Interpretation of Chest Radiographs

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When x-rays are produced and directed toward the patient, they may act in three basic ways:

- **They may be...** Which means...
  - unabsorbed: they pass through the patient unchanged and strike the x-ray film
  - completely absorbed: the energy of the x-ray is totally deposited within the patient
  - scattered: they are deflected within the patient but may still strike the x-ray film

X-ray Absorption

Factors that contribute to X-ray absorption include:

- The density of the tissue the beam strikes
- The energy of the X-ray beam (the energy of the X-ray beam is usually fairly constant in posterior/anterior and lateral radiography)

Tissue Density

Whitest/Most Dense
- Metal
- Contrast material (i.e., x-ray dye)
- Bone
- Calcium
- Soft tissue
- Fat
- Air or gas

Blackest/Least Dense
Posterior/Anterior (PA) Radiograph

- The term posterior/anterior (PA) refers to the direction of the X-ray beam which in this case traverses the patient from posterior (back) to anterior (front)
- The PA view taken at a distance of 6 feet to reduce magnification and enhance sharpness

Normal Frontal (PA) Chest Radiograph

PA & AP Chest X-rays
Lateral Radiograph

- The other routine view is the lateral radiograph.
- By convention it is taken at a distance of 6 feet and the left side of the chest is held against the X-ray cassette.
- Often it is difficult to detect lesions located behind the heart, near the mediastinum, or near the diaphragm on the PA view.
- The lateral view generally shows such lesions, so we use it routinely.

Normal Lateral Chest Radiograph

Basic Patterns of Disease

- **Consolidation** (or airspace filling)
- **Interstitial** (including linear and reticular opacities, small well-defined nodules, miliary patterns, and peribronchovascular thickening)
- **Solitary nodule**
- **Mass**
- **Lymphadenopathy**
- **Cyst/cavity**
- **Pleural abnormalities**
Consolidation

- Also known as air space disease (ASD), alveolar filling disease, or acinar disease

- Appearance and findings
  - Increased opacity
  - Ill defined, hazy, patchy, fluffy, or cloud-like
  - Silhouette sign
  - Air bronchograms
  - Butterfly or bat-wing pattern
  - Lobar or segmental distribution

PA Chest Radiograph (LLL pneumonia consolidation)

Lateral Chest Radiograph (LLL pneumonia consolidation)
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Interstitial Lung Disease (ILD)

- **Appearance and findings**
  - Reticular pattern, increased linear opacities
  - Interlobular septal thickening (Kerley B lines)
  - Peribronchial thickening (cuffing or tram tracking)
  - Honeycombing
  - Discrete milliary nodules
  - Reticulonodular pattern
Miliary Pattern

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Masses

- Nodules and masses are discrete areas of increased lung opacity whose borders do not conform to anatomic divisions (such as a fissure)
- Masses are similar to nodules except that they are larger, measuring greater than 30mm in diameter
- Nodules and masses should be described by noting their size, the sharpness of their borders, their number, their location and the presence or absence of calcification

Lung Mass
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**Lymphadenopathy**

- Enlarged lymph nodes appear on the chest radiograph as soft tissue densities in characteristic locations, including:
  - Right paratracheal area
  - Hila
  - Aorticopulmonary window
  - Subcranial mediastinum
  - Supraclavicular area
  - Paraspinal region
  - Retrosternal area on the lateral radiograph

- One or more regions may be involved, and in certain conditions, nodes may calcify

**Lymphadenopathy**

- Hilar enlargement due to adenopathy is frequently lobular
- Thickening of the posterior wall of the bronchus intermedius may be due to lymphadenopathy, tumor or edema
- Lymphadenopathy is often best visualized on the lateral radiograph, when it fills the normally clear infrahilar window with an unexpected contour
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Cysts and Cavities

- Focal lucent areas within the lung may result from cavities, cysts, emphysema, and bronchiectasis
- Pulmonary cysts differ from cavities in that cavities are created by necrosis of lung parenchyma, whereas true cysts are formed by other means
- Pulmonary cavities may result from infection, neoplasms, and infarction
- Pulmonary cysts commonly result from infections, trauma, or toxic ingestion, as well as other rare etiologies
Cysts and Cavities

- Pulmonary cysts and cavities are characterized by noting:
  - Their distribution
  - Their number
  - The character of the inner lining
  - The thickness of the wall (at the thickest portion, not including air-fluid levels) and
  - The nature of the contents of the lesion

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Pleural Disease

- Because pleural abnormalities are, by definition, outside the lung parenchyma, an air bronchogram cannot be seen
- Pleural abnormalities are usually homogeneous opacities
- In the upright patient, a pleural effusion will form a curvilinear interface with aerated lung that resembles a meniscus. This occurs because the pleural fluid settles dependently within the pleural space
- In the supine patient, a pleural effusion may layer posteriorly in a dependent fashion, creating a hazy opacity over the entire hemithorax
Pleural Effusion

Self Check

Primary TB in a Child

Primary TB in a Child
Post-Primary (Reactivation) TB (PA View)

Post-Primary (Reactivation) TB (Lateral View)

Tuberculoma

Airspace Consolidation with Cavitation
Summary: Chest Radiographs

• Tuberculosis has a myriad of radiographic appearances
• Chest X-rays are snapshots and cannot determine if the disease is active or infectious
• Tuberculosis may present atypically when patients are immune compromised
• Direct comparison to old films is critically important to follow disease progression
Acknowledgements
