

Preventive and Therapeutic Effects of a Moisturizer

An Experimental Study of Human Skin

DORTE W. RAMSING and TOVE AGNER

Department of Dermatology, Gentofte Hospital, University of Copenhagen, Denmark

The effect of a moisturizer was tested on experimentally irritated human skin in two studies. In a prevention study, 12 volunteers had both hands immersed into a 0.375% sodium lauryl sulphate solution, 10 min twice daily for 2 days. Before each immersion one hand was treated with the moisturizer; the other hand served as control. In a therapeutic study, 12 volunteers had both hands immersed in the same way as mentioned above. After the last immersion one hand was treated for 5 days with the moisturizer; the other hand served as control. Skin barrier function was evaluated by transepidermal water loss (Evaporimeter), and blood flow was evaluated by laser Doppler flowmetry and skin hydration by electrical capacitance (Corneometer).

A significant preventive effect was obtained on the treated hand, compared to the control hand, judged by all measured parameters. A significant therapeutic effect was observed on skin barrier function and on skin hydration on the treated hand, compared to the control hand, while no difference between the hands in blood flow was observed after the end of treatment.

The moisturizer could prevent irritant skin reactions induced by a detergent, and it could also accelerate regeneration of the barrier function of irritated skin. **Key words:** bioengineering methods; skin barrier function.

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D. W. Ramsing, Frøndevej 40, DK-2860, Søborg, Denmark.

Irritant contact dermatitis (ICD) is frequent in wet occupations (1–3). Use of skin protection creams, better known as barrier creams, is common. An authorised definition of barrier creams and skin care products does not exist, and there is no clear distinction between moisturizers used before and after work. Likewise the efficacy is debated. One field study indicated a positive effect on skin hydration from the use of moisturizers during work (4), and another study found that moisturizers prevented experimental irritant dermatitis induced by a detergent on restricted areas of the upper arm (5). Barrier creams and after work emollient creams were not found to have a significant effect in metal workers in preventing cutting fluid dermatitis (6). Experimental studies on the effect of barrier creams in humans found that while some barrier creams were protective against specific irritants, other barrier creams might even aggravate the response of the irritants (7, 8).

In the present studies a commonly used moisturizer, commercially available on the Danish market, was tested as prevention as well as treatment of irritant skin reactions, induced in a standardized experimental irritation model.

MATERIAL AND METHODS

Healthy volunteers without skin disease were included in the studies. Informed consent was obtained from all participants and the studies were approved by the local ethical committee.

An experimental subclinical irritation was elicited by immersion of both hands into a 0.375% aqueous sodium lauryl sulphate solution (SLS, Sigma >99% purity), temperature 30°C. Immersion took place for 10 min, twice daily for 2 consecutive days, with an interval of at least 4 h between immersions (9). The same moisturizer was used in the prevention study and in the treatment study (Locobase[®], Yamanouchi Pharma, containing methylparahydroxybenzoate, cetomacrogol 1000, cetostearyl alcohol, paraffin, liquidum, petrolatum album, sodium citrate anhydricum, acidum citrium anhydricum, aqua purificata). The moisturizer was applied to the dorsum of the test hand with the index finger of the control hand, using a finger cut. The moisturizer tubes were weighed before and after treatment.

Prevention study

Twelve volunteers (11 women, 1 man, median age 40 years, range 25–56 years) were included in the preventive study. After randomisation, one hand was treated with the moisturizer, which was applied 15 min prior to each immersion into the SLS solution. The other hand was not treated and served as control. Evaluation was performed at baseline (day 1), and after ended irritation (day 3).

Treatment study

Twelve volunteers (11 women, 1 man, median age 46.5 years, range 21–55 years) were included in the treatment study. After randomisation, treatment of one hand with the moisturizer was initiated after the last SLS immersion (day 3) for 5 days, 3 times daily. The other hand was not treated and served as control. Evaluation was performed at baseline (day 1), after ended irritation before treatment (day 3) and after ended treatment (day 8).

Use of other moisturizers than the one tested in the study was not allowed 12 h prior to and during the study period. The volunteers were allowed to wash their hands as usual, ensuring that the hands were equally exposed. The randomization code was not known to the investigator. Three test sites were chosen for measurements, placed on the radial, central and ulnar part of the dorsum of the hands, avoiding the veins. Evaluation was performed more than 12 h after the last application of the moisturizer with the following non-invasive measuring methods:

Transepidermal water loss (TEWL) was measured by an Evaporimeter EP1 (Servo Med, Stockholm, Sweden), according to the Guidelines from the Standardization Group of the European Society of Contact Dermatitis (10). Details of the operating principle of the Evaporimeter are given elsewhere (11).

Blood flow was measured by a laser Doppler blood flow monitor MBF3/D (Moor Instruments, England), according to the Guidelines from the Standardization Group of the European Society of Contact Dermatitis (12). Details of the operating principle of the laser Doppler flow monitor are described elsewhere (13).

Electrical capacitance was measured by a Corneometer CM 820[®], indicating the hydration of stratum corneum (14).

Measurements were performed following a relaxation period of 15–30 min. The relative humidity varied between 18–39%; ambient temperature was kept at 20–22°C, and the skin temperature measured in the test region was 29.1°C (28.3°C–31.1°C), given as median and 25/75 percentiles. The study was performed in the period January–February 1996. Values for the recordings of TEWL, laser Doppler flowmetry and electrical capacitance are expressed as the mean value obtained from the three test sites on the back of each hand.

Statistics

The Wilcoxon test for paired samples, modified according to Pratt, was used for comparative studies. $p < 0.05$ was chosen as level of significance.

RESULTS

Prevention study

TEWL, blood flow and electrical capacitance remained at baseline values on the treated hand. TEWL and blood flow were significantly increased and electrical capacitance was significantly decreased after ended irritation (day 3) on the control hand, compared to the treated hand (p TEWL = 0.001, p blood flow = 0.008, p electrical capacitance = 0.002). No significant differences were observed between the hands at baseline (day 1) in any of the parameters. The amount of moisturiser used was 1.69 g (1.27–2.74 g) given as median and 25/75 percentiles.

Treatment study

An increase was observed in TEWL and blood flow and a decrease was observed in electrical capacitance on both hands just after SLS immersions (day 3), as observed on the control hand in the prevention study. TEWL was significantly increased on the control hand, compared to the treated hand, after 5 days of treatment on day 8 ($p = 0.012$). On day 8 TEWL values on the treated hand were like values at baseline. On day 8 electrical capacitance on the treated hand remained at values found just after irritation (day 3), while a further decrease was observed on the control hand. The electrical capacitance was significantly decreased on the control hand, compared to the treated hand, on day 8 ($p = 0.001$). Blood flow was spontaneously restored on day 8 and no significant difference was observed between the hands. No significant differences were found between the hands at baseline (day 1) or immediately after SLS immersions (day 3) in any of the parameters. The amount of moisturizer used was 4.09 g (2.61–8.69 g) given as median and 25/75 percentiles.

Clinical observations

Slight dryness and scaling were observed just after the experimental irritation (day 3) on the control hand in the preventive study and on both hands in the treatment study. Dryness, scaling and chapping were observed on the control hand in the treatment study on day 8.

DISCUSSION

The moisturizer could prevent the irritant skin reaction induced by SLS, and it could accelerate regeneration of the skin barrier function of SLS-irritated skin and improve the clinical signs of irritation, as observed on the control hand.

Prevention

Earlier studies on barrier creams have reported that some are effective, some ineffective and that some may even aggravate the response of the irritant (7, 8). It is important to realize that a barrier cream which is effective against detergents is not necessarily effective against other irritants and may even

aggravate the skin response to these. In the present study the moisturizer was found to protect against one detergent, and conclusions cannot be drawn as to irritants like acids, alkalis, organic solvents or other chemicals. The moisturizer used in the present study contained 70% oil-in-water. The mode of action could be that the moisturizer prevents the penetration of SLS through the epidermis by a binding of the SLS molecule to substances in the moisturizer, instead of a binding to stratum corneum protein. Another possible mode of action may be that skin contact with the SLS in solution is reduced when using a water-repellent moisturizer. The moisturizer may also have improved the skin barrier to better resist an irritant trauma by increasing the skin hydration. A urea-containing moisturizer used before experimental irritation with SLS was reported to prevent the response of SLS judged by non-invasive measuring methods (15). Increased skin hydration following application of the moisturizer may have prevented the deteriorating effect of SLS.

Treatment

Compared to the control hand, treatment with the moisturizer significantly accelerated skin barrier repair, judged by measurements of TEWL and electrical capacitance, and it improved the clinical signs, which were observed on the control hand. The improvement measured by electrical capacitance is in agreement with earlier studies on the effect of moisturizers on normal skin (4, 16, 17). In our study the effect of a moisturizer on deteriorated skin was studied, and the positive effect on TEWL is in agreement with an earlier report, where it was shown that application of lipids improved the barrier function of SLS-irritated skin (18). The moisturizer contains water and this may have influenced TEWL. However, measurements were performed 12 h or more after the last application, and the evaporation phase after a single application of a moisturizer was earlier shown to last less than 15 min (16). Theoretically, the improvement in the barrier function could be due to absorption of the moisturizer into the delipidized stratum corneum, acting as an effective barrier, as suggested in a study on the effect of petrolatum (19). The blood flow was markedly increased just after the immersions, but no differences were observed between the hands after treatment, indicating a spontaneous restoration in the blood flow after the experimental irritation.

Experimental irritation models for evaluation of moisturizers

The experimental model for eliciting ICD was useful in testing the effect of the moisturizer. Repetitive irritation patch tests on the back of healthy volunteers and repetitive washing procedures on the forearm have recently been suggested as models for barrier cream testing (8, 20). However, the products are not tested on the hands, where they are used in daily life, and these models have to be validated in relation to more realistic studies. The immersion model (9) has been used in previous studies by our group as a standardized irritation model of the hands (21, 22). The model can be adjusted according to climate and skin sensitivity of the volunteers. The method is time-consuming: only one detergent and one moisturizer can be tested in this model. Care should be taken not to include subjects at risk of developing hand eczema (atopics, subjects sensitized to allergens), and the method

cannot be recommended for large-scale studies. However, results obtained in the immersion model could be used as standards in developing new and more accessible irritation models. Standardized, reliable models for skin care product testing are important for the improvement of the products, and for documentation of their efficacy.

In conclusion, the tested moisturizer was effective as prevention as well as treatment of subclinical ICD in an experimental study.

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