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EFFECTS OF MOBILE PHONE RADIATION ON THE LIVER IN RATS

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ABSTRACT

In recent decades many studies has taken to investigate the relationship between electromagnetic fields with different intensities on the incidence of fetal developmental disorders, infertility, sleep disorders, gastrointestinal, cardiovascular, hematopoietic tissue neoplasms in a variety of disorders or hematopoietic growth process. The results of these studies were varied and contradictory; therefore, the research in this field is still wide. In this study the effect of mobile radiation has been studied on the liver in rats.

A total of 40 adult male Wistar rats weighing 20 ± 200 g were prepared and divided into 4 groups of 10 categories, including: Control, Sham, experiment 1 and experiment 2. Control group received no radiation exposure controls. Sham group were used no conversations on mobile phones and similar devices used in the experimental group (with the same conditions). Experimental groups 1 were exposed to 5 times per day for 1 month, and every 10 minutes on the phone calls and experimental groups 2 were exposed to 5 times per day for 1 month, and 20 min to mobile calls. Then at the end of a period of months, rats sacrificed in all groups and describe the changes in hepatocytes, cell necrosis and lymphocytic invasion of liver cells in different groups. There was a significant increase in liver weight in experimental groups 1 and 2 compared to the control group. Changes indicate liver cell necrosis and fatty changes in the different experimental groups ($P < 0.05$). The results show that radiation from mobile phones may have severe effects on the liver.

Keywords: Mobile Wave, Liver, Rat

INTRODUCTION

Despite extensive research on the biological effects of electromagnetic fields, radio frequency systems, mobile phones and provides safety recommendations and the thermal effects of microwave stations, less attention is to the biological effects of pulsed low frequency magnetic fields from mobile phones [1, 2]. Incidence of neurological problems are not available in some phone users and non-thermal effects are not conclusive in this field, the biological effects of low-intensity pulsed radiation has made the telecom systems, so that in the event of damage to the public health, safety recommendations [3]. It is a physical phenomenon associated with electrodynamic electromagnetic phenomena. Electrical and magnetic properties of the following areas that are relevant to the position, so that the electric field and the magnetic field varies with each individual particle in the field at the same time, other factors contribute to the atmosphere. Both particle and wave properties of electromagnetic waves is a point [4]. The speed of light as a wave of wavelength and frequency is divided and when it is considered as a particle known as photons and energy associated with each wave are given [5-7]. The basic structure of matter consisting of a charged particle in

different directions is very high. When electromagnetic radiation occurs in the range of charged particles on a material and obtains energy. The final state energy is situation dependent and can reflect the rate and distribution of reflected or transmitted light appears. The same can be other microscopic motions within the matter that resulting in thermal equilibrium and demonstrate its power to heat the material to appear [5]. Electromagnetic radiation can be absorbed and readily available material is heated, radio waves can be severe thermal burn living tissue and can cook. In addition to infrared lasers, sufficiently intense lasers in the visible and ultraviolet range of the fast electrons in the material and break chemical bonds. The radiation can be absorbed simultaneously by the other components of energy balance and is warming the material [6]. Average frequency waves emitted from cell phones to GHz1 MHZ900 this frequency is limited. The wavelength of the radiation energy absorbed by the molecules, causing molecular vibrational energy of the molecule and its temperature is changed. Biological effects of microwave detection is complex and controversial, and there is evidence that indicates the severity and frequency of these waves in terms of frequency and duration of

exposure for biological effects of exposure to radiation can cause different molecules [9, 10]. In previous research stated that cell phone radiation for three weeks, 8 hours a day, reduced the rabbit serum antioxidant capacity [11]. Waves can cause irritability, bone marrow cells [12]. Magnetic fields on cell properties, sharing plan and could affect mitotic apparatus reorientation [13]. So according to the above and effect of microwave radiation and the risk of liver cell phone as a necessary organ in the body is an important issue that is important in this study. In all of the research ethics of working with laboratory animals have been observed. 40 adult male Wistar rats weighing 20 ± 200 g and were taken two and a half months. Before starting the experiment, the animals are given a week to get used to the new environment and began the test period. Animals in laboratory conditions include a temperature of 2 ± 22 ° C and 12 h light and 12 h dark cycle was used. Rodents used in food animals and food and water were free. How to create waves in the case of three mobile phones that are connected to one side of the cage was used. Rats were kept in cages inside the aluminum box and a 5 means it was not put back to keep out radiation. To create waves, cell phone calls and put the state during irradiation to ensure the aluminum sheet was

placed on the cage. The rats were randomly divided into 4 groups of 10.

1. Control group did not receive waves, and were kept under normal conditions.
2. Sham group: The group exposed to light, but no phone calls using the same phone in the experimental group (with the same conditions) were used.
3. Experimental1 group: per day for 1 month and 5 times, each time for 10 minutes of phone calls was exposed.
4. Experimental 2group: the period of 1 month and 20 minutes per day, 5 times the calls were placed under mobile.

After the injections, the mice in all groups after anesthesia were dissected and liver tissue in 10% formalin after washing with saline (fixator) and next steps for the preparation of slides of tissue sections stained with hematoxylin and eosin were used. Then the tissues taken from different sections of liver cell necrosis of hepatocytes, influx of lymphocytes, hydropic swelling, granular cells, liver Kupfer cells increasing congestion of central vein lobules, chromatin changes in the liver cells, the nucleus of the cell wall changes in hepatocytes and channels and increased biliary and hepatocyte ballooning to examine it by the light microscope were performed. The liver histopathological

changes were scored using the results in **Tables 1, 2 and 3** are shown below. Tables indicate the degree of tissue damage is zero to 4 represent the minimum and maximum damage. Zero means there is no harm. Level 1 of the degree of injury is very low, grade 2 moderate degree of injury, grade 3 and grade 4 large degree of injury is too high.

RESULTS

Liver weight in experimental groups 1 and 2 of **Figure 4** is a significant increase compared to the control group ($P < 0.05$). What is certain

is that the photomicrograph [2] is well seen in hydropic swelling, photomicrograph [3] cell necrosis, Photomicrograph [4] influx of lymphocytes and photomicrograph [5] Changes in nuclear and chromatin wall. According to **Tables (2 and 3)** changes in fat cell necrosis was observed in most groups. To compare the effects of different sounds waves, the statistical analysis of ANOVA followed by Tukey's post hoc test was performed using SPSS software, and the level of significance ($P < 0.05$) were selected.

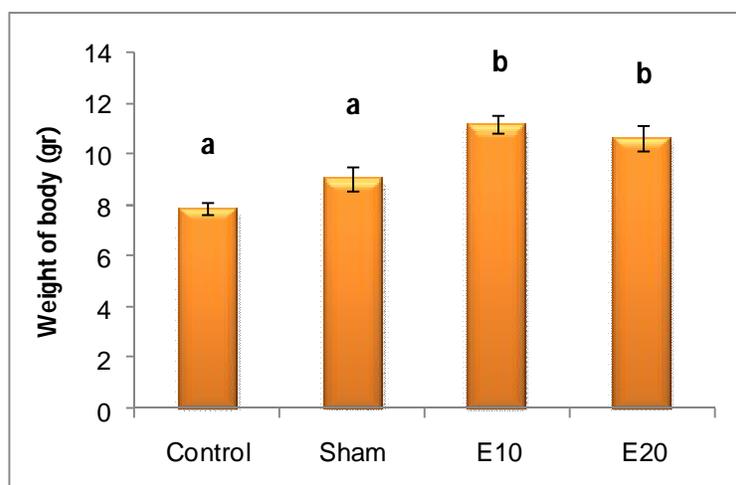


Figure 1: Changes in Liver Weight After Radiation From Mobiles

Table 1: Changes in Liver Tissue of the Control and Test Groups of Rats

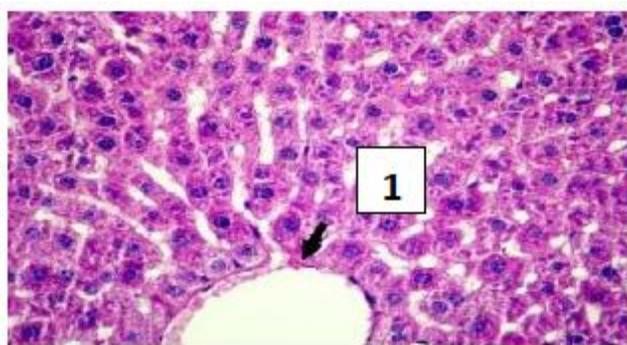
Changes in the core wall		Granular cells		Cell necrosis		Changes in fat		Hydropic swelling		Lymphocytic invasion	
Rat	Degree of damage	Rat	Degree of damage	Rat	Degree of damage	Rat	Degree of damage	Rat	Degree of damage	Rat	Degree of damage
6	0	6	0	2	0	3	0	6	0	6	0
	1		1	4	1	3	1		1		1
	2		2		2		2		2		2
	3		3		3		3		3		3
	4		4		4		4		4		4

Table 2: Changes in the Liver in the Experimental Group After the First Test in Rats

Changes in the core wall		Granular cells		Cell necrosis		Changes in fat		Hydropic swelling		Lymphocytic invasion	
Rat	Degree of damage	Rat	Degree of damage	Rat	Degree of damage	Rat	Degree of damage	Rat	Degree of damage	Rat	Degree of damage
6	0	6	0	0	0	0	0	6	0	6	0
	1		1	0	1	6	1		1		1
	2		2	6	2		2		2		2
	3		3		3		3		3		3
	4		4		4		4		4		4

Table 3: Changes in the Liver of Rats in Experimental Group 2 After the Test

Changes in the core wall		Granular cells		Cell necrosis		Changes in fat		Hydropic swelling		Lymphocytic invasion	
Rat	Degree of damage	Rat	Degree of damage	Rat	Degree of damage	Rat	Degree of damage	Rat	Degree of damage	Rat	Degree of damage
6	0	6	0	0	0	0	0	6	0	6	0
	1		1	0	1	6	1		1		1
	2		2	6	2		2		2		2
	3		3		3		3		3		3
	4		4		4		4		4		4

Figure 1: Optical Photomicrograph the Central Vein of the Liver in the Control Group (1) is Normal (H & E Staining, Magnification $\times 400$)

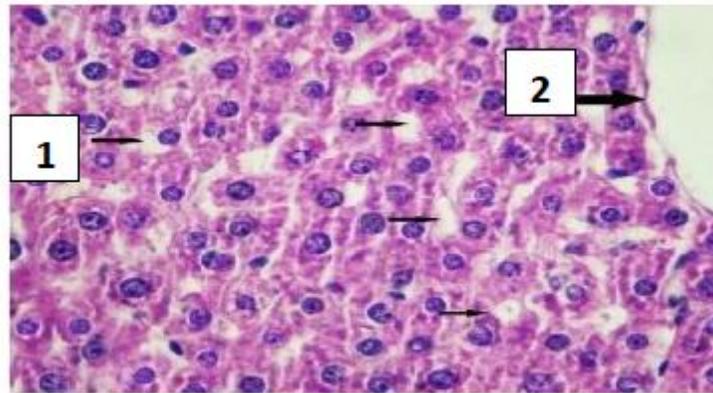


Figure 2: Photomicrograph Light Hydropic Swelling of the Liver Hepatocytes (1) Around a Small Central Vein (2) Mild and Gentle as can be seen (H & E Staining, Magnification $\times 400$)

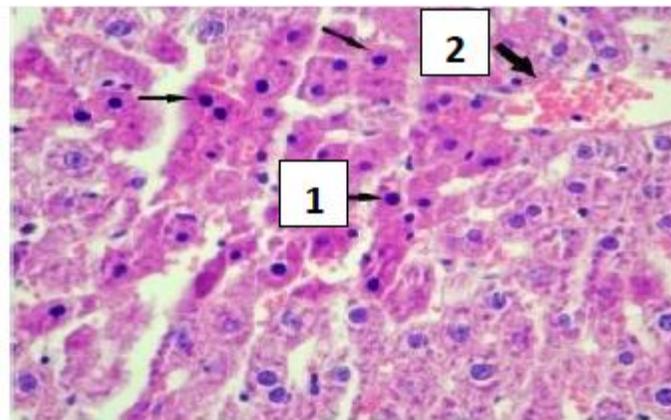


Figure 3: Photomicrograph Light of the Liver, Liver Cell Necrosis (1) Around a Small Central Vein; Hyperemia (2) can be seen (H & E Staining, Magnification $\times 400$)

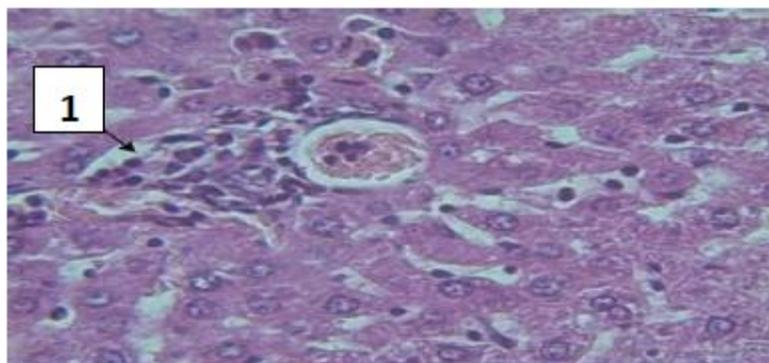


Figure 4: Photomicrograph Light, Liver Tissue Influx of Lymphocytes (1) Around a Small Central Vein, Congestion is Observed (H & E Staining, Magnification $\times 400$)

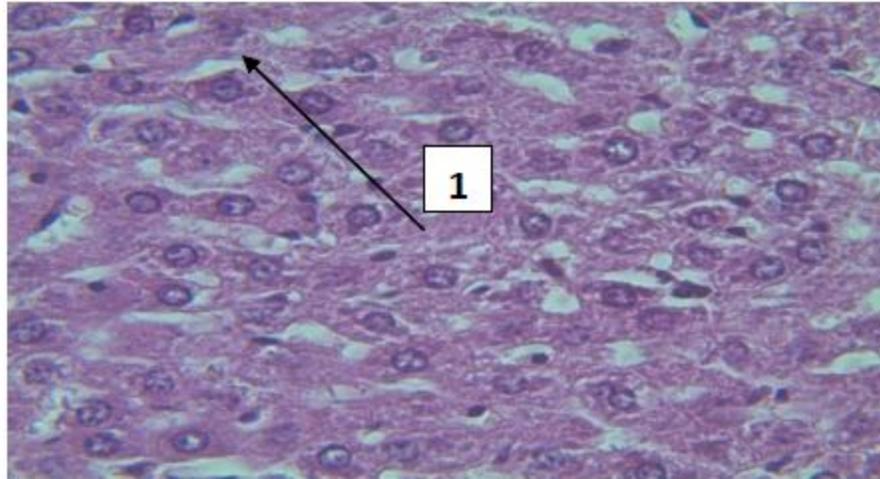


Figure 5: Photomicrograph Light Liver, Changes in Chromatin and Core Wall (1) (H & E Staining, Magnification $\times 400$)

DISCUSSION

Study on characteristics of electromagnetic fields began in the twelfth century; a very unusual trait in that period was attributed to the electromagnetic field. Celsus also believed that the "force of the magnet will stop the disease. Hence, it should be at the center of disease" [14]. Electromagnetic waves can affect the homeostasis of iron in biological systems. The result is an increase in cytoplasmic and nuclear free iron may increase the hydroxyl free radical production and damage to DNA [15]. All electrical equipment every day at work, home, or place of rest we use them all and we humans are electromagnetic waves produced due to modern life we are exposed to these waves [14]. Many different studies have investigated the effects of mobile phone radiation damaging various organs including adverse

effects on renal tissue that impairs blood flow in the renal that this suggests that a hemodynamic disorder, stromal edema, renal tubular dystrophy, inflammation of the interstitial tissue and sclerosis around their glomeruli [16]. Liver weight in rats in the experimental group 1 than in the control group showed a significant increase (**Figure 1**). The research that has been done in the past expressed that the sounds of waves with a frequency of 900 MHz to 1 GHz on liver weight in mice suggests ineffective waves have been studied [17], which is contrary to the study. The effect of magnetic fields on accelerating the growth of liver tumors has been observed in different individuals [18]. However, the risk of changes in the liver has been many people who are constantly exposed to electromagnetic fields have been reported [19]. Also clear that the

electromagnetic waves emitted by human means used to increase intracellular calcium [20, 21]. Also known as the waves are induced production of free radicals [22, 23]. In the present study, the majority of the experimental groups in lipids have been observed in liver tissue that this could be the reason for the increase in liver weight and of course, the difference with previous studies of the electromagnetic field can be generated, gender and duration of rats tested as well. The experimental group also had a 10-minute necrosis. The experimental group received 20 minutes of changes in fat cell necrosis and granular cells was observed in hepatocytes. In this study, degenerative changes and extensive areas of necrosis and hemorrhage were caused by radiation emitted from mobile phones. Create free radicals in cells and cell membranes in combination with unsaturated fatty acids with molecular oxygen to produce lipid radical and endoplasmic reticulum phospholipids, resulting in the release of enzymes that break down and cause these reactions ultimately leads to cell death and cell necrosis [24, 25]. As stated in previous reports, the electromagnetic waves are produced free radicals [22, 23]. Cell necrosis in the different experimental groups seems quite reasonable. It is thought that electromagnetic fields on the body with a

rapid exchange of water and electrolytes, such as the liver, with different intensities affect different effects. However, some parts of the electromagnetic field in the liver, but this does not mean ineffective that these waves have no effect on the tissues, but the intensity is necessary for the special effects are different in different organs, organ may be sensitive to low intensity, While the other extremity is highly sensitive and high-capacity electromagnetic field intensity varies depending on the tissue and two parts of a building will never have the same effect [26]. Changes seen in the liver of experimental groups with different severity of injury [27]. The most severe effects of electromagnetic fields have increased body temperature. The main effect of these fields has increased body temperature, although many studies have shown that the temperature of the skin and subcutaneous tissue is extremely high and can sometimes cause skin burns. High temperatures and cause damage to internal body organs, vessels, internal bleeding causes. In fact, this is one of the mechanisms that cause cell damage, hypothermia [28]. Studies have shown that static electromagnetic waves into the body, especially the extremities with intermittent exchanges of water and electrolytes beat. Intensity pulsed electromagnetic fields 0.5-0.3

Tesla and 24-4h for different cells are the harmful effects [29]. Other research has shown that the electromagnetic field intensity 0.5mt affecting the balance between cell death and proliferation. Morphological analysis is shown the percentage of necrotic cells. Gradual decrease in the intensity gradually increased apoptosis and necrotic cell morphology occur. The effect of electromagnetic field depends on the cell type and may be stored nephropathogenic of tissue [30] or, in some cases, as well as increased numbers of mast cells and nerve cell function [31]. However, each of these changes are detrimental and was expressed as the increase of heat generated is also another way to liver damage that caused by electromagnetic waves.

CONCLUSIONS

According to research conducted, it can be found that radiation from mobile phones can have harmful effects on the liver. However, the duration and intensity of the radiation emitted waves will also consider the results of this research can be extended in part to humans.

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