Acta Derm Venereol (Stockh) 1994; Suppl. 186: 131–132

Interlamellar Lipid Differences between Normal and Psoriatic Stratum Corneum

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Intercellular lipids of the stratum corneum are involved in permeability barrier integrity and function. In psoriasis, desquamation and permeability barrier homeostasis are modified; these observations are consistent with an alteration in stratum corneum lipid production. Therefore, in the present study, we determined and compared the total content of the three main intercellular lipids in psoriatic scales and normal human stratum corneum. Our results showed that the relative free fatty acid content decreased remarkably (46%) in psoriatic scales, compared with normal human stratum corneum. This decrease may reflect a general state of emergency of keratinocytes, in which free fatty acids can be employed. ***Key words: pemeability barrier; linoleic acid; abnormal desquamation.***

Acta Derm Venereol (Stockh) 1994; Suppl 186: 131–132.

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The functional structure of stratum corneum is appropriately explained by the 'two compartment model' devised by Elias (1). According to this hypothesis, corneocytes are stacked together by intercellular lipids to form membranous bilayers. Both the cellular and the lipid components are essential to maintain such a protective and permeable barrier.

Free fatty acids (FFA), cholesterol (CHOL) and ceramides (CER), the three main species of intercellular lipids, are implicated in horny layer homeostasis. In psoriasis, the increase in keratinocyte proliferation and the incomplete process of differentiation lead to the formation of a highly deranged horny layer and, as a consequence, permeability functions are impaired, causing an increase in water flux and absorption (2). These observations are consistent with an alteration in stratum corneum lipid production. Up to now, few data are available on psoriatic skin lipids: together with the abnormal formation of the protein envelope (3), an elevated level of bound linoleic acid, associated with alterations in the covalently-bound ceramides have been described by Wertz et al. (4). In a previous work (5) we observed that in psoriatic scales the relative total content of ceramides, the main sphingolipid class present in the stratum corneum, is the same as in normal human stratum corneum.

These data are largely insufficient to justify the impairment in psoriatic barrier homeostasis. Therefore, in the present study, we determined the total content of the three main intercellular lipids of stratum corneum, FFA, CHOL and CER, in psoriatic scale[3], and compared the results with normal human stratum corneum.

MATERIAL AND METHODS

Abdomen skin sample of 6 normal subjects of both sexes were obtained from plastic surgery and processed according to Elias (6). Psoriatic scale samples were obtained from lesional areas of 10 psoriatic subjects, all males. EDTA and trypsin-obtained normal stratum corneum sheets (6) and psoriatic scales were minced and lipids were extracted by the Bligh – Dyer method (7). All separations were carried out using thin-layer plates (10 × 20 HPTLC, Merck), based on a previous report (8), with slight modifications. Pure lipid standards: free cholesterol, cholesteryl oleate, palmitic acid tripalmitin, 1-eicosene, Type III and Type IV ceramide, purchased from Sigma (St. Louis, Mo.) were applied (10 μg each) in parallel for identification and calibration purposes. After elution, the plates were air-dried, sprayed and charred on a 180°C hotplate (9). Quantification of different lipid classes (ceramides, cholesterol and free fatty acids) was done by densitometry, using a Camag TLC Densitometer equipped with a computerised image analyser (10).

RESULTS

The results, expressed in μmoles/mg total lipids of each lipid fraction, are shown in Fig. 1. The mole ratio among FFA/CHOL/CER in normal human stratum corneum was 4.1/1.3/1; in psoriatic scales, 2.2/1.3/1.

The main result was the remarkable decrease (46%) in FFA ratio vs. other lipid fractions of the psoriatic scales vs. normal stratum corneum.

DISCUSSION

Many earlier studies on the stratum corneum lipids indicated their role in maintaining permeability barrier homeostasis (11, 12) and in regulating lamellar stacking and desquamation (13, 14). However, studies on lipids of normal human stratum corneum are few and not particularly comparable because of the different extraction methods and site of harvesting. The FFA/CHOL/CER ratio of normal stratum corneum may be considered in the range of literature data shown in Table I.

Recently, Elias and co-workers, using lipid synthesis inhibitor

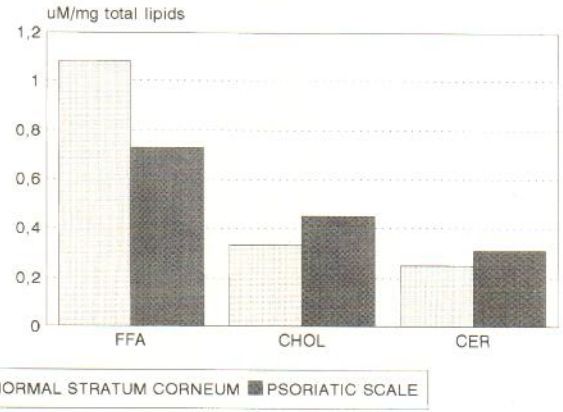

Fig. 1. Content of FFA, CHOL and CER in normal stratum corneum and psoriatic scales.

  ISSN 0365-8341

Table I. *Literature review and new data on quantifiation of interlamellar lipid species in normal human stratum corneum and psoriatic scales*

Reference	Origin	FFA/CHOL/CER
Elias P.M. J. Lipid Res. (1983) 24, 131–140	Abdomen	2.9/1.5/1
Melnik B. et al. J. Invest. Dermatol. (1989) 92, 231–234	Plantar	1.5/1.6/1
Melnik et al. Arch. Dermatol. Res. (1990) 282, 549–551	Plantar Lumbar Nail	1.5/1.6/1 4.8/0.6/1 8.5/3.1/1
Melnik et al. J. Invest. Dermatol. (1991) 96, 959–962	Lumbar	10/0.8/1
Our data 1993	Abdomen NSC Abdomen PS	4.1/1.3/1 2.2/1.3/1

Data are expressed as a molar ratio, FFA/CHOL/CER.

of each species, demonstrated the importance of each single class of lipids for barrier homeostasis (15). If the stratum corneum lipids are synthesized in a functionally determined ratio, in psoriatic scales, in which both permeability and desquamation are altered, this ratio should be modified, too.

Knowledge of psoriatic scale lipids is scanty. Wertz and co-workers investigated the normal human stratum corneum covalently bound lipids and demonstrated a similar total concentration in psoriatic scales, but a different proportion of the individual lipid (4).

We observed, in a previous work on stratum corneum ceramides, that the relative content of this class of total lipids was the same in psoriatic scales as in normal human stratum corneum. However, the species isolated from psoriatic scales displayed a different pattern of ceramide distribution, particularly a decrease in ceramide 1, a complex species in which an additional ester linkage with linoleic acid is present (5).

In the present study, in order to extend our knowledge in this field, we investigated the content of the three main classes of interlamellar lipids in psoriatic scales, compared with normal stratum corneum. Our results showed that relative FFA content decreased remarkably (46%) in psoriatic scales, compared with normal human stratum corneum.

The decrease in free fatty acids in psoriatic scales may reflect a general state of emergency of keratinocytes in the disease, in fact the rapid turnover of these cells may also involves energy-consuming processes, in which free fatty acids can be directly or indirectly employed.

The previous evidence of an accumulation of covalently bound linoleic acid in psoriatic scales (4) appears to agree closely with our results. Moreover, preliminary data from our laboratory seem to indicate a tendency to increase triglycerides and sterol-esters.

In conclusion, a shift from the 'free' to the 'bound' form of fatty acids (as in covalently bound lipids, triglycerides and sterol-esters) appears to be a distinctive biochemical feature of psoriasis. Further investigation of free fatty acid species, absent or depleted in psoriasis, will help to shed light on the biochemical effect present in psoriasis at this level.

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