OSTEOMYELITIS: TREATMENT CONCEPTS

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Osteomyelitis is one of the most serious and difficult disorders of the lower extremity to treat. Most patients will require long term antibiotic therapy and surgical debridement. The word "cure" is seldom used because despite proper therapy, upwards of 10% of these cases will become chronic and recurrent.

Osteomyelitis can be as difficult to diagnose and categorize as it is to treat. Several classification schemes have been devised to better define the types and stages of bone infection. Unfortunately, there is no consensus among surgeons as to which is the most appropriate. This section will be a practical approach to therapy based on clinical and radiographic findings.

The goal in the osteomyelitic patient is not only to eradicate infection, but also attempt to preserve form and function. Therefore, it becomes very important after determining that the bone is infected to what extent the infection has involved the bone and associated structures.

INITIAL PHASE

During the initial phase of osteomyelitis, an accurate diagnosis is as important as it is difficult. Standard radiographs usually show nonspecific demineralization without frank destruction of bone. These changes often result from periods of non-weightbearing and inflammation typically seen in the postoperative patient. Nuclear medicine is helpful in diagnosing infection from contiguous spread, but has limited usefulness in the postoperative and post-traumatic patient.

Laboratory studies will diagnose infection, but none are specific for osteomyelitis. Since osteomyelitis in the foot is often localized to a small anatomic area, the white blood cell count may remain normal. The erythrocyte sedimentation rate and C-reactive protein are usually elevated, but these are nonspecific and will rise normally in the postoperative and post-traumatic patient.

The diagnosis is often empiric, based upon clinical findings and a detailed history. The foot typically demonstrates the cardinal signs of infection.

The only way to definitively diagnose and establish the proper therapy is to perform bone biopsy and culture. This can be performed percutaneously or during open incision and drainage. If antibiotics are being administered, they should be discontinued 2-3 days prior to biopsy when possible. In order to prevent contamination of the sample, and inoculation of bone, the biopsy needs to be performed through an area devoid of cellulitis. The sample is sent for culture and for histopathologic exam. Microscopic exam should confirm the presence of infection.

Neoplasm may be part of the differential diagnosis. This requires careful biopsy site planning since most tumors will "seed" the biopsy tract. Should amputation be required, the biopsy site must be included in the amputation.

Once osteomyelitis has been definitively diagnosed, all necrotic bone must be removed. However, all necrotic bone does not mean all infected bone. It has been the author's experience that bone showing mild demineralization without necrosis on x-ray does not require immediate debridement. If there is any indecision, the wound should be opened and debrided. At the time of surgical debridement, bone should not be removed unless it is clearly necrotic (soft and gray). If pressure from a scalpel can not penetrate cortical bone, leave the bone, carefully monitor the patient and perform further debridement as necessary.

Whether or not sequestrectomy is performed, antibiotics based upon bone culture should be instituted parenterally and continued for 4-6 weeks, sometimes 8. Serial radiographs are taken every 7-10 days for the next 2-3 months. Any evidence of further bone destruction requires an additional trip to the operating room.

ACUTE PHASE

In the acute phase of osteomyelitis, active bone destruction is evident. Unless there is significant vascular disease or medical contraindication to surgery, debridement must be performed. All necrotic tissue, both soft tissue and bone, must be removed. It is best to perform this debridement under tourniquet hemostasis. Upon release of the tourniquet, all remaining tissues should bleed freely. Debridement to the level of healthy-appearing bone is not curative. The bone should be considered contaminated and antibiotic therapy continued for the next one to two months. Surgery is curative only when the affected bone is disarticulated.

The removal of internal fixation devices is somewhat controversial. Although these devices are inert foreign bodies and a possible nidus for continuing infection, they should not be removed if they provide significant stability of the bone fragments. Premature removal of internal fixation devices results in bone movement and subsequent necrosis at the bone-bone interface. This instability produces necrotic tissue, a potent breeding ground for bacteria, and barrier for antimicrobial therapy.

CHRONIC PHASE

Although proper therapy has been administered, the infection may progress to a chronic relapsing state. If removal of the entire bone would be catastrophic to the patient's gait and well being (i.e. infection of the tibia), debridement and coverage of the bone with a muscle flap should be attempted. Muscle coverage over open medullary bone may provide the necessary vascularity to eradicate the infection.

WOUND MANAGEMENT

Although some authors prefer primary wound closure, most surgeons leave the wound open following debridement. In these cases, the wound can be closed primarily at a later date or be allowed to close by secondary intention. Delayed primary closure is performed no earlier than three days post-debridement. Wounds should be closed if large areas of bone are exposed as granulation tissue will not cover large areas of cortical bone.

The wound should not be closed until all evidence of infection has been resolved. This can be most accurately assessed by colony count per gram of tissue. Unfortunately, this test is still not widely available. Clinically, the wound should be absent of swelling, erythema, odor or purulence. Serial wound cultures should be negative.

At the time of closure, all dead space must be eliminated and drains used as needed. The smallest amount of buried suture should be used. Often deep retention sutures of a removable non-absorbable material can be employed to eliminate dead space and remove tension from the wound margins.

ANTIBIOTIC IMPREGNATED BEADS

Antibiotics impregnated into bone cement, polymethylmethacrylate (PMMA), will elute into the surrounding soft tissues in high enough concentrations to be bactericidal. Although many different antibiotics have been combined with PMMA, gentamycin is most commonly utilized. Gentamycin is bactericidal against a large number of gram positive and gram negative organisms, water soluble and has a low incidence of allergenicity. In order for the beads to be effective, they must be maintained in a moist environment. Therefore, the wound should be closed over the beads. The beads generally remain for 14 days.

PMMA beads are not designed to replace the basic steps of debridement and antibiotic therapy. The beads release a high concentration of antibiotic which allows the wound to be closed primarily at time of debridement even if cellulitis is present. PMMA beads can be effective both in soft tissue and bone infections.

HYPERBARIC OXYGEN

Hyperbaric oxygen has been reported as an adjunctive therapy for chronic osteomyelitis. High levels of tissue oxygen are believed to be bactericidal and promote neovascularization. In order to effectively obtain such high concentrations, oxygen must be inspired in a total body chamber. Extremity chambers are of little value.

Hyperbaric oxygen is not an approved therapy for osteomyelitis and should be employed after all other modalities have been tried. Many insurance companies will not pay for hyperbaric oxygen.

CLOSED SUCTION DRAINAGE

Closed suction drainage lavages wounds with high concentrations of antibiotics. It provides constant wound debridement and prevents contamination because it is a closed system.

This form of wound management has lost popularity over the years. Dead space in most pedal wounds is usually quite small and makes the system difficult to maintain. Other disadvantages include maceration of the wound, pooling of the irrigant and poor patient compliance as the individual must remain completely immobile.

OPEN PACKING

In order to prevent premature wound closure, abscess formation and accumulation of other necrotic debris, open packing is the most common form of wound management.

The wound should be packed with sterile gauze on a daily basis. If significant drainage is present, the packing should be changed more frequently. Once the wound cultures are negative, delayed primary closure can be performed or the patient can be sent home with packing still performed on a daily basis.

WOUND MONITORING

Serial radiographs should be obtained every 7-10 days. If further bone necrosis occurs, additional debridement and re-evaluation of antibiotic therapy should be performed. The white blood cell count, if initially elevated, should fall to normal values shortly after therapy is instituted. The WBC is of little value in following the long-term progression of the disease.

The CRP has been used to follow the course of treatment. However, to be of value CRP titres must be obtained. Unfortunately these are expensive and not readily available. A simpler, less expensive test is the ESR. Although the ESR does not accurately correlate to the degree of infection, decreasing levels should be seen during the course of treatment.

Still, the best method of monitoring the patient is the clinical exam. All the cardinal signs of infection should be resolved prior to wound closure or discharge from the hospital.

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