Original research article

Correlation of Brain Stem Auditory Evoked Potentials in Hypertensive Patients.

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Abstract

Introduction: Hypertension is a complex cardiovascular disorder characterized by the presence of a chronic elevation of systemic arterial pressure worldwide killing nearly 9.4 million people every year and the problem is still growing. In chronic stages its found to be lethal for central nervous system.

Hence present study was undertaken to observe the correlation between hypertensive patients and BAEP which may potentially be helpful in prevention of microvascular injuries to the affected individual.

Materials: We performed hospital based cross section observational study of Brainstem Auditory Evoked Responses. After obtaining approval from the institutional Ethical committee and informed written consent was taken from each subject before commencement of the study. In present study 118 subjects were primarily considered of which 14 subjects left study intermittently hence summing up 104 subjects finally.

Results: Considering the total study population 59 males and 45 females at the end. After obtaining the demographic data BAEP values obtained for patients for individual ear according to standard guidelines and correlation was obtained between BAEP waves to see the correlation. Values of r were found to have positive correlation between BP and the latency waves.

Conclusion: This correlation between hypertension and BAEP clearly demarcates the electro-physiological changes in the central nervous system and or auditory system of the patient. Hence a wide and lager scale studied are required to setup the evidential data so that early deterioration of central microvasculature can be picked up. More over benefits non invasive and cheaper techniques like BAEP can be crucial which would be a stepping stone towards early detection of the hypertensive comorbidities.

Keywords: Hypertension, Microvascular injury, BAEP (brain stem auditory evoked potentials)

Introduction

The lifestyle disorders are influenced by number of risk factors related to individual's lifestyle. These have a serious impact on society in general as they affect the quality of life and could be a financial burden for upcoming ages. In 2013 WHO had also taken an initiative to set up controlling measures for hypertension [1]

Hypertension is a complex cardiovascular disorder characterized by the presence of a chronic elevation of systemic arterial pressure. [2] It is of two types- essential or primary hypertension and secondary hypertension. [3] Essential hypertension tends to be familial and is likely to be the consequence of an interaction between environmental and genetic factors. In individuals with secondary hypertension specific mechanism for blood pressure elevation is often more apparent. [4] [5]

Globally High blood pressure is one of the most important causes of premature death worldwide killing nearly 9.4 million people every year and the problem is still growing. [6] Hypertension is reported as fourth and seventh contributor to premature death in developed and in developing countries respectively. [7]

Over 1 billion people have high blood pressure worldwide including those on medication for high blood pressure in adults aged 25 and above was around 40%. [6] In India, percentage of high blood pressure is increased from 5% in the 1960s to nearly 12% in 1990s, to more than 30% in 2008. Also, hypertension is the major cause for 57% of all stroke deaths and 24% of all coronary heart disease (CHD) deaths in our country. [7]
So, one may not be aware that it is damaging our arteries and other organs like heart, kidney, brain, retina etc. Thus, it's the most significant risk factor for various organ diseases like myocardial infarction, left ventricular hypertrophy, congestive heart failure, aneurysm, stroke, dementia, chronic kidney disease, hypertensive retinopathy and erectile dysfunction. [8]
Central nervous system dysfunctions e.g., stroke, vascular cognitive impairment, dementia are common in patients of essential hypertension. This is attributed to micro-infarctions resulting from arterial and arteriolar spasm in cerebral blood vessels. [9, 10]

Sensory and motor deficits in essential hypertension along with central neuronal damage at brainstem level is due to micro vascular insufficiency. [11] These central neuronal damages may alter electrical activity in the central nervous system and may affect various evoked potentials. [12] Evoked potentials are responses to stimulation of a sensory pathway in the nervous system. This comprise of stimulation of a sensory nerve in the limb (Somatosensory evoked potentials - SSEPs), the visual system (visual evoked potentials - VEP) or the auditory system (brain stem auditory evoked potentials – BAEP or brain stem auditory evoked responses - BAER).
Hence present study was undertaken to observe the correlation between hypertensive patients and BAEP which may potentially be helpful in prevention of microvascular injuries to the affected individual.

Material and methods:

We performed hospital based cross section observational study of Brainstem Auditory Evoked Responses. After obtaining approval from the institutional Ethical committee and informed written consent was taken from each subject before commencement of the study. In present study 118 subjects were primarily considered of which 14 subjects left study

intermittently hence summing up 104 subjects finally. Considering the total study population 59 males and 45 females at the end.

Inclusion Criteria

1) Newly diagnosed cases of essential hypertension of both sexes in the age group of 35-60 years.
2) All hypertensive patients were of Grade I hypertension (SBP: 140–159 and DBP: 90-99) according to JNC 7 classification. [13] based on the average of 2 or more readings taken during each of his /her visit to OPD.
3) All having normal auditory function test.

Exclusion Criteria

1. Patients with conductive or sensorineural deafness.
2. Patients with H/O taking otoxic drugs e.g. aminoglycosides.
3. Patients with presbycusis.
4. Patients with H/O stroke.
5. Patients with H/O head injury, Meningitis.
6. Patients with dementia and multiple sclerosis.
7. Patients with various causes of secondary hypertension such as other cardiovascular disorder like myocardial infarction, Hepatic disorder, renal disorders, endocrinal disorders etc.
8. Patients of diabetes mellitus.
9. Alcoholics, smokers and H/O tobacco chewing.
10. Significant occupational noise exposure.
11. Female patient were not taking hormonal replacement therapy.

The evaluation was done in following stages-

1. A detailed history by way of self-administered questionnaire about medical history and lifestyle were taken.
2. A detailed general and clinical examination of all the system was done to exclude any other medical problems.
3. Blood pressure was measured in both the groups.
4. Detailed ear, nose, throat checkup by way of otoscopic examination, tuning fork test was done.
5. Routine pathological and biochemical lab investigation like Basal Sugar Level, Urine Protein, Blood Urea, Serum Creatine was Within Normal Limit.
6. Pure tone audiometry was done in both the groups.
7. Brainstem auditory evoked potentials (BAEP) recording were done.

Data was collected on case record form which was designed to obtain basic information on demography such as age, weight, height and body mass index (BMI). Height was measured in cm by scale encrypted on wall. Weight was measured using Kohinoor millennium balance weighing machine with minimum clothing and footwear removed. BMI was calculated using traditional formula-[14,15]

Diamond Mercury Sphygmomanometer was used under same clinical setting with optimum temperature. The same instrument was used throughout the study. On an average 2 readings were taken.

Brainstem auditory evoked potential (BAEP) recording: [16]

All the techniques of recording, machine setting and instrument were maintained uniformly throughout the study. Patients were made to lie down comfortably on couch and were asked to close their eyes and relax. EEG on monitor was used as indicator for stable and relaxed brain. And then BAEPs are obtained using monoaural (one ear at a time) stimulation. Electrode placement-
Active electrode (Mi, Mc)- over mastoid processes.
Reference electrode (Cz) -at vertex
Ground electrode (Fz) - at forehead in midline.
Montage consisting of the following derivations was used for BAEP recording-
Channel 1: Vertex- ipsilateral mastoid process (Cz-Mi).
Channel 2: Vertex – contralateral mastoid process (Cz-Mc).
The following machine setting was used throughout the study.

1. Stimulus - Monaural auditory stimulus in the form of clicks at a rate of 11.1 per Second (11.1Hz) were delivered through ear inserts placed inside the ear. The click stimulus at an intensity of 70dB SPL was given to the stimulated ear (ipsilateral) and masking sound (white noise) of 60 dB SPL to non-stimulated, contra lateral ear through the ear inserts. Stimulus duration was 100µsecond. Responses to 2000 click stimuli were averaged for 10 millisecond.
2. Filter - Low and High band pass filter was set at 150Hz and 3000Hz respectively.
3. Impedance - the electrode impedance was kept below 5kΩ.
The signals picked up by these electrodes were filtered, averaged, amplified and displayed on the computer monitor. Two trials of recording were done and waveforms were superimposed to check for reproducibility.
BAEP waveforms from each ear were recorded. Parameter recorded and analysed were:
1. Absolute latencies of waves I, II, III, IV and V in msec.
2. Interpeak latencies (IPLs) of I-III, III-V, I-V in msec.
3. Amplitude ratio of waves V and I.

To conclude data was gathered in Excel sheet in Microsoft office 2021 and Pearson's correlation test was applied using graph pad prism 9 to obtain results.

Results:
Considering the demographic values of 59 males 45 females included in present study was as follows

Table 1: shows demographic profile of male and female Hypertensive patients.

S.NO	PARAMETERS	Hypertensive males (MEAN± S.D.)	Hypertensive females (MEAN ± S.D.)	p VALUE	S/NS
1.	AGE	49.36 ± 0.8886	48.16 ± 0.9516	0.3613	NS
2.	WEIGHT	65.68 ± 0.4645	65.88 ± 0.5869	0.7904	NS
3.	HEIGHT	162.6 ± 0.2762	162.5 ± 0.3422	0.7861	NS
4.	BMI	24.84 ± 0.2083	24.95 ± 0.2434	0.7283	NS

Table 2: shows pulse rate and blood pressure variables of female and male hypertensive patient.

S.NO	PARAMETERS	Hypertensive male (MEAN± S.D.)	Hypertensive female (MEAN± S.D.)	P VALUE
1.	PULSE RATE	74.56 ± 0.3270	73.56 ± 0.45	NS
2.	SBP	143.4 ± 0.4549	141.6 ± 0.45	NS
3.	DBP	89.76 ± 0.3124	88.16 ± 0.32	NS
4.	MBP	107.7 ± 0.2468	105.8 ± 0.3	NS

Non-significant (NS) at p>0.05 Significant at p<0.05****

After obtaining the demographic data BAEP values obtained for patients for individual ear according to standard guidelines whose values are depicted in table 3.

Table 3: Show Baep Right Ear Latency, Interpeak Latency and Amplitude Ratio of Control and Hypertensive Patient.

S.NO	BERA PARAMETERS	BERA WAVE	RT ear (MEAN±S.D.)	Lt Ear
1.	LATENCY(ms)	WAVE I	1.728 ± 0.008676	1.735 ± 0.009072
2.		WAVE II	2.737 ± 0.009552	2.748 ± 0.009374
3.		WAVE III	3.701 ± 0.01219	3.710 ± 0.01189
4.		WAVE IV	4.852 ± 0.006450	4.852 ± 0.006365
5.		WAVE V	5.844 ± 0.009471	5.849 ± 0.009356
6.	INTERPEAK LATENCY(ms)	I-III	1.973 ± 0.006644	1.975 ± 0.007029
7.		III-V	2.143 ± 0.006617	2.139 ± 0.006554
8.		I-V	4.116 ± 0.002666	4.114 ± 0.002828
9.	AMPLITUDE RATIO.	V/I	3.385 ± 0.01181	3.374 ± 0.01261

to see the correlation. Values of r were plotted in table 4 to find the correlation trend. Values of r tending towards +1 are having a positive correlation and values from 0 to – 1 are having negative correlation.

Table 4: shows correlation of latency, interpeak latency and amplitude ratio of waves of BAEP of both ears with systolic, diastolic and mean arterial blood pressure.

BAEP PARAMETERS	BAEP WAVES	SYSTOLIC BP		DIASTOLIC BP		MEAN BP	
		RT ear	LT ear	RT ear	LT ear	RT ear	LT ear
		r value	r value	r value	r value	r value	r value
LATENCY	WAVE I	0.040	0.069	0.064	0.042	0.080	0.078
	WAVE II	0.138	0.164	-0.024	-0.048	0.065	0.060
	WAVE III	0.061	0.090	0.118	0.158	0.136	0.188
	WAVE IV	0.129	0.219	0.014	-0.030	0.091	0.109
	WAVE V	0.096	0.033	-0.011	0.027	0.050	0.043
INTERPEAK LATENCY	I-III	0.057	0.062	0.132	0.213	0.146	0.217
	III-V	0.025	0.115	0.232	0.248	0.180	0.280
	I-V	0.203	0.112	-0.245	-0.048	-0.082	-0.109
AMPLITUDE RATIO	V/I	-0.017	-0.084	-0.100	-0.053	-0.095	-0.096

Discussion:

In present study it was observed that hypertension does affect the neuronal excitation in the auditory pathways, thereby suggesting that BAEP may provide the early evidence for the presence of CNS dysfunction in the patients of essential hypertension similar results were seen by S Gawli. [17]
with latency of waves I, II, III, IV and V, interpeak latency I-III, III-V and I-V and amplitude ratio V/I of both right and left ear respectively.

It was found that there was significant positive correlation between the above-mentioned parameters of BAEP and SBP, DBP and MBP in hypertensive patients.
Tandon OP et al [18] demonstrated significant correlation between rise in systolic and diastolic blood pressure with absolute peak latencies of BAEPs. They found significant prolongation of absolute peak latencies of wave I, II, V and interpeak latency of wave III-V in Grade III hypertensive patients.
Khullar S et al [19] got significant prolongation of absolute peak latencies of waves I, II and V and interpeak latency III-V in essential hypertensive patients. So, they inferred significant correlation of rise in systolic and diastolic blood pressure with absolute peak latencies of BAEP in hypertensive patients

All the above studies have shown prolongation of latency of waves I to V interpeak latency and amplitude ratio in patients with chronic intracranial hypertension.
As far present study is concerned all the subjects in our study were of grade I hypertension i.e. SBP, DBP and MBP. This may be the reason for significant correlation of blood pressure with different parameters of BAEP.

Conclusion:

This correlation between hypertension and BAEP clearly demarcates the electro-physiological changes in the central nervous system and or auditory system of the patient. Hence a wide and lager scale studied are required to setup the evidential data so that early deterioration of central microvasculature can be picked up. More over benefits non invasive and cheaper techniques like BAEP can be crucial which would be a stepping stone towards early detection of the hypertensive comorbidities.

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