

Biometrological Evaluation of the Stratum corneum Texture in Patients under Maintenance Hemodialysis

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Abstract

Xerosis and hydration of the stratum corneum were evaluated in 60 hemodialyzed patients. Xerosis and a low capacitance of the stratum corneum were evidenced in more than 80% of the patients. Pruritus was present in two third of the subjects. We failed to disclose any significant relationship between severity of these three parameters.

Keywords: Hemodialysis, Xerosis, Stratum comeum, Water, Pruritus

Many patients undergoing maintenance hemodialysis suffer from a 'dry-looking skin' [1-6]. It has been reported that this was in part related to a decreased amount of water in the stratum corneum [4-6]. A positive correlation was also suggested between the degree of xerosis and severity of pruritus [1]. However, so far results have been somewhat contradictory.

Recently, we disputed the vague concept of 'dry skin' in dermatology by comparing the structure of the stratum corneum with measurements of its hydration. We concluded that all types of 'dry skin' were not lacking water [7] and should better be referred to as 'rough skin'.

The aim of this study is to revisit the possible relationships between the structure of the stratum corneum, its hydration, and the intensity of pruritus in patients under chronic hemodialysis.

MATERIAL AND METHODS

Subjects

Sixty Caucasian patients with chronic renal failure were included in this study. They were aged 49 ± 11 years (range 21-77) and were under hemodialysis for a cumulative period ranging from 1 month to 18 years. These patients had no sign of dermatitis such as eczema.

Evaluations of Capacitance

The hydration of the stratum corneum is proportional to its electrical capacitance [7-9]. We measured the capacitance of the deep part of the stratum corneum by means of the Corneometer[®] CM420 (Courage-Khazaka, Köln, FRG). The mean of four evaluations was recorded. These evaluations were made on the forearm before dialysis sessions when the patients were at rest in a room with constant temperature (20 ± 1 °C) and humidity (RH $43 \pm 2\%$). A few evaluations made during and after dialysis sessions were not significantly different from those of the main study. They are not further considered in this work.

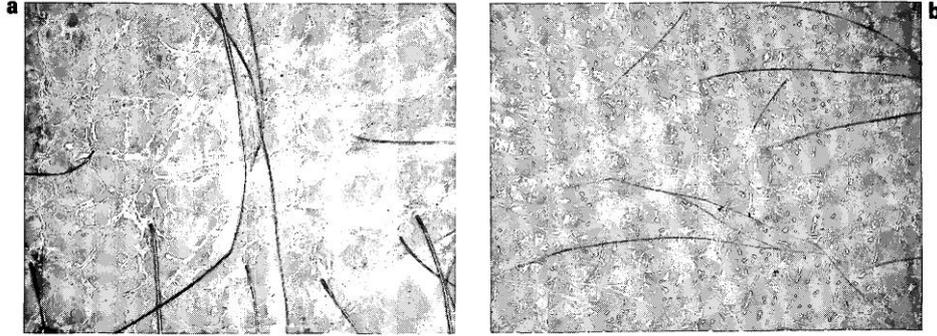
Evaluations of the Structure of the Stratum corneum

Rating xerosis ('dry skin') is possible by cyanoacrylate skin surface strippings [10-13]. Samples were taken from the forearm according to a procedure previously described in details [11,12]. In short, a drop of cyanoacrylate adhesive (Loctite 495) was deposited on a plastic film (terephthalate polyethylene, Melinex O[®], ICI plastics) and pressed firmly on the skin. After 30 s the material was gently lifted, removing a thin sheet of stratum corneum. This material was then stained with polychrome multiple stain (PMS, Dermatologic Lab. suppl., Council Bluffs, USA) during 3 min to rate microscopically the degree of xerosis. Grade 1 referred to discrete hyperkeratosis restricted to the primary lines of the skin, grade 2 was attributed to hyperkeratoses involving less than 30% of the skin surface, and grade 3 corresponded to hyperkeratoses extending over 30% of the skin

surface.

Representative samples of the different grades were coated with gold-palladium and examined by scanning electron microscopy.

Fig. 1. Macrophotographic aspect of the surface of the skin in grade 3 xerosis of hemodialysis (a) compared to a normal stratum corneum (b). Xerosis is characterized by the presence of flaky clumps of corneocytes.



Evaluations of Pruritus

The subjective assessment of pruritus by the patient was rated as severe (++), moderate (+) or absent (O). This information was not further measured into details due to the extraordinary lability of this symptom.

Statistical Analysis

The relationship between xerosis, capacitance and pruritus was evaluated by the χ^2 test.

RESULTS

Xerosis was variable among the patients, and was rated from grade 1 to grade 3 (fig. 1, table 1). As seen by scanning electron microscopy, the superficial layers of the stratum corneum were rough when rated grades 2 and 3. Irregular flakes and clumps of corneocytes were lifted all over the surface of the skin (fig. 2). Pruritus was localized with no predilection areas, or was generalized. It was fluctuant in time, related or not to the moment of dialysis session. It was also variable in intensity, ranging from absent to moderate and severe, about $\frac{1}{3}$ of the patients being included in each group (table 1). Capacitance ranged from 57 to 99 units, corresponding to a mean value of 75.6 ± 10.2 (tables 2, 3).

There was no significant relationship between the intensity of xerosis and pruritus (table 1 ; $\chi^2=6.52$). Moreover, no relationship was found between, on the one hand, the intensity of pruritus or the degree of xerosis and, on the other hand, the values of capacitance of the stratum corneum (tables 2, 3).

Clinical data regarding age, sex, nature of renal disease and routine laboratory analyses were unrelated to the presence and severity of xerosis, pruritus and low capacitance findings. Cumulative duration of hemodialysis was, however, directly correlated to the xerosis intensity while it had no apparent influence on low capacitance and itching (table 4).

Table 1. Number of patients suffering from various degrees of xerosis and pruritus

Pruritus	Xerosis grading			Total
	1	2	3	
O	6	7	7	20
+	1	12	10	23
++	2	6	9	17
Total	9	25	26	60

Table 2. Relationship between pruritus and capacitance of the stratum corneum

Pruritus	Capacitance
O	73.65 ± 11.88
+	76.57 ± 9.24
++	75.88 ± 9.14

Table 3. Relationship between pruritus and capacitance of the stratum corneum

Xerosis grading	Capacitance
1	76.4 ± 11.7
2	78.2 ± 8.9
3	73.3 ± 10.1

Fig. 2. As seen by scanning electron microscopy xerosis of hemodialysis is due to the uneven cohesion between corneocytes. Some of them are lifted up on their margins to form scales. The surface of the skin is rough, (a, x 69; b x 275) compared to a normal-looking stratum corneum (c x 69; d x 275).

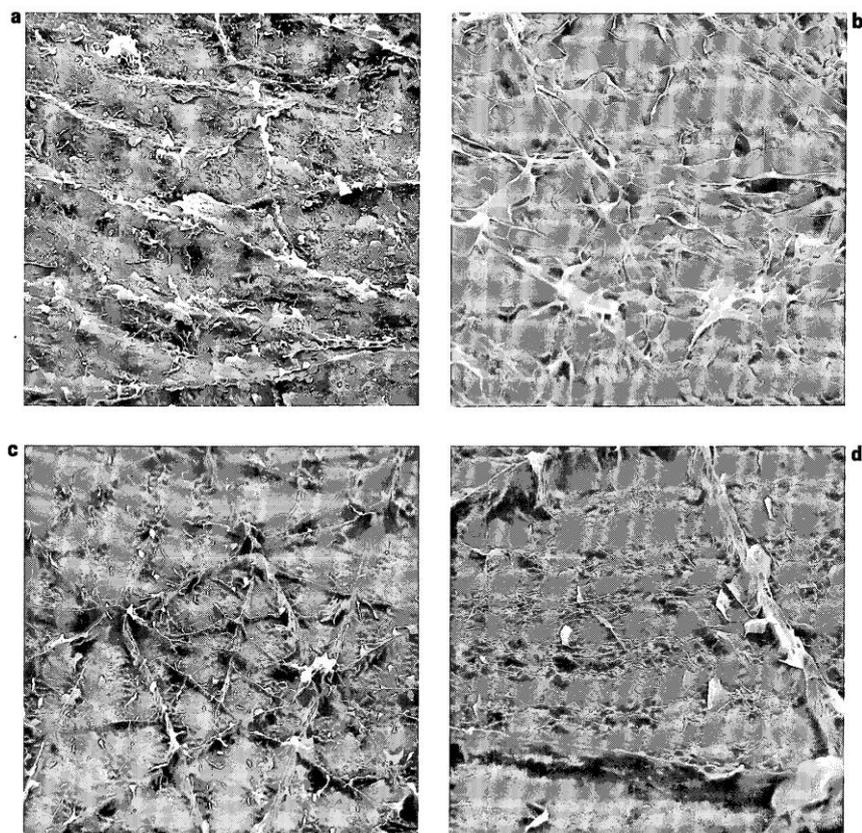


Table 4. Relationship between duration of hemodialysis, skin capacitance and degree of xerosis

Duration of hemodialysis years	patients		Capacitance	Xerosis grading % of patients		
	number	age				
				1	2	3
<2.5	21	53±15	77±9	32	45	23
2.5-5	16	56±12	72±9	6	44	50
5-10	12	60-10	77±10	17	50	33
10-15	8	43±12	73±13	0	12	88
>15	3	63±2	82±14	0	33	67

DISCUSSION

Compared with our previous experiences dealing with 'normal' skin and seasonal xerosis [12-14], the present data indicate that patients under maintenance hemodialysis have both a rough stratum corneum and apparent low water content. We however failed to confirm any significant relationship between severity of xerosis, degree of hydration of the stratum corneum and intensity of pruritus as suggested by other authors [1, 4-6]. In normal skin, flat corneocytes adjoining their margins form superposed sheets with a smooth surface [10,12]. At the opposite, xerosis of hemodialyzed patients is characterized by an uneven adhesion of corneocytes resulting in the formation of flaky clumps of cells giving a rough aspect to the skin surface. This is probably associated to an altered rate of formation and elimination of corneocytes [15].

The evaluation of capacitance is only reliable if there is a close contact between the probe and the skin surface. This is not secured in xerosis where we have shown the rough presentation of the stratum corneum. Any decrease in capacitance in these circumstances [4-6] should be looked at with caution, and may well be an artefact unrelated to a true decrease in the water content of stratum corneum.

The lack of close relationship between xerosis and pruritus in hemodialyzed patients recalls other xerotic conditions genetically related or induced by environmental aggressions which are not pruritic. Therefore, we are inclined to consider the dialysis pruritus is likely associated with several other factors [5,6,16-19] which are not yet identified with certainty. Among these possibilities, a series of controversies arose over the years concerning the relationship between pruritus, divalent ions and PTH serum concentrations, histamine levels, vitamin A accumulation, and mast cell hyperplasia.

References

- 1 Young A, Jr, Sweeney E, David D, Cheigh J, Hochgelerent E, Sakai S, Stenzel K, Rubin A: Dermatologic evaluation of pruritus in patients on hemodialysis. *NY State J Med* 1973; 73: 2670-2674.
- 2 Gupta AK, Gupta MA, Cardella CJ, Haberman HF: Cutaneous associations of chronic renal failure and dialysis. *Int J Dermatol* 1986; 25: 498-504.
- 3 Stahle-Bäckdahl M, Hagermark O, Lins LE: The sensitivity of uremic and normal human skin to histamine. *Acta Derm Venereol* 1988 ; 68 : 230-235.
- 4 Stahle-Bäckdahl M: Stratum corneum hydration in patients undergoing maintenance hemodialysis. *Acta Derm Venereol* 1988 ; 68:531-534.
- 5 Stahle-Bäckdahl M: Uremic pruritus. Clinical and experimental studies. *Acta Derm Venereol* 1989 ;(suppl): 145.
- 6 Stahle-Bäckdahl M: Pruritus in hemodialysis patients. *Skin Pharmacol* 1992;5:14-20.
- 7 Piérard GE: What do you mean by dry skin? *Dermatologica* 1989;179:1-2.
- 8 Blichmann CW, Serup J: Assessment of skin moisture. *Acta Derm Venereol* 1988 68:284-290.

- 9 Triebkorn A, Gloor M, Greiner F: Comparative investigations on the water content of the stratum corneum using different methods of measurement. *Dermatologica* 1983 ; 167 : 64-69.
- 10 Piérard-Franchimont C, Piérard GE: Les xeroses : Structure de la peau sèche. *Int J Cosmet Sci* 1984;6:47-54.
- 11 Piérard-Franchimont C, Piérard GE: Skin surface strippings in diagnosing and monitoring inflammatory, xerotic and neoplastic diseases. *Pediatr Dermatol* 1985;2:180-184.
- 12 Piérard-Franchimont C, Piérard GE: Assessment of aging and actinic damages by cyanoacrylate skin surface strippings. *Am J Dermatopathol* 1987;9:500-509.
- 13 Piérard GE: Assessment of environmental 'dry skin'. *Bioeng Skin* 1986;2:31-37.
- 14 Rurangirwa A, Piérard-Franchimont C, Lê T, Ghazi A, Piérard GE: Corroborative evidence that 'dry skin' is a misnomer. *Bioeng Skin* 1987;3:35-42.
- 15 Marks R: Clinical methods for measuring scaling and desquamation. *Bioeng Skin* 1987;3: 319-333.
- 16 Rollino C, Goître M, Piccoli G, Puiatti P, Martina G, Formica M, Quarello F, Bernengo MG: What is the role of sensitization in uremic pruritus? *Nephron* 1991;57:319-322.
- 17 Olerud JE, Lee MY, Uvelli DA, Goble GJ, Babb AL: Presumptive nickel dermatitis from hemodialysis. *Arch Dermatol* 1984;120:1066-1068.
- 18 Mettang T, Fritz P, Weber J, Machleidt C, Hübel E, Kuhlmann U: Uremic pruritus in patients on hemodialysis or continuous ambulatory peritoneal dialysis (CAPD). The role of plasma histamine and skin mast cells. *Clin Nephrol* 1990; 4:136-141.
- 19 Kessler M, Moneret-Vautrin DA, Cao-Hun T, Mariot A, Chanliau J: Dialysis pruritus and sensitization. *Nephron* 1992; 60:241.