

Psychological Predictors of Pruritus during Mental Stress

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Experimentally-induced mental stress activates the psychoneuroendocrine systems. The cutaneous (itch and flare) responses of human skin to intradermal injection of histamine remain despite this unaltered. Major interindividual differences, however, exist in both neurophysiological reactions and cutaneous reactivity. The *individual* skin responses are interrelated to the urinary adrenaline response pattern. Psychosomatic status and psychosocial factors were in this study observed to be good predictors of skin responsiveness assessed by a multivariate model. We suggest that future studies on stress and pruritus should take these aspects into consideration. Knowledge of individual characteristics and coping strategies might help us understand why some patients suffer from itching in response to stress while others do not. (Received April 12, 1985.)

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We have previously reported that exposure to mental stressors under experimental circumstances activates the psychoneuroendocrine systems (1) without any effects on cutaneous responsiveness to intradermal injection of histamine in a *group* of healthy volunteers (2). *Interindividual* differences, however, were pronounced and partly related to the urinary adrenaline response pattern, i.e. adrenaline appeared to have a depressive effect on itch and an enhancing effect on flare responses (2). We have also shown that psychosocial factors and neurotic character traits may explain major interindividual differences in stress-induced neurophysiological reactions (3). The aim with the present study was therefore to assess putative influences of psychosocial factors, personality characters and psychosomatic status on cutaneous itch and flare reactions induced by intradermal injection of histamine during mental stressor exposure.

MATERIAL AND METHODS

Subjects

Ten healthy volunteers, aged 23-42 years, median age 30.5 years, participated in this study, which was approved by the ethical committee of the Karolinska Hospital. The subjects were instructed not to take drugs known to interfere with the experimental procedure, such as aspirin, antihistamines and sedatives (orally) and steroid creams (locally) for one week prior to the experiment. Alcoholic beverages were not allowed for 24 hours prior to the investigation. Each subject refrained from smoking, coffee, tea and chocolate on the day of the study. Breakfast was completed at home before 09.00 a.m. None of the subjects were colour blind or had been involved in a similar experiment previously.

Experimental design

The subjects reported to the laboratory no later than 10 a.m. A short indwelling catheter was inserted into an antecubital vein. Pulse rate was recorded by a photocell plethysmograph (Sanyo pulse meter, model HMR 100E) placed on one earlobe. A pre-stress period of approximately 50 min, in order to control surges in growth hormone secretion induced by venopuncture, was followed by a relaxation period of 40 min (control period).

During the control period the subjects listened to a relaxation tape (a Swedish modification of Jacobsen's relaxation procedure). The subjects were thereafter exposed to two types of mental stressors for 50 min, and were then followed for another 40 min during the recovery phase.

Stressor exposure

Two stressors were used, a colour word conflict test (CWT) and a mental arithmetic problem.

1. The CWT-test is a visual-audial conflict test based on the "Stroop test" (4). The filmed version was run for 40 min. The subjects heard a voice from an accompanying sound tape reading out one of four colour adjectives (red, blue, green or yellow) in a randomized order. The voice accompanied a colour adjective word written in one of these colours shown at random on a screen. Each stimulus was presented randomly for 0.4-1.0 sec with an interval of 0.8-1.7 sec. The subjects were requested to respond to the *colour* of the print regardless of the conflicting meaning of the word and the message of the voice. To fill out a questionnaire correctly, with all alternatives presented arbitrarily, is usually under such circumstances experienced as stressful.

2. The second stressor consisted of a forced arithmetic problem administered during a 10 min period. The subjects were instructed to subtract the number 17 continuously from 1194 during the limited time available. The answers were marked on printed forms.

The stressor exposure period was preceded and followed by psychological, physiological and biochemical observations, as well as evaluation of skin reactivity to histamine.

Psychological observations

Questionnaires utilized concerned the previous week's, as well as present psychological, somatic and psychosomatic well-being. Furthermore, degrees of feelings of fatigue, wakefulness, boredom, monotony, impatience, irritation, tension, concentration, thirst, hunger, relaxation, interest in, and degree of amusement in the test, as well as perceived stressfulness were estimated. Answers were given on graphic scales (100 mm), with end points "0" and "100" representing e.g. "not at all stressed" and "very stressed". Distance in mm from the lower (0) point was used for scoring the answers in the graphic scales. Furthermore, subjects were instructed to fill out the following scales:

1. Eysenck's short questionnaire for the measurement of two dimensions of personality (5), i.e. degrees of extrovertness and neuroticism.
2. World Health Organization collaborative study on strategies for extending mental health care: Instrument 2 (General Health Questionnaire). This test is a widely used measurement of the existence of somatic, psychological and psychosomatic complaints. Furthermore, the subject's view of themselves is assessed. Existence of psychotic symptoms is roughly investigated by the scale.
3. Beck's Hopelessness Scale, consisting of 20 questions regarding the subject's view of their future (6). The answers were dichotomized and were scored 1 (no) and 2 (yes).

Physiological and biochemical observations

Pulse rate, systolic and diastolic blood pressure were recorded. Blood was collected through an indwelling catheter for later biochemical determination of cortisol, growth hormone (GH), prolactin, progesterone, triglycerides, cholesterol, HDL-cholesterol, glucose, ASAT, ALAT, gammaglutamyl-transferase (GGT), HbA_{1c}, hematocrite and creatinine. Subjects also voided into specially prepared bottles for later determination of catecholamines (adrenaline, noradrenaline, dopamine), cortisol and creatinine. For methods utilized, see (1).

Intradermal tests

Pruritus was induced in a single blind procedure by intradermal injection of 0.01 ml of histamine hydrochloride (ACO, Solna, Sweden), 10 µg/ml. The lateral aspect of the upper arms was used. Itch duration was registered. The concomitant flare was outlined after 5 min on the skin with a marking pen and traced onto a transparent plastic film where its size was measured planimetrically. The skin responses were investigated both immediately before and immediately after the mental stressor exposure.

Statistical analysis

Statistical analysis regarding possible influence of psychosocial factors in predicting skin reactivity to histamine as well as on neuroendocrine stress reactions was completed with multiple stepwise regression analysis (BMDP2R). Levels of physiological variables prior to stressor exposure were thereby subtracted from corresponding levels following stressor exposure in order to illustrate dynamic events. Thus, e.g. Δ -pruritus signifies itch duration after minus itch duration before stressor exposure. Significance level was set to $p < 0.05$.

RESULTS

Psychological scales

No statistical changes were noticed between data prior to and following stressor exposure regarding feelings of fatigue, wakefulness, boredom, monotony, impatience, irritation, tension, concentration, thirst, hunger, relaxation, interest in, and degree of amusement in the test as well as of perceived stressfulness. The following data, mean \pm SD (range), for selected Δ -variables were found: feelings of moodiness during stressor exposure (graphic scale, 100 mm) 8.88 ± 8.54 (2.2–28.0), feelings of tediousness during stressor exposure (graphic scale, 100 mm) 35.89 ± 30.11 (1.0–75.0), feelings of control of the experimental stress situation (graphic scale, 100 mm) 45.33 ± 21.77 (15.0–92.0), feelings of being pressured for time during the experiment (graphic scale, 100 mm) 68.44 ± 21.26 (45.0–100.0). The following data were also observed: Eysenck's questionnaire-dimension for extroversion 3.44 ± 1.23 (2.0–6.0), dimension for neuroticism 2.33 ± 1.32 (0.0–4.0), General Health Questionnaire 1.55 ± 1.81 (0.0–5.0) and Beck's Hopelessness Scale 5.33 ± 1.41 (3.0–7.0).

Neurophysiological reactions

The neurophysiological and cutaneous reactions to stressor exposure have been presented in detail elsewhere (1, 2). To summarize: pulse rate, blood pressure, plasma glucose and urinary excretion of adrenaline increased, while prolactin and urinary excretion of cortisol decreased. Skin responsiveness to intradermal injection of histamine remained uninfluenced. Expressed as Δ -variables, i.e. data prior to stressor exposure subtracted from data following stressor exposure, the following observations of selected parameters, mean \pm SEM (range), were found: Δ -pulse rate 6.10 ± 3.19 (–6.0–20.0) bpm, Δ -systolic blood pressure 10.50 ± 1.89 (0.0–20.0) mmHg, Δ -diastolic blood pressure 3.50 ± 1.67 (–5.0–10.0) mmHg, Δ -serum prolactin -1.00 ± 0.42 (–3.0–1.0) $\mu\text{g/l}$, Δ -serum glucose 0.41 ± 0.13 (–0.3–1.1) mmol/l, Δ -serum growth hormone -0.10 ± 3.83 (–27.9–21.9) ng/l (NS), Δ -urinary adrenaline 0.98 ± 0.56 (–1.79–4.48) nmol/mmol creatinine, Δ -urinary noradrenaline 0.54 ± 1.19 (–3.47–7.63) nmol/mmol creatinine (NS), Δ -urinary cortisol -7.27 ± 3.89 (–30.4–6.8) nmol/mmol creatinine, Δ -pruritus 8.50 ± 22.18 (–118.0–120.0) sec (NS) and Δ -flare 112.70 ± 117.79 (–412.0–952.0) mm^2 (NS).

Psychological predictors of cutaneous reactions

The results are presented in Table I. Thus, 55% of variance in Δ -pruritus is explained by degrees of stress-induced moody feelings. Stressor influence on Δ -flare is explained to 39% by psychosomatic status evaluated in the general health questionnaire. If three additional questions regarding feelings related to the test situation were included in the analysis, 91% of the variance was explained.

Physiological influences on cutaneous reactions

Stressor influence on urinary excretion of adrenaline was negatively correlated to Δ -pruritus, $r = -0.60$, $p < 0.05$, and positively to Δ -flare, $r = 0.64$, $p < 0.05$. Δ -pulse rate correlated positively with Δ -flare, $r = 0.67$, $p < 0.05$. More data on physiological relationships are presented in ref. (2, 3).

DISCUSSION

There is impressive evidence both clinically and experimentally that pruritus is influenced by mental stress (cf. 7, 8, 9, 10). Major individual differences, however, do exist. One important factor in understanding these differences may be that both itch mediating and itch modulating systems are activated (cf. 2). The more precise mechanisms involved,

however, remain to be elucidated. The aim with the present study was not to explore this interesting field but to evaluate the influence of some psychosocial factors, psychosomatic status and personality traits on skin responsiveness to a pruritic stimulus. Knowledge of individual characteristics in these respects may help us in understanding why some people report more itching in response to stress while others do not.

We have previously shown that individual factors reflecting opinions of the experimental situation as well as personality traits seem to be fairly good predictors of stress-induced neuroendocrine responses (3). Psychosocial factors are therefore likely to have a role in itch perception as well. This field remains to be further explored since hitherto "numerous studies in this field have resulted in little more than conflicting theories" (11). Repressed emotions, conditioning scratch reflexes and personality traits are examples of what have been discussed. The old problem of whether such factors are interrelated or causal also remains unsolved.

We could in this study observe that psychosocial factors were of importance in explaining major individual differences in cutaneous (itch and flare) responses to intradermal injection of the itch eliciting substance histamine. Thus, participants' feelings regarding the test situation, as well as psychosomatic status correlated to the experimental outcome. Δ -pruritus was thus more pronounced in subjects experiencing moodiness and Δ -flare in those experiencing control of the experimental situation during stressor exposure, as well as in participants with higher scores in the General Health Questionnaire while Δ -flare was less pronounced in subjects experiencing tediousness and pressure for time. Reported feelings of stressfulness did not contribute to explain the individual differences. Our findings clearly indicate that, although skin reactivity and urinary adrenaline excretion patterns during stress are interrelated, psychosomatic well-being and psychosocial factors are of great importance in determination of the cutaneous responses. This is in line with studies regarding psychological mediators of neuroendocrine responses elicited by psychosocial stress (12). Although much remains to be learned about the basic mechanisms

Table I. Psychosocial predictors of Δ -pruritus and Δ -flare

– denotes negative relationships

Cutaneous reaction (Dependent variable)	Independent variables	Multiple			Step no.
		R	R square	F	
Δ -pruritus	Did you feel moody during the stressor exposure? (graphic scale)	0.78	0.55	10.99	1
Δ -flare	General Health Questionnaire (raw scores)	0.68	0.39	6.23	1
	Did you find the stressor exposure tedious? (graphic scale) (–)	0.85	0.63	5.65	2
	Did you feel in control of the experimental stress situation? (graphic scale)	0.92	0.77	4.75	3
	Did you feel pressed for time during the stressor exposure? (graphic scale) (–)	0.97	0.91	8.30	4

involved, our findings suggest that psychosomatic status and psychological factors should be incorporated in future studies on this topic.

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