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Original Research Article

Effect of severity of hypertension on brain stem auditory evoked potentials

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ABSTRACT

Background: Hypertension is one of the most important public health problems among worldwide. Central nervous system dysfunctions are common in these patients due to micro-infarctions caused by arteriolar spasm of cerebral blood vessels. This will lead to hypoperfusion, subcortical white matter demyelination, and cognitive decline. The Brainstem auditory evoked potentials (BAEP) are far field subcortical electrical potentials which provide an objective electrophysiological method for assessing the auditory pathway from auditory nerve to the brainstem. Aim and objective of the study was to assess the effect of increasing severity of hypertension on the brainstem auditory pathway, among the patients of essential hypertension.
Methods: A total of 75 subjects of age group 30 to 60 years were included in the study. Among them 25 were healthy age and sex matched controls (Group I), 25 were stage 1 hypertensives (Group IIa) and 25 were stage 2 hypertensives (Group IIb) as per JNC 7 criteria. The absolute latencies I, III, V and interpeak latencies (IPL) I-III, III-V, I-V were recorded by using Neuroperfect EMG 2000 system with installed BAER and data were statistically analyzed using Student unpaired t test.
Results: All the hypertensive (Group IIa and IIb) patients were found to have significantly prolonged absolute latency of wave III, V and IPL III-V, I-V as compared to that of normal healthy controls. The wave V latency was prolonged as the severity of hypertension increased. Intergroup comparison among hypertensive patients (Group IIa and IIb) revealed a significant prolongation of absolute latency of Wave III, V and IPL III-V, I-V.
Conclusions: The results show that there exists a sensory deficit along with synaptic delay across the auditory pathway in the hypertensive patients and the sensory deficit progresses with the severity of the disease.

Keywords: Brain stem auditory pathway, Brainstem auditory evoked response, Hypertension, Inter peak latency

INTRODUCTION

Essential Hypertension or Systemic Hypertension is one of the leading causes of global burden of non-communicable diseases. Though hypertension is a silent disease, it doubles the risk of coronary heart disease (CHD), congestive heart failure (CHF), stroke, renal failure, and peripheral arterial disease. Thus, it affects almost all organ systems of the body and contribute to the major morbidity and mortality.[1] When the severity of hypertension increases the viscosity of blood also increases that causes diminishment of the capillary blood flow and oxygen transport. This causes micro infarctions.[2]

CNS is one of the most commonly affected system in hypertensive patients. The symptoms like dizziness, vertigo, tinnitus and occipital headache in hypertensive

patients suggest the presence of micro-vascular insufficiency in cerebral tissue. Such type of micro-vascular damage may alter electrical activity in the CNS like brain stem auditory evoked potentials (BAEPs), somatosensory and visual evoked potentials (VEP).[2,3] Recently, attention has shifted to control and prevention of non-communicable diseases including stroke, hypertension and coronary artery disease at the national level in view of the rising trends.

BAEP is an objective way of eliciting the brain stem potentials in response to audiological click stimuli and it measures the functioning of the auditory nerve and auditory pathway in the brainstem. The auditory brainstem response (ABR**)** is an auditory evoked potential extracted from ongoing electrical activity in the brain and recorded via electrodes placed on the scalp. The resulting recording is a series of vertex positive waves of which I through V are evaluated.[4]

These waves, labelled with roman numerals in Jewett and Williston convention, occur in the first 10milliseconds after onset of an auditory stimulus. The auditory structures that generate the auditory brainstem response are believed to be as follows:

- Wave I - generated by the peripheral portion of cranial nerve VIII
- Wave II - generated by the central portion of cranial nerve VIII
- Wave III - generated by the cochlear nucleus
- Wave IV - generated by the superior olivary complex/lateral lemniscus
- Wave V- generated by the lateral lemniscus/inferior colliculus

These generators of BAEP may be affected by hypertension and produces abnormality in the waves.[5]

Several studies have analyzed whether individuals with hypertension have hearing loss or not, when compared to normal individuals by using pure tone audiometry or BAEPs. Some found a relationship between hearing loss and hypertension but some not.[6-8]

In this study we tried to find the effects of hypertension on BAEP and whether the increasing severity of hypertension also affects the amplitude and latency of BAEP.

The study is to analyze the various parameters of BAEP waves in essential hypertensive patients and aimed:

- To find the relationship of BAEP waves between hypertensive and normotensives.
- To assess the magnitude of involvement of brainstem auditory pathway with increasing severity of hypertension, among the patients of essential hypertension.

METHODS

This study was performed in the Research Laboratory of Department of Physiology, Coimbatore Medical College, Coimbatore. The study period extended from January 2015 to March 2015. The clearance from the ethical committee of the institution was obtained prior to the commencement of the study. A written informed consent and detailed medical history were obtained from each subject.

Inclusion criteria

A total of 75 subjects of age group 30 to 60 years were included in the study. Among them fifty were primary hypertensive patients who were recruited from the hypertensive clinic and twenty five were normal healthy individuals as controls. Hypertensive patients were selected based on the seventh report of the Joint National Committee (JNC 7) for hypertension.[9]

Patients having systolic BP ≥140mmHg and diastolic ≥90mmHg were included in this study as study group.

Subjects with diastolic BP below 80 mmHg and systolic BP below 120mmHg were considered as controls. 25 normal healthy controls were considered as Group I, all 50 hypertensive patients were considered as Group II among them 25 stage 1 hypertensive patients, were grouped as Group IIa and 25 stage 2 hypertensive patients were grouped as Group IIb as per JNC 7 criteria.

Exclusion criteria

- Diabetes mellitus
- Ischemic heart disease (IHD)
- Cerebrovascular disease
- Hyperlipidemia
- Hypothyroidism
- Renal disease
- Subjective symptoms of hearing loss
- Working in noisy environment
- Subject with any external ear, middle ear or cochlear disease
- Subjects taking ototoxic drugs
- Subjects with history of chronic smoking and alcohol abuse

Recording of blood pressure

Blood pressure was measured by using mercury sphygmomanometer.

Individuals were made comfortable and seated for at least 5 min before measurement. Two readings were taken half an hour apart and average of the two values was taken as final reading. The patients were then graded as per the JNC 7 classification of hypertension.

Recording of BAER

Before recording the BAEPs, the procedure was explained to the subjects as well as to the controls. Ear examination was done to rule out hearing abnormality.

As the electrodes are placed over the head, the hair must be oil free. The subjects were instructed to have shampoo bath before coming for the procedure**.** The subjects were lying down at the time of study in a sound proof room between 10a.m to 12p.m. Ag/AgCl disc electrodes were fixed using conducting paste according to '10-20 International system of electrode placement'. The standard electrode configuration for BERA involves placing a non inverting electrode over the vertex of the head, and inverting electrodes placed over the mastoid prominence. One more earthing electrode is placed over the forearm. This earthing electrode is important for proper functioning of preamplifier.[10,11]

The potentials were recorded to the clicks presented at 80 db (SL) for stimulus rates of 10 clicks per second. The auditory potentials were recorded in the NEUROPERFECT EMG 2000 SYSTEM.

Statistical analysis

The absolute latencies I, III, V and interpeak latencies (IPL) I-III, III-V, I-V were recorded and data were statistically analysed by using student unpaired t test.

RESULTS

The results were tabulated and from the table the results were depicted in graphical representation. The values in graph were absolute and IPL latencies in milliseconds presented as mean±SD.

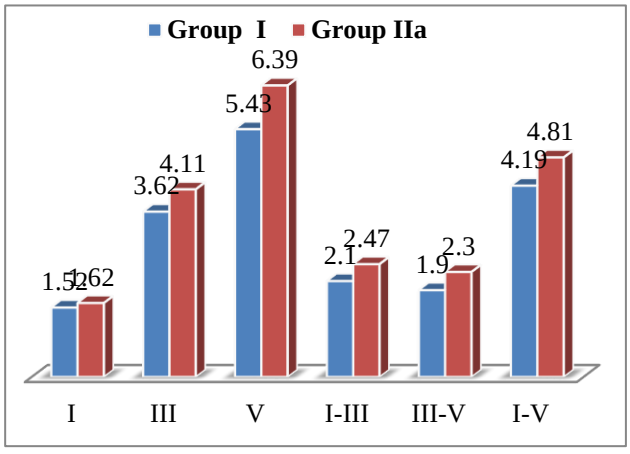

Figure 1: Comparison of group I vs Group IIa.

Figure 1 shows comparison between normal healthy controls and stage I hypertensives who are in Group IIa. It revealed a statistically significant increase in the absolute latencies of wave III, V (wave III p= 0.02, wave V p=0.002) and IPL III - V, I - V (IPLIII - V p= 0.007, IPL I - V p=0.005) in stage I hypertensives (group IIa).

Figure 2 shows comparison between normal healthy controls and stage II hypertensives which is Group IIb. It showed a statistically significant prolongation of absolute latencies III, V (wave III p= 0.02, wave V p=0.002) and IPL III - V, I – V (IPLIII - V p= 0.007, IPL I - V p=0.005) in stage II hypertensive (group IIb).

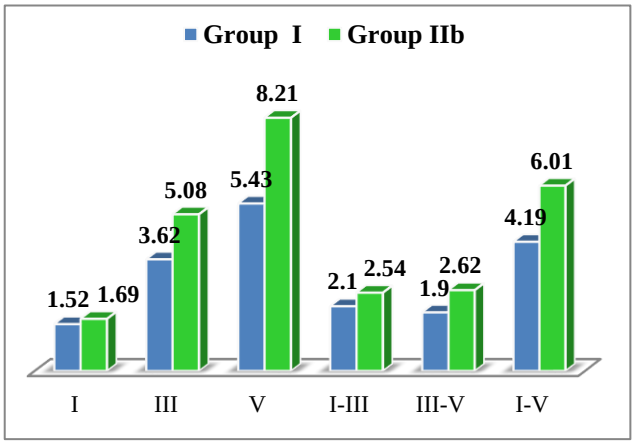

Figure 2: Comparison of group I vs Group IIb.

Figure 3 shows intergroup comparison between stage I and stage II hypertensives, revealed statistically significant prolongation of absolute latencies III, V (wave III p=0.0002, wave V p =0.0001 and IPL I - V (p =0.0001) with increasing severity of hypertension.

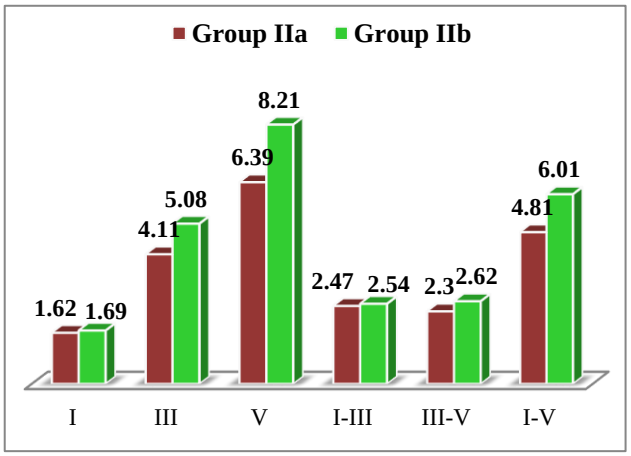

Figure 3: Comparison of group IIa vs Group IIb.

To summarise all the hypertensive both Group IIa, IIb patients were found to have significantly prolonged absolute latency of wave III and V and IPL III-V and IPL I - V as compared to that of normal healthy controls. The wave V latency was prolonged as the severity of hypertension increases. Intergroup comparison among hypertensive patients (Group IIa and IIb) revealed a significant prolongation of absolute latency of Wave III, V and IPL I-V.

The absolute latencies I, III, V and interpeak latencies I-III, III-V, I-V in milliseconds were depicted in graph and data presented as mean±SD.

DISCUSSION

The results of the present study are consistent with following studies where BAEP wave latencies and inter peak latencies were found to be prolonged in hypertensive patients when compared to healthy controls.

Tandon et al, recorded BAEP in 23 hypertensive patients and found that there was significant increase in the absolute peak latencies of I, II, V and IPL III-V in stage 3 hypertensive patients.[6] Shilpa et al, in their study, found that absolute peak latency I, II and V and IPL III-V were prolonged on essential hypertension patients compared with controls. This was attributed to the vascular responses of the cerebral blood vessels and causes ischemic delay in the auditory processing. These findings are similar to our study results.[7]

Goyal et al, had suggested that, prolongation of IPL III - V in hypertensives indicates the involvement of pontomesenchymal region of the auditory pathway. They added that the delay in auditory processing time may be considered as an index of subclinical expression of visceral damage in hypertensive patients.[8]

Jyoti et al, also showed prolongation of all absolute latencies of BAEP waves I and V in hypertensive group and strongly reported that the changes in hypertensive patients, can be due to multiple factors that include associated dyslipidemia, oxidative stress or arteriosclerosis leading to poor blood supply to different organs.[12]

Haldwani et al, in their study found the relation between mean arterial pressure and BAEP latencies in hypertensive patients and they added that it provided an electrophysiological evidence of interaction of BP control mechanism in the brainstem with auditory pathway.[13]

In a study, BAEP were measured on elderly people with elevated serum cholesterol and triglyceride levels. They found that the latencies of wave V, IPL I-V and IPL III-V were prolonged in them compared with normal elderly subjects. They concluded that the hearing disorders in the study group were related to duration of illness and complications of hypertension.[14]

Karamitsos et al, studied BAER in 30 ischemic heart disease patients, demonstrated the increase in absolute and inter peak latencies and recommended that BAER may become part of the non invasive assessment of IHD and essential hypertensive patients.[15]

This study results suggest the involvement of auditory pathway at the level of inner ear and auditory pathway upto medulla and also the auditory processing time along the auditory pathway prolongs as the severity of hypertension increases. It may be considered as an index of subclinical expression of hypertensive neuropathy.

CONCLUSION

Thus, findings of our study suggest that hypertension affects the sensory conduction in the auditory pathway at the brainstem level. As the severity of hypertension increases, the delay in sensory conduction also worsens. It may be considered as subclinical involvement of CNS. So, it is recommended that an integrated work of otorhinolaryngologists and audiologists along with cardiologists is necessary to improve the quality of care in the therapy and rehabilitation of these patients.

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