Indian J Physiol Pharmacol 2009; 53 (3): 283–286

LETTER TO THE EDITOR

HYPOACTIVITY OF WISTAR RATS EXPOSED TO MOBILE PHONE ON ELEVATED PLUS MAZE

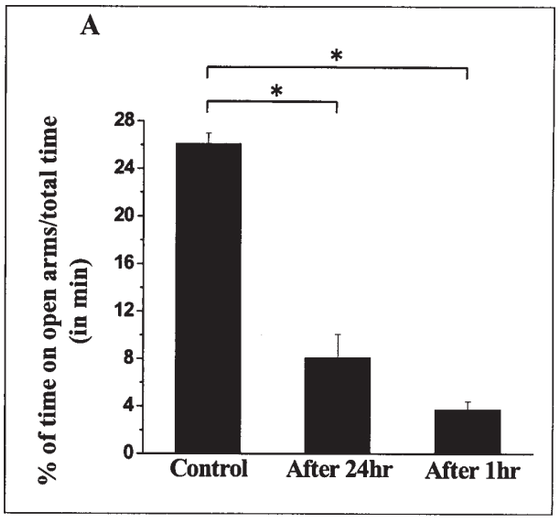
Sir,

(Received on June 10, 2009)

Following the enormous increase in the use of wireless mobile telephony across the world concerns on health effects of hand-held mobile phone radiations have induced a large body of research, both epidemiological and experimental. This wireless technology uses electromagnetic radiation in microwave range which may be harmful to human health. Parts of the radio waves from the phones are absorbed by the human head. One well understood effect of microwave radiation is dielectric heating also known as electronic heating or high frequency heating, in which any dielectric material (such as living tissue) is heated by rotations of charged molecules induced by the electromagnetic field. In mobile phone users, most of the heating effect will occur at the surface of the head causing increased temperature. Whether these low frequency pulsing signals from mobile phones have biological significance has been subject to debate. In the present preliminary study, we tested whether mobile phone exposure causes changes in behavior of Wistar rats on elevated plus maze (EPM).

Male Albino rats of Wistar strain, 10–12 weeks old were housed in plastic cages of size 14”×9”×8” (3 rats in each cage) inside a well-ventilated room at 22±2°C with a 12 h light : dark cycle. All animals had free access to standard diet and water. The animal Ethics Committee, Manipal University, Manipal approved all the procedures used. Animals were divided into two groups of 6 rats each; group I control and group II: were exposed to 50 missed calls (with 15 s interval between each missed call) per day for 4 weeks, keeping a GSM (900/1800/MHz) mobile phone in vibratory mode (no ring tone) in the cage. Each missed call was of the duration of 1 min. Animals were free to move in the cage and the phone was kept in a 4”×2”×1” wood-bottom cage to avoid animal’s contact with phone. After the experimental period, all animals were tested on EPM.

Elevated plus maze (EPM) apparatus was made out of black plexi-glass; with two closed and two open arms (50×10 cm) from an open centre (5×5 cm) in plus shape. Closed arms were surrounded by high walls (40×10 cm) and the whole apparatus was raised to a height of 50 cm above the floor. Experiments were carried out in a sound-attenuated, temperature controlled room, illuminated by a 40 W white light. Animals were brought to the test room 1 day prior to the experiment. The observer stayed in the same room, 1 m away from the maze. At the start of each trial, animal was placed on the central platform facing the closed arm. Over a period of 5 min, the time spent in the open arm was recorded. The criterion



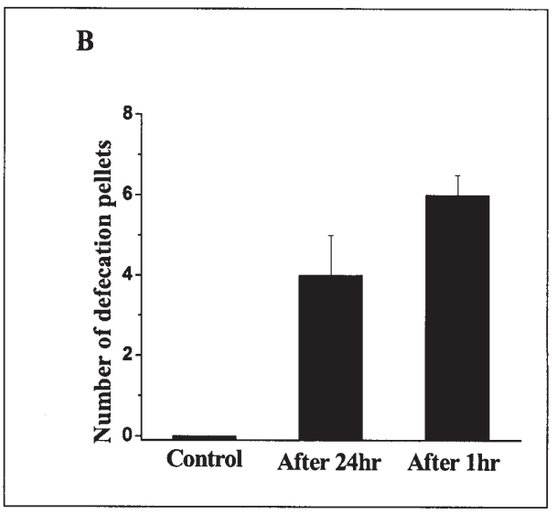


Fig. 1 : **Elevated plus-maze exploration :** A. Percentage of time spent on open arms/total time (in minutes) by the rats. Mobile phone exposed rats spent significantly less time on open arms than controls. *P<0.05. B. Number of defecation pellets. Defecation pellets were found with phone exposed animals while it was absent in case of controls. Results are expressed as means±SD.

for an arm visit was considered only when the rat decisively moved all its four limbs into the arms. The maze was cleaned using 70% ethanol after each trial. Three of the mobile phone exposed animals were tested 1 hr after the last exposure while other three were tested 24 h after. Controls were tested along with the 24 h post exposure group. All events were recorded by video camera. Statistical analysis were performed by Students 't' test and significance of difference was set at $P<0.05$.

The elevated plus maze is widely used to test anxiety in animal model (1). The percentage of open arm entries and time spent in the open arms has been validated as a measure of anxiety (1, 2). In EPM test, animals cannot be exposed twice as prior experience will change animals behavior. Therefore three of the mobile phone exposed animals were tested 1 h after the last exposure while other three were tested 24 h after. Exposure to mobile phone modified the rat behavior on the elevated plus maze, decreasing the exploration of open arms and it remained even 24 h after the last exposure. In comparison to controls, time spent in the open arms was ~3 and ~6 times less in animals tested 24 hr and 1 hr after the last phone exposure respectively. During EPM test, defecation pellets were found with phone exposed animals while they were absent in the case of controls. Defecation pellets are commonly used as a sign of fear since emotional subjects are likely to defecate in mildly stressful situation (3) resulting from the emotional induced parasympathetic activity. This mobile exposure induced modification of rat behavior could be due to microwave radiation from the phone or its vibrations,

or may be a cumulative effect of both. To determine which one is important further study is warranted.

Previous studies have confirmed deleterious effects of vibration on brain functions. Whole body vibrations of 20 Hz resulted in elevated plasma corticosterone and brain 5-hydroxy-tryptamine (5-HT) and 5-hydroxy-indole-acetic-acid (5-HIAA) levels (4) in rats. In some other study, vibrations of 20 Hz increased gamma-amino-butyric-acid (GABA) level, glutamate decarboxylase enzyme activity and decreased brain noradrenaline in the large hemispheres, cerebellum and brain stem of adult male rats (5). The postero-ventro-lateral thalamus (PVLT) exposed to the exposed to vibration of low frequency induced mild alterations of PVLT such as shortening of active zone, astrocyte muff presence, overloading with vesicles in synapses (6).

Even though there is no direct evidence to prove the behavioral changes induced by the microwave radiation from mobile phone, we cannot completely exclude this possibility. Exposure of adult Sprague-Dawley rats to regular cell phones resulted in mRNA up regulation of calcium ATPase, neural cell adhesion molecule, neural growth factor, and vascular endothelial factor (7). Radiofrequency (RF) 1950 MHz significantly decreased the protein level of phosphorylated HSP27 (78 ser) in human glioma MO54 cells (8). Study in guinea pigs has shown increase in malondialdehyde (MDA) and decrease in glutathione (GSH) level and catalase activity in brain tissue on exposure to 890-915 MHz RF of a cellular phone (9). In rat brain, mobile phone exposure induced glial reactivity (10) probably due to a hypertrophy of glial cells. Prolonged exposure to mobile telephone-type radiation produced disruption to blood-brain barrier integrity (11). In rodents low frequency vocalizations induces avoidance and index anxiety. Study in Wistar rats demonstrates presence of background noise differentially activate auditory areas with a frequency-dependant activation in the auditory cortex, and specific forebrain, thalamic, hypothalamic and brain stem areas (12). Noise stress inhibits the central nucleus of the amygdala which is major output nucleus of the amygdala and is involved in responses to stress, fear and anxiety (13).

In conclusion, our preliminary results indicate mobile phone exposure induced behavioral changes in rats, expressed as a deficit in open arm exploration on elevated plus-maze. The study needs to be repeated with larger group of animals generated by selective bidirectional breeding.

RAJU SURESH KUMAR*, SAREESH N. N.*, SATHEESHA NAYAK** AND MANEESH MAILANKOT***

*Departments of *Physiology, **Anatomy and ***Biochemistry, Melaka Manipal Medical College (Manipal Campus), Manipal University, Manipal – 576 104*

***Corresponding Author : M. Maneesh, E-Mail : manu_only@hotmail.com; Phone : 0820 2922637

REFERENCES

1. Calabrese EJ. An assessment of anxiolytic drug screening tests: hormetic dose responses predominate. *Crit Rev Toxicol* 2008; 38: 489–542.
2. Appenrodt E, Kröning G, Schwarzberg, H. Increased plasma ACTH in rats exposed to the elevated plus-maze is independent of the pineal gland. *Psychoneuroendocrinology* 1999; 24: 833–838.
3. Sanberg PR, Newman MB, Manresa JJ, Potts SE, Alvarez F, Cahill DW, Shytle RD. Mecamylamine effects on haloperidol-induced catalepsy and defecation. *Int J Neurosci* 2001; 109: 81–90.
4. Makoto Ariizumi, Akira Okada. Effect of whole body vibration on the rat brain content of serotonin and plasma corticosterone. *European Journal of Applied Physiology* 1983; 52: 15–19.
5. Safarov MI, Kerimov SA. The effect of low-frequency vibration on GABA metabolism in brain structures. *Fiziol Zh* 1991; 37: 3–7.
6. Nasibullin BA. The structural-metabolic bases of the action of vibration on the thalamic structures of the brain. *Morfologiia* 1994; 107: 53–62.
7. Yan JG, Agresti M, Zhang LL, Yan Y, Matloub HS. Upregulation of specific mRNA levels in rat brain after cell phone exposure. *Electromagn Biol Med* 2008; 27: 147–154.
8. Miyakoshi J, Takemasa K, Takashima Y, Ding GR, Hirose H, Koyama S. Effects of exposure to a 1950 MHz radio frequency field on expression of Hsp70 in human glioma cells. *Bioelectromagnetics* 2005; 26: 251–257.
9. Meral I, Mert H, Mert N, Deger Y, Yoruk I, Yektin A, Keskin S, Effects of 900-MHz electromagnetic field emitted from cellular phone on brain oxidative stress and some vitamin levels of guinea pigs. *Brain Res* 2007; 1169: 120–124.
10. Brillaud E, Pitrowsky A, De seze R. Effect of an acute 900 MHz GSM exposure on glia in the brain: a time-dependent study. *Toxicology* 2007; 238: 23–33.
11. Finnie JW, Blumbergs PC, Manavis J, Utteridge TD, Gebski V, Davies RA, Vernon-Roberts B, Kuchel TR, Effect of long-term mobile communication microwave exposure on vascular permeability in mouse brain. *Pathology* 2004; 36: 96–97.
12. Sadananda M, Wohr M, Schwarting RK, Playback of 22-kHz and 50-kH ultrasonic vocalizations induces differential c-fos expression in rat brain. *Neurosci Lett* 2008; 435: 17–23.
13. Day HE, Nebel S, Sasse S, Campeau S. inhibition of the central extended amygdala by loud noise and restraint stress. *Eur J Neurosci* 2005; 21: 441–454.