DISTRIBUTION OF SKIN TUMOURS OF SOLE OF FOOT

BY

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This study of skin tumours of the foot, especially those of the sole, was undertaken to find out whether pressure contributed to the dissemination of the malignant melanoma. Some unexpected clinical and anatomical facts emerged as the data accumulated, and the fundamental question itself was shown to be wrong because the melanomas in fact were not situated mainly on the weight-bearing areas of the sole.

Present Investigation

The cases of the survey consisted of 511 lesions of the foot seen in the Christie Hospital from 1932 to 1955. Many had been recorded on diagrams or photographs. Tables I and II indicate the types of cases seen and their numbers.

TABLE I.—*New Skin Lesions (Malignant). Referred 1932-55 Inclusive. Population Catchment 4.5 Million*

	Squamous-cell Carcinoma	Squamous-cell on Lupus	Basal-cell Carcinoma	Malignant Melanoma
All sites	4,823	218	11,087	478
Lesions of foot:				
Sole	31	1	—	32
Dorsum	21	—	—	20
Other parts or not stated ..	16	—	—	15
	68 (1.4%)	1	—	67 (14%)

TABLE II.—*New Skin Lesions (Benign). Referred 1932-55 Inclusive. Population Catchment 4.5 Million*

	Angioma	Skin Warts	Keloid	Benign Melanoma	Other Benign Conditions
All sites	3,645	2,801	576	347	2,289
Lesions of foot:					
Sole	6	141	—	2	20
Dorsum	4	12	4	2	4
Other parts or not stated ..	36	69	11	3	61
	46	222	15	7	85

Cases without adequate clinical records were discarded and some were reclassified histologically. All the available histological specimens were re-examined; they were mainly those of the squamous-cell carcinomas and melanomas. Microscopical appearances are not presented in this paper. It may be noted, however, that no basal-cell tumour was found.

The lesions fell mainly into five main categories: (1) squamous-cell carcinoma (Table III); (2) melanomas (Table IV); (3) malignant change occurring upon pre-existing conditions, such as burns, irradiated psoriasis, tabes dorsalis; (4) plantar warts and hyperkeratotic lesions (Table V); and (5) angiomas.

When the site diagrams were superimposed as single diagrams an unexpected and striking distribution on the sole emerged (Figs. 1-5). The melanomas almost all fell in the arch region in contrast to the squamous-cell carcinomas and hyperkeratotic lesions, which were on the metatarsal and heel sites. Subsequently, three melanomas were discovered in the arch site by routine appraisal of the feet at post-mortem examinations. The tumours arising in areas of pre-existing disease were scattered indiscriminately. Unlike all the other lesions, the angiomas could mould themselves

TABLE III.—*Squamous-cell Carcinoma of Foot (Excluding Induced Tumours)*

Sex	Registrations 1932-55	No. for Survey	Site		Age Range
			Dorsum	Sole	
Male	24	17	3	14	42-81
Female	10	5	1	4	57-78
Total	34	22	4	18	42-81

TABLE IV.—*Melanoma of Foot*

Sex	Registrations 1932-55	No. for Survey	Site		Age Range
			Dorsum	Sole	
Male	25	17	3	14	26-74
Female	38	25	11	14	17-81
Total	63	42	14	28	17-81

TABLE V.—*Plantar Warts and Hyperkeratotic Lesions*

Age Group	Male	Female
0-9 years	5	9
10-19 "	16	30
20-29 "	46	20
30-39 "	25	8
40-49 "	7	4
50-59 "	7	6
60- "	5	4
	111	81

The weighting between 10 and 39 years is due to Army personnel and schoolchildren seen from 1939 to 1945.

over wide surfaces extending frequently from the dorsum to the sole, or vice versa. This plasticity can be explained by the vascular nature of the lesion, and is a feature of the angioma that might be more emphasized in its clinical diagnosis.

Certain trends in age and sex distribution were also apparent. The squamous-cell carcinomas occurred more often in the male, as in other sites of origin; the melanomas seemed to be more prevalent in women. The incidence of angiomas was greater in female infants in the first year of life. The age range of patients was wider in the melanoma group than in the squamous-cell carcinoma group, and was not so heavily weighted towards the older end (Table VI).

TABLE VI.—*Age Frequency Distribution*

Age Group	Squamous-cell Carcinoma	Melanoma
0-24 years	0	2.3%
25-34 "	0	9.3%
35-44 "	4%	7.0%
45-54 "	12%	20.9%
55-64 "	26%	27.9%
65-74 "	28%	25.6%
75 and over	28%	7.0%
	100%	100%

Discussion

The outstanding feature of this study has been the graphic one of apparent sites of election for carcinomas and melanomas. A symmetrical pattern appears to be emerging on the soles of the feet regarding the development of benign and malignant melanomas. The original problem posed was the part pressure might play in dissemination of the malignant melanoma. The population surveyed was a white one wearing shoes, the weight of the body being normally carried on the heads of the metatarsals and the heels. It is here that the miscellaneous group of hyperkeratotic lesions and squamous-cell carcinomas occur. At this stage it would be fitting to quote Nicholson (1950). Boycott (1929) observed that the difficulty in most scientific work lies in framing the questions rather than in finding the answers. By the time we are in a position to know what the crucial question really is, we have generally pretty well got the answer. Nicholson comments: "We shall never frame it

if we continue in the vain hope to 'explain the cause of cancer.' How can we expect to explain before we learn, know, and understand? In the sure and certain faith that extrinsic stimuli and intrinsic reactions of the organisms together determine tumour formation, and bearing the necessary action of the former carefully in mind, the first question to be asked of biology is this: What is the mechanism of determination of the reactions of the organism?"

FIG. 1.—Squamous-cell carcinoma. Age range 42-81 years.

FIG. 2.—Melanomas, benign and malignant. Age range 17-81 years.

FIG. 3.—Acquired lesions.

FIG. 4.—Plantar warts and hyperkeratotic lesions.

FIG. 5.—Angiomatous lesions.

The observations that the melanomas tend to occur in the arch site, where there is little weight-bearing, suggest that much more will have to be learnt before accepting pressure or irritation as the mechanism of spread, at least in the early stages.

To the best of our knowledge none of the benign hyperkeratotic lesions and warts have become malignant. The incidence of carcinoma of the foot of 1.4% is comparable to the figure Harnett (1952) quotes in the B.E.C.C. survey of 1952—1.9% of all squamous-cell carcinomas. This low incidence, when coupled with a much greater incidence of squamous-cell carcinoma in men in later years of life, suggests that the constant trauma of walking may not by itself be a prime factor in carcinogenesis.

No basal-cell tumours were seen at this hospital either on the sole or on the dorsum of the foot. Their absence from the sole agrees with the findings of Lever (1948), who has never seen such tumours on the palms of the hands or on the soles of the feet. He believes that these tumours can originate only from the so-called primary epithelial germ cell, from which hair follicles and sebaceous glands develop. These structures are not found in the palms or soles. This explanation would be acceptable, but Pascher and Sims (1954) have reported two histologically proved basal-cell epitheliomas of the sole. They revert to the hypothesis that these tumours develop from the basal-cell layer of the epidermis. The induction of such tumours has frequently been associated with prolonged exposure to sunshine. Is the absence of this or some other unknown exogenous factor another reason for their absence? Similarly, might not the induction of squamous-cell carcinomas be dependent on some factor, like the tar of the road surface, acting on the susceptible individual, as is probably the case with arsenic-induced cancers of the palms and soles?

Many of the haemangiomas of infants have a characteristic natural history, with a period of rapid growth followed by regression and subsequent disappearance. Lampe and Latourette (1957) believe that the growing phase of the lesion does not extend beyond the age of 1 year and often ceases much earlier. In their series of 346 cases the incidence of female to male infants was about 2.5:1. The effect of pregnancy on melanomas or on the growth of angiomas can be very grave, and has been attributed to increased secretion of oestrogens. It is tempting to ascribe this sex difference in the incidence of angiomas to a similar hormonal process.

Summary

The suggestion that pressure might influence the spread of malignant melanoma has led to a study of tumours of the skin of the foot. This has revealed unexpected patterns of distribution and differences in age and sex incidence without answering the original problem. These findings may be of value in diagnosis.

My thanks are due to Dr. H. Russell for her constant advice and criticism. I am indebted to the many members of the clinical staff of the Christie Hospital who have contributed to the clinical and histological data, and in particular to Miss M. H. Russell and her staff for statistical work.

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