Original Article

Electromagnetic Radiations on Thyroid

Effects of Electromagnetic Radiations on Thyroid Follicles of Mice

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ABSTRACT

Objective: To study the effects of electromagnetic radiations on follicles of Thyroid gland of mice.
Study Design: Laboratory based randomized controlled trials.
Place and Duration of Study: The study was carried out in department of Anatomy, Army Medical College Rawalpindi in collaboration with National Institute of Health, Islamabad from November 2009 to November 2010.
Materials and methods: Twenty adult Balb/C male mice were divided randomly into two study groups, comprising of 10 animals in each group.Group A was kept under experimental conditions without mobile phone exposure, group B exposed to radiations for 1 hour /day, for two months from mobile phone set. Thyroid glands were removed and sectioned after exposure period. Sections were stained with hematoxylin and eosin for microscopic examination.
Results: Results showed statistically significant difference in number and mean size of Thyroid follicles in gland of experimental groups.
Conclusion: Thus it is concluded that exposure to EMFs causes decrease in size and increase in number of follicles of thyroid gland of mice, indicating hyperactivity of gland.
Key Words: Mobile Phone, Thyroid Follicles, Balb/c and Mice.

INTRODUCTION

Electromagnetic field (EMF) and its potential harmful effects on the human body are heavily researched in the medical field. Electromagnetic field is an area that is generated by the source of the radio frequency and distributed in space[1]. All the electronic equipment we use in our daily life, without thinking how much we use or how often we use, create EMF[2]. Electromagnetic sources can be classified as Natural Electromagnetic Sources like Sun, stars, atmospheric discharges like thunder and Unnatural or Human Made Sources like Cables that carry electrical currents, television (TV) and computers, electrical home gadgets, radio and TV base stations, cell phones and their base stations[3].

Frequency is number of vibrations of electromagnetic waves in a particular time, at certain points. One cycle of an electromagnetic wave in one second is 1 Hertz (Hz), and one megahertz (MHz) is equal to one million cycles in 1 second. Analog phones work at frequencies between 800 and 900 MHz whereas digital phones work at 1850 to 1990 MHz[4].

Harmful Effects of EMF Sources: Due to the frequent use of cell phones, they have a unique place in EMF studies. The effects of cell phones on the human body can be categorized as thermal and non-thermal effects[5]. Mobile phone is considered one of the important sources for the EMF generation, Even though they have internal safety mechanism they still present a risk factor[6].

Decreasing of the area of vision[7] heavy stress and feeling of tiredness, loosing of concentration and attention, voices in the ears and warming of ears, reversible hearing problems[8], headache, electrical burn[9] and such can be seen as the short term effects.

The long term effects that commonly encountered are; irreversible hearing problems, damaging of the embryonic development[10] increasing risk of miscarriage, decrease in the number of sperms[11], damaging of the brain tissue[12] heart related problems, weakening of the memory[13], lymphoma[14] and damaging of the genetic structure[15]. Purpose of this study was to see the harmful effects of these radiations on the size of thyroid gland follicles because secretion of thyroid hormone is directly related with the size of thyroid gland follicles.

MATERIALS AND METHODS

The study was carried out in department of Anatomy, in collaboration with National Institute of Health, Islamabad from November 2009 till November 2010. Twenty adult Balb/C male mice were taken. Animals were given standard diet and kept at standard temperature 21 ± 2 C and animal room was maintained on 12 hour light/dark cycle. They were divided randomly into two study groups, comprising of 10 animals in each. Experimental animals were housed in the standard plastic cage with the exposure device (mobile phone) kept in centre of the animal cage, in a separate small cage. Group A (Control Group) kept

under same experimental conditions without a mobile phone. Group B exposed to mobile phone radiations for 1hour/day for two months. At the end of experiment, animals sacrificed by over dose of ether, midline incision given in neck, overlying muscles, lymph nodes and salivary glands were removed thyroid gland taken out along with trachea and esophagus. Tissue preserved in 10% formalin, for forty-eight hours then taken and processed for paraffin embedding, 5µm thin sections of tissue prepared and mounted on glass slides. Hematoxylin eosin stain used. Sections of thyroid were examined microscopically for:

- Size of follicles under high power field.
- Number of follicles under low power field.

For the calculation of size of follicles an ocular micrometer was used in calibration with a standard stage micrometer. Two measurements were taken for each follicle. One measurement was taken at the maximum transverse diameter of follicle and another at perpendicular to the first one (16) so the average diameter of the thyroid follicle was measured by taking the mean of the two diameters i.e Max transverse diameter + max perpendicular diameter = 2

Three observations were made in each lobe of gland in this way six observations in each section and 60 observations in each group.

Number of follicles was counted in each lobe of thyroid gland at 10X moving from pole to pole and from medial side (that is trachea) to the lateral side.

Data were entered in a database using SPSS version 15. Descriptive statistics were used to describe the data i.e mean and standard error (SE) for follicular size (ANOVA) followed by Post_hoc tukey test. The difference was regarded statistically significant if the "p" value was equal to or less than 0.05. "p" value was found by means of "t" distribution table.

RESULTS

Group A (control): On microscopic examination thyroid gland revealed normal morphology (fig 1) The thyroid gland of control animals was characterized by the predominance of macro follicles rich in a colloid material. There diameter was 117 ± 5.03/m (table 1)

Table No. 1: Comparison of Follicular diameter in thyroid Tissue between Control and Experimental Groups.

Groups	Mean±SE	P-Value
Control Group A	117.56 ± 5.03	<0.00**
Experimental Group B	92.50 ± 2.25	

Number of follicles in control group was 163 ± 5.53 **(**table 2)

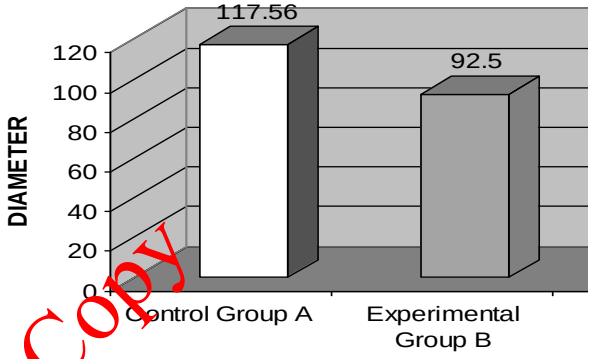
Group B (experimental): Lobes in the exposed group showed numerous micro follicles with less colloid content. (figure 2)

Mean diameter of follicles was 92.50 ± 2.2 (Tab 1, bar chart 1)

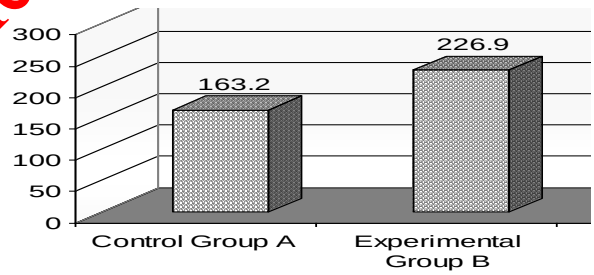
Total number of follicles was increased, number was 226.9 ± 8.949. (Tab 2, bar chart 2)

Table No. 2: Comparison of number of follicles in thyroid Tissue between Control and Experimental Groups.

Groups	Mean±SE	P-Value
Control Group A	163.2± 5.53	<0.00**
Experimental Group B	226.9 ± 8.949	



Bar Chart No.1. Comparison of Follicular diameter in thyroid Tissue between Control and Experimental Groups



Bar Chart No.2: Comparison of number of Follicies in thyroid Tissue between Control and Experimental Groups

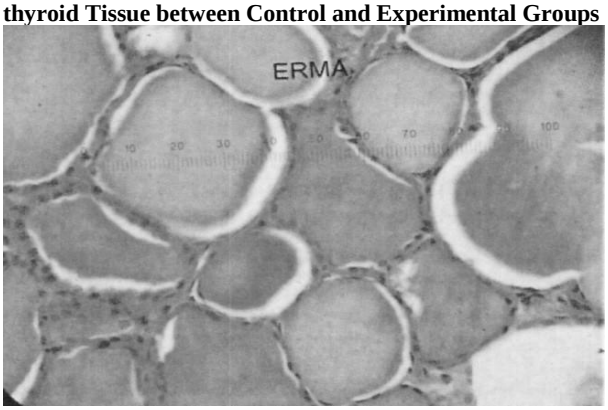


Figure No.1. Photomicrograph of a cross section from thyroid gland of animal of control group showing follicular diameter H&E stain.

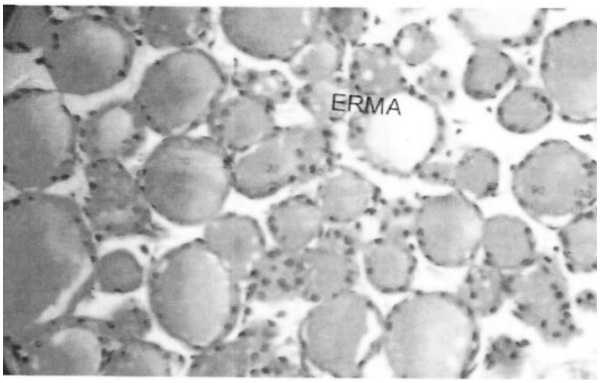


Figure No.2: Photomicrograph of a cross section from thyroid gland of animal of experimental group showing follicular diameter H&E stain.

DISCUSSION

The widespread use of mobile phones has been going sky-high over the past decade and now its use is an essential part of business, commerce and society. The fact that so many people own mobile phones attests to their perceived importance to the general public. The use of mobile phones and related technologies will continue to increase for the foreseeable future[17]. Mobile phones are low power radio devices that transmit and receive radio frequency radiation at frequencies in the microwave range of 900-1800 MHz[18]. Despite repeated horror stories on mobile phones in the media; nearly more than 500 million people worldwide use mobile phones[19]. The extensive use of mobile phones has been accompanied by public debate on the possible adverse effects on human health. The concerns relate to the emissions of radio frequency (RF) radiation from the mobile phones and the base stations that receive and transmit the signals.

In the evaluation of biological effects of radiofrequency fields, many studies were focused on the endocrine system, because of its crucial role in human health status. Due to proximity of thyroid gland to the cell phone during its normal use, the thyroid gland could be involved in interaction with electromagnetic field emissions.

It is certain from literature that; EMF has potential harmful effects on tissues in human and experimental animals. Moreover; it had concluded that there are roles of molecular pathways such as oxidative stress on electromagnetic field-induced diseases. Electromagnetic field reduces the speed of destroying free radical compounds thus allowing them to affect longer periods of time. Therefore, the fact that electromagnetic field increases the amount of free radicals makes us believe that they can also cause cell damage as well as tumors[20]. Results of the present study have shown that histomorphology of thyroid gland in male Balb/C mice after exposure to EMFs generated by mobile phone for two months demonstrated increased activity of thyroid gland; this is indicated by decreased size and increase in number of thyroid follicles.

CONCLUSION

Turnover of hormone within the lumen of follicle depend on diameter of the follicles. Thus, it could be suspected that the synthesis and secretion of thyroid hormone was more intense and faster in smaller follicles suggesting an increase activity of the thyroid gland. There is rapid multiplication of smaller and more active follicles to meet the secretary needs of the gland.

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