

Pitted keratolysis ✓

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KEY WORDS: Pitted keratolysis, Dermatophilus, Micrococcus

The Corynebacteria are a diverse group of gram-positive bacilli which include *Corynebacterium diphtheriae* as well as a bewildering number of species that are found on the skin as part of the normal flora. These latter organisms are usually referred to as diphtheroids or coryneforms. Three skin conditions appear to be related to an overabundance of these coryneforms: pitted keratolysis, erythrasma, trichomycosis. Interestingly, all three have been reported to coexist in the same person.^[1]

PITTED KERATOLYSIS

Pitted keratolysis is an acquired, chronic, usually asymptomatic, non-inflammatory, superficial bacterial infection of the skin, confined to the stratum corneum of the soles, characterized clinically by multifocal, discrete, superficial crateriform pits and superficial erosions. It can rarely occur on the palms.

HISTORICAL REVIEW

Pitted keratolysis was first reported in a Ceylonese patient in 1910, by Castellani under the term "Keratoma plantare sulcatum", a disease limited to the soles and characterized by small pits which coalesced and formed sulci.^[2] In 1930 Acton and McGuire^[3] described eight

cases of Keratoma plantare sulcatum from Bengal. They stated that the pits were associated with an organism belonging to the actinomycetes group and named it *Actinomyces keratolytica* sp. nov. Acton and McGuire renamed the disease "Keratolysis plantare sulcatum", since the condition in reality is a partial loss of the stratum corneum rather than a hyperkeratosis as Castellani's "Keratoma" implied. In 1931, Acton and McGuire^[4] suggested that *Actinomyces keratolytica* was the causative agent. Zaia et al, observing the erosion of the horny layer of the plantar surfaces, assigned the condition its current name, "Pitted keratolysis."^[5]

EPIDEMIOLOGY

Pitted keratolysis has a worldwide distribution, but is more common among barefooted people living in tropical regions.^[6] In a study of 142 homeless men in the Boston area (USA) 20.4% had pitted keratolysis.^[7] Prevalence rates have ranged from 1.5% in Japan (evaluation of 4,325 industrial workers) to 2.25% in New Zealand (random evaluation of 490 subjects). A much higher prevalence of 53% was recorded in volunteer soldiers in a study conducted in South Vietnam, where heat, humidity, and boots combine to produce a microenvironment that predisposes to this disease. Recently, in a study conducted among athletes in

How to cite this article: Singh G, Naik CL. Pitted keratolysis. Indian J Dermatol Venereol Leprol 2005;71:213-5.

Received: July, 2004. Accepted: November, 2004. Source of Support: Nil.

Britain, 25 of 184 examined had pitted keratolysis.^[8]

No race predilection exists for pitted keratolysis. Pitted keratolysis is commonly seen during summer and rainy seasons. Pitted keratolysis can affect any age^[8] but adult males with sweaty feet are most susceptible (97% of the cases).^[6] Few cases have been reported in the elderly.^[6]

Theoretically, both males and females should be affected; however, most written case reports or studies have involved male patients.^[8] Pitted keratolysis is reported to be more common among barefooted laborers/farmers, marine workers, soldiers and industrial workers wearing occluded shoes for prolonged periods.

ETIOLOGY AND PATHOGENESIS

Pitted keratolysis is caused by a cutaneous infection with *Micrococcus sedentarius* (now renamed as *Kytococcus sedentarius*),^[9] *Dermatophilus congolensis*,^[10,11] and the *Corynebacterium* species.^[12]

The organism *Kytococcus sedentarius* is a gram-positive Staphylococcus-related bacterium; it can be grown on tryptase-soy agar. *Dermatophilus congolensis* is an aerobic gram-positive bacillus, with branching and septate filaments. They form rough, β -hemolytic colonies on horse blood agar. *Corynebacterium* species are gram-positive, catalase-positive, aerobic or facultatively anaerobic, generally non-motile rods.

Under appropriate conditions (i.e. prolonged occlusion, hyperhidrosis, increased skin surface pH), these bacteria proliferate and produce proteinases that destroy the stratum corneum, creating pits. *Kytococcus sedentarius* has been found to produce two keratin-degrading enzymes, protease P₁ (30 kd) and P₂ (50 kd) respectively.^[13] The malodor associated with pitted keratolysis is presumed to be due to the production of sulfur-compound by-products, such as thiols, sulfides and thioesters.^[14]

CLINICAL FEATURES

The patients with pitted keratolysis may complain of

hyperhidrosis,^[6] sliminess, malodor and occasionally, soreness, itching and pain while walking,^[15] however, the pits normally are asymptomatic.

The lesions are composed of numerous small pits or craters present over the soles. They are conspicuous, discrete, shallow, circular with a punched-out appearance, and coalesce in places to produce irregular erosions or sulci, ranging from 0.5 to 7.0 mm in diameter and 1 mm to 2 mm in depth. A variant of markedly enlarged lesions, called crateriform pitted keratolysis, also has been described. In addition to pits, erythematous to violaceous macules to plaque-like lesions may be present. Sites of involvement are pressure-bearing areas such as the ventral aspect of the toe, the ball of the foot and the heel, but are also rarely seen on the non-pressure bearing areas of the plantar surface and the palms of the hand.^[6] Interdigital intertrigo and paronychia may coexist but does not influence the onset or course of the disease. Coexistence of psoriasis has also been reported.^[6]

Differential Diagnosis

Conditions commonly included in the differential diagnosis are plantar warts and tinea pedis. Plantar warts typically have localized areas of hyperkeratosis and are often painful, whereas athlete's foot presents as 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, yaws and keratolysis exfoliativa.^[16]

HISTOPATHOLOGY

Histological evaluation reveals a crater limited to the stratum corneum. Filaments and coccoid organisms may be seen in the base and margin of the same with H/E stain, however, the organisms can be detected more easily with special stains like Gram stain, Periodic acid-Schiff (PAS), or methenamine silver stains.^[17] The mid-dermis may contain a spotty 'infiltrate of round cells'.^[16] Two types of pitted keratolysis can be distinguished histologically; in the superficial or minor type there is only a small depression due to focal lysis, and coccoid bacteria are distributed in groups in some and in chains

in others. Whereas in the classical or major type, the organisms exhibit dimorphism with septate "hyphae" as well as coccoid forms, which extend into the stratum corneum forming more definitive pits.^[18]

DIAGNOSIS

Skin biopsies are not performed routinely, as the diagnosis can be made easily by the unique clinical presentation and recognition of characteristic odor. Wood's ultraviolet light examination is not consistently helpful, but the affected area displays a characteristic coral red fluorescence. The 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).^[16]

Prevention and Treatment

Various preventive measures recommended are, avoiding use of occlusive footwear, reduction of foot friction with properly fitting footwear, using absorbent cotton socks, wearing open toed sandals whenever possible, washing feet with soap or antibacterial cleanser twice a day, and avoiding sharing of footwear or towels. In some cases it may be helpful to reduce any associated hyperhidrosis with the application of a roll-on antiperspirant or 20% aluminum chloride solution.^[8]

Topical antibiotics are effective, easy to use and accepted by patients. Recommendations include twice daily application of erythromycin^[16] solution or gel, 1% clindamycin hydrochloride solution,^[19] fusidic acid cream and mupirocin cream.^[8]

Various other medications, like 0.1% triamcinolone acetonide, iodochlorhydroxyquin-hydrocortisone cream, flexible collodion, benzoic and salicylic acid ointment, 2% buffered glutaraldehyde,^[20] Castellani's paint, gentamicin sulphate cream,^[21] 1% clotrimazole cream, 2% miconazole nitrate cream, 1% clindamycin solution, 5% formalin solution and Whitfield's ointment^[22] have been used with limited success. Success has also been reported with oral erythromycin therapy.^[16] Pitted keratolysis has an excellent prognosis; effective treatment clears both the lesion and the odor in 3-4 weeks.

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