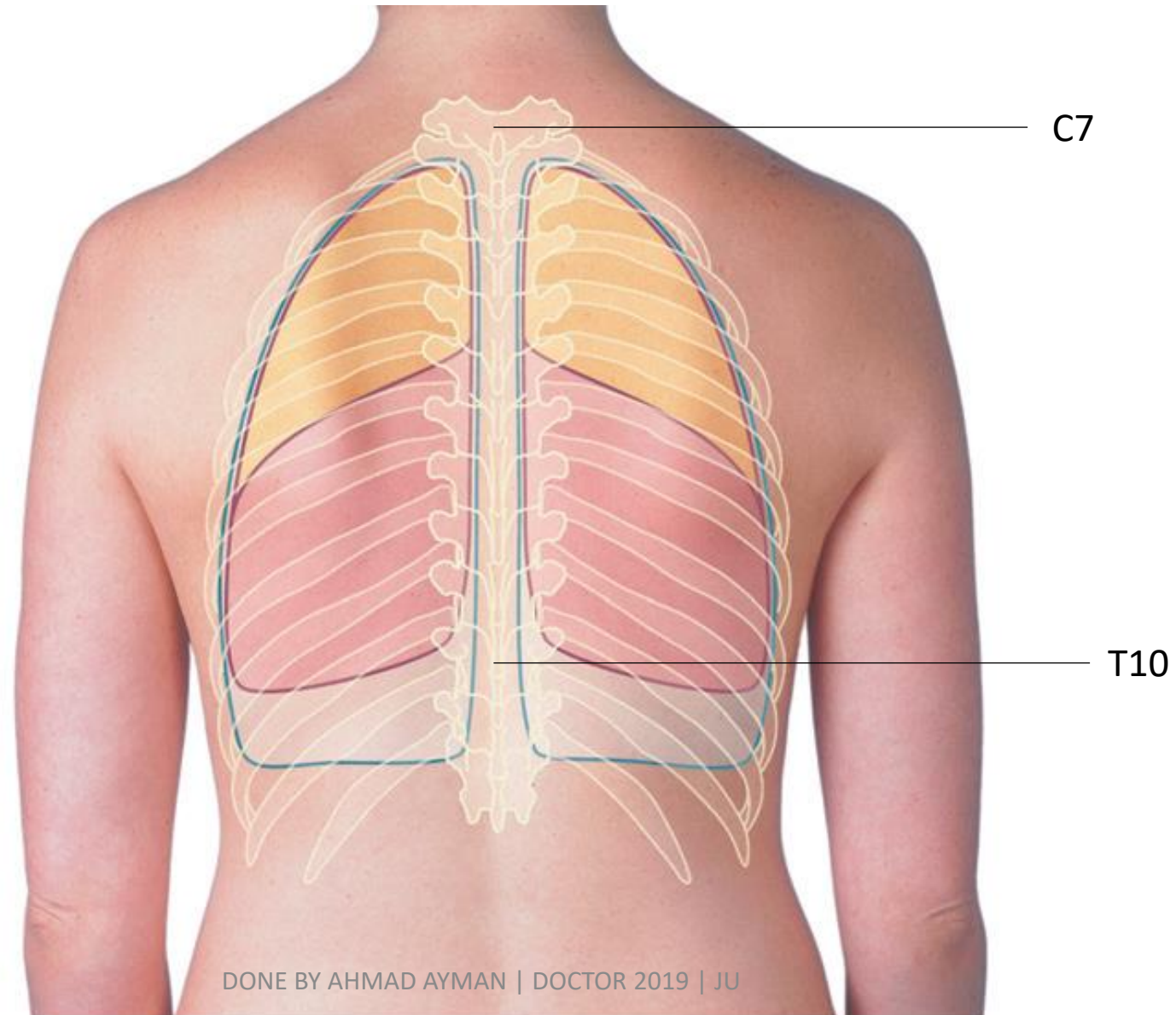
- At the end of expiration (so the volume of the lung is as least as possible), the base of the lung crosses:
  - The midclavicular line at the 6<sup>th</sup> rib.
  - The midaxillary line at the 8<sup>th</sup> rib.
- The vertical line drawn from the inferior angle of the scapula parallel to erector spinae muscle at the level of T10



The posterior border Extend from C7 To T10, it lies 4 cm lateral to the midline.

The apex is at the level of T1

The inferior border Ascends and descends between 9<sup>th</sup> & 12<sup>th</sup> rib

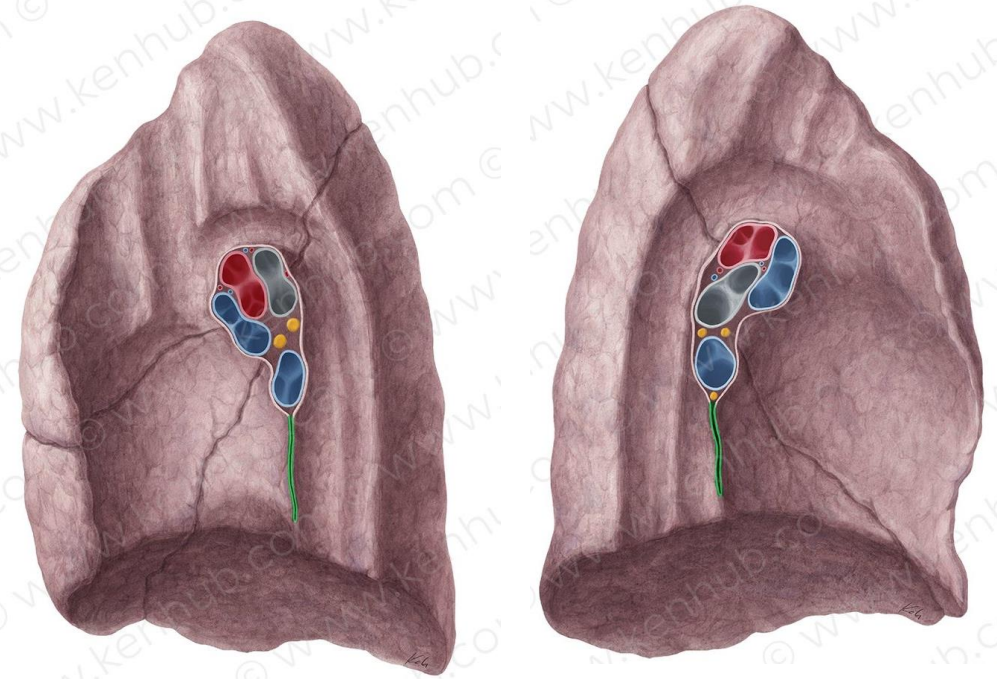




# ROOT AND HILUM

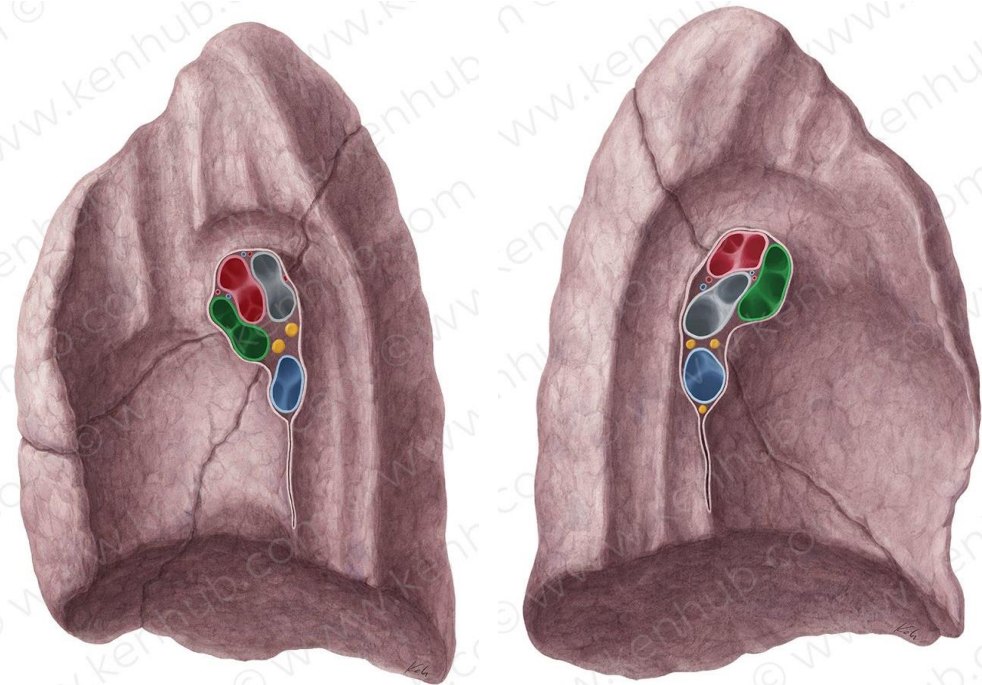
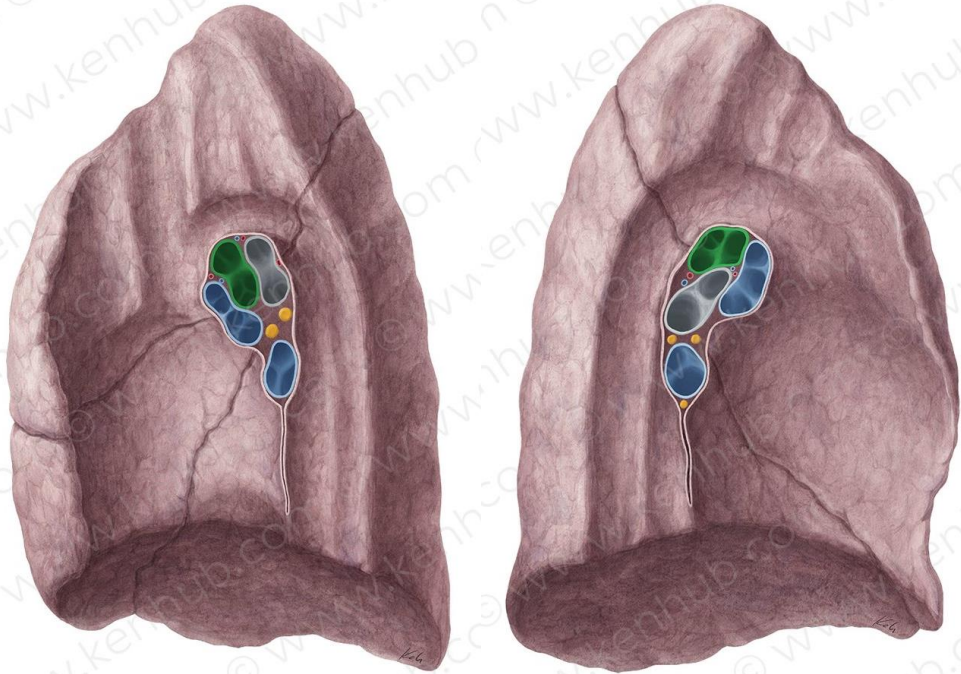


- The root of each lung is a short tubular collection of structures that together attach the lung to structures in the mediastinum
- the root covered by a sleeve of mediastinal pleura that reflects onto the surface of the lung as visceral pleura

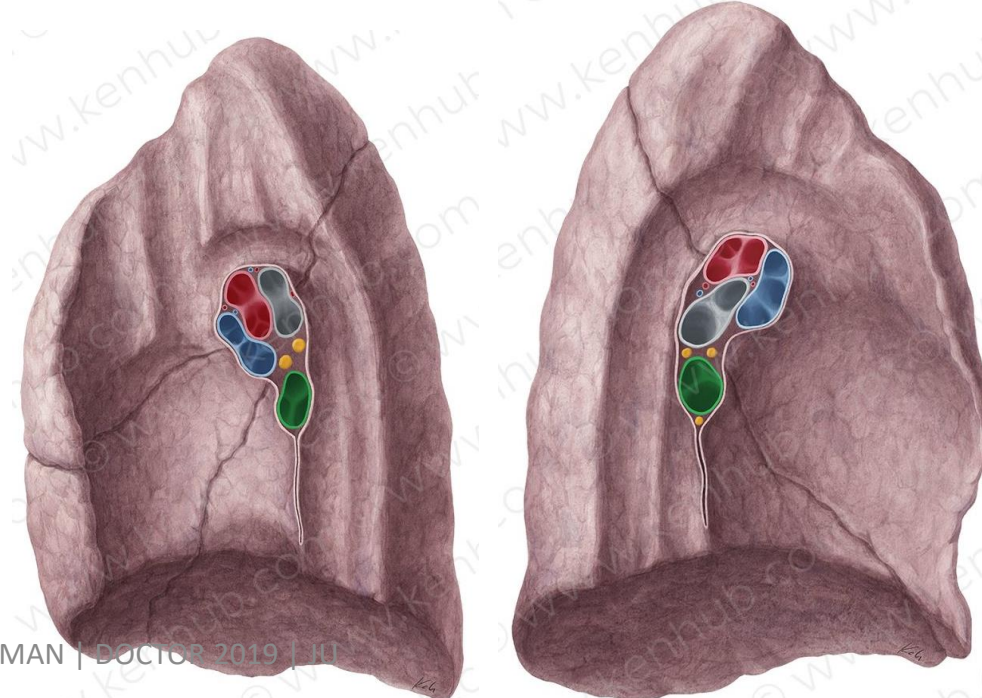


- A thin blade-like fold of pleura projects inferiorly from the root of the lung. This structure is the **pulmonary ligament**
- **pulmonary ligament** stabilize the position of the inferior lobe and may also accommodate the down-and-up translocation of structures in the root during breathing
- Note: at the site of the pulmonary ligament, the visceral and parietal pleurae are adherent to each other.

Within each root and located in the hilum are:

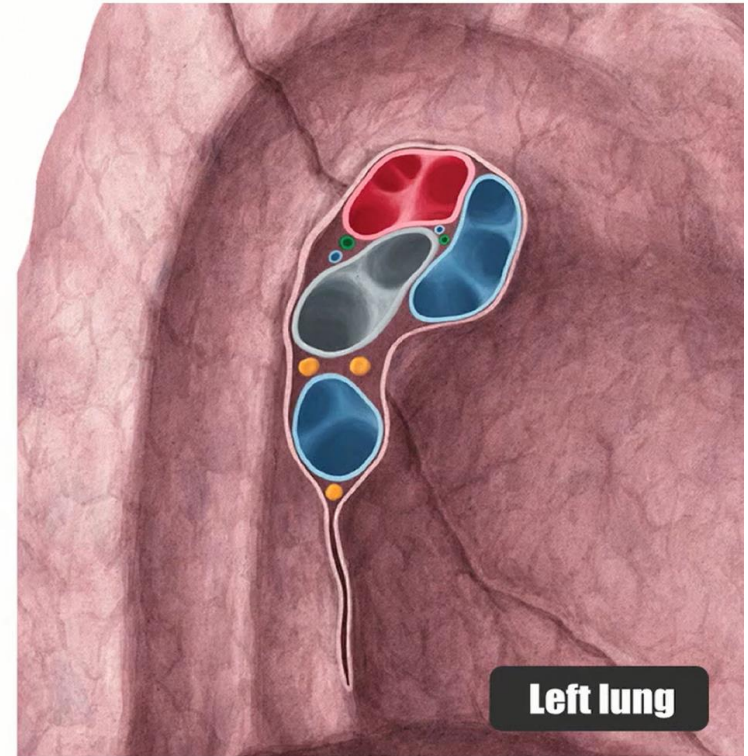
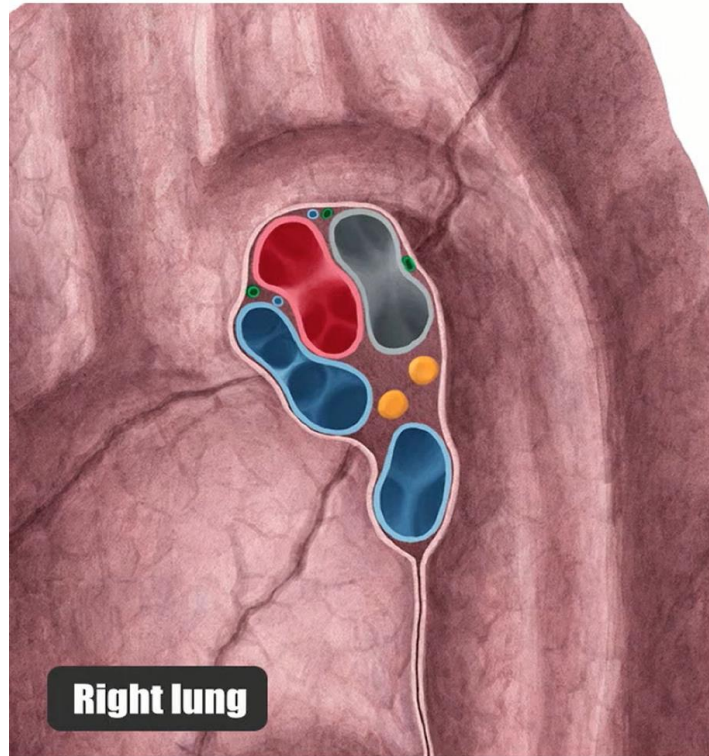
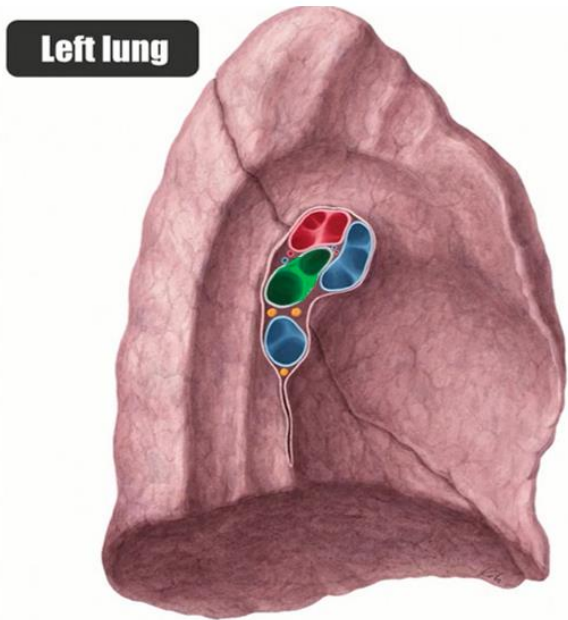
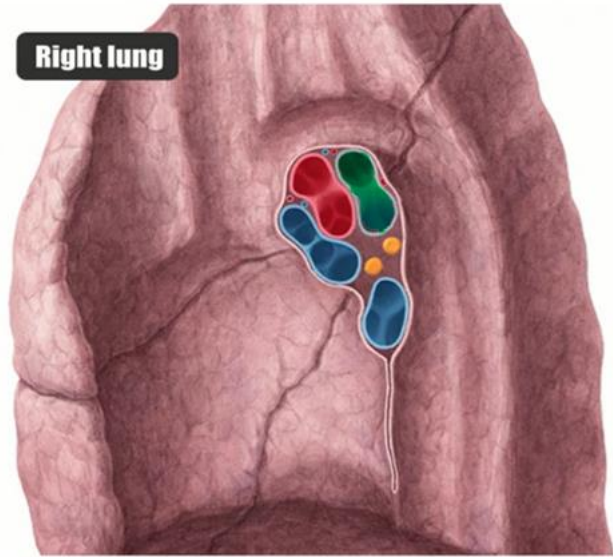


Two (superior and inferior) pulmonary veins within each hilum, the vein are inferior in position.



The pulmonary arteries, in the left hilum, the pulmonary artery is the most superior structure, but in the right hilum, it is located between the eparterial and hyparterial bronchi.

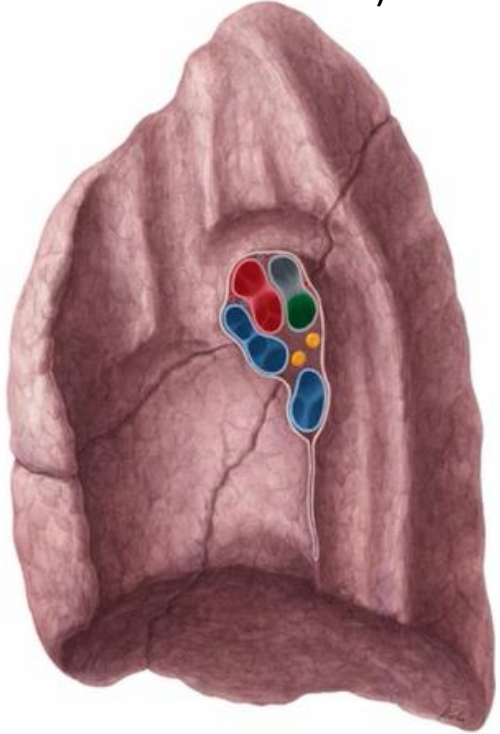




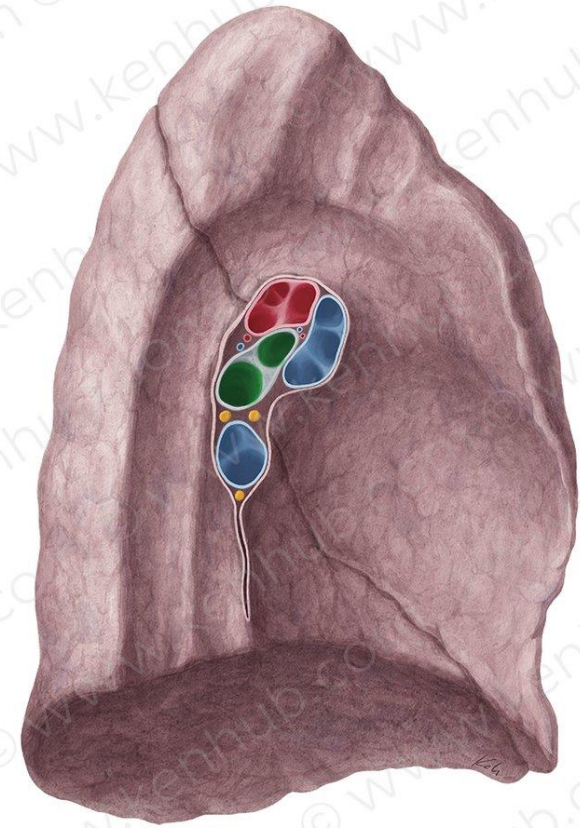
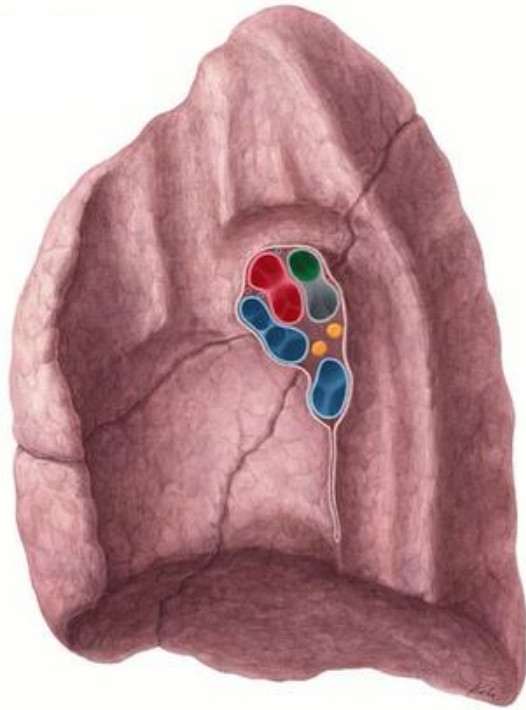
Bronchial Vessels

A main Bronchus, they are somewhat posterior in position within the hilum

Hyparterial bronchus (some consider it only a continuation of the right main bronchus)



Eparterial ( right superior lobar) bronchus

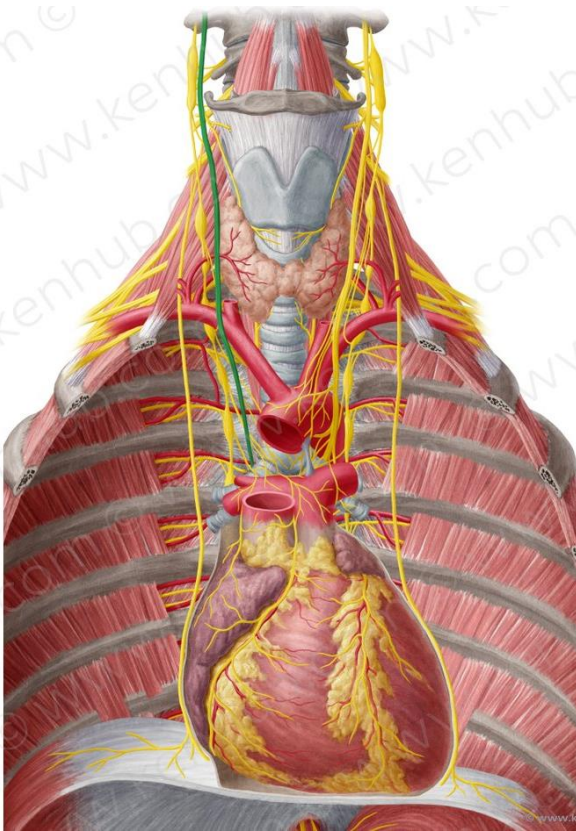


In the right side, some references say that the superior lobar (eparterial) bronchus branches from the right main bronchus within the hilum, then, the main bronchus continues inside the lungs where it divides into right middle and right inferior lobar bronchi, other references say that the right main bronchus divides into eparterial (right superior lobar) bronchus and hyparterial bronchus, and the hyparterial bronchus is the one that divides into right middle and right inferior lobar bronchi.

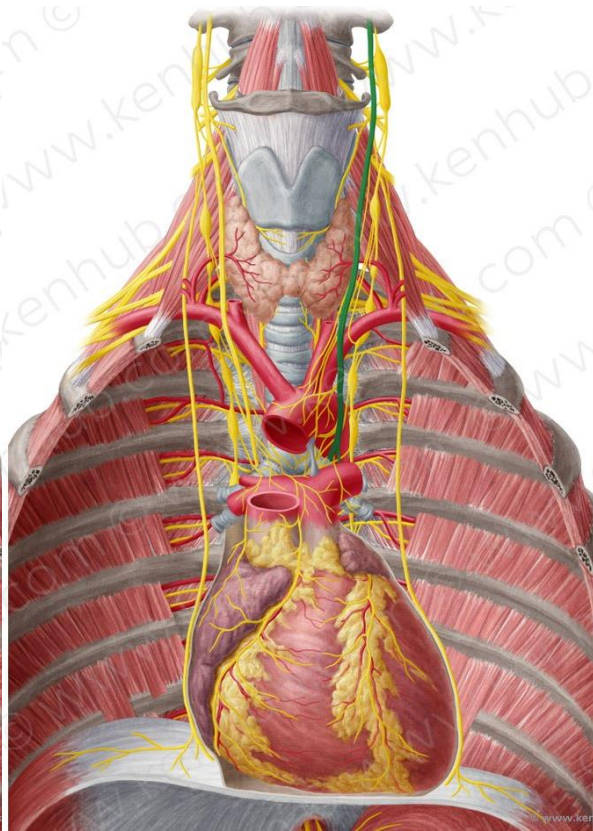
The left main bronchus divides within the left lung into left superior and left inferior lobar bronchi



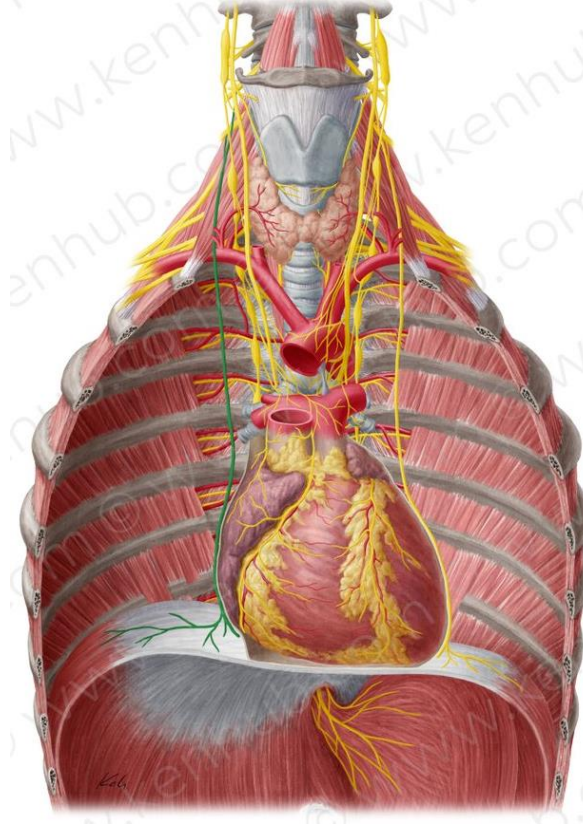
The vagus nerves pass immediately posterior to the roots of the lungs, while the phrenic nerves pass immediately anterior to them.



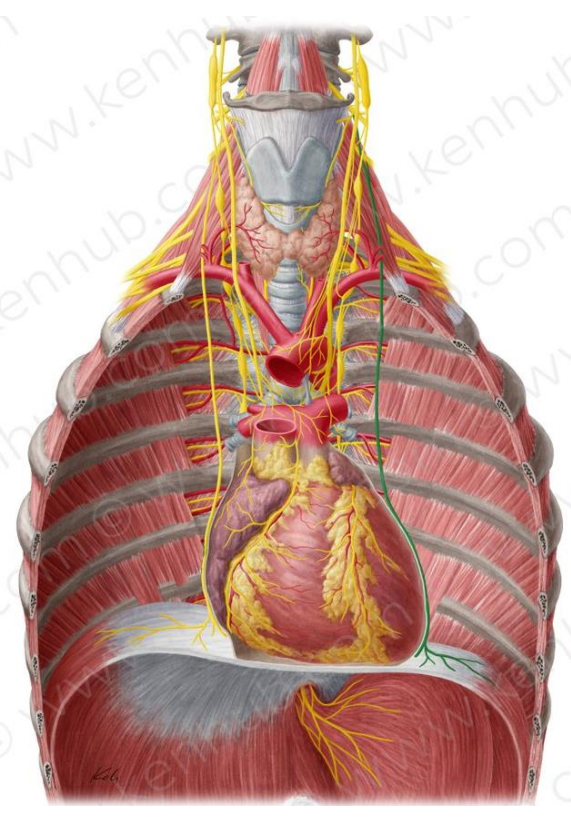
Right Vagus Nerve



Left Vagus Nerve



Right Phrenic Nerve



Left Phrenic Nerve

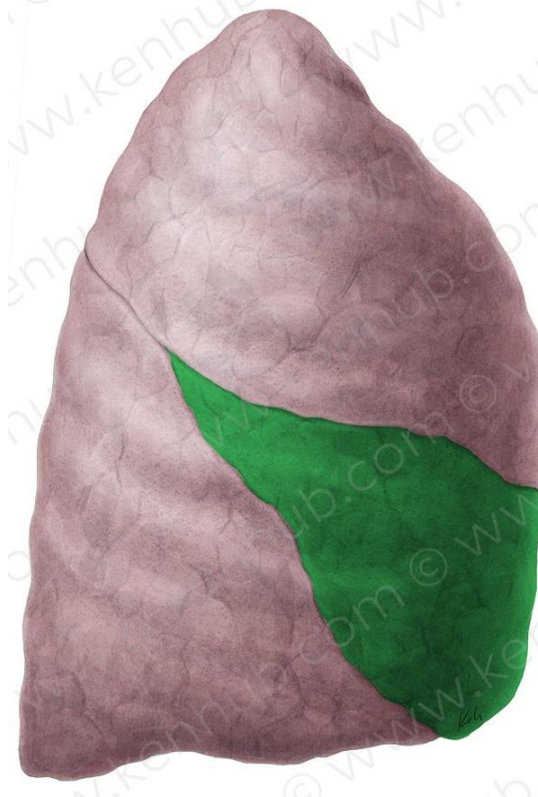
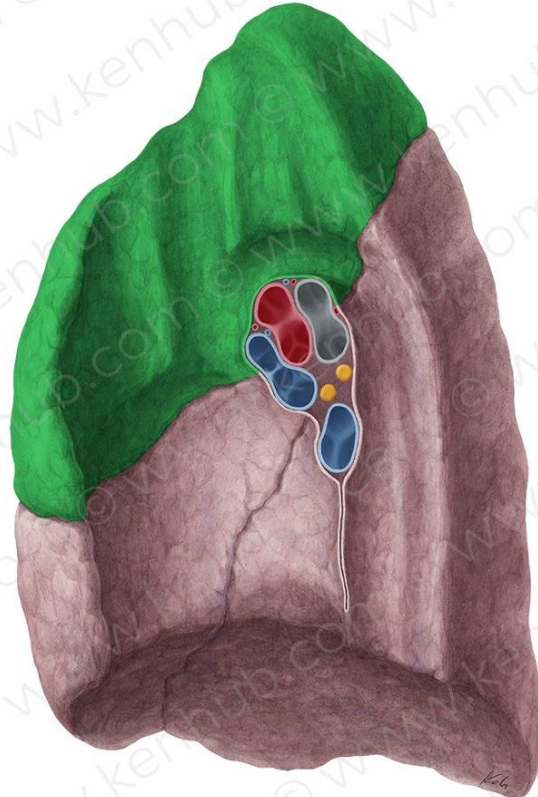


# THE RIGHT LUNG

The right lung has three lobes, normally, the lobes are freely movable against each other because they are separated, almost to the hilum, by invaginations of visceral pleura\*.

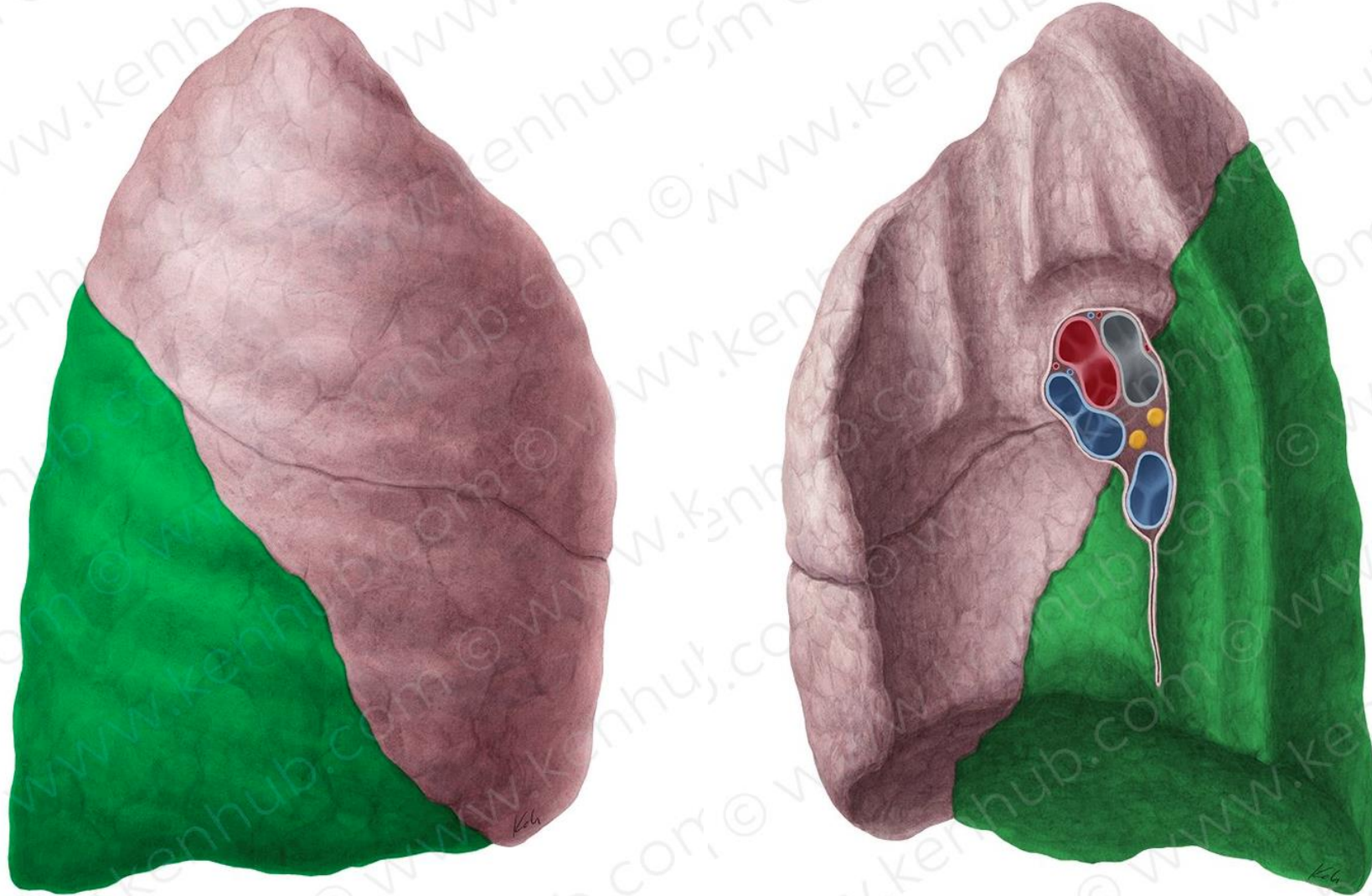


Superior Lobe of Right lung.

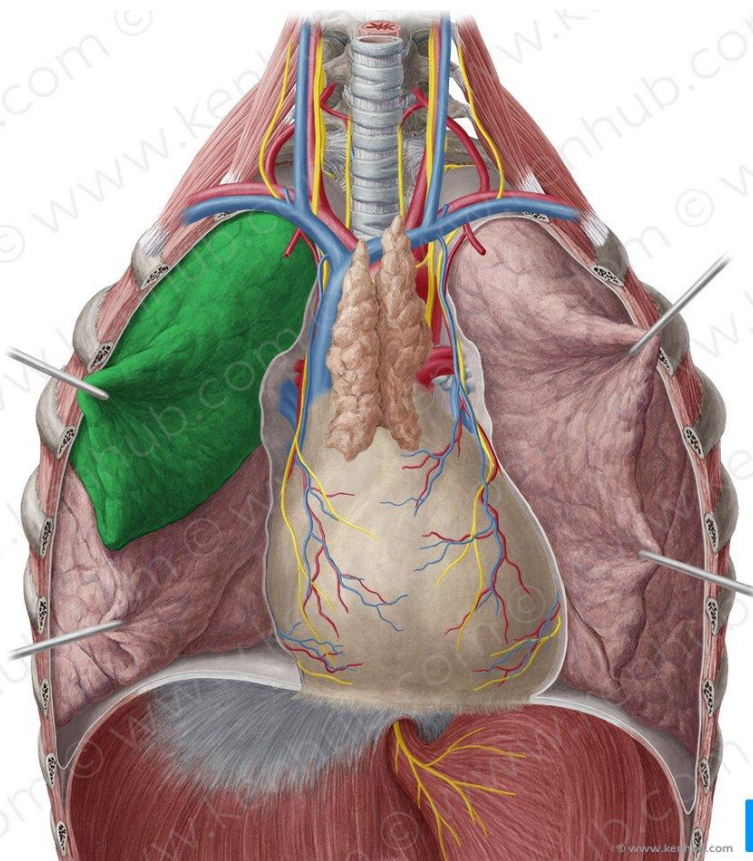


Middle Lobe of Right lung.

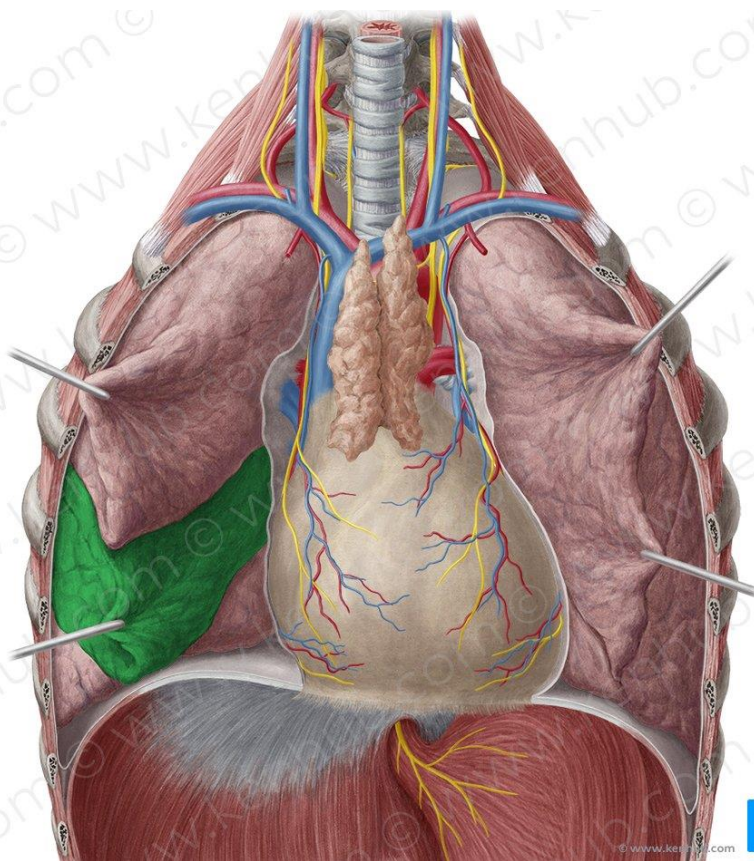




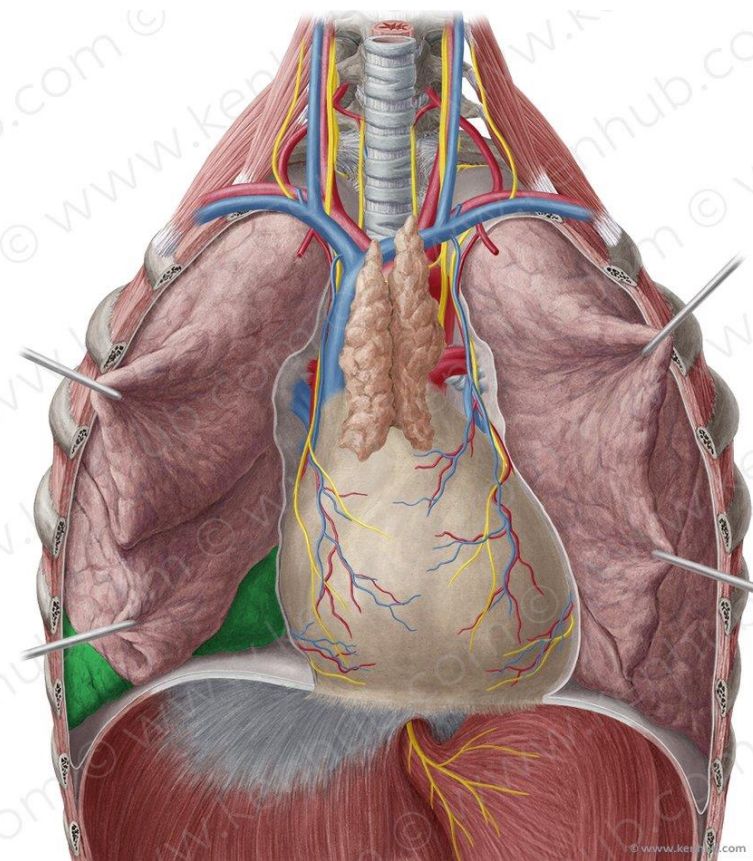
Inferior lobe of Right Lung



Superior Lobe



Middle Lobe

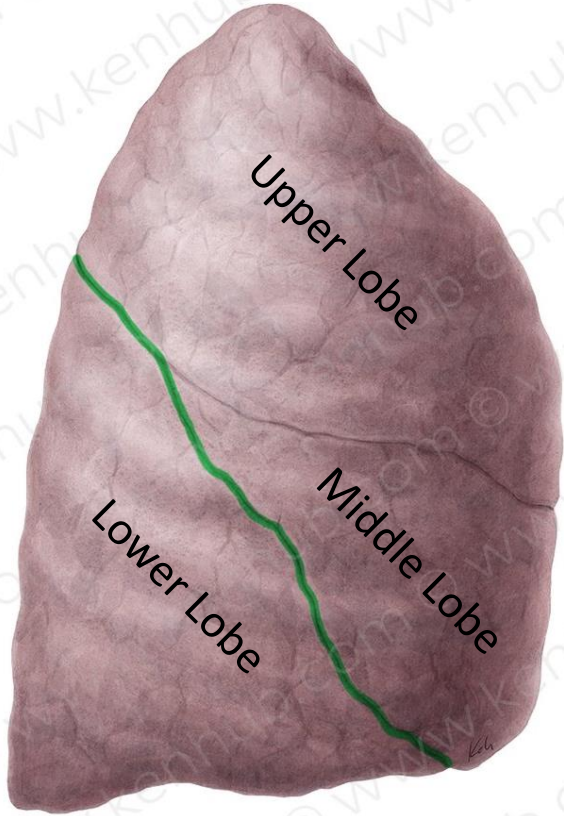


Inferior Lobe

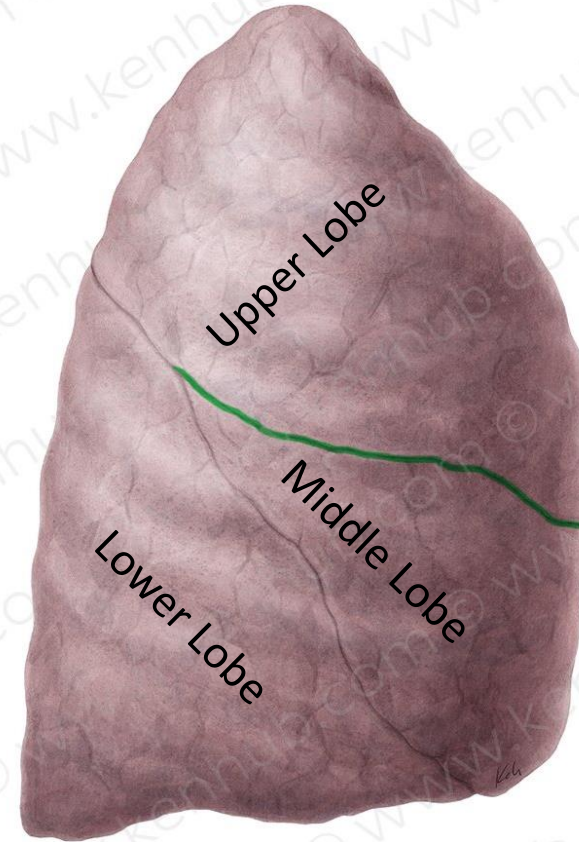
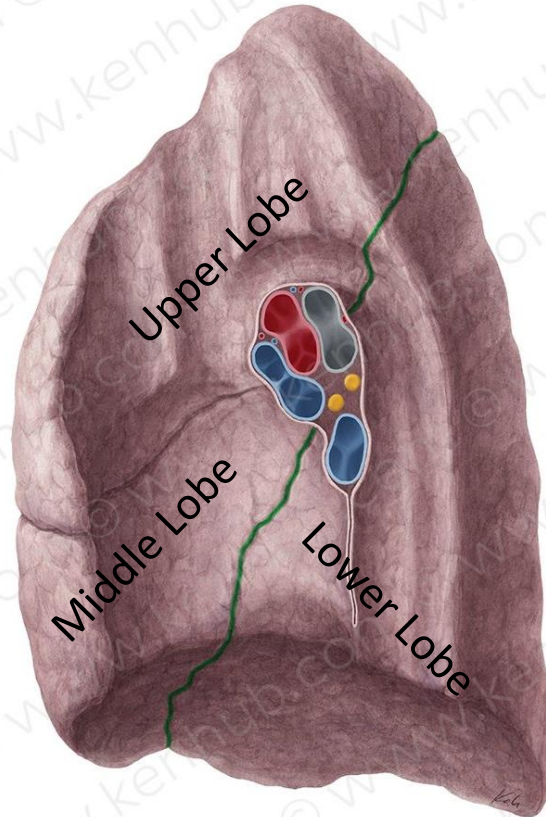


These invaginations of the visceral pleura form the **fissures**:

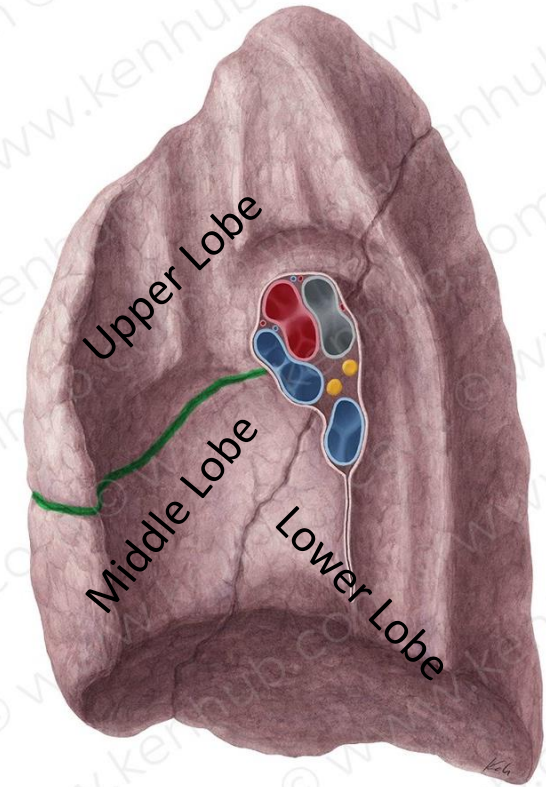
- The **oblique fissure** separates the inferior (lower) lobe from the superior (upper) lobe and the middle lobe of the right lung;
- The **horizontal fissure** separates the superior (upper) lobe from the middle lobe.



The Oblique Fissure

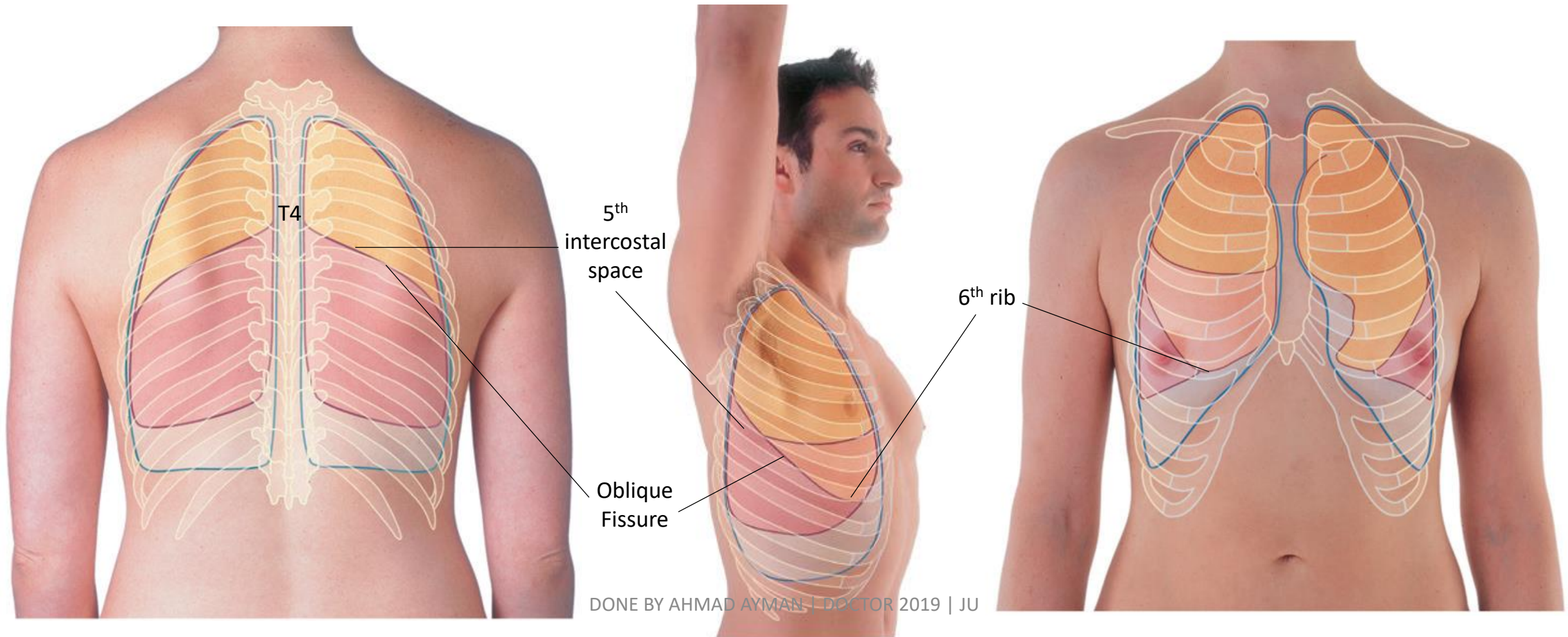


The Horizontal Fissure



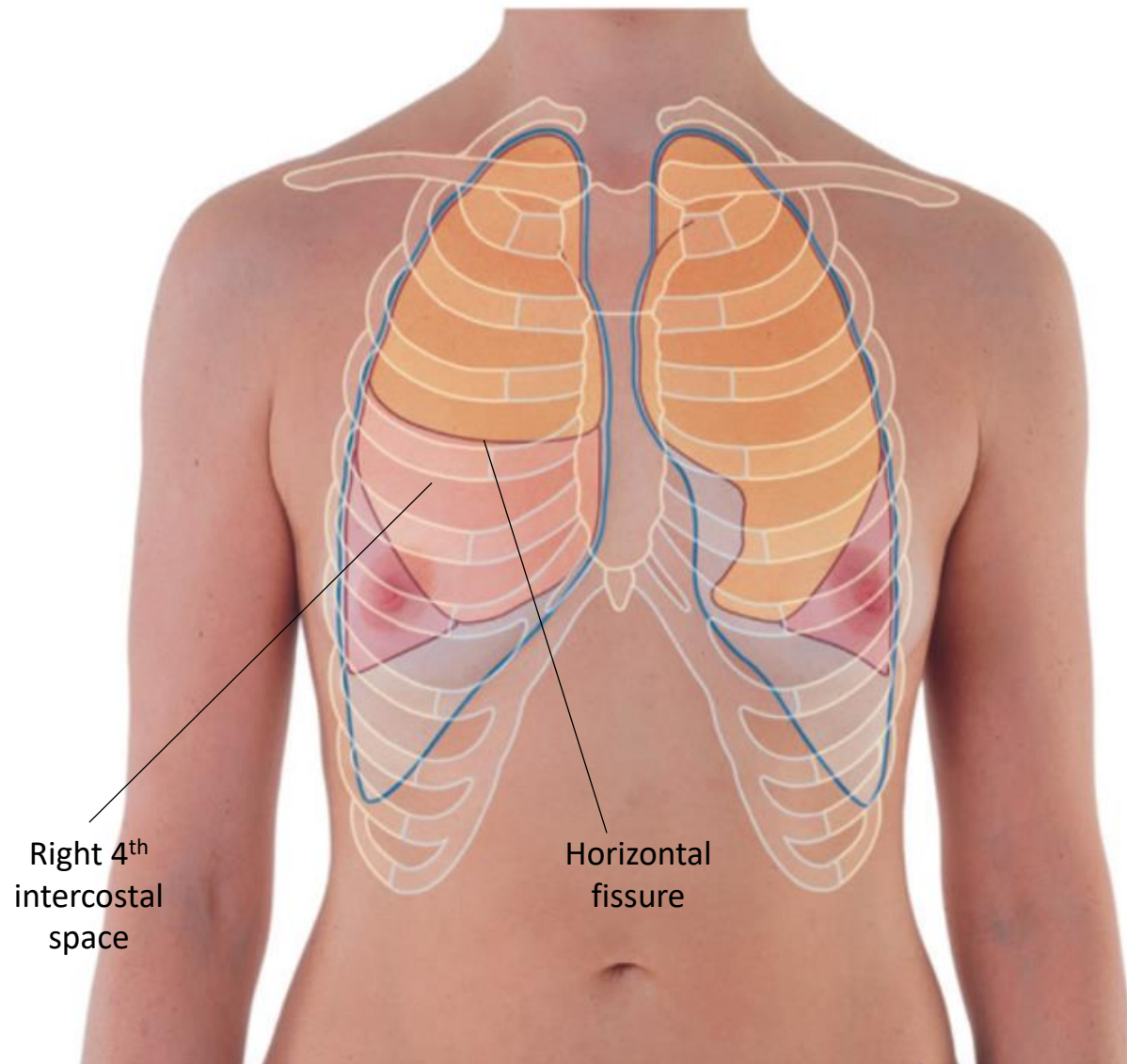
# SURFACE ANATOMY OF THE FISSURES OF THE RIGHT LUNG

- This slide shows approximate position of the right oblique fissure in quiet respiration (so the lung volume is not changing that much).
- The right oblique fissure begins roughly at the spinous process of vertebra T4 , crosses the fifth interspace laterally, and then follows the contour of the 6<sup>th</sup> rib anteriorly.





The horizontal fissure (present only in the right lung) follows the 4<sup>th</sup> intercostal space from the sternum until it meets the oblique fissure as it crosses the 5<sup>th</sup> rib.



# HOW TO ASCULTATE THE LOBES OF THE RIGHT LUNG

The orientations of the oblique and horizontal fissures determine where clinicians should listen for lung sounds from each lobe.

When listening to lung sounds from each of the lobes, it is important to position the stethoscope on those areas of the thoracic wall related to the underlying positions of the lobes.



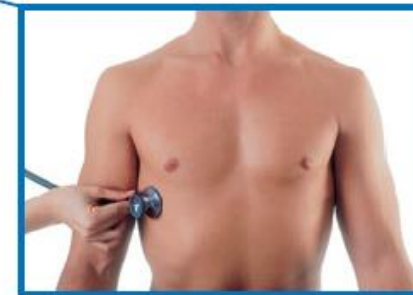
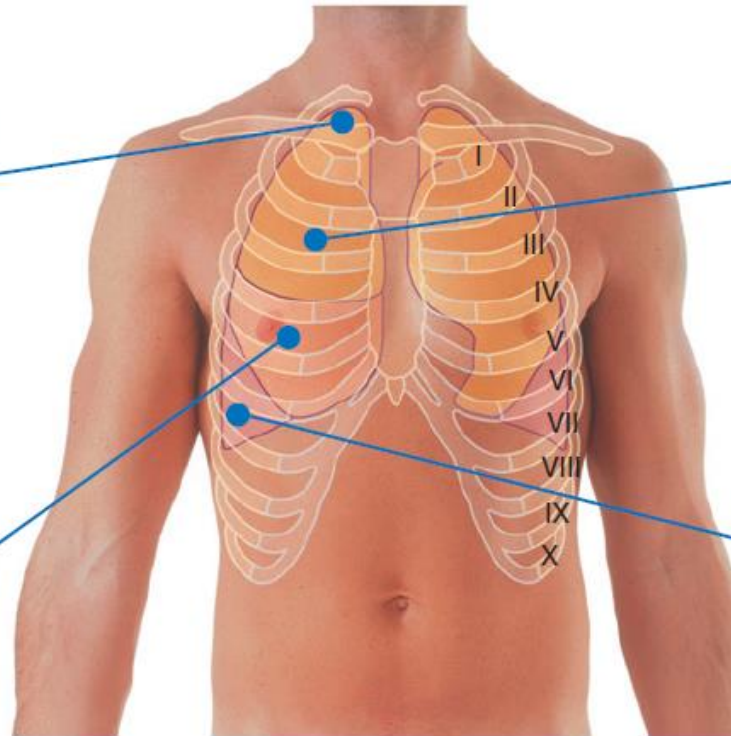
Apex of right lung



Superior lobe of right lung



Middle lobe of right lung

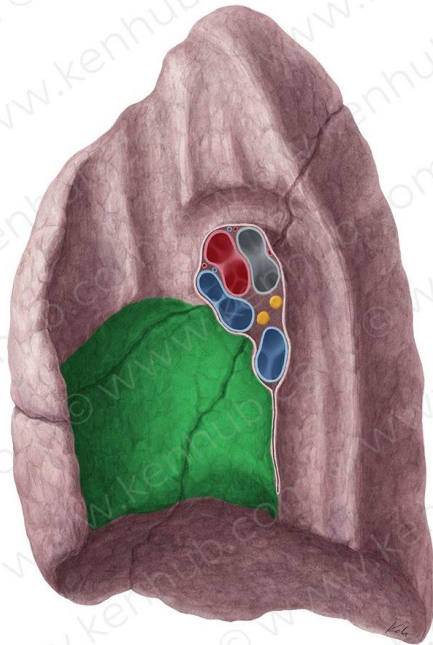


Inferior lobe of right lung

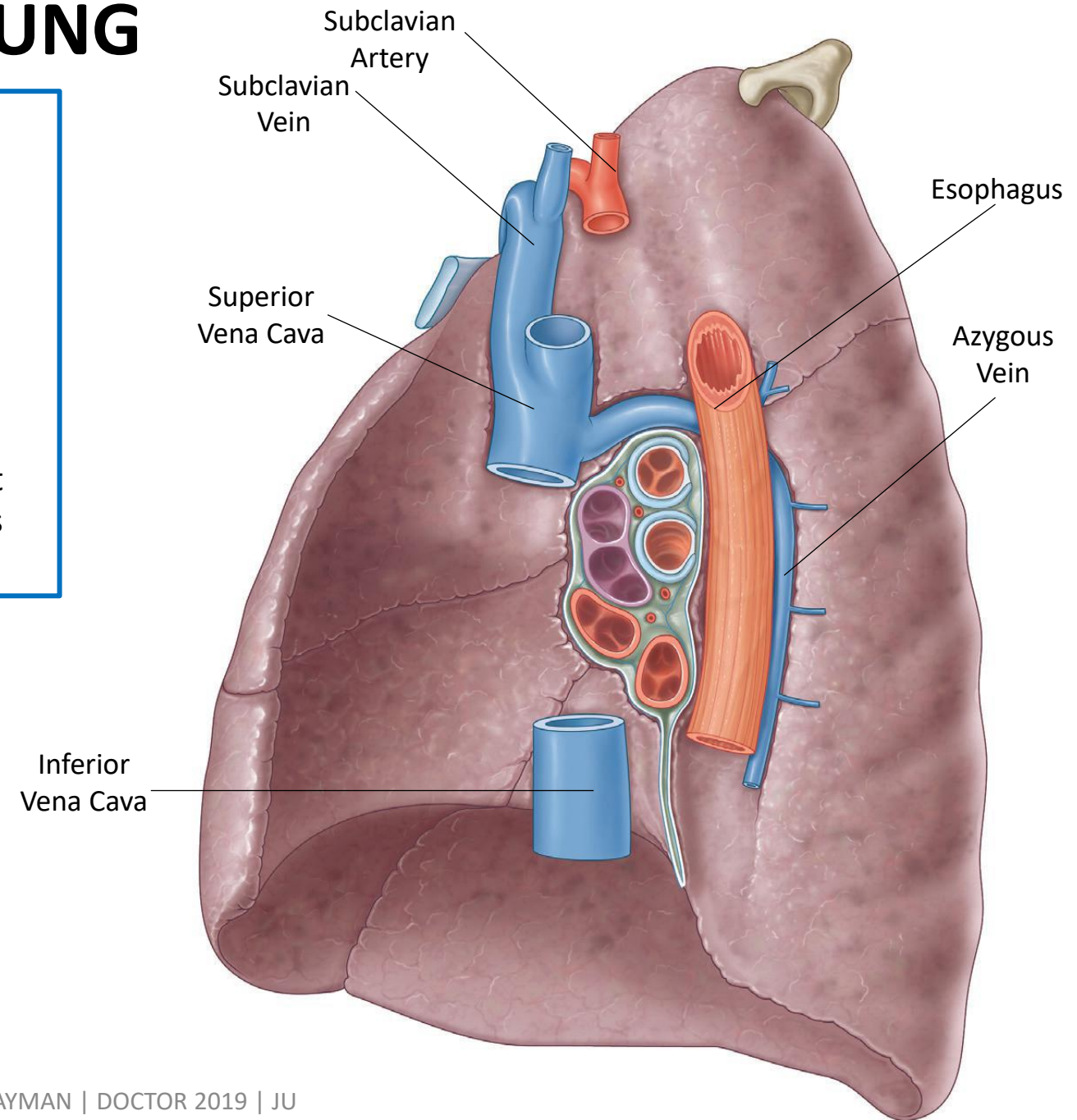


# IMPRESSIONS OF THE RIGHT LUNG

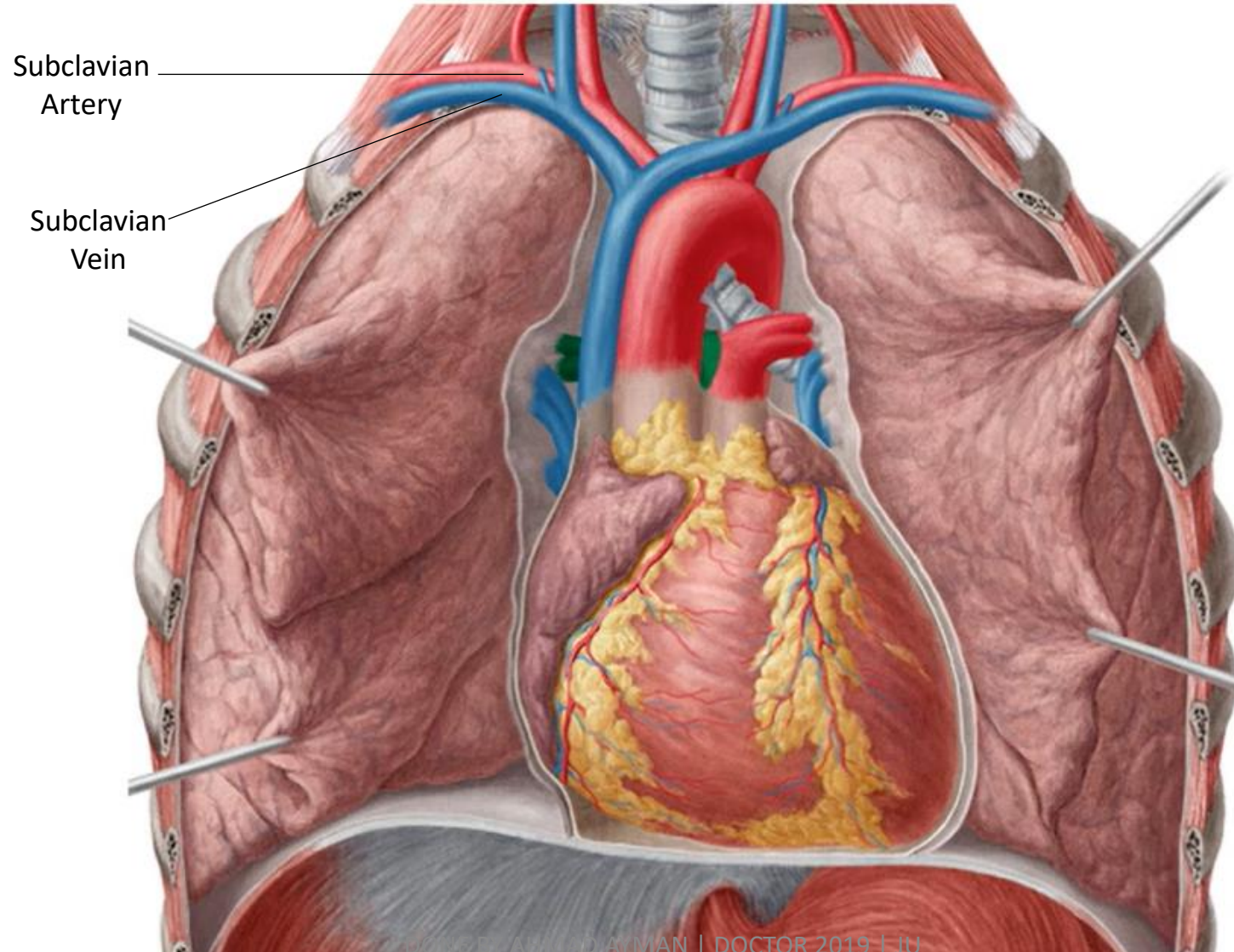
- The medial surface of the right lung lies adjacent to a number of important structures, including:
- The Heart (the right atrium)
- Inferior Vena Cava
- Superior Vena Cava
- Azygous Vein.
- Esophagus (posteriorly).
- The trachea (it has an impression on the right lung but not the left one because it is deviated to the right), (the tracheal impression is slightly anterior to that of the esophagus).



Cardiac Impression (formed by the right atrium).



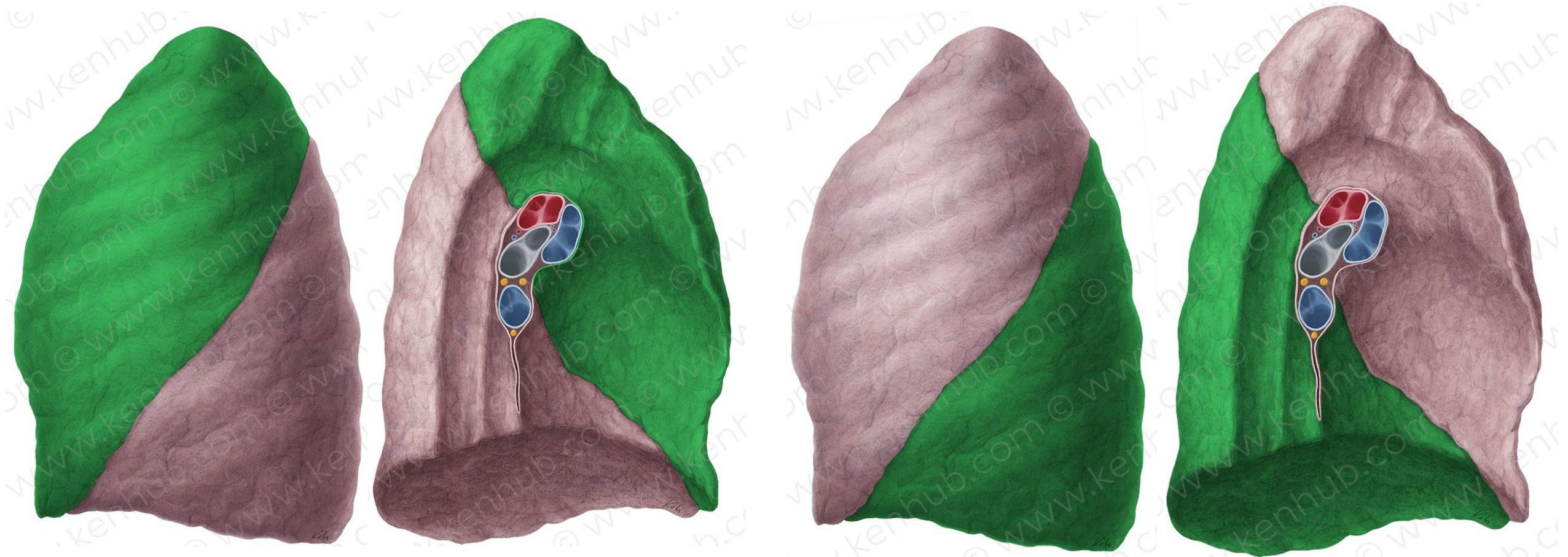
The right subclavian artery and vein arch over and are related to the superior lobe of the right lung as they pass over the dome of cervical pleura\* and into the axilla.





# THE LEFT LUNG

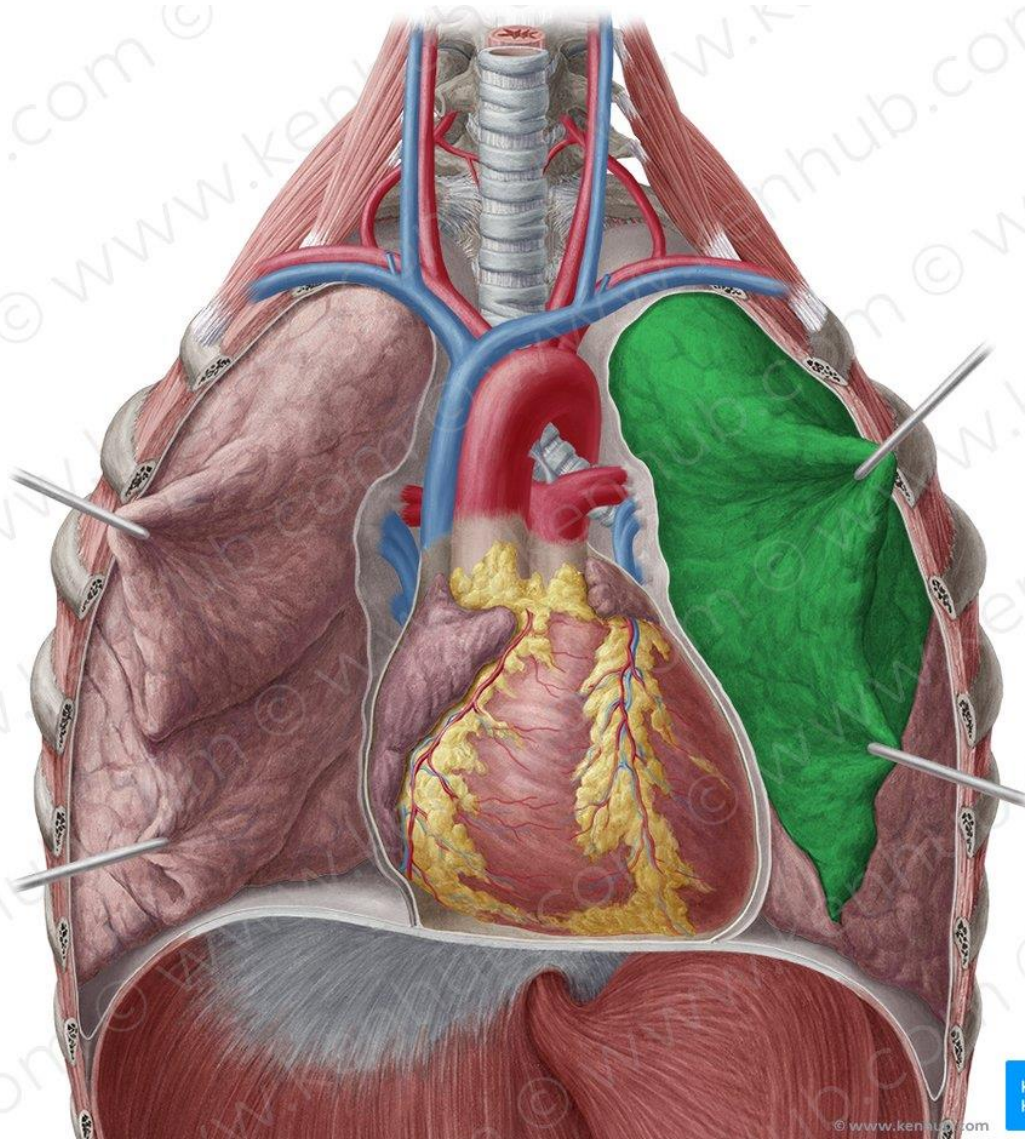
The left lung is smaller than the right lung, it has **two** (upper and lower) lobes separated by an **oblique fissure**.



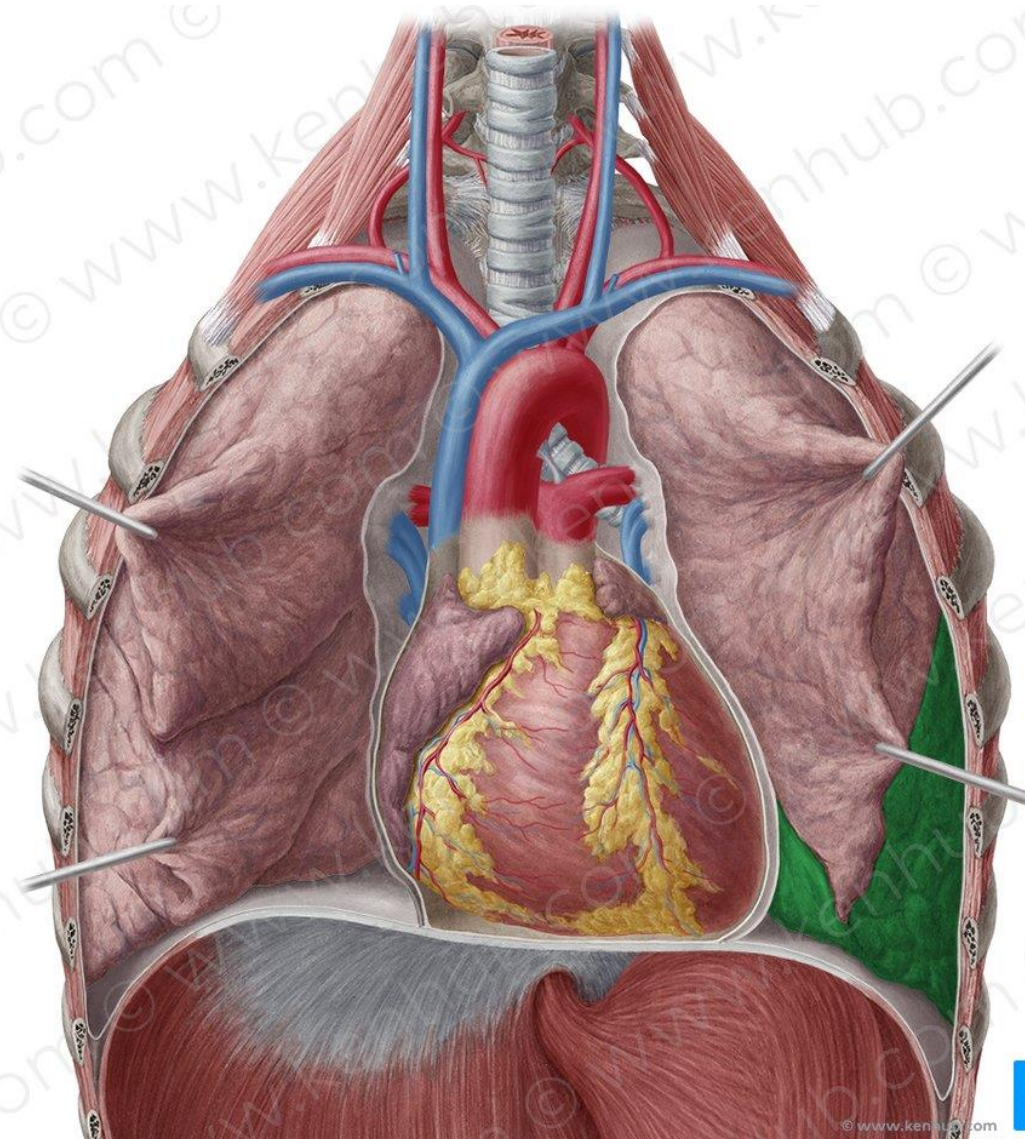
Superior (upper) lobe

Inferior (Lower) lobe





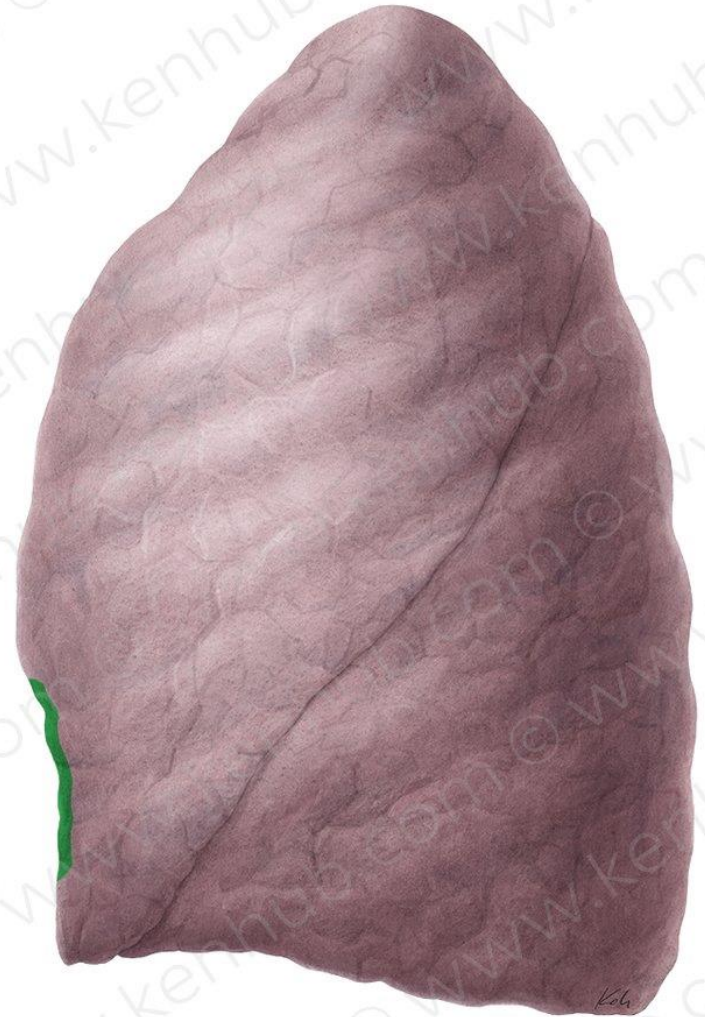
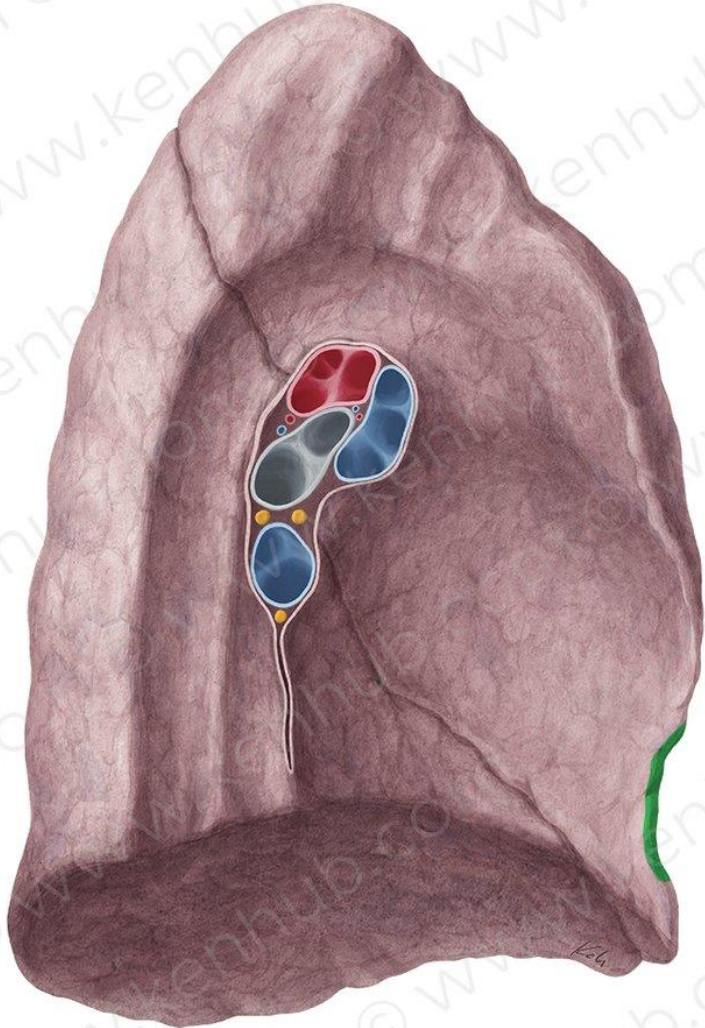
Superior Lobe of left Lung



Inferior Lobe of left Lung



The inferior portion of the medial surface of the left lung, is notched because of the heart's projection into the left pleural cavity from the middle mediastinum, this notch is called the **cardiac notch**.

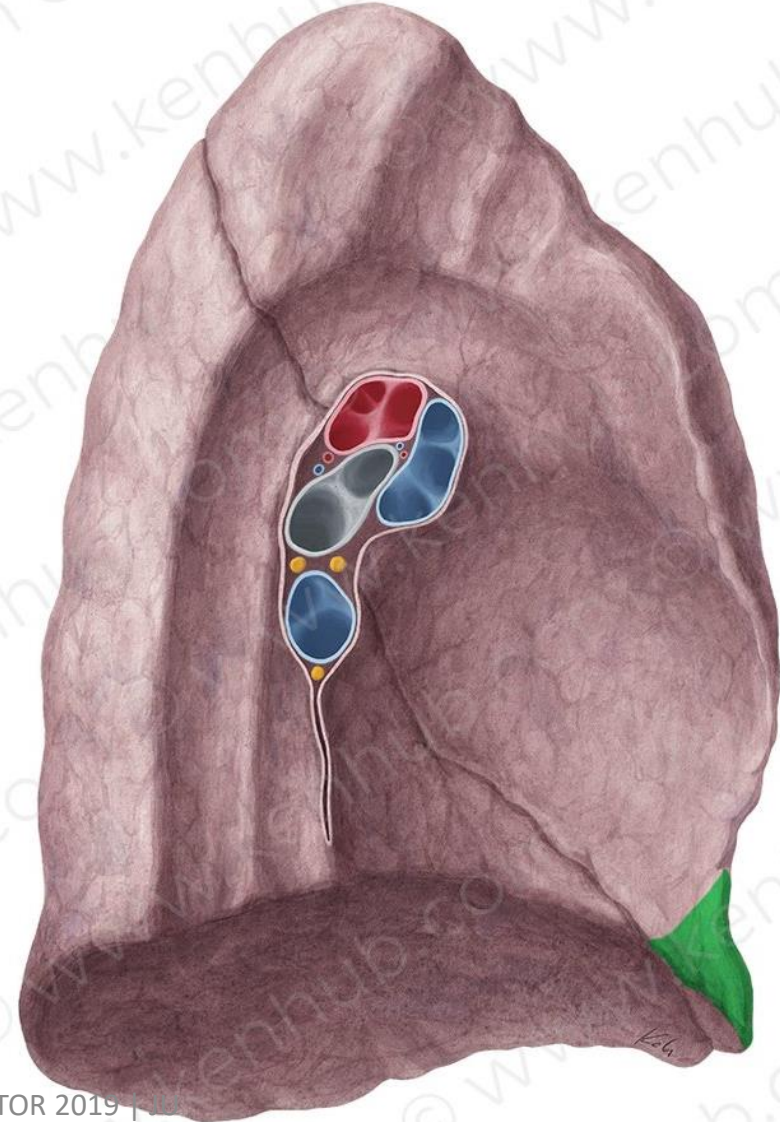


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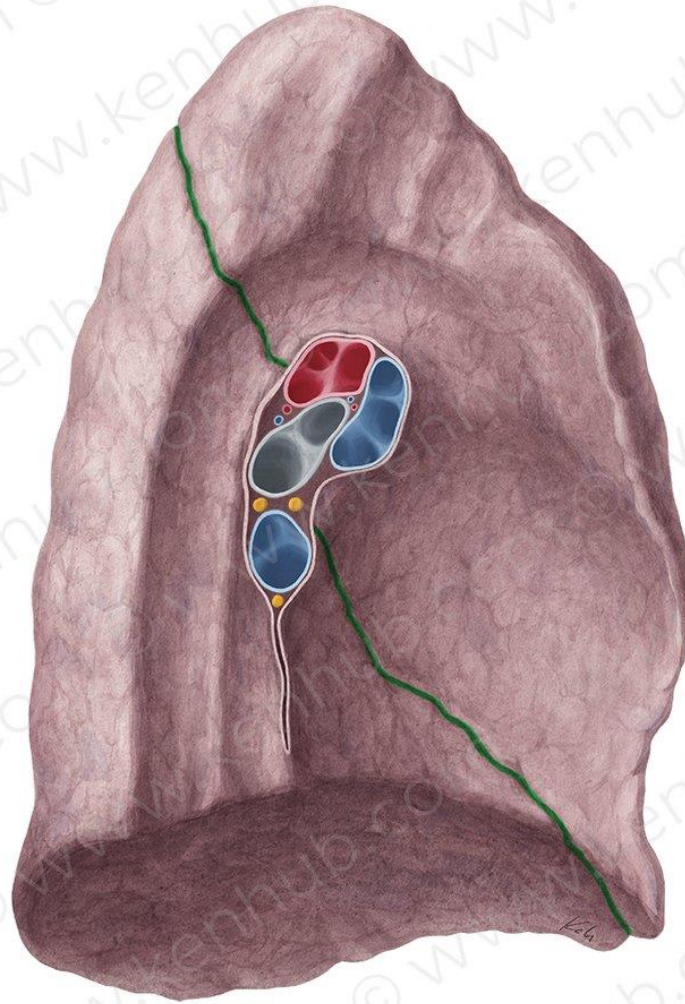
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On the anterior surface of the lower part of the superior lobe a tongue-like extension called the **lingula of left lung** projects over the heart bulge.

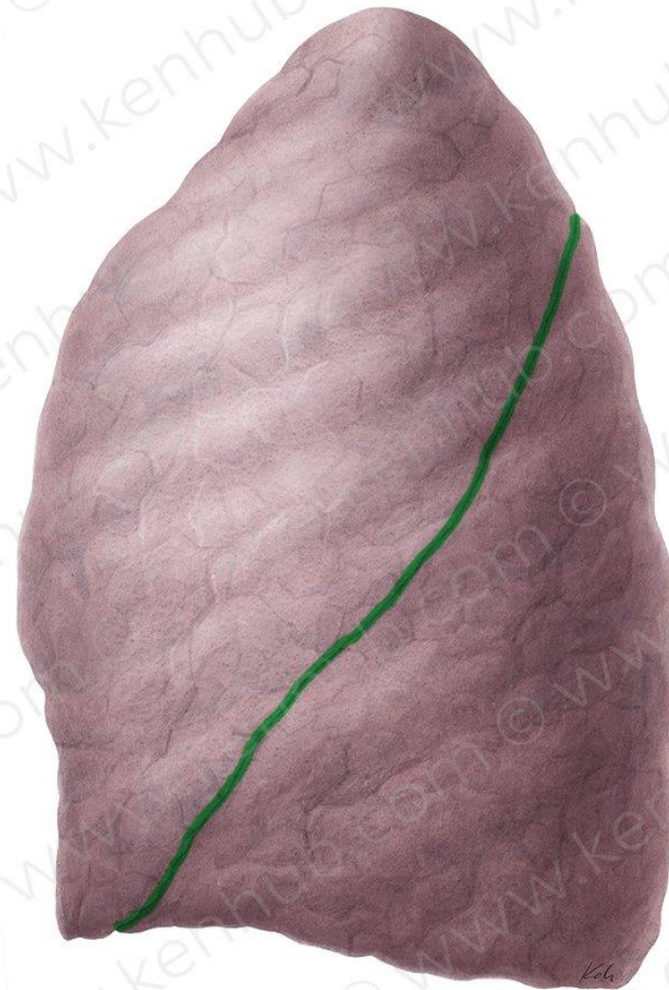




**Oblique fissure** of the left lung is slightly more oblique than the corresponding fissure of the right lung.



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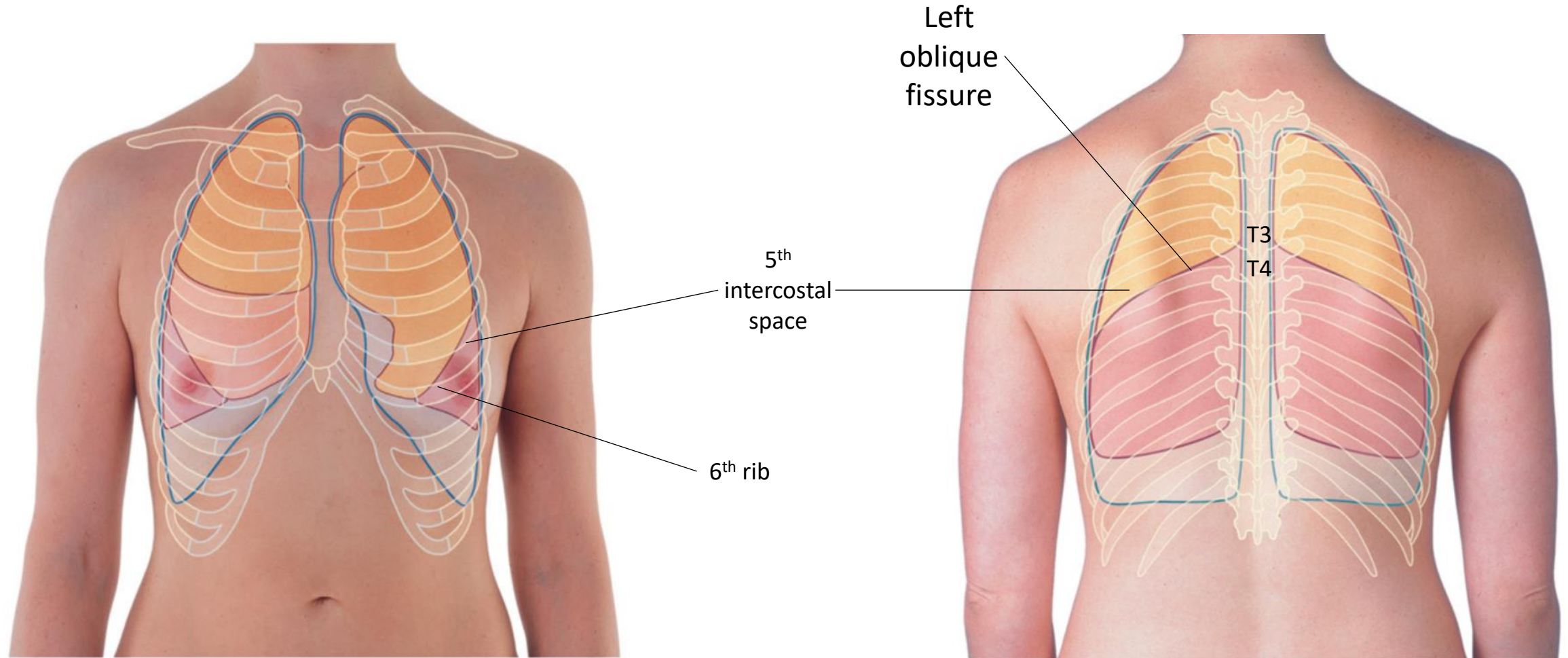


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# SURFACE ANATOMY OF THE LEFT LUNG

During quiet respiration, the approximate position of the left oblique fissure can be marked by line on the thoracic wall that begins between the spinous processes of vertebrae T3 and T4, crosses the 5<sup>th</sup> intercostal space laterally, and follows the contour of 6<sup>th</sup> rib anteriorly.



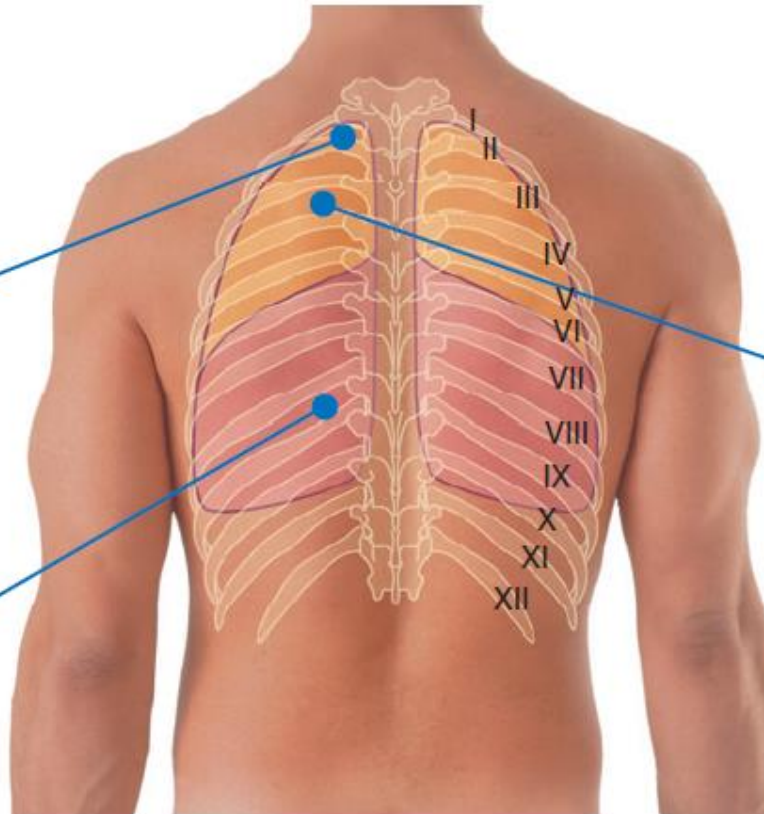


# HOW TO ASCULTATE THE LOBES OF THE LEFT LUNG

As with the right lung, the orientation of the **oblique fissure** determines where to listen for lung sounds from each lobe.



Apex of left lung



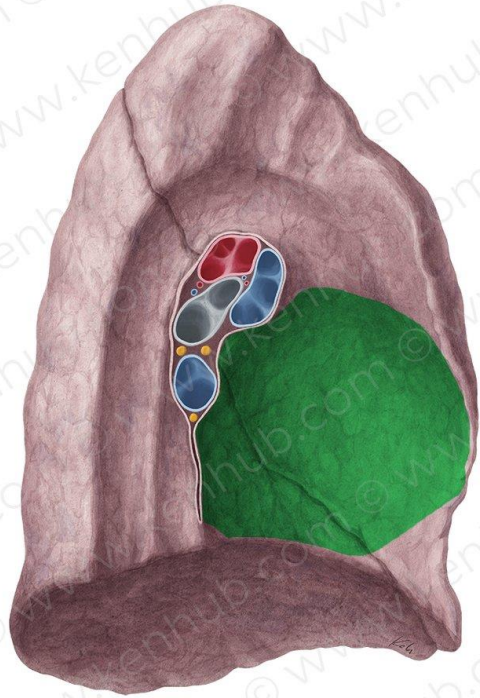
Superior lobe of left lung



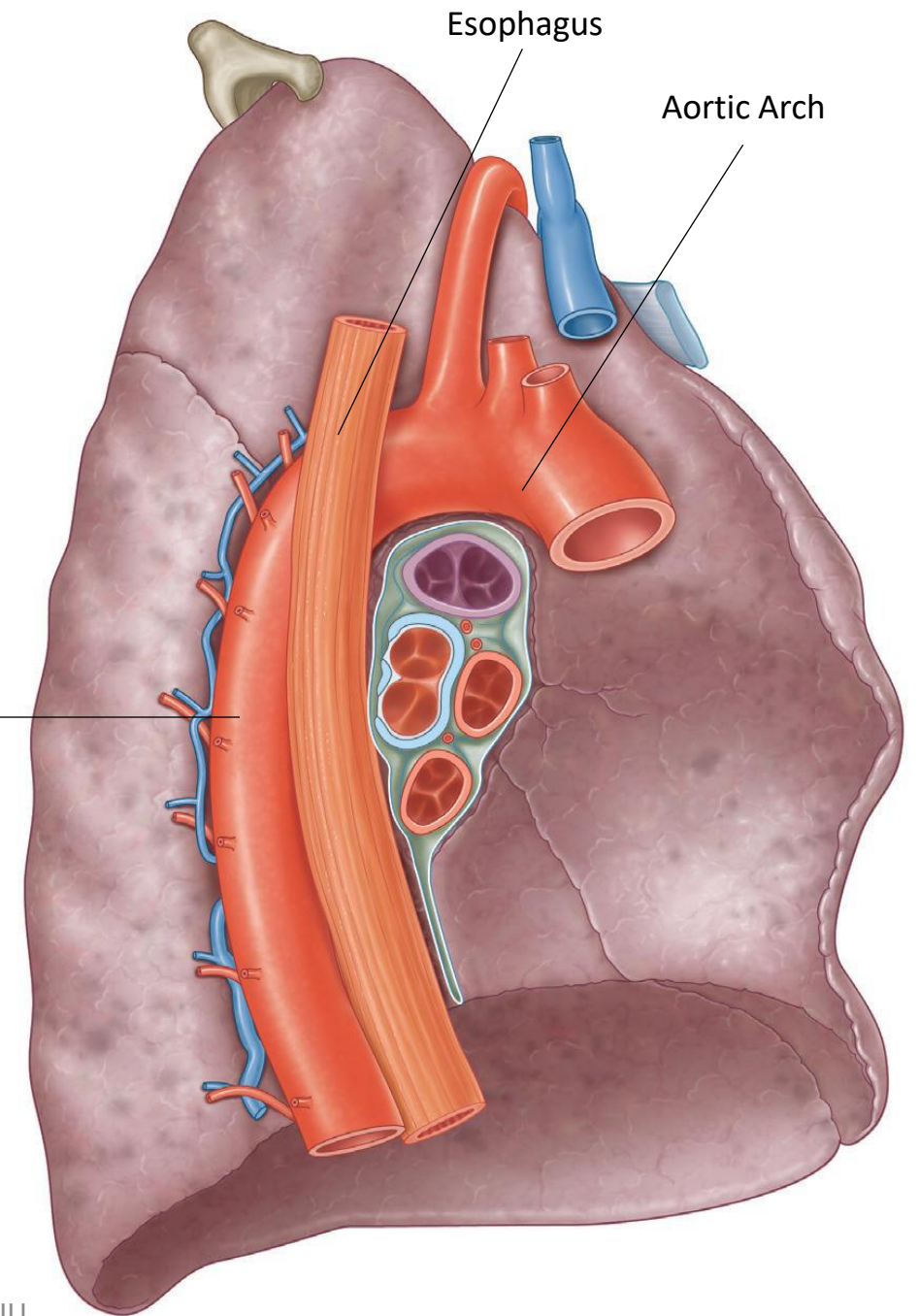
Inferior lobe of left lung

# IMPRESSIONS OF THE LEFT LUNG

- The medial surface of the left lung lies adjacent to a number of important structures, including:
- heart
- aortic arch,
- thoracic aorta,
- esophagus



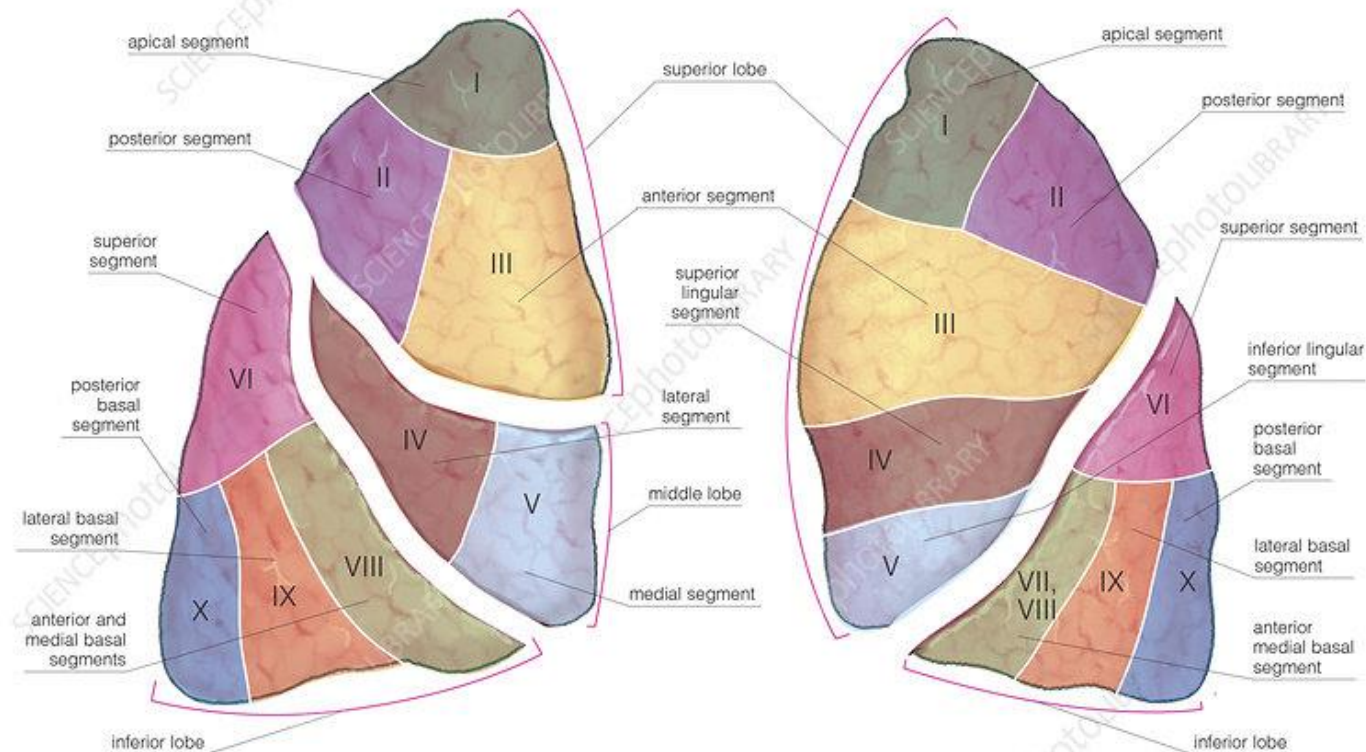
Cardiac impression of the left lung.



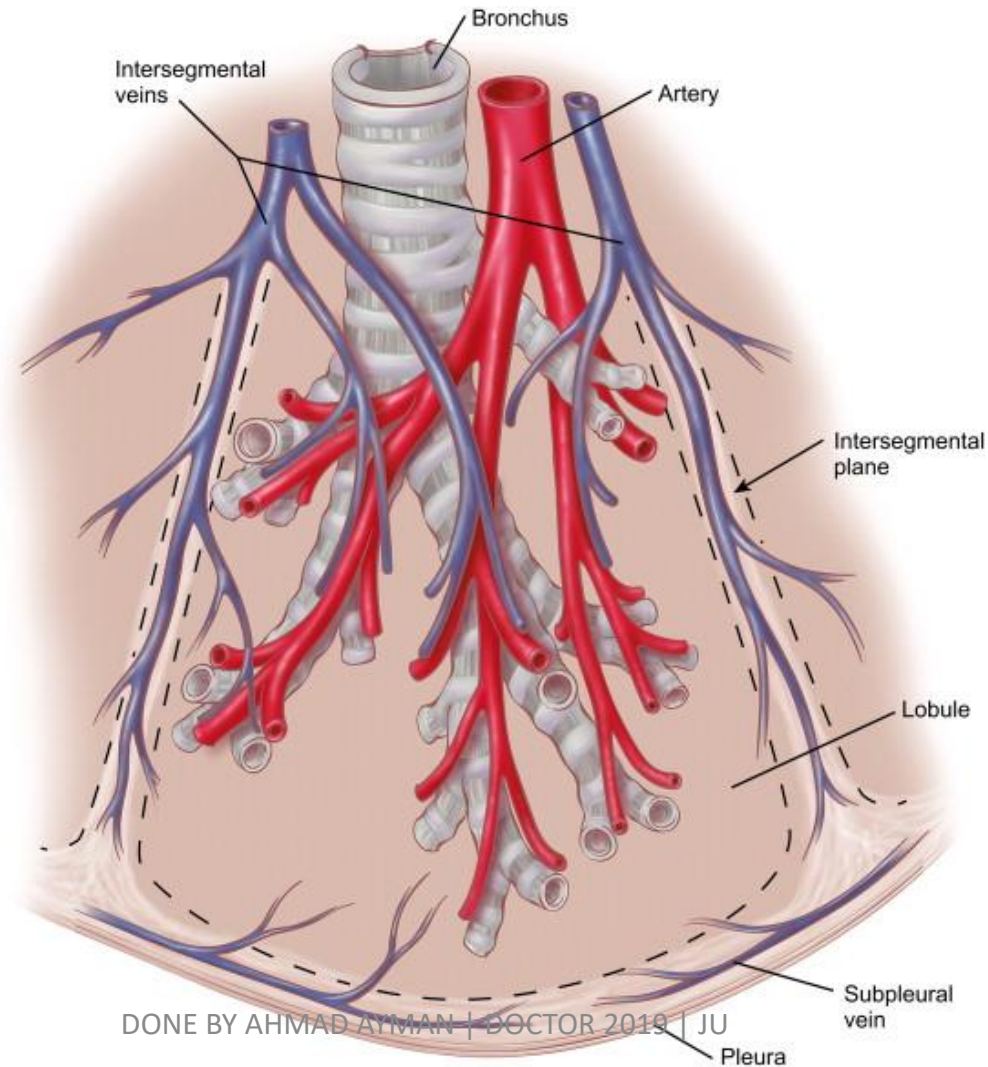


# BRONCHOPULMONARY SEGEMENTS OF THE LUNGS

- A bronchopulmonary segment (also referred to as the pulmonary unit) is the area of lung supplied by a single segmental (tertiary) bronchus\* and its accompanying pulmonary artery branch.
- It is a subdivision of a lung lobe.
- Each bronchopulmonary pyramid shaped, with its apex toward the lung root.



Each bronchopulmonary segment is separated from the other segment by connective tissue. Each bronchopulmonary segment has its own segmental bronchus, segmental artery, lymph vessels, and autonomic nerves. The segmental veins lie in the connective tissue between adjacent bronchopulmonary segments, so veins are the landmark that tells you that this is a segment.





# BRONCHOPULMONARY SEGMENTS OF THE RIGHT LUNG

## Upper Lobe Segments:

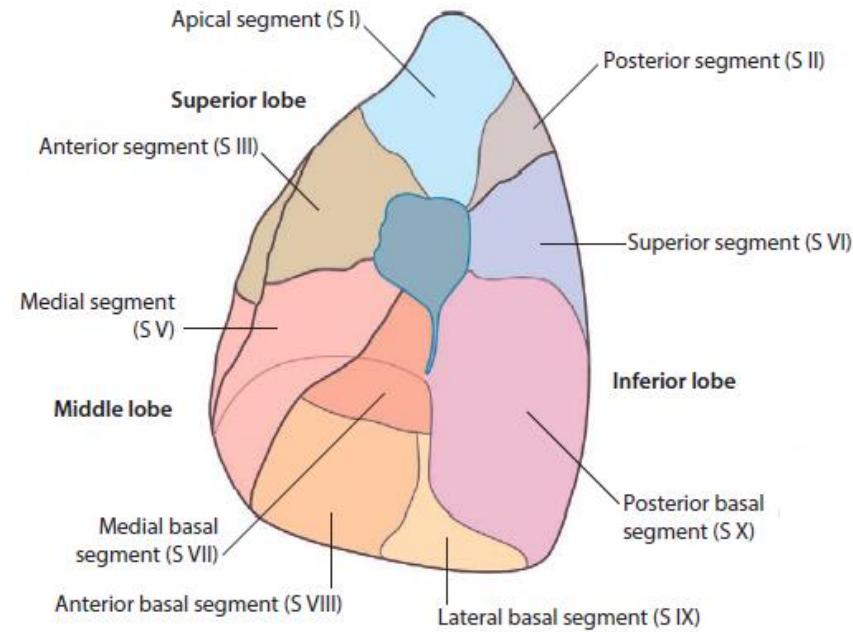
- **A**pical (located at the apex)
- **P**osterior (located at the posterior border of the lung)
- **A**nterior (located at the anterior border of the lung)

## Middle Lobe Segments:

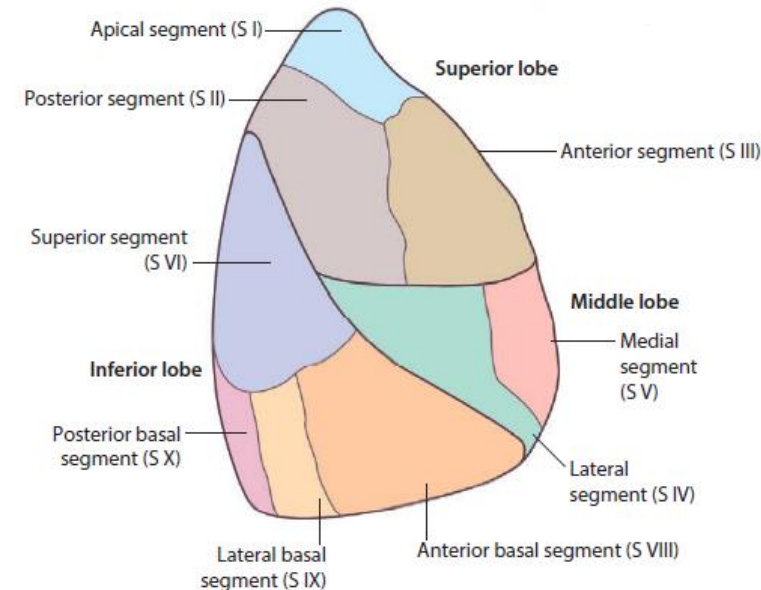
- **M**edial (at the mediastinal surface of the lung)
- **L**ateral (at the costal surface of the lung).

## Lower Lobe Segments: (= UPPER +MIDDLE ☹️)

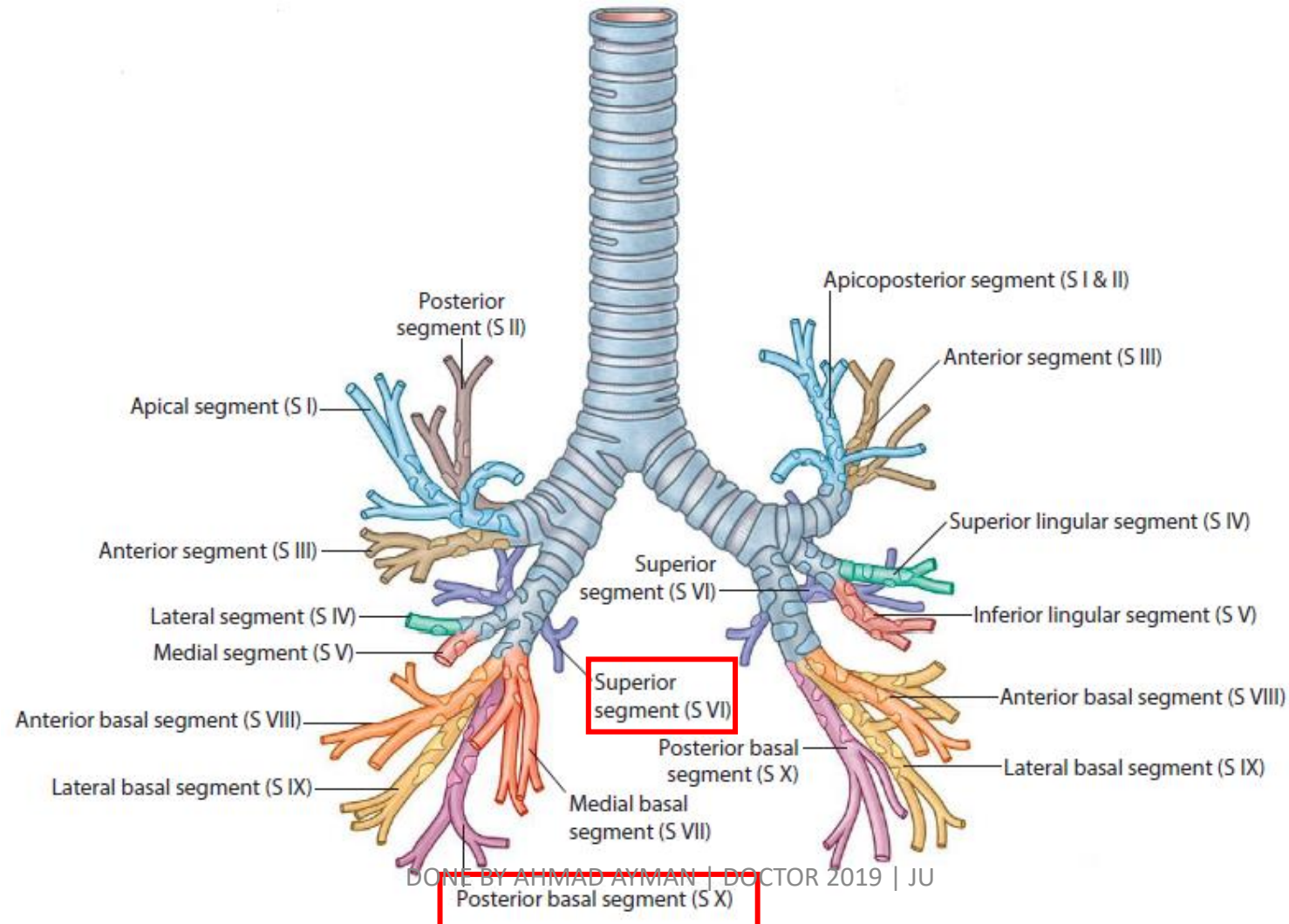
- Apical (it is the most superior segment in the inferior lobe, it is called the apicobasal segment)
- Anterior (anterior border)
- Posterior (posterior border)
- Medial (mediastinal border)
- Lateral (costal border)



Note: each lung has  
10  
bronchopulmonary  
segments



As we said, because of the anatomy of the right main bronchus, inhaled foreign objects tend to lodge in the right lung, specifically, they tend to lodge in the lower lobe because of the position of right inferior lobar (secondary bronchus), more specifically, they tend to lodge in the right apicobasal segment (segment VI) if the body was inhaled while the patient was in supine position (like if you are extracting a tooth and it has dropped inside the patient's throat), and in the posterior inferior segment (S X) if the patient was in erect position while inhaling the foreign body.





# BRONCHOPULMONARY SEGMENT OF THE LEFT LUNG

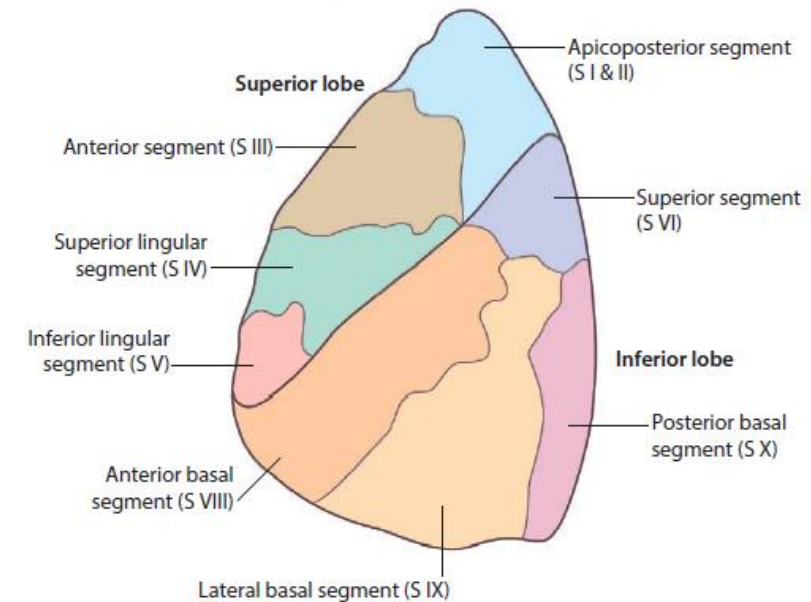
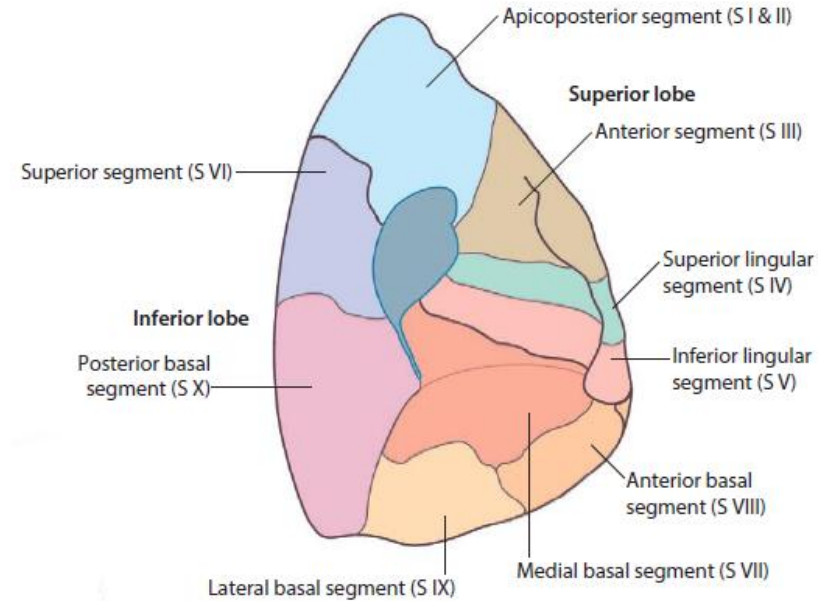
**Upper Lobe Segments: (same as the right lung but just add the lingual segments**



- Apical
- Posterior
- Anterior
- Superior Lingual
- Inferior Lingual

**Lower Lobe Segments: (same the right lung)**

- Apical (apicobasal)
- Anterior
- Medial
- Lateral
- Posterior



Note: at birth, the left lung is composed of only 8 segments, this is because the apical and posterior upper segments are firstly united as the apicoposterior segment, which separate in first ten years of life, the same is true for the lower anterior and medial segments (anteromedial segment).

# Right lung

Anterior View



Posterior View



Lateral/Medial Views



Inferior View



**Lobes of right lung:**

**Superior lobe**

- Apical
- Posterior
- Anterior

**Middle lobe**

- Lateral
- Medial

**Inferior lobe**

- Superior
- Anterior basal
- Medial basal
- Lateral basal
- Posterior basal

**Lobes of left lung:**

**Superior lobe**

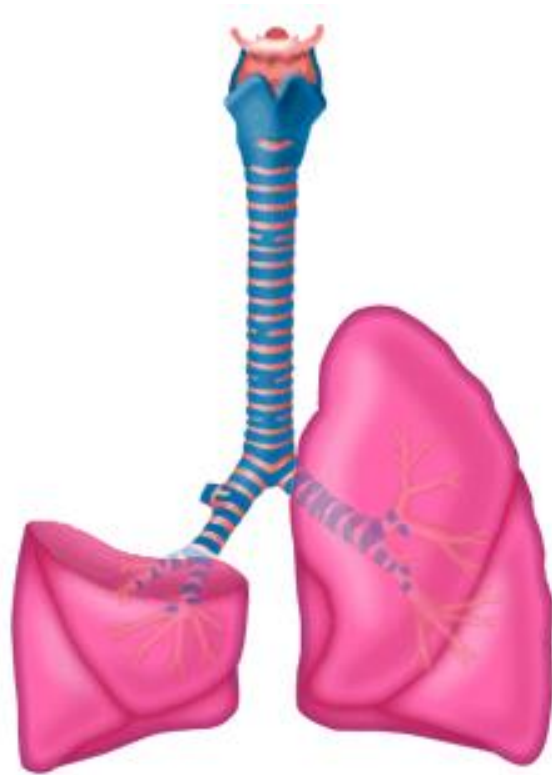
- Apical
- Posterior } \*\*
- Anterior
- Superior lingular
- Inferior lingular

**Inferior lobe**

- Superior
- Anterior basal } \*
- Medial basal
- Lateral basal
- Posterior basal



Until recently, lung cancer and several other pulmonary diseases used to be treated through lobectomy, which is surgical removal of the whole affected lung lobe (the whole lobe used to be removed even though only a small part of it was diseased), of course that would result in a severe decline in lung functions and patients could hardly tolerate this procedure, however, recently, they have invented segmentectomy, which is surgical removal of a lung segment, we remove the diseases segment by ligation of the artery and the bronchus which supply at and that wouldn't result in severe complication as those of lobectomy, you have to be familiar with the bronchopulmonary segments if you want to become a thoracic surgeon.



Lobectomy



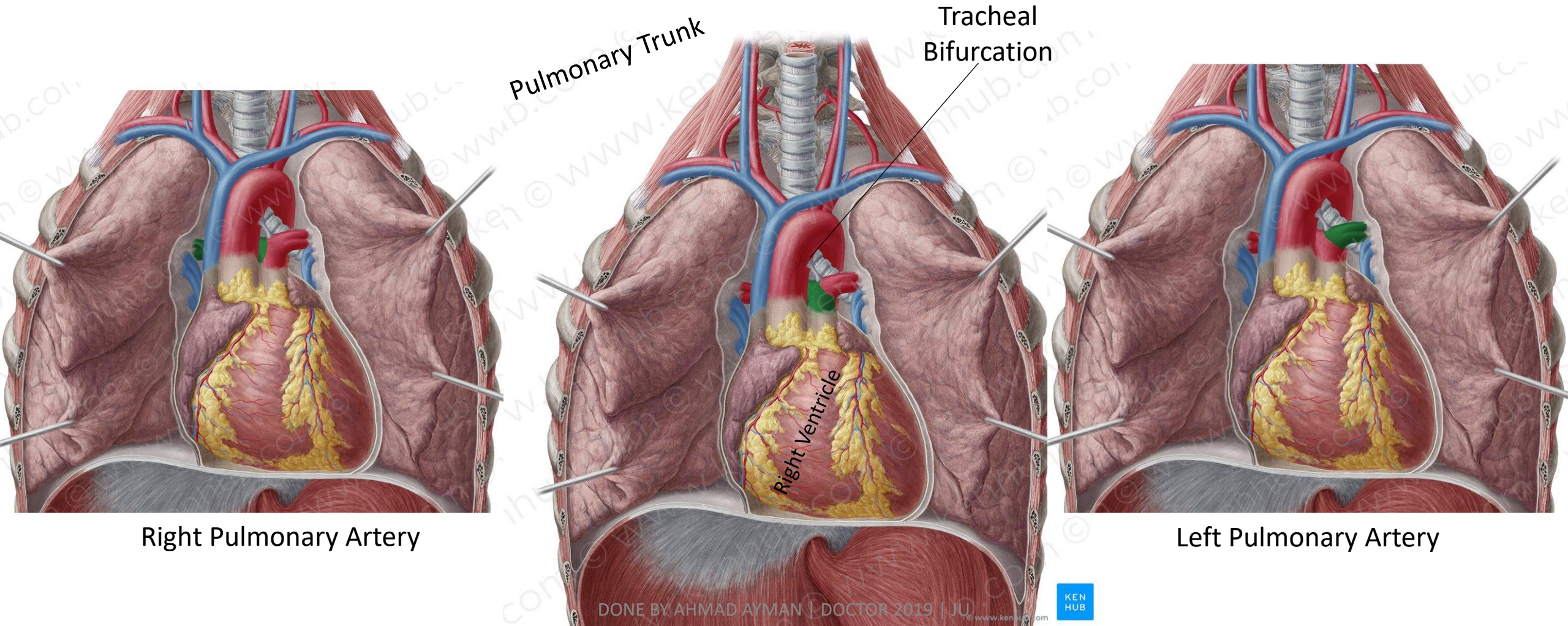
Segmentectomy

Note: bronchopulmonary segments are also significant in:

- Infections (can be localized within one segment.)
- No barrier (meaning that the connective tissue between the segments can be penetrated by infections)
- Surgery
- Postural drainage (which is a procedure in which we insert a tube inside the lung to drain its contents like foreign bodies)
- Bronchoscopy

# THE PULMONARY ARTERIES

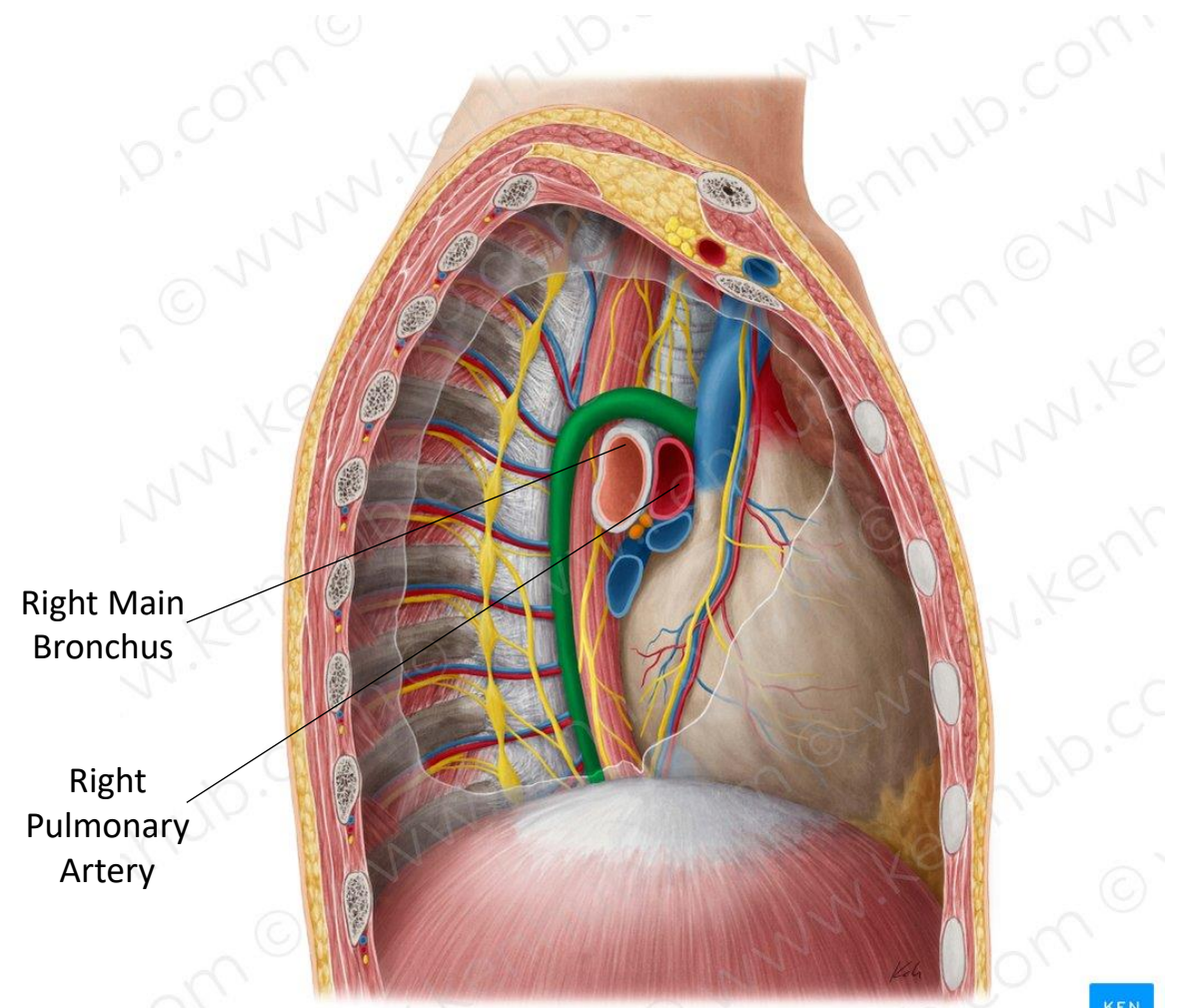
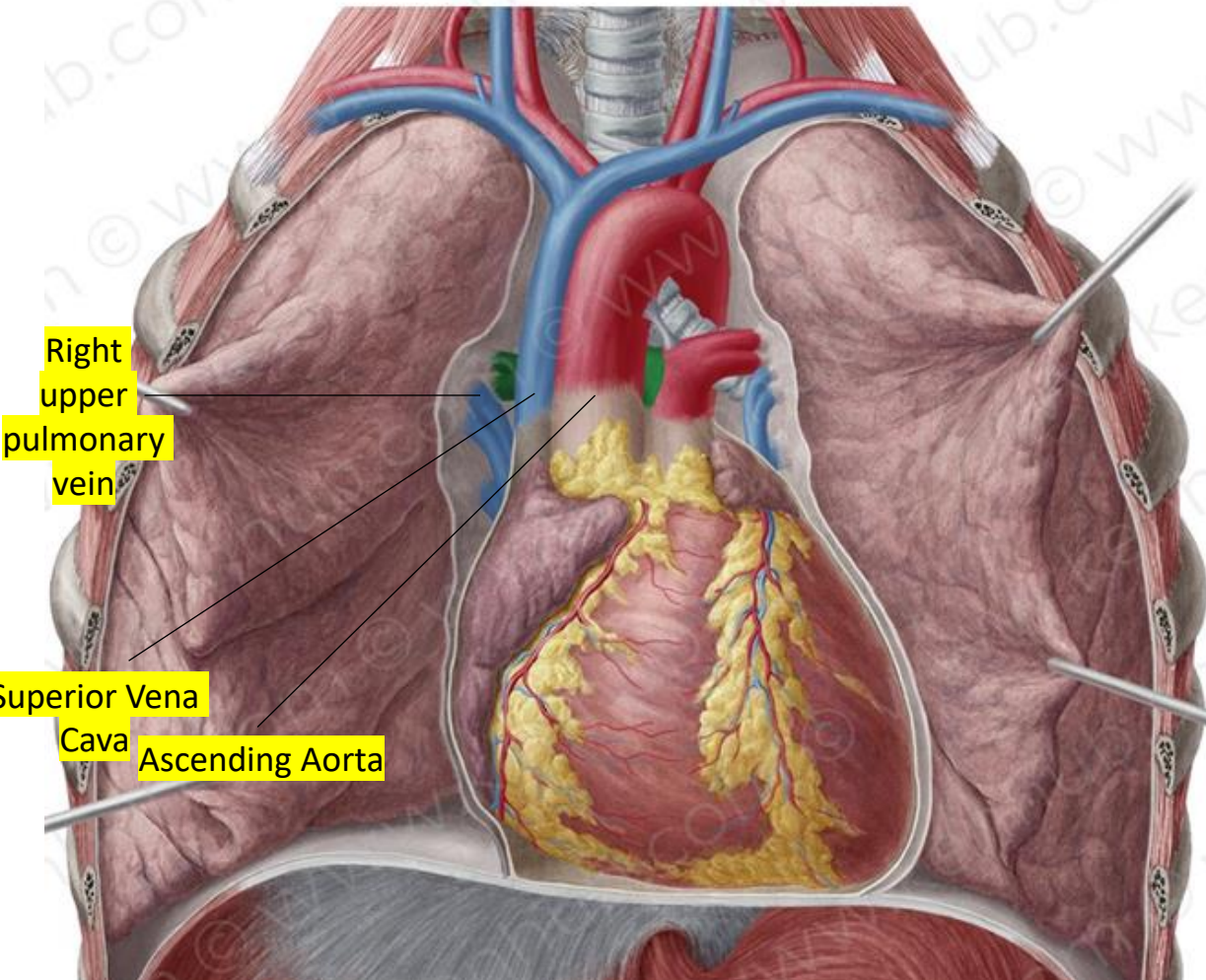
The right and left pulmonary arteries originate from the pulmonary trunk and carry deoxygenated blood to the lungs from the right ventricle of the heart  
The bifurcation of the pulmonary trunk occurs to the left of the midline just inferior to vertebral level T4, and anteroinferiorly to the left of the bifurcation of the trachea.



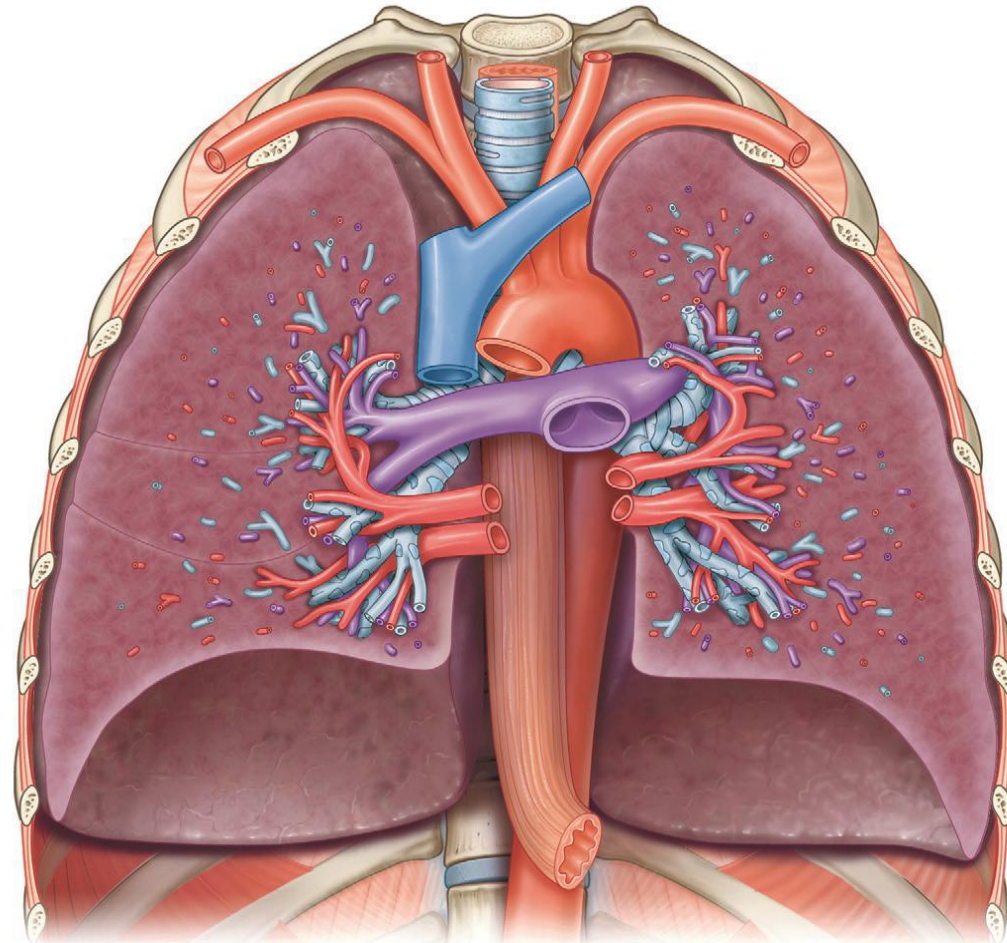


The right pulmonary artery is longer than the left and passes horizontally across the mediastinum. It passes:

- anteriorly and slightly inferiorly to the tracheal bifurcation and anteriorly to the right main bronchus.
- posteriorly to the ascending aorta, superior vena cava, and upper right pulmonary vein.

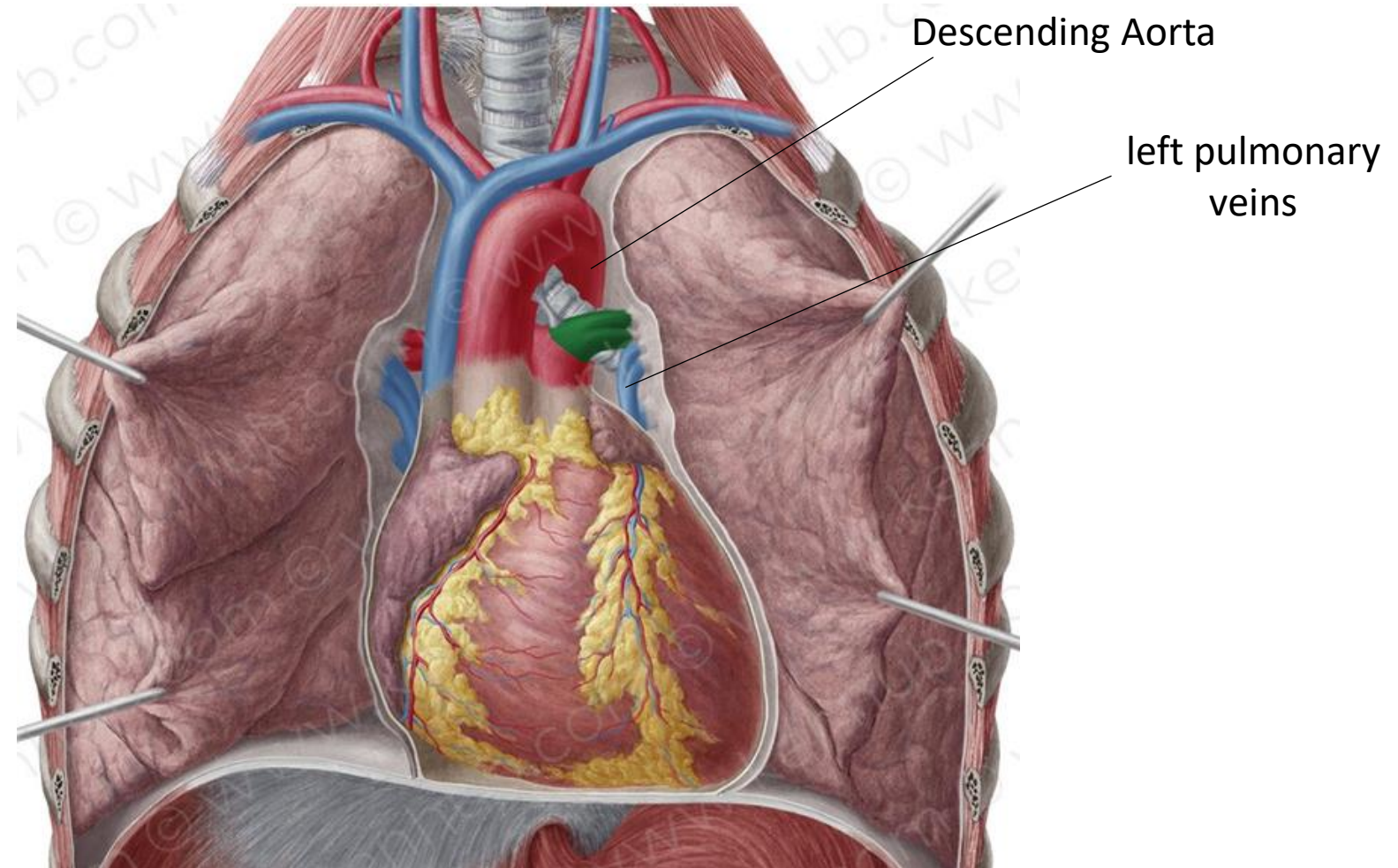


- The right pulmonary artery enters the root of the lung and gives off a large branch to the superior lobe of the lung.
- It continues through the hilum of the lung, gives off a second (recurrent) branch to the superior lobe, and then divides to supply the middle and inferior lobes.



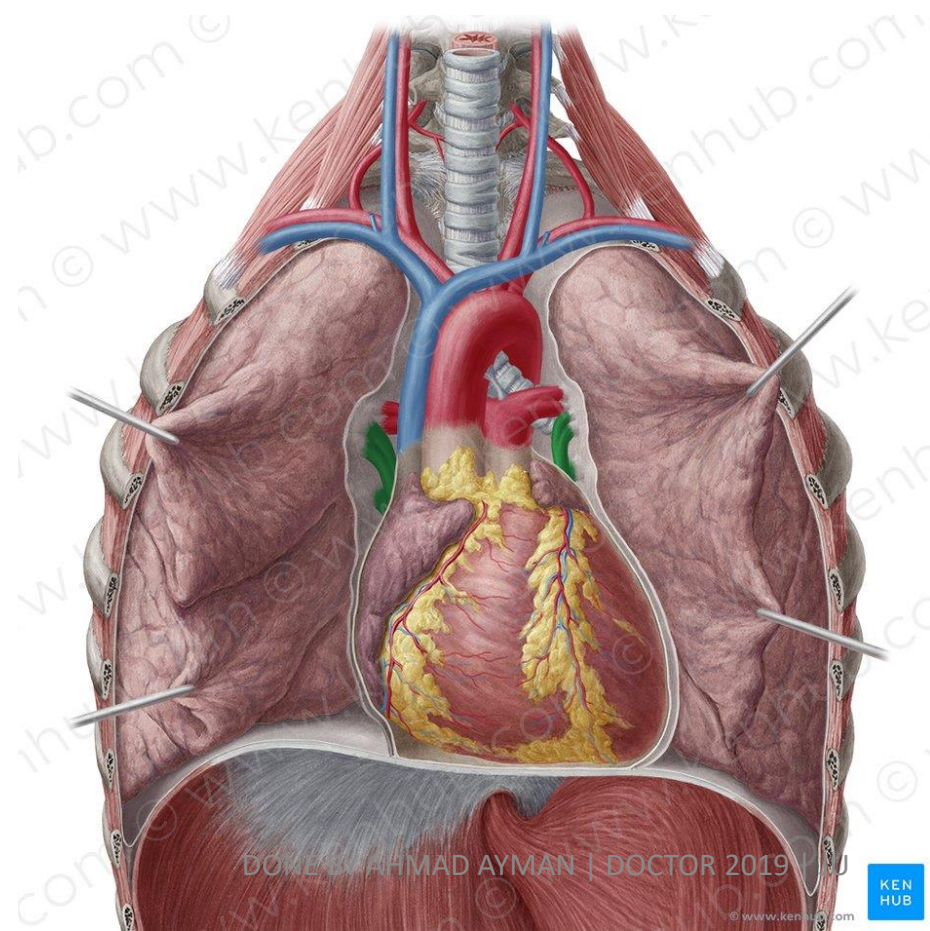


- The left pulmonary artery is shorter than the right and lies anterior to the descending aorta and posterior to the superior pulmonary vein
  - It passes through the root and hilum and branches within the lung.



# PULMONARY VEINS

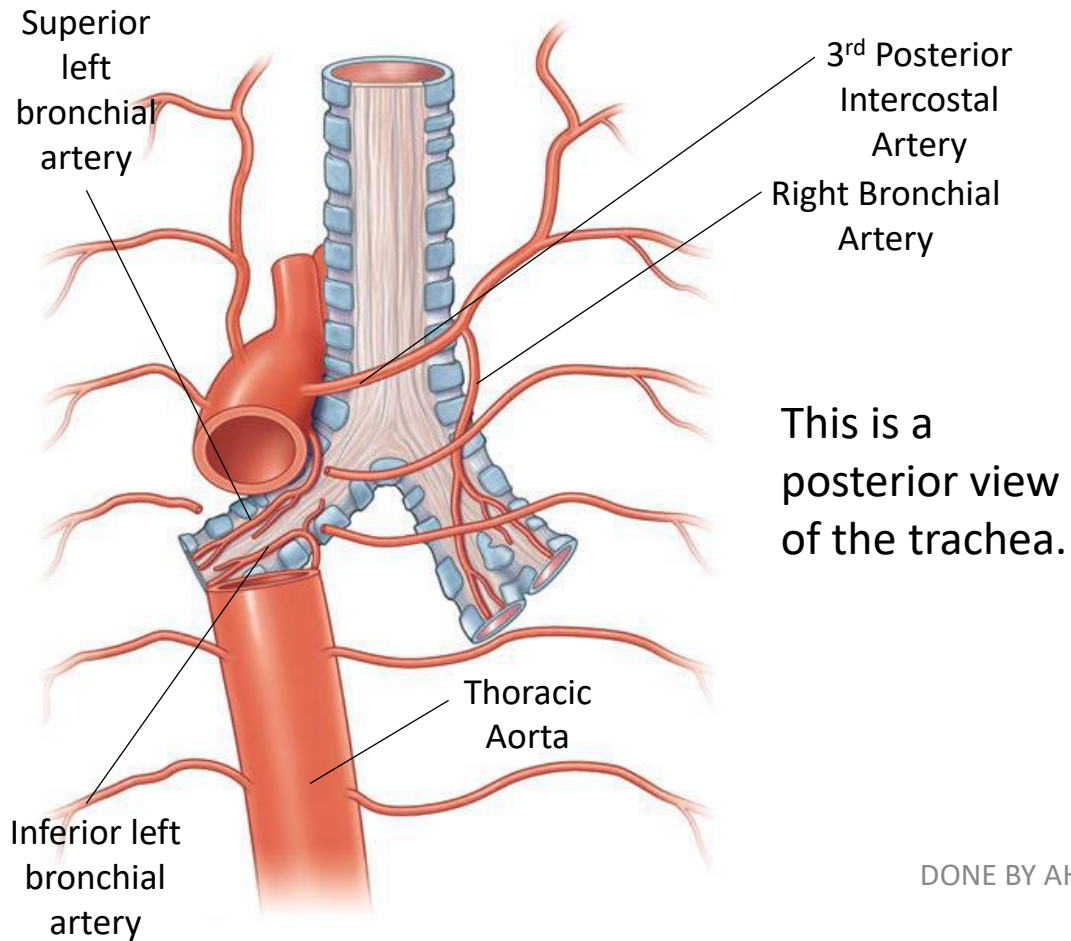
- On each side a **superior pulmonary vein** and an **inferior pulmonary vein** carry oxygenated blood from the lungs back to the heart
- The veins begin at the hilum of the lung, pass through the root of the lung, and immediately drain into the left atrium.





# BRONCHIAL ARTERIES

- constitute the 'nutritive' vascular system of the pulmonary tissues (bronchial walls and glands, walls of large vessels, and visceral pleura).
- They interconnect within the lung with branches of the pulmonary arteries and veins.
- The bronchial arteries run on the posterior surfaces of the bronchi and ramify in the lungs to supply pulmonary tissues.
- They are too small compared to the pulmonary arteries.



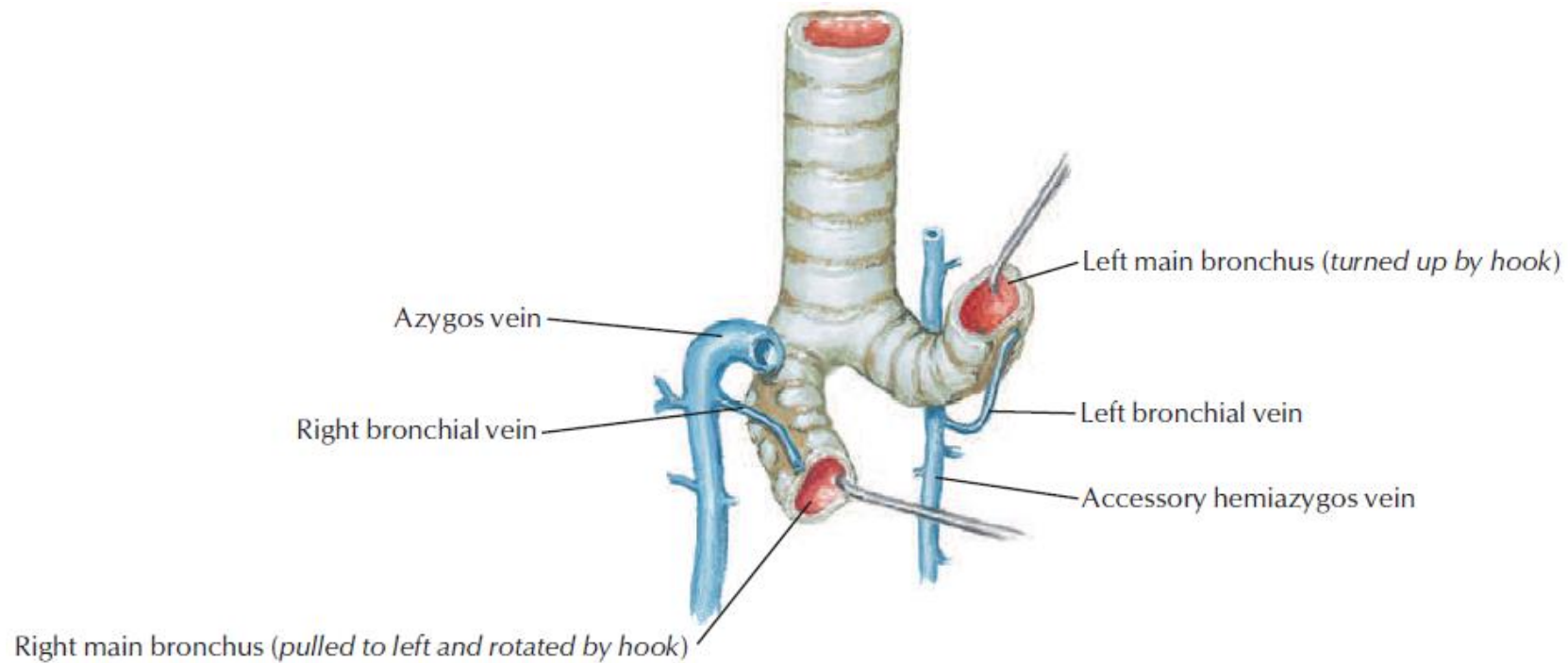
- A single right bronchial artery normally arises from the 3<sup>rd</sup> posterior intercostal artery
- two left bronchial arteries arise directly from the anterior surface of the thoracic aorta
- the superior left bronchial artery arises at vertebral level T5, and the inferior left bronchial arteries, arises inferior to the left main bronchus.

Note: you might think that the lungs get their blood supply from the bronchial artery, this is absolutely wrong, the bronchial arteries have only a minimal contribution to the blood supply of the lungs, lungs get their most of their own blood supply from the pulmonary arteries themselves, ligation of the bronchial arteries doesn't result in anything, however, occlusion of the pulmonary artery results in a pulmonary infarct.

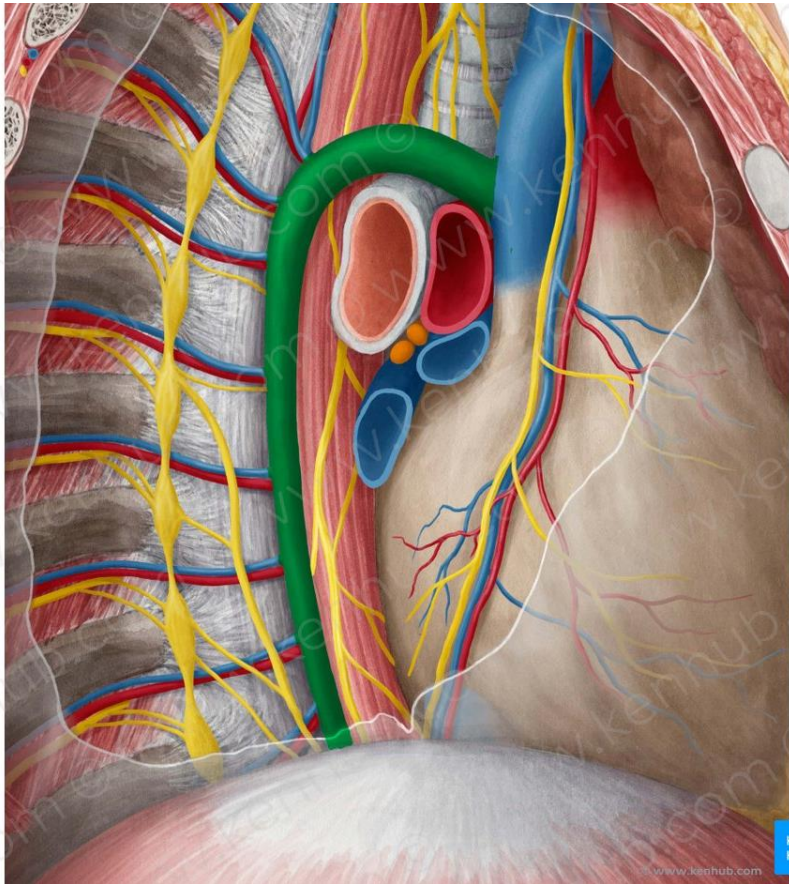
# BRONCHIAL VEINS

bronchial veins drain into:

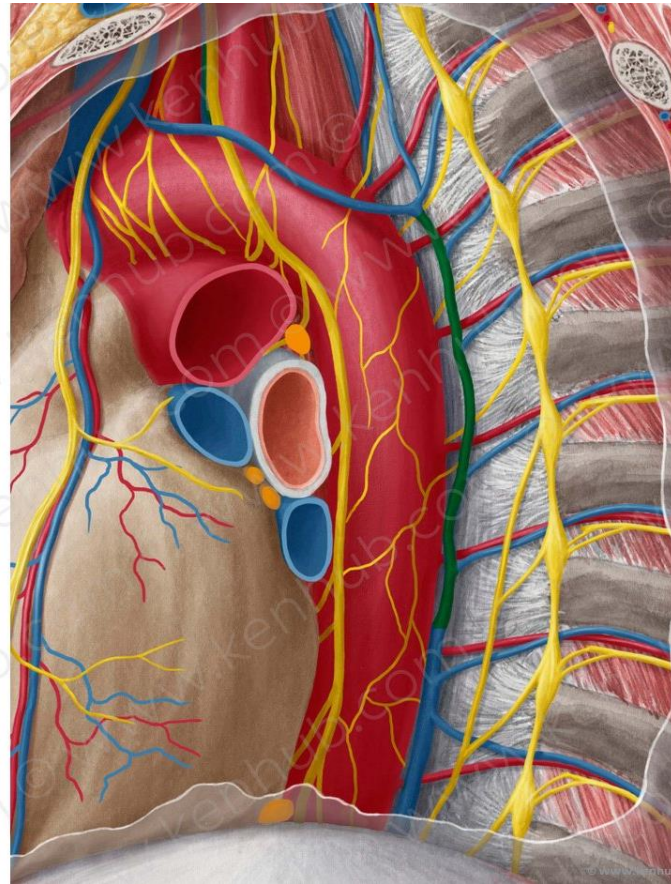
- either the pulmonary veins or the left atrium;
- into the azygos vein on the right or into the superior intercostal vein or hemiazygos vein on the left.



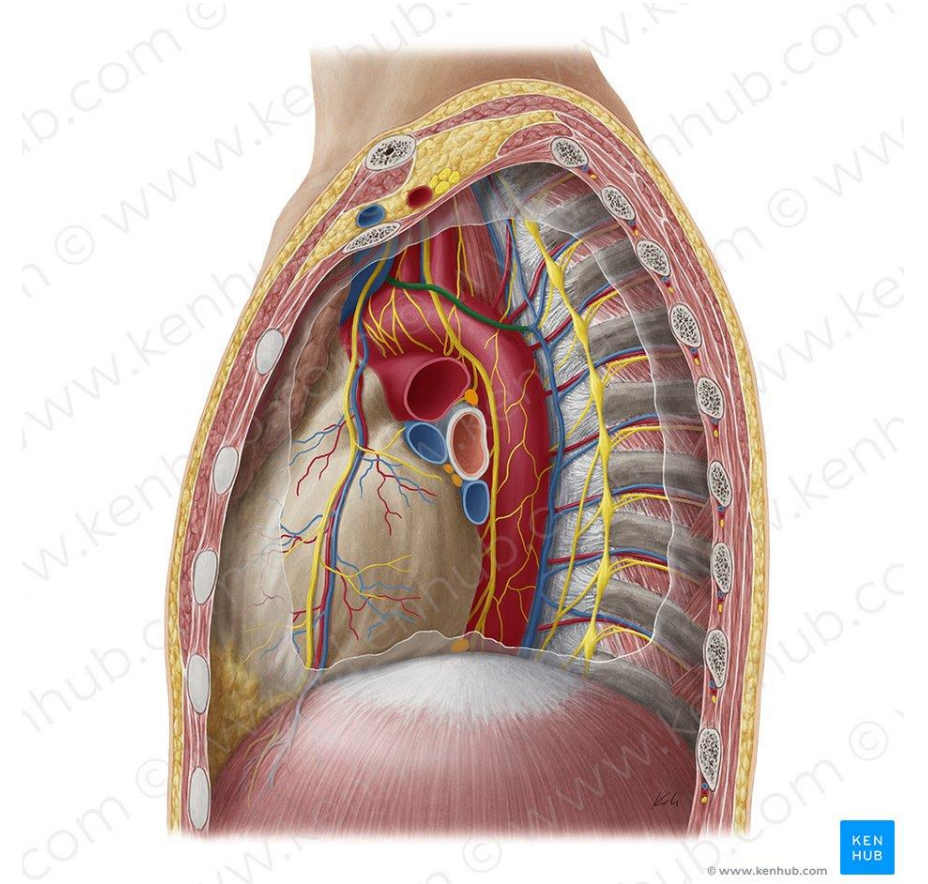




Azygous Vein



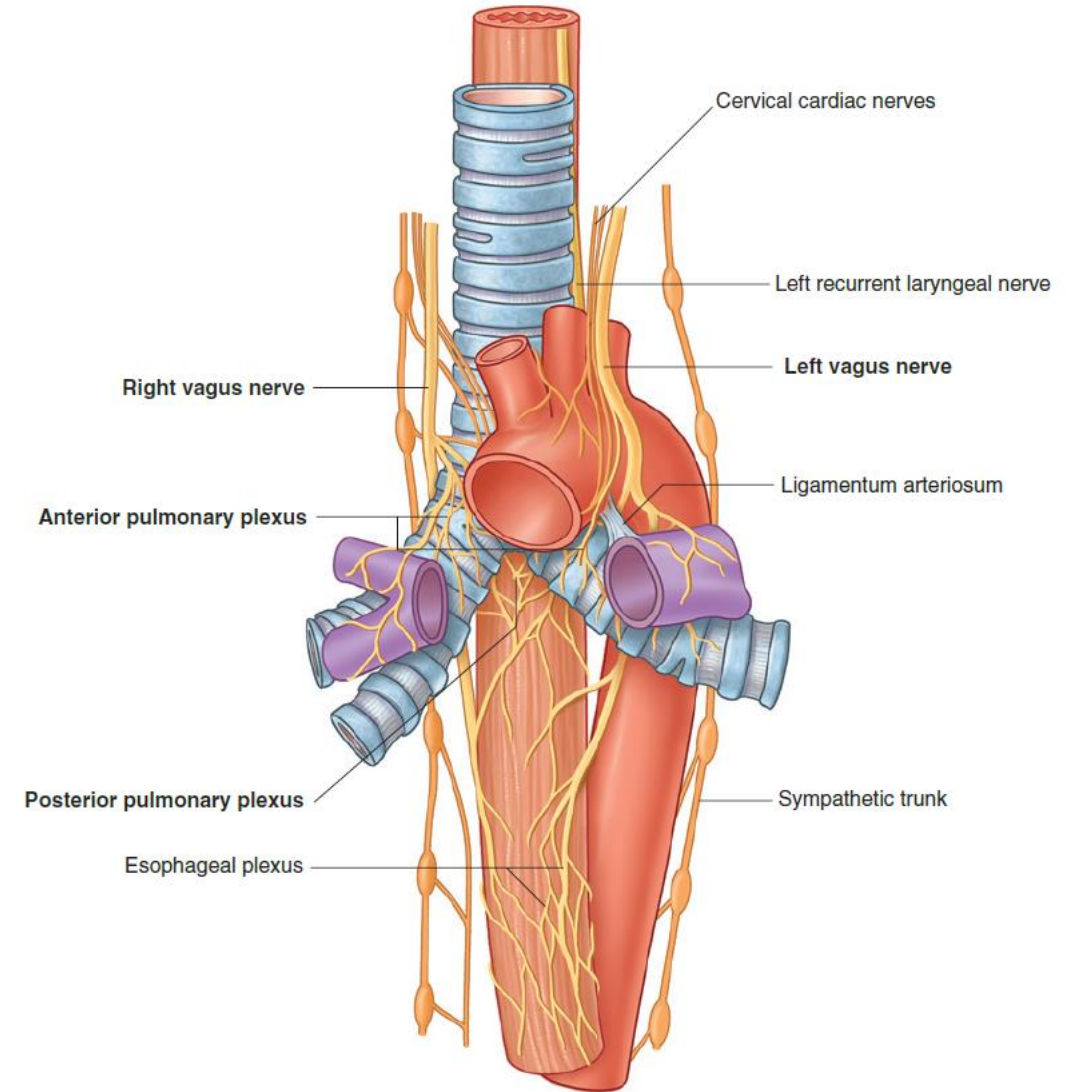
Superior hemiazygous Vein



Left superior Intercostal Vein

# INNERVATION OF THE LUNG

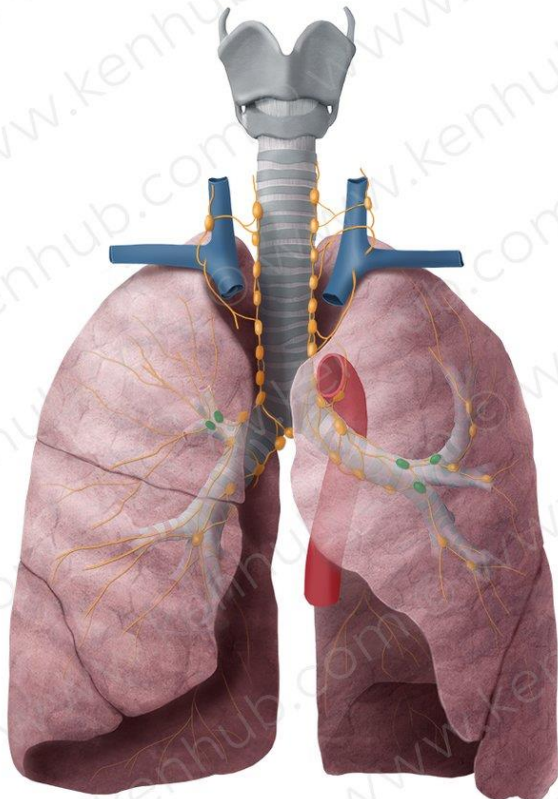
- The visceral pleura and other structures of the lung are supplied by visceral afferents (sensory) and efferents (motor) distributed through the anterior pulmonary plexus and posterior pulmonary plexus
- These interconnected plexuses lie anteriorly and posteriorly to the tracheal bifurcation and main bronchi.
- The anterior plexus is much smaller than the posterior plexus.
- Branches of these plexuses, which ultimately originate from the sympathetic trunks and vagus nerves, are distributed along branches of the airway and vessels
- Visceral efferents (motor) from:
  - the vagus nerves constrict the bronchioles;
  - the sympathetic system dilate the bronchioles. So that's why epinephrine is used for obstructive lung diseases....
- Visceral afferents provide **visceral sensation** to the lungs and visceral pleurae, meaning that they do sense stretch, but not pain, touch or temperature, etc.



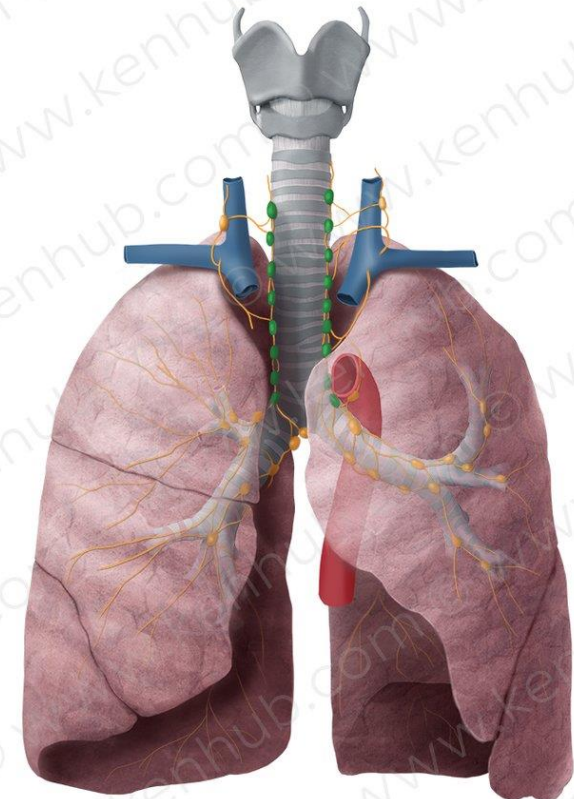


# LYMPATHIC DRAINAGE OF THE LUNGS

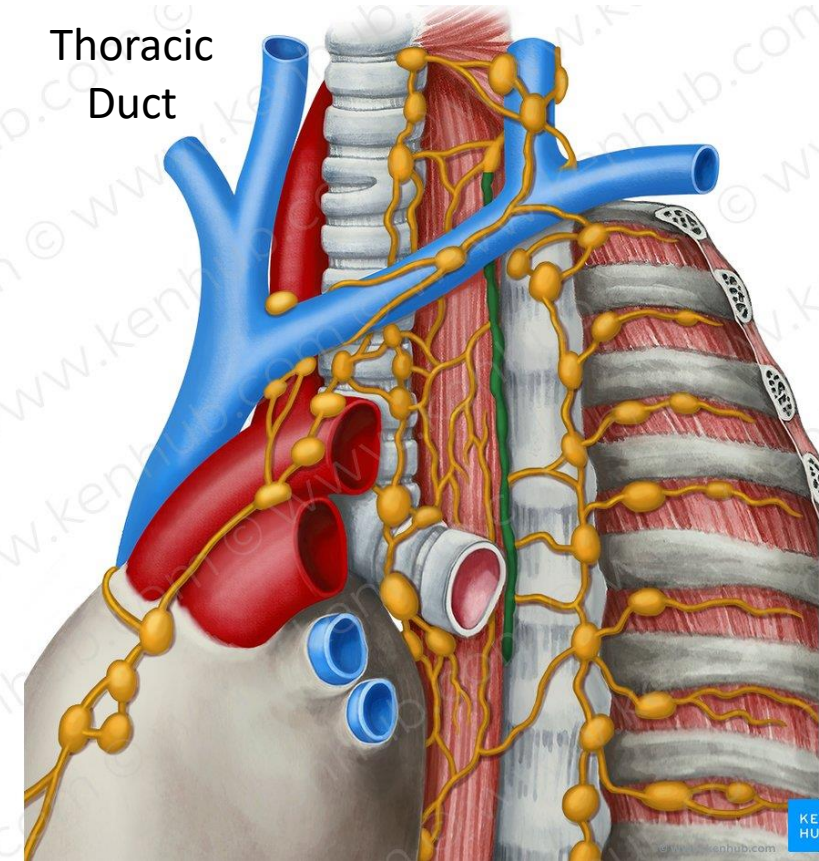
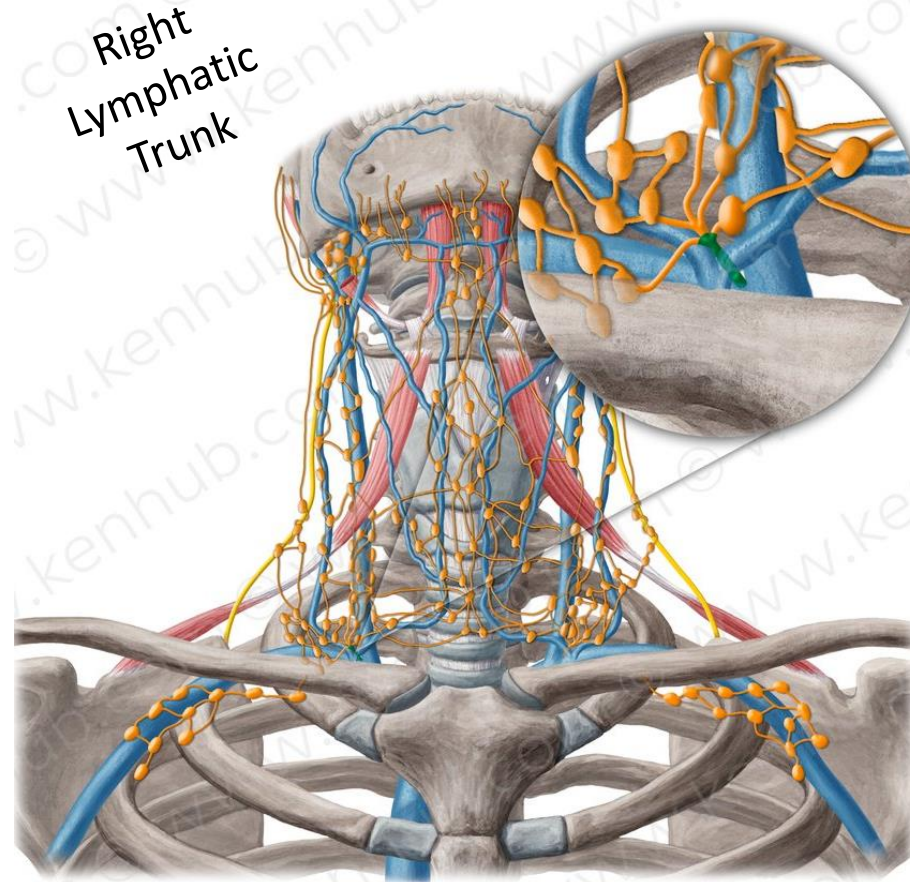
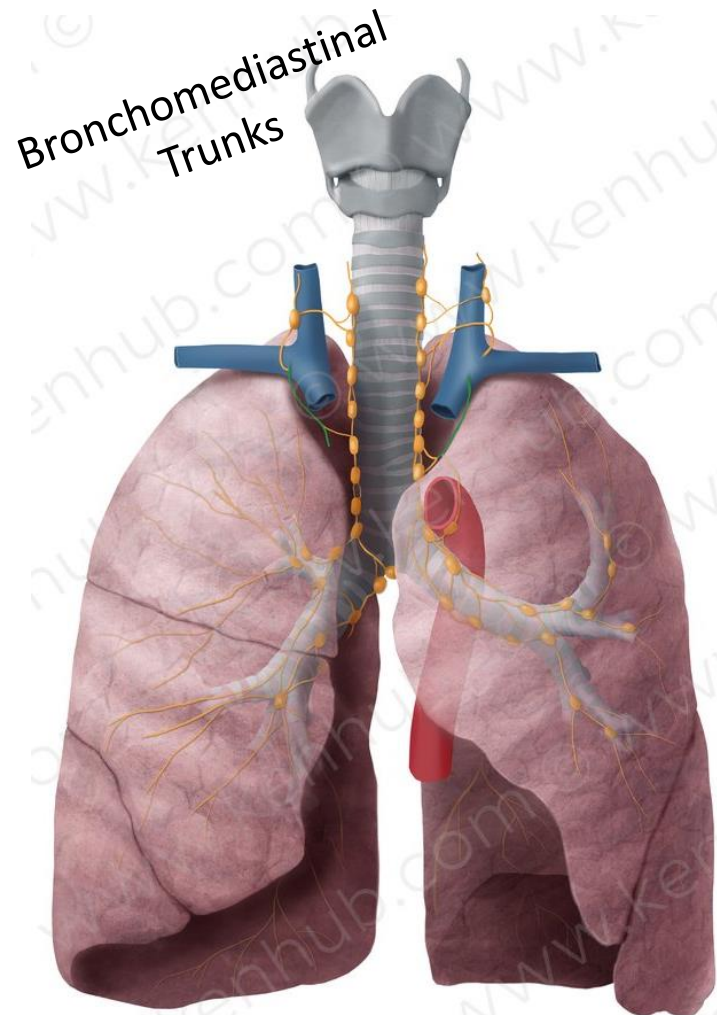
- Superficial, or subpleural, and deep lymphatics of the lung drain into lymph nodes called **tracheobronchial nodes (paratracheal or bronchotracheal lymph nodes)** around the roots of lobar and main bronchi and along the sides of the trachea.
- As a group, these lymph nodes extend from within the lung, through the hilum and root, and into the posterior mediastinum.



These are  
tracheobronchial  
nodes 😊

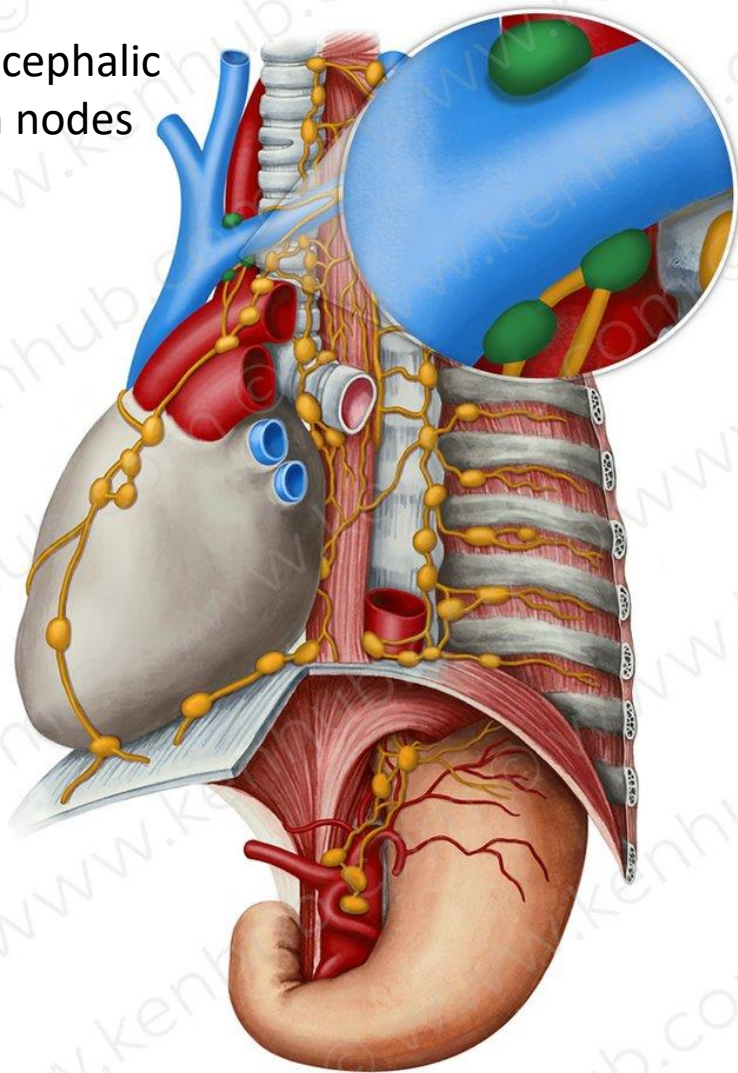


- Efferent vessels from these nodes pass superiorly along the trachea to unite with similar vessels from parasternal nodes and brachiocephalic nodes, to form the **right and left bronchomediastinal trunks**
- These trunks drain directly into deep veins at the base of the neck, or may drain into the **right lymphatic trunk or thoracic duct.**
- The right lymphatic duct and the thoracic duct drain into their corresponding brachiocephalic veins.

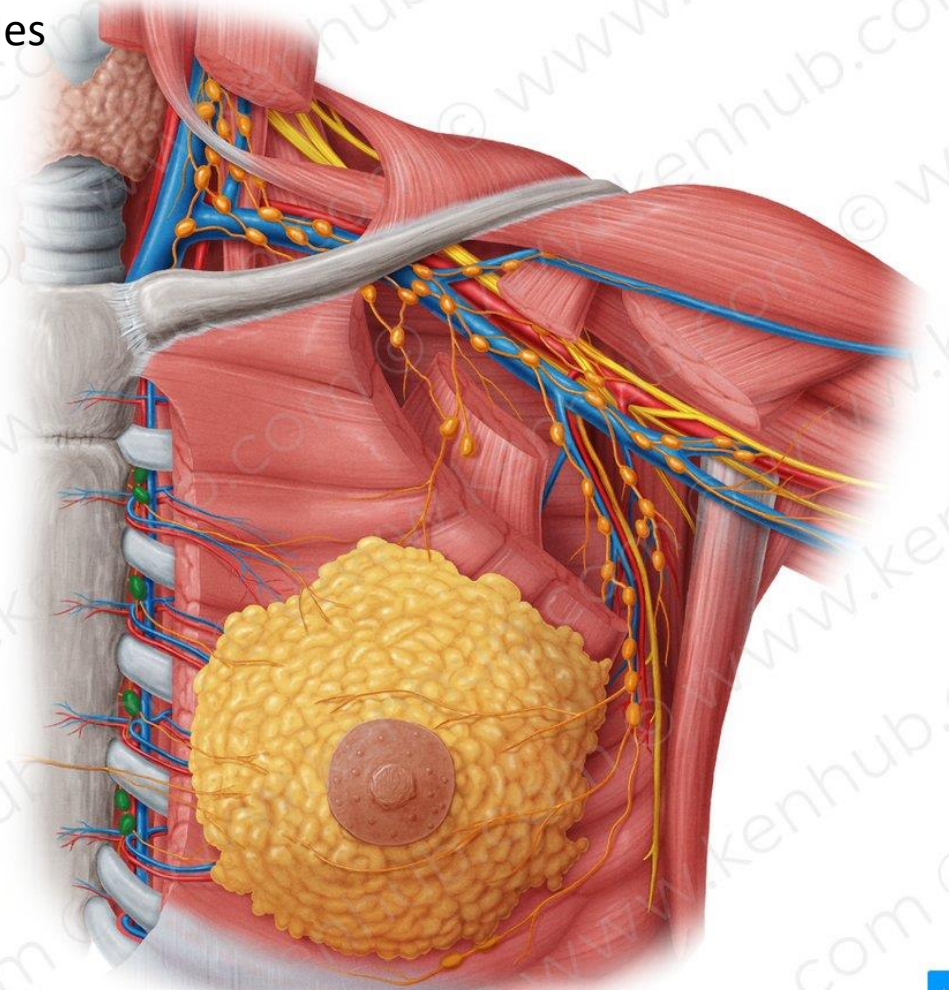




Brachiocephalic lymph nodes

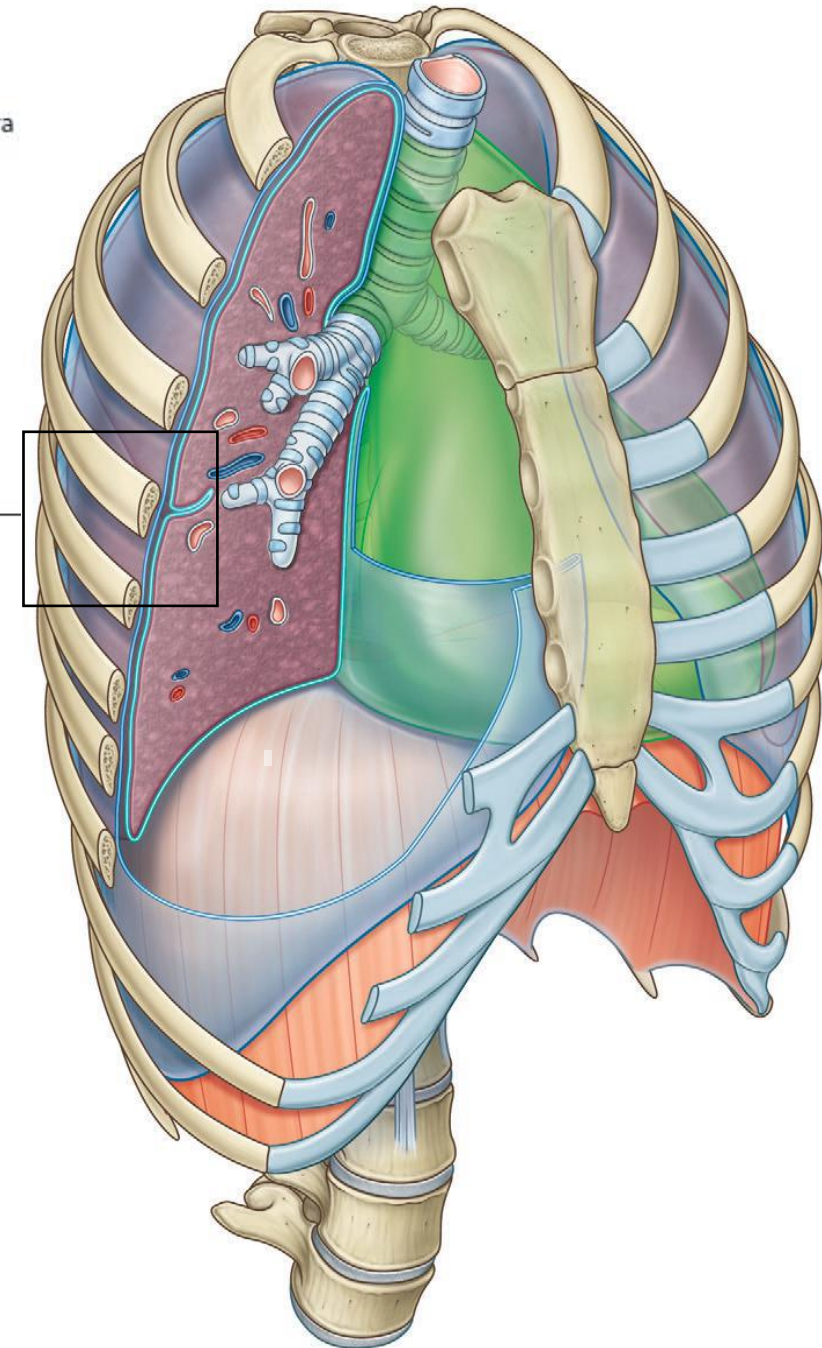
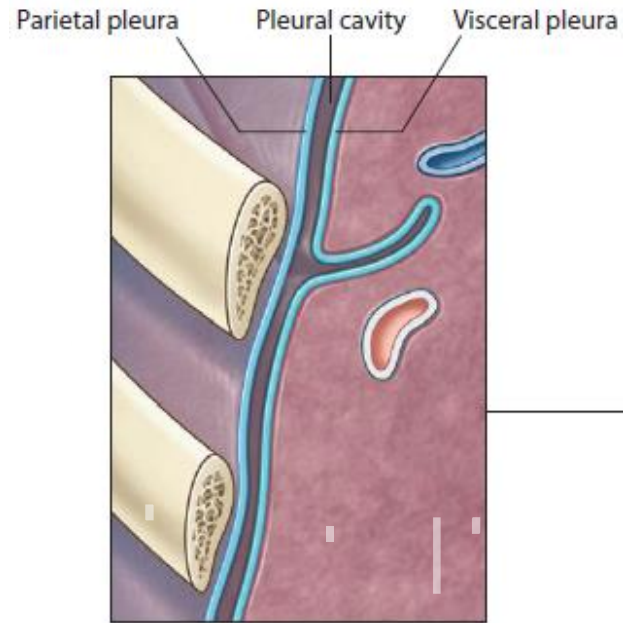


Parasternal Lymph Nodes



# THE PLEURA

- Each pleural cavity is lined by a single layer of flat cells called the **mesothelium**, and an associated layer of supporting connective tissue; together, they form **the pleura**.
- The pleura is divided into two major types, based on location:
- pleura associated with the walls of the pleural cavity is the **parietal pleura**. (it lines the thoracic wall internally)
- **visceral pleura** which adheres to and covers the lung.
- Each pleural cavity is the **potential space** enclosed between the **visceral and parietal pleurae**, they normally contain only a very thin layer of **serous fluid**.
- The serous fluid decreases **the friction** that occurs during **inspiration** which pushes the visceral pleura against the parietal pleura.
- Note: the pleura cavity is a potential space, meaning that normally, **this space doesn't exist**, however, it can be filled with air or fluid abnormally.
- As a result, the surface of the lung, which is covered by visceral pleura, directly opposes and freely slides over the parietal pleura attached to the wall.



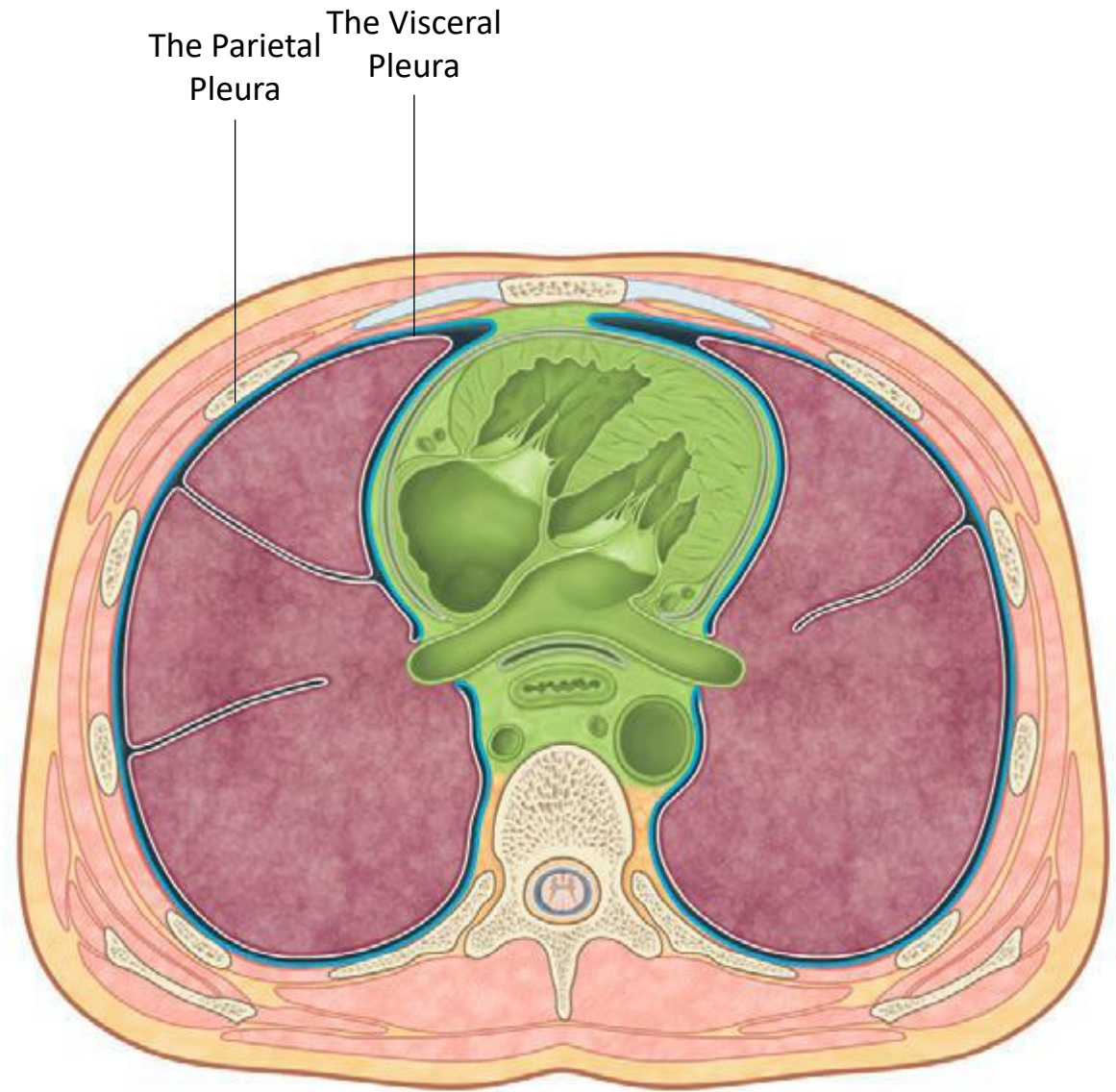


# FUNCTIONS OF THE PLEURA

1- protection

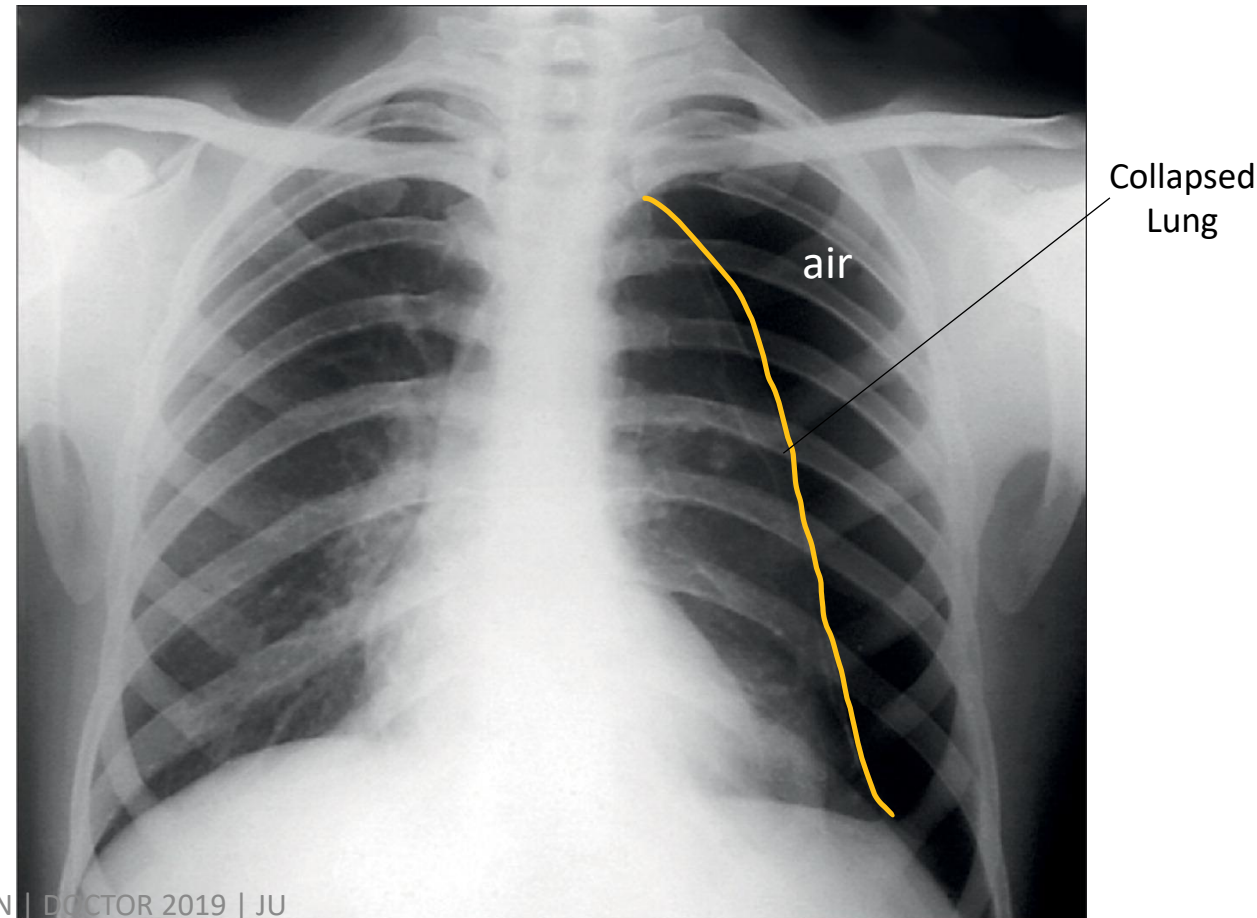
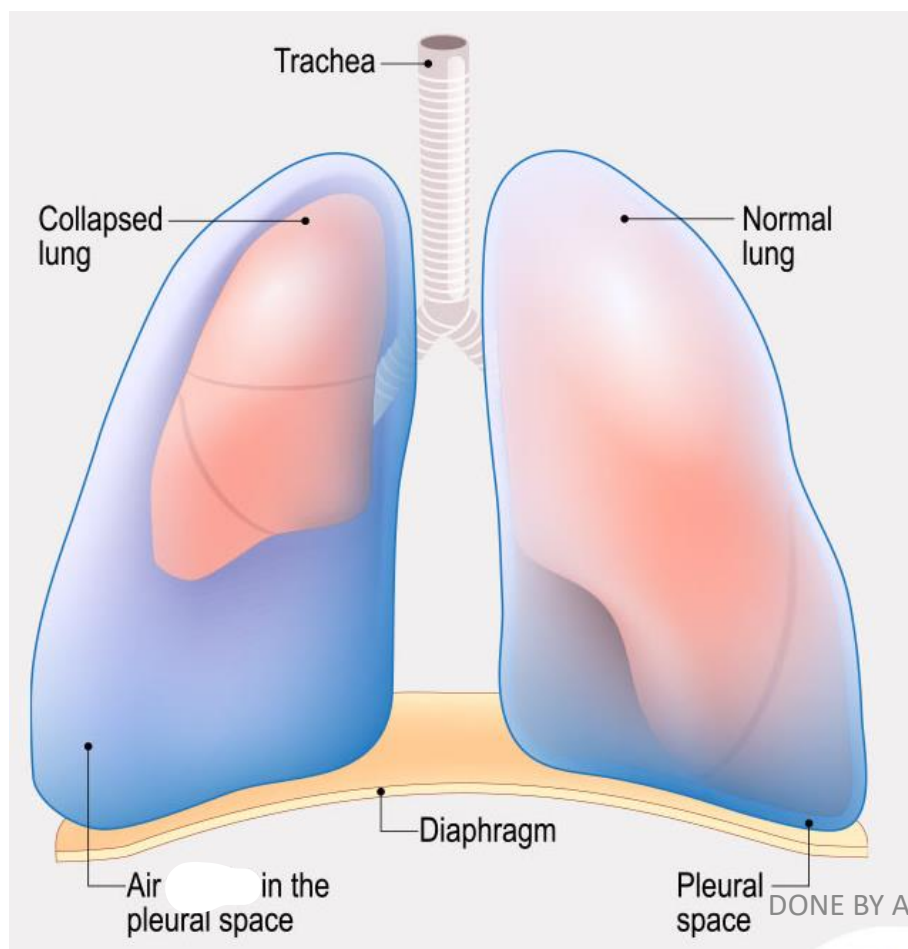
2- Produces fluid that allows for lubrication

Failure of the pleura to function results in difficult painful breathing.



# PNEUMOTHORAX

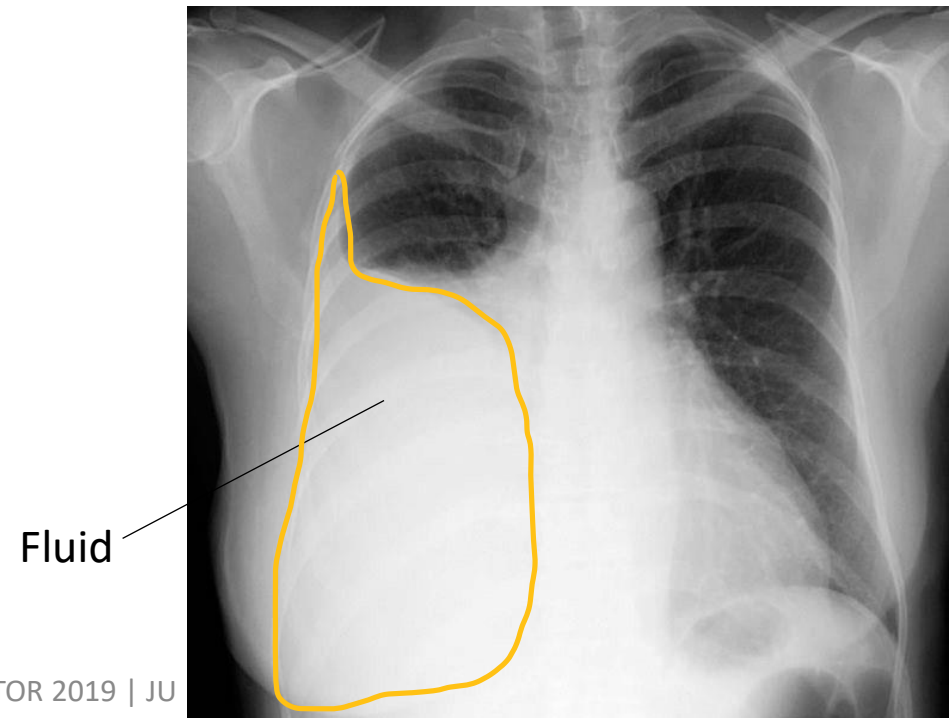
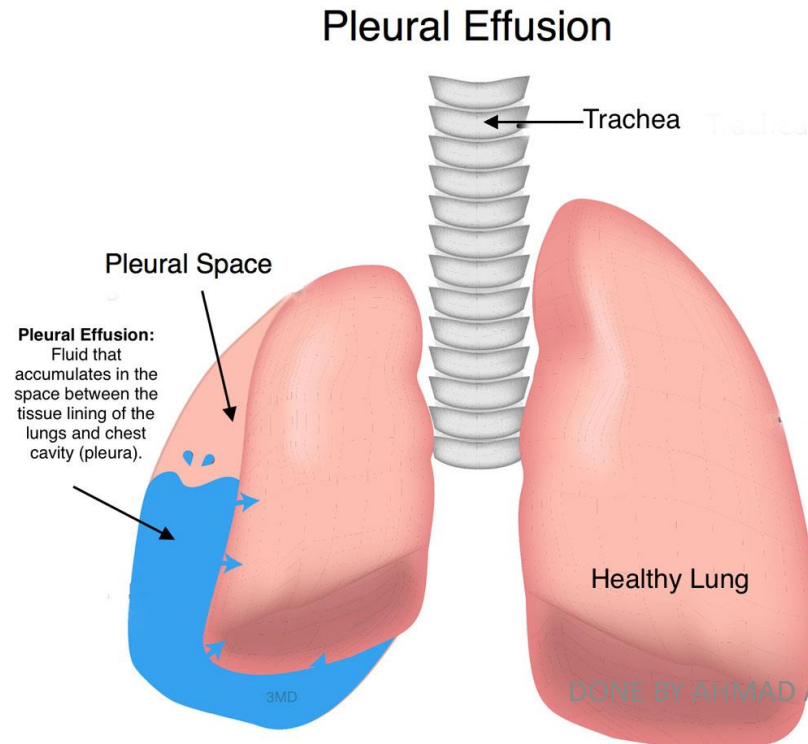
- Pneumothorax is collection of air in the pleural cavity, it happens usually due to trauma to chest wall (e.g. stab wounds) that result in rupture of the parietal pleura and collection of air in this potential space, pneumothorax result in collapse of the affected lung because air will compress it from the outside.
- Moreover, a pneumothorax can be iatrogenic due to subclavian vein catheterization, because this vein is close to the apex of the lung \*, its catheterization may result in trauma to the parietal pleura and subsequently, pneumothorax.





# PLEURAL EFFUSIONS

- Pleural space normally contain 5- 10 ml of clear fluid, this fluid is absorbed normally by visceral pleura by hydrostatic and osmotic pressure.
- Pleural effusion is accumulation of excess fluid within the pleural cavity, pleural fluid could increase more than 300 (ml), and it collects in the costodiaphragmatic recess\*
- this fluid could be a serous fluid that accumulates due to various causes including infections or cancer, or it may occur spontaneously, this fluid usually fills the lower parts of the pleura due to gravity.
- Pleural effusions results in collapsed lungs, so the fluid must be aspirated.
- Empyema (pyothorax) is collection of pus in the pleural cavity, it occurs due to infections.
- Hemothorax is accumulation of blood in the pleural cavity, it occurs to trauma, commonly due to stab wounds.



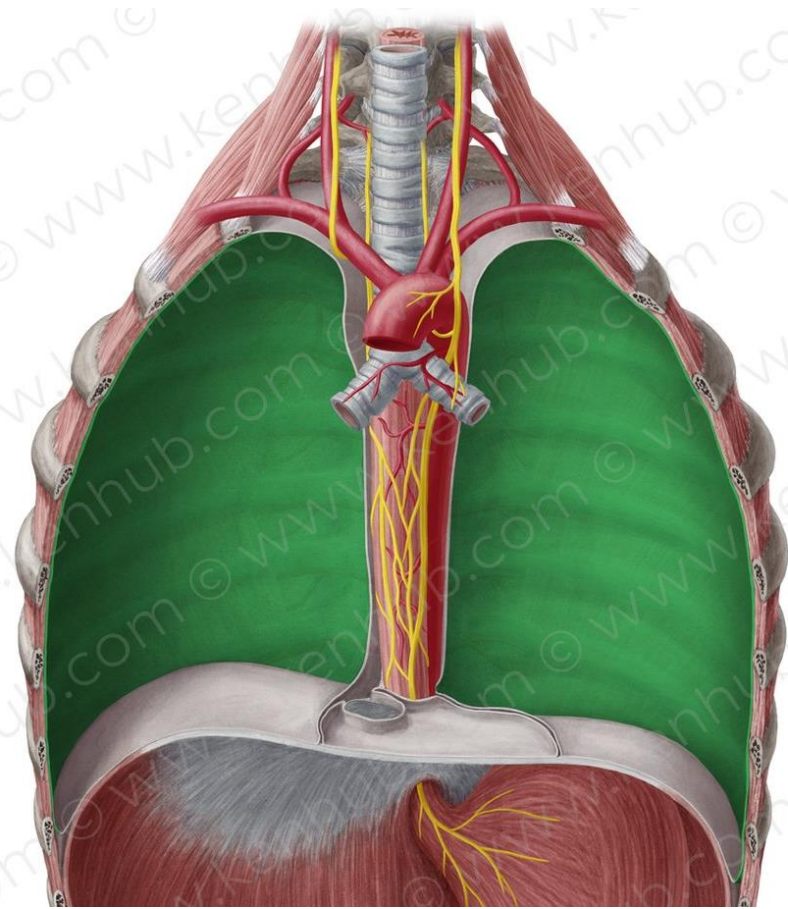
# CLINICAL MANIFESTATIONS OF PLEURAL EFFUSION

- Decrease in lung expansion
- Decrease breath sound
- Percussion shows Dullness (no resonance)
- Pain
- Cough

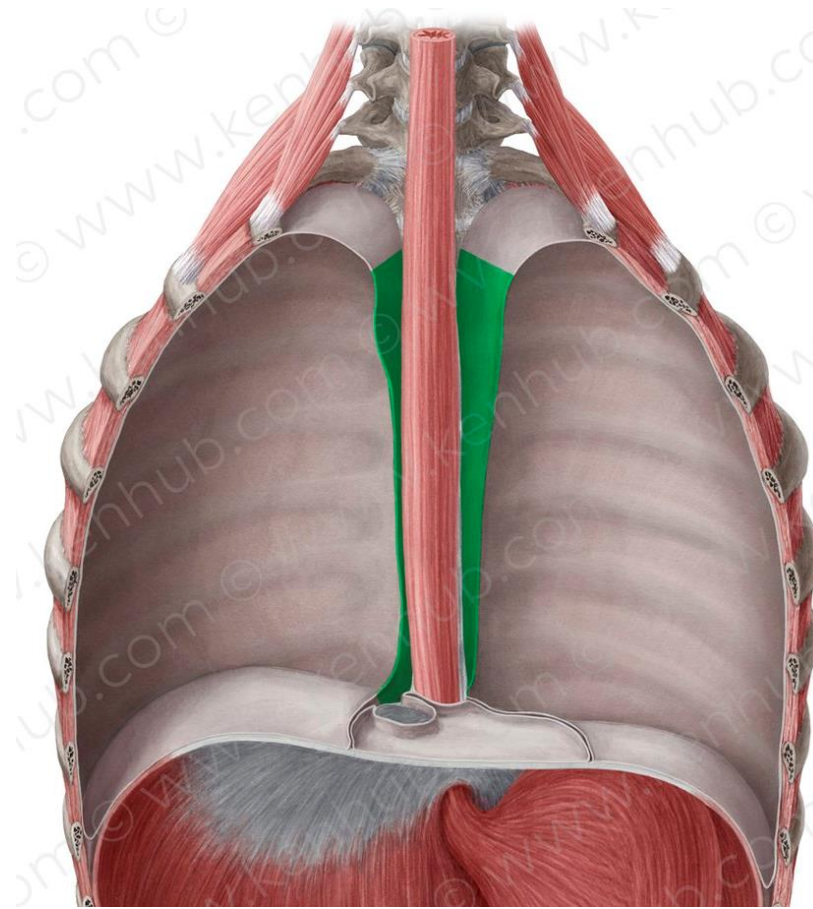


# THE PARIETAL PLEURA

The names given to the parietal pleura correspond to the parts of the wall with which they are associated.

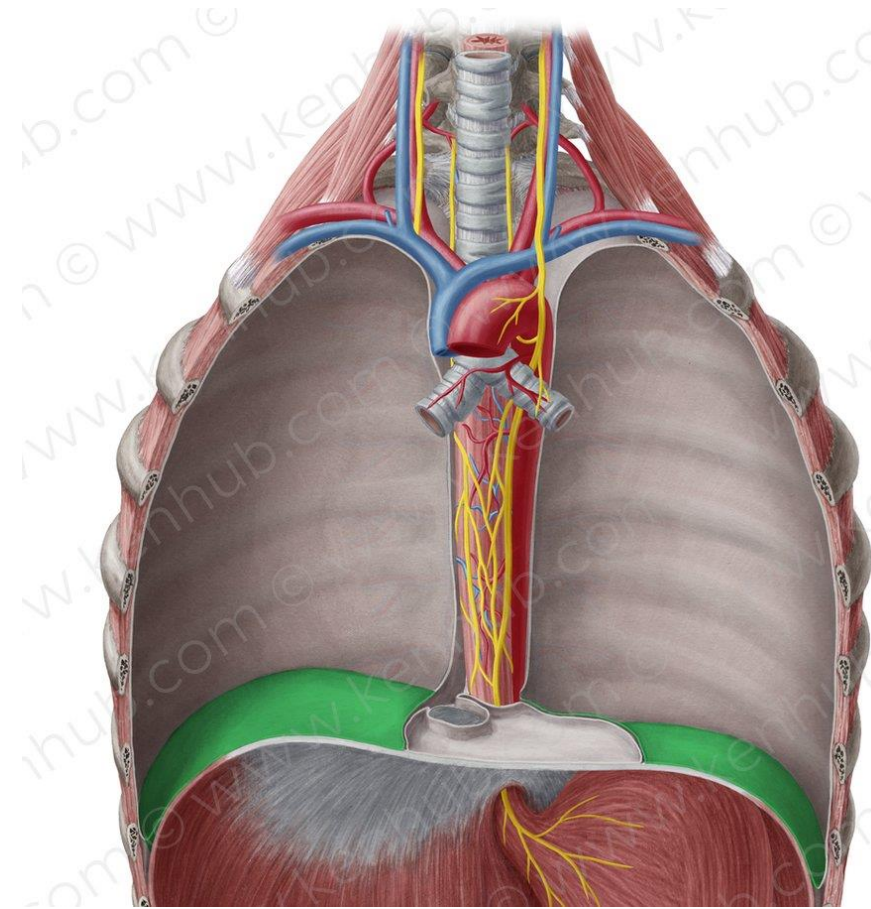


Pleura related to the ribs and intercostal spaces is termed the **Costal Pleura**.



Pleura covering the mediastinum is the **Mediastinal Pleura**.

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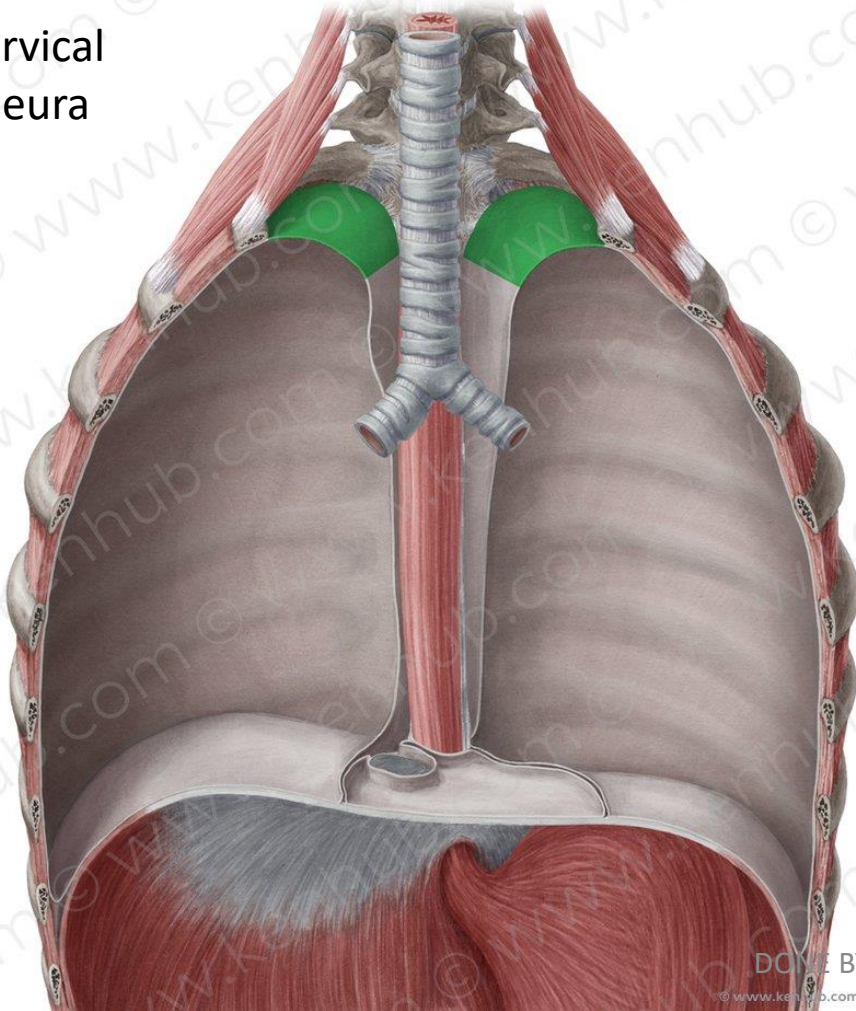


Pleura covering the diaphragm is the **Diaphragmatic Pleura**.

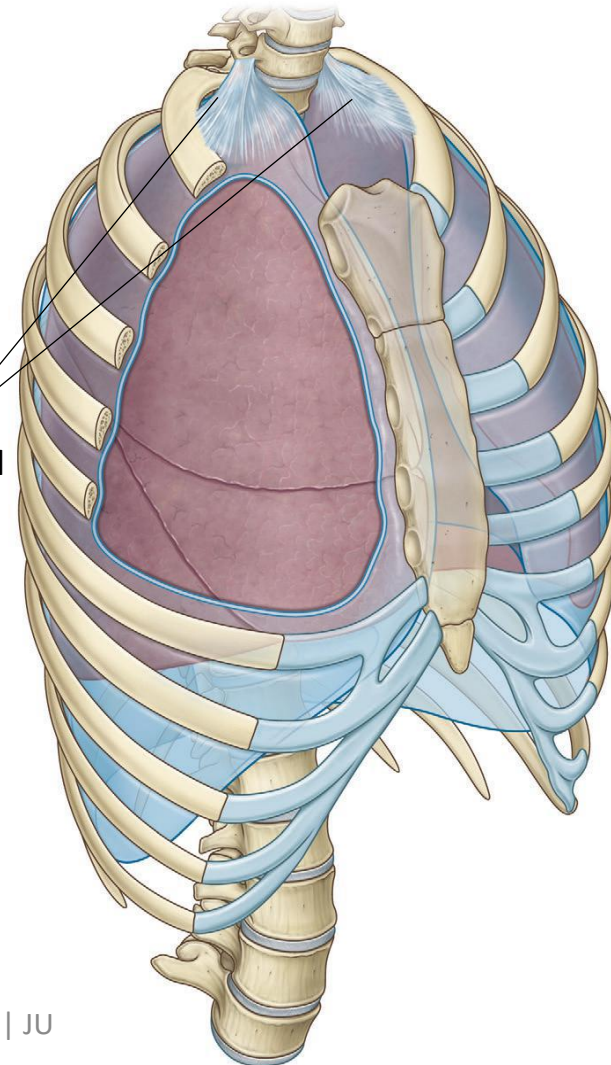


- the dome-shaped part of the parietal pleura lining the cervical extension of the lung (the apex) is called the cervical pleura, it is also called dome of pleura or the pleural cupola, it is related to the cervical vertebrae.
- The cervical pleura is covered by suprapleural membrane (Sebson's fascia), which is an extension of the cervical fascia.
- In the region cervical pleura, the parietal pleura is the same size as the lung, there is no reflections.

Cervical  
Pleura



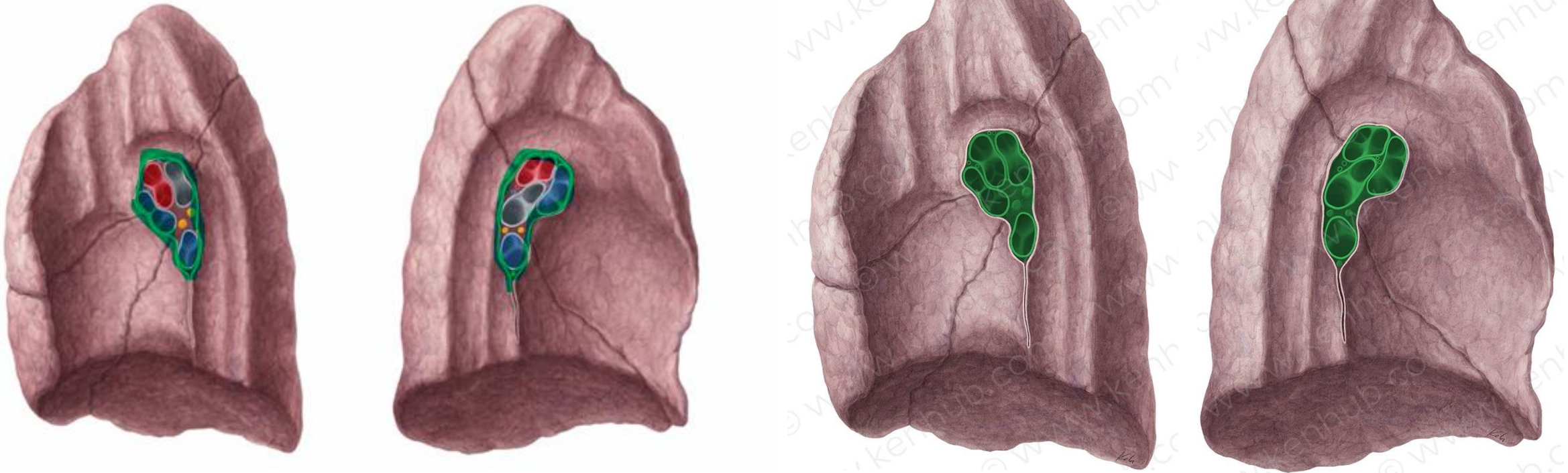
Suprapleural  
Membrane



Remember: the apex of the lung extends 1 inch (2.5 cm) above the clavicle or 3-4 cm above the 1<sup>st</sup> rib.



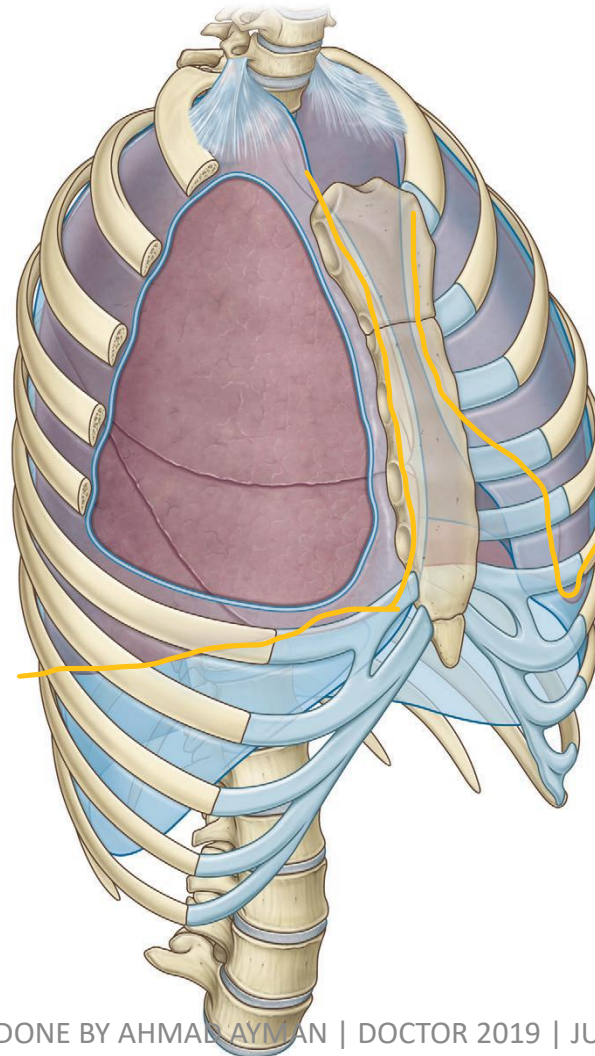
- in the region of vertebrae T5 to T7, the mediastinal pleura reflects, forms the root of the lung.
- The root joins the medial surface of the lung at the hilum, and the mediastinal pleura becomes continuous with the visceral pleura.



# PERIPHERAL REFLECTION OF THE PLEURA

- The peripheral reflections of parietal pleura mark the extent of the pleural cavities.
- These reflections occur at the sites where the parts of the parietal pleura meet each other, like where the costal meet the mediastinal pleura.

The yellow line marks the borders of the lungs, notice how the pleural cavity extends beyond the lungs

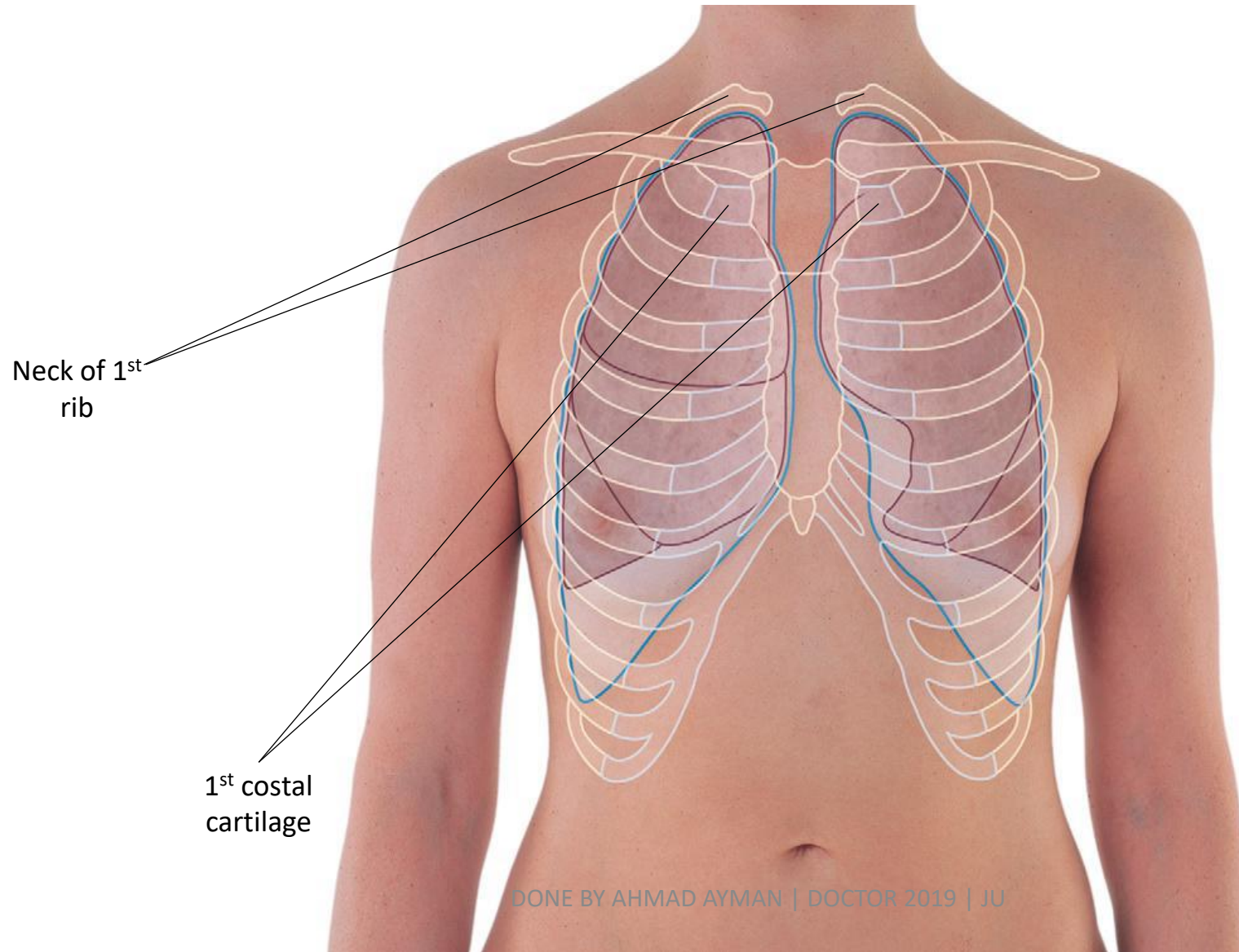


Note that the parietal pleura is sort of “wide” on the lung, that’s why we have pleural reflections. But these reflections occur inferiorly and medially. Superiorly, the parietal pleura is the same size as the lungs so there is no reflections.

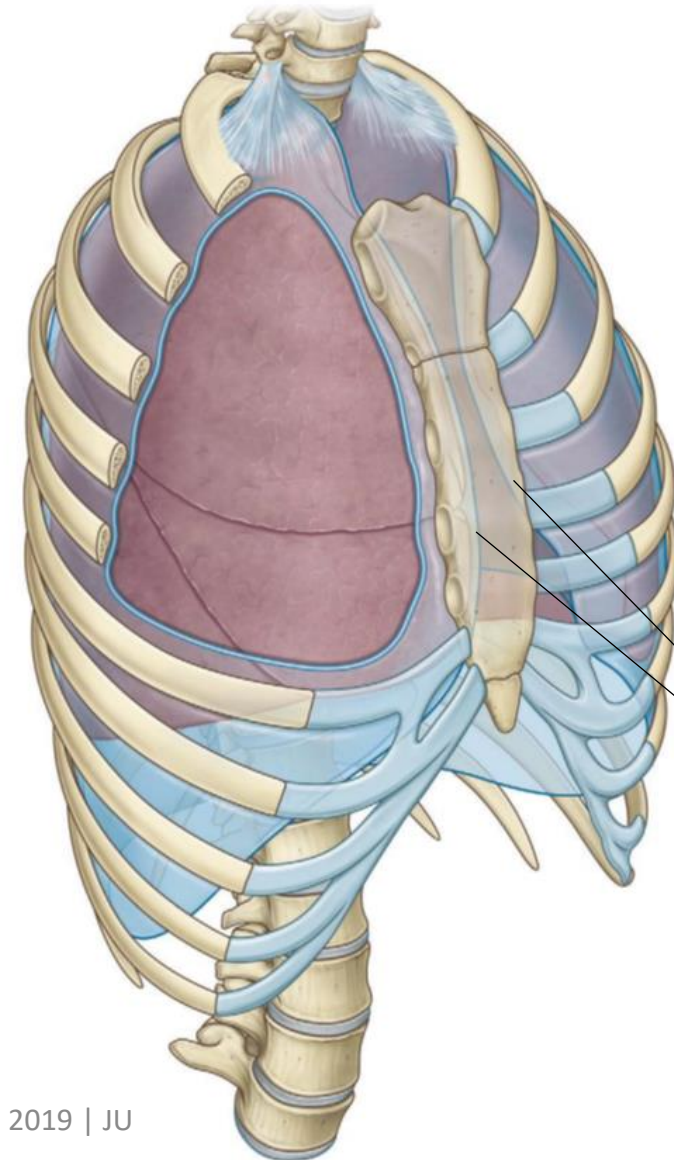
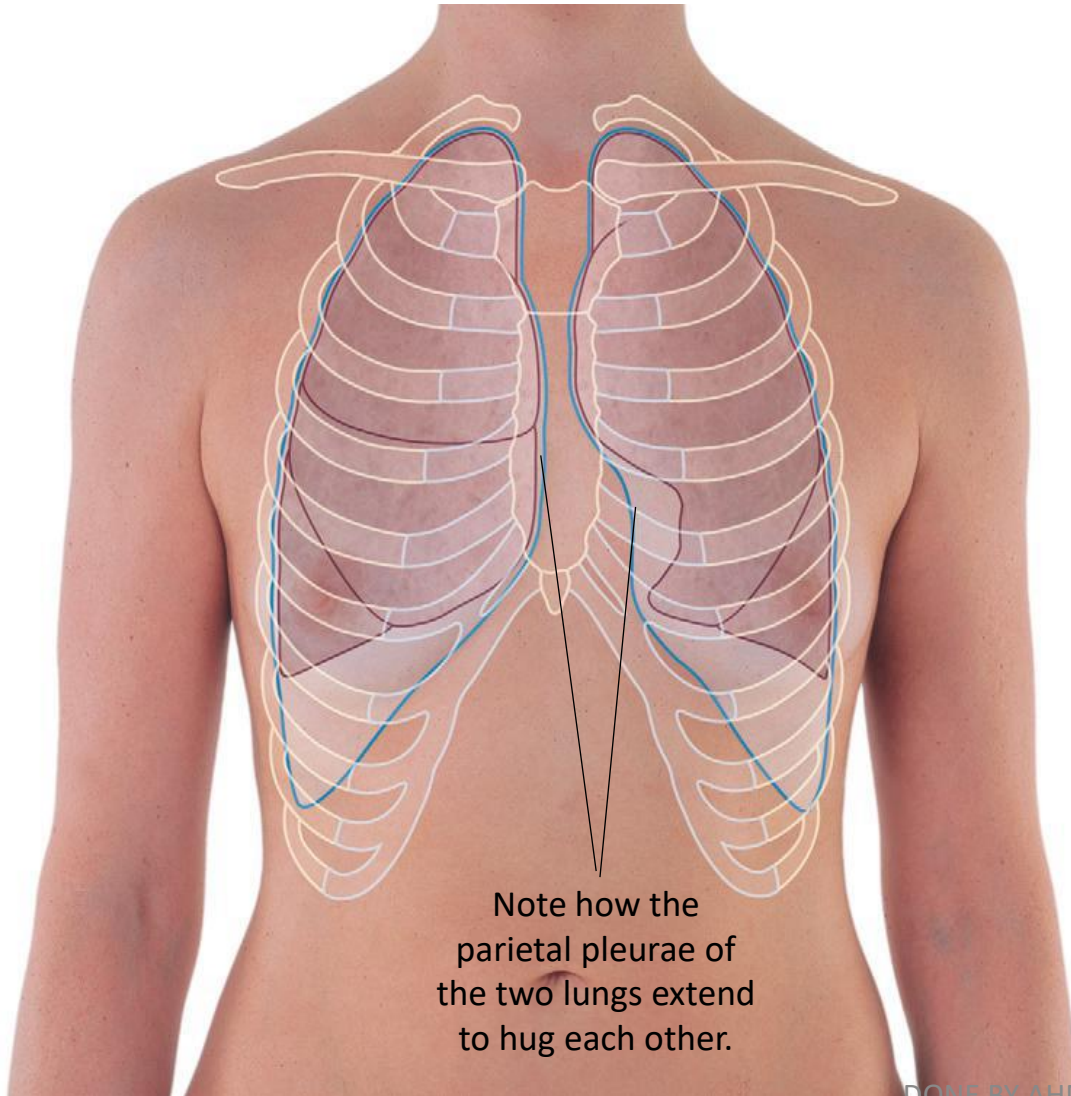


Superiorly, the pleural cavity can project as much as 3-4 cm above the 1<sup>st</sup> costal cartilage, but does not extend above the neck of 1<sup>st</sup> rib

This limitation is caused by the inferior slope of the 1<sup>st</sup> rib to its articulation with the manubrium.

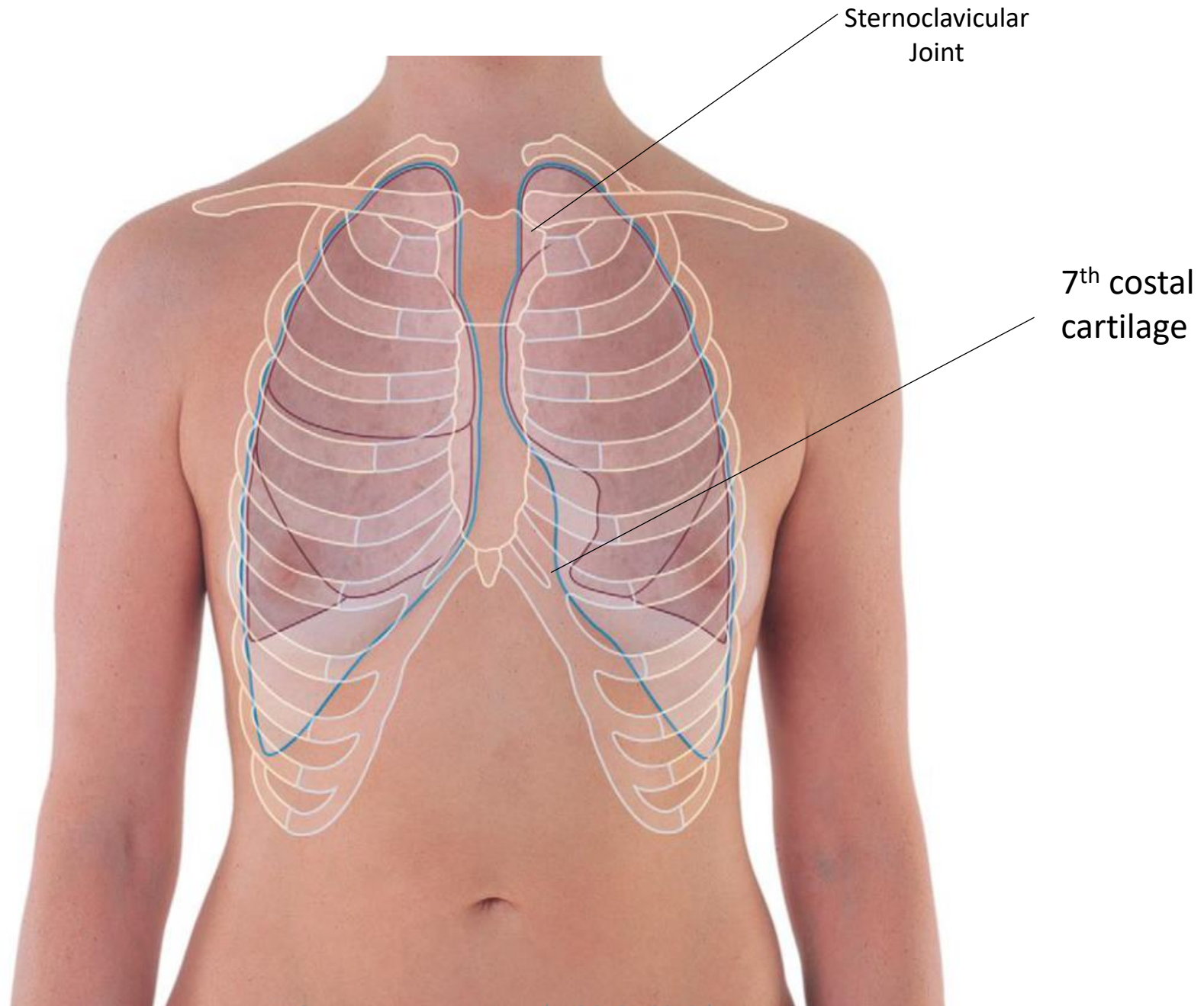


- Anteriorly, the pleural cavities approach each other posterior to the upper part of the sternum.
- posterior to the lower part of the sternum, the parietal pleura does not come as close to the midline on the left side as it does on the right because the heart bulges to the left.

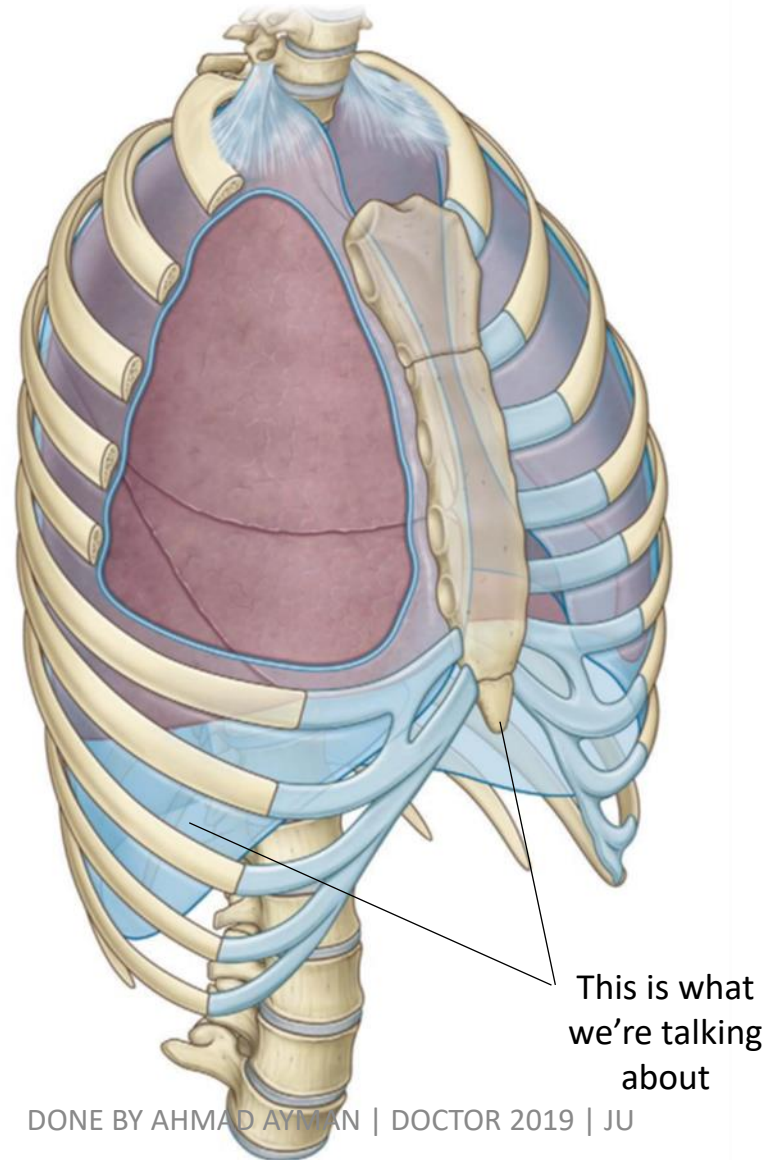




The anterior border of the pleural cavity can be approximated by drawing line as follows: 1 inch above the clavicle, sternoclavicular joint, 7<sup>th</sup> costal cartilage instead of the 6<sup>th</sup> one (as in the lungs)

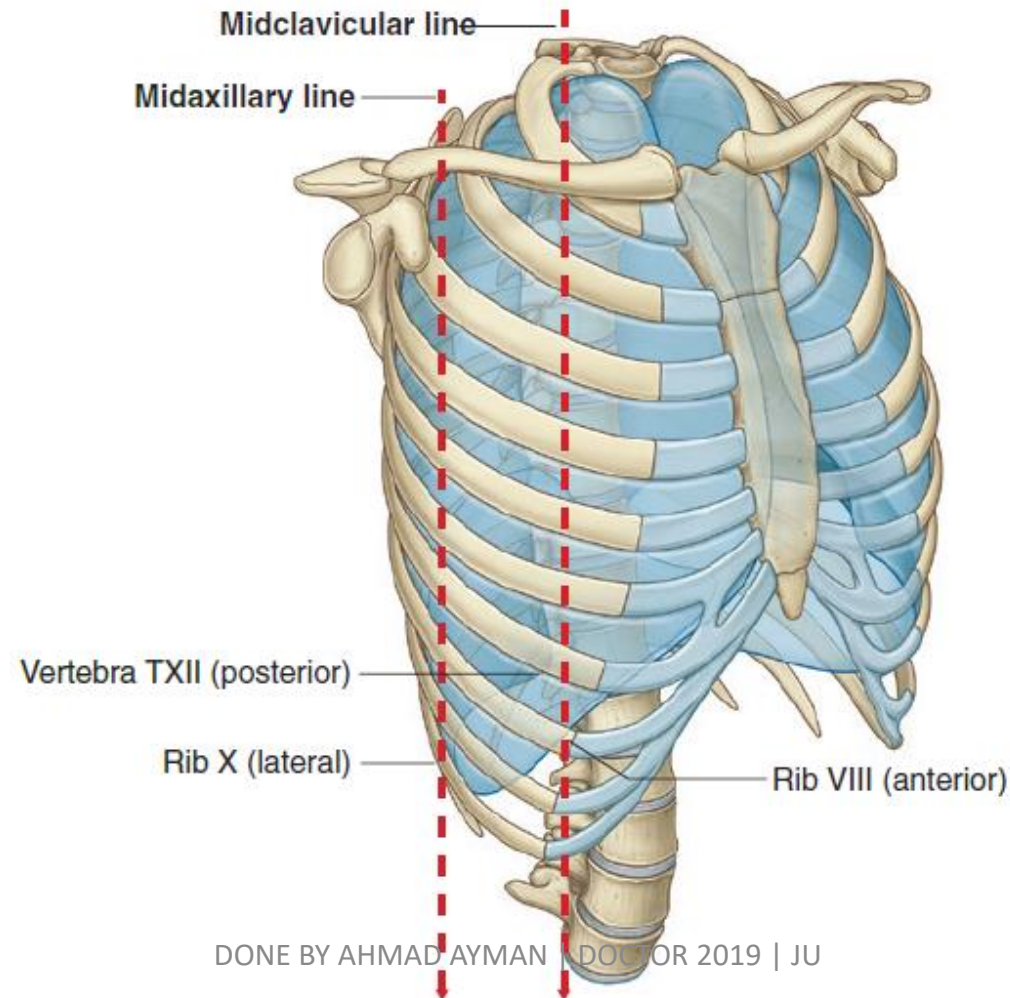


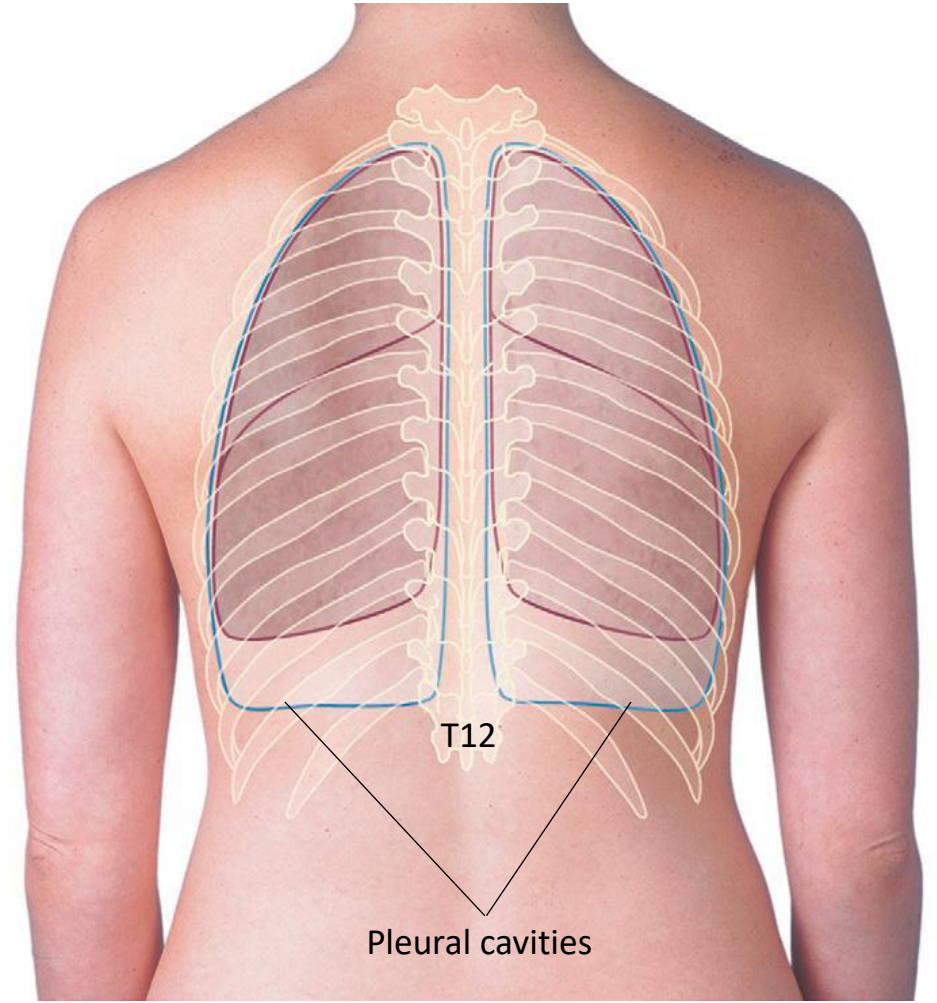
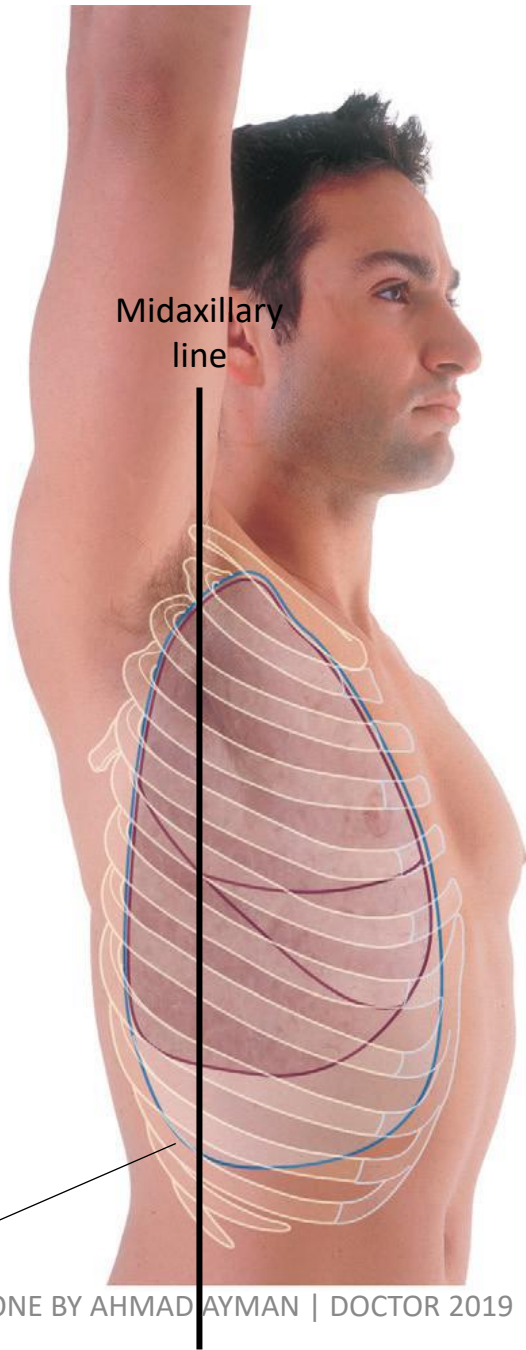
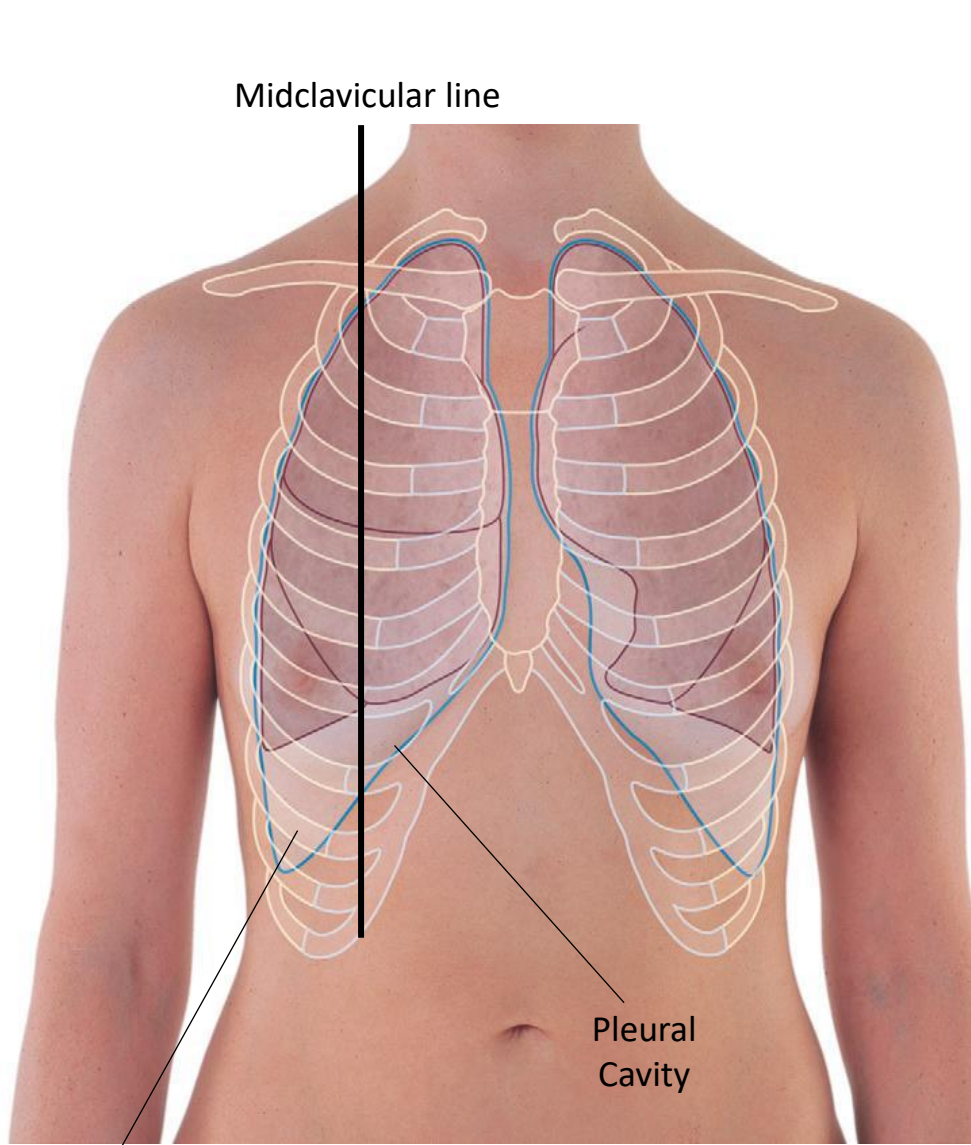
Inferiorly, the costal pleura reflects onto the diaphragm above the costal margin.





- In the midclavicular line, the pleural cavity extends inferiorly to approximately 8<sup>th</sup> rib.
- In the midaxillary line, it extends to 10<sup>th</sup> rib.
- From this point, the inferior margin courses somewhat horizontally, crossing the 11<sup>th</sup> and 12<sup>th</sup> rib to reach vertebra T12.
- From the midclavicular line to the vertebral column, the inferior boundary of the pleura can be approximated by a line that runs between the 8<sup>th</sup> rib, 10<sup>th</sup> rib, and T12 vertebrae .



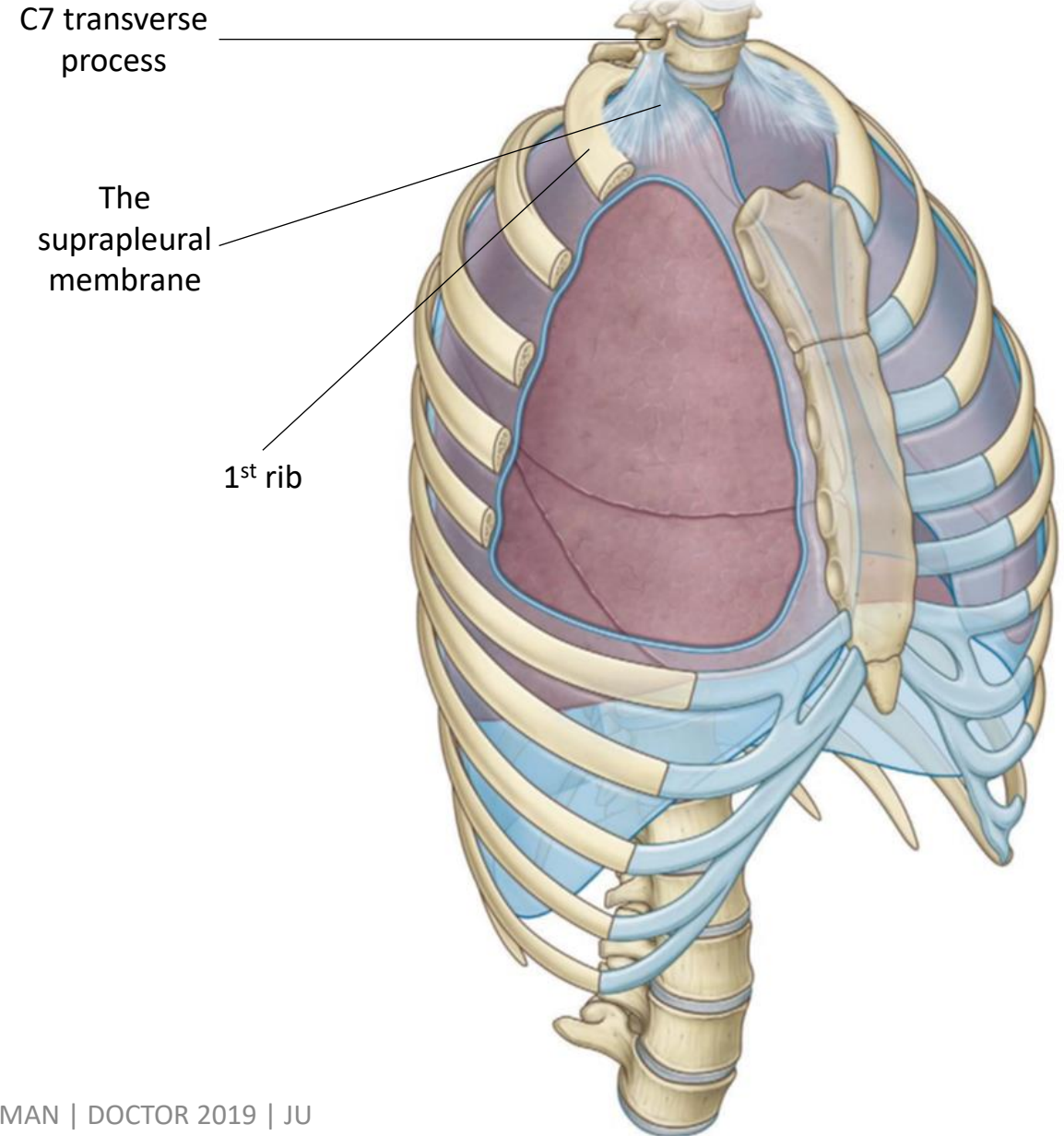




# THE SUPRAPLEURAL MEMBRANE

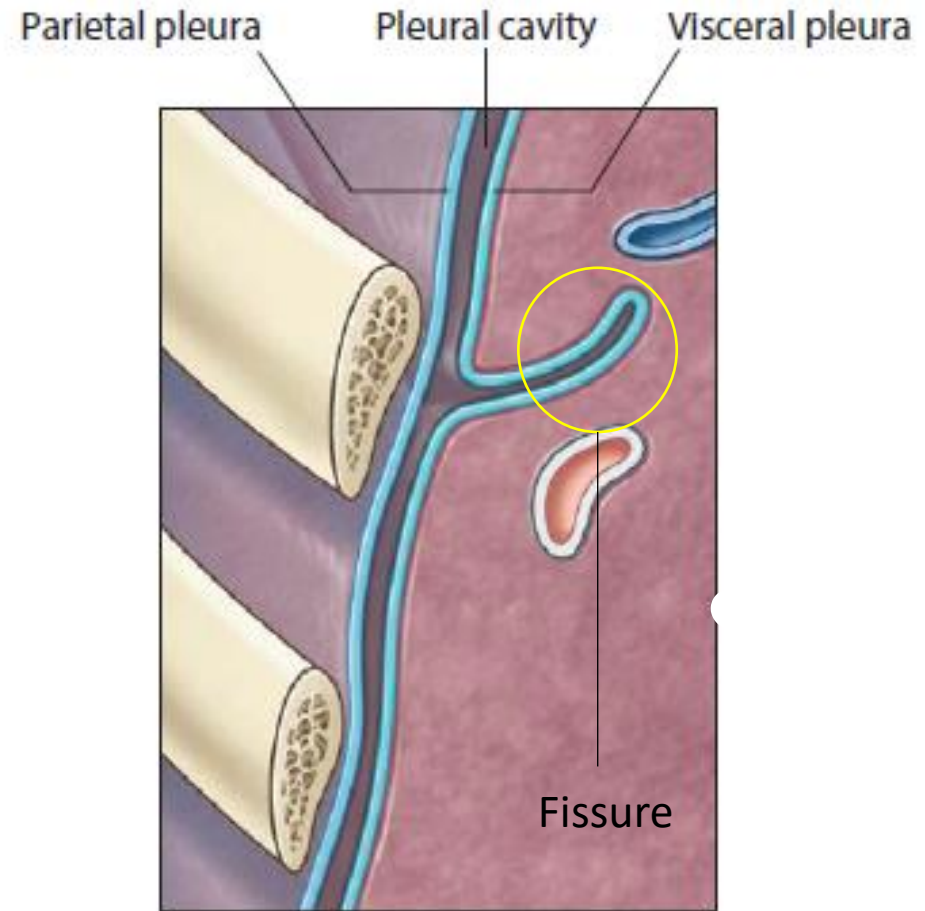
The suprapleural membrane is a fibrous sheath that is attached:

- Laterally: medial border of 1<sup>st</sup> rib and costal cartilage
- Medially : blend with fascia investing the structure that pass from thorax to neck (Sepson's fascia).
- Apex : to the tip of the transverse process of the 7<sup>th</sup> cervical vertebra
- Action : protect the cervical pleura and lung.
- It also resist changes in the intrathoracic pressure during respiratory movements (so it seals the thoracic cavity,



# VISCERAL PLEURA

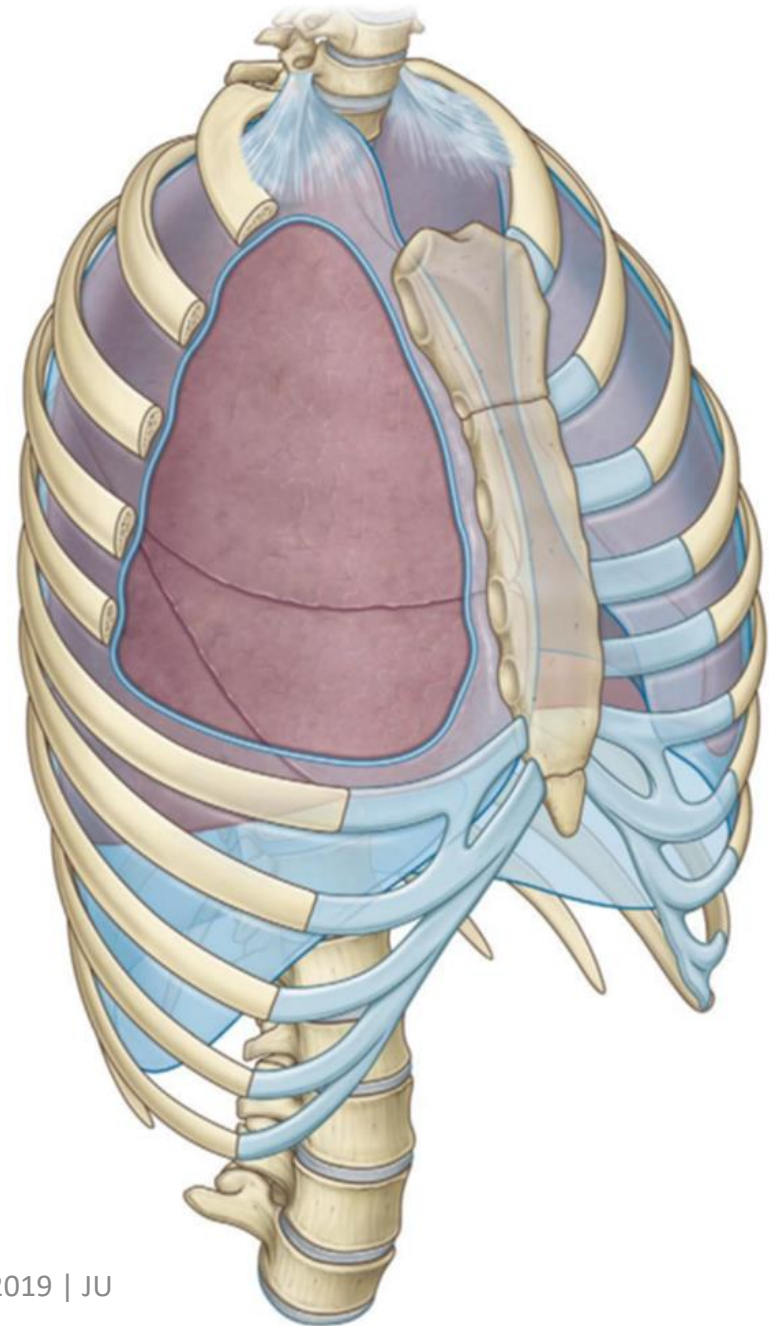
- Visceral pleura is continuous with parietal pleura at the hilum of each lung where structures enter and leave the organ
- The visceral pleura is firmly attached to the surface of the lung, including both opposed surfaces of the fissures that divide the lungs into lobe, so it is sort of enters the fissure in contrast to the parietal pleura.

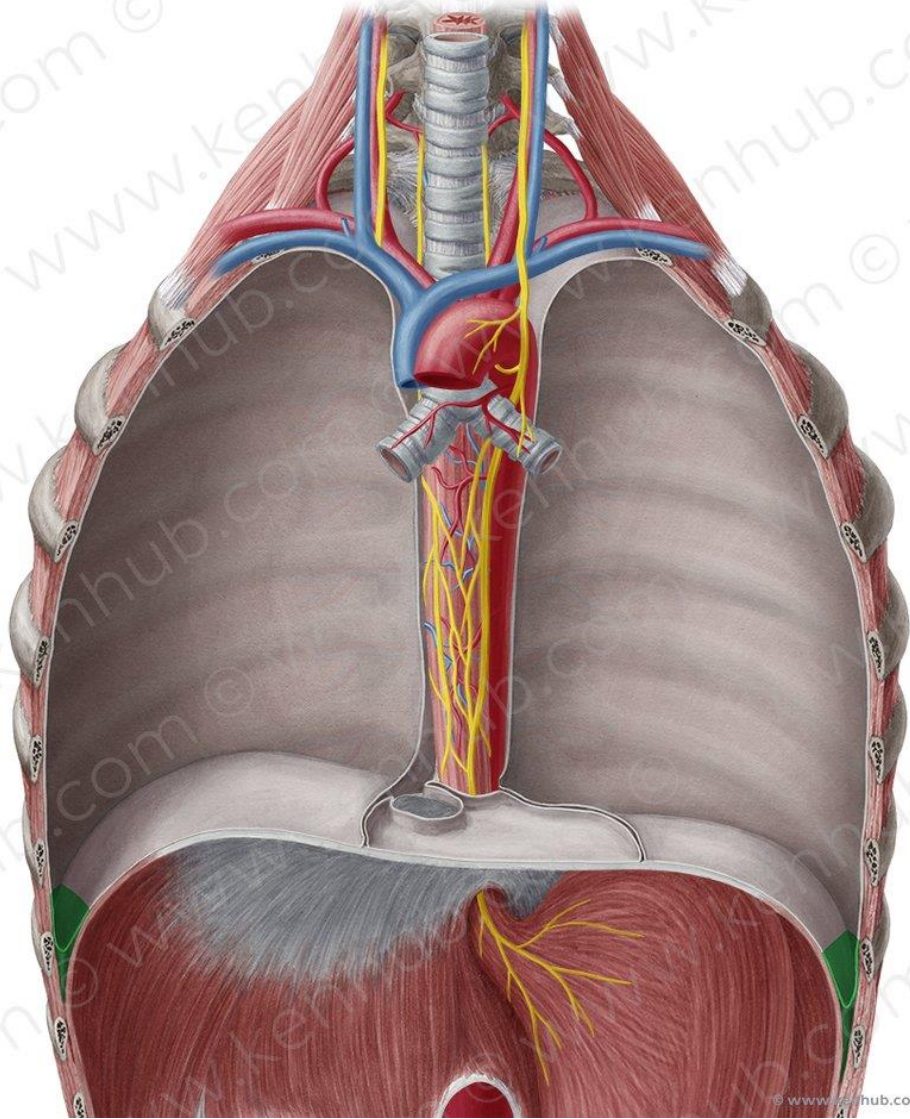




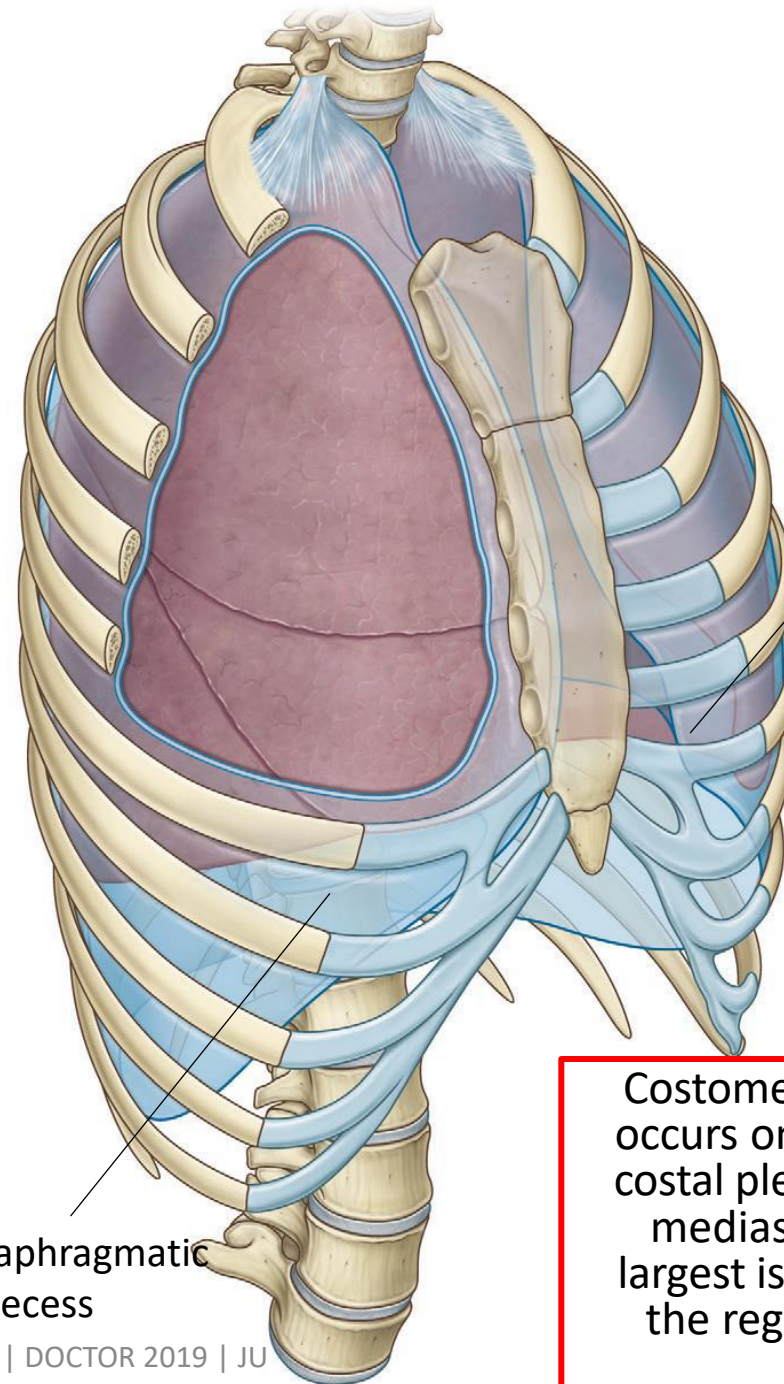
# PLEURAL RECESSES

- The lungs do not completely fill the anterior or posterior inferior regions of the pleural cavities
- This results in recesses in which two layers of parietal pleura become opposed.
- Expansion of the lungs into these spaces usually occurs only during forced inspiration
- the recesses also provide potential spaces in which fluids can collect and from which fluids can be aspirated.





Note: the pleural recesses are deepest after forced expiration and shallowest after forced inspiration.



Costomediastinal Recess

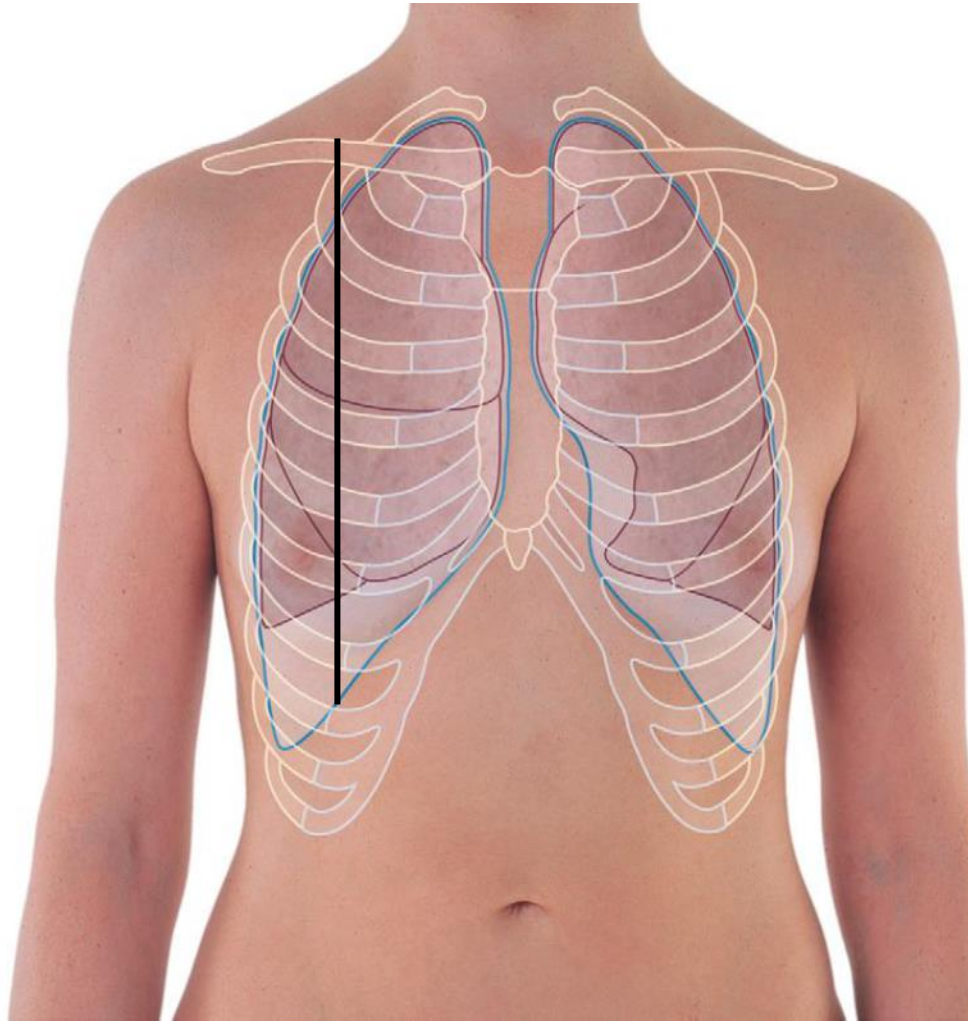
Costodiaphragmatic Recess

The largest and clinically most important recesses are the **costodiaphragmatic recesses**, which occur in each pleural cavity between the costal pleura and diaphragmatic pleura, it is located between the inferior margin of the lung and the inferior margin of the pleural cavity

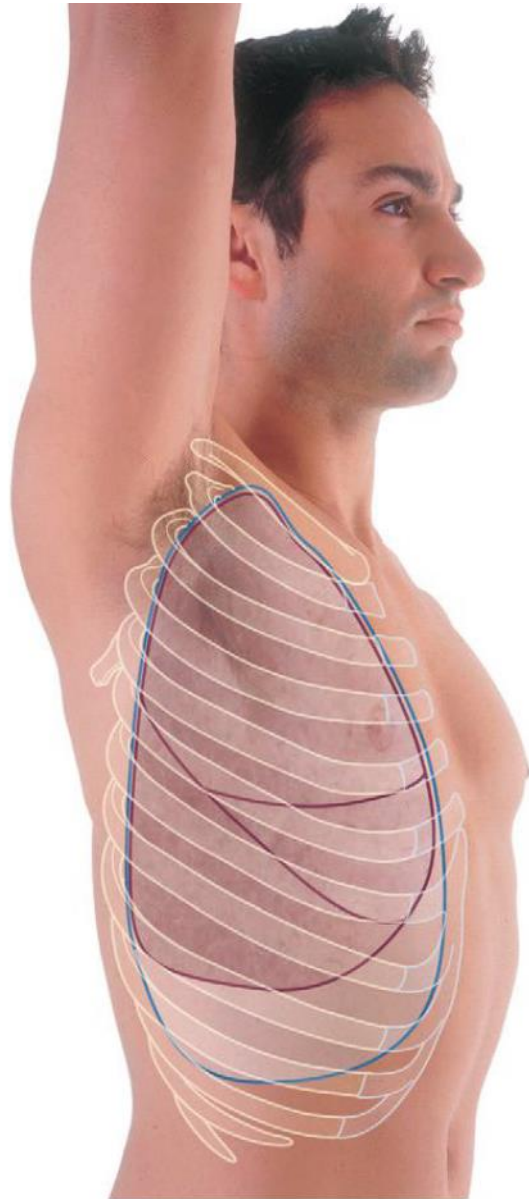
Costomediastinal recesses occurs on each side where costal pleura is opposed to mediastinal pleura. The largest is on the left side in the region overlying the heart.



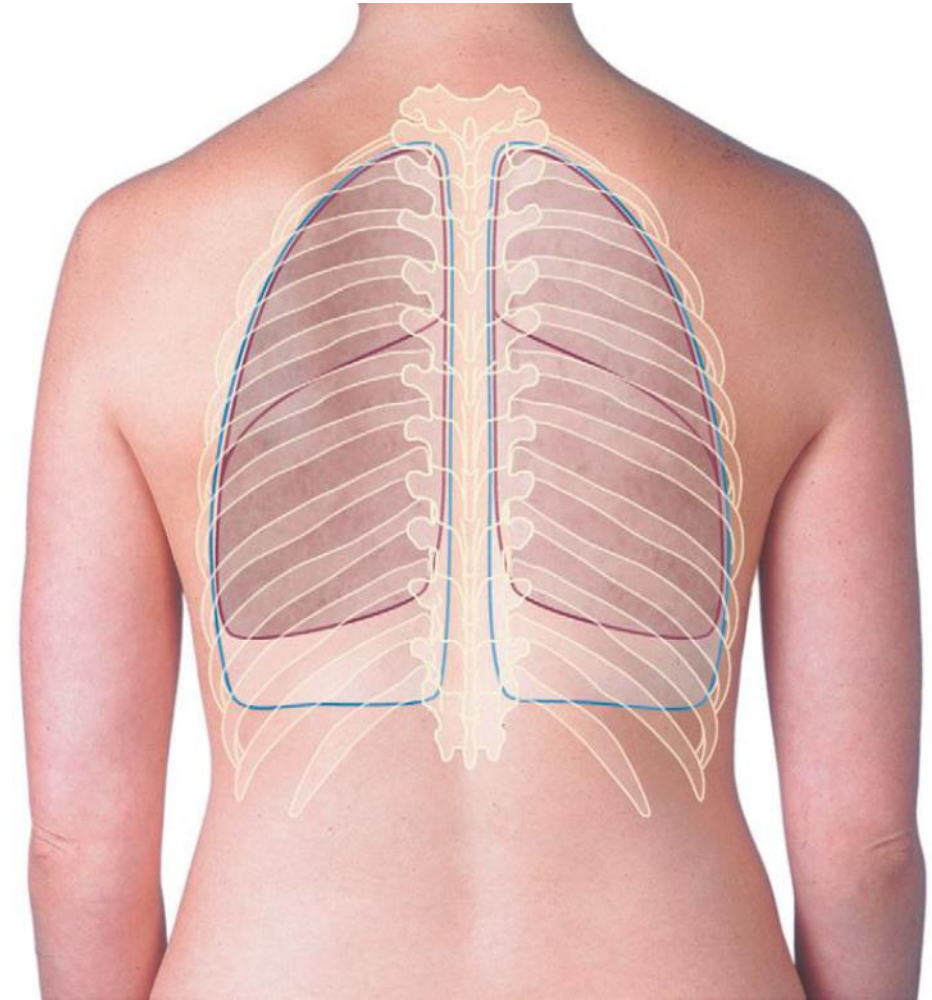
# SURFACE ANATOMY OF THE COSTODIAPHRAGMATIC RECESS



At the midclavicular line, the recess is between 6<sup>th</sup> and 8<sup>th</sup> ribs and its length is 1 inch,



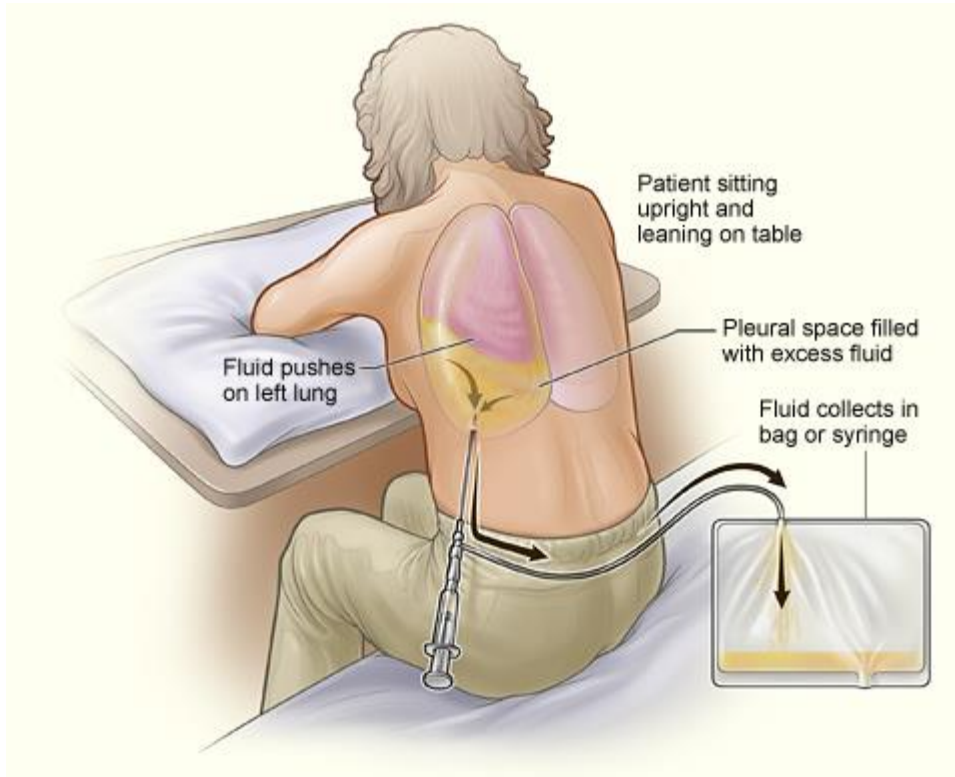
At the midaxillary line, the recess is between 8<sup>th</sup> and 10<sup>th</sup> ribs and its length is 3 inches



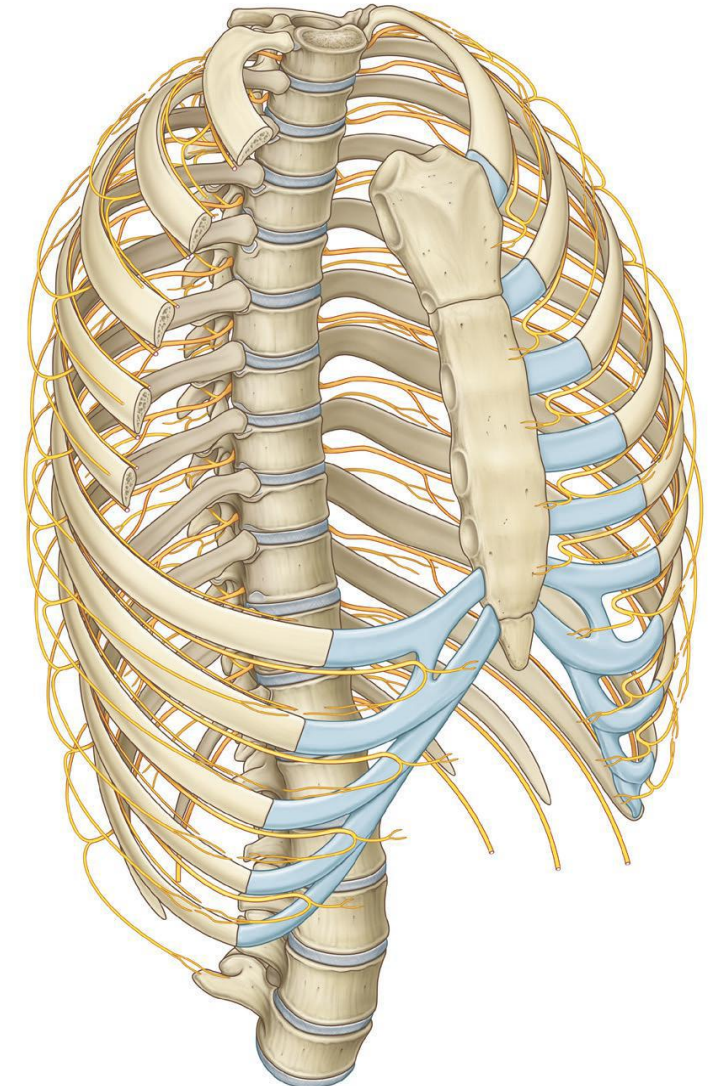
At the paravertebral line, the recess is between 10<sup>th</sup> and 12<sup>th</sup> ribs and length is 2 inches

**Clinical note:** Aspiration of fluid from the pleural cavity by putting a needle through the 7<sup>th</sup> intercostal space in the midclavicular line or in the 9<sup>th</sup> intercostal space in the midaxillary line.

- The needle is put in the lower border of the space (upper border of the rib) to avoid injury to the intercostal nerves.



As you can see, intercostal nerves are close to the lower border or ribs, so we must insert the needle near to the upper border to avoid their injury.





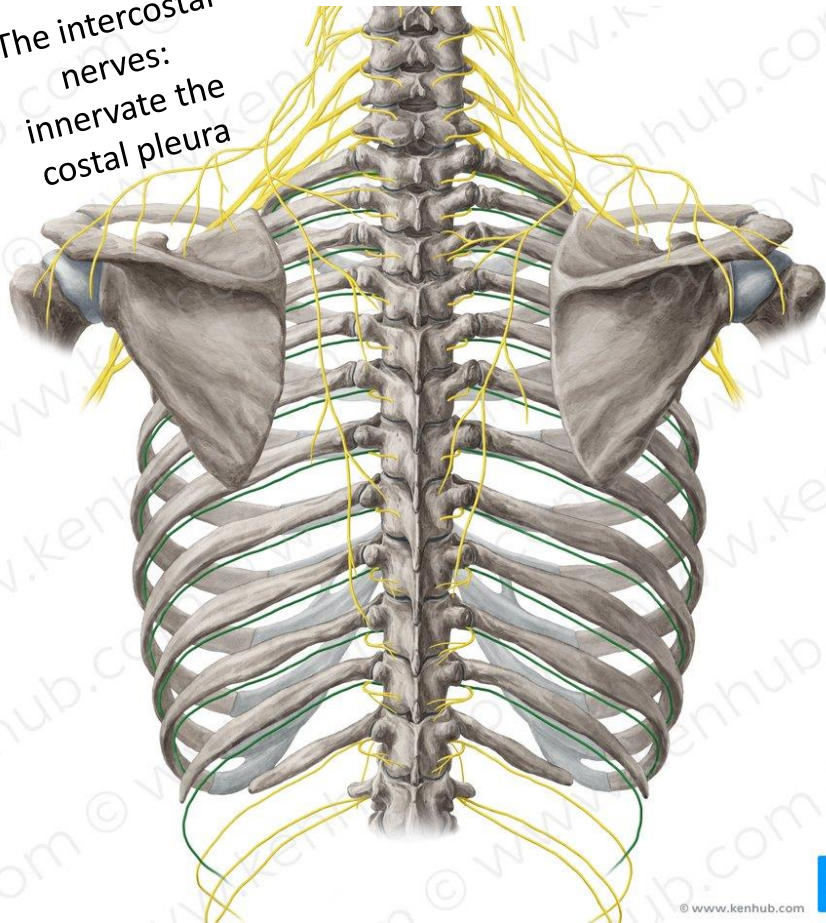
# NERVE SUPPLY OF THE PLEURA

The Parietal pleura is supplied by somatic fibers, so it is sensitive to pain, temperature, touch and pressure.

The visceral pleura is supplied by visceral fibers, so it is sensitive to stretch, but it is insensitive to pain, temperature or touch, it is supplied by pulmonary plexus and the autonomic nervous system.

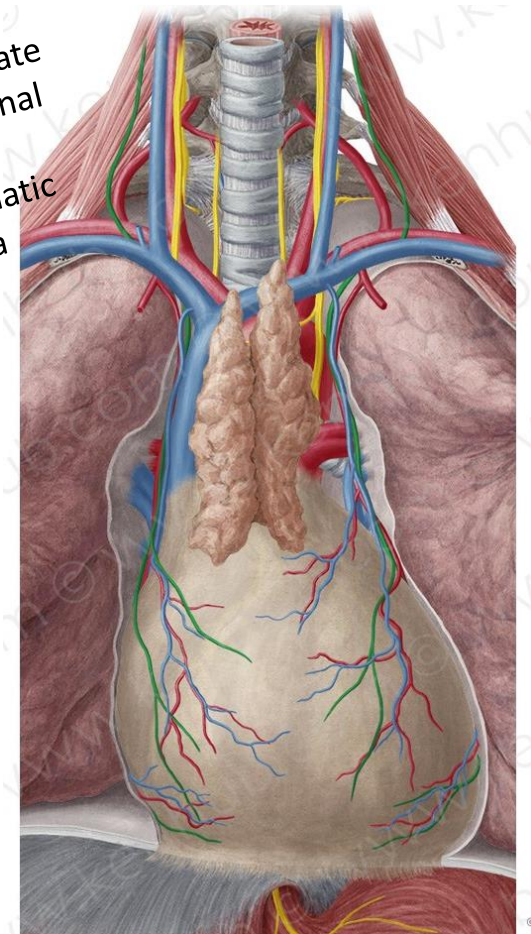
Nerves that contribute to the innervation of the parietal pleura include:

The intercostal nerves:  
innervate the  
costal pleura



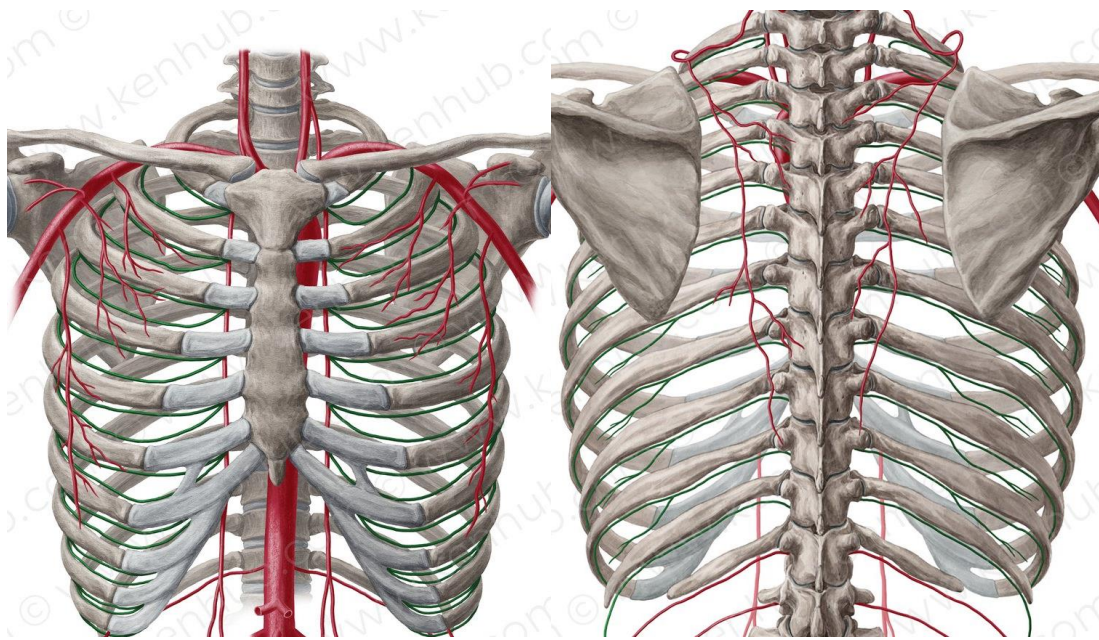
The lower six  
intercostal  
nerves  
innervate the  
pleural  
reflections.

The phrenic  
nerves innervate  
the mediastinal  
and  
diaphragmatic  
pleura

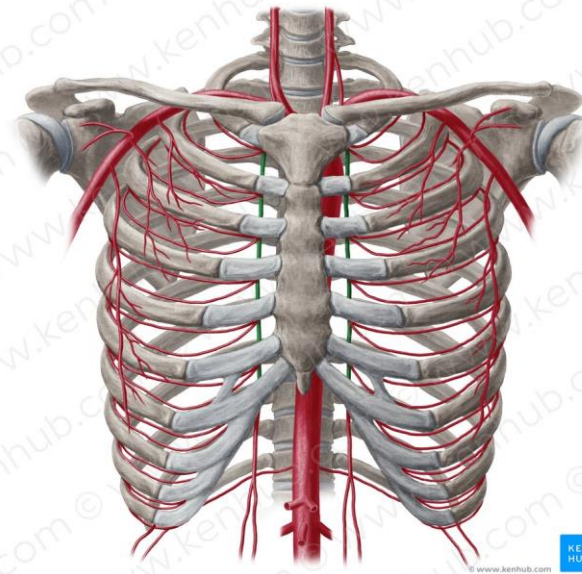


# ARTERIAL SUPPLY OF THE PLUREA

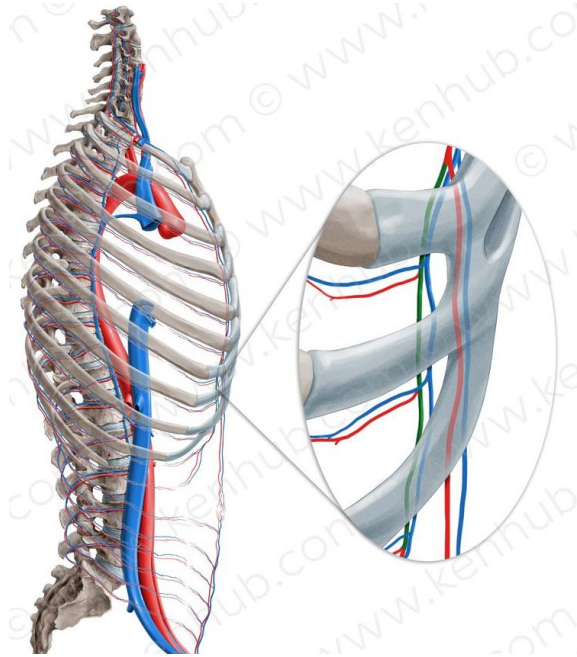
The arterial supply of the parietal pleura is from the arteries that supply the thoracic wall, including:



Anterior and posterior intercostal arteries.



Internal Thoracic Artery



Musculophrenic artery

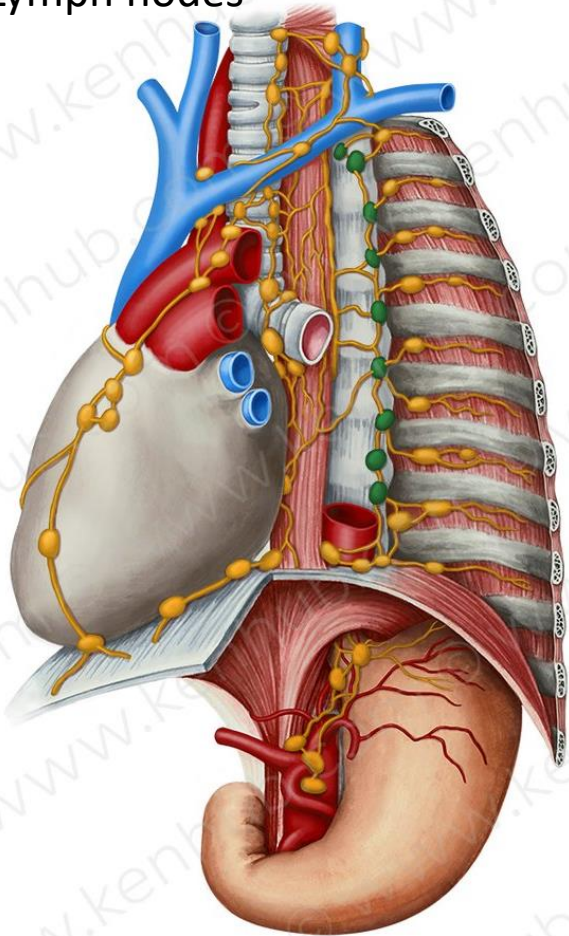
The visceral pleura is supplied by the bronchial arteries.  
Veins of the parietal and visceral pleura drain into the azygous vein and the internal thoracic vein.



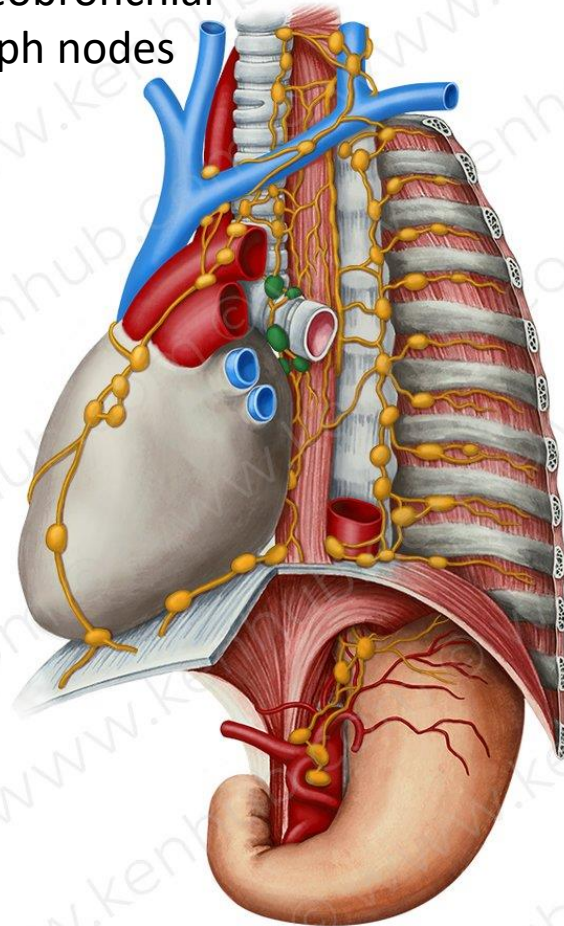
# LYMPHATIC DRAINAGE OF THE PLEURA

The mediastinal pleura is drained by:

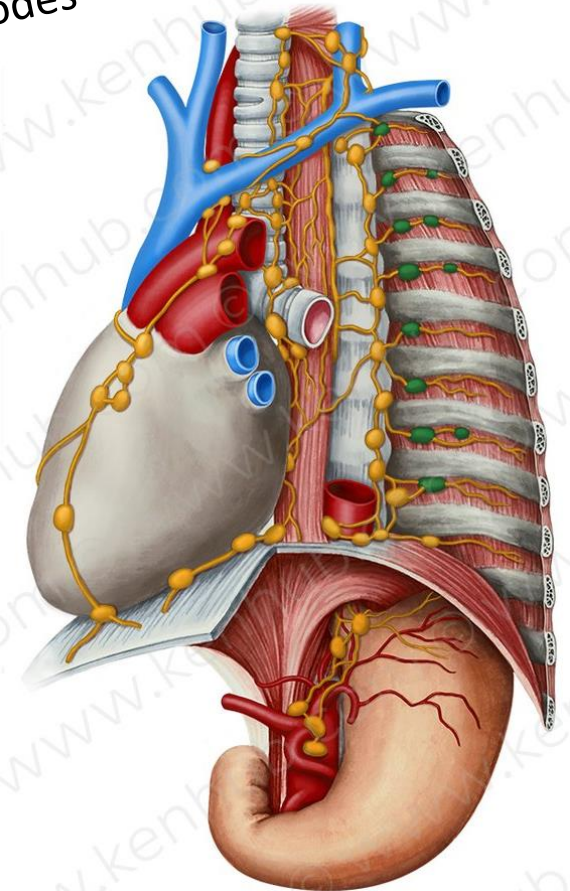
Mediastinal  
Lymph nodes



Tracheobronchial  
Lymph nodes



Intercostal  
lymph nodes



The diaphragmatic pleura drains into parasternal and tracheobronchial nodes.  
Lymphatics draining the visceral pleura follow the bronchial vessels to drain into  
bronchopulmonary nodes