Bulletin of Environment, Pharmacology and Life Sciences
Bull. Env. Pharmacol. Life Sci., Vol 3 (1) December 2013: 223-227

Online ISSN 2277-1808
Journal's URL:http://www.bepls.com
CODEN: BEPLAD
Global Impact Factor: 0.533
Universal Impact Factor: 0.9804

ORIGINAL ARTICLE

Effects of Extremely low Frequency Electromagnetic Fields on Liver Enzymes in Male Rats

Allahverdi Hazeghi Rad[1], AliZanbouri [1], EhsanHosseini*[2]

1. Department of Animal sciences, Maraghe branch, Islamic Azad University of Maraghe, Iran.
2. Faculty of Para-Veterinary Medicine, ILAM University, ILAM, Iran

ABSTRACT

This paper is based on studying the impact of electromagnetic fields with extremely low frequency on liver ofrats. For this purpose 24 maleratsweighing approximately 250 g were selected andrandomly divided into three groups.First group was assigned as control group and no treatment was applied on them. The Second group was named T1 and rats was kept one hour daily in electromagnetic fields for five days and third group was named T2 and was kept one hour daily in electromagneticdevices for thirty days to study the impact of chronic conditions. After spending the treatment period blood sampling was directly taken from their heart and by applying serum making process the volume of five liver enzymes named Aspartate amino- Transferase (AST) , Alkaline phosphatase (ALP), alanine amino-transferase (ALT), Lactate dehydrogenase (LDH) and creatine kinase (CK) were measured and recorded by "ara1000otoanalyzer" .Results showed there is a significant increaseinlevels of ALT,CK and AST in T1 and T2 groups compared with control group. ALP and LD has significant difference with control group only in T2. Current research represented that extremely low frequency electromagnetic fields was able to disturb enzymatic balance in liver of rats.

Keywords: *electromagnetic fields, Liver Enzymes, male rats*

Received 23/10/2013 Accepted 03/12/2013

INTRODUCTION

Among the human invention electricity has a special place. Discussions about electromagnetic fields were raised as soon as industrial electricity since Faraday era. In 1976 the first human biological effect of these fields came to mind, when this phenomenon covers almost all aspects of his life adverse effects were found in discussions and reports of harmful effects were established. Most studies on the Electromagnetic are about residential electricity, while there are the other kinds that even some times come to the aid of man. With the beginning of the twentieth century and the increasing use of electricitywe are seeing the emergence of more applications of this phenomenon so that one can say human life is involved with it today more than any time. [2,3and14]. simultaneously, extensive research on the biological effects of electromagnetic fields was rising each day. First, electromagnetic was discussed as a secondary effect of electric but latter it found isolated nature and personality. Nowadays, by development of technology in various fields animals and human are living with huge variety of waves. What has been reported in association with electromagnetic was about the adverse effects of these fields that consist of static magnetic fields and electric currents or pulsed electromagnetic fields.In this connection, there are a limited number of reports that somehow attempting to use this phenomenon in order to help human challenges.This paper tried to assay the effect of electrical generator signals on biological changes and in this regard the effect of pulsed electromagnetic fields caused by triangular electrical wavesin the frequency range of 10 Hz with low intensity (700Mm Gaussian) on certain blood enzymes were studied.

MATERIALS AND METHODS

Animals and treatment

24 maleratsweighing approximately 250 g were selected andrandomly divided into three groups .First group was assigned as control group and no treatment was applied on them. Second one was named T1 and rats was kept one hour daily in electromagnetic fields for five days and third group was named T2

and was kept one hour daily in electromagnetic fields for thirty days to study the impact of chronic conditions.

Electromagnetic fields

Power supply unit: This device was manufactured by PHYWE in Germany and was able to produce DC electricity, Six volts of output voltage and current of 500 mA that total power output was 3 watts.

Wave-making machine: that is capable of producing three waveforms of Sinusoidal, squareand triangular and the forms of waves are changeable manuallyby selector. In this research only triangular waveform is used.

Oscillator Signal generator: which is able to produce a limited frequency from 10 Hz to 110 kHz (PHYWE, Germany).

Springs: which are made of two soft iron core that their characteristics are as follow;number of laps600, internal resistance 2.5 ohms with a maximum tolerance of 2 amps, the coil length0.06 m and the core area $2 \times 2=4cm^2$that are placed with a distance of 14.5cm of each other and plugged to power supply regulatory.

The intensity of the generated electromagnetic field was measured 7.25 cm far from each coil by a digital Teslameter device and rate is recorded as 700±20 Gauss.

A box of dimensions 20 × 25 × 30 cm was made of thin fiber to put the animal during irradiation and nonails were used. Two windows of dimensions 2 × 2 cm in front of each other wereembedded in walls that the soft part of core was in touch with inside by them.

Biochemical methods

The levels of enzyme aspartate aminotransferase (AST) alanine aminotransferase (ALT) and alkaline phosphatase (ALP), Lactate dehydrogenase (LDH) and creatine kinase (CK) inobtained sample serum were assessed by using ELISA kits with Pars Azmon kit (Iran - Tehran)..

Data processing & Statistical Analysis

Gathered data of 24 Wistar male rats that were selected randomly by concerning research criteria, were compiled into SPSS. Normality of the data distribution was checked and confirmed. ANOVA test was applied to comparing multi groups by Duncan post hoc. Significance of differences was assessed by 95 percent of confident and data were reported as mean ± SD. The $P<0.05$ considered as statistical difference.

Ethical issues

The rats are kept in small animal unit with twelve hourslight and dark cycle and twenty-five Celsius degrees temperaturein special cages with freely access to food and water. Quick and easydeath method was used for this study and their bodies were euthanized concerning the standard rolls.

RESULTS AND DISCUSSION

There is a significant rising in the level of liver enzyme (ALT, AST) in both T_1 and T_2 groups compared to the control group but ALP, LDHand CK have significant difference only in T_2.

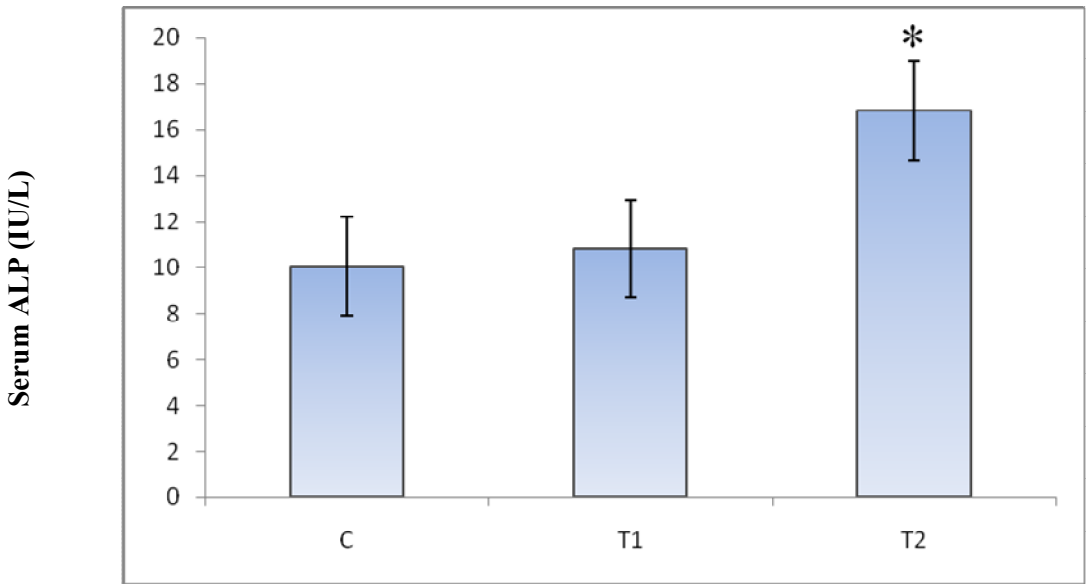

Fig. 1: The serum ALP levels in control(C), T1(Acute electromagnetic exposed group) , T2(Acute electromagnetic exposed group). Each test group was compared with the control group. (* = $P<0.05$)

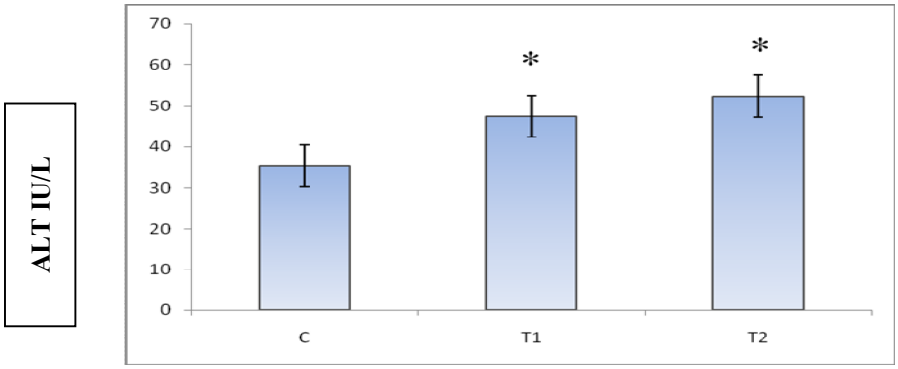

Fig. 2: The serum ALT levels in control(C), T1(Acute electromagnetic exposed group) , T2(Chronic electromagnetic exposed group). Each test group was compared with the control group. (* = P<0.05)

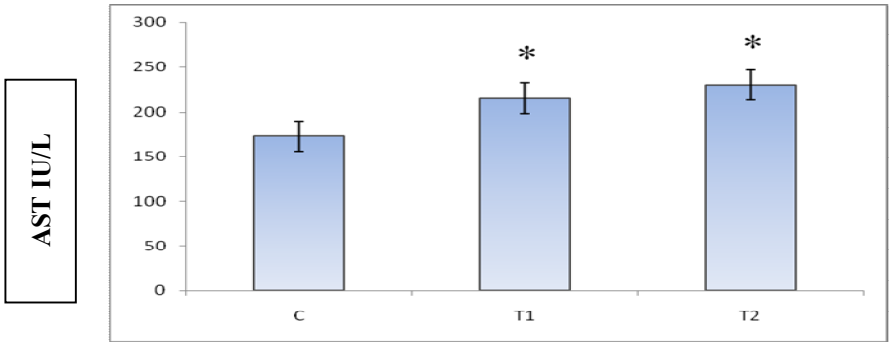

Fig. 3: The Serum AST levels in control(C), T1(Acute electromagnetic exposed group) , T2(Chronic electromagnetic exposed group). Each test group was compared with the control group. (* = P<0.05)

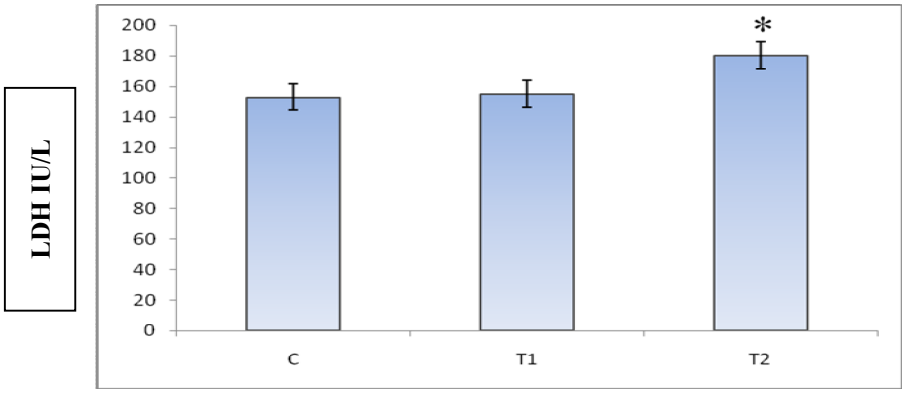

Fig. 4: The serum LDH levels in control(C), T1(Acute electromagnetic exposed group) , T2(Chronic electromagnetic exposed group). Each test group was compared with the control group. (* = P<0.05)

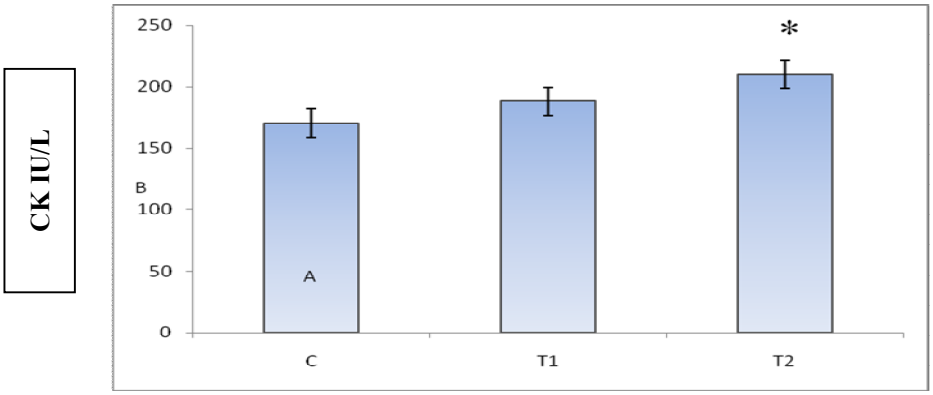

Fig. 5: The serum CK levels in control(C), T1(Acute electromagnetic exposed group) , T2(Chronic electromagnetic exposed group). Each test group was compared with the control group. (* = P<0.05)

DISCUSSION

In this study compared with control group a significant increase ofAST and ALT volume in serum of rats was found in both T_1 and T_2 treatment that exposed to electromagnetic fields.Most Studies about effects of electromagnetic fields on animals and humans has shown these fields affect the important biochemical mechanism in vary ways [5, 6, 7 and 8]. Several studies have been done on the effects of low frequency electromagnetic fields on the activity of transaminase enzymes thatsome part of thisresearch results are confirmed by a study which is done on ALT and AST Serum of a steel factory workers in 1999,in this study there is a significant rising in AST enzyme volume of workers with more than 10 years working record. Frequency and intensity of field in these workers environment was 50 Hz and 20 V/M respectively [9]. In another study the effects of electromagnetic fields transaminase enzyme activity was analyzed in liver of Indian pigs. In this study a 50Hz electromagnetic field caused changes in ALT and AST in liver of Indian pigs. The effect of electromagnetic field on liver's metabolism cells was the cause of hyper activity of AST and ALT enzyme in Indian pig's liver [8].In another study ten volunteers were place in an electromagnetic field with 10 mt (100mili gauss) of intensity for 15 days continuously and discontinuously and no changes in AST and AST enzyme volume have found (10,66). Also in another study that have been done on workers of electricity distribution units in 2003, no changes in AST and ALT activity have been recorded [1].Yaghmaei and colleagues in their study determined that short-term exposure to electromagnetic fields in rats has no significant change in alanine aminotransferase of rate but it can change aspartate aminotransferase (15). Another research determined long-term exposure (two weeks) of electromagnetic on rats can cause a significant rising of alanine aminotransferase and aspartate aminotransferase volume [4, 6].In some researches increase of alanine aminotransferase, aspartate aminotransferase and alkaline phosphatase in liver and increase of Billy Rubin, Albumin and proteins in rats' serum happend4.1, 0.1 and 6.2 mili tesla electromagnetic filed during two hours a week [16].Zaree and colleagues were observed Glycogenincrease in liver in Indian pigs by exposure them two and four hours during five days [17] There are several researches about the effects of electromagnetic fields on biological process such as Transaminase enzyme activity and vary results are reported [11, 12 and 13]. In some of these reports electromagnetic fields cause increase the activity of Transaminase enzyme but in some others no changes in activity of this enzyme were reported. One can say the vary results are caused by variety in factors such as frequency, field intensity, wave form, duration of exposure and type of animals. Previous results about the effects of electromagnetic fields on animals determined there are several factors involved in this process. Although it is a very complicated process but we can say that electromagnetic fields make some physical and chemical changes in body and then biological effects of these fields are observed. One of these main physical and chemical effects of electromagnetic fields is displacement bio-pole components and ion [9, 18 and19].In this research increase of ALT, ALP and AST enzyme in blood Plasma of animalswas observed. These enzymes areproposed as sensitivetitleIndex in relationship with livercellinjury. These enzymes contain high densityTransaminase inside the liver cells and log in the blood to change the permeability or destroyed the liver cells. Electromagnetic fields can affect the transaminase enzyme in vary forms such as their effects on liver Parenchyma cells. Another reason for increasing of transaminase enzyme activity may bethe effect of electromagnetic fields on basic trans-aminesenzyme's hormones contribution and performance in tissues like Glucocorticoid.In some studies it has been determined that electromagnet fields can effect on the level of some hormones in blood. In a study in 2005 on Indian pigs increasing of Cortisol hormone was observed in animals that were exposed by electromagnetic fields [18].

Considering the results of this research it can beconcluded that there are several factors involved in increasing liver enzymes in this situation so it is suggested to do supplementaryresearchs on effects of electromagnet fields on other enzymes and describe the clear relationship of those enzymes on liver activity.

REFERENCES

1. Pashaee,R., (2003). The Physics and its applications in health science.Third Edition. *Tehran University Press*.Tehran.3:48.
2. Aziz, Z., Flemming, K., Cullum, N.A. and OlyaeeManesh, A, (2010). Electromagnetic therapy for treating pressure ulcers.*Cochrane Database System Review*, 10: 11-17.
3. Edmonds, D.T., (1993). Larmor precession as a mechanism for detection of static and alternating magnetic fields. *Biochemistry and Bioenergetics*, 30:3-12
4. Garaj-Vrhovac, V., (1990). The effect of microwave radiation on the cell genome. *MutationResearch*, 243: 87-93.
5. Juutilainen,J., (2003). Developmental effects of extremely low frequency electric and magnetic fields. *Radiataion Protection Dosimetry*. 106(4):385-390.
6. Yokus, B., Cakir, D.U., Akdag, M.Z., Sert, C., Mete, N., 2005. Oxidative DNA damage in rats exposed to extremely low frequency electromagnetic fields. *Free Radical Reserch*.39(3):317-323

7. Kula ,B., (1993).A study of magnetic field effects on fibroblasts cultures. The evaluation of effects of static and extremely low frequency (ELF) magnetic fields on glycoaminoglycan metabolism in fibroblasts, cell coat and culture. *Bioelectrochemistry and Bioenergetics*. 39: 31–37.
8. Kula, B., (1988). Effect of electromagnetic fields on the living body. II. Changes in alanine and Aspartate aminotransferase activities in subcellular fractions of the liver of guinea pigs. Medical Progress.39(1):8-14.
9. Kula, B., Sobczak, A., Grabowska-Bochenek, R., 1999. Effect of electromagnetic field on serum biochemical parameters in steelworkers. *Journal of Occupational Health*.41:177-180.
10. Lahijani, M.S., Ghafoori, M., (2000). TeratogenicEffects of Sinusoidal Extremely Low Frequency Electromagnetic Fields onMorphology of 24 hr Chick Embryos.*Indian Journal of Experimental Biology*.38(7):692-9.
11. Rajaei, F., Mohammadian, A., (2013). Effects of Extremely Low Frequency Electromagnetic Field on Mouse Liver Histology. *Qom University Medical Science Journal*. 6(4):8-13
12. Saadat, I., Sedaghat, Z., Afhami, M., Bahaoddini, A., Saadat, M., (2010). Effect of a 50-Hz Electromagnetic Field on the GeneExpression of Glutathione S-transferase T1 (Gstt1) In the Testis and Liver of Male Rats. *Comparative Clinical Pathology*.19:211-214.
13. Selmaoui B, Lambrozo J, Touitou Y, (1999). Assessment of the effects of nocturnal exposure to 50-Hz magnetic fields on the human circadian system.A comprehensive study of biochemical variables.*Chronobiology International*.16 (6):789-81
14. Sherman, R.A., Acosta, N.M.,Robson, L., (1999). Treatment of migraine with pulsing electromagnetic fields, a double-blind, and placebocontrolled study.*Headache*. 39:567-575.
15. Yaghmaei,p., K,Parivar., D,Doranian., M,Hashemi., F,Torkaman., (2009). Study the effect of extremely low frequency electromagnetic fields on some blood serum's lipoproteins, liver enzymes and P448/P450 cytochrome enzyme system in NMRI female mice. *Journal of Paramedical Science*. 1: 74-80.
16. Yokus, B., Cakir, D.U., Akdag, M.Z., Sert, C., Mete, N., 2005. DNA Oxidative Damage in Rats Exposed to Extremely Low Frequency Electromagnetic Fields. *Free RadicalResearch*. 39(3):317-23
17. Zare, S., Alivandi, S., Ebadi, A., (2007. Histologicalstudies of the low frequency electromagneticfields effect on liver, testes and kidney inguinea pig. *World Applied Sciences Journal*.2 (5):509-11.
18. Zare, S., Hayatgeibi, H., Alivandi, S., (2005). Effects of whole-body magnetic field on changes of glucose and cortisol hormone in guinea pigs. *American Journal of Biochemistry and Biotechnology*.1 (4):217-219.
19. Zhang, X., Zhang, H., Zheng, C., Li, C., Zhang, X., Xiong, S., (2002). Extremely low frequency (ELF) pulsed-gradient magnetic fields inhibit malignant tumor growth at different biological levels. *Cell Biology International*.26:599–603.

Citation of this article

Allahverdi Hazeghi Rad, Ali Zanbouri , Ehsan Hosseini. Effects of Extremely low Frequency Electromagnetic Fields on Liver Enzymes in Male Rats.Bull. Env. Pharmacol. Life Sci., Vol 3 (1) December 2013: 223-227