

# Respiratory system

## Anatomy



sheet



handout



slides

Number

6

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Some recommended videos are attached to this sheet ( if u are studying online click on them, if not u can reach them by typing their names on the youtube search bar .) , some figures are added from a source other than the slides for clarifying , so please check up the doctors' slides .

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So last lecture we begin talking about the two lungs , we've finished the lecture by talking about the surface anatomy of the pleura and lungs. The surface anatomy hasn't finished yet ..it will be continued in this lecture.

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## Lungs Anatomy cont.

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### Root and hilum

- ✓ Presented on the mediastinal surface.
- ✓ Contains mainly bronchus & pulmonary vessels (along with other structures)
  - ✓ Right side hilum , contains [figure1].
    - eparterial and hyarterial main bronchus (above and below the Rt pulmonary artery , respectively ).
    - Rt. Pulmonary artery. ○ 2 Pulmonary veins(superior & inferior) .
    - Bronchial arteries ,lymph nodes ,lymphatic vessels & nerves ( they are not always shown ) .
  - ✓ left sided hilum , contains [figure1].
    - Only one main bronchus. ○ Lt. Pulmonary artery (most superior) – important. ○ 2 pulmonery veins.

Recall from CVS : the Rt. Pulmonary artery is longer than the left (as the whole heart is deviated to the left).

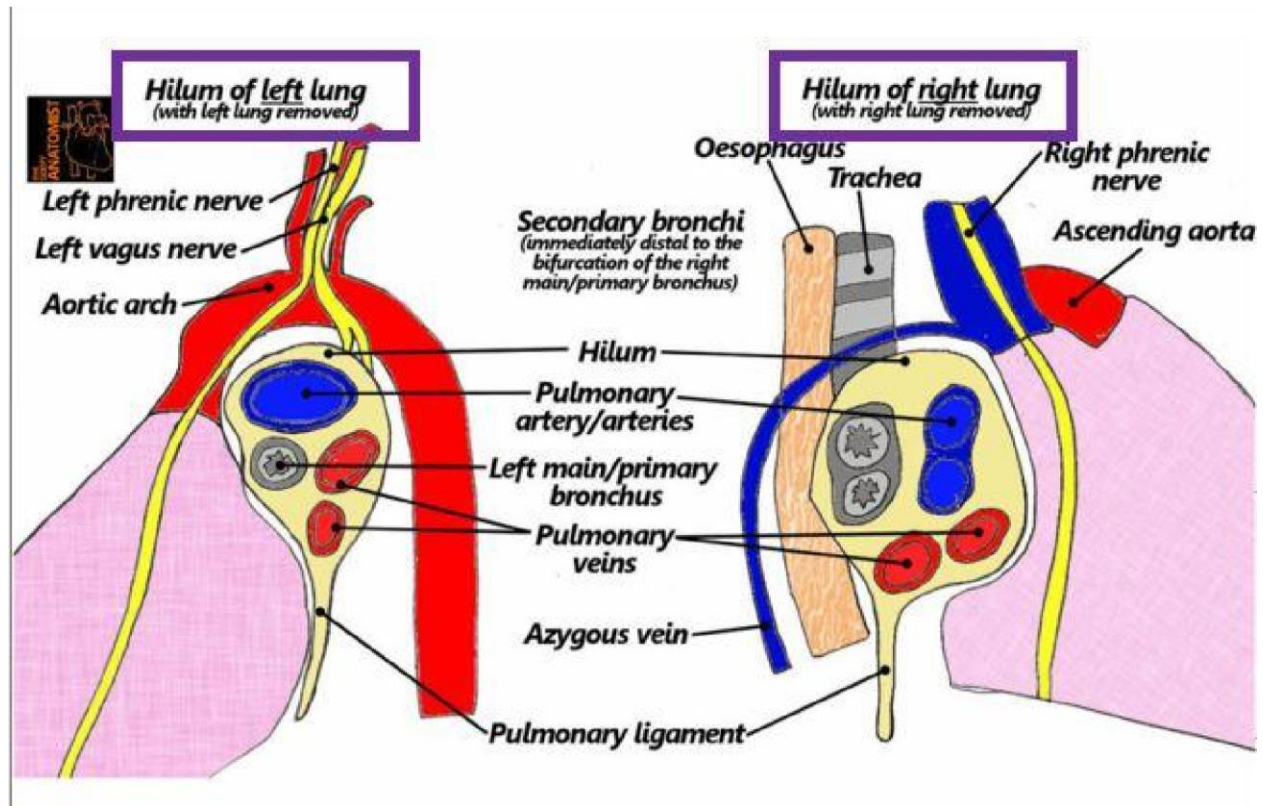
### Pulmonary sleeve/cuff and the pulmonary segment [figure1].

- ✓ Resulted from the adhesion of parietal and visceral pleura around the hilum.
- ✓ Lies between T5-T7 (same range for the hilum).
- ✓ The pulmonary ligaments are elongations of the pulmonary sleeve, their function is to stabilize the lower lobes of the lungs (especially during respiration process).

Some notes:

- ➡ The pulmonary veins are 4 in no. (2 for each side), they carry oxygenated blood (these will end at the left atrium ).
- ➡ The pulmonary arteries are 2 in no. (1 for each side), they carry deoxygenated blood (arise from the RV>> pulmonary trunk >> then bifurcate).
- ➡ Some other contents of the hilum (bronchial vessels, nerves "vagus and sympathetic fibers", lymphatics).
- ➡ Remember that the lung has dual blood supply : pulmonary and bronchial>> the bronchial blood supply represent the true blood supply to the lungs (we will talk about these in details), while the pulmonary blood supplies the lungs for the sake of gas exchange.
- ➡ In the hilum, there are a lot of lymphatics (lymphatics vessels and nodes) these appear as black dots in smokers.





**Figure 1:** Rt + Lt Hilum—well indicated —be aware that the Lt and Rt directions are flipped (you must memories the arrangement of A, V, B in each hilum- most importantly).

\* Lt pulmonary artery is the most superior at its hilum.

\*notice how the Rt main bronchus bifurcates into ep- and hyp-arterial main bronchus).

## Lobes and fissures [figure2].

Watch this video [[Surface Anatomy - Pleura Lungs \(3D\)](#)].

Right lung

- ✓ 3 lobes (upper, middle, lower). ✓ 2 fissures ( horizontal , oblique) ✓ Surface anatomy of Rt fissures:

○Oblique fissure:

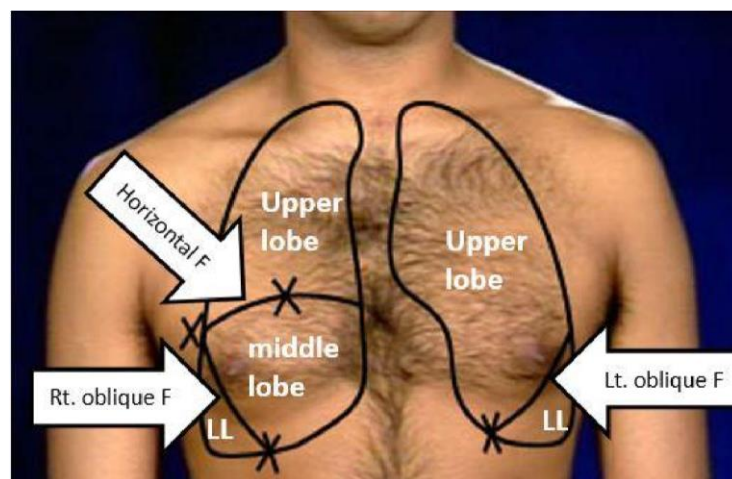
- Separates the lower lobe from the (upper and middle lobes).
- Below it is the lower lobe.
- Starts posteriorly from spinous process (dorsal spine) of T4.

- Then moves laterally crossing the 5<sup>th</sup> intercostal space.
- Then anteriorly , at the level of 6<sup>th</sup> rib.... So (4,5,6 – vertebra , intercostal cartilage, rib –from posterior to anterior).
- Horizontal fissure:
  - Above it is the upper lobe , below it is the middle lobe.
  - Starts anteriorly at the level of 4th intercostal space.
  - Then Laterally lies horizontal at the level of the 5<sup>th</sup>rib ..( so 4,5-ICS, rib – from anterior to posterior).

### Left lung

- ✓ 2 lobes (upper, lower).
- ✓ 1 fissure ( oblique).
- ✓ Surface anatomy of the oblique fissure (differ slightly from the Rt oblique)
  - Starts posteriorly from spinous process (dorsal spine) of T3 or T4.
  - Then moves laterally crossing the 5<sup>th</sup> intercostal space.
  - Then anteriorly , at the level of 6<sup>th</sup> rib.

The importance of knowing fissures' surface anatomy is that when the Dr put his stethoscope to hear the lung sounds he will know what lobe is under it, for example if he put it below the horizontal fissure >> he examines middle lobe sounds.



**Figure 2:** surface anatomy of the fissures, note: the fissures have continuation on the posterior view.

Recall that the Left lung has a lingua & a cardiac notch (as the heart is more deviated to the left).

The cardiac notch is 1cm to the left of the mid-line semicircle (this notch is what make the ant. Border of each lung different – when talking about normal/surface anatomy).

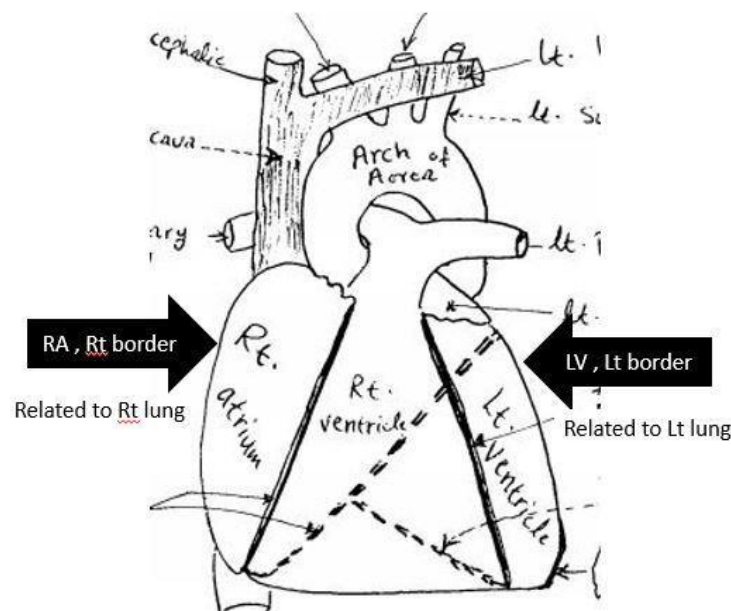
## Surfaces and impressions [figure4]

Every lung has mediastinal surface related to blood vessels and other mediastinal structures.

How is the heart related to the lungs?

put in mind that :the lungs really hug the heart.

recall [figure3] from CVS that the Rt border of the heart is composed from the Rt atrium , while the Lt border of the heart is composed from the Lt ventricle so u must expect to see RA depression on the Rt lung and LV depression on the Lt lung.



**Figure 3:** Rt and Lt borders of the heart are related to the lungs.

Impressions and relations of the Rt lung (mediastinal surface) : -look at fig4

- ✓ Right atrium ; anterior to the hilum.

- ✓ IVC.
- ✓ SVC
- ✓ Arch of the azygous which opens in SVC (above the hilum).
  - from here we can say that the Rt lung is related to deoxygenated blood, as it's related to RA , IVC , SVC , azygous arch >> veins).
- ✓ Esophagus and trachea (above the hilum)
- ✓ Subclavian vein and artery and brachiocephalic vein (their impressions do not appear well ) as they unite to form SVC .
- ✓ 1<sup>st</sup> rib leaves an impression but here on costal surface and anterior border.(not the mediastinal surface like the others).

#### Notes:

- ➡ The trachea is related to Rt lung only as it's deviated to the right.  
and logically the trachea must leave its impression above the hilum of Rt lung because –as we stated earlier the hilum is at the level of T5-T7 , while the trachea ends at the level of T4 so it “exist” above the level of the hilum.
- ➡ The esophagus is posterior to the trachea it leaves impressions on both lungs as it descends behind the hilum.
- ➡ To differentiate between the Rt and Lt lungs in practical exam, use ur knowledge about the fissures and lobes numbers (also the Rt lung hilum contain two main bronchus).

#### Impressions and relations of the Lt lung (mediastinal surface): -look at fig4

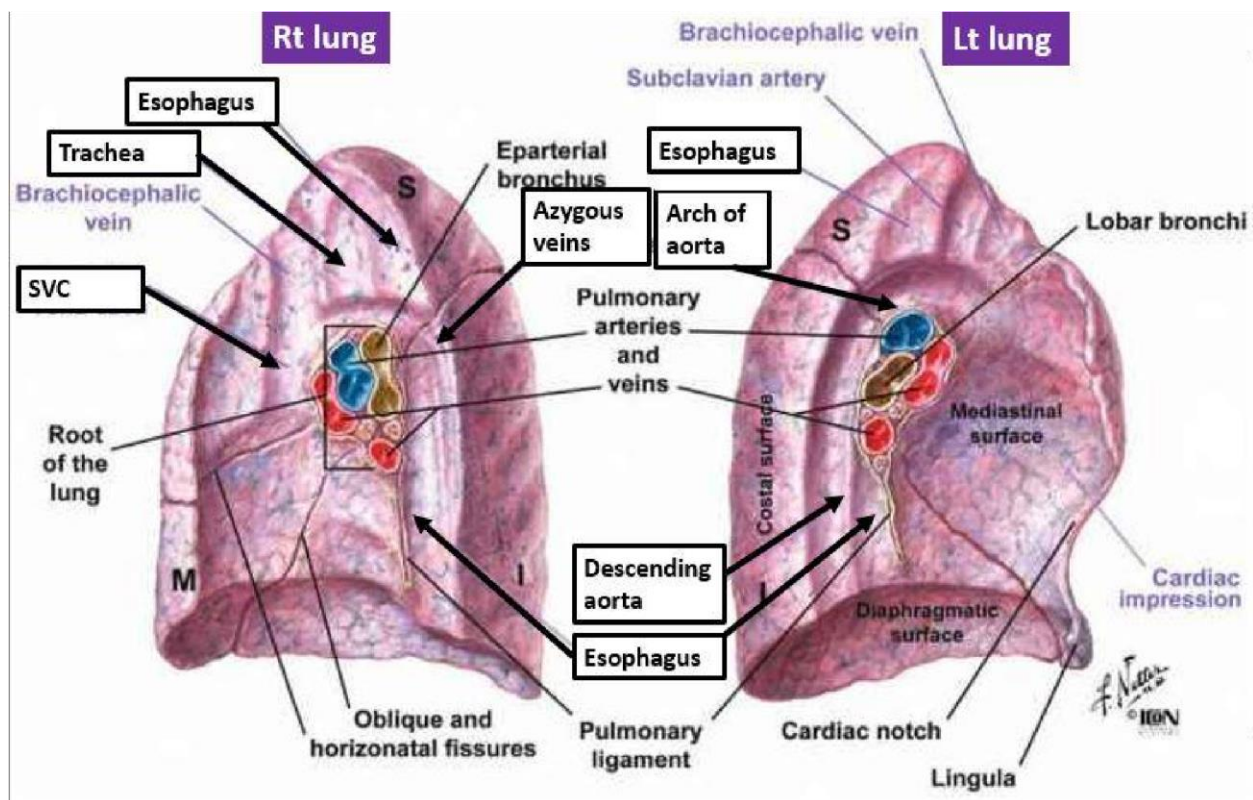
- ✓ Left ventricle ; anterior to the hilum.
- ✓ Arch of the aorta (arise from the LV – above the hilum).
- ✓ Descending aorta and thoracic aorta (continuation of the arch).
- ✓ Lt subclavian and Lt common carotid arteries (arise from arch of the aorta).
  - from here we can say that the Lt lung is related to oxygenated blood, as it's related to LV and arteries ).
- ✓ Esophagus (behind the hilum and lower). & first rib

Notes :

- ✓ Why the esophagus leaves an impression on the Lt lung?

-because the esophagus deviate 1 Inch to the left as it descend to its orifice at the diaphragm at the level of T10.

at its course the esophagus crosses the thoracic aorta and become ant. to it (that's why if u look at figure 4 u will notice that the esophageal impression on the Lt lung is anterior to thoracic (descending) aorta). ant= behind the hilum directly.



**Figure 4:** impressions on both lungs – most important impressions are indicated.

\*\* phrenic nerve lies anterior to the hilum of both lungs , whereas vagus nerve lies posterior to the hilum .



## Pulmonary arteries and veins [figure5]

The pulmonary trunk arises from the RV (divides into Rt and Lt pulmonary arteries at the level of T4).

\*rem. The Rt pulmonary artery is longer than the Lt. (and the Rt pass horizontal).

The Dr read this part from the slides

### **-pulmonary arteries**

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

SO ,Relations to the Rt pulmonary artery :

post to it: bronchus ant to it : superior pulmonary veins.

**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.( and at the Lt hilum it is the most superior part).

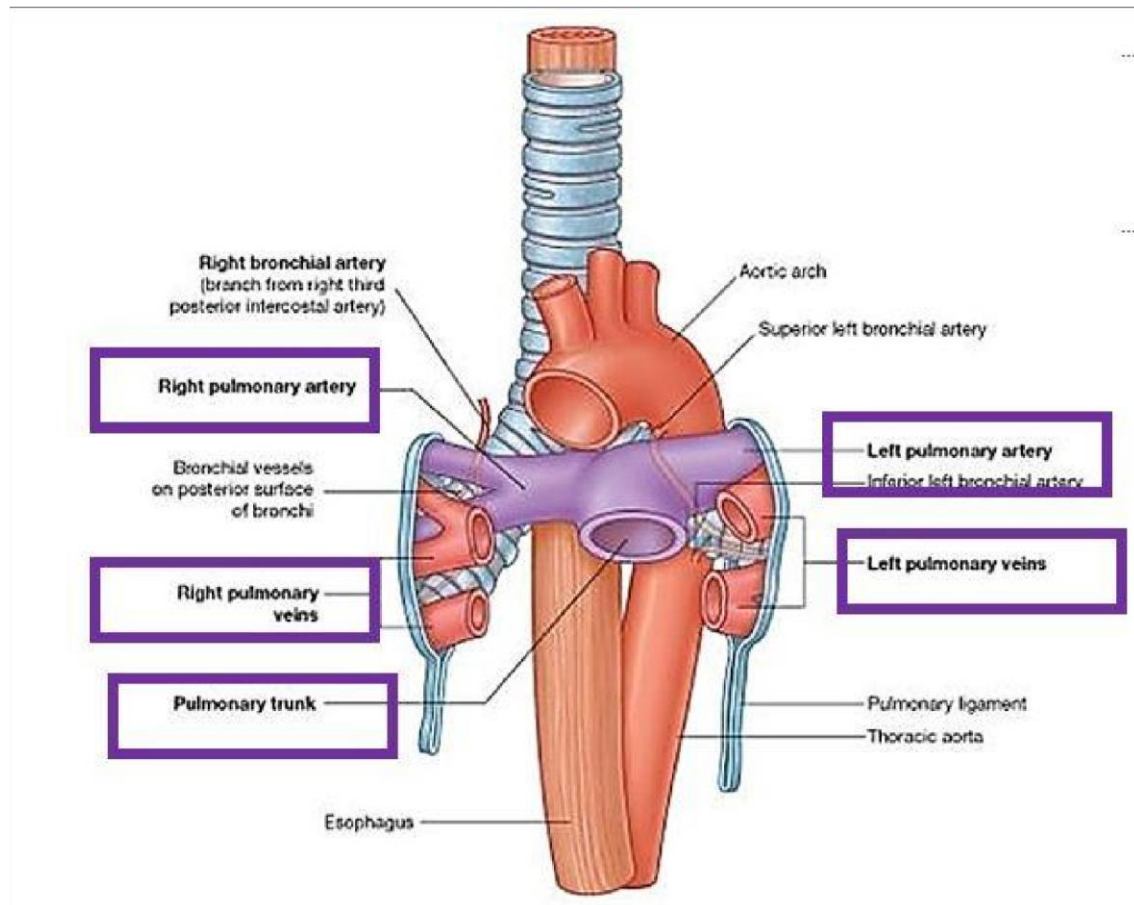
so , relations of the Lt pulmonary artery :

Post to it : descending aorta & bronchial vessels.

Ant to it :superior pulmonary vein.

## -pulmonary veins

As stated earlier in this sheet these are 4 in no. , and carry oxygenated blood, They drain into the LA.



**Figure 5 :** Pulmonary arteries and veins.

## Bronchial arteries and veins[figure6]

### Bronchial arteries

- ✓ Supply the lung tissue and visceral pleura with Nutritious blood.
- ✓ Contents of the hilum.
- ✓ Rt bronchial artery is a branch of third posterior intercostal artery (which itself is a branch of descending aorta).  
rem: all posterior Intercostal arteries are branches of thoracic aorta except the 1<sup>st</sup> and 2<sup>nd</sup> branch from subclavian artery .
- ✓ Lt bronchial artery branch from the descending aorta (directly).
- ✓ Superior left bronchial artery arises at vertebral level T5, and the inferior one inferior to the left bronchus.
- ✓ They communicate with pulmonary arteries and vein

### Bronchial veins

- ✓ These eventually drain into pulmonary veins or LA ( although they contain deoxygenated blood but they are little amount compared to the oxygenated blood so they dissolved ) .
- ✓ On the Lt side of the chest these veins drain into the hemiazygous vein or intercostal veins >> will drain eventually into the pulmonary veins.(recall ur

self with this drainage system with fig6)

Figure 6

## Bronchial Arteries

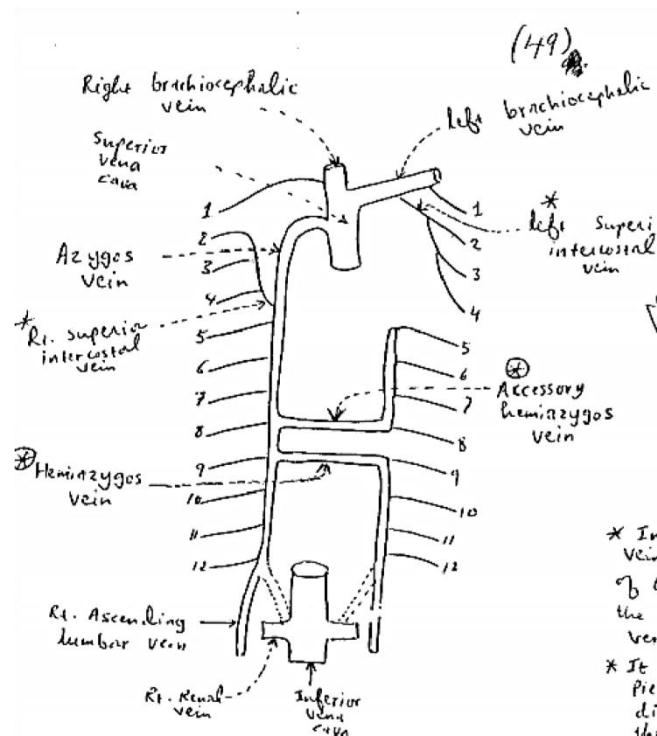
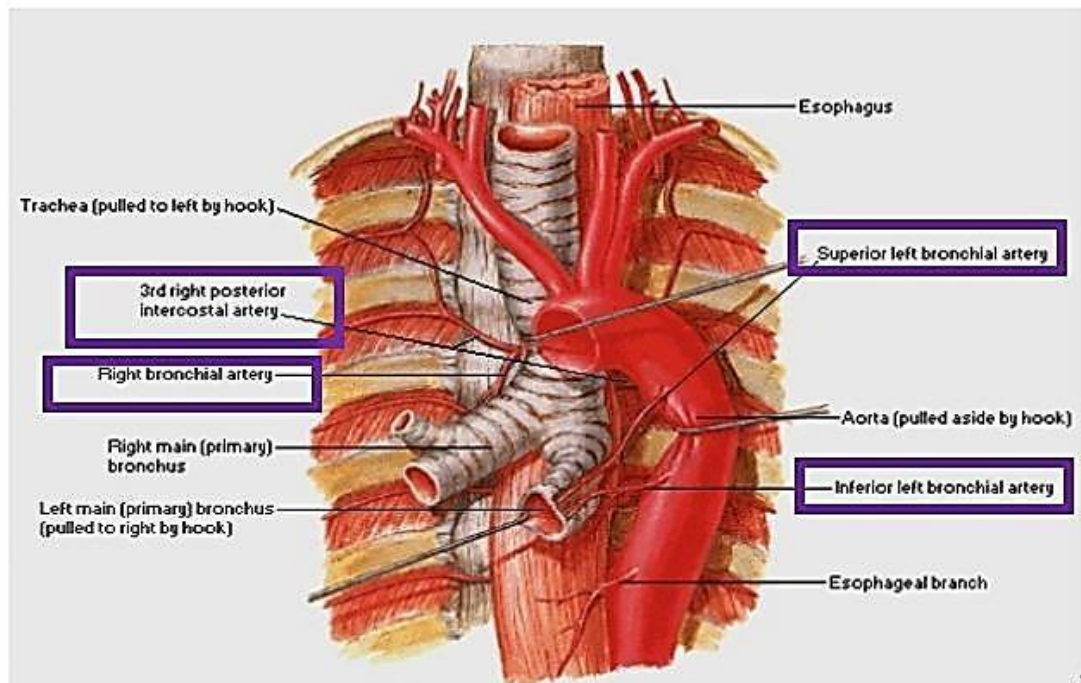


Figure 6: Hemizygous vein and posterior intercostal veins drain left bronchial veins.



## Innervation of lung<sup>[figure7]</sup>

Here we are talking about innervation to both lung and visceral pleura , which are sensitive to stretch (only).

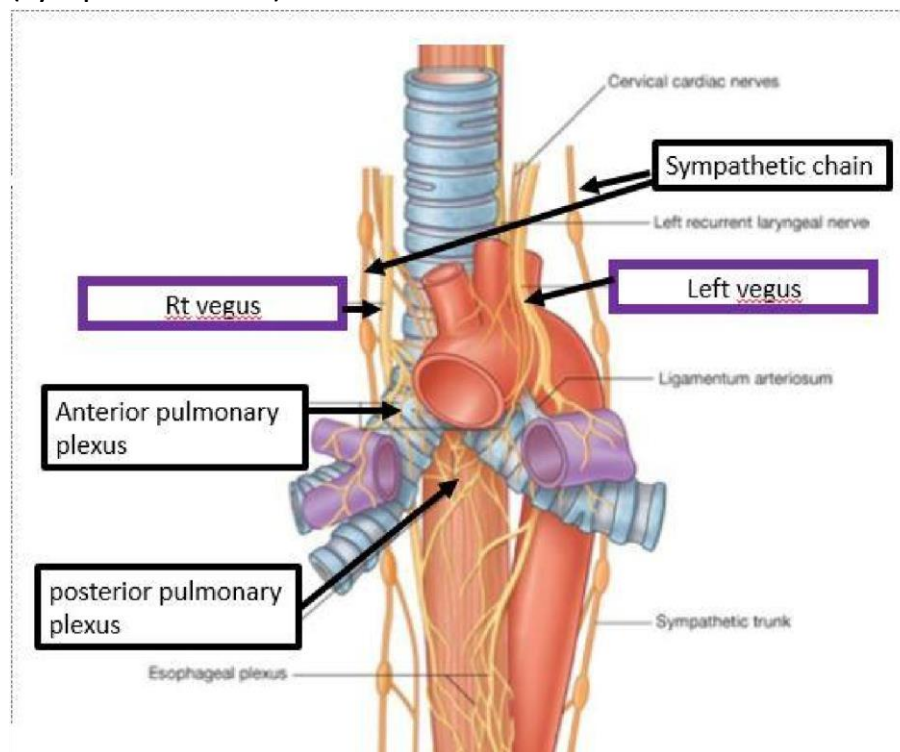
Here the innervation comes from plexus of nerves “**pulmonary plexus**” ( mix of vagus (para.) and branches of the sympathetic chain (symp.) ).

This plexus occur anterior and posterior to the bifurcation of trachea at the level of T4.

**Effect of parasympathetic** = bronchoconstriction

**Effect of sympathetic** = bronchodilation( opposite to their “vaso” effects)

Clinical correlation : we give an asthma patient in emergency situations epinephrine (sympathomimic ) to bronchodilate his bronchus.



**Figure 7:**innervation to lung.

## Lymphatic drainage [figure8]

Tracheobronchial lymph nodes = around the trachea and bronchi.

Parastrnum group = around the sternum.

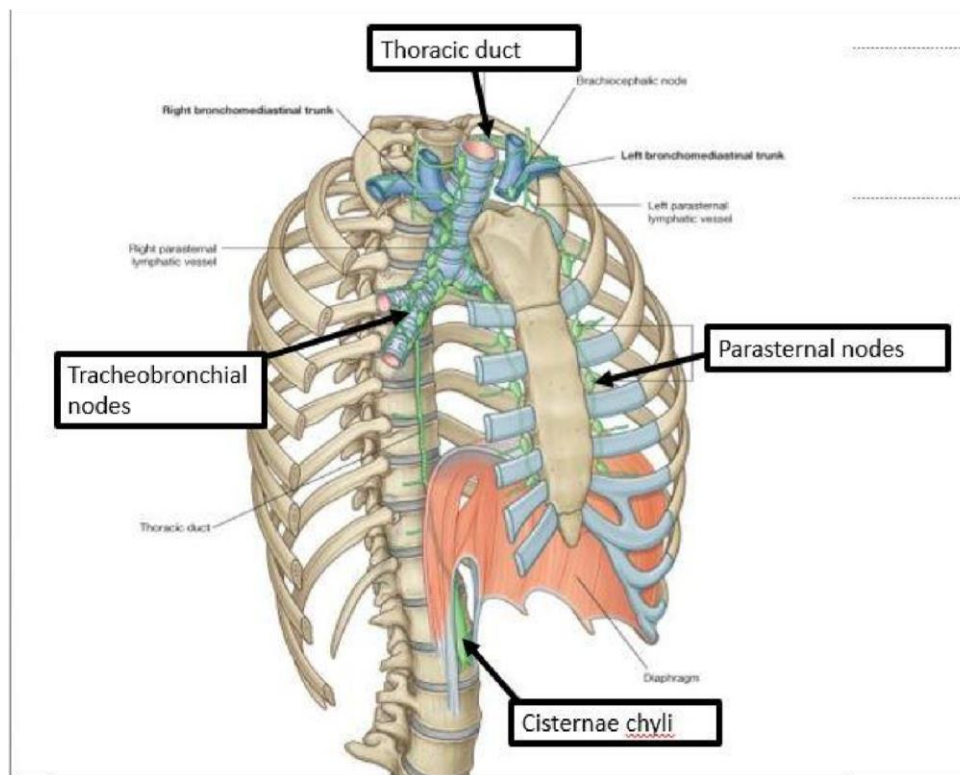
These all will collect in Rt and Lt bronchiomediastinal lymph nodes and vessels.

On the Rt side these will drain into Rt lymphatic duct.

On the Lt side will drain into the thoracic duct.

remember :

- ✓ This duct is the main lymphatic duct in the body .
- ✓ That the lower limb lymph collects in cisternae chyli –at the opening of the abdominal aorta>> then drains into thoracic duct.
- ✓ The course of the thoracic duct : begins at the cisterna chyli>> ascend upwards to the Lt of the esophagus then behind and to its Rt. then it opens at the beginning of Lt brachiocephalic vein. (the Rt duct also opens at the Rt brachiocephalic vein).



**Figure 8:**  
*lymphatic  
drainage of the  
lungs.*

# Pleura

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Watch this video [[Pleural Space \[HD\]](#)]

- ✓ Simply it is a sac covering the lung.
- ✓ Composed of 2 layers : parietal and visceral.
- ✓ The visceral layer is adherent to the lung, included with the fissures ( that's why it is related to lung's lymphatics , innervation , blood supply..).
- ✓ The parietal layer is adherent to the thoracic cage (lining the thoracic wall)
- ✓ In between these, two there is a potential space contains serous fluid, called **pleural space** – figure10.
- ✓ At the hilum , the visceral pleura adheres to the parietal forming **pulmonary ligament**
- ✓ Functions of pleura :
  - Protection of lungs.
  - The fluid in the pleural space provides lubrication and prevents friction during inflation.
- ✓ If the parietal pleura “pleuritis “get infected this is going to be painful (especially during breathing).
- ✓ Visceral pleura is only sensitive for stretch , whereas the parietal is also sensitive for temp. and pain .
- ✓

## **clinical correlations:**

- ✓ Air can accumulate in the pleural space >> in this case we call it “Pneumothorax” >> this a medical emergency (as the lungs collapse) [can caused by placing the subclavian catheter].
- ✓ Fluid can fill the pleural cavity >> we call this case “pleural effusion”>> [can be idiopathic , or caused 2ry to other causes like inflammation, trauma, cancer ..] –always the accumulation of fluids occur in lower part (lower two spaces).
- ✓ Empyema (accumulation of pus) & haemothorax (accumulation of blood).

## Parts of pleura (especial the parietal )- figure10

### 1. Cervical:

- a. Around the apex of the lungs ( rem. At the apex of the lung both parietal and visceral layers are adherent to each other – no space ), 1 Inch around the medial  $\frac{1}{3}$  of the clavicle.
- b. covered by suprapleural membrane & sibson's fascia.-figure 13
  - i. These extend from the root of the neck to the apex of the lungs.
  - ii. sibson's fascia is part of deed investing fascia at the root of the neck.
  - iii. attachment for the suprapleural membrane :
    - **Laterally**: medial border of 1st rib and costal cartilage.
    - **Medially** : blend with sibson's fascia.
    - **Apex** : to the tip of the transverse process of the 7th cervical vertebra.
  - iv. Function : protection and ceiling the thoracic cavity (as the thoracic cavity must be closed to form intrathoracic pressure >> which is the basic principle in respiration :inspiration [-ve intrapressure], expiration [+ve intrapressure]).

### 2. Costal :

- a. related to costal cartilages (costal surface).
- b. on the periphery and outside.

### 3.diaphragmatic :

- a.above the diaphragm, covering the base.

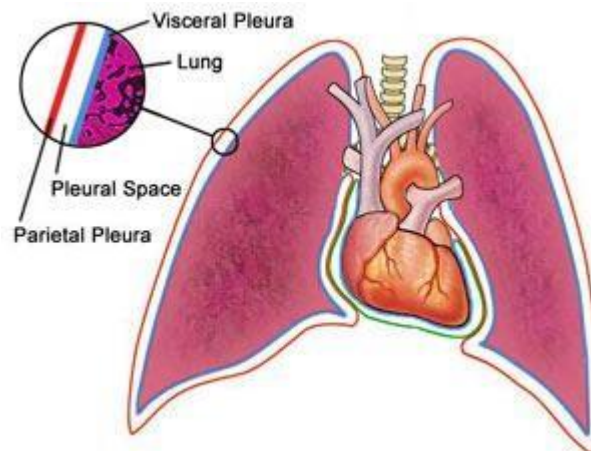
### 4.mediastinal :

- a. covering the mediastinal surface.
- b. this part of the pleura is what form the sleeve of pleura around the hilum ( in which the two pleura layers become adherent) +they form the pulmonary ligaments below the hilum.

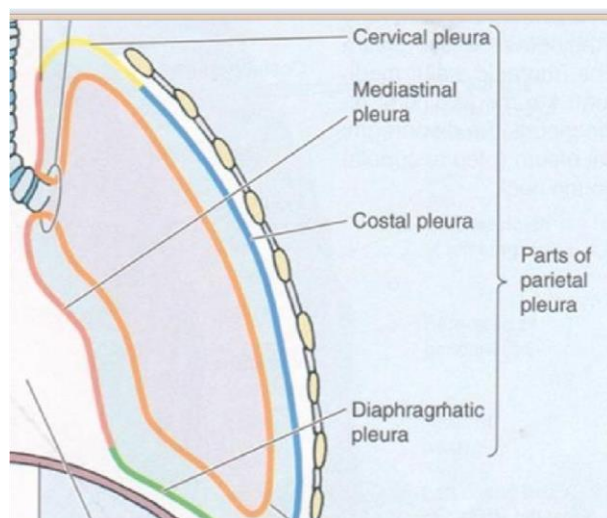


## Surface anatomy of the pleura –repeated –figure11

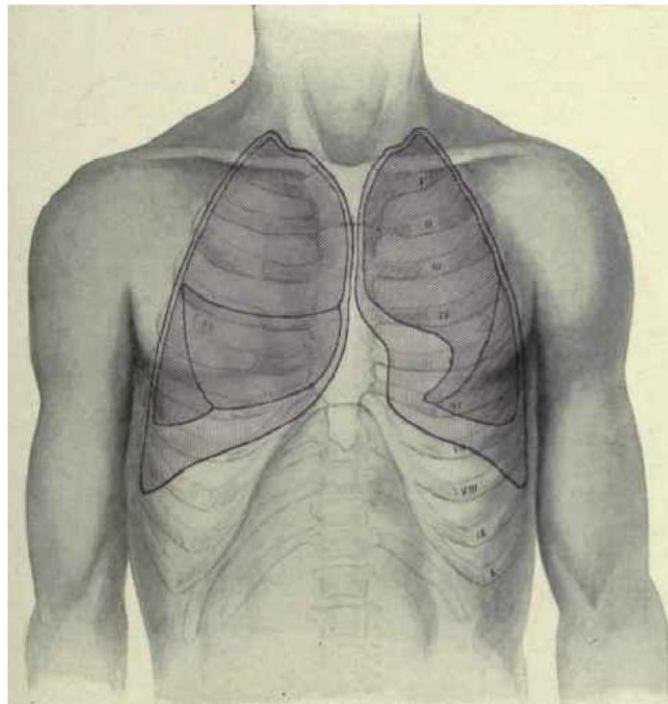
- ✓ the apex of the pleura is the same of the lungs (1 inch (2.5 cm) above the medial third of clavicle or 3-4 cm above the 1<sup>st</sup> costal cartilage).
- ✓ the anterior border from the apex to the 7<sup>th</sup> intercostal space ( on the Lt side things are little different as there's the cardiac notch –which push the ant border to 1cm to the left at the level of T4- T6).
- ✓ posterior border : from the apex to T12 scapular line (4cm away from the dorsal spine line of thoracic vertebra “midline posteriorly” ).
- ✓ the base : extend laterally cross midclavicular line at 8<sup>th</sup> rib , cross the mid axillary line at 10<sup>th</sup> rib , and posteriorly 12<sup>th</sup> thoracic spine.



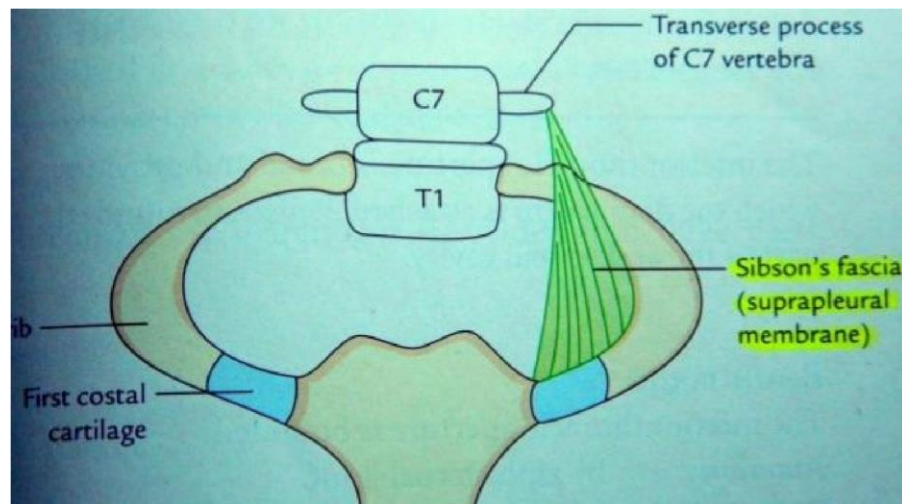
**Figure 9:** pleura layers and pleural space.



**Figure 10:** types of pleura.



**Figure 11:** surface anatomy of lung and pleura- follow the borders & try to put ( \*) on each surface mark u know



**Figure 12:** suprapleural membrane.

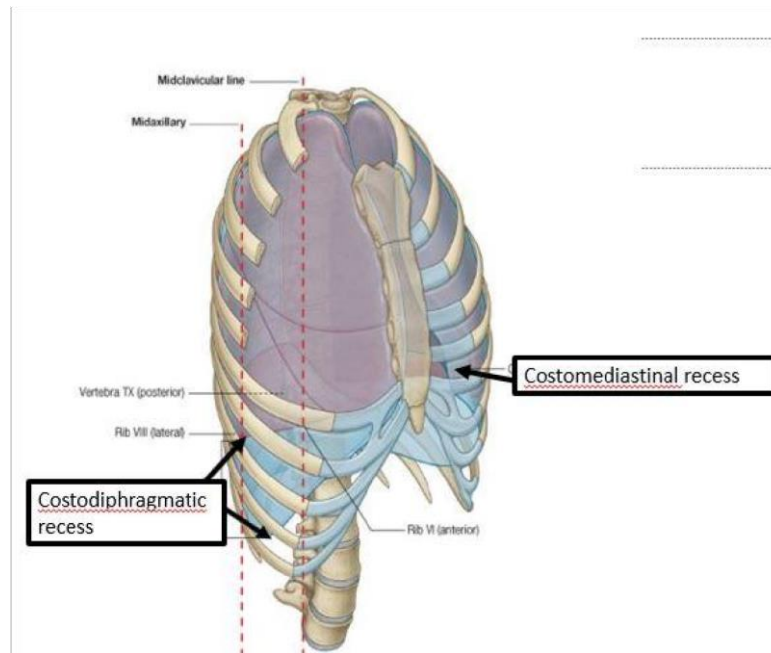
## Pleural recesses –figure13.

In this video, the recesses are clearly shown [[UNDERSTANDING HUMAN ANATOMY-THORAX PLEURA](#)] \*speed up the video and skip the first 13 minutes.

- ✓ These are reflections of pleura, represent the joining btw two different types of parietal pleura.
- ✓ For example when the lung expand it fill the **costodiphragmatic recess** (which is nth but the angle between costal and diaphragmatic pleurae ).
- ✓ This **costodiphragmatic recess** is the larger recess and the most important one, it extends laterally by intervals of these lengths:
  - 1 inch in the midclavicular line.
  - 2 inches in the scapular line post.
  - 3 inches in the mid-axillary line (the most extended part) .
- ✓ Also the fluid and air collect in these recesses. ✓ Also there's **mediastinodiaphragmatic recesses** between mediastinal and diaphragmatic pleura which is shorter than the costodiaphragmatic recess .

With regard to this subject there's a lot of details mentioned in the slides (not mentioned by the Dr) remember in sheet5 in the surface anatomy of the pleura and lung we have said that there is two spaces inferiorly between the lung and the pleura , in case of pneumothorax the air is collected there and this collection collapse the lung. >> so we have to release this air "aspiration " by inserting a tube called "underwater seal" in the potential space we put this tube ( in midclavicular 7<sup>th</sup> intercostal , at the level of mid axillary at the 9<sup>th</sup> intercostal space, posteriorly "scapular at 11<sup>th</sup> intercostal space) . two important notes :

- ➡ We usually insert the tube at midaxillary line as the space there is the most extended (3 inches).
- ➡ when inserting the tube at the intercostal space , it must be at the lower of the intercostal space. (upper border of the rib) –by this we keep safety distance between the tube and the VANs (intercostal Veins , Arteries, Nerves ) which are present at the upper intercostal space.



**Figure 13:**pleural recesses.

## Clinical correlations:

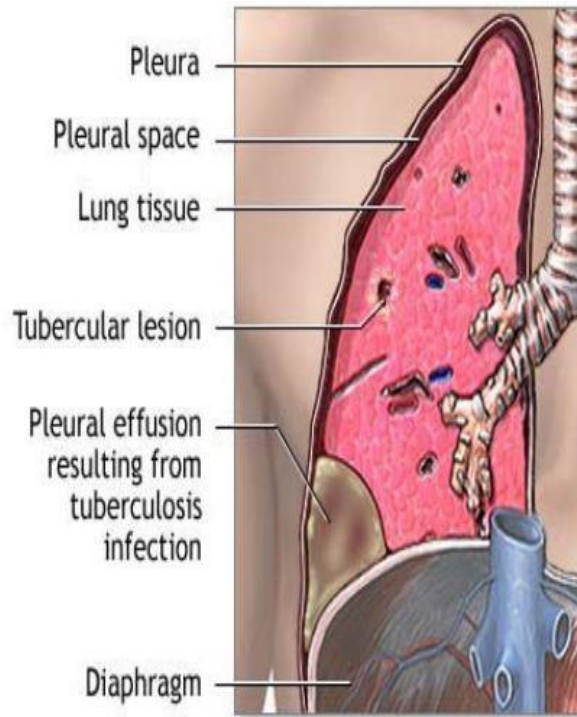
### Pleural effusion

- ✓ when there's pleural effusion the fluid inside the pleural cavity increases (normally 10 ml >>In PE 300 ml).
- ✓ can be caused 2ry to many things.( inflammation, cancer..), or it could be idiopathic .
- ✓ when the Dr tries to hear the breathing sounds of effused area it will appear different ( very weak sound ) , also when the Dr preforms the percussion procedure (Percussion is a method of tapping on a surface to determine the underlying structure, and is used in clinical examinations to assess the condition of the thorax or abdomen).- the physician placed his fingers between the ribs and then he tap on them >> then he detect the sound ,resonance of the voice is detected if the underlying substance is “air” , while dullness will appear if the underlying substance is fluid “ in case of effusion >>

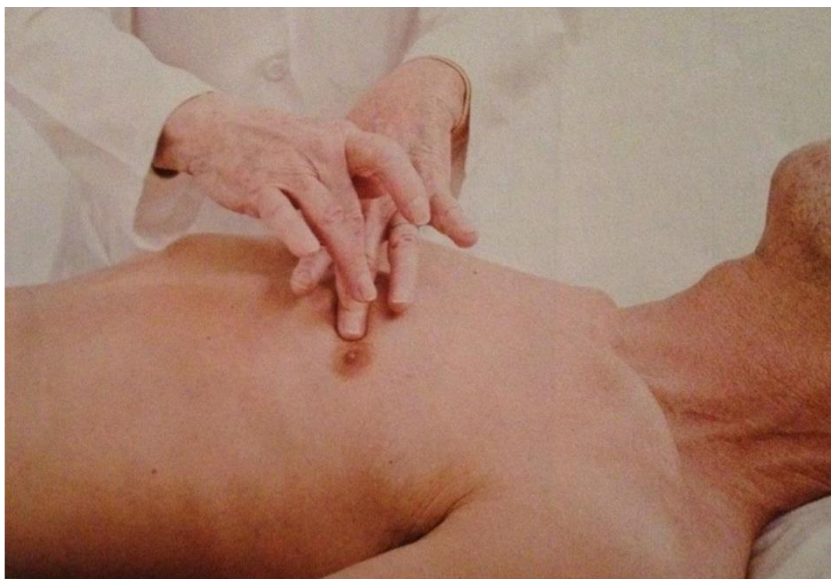


dullness is detected after the percussion procedure. a demonstrative fig of percussion procedure –at figure 15

at figure 14 u can see a pleural effusion at the costo-diaphragmatic recess.



**Figure 14:** pleural effusion.



**Figure 15:** Percussion test of the thorax.

So collectively these are the clinical manifestations of the PE

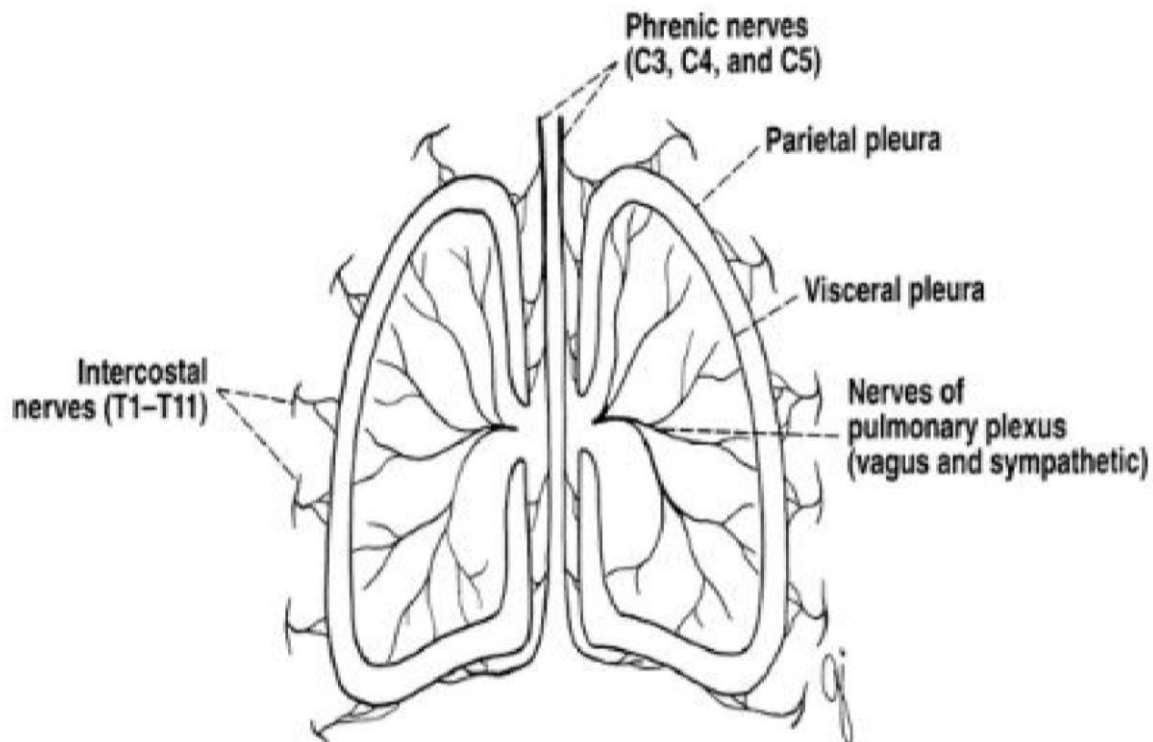
# Clinical Manifestations

- Decrease in lung expansion
- Decrease breath sound
- In Percussion → Dullness
- Pain
- Cough

dimin  
collapsed right l.

## Nerve supply of the pleura –figure16

- ✓ Here we are talking about partial pleura ( as the visceral follows blood and nerve supply of the lungs)>> from here a huge difference arise between the parietal and visceral layer.
- ✓ The visceral is sensitive to stretch only ( supplied by autonomic fibers [sympathetic + parasympathetic ] )
  - Supplied by pulmonary plexus & autonomic N.S
- ✓ The parietal is supplied by another types of fibers>> sensitive to pain, Temp , Touch & pressure. ○ Supplied by :
  - 1-Intercostal nerves >> Costal pleura(segmentally).
  - 2- Phrenic nerve >>Mediastinal pleura + diaphragmatic pleura.
  - 3- lower 6 intercostal >> peripheral pleura ( I think this is the cervical pleura).



**Figure 16:**nerve supply of parietal pleura

## Blood supply of the pleura.

Arterial blood supply of the **parietal layer** is mainly by intercostal arteries (anterior and posterior ICA).

Ant intercostal arteries >> branch of internal thoracic artery (internal mammary).

Posterior intercostal arteries >> branches of descending aorta (except first two from subclavian) .also Musculophrenic arteries supply the parietal pleura.

The **visceral pleura** follows the lung >>supplied by Bronchial arteries, which are branches of the thoracic aorta.

## Veins.

Opposite to the arteries, drain into azygos& internal thoracic veins>>> SVC.

## Lymphatic drainage of pleura.

### **parietal pleura**

Mediastinal pleura by

- 1- mediastinal nodes
- 2- Tracheobronchial nodes
- 3- Intercostal nodes

### **Diaphragmatic pleura**

- 1- Parasternal nodes
- 2- Post.mediastinal nodes

- **Pulmonary pleura(visceral)** :along bronchial arteries →bronchopulmonary nodes

Finally ,all of them of drains into RT lymphatic duct in the RT side , and thoracic duct in the left side .

**GOOD LUCK**