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Short Communication

Assessment of auditory evoked potential in long term mobile phone users

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Abstract

Mobile phones emit strong electromagnetic wave which causes structural and functional changes in the cell membrane within the central nervous system especially auditory system. The effect of duration of mobile phone use on auditory function was examined One hundred and seventy three long-term mobile phone users aged around 17-39 yrs (both male and female) were recruited in this study. The subjects were divided into three groups according to their age Group I (17-19 yrs), Group II (20-29 yrs), Group III (30-39 yrs). After getting informed consent the subjects were instructed to fill the questionnaire for the history related to our study, conduction deafness auditory brainstem response in both the ears were assessed. Significant difference was observed among three groups in their duration of mobile phone use. Latency of Waves in three groups showed significant difference. The average latency (both right and left ear) of waves I-V was found to be prolonged in Group II when compared to Group I and Group III. Interpeak latencies I-V and I-III showed differences among three groups. The findings of present study showed abnormalities in the conduction of electrical signals in different levels of auditory pathway.

Introduction

Currently there are 929.37 million mobile phone users in India compared to 31.53 million fixed line subscribers. India primarily follows the GSM mobile system, of 900 MHz band. Recently the operators operate frequency of 1800 MHz band. The increasing usage and dependability of mobile phones undoubtedly become the most impactful innovation of this time. Maximizing Mobile report released by the World Bank says that mobile communication has arguably had a bigger impact on humankind in a shorter period of time than any other invention in human history. Indian mobile users speak for 330 minutes per month on average, or 11 minutes per day. This is at par with most of the averages in other countries. Though rapid use of modern telecommunication are useful at the time of emergency, mobile phone users have been suffering with a lot of possible adverse health effects. Early consumers have the complaints of health problems like fatigue, headache, cognitive dysfunction and stress (1). Reduced fingers muscle strength can occur in those subjects who send short message service (SMS) frequently. Headset for hearing music to seek relaxation has come into widespread use in this busy world.

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Emission of invisible ionized Electromagnetic radiations (EMR) coming from telecommunications systems are absorbed by recipient's body cause change in the brain electrical activity sensations of burning or warmth around the ear, alteration of the blood-brain barrier, decrease in regional cerebral blood flow (2, 3). Long-term mobile phone use cause damage to cochlea as well as the auditory cortex (4) However Sievert et al 2007 (6) was not able to observe abnormalities in the inner ear from cochlea to inferior colliculus in his study population (mobile phone users).

Ingrida et al (7) stated that 10-min exposure of EMR emitted from a mobile phone do not produce immediate effect and measurable hearing deterioration in young human subjects. Similar changes were observed by (8) Mariola et al. Electromagnetic radiations alter the electrical activities of brain which can be observed by the waves of electroencephalogram (EEG) (9). Exposure of electromagnetic radiation emitted from mobile phones may cause adverse effects in auditory pathway. Auditory Evoked potential being a part of EEG, our study may be consistent with the analysis of small area (auditory apparatus). Hence this study was conducted to assess the auditory evoked potential in long term mobile phone users between 17-39 years of age.

Materials and Methods

Study population

We recruited 173 healthy Mobile phone users for more than 3 year aged around 17-39 yrs (both sexes) in this study. We excluded otological diseases, Family/own history of diabetes mellitus and hypertension, familial hearing disorder, exposure to severe noise, consumption of alcohol or drugs 24 hours prior to testing. Subjects were divided into three groups based on the age as Group I (17-19 yrs) (n-60), Group II (20-29 yrs) (n-70) and Group III-30-39 yrs (n-43). Questionnaire was filled up by the subject to get the detailed history of mobile phone use like model of mobile phone for frequency variation, duration of mobile phone use (Hours/day and years). Informed consent was obtained. Our study was approved by Institutional Ethical Committee.

Parameters measured

Anthropometric parameters – Height in cms, weight in kgs, BMI (kgs/m^2). After a routine auditory examination, the subjects were prepared for the recording of auditory evoked potential. Standard silver – silver electrode disc electrodes were placed according to the International 10/20 system. Impedance kept low below 5 kilo ohms. Stimuli were of clicks with intermediate rates at about 11-30 per second. In ipsilateral ear the clicks were about 90 dB, whereas in the contralateral ear white noise was given. The evoked potentials were amplified, averaged and recorded for 2000 stimuli. Parameters measured were Latency of waves I, II, III, IV and V in milliseconds and inter peak latencies – I-III, I-V and III-V in milliseconds (14). Statistical analysis: All data were expressed in mean ± standard deviation. ANOVA was used to analyze the variations among different age groups.

Results

Age and duration of Mobile phone use

In Group I (17-19 yrs) and Group II (20-29 yrs) though subjects used mobile phone for less number of years, their usage per day was found to be more (Table I) when compared to Group III (30-39 yrs) which was

TABLE I: Comparison of Average Latency of right and left ear with age and duration.

Age	*Wave I*	*Wave II*	*Wave III*	*Wave IV*	*Wave V*	*HIII*	*I-V*	*III-V*
Group I	1.67±0.15	2.72±0.18	3.68±0.13	4.76±0.21	5.33±0.21	2.02±0.28	3.68±0.29	1.58±0.29
Group II	1.7±0.12	2.77±0.16	3.7±0.12	4.76±0.19	5.68±0.36	2.80±0.18	4.02±0.3*	1.97±0.32
Group III	1.6±0.12	2.7±0.2	3.55±0.13	4.68±0.19	5.61±0.33	2.001±0.22	3.98±0.34	1.35±0.38

Values are expressed in mean±STD Not Statistically significant.
Values are expressed in mean±std * statistically significant value ($p<0.05$).

statistically significant. But Group III subjects used mobile phone for more years with less hours/day.

Discussion

In the present study, the prevalence of mobile phone usage in different age group of study population, duration of mobile phone use in year and hours/ day were also evaluated. The results showed that the prevalence of mobile phone use was much lower in Group III (25%) when compared to Group I (34%). The mobile phone usage prevalence was higher in Group II (41%). Less judgmental sense of discretion on age variation might be the reason for over usage of mobile phone (10). Understanding Mobile Phone users in India and their mobile usage behavior and preferences surveyed and published that the single largest mobile user age group was 25-35 years. However, subjects between 19-24 years showed the highest penetration as well as the highest 'propensity' to own mobile phones (10). In contrast to our study Uloziene et al (9) did not observe hearing deterioration in subjects with 18-30 years of age. The duration of mobile phone usage was lesser than the present study which might be the reason for the difference in the effect of EMRs on auditory pathway between two studies.

The average latency (both right and left ear) of waves I-V was found to be prolonged in Group II when compared to Group I and Group III. The reason for the differences could be due to differences in the ratio of years and hours/day of duration of mobile phone use between Group I, II and III. Prolonged latency of wave I which originates from VIII nerve in Group II showed peripheral hearing impairment in this study. In this study the latency difference between I-V was shorter when compared to normal (4.5 ms) in all Groups this could be due to conduction abnormality from proximal VIII nerve through pons to midbrain (11). Prolonged I-III latency difference in Group II was susceptible to disorders affecting the proximal portion of VIII nerve, pontomedullary junction, and lower pons around superior olive and trapezoid bodies. EMRs exposure in the ear may delay the conduction from VIII verve across subaracnoid space into the core of lower pons, because mobile phones are directly held in the external ear (12).

In this study different frequencies of sound wave transmission from different model of mobile phones were observed by questionnaire. The average range of frequency used by our subject was 300-900 MHz which was considered as low frequency. It is apparent that low frequency sound waves cause activation of basilar membrane near the apex of the cochlea. In fact, continuous exposure low frequency sound waves from the mobile phones may destroy the entire apical half of the cochlea, which may destroy the basilar membrane where all the low frequency sounds are normally detected.

Conclusion

We concluded that subjects (17-29 yrs) who used mobile phone for longer hours per day may suffer with conduction abnormalities in different levels of auditory pathway, lack of attention, cognition and intellectual activities. Avoiding mobile phones for longer hours per day can improve both physiological and psychological activities, because this age group (17-19 yrs) is the stepping stone of future. Subjects around 20-29 years are more prone for earlier otological disturbances as they are exposed to the EMRs to the maximum. Limitation of our study: Variation among the sex was not analyzed.

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