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RESEARCH PAPER

Effects of Radiofrequency Electromagnetic Radiation of Mobile Phones on Sperms Shape and Number in Male Albino Mice

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A B S T R A C T:

The majority of adult populations throughout the world currently use and are exposed to radiofrequency electromagnetic radiation emitted from mobile phones, and male infertility accounts for around half of all cases worldwide. The goal of this study was to evaluate the impacts of radiation from mobile phones on morphology and the number of sperm in male albino mice in both talking and non-talking modes. In this investigation, twenty-four mice were used and separated into three groups each of eight mice. The first group was the control group; exposed to a switched-off mobile phone for two hours per day. While, the second group was exposed to a mobile phone with non-talking mode for 2 hours per day, and the third group to a mobile phone in talking mode for 20 minutes per day. All mice were tested for sperm shape abnormalities and sperm count tests after six weeks of treatment. Results of the current work showed that exposed group G3 (mobile phone in talking mode) have significant changes in sperms shape and decline in sperm count in comparison with control group (G1). While the limited handling of mobile phone without talking (for about two hours per a day, G2 group) has no bad effects on sperms morphology and concentration in compare with the control group (G1).

KEY WORDS: Radiofrequency electromagnetic radiation, Mobile, Sperm shape abnormalities, Sperm count.
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1. INTRODUCTION :

Mobile phones are currently owned by the majority of adult men. Possible impacts of mobile use on human health are a concern nowadays. Mobile phones emit electromagnetic radiation (EMR) at low level radiofrequency (RF) between 800 and 2200 MHz that can be absorbed by the human body (Agarwal et al., 2009). The majority of mobile phones are having a specific absorption rate (SAR) of 1.4 W/kg which is legally limited to 2.0 W/kg (Agarwal et al., 2011).

EMR is unlikely to ionize atoms or molecules at this low frequency (Erogul *et al.*, 2006). However, the potential harmful effects of EMR on human health include: headaches, abnormal changes during sleep in electroencephalographic (EEG) activity (Oftedal et al., 2000), and elevation of resting blood pressure (Braune *et al.*, 1998).

Huber et al., (2000) proposed that mobiles and other devices that can emit Rf-EMR radiation have destructive effects on human fertility (La Vignera *et al.*, 2012).

In certain animal studies, mobile phone use has been associated with a cause decreasing in sperm quantity (Kesari *et al.*, 2010) and motility (Mailankot *et al.*, 2009), assuming a male reproductive impairment, but their effects are not consistently observed by Dasdag *et al.*, (2003). Mobile phone use has been associated with lowering sperm motility, vitality, and viability in humans (Dkhil *et al.*, 2011). However, the investigations are contradictory. Some studies have shown negative effects on sperm motility but not on sperm count (Fejes *et al.*, 2005), but others have found no link between sperm quality and exposure to electromagnetic radiation (Feijo *et al.*, 2011 and Syam *et al.*, 2017). Another study

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discovered harmful effects on sperm viability and motility from use of the mobile phones (Adams *et al.,* 2014).

The major targets of mobile radiation harm on the reproductive system in the males are leydig cells, seminiferous tubules, and spermatozoa. Cellphone exposure, in particular, lowers testosterone production, weakens spermatogenesis, and destroys sperm DNA. The major mechanisms of injury include scrotal hyperthermia and oxidative stress and oxidative stress (Depinder *et al.,* 2007).

At least two of the most extensively used parameters for evaluating sperm quality appear to be affected by mobile phone usage (WHO, 2010). Exposed men's sperm motility is expected to be 8% reduce than non-exposed men's. However, the effect of using cell phones is accumulative and use of it might be part of a larger effect of modern environmental exposures that impair sperm quality and explain current infertility problems. Wi-Fi from laptops, for example, has been shown to hurt sperm quality (Avendano *et al.,* 2012).

The present work was designed to investigate the effects of radiofrequency electromagnetic radiation of mobile phones in both talking and non talking mode on sperms shape and number in male albino mice, using sperm shape test and sperm count test.

2. MATERIALS AND METHODS

2.1.Mice treatment:

Adult Male albino mice (16-20 weeks) and weight about (30-35 g), were utilized in the experiment, which were housed at the Biology department of College of Science - Salahaddin University – Erbil's animal house and lived with continuous environmental situations with a 12:12 light-dark cycle. The mice were fed standard chow and permitted to drink water as needed (Aziz *et al.,* 2012).

2.2. Experimental design:

Twenty-four mice were involved in the current work, which were divided into three groups of eight mice each. For six weeks, the first group (G1) was exposed to a switched-off mobile phone for two hours every day, the second group (G2) was exposed to a switched-on, none-talking mode mobile phone for two hours daily. While the third group (G3) was exposed to a mobile phone in talking mode for 20 minutes each day according to Dasdag, et al., (2003). Samsung Galaxy phone (J7 prime model) was used by placing the mobile 5 cm above the cages.

2.3. Slides preparation of sperm from epididymis:

The epididymis and vas deference were taken after the animals were killed and then they placed in a tiny petri plate containing normal saline. Then sliced into many pieces with a sharp scissor and the sperms were discharged into the saline solution. The sperm suspension was smeared on a slide and dried, then fixed with fixative (absolute methanol and glacial acetic acid in a ratio of 3:1) before being stained with Hematoxylin for 15 minutes. The slides were then rinsed with tap water and stained with 1% Eosin for 5 minutes. The slides were cleaned with distilled water and allowed to dry, then examined under the microscope (Yaseen and Al-Attar, 2014).

2.4. Sperm counting:

The epididymis was removed, sliced and minced in a small petri dish containing 2 ml of phosphate buffer saline (pH= 7.2). Then, the tissue fragments were removed by filtering the sperm suspension with a mesh. After that, an aliquot (0.05) from the filtered sperm suspension (1m) was prepared with phosphate buffer saline (1:40) and mixed well. Later, from the diluted suspension, few drops were mounted on the hemocytometer and examined under a light microscope to count the sperms. The number of counted sperms in 8 large squares was multiplied by 5x106 to represent the number of sperms per epididymis. (Shetty and Bairy, 2015).

2.5. Microscopic examination:

Examinations of sperm slides were conducted with a Novel digital microscope (XSZ-N107T, made in China) with 1000X, as well as

pictures were obtained with the same microscope (Figure 1). All of the research was carried out in Salahaddin University – Erbil's Genetics lab, which is part of the Biology department.

2.6.Statistical Analysis:

Data are represented as means ± standard error (M±SE). The results were statistically analyzed using student t-tests for independent samples also to ensure that the data were normally distributed. P-values less than or equal to 0.05 were regarded a statistically different. All of the results were analyzed using the PC software program GraghPad Prism 8.

3. RESULTS

3.1. Sperm shape Abnormalities.

Results of Table 1, demonstrate the impacts of radiofrequency electromagnetic radiations of mobile phones on sperm shape abnormalities. Depending on the current results there is no significant difference between ratios of sperms shape abnormalities between the control group (G1) and G2 (none talking mode) group in all parameters of sperm shape abnormalities. While there is a clear significant statistical difference ($P<0.05$) in most of the sperm shape abnormalities parameters between G3 (talking mode) group in compare with control group (G1) including: significant decrease in total normal sperm (67.75 ± 2.737) in G3 compared with control group (87.875± 0.515), significant increase in total abnormal sperm (34.25 ± 2.737) in G3 compared with control group (12.125± 0.515), significant increase in sperm without head in G3 was (6.00 ± 1.254) compared with control group (1.625 ± 0.263), sperm without hook significantly increased (3.00 ± 0.327) in G3 but (1.00 ± 0.267) in control group, swollen head sperm significantly increased (4.625 ± 0.980) in G3 while in control group (1.75 ± 0.163), significant elevation in defective head sperm (8.625 ± 1.308) in G3 and in compare with control group (2.875 ± 0.350), significant elevation in folded sperm (5.50 ± 0.779) in G3 in compare with control group (1. 25 ± 0.250), and short tail sperm significantly increased (3.25 ± 0.366) in G3 in comparison with G1 (1.25 ± 0.250). Meanwhile, there was no significant difference in only two of sperm shape abnormalities between the control group and the G3 group including, sperm without tail (2.75 ± 0.453 in G3 while in G1 (1.875 ± 0.226) and a double tail sperm (0.50 ± 0.267 in G3 group while in G1 group was 0.50 ± 0.189).

3.2. Sperm count.

Figure 2, indicates the effects of mobile phone radiations on sperm count in the epididymis. According to these results, there was no clear statistical difference in the sperm count between the exposed group G2 (none talking mode, 14*106 ±1.165) and G1 (control group, 14.375*106 ±1.745). But there was a clear statistical decrease in sperm count in the G3 group (talking mode, 10*106 ±0.566) in compare with the sperm count in the control group (14.375*106 ±1.745).

4. DISCUSSION

4.1. Sperm shape abnormalities.

The change in sperm properties is in deeded in both experimental animals and people. Using the mobile phones change sperm properties. The two most often altered factors appear to be Sperm motility and morphology. Radiations of mobile phone lead to cause DNA and lipid damage in the membrane of sperm by causing oxidative stress and the duration of time spent on a mobile phone is directly linked to these abnormalities (La Vignera *et al.,* 2012).

Depending to Table 1, that shows impact of mobile phone radiation on sperm shape abnormalities. There was a significant harmful effect of radiations emitted from the mobile phone on the morphology of sperms in the exposed group (G3, in talking mode) in compare to the control group (G1), and there were no harmful impacts in the exposed group (G2, none talking mode) in compare to the control group. The radiations of mobile phones (RF-EMR) may have both thermal and non thermal impacts on biological tissue, which might explain these negative consequences. A generation of reactive oxygen species (ROS) is thought to be increased by non thermal interactions, which might lead to DNA damage (Challis, 2005). De Iuliis and his colleagues (2009) reported that radiations of

mobile cells increase mitochondrial ROS production and DNA fragmentation in sperm in vitro. Meanwhile, because mobiles are usually put in pockets close to reproductive organs; thermal impacts might elevate the temperature of the testes and lower rate of spermatogenesis and sperm spermatogenesis (Agarwal *et al.,* 2011).

Dasdag *et al.,* (2003) examined the impacts of RF-EMR on testicular and sperm function. Mobiles (with frequencies between 800 and 18000) were put a half cm beneath the cages. For one month, the experimental rats were exposed to cellular phones that were activated for 20 minutes every day, whereas the rats of control were exposed to switched-off mobile phones. findings of this study revealed no statistically significant differences in sperm morphology or malondialdehyde (MDA) concentrations between exposed and control rats. On the other hand, Yan *et al.,* (2007); found a considerably increased rate of death in spermatozoa collected from the epididymis in adult rats exposed to RF-EMR compared to rats that were not exposed. Furthermore, the exposed rats showed aberrant spermatozoa clumping that was not observed in unexposed rats. However, Aitken *et al.,* (2005) proposed that mobile phones have considerable genotoxic impacts on epididymal spermatozoa. They used a quantitative polymerase chain reaction to examine DNA integrity and indicated statistically harmful damage in the mitochondrial genome and the nuclear b-globin gene.

4.2. Sperm count.

Figure 2 illustrates that there are no significant differences in sperm count between the exposed group G2 (none talking mode) in comparison with the control group, while there was an obvious significant difference in the results of sperm count test between G3 (talking mode) in comparison with sperm count in the control group. And this outcome was in agreement with the results of Meo *et al.,* (2011) study, and they reported that 18.7% of male Wister rats exposed to mobile phone radiation for one hour per day (whole body) for three months had hypospermatogenesis, while another 18.7% experienced maturation arrest. But in rats exposed to cell phone radiation for 30 minutes every day for three months, no spermatogenesis problems were discovered.

However; in another hand, Lee and his coworkers' (2010) studied the number of sperm in the epididymis, rate of spermatogenesis stages and the number of germ cells in the testis of rats exposed to RF-EMR of 848.5 MHz for twelve weeks split into two 45 minutes halves separated by a 15 minutes break.. The researchers determined that sub-chronic exposure to 848.5 MHz had no discernible negative effects on rat spermatogenesis. Similarly, rats exposed to RF-EMR emitted by mobile phones for one hour per day for four weeks (Mailankot *et al.,* 2009) and rats exposed to cellular phones activated for twenty minutes per day for one month (Dasdag *et al.,* 2003) had no impacts on sperm count when compared with rats of control group when compared to the control group rats.

5. CONCLUSIONS

In conclusion, mobile use (in talking mode) may have harmful effects on sperm shape abnormalities and sperm concentration. And the limited handling of mobile phones without talking (for about 2 hours per day) has no bad effects on sperms morphology and concentration.

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Table 1: Sperm shape abnormalities frequencies of control and exposed groups in male albino mice. (Mean ± SE) (P<0.05).

Groups	Sperm Shape Abnormalities									
	Total normal sperm	Total abnormal sperm	Sperm without head	Sperm without tail	Sperm without hook	Swollen head sperm	Defective head sperm	Double tail sperm	Folded sperm	Short tail sperm
G1 (Control)	87.875 ± 0.515^{a}	12.125 ± 0.515^{a}	1.625 ± 0.263^{a}	1.875 ± 0.226^{a}	1.00 ± 0.267^{a}	1.75 ± 0.163^{a}	2.875 ± 0.350^{a}	0.50 ± 0.189^{a}	1.25 ± 0.250^{a}	1.25 ± 0.250^{a}
G2 (None talking mode)	86.875 ± 0.515^{a}	13.125 ± 0.462^{a}	2.25± 0.163^{a}	2.25 ± 0.250^{a}	1.125 ± 0.226^{a}	1.50 ± 0.189^{a}	2.375 ± 0.323^{a}	0.375 ± 0.183^{a}	1.75 ± 0.163^{a}	1.50 ± 0.189^{a}
G3 (Talking mode)	65.75 ± 2.737^{b}	34.25 ± 2.737^{b}	6.00 ± 1.254^{b}	2.75 ± 0.453^{a}	3.00 ± 0.327^{b}	4.625 ± 0.980^{b}	8.625 ± 1.308^{b}	0.50 ± 0.267^{a}	5.50 ± 0.779^{b}	3.25 ± 0.366^{b}

Note: Same letters in each column mean none significant difference and different letters mean significant difference between them.

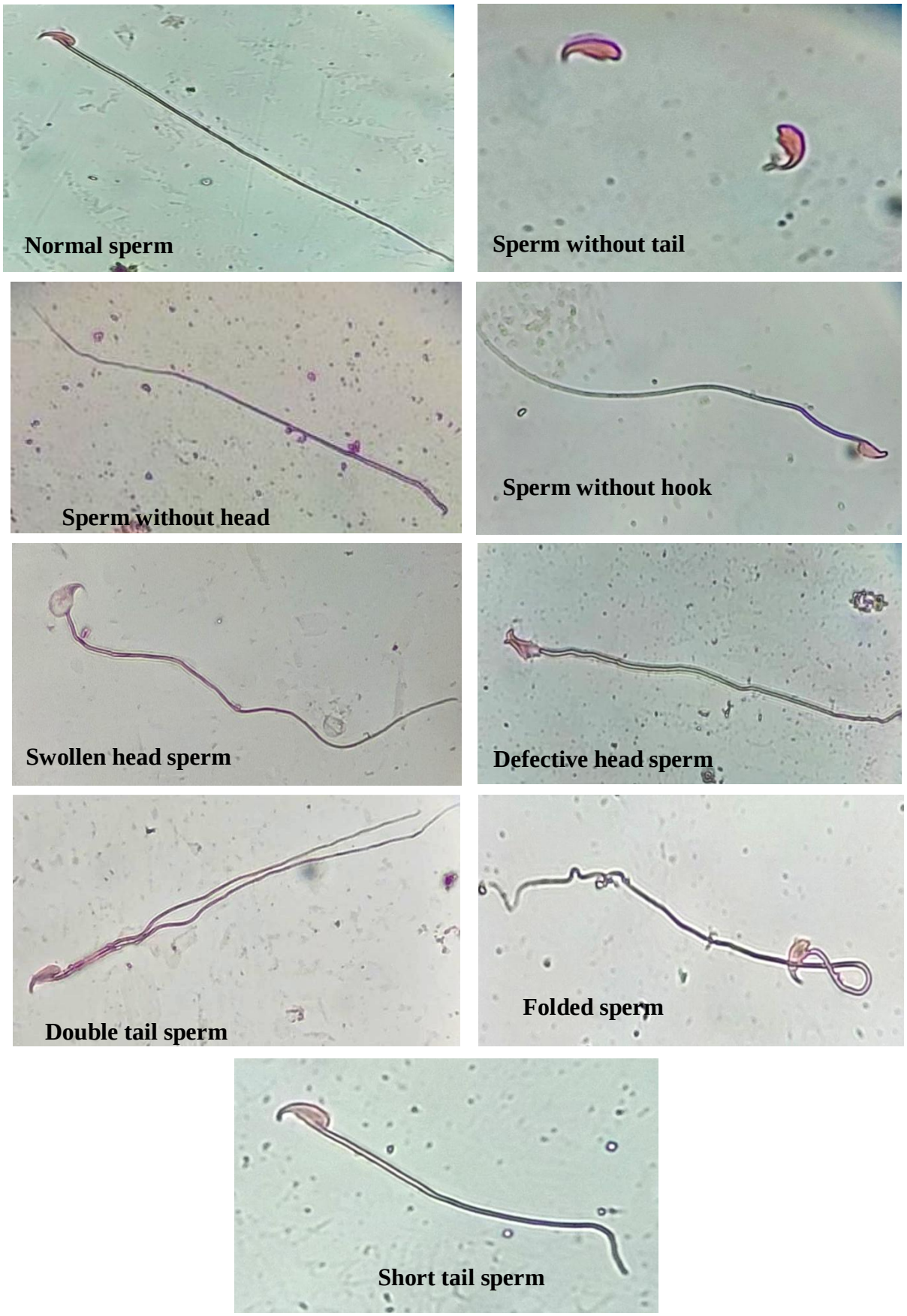

Figure (1): Morphological sperm abnormalities in male albino mice induced by radiations of mobile phone (1000 X).

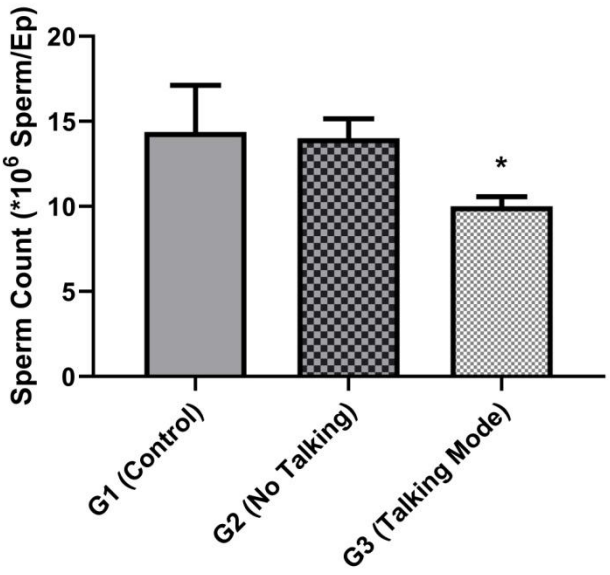

Figure 2: Sperm count of exposed groups compared to control ($^{*}10^{6}$ Sperm/Epididymis)

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