Epiphyseal Osteomyelitis Caused by Mycobacterium Species in Otherwise Healthy Children

Won Joon Yoo, MD,1 In Ho Choi, MD,1 Tae-Joon Cho, MD,1 Jung-Eun Cheon, MD,2 Mi Hyun Song, MD,1 Chin Youb Chung, MD,3 Moon Seok Park, MD,3 Eun Hwa Choi, MD,4 Hwan Jong Lee, MD,4 Kyung Woon Park, MD,5

Departments of 1Orthopedic Surgery, 4Pediatrics and 2Radiology, Seoul National University Children’s Hospital, Seoul, Korea

Departments of 3Orthopedic Surgery and 5Laboratory Medicine, Seoul National University Bundang Hospital, Seongnam, Korea
Epiphyseal osteomyelitis

(Hobo 1921)

Diagram of the course of the blood vessels in the marrow of a young rabbit. (After Hobo)

(Brookes 1971)

Diagram of the arterial supply to the structures about the knee of a child (modified from Brookes [11]). C = circulus articuli vasculosus (Hunter vascular circle), E = epiphyseal arteries, P = physis (growth cartilage), M = metaphyseal artery, N = branches of nutrient artery.
Epiphyseal osteomyelitis

- Primary osteomyelitis involving only the epiphysis (POE) of long bone
  - Rare
    - ‘44 cases reported until 2003’ (Hempfing et al 2003)
  - Bacterial vs no microorganisms identified
    - *S. aureus* : mc
  - Subacute (Green et al 1981) vs acute (Rosenbaum 1985)
  - Benign clinical course
Mycobacterial POE

• Exceptionally rare
  – “BCG”: 4 cases (Peltola et al. 1984)
  – “Tuberculous”: 2 cases (Rasool et al. 1985)
  – “Atypical Tbc”: 1 case (Hayek et al. 2003)

• Clinical & radiological features: unknown
Purpose

• To characterize **clinical features** of mycobacterial POE

• To assess the role of magnetic resonance imaging (**MRI**) in preoperative and follow-up evaluations
Patients

• **Inclusion**
  – Epiphyseal involvement on plain radiographs / MRI
  – Infection signs

• **Exclusion**
  – Pathology other than infection
  – Meta-epiphyseal involvement at the time of initial presentation
  – Immune-suppressed hosts

• **11 patients w/ POE**
  – Median age: 18 mos (range, 17 days to 48 mos)
  – M:F = 9:2
Methods

• Clinical features
  – presenting symptoms, laboratory findings, abscess extension to the metaphysis / joint/ adjacent soft tissues, response to treatment, and complications

• MRI role
  – contribution to the diagnosis, choice of surgical approach, and assessment of physeal abnormality
Results: overall

- **Site of involvement**
  - **Distal femur** (9), Proximal tibia (2), Greater trochanter (1)

- **Pathogens**
  - **Mycobacterial** (7)
    - M. tuberculosis (3)
    - M. bovis (BCG, Tokyo strain) (3)
    - Non-tuberculous mycobacteriosis (1)
  - Bacterial (2)
    - MSSA
  - Not identified (2)
Mycobacterial Colonies

Real-time PCR (IS6110 region) **POSITIVE**

*M. tuberculosis* complex

Real-time PCR (MIRUs of *senX3-regX3* intergenic region) **Only 77-bp**

*M. bovis*

PCR (RD 1) **Deletion (+)**

*M. bovis BCG*
M. bovis BCG

PCR (RD 8 & RD 14) Both POSITIVE

BCG Tokyo strain
Results: clinical features (1)

- **Abscess extension outside the epiphysis**
  - Mycobacterial: **7 of 7**
    - Metaphysis through the physis (4)
    - Joint (4)
    - Extra-articular soft tissues (4)
  - Non-mycobacterial: none
Results: clinical features (2)

- **Reoperations**
  - Mycobacterial: *4 of 7*
  - Non-mycobacterial: none
Results: clinical features(3)

- **Physeal damage**
  - Mean f/u 3 yrs (range, 9 mos to 6.3 yrs)
  - **Mycobacterial**: 4 of 7
  - Non-mycobacterial: none
## Results: clinical features (4)

<table>
<thead>
<tr>
<th>Pathogen identified</th>
<th>Gender</th>
<th>Age (months)</th>
<th>Initial presentation</th>
<th>Initial symptoms</th>
<th>Initial lab. findings</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Local</td>
<td>Fever</td>
</tr>
<tr>
<td>M. Bovis (BCG)</td>
<td>F</td>
<td>18.0</td>
<td>Subacute</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>M. Bovis (BCG)</td>
<td>M</td>
<td>3.6</td>
<td>Subacute</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>M. Bovis (BCG)</td>
<td>M</td>
<td>18.1</td>
<td>Acute</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>M. Tuberculosis</td>
<td>F</td>
<td>20.8</td>
<td>Acute</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>M. Tuberculosis</td>
<td>M</td>
<td>12.4</td>
<td>Subacute</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>M. Tuberculosis</td>
<td>M</td>
<td>13.9</td>
<td>Subacute</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>NTM</td>
<td>M</td>
<td>23.9</td>
<td>Subacute</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>MSSA</td>
<td>M</td>
<td>0.6</td>
<td>Acute</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>MSSA</td>
<td>M</td>
<td>48.0</td>
<td>Acute</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>None</td>
<td>M</td>
<td>31.9</td>
<td>Acute</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>None</td>
<td>M</td>
<td>18.1</td>
<td>Subacute</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>
Results: MRI role (1)

- Diagnostic value for the lesions involving only the **cartilaginous epiphysis** (n=2)
Results: MRI role (2)

- Decision-making for surgical approach (n=6)
Results: MRI role (3)

• Evaluation for **physeal damage** (n=4)
Discussion

- Osteolytic lesion of the epiphysis with insidious onset, mild symptoms & inconsistent lab. findings
  - Neoplastic
    - chondroblastoma, LCH > osteoid osteoma, osteosarcoma, Ewing sarcoma, leukemia
  - Infectious (subacute >> acute)

- Mycobacterium species: extremely rare cause of POE in Korea??
  - Still prevalent tuberculous infection
  - Routine BCG vaccination
Conclusions(1)

• Mycobacterial infection should be listed as an important etiology of POE in young children.

• In contrast to the reported benign features of POE caused by bacterial species, mycobacterial POE seems to run an unfavorable clinical course.
  – Delayed diagnosis?
  – High virulence?
  – Slow response to chemotherapy
Conclusions(2)

- **MRI is of value** in terms of early diagnosis of cartilaginous lesion, decision-making for surgical approach, and follow-up evaluation of physeal damage.
Thank you.

2012 KPOS annual meeting