



Interpretation of Chest Radiographs

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X-Rays

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

<i>They may be...</i>	<i>Which means...</i>
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



Normal Frontal (PA) Chest Radiograph



PA & AP Chest X-rays



PA View

AP View



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



Normal Lateral Chest Radiograph



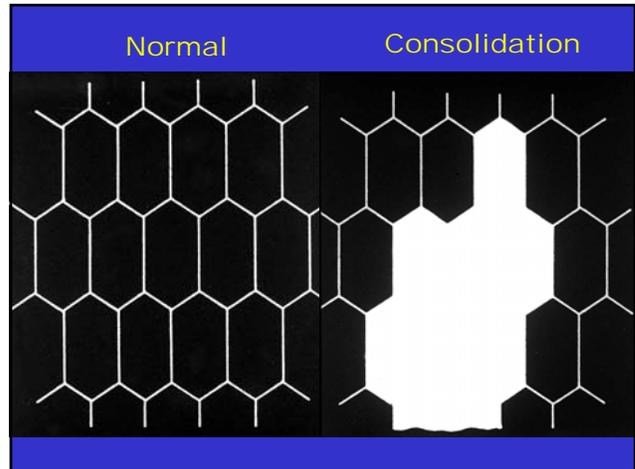
Basic Patterns of Disease

- **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**

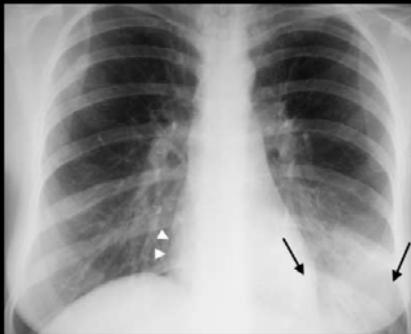


Consolidation

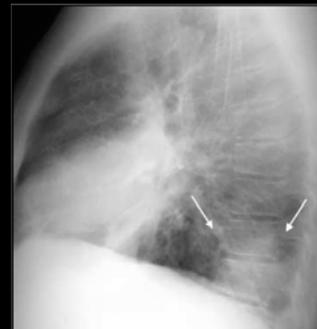
- Also known as air space disease (ASD), alveolar filling disease, or acinar disease
- Appearance and findings
 - Increased opacity
 - Ill defined, hazy, patchy, fluffy, or cloud-like
 - Silhouette sign
 - Air bronchograms
 - Butterfly or bat-wing pattern
 - Lobar or segmental distribution



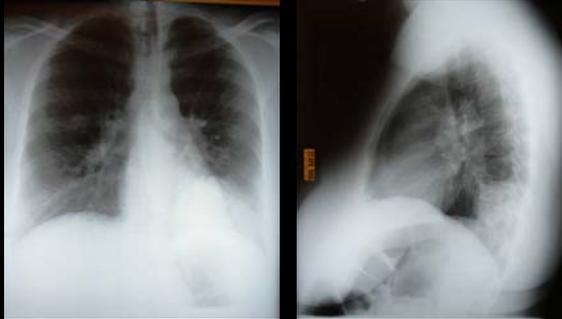
PA Chest Radiograph
(LLL pneumonia consolidation)



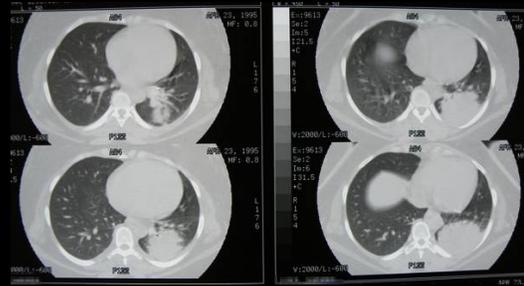
Lateral Chest Radiograph
(LLL pneumonia consolidation)



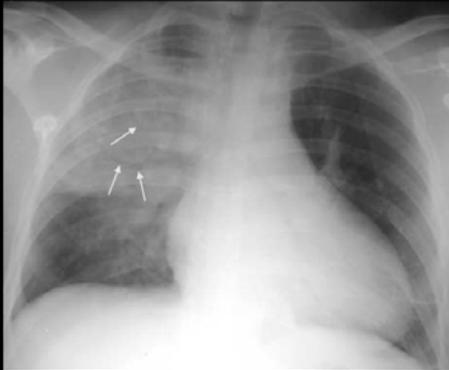
Self Check



Chest CT



Consolidation (Airspace Opacity) (RUL pneumonia)



Basic Patterns of Disease

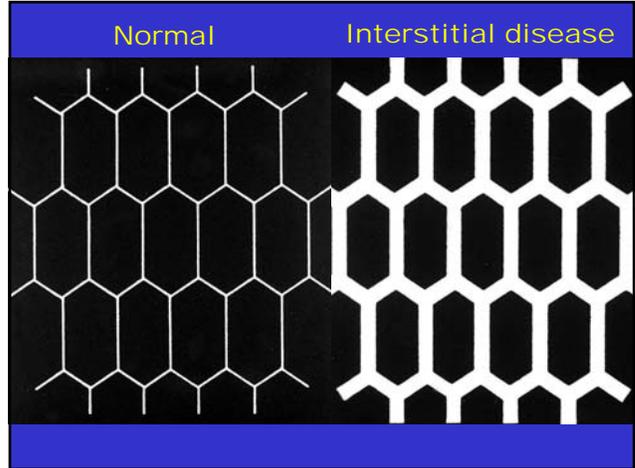
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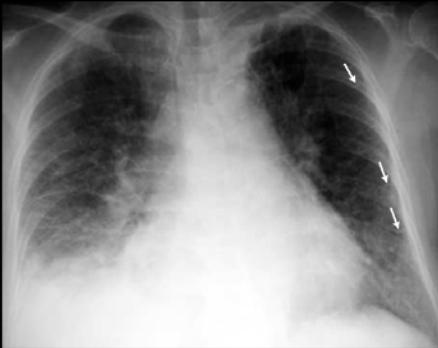
Interstitial Lung Disease (ILD)

• Appearance and findings

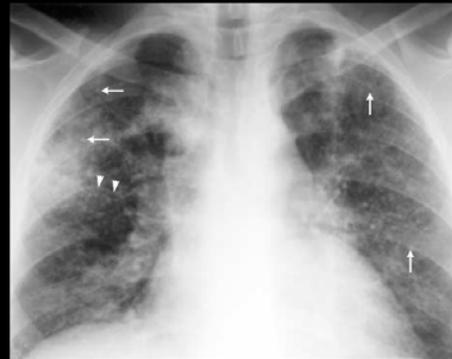
- Reticular pattern, increased linear opacities
- Interlobular septal thickening (Kerley B lines)
- Peribronchial thickening (cuffing or tram tracking)
- Honeycombing
- Discrete miliary nodules
- Reticulonodular pattern



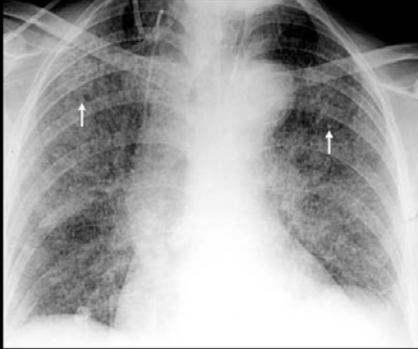
Linear Opacities



Nodules



Miliary Pattern



Basic Patterns of Disease

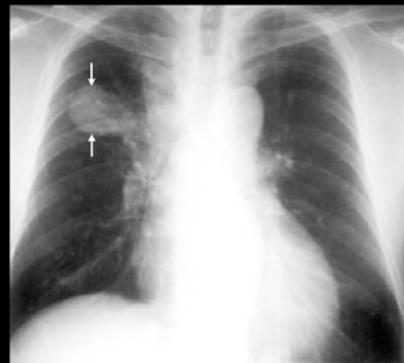
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Masses

- **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

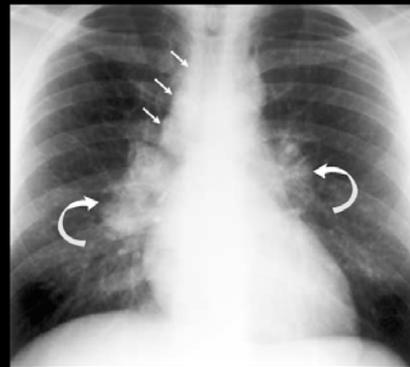
- **Enlarged lymph nodes appear on the chest radiograph as soft tissue densities in characteristic locations, including:**
 - Right paratracheal area
 - Hila
 - Aorticopulmonary window
 - Subcranial mediastinum
 - Supraclavicular area
 - Paraspinous region
 - Retrosternal area on the lateral radiograph
- **One or more regions may be involved, and in certain conditions, nodes may calcify**



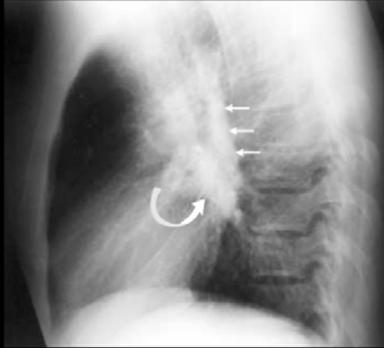
Lymphadenopathy

- **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**

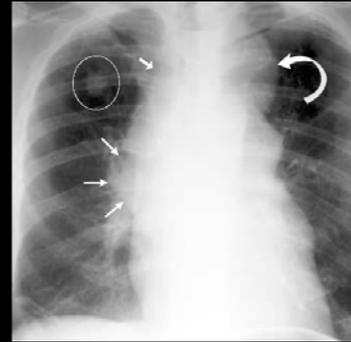
Lymphadenopathy



Lymphadenopathy



Mediastinal Lymphadenopathy



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Cysts and Cavities

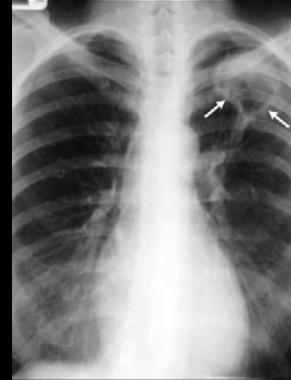
- **Focal lucent areas within the lung may result from cavities, cysts, emphysema, and bronchiectasis**
- **Pulmonary cysts differ from cavities in that cavities are created by necrosis of lung parenchyma, whereas true cysts are formed by other means**
- **Pulmonary cavities may result from infection, neoplasm, 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

Cavity



Basic Patterns of Disease

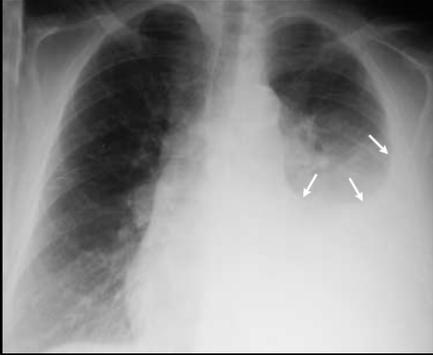
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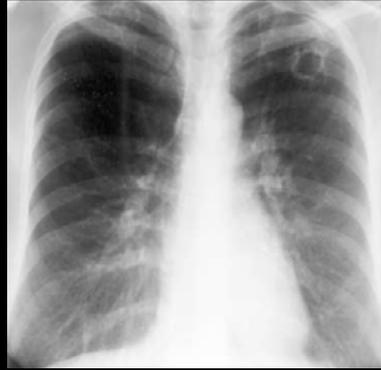
Pleural Disease

- **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**

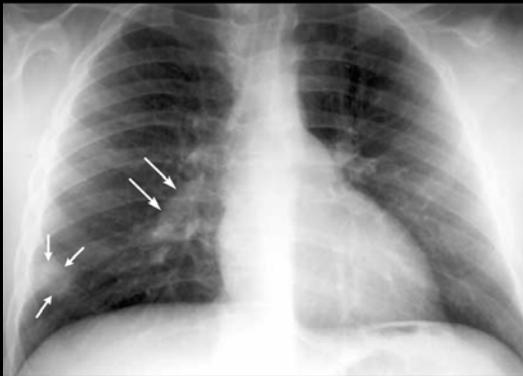
Pleural Effusion



Self Check



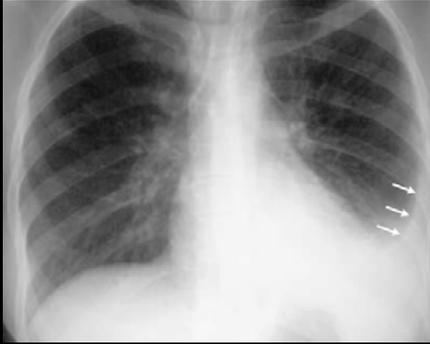
Primary TB in a Child



Primary TB in a Child



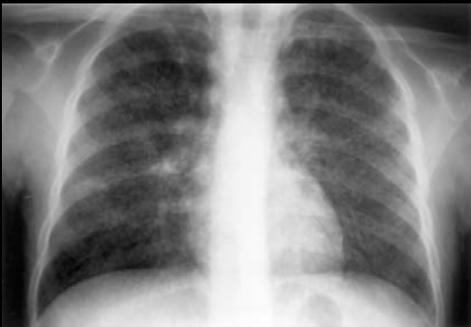
Primary TB in an Adult



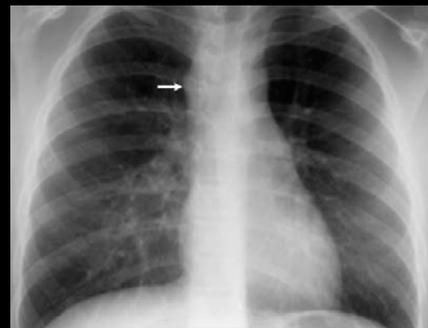
Primary TB with Cavitation



Tuberculosis...



TB in a 10 year old



Post-Primary (Reactivation) TB
(PA View)



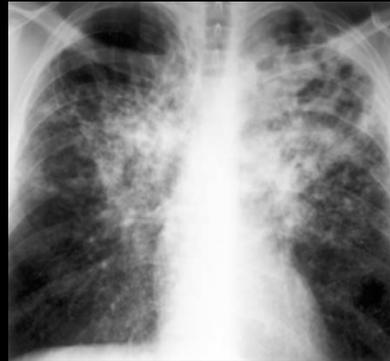
Post-Primary (Reactivation) TB
(Lateral View)



Tuberculoma



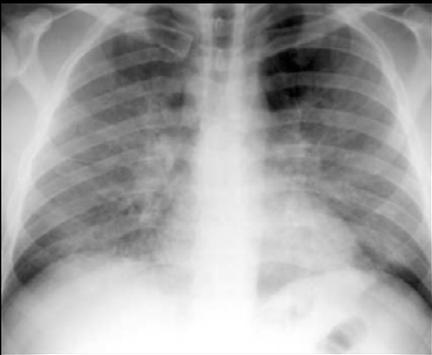
Airspace Consolidation with Cavitation



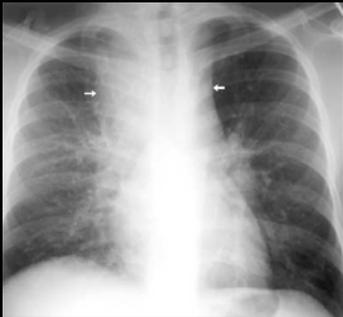
Volume Loss (Atelectasis)



Self Check



Paratracheal Adenopathy in HIV



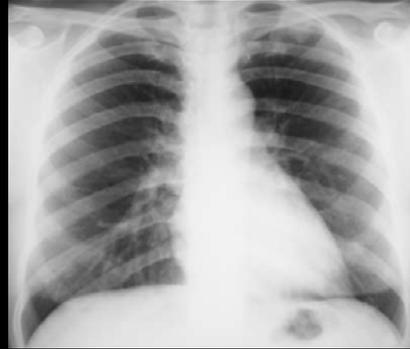
Fibrotic Scarring



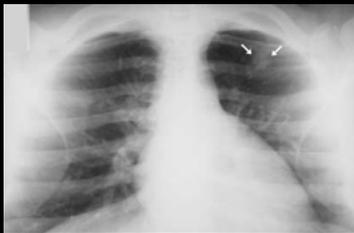
Self Check



Self Check



Answer



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

Daley, C.L., Gotway, M.B., Jasmer, R.M. (2006). *Radiographic Manifestations of Tuberculosis* (2nd ed.). Francis J. Curry National TB Center (www.nationaltbcenter.edu)

Goodman, L.R. (2007) *Felson's Principles of Chest Roentgenology: A Programmed Text* (3rd ed.). Philadelphia: Saunders.