or recurrent infection. In this regard, it is often necessary to remove any fixating hardware, plastic device, bone graft, or other donor tissue if the infection has been present for longer than 1 month or is recurrent. Cadaveric donor tissue infections often are caused by atypical organisms such as *Clostridium* spp. Historically, sequestra developed in sites of chronically infected bone. These are produced by the action of the immune system and histologically are characterized by granulomatous tissue that serves to isolate the infection. Although this reaction is effective in containing the infection, it represents a risk for recurrence as well as an area of bone weakening. Any sequestra that are discovered should be surgically excised.

Infection that occurs in the immediate postoperative period (i.e., within 1 month after placement of hardware and grafts) and appears to involve only the soft tissue may be treated with débridement and antibiotics alone with a reasonable chance of success. Occasionally, infected hardware must be left in place to stabilize the bone while a fracture is healing. In such cases, it may be necessary to continue antibiotic treatment until the hardware can be removed. Infected spine hardware, which must remain in place, may necessitate prolonged antibiotic treatment, at times even indefinitely. The addition of rifampin for susceptible staphylococcal infections with retained hardware improves the overall cure rates.

Septic arthritis requires either repeated aspiration or serial débridement of the joint until active purulence has resolved. This is indicated by decreasing cell counts and sterilization of joint fluid cultures. Prosthetic joint infection typically requires removal of the infected prosthesis and placement of an antibiotic spacer for 4 to 6 weeks while antibiotics are administered. This is followed by placement of a new prosthesis after all signs and symptoms of infection have resolved. Selected infections with coagulase-negative *Staphylococcus* and *Streptococcus* spp may be treated with débridement, joint retention, and a course of antibiotics lasting 6 weeks or longer. Consideration should then be given to chronic suppressive antibiotic therapy, assuming that an appropriate agent is available.

Antibiotic treatment should be with agents that are active against the infecting organism, depending on culture and susceptibility data. β-lactams are the preferred agents in most cases. Therapy with quinolones for Enterobacteriaceae and, in combination with rifampin, for *Staphylococcus* spp may be considered. These drugs have the advantage of high oral bioavailability that results in tissue levels that approach or are equal to those achieved when they are given intravenously. Care should be taken regarding drug interactions with rifampin as well as the risks of *Clostridium difficile* colitis and Achilles tendon rupture with quinolones. In the face of negative cultures, empirical therapy with an agent that is active against typical pathogens, including methicillin-resistant *S. aureus* (MRSA), is reasonable. Caution should be exercised in the use of daptomycin because there have been failures in the treatment of bone infections with this drug. Vancomycin remains the standard agent for empirical therapy to cover resistant staphylococci (e.g., MRSA). Prior administration of antibiotics may lead to negative cultures even in cases of unequivocal infection. In this situation, empirical therapy should be based on the activity of the agents previously administered as well as the potential pathogens based on exposure history.

In all cases, the clinical response to treatment of the infection should inform subsequent decision making regarding the need for additional débridement or changes in antibiotic therapy. Monitoring of inflammatory markers such as CRP or ESR is helpful in determining the adequacy of response to treatment. In particular, if these markers are elevated at the start of treatment, they should fall to normal or near-normal levels by the time the treatment is finished. Signs and symptoms of inflammation at the site of infection should have also resolved by the cessation of treatment. There have been few randomized controlled trials comparing different durations of antimicrobial therapy. In general, acute osteomyelitis should be treated for 4 to 6 weeks. It is reasonable to continue treatment if the patient has improved but has failed to resolve elevated inflammatory markers or local signs of inflammation. Such patients should be closely monitored and evaluated for the need for additional débridement or other measures aimed at diagnosis and source control. Chronic osteomyelitis may require 12 or more weeks of therapy, and treatment is usually individualized based on the clinical situation.

Patients undergoing therapy should also be monitored weekly for toxicity to antibiotics. Assessment of renal and hepatic function, complete blood counts, and drug levels are typically monitored, depending on the specific agent used. In the case of aminoglycosides, renal function and peak and trough levels of antibiotics should be measured twice weekly. Adjunctive therapies such as bone grafting, revascularization procedures, and the placement of muscle flaps to cover and protect exposed bone may be used in the appropriate clinical situation.

Native joint septic arthritis may be treated with a 4-week course of antibiotics; prosthetic joint infections are typically treated for 6 weeks or longer. Monitoring for toxicity and response to treatment is similar to that for osteomyelitis.

PROGNOSIS

The prognosis for most cases of osteomyelitis or septic arthritis is excellent, assuming adequate diagnosis, débridement, and antimicrobial therapy. The most common complication is residual pain and/or decreased function of the affected bone or joint. However, these effects are relatively rare and relatively minor. An exception is prosthetic joint infections: 25% to 50% of patients experience some loss of function as a result of the infection. Recurrence rates for chronic osteomyelitis, especially in diabetics, may be as high as 30%. In more complex cases, such as open contaminated fractures or infected hardware that require retention, complications including non-union, prosthesis failure, and chronic osteomyelitis may occur. Ultimately, infections that cannot be controlled may lead to the need for amputation and its attendant loss of function and mobility. Occasionally, bone or joint infections can disseminate to other joints or to the bloodstream, resulting in life-threatening sepsis. Such cases usually involve infection with *S. aureus* and fortunately remain the exception.

For a deeper discussion on this topic, please see Chapter 272, "Infections of Bursae, Joints, and Bones," in Goldman-Cecil Medicine, *25th Edition.*