

Infections of the bones and joints

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Infections of the bones and joints

- Infections of the bones and joints include **osteomyelitis** and **septic arthritis**.
- Osteomyelitis is an infection of the bone and includes the periosteum, medullary cavity, and cortical bone.
- Septic arthritis is an infection of the surface of the cartilage that lines the joint and the synovial fluid that lubricates the joint.
- ***Staphylococcus aureus*** is the most common cause of infection in both diseases.
- Children and elderly adults are more likely to contract osteomyelitis and septic arthritis. Children usually develop osteomyelitis of the long bones, and elderly persons usually develop osteomyelitis of the vertebral body in the lumbar region of the spine.

Infections of the bones and joints

- Two different types of arthritis are associated with microbial infections: reactive arthritis and septic (infectious) arthritis.
- Reactive arthritis is a sterile inflammatory process in the joint and can occur following a bacterial infection at a distant site in the body.
- Reactive arthritis (Reiter syndrome) results in asymmetrical polyarthritis (e.g., ankles, knees, feet, and sacroiliitis). The most common cause of this type of arthritis is *Chlamydia trachomatis*. However, *Campylobacter jejuni*, *Yersinia enterocolitica*, *Shigella*, or *Salmonella*, can all cause reactive arthritis. It occurs more commonly in patients with **HLA-B27**.

Infections of the bones and joints

- Septic arthritis are mostly caused by bacteria.
- *S. aureus* is the most common cause of septic arthritis, which is more commonly seen in children and in elderly adults. Patients usually present with a triad of fever, joint pain, and impaired range of motion.
- Unlike osteomyelitis, septic arthritis can rapidly cause permanent damage to the joint and disability for the patient if not treated quickly and aggressively.

Osteomyelitis

- A progressive infection that can include one or multiple parts of the bone (e.g., periosteum, medullary cavity, and cortical bone).
- It is usually a subacute to chronic infection that can cause severe disability if not properly treated.
- If untreated, the disease progresses from inflammatory destruction of bone to necrosis, followed by new bone formation.

Etiology of osteomyelitis

Profile	Common causes
Infants	<i>Staphylococcus aureus</i> , <i>Streptococcus agalactiae</i> (group B Streptococcus), <i>Escherichia coli</i>
Children (1–16 years)	<i>S. aureus</i> , <i>Streptococcus pyogenes</i> (group A Streptococcus), <i>Haemophilus influenzae</i>
>16 years	<i>S. aureus</i> , coagulase-negative staphylococci (e.g., <i>Staphylococcus epidermidis</i>), gram-negative bacilli (e.g., <i>E. coli</i> , <i>Pseudomonas</i> , <i>Serratia</i>)
Diabetic foot	<i>S. aureus</i> , Streptococci, Enterococcus, gram-negative bacilli (e.g., <i>Proteus mirabilis</i> , <i>Pseudomonas</i>), anaerobes (e.g., <i>Prevotella</i> , <i>Bacteroides</i> , <i>Fusobacterium</i> , <i>Peptostreptococcus</i>)

Osteomyelitis

- Elderly persons are more frequently infected with *S. aureus* and gram-negative, rod-shaped bacteria (e.g., *E. coli*, *Pseudomonas aeruginosa*, *Serratia marcescens*), and are more likely to develop gram-negative infections of the bloodstream following diverticulitis, acute prostatitis, and urinary tract infections.
- These organisms are also more likely to seed vertebrae in the lumbar region of the spine causing vertebral osteomyelitis.

Osteomyelitis

- Intravenous drug users are more likely to acquire *P. aeruginosa* infections of the cervical vertebrae.
- Osteomyelitis in patients with sickle cell disease is most likely due to *S. aureus* and *Salmonella*.
- Infections of prosthetic joints are most commonly due to **coagulase-negative Staphylococcus** (e.g., *S. epidermidis*) and the second most common cause of these infections is *S. aureus*.

Osteomyelitis – Clinical manifestations

- The onset of symptoms of acute osteomyelitis can occur within 1–2 days, or symptoms of chronic osteomyelitis can take weeks to months to develop.
- Children are more likely to develop acute long bone osteomyelitis, which manifests with symptoms of chills, fever, and malaise. There is usually pain and localized swelling and redness over the site of infection in the bone and guarding of the body part.
- Elderly persons are more likely to develop subacute or chronic vertebral osteomyelitis, and usually present with localized lower back pain and tenderness with fever.

Osteomyelitis – Epidemiology

- Acute hematogenous osteomyelitis occurs most commonly in children and usually results in a single site of infection that involves the metaphysis of the long bones (e.g., tibia, femur, and humerus).
- Osteomyelitis in adults usually involves the vertebral bodies. The lumbar vertebrae are most affected, followed by the thoracic vertebrae, and rarely the cervical vertebrae.
- Intravenous drug users are more likely to develop vertebral infections in the cervical vertebrae.

Osteomyelitis – Pathogenesis

- The most common site of osteomyelitis by hematogenous spread in adults is the vertebrae, which contain small arteriolar vessels that trap bacteria in the vertebral body.
- A plexus of veins lacking valves, called Batson plexus, surrounds the vertebrae and drains the bladder and pelvic regions.
- As adults age, they are more likely to develop infections of the urinary tract (e.g., cystitis, prostatitis) that are most caused by *E. coli*, a gram-negative coliform, among other gram-negative coliforms causing UTI. These bacteria travel from the urinary tract to the vertebral bodies via Batson plexus and infect the vertebrae.

Osteomyelitis – Diagnosis

- In both acute and chronic osteomyelitis, the erythrocyte sedimentation rate is usually elevated.
- C-reactive protein levels are also elevated in acute and chronic conditions.
- Osteomyelitis is usually diagnosed using imaging studies that include plane film radiographs, CT scans, and MRI.
- Because MRI is more sensitive than plane films or CT scans, it can be used much earlier in the disease process to detect abnormalities.
- Two or three blood cultures may be useful in determining the cause of the infection.

Osteomyelitis – Treatment and Prevention

There are three important steps to treating osteomyelitis in adults.

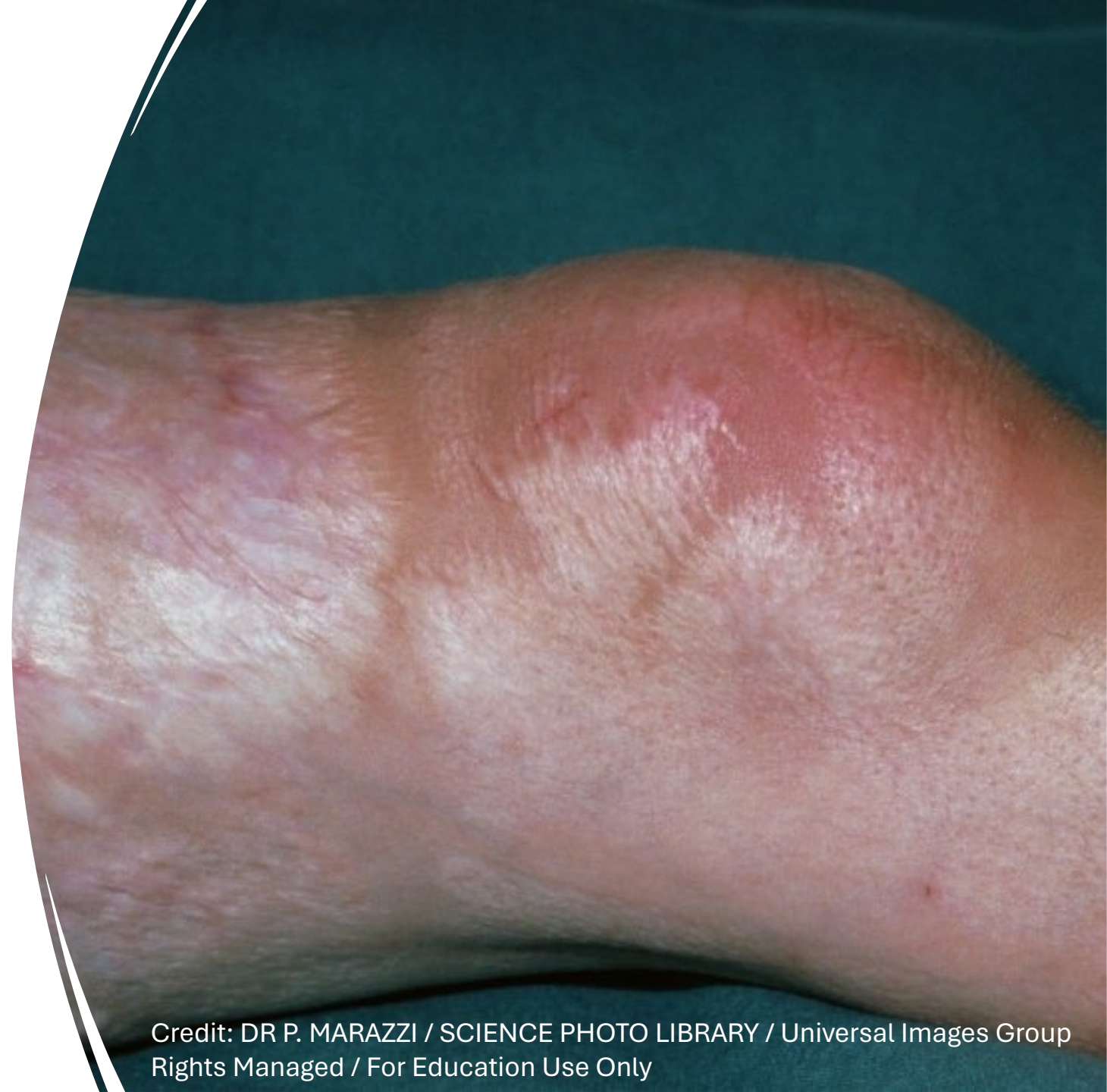
1. An adequate sample collected deep in the infected tissue should be obtained for culture and histopathology.
2. A specific antimicrobial regimen should be designed for the patient.
3. Surgery usually is not needed in the treatment of acute hematogenous osteomyelitis; however, antibiotic treatment for 4–6 weeks is required. Patients with chronic osteomyelitis usually require surgery.

Osteomyelitis – Treatment and Prevention

- A patient with osteomyelitis due to methicillin-sensitive *S. aureus* can be treated with nafcillin or oxacillin. However, if the infection is due to methicillin-resistant *S. aureus* (MRSA), **vancomycin should be given**.
- Streptococcus infections can be treated with penicillin G.
- If the osteomyelitis is due to *Serratia* or *Pseudomonas*, piperacillin-tazobactam and gentamicin can be used. If anaerobic bacteria are the cause of osteomyelitis, clindamycin or metronidazole should be given.

Septic Arthritis

- Viruses, fungi, and bacteria can all cause infectious arthritis.
- Bacterial infectious arthritis causes the most injury.
- Bacterial (septic) arthritis is a serious infection, and if not treated quickly, can result in significant permanent damage to the joint and disability.



Septic Arthritis – Etiology

- ***S. aureus*** is the most common cause of septic arthritis in patients of all ages.
- There are two major classes of septic arthritis: gonococcal and non-gonococcal arthritis. ***S. aureus*** is the most common cause of non-gonococcal arthritis, and ***Neisseria gonorrhoeae*** is the most common cause of gonococcal arthritis in sexually active young adults.
- Gram-negative bacilli are more likely to cause septic arthritis (e.g., ***E. coli***, ***Proteus***, and ***Serratia***) in the elderly.
- ***Streptococci*** (e.g., viridans Streptococci, *S. pneumoniae*, and *S. agalactiae*) accounts for 20% of cases of septic arthritis.
- Infections with anaerobic organisms usually are a consequence of trauma or of abdominal infection.

Septic Arthritis – Clinical Manifestations

- Patients with non-gonococcal septic arthritis usually present with the triad of **fever, joint pain, and impaired range of motion**.
- Most patients with nongonococcal septic arthritis present with pain and swelling in a single joint.
- Polyarticular arthritis is commonly seen in gonococcal septic arthritis, which is primarily an infection of sexually active young adults and teenagers.
- In gonococcal septic arthritis, skin lesions evolve over a few days from papular to pustular or vesicular to necrotic.

Septic Arthritis – Epidemiology

- Most cases occur in young, old, and among IDUs.
- In gonococcal joint infection, the mortality rate is low. In septic arthritis due to *S. aureus*, the mortality rate can reach 50%.
- In adults, the knee is the most infected joint, followed by the hip, shoulder, ankle, and wrists; in children, the hip joint is most affected, followed by the knee.
- Almost all cases of non-gonococcal arthritis are monoarticular. Polyarticular arthritis usually is observed in patients with gonococcal septic arthritis.
- Nearly 50% of patients who develop septic arthritis have an underlying chronic joint disease (e.g., rheumatoid arthritis, osteoarthritis).
- Gonococcal septic arthritis is more likely to occur in females.

Septic Arthritis – Pathogenesis

- Organisms can enter the joint by direct inoculation, contiguous spread from infected periarticular tissue, or by bacteremia. However, the most common route of infection is following bacteremia.
- Causes of bacteremia leading to septic arthritis include UTI, IDU, intravenous catheters, endocarditis, and soft tissue infections. Some bacteria have surface factors that promote their adherence to the joint.
- In patients with osteomyelitis, the arteriolar anastomosis between the epiphysis and the synovium allows the organisms to spread into the joint space.

Septic Arthritis – Pathogenesis

- Damage of joint cartilage is the major debilitating result of septic arthritis.
- Bacterial growth in the joint causes an acute inflammatory reaction that results in infiltration of polymorphonuclear leukocytes.
- Injury to joint cartilage is due to the synthesis of cytokines and inflammatory products produced by the polymorphonuclear leukocytes and bacterial production of factors such as chondrocyte proteases of *S. aureus*, which cause joint damage.

Septic Arthritis – Pathogenesis

- Most joint injury may be caused by the cytokines and inflammatory products produced by the polymorphonuclear leukocytes. Infection with *N. gonorrhoeae* induces a relatively mild influx of polymorphonuclear leukocytes into the joint; thus, minimal joint destruction is usually observed in infections with this organism.
- In *S. aureus* infections, a significant number of polymorphonuclear leukocytes are recruited to the joint resulting in significant damage to the joint cartilage. Cartilage erosion eventually occurs at the lateral margins of the joint and causes significant cartilage damage followed by joint space narrowing. In untreated infections, significant damage to the joint can occur within 3 days.

Septic Arthritis – Diagnosis

- A critical laboratory test used to diagnose septic arthritis infections is analysis of the synovial fluid. A white blood cell count, gram stain smear, and culture of the synovial fluid are essential in determining the cause of septic arthritis.
- The most important use of synovial fluid analysis is to differentiate between non-inflammatory, inflammatory, and septic arthritis.
- Blood cultures should also be obtained and are useful in a significant number of cases. In cases of gonococcal septic arthritis, pharyngeal, rectal, cervical, or urethral specimens should be placed on Thayer-Martin plates.

Septic Arthritis – Diagnosis

Feature	Normal	Septic arthritis (SA)	Non-inf arthritis	Inf arthritis
Clarity and color	Clear	Opaque, yellow to green	Clear, yellow	Translucent, yellow, or opalescent
Viscosity	High	Variable	High	Low
White blood cells/mm³	<200	>100,000	200–2000	2000–10,000
% PMN	<25%	>75%	<25%	>50%
Total protein g/dL	1-2	3-5	1-3	3-5
Glucose concentration relative to blood	Nearly equal	<25%	Nearly equal	50-80%
Culture	Negative	Positive in non-gonococcal arthritis; usually negative in gonococcal arthritis	Negative	Negative
Disease	NL	SA	Osteoarthritis, trauma to joint	Rheumatoid arthritis, Reiter disease, Gout, Acute rheumatic fever

Septic Arthritis – Treatment and Prevention

- Treatment of non-gonococcal septic arthritis involves two essential components. First, purulent exudate should be completely drained and washed by arthroscopy or surgery. Second, an appropriate antibiotic based on gram stain smear, culture results, and clinical presentation should be administered intravenously.
- Antimicrobial treatment for non-gonococcal septic arthritis is 3–4 weeks as opposed to 4–6 weeks for osteomyelitis. Even with appropriate treatment, one third of patients with non-gonococcal septic arthritis suffer significant joint damage. Elderly patients, patients with pre-existing chronic joint disease, and patients with prosthetic joints are more likely to have adverse outcomes.

Septic Arthritis – Treatment and Prevention

- Treatment of gonococcal septic arthritis requires complete drainage and washing of the purulent synovial fluid from the joint and antibiotic therapy with intravenous ceftriaxone for 24–48 hours after clinical improvement.
- Oral cefixime, ciprofloxacin, ofloxacin, or levofloxacin should be used to complete a total of 7–10 days of therapy.
- Residual joint damage is unusual.
- Prevention of non-gonococcal arthritis involves avoiding joint trauma and appropriate and timely treatment of infections.
- Prevention of gonococcal arthritis involves avoiding sex partners who have gonorrhea and identifying and treating those with gonorrhea and practicing safe sex.

Thanks for listening!