



431

## Radiology Team

Leader: Lama AlShwairikh

Sub-leader: Abdulaziz Almutair

## Lecture 4&5: Radiologic Investigation of Chest and CVS diseases (Part 2)

Done By: Ebtihal Alamer

Revised By: Lama AlShwairikh & Abdulaziz Almutair



◆ Important

◆ Doctor's notes

◆ Team's notes

\*We thank 430 Team for their helpful notes\*

From Slides

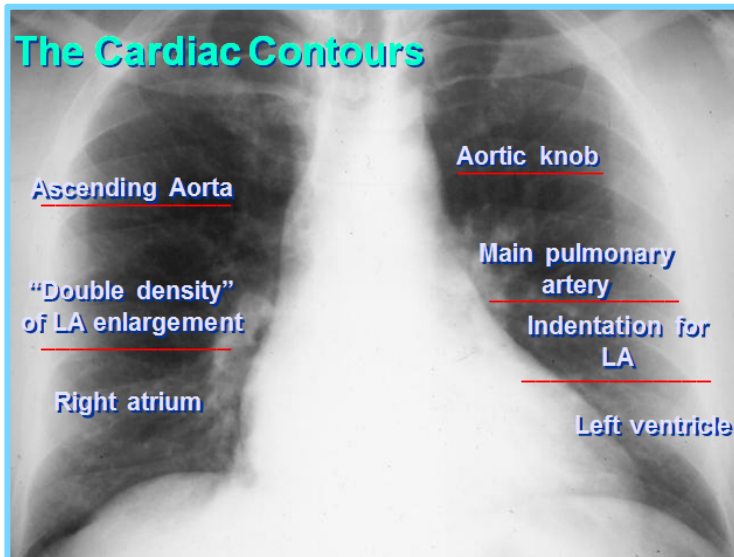
Extra Images

P.S. The doctor skipped some slides. When asked, he said that we only need to know what he explains. So, we've only added that.



- The role of chest x-ray in cardiac assessment is very limited, but the main role of chest x-ray in cardiac assessment is **to detect the effect of cardiac conditions on the lungs, parenchyma & pulmonary vessels.**

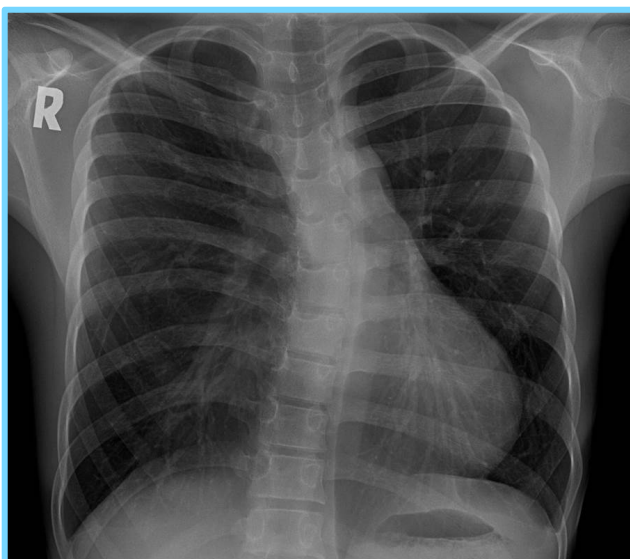
## The Cardiac Contours



The top 5 are the most important in making a diagnosis

- In normal adult, **2/3 of the heart is located in the left side whereas 1/3 of the heart is in the right side.**
- In children, **1/2 of the heart is in the left and the other 1/2 in the right side.**
- Otherwise than that, it will indicate abnormality.
- Left cardiac contour is mainly formed by Left Ventricle & Aortic Knob (knuckle).
- Right cardiac contour is mainly formed by Right Atrium & Ascending Aorta.

## Cardiac displacement :

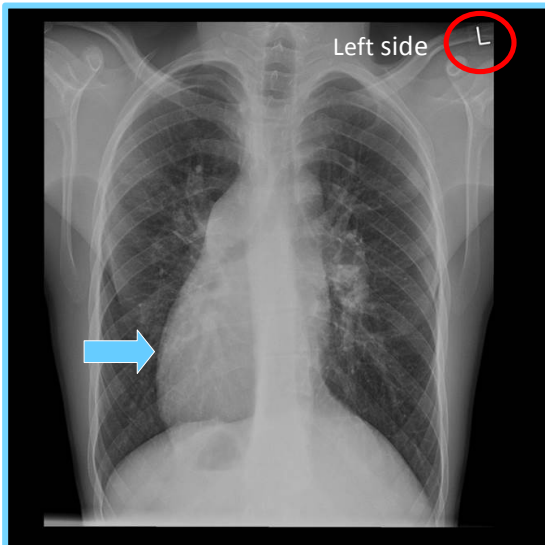


- Normally, the vertebra is mild kyphosis (anterior-posterior kyphosis) (S shaped).
- Any deviation of vertebra to the right or left is scoliosis.
- Here we have a scoliosis deviated to the left. (you have to mention in which side the deviation is)
- The heart is also deviated → to insure the reason of its deviation we do lateral CXR.

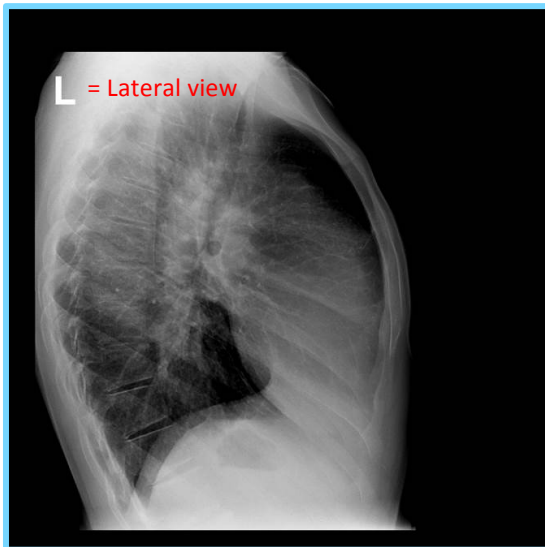


- Lateral view CXR reveals that this patient is also having a **Pectus Exavatum** → and it is the actual cause of heart deviation in addition to the scoliosis.
- **Pectus Exavatum** : is the most common congenital deformity of the anterior wall of the chest, in which several ribs and the sternum grow abnormally "**depressed sternum**". This produces a caved-in or sunken appearance of the chest.

**Dextrocardia :**

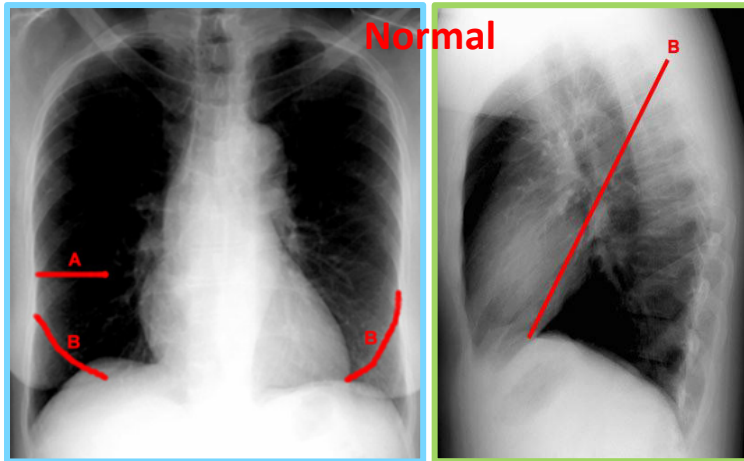


- **Dextrocardia** is a condition in which the heart is located in the right side.
- **Situs inversus** is a rare congenital condition in which the major visceral organs are reversed or mirrored from their normal positions.

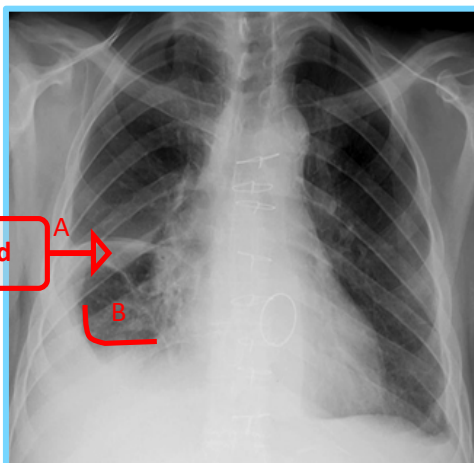




## Fissures :



- The fissures are not seen in normal x-rays (only in 30% of Pt)
- If we know the location of each fissure we can also know which lobe is involved (in case of any lung diseases).
- Always COMPARE both lungs looking for an abnormality.
- On the PA chest x-ray, the Transverse (A) fissure divides the right middle lobe from the right upper lobe and is sometimes not well seen. There is no Transverse fissure on the left.
- The Oblique fissures (B) are usually not well seen on the PA view because you are looking through them obliquely. If there is fluid in the fissure, it is occasionally manifested as a density at the lower lateral margin



<- Abnormal (pleural effusion)

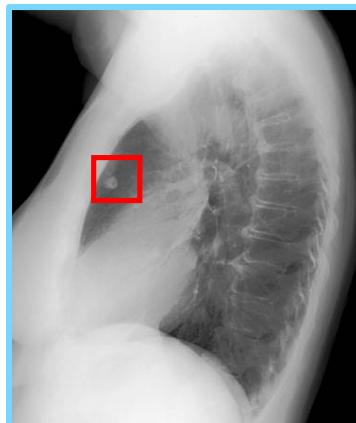
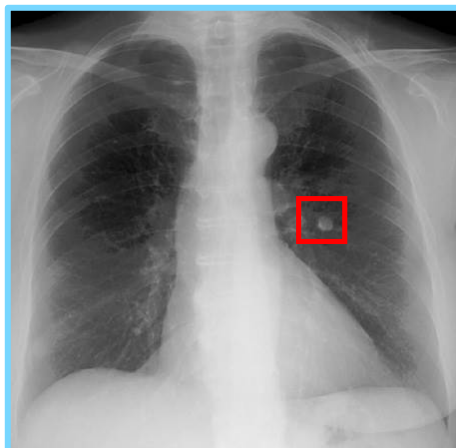
## Mass Vs. Diffuse Infiltration :



- The basic diagnostic instance is to detect an abnormality.
- In both cases, there is an **abnormal opacity in the left upper lobe**.
- The main difference is in **the edges**. It is important to differentiate between the two for the differential diagnosis.
- In the case ABOVE, the opacity would be best described as a **mass**, because its **EDGES** are well defined 3-D STRUCTURE. (Could be a tumor or abscess)
- The case BELOW, the opacity is **poorly defined Diffuse Infiltration**). Seen in airspace diseases such as **pneumonia**. (Most of the time with inflammatory diseases (like pneumonia), but sometimes it can be seen in a tumor)
- Radiologists also depend on clinical data. E.g. if the second image was for an **old** patient with **no fever**, neoplasm would be suspected. Pneumonia wouldn't be as much, because fever is not a common symptom in older adults.  
<http://www.webmd.com/lung/tc/pneumonia-symptoms>



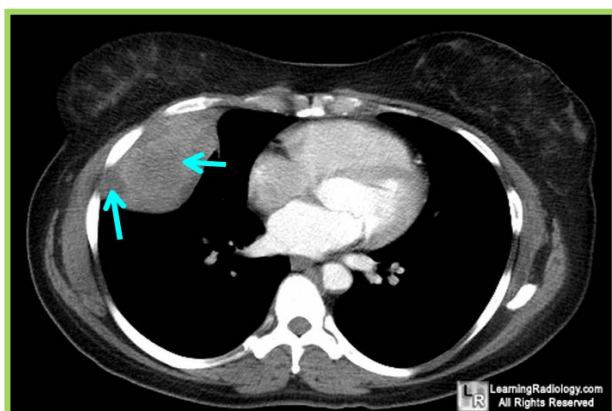
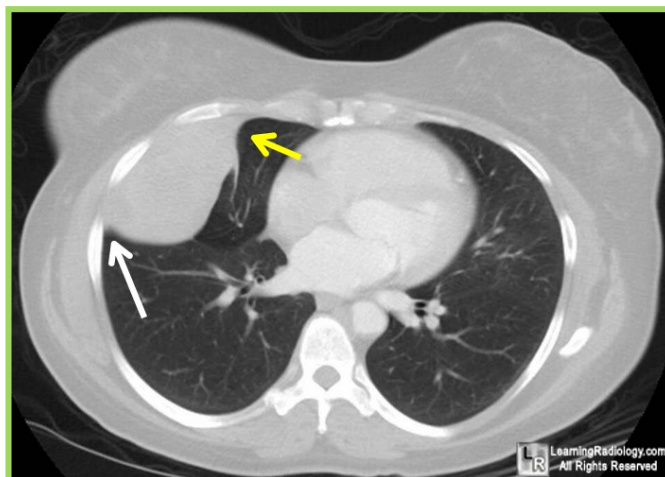
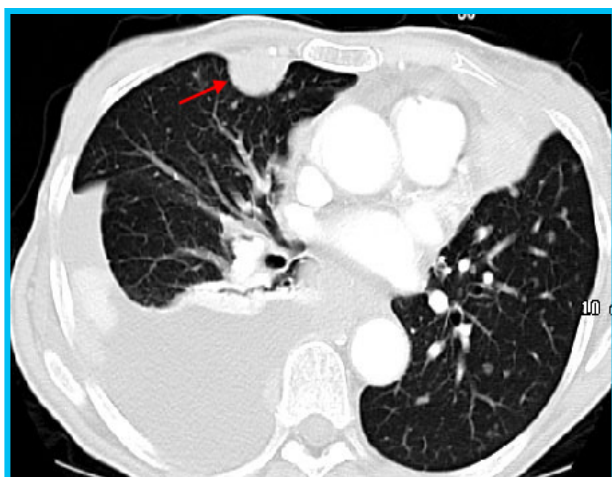
## Solitary Nodule in The Lung: \*solitary = single, Nodule = opacity with margins



- Solitary = Single.
- Nodule: opacity with demarcated margins (has 3D Dimension)
- A solitary nodule in the lung can be totally innocuous 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. Be sure to evaluate 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.

## Pleural Based Lesion

Mentioned only  
by male's doctor



Mediastinal windows show heterogeneous nature of the contrast-enhancing mass with some areas of lower attenuation (blue arrows) most likely representing necrosis.

**Localized Fibrous Tumor of the Pleura.** Large, pleural-based soft tissue mass abuts pleura in right lower lung with an acute angle (white arrow) and obtuse angle (yellow arrow) where it meets the chest wall.

# DEFINITIONS

## Atelectasis

- **Atelectasis: Loss of volume** of lobe, segment or sub segment of the lung. (e.g. : Atelectasis of the upper lobe, Atelectasis of the right lung & Sub segmental Atelectasis )
- Example: **collapse (lung)**
- **Most Common Cause:** Bronchial obstruction, Pneumothorax & Pleural effusion.

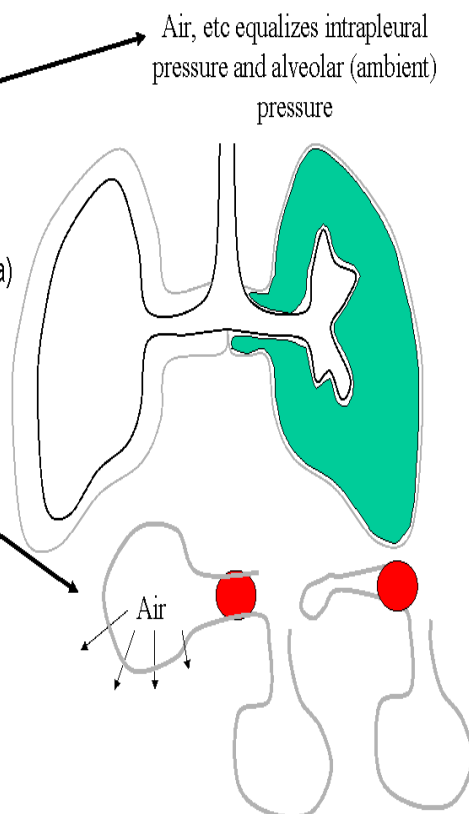
## Consolidation: = dense & solid

- **Consolidation: Loss of air in lobe,** segment or sub segment of the lung.
- Example: **pneumonia** (lobe), tumor, TB, heart failure, infections.
- **Other common causes:** Infarction, Contusion & Immunological Disorders

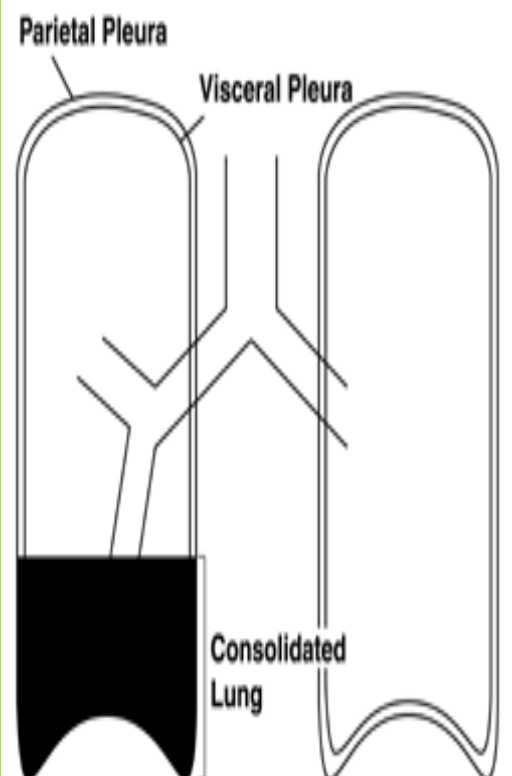
Atelectasis	Consolidation (pneumonia)
<ul style="list-style-type: none"> <li>- Volume <b>loss</b></li> <li>- Associated with ipsilateral shift.</li> <li>- Linear, wedge-shaped.</li> <li>- Apex at hilum.</li> </ul>	<ul style="list-style-type: none"> <li>- <b>Normal</b> or ↑ volume</li> <li>- No shift or contralateral (if presented)</li> <li>- Consolidation, air space process.</li> <li>- Not centered at the hilum.</li> </ul>
Air bronchograms can occur in both	

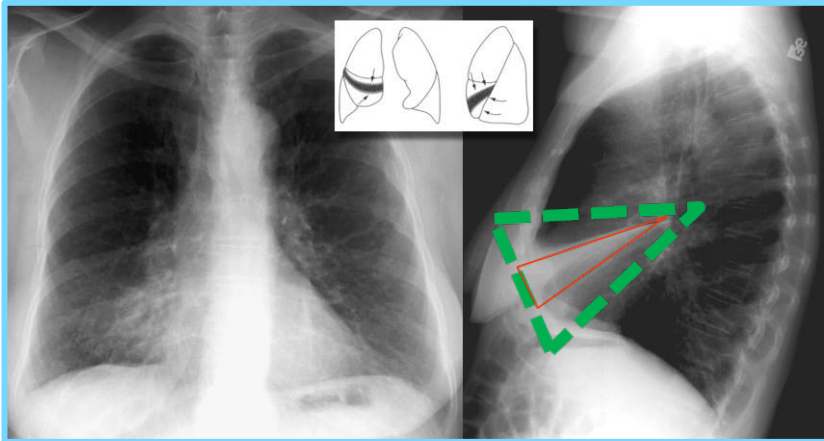
### Atelectasis

1. Compression
    - a. Tumor/mass
    - b. Pleural Effusion
      - transudative
      - suppurative/empyema)
    - c. Pneumothorax
      - (1) Trauma
      - (2) Spontaneous
    - d. Hemothorax
  2. Absorption or Obstructive
  3. Contraction
    - scars
  4. Patchy
    - loss of surfactant
- tx: deep breathing



### CONSOLIDATION





- **Green lines** a normal fissure
- **Red lines** an actual fissure as appeared in x-ray
- There is a **shift of the fissures** toward each other, **loss of volume** (Atelectasis)
- ↑ Opacity (density) in the right lower lobe



There is ↑ in density in the right Middle lobe without loss of volume + there is no shift of the transverse and oblique fissure (**red arrows**) + trachea is slightly moved to the other side → **consolidation (pneumonia)**.

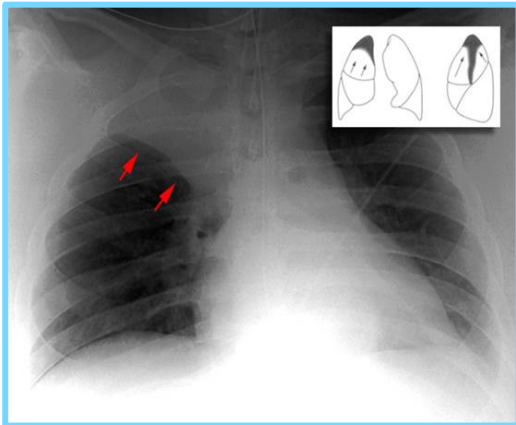
### Example 1:



- PA view shows ↑ in density in the right upper + middle lobe. (Above the transverse fissure).
- Lateral view: there is no shifting of the fissures → no volume loss → **consolidation (pneumonia)**.

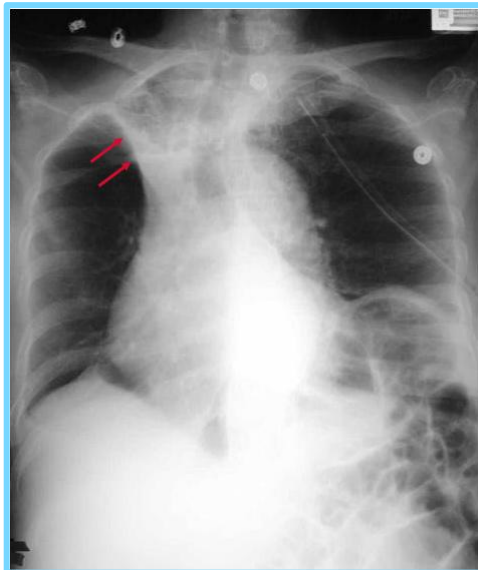


**Examples 2:**

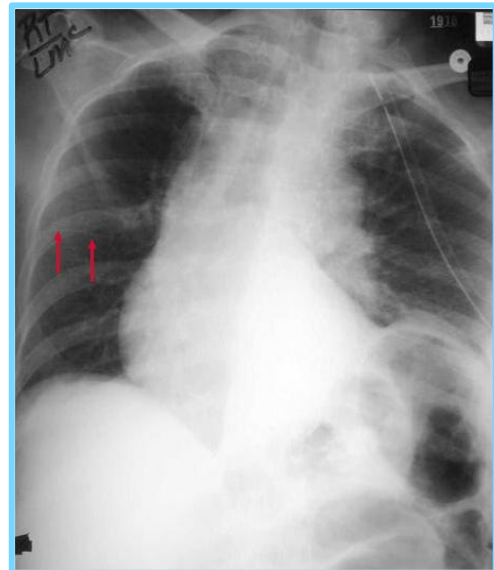


- There is  $\uparrow$  in opacity in the Right upper lobe + the transverse fissure is moved upward (red arrows)  $\rightarrow$  **Atelectasis of the Right upper lobe.**

**Example 3:**



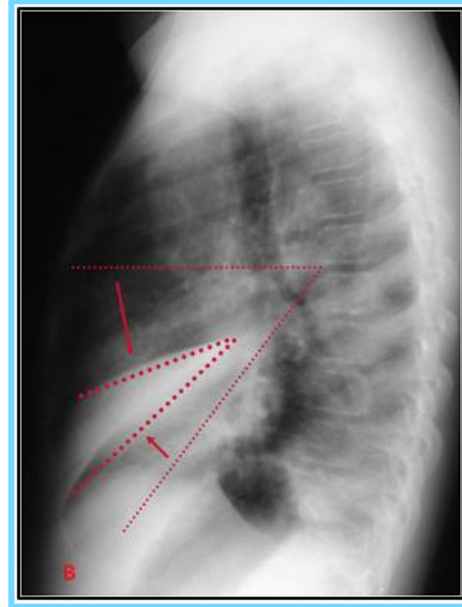
There is a shift in the transverse fissure (red arrows) caused by upper lobe collapse in the right lung  $\rightarrow$  **Right Upper Lobe Atelectasis. (RUL Atx)**



After treatment  $\rightarrow$  the shifting has disappeared after treatment.

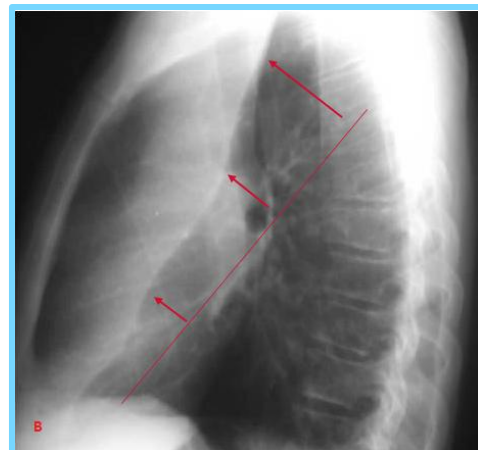
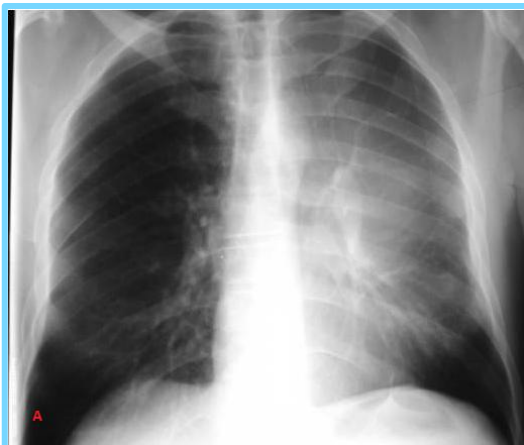
- In atelectasis, the trachea and the heart are deviated toward the affected side.  
<http://emedicine.medscape.com/article/296468-clinical#a0217>
- An example of right tension pneumothorax, the mediastinum is displaced to the left. (Step-Up to Medicine. 3<sup>rd</sup> edition. Page 87)

**Example 4:**



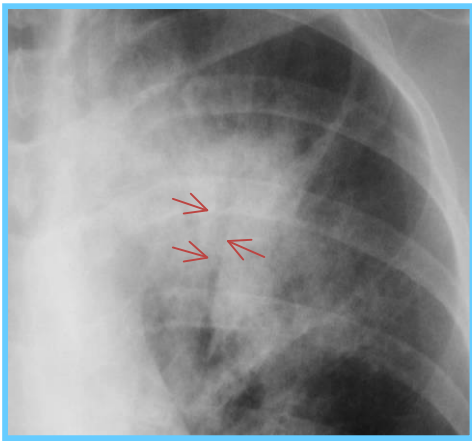
- In A (PA view) → there is ↑ in density in the middle lobe of the right lung.
- In B (lateral view) → there is a shifting in both transverse and oblique fissures which indicates loss of volume of the middle lobe → **Right Middle Lobe Atelectasis (RML ATx)**.

**Example 5:**

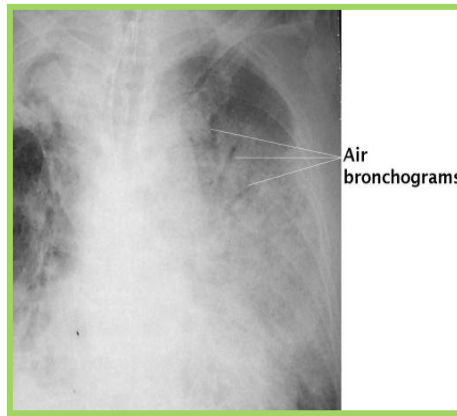


- In (A) abnormal left lung with no displacement of the trachea.
- In (B) the oblique fissure is moved from its normal site (**red line**) to upward toward the collapsed side (**red arrows**) **Left Upper Lobe Atelectasis (LUL ATx)**.

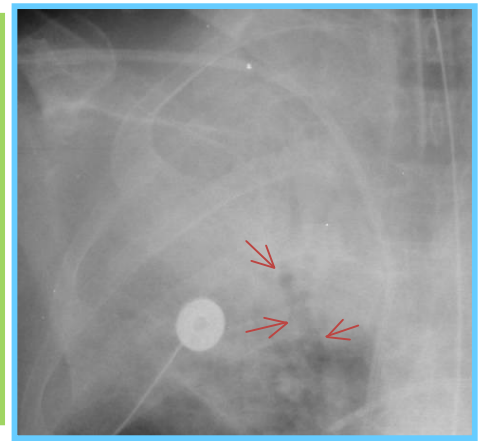
❖ **Air bronchogram sign:** is a sign of air space disease or consolidation.



Lung Cancer



Air bronchograms



Pseudomonas Pneumonia

### Air bronchograms - CT:

Air bronchogram



Blood Vessels

DX:Pneumonia

You can see bronchial tree black in color d/t surrounding whitish diseased lung parenchyma

Air bronchogram is Important because if you have consolidation like this with no air bronchogram, it means that the bronchial tree is obstructed by a tumor.

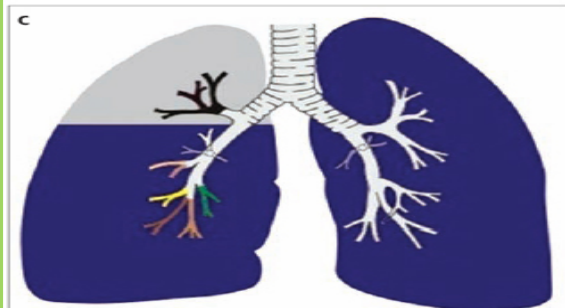
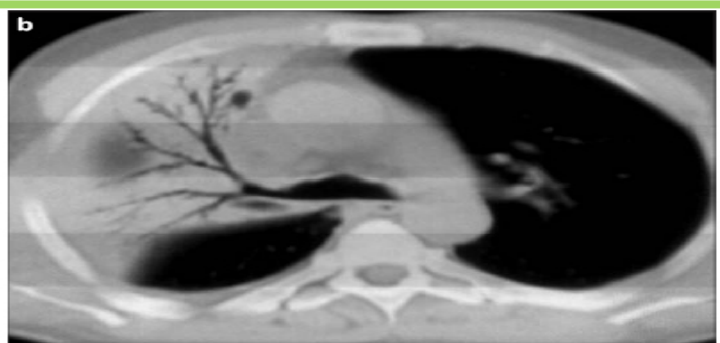


Figure 1. a-c. Air bronchogram sign. a. Chest X-ray of a patient who had radiotherapy for breast cancer. Consolidation with air bronchograms (arrows) due to radiation pneumonitis at the upper lobe of the right lung. b. Air bronchogram sign on CT. c. Illustration of air bronchogram sign.



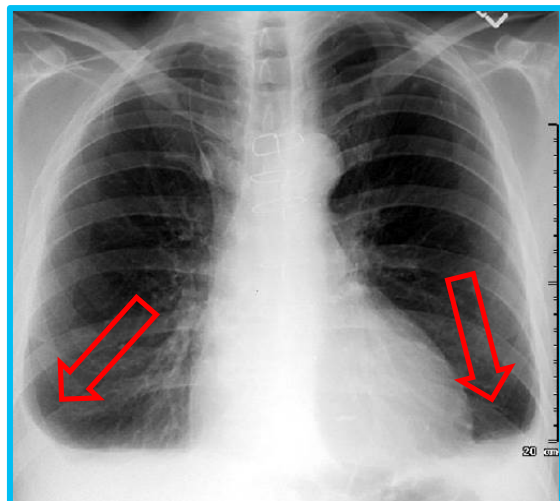
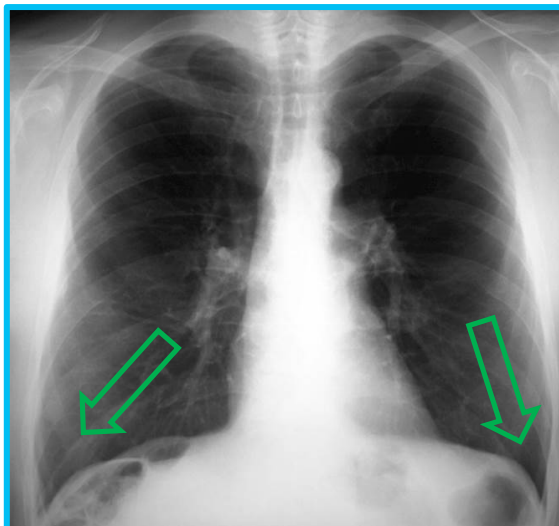
## Lobar Atelectasis:

- 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

The doctor didn't mention this. But it seems helpful.

## Pleural Effusion:

- Compare costo-phrenic angles :



The costo-phrenic angle is the most dependent part of the pleural cavity. If there's a collection of water, it will be blocked.

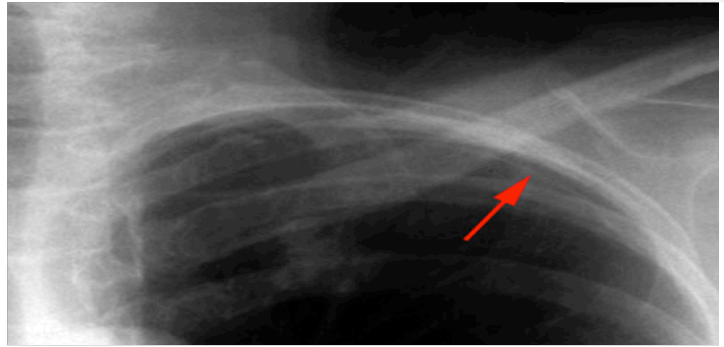
The doctor didn't mention this. But it seems helpful

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. Larger effusions, especially if unilateral, are more likely to be caused by malignancy than smaller ones.

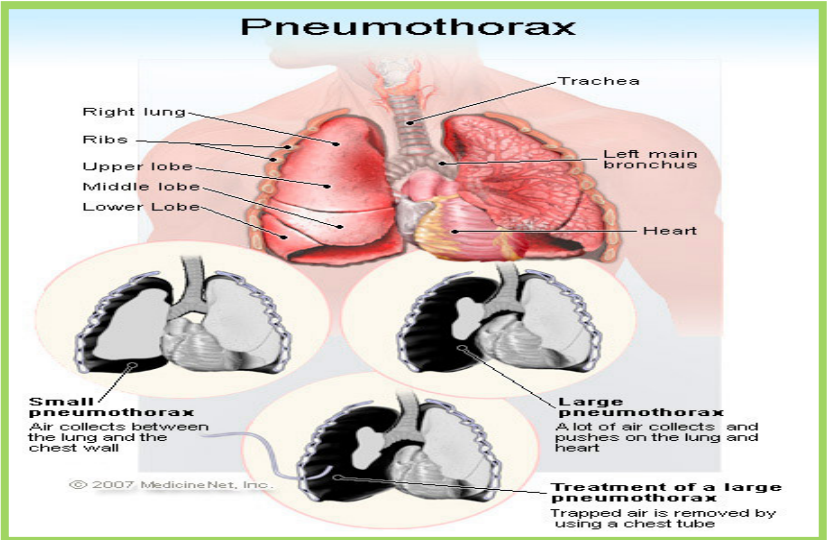
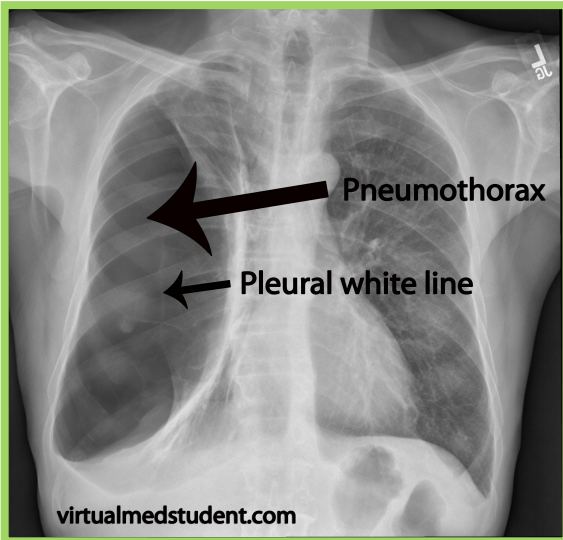
# PNEUMOMEDIASTINUM Vs PNEUMOTHORAX

Mentioned only  
by male's  
doctor

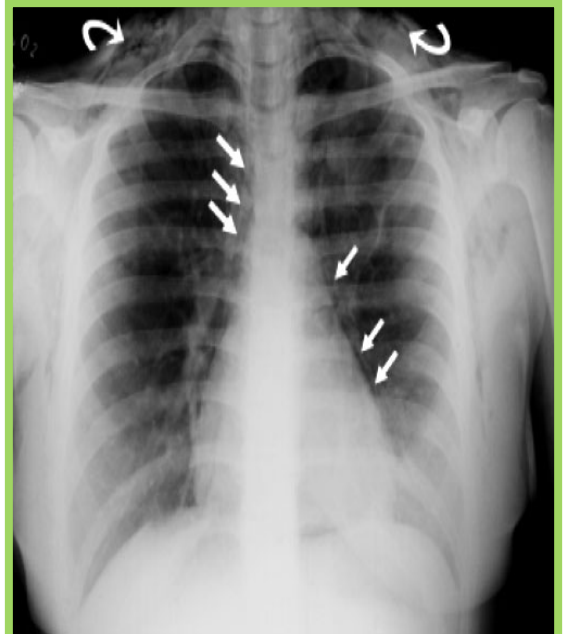
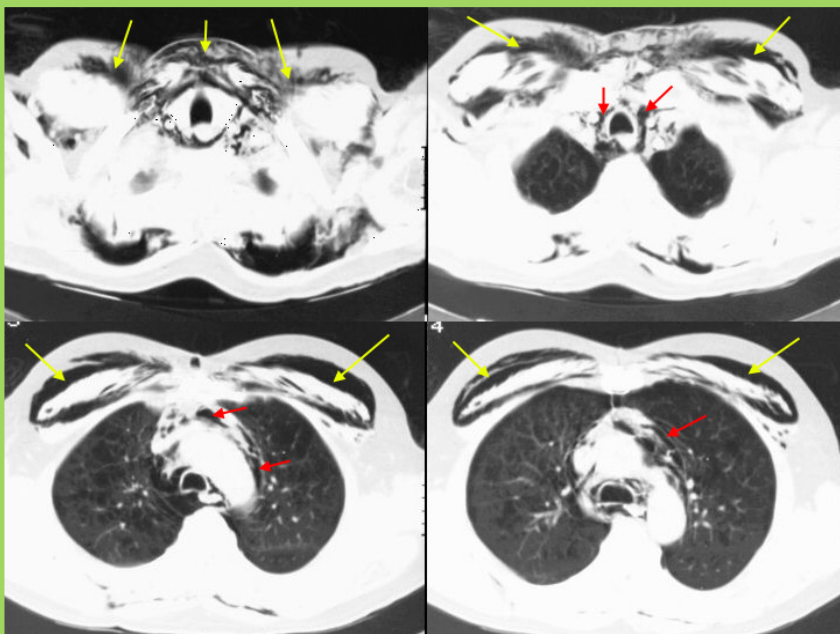


- A pneumothorax is defined as air inside the thoracic cavity but outside the lung. A spontaneous pneumothorax (PTX) is one that occurs without an obvious inciting incident. Some causes of spontaneous PTX are; idiopathic, asthma, COPD, pulmonary infection, neoplasm, Marfan's syndrome, and smoking cocaine.

## Pneumothorax

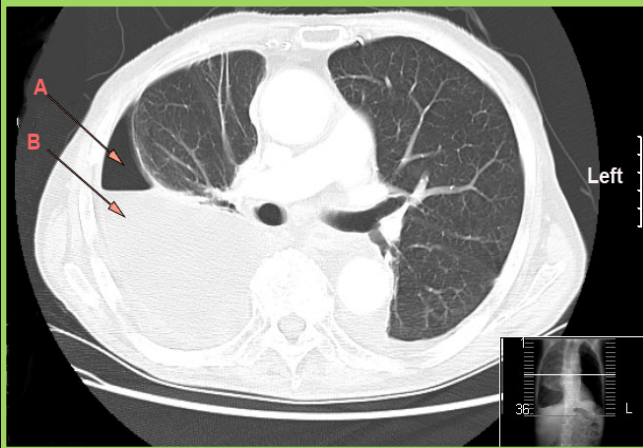


## PNEUMOMEDIASTINUM



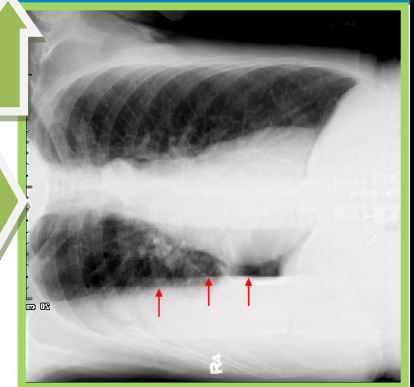
## Hydro-pneumo-thorax

Mentioned only by  
male's doctor



CT chest: Arrow A- air, B- Fluid. Large hydro-pneumothorax, unilocular, some pleural thickening. Appearance suggestive of empyema. Associated collapse of right lung.

Three images show a hydro-pneumothorax in three different views. The PA, lateral, and right decubite reveal a layering out of the air and fluid. The right decubite film demonstrates a right hydro-pneumothorax. Note the pleural air/fluid level demonstrated by the horizontal air/fluid interface (arrows).



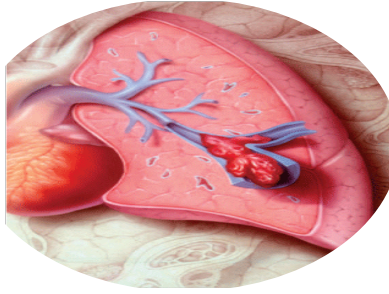
## EMPHYSEMA



Emphysema is commonly seen on CXR as diffuse hyperinflation with flattening of diaphragms, increased retrosternal space, bullae (lucent, air-containing spaces that have no vessels that are not perfused) and enlargement of PA/RV (secondary

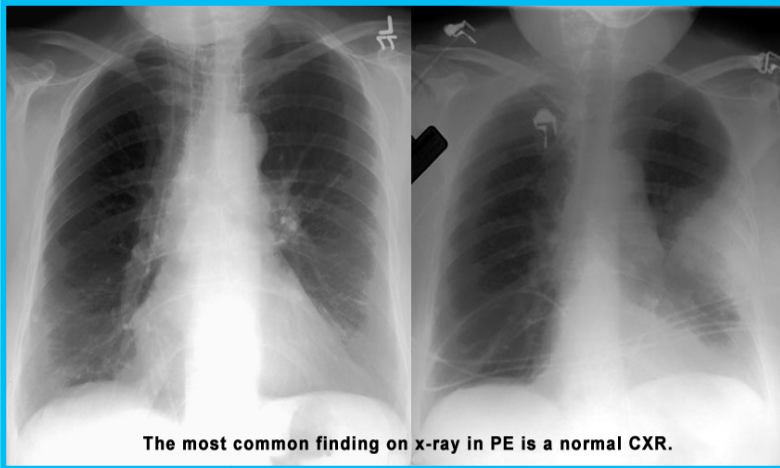
Emphysema is loss of elastic recoil of the lung with destruction of pulmonary capillary bed and alveolar septa. It is caused most often by cigarette smoking and less commonly by alpha-1 antitrypsin deficiency



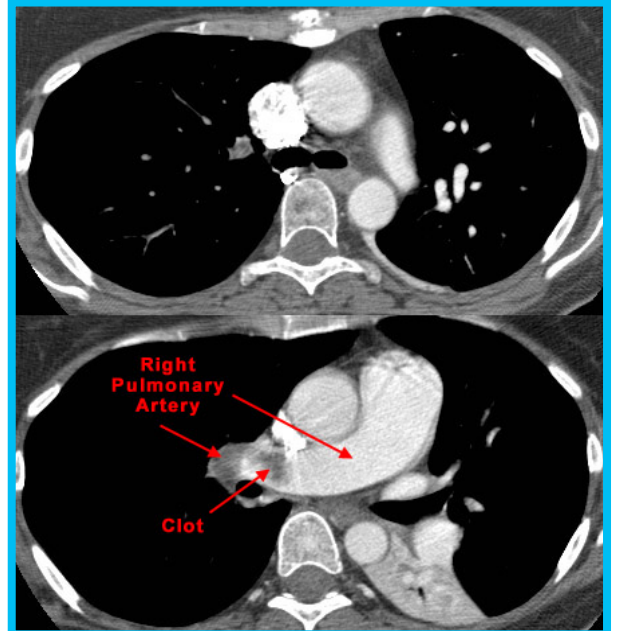


Mentioned only by  
male's doctor

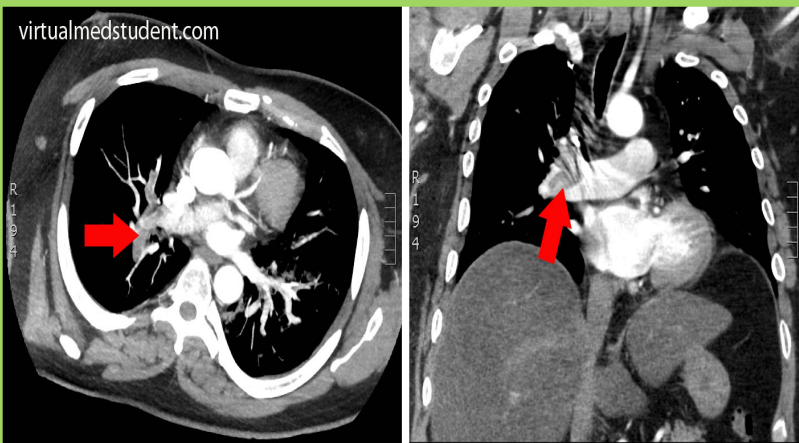
# Pulmonary Embolism



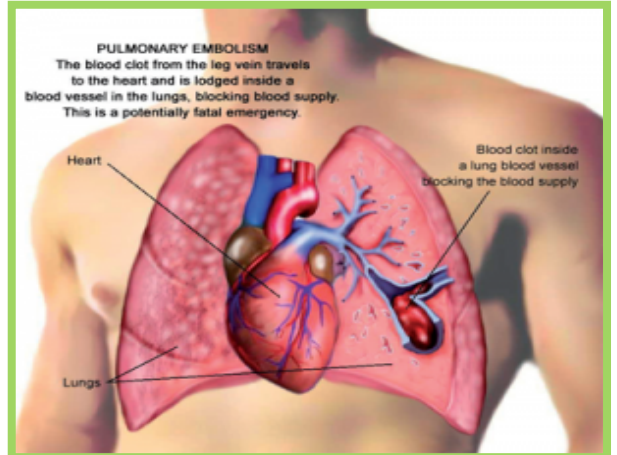
The most common finding on x-ray in PE is a normal CXR.



virtualmedstudent.com



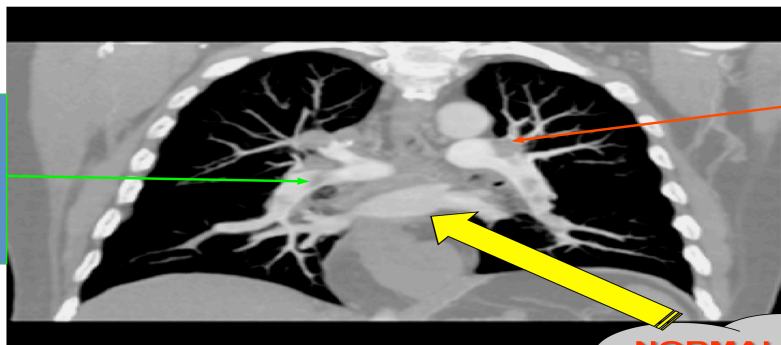
The areas at the tip of the arrowheads are slightly "darker" than normal indicating a decreased ability for contrast dye to enter the pulmonary artery and its branches. This is indicative of a pulmonary embolism (ie: a blood "clot" in the blood vessels of the lung).



**PULMONARY EMBOLISM**  
The blood clot from the leg vein travels to the heart and is lodged inside a blood vessel in the lungs, blocking blood supply. This is a potentially fatal emergency.

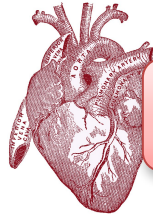
## CTA (Coronal Reconstruction)

Embolus in descending right pulmonary artery



Embolus in left main pulmonary artery

**NORMAL HOMOGENOUS FILLING OF THE VESSELS**



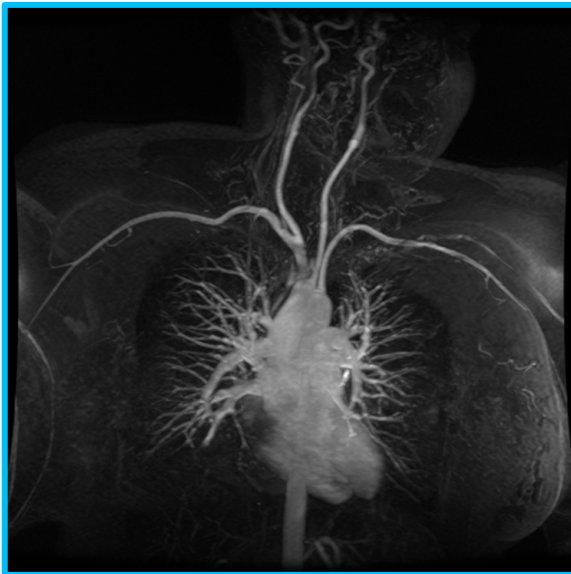
## Cardiovascular Imaging

Gold standard for diagnosing acute pulmonary embolism: CT angiogram (because we need to see the pulmonary artery)

To see the lung parenchyma: high resolution CT of the chest.

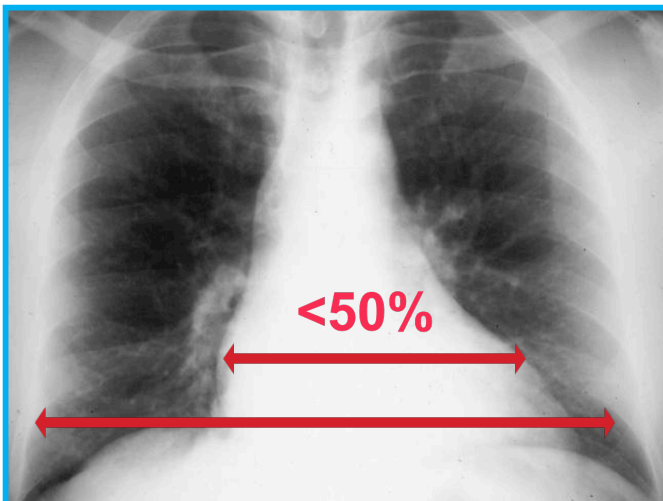
To see which chamber of the heart is enlarged and the details of the cardiac muscles: echocardiogram (Done by the cardiology department)

To Assess pulmonary vasculature: chest x-ray (the only simple way)



### Aortic Arch Anatomy

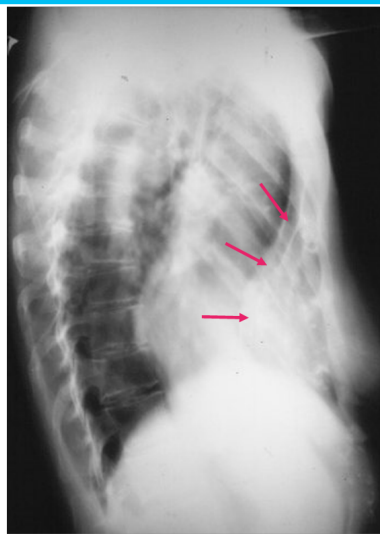
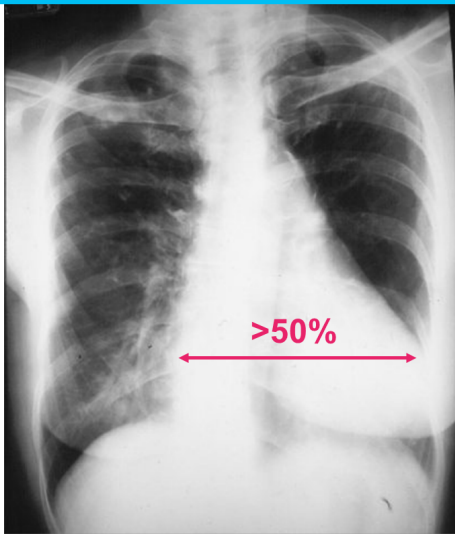
MRI Angiography “without contrast”



### Cardio-thoracic Ratio (CTR)

- The widest diameter of the heart compared to the widest internal diameter of the rib cage.
- It is a crude assessment of the cardiac size.
- It has to be measured under only **PA view + erect position with full inspiration**
- The normal is less than 50%. (It can be less than 50% with **ABNORMAL heart**) If more than 50%, it usually means that the heart is enlarged, but **NOT ALWAYS**.

[Examples in the next page]

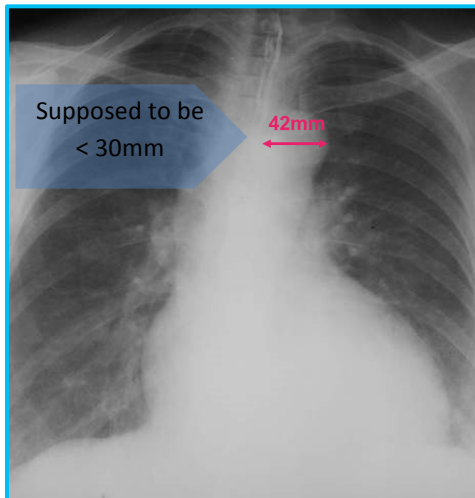


Here is a heart that is larger than 50% of the cardiothoracic ratio, but it is still a normal heart. This is because there is an extracardiac cause for the apparent cardiomegaly. On the lateral film, the arrows point to the inward displacement of the lower sternum in a pectus excavatum deformity.

\*Sometimes, CTR is more than 50%  
but Heart is Normal

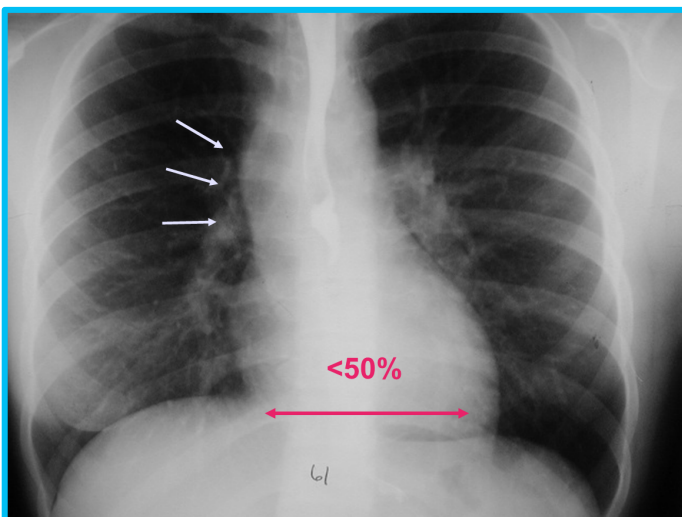
• **Extra cardiac causes of cardiac enlargement:**

- Portable AP films
- Pregnant
- Straight back syndrome
- Pectus excavatum
- Obesity
- Ascites



**Aortic Knob is enlarged with:**

- Increased pressure (HTN)
- Increased flow
- Diseases and changes in aortic wall like aortic aneurysm



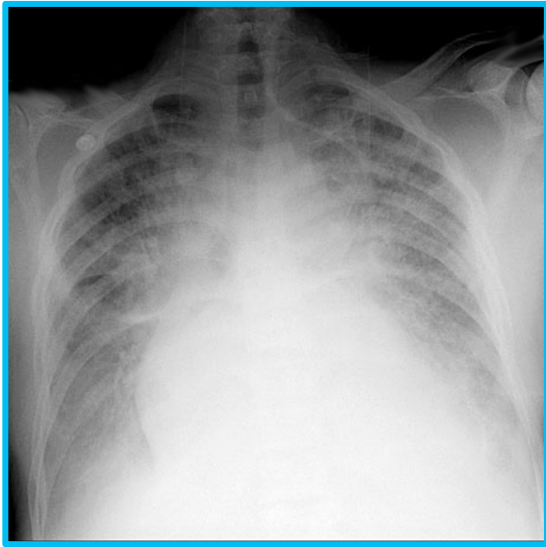
Here is an example of a heart which is less than 50% of the CTR in which the heart is still abnormal. This is recognizable because there is an abnormal contour to the heart (arrows).

Sometimes, CTR is less than 50%  
but Heart is Abnormal

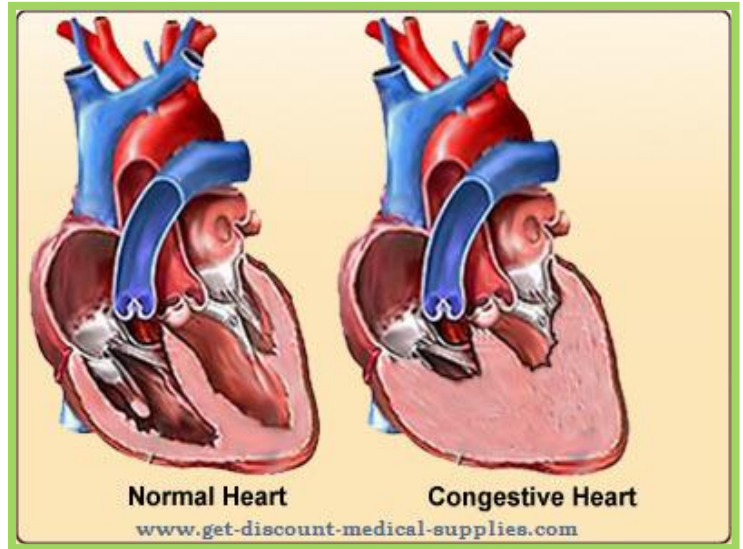
- Obstruction to outflow of the ventricles
- Ventricular hypertrophy

Must look at cardiac contours





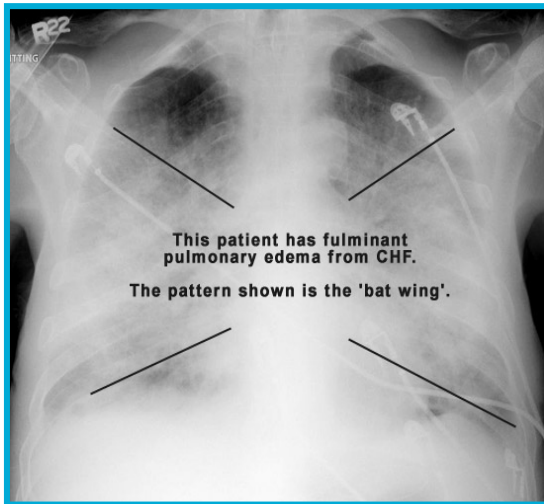
CHF with cardiomegaly



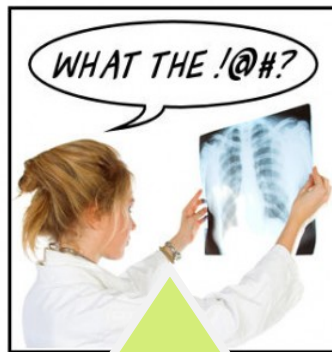
Normal Heart

Congestive Heart

www.get-discount-medical-supplies.com

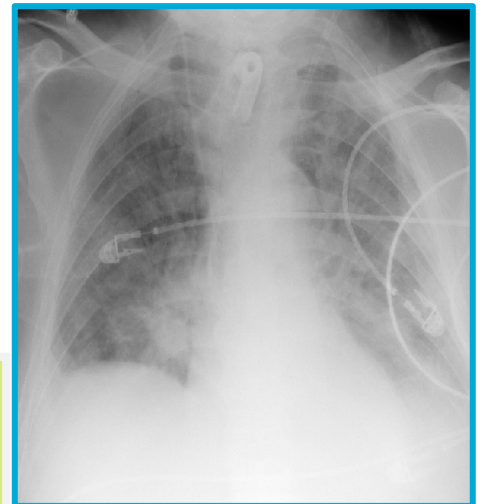


Before: The patient has fulminant pulmonary edema from CHF. The pattern shown is the "bat wing"



Pneumonia and CHF sometimes look similar in CXR. So "history" (feverish or not) is very important as fever suggest pneumonia, not CHF.

Always remember:  
Diagnosis= History + physical examination + investigations.



After treatment



Good Luck!