

Bone and Joint Infections

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Introduction

- This is an overview
- Initial treatment → based on presumed infection type → clinical findings and symptoms
- Definitive treatment → based on final culture
- **Glycocalyx**
 - exopolysaccharide coating
 - envelops bacteria
 - enhances bacterial adherence to biologic implants

Bone Infection

Bone Infection

- Osteomyelitis
- infection of bone and bone marrow
- Route of infection
 - direct inoculation → Open fractures
 - blood-borne organisms → hematogenous
- **Determination of the offending organism**
 - **Not a clinical diagnosis**
 - **Deep culture is essential**

Classification

- Acute hemotagenous OM
- Acute OM
- Subacute OM
- Chronic OM

Acute Hematogenous OM

Clinical Features

- caused by blood-borne organisms
- More common in children
 - Boys > girls
 - most common in long bone metaphysis or epiphysis
 - Lower extremity >> upper extremity
- Pain
- Loss of function of the involved extremity
- Soft tissue abscess



Acute Hematogenous OM

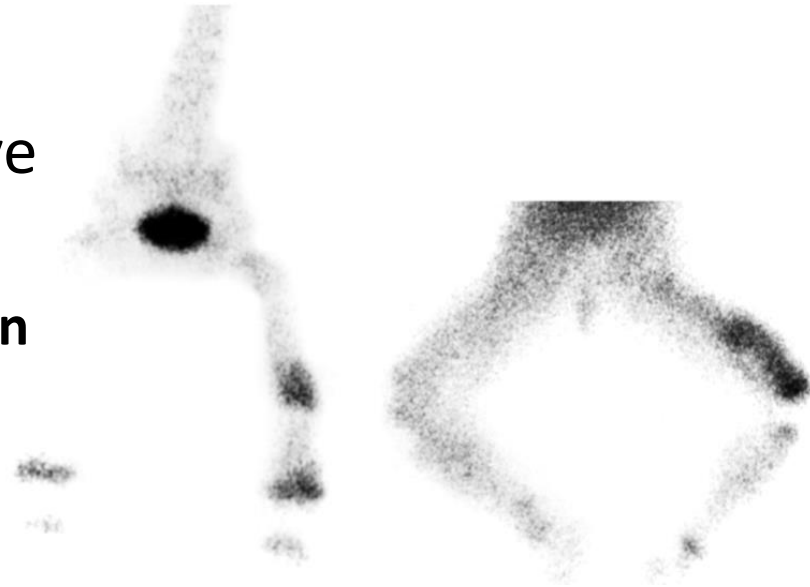
Radiographic Changes

- soft tissue swelling (early)
- bone demineralization (10-14 days)
- **sequestra** → dead bone with surrounding granulation tissue → later
- **involucrum** → periosteal new bone → later



Diagnosis

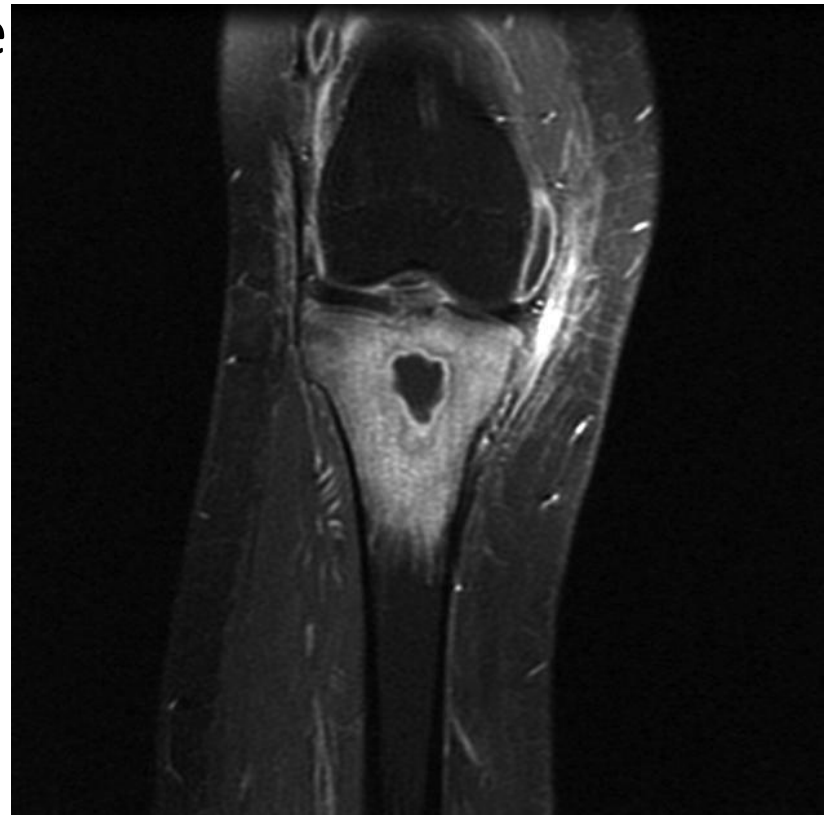
- Diagnosis
 - elevated WBC count
 - elevated ESR
 - blood cultures → may be positive
 - **C-reactive protein**
 - **most sensitive monitor of infection course in children**
 - short half-life
 - dissipates in about 1 week after effective treatment
 - Nuclear medicine studies → may help when not sure



Diagnosis

- **MRI**

- shows changes in bone and bone marrow before plain films
- decreased T_1 -weighted bone marrow signal intensity
- **increased postgadolinium fat-suppressed T_1 -weighted signal intensity**
- increased T_2 -weighted signal relative to normal fat



Treatment Outline

- identify the organisms
- select appropriate antibiotics
- deliver antibiotics to the infected site
- halt tissue destruction

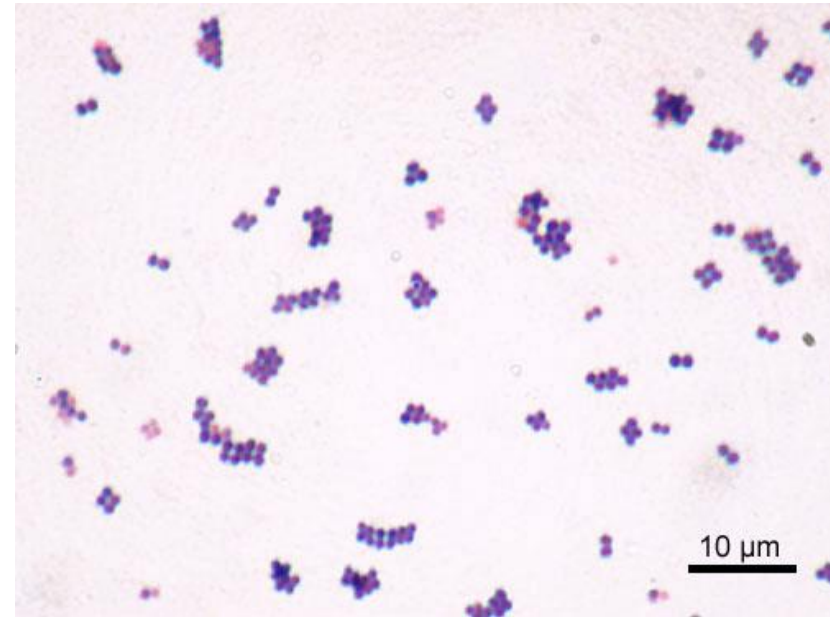
Empirical Treatment

- Before definitive cultures become available
- based on patient's age and other circumstances

Empirical Treatment

Newborn (up to 4 months of age)

- The most common organisms
 - *Staphylococcus aureus*
 - gram-negative bacilli
 - group B streptococcus
- Newborns
 - may be afebrile
 - 70% positive blood cultures
- Primary empirical therapy includes
 - oxacillin plus
 - 3rd -generation cephalosporin



Empirical Treatment

Children 4 years of age or older

- most common organisms
 - *S. aureus*
 - group A streptococcus
 - coliforms → (uncommon)
- empirical treatment →
 - oxacillin or cefazolin
 - If suspecting gram-negative organisms → 3rd - generation cephalosporin
- ***Haemophilus influenzae* bone infections → almost completely eliminated → due to vaccination**

Empirical Treatment

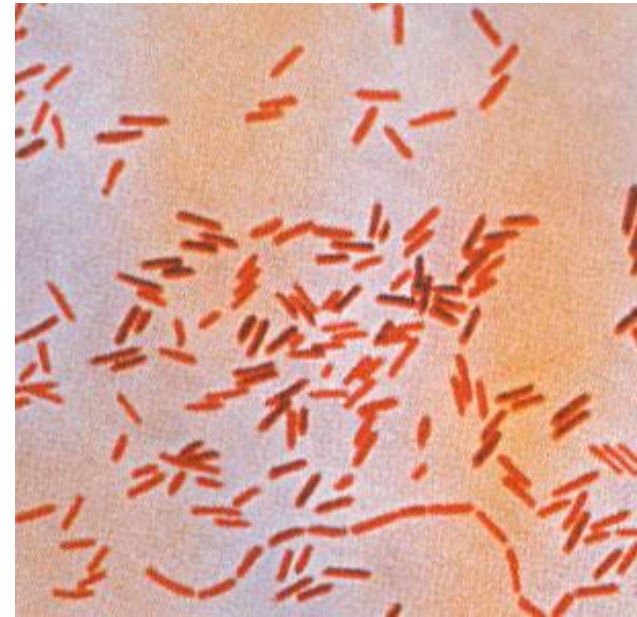
Adults 21 years of age or older

- **Organisms**
 - most common organism → *S. aureus*
 - wide variety of other organisms have been isolated
- Initial empirical therapy → oxacillin or cefazolin

Empirical Treatment

Sickle cell anemia

- *Salmonella* is a characteristic organism
- The primary treatment → fluoroquinolones (only in adults)
- alternative treatment → 3rd - generation cephalosporin



Empirical Treatment

Hemodialysis and IV drug abuser

- Common organisms
 - *S. aureus*
 - *S. epidermidis*
 - *Pseudomonas aeruginosa*
- treatment of choice → penicillinase-resistant synthetic penicillins (PRSPs) + ciprofloxacin
- alternative treatment → vancomycin with ciprofloxacin

Operative Treatment

- started after cultures
- indications for operative intervention
 - drainage of an abscess
 - débridement of infected tissues to prevent further destruction
 - refractory cases that show no improvement after nonoperative treatment

Acute Osteomyelitis

after open fracture or open reduction
with internal fixation

Acute osteomyelitis

- Acute OM after open fracture or open reduction with internal fixation
- Clinical findings → similar to acute hematogenous OM
- Treatment
 - radical I&D
 - removal of orthopaedic hardware if necessary
 - rotational or free flaps for open wounds → if needed



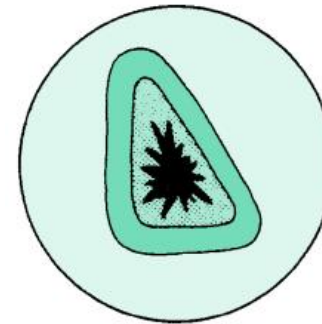
Acute osteomyelitis

- Most common offending organisms are
 - *S. aureus*
 - *P. aeruginosa*
 - Coliforms
- Empirical therapy → oxacillin + ciprofloxacin

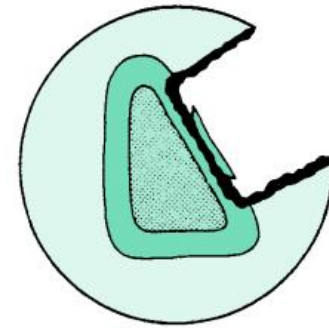
Chronic Osteomyelitis

Chronic OM

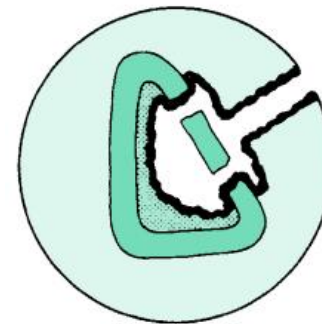
- Common in
 - inappropriately treated acute OM
 - trauma
 - immunosuppressed
 - diabetics
 - IV drug abusers
- Anatomical classification → check fig.



Medullary



Superficial



Localized



Diffuse

Chronic OM

- Features
 - Skin and soft tissues involvement
 - Sinus tract → may occasionally develop squamous cell carcinoma
 - Periods of quiescence → followed by acute exacerbations
- Diagnosis
 - Nuclear medicine → activity of the disease
 - **Best test to identify the organisms → Operative sampling of deep specimens from multiple foci**

Chronic OM - Treatment

- **empirical therapy is not indicated**
- **IV antibiotics → must be based on deep cultures**
- Most common organisms
 - *S. aureus*
 - Enterobacteriaceae
 - *P. aeruginosa*

Chronic OM - Treatment

- surgical débridement
 - **complete removal of compromised bone and soft tissue**
 - **Hardware**
 - **most important factor**
 - **almost impossible to eliminate infection without removing implant**
 - **organisms grow in a glycocalyx (biofilm) → shields them from antibodies and antibiotics**
 - **bone grafting and soft tissue coverage is often required**
 - **amputations are still required in certain cases**



Subacute Osteomyelitis

Subacute Osteomyelitis

- Diagnosis → Usually
 - painful limp
 - no systemic and often no local signs or symptoms
 - Signs and symptoms on plain radiograph
- May occur in
 - partially treated acute osteomyelitis
 - Occasionally in fracture hematoma
- Frequently normal tests
 - WBC count
 - blood cultures

Subacute Osteomyelitis

- Usually useful tests
 - ESR
 - bone cultures
 - radiographs → **Brodie's abscess** → localized radiolucency seen in long bone metaphyses → difficult to differentiate from Ewing's sarcoma



Subacute OM - Treatment

- Most commonly involves femur and tibia
- it can cross the physis even in older children
- Metaphyseal Brodie's abscess → surgical curettage

Septic arthritis

Septic Arthritis

- Route of infection
 - hematogenous spread
 - extension of metaphyseal osteomyelitis in children
 - complication of a diagnostic or therapeutic joint procedure
- Most commonly in infants (hip) and children.
- **metaphyseal osteomyelitis can lead to septic arthritis in**
 - **proximal femur → most common in this category**
 - **proximal humerus**
 - **radial neck**
 - **distal fibula**

Septic Arthritis

- Adults at risk for septic arthritis are those with
 - RA →
 - tuberculosis → most characteristic
 - *S. aureus* most common
 - IV drug abuse → *Pseudomonas* most characteristic
- Empirical therapy
 - prior to the availability of definitive cultures
 - Based on the patient's age and/or special circumstances

Septic arthritis – Empirical Rx

- **Newborn (up to 3 months of age)**
 - most common organisms →
 - *S. aureus*
 - group B streptococcus
 - less common organisms →
 - Enterobacteriaceae
 - *Neisseria gonorrhoeae*
 - 70% with adjacent bony involvement
 - Blood cultures are commonly positive
 - Initial treatment → PRSP + 3rd-generation cephalosporin

Septic arthritis – Empirical Rx

- **Children (3 months to 14 years of age)**
 - most common organisms
 - *S. aureus*
 - *Streptococcus pyogenes*
 - *S. pneumoniae*
 - *H. influenzae* → **markedly decreased with vaccination**
 - gram-negative bacilli
 - Initial treatment → PRSP + 3rd -generation cephalosporin
 - alternative treatment → vancomycin + 3rd -generation cephalosporin

Septic arthritis – Empirical Rx

- **Acute monoarticular septic arthritis in adults**
 - The most common organisms
 - *S. aureus*
 - Streptococci
 - gram-negative bacilli
 - Antibiotic treatment → PRSP + 3rd -generation cephalosporin
 - Alternative treatment → PRSP plus ciprofloxacin

Septic arthritis – Empirical Rx

- **Chronic monarticular septic arthritis**
 - most common organisms
 - *Brucella*
 - *Nocardia*
 - *Mycobacteria*
 - fungi
- **Polyarticular septic arthritis**
 - most common organisms
 - Gonococci
 - *B. burgdorferi*
 - acute rheumatic fever
 - viruses

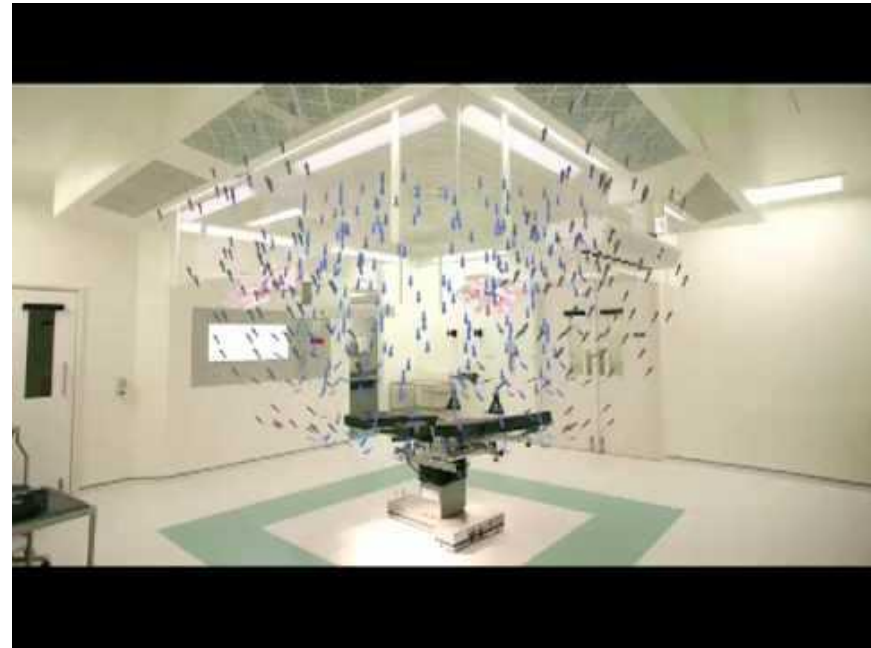
Septic Arthritis – Surgical treatment

- mainstay of treatment
 - Surgical drainage → open or arthroscopic
 - daily aspiration
- Tuberculosis infections → pannus → similar to that of inflammatory arthritis
- Late sequelae of septic arthritis → soft tissue contractures → may require soft tissue procedures (such as a quadricepsplasty)

Infected Total Joint Arthroplasty

Infected TJA - Prevention

- Perioperative intravenous antibiotics → most effective method for decreasing its incidence
- Good operative technique
- Laminar flow → avoiding obstruction between the air source and the operative wound



Infected TJA - Prevention

- Special “space suits”
- Most patients with TJA do not need prophylactic antibiotics for dental procedures
- Before TKA revision → knee aspiration is important to rule out infection



Infected TJA - Diagnosis

- Most common pathogen →
 - *S. epidermidis* → most common with any foreign body
 - *S. aureus*
 - group B streptococcus
- ESR → most sensitive but not specific
- Culture of the hip aspirate → sensitive and specific
- CRP may be helpful
- Preoperative skin ulcerations → ↑ risk
- most accurate test → tissue culture

Infected TJA - Treatment

- **Acute infections → within 2-3 weeks of arthroplasty → Treatment**
 - prosthesis salvage → stable prosthesis
 - Exchange polyethylene components
 - Synovectomy → beneficial
- **chronic TJA infections → >3 weeks of arthroplasty**
 - **Implant and cement removal**
 - staged exchange arthroplasty
 - Glycocalyx
 - Formed by polymicrobial organisms
 - Difficult infection control without removing prosthesis and vigorous débridement
 - Helpful steps
 - use of antibiotic-impregnated cement
 - antibiotic spacers/beads

Good luck!