Role of brainstem auditory evoked potential in Forensic Medicine

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Abstract

Brainstem Auditory Evoked Potential (BAEP) is an important test used in clinical practice. It is used to diagnose auditory threshold changes and to characterize the type of hearing loss as it does not depends on voluntary response from the subject. Its role in forensic medicine becomes relevant for the assessment of type of hearing loss in medicolegal cases for conductive or sensory neural. It can be used for assessing nature of injuring cases of malingering and pinpointing the neuronal pathway, hhearing loss and whether the victim had hearing loss before the injury or after the injury. This study presents latencies of wave I, II, III, IV and V, interpeak latencies of wave I-III, I-V, III-V and amplitudes of waves I-Ia, V-Va and absolute amplitude R in 100 healthy normal hearing in medical students of same age group comprising of 50 females and 50 male for comparison of inter gender difference and for the purpose of establishing normal values. In the present study, it has been concluded that there is highly significant difference in the waves and interpeak latencies III, V and I-V between females and males. It was also found that the duration of wave I showed statistically highly significant differences and V-Va showed significant difference between left and right ear in females. It was also found that the duration of wave showed statistically highly significant difference in males.

Keywords: Brainstem auditory evoked response, wave latencies, interpeak latencies, forensic medicine.

Introduction

The Brainstem auditory evoked response (BAER) test measures brain wave activity within 10 millisecond that occurs in response to brief auditory stimulation to assess the conduction through auditory pathway up to midbrain[1]. Thus BAER is the assessment of normal functioning of auditory pathway. BAER comprises of five or more peaks from sequential activation of peripheral, ponto-medullary, pontine and mid brain portion of auditory pathways[2].

Wave I: Originates from the peripheral portion of VIII cranial nerve
Wave II: Originates from cochlear nucleus
Wave III: From superior olivary nucleus
Wave IV: From the lateral lemniscus.
Wave V: From inferior colliculi

As voluntary response is not required from the subject[3], its role in forensic evaluation becomes relevant. This may include assessment of type of

hearing loss, conductive or sensorineural; nature of injury in case of trauma; in cases of malingering, where victim presents with the complain of hearing loss and falsely alleges hearing loss for purpose of making grievous injury, the doctor can perform BAER and assess whether the victim is providing the correct information or not as here subjects response is not required.. Due to above reasons, it can be used as a tool for assessment of hearing loss in medico legal cases in forensic sciences where a victim comes with the complaint of hearing loss.

Materials and Methods

The present study has been conducted on 50 male and 50 female audiometrically normal healthy subjects in the age group of 18-24 years. The subjects for the study were taken up from amongst the students of Govt. Medical College, Patiala. inclusion criteria were subjects who had all the hearing tests like rene , weber test normal and all those subjects who showed abnormal hearing tests and have hearing loss conductive as well as sensorineural, due to any cause were excluded. The subject was asked to clean the area where electrodes were placed to reduce impedance, and the test was done in sound proof room, with the subject relaxed and having his back towards the recording machine.

The test was conducted on 'RMS EMG EP MARK II' it is the name of the machine with which test was performed of Recorders and Medicare. After explaining the procedure to the subject electrodes are placed on the mastoid processes bilaterally (reference), forehead (ground) and vertex (active)[4]. The BAER values were obtained in the form of graphical and numerical data in each case. This included waves I to V (in milliseconds), amplitude (millivolts) and interpeak latency (IPL in milliseconds) measured as the distance between the peak of two waves. e. g. I-V, I-III and III-V[2]. The obtained data was analyzed statistically and independent t-test was performed with the help of SPSS/PC + version 11.0. The p-value less than 0.05 were considered significant and p-value less 0.01 was considered highly significant.

Results

The present study was undertaken to establish the normal values and effect of gender on brainstem auditory evoked response. The present study was conducted on 100 audiometrically normal medical students, 50 males and 50 females, which were taken from Govt. Medical College, Patiala. The comparison of the brainstem auditory evoked potentials was done as shown in table 1to 3.

Table 1: Comparison of waves, interpeak latencies & amplitude of BAER in females and males

Parameters	Female		Male		'p'
	Mean	SD	Mean	SD	Value
I (ms)	1.60	0.18	1.64	0.20	0.07
II (ms)	2.76	0.25	2.76	0.21	0.43
III (ms)	3.61	0.29	3.70	0.19	0.002 HS
IV (ms)	4.87	0.31	4.89	0.21	0.30
V(ms)	5.49	0.42	5.63	0.30	0.005 HS
I-III (ms)	2.03	0.29	2.07	0.22	0.17
I-V (ms)	3.89	0.42	4.00	0.34	0.025 HS
III-V (ms)	1.90	0.44	1.93	0.35	0.25
I-Ia (mV)	1.13	1.80	1.60	3.01	0.08
V-Va (mV)	1.49	2.42	1.74	2.46	0.21
Amplitude R(mV)	1.82	2.02	1.81	1.31	0.48

There is highly significant difference in the waves and interpeak latencies III, V and I-V between females and males[5-8].

Table 2: Comparison of waves, interpeak latencies & amplitude of BAER between left and right ear of females

Parameters	Left Ear		Right Ear		'p'
	Mean	SD	Mean	SD	value
I (ms)	1.65	0.18	1.56	0.17	0.005 HS
II (ms)	2.78	0.24	2.74	0.20	0.28
III (ms)	3.64	0.29	3.58	0.16	0.09
IV (ms)	4.87	0.32	4.86	0.19	0.86
V (ms)	5.50	0.44	5.49	0.38	0.79
I-III (ms)	2.00	0.27	2.06	0.36	0.25
I-V (ms)	3.86	0.44	3.93	0.39	0.08
III-V (ms)	1.88	0.46	1.91	0.38	0.59
I-Ia (mV)	1.31	1.68	0.96	0.76	0.08
V-Va (mV)	1.86	2.39	1.12	0.44	0.024 S
AMPLITUDE R (mV)	1.91	1.86	1.72	1.43	0.52

It was found that the duration of wave I showed statistically highly significant differences and V-Va showed significant difference between left and right ear in females.

Table 3: Comparison of waves, interpeak latencies & amplitude of BAER between left and right ear of males

Parameters	Left Ear		Right Ear		'p' value
	Mean	SD	Mean	SD	
I	1.69	0.19	1.58	0.18	0.001 HS
II	2.77	0.21	2.74	0.22	0.36
III	3.73	0.19	3.67	0.20	0.06
IV	4.87	0.22	4.90	0.19	0.38
V	5.66	0.29	5.60	0.32	0.11
I-III	2.04	0.22	2.09	0.22	0.18
I-V	3.97	0.34	4.02	0.35	0.27
III-V	1.93	0.34	1.93	0.37	0.90
I-Ia	1.96	2.92	1.23	3.11	0.22
V-Va	2.31	3.03	1.17	1.59	0.02
AMPLITUDE	1.92	1.49	1.70	1.11	0.33

Table 3 shows comparison of mean and standard deviation and significance of waves (I, II, III, IV & V), interpeak latencies & amplitude of BAEPs between left and right ear of males. It was found that the duration of wave I showed statistically highly significant difference.

Discussion

BAEP is an important test used in clinical practice. It is used to diagnose auditory threshold changes and to characterize the type of hearing loss, to identify retrocochlear or central nervous system alterations, to assess the central auditory system maturity in neonates. Its sensitivity for detecting such conditions is optimal since it does not depend on information from patient.

As it does not depend on patient information its role in forensic sciences becomes relevant due to following reasons:

i. Assessment of type of hearing loss, conductive or sensorineural
ii. Severity of head injury
iii. In cases of malingering, where victim presents with the complain of hearing loss
iv. Pinpointing the neuronal pathway involved in hearing loss.
v. Whether the victim had hearing loss before the injury

Due to above reasons, it can be used as a tool for assessment of hearing loss in medico legal cases in forensic sciences where a victim comes with the complaint of hearing loss.

Because of questions raised by many authors about interferences from certain physiological factors e.g. sex, a study was needed to assess these variables in normal individuals. Also there was a need to establish normal values for our institute for the comparison of the subject with apparent hearing loss[8] .

This study presents latencies of wave I, II, III, IV and V, interpeak latencies of wave I-III, I-V, III-V and amplitudes of waves I-Ia, V-Va and absolute amplitude R of brainstem auditory evoked responses in 100 healthy normal hearing medical students of same age group comprising of 50 females and 50 male students and comparison of inter gender difference.

The mean value with standard deviation of waves I, II, III, IV, V, interpeak latencies I-III, I-V, III-V, amplitude I-Ia, V-Va & R of BAEP between females and males has been tabulated. The mean and standard deviation of BAEP between left and right ear of both females and males have been tabulated. From the tables it has been concluded that there is highly significant difference in the waves and interpeak latencies III, V and I-V between females and males. Furthermore the results can be explained by assuming that the stiffness gradient in the cochlea is 13% larger in females than in males[9]. This prediction is highly consistent with recent anatomical studies of cochlear length and gender, thus indicating possible important cochlear mechanisms that influence the main parameters of BAERs. Also difference in the latencies in females might be due to higher oestrogen levels[10.]

It was found that the duration of wave I showed statistically highly significant differences and V-Va showed significant difference between left and right ear in females. In males it was found that the duration of wave I showed statistically highly significant difference.

The difference between the left and right ear in the present study in wave I of BAEP has shown significance but there difference is less than 0.2 milliseconds, as it is seen in studies previously done that only if the value exceeds more than 0.2 ms between two ears of an individual, it may be of diagnostic importance[11].

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