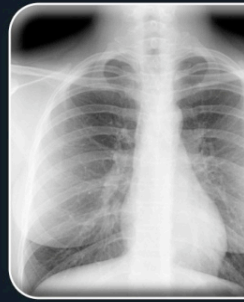


Radiology Team 429

Radiologic Investigation of Chest and CVS Diseases



Radiology team 429

In this team we used the outlines from the:

- Doctor's slides
 - Lecture notes
 - 427 Radiology team
 - Diagnostic Imaging –PETER ARMSTRONG – 6Th Edition
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- Sorry we don't hold responsibility for any missing information or perhaps – perhaps -wrong material.
 - We tried our best to present this lecture in the best way, and we hope what we wrote is enough to cover the subjects.

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Best Wishes :)

What to study:

- The pulmonary investigations are extra information so you can understand the chest x-ray as a whole. According to the doctor, we will take the pulmonary investigations in detail in another lecture.

Imaging Techniques for Chest Examination

- A. Plain film, chest x-ray
- B. CT
- C. High Resolution CT
- D. Angiogram

Chest X-ray

1) Golden standard for diagnosing chest diseases

2) Best view for taking an x-ray:

Posteroanterior view:

- Patient standing upright: To push down the organs under the diaphragmatic cupula and let gravity pull down heavy organs then the lung will be clear
- Both hands on hips: scapula moves away laterally
- Film taken on inspiration: lung bases are clear, no increase in heart shadow
- Films taken on expiration are difficult to interpret, because in expiration the lung bases appear hazy and heart shadow increases in size



3) Other views:

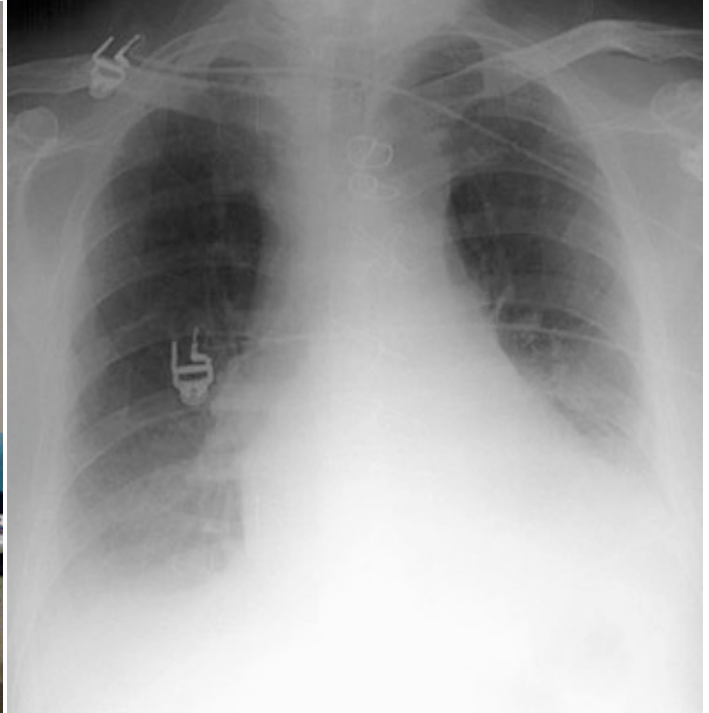
- Lateral view: the spine is visible unlike other views



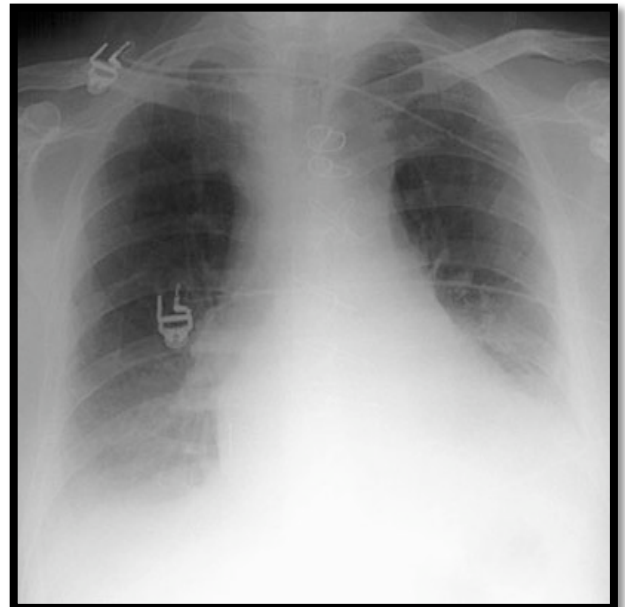
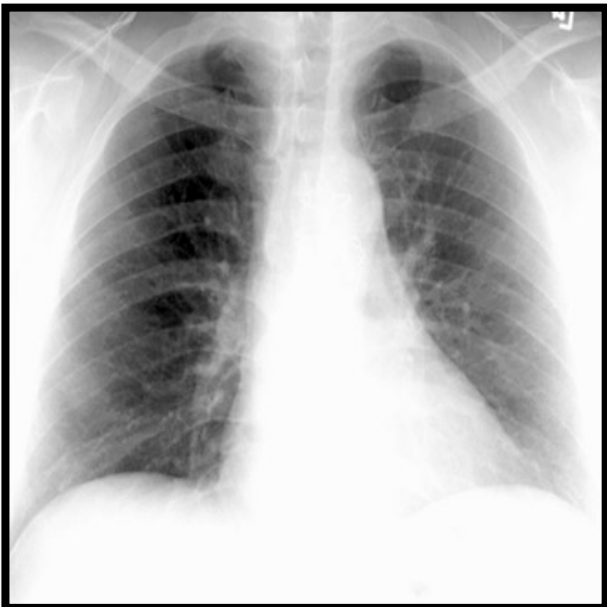
- Anteroposterior view: Done while lying down, only for the following exceptions: the Disabled, children, and comatose patients. Any patient that cannot move should have the x-ray taken in the AP view.

Disadvantages of AP view:

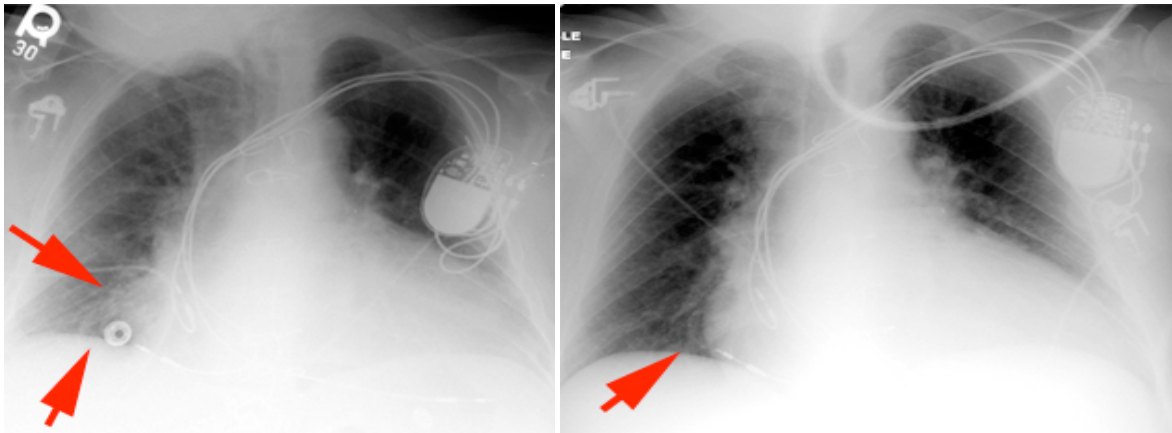
- False impression of cardiac enlargement
- The pulmonary vasculature is also altered
- Contrast is lesser than PA
- Diaphragmatic copula is not clear because of the false enlargement, we cannot see the costophrenic angles and medial ends of clavicles



PA view	AP view
Scapula is not visible	Scapula is clear
Clavicles clear	Clavicles are not clear
Heart is normal in size	Heart is magnified
Diaphragm is clear	Heart outlines are ill defined



- 4) Inspiration: The patient should be examined in full 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
- 5) Hypo-inspiratory vs inspiratory
A patient can appear to have a very abnormal chest if the film is taken during expiration. Look at the case below - on the first film, the loss of the right heart border silhouette would lead you to the diagnosis of a possible pneumonia. However, the patient had taken a poor inspiration. On repeat exam with improved inspiration, the right heart border is normal.

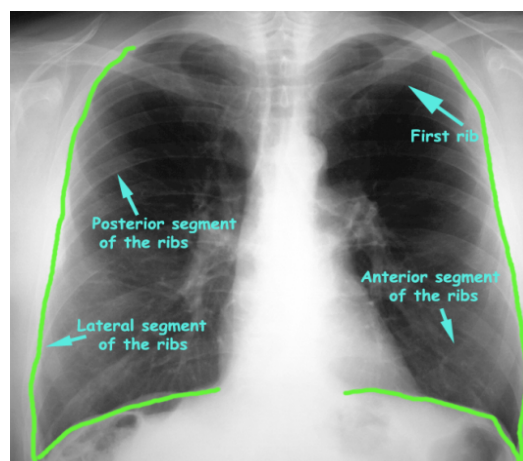


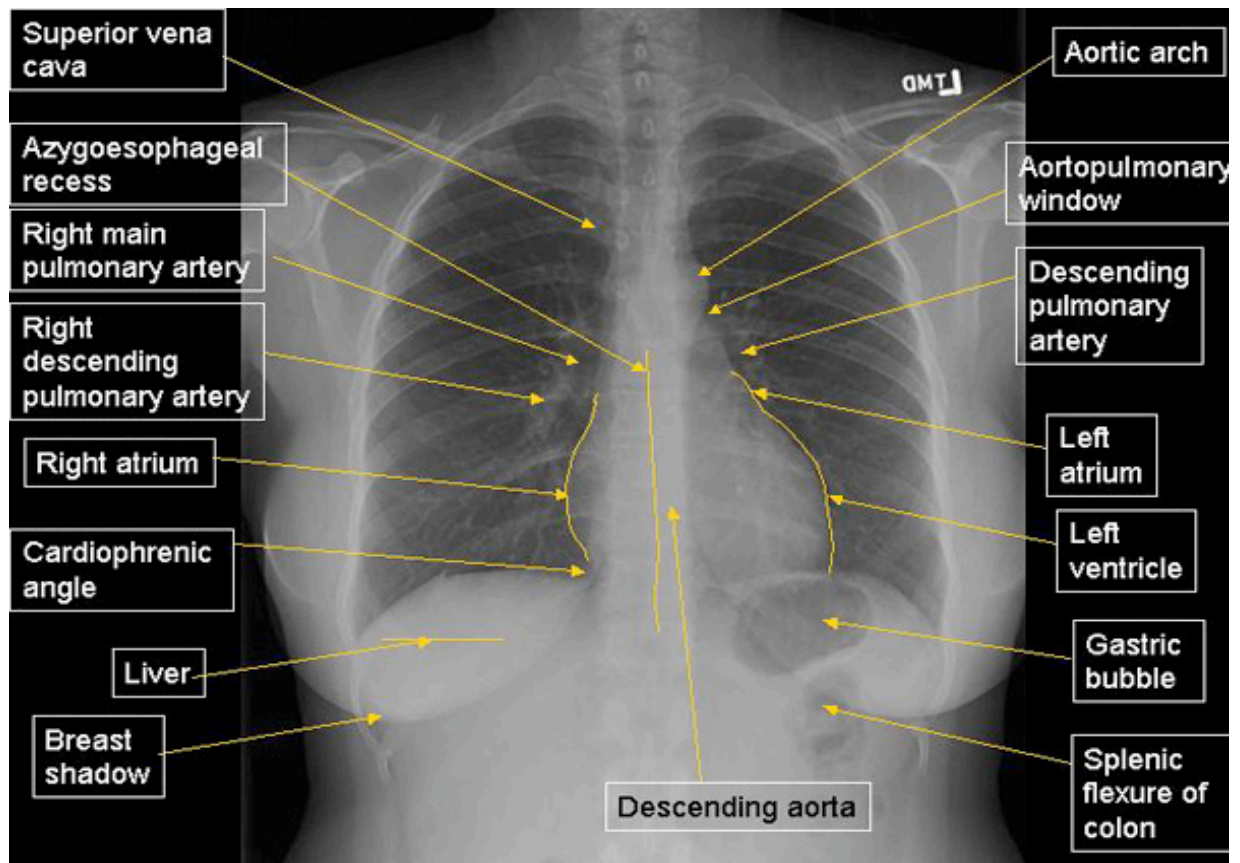
Normal Anatomy and Pathology

- When evaluating the patient, look at ALL the structures in the chest such as the ribs, spine, lungs, heart, vessels such as the aorta and pulmonary arteries
- Important areas to recognize: mediastinum, hilum, aortic knob, costophrenic angles

1) Frontal Chest X-ray:

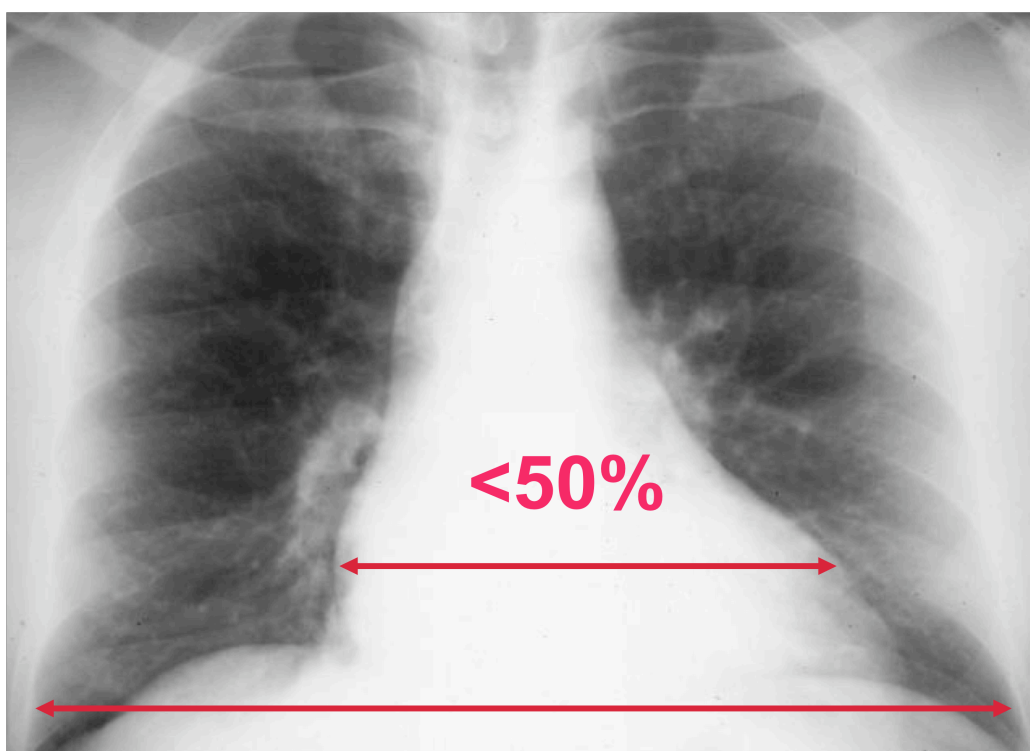
- When studying the x-ray, divide it into several compartments and compare both sides
- We can see the SILHOUETTE of the heart, the anterior and posterior ends of the ribs, and the diaphragmatic cobula
- The most important things in chest x-ray in PA view are :
 - Lung field
 - Hilum shadow
 - Heart
 - Cardiac silhouette



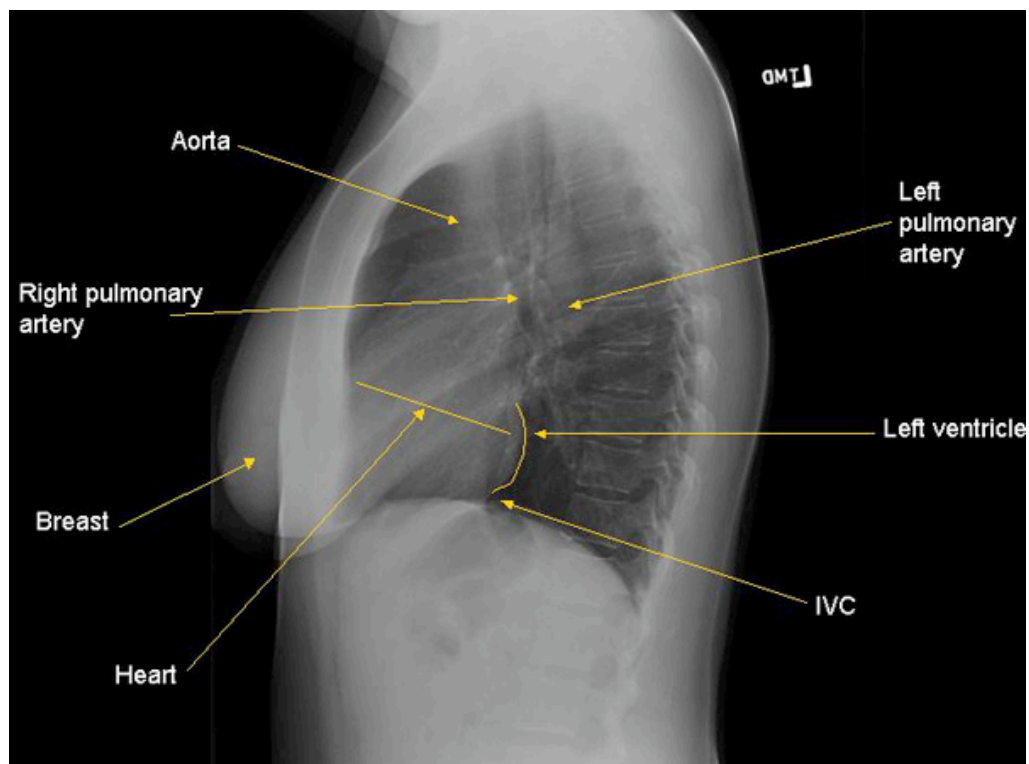


2) Cardio-thoracic Ratio:

- It is the Transverse cardiac diameter/Transverse thoracic diameter
- Transverse cardiac diameter: Farthest point on the left side of heart until the farthest point on the right side.
- Transverse thoracic diameter: a line just above the costophrenic angle starting from one side to the other side.
- This is only a rough estimation not a define measurement.
- Less than or equal 50% = normal. More than 50% = enlargement of the heart

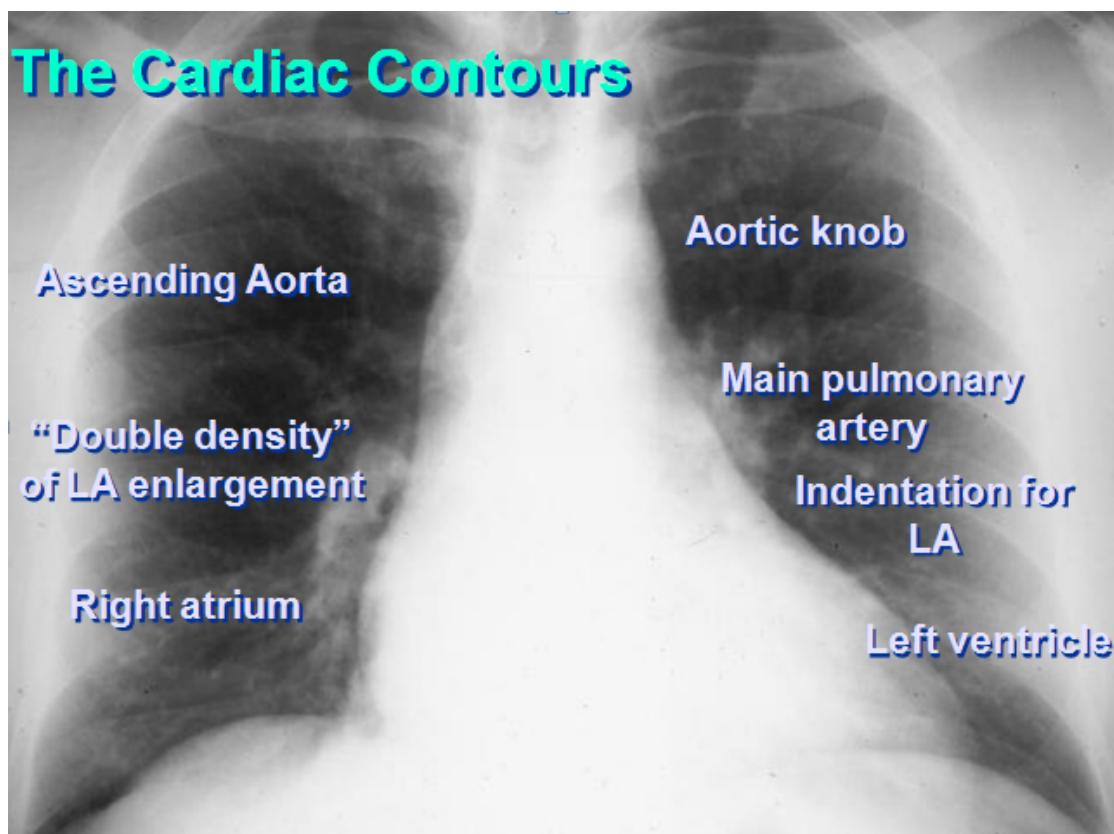


3) Lateral Chest X-ray



4) Heart:

- There are 7 contours to the heart in the frontal projection in this system, but only the top five are really important in making a diagnosis



- Heart Valves:

- The location of the cardiac valves should be known in patients with valve replacement, Rheumatic heart disease “ calcification of the mitral valve “
- Locations of the valves on the CXR:

PA view

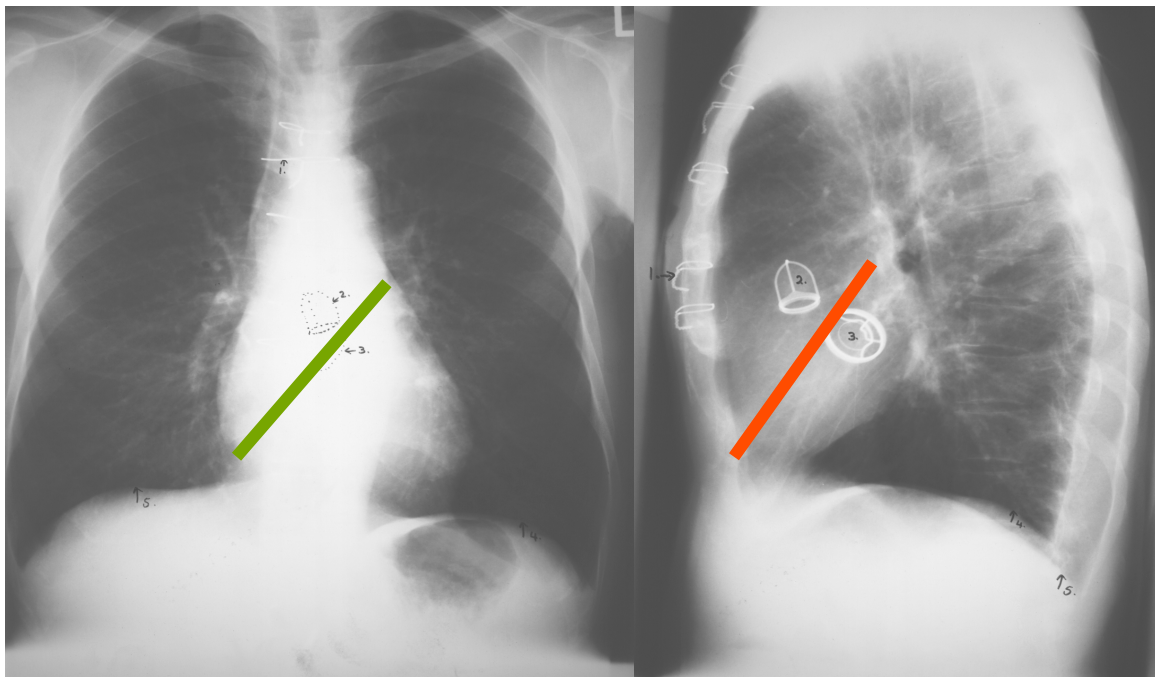
- Draw an imaginary line from the Right cardiophrenic angle until the left hilum. Above this line is the aortic valve and what's below this line is the mitral valve.

Lateral view

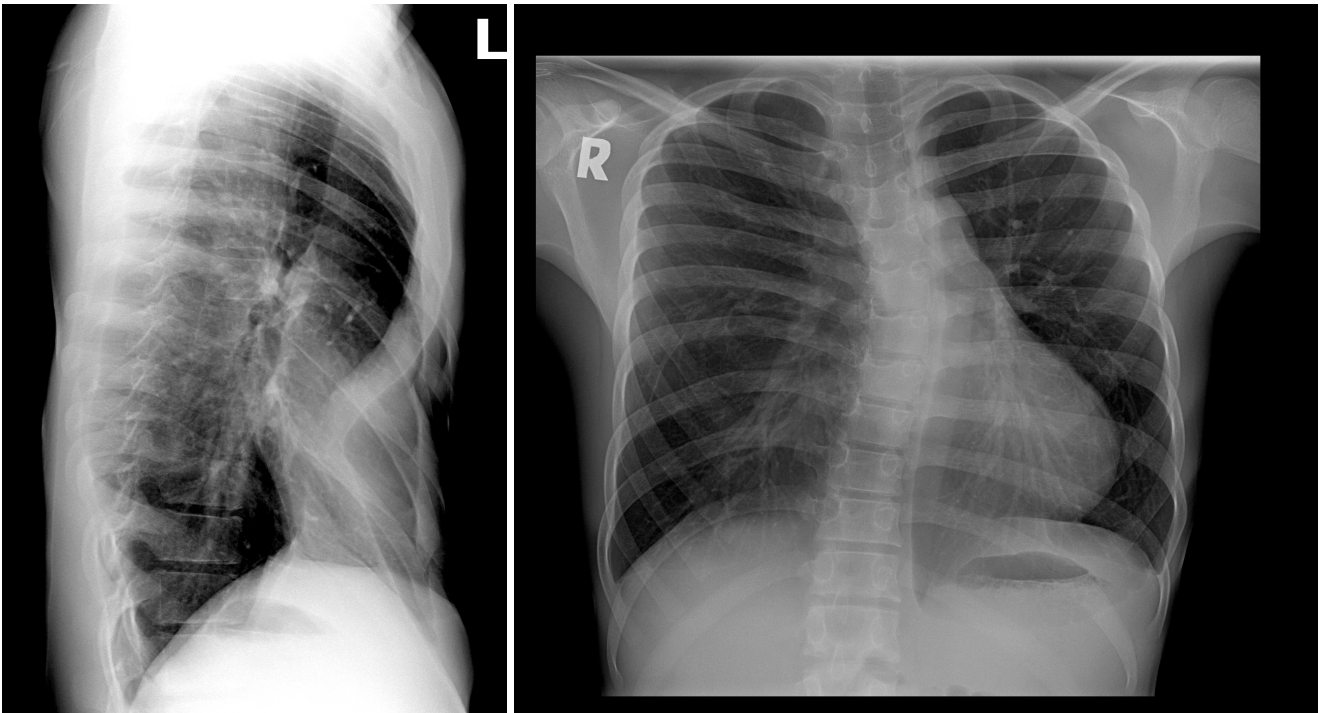
- Draw an imaginary line from the cardiophrenic angle to the hilum
- Above → aorta
- Below → mitral

Abnormalities or Diseases

- In the picture below, a patient has a malfunctioning mitral valve (between left atrium and left ventricle) and aortic valve (between left ventricle and aorta) and prosthetic valves were inserted (better seen on lateral)



- Cardiac displacement: Normally part of the heart is on the right side and other larger part on the left, but In the image below: there is scoliosis of the spine and deviation of (displacement) the heart to the left side
- What could be the cause of that? This deviation could be a result of something pushing the heart to the other side, so we need to use the lateral view that will help us determine the cause.
- What happened to the heart? The sternum looks pressed (pectus excavatum), so the sternum pushed the heart to the left, and the spine could contribute in that displacement. When you see the diameter of the heart shadow increasing, look at other structures in the chest if they are abnormal.



5) Vessels:

- Aortic knob:

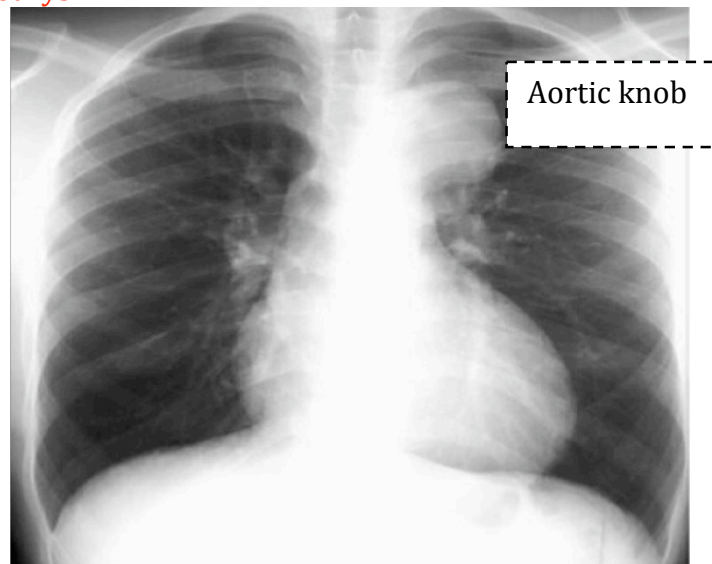
- The aortic knob is a radiographic structure that is formed by the aortic arch and a portion of the descending aorta.
- In normal people the aortic knob measures less than 35mm

- Hilum:

- The hilum is the area where all pulmonary vessels and the bronchus are present
- In the X-ray we see the shadows of the pulmonary vessels only
- If the hilum is visible then it could be hilar masses or the lymph node of the hilum

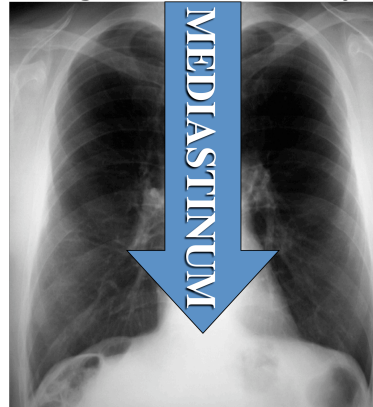
Abnormalities or Diseases

- The aortic knob is enlarged with:
 - **Increased pressure**
 - **Increased flow**
 - **Changes in aortic wall**
- In the image below, the aortic knob is enlarged and bulging because of an **aneurysm**



6) Mediastinum:

- MEDIASTINUM → formed of heart, great vessels and spine posteriorly .
- The radiologist needs to know both the structures within the mediastinum forming the mediastinal margins and the lobes of the lungs forming the margins of the lungs along the mediastinum and chest wall.
- If a mass or pneumonia "silhouettes" a part of the lung/mediastinal margin, the radiologist should be able to identify what part of the lung and what organ within the mediastinum are involved. The margins of the mediastinum are made up of the structures shown below. Trace the margin of the mediastinum with your eye all the way around the margin. Think of the mediastinal structures that comprise this interface. If the margin were abnormal you could diagnose the cause.



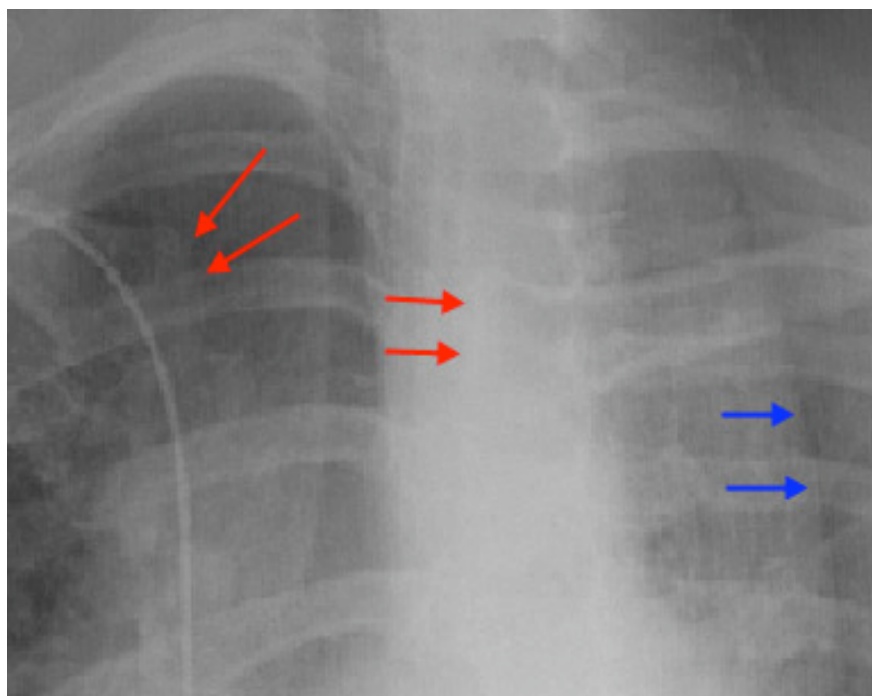
7) Ribs:

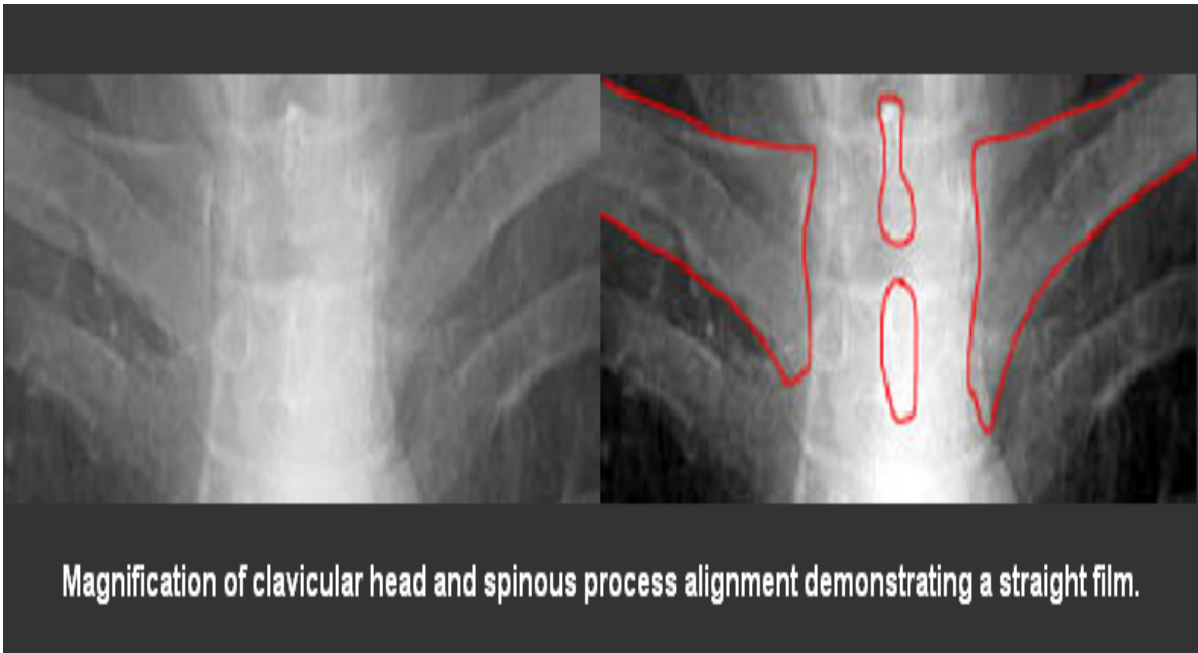
- From the PA view, the ribs are attached to the corresponding thoracic vertebrae
- The diaphragm is found at about the level of the 8th - 10th posterior rib or 5th - 6th anterior rib on good inspiration.
- To count the rib: first identify the first rib and its vertebrae. Then start counting the vertebrae.

Incorrect Imaging

- Rotation:

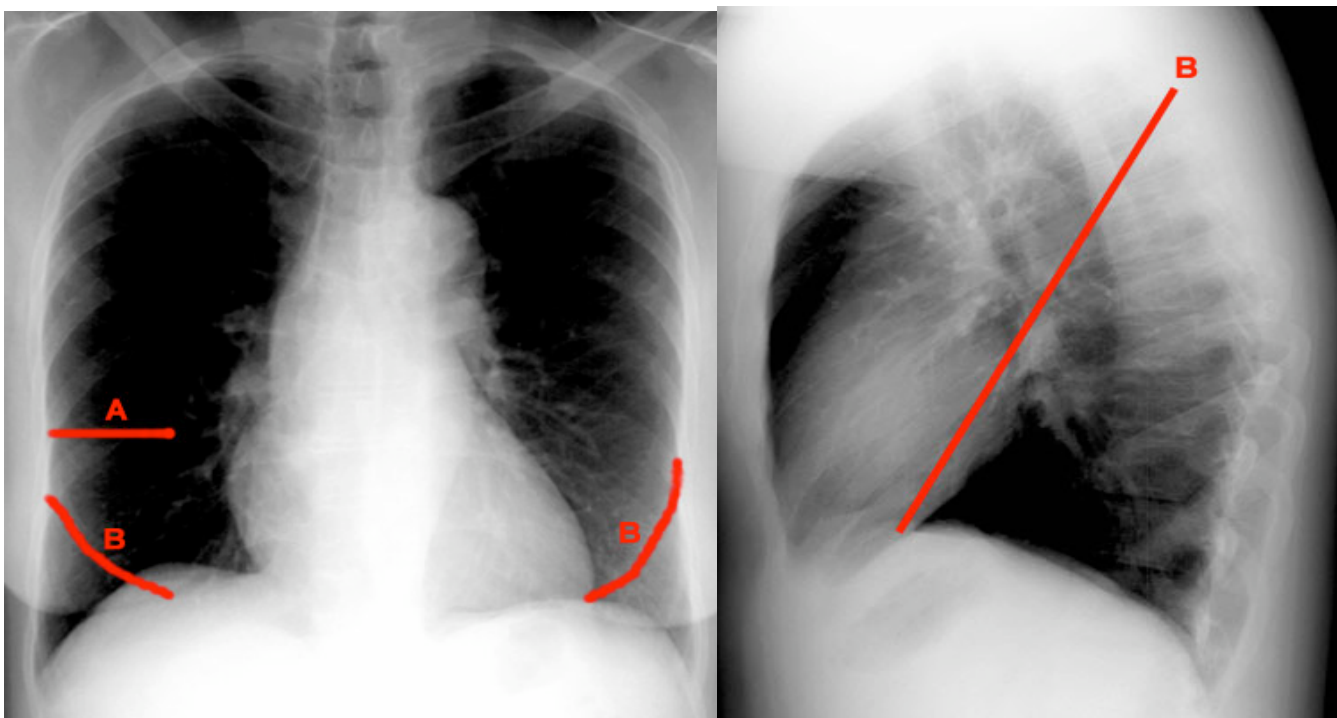
When the patient is not well adjusted and centralized, the image appears rotated. Skin folds (red arrows) can be mistaken for a tension pneumothorax (blue arrows) A good x-ray shows the alignment of the clavicular and spinous process in the middle.





8) Lungs:

- The lung is made of lobes that are separated by fissures which are folds of pleura
- The left lung has two lobes separated by the oblique fissure
- The right lung is made of three lobes separated by the horizontal and oblique fissures
- The fissures are not seen in normal x-rays
- Always **COMPARE** both lungs looking for an abnormality
- Deep inspiration helps radiologists to determine if there are any intrapulmonary abnormalities.
- On the PA chest x-ray, the minor fissure divides the right middle lobe from the right upper lobe and is sometimes not well seen. There is no minor fissure on the left. The major fissures 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.

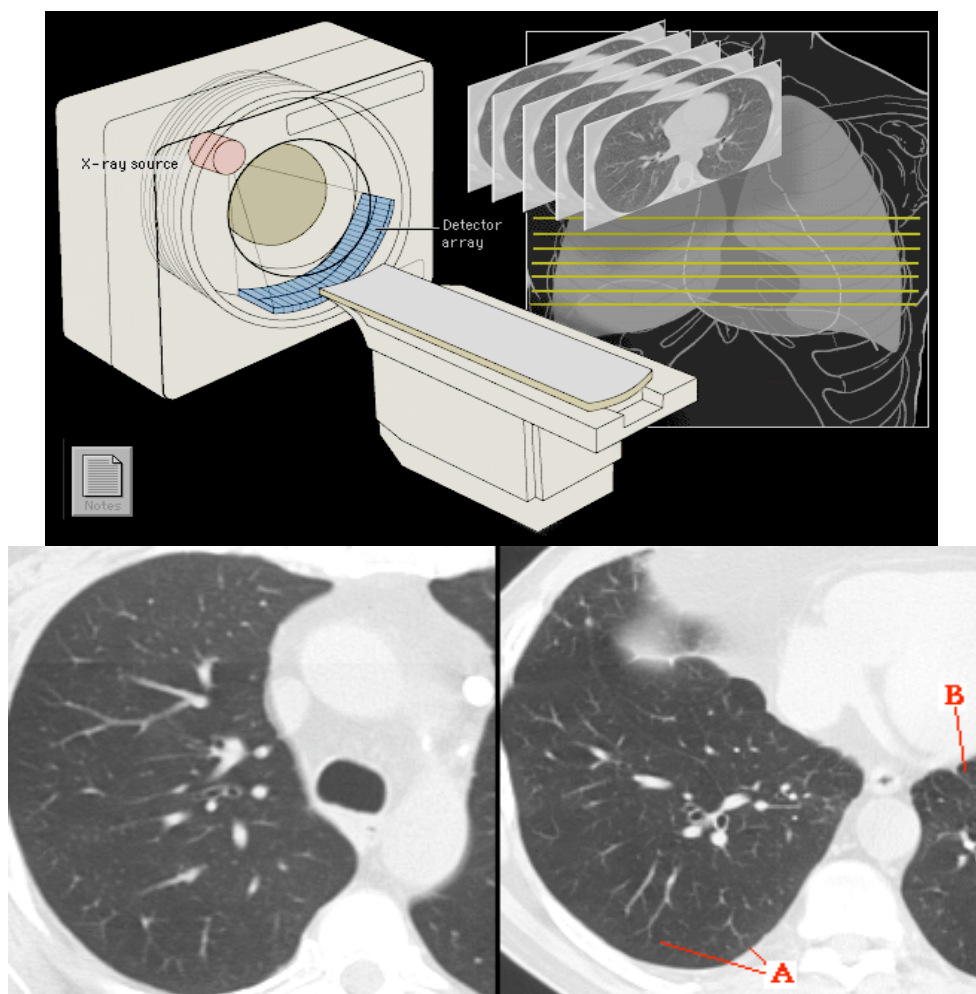


Abnormalities or Diseases

- The costophrenic angle & lung fissures are important areas to look for and diagnose pleural effusion.
- If there are fluids in the lungs, it tends to localize in fissures, making them visible on x-rays ex. Plural effusion, Pneumonia, Pulmonary embolism that has lead to a filling deficit then pulmonary edema

High Resolution CT Scan

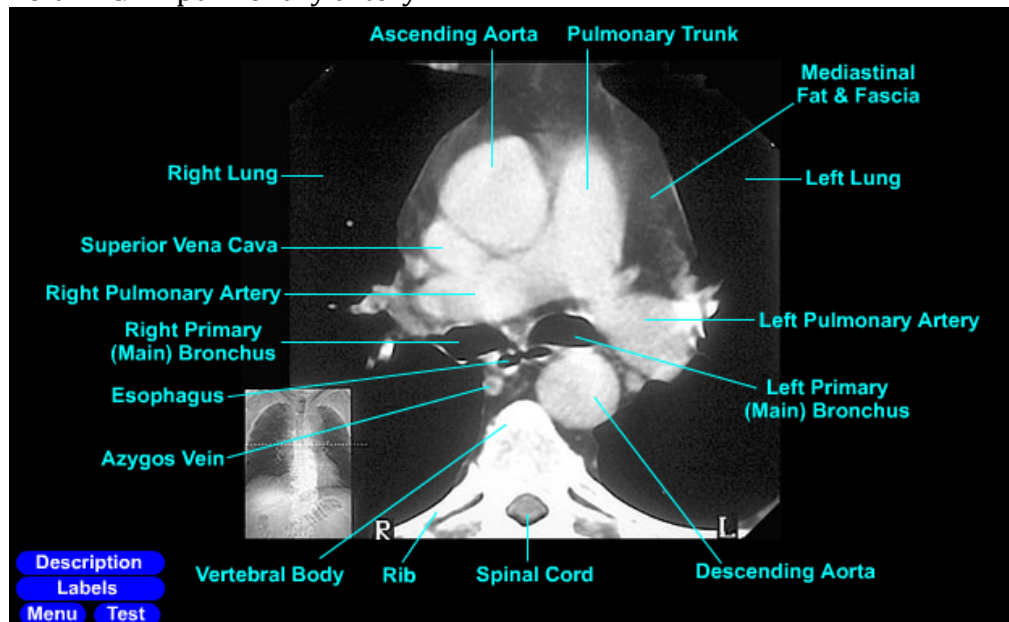
- HRCT uses very thin slices (1mm) to achieve better spatial resolution and precision.
- HRCT is indicated after a CXR appears normal in a symptomatic patient, high clinical suspicion of disease.
- Advantages:
 - High sensitivity for adenopathy, infiltrates, and architectural distortion.
 - HRCT can identify areas of reversible vs. irreversible lung damage



Normal upper (left) and lower (right) HRCT scans obtained in the prone position. The center of a pulmonary lobule is defined by the presence of a distal pulmonary artery (A). The faint outline of a distal interlobular septum is noted in the lower lobes (B). A subpleural clear space is normally present in the nondependent lung.

CT Angiogram

- Every organ of the body receives the contrast in its different way and timing e.g.
 - Aorta – after 30 sec you find the contrast
 - Pulmonary vessels – after 40 sec
 - Vessels of the liver – after 60 sec
- The timing has to be set to get the right picture at the right time
- A good filling of the artery means that the contrast is filling the whole vessels, clear wall and white lumen “homogenous filling of the vessels”.
- Best modality to check for acute pulmonary embolism is CT angiography “CTA” because it cannot be seen on CXR. On the CXR it appears normal.
- **CT angiography for the pulmonary vessels:**
This section shows a Mercedes like sign when the contrast is given:
 - 1- Above: pulmonary trunk
 - 2- Right: LEFT pulmonary artery
 - 3- Left: RIGHT pulmonary artery



Filling defect as stated above “Bilateral pulmonary embolism”

- **Why don't we do MRI for all patients ?**

- 1- Some patients have a pacemaker or artificial valves
- 2- Costly “ expensive”
- 3- A patient with pulmonary embolism cannot lie flat for 7 minutes.
- 4- CT of the lung is very efficient. “MRI doesn't show air as good as CT”