Pitted keratolysis usually presents no diagnostic difficulties because of its distinctive clinical appearance and odor. Participating in a sport that makes the feet hot and sweaty often contributes to this dermatologic condition. Sometimes simple measures such as proper foot drying and ventilating procedures are enough to clear the infection. The next line of treatment involves the use of topical agents such as erythromycin 2% solution.

Pitted keratolysis, a skin infection of the feet, is common in active people because it thrives in their warm, sweaty sneakers. Its distinct clinical appearance and odor make it easy to diagnose. Treatment generally consists of hygienic measures, sometimes supplemented by topical medications and perhaps an oral medication.

**Corynebacterium** as the Culprit

Though pitted keratolysis was first described by Castellani in 1910, the source of infection was not identified until 1967 when Taphlin and Zaias determined that a member of the *Corynebacterium* genus caused the disorder. (Two years earlier their group had originated the term "pit-

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bacteria are not generally considered pathogenic, though they do threaten immunocompromised individuals. A study has shown that these bacteria can hydrolyze keratin, the main protein component of the upper skin layers.

Hyperhydration greatly enhances growth of corynebacteria on the feet. In one study, pitted keratolysis developed in 53% of 387 military volunteers whose feet remained wet for 3 or more days. It is not surprising, then, that athletes easily acquire this disorder. Sports that make the feet hot not only produce sweating and hyperhydration, but also contribute to the formation of calluses, which provide abundant keratin for corynebacterial growth.

Identifying the Infection

Physical findings. Pitted keratolysis manifests as discrete pits or craterlike lesions on the plantar surfaces. These “punched out” lesions congregate on the thicker, pressure-bearing areas of the heels, balls of the feet, and toe pads (figure 1). The craters range from 1 to 7 mm in diameter and are similar in depth. Their dimensions are proportional to the size of the bacterial colony on the skin surface. Some pits have a brownish color that may give the feet a dirty appearance (figure 2). Adjacent pits may coalesce (figure 3). Affected areas have little or no inflammation, and most cases are asymptomatic. Hyperhidrosis is often noted on the feet, and the pits are more prominent when water-soaked. The feet of a patient who has pitted keratolysis are typically malodorous, providing a distinctive, pungent clue to the correct diagnosis.

The differential diagnosis of pitted keratolysis includes plantar warts and tinea pedis (athlete’s foot). Plantar warts typically have localized areas of hyperkeratosis and are often painful. Athlete’s foot involves pruritus between the toes and is not limited to pressure-bearing areas. Less common considerations in the differential diagnosis include punctate hyperkeratosis, porokeratosis, basal cell nevus syndrome, arsenic keratosis, tungiasis, and yaws.

Wood’s ultraviolet light examination is not consistently helpful, but the affected area...
plays a characteristic coral red fluorescence in the presence of pitted keratolysis. Fluorescent examination of the patient's intertriginous areas may be helpful because other corynebacteria-induced infections such as erythrasma and tinea versicolor axillaris commonly coexist with pitted keratolysis.

Laboratory findings. Laboratory testing is rarely needed to diagnose pitted keratolysis. Silver stains of superficial biopsies of the stratum corneum are most helpful for laboratory diagnosis, if needed. Studies with tissue gram stain or methenamine silver reveal gram-positive or argyrophilic organisms, respectively. High magnification demonstrates poorly staining filamentous and diphtheroid organisms that are less than 1 μm in diameter. Diphtheroid to oval or beaded forms predominate in more superficial layers of the stratum corneum. Examination of deeper layers shows longer filaments that tend to branch. The underlying dermis may contain a spotty infiltrate of round cells. Superficial biopsy of affected tissue shows a crater defect in the upper two-thirds of the stratum corneum.

Organisms may be obtained from the pitted lesions and cultured on brain-heart infusion agar under nitrogen and carbon dioxide at 98.6°F (37°C).

Treatment Options
Pitted keratolysis may undergo spontaneous remissions or exacerbations, and it may last for many years if not treated. In general, the condition is worse in warm weather and when the feet are damp. Effective long-term treatment and prevention require removal of the warm, moist

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conditions that promote bacterial growth.

When bathing, patients should scrub their feet with an antibacterial soap, rinse them, then dry them well. A blow dryer can dry the skin more thoroughly. An underarm antiperspirant spray may then be applied. Going barefoot or wearing only socks or sandals when possible exposes the feet to more air.

Patients should wear athletic footwear measures that may help curb bacterial growth include frequent sock changes and wearing shoes that 'breathe.'

mesh, cloth, or leather. Patients should avoid shoes made of vinyl, an occlusive material. Shoes should be allowed to air out at least 24 hours after use; it is a good idea to alternate wearing at least two pairs of shoes. Patients should always wear socks when wearing shoes.

When pitted keratolysis resists hygienic measures, patients may require medication, and many effective agents are available. Applying aluminum chloride hexahydrate 20% (Drysol) to the feet can decrease perspiration. Erythromycin 2% solution is a safe, effective, inexpensive treatment for pitted keratolysis. Other effective topical medications include 1% clotrimazole cream, 2% miconazole nitrate cream, 1% clindamycin solution, Whitfield's ointment, and 5% formalin solution. These agents are usually applied to the feet twice daily. Success has also been reported with oral erythromycin 250 mg four times daily; oral penicillin, however, is not effective. Once the condition has resolved, antibacterial soap may protect against recurrence.

Patient-Oriented Results

Pitted keratolysis does not typically impede activity, but it can be unpleasant and embarrassing for patients. Informing them about how to keep their feet dry and how to select breathable footwear is the initial treatment strategy. When more aggressive treatment is needed, several medication options are available that can resolve this common infection.

Address correspondence to Michael L. Ramsey, MD, Department of Dermatology, Geisinger Medical Center, 100 N Academy Dr, Danville, PA 17822-1406.

References