

Effects of Electromagnetic Radiations from Cell Phones on the Concentration of Sperm in Albino Rats

1. Sarwat Jabeen 2. Ghulam Sarwar Qureshi 3. Muhammad Rafique

1. Asstt. Prof. of Anatomy, SMC, JSMU, Karachi 2. Prof. of Anatomy, SMC, JSMU, Karachi

3. Prof. of Anatomy, Al- Tibri Medical College, Isra University, Karachi

ABSTRACT

Objectives: To observe the changes in the number of sperms in semen in response to exposure to the electromagnetic radiation (EMR) from cell phones.

Study Design: Experimental comparative study.

Place and Duration of Study: The study was conducted in Institute of Basic Medical Sciences (IBMS), Animal house of Dow University of Health Sciences (DUHS) and Dow Diagnostic Research and Reference laboratory, Ojha campus, Karachi from February 2011 to October 2011.

Materials and Methods: Seventy male Albino rats obtained from the animal house of IBMS, DUHS, Karachi, were divided into two main groups. Group A (control) and Group B (exposed), each containing 35 rats. Both groups were subdivided in five subgroups A1, A2, A3, A4, A5 for control group A and B1, B2, B3, B4, B5 for exposed group B, each consisting of 7 rats. The EMR was given by cell phones to exposed group for 3 hours/day and were sacrificed on 30, 50, 70, 90 and 110 days of exposure. Mean values of concentration of sperm in group A were compared with exposed group B. Statistical analysis was performed by SPSS using One Way Analysis Of Variance to find significance among groups. T-test was used to compare mean differences between groups.

Results: The concentration of sperm was found to be significantly decreased in exposed groups.

Conclusion: This study concluded that exposure to EMR from cell phones affects the semen quality by producing significant decrease in concentration of sperm.

Key Words: Cell phones, electromagnetic radiation, male infertility, sperm concentration, neubauer chamber.

INTRODUCTION

Reproduction is necessary for the survival. More than 4.5 million couples experience infertility each year.¹ Currently, there is a great scientific discussion about data suggesting that male fertility is going to decline markedly as a result of modern lifestyle.² Life style risk factors include cigarette smoking, alcohol consumption, chronic stress and nutritional deficiencies. Recent studies suggest, environmental reasons also produce adverse effects on sperm quality, in addition to factors such as occupational exposure to chemicals, heat, radiation and heavy metals.³

Infertility is a major health issue; many couples of reproductive age in human population suffer from this problem. Irrespective of cause of infertility, whether it is primary or secondary, infertile couples suffer from severe psychological as well as emotional stress.⁴ It is therefore, not only a medical problem but also a psychological stress on the relationship of couples. Various psychological consequences of infertility include anxiety, depression and problems in marital relationship.⁵ Parenthood is no doubt one of the most universally accepted aspiration in adulthood. According to the WHO, infertility is to be considered as a public health issue.^{6, 7}

It is a major problem that affects families instead of individual. When considering causes of infertility

approximately half of them involving male partner. When these couples seek options to resolve their problem and do not become successful, suffer from mild to severe depression, anxiety and disappointment. It can be a major crisis in the lives of many couples.⁴

Besides life style, infertility or subfertility is caused by some environmental factors, like smoking that can affect the normal development of gamete and embryo.⁸ Apart from many other causes affecting the fertility, environmental factors like exposure to EMR play a vital role in development of infertility to some extent. Cellular phones give off low levels of radiofrequency (RF) in microwave range in their active mode.⁹

EMR is a self-propagating wave in space or through matter. EMR has an electric and a magnetic field component which oscillate in phase perpendicular to each other and to the direction of energy propagation. EMR is classified into different types according to frequency of wave, (in order of increasing frequency): radio waves, microwaves, infra red radiation, visible light, u v radiation, x- rays and gamma rays have the highest frequency wave. Energy and momentum is carried by EM radiation which can be transferred when it interacts with matter.¹⁰

Behaviour of EM radiation depends on its wavelength. Higher frequencies have shorter wavelength and lower frequencies have longer wave lengths.^{10, 11, 12, 13}

Research on EMR is being conducted worldwide and is continuing to find adverse effects on health.¹⁴

Among different networks linking societies worldwide, cellular phone technology network form a major part of this. Radiofrequency electromagnetic waves have been used for a long time for different types of wireless broadcast like radio and television.¹⁵

Due to advancement in the field of science and technology the chances for Electromagnetic fields (EMFs) exposure are increased. Commonly used appliances like hair dryers, microwaves and vacuum cleaner have been known to produce EMFs and levels are high enough to produce adverse health effects. The laboratory equipment like incubators and centrifuge mostly used in laboratories for processing sperm for assisted reproductive procedures are supposed to produce EMFs that eventually lead to cause adverse effects on sperm.¹⁶

MATERIALS AND METHODS

This experimental comparative study was conducted at the Department of Anatomy, Institute of Basic Medical sciences (IBMS), Animal house of Dow University of Health Sciences (DUHS) and Dow Diagnostic Research and Reference laboratory (DDRL), Ojha campus, Karachi from February 2011 to October 2011.

Seventy adult male albino rats were selected for study. The rats were divided into 2 groups, control group (A) and exposed group (B), each comprising 35 rats. Both the groups were subdivided into five subgroups A1, A2, A3, A4 and A5 (control) and B1, B2, B3, B4 and B5 (exposed) respectively with seven rats in each group. Each subgroup of exposed group "B", was exposed to EMR emitted from conventional GSM (global system for mobile communication) cellular phones (1835 to 1850 MHz) for 3 hours daily for a period of 30, 50, 70, 90 and 110 days. Each cage was provided with 8 cell phone sets in active silent mode. The small cages which were specially designed to keep 8 sets of cell phones were then placed inside the plastic cages of rats for 3 hours for the purpose of exposure to EMR emitted from cell phones.

After the exposure to EMR from cell phones for 30, 50, 70, 90 and 110 days to the subgroup B1, B2, B3, B4 and B5 respectively, rats were sacrificed. The scrotal sac was exposed and testes along with the spermatic cord were identified. The testes along with epididymis, ductus deferens and blood vessels were excised. Epididymis was cleared from all tissues, tail of epididymis was identified. A small nick was given to cauda epididymis with the help of sharp scalpel and was cut longitudinally and placed in Petri dish containing 5 ml of normal saline. The cut epididymis were left for few minutes in Petri dish so that the sperms from epididymis could swim out of epididymis and collected in saline. The transparent normal saline changed into turbid grayish white color.¹⁷

The number of sperms were counted with the help of Neubauer ruling method.¹⁸ A small drop of fluid from Petri dish was taken with the help of hemoglobin pipette and charged the Neubauer chamber. Out of 9 squares counting was done in large 5 squares. The numbers of sperms were counted in four outer large squares and one large central square at magnification power of 10 under light microscope.

Formula for counting cells in Neubauer chamber:

Ocular counting reticule was used for counting sperm in a specified area. In present study, reticule was placed in eye piece of light microscope. The counting reticule had 20 squares in both axes.¹⁹ Statistical analysis was performed by SPSS version 16 using One Way Analysis Of Variance (ANOVA) to find the significance difference among groups. Independent sample T-test was used to compare the mean differences between the groups. Statistically significant p value of ≤ 0.05 is taken as significant.

RESULTS

Intergroup comparisons were done between subgroups of control Group A and Exposed Group B at different time intervals. Intragroup comparisons were done between subgroups of exposed Group B to evaluate changes in the concentration of sperm after being exposed to EMR from cell phones. The changes in concentration of sperm were measured in million/ml of semen.

Intra group comparisons: Mean $\pm$ SD values of exposed subgroups B1, B2, B3, B4 and B5 were 7.02 ± 0.81 , 5.55 ± 0.57 , 4.52 ± 0.56 , and 4.12 ± 0.52 and 2.92 ± 0.23 million/ml respectively as shown in Table 1.

Table No.1: Mean number of sperm (Neubauer chamber) million/ml $\pm$ S.D in different groups at variable time interval:

Animal Subgroups (n=7)	Control group A (n=35) A1-A5	Exposed Group B (n=35) B1-B5	P- value
30 Days	7.28 ± 0.79	7.02 ± 0.81	0.55
50 Days	7.79 ± 0.63	5.55 ± 0.57	0.000***
70 Days	7.97 ± 0.70	4.52 ± 0.56	0.000***
90 Days	7.84 ± 0.68	4.12 ± 0.52	0.000***
110 Days	7.27 ± 0.65	2.92 ± 0.23	0.000***
Mean $\pm$ S.D	$7.63 \pm .72$	4.83 ± 1.50	0.000***

P Value: ≤ 0.05 = Significant *
 ≤ 0.005 = moderately Significant **
 ≤ 0.0005 = highly Significant ***
 ≥ 0.05 = Insignificant

Statistically significant decrease in concentration of sperm was observed while comparing Group B1 and B2 (P-value 0.000), B2 and B3 (P-value 0.01), B3 and B4

(P-value 0.68), B4 and B5 (P-value 0.004) at C.I of 95% as shown in Table 1.

Intergroup comparisons: When the mean $\pm$ SD values of concentration of sperm in control subgroup was compared with respective exposed subgroup, a highly significant (P-value 0.000) decrease was observed in concentration of sperm in exposed subgroups at C.I of 95% as shown in Table 1.

DISCUSSION

Male reproductive functions recently more focused due to reports and data showing time related decline in semen quality. Retrospective data analysis indicated that there may be decline in sperm count in some part of the world. In occupational studies, only a few types of exposure were found to have an impact on male reproductive function. Lifestyle and general environmental factor might play a crucial role.²⁰

Attention of scientific community and public have been attracted over global decline in semen quality. Numerous studies have been published showing a compromise in sperm quality. The reason for decline in semen quality is possibly due to environmental, nutritional, socioeconomic or other unknown causes.²¹ Present study identified a highly significant reduction in number of sperm in exposed group when compared with controls. Decrease in the number of sperm was more significant in groups exposed to EMR for longer duration. This was also observed in a study by Salama N (2010). In this study 24 rabbits divided into 3 groups, exposed to radiation for 8 hours per day for 12 weeks in specially designed cages. A drop in sperm concentration was noticed at week 6 which was statistically more significant at 8 weeks.²²

Recent studies on human semen by Agarwal A et al (2008) and De luliis GN (2009) demonstrated that there was an increased production of ROS in human semen due to radiation from cell phones. It was suggested that RF-EMW may cause disturbance of ROS metabolism either by causing increase production of ROS or by decreased activity of antioxidant enzymes.^{23, 24}

Specific absorption rate (SAR), is the amount of radiofrequency (RF) energy absorbed from cellular phones into the local tissue. SAR is the most useful quantitative measure for determining exposure from transmitters or source that is kept close to the body. SAR of cell phones is differing from cell phones to cell phones. But it usually ranges from 0.12 to 1.6 watt /kg body weight depending on the model. According to Federal Communication Commission, 1999; the accepted upper limit of SAR in USA is 1.6 watt/kg. The higher the SAR of cell phones the more harmful would be the effects on exposed tissue.^{25, 26} In their studies Erogul O et al (2006), Agarwal et al (2008), Davoudi M

et al (2002) and Kilgallon SJ et al (2005) also suggested that EMW emitted from cell phones can reduce the fertilization capacity of men.^{10, 23, 27, 28}

A review by Deepinder F (2007) also in agreement with current study which demonstrated the type and the degree of adverse effects that have known to be produced due to the EMR emitted from cell phones.²⁵

Several studies with limitations in study design, suggest a possible link between cell phone use and infertility. The current study is in accordance with a study by Lahdetie (1995) found that use of cell phone causes adverse effect on the quality of semen by decreasing sperm counts, mobility, viability and morphology.³

These findings were also observe in a human study by Agarwal A et al (2008), including 361 men attending an infertility clinic indicated that the use of cellular phones has adverse effects on semen quality, resulting in decrease in sperm count, motility, viability and morphology. These four sperm parameters decreased in the population of study who were in habit of using cell phones for long hours. These hazardous effects on semen quality might result in male infertility.²⁹

A study performed by Kilgallon et al (2005) also supported this finding, suggested that cellular phones when stored close to testis had significant negative impact on concentration of sperm as well as on the percentage of motile sperms.²⁸

CONCLUSION

The present study indicated that EMR from cell phones has adverse effects on testes of albino rats. EMR decreases the quality of semen by affecting the concentration of sperm. It is observed that human exposed to EMR might suffer from subfertility or even infertility, depending on the duration of exposure to EMR.

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Address for Corresponding Author:

Dr. Sarwat Jabeen

Assistant professor of Anatomy
Sindh Medical College, Jinnah Sindh Medical
University, Karachi.