Septic Arthritis and Osteomyelitis

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Septic Arthritis

- Definition (Morrey and Peterson)
- Fever >38.6°
- Pain in joint worse with motion
- Periarticular swelling
- Systemic symptoms
- Response to Antibiotics
- Absence of other pathology
- Need 5 of 6
Osteomyelitis

**Definition (Peltola and Vahvanen)**

- Pus from bone
- Positive blood or bone culture
- Classical symptoms (pain, ROM, warmth)
- Radiographic changes

*Need 2 of 4*
Osteomyelitis

**Definition (Morrey and Peterson)**

- **Definite:** pus from bone or histology +ve
- **Probable:** positive culture and radiographic evidence
- **Likely:** clinical and x-ray. Responds to antibiotics
Epidemiology/Risk Factors

- Bimodal (age 0-10 and >50)
- Early summer and late fall
- Posttraumatic
- Males>females 2:1
- Lower extremity > upper extremity
Anatomic Location

Acute haematogenous osteoarthritis

Septic arthritis

Multifocal = 9 (9%)
Organisms Commonly Isolated in Osteomyelitis Based on Patient Age

- **Infants (<1 year)**
  - S. Aureus
  - Group A and B Strep
  - Strep Pneumoniae
  - E. Coli
  - H. Influenza type B rare due to immunizations, but can be present if child not immunized

- **Children (1 to 16 years)**
  - S. aureus
  - Streptococcus pyogenes
  - Kingella kingae – common in respiratory infections
  - Neisseira Gonorrhea (r/o sexual abuse)

- **Adults (>16 years)**
  - S. aureus
  - Staphylococcus epidermidis
  - Pseudomonas aeruginosa
  - E. coli
  - Neisseira Gonorrhea
Osteomyelitis

- Osteomyelitis due to hematogenous spread
- Osteomyelitis due to exogenous trauma
Acute Hematogenous Osteomyelitis

- Vascular architecture of the metaphysis predisposes region for infection
- Nutrient capillary arteries form sharp loops
- Bacteria becomes lodged in the small end arteries and multiply
- WBC accumulate, further compromising blood flow leading to necrosis
Stages of Osteomyelitis and Septic Arthritis

Stage 1
- Trauma

Stage 2
- Lifts Periosteum

Stage 3
- Intracapsular Joint
  - tracks into joint

Stage 4
- Involucrum formed around (dead) sequestrum
Postraumatic Arthritis

- Traumatized soft tissue and bone exposes potential binding sites for bacteria
- Compromises blood supply, leading to bone and tissue necrosis
- Fixation devices may lead to additional sites for bacterial colonization
- Trauma delays the inflammatory response to bacteria
Pediatric Osteomyelitis

Pathophysiology

- Children’s growth plates, thick periosteum, and rapidly growing bones all play a role in causing AHO

- growth plates lead to area below plate in which end-arterioles deposit bacteria

- relatively low O2 tension and few WBC cells; therefore, infection can persist

- thick periosteum can lift off and keep making bone = involucrum
Effect of Septic Joint

Articular cartilage destroyed by:
1) degradation by proteolytic enzymes
2) cascade of events when interleukin-1 released from monocytes acting as a trigger to chondrocytes to release acid

S. Aureus can trigger the proteoglycan matrix to be lost at 5 days and collagen lost at 9 days
Septic Hip

- Although knee most common site of septic arthritis, most disastrous results occur in hip
- Delay in diagnosis (referred pain)
- Reluctance to do aspirate (sedation, U/S)
- Antibiotics started empirically, poor specificity
- Associated proximal femoral OM in neonates
- Poor prognosis if patient <1 year or symptoms >4 days before treatment
Sequela of Septic Hip

- **Type I:** minimal femoral head collapse
- **Type IIA:** deformity of femoral head with intact physis
- **Type IIB:** premature fusion of physis
- **Type III:** pseudarthrosis of femoral head
Sequelae of Septic Hip

- Type IVA: complete destruction of epiphysis with stable neck
- Type IVB: small unstable neck fragment not seated in acetabulum
- Type V: complete loss of head and neck, no articulation with the acetabulum
Principles of Treatment

1- ID the organism

2- Select the correct ABX

3- Deliver the ABX to the organism

4- Stop tissue destruction
<table>
<thead>
<tr>
<th>Drug</th>
<th>Daily Dose, mg/kg of body weight</th>
<th>Maximum Daily Dose, g</th>
<th>Dosage Interval*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amoxicillin</td>
<td>100</td>
<td>4</td>
<td>q6h</td>
</tr>
<tr>
<td>Ampicillin</td>
<td>150</td>
<td>4</td>
<td>q6h</td>
</tr>
<tr>
<td>Cefaclor</td>
<td>120–150</td>
<td>4</td>
<td>q6h</td>
</tr>
<tr>
<td>Cefuroxime</td>
<td>75–100</td>
<td>4</td>
<td>q8h</td>
</tr>
<tr>
<td>Cephalexin</td>
<td>100</td>
<td>4</td>
<td>q6h</td>
</tr>
<tr>
<td>Chloramphenicol</td>
<td>75</td>
<td>2–4</td>
<td>q6h</td>
</tr>
<tr>
<td>Clindamycin</td>
<td>30–40</td>
<td>1.2–1.8</td>
<td>q6h</td>
</tr>
<tr>
<td>Cloxacillin</td>
<td>100</td>
<td>4</td>
<td>q6h</td>
</tr>
<tr>
<td>Dicloxacillin</td>
<td>75–100</td>
<td>4</td>
<td>q6h</td>
</tr>
<tr>
<td>Penicillin V</td>
<td>100</td>
<td>4</td>
<td>q6h</td>
</tr>
</tbody>
</table>

*Abbreviations: q6h = once every 6 hours; q8h = once every 8 hours.
Antibiotic Resistance

Antibiotic resistance results from gene action

Bacteria acquire genes conferring resistance in one of three ways:

1) In spontaneous DNA mutation, bacterial DNA (genetic material) may mutate (change) spontaneously (indicated by starburst). Drug-resistant tuberculosis arises this way.
Resistance

2) In a form of microbial sex called transformation, one bacterium may take up DNA from another bacterium. Pencillin-resistant gonorrhea results from transformation.

3) Resistance acquired from a small circle of DNA called a plasmid, that can flit from one type of bacterium to another. A single plasmid can provide a slew of different resistances.

- Retrospective chart review of children <15 presenting to Children’s Hosp. in Australia
- Aim was to review large series of children with AHO and SA
- Discharge code consistent with AHO or SA
- 41/2 year period
- 102 AHO
- 42 SA
- Age 4 wks to 15 yrs. 40% under 3 yrs.
• AHO – organism identified 45% of the time
• SA - organism identified 38% of the time
• Staph Aureus most common organism for both (AHO 76%, SA 39%)
• MRSA responsible for 9% AHO and 6% SA cases
• No cases of H. influenza
• 66% AHO treated non-operatively
• 74% SA had one or more OR’s
Conclusions

- Staph Aureus most common organism
- MRSA emerging
- H. influenza no longer common cause
- Compared results to study by Nade (1974)
- 5 year study of AHO and SA
- Children presenting with less florid illness, increased MRSA and decreased H. flu

- Linezolid (Zyvox) belongs to the oxazolidinones class of antibiotics.
- Disrupts protein synthesis.
- Presently works against MRSA and VREF (vancomycin resistant *enterococcus faecalis*), methacillin resistant *staph epidermidis*.
- Linezolid has 100% oral bioavailability.
- 400-600 mg IV/PO bid.
Prospective, open label, non-comparative, non-randomized compassionate use program

55 patients with OM (53% long bone, 18% diabetic foot, 14% sternal wound, 15% vertebral OM)

All patients clinically had systemic infection

Gram + organism
<table>
<thead>
<tr>
<th>Pathogen</th>
<th>N</th>
<th>(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Methicillin-resistant <em>Staphylococcus aureus</em></td>
<td>25</td>
<td>(45.5)</td>
</tr>
<tr>
<td>Vancomycin-resistant <em>Enterococcus faecium</em></td>
<td>17</td>
<td>(30.9)</td>
</tr>
<tr>
<td>Methicillin-susceptible <em>S. aureus</em></td>
<td>3</td>
<td>(5.5)</td>
</tr>
<tr>
<td>Vancomycin-susceptible <em>Enterococcus</em> spp.</td>
<td>2</td>
<td>(3.6)</td>
</tr>
<tr>
<td>Methicillin-resistant <em>Staphylococcus epidermidis</em></td>
<td>2</td>
<td>(3.6)</td>
</tr>
<tr>
<td>Vancomycin-resistant <em>Enterococcus faecalis</em></td>
<td>2</td>
<td>(3.6)</td>
</tr>
<tr>
<td>Vancomycin-resistant <em>Enterococcus</em> spp.</td>
<td>1</td>
<td>(1.8)</td>
</tr>
<tr>
<td>Other</td>
<td>3</td>
<td>(5.5)</td>
</tr>
</tbody>
</table>
F/u at 195 days
Claim 81.8% cure rate
All patients with VREF and gm+ infections other than MRSA cured
60% MRSA OM cured (generally comparable to Vancomycin)
Conclusions

- Linezolid good option for VREF and MRSA
- May give orally once patient stable
- Good bone penetration
- Many of the patients had failed vanco; good option to have
- Mainly gastro side effects (diarrhea, vomiting)