Although the published evidence is limited, patients with diabetes mellitus are more likely to develop onychomycosis than are patients without diabetes mellitus. A study conducted by Gupta et al showed that onychomycosis is 2.8 times more prevalent among people with diabetes mellitus than in those without the disease.\(^1\) Diabetic neuropathy can predispose a patient to develop onychomycosis and also can complicate the disease. Patients with diabetic neuropathy experience numbness in their feet. These patients cannot determine if their shoes are the correct size, thus tend to wear 1 to 2 sizes too small—the pressure from the small shoe activates the nerve endings, allowing them to feel their shoes. Onychomycosis causes thickening of the toenails, which can lead to serious bacterial infections and foot ulcerations.\(^3\) Along with the thickened toenails, the neuropathy creates the perfect environment for foot ulceration. A tight shoe causes trauma to the toenail and nail bed, and the neuropathy prevents the patient from experiencing the pain of the ulceration.

Ulceration is the predisposing factor in up to 85% of lower extremity amputations. Foot ulceration occurs in approximately 19% of patients with diabetes mellitus. In those patients with foot ulceration, the prevalence of lower extremity amputation ranges from 6% to 43%, depending on the severity of the ulcer.\(^4\) More than 90 000 lower extremity amputations performed in the United States are caused by diabetes mellitus. The 5-year survival rate of a person with diabetes mellitus who has undergone a unilateral amputation is 39% to 68%.\(^5\)

More recently, a study by Doyle et al showed an association among onychomycosis, ulceration, and gangrene.\(^6\) Patients with diabetes mellitus and with onychomycosis had a significantly higher rate of foot ulceration, gangrene, and a combination of foot ulcer and gangrene than did patients with diabetes without onychomycosis (Figure 1).\(^6\) Although these data do not prove that onychomycosis causes ulcerations and gangrene, they strongly suggest a positive association. In my experience, onychomycosis usually is present in an amputated lower limb.

Onychomycosis presents as a spectrum of disease, ranging from mild to extremely severe and is an infection that should be treated as such because it can spread within a nail, across toes, or to other parts of the foot or body. Onychomycosis is a progressive infection that has serious consequences, thus it must be treated aggressively.

The following are 5 cases that exemplify the sequelae of onychomycosis in a diabetic population.

**CASE 1**

This patient shows classic signs of onychomycosis with 10, thick, mycotic toenails (Figure 2). This pre-
sentation, combined with the presence of neuropathic pain, will ultimately require debridement, and subungual ulcerations may be found.

CASE 2

Debridement was performed on this patient’s toenail. During the procedure, a bead of pus leaked from beneath the toenail. As the debridement continued, the nail lifted from the nail bed, revealing the ulceration (Figure 3). Even in healthy patients, only a small amount of soft tissue resides between the nail, nail bed, and bone. In this case, the ulceration down to distal phalanx is visible, resulting in probable osteomyelitis. Thus, onychomycosis can lead not only to ulceration but also to secondary bacterial infection, cellulitis, and subungual osteomyelitis.

CASE 3

This patient offers another clinical example of subungual ulceration revealed during debridement. In the hallux nail, during debridement, the toenail lifted from the nail bed, and the drainage, moistness at the distal tip of the toe, and subungual ulceration became visible (Figure 4). Also, the thickness of the nail demonstrates the point of pressure creating the ulceration.

CASE 4

This elderly patient had diabetes mellitus and peripheral vascular disease (PVD). The infected toenail was debrided and a subungual ulceration was found (Figure 5). Her skin shows the classic signs of PVD with diabetes mellitus: limited hair growth, loss of turgor, dystrophy of other nails, and “rice paper” skin (crinkly, thin). This patient will face additional challenges because the PVD will make healing of the ulceration more difficult. She probably will require vascular consultation or the infection will become gangrenous.

CASE 5

This patient represents an extreme example of dystrophic toenails resulting from neuropathy (Figure 6). This patient also has diabetic retinopathy, thus she is unable to see her nails; severe arthritis prohibits her from treating her nails. As a result, the dystrophic hallux nail stretches to the third toe, creating ulceration on the third toe down to the bone, thus causing osteomyelitis. She also has a “kissing ulcer” between the hallux and second toe at the interphalangeal joint. For these types of patients (with neuropathy and...
retinopathy), the first indication of onychomycosis is often when they notice that their socks or stockings are sticking to their feet or there is a foul odor emanating from their shoes. Otherwise, these patients are unaware of any problems with their feet.

**CLINICIAN INTERVIEW**

Warren S. Joseph, DPM, FIDSA, has been appointed as Consulting Editor to Podiatry Management. Dr Joseph currently serves as editor of the Journal of the American Podiatric Medical Association and is an internationally recognized authority on onychomycosis and infectious diseases of the feet. He is also Adjunct Associate Professor, Internal Medicine, Section of Infectious Diseases, Temple University School of Medicine, Philadelphia, Pennsylvania.

A senior clinical editor for Advanced Studies in Medicine (ASiM) interviewed Dr Joseph about diagnosing and managing onychomycosis in patients with diabetes because these cases are common in primary care and often have coexisting conditions and concomitant medications.

**ASiM:** How aware are patients with diabetes of the seriousness of onychomycosis and the importance of treating this infection?

**Dr Joseph:** Actually patients with diabetes mellitus do have an awareness of the disease. Novartis Pharmaceuticals conducted an interesting study that investigated patients’ perceptions about onychomycosis. Results showed that approximately 88% of patients who had diabetes mellitus and onychomycosis knew the condition was serious and should be treated.

**ASiM:** When you are treating patients with diabetes mellitus, what strategies other than aggressive treatment do you recommend?

**Dr Joseph:** These patients must be treated even more aggressively than the nondiabetic population, and I think we can do better. Study results show that many patients with diabetes mellitus aren’t being treated aggressively enough. I hear comments such as, “These patients are on too many medications; they have too many other problems. Why should we be concerned about the onychomycosis?” In fact, these are the exact patients who should be concerned about onychomycosis because of the potential for complications.

**ASiM:** Is the follow-up different for patients with diabetes versus other patients?

**Dr Joseph:** These patients may have a higher predisposition to develop onychomycosis. A study by Gupta et al suggests that these patients are up to 2.8 times more likely to develop onychomycosis than are patients who don’t have diabetes, thus follow-up over time is vitally important. Although a patient with diabetes mellitus may be cured of onychomycosis, the physician must be sure the patient is using preventive therapy, such as antifungal foot powders in their shoes and antifungal skin creams. The natural history of onychomycosis starts with tinea pedis, a skin infection that develops underneath the toenail. Therefore, the fungus must be kept away from the feet, thus it cannot recur under the toenails. More aggressive long-term follow-up is required.

**ASiM:** How is onychomycosis diagnosed in the general patient population? What guidelines do you recommend to a general practitioner?

**Dr Joseph:** Most podiatrists accurately diagnose onychomycosis clinically. However, a dermatologist may say—and there are some studies that may or may not support this—that up to 50% of patients with dystrophic nails do not have onychomycosis but have other conditions, such as psoriasis and lichen planus. Unfortunately, many insurance companies or healthcare carriers won’t pay for antifungal therapy unless there is a laboratory confirmation, and that’s really what drives the whole issue of laboratory diagnosis. If a clinician is going to prescribe an oral antifungal that may have some potential toxicities (as rare as they are), it’s important (but not absolutely necessary) to confirm the diagnosis. A confirmation of diagnosis could include potassium hydroxide, sending part of the nail for a culture, or requesting a PAS (periodic acid-Schiff stain). A PAS is considered by many clinicians as the best, easiest, and most sensitive test available currently, and supportive literature is available. A general practitioner who is not experienced in treating onychomycosis or is not comfortable making the diagnosis, certainly should consider sending a nail clipping or debris sample for laboratory testing.

If general practitioners are not comfortable making the diagnosis for their patients who are concerned about onychomycosis or don’t often prescribe drugs for the disease, then referring the patient to a podiatrist is the best route.

**ASiM:** When should a primary care practitioner refer the patient to a specialist?

**Dr Joseph:** To confirm a diagnosis and if they don’t
have enough experience in treating onychomycosis. A general practitioner is treating the patient’s diabetes mellitus, high blood pressure, or hypercholesterolemia and may worry about the patient becoming upset about additional drug recommendations. Therefore, if general practitioners are not comfortable with making the diagnosis or with the treatment regimen, they should refer the patient to a podiatrist or dermatologist. Patients who need the adjunctive debridement along with the antifungal therapy are good candidates for a referral to a specialist.

**ASiM: What educational sources do you provide to your patients—pamphlets, Web sites? Are there Web sites you particularly find useful?**

*Dr Joseph:* I spend a lot of time talking to my patients, educating them about their options. There are many different and useful Web sites. The American Podiatric Medical Association site (www.apma.org) contains information on onychomycosis, in addition to other important topics, such as foot health, foot health brochures, diabetes information, bunions, and diabetic wound care. Most pharmaceutical companies have Web sites. However, I prefer to personally interact with my patients, talking to them and educating them about their disease and their treatment options.

**REFERENCES**


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