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The Effects of Electromagnetic Radiations from Conventional and Advanced Mobile Phones on the Diameter of Malpighian Corpuscle and Glomeruli in the Mesonephros of Developing Chick Embryo

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Abstract: ***Objective: The study was conducted to investigate the comparative histomorphogical effects of radiations from conventional and advanced mobile phone, on the developing kidney of chick embryo. Study Design: Randomized Control Trial Duration of Study: Army Medical College, NUST, Rawalpindi, 3months from May 2012 till July 2012. Material and Methods: Fifty fertilized eggs of Fayoumi breed were selected and divided into five groups. Group I being control. Two groups II and IV were exposed to conventional mobile phone radiations and two groups III and V were exposed to advanced mobile phone radiations, for 15 and 30 minutes respectively. Results: The results were statistically insignificant when all the groups were compared with each other. Conclusion: The results showed that advanced and conventional mobile phone radiations did not show any differtiable effects on the diameters of glomeruli and malpighian corpuscle.***

Keywords: Advanced Mobile Phone, Conventional Mobile Phone, Chick Embryo, Mesonephros, Malpigian corpuscle

1. Introduction

Mobile phone is the most popular device of modern times. New innovations in the technology of mobile phone like the WLAN (wireless local area network)/Wi-Fi (wireless fidelity), GPRS (general packet radio service) and Bluetooth have replaced the simple and conventional cell phones with sophisticated and advanced ones. A decade ago, mobile phones were used only for voice communication and messaging.

But with the advancement in technology, cell phones are used for many purposes. They are a source of communication and entertainment. The teenage group and children are more inclined towards its use[1]. Therefore, children are proned to the harmful effects of radiations as their brain tissue is developing. Their skulls are thinner than adults and and there is danger of more years of exposure to mobile phone radiations[2,3]. According to WHO, at the end of 2009, estimated global subscriptions of mobile phone were 4.6 billion[4].

After the introduction of the GPRS and wireless fidelity (Wi-Fi/WLAN) technology in mobile phones, one does not have to carry a laptop all the time for using internet. Mobile phone can serve this purpose as well. It is internet in the pocket. But with this advancement, exposure to the electromagnetic radiations increases. In the current study, the effects of Wi-Fi radiations will be studied, which are emitted in the advanced mobile phones while using internet and conventional mobile phones are the simple talk and text mobile phones.

2. Methodology

The study was carried out in Army Medical College Rawalpindi in collaboration with Poultry Research Institute Rawalpindi, from where zero day eggs were bought for experimental purpose. Fertile eggs of Fayoumi breed were chosen for incubation at 37 ºC and humidity range of 50-60% [5].

A still-air incubator with measurements of 24 inch (length) x 24 inch (width) x 12.5 inch (height), with 100 eggs capacity was used for the project. The eggs were divided into five groups. Group I (control), Group II (Experimental, 15 minute GSM radiation exposure), Group III (Experimental, 15 minute GSM and Wi-Fi radiation exposure), Group IV (Experimental, 30 minute GSM radiation exposure), Group V (Experimental, 30 minute GSM and Wi-Fi radiation exposure). The temperature was monitored by mercury thermometer. The humidity was maintained by filling the plastic pans with water and monitored by hygrometer. The eggs were marked with 'X' on one side and 'O' on the other side with lead pencil so that egg turning is not missed.

They were turned thrice a day manually, after every eight hours. In the experimental groups, the mobile phone was placed at the center and 5 eggs were placed at one end and five eggs at the other end of the mobile phone, at the distance of 10 cm from the mobile phone, so that the eggs lie within one wavelength of GSM and Wi-Fi radiations. The time of exposure to GSM radiations was 15 minutes (approx.23 missed calls) and 30 minutes (approx. 45 missed calls), daily, in the II and IV groups. In group III the GSM exposure was for 15 minutes (23 missed calls) daily and exposure to Wi-Fi radiations, induced by downloading files,

was for 15 minutes. In group V, the time of exposure to GSM radiations was 30 minutes (45 missed calls) and to Wi-Fi radiations was also 30 minutes daily.

After the completion of their respective time period of incubation, that was of 15 days, and time of exposure in the experimental groups, that was also of 15 days, the chick embryos were dissected by crack opening the shell at the broader end, which contains air sac. The inner and outer shell membranes were removed. The chick embryos were taken out by cutting the chorioallantoic membranes and amnion and removing albumin and yolk. Then living embryos were decapitated and fixed in 10 % formalin filled jars for 48 hours. After fixation, they were dissected to expose the kidneys in the posterior abdominal wall of the chick embryo.

Then they were processed and embedded. Tissues were cut into 5 microns thick sections using rotary microtome. The sections were stained with autostainerHematoxylin and Eosin (H&E) and PAS stains were used. Micrometery was carried out for measurement.Maximum transverse and vertical diameters were measured in three randomly chosen glomeruli in three different fields at X40 in each slide (one slide per specimen).

Both transverse and vertical readings for same glomeruli were observed. As the section was coronal, maximum vertical diameter was measured parallel to long axis of the section and maximum transverse diameter at right angle to the vertical one as observed by Zamanet al[6]. Then mean of both diameters was taken, the result was the transvertical diameter of the glomeruli. Same was done for malpighian corpuscle. Three readings were observed. Then mean of the three readings was taken as the observed diameter of the glomeruli and malpighian corpuscle for the particular specimen. The data was entered in data base using start package for social services (SPSS). The significance difference was determined using ANOVA. Results were considered significant at $p<0.05$.

3. Results

Mean transvertical diameter of glomeruli in the mesonephrosof control group I was 120.27±5.18µm. Mean transvertical diameter of the glomeruli in the mesonephric tissue, in group II was 114.72±2.71µm, in group III was 112.34±6.70µm, in group IV was 105.26±9.15µm and in group V was 103.33±2.96µm (table-I).Mean transvertical diameter of malpighian corpuscle in the mesonephros of control group I was 132.22±6.85µm. Mean transvertical diameter of the corpuscle of the mesonephric tissue in group II was 126.61±5.20µm, in group III was 124.47±4.25µm, in group IV was 122.08±4.49µm and in group V was 122.16±6.45µm (0µm, in group IV was 105.26±9.15µm and in group V was 103.33±2.96µm (Table-II)

Table 1: Transvertical diameter of glomeruli incontrol and experimental groups II, III, IV and V(mesonephros)

Groups	*Comparison*	*P-value*
I	II	0.96
	III	0.87
	IV	0.37
	V	0.28
II	I	0.96
	III	0.49
	IV	0.79
III	I	0.87
	II	0.49
	V	0.83
IV	I	0.37
	II	0.79
	V	0.99
V	I	0.28
	III	0.83
	IV	0.99

*p-value <0.05 siginificant
**p-value <0.001 highly siginificant

Table 2: Transvertical diameter of malpighian corpuscle in control and experimental groups II, III, IV and V (mesonephros)

Groups	*Comparison*	*P-value*
I	II	0.94
	III	0.85
	IV	0.68
	V	0.71
II	I	0.94
	III	0.99
	IV	0.97
III	I	0.85
	II	0.99
	V	0.99
IV	I	0.68
	II	0.97
	V	1.000
V	I	0.71
	III	0.99
	IV	1.000

*p-value <0.05 siginificant
**p-value <0.001 highly siginificant

4. Discussion

The mean transvertical glomerular and Malpighian corpuscular diameters, in mesonephros, were statistically insignificant when respective groups were compared with each other, however, the mean results of glomerular diameter decreased in the mesonephric tissue with increasing exposure to the radiations. The malpighian corpuscle diameter also seemed to be decreasing when exposed to Wi-Fi radiations and increasing time of exposure., but the results remained statistically insignificant (figure-1 and 2). Khayyat[7] observed increase in the Bowman's space in mouse with atrophied glomeruli,after exposure to isothermal electromagnetic radiations. and Al-Glaib et al[8]noticedglomerular atrophy after exposure to mobile phone radiations of GSM type. In a study on effects of EMR of 5Hz and 50Hz on kidney of guinea pigs, the glomeruli adhered to the Bowman's capsule obliterating the urinary or bowman's space[9]. Similarly a study on effects of

GSM radiation on kidney of chick embryo also showed a reduction in the Bowman's space[10].

5. Conclusion

It can be concluded that there were changes in the diameters of glomeruli and malpighian corpuscles with advancement of technology in mobile phones and increased exposure time to radiations, resulting in decrease in the diameters but statistical insignificance of results does not highlight any notable effects on the diameters of the glomeruli and renal corpuscles.

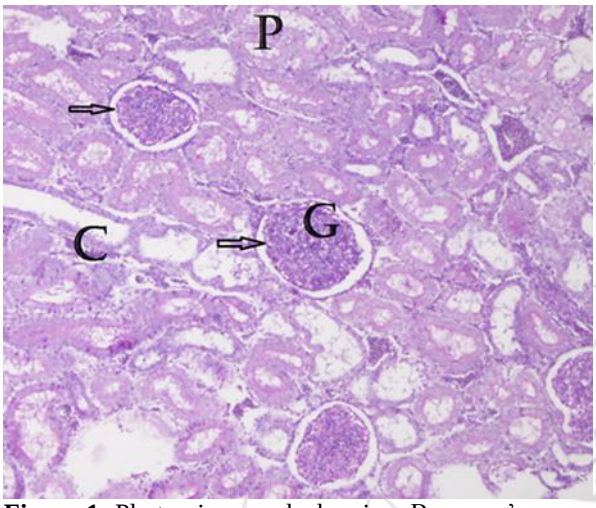

Figure 1: Photomicrograph showing, Bowman's space (arrow) in controll group I (PAS, Approx. X 500) P; proximal tubule, C; collecting tubule, G; glomeruli

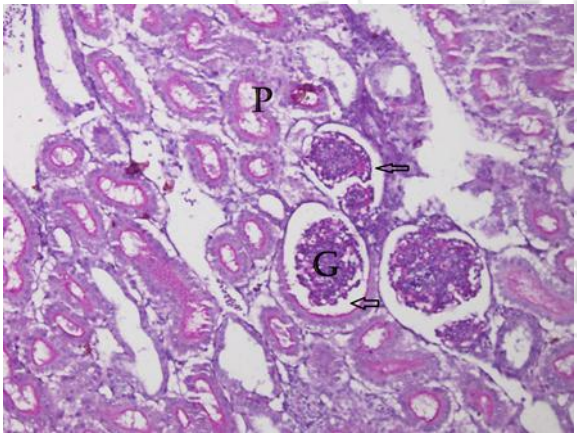

Figure 2: Photomicrograph showing an increase in the Bowman's space (arrow) in experimental group III (PAS, Approx. X 500) P; proximal tubule, G; glomeruli

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