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STUDY EFFECT OF ELECTROMAGNETICFIELD ON SOME PHYSIOLOGICAL AND HISTOLOGICAL CHARACTERISTICS ON THE LIVER OF MICE

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Abstract–Since electromagnetic fields are present everywhere all over the world and are produced by either natural sources or human-made sources, there is a growing interest in the potential biological effects on both human and animal health. For that, we conducted this study. The aim of the present work is to evaluate the effect of electromagnetic field (EMF) of intensities 217G generated from 220 volt electric on the physiology and histology of the liver in male mice. The male mice were, the whole body, exposed to these intensities an hour/day for 30 days. In this study, twenty adult male Swiss mice at 30 days were divided into two groups of 10 animals: Group I (control group) was not exposed to EMF and Group II (experimental group) was exposed to an hour/day for 30 days to 217G generated from 220 volts electric. At the end of 30 days, the mice were weighted sacrificed dissected, after then the liver was weighted and submitted for histologic examination. The rat liver function was studied through analysis of Aspartate transaminase (AST), Alkanine transaminase (ALT), Alkaline phosphatase (ALP) and total dissolved protein, after exposure to the magnetic fields. The results showed that exposure to the electromagnetic field had a significant increase in total dissolved protein, and ALT concentration compared with control group ($P<0.01$). And a significant decrease in Concentration of ALP enzyme compared to control group ($P<0.01$). While there was no a significant increase in the efficacy of (AST) compared with the control group. Also, the histological study showed significant tissue changes in the central vein and proximal blood pockets compared to control group.

INTRODUCTION

In view, the recent developments in technologies, daily exposure to strong static magnetic fields (SMF) are increasing. In particular is the increasing use of magnetic resonance imaging (MRI) for medical diagnoses. Such strong-SMF exposure systems have great potential to improve medical and research applications. The hitherto studies indicated that SMF causes changes in electrolytes level and tissues histology (Aberumand *et al*., 2016).

Recently, the environmental contact with electromagnetic energy sources has increased steadily with increasing demand for electricity, ever-advancing technologies and changes in social behavior have created many artificial sources, including power lines, microwave ovens, computers and television, and most recently mobile phones and their base stations. Therefore, there has been increasing interest in the biological effects and possible health outcomes of Electromagnetic Fields (Azab and Ebrahim, 2017; Casselman, 1962). Epidemiological studies on magnetic fields and cancer, reproductive and neurobehavioral reactions

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have been presented. More recently, neurological, degenerative and cardiac diseases have been reported to be related to these electromagnetic fields (Aberumand *et al.*, 2016; Elmas, 2016).

MFs were observed to influence enzyme action, protein synthesis, gene expression and signal transduction. These activities play an important role in regulating cell growth and process important to promotion (Ebrahim, 2016). In addition, the alteration may affect biochemical processes in the cell, thus changing both biochemical parameters and enzyme activities of the blood serum. Recent electron microscopy studies on the liver tissue and hepatocytes have shown that constant magnetic fields exhibited structural changes in hepatocytes, primarily in mitochondria and also cell membrane division (Gornal, 1949). Moreover, constant and low-frequency MFs exert a preponderant controlling effect on the metabolism; thermoregulation and hematology in rats (Goodman and Blank, 2002). The exposition of rats 1 hour/day for 10 consecutive days to a Static MF of 128 mT causes an increase in hematocrit, hemoglobin, plasma fuel metabolites and tissue enzymes releases within the blood (Havas, 2013). Several studies suggested that chemical and physical processes at the atomic level are the bases of reactions between biomolecules in electromagnetic fields from the field can magnetism affect the chemical bonds between adjacent atoms with consequent production of free radicals (Henry, 1964; Hudyma, 1994). Liver function tests represent a broad, wide of normal functions performed by the liver. The diagnosis of liver diseases depends on a complete history, complete physical examination and evaluation of liver function tests. Hepatocellular inflammation leads to elevation of (ALT), and (AST). Inflammation of the biliary tract cells predominantly results in an elevation of (ALP). Liver diseases, there are crossovers between purely biliary and hepatocellular diseases (Herbert, 2013; Ibrahim *et al.*, 2008].

The aim of this study is to evaluate the effect of magnetic fields on physiology and histology of the liver in male mice.

MATERIALS AND METHODS

Animals

Twenty male Swiss mice of the Balb type were used in the study. The average age was (30) days, and weighing (20-30) g that were obtained from the National Monitoring and Drug Research Center of the Ministry of Health - Baghdad. The mice used in the present work complied with legal requirements and institutional guidelines. The mice were housed individually in plastic boxes under similar conditions of temperature,illumination, and received the same diet during the course of experiments (Jadidi *et al.*, 2013).

Exposure System and Magnetic Field

The exposure system is designed locally by one of the competent electrical engineers as shown in Fig 1. Electromagnetic energy generator 217G was generated from 220-volt electric. Animals were grouped as follows: Control group (n=10) and experimental groups (n=10). Mice exposed an hour/ day for 30 days to 217G were compared to control group. Control group was fed under the same environmental conditions as the experimental group.

Fig. 1. Exposure System

Biochemical Analysis and Tissue Preparation

Liver tissues of the experimental animals were removed after the expiry of the exposure period for that magnetic intensity; mice were taken and weighed before the killing, and then explained. The liver was weighted and placed in (10% Formalin +0.8 Normal saline) for 24 hours. Then the liver tissue was crushed using a Homogenizer in a snowy environment after adding the solution (Tris HCl, pH 7.2) and 1: 5 (weight/ volume) to determine total protein content using the method adopted by Henery (Khaki *et al.*, 2015). The serum was used to measure the liver function tests; where serum total protein measured by using the Biuret method[15], according to Reitman and Frankel [16] Was measured (ALT), (AST), and the efficiency of the enzyme (ALP) was measured by Kind & King [17] method.

And for the purpose of histological study followed the steps Histological technique which can be divided into a similar series of steps as follows: Tissue resection, Fixation, Dehydration, Clearing, Infiltration, Embedding in paraffin and Staining& Catting (Hematoxylin and Eosin=H &E stained) (Lagroye *et al.,* 2011).

Statistical Analysis

The experimental data are presented as mean±SD. The statistical analysis was conducted by CoStat software (CoHort Software, Monterey, CA, USA). Differences between the two groups were detected by one-way analysis of variance (ANOVA) and the t test. A (*P*) value <0.01 was considered significant.

RESULTS

Effect of the stable electromagnetic field on the male mouse liver function

The results showed that the activities of all examined function tests increased if compared to control. There was a significant increase (P<0.01) in the total dissolved protein and the efficacy of ALT in the male liver exposed to a magnetic field of 217G compared with the control group as shown in fig (2A and 2C). Also, In fig (2B) the results showed that there was a significant decrease (P<0.01) in the activity of Alkaline phosphatase (ALP), in the liver of male mice that have been exposed to a magnetic field of 217G compared to control group.

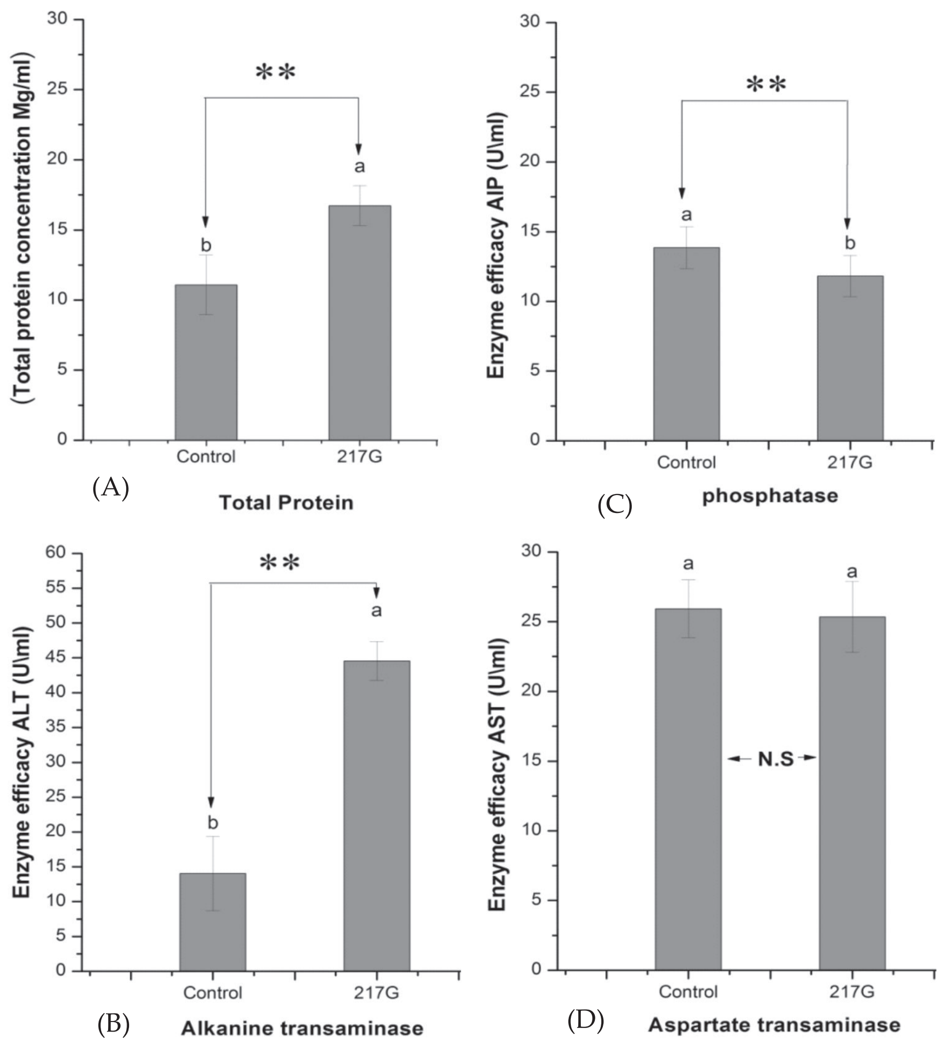

Fig. 2. The effect of the stable electromagnetic field on the male mice liver exposed to the 217G within 30 days. (A) Total dissolved protein in the group exposed to 217 G and control group. (B) Efficacy of Alkaline phosphatase (ALP), in the liver of male mice.(C) Efficacy of Alanine transaminase (ALT), in male liver mice. (D)Efficacy of Aspartate transaminase (AST), in the liver of male mice.The significant difference (P<0.01). (n=10)

While the results of our study showed that there was no a significant increase in the efficacy of Aspartate transaminase (AST) for male mice liver exposed to a magnetic field of 217G compared with the control group as shown in fig 2D.

Histological Study

The histological study of the male liver exposed to a magnetic field of 217G showed some histological changes in the transverse sections compared to the control group (Fig 3). Hepatic cells were large, a distinct central nucleus, and a clear acidic cytoplasm separated by the sinusoids, which appeared somewhat enlarged, lined with dark-colored endothelial cells and some Kupffer cells. Also, the central vein was slightly enlarged in the middle of each hepatic lobule (Fig 4).

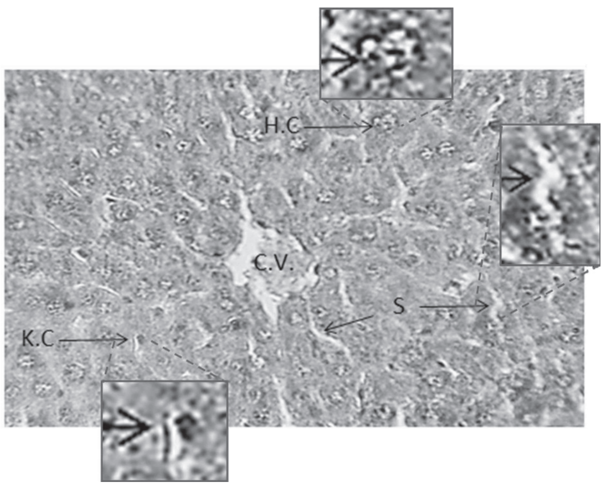

Fig. 3. Microscopic section of the liver of the control group showing Hepatic cells (H.C), Sinusoids (S) and the emergence of infected cells Kupffer cells (K.C.) with the appearance of the Central Vein (C.V.). (OriginalmagnificationX1230, H & E stained).

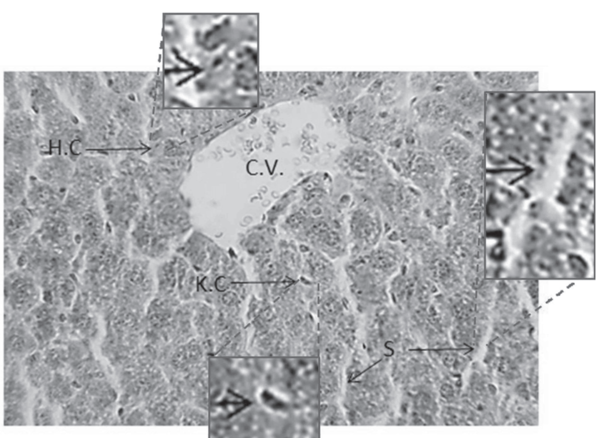

Fig. 4. Microscopic section of the liver of male mice exposed to a strong magnetic field 217G, where hepatic cells (H.C), the appearance of Sinusoids (S) are enlarged and the number of infected cells is exposed Kupffer cells (K.C) With central vein (C.V) appearing in the center of the liver lobes. (Original magnification x1230, H & E stained).

DISCUSSION

The results of the present study showed a significant increase in the concentration of total dissolved protein in the male mice liver exposed to (EMF), This increase may be explained by the role of the magnetic fields in the process of making proteins and thus may cause the production of new proteins (Markov, 2004). Exposure to magnetic fields improves metabolism and synthesis protein by supporting and forming amino acids. These fields act as nutrients to transport and absorb nutrients through cell walls and membranes easily (Parafiniuk *et al.,* 1992).

The obtained data showed that (EMF), produced an alteration in biochemical parameters of the liver in mice. We found a decrease in the efficacy of ALP may be due to the effect of these domains in the process of synthesis of the enzyme. Which in turn affects the process of release of the inorganic phosphate group. Thus altering the activity of the organism (Reitman and Frankel, 1957). Also, the results showed that exposure to (EMF) could cause an increase in the enzyme activity of ALT and AST in the male mice liver extract. This increase may be due to the role of these domains in the magnetization of the body water, which plays an important role in activating enzymes, which in turn works to modify the cell function (Roivainen *et al.,* 2014). This is consistent with Ibrahim et al. [23] studied the effect of 50 Hz magnetic fields on liver function and attributed the increase in the liver enzymes and protein as a result of the damaged cells which leak into circulation after exposure to magnetic fields. It was also found that *in vivo* exposure to a pulsed magnetic field at 1.5 mT caused significant changes in plasma proteins in rats (Stein *et al.,* 2015). This observation supports the hypothesis that the state of physiological balance of a biological system is crucial to its response to a potentially effective electromagnetic field (Sihem *et al.,* 2006).

The histological study, showed there was no apparent effect on the liver tissue compared with the control animals. The effect mechanism of (MF) in the histological characteristics is not yet known. However, different mechanisms have been proposed that (EMF) might amplify electric currents in tissues and cells or affect through resonance with a local field focus (Sepehrimanesh *et al.*, 2014). Another possibility is that (MF) may interact with the intracellular magnetic field, while the presence of magnetic impulse in tissue has been reported (Sallam *et al.*, 2006). Because these effects depend mainly on the severity of the area exposed to the living organism (Sonnier *et al.*, 2005), but the occurrence of some minor changes in the compositional structures may depend on the direct impact of those areas that cause Apoptosis (Zhang *et al.*, 2014).

CONCLUSION

The results of our studies showed All liver function tests are influenced as a result of exposure to EMF. As is known liver enzymes increase in hepatic diseases and toxic damage to liver cells. Also, the field affects the liver tissue.

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