

RESPIRATORY SYSTEM

جنازة
ANATOMY



Title: Sheet 6 – Pleura and lungs 2

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(note: anything in blue is not mentioned by the doctor)

Pulmonary vessels

The pulmonary trunk starts from the pulmonary valve in the right ventricle, then it divides to right and left pulmonary arteries *anteroinferiorly to the left of the bifurcation of the trachea, inferior to the level of sternal angle at T5 (sternal angle is at T4) and below aortic arch.* Those arteries carry deoxygenated blood to the lungs.

The right pulmonary artery:

-The pulmonary trunk divides to the left of the median plane; this means that the right branch is longer.

-Enters the hilum (root) of the right lung between epiarterial and hyperarterial bronchi and *crosses the mediastinum horizontally to give off a large branch to the superior lobe of the lung > the main vessel continues and then gives off a second (recurrent) branch to the superior lobe > then it divides to supply the middle and inferior lobes.*

-Its relations (IMPORTANT):

1-Posteriorly: right main bronchus going to hilum

2-Anteriorly: SVC, ascending aorta, superior (upper) right pulmonary vein.

The left pulmonary artery:

-Shorter than the right.

- The most superior structure in the hilum of the left lung.

-Its relations (IMPORTANT):

1-Posteriorly: descending aorta

2-Anteriorly: superior pulmonary vein.

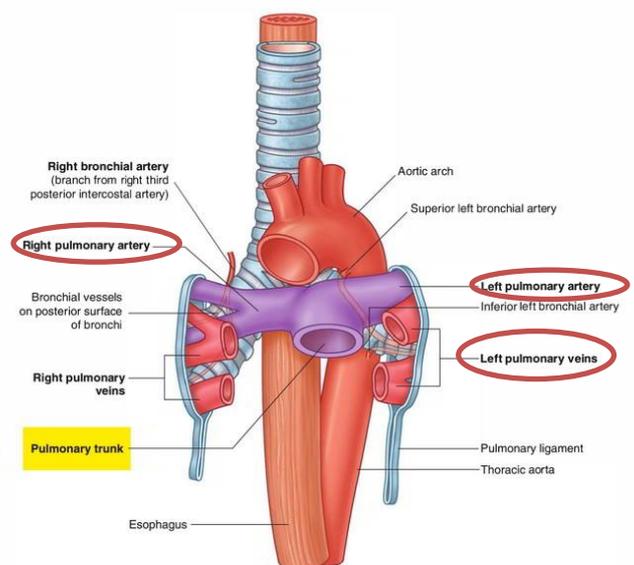
3-Inferiorly: Left main bronchus.

Pulmonary veins:

-Two on each side (superior, inferior)

-Begin at the hilum of the lung, pass through the root of the lung.

- Carry oxygenated blood from the lungs back to left atrium.



Bronchial vessels

-The main nutritive blood supply of the pulmonary tissues (imp)

(bronchial walls and glands, walls of large vessels, lungs and

visceral pleura).

- Are found in the hilum of lungs.

-They interconnect within the lungs with branches of the pulmonary arteries and veins.

-We have one right and two left (superior & inferior) bronchial arteries.

-Bronchial arteries *run on the posterior surfaces of bronchi* & are small in size compared to pulmonary artery.

-The right bronchial artery:

Originates from the third posterior intercostal artery > a branch of the descending thoracic aorta.

-The left bronchial arteries:

-Both arise directly from the anterior surface of the descending thoracic aorta.

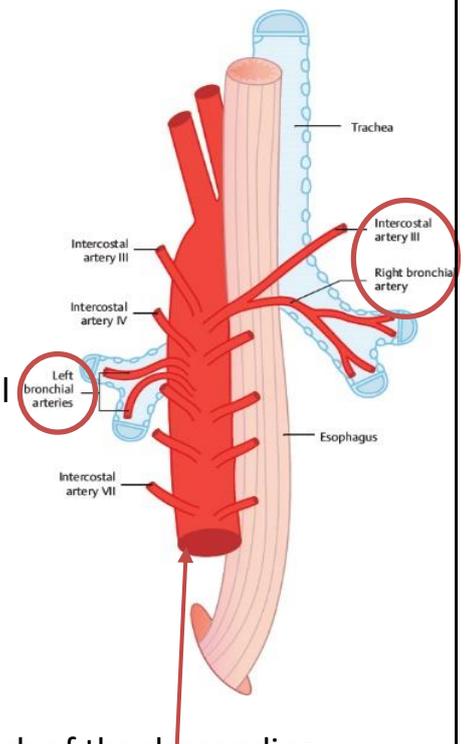
-The superior left bronchial artery arises at the level of T5.

-The inferior left bronchial artery arises below left main bronchus.

-The bronchial veins: (10:00)

-The left side drains into the hemiazygos vein or intercostal veins into > the pulmonary veins or the left atrium (the amount of blood CO₂ in bronchial veins is small compared to the amount of blood O₂ in the left atrium and pulmonary veins so the CO₂ is dissolved).

-The right side drains into azygos vein (main vein that drains the chest) > arch of azygos > SVC > right atrium (this is the usual pathway of deoxygenated blood)



Autonomic innervation of lungs and visceral pleura

-Plexus of sympathetic chain+ parasympathetic (vagus nerve) around the tracheal bifurcation and main bronchi. There are anterior and posterior pulmonary plexuses.

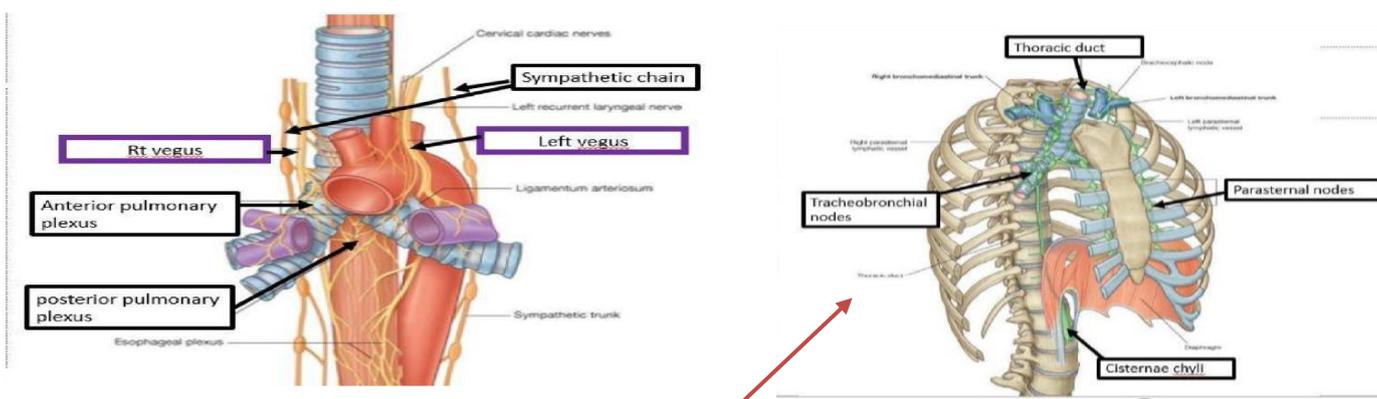
-The anterior plexus is much smaller than the posterior plexus

-Supplied by *visceral afferents and efferents* & **sensitive to stretch**

-Effect of parasympathetic (imp) = bronchoconstriction *by visceral efferents from the vagus*

-Effect of sympathetic (imp) = bronchodilation (opposite to their “vaso” effects) *by visceral efferents from the sympathetic system*

Clinical correlation: we give an asthma patient in emergency situations epinephrine (adrenaline =sympathomimetic) to bronchodilate his bronchus



Lymphatic drainage of lungs

-We have superficial (subpleural) and deep plexus of lymphatics which drain into the hilum as **mediastinal LN** from lung tissue and visceral pleura.

-Lymph nodes:

a-Parasternal LN > deep to sternum (one right and one left)

b-Paratracheal LN = tracheobronchial LN > run along the sides of trachea, near the hilum

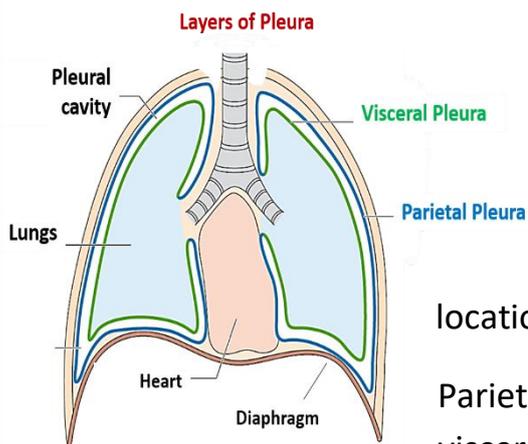
c-Bronchomediastinal LN > (one right and one left)

- *drain into tracheobronchial nodes around the roots of lobar and main bronchi and along the sides > these lymph nodes extend from within the lung, through the hilum and root, and into the posterior mediastinum > Efferent vessels from these nodes pass superiorly along the trachea to unite with similar vessels from parasternal nodes and brachiocephalic nodes > forming the right and left bronchomediastinal trunks >These trunks (all LN) drain directly into deep veins at the base of the neck or*

-LN on the Rt side drain into Rt lymphatic duct > Right brachiocephalic vein > heart.

-LN on the Lt side will drain into the thoracic duct (which starts from the right side of abdominal aorta's opening in diaphragm> ascending to right side of esophagus> at the

level of T5 it deviates to the left side) > Left brachiocephalic vein at the root of the neck > heart.



Pleura

It is a sac *lined by a single layer of flat cells, mesothelium, and an associated layer of supporting connective tissue* that covers the lungs like the pericardium that surround the heart, divided into two layers based on location: the parietal pleura and visceral pleura.

Parietal/ lines thoracic wall from inside (sensitive for pain), the visceral/ adherent to the lungs (autonomic no pain). Between these two layers is a potential space known as the pleural cavity or pleural space. This space is filled with a small amount of serous fluid or viscous fluid for lubrication purposes during respiration. *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 pleura (20:00):

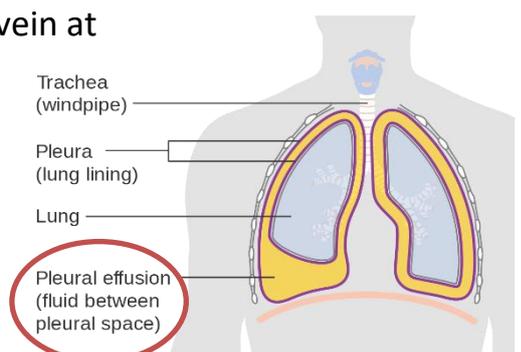
- 1- Protection of the lungs by its two membranes.
- 2- Production of fluid that allows for lubrication during respiration (inflation and deflation of the lung).

Failure in the function of pleura (pleuritis or infection) result in **difficult painful breathing**. In acute pleuritis, each breath will be accompanied by severe pain at the site of inflammation especially at the parietal pleura because it's very sensitive to pain, touch and temperature.

Pathological cases related to the pleural cavity:

Pneumothorax (air filling the pleural cavity because of injury like a stab wound that penetrates the pleura or by a catheter in the subclavian vein at the apex), which causes the lungs to collapse.

-The pleural cavity between parietal pleura and visceral pleura (visceral pleura is adherent to the lungs) can also be filled with fluid leading to **pleural effusion** (due to trauma, infection, cancer or could be spontaneous) and



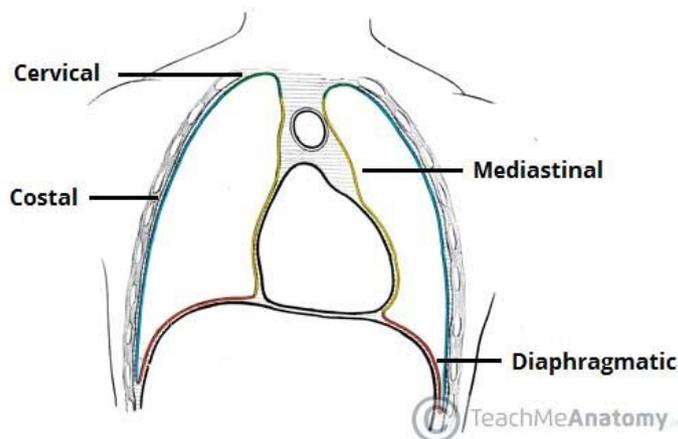
this fluid should be removed by aspiration using (under water seal drainage using bottle and tube explained later in this sheet).

Empyema is pus accumulation in the pleural cavity following a severe infection, also this should be drained.

Haemothorax is blood in the pleural cavity (also due to trauma or stab wound), needs to be treated.

Types of parietal pleura

These types are according to the site of the pleura. *The names given to the parietal pleura correspond to the parts of the wall with which they are associated.* Accordingly, the parietal pleura is divided into:

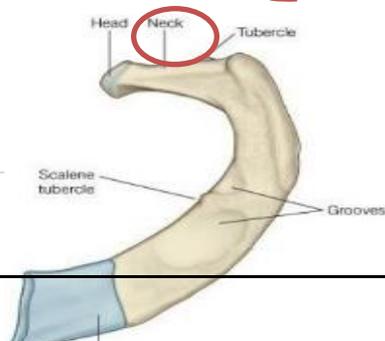
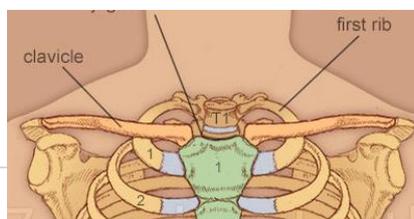


1-Cervical pleura: (dome of pleura or pleural cupola) at the root of the neck, related to cervical vertebra, covers the apex of the lung. The parietal pleura here is adherent to the visceral pleura and the lungs, which means there's no pleural space. This pleura is covered by suprapleural membrane (also called Sibson's fascia explained later in this sheet) is part of the deep fascia at the root of the neck, it acts like a roof to the thoracic cavity and adherent to the apex of the lung. The pleural cavity superiorly is 1 inch (2.45 cm) above the medial 1/3 of the clavicle or 3-4 cm above the first costal cartilage (the 1 cm difference between the clavicle and first costal cartilage is because the clavicle is higher), *but does not extend above the neck of the first rib because of the inferior slope of rib 1 to its articulation with the manubrium.* (see the pic below to get it better).

2-Diaphragmatic pleura: at the base of the lung covers the diaphragmatic surface of the lung.

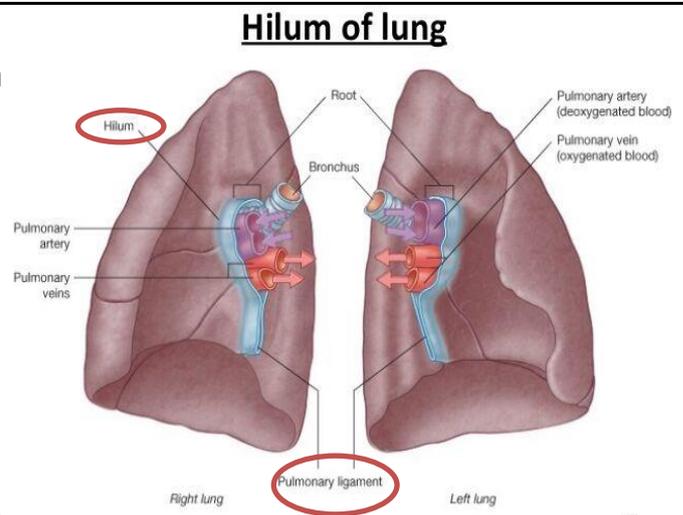
3-Costal pleura: at the parietal and the lateral side related to the costal cartilages and ribs.

4-Mediastinal pleura (30:00): covers the mediastinal surface of the lung, in this part of the pleura, the two pleural layers become one and sleeve around the hilum of the lung (at level T5-T7), and at the lower part forms the pulmonary ligament below the hilum.



So, between T5 to T7 the mediastinal pleura surrounds the root of the lung or the hilum forming pulmonary ligament.

Recesses are explained later in this sheet.



Peripheral reflections (= recesses):

Anteriorly, the pleurae of both lungs approach each other posterior to the upper part of the sternum > then they turn back to form mediastinal pleurae > this forms a reflection

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. So, the pleurae of both lungs come close to each other except at the cardiac notch, where the heart bulges and pushes the left pleura 1 cm to the left.

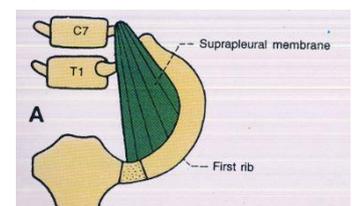
Inferiorly, the costal pleura reflects onto the diaphragm above the costal margin

Surface anatomy of the pleura

The anterior border of the lung is covered by pleura that goes towards the sternocostal cartilage (sternoclavicular joint), then to the angle of Louis (sternal angle) all the way to the inferior border of both pleurae at the 7th costal cartilage (remember the lung ends at the 6th costal cartilage, thus the pleurae are lower than the lungs). One difference between the right and left side is that the anterior border on the right side goes to the midline, while the left side goes along cardiac notch (between 4th & 6th costal, one cm to the left) , which takes on the same shape as the lungs: a circle with a radius of 0.5 inch.

The surface anatomy of the base (lower border) of the pleura is always lower than the lungs by two intercostal spaces.

Suprapleural membrane



-Fibrous sheath which covers the apex (dome) of lungs and visceral pleura.

-Attachments (imp):

a- Laterally: the *medial* (inner) border of first rib *and costal cartilage*.

b- Medially: blends with the deep or the investing fascia or Sibson's fascia of the neck.

c- Superiorly (apex): attached to the transverse process of **C7**.

-Functions (imp):

a-Protects cervical pleura and apex of lung

b-Resists changes in the intrathoracic pressure during respiratory movements = ceiling of the thoracic cavity because it has an attachment.

-The suprapleural membrane holds the diaphragm when it descends and ascends to control the changes in pressure produced by this respiratory movement.

-Inspiration caused by the descent of the diaphragm downwards by active contraction of diaphragm > decreases the intrathoracic pressure below the atmospheric pressure > air rushes in and inflates the lungs.

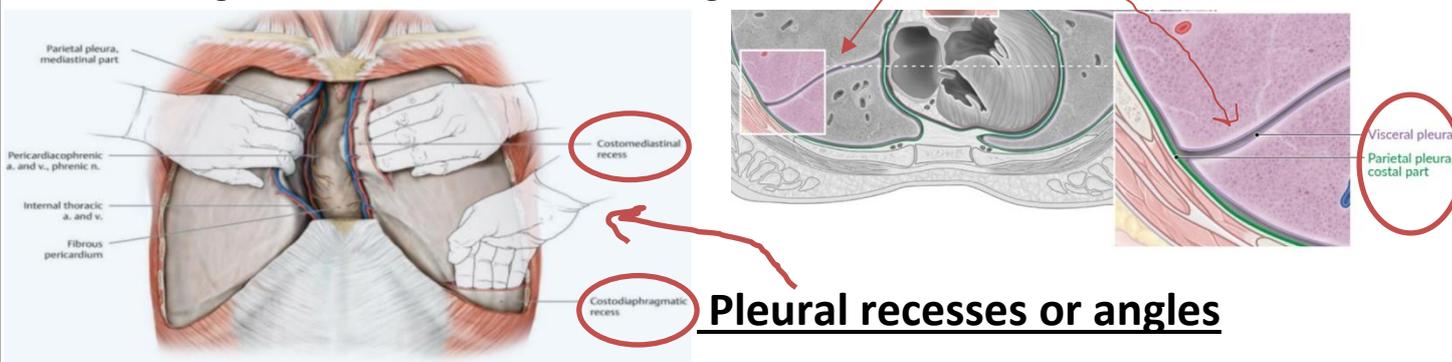
-Expiration (the opposite) caused by the ascent of the diaphragm upwards by passive relaxation of the diaphragm > increases the intrathoracic pressure above the atmospheric pressure > air goes out and deflates the lungs, because of the elastic and reticular fibers the lung decreases in size.(40:00)

Visceral pleura

-Continuous with parietal pleura at the hilum of each lung (mediastinal surface) *where structures enter and leave the organ*

-Firmly attached to the surface of the lung, including *both opposed surfaces of the fissures*. (visceral pleura descends deeply along with fissures, on the other hand, parietal pleura crosses over the fissures)

*Each lung has fissures that divide the lungs into lobes.



Pleural recesses or angles

- The pleura is a sac, so the continuation of each part of this sac with form peripheral reflections or “recesses”: an angle between two types of parietal pleura.

-The lungs do not completely fill the inferior regions of the pleural cavities > this results in recesses in which two layers of **parietal pleura** become opposed.

1- Costal pleura + diaphragmatic pleural junction > **costodiaphragmatic recess** = the largest and most clinically important recesses (*between the inferior margin of the lungs and inferior margin of the pleural cavities*). It's 1 inch in the midclavicular line, 2 inches

in the scapular posterior line and 3 inches in the **midaxillary line** (the preferred place for aspiration because it's the longest and the most common site of fluid and pus accumulation).

2- Costal + mediastinal pleural junction > costodiaphragmatic recess (on the medial and lateral side). *The largest is on the left side in the region overlying the heart.*

3- Mediastinal and diaphragmatic pleura will form mediastinodiaphragmatic recess.

-Expansion of the lungs into these spaces usually occurs only during forced inspiration so *they are deepest after forced expiration and shallowest after forced inspiration.* The inflation is mainly downward to fill the spaces of the pleura. Lungs don't go upwards but go a little bit anteriorly, inferiorly, and posteriorly.

-Provide potential spaces in which fluids can accumulate and from which fluids or pus (empyema or serous fluid) can be aspirated by a cannula or needle between surface anatomy of base of the lung and pleura (imp).

The recesses locations where the needle or cannula to be inserted (imp):

The needle is put in the **lower** border of the **intercostal** space = upper border of rib to make sure we don't cut **VAN (intercostal Veins, Arteries, Nerves)**

1- **In the midclavicular line:** between rib space 6 and 8 = **7th intercostal**

space because in this line the inferior margin of the lung is at the level of the 6th rib and the inferior margin of the pleura is at the level of the 8th rib.

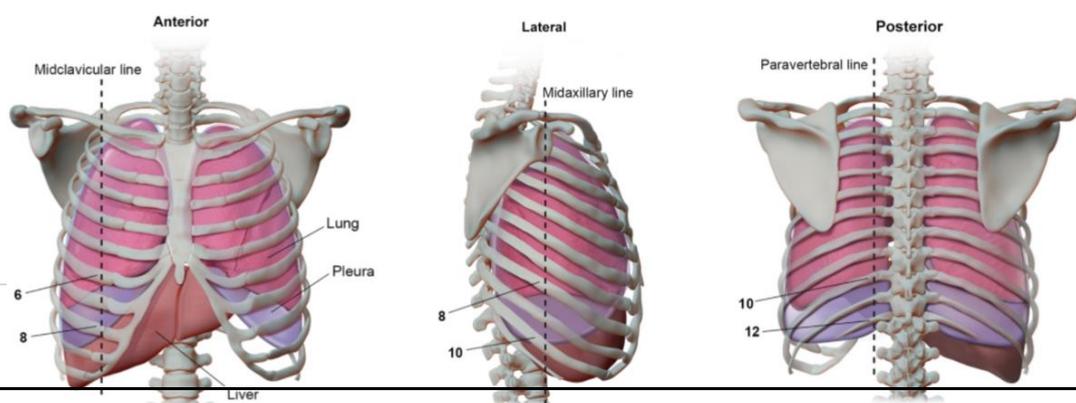
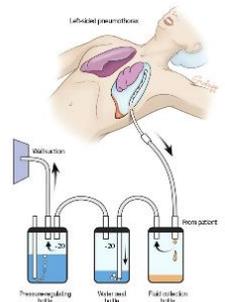
2- **In the midaxillary line:** between 8 and 10 = **9th intercostal space**

because in this line the inferior margin of the lung is at the level of the 8th rib and the inferior margin of the pleura is at the level of the 10th rib.

3- **In the paravertebral(scapular/posterior) line:** between 10 and 12 = **11th intercostal**

space because in this line the inferior margin of the lung is at the level of the 10th rib and the inferior margin of the pleura is at the level of the 12th rib and T12.

- In case of pneumothorax > aspiration of air collected in the pleural cavity by using a bottle filled with water and cannula (*underwater seal drainage*) inserted through the 7th intercostal space in the midclavicular line or in any other recesses > to suck the air out.



The pleural cavity

-Contains normally 5-10 ml of clear fluid.

-Absorbed normally by the visceral pleura by hydrostatic and osmotic pressure.

Pleural effusion (50:00)

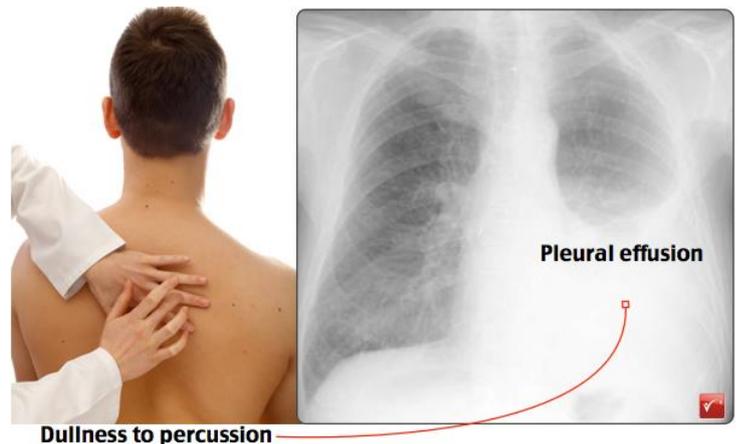
-Abnormal accumulation of fluid (more than 300 ml) in the pleural cavity and particularly in the costodiaphragmatic recess.

-Causes of pleural effusion:

- 1- Infection
- 2- Injury
- 3- Spontaneously (no obvious cause)

-Clinical manifestations:

- 1- Decrease in lung expansion
- 2- Decrease breath sound when listening using a stethoscope
- 3- Dullness in percussion because of fluid accumulation, normally there should be some resonance in percussion (drum sound) because of the air. (more about this here: https://www.youtube.com/watch?v=P4Ryk5IKf_4&ab_channel=HippocraTV)
- 4- *pain and cough(irritation)*



Nerve supply of the parietal pleura (visceral is in page 2)

-Sensitive to pain, temperature, touch and pressure

- 1- Intercostal nerves > supply costal pleura (*segmentally= for example 3rd intercostal N supplies 3rd intercostal space and pleura, the 4th inter costal N supplies the 4th space and pleura and so on*)
- 2- Lower 6 intercostal nerves > supply peripheral pleura
- 3- Phrenic nerve > supplies mediastinal pleura+ diaphragmatic pleura

Arterial supply of parietal pleura (visceral is in page 2)

-From arteries that supply the thoracic wall

- 1- Intercostal arteries (anterior and posterior) > *branches of descending aorta*

2-Internal thoracic (mammary) artery > *branch of subclavian arteries*

3-Musculophrenic arteries > *terminal branch of internal thoracic artery*

Venous drainage of pleura

-Veins drain into azygos & internal thoracic veins

Lymphatic drainage of pleura (all at the end drain into the thoracic duct)

Parietal pleura:

1-Mediastinal pleura (with hilum) by:

a- *mediastinal nodes*

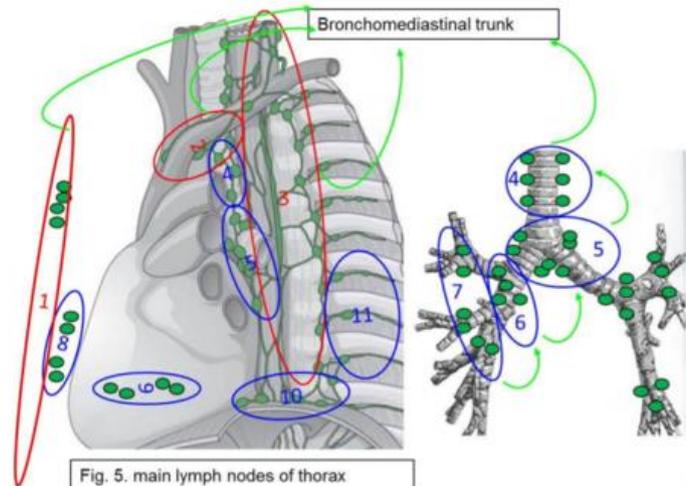
b- *Tracheobronchial nodes*

c- *Intercostal nodes*

2-Diaphragmatic pleura by:

a- *Parasternal nodes*

b- *Posterior mediastinal nodes*



Pulmonary pleura(visceral): *bronchial arteries* → *bronchopulmonary LN* > *mediastinal LN*

Past papers

Wrong about pulmonary arteries – bronchial arteries are branches of them

Wouldn't cause right lung pneumothorax – a wound stab in ninth intercostal space in midclavicular line

A needle in the right ninth intercostal space at midaxillary line wouldn't affect – A.Diaphragm B.spleen C.Lung D.Pleura E.Peritoneum

Wrong about suprapleural membrane – attaches to transverse process of T1

Wrong about the lungs – doesn't have lymph nodes

A patient had pleural effusion & a nurse did aspiration to suck the fluid at the

*midaxillary line at the **upper part of his 9th intercostal space**, the second day, he complained of tickling skin sensation that reached the skin of his abdomen, which is correct: the needle inserted for aspiration caused injury to his 9th intercostal nerve*

wrong statement: When you insert a canula in pneumothorax, it must be inserted at the upper border of intercostal space.