ETIOLOGY OF PLANTAR KERATODERMA
(an analysis of 200 cases)

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Summary

A series of 200 cases of plantar keratoderma was studied among 42,000 out-patients of the Division of Dermatology, Medical College and Hospitals, Calcutta.

Patients of plantar keratoderma attended the clinic all throughout the year though a considerable waning was noticed during the summer months. Male preponderance was ascribed to probable occupational factors. The highest incidence was found in the student community belonging to the age group of 11–20 years.

19 disease groups, acquired and genetic, were found to cause the morbid change of which exogenous eczema was the commonest (28.5%) of the acquired groups, corn and callosity being the next common (18.5%) while, of the genodermatoses, ichthyosis was the commonest (11.5%) with Psoriasis as a close second (11%).

Two new entities viz. Familial Plantar Keratoderma and Acquired Symmetrical Erythrokeratoderma have been mentioned.

Introduction

Keratoderma of the soles of the feet is not an uncommon clinical condition with which the patients present themselves for advice in the Skin Out-patients Department. Such change of the plantar skin can be caused by a host of dermatological disorders, genetic or acquired, as the only morbid change or as a part of a more widespread dermatosis or even as a manifestation of an internal malady.

Systematic study on the etiology of plantar keratoderma has not been done in this country as evidenced from the available literature and, as such, the data on the incidence of various etiological factors causing hyperkeratosis of the soles in Indian patients is not known. The aim and purpose of the present clinical study was to assess the incidence of different diseases causing plantar keratoderma.

Material and Methods

The patients who presented themselves with plantar or palmoplantar keratoderma as the only complaint or as part of a generalised dermatoses at the Out-patient Department of Dermatology, Medical College and Hospitals, Calcutta were selected for the study. Thus a series of 200 cases of this malady were collected and studied among 41928 (42,000 approx) new dermatological patients during the period from November, 1970 to March 1972.

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The patients were from all sections of life, of different age groups and various occupations coming mainly from the city of Calcutta and its suburbs as well as from rural areas of the State of West Bengal. Each case was examined clinically and the diagnosis confirmed by histopathology.

I. Clinical study

The name, address, age, sex, past history, family history, symptoms, onset and duration of the disease; and the morphology of the lesions were precisely recorded. Lesions on other parts of the body and any other associated dermatoses or systemic diseases were also sought for and noted. In case of children the clinical history was collected from their guardians.

II. Histopathological study

A clinically typical hyperkeratotic Plantar lesion was selected for biopsy. An elliptical bit of tissue including an adjoining bit of normal skin deep enough to contain the subcutaneous layer was excised, formol-fixed, processed and blocked in paraffin by usual standard method. Serial sections of 3 - 5 microns thick, were stained with Haematoxylin and Eosin; and studied for a definite diagnosis in corroboration with clinical findings.

III. Laboratory study

Routine estimation of Haemoglobin, total and differential count of leucocytes, general examination of urine and stool were done in each case. Special tests e. g. - S. T. S. Mantoux test and Potassium hydroxide slide test were done as and where necessary. Periodic Acid Schiff's stain (Hotchikis Mc-Manus) and Levaditi's stain were done for histological demonstration of fungi and treponema respectively.

Results

The incidence of 200 cases of plantar-keratoderma were studied (A) in different age groups, (B) in different seasons and (C) in various occupations between the two sexes. The results are given below:

(A) Incidence in different age groups:

Age groups in years	No. of cases Male	Female
0–10	18	7
11–20	42	24
21–30	31	11
31–40	26	9
41–50	18	5
51–60	5	2
61–70	1	0
71–80 & onwards	1	0
Total	142	58

Observation

The morbid change was more common in males though the general attendance of both sexes is almost the same. The highest incidence in the age group of 11-20 in both the sexes was considered to be an interesting finding. Otherwise the age incidence curve is parallel to general incidenee of the diseases. Predisposition to trauma due to working or playing barefooted was thought to be one of the main causes of the male preponderance and age group distribution.

B. Incidence in different seasons

Different seasons	Number of cases Male	Female
1. Summer (April, May & June)	11	2
2. Rainy (July & August)	25	7
3. Autumn (September, October & November)	32	12
4. Winter (December & January)	38	23
5. Spring (February & March)	36	14
Total	142	58

Observation

Cases of plantar keratoderma visited the Skin O. P. D. all throughout the year but the incidence was comparatively low in summer.

C. Incidence in various occupations :

Various occupations	Number of cases Male	Female
1. Student	39	23
2. Housewife/ Domestic worker	8	31
3. Labourer	26	0
4. Farmer	20	0
5. Mechanical worker	15	0
6. Business	12	0
7. Office worker	7	0
8. Nil (No occupation)	15	4
Tota	142	58

Observation

The highest incidence was found in the student community in contrast to the usual belief that the plantar hyperkeratotic change would be more prevalent among the working class.

The diseases causing plantar keratoderma observed in the study of 200 cases are tabulated in order of their incidence as follows :

Disease groups	Total number of cases	Male/female	Percentage
1. Eczema	57	43/14	28.5
2. Corn and callosity	37	31/6	18.5
3. Ichthyosis	23	12/11	11.5
4. Psoriasis	22	15/7	11.0
5. Familial plantar keratoderma	12	3/9	6.0
6. Verruca plantaris	8	5/3	4.0
7. Tuberculosis verrucosa cutis	8	7/1	4.0
8. Tylosis	7	7/0	3.5
9. Lichen planus	4	2/2	2.0
10. Treponematosis	4	4/0	2.0
11. Keratoma plantar sulcatum	3	1/2	1.5
12. Symmetrical erythrokeratoderma palmaris et plantaris	3	2/1	1.5
13. Pityriasis rubra pilaris	2	2/0	1.0
14. Congenital ichthyosiform erythroderma	2	1/1	1.0
15. Pellagra	2	2/0	1.0
16. Lupus erythematosus	2	2/0	1.0
17. Malum perforans	2	2/0	1.0
18. Keratosis circumscripta	1	1/0	0.5
19. Keratoderma climactericum	1	0/1	0.5

Discussion

The nineteen diseases which comprised the 200 cases were classified into two broad groups :— (A) Genetic and (B) Acquired.

The acquired diseases were subclassified into four groups :—

(i) Eczema and eczematoid conditions.

(ii) Hyperplastic condition due to trauma of intermittent, repeated or continuous mild friction or minimal pressure.

(iii) Infections

(iv) Inflammatory conditions.

Most of the cases of eczemas were basically of infective origin and yet as the hyperkeratotic change was due to subacute and chronic eczematous change, they were classified separate from the proper Infections group. In the latter, the infection itself produced the hyperkeratotic change without any secondary sensitization dermatitis. For brevity only the salient findings in each disease have been discussed.

A. GENETIC

(1) Ichthyosis

The disease comprised 11.5% of the 200 cases of which 21 could be classified as dominant ichthyosis vulgaris and

remaining two as sex-linked recessive. These 23 cases out of total number of 168 cases of ichthyosis presented with hyperkeratosis of soles and were included in the study. The figure showed that only 13% cases of ichthyosis presented with plantar keratoderma. Though it was not mentioned by Wells and Kerr[2] whether recessive cases had palmo-plantar keratoderma, yet considering the severe, generalised and perennial nature of the disease it was expected that the palms and soles would also be involved in the sex-linked type as exemplified by the 2 cases in this study. The over-all incidence of ichthyosis among 42,000 of dermatological patients was 4 in 1000.

While 2 cases of recessive ichthyosis vulgaris developed in infancy as expected, development of dominant ichthyosis vulgaris by the age of 1 year in 8 out of 21 cases was interesting.

The conspicuous rarity of cases of Ichthyosis above the age of 30, indicated that spontaneous improvement of the disease occurred in later life and dominant Ichthyosis vulgaris rarely became severe after the 4th decade.

The sex incidence of the disease was found to be almost equal. All patients noticed aggravation of the disease during winter and spring and complete clearance of the disease was noticed only in 2 of 21 cases of the dominant type. The 2 cases of sex-linked type showed only slight favorable variation during summer months.

Majority of the patients being in the younger age group, the disease appeared to be common in students. However in adults hyperkeratosis associated with ichthyosis was often pronounced due to their walking barefooted.

Though scalp hairs were reported to be normal in Ichthyosis 7 cases of the series showed rough and coarse hairs and 2 cases rough and thickened nails. In contrast to the observation of Wells and Kerr[2] no atopics were found amongst the cases of Ichthyosis. This could be due either to low incidence of atopic eczema in this clinic (0.3% of all eczemas), or to the possibility that atopics with mild Ichthyotic skin did not bother to consult the dermatologist.

(2) Congenital Ichthyosiform Erythroderma

The disease was rarer than ichthyosis vulgaris and only 2 cases could be included. Both the cases were clinically and histologically proved to be cases of congenital ichthyosiform erythroderma of the lamellar variety, one being male and the other female. The onset of the disease was at birth in one and probably in early infancy in the other. The parents were free of the disease. No associated defects were found in either of the two cases.

(3) Pityriasis Rubra Pilaris (PRP)

2 cases out of 200 cases were included in the series as PRP clinically and histopathologically. Both the cases were nonfamilial and occurred in adult life at the age of 27 and 59 years. There was severe involvement of the palms and soles which showed yellowish discolouration. The nails were thick, heaped, rough and lustreless. Scalp hairs were thin and scanty. Lesions on glabrous skin were characteristic.

(4) Psoriasis

22 cases of psoriasis who had clinically evident plantar keratoderma formed 11% of the 200 cases. 13 of these 22 cases showed involvement of the soles only, while the other 9 cases were associated with widespread psoriasis. 71 cases of psoriasis with a few scattered and insignificant lesions on the soles and widespread psoriasis elsewhere on the body, were not included due to the insignificance of the plantar lesions and absence of clinically recognisable keratoderma.

It was interesting to note that the diagnosis was easy in the latter group while in the former, 4 out of 13 cases were clinically diagnosed as eczema indicating the importance of histopathology for a definite diagnosis particularly in cases of psoriasis presenting with Plantar keratoderma alone. It was also noted that 9 out of 22 cases showed characteristic morphology of psoriasis while the others presented a non-specific clinical picture. Nail changes proved to be a useful clinical sign.

Localisation of plantar psoriasis could be determined by factor of trauma and resulting Koebner phenomenon[4,5] especially in the barefooted patients, as seen in 13 cases in the present series. Office workers of sedentary habits were almost free of plantar keratoderma which substantiated the contention further.

The age incidence showed the peak at puberty and the probable rarity of psoriatic plantar keratoderma in extremes of age was in conformity with the observations of Hellgren[6] and Wilkinson[7].

In this series, male-female ratio was 15 : 7. This male predominance could probably be attributable to occupational factors. Psoriasis with plantar keratoderma attended the clinic throughout the year with the acme in spring probably as a result of aggravation of the disease during the preceeding winter months.

No association with other diseases, for example seborrhoeic dermatitis, lichen simplex, lichen planus[7] was found in these cases. Only one of these cases presented with exfoliative erythroderma and arthropathy.

Family history was usually negative as is the common experience here and only 4 out of 22 cases gave a positive history.

5. Tylosis

The incidence of Tylosis was 7 out of 200 cases (3.5%) of plantar keratosis while the overall incidence of the disease was 1 in 6000 of 42,000 dermatological patients. The incidence was found to be higher than for the Western countries[8,9] where the reported incidence wan 1 in 10,000 or even less. Family history suggested a dominant inheritance as is generally seen in which usually less than 50% offsprings inherited the disease. (No case of recessive type was noted). Though all the 7 cases were males, there was history of affection of females in the same families indicating absence of sex-predilection of the disease,[10,11,12].

No particular occupation seemed to aggravate tylosis. Though the disease was persistent throughout the year, it possibly became worse in winter and spring months as 5 of the 7 cases presented during this time.

Though the age of onset was consistently early infancy in all the cases, 3 patients were adults within the ages of 21 and 40, while the other four were children.

The palms were affected in all the cases, the surface being rough in 4 and smooth in 3. The latter occurred irrespective of age and was considered to be an unusual variant of the disease[1].

Painful cracks and fissures in soles were a common presenting feature. In contrast to the observation of Aars[13] who noticed the conspicuous absence of infections on the hyperkeratotic soles in tylosis, Actinomycosis keratolytica was found in one case Fig. 1 page No. 143.

Among other unusual findings, overgrowth of the cuticles of all the fingers and toes in one case and presence of coarse scalp hairs in all the 7 cases were considered to be hitherto unreported significant clinical findings.

Systemic examination of the patients did not reveal any abnormality.

(6) Familial Plantar Keratoderma

This group of 12 cases (6%) were isolated as a separate entity, somewhat similar but positively distinctive from the cases of tylosis. They presented with mild to moderate hyperkeratosis with cracks and scaling of the soles with affection of palms in most of the cases (8 out of 12). Family history was invariably present and females were predominantly affected (3 : 1). The disease appeared in winter months and in contrast to tylosis disappeared completely at the end of spring leaving the palms and soles completely normal. There was no xerosis, ichthyosis, asteatosis, or any evidence of infection. The histopathology was indistinguishable from tylosis with variation only in degree.

The disease had no relation with occupation. The age incidence was between 11 & 50 years. The scalp hairs were observed to be normal[14].

(7) Keratosis circumscripta

The single case of keratosis circumscripta starting at the age of 4 presenting with diffuse hyperkeratosis of palms and soles along with discoid areas of follicular keratosis with slight scaling in extensors of the knees and elbows, sacro-coccygeal joint and dorsae of the hands conformed to the description of the disease by Shrank[15]. There was no history of the disease in the family of the patient.

B. ACQUIRED :

1. Eczema and Eczematoid conditions :

(1) Eczema :

Hyperkeratotic subacute and chronic eczematous lesions of the soles comprised the largest group, with 57 cases (28.5%). The figure was comparable to the overall incidence of eczema-25% of all cases attending the skin O.P.D. of Medical College and Hospital, Calcutta.

Eczematous keratoderma of the soles were 3 times more common in males. The onset of the disease in the age group of 11 to 20 was indicative of sensitization at an early age. The disease was uniformly prevalent throughout the year without any seasonal variation.

Majority of the cases (54) were due to exogenous causes as for example-infective 29 cases, contact 20 cases, pompholyx 4 cases, and drug sensitization 1 case while the remaining 3 cases had lichen simplex.

While 29 cases of infective eczema were microbic in origin, 4 cases started as pompholyx associated with dermatophytosis elsewhere in the body. Though basically pompholyx was endogenous, the subacute hyperkeratosis in these 4 cases were the result of recurrent smouldering pompholyx and secondary bacterial infection. Significantly no case of primary hyperkeratotic type of tinea pedis with or without eczematization could be included in the series.

Various contacts were responsible for the contact dermatitis. Some were from foot-wears, others were cement, motor oil and medicaments. These substances were potent contactants in 18 cases. In the remaining 2 cases in females the contactant was an Indian cosmetic dye 'alta'.

Working bare foot was considered to be a major contributory factor in exogenous eczemas.

3 cases of Lichen simplex were diagnosed by their characteristic clinical feature, presence of lesions in characteristic sites and histopathology. None of the patients showed any stigmata of atopy.

Two other groups of diseases also showed spongiotic epidermal changes, resembling eczema clinically and histopathologieally, namely — pellagra (2 cases) and keratoderma climactericum (1 case).

2. Pellagra

Cases of pellagra are quite rare and the 2 cases were diagnosed clearly by their clinical features. Palms and soles were diffusely hyperkeratotic, scaly and hyperpigmented (Fig. 2 Page No. 143) and cleared completely after treatment with a balanced diet and oral Vit. B. complex. No seasonal variation was seen as suggested by Harrison[16] and the patients did not give history of taking any drugs suggesting iatrogenic pellagroid condition[17] (Connell & Cheetham, 1952).

3. Keratoderma climactericum

Only a single female patient aged 58 had keratoderma climactericum as a part of the features of her menopausal syndrome. The lesion was a circumscribed hyperkeratotic patch on the margins and undersurface of heels with clinical and histopathological similarity to chronic lichenified eczema.

II. Hyperplastic conditions due to intermittent repeated or continuous mild physical trauma :

Corn Callosity

The next largest group of thirty seven cases presented with single or multiple circumscribed localised lesions of hyperkeratosis on pressure points. They were almost smooth-surfaced, faintly elevated centrally and were characterized by the persistence of epidermal ridges even after thorough paring of the lesion with a scalpel. Almost all of them had a central conical core which was harder than the rest of the lesion. The central conical core consisted of the spike of hyperkeratosis projecting downwards towards the dermis. These were always more tender on direct pressure than lateral pressure (c.f. warts).

The incidence of corn-callosity gradually and steadily rose as the age advanced, reaching the peak in the age group of 21–30 years the ages of maximum occupational activity, after which it declined and became nil after the age of 50. Pre-occupational trauma being the major contributing factor, male patients predominated over females, their ratio being 31 : 6. This condition was found in patients engaged in various occupations.

The maximum number of patients were seen in the rainy seasons complaining of pain in the lesion. High environmental humidity probably contributed to this.

Verruca plantaris was closely similar clinically and is discussed below.

III. Infections :

(1) Verruca plantaris

Painful and tender plantar warts affecting one or both soles was found in 8 among 200 cases. Presence of Warts on pressure points presented diagnostic difficulty but the typical appearance, paring the surface and more tenderness on lateral pressure helped in diagnosis which was confirmed by histopathology in each case.

5 of the 8 cases belonged to the age group of 10–20. No cases were seen below 10 and above 40, indicating that trauma was a probable predisposing factor and development of specific immune body against the virus in higher age groups. Males were more in number than the females in contrast to the findings of western observers[18]. No case of mosaic wart was seen.

(2) Tuberculosis Verrucosa cutis

Reinfection type of warty tuberculous lesion of the sole was seen in 8 out of 200 cases (4%) comprising an unexpectedly high percentage. All the cases showed a highly reactive Mantoux test,

diagnostic histopathology and favourable response to anti-tuberculous therapy. The cases belonged to a wide range of age groups of 11 to 50. Seven out of eight cases were males pointing towards occupational trauma as a predisposing factor. The right sole was involved in 7 out of 8 cases, the reason for which could not be accounted for.

(3) Treponematosis

Treponematosis causing plantar keratoderma was found in 2% of the cases. 3 cases showed florid lesions of secondary syphilide while the 4th was a case of pinta. The diagnosis was confirmed by S. T. S. and histopathology. The patients belonged to the age group of 18 to 27. Affection of the soles in secondary syphilis is a common feature though actual hyperkeratosis is rare. It is possible that more cases have a hyperkeratosis due to the treponematosis but are not seen by the dermatologist as majority of the patients attend the Venereology out-patient Department.

(4) Keratoma plantare sulcatum

This may be caused by infectious agents like conynebacterium actinomyces keratolytica[19] or by a species of streptomyces[20,21]. Keratoma plantare sulcatum was not an uncommon condition though only 3 cases among the series presented with the disease. This could be attributable to the indifference of the patients who were almost invariably poor barefooted villagers. All the patients presented during the rainy season probably due to aggravation of the condition due to soddening with water and mud.

(5) Malum perforans

Of the 200 cases under study, only two cases were diagnosed as malum perforans due to Hansen's infection of the foot. Both were adult males.

IV. Inflammatory conditions

(1) Lichen planus (L.P.)

4 out of the 200 cases of plantar keratoderma were diagnosed as L. P. by their clinical features and histopathology. One of these which simulated hyperkeratotic eczematous lesion showed typical histopathology of L. P. The remaining three cases had widespread typical lesions of L. P. on the body and palms. One of these 3 cases had dystrophic nails causing pterygium unguis as noted by Ormea et al[22]; and also diffuse alopecia on scalp. The remaining cases had normal nails and hairs. Mucous membrane lesions were present in all the 4 cases.

These 4 cases of L. P. causing plantar hyperkeratosis formed 2.7% of the total of 150 cases of L.P. seen during the period. This incidence was lower in comparison to the finding of Altmen et al[23] who reported 10 cases 5% with plantar affection out of 197 cases of L.P.

2 patients were males and 2 were females. One case was in the age group of 0–10 years while the remaining 3 were in the age group of 31–40 years. The disease had no relation with occupation or season.

(2) Lupus Erythematosus

Affection of the soles in lupus erythematosus with hyperkeratotic lesions occurred only in cases of so-called subacute L.E. as evidenced in the 2 cases of the series. Both cases were males.

In S.L.E. the lesions are superficial, scaly or purpuric. In D.L.E. on the other hand the affection of the hands and feet is rare, and such occurrence should always alert the clinician of the possibility of subacute or acute transformation[24].

Associated typical lesions on typical sites and bilateral affection of soles helped in the diagnosis. Lesions on the soles as such closely resembled partially treated cases of tuberculosis verrucosa cutis (Fig. 3 Page No. 143). One of the 2 cases developed systemic features with positive L.E. cells 9 years after the onset of the disease.

(3) Symmetrical Erythrokeratoderma palmaris et plantaris

3 patients among this series of 200 cases showing symmetrical erythematous and oedematous keratoderma of the palms and soles without any family history could not be grouped under any disease described in the literature and were designated as symmetrical erythro keratoderma palmaris et plantaris. The disease was different from progressive erythro keratoderma a dominantly inherited disease in which the palms and soles were spared[3]. All the 3 cases were young; of the age group of 11–30 years and came with history of progressive redness and thickening of palms and soles of a subacute onset following an attack of sore throat by strepto β haemolyticus. The lesions responded to Penicillin and Gentamycin. Considering the nature of the disease it might be postulated that it was a form of subacute toxic erythema in which the inflammatory process was insidious leading to a slowly progressive hyperkeratosis of the palms and soles with or without involvement of adjoining proximal sites by extension. Histopathology was distinctive from psoriasis and eczema.

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