Original Research Paper

International Physiology
Vol. 4 No. 1, January - June 2016
DOI: https://dx.doi.org/10.21088/ip.2347.1506.4116.3

Correlation Between Age, Gender and Brainstem Auditory Evoked Potential

Sunita Nighute[1], Maria Shaikh[2]

Abstract

Brainstem auditory evoked potential is a physiological technique for evaluation of auditory pathway. A number of electrical potentials can be recorded from the human scalp following acoustic stimulation. The potentials which occur within 10 msec of the stimulus onset termed the brain stem auditory evoked potentials (BAEPs). Latency appears to be the most stable measure and in consequence knowledge of the exact limits of normal latency of each wave is important. Since age and sex effects on central conduction time in the acoustic pathway are still debated, the following study was conducted to investigate possible age and sex differences in BAEP component latencies in younger and older male and females, total 60 of age 21-30yrs and 51-60 yrs respectively, The absolute peak latency of waves I, & V and interpeak latency of wave's I-III, & I-V in younger and older age group male and females are analyzed. The data was statistically compared between the different age groups and between the males and females and regression analysis was done. Absolute latencies of the waves I, and V and the interpeak latency of the waves, I-III and I-V showed significant increase with age, thus suggesting degenerative changes in the auditory pathway and synaptic delay. There were significantly increased values of the latencies of the waves I, and V and interpeak latencies of the waves, I-III, I-V in males as compared to the females. Thus, age and sex have an effect on latency and interpeak latency in Brainstem auditory evoked potentials.

Keywords: Auditory Evoked Potential; Interpeak Latency; Age and Sex.

Introduction

Evoked potentials provide a useful tool for neurophysiological research [1]. It is the record of electrical activity produced by groups of neurons within the spinal cord, brainstem, thalamus or cerebral hemispheres following stimulation of one or another specific system by means of visual, auditory, or somatosensory input. Brain stem auditory evoked potential (BAEP) recording is a physiological technique for evaluation of auditory pathway. BAEPs are the electrical activities resulting from the activation of the eighth nerve, cochlear nucleus, tracts and nuclei of the lateral lemniscuses and inferior colliculus [2]. These waves are generated at the following points of the auditory pathway: Wave I- Cochlear nerve, Wave II- Cochlear nuclei, Wave III- Superior olivary nucleus, Wave IV- Lateral leminiscus and Wave V- Inferior collicus. The clinical applications of BAEP consist of identification of neurological abnormalities in the VIIIth nerve & auditory pathways of brainstem and the estimation of hearing sensitivity. It is a measure of neural synchrony of the time-locked, on sensensitive, single-unit activity in the auditory nerve and the brainstem [3].

AEP is affected by factors like age, gender ,head size and hearing loss. The absolute peak latencies of the AEP waves increase with an increase in age. The waves I, III, and V have a direct influence on age [4]. Also, the interpeak latencies (IPLs) of the waves I-III,III-V and III-V in the older age groups had an increased value as compared to that in young people [5].

In humans, ABR can be recorded from about 26 weeks of gestational age (GA). After that, waves develop rapidly until term birth. From birth ABR

Author's Affiliations: [1]Associate Professor, Dept of Physiology, PDVVPF'S Medical College, Ahmednagar, Opposite govt milk dairy, vilad ghat, Ahmednagar, 414111 Maharashtra. [2]Assistant Professor Physiology PCMS & RC, Bhopal (MP).

Corresponding Author: Sunita Nighute, Associate Professor, Dept of Physiology, PDVVPF'S Medical College, Ahmednagar, Opposite govt milk dairy, vilad ghat, Ahmednagar, 414111 Maharashtra.
E-mail: drsunitanighute@gmail.com

continues development more slowly and in 18-24 month children, all the components are completely mature and adult-like [6,7]. In diagnostic audiology, interpeak latency interval (IPL) or inter-wave interval (IWI) of main ABR components especially I-V are very important because IPL I-V reflect the central conduction time (CCT) or brain stem conduction.

The influences of subject factors, especially advanced age, on the BAEP gain experimental attention. Fujikawa and Weber (1977), focusing on Wave V, found prolonged latency shifts from a 13 click/sec baseline response when older individuals were compared to young adults. Below the age of 2 years, interpeak latencies are prolonged relative to adult values. By the age of 2 years, the ranges for adults are reached, the absolute latencies of wave I, III, V increase by 0.1-0.2 msec with age. The reason for the age related latency shift is progressive myelination of the auditory tract. Some of the changes that occur in the aging auditory system may significantly influence the interpretation of the auditory brainstem responses in comparison with younger adults [8].

There also occurred gender differences of these waves. Males were found to have 0.1 to 0.2 ms longer latencies of the waves III and V and longer I–V interpeak intervals than females. The sources of the male and female related differences could be factors such as head size or gender-dependent sizes of the external acoustic meatus. Several factors may affect the peak latencies, IPL and wave amplitudes in ABR. These factors are classified as recording variables (electrodes, reference, filters), stimulus variables (stimulus intensity, stimulus rate, stimulus mode and stimulus phase) and subject variables (age, sex, body temperature, and cochlear hearing loss). Subject variables especially 'age' and 'gender' have powerful influences on ABR [5]. It has been shown that females may have shorter ABR latencies and IPL latencies than males. Also, in the elderly ABR waves have delayed latencies in comparison to young adults [9.10].

Since age and sex effects on central conduction time in the acoustic pathway are still debated, so the aim of our study is to investigate the differences, in BAEP component latencies in different age groups in male and females.

Materials and Method

In our study about sixty normal healthy subjects including both male and female in equal number were assigned to the following age groups:

2. 21-30 years (n=30)
5. 51-60 years (n=30)

BAEP test procedure was explained & written consent obtained from the subjects, a detailed history and thorough clinical & ENT examination were carried out to rule out any medical problem. Specific history was also taken to rule out any prolonged exposure to noise. Their height & weight were also taken.

BAEP recording was done in a quiet air conditioned room (28 + 1 oC). All the subjects were studied in the sitting position with appropriate head positioning so as to minimize postural muscle activity in the head & neck. The subjects were made to relax in order to minimize muscle artifacts. The recording surface electrodes filled with conductive paste were fixed on vertex (Cz, 10-20 international electrode placement system) & the on the mastoid process ipsilateral to the ear being stimulated. The ground electrode was placed on forehead (Fz). Electrodes were connected to the evoked potential recorder (RMS EMG. EP MARK II Machine manufactured by RMS recorder & medicare system, Chandigarh). Impedance of electrode was kept below 5 k ohms. A band pass of 100-3000 Hz was used to filter out undesirable frequencies in the surroundings. Responses to 2000 click presentation were averaged for 10 msec. Because of poor signal to noise ratio, it is necessary to average several hundreds of signal responses to get a recognizable BAEP waveform.

Brainstem Auditory Evoked Potential

The subject's hearing threshold was determined for each ear at the time of testing. The acoustic stimulus was rarefaction clicks, which were generated by passing 0.1 ms square pulses through shielded headphones. Clicks of intensity 60 dB above the hearing threshold were Delivered at the rate of 10 pulses per second .Monaural stimulation was used & contra lateral ear was masked by white noise at 30 dB below the click intensity. BAEP waves were identified & labeled. The peak latencies of waves I & V were measured. The interpeak latencies I-III, I-V was computed. Amplitudes of waves were also measured from peak to following trough of the wave. The waveform measured between the vertex and the ear be ear being stimulated constitutes the ipsilateral recording, whereas the waveform measured between the Vertex & ear opposite of the ear being stimulated constitutes the contra lateral recording.

Results

The mean and standard deviation of the absolute peak latency and interpeak latency in male and female in milliseconds are shown in Table-1

The absolute peak latency of the waves I and V and the interpeak latencies of the waves, I-III and I-V were significantly increased in males than in females.

The mean & standard deviation of the absolute peak latency and interpeak latency in different age groups in milliseconds are shown in Table 2.

The data collected from both ears showed that increase in age will cause an increase in peak latency of wave I and V and the interpeak latencies of the waves, I-III and I-V were significantly increased in age from younger to older age.

Table 1: The mean and standard deviation of the absolute peak latency and interpeak latency in male and female in milliseconds.

Parameters	Males(30) Mean (Sd)	Female(30) Mean (Sd)	P-Value
Absolute Latency			
I	1.40±0.1	1.32±0.09	<0.001**
V	5.60±0.17	5.40±0.17	<0.001**
Interpeak Latency			
I-III	2.27±0.13	2.18±0.14	<0.001**
I-V	4.10±0.15	3.90±0.17	<0.001**

P-VALUE <0.001**= significant

Table 2: The mean & standard deviation of the absolute peak latency and interpeak latency in different age groups in milliseconds .

Parameters	AGE 21-30 yrs(30) Mean (SD)	AGE 51-60 yrs(30) Mean (SD)	P-Value
Absolute Latency			
I	1.75±0.049	1.85±0.035	<0.001**
V	5.50±0.022	5.70±0.019	<0.001**
Interpeak Latency			
I-III	2.02±0.021	2.09±0.148	<0.001**
I-V	3.29±0.077	3.90±0.038	<0.001**

P-VALUE <0.001**= significant

Discussion

The present study revealed that increase in age will cause an increase in peak latency and interpeak latency of waves I & V and interpeak latencies of the waves, I-III and I-V. There occurred significantly increased latencies of the waves I, and V and interpeak latencies of the waves, I-III and I-V in males as compared to the females, thus showing that age and gender affects these waves. Our study is comparable with the findings of previous one: Stephen W H (1981), observed peak latency increases in the elderly, to be due to peripheral processes [11]. Nai-Shin Chu (1985), showed small progressive prolongation in the peak latency with increasing age, particularly peak V [12]. Rosenhall U *et al* (1985), found latencies of waves I, III and V increase 0.1-0.2 msec with increasing age.

Harinder J S,earch.(2010) found positive correlation between the latencies of the waves III, IV and V and between the interpeak latencies of the waves I-III, III-V and I-V with age and sex in all the subjects [13].

Yones Lotfi, et all in October 2012 Their results indicate that there is a significant difference between males and females in absolute latencies and IPLs of ABR, irrespective of age. Females have shorter absolute latencies and IPLs in ABR. Furthermore, this study shows that absolute latencies and IPLs of ABR increase with aging especially in the 51-70 year-old interval [14].

It has been reported that females have shorter conduction times and ABR latencies than age matched males [15,9], and that gender has more powerful effects on ABR than aging [16-17]. Stuzebecher E et al (1987), which showed that the wave latency I and II and the interpeak latencies of the waves III-V showed statistically significant differences between males and females [18]. This finding is supported by Fallah TM (2007), showed increasing trend in age from younger to older caused values of interpeak latencies I-III , III-V & I-V increase 9. Rowe (1978) reported increased wave I-III interpeak latency in older than in young persons [19].

The increased latency and the interpeak latency which were observed in elderly individuals could be due to degenerative changes like auditory nerve atrophy, synaptic delay and peripheral hearing loss with age. Increasing age also causes neuronal loss and changes in the permeability of the neural membrane, which might have led to the increased latencies of the BAEPs [20].

The latencies of waves III & V and interpeak latencies I-III and I-V are significantly higher in male as compared to female. Females have shorter interpeak latencies than males. This may be explained by shorter corresponding segments of the auditory pathway due to smaller brain size in female [21]. Aging changes that is, increases in latency attributable to increased conduction time in older subjects were observed in brainstem auditory pathway and males tended to show larger aging effects than females [22].

Our study is supported by Aoyagi M et al (1990) [9] & Harinder J S et al (2010) [13]. Aoyagi M et al (1990) investigated ABR latencies in 107 adults (57 males and 50 females) with normal hearing & found Wave III and wave V latencies and I-III and I-V interpeak latency intervals were significantly shorter in females than in males. He obtained significant positive correlations between head size and above-mentioned ABR wave latencies and IPLs. These results suggest that head size, which may reflect brain size, is one of the important factors for the basis of gender difference in ABR latencies. Harinder J S et al (2010) found BAEP waves III and V and interpeak latencies I-III and I-V are significantly higher in male as compared to female.

Conclusion

The results of this study among others show that age and gender affects the normal ABR latencies. and interpeak latencies this will be helpful for the interpretation and diagnosis in clinical practice.

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