694

SYMPATHETIC SKIN RESPONSE AND R-R INTERVAL IN SIMULATED MICROGRAVITY

De Bartolo M.[1,2], Saltuari L.[2], Prevec T.[3], Willeit J.[2], Gerstenbrand F.[2], Bramanti P.[1]

[1] Centro per lo Studio ed il Trattamento dei Neurolesi Lungodegenti, Cattedra di Neurofisiopatologia, University of Messina
[2] Department of Neurology, University of Innsbruck, Austria
[3] Institute of Clinical Neurophisiology, University Medical Centre, Ljubljana, Slovenia

Abstract

The study of sympathetic skin response (SSR) associated with the RR interval variation (RRIV) was carried out on a group of 8 healthy volunteers. The evaluation of variations of electrophysiological parameters regarding the autonomous nervous system (ANS) was carried out for 10 days in conditions of simulated microgravity.

Keywords: SSR, RRIV, Simulated microgravity

Runnig title: sympathetic skin response and R-R interval in the simulated microgravity

Reprint request to: Dr. Matteo De Bartolo, Università degli Studi di Messina, Centro per lo studio ed il trattamento dei neurolesi lungodegenti, via Provinciale Palermo, ctr. Casazza, 98124 Messina, Italy

Introduction

Neurophysiological changes in man in the absence of gravity constitute an experimental clinical model of extreme interest. Various electrophysiological and biochemical studies have shown similarities between the changes caused by real or simulated microgravity and bedrest syndrome. This term refers to a clinical syndrome characterized by lesion of the peripheric nervous system with widespread atrophy which affects all subjects who are confined to bed for long periods (1-4). At the neurological Institute of Innsbruck it is possible to simulate microgravity using an experimental immersion pool covered by a plastic sheet. The subject examined did not sink but remained completely immobile for the whole period of immersion and had the impression of being suspended. The study of sympathetic skin response (SSR) related to the variation R-R interval (RRIV) was carried out in 8 volunteers. The aim of this work was to obtain the modification of ANS in a simulated microgravity for different lengths of time.

Patients and methods

We studied 8 healthy male volunteers between the ages of 20 and 30 (mean 25.25). There was also a control group. Each subject, after a neurological examination to evaluate his integrity, was subjected to daily SSR study and subsequently to that of RRIV.

The first group spent three days and nights in bed as an adjustment period followed by three days and nights in the immersion tank. The second group spent five days and nights in bed as an adjustment period followed by five days and nights immersion. We examined two separate groups to establish an early response gradient with these simulated microgravity and the bedrest condition are valid.

The room temperature was 26-28 ˉC and temperature of the palm of the hand 33-34 ˉC. During immersion the pool temperature was 34-35 ˉC. To study the SSR, active adhesive electrodes were placed on the palm of the hand and on the sole of the left foot. We employed electrical stimulation to the controlateral median nerve, in correspondence with the pulse, using single impulses of 0.1 ms, with 20 ms intervals between the impulses.

The intensity of the stimulus was regulated according to the motor response visible from the movement of the thumb. The technical characteristics were as follows: sensitivity 500 uV, LF 0,1 Hz, HF 1 KHz, Reap Rate pps 0.1, Sweep speed 10 ms. The latency was measured from the beginning of the stimulus until the appearance of the deflection of the response from the baseline. The measurement of the amplitude was measured from peak to peak of the response waves.

The study of the RRIV was carried out on subjects in a supine position. The recordings were made using normal adhesive electrodes of which one was placed at the centrum cordis and the other at the 5th left intercostal space. We used the following parameters: sensitivity 200 uV, LF 20 Hz, HF 10 KHz, Sweep speed 2 s.

In the first phase 20 EKGs were recorded at rest; the subjects were asked to breathe normally.

In the second phase the EKGs were recorded when the subjects were asked to hyperventilate a pause of ten seconds and then exsufflation. With the formula RRIV = a/b x 100 we calculated the percentage of the variation of the R-R interval (5-7).

The recordings were carried out on Medelech Sapphire apparatus.

Results

The RRIV were normal for all parameters, both during rest and during hyperventilation.

With regard to the study of SSR, we noted that the response was present in all subjects throughout testing. Being only a preliminary study we will limit ourself to pointing out a modification of the amplitude on the fifth day of immersion, even if this is not statistically significant (N.S.).

Conclusion

The SSR is a multisynaptic response, mediated by the activity of the sweat glands. In the formation of this reflex, central and peripheral factors were involved. Among these the limbic system, hypothalamus, hippocampus, fornix, locus caeruleus, the frontal area. In all probability these have a facilitatory effect on electrodermic activity of the sweat glands via pregangliar and postgangliar fibres (8). A method for evaluating the vagal parasympathetic function is given by the test for the percentage measurement of the variation of the RRIV. The autonomic distal function can be evaluated with the use of the SSR which quantifies the sweat producing activity of the skin and therefore indirectly allows us to evaluate the integrity of the pregangliar and postgangliar fibres (9-10). Therefore we can state that, the activity of the sympathetic fibres, apart from being analysed directly by microneurographical tests (11), can also be studied indirectly by observing the activity of certain effector organs innervated by these fibres. The purpose of our studies, was to establish if, after various exposure periods, indirect modifications due to the ANS were noted. We used simple methods and the time value was the only variable. It emerges from our results that in immersion simulated microgravity the ANS does not produce any statistically significant modification, even if on the fifth day of immersion the amplitude value for the hand decreases with respect to the bedrest model. It is necessary to continue this study by prolonging the immersion periods in order to demonstrate the validity of the methods used in the above mentioned experimental conditions.

References

ELIE B., GUIHENEUC P.: *Sympathetic skin response: normal results in different experimental conditions.* Electroenceph Clin Neurophisiol 1990;76:258-267.

FAGIUS J., WALLIN B.G.: *Sympathetic reflex latencies and conduction velocities in normal man.* J. Neurol. Sci. 1980;47:433-448.

GREENLEAF J.E., BULBULIAN R., BERNAUER E.M., HASKELL W.L., MOORE T.: *Exercices-training protocols for astronauts in microgravity.* J. Appl. Physiol. 1989;67:2191-2204.

JUVELA S., KASTE M., HILLBOM M.: *The effects of earlier surgery and shorter bedrest on the outcome in patients with subarachnoid haemorrhage.* J. Neurol. Neurosurg Psychiatry 1989;52:776-777.

LAYNE C.S., SPOONER B.S.: *EMG Analysis of human postural responses during parabolic flight microgravity episodes.* Aviat. Space Environ Med 1990; 61:994-998.

LEVY D.M., REID G., ROWLEY D.A., ABRAHAM R.: *Quantitative measures of sympathetic skin response in diabetes: relation to sudomotor and neurological function.* J. Neurol. Neurosurg Psychiatry 1992;5: 902-908.

MANO T., MIWA C., IWASE S., MATSUKAWA T., KOGA K., SUGIYAMA Y., SUZUKI H.: *Microneurographic analysis of sympathetic nerve activity in humans under simulated microgravity.* In: 1° International Workshop Space and Underwater Neurology. Messina-Taormina 23-24 october 1992.

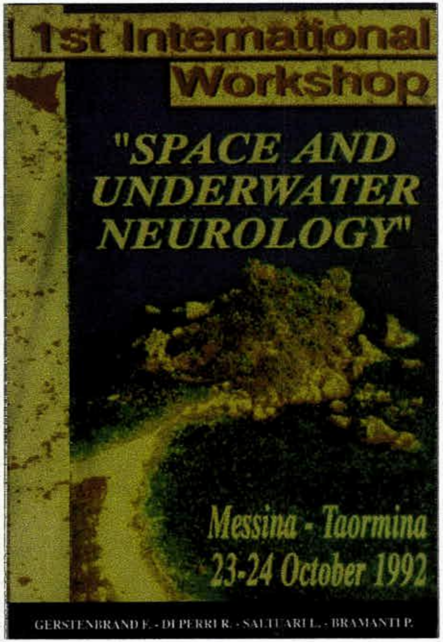
SHAHANI B.T., DAY T.J., CROS D., KHALIL N., KNEEBONE C.S.: *RR Interval variation and the sympathetic skin response in the assessment of autonomic function in peripherial neuropathy.* Arch. Neurol. 1990; 47:659-664.

VAITKUS P.J., JONHSTON K.W., BONDAR R.L., et al.: *Development of methods to analyse transcranial doppler ultrasound signal recorded in microgravity.* Med. Biol. Eng. Comput. 1990; 28:306-308.

VENABLES P.H.: *Autonomic Activity.* In: Window on the brain Neuropsychology's technological frontiers. Ann. N. Y. Acad Sci. Vol. 620.

WATAHIKI Y., BABA M., MATSUNAGA M., TAKEBE K., ONUMA T.: *Sympathetic skin response in diabetic neuropathy.* Electromyogr Clin. Neurophysiol 1989; 29:155-159.

SUMMARY



The pubblication of this book was made possible by the financing of C.N.R. (Centro Nazionale delle Ricerche).

Special thanks to Dr. Tunner and Dr. Marosi.

EDAS - Edizioni Dott. Antonino Sfameni
tel. (090) 67.56.53 / fax (090) 67.91.22
98122 Messina - Via S. Giovanni Bosco, 14