Chest Radiology
What Will Be Discussed...

• Indications.
• Anatomy.
• Systematic Approach of Interpretation.

Rdaiiological Overview

Chest Radiograph
Radiological Overview

- Ultrasound
- C.T Scan.
- MRI
- Nuclear Imaging.
Gross Anatomy
Chest Radiograph

- The most common radiographs
- They may not have a radiologist report
- The most difficult image to interpret
Indications.

- Preop Evaluation.
- Chest pathology like suspected pneumonia.
- Follow up of pathology resolution like pleural effusion.
- Trauma patients.
Systematic Approach

- Minimizes the chance of missing an abnormality.
- Enables a detection of second or related lesions.
- Makes complex images easier to interpret.
- Builds up a mental databank of what is normal.
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<td>Air / gas: most lucent</td>
<td>Soft tissue: relatively radiolucent</td>
<td>Bone And Metal: Radiopaque</td>
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Views Of Radiograph

- AP (Supine or setting)
- PA (Erect)
- Decubitus Right or left
Radiograph Views (AP)
Radiograph Views .. (PA)
How To Differentiate?
in PA view posterior aspect gives better shadow, while in PA view anterior aspect gives better shadow.

in PA view the anterior aspect of ribs is more clear (the more tilted part), while in AP view the posterior aspect of ribs (horizontal part) along with scapula is more clearer.
Other differential Points

- The superior mediastinum appears widened due to AP magnification.
- The heart appears enlarged - a combination of AP magnification and underinflation.
- There appears to be a bilateral interstitial infiltrate - also due to underinflation.
Same Patient
PA view
The patient is laying either left lateral or right lateral on a trolley on top of a radiolucent sponge, the film is named in relation to the **downward** side.

When investigating pneumothorax the side of interest should be up; when investigating pleural effusion the side of interest should be down.
If pleural effusion is suspected then lie the suspected side downward. If pneumothorax is suspected lie the suspected side upward.
Lateral decubitus Film

- A radiopaque foreign body is demonstrated projected over the left hilum. There is consequent air-trapping confirming the obstruction.
Technical Factors

- Inclusion
- Rotation
- Inspiration
- Penetration
Anatomy Inclusion

All Of these should be included in the image:

- First ribs?
- Costophrenic angles?
- Lateral edges of ribs?
Example.. Inclusion
Technical Factors

• Check side marker
• Rotation: Look at medial ends of clavicles in relation to T4 on PA images, the distance should be equal bilaterally.
pedicles

anterior ribs

rotated

straight
CAUTION!!

• Always Check The side of heart !!!
Inspiration

The diaphragm should be intersected by the 5th to 7th anterior ribs in the mid-clavicular line. Less is a sign of incomplete inspiration.
Pneumothorax on Inspiration And Expiration

Expiratory films are helpful in detection of small amounts of pneumothorax and hyperinflation of lungs due to foreign body inhalation.
Expiration

- (Same patient as next image)
- Anteriorly only the third rib intersects the diaphragm at the mid-clavicular line
- The lung bases are white - Is there consolidation?
- How big is the heart?
Inspiration

- (Same patient as previous image)
- Anteriorly the sixth rib intersects the diaphragm at the mid-clavicular line
- The lungs are not consolidated
- The heart size is clearly normal
Penetration is the degree to which X-rays have passed through the body.

A well penetrated chest X-ray is one where the vertebrae are just visible behind the heart.

The left hemidiaphragm should be visible to the edge of the spine.
Under penetration

- The left hemidiaphragm is not visible to the spine
- Lung tissue behind the heart cannot be assessed
- Re-windowing the image using digital software can compensate
Proper Penetration

The diaphragm (long arrows) is visible to the spine.

The left paravertebral soft tissues are visible (short arrows), and the right side of the spine is clear (arrowheads). There is no abnormality of lung tissue behind the heart.
Some chest X-rays are performed solely to assess the position of medical devices.
Nasogastric Tube Placement

- This tube is only just in the stomach and so was advanced and the position rechecked prior to using it for feeding.
- The tip of a naso-gastric tube should also lie on the left. If it crosses the midline it has entered the duodenum.
Systematic Approach

• Areas Of Interest.
  • Lungs and trachea
  • Heart.
  • Mediastinum.
  • Diaphragm and costophrenic angles.
  • Hila
  • Bones.
  • Pleura.
  • Upper Abdomen.
  • Soft Tissues.
Interpretation....ABCDEFG

- Air (Lungs and airway)
- Bone
- Cardiac size and silhouette.
- Diaphragm.
- Etc. (Upper abdomen and soft tissues).
- Foreign bodies, instruments.
- Gas under diaphragm
- Hila.
Lung Zones

Nearly every TWO rib spaces are considered a zone. Zones are not related to lung lobes.
Pathology..Lungs

Divided into:

Radiopacity

Radiolucency.
Radiopaque pathology

- White shades object
- An object that stops (absorbs) the x-rays: Metal
- Bone and calcifications
- Contrast
Radiolucent Pathology

Black object

An object that allows the x-ray beam to pass with little absorption

Air and Fat
Radiopacity .. Example

- Frontal Radiograph of the chest showed a well defined oval shaped radiopacity at upper and middle left lung zones peripherally abutting pleura with no definite mediastinal shift.
Radiolucencey..Example
Frontal Radiograph of the chest showed a peripheral rim of lucecnyc at left hemithorax with no clear lung markings suggestive of pneumothorax with mediastinal shift to the right side
Consolidation
Consolidation/Air space opacification

Descriptive term that refers to filling of the pulmonary tree with material that attenuates x-rays more than the surrounding lung Parenchyma.

It is one of the many patterns of lung opacification and is equivalent to the pathological diagnosis of pulmonary consolidation.
PA chest radiograph of a patient with pneumococcal pneumonia shows a patchy left upper lobe consolidation with air bronchograms (white open arrow) and central bronchial wall thickening (white curved arrow).
<table>
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<td>Transudate, e.g. Pulmonary edema secondary to heart failure</td>
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<tr>
<td>pus, e.g. bacterial pneumonia</td>
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<tr>
<td>blood, e.g. Pulmonary hemorrhage</td>
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<tr>
<td>cells, e.g. Bronchoalveolar carcinoma</td>
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<tr>
<td>protein, e.g. Alveolar proteinosis</td>
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<tr>
<td>fat, e.g. Lipoid pneumonia</td>
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<tr>
<td>gastric contents, e.g. Aspiration pneumonia</td>
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<tr>
<td>water, e.g. drowning</td>
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Patterns Of Consolidation

Lobar

Bronchopneumonia
Lobar Consolidation

Right upper lobe consolidation. Note it outlines the horizontal fissure nicely.
Right Middle Lobe Pneumonia
Lobar Pneumonia

Radiological pattern associated with homogeneous and fibrinosuppurative consolidation of one or more lobes of a lung in response to bacterial pneumonia.

Streptococcus Pneumoniae (also known as pneumococcus) is the most common causative organism of lobar pneumonia.
Pathology

There is characteristic relative sparing of the bronchi, creating the appearance of air bronchogram.

The distribution of consolidation is lobar because of the spread of infection across segmental boundaries - although limited by pleural boundaries.
Radiological Findings, Radiograph

Homogeneous opacification in a lobar pattern. The opacification can be sharply defined at the fissures.

The non-opacified bronchus within a consolidated lobe will result in the appearance of air bronchogram.
Bronchopneumonia

- A.K.A **lobular pneumonia**, is a radiological pattern associated with suppurative peribronchiolar inflammation and subsequent patchy consolidation of one or more of secondary lobules of the lungs in response to bacterial pneumonia.
Bronchopneumonia is precipitated by inhalation (or rarely haematogenous spread) of a causative organism.

- **Staphylococcus aureus**
- **Klebsiella pneumoniae**
- **Haemophilus influenzae**:
- **Pseudomonas aeruginosa**:
Radiological Findings.. Radiograph

Characterized by multiple small nodular or reticulonodular opacities which tend to be patchy and/or confluent.

This represents areas of the lung where there are patches of inflammation separated by normal lung parenchyma.

The distribution is often bilateral and asymmetric and predominantly involves the lung bases.
Pleural effusion
Pleural Effusion

Normal accumulations of fluid within the pleural space.

Types of pleural fluid

Empyema
Chylothorax
Hemothorax
Urinothorax
Chemothorax
Chest radiographs are the most commonly used examination to assess for the presence of a pleural effusion.

On a routine erect chest x-ray as much as 250-600 mL of fluid is required before it becomes evident.

A lateral decubitus film is most sensitive, able to identify even a small amount of fluid.

At the other extreme, supine films can mask large quantities of fluid.
A large left sided pleural effusion is present with no fluid seen on the right. No evidence of cardiomegaly or pulmonary venous congestion. No evidence of trauma. Multiple surgical clips are seen in the right supraclavicular fossa.
Hilae
AP chest radiograph of a young woman with nodular sclerosis Hodgkin lymphoma shows mediastinal widening and the hilum overlay sign.
PA chest radiograph of a 27-year-old man with sarcoidosis shows bilateral hilar (cyan solid arrow), right paratracheal (cyan curved arrow), and aortopulmonary window (cyan open arrow) lymphadenopathy.
Mediastinum
PA chest radiograph in a patient with a fusiform aneurysm involving the ascending aorta shows abnormal convexity along the superior cardiomedial silhouettes on the right (white solid arrow). While even moderate aneurysms could be overlooked on radiography, this is a classic finding that should always be worked up when seen on radiography.
Axial chest CECT shows fusiform aneurysm involving the ascending thoracic aorta (white solid arrow). Note diameter of the pulmonary trunk (white curved arrow), which normally is approximately the same size as the ascending aorta.
Axial chest CECT in the same patient shows dilated distal ascending thoracic aorta (white solid arrow). Note that there is thin intraluminal thrombus (white curved arrow) within the aneurysm. Also note that the pulmonary trunk exhibits a discordant diameter (white open arrow).
Pneumothorax
Pneumothorax

the presence of gas (air) in the pleural space.

Tension pneumothorax: When this collection of gas is constantly enlarging with resulting compression of mediastinal structures, it can be life-threatening.

Simple: If no tension is present.
Types

- **PRIMARY SPONTANEOUS:** NO UNDERLYING LUNG DISEASE
- **SECONDARY SPONTANEOUS:** UNDERLYING LUNG DISEASE IS PRESENT
- **IATROGENIC / TRAUMATIC**
• When the underlying lung is abnormal, causes are many!!

• **cystic lung disease**
  • Bullae
  • Emphysema
  • PJP infection.
  • Honeycombing: end-stage interstitial lung disease
  • Cystic fibrosis.

• **parenchymal necrosis**
  • Abscess, T.B
  • Cavitating neoplasms.
  • radiation necrosis
  • Pulmonary infarct
• **iatrogenic/trumatic**

  • **iatrogenic:**
    - percutaneous biopsy
    - barotrauma (e.g. divers), ventilator
    - radiofrequency (RF) ablation of lung mass
    - endoscopic perforation of the esophagus
    - Central venous Catheter insertion, NGT placement

  • **trauma:**
    - Pulmonary laceration
    - Tracheobronchial rupture
    - Esophageal rupture
Radiographic features

- visible visceral pleural edge is seen as a very thin, sharp white line
- no lung markings are seen peripheral to this line
- peripheral space is radiolucent compared to the adjacent lung
- lung may completely collapse
- Mediastinal shift to other side if tension presents.
- Additional features: SQ emphysema or pneumomediastinum.
Advanced Techniques

Lateral Decubitus radiograph

- should be done with the suspected side up
- the lung will then 'fall' away from the chest wall

Expiratory Chest radiograph

- lung becomes smaller and denser
- pneumothorax remains the same size and is thus more conspicuous.
Left Decubitus

There is a knife projected through the right scapula between the posterolateral right third and fourth ribs extending into the right thorax with an associated large pneumothorax.
Pneumothorax noted on the left side with a partially collapsed lung. An intercostal drainage tube is noted in situ.
Mobile chest x-ray of an intubated patient with a large right-sided pneumothorax. The right lung is collapsed and there is leftward shift of the mediastinum consistent with a tension pneumothorax.
Frontal radiograph in full inspiration demonstrates a thin white line of the visceral pleura (white open arrow) outlined by a large right pneumothorax. The patient was a 28-year-old male smoker.
PA chest radiograph of a 30-year-old man status post stab wound to the anterior left chest shows a large left pneumothorax, a moderate left pleural effusion (a presumed hemothorax), complete left lung atelectasis, and mediastinal mass effect related to tension pneumothorax.
Collapse
Types

- Whole lung.
- Lobar
- Segmental/Subsegmental.
Lobar Collapse

collapse of an entire lobe of the lung.

It is a subtype of Atelectasis; which is a more generic term for 'incomplete expansion').

Individual lobes of the lung may collapse due to obstruction of the supplying bronchus.
Etiology

- Aspirated foreign material
- Mucus Plug

- Bronchogenic carcinoma

- Compression by adjacent mass
Radiographic features

- Bowing or displacement of a fissure/s occurs towards the collapsing lobe.
- Volume loss of the affected lung.
- The collapsed lobe is triangular or pyramidal in shape, with the apex pointing to the hilum.
• The collapsed lung peripherally maintains contact with the costal parietal pleura, except:
  • in RML collapse where the lobe collapses adjacent to the mediastinum
  • in the presence of Pleural effusion
  • in the presence of pneumothorax
Volume loss in the right hemithorax. Right upper lobe opacification with a sharply delineated margin in keeping with an elevated and medially oriented horizontal fissure. Elevated right hilum. Left lung clear.
Isolated right lower lobe collapse with incomplete volume loss suggesting a concomitant degree of consolidation.
Triangular shaped opacity medially in the right lower zone, with effacement of the right heart border silhouette. Subtle volume loss in the right hemithorax. Left lung clear. Heart size normal.
Plain radiograph

- Central pulmonary congestion
- Cephalization of pulmonary veins.
- Pulmonary interstitial and alveolar edema.
- Cardiomegaly (may or may not be present depending on etiology)
- Pleural effusions.
The heart occupies more than half of the thoracic diameter. Cephalization of the lung vasculature. Kerely B lines.
PA radiograph of patient with left heart failure shows cardiomegaly (with an enlarged cardiothoracic ratio), cephalization of pulmonary blood flow, and interstitial edema. Kerley B lines and small pleural effusions (black solid arrow) are also apparent.
Lung Cancer

- A.K.A bronchogenic carcinoma is a broad term referring to the main histological subtypes of primary lung malignancies that are mainly linked with inhaled carcinogens and cigarette smoke being a key culprit.
Each subtype has a different radiographic appearance, demographic, and prognosis:

- Non small cell carcinoma of the lung.
- Small cell carcinoma of the lung.
The dense hilum sign and a lobulated soft tissue mass lesion is noted posterior to the left hilum.
Large spiculated left hilar mass.

Hyperinflated lungs in keeping with COPD.

Tiny left sided pleural effusion.