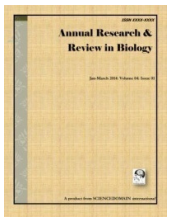

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Histological Effect of Static Magnetic Fields on Testis and Epididymis in Male Mice

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Authors' contributions

This work was carried out in collaboration between all authors. Author NIL designed the study, wrote the protocol and interpreted the data. Author AAT anchored the field study, gathered the initial data and performed preliminary data analysis. Authors MSS and EMS managed the literature searches and produced the initial draft. All authors read and approved the final manuscript.

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ABSTRACT

Background: Considerable attention is focused on effects of static magnetic field (SMF) and its increasing use in everyday life. Appliances and various equipments are sources of static magnetic fields with awide – range of technical characteristics.
Objective: In this study we investigated the effect of (SMF) (750 G, 1500 G and 3000 G) on testis and epididymis duct in mice.
Materials and Methods: Fifty BALB\C mice were selected and divided in to four groups (Control and 3 experimental), while control was not exposed to SMF, the experimental group was exposed to SMF (750 G, 1500 G and 3000 G) for 30 days. At the end of 30 days, the mice were weighted sacrificed dissected, after then the testis and epididymis were weighted separately and samples from testis and epididymis duct in all groups were taken and processed for light microscopic studies. Fifty microscopic fields from each group were randomly selected. The diameters and the

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height of epithelial cells of seminiferous tubules and epididymis duct in 4 group were measured and compared using statistical methods.
Results: The data showed that the weight of testiclesin SMF groups (750 G and 1500 G) significantly reduced compared to the control group (P< 0.05) and the weight of epididymis insignificantly reduced. The weight of testicles and epididymisin the experimental group (3000 G) insignificantly increased compared to control group (P< 0.05). The diameter of epithelial cell of seminiferous tubules and ductus epididymis in experimental group (750 G and 1500 G) significantly decreased compared to the control group (P< 0.05) and insignificantly increased in experimental group (3000 G). The height of epithelial cell of seminiferous tubules and ductus epididymis in the experimental groups (750 G and 1500 G) significantly reduced and in the group (3000 G) significantly increased, compared to control group (P< 0.05).
Conclusion: It could be concluded that the exposure to SMF leads to detrimental effects on male reproductive system in mice as seen by adecrease in diameter of reproductive ducts, the height of epithelial cells and weight of testis and epididymis.

Keywords: Static magnetic field; testis; epididymis; reproductive system; mice; histology.

1. INTRODUCTION

Using of the technologies that employ all phases of the electromagnetic field (EMFs) and radiations increased rapidly over the recent years [1]. There is a growing increase in the number of applications and the levels of exposure are known to be increasing [2]. The concerns about the bio- effect of magnetic field resulted in the increasing distribution and use of the electrical and electronic equipments [3]. The effects of magnetic field on the metabolism of call cultures, animals and human have been studied biochemically [4]. There are different effects of exposure to magnetic fields, such as superoxide anion in different cell and organs, changes in enzyme activity and gene expression, on membrane structure and function, DNA damage [5], on reproductive system and development of fetus [6]. Exposure of the mice to magnetic fields caused a decrease in sperm count, motility and daily sperm production with marked testicular histopathological changes [7]. As a result of exposure to radiation field (RF), DNA damage and decrease of enzyme activity in the testes were reported [8]. The exposure to 1800 MHz RF-EMW radiation indicated to a negative time-dependent effect of on bovine spermatozoa mortality [9]. The deferens duct is important reproductive organ so that the ejaculation disorder due to its disorder classify as one of the major causes of infertility among men [10]. Subchronic exposure to SMF failed to alter spermatogenesis in rat testis [11]. Exposure to static magnetic fields to 0.5 – 0.7T affects testis and epididymis development in mice [12]. MFs produced genotoxicity through oxidative DNA base damage in male germ cells [13]. Exposure to environmental pollutants enhances the generation of reactive oxygen species (ROS) and thus causes destructive effects on various cellular organelles like mitochondria and sperm DNA [14].

The aim of this study is to investigate the effect of static magnetic fields on morphology of the reproductive system in adult male mice.

2. MATERIALS AND METHODS

This was an experimental study at College of Science – University in Anbar (Iraq). Fifty BALB/C mice weight between (15-30) grams purchased from Ministry of Health, National Center for Drag Control and Research (NCDCR) (Baghdad). The animals divided in to control rats (n=10) and SMF – exposed rats (n=10). Animals were housed in groups of ten in cages and kept in a humid atmosphere (65-70%) at 25℃ at comparative biology department while a time interval of 12 hours of access to light and darkness (12:12) light/dark cycle with free access to food and water, during each day for a total of one week was provided for acclimatization.

2.1 Exposure System

The intensity of SMF was measured and standardized in the total floor area of the cage (750 G, 1500 G, 3000 G) checked by Teslameter. The cage was (14cm, 35cm, 6cm). Male rats were exposed to SMF 24 h/ day during 30 consecutive days for the intensities (750 G, 1500 G, and 3000 G). The control group was placed in the same conditions without applying the SMF.

2.2 Tissue Preparation

At the end of the study period, the animals were sacrificed through cervical dislocation followed by removal and weighting of the left testicles in the first place with further sampling from epididymis of the left side. Samples were fixed in 10% formalin (formal saline) (Merck, Germany) for 48 hours and processed. These tissues were dehydrated in ethanol embedded in paraffin wax and the slices with diameter of 5-µm sections were produced by rotator microtome and stained with Hematoxylen and Easin technique for microscopic examinations. Finally, 50 microscopic fields from a similar number of slides in each group were randomly selected and photographed using a digital camera. The diameter and the length of epithelium height in seminiferous tubules and also epididymis duct measured using computer morphometric software "Image tools.

2.3 Statistical Analysis

The data obtained were subjected to descriptive statistical analysis and to one – way analysis of variance (ANOVA), to assess whether experimental group varied significantly compared to the control group under the different intensities of SMF, probabilities less than 0.05 ($p < 0.05$) were considered statistically significant, using Statistica Release 7 software.

3. RESULTS

The obtained results were listed and illustrated in Table 1 and Figs. 1 and 2. The results showed that there are significant differences between weight of testicles in experimental group (750G and 1500 G) compared to control groups, and insignificant difference in experimental group (3000G). In contrast, the differences of the epididymis weight in all experimental groups were insignificant. The values of diameter of seminiferous tubules and Ductus epididymis in experimental group (750 G and 1500 G) showed significant differences compared to those of the control, and insignificant differences in experimental group (3000 G). Significant differences in height of the epithelial cells of seminiferous tubules and epididymis in all experimental groups were reported compared to control group.

4. DISCUSSION

There are no morphometric studies about the SMF effects on testis and epididymis in literature and all studies have been focused on effects of electromagnetic fields (EMFs) on epididymis and deferens ducts, semen fluid parameters and sexual hormones [15]. Our study showed that exposure to SMF resulted in reduction of weight of testicles and epididymis. This finding is in accordance with the results of exposure to EMF. Wilson et al. showed that exposure to EMF (50 Hz, 0.1 T) could result in reduction of testes weight [16]. Kim et al. pointed to the reduction of testes weight as a result of exposure to EMF [17]. Rajaei et al. confirm that the reduction of testes weight following the exposure to EMF [18]. The reason for reduction of testes weight could be attributed to an increased cellular death as a result of the exposure to electromagnetic radiation [18]. Al-Akhras et al. [6] found that there was no significant reduction in testes weight following the exposure to EMF. Lee et al. [19] showed that no change in testes mass as a result of the exposure of rats to EMF.

Table 1. Effects of SMF exposure on testis and epididymis in male mice

Group	Control	750G	1500G	3000G
Testis weight (gm)	0.0391±0.0029	0.0332±0.0015 P= 0.007	0.0308±0.0005 P= 0.014	0.0430±0.0024 P= 0.318
Epididymis weight (gm)	0.0249±0.0015	0.0231±0.0008 P= 0.336	0.0216±0.0018 P= 0.206	0.0263±0.0008 P= 0.443
Seminiferous tubules diameter(µ)	149.91±1.40	129.54±1.16 P= 0.000	123.30±2.14 P= 0.000	155.83±2.55 P= 0.093
Ductus epididymis diameter(µ)	114.93±1.45	101.07±1.18 P= 0.000	91.74±0.90 P= 0.000	118.09±1.15 P= 0.240
Height of seminferous epithelial cell(µ)	32.97±0.76	22.47±0.54 P= 0.000	19.20±0.47 P= 0.000	51.84±0.98 P= 0.000
Height of epididymis epithelial cell(µ)	27.06±0.56	23.31±0.42 P= 0.000	19.20±0.36 P= 0.000	31.95±0.64 P= 0.000

Significance level is less than 0.05 ($p < 0.05$)

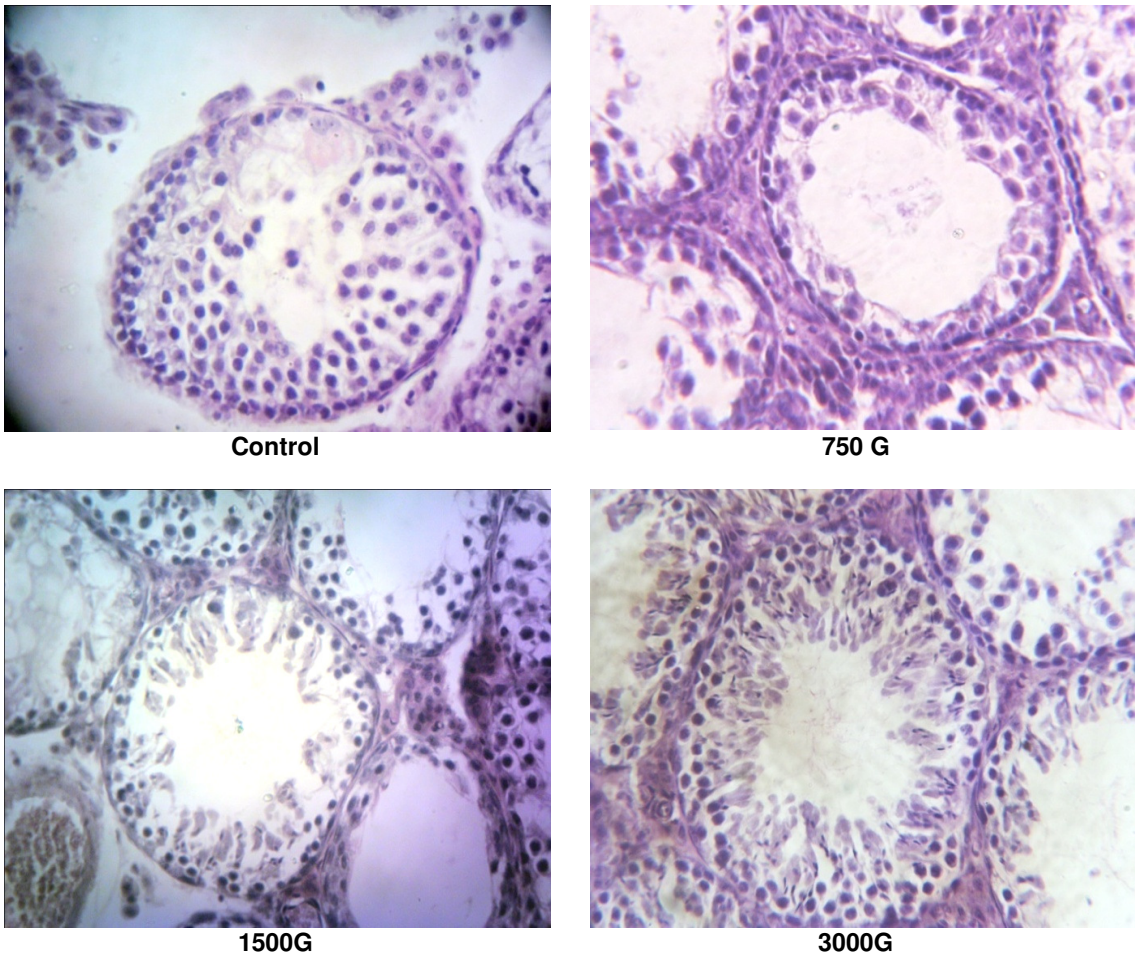

Fig. 1. Microscopic section of seminiferous tubules showing the differences in diameter and height of epithelial cells (400X)

In the present study, we found that the exposure of rats to SMF decreased the diameter and height of epithelial cells. These findings are in a good agreement with those found in the study of Rajaei et al. [18]. Tablado et al. [12] showed that when the pregnant in mice were exposed to EMF (0.5 – 0.7 T) since the 7 days of pregnancy to birth time no apparent histopathological change in testis and epididymis of fetus was demonstrated. Decreasing of cell height and duct diameter in the present study could be due to synthesize disorder of proteins which involved in cell structure [20]. Amara et al. in 2006 demonstrate that subchronic exposure to (SMF) failed to alter spermatogenesis in rat testis and the same treatment decreased testosterone levels and induced DNA oxidation [11]. The results of present study show that the diameter and height of seminiferous tubules and epididymis in experimental groups (750 G and 1500 G) significantly decreased while in experimental group (3000 G) significantly increased compared to control group ($P< 0.05$). The exposure to (EMFs) leads to detrimental effects on male reproductive system in mice as seen by a decrease in diameter of reproductive ducts, the height of epithelial cells and weight of testis [18]. AL-Akhras et al. in 2005 found that exposure to sinusoidal (25µT) decreases the testosterone level in rats but elevated the Luteinzing hormone (LH) concentration [15].

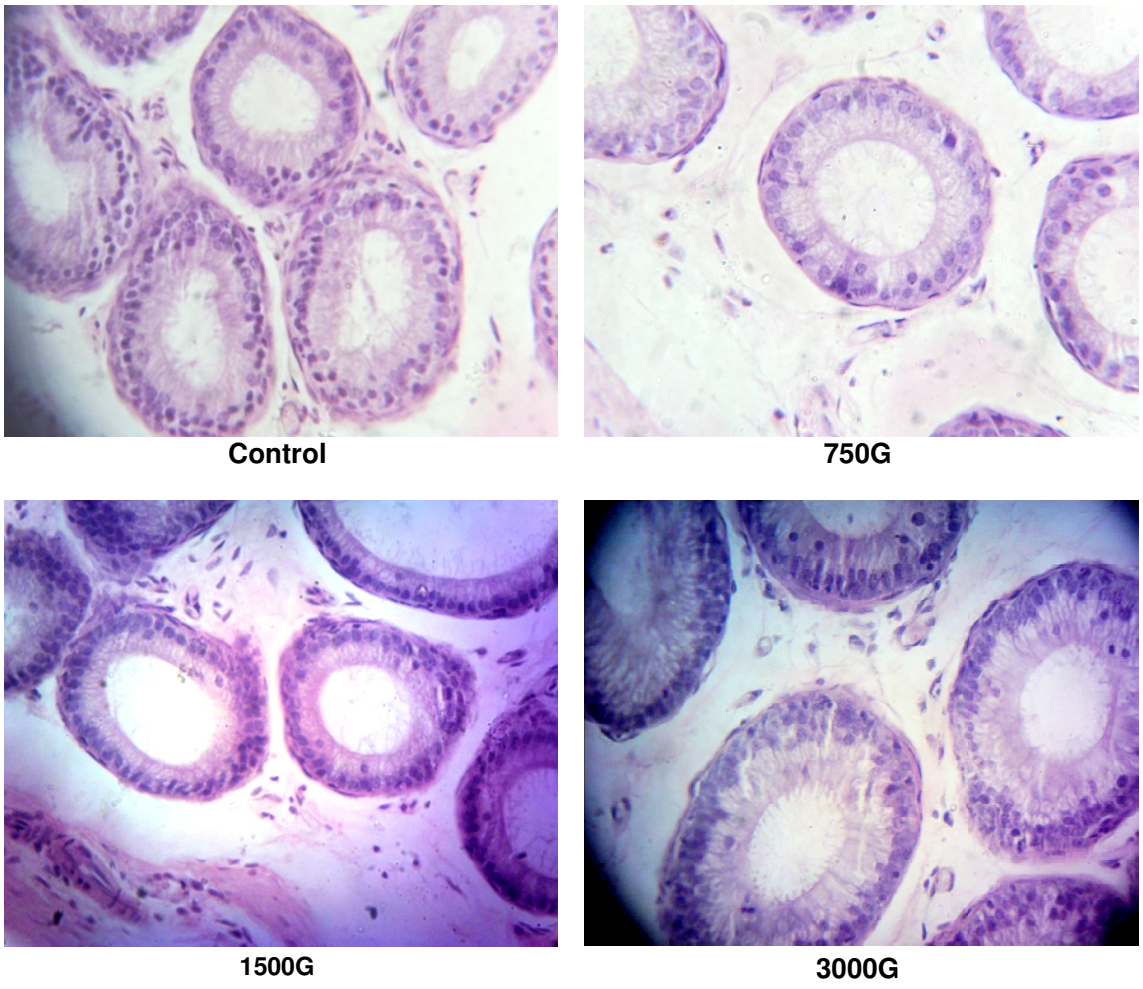

Fig. 2. Microscopic section of epididymis showing the differences in diameter and height of epithelial cells of epididymis (400X)

4. CONCLUSION

Our study showed that exposure to SMF resulted in detrimental effects on male reproductive system. We found decrease in diameter of reproductive ducts, the height of epithelial cells, and weight of testis and epididymis.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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