Imaging in the Infant and Young Child

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Congenital Diaphragmatic Hernia

- Clinical manifestations:
  - respiratory distress, scaphoid abdomen
- Radiology:
  - opaque hemithorax (fluid filled bowel or solid visceras)
  - cystic lucencies (gas filled bowel loops)
  - herniated bowel or solid visceras → mediastinal shift

Diagnosis: Congenital diaphragmatic hernia (6-hour interval between exams)

Respiratory emergencies

- Clinical presentations
  - Tachypnea
    - Cardio-pulmonary
    - Acid-base imbalance
  - Wheezing, stridor (reactive airways)
  - Bronchiolitis
    - Asthma, cystic fibrosis
    - Airway obstruction
    - Gastroesophageal reflux disease – ALTE (aparent life threatening event)
  - Cough & fever
    - Pneumonias – acute, chronic
• History
  
  - 21-month-old with wheezing and choking episode on the day prior to admission.

Which imaging study would be most appropriate to order next?

1. Chest CT with contrast
2. Decubitus chest radiographs
3. Barium swallow/UGI exam
4. Diaphragm ultrasound exam

• Decubitus chest radiographs
Foreign body aspiration
Right Main Bronchus Obstruction
(aspirated almond)

• History
  - 2-year old with inspiratory wheezing associated with coughing; febrile.

Viral Bronchiolitis
• Clinical presentation
  - cough and fever
• Imaging findings
  - parahilar opacity ("dirty hilum sign")
  - hyperinflation
  - peribronchial cuffing or thickening
  - peripheral opacities
Viral Bronchiolitis
• Clinical presentation
  • cough and fever
• Imaging findings
  • parahilar opacity ("dirty hilum sign")
  • hyperinflation
  • peribronchial cuffing or thickening
  • peripheral opacities

• History
  • 7-year-old with localized wheezing and history of recurrent pneumonia

Diagnosis: Cystic Fibrosis

Respiratory Distress
• Wheezing
  • Differential diagnoses
    • Bronchiolitis
    • Asthma
    • Cystic fibrosis
    • Foreign body aspiration
    • Extrinsic compression of the airway
- History
  - 4-year-old presents with difficulty breathing

<table>
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<th>Bronchogenic Cyst</th>
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<tr>
<td>Foregut Anomaly</td>
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</table>
• History
  - Newborn with respiratory distress
• Findings
  - Nasogastric tube ends in blind proximal pouch
  - Gas noted in the stomach
• Diagnosis
  - Esophageal atresia with tracheoesophageal fistula

Classification EA / TE Fistula

- EA with dilated TEF 8%
- Isolated EA 8%
- Isolated TEF 4%
- EA with proximal TEF 1%
- EA with double TEF 1%

• History
  - Newborn chest-abdomen radiograph
• Findings
  - Mass/consolidation left lung base
  - Mediastinal shift
• History
  - Newborn chest-abdomen radiograph

• Differential diagnoses to be considered
  - Pneumonia
  - Pleural effusion
  - Hernia or diaphragm eventration
  - Mass lesion

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Bronchopulmonary Sequestration

• Extralobar
  - arterial supply from the aorta
  - venous return to hemiazygous vein

• Intralobar
  - arterial blood supply from the aorta
  - venous return to the pulmonary veins
• History
  - 6-week-old with two week history of post-prandial, projectile vomiting (non-bilious).
  - An ultrasound was ordered

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Hypertrophic Pyloric Stenosis
A “double bubble” sign is most likely associated with:

1. Gastric outlet obstruction
2. Meconium ileus
3. Intussusception
4. Duodenal obstruction

• History
  2-day-old infant transferred with abnormal abdominal film.
• Diagnosis?

Intestinal Malrotation with Midgut Volvulus

• These images are from a child with intermittent abdominal pain
Which one of these would be the most appropriate next study for this patient?

1. Abdominal CT with contrast
2. UGI examination
3. Contrast enema exam
4. None of the above

Enema shows an intussuscepting mass at the hepatic flexure of the colon
A 6-month-old with history of duodenal atresia

Which of the following is the most likely cause of this intestinal gas pattern?

1. Necrotizing enterocolitis
2. Small bowel atresia
3. Pyloric stenosis
4. Post surgical adhesions
Which of the following is not associated with an increased intestinal gas pattern?

1. Bowel ischemia (early phase)
2. Duodenal atresia
3. Aganglionosis
4. Crying infant

Meconium ileus

Findings: Microcolon with filling defects in terminal ileum.
Hirschsprung Disease
• History: newborn with distended abdomen
  
  Findings: markedly dilated large bowel.

• History
  • 16-year-old with abdominal pain and diarrhea
• Findings
  • Bowel strictures with narrowed terminal ileum
  • Dilated SB segments
• Diagnosis
  • IBD (Crohn disease)

Pelvis shown secondary to ruptured appendix

A.

Apendicolith, abscess with thickened, enhancing wall, gas bubbles and fluid

8 y/o with abdominal pain & fever
History: 4-year-old with palpable abdominal mass discovered during bathing

“Claw sign”

Wilms Tumor
Tumor Thrombus in the IVC
• History
  - 3-year-old presents with nausea, emesis and increased irritability
• Findings
  - LUQ ultrasound shows a heterogeneous echo-texture mass

Left Upper Quadrant Ultrasound

Diagnosis: Neuroblastoma

Neuroblastoma
• Imaging features
  • heterogeneous
  • calcification demonstrated in 90% with CT
Anatomy – Immature Skeleton

• Things to remember
  • The epiphyseal centers are fed by a single blood supply from the epiphyseal artery.
  • In infants the rich blood supply to the physis and the cartilaginous epiphysis is enhanced to support growth and development.
  • The physis (growth plate) generally serves as a natural barrier to neoplastic extension.
  • Neoplasia involving epiphyseal centers are more likely to be cartilaginous in origin.
  • The metaphysis has a rich vascular supply from the metaphyseal and nutrient arteries.
  • Infections are usually located at the ends of long bones in the metaphysis, but they can cross the physis.

Common/Important Conditions

• Musculoskeletal disorders
  • Child with a limp
  • Infectious/inflammatory
  • Post traumatic
  • Non-accidental trauma
  • Imaging features
  • Physical findings
  • Health care professional’s responsibility
## Osteomyelitis

- **Radiography**
  - Sensitivity 43 – 75%
  - Specificity 75 – 83%
- **Timing**
  - Soft tissue changes usually present within 3 days
  - Bone changes usually visible within 1 – 2 weeks
- **Early findings**
  - Osteopenia
- **Late findings**
  - Cortical erosion, mixed lucency and sclerosis, periosteal reaction
  - Sinus tract
  - Sequestrum
  - Soft tissue swelling

## Osteomyelitis - MRI

- **Active/Acute**
  - Medullary space fat is replaced by edema (low T1 signal, high signal with T2, STIR, or FS sequences)
  - Cortical disruption
  - Wide transition zone
  - Soft tissue edema, abscess, sinus tract, ulcer, cellulitis
- **Chronic**
  - Low signal on T1 and T2
  - Bone sclerosis with cortical thickening
  - Sequestra with gadolinium enhanced T1
  - Narrow zone of transition

## Osteomyelitis – Nuclear Medicine

- **Nuclear Medicine – Skeletal Scintigraphy**
  - Three-phase bone scan (Tc99m tracer)
    - Blood flow phase – immediate post injection, increased activity (inflammation)
    - Blood pool phase – delayed 15 minutes post injection, shows areas of vascular permeability
    - Delayed phase – 4 hours post injection, shows areas of retained uptake of radiotracer, most specific for osteomyelitis
  - Sensitivity 73 – 100% for positive in all 3 phases
  - Sensitivity decreases with co-existing conditions such as trauma, surgery, orthopedic hardware, diabetes
Osteomyelitis

- **History**
  - 9-month-old presents with shoulder swelling and shoulder pain with motion

- **Radiographic findings**
  - Soft tissue swelling

- **MR features**
  - Epiphyseal involvement
  - Joint effusion
  - Soft tissue swelling

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Osteomyelitis

- **History**
  - 9-week-old

- **Radiographic findings**
  - Intraosseous abscess
  - Soft tissue swelling

- **MR features**
  - Metaphyseal involvement with extension through physis to epiphysis
  - Joint effusion
  - Soft tissue swelling

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Osteomyelitis

- **History**
  - 6-year-old woke up with ankle pain and limping; has a fever

- **MR features**
  - Diametaphyseal involvement
  - Subperiosteal abscess formation with subcutaneous fistula
  - Soft tissue swelling/edema (localized cellulitis)
History:
- 3 y/o refusing to bear weight with left hip pain

Differential Diagnosis of Hip Pain

• Common
  - Septic arthritis
  - Reactive transient (toxic) synovitis
  - Trauma (avulsion fractures)
  - Avascular necrosis
    - Idiopathic (Legg Calve Perthes disease)
    - Acquired (steroid therapy, SC disease, Gauchers disease)
  - Slipped capital femoral epiphysis
  - Osteomyelitis

• Less common
  - Metastatic disease (neuroblastoma)
  - Referred pain
    - Psoas abscess
    - Pyogenic sacroilitis
    - vertebral osteomyelitis/discitis

Ultrasound exam sagittal views showing left hip joint effusion
Septic Arthritis
• Hip involvement is a surgical emergency
• Diagnosis
  • ultrasound
  • MRI
  • arthrography
• Treatment
  • immediate arthrotomy

Legg-Calve-Perthes Disease
• Idiopathic
  • self-limiting
  • male:female 4-5 to 1
  • rare in African Americans
  • increased incidence with (+) family hx, low birth weight, abnormal pregnancy and delivery
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