Pediatric TB Intensive
Houston, Texas
October 14, 2013

*Radiologic Presentation of Childhood TB*
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October 14, 2013

Disclosures

- I have no disclosures or conflicts of interest to report
Imaging TB

- Clinical diagnostic features are often non-specific
- Culture of organism is slow and often ineffective
- Imaging may provide important and relatively specific clues

Learning Objectives

- 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 problems.
Primary Tuberculosis

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

Common Imaging Modalities

- Radiographs
  - Universally available
  - Insensitive
- US
  - Pleural disease
  - Lymphadenopathy
  - Abdominal findings
Common Imaging Modalities

- **CT**
  - More sensitive for chest, abdomen disease
  - Higher radiation exposure
  - Requires IV, GI contrast
- **MRI**
  - Important for CNS disease
  - No ionizing radiation
  - Requires sedation
  - Not universally available

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

- Radiograph
  - Ghon focus
    - Variable in size
    - Often transient, hidden
    - Mild pleural reaction
    - May progress locally or lead to intrabronchial spread

Ghon Focus
Pulmonary TB in Children

- Adult-type disease
  - Less common
  - Opacity in apical lung segments
    - Apical and posterior – Upper
    - Apical – Lower
  - May lead to cavities and fibrosis
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 Nodules - CT
Teen with GI malignancy, TB

Tree-in-bud pattern
Congenital TB

• Rare form of transmission
• Chest radiograph may resemble other types of neonatal pneumonia
• Lymphadenopathy key to the diagnosis
Lymphadenopathy

• Hallmark of primary TB
  – Only radiologic finding in 50%
  – More common < 5 yrs of age

• Radiographs
  – Difficult to see with confidence
  – PA and lateral views needed
  – Hilar, paratracheal most common
Normal

Lymphadenopathy
Lymphadenopathy

- CT improves visualization
  - Up to 60% with normal CXR have LNs on CT
  - (Delacourt, 1993, Arch Dis Child 69:430.)
- CT technique
  - Use IV contrast
  - Multidetector improves resolution

Lymphadenopathy

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

- **Size criteria**
  - Generally use 1 cm or greater
  - Not well-established

- **Appearance**
  - Low-density center with enhancing rim
  - Interrupted peripheral enhancement
  - Calcification uncommon
Miliary TB with Calcified Lymphadenopathy and Granulomata

Previous Pulmonary TB

- 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
- Other rare findings
  - Bulla
  - Bronchiectasis
TB with calcified lymph nodes
Thymus is normally prominent in infants and should not be mistaken for mediastinal disease.
Lymphadenopathy on CT—How Good Are We?

  - Only moderate agreement between 4 radiologists
    - Rt hilar, subcarinal best
    - Lt hilar, anterior mediastinal worst
  - Thymus causes confusion
- Fletcher, J Clin Oncol (1999) 17:2153
  - Hodgkins disease—experts don’t agree
Lymphadenopathy in PTB-Complications

• Airway compromise
  – Extrinsic compression
    • Obstructive emphysema
    • Atelectasis
    • Left > Right
  – Bronchial wall granulomas
  – Intrabronchial caseous material
Atelectasis
Bronchial Compression/Endobronchial Granuloma

Penetration of Adjacent Spaces

• Pleural effusion
  – Unilateral = direct spread
  – Bilateral = hematogenous
  – Transudate most common
    • Hypersensitivity response
  – Size variable

• Pericardial effusion
  – Subcarinal lymph nodes
Patchy or Nodular
Pleural Effusion

Small Pleural Effusion with Decubitus View
CNS TB in Children

- Hematogenous most common
  - Spread from calvarium, middle ear
- Manifestations
  - Focal disease
  - Meningitis
  - Infarction
  - Hydrocephalus

TB Localized CNS Disease

- Tuberculoma most common
  - Abscess uncommon
- CT (use IV contrast)
  - Enhancement patterns
- 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
TB Meningitis with Communicating Hydrocephalus

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
- Solid organs
  - Calcified or low density lesions
  - Granulomas, abscess
12 year old with night sweats, 20 lb wt loss, and back pain
Solid Organ Disease

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

Abdominal TB

- Ascites
  - May be high density on CT (HU 20-45)
  - US useful but non-specific
- Ileocecal region
  - Bowel wall thickening
  - Inflammatory phlegmon
TB Peritonitis
Skeletal TB in Children

• Uncommon (1-2% of all cases)
• Hematogenous origin
  – Primary site often unknown
• Granuloma >> caseating focus >> trabecular destruction >> cortical destruction >> periosteal, soft tissue involvement

TB of Spine

• Common site
  – Deposited in anterior aspect of vertebral body
  – Spread to disc, subligamentous, soft tissues
  – Posterior elements seldom involved
  – Multiple contiguous vertebrae (85%)
TB of Spine

- Not seen early radiographically
- MRI valuable
  - T1 – low signal
  - T2 – heterogeneous high signal
- CT
  - Cortical bone sclerosis, destruction

TB Spondylitis
Spinal Soft Tissue Extension

- Paravertebral, epidural mass common
  - May lead to cord compression
- Subligamentous spread
- Cervical – retropharyngeal mass
- Extension along iliopsoas
  - Buttocks, groin, chest

TB Arthritis

- 2nd most common site in children
- Monoarticular
  - Hips, knees most common
- Metaphyseal infection
  - May cross physis to epiphysis
TB Arthritis

• Imaging findings
  – Joint effusion
  – Periarticular demineralization
  – Cortical irregularity
  – Osteolytic lesions
  – Periosteal new bone

• Late findings
  – Narrowed joint, overgrown epiphyses
  – Ankylosis

Joint Ultrasound

Normal
Joint effusion
TB Osteomyelitis in Children

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

TB Osteomyelitis - Patterns

• Cystic
  – Most common
  – Well-defined lytic lesion
  – Mild sclerosis, expansion
• Infiltrative
  – “Moth-eaten”, ill-defined
  – Nonspecific (Ewings, fungal, chronic pyogenic osteomyelits)
• Spina ventosa (dactylitis)
TB of Femur
TB of the Sternum

Calvarial TB

- 1% of all skeletal tuberculosis
- 75% of patients are <20 yrs age
- Parietal bone most common site
- > 80% have bone destruction
  - Frequently visible on radiographs
  - Discrete lytic circumscribed lesion
- 92% have subgaleal swelling
Calvarial TB

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