may be made by three-phase bone scanning or computed tomography. These modalities may be especially helpful for patients with renal insufficiency who cannot undergo gadolinium-enhanced studies due to the risk of nephrogenic systemic fibrosis. An elevated C-reactive protein (CRP) level or erythrocyte sedimentation rate (ESR) supports the diagnosis.

Microbiologic diagnosis of osteomyelitis is made by positive blood cultures or by bone biopsy and culture. Culture of cutaneous ulcers is typically not helpful because the results usually demonstrate multiple colonizing organisms and do not correlate with organisms isolated on bone culture. An exception is the isolation of *S. aureus* or *Salmonella* from a draining fistula or, on occasion, *Pseudomonas* from an ulcer. In the former case, the bacterium can be presumed to be the pathogen; in the latter, a decision would have to be made to include coverage of *Pseudomonas* spp in an empirical antibiotic regimen. If cultures of bone obtained by bone aspirate under radiographic guidance are negative, either the procedure should be repeated or an open biopsy with culture should be performed.

Septic arthritis almost always manifests with the cardinal features of inflammation (i.e., erythema, swelling, warmth, and pain) when it involves the extremities. Fever is frequently present, and there is often an associated bacteremia. Septic arthritis of the spine, pelvis, or hip may require imaging, usually MRI, because these sites are difficult to assess by examination alone. Persistent back, pelvic, or hip pain that is otherwise unexplained should prompt radiographic evaluation even in the absence of fever.

The diagnosis of septic arthritis ultimately relies on joint aspiration. Such procedures should occur before the administration of antibiotics. Fluid should be sent for cell count with differential, crystal analysis, Gram stain, aerobic and anaerobic culture, and fungal and acid-fast stains and cultures. Positive stains or cultures are taken as evidence of infection in most cases in which an appropriate clinical syndrome is also present. White blood cell (WBC) counts higher than 50,000 cells/μL are suggestive of infection. In cases that are difficult to diagnosis and in instances in which antibiotics were given before aspiration, it may be appropriate to have cultures held for up to 14 days. Specialized culture techniques for fastidious organisms such as anaerobes and nutritionally deficient streptococci may be required. Ultimately, tagged WBC scans may help to clarify the presence or absence of septic arthritis in difficult cases. Evolving molecular technologies such as polymerase chain reaction (PCR) and 16S ribosomal sequencing may offer alternative and more rapid and precise diagnosis in the future.

Most cases of osteomyelitis and septic arthritis are caused by *Staphylococcus* spp, *Streptococcus* spp, and aerobic gram-negative bacilli, although almost any pathogenic microorganism can cause such an infection in the appropriate circumstance. Infecting *Staphylococcus* spp include both *S. aureus* and coagulase-negative staphylococci. The latter are often implicated in prosthetic joint infections and infections associated with orthopedic hardware. *Streptococcus* spp that cause bone and joint infections include groups A, B, C, G, and F, as well as *Abiotrophia* and *Gemella* (formerly termed "nutritionally deficient streptococci").

Gram-negative organisms account for as many as 30% of hematogenous infections. They are seen more commonly in the elderly as a result of urinary tract infection with associated bacteremia. Isolated species include *Escherichia coli, Haemophilus influenzae*, and *Haemophilus parainfluenzae*. Infections with *Serratia marcescens* and *Pseudomonas* spp are associated with exposure to water and are usually nosocomial or related to intravenous drug use.

Fungi such as *Candida, Aspergillus*, and *Zygomycetes* may cause bone and joint infections particularly in immune-compromised patients, diabetics, and those who have suffered trauma. *Nocardia* and other acid-fast organisms may be seen after trauma or in association with prosthetic joints, and several attempts at débridement may be needed before the organism can be isolated. *Propionibacterium acnes* is often isolated from shoulder infections, especially those involving prosthetic joints. The variety of potential pathogens underscores the need to obtain appropriate specimens for culture before administration of antibiotics.

Infection with *Borrelia burgdorferi*, the causative agent of Lyme disease, can lead to a multifocal or monoarticular septic arthritis. Fluid analysis is consistent with bacterial septic arthritis but is negative for typical organisms on culture. Associated findings of erythema migrans, diffuse myalgias and arthralgias, cranial nerve palsies, fever, and aseptic meningitis may also be present. PCR analysis of joint fluid has a reported sensitivity between 30% and 75%. Diagnosis relies on serology and associated findings in patients who reside in endemic areas. Later-stage disease may manifest with a less inflammatory-appearing effusion, often without any other symptoms. Treatment is with doxycycline or ceftriaxone, depending on the stage of disease.

Neisseria gonorrhoeae can cause a solitary or multifocal septic arthritis often associated with tenosynovitis and skin lesions. It is usually seen in sexually active younger adults. Culture of the joint fluid may be negative, but testing of specimens from the pharynx, urethra, or rectum is usually positive by nucleic acid amplification. The treatment of choice is ceftriaxone.

DIFFERENTIAL DIAGNOSIS

The differential diagnosis of both osteomyelitis and septic arthritis includes noninfectious inflammatory disorders such as gout, pseudogout, rheumatoid arthritis, inflammatory bowel disease, and other inflammatory and autoimmune disorders. Occasionally, neoplasms such as sarcomas or metastatic lesions may manifest similarly to osteomyelitis. Infection with several viruses such as rubella, parvovirus B19, and hepatitis B virus can manifest with arthritis.

Chronic recurrent multifocal osteomyelitis is a noninfectious inflammatory lesion of bone that is thought to be autoimmune in nature and is characterized by findings on MRI similar to those of osteomyelitis. It is culture-negative and unresponsive to antibiotics. The diagnosis is one of exclusion and often is made only after several attempts at diagnosing and treating presumed bacterial osteomyelitis. Although it is typically seen in children, it can also occur in adults.

TREATMENT

Treatment of osteomyelitis involves débridement of appropriate infected or necrotic tissue and the administration of antibiotics. It is critically important to remove all necrotic or devitalized tissue. If not removed, such tissue may serve as a nidus of chronic