

EFFECT OF ELECTROMAGNETIC FIELD RADIATION FROM CELLULAR WIRELESS SYSTEM ON SD RATS

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Abstract

The analysis of electromagnetic field radiation exposure from cellular wireless system is expected to become more and more important in research field so that researchers can provide the solution of the effect of electromagnetic field radiation on human living things. In this paper, test group animals were exposed to electromagnetic field radiations for 8 hours per day for 30 days. Behavioral parameters were observed by using elevated plus maze and open field test. Behavioral test were performed on 8th, 15th and 30th day of exposure. Our findings include that the EMF radiation exposure is a major factor related to EMF radiation toxicity. As duration of exposure increased with relative increased in extent of toxicity. In addition, this study revealed that EMF radiation exposure caused neuronal damage.

Keywords: Electromagnetic Field, Radiation, Cellular Wireless System, Elevated Plus Maze, Toxicity.

1. INTRODUCTION

The exposure caused by the transmission of electromagnetic (EM) waves, that are associated with the use of electrical power and various forms of natural and artificial lights, is referred to as EM field (EMF) exposure. In the earlier period, a large amount of investigation hard work have been devoted to first recognize how human beings are affected by EMF exposure and, then, to design tools to measure the exposure and characterize exposure metrics; these measurement tools and metrics being in turn useful for setting exposure guidelines and preventive the possible adverse effects of EMF exposure on human beings. In the past few decades the growth of wireless cellular communication system has been so relentless that it is now one of the most important sources of EMF exposure in the general surroundings. [7]

Electromagnetic radiation (EMR) emitting from the normal surroundings, as well as from the use of manufacturing and daily appliances, continuously influences the human body. The effect of this type of vigor on living organisms may exert a variety of effects on their performance, although the mechanisms conditioning this observable fact have not been completely much more attention due to the fewer investigates. It may be expected that the communications between electromagnetic radiation and the living organism would depend on the quantity and constraint of the transmitted power and type of tissue exposed. Electromagnetic waves exert an influence on human living things in depth because an electromagnetic radiation can be

viewed as the combination of an electric field and a magnetic field; therefore, both components are important in the analysis of exposure in case of the detection study of the same. [9]

Electromagnetic Fields (EMF) are invasive in daily living. Antennas, including GSM (Global System for Mobile Communication) antennas for cellular phones in resident area rendering most of the human residents to emission at several frequencies, mainly Radio Frequency (RF). Much research in the last decade has depicted variations in the biological parameters of living organisms after get in touch with EMF. A number of sections of the residents may be additional susceptible to potentially unsympathetic effects stemming from work exposure or individual vulnerability. Significant epidemiological and investigational studies have tempted to estimate EMF revelation and its belongings on various hazardous diseases and disorders and the individual residents at huge or precise groups that may incur larger risk due to additional straight exposure. [10]

Nowadays the mainly unseen ecological pollution in developed as well as emergent countries is the Electro Magnetic Fields (EMF) exposures produced by the immense group of wireless cellular systems. The EMF emission pervading the surroundings are currently gradually more understand and this has supplementary to a fresh contaminant to the index of pollutants into the surroundings which is unseen and dangerous. Electro- magnetic pollution by human beings has assumed important significance which is in attention in current times for all negative reasons. There has been extraordinary development in the communication engineering in current history causing a dramatic enlarge in a quantity of communication towers and more and more towers are being erected each year. Data requirements have enhanced on cellular mobile network and are rapid increasing from cities to towns and to villages. Additional with enlarged affordability, reduced expenses their uses have increased spectacularly and the on the whole coverage of the population as an entire to EMF due to cellular phones have increased significantly. Electromagnetic radiations are not simply acknowledged and visible. However their impacts are being felt on human beings, environment, and wildlife.[11]

There has been an extraordinary development in the universal communication manufacturing in current years which has resulted in a spectacular enlarge in the number of wireless devices. Electromagnetic radiations, in the form of waves of electric and magnetic power, have been circulating jointly through surroundings. The electromagnetic field includes radio waves, microwaves, infrared rays, light rays, ultraviolet rays, X-rays, and gamma rays hence; the community is being exposed to constant, small concentration radiations from these radiations. Since the electromagnetic radiations, also known as electro smog cannot be seen, smelt or felt, one would not understand their possible damage over extended periods of exposure until they manifest in the form of biological disorders. [12]

2. PROPOSED METHODOLOGY

2.1 EXPERIMENTAL DESIGN

This paper proposes an effect of electromagnetic field radiation from cellular wireless system on SD rats. SD rats were exposed for Electromagnetic field radiations for 30 days, daily at a rate of 8 hours per day (10.00 AM to 17.00 PM). During exposure period, test animals were placed in Plexiglas boxes. Electromagnetic field radiation transmitter was fitted to the roof of

the cage from inside. Rats were exposed to EMR radiations emitted from the transmitter. Control rats were not given any exposure.

The analysis of electromagnetic field radiation exposure from cellular wireless system is expected to become more and more important in research field so that researchers can provide the solution of the effect of electromagnetic field radiation on human living things.

Table. 1. Animals grouping

Group	Treatment	No. of Animals
I	Test group -Exposure of EMF radiation for 8 hours/day for 30 days	03
II	Control group -Without exposure of EMF radiations	03



Fig. 1. Electromagnetic field radiations exposure

3.2 BEHAVIORAL EVALUATION

Elevated plus maze-The elevated plus maze consisted of two open arms, 50 x 10 cm, and two enclosed arms, 50 x 10 x 40 cm, with an open roof, arranged such that the two open arms were opposite to each other. The maze was elevated to a height of 50 cm. The measures indicated in the procedure section were taken by two observers, sitting in the same room as the maze. Animals were placed into maze for 5 min.

- a. Times spend in center
- b. Times spend in open and closed arm.

Open field test-The Open field test was used to assess anxiety-like behaviour and mood disturbances. The Open field used was a 1 m × 1 m square with sides of 50 cm high. It had demarcated inner and outer zones and the floor was divided into squares of equal size

- a. Locomotor activity- Number of squares rat crossed was counted and used as a measure of locomotor activity.
 - Number of square crossed
- b. Exploratory behavior- Two parameters were assessed as an indication of exploratory behavior
 - Number of rearing

- Grooming- Time spent grooming was measured.

Behavioral parameters were measured on 8th, 15th and 30th day of exposure period and then all animals were euthanized, blood were processed for AST, ALT, Urea and Creatinine measurement. Brain tissue were collected and processed for histopathological and oxidative markers evaluation.

4. RESULTS AND DISCUSSION

This section provides the experimental results of individual animal elevated plus maze test observation, individual animal open field test observation, individual animal oxidative markers of brain tissue, individual animal liver function test data, individual animal kidney function test and individual animal lipid profile test using above said two groups with respect to animal.

Table. 2. Individual animal elevated plus maze test observation

Group	Animal No.	Elevated plus maze test on 8 th day		
		Time spent in center (sec.)	Time spent in closed arm (sec.)	Time spent in open arm(sec.)
I	1	14	319	10
	2	22	292	22
	3	7	326	15
II	1	13	322	11
	2	7	282	5
	3	22	306	19

Group	Animal No.	Elevated plus maze test on 15 th day		
		Time spent in center (sec.)	Time spent in closed arm (sec.)	Time spent in open arm(sec.)
I	1	68	238	33
	2	55	252	38
	3	47	281	41
II	1	5	332	8
	2	8	292	9
	3	10	318	16

Group	AnimalNo.	Elevated plus maze test on 30 th day		
		Time spent in center (sec.)	Time spent in closed arm (sec.)	Time spent in open arm(sec.)
	1	81	212	36

I	2	93	208	52
	3	105	186	42
II	1	15	341	14
	2	9	274	24
	3	21	282	10

Table. 3. Individual animal open field test observation

Group	AnimalNo.	Open field test on 8 th day		
		No. of squared crossed	No. of Rearing	Time spent grooming (sec.)
I	1	143	8	18
	2	130	9	9
	3	153	5	12
II	1	142	4	10
	2	133	6	14
	3	147	7	12

Group	AnimalNo.	Open field test on 15 th day		
		No. of squared crossed	No. of Rearing	Time spent grooming (sec.)
I	1	164	18	47
	2	153	17	42
	3	170	23	39
II	1	144	9	13
	2	132	12	9
	3	126	8	15

Group	Animal No.	Open field test on 30 th day		
		No. of squared crossed	No. of Rearing	Time spent grooming (sec.)
I	1	188	23	63
	2	204	30	58

	3	195	36	62
II	1	138	8	14
	2	156	14	10
	3	151	11	12

Table 4. Individual animal oxidative markers of brain tissue

Group	AnimalNo.	Oxidative markers			
		SOD (U/g protein)	GSH-PX (U/gprotein)	CAT (K/g protein)	GR (nM/g protein)
I	1	0.34	1.23	3.12	0.72
	2	0.37	1.14	3.07	0.69
	3	0.29	1.17	3.09	0.68
II	1	0.68	1.78	4.08	1.19
	2	0.71	1.69	4.13	1.26
	3	0.69	1.88	4.02	1.24

Table 5. Individual animal liver function test data

Group	Animal No.	Liver function test	
		AST	ALT
I	1	72	20
	2	58	34
	3	74	47
II	1	63	43
	2	85	37
	3	77	22

Table 6. Individual animal liver function test data

Group	Animal No.	Kidney function test	
		Urea	Creatinine
I	1	45.3	0.57
	2	42.7	0.62
	3	39.6	0.48
II	1	26.3	0.22
	2	29.8	0.21
	3	23.2	0.18

Table. 7. Individual animal liver function test data

Group	Animal No.	Lipid profile test	
		Cholesterol	Triglycerides
I	1	68	31
	2	46	47
	3	39	23
II	1	54	43
	2	37	28
	3	72	35

In present study, Test group animals were exposed to electromagnetic field radiations for 8 hours per day for 30 days. Behavioral parameters were observed by using elevated plus maze and open field test. Behavioral test were performed on 8th, 15th and 30th day of exposure. SD rats have an aversion for high in open space and prefer closed arm. Therefore, Rats were spent a greater amount of time in enclosed arm, when animals enter open arm; they freeze, become immobile, defecate and show fear-like movements (Anxiety). In present study, rats were exposed for EMF radiations for 30 days, due to these chronic exposure period, rats were showed decrease in movements on 15th and 30th day. In elevated plus maze and open field test, rats were freezed and immobile in closed arm compared to control group animals. Movements in open arm and center of maze were increased as compared to control group animals.

Effect of EMF radiation depends on duration of exposure, no effect were showed on 8th day elevated plus maze and open field behavioral parameters. In case of open field test, rats were showed stressed behavior, increased movements in open field apparatus on 15th and 30th day. Significant increase in number of square crossed, rearing and time spent in grooming were observed.

Besides, we performed liver, kidney function and lipid profile testing. No significant deviations were observed in liver and lipid profile parameters. But significant increase in urea and creatinine value due to EMF radiation chronic exposure for 30 days.

The EMF radiations toxicity was related different biochemical alterations, and these results into the peroxidation of membrane lipids and depletion in the antioxidant defense system. Glutathione, a tripeptide is recognized for the removal of potentially toxic electrophilic compounds. EMF exposure alters GSH level brain tissues. GSH content was significantly decreased after EMF radiation exposure, prominently in brain tissue. SOD and catalases are the enzymes involved in the intracellular degradation of O₂ and H₂O₂. It represents the activity of SOD in the liver and brain tissues. Test group showed significant decrease in antioxidant marker level i.e. SOD, CAT, GSH. In this study, biochemical, histopathological analysis, connectivity of brain damage to examine the structural and functional integrity in EMF radiations exposed animals.

Histopathological evaluation and oxidative markers measurement were performed on brain tissue, significant decrease in SOD, GSH-PX, CAT, GR (Oxidative markers) level were

observed. Chronic exposure of EMF radiation elevates oxidative stress in brain, it was indicated through depletion in antioxidant enzymes i.e. SOD, Catalase, reduced glutathione. Brain tissue showed major histopathological alterations as compared to control group.

5. CONCLUSION

Our findings represents that the EMF radiation exposure is a major factor related to EMF radiation toxicity. As duration of exposure increased with relative increased in extent of toxicity. In addition, this study revealed that EMF radiation exposure caused neuronal damage.

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