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INVESTIGATING 500 MICRO-TESLA ELECTROMAGNETIC FIELD EFFECTS ON TESTICULAR TISSUE CHANGES AND HORMONES LH AND TESTOSTERONE IN SYRIAN MICE RACE BALB/C

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ABSTRACT

Electromagnetic fields carry energy, intensity, and different frequencies, and their biological amplitude effects are so wide. In this regard, the effect of electromagnetic field on testicular tissue and LH and testosterone hormones rates were investigated simultaneously. 60 Syrian mice (30-50 gr) of Balb/C race were randomly divided into control group and attendance group. Control group was not exposed to electromagnetic field and attendance group was exposed to 500 micro-tesla field for 4 hours over a period of 60 days. 20 days after start of experiment 10 mice of both groups were randomly selected and rate of LH and testosterone hormones rates, diameter of lumen, and number of spermatogonia and sperm cells were examined. This method was repeated for other mice after 40 and 60 days of beginning experiment. The experimental data show that amount of LH and testosterone hormones in attendance group increased in 20 and 40 days, but at the end of 60 days decreased in comparison to control group. Number of spermatogonia and sperm cells in attendance group declined over time compared to control group. Lumen diameter in attendance group decreased at 20 and 40 days, but it significantly

decreased at the end of the 60 days compared with control group. Electromagnetic fields can have different effects on testicular tissue and hormones secretion regulator, and the time duration of exposure to electromagnetic fields has an important role.

Keywords: Electromagnetic Field, LH, Testosterone

INTRODUCTION

The term electromagnetic field (EMF) is a broad concept that includes electrical fields caused by charged particles, magnetic field produced by moving charged particles and radiation fields such as radio, TV, mobile and microwave. Electromagnetic fields with very low frequency, about several hertz, are known as ELF, a subset of EMF **[1]**. Nowadays, the use of different devices that produce electromagnetic fields is growing rapidly, and humans are exposed to electromagnetic waves every day, more than the day before. Appliances such as the hair dryer, sewing machine, vacuum cleaner, TV, refrigerator, freezer and other devices that have electrical motors, satellite signals, radar, mobile phones and transmitting and receiving stations and computers, power transferring lines, especially high pressure lines, transformer stations, TV transmitter towers, copy machines, microwaves and etc. All are produced and distributed resources of electromagnetic waves whereby the power of radiation waves, depending on the type of application, have different severity and frequency and their range is so wide and individuals, People are exposed to these waves **[2]**. So investigating the effect of electromagnetic fields on living subjects is one of the latest issues under discussion globally. This study has attempted to investigate the effect of electromagnetic fields on mouse testicular tissue and secretion of hormone LH and testosterone that is due to the effect of this field on hypothalamic – pituitary – testicle, and as a result, scientific and practical application will be done at the right time. It is hoped that the results of this research will be used in medical centers, biologic and genetic research centers, physiological, environmental organizations, manufacturers of home appliances and toys, ministries of energy and post and telecommunications so biological health in the community will be increased.

MATERIALS AND METHODS

For measuring hormones in serum, animals were first anesthetized with ether by 2cc syringe, blood samples were collected from the heart, and after providing serum were maintained at - 20°C. After that, in sterile condition with gaping lower abdomen,

testicles were removed and placed in bouin fixative solution for histological studies.

Measuring LH and testosterone hormone: LH and Testosterone hormone were measured by ELISA kit (DRG Company, Germany). At this stage the samples were poured into the wells and after adding solutions were incubated for 90 minutes at 37°C. The wells were then washed with deionized water and substrate was added to each well and incubated for 20 minutes. Reaction by adding stop solution, stopped, and absorption was measured at a wavelength of 450 Nano meter.

Histological examination of testis: Left testicular was placed in bouin fixative, taken out of solution and the remaining tissue molded with paraffin. Then, sections that had been cut into pieces 5 microns in diameter were prepared and stained with hematoxylin-eosin method. Stained slides, the number of spermatogonia, and spermatids cells were assessed using a light microscope by a pathologist who had no knowledge of the group size. From each sample 5 horizontal sections were produced, and 20 fields by light microscope Nikon E 100 were investigated. Obtained values were expressed as average number of cells in each tube.

Measuring the diameter of lumen: For measuring the lumen diameter a lens containing graticule was used so that each section of lumen measured 200 diameter and average values were calculated with SPSS software.

RESULTS

The experimental data show that amount of LH and testosterone hormones in attendance group increased in 20 and 40 days, but at the end of 60 days decreased in comparison to control group. Number of spermatogonia and sperm cells in attendance group declined over time compared to control group. Lumen diameter in attendance group decreased at 20 and 40 days, but it significantly decreased at the end of the 60 days compared with control group **(Table 1-4)**.

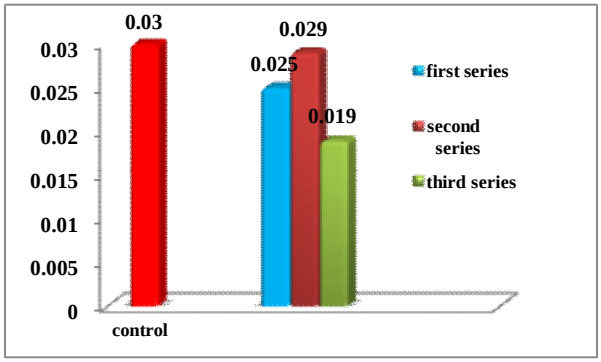

Table 1: Results of Hormone LH Changes Between First Series (Day 20), Second Series (Day 40), and Third Series (Day 60) in Receptor Group of Electromagnetic Field with 500 Micro-Tesla

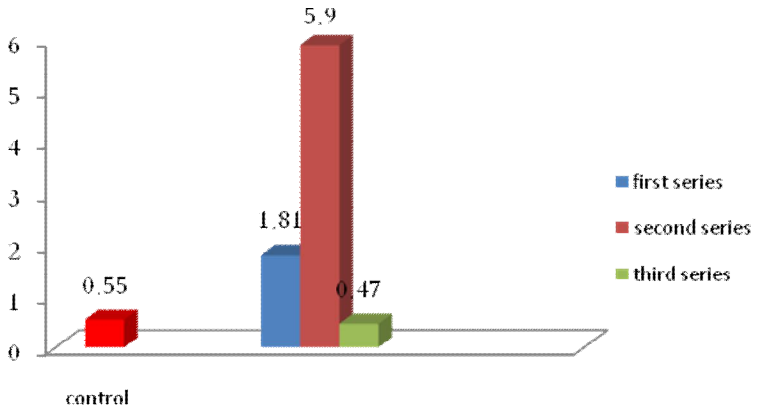

Table 2: Results of Testosterone Hormone Changes Between First Series (Day20), Second Series (Day40), and Third Series (Day60) in Receptor Group of Electromagnetic Field With 500 Micro Tesla

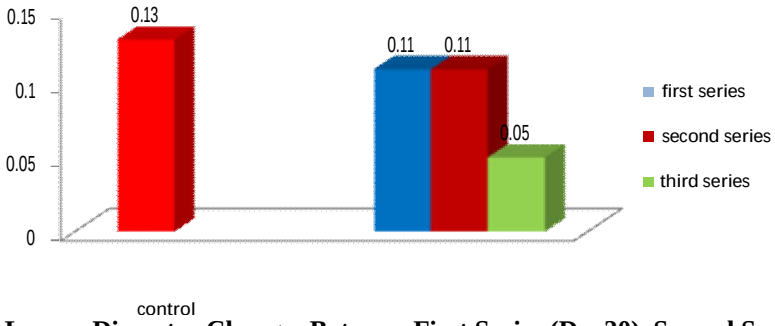

Table 3: Results of Lumen Diameter Changes Between First Series (Day20), Second Series (Day40), and Third Series (Day 60) in Receptor Group of Electromagnetic Field With 500 Micro Tesla

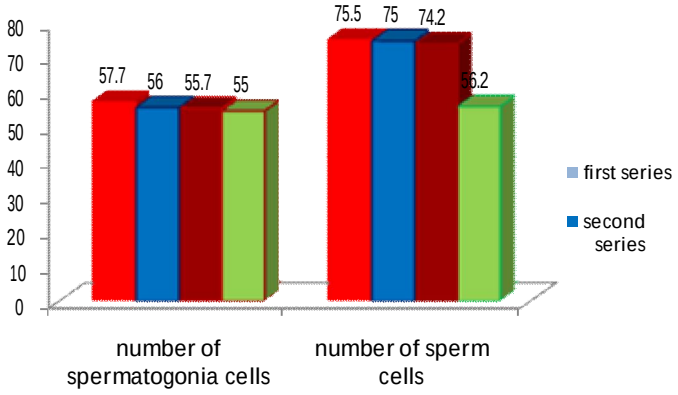

Table 4: Results of Number of Spermatogonia and Sperm Cells Changes Between First Series (Day20), Second Series (Day40), and Third Series (Day60) in Receptor Group of Electromagnetic Field With 500 Micro Tesla

DISCUSSION

Regarding the significant increase of hormone LH after 20 and 40 days based on space-time accumulation hypothesis, it should be mentioned that probably, due to electromagnetic field on nervous system, the number of presynaptic neurons was activated simultaneously, generating a signal in postsynaptic neuron that in hypothalamic causes hormone GNRH secretion, and in pituitary causes hormone LH secretion. However, after 60 days, it will decrease the amount of LH; this mechanism may be based on the effect of electromagnetic field inhibits proteins function due to third structure changes of proteins. In this regard, scale of field force is an important and determining factor, so perhaps field with changes in the third structure of hormone LH may cause scale decrease. Regarding which direction of magnetic field can affect organisms, different hypothesis have stated that the result of this research is common with mecnisms of some of these hypotheses. Among these hypotheses, the guidance hypothesis is based on field effect in leading and transmission biological signals through direct effect on ion and changes in neurotransmitter level and, finally, change in hormone level. It seems that the mechanism of this hypothesis is more consistent with current research **[3]**. Also, results of the current research corresponds with Askavejer hypothesis which states that electromagnetic fields cause the release of free radicals which cause with severe collision with biomolecules and change them to correspond **[4]**. Concerning electromagnetic field effect on the regulation of secretion of testosterone hormone and the significant increase of this hormone, different mechanisms can be represented as follow. One of these mechanisms is the case for testosterone hormone secretion changes in the concentration of mediator intracellular calcium, which should be established, leading to activation of protein kinase C, and finally causing testosterone secretion. In a research done by Escandari in 2007, It was found that electromagnetic fields cause increased ion in plasma which occurs through two mechanisms. One way is to affect protein kinase c enzyme in the parathyroid gland and the other is the insensitivity of PTH receptors and thus enzyme activity is inhibited, which causes increased calcium in plasma. Increase in plasma calcium around interstitial cells enables this ion to enter these cells and activate the protein kinase c pathway; finally this caused an increase in testosterone secretion during the first 40 days that the rats were exposed to electromagnetic field. However, over time, treatment was tested

with different physiological activities opposition to increase calcium, return to normal calcium range so it can continue survive activities. On the other hand, based on the Ikiehara and colleagues study in 2002, electromagnetic field released calcium, inhibited intracellular stores **[5]**, and thus, intracellular intermediate calcium decreased, subsequently testosterone hormone secretion after 40 days will also be decreased. For testosterone decrease, another mechanism that can be presented is that based on Askavejer hypothesis, that electromagnetic fields cause production of free radicals. Free radicals have the power to impact biomolecules, and also the field causes more longevity of free radicals, thus free radicals with further longevity may have more severe side effects **[4]**. Moreover, free radicals attack sugars and organic bases available in DNA structure, causing breakage and cracking of DNA cells, and ultimately, decreased testosterone secretion. Free radicals that attack lipids may cause further damage to testosterone secretion directly. The obtained result of this research regarding increasing testosterone hormone is consistent with the works of Furuya and colleagues in 2005. They investigated the effect of electromagnetic field with 50 Hz and severity of 1 MT on adult rats and concluded that electromagnetic field causes significant increase in testosterone concentration **[6]**. Concerning the decrease of lumen diameter in receptor group of 500 micro tesla compared with control group, it is likely that the conflict of electromagnetic wave into germinal layers of sperm tubes causes disruption of histological and changes in open junctions of cells. So taking away the cell layer of each and bowing toward the center of lumen caused the decrease in lumen center space, and consequently lumen diameter decreases. Greater decrease of lumen diameter in the third series of receptor group of field with 500 micro-tesla indicates that if field strength and time of radiation increase, the effect on testis tissue and productive sperm layers in sperm tube will increase, which is consistent with Chiang's research in 1999 and also with Soleimani Rad and colleagues in 2007 **[7, 8]**. In the absence of significant decrease in number of spermatogonial cells in treated group compared to control group, it can be mentioned that with the power of 500 micro tesla, spermatogonia cells adapt to new conditions and vulnerability will decrease. To support this theory, it is indicated that exposure to electromagnetic field causes the formation of a protein called HSP, which appears under stressful conditions and maintains the structure of protein cells **[9]**. In support of this theory, previous findings

indicated that, in rats under electromagnetic field the number of macrophages and eosinophils tissues is increased **[8]**. Goodman and colleagues in 1996 also examined the effects of electromagnetic fields on molecules and cells and found that cells affected by electromagnetic field without having to change and die, can adapt themselves with interventions and stress. The nature of cell response to electromagnetic field depends on cell type, age and stage that cell is placed in, and other environmental factors such as field, frequency, and cell distance from the field center **[10]**.

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REFERENCES

[1] Rojas AH, Hernandez DE and Fuente AO, Lack of alternations on meiotic chromosomes and morphological characteristics of male germ cells in mice exposed to 60Hz and 2mT magnetic field, 2003, Wiley Interscience.

[2] Leppens H, Vanden Heval R and Nemethova G, Haemopietic cell proliferation in murine bone marrow cells exposed to extreme low frequency (ELF) electromagnetic fields, Toxi. In vitro: 15, 1993, 351-355.

[3] Kula B and Sobczak A and Kuska R, Effects of electromagnetic field on free-radical processes in steel workers, Part 1: magnetic field influence, J. Occup. Heath, 44, 2002, 226-229

[4] Chen KM and Hessary M, Local heating of biological bodies with HF magnetic fields, 3rd Ed., Bioelectromagnetic Conference, Washington DC, 1992.

[5] Ikehara T, Park KH, Yamaguch H, Hosakawa K and Houchi H, Effects of a time varing strong magnetic field on release of cytosolic free Ca2+ form intracellular stores in bovine adrenal chromaffine cells, Bioelectromagnetics, 23 (7), 2002, 505-515.

[6] Furuya H, Aikawa H, H, Hagino T, Yoshida T and Sakabe K, Flow cytomertic analysis of the effects of 50 hz magnetic field on mouse spermatogenesis, Medical hypothesis, 35 (3), 1991, 265-274.

[7] Chiang H, EMF health effects Research ICNRP and WHO conference, November 21-25, 1999.

[8] Mohammad Nejad and Vslymany Rod, Inhibitory effect of vitamin E on histological changes induced by electromagnetic fields, Since 1978 Fourth Congress of Anatomy.

[9] Di Carlo A, White N, Guo F, Garrett P and Litovitz T, Chronic electromagnetic field exposure decrease HSP70 levels and lowers cytoprotection, Cell Biochem., 84 (3), 2002, 445-54.

[10] Goodman A, 1996, The pharamacological of the threapeutics, 9th Ed., 1441-1455.