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ORIGINAL ARTICLE

The influence of chronic exposure to low frequency pulsating magnetic fields on concentrations of FSH, LH, prolactin, testosterone and estradiol in men with back pain

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Abstract

OBJECTIVES: There is widespread public concern that electromagnetic fields might be hazardous. However, studies on the biological effects of magnetic fields (MFs) have not always been consistent. Influence of extremely-low frequency MFs used in physiotherapy on endocrine system was rarely examined. Therefore, the aim of the present study was to investigate the concentrations of some pituitary (FSH, LH, prolactin) and sex (testosterone, estradiol) hormones in men with back pain exposed to magnetic fields applied during magnetotherapy or magnetostimulation over the period of three weeks.

MATERIAL ND METHODS: The study was performed on 20 men aged 28–62 years (mean±SEM: 46.4±2.0 years) suffering from chronic low back pain who underwent magnetotherapy (10 patients, mean age±SEM: 48.4 years, range: 28–62 years) or subjected to magnetostimulation (10 patients, mean age±SEM: 44.3 years, range: 34–52 years) for 15 days (daily at 10:00 h, with weekend breaks). Blood samples were collected at 08:00 before magnetic field application, one day and one month following the application. Concentrations of hormones were measured by micromethod of chemiluminescence.

RESULTS: Both magnetotherapy and magnetostimulation lowered levels of prolactin.The levels of LH decreased significantly one month after magnetotherapy in comparison with the baseline whereas following magnetostimulation slight but insignificant increase was observed. Estradiol concentrations were significantly lower one day and one month following magnetosimulation in comparison to the baseline and did not change after magnetotherapy. No statistically significant changes were observed in levels of FSH and testosterone after either magnetotherapy or magnetosimulation at any time examined.

CONCLUSION: Magnetic fields applied in physiotherapy exert no or very subtle effect on concentrations of FSH, LH, prolactin, testosterone, and estradiol in men.

Introduction

Electromagnetic fields are commonly present in daily life all over the world because they are associated with the use of electric power applied in residential and occupational environments. Wherever electricity is generated, transmitted or used, electric and magnetic fields are created, due to the presence of motion of electric charges. They are emitted by power lines, electrical panels, transformers, and service wires but also by such household appliances as televisions, electric blankets, hair driers, etc. Magnetic field is created by an electric current and describes the magnitude and direction of the force exerted on a nearby current [1].

Moreover, because of many beneficial effects (e.g. improvement of soft tissue regeneration processes, vasodilatory action, acceleration of bone adhesion formation, anti-inflammatory and analgesic action) magnetic fields (MFs) are used in the physiotherapy of many diseases (e.g. low back pain syndrome, migraine and vasomotoric headaches, multiple sclerosis, degenerative processes of the bones and joints, rheumatoid arthritis) [2, 3].

Recently attention has been drawn to the possible health effects of extremely low-frequency electromagnetic fields. However, studies on the biological effects of MFs have not always been consistent [1, 4]. Although there is no clear answer to the question whether exposure to electromagnetic field may promote cancer or initiate other health problems, the studies on its influence on humans physiology and pathology are needed.

Studies on the effects of MFs on living organisms concentrate mainly on power-line frequency fields or fields used in mobile phones. Influence of extremely-low frequency MFs used in physiotherapy on endocrine system was rarely examined.

In previous studies we demonstrated that magnetic field may influence endocrine system [5–9]. Changes in melatonin [5–7], cortisol [8], and TSH, fT4 [9] secretion have been found in humans exposed to MFs.

On the basis of induction and frequency of MFs used in physiotherapy Sieron et al. [10, 11] divided the procedure on magnetotherapy and magnetostimulation. In magnetotherapy MFs of frequency below 100 Hz and induction of 0.1 to 20 mT (e.g. two-three times higher than earth-strength MFs) are applied, whereas in magnetostimulation MFs of much higher frequency (up to 2000–3000 HZ) and induction of 1 pT to 0.1 mT (e.g. in the range of earth-strength MFs).

The aim of the present study was to investigate the concentrations of some pituitary (FSH, LH, prolactin) and sex (testosterone, estradiol) hormones in men with back pain exposed to magnetic fields applied during magnetotherapy or magnetostimulation over the period of three weeks.

Material and methods

The study was performed on 20 men aged 28–62 years (mean±SEM: 46.4±2.0 years) suffering from chronic low back pain. The patients were divided into two groups. The first group consisted of 10 patients (mean age±SEM: 48.4 years, range: 28–62 years) who underwent magnetotherapy, whereas the second group consisted of 10 patients (mean age±SEM: 44.3 years, range: 34–52 years) subjected to magnetostimulation for 15 days (daily at 10:00 h, with weekend breaks). Magnetotherapy in the form of magnetic field induction (Magnetronic MF-10; induction – 2.9mT, frequency – 40 Hz, square wave, bipolar; device) was applied for 20 minutes to lumbar region. Magnetostimulation (Viofor JPS system, M2P2 program induction – 25–80μT, frequency – 200 Hz, complex saw-like shape with a plateau halfway the height of the wave, bipolar) was applied for 12 minutes in the same region. Blood samples were collected at 08:00 before magnetic field application, one day and one month following the application. Concentrations of hormones were measured by micromethod of chemiluminescence.

Studied patients did not suffer from other diseases and did not receive any medication. All patients were subjected to standard kinezytherapy and lumbar traction.

The data were statistically analyzed using paired and unpaired Student's t test.

The study was approved by the Regional Committee for Studies with Human Subjects. The experimental protocol was explained to each patient, and informed consent was obtained.

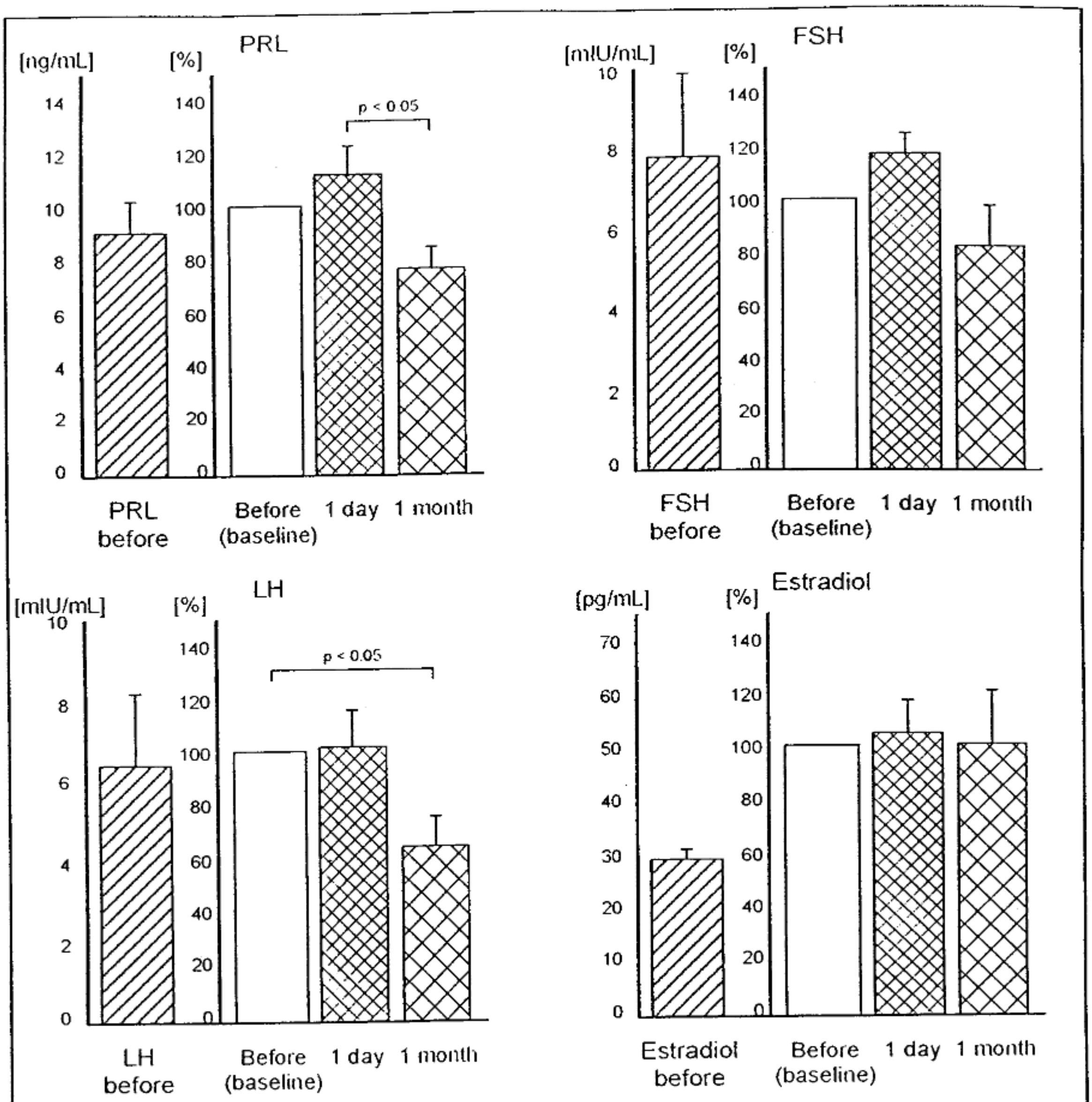
Results

Decrease in prolactin concentrations one month after magnetostimulation in comparison to those before therapy (Fig. 1) and between first day and one month following magnetotherapy was observed (Fig. 2). The levels of LH decreased significantly one month after magnetotherapy in comparison with the baseline (Fig. 2), whereas following magnetostimulation slight but insignificant increase was observed (Fig. 1). Estradiol concentrations were significantly lower one day and one month following magnetosimulation in comparison to the baseline (Fig. 1) and did not change after magnetotherapy (Fig. 2). No statistically significant changes were observed in levels of FSH and testosterone after either magnetotherapy or magnetosimulation at any time examined (Figs. 1 and 2).

Discussion

Magnetic field of different characteristics, applied during routine physiotherapy, were used in the present study. It has already been suggested that considerable differences among various studies on the influence of MFs on some physiological and/or biochemical parameters may depend on different experimental paradigms [5–7].

Although, in our study the influence of MFs on some pituitary and sex hormones was not pronounced, there are some differences among magnetotherapy and magnetostimulation. Neither magnetotherapy nor magnetostimulation significantly affected concentration of



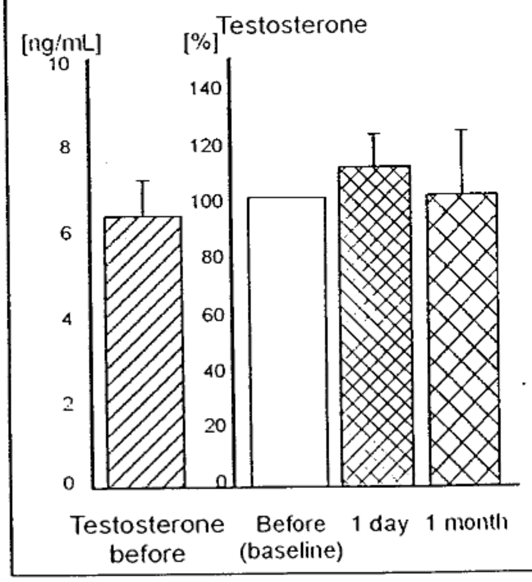
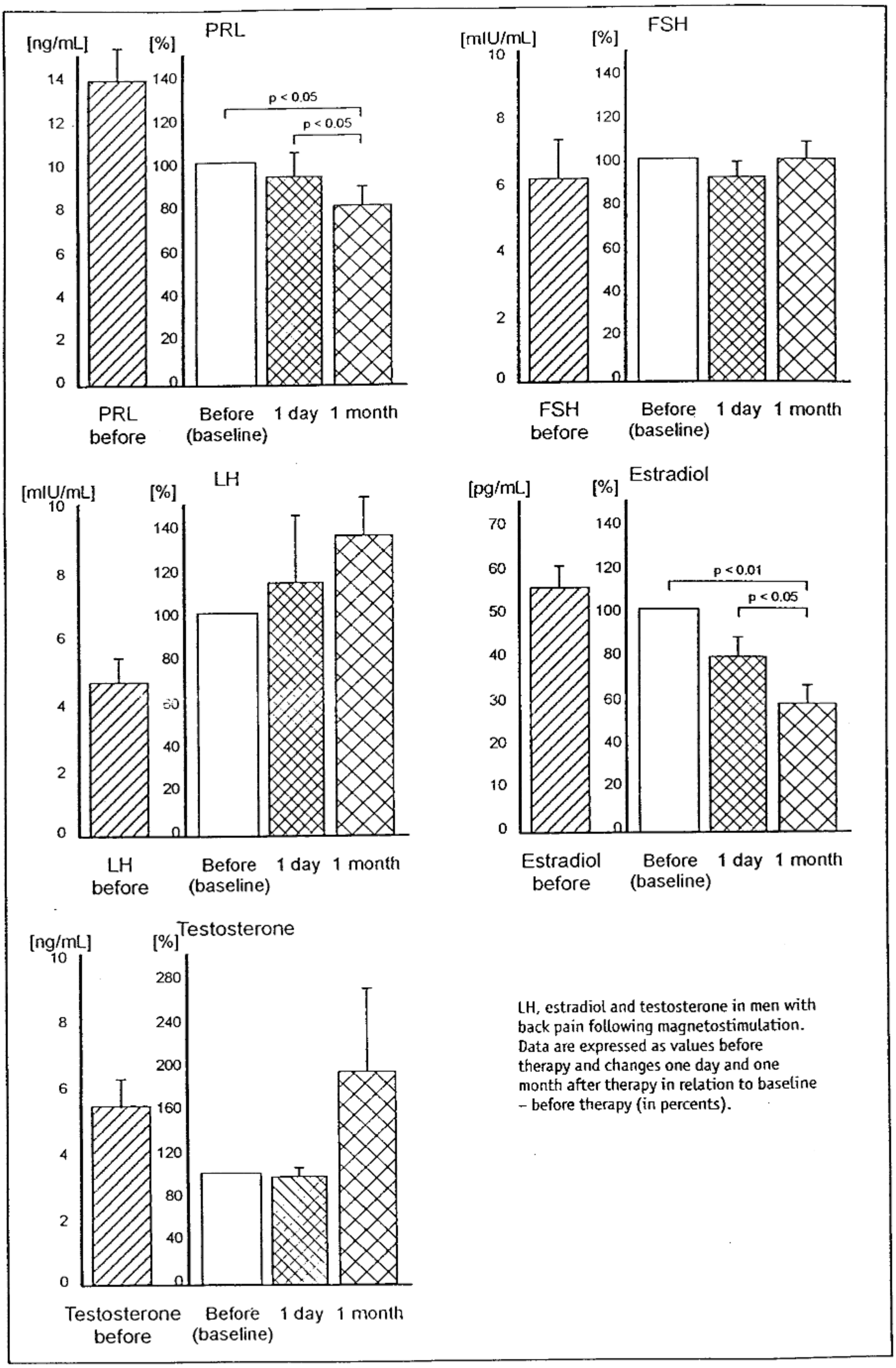


Fig. 1. Concentrations of prolactin (PRL), FSH, LH, estradiol and testosterone in men with back pain following manetotherapy. Data are expressed as values before therapy and changes one day and one month after therapy in relation to baseline – before therapy (in percents).

Fig. 2. Concentrations of prolactin (PRL), FSH,



LH, estradiol and testosterone in men with back pain following magnetostimulation. Data are expressed as values before therapy and changes one day and one month after therapy in relation to baseline – before therapy (in percents).

FSH and testosterone. However, magnetostimulation decreased estradiol concentrations, whereas magnetotherapy was without effect. On the contrary, levels of LH were significantly lower one month following magnetotherapy, whereas magnetostimulation did not affect significantly its concentrations. Both procedures lowered levels of prolactin.

In our earlier studies differences between effects of magnetotherapy and magnetostimulation have been also demonstrated in levels of melatonin [6], TSH, fT4 [9], and cortisol (at 16:00h)[8].

Generally, MFs have been shown to exert weak or no effect on the levels of various hormones. The most numerous are studies on the influence of MFs on melatonin secretion in humans. Although, in many studies inhibitory effect of MFs on melatonin has been demonstrated, many authors were not able to observe any effect. Moreover, it has been suggested that the differences may depend on different characteristics of applied MFs, acute or chronic exposure, differences in exposure time and duration, etc. [see 12].

In a complex study Selmaoui et al [13] did not observe any acute influence of MF on pituitary-thyroid and pituitary-adrenal axes. Both concentrations and diurnal rhythms of TSH, T3, fT3, T4, fT4 as well as cortisol and 17-hydroxycorticosteroids were unaffected in men exposed to continuous or intermittent MF (10 μT, 50 Hz) for 9 hours (from 23:00h to 08:00h) in comparison to sham-exposed individuals.

It has been also reported in other studies that acute exposure of humans to MFs of various characteristics (1 – 20 μT, 50 Hz; 900 MHz pulsed with 217 Hz, power density 0.02 mW/cm3, 23.3 μT, 2.8 kV/m) did not affect concentrations of prolactin [14, 16, 18], FSH [13, 14], LH [13–15], growth hormone [15, 16, 18], cortisol [14–18], testosterone [14, 16], and TSH [14]. The changes in prolactin and LH observed after exposure to MF in our studies, that differs form the results of other studies, may by explained, at least in part, by the fact that of chronic application of MF in our patients and acute exposure employed in the studies of other authors.

In some experimental animal studies the influence of MFs on the concentration of corticosterone (mice [19]), growth hormone (rat [20]), testosterone (rat [21]; mouse primary Leydig cell culture [22]), and prolactin (Djungarian hamster [23]) has been demonstrated, whereas other studies failed to show any changes in the levels of corticosterone, prolactin, growth hormone, TSH, FSH, LH, and testosterone [20, 24, 25]. However, since it seems that animal detect and perceive magnetic field differently that humans [26], it is difficult to extrapolate data from the animal studies to humans. Moreover, although not proven, it seems probable that sensitivity to MFs varies among individuals [see 1, 4].

In general, it seems that MFs exert no or very subtle effect on endocrine system. Small differences reported in various studies may depend on different characteristics of applied MF, and different experimental paradigm.

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