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Full Length Research Paper

The Sperm function is affected by the electromagnetic radiation emitted by mobile phone

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The use of mobile phone has become more widespread, concerns have mounted regarding the potentially harmful effects of the electromagnetic radiation (EMR) emitted from it. The current study aimed to investigate the effect of the EMR emitted by mobile phone on sperm function. Semen samples were subjected to swim up then separated into two groups. The first group acted as a control group which was unexposed to the electromagnetic radiation. The second group was exposed to radiation emitted by a mobile phone at a distance of 5 cm. Semen parameters were improved after swim up in FertiCult™ IVF medium. Our results showed a significant decrease in sperm function as indicated by a decrease in sperm vitality and viability as well as sperm motility. Sperm cells exposed to the EMR emitted by mobile phones, will become weakened. Sperm cells exposed to EMR may start functioning poorly and this means that a potential decrease in male fertility.

Key words: Mobile phone, electromagnetic radiation and sperm function.

INTRODUCTION

Males are exposed to the effect of various environmental factors which may decrease their reproductive capa-bilities (Claman, 2004; Sheiner et al., 2003). A decrease in male fertility is a phenomenon which occurs over the years (Wdowiak et al., 2007). This may suggest that one of the reasons for the decrease in semen parameters is the effect of the development of techniques in the surrounding environment. A hazardous effect on male fertility may be manifested by a decrease in the amount of sperm cells, disorders in their motility, as well as structure. The causative agents may be chemical substances, ionizing radiation, stress, as well as electromagnetic waves years (Wdowiak et al., 2007).

In the last decades the widespread use of electric devices and telecommunication equipments increased the electromagnetic radiation in our environment from 0 Hz up to 300 GHz. The effect of electromagnetic waves on living organisms depends on the wave frequency and intensity. The hazardous effect of radio waves of high frequency (0.3 to 300 GHz) is associated with an increase in body temperature (Deepinder et al., 2007).

With the popularized use cell phones, more and more concern has been aroused over the effects of their radiation on human health, particularly on male repro-duction. Cell phone radiation may cause structural and functional injuries of the testis, alteration of semen parameters, reduction of epididymal sperm concentration and decline of male fertility (Kang et al., 2010).

Exposure of sperms to EMF from mobile phones affects sperm motility and vitality leading to impaired male fertility (Iuliis et al., 2009; Mailankot et al., 2009).

The current study aimed to investigate the effect of the EMR emitted by mobile phone on sperm function.

MATERIALS AND M ET HODS

Collection and evaluation of semen samples

Tw enty healthy donors were used in our study. The semen samples were obtained by masturbation directly into sterile plastic containers after at least 2 days of sexual abstinence. Samples w ere allowed to liquefy for 30 min at 37°C (WHO, 1999). Each specime n w as evaluated according to standard procedures recommended by the

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Table 1. Improvement of sperm parameters after sw im up.

Parameters assessed	Fresh semen[a]	Swim up using FertiCult™ IVF medium
Count X 106 / ml	52. 20 ± 11. 02	25. 80 ± 02. 80*
Motility (%)		
Progressive	69. 40 ± 03. 4	84. 00 ± 03. 30*
Non progressive	15. 10 ± 03. 54	11. 60 ± 03. 00*
Immotile	14. 50 ± 40. 04	05. 40 ± 02. 41*
Normal morphology (%)		
Normal	65. 40 ± 04. 30	85. 20 ± 03. 60*
Head defect	16. 30 ± 03. 80	10. 30 ± 04. 01*
Tail and neck defects	18. 30 ± 01. 6	04. 50 ± 03. 20*
Vitality (Eosin test; %)	77. 50 ± 01. 8	86.40 ± 04.20*
HOS test (%)	71. 30 ± 03. 6 0	87. 00 ± 02. 5*

Values are means ± SD. [a] Normospermic specimens according to WHO standards. *Significant improvements noted in all parameters assessed in comparison to fresh semen (p ≤ 0.05). n = 20.

World Health Organization (WHO) manual w ith a phase-contrast microscope (WHO, 1999). Semen parameters assessed included sperm volume, count, motility, morphology, v itality and viability. Donors specimen w ere included if they had sperm parameters w ithin the normal range defined by the WHO (WHO, 1999). All studies w ere approved by the Human Investigation Committee of Libyan health organization.

Sw im – up procedure

Pr ogressively motile sperms have been separated by sw im up technique as mentioned previously (Younglai et al., 2001). FertiCult ™ IVF medium-0.4% human serum albumin (FetriCult, Beemen, Belgium) w ere used in the separation process. After swim up sperm assessed parameters have been evaluated.

Exposure of semen samples to electromagnetic w aves

Semen sample w as exposed to EMW emitted from a commercially available mobile phone in talk mode (Nokia 73; GSM-Global System for Mobile communications network; 850 MHz frequency; maximum pow er <1 W; SAR 1.46 W/kg). The distance between the phone semen samples w as kept at 5 cm. The duration of exposure was 60 min. Unexposed (control semen samples) were kept under identical conditions but without electromagnetic wave exposure.

Evaluation of sperm morphology

Sperm morphology w as assessed by spreading 5 µl of semen along the length of a microscope slide. The resulting thin smear w as allowed to air dry for 20 min before staining with Giemsa stain (WHO, 1999). Sperm morphology has been estimated at X1000 magnification under oil emersion and at least 100 spermatozoa were counted on each slide according to Kruger et al. (1987).

Sperm function testing

Viability of spermatozoa was determined by mixing 10 µl of an aliquot of spermatozoa w ith one drop of a supravital stain (0.5% eosin Y in aqueous solution of 0.9% NaCl) (WHO, 1999). Counting of Living sperms (unstained) and dead ones (stained) were observed at × 400.

To assess the sperm membrane function, HOS test were carried out as mentioned previously (Jeyendran et al., 1984). Sperm motility was assessed before and after sw im up according to the methods described by the WHO (1999). In brief, a motile spermw as defined as a cell having a progressive or non-progressive motion, w ith non-progressive sperms showing clear flagellar movement but no change in position. Immotile sperms included all nonmoving cells w ithout flagellar motion and sperm heads w ithout a flagellum.

To study the effect of the EMR on sperm motility, Hamilton Thorne computerized sperm analysis system (CASA; Hamilton-Thorne Biosciences, Beverly, Mass.) w as used. Sperm kinetic assessment w as based on the determination of the percentage of total motile cells, progressively motile cells, average path velocity (VAP-µm/s), straight-line velocity (VSL–µm/s) and curvilinear velocity (VCL–µm/s) of motile cells. Ten microscope fields w ere evaluated and means calculated for all sperm variables us ing Animal Motility Softw are version 12.1.

Statistical analysis

Statistical analyses w ere performed using an unpaired Student's t-test. The data w ere analyzed by using Excel 2000 (Microsoft, USA), and SigmaPlot 2001 (SPSS, USA).

RESULTS

Progressive motile sperms increased significantly (P < 0.5) after swim up. Both non-progressive and immotile sperms were significantly reduced after swim up (Table 1). Light microscopic examinations showed significant improvement (P ≤ 0.5) in sperm morphology in specimen after swim up. Normal spermatozoa were approximately 65.4%, while it reached 85.2% in swim up specimens

Table 2. Effect of EMR from cell phone on sperm viability and membrane integrity.

Parameter	-ve EMF	+ve EMF
Vitality (Eosin test; %)	84.1± 01.3	80.60 ± 01.40*
HOS test (%)	85.40± 01.60	88.30 ± 01.70*

Values are means ± SD. *Significance at ($p \leq 0.05$).

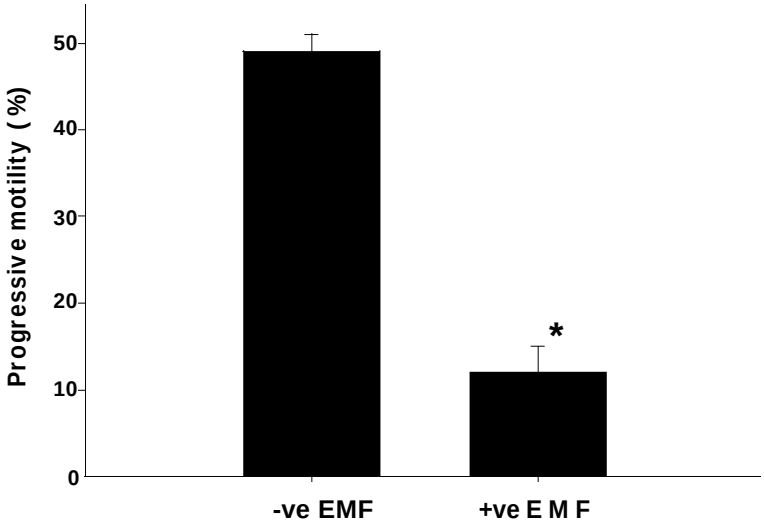

Figure 1. EMR emitted by mobile phone decrease motility of human spermatozoa. Values are means ± SD. *Significance at ($p \leq 0.05$).

(Table 1). Sperm head defects were reduced after swim up to 10.3 ± 4.1% in comparison to 16.3 ± 3.8% in fresh semen. Tail and neck defects have been reduced in swim up specimen (Table 1). In addition, the viability of sperms and the percentage of sperms with intact membrane were increased to about 86 and 87%) respectively (Table1).

The EMR from the mobile phone was able to decrease the sperm vitality as well as the membrane integrity by about 20 and 12% respectively, (Table 2). Qualitative analysis determining the difference in motility of the control and EMR-exposed sperms are presented in Figure 2. EMR induced a significant decrease in motility reaching about 4 folds (Figure 1).

EMR effects were observed on average path velocity (VAP), straight-line velocity (VSL), and curvilinear velocity (VCL), which was significantly decreased ($P < 0.05$) in sperms exposed to mobile phone (Figure 2).

DISCUSSION

Exact causes of the decline in semen quality are not yet known, environmental factors have been considered to play an important role. While the focus has been on chemical exposures, mostly pesticides, risk factors of the physical environment such as man-made electromagnetic fields could contribute to the etiology of the decline in sperm quality.

Compared to the many previous studies on the electromagnetic field (EMF) health effect (Iuliis et al., 2009; Jurewicz et al., 2009; Falzone et al., 2010; Otitoloju et al., 2010), the current study has an important strength which is the usage of swim up technique before exposing the sperms to the emitted radiation from the mobile phone to ensure that intact sperms are only exposed to the electromagnetic radiation.

Male factors, including decreased semen quality, are responsible for 25% of these cases (Ursini et al., 1999; Sharlip et al., 2002; Moslemi and Tayanbakhsh 2011). Swim up could improve sperm quality resulting in high fertilization and pregnancy rates (Ozguner et al., 2009).

The importance of sperm morphology and motility in the assessment of male fertility is evident in a large number of studies (Zavos and Centola, 1991; Hammadeh et al.,2001; Aitken et al., 1995). Our results demonstrated that semen sample subjected to swim up separate spermatozoa that have improved morphology compared to that in fresh semen.

A magnetic field exposure level was associated with reduced sperm quality for every parameter measuring

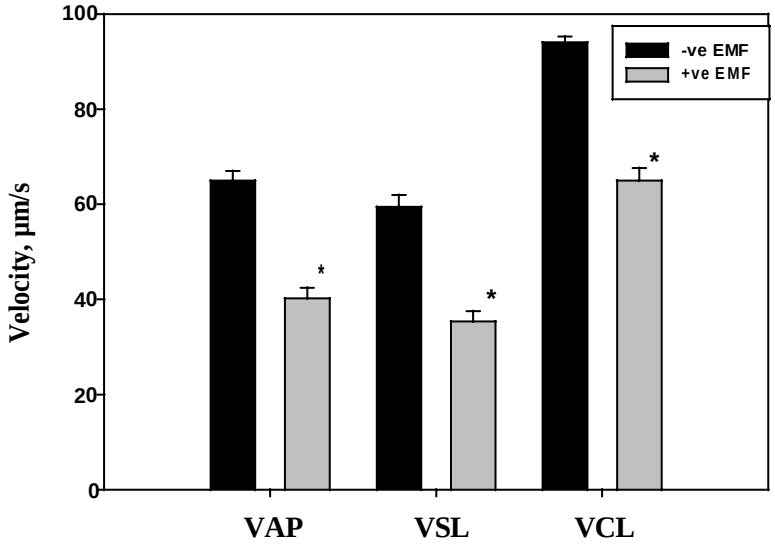

Figure 2. Changes in sperm velocity due to exposure of sperms to EMR emitted by mobile phone. Values are means ± SD. *Significance at ($p \leq 0.05$). VAP, average path veloc ity; VSL, straight-line veloc ity; VCL, curvilinear velocity.

semen quality with a statistically significant correlation with sperm vitality and motility. Such a direct link between magnetic field exposure level and poor sperm quality has not been reported. However, cell phone use has been reported to be associated with poor sperm quality (Fejes et al., 2005; Erogul et al., 2006; Agarwal et al., 2008).

Collectively, sperm cells exposed to the electromag-netic radiations emitted by mobile phones, will become weakened. Sperm cells will start to function poorly and that means that a potential decrease in male fertility (Aitken, 2006).

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