Original Research Article

Brainstem auditory evoked potentials in medical students who use ear phones for varying time durations

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Abstract

Background: Over a period of just a few years, mobile phones have produced a revolution, involving not only communication systems and the technological sphere, but also the whole social and environmental domains. The younger generation use portable equipment like earphones for communication and to listen music. The use of earphones, in a short or long term could bring irreversible damage to the auditory system. **Aim:** To compare the brainstem auditory evoked potentials among medical students who use ear phones for durations less than and greater than 2 hours per day. **Materials and Methods:** This study involving 100 medical students aged 18 to 22 years who used ear phones, was conducted after obtaining institutional ethical committee clearance. Group I consisted of 50 medical students who used ear phones for < 2hours/day, while Group II consisted of 50 medical students who used ear phones for >2 hours /day. Brain stem auditory evoked potential (BERA) was done on all the subjects. Comparison of the latencies and inter-peak latencies of BERA waves between the groups was done by Student's unpaired t-test. **Results:** No significant difference ($p>0.05$) was found in latencies and interpeak latencies of brain stem auditory evoked potential waves between the two groups of medical students who used ear phones for durations less than and greater than 2 hours per day. **Conclusion:** This study done to compare the brainstem auditory evoked potentials among medical students who use ear phones for durations less than and greater than 2 hours per day did not reveal any statistically significant difference in the latencies and inter-peak latencies of BERA waves between the groups. Further studies are warranted to overcome the limitations of this study and to obtain a clear picture.

Keywords: mobile phone, hearing, brain stem auditory evoked potential

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Introduction

Over a period of just a few years, mobile phones have produced a revolution, involving not only communication systems and the technological sphere, but also the whole social and environmental domains; the younger generation especially use portable equipment like earphones for communication and to listen music.[1] Short or long term use of earphones can cause irreversible damage to the auditory system depending on the volume of sounds.[2] Exposure to high level intensity noises can trigger many different symptoms such as: intolerance to intense sounds, dizziness, earache, trouble understanding or hearing words, ringing in the ear and loss of hearing [3,4] Besides hearing impairment, there is extra-hearing damage as: sleep disturbances, cardiovascular disorder, stress, fatigue, tension, irritability, inattention, tiredness, nervousness, headaches and high blood pressure. [3,4]

Hearing problems are no longer a concern only among the elderly, cellular phone use is shown to affect the hearing of many young people who use portable amplifying equipment for long periods of time in their ears, especially with the volume turned up to high intensities.[4,5] Hearing loss caused by the constant use of earphones has similar characteristics to the hearing loss caused by occupational exposure to noise.[6]

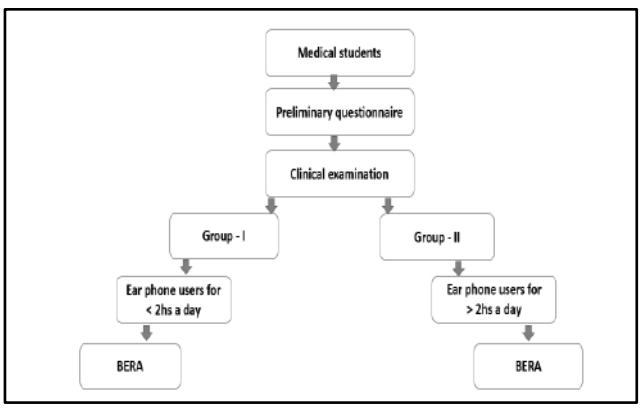
Audiology screening is aimed at detecting possible alterations in the auditory system, peripheral or central. The auditory brainstem-evoked responses may allow quantifying the activity and functions of auditory organ, including the auditory nerve and subcortical centres.[7] They are potentials recorded from the ear and vertex in response to brief auditory stimulation to assess conduction through the auditory pathway up to the level of midbrain.[7] Given these findings, we were interested in studying the brainstem auditory evoked potentials in young ear phone users. We intended to compare the brainstem auditory evoked potentials among medical students who use ear phones. The aim of this study was therefore to compare the brainstem auditory evoked potentials among medical students who use ear phones for durations less than and greater than 2 hours per day.

Materials and methods

The Institutional Human Ethics Committee (IHEC) approval was obtained prior to commencing the study. Convenience sampling was employed and medical students of both genders belonging to the age group of 18 to 22 years from Karpaga Vinayaga Institute of Medical Sciences & Research Centre, ChinnaKolambakkam, Kanchipuram, Tamil Nadu were asked to answer a short preliminary questionnaire which was used to segregate them into groups. They further underwent clinical examination to rule out other possible causes of tinnitus, the warning sign of hearing loss. Students with any other possible causes of hard of hearing such as : history of tympanic membrane perforation, secretory otitis media, otosclerosis, otitis media, sudden/repeated exposure to noise without adequate protection, trauma to the head or neck, any ear surgery, radiotherapy, chemotherapy, history of intake of known ototoxic drugs or any other medication that might affect normal functioning of the nervous system and family history of deafness or any systemic illness that might affect the nervous system were excluded. The students were informed about the purpose and the procedure of the study and their consent obtained for their participation in the study. The study population was categorized into two groups from the data collected by a questionnaire as follows:

Group 1: Ear phone users for less than 2 hours a day
Group 2: Ear phone users for more than 2 hours a day (Figure 1)

Figure 1: Study Protocol for data acquisition and analysis



Hearing was tested by tuning fork tests to rule out any kind of hearing loss then brainstem auditory evoked potential was recorded using surface electrodes which are placed according to the 10-20 international system(NEURO STEM). The recommended montage for BAEP is: Channel 1:A_1-C_z, Channel 2:A_2-C_z, Ground:F_z.. Monaural brief click acoustic stimuli are given via a headphone to the ear to be tested. Each click is a square wave pulse of 0.1 ms duration. 1500 alternating condensation and rarefaction click stimuli were given at a frequency of 10 clicks per second. The intensity of the click sound was kept at 60 db above individual hearing threshold which was done by audiometry. The contralateral ear was suitably masked by white noise at 40 db thus preventing the false BAEP response.

The recording was obtained as a graph plotted with amplitude (in microvolts along the Y axis) and time (in milliseconds along the X axis from onset of stimulation) and displayed on the screen of the Evoked potential recorder. The following parameters were considered: Latencies of BAEP waves, interpeak latencies of BAEP waves.

Statistical analysis: Compilation of the data and statistical analysis was done with the help of Microsoft Excel and Statistical Package for the Social Sciences (SPSS) software version 16.0. Results on continuous measurements are presented as Mean ± Standard Deviation (SD). Comparison of hearing between the groups was done by Student's unpaired t -test. A p value < 0.05 was considered significant.

Results

This study was conducted to compare the brainstem auditory evoked potentials among medical students who use ear phones for durations less than and greater than 2 hours per day. The mean age (years), height (meters), weight (kg) and Body Mass index (kg/m^2) of the medical students in Group I (Ear phone usage less than 2 hours per day) and Group II (Ear phone usage greater than 2 hours per day) are shown in Table 1.

Table 1: Descriptive characteristics of the two groups of medical students

Parameters	Group I (n = 50)	Group II (n = 50)	p value
Age (years)	20 ±1.62	20 ±1.02	>0.05
Height (meters)	1.57 ±0.06	1.56 ±0.52	>0.05
Weight (kg)	62.15 ± 14.7	60.12 ±15.8	>0.05
BMI (kg/m^2)	23.44 ± 2.56	22.57 ±3.12	>0.05

Group I = Ear phone usage less than 2 hours per day, Group II = Ear phone usage greater than 2 hours per day

Table 2 and Table 3 show the comparison of the latencies and inter-peak latencies in of BERA waves in the right and left ears of the medical students belonging to Group I and Group II. Statistical analysis of BERA findings demonstrated no statistically significant differences (p>0.05) in latencies and interpeak latencies of waves among the Group I and Group II in right ear (Table 2) and left ear (Table 3).

Table 2: Comparison of latencies and inter-peak latencies (in milliseconds) of BERA waves in the right ear

Waves	Group I (n= 50) Mean ± SD	Group II (n= 50) Mean ± SD	p value
I	1.44 ± 0.24	1.52 ± 0.26	0.235
II	2.53 ± 0.26	2.56 ± 0.25	0.50
III	3.49 ± 0.25	3.5 ± 0.26	0.835
IV	4.45 ± 0.3	4.86 ± 0.32	0.258
V	5.61 ± 0.19	5.6 ± 0.19	0.85
I – III	1.85 ± 0.38	1.9 ± 0.42	0.67
I – V	4.32 ± 0.22	4.32 ± 0.22	0.96
III – V	1.73 ± 0.25	1.73 ± 0.25	0.85

Group I = Ear phone usage less than 2 hours per day, Group II = Ear phone usage greater than 2 hours per day, p>0.05- not significant

Table 3: Comparison of latencies and inter-peak latencies (in milliseconds) of BERA waves in the left ear

Waves	Group I (n= 50) Mean ± SD	Group II (n= 50) Mean ± SD	p value
I	1.37 ± 0.25	1.46 ± 0.25	0.248
II	2.52 ± 0.24	2.48 ± 0.22	0.455
III	3.5 ± 0.24	3.49 ± 0.25	0.805
IV	4.9 ± 0.32	4.76 ± 0.28	0.109
V	5.63 ± 0.18	5.56 ± 0.19	0.72
I – III	1.81 ± 0.37	1.73 ± 0.36	0.384
I – V	4.3 ± 0.21	4.3 ± 0.2	0.836
III – V	1.75 ± 0.23	1.72 ± 0.23	0.656

Group I = Ear phone usage less than 2 hours per day, Group II = Ear phone usage greater than 2 hours per day, p>0.05- not significant

Discussion

BAEP testing is a widely used procedure in the audiological evaluation. Analysis of wave I, III and V absolute and inter-peak latencies and investigation of the electrophysiological threshold using wave V latency-intensity function facilitates the differential diagnosis of cochlear and retrocochlear hearing loss and helps predict the degree of hearing loss when behavioral methods cannot be done.[8,9] It is very common practice among students to put on their ear phone and listen to music and watch videos whenever they get time and also the ease of availability of applications in all the android mobile phones has made the usage more rampant. The private and continual blaring of music through ear buds is seductive to so many because it creates a personal buffer that drowns out the outside world and relieves stress by bringing beats so close one can feel the vibrations. This intense, intimate merger with music, however, can be fatal to hair cells in the ears and lead to hearing loss. The risk is most prevalent among teenagers, according to Colorado University audiologists whose research determined that not only do they listen to music at volumes that are louder than the average adult, but that they are even unaware of how excessive their volume is.[1]

In a study carried out among college students in New York, nearly one-third of the users of personal music players exceeded permissible exposure levels, and many of them exceeded them drastically.[10] In a later study, the listening habits of 5% of users exceeded those levels, which would lead to hearing damage in the case of long-term use.[11] In the light of current guidelines, which are even more stringent, 10% of the users covered by this study would have exceeded permissible levels. In 1995, a study concluded that 5% of the young people they tested could have a permanent hearing loss of 20 dB after 5 years of use of personal music players. Restricting the maximum output level of personal music players to 90 dB would therefore limit the risk of hearing loss.[2] In contrast to these studies various papers have suggested that exposure to mobile phone microwaves has no influence on the activity of cochlear outer hair cells or of cochlear nerve electrical conduction, both in vivo and in vitro.[12-15] Currently manufactured digital hearing aids include effective protective features against mobile phone electromagnetic interference. Subjects still using analogue prostheses may couple their handsets to an induction loop, albeit at a cost. User of any hearing aid may, thus, use digital mobile phones with no discomfort. This study aims to compare the effects of short term ear phone usage on the human auditory system. As there was no statistically significant difference noted in the latencies and inter-peak latencies of BERA waves, the results of our study seem to indicate that auditory pathways from cochlear nerve to auditory brainstem are not affected by ear phone usage in our sample of medical students using ear phones for lesser than two hours per day or in those using ear phones for greater than two hours per day. However, the quantification of headphone usage in terms of duration and severity and the frequency could have been taken into consideration too; arbitrary selection of two hours duration of ear phone usage could also account for the failure to demonstrate any significant difference in the latencies and inter-peak latencies of BERA waves of the two groups. Limitations of the study include the sample size, the non-representativeness of the sample and the fact that the effects of other factors like the duration and frequency of ear phone usage and the volume at which the sounds were heard was not analyzed. These factors too will be taken into consideration and the research may be extended in a larger sample with a longer duration of usage in order to get a clear picture.

Conclusion

This study done to compare the brainstem auditory evoked potentials among medical students who use ear phones for durations less than and greater than 2 hours per day did not reveal any statistically significant difference in the latencies and inter-peak latencies of BERA waves between the groups. Further studies are warranted to overcome the limitations of this study and to obtain a clear picture.

Acknowledgment: Nil

Conflicts of interest: Nil

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