Sensitive skin: correlation with skin surface microrelief appearance

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Background/purpose: Sensitive skin has been defined as a condition associated with reduced cutaneous tolerance to environmental factors such as cold, heat and wind, and/or frequent or prolonged applications of some topical products, such as cosmetics. The clinical manifestations consist mainly in neuro-sensory symptoms, such as discomfort, itching, stinging and burning, and may include erythema and scaling; since generally no clinical sign is evident on the skin, the manifestations do not meet the criteria for contact dermatitis. The most frequently affected part of the body is the face, especially the nasolabial folds (1). The stinging test, which consists in the application of a 10% lactic acid solution onto the nasolabial fold, is generally accepted as an objective test of skin sensitivity (1, 2). The pathophysiology of skin sensitivity has not been fully elucidated. Studies have suggested that it is because of skin barrier impairment and of a tendency to overreact to topical agents associated with heightened neuro-sensory response (3). Few epidemiological studies have been carried out on skin sensitivity. An epidemiological study based on self-assessment questionnaires in the UK suggested that nearly half the general population has sensitive skin (4). However, self-assessment is not always an accurate parameter for categorizing skin as sensitive or non-sensitive (3). The objective of our study was to find probable correlation between intensity of skin sensitivity to lactic acid test and a parameter related to skin integrity: irregularity of skin surface microrelief, expressed as the irregularity skin index (ISI).

Methods:

During an epidemiological survey conducted for a campaign promoted by International Society of Plastic Dermatology in Italy, 243 adult healthy subjects of both sexes with no evident dermatological disorder but positive to the lactic acid stinging test, were submitted to cyanoacrylate stratum corneum stripping from the volar forearm for the determination of the irregularity of the skin surface microrelief (irregularity skin index (ISI)).

Results: A significant correlation was found between intensity of symptoms in stingers and ISI ($r_s = -0.47; P<0.001$).

Conclusion: Sensitive skin is common in the healthy population. ISI can contribute towards the identification of subjects with sensitive skin and the development of more specific skin treatments for this prevalent condition.

Key words: sensitive skin – fast Fourier transform – microrelief – skin surface properties

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emic disorders; any dermatological disorders; surgery in the past year; cosmetic treatment (peeling, biomaterial implant, laser) in the last year; ongoing pharmacological treatment.

**Stinging test**

The lactic acid test was carried out applying the solution onto the nasolabial fold and asking the subjects whether they perceived any local reaction after about 3 min, according to the method described by Issachar et al. (2). Subjects who did not report any local reaction were classified as ‘non-stingers’, whereas those who reported slight discomfort, burning or stinging were classified as ‘stingers’ and included in the study. Intensity of referred symptoms was scored from 0 (= absent) to 3 (= very intense).

**Stratum corneum stripping**

Stripping was carried out in the middle of the volar forearm only on one side. Three drops of cyanoacrylate were put onto a microscope slide. After 30 s the slide was placed onto the skin for 60 s, so that the substance could get dry, exerting constant pressure onto the slide to prevent the formation of air bubbles. The slide was then pulled off the skin starting from one of its extremities. In this way a sample of stratum corneum remained stuck on the central part of the slide, which was to be identified by the initials and consecutive study number of the patient written in indelible ink. The slide was then to be put into the provided container and kept for subsequent examination. Any residues of cyanoacrylate were removed with cotton wool soaked in a small quantity of pure acetone.

**Image analysis of stripping**

The slides obtained were examined by means of the computer-assisted fast Fourier transform (FFT) to determine microrelief irregularity (5). The acquisition of the images was performed using a stereomicroscope connected to an analogic video-camera. In order to ensure the reproducibility and comparability of data, the acquisition was carried out in standardized conditions in terms of camera model and setting, magnification (8X), distance, intensity and incidence of illumination and environmental darkness. An example of the acquired image is provided in Fig. 1. FFT of the image of the skin surface microrelief (Fig. 2) was evaluated by means of the mean values of gray obtained along the abscissa and the ordinate: ISI\textsubscript{xx} and ISI\textsubscript{yy} (ISI of ox-axis and oy-axis) are the integrals of the areas defined by the two curves derived from pixel distribution along the ox and oy axes.

**Statistical analysis**

Descriptive statistics (mean ± SD) related to the main features of the study population were provided. The correlation of ISI (ox and oy) with intensity of stinging was calculated by means of Spearman coefficient (r\textsubscript{s}).

**Results**

**Subjects**

Two hundred and forty-three adult informed subjects, age range 18–73 (average: 39 ± 12) years,
of both sexes who appeared to be healthy but positive to the lactic acid stinging test, were observed. Their phototype (according to Fitzpatrick classification) was usually III (59.7%) or II (23.1%); phototypes IV and I were less common (12.2% and 4.5%, respectively). The remaining types were rare (0.5%). Approximately half of the subjects reported that their skin was sensitive to wind/cold, changes in temperature, small trauma or rubbing and emotions. The intensity of stinging was found to be inversely correlated with the age of the subjects ($r_s = -0.91, P<0.001$).

**Analysis of skin surface regularity**

In the stinger subjects a significant correlation was found between intensity of symptoms (in ascending order: discomfort, itching and burning) following chemical stimulation with lactic acid and ISI ($r_s = 0.46; P<0.001$). This means that regularity of skin surface microrelief diminished as the intensity of the reaction to lactic acid increased (Fig. 3).

**Discussion**

To our knowledge, relatively few studies have been carried out on skin sensitivity in which an objective definition such as ours based on the lactic acid test, has been used. An issue that has been extensively debated is the biological basis of the stinging phenomenon, which could be because of an increased neuronal response to irritants, to a structural alteration of the skin or a mixture of both of these factors (4, 6). Recent evidence suggests that damage to the epidermal barrier is a major factor that contributes towards an increased neurosensory response in stingers (3). Although a certain degree of correlation was found between the stinging phenomenon and objective, non-invasive skin measurements, such as trans-epidermal water loss, electrical capacitance and pH, none of these can be considered to be of predictive value for sensitive skin (7, 8). Our study shows that stinging intensity was closely correlated to the extent of irregularity of skin surface microrelief. The only problem of interpretation of data could arise from previously found correlations between age and ISI on one side and age and intensity of stinging on the other. With aging, ISI tends to increase slightly while intensity of stinging tends to a very important decrease: considering that ISI also increases with intensity of symptoms, the two findings seem to be conflicting. Effectively, reduction of intensity of stinging with age does not imply changes in the ISI, at least as a direct consequence. These correlations are simply because of the fact that both measured parameters are independently linked to age. Nevertheless, our study of microrelief irregularity offers a clear-cut (albeit still insufficient in terms of predictivity) correlation between the subjective phenomenon and skin parameters. The combination of various methods of investigation, including computerized image analysis, as well as the assessment of electrical and chemical properties of skin surface could contribute towards improving the identification of subjects with a sensitive skin and towards setting up more specific skin treatments dedicated to this prevalent phenomenon.

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