Original Article

Impact of Radiation Emitted by Mobile Phone During Call Mode on the Ejaculated Semen

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Abstract

Objective: To study the motility changes in the human spermatozoa after exposure to Radio Frequency Electromagnectic Waves (RF-EMWs) emitted by the cell phone during the call attended mode from different directions.

Design: Prospective single blind study.

Settings: Central Animal facility, Department of Reproductive Medicine, Chettinad Super Speciality Hospital.

Patients: Thirty men with normozoospermia were randomly selected from those attending the infertility clinic were randomly selected, during the months of January to May 2013.

Interventions: The semen samples were collected soon after ejaculation and sperm concentration and motility were assessed and noted. Then the sample was taken to the animal facility for the RF-EMWs exposure for 1 hour and then again the sperm concentration and motility was evaluated and noted.

Results : Exposure of the semen sample to the RF-EMWs produces a negative effect on the sperm motility. There is a statistically significant decline in the sperm motility after RF-EMW exposure for one hour.

Conclusion : After RF-EMWs exposure there is a definitive decline in the sperm motility when compared to the control group.

Key Words: RF-EMWs, Spermatozoa motility, Mobile phone

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Introduction

Male reproduction is partly affected due to the innovations in cell phones which also have detrimental effects on the human brain and cardiovascular system[1]. In the last decade there has been a tremendous development and use of mobile telecommunication services which drastically increased the amount of radiofrequency electromagnetic wave (RF-EMW) exposure in daily use; this has harmful effects on human health. In 1996 the World Health Organization (WHO) established the International EMF Project to assess the scientific evidence of possible health effects in the range of 30 Hz to 300 GHz of electromagnetic frequencies[2].

These phones operate at different frequencies in different countries and continents, differing in respect to the frequency usage. Cell phone companies have assured people for years that cell phones are safe. However, literature reports of adverse effects of RF EMW emitted from cell phones on biological systems is available. Recent studies on EMW emitted from cell phones suggest that they can reduce the fertilizing potential of men[3-7]. Specific absorption rate (SAR) is a measure of the rate at which energy is absorbed by the body when exposed to a radio frequency (RF) electromagnetic field. It is the power absorbed per mass of tissue and is expressed in units of watts per kilogram (W/kg)[8]. It is generally recognized that most of the men place the mobile phones in their trouser pockets, adjacent to the testis. Thereby, a possibility exists that the testicular tissue is constantly exposed to RF-EMWs.

In our study, we strived to determine whether the RF EMWs emitted from the cell phone in talk mode (call attended mode) from different directions may negatively affect sperms and impair male fertility.

Methodology

Type of Research Study: A prospective single blinded study conducted at the Central Animal facility, Department of Reproductive Medicine, Chettinad Super Speciality Hospital.

The study involved 30 normozoospermic semen samples from the Andrology laboratory, Department of Reproductive Medicine, Chettinad Super Speciality Hospital from January to May 2013. The samples were from men in the age group of 25 to 48 years, with abstinence from sexual activity ranging between 2 to 14 days. Discarded semen samples with volume more than

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1.5 ml were included in the study after the routine semen analysis was done (Table 1). Written and informed consent was obtained from each participant in their own vernacular language and in English.

The participants were requested to collect the semen sample in a clean non toxic container by masturbation. The samples were kept at 37° C for liquefaction before analysis. Upon liquefaction, semen analysis was done as per the WHO criteria 2010.

After the primary analysis, the remaining semen sample was homogenized and aliquoted into 4 different vials and were taken to the animal facility for RF EMWs exposure.

the mobile, then the power density at the back was 15.26 minimum and 270.86 maximum with an average of 70.5, at the antenna side the power density was 23.97 minimum and 302.67 maximum with an average of 103.5 (Table 2). These power density measurements were taken with the help of a field strength meter (Fig 2) by the research scholars of Dept. of Electronics and Communication, Anna University, Guindy College of Engineering, Chennai.

According to the International Commission for Non-ionizing Radiation Protection (ICNIRP 1998) and the Federal Communications Commission (FCC 1999), the reference level for exposure of RF-EMWs is peak power density[9].

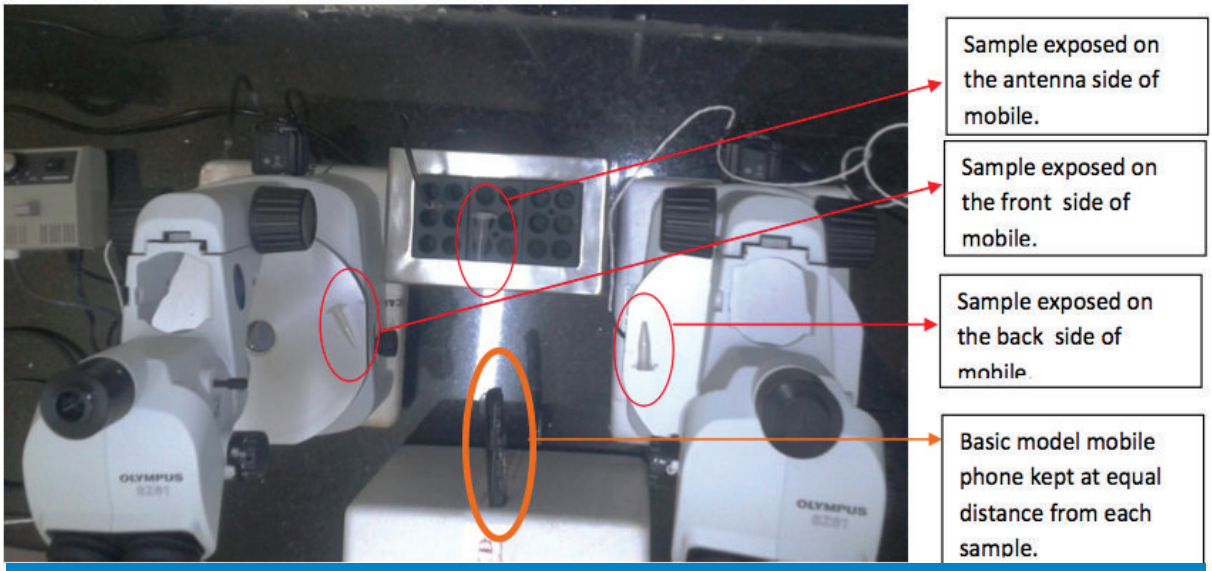

Fig 1: View of the setup from the top

RF-EMWs exposure

A basic model mobile phone was taken for the RF EMWs exposure with 90% of battery point and at the place where there was at least 4 points signal (tower availability).Then the sample in the 4 vials were kept at 4 different places, one in the incubator which serves as the control, one in front of the mobile, one at the back and one at the antenna side each at a distance of 2.5 cm away from the mobile. The samples which were placed at the front, back and antenna side were placed on a warm stage so that there was no effect in the sperm motility due to temperature variations (Fig 1).

Then the mobile was activated in a call attended mode with another mobile away from the research field for an hour. During the call attended mode the mobile generated power density of 16.53 minimum and 233.67 maximum with an average of 63.57 in the front side of

Post RF-EMWs exposure analysis

After one hour, the four aliquots were re-analyzed for the sperm concentration and the motility estimation was done by placing 5 µl of the well mixed post RF EMWs exposed samples from the front, back and antenna sides and control sample (incubator) was placed on a glass slide covered with cover slip under 40 x magnification. Totally 100 spermatozoa were graded into progressively motile (PR), non progressively motile (NP) and immotile (IM). Each value was noted separately and analyzed later. The whole study was conducted by the same observer and the analyst of the sample after exposure was blinded to the sample analyzed. The data were analyzed using SPSS software. P-values were calculated using paired t -test.

Table 1: Descriptive analysis of participants and samples of the study (N=30)

Parameter	Mean	Std deviation	Minimum	Maximum
Age in years	32	4.9	25	48
Volume of semen collected in ml	3.03	1.51	1.5	8
pH of the semen	8.1	0.35	7.5	9.5
Abstinence in days			2	14

Table 2: Power density generated by the mobile in the call attended mode at different places

Power density generated	Front	Back	Antenna
Minimum	16.53	15.26	23.97
Maximum	233.67	270.86	302.67
Average	63.57	70.5	103.5

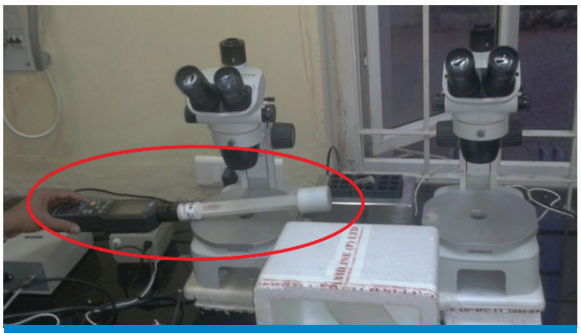

Fig 2: Field strength meter used to measure the power density.

Compared to the control group, there was 7.6% decline in mean percentage of progressively motile sperms in the group exposed from the back of the mobile, which is statistically significant (95% CI -11.74 to -3.45, p value 0.001). There was a slight decline of 0.83% in the mean percentage of non progressive sperms. The mean percentage of immotile sperms had increased by 8.4%, which was statistically significant (95% CI 4.48 to 12.31, p value 0.00). (Table 4)

Compared to the control group, there was 12.23% decline in mean percentage of progressively motile sperms in the group exposed from the antenna of the mobile, which was statistically significant (95% CI -16.46 to -8.0, p value 0.00). There was a decline of 2.3% in the mean percentage of non progressive sperms. The mean percentage of immotile sperms had increased 14.56%, which was statistically significant (95% CI 9.14 to 19.98, p value 0.00). The mean percentage difference among different sides of the antenna are given in table 5.

Table 3: Comparison of quality of sperms between control group Vs exposed group from behind (N=30)

Quality of sperms	Mean % Exposed from back	Mean % control	Mean % difference	95%CI		P-value (Paired t test)
				Lower	Upper	
Progressively motile	25.03%	32.63%	-7.60%	-11.74%	-3.45%	0.001
Motile- Non progressive	22.23%	23.06%	-0.83%	-4.75%	3.09%	0.66
Immotile	52.73%	44.33%	8.40%	4.48%	12.31%	0.000

Table 4: Comparison of quality of sperms between control group Vs exposed group from Antenna (N=30)

Quality of sperms	Mean % Exposed from antenna	Mean % control	Mean % difference	95%CI		P-value (Paired t test)
				Lower	Upper	
Progressively motile	20.40	32.63%	-12.23%	-16.46%	-8.00%	0.000
Motile- Non progressive	20.73	23.06%	-2.33%	-5.31%	0.64%	0.12
Immotile	58.90	44.33%	14.56%	9.14%	19.98%	0.000

Table 5: Mean % Difference Comparison between Front, Back & Antenna side

Quality of sperms	Mean% Difference of front exposure group	Mean% Difference of back exposure group	Mean% Difference of antenna exposure group
PM	-4.26%	-7.60%	-12.23%
NPM	0.46%	0.83%	-2.33%
IM	3.76%	8.40%	14.56%

Results

Compared to the control group, there was 4.26% decline in mean percentage of progressively motile sperms in the group exposed from the front side of the mobile, which is statistically significant (95% CI -8.18% to -0.34%, p value 0.03). There was a slight increase of 0.46% in the mean percentage of non progressive sperms. The mean percentage of immotile sperms had increased to 3.76%, which was statistically significant (95% CI 0.77% to 6.76%, p value 0.01). (Table 3)

Discussion

According to a study in 2006, significant decrease in sperm motility was observed after exposure to EMR. Results between the control and the EMR exposure group showed statistically significant changes in sperm motility[6].

In 2009, De Iuliis G.N et al., conducted a study on purified human spermatozoa exposed to RF-EMR. Motility and vitality were significantly reduced when SAR was increased. The DNA fragmentation and generation of ROS (reactive oxygen species) were significantly elevated (p <0.001). Therefore, these findings show that use of mobile phones potentially affects the health, fertility and wellbeing of their offspring in the reproductive age group men[10].

A study by Agarwal A et al in the year 2008[7], compared the semen parameters with different cell phone usages. Totally 361 men were divided into four groups according to their active cell phone use: group A: no use; group B: <2 h/day; group C: 2-4 h/day; and group D: >4 h/day. The comparisons of semen

parameters between these groups were statistically significant. As the duration of daily exposure to cell phones increased, the sperm parameters decreased. Therefore, the author concluded that, decrease in sperm parameters was dependent on the duration of daily exposure to cell phones. The same author in 2009, extended his study to normal healthy donors (n=23) and infertile patients (n = 9). The objective was to evaluate unprocessed (neat) ejaculated human semen after radiofrequency electromagnetic waves (RF-EMW) exposure from mobile phone during talk mode. Neat samples were divided into 2 aliquots after liquefaction. One aliquot was exposed to cellular phone radiation (in talk mode) for 1 h, and the second aliquot served as the control. Results showed samples exposed to RF-EMW had a significant decrease in sperm motility and viability. Levels of DNA damage showed no significant difference[11].

In a study by Nadia Falzone et al[12], they examined the effect of 900 MHz GSM radiation on the induction of pro-apoptosis events such as activity of caspases, externalization of phosphatydylserine, DNA strand breaks and activation of ROS in human spermatozoa. The study concluded no evidence of any in vitro effect of RF EMF exposure on caspase activation, DNA fragmentation, phosphatydylserine expression (pro-apoptosis) or ROS generation in human spermatozoa. These results appear to be reliable because great care was taken to rule out any temperature rise related effects.

Available scientific evidence shows mobile phone usage decreases semen quality. One study suggests that semen quality is influenced by lifestyle and that use of mobile phones close to the testes can decrease semen quality[5]. Another study suggests pro-longed use affects sperm motility characteristics[4].

DNA damage (spermatogenesis and sperm maturation level) results from cellular phone EMR[13]. DNA damage in sperm cells by RF radiation exposure, has been shown to affect sperm motility[3,4,6] and a negative correlation exists between sperm chromatin damage and sperm motility[14].

According to our results there is a statistically significant decline in percentage of progressively motile sperms in all the exposure groups compared to the control group. Therefore the RF EMWs have a significant impairment on the sperm motility irrespective of the side of exposure from the mobile phone. Therefore we suggest that placing of mobile phones during call attended mode in the trouser pockets, while using hands-free or bluetooth devices, would definitely impair male fertility.

Conclusion

Awareness regarding the potential hazards of the cell phone usage on the man's fertility has to be created among the public. Measures have to be taken to reduce the use of this modern gadget to the barest minimum possible by all age group of men and women to avoid health risks and especially to reproduction.

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The authors declare no conflict of interest.

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Vitamin D and Calcium: A Systematic Review of Health Outcomes (Update)

Majority of studies have rarely observed clear dose-response relationships between intakes of vitamin D, alone or in combination with calcium, and health outcomes. Although a large number of new studies (and longer follow-ups to older studies) were identified, particularly for cardiovascular outcomes, all-cause mortality, several types of cancer, and intermediate outcomes for bone health, no firm conclusions have been drawn so far. Studies suggest a possible U-shaped association between serum 25(OH)D concentrations and both all-cause mortality and hypertension and also suggest that the level of supplemental vitamin D and calcium administered in the Women's Health Initiative Calcium-Vitamin D Trial are not associated with an increased risk for cardiovascular disease or cancer among postmenopausal women who are not taking additional supplemental vitamin D and calcium. Studies suggest the method used to assay 25(OH)D may influence the outcomes of dose-response assessments. Beyond these observations, it is difficult to make any substantive statements on the basis of the available evidence concerning the association of either serum 25(OH)D concentration, vitamin D supplementation, calcium intake, or the combination of both nutrients, with the various health outcomes because most of the findings were inconsistent. Agency for Healthcare Research and Quality (US): 2014 Sep.

- Prof. RM. Pitchappan