Joint Infection/Septic Arthritis: Approach to the Infected Joint

Suraj Achar, MD, FAAFP

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Learning Objectives

1. Recognize when a joint must be tapped and when you can treat for problems such as gout without tapping the joint.

2. Use appropriate laboratory test values in the assessment of septic arthritis.

3. Recognize the role of imaging studies in the diagnosis of osteomyelitis.

4. Evaluate the risks and benefits of oral antibiotics.

5. Counsel patients with recurrent infections about decolonization regimens.

Audience Engagement System
Poll Question 1

What is the most common reason for septic arthritis?

A. Neisseria Gonorrhea
B. Prosthetic joint implantation
C. Animal bite
D. Hematogenous spread of staph aureus

Prevalence

20,000 cases of septic arthritis occur in the United States
- 7.8 per 100,000, 2.8 per 100,000 with gonorrhea

Prosthetic joint infection (PJI): 2% to 10%.
- Falsely low because surveillance is limited to the operative hospital

Septic Arthritis → 45% > 65y/o
- Immunosuppressed
- More likely to have various comorbid disease states

Prevalence
Route

- Hematogenous
- Direct inoculation
  - Joint Surgery
  - Replacement
  - Arthroscopy or open joint surgery
  - Arthrocentesis (>CSI)
- Contiguous spread from adjacent infected soft tissue or bone

Host factors

- RA
  - neovascularization and increased adhesion factors in synovium
- Immunosuppression
- DM
- Malignancy
- CRF
- IVDA
- Severe skin diseases
- Advanced age
Risk factors & clinical characteristics of deep knee infection in patients with IA injections:

A matched retrospective cohort analysis

BMI ≥25 kg/m^2 [odds ratio (OR) = 2.3; 95% confidence interval (CI): 1.1-4.7]

CSI: (OR = 3.21; 95% CI: 1.63-6.31)

RA: OR = 2.61; 95% CI: 1.20-5.68)

Injections performed by general practitioners (OR = 5.23; 95% CI: 2.00-13.67)

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### Microbiology Native Joints

<table>
<thead>
<tr>
<th>Bacteria</th>
<th>Notes</th>
<th>Microbiology</th>
<th>Risks Factors/Prognosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Staph Aureus, MRSA</td>
<td>37-65% of native joint septic arthritis, more MRSA</td>
<td>Binds → articular elastin, hyaluronic acid, &amp; prosthetic material via specific tissue adhesion factors → severe joint destruction</td>
<td>50% mortality rate</td>
</tr>
<tr>
<td>B Streptococcus</td>
<td></td>
<td></td>
<td>DM, GU structural abnormal</td>
</tr>
<tr>
<td>Gram Neg Bacilli</td>
<td></td>
<td></td>
<td>Neonates, PWID (persons who inject drug), immunocompromised</td>
</tr>
<tr>
<td>Pasteurella multocida</td>
<td>Small joints of hands</td>
<td></td>
<td>Animal bites</td>
</tr>
<tr>
<td>Eikenella corrodens</td>
<td></td>
<td></td>
<td>Human bites</td>
</tr>
<tr>
<td>N gonorrhoeae</td>
<td>Usually monoarticular Knees/wrists/ankle</td>
<td>relatively mild influx of (WBCs) → minimal joint destruction</td>
<td>Sexually active: low mortality</td>
</tr>
</tbody>
</table>
Gonococcal arthritis (humans only)

- Rare
  - 3-year retrospective study from France of 21 cases of disseminated gonococcal infection, which included 14 cases of arthritis
  - 60% arthritis-dermatitis syndrome (polyarticular):
    - Asymptomatic rash
    - 40% localized septic arthritis.
- AA 10x rate of Asian Americans > Caucasians
- Generally not joint destructive like SA
- Hematogenous spread 0.5-3%
- Hard to diagnose synovial cultures <50%
  - Nucleic Acid Amplification Tests (NAATs)
  - Cervix, urethra, synovium, rectum, pharynx,
- Usually require inpatient IV → good prognosis

Poll Question 2

What is not part of the classic triad?

A. Fever
B. Painful Joint
C. Erythematous rash over the joint
D. Decreased ROM
PE: native joint

- Usually
  - Fever & chills (40-60%)
  - Joint red/ warm and swollen
  - Effusion
  - < ROM and painful (>80%)
  - Axial joint → often only pain
- PE → reveal a distant source of joint ~ 50%

- Subtle signs
  - Oral or intra-articular steroids
  - Immunocompromised
  - RA
  - Advanced age

Special factors
prosthetic joints

- Propensity → coated by host proteins such as fibrinogen & fibronectin after implantation
  - Colonization surface → bacteria readily adhere, like the fibrinogen and fibrin binding receptors of S. aureus
- Reduced blood flow
- Local immunocompromise by impairing natural killer, lymphocytic, and phagocytic cell activities.
Frustrated phagocytosis

• Undergo apoptosis → encountering a substrate of a size beyond their phagocytic capability
  • Release of reactive products of oxygen and lysosomal enzymes may cause accidental host tissue damage and local vascular insufficiency
  • NI phagocytic processes are devoted to removal of the implant foreign material (particularly with metals, methylnathacrylate, and polyglycolic acid)

Other factors → Infection of prosthetic joints

Some prosthetic joints remain close to the surface and have poor soft tissue coverage (e.g., total elbow arthroplasties)

Prolonged surgery time

Bone cement is inhibitory to PMN’s

Some bone may die with heat of surgery leading to non-vascularized area “ripe” for infection
### Categories of synovial fluid

<table>
<thead>
<tr>
<th>Measure</th>
<th>NL</th>
<th>OA</th>
<th>RA (inflammatory)</th>
<th>Septic</th>
<th>Hemorrhagic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Effusion</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Clarity</td>
<td>Transparent</td>
<td>transparent</td>
<td>Mostly transparent</td>
<td>Opaque</td>
<td>Bloody</td>
</tr>
<tr>
<td>WBC</td>
<td>&lt;200</td>
<td>0-2000</td>
<td>&gt; 2,000</td>
<td>&gt; 20,000</td>
<td>variable</td>
</tr>
<tr>
<td>PMN's cells/mm³</td>
<td>&lt;25</td>
<td>&lt;25</td>
<td>≥50</td>
<td>50-150</td>
<td>50-75</td>
</tr>
<tr>
<td>Gram Stain</td>
<td>NL</td>
<td>Neg</td>
<td>Neg</td>
<td>30-50% +</td>
<td>neg</td>
</tr>
<tr>
<td>Culture Joint</td>
<td>Neg</td>
<td>Neg</td>
<td>Neg</td>
<td>Often + Blood culture 50% if hematogeneous</td>
<td>Neg</td>
</tr>
</tbody>
</table>

### Poll Question 3

What is true about laboratory testing?

A. ESR & CRP are more useful for following a disease course than discriminating the presence or absence of the disease in patients with monoarthritic.

B. A normal Uric Acid level rules out Gouty Arthritis.

C. Serum WBC is more helpful than joint WBC in determining septic arthritis.

D. The upper limit of normal jWBC has been clearly established.
Diff diagnosis

- Other infections
  - Septic bursitis
  - Lyme disease
  - Viral
    - Dengue: break bone fever
  - Synovitis in children
  - Indolent
    - Fungal
      - Cocci: "desert rheumatism" includes the combination of fever, joint pains, E nodosum
    - TB

Lyme

- Endemic area;
- erythema migrans rash
  - 80% Europe/20% US,
- Fever
- Migratory arthralgias may occur weeks or months prior.
- Dx: serology
- The diagnosis is established via serologic testing
TB arthritis

- Indolent presentation
- Culture neg
- Hip/Knee/Back
- Synovial fluid AFB low sensitivity
- Dx: synovial membrane histopathology and culture

Diff Dx: non infectious

- Trauma
- Gout
- Reactive Arthritis
  - Most patients GU or GI signs or symptoms, conjunctivitis, or skin or mucus membrane lesions.
  - Develops in response to an infection in another part of the body (cross-reactivity).
  - By presentation "trigger" infection has been cured or is in remission in chronic cases
- RA
Joint infection is uncommon → Key History!

- Acuteness of onset
- Previous history of joint disease or trauma, whether accidental or iatrogenic (e.g., infection complicates 0.4% of arthrocentesis?)
- Whether the process is monoarticular or polyarticular and which joints are involved
- The presence of extra-articular symptoms
- History of vascular invasion due to catheterizations or intravenous drug abuse?

Pediatric Case 2

5 y/o boy → Acute L thigh pain

- Onset: 2am?
- ROS: Ø
- PE
  - Temp 99.4 AVSS
  - Irritable
  - Hip flexed, abducted and ER
  - TTP ant thigh
  - Antalgic gait
  - Painful ROM
- Dx: cellulitis?
Case 2: Evaluation?

- Day 1 (8hrs post symptoms)
  - WBC 16,000

- Day 2
  - ESR-34
  - CRP< 0.5 (0-1.0mg/dl =nl)
  - WBC-11.6 49s,0b

Poll Question 4

What is the gold standard diagnostic test?

A. CBC
B. C-reactive protein
C. Blood culture
D. Hip aspiration
E. Ultrasound
Transient synovitis of the hip 
(toxic synovitis)

Dx of exclusion!!!
- Septic arthritis?

Most common cause of the limping child?

Self limiting!

Etiology?

Age range 18m-12y

Boys>girls (2:1)

BL in 5%

Hx
- URI, pharyngitis or mild trauma??
- Acute Onset < 2 weeks

All patients limp->
- refusal to ambulate?

Night pain?

Radiation to thigh, or knee?
Synovitis: Exam

- Low grade fever (<101°F) c nl VS
- Painful ROM
  - Modified Log Roll >30°
- Hip position?
  - Flexion, abduction, ER
  - (maximizes joint volume)

Dx studies (Significant Overlap!)

- WBC?
- ESR (CRP)-

% of pts with ESR >30mm/hr

<table>
<thead>
<tr>
<th>Condition</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transient synovitis</td>
<td>28%</td>
</tr>
<tr>
<td>Septic hip arthritis</td>
<td>79%</td>
</tr>
</tbody>
</table>

- X-ray-
  - Medial joint clear space?
- Ultrasound –
  - Hip joint effusion in 95%
  - Echogenicity?

Del Beccaro, Ann Emerg Med
# Clinical Variables Suggestive of Septic Arthritis

<table>
<thead>
<tr>
<th>Kunnamo</th>
<th>Del Beccaro</th>
<th>Kocher</th>
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<tbody>
<tr>
<td>CRP &gt; 20mg/l</td>
<td>ESR &gt;20mm/hr</td>
<td>Hx of Fever</td>
</tr>
<tr>
<td>Temp&gt; 38.5°C</td>
<td>Temp &gt;37.5°C</td>
<td>Non-weight bearing</td>
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<tr>
<td></td>
<td></td>
<td>WBC &gt;12,000</td>
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<tr>
<td></td>
<td></td>
<td>ESR &gt;40mm/hr/Or CRP&gt; 2.0</td>
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<tr>
<td></td>
<td></td>
<td>100% sensitivity</td>
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<tr>
<td></td>
<td></td>
<td>87% specificity</td>
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<td></td>
<td></td>
<td>97% for SA</td>
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<td></td>
<td></td>
<td>3% if ½</td>
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<tr>
<td></td>
<td></td>
<td>40% if 2/4</td>
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<tr>
<td></td>
<td></td>
<td>93% if ¾</td>
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<tr>
<td></td>
<td></td>
<td>99.8% if 4/4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4 of 34 children who met one or none of these criteria had +hip aspiration</td>
</tr>
</tbody>
</table>

## Rx & F/U: Transient synovitis of the hip

- **Symptomatic**
  - Duration: 2 weeks
  - Ultrasound not diagnostic
  - 2/3 resolve ≤ 1 week
  - Pain > 1 month?
    - 12%
  - Recurrence rate
    - 4-15%
    - LCP (4/192)

Pediatric Septic Arthritis

Historically difficult to treat

Etiology and Incidence?

Peak age <2y/o

M>F 2:1

75% LE: Knee>hip

How much time do we have?

- children treated < 5d
  - no morbidity¹
- 11 children treated >1 week
  - 9/11 had complications -
    ->AVN, growth arrest ->chronic
    pain, limited ROM¹
Management

Adequate & timely drainage of the infected synovial fluid
Administration of appropriate antimicrobial Rx, & immobilization of joint to control pain.

Acute (PJI) (< 3 wk in duration) medical cure → early type without any periarticular soft-tissue involvement or joint instability.

Antibiotics

IV for at least 2 weeks (4 weeks with SA)
Group B strep → combination of pcn (resistant) and Gent or 3rd cephalosporin
GN joint infection and N Gonorrhea

- May use 1-2 weeks oral Cipro
- If N Gonorrhea 2 g of azithromycin or 7 days of doxycycline BID (concurrent Rx of Chlamydia)
Rx Slime

- Rifampin
  - Bacteriocidal
  - Some effect against the slow-growing organisms that are protected within a biofilm (eg, coagulase-negative Staphylococcus aureus [CONS])
- Do not use alone → rapid development of bacterial resistance to the drug.

Suppressive Rx: when removal of PJI is not possible

Cure rates as high as 62% have been documented in relatively small series.

Generally suppressive and not curative.
Joint Immobilization & Physical Therapy

Initial immobilization for pain relief

After 5 days of treatment, begin gentle mobilization of the infected joint.

Most patients require aggressive PT → allow maximum post infection functioning of the joint.
  • Initial PT → passive ROM, non weight bearing (avoid BFR)
  • F/U aggressive PT once clinical signs and symptoms of synovitis have resolved. OK to start BFR

Avoid Opioids (<5d?) and Benzodiazepines: SPACE trial

Synovial Fluid Drainage
Percutaneous vs Surgical

• Percutaneous →
  • Ultrasound is helpful
  • Repeat frequently significant to avoid reaccumulation of fluid (Aspirating the joint 2-3 times a day!)
  • Gonococcal-infected joints rarely require surgical drainage.
Surgical Drainage

Surgical drainage is indicated when one or more of the following occur:

- The appropriate choice of antibiotic and vigorous percutaneous drainage fails to clear the infection after 5-7 days
- The infected joints are difficult to aspirate (e.g., hip)
- Adjacent soft tissue is infected

With arthroscopic drainage, the operator can visualize the interior of the joint and can drain pus, debride, and lyse adhesions.

Surgical Intervention in Prosthetic Joint Infection

Debridement and retention of the prosthesis

- considered if infection < 30 days of implantation or
- present < 3 weeks of the development of symptoms if the prosthesis appears to be well fixed and no sinus tract.
First, remove the prosthesis

• ~6 weeks of antibiotic therapy
• Impregnate methyl methacrylate cement \(\rightarrow\) gentamicin, tobramycin
• Antibiotic diffusion into the surrounding tissues is the goal. The success rate ~95% for both hip and knee joints.

1-stage surgical procedure with concomitant antibiotic therapy \(\rightarrow\) succeeds in 70-90% of cases.

Surgical Intervention in Prosthetic Joint Infection: Removal of PJIs

Rx of Septic arthritis: Prosthetic Implant

• Colonized, bacteria (staph) synthesize a “slime” layer, termed the glycocalyx or biofilm
  • Prevents inward diffusion of antibiotics & host phagocytic cells \(\rightarrow\) bacteria to escape
• Once an implant is colonized \(\rightarrow\) osteomyelitis only Rx is implant removal.
Prevention

Clean technique for joint procedures
• Don’t inject a joint through a soft tissue infection

Prosthetic Joints
• Don’t inject CSI, HA or PRP in or around prosthetic joints
• Sterile aspiration for those potentially infected

Antibiotic prophylaxis
• Ant staph antibiotic reduce infections in joint replacement surgery
• RCT’s show no need for antibiotic prophylaxis prior to dental procedures

Learning Points

PJI most common
• (2-10%)

Risk factors for a joint infection with IA injection
• Infection near joint
• Obesity
• CSI
• Less experience

Classic Triad
• Fever
• Painful joint
• ↓ROM
Learning Points: Rx

- **SA and MRSA: super dangerous**
- **N gonorrhoeae Rx** → IV antibiotics
- **Cloudy = Infection!**
- **Debridement & retention of PJI is possible early**

### Practice Recommendations

- Don’t inject in or around a prosthetic joint
- **Triad for Septic Arthritis:** Fever, painful joint & < ROM
- Tools to evaluate Transient Synovitis: ESR/CRP/CBC and hip aspiration
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Questions