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Analgesic Effect of Simultaneous Exposure to μt Magnetic Field and Infrared Radiation 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 pain perception in rats, as well as the involvement of endogenous opioid system in the mechanism of this effect. 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. The pain perception was determined by means of "hot plate" test. As a result of repeated exposures a significant increase in analgesic index persisting till 14th day after the end of a cycle of exposures was observed. This analgesic effect was inhibited by prior injection of opioid antagonist – Naloxone.

Keywords: μT variable magnetic field, infrared radiation, analgesic effect, rats

Introduction

Literature data confirm that some forms of variable magnetic fields and low-level laser radiation evoke a strong, analgesic effect in experimental animals [1-5]. Results of experimental studies indicate that one of possible mechanisms of magnetic field-induced analgesic effect could be the influence on the activity of endogenous opioid system [1, 2]. It was also proved that analgesic effect of laser radiation is dose-related [3] and that both endogenous opioid system and some other mediators not related to endogenous opioids are involved in the mechanism of this effect [4, 5].

The aim of the study was to estimate the influence of chronic, whole body simultaneous exposure to μT variable magnetic field infrared radiation on pain perception in rats, as well as the involvement of endogenous opioid system in the mechanism of this effect.

Experimental procedures

Experimental material consisted of 32 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

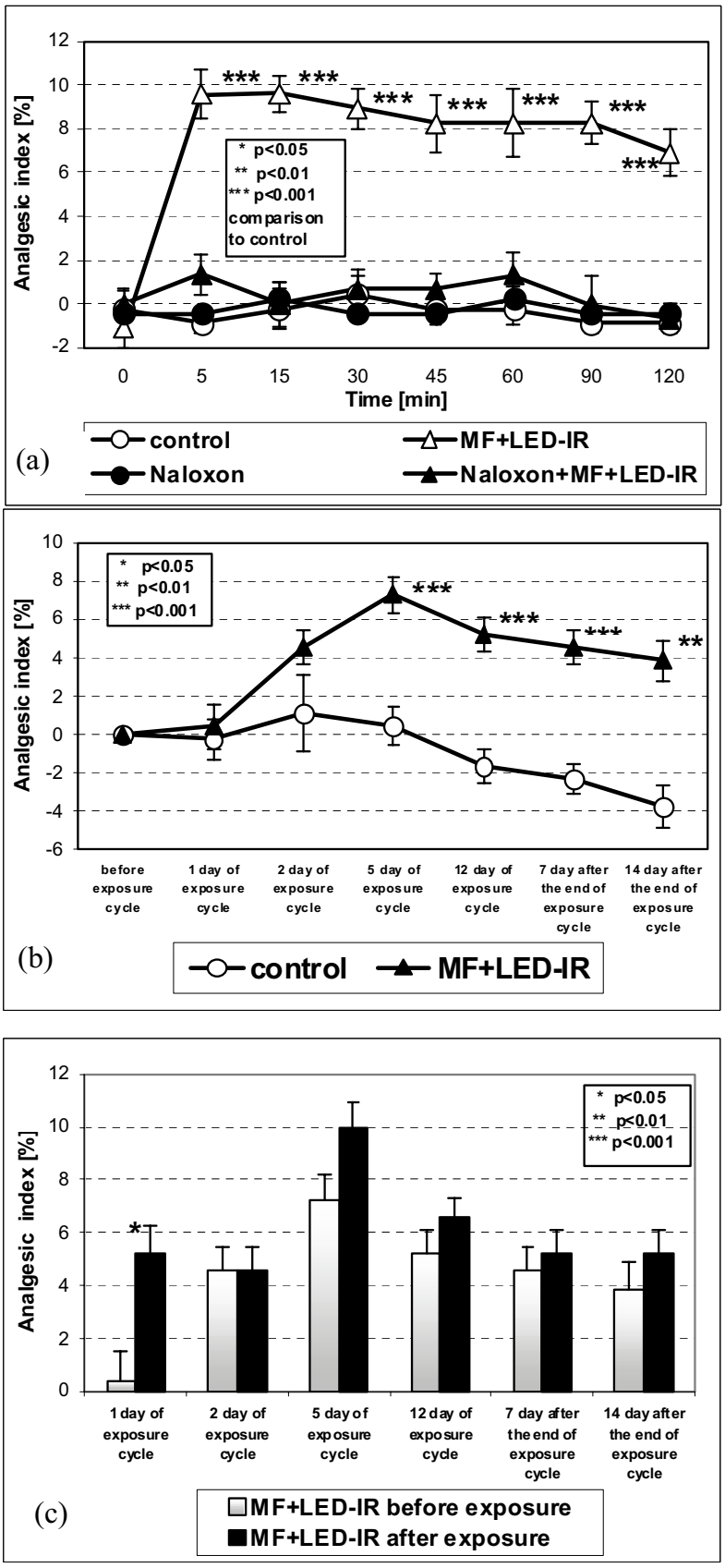

Fig. 1. Analgesic index (mean value ± SEM) in experimental rats exposed simultaneously to μT variable magnetic field and infrared radiation and in control, sham-exposed rats respectively: (a) In particular time intervals after a single exposure (including groups with prior i.p. injection of Naloxone), (b) In succeeding days of exposure cycle, (c) Immediately before and after exposure in succeeding days of exposure cycle (in experimental rats)

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 4 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.

In order to estimate the involvement of endogenous opioid system in the mechanism of magnetic field and infrared radiation-induced analgesic effect, in next 2 groups prior (30 minutes before exposure) to active or sham-exposure, respectively, i.p. injection of Naloxone hydrochloride (1mg/1kg of body mass) – antagonist of opioids – was made.

The pain perception was determined by latency of foot-licking or jumping from the surface of hot plate (temperature of 56^{o}C). On the basis of measured values of pain reaction latency time the analgesic index expressing the percentage of maximal analgesic effect was calculated according to the equation: $T_{\%} = (T_x\text{-}T_o) : (15\text{-}T_o) \times 100$, where $T_{\%}$ – analgesic index, T_0 – initial latency time [s], T_x – latency time in particular time interval [s] and 15 [s] – a maximal value of pain reaction latency time observed in adult male rats.

The measurements were made at 5th, 15th, 30th, 60th, 90th and 120th minute after the end of a single exposure, and then at 24 hours after a single exposure, on 5th and 12th day of exposure cycle and on 7th and 14th day after the end of a cycle of exposures.

The results from each group presented as mean value ± SEM were analyzed statistically by means of a STATISTICA program using ANOVA and U Mann-Whitney test.

Results

As a result of a single simultaneous exposure, a significant increase in analgesic index value persisting till 120 minute after the end of exposure as compared to sham-exposed group was observed (fig. 1A). This magnetic field–induced analgesic effect was inhibited by prior i.p. injection of opioid antagonist – Naloxone hydrochloride (fig. 1A).

In succeeding days of exposure cycle, an increase in analgesic index value was observed in exposed rats as compared to control animals, which was significant from 5th day of exposure cycle till 14th day after the end of this cycle (fig. 1B).

In experimental group of rats in succeeding days of exposure cycle, after each exposure, a distinct increase in analgesic index value as compared to the values before particular exposure was noticed (fig. 1C), which was not observed in control group.

Discussion

The results of this experiment indicate that repeated, simultaneous exposure to μT variable magnetic field and infrared radiation exerts a strong, long-lasting analgesic effect in rats and that in the mechanisms of this effect is involved endogenous opioid system. This observation makes an experimental basis for application of devices using simultaneous action of both analyzed physical factors in the treatment of pain syndromes of different origin. The therapeutic efficacy of such devices was so far proved in a pilot clinical trial, in which patients suffering from inflammatory and degenerative diseases of motional system were treated with use of Viofor JPS System Magnetic & Light Therapy [6].

Aknowledgements

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