

SHORT REPORTS

Epidermal Hydration of Psoriasis Plaques and the Relation to Scaling

Measurement of Electrical Conductance and Transepidermal Water Loss

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Seventy-seven plaques of ten patients with psoriasis vulgaris were studied with measurement of electrical conductance (3.5 MHz), measurement of transepidermal water loss (TEWL), and clinical scoring of erythema, induration and scaling. Uninvolved skin of the same body region served as control. Findings were very distinct with decreased conductance and increased TEWL. Plaques with no or mild scaling did not differ from grossly scaly plaques. Scales of psoriasis do not seem to exert any major occlusive effect on the water evaporation. The inverse relation between conductance and TEWL indicates reduced water-holding capacity of psoriatic epidermis, being a very common feature. *Key words: Transepidermal water loss; Conductance.* (Received November 17, 1986.)

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Studies on epidermal hydration and psoriasis are few, Janet Marks and co-workers showed in a material of fifteen patients that the transepidermal water loss (TEWL) is increased in psoriasis (1). They found that TEWL measurements are useful for monitoring the healing effect of dithranol treatment. Tagami and co-workers made similar observations in four and six patients (2, 3). Additionally, the electrical conductance as an indicator of epidermal hydration was measured. They found an inverse relationship between these two parameters, i.e. reduced conductance in contrast to increased TEWL, which they concluded to be a sign of reduced water-holding capacity of the diseased stratum corneum. This was in accordance with experiments on water sorption-desorption in a variety of scaly dermatoses including psoriasis (4).

The purpose of this study was to verify the observations of Tagami and co-workers and further to elucidate the relation to clinical data. This has a consequence for the future usage of the two non-invasive methods for monitoring the effect of therapy and for diagnosis and documentation of healing.

MATERIAL AND METHOD

Ten patients (7 males, 3 females) suffering from psoriasis vulgaris were studied. Their mean age was 39.8 years (range 19-62 years), and the mean period since debut of psoriasis was 18.7 years (range 2-50 years). At entry of the study the mean affected skin surface area was 21.5% (range 5-50%). Only patients with a definite clinical diagnosis were included.

Seven plaques were selected for recording in each patient. The mean duration of these plaques was 7.8 months (range 1-24 months). The symptoms—erythema, scaling and induration—were graded into groups 0, 1, 2 and 3 with 0 indicating no alteration, and 1, 2 and 3 mild, moderate and severe alterations respectively. This clinical grading was performed before recordings were taken.

Regional control measurements were obtained from the healthy appearing skin of the same individuals of either the same or the symmetrical body region.

The electrical conductance indicating the hydration of the superficial epidermis was performed

using the Skicon-100® high-frequency (3.5 MHz) hydrometer introduced by Tagami et al. and invented by Masuda et al. (2, 5). The probe is constructed with two concentrically arranged brass electrodes, appicated to the skin surface with a standard pressure of 30 g. The current flowing between these electrodes via the skin is registered and displayed digitally. Values are expressed as reciprocal impedance in terms of $1/\mu\text{ohm}$ or " μmho ". In four patients (28 plaques) measurement of the electrical capacitance was performed using the Corneometer® of Schwarzhaupt for the purpose of verification. The Skicon-100® depicts the skin hydration very superficially while the Corneometer® depicts hydration down to a depth of about 0.1 mm (6). In our previous studies on methodological aspects both methods were found accurate (6, 7).

The transepidermal water loss was measured using the Servo Med EPI® evaporimeter (8). Under normal circumstances the evaporation is mainly determined by the water diffusion capacity of the superficial epidermis. The probe has an open chamber 12 mm in diameter mounted with sensors for determination of temperature and relative humidity. From these registrations the TEWL is automatically calculated and displayed digitally in units of $\text{g}/\text{m}^2 \text{ h}$. Results were read 30 sec after application of the probe onto the skin according to our previous experiences (7).

Patients were examined in a relaxed condition after an adaptation period of 15 min. Convection of air in the laboratory was intended minimal. The room temperature ranged between 20–23°C, and the relative humidity between 20–36%.

For analysis of results averages (of the seven plaques studied) were calculated in each patient since the intraindividual variation was small in comparison with the interindividual variation of observations.

RESULTS

The electrical conductance of psoriasis plaques was in every case lower than control values. The mean decrease in conductance was $10.3 \mu\text{mho}$ (range 4.9–20.9 μmho). Furthermore, each case showed decreased value of each plaque in comparison with its respective control. Thus all 77 plaques studied presented decreased electrical conductance. Confirmative measurements by the Corneometer® in four patients also showed decreased values in every patient and in every plaque (mean decrease 72, 52, 63 and 61 arbitrary units, mean value normal appearing skin of the four patients 103 arbitrary units).

TEWL was increased in every patient and in every plaque in comparison with its regional control except for one plaque, which showed similar values. The mean increase in TEWL was $16.7 \text{ g}/\text{m}^2 \text{ h}$ (range 6–29 $\text{g}/\text{m}^2 \text{ h}$).

The increase of relative humidity as measured immediately over normal appearing skin and psoriatic plaques of five patients was 5.4% (range 3–10%) and 11.2% (range 6–14%) respectively with the ambient air as a reference.

The mean erythema score was 2.1 (range 1.5–3), the mean scaling score 1.4 (range 0–3), and the mean induration score 2.0 (range 1.5–3). There was no relation between clinical score, and electrical conductance and TEWL, see Table I. Neither was there any relation between decrease in conductance and increase in TEWL (Spearman correlation coefficient 0.048, $n=10$).

Table I. *Scaling score and mean differences and range (plaque-control) in TEWL and electrical conductance of psoriasis plaques in comparison with regional control of normal appearing skin (10 patients, 77 plaques)*

<i>n</i>	Scaling score	TEWL ($\text{g}/\text{m}^2 \text{ h}$)	Conductance (μmho)
3	0–0.5	19 (13–29)	–9.5 (4.9–12.5)
2	1–1.5	13 (6–26)	–9.7 (7.4–12.0)
5	2–3	11 (10–27)	–11.1 (5.0–20.9)

DISCUSSION

This study confirms that psoriatic plaques show an inverse relationship between TEWL and electrical conductance. Recently we made similar observations in scaly hand eczema (9). Our conclusion is in accordance with a preliminary study, which showed decreased conductance of psoriatic lesions (10). Ichthyosiform dermatoses show increased TEWL (11). Thus, this inverse pattern seems to be a common feature in scaly dermatoses. The air immediately outside scaly skin is more humid than the ambient atmosphere, and, thus, our results indicate that the water holding capacity of scaly skin is reduced.

Clinical scoring of plaques showed no plaques with no or mild erythema and infiltration while scaling represented a broader spectrum. Neither TEWL nor electrical conductance were correlated to scaling. From a pathophysiological point of view there need not be any relation between defects in the epidermal water barrier and clinical signs of scaling. If scaling in psoriasis is a direct consequence of reduced epidermal hydration we would expect that plaques with a glossy appearance, i.e. a low scaling score, showed higher conductance in comparison with plaques with lamellar scaling, which was not the case. Thus, low conductance of psoriatic skin was probably a manifestation of abnormal keratinization. It is known that a significant proportion of abnormal polypeptides is found in psoriatic epidermis (12, 13). One may speculate if abnormal constituents of psoriatic epidermis represent a spectrum with some fractions associated with lamellar scaling and others with a glossy and coagulated appearance, however, all fractions having reduced water holding capacity in common as a basic feature.

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