Osteomyelitis and Complications in Pediatric Patients: Case and Literature Review

Matthew Martin, D.O.; Matthew Carlson, D.O.; Michelle Mark, D.O.; Glenn Barnes, D.O.; Michelle Lin, D.O.

Presented by: Michelle Mark, D.O.; Glenn Barnes, D.O.; Michelle Lin, D.O.

NOMA May 3, 2018
Introduction - Goals and Objectives

● Osteomyelitis
  ○ Pediatric case of osteomyelitis
  ○ Highlighting common findings and differences between pediatric and adult cases
  ○ Discuss complications of osteomyelitis
  ○ Discuss ways to improve outcomes
Introduction

● Osteomyelitis
  ○ Infection localized to the bones generally via hematogenous pathway
  ○ Early symptoms: back pain
    ■ Pediatric cases: may be nonspecific
  ○ Complications:
    ■ Sepsis
    ■ Long bone fractures
  ○ Early diagnosis and treatment to prevent complications
Presenting Signs & Symptoms of Osteomyelitis

- Pain*
- Malaise
- Fever
- Localized symptoms
  - Swelling
  - Tenderness to palpation of spine with stiffness
- Decreased range of motion
- Decreased ability to bear weight
Signs and Symptoms in *Pediatric Population*

- Back pain
- Nonspecific musculoskeletal pain
- Decreased appetite
- Fever
Initial Presentation: Outpatient Office

- 11 year old female presenting with back pain for 5 days
- Possible injury playing soccer
- Pain described as tingling in mid-low back
- 48 hours after: severe pain awakening from sleep
- Symptoms:
  - Fever (101 F), fatigue, nausea, decreased appetite
- Relieving factors:
  - Laying down, not moving
- Precipitating factors:
  - Any movement
Initial Presentation: Outpatient Office

- **Past Medical History**
  - Hx of several MRSA skin infections since 8 years old
- **Past Surgical History**
  - None
- **Past Social History**
  - Lives with family
  - In school
- **Medications**
  - None
- **Immunizations**
  - Up to date
Initial Presentation: Vital Signs

- Temperature 101.1 F
- Blood pressure 100/61
- Pulse tachycardic
- Height: 86%ile
- Weight: 56%ile
Initial Presentation: Physical Exam

- General: mild to moderate distress, generalized malaise, decreased talkativeness, antalagic movements
- Cardiovascular: tachycardia, global systolic murmur
- Abdomen: infraumbilical tenderness to palpation, moderate abdominal distention
- Skin: 0.5cm hyperpigmented lesion around T10-11 spinous process
- Musculoskeletal: bilateral tenderness to palpation T10-L5, innominates, reproducible back pain at T10-11 with passive flexion of hips and neck
Initial Presentation: Outpatient Office

- Based on the previous findings, patient and family were directed to ER for further evaluation
Initial ER Evaluation

- Additional symptoms:
  - No bowel movements x 5 days
  - Decreased oral intake

- Diagnostic findings
  - WBC normal, neutrophil 81.6%, ESR 41 (elevated), Sodium 130, glucose 120, CRP 15.3 (elevated)
  - Blood cultures: pending

- Imaging
  - MRI Lumbar spine w/o contrast: normal
  - XR Abdomen: gaseous colonic dilatation with moderate fecal loading suggestive of functional colonic motility disorder
  - XR of Lumbar Spine: normal
  - XR of Sacrum/Coccyx: normal
Initial ER Evaluation

- **Treatment:**
  - Morphine and Tramadol in ER

- **Discharge Plan**
  - Home
  - Rx of Norco, Motrin, Miralax
Results of Blood Cultures

● Available 6 days later
● Positive for MRSA
  ○ Sensitive to Clindamycin and Bactrim
● Patient and family were notified and recommended to return to ER
Pathology
Epidemiology
Microbiology
Diagnosis
Treatment
Prognosis
Pathogenesis of Pediatric Osteomyelitis

- Hematogenous deposition of bacteria into metaphysis of long bones or vertebral disk is most common path to infection.
  - Less common is direct extension of soft tissue infections or direct inoculation
- Resultant cellulitis on bone marrow creates increased marrow pressure forcing exudate through cortex, periosteum and eventually joint space in up to $\frac{1}{3}$ of cases resulting in septic arthritis. \(^{(1)}\)
  - Younger patients have thinner cortices and increased metaphyseal nutrient arteries that can carry the infection into the diaphysis and epiphysis resulting in septic joints. \(^{(5)}\)
Epidemiology

Geographic distribution of incidence

- Developed countries 1:7700 and undeveloped countries 1:500 \(^1\)
- Of note in USA, incidence of MRSA pediatric osteomyelitis is increasing \(^2,3\)

Risk Factors are based on patient age \(^4,5,6\)

- Neonates (<30 days): complicated delivery, maternal infection, skin infections, central lines, urinary tract abnormalities
- Infants and Children: Sickle Cell, Immunodeficiency, sepsis, indwelling catheters, **minor trauma with coincident bacteremia**
Microbiology

Most are caused by single organism (4 most common listed below)

1. *Staphylococcus aureus* - $\frac{2}{3}$ of all cases
   a. MRSA associated with PVL mutation involved in all complications

2. Group A and B *Streptococcus*
   a. Group A in older infants and children as complication of VZV infection
   b. Group B in infants < 3 months but usually 2-4 weeks. Commonly with no preceding infection

3. *Streptococcus pneumoniae*
   a. More common in at pneumococcal at risk patients (i.e. heart/lung disease, diabetes, sickle cell, splenic dysfunction)

4. *Kingella kingae*
   a. More commonly affects non-tubular bone. Increasingly being identified as causative organism
Microbiology Cont’

Other rare causative organisms \(^{(44-50)}\)

- E. Coli, H. Flu Type B, Bartonella henselae, Pseudomonas aeruginosa, Brucella, Mycobacterium tuberculosis, Actinomyces, Fusobacterium, Coccidiomycosis, Aspergillus

Polymicrobial osteomyelitis typically occurs due to contiguous spread of soft tissue/articular infection. \(^{(56)}\)
Diagnosis of Pediatric Osteomyelitis

Begins with **clinical suspicion** based on signs of bone infection such as focal bone tenderness, limitation of bone function, and elevated inflammatory markers along with constitutional symptoms.

Ways to confirm diagnosis

1. Bone biopsy, marrow aspirate showing + culture or histopathologic evidence of inflammation. **GOLD STANDARD.** Requires specialists.
2. Infection is likely with symptoms plus clinical, laboratory or imaging evidence of bone infection. Also likely if cultures negative but good response to empiric antibiotics.
3. Unlikely if MRI is normal.
Empiric and Targeted Treatment

Treatment delay with empiric therapy most dangerous with S. aureus.

- Blood culture and focal infection cultures should be performed first.*

Considerations for antibiotic selection include age, clinical features, and prevalent organisms. (1, 2, 3, 4) All therapy should be parenteral!

- 0-3 months - Vancomycin and 3rd gen Cephalosporin (Cefotaxime preferred)
- > 3 months - Nafcillin/Oxacillin if community resistance <10%. If >10%, vancomycin or clindamycin

Targeted therapy should be started immediately once cultures and sensitivities become available.
Prognosis

With prompt treatment before bone necrosis cure rate ~ 95% \(^{(1, 2)}\)

Factors portending worse prognosis \(^{(3)}\)

1. MRSA with PVL mutation
2. Septic arthritis, pyomyositis, or abscess
3. Hip, ankle, knee involvement
4. Positive culture
5. Young age
6. Delay in treatment *
Hospital Course

- Vitals: tachycardia, tachypnea, hypotension, fever
- Difficulty with ambulation
- Treatment:
  - IV fluids
  - Supplemental oxygen
- Admitted to: Pediatric ICU
- Antibiotics:
  - IV Ceftriaxone, Vancomycin, Acyclovir
Hospital Course: Labs/Diagnostics

- Thrombocytopenia
- Hyponatremia
- Hypocarbia
- INR 1.5
- Elevated alkaline phosphatase
- Hypoalbuminemia
- Increased creatinine
- Decreased level of ADAMTS13
  - Possible acquired TTP
- CXR: reticulonodular pattern
Hospital Course: Procedures

● Bronchoscopy
  ○ Hemorrhagic secretions throughout lungs
  ○ Several mucus plugs removed

● Bronchoalveolar lavage of bilateral lower lobes
  ○ Strong growth of MRSA

● Echocardiogram
  ○ Dilated IVC and large atrial sided tricuspid valve vegetation
    ■ Posterior and septal leaflets with mild insufficiency

● CT abdomen/pelvis with IV contrast
  ○ Fecal loading, ascites, anasarca
Hospital Course: Complications

- Septic shock secondary to MRSA
  - Required intubation and vasopressor support via PICC line
- Supraventricular tachycardia
  - Spontaneously resolved
- Multisystem organ failure
- DIC
- Septic endocarditis with likely septic pulmonary emboli
Hospital Course: Treatment

- Infectious disease consulted
  - Ceftriaxone
  - Later switched to Gentamicin after review of sensitivities
- Transferred to facility for pediatric cardiac surgery
  - Vegetation and septic emboli removal
Outcome/follow up

- Discharge summary 1 month after transfer to surgery
  - Final dx: R fibula osteomyelitis complicated by flexion contractures
- 8 week course of linezolid, steroid taper, pain medication
- Walker for ambulation
- Follow up with cardiology, endocrinology, infectious disease
- Patient was lost to follow up.
Complications

- Varies with age
- Site of involvement
- Pathogen
- Duration if infection
Complications: Musculoskeletal

- New born + CA-MRSA:
  - Abnormal bone growth at physis and epiphysis
  - Multifocal infection
- Young infants: extension into soft tissue
- Septic arthritis if involving proximal humerus and femur or hematogenous delivery
- Subperiosteal abscess/ Brodie abscess
Complications: Musculoskeletal cont’d

- CA- MRSA: Pathologic fractures
- Osteonecrosis of femoral head
- Vertebral body destruction w/ assoc kyphosis or spinal cord compression
- Devitalized bone and cutaneous fistulae
- Chronic osteomyelitis
  - Devitalized bone on radiograph + ≥2 weeks of bone inflammation
  - Inadequate duration of therapy
Complications: Venous thrombosis/Septic emboli

- Children $\text{Age} \geq 8$ and adolescents
- At sites adjacent to osteomyelitis
- S. aureus, MRSA
- Coagulation abnormalities
- Disseminated infection
- CRP $>6\text{mg/dl at presentation}$
- Increased severity of infection
Final Comments

- Be aware of atypical presentation of osteomyelitis
- Aggressive diagnostics
  - Labs (CRP, Cultures), Radiographs, MRI
- Empirical parenteral antibiotics
- Be aware of the complications
- Considering further diagnostics in context of symptoms
- Consider preemptive education for parents for children with MRSA infections
References


Questions?