

Septic Arthritis

Clinical Background

Septic arthritis may be caused by any number of different microorganisms and results in an erythematous, painful, swollen joint.

Epidemiology

- Incidence – 2-10/100,000 in the U.S.
 - 30-40/100,000 in patients with rheumatoid arthritis
 - 40-70/100,000 in patients with prosthetic joints
- Transmission
 - Most cases are hematogenously acquired
 - Other mechanisms for infection
 - Surgery
 - Trauma
 - Percutaneous puncture
 - Spread from contiguous structure infection

Organisms most commonly involved

- Bacteria
 - Children – classically *Haemophilus influenzae* (now rare in vaccinated populations), *Staphylococcus aureus*, group A streptococcus, *Kingella kingae*
 - Neonates – *S. aureus*, group B streptococcus, *Escherichia coli* and other gram negative rods
 - Adults
 - *S. aureus* – most common (50% of cases)
 - *Streptococcus* spp
 - *Neisseria gonorrhoeae* – almost exclusively in sexually active patients
 - Gram-negative bacilli – elderly, IV drug abusers, immunocompromised persons
 - *E. coli*
 - *Pseudomonas aeruginosa*
 - *Salmonella* – sickle cell disease
 - Coagulase negative staphylococci – prosthetic joint
 - *Listeria* (rare) – rheumatoid arthritis and immunosuppression
 - Anaerobes (rare) – prosthetic joints, bite victims
 - Polymicrobial – up to 20% of arthroplasty patients; most commonly methicillin-resistant *Staphylococcus aureus* (MRSA) or anaerobes plus other organisms
- Virus – rare; most common is parvovirus B19
- Fungi – uncommon
 - Endemic dimorphic fungi
 - *Candida* species – immunocompromised persons
- Parasites – rare
 - Helminths
 - *Filaria*

Risk Factors

- Non-prosthetic joint
 - Joint disease

- Rheumatoid arthritis
- Crystalline arthritis
- Osteoarthritis
- Loss of skin integrity
 - Psoriasis
 - Eczema
 - Skin ulcers
- Trauma
 - Surgery – arthroscopy
- Chronic disease
 - Diabetes mellitus
 - Chronic renal/hepatic disease
 - Alcoholism
- Immunosuppression
- Intravenous drug use
- Bacteremia, endocarditis
- Prosthetic joint
 - Patient-related
 - Previous arthroplasty
 - Tobacco abuse
 - Obesity
 - Rheumatoid arthritis
 - Diabetes mellitus
 - Immunosuppression
 - Bacteremia, endocarditis
 - Surgery-related
 - Simultaneous bilateral arthroplasty
 - Operative time >2.5 hours
 - Allogenic blood transfusion
 - Post-operative complications
 - Delayed wound healing
 - Atrial fibrillation
 - Myocardial infarction
 - Urinary tract infection (UTI)
 - Prolonged hospital stay

Pathophysiology

- Organism accesses joint space either directly or hematogenously
- Organisms cause release of inflammatory cell cytokines, proteases
 - Leads to destruction of cartilage, inhibition of new cartilage synthesis, and bone loss

Clinical Presentation

- Fever
- Warm, swollen, erythematous, painful joint
- Prosthetic joint
 - Draining sinus
 - Loosening of prosthesis

- Pain in the area around the prosthesis
- Infection may disseminate systemically

Treatment

- Antibiotics based on
 - Results of gram stain
 - Identification of microorganism
 - Patient presentation

Diagnosis

- Indications for testing
 - Hot, swollen joint with risk factors for septic arthritis
 - Loosening of prosthesis
- Laboratory testing
 - CBC with differential – expect mild to moderate leukocytosis and left shift of cell composition (immature band forms)
 - Results that increase likelihood ratio (LR) for septic arthritis
 - White blood cell count (WBC) >10,000/μL = LR 1.4
 - Neutrophils >90% = LR 3.4
 - Joint aspiration (arthrocentesis) with synovial specimen is cornerstone of diagnosis and should be performed prior to antibiotic administration
 - Should not be performed through overlying cellulitis
 - Macroscopic assessment – viscosity, color, clarity
 - Inflammatory fluid
 - Color – ranges from yellow to greenish
 - Consistency – turbid
 - WBC count with differential
 - Usually >50,000/μL with predominance of neutrophils
 - Same degree of leukocytosis may be noted in gout and pseudogout
 - WBC count >50,000/μL increases likelihood of septic arthritis (LR 7.7 positive; LR 0.42 negative)
 - At least 90% leukocytes (LR 3.4 positive; LR 0.34 negative)
 - <50,000/μL does not rule out septic arthritis
 - Low WBC count common in immunosuppressed patients
 - Prosthetic joints – cell count cutoffs are much lower
 - Knee – WBC >1,700/μL or differential >65% neutrophils
 - Any other joint – WBC >4,200/μL or differential >80% neutrophils
 - Gram stain – low sensitivity; diagnostic if organisms are identified
 - Culture – moderately high sensitivity if positive
 - <50% positive in gonococcal arthritis
 - Recommend diagnosis of gonococcal arthritis be made based on clinical presentation and cultures of cervix, rectum, urethra or oropharynx
 - Crystal scan with polarized microscope – to evaluate for crystalline arthritis
 - Monosodium urate demonstrates negative birefringence
 - Calcium pyrophosphate dehydrate (CPPD) crystals have weak birefringence
 - Not recommended

- Measures of glucose and lactate dehydrogenase (LDH) and/or protein are neither sensitive nor specific
- PCR for specific organisms is not currently recommended
- Erythrocyte sedimentation rate (ESR) and/or C-reactive protein (CRP)
 - Usually elevated; absence of increased concentrations does not exclude septic arthritis
 - ESR >30 mm/hr increases likelihood of septic arthritis (LR 1.3)
 - CRP >10 mg/L (>1.0 mg/dL) increases likelihood of septic arthritis (LR 1.6)
 - CRP ≥13.5 mg/L (≥1.35 mg/dL) in prosthetic joints – sensitivity 73-91%, specificity 81-86%
 - CRP remains elevated up to 2 months post-arthroplasty, then becomes normal
- Cultures
 - Blood cultures
 - Positive in 50-70% of patients with non-gonococcal bacterial arthritis
 - Diagnostic if positive
 - Limited usefulness but may be helpful when ruling out other diseases, particularly in children
 - Tissue cultures
 - Prosthetic joints – multiple intraoperative tissue samples should be sent for culture (ideal is 5-6)
 - Antimicrobial susceptibility testing may help guide therapy
- Serologic testing for [Lyme disease](#) in patient with negative cultures and who resides in an endemic area
- Imaging studies
 - X-ray/ultrasound – useful in detecting the presence of fluid; uncommon for use in diagnosis of osteomyelitis unless late in course of disease
 - Prosthetic joints – periprosthetic lucency, osteolysis or prosthesis migration may be seen
 - Bone scan or MRI – may be necessary to rule out osteomyelitis
 - Sensitive for detecting failed implants but not specific for infection
- Histology
 - Prosthetic joints –intraoperative frozen sections often show >5-10 polymorphonuclear neutrophils per high-power field (PMNs/hpf) which indicates acute inflammation

Differential Diagnosis

- Noninfectious inflammatory arthritis
 - Gout
 - Pseudogout
 - Rheumatoid arthritis
 - Osteoarthritis
 - Reactive arthritis
 - Systemic lupus erythematosus
 - Pediatric
 - Slipped capital femoral epiphysis
 - Legg-Calvé-Perthes disease (LCPD)
 - Avascular necrosis
- Intra-articular injury
 - Fracture
 - Meniscal tear

- Osteonecrosis
- Traumatic effusion
- Hemarthrosis
- Other
 - Sickle cell disease
 - Cancer/tumor
 - Infectious inflammatory arthritis
 - Lyme disease
 - Osteomyelitis
 - Toxic (or transient) synovitis

Monitoring

- ESR, CRP levels – nonspecific, but often elevated during infection

Lab Tests

Indications for Laboratory Testing

Tests generally appear in the order most useful for common clinical situations. For test-specific information, refer to the test number in the ARUP Laboratory Test Directory on the ARUP Web site at www.aruplab.com.

Test Name and Number	Recommended Use	Limitations	Follow Up
CBC with Platelet Count & Automated Differential 0040003 Method: Automated Cell Count with Flow Cell Differential	Initial screening test in septic arthritis Test components include hematocrit, hemoglobin, red and white blood cell count, RDW, platelets, MPV, MCV, MCH, MCHC, number and percentage of granulocytes, basophils, monocytes, and lymphocytes	Normal WBC count does not rule out septic arthritis	
Cell Count, Body Fluid 0095019 Method: Cell Count/Differential	Cornerstone test for differential diagnosis on synovial fluid aspirate		
Crystals 0009500 Method: Manual/Polarized Microscopy	Rule out arthritis due to crystalline deposits		
Gram Stain 0060101 Method: Stain/Microscopic Exam	Identify bacteria in the synovial fluid	Low sensitivity (30-50%) negative gram stain does not rule out septic arthritis	
Sedimentation Rate, Westergren (ESR) 0040325 Method: Westergren	May be helpful in initial diagnosis of septic arthritis	Normal ESR does not rule out septic arthritis	

<p>C-Reactive Protein 0050180</p> <p>Method: Immunoturbidimetric</p>	<p>May be helpful in initial diagnosis of septic arthritis</p>	<p>Normal CRP does not rule out septic arthritis</p>	
<p>Blood Culture 0060102</p> <p>Method: Bactec® 9240, continuous monitoring system. Standard reference procedures for identification of aerobic and anaerobic microorganisms</p>	<p>Identify presence of bacteremia</p>	<p>Positive in 50-70% of patients with septic arthritis</p> <p>Time-sensitive test</p>	
<p>Body Fluid Culture (Includes Gram Stain) 0060101 0060108</p> <p>Method: Standard reference procedures for bacterial stain, aerobic culture, and identification. Anaerobe culture performed on properly collected specimens</p>	<p>80-97% sensitivity for non-gonococcal septic arthritis</p>		
<p>Tissue Culture (Includes Gram Stain) 0060101 0060127</p> <p>Method: Standard reference procedures for bacterial stain, aerobic culture, and identification. Anaerobe culture performed on properly collected specimens.</p>	<p>Identify bacteria in periprosthetic tissues</p>		

Guidelines

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General References

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Reviewed by

Fisher, Mark A., PhD. Medical Director, Bacteriology and Antimicrobials at ARUP Laboratories; Assistant Professor of Pathology, University of Utah

Roberts, William L., MD, PhD. Medical Director, Automated Core Laboratory at ARUP Laboratories; Professor of Pathology, University of Utah

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