Original Article

Analysis of gender based differences in auditory evoked potentials among healthy elderly population

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Abstract

Background: Influence of gender on auditory evoked potentials is contentious. Although there are quite a few studies documenting the gender as an influencing factor on auditory evoked potentials in younger subjects, but there is a lack of similar studies among elderly population. The present study was conducted to find out the pattern of gender based differences in auditory evoked potentials among healthy elderly subjects.

Materials and Methods: A cross-sectional study was conducted on age matched, healthy males ($n = 35$) and females ($n = 34$), aged 50-70 years. The measures included latencies of waves I-V and interpeak latencies (IPL) I-III, III-V and I-V separately for both ears. Data was analyzed statistically using Students unpaired *t*-test, using Statistical Package for Social Sciences software v13.0.

Results: The values of all the latencies and IPL for both the ears were non-significantly higher ($P > 0.05$) in males as compared to females. These results may be attributed to the differences in head circumference between both the genders and to the changed hormonal milieu of sex hormones after menopause.

Conclusions: Statistical insignificance of latencies among male and female elderly subjects excludes gender as an influencing factor on auditory evoked potentials in this age group.

Key Words: Auditory evoked potentials, elderly subjects, gender differences, interpeak latency

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INTRODUCTION

Brainstem auditory evoked potentials (BAEP) have recently emerged as a useful tool not only for the clinical assessment of hearing in uncooperative patients and children, but also to note the severity of hearing defects in patients with brain stem dysfunction.[1] A typical BAEP waveform comprises of five or more waveforms that are recorded within 10 ms of an acoustic stimulus. Wave I originates from peripheral portion of cranial nerve VIII (auditory nerve) near the cochlear nucleus. Wave II originates from cochlear nucleus, wave III from superior olivary nucleus, wave IV from lateral lemniscus and wave V from inferior colliculi in the midbrain.[2]

The influence of age on BAEP waveform is well documented.[3-5] However, there is an ongoing debate regarding the influence of gender on BAEP patterns. Previous studies[6,7] have shown that gender differences in BAEP patterns were found to exist in 16-45 year age group, but were absent in younger (3-13 year old) as well as in older subjects (>46 year old).

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Although there are quite a few studies that have investigated the gender based differences in BAEP waveform patterns among children and young adults, there is a lack of similar studies among elderly population. Hence the present study was undertaken to investigate whether any gender based differences in BAEP waveforms also existed in these subjects or not.

MATERIALS AND METHODS

The study was conducted in the Physiology Department of the Institute. The study protocol was approved by the Ethical Committee of the Institute and was as per the Helsinki declaration of 1975. Written consent was taken from all the enrolled subjects after explaining them the details of the study in their own language.

Participants

The study subjects comprised of 35 males and 34 females, aged 50-70 years. These were selected randomly from among the apparently healthy relatives of the patients visiting the out-patient department of the hospital. It was ensured that only those females were included in the study who were in menopause and had not taken/were not taking any kind of hormone replacement therapy, before/during the study.

Exclusion criteria

For both groups, subjects excluded were who had a history of head/ear trauma, significant occupational noise exposure, intake of known ototoxic drugs (e.g., aminoglycosides) or any other medication that might affect normal functioning of the nervous system (e.g., antidepressants, antipsychotics, methyldopa, etc.), family history of deafness or any systemic illness that might affect the nervous system (uremia, diabetes mellitus, stroke, hepatic encephalopathy, multiple sclerosis, thyroid disorders, anemia, meningitis, etc.), history of tobacco chewing, chronic alcoholism or cigarette smoking, an year surgery, radiotherapy or chemotherapy.

Medical examination

Prior to the BAEP recordings, all the subjects were made to undergo the following:

- Detailed history by way of self-administered questionnaires about medical history and life-style
- Detailed general physical and systemic examination
- Complete ear, nose and throat check up by way of otoscopic examination, tuning fork tests and audiometry, to rule out peripheral hearing loss.

BAEP study

It was performed as per the guidelines of the American Clinical Neurophysiological Society.[8] BAEPs were recorded with a Personal computer based, Recorders and Medicare Systems Evoked Potential Marc-II Channel machine (Recorders and Medicare Systems Pvt. Ltd. Chandigarh, India). Before starting the test, age was calculated to the nearest completed year. Standing height without shoes (in cm), body weight with minimal clothing (in kg) and head circumference (in cm) were also noted. The BAEP recordings were done in a semi-dark room with quiet surroundings. The subjects were made to sit comfortably in a chair, whose back was turned towards the recording machine. The participants were asked to avoid unnecessary movement and to remove all the metallic ornaments that they were wearing. The recording method for BAEP is summarized below:

Monoaural stimulation (i.e., one ear at a time), in the form of "broad-band clicks", the acoustic energy of which is spread over a wide range of audio frequencies, was given via headphones at the rates of 11.1 Hz, along with masking of sounds in the contralateral ear. Two thousand clicks were averaged by a filter setting of 100 Hz and 3000 Hz. The clicks were given at an intensity of 60 dB level above the individual perceptual hearing threshold. The latter was estimated by using the ascending and descending limit method, with increment and decrement intervals of 1 dB. Percutaneous silver disc electrodes were used to record the BAEPs. The active electrodes were placed at the left and right mastoid processes (M1 and M2); reference electrode was placed at vertex (Cz position of the 10-20 International system of electroencephalography electrode placement), while the ground electrode was placed on the scalp, in the midline frontal location (Fz position of 10-20 system). Electronic impedance was kept below 5 kΩ. Two or more responses were obtained for both the ears separately, to show replicability. The BAEP results were interpreted for the latencies of waves I-V and interpeak latencies (IPL) I-III, III-V and I-V.

Statistical analysis

The data was analyzed statistically by using Statistical Package for (Social Sciences version 13.0 Inc. Chicago, US). Student's unpaired *t*-test was used for the analysis. $P < 0.05$ was considered to be statistically significant.

RESULTS

The present study tested the BAEP latencies of age matched healthy male and female elderly subjects. Comparison of anthropometric data of both the genders

revealed a significant difference in height, weight and head circumference but not in age [Table 1].

Tables 2 and 3 depict the comparison of various BAEP latencies in males and females for left and right ear respectively. It is evident from the results that for both ears, although all the peak latencies and IPL were higher in males as compared to females; however, the differences between the mean values of these latencies were statistically non-significant ($P > 0.05$).

DISCUSSION

The study investigated the influence of gender on BAEP latencies in healthy elderly subjects of either sex. Results revealed that males had longer latencies than females, the difference between similar latencies being non-significant statistically. These results are in contrast to many previous studies[9-11] in whom males were found to have significantly higher ($P > 0.05$) values than females. However the results of present study are in agreement with a previous Indian study[7] in which males and females aged >46 years were found to have comparable values of all BAEP latencies.

Some of the discrepancies between the results of this study and those previously mentioned can be explained by the fact that those studies included younger subjects while in our study comprised of elderly subjects.

The cause of lower values of BAEP latencies in females, as compared to males can be due to the faster neuronal conduction which may further be attributed to their smaller head size and higher body core temperature.[12,13]

There are studies[14,15] which document the possibility of acetylcholine (Ach) as being one of the possible neurotransmitters in auditory pathway and an interaction between estrogen and Ach for improvement of auditory transmission. It has also been proposed that female sex hormones (especially estrogen) have a favorable influence on the neuronal plasticity and metabolic levels of neurotransmitters, thereby resulting in faster neuronal conduction time in the auditory pathway. Hence, in post-menopausal women, with the onset of a fall in circulating estrogen levels, the neuronal transmission is also probably slowed down.[16] This may also explain the increase in the BAEP latencies of females and hence their comparability with those in males, as revealed by the present study.

The above explanation is substantiated by the findings of a previous Indian study,[17] in which a significant improvement in neuronal transmission among post-menopausal women was observed after 6 months of hormonal replacement therapy, as evidenced by a significant reduction in various BAEP waveform latencies.

Table 1: Comparison of anthropometric data and in study subjects

Parameter	Males (*n*=35) mean±SD	Females (*n*=34) mean±SD	*P* value
Age (years)	58.24±42.35	58.72±33.96	0.103
Height (cm)	163.8±27.08	156.36±13.65	<0.001*
Weight (kg)	69.96±52.04	59.32±62.14	<0.001*
Head circumference (cm)	55.56±1.88	52.22±1.08	0.005*

n=No. of subjects. *Statistically significant (*P*<0.05)

Table 2: Comparison of BAEP latencies (in ms) in left ear of study subjects

BAEP waveform	Males mean±SD	Females mean±SD	*P* value
I	1.63±0.25	1.61±0.03	0.362
II	2.76±0.04	2.68±0.05	0.094
III	3.64±0.02	3.63±0.06	0.487
IV	4.72±0.03	4.62±0.11	0.206
V	5.55±0.05	5.47±0.07	0.118
I-III	2.01±0.05	2.00±0.03	0.423
III-V	1.92±0.11	1.82±0.05	0.137
I-V	3.93±0.09	3.83±0.05	0.098

None of the differences are statistically significant (*P*>0.05), BAEP: Brainstem auditory evoked potentials

Table 3: Comparison of BAEP latencies (in ms) in right ear of study subjects

BAEP waveform	Males mean±SD	Females mean±SD	*P* value
I	1.59±0.04	1.52±0.02	0.067
II	2.74±0.05	2.72±0.05	0.388
III	3.61±0.04	3.54±0.02	0.063
IV	4.84±0.04	4.76±0.08	0.118
V	5.48±0.11	5.39±0.03	0.117
I-III	2.02±0.05	2.01±0.03	0.488
III-V	1.86±0.08	1.84±0.02	0.351
I-V	3.89±0.09	3.86±0.04	0.388

None of the differences are statistically significant (*P*>0.05), BAEP: Brainstem auditory evoked potentials

Study limitations

It is a limitation of the present study that hormonal assay was not done and thus the role of hormones on BAEP could not be quantitatively established. Another limitation might be due to the smaller sample size of the study, but this was the maximum number of eligible subjects that were available during the study duration.

CONCLUSION

Statistical insignificance of BAEP latency differences among age matched elderly male and female subjects

excluded gender as a basis of variation in BAEP among this age group. Also in consideration of a lack of similar studies among this age group, there is an urgent need to conduct more such studies on a regional basis. This would also help in standardizing the pattern of BAEP waveforms among elderly population.

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