

Changes in the Water Holding Capacity of Psoriatic Stratum corneum *In vivo*

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This study investigated the functional capacity of the stratum corneum of psoriatic skin to bind water *in vivo* during a relatively long period of time (water holding capacity—WHC). An electrical capacitance test was applied to the psoriatic skin on the elbows, perilesional skin and apparently normal skin of 11 patients and the elbows of 10 controls. Measurements of electrical capacitance were performed using a Corneometer Schwarzaupt for 25 min. The WHC levels were calculated for this period. Our results demonstrate that the WHC of psoriatic stratum corneum does not differ from controls in the first 10 min. Only after the 20th min do the WHCs differ significantly ($p < 0.02$). Despite the biochemical keratin changes in psoriatic plaque, the latter is highly hygroscopic, in particular in the first minute after bathing. Perilesional skin binds water like the stratum corneum of controls, though not beyond the 20th minute after bathing. **Key words:** *Psoriasis; Water holding capacity; Hygroscopicity.*

When we consider that anomalous maturation of the polypeptides in the psoriatic stratum corneum is the consequence of the complex set of pathogenetic factors (1), it becomes clear that a pathological keratinization will lead, among other things, to changes in the hygroscopicity of the substrate and an inability to hold water. Studies on epidermal properties are fairly frequent, owing to improved research techniques (2-6). However, these studies generally adopt a "single snapshot" approach to physical characteristics of the psoriatic lesion or are restricted to a time span not exceeding a few seconds.

What is attempted in this study is an assessment of the water holding capacity (WHC) of the psoriatic stratum corneum over a period of time.

MATERIALS AND METHODS

Measurements were carried out on patients affected by psoriasis who had erythematous-squamous patches on the elbows of varying thickness. There were 7 males and 4 female patients aged 43.8 ± 21 years, matched against 10 controls of both sexes (average age 41.3 ± 17). Measurements were made

with a Corneometer CM 820 PC Schwarzaupt which uses electrical capacitance to measure skin humidity. The areas analyzed were the psoriatic plaques on elbows, perilesional skin and the apparently healthy skin of the ipsilateral arm. The same technique was applied to the elbow skin of controls. Both patients and controls were tested after about 15 min acclimatization in the recording room where there was a constant temperature of 20°C and where the humidity varied between 60 and 70%.

The baseline moisture was obtained from the arithmetical average of 4 consecutive measurements in the same area. Hygroscopicity was taken as the rapid intake of water by the stratum corneum measured 1 min after bathing with 1 ml of water on a surface of 50 cm² including skin affected by psoriasis, perilesional and apparently healthy skin. Furthermore, the water holding capacity (WHC) was calculated (3) as defined in the following equation:

$$\text{WHC (\%)} = \frac{\text{average of 4 measurements}}{\text{highest of the 4 measurements}} \times 100$$

The capacitance findings relating to change in moisture level, and hence WHC, were carried out after bathing with water at the 1st, 5th and 10th min and every fifth minute until the 25th minute. Variance analysis was performed on the data thus obtained.

RESULTS

Only data relating to WHC are discussed here. Table I gives average WHC levels for both pathological skin (11 patients: psoriatic patch, perilesional skin and apparently healthy skin) and for control skin (10 controls).

DISCUSSION

The stratum corneum acts as a two-way substrate retaining atmospheric humidity by virtue of its relative physiological dryness and governing the transepidermal water loss by limiting perspiratio insensibilis. Dry skin (physiological and/or pathological) tends to have high hygroscopic levels when the environmental humidity is high: in a dry environment, on the other hand, the WHC of normal skin dry skin varies considerably.

Table I. Mean hygroscopicity and WHC levels in the areas considered before and after bathing (arbitrary capacitance units)

Time	Controls		Psoriatic plaque		Perilesional skin		Healthy app.skin	
	86		79		81		94	
Baseline	86		79		81		94	
<i>1 ml water bathing</i>								
	Hygr.	WHC %	Hygr.	WHC %	Hygr.	WHC %	Hygr.	WHC %
Min 1	121.6	98	111	97	120.4	98	118	97
5	102.1	92	93.1	95	103.9	94	101	95
10	74.5	90	65.9	93	70.5	90	70.1	94
15	65.2	91	48.6	86	59.8	91	68.3	93
20	66	91	33.72	83	57.4	90	64.8	91
25	61.4	93	26.1	81	53.8	88	62.8	93

Hygroscopicity and WHC are related to each other and are interlinked but they express two different phenomena; the first defines a passive and aspecific characteristic, whereas the second defines the quality and the integrity of the keratin substrate by a percentage.

The method we used indirectly defines the quantity of water to a greater depth than other studies (7). This is crucial in a condition characterized by a thickening of the skin such as psoriasis. Our data (Table II), in fact, show that whereas there are no significant differences in WHC in psoriatic skin as compared with healthy controls one minute after bathing, the WHC becomes significantly different between the 20th and 25th minutes ($p < 0.02$). In particular, there are significant differences in the retention of water (a) be-

tween the psoriatic lesion and the apparently healthy skin of the psoriatic subject and (b) between psoriatic plaque and healthy skin of controls (Fisher test 8.03 and 9.83).

Our study supports the view that the electrical capacitance of the stratum corneum in the psoriatic lesion is directly proportional to the moisture which was artificially produced. Over short periods (1 min), WHC in the psoriatic lesion, perilesional skin and apparently healthy skin of the psoriatic subject is high and indistinguishable from WHC in the skin of healthy controls. The levels of WHC reached at one minute after bathing are unrelated to initial baseline levels of the sites tested. Our findings differ from those of other authors (4) which show, albeit by other means, that the hygroscopicity of the corneum of the

Table II. No significant differences in WHC of psoriatic skin and controls 1 min after bathing and significant differences in WHC ($p < 0.02$) at 25th min after bathing

Comparison	Mean. Diff.		Fisher PLSD		Scheffe F-test		Dumnett t	
	1 min after bath	25 min after bath	1 min after bath	25 min after bath	1 min after bath	25min after bath	1 min after bath	25 min after bath
Plaque vs. perilesional	-1.125	-7.625	2.278	8.03	0.346	1.281	1.019	1.96
Plaque vs. uninvolved	-0.363	-11.625	2.278	8.03*	0.036	2.977	0.328	2.988
Plaque vs. healthy	-0.988	-12	2.79	9.834*	0.178	2.115	0.731	2.519
Perilesional vs. uninvolved	0.762	-4	2.278	8.03	0.159	0.352	0.691	1.028
Perilesional vs. healthy	0.137	-4.375	2.79	9.834	3.449E-3	0.281	0.102	0.918

* Significant at 95%

psoriatic lesion is low (after 10 sec bathing) as compared with "normal" adjacent skin.

The adjacent skin is not normal, as may be seen in Table I in which the WHC values differ at the 25th minute. Moreover, it has been shown (4) that the stratum corneum of the psoriatic lesion is not able to hold water after bathing for more than one minute, becoming "dry" after 60 sec.

Our data show, on the contrary, that the psoriatic lesion holds water, until the 10th minute in quantities at least as high as the stratum corneum of healthy controls. From the 10th minute onwards the WHC of the stratum corneum of the psoriatic lesion rapidly declines, while the WHC of controls remains constant. In conclusion, our data would appear to show that:

- 1) the stratum corneum of the psoriatic lesion is heavily hygroscopic;
- 2) despite the biochemical changes in the keratin protein substrate it is able to hold water for at least 10 min;
- 3) WHC of the stratum corneum of the psoriatic lesion differs significantly from controls only after the 20th minute ($p < 0.02$).
- 4) perilesional skin holds water like the stratum corneum of controls until at least the 20th minute

after bathing; after this the percentage of water decreases.

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