INFECTIONS OF THE BONES AND JOINTS

Malik Sallam, MD, PhD

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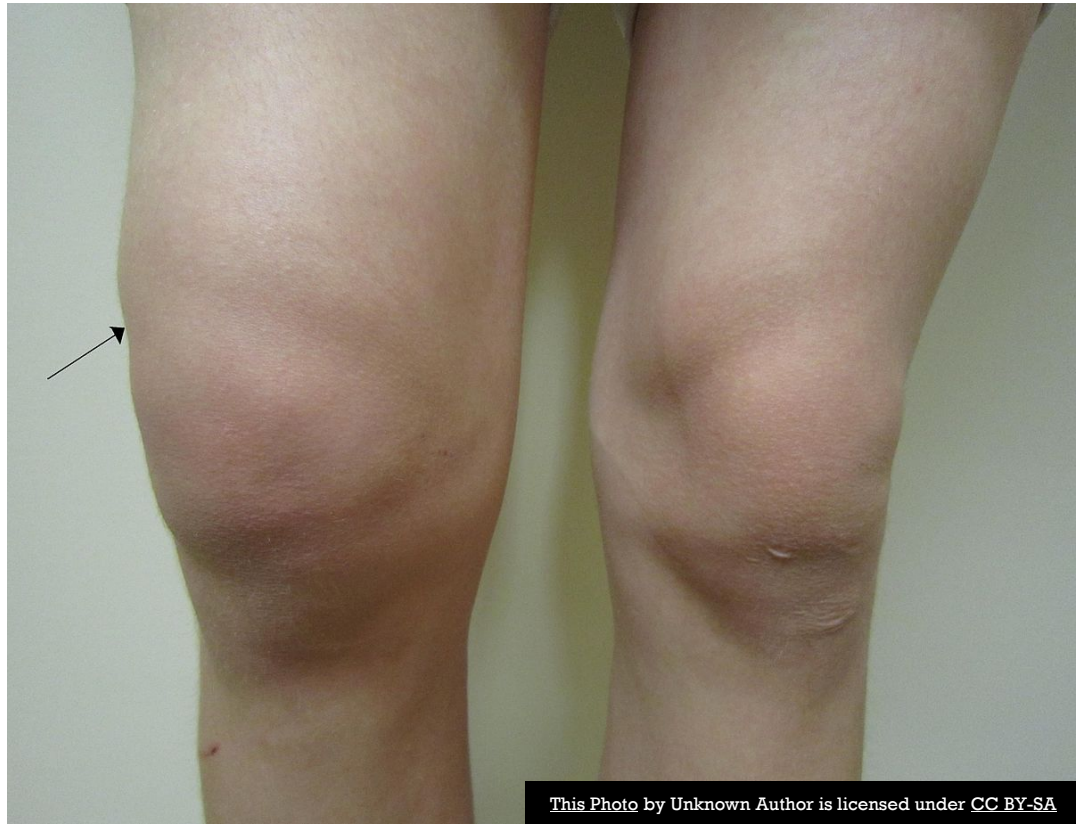


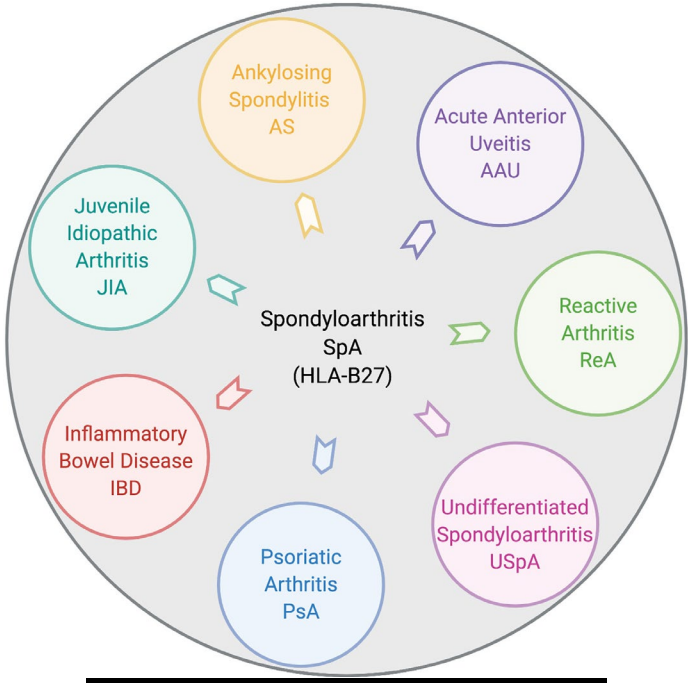
- Infections of the bones and joints include **Osteomyelitis** and **Septic Arthritis**.
- Osteomyelitis is an infection of the bone including the periosteum, medullary cavity, and cortical bone.
- Septic arthritis is an infection of the surface of the cartilage that lines the joint and the synovial fluid that lubricates the joint.
- ***Staphylococcus aureus* is the most common cause of infection in both diseases**.

INFECTIONS OF THE BONES AND JOINTS

- 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**.
- Osteomyelitis usually requires several weeks to cause extensive damage to the bone.
- Successful treatment of osteomyelitis requires 4–6 weeks of antibiotic therapy.
- In cases of extensive bone damage, **antibiotic therapy plus surgery** is required to eliminate the infection.

INFECTIONS OF THE BONES AND JOINTS

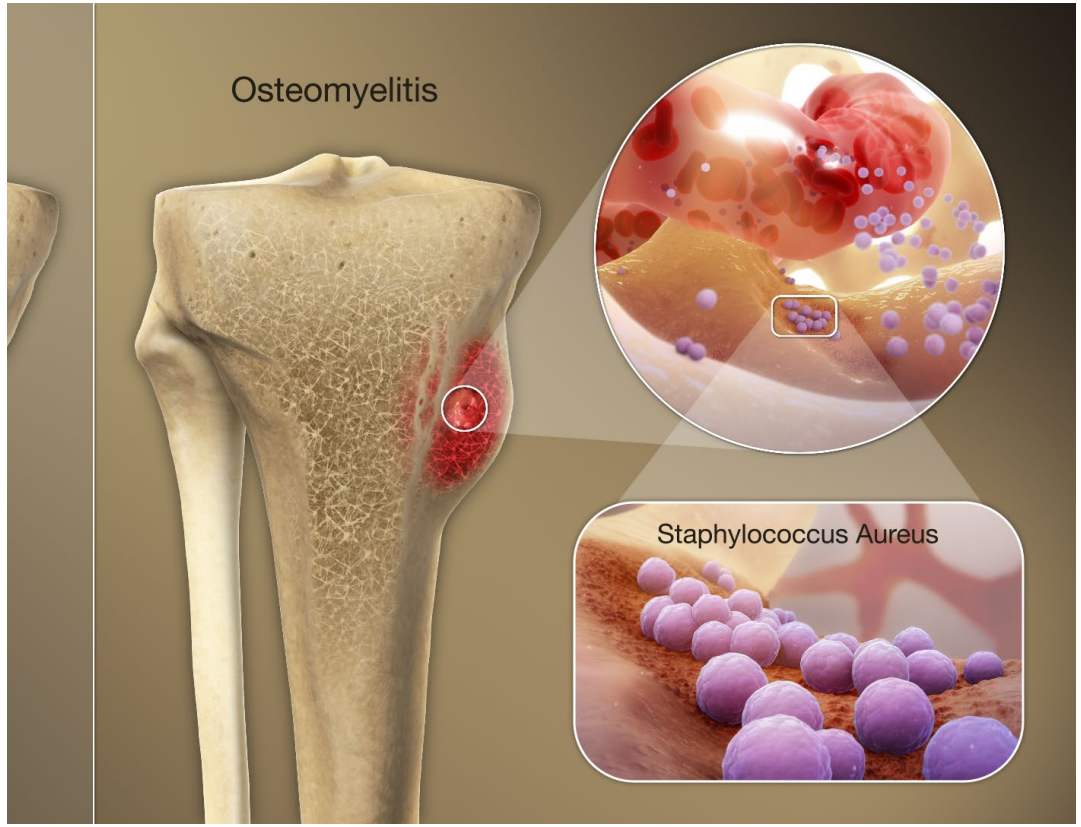
- Two types of arthritis are associated with microbial infections:
  - ❖Reactive arthritis
  - ❖Septic (infectious) arthritis.
- Reactive arthritis is a **sterile** inflammation in the joint following a bacterial infection at a distant site in the body.
- Reactive arthritis (Reiter syndrome), results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



INFECTIONS OF THE BONES AND JOINTS

- Septic (infectious) arthritis can be caused by a variety of microorganisms including fungi, and mycobacteria; however, bacteria are the most common cause.
- *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**
  - **Impaired range of motion.**
- They do NOT have the rash, urethritis, and conjunctivitis that is characteristic of reactive arthritis.
- 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.

ETIOLOGY OF OSTEOMYELITIS

Profile	Common causes
Hematogenous	Usually only one organism
Infants	S. aureus, S. agalactiae (group B Streptococcus), E. coli
Children (1–16 years)	S. aureus, S. pyogenes (group A Streptococcus), H. influenzae
>16 years	S. aureus, CoNS (e.g., S. epidermidis), gram-negative rods (e.g., E coli, Pseudomonas, Serratia)
Contiguous spread	More likely to be polymicrobial
Diabetic foot	S. aureus, Streptococcus, Enterococcus, gram-negative rods (e.g., Proteus mirabilis, Pseudomonas), anaerobes (e.g., Prevotella, Bacteroides, Fusobacterium, Peptostreptococcus)

The NEW ENGLAND JOURNAL of MEDICINE

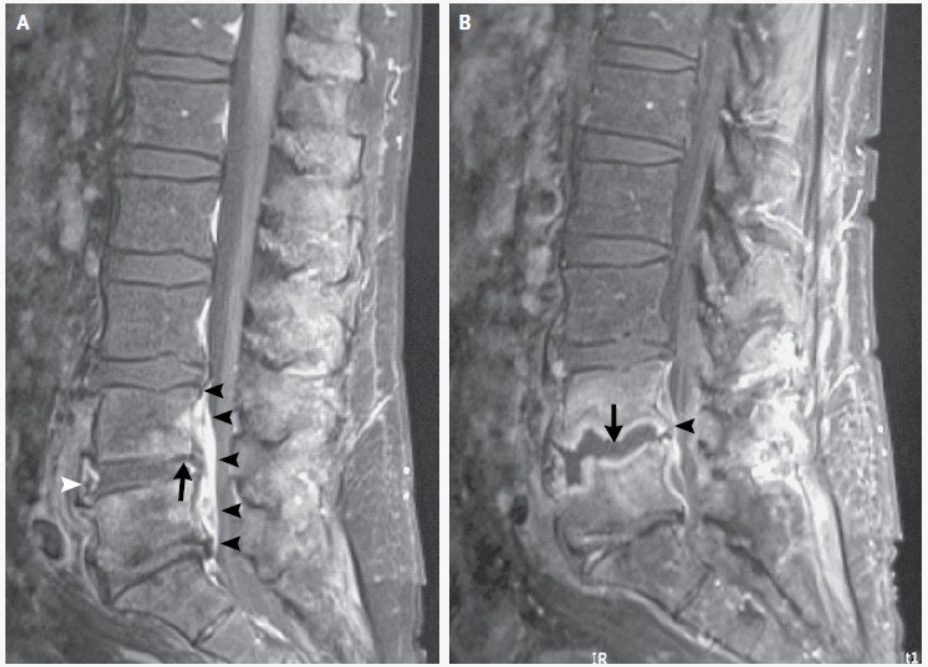
CLINICAL PRACTICE

Vertebral Osteomyelitis

Werner Zimmerli, M.D.

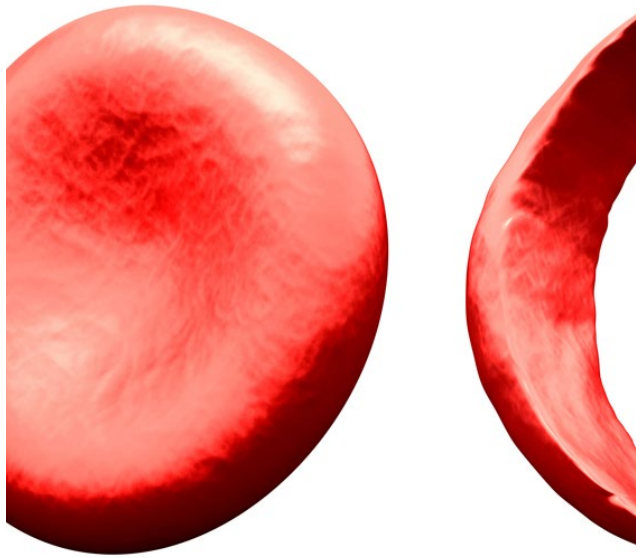
This Journal feature begins with a case vignette highlighting a common clinical problem. Evidence supporting various strategies is then presented, followed by a review of formal guidelines, when they exist. The article ends with the author's clinical recommendations.

A 57-year-old man presents with fever, chills, and new lumbar back pain 2 weeks after undergoing a prostate biopsy because of an increased prostate-specific antigen level. His temperature is 39.7°C; he has an enlarged, tender prostate and lumbar spine tenderness. His white-cell count is 9100 per cubic millimeter, and the C-reactive protein level is 343 mg per liter. Urine and blood cultures reveal multidrug-resistant, extended-spectrum β-lactamase–producing *Escherichia coli* susceptible to imipenem. How should he be evaluated and treated?



OSTEOMYELITIS

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



OSTEOMYELITIS

- Some patients are more likely to develop a particular bacterial osteomyelitis because of their predisposition to certain factors/behaviors.
- IDUs are more likely to acquire P. aeruginosa infections of the cervical vertebrae.
- Athletic shoes are more likely to harbor increased numbers of P. aeruginosa and S aureus. Therefore, puncture wounds to the feet of persons wearing these shoes are more likely to result in infections due to P aeruginosa or S aureus.
- Diabetic patients with peripheral vascular disease can develop OM as mentioned earlier.
- 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 CoNS (e.g., S epidermidis); the second most common cause of these infections is S aureus.

OSTEOMYELITIS – CLINICAL MANIFESTATIONS

- Acute osteomyelitis: Symptoms appear within 1–2 days; more common in children (long bones).

Symptoms: Fever, chills, malaise, localized bone pain, swelling, redness.

- Chronic osteomyelitis: Develops over weeks to months; often affects adults/elderly.

Symptoms: Intermittent localized pain, often without fever.

- Elderly: Prone to vertebral osteomyelitis; presents with lower back pain with or without fever.

OSTEOMYELITIS – PATHOGENESIS

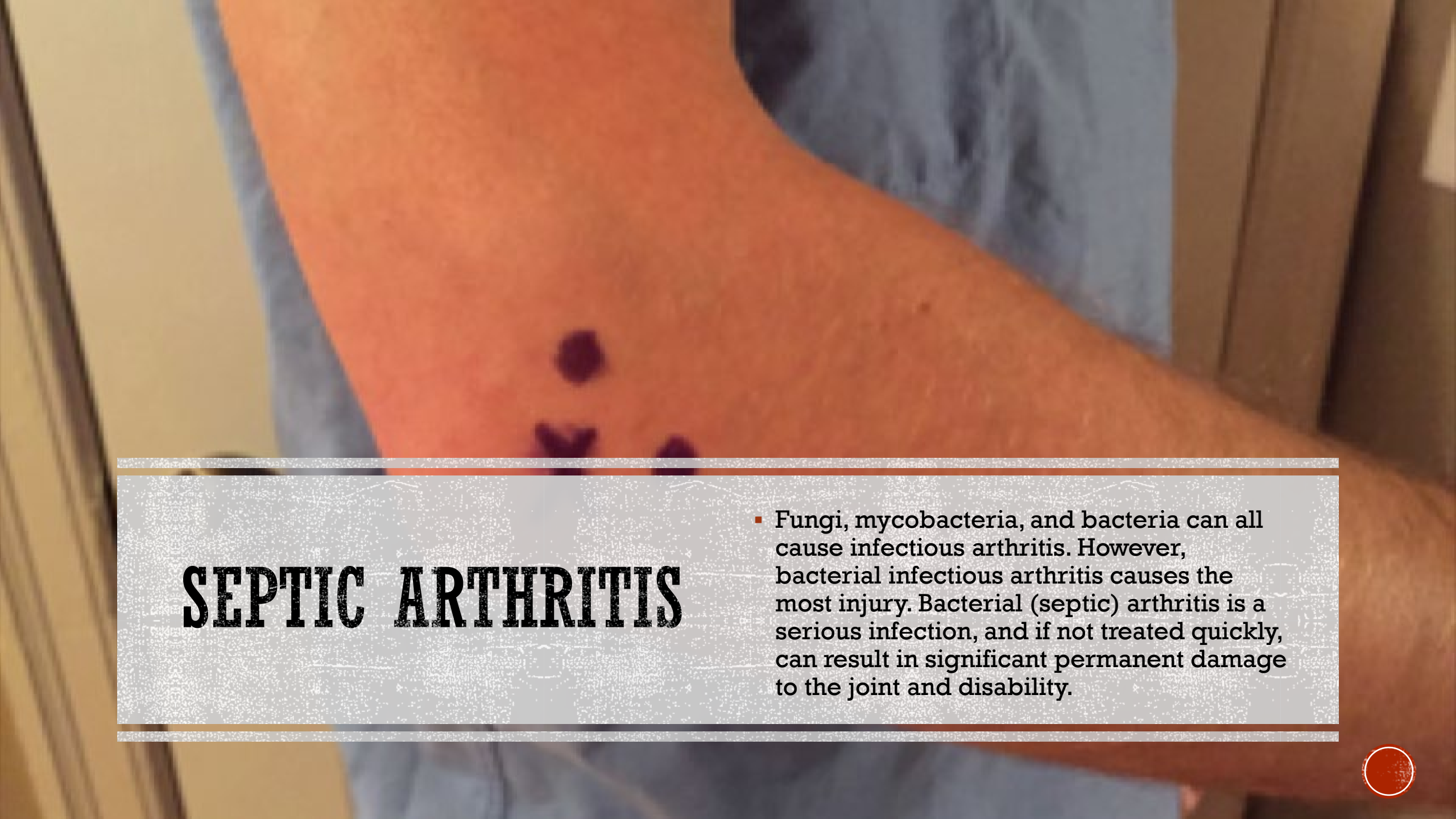
- Children & Adolescents:
- Active growth plates with sharp vascular loops slow blood flow. Bacteria adhere, multiply, and invade metaphysis. Hematogenous spread typically affects long bones (e.g., femur, tibia).
- Adults:
- After growth-plate closure, nutrient flow to epiphysis decreases. Long bone OM rare unless due to trauma. Hematogenous OM usually involves the vertebrae, especially lumbar. Small arterioles & Batson venous plexus trap bacteria. UTIs (e.g., prostatitis, cystitis) leading to bacteria like E. coli spreading via Batson plexus which infect adjacent vertebral bodies & discs.

OSTEOMYELITIS – DIAGNOSIS

- ESR & CRP: Elevated in both acute and chronic cases
- Magnetic resonance imaging (MRI) is the imaging modality with greatest sensitivity for diagnosing osteomyelitis
- The preferred diagnostic criterion for osteomyelitis is a positive bacterial culture from bone biopsy, but clinical, laboratory, and radiographic findings can also inform a clinical diagnosis.

OSTEOMYELITIS – TREATMENT

- **Antibiotic therapy**
- Acute OM: 4–6 weeks of antibiotics; surgery usually not needed
- Chronic OM: Surgery usually required
- **Antibiotic by pathogen:**
- MSSA: Nafcillin or Oxacillin
- MRSA: Vancomycin
- Streptococcus spp.: Penicillin G
- Gram-negative rods: Ciprofloxacin
- Pseudomonas: Piperacillin-tazobactam + Gentamicin
- Anaerobes: Clindamycin or Metronidazole



SEPTIC ARTHRITIS

- Fungi, mycobacteria, and bacteria can all cause infectious arthritis. However, 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

- Most Common Causes:
- All ages: Staphylococcus aureus (most common overall)
- Young, sexually active adults: Neisseria gonorrhoeae (Gonococcal arthritis)
- Elderly: Gram-negative bacilli (e.g., E. coli, Proteus, Serratia)
- Other Pathogens:
- Streptococcus spp. (20%): S. pneumoniae, S. agalactiae, viridans group
- Anaerobes: Rare; usually post-trauma or abdominal source

SEPTIC ARTHRITIS – CLINICAL MANIFESTATIONS

- Nongonococcal (e.g., S. aureus, S. agalactiae)
- Triad: Fever, joint pain, decreased ROM (elderly may be afebrile)
- Usually monoarticular
- S. agalactiae: Sacroiliac or sternoclavicular joints
- Gonococcal (N. gonorrhoeae) – in sexually active young adults
- Disseminated (DGI): Fever, tenosynovitis, polyarthritis, skin pustules
- Positive cultures: blood; synovial fluid usually negative

SEPTIC ARTHRITIS – PATHOGENESIS

- Pathogen entry (Most common: Bacteremia):
- Sources: UTIs, IV drug use, catheters, endocarditis, soft tissue infections
- Spread via bloodstream or from osteomyelitis (via epiphysis-synovium anastomosis). Other routes: Direct inoculation, contiguous spread
- Synovial cells: Phagocytose, release antibacterial proteins.
- Synovial fluid: Phospholipase A2 targets gram-positives (S. aureus)
- Increased susceptibility in: RA, OA, SLE, trauma, intra-articular steroids
- Joint destruction: Caused by PMNs, cytokines, and bacterial enzymes (e.g., S. aureus proteases)

SEPTIC ARTHRITIS – DIAGNOSIS

- Diagnostic Workup
- Synovial Fluid Analysis (Critical Test):
- Perform: WBC count, Gram stain, and culture
- Helps distinguish: Noninflammatory, Inflammatory, Septic arthritis
- Blood cultures: Positive in many cases
- Suspected gonococcal arthritis: Collect pharyngeal, rectal, cervical, or urethral swabs
- Culture on Thayer-Martin media

SEPTIC ARTHRITIS – DIAGNOSIS

Lab	NL	Septic arthritis	Non-inf A	Inf A
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
Culture	Negative	Often positive in nongonococcal arthritis; usually negative in gonococcal arthritis	Negative	Negative

SEPTIC ARTHRITIS – TREATMENT AND PREVENTION

- Nongonococcal (e.g., S. aureus, Streptococcus):
- Joint drainage & lavage (arthroscopy/surgery)
- IV antibiotics based on Gram stain/culture
- Duration: 3–4 weeks
- Poor outcomes in elderly, prosthetic joints, or preexisting joint disease
- Prevention: Prompt treatment of UTIs, SSTIs, pneumonia
- Avoid joint trauma

SEPTIC ARTHRITIS – TREATMENT AND PREVENTION

- Gonococcal (N. gonorrhoeae):
- Drain joint, then IV ceftriaxone until improvement (24–48 hrs)
- Oral antibiotics (cefixime, ciprofloxacin, etc.) to complete 7–10 days
- Residual joint damage is rare
- Prevention:
- Safe sex practices
- Identify & treat infected partners

THANK YOU!