EFFECT OF EXTREMELY LOW FREQUENCY ELECTROMAGNETIC FIELD ON BLOOD VESSELS OF ADENOHIPOHYSIS IN RAT

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Abstract

Potential health risk of extremely low frequency electromagnetic field [ELF-EMF] exposure are of considerable public interest. In the present study we investigated the effect of three months exposure to ELF-EMF of frequency [50 Hz] and intensity [50 μT to 500 μT] to which humans can be exposed in their home and work environments on the blood vessels morphology and number in adenohypophysis of male Wistar rats. Results of histological and stereological analysis of five micrometer thick adenohypophysal slides showed increased number and volume of blood capillaries in adenohypophysis compared to corresponding controls what can indicate influence of these fields on microcirculation

Keywords:

adenohypophysis, blood vessels, extremely low frequency electromagnetic field [ELF-EMF]

1. INTRODUCTION

Extremely low frequency [<300 Hz] electromagnetic fields [ELF-EMFs] and its biological effects and their consequences on human health are receiving increasing scientific interest and have become the subject of great public debate. The controversy has been stimulated by some epidemiological studies that have reported a relation between magnetic field and human disease [17,4,12,16]. However, so far no accepted, biologically plausible mechanism has been advanced to explain how fields interact with biological systems to yield observed in vitro responses, much

less disease in an organism. Considering ELF EMFs interactions from the purely point of view several mechanisms have been proposed to account for the initial interactions with cells [8,9,1,5], but these models have been limited by their inability to account for the wide range of experimental observations.

One of the robust biological effects of ELF-EMFs is its influence on angiogenesis. From that reason this study was designed to look for possible effects of long-term exposed to ELF-EMFs at the levels found in residential, occupational and general community on rat adenohypophysal blood capillary network.

2. MATERIAL AND METHODES

A total of 20 male Mill Hill rats were used in these experiments. All animals were maintained under controlled laboratory conditions. Ten animals were exposed to the influence of ELF-EMFs [50 Hz] for 7 hours a day, 5 days a week, beginning from 24 h after birth until the end of third month of postnatal life. Control animals were housed under identical conditions except for the ELF-EMFs.

ELF-EMF-inducing system consisted of a single coil of 2.5 mm thick wire winded in 1320 turns on wooden frame. The coil was energized from standard 220 V, 50 Hz, 16 A outlets via an autotransformer, which provided 60 V output and was used in order to reduce the electric field, measured to be less then 10 V/m anywhere in the room. The cages with animals were placed symmetrically on both sides of the coil. Along the cages, the coil produced a magnetic field of decaying intensity from 500 μT to 50 μT.

After sacrificing, the hypophyses, were removed and fixed in Romeis's solution. Paraffin-embedded glands were cut serially and stained after the method of Hurduc, and El-Etrery Tüshaus. Three adenohypophysal gland sections per animal were subjected to histological and stereological analysis. The volume density [Vvk] and numerical density of adenohypophysal blood capillaries with grid M42 were determined. The results were statistically analyzed by Student's *t*-test.

3. RESULTS

The mast prominent morphological characteristics of the adenohypophysal capillary network in rats sacrifices after 3 months of exposure to ELF-EMFs compared to the controls were increase of number of adenohypophysal blood capillary and appearance of its dilatation, especially in the center of gland. These histological findings were substantiated with the results of stereological analysis.

In animals exposed to ELF-EMFs influence numerical density of adenohypophysal capillary network was significantly [$p<0.001$] increased [Fig. 1]. At same time the volume density of adenohypophysal capillary network was, also, significantly [$p<0.01$] increased compared to the non exposed animals [Fig. 2].

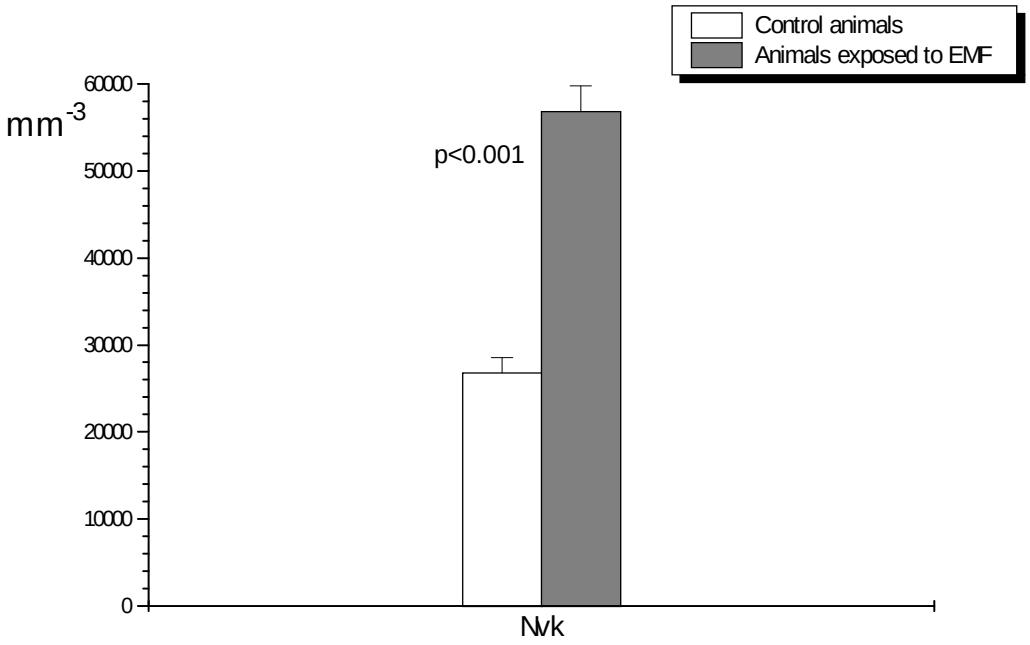

Fig. 1. Numerical density of adenohypophysal blood capillary network. Mean±SE".

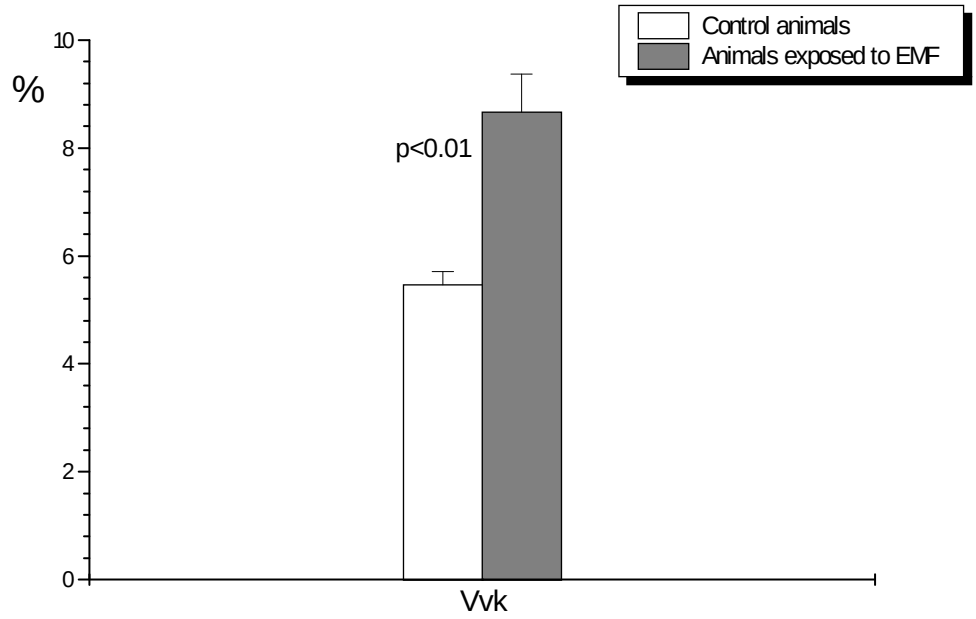

Fig. 2. Volume density [Vvk] of adenohypophysal blood capillary network. Mean±SE"

4. DISCUSSION

As the present results show, long term exposition to ELF-EMFs can change the morphology of adenohypophysal capillary network.

The available data imply that the response of blood vessels to ELF-EMFs is extremely heterogeneous with regard to the strength and frequency of the field. Beyond this divergences of the frequency scale, the use of pulsed or modulated fields raise additional problems. The contradictoriness of the results may also be due to differences in experimental design and procedures.

A mathematical model for changes in several typical blood vessels [aorta, artery, arteriole, capillary, venule, vein] under action of an alternating magnetic field has been developed [15]. It has been demonstrated that the blood serum ions interacting with this field have the largest impact in large vessels; changes in capillary parameters are small and can be caused mostly by neuronal factors and redistribution of the blood from arteries and arterioles; the venous vessels are more susceptible the influence by the EMFs as compared to the arterial ones.

Investigations of he effects of three waveforms of pulsed electromagnetic fields on blood vessel growth in the rabbit ear chamber showed that first, a pulse burst waveform, produced a significant increase, but second and third, two different single pulse waveforms, had, in contrast, no significant effect on rate of vascular growth [5].

Also effect of global system for mobile communication radiofrequency fields [RFs] on vascular permeability in the brain was studied using a purpose-designed exposure system. Shimacher et al. [2000] were show that EMF of 1.8 GHz increase permeability to sucrose of the blood-brain barrier in vitro, while 30 min of exposure to RF [900 MHz] significantly increase blood pressure [2]. Opposite of this, transcranial pulsed magnetic stimulation on blood-brain barrier no effect on its permeability [13].

Our results indicated that ELF-EMFs can increased both numerical and volume density of adenohypophysal blood capillary network. Influence of ELF-EMFs on blood vessels in some other endocrine gland we already described and discussed earlier [11]. According some other authors EMF has influence on angiogenesis and they concluded that some of observed effects of EMF on tissue healing may be mediated trough a primary effect on vascular growth [6]. Once can postulated that EMFs influence angogenesis through cell cycle of endothelial cells. It is well known that growth of cells can be controlled by the interaction of growth factors with their receptors on the plasma membrane. Such interaction may, for example, cause quiescent, somatic cells to leave G_0, traverse G1, and enter S phase, whereupon they are normally committed to at list one round of the cell cycle. Activated growth factor generate one or more primary signals that promote a sequence of metabolic events. It is possible that EMFs may stimulated this cycle on the some step of endothelial cell cycle.

From reason that, still remains difficult to correlate exposure to ELF-EMFs with health risk, once has supposed that factors other than electromagnetic waves may be involved [10]. According some authors harmful effects, if any, should therefore be induced by an indirect effect with these fields acting as a promoting, or co promoting agent rather than as an initiator. This could for example be by favoring the amount and longevity of free radicals [3] or by enhancing the effect of a chemical or physical mutagen [7]. It is, therefore, very often concluded that this quite certainly points to an absence of any major ELF-EMFs-releated health hazards, but as almost everybody is exposed to different types of ELF-EMFs uncertainties still justify further investigations.

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