



# Taking Control of Septic Joints: A Guide to Joint Infections

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Septic arthritis, an acute, rapidly progressive, destructive infection of a joint, is a common clinical presentation. The knee and hip joints are most commonly involved, but nearly all joints can be infected. Due to the rapid progress of the disease, it is important to diagnose and treat this condition as early as possible. The classification and causative organisms of septic arthritis are shown in Table 1.<sup>1</sup>

## What are the predisposing factors

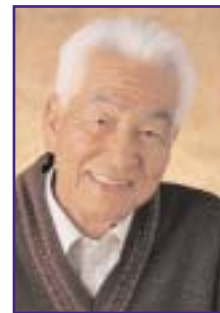
A number of predisposing factors have been defined, including:

- age,
- diabetes mellitus,
- pre-existing arthritis,
- prosthetic joints,
- immunosuppression,
- intravenous drug use,
- skin ulcers/infections,
- intra-articular injections, and
- sexually transmitted diseases.

*Staphylococcus aureus* is the most common cause of native joint septic arthritis. This usually implies significant joint damage and possibly the need for a joint arthroplasty.

## Lewis' Close Call

Lewis, a 76-year-old resident of a long-term care facility is transferred to the emergency department because of a swollen, hot, and painful right knee (Figure 1). The swelling and erythema have been gradually increasing over the past two months. Underlying cognitive impairment is present. A right knee arthroplasty was performed approximately 18 months prior. A radiograph of the right knee reveals that the tibial component had eroded through the tibia (Figure 2). Aspiration of the right knee reveals 75,000 white blood cells/mm<sup>3</sup>, of which 90% were polymorphonuclear cells.



Upon initial presentation, prior to the availability of any results, cephazolin and gentamicin were initiated. Once the results of the cultures became available, the patient was switched to parenteral ceftriaxone.

Due to the patient's overall state, a conservative approach of parenteral antimicrobial therapy was initiated and an above-knee amputation was contemplated. The patient died three days after admission to hospital.

Although bacteria was not observed on direct gram stain, *Escherichia coli* was recovered from the culture. A review of this patient's medical record revealed that he had been admitted with an *E. coli* bacteremia approximately six months ago. The antibiotic susceptibility profiles of the organism recovered from the knee and bloodstream were identical.

It is likely Lewis' previous bacteremia arising from the urinary tract, seeded the prosthetic joint leading to the clinical manifestations observed six months later.

Table 1

## Septic arthritis—microbiology and classification

### Native joints

#### Acute

- *Staphylococcus aureus*
- *Neisseria gonorrhoeae*
- *Streptococcus spp.*
- *Pseudomonas aeruginosa*
- Aerobic and anaerobic gram negative bacilli

#### Chronic

- Mycobacterium
- Fungi
- *Pasteurella multocida*
- *Capnocytophaga spp.*
- *Eikenella spp.*
- *Fusobacterium spp.*

### Prosthetic joints

#### Early ( $\leq$ 1 month of joint replacement)

- *Staphylococcus epidermidis*
- *Staphylococcus aureus*

#### Late ( $>$ 1 month of joint replacement)

- *Staphylococcus aureus*
- *Staphylococcus epidermidis*
- Aerobic gram negative bacilli
- Anaerobic gram negative bacilli
- *Streptococcus spp.*



Figure 1. Clinical presentation of Lewis' right knee.



Figure 2. Radiograph of Lewis' right knee demonstrates bone destruction and erosion of the tibial component through the tibia.

Table 2

## Organisms and clinical associations

### Organism

### Clinical associations

<i>Staphylococcus aureus</i>	Healthy adults, pre-existing joint disease, prosthetic joint, skin break down, injection drug use
<i>Pseudomonas aeruginosa</i>	Injection drug use, skin breakdown
<i>Neisseria gonorrhoeae</i>	Healthy young sexually active adults, associated tenosynovitis, vesicular pustules on erythematous base, late complement deficiency, negative synovial fluid culture/gram stain
<i>Streptococcus spp.</i>	Healthy adults, splenic dysfunction
Aerobic and anaerobic gram negative bacilli	Immunosuppression/ immunocompromized, trauma, gastrointestinal infection
<i>Mycobacterium spp.</i>	Immunosuppression/ immunocompromized, travel to or residence in endemic area
<i>Pasteurella multocida</i> , <i>Capnocytophaga spp.</i>	Cat or dog bite
<i>Streptobacillus moniliformis</i>	Rat bite
<i>Eikenella corrodens</i> , <i>Fusobacterium nucleatum</i>	Human bite

Previous septic arthritis with *S. aureus* is probably the greatest risk factor for joint septic arthritis. Total knee and hip arthroplasties done in this setting have an infection rate of 10% at three years and 26% at 10 years. On average, up to three repeat procedures may be required due to reinfection.

### **What organisms are responsible?**

Table 2 lists the common clinical features associated with organisms causing septic arthritis.<sup>1</sup> Rarer causes of septic arthritis have been reported, but the focus should always be on the most common causes, especially *S. aureus*, which can completely destroy a joint in two to three days.

### *How does septic arthritis present?*

Septic arthritis classically presents as an acutely swollen, red, hot, and tender joint, most commonly the knee or hip. The joint usually displays a severe restriction of motion. Fever may be low to high-grade, and is not usually accompanied by chills or sweats. Thus, there may not be much evidence of a febrile illness. There may also be associated tenosynovitis and bursitis. It is important to keep in mind that an aggressive diagnostic strategy is needed because septic arthritis can totally destroy a joint in 24 to 72 hours.

While prosthetic joint infections may present acutely, they are typically chronic infections, with the patient experiencing persistent pain (worse at night and at rest) from the time the joint was implanted.

### *What's the differential diagnosis?*

There are many conditions that can replicate the clinical presentation of septic arthritis (Table 3). In the common clinical scenario, it will usually come down to a differentiation between septic arthritis or crystal arthropathy. An early joint aspiration for cell count, crystals, gram stain, and culture/sensitivity are paramount for the diagnosis.

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Table 3

#### Differential diagnosis for septic arthritis

- Crystal arthropathy (usually uric acid, less often calcium pyrophosphate dihydrate deposition)
- Erosive variant of osteoarthritis
- Oligoarthritic variant of rheumatoid arthritis
- Viral arthritis
- Lyme's disease
- Reiter's disease
- Hemarthrosis
- Pigmented villonodular synovitis
- Chondrosarcoma
- Meniscal/Ligament tear

### *How is septic joint investigated?*

#### *Septic arthritis*

The best approach to investigating septic arthritis is a stepwise evaluation (Figure 3). Without exception, a joint aspiration should be done immediately. With regards to synovial fluid, there will typically be > 50,000 white blood cells (WBC) with polymorphonuclear leukocytes (PMNs) accounting for  $\geq 75\%$ .<sup>2</sup> However, while WBC counts may be below 28,000 in the setting of malignancy, corticosteroids, or intravenous drug use, the proportion of PMNs remains the same and may even be higher. Protein and glucose determinations are neither specific nor sensitive for septic arthritis. Other diagnostic options are synovial tissue culture and polymerase chain reaction testing for bacterial DNA in synovial fluid and tissue.

Conventional radiographs are relatively insensitive in detecting acute native septic arthritis in adults. Typically, only soft tissue swelling or evidence of a joint effusion is observed and there is usually no osteopenia. Radionuclide imaging in the acute septic

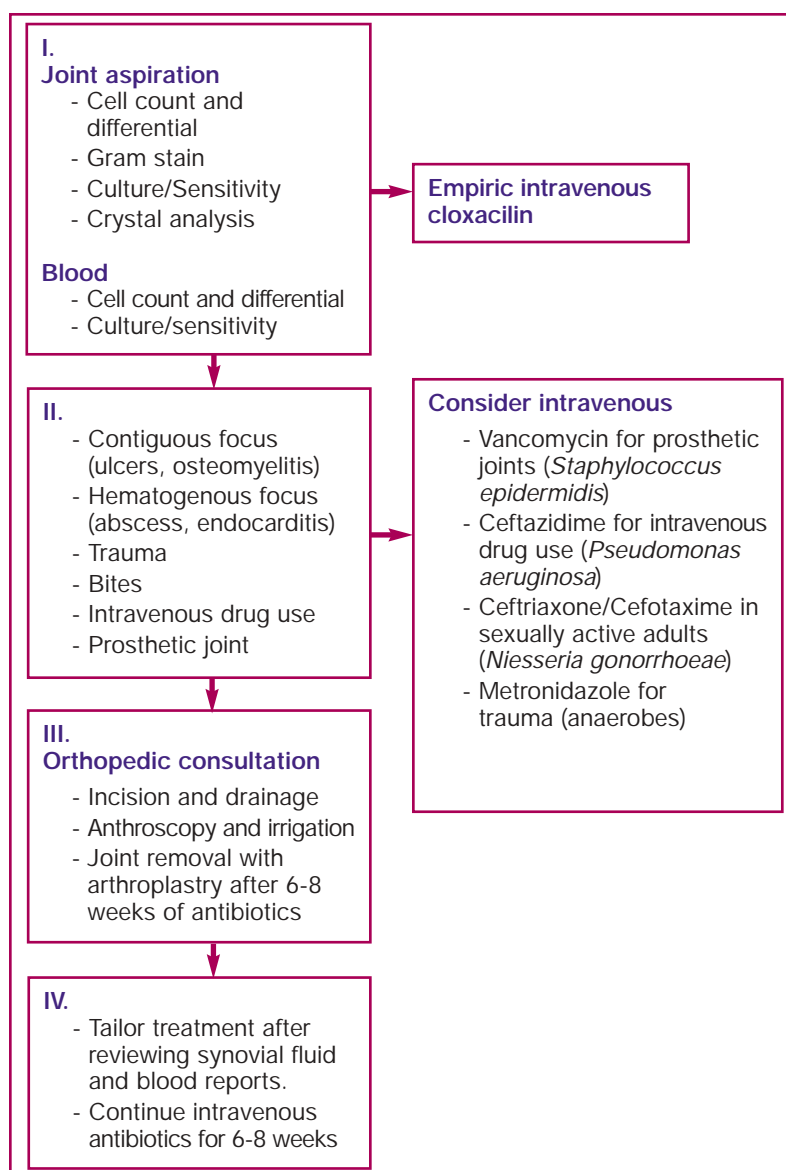


Figure 3: Approach to septic arthritis—diagnosis and management.

native joint is seldom of benefit. In complicated cases, magnetic resonance imaging (MRI) may be helpful to delineate the extent of adjacent soft tissue and bone marrow involvement.

### Prosthetic joint infections

Detecting prosthetic joint infections is a diagnostic challenge. Determining erythrocyte sed-

imentation rate (ESR) and C reactive protein (CRP) levels are helpful. ESR > 35mm/hour and a positive CRP are considered good predictors of prosthetic infection.

Radiographic evaluation is also unreliable in the investigation of a septic prosthetic joint. Joint aspiration should be performed as the initial step in the investigation of the suspect infected prosthesis. The sensitivity and specificity of findings, such as endosteal scalloping and periosteal reaction for infection, range from 25% to 47% and 92% to 96% respectively.<sup>3</sup> Radionuclide imaging, with an overall accuracy of approximately 50% to 70%, may be helpful in the evaluation of the suspect septic prosthetic joint.

### How should a septic joint be managed?

Intravenous antibiotics should be started empirically (Table 4).<sup>4</sup> Since *S.*

*aureus* is the most likely pathogen in native joints, cloxacillin can be used in the majority of cases until gram stain and culture/sensitivity reports arrive. In the case of prosthetic joints, vancomycin should be used because *S. epidermidis* can cause infection in prosthetic joints. If there is a history of injection drug use, the patient should also

## Ruth's Complications

Ruth, 80, underwent a right total hip arthroplasty for osteoarthritis. Over the ensuing two weeks, edema and erythema persisted at the surgical site and a small draining sinus developed (Figures 4 and 5). The hip arthroplasty could be palpated at the base of the sinus. *Staphylococcus aureus* was recovered from the draining material.



The patient was subsequently taken to the operating room for debridement with retention of the prosthesis. She received six weeks of parenteral cloxacillin, followed by one year of oral trimethoprim sulfamethoxazole.

Two years later, Ruth is stable without any further complication.

## Randy's Hands

Randy, a 52-year-old truck driver, presents with an acutely swollen, painful, and erythematous left wrist. He does not have a history of trauma, or sexually transmitted diseases. He does not have any other intercurrent illnesses.



Figure 6 demonstrates his hands. The left hand is grossly edematous, erythematous, and with decreased range of motion because of pain.

Palpation of the joint space produces profound pain. The plain radiograph is unremarkable. Aspiration of the joint yielded negative birefringent crystals, establishing a diagnosis of gout. Culture of the synovial fluid was later reported sterile.

The patient received indomethacin with prompt improvement of his symptoms.

Table 4

### Empiric antimicrobial therapy for treatment of septic arthritis

Patient	Organism	Primary therapy	Alternative therapy
Infants < 3 months	<i>S. aureus</i> , Enterobacteriaceae, Group B streptococcus, <i>N. gonorrhoeae</i>	Cloxacillin and 3rd-generation cephalosporin	Vancomycin (MRSA) and anti-pseudomonal aminoglycoside
Children 3 months-14 years	<i>S. aureus</i> , <i>S. pyogenes</i> and <i>S. pneumoniae</i> , <i>H. influenzae</i> , gram negative bacilli, <i>N. gonorrhoeae</i> and <i>N. meningitidis</i>	Cloxacillin and 3rd generation cephalosporin	Vancomycin (MRSA); Cloxacillin and 3rd generation cephalosporin
Adult-Native joint monoarticular, sexually active	<i>N. gonorrhoeae</i> , <i>S. aureus</i> , <i>streptococci</i> , gram negative bacilli	Cloxacillin and cefotaxime/ceftriaxone	Vancomycin (MRSA) and cefotaxime/ceftriaxone
Adult-Native joint monoarticular not sexually active	<i>S. aureus</i> , <i>streptococci</i> , gram negative bacilli	Cloxacillin and 3rd generation cephalosporin	Vancomycin (MRSA) and 3rd-generation cephalosporin
Adult-Prosthetic joint, post-operative, or intra-articular injection	<i>S. epidermidis</i> , <i>S. aureus</i> , <i>P. aeruginosa</i> Enterobacteriaceae	Vancomycin and ciprofloxacin	Vancomycin and 3rd generation cephalosporin

MRSA: Methicillin-resistant *Staphylococcus aureus*



Figure 4. Ruth's hip, a sterile swab for dimensions.



Figure 5. Ruth's hip with the sterile swab inserted through the draining sinus.



Figure 6. Rick's hands; note the grossly edematous and erythematous left hand.

receive ceftazidime or an appropriate replacement to cover for *P. aeruginosa*.

If the patient is systemically well and a prosthetic joint infection is suspected, it may be better to hold antimicrobial therapy until intraoperative cultures can be obtained. The antibiotics are then started after appropriate tissue samples have been obtained.

Next, look for a contiguous focus of infection, hematogenous focus of infection, evidence of intravenous drug use, trauma/bites, or past tuberculosis, and other joint involvement. Baseline radiographs of affected joint/joints should also be obtained.

An orthopedic consultation should also be obtained immediately, as the affected joint will need surgical debridement.

Intravenous antibiotics can be tailored according to culture/sensitivity reports, but must be continued for at least six weeks.

### **What are the surgical options?**

#### *Native joint septic arthritis*

Joint debridement is an essential component of management. In accessible joints, this may be done arthroscopically if performed early. In inaccessible joints, or if the diagnosis is delayed, an open arthrotomy, drainage, and synovectomy are required.

Patients are especially at risk for post-septic arthritis if the diagnosis and surgical

debridement were delayed. If there is no evidence of ongoing infection, the arthritis can be managed with prosthetic joint replacement. However, these patients are at significantly higher risk of developing a prosthetic infection and, therefore, special precautions, such as antibiotic cementing techniques, are typically employed during implantation.

#### *Prosthetic joint infections*

Surgical intervention for prosthetic infection is essential. The options include:

- debridement and component retention,
- one-stage revision, or
- two-stage revision.

The decision is based on a number of factors including:

- type of infection (acute or chronic),
- virulence of organism,
- clinical condition of patient, and
- condition of the prosthetic joint and surrounding tissues.

#### *Debridement*

The best results are obtained when the organism is of low virulence and treatment is instituted within two weeks of the infection's onset.

#### *One-stage revision*

This is an acceptable option in an elderly or an unwell patient with a low virulence infection.

A minimum of six weeks of intravenous

CME

## Septic Joints

antibiotics is then required.

### *Two-stage revision*

This is currently the most effective intervention for prosthetic infection. The first stage involves prosthetic removal, debridement, and implantation of an antibiotic loaded spacer. The patient is then treated for a minimum of six weeks with intravenous antimicrobial therapy, followed with an antibiotic-free interval prior to the second stage. The joint is then re-implanted in a standard fashion with further antibiotic therapy until operative cultures have been deemed negative. CME

## Take-home message



- Septic arthritis can be a devastating condition, particularly in persons with a prosthetic joint.
- The patient should undergo aspiration of the joint with submission of fluid for gram stain and culture (mycobacteria, bacteria, fungi).
- If a prosthetic joint is involved, immediate consultation with the orthopedic surgeon who implanted the prosthesis should be undertaken.
- ESR > 35mm/hour and a positive C reactive protein are considered good predictors of prosthetic infection.

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