

Radiologic Manifestations of Pediatric TB

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Disclosures

No financial disclosures.

Objectives

At the end of this presentation the attendee will be able to:

- Recognize the characteristic imaging findings of tuberculosis in infants and children.
- Differentiate TB from other conditions with similar imaging findings.
- Use advanced imaging to solve special diagnostic challenges.

Primary Tuberculosis

- Any system can be involved
 - Thoracic
 - Central nervous system
 - Abdominal
 - Musculoskeletal
- Multimodality imaging

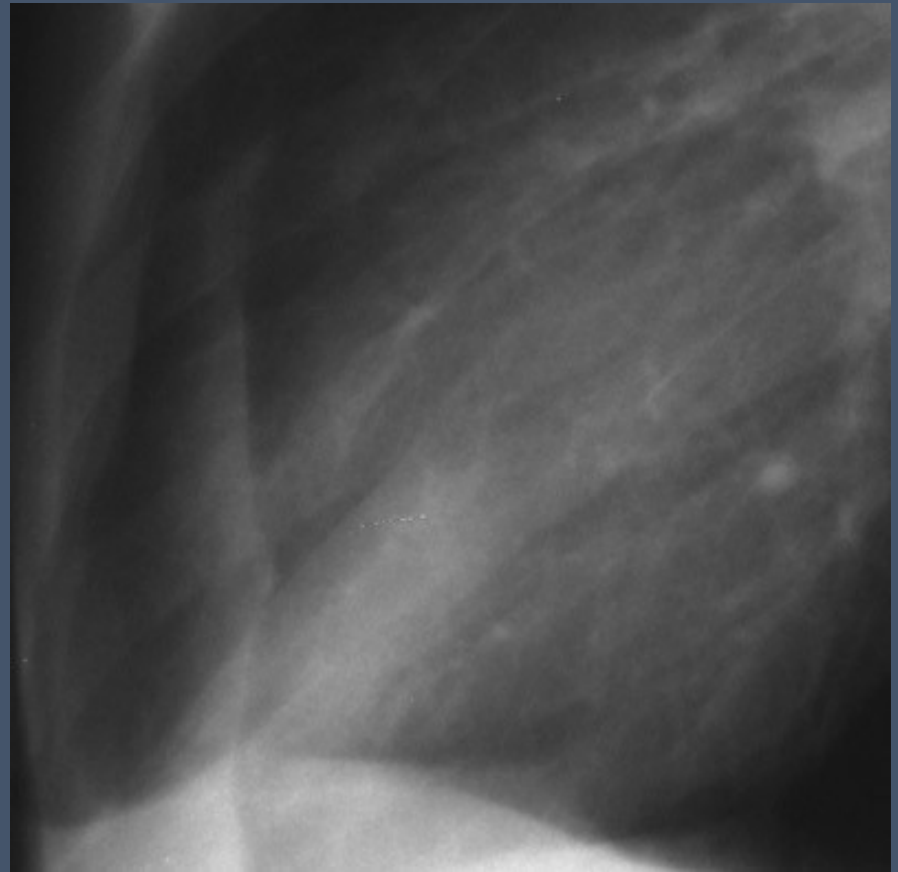
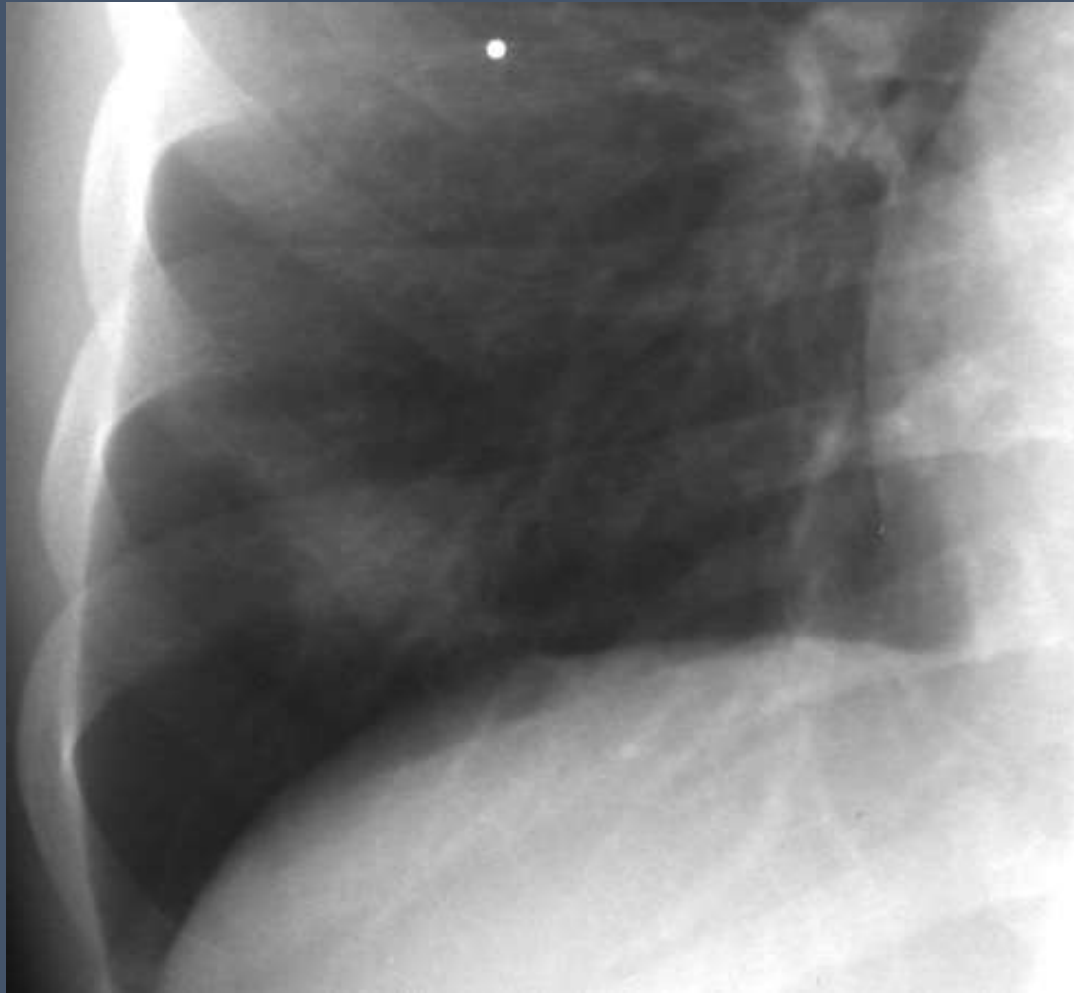
Thoracic Primary Tuberculosis

- Imaging findings reflect progression of infection
 - Ghon focus
 - Drainage to regional lymph nodes
 - Intrabronchial spread
 - Penetration of adjacent spaces
 - Hematogenous dissemination

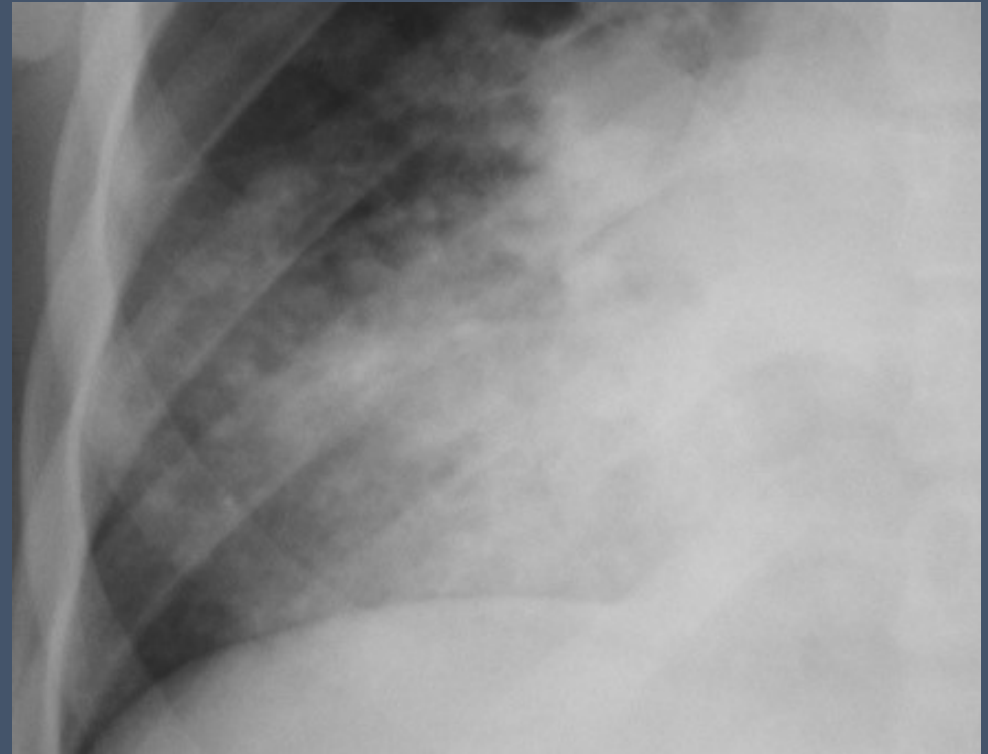
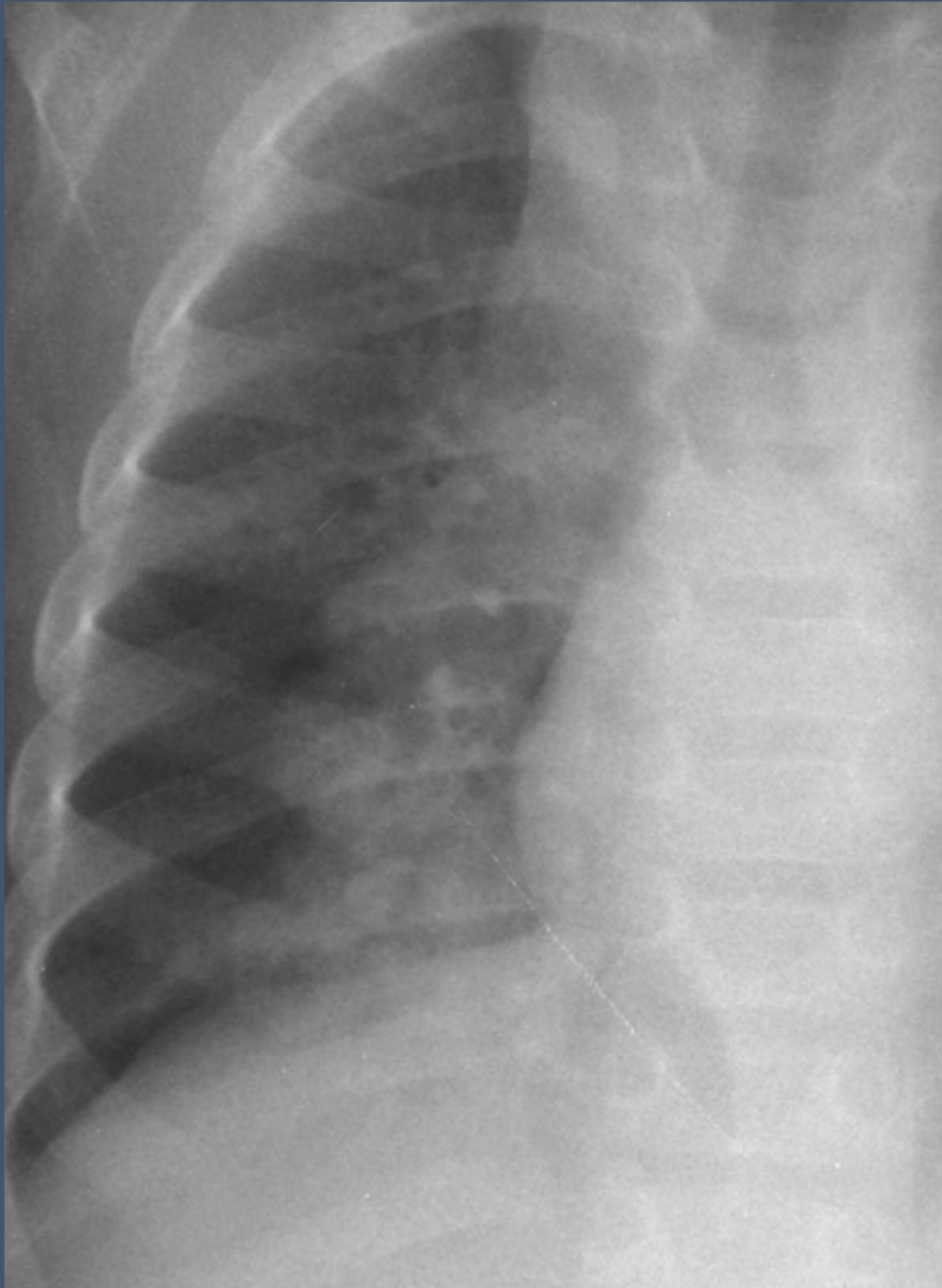
Primary Pulmonary TB

- Radiographs
 - Pulmonary (Ghon) focus
 - Focal airspace opacity
 - Variable in size
 - Often transient, hidden
 - Mild pleural reaction

Ghon Focus



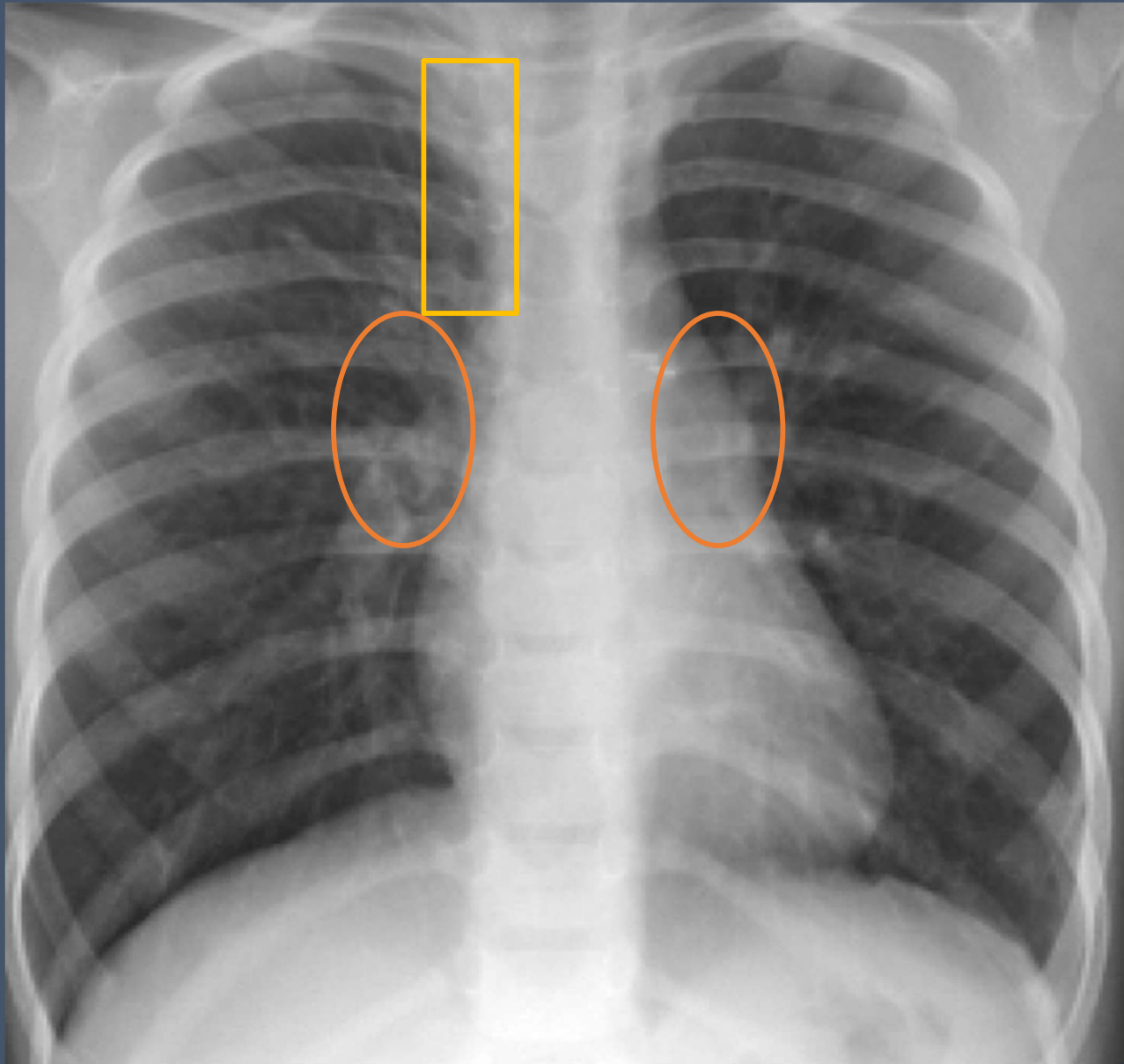
**Air space
disease with
primary TB**



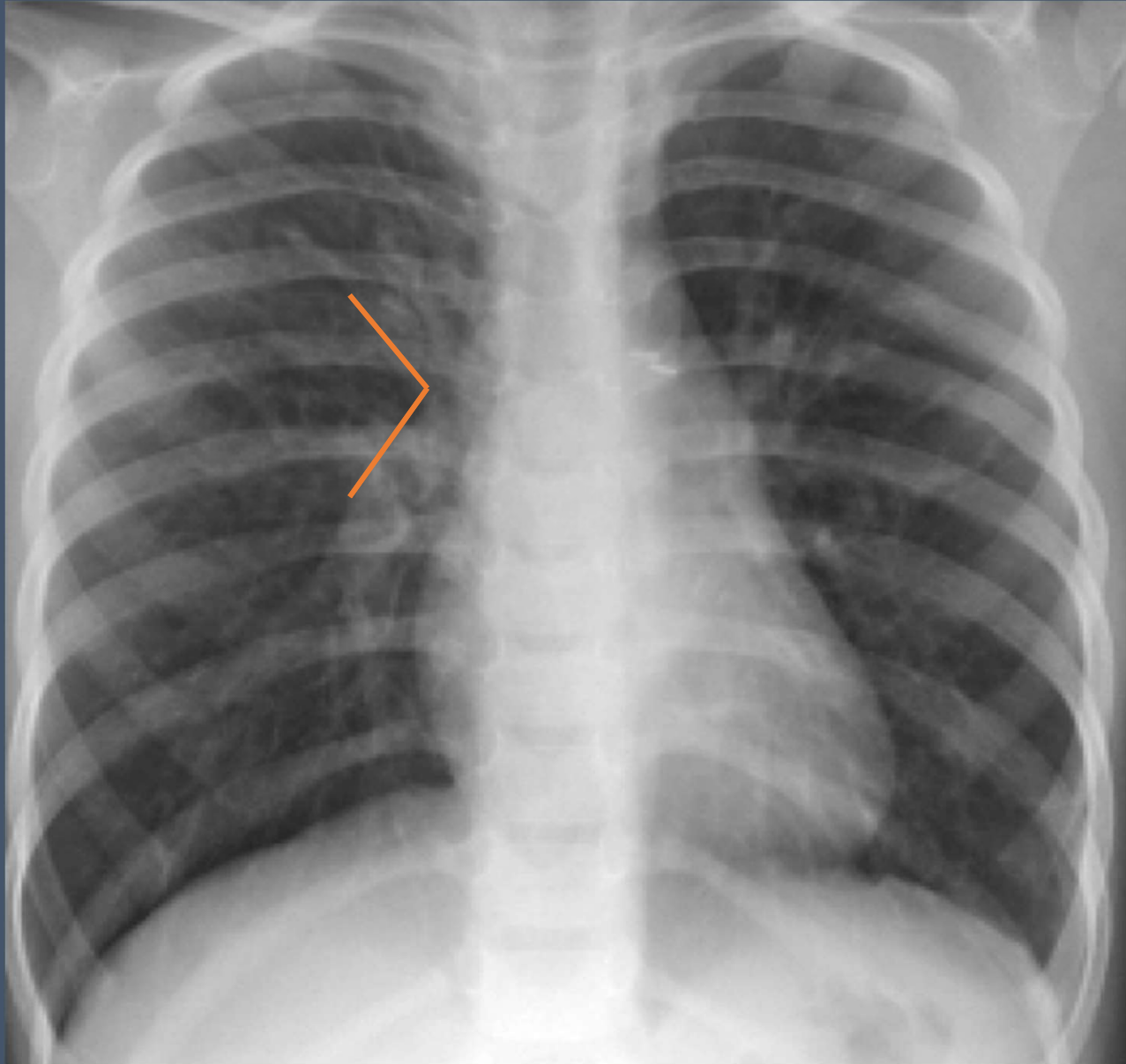
Lymphadenopathy

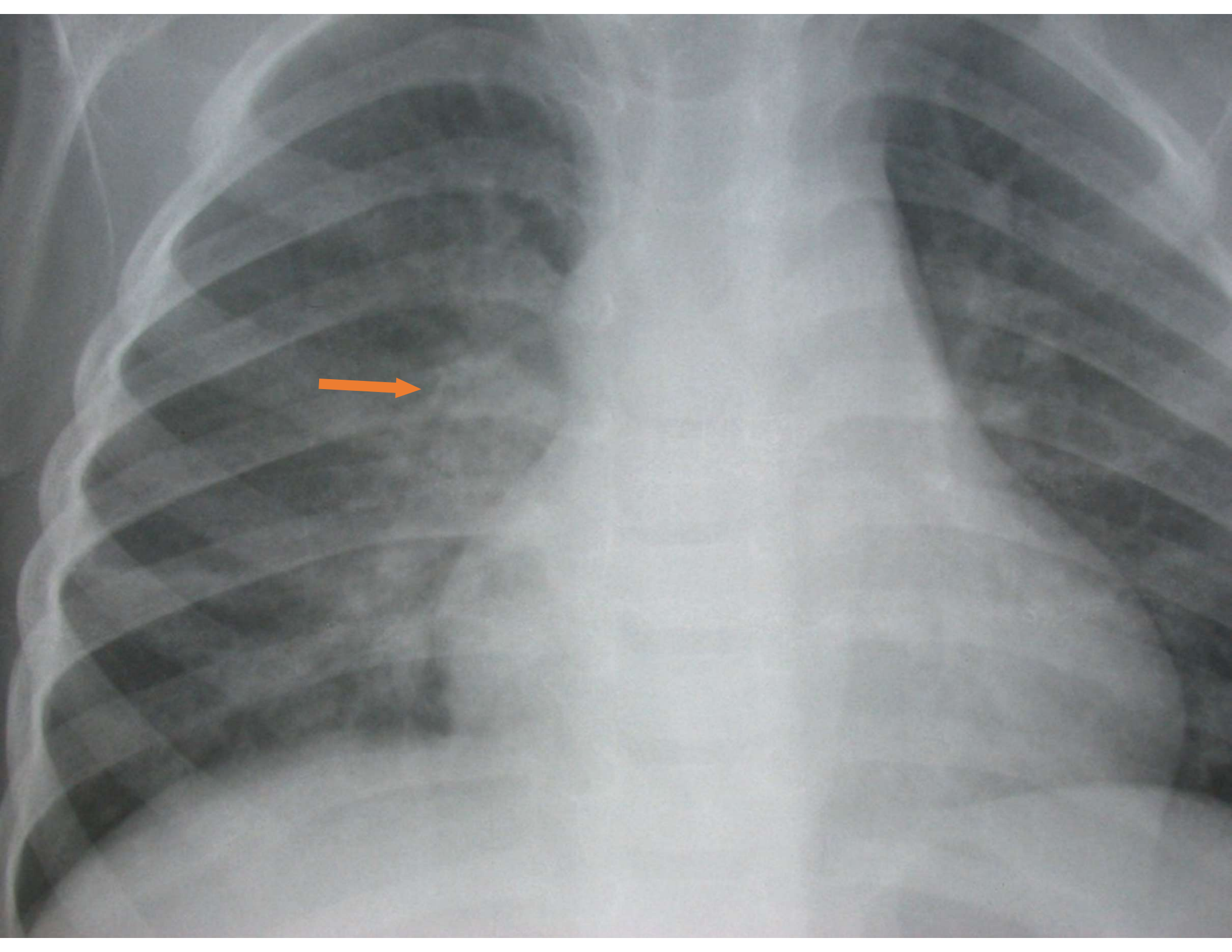
- Hallmark of primary TB on CXR
 - Visible in 50-70% of cases after 1-3 months
 - More common in children <3 yrs of age (50%)
 - 5-14 years of age (9%)
 - Poor interobserver agreement
- Radiographs
 - Difficult to see with confidence
 - PA and lateral views valuable
 - Right hilar, paratracheal most commonly visible

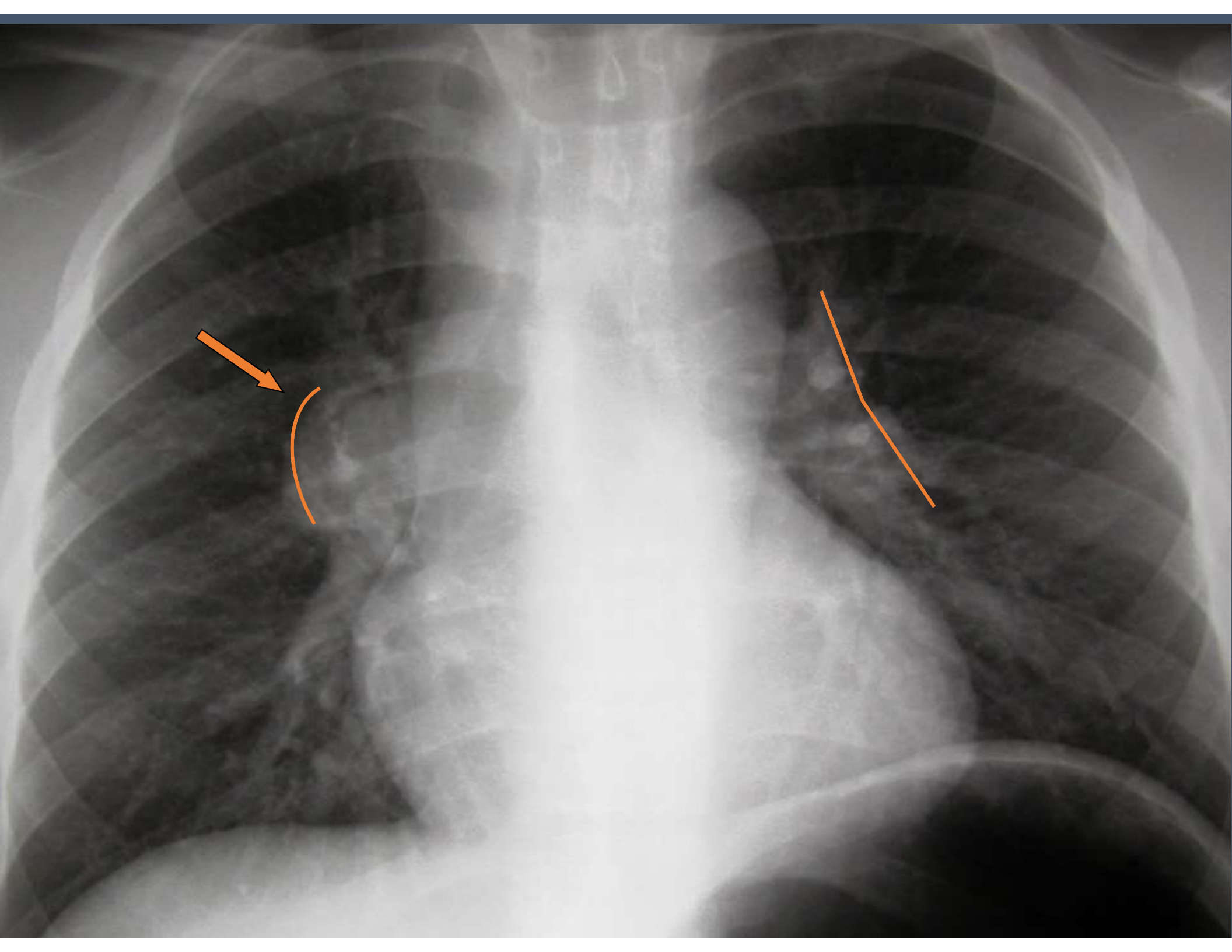
LN Locations on Radiographs

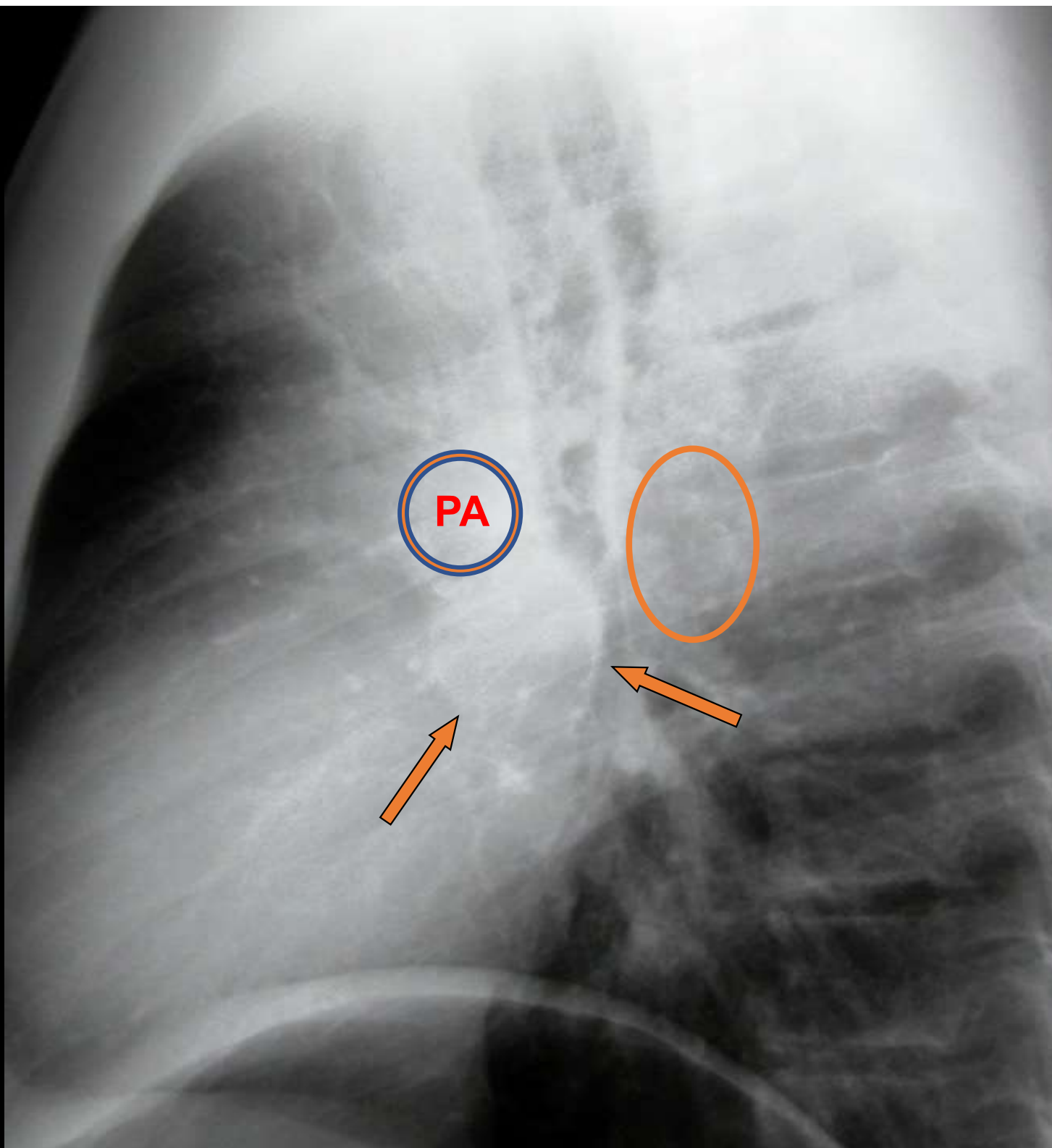


LN Locations on Radiographs

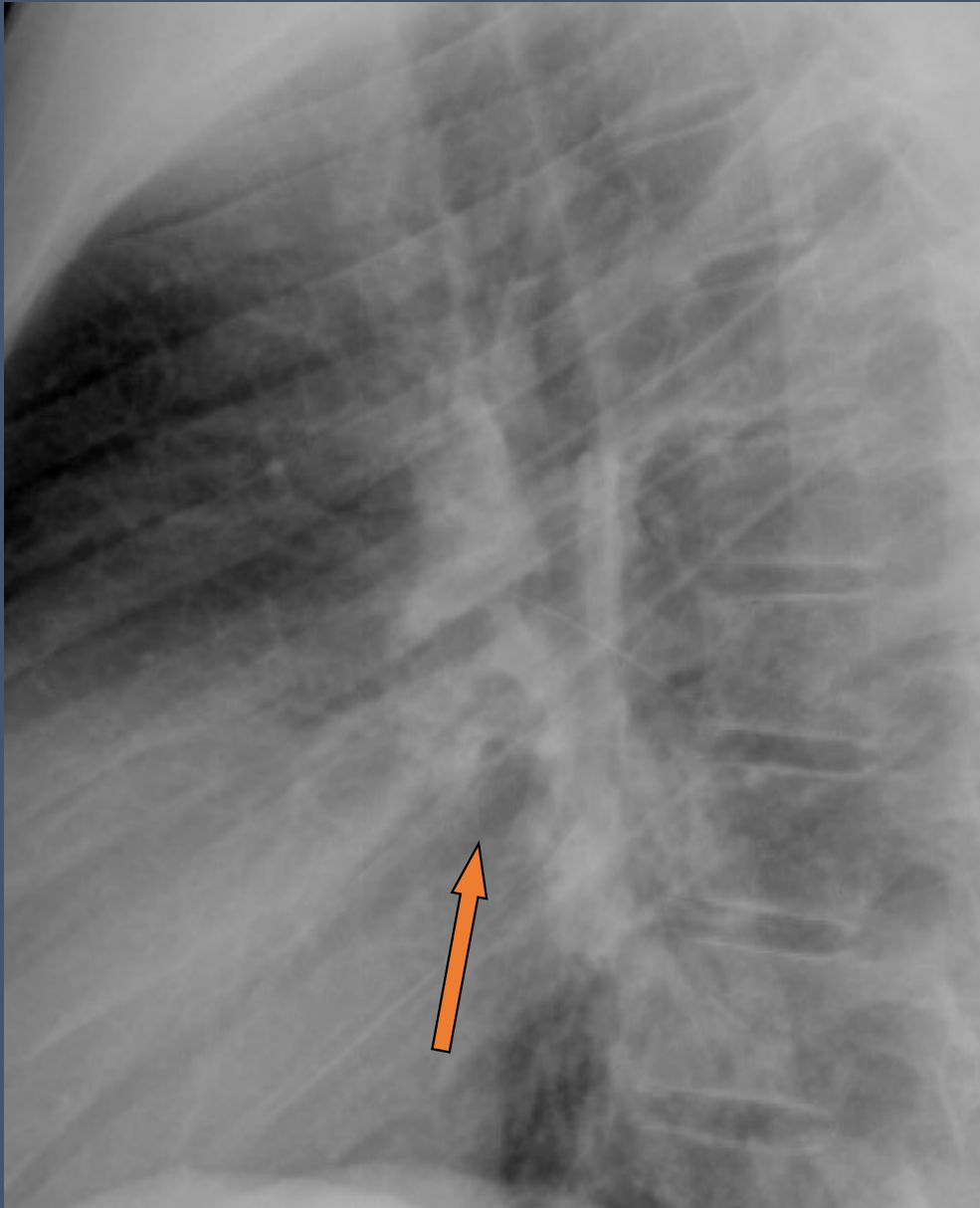




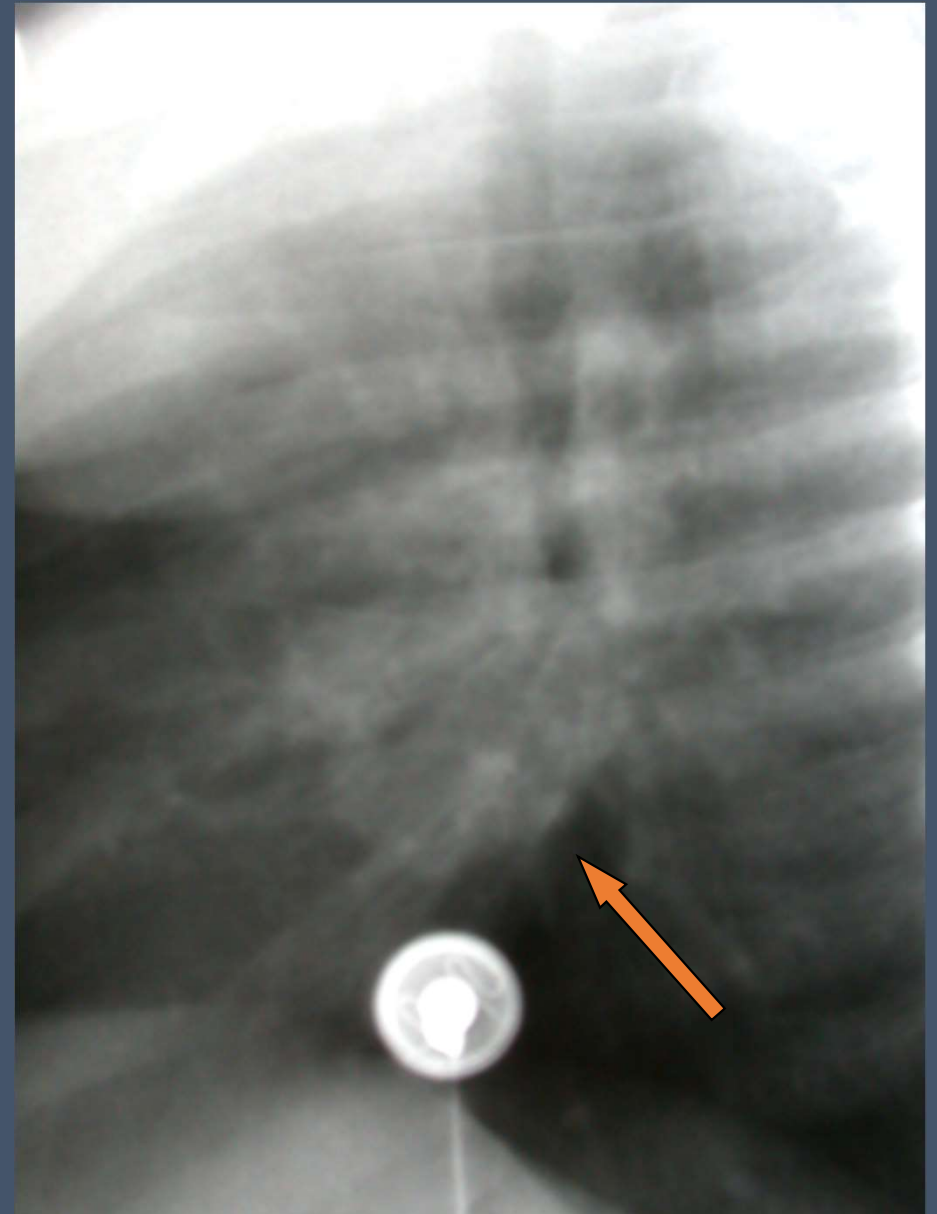


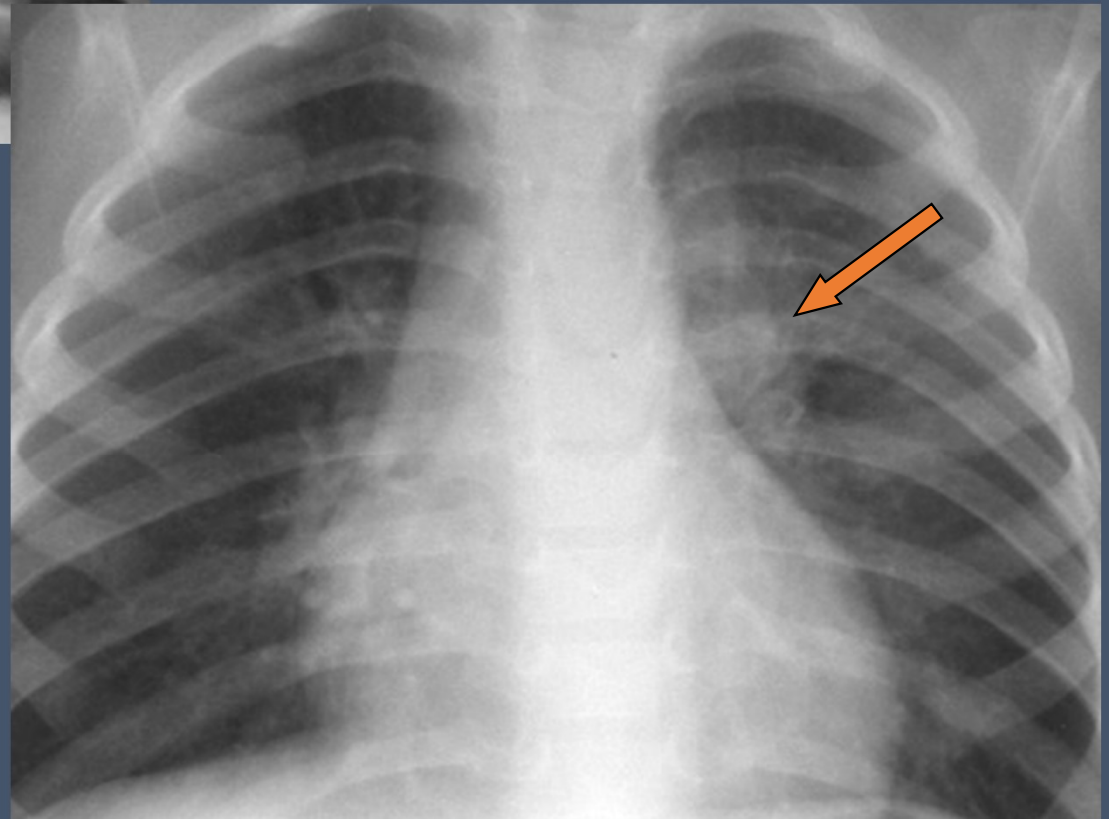
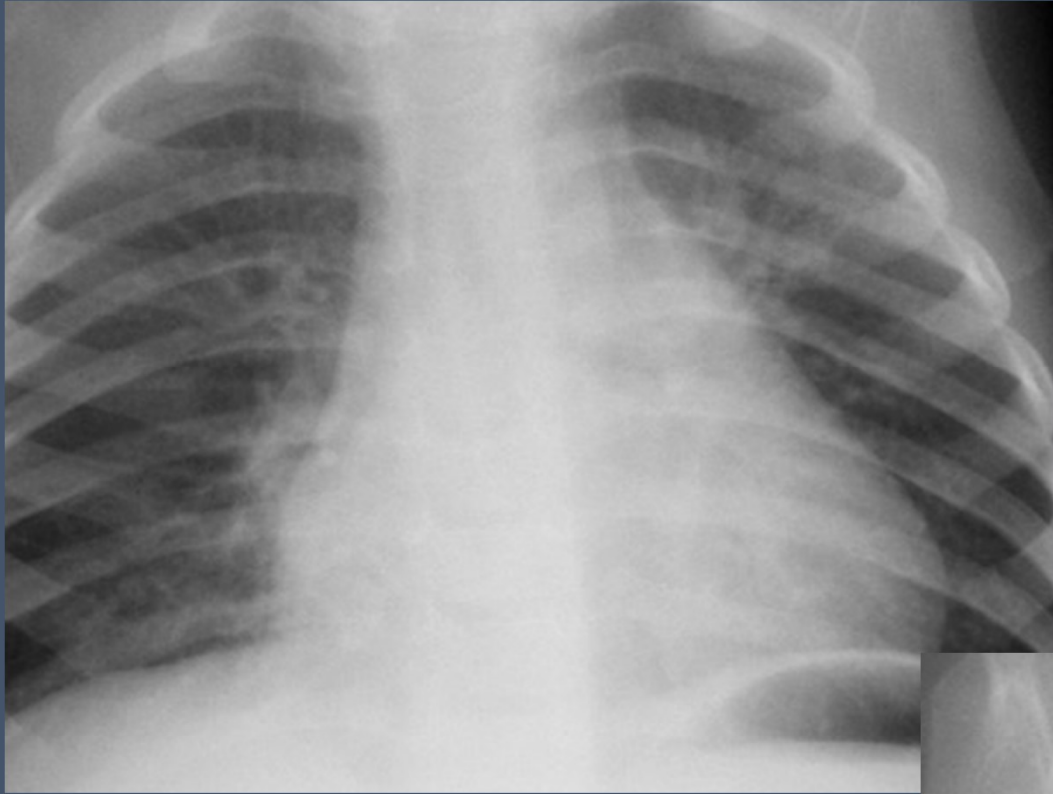


Normal



Lymphadenopathy

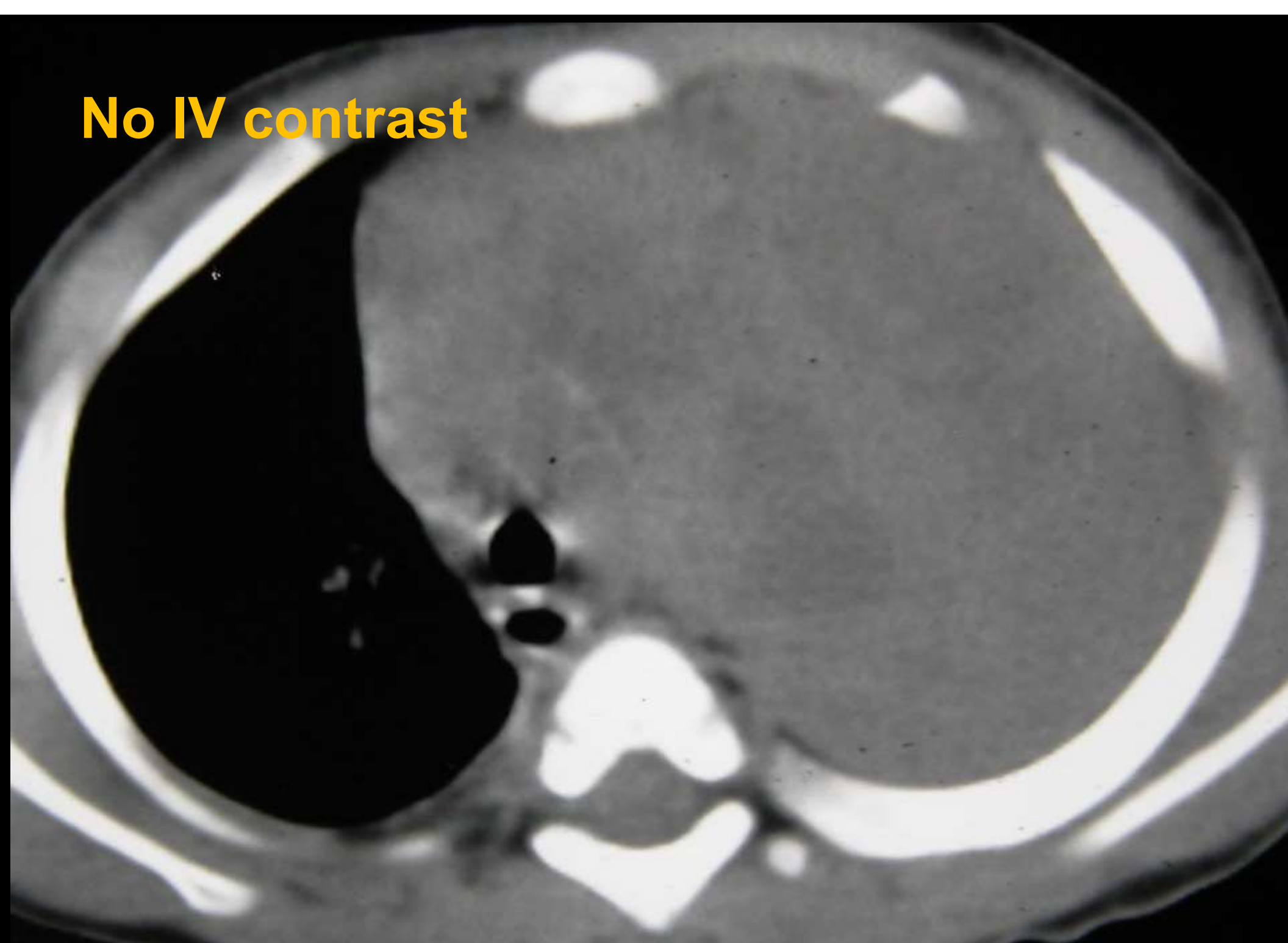




Lymphadenopathy

- CT improves detection
 - Up to 60% with normal CXR have LNs on CT
 - (Delacourt, 1993, Arch Dis Child 69:430.)
- Indicated for:
 - Equivocal or occult disease on XR
 - High risk groups
- CT technique
 - Use IV contrast
 - High resolution protocols for lung disease
 - Not suitable for young children

No IV contrast



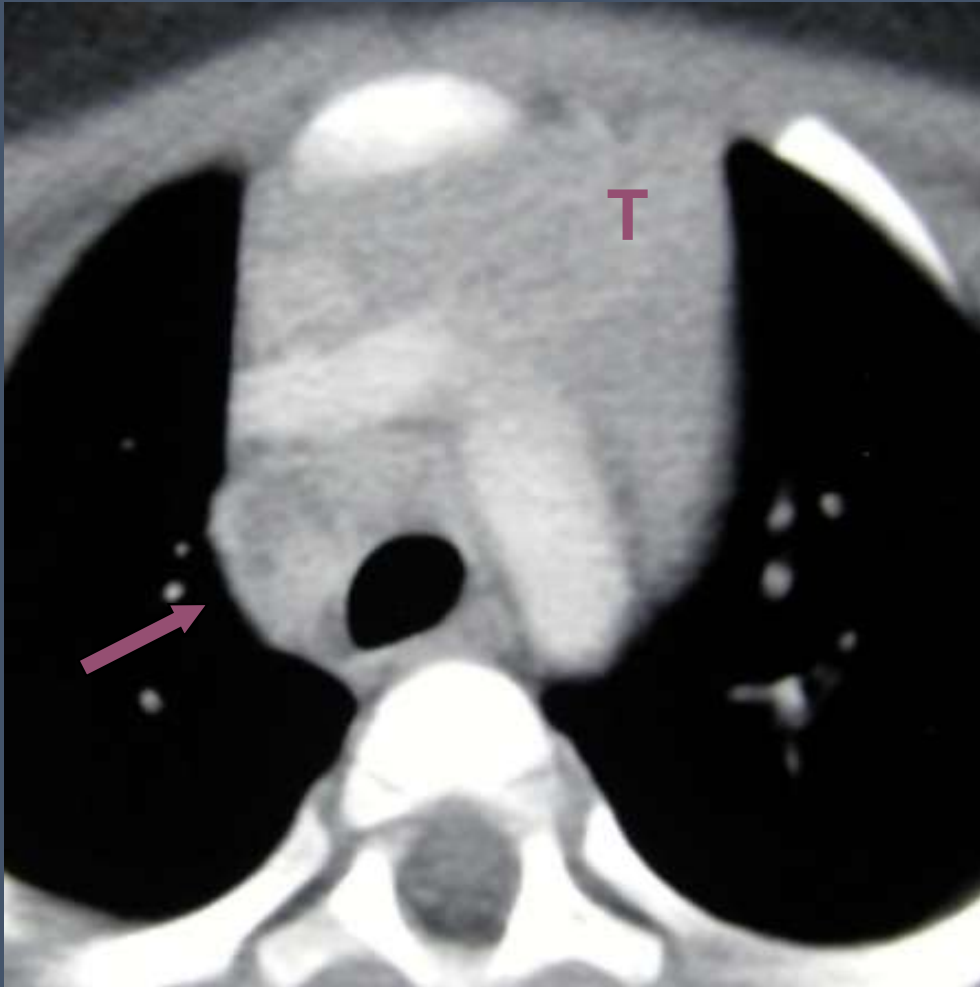
MRI for Lymphadenopathy

- Benefits
 - Highly effective for:
 - Mediastinal lymph nodes > 7 mm
 - Consolidation
 - Pulmonary nodules > 3 mm
 - Pleural effusions
- Detractors
 - Expensive
 - Need for sedation/anesthesia
 - Poor visibility of lung disease

Lymphadenopathy

- **Sites on CT**
 - Subcarinal (90%)
 - Hilar (Bilateral 72%)
 - Anterior mediastinum
 - Precarinal
 - Right paratracheal
 - Multiple sites (96%)

(Andronikou, Pediatr Radiol (2004) 34:232)

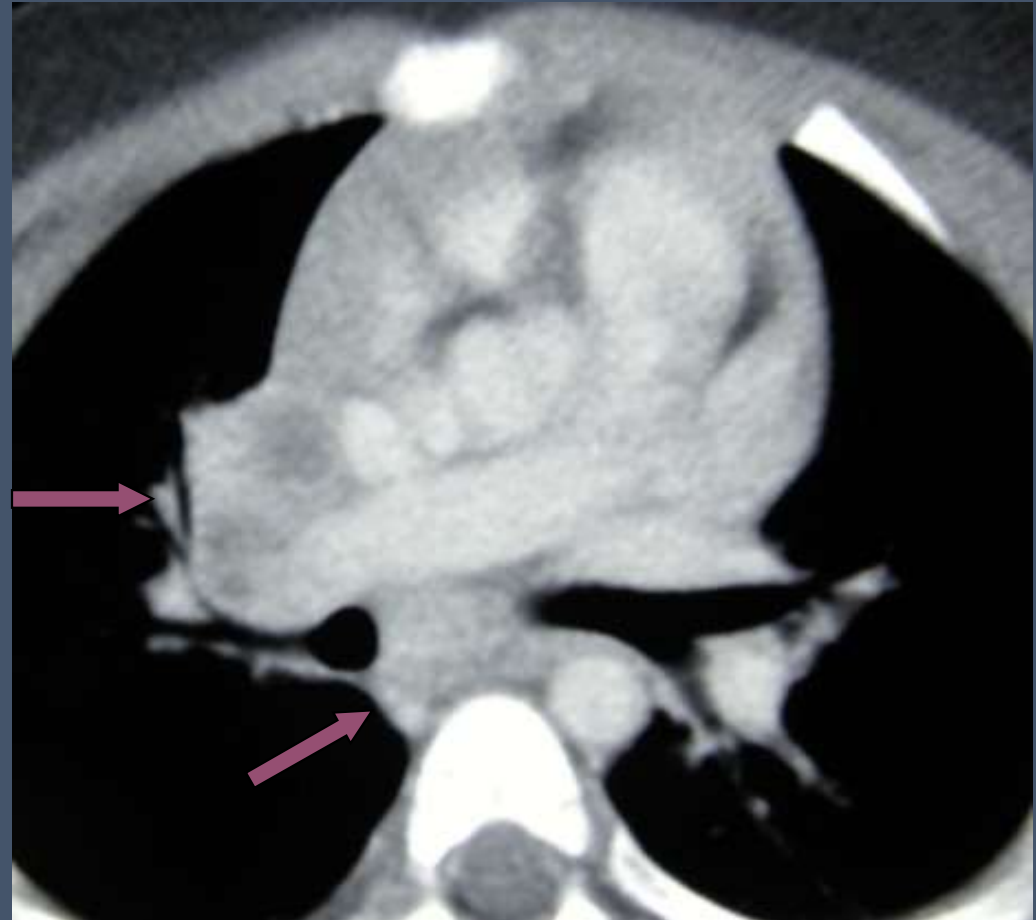


Paratracheal

Hilar

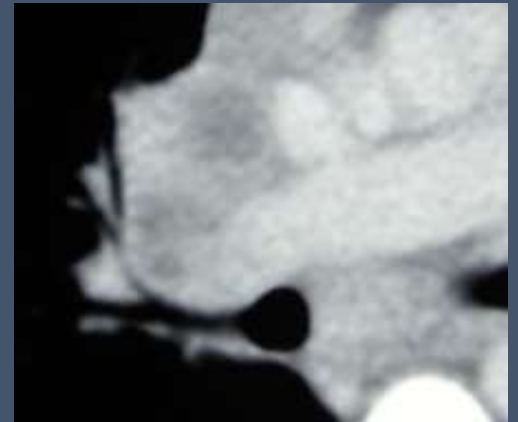
Subcarinal

Lymphadenopathy on CT



Lymphadenopathy in PTB

- Size criteria
 - Generally use 1 cm or greater
 - Not well-established
 - May continue to enlarge for 4-12 months after exposure
- Appearance
 - Low-density center with enhancing rim
 - Characteristic, not pathognomonic
 - Calcifications

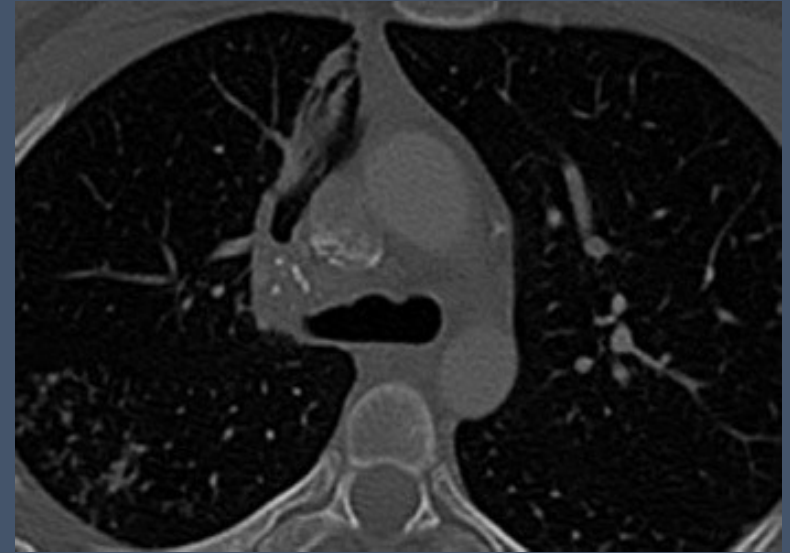
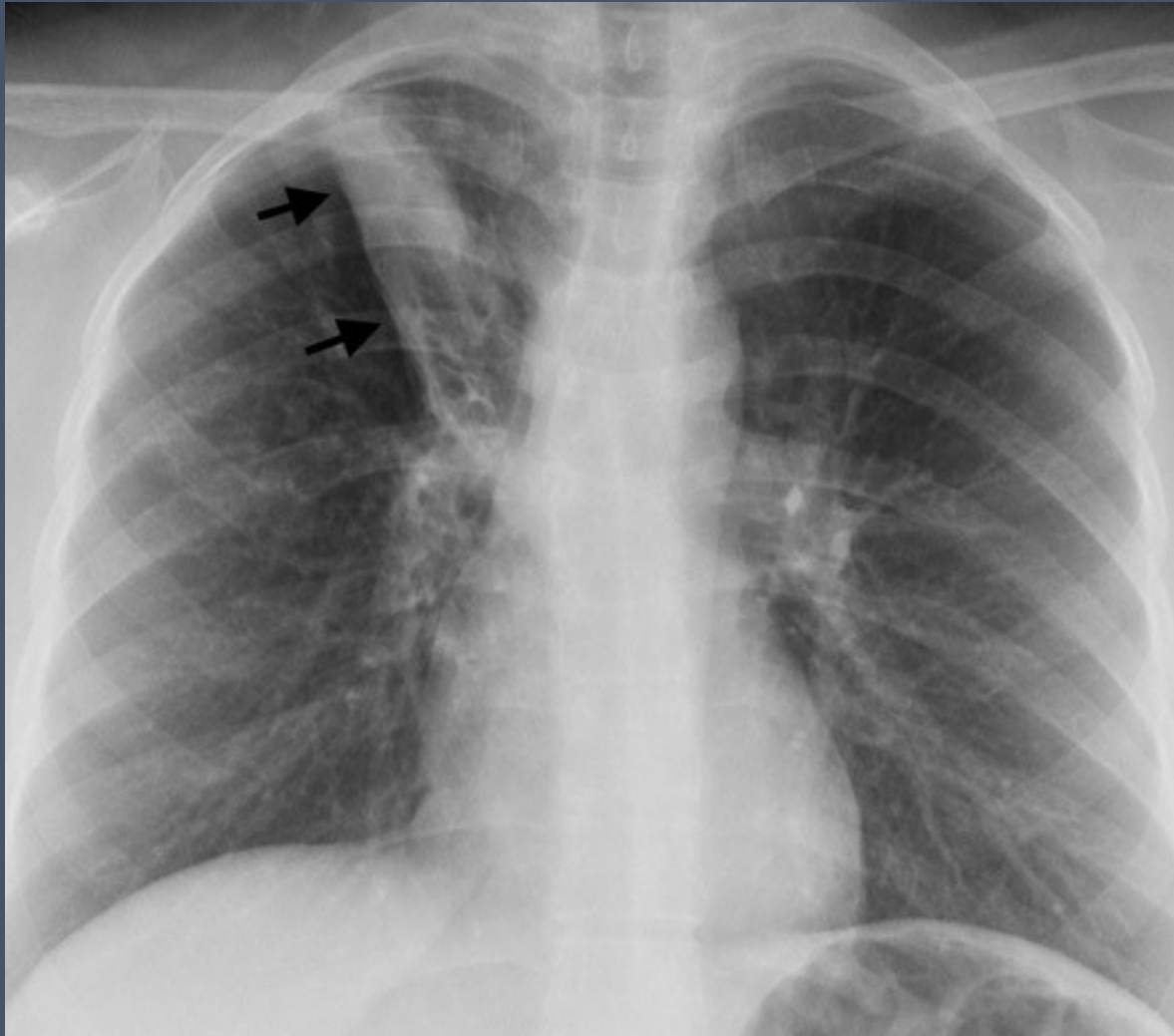


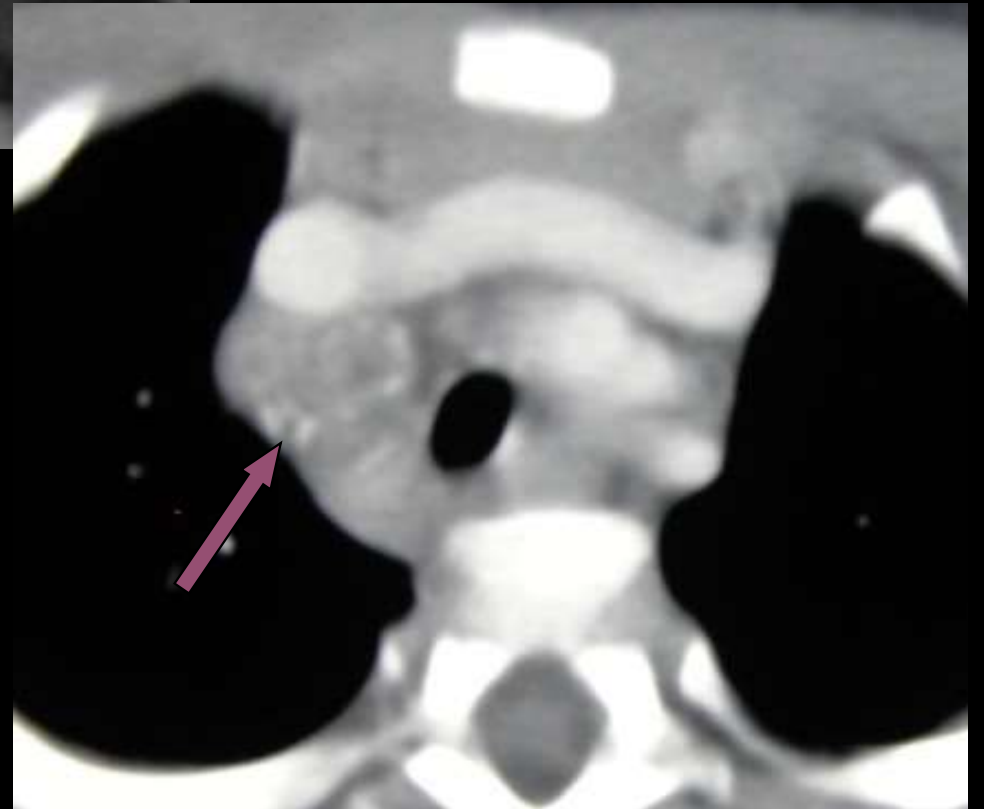
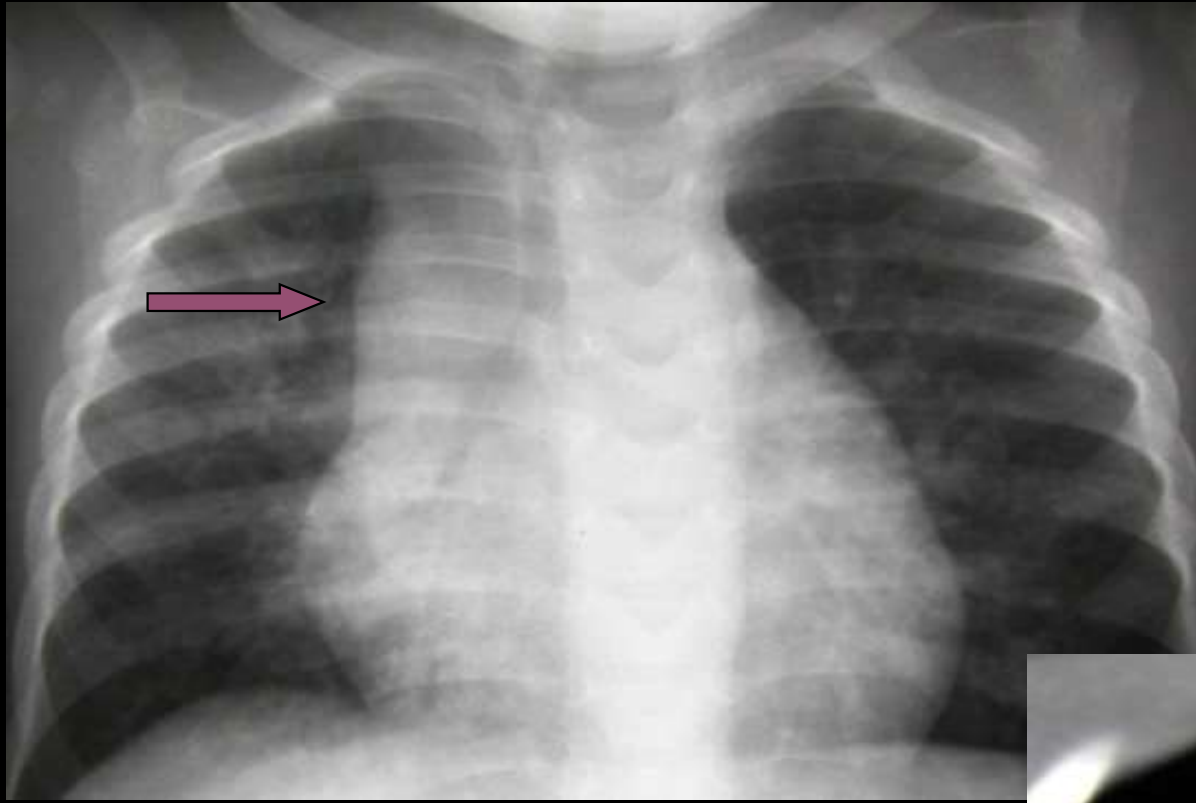
Lymph Node Calcifications

- Calcifications (15-20% on CT)
 - Occurs in areas of caseation
 - 6 mons – 4 yrs after infection
 - Not seen in young infants
 - Occurs earlier in young children



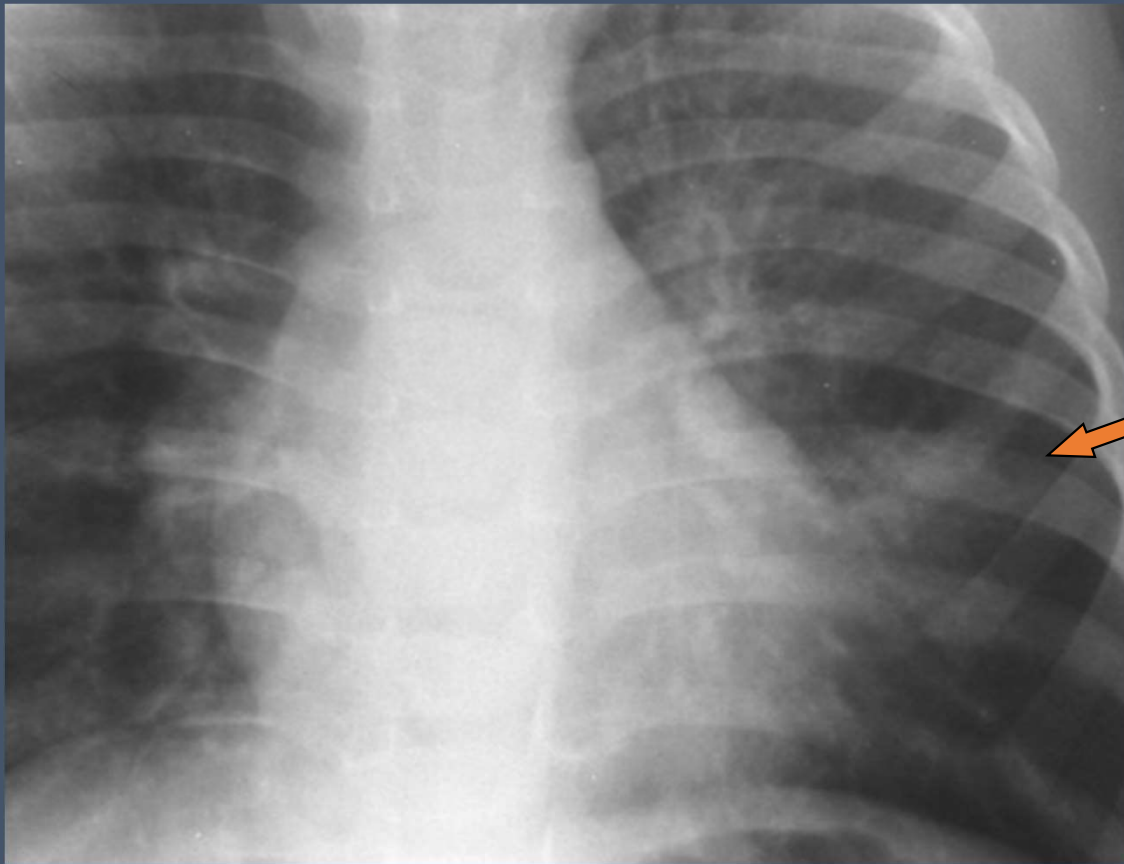
TB with calcified lymph nodes



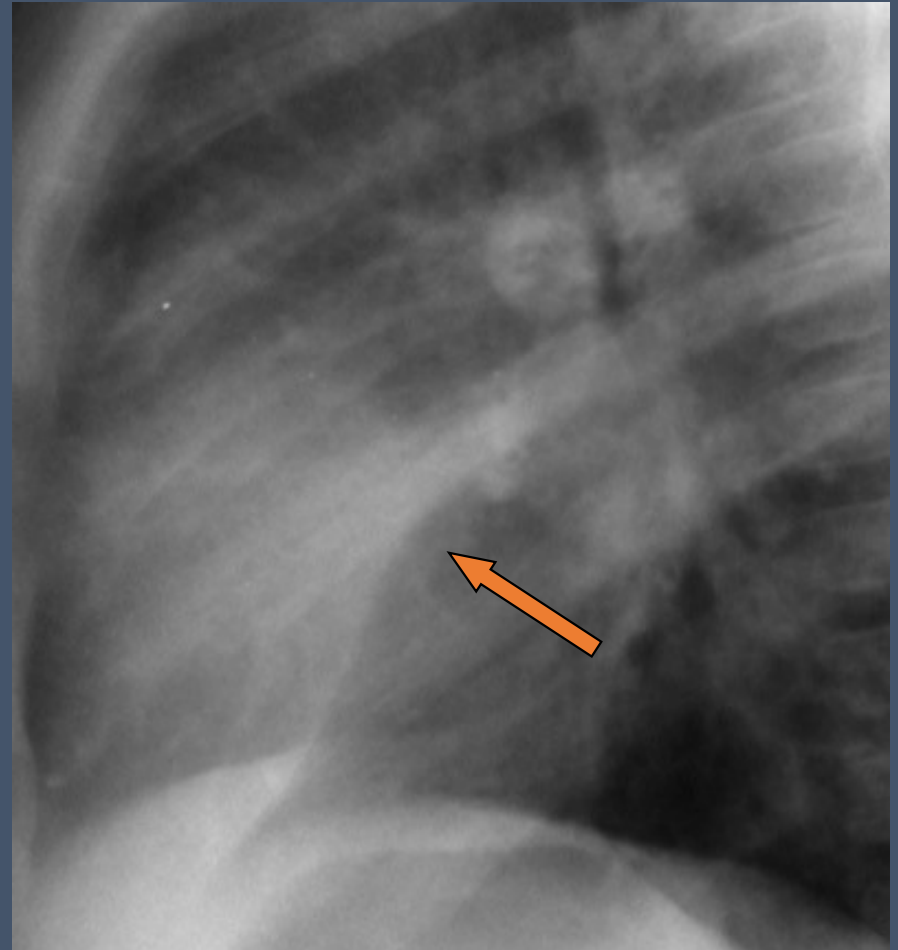


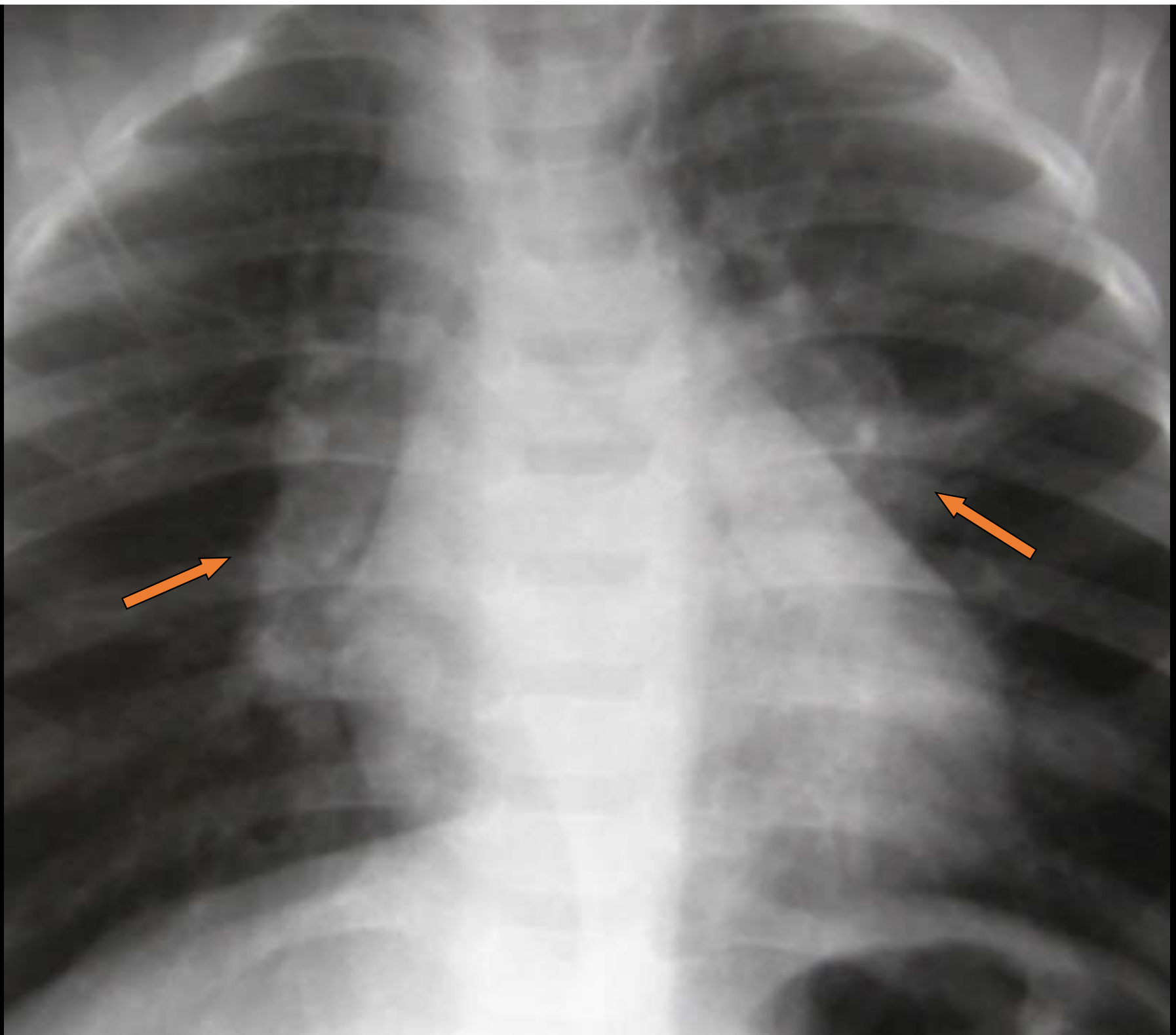
Lymphadenopathy in PTB- Complications

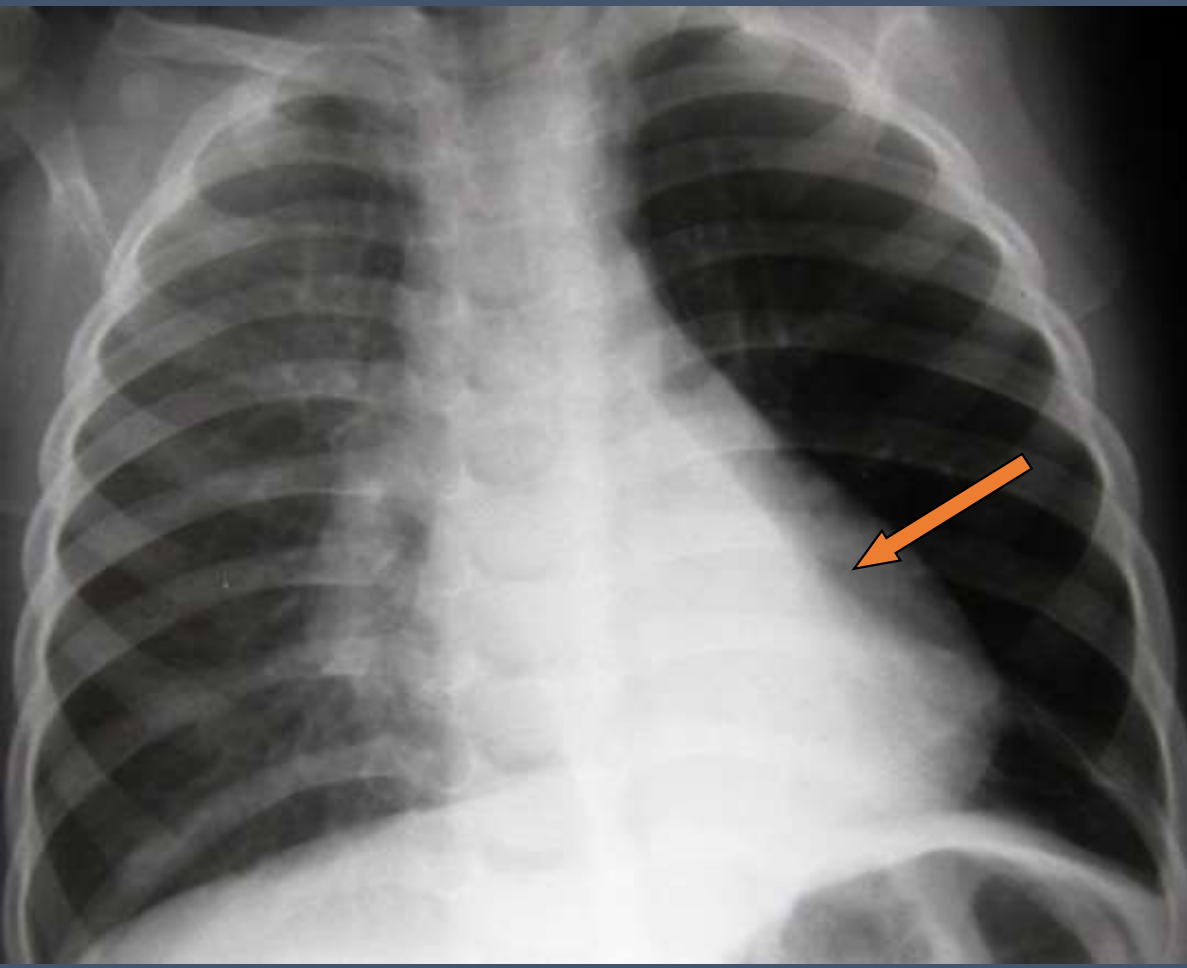
- Airway compromise
 - Extrinsic compression
 - Obstructive emphysema
 - Atelectasis
 - Left > Right
 - Bronchial wall granulomas
 - Intrabronchial caseous material



Atelectasis

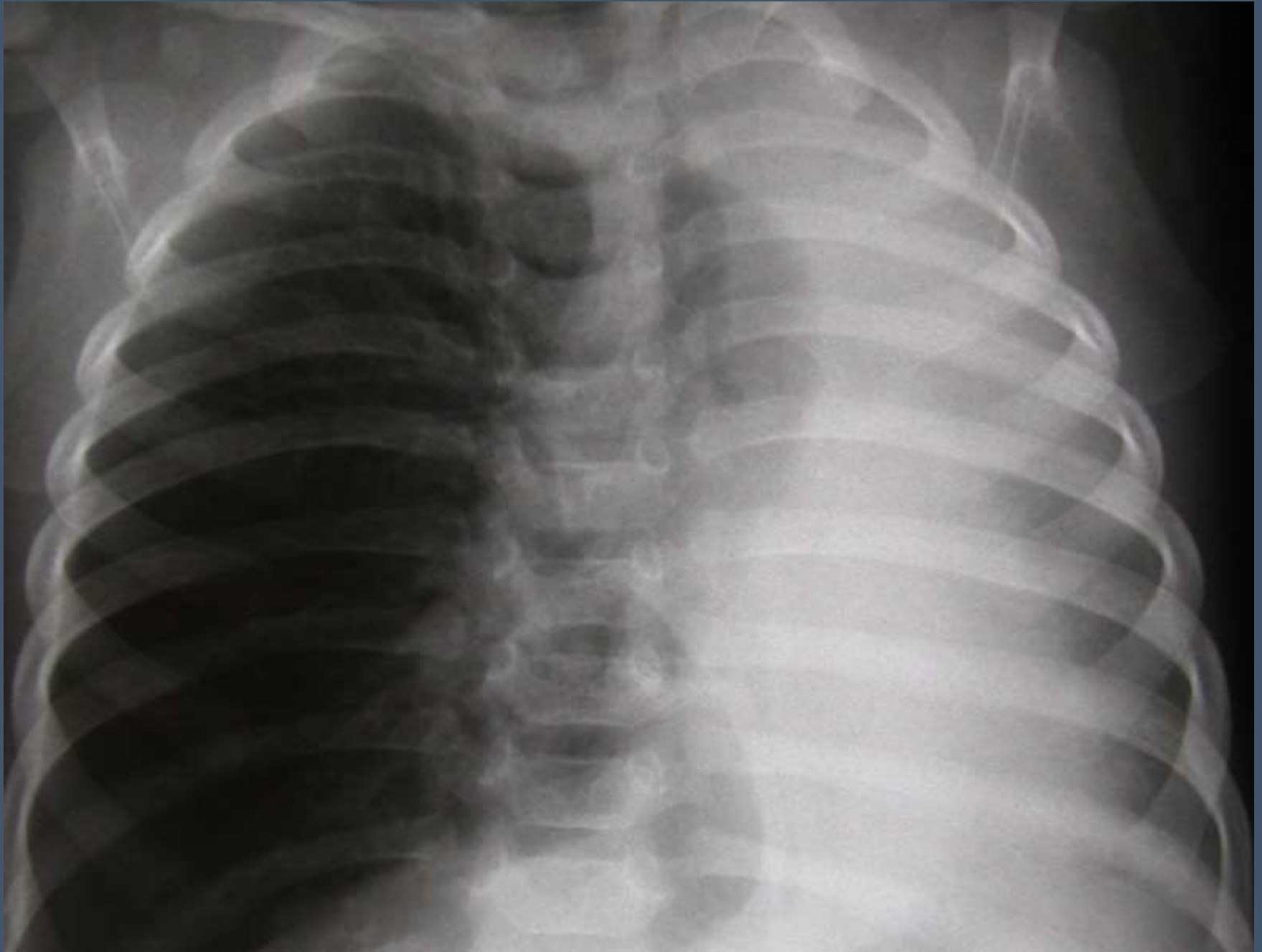




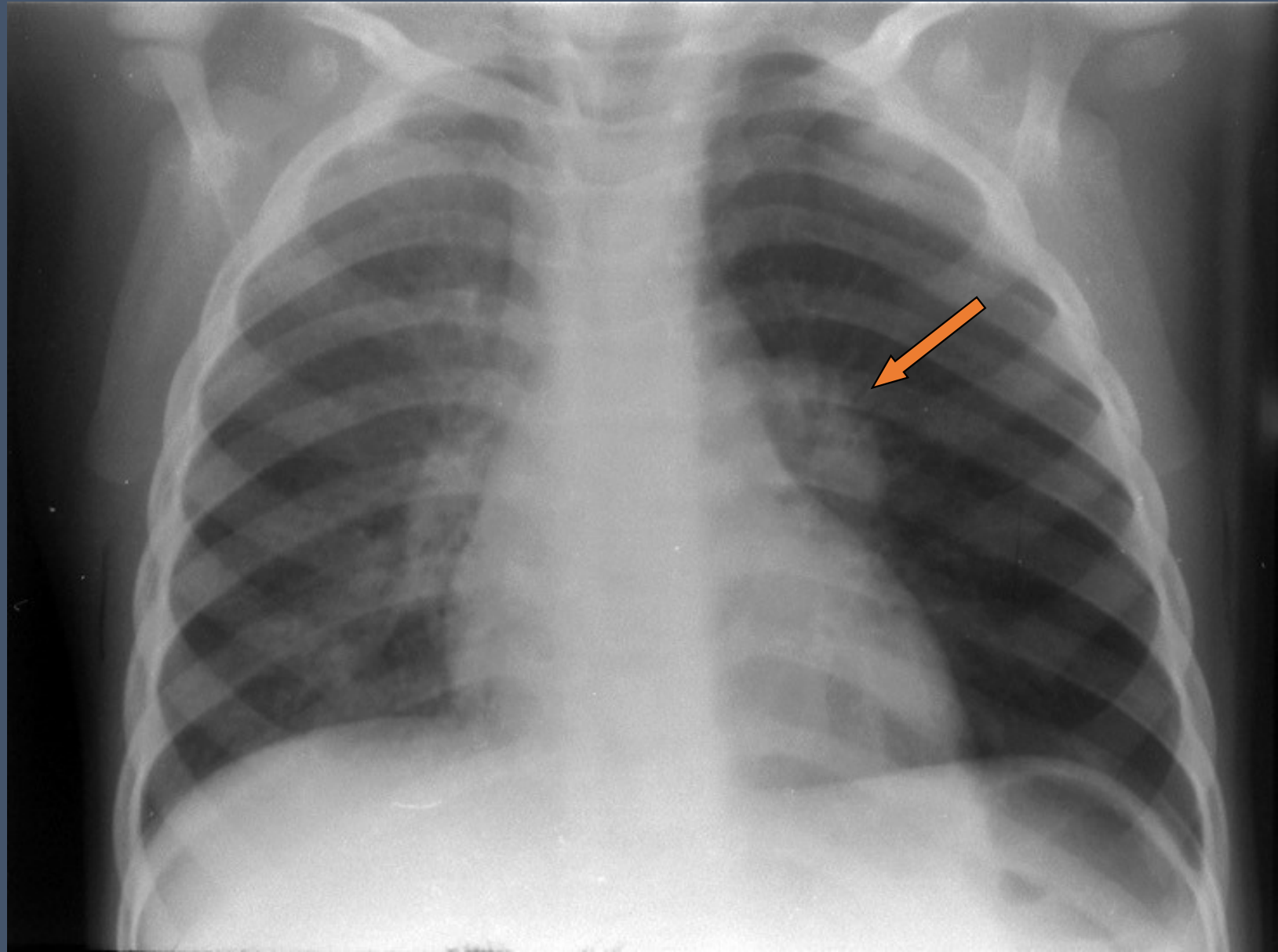


**1 month
later**



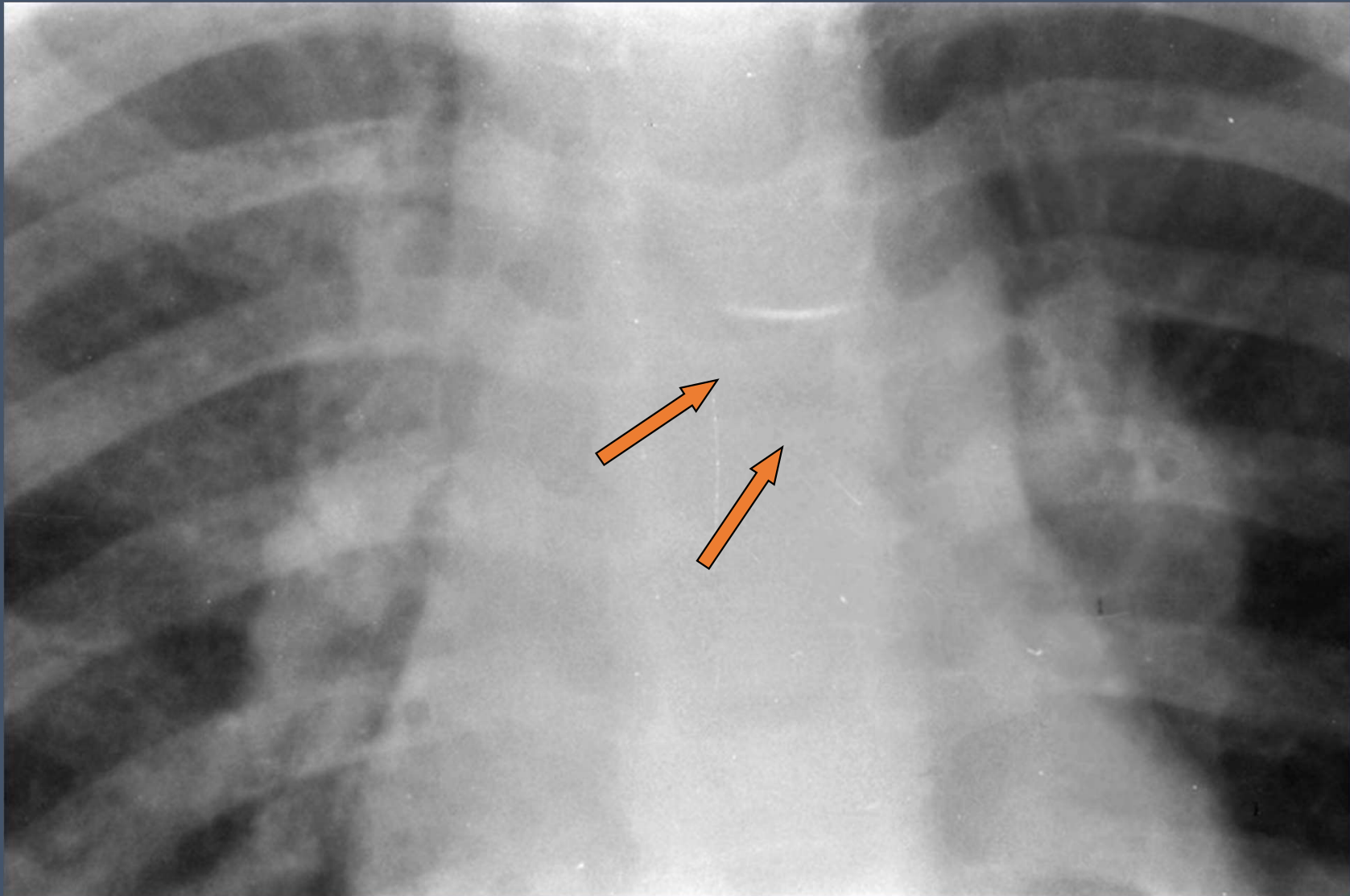


7 days later

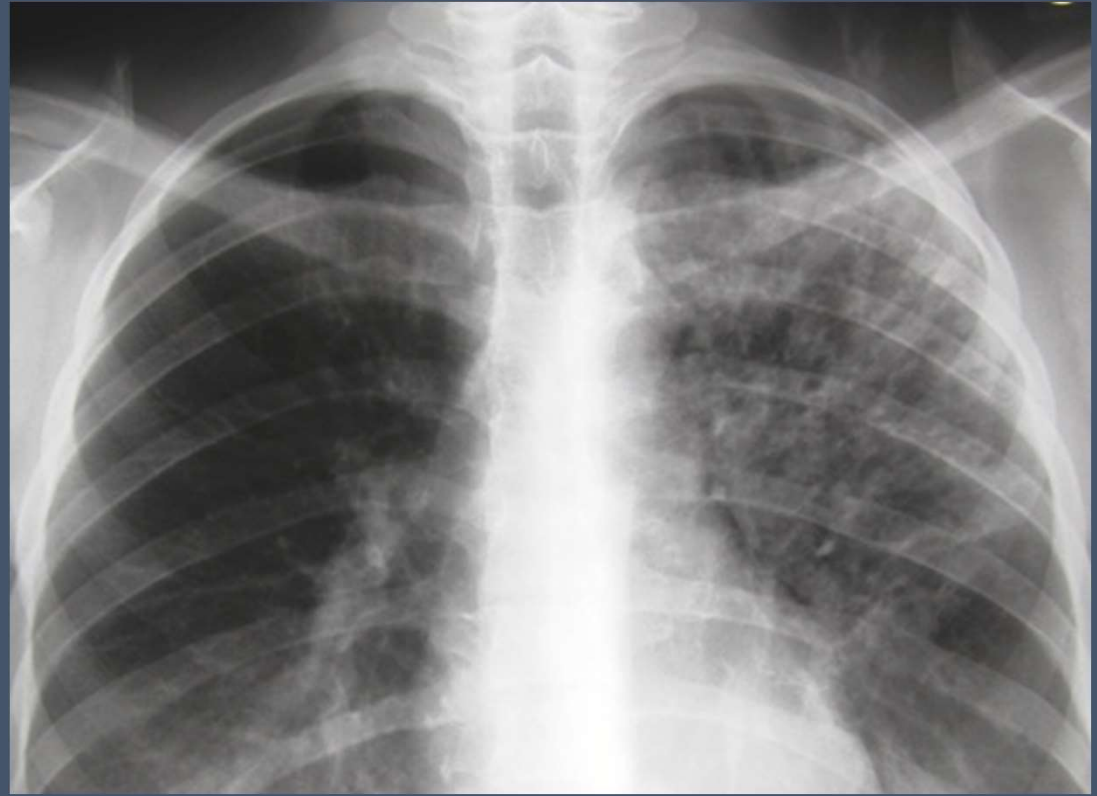


Obstructive Emphysema in TB

- Airway compression more common in young children
- Strong association with TB
 - Poor interobserver agreement on XR



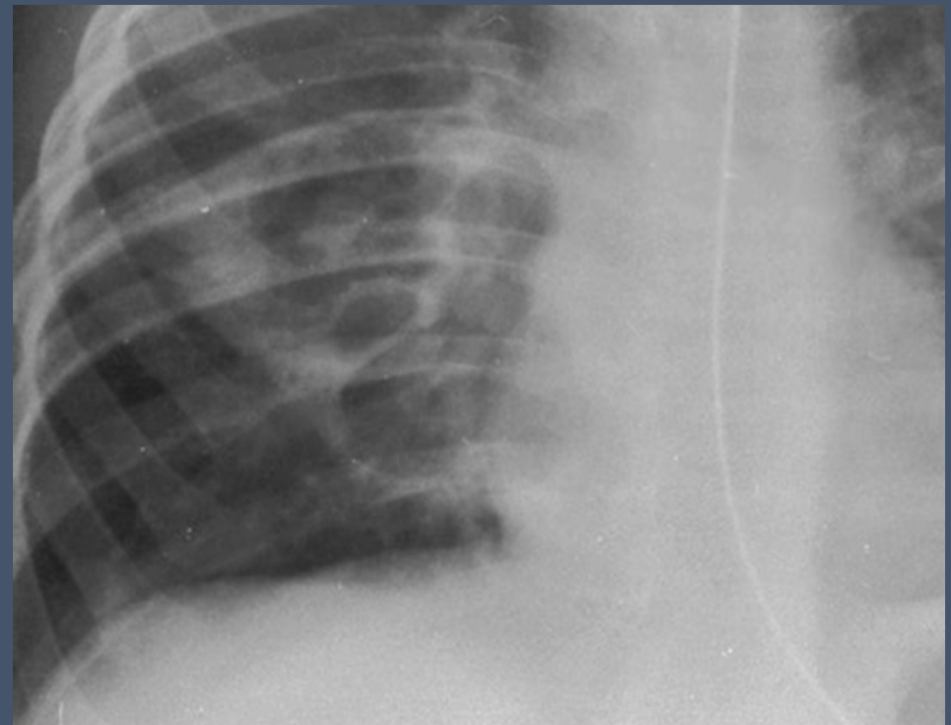
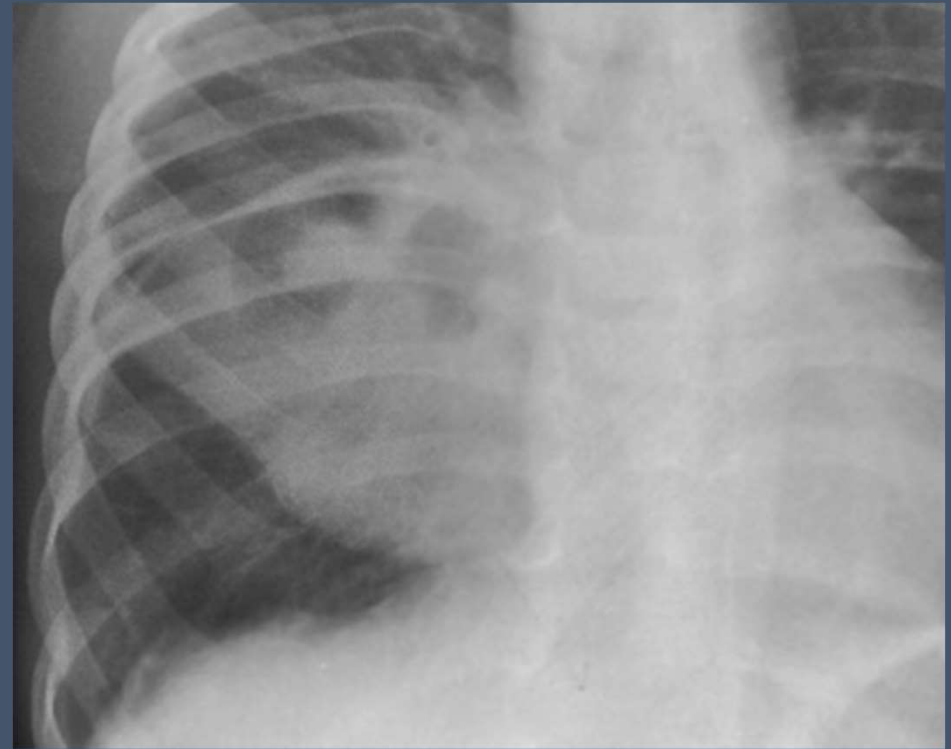
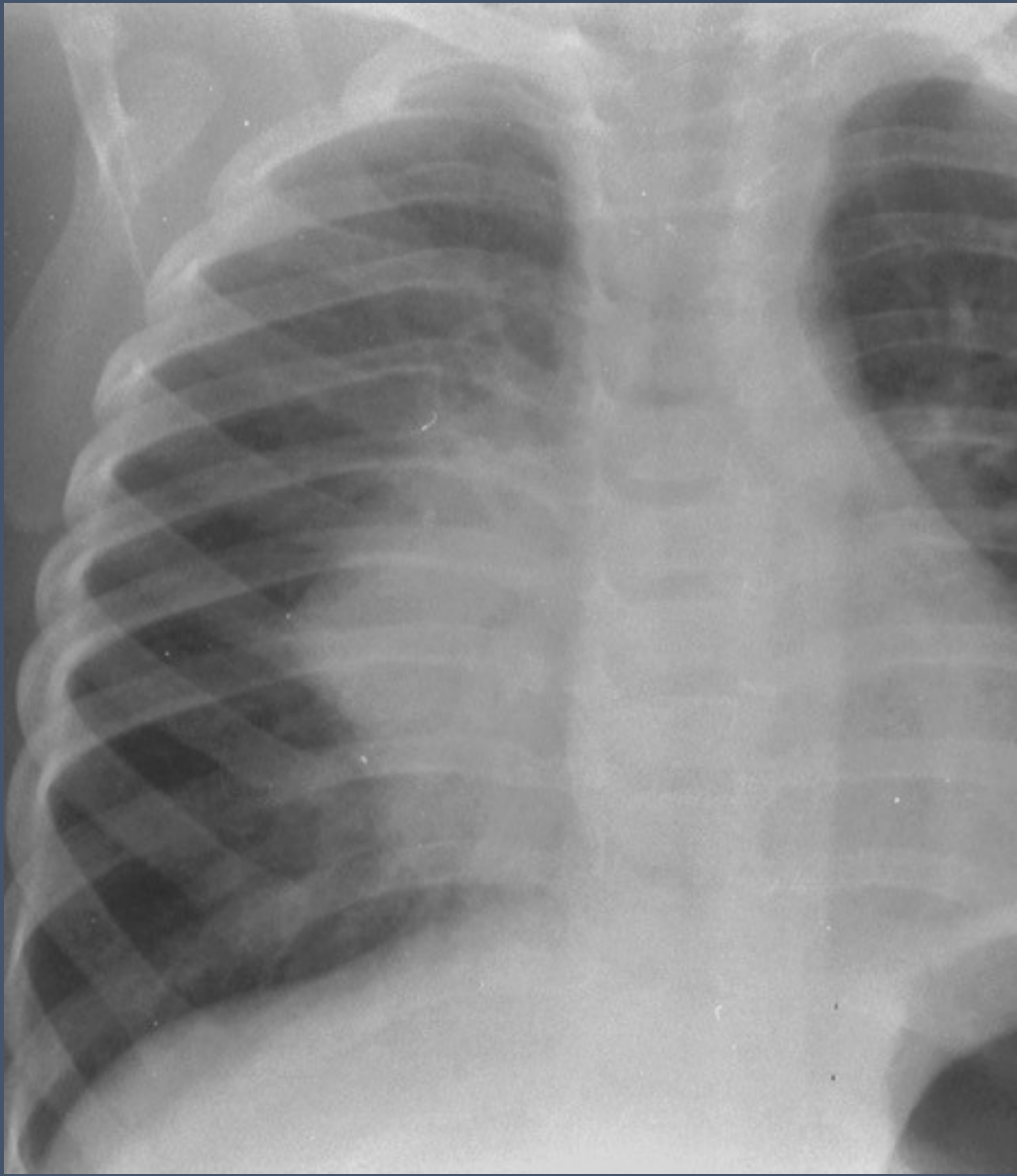
Post-primary TB



- Mainly in adolescents
- Opacity in apical lung segments
 - Apical and posterior – Upper
 - Apical – Lower
- May lead to cavities and fibrosis

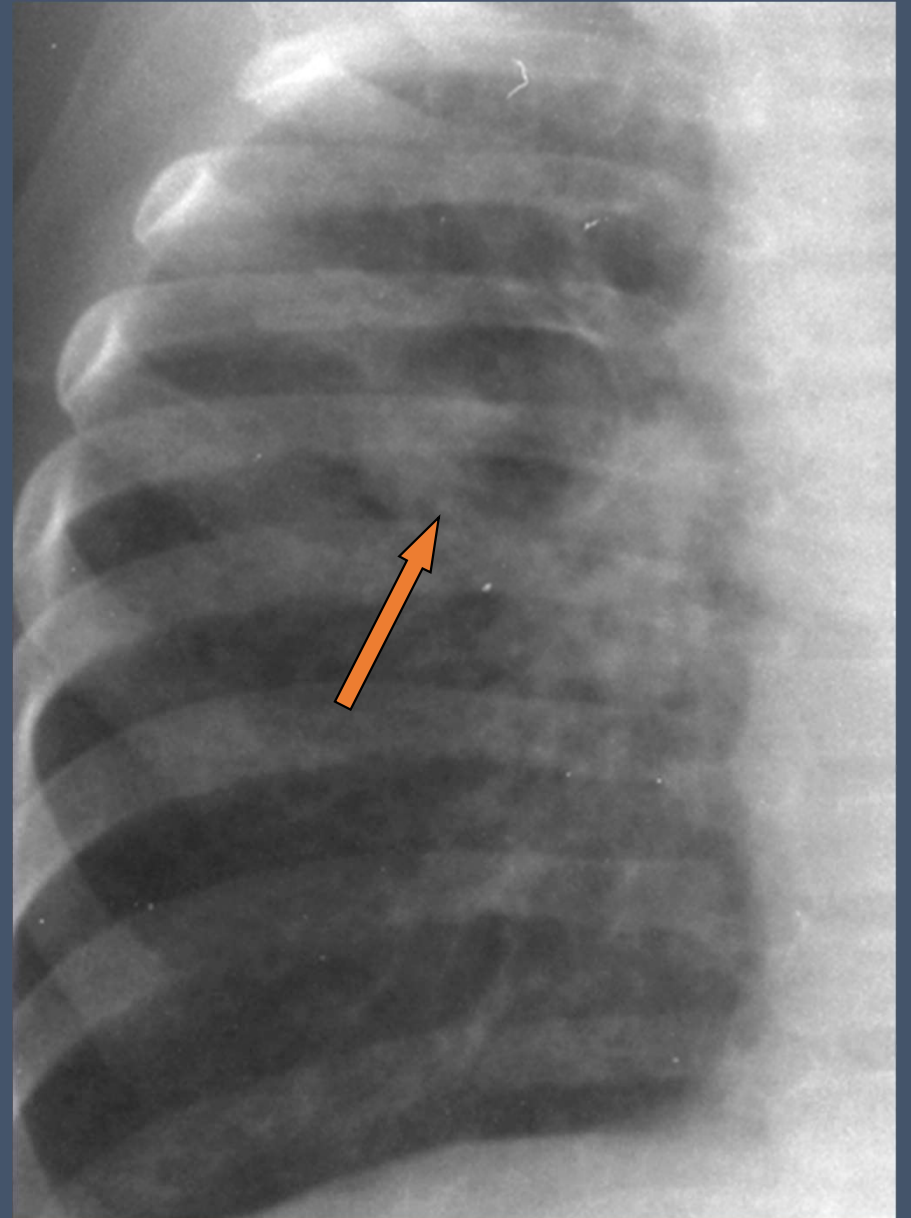
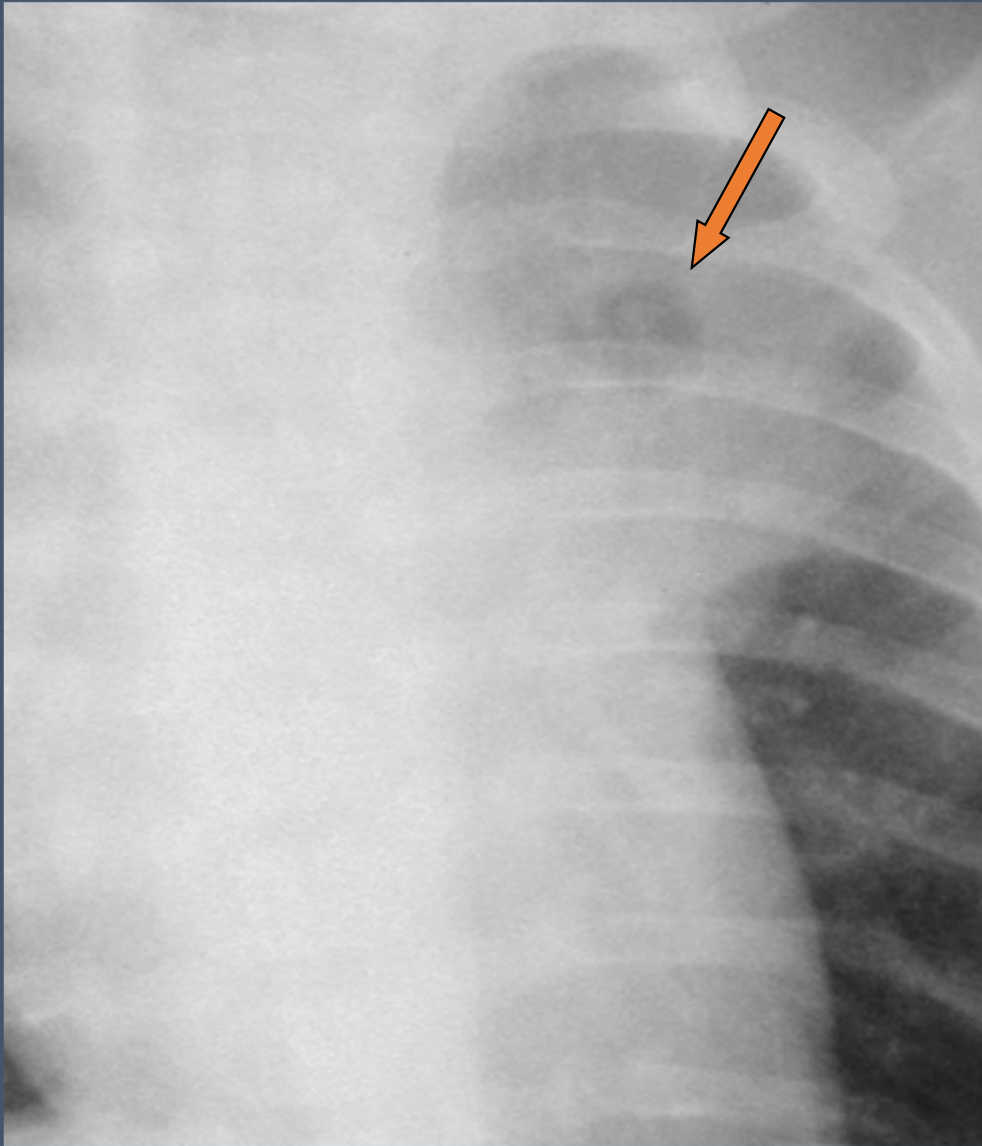
Post primary TB – 13 year old

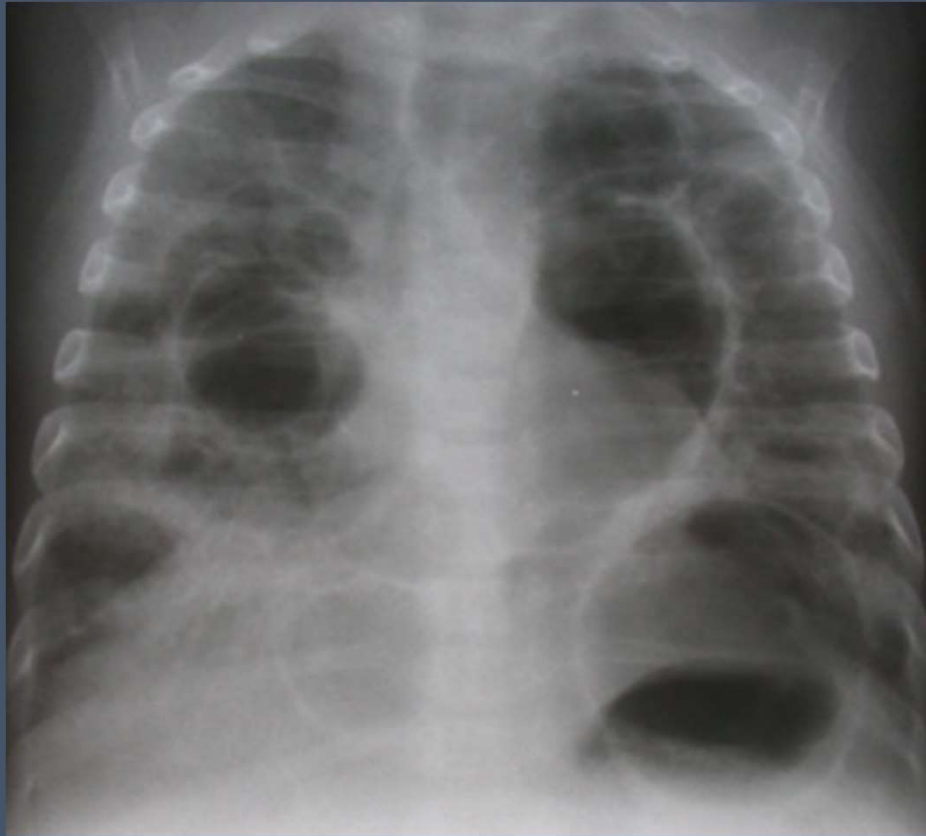




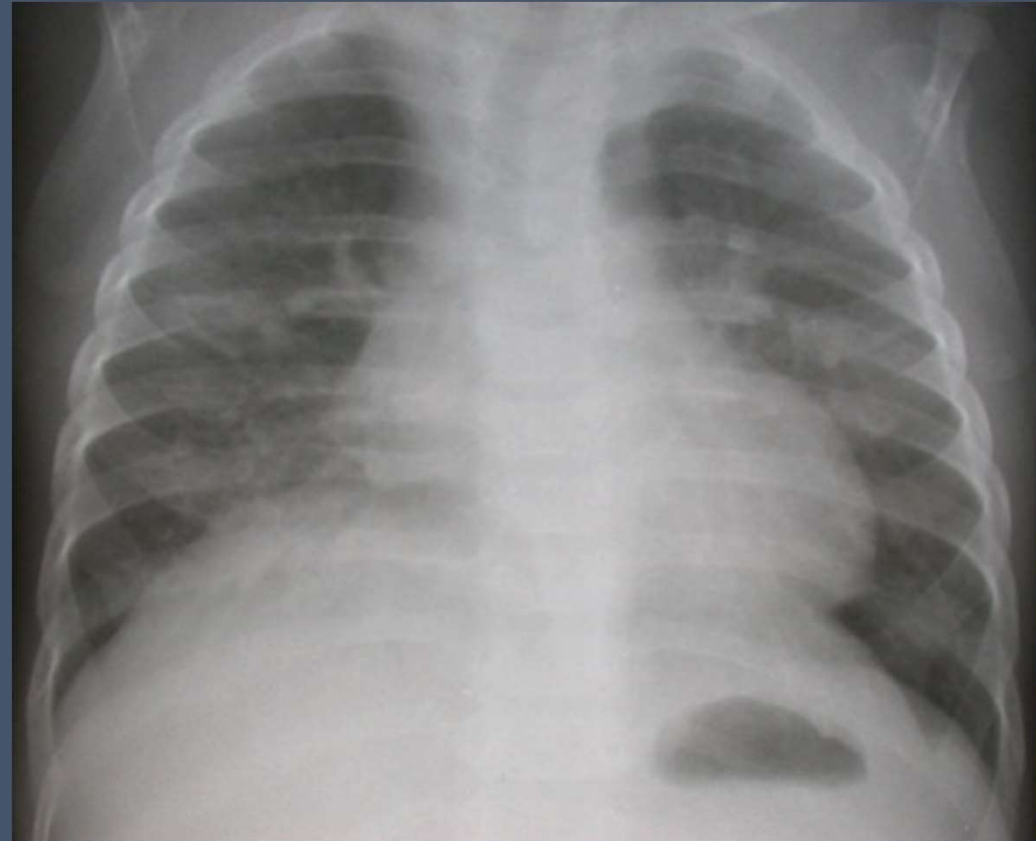
Cavities can occur in cases of progressive primary disease

Pneumatoceles also common





At discharge

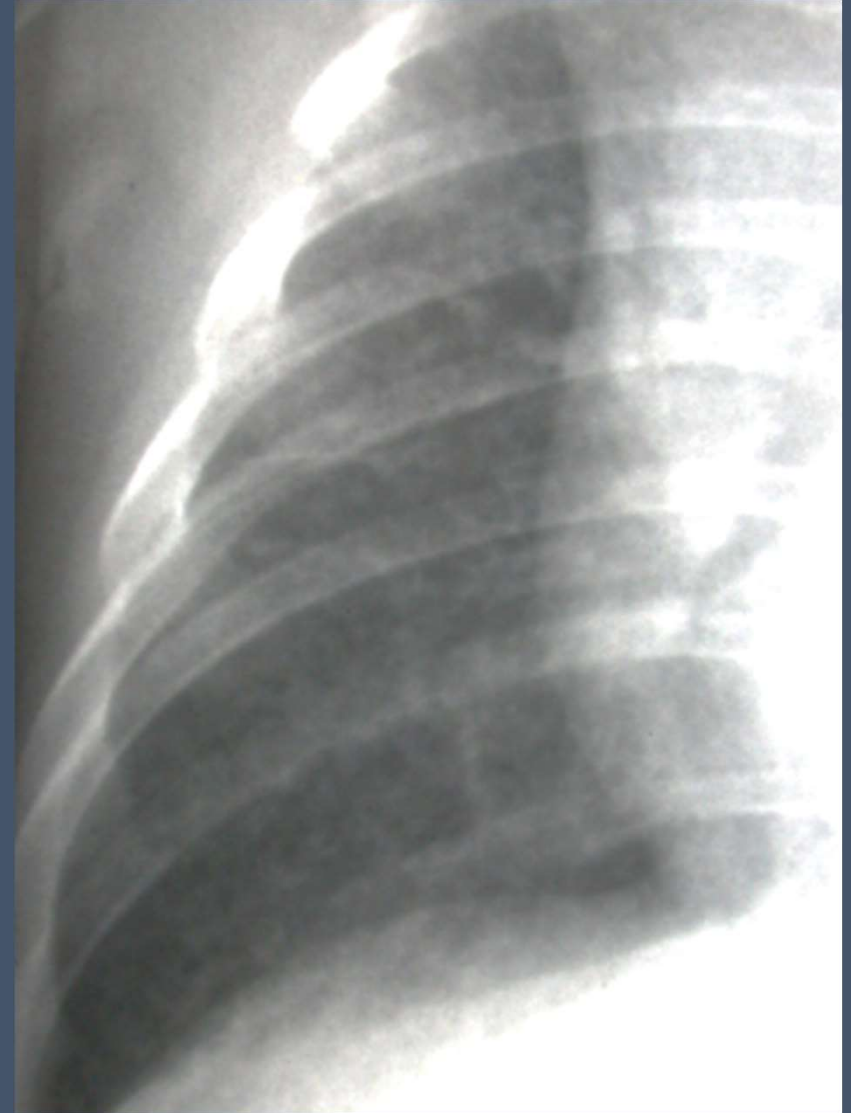


6 months later

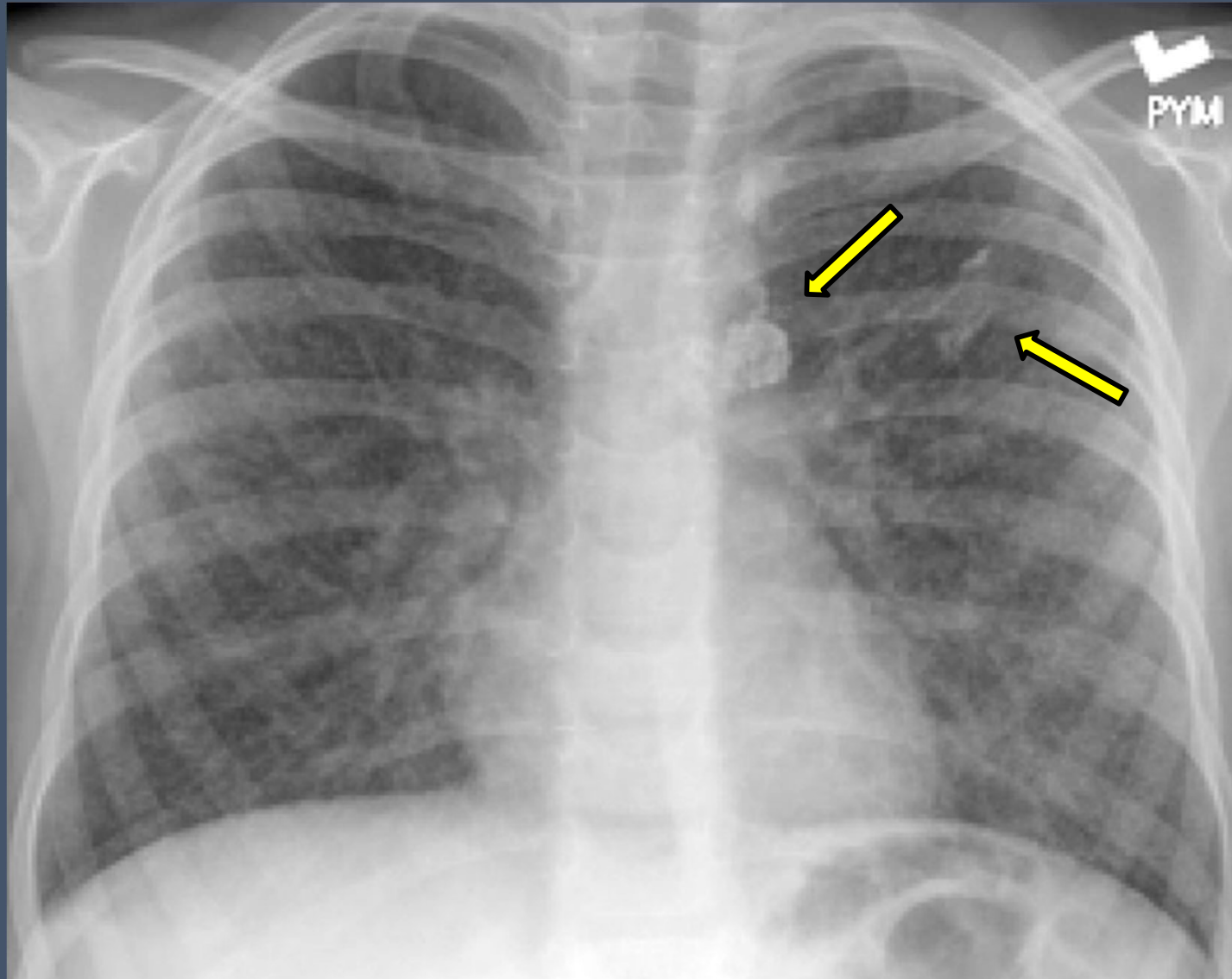
Congenital TB - Pneumatoceles

Disseminated Pulmonary TB

- “Miliary”
 - Hard to see in early stage
 - Typical - <2mm size
 - Larger nodules or ill-defined patches can occur in children
 - Bilateral
 - Evenly distributed

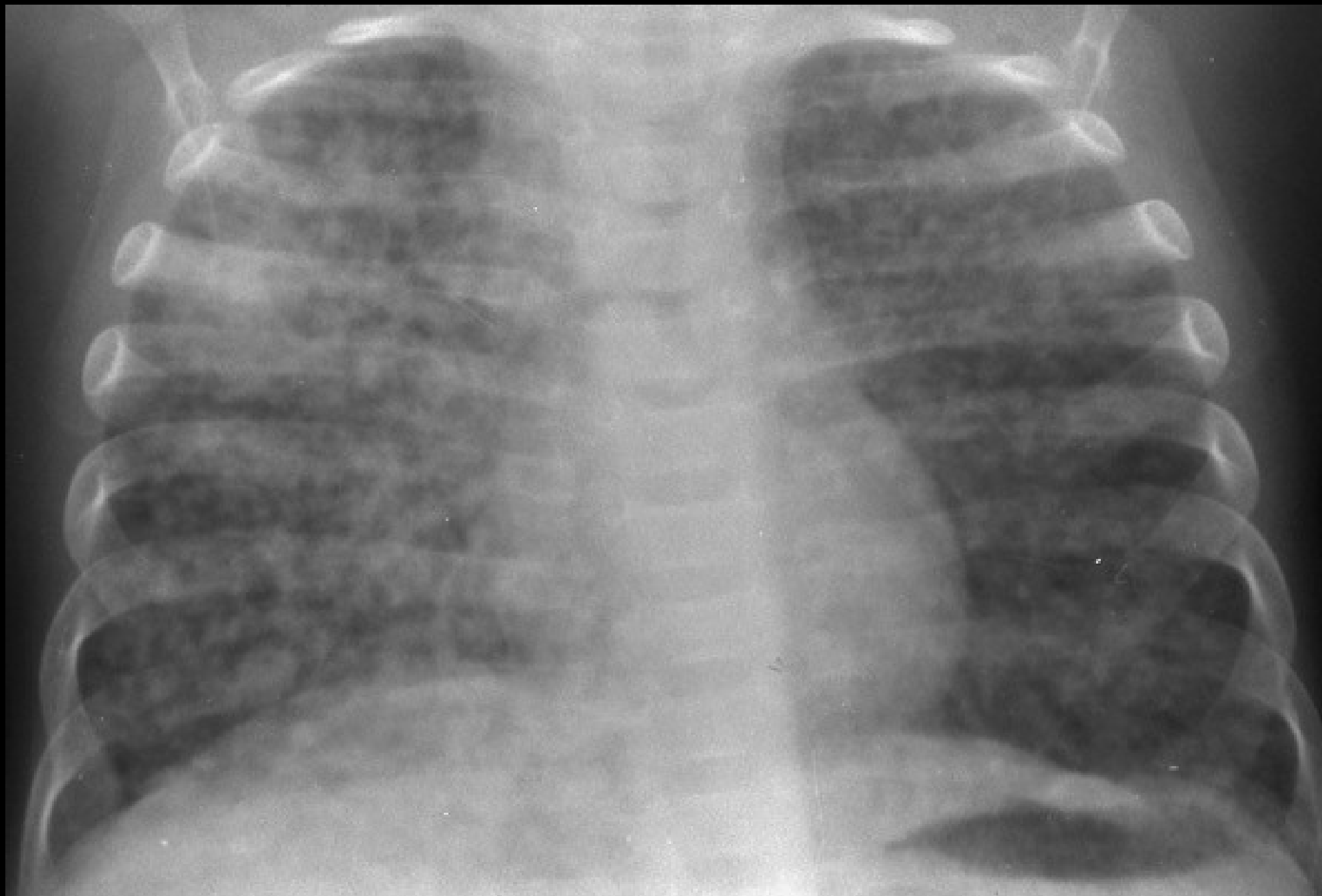


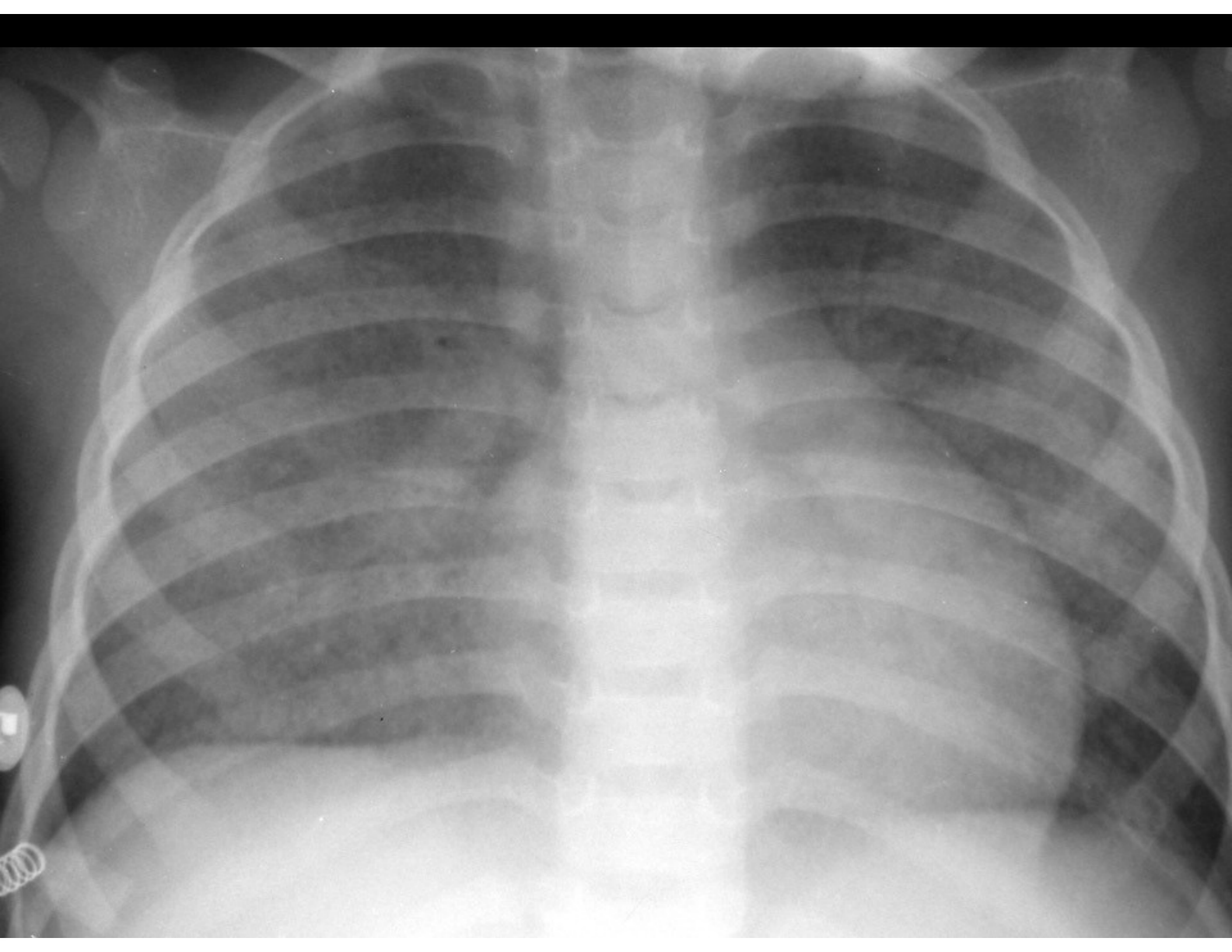
Miliary TB with Calcified Lymphadenopathy and Granulomas

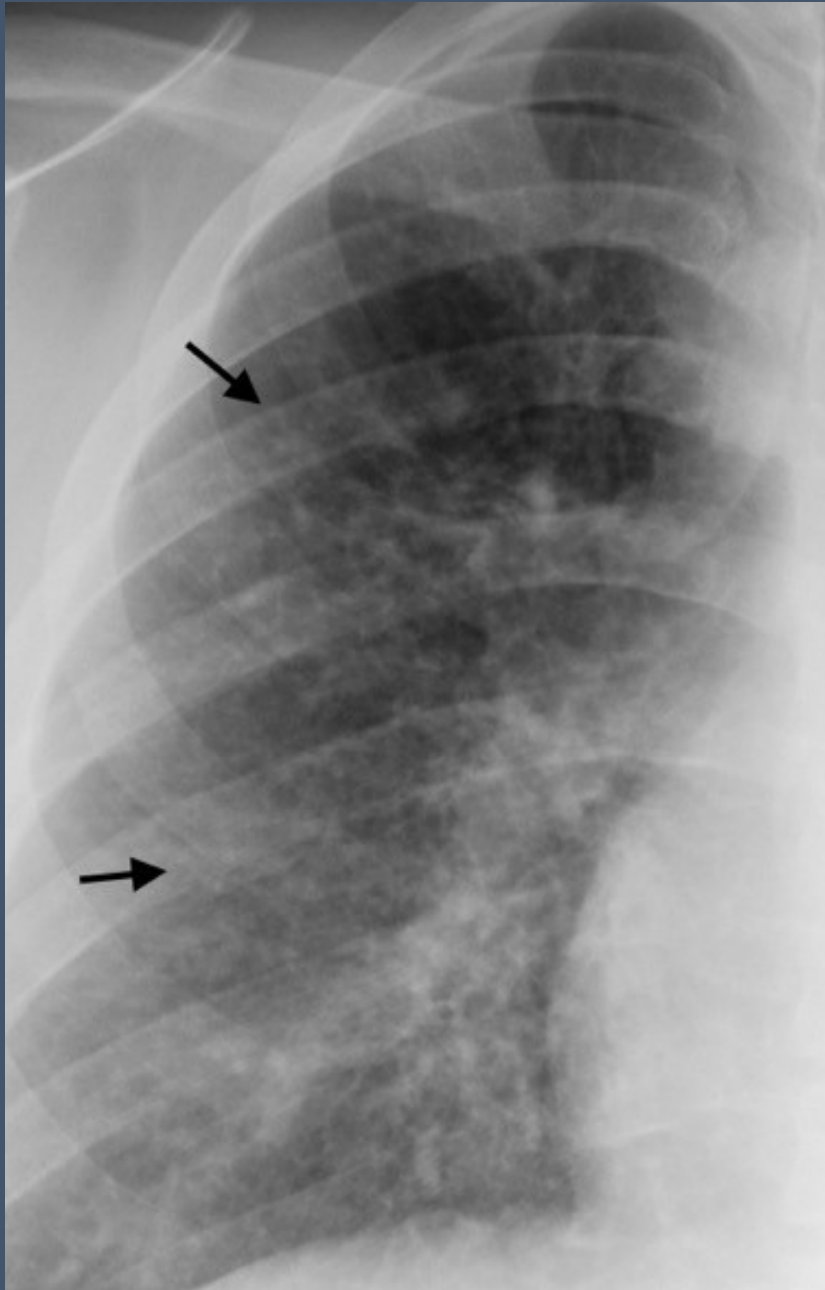


Miliary Nodules - CT

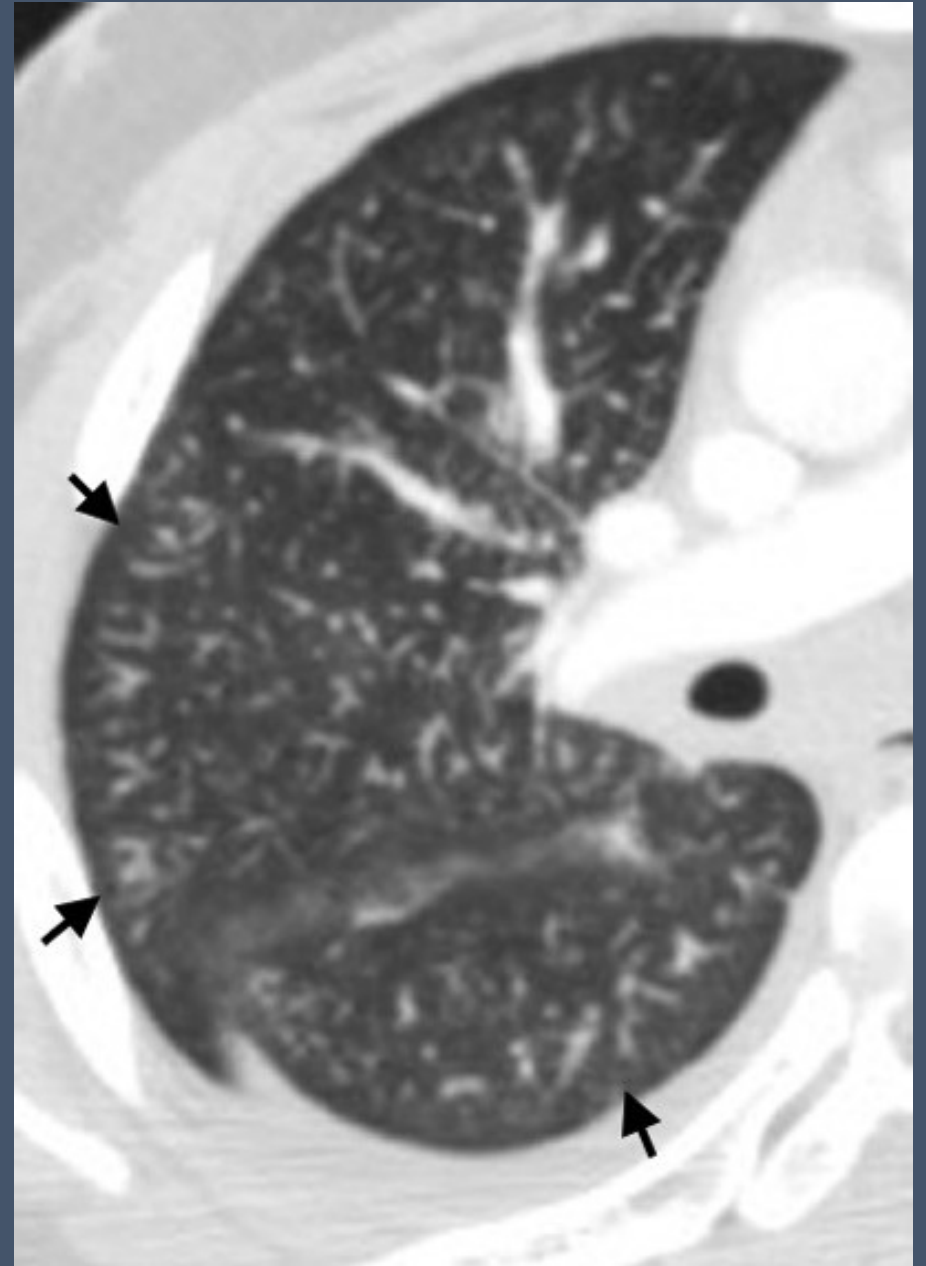




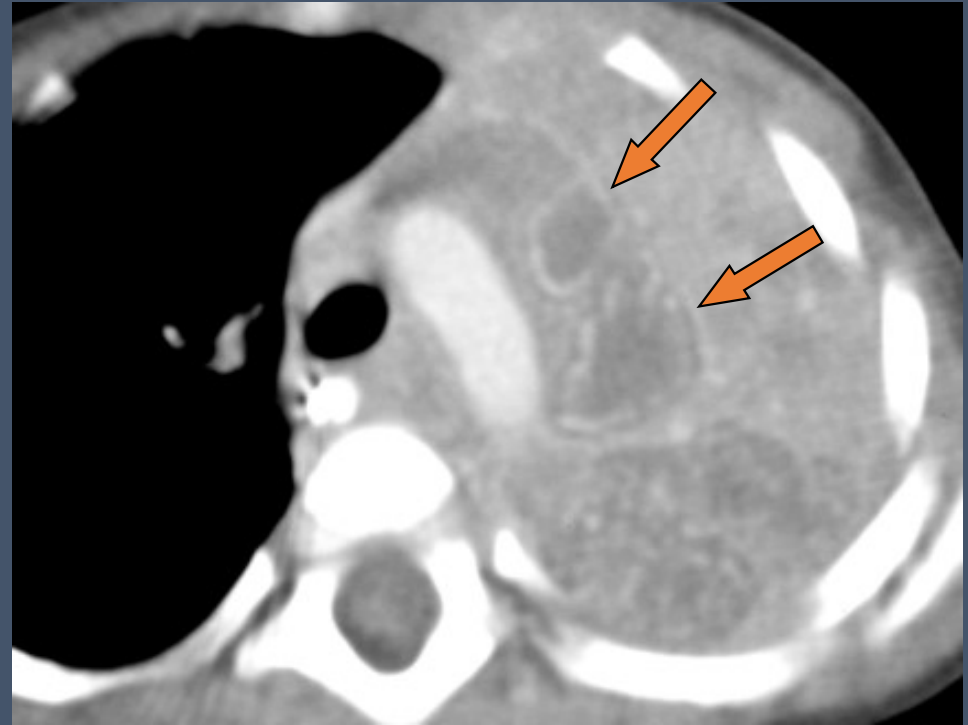
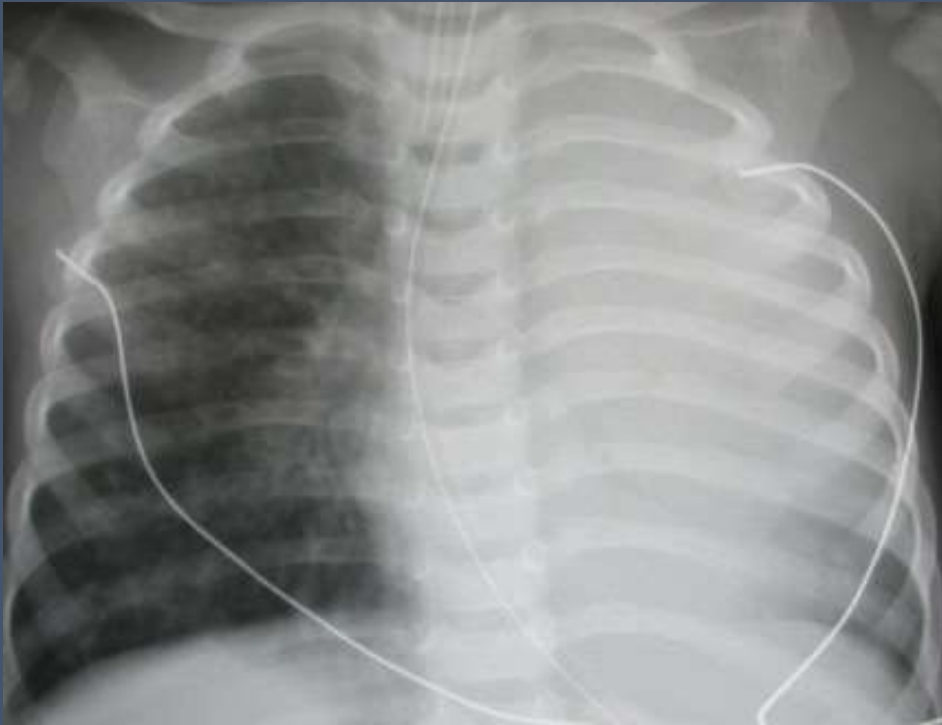




Teen with GI malignancy, TB



Tree-in-bud pattern
Caused by endobronchial spread



Progressive Primary TB

- Atelectasis
- Fibrosis
- Persistent lymphadenopathy
- Cavitation, bronchiectasis

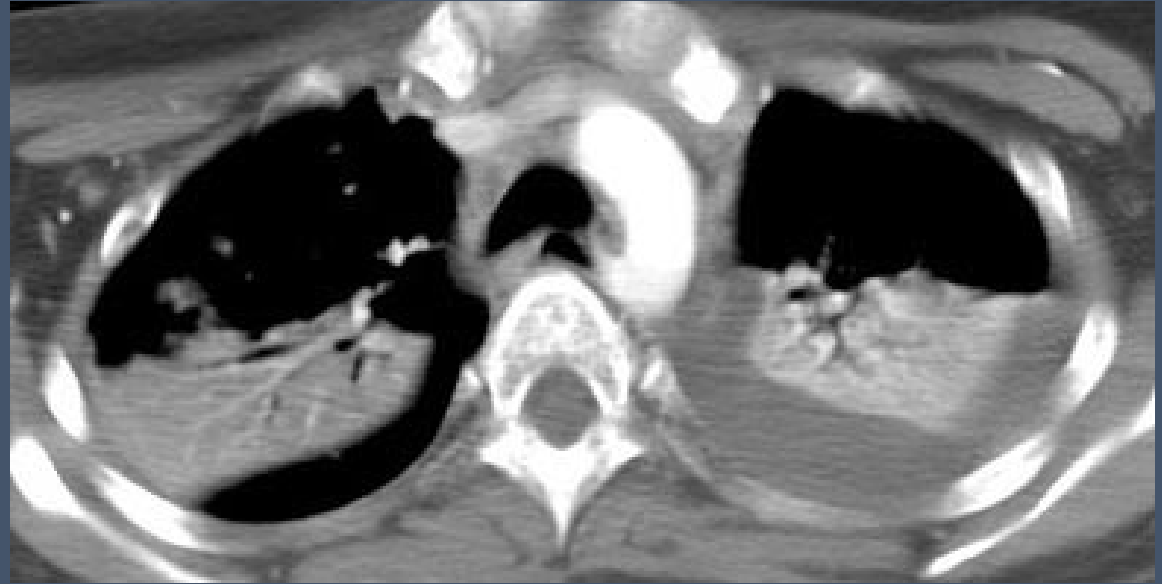
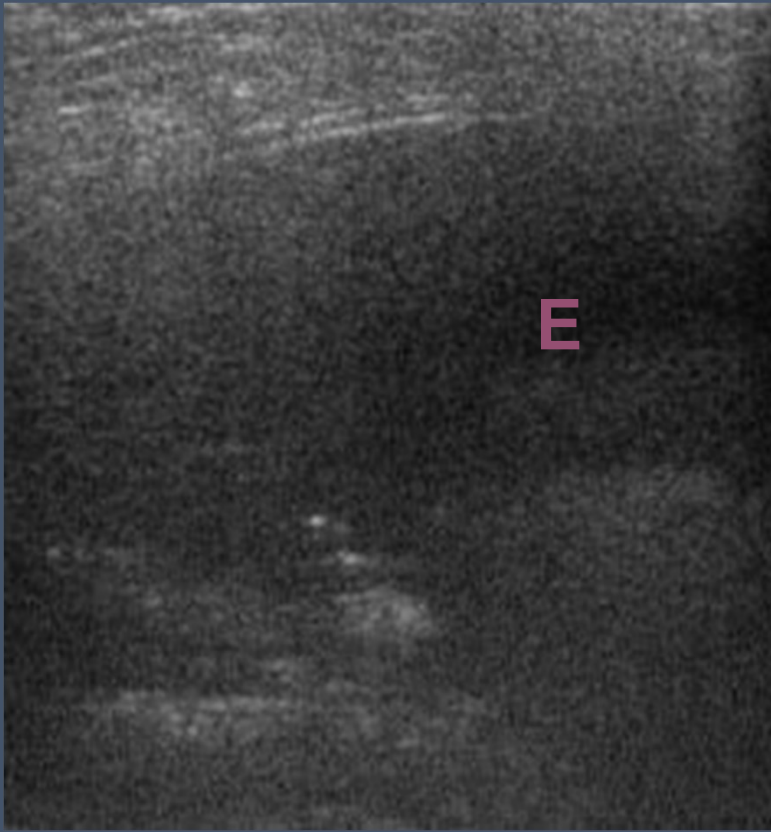
Pleural/Pericardial Disease

- Pleural effusion
 - Obstruction of lymphatics vs. hypersensitivity reaction
 - Cultures generally negative
- Pericardial effusion
 - Uncommon – 1% of cases
 - Direct extension from mediastinal lymph nodes
 - Hematogenous spread less common



- Can occur 3-6 months after infection.
- Sometimes asymptomatic.
- Usually self-limiting.

Pleural Effusion



Associated with
airspace
consolidation in 29%

Kim WS, et.al. AJR (2006) 187: 1024-1033.

CNS TB in Children

- 50% <2 years of age
 - Near 90% have abnormal CXR
- Hematogenous spread most common
 - Spread from calvarium, middle ear
- Manifestations
 - Focal disease
 - Meningitis
 - Infarction
 - Hydrocephalus – may occur as early as 1 week after onset in children

TB Localized CNS Disease

- Tuberculoma most common
- CT or MRI (use IV contrast)
 - Ring-enhancing
 - Solid
- Usually < 2 cm diameter
- Rarely calcify



TB Meningitis

- Diffuse most common
- CT
 - Non-contrast – 50% show increased density in basal cisterns
 - Contrast – prominent basal enhancement (double line sign)
- MRI – similar findings

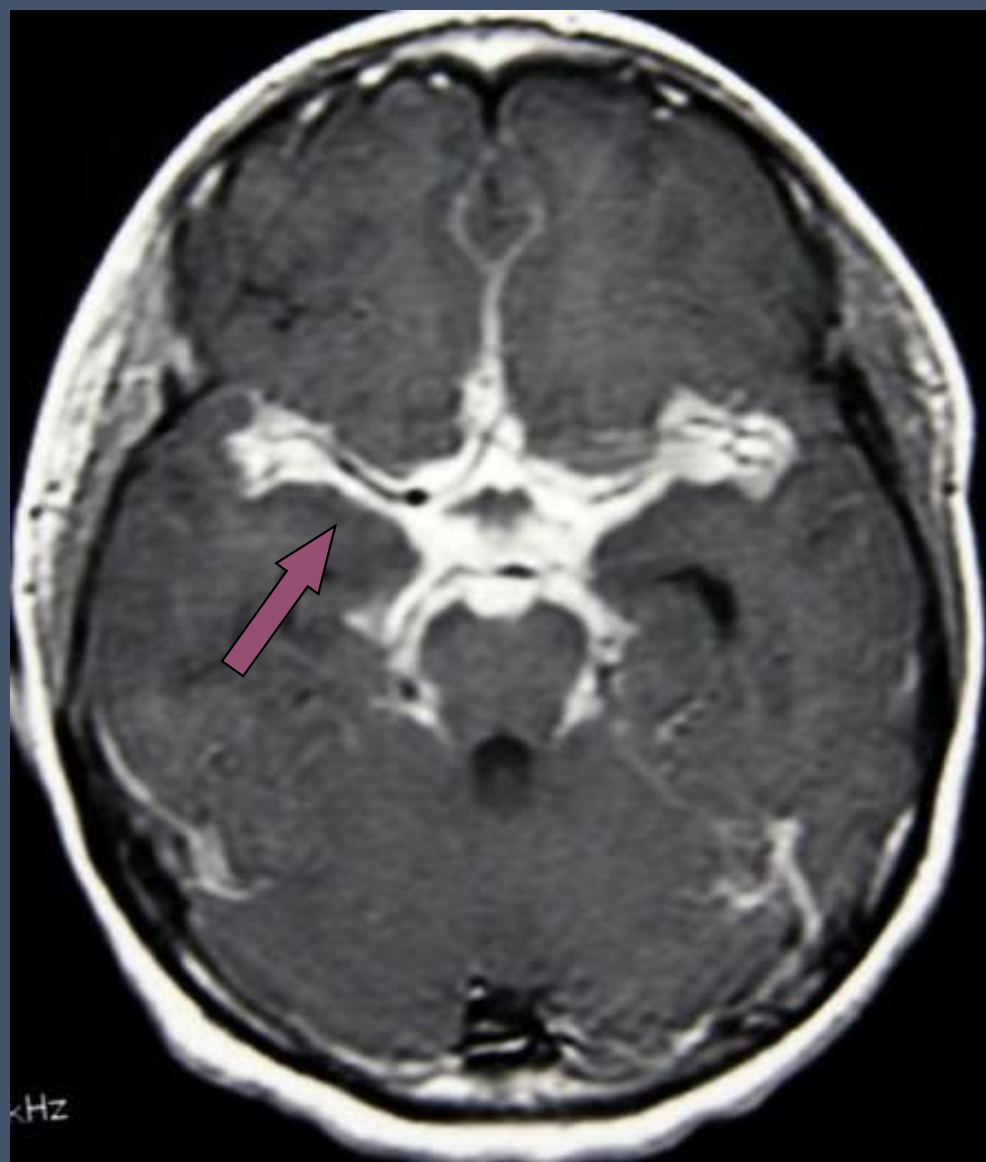
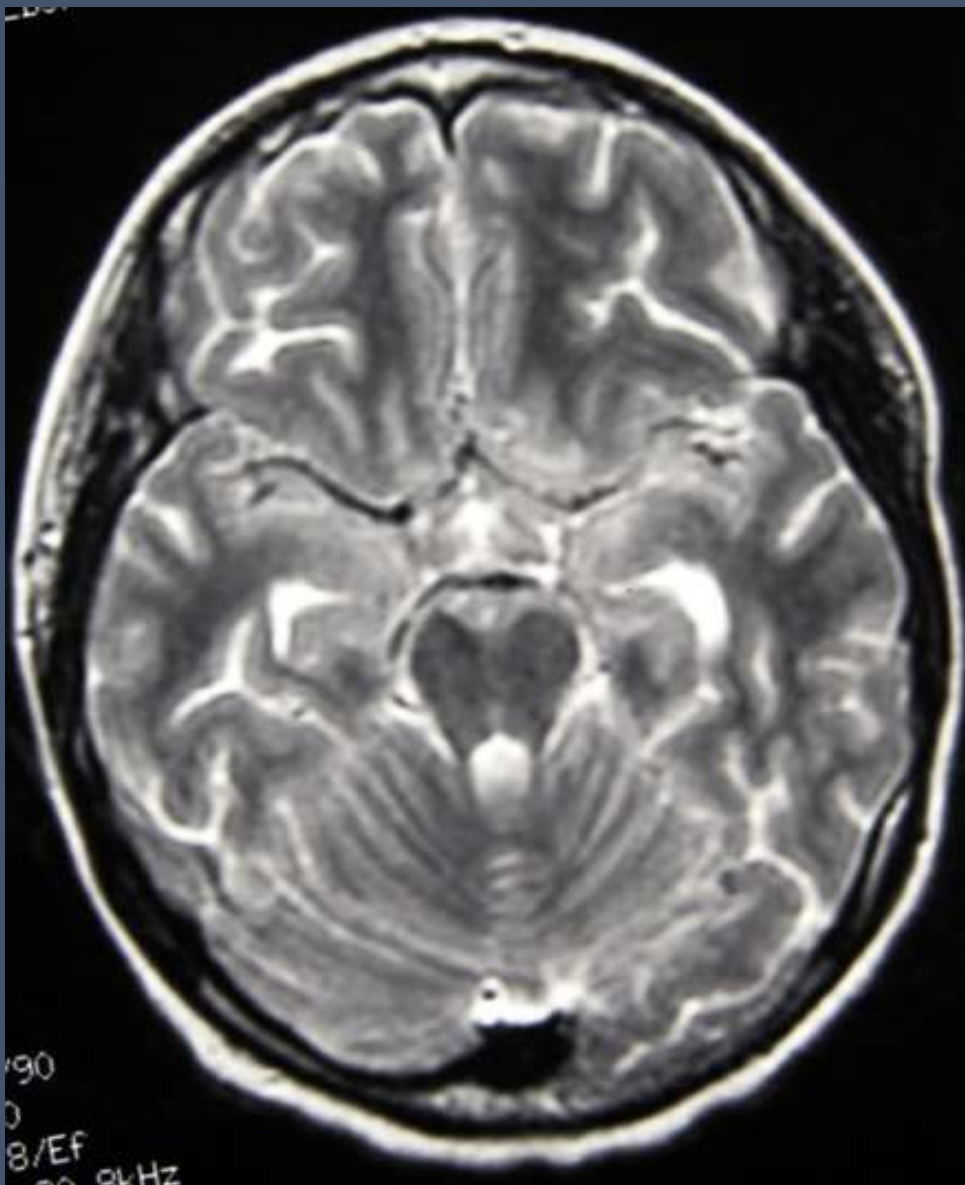


No IV contrast



IV contrast

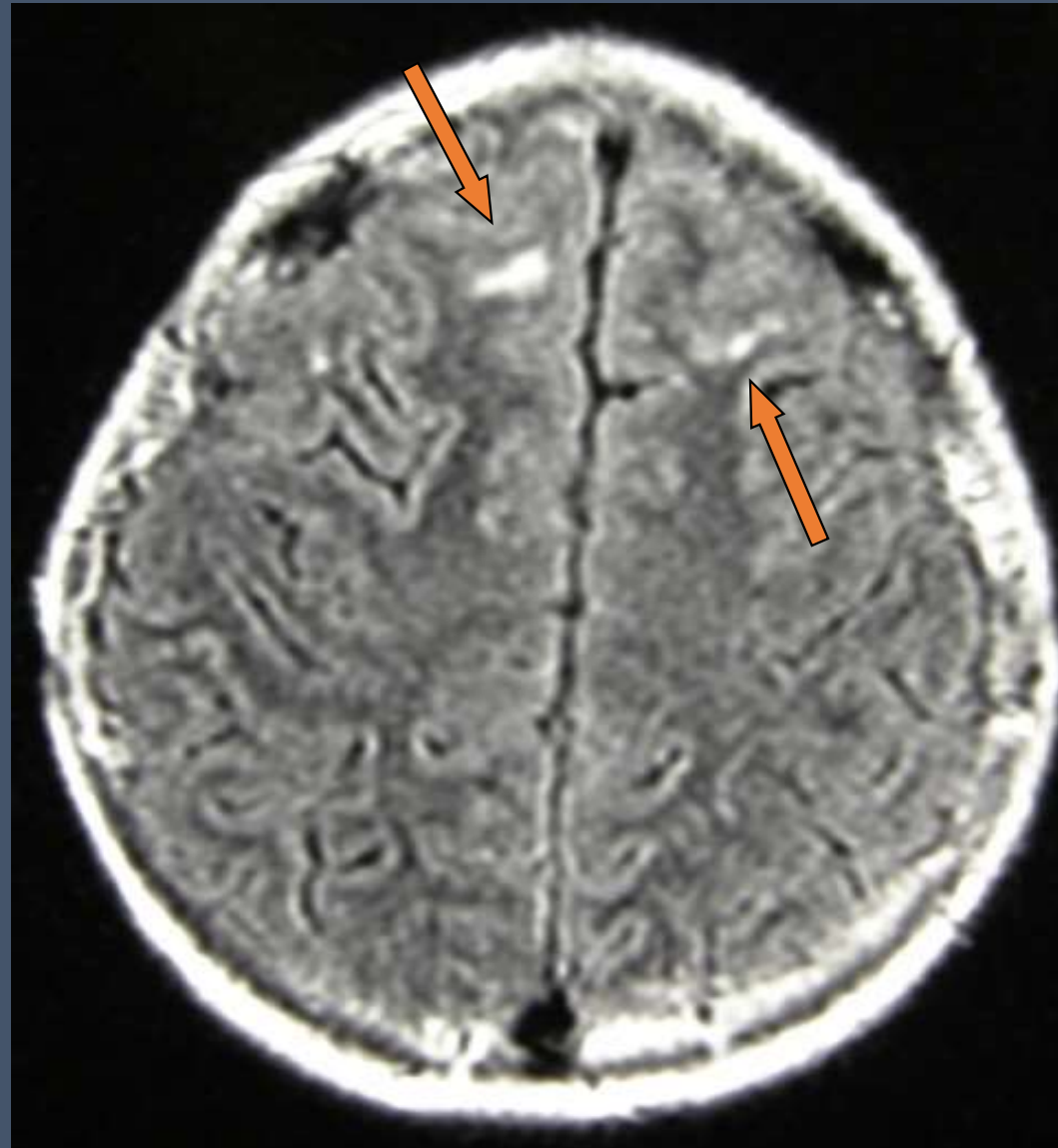
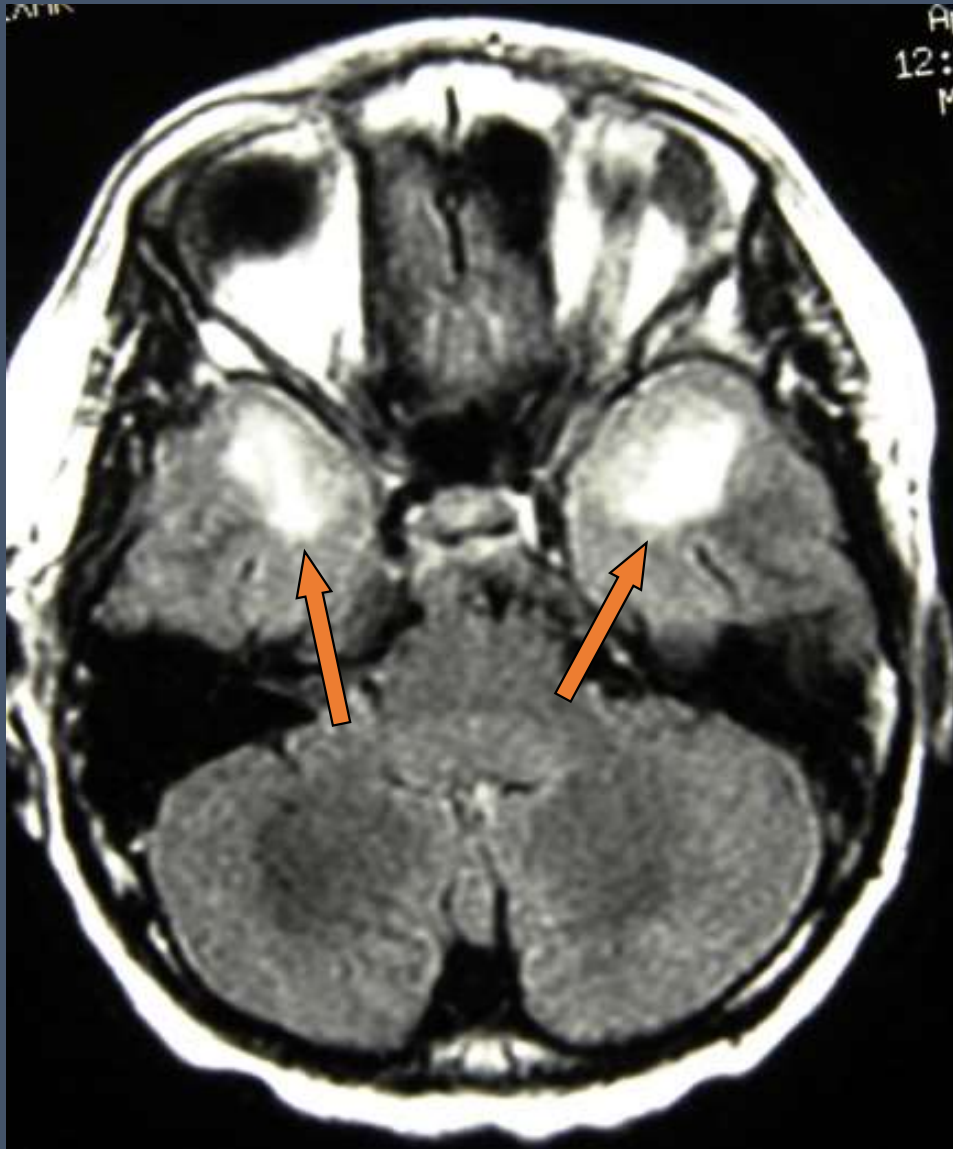
MRI – TB Meningitis





**Nodular Meningeal
Enhancement –
TB Meningitis**

Post-meningitis Infarcts



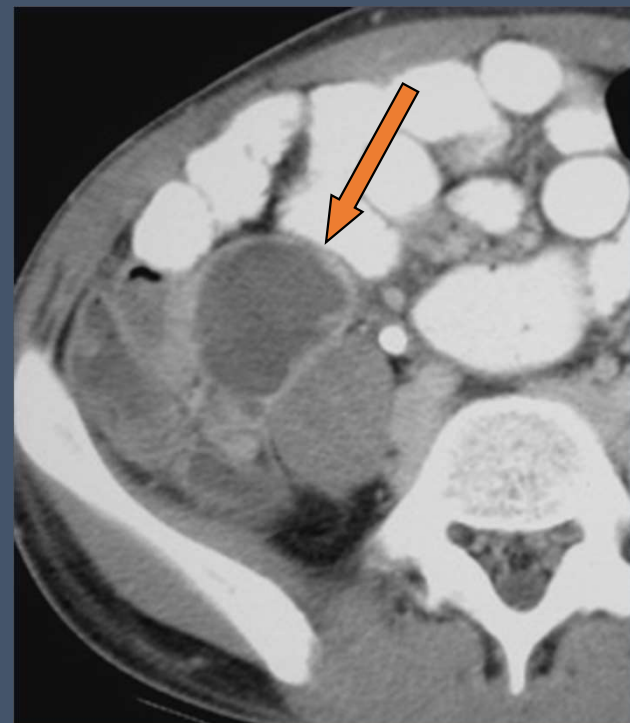
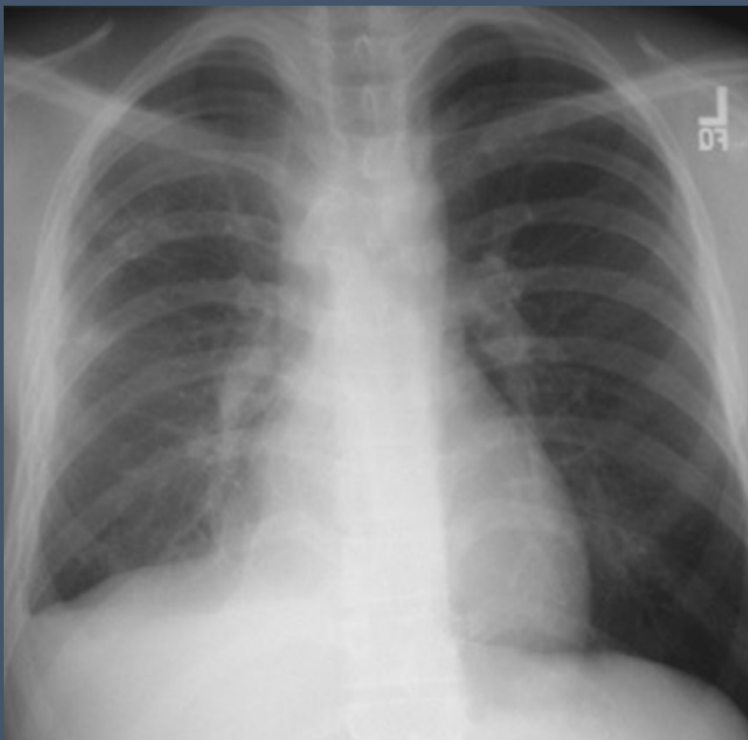
Abdominal TB in Children

- Less common than in adults
- Findings
 - Lymphadenopathy
 - Solid organ lesions
 - Ascites
 - Bowel wall involvement
 - Inflammatory mass
 - Omental thickening

Abdominal TB

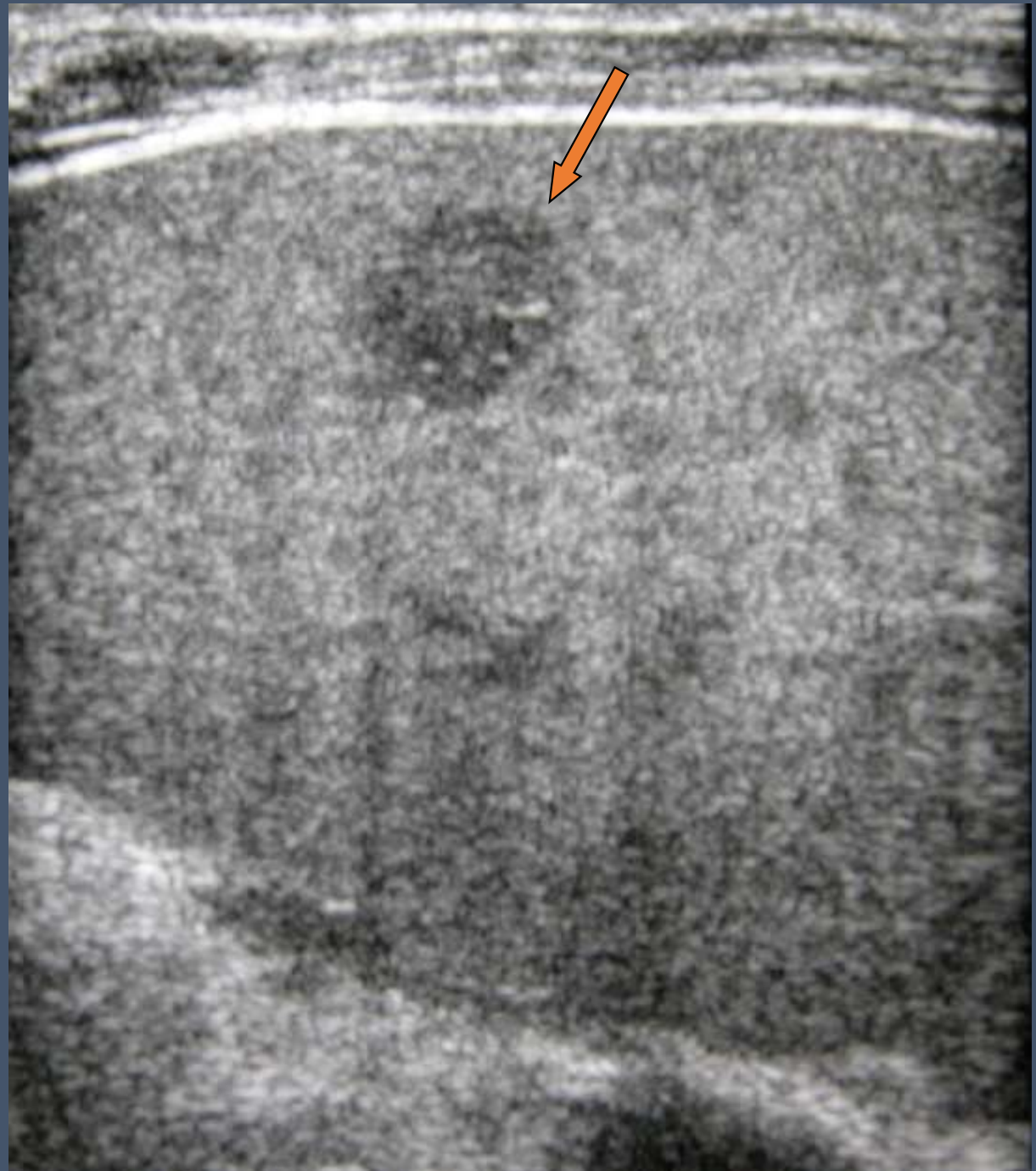
- Lymphadenopathy
 - Para-aortic, mesenteric, periportal most common
 - Commonly calcifies

**12 year old with night
sweats, 20 lb wt. loss,
back pain**



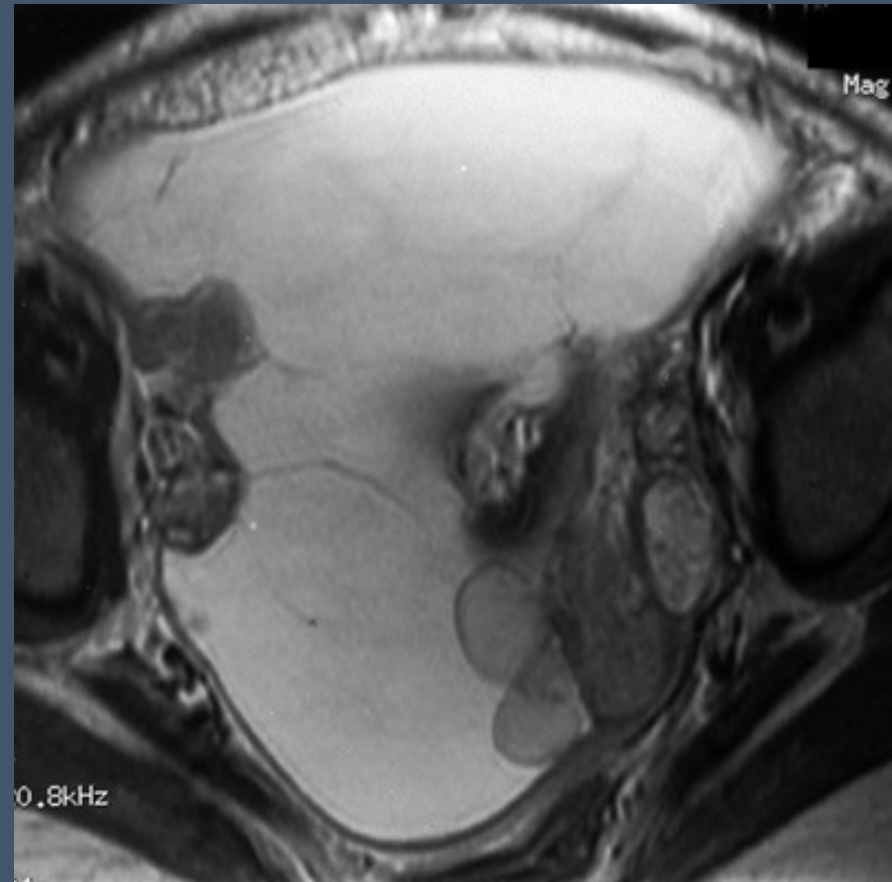
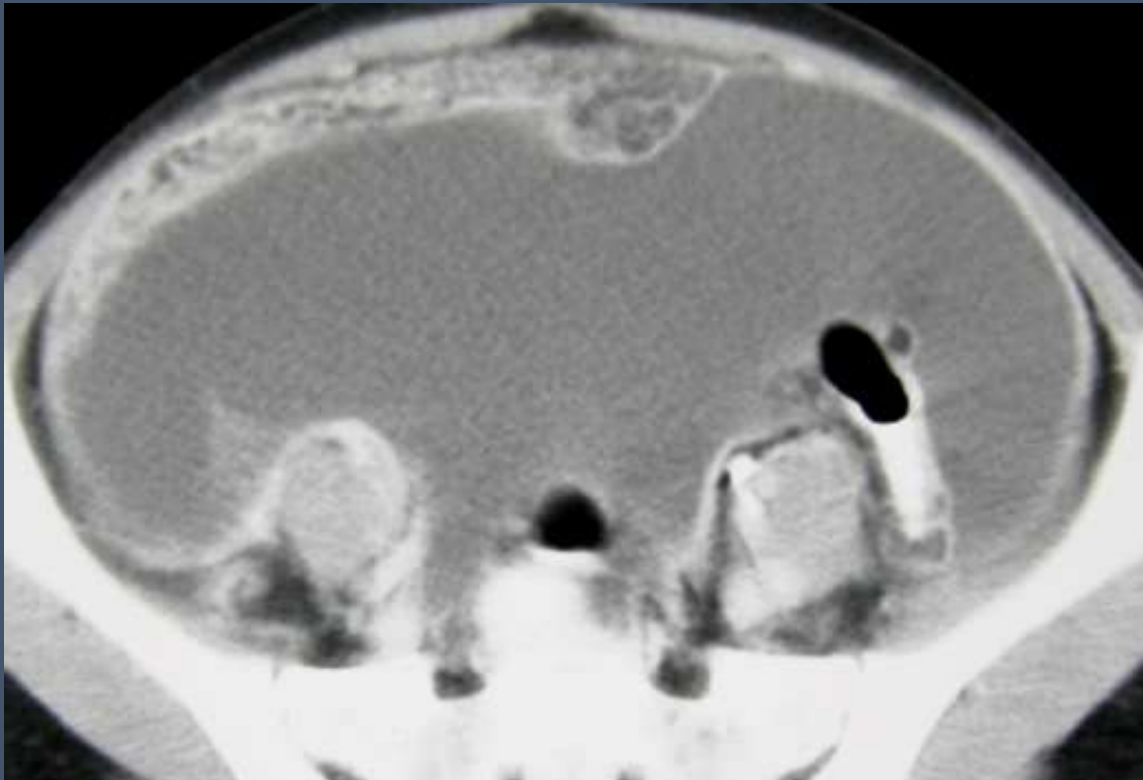
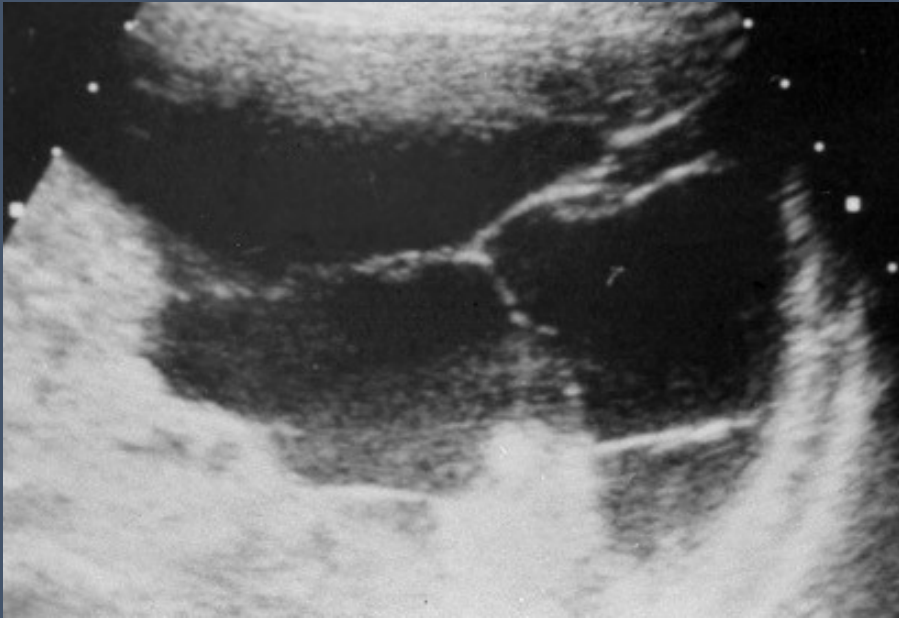
Solid Organ Disease

- Microabscess or granuloma
- Liver, spleen
- High frequency ultrasound most sensitive



TB Peritonitis

- Rare
- Adhesive peritonitis most common in children



Skeletal TB in Children

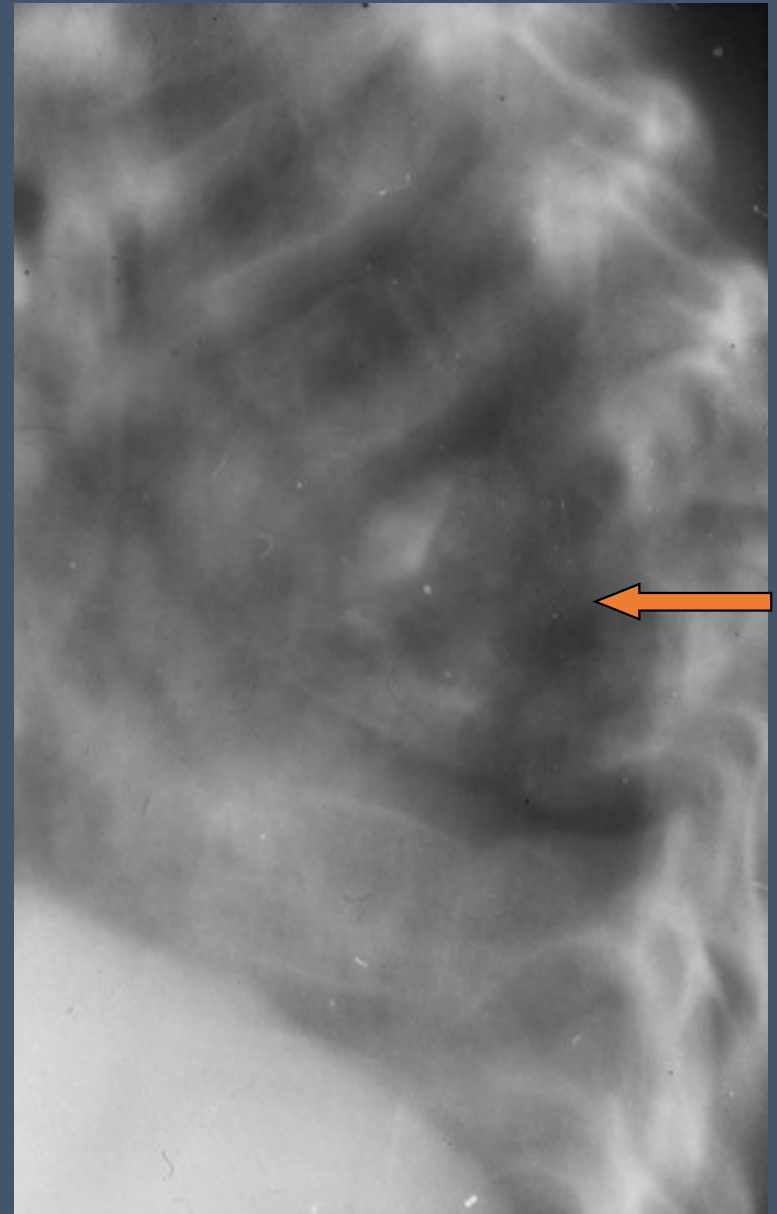
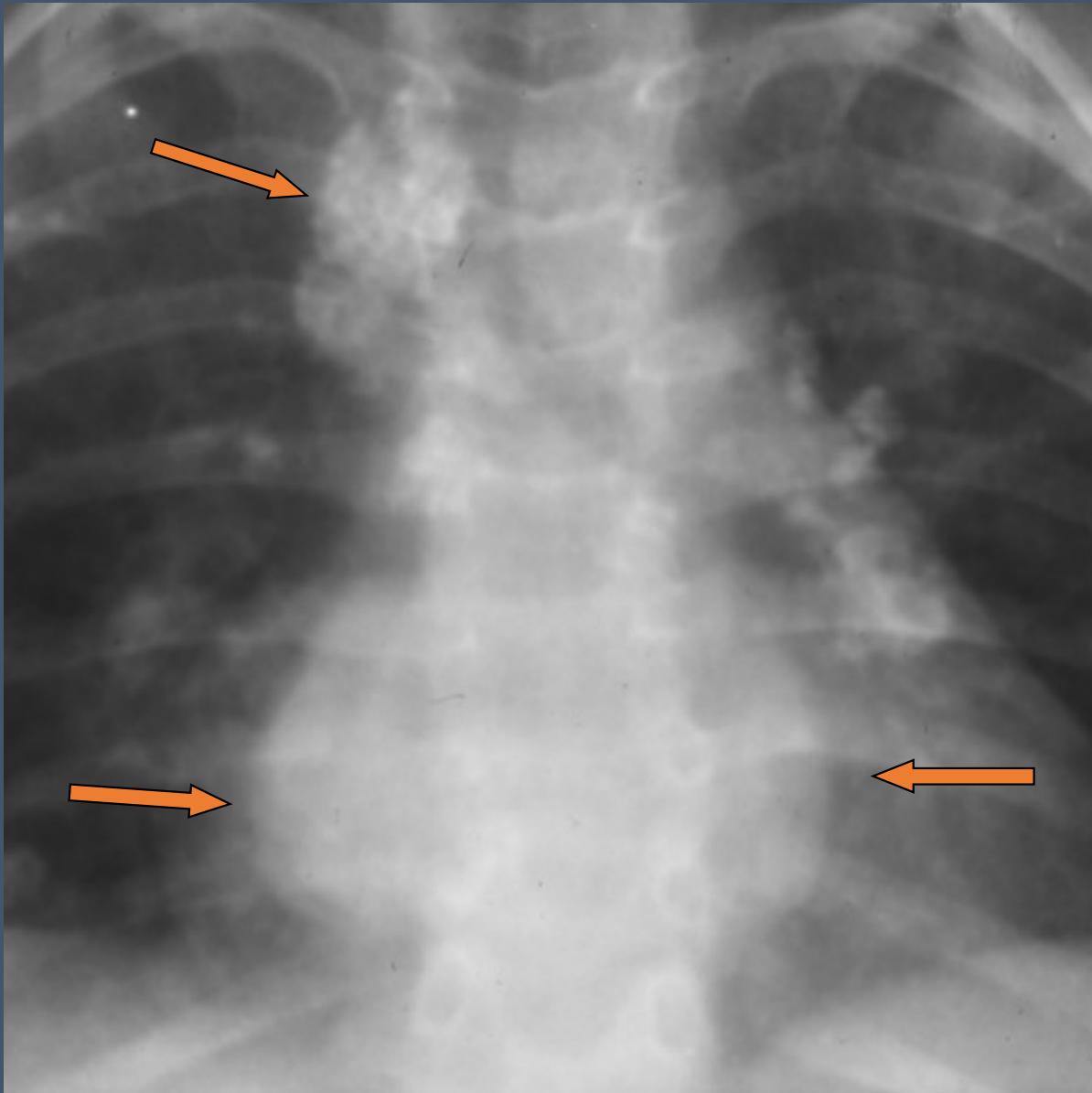
- Uncommon
 - 20% of extrapulmonary TB
- Hematogenous origin
 - Primary site often unknown
- Granuloma >> caseating focus >> trabecular destruction >> cortical destruction >> periosteal, soft tissue involvement

TB of Spine

- Common site
 - Vertebral intraosseous abscess
 - Multiple contiguous vertebrae (85%)
 - Spread to disc, subligamentous, soft tissues
 - Posterior elements seldom involved



TB Spondylitis



TB Arthritis

- 2nd most common MSK site in children
- Monoarticular
 - Hips, knees most common

US good for screening



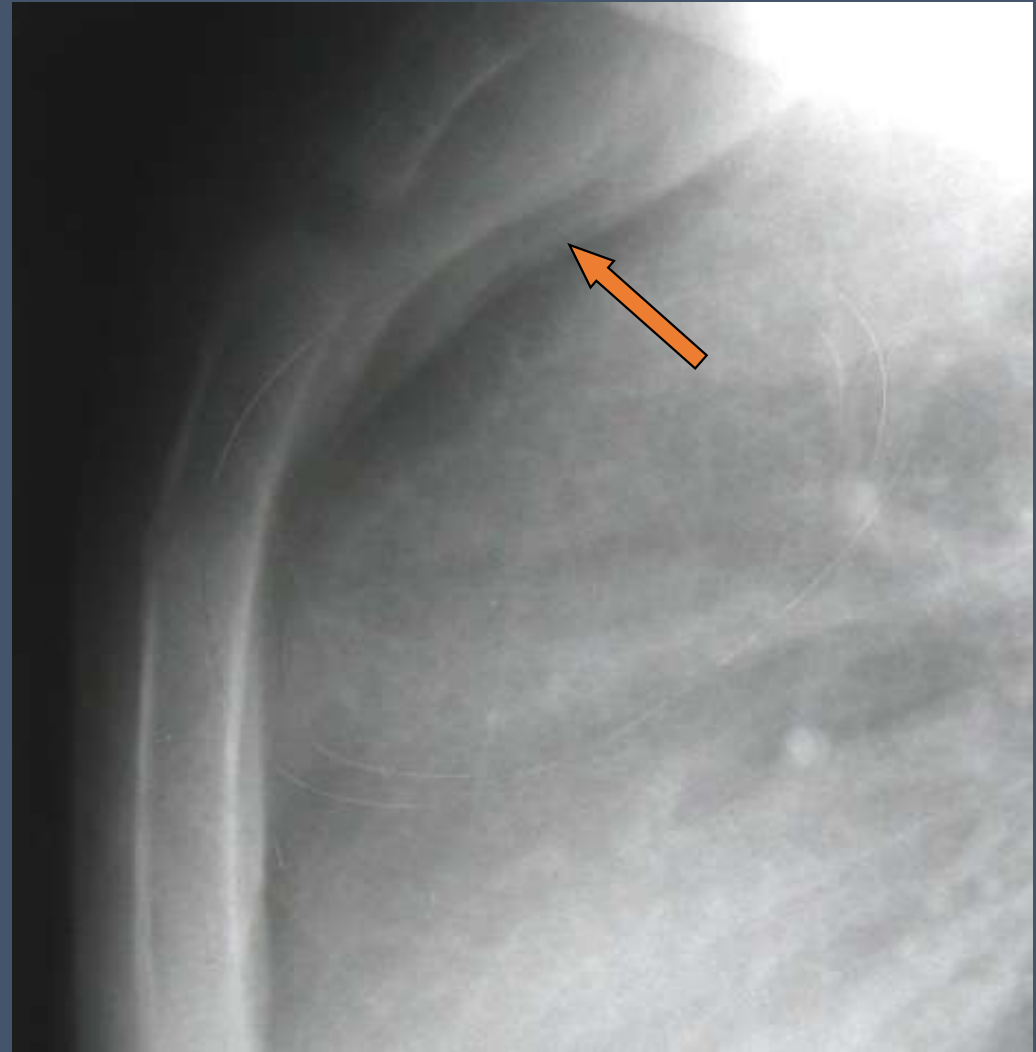
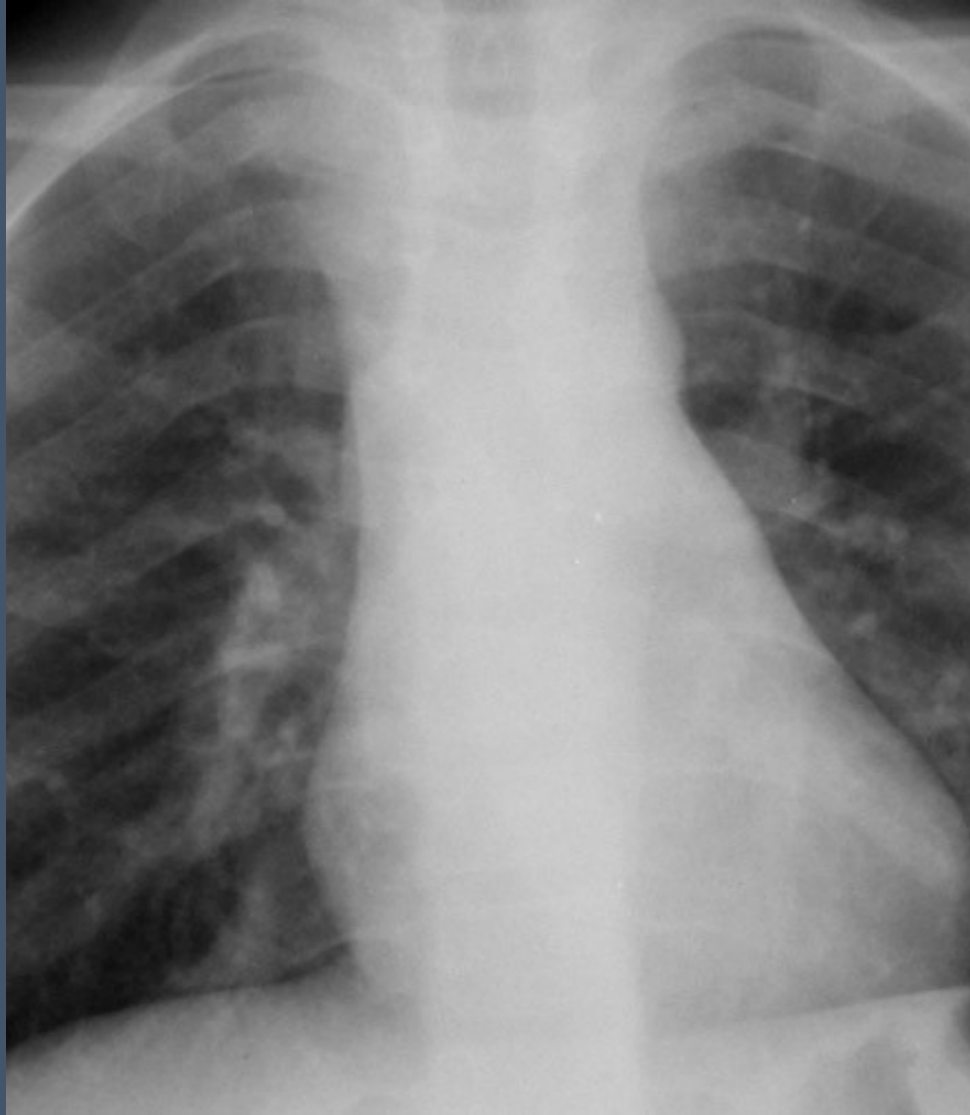
TB Osteomyelitis in Children

- Uncommon – only 11% of skeletal cases
- Solitary lesions most common
- Chest radiograph often normal
- Common sites
 - Skull
 - Hands, feet
 - Long bone metaphyses
 - Ribs



TB Osteomyelitis - Patterns

- Cystic
 - Most common
 - Well-defined lytic lesion
 - Mild sclerosis, expansion
- Infiltrative
 - “Moth-eaten”, ill-defined
 - Nonspecific (Ewings, fungal, chronic pyogenic osteomyelitis)
- Spina ventosa (dactylitis)

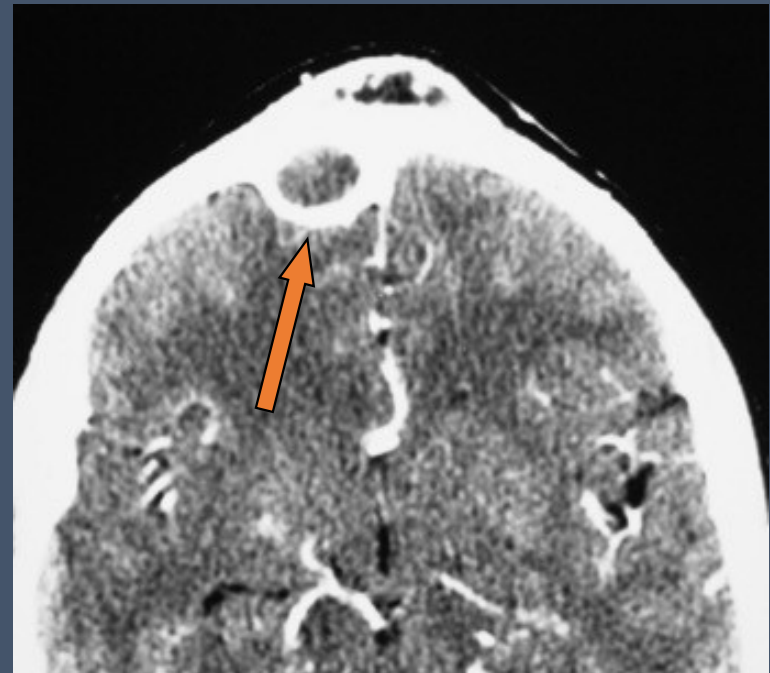
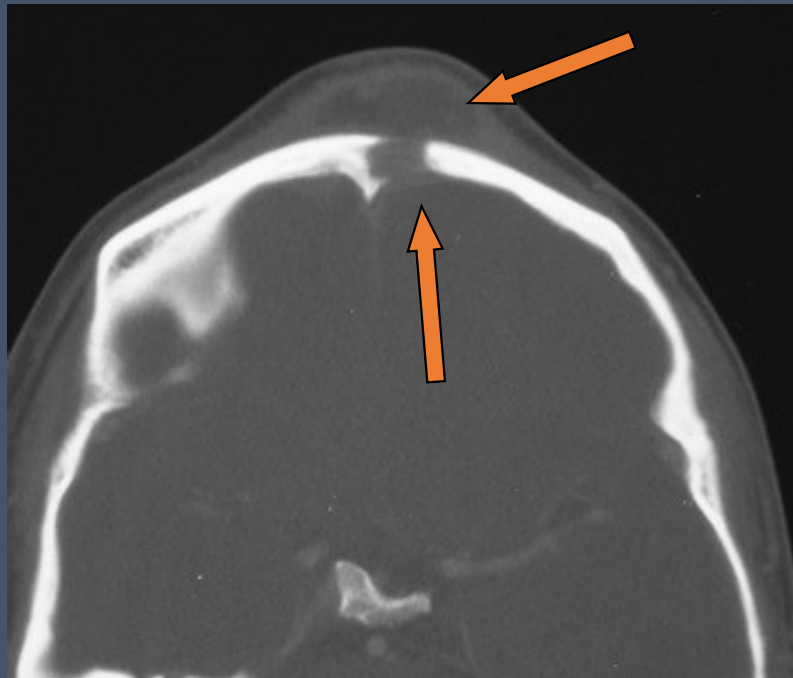


TB of the Sternum



Calvarial TB

- 1% of all skeletal tuberculosis
- 75% of patients are <20 yrs age
- > 80% have bone destruction
 - Frequently visible on radiographs
- 92% have subgaleal swelling



Conclusion

- Primary TB in children has variable and often non-specific appearances on imaging
- Lymphadenopathy remains a key finding
- Use advanced imaging when radiographs are suggestive or confusing

Questions?