ORIGINAL RESEARCH PAPER

Volume-8 | Issue-3 | March-2019 | PRINT ISSN No 2277 - 8179

INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

INFLUENCE OF HEAD SIZE ON BRAINSTEM AUDITORY EVOKED POTENTIALS

Physiology

Shikha Jaiswal Demonstrator, Department of Physiology, Government Allopathic Medical College, Banda, U.P., India.

Suchet Trigotra* Professor, Department of Physiology, Dr.Y.S.Parmar Government Medical College, Nahan, H.P., India. *Corresponding Author

Sunidhi Sharma Demonstrator, Department of Physiology, KM Medical College & Hospital, Mathura, U.P., India.

ABSTRACT

Objectives: Brainstem auditory evoked potentials (BAEPs) possess well established clinical utility. Head size is an important physiological variable leading to inter-subject variability in the test. However, there are conflicting results from the different studies correlating head size with BAEP parameters. Hence the present study was planned to evaluate the influence of head size on the BAEP parameters in healthy adults.

Material and Methods: BAEP was recorded in 150 healthy adults in the age group of 18-67 years (75 males and 75 females). Head size was measured from nasion to inion. Pearson correlation coefficient was used to correlate head size with BAEP parameters. The p-value<0.05 was considered as statistically significant.

Results: A statistically significant positive correlation was found between head size and absolute latencies of all waves and the I-V interpeak latency in total participants. In males absolute latencies of wave I, III and V and IPL of wave I-V showed a statistically significant (p<0.05) correlation with head size while in females absolute latencies of waves I, III, V and IPLs I-III and I-V showed statistically highly significant (p<0.001) and IPL of wave III-V showed a significant (p<0.05) correlation with head size.

Conclusion: Head size shows a positive correlation with BAEP latencies. Hence head size should be considered as one of the important variables affecting BAEP response.

KEYWORDS

Brainstem Auditory Evoked Potential, Head size, Latencies, Interpeak latencies.

INTRODUCTION:

Brain stem auditory evoked potentials (BAEPs) are objective, non-invasive investigation and provide a measure of functional integrity of auditory pathways. The BAEP test has well established clinical utility in audiology, neonatology and neurology. These evoked potentials are recorded from the ear and vertex in response to a brief auditory stimulation to assess the conduction through the auditory pathway up to midbrain. They are recorded within 10ms after the sound stimulus and a series of potentials corresponding to sequential activation of peripheral, ponto- medullary, pontine and midbrain portion of auditory pathways can be recorded. There are five distinct waveforms, named from I to V, recorded within 10ms of the auditory stimulus.[1]

Although normal ranges of BAEP latencies can be determined under recording conditions of each electrophysiology laboratory, inter-subject variability remains as an important factor influencing the BAEP based clinical diagnosis.[2] BAEP variables in normal healthy individuals are known to be influenced by various physiological factors, out of which age and gender are the most extensively studied variables.[3-5]

Head size is another important physical variable.[6] Head size indirectly reflects the brain size and hence the length of the conduction pathway.[7] Studies in the past, correlating head size of the study participants and BAEP latencies provided conflicting results.[7-9] Hence, the present study was planned to evaluate the influence of head size on BAEP parameters in healthy individuals.

MATERIALS AND METHODS:

A cross-sectional analytic study was conducted in the Department of Physiology, MM Institute of Medical Sciences & Research, Haryana, India. 150 participants, comprising of 5 different age groups of 30 each, were selected. Each group was further divided equally into 15 male and 15 female participants. Group-1(18-27 years),Group-2 (28-37 years), Group-3(38-47 years), Group-4(48-57 years) and Group-5(>58 years).

Approval was obtained from Institutional Ethics Committee to carry out the research study.

Inclusion criteria: One hundred fifty healthy participants from Mullana area of Ambala were selected.

Exclusion criteria: Participants with any external, middle or inner ear pathology, diabetes mellitus, hypertension, HIV infection and chronic use of ototoxic drugs were excluded from the study.

After getting the informed consent from participants, they were made comfortable with electrophysiology laboratory set up conditions and were familiarized with the procedure. They were advised to relax completely during recording. Anthropometric data i.e. age, height and weight was noted and BMI was calculated by using Quetelet's index i.e. Weight (in kg)/ Height^2 (in m). Head size was measured from nasion to inion (in cm) with measuring tape. A detailed history was taken, complete neuro-otological and general physical examination was done to exclude any medical illness or drug intake which could affect the BAEP variables.

BAEP RECORDING: BAEP was performed on Allengers Scorpio-*EMG EP NCS* system in Electrophysiology laboratory, made dark and sound attenuated for the test. Placement of standard disc surface electrode was done according to International Federation of Clinical Neurophysiology committee using10/20 international system of electrode placement, with active electrode at M1/ M2, reference electrode at Cz, ground electrode at Fpz.[10] Monaural auditory stimulus consisting of rarefaction click with intensity of 60 dB nHL at the rate of 11.1/sec was delivered through head phones. The contralateral ear was masked with white noise 30 dB below the BAEP stimulus. The low filter setting was adjusted at 100 Hz and high filter setting at 3000 Hz. Responses to 2000 click presentations were averaged to obtain a single BAEP waveform pattern. The two responses were recorded and superimposed to verify the reproducibility of the waveform.

DATA MANGEMENT AND STATISTICAL ANALYSIS:

The data entry was carried using Microsoft Office Excel Worksheet. Statistical analysis was done using statistical package for social sciences (SPSS) 20.0 version. Results were presented as Mean ± SD. Pearson's correlation analysis was performed to assess the correlation between head size and BAEP parameters. The p-value of less than 0.05 was considered statistically significant.

RESULTS:

The anthropometric parameters i.e. mean age, weight, height, head size and BMI of 150 healthy participants is summarized in table no. 1. Correlation of head size of male and female participants with wave I, III and V absolute latencies and I-III, III- V and I-V inter-peak latencies are shown in table no. 2-7. The correlation of head size with absolute latency of wave V in various age-groups is also shown (table no. 8).

Table no.1: Anthropometric profile of study participants.

Parameters	Males (n=75) (mean±SD)	Females (n=75) (mean±SD)	Total (n=150)	p- value
Age(year)	41.75±14.507	41.72±14.775	41.73±14.64	0.991
Height(cm)	170.729±6.240	158.343±5.029	164.54±8.39	0.000**
Weight(Kg)	64.626±8.480	55.66±8.42	60.145±9.55	0.000**
BMI (Kg/m^2)	22.29±2.295	22.25±3.254	22.27±2.82	0.668
Head Size(cm)	34.287±0.913	32.153±1.045	33.22±1.45	0.000**

P<0.05 considered as statistically significant* and p≤0.001 considered as statistically highly significant**

Table no.2: Correlation of head size with absolute latency wave I in males and females.

Gender	No. of subjects (n)	Mean Head size (cm±SD)	Absolute latency Wave I (mS±SD)		Correlation coefficient (r)		p- value	
			Right ear	Left ear	Right ear	Left ear	Right ear	Left ear
Males	75	34.287±0.913	1.692±0.09	1.696±0.11	0.305*	0.314*	0.008*	0.006*
Females	75	32.153±1.045	1.637±0.073	1.638±0.079	0.515*	0.448*	0.000*	0.000*
Total	150	33.22±1.45	1.664±0.091	1.667±0.10	0.475*	0.447*	0.000*	0.000*

p<0.001 extremely significant for correlation between head size and absolute latency wave I in females and total subjects while p<0.05 for males.

Table no.3: Correlation of head size with absolute latency wave III in males and females.

Gender	No. of subjects (n)	Mean Head size (cm±SD)	Absolute latency Wave III (mS±SD)		Correlation coefficient (r)		p- value	
			Right ear	Left ear	Right ear	Left ear	Right ear	Left ear
Males	75	34.287±0.913	3.761±0.13	3.755±0.14	0.250*	0.233*	0.031*	0.044*
Females	75	32.153±1.045	3.707±0.150	3.706±0.153	0.488*	0.501*	0.000*	0.000*
Total	150	33.22±1.45	3.733±0.146	3.73±0.149	0.390*	0.373*	0.000*	0.000*

p<0.001 extremely significant for correlation between head size and absolute latency wave III in females and total subjects while p<0.05 for males.

Table no.4: Correlation of head size and absolute latency wave V in males and females.

Gender	No. of subjects (n)	Mean Head size (cm±SD)	Absolute latency Wave V (mS±SD)		Correlation coefficient (r)		p- value	
			Right ear	Left ear	Right ear	Left ear	Right ear	Left ear
Males	75	34.287±0.913	5.737±0.126	5.740±0.120	0.284*	0.244*	0.014*	0.035*
Females	75	32.153±1.045	5.698±0.10	5.697±0.11	0.540*	0.518*	0.000*	0.000*
Total	150	33.22±1.45	5.717±0.118	5.718±0.119	0.393*	0.390*	0.000*	0.000*

p<0.001 extremely significant for correlation between head size and absolute latency wave III in females and total subjects while p<0.05 for males.

Table no.5: Correlation of head size with inter-peak latency wave I-III in males and females.

Gender	No. of subjects (n)	Mean Head size (cm±SD)	Inter-peak latency Wave I-III (mS±SD)		Correlation coefficient (r)		p- value	
			Right ear	Left ear	Right ear	Left ear	Right ear	Left ear
Males	75	34.287±0.913	2.067±0.074	2.057±0.077	0.028	-0.045	0.813	0.700
Females	75	32.153±1.045	2.069±0.09	2.067±0.10	0.384*	0.410*	0.001*	0.000*
Total	150	33.22±1.45	2.068±0.084	2.062±0.090	0.150	0.111	0.066	0.017

p<0.001 significant for correlation between head size and interpeak latency wave I-III only in females.

Table no.6: Correlation of head size with inter-peak latency wave III-V in males and females.

Gender	No. of subjects (n)	Mean Head size (cm±SD)	Inter-peak latency Wave III-V (mS±SD)		Correlation coefficient (r)		p- value	
			Right ear	Left ear	Right ear	Left ear	Right ear	Left ear
Males	75	34.287±0.913	1.980±0.062	1.985±0.061	0.129	0.023	0.270	0.842
Females	75	32.153±1.045	1.992±0.066	1.992±0.079	-0.245*	-0.238*	0.034*	0.040*
Total	150	33.22±1.45	1.986±0.064	1.988±0.071	-0.119	-0.125	0.146	0.128

p>0.05 insignificant for correlation between head size and interpeak latency wave III-V in males and total subjects.

Table no.7: Correlation of head size with inter-peak latency wave I-V in males and females.

Gender	**No. of subjects (n)**	**Mean Head size (cm±SD)**	**Inter-peak latency Wave I-V (mS±SD)**		**Correlation coefficient (r)**		**p- value**	
			Right ear	**Left ear**	**Right ear**	**Left ear**	**Right ear**	**Left ear**
Males	75	34.287±0.913	4.058±0.062	4.054±0.051	0.625*	0.335*	0.000*	0.003*
Females	75	32.153±1.045	4.06±0.051	4.07±0.049	0.775*	0.516*	0.000*	0.000*
Total	150	33.22±1.45	4.059±0.057	4.062±0.050	0.459*	0.164*	0.000*	0.045*

p<0.001 extremely significant for correlation between head size and interpeak latency wave I-V only in female

Table no.8: Correlation of head size with absolute latency of wave V in various age-groups.

Age groups (n)	**Head size (cm±SD)**	**Absolute latency of wave V (mS±SD)**		**Correlation coefficient (r)**		***p*- value**	
		Right ear	**Left ear**	**Right ear**	**Left ear**	**Right ear**	**Left ear**
Gp1:18-27 years (n=30)	32.583±1.86	5.556±0.073	5.567±0.080	0.584*	0.629*	0.001*	0.000*

Gp2:28-37 years (n=30)	33.133±1.38	5.675±0.025	5.678±0.027	0.382*	0.383*	0.037*	0.037*
Gp3:38-47 years (n=30)	33.3±1.12	5.717±0.019	5.707±0.024	0.556*	0.077	0.001*	0.687
Gp4:48-57 years (n=30)	33.683±1.24	5.769±0.03	5.765±0.04	0.658*	0.599*	0.000*	0.000*
Gp5: >57 years (n=30)	33.4±1.29	5.87±0.089	5.88±0.091	0.405*	0.380*	0.026*	0.038*
Total (n=150)	33.22±1.45	5.717±0.118	5.718±0.119	0.393*	0.390*	0.000*	0.000*

p<0.001 extremely significant for correlation between head size and absolute latency wave V in Age-Group-I, IV, III(only right ear) and total subjects while rest groups having p<0.05 (Pearson correlation test).

DISCUSSION:

In our study correlation of head size with absolute latencies of wave I, III, V and inter-peak latencies (IPLs) I-III, III-V and I-V was evaluated in total participants and in male and female participants separately (**Tables no. 2-7**). In males absolute latencies of wave I, III and V and IPL of wave I-V showed a statistically significant (p<0.05) correlation with head size while in females absolute latencies of waves I, III, V and IPLs I-III and I-V showed statistically highly significant (p<0.001) and IPL of wave III-V showed a significant (p<0.05) correlation with head size. These findings suggest that females have a stronger positive correlation with head size as compared to males. A highly significant (p<0.001) positive correlation coefficient was found in absolute latencies of all waves and only inter-peak latency of wave I-V showed a statistically significant (p<0.05) correlation with head size in total participants. Thus we found a significant positive correlation between head size and latencies even when analyzing males and females separately.

The present study also showed a positive correlation of head size with absolute latency of wave V in various age groups (**Tables no.8**) which was statistically highly significant (p<0.001) in age groups-1, 3 (right ear), 4 and total participants (n=150) while in 2 and 5 age groups it was statistically significant (p<0.05).

Similar to current study, a few research studies also discussed correlation between head size and various BAEP variables. Aoyagi M et al[2] in their study found that head size of males was significantly larger than females and showed that wave III and V latencies & I-III and I-V interpeak latencies of BAEP were significantly shorter in females than in males. Thus similar to our study they also found significant positive correlations between head size and BAEP latencies, even when each gender was analysed separately. Solanki JD et al[11] in 2012 found a slight prolongation of BAEP waveforms in males as compared to females which was statistically significant only for I-III and III-V interpeak latencies. They also discussed that when test groups with comparable head size were compared, the difference decreased with no statistically significance for either latencies or IPLs. This finding reinforced the fact that that head size that reflects brain size is one of the important factors to influence BAEP variables. Ghugare BW et al[12] observed a stronger positive correlation between head size and wave V latency (r=0.5) and weaker positive correlation between head size and IPLs of wave III-V and I-V (r=0.3) and thus concluded that head size remains as an independent variable affecting BAEP parameters. Dempsey JJ etal[7] investigated relationship between head size and latency of the auditory brainstem response in 22 normally hearing individuals and observed a strong positive correlations between head size and the latency of both wave V and the I- V interpeak interval. Durrant JD et al[9] in their study found that correlations of head size with BAEP latencies was somewhat weak and further observed that head-size matched male and female participants also demonstrated significant differences in wave V latency.

A positive correlation of head size with absolute latencies and with interpeak latencies is found in our study. This reinforces the fact that head size reflects indirectly the brain size, which affects the conduction time of the neural pathways. The head size appears to be an important source of intersubject variability and hence should be considered an independent variable while interpreting BAEP results.

CONCLUSIONS:

As head size shows a positive correlation with BAEP latencies, it should be considered as one of the important variables affecting BAEP response. The clinical usefulness of BAEP can be improved by taking this physiological variable into consideration.

REFERENCES:

1. Mishra UK, Kalita J. Textbook of clinical neurophysiology.2nd edition. New Delhi. Reed Elseiver. 2008: p.329-45, 423-34.
2. Aoyagi M, Kim Y, Yokoyama J, Kiren T, Suzuki Y and Koike Y. Head size as a basis of gender difference in the latency of the brainstem auditory evoked response. J of Audiology. 1990; 29:107-112.
3. Khatoon M, Nighute S and Awari A. Brainstem auditory evoked potential in different age groups. International J of Biomedical Research 2012; 3 (6): 271-76.
4. Harinder JS, Ram Sarup S, Sharanjit K. The study of age and sex related changes in the brainstem auditory evoked potential. Journal of Clinical and Diagnostic Research 2010 Dec; 4: 3495- 3499.
5. Kaewsiri SI, Waseenon V, Navacharoen N, Panyathong R and Phuackchantuck. Correlation between age and gender, and parameters of auditory brainstem evoked response. Chiang Mai Medical Journal. 2015; 54(4):163-9.
6. Trune DR, Mitchell C, Phillips DS. The relative importance of head size, gender and age on the auditory brainstem response. Hear Res 1988; 32:165–174.
7. Dempsey JJ, Censoprano JJ, Mazor M. Relationship between head size and latency of auditory brainstem response. Audiology 1986; 25:258–262.
8. Costa Neto TT, Ito YI, Fukuda Y, Gananca MM, Caovilla HH. Effects of gender and head size on the auditory brainstem response. Rev Laryngol Otol Rhinol (Bord) 1991; 112:17-19.
9. Durrant JD, Sabo DL, Hyre RJ. Gender, head size, and ABRs examined in large clinical sample. Ear Hear 1990; 11:210-214.
10. American Clinical neurophysiology society. Guideline 9C: Guidelines on Short-Latency Auditory Evoked Potentials. Journal of Clinical Neurophysiology. April 2006; 23 (2):157-167.
11. Solanki DJ, Joshi N, Mehta BH et al. A study of gender, head circumference and BMI results of late teenagers. J of Indian Otology. 2012; 18(1):3-6.
12. Ghugare WB, Jain S, Parmar DJ, Dinkar MR, Ninama R. Influence of BMI and head circumference on variables of auditory evoked potential in young healthy male human participant. J of Egypt. of Otolaryngol. 2016;32:53-56.