Musculoskeletal Infection

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Disclosure

• Nothing to disclose
Objectives

- When
- How
- What
- Mimickers
- When NOT to image
- Forget-me-nots
When to image
- History
- Physical Examination
- Laboratory Tests
- Diagnostic Imaging Studies

*Diagnostic Imaging Studies:*
Obtain a plain radiograph to rule out fracture or malignancy.
Obtain magnetic resonance imaging (MRI) for diagnostic and surgical interventions. (13,16-20)
Subperiosteal abscess, contiguous arthritis present (with drainable fluid collection)

Yes
- Consult Orthopedic Surgery
- Obtain bone biopsy and aspiration
- Send cultures for histopathology of the bone, routine bacterial gram stain, culture, and aspirate in blood culture bottle

No
- Obtain IR bone biopsy if pathogen not available from blood culture after 24 hours (Consult Orthopedic Surgery if IR is unavailable)
- Send cultures for histopathology of the bone, routine bacterial gram stain, culture, and aspirate in blood culture bottle
Clinical Algorithm for Hip Septic Arthritis

- Admit to PHM under observation status
- NSAIDs

Any elevated laboratory marker:

Yes

→ ≥3 of the following risk factors for concurrent infection:
- Age > 4 years
- CRP > 13.8 mg/L
- Duration of symptoms > 3 days
- Platelets < 314x10^9 cells/μL
- ANC > 8.6x10^9 cells/μL

No

→ Hip ultrasound

Yes

- Pelvis MRI w/ contrast within 8 hours
  (Call Radiology front desk to confirm order)
- Admit to PHM

Notes:
- Cutoffs:
  - ESR > 40 mm/h
  - CRP > 2 mg/dL
  - WBC > 12x10^9 μL

*Immediately refer to the Septic Shock guideline and administer antibiotics if patient has toxic-appearance, ill-appearance, altered mental status, and/or compromised perfusion with abnormal vital signs. Administer antibiotics if patient is bacteremic or has a significantly elevated white count.
How to image
2 – 8 yo fast infection protocol

- Child life on board early
- Shortened exam
- No coil change
- If fails…
  - Next available sedation slot
Fast vs “regular” infection protocol

<table>
<thead>
<tr>
<th>Fast Protocol</th>
<th>Regular Protocol</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 sequences pre-contrast</td>
<td>5 sequences</td>
</tr>
<tr>
<td>2 post</td>
<td>2 post</td>
</tr>
<tr>
<td>Each sequence about 1.5 minutes</td>
<td>25 minute total scan time</td>
</tr>
<tr>
<td>Total scan time 11 minutes</td>
<td></td>
</tr>
</tbody>
</table>
How to image
Contrast or no contrast

- No contrast
  - Negative MR in an older child
  - Uncomplicated OM

- Contrast
  - Infants & young children*
  - Confidence

How to image
To $B_{(ilateral)}$ or not to $B_{(ilateral)}$

- Bilateral
  - Difficulty in physical exam
  - Non verbal patients
  - 16% overall rate of contralateral abnl
  - “Normal” comparison
  - No radiation
  - No added time (usually)

- Unilateral
  - Little to no alteration in pt management

Metwalli et al. AJR: 201, 2013
How to image
• Extended FOV can “compromise resolution if imaging time not increased”
• Start large for survey with IR sequence, then cone down to area with dedicated coil and focus ROI as needed
  • ie (Q body → knee coil on)
What
Definitions

- Acute
- Subacute
- Chronic
- Cloaca
- Sequestrum

- Involucrum
- Hematogenous
- Direct Inoculation
Pain and limp, elevated inflammatory markers
Acute hematogenous OM, uncomplicated
4 yo with pain, swelling & erythema
OM with subperiosteal & intra-muscular abscess)
2 yo, suspect osteo
Acute OM & concurrent septic arthritis
Concurrent OM & SA

TABLE 1: Age Distribution of Septic Arthritis and Osteomyelitis

<table>
<thead>
<tr>
<th>Age Range (y)</th>
<th>No.</th>
<th>Osteomyelitis Only</th>
<th>%</th>
<th>Septic Arthritis Only</th>
<th>%</th>
<th>Septic Arthritis and Osteomyelitis</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>0–2</td>
<td>43</td>
<td>7</td>
<td>16.3</td>
<td>16</td>
<td>37.2</td>
<td>20</td>
<td>46.5</td>
</tr>
<tr>
<td>&gt;2–5</td>
<td>29</td>
<td>16</td>
<td>55.2</td>
<td>5</td>
<td>17.2</td>
<td>8</td>
<td>27.6</td>
</tr>
<tr>
<td>&gt;5–10</td>
<td>52</td>
<td>28</td>
<td>53.8</td>
<td>3</td>
<td>5.8</td>
<td>21</td>
<td>40.4</td>
</tr>
<tr>
<td>&gt;10–18</td>
<td>53</td>
<td>23</td>
<td>43.4</td>
<td>9</td>
<td>17.0</td>
<td>21</td>
<td>39.6</td>
</tr>
<tr>
<td>All</td>
<td>177</td>
<td>74</td>
<td>41.8</td>
<td>33</td>
<td>18.8</td>
<td>70</td>
<td>39.6</td>
</tr>
</tbody>
</table>

TABLE 4: Percentage of Septic Arthritis Patients With Osteomyelitis According to Age

<table>
<thead>
<tr>
<th>Age Range (y)</th>
<th>Septic Arthritis Patients Who Had Underlying Osteomyelitis (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0–2</td>
<td>56 (20/36)</td>
</tr>
<tr>
<td>&gt;2–5</td>
<td>61 (8/13)</td>
</tr>
<tr>
<td>&gt;5–10</td>
<td>87 (21/24)</td>
</tr>
<tr>
<td>&gt;10–18</td>
<td>70 (21/30)</td>
</tr>
<tr>
<td>All patients</td>
<td>68 (70/103)</td>
</tr>
</tbody>
</table>

Note—Includes all septic arthritis with osteomyelitis patients (isolated septic arthritis or septic arthritis with osteomyelitis patients).
Concurrent OM & SA

- At our institution, presence of a coexisting joint effusion in the setting of metaphyseal osteomyelitis was found to represent concurrent septic arthritis in a majority of cases (75%), P-value of <0.0001.

Table 2: Incidence of multiple variables in the setting of metaphyseal osteomyelitis with presence of coexisting septic arthritis (n=103)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Total (%)</th>
<th>Number of coexisting septic arthritis (%)</th>
<th>P-value via Fisher exact test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Joint effusion</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>55 (53%)</td>
<td>41 (75%)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>No</td>
<td>48 (47%)</td>
<td>0 (0%)</td>
<td></td>
</tr>
<tr>
<td>Epiphyseal edema</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>73 (71%)</td>
<td>29 (40%)</td>
<td>1.0000</td>
</tr>
<tr>
<td>No</td>
<td>30 (30%)</td>
<td>12 (40%)</td>
<td></td>
</tr>
<tr>
<td>Intra-articular metaphysis</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>31 (30%)</td>
<td>17 (55%)</td>
<td>0.0499</td>
</tr>
<tr>
<td>No</td>
<td>72 (70%)</td>
<td>24 (33%)</td>
<td></td>
</tr>
<tr>
<td>Age group</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;24 months</td>
<td>21 (20%)</td>
<td>9 (43%)</td>
<td>0.8053</td>
</tr>
<tr>
<td>≥24 months</td>
<td>82 (80%)</td>
<td>32 (39%)</td>
<td></td>
</tr>
</tbody>
</table>
3 mo with limited hip motion
Infectious chondritis
Complications
Complications
6 yo with foot pain
Direct inoculation osteomyelitis
2 yo, routine clinic visit for acute OM 4 months prior complicated by pathologic fx
Chronic osteomyelitis
9 yo with hip pain, h/o right proximal femur bone cyst s/p treatment & surgical fixation
Implant related infection
5 yo with new hip pain and swelling, s/p osteotomies 8 months prior
Mimickers
10 yo female, pain & swelling
Nearly 3 months later
Ewing Sarcoma
• 31 patients with EWS, 32 OM
• Only 2 features were statistically significant
  • African American (OM > EWS)
  • Soft tissue mass (EWS > OM)
• Open bx in EWS yielded dx in 88%
  • Repeat if non-diagnostic
5 yo with knee pain
MSSA subacute osteomyelitis
4 yo with knee pain & lytic lesion OSH
Subacute Osteomyelitis (Brodie’s abscess)
The “penumbra sign” on T1-weighted MRI for differentiating musculoskeletal infection from tumour

B. McGuinness · N. Wilson · A. J. Doyle
15 yo football player with injury 5 months prior, reinjury and swelling
Osteoid osteoma & infrapatellar bursitis
4 yo with fever and right hip pain, eval septic arthritis vs. osteo
Pre B cell ALL with marrow necrosis
7 yo, swelling, pain, limited mobility
Leukemic arthritis
4 yo with limp for 2 days
Metastatic Neuroblastoma
When not to image
Forget-me-nots
11 yo, pain, swelling, r/o hematoma
Epitrochlear lymphadenitis
5 yo with injury
Suppurative epitrochlear lymphadenitis from cat scratch
17 yo with very high risk ALL in induction therapy & pseudomonas bacteremia
Ecthyma gangrenosum
Objectives

- When
- How
- What
- Mimickers
- When NOT to image
- Forget-me-nots
Key Points

- Optimize your imaging tools
- Organize your pattern of interpretation & dictation to the most pertinent clinical question…
  - Is there MSK infection?
  - Is it surgical?
- Use ultrasound for implants
Questions?

- Thank you
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