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Influence of Simultaneous Exposure to μt Magnetic Field and Infrared Radiation on Behavior in Rats

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Abstract

The aim of the study was to estimate the influence of chronic whole body simultaneous exposure to μT variable magnetic field and infrared radiation on such behavioral reactions as locomotor activity, exploratory activity, space memory and irritability in rats. Male Wistar rats were simultaneously exposed to variable magnetic field and infrared radiation 12 minutes daily for 2 periods of 5 consecutive days, with 2 days-lasting break between them, while control animals were sham-exposed. As a result of repeated exposures, in experimental rats only a slight reduction of locomotor activity was observed as compared to control group. No significant changes in exploratory activity, space memory and spontaneous irritability were observed between experimental and control rats.

Keywords: μT variable magnetic field, infrared radiation, behavior, rats

Introduction

Experimental data proved that different forms of variable magnetic field and laser radiation affect the activity of many neurotransmitter systems (i.e., dopaminergic, serotoninergic, parasympathetic and cholinergic neurons) [1-3], and alterations induced in these associated neurotransmitter-specific neural circuits can account for a variety of behavioral alterations produced by these physical factors [4-6].

The aim of the study was to estimate the influence of chronic whole body simultaneous exposure to μT variable magnetic field used in magnetostimulation and infrared radiation on such behavioral reactions as locomotor activity, exploratory activity, space memory and irritability in rats.

Experimental procedures

Experimental material consisted of 16 male Wistar albino rats weighting 180-200 g.

Weak variable magnetic field of saw-like shape of impulse, pointed perpendicularly to animal's body axis, at a frequency of basic impulse 180-195 Hz and induction of 352-408 μT (depending on the position of magnetic field induction measuring points) and infrared radiation (emitted by Light Emitting Diodes (LED), wavelength – 855 nm, mean power – 2,82 W, energy density of illuminating radiation identical for all experiments – 5,45 J/cm^2) generated simultaneously by magnetic-light applicator of device for magnetostimulation Viofor JPS (Poland) were used. During whole-body exposure animals were placed

individually in a plastic chamber with cover made up by square magnetic-light applicator.

All animals were randomly divided into 2 groups (8 animals each). In first group whole body exposure lasting 12 minutes daily for 2 periods of 5 consecutive days with 2 days-lasting break between them, was made. In second, control group sham-exposure without generating magnetic field and infrared radiation inside of applicator was made.

The evaluation of behavior was made at 24 hours before first exposure, immediately and at 24 hours after first exposure, and then on 2nd, 5th and 12th day of exposure cycle and on 7th and 14th day after the end of a cycle of exposures.

A locomotor activity was determined in the "open field" test by recording a number of episodes of crossings, peepings, rearings, grooming and defecation per 3 minutes of observation. An exploratory activity was examined in the "hole" test by recording a number of head dips into special holes per 3 minutes of observation. Space memory was determined by means of "water maze" test by measuring of time of finding a platform hidden in one corner of rectangular maze filled with water. A spontaneous irritability was evaluated by means of Nakamura and Thoenen's score scale test.

In order to eliminate the influence of individual behavioral reactivity of particular animals on the final interpretation of obtained results the values of measurements of particular parameters for each animal in succeeding days of observation were presented as percentage changes in comparison to initial values (before beginning of exposure cycle).

The results from each group presented as mean value ± SEM were analyzed statistically by means of STATISTICA program using initially ANOVA and subsequently post-hoc U Mann-Whitney tests.

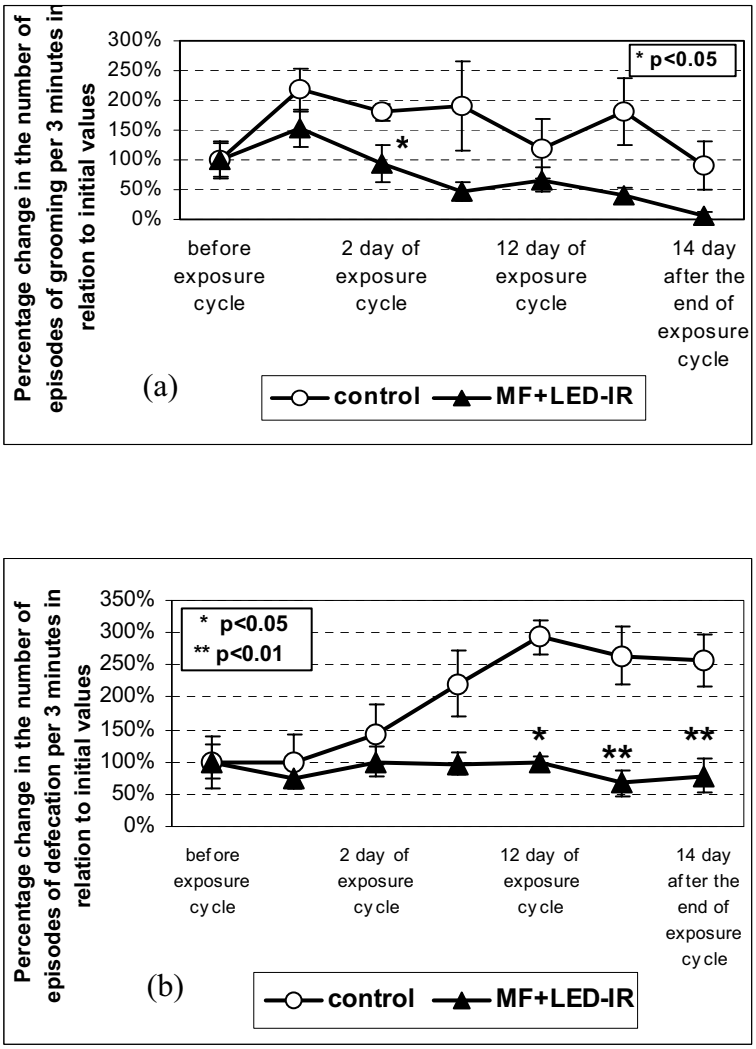

Fig. 1. Percentage change in the number of episodes of grooming (a) and defecations (b) in „open field" test in relation to initial values before the beginning of exposure cycle (mean value ± SEM) in particular days during and after the end of exposure cycle in rats simultaneously exposed to μT variable magnetic field ands infrared radiation or sham-exposed controls, with statistical evaluation

Results

Initial absolute values of particular behavioral parameters measured before the beginning of experiment showed no significant differences between experimental and control groups of rats.

As a result of repeated simultaneous exposures to variable magnetic field and infrared radiation in exposed rats a significant decrease in the number of episodes of grooming in "open field" test on 2nd day of exposure cycle (fig. 1 A.) and a significant decrease in the number of episodes of defecation in "open field" test on the last day of exposures and after the end of exposure cycle was observed as compared to control rats (fig. 1 B.).

No significant changes in the number of episodes of crossings, peepings and rearings in "open field" test, number of head dips in "hole" test, time of finding a platform in water maze test as well as in irritability scores in Nakamura and Thoenen's test between both groups of animals were found.

Discussion

The results of this study showed that chronic simultaneous exposure of rats to μT variable magnetic field and infrared radiation does not affect significantly behavior of rats, except of a slight reduction of locomotor activity after the end of exposure cycle.

Basing on this preclinical experiment it seems that devices using both analyzed physical factors can be safely applied in patients without pathology of central nervous system. On the other hand some clinical trials confirmed therapeutic efficacy of magnetostimulation with use of μT variable magnetic field with higher induction values in the treatment of disorders of mental state and function of central nervous system in patients with multiple sclerosis, Parkinson's disease and vegetative neurosis, related to i.e. significant reduction of excessive irritability of nervous system, improvement of sleep disorders, sedation, relaxation and subsidence of hypersomnia and depressive mood [7].

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