FAST FACTS AND PEARLS FOR PEDIATRIC ORTHOPEDIC EMERGENCIES
UCSF High Risk Emergency Medicine, May 25, 2012

1. DISCITIS

Epidemiology:
- Mean age of 2.8 years,
- Duration of sx shorter with discitis than OM; less likely to be febrile than OM
- Infectious etiology? Unclear. Organism rarely recovered
- Delay in diagnosis is common (1-2 weeks average)

Clinical:
- Infant: refusal to sit, uncomfortable with diaper change
- Toddler: refusal to walk, progressive limp (63-85%), may have back pain (27% in one study)
- Crying/uncomfortable child, refusing to walk/sit, with normal hip/knee exam should raise concern for discitis
- May be afebrile: more likely to be febrile with vertebral osteomyelitis (Fernandez, 2000)

Labs:
- ESR correlated best among inflammatory markers, but some patients have mildly elevated or normal ESR

Radiography:
- Plain film: disc narrowing usually visible 2-4 wks after onset of sx
  - Fernandez, 2000: 76% had abnormal radiographs
- MRI: diagnostic in most (85-100%), and may improve time to diagnosis

Treatment:
- Anti-staphylococcal antibiotics (clinda or vanco in MRSA area) for 6 weeks
- Case series have reported as high as 50% resolution without antibiotics (eg: Fernandez, 2000)

Pearl: Consider discitis in the uncomfortable infant or toddler refusing to walk or sit, with a normal joint/bone exam

2. OSTEOMYELITIS

Epidemiology
- Incidence highest in 1st 5 years of life (1/2 are younger than 5)
- In kids, a disease of healthy population

Pathophysiology
- Hematogenous source is most common type of OM in peds
  - Direct inoculation: rare in kids, most likely in foot (pseudomonas)
- Organisms vary by age: S. aures, H. flu, GAS and GBS, enterobacter
- S. aures may be associated with multiple sites
- Long bones (femur, humerus, tibia) most often involved

Clinical facts by age:
- Neonate
  - Typically occurs in those with risk fx, including prematurity and previous infection (50%)
  - Multi-focal disease more common (likely due to MRSA)
  - Fever may be absent
  - S. aures, GNR, GBS
- Toddlers:
  - Fever in 40-80%, localized pain in 56-95%
  - Limp often a presenting complaint: decreased mobility in 50-85%
  - Unlike those with SA, passive ROM of joint may be normal
  - Vertebral infections: more likely involve the disc
  - S. aures and GAS
• Older Kids:
  o More likely to have localized pain
  o Brodie’s abscess: occurs most commonly in teens

**Differential dx:**
• Neonate/Infant: occult fx, other infection, malignancy (rare) NM disorder,
• Toddler/kid: septic arthritis, cellulitis, malignancy, bone infarction, Caffey’s disease (infantile cortical hyperostosis)/fibrodysplasia ossificans progressive

**Labs**
• Labs should be interpreted in light of clinical suspicion
• ESR:
  o 70-100% sensitive; lower sens in puncture-related OM (Harris, 2011)
• CRP:
  o Prospective trial (Unkila-Kallio): CRP performed as well as ESR
  o Jaakkola and Kehl: only 47% sensitive
• PCT better predictor of OM than other bone/joint infections, but sensitivity still poor
  o Butbul-Aviel, 2005: PCT value was elevated in 7 patients (58.3%) with osteomyelitis, only 3 children (27.2%) with septic arthritis and NO children with other (benign) diagnoses
• CBC
  o Generally lacks sens/spec, but may identify other conditions (eg: leukemia)
  o Lower sensitivity (12-58%)
• Blood cultures
  o Poor sensitivity (< 50%) – but may be helpful in isolating organism (eg: Kingella – fastidious org, longer to grow)
  o Only 40-60% of bone cultures are +

**Imaging:**
• Plain film: evidence by 10-21 days (in neonates, may be apparent by 7-10 days)
• Scintigraphy may be useful when attempting to localize infection (80-100% sens/70-96% spec)
• MRI: best imaging modality 97% sens/92% spec

**Treatment**
• Neonate: cefotaxime + vanco
• Older infants/kids: vancomycin (+nafcillin if known MSSA)
  o Kingella; susc to cephalosporins but resistant to vanco/clinda: consider adding cefazolin if suspected
• Sickle cell; add ceftriaxone for salmonella/H. flu

Pearl: Consider osteomyelitis in neonates with FWS, and cover empirically for GBS, enterococcus and S. aureus

Pearl: Osteomyelitis is most often hematogenous in the pediatric population

**3. TODDLERS’ FRACTURE:**
• Definition: a spiral fracture of the distal tibia, typically associated with the accidental twisting of the distal leg that occurs when a toddler catches their foot while running/walking
• Toddlers’ fracture may be a subset of CAST fractures (childhood accidental spiral tibial fractures)
• Accidental fractures typically occur in distal ½ of tibia, without displacement

**Age:**
• In one series, 1/3 occur in kids < 3, NONE in kids < 12 mo (Mellick, 1999)
• Overall, the majority of fractures of abuse occur in kids < 12 mo:
• Accidental fx are RARE in kids < 12 mo

**Diagnosis:**
- Initial radiographs may be normal in 43% of cases
- Internal oblique view best for visualizing the spiral fracture

**Pearl: A spiral tibial fracture in a child < 12 months should prompt concern for child abuse**

4. SCFE

**Epidemiology:**
- Average age: 12.7 years for boys and 11.2 years for girls,
  - Near the end of linear growth, prior to menarche/ Tanner IV
  - Age decreasing over time: earlier puberty?
- Lehmann (2006):
  - Rates almost 4 x higher in blacks, 2.5 x higher in Hispanics and 1.62x higher in Asian/Pacific Islanders compared to white children
- Obesity is recognized as a strongly associated factor of SCFE.
  - Increased BMI increases the shear stress across the physis, thus weakening it and causing a slip. The varying surge and level of hormonal activity associated with adolescent growth spurt may also contribute to the cause of SCFE
- Commonly bilateral (~20%)
- Rarely the result of an endocrine or metabolic disorder
- Delay in diagnosis worsens prognosis

**Clinical Factors:**
- **History**
  - Typically present with knee, hip, groin, thigh pain or all
  - May be trivial trauma or discomfort (painless limp also common)
  - Acute major trauma is rarely involved; gradual onset of symptoms and deformity (external rotation) is more common
- **Exam:**
  - Limited internal rotation is UNIVERSAL
  - External rotation of extremity
  - Obligatory external rotation with passive flexion of 90 degrees

**Diagnosis:**
- Radiology: plain films diagnostic in most, although may be negative with early/posterior slip
  - AP and frog-leg lateral (frog-leg view more sensitive)
  - Important to visualize both hips
  - Klein’s line (AP view): line drawn along femoral neck should intersect the lateral portion of the femoral head – if not, suspect SCFE

**Management:**
- Treatment is surgical, with stabilization across the physis by in-situ pinning
- Urgency based on stability:
  - **Stable** = able to bear weight (>90%)
    - Manage surgically as soon as possible
    - May progress to a more severe or unstable slip
  - **Unstable** = unable to bear weight (even with support)
    - Make non-weight bearing immediately and admit
    - Risk of osteonecrosis 20-50%

**Pearl: Always get bilateral hip views in suspected SCFE: 20% are bilateral**

5. LEGG-CALVE-PERTHES DISEASE
- Idiopathic avascular necrosis of hip
• Epidemiology/Presentation
  o Clinical: Insidious onset of limp, with pain often referred to thigh or knee
  o **Peak incidence between 5 and 7** (seen between ages 3 and 12)
  o 10% of cases are familial
  o Male: female ratio = 4:1

• Exam: Limited internal rotation of hip, may result in atrophy of thigh/buttocks
  o Galeazzi test (leg length discrepancy) and Trendelenberg test (for unilateral gluteal muscle weakness) may be positive
  o Trendelenberg test also abnormal in SCFE, DDH - suggests hip pathology

• Diagnosis:
  o Generally visible on plain film, although initial radiographs may be normal
  o Obtain AP and lateral films, and views of both hips.
  o Repeat if symptoms persistent

• Management: make NON-WT-BEARING immediately, and obtain orthopedic consultation

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### Pearl: Findings suggestive of a SCFE in younger child (5-7 years of age) should prompt concern for Legg-Calve-Perthes Disease

6. **SKELETAL MALIGNANCIES: OSTEOSARCOMA VS EWING’S SARCOMA**

<table>
<thead>
<tr>
<th></th>
<th>Osteosarcoma</th>
<th>Ewing’s Sarcoma</th>
<th>“Growing pains”</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Origin</strong></td>
<td>Primitive bone mesenchyme</td>
<td>Poorly differentiated (mesenchyme?)</td>
<td>Unknown (NOT caused by growth!)</td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td>Boys &gt; girls (1.5:1)</td>
<td>Boys &gt; girls (1.5:1)</td>
<td>Girls&gt; boys</td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td>Peak 13-16 (growth spurt) Adults &gt; 65</td>
<td>Peak 13-16 Can be seen into 40’s</td>
<td>2-12 years</td>
</tr>
<tr>
<td><strong>Race</strong></td>
<td>Black&gt; Caucasian</td>
<td>Caucasian&gt; Black/Asian</td>
<td>None</td>
</tr>
<tr>
<td><strong>Frequency</strong></td>
<td>Rare; most common bone malignancy</td>
<td>Rare; 2nd most common bone malignancy</td>
<td>Common (10-20%)</td>
</tr>
<tr>
<td><strong>Location</strong></td>
<td>Metaphyses of long bones (distal femur&gt; proximal tibia, proximal humerus)</td>
<td>Pelvis &gt; metaphysis/diaphysis of LE long bones &gt; spine</td>
<td>More common in lower extremities</td>
</tr>
<tr>
<td><strong>Clinical Signs/ Symptoms</strong></td>
<td>intermittent local pain/ tenderness</td>
<td>intermittent local pain/ tenderness</td>
<td>Nightly bilateral, deep pain in thigh/calf</td>
</tr>
<tr>
<td></td>
<td>Rarely at night</td>
<td>Rarely at night</td>
<td>Absent during day</td>
</tr>
<tr>
<td></td>
<td>+/- mass (~30-40%)</td>
<td>+/- mass (~30-40%)</td>
<td>No physical findings</td>
</tr>
<tr>
<td></td>
<td>Average 2-3 months duration</td>
<td>Average 3-4 mo duration</td>
<td>Chronic, episodic pattern</td>
</tr>
<tr>
<td></td>
<td>Constitutional symptoms rare</td>
<td>Constitutional symptoms: 10-20%</td>
<td>Otherwise normal activity</td>
</tr>
<tr>
<td><strong>Radiographic appearance</strong></td>
<td>Lytic/sclerotic mass</td>
<td>“Moth-eaten” lytic/sclerotic mass</td>
<td>None</td>
</tr>
<tr>
<td></td>
<td>Calcified soft tissue mass</td>
<td>“Onion-skinning” of periostea</td>
<td></td>
</tr>
<tr>
<td></td>
<td>“Sunburst” periostal reaction</td>
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</tbody>
</table>

**Pearl:** “Growing pains” should never cause pain during the day, or interfere with activity
7. SEPTIC ARTHRITIS

Epidemiology/Pathophysiology
- 80% lower extremity (hip and knee most common)
- 10% more than one joint

Causes
- Neonates/infants = GBS, *N. gonorrhea*, *E. coli*, *S. aureus*
- Infants/Toddlers: *S. aureus* (including MRSA) + *Kingella kingae*
  - *Kingella* = gram negative coccobacillus, an emerging pediatric pathogen
  - Nationwide study of *Kingella* (Dubnov-Raz, 2010):
    - 96% of children with *Kingella* were <3
    - 53% of infections were skeletal infections
    - 43% of infections were bacteremia

Diagnosis
- Also consider: Toxic Synovitis, JIA, post-strep arthritis, serum sickness, trauma, SCFE, LCP
- Labs:
  - ESR and CRP better negative than positive predictors
  - Eg: CRP < 1 mg/dL has NPV of 87% (Levine 2003)
  - CRP peaks 36-50hrs after onset of infection
  - PCT a poor predictor: only 27% sensitivity in one study (Butbul-Aviel, 2005)
- Radiography
  - Plain radiographs:
    - May demonstrate joint effusion, but not sensitive
    - Frog leg view of hips: may increase sensitivity for joint effusion
    - Better to R/O other bone abnormalities
  - Ultrasound:
    - May identify and quantify joint effusion, high NPV for hip arthritis
  - Bone scan:
    - Generally not indicated, unless searching for a source of fever, or osteo suspected
  - MRI:
    - May help distinguish b/w SA and TS/
    - Can evaluate comcominant osteo or abscess
- Fluid:
  - Best diagnostic test, but studies inconsistent due to varying gold standards
  - Higher WBC associated with higher likelihood of SA
  - WBC > 50 K with > 90% neuts suggests SA, but is not 100% sensitive or specific

Treatment
- Neonate (<3 mo):
  - Bugs: *S. aureus*, GBS, *E. Coli*
  - Drugs: vanco + ceftriaxone or cefotaxime
  - Consider gonorrhea if risk factors present
- Kids >3 mo:
  - Bugs: *S. aureus*, GAS (*Kingella* in kids <3 yrs)
  - Drugs: vancomycin or clindamycin
  - Consider adding cefazolin for *Kingella* in kids <3 years
  - Consider adding ceftriaxone in teens (*N. gonorrhea*) or sickle cell (*Salmonella spp*)

8. SEPTIC ARTHRITIS (SA) VS TRANSIENT SYNOVITIS (TS)
- Both present with similar symptoms, in similar joints, and in similar patient populations
- Multiple studies have attempted to develop a clinical prediction rule that can identify children at
low risk of SA

**Kocher Criteria**

- Kocher (1999) found that 5 findings were associated with septic arthritis (99.7% positive predictive value, AUC of .96)
  1. Fever ≥38.5°C (101°F)
  2. Inability to bear weight
  3. White blood cell count >12,000/mm3
  4. Erythrocyte sedimentation rate >40 mm per hour
  5. C-reactive protein > 2.0 mg/dL (20 mg/L)

**Subsequent Validation of Kocher criteria:**

- PPV varies from 59-93% in retrospective and prospective studies (Kocher 2004, Luhmann 2004, Caird 2006),
- NPV only 83% (Caird)

**Other predictive models:**

- Luhmann, 2004 (retrospective)
  - 3 variables had PPV of 71% for septic arthritis:
    1. History of fever
    2. WBC of >12K
    3. Previous health-care visit

- **Singhal, 2007 (retrospective)**
  - A CRP > 20 mg/l had OR of 81.9
  - 2 determinants
    1. Weight-bearing status
    2. CRP > 20 mg/l
  - Absence of both: < 1% had septic arthritis
  - Presence of both: 74% had septic arthritis

- **Pakkonen, 2010 (prospective)**
  - Best sensitivity (98%) for SA with combined ESR (>20) and CRP (>20 mg/L)

- **Caird 2006 (prospective)**
  - C-reactive protein level of >2.0 mg/dL (>20 mg/L) was a strong independent risk factor and a valuable tool for assessing and diagnosing children suspected of having septic arthritis of the hip.

**Pearl: In differentiation SA and TS, take into account the entire clinical picture**

- If suspicion is high, obtain hip ultrasound and arthrocentesis even if labs are normal
- If suspicion is low, and CRP/ESR are normal, unlikely to have SA
REFERENCES: