Pitted keratolysis: clinical manifestations in 53 cases

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Summary

Pitted keratolysis (PK) has been reported to be more common among bare-footed people living in tropical regions. It is now known that the disease is not limited to the tropics but has a world-wide distribution. However, no study has previously been performed analysing the clinical manifestations of the disease in temperate countries. A survey of 53 patients revealed several distinctive clinical features. Hyperhidrosis is the most frequently observed symptom of this condition. Malodour and sliminess of the skin are also distinctive features, evident in 88·7% and 69·8% of the cases, respectively. The most common sites of onset of PK are the pressure-bearing areas, such as the ventral aspect of the toe, the ball of the foot and the heel. The next most common site is a friction area, the interface of the toes. Lesions are rarely seen on the non-pressure-bearing locations. Some of the primary lesions originate as a small defect along the plantar furrow, which gradually grows into the characteristic crateriform pit. Several clinical features are helpful in diagnosing PK.

Pitted keratolysis (PK) is a disease caused by a Gram-positive organism, which infects the stratum corneum of the plantar skin, presents as coccoid and filamentous forms, and produces crateriform pits in the horny layer. There have been some disputes about the aetiological agent, which was identified as Corynebacterium species in 1967 by Taplin and Zaias.1 Recently, Micrococcus sedentarius2 and Dermatophilus congolensis3,4 have also been reported to be the causative agents. PK is usually asymptomatic5 in the sense of being painless,4 although hyperhidrosis is commonly associated with this disease.5 In our out-patient clinic, malodour and sliminess of the skin are the two major complaints afflicting patients with PK. The former was noticed by a few previous authors,6–8 but the latter has not been described in the literature. To the best of our knowledge, no study has previously been performed analysing the significance of PK signs and symptoms. This report describes the clinical manifestations of 53 cases of PK.

Patients and methods

Patients

Fifty-three patients with PK (47 men and six women; aged between 9 and 63, mean ± SD 27·5 years ± 12·5) were included in this study. All patients were seen in the Takama Dermatology Clinic between January 1992 and December 1995. The period they had been suffering from PK varied from 1 day to 5 years with a mean of 6·8 months. Six patients were seen within 2 weeks of onset. Most patients were healthy young men. None had any severe systemic diseases except for one who had hypertension and another who had psoriasis. Concurrent infection of the feet with dermatophytes was seen in four men.

Skin biopsies

Biopsy specimens of the cornified layer were obtained from all patients, using the shaving technique.8,9 All specimens were formalin-fixed, paraffin-embedded and then stained with haematoxylin and eosin (HE), Gram, periodic acid Schiff (PAS) and methenamine silver. The diagnosis of PK in each patient was confirmed by the presence of Gram-positive coccoid and filamentous organisms.

Results

Signs and symptoms

Hyperhidrosis is the most frequently observed PK symptom, evident in 96·2% of our cases (51 of 53), and especially noticeable around the involved areas.
Malodour was present in 88.7% of the patients (47 of 53). Sliminess of the skin, often presenting as the foot sticking to the socks, was a complaint in 69.8% of the patients (37 of 53). Soreness and itching were reported by 11.3% (six of 53) and 7.5% (four of 53) of the patients, respectively.

Location of skin lesions

All the patients presented with the characteristic lesion of the foot, a superficial erosion of the horny layer composed of numerous small crateriform pits coalescing to form a large discrete defect of the plantar surface (Fig. 1A). These pits were located predominantly on the pressure-bearing areas, such as the ventral aspect of the toe, the ball of the foot and the heel, but were rarely seen on the non-pressure-bearing areas (Table 1). The interface lesion between the toes was seen in 17 patients, including five patients of six seen within 2 weeks of onset. All six patients showed a tendency to have more severe lesions in the toe region rather than any other area of the foot.

The primary lesion

Circular crateriform pits, the diagnostic feature of PK, were observed in 51 patients, representing 96.2% of all cases. Most of them were 0.7 mm or larger in size. Besides them, smaller defects (less than 0.5 mm in width) with elongated configurations were found along the plantar furrows (Fig. 1B), ascertained by histological examination (Fig. 2A,C). Each of the small circular lesions had a furrow in its centre around the larger pits or the coalesced plaques.

Microscopic examination

Biopsy specimens from each patient revealed the presence of the micro-organisms in the walls and bases of the crateriform defects in the upper layer of the stratum corneum (Fig. 2). They were positively stained by Gram, methenamine silver and PAS methods. Special staining techniques showed these organisms to be composed of

Table 1. Location of the skin lesion in pitted keratolysis

<table>
<thead>
<tr>
<th></th>
<th>Total (53 patients)</th>
<th>Early stage (≤ 2 weeks)</th>
<th>Later stage (&gt; 2 weeks)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pressure-bearing areas</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ventral aspect of the toe</td>
<td>49 (92.5%)</td>
<td>5 (83.3%)</td>
<td>44 (93.6%)</td>
</tr>
<tr>
<td>Ball of the foot</td>
<td>44 (83.0%)</td>
<td>4 (66.7%)</td>
<td>40 (85.1%)</td>
</tr>
<tr>
<td>Heel</td>
<td>15 (28.3%)</td>
<td>1 (16.7%)</td>
<td>14 (29.8%)</td>
</tr>
<tr>
<td><strong>Friction area</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interface between the toes</td>
<td>17 (32.1%)</td>
<td>5 (83.3%)</td>
<td>12 (25.5%)</td>
</tr>
<tr>
<td><strong>Non-pressure-bearing areas</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Web</td>
<td>5 (9.4%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arch</td>
<td>1 (1.9%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Instep</td>
<td>1 (1.9%)</td>
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</tbody>
</table>
Figure 2. (A, C) Small defect seen in the upper layer of the stratum corneum haematoxylin and eosin stain obtained with shave-biopsy technique (HE). (B) Microorganisms found in the wall of the pit (close-up view of A, HE). (D, E) Microorganisms with coccoid and filamentous forms stained by Gram, periodic acid-Schiff reagent and methenamine silver, showing the branches and septa (D: Gram, E: methenamine silver).

coccoid and filamentous forms with branches and septa. They divided only transversely without longitudinal septation. Most of the coccoid forms were observed near the surface of the pit, while the filamentous forms were seen growing into the deeper portion.

Discussion

PK was first described by Castellani as ‘keratoma plantare sulcatum’ in part of the inaugural address delivered when he was appointed President of the Ceylon Branch of the British Medical Association. The disease was first seen in those who went barefooted during the rainy season. Acton and McGuire stated that five clinical types were observed among the bare-footed people in Bengal and that amputation of the toe was performed in the most severe cases characterized by deep ulcers associated with secondary sepsis. Severe cases were more frequently reported in tropical regions but rarely in temperate ones. Clinical manifestations of PK can be different between tropical and temperate zones. Clinical manifestations of PK and its incipient stages were studied in this work.

In our study, 37 of 53 patients (69.8%) had the characteristic sign of sliminess of the plantar skin. Forty-seven patients (88.7%) had malodour, another distinctive sign, previously pointed out only by a few authors. Fifty patients had either sliminess, malodour, or both, representing 94.3% of all cases, while 51 patients (96.2%) had hyperhidrosis. Although hyperhidrosis is the most frequent condition associated with PK, as reported previously, it is not always specific for PK. Sliminess and malodour may be more distinct clinical clues to a diagnosis of PK, in combination with evidence of prominent crateriform pits.

The most common sites for PK are the pressure-bearing areas. More than 80% of our patients were affected on the pressure-bearing areas of the sole, especially the ventral aspect of the toe and the ball of the foot. The heel was involved at a rate of 28.3%, whereas the interface of the toes receiving friction was affected 32.1%. Five of six patients in the early stage had interface lesions and all of these patients had a preponderance of PK in the toe region. It may be suggested that PK begins in the toe region among people who do not walk barefoot in temperate climates.

The characteristic lesion is a discrete crateriform defect from 1 to 7 mm in width, whose size is related to the size of colony that the bacteria maintain on the surface of the soles. In addition to these circular pits, smaller defects (less than 0.5 mm in width) with an elongated form were discovered along the plantar furrows. Histological examination also supported this finding. This may suggest that dirt collected along the plantar furrows contained the keratolytic microorganisms which proliferated to make a discrete crateriform pit. At least a portion of these pits seems to have been formed in this way.

Several features of PK were elucidated in this study. No severe cases were included in our series but milder ones. Clinical manifestations of PK are different in Aichi, Japan, which has a temperate climate, where patients wear shoes and are not in the habit of walking barefoot, from those reported in tropical countries, where farmers go barefoot to water the fields. It may, therefore, be suggested that the disease originates in the toe region and that some of the primary lesions begin in the plantar furrows of the foot.

References
