

SHORT REPORTS

Stratum Corneum Hydration in Patients Undergoing Maintenance Hemodialysis

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Dry-looking skin of unknown etiology develops in a majority of patients with chronic renal failure. The hydration of the stratum corneum influences the appearance of the skin and lack of water is considered to induce roughness, e.g. in atopic dermatitis. The aim of the present study was to compare the water content in uremic and healthy skin and to evaluate the possible relationship between skin hydration and pruritus in uremic patients. Thirty-one patients, 19 with pruritus, undergoing chronic hemodialysis participated. Twelve healthy age-matched subjects served as controls. The skin of the uremic patients appeared generally xerotic, whereas the controls had normal-looking skin. The water content of the stratum corneum was recorded with the Corneometer, a capacitance-measuring device, on three different sites: the neck, the chest and the lower leg. There was a significant difference in water content between locations in all groups, the water content being highest in the neck and lowest in the leg ($p < 0.01$). There was a tendency that patients with pruritus had a lower water content than patients without pruritus, but there was no significant difference between uremic patients and controls. Hence, insufficient hydration does not seem to explain the difference in skin texture between uremic patients and healthy subjects. *Key words: Xerosis; Uremia; Water content.* (Received March 11, 1988.)

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Dry skin (xerosis) is the most common cutaneous abnormality in chronic renal failure, appearing in about 90% of patients undergoing maintenance hemodialysis (1). Dry skin has been suggested as a cause of uremic pruritus. Young et al. (2) reported a positive correlation between the degree of xerosis and severity of pruritus, but the assessment of dryness relied upon clinical examination and the concept of dry skin was not defined in a reproducible way.

Literally, the word dryness reflects the degree of hydration, but the clinical description 'dry skin' is difficult to define and is often used interchangeably with rough, scaly skin of multiple origin (3). The etiology and the underlying pathophysiological mechanisms responsible for the roughened skin texture encountered in uremic skin are basically unknown. The present study was undertaken to investigate the water content in the skin of uremic patients, compared with healthy controls and to evaluate the possible relationship between hydration and the presence and severity of pruritus in these patients.

SUBJECTS, MATERIALS AND METHODS

Subjects

All patients undergoing maintenance hemodialysis during one week at the Division of Nephrology, Department of Medicine, Karolinska Hospital were asked to take part in the study. Of the 42 patients, 8 refused to participate, one was excluded due to serious illness and 2 did not follow the instructions. The age range of the remaining 31 patients, 16 men and 15 women, was 34 to 78 (mean 58) years. Twelve healthy volunteers, 7 men and 5 women, age from 34 to 75 (mean 53) years served as controls.

At the time of the investigation, 19 patients (61%) complained of pruritus, while 12 patients (39%) were free from itch. There was no difference between the two groups of patients regarding age,

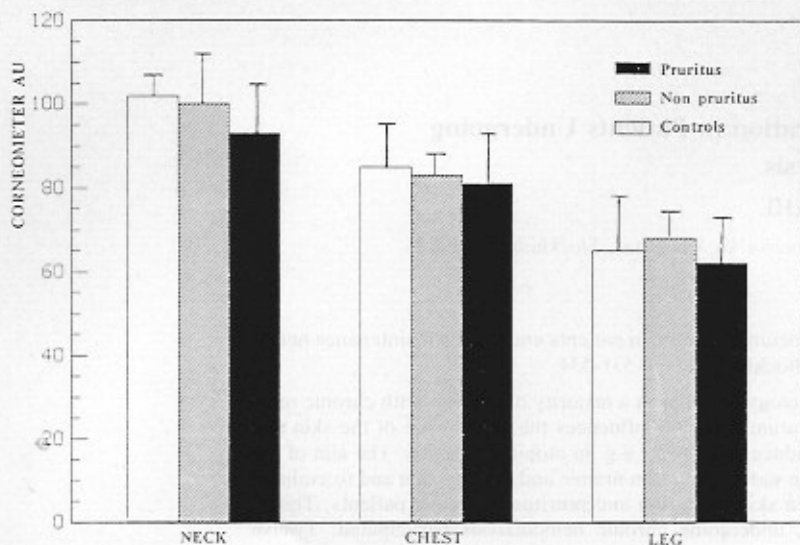


Fig. 1. Water content measured with the Corneometer (AU) in uremic patients with ($n = 19$) and without pruritus ($n = 12$) and in controls ($n = 12$). Mean values (\pm SD) are presented. There was no difference between groups, but a significant variance between locations within each group (neck > chest > leg), $p < 0.01$ respectively.

duration of dialysis, predialytic serum creatinine level or medication. The volunteers had normal serum creatinine concentrations, were free of drugs and had no history of skin disease. Prior to the study, no topical ointment was allowed for 3 days and no shower or bath for 24 h.

Experimental procedure

The whole investigation took place during one week in the wintertime in one and the same room at the dialysis unit. The room temperature was kept nearly constant (21.0–21.5°C) and the relative humidity varied between 15 and 30%. Measurements were performed on three different sites: the sides of the neck, the chest and the lower leg. The appearance of the skin was estimated clinically as follows: normal or smooth (-), rough (+), rough with minute scaling(++), rough with extensive scaling(+++). Measurements were performed both before and after dialysis treatment and patients with pruritus were asked to rate the degree of pruritus on a visual analog scale. Healthy controls participated on one occasion only. Skin temperature was recorded with a thermistor (Ellab, Copenhagen).

Corneometer

Measurements of the water content were performed with the Corneometer CM 420 (Schwartzhaupt, Medizintechnik GmbH 5000, Köln 30). The surface of the recording probe is a capacitor which is influenced by a change in the dielectrical constant of the material in contact with the probe. In the skin, water has by far the highest dielectric constant and an increase in water content will increase the capacitance of the Corneometer. The values are shown on a digital display without denomination as AU (arbitrary units). Thus a high value indicates a relatively high water content. The mean value of three recordings was used.

Statistical analysis

Analysis of variance according to a repeated measure design was applied in statistical analysis of the clinical data, Corneometer readings and skin temperature. The relations between itch and Corneometer data and between skin temperature and Corneometer data were evaluated with Pearson's product moment correlation coefficient.

RESULTS

There was no difference in the water content between dialysis patients and healthy controls. There was a tendency towards lower values in pruritic patients, but the difference was not statistically significant. However, there was a significant variance between locations ($p < 0.01$). The same pattern was seen in all three groups, the water content being highest in the neck and lowest in the leg (Fig. 1). There was no difference between measurements before and after dialysis.

Skin temperatures on the chest were higher ($p < 0.01$) in uremic patients than controls, possibly due to arteriovenous anastomoses increasing blood circulation in dialysis patients. However, there was no correlation between skin temperature and Corneometer readings in either group or location.

The clinical appearance of the skin is presented in Table I. Within each group the skin appeared most xerotic on the legs and least xerotic on the neck. Between groups, patients with pruritus were estimated as having the most pronounced xerosis. However, there was no correlation between itch estimations on the visual analog scale and Corneometer data.

DISCUSSION

The water content of the stratum corneum undoubtedly influences the mechanical properties and the appearance of the skin (4). Insufficient hydration reduces the pliability and the skin tends to crack. Consequently, treatment of rough, scaly skin, e.g. in atopic dermatitis, usually aims at increasing skin hydration.

Several methods taking advantage of the electrical properties of the skin have been developed for in vivo measurement of the water content of the horny layer. Different techniques were thoroughly evaluated by Triebkorn et al. (5), and among these the capacitance measuring device was considered to give reliable and reproducible data comparable to other methods. A low water content has recently been demonstrated with the Corneometer both in dry-looking atopic skin (6) and in scaly psoriatic plaques (7).

In the present study there was no difference in stratum corneum water content between uremic patients and healthy controls, thus supporting the clinical impression that topical emollients have a poor effect in these patients. However, the results must be interpreted with caution. There was a tendency towards lower values in patients with pruritus and since the recording area of the Corneometer is in the deeper parts of the stratum corneum, we have no information about the superficial layers which may be essential for the physical characteristics of the surface (5). Also, within each group, the water content was significantly lower in skin which appeared more xerotic clinically (Table I). Thus, our

Table I. Clinical appearance of skin xerosis; the numbers indicate % of patients in each group

	Xerosis			
	-	+	++	+++
<i>Neck</i>				
Pruritus	11	84	5	-
No pruritus	16	84	-	-
Controls	100	-	-	-
<i>Chest</i>				
Pruritus	5	63	32	-
No pruritus	16	84	-	-
Controls	100	-	-	-
<i>Leg</i>				
Pruritus	5	52	32	11
No pruritus	16	33	51	-
Controls	75	25	-	-

results suggest that the degree of hydration has some influence on skin appearance, but lack of water cannot account for the difference in skin texture between uremic patients and healthy subjects.

It is evident that various factors besides hydration determine the physical properties of the epidermis. In recent years, attention has been drawn to the importance of epidermal lipids for cell cohesion and the process of desquamation (8). Histologically, epidermal atrophy and atrophy of sebaceous and eccrine sweat glands have been reported in uremic skin (9, 10), but to our knowledge there have been no studies on the composition of sebum or lipids produced within the epidermis in these patients.

The skin appeared more xerotic in patients with pruritus than in those without (Table I) which is in accordance with previous studies that show a positive correlation between the estimation of 'dry skin' and pruritus (2). The clinical assessment of xerosis is of course highly subjective and new methods using skin stripping and computerized image analysis will probably prove useful for a more detailed and reproducible evaluation of changes in the stratum corneum (11, 12).

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