

Diagnosis, Treatment of Diabetic Foot Infections

Most diabetic foot infections are caused by unrecognized or mistreated ulcerations.

BY WARREN S. JOSEPH, DPM

The Infectious Diseases Society of America (IDSA) released guidelines for the diagnosis and treatment of diabetic foot infections.¹ Among patients with diabetes, foot infections are responsible for substantial numbers of health care provider visits, morbidity and hospitalizations. Diabetic foot complications are the largest nontraumatic cause of lower extremity amputations, with almost 90,000 per year.²

Most of these infections are caused by foot ulcerations that are either not recognized in a timely fashion or inadequately treated. A coordinated approach is required to manage diabetic foot infections, preferably by a multidisciplinary team, including an infectious disease specialist, internist, vascular surgeon, podiatrist as well as a medical microbiologist. The IDSA guidelines were compiled to help reduce medical morbidity, psy-

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chological distress and financial costs associated with diabetic foot infections.

COORDINATED TEAM NEEDED

In the IDSA executive summary, my colleagues and I wrote that diabetic foot infections require attention to local and systemic issues by a coordinated team, as mentioned above. Foot ulceration is the major factor predisposing the diabetic foot to infections. This condition is usually associated with diabetic peripheral neuropathy, while peripheral vascular disease and immunological disturbances play secondary roles.

Contrary to earlier convention that all diabetic foot infections were a polymicrobial mix of gram-positive, gram-negative aerobic and anaerobic organisms, it is now recognized that *Staphylococcus aureus* and other aerobic gram-positive cocci are the primary pathogens in diabetic foot infections. However, gram-negative rods may be found in patients who have chronic wounds or who have recently received antibiotics. Patients who have foot ischemia or gangrene may have obligate anaerobic pathogens.

The diagnosis of these infections should be made on a clinical basis by observing local signs and symptoms of inflammation. There is limited usefulness for lab tests including wound cultures in infection diagnosis, with the exception of osteomyelitis cases.

Although the guidelines indicate that, if possible, specimens should be sent for culture prior to the initiation of empirical antibiotic therapy, such therapy

TAKING CARE OF THE DIABETIC FOOT

- Wash feet with mild soap and warm water, making sure to test the water temperature with your hand before submerging the feet.
- Do not soak feet.
- Pat feet dry with a towel, and pay close attention to drying skin between the toes.
- Use quality lotion to keep the skin of your feet soft and moist. Do not put lotion between the toes.
- Trim your toenails straight across, and avoid cutting the corners of the toenails. Instead, use an emery board to file the nail.
- Do not use antiseptic solutions, drug store medications, heating pads or sharp instruments on your feet.

Source: American Academy of Orthopaedic Surgeons

TABLE 1. RISK FACTORS FOR FOOT ULCERATION AND INFECTION

Risk Factor	Mechanism of Injury or Impairment
Peripheral motor neuropathy	Abnormal foot anatomy and biomechanics, with clawing of toes, high arch, and subluxed metatarsophalangeal joints, leading to excess pressure, callus formation and ulcers
Peripheral sensory neuropathy	Lack of protective sensation, leading to unattended minor injuries caused by excess pressure or mechanical or thermal injury
Peripheral autonomic neuropathy	Deficient sweating leading to dry, cracking skin
Neuro-osteoarthropathic deformities (ie, Charcot disease) or limited joint mobility	Abnormal anatomy and biomechanics, leading to excess pressure, especially in the midplantar area
Vascular (arterial) insufficiency	Impaired tissue viability, wound healing and delivery of neutrophils
Hyperglycemia and other metabolic derangements	Impaired immunological (especially neutrophil) function and wound healing and excess collagen cross-linking
Patient disabilities	Reduced vision, limited mobility and previous amputation(s)
Maladaptive patient behaviors	Inadequate adherence to precautionary measures and foot inspection and hygiene procedures, poor compliance with medical care, inappropriate activities, excessive weight-bearing and poor footwear
Health care system failures	Inadequate patient education and monitoring of glycemic control and foot care

should be directed primarily against the aerobic gram-positive organisms.

INFLAMMATION CAN MIMIC INFECTION

Not all patients with ulceration and surrounding inflammation will have infections. Charcot joint changes, superimposed gouty arthritis, inappropriate footwear and excessive weight bearing can cause inflammation and changes that mimic infection.

Imaging studies are useful for a better diagnosis or definition of deep, soft-tissue purulent collections. Imaging studies are regularly needed for the detection of pathological findings in bone. While plain radiography may be acceptable in many of the cases, MRI is more sensitive and specific for the detection of soft-tissue lesions.

The guidelines state that infections should be categorized according to severity, based on clinical and laboratory features. Most importantly are the extent and specific tissues involved, the adequacy of arterial perfusion and the presence of systemic toxicity or metabolic instability. Infection categorization enables a determination to be made regarding the risk to the patient and

the limb, in turn dictating the urgency of treatment.

Current evidence does not support routine culturing or treating uninfected ulcers with antibiotics. It is necessary for virtually all infected wounds, however, but it must be coupled with appropriate wound care.

SELECT REGIMEN BASED ON SEVERITY

The guidelines direct caregivers to select an antibiotic regimen based on the severity of the infection and the likely etiology. Therapy aimed at aerobic gram-positive cocci might be enough for mild-to-moderate infections in patients who have not recently had antibiotic treatment. Broad-spectrum therapy, while not typically required, is indicated for severe infections. Recent antibiotic use and local antibiotic susceptibility data should be considered. Culture results and susceptibility data should form the basis of a definitive therapy. The presence of methicillin-resistant *S. aureus* (MRSA) is becoming an increasing problem in the diabetic foot infection and should be considered in communities with a large prevalence of these organisms or in patients at high-risk. These high-risk patients include those that have had previous MRSA infection, those that have been institu-

tionalized or those who have been on multiple previous courses of antibiotics.

Only limited evidence exists for the choice among topical, oral and parenteral antibiotic agents. Almost all severe and many moderate infections require parenteral treatment, at least initially. The guidelines recommend the use of highly bioavailable oral antibiotics for most mild and some moderate infections and topical therapy for some mild, superficial infections.

TREAT UNTIL RESOLVED

Antibiotic treatment should continue until the infection has resolved – not necessarily until the wound has healed. A basic guideline would be 1 to 2 weeks for mild infections, with an additional 1 to 2 weeks if needed; 2 to 4 weeks for moderate infections and 4 to 6 weeks for osteomyelitis.

Clinically stable patients in whom infections do not clear up after one or more courses of therapy should

be discontinued from all antimicrobials and cultured. Surgical consultations should be obtained for infections that are accompanied by a deep abscess, extensive bone or joint involvement, crepitus, substantial necrosis or gangrene or necrotizing fasciitis. The guidelines committee said that evaluating the limb's arterial supply and revascularizing when indicated are particularly important.

WOUND CARE NEEDED

Wound care – combined with antibiotics – is crucial for healing. This includes proper cleansing, debridement and off-loading pressure. A specific wound dressing or wound healing agent is not recommended, due to lack of sufficient evidence.

Patients should have early and careful observations. While studies have not clearly defined the role of adjunctive therapies for diabetic foot infections, some reviews suggest that granulocyte colony-stimulating

CHARCOT FOOT MAY NOT DIRECTLY AFFECT MORTALITY IN DIABETIC PATIENTS

There was no difference in mortality rate between two groups enrolled in a retrospective study.

The mortality rate in diabetic patients with neuropathic osteoarthropathy (Charcot foot) was higher than expected during a retrospective analysis, however, researchers said that Charcot foot did not independently cause an increased mortality rate in diabetic patients.

Researchers at the City Hospital in Nottingham, United Kingdom, reported their findings in *Diabetic Medicine*. They compared the survival and amputation rates of 47 patients with Charcot foot to a control population with uncomplicated neuropathic ulceration. They concluded that there was no significant difference in mortality rates between the two groups. Researchers wrote that neuropathy, not Charcot foot, may be independently associated with the increased mortality.

"The main take-home message relates to the possible pathophysiological link between microvascular complications and macrovascular ones," William Jeffcoate, MD, of the department of diabetes and endocrinology, City Hospital, told *Diabetic Microvascular Complications Today*.

Patients were identified through the hospital's comprehensive database; 21 women and 26 men were identified and treated at a single specialist unit. Eighteen had type 1 diabetes.

A total of 21 patients with Charcot foot and 16 patients with uncomplicated neuropathic ulceration died (mean interval 3.1 ±2.7 years). Of the survivors (mean Charcot group follow-up 4.7 ±4.9 years, mean control group follow-up 5.3 ±3.9 years), 11 underwent a major amputation on the index lesion side in the Charcot group versus five in the control group.

Data from the study are preliminary, and came from a selected population, Jeffcoate said. Researchers said that the findings indicate that no difference in mortality existed between the two groups, and that Charcot osteoarthropathy is not associated with increased diabetic mortality rates. A multicenter study is needed to further study diabetic neuropathic osteoarthropathy. Jeffcoate also said that further studies, with "carefully defined populations," are needed to determine the possible links between neuropathy and cardiovascular mortality. ■

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Gazis A, Pound N, Macfarlane P, et al. Mortality in patients with diabetic neuropathic osteoarthropathy (Charcot foot). *Diabetic Medicine*. 2004;21:1243-1246.

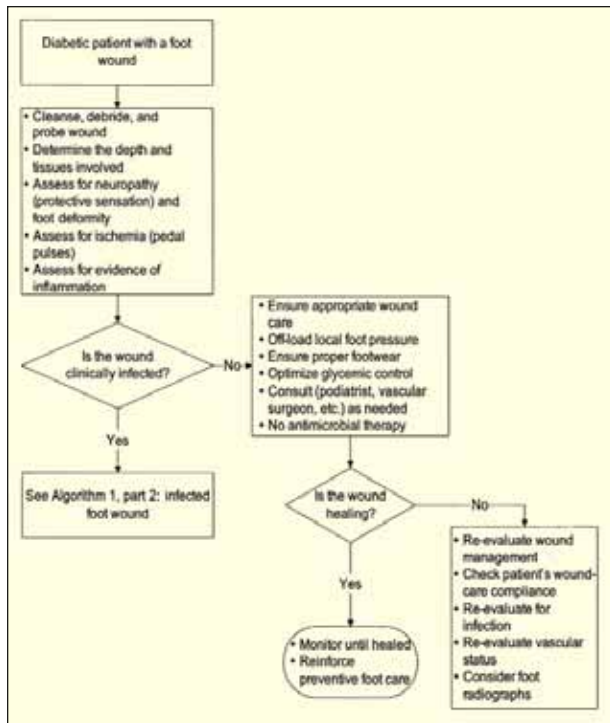


Figure 1. Algorithm 1, part 1: Approach to treating a diabetic patient with a foot wound.

factors and systemic hyperbaric oxygen therapy may help prevent amputations. These treatments may be indicated for severe or nonresponsive infections.

Osteomyelitis may be difficult to distinguish from noninfectious osteoarthropathy, therefore bone biopsy may be required, the guidelines note.

Attempts have been made to classify malperforans ulcerations, and while some systems have been in general usage, an accepted and validated system has not been adopted. Foot ulcerations in diabetic patients can have a wide spectrum of appearances and even with the best medical care any lesion can worsen rapidly.

CONCLUSIONS

The ultimate goal of diabetic foot infection treatment is to eradicate the infection and avoid soft tissue loss and subsequent amputations. A patient who has had an infection is likely to have more. It is important for clinicians to emphasize preventive strategies with patients. The best way to prevent foot infections is early detection of neuropathy. Patients should be told about the importance of optimal glycemic control, appropriate footwear, avoiding trauma, daily self-examination of the feet and reporting any changes to their physician.

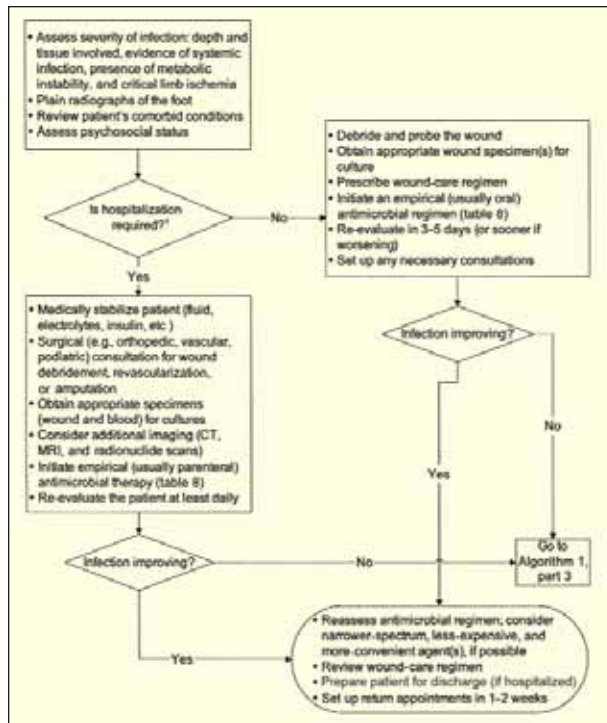


Figure 2. Algorithm 1, part 2: Approach to treating a diabetic patient with a foot infection. Consider hospitalization if any of the following are present: systemic toxicity (eg fever and leukocytosis); metabolic instability (eg severe hypoglycemia or acidosis); rapidly progressive or deep-tissue infection, substantial necrosis or gangrene, or presence of critical ischemia; requirement of urgent diagnostic or therapeutic interventions; and inability to care for self or inadequate home support.

Current research has uncovered much about the treatment of diabetic foot infections, however more research is needed. The committee especially recommends that adequately powered prospective studies be undertaken to elucidate and validate systems for classifying infection, diagnosing osteomyelitis, defining optimal antibiotic regimens in various situations and clarifying the role of surgery in treating osteomyelitis. ■

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1. Lipsky BA, Berendt AR, Deery HG et al. ISDA guidelines: Diagnosis and treatment of diabetic foot infections. *Clin Infect Dis*. 2004;39:885-910.
 2. Joseph WS, Tan JS. Infections in diabetic foot ulcerations. *Current Infectious Disease Reports*. 2003;5:391-397.