Biogenic Amines Vol. 25, issue 1 (2011), pp. 34–41
BIA250111A01

Psychophysiological stress profile: a protocol to differentiate normal vs pathological subjects

Reprinted from: Activitas Nervosa Superior Rediviva 2010; **52**(4): 241–245.

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Key words: psychophysiology; assessment; stress; psychopathology; heat rate

Abstract

Psychophysiological stress profile examination is useful to quantify the level of individual stress reactivity. The aim of this study is to find differences between healthy subjects and subjects with psychopathological features. We have recruited 20 healthy subjects, aged between 25 and 40 years. Subjects with a history of psychopathological episodes, epilepsy, head injuries, drug abuse were excluded. This group was compared with one group of subjects with Major Depressive Disorder (MD), one with Panic Attack Disorder (PAD) and one with Obsessive Compulsive Disorder (OCD). Assessment of the psychophysiological stress profile was performed while the participants underwent a stress test, and included the simultaneous recording of the following variables: electrodermal activity, heart rate, surface electromyogram. The schedule of the stressors was: 2 minutes baseline, tactile stimulus, visual stimulation, painful stimulus, mental calculation, hyperpnoea. The total length of the profile was 30 minutes. For each variable, baseline, max value and mean value of the session were calculated and then compared across groups. Our study shows that healthy subjects present different profile compared to pathological subjects. These preliminary results suggest that our model is able to measure differences between healthy and pathological subjects. Therefore, it could represent a tool for the assessment of the patient, orienting the aims of the succeeding psychotherapy.

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Abbreviations:
MD – major depressive disorder
PAD – panic attack disorder
OCD – obsessive compulsive disorder
PD – personality disorder
PSP – psychophysiological stress profile
EMG – elctromiogram
GSR – galvanic skin response
HR – heart rate

INTRODUCTION

Psychophysiological stress profile (PSP) is a tool which allows the evaluation of the neurovegetative physiological trend (Stern *et al.* 2001; Cacioppo *et al.* 2000). Usually, PSP is assessed during periods of rest and cognitive or perceptual tasks, in order to understand the state of the autonomic nervous system and its responses to environmental stimuli (Hatch & Saito 1990). In the laboratory, the delivery of the experimental stimuli is adopted to understand the patient's condition, with or without environmental requirements, in a way which is comparable among subjects.

Here, we want to describe a psychophysiological stress profile protocol and its application to healthy and psychopathological subjects, in order to show differences between them. The main aim of this work is to evaluate the possibility of using PSP as an objective tool to understand the patient's condition (Diaz *et al.* 2003), which might complement subjective data routinely collected in clinical practice via questionnaires. It's common experience to discover psychophysiological dynamics (Schwartz 1999) discordant to what the patient describe: patients telling quietness while are psychophysiologically stressed or patients organically relaxed but describing themselves as strongly stressed.

If the usefulness of such a tool were demonstrated, it could be employed to guide the therapist, possibly maximizing the treatment efficiency.

It would be possible to understand better the real pathological state (Pruneti & Boem 1995; Clements & Turpin 2000); consequently, treatment follows right aims easier, sharable with the patient and with the scientific community.

Biofeedback monitoring tools are nowadays getting technically easier to use and also less expensive, and could therefore be widely adopted to obtain a more complete profile of the patient.

MATERIALS AND METHODS

We have recruited 20 subjects without psychological diagnosis, aged between 25 and 40 years, mean age 30 ± 4.35. Subjects with a history of psychopathological episodes, epilepsy, head injuries, drug abuse were excluded.

We have also recruited 20 pathological subjects, with the following diagnosis and before starting any subsequent therapy (pharmacological o psychological): Major Depressive Disorder (MD, n=5, mean age 37.0 ± 4.90), Panic Attack Disorder (PAD, n=5, mean age 32.60 ± 2.79) (Alpers 2009), Obsessive Compulsive Disorder (OCD, n=5, mean age 34.2 ± 10.78), Personality Diseases (PD, n=5, mean age of 36 ± 8.68).

Assessment of the psychophysiological stress profile (American Psychological Association 1993) was performed while the participants underwent a stress test, according to the following protocol: 2 minutes baseline, tactile stimulus (a soft single tip of the right forearm), 1 minute without stimuli, threat stimulus (i.e. presentation of a dangerous object, such as a nail, with the information that the operator is going to use it to hurt the subject), 1 minute rest, painful stimulus (touching the subject with an needle), 1 minute rest, mental calculation (serial subtraction of the number 17 from the number 1013) for two minutes, 1 minute rest, hyperpnea (fast breathing) for 2 minutes.

Assessment of the psychophysiological stress profile (Schwartz & Andrasik 2003) included the simultaneous recording of the following variables: electrodermal activity (GSR), heart rate (HR), electromyogram surface (EMG) (Figure 1). Autonomic measures were collected using Psycholab VD13S (Satem, Rome).

EMG was acquired thanks to electrodes placed on the forehead, GSR with electrodes golden covered on the fingerprints of the dominant hand, heart rate with electrodes placed on the wrist.

The first aim of the present study was to evaluate whether psychophysiological stress profile could differentiate the healthy controls from all pathological subjects (pathological group).

Since our data were not normally distributed and given the relatively small size of our sample we used non-parametric statistics.

To this end, the Mann-Whitney test was used to compare across groups each of the autonomic measures independently. Then, we looked at differences between healthy subjects and each subgroups of patients, by using "subgroup"

Tab. 1. Summary of variables significantly different between groups crossing one with all the others.

	GSR baseline	GSR tactile	HR baseline	HR tactile	HR visual	HR painful	HR mental calculation	HR hyperipnoea	HR global mean value
Chi-square	9.591	11.444	19.785	21.175	19.831	26.137	12.293	15.255	22.183
p-value	0.048	0.022	0.001	<0.001	0.001	<0.001	0.015	0.004	<0.001

Tab. 2. Summary of variables significantly different between healthy and personality disease group.

	HR baseline	HR tactile	HR visual	HR painful	HR global mean value
Chi-square	12.000	10.500	12.500	6.000	4.000
p-value	0.007	0.005	0.008	0.001	<0.001

Tab. 3. Summary of variables significantly different between healthy and OCD group.

	HR baseline	HR tactile	HR visual	HR painful	HR global mean value
Chi-square	20.000	14.000	17.000	11.500	16.500
p-value	0.040	0.012	0.022	0.006	0.020

Tab. 4. Summary of variables significantly different between healthy and depressed group.

	EMG visual	HR baseline	HR tactile	HR visual	HR painful	HR mental calculation	HR hyperipnoea	HR global mean value	HR tactile
Chi-square	9.000	5.000	4.500	5.000	0.000	13.000	6.000	5.000	4.500
p-value	0.003	0.001	0.001	0.001	<0.001	0.009	0.001	0.001	0.001

Tab. 5. Summary of GSR variables significantly different between healthy and PAD group.

	GSR baseline	GSR tactile	GSR visual	GSR mental calculation	GSR hyperipnoea	GSR global mean value
Chi-square	13.000	9.000	10.000	13.000	14.000	12.000
p-value	0.009	0.003	0.004	0.009	0.011	0.007

Tab. 6. Summary of HR variables significantly different between healthy and PAD group.

	HR baseline	HR tactile	HR visual	HR painful	HR mental calculation	HR hyperipnoea	HR global mean value	HR baseline
Chi-square	7.000	7.500	6.500	4.000	12.500	12.500	7.000	7.000
p-value	0.001	0.002	0.001	<0.001	0.008	0.008	0.001	0.001

(healthy, PAD, OCD…) as between subject factor. In this case, the Kruskal-Wallis test was used to compare all measurements across groups.

All statistical analysis were performed with SPSS, using an alpha value of 0.05.

RESULTS

Firstly, we have looked if each group could be different from all the others. We discovered differences at baseline for both GSR and HR, as well as visual, painful, mental calculation stimuli for HR (Table 1).

Secondly, we have compared healthy controls *vs* pathological subjects (Hoehn-Saric & McLeod 1988). We observed differences in GSR channel: baseline and visual, painful and calculation stimuli. GSR baseline normal value was 8.2 μS, mean value of pathological group was 12.73 μS.

In HR channel differences were observed in all the variables measured. HR baseline value of healthy group was 72.5 bites per minute (bpm); pathological mean value 89.5 bpm.

About EMG channel, differences about visual, painful and hyperipnea were significant.

Then, we proceeded with the following comparisons.

Healthy subjects were different from PD in all HR values, but mental calculation and hyperipnea (Table 2). Particularly PD group had HR baseline value of 87.6 μS. The same pattern (Table 3) was found in healthy *vs* OCD comparison (Zahn *et al.* 1996).

All HR values and visual stimulus in EMG were different in MD compared to healthy subjects. Mean value during baseline of MD group was 94 bpm (Table 4).

PAD shows different GSR and HR ($p<0.01$) pattern (Tables 5 and 6) compared with healthy sample (Spira *et al.* 2004; Freedman *et al.* 1984).

Subjects with PD are similar to subjects with OCD. Again, PD group show a quite similar pattern with MD. Otherwise PD is different from PAD only about GSR baseline and tactile stimulus.

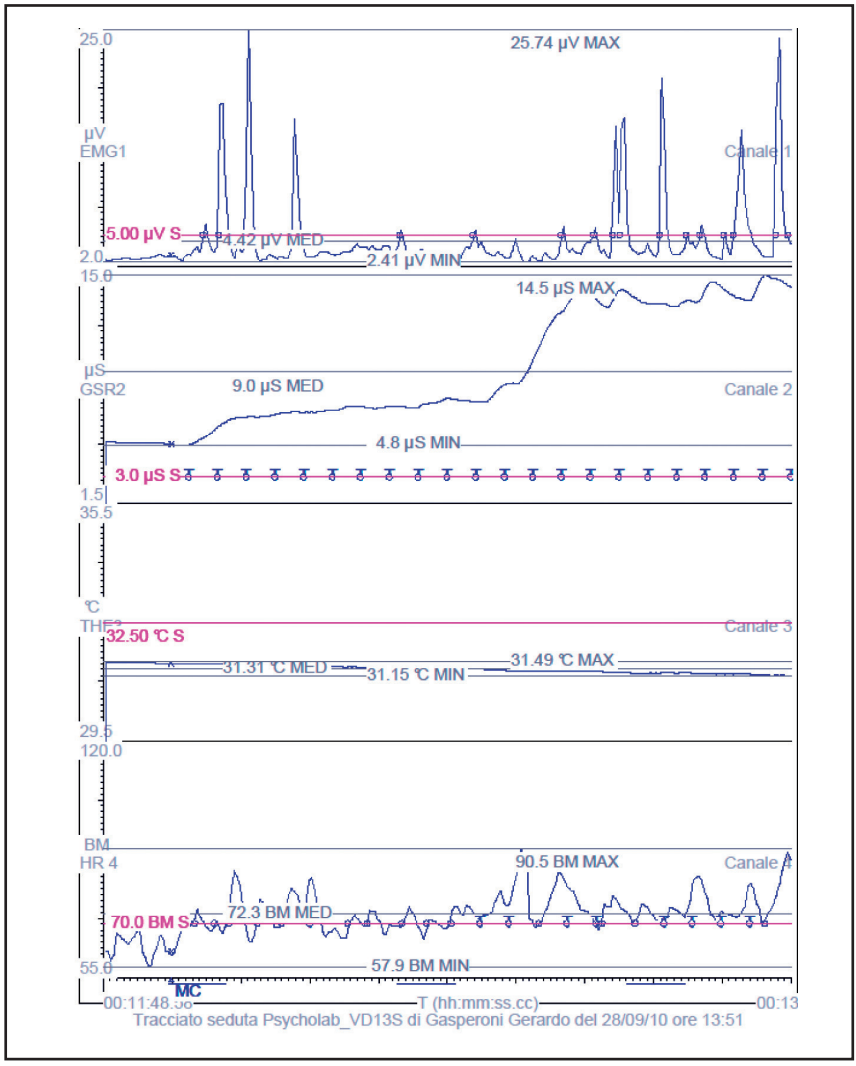

Fig. 1. On line display of the psychophysiological trend. On the first stripe Electromiogram (EMG) measured in µV; on the second one, skin conductance in µS; on the third peripheral temperature in Celsius and on the fourth the heart rate. At the bottom, MC means the start point of the stressor, i.e. mental subtraction.

OCD *vs* MD are different only in GSR and HR painful stimulus, so giving substantially a similar profile. OCD *vs* PAD are different in GSR tactile and painful stimuli. More interesting is the global mean value of the assessment, significantly different in these two groups.

Depressed *vs* PAD didn't seem significantly different.

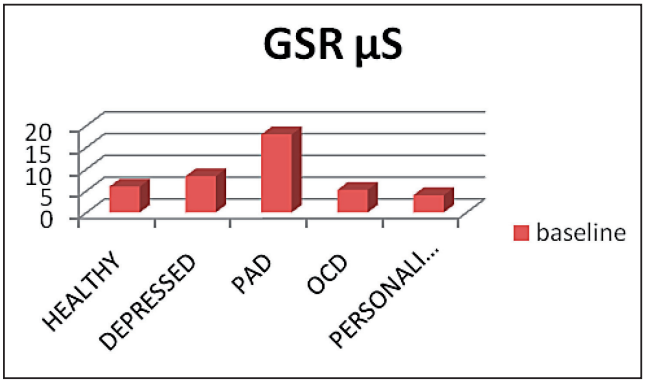

Fig. 2. On line display of the psychophysiological trend.On the first stripe Electromiogram (EMG) measured in µV; on the second one, skin conductance in µS; on the third peripheral temperature in Celsius and on the fourth the heart rate. At the bottom, MC means the start point of the stressor, i.e. mental subtraction.

DISCUSSION

Our data show as general index differentiating healthy subjects from patients: HR values included in the protocol and HR and GSR baseline. It means that simply recording the psychophysiological variables considered at rest, we could acquire data about the presence of a possible pathological condition.

So, healthy sample is different from the pathological one about HR channel. Looking at specific pasychopathologies, PAD is also different about GSR baseline (Figure 2). It seems that skin conductance pattern mainly describe people suffering from PAD.

Data describe as similar patients with OCD and depressed patients. This evidence could support neurophysiological knowledge and epidemiology, where OCD is frequently associated with depression (Sobin *et al.* 1999). Instead, a different picture appears between OCD and PAD patients.

We can consider this assessment tool as useful in psychological clinical practice, firstly during diagnostic process and then monitoring treatment evolution (La Vaque *et al.* 2002; Jacobson & Truax 1992). Cost effectiveness balance is clinically good, requiring una tantum session.

ACKNOWLEDGMENTS

We thank Dr. Marco Loggia for helpful comments to the manuscripts.

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