



RADIOLOGY

TEAM 435

Radiology of the respiratory disease

[Color index: **Important** | **Notes** | Extra]

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● Resources:

- 435 Slides
- 434 Team
- 435 Notes

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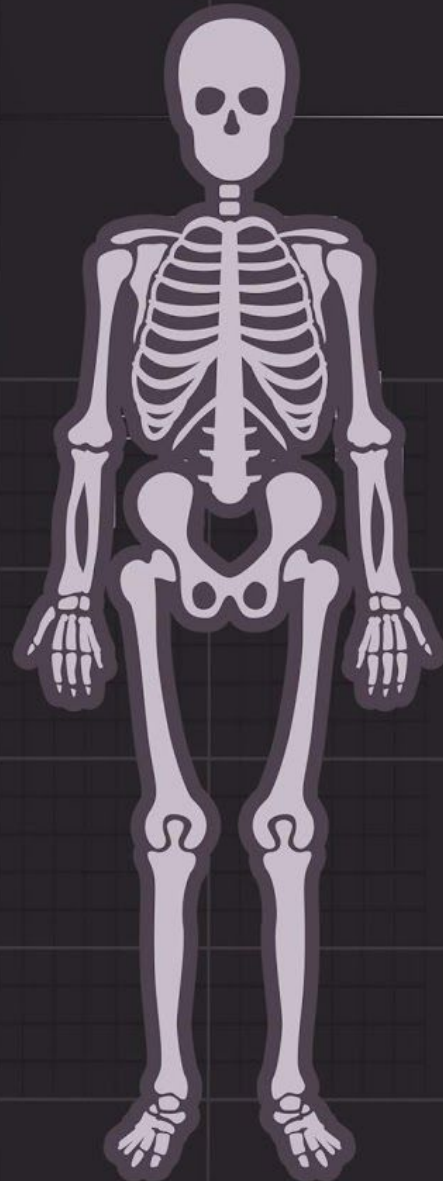
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Introduction

● Imaging Modalities for chest and CVS examinations :

- Plain film = chest x ray (CXR)
- CT:
 - a. CT for chest and mediastinum usually w. I.V contrast
 - b. High resolution CT of the chest (HRCT) for lung parenchyma
- angiography > rare used
- MRI > rare used

● CXR optimal position :

- **erect** position. to see the good distension of the lungs and see costophrenic angles + subphrenic areas

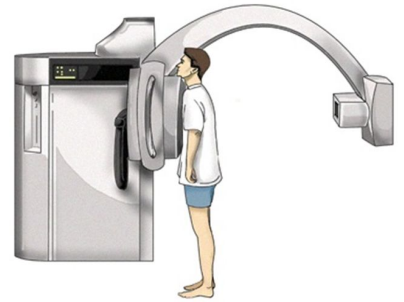
- **PA** view is **better** than **AP** view , **why?**

- 1) reduce magnification of heart therefore preventing appearance of cardiomegaly.

- 2) reduce radiation dose to sensitive organs such as thyroid , eyes and breasts

- 3) visualise maximum areas of lung and costophrenic angle

if the p. can't be in erect and we have to do it in supine position then we do **AP** view, costophrenic angle not seen clearly in AP.



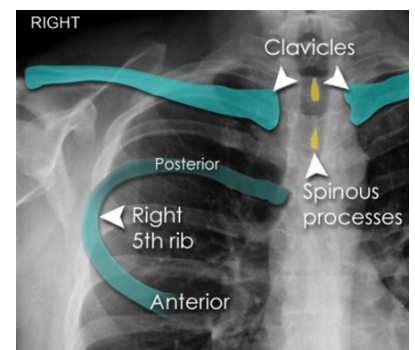
● Inspiration:

- This greatly helps the radiologist to determine if there are **intrapulmonary abnormalities**.

- The diaphragm should be found at about the level of the **8th - 10th posterior rib** or **5th - 6th anterior rib** on good inspiration.

- To make sure that the image provided is good count the ribs (**better to count the posterior ribs because they are more fixed**).

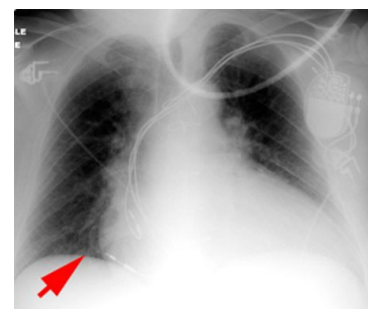
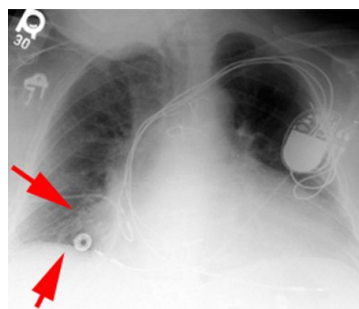
Full inspiration > the more details will be seen (low Part lesions) > optimal exam of CXR .



● hypo-inspiratory vs hyper:

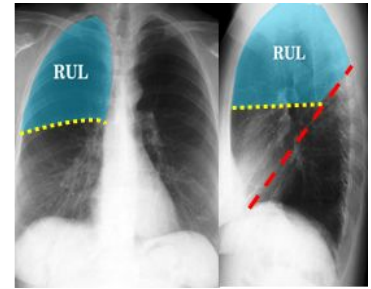
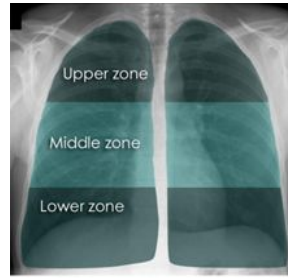
- the depth of inspiration affects the image quality, as visualization of pathology depends on contrast provided by air in the lung.

- **Left pic: it seems like there is a lesion! but after deep inspiration, It's gone ! so it's not a lesion**



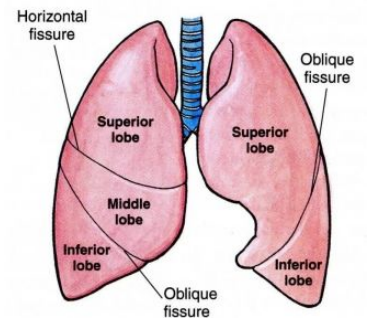
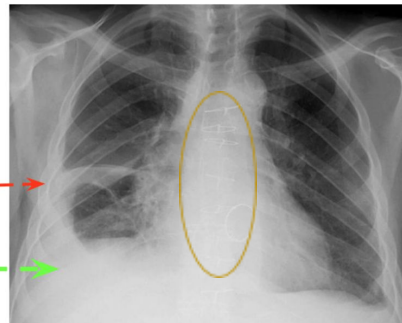
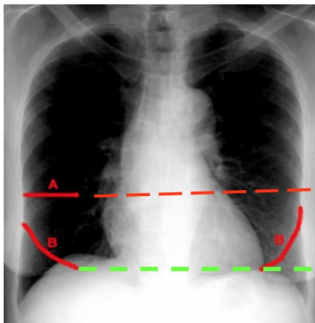
- **For diagnostic reasons the lung is divided into:**

- zones "which are not clearly divided"
- lobes "divided by fissures"
- **One of the most important things in lung X-Ray are the fissures , It has 2 benefits:**



1. It shows us the lung anatomy (upper, middle, lower lobes)
2. The fissures are movable, if they move up or down on X-Ray you may consider a pathology

How to differentiate between fissures and vessels? -> vessels are branching, while fissures continue to the lateral side.



Encysted effusion of transverse fissure (red arrow) and oblique fissures (green arrow)

The fissures outlines becomes more clear and thick as they contain fluid "in case of valve replacement" sternotomy metallic sutures > closed of open chest in valve replacement surgery "the yellow circle"

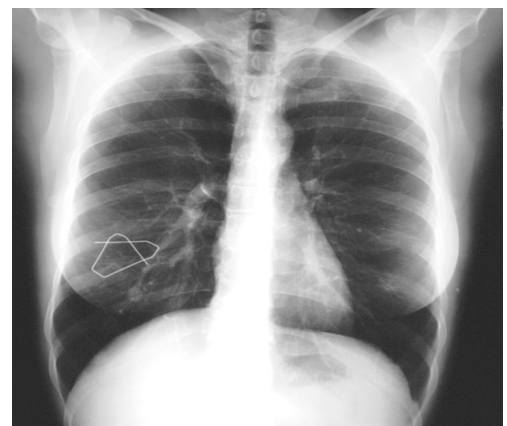
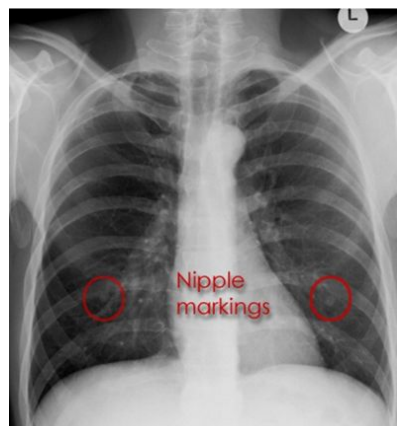
- **Is it nipple shadow or lesion ?**

Nipple shadows are often seen on chest x-rays and can be easily confused for a nodule.

If there is any doubt the easiest method of determining whether opacities represent nipple shadows is a repeat chest x-ray with nipple markers (This can be a small ball-bearing, unraveled paperclip reformed in a triangle around the nipple or other radiopaque marker) if the nodule is inside the marker, it is a nipple

How to differentiate a nipple from a pathology?

- Do CT
- Lateral view: The nipple won't appear in lateral view
- Compare the 2 sides, if it is in one side, this is a focal pathology (e.g. Intrapulmonary nodule: hamartoma)
- Paperclip around the nipple and reperform X-Ray to check if the nodule is outside the paper clip

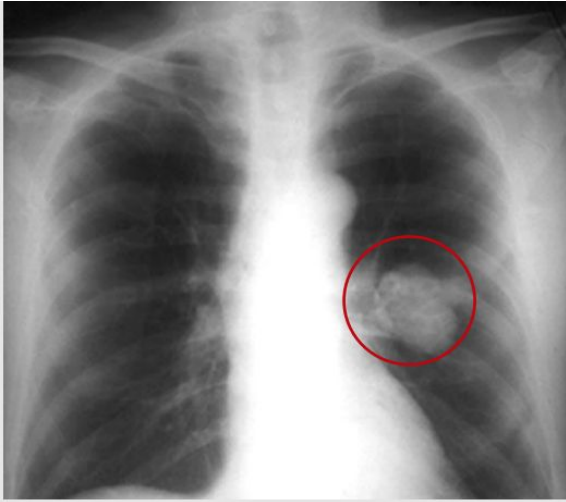
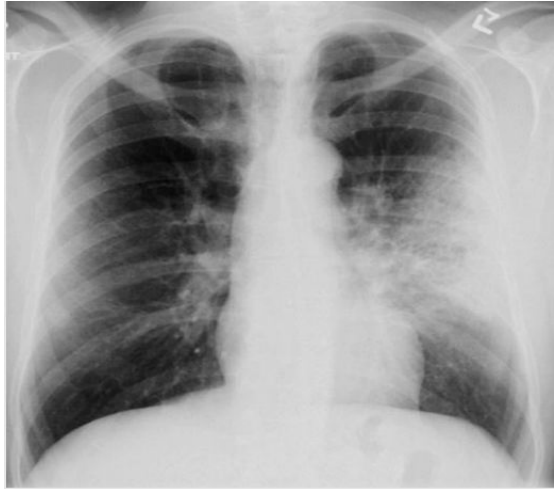


- **What are the benefits of CT scan?**
- More detailed (it shows us the lesion in 3D)
- We can see the texture of the mass (Very hypodense = fat, air, hyperdense = soft tissues)
- By the computer we can point at any area of the mass and we can know what the pointed area contains (Fat, soft tissue, fluid, calcification)
- When you give I.V contrast you can detect the pattern of enhancement, is it benign or malignant.
- In high resolution CT, we can see bronchioles and even a 1 mm abnormality

<ul style="list-style-type: none"> ● Lung abnormalities: 1. Consolidation (as pneumonia) 2. Nodules (small) 3. Mass (large) 4. Atelectasis (Lung collapse) 5. Interstitial = diffuse lung disease 	
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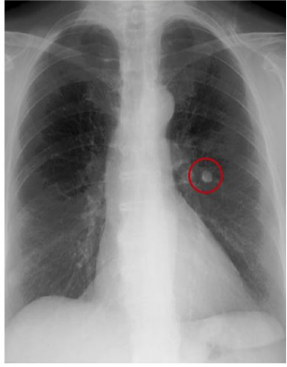

MASS Vs. Diffuse Infiltration:

- The basic diagnostic instance is to detect an abnormality.
- In both cases, there is an abnormal opacity “consolidation”


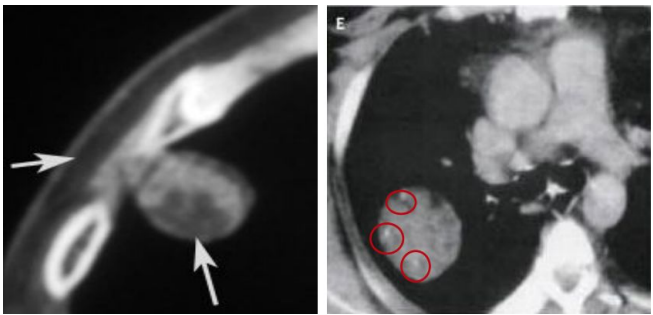
MASS	DIFFUSE INFILTRATION
	
<ul style="list-style-type: none"> - well- defined edges (clear outline) . - 3-D structure “mass like orange” . - We can see the mass in PA and lateral views which prove the 3D nature of the mass.- <p>so! The opacity here would best be described as a mass.</p>	<ul style="list-style-type: none"> - poorly defined edges (Not clear outline). - This is airspace disease such as pneumonia (diffuse disease). - Involve large space of the lung, flat and diffused. - In lateral view there will be a change in its appearance.

Solitary nodule in the lung

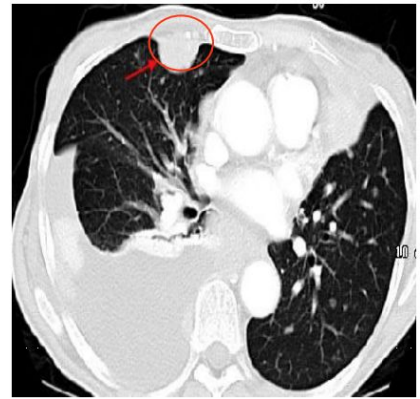
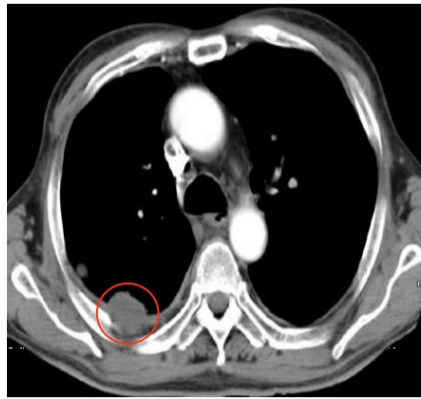
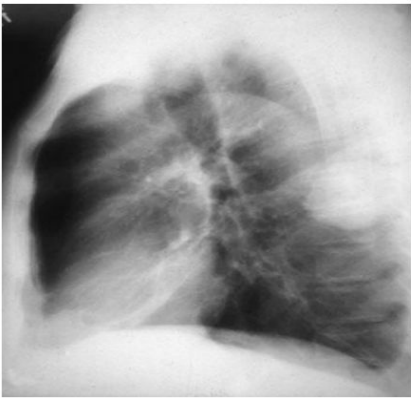
- can be totally innocuous “harmless” or potentially a fatal lung cancer
- After detection, the initial step in analysis is to compare the film with prior films if available.
- A nodule that is unchanged for **two years** is almost certainly benign
- check for the presence of **multiple nodules** as this finding would change the differential entirely.
- If the nodule is indeterminate after considering old films and calcification, subsequent steps in the work-up include ordering a CT and a tissue biopsy.

<p>Pic 1</p>  <p>Pic 2</p> 	<p>[Pic1] you can tell that there is a small rounded lesion. But is it a small infiltration or a mass lesion?</p> <p>We will do lateral view [Pic2] and we will see the lesion in 3D, we can know what is the exact location of that nodule which is anterior lung solitary nodule.</p>
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MASS

<p>We can see a mass lesion in PA view of the</p>  <p>lungs</p>	<p>And to make sure, we can do lateral view or CT scan</p> 
<p>Mass lesion like orange</p>	<p>Rounded structure (contains fat and soft tissue in other segments).</p>

PLEURAL BASED LESION

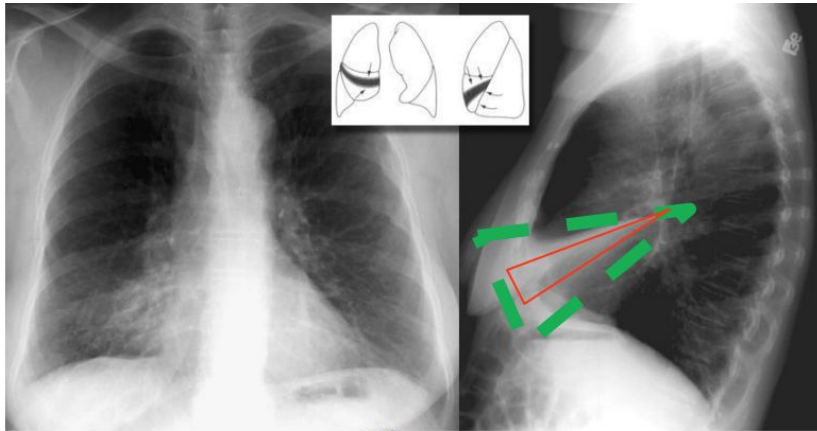


- If the mass arises from the pleura (peripheral mass) it is called "Pleural Based Lesion" by this name it can help us to minimize and know the Differential diagnosis.
- DDx of pleural based masses is either : pleural lesion or metastasis
- If the lesion in the core of the lung the first and the most important DDx is bronchogenic carcinoma

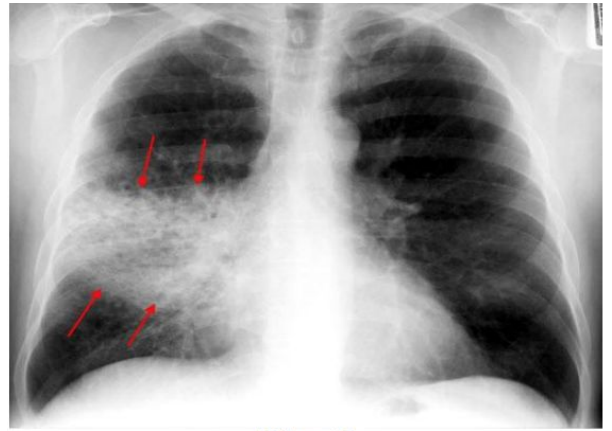
Atelectasis Vs. Consolidation

Atelectasis	Consolidation
Loss of volume of lobe, segment or subsegment of the lung.	Loss of air in lobe, segment or subsegment of the lung without loss of volume because air is replaced by inflammatory cells
Example: collapse (lung)	Example: pneumonia (lobe)
Major differentiating factors between atelectasis and pneumonia:	
<ul style="list-style-type: none"> - Volume loss (so the fissure goes up) - Associated ipsilateral shift (trachea and pleura will try to fill the collapsed area) - Linear, Wedge-shaped - Apex at hilum 	<ul style="list-style-type: none"> - Normal or increase volume - No shifting, or if present then contralateral - Consolidation, Air space process - Not centered at hilum
<p>Air bronchograms can occur in both. Sometimes consolidation and collapse happens together but it's rare, so there will be loss of volume and some replacement of air.</p>	

PNEUMONIA VS ATELECTASIS



Pic 1



Pic 2

Pic 1 : in PA view there is an area of consolidation, is there any loss of volume or not ?

We did a lateral view and we found opaque area:

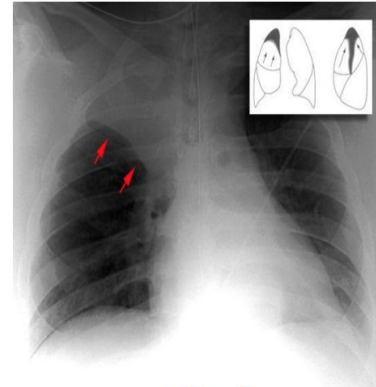
- the green line → normal position of transverse and oblique fissures.
- red line → is the collapsed right middle lobe.

We can see that there is loss of volume because the fissures has changed their position from the green to the red lines. - There is displacement of the trachea toward the side that lost the volume in atelectasis "Known as effective loss" .

Pic 2 : middle lobe consolidation typically pneumonia



Pic 1



Pic 2

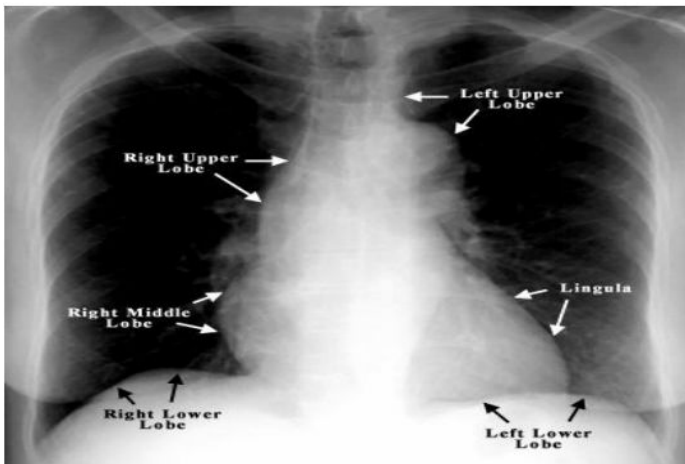
Pic 1 : diffuse area of consolidation in PA view, we don't know if there is loss of volume or no, so we will do lateral view. And the lateral view shows normal oblique fissure , so the area of consolidation that involves the upper and middle lobe is pneumonia

Pic 2 : chest X-Ray shows consolidation in the right upper lobe and very clear line (red arrow) which is transverse fissure, these finding represent upper lobe atelectasis.

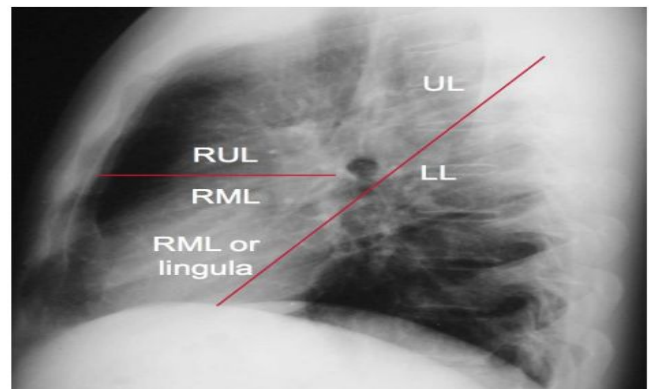
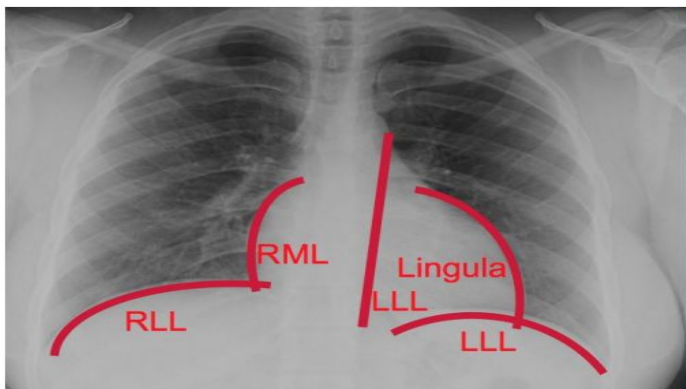
- **Recognizing air space disease:**

- ❖ Alveolar spaces filled with...something.
- ❖ Radiologist's report:
 - "consolidation"
 - "airspace opacity"
 - "fluffy density"
 - "infiltrate"
- ❖ Nonspecific:
 - Atelectasis, pneumonia, bleeding, edema, tumor.

SILHOUETTE sign : (the doctor said it's not important!!!)



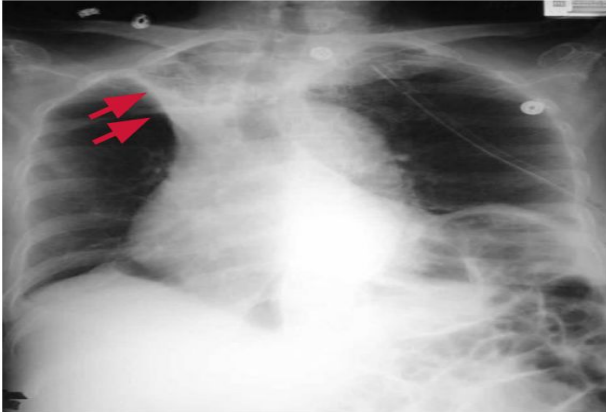
Localizing disease from the silhouette sign:



● Lobar Atelectasis:

- Best sign: shift of a fissure
- Rapid development and clearance
- Air bronchograms if non-obstructive
- Secondary signs:
 - Mediastinal shift
 - Elevated diaphragm
 - Ribs closer together
 - Vague increased density

● Right Upper lobe Atelectasis:

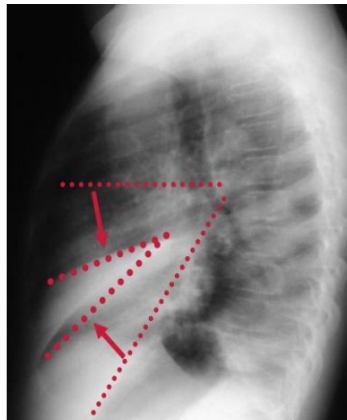


Upper Pic: patient presented with fever, they put intratracheal tube and after they put the tube, he gets dyspnea and after that chest x ray was done and they found : right upper lobe atelectasis.



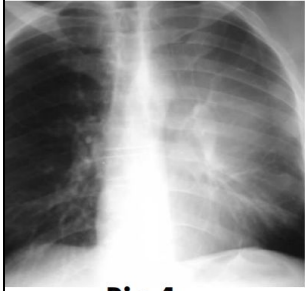
Lower Pic: The patient took antibiotic and the proper treatment. They also remove the tube and they did follow up chest x ray. They found the transverse line come back to its normal position

● Right middle lobe Atelectasis:

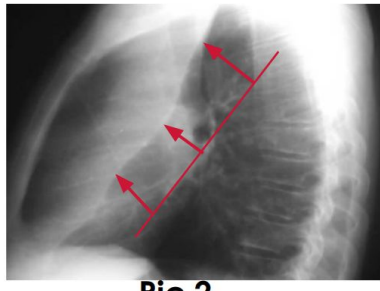


In the middle area of the right lung there is consolidation, is it collapse ? We did lateral view and we can see that the transverse and oblique fissures moved from their normal position which indicates right middle lobe atelectasis

● Left Upper Lobe Atelectasis:



Pic 1

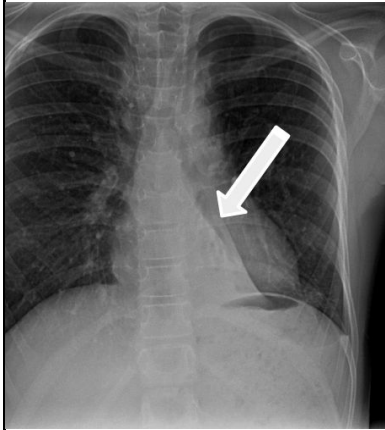


Pic 2

Pic1 : there is area of consolidation on the left lung, we will do lateral view

Pic 2 : lateral view of the lung shows a clear cutline which is the oblique fissure moved from its normal position (normal oblique line crosses the lung hilum)

● Left Lower Lobe COLLAPSE:



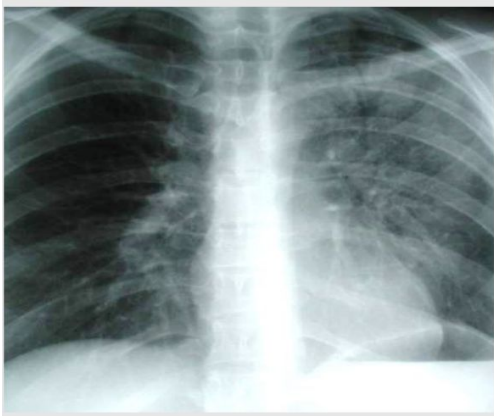
- The lungs are filled of air and also the bronchi , we can't see brachial tree because it's also filled with air as the lungs, so both appear in black color while vessels appears in white because it filled with blood.
- In case of pneumonia it appears as consolidation of lungs. The air is replaced by fluid or inflammatory cells. However. Bronchial tree remains as it is patent so we will be able to see bronchial tree on background of consolidation

PNEUMONIA

- signs :

- Air bronchogram
- Silhouette - “positive” or “negative”
- Dense hilum
- Spine sign Normally, the thoracic spine “appears” to become darker (black) as you view it from the top to bottom on a lateral chest radiographic but in **spine sign** On the lateral view, the thoracic spine appears whiter just above the hemidiaphragm
- All are signs of any air space process.
- Dx of pneumonia depends on appropriate clinical scenario.

● AIR-BRONCHOGRAM

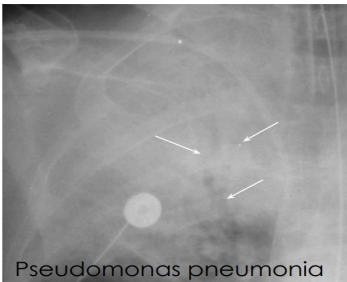


The Right lung is normal; no obvious bronchial tree, all air spaces in normal lung will have the color black on X-Ray because it contains air and also bronchial tree will appear black because in contains air.

In the Left lung there are very thin like lines “ hair branching lines “ which is bronchial tree called AIR-BRONCHOGRAM.

If there is pneumonia (left lung) the lung will be white in color because the air can’t go through the lung spaces and alveoli, but we may see bronchi in some cases because the bronchi are not affected.

● Air bronchogram sign:



- Air consolidation in the right upper lobe and we can see some dark grey lines on X-Ray (white arrows) which represent the bronchial tree
- AIR-BRONCHOGRAM very clear it’s a sign of pneumonia

Air bronchograms — CT :



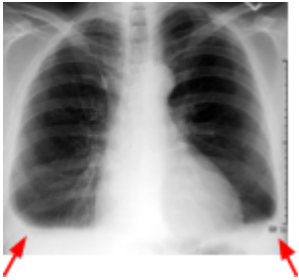
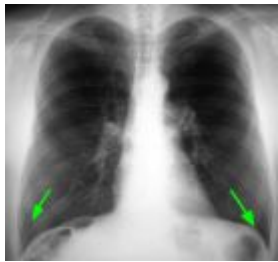
Pneumonia

The Left side is completely healthy lung and we can’t see the bronchial tree clearly because the hole lung contains air and the bronchial tree contains air so they will be all black

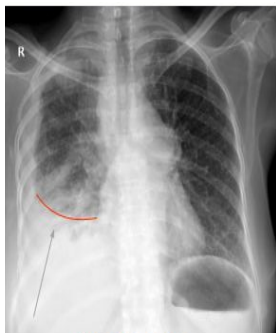
The Right diseased lung we can see consolidation and that consolidation is caused by loss of air in the lung so it will be white , but the bronchial tree is still containing air so it will be black

PLEURAL EFFUSION

- what is pleural effusion?
- when we have little fluid in the pleural cavity.



- green arrow : normal chest in which you can see costophrenic angle in both side
- red arrow : when there is a fluid in pleural cavity causing blunted costophrenic angle
- On an upright film, an effusion will cause blunting on the lateral and if large enough, the posterior costophrenic sulci. Sometimes a depression of the involved diaphragm will occur.
- A large effusion can lead to a mediastinal shift away from the effusion and opacity the hemithorax.
- Approximately 200 ml of fluid are needed to detect an effusion in the frontal film vs. approximately 75ml for the lateral.
- Larger effusions, especially if unilateral, are more likely to be caused by malignancy than smaller ones.



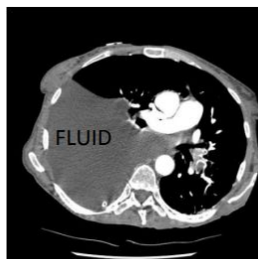
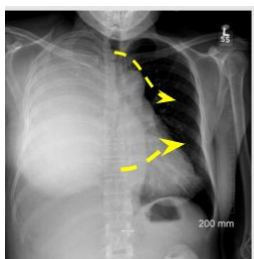
Moderate



mild

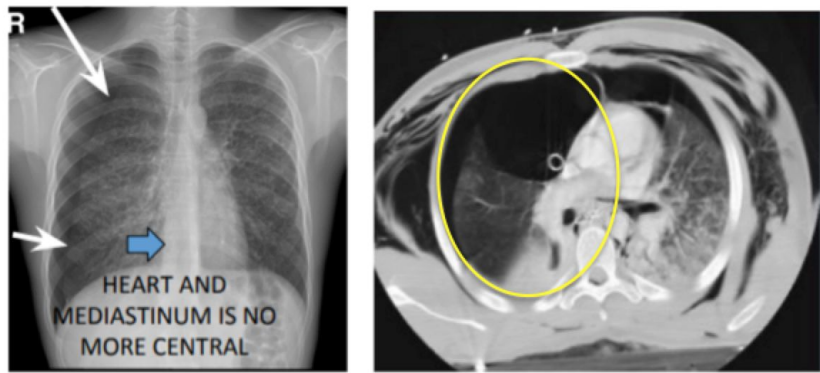
- once fluid increase it goes up in curve line level, it is **not** like a cup of water with flat line level, costophrenic angle blunted once amount of fluid increase
- The doctor mentioned an experiment we used to do in school, we bring cup of water half empty when we see it from outside we see fluid level in flat line. if we cover it and sucked air inside it it goes up in curve line (because there is no air , no pressure so it will be curved).
- naturally it has a low pressure because once fluid inside it, it will be sucked out
- always fluid in costophrenic angle given curve line however this is mild or moderate pleural effusion
- if we have mild pleural effusion we will get curve like in right picture, if we have Moderate pleural effusion we will get picture like in the left .

● SEVERE PLEURAL EFFUSION :



- The Right lung completely filled with fluid “opaque right side”.
- “Yellow arrow” Air on right side push mediastinum to the other side due to pressure
- In CT image there is fluid in right lung.
- if we insert needle it will suck out the fluid from the right hemidiaphragmatic angle. if we measure(Fluid evaluation value) you will see it as a fluid .

PNEUMOTHORAX

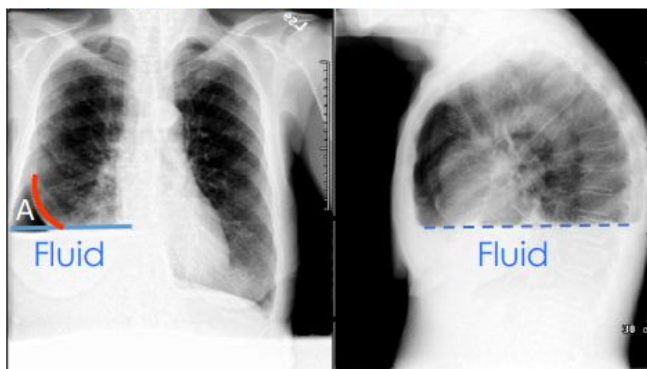


- A pneumothorax is defined as air inside the thoracic cavity but outside the lung.
- A spontaneous pneumothorax is one that occurs without an obvious inciting incident.
- pneumothorax is a serious problem you can see it as hair (pleural lines) in chest X-Ray
- air goes inside the pleural cavity that compresses lung and result in lung collapses as a result there is some sort of displacement of mediastinum from pressure as what happened with the fluid before but here air itself make a pressure and move mediastinum slightly to other side.
- if we do CT scan we can see the difference between lung that have vessels (normal) and jet black (no vessel) which air in pleural cavity > called the pneumothorax . "yellow circle"
- tension pneumothorax is huge of air that compresses the heart cause (HF) > "medical emergency"



- Right side lung with vessels .
- On the Left side (Jet black air= air in pleural cavity), takes all left hemithorax we don't have any lung here you can see the difference between Right side and Left side .

● Hydro-pneumo-thorax:



Hydropneumothorax is the only case of effusion where the fluid level appears flat (because there is air as well)

- **hydro = water , pneumo=air**

In Hydro-pneumo-thorax air + fluid level appears **flat** we have three things in right side: air – fluid level , above it jet black air. so we have fluid, air and the lung.

EMPHYSEMA

- **what is it ?**
- loss of elastic recoil of the lung with destruction of pulmonary capillary bed and alveolar septa. It is caused most often by **cigarette** smoking and **less** commonly by alpha-1 antitrypsin deficiency.

- Patient with emphysema take deep inspiration and can't expire it out this will cause distention of the lung all the time will be full with air .
- Ability to take short inspiration and expiration.
- Cyanosed and has problem in inspiration and most of the times will be in ER.
- leads to cor pulmonale.

EMPHYSEMA



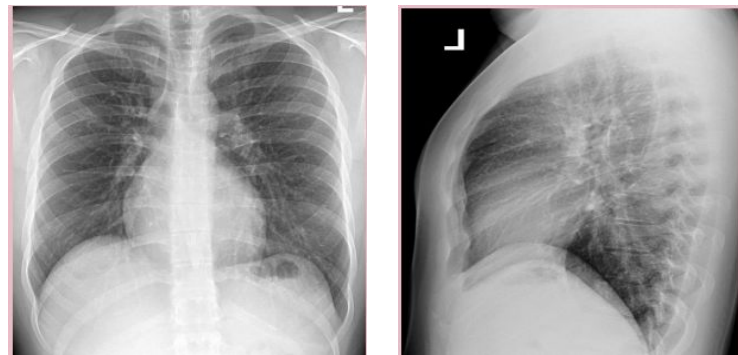
- elastic recoil of lungs is lost .
- lung is rigid, there will be difficulty in exhalation of that air as a result distention of lung.

CXR:

- diaphragmatic cupola "dome" flatten
- heart decreased in size
- retrosternal air space increases.
- Increased Lung Volume
- Flattened Diaphragms
- Barrel chest
- Small Vessels
- Small, narrow cardiac shadow.
- diffuse hyperinflation
- bullae (lucent, air-containing spaces that have no vessels that are not perfused)
- enlargement of PA/RV (secondary to chronic hypoxia) an entity also known as cor pulmonale.

Hyperinflation and bullae are the best radiographic predictors of emphysema.

Normal



normal recoiling and emptying of the air without exertion

CXR:

- diaphragmatic cupola curved in lateral and front view
- heart broad
- retrosternal air small and