Project: Ghana Emergency Medicine Collaborative

**Document Title:** Bone and Joint Infections

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## **Bone and Joint Infections**

#### Keith Kocher, MD MPH

April 4<sup>th</sup>, 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 ぐ 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



### 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:

Butalia S, et al. Does this patient with diabetes have osteomyelitis of the lower extremity? JAMA; 2008:299(7): 806-813.

Margaretten ME, et al. Does this adult patient have septic arthritis? JAMA; 2007:297(13):1478-1488.

Janssens HJEM, et al. A diagnostic rule for acute gouty arthritis in primary care without joint fluid analysis? Archives of Internal Medicine; 2010:170(13):1120-1126.

## 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



### 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 4<sup>th</sup> 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



### 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 preadolescent 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

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

#### 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
- <u>Pseudomonas</u> related osteomyelitis: puncture wound to heel (osteomyelitis of the calcaneus)
- Sternal osteomyelitis: after cardiac surgery
- Diabetic foot ulcer related

## Microorganisms

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

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

Lewis DP and Waldvogel FA. Osteomyelitis. The Lancet, 2004;364:369-379.

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Note: source of infection generally determines organism

#### 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

#### 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



Learch TJ and Gentili A. Advanced Imaging of the Diabetic Foot and Its Complications. *American Journal of Roentgenology*; 2000:175(5):1328.

Source undetermined

Plain films:
 Sensitivity: 28% - 93%
 Specificity: 33% - 92%

+LR: ~2.2
-LR: ~0.5





LearningRadiology.com

Learch TJ and Gentili A. Advanced Imaging of the Diabetic Foot and Its Complications. *American Journal of Roentgenology*; 2000:175(5):1328.

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Source undetermined

#### \*MRI:

- Superior study
- Sensitivity: 29% 100%
- Specificity: 67% 95%

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

- +LR: ~7.2
- -LR: ~0.04

**US:** 

Useful to look for joint effusion for aspiration

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

Learch TJ and Gentili A. Advanced Imaging of the Diabetic Foot and Its Complications. *American Journal of Roentgenology*; 2000:175(5):1328.

## Diabetic Foot – Osteomyelitis



THE RATIONAL CLINICAL EXAMINATION

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CLINICIAN'S CORNER

Does This Patient With Diabetes Have Osteomyelitis of the Lower Extremity?

- No studies addressed aspects of history that are helpful
  - Physical exam features:
    - \*Ulcer area larger than 2 cm<sup>2</sup>: +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

Butalia S, et al. Does this patient with diabetes have osteomyelitis of the lower extremity? *JAMA*; 2008:299(7):806-813.

## 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

Butalia S, et al. Does this patient with diabetes have osteomyelitis of the lower extremity? *JAMA*; 2008:299(7):806-813, and Kapoor A, et al. MRI for diagnosing foot osteomyelitis. *Archives of Internal Medicine*; 2007:167:125-132.

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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)

Lazzarini L, et al. Antibiotic treatment of osteomyelitis: what have we learned from 30 years of clinical trials? *International Journal of Infectious Diseases*; 2005:9:127-138.

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#### 2011 EMRA Antibiotic Guide

#### **OSTEOMYELITIS**

#### Adult: Hematogenous Spread

Common Organisms: Staphylococcus spp., Streptococcus spp., Pseudomonas spp. in IVDA, 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

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Common Organisms: S. aureu s, 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/Sulbactam 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 Organism's: 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

Levine BJ, ed. 2011 EMRA Antibiotic Guide; Irving, TX:2010.

#### **2011 EMRA Antibiotic Guide**

#### **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 (fc r 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

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Levine BJ, ed. 2011 EMRA Antibiotic Guide; Irving, TX:2010.

 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

Table 1. Differential Diagnosis Of Joint Pain According To Classification.

Monoarticular

Osteoarthritis Septic arthritis Gout Pseudogout Trauma Hemarthrosis

Polyarticular Rheumatoid arthritis Systemic lupus erythematosus Viral arthritis Rheumatic fever Reiter's syndrome Lyme disease Drug-induced

Periarticular Bursitis Tendinitis Cellulitis

Rudor S and Lewiss RE. Arthritis in the ED: detecting high-risk etiologies and providing effective pain management. *Emergency Medicine Practice*; 2004:6(10).

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#### 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)



Wikimedia Commons

- 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

Rudor S and Lewiss RE. Arthritis in the ED: detecting high-risk etiologies and providing effective pain management. *Emergency Medicine Practice*; 2004:6(10). 31

- 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</p>

- How do you get septic arthritis?:
- (1) Hematologic spread

(2) Direct innoculation

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

Less common

- Examples
  - **Trauma or bite**
  - Surgery
  - Pre-existing osteomyelitis
  - Overlying skin infections

JAMA The Journal of the American Medical Association

History

THE RATIONAL CLINICAL EXAMINATION **CLINICIAN'S CORNER** 

#### Does This Adult Patient Have Septic Arthritis?

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# 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)

#### **Tests**

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

ImagingPlain films

#### Joint fluid analysis

Margaretten ME, et al. Does this adult patient have septic arthritis? *JAMA*; 2007:297(13):1478-1488. <sup>35</sup>

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

			Sensitivity, %	Specificity, %	Relative Risk	Likelihood Ratio (95% Cl)	
		Source				Positive	Negative
Ri	sk faatare						
	Age >80 y	Kaandorp et al, <sup>42</sup> 1995	19	95	4.1	3.5 (1.8-7.0)	0.86 (0.73-1.00)
	Diabetes mellitus	Kaandorp et al, <sup>42</sup> 1995	12	96	2.8	2.7 (1.0-6.9)	0.93 (0.83-1.00)
	Rheumatoid arthritis	Kaandorp et al, <sup>42</sup> 1995	68	73	5.4	2.5 (2.0-3.1)	0.45 (0.32-0.72)
	Recent joint surgery	Kaandorp et al, <sup>42</sup> 1995	24	96	8.4	6.9 (3.8-12.0)	0.78 (0.64-0.94)
	Hip or knee prosthesis	Kaandorp et al, <sup>42</sup> 1995	35	89	4.1	3.1 (2.0-4.9)	0.73 (0.57-0.93)
	Skin infection	Kaandorp et al, <sup>42</sup> 1995	32	88	3.6	2.8 (1.7-4.5)	0.76 (0.60-0.96)
	Hip or knee prosthesis and skin infection	Kaandorp et al, <sup>42</sup> 1995	24	98	18	15.0 (8.1-28.0)	0.77 (0.64-0.93)
	HIV-1 infection	Saraux et al,43 1997	79	50	3.2	1.7 (1.0-2.8)	0.47 (0.25-0.90)
Pł	iysical examination Fever	Kortekangas et al,47 1992	46	31	NA	0.67 (0.43-1.00)	1.7 (1.0-3.0)
Se	num laboratory values*						
	Abnormal peripheral WBC count	Jeng et al, <sup>48</sup> 1997	90	36	NA	1.4 (1.1-1.8)	0.28 (0.07-1.10)
	Erythrocyte sedimentation rate	Jeng et al,48 1997	95	29	NA	1.3 (1.1-1.8)	0.17 (0.20-1.30)
	C-reactive protein	Söderquist et al,44 1998	77	53	NA	1.6 (1.1-2.5)	0.44 (0.24-0.82)
_							

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

Margaretten ME, et al. Does this adult patient have septic arthritis? JAMA; 2007:297(13):1478-1488.

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Table 4. Test Characteristics of	of Synovial Fluid Studies				
			Se	ptic Arthritis	
		Sensitivity,	Specificity, %	Likelihood Ratio (95% Cl)	
	Source			Positive	Negative
WBCs >100 000/µL					
	Söderquist et al,44 1998	30	93	4.7 (1.1-20.0)	0.75 (0.59-0.96
	Krey et al,45 1979	40	99	42.0 (13.0-138.0)	0.61 (0.49-0.77
	Shmerling et al, <sup>46</sup> 1990 (prospective)	13	100	31.0 (1.1-914.0)	0.84 (0.64-1.10
	Shmerling et al, <sup>46</sup> 1990 (retrospective and prospective)	19	100	37.0 (2.0-687.0)	0.81 (0.68-0.97
	Kortekangas et al,47 1992	25	98	12.0 (1.5-97.0)	0.77 (0.61-1.00
	Summary	29	99	28.0 (12.0-66.0)	0.71 (0.64-0.79
WBCs >50 000/µL	Söderguist et al <sup>44</sup> 1998	58	7/	22(11-11)	0.57 (0.36-0.90
	Krev et al <sup>45</sup> 1979	70	92	87 (57-130)	0.33 (0.22-0.51
	Shmerling et al. <sup>46</sup> 1990 (prospective)	50	97	15.0 (4.0-58.0)	0.52 (0.26-1.10
	Shmerling et al, <sup>46</sup> 1990 (retrospective and prospective)	63	97	19.0 (6.0-62.0)	0.38 (0.23-0.63
	Kortekangas et al, <sup>47</sup> 1992	53	86	3.8 (1.8-8.4)	0.54 (0.40-0.80
	Summary	62	92	7.7 (5.7-11.0)	0.42 (0.34-0.51
WBCs >25 000/µL	Södorauist at al 44 1008	72	59	17(1120)	0.47.0.25.0.00
	Krov et al 45 1070	00	71	21(25.2.0)	0.47 (0.23-0.90
	Cherror et al 46 1000 (proppartius)	00	71	3.1 (2.3-3.6)	0.17 (0.06-0.30
	Shmening et al. (* 1990 (prospective)	03	83	3.0 (1.8-7.3)	0.45 (0.17-1.10
	Shmerling et al,45 1990 (retrospective and prospective)	70	83	4.0 (2.4-6.8)	0.36 (0.20-0.66
	Kortekangas et al," 1992	/1	62	1 0 (1 9 9 0)	0.46 (0.94-0.87
	Summary		73	2.9 (2.5-3.4)	0.32 (0.23-0.43
Polymorphonuclear cells ≥90%	Söderquist et al, <sup>44</sup> 1998	92	78	4.2 (3.3-5.3)	0.10 (0.04-0.26
	Krey et al,45 1979	63	82	3.4 (1.7-6.4)	0.46 (0.18-1.20
	Shmerling et al, <sup>46</sup> 1990 (prospective)	58	83	3.3 (1.9-5.9)	0.51 (0.32-0.82
	Shmerling et al, <sup>46</sup> 1990 (retrospective and prospective)	57	68	18(10-30)	0.63 (0.39-1.00
	Summary	73	79	3.4 (2.8-4.2)	0.34 (0.25-0.47

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

Margaretten ME, et al. Does this adult patient have septic arthritis? JAMA; 2007:297(13):1478-1488.

		Sensitivity, %	Specificity,	Likelihood Ratio (95% Cl)	
	Source			Positive	Negative
Low glucose*					
-	Söderquist et al, <sup>44</sup> 1998	64	85	4.2 (1.4-13.0)	0.43 (0.24-0.78
	Shmerling et al, <sup>46</sup> 1990 (prospective)	38	85	2.5 (0.87-6.90)	0.74 (0.43-1.30
	Shmerling et al, <sup>46</sup> 1990 (retrospective and prospective)	44	85	2.9 (1.5-5.6)	0.66 (0.46-0.94
	Summary	51	85	3.4 (2.2-5.1)	0.58 (0.44-0.76
Protein >3.0 g/dL					
	Shmerling et al, <sup>46</sup> 1990 (prospective)	50	46	0.93 (0.45-1.90)	1.10 (0.53-2.20
	Shmerling et al, <sup>46</sup> 1990 (retrospective and prospective)	48	46	0.89 (0.55-1.40)	1.10 (0.68-1.80
	Summary	48	46	0.90 (0.61-1.30)	1.10 (0.76-1.60
LDH >250 U/L					
	Shmerling et al, <sup>46</sup> 1990 (prospective)	100	51	1.9 (1.5-2.5)	0.11 (0.01-1.70
	Shmerling et al, <sup>46</sup> 1990 (retrospective and prospective)	100	50	1.9 (1.5-2.5)	0.09 (0.01-1.40
	Summary	100	51	1.9 (1.5-2.5)	0.10 (0.00-1.60

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.

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Margaretten ME, et al. Does this adult patient have septic arthritis? *JAMA*; 2007:297(13):1478-1488. 38

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

Measure	Normal	Noninflammatory	Inflammatory	Septic	Hemorrhagic
Volume, mL (knee)	<3.5	Often >3.5	Often >3.5	Often >3.5	Usually >3.5
Clarity	Transparent	Transparent	Translucent- opaque	Opaque	Bloody
Color	Clear	Yellow	Yellow to opalescent	Yellow to green	Red
Viscosity	High	High	Low	Variable	Variable
WBC, per mm3	<200	200-2,000	2,000-100,000	15,000- >100,000*	200-2,000
PMNs, percent	<25	<25	≥50	≥75	50-75
Culture	Negative	Negative	Negative	Often positive	Negative
Total protein, g/dL	1-2	1-3	3-5	3-5	4-6
Glucose, mg/dL	Nearly equal to blood	Nearly equal to blood	>25, lower than blood	<25, much lower than blood	Nearly equal to blood

#### Categories of synovial fluid based upon clinical and laboratory findings

\* Lower part of range with infections caused by partially treated or low virulence organisms.

## Synovial fluid should be sent for:

- \*Cell count and differential
- Crystals

- Gram stain and culture
- Protein, glucose

Sholter DE and Russell AS. Synovial fluid analysis and the diagnosis of septic arthritis. UpToDate, 2012. 40

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

Janssens HJEM, et al. A diagnostic rule for acute gouty arthritis in primary care without joint fluid analysis? *Archives of Internal Medicine*; 2010:170(13):1120-1126.

- 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 RuleAfter Transforming the Regression Coefficients Shrunkby the Bootstrap Method

Predefined Variable	Regression Coefficient After Shrinkage	Clinical Score
Male sex	1.01	2.0
Previous patient-reported arthritis attack	0.95	2.0
Onset within 1 d	0.03	0.5
Joint redness	0.40	1.0
MTP1 involvement	1.25	2.5
Hypertension or $\geq 1$ cardiovascular diseases <sup>a</sup>	0.72	1.5
Serum uric acid level >5.88 mg/dL	1.85	3.5
Maximum score	6.21	13.0

Abbreviation: MTP1, metatarsophalangeal joint.

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

<sup>a</sup>Angina pectoris, myocardial infarction, heart failure, cerebrovascular accident, transient ischemic attack, or peripheral vascular disease.

PD-INEL

http://www.umcn.nl/goutcalc

Janssens HJEM, et al. A diagnostic rule for acute gouty arthritis in primary care without joint fluid analysis? Archives of Internal Medicine; 2010:170(13):1120-1126.

#### Irrigation in the OR

#### **SEPTIC ARTHRITIS**

#### Antibiotics

#### 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

- 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

#### Sterile procedure



Source: Tintinalli JE, Stapczynski JS, Ma OJ, Cline DM, Cydulka RK, Meckler GD: *Tintinalli's Emergency Medicine: A Comprehensive Study Guide, 7th Edition:* http://www.accessmedicine.com Copyright © The McGraw-Hill Companies, Inc. All rights reserved.

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#### PD-INEL Medial approach



Source: Tintinalli JE, Stapczynski JS, Ma OJ, Cline DM, Cydulka RK, Meckler GD: *Tintinalli's Emergency Medicine: A Comprehensive Study Guide, 7th Edition:* http://www.accessmedicine.com Copyright © The McGraw-Hill Companies, Inc. All rights reserved.

#### Lateral approach

Burton, JH. "Acute disorders of the joints and bursae," in Tintinalli's Emergency Medicine: A Comprehensive Study Guide, ed. 7. 2011.



Source: Tintinalli JE, Stapczynski JS, Ma OJ, Cline DM, Cydulka RK, Meckler GD: Tintinalli's Emergency Medicine: A Comprehensive Study Guide, 7th Edition: http://www.accessmedicine.com

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#### Ø PD-INEL

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.* 



Burton, JH. "Acute disorders of the joints and bursae," in Tintinalli's Emergency Medicine: A Comprehensive Study Guide, ed. 7. 2011; and, Roberts WN, Jr. Joint aspiration of injection in adults: techniques and indications. UpToDate, 2012.

Is it safe to do on someone taking warfarin?

- Prospective study of patients in rheumatology office setting with most recent INR < 4.5</p>
  - 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

Thumboo J and O' Duffy JD. A prospective study of the safety of joint and soft tissue aspirations and injections in patients taking warfarin sodium? *Arthritis and Rheumatism*; 1998:41(4):736-739.

## Outline



### 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 4<sup>th</sup> 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? 50

## **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?