Understanding Onychomycosis: Resolving Diagnostic Dilemmas

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Abstract

No scientifically rigorous, large, prospective studies have been done to document the true prevalence of onychomycosis; the reported rates vary mainly by climate and by population, but the overall prevalence in the United States is estimated to be at least 10%. Advanced age and diabetes are the most commonly reported risk factors for onychomycosis. The differential diagnosis of onychomycosis is lengthy, and visual inspection alone is not sufficient for a definitive diagnosis—direct microscopic examination of a wet-mount preparation with 10% to 20% potassium hydroxide is the first-line diagnostic test.

Key Words

Dermatophyte; onychomycosis; *Trichophyton rubrum*

Semin Cutan Med Surg 35(supp3):S48-S50

TABLE 1. Risk Factors for Onychomycosis

- Tinea pedis[4,5]
- Nail trauma[5]
- Diabetes[6-8]
- Psoriasis[9]
  - 18% in a systematic review of the literature[10]
  - 28% in a prospective study of hospitalized psoriasis patients[11]
- Advanced age[12-15]
- Peripheral vascular disease[5]
- Compromised immune function[16]
- Personal/family history of onychomycosis[17]

Onychomycosis prevalence estimates vary widely; based on the available studies, the overall prevalence of onychomycosis is probably at least 10% to 12%, possibly higher.[1-3] The vast majority of cases of onychomycosis involve dermatophyte molds, particularly *Trichophyton rubrum*, which accounts for 90% of infections, and *T. mentagrophytes*. *Candida* species cause between 10% and 20% of onychomycosis, and a small number of cases can be attributed to nondermatophyte molds, such as *Acremonium, Fusarium,* and *Scopulariopsis* spp.[1-3]

Risk Factors for Onychomycosis

Despite the lack of more exact epidemiologic data, climate, population, and other risk factors can be helpful in narrowing the diagnosis in patients with nail symptoms. Onychomycosis is more common in hot, humid regions and is less commonly seen in temperate or cold, dry climates. Other environmental risk factors include public areas where individuals may walk barefoot—pools, spas, gym locker rooms, and hot tubs. In addition, increasing age is a risk factor: it is clear that onychomycosis is uncommon in pediatric patients, whereas its prevalence in geriatric populations is estimated to be as high as 60%.[3]

A number of medical conditions also are associated with an increased risk for onychomycosis (Table 1), including several comorbid conditions: diabetes, psoriasis, peripheral vascular disease, tinea pedis, and diseases that adversely affect immune function.[4-17] Among these, diabetes is the most common—up to one-third of patients with diabetes also have onychomycosis.[6-8]

Patients with psoriasis also are at increased risk for onychomycosis. In one review of the literature, Klaassen et al[10] reported that about 18% of patients with psoriasis have onychomycosis, and Méndez-Tovar and colleagues[11] found onychomycosis in 28% of hospitalized patients.

Tinea pedis increases the risk for nail infection (Figure 1). Although such coinfections are not among the most common, when onychomycosis is suspected, examination should be done for signs of tinea pedis between the toes (interdigital distribution) and on the soles of the feet (moccasin distribution). Individuals who share a residence with a patient who has onychomycosis also should be asked about and, if possible, examined for fungal infections of both nail and skin. This is particularly important in cases of pediatric onychomycosis or recurrent nail infections. Onychomycosis is uncommon in young children in general but is more common among children whose parents or older siblings have onychomycosis or tinea pedis. In patients with recurrent in-

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Publication of this CME/CE article was jointly provided by the University of Louisville, and Global Academy for Medical Education, LLC with Skin Disease Education Foundation (SDEF) and is supported by an educational grant from PharmaDerm, a Fougera Pharmaceuticals company.

Dr Stein Gold has received an honorarium for her participation in this activity. She acknowledges the editorial assistance of Joanne Still, medical writer, and Global Academy for Medical Education in the development of this continuing medical education journal supplement.

Linda F. Stein Gold, MD, *Consultant*: Anacor Pharmaceuticals Inc., Eli Lilly and Company, Galderma Laboratories, L.P., LEO Pharma Inc., Novartis Pharmaceuticals Corporation, Pfizer Inc., Sandoz, Taro Pharmaceutical Industries Ltd., and Valeant Pharmaceuticals North America LLC. *Speaker*: Galderma, LEO, Novartis, and Valeant. *Grant Research/Support*: Anacor, Galderma, GlaxoSmithKline, LEO, Novartis, Pfizer Inc., Sandoz, Taro, and Valeant.

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 1085-5629/13$-see front matter
DOI: 10.12788/j.sder.2016.008

n **FIGURE 1. Onychomycosis and Tinea Pedis.** When onychomycosis is suspected, the skin should be inspected for signs of tinea pedis. The reverse is also true—if a patient complains of symptoms of athlete's foot, the toenails should be examined for evidence of onychomycosis. Photo courtesy of Theodore Rosen, MD.

fections, other individuals in the household who have untreated tinea pedis may be a source of chronic reinfection.

In addition, any type of nail trauma can increase the risk for onychomycosis, as damage to the nail plate—and, consequently, disruption of the plate from the nail bed—allows introduction of potentially pathogenic organisms.

Differential Diagnosis

Although onychomycosis is a common nail disease, it is important to note that 50% of cases of nail disease can be attributed to causes other than fungus or yeast infections.[18] As shown in Table 2, a number of other conditions can mimic onychomycosis, including other infections or diseases and trauma.[18-21] Because discoloration, brittleness, and other signs of nail dystrophy are common to many clinical entities, visual inspection alone is not sufficient to establish a diagnosis of onychomycosis (Figure 2); objective diagnostic techniques should be used.

Diagnostic Techniques

The first-line diagnostic technique for onychomycosis is direct microscopy of a carefully prepared specimen of affected subungual tissue in 10% to 20% potassium hydroxide (KOH). For more a more definitive diagnosis—ie, identification of the infecting organism(s)—a culture or histopathologic techniques (periodic acid–Schiff [PAS] stain or polymerase chain reaction [PCR] testing) may be considered. An overview of these recommended diagnostic techniques is provided below. [For a more detailed discussion of onychomycosis presentations, mycology, and diagnostic testing, the reader is referred to the comprehensive article published by Elewski.[5]]

Potassium Hydroxide Preparation: Examination and Culture

Microscopic examination of a specimen prepared with 10% to 20% KOH is a readily accessible technique for determining whether fungal organisms are present in a sample; however, proper sampling is essential to its value as a first-line diagnostic tool.

To obtain a good subungual sample, it is necessary to trim back the nail to access the moist debris that lies behind the dry, flaky material at the end of the distal nail. After trimming, the nail and surrounding tissue should be cleaned thoroughly to prevent bacterial contamination of the sample. In obtaining a sample, a curette may be more helpful than a blade to minimize bleeding and patient discomfort.

n **TABLE 2. Differential Diagnosis of Onychomycosis[18-21]**

- Nail trauma
- Psoriasis
- Lichen planus
- Paronychia
- Bacterial infection
- Pachyonychia congenita
- Nail bed tumors (squamous cell carcinoma) and verrucae
- Yellow nail syndrome
- Alopecia areata
- Contact/atopic dermatitis
- Idiopathic onycholysis
- Twenty-nail dystrophy (trachyonychia)
- Nail changes associated with systemic disease or nail cosmetics

Mycologic Culture

A mycologic culture can be considered if onychomycosis is suspected but KOH findings are negative, or to identify the specific organism when hyphae, spores, or other fungal structures are seen on direct microscopy. The results usually are available in 4 to 6 weeks; meanwhile, therapy can be initiated, if indicated.

Histologic Evaluation

Histologic evaluation of a sample of nail clippings using PAS stain also can be ordered to identify the infecting organism. In contrast to culture, the results of PAS studies are available in 1 to 2 days. Moreover, PAS results are more specific than fungal culture findings. This superior sensitivity was demonstrated in a study of 100 consecutive cases of suspected onychomycosis in which direct

n **FIGURE 2. White Superficial Onychomycosis.** Several clinical signs, including erythema and swelling of the nail folds, make visual inspection alone an unreliable diagnostic method. This patient has white superficial onychomycosis, confirmed by diagnostic testing. Photo courtesy of Theodore Rosen, MD.

microscopy and fungal culture results were negative. Mayer and colleagues[22] showed that 38 patients (38%) had positive fungal elements when the nail clippings were processed with hematoxylin, eosin, and PAS.

PCR testing also has been shown to be more sensitive than PAS in detecting the presence of mycologic organisms compared with direct microscopy with KOH or culture. In one study that compared the positivity rates with KOH/microscopy, culture, and PCR, the investigators reported rates of 10%, 29%, and 40%, respectively.[23] The results of PCR testing usually are available in about 3 days.

Conclusion

The accurate diagnosis and early treatment of onychomycosis is important to the preservation and function of the nail plate in patients with early disease and to the prevention of progressive destruction and deformity in patients with long-standing disease. In addition, onychomycosis represents a reservoir of fungus that can seed the skin of other areas of the body, and can be transmitted to others with whom the patient comes in contact. Effective therapy is available.

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