STUDY OF THE PROPRIOCEPTIVE SOMATOSENSORY SYSTEM FUNCTIONS IN SIMULATED MICROGRAVITY: PRELIMINAR STUDY ON 10 HEALTHY VOLUNTEERS

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Abstract

Evoked somatosensory potentials were studied in a group of 10 healthy volunteers subsequent to stimulation of the medial nerve at the wrist and of the tibial posterior nerve at the ankle. The experiments were carried out in conditions of simulated microgravity. "Bed-rest" and "dry water-bed" models were both used. Five days in bed were followed, after an interval of seven days, by another five days' immersion.

The electrophysiological parameters examined were not modified in anyway during our study.

Keywords: Bed-rest condition, dry-waterbed model, simulated microgravity, somatosensory evoked potentials

Introduction

The observable effects of microgravity on man open up possibilities for new research whose aspects still need to be defined (1,2).

Microgravity conditions can be partially simulated for short periods during parabolic flights and for longer periods by "bedrest or water immersion models" (simulated microgravity).

Recent observations have shown the presence of neurological alterations in conditions of simulated microgravity, especially over a long period. These symptoms include impairment of oculomotion, of balance and of cerebellar functions, reduction of muscle tone, deterioration of motor functions, alterations of body schema and of the proprioceptive

system and even the appearance of frontal signs. These symptoms go under the name of Space Motion Sickness (SMS) or Space Adaptation Syndrome (SAS) (3,5,6,7,8,9).

The aim of our study was to analyse the functions of the proprioceptive system (dorsal column - medial lemniscus) in man and to discuss eventual alterations in conditions of simulated microgravity, using both the bed-rest and dry waterbed model.

Materials and methods

In ten healthy male volunteers aged between 26 and 35 years (mean age 29,4 years) somatosensory evoked potentials (SSEP) were recorded both in bed rest condition and in simulated microgravity. The volunteers stayed in anormal anti-bed-sore bed for a five day period, always in supine position. After a seven day interval period they were exposed for another five day period to a dry waterbed condition.

The pool used for this purpose was circular with a 3,5m diameter and one meter depth, resting on the floor and separated by an appropriate insulating material. The pool was always full of water which was continuously changed by a pump and mantained at the constant temperature of 31°C by a termostat. A 2mm thick plastic sheet was placed above water level. The subjects were separated from the plastic sheet by a cotton sheet.

Two volunteers were immersed in the pool at the same time to avoid the occurrence of psychological problems related to the adaptation.

During the daytime the volunteers were allowed to enjoy various recreative activities (reading books, watching movies, etc.). Some of them assumed treatment to relieve the back pain usually related to the experimental conditions.

Somatosensory potentials were evoked by electrical stimulation of the medial nerve at the wrist and of the posterior tibial nerve at the ankle.

The recordings were carried out in both experimental conditions (bed rest and dry waterbed immersion model) on the first, third and fifth days.

Circular Ag-AgCl electrodes were used. Nerve action potentials (NAP) were recorded at the brachial plexus (Erb-point), and at the posterior tibial nerve in the poplitea fossa. Spinal evoked potentials (SpEP) of the cervical and the lumbal spinal cord (at the level of C7 and respectively L1), and cerebral evoked potentials above the respective primary cortical

somatosensory region (CEP) (4,10) were carried out during stimulation of the medial and the posterior tibial nerves.

Latencies of NAP, SpEP and CEP were analyzed. Peripheral conduction time (PCT=SpEP latency-NAP latency) and central conduction time (CCT=SpEP latency-CEP latency) were calculated.

A comparison between the values obtained during each day in bed and those obtained for each day in the dry waterbed condition was performed.

All the parameter obtained were compared with those of a control group.

Results

No alteration of any studied parameters was observed either during the bed recordings or those in simulated microgravity.

From a statistical point of view the T Student Test was applied to paired data and no significance was found.

Discussion

The neurophysiological adaptation of the human organism to the absence of gravity is of great importance to those working in space medicine.

Prolonged periods in condition of microgravity give rise to a series of neurological symptoms called Space Adaptation Syndrome.

We studied the SSEP in our volunteers. None of the parameters examined were altered, either during recordings in bed-rest or in dry waterbed immersion conditions.

It would be interesting to evaluate the effects of a langer period of exposure to simulated microgravity, in order to consider eventual disturbances of proprioceptive functions.

References

ALPATOV A.M.: *Studies of circadian rhythms in spaceflight: some results and prospects.* Physiologist, 1991 Feb, 34 (1), 145-6.

MILLER J.D., McMILLEN B.A., McCONNAUGHEY M.M. et al: *Effects of microgravity on brain neurotransmitters receptors.* Eur. J. Pharmacol., 1989 Feb. 28, 161 (2-3), 165-71.

GERSTENBRAND F., BERGER M., MAROSI M. et al: *Neurological effects of water immersion. Pan European Society of Neurology,* Second Congress, Wien, Dec. 7-12, 1991.

CURATOLA L., ONOFRJ M., MALATESTA G. et al: *Potenziali evocati somestesici (PES).* In: *Atlante topografico e clinico dei potenziali evocati stimolo-evento correlati.* a cura di Onofrj M. e Gambi D., DS Editrice, 1990.

Kozlovskaya I.B., Kreidich U.V., Barmin V.A. et al: *Space biology,* 1982, 5, pp. 41-45.

KORNILOVA LN., BODO G.: *Otorhinolaryngology Bullettin,* 1990, 3, pp. 37-43.

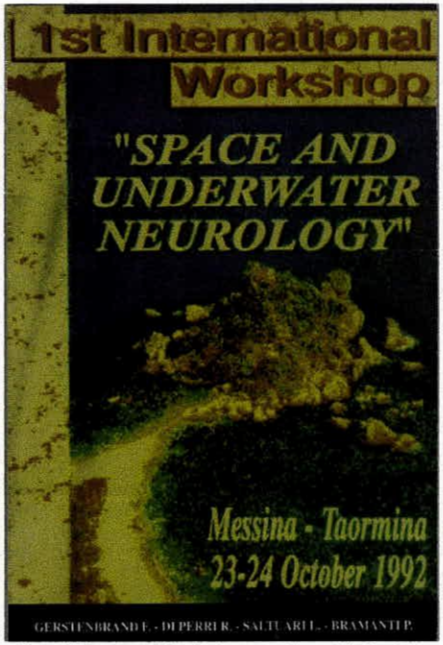
RESCHKE M.: *Scientific and Technical Proposal Space Lab. One.* Houston: Johnson Space Center, 1976.

SIGALEVA E.E., KOZLOVKAYA I.B., ILLARIOSHKIN S.N. et al: *Brainstem auditory responses (ABR) in special conditions simulating various physiological effects of weightless.* 1° International Workshop "Space and Underwater Neurology", Taormina 23-24 Oct., 1992.

RESCHKE M., HORNICH J.: *Aerospace Medical Assoc.,* 1983.

STOEHR M.: *Somatosensory evoked potentials.* In: *Evoked potentials.* Maurer K., Lowitzsch K., Stoehr M. Ed. Decker Inc. 1989.

SUMMARY



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