

## Evaluation of the Hydration and the Water-holding Capacity in Atopic Skin and So-called Dry Skin

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The hydration, the hygroscopicity and the water-holding capacity as well as the rate of water loss were measured in 1) dry non-eczematous skin in 13 patients (mean age 32 years) with atopic dermatitis (AD), 2) dry, xerotic skin of old patients (mean age 75 years) and 3) 17 controls (mean age 36 years) with normal skin and no history of AD. Significantly higher water flux was found in patients with AD compared to the other groups while all the other functional parameters were much lower. The obtained data suggest different functional disturbances in dry skin of patients with AD compared to old, dry (xerotic) skin. *Key words: Hydration; Water loss; Atopic dermatitis; Old; Dry skin.*

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Skin dryness and itch are typical features of atopic dermatitis (AD) and it seems logical to relate both symptoms to abnormalities of the horny layer. While a low itch-threshold and prolonged itching could be objectively demonstrated several years ago (1), a low hydration of the stratum corneum combined with a high transepidermal water loss (TEWL) were only observed recently with newly developed technical devices (2). An increased rate of waterflux is characteristic of a defect barrier function and is typically recorded in AD and various scaly dermatoses (2, 3, 4).

The water-sorption-desorption test as developed by Tagami et al. (5) gives information about the hygroscopicity, i.e. the ability to take up water, and the water-holding capacity of the stratum corneum. While it was at first surmised that the former to a large extent was dependent on soluble, hygroscopic substances or the so-called "natural moisturizing factor" (NMF) components, which can be leached out of the epidermis by washing or treatment with acetone/ether application of the skin, this theory has now been revised. It is believed that the intercellular lipids are of great importance for the water-holding state of the stratum corneum (6, 7). Besides this they have an important role in the cohesion of the corneocytes, in

the barrier function, in protecting water soluble substances and they also contribute to a large extent to the plasticising properties of the stratum corneum (8).

Some studies have indicated that the hygroscopic properties are sooner restored than the water-holding capacity and the TEWL (5). These findings indicate that a normalization of the water-holding capacity requires a complete restoration of the stratum corneum, whereas the NMF components are restored or normalized earlier.

Clinically dry skin is an expression which needs objective evaluation. It is typically observed in patients with atopic dermatitis and old non-atopic patients with xerosis. It is of interest to investigate if the functional parameters related to the barrier function and the hydration are different in these two conditions. If so, this might indicate that there are different underlying pathogenetic mechanisms.

### MATERIALS AND METHODS

The water-sorption-desorption test as described by Tagami et al. (5) was used in order to evaluate the water content, the hygroscopicity, i.e. the ability to take up water, and the water-holding capacity. Measurements were performed with the Corneometer CM 420 (3) on the upper arm before the application of water for 30 sec, 10 sec after blotting and at intervals of 30 sec for 2 minutes. The TEWL was measured with the evaporimeter as described by Nilsson (9). All measurements were performed at room temperature 19°-20°C and no ointment was applied to the area of measurement before the study.

Thirteen patients (mean age 32 years) who suffered from dry skin and otherwise fulfilled the criteria of AD were included in the study. The same measurements were also performed in 10 elderly subjects (mean age 75 years) who suffered from dry skin, and in 17 controls with normal skin and no history of atopy (mean age 36 years).

### RESULTS AND DISCUSSION

In the present study the hydration values, the hygroscopicity and the water-holding capacity were significantly lower in the AD group than in both the controls and in the patients with dry, old skin (Fig. 1), indicat-

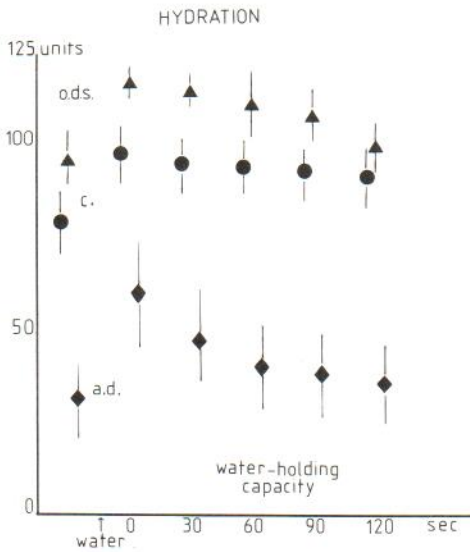


Fig. 1. Water sorption-desorption test showing the pre-hydration state, the hygroscopicity and the water-holding capacity in old, dry skin (o.d.s.), controls (c.) and atopic dermatitis (a.d.).

ing a functional defect of the horny layer. An assumption which is supported by the observation that the TEWL values were clearly much higher in the AD group than in the two groups (Table I). For comparison are the values obtained in a previous study (10) included in the Table. One conclusion from the present study is that clinically dry-appearing skin in AD patients is really dry as measured with the Corneometer.

Previous reports on the water content of the stratum corneum in patients with AD and dry skin have shown conflicting data. This depends partly on the different methods applied, the different anatomical sites examined and probably also whether treated or non-treated skin was investigated. Two studies have indicated an increased water content of the uttermost portion of the stratum corneum in AD (11, 12). One was performed at the same anatomical site as the present one, but later these investigators (18) used the device of Tagami et al. (14) and came to the conclusion that there was no significant difference between the control subjects and patients with dermatitis in an inactive stage, including AD-patients. The present method measures mainly the deeper portions of the horny layer and the data are in accordance with those obtained by Werner (3) who used the same method. Also Tagami (5) came to the same conclusion regarding the water content, the hygroscopicity and the wa-

Table I. Mean values of TEWL ( $g/m^2/h$ ) and hydration obtained in the present and a previous study<sup>a</sup>

	TEWL	Hydration
<i>Controls</i>		
<i>n</i> =23*	8.3	70.5
Mean age 29 yrs	6.5-10.2	66.3-74.7
<i>n</i> =15*	4.6±1.14	80.7±2.7
Mean age 81 yrs		
<i>n</i> =17	4.8±2.0	79.8±16.9
Mean age 36 yrs		
<i>Old, dry skin</i>		
<i>n</i> =40*	6.9	71.8
Mean age 65 yrs	5.5-8.3	67.8-75.8
<i>n</i> =10	6.6±4.4	86.5±16.2
Mean age 75 yrs		
<i>Atopic dermatitis</i>		
<i>n</i> =13	20.0±7.75	29.2±21.3
Mean age 32 yrs		

<sup>a</sup> Data from REF (10).

ter-holding capacity in patients with various dermatoses including AD. It is apparent that the clinical state of the skin to be examined is of paramount importance since normal appearing skin in such patients show normal values. The high rate of water flux in AD-patients with dry skin is in concordance with the observations of others (2, 4). Interestingly, there are reports on the occurrence of abnormally small corneocytes and increased intracorneal cohesion in non-eczematous dry skin associated with AD (12, 13). All the findings are indicative of an abnormal barrier function.

The hydration data which were recorded in old, dry skin were higher but not significantly different from those observed in the control groups (Table I). This concerns also the hygroscopicity and the water-holding capacity (Fig. 1). Thus clinically dry appearing old skin is not always dry by measurement. On the other hand, by employing another *in vivo* technique which measures the propagation of shear waves through the skin, a lower moisture content in aged skin compared to young skin was suggested (15). Also *in vitro* measurements of the hygroscopicity and amount of bound water in samples of senile xerotic skin have indicated lower values than in normal horny layer (8).

The TEWL data from the patient groups with old, dry skin were quite similar. The same also holds true for the control groups with the exception of the youn-

ger ones which had a significantly higher rate of water flux. The reason for this discrepancy is not clear, but can probably be ascribed to the circumstances mentioned above concerning the hydration data in patients with AD.

Altogether, the present study indicates that the barrier function and the water-content in old, dry skin is not so much altered that it can be disclosed by the present techniques. The obtained data suggest different functional disturbances in old, dry skin compared to dry skin in patients with AD.

Since the skin is the primary site of involvement in AD it seems logical that more chemical and immunohistochemical research should be directed toward abnormalities in the epidermis, in particular the horny layer. Recent studies concerning intercellular lipid abnormalities combined with enzyme defect(s) (16) and the demonstration of Fc-R on Langerhans' cells from AD patients (17) are very promising in this respect.

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