

THE EFFECTS OF ELECTROMAGNETIC RADIATIONS FROM CONVENTIONAL AND ADVANCED MOBILE PHONE ON THE HISTOMORPHOLOGY OF PROXIMAL TUBULES OF MESONEPHROS OF CHICK EMBRYO

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ABSTRACT

Objective: The study was conducted to investigate the comparative histomorphological effects of radiations from conventional and advanced mobile phone, on the developing kidney of the chick embryo.

Study Design: Randomized control trial.

Duration of Study: Three months.

Material and Methods: Fifty fertilized eggs of Fayoumbreed were selected. Two groups II and IV were exposed to conventional mobile phone radiation and two groups III and V was exposed to advanced mobile phone radiation for 15 and 30 minutes respectively, group I, being the control.

Results: The results were significant between control and groups III, IV and V regarding tubular diameter. The luminal diameters were statistically insignificant between the respective groups but significant between groups I and all the experimental groups, II and III when comparing proximal tubular cell's height.

Conclusion: The proximal tubular and luminal diameters and epithelial height of the cells lining the proximal tubules of mesonephros were affected by not only advancement in the mobile phones but also increase in the exposure time to the radiations.

Keywords: Chick Embryo, Mesonephros, Proximal Tubules, Conventional Mobile Phone, Advanced Mobile Phone.

INTRODUCTION

Plenty of work has been done on the effects of GSM (Global system for mobile communications) electromagnetic radiations emitted from the mobile phones during phone rings, voice calls and text messages. But nowadays, as the advanced mobile phones like Smartphones are taking place of the old styled conventional mobile phones, which emit GSM radiations only, there is fear of increased exposure to electromagnetic radiations because of the multiple features like Wi-Fi in these cell phones. Not too long ago, mobile phones were used only for voice communication and messaging. But with the advancement in technology, cell phones are used for many puposes. They are a source of communication, entertainment and work. Hence, mobile phones

have become an indispensable gadget for almost all age groups. The teen age group and children are more inclined towards the usage of mobile phones¹. Therefore, children are prone to the harmful effects as their brains are developing.

The mobile phones that can be used only for the purpose of voice calls and messaging are the conventional ones. WLAN/Wi-Fi, GPRS, bluetooth feature is not present in these mobile phones. The electromagnetic radiation emitted by such mobile phone is in GSM frequency range of 850-1900 MHz, when used for phone calls and messaging. Advanced mobile phones include the modern cell phones that are not used only for voice and message communication but also have additional features of Wi-Fi /WLAN technology, GPRS and bluetooth.

The electromagnetic radiations from the mobile phone are classified as 2B, by international agency for cancer research, which means it is a possible carcinogenic. An increase in blood glucose metabolism was recorded after a 50

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min call in the region close to antenna of mobile phone in a recent study². Symptoms of headache (21.6%), sleep disturbance (4%), tension (3.9%), fatigue (3%) and dizziness (2.4%) were recorded in 437 subjects who were using mobile phone³. A decrease in sperm motility and viability was observed after an hour of mobile phone radiation exposure, leading to oxidative stress in semen. The reactive oxygen species were higher in the exposed group in comparison to control group⁴. An increased risk of glioma after more than or equal to ten years use of cell phones was observed in a study carried out in Germany⁵. In a study conducted in the department of oncology, in Sweden, the risk of tumor of central nervous system increased on the ipsilateral side, where the handset was kept while phone calls⁶. In chick embryo, the retina showed derangement in pigmentation that was mild on 10th day of incubation and intense on the 15th day of incubation, after daily half hourly exposure to mobile phone radiation exposure⁷. The kidney of rats showed congestion and atrophy in the glomerular size after mobile phone radiation exposure⁸.

There was a decrease in the motility of the sperms as well as DNA fragmentation after they were exposed to Wi-Fi radiations from a laptop connected to internet for 4 hours in ex vivo⁹. The pregnant rats were given in utero exposure of Wi-Fi for 2hr/day for 6 days for 18 days. They did not show any abnormality and the prenatal and post natal development of the pups was also not affected by the Wi-Fi radiations¹⁰. The rationale of current study is to observe any harmful effects of advanced mobile phone radiations on developing tissue in comparison with conventional talk and text cell phones.

MATERIAL AND METHODS

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 °C and humidity range of 50-60%¹¹.

Incubation of eggs

A still-air incubator with measurements of 24 inches (length) x 24 inch (width) x 12.5 inch (height), with 100 egg capacity was used for the project. The eggs were divided into five groups. Group I(control), Group II (Experimental, 15 minutes GSM radiation exposure), Group III (Experimental, 15 minute GSM and Wi-Fi radiation exposure), Group IV (Experimental, 30 minutes GSM radiation exposure), Group V (Experimental, 30 minutes 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 (23 missed calls) and 30 minutes (45 missed calls), daily, in the II and IV groups. In groups III and V, the GSM exposure was for 15 minutes (23 missed calls) daily. In group III, Wi-Fi radiations were induced by downloading files 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.

Dissection, Fixation, Processing and Staining of eggs

After the completion of their respective time period of incubation (15 days), and time of exposure in the experimental groups,(also 15 days), the chick embryos were dissected by crack opening the shell at the broad 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 a rotary microtome. The sections were stained with autostainer with Hematoxylin and Eosin (H&E) for routine histological study of kidney and Periodic Acid Schiff (PAS) reagent for basement membrane staining.

Histopathological study

Qualitative parameters

The qualitative examination was done at 4X, 10X, 40X objectives. The slides were studied for general architecture (disrupted or undisrupted).

Quantitative parameters

Micrometry was carried out for measurement of the diameters and epithelial height (fig-3)

Tubular diameter

It was taken from the basement membrane of the cells on one side to the basement membrane of the cells on the opposite side in rounded tubules. Three observations were taken and their average as a final reading for that specimen.

Luminal diameter

It was taken from the apical surface of one cell to the apical surface of the opposite cell in the rounded tubules. Three observations were taken and their average as a final reading for that specimen.

Epithelial height of the cells

Ten cells were chosen randomly from each tubule. It was taken from apical till basal end of the cells lining the tubules. The average was taken as a final reading for the specimen.

Statistical analysis

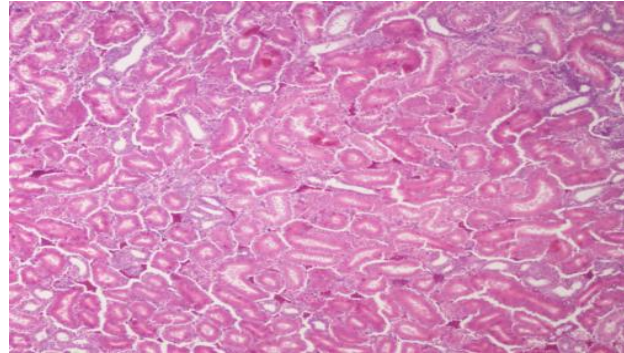


Figure-1: Mesonephric tubules at 10 X (H and E).

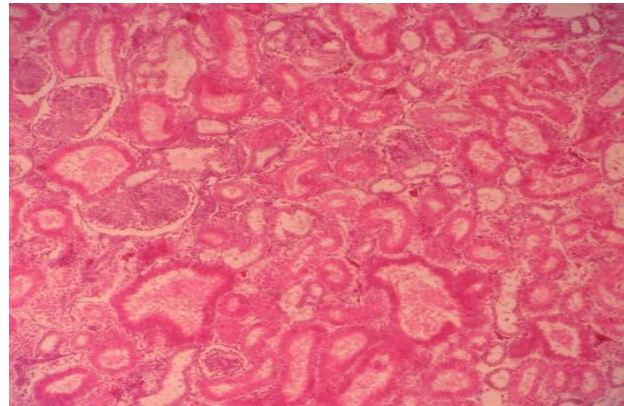


Figure-2: Mesonephric tubules dilated at 10X (H and E).

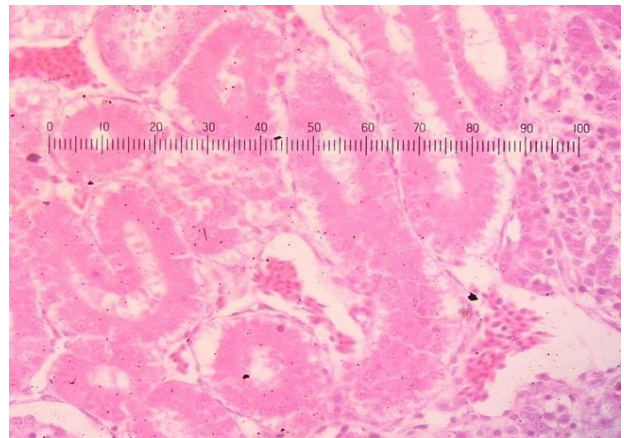


Figure-3: Calibration of proximal tubular and luminal diameter and epithelial height at 40X (H and E).

The data was analyzed by using statistical package for social services (SPSS). The significant difference was determined using independent student t-test. The results were considered significant at $p < 0.05$.

RESULTS

The H and E stained slides showed disruption in the normal cytoarchitecture of the renal tissue. The renal tubules were dilated (fig-2) in the mesonephros of the experimental groups.

There were no inflammation or necrosis. The proximal tubular diameter (table-1) in the mesonephric tissue increased among the groups when compared with control group I. Similarly, the proximal tubule luminal diameter (table-2) in all the experimental groups was higher than control group I. The epithelial height of the cells (table-3) of the proximal tubules of mesonephros decreased among the groups with significant difference between control group I and all the

Table-1: Proximal tubular diameter in control and experimental groups II, III, IV and V.

Groups	Proximal tubular diameter mean \pm SEM (μm)	Comparison	Significance
I	69.99 \pm 2.62	II	> 0.05
		III	<0.05*
		IV	< 0.05*
		V	< 0.05*
II	94.89 \pm 15.02	I	> 0.05
		III	> 0.05
III	86.64 \pm 4.18	I	< 0.05*
		II	> 0.05
IV	88.64 \pm 7.47	I	<0.05*
		V	> 0.05
V	84.04 \pm 4.78	I	<0.05*
		IV	> 0.05

Table-2: Proximal luminal diameter in control and experimental groups II, III, IV and V.

Groups	Proximal luminal diameter mean \pm SEM (μm)	Comparison	Significance
I	35.01 \pm 6.29	II	> 0.05
		III	> 0.05
		IV	> 0.05
		V	> 0.05
II	57.91 \pm 13.31	I	> 0.05
		III	> 0.05
III	46.35 \pm 5.39	I	> 0.05
		II	> 0.05
IV	43.85 \pm 7.23	I	> 0.05
		V	> 0.05
V	41.66 \pm 5.61	I	> 0.05
		IV	> 0.05

experimental groups. Comparing the experimental groups, significant results were present between group II and III regarding proximal tubular height.

DISCUSSION

The objective of this study was to see the effects of conventional and advanced mobile phone induced electromagnetic fields on the histomorphology of the developing kidney of the chick embryo. The experimental groups were

mice¹². The GSM electromagnetic radiation exposure to mice also had the same results¹³.

Dilatation of renal tubules was observed by Al-Glaib¹³ in mouse kidney and, because of GSM mobile phone radiations, Accini¹⁴ noted collapse of the renal tubules. The results showed that the proximal luminal diameter increased in the mesonephros of all the experimental groups than the control group. But the results were not significant between the groups. In case of

Table-3: Mean epithelial height of proximal tubular cells in control and experimental groups II, III, IV and V.

Groups		Comparison	Significance
I	18.22±0.43	II	< 0.05*
		III	< 0.05*
		IV	< 0.05**
		V	< 0.05**
II	15.71±0.75	I	< 0.05*
		III	< 0.05*
III	12.12±0.47	I	< 0.05*
		II	< 0.05*
IV	12.40±0.08	I	< 0.05**
		V	> 0.05
V	12.03±0.25	I	< 0.05**
		IV	> 0.05

**p*-value <0.05 significant

***p*-value <0.001 highly significant

compared with the control group, as well as with each other. The results of control were compared with all the experimental groups. The results of group II were compared with group III and of group IV in group V.

No features of inflammation were observed in the experimental groups. In previous studies on the effects of electromagnetic radiations, the exposure resulted in infiltration of the intertubular interstitium with neutrophils in

proximal tubular diameter, statistical significance existed between group I and groups III, IV and V. The epithelial height was observed to be decreased in the germinal epithelial in the rat testis after exposure to cellular radiation¹⁵, but the contrary finding was observed in the thyroid follicular cells that showed an increase in the height¹⁶. In mesonephros, the results were significant between group I and all experimental groups, between II and III for proximal tubular cells showing that advanced mobile phone

radiations decreased the height of the cells more than conventional cell phone radiations.

CONCLUSION

Morphometric measurements showed that the advancement in the technology of mobile phones like Wi-Fi, can lead to significant changes as the results of group II and III were statistically significant. Moreover, increasing the time of exposure can also lead the histomorphological changes as the results of tubular diameter and cellular height were statistically significant between groups I and groups IV and V. The main results of groups IV and V were so close that no statistical significance was present when these two groups were compared.

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