

The Effects of Cell Phone Radiation on Anxiety in Male Rats

Parsania S., Pourjabbari H. * ,Kakpour B., and Ahmadi R.

Abstract—Widespread use of cell phones is the most important risk factor of human health in the age of technology. The aim of this study was to investigate the effects of mobile phone radiation on anxiety level in male rats. In this laboratory-experimental study, the male Wistar rats were divided into control and exposed to cell phone radiation for 1h, 3h, and 6h/day. After 8 weeks, Elevated Plus Maze was used for anxiety evaluation. The results of the elevated plus maze test showed that the percentage of time spent in open arms significantly decreased in all experimental groups compared with control rats ($P < 0.001$). There was also significant decrease in the percentage of entries into open arms in all experimental groups compared to control group ($P < 0.001$). The findings of this study showed that the exposure to cell phone radiation results in enhanced anxiety level.

Index Terms—Cell phone, Anxiety, Female Rat.

I. INTRODUCTION

A cell phone is a device that can make and receive telephone calls over a radio link whilst moving around a wide geographic area. It does so by connecting to a cellular network provided by a mobile phone operator, allowing access to the public telephone network. In today's world, people are getting more and more addicted to cellphones. [1] In the last 20 years, worldwide mobile phone subscriptions have grown from 12.4 million to over 5.6 billion, penetrating about 70% of the global population. Its usage has also become an important public health problem as there have been reports of plenty of health hazards, both mental and physical, in people of all age groups. Some of these effects are critical like cancers. On 31 May 2011 the World Health Organization confirmed that cell phone use indeed represents a health menace, and classified mobile phone radiation as a carcinogenic hazard, possibly carcinogenic to humans. [2]

All cell phones emit a type of radiation called an electromagnetic field (EMF), composed of waves of electric and magnetic energy moving together through space. Different radiation frequencies are used by different technologies .Radio waves and microwaves emitted by transmitting antennas are a form of electromagnetic energy collectively referred to as radiofrequency (RF) energy or radiation. The RF part of the electromagnetic spectrum

Sanaz Parsania (MSc) is with Department of Physiology, Faculty of Basic Sciences, Islamic Azad University, Hamedan Branch, Hamedan, Iran. (Msiavahi@yahoo.com).

Hannah Pourjabbari (*corresponding author) is with the Department of Cell and Molecular Biology, Faculty of Basic Sciences, Pharmaceutical Sciences Branch, Tehran – Iran (IAUPS) (e-mail: Hpourjabbari@yahoo.com).

Behruz Khakpour (PhD) is with the Department of Physiology, Faculty of Medicine, Guilani University of Medical Sciences, Rasht, Iran.

Rahim Ahmadi (PhD) is with Department of Physiology, Faculty of Basic Sciences, Islamic Azad University, Hamedan Branch, Hamedan, Iran. (Rahahmadi2001@yahoo.com).

consists of frequencies in the range of about 3 kilohertz (3 kHz) to 300 gigahertz (300GHz). RF energy is used in telecommunications services, including radio and television broadcasting, mobile communication, GPS devices, radio communications for police and fire departments, and satellite communications. Non-communication sources of RF energy include microwave ovens, radar, and industrial uses.

The complete electromagnetic spectrum consists of both ionizing and non-ionizing radiation. Non-ionizing radiation refers to any type of electromagnetic radiation that does not carry enough energy to remove an electron from an atom or a molecule. Sources of non-ionizing radiation include microwaves, radio waves, cordless phones, wireless networks (wifi), power lines and MRIs. Ionizing radiation has high-frequency waves with enough energy to eject electrons from molecules. It can damage the structure of cells in the body (including DNA) and has well-documented effects on human health. Ionizing radiation is emitted by radon, uranium, and other naturally occurring radioactive elements and is used for X-rays, nuclear medicine, and CT scans.[3]

A carrier wave oscillates at 1900 megahertz (MHz) in most phones, which is mostly invisible to our biological tissue and doesn't do damage. The information-carrying secondary wave necessary to interpret voice or data is the problem, says Dr. Carlo. That wave cycles in a hertz (Hz) range familiar to the body. Your heart, for example, beats at two cycles per second, or two Hz. Our bodies recognize the information-carrying wave as an "invader," setting in place protective biochemical reactions that alter physiology and cause biological problems that include intracellular free-radical buildup, leakage in the blood-brain barrier, genetic damage, disruption of intercellular communication, and an increase in the risk of tumors. The health dangers of recognizing the signal, therefore, aren't from direct damage, but rather are due to the biochemical responses in the cell.[4] The aim of this study was to investigate the effects of mobile phone radiation on anxiety level in male rats.

II. MATERIAL AND METHODS

A. Animals

Adult Wistar rats weighting 200 ± 30 g were purchased and raised in our colony from an original stock of Pasteur institute (Tehran, Iran).The temperature was at $23\pm2^{\circ}\text{C}$ and animals kept under a schedule of 12h light:12h darkness (light on at: 08: 00 a.m.) with free access to water and standard laboratory chow.

B. Elevated plus-maze test

We used an elevated plus-maze to determine the anxiety level in animals exposed to cell phone radiation. The apparatus, constructed from black Plexiglas, consisted of two open arms, two enclosed arms and a central platform. The maze was elevated 70 cm above the floor. After exposing the

animals to cell phone radiation, animals were placed at the center of the maze, facing one of the enclosed arms. During the test period, the time that each mouse spent on dark platform, open platform and middle of the maze was accurately recorded. After the test, the maze was carefully cleaned with 10% ethanol solution.

C. Protocol of Study

In this laboratory-experimental study, the male Wistar rats were divided in to control and exposed to cell phone radiation for 1h, 3h, and 6h/day. After 8 weeks, Elevated Plus Maze was used for anxiety evaluation. The test was performed for 300 sec for each rat and was repeated twice at 5-day interval. High levels of anxiety was measured by increased length of time for the animal to emerge into the lighted portion of the apparatus.

D. Statistical Analysis

All values are presented as mean \pm S.E.M. Statistical significance was evaluated by one-way analysis of variance (ANOVA) using SPSS 19. Differences with $P<0.05$ were considered significant.

III. RESULTS

Our findings indicate that there was significant difference in mean time in open area that rats spent in groups receiving cell phone radiation for 1,3 or 6 hours compared with control rats ($P<0.001$), indicating the increased anxiety level in rats exposed to mobile phone radiation (Figure I).

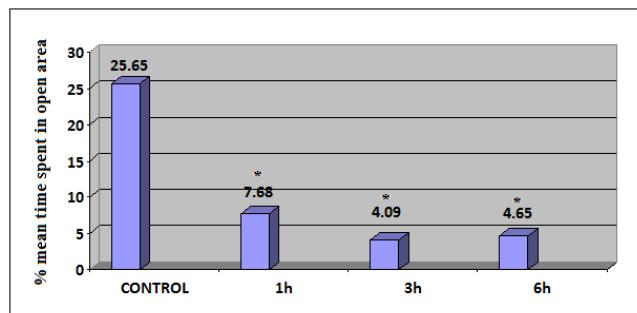


Fig I. % mean time in open area that rats spent in groups receiving cell phone radiation for 1,3 or 6 hours compared with control rats. * indicates significant difference compared with control animals.

IV. DISCUSSION

The findings of this study showed that the exposure to cell phone radiation results in enhanced anxiety level. The first damaging source occurs from the near-field plume of radiation generated by the cell phone's antenna. The second form of damage comes from a radio wave called the Information-Carrying Radio Wave, or ICRW. However, when a person speaks or sends a text message the information is "piggy-backed" or packeted onto the first radio wave. Receptors are located on the cell membrane of each cell in our body. These receptors are both chemical and vibrational. The vibrational receptors pick up signals which vibrate in the hertz range. As the information from the ICRW contacts the vibrational receptors on the cell membrane the ICRW is recognized as a foreign invader and begins disrupting cell communication and function.

Consequently, the vital cell-to-cell communication process is lost. When this communication is lost a basic physiological process is disrupted. As waste material and free radicals build up inside the cell mitochondria are damaged and cellular dysfunction ensues.[5] , [6] The free radicals that build up inside the cell also interfere with the repair and replication of DNA. Many studies have shown the formation of micronuclei following exposure to information-carrying radio waves.[7]

Laboratory studies also showed that the nervous system of both human as well as animal is sensitive to both ELF MF and radiofrequency (RF) fields. Assessable changes in brain function and behavior occur at level associated with new technologies including cell phone use. Relatively limited study has been done on the effect of ELF MF and RF on the emotional status.[8] Concern about the possible adverse psychological consequences of exposures to EMFs stems from reports in the late 1960's of symptoms such as headache, fatigue and disruption of sleep patterns in occupationally exposed extra-high voltage switchyard workers [9], [10]. Nervous and behavioral effects of RF radiations on humans have been reported for five decades. Behavioral changes due to RF radiations are reported in many scientific studies [11]. Silverman, (1973) is an early reviewer of health effects linked to microwave exposure. In an earlier study, Lai et al. (1992) also addressed the effects of electromagnetic fields (EMFs) on benzodiazepine receptors in the rat brain; and found the latter to be increased in the cortex [12]. Interestingly, these receptors are involved in stress and anxiety responses [13]. Furthermore, exposure to EMFs was occasionally reported to induce stress [14]. Epidemiological study has also suggested an association between chronic ELF MF exposure and depression. It was also reported that residential exposure to ELF MF could increase trait anxiety in women. Moreover, a kind of therapeutic magnetic field, repetitive transcranial magnetic stimulation (rTMS), was reported to cause anxiety in normal volunteers [15]. Sokolovic et al. (2012) studied the effect of microwave radiation from mobile phone on anxiety behavior and it is reported to produce anxiety related behavior in animals. The rats were exposed to microwave radiation (4 h/day) for 20, 40 and 60 days. Microwave radiation exposed animals showed an anxiety related behavior (agitation, irritability) after 10 days of exposure and, also suggested the involvement of melatonin in its effect.[16]. However, another study by using RF radiation has shown that short term exposure to a 1439 MHz time division multiple access (TDMA) EMF does not alter melatonin and serotonin synthesis in rats [17]. Furthermore, recent study address possible associations between excessive use of mobile phones and certain psychological variables indicates that chronic stress, low emotional stability, depression are associated with problematic mobile phone use [18] suggesting possible adverse effects on nervous system . In addition, a recent literature on mobile phone use suggests that women with low self-esteem are the most vulnerable group, and the most commonly associated psychopathological symptom in relation to mobile phone use reported was depression [19].

Although numerous studies have been carried out in the epidemiology, cellular biology, and pharmacology and toxicology research fields, the potential adverse effects of

EMR exposure on the human central nervous system (CNS) are still controversial [20].

V. CONCLUSION

We have shown that the long term exposure to cell phone radiation results in enhanced anxiety level.

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Hannaneh Pourjabbari
(Corresponding author) is with the Department of Cell and Molecular Biology, Faculty of Basic Sciences, Pharmaceutical Sciences Branch, Tehran – Iran (IAUPS)