Chest Imaging

Systematic Approach and Recognizing the Basics

Lecture 1

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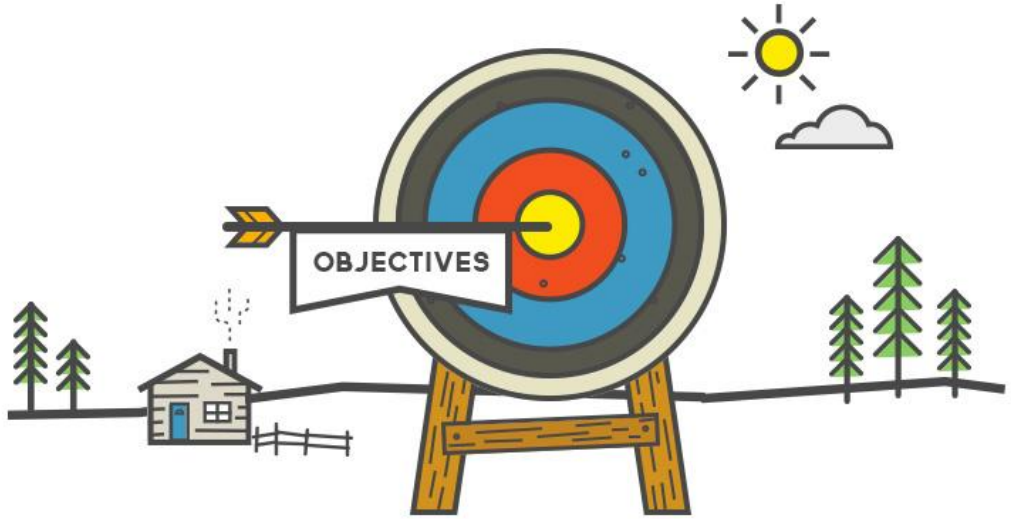
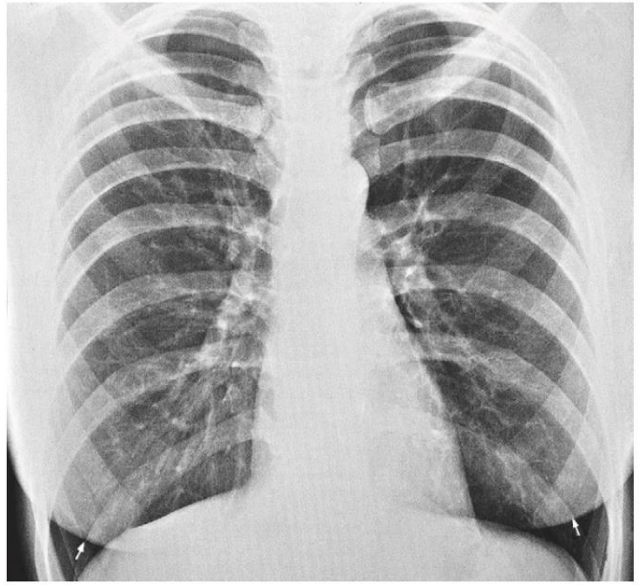
Learning Objectives

By the end of this lecture, you will be able to:

- Describe the standard techniques for chest radiography (CXR) and Computed Tomography (CT).
- Apply a systematic approach (ABCs) to interpret a normal CXR.
- Identify the key anatomical structures on PA and Lateral CXR.
- Define and recognize the fundamental patterns: Consolidation, Collapse, and Pleural Effusion, nodules, masses, cavity and cysts and interstitial lung changes.



The Plain Chest Radiograph (CXR): First-Line Tool



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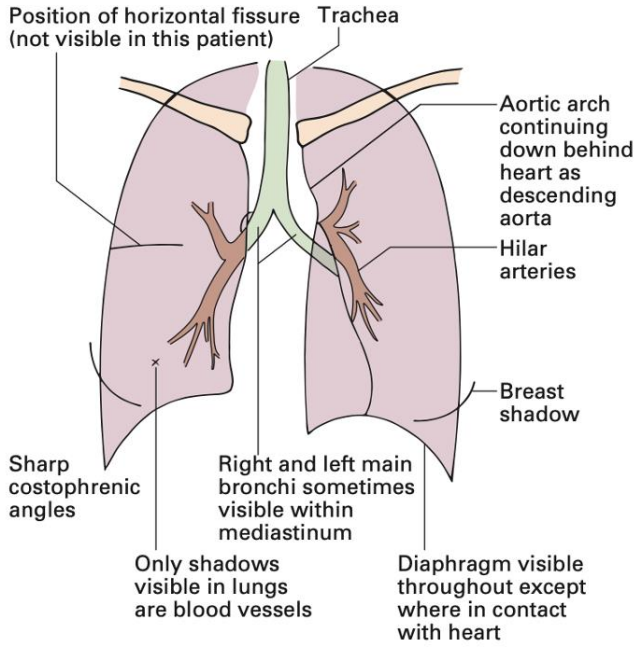
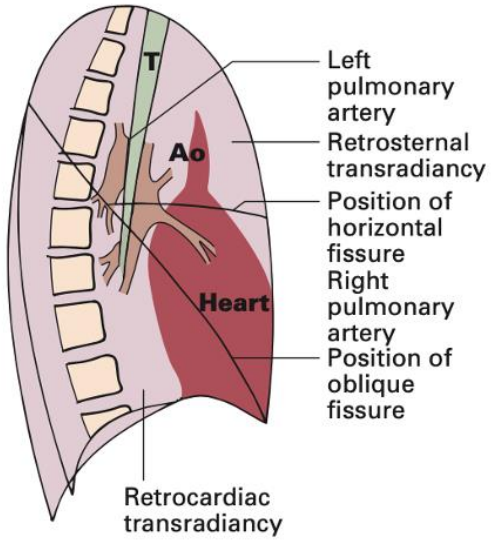


Standard Projections:

- **Posteroanterior (PA):** Gold standard. Patient stands, beam from back to front. Minimizes heart magnification.
- **Lateral:** Essential for locating lesions and visualizing retrosternal/ retrocardiac spaces.
- **Anteroposterior (AP):** Often portable. Lower quality, magnifies heart.

Crucial Factor: Inspiration.
Expiratory films mimic disease (hazy bases, large heart).

The Plain Chest Radiograph (CXR)



The Lateral View

- **Purpose:**
  - Localizes lesions seen on PA view (e.g., right vs. left lung, which lobe?).
  - Visualizes retrosternal and retrocardiac spaces.
  - Assesses the fissures.

Systematic Approach: The "ABCs"

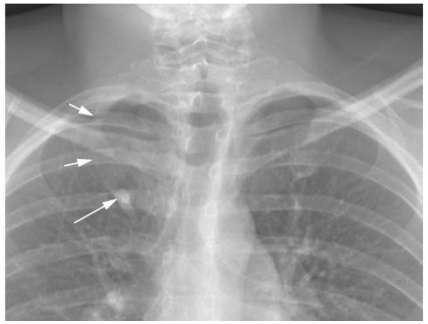
- A - **Airway:** Trace the trachea. Is it midline?
- B - **Breathing (Lungs):** Compare left and right. Look at vascular markings, lung fields.
- C - **Cardiac:** Assess heart size (cardiothoracic ratio <50%), shape, and borders.
- D - **Diaphragm:** Right hemidiaphragm is usually higher. Look for costophrenic angles.
- S - **Soft Tissues, Bones, Spine:** Check for fractures, mastectomy, subcutaneous emphysema.

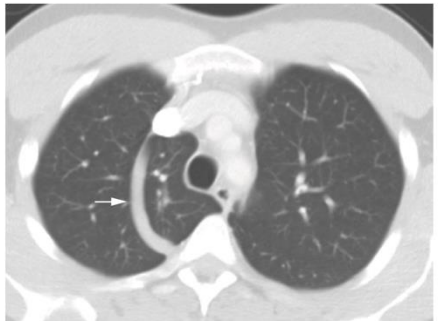
Normal Anatomy & Important Variants

- **Landmarks on PA:** Trachea, hila (vessels, not nodes), heart borders, aortic knuckle, hemidiaphragms.
- **Landmarks on Lateral:** Retrosternal space, hilar structures, fissures, retrocardiac space.
- **Don't Mistake for Disease!**
  - Thymus in children ("sail sign").
  - Azygos lobe fissure (incidental finding).
  - Nipples, skin lesions, hair plaits.

Normal Anatomy on Lateral CXR (Diagram)

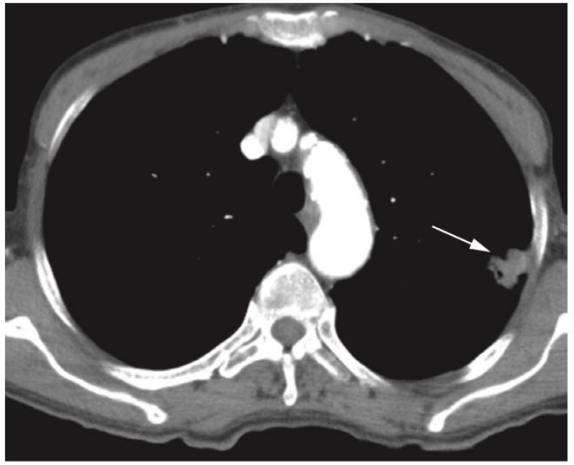
- Labeled image showing:
  - Retrosternal Clear Space
  - Hilum (in the center)
  - Right and Left Hemidiaphragms
  - Fissures (Major and Minor)
  - Retrocardiac Space





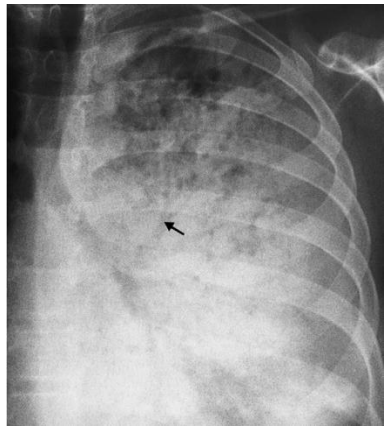
Introduction to Computed Tomography (CT)

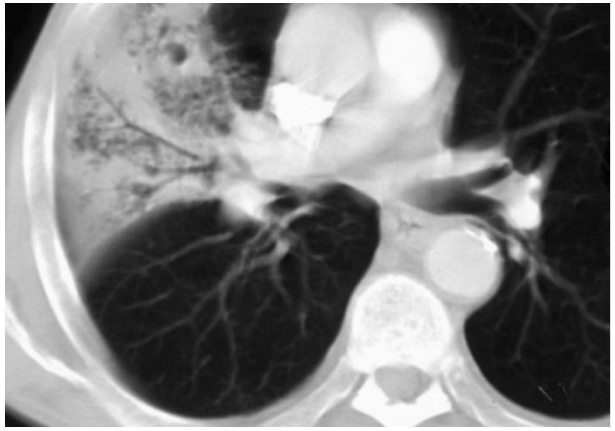
- Cross-sectional imaging that eliminates superimposition.
- **Technique:** Intravenous contrast is often used to assess vessels and mediastinum.
- **Windows are Key:**
  - **Lung Window:** Optimized to see lung parenchyma, airways, and vessels.
  - **Mediastinal Window:** Optimized for heart, mediastinum, and soft tissues.

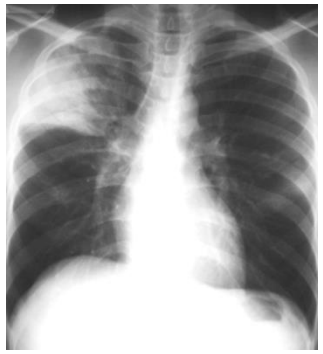


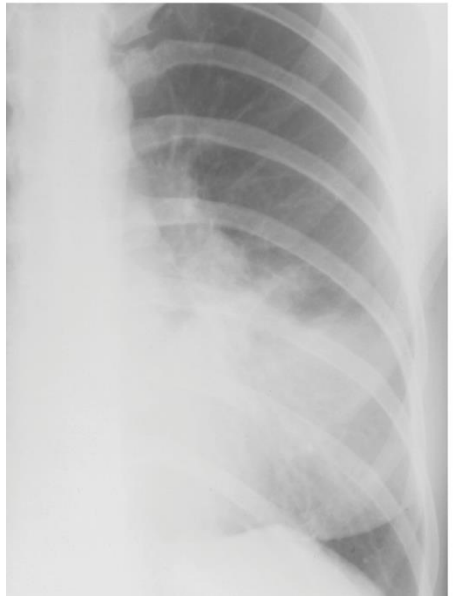
Pattern 1: Air-Space Opacification (Consolidation)

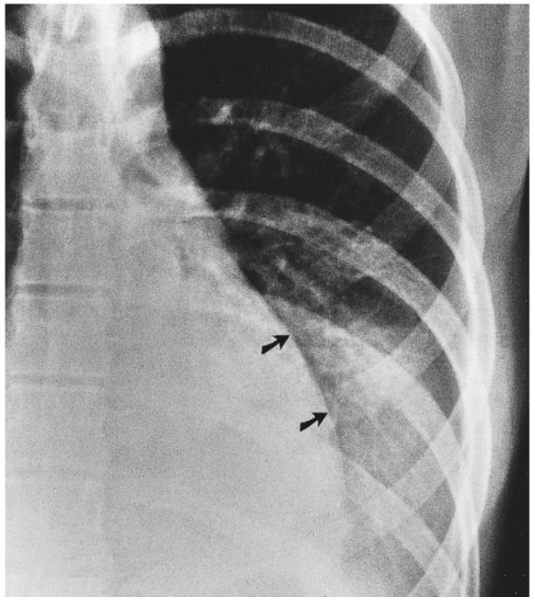
- **Pathology:** Alveoli filled with fluid, pus, blood, or cells.
- **Key Signs:**
  - Ill-defined opacity except where bordered by a fissure.
  - **Air Bronchogram:** Air-filled bronchi seen against opacified lung. *Pathognomonic*.
  - **Silhouette Sign:** Loss of the border of the heart or diaphragm.
  - **No volume loss.**
  - **Causes:** Pneumonia, Pulmonary Edema, Hemorrhage.





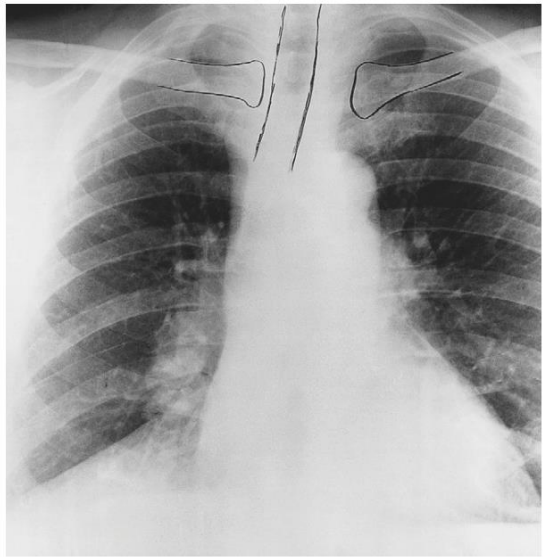


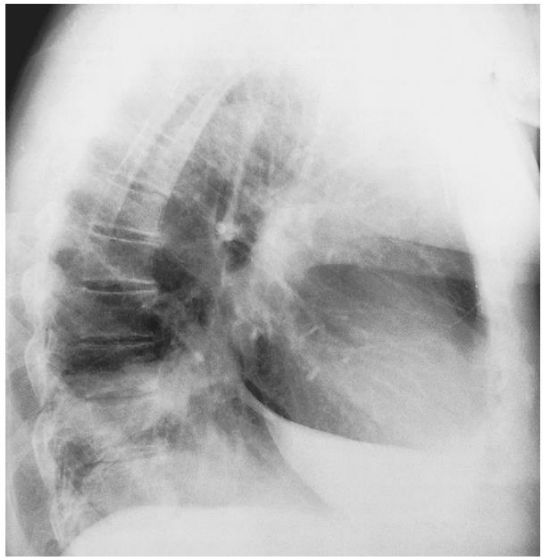


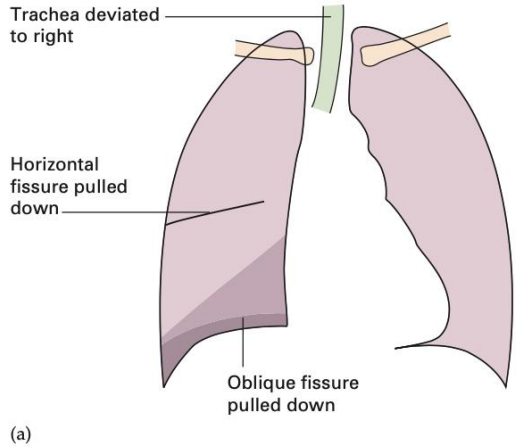


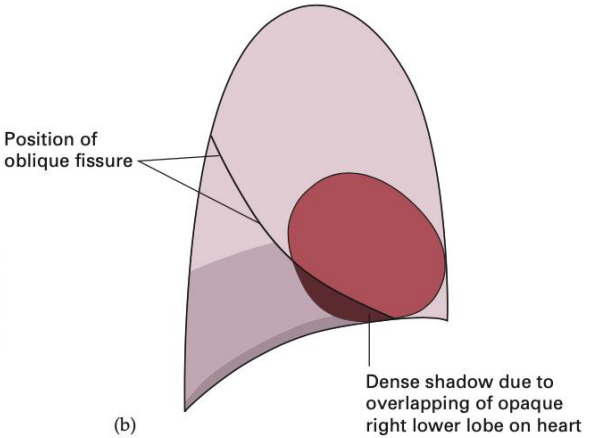
Pattern 2: Pulmonary Collapse (Atelectasis)

- **Pathology:** Loss of lung volume.
- **Common Cause:** Bronchial obstruction (e.g., mucus plug, tumor).
- **Key Signs:**
  - **Opacity with signs of volume loss.**
  - **Signs of Volume Loss:** Displaced fissures, elevated hemidiaphragm, mediastinal shift *towards* the collapse, rib crowding.
  - Can be lobar or sub-segmental.





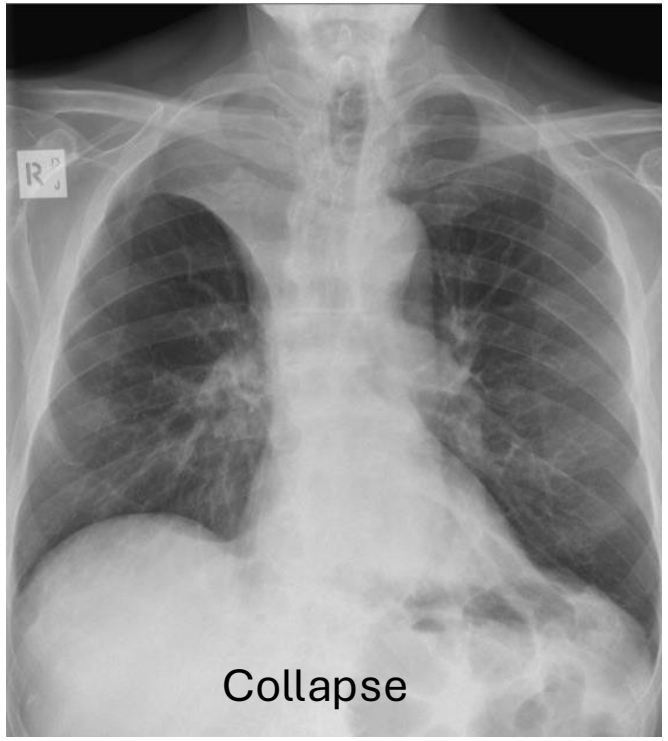


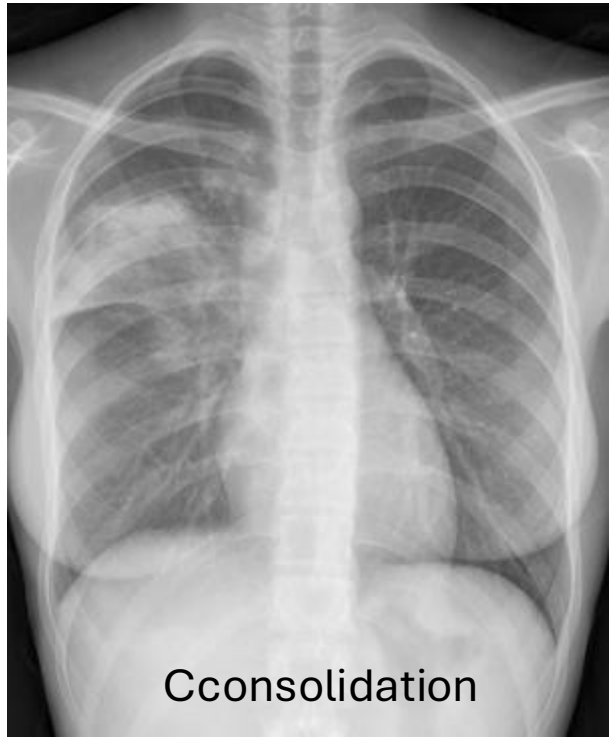


Consolidation vs. Atelectasis

Side-by-side comparison:

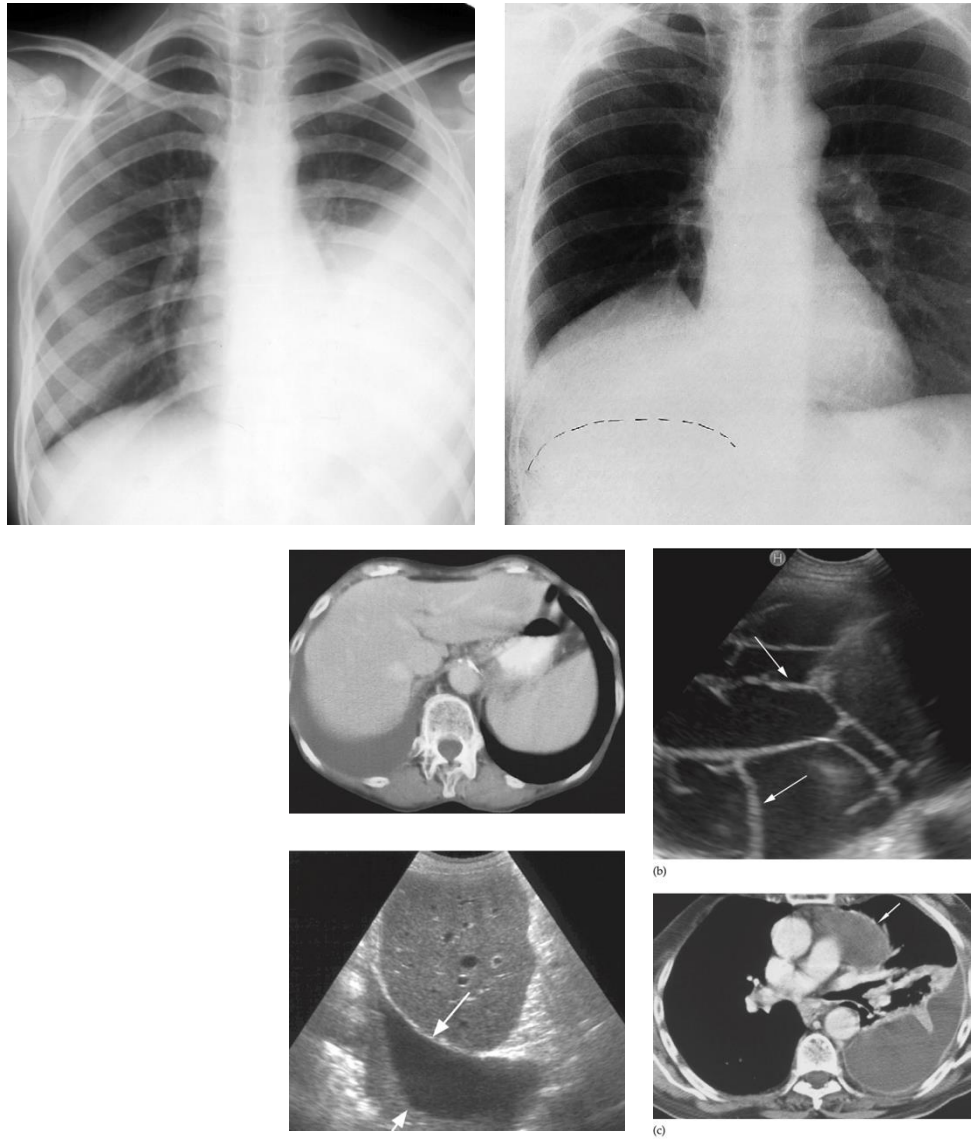
- **Vessels:** Obscured in both.
- **Air Bronchograms:** Common in Consolidation, rare in Atelectasis.
- **Volume:** Normal or increased in Consolidation, Decreased in Atelectasis.
- **Mediastinum:** No shift or shift away (if massive consolidation), Shift towards in Atelectasis.

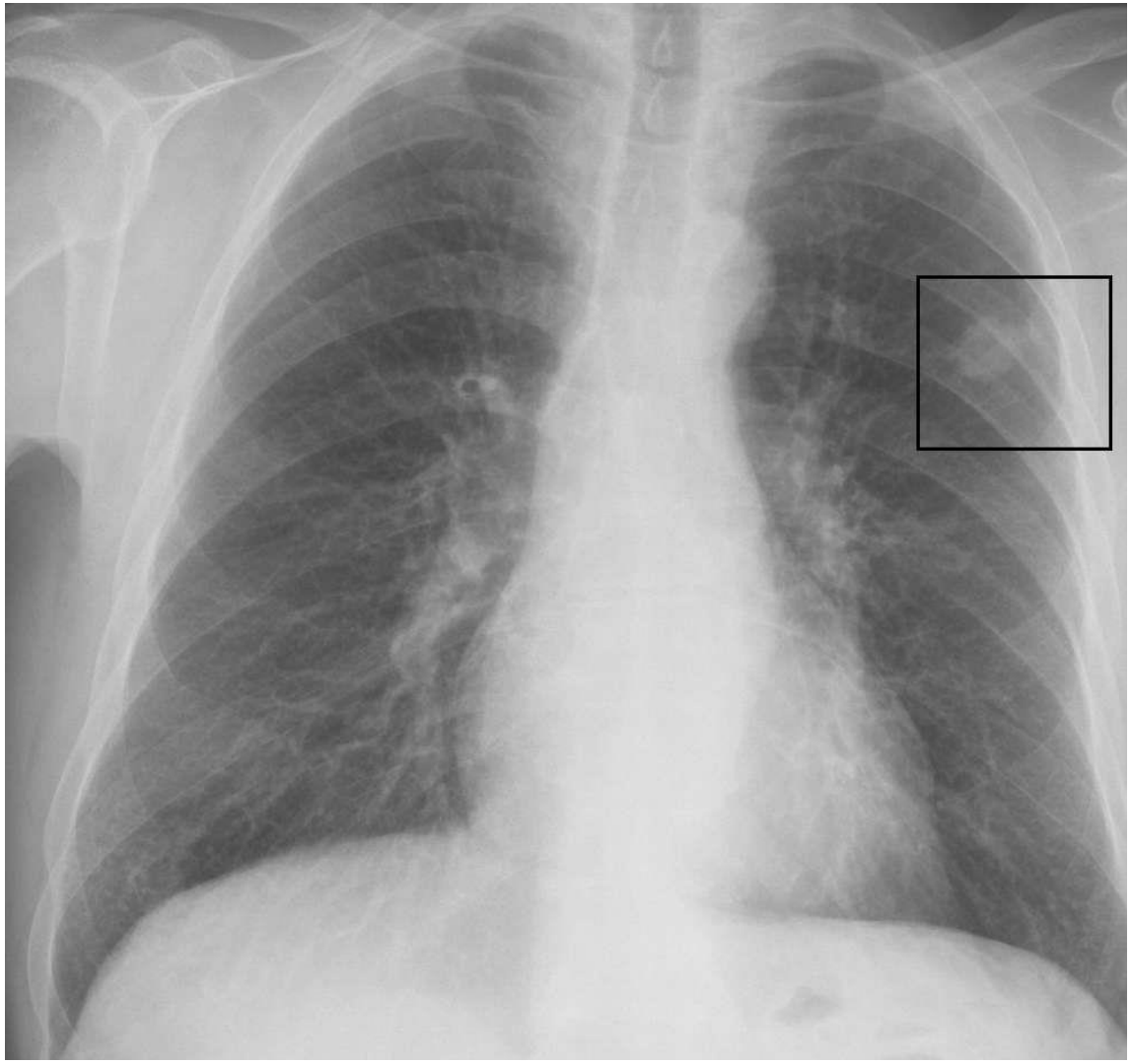

Collapse


Cconsolidation

Pattern 3: Pleural Effusion

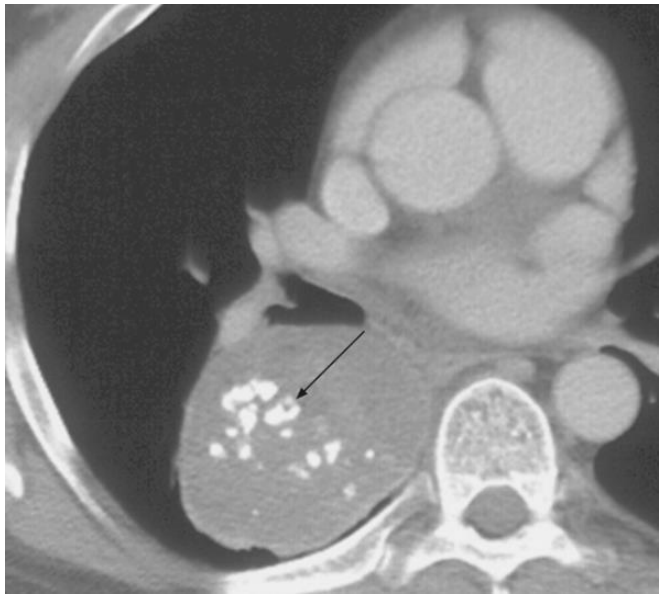
- **Pathology:** Fluid in the pleural space.
- **CXR Appearance (Upright):**
  - Blunting of costophrenic angle with a curved upper border (**meniscus sign**).
  - Homogeneous opacity, higher laterally.
- **X-ray Appearance (Supine):**
  - Hazy opacity over the entire lung field ("veiling").
  - Blunted costophrenic angle may be the only clue.
- **Subpulmonary Effusion:** Mimics a raised hemidiaphragm.
  Ultrasound & CT: Excellent for confirming and localizing fluid, especially when loculated.

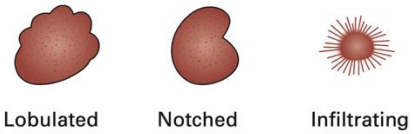




Pattern 4: Nodules and Masses

- **Nodule:** < 3 cm, spherical opacity.
- **Mass:** > 3 cm.
- **Key Features to Describe:**
  - **Size**
  - **Margin:** Smooth, spiculated (suggests malignancy), ill-defined.
  - **Location**
  - **Calcification:** Benign patterns (e.g., popcorn, central, diffuse).





The Solitary Pulmonary Nodule (SPN)

- **Definition:** A single, spherical opacity <3 cm in diameter.
- **Major Question:** Benign vs. Malignant?
- **Key Factors:**
  - **Patient Age & History:** >50 y/o + smoker = high risk for carcinoma.
  - **Growth:** Stability for 2+ years suggests benignity.
  - **Calcification:** "Popcorn" (hamartoma), central, concentric = benign.
  - **Margins:** Spiculated, lobulated, or infiltrating edges suggest malignancy.

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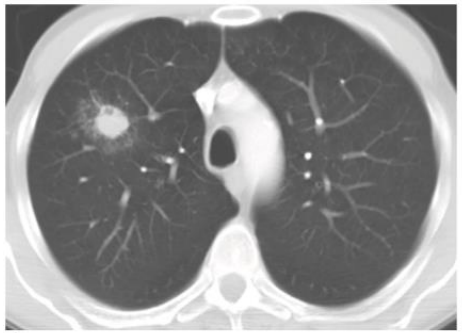
(c)



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Advanced Nodule Characterization: CT & PET

- **Role of CT:**
  - Confirms calcification and benign morphology.
  - Assesses margins and cavitation.
  - Identifies additional nodules.
- **Role of FDG-PET/CT:**
  - Most malignant nodules show high metabolic activity (FDG uptake).
  - **Caution:** Active inflammation can also cause FDG uptake (false positive).
- **Management:** Follow Fleischner Society guidelines for incidental nodules.

Advanced Nodule Characterization: CT & PET

Table 2.1 Recommendations for follow-up and management of nodules smaller than 8 mm detected incidentally at non-screening CT: Fleishner guidelines

Nodule size	Low risk patients*	High risk patients*
≤4 mm	No follow-up needed	Follow-up at 12 months. If no change, no further imaging needed
>4 to 6 mm	Follow-up at 12 months. If no change, no further imaging needed	Initial follow-up CT at 6–12 months and then at 18–24 months if no change
>6 to 8 mm	Initial follow-up CT at 6–12 months and then at 18–24 months if no change	Initial follow-up CT at 3–6 months and then at 9–12 and 24 months if no change
>8 mm	Follow-up CTs at around 3, 9 and 24 months. Dynamic contrast-enhanced CT, PET and/or biopsy	Same as for low risk patients

*Low risk patients: minimal or absent history of smoking and of other known risk factors. High risk patients: history of smoking or of other known risk factors.

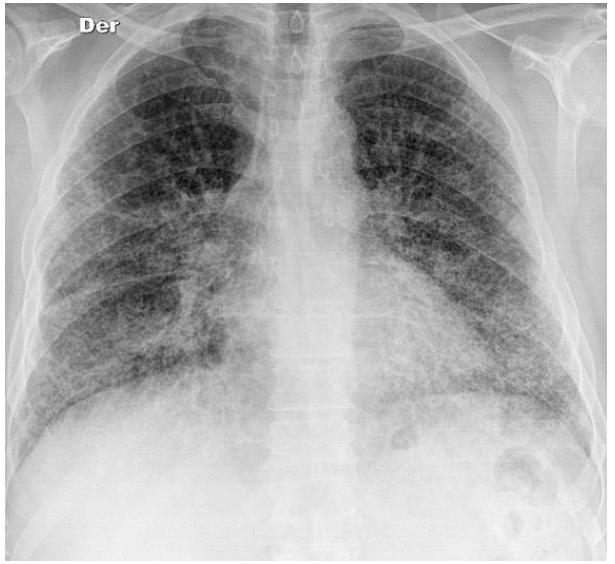
CT, computed tomography; PET, positron emission tomography.

Pattern 5: Cavities & Cysts

- **Cavity:** A gas-filled space within a nodule, mass, or area of consolidation. Wall is usually thick.
  - Thick, irregular wall: Suggests malignancy or abscess.
  - Thin, smooth wall: Suggests benign process (e.g., bulla).
- **Cyst:** A thin-walled (usually <2mm), well-defined, air- or fluid-filled lesion.

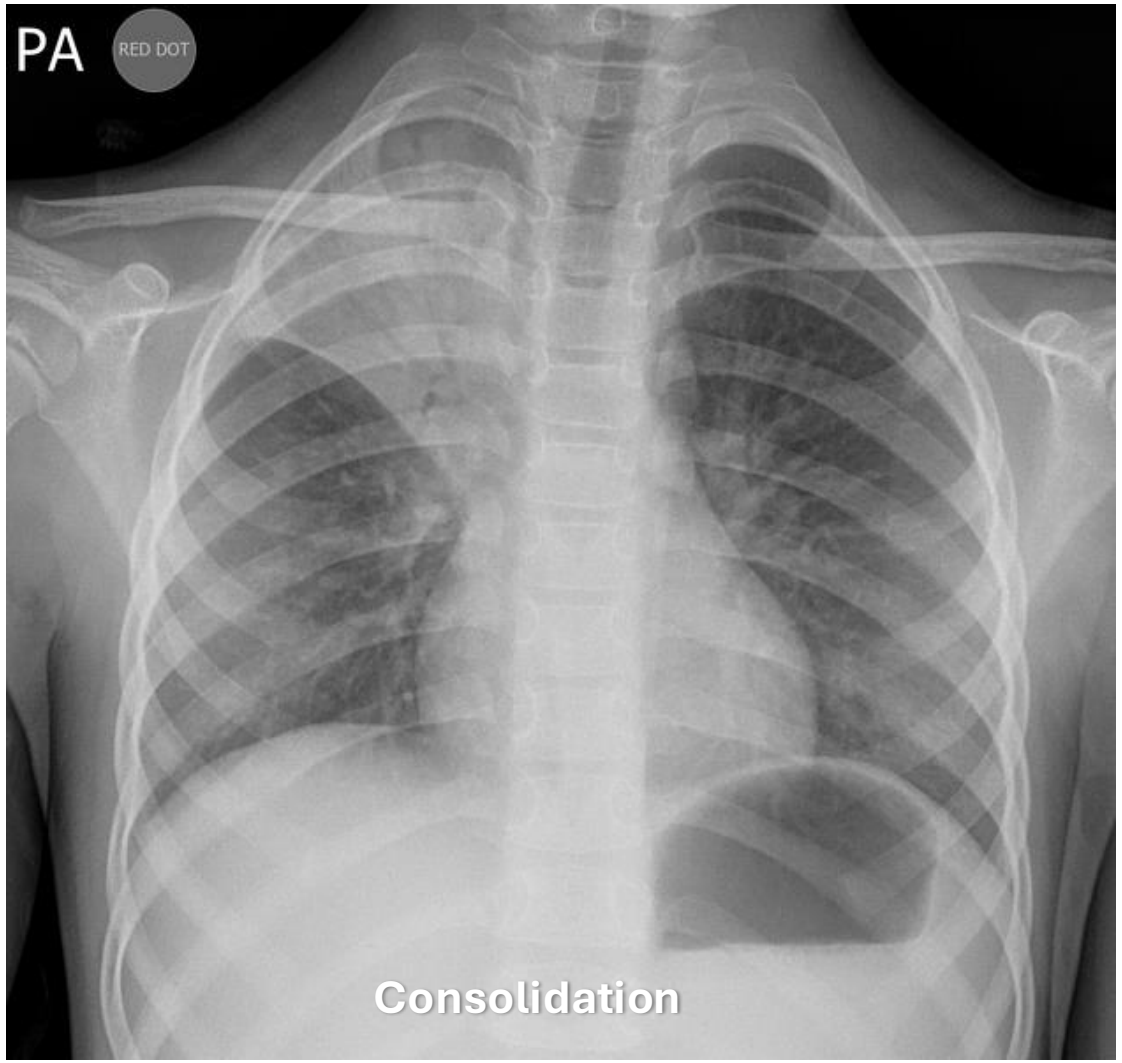
Pattern 6: Interstitial Lung Disease (ILD)

- **Pathology:** Thickening of the lung's supporting structures (interstitium).
- **X-ray Appearance:**
  - **Reticular:** Net-like lines.
  - **Nodular:** Countless small nodules.
  - **Reticulonodular:** A combination.
  - Often described as "increased interstitial markings."
- **"Honeycombing":** End-stage lung disease with clustered cystic spaces.

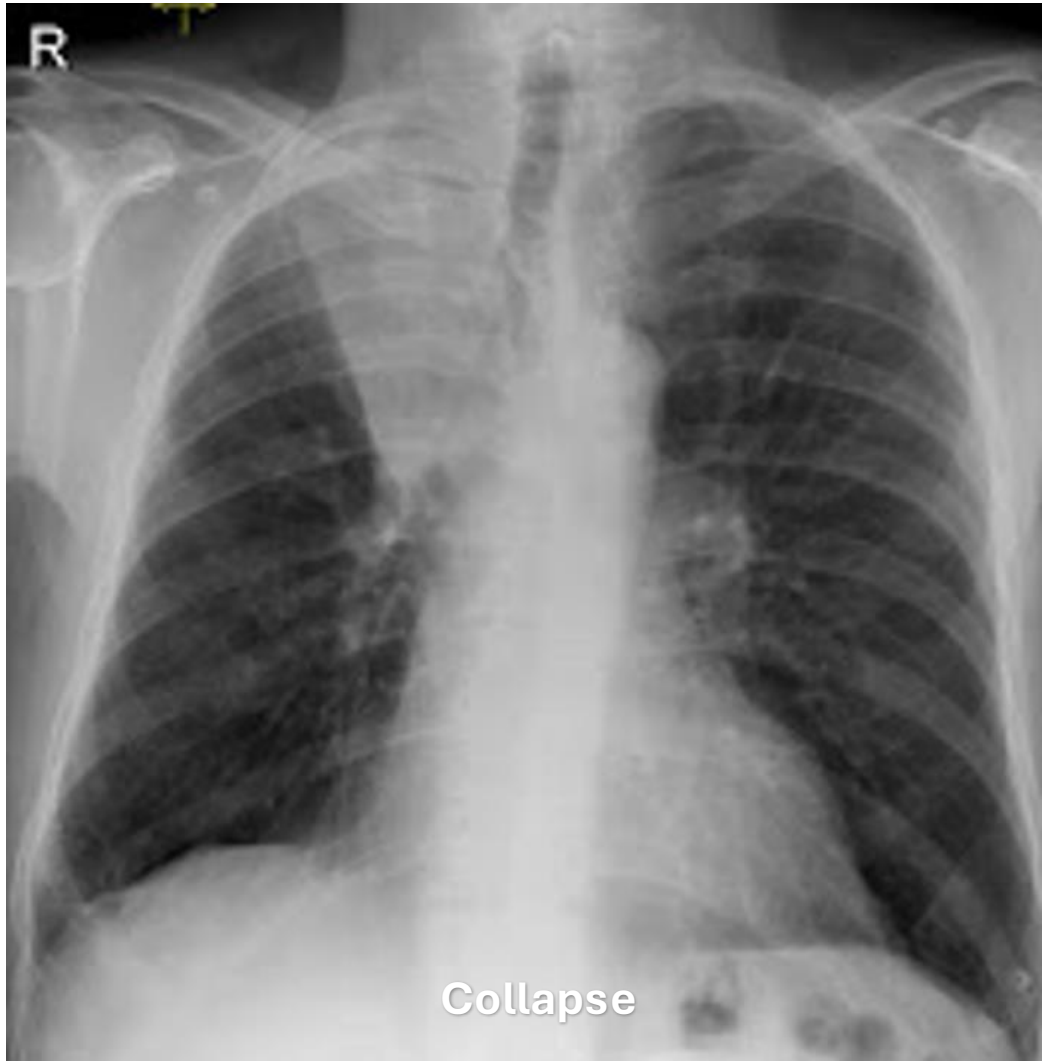


Summary & Key Takeaways

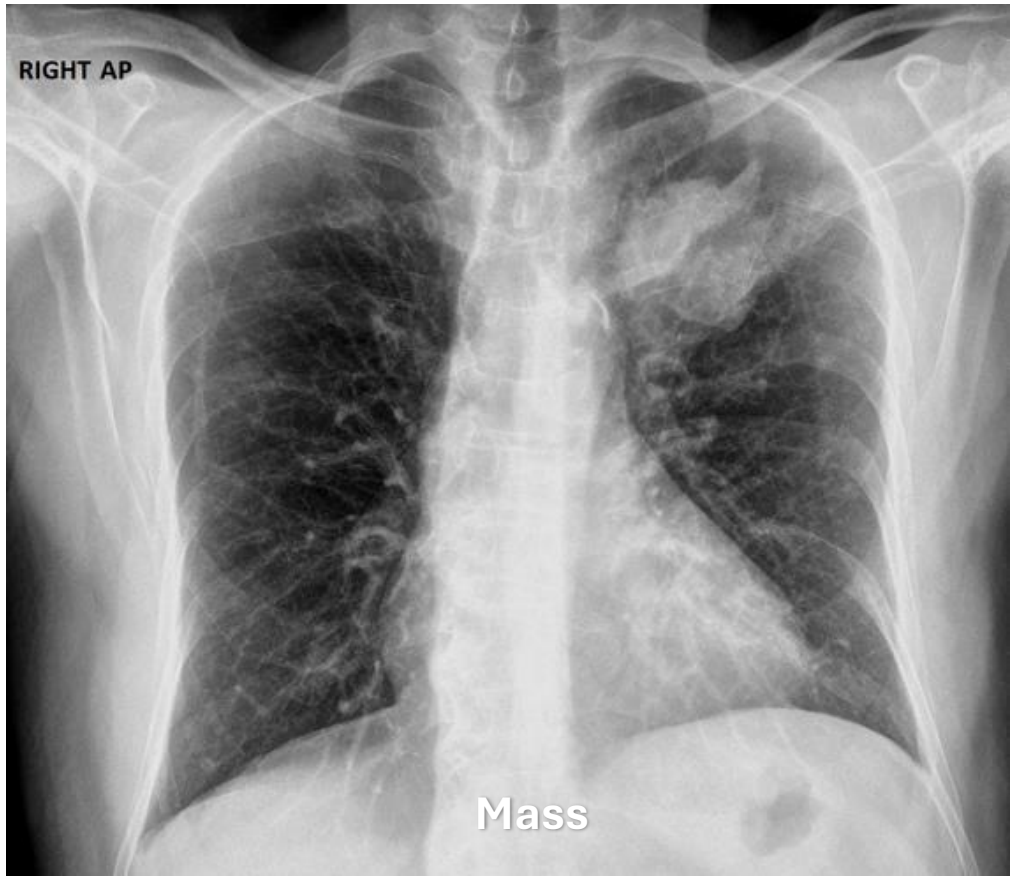
- Always use a systematic approach (ABCs) for every CXR.
- PA and Lateral views are the standard; inspiration is critical.
- Consolidation = Airspace filling (look for air bronchogram).
- Collapse = Volume loss (look for shifted fissures/mediastinum).
- Pleural effusion blunts the costophrenic angle.
- Look for nodule size and morphology.
- Don’t neglect reticular lung shadows.



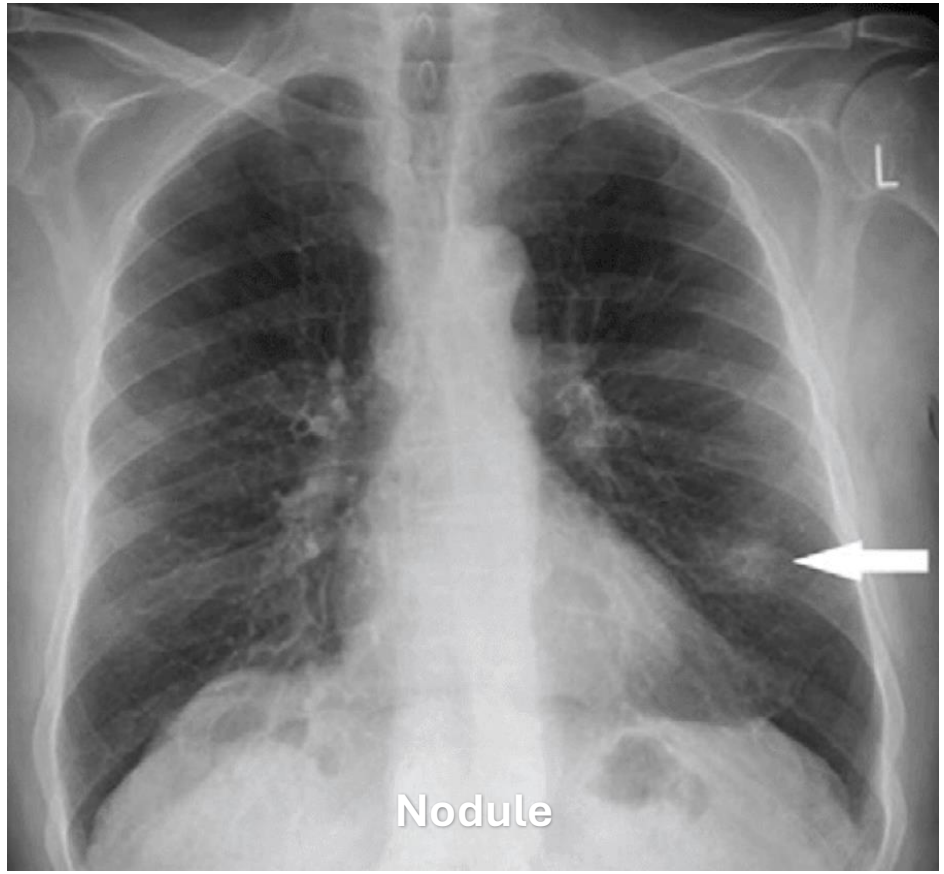
Consolidation



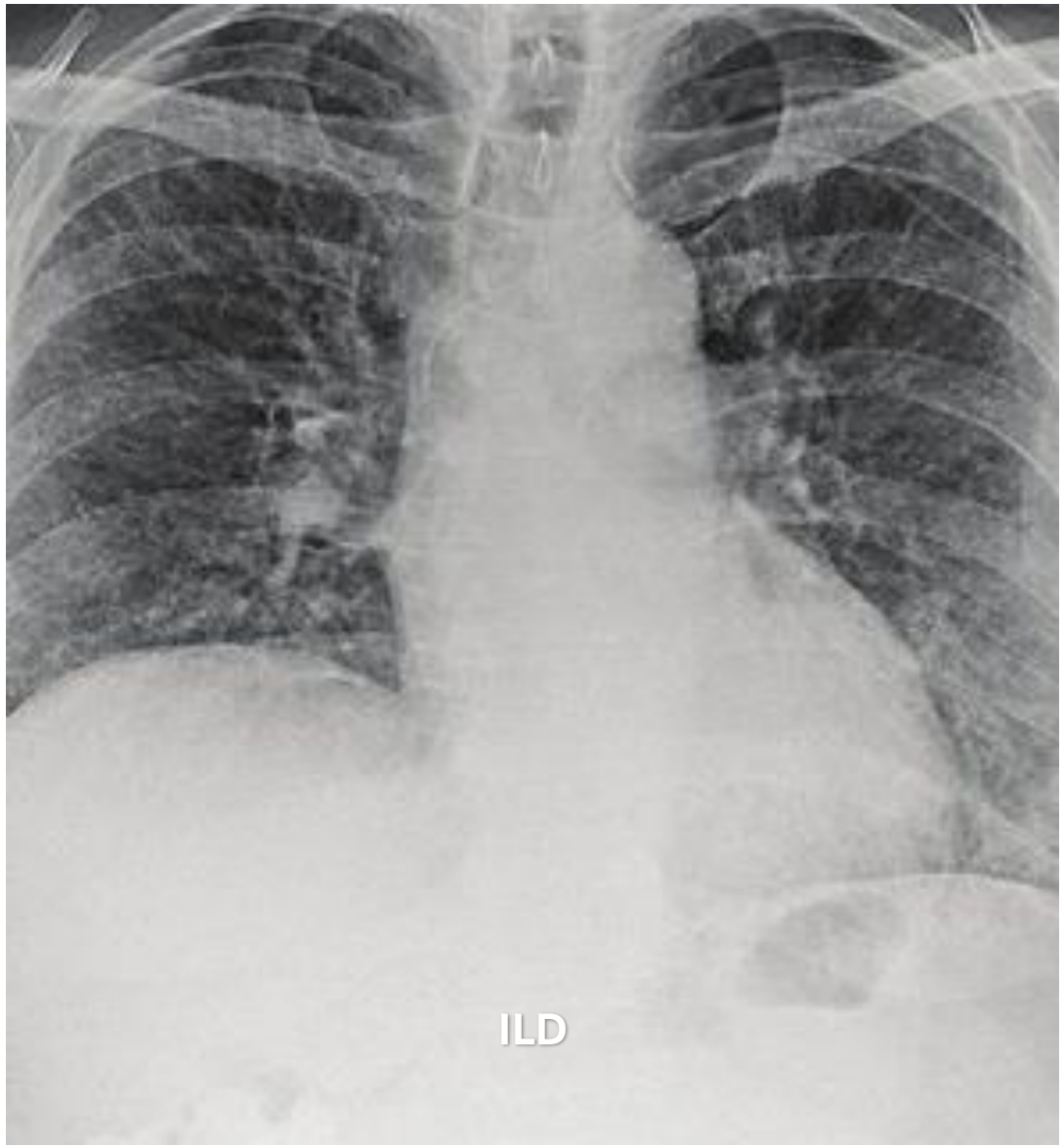
Collapse



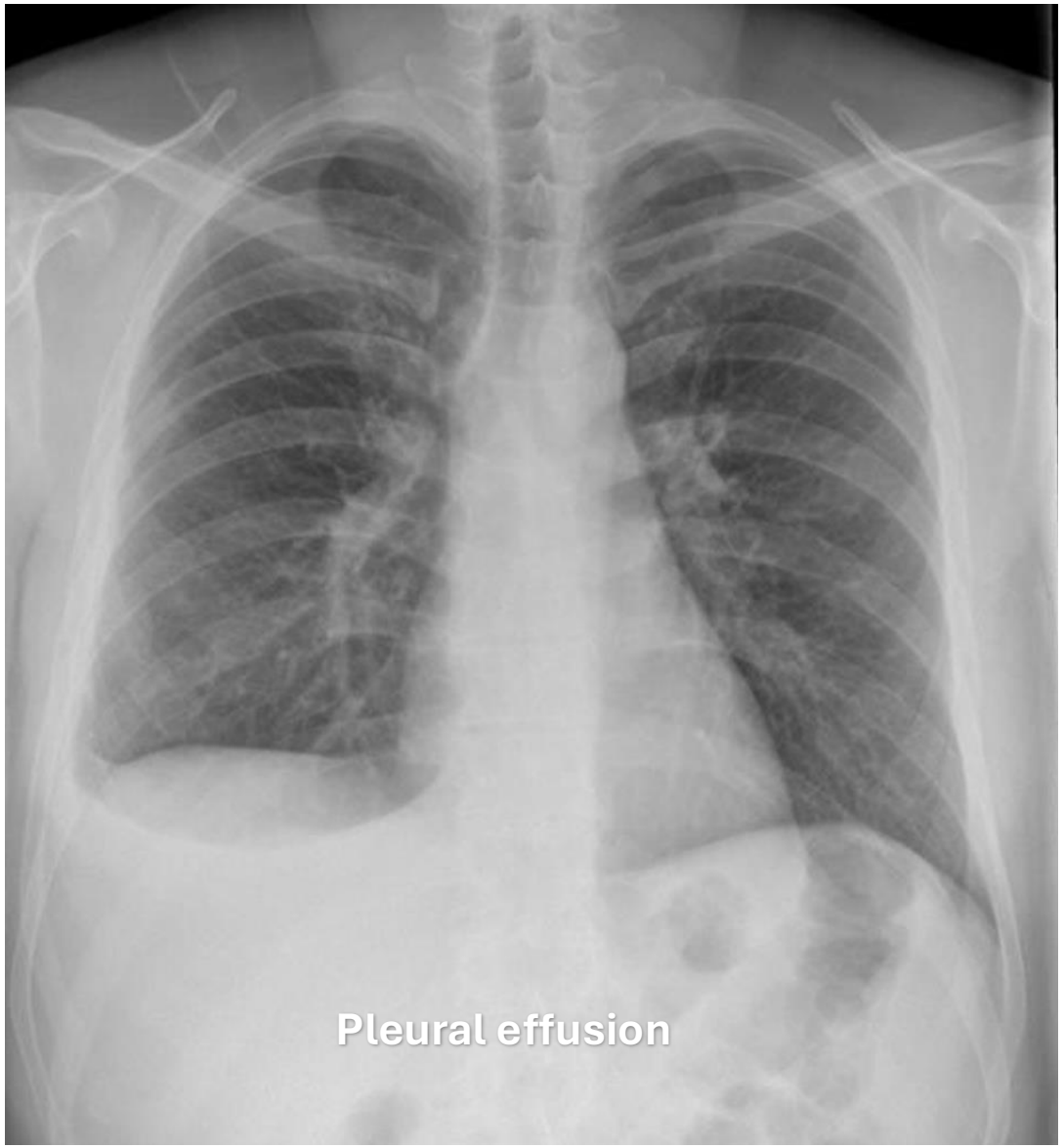
Mass



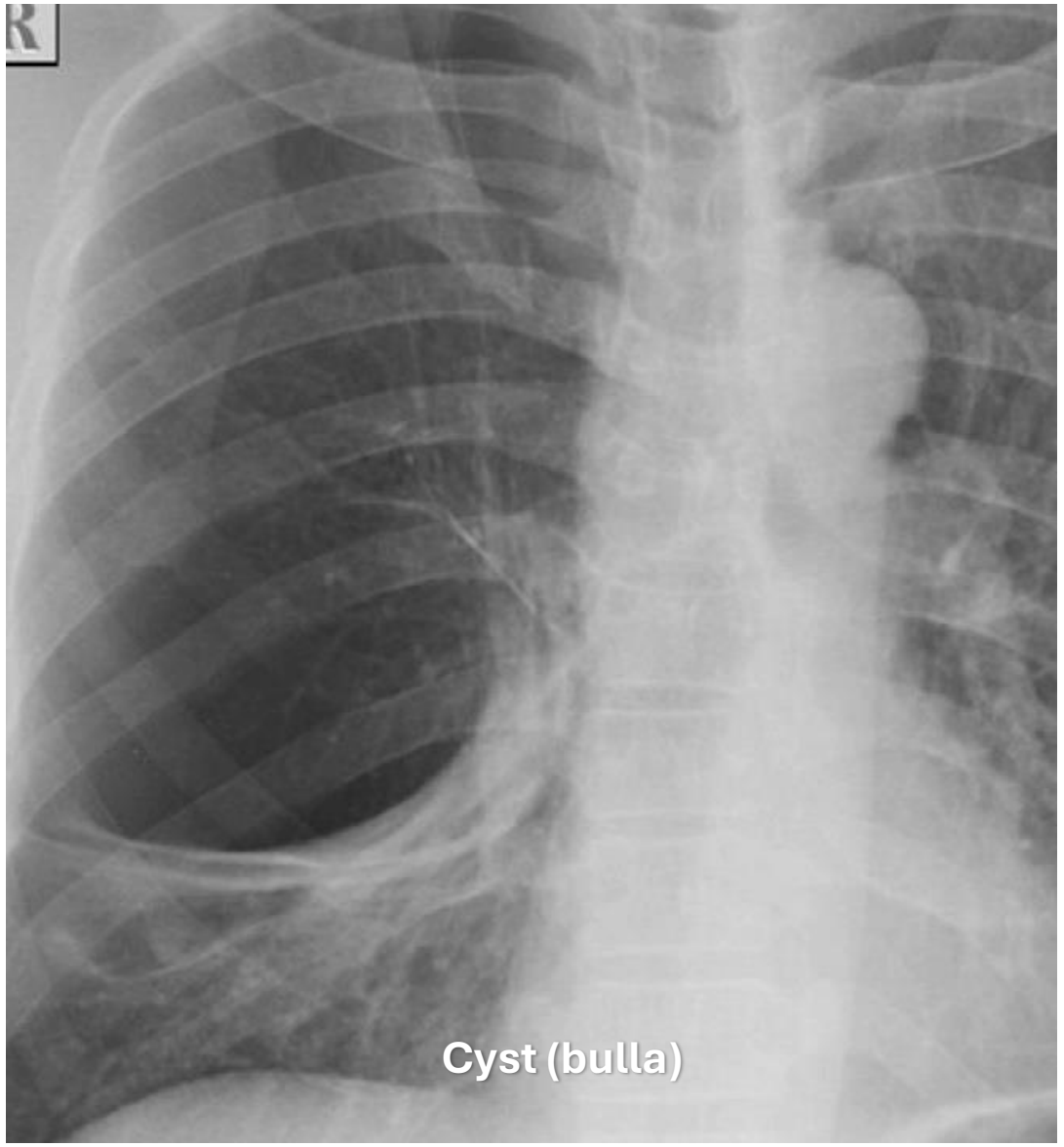
Nodule



ILD

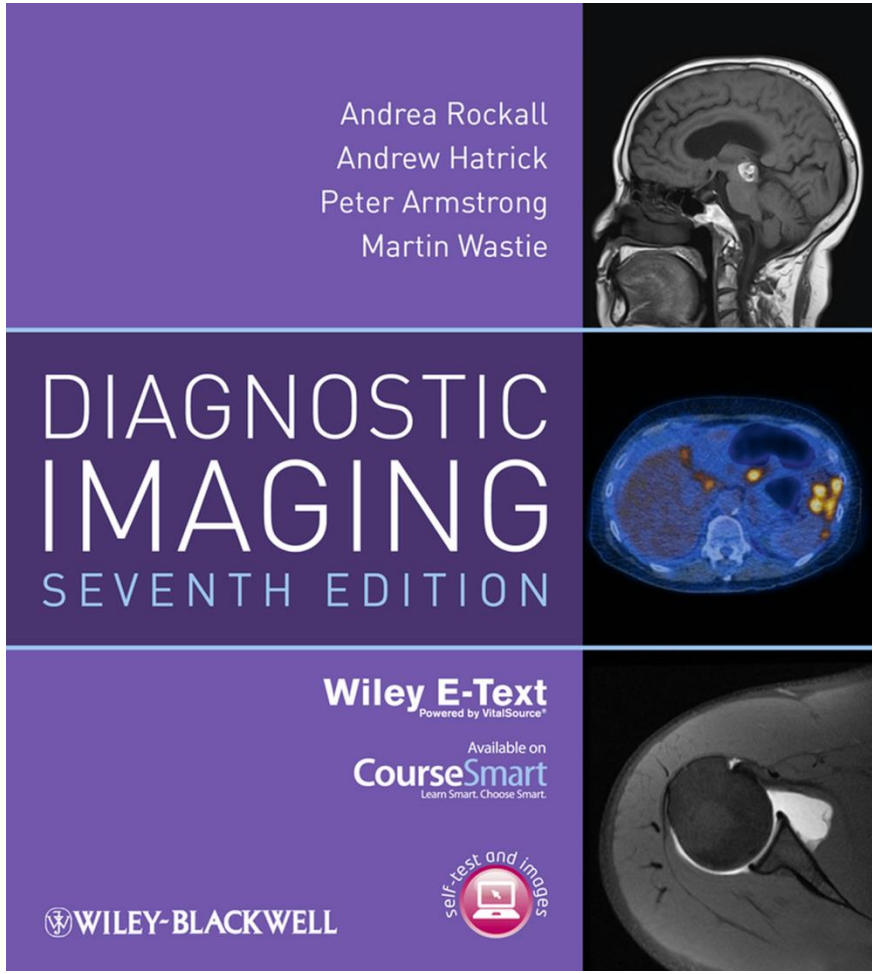


Pleural effusion



Cyst (bulla)

Cavity with air-fluid level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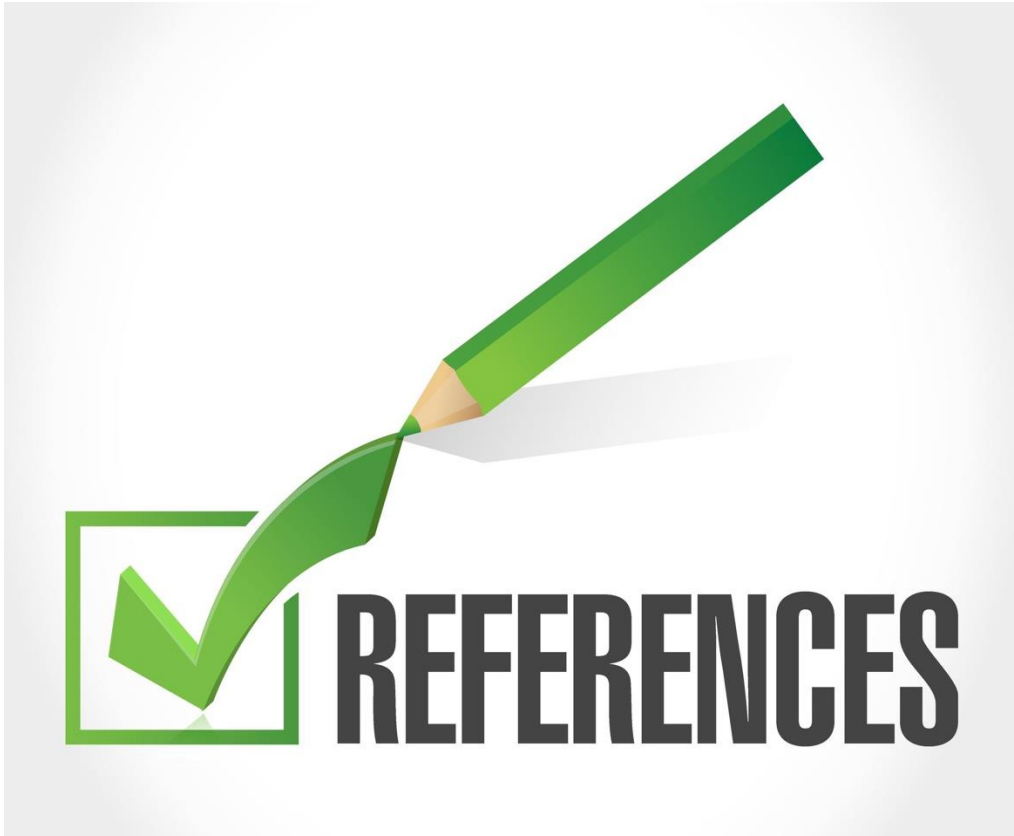
REFERENCES