

MISCONCEPTIONS REGARDING MANAGEMENT OF INFECTIONS

Stephen V. Corey, D.P.M.

Peter Barrett, D.P.M.

The recognition and treatment of infection plays a fundamental role in every podiatrist's practice, and yet is an area that is not given the respect that it deserves. Regardless of the type of practice, all areas of infection related to the foot and ankle must be fully understood by the foot and ankle specialists, more than any other area of this specialty. The authors will present information in an effort to dispel some common misconceptions regarding management of infections that have developed over the years.

"A conservative approach to infection results in less destruction than does an aggressive approach."

When considering infection, a conservative approach is, paradoxically, an aggressive approach. While hospitalization, intravenous antibiotics and/or surgical intervention may appear to the patient as unnecessary or inconvenient, it is the physician that must recognize and act on what is in the best interest for the patient. Infection, when left to follow its own course, can lead to disastrous results, i.e. loss of limb, permanent disability, or death. These concerns are best communicated to the patient early on in the treatment process. Patients are more tolerant to suggestions when they have been advised of all possibilities early on. Any situation that may appear out of the scope of the clinician, should always be referred immediately to a specialist that can appropriately deal with that situation. Remember, a conservative approach is the aggressive approach, and may ultimately prevent amputations and spare the limb for future ambulation.

"Leukocytosis is a reliable, pure indicator for infection in diabetic, immunocompromised, juvenile, and post-surgical patients."

Causes of compromised immunity in the patient are obesity, dehydration, shock, malnutrition, anemia,

infection at remote site(s), recent antibiotic therapy, uncontrolled diabetes, steroid therapy, and recent use of immunosuppressive drugs (i.e. methotrexate). The very young and the very old are more susceptible to infection, and are therefore considered immunocompromised. The underlying defects, however, are usually different. Young children are at particular risk after their maternal antibody disappears, and before they have had time to stimulate their own antibody production, and this primarily applies only to neonates and infants. Although in the elderly, there is a functional decline in cell-mediated immunity, there is also a diminution in the functions of certain organ systems such as the lung. Infection is more likely to cause fever in young healthy patients than in the elderly, very young, or immunocompromised. Only 10% of the elderly patients are febrile, and only 1/3 have marked leukocytosis.

Leukocytosis is often considered an indicator of infection. In the immunocompromised patient, it is less reliable. In a review of 110 episodes of pedal osteomyelitis in the diabetic, with histological proof of osteomyelitis in 96%, only 8% had a temperature of greater than 100 F, and only 33% had an elevated white blood cell count of greater than 10,000 (Gibbons and Eliopoulos). Clearly, immunocompromised patients are more susceptible to infections due to the lowered immune mechanism. This same mechanism is often the clinician's tool as an indicator for infection. It is therefore unreliable, and other signs and symptoms must be used to determine the presence and extent of the infection. Symptoms include fever, chills, nausea, vomiting, hypotension, tachycardia, and tachypnea; while signs may include erythema, warmth, drainage, tenderness, exposed bone, lymphadenitis, and lymphangitis to the affected limb. A conservative approach is the aggressive approach, especially in regard to the treatment of infection in the immunocompromised patient.

“Septic arthritis without bacteremia is not possible.”

Septic arthritis, while not always the primary etiology for a red, hot and swollen joint, should always be ruled out first. This clinical entity can leave a patient disabled within 24 hours, if the infection is not treated appropriately. This presents a dilemma to the clinician, when the patient presents with a red, hot, and swollen joint.

Common etiologies can be investigated primarily, including the differentiation of cellulitis versus septic arthritis. Generally, these can be differentiated by the location of pain. Septic arthritis presents with pain with range of motion of the suspected joint, while cellulitis is painful primarily with palpation of the erythema. In addition, septic arthritis is tender with palpation along the joint line, circumferentially. These simple clues can easily differentiate between these common clinical entities. Other etiologies of a red, hot and swollen joint, other than septic arthritis and cellulitis include: gout, Reiter's syndrome, ankylosing spondylitis, psoriatic arthritis, rheumatoid arthritis, HIV arthropathy, and lupus.

Assessments always begin with a history. A history of recent exposure to tuberculosis (TB) via a nursing home or family member with TB must be assessed. These patients may also relate recent fever and/or productive cough. Likewise, a social history of sexually-transmitted diseases, including gonorrhea, chlamydia, and HIV, must be documented. Use of intravenous drugs increases the patient's risk of certain infections, and as a result, must be documented. Recent nature walks may expose the patient to ticks, and therefore to Lyme's disease.

Next, a physical examination may rule in or out any suspected infectious causes of the arthralgia. Look for uveitis or conjunctivitis and urethritis, and culture the urethra for gonococcal (GC) if gonorrhea or chlamydia is suspected. Investigate the integument for lesions such as keratoderma blennorrhagicum, pustular lesions on the soles and palms, or balanitis circinata, a hyperkeratotic scaly lesion on the glans of the penis for suspected Reiter's syndrome. The integument may also reveal target-like lesions that are consistent with Lyme's disease. Inspect other joints for tenderness, i.e. lumbosacral spine, knees, hands and wrist, and contralateral foot and ankle.

Lastly, laboratory evaluation is performed as an adjunct to the history and physical examination. Erythrocyte sedimentation rate is usually significantly elevated. Arthrocentesis is the gold standard in the evaluation of the red, hot swollen joint, and should be performed whenever this clinical entity presents, without exception. Gross inspection of this fluid will reveal a low viscosity, and perhaps purulence. The fluid should always be sent for cell count, culture and sensitivity including gram stain, TB smear, TB culture, growth on chocolate agar, and aerobic and anaerobic cultures. Cell count of the synovial fluid will reveal a WBC greater than 100,000 in septic arthritis. This count may be lower in the compromised host. TB and gonococcal infections may be even lower. Most cases will reveal a positive joint culture, blood culture or both. Rheumatoid arthritis (RA) patients usually don't have fever and leukocytosis as prominent features. Only 1/3 of RA patients will have a positive joint culture. Sputum and urethral cultures should also be performed whenever TB or Reiter's is suspected. Realize, however, that TB and chlamydial cultures may take 3 to 6 weeks, and GC cultures have a 50% false positive result. An acid fast bacilli smear may be helpful and can give immediate results. The diagnosis of septic arthritis is multifactorial, and includes one or more components of symptoms, physical signs, and positive laboratory values.

The treatment of a septic joint is admission, with daily arthrocentesis and/or open joint lavage. Surgical treatment of RA septic arthritis reveals a 66% good outcome versus 44% with medical treatment, that being intravenous antibiotics. If surgical treatment is delayed, permanent destruction of articular cartilage can result, which increases the potential for osteomyelitis. Thirty-percent of infected joints progress to osteomyelitis, and 50% of the survivors will have a poor functional outcome.

Only when infectious arthritis is ruled out, can other causes of the red, hot and swollen joint be considered. Consider also that multiple arthritides may occur in a single joint. The patient may have history of gout in the affected joint, but if a history of fever and chills, for example, are related, then the clinician is obligated to rule out an infectious process.

“Ciprofloxacin (and other quinolones) cover all bacterial infections.”

Perhaps due to aggressive marketing efforts on behalf of pharmaceutical companies, some products are noted as having more capabilities than they actually have. Or, perhaps, the availability of free samples provides easy access of drug coverage. An example is ciprofloxacin. Clinicians all too often use this drug as the panacea for all infections. In fact, ciprofloxacin is only recommended in primarily gram-negative infections. It does not have optimal gram-positive coverage, and has no anaerobic coverage. Therefore, it is not the ideal antibiotic for postoperative or skin infections. If a gram-negative infection is suspected, the current ideal drug may be levofloxacin, because of the once-a-day administration and therefore lower overall cost. Once-a-day administration tends also to have a higher compliance rate and therefore is the overall drug of choice for these types of infection.

If a postoperative infection is suspected, the best drug is one that covers primarily gram-positive microorganisms, with some gram-negative coverage. Second generation cephalosporins are ideal for this scenario. Other good antibiotics for postoperative infections in the non-diabetic are erythromycin, bactrim, and clindamycin. Diabetic infections should always be covered, at least initially, with broad-spectrum antibiotics.

“All ulcers need antibiotics.”

The etiologies of ulcerations are extensive; infection is not the only cause. Other common causes are neuropathy, ischemia, venous stasis, and skin malignancies. Therefore, the first step in ulcer care is identification of the etiology, which can be investigated through a thorough history and physical examination. Should the history and physical reveal signs and symptoms of infection, then medical intervention in the form of antibiotics would be indicated for its treatment.

Another important point to understand, is the difference between colonization and infection. There is a spectrum between a aseptic (sterile) wound, and an infected wound. On the one end is the clean and bacteria-free wound, on the other end is the wound that manifests all the signs of infection. In the middle is colonization. A colonized wound is one that may grow bacteria, but they are either

nonpathologic, or are too few to either cause destruction, or mount an inflammatory response. These types of wounds do not require antibiotic therapy.

The use of antibiotics in ulcers without indications of infection is poor practice, and may lead to superinfection and drug resistance. Superinfection is defined as a new infection that develops during antibiotic treatment. Whenever antibiotics are used, they exert a selective pressure on the endogenous and exogenous bacteria of the patient. Bacteria that survive application of the antibiotic are resistant to that antibiotic and render it useless in the future for that patient. When this is practiced extensively, and unfortunately it is, fewer antibiotics are left in the arsenal against infection. This tends to drive up health-care costs and increases the mortality of infection as a whole.

An often ignored area in ulcer care is the need for tetanus immunization. As an open wound, ulcers are potential portals. If an ulcer is exposed to a gram-negative bacillus called *Clostridium tetani*, it can very easily become intoxicated rather than infected. Tetanus, while rare, is easier to prevent than treat. Only 50 cases are reported per year, but each case carries with it a 50% mortality rate. More concern should be placed on tetanus immunization than on antibiotic coverage when dealing with ulcerations.

“Bone scans and MRI can diagnose infections.”

Many times we rely on radiographic or laboratory testing to diagnose the pathology, thus applying these tests to a function for which they were not intended. Nowhere is this more true than in the diagnosis of infection via bone scans and MRI. While these tests are extremely sensitive in identifying areas of inflammation and bone growth as in bone scans, they can not be relied upon to diagnose infection, a process that shares many inflammatory responses. Many times, areas of inflammation may be interpreted by the radiologist as an area of “possible infection.” The leap between possible infection and bona-fide infection cannot be made without other clinical evidence and/or positive culture results. As with any special study, results must be correlated with clinical findings, and should only be used to support or reject an existing diagnosis.

“Vascular reconstruction is necessary prior to incision and drainage.”

Once an infection is recognized, and surgical management is indicated, incision and drainage should be performed as soon as possible. Once the infection is eradicated, a vascular surgeon must decide whether or not the patient is a bypass candidate. This may include an evaluation by a cardiologist, since these patients often have concomitant coronary artery disease. Candidacy for lower extremity bypass is determined by arteriogram, which includes the abdominal aorta and renal arteries. As the admitting attending, the podiatric surgeon must ensure that the renal status and hydration are adequate for the arteriogram. As in any surgical procedure, coagulation must be assessed preoperatively. If the patient requires a bypass that crosses the knee, an additional special study evaluating the veins, (venous mapping), must be performed prior to approval for candidacy.

In addition, some infections may be so aggressive that much of the foot and/or ankle is quickly infected, leaving little to act as a stable platform after incision and drainage. Even in these cases the incision and drainage may need to be performed over a below-knee or above-knee amputation to provide stabilization, and increase the integrity of the soft tissue for an eventual more proximal amputation. Often, what is recognized in chronic infections of the foot and ankle, is an overall increase in edema of the lower extremity. This does not provide good tissue for healing and rapid progression into a prosthesis. Therefore, timely incision and drainage is a necessary first step towards a speedy convalescence period for infections of the foot and ankle.

“Infections can only occur with a portal of entrance. If you don’t have a wound, you can’t possibly have an infection.”

There are two main routes of infection once the body has been exposed to the microorganism: contiguous and hematogenous. Although most foot infections are directly related to contiguous infection from an open wound, there are instances where the infecting organism is spread to the foot from a distant site. Distant infections, when introduced to the blood stream, tend to gather in

areas of trauma, for example arthritis which develops into septic arthritis, or hematoma which develops into cellulitis or an abscess. Common sites for this means of infection are the lungs, urinary tract, upper respiratory tract, ear, heart and urethra. The urethra is separated from the urinary tract to remind us of sexually-transmitted diseases. Many of these distant sites of infection have concomitant dermatological signs that can be used to help the assessment. For example, a gonorrheal infection may be suspected in the younger patient if kerrato blanorrhagica and/or balanitis circinata with penile discharge are often present. Or, as in subacute endocarditis, the patient may have murmurs with Janeway lesions and/or Olier’s nodes. Pulmonary pathology is generally suspected in those patients with clubbing of their nails. It is also good practice to investigate these other distant sites, despite an open wound.

“Abscesses can be treated merely by increasing the dosage of the antibiotic.”

The treatment of an abscess is surgical incision and drainage. This is because phagocytic cells cannot function properly with the low oxygen tension usually present. Antibiotics penetrate abscesses poorly. Increased colony counts in abscesses tend to decrease and dilute the effectiveness of antibiotics. Since most bacteria are not actively dividing, and antibiotics work best on actively dividing bacteria, they are not very effective against bacteria in abscesses.

“Diabetic infections are not painful.”

Diabetic neuropathy comes in many forms: radiculopathy, mononeuropathy, polyneuropathy, diabetic amyotrophy, and autonomic neuropathy. Certainly symmetrical polyneuropathy is the common form of diabetic neuropathy. Depending on the degree and combination of any of these forms of diabetic neuropathy, the patient will be able to feel infections of their feet. However, pain is certainly a less reliable symptom in diabetics. In fact, while pain is often an initial indication of pathology in the normal foot, it may be the last symptom in the diabetic foot. Often abnormal blood glucose and flu-like symptoms are the first to manifest in diabetic foot infections.

“A positive culture is equated with an infection.”

The presence of bacteria in a wound does not define an infection. In fact an infection is defined as the pathological presence of bacteria with an initiation of an inflammatory response by the host. In academic circles, the necessary quantity of pathogens to define an infection has been set at 10⁶, thus helping to differentiate between colonization and infection. An infection is defined by many signs and symptoms. These include pain, swelling, warmth/heat, erythema/cellulitis, drainage, loss of function, necrosis, fever, chills, hypotension, tachycardia, malaise, nausea and vomiting. No single sign or symptom is enough to categorically define the wound as an infected wound. The same holds true for a positive wound culture. A positive culture can exist with or without infection. Equally illustrative in the concept of the multiple facets of infection, is the documentation of which signs and symptoms of infection are and which are not present.

“Superficial wound cultures correlate with the infecting organism.”

Studies have shown that superficial wound cultures do not always correlate with the pathogen. For example, a draining sinus may show no organisms at all, and we would expect that, as pus is a collection of phagocytized cells of both PMN's and bacteria. The ideal method of identifying the pathogen is biopsy and deep culture. This may involve curettage of bone or soft tissue, rather than swab for the collection of the microorganism.

“The infection has resolved when you have achieved three negative cultures.”

This popular misconception has perpetuated itself without substantial studies to back it up. As mentioned previously, an infection is defined by many signs and symptoms. Therefore an infection is resolved when all or most of the signs and symptoms have resolved.

“Arthrocentesis causes joint infections.”

The risk of joint infection following intra-articular injection is well-recognized, but has an instance of less than 1 in 10,000 in diagnostic arthrocentesis. Septic arthritis developing one week to three months after injection probably occurs after bacteremia from a remote site of infection.

There are probably no absolute contraindications to diagnostic arthrocentesis, particularly if septic arthritis is suspected. Relative contraindications are infections of the skin or subcutaneous tissue over the joint, or significant bleeding diathesis. Iatrogenic infection is possible, but unlikely. The likelihood of unsuspected infectious arthritis must be many times greater than the risk of complication. The likelihood of complications can be minimized by not puncturing through obvious skin lesions.

Anticoagulation itself is not a contraindication. If, however, the patient has a known coagulopathy, than prophylactic treatment with appropriate coagulation factors is necessary. Ultimately, if an arthrocentesis is indicated, than it should be done, because the possibility of permanent disability hangs in the balance.

“Bone biopsy causes osteomyelitis.”

Reports of unusual infecting organisms underscore the necessity of obtaining a biopsy. Biopsy also aids in diagnosis when the clinical picture is equivocal, and cultures grow a non-pathogen, or nothing at all. Biopsy can determine if organisms exist within the suspected tissue, if signs of infection exist. In addition, a negative biopsy can be reassuring in those cases when no diagnosis can be made. Most importantly, bone biopsy should be regarded as the gold standard in organism identification for antibiotics.

“Diabetics heal poorly and therefore when incision and drainage is performed, a small stab incision is preferred over a larger incision.”

All necrotic tissue must be removed, and the incision designed so that no purulence can accumulate while the patient recuperates in the hospital. Very much like abscesses, necrotic tissue renders the body's immune response less effective. The only real factor needed for wound healing is adequate blood flow.

ACKNOWLEDGMENT

The authors remain indebted to Dr. Helga Barrett for her assistance in preparing the manuscript.

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