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Effects of Mobile Phone Radiation on Heart Rate Variation in Healthy Volunteers

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ABSTRACT

The electromagnetic field (EMF) generated by mobile phones (MP) mayhave an influence on the autonomic nervous system (ANS) and modulates the function of circulatory system. To evaluate the effect of mobile phone (MP) radiation on cardiac electrical activity by examining the variation in heart rate. To compare the variation in heart rate due to mobile phone radiation in MP users and non MP users. This was a prospective comparative study. Total 53 completely healthy male subjects were selected for the study and divided into two groups as MP users and non MP users. Heart rate was assessed by recording ECG in lead II in supine position of the body before, during and after 5 min when mobile phone ring was stopped. Descriptive statistics was done and presented using tables and graphs, including mean values for continuous data to discuss the results. Comparison of outcome parameters was calculated with significance test. This study suggests that MP radiation have no statistically significant influence on the variation in the heart rate. The study concludes that MP has no effect on heart rate, cardiac electrical activity and therefore on autonomic nervous system.

Keywords: Mobile phone (MP), Heart rate, Electromagnetic field (EMF), Autonomic Nervous System (ANS)

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INTRODUCTION

Use of mobile phone (MP) has become a very common phenomenon all over the globe.MP use electromagnetic radiation in the microwave region (900 – 1800 mhz), and it is believed that the emission of electromagnetic radiation cause adverse health effect in mobile phone users [1]. Few studies have reported effect of mobile phone ring on the heart rate in mobile phone users. A number of studies investigating the effect of MP on human health (on reproductive system, central nervous system, human auditory brainstem, cardiovascular system (CVS), cognitive functions and carcinogenesis etc.) have recently been published [2-4].

Radiofrequency (RF) electromagnetic fields (EMF) of mobile communication systems are widespread in the living environment. The potential health risk of EMF emitted by MP is of considerable public interest. Exposition to high-power RF energy may have negative thermic effects on living organisms and cause cataracts, skin burns, miscarriages or birth defects [5-7]. Many authors suggest that EMF emitted by cellular phones may interfere with work of cardiac pacemakers and other implantable medical devices [8,9].

The influence of MP on heart rate and blood pressure is still problematic [10,11]. The effects of MP on heart rate (HR), blood pressure (BP), and heart rate variability (HRV) parameters were evaluated from a particular distance, at headset or handset position while MP was on or off position, and different results had been obtained [12-14].

In the present study, we aimed to evaluate the effect of mobile phone ring on heart rate variation in MP users and non MP users.

MATERIAL AND METHODS

The present study was carried out in the Department of Physiology, Rural Medical College Loni, Maharashtra, India. The anthropometric measurements were carried out in all the groups. History taking and medical examination was carried out. The nature of the test was explained to the subjects.

Inclusion criteria - A total of 53 healthy volunteer males were included in this prospective study and were divided into two groups as MP users (n= 33) and non MP users (n=20). Their age, height, weight, body-mass index (BMI) and previous medical history were recorded. All MP users had used MP for more than 5 years prior to the study & all MP non users had never used MP.

Exclusion criteria – Subjects suffering from any major illness like any serious cardiovascular disease, including arterial hypertension, metabolic and neurological disorders that could influence heart rate variability and serious arrhythmias and with chronic addiction were excluded from the study.

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Mobile phone was set into silent mode (not vibrate or illuminate) so that the participants were not able to understand if it was on, off, or ringing. Participants were asked not to eat chocolate or drink tea, coffee, cola-containing, or alcoholic beverages, and not to take a long cellular or wireless call (longer than 60 min).

Then mobile phone was placed at different locations on the body such as, in trouser pocket, shirt pocket & mobile phone cover attached to the waist belt. Mobile phone ring was given at different locations where mobile phone was placed on the body. The 12-lead ECG was recorded from each participant (25 mm/s rate and 1 cm/mv amplitude). Heart rate was assessed by recording ECG in lead II in supine position of the body before, during and after 5 min when mobile phone ring was stopped.

RESULTS

TABLE I: DISTRIBUTION OF THE CASES UNDER STUDY

Parameters	MP users(Total = 33) – Gr- I			Non- MP users(Total = 20)- Gr-II		
Age(years)	10-20 (n=11)	21-30 (n=14)	>30 (n=8)	10-20 (n=2)	21-30 (n=4)	>30 (n=14)
Height(cms)	171.63	169.57	164.87	174.5	164.75	164.07
Weight(Kgs)	58.36	58.85	60	52.5	54	57
BMI	19.85	20.66	21.92	17.19	19.7	20.75

TABLE II: HEART RATE VARIATION IN GROUP- I

Age Group (Years)	Before Ring (Mean ± SD)	During Ring (Mean ± SD) Trouser Pocket	Waist Cover	Shirt Pocket	5 min after ring is over (Mean ± SD)	*'p'* value	Result
10-20 (n=11)	70.16 ± 2. 265	72.32 ± 1.975	72.40 ± 1.842	71.72±1.983	67.70 ±1.605	p>0.05	Not Significant
21-30 (n=14)	67.17 ± 2.027	69.41± 1.965	67.87 ± 1.688	69.11±1.778	68.01 ±1.919	p>0.05	Not Significant
>31 (n=8)	69.83 ± 2.771	7O.74 ± 2.562	69.19 ± 2.356	71.40±2.647	67.63 ±2.254	p>0.05	Not Significant

TABLE III: RR INTERRVAL VARIATION IN IN GROUP- I

Age Group (Years)	Before Ring (Mean ± SD)	During Ring (Mean ± SD) Trouser Pocket	Waist Cover	Shirt Pocket	5 min after ring is over	*'p'* value	Result
10-20 (n=11)	861.05 ± 31.947	835.34 ± 22.375	833.90 ± 21.413	843.36±25.032	865.19 ± 19.842	p>0.05	Not Significant
21-30 (n=14)	903.77 ± 25.898	873.11 ± 23.03	890.63 ± 20.648	879.49±22.373	892.48 ± 22.06	p>0.05	Not Significant
>31 (n=8)	868.31 ± 35.327	868.31 ± 35.327	857.28 ±32.917	874.63±30.908	894.96 ± 30.126	p>0.05	Not Significant

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TABLE IV: HEART RATE VARIATION IN GROUP – II

Age Group (Years)	Before Ring (Mean ± SD)	During Ring(Mean ± SD) Trouser Pocket	Waist cover	Shirt Pocket	5 min after ring is over	'p' value	Result
10-20 (n=2)	61.68±0.505	62.54±0.325	63.19±0.835	62.39±0.385	62.39 ± 0. 385	p>0.05	Not Significant
21-30 (n=4)	72.67±8.038	73.71±8.207	72.98 ± 7. 849	72.54 ± 7.256	72.27± 8.121	p>0.05	Not Significant
>31 (n=14)	71.08±2.135	71.65 ± 2.126	71.30 ± 1.921	72.25 ± 2.321	69.74 ± 1.786	p>0.05	Not Significant

TABLE V : RR INTERRVAL VARIATION IN IN GROUP – II

Age Group (Years)	Before Ring (Mean ± SD)	During Ring(Mean ± SD) Trouser Pocket	Waist cover	Shirt Pocket	5 min after ring is over	'p' value	Result
10-20 (n=2)	973.3 ± 8.000	959.95 ± 5.350	950.6 ±11.997	959.95 ± 2.650	961.3 ± 6.696	p>0.05	Not Significant
21-30 (n=4)	857.3 ± 88.948	847.3 ± 94.685	852.65 ± 93.129	854.62 ± 88.814	863.96 ± 98.630	p>0.05	Not Significant
>31 (n=14)	854.45 ± 24.032	847.6±24.267	850.814± 22.401	838.65 ± 25.412	868.52 ± 21.396	p>0.05	Not Significant

The statistical analysis for variation in heart rate and variation in R-R Interval was carried out separately for the two groups before MP ring, during MP ring and 5 minutes after the MP ring was over.

In all the age groups in Group-I, no significant variation in the heart rate was observed during all phases of the study. Similarly in all the age groups in Group-I, no significant variation was observed in R-R interval duration during all phases of the study.

In all the age groups in Group-II, no significant variation in the heart rate was observed during all phases of the study. Similarly in all the age groups in Group-II, no significant variation was observed in R-R interval duration during all phases of the study.

Overall there were no statistically significant differences between the two groups in the Heart rate as well as R-R interval, during all the phases of the study.

DISCUSSIONS

Few studies carried out in the recent past have proved the effect of MP radiation on the variation in heart rate. However, such kind of studies are actually lacking in this part of the country. So the present formal study was planned to evaluate the effect of MP radiation on the variation in heart rate as well as on R-R interval.

In contrast to our study, some previous studies reported decrease in heart rate in MPU due to interference of electromagnetic radiation emitted by MP.

Decrease in heart rate is indication of the increase in parasympathetic tone and decrease in sympathetic tone which may be major cause in decreasing heart rate in MP users. These findings were also reported by some of the workers indicating the role of increased efferent vagal activity [15,16].

These findings consistent with findings of other study by Andrzejak R where the tone of the parasympathetic system measured indirectly by analysis of heart rate variability, was increased while sympathetic tone was lowered during the call with use of a mobile phone. It was shown that the call with a mobile phone may change the autonomic balance in healthy subjects [1] .

Following studies tried to demonstrate the effects on cardiac tissue, HR, BP and HRV parameters. Ozguner et al [17] showed that MP increased the oxidative stress in heart tissue. Different results about this subject were obtained in previous studies.

Vangelova et al [18] found that electromagnetic radiation exposure increased BP. Szmigielski et al [19] reported BP and HR changes in subjects working in electromagnetic fields. Effects of signals from a MP handset on the BP of normal volunteers were first reported by Braune et al [20], and he showed an increase of 5-10 mmHg. Hietanen et al [13] found that MP effected BP and HR among healthy adults. However, our findings are consistent with study of Tamer et al [21] who found no statistically significant differences between the groups, in the BP, heart rate, P-wave dispersion, QT dispersion and QT corrected dispersion parameters in subjects without MP, while the MP is off, on, and ringing.

CONCLUSIONS

To conclude, our study demonstrated no statistically significant variation in heart rate as well as in R-R interval during & after the mobile phone ring, which reflected that mobile phone radiation has no effect on heart rate. So, present study suggested that the radiation of the mobile phone do not on have effect on cardiac electrical activity and therefore do not influence the variation in the heart rate and so change the autonomic balance.

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