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RESEARCH ARTICLE

RADIO FREQUENCY ELECTROMAGNETIC RADIATION EXPOSURE EMITTEDFROM CELL PHONE ALTERS THE FSH, LH HORMONES LEVEL*IN VITRO.*

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Abstract

Background: Increasing use of cell phones emitting radiofrequency electromagnetic field(RF-EMF) in daily life and through *in vitro* and *in vivo* studies, EMF exposure was found to alter the reproductive endocrine hormones, gonadal function, embryonic development, pregnancy, and fetal development.

Aims: This study aimed to investigate the effects of *in vitro* radiofrequency electromagnetic field (RF-EMF) exposure emitted from cellphone on FSH, LH, hormoneslevel.

Subjects and methods: The study was performed in the physiology & medical physics department, College of medicine, university of Diyala, Iraq in Feb 2016. The blood samples collected from 15 males & 13 females; and were divided into two groups , group l (control group) was not exposed to EMF and group II (exposure group) was exposed to radiofrequency emitted from cell phone for 20 minutes. Follicle stimulating hormone (FSH) and Luteinizing hormone (LH)levels weremeasured by radioimmunoassay**.**

Results: Two hypotheses was tested.Paired t test were used to examine the FSH, LH hormone levels after exposed to radiofrequency emitted from cell phone for 20 minutes. There was no significant effects in LH and FSH levels in RF-EMF exposure groups compared to thecontrol groups ($p>0.05$) in female and male samples.

Female: FSH;Mean: before=4.552, after=4.691;t= 0.7, df= 12, p>0.05;LH;Mean: before= 5.247, after=5.521;t= 0.135, df= 12, p>0.05.

Male: FSH;Mean: before= 7.04 , after =7.491; t= 0.96, df= 14, p>0.05;LH; Mean: before =5.959, after = 6.054t= 0.1593, df= 14, p0>.05.

Conclusions: We conclude that in vitro exposure to Radiofrequency electromagnetic field (RF-EMF)emitted from cell phone of no significanteffect on the level of FSH, LH hormones in the males and females blood samples.

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Introduction:-

Nowadays, cell phone technology is an integral part of everyday life, and its use will continue to grow as their providers proceed to offer more liberal services and newer, better products. Generally, a growing concern for possible adverse effects of cell phones on human health has evoked a flurry of scientific activity. Several studies have shown the association between human health and exposure to radiofrequency electromagnetic field (RF-EMF), emphasizing on clinical conditions as childhood leukemia, brain tumors, neurodegenerative diseases and genotoxicity [1].

RF energy is a type of non-ionizing radiation, including electromagnetic radiation (EMR), produced by cell phones, but is not strong enough to cause ionization of atoms or molecules. Cellular phones emit low levels of RF in the micro-wave range while being used. Although high-level of RF causes adverse health effects through heating body tissues, exposure to low-level RF does not produce such effects. Several experimental studies demonstrated that exposure to electromagnetic or static magnetic fields had adverse effects on the reproductive system [2].

Interesting about the possible hazard effects of mobile phone usage aregrowing as the number of users has increased tremendously over the past years. Mobile phone technology uses radiofrequency electromagnetic radiation (RF-EMR) and has drastically increased the RF-EMR exposure encountered indaily life [3].

Cell phone has become indispensibledevices in our daily life , these phones operates between 400MHz and2000MHz frequency bands and emit radiofrequency electromagnetic waves (EMW). These phones operate at differentfrequencies, differing in respect to the frequency usage in different countries.Concerns are growing about the possible hazard effects of radio-frequencyelectromagnetic waves (RF-EMW) emitted by these devices on human health [4]. The effects of EMW on living organisms depends on the wave frequency and intensity, The hazardous effect of radio waves of highfrequency is associated with an increase in body temperature [5].

Cell phones emit radiofrequency electromagnetic waves (RF-EMW) to nearby relay base stations orantennas. Our bodies act as antennas that absorb the radiation and convert it into alternating eddy currents.The frequencies of these radio waves fall in the low frequency microwave range (800- 2200 MHz),therefore, this radiation is of non-ionizing type as the energy emitted is too low to break chemical bonds inbiological system [6].

When speaking into a cell phone, the sound wave from the speaker goes through a transmitter that converts the sound into a sine wave. Thetransmitter then sends the signal to the antenna, which then sends it out into space in all directions. Thetransmitter in cell phone operates on about 0.75 to 1 watt of power, with 2 W at peak usage. This electricsine wave current running through the transmitter circuit also creates an electromagnetic field around it. Asthe electric current moves back and forth, the fields continue to build and collapse, forming electromagneticradiation. Thus, cell phone radiation is generated in the transmitter, and is emitted through the antenna inthe form of a radio wave [7].

Modern advances in cell phone telecommunication systems are associated withan increase in signal frequency, which correlates with higher energy radiofrequency waves [8].

Most European andAsian countries network operates at 850/900 MHz, while the United States network operates at1800/1900 MHz. The higher the frequency the more energy the waves carry. The impact ofthese radio frequency electromagnetic waves on the human body is measured via a standardized unit calledthe SAR value. The SAR (Specific Absorption Rate) is a measure of the rate of radiofrequency energyabsorption in the body and is calculated as watt/kg. Device specific SAR tests are conducted with thewireless device transmitting at its highest power level in all tested frequency bands. This value SAR depends on multiple factors such as proximity to a cellsite, the proximity of the wireless device to the body while in use, the mode of usage of the device (talkversus standby mode), and the use of hands-free (Bluetooth) devices [9].

A summaries of the biological effects of RF-EMR on male reproductive pattern. This induction calcium efflux and enhanced intracellular reactive oxygen speciesROS due to mobile phone radiation can cause several changes atenzymatic and hormonal level, which may result infertility [10].

AL-Akhras's resultsshowed that the rats exposed to 50 Hzelectromagnetic field and 25 μT intensity causesignificant reduction in total number of sperm and also they showed that changes of FSH hormone isnegligible in this field, but LH and FSH hormoneshave significant increase and reduction, respectively[11].

Subjects and methods:-

The study was performed in the physiology & medical physics department, College of medicine, university of Diyala, Iraq in Feb 2016. The blood samples collected from 15 males & 13 females; and were divided into two groups , group l (control group) was not exposed to EMF and group II (exposure group) was exposed to radiofrequency emitted from cell phone for 20 minutes. Follicle stimulating hormone(FSH) and Luteinizing hormone (LH)levels weremeasured by radioimmunoassay**.**

The blood samples collected from (13) females and (15) blood samples from males. The female that collected blood from them must be not pregnant and they have mobile phone and usually use it and also their ages must be below 50 years and not menopause and have no menstrual and hormonal disturbances.

From each one average collection is 5cc of blood ; divided in 2 tube, in each tube 2.5cc of blood and give it name, for example (tube1) (control group) and the other tube also 2.5cc of blood and named (tube 1a)(exposure group). Then isolate the (13 tube) from (13a tube) and the same methods applied to male samples. Then expose mobile phone radiation on (13a tube) and (15a tube) horizontally, put the mobile on the tube and the radiation emitted from the cell phone talk mode for 20 minutes, the type of the cell phone used is (Galaxy, Grand, Samsung) which produce 1.2 GHz RF radiation.

Hormone analysis. To analyze FSH, LH hormone, blood samples were collected intoheparinized tubes and separated by centrifugation at 3000 rpm for 10minutes andserum was stored at –70 ℃ until use, and then measure FSH and LH level in each sample from the two groups (expose and not expose to mobile phone radiation) by radioimmunoassay.

Statistical analysis. Statistical differences were analyzed using paired t student test for comparisons betweentwo sub-groups where $p<0.05$ was set as significant.

Results:-

Two hypotheses was tested.Paired t test were used to examine the FSH, LH hormone levels after exposed to radiofrequency emitted from mobile phone for 20 minutes.

This in vitroRF-EMF exposure emitted from mobile phonestudy shows that there was no significant effects in FSH and LH levels amongexposure groups compared to thecontrol group ($p>0.05$) in female and male samples.

Table 1: The level ofFSH(mlU/mL) hormonesbefore and after irradiation among female

No	Age	FSH(mlU/mL) level	
		Before	After
1	30	3.02	3.29
2	44	2.85	3.07
3	36	4.29	4.44
4	24	1.96	2.06
5	39	5.06	5.43
6	44	5.90	6.19
7	29	4.71	4.54
8	27	3.56	3.67
9	45	7.37	7.59
10	41	5.06	5.19
11	31	5.92	6.07
12	32	8.48	8.45
13	22	1.00	0.997
Mean		4.552	4.691

Mean: FSH before=4.552, after=4.691
tabulated t= 2.18, calculated t= 0.7, df= 12, p>0.05

Table 2: The level of LH (mlU/mL) hormones before and after irradiation among female

No	Age	LH(mlU/mL) level	
		Before	After
1	30	10.52	11.26
2	44	4.62	5.06
3	36	5.50	5.78
4	24	1.45	1.55
5	39	8.17	8.77
6	44	5.47	6.00
7	29	4.30	4.05
8	27	6.98	7.66
9	45	2.85	3.02
10	41	9.72	10.06
11	31	4.02	3.98
12	32	3.73	3.74
13	22	0.881	0.844
Mean		5.247	5.521

Mean: LH before= 5.247, after=5.521
tabulated t= 2.18, calculated t= 0.135, df= 12, p>0.05

Table 3: The level of FSH (mlU/mL) hormones before and after irradiation among male

No	Age	FSH(mlU/mL) level	
		Before	After
1	18	4.72	4.83
2	24	4.93	5.54
3	35	1.58	1.79
4	40	33.16	37.12
5	20	1.84	2.06
6	33	6.26	7.3
7	24	2.64	2.67
8	38	7.28	7.36
9	26	2.36	2.43
10	22	2.67	2.78
11	21	2.27	2.31
12	33	26	26.29
13	34	5.19	5.14
14	24	2.33	2.38
15	18	2.37	2.36
Mean		7.04	7.490

Mean: FSH before= 7.04 , after =7.491
tabulated t= 2.16, calculated t= 0.96, df= 14, p>0.05

Table4: The level of LH (mlU/mL) hormones before and after irradiation among male

No	Age	LH(mlU/mL) level	
		Before	After
1	18	4.85	4.85
2	24	4.94	5.16
3	35	5.04	5.01
4	40	15.74	15.5
5	20	4.01	3.81
6	33	4.1	4.03

7	24	1.76	1.8
8	38	12.53	12.75
9	26	3.78	3.96
10	22	3.84	4.03
11	21	1.8	1.84
12	33	7.82	7.88
13	34	5.6	6.09
14	24	6.37	6.51
15	18	7.2	7.59
Mean		5.958	6.054

Mean: LH before =5.959, after = 6.054
tabulated t= 2.16, calculated t= 0.1593, df= 14, p>0.05

Discussion:-

The results of our study indicated that long term exposure to mobile phone radiation in vitro exposure to Radiofrequency electromagnetic field (RF-EMF)didnot show a significant change in the level of FSH, LH hormonesin the males and females blood samples. In line with our finding there are other studies showing that exposure to cell phone radiation threaten many aspects of human health [12]. The studies show that cell phone radiation may seriously influence our endocrine system . There is also evidence showing that cell phone radiation causes changes inserum levels of sex hormones [13,14].

Despite studies reporting the harmful effects of cell phone radiation on health [1], including our finding, some studies suggest no significant influence of mobile phone radiation on our body systems functions such as heart rate and blood pressure in subjects exposed to cell phone waves [15,16]. However, it is expected that radiation emitted from a cell phone can reach all parts of the body and penetrate into the living tissues, and influence the body at the cellular level, leading to changes in glands structure and function resulting in changes in serum levels of hormones including sex steroid hormones.

Dasdag et al found no evidence suggesting anadverse effect of cell phone exposure on testeshistology, p53 immune reactivity, malondialdehydeconcentrations, sperm counts, sperm morphology,and rectal temperature of rats after cellular phoneactivation for 20 minutes per day (7 days a week)for one month. The duration of exposure andfrequency of radiation in our study were similarwith this previous study [17].

Other results was theeffect of microwave emitted from mobile phones on the estrogen, progesterone, FSH and LH hormones,which has been shown that, except LH which didnot show a significant change, the concentration ofFSH, estrogen and progesterone hormones hadsignificant increase. The results of this study areconsistent with the study which has done byBahararaet *al*, In a study conducted by thisresearcher that the experimental rats were takenunder simulated waves, results showed that progesterone levels are significantly lower inexperimental groups, but LH, FSH and estrogenhormones did not show significant change [18].

This study disagree with the study done by Bruheim K, Svartberg J, Carlsen E, et al that serum FSH was 3 times higher in the radiotherapy group than in the control group (median, 18.8 vs. 6.3 IU/L, p <0.001), and serum LH was 1.7 times higher (median, 7.5 vs. 4.5 IU/l, p <0.001) [19].

Conclusions:-

Due to limitations and difficulties associated with *in vivo*studies, at this work an *in vitro* experiment was performedto investigate the effects of exposure to the cell phone onthe FSH, LH hormoneslevelin the male and female blood samples. Nevertheless, *in vivo* studies, whether onanimals or human beings, may provide more convincingevidence of the EMF effects.

We conclude that in vitro exposure to Radiofrequency electromagnetic field (RF-EMF) of no significanceon the level of FSH, LH hormonesin the male and female blood samples.Through *in vitro* and *in vivo* studies, EMF exposure was found to alter the reproductive endocrine hormones, gonadal function, embryonic development, pregnancy, and fetal development. These effects were different according to the frequency, duration of exposure, and strength of EMFs. Humans in modern society cannot avoid various kinds of EMFs during household and

occupational activities, but should be aware of the biological hazard of EMFs. The effort to avoid EMF exposure and techniques to protect or relieve EMF radiation are required to preserve our reproductive potential.

Recommendations:-

1. Evidences for such impacts come from designed animal and in vitro studies which may be different from in vivo human exposure. Nevertheless, the important advice is to apply strict regulations on further increase in the power density of the emitted cell phone radiation and to conduct in vivo human research to study its negative effects on fertility.
2. Reduce your exposure to electromagnetic radiation and cell phone radiation. Don't carry the cell phone near your body. Don't carry it on a belt clip or in a pocket. Don't lay it in your lap while driving. Keep electric clocks away from your bed at night. And if you must spend a lot of time on a computer or on a cell phone or in an area where electromagnetic radiation is present (ie everywhere) use some type of protective devices that will help neutralize the radiation.

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