Influence of Ringing Mobile Phone Electromagnetic Radiation wave on ECG parameters in the Chest Pocket Level Among Healthy Adult Volunteers.

Original Research Article

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ABSTRACT

Objectives: The study was aimed to detect the effect of ringing mobile phone on ECG parameters among healthy adult volunteers .

Methodology : It was an experimental comparative study,study was carried among 154 healthy volunteers , 99% level of confidence was used for data analysis, the P value was (0.01). ECG was done before and after acute exposure to mobile phone. The data were analyzed by statistical package of social science. Frequency, presented mean and standard deviation, cross tabulation were used and excel program was used for figures and was presented in tables.

The results: The results show 90.5% of male their ECG rhythm became irregular , while 91.4% of females' ECG rhythm became irregular . The mean +sd of P, PR, ST and QT durations have significant changes within normal range.

Conclusion: The acute exposure of ringing mobile phone near the chest has a direct effect on ECG parameters which can lead to sinus arrhythmia.

Key word: ECG parameters , ringing mobile phone , Electromagnetic radiation , chest pocket level, healthy Adult volunteers.

I. INTRODUCTION

During recent years, there has been an increase in the use of telecommunication devices, which has become an easy means of communication. During the last decade the use of mobiles has become more conspicuous. Thus, has led to construction of transmission towers in large numbers, both in the urban, as well as in rural areas including other sparsely populated areas Many attempts are made to investigate the effect of mobile phones (MP) on human health For instance, the effect of MP on reproductive system, central nervous system, human auditory brainstem, cardiovascular system(CVS), cognitive functions and carcinogenesis etc. [1]. Electromagnetic radiation is a form of energy exhibiting wave like behavior as it travels through space. Electromagnetic radiation has both electric and magnetic field components, which oscillate in phase perpendicular to each other and perpendicular to the direction of energy propagation [2]. Although the amount of electromagnetic energy due to cell phones is quite small in comparison to other radiofrequency sources, the increased use of wireless mobile phones worldwide (3.8 billion mobile users) has focused interest on its possible side effects, and the potential health impacts [3]. Therefore, most countries consider the radio frequency (RF) spectrum to be the exclusive property of the state. In the 1980s, the RF spectrum was only used for radio and television broadcasting. Well, nowadays the use of RF includes mobile phones, wireless computers, and many other wireless devices. The RF spectrum is divided into different frequency bands, each of which has specific applications[4].The potential health risk of the electromagnetic fields which are emitted by mobile phones (MP) is of considerable public interest [5]. The time and frequency domain measures of the HRV (Heart Rate Variability) have provided prognostic information and they have also made it possible to perform non-invasive studies on the significance of the changes in the regulation of heart rate behavior. Electromagnetic fields which are emitted by cellular phones interfere with the work of cardiac pacemakers and other implantable medical devices [6, 7].Heart rate is defined as the measure of heart beats per unit time, typically expressed as beats per minute (Bpm). Heart rate measurements are used by medical professionals to assist in both diagnosis and tracking of medical conditions as well as monitoring fitness levels. HRV is a reliable marker for many physiological factors that modulate the normal rhythm of the heart. Furthermore, it is a powerful means of observing the interplay between the sympathetic and parasympathetic nervous systems [8] The World Health Organization (WHO) has acknowledged that electromagnetic (EM) fields influence the human environment.. However, the WHO denies that EM fields, emitted from mobile phones (MPs) pose a health threat to human individuals, nevertheless, this organization acknowledges that there is a public concern about this issue [9] and [10].Spectrum of electromagnetic waves has an extensive frequency range from 300 MHz to 300 GHZ and their wave lengths vary from 1 mm to 1 m. Waves emitted by mobile phones with an average frequency of 900 MHz to 1 GHz are also in this frequency range [11]. The variability of heart rate is divided into high frequency (0.15-0.40 Hz), low frequency (0.04-0.15Hz), and very low frequency (0.0-0.04 Hz) [12]. Cardiac muscle has some similarities to neurons and skeletal muscle, as well as important unique properties. Like a neuron, a given myocardial cell has a negative membrane potential when at rest. Stimulation above a threshold value induces the opening of voltage-gated ion channels and a flood of cations into the cell. The positively charged ions entering the cell cause the depolarization characteristic of an action potential. Like skeletal muscle, depolarization causes the opening of voltage-gated calcium channels and release of Ca2+ from the t-tubules. This influx of calcium causes calcium-induced calcium release from the sarcoplasmic reticulum, and free Ca2+ causes muscle contraction. After a delay, potassium channels reopen, and the resulting flow of K+ out of the cell causes repolarization in the resting state. [13][14]

II. SUBJECT AND METHODS

Study area: This study was carried out from march 2014 to August 2016 in the skill laboratory of Health Sciences faculty at the ElsheikhAbd Allah Elbedri University in north of Sudan.

Study population: Healthy adult volunteers from both gender with age group between 16 to less than 50 years old who study or work in the faculty of health sciences. The samples were selected by cluster Simple random technique.

Study design: Experimental analytic, comparative study about the effect of mobile phone electromagnetic radio frequency wave on ECG parameters among healthy adult male and female with different ages, during mobile phone was ringing on the chest pocket level .

This study was conducted by 2 phases:

1. ECG procedure was performed in the absence of a mobile phone.
2. ECG was performed in the presence of ringing mobile phone at the chest pocket level.
3. Comparison between the results in 10 second, 20 seconds and 30 second post exposure was done.

Ethical approval:

Permission to carry out the study from the responsible authorities was taken.The procedure was explained to volunteers to provide privacy for female.The objectives of the study were known by volunteers & their verbal acceptance was considered. The study protocol was approved by the institutional ethics committee of the university prior to the commencement of the study.

Description of Study Procedure

The volunteers were asked not to drink tea, coffee or cola containing beverages or alcohol and not to use mobile phone before 30mintues of ECG recording to minimize the effect of these factors on ECG parameters or heart rate. We used volunteers' mobile cell (2G, 3G, Nokia during study time).ECG was performed for 154 volunteers in the absence of a mobile phone as baseline data, and the pulse rate was calculated manually before exposure to mobile phone wave, then The mobile phone was placed in the left chest pocket level (anterior wall of the chest) for male and female AND ECG was recording while mobile phone was ringing.

Data analysis method:

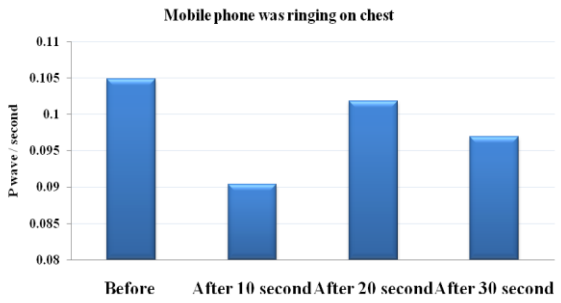
The data were analyzed by using statistical package of social science (SPSS), Frequency presented mean and stander deviation, paired T.test and cross tabulation were used for data analysis as statistical tests and excel program was used for figures and was presented in tables, figures presentation include: Bar graph, pie graph.

III. RESULT

In table 1: results appear as the following:

P wave duration result :There was significantly decrease in Mean ± Std before and after phone exposure in first 10 second the p value(0.000) , while there was no significant change in the 2nd 20 second in p wave duration is p value (0.008) . In the 3rd 30 second there was significant decrease in the p wave p valueis(0.000) as result appears in figure (1.1) .

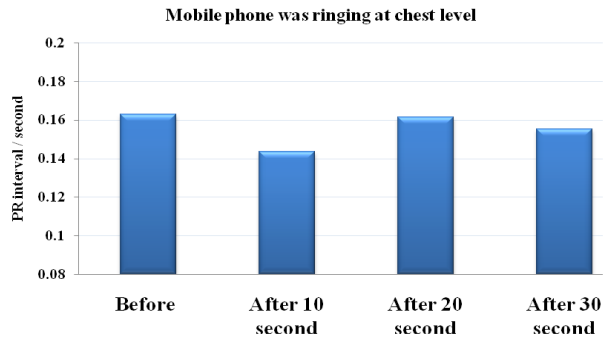
Figure (1.1) Effect of ringing mobile phones on P wave duration.



Source : prepared by the researcher. Used EXEL program. Questionnaire data, 2017.

PR interval duration result :There was significantly decrease in Mean ± Sd of PR interval duration before and after phone exposure in first 10 second the p value (0.000) , while there was no significant change in PR interval in 2nd 20 second p value is (0.305) .The 3rd 30 second the PR wave there was significantly decrease the p value is(0.000) .The changes in duration of PR were within normal range no signs of heart block appeared as result reflect in figure (1.2).

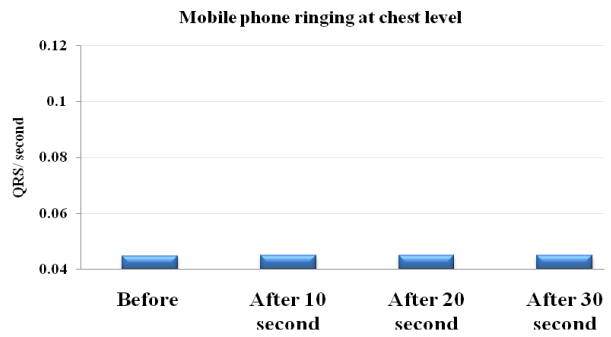
Figure (1.2) Effect of ringing mobile phones on PR interval Duration



Source : prepared by the researcher. Used EXEL program. Questionnaire data, 2017

QRS wave result :There was no significantly decrease or increase in Mean ± Sd of QRS duration before and after phone exposure in first 10 second and 2nd 20 second and 3ed 30 second the p value(0.158) in all duration , as result revealed in figure (1.3) QRS duration was not affected at all.

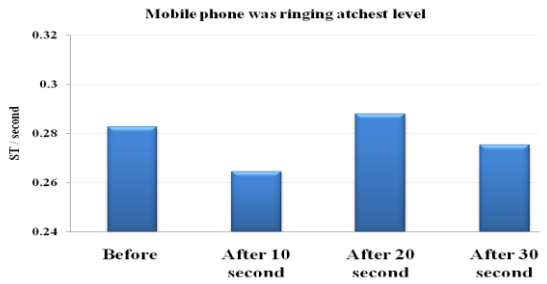
Figure (3) Effect of ringing mobile phone on QRS complex duration.



Source : prepared by the researcher. Used EXEL program. Questionnaire data, 2017.

ST segment duration result :There was significantly decrease in Mean ± Sd before and after phone exposure in first 10 second the p value (0.000) , while there was no changes in ST segment in 2nd 20 second o value (0.029) and in the 3rd 30 second there was no significant change in the ST segment the p value is(0.003) . ST segment was normal in position during mobile exposure it was not elevated or depressed the effect appeared only in it is duration as result shows in figure (1.4).

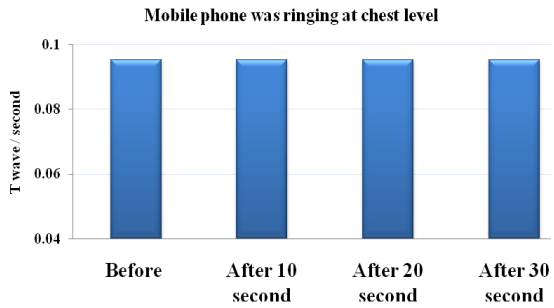
Figure (1.4) Effect of ringing mobile phone on ST wave duration



Source : prepared by the researcher. Used EXEL program. Questionnaire data, 2017.

T wave duration result : The Mean ± Sd of T wave did not significantly increase before and after phone exposure in all T wave duration , in the first 10 second the p value(0.053) , in the 2nd 20 second p value(1.000) and in 3rd 30 second p value (0.033). As revealed there was no change in T wave amplitudes as result refect in figure (1.5).

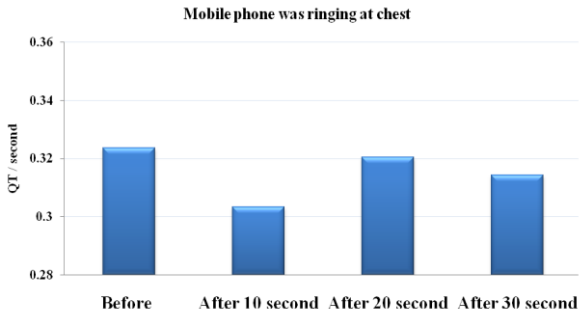
Figure (1.5) Effect of ringing mobile phone on T wave duration.



Source : prepared by the researcher. Used EXEL program. Questionnaire data, 2017.

QT duration result :The Mean ± Sd of QT significantly decreased before and after phone exposure in first 10 second the p value(0.000) , while there was no significant change in the QT in 2nd 20 secondp value is (0.367) and in the 3rd 30 second the QT there was significantly decrease o value is (0.000) as a result appears in figure (1.6)

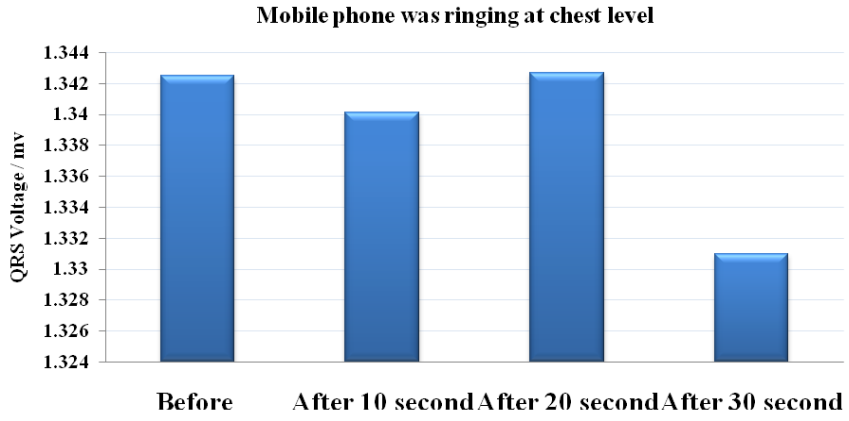
Figure (1.6) Effect of ringing mobile phone on QT interval duration.



Source : prepared by the researcher. Used EXEL program. Questionnaire data, 2017.

QRS Voltage result :The Mean ± Sd of QRS voltage did not change significantly before and after phone exposure in all duration , in the first 10 second the p value(0.888) , in the 2nd 20 second p value(0.985) and in 3rd 30 second p value(0.491) as revealed the change in voltage was about ±0.1mv as a result appears in figure (1.7).

Figure (1.7) Effect of ringing mobile phone on QRS voltage



Source : prepared by the researcher. Used EXEL program. Questionnaire data, 2017

Table No (1) The effect mobile in ringing mode at chest pocket level on ECG parameters Mean ± Sd .

	B	A1	A2	A3
	Mean ± Sd.	**Mean ± Sd.**	**Mean ± Sd.**	**Mean ± Sd.**
P	0.105±0.020	0.090±0.019	0. 102±0.021	0.097±0.021
P value		***0.000***	***0.008***	***0.000***
PR	0.163±0.025	0.144±0.024	0.162±0.026	0.1553±0.024
P value		***0.000***	***0.305***	***0.000***
QRS	0.045±0.0121	0.045±0.012	0.045±0.012	0.045±0.012
P value		***0.158***	***0.158***	***0.158***
ST	0.283±0.024	0.264±0.030	0.288±0.031	0.275±0.029
P value		***0.000***	***0.029***	***0.003***
T	0.094±0.038	0.101±0.051	0.094±0.040	0.095±0.037
P value		***0.053***	***1.000***	***0.033***
QT	0.324±0.021	0.303±0.031	0.321±0.042	0.314±0.029
P value		***0.000***	***0.367***	***0.000***
Voltage	1.343±.528	1.340±0.534	1.343±0.527	1.331±0.525
P value		***0.888***	***0.985***	***0.491***

IV. DISCUSSION

The Mean ± Sd of PR interval significantly decreased over the first 10 seconds post phone exposure, while over the next 20 seconds post exposure to mobile there Mean ± Sd of PR interval did not significantly decreased during ringing mode and it has not significantly increased over 30 seconds. Our study results were similar to that Alhusseiny et al (2012) were noted significantly shortened P-R period as an effect of radiofrequency of mobile phone (turn ON mode) placed at belt level [15]. The Mean ± Sd of QRS wave during exposure to mobile phone has no significant changes in all durations.This result is similar to the result of another study by Gholamreza Komeili et al 2012 which noted that there wasn't any conducted significant difference in time of the QRS wave at any of the groups under study[16]. The Mean ± Sd of ST segment duration showed that there was a significant decrease over1st 10 seconds post mobile exposure, while the Mean ± Sd ST segment did not significantly increase over the next 20 second and in 30 second post exposure it is significantly decreased in ringing mode . The presented study showed that the Mean ± Sd of T wave while mobile phone on the chest pocket level was not changed. No ST elevation or depression was noted. The study also investigated the mobile phone effect on QT interval duration ,the result of Mean ± Sd of QT while mobile phone on the chest pocket level revealed that it was significantly decreased over 10 seconds post exposure ,while it did not change significantly in ringing mode over 20 second and it was significantly decreased over 30 seconds post exposure**.** On other hand the study investigated the voltage of QRS while mobile phone on the chest pocket level, the result showed the Mean ± Sd of the ECG voltage did not significantly change during ringing mode. Also, our study result is similar to that of the study conducted by Tamer et al [17] . A large number of experimental studies on healthy human volunteers have been carried out after the published literature which demonstrated the impact of mobile phone on cardiac pacemaker [18]. Our general results about the effect of mobile phone on ECG parameters was near to result of another study done by Komeili G, Nabizadeh et all, (2012) Studying the Effects of Mobile Phone Waves on Electro Cardiogram Parameters of Students in Zahedan University of Medical Sciences.This study was conducted in order to survey the effects of mobile electromagnetic waves on electrocardiogram parameters as heart rate, TP segment, PR interval, Time of QRS and T waves, and voltage of R wave. Results**:** There was significant difference between heart rate during talking in comparison with heart rate during ringing and resting in both genders. There was a significant decrease of resting TP segment in comparison with TP segment during ringing and talking in males whereas in females TP segment indicated significant difference in all three conditions. There was a significant increase in T wave time in males during talking in comparison with resting and ringing; however there was no significant difference in that of females in any of the three stated conditions. This study revealed that there was no any significant difference in PR interval, Time of QRS wave and R wave voltage. According to the results of this study, mobile phones can affect the heart rate, TP segment and time of T wave. [19]

V. CONCLUSION

According to the results of this study, mobile phones are not saving device , it can affect the ECG parameters, it seems that long term use can affect the heart. There for further studies are needed to detect the effect of mobile phone on ECG parameters.

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