



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:

They may be...

unabsorbed

completely absorbed

scattered

Which means...

they pass through the patient unchanged and strike the x-ray film

the energy of the x-ray is totally deposited within the patient

they are deflected within the patient but may still strike the x-ray film



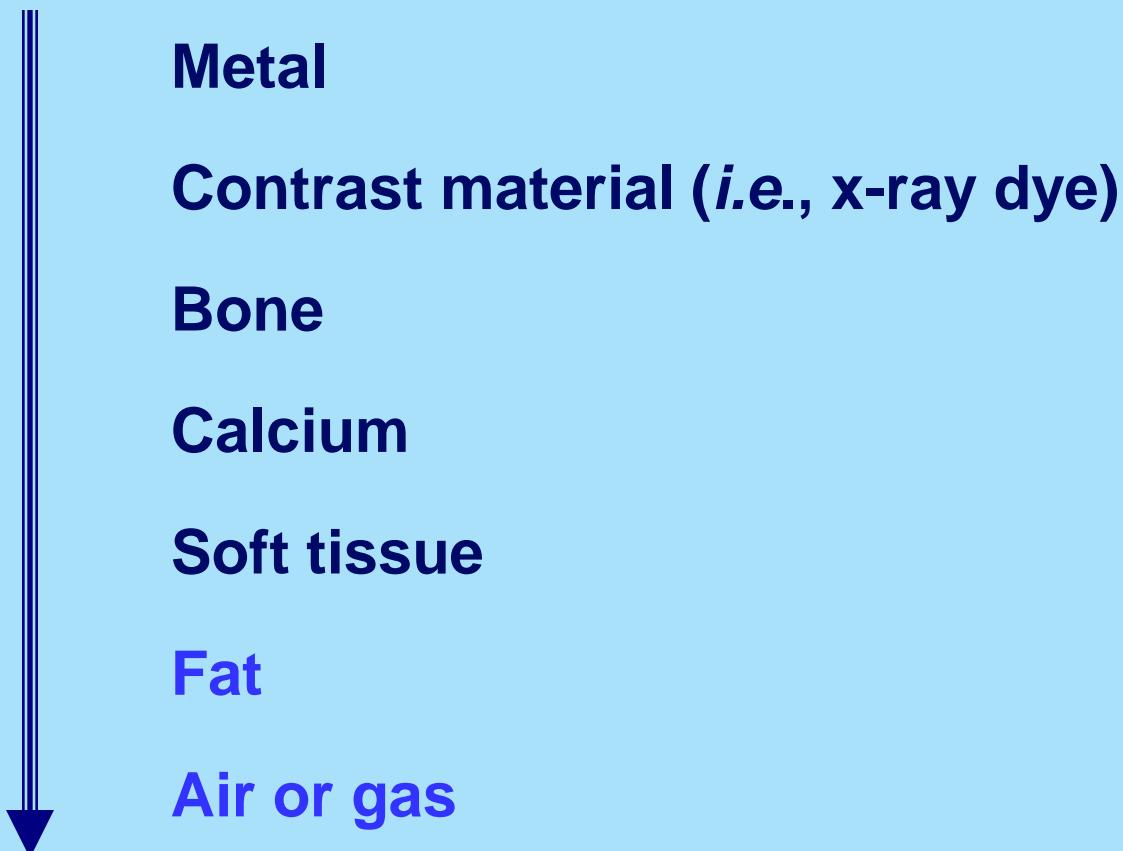
X-ray Absorption

- 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



Blackest/Least Dense



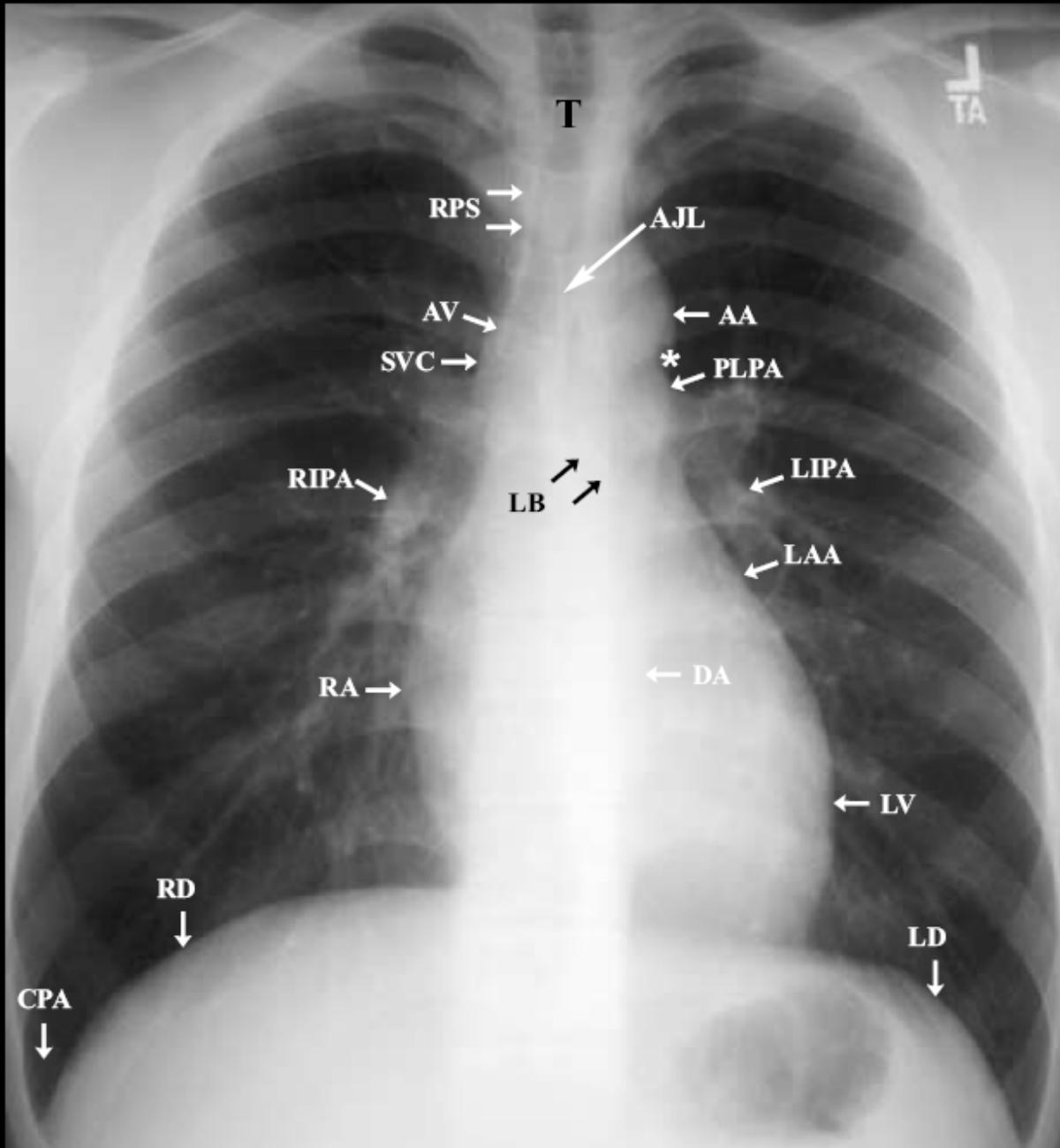
Posterior/Anterior (PA) Radiograph

- 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

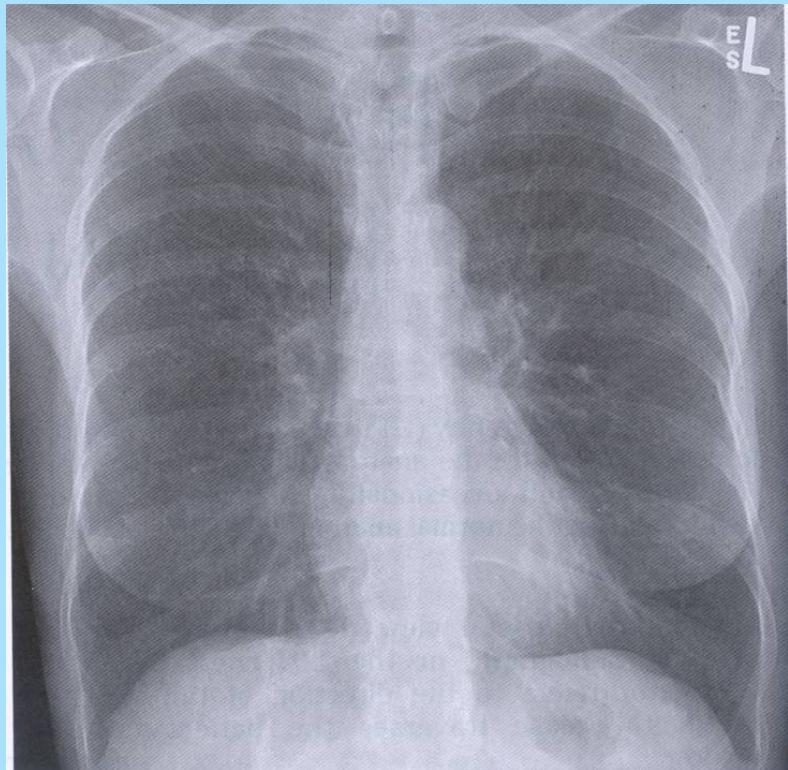


Normal Frontal (PA) Chest Radiograph

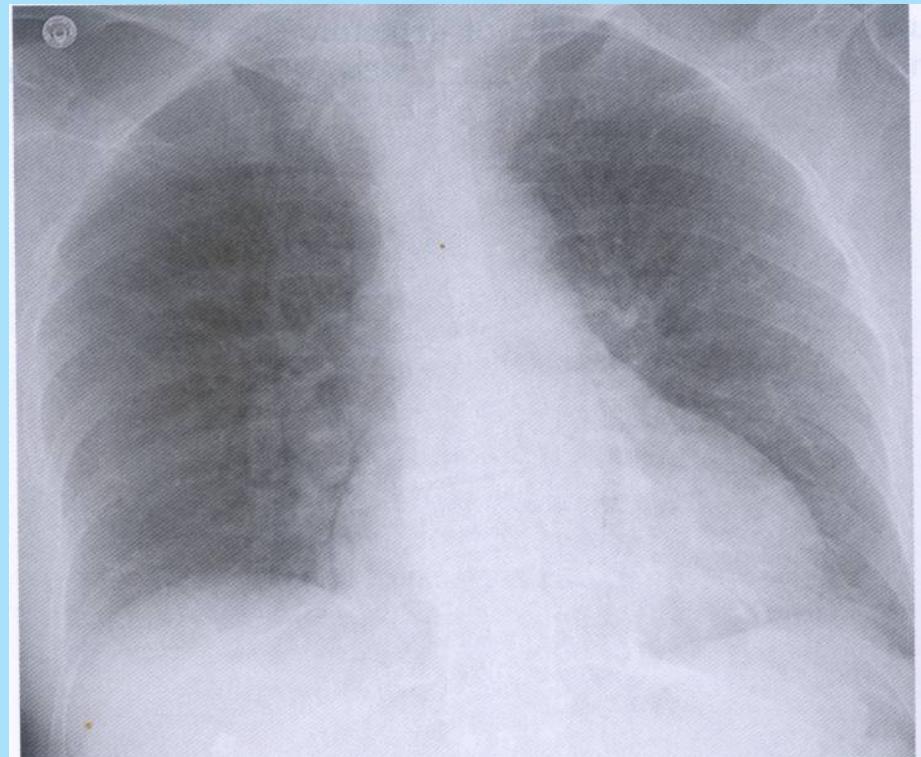




PA & AP Chest X-rays



PA View



AP View



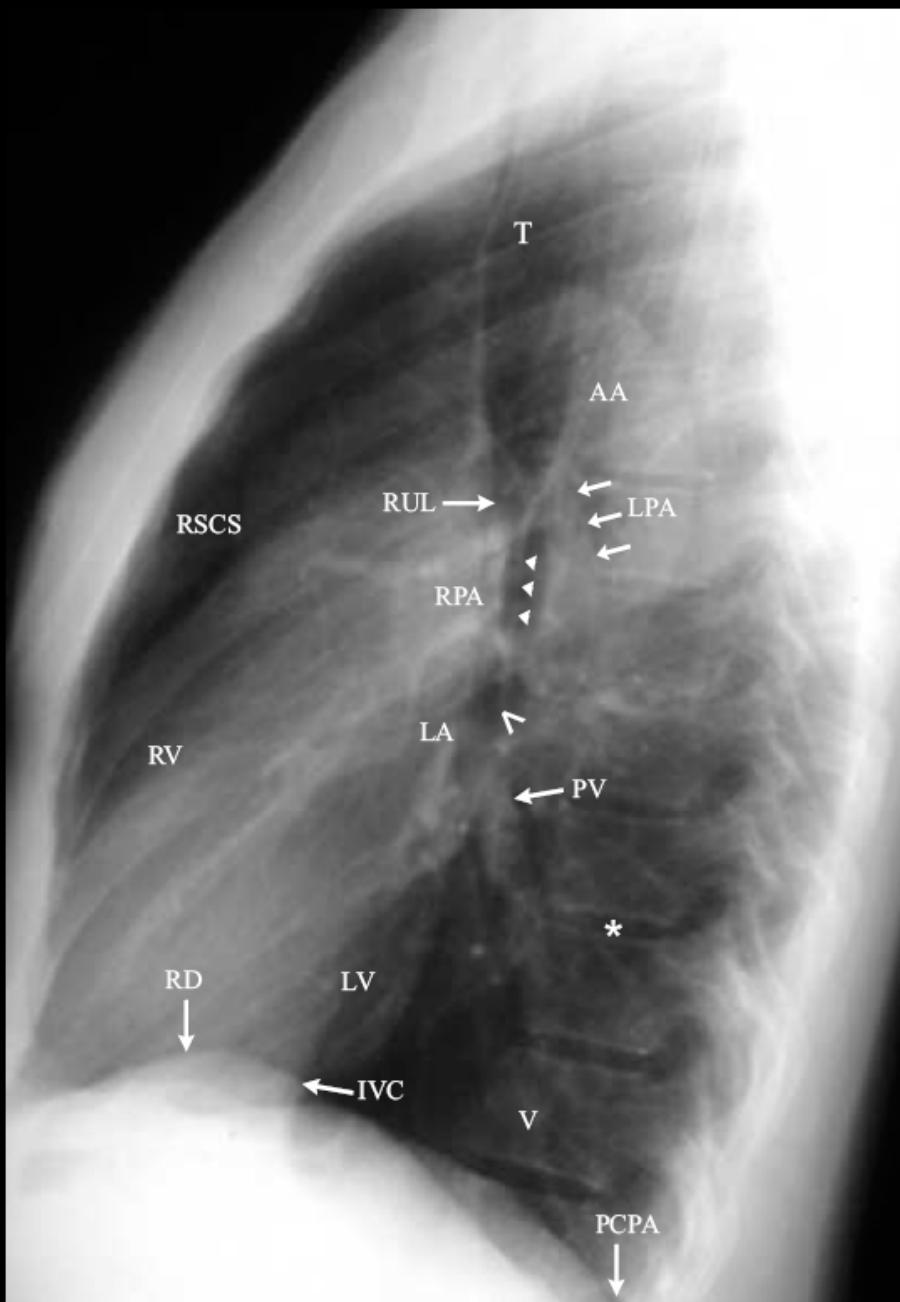
Lateral Radiograph

- 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

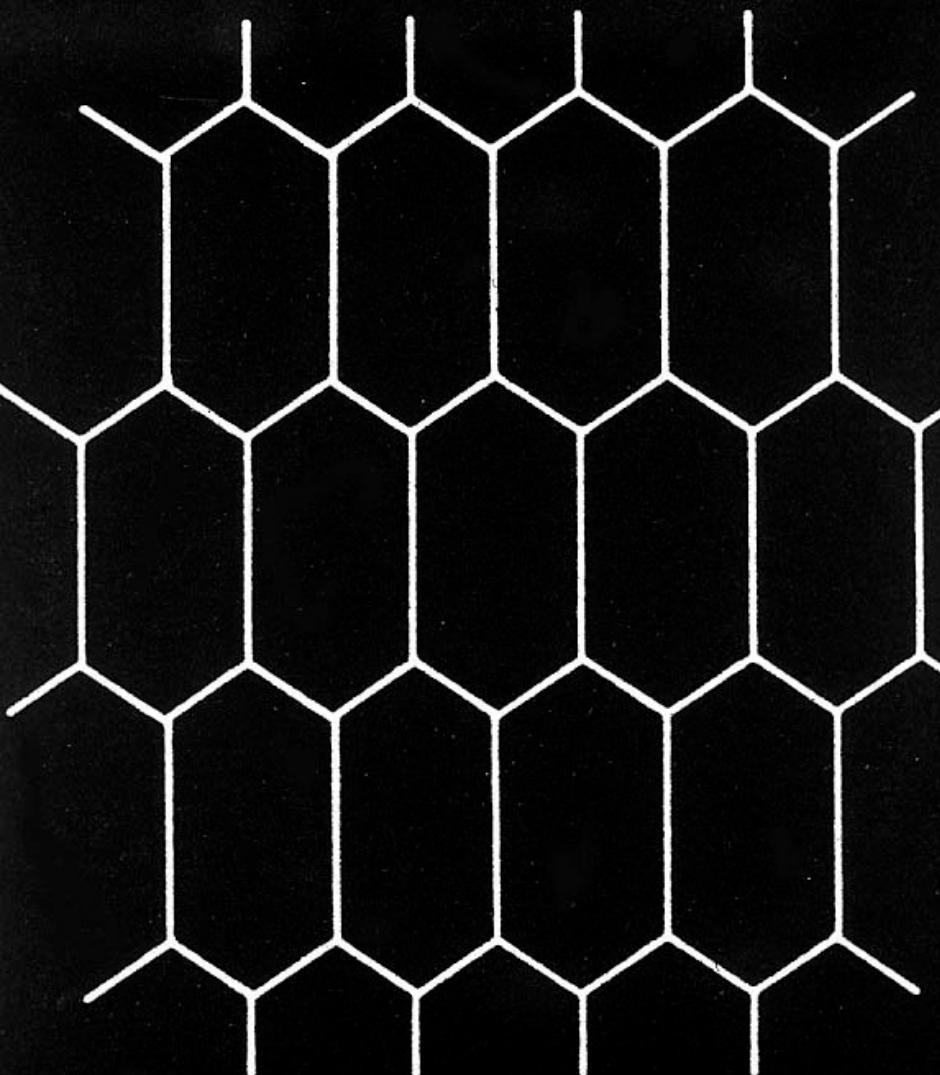
- **Consolidation** (or airspace filling)
- **Interstitial** (including linear and reticular opacities, small well-defined nodules, miliary patterns, and peribronchovascular thickening)
- **Solitary nodule**
- **Mass**
- **Lymphadenopathy**
- **Cyst/cavity**
- **Pleural abnormalities**



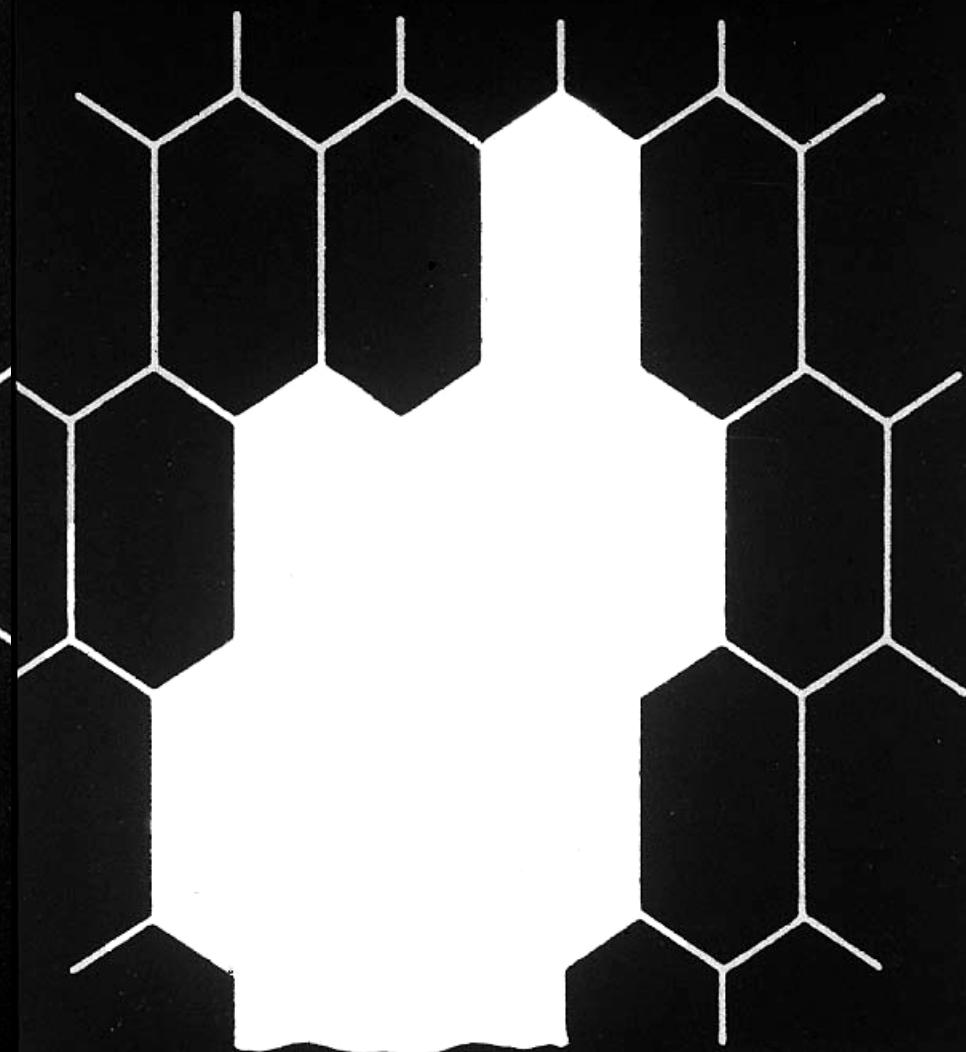
Consolidation

- 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

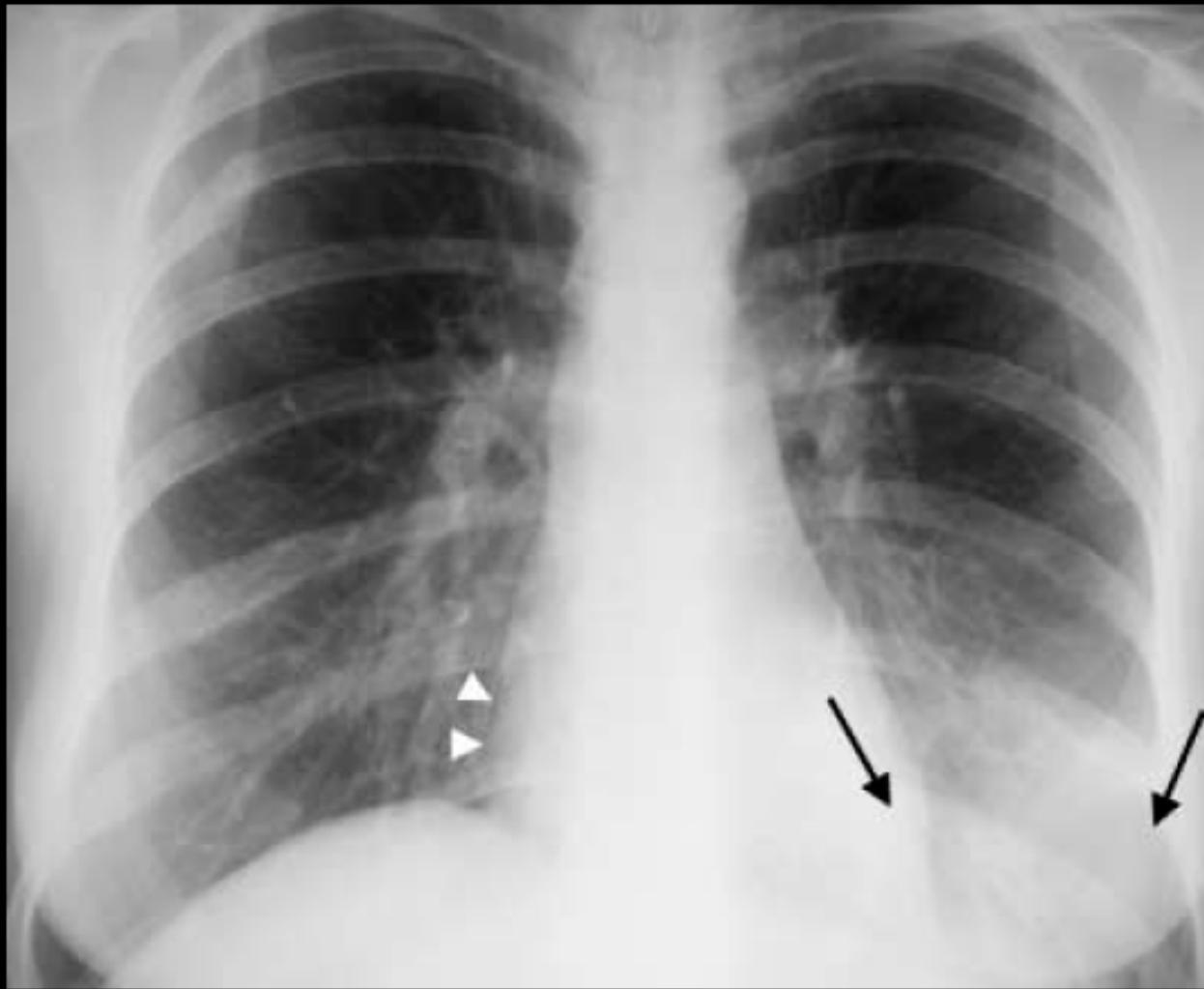
Normal



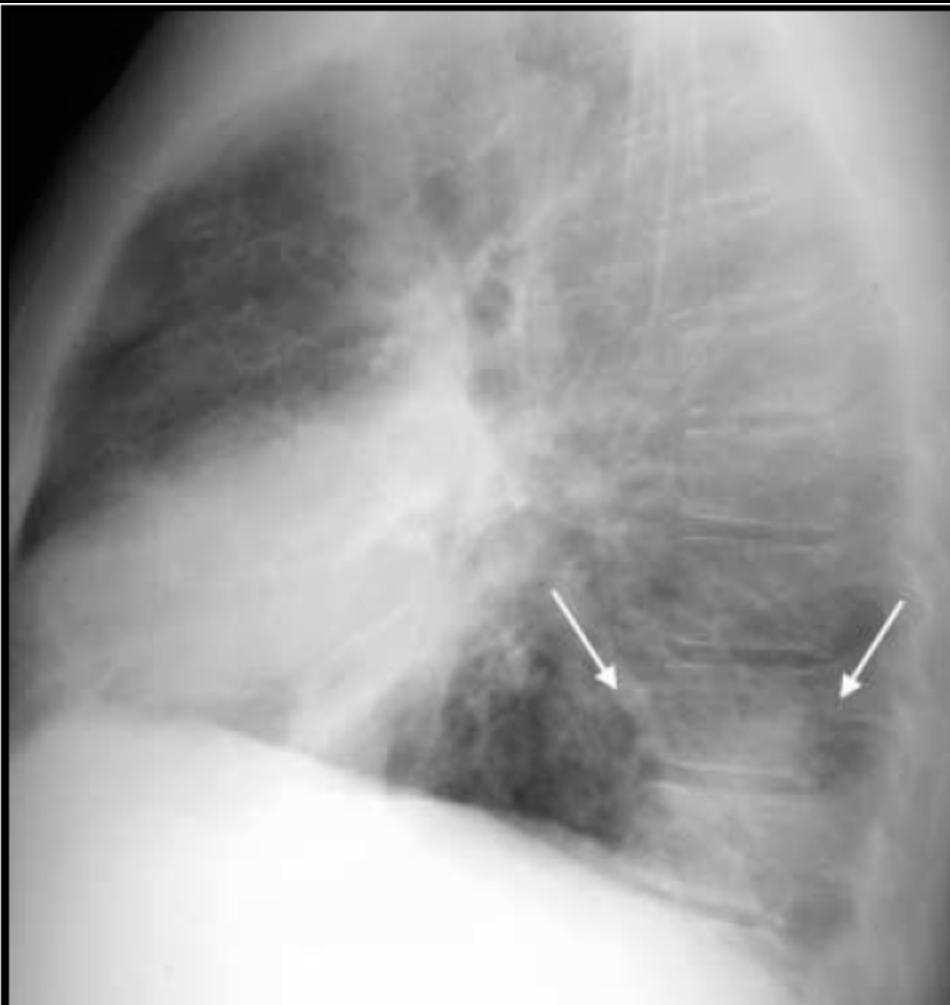
Consolidation



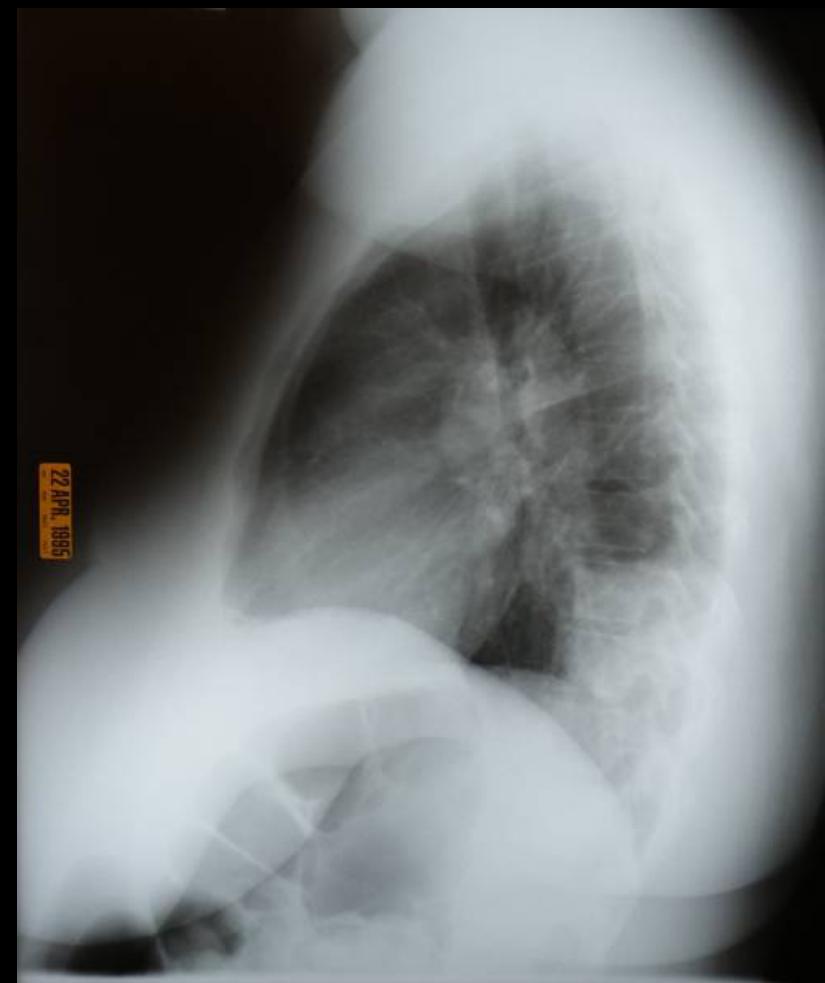
PA Chest Radiograph (LLL pneumonia consolidation)



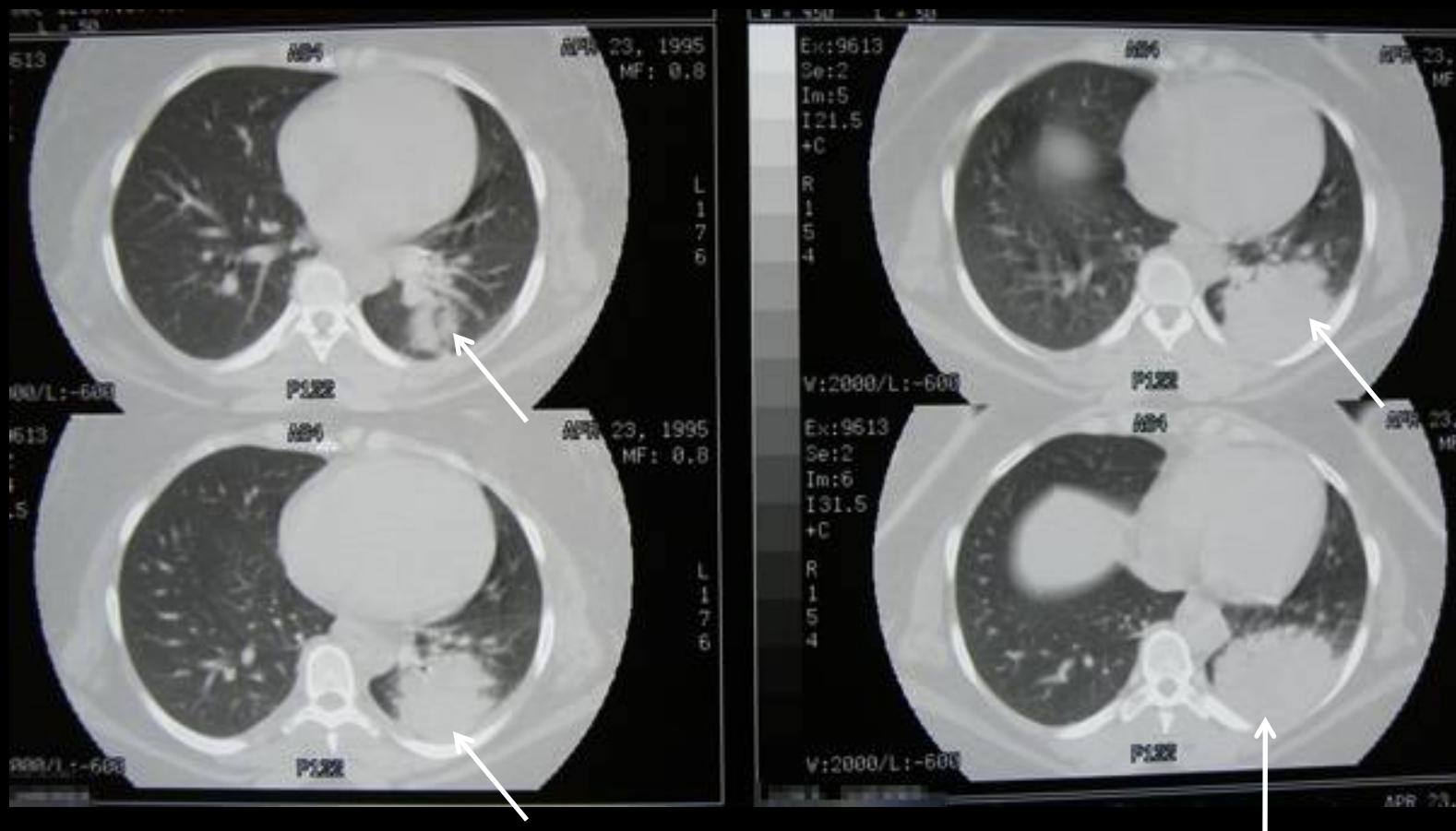
Lateral Chest Radiograph (LLL pneumonia consolidation)



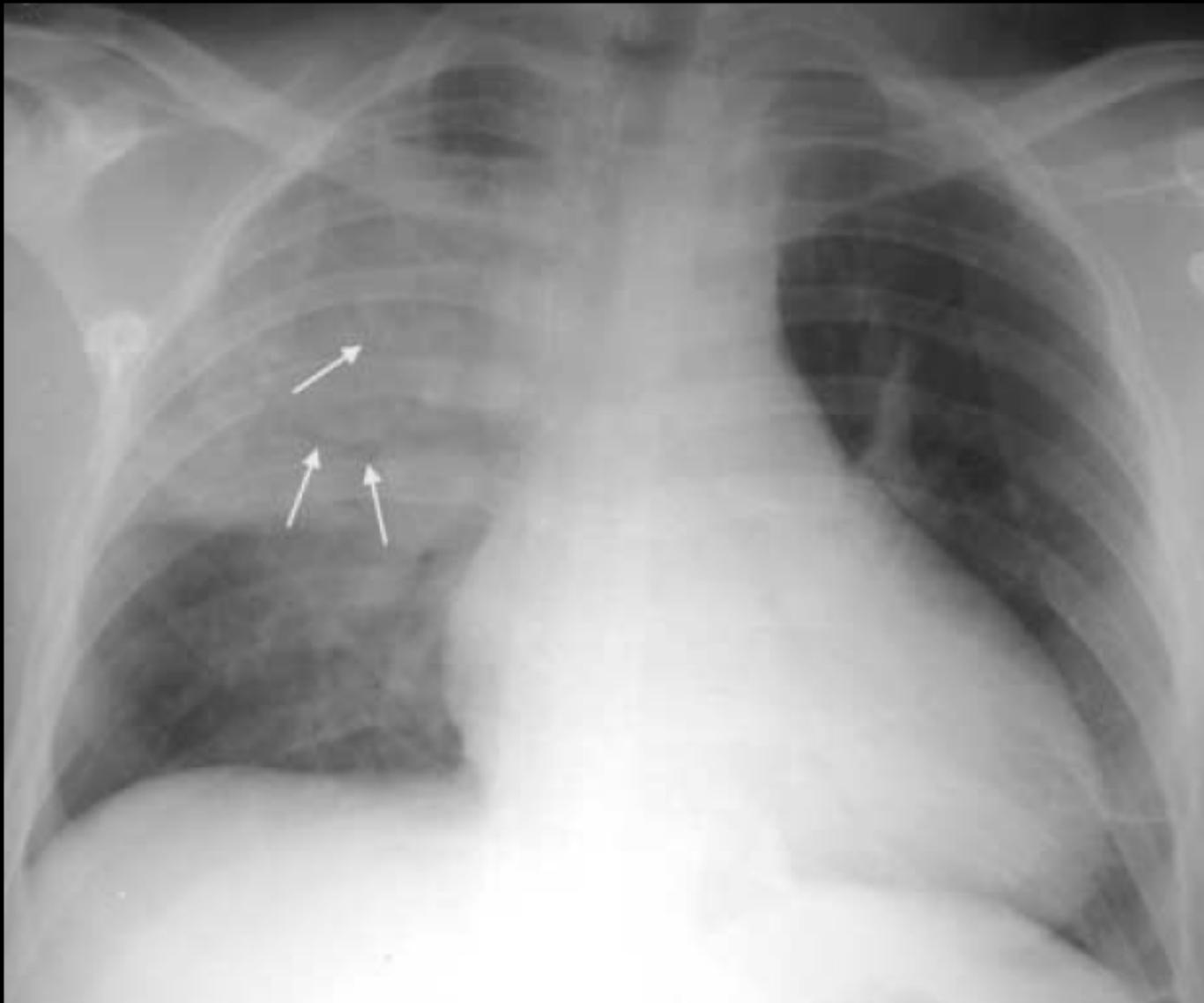
Self Check



Chest CT



Consolidation (Airspace Opacity) (RUL pneumonia)





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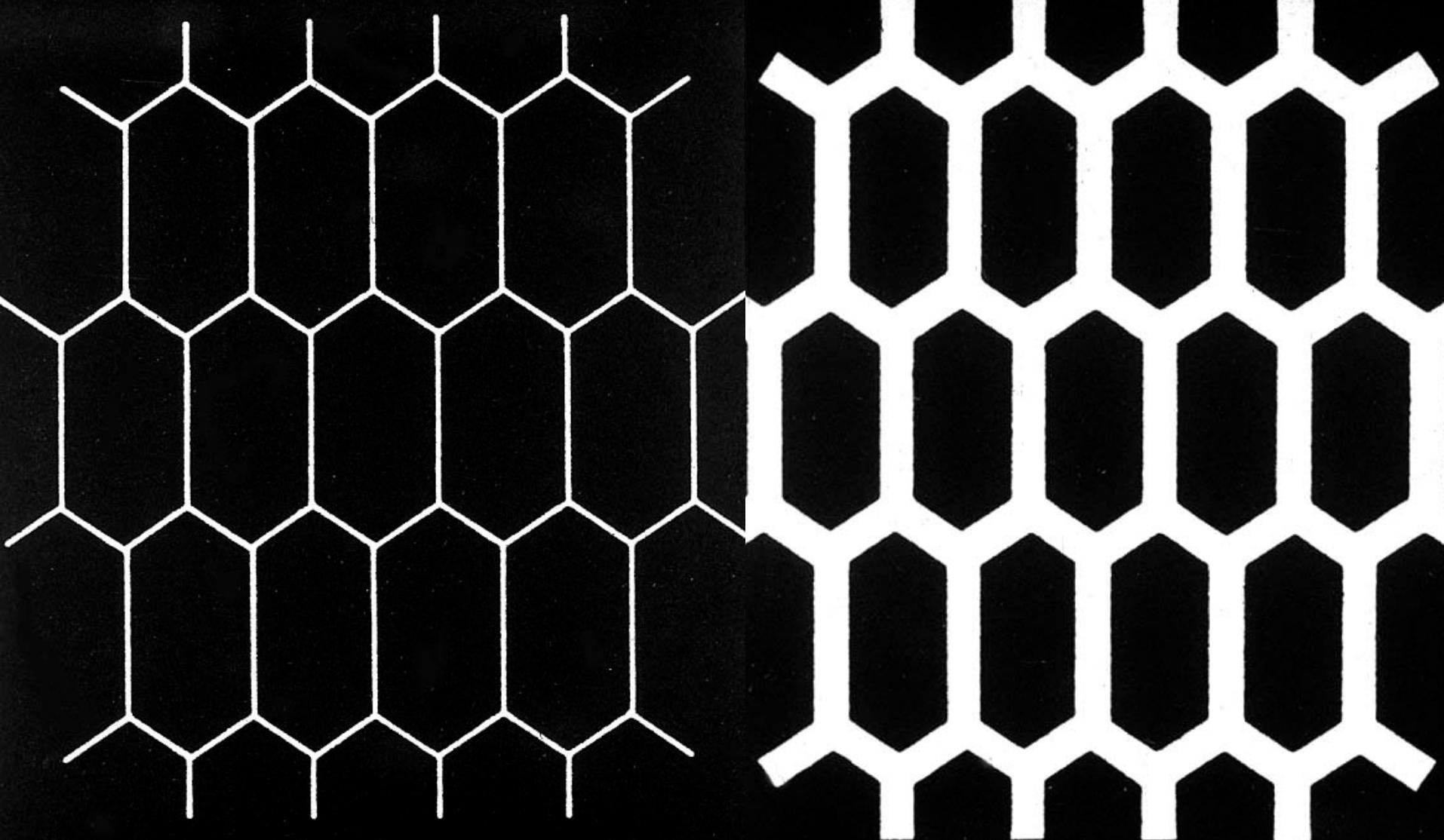
Interstitial Lung Disease (ILD)

- **Appearance and findings**

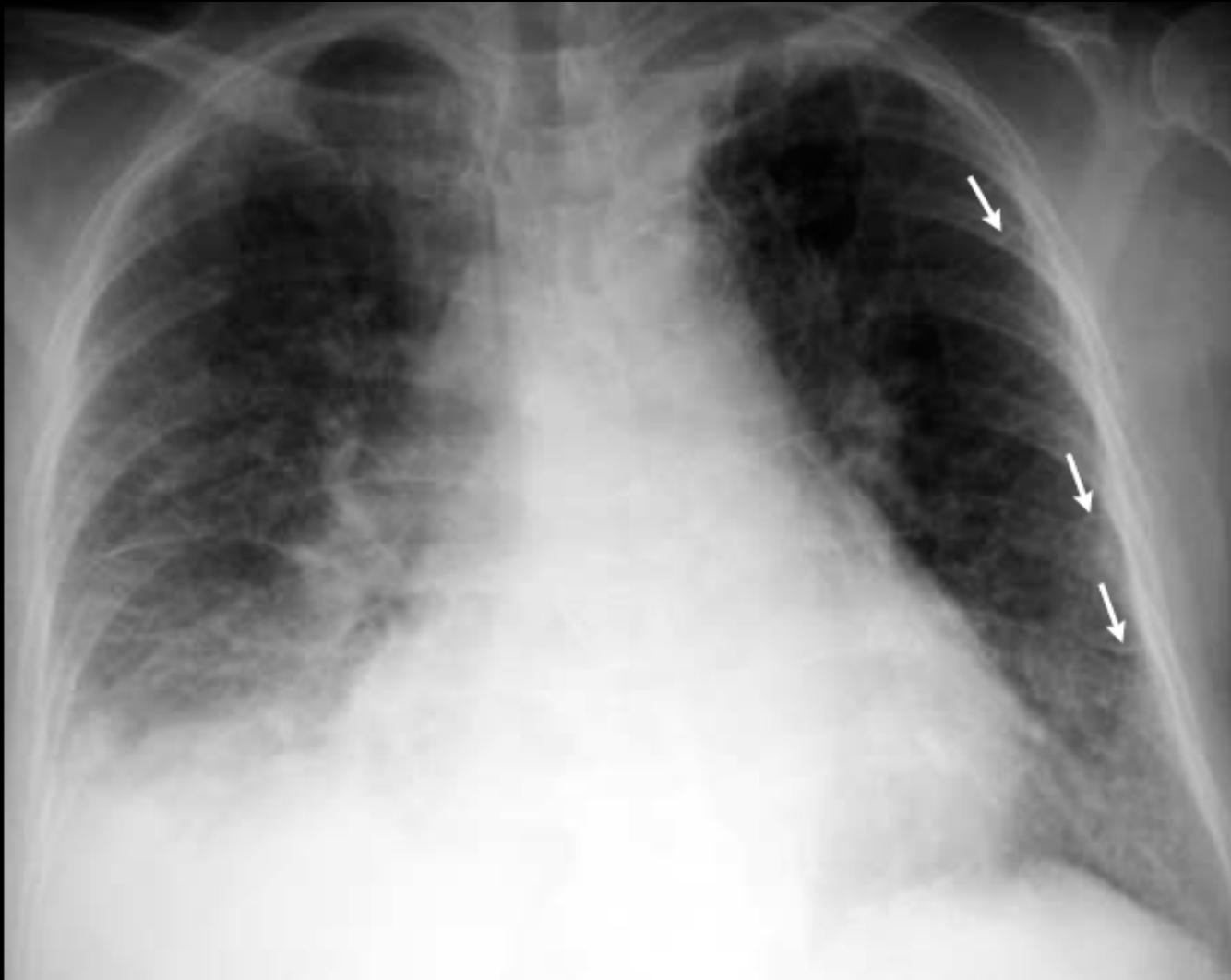
- Reticular pattern, increased linear opacities
- Interlobular septal thickening (Kerley B lines)
- Peribronchial thickening (cuffing or tram tracking)
- Honeycombing
- Discrete miliary nodules
- Reticulonodular pattern

Normal

Interstitial disease



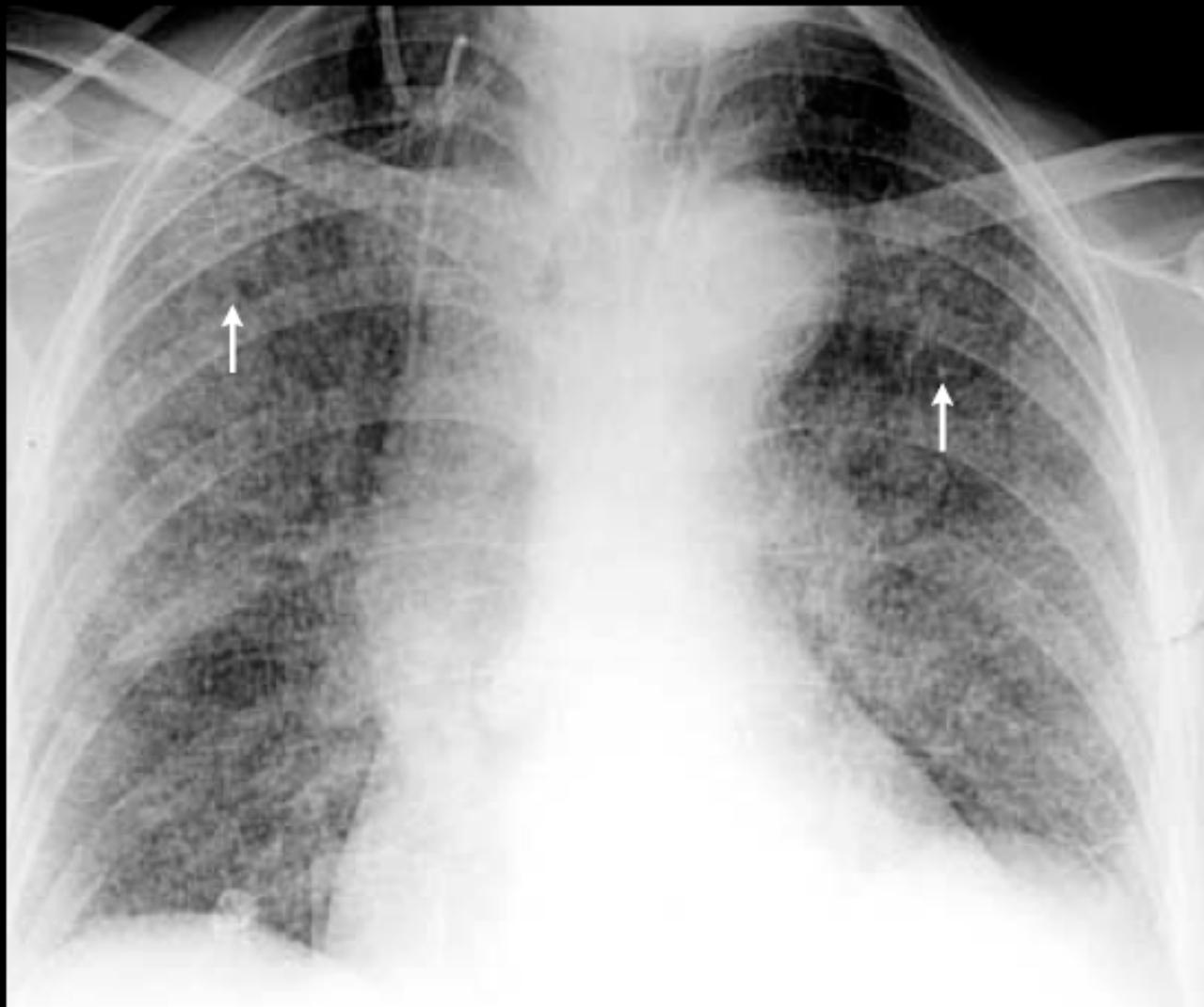
Linear Opacities



Nodules



Miliary Pattern





Basic Patterns of Disease

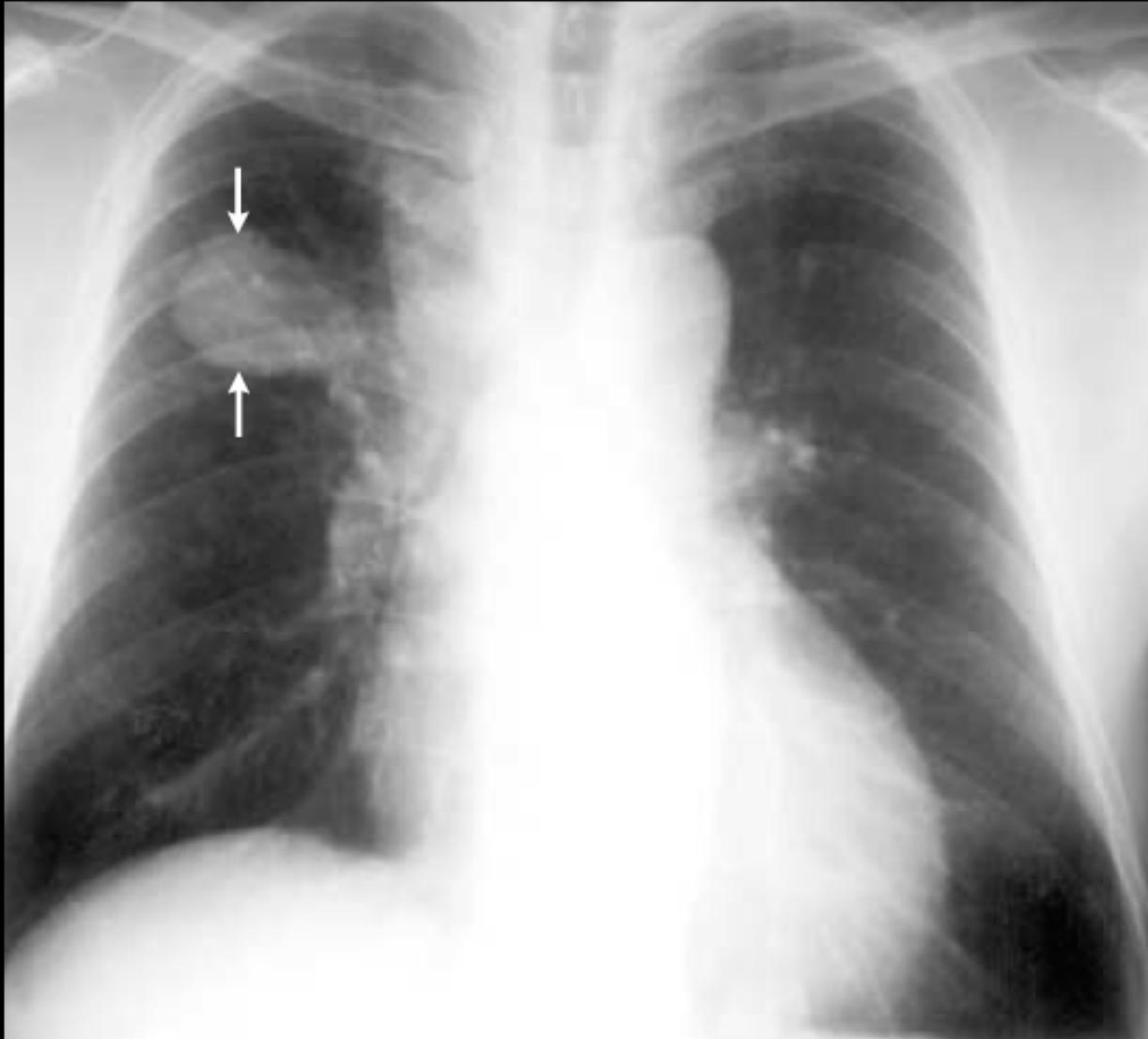
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Masses

- 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

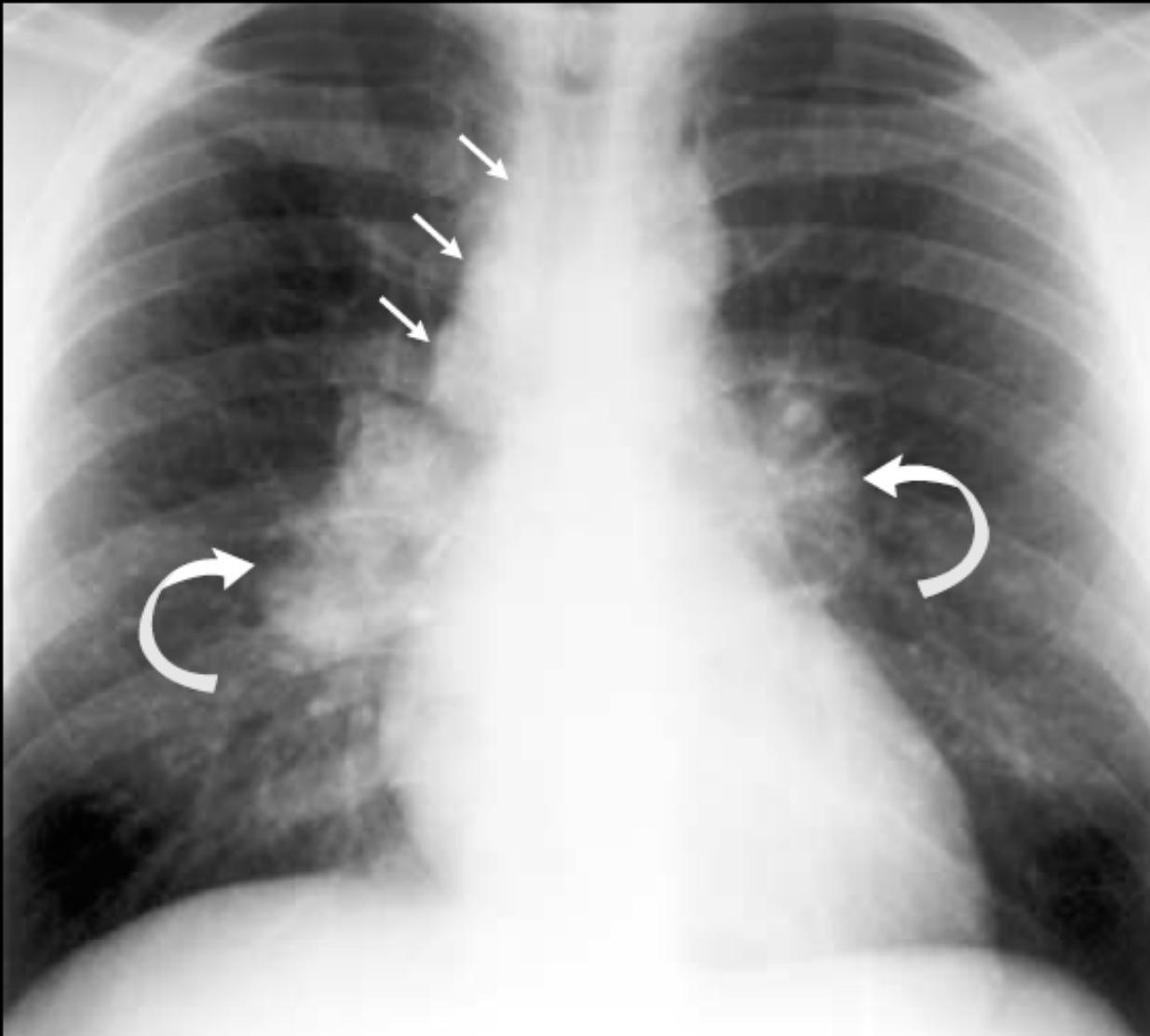
- Enlarged lymph nodes appear on the chest radiograph as soft tissue densities in characteristic locations, including:
 - Right paratracheal area
 - Hila
 - Aorticopulmonary window
 - Subcarinal mediastinum
 - Superior mediastinum
 - Supraclavicular area
 - Paraspinous region
 - Retrosternal area on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



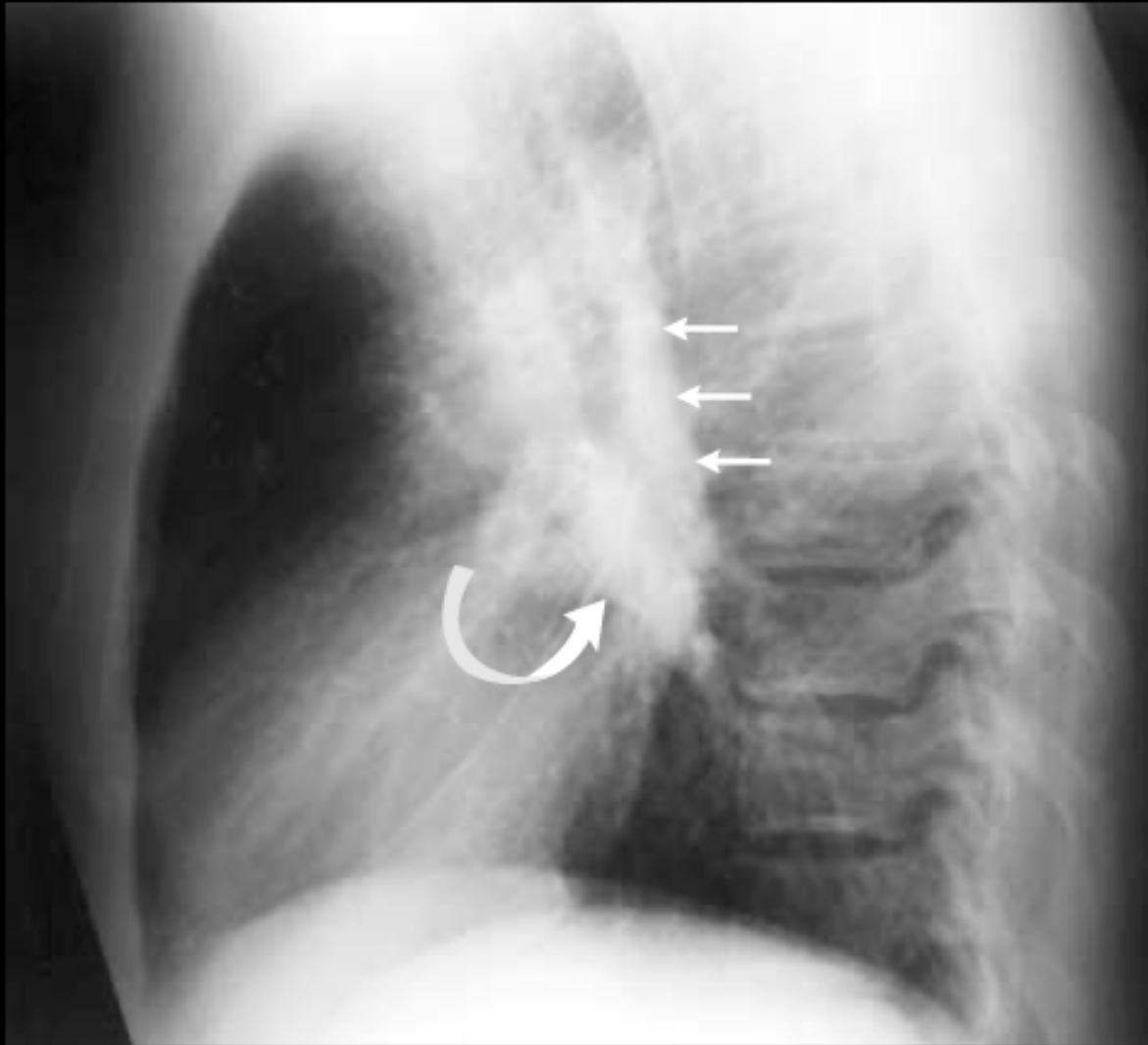
Lymphadenopathy

- 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

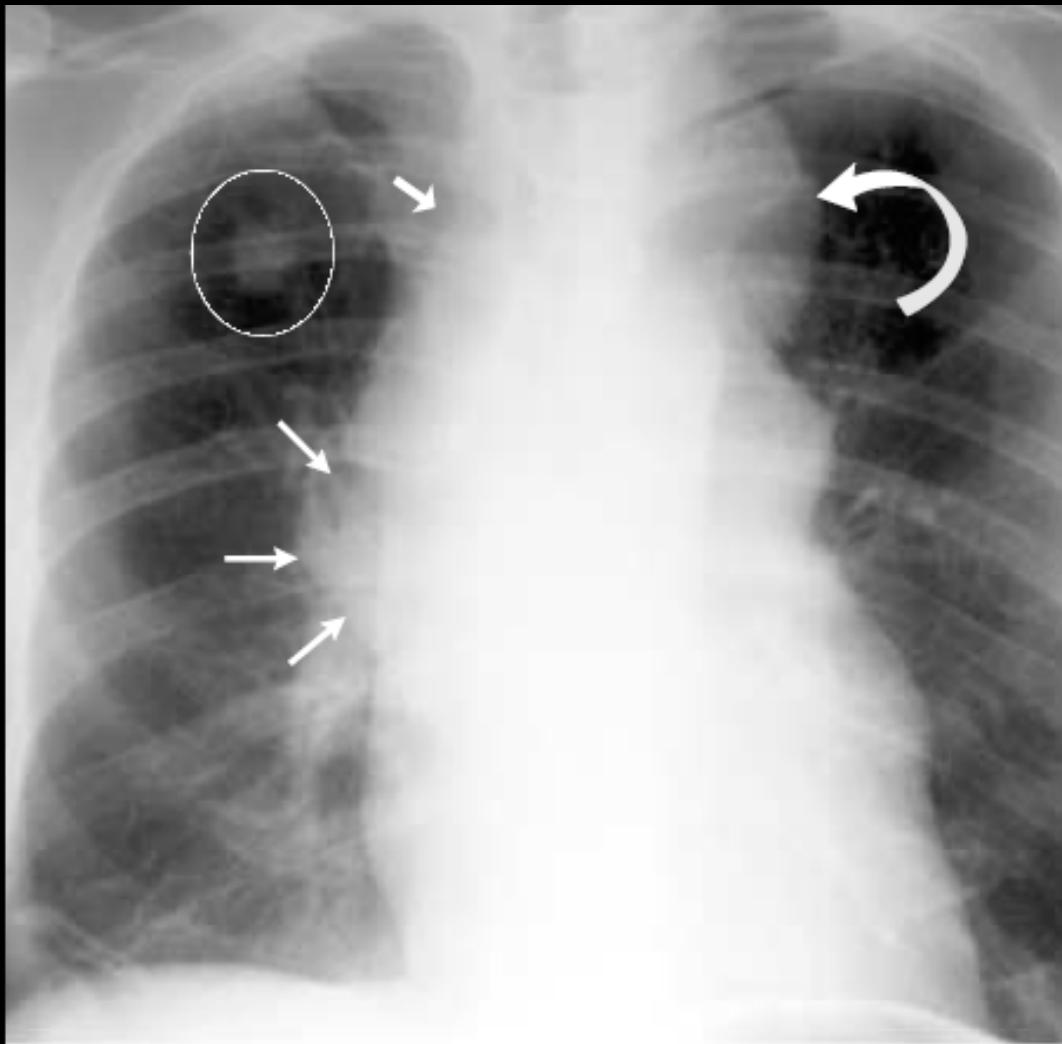
Lymphadenopathy



Lymphadenopathy



Mediastinal Lymphadenopathy





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Cysts and Cavities

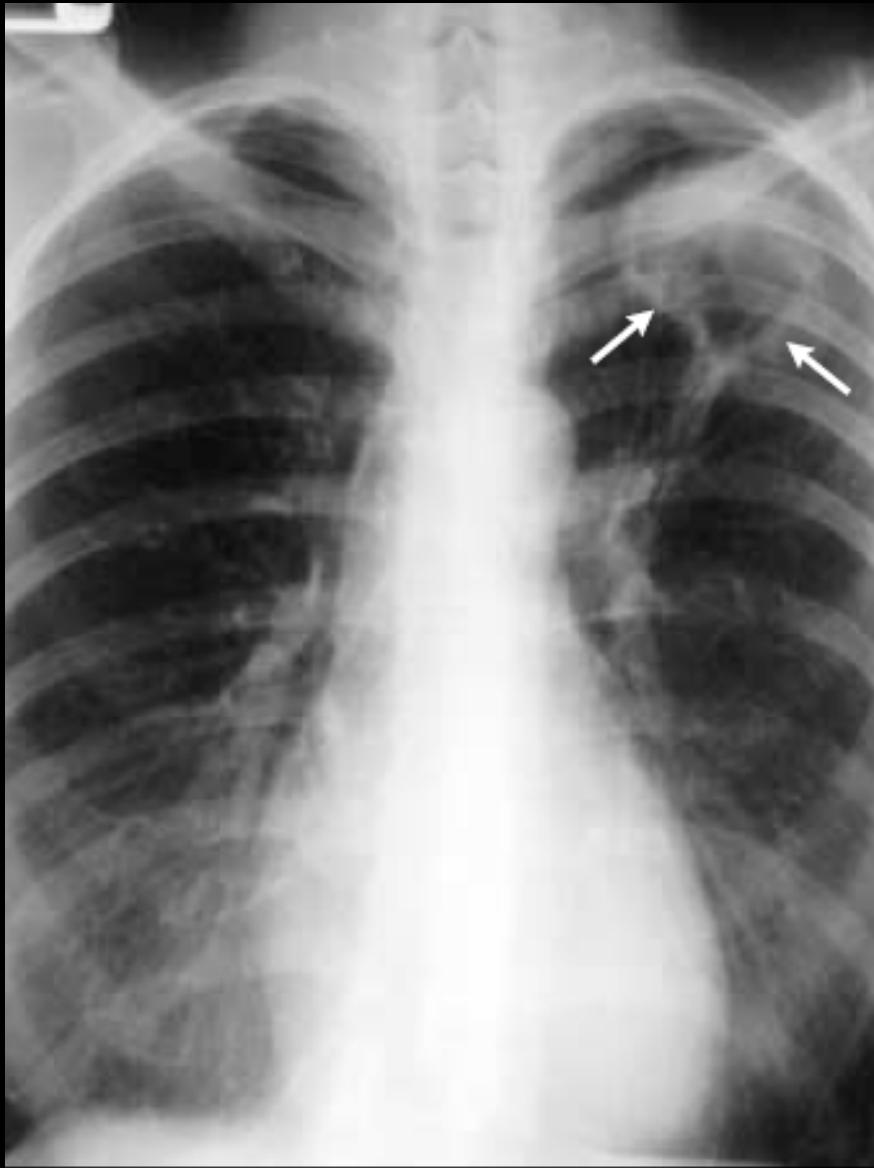
- Focal lucent areas within the lung may result from cavities, cysts, emphysema, and bronchiectasis
- Pulmonary cysts differ from cavities in that cavities are created by necrosis of lung parenchyma, whereas true cysts are formed by other means
- Pulmonary cavities may result from infection, neoplasm,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

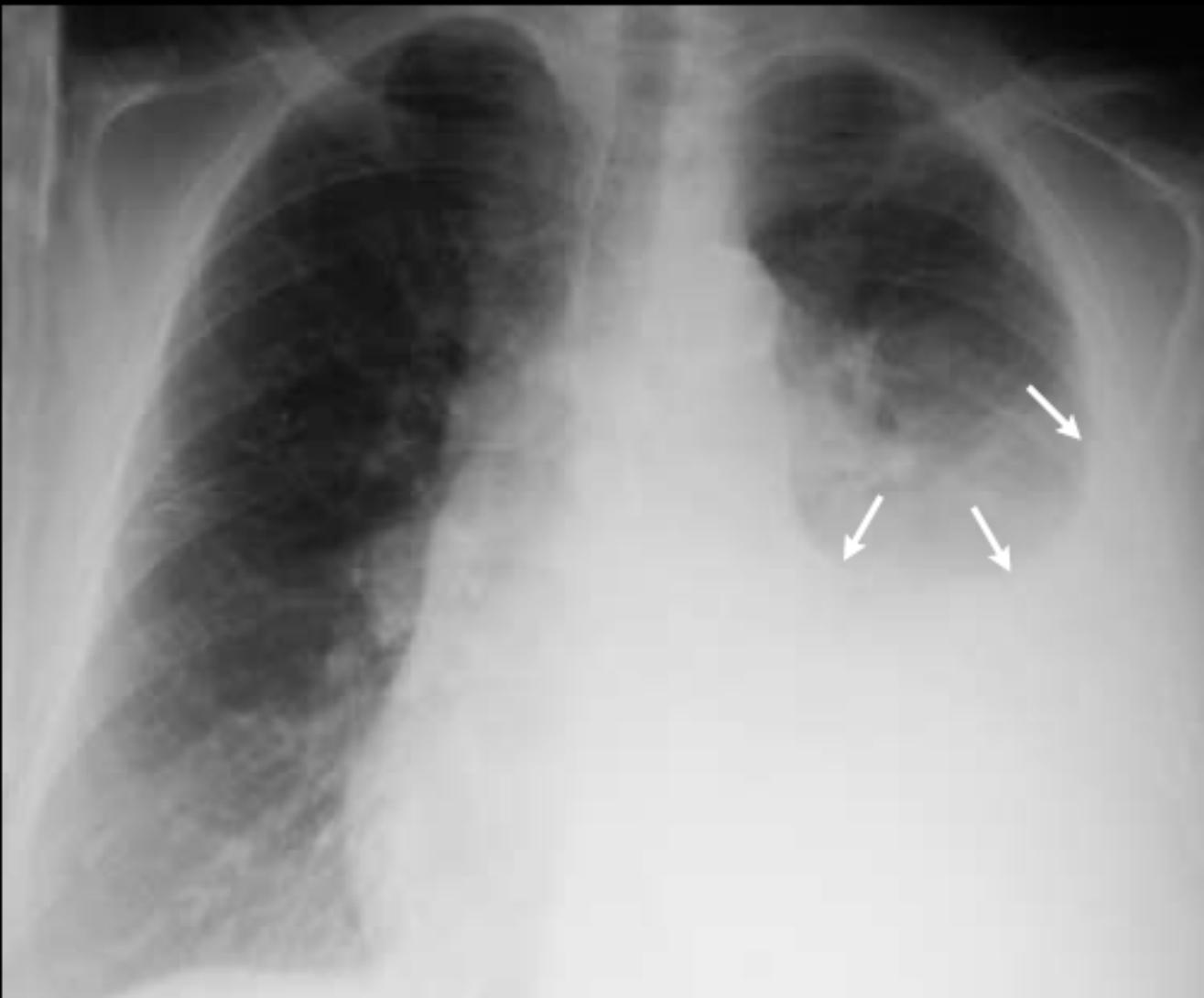
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Pleural Disease

- 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

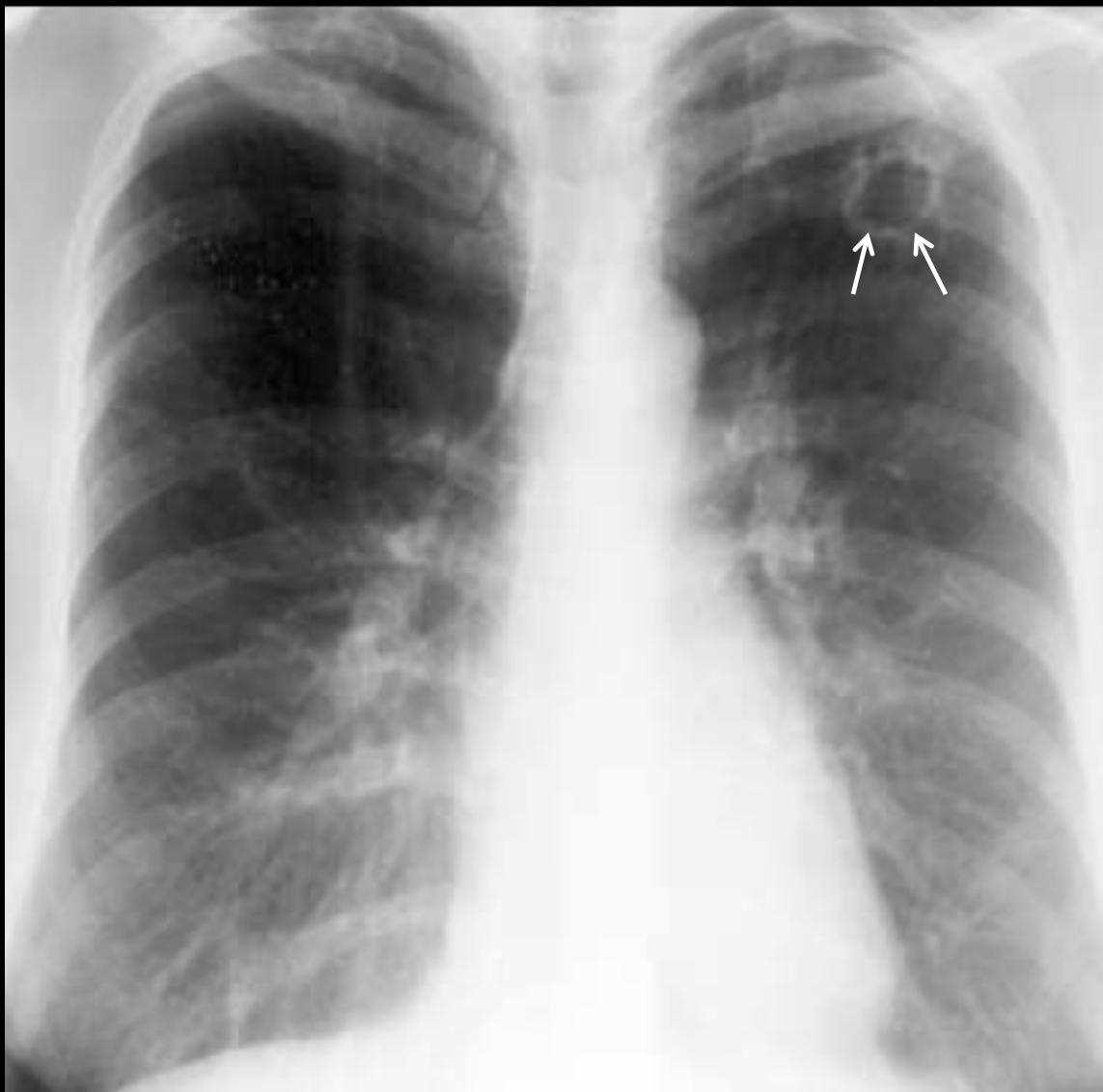
Pleural Effusion



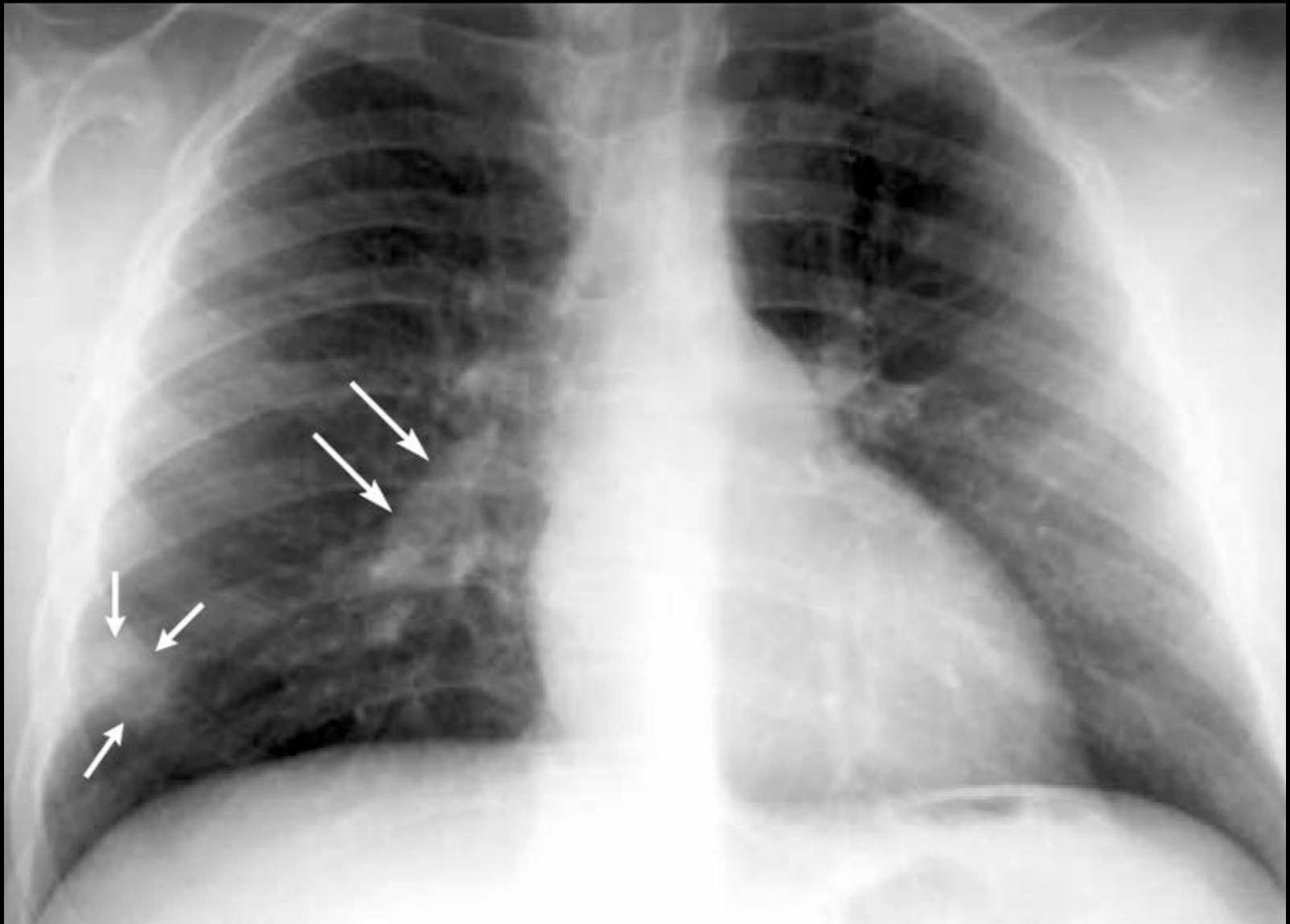
Self Check



Answer



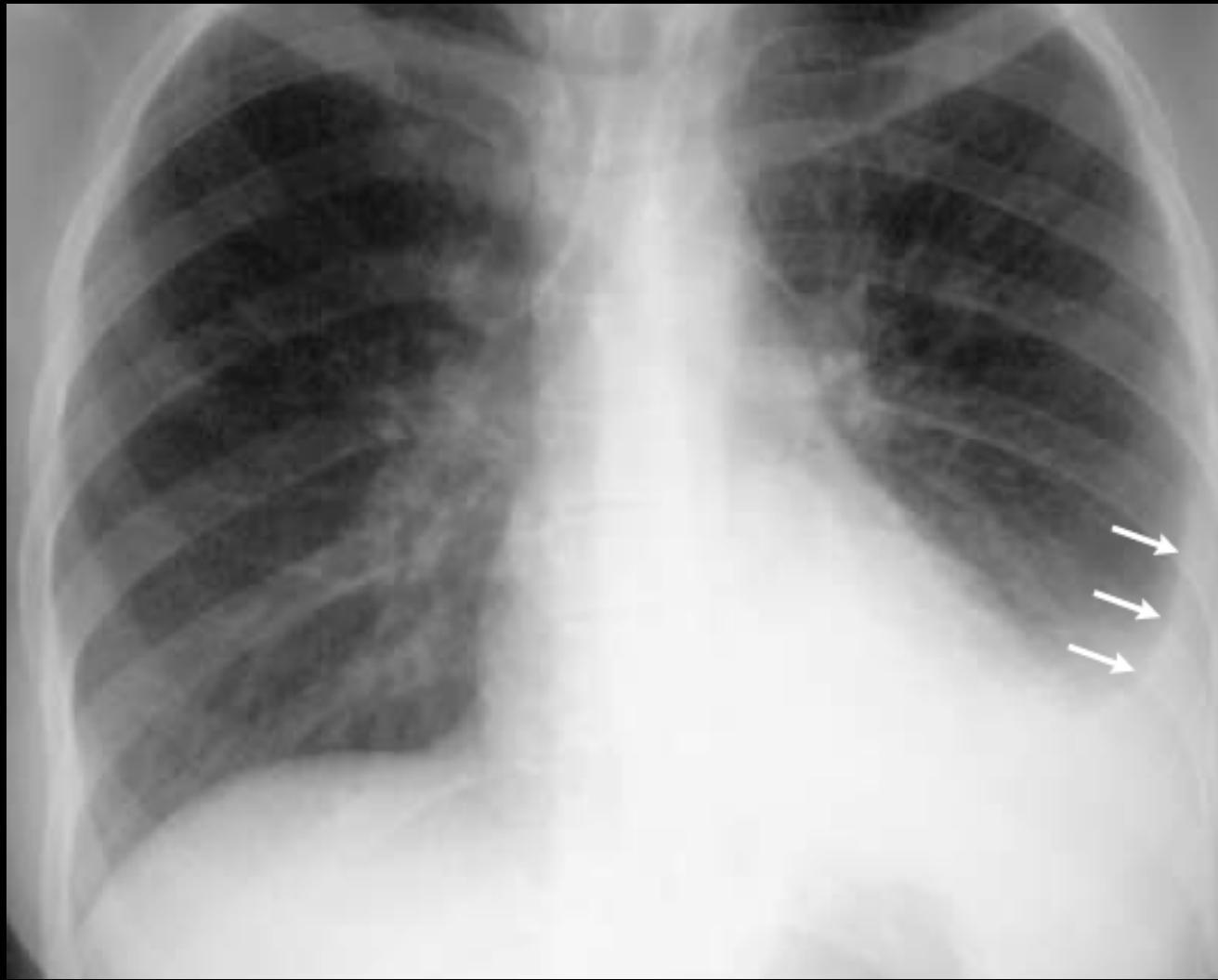
Primary TB in a Child



Primary TB in a Child



Primary TB in an Adult



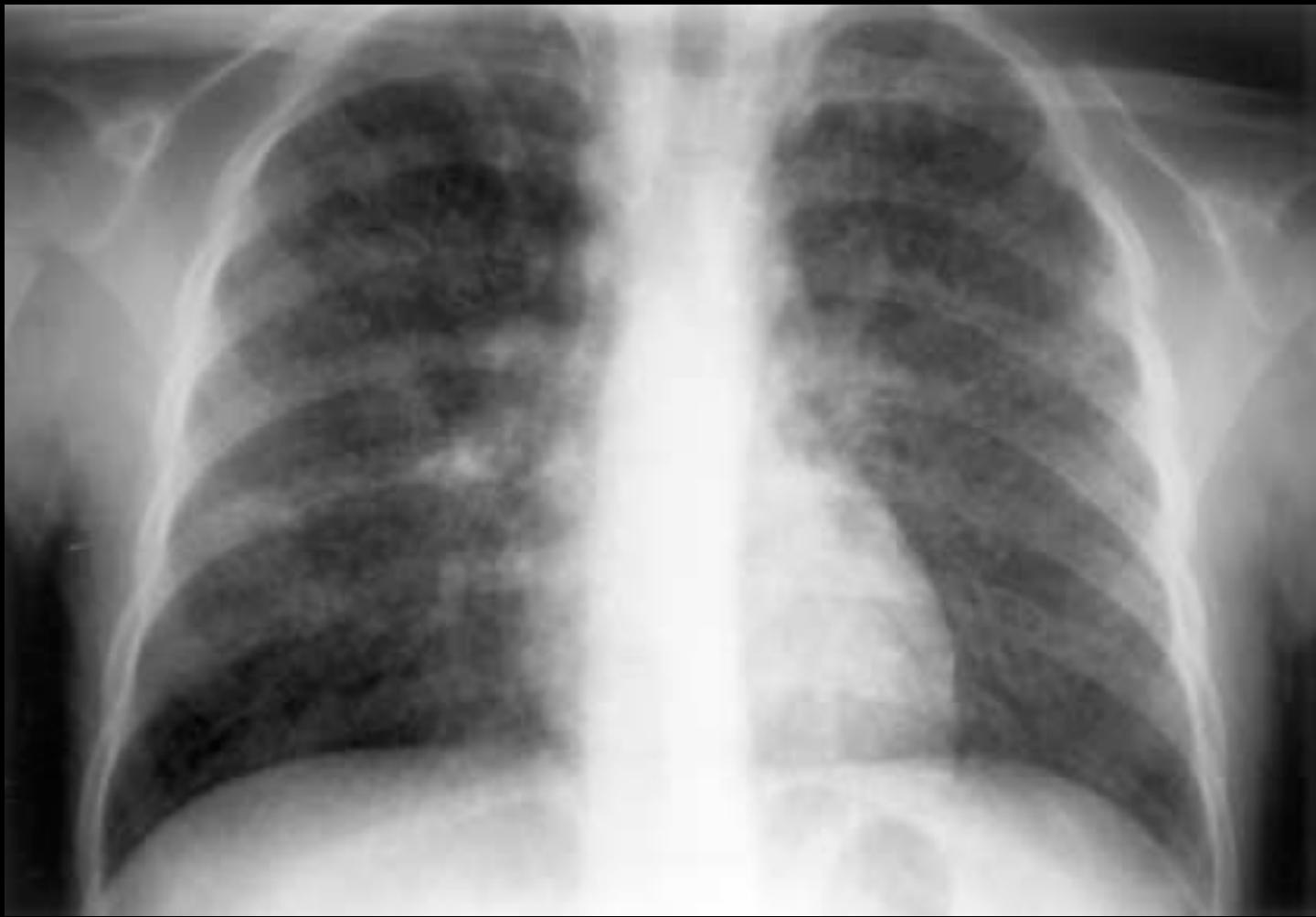
Primary TB in an adult (RLL consolidation)



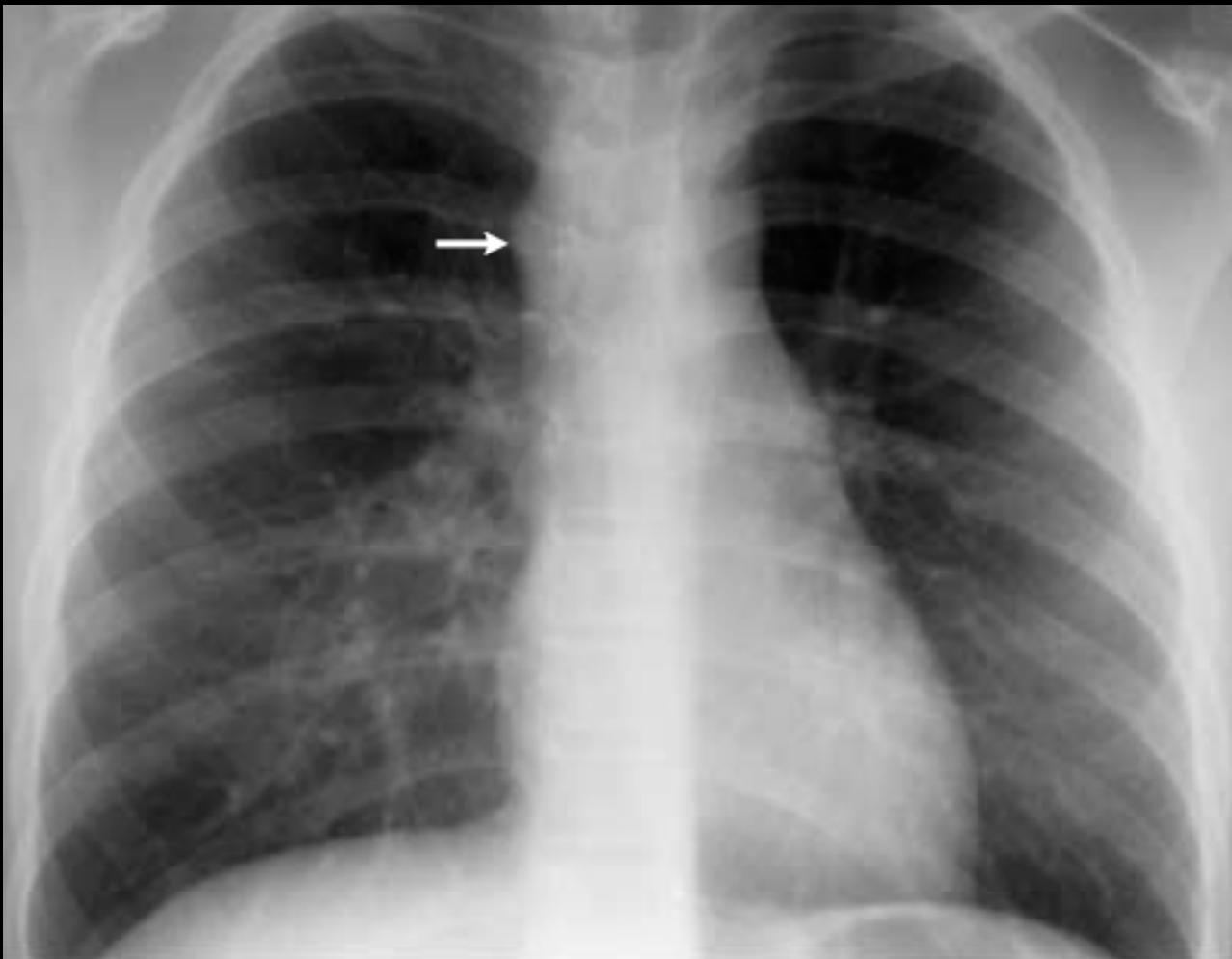
Primary TB with Cavitation



Tuberculosis...



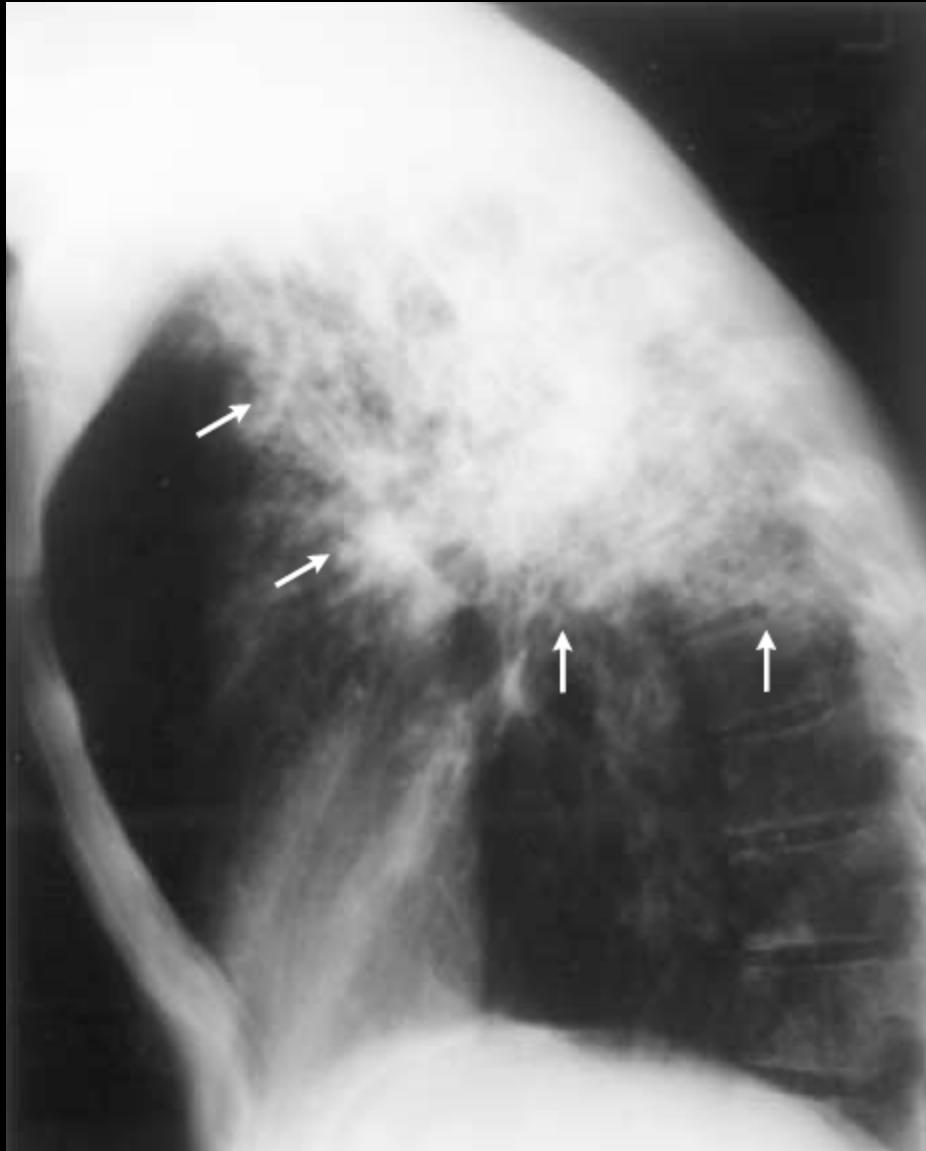
TB in a 10 year old



Post-Primary (Reactivation) TB (PA View)



Post-Primary (Reactivation) TB (Lateral View)



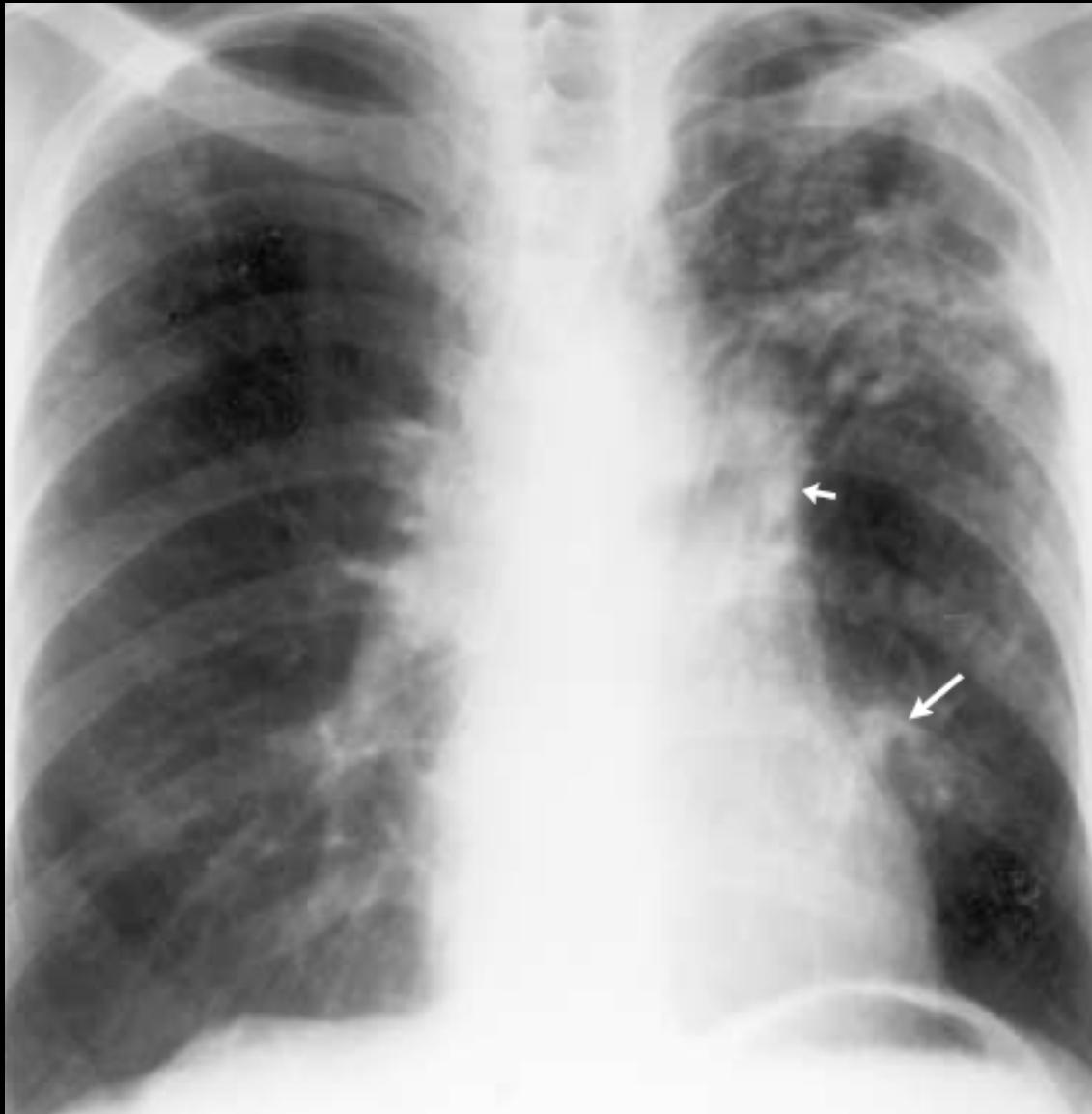
Tuberculoma



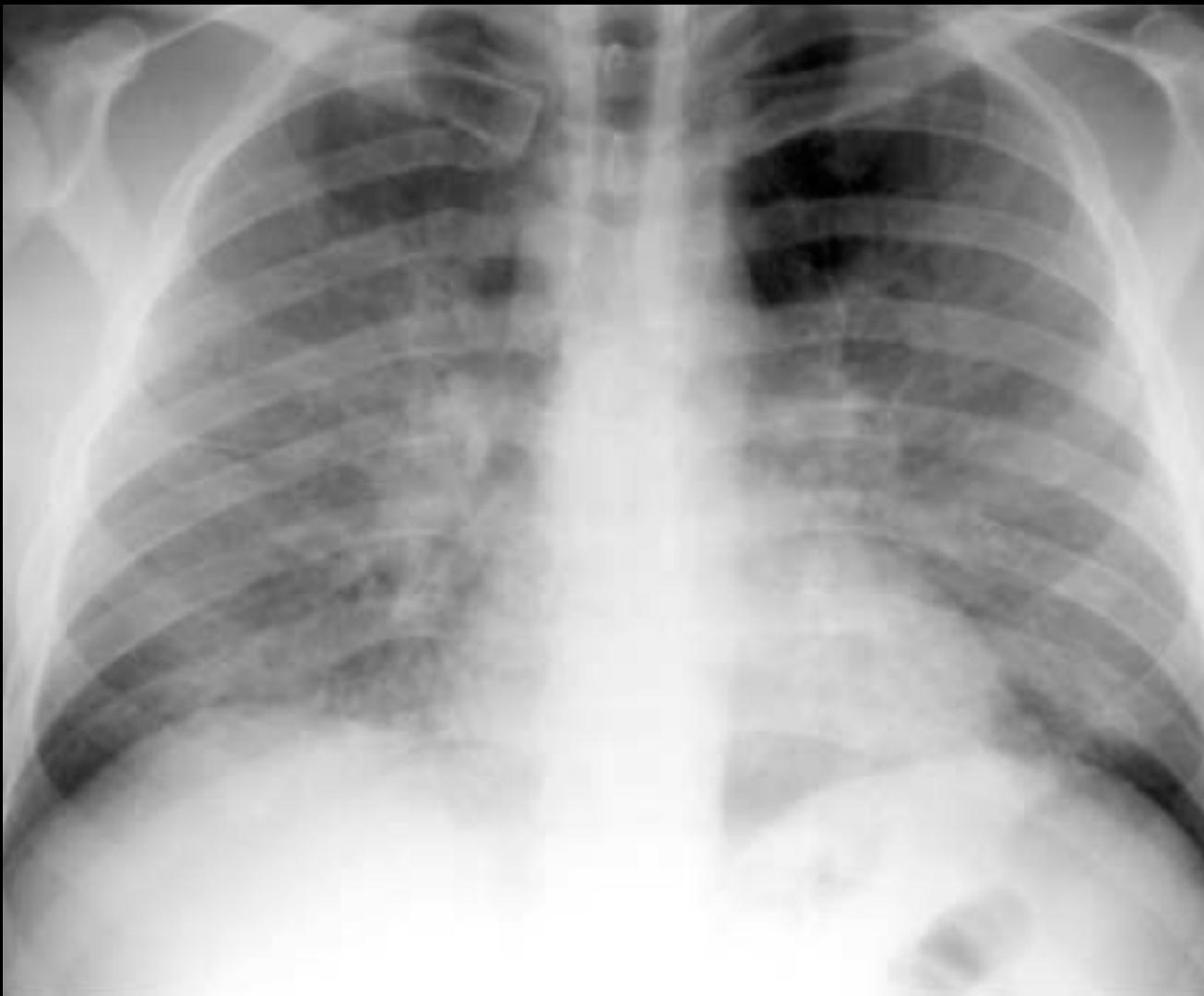
Airspace Consolidation with Cavitation



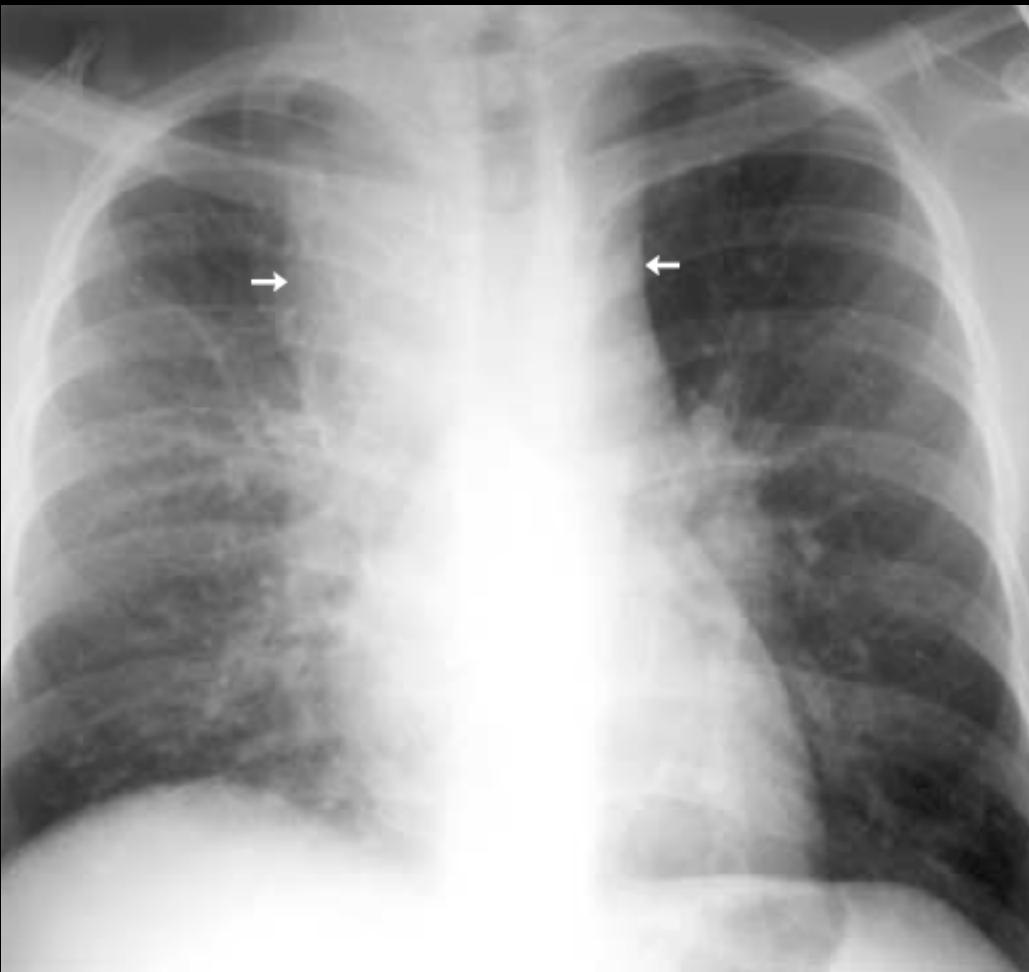
Volume Loss (Atelectasis)



Self Check



Paratracheal Adenopathy in HIV



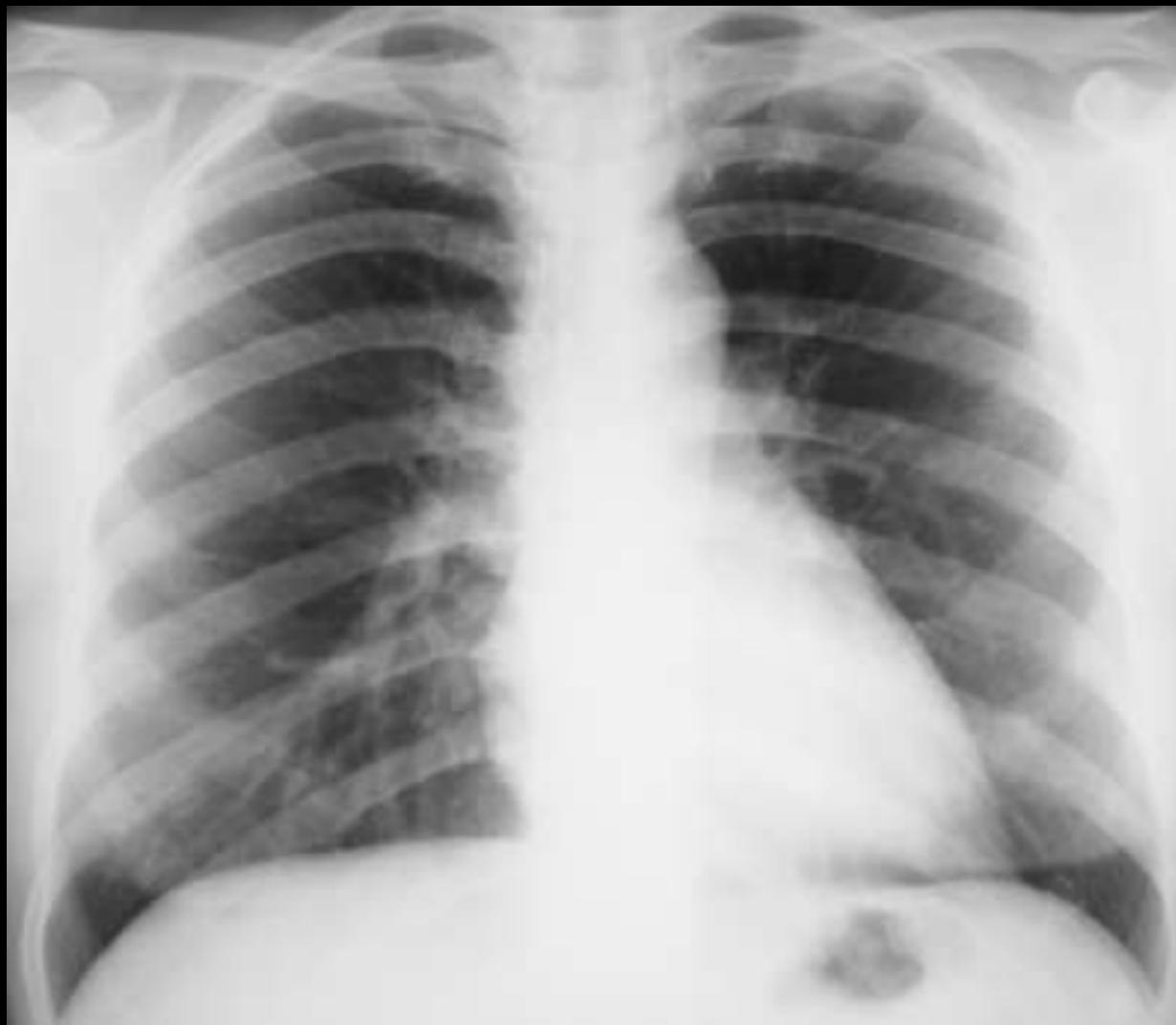
Fibrotic Scarring



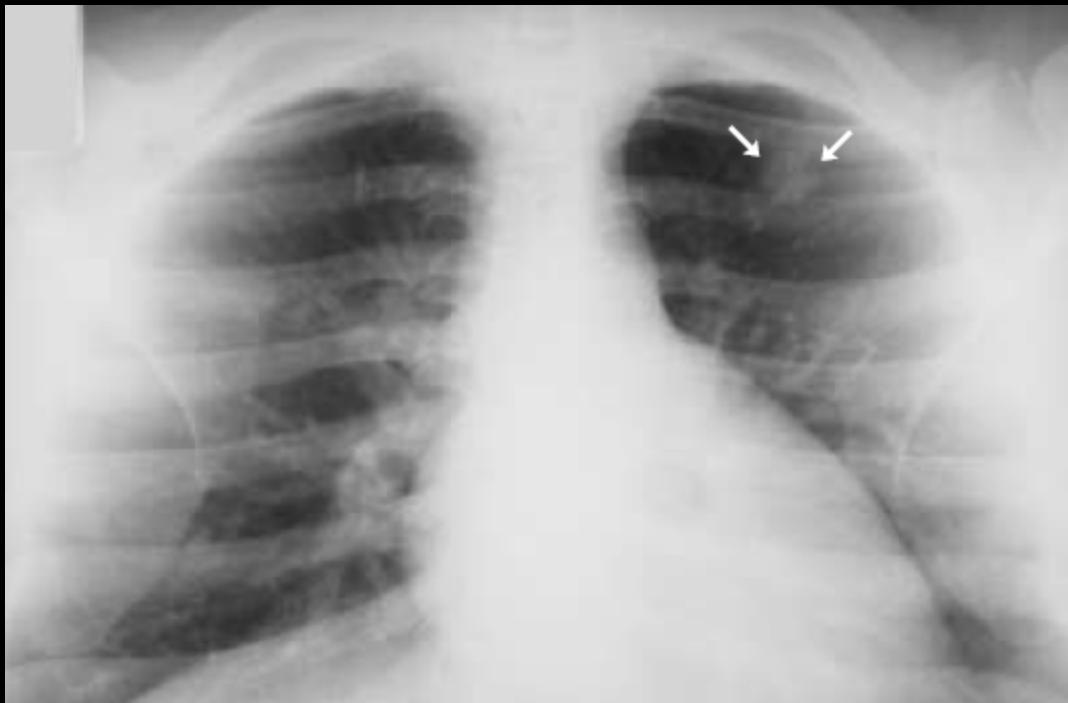
Self Check



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.