

ORIGINAL CONTRIBUTIONS

THE STUDY OF STRATUM CORNEUM IN DIABETES MELLITUS

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Dried pulverized callus from the sole of diabetic patients showed poor water-uptake ($P < 0.001$ to < 0.05) and water-loss at different humidities (25% to 100%) and at different temperatures (5°C, 37°C and 50°C), a finding not observed after either washing or ether-water washing. The total nitrogen content of the diabetic callus showed no significant variation from the normal controls. The cutaneous insensible perspiration when measured by the unventilated chamber technic of Monash and Blank showed poor diffusive power ($P < 0.001$).

Key words : Dryness, Diabetes mellitus, Hydration, Insensible perspiration, Nitrogen content.

Pruritus, especially of the extremities in diabetes mellitus has been attributed to dryness of the skin.¹ Its mechanism still remains unknown.² It is now well-recognized,^{3,4} that the water content of stratum corneum (SC) is the prime factor in maintaining the softness and pliability of the skin. A level below 10 mg% of dry weight of keratin tends to make it dry and brittle, and it cannot be softened by adding any amount of lipid for any length of time. Moreover, the water-content of SC is dependent upon various external environmental factors, like relative humidity, wind speed, atmospheric temperature; and internal factors, like production of defective SC by some disease process, the best example of which is psoriasis.⁵ The water-soluble fraction of the SC, probably contains a glyco-protein which is responsible for its water-holding capacity.

The SC gets its water by the process of diffusion from its under surface, especially in winter when the sweat glands remain inactive.⁶

This insensible perspiration⁷ has been found to be 0.2 to 0.4 mg/cm²/hour on the forearm and most other central, areas of the body, at 30°C.^{8,9} The present study was undertaken to ascertain the (i) hydration capacity, (ii) diffusive power, and (iii) total nitrogen content of the SC of patients having diabetes mellitus.

Materials and Methods

Hydration of stratum corneum

Six male patients having diabetes mellitus (non-insulin dependent type) of ten years duration, age group 40-60 years, were selected for this study, and 6 normal controls of the same age-group and same social and physical status were included as controls.

Callus samples from the sole of the subjects were collected as representative of SC. The sole was washed with water, dried with cotton-wool and pieces of thick callus were cut with a sharp razor blade. Special care was taken to avoid bleeding or pain, and that the samples were almost of the same thickness from every patient and the control.

The specimens were dried over fused calcium chloride and pulverized. One part was kept as

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unprocessed (UC), and the rest was ether-washed (EWC), or ether-water-washed (EWWC) as per the method of Flesch and Esoda⁵ with a slight modification to suit the local conditions. Water-uptake and water-loss were studied in different humidity chambers¹⁰ and at 5°C, 37°C, and 50°C.

Cutaneous insensible perspiration (CIP)

CIP was measured in eight patients and eight normal controls by the unventilated chamber method based on recording the change in the weight (semi-analytical micro-balance ± 0.1 mg) of a hygroscopic salt calcium chloride.^{11,12} All the measurements were done in winter months at prevailing atmospheric temperature of 20°C to 23°C. The results obtained in our normal controls were comparable to the data obtained by more sophisticated methods using a ventilated chamber and passing dry air or nitrogen over the skin which is later analyzed in a MEECO water-analyzer.⁹

Estimation of nitrogen content

For estimation of the nitrogen content, the dried pulverized samples of callus from six patients and six controls were put to direct estimation by Duma's semi-micro-combustion technique.¹³

Results

Hydration of stratum corneum

The mean values of water-uptake of three differently processed SC (UC, EWC and EWWC) of both diabetic and normal controls plotted against time in hours (Fig. 1) show that the difference between the two groups can be appreciated at all the levels of temperature in the case of UC. Such difference is not appreciable in the case of EWC and EWWC. Comparison of the 24-hour water-uptake of the two groups employing Student's t-test, showed variations to be statistically highly significant ($P < 0.001$), at 5°C and significant ($P < 0.01$ and 0.05) at 37°C and 50°C respectively. After the removal of ether-soluble fractions (EWC), this variation, though statistically significant ($P < 0.05$) at 5°C,

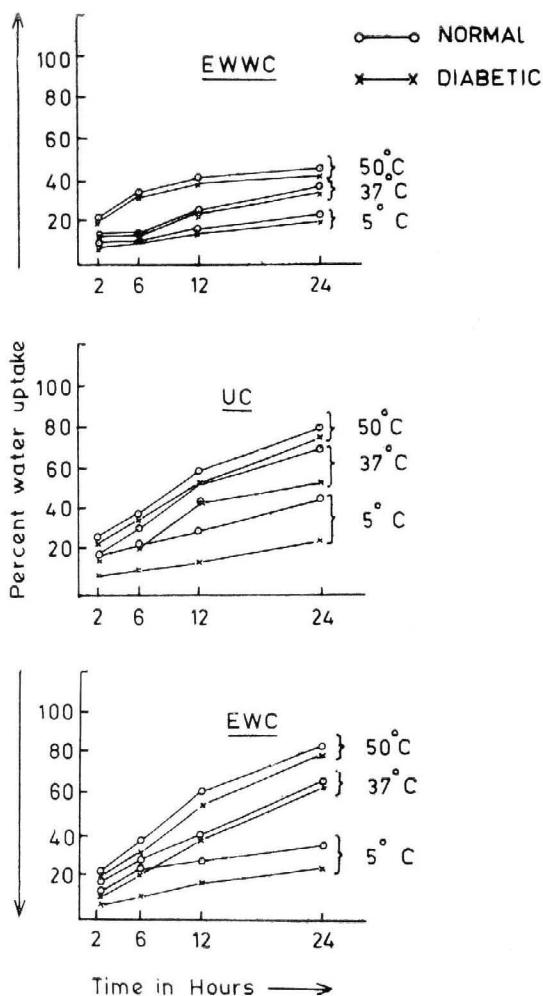


Fig. 1. Water uptake of callus at 100% humidity.

was almost absent at higher temperatures. In the case of EWWC, there was no variation between the two groups ($P > 0.05$) at all levels of temperatures.

The rate of water-loss of hydrated callus (UC) at 25% humidity at 5°C was faster in the diabetics (Fig. 2). The critical level of 10 percent water content of UC was achieved within 1½ hours in the case of diabetics while it took about 5 hours in normal controls to achieve the same level.

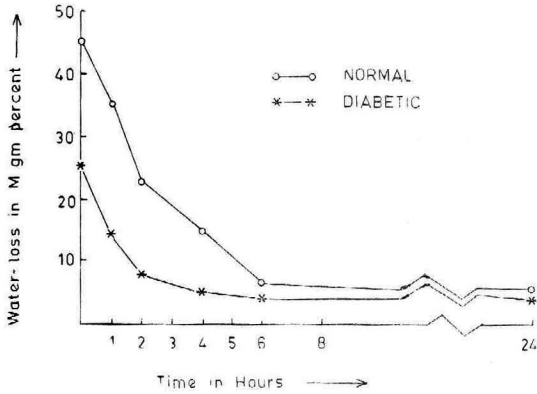


Fig. 2. Rate of water loss of hydrated callus at 25% humidity at 5°C.

Cutaneous insensible perspiration (CIP)

The CIP values in mg/cm²/hour of the diabetics appear low (0.0934 ± 0.0354) as compared to the normal controls of the same age groups (0.2209 ± 0.0445), the variation being statistically highly significant ($P < 0.001$).

Total nitrogen content

The total nitrogen content of diabetic UC (12.51 ± 2.99 percent) was not significantly different from the normal controls (11.19 ± 1.81 percent).

Comments

Our studies indicate that the stratum corneum of diabetic patients shows poor water-holding power which appears to be more apparent at low temperatures when the requirement of water of this protective membrane is high. The diffusion of water to the stratum corneum from the underlying wet tissue is also reduced as shown by the poor CIP values. These findings suggest an altered and defective cornified epithelium in diabetics especially those who have had this disease for a long period. This defect, however, does not appear to reflect upon its total nitrogen content. The precise mechanism of this defect in diabetic skin is not known. Quite a few diseases of very diverse aetiology, such as psoriasis, atopic eczema, ichthyoses, diabetes mellitus, hypothyroidism are known for dry skin. The aetio-pathogenesis of dryness in most of these diseases is ill-understood.

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