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Original Research Paper

Effect of Electromagnetic Radiation of Mobile Phone on Sperm Count in Albino Rats

Medical Science

KEYWORDS : Electromagnetic radiation, sperm count, testis, mobile phone

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ABSTRACT

Electromagnetic waves are emitted from a number of sources (television , microwave ovens, toasters, cameras, mobile phones, X ray and CT and MRI machines) out of which most commonly used are cell phones. The present study was carried out to see the possible effects of electromagnetic radiation on sperm count. Thirty male albino rats were divided into five groups of 6 each i.e. control and four experimental groups. . In experimental groups animals were exposed to electromagnetic radiations in variable manner by placing a mobile phone over the cage. After respective exposure periods animals were sacrificed and the sperm count was done. Results showed decrease in the sperm count in all the experimental groups as compared to the control.

Introduction:

The widespread use of mobile phones in recent years has raised the research activities in many countries. Concerns are growing about the possible hazardous effects of radio-frequency electromagnetic waves (RF-EMW) emitted by these devices on human health (Markov and Kostarakis, 2007).

Use of cell phones has been demonstrated to cause dose dependent difficulty in concentration, fatigue and headache (Oftedal et al, 2000), increase in reaction time (Preece et al, 1999), and alteration in electroencephalogram pattern and disturbance in sleep (Huber et al, 2000).

A number of reports, though with limitations in study design, suggest a possible link between cell phone use and infertility. Several studies have indicated that EMW emitted from cell phones can reduce the fertilizing potential of men (Davoudi et al, 2002; Fejes et al, 2005; Agarwal et al, 2008; Priyanka et al, 2013). In a recent study, keeping cell phones close to the waist has been found to decrease sperm concentration as compared with men not using cell phones at all or storing it elsewhere (Kilgallon and Simmons, 2005).

In order to measure the impact of radio frequency electromagnetic waves on the human body a standardized unit called the SAR value (Specific Absorption Rate) was established. The SAR measures the rate of radiofrequency energy absorption in the body, expressed as watt/Kg. In INDIA upper limit of SAR allowed is 2 watt/kg.

Material and methods:

The present study was conducted in the Department of Anatomy, King George's Medical University, UP, Lucknow. Thirty male albino rats weighing 200-250g were used for the present experiment. Animals were obtained from animal house of Indian Institute of Toxicology & Research, Lucknow. The rats were maintained under standard laboratory conditions in an air conditioned room and housed in polyethylene cages at temperature 22±3°C and relative humidity 30–70%. They were fed with standard pellet diet and water ad libitum. Animal care was as per Indian National Science Academy (INSA) guidelines for Care and Use of Animals in Scientific Research. The study protocol was approved by the Institutional Animal Ethical Committee (IAEC). After acclimatization for 2 weeks in laboratory conditions, animals were divided into 5 groups of 6 rats each. Group I served as control. In group II and group III, animals were exposed to electromagnetic radiation by placing a mobile phone (micromax q5, SAR - 1.87) over the cage for 5 hours per day for two months. The mode of exposure was 4½ hr in standby mode and ½ hr answering mode in group II and 4hr in standby mode and 1 hr in answering mode in group III. In group IV animals were exposed to radiation same as that of group II and then kept for one month without exposure. In group V animals were exposed to radiation same as that of group III and then kept for one month without exposure.

At the end of respective treatment periods, animals of all the groups were anaesthetized by intraperitoneal administration of Nembutol (30 mg/kg body weight). Rats were sacrificed and testes were taken out along with epididymis. Sperms were obtained by mincing the epididymis in normal saline and filtering the suspension through nylon mesh. The epididymal sperm were counted by using Neubauer chamber. Normal saline containing epididymal sperms was drawn to the 0.5 mark of a WBC pipette. Then the semen diluting fluid (soda bicarb) was drawn to the 11 mark and mixed well. The improved Neubauer chamber was loaded and the sperms were allowed to settle for about 5 minutes. Then sperms were counted in the four corner squares.

$$\text{Sperms/ml of semen} = \frac{\text{Sperms counted in 4 square} \times 10 \times 20 \times 1000}{4}$$

Observation and Results:

It was observed that mean sperm count in control group (group I) was 33.83 ± 17.84 m/ml. In group II (1/2 hr exposure), mean sperm count was 18.25 ± 5.90 m/ml, which was less in comparison to control. In group III (1 hr exposure), mean sperm count was 12.92 ± 6.41 m/ml, which was less in comparison to group I as well as group II. In group IV (1/2 hr + 1m), mean sperm count was 29.20 ± 2.28 m/ml, which was higher than the group II (1/2 hr exposure) but was less in comparison to group I. In group V (1 hr +1m), mean sperm count was 19.75 ± 4.54 m/ml, which was higher than the group III (1 hr exposure) but the value was less in comparison to control group.

Table 1: Mean Sperm Count in Animals of different groups (Values are x10⁶)

SN	Group	N	Mean	SD	Minimum	Maximum
1.	I	6	33.83	17.84	9	49
2.	II	6	18.25	5.90	13	26
3.	III	6	12.92	6.41	3	21
4.	IV	6	29.20	2.28	26	32
5.	V	6	19.75	4.54	15	28

F=4.871; p=0.005 (ANOVA)

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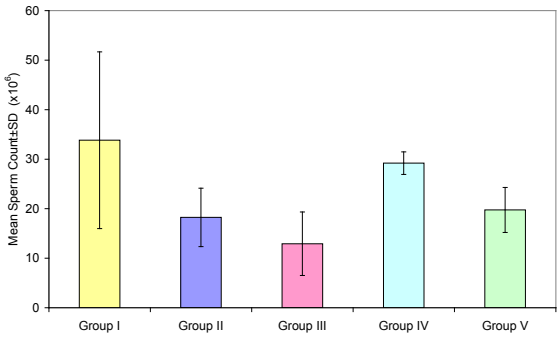

Fig. 1 bar diagram showing Sperm Count in control and experimental groups

Discussion:

In the present study, we observed that electromagnetic radiation caused a significant decrease in sperm count. In group II (1/2 hour exposure) sperm count was decreased in comparison to control but this decrease was statistically non significant. In group III (1 hour exposure) sperm count was significantly (p=0.006) decreased in comparison to controls. Our findings were in agreement with that of Kesari et al (2010) and Salama et al (2010). Kesari et al (2010) found a significant decrease in mean value of total sperm count (31.14 ± 13.6 vs. 61.33 ± 3.68) in rats exposed to cell phone RF-EMR for 2 hours per day for 35 days. Salama et al (2010) in his study on rabbits found a significant decrease in sperm count after RF-EMR exposure of 8 hours/day for 8 weeks. Similarly Fejes et al (2005) in an observational study on human beings analyzed 231 men over a 13 month period, and showed that for heavy users of cell phones, sperm counts were 30% lower than in men who did not use a cell phone.

Dasdag et al (1999) reported non significant decrease in sperm count in rats following exposure to electromagnetic radiation and the reason for non significant changes may be less duration of exposure. In his study total duration of exposure was one month (2 hours per day, during which phone was turned to answering mode for 3 minutes only) while in present study total duration was two months (5 hours per day and phone was turned to answering mode for ½ hour in one group and 1 hour in other group).

Mailankot et al (2009) also found no significant decrease in sperm count in rats while Dasdag (2003) and Ribeiro (2007) reported no change in sperm count following EMR exposure.

After exposure period of 2 months, we kept the animals for 1 month without mobile phone in group IV and group V, to see the effect on sperm count and observed that sperm count was improved in both the groups. We could not find any study in literature in which the reversibility of adverse effects was studied.

Grundler et al (1992) were the first to demonstrate that EMW induce free radical activity in cells. Free radicals that are derived from oxygen metabolism are known as reactive oxygen species (ROS). ROS are continuously neutralized by antioxidants present in body tissues. Whenever production of ROS exceeds the scavenging capacity of antioxidants, it leads to oxidative stress (Desai et al, 2009). OS not only prematurely activates lysosomal enzymes but can also directly drive the cells into apoptotic pathways (Simon et al, 2000). This may be the possible mechanism for decrease in sperm count. When the exposure to EMR was discontinued, production of reactive oxygen species was decreased leading to decrease in oxidative stress and apoptosis of sperm cells. This may be the possible cause for increase in sperm count following discontinuation of EMR exposure.

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