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CASE REPORT

IMPACT OF LENGTH OF AUDITORY PATHWAY ON BAEP LATENCIES

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ABSTRACT

Introduction: BAEP latencies and amplitudes tend to vary with many factors like age, gender, corebody temperature,hormones and headsize. controversy exists regarding the effect of head size on BAEP latencies. It was hypothesized that headsize would indirectly reflects brainsize and hence the length of the auditory pathway. Therefore in this study, BAEP latencies were compared with headsize for males and females to analyze the impact of length of the auditory pathway on BAEP latencies.

Methods: 36 subjects, 18 males and 18 females of age group between 17-25 were selected. Head measurements like head circumference (HC), nasion to inion (AP-anteroposterior-measured across the top of the head),and right external auditory meatus to left (RL-also measured across the top of the head), were measured. BAEPs were performed by brief acoustic monaural click stimuli.

Results: Statistical analysis showed a significant difference in head size(HC,AP, RL and total head size) between males and females with a significant P value of < 0.001.Wave V absolute latency and I-V inter peak latency were slightly prolonged in males than females but statistically insignificant. However, when wave V latency and IPL I-V were corelated with head measures ;head size has a significant weak positive influence on BAEP latency.

Conclusion: Results revealed that males had significantly bigger head size than females. Slight prolongation of wave V and IPL I-V latencies in males could be because of larger head size .Pearson's correlation study revealed, regardless of subject gender, head size has a weak positive influence on BAEP waveV and IPL I-V latencies. Thus head size should be considered for normal BAEP recording.

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INTRODUCTION

Evoked potentials are the important noninvasive diagnostic tool used in the assessment of conduction of sensory impulses in the nervous system. (Michael and Aminoff, 2005) .Auditory evoked potentials (AEPs) have been classified into short latency components, with latencies of under 10msec in adults; long latency AEPs, with latencies exceeding 50msec; and middle latency AEPs, with imtermediate latencies. Short latency AEPs are commonly called Brain stem auditory evoked potentials (BAEPs). Other synonyms include auditory brain stem response, brain stem audiometry, brain stem evoked response auditory (BERA) and far field electro cohleography (Michael Jand Aminoff, 2005). Sohmer Hand Feinmesser (1967) were the first to publish auditory brainstem response recorded with surface electrodes in humans. In 1971,Jewett and Williston, (1971) described the interpretations of waves arriving from the brainstem. BAEPs are potentials recorded from the ear and vertex in response to brief auditory click stimuli to assess the conduction through the auditory pathway up to the midbrain. It comprises of 5 or more waves and 3 interpeak latencies (IPL) within 10 msec of the stimulus (Misra and Kalita, 2006). BAEP latencies and amplitudes tend to vary with many factors like age, gender, corebody temperature, hormones and headsize (Trune *et al*., 1988; Chambers *et al.,*1989; Mitchell *et al.,*1989; Mcclelland *et al.,*1977; Rosenhamer *et al.,* 1980; Jerger *et al.,* 1980; Rawool *et al*., 2007).

It was hypothesized that head size would indirectly reflects brainsize and the length of the auditory pathway (Chambers *et al.,*1989; Allison *et al.,*1983; James *et al.,*1986; Masaru Aoyagi *et al.*, 1990). Certain studies have reported a positive corelation between head size and BAEPs latencies, while others have noted little or no significance. The absolute latency of wave V and I-V IPL is particularly important because it represents the central conduction time along the auditory pathway-(Weber 1983) (James *et al.,*1986). Therefore, in the present study BAEP wave V absolute latency and I-V IPL were compared with head size for males and females to analyze the impact of length of the auditory path on BAEP latencies.

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MATERIALS AND METHODS

36 subjects, 18 males and 18 females of age group between 17-25 were selected. The study was done at physiology research laboratory, Thanjavur medical college, Thanjavur from April2014 to May 2015. A detailed history and thorough clinical and ENT examination was carried out to ruleout any medical problems. Subjects with hearing impairement, history of alcoholism, history of ENT surgery, neurological disorders, seizures, psychiatric illness, vertigo, subjects who had past history of predisposing risk factors for abnormal hearing like meningitis, enteric fever, severe jaundice, diabetes were excluded. Informed written consent was obtained from all the participants and experimental protocol was approved by the college ethical committee.

Head measurements like, head circumference (HC), nasion to inion (AP-anteroposterior-measured across the top of the head), and Right external auditory meatus to left (RL-also measured across the top of the head) were measured. Total head size was formed by adding all three measures. BAEPs were recorded by using 4-channel Digital Polygraph, Digital intex colour monitor,17″ model no:IT-173SB

BAEP-experimental design and recording

Electrode placement and recording parameters used was standardized as recommended by the International federation of clinical neurophysiology committee using 10-20 international system (Misra and Kalita, 2006).

Electrode placement

Channel -1 is placed at Ai-C_Z (ipsilateral ear)
Channel-2 is placed at Ac-C_Z (contralateral ear)
Ground electrode is lplaced at Fz

The subject was instructed to avoid hair spray or oil after the last hairwash. Instrument setting: filter low cut 100 Hz, high cut 10KHz, sweep 5msec,sensitivity 10μv,pulse 11/sec,pulse width 0.1msec,notch-on,100 averages were recorded using click sound as stimulus. Head phones are placed on the ears for the delivery of the auditory stimulus at intensity of sound 30db.computerized averaging and superimposing of recording were done. Monaural stimulus was used and contra lateral ear was masked. Absolute latencies of waves I,II,III,IV&V and interpeak latencies(IPLs)between I-V,I-III,&III-V were recorded during the first 10ms after giving the click stimulus for each ear separately.

Statistical Analysis

Head size, Wave V, and IPL I-V between males and females were analyzed by unpaired student's *t*- test. Wave V and I-V IPL latencies were correlated with head size by pearson's correlation coefficient. Graphpad statistical software was used for data analysis.

RESULTS

The mean age for male and female group was 17.8,17.66 respectively. Comparison of head size of 2 groups showed signifant differences in HC, AP, RL and in total head size (Table 1).

Table 1. Head sizes of male and females

Head size(cm)	Mean±SD	P
Male(n=18) HC	55.28±1.18	
Female(n=18)	53.72±0.57	< 0.0001
Male AP	34.83±1.54	
Female	32.17±1.20	< 0.0001
Male RL	34.28±2.02	
Female	32.39±1.29	0.0020
Male Total headsize	124.39±3.90	
Female	118.28±1.49	< 0.0001

Table 2 Wave V&IPL I-V

Waves(ms)	Mean±SD	P
Male V	5.7861±0.3442	
Female	5.7056±0.2000	0.3966
I-V Male	4.0839±0.3731	0.7520
Female	4.0494	

Table 2 lists the latency data for males and females. Wave V absolute latency and IPL I-V latencies were slightly prolonged in males but statistically insignificant. However, when wave V and I-V latencies were correlated with total head size in whole group, wave V showed significant positive correlation with P < 0.01.IPL-I-V showed positive correlation at P < 0.1. When pearson's correlation test was done separately in males it was significant at P <0.05 for wave V ,and IPL I-V showed significance with a P value of <0.1.In females, different results were observed ;wave V showed significance at P< 0.01, and IPL I-V was insignificant (Table 3).

DISCUSSION

This study analyzed the impact of length of auditory nerve on BAEP latencies between males and females.

Table 3. Pearson's correlation

Waves (ms)	Whole group(n=36) Total head size		Male (n=18) Total head size		Female(n=18) Total head size	
	Pearson's correlation (r)	P value	Pearson's Correlation (r)	P value	Pearson's correlation (r)	P value
V	0.4524	0.005601***	0.483	0.042315**	0.6767	0.002042***
I-V	0.3007	0.074745*	0.4216	0.081405*	0.2967	0.231861(NS)

*** P<0.01 **P<0.05 *P<0.1 NS: not significant

Slight prolongation seen in wave V and IPL I-V could be because of larger head size in males. However the differences were statistically insignificant. True *et al.* in 1988 studied the relative importance of head size, gender and age on auditory brain stem response and demonstrated that head diameter and

gender were significantly correlated with the wave latencies and IPLs. Males had longer latencies than females with comparable head diameter (Trune *et al*., 1988). Controversy exists regarding the effect of gender on BAEPs in neonates .Some authors report that sex differences are seen in neonates (Chiarenza *et al.,*1988), while others found that there was no sex differences in neonates (Mandal *et al.,*1989; Stokard *et al.,*1979). O.P.Tandon 1990, found that gender differences occur after puberty for BAEP latencies, but not in children and old people. As a corollary of the above Mcclelland R found that sex differences occur after puberty. Jerger and Hall in 1980 and Allison *et al.,*1983, observed differences in central conduction time between males and females and suggested that those differences were due to the differences in growth in central nervous system and actual brain size. Whereas James J and Dempsey *et al* in 1986 revealed a significant positive relationship between overall head size and wave V latency and IPL between I-V. They noticed regardless of subject sex, the larger the head size the greater the latency of BAEP. Similar findings were observed in the present study and it was significantly weak positive correlation.

Conclusion

Males showed significantly bigger head size than females. Slight prolongation of latencies could be because of larger head size in males. Pearson's correlation revealed head size has a weak positive influence on wave V and IPL I-V latencies, irrespective of subject gender. Thus head size should be considered for BAEP recording. Further studies can also be carried out in different age groups.

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