RAD 420

Abnormal Chest Radiographs

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Introduction

- The first step in localizing a shadow in an abnormal chest radiograph is to ask:
- "where is the abnormality?" "How extensive is it?"
- After locating the abnormality then the question that naturally follows is: "what is it?"
- Note well the differential diagnose for pulmonary lesions are quite different from mediastinal and, chest wall abnormalities.
- It is also important to examine all available films before making a conclusive diagnosis.

The Silhouette Sign

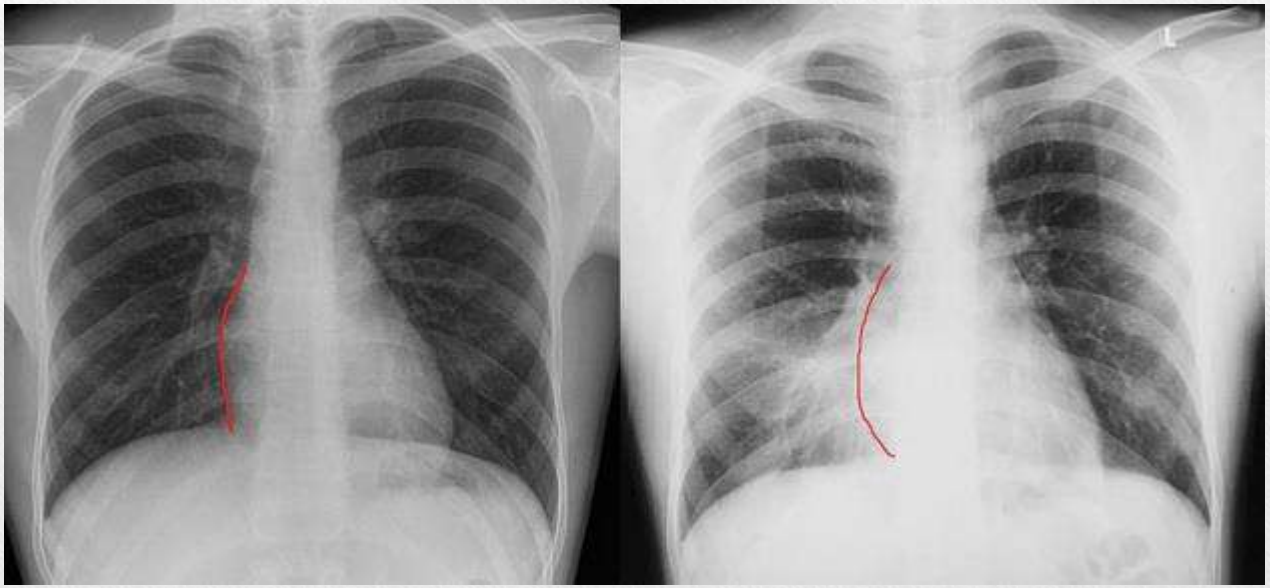
- The ***silhouette sign*** is an invaluable sign for localizing lesions on the plain chest radiograph. But a good knowledge of radiological anatomy of the chest is required to apply this.
- The information on a chest radiograph is largely dependent on the contrast between the radiolucent air in the lungs compared and the opacity of the heart, blood vessels, mediastinum and diaphragm. An intrathorax lesion touching a border of the heart, aorta or diaphragm will obliterate that border on the chest radiograph.

The Silhouette Sign

- This sign named "the silhouette sign" by Felson has two important applications. The applications are:

- It most times makes it possible to localize a shadow by observing which borders are lost. An example is loss of the heart border which means that the shadow lies in the anterior half of the chest. Alternatively, loss of part of the diaphragmatic outline indicates disease of the pleura or lower lobes of the lung.
- It makes it possible on occasion to diagnose disorders such as pulmonary consolidation even when one is uncertain as to the presence of opacity. It is a surprising fact that a wedge or lens-shaped opacity may be very difficult to see because of the way the shadow fades out at its margins, but if such a lesion is in contact with the mediastinum or diaphragm it causes loss of this normally distinct borders.

Figure 1: *PA chest radiograph with demonstrable silhouette sign*

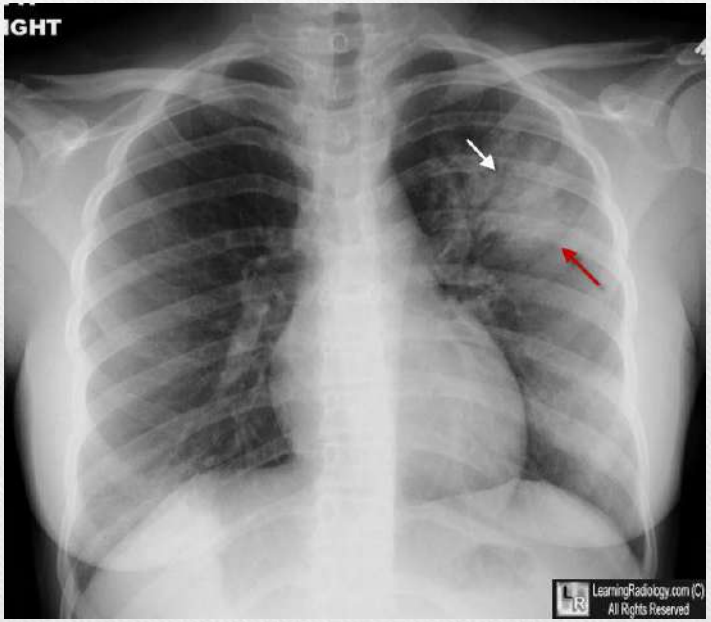


Air Bronchogram

- This is an important sign that shows that an opacity or shadow is intrapulmonary.
- The bronchus contains air and when normal is not seen on a radiograph because the walls are too thin. But when there is consolidation, that is a situation where the air in alveoli is replaced by fluid, mainly exudates, the bronchus surrounded by the fluid-filled parenchyma becomes visible.
- Air bronchogram is often seen as scattered linear translucencies rather than continuous branching pattern of translucencies. It is commonly seen in pneumonia and pulmonary oedema.

***Figure 2**: PA chest radiograph with demonstrable air bronchogram*

- Air bronchogram is not seen within pleural effusions and rarely occurs in tumors except for alveolar cell carcinoma and rarely lymphoma.
- It is also a feature seen in consolidation distal to malignancy if the bronchus remains patient. An important fact to always remember is that air bronchogram is a feature seen in all disease processes that are characterized by air-space filling.



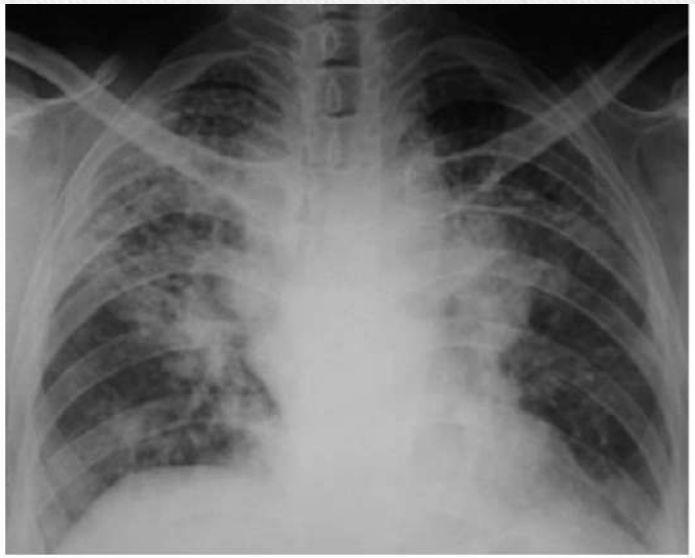
Types of Abnormal Pulmonary Shadows

- **Nodular Shadows**: These are round discrete opacities of various sizes. They have smooth borders except in those occurring with granulomatous diseases which irregular borders.
- **Interstitial Shadows**: They are linear and it extensive form circular shadows enclosing air. They can lead to lack of definition of diaphragm and heart (silhouette sign). **(See slide #9)**
- **Alveolar Shadows**: They are described as ill-defined blotches which may coalesce to form bigger shadows. Air bronchograms may be seen within the blotches. **(See slide #9)**

Figure 3: *Alveolar shadows vs Interstitial shadows*

Alveolar shadows

Interstitial shadows



Localized Intrapulmonary Shadows

- Some common causes of localized intrapulmonary shadows on radiographs are:

➢ Lobar pneumonia

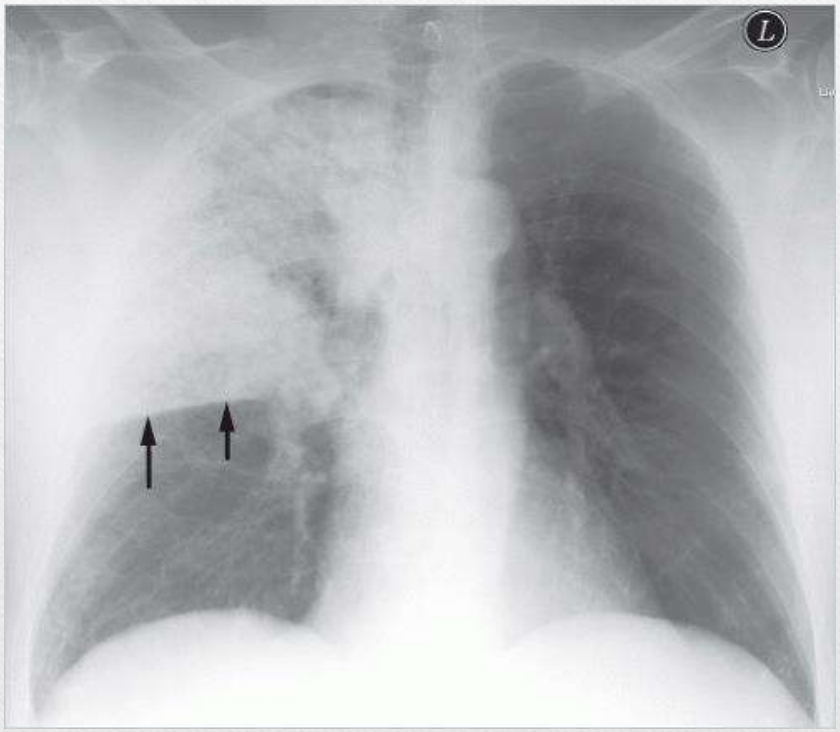
➢ Lung Collapse (Atelectasis)

➢ Bronchopneumonia

Lobar pneumonia

- The radiological features seen in lobar pneumonia are:
- Consolidation of a whole lobe of lung.
- The consolidated lung remains the same size or becomes slightly larger.
- There is no displacement of hilar shadows, fissures, mediastinum or diaphragm.
- The consolidated lobe can be made out using the silhouette sign discussed earlier.

***Figure 4**: Lobar pneumonia involving the right middle and upper lobe*

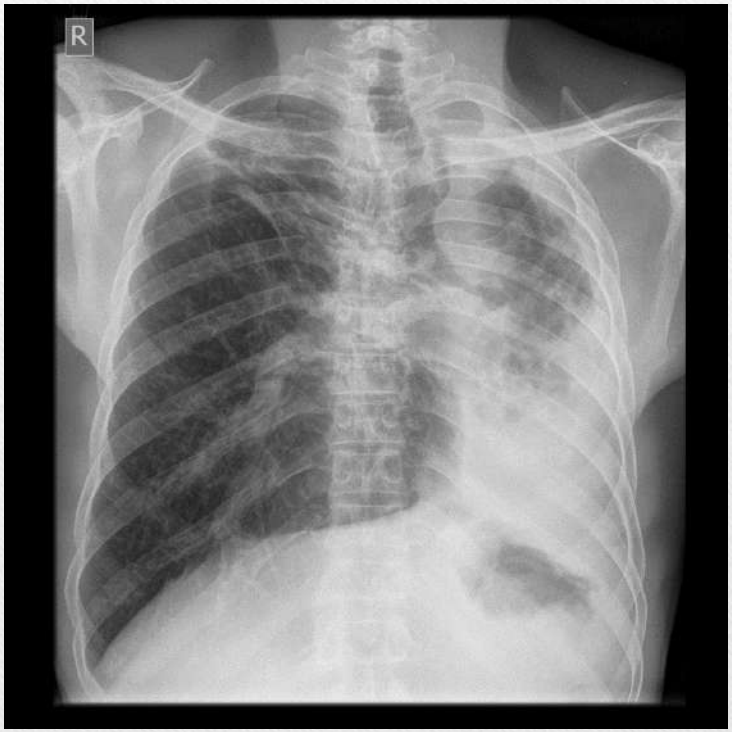


Lung Collapse (Atelectasis)

- The radiological features of lung collapse are:
- Shadow of the collapsed lung or lobe of the lung.
- The silhouette sign; that is obliteration of the borders to the collapsed lung or lobe of the lung.
- Displacement of structures to take up the space normally occupied by the collapsed lung or lobe of the lung. If the collapsed lung is the left, structures such as the trachea will be displaced towards the left as the right lung and mediastinum move to take up the space normally occupied by it.
- Compensatory over-inflation of the unobstructed lobes (compensatory emphysema) which is reflected by displacement of fissures and the movement of the hilum towards the collapsed lobe.
- Elevation of the hemi diaphragm in case of lower lobe collapse.
- No air bronchogram is seen if the cause of the collapse is bronchal obstruction.

Figure 5: *Right lung collapse showing over-inflation of the left lung, flattening of the left hemi-diaphragm, and displacement of the heart and trachea to the right*

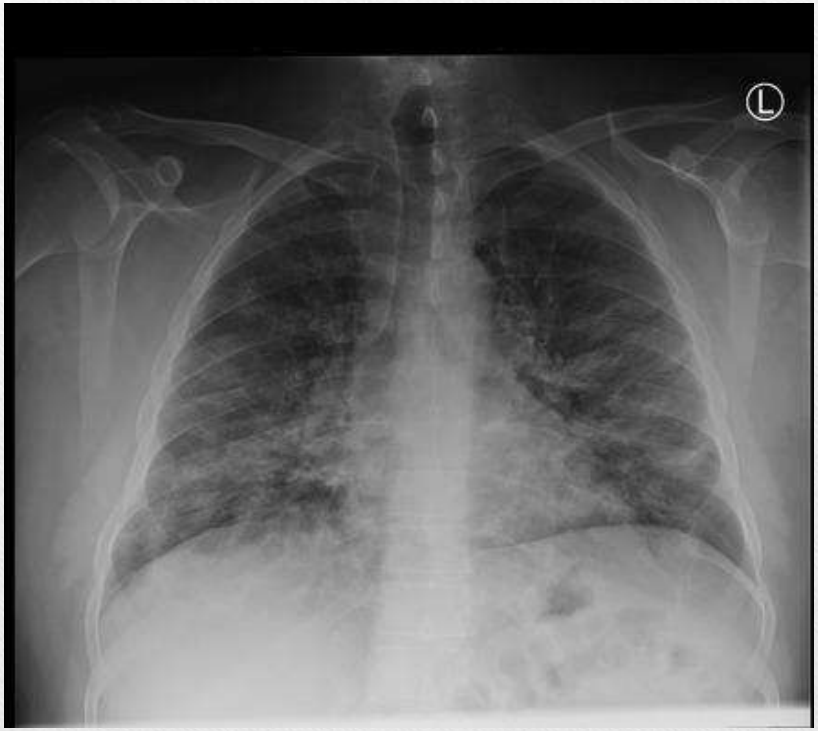
Figure 6: *Mediastinal shift and over inflation of the right lung following the collapse of the left lower lobe. Note the shadow of the collapsed lobe, deviation of the trachea to the left and loss of the outline of the left hemi-diaphragm*



Bronchopneumonia

- This presents as multiple subsegmental or lobular shadows seen usually at the basal portion of the lungs.
- This pattern can also occur in pulmonary embolism, aspiration of gastric or oesophageal contents (mid and lower zone consolidation) and alveolar cell carcinoma.
- In pulmonary embolism the chest radiograph is often normal but shadowing occurs if there is accompanying infarction.

Figure 7: *PA chest X-ray demonstrating bronchopneumonia*



Solitary Rounded Shadows

- These are commonly due to:

- Primary carcinomas although secondary deposits may at times be solitary. Primary carcinomas may involve the ribs, the apex of the lung (known as ***Pancoast tumor***) and the brachial plexus. Primary carcinomas do not contain calcium and when calcification is seen carcinoma can be ruled out confidently.
- Harmatomas which are benign tumors consisting largely of cartilage and fat with sharp outline and characteristic "popcorn" calcification which may be present,
- Tuberculomas
- Hydatid cyst
- Pulmonary arteriovenous fistulae, and
- Bronchial adenomas.

Solitary Shadows with Cavities

- These shadows are caused by:

- **Lung Abscess**: It is usually rounded and with air-fluid level if the abscess had ruptured into a bronchus allowing air to enter it.
- **Cavitating Carcinoma**: It usually has thicker and more irregular wall than pyogenic lung abscess.
- **Tuberculosis**: The lesion usually has multiple cavities which are thin walled. Air-fluid levels are usually not common.
- **Mycetoma**: It appears as cavities in the apex of the lung which may contain a mass with a halo of air in the cavity.

Pulmonary tuberculosis (PTB)

- The remarkable feature of PTB that must be borne in mind at all times is that any shadow on the lung fields can be due to PTB as it has widely varying patterns. However the common radiological appearances (features) are as follows:

- Homogenous areas of consolidation.
- Mottled opacities of varying sizes.
- Associated hilar adenopathy

Pulmonary tuberculosis (PTB)

- Pulmonary cavities appearing as ring shadows with transradiant centres.
- Calcification may occur in healed fibrotic scars.
- Tracheal displacement due to collapse or fibrosis may occur later.
- Pleural effusion which is usually unilateral.
- Pleural and diaphragm calcifications.

Figure 8: *PA chest X-rays demonstrating pulmonary tuberculosis*

Diffuse Nodular Shadows

- These conditions are usually considered as differentials when this type of pulmonary shadows is seen:

- Miliary PTB
- Sarcoidosis
- Pneumoconiosis
- Allergic aleovitis
- Secondary malignant deposits

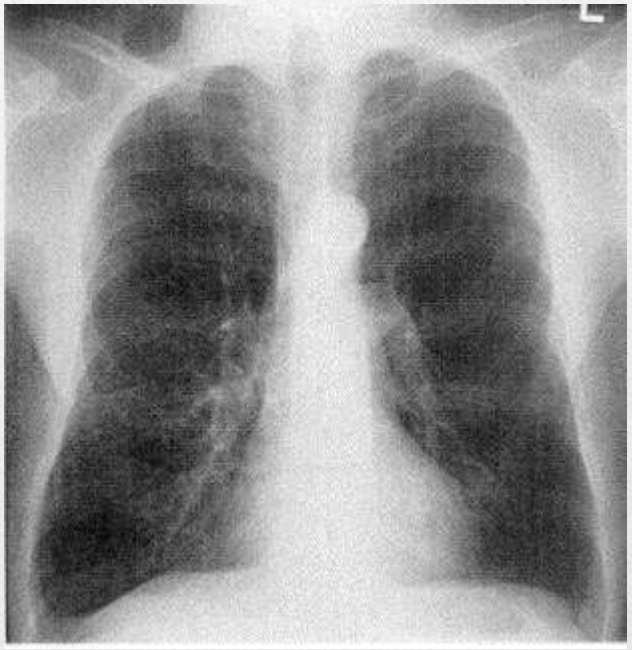
Chronic Obstructive Airways Disease (COAD)

- COAD is a collective term for asthma, chronic obstructive bronchitis and emphysema.
- In these three conditions, radiological appearances are often normal; the value of chest x-ray examination being to exclude other diseases and complications.
- Asthma is characterized by variable airflow obstruction while there is chronic productive cough in chronic bronchitis and; tissue destruction at alveolar level in emphysema.
- The common feature in the three conditions is airflow limitation mainly in expiration which leads to over inflation of the lungs and occasionally appearance of bullae in emphysema.

Radiological features of COAD

- The radiological features of over inflation of the lungs are:
- Flattened diaphragms: The dome of hemi diaphragms less than 1.5 cm high.
- Increased size of retrosternal transradiancy on the lateral radiograph. Normal size of retrosternal transradiancy is 2-3 cm at the level of sternal angle and 7cm at the lower limit which is just above the diaphragm.
- The heart shadow tends to be long and narrow with a transverse diameter of 11.5 cm or less.
- Lower levels of hemi diaphragms.
- Limited diaphragmatic excursion on fluoroscopic screening of the chest.
- Changes on pulmonary vascular pattern are observed in emphysema. There is usually a decrease in number of intrapulmonary vessels or their complete absence, especially where bullae are present. A bulla is a hair-line shadow containing a translucent area. If infection is present it may fill with fluid and contain air-fluid level. Chronic obstructive airways disease may also cause pulmonary hypertension and heart enlargement.

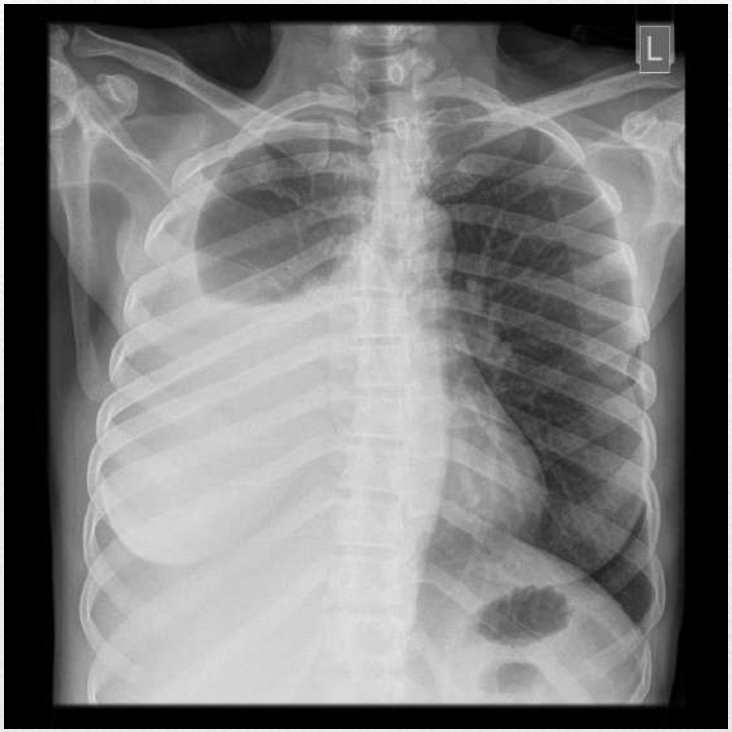
Figure 9: *PA chest X-ray demonstrating features of COAD*



Pleural Effusion

- In pleural effusion, there is a homogenous opacity usually starting at the base of the lung and extending upwards as shown in figure 10.
- The opacity usually has a medially directed concave menicus (upper border) with the fluid tracking higher at the lateral margins than the medial margins.
- The amount of fluid present may produce changes varying between obliteration of the costophrenic angle and the entire lung field. It should be noted that a minimum of 200 ml of fluid must be present in the pleural space before the costophrenic angle becomes obliterated.
- At the early stage ultrasonography is more sensitive in detecting pleural effusion.

Figure 10: *Right-sided pleural effusion. The fluid tracks up laterally producing a medially directed concave meniscus. The left lung field is normal and the left costophrenic angle is not obliterated. Note the obliteration of the right heart border by the opacity cast by the effusion.*



Pleural Effusion

- Bilateral pleural effusions occur in heart failure, pulmonary infarction, hypoproteinaemia, renal failure, collagen vascular disease and subdiaphragmatic inflammation.
- Unilateral pleural effusion occurs as a result of infections including PTB and, malignancy.
- It is often very difficult to distinguish pleural effusion from shadow due to basal consolidation or lung collapse. To do this a lateral decubitus projection is essential to see if the suspected fluid will move to the dependent part.

Chest Trauma

- Features that may be seen in chest trauma are:

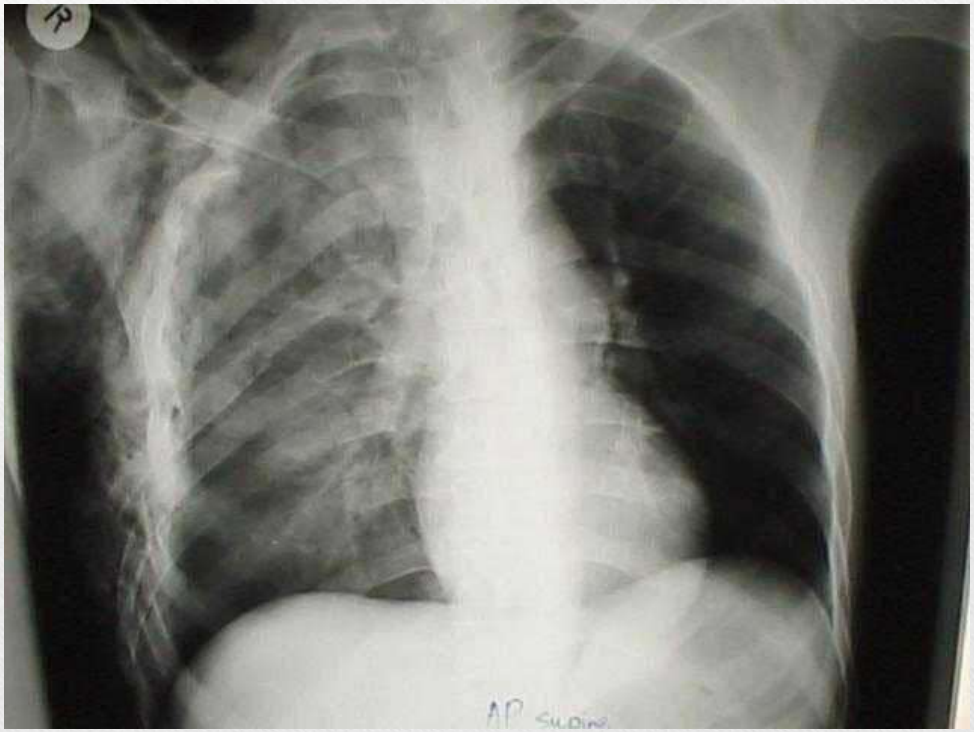
➢ Fracture of a rib segment. Fractured ribs may at times be multiple.

➢ Localized or extensive opacification of the lungs due to contusion, pneumothrax or haemothorax.

➢ Widening of the mediastinum.

➢ Elevation of the diaphragm which may be due to rupture of the diaphragm or segmental collapse of the lungs.

***Figure 11**: Chest X-ray demonstrating features of blunt chest trauma*



Cardiomegaly

- Cardiac size assessment is performed by:

- Measuring the maximum transverse diameter of the heart represented by the horizontal distance between the extreme edges of the heart borders. This must not exceed 15.50cm on PA film of normal subjects. Any value greater than 15.50cm is suggestive of cardiomegaly.
- Use of cardiothoracic ratio (CTR): This gives a ratio of about 0.5 in normal subjects. Any CTR value significantly greater than 0.5 is suggestive of cardiomegaly.
- Comparison with pre-existing radiographs done in standard projection. This enables the clinician to note any change in heart size over a time interval.
- Two thirds of the heart lies closer to the left of the midline than the right on a PA film. A distortion of this pattern of cardiac mass distribution in correctly projected chest radiograph is suggestive of cardiomegaly.

Causes of cardiomegaly

- Congestive cardiac failure.
- Pericardial effusion.
- Multiple valvular lesions.
- Dilated cardiomyopathy.
- Myocarditis.
- Ebstain's disease.
- Hyperdynamic circulation.
- Complete heart block.
- Ischaemic heart disease.

End

Thank you for listening