Project: Ghana Emergency Medicine Collaborative

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Bone and Joint Infections

Keith Kocher, MD MPH

April 4th, 2012

University of Michigan
Department of Emergency Medicine
Relationships with Industry

UMMS policy requires that faculty members disclose to students and trainees their industry relationships in order to promote an ethical & transparent culture in research, clinical care, and teaching.

- I occasionally am a consultant for Magellan Health Services, Inc., a publicly traded health care management company. I advise primarily on use of imaging in the ED.

- Currently, I do not serve as the PI on any industry supported research projects.

Disclosure required by the UMMS Policy on Faculty Disclosure of Industry Relationships to Students and Trainees.
Objectives

- Know when to suspect osteomyelitis
- Know how to evaluate someone with a monoarticular arthritis
- Know how to treat osteomyelitis and septic arthritis
- Know how to competently perform joint aspirations
Outline

- **Background**

- **Small group discussion**

- **Evidence based lecture: bone then joint**

- **Final thoughts and questions/comments**
Lecture/Topic Boundaries

- Lecture confined to evaluation and management of bone and joint infections within the ED setting

- Generally discussing adults

- Will touch on several neighboring disease processes as well, so not the definitive lecture on the entire range of arthritis, fracture management, etc
Lecture/Topic Boundaries

- I want to specifically encourage interruptions, questions, and discussion during my talk.

- The literature on osteomyelitis and septic arthritis has not particularly advanced significantly in the last decade.
  - Therefore much of the evidence comes from established practice, systematic reviews, and textbook type sources.
Lecture/Topic Boundaries

However, we will touch on some more recent evidence based help that can better guide the evaluation and work-up:


Definitions

- **Osteomyelitis**
  - Inflammation in bone or bone marrow, usually due to an infection

- **Arthritis**
  - Inflammation of a joint
  - Monarticular vs. polyarticular vs. periarticular arthritis

- **Septic joint (septic arthritis, infectious arthritis)**
  - Inflammation of a joint due to an infection
Outline

- Background
- Small group discussion
- Evidence based lecture
- Final thoughts and questions/comments
Rules

■ **Groups of 4-5**

■ **Mix of experience**
  ■ Some junior level residents, some senior level residents, faculty spread around

■ **Elect a spokesperson**
  ■ Will report back to the group
Rules

2 Cases

Specifically I want you to discuss:

- How evaluate (history, exam, labs, imaging, other testing or procedures)
- How manage (treatment options, consultants)
- How to disposition (admit, discharge, outpatient treatment, follow up instructions)
Case #1

A 64 year old woman with a history of diabetes presents to your ED with a non-healing right foot ulcer. She has a small wound over the 4th metatarsal head for last 3 weeks. She was prescribed a 10 day course of antibiotics by her PCP which she just completed. She comes in to the ED because it has not healed, it’s the weekend, and she’s concerned. On exam the wound is round, 3 cm in diameter, with redness and swelling. Vital signs are: bp 155/85, pulse 85, temp 37.5, pulse ox 99% on RA.

Questions:

1. What do you want to do diagnostically?, therapeutically?
2. What is your disposition plan?

Case #2

A 57 year old man with a history of hypertension and alcoholism presents with a swollen knee. He noticed development of this over the last 24 hours. No other joints hurt. He denies fever or rashes. He recalls no recent trauma. He has no history of arthritis. He denies any history of similar episodes of painful joints. Exam shows a swollen, red, and warm right knee joint. He is neurovascularly intact and without associated rash. Vital signs are: bp 155/85, pulse 85, temp 37.5, pulse ox 99% on RA.

Questions:

1. What do you want to do diagnostically?, therapeutically?
2. What is your disposition?
Outline

- Background
- Small group discussion
- Evidence based lecture
- Final thoughts and questions/comments
Osteomyelitis

How do you get osteomyelitis?:

(1) Contiguous focus
- Most common
- After trauma, surgery, insertion of hardware
- Can occur at any age and with any bone

(2) Vascular insufficiency
- Second common
- Related to diseases such as diabetes (predominantly), peripheral vascular disease
- Almost always begins with a soft tissues infection that spreads to bone

(3) Hematologic spread
- Least common
- Seeded from another source
- Examples: IV drug use, sickle cell disease
- Seen mostly in pre-adolescent children and elderly
Types

- Differences between acute and chronic osteomyelitis
  - Acute = develops over days to weeks
  - Chronic = develops over months to years, involves relapses

- Probably not an important distinction in the ED, except to know that a chronic infection that appears “healed” can relapse
Evaluation

- First step in evaluation is always to be able to generate the differential

- Presentation – variety of symptoms:
  - open wound with exposed bone → draining sinus tract
  - local swelling with bone pain tenderness
Evaluation

- Specific clinical scenarios to consider:
  - **Vertebral osteomyelitis (discitis):** IV drug user (or those with indwelling vascular catheters) with sub-acute back pain
  - *Salmonella* related osteomyelitis: sickle cell patient with hip pain
  - **Prosthetic joint related osteomyelitis:** risk of infection remains highest for first 2 years, but still persistent at lower levels for life of prosthesis
  - *Pseudomonas* related osteomyelitis: puncture wound to heel (osteomyelitis of the calcaneus)
  - **Sternal osteomyelitis:** after cardiac surgery
  - **Diabetic foot ulcer related**
## Microorganisms

<table>
<thead>
<tr>
<th>Most common clinical association</th>
<th>Microorganism</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequent microorganism in any type of osteomyelitis</td>
<td><em>Staphylococcus aureus</em> (susceptible or resistant to meticillin)</td>
</tr>
<tr>
<td>Foreign-body-associated infection</td>
<td>Coagulate-negative staphylococci or <em>Propionibacterium</em> spp</td>
</tr>
<tr>
<td>Common in nosocomial infections</td>
<td><em>Enterobacteriaceae</em>, <em>Pseudomonas aeruginosa</em>, <em>Candida</em> spp</td>
</tr>
<tr>
<td>Associated with bites, diabetic foot lesions, and decubitus ulcers</td>
<td>Streptococci and/or anaerobic bacteria</td>
</tr>
<tr>
<td>Sickle-cell disease</td>
<td><em>Salmonella</em> spp or <em>Streptococcus pneumoniae</em></td>
</tr>
<tr>
<td>HIV infection</td>
<td><em>Bartonella henselae</em> or <em>B quintana</em></td>
</tr>
<tr>
<td>Human or animal bites</td>
<td><em>Pasteurella multocida</em> or <em>Eikenella corrodens</em></td>
</tr>
<tr>
<td>Immunocompromised patients</td>
<td><em>Aspergillus</em> spp, <em>Candida albicans</em>, or <em>Mycobacteria</em> spp</td>
</tr>
<tr>
<td>Populations in which tuberculosis is prevalent</td>
<td><em>Mycobacterium tuberculosis</em></td>
</tr>
<tr>
<td>Populations in which these pathogens are endemic</td>
<td><em>Brucella</em> spp, <em>Coxiella burnetii</em>, fungi found in specific geographical areas (coccidiodomycosis, blastomycosis, histoplasmosis)</td>
</tr>
</tbody>
</table>

*Table 1: Microorganisms isolated from patients with osteomyelitis and their clinical associations*

- **Note:** source of infection generally determines organism
**Evaluation**

**Testing options**

- **Blood tests:**
  - CBC (the ubiquitous, over-played, and over-relied-upon WBC)
  - Inflammatory markers
    - ESR – traditional marker
    - CRP – tends to rise earlier in illness, probably more reliable in following response to treatment
  - Blood cultures – attempt to isolate the organism (although bone biopsy with culture is gold standard)

- **Imaging:**
  - Plain films
  - US
  - CT
  - MRI
  - Bone scan
Evaluation

- **Plain films:**
  - cortical erosions
  - bony radiolucencies/destruction
  - periosteal reaction
  - soft tissue gas or swelling
  - narrowing/widening joint spaces

- May not see changes until 1-2 weeks into an episode of acute osteomyelitis


Source undetermined
Evaluation

Plain films:
- Sensitivity: 28% - 93%
- Specificity: 33% - 92%
- +LR: ~2.2
- -LR: ~0.5

Evaluation

- **MRI:**
  - Superior study
  - Sensitivity: 29% - 100%
  - Specificity: 67% - 95%
  - +LR: ~7.2
  - -LR: ~0.04

- **Bone scan:**
  - Uses a radiotracer
  - Takes time to perform (>6 hours) = not an ED test

- **CT**
  - Not as good as MRI which can detect osteomyelitis earlier
  - However, can be used to evaluate extent of bony involvement and can be used to follow response to therapy

---

No studies addressed aspects of history that are helpful

Physical exam features:

* Ulcer area larger than 2 cm²: +LR 7.2, -LR 0.5
  * Presence/absence of erythema, swelling, purulence doesn’t make a difference

* Probe-to-bone test: +LR 6.4,
  -LR 0.4

* Clinical gestalt: +LR 5.5, -LR 0.5

Temperature useless

Diabetic Foot – Osteomyelitis

- **Laboratory tests:**
  - ESR >70: +LR 11, -LR 0.35
  - WBC useless
  - Swab culture useless, doesn’t reliably detect bone organism
  - ?CRP

- **Imaging tests:**
  - Plain films: +LR 2.3, -LR 0.6
  - MRI (foot/ankle): +LR 5.1, -LR 0.12

Treatment

- **Antibiotics (in the ED)**
  - But often times paired with eventual surgical source control

- **No clear guidelines because no clear evidence**

- **Open fracture prophylaxis**

- **Clinical bottom line: choice of initial antibiotics depends on likely pathogen (like all of our clinical scenarios)**

Treatment

- 2011 EMRA Antibiotic Guide

**OSTEOMYELITIS**

**Adult: Hematogenous Spread**

Common Organisms: *Staphylococcus spp.*, *Streptococcus spp.*, *Pseudomonas spp.* in VNA, gram negative species

- Nafcillin/Oxacillin 2g IV six times daily OR Cefazolin 2g IV three times daily PLUS
  - If MRSA suspected, Vancomycin 15-20mg/kg IV two times daily
  - If gram negative rods suspected
    - Ceftriaxone 2g IV once daily (or other 3rd generation Cephalosporin)
    - If *Pseudomonas* suspected ADD
      - Cefepime 2g IV two-three times daily OR
      - Ciprofloxacin 400mg IV three times daily OR 750mg PO two times daily OR
      - Levofloxacin 750mg IV/PO once daily

**Adult: Sickle Cell Disease**

Common Organisms: *S. aureus*, *Salmonella*, gram negative species

- Vancomycin 15-20mg/kg IV two times daily PLUS
  - Ciprofloxacin 400mg IV three times daily or 750mg PO two times daily OR
  - Levofloxacin 750mg IV/PO once daily

**Adult: Diabetes Mellitus or Vascular Insufficiency**

Common Organisms: *Polymicrobial*

- For mild disease
  - Amoxicillin/Clavulanate 875mg PO two times daily
  - Clindamycin 450mg PO three times daily
- Vancomycin 15-20mg/kg IV two times daily OR Linezolid 600mg IV two times daily PLUS
  - Piperacillin/Tazobactam 4.5g IV three times daily OR
  - Ampicillin/Subactam 3g IV four times daily OR
  - Levofloxacin 750mg IV once daily AND Metronidazole 500mg IV three times daily

**Adult: Puncture Wound (nail through shoe)**

Common Organisms: *Pseudomonas spp.*, *S. aureus*

- Ciprofloxacin 400mg IV three times daily OR 750mg PO two times daily
- Levofloxacin 750mg IV/PO once daily
- Cefepime 2g IV two-three times daily
- Ceftazidime 2g IV three times daily

**Treatment**

- **DISCITIS/VERTEBRAL OSTEOMYELITIS**

  Common Organisms: *S. aureus, Streptococcus spp., Pseudomonas spp., E. coli, M. tuberculosis*
  - Vancomycin 15-20mg/kg IV two times daily (10mg/kg IV four times daily)
  - AND Nafcillin/Oxacillin 2g IV six times daily (50mg/kg IV four times daily)
  - If *Pseudomonas* or other gram negative suspected, ADD Gentamicin 5-7mg/kg (2.5mg/kg) IV

- **OPEN FRACTURES**

  Common Organisms: *S. aureus, S. epidermidis, polymicrobial*

  **Open Fracture**
  - Cefazolin 2g (30mg/kg) IV three times daily
  - Vancomycin 15-20mg/kg IV two times daily (10mg/kg IV four times daily)
  - Ciprofloxacin 400mg IV two times daily (for Grade I/II fractures only – not in peds)
  - If heavily contaminated or Grade III fracture, ADD Gentamicin 5-7mg/kg IV once daily (2.5mg/kg IV three times daily)
  - If concern for *Clostridia* due to farm injury, soil contamination, or vascular injury, ADD
    - Penicillin G 4 million units IV six times daily (100,000 units/kg IV four times daily) PLUS
      - Metronidazole 500mg IV three times daily (7.5mg/kg IV four times daily) OR
      - Clindamycin 600-900mg IV three times daily (7.5mg/kg IV four times daily)
    - Piperacillin/Tazobactam 4.5g (80mg/kg) IV three times daily for monotherapy
Joint Infections

- Trauma in the most likely cause of an acute monoarticular arthritis in the ED setting

- Clinical bottom line:
  - Distinguish between septic arthritis and other acute arthritis

- Important because the infection can destroy the joint within a matter of days

Joint Infections

- Polyarticular infectious arthritis:
  - Lyme disease (*Borrelia burgdorferi*)
    - Transmitted by tick bite
    - Pathognomonic rash: erythema chronicm migrans
    - Can develop arthritis in ~50% of patients
    - Occurs late in illness (weeks to years)
    - Usually afebrile with asymmetric arthritis, primarily affecting large joints
    - Treat with extended course of oral antibiotics (doxycycline or amoxicillin)
    - Admit if patient has additional neurologic or cardiac manifestations for treatment with IV antibiotics

Joint Infections

- Septic arthritis occurs primarily in large peripheral joints
  - 50% of the time in the knee, can also be wrist, ankles, hips
  - IV drug users seem to have predilection for axial joints as well (sternoclavicular, sternomanubrial)

- 2 different kinds of septic arthritis:
  - Nongonococcal
  - Gonococcal – from bacteremic spread of sexually transmitted infection (disseminated gonococcal infection), often associated with a polyarthritis/tenosynovitis, skin lesions, age <40, often synovial fluid culture negative

Joint Infections

How do you get septic arthritis?:

- (1) Hematologic spread
  - Most common
  - Related to bacteremia of any cause
    - More likely to occur with underlying joint disease
      (rheumatoid arthritis, osteoarthritis, etc)

- (2) Direct inoculation
  - Less common
  - Examples
    - Trauma or bite
    - Surgery
    - Pre-existing osteomyelitis
    - Overlying skin infections
Evaluation

History

- No studies specifically addressed both sensitivity and specificity
- Joint pain and swelling is suggestive of septic arthritis

Physical exam

- Fever fairly useless
- No findings or maneuvers that have been studied that help (e.g., range of motion, degrees of swelling, etc)

Evaluation

- **Tests**
  - Serum studies
    - CBC
    - Blood cultures
    - Inflammatory markers (CRP, ESR)
    - Uric acid level?

- **Imaging**
  - Plain films

- **Joint fluid analysis**

### Table 2. Likelihood Ratios for Risk Factors, Signs, and Serum Laboratory Values

<table>
<thead>
<tr>
<th>Source</th>
<th>Sensitivity, %</th>
<th>Specificity, %</th>
<th>Relative Risk</th>
<th>Positive (95% CI)</th>
<th>Negative (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Risk factors</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age &gt;80 y</td>
<td>19</td>
<td>95</td>
<td>4.1</td>
<td>3.5 (1.8-7.0)</td>
<td>0.86 (0.73-1.00)</td>
</tr>
<tr>
<td>Diabetes mellitus</td>
<td>12</td>
<td>96</td>
<td>2.8</td>
<td>2.7 (1.0-6.9)</td>
<td>0.93 (0.83-1.00)</td>
</tr>
<tr>
<td>Rheumatoid arthritis</td>
<td>68</td>
<td>73</td>
<td>5.4</td>
<td>2.5 (2.0-3.1)</td>
<td>0.45 (0.32-0.72)</td>
</tr>
<tr>
<td>Recent joint surgery</td>
<td>24</td>
<td>96</td>
<td>8.4</td>
<td>6.9 (3.8-12.0)</td>
<td>0.78 (0.64-0.94)</td>
</tr>
<tr>
<td>Hip or knee prosthesis</td>
<td>35</td>
<td>89</td>
<td>4.1</td>
<td>3.1 (2.0-4.9)</td>
<td>0.73 (0.57-0.93)</td>
</tr>
<tr>
<td>Skin infection</td>
<td>32</td>
<td>88</td>
<td>3.6</td>
<td>2.8 (1.7-4.5)</td>
<td>0.76 (0.60-0.96)</td>
</tr>
<tr>
<td>Hip or knee prosthesis and skin infection</td>
<td>24</td>
<td>98</td>
<td>18</td>
<td>15.0 (8.1-28.0)</td>
<td>0.77 (0.64-0.93)</td>
</tr>
<tr>
<td>HIV-1 infection</td>
<td>79</td>
<td>50</td>
<td>3.2</td>
<td>1.7 (1.0-2.8)</td>
<td>0.47 (0.25-0.90)</td>
</tr>
<tr>
<td><strong>Physical examination</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fever</td>
<td>46</td>
<td>31</td>
<td>NA</td>
<td>0.67 (0.43-1.00)</td>
<td>1.7 (1.0-3.0)</td>
</tr>
<tr>
<td><strong>Serum laboratory values</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Abnormal peripheral WBC count</td>
<td>90</td>
<td>36</td>
<td>NA</td>
<td>1.4 (1.1-1.8)</td>
<td>0.28 (0.07-1.10)</td>
</tr>
<tr>
<td>Erythrocyte sedimentation rate</td>
<td>95</td>
<td>29</td>
<td>NA</td>
<td>1.3 (1.1-1.8)</td>
<td>0.17 (0.20-1.30)</td>
</tr>
<tr>
<td>C-reactive protein</td>
<td>77</td>
<td>53</td>
<td>NA</td>
<td>1.6 (1.1-2.5)</td>
<td>0.44 (0.24-0.82)</td>
</tr>
</tbody>
</table>

Abbreviations: CI, confidence interval; HIV-1, human immunodeficiency virus type 1; NA, not applicable; WBC, white blood cell.
*Defined as abnormal peripheral WBC count of more than 10,000/μL, elevated erythrocyte sedimentation rate of more than 30 mm/h, and elevated C-reactive protein of more than 100 mg/L.

---

**Serum laboratory testing of limited value**

Table 4. Test Characteristics of Synovial Fluid Studies

<table>
<thead>
<tr>
<th>Source</th>
<th>Sensitivity</th>
<th>Specificity</th>
<th>Positive (95% CI)</th>
<th>Negative (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>WBCs &gt;100,000/μL</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Söderquist et al, 1998</td>
<td>30</td>
<td>93</td>
<td>4.7 (1.1-20.0)</td>
<td>0.75 (0.59-0.96)</td>
</tr>
<tr>
<td>Krey et al, 1979</td>
<td>40</td>
<td>99</td>
<td>42.0 (13.0-138.0)</td>
<td>0.61 (0.49-0.77)</td>
</tr>
<tr>
<td>Shmerling et al, 1990 (prospective)</td>
<td>13</td>
<td>100</td>
<td>31.0 (1.1-914.0)</td>
<td>0.84 (0.64-1.10)</td>
</tr>
<tr>
<td>Shmerling et al, 1990 (retrospective and prospective)</td>
<td>19</td>
<td>100</td>
<td>37.0 (2.0-687.0)</td>
<td>0.81 (0.68-0.97)</td>
</tr>
<tr>
<td>Kortekangas et al, 1992</td>
<td>25</td>
<td>98</td>
<td>12.0 (1.5-97.0)</td>
<td>0.77 (0.61-1.00)</td>
</tr>
<tr>
<td><strong>Summary</strong></td>
<td>29</td>
<td>99</td>
<td>28.0 (12.0-66.0)</td>
<td>0.71 (0.64-0.79)</td>
</tr>
<tr>
<td><strong>WBCs &gt;50,000/μL</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Söderquist et al, 1998</td>
<td>58</td>
<td>74</td>
<td>2.2 (1.1-4.4)</td>
<td>0.57 (0.36-0.90)</td>
</tr>
<tr>
<td>Krey et al, 1979</td>
<td>70</td>
<td>92</td>
<td>8.7 (5.7-13.0)</td>
<td>0.33 (0.22-0.51)</td>
</tr>
<tr>
<td>Shmerling et al, 1990 (prospective)</td>
<td>50</td>
<td>97</td>
<td>15.0 (4.0-58.0)</td>
<td>0.52 (0.26-1.10)</td>
</tr>
<tr>
<td>Shmerling et al, 1990 (retrospective and prospective)</td>
<td>63</td>
<td>97</td>
<td>19.0 (6.0-62.0)</td>
<td>0.38 (0.23-0.63)</td>
</tr>
<tr>
<td>Kortekangas et al, 1992</td>
<td>53</td>
<td>86</td>
<td>3.8 (1.8-8.4)</td>
<td>0.54 (0.40-0.80)</td>
</tr>
<tr>
<td><strong>Summary</strong></td>
<td>62</td>
<td>92</td>
<td>7.7 (5.7-11.0)</td>
<td>0.42 (0.34-0.51)</td>
</tr>
<tr>
<td><strong>WBCs &gt;25,000/μL</strong></td>
<td></td>
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<td>62</td>
<td>1.9 (1.2-2.9)</td>
<td>0.46 (0.24-0.87)</td>
</tr>
<tr>
<td><strong>Summary</strong></td>
<td>77</td>
<td>73</td>
<td>2.9 (2.5-3.4)</td>
<td>0.32 (0.23-0.43)</td>
</tr>
<tr>
<td><strong>Polymorphonuclear cells ≥90%</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Söderquist et al, 1998</td>
<td>92</td>
<td>78</td>
<td>4.2 (3.3-5.3)</td>
<td>0.10 (0.04-0.26)</td>
</tr>
<tr>
<td>Krey et al, 1979</td>
<td>63</td>
<td>82</td>
<td>3.4 (1.7-6.4)</td>
<td>0.46 (0.18-1.20)</td>
</tr>
<tr>
<td>Shmerling et al, 1990 (prospective)</td>
<td>58</td>
<td>83</td>
<td>3.3 (1.9-5.9)</td>
<td>0.51 (0.32-0.82)</td>
</tr>
<tr>
<td>Shmerling et al, 1990 (retrospective and prospective)</td>
<td>57</td>
<td>68</td>
<td>1.8 (1.0-3.0)</td>
<td>0.63 (0.39-1.00)</td>
</tr>
<tr>
<td><strong>Summary</strong></td>
<td>73</td>
<td>79</td>
<td>3.4 (2.8-4.2)</td>
<td>0.34 (0.25-0.47)</td>
</tr>
</tbody>
</table>

Abbreviations: CI, confidence interval; WBC, white blood cell.

### Evaluation

#### Table 5. Other Synovial Fluid Laboratory Test Results

<table>
<thead>
<tr>
<th>Source</th>
<th>Sensitivity, %</th>
<th>Specificity, %</th>
<th>Likelihood Ratio (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Positive</td>
</tr>
<tr>
<td>Low glucose*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Söderquist et al, 44 1998</td>
<td>64</td>
<td>85</td>
<td>4.2 (1.4-13.0)</td>
</tr>
<tr>
<td>Shmerling et al, 46 1990 (prospective)</td>
<td>38</td>
<td>85</td>
<td>2.5 (0.87-6.90)</td>
</tr>
<tr>
<td>Shmerling et al, 46 1990 (retrospective and prospective)</td>
<td>44</td>
<td>85</td>
<td>2.9 (1.5-5.6)</td>
</tr>
<tr>
<td>Summary</td>
<td>51</td>
<td>85</td>
<td>3.4 (2.2-5.1)</td>
</tr>
<tr>
<td>Protein &gt;3.0 g/dL</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shmerling et al, 46 1990 (prospective)</td>
<td>50</td>
<td>46</td>
<td>0.93 (0.45-1.90)</td>
</tr>
<tr>
<td>Shmerling et al, 46 1990 (retrospective and prospective)</td>
<td>48</td>
<td>46</td>
<td>0.89 (0.55-1.40)</td>
</tr>
<tr>
<td>Summary</td>
<td>48</td>
<td>46</td>
<td>0.90 (0.61-1.30)</td>
</tr>
<tr>
<td>LDH &gt;250 U/L</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shmerling et al, 46 1990 (prospective)</td>
<td>100</td>
<td>51</td>
<td>1.9 (1.5-2.5)</td>
</tr>
<tr>
<td>Shmerling et al, 46 1990 (retrospective and prospective)</td>
<td>100</td>
<td>50</td>
<td>1.9 (1.5-2.5)</td>
</tr>
<tr>
<td>Summary</td>
<td>100</td>
<td>51</td>
<td>1.9 (1.5-2.5)</td>
</tr>
</tbody>
</table>

Abbreviations: CI, confidence interval; LDH, lactate dehydrogenase.

*Defined in the different studies as serum/synovial fluid glucose ratio of less than 0.5 or 0.75, synovial fluid glucose level of less than 1.5 mmol/mL, or both. To convert synovial fluid glucose to g/dL, divide by 0.0555.

Clinical bottom line: history and physical exam are not able to substantially change the pretest probability of disease with an acutely painful and swollen joint.

Requires arthrocentesis with joint fluid analysis:

- WBC count and %PMN
- Synovial fluid protein, glucose, LDH not informative
- Caution: a low synovial WBC count cannot completely rule out the possibility of septic arthritis

- **Synovial fluid should be sent for:**
  - *Cell count and differential*
  - *Gram stain and culture*
  - *Crystals*
  - *Protein, glucose*

Is there a way to determine if a patient has gout as a cause of their acute monoarticular arthritis?

Prospective study of patients in Dutch family practice office setting

- Signs/symptoms of acute monoarticular arthritis, irrespective of previous similar episodes
- Collected detailed information on history, PE, meds, etc
- Underwent joint aspiration within 24 hours
- Created scoring system to predict possibility of gout

7 variables to score, 13 total points

Authors suggest:
- ≤4 or less rules out gout
- ≥8 or more rules in gout

In the ED:
- High score (≥ 8) probably rules in gout and can treat empirically without arthrocentesis

Table 4. Clinical Scores of the Final Diagnostic Rule After Transforming the Regression Coefficients Shrunken by the Bootstrap Method

<table>
<thead>
<tr>
<th>Predefined Variable</th>
<th>Regression Coefficient After Shrinkage</th>
<th>Clinical Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male sex</td>
<td>1.01</td>
<td>2.0</td>
</tr>
<tr>
<td>Previous patient-reported arthritis attack</td>
<td>0.95</td>
<td>2.0</td>
</tr>
<tr>
<td>Onset within 1 d</td>
<td>0.03</td>
<td>0.5</td>
</tr>
<tr>
<td>Joint redness</td>
<td>0.40</td>
<td>1.0</td>
</tr>
<tr>
<td>MTP1 involvement</td>
<td>1.25</td>
<td>2.5</td>
</tr>
<tr>
<td>Hypertension or ≥1 cardiovascular diseasesa</td>
<td>0.72</td>
<td>1.5</td>
</tr>
<tr>
<td>Serum uric acid level &gt; 5.88 mg/dL</td>
<td>1.85</td>
<td>3.5</td>
</tr>
<tr>
<td>Maximum score</td>
<td>6.21</td>
<td>13.0</td>
</tr>
</tbody>
</table>

Abbreviation: MTP1, metatarsophalangeal joint.
SI conversion factor: To convert serum uric acid level to micromoles per liter, multiply by 59.485.

aAngina pectoris, myocardial infarction, heart failure, cerebrovascular accident, transient ischemic attack, or peripheral vascular disease.

http://www.umcn.nl/goutcalc

Treatment

- Irrigation in the OR

- Antibiotics

### SEPTIC ARTHRITIS

**Adult: Non-gonococcal**

- Common Organisms: *S. aureus, Streptococcus spp., Pseudomonas spp., Enterococcus, B. burgdorferi, Mycobacterium*
  - Vancomycin 15-20mg/kg IV two times daily PLUS
    - Cefotaxime 1g IV three times daily OR
    - Ceftriaxone 2g IV once daily OR
    - Ciprofloxacin 400mg IV three times daily OR
    - Levofloxacin 750mg IV once daily

**Adult: Gonococcal**

- Ceftriaxone 1g IV once daily
- Ciprofloxacin 400mg IV two times daily (based on local resistance patterns)

**Prosthesis Infection**

- Common Organisms: *S. aureus, Pseudomonas spp., Propionibacteriaceae, Streptococcus spp.*
  - Rifampin 600mg PO/IV once daily PLUS
    - Vancomycin 15-20mg/kg IV two times daily OR
    - Ciprofloxacin 400mg IV three times daily OR
    - Levofloxacin 750mg IV once daily
Arthrocentesis

- What joints do we do in the ED?
- Needle size?
- Do you go through an area of cellulitis (redness) or not?
- Do you inject (steroids) or only aspirate?
- Risks?
  - Iatrogenic septic arthritis: 1 in 2,000 to 1 in 15,000 (UpToDate)
- How much fluid to you take off?
- What do you do if you get a “dry” tap?
  - Use US guidance?
  - Try a different approach
Arthrocentesis

- Sterile procedure

Medial approach

Lateral approach

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Arthrocentesis

Elbow arthrocentesis

The landmarks for injection or aspiration of the elbow joint are the radial head, lateral epicondyle, and tip of the olecranon. A needle inserted into the center of the triangle penetrates only the anconeus muscle and capsule before entering the joint. The patient is supine with the elbow flexed to 90 degrees and the hand tucked under the buttock. A triangle is made with points at the lateral epicondyle, radial head, and olecranon process. The needle is inserted in the center of the triangle, perpendicular to the skin and parallel to the radial head, 3/4 to 1 inch deep.

Photo courtesy of Bruce C Anderson, MD.

Arthrocentesis

- Is it safe to do on someone taking warfarin?

- Prospective study of patients in rheumatology office setting with most recent INR < 4.5
  - Typical needle sizes (18 gauge for knee, 20 for other procedures, 25 for the MTP joint)
  - Telephone follow up at 4 weeks
  - No patients experienced self-reported joint or soft tissue hemorrhage

Outline

- Background
- Small group discussion
- Evidence based lecture
- Final thoughts and questions/comments
Objectives

- Know when to suspect osteomyelitis
- Know how to evaluate someone with a monoarticular arthritis
- Know how to treat osteomyelitis and septic arthritis
- Know how to competently perform joint aspirations
Case #1
A 64 year old woman with a history of diabetes presents to your ED with a non-healing right foot ulcer. She has a small wound over the 4th metatarsal head for last 3 weeks. She was prescribed a 10 day course of antibiotics by her PCP which she just completed. She comes in to the ED because it has not healed, it’s the weekend, and she’s concerned. On exam the wound is round, 3 cm in diameter, with redness and swelling. Vital signs are: bp 155/85, pulse 85, temp 37.5, pulse ox 99% on RA.

Questions:
1. What do you want to do diagnostically?, therapeutically?
2. Would you do anything differently now?

Case #2
A 57 year old man with a history of hypertension and alcoholism presents with a swollen knee. He noticed development of this over the last 24 hours. No other joints hurt. He denies fever or rashes. He recalls no recent trauma. He has no history of arthritis. He denies any history of similar episodes of painful joints. Exam shows a swollen, red, and warm right knee joint. He is neurovascularly intact and without associated rash. Vital signs are: bp 155/85, pulse 85, temp 37.5, pulse ox 99% on RA.

Questions:
1. What do you want to do diagnostically?, therapeutically?
2. Would you do anything differently now?
Final Thoughts

■ **Osteomyelitis: goals in evaluation**
  - Decide if someone has clinical concern for osteomyelitis, think about specific high risk clinical scenarios
  - Understand (limitations) testing options
  - Treat based on likely pathogens
  - Disposition without definitive diagnosis

■ **Septic arthritis: goals in evaluation**
  - Decide if someone has clinical concern for septic arthritis
  - Understand testing options: arthrocentesis or not?
  - Know how to competently perform an arthrocentesis

■ **Questions/comments?**