

Site variations in susceptibility to SLS

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According to the European Society of Contact Dermatitis (ESCD) guidelines on the sodium lauryl sulfate (SLS) exposure test 'the flexor side of forearm skin with cubital fossa and wrist excluded is the preferred study site'. In this study we analysed the exact anatomic region within the suggested test area in respect to the outcome of the SLS exposure test. 3 test areas at the volar forearm were chosen: 'distal' with a 5-cm distance to the wrist, exact 'midvolar' and 'proximal' with a 5-cm distance to the cubital fossa. 25 healthy volunteers were irritated for 24 hr with 1% SLS. Transepidermal water loss (TEWL) measurements were taken before and 1 and 24 hr after removal of Finn Chambers®. Median baseline TEWL showed no significant differences in the 3 test sites. However, postexposure TEWL proximal was significantly ($P < 0.01$) higher than midvolar and distal. The distal volar forearm showed the lowest TEWL 24 h after the irritation. The differences were in comparison to midvolar ($P < 0.01$) and proximal ($P < 0.001$) significant. The results show that it is essential to point out the exact position of the test area at the volar forearm in study reports and to randomize the irritation areas at the volar forearm if different treatments are to be compared.

Key words: bioengineering methods; site variations; sodium lauryl sulfate (SLS); transepidermal water loss (TEWL). © Blackwell Munksgaard, 2007.

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Sodium lauryl sulfate (SLS) has been used extensively as a model irritant in the field of skin irritation testing (1). In assessing the susceptibility to SLS in humans regional differences must be considered. Intraregional differences in basal physiological conditions and skin sensitivity have been reported (2–6). For bioengineering studies the volar forearm is the preferred location. On the volar forearm significantly higher transepidermal water loss (TEWL) baseline values were found next to the wrist and next to the cubital fossa as compared with the other sites of the volar forearm (7, 8). Van der Valk and Maibach (8) found that there is also a site variation in susceptibility to SLS on the volar forearm as evaluated by TEWL and visual scoring. Postexposure TEWL next to the cubital fossa was significantly higher than the other sites on the volar forearm, the area next to the wrist having the lowest value. It has been suggested therefore that these areas should be excluded when testing. According to the 'guidelines on sodium lauryl sulphate (SLS) exposure test' of the ESCD standardization group 'the flexor side of forearm skin with cubital fossa and wrist excluded is the preferred study site' (9). The purpose of this study was to analyse in more detail

the outcome of SLS exposure test within the suggested test area.

Patients and Methods

Volunteers

25 non-preselected volunteers (8 males, 17 females; aged 25–54 years; average age: 34 years) participated in the study. The study was approved by the local ethical committee which gave it unanimous approval. Informed consent was obtained from all participants prior to their inclusion in the study. Subjects did not have a history of atopic dermatitis nor any other chronic skin disease. Subjects were allowed to bathe as usual but were instructed to avoid direct application of detergents, moisturizers, emollients or topical medications to their forearms 5 days prior to and during the investigation.

Test procedure

3 test areas of 1.5 cm diameter were marked on clinically normal skin at the volar forearm: 'distal' with a 5-cm distance to the wrist, exact 'midvolar' and 'proximal' with a 5-cm distance to the cubital

fossa. To initialize skin irritation, 50 µl of a 1% SLS solution (analytical grade, purity >99%, Sigma, München, Germany, dissolved in deionized water) was applied to each of the 3 test areas. The solution remained under occlusion using large Finn Chambers[®] (12 mm diameter; Scanpor[®] chambers; Hermal, Reinbek, Germany) for 24 hr according to the methods described by Fartasch et al. (10).

TEWL as an indicator of the integrity of stratum corneum barrier function and a sensitive indicator of surfactant-induced irritation (11, 12) was measured employing the Tewameter TM 300[®] (Courage & Khazaka Electronic GmbH, Cologne, Germany). During the TEWL measurements, air convection was prevented by a protective measuring chamber and by reducing movement and speech in the test room. The test results were evaluated by 1 experienced person according to the guidelines of the Standardization Group of the European Society of Contact Dermatitis (13). Prior to the measurements, the volunteers rested for at least 0.5 h in the fully air-conditioned test room with a constant temperature of 20 ± 0.5 celsius and a relative humidity of $45 \pm 2\%$. Measurements were taken before irritation and 1 and 24 hr after the removal of Finn Chambers[®].

Statistical methods

Statistical analysis was conducted with spss (version 13.0). The calculation with Kolmogorov–Smirnov test showed not normally distributed data, so the values were represented as medians. Data of TEWL measurements are presented as delta values (after irritation values minus baseline values). Differences between test areas on the volar forearm were tested for their statistical significance using the Mann–Withney *U*-test for not normally distributed non-paired data. Wilcoxon signed rank test was used when comparing the results in the course of each test area.

Results

The results of the TEWL measurements are shown in Table 1 and Fig. 1.

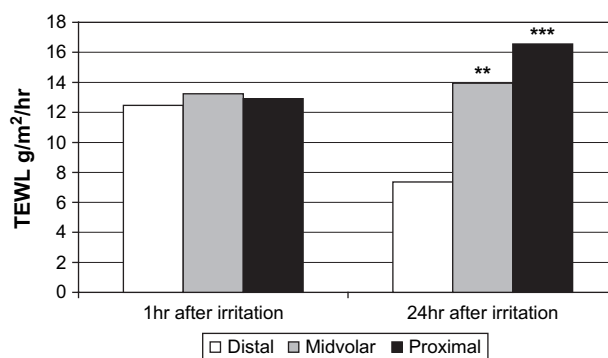


Fig. 1. Delta transepidermal water loss median values 1 and 24 hr after removal of Finn Chambers[®] (1% sodium lauryl sulfate patch test for 24 hr) at three different locations on the volar forearm. ** $P < 0.01$; *** $P < 0.001$.

Before irritation, median value of TEWL proximal was higher than midvolar and distal on the volar forearm, the midvolar area revealing the lowest value. In statistical analysis no significant differences for baseline values at the three different areas at the volar forearm were observed. The irritation with 1% SLS under occlusion over the duration of 24 hr leads to eczematous skin reactions, clearly visible and objectively detectable by a significant ($P < 0.001$) increase in TEWL values at all test areas if compared with baseline values. 1 hr after removal of Finn Chambers[®] no significant differences of Δ -TEWL between the test areas were found. Significant differences of Δ -TEWL were observed 24 hr after the removal of Finn Chambers[®]. The skin of the volar forearm showed a significant increase in sensitivity from the distal to the proximal test area. Postexposure Δ -TEWL values proximal were significantly ($P < 0.01$) higher than midvolar and distal. The distal volar forearm showed the lowest Δ -TEWL after the irritation with 1% SLS. The differences were in comparison to the midvolar area ($P < 0.01$) and to the proximal area ($P < 0.001$) significant.

Discussion

Skin irritability varies with body site (3); on the arm the back of hand is less irritable than the

Table 1. Transepidermal water loss distribution at the 3 test areas at the volar forearm in the course of the study

	Baseline			1 h postirritation			24 h postirritation		
	LQ	Med	UQ	LQ	Med	UQ	LQ	Med	UQ
Distal volar forearm	6.00	6.88	8.15	12.88	19.35	24.33	11.75	14.25	22.75
Midvolar forearm	6.08	6.58	7.33	15.53	19.83	23.15	13.18	20.53	25.65
Proximal volar forearm	6.70	7.73	8.48	16.48	20.65	24.58	16.65	24.28	33.10

Med, median; LQ, lower quartile; UQ, upper quartile.

forearm (5). If only the forearm is examined, there is also an increase in sensitivity from distal to proximal, as was shown by Van der Valk and Maibach (8). In accordance to their results we found an increasing sensitivity to SLS from the wrist to the elbow. But in contrast to these authors, we avoided the skin next to the wrist fold and the cubital fossa and analysed the skin area in between regarding skin irritability with SLS. Taking the findings of Van de Valk and Maibach (8) and our results together, it can be concluded that there are significant differences in irritability not only at the areas next to wrist and cubital fossa but also at the area in between which are recommended as preferred study site according to the ESCD guidelines (13).

The results show that it is essential

- (1) to point out the exact position of the test area at the volar forearm in study reports and
- (2) to randomize the irritation areas at the volar forearm if different treatments are to be compared.

Future work and test ideas as to the underlying mechanisms will have to develop.

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