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TESTICULAR MORPHOLOGY;
EFFECTS OF MOBILE PHONE INDUCED ELECTROMAGNETIC FIELDS ON MICE TESTES.

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ABSTRACT... Objective: To study the effects of mobile phone induced Electromagnetic fields (EMFs) on testis of young mice. **Settings:** Department of Anatomy, College of Physicians and Surgeons Pakistan, Regional Centre, Islamabad. **Period:** January to June, 2008. **Study Design:** Experimental animal study. **Materials & Methods:** This study was conducted on two groups of young BALB-c (6 weeks of age) purchased from National Institute of Health Islamabad. These animals were divided into two groups control and treated, each consisting of twenty animals. The treated group was exposed for one month to mobile phone induced EMFs by placing a mobile phone in the floor of the cage. This phone was rung upon from any other line or cell phone twice daily for 15 minutes. The control group was kept under identical conditions except for mobile phone on the cage floor. **Results and observations:** Histological comparison of testis of the both group animals showed a significant increase, in the number of tubules with sperms in the lumen, increased sub capsular congestion of vessels, presence of vacuolation and giant cells in germinal epithelium and abnormal cells in the lumen of seminiferous tubules of the treated group. **Conclusion:** The results indicate altered testicular morphology of the EMFs exposed mice.

Key words: Mobile Phone, Electromagnetic Fields, Sperms.

INTRODUCTION

The public concern on potential health risks of radio frequency/microwave radiation emissions (RF) from wireless communications is rising with the growing technologies.

The biological electrical activities of human body are vulnerable to “interference” from the oscillatory aspects of EMFs, bringing about subtle non-thermal effects on fundamental cellular activities. Electromagnetic waves can inflict their effects through both thermal and non-thermal damages. These effects, reported in many previous studies, range from changes in cognitive behavior, cell kinetics and proliferation effects, effects on genes, signal transduction effects and alterations in membrane structure and function, metabolic effects, effects associated with free radical production, DNA damage and chromosomal breakdowns. The cell phone technology exposes the community in two possible ways; firstly the mobile phone handset operates in close proximity to the human body - generally within a wavelength distance of the emitting EMFs, secondly a large number of base station antennas are required to

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provide widespread availability of service continuously bombarding our environment with EMFs causing a compulsive exposure to the community. Despite all the nonsettled health related issues, the mobile culture is spreading fast. Not only that but the trend is getting popular among teenagers and young children. Effects of EMFs on fertility is one aspect which currently focused on. Many studies are carried out in these lines. Agarwal et al. (2008)has pointed out a decreased in semen quality associated with a decrease in sperm count, motility, viability, and normal morphology of sperms in cell phone user men[1]. EMFs induced cell death in all types of cells constituting an egg chamber (follicle cells, nurse cells and the oocyte) has been reported in the early and mid stages of oogenesis in Drosophila melanogaster by Panagopoulos et al[2]. However, there are studies which report an increase in the reproductive capacity and off-spring number of organisms on exposing them to RF-EMFs[3].

Keeping in view the current controversy regarding the effects of mobile phone induced EMFs on reproductive organs and fertility, a study was planned to study the histomorophological effects of mobile phone induced EMFs on the tests of young male mice (6 weeks of age). Adolescence period in male mice (post natal day 25-57) is characterized by sexual maturation and spermatogenesis. If this normal maturation process is interfered with any environmental or physical agents, the sexual development may be affected, negatively influencing the fertility of the animal.

MATERIALS AND METHODS

Six weeks old, young BALB-c male mice were purchased form NIH, Islamabad. They were randomly divided into two groups A and B with twenty animals in each group. Group A was labeled as control, while group B as experimental group. The mice were housed under a 12 hr light/12 hr dark cycle in separate cages and were fed ad libitum. In the floor of the group B cage, a GSM operated mobile was placed in plastic casing and set in non vibrating silenced mode. This placement of the mobile phone ensured a close (near field) exposure of the mice through the omnidirectional antenna of mobile phone. The phone was “rung” upon from any other line or cell phone for 15 minutes twice daily for one month. The EMFs emitting from the antenna of this silent ringing mobile phone served as a source of whole body exposure of the group B animals.

After one month the animals were sacrificed, their testes dissected out and after fixation were processed for paraffin embedding. Seven micrometers thick transverse sections were cut, stained with Hematoxylin & Eosin, and observed microscopically for testicular capsular thickness, germinal epithelium thickness, diameter of the seminiferous tubules, total number of seminiferous tubules per unit area and total number of tubules (per unit area) with sperms in the lumen. The differences of the means were analyzed statistically, by applying student’s test. A p-value of less than 0.05 was taken as significant. The sections were also assessed for any histopathological features e.g. cellular degeneration, giant cell infiltration, vacoulation of the cells, interstitial hyperplasia, absence of basement membrane, architectural disruption of tubules or any other pathological features.

RESULTS

The differences of the means of the quantitative data when compared through student’s test showed significant increase ($p<0.05$) in the number of tubules with sperms in the lumen of the treated group. Rest of the quantitative parameters did not show any significant differences (Table-I). However the qualitative assessments of the histological sections exhibited increased subcapsular congestion of the experimental group (Figure 1), along with presence of vacuolation (Figure 1) and giant cells in the germinal epithelium of the treated group. Also some large cells were abnormally noticed in the lumen of the seminiferous tubules of the treated group (Figure 1). There were absent basement membrane of some of the tubules along with destruction of the tubular architecture (Figure 1).

Table-I.			
PARAMETERS	MEAN ±S.E		P-Value *Significant.
	Control A (n=20)	Treated B (n=20)	
Capsular thickness	10.35µm ± 0.03	10.41µm ± 0.04	P > 0.05
Germinal epithelial thickness	52.74µm ± 0.25	52.10µm ± 0.25	P > 0.05
Diameter seminiferous tubules	171.11µm ± 0.98	174.29µm ± 1.7	P > 0.05
Number of tubules (with mature sperms in the lumen) unit area	1.95 ± 0.31	3.50 ± 0.26	P = 0.001*
Number of tubules / unit area	10.75 ± 0.27	11.25 ± 0.34	P > 0.05

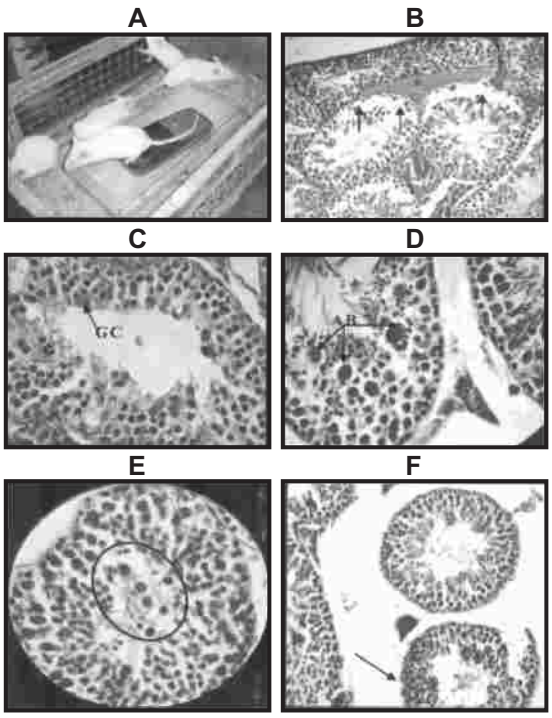

Fig-1. Exposure of mice to Electromagnetic fields and its histpathological effects.

A: A mobile phone placed in the floor of the mice cage, ringed upon twice daily for 15 minutes, inducing 'whole body exposure. **B:** The astrick is in a pool of abnormal homogenous pinkish material collected in the intertubular area. There is congested vessel **'V'** The arrows are pointing into tubular desruption with vacuolation. **C:** The arrow is pointing to a Giant cell in the germinal epithelium **D:** Abnormal cells 'AB' seen towards the lumen of the tubule. **E:** Encircled is a group of abnormal cells in the lumen of the tubules. **F:** The arrow is pointing to absent basement membrane. Notice the lost integrity of the tubule.

DISCUSSION

Significant increase in the number of tubules with mature sperms in the lumen of experimental group is noticed in this project may be indicative of some closeness to precocious puberty in the animals of this group. True precocious puberty is the result of premature initiation of the function of the hypothalamic-pituitary axis. Premature release of the luteinizing hormone releasing hormone by the hypothalamus triggers secretion of the pituitary gonadotropin hormones. As a consequences, the gonads function at an inappropriately early age manifesting as early spermatogenesis and other secondary sex characters. Precocious puberty is also known as familial testotoxicosis, gonadotropin-independent familial sexual precocity, and pubertas praecox.

Since EMFs are a known cause of stress[4], it is possible that exposure of the animals to the same may have triggered the stress response of the gonads causing an early puberty in them. However as the age of the animals selected in the project was not pre pubertal it is hard to comment with confirmation that the significantly increase number of tubules with mature sperms noticed in the experimental group was definitive sign of precocious puberty. At the same time chance cannot be positively omitted.

The height of the spermatogenic epithelium in treated group presented a decrease in relation to the control. Although this difference was not statistically significant, this change in the seminiferous epithelium indicates a decreased proliferation of the male germinal epithelium. (A further elaborate investigation on other project is

currently under way).

The abnormal cellular morphology observed in the experimental group indicates cellular damages and tissue trauma. The sub capsular increased congestion could be due to the thermal effects of the EMFs. At the same time presence of giant (large multinucleated) cells in the germinal epithelium more so on the luminal aspect, as well as exfoliated cells in the lumen of the tubules may indicate histopathological transformations. In addition, prominent spaces detected within the germinal epithelium vacuolation and destruction of the basement membrane are consistent with structural disorganization.

The results obtained have provided grounds for future more elaborate and targeted projects questioning the safety of mobile telephone regarding male fertility. Currently a detailed histological study on the testes of mammals is under way.

CONCLUSION

In summary it is concluded that mobile phone EMFs has altered the histomorophological features of the adolescent mice testes. Future projects studying the effects of EMFs on the fertility of young males are suggested. Till the time the safety issue of EMFs exposure is settled, a careful approach to mobile telephone usage and base station implantation is recommended.

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