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A Study of Affected Cardiac Activities Due to the Use of Mobile Phones

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***Abstract*--** The main objective of this double-blind study was to evaluate the effect of mobile phone (MP) on cardiac electrical activity by examining the heart rate variability (HRV), QT, P dispersions and blood pressure (BP) while the MP is located on the precordium. As we know already that our hearts and brains are bioelectrical systems which are regulated by internal bioelectrical signals.Environmental exposures to artificial EMFs can interact with fundamental biological processes in the human body. The increasing extensive use of cellular phones has generated public concern about exposure to the microwave radiation associated with these phones. The probable biological effects due to the use of the mobile phones can be regarded as a result of energy absorbed by the heart that may also damage the brain and nervous tissues. The conveniences and satisfaction derived in the use of GSM mobile phone are being threatened by assertions of adverse effects on human health by radiation coming from this device. This radiation belongs to the type called non-ionizing radiation the health hazard of which remains debatable. It is been also said that "When a GSM phone transmits, it immediately goes to the peak power, and then the power control circuitry ratchets down the power to an acceptable level. Also, CDMA phones operate at a fraction of their maximum outputs, emitting about 28 times less radiation than GSM phones", ultimately making a GSM phone more harmful than that of CDMA.

***Keywords*--** *Biological Processes, HRV(Heart Rate Variability), MP(Mobile Phone), GSM(Global System for Mobile), CDMA(Code Division Multiple Access), SAR(Specific Absorption Rate), ELF(Extremely Low Frequency).*

I. INTRODUCTION

Radiofrequency (RF) electromagnetic fields (EMF) of mobile communication systems are widespread in the living environment. The potential health risk of electromagnetic field emitted by mobile phones (MP) is of considerable public interest. Cell phones transmit and receive electromagnetic (EM) waves, mainly at frequencies of 8001900 MHz [6]. Adverse effects of these important communications tools are being reported. Sensations of burning or warmth around the ear, headache[7], disturbance of sleep, alteration of cognitive function and neural activity, are some of the effects being reported as resulting from mobile phone use. In spite of previous studies, knowledge about the adverse effect of radiofrequency and microwaves (RF/MW) radiation on human health, or the biological responses to RF/MW radiation exposure is still limited. Mobile phones are usually held in the close proximity to the human heart therefore exposure to radiation is high.

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 [8-12]. However, the effects of MP have not been evaluated at the position closest to the heart and the ringing mode of MP. In this study, we aimed to evaluate the effects of MP (on, off and ringing mode) on cardiac electrical activity, including dispersion of atrial conduction by means of P wave dispersion analysis, spatial dispersion of repolarization using QT dispersion analysis, and cardiac autonomic modulation by examining the HRV in healthy subjects when the MP is in immediate proximity to the heart. Widespread utility of mobile communication systems has created great concern about the probable health effects caused by the radio frequency (RF) fields emitted from both base stations and cell phones among the people. When a mobile phone connects to the network, it uses radio signals to communicate with the nearest base station in the network and initiates a call. The level of RFexposure from base stations are too low to cause significant health effect in human bodies as the base stations radiation diminishes rapidly over the distance between the person and the base station antennas. While, the cell phone exposes its user to a non-negligible amount of electromagnetic energy. The RF energy emitted by cell phones is more powerful than that emitted by base stations as the mobile phone is usually held close to the head for a considerable length of time while being used[13][14]. The power control and discontinuous transmission used in Global System for Mobile Communication (GSM) phones reduces the transmitted power to the minimum levels whilst maintaining good call quality [15]. Phones operated in ideal mode cause typically much lower exposure compared to mobile phones operated with maximum power. There is no exposure occurs from a mobile phone being switched off as no signal will be sent [13].

II. OBSERVATIONS

In an experiment, Nokia 2600 MP (15-95 g. 900-1800 MHz Dual band, 2.0 W/kg, Nokia Corporation, Helsinki, Finland) was used, and it was put in a short pocket suspended from the neck, and placed in the left parasternal area between the second and fifth intercostal spaces of anterior chest wall. 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. The 12-lead ECGs were recorded from each participant with sinus rhythm (25 mm/s rate and 1 cm/mV amplitude). Electrocardiographic measurements were made by a student who was unaware of the individuals that the ECGs had been obtained from. Then, electrocardiograms were transferred to a personal computer via a scanner, magnified 400 times, such that the duration of P wave, QT and RR intervals could be calculated effectively. The starting point of P wave was referred as the positive deflection crossing the isoelectric line and the end-point was referred as the end of the deflection crossing the isoelectric line. The P wave dispersion (Pdisp) was calculated by subtracting the minimum P wave (Pmin) duration time from the maximum duration (Pmax). QT interval, which is the duration from beginning of QRS complex to the end of T wave, was measured in all derivations in which T wave was clearly seen. QT dispersion (QTd) was defined as the difference between the longest QT interval (QT

max) and shortest QT interval (QT min). Measured QT intervals were corrected by Bazett‟s Formula (QT/ √RR), and defined as corrected QT interval (QTc). The difference between the longest QTc (QTc max) and shortest QTc (QTc min) was defined as corrected QTd (QTcd). Blood pressure was also measured manually in standard fashion using the Schiller BR-102 plus semi-automated device, and systolic and diastolic BP results were recorded and mean arterial pressure (MAP), mean HR, minimum HR, maximum HR and pulse pressure (PP) were also measured. Radiofrequency radiation from cell phone and cordless phone exposure has also been linked in more than one dozen studies to increased risk for brain tumors and/or acoustic neuromas (a tumor in the brain on a nerve related to our hearing).

For brain tumors, people who have used a cell phone for 10 years or longer have a 20% increase in risk (when the cell phone is used on both sides of the head). For people who have used a cell phone for 10 years or longer predominantly on one side of the head, there is a 200% increased risk of a brain tumor. The risk of brain tumor (high-grade malignant glioma) from cordless phone use is 220% higher (both sides of the head). The risk from use of a cordless phone is 470% higher when used mostly on only one side of the head. This information relies on the combined results of many brain tumor/cell phone studies taken together (a meta-analysis of studies). For acoustic neuromas, there is a 30% increased risk with cell phone use at ten years and longer; and a 240% increased risk of acoustic neuroma when the cell phone is used mainly on one side of the head. These risks are based on the combined results of several studies (a meta-analysis of studies). There is evidence that high levels of amyloid beta are a risk factor for Alzheimer's disease, and exposure to ELF can increase this substance in the brain. There is considerable evidence that melatonin can protect the brain against damage leading to Alzheimer's disease, and also strong evidence that exposure to ELF can reduce melatonin levels. Thus it is hypothesized that one of the body's main protections against developing Alzheimer's disease (melatonin) is less available to the body when people are exposed to ELF. Prolonged exposure to ELF fields could alter calcium (Ca2+) levels in neurons and induce oxidative stress [16]. It is also possible that prolonged exposure to ELF fields may stimulate neurons (particularly large motor neurons) into synchronous firing, leading to damage by the build-up of toxins. People who are chronically exposed to lowlevel wireless antenna emissions report symptoms such as problems in sleeping (insomnia), fatigue, headache, dizziness, grogginess, lack of concentration, memory problems, ringing in the ears (tinnitus), problems with balance and orientation, and difficulty in multi-tasking. In children, exposures to cell phone radiation have resulted in changes in brain oscillatory activity during some memory tasks. Changing the balance of delicate biological processes, including hormone balances in the body, can damage or destroy cells, and cause illness. In fact, many chronic diseases are directly related to this kind of damage that does not require any heating at all. Interference with cell communication (how cells interact) may either cause cancer directly or promote existing cancers to grow faster. Biological tissue is, for all practical purposes, nonmagnetic with a permeability μ (H/m) close to that of free space [17]. There are three established basic coupling mechanisms through which time-varying electric and magnetic fields interact directly with living matter (UNEP/WHO/IRPA 1993): The one relevant to this study is „absorption of energy from electromagnetic fields‟. As regards absorption of energy by the human body,electromagnetic fields can be divided into four ranges (Durney et al. 1985). GSM phones fall within one of these ranges which are „frequencies in the range from about 300 MHz to several GHz, at which significant local, non-uniform absorption occurs [18]. The evidence that power lines and other sources of ELF are consistently associated with higher rates of childhood leukemia has resulted in the International Agency for Cancer Research (an arm of the World Health Organization) to classify ELF as a Possible Human Carcinogen (in the Group 2B carcinogen list). It is the most common type of cancer in children.

CONCLUSION

It was concluded on the basis of resultsof various studies that MP has no effect on hemodynamic (heart rate, blood pressure) and cardiac electrical activity (P-wave and QT dispersions) parameters when it is positioned on the chest in immediate proximity to the heart, and it does not cause cardiac autonomic dysfunction examined by HRV analysis in healthy adult subjects. [1] The objective of the research work was achieved when in the analysis carried out, it was observed that the elderly ones, basically of age 40 years and above, showed a slight decrease of about 1.4% in pulse rate after exposure. Even though this just barely above 1%, it is advisable that this age group should avoid keeping phone anywhere close to their heart as this may further put stress on their ageing hearts. [3] But, overall, variation in pulse rate after Subjects have been exposed to mobile phone radiation is not significant as to call for serious concern.

1. Results of the present study demonstrate that the call with a mobile phone may influence heart rate variability and change the autonomic balance.
2. The increase in the parasympathetic tone concomitant with the decrease in the sympathetic tone measured indirectly by analysis of heart rate variability was observed during the mobile telephone call.
3. Changes in heart rate variability during the call with a mobile phone could be affected by electromagnetic field, but the influence of speaking cannot be excluded.

LIMITATIONS

1. Electrocardiograms were interpreted by one observer unaware of the ECGs.
2. The number of cases included in the study is relatively low.
3. We could not measure frequencydomain parameters of HRV. But, it has been stated that each of the frequency domain spectral measures has an equivalent time-domain variable, which is highly correlated with it, because both are influenced by the same physiological inputs and because of mathematical relationships (11, 24)

SUGGESTIONS

1. A relatively more no. of cases could be taken of varied age groups.
2. Since it is difficult to interpret the characteristics of ECG waveform, they could be analysed using some other software like MATLAB, which could make it easier to read those complicated waveforms.
3. A questionnaire/survey could be conducted, which could further help in making the observations easier.

PRECAUTIONAL MEASURES

1. Phone could be kept switched off during non-working hours, if not possible, could be kept on ringing mode in place of vibration mode.

2. GSM user can switch over to CDMA phones.
3. Landlines could be used for long duration calls or for major purposes if possible.
4. Avoid using your phone while kept on charging.

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