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RESEARCH ARTICLE

Visual evoked potential changes among hypertensive and normotensive individuals: A cross-sectional study

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ABSTRACT

Background: Visual evoked potential (VEP) is a highly advanced visual function measurement test that objectively measures functioning of entire visual pathway is working and results of it will help to diagnose early detection of visual pathway changes in the patients of hypertension (HTN). This property of VEP will be used to diagnose early changes in the visual field in the patient of HTN and use of this to deviate ophthalmic complications of HTN. **Aims and Objectives:** The objective of this study was to find out changes in the VEP among the primary hypertensive patients and its comparison with normotensive subjects. **Materials and Methods:** Eighty study participants ($n = 40$ normotensive and $n = 40$ hypertensive) were selected for this cross-sectional survey. Pattern reversal VEP test was performed for each participant and measurements (latency and amplitude) were recorded. Differences in latencies in both groups were assessed using unpaired *t*-test for continuous variables. $P < 0.05$ was considered to be criteria to prove statistical significance. **Results:** Mean values of latencies of waves N75 and P100 were found to be prolonged in the hypertensive group. It can be seen from correlation graph, as the value of blood pressure (mm of Hg) increases, latencies of VEP also increase, which is evident from the values of correlation factor (r). **Conclusion:** Results of the study express statistically significant association between increase in latencies of VEP and HTN. Thus, it could be recommended that VEP can be added as policy intervention among the primary hypertensive patients to detect early visual pathway changes and strategic implementation of the same.

KEY WORDS: Visual Evoked Potential; Hypertension; Correlation; Public Health Approach

INTRODUCTION

Hypertension (HTN) is recognized as a significant public health problem, which contributes to enormous rise in morbidity and mortality statistics of India and control of it a substantial challenge to the health professionals.[1] Global burden of HTN data analysis reported (2005) that India was exhausted by misery of HTN as 20.6% of Indian men and 20.9% of Indian women were suffering from HTN in 2005.[2]

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Unfortunately, no system of the body has been left out of the effect of HTN and mainly affected systems were cardiovascular, renal, and central nervous system (CNS) extensively, but not limited to that.[3,4] HTN causes acute changes of intracerebral vasculature, hemorrhage, and cerebral edema over chronic changes of hyaline and fibrinoid arteriolosclerosis. HTN also damages retinal blood vessels and puts pressure on optic nerve causing its damage and serious visual problems.[5]

Being a part of brain, lesions of CNS can affect optic nerve and cause retinopathy that leads to visual changes.[4,5] Subclinical

changes in the brain may lead to grave consequences if not identified and treated in its early stage as secondary prevention in the level of prevention pyramid, by which one can prevent from the development of diseases to disability. However, the challenge is the identification of lesion in subclinical phase, and the visual evoked potential (VEP) is one such non-invasive test that is able to detect subclinical changes in its primary stage, as it is supported by other few researchers also.[4,6,7]

The VEP tests the integrity and function of the visual pathway. VEPs are most useful for testing optic nerve function, especially anterior visual conduction disturbance. VEPs are sensitive indicators of optic nerve dysfunction. Since visual loss is a serious complication of HTN, VEP is measured in an attempt to evaluate the optic nerve damage in patients with HTN that remains undetected many times. VEP is the non-invasive procedure, easy to perform and can be acceptable as screening or diagnostic tool; only after proving its validity and reliability. However, relative literature search using medical subject headings terms did not reveal much evidence in regard to changes in VEP in patients with HTN. Hence, considering all these facts, researcher of this article intends to do a study to establish relation between two variables; systolic blood pressure (SBP)/diastolic blood pressure (DBP) and VEP latency changes, if it exists.

MATERIALS AND METHODS

Study Design and Study Area

It was a hospital-based cross-sectional study conducted in the research laboratory of the Department of Physiology, Government Medical College and New Civil Hospital, Surat.

Sample Size

The current study was done among the purposively selected 40 subjects in each group of normotensive and hypertensive non-shift worker security guards. The current study was done as an extension of our other research work which describes VEP changes among security guards.[8]

Sampling Method

In the current study, we used data of non-shift worker security guard of our previous publication and also new data were added of purposively selected non-shift worker security guard to reach the sample size of total 80 study participants.

Inclusion Criteria

The study participants included male security guards who were non-shift workers in Government Medical College and New Civil Hospital, Surat, between the age group of 20 and 50 years and who provided informed consent.

Exclusion Criteria

- Study participants who were doing shift work to avoid effect of change in circadian rhythm.
- If the study participants had shown any probable cause of secondary HTN.
- Known case of the study participants with any positive history or physical examination or findings suggestive of CNS disease, diabetes mellitus, hypothyroidism, metabolic disorders, cataract, retinopathy, uncorrected refractive errors, chronic use of mydriatics/miotic drugs, and history of chronic smoking and/or alcohol abuse were excluded from the study.

Study Method

After obtaining informed consent, they were asked to come to the research laboratory in physiology department in morning hours and also instructed to avoid oil/hairspray before the procedure day. The height (cm), weight (kg), blood pressure (mm of Hg), and head circumference of the study participants were measured as a part of the general examination, and body mass index was calculated as weight (kg)/height (m^2). Pattern reversal VEP was performed on neurostim electromyography/nerve conduction velocity/evoked potential system. Individuals were asked to sit 100 cm away from a monitor screen. The monitor was presented with a black and white checkerboard pattern with a red fixation spot in the center of the screen. The scalp skin was prepared by abrading and degreasing. Standard disc surface electrodes were placed according to the international 10/20 system of electrode placement using conductive jelly. The recording electrode was placed at Oz (10% from inion), the reference electrode at Fpz (10% from nasion), and the ground electrode at the vertex Cz. Pattern reversal stimulation was given to each eye one after another at stimulation rate of 1 Hz. The recording sensitivity was kept at 5 μV with electrode impedance which was set at below 5 kΩ. Recordings were done and data were collected for each study group separately. The measured parameters were latencies of N75, P100, N145 waves, and peak-to-peak amplitude of P100 wave.

Ethical Approval

The approval for doing study was taken from the Institutional Human Research Ethics Committee, Government Medical College, Surat.

Statistical Analysis

Data were recorded and entered into MS Excel and analyzed with Epi Info software version 7.2.2.6. Data were represented as mean ± standard deviation. Unpaired Student's *t*-test was used

to compare the means of VEP between the normotensive and hypertensive group. Pearson correlation was applied to know the change in latency of VEP with respect to increase in SBP and DBP. $P < 0.05$ was considered for statistical significance.

RESULTS

According to Table 1, both the studied groups were comparable to each other as means of age, height, and weight were insignificant ($P > 0.05$) and variables of blood pressure were distributed differently in both groups ($P < 0.05$). It is shown from Table 2 that the mean values of latencies of waves N75, N145, and P100 were found to be significantly prolonged (<0.05) in the hypertensive group as compared to normotensive group on both sides. It is shown from Figure 1, N75 and P100 latency of VEP are increased along with rise of SBP. It is shown from Figure 2, N75 and P100 latency of VEP are increased along with rise of DBP. Pearson correlation in Table 3 is showing that, with each 1 mm of Hg of blood pressure increases, N75 and P100 latency of VEP increase in both eyes.

DISCUSSION

VEP is a highly advanced visual function measurement test that objectively measures how well your entire visual pathway is working. The results of VEP test will help to diagnose early detection of visual pathway changes in the patients of HTN. It was also documented in literature that HTN alters the responsiveness of the cerebrovasculature to neural activation as sensitivity may decrease due to chronic arteriolar vasoconstriction and reduced capacity of distension of vessels resulting from the hemodynamic alteration of the brain to systemic HTN.[9] Hence, the present study was planned with the aim to compare two groups; normotensive and hypertensive, for the changes in latency of VEP in subjects with normal blood pressure and primary HTN.

It was cross-sectional analysis on 80 male security guards who were non-shift workers; among them, 40 were hypertensive and 40 were normotensive subjects. The present study found that N75, P100, and N145 latency of VEP increased in hypertensive group significantly ($P < 0.05$). Apart from this, the present study also found that a significant change in latency of N75 was observed with the increases in each unit of blood pressure (mm of Hg).

It is shown from Table 1 that both the groups were comparable to each other in all aspects (statistically insignificant with $P > 0.05$), except having HTN (statistically significant with $P < 0.05$). The comparability of table is in concurrence with the study of Nigam *et al*.[7] The current study reported that N75, P100, and N145 latency of VEP increased in hypertensive group compared to normotensive and the difference is found to be statistically significant ($P<0.05$). Mean increases in the latencies of VEP were also found in various studies done by Nigam *et al*.,[7] Achuthan and Girija,[6] and Tandon and Ram.[10] The difference was also statistically significant in a study of Tandon and Ram;[10] while non-significant difference was reported in Nigam *et al.* study.[7] It is obvious from scatter Graphs Figures1 and 2 that with increases of blood pressure, latencies of VEP increased simultaneously. VEP latencies were influenced by the elevated changes of blood pressure. Pearson correlation of N75 latency was positively correlate with correlation coefficient of $r = 0.169$ and $r = 0.551$ with

Table 1: Descriptive statistics of normotensive and hypertensive group

Variables	Normotensive (n=40)	Hypertensive (n=40)	P-value
Age	37.32±7.66	39.72±7.47	>0.05
Height	166.67±7.20	164.72±7.02	>0.05
Weight	59.52±11.68	61.82±7.69	>0.05
SBP	118.7±5.13	146.35±5.88	<0.05
DBP	77.25±4.31	93.5±4.40	<0.05

*P<0.05: Statistically significant, SBP: Systolic blood pressure, DBP: Diastolic blood pressure

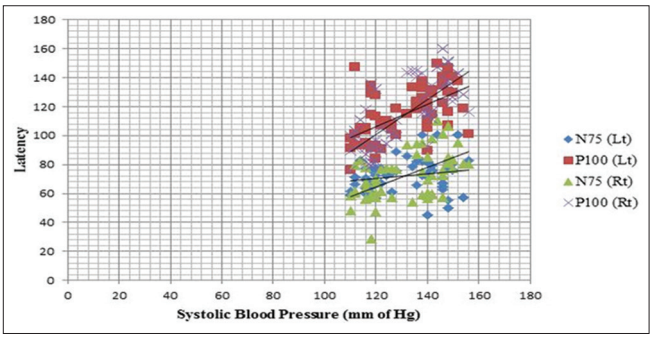

Figure 1: Correlation of systolic blood pressure with latency (right and left N75 and P100) of visual evoked potential (Lt: Left, Rt: Right)

Table 2: Mean values of wave latencies of VEP in the two groups

Variables	Left side			Right side		
	Normotensive	Hypertensive	P-value	Normotensive	Hypertensive	P-value
N75	70.13±8.95	74.39±15.54	>0.05	63.90±12.56	81.08±16.65	<0.05
P100	104.38±14.59	125.87±14.18	<0.05	97.6±14.31	132±15.09	<0.05
N145	148.35±17.02	165.51±12.03	<0.05	144.71±19.76	172.76±10.36	<0.05

VEP: Visual evoked potential

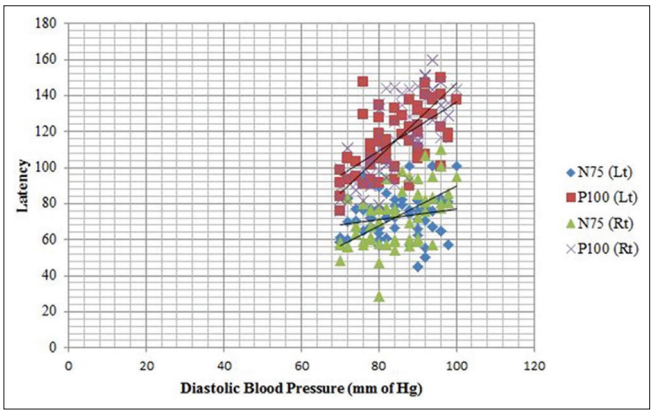

Figure 2: Correlation of diastolic blood pressure with latency (right and left N75 and P100) of visual evoked potential (Lt: Left, Rt: Right)

Table 3: Correlation coefficient (*r*) of SBP and DBP with latency N75 and P100 wave

Variables	Correlation coefficient (*r*)		
SBP		Left	Right
	Pearson correlation		
	Latency (N75)	0.169	0.551*
	Latency (P100)*	0.604	0.743
DBP		Left	Right
	Pearson correlation		
	Latency (N75)	0.189	0.551*
	Latency (P100)*	0.634	0.751

*Correlation is significant at 0.05 level (two tailed). SBP: Systolic blood pressure, DBP: Diastolic blood pressure

SBP on the left and right side, respectively, and the same correlation coefficient of $r = 0.189$ and $r = 0.551$ with DBP above respective side of eye [Table 3]. Pearson correlation of N100 latency was positively correlate with correlation coefficient of $r = 0.604$ and $r = 0.743$ with SBP on the left and right side, respectively, and the same correlation coefficient of $r = 0.634$ and $r = 0.751$ with DBP above respective side of eye [Table 3]. This was in agreement of results found in the study of Achuthan and Girija.[6] HTN can cause structural changes of hyalinization the vascular endothelium which may contribute to demyelination in the susceptible regions of the brain. Optic nerve being a part of brain can be affected by hypertensive changes in the brain and responsible for changes in VEP latencies.

There were several limitations of this study. We did not separate study participants into low and higher grade of HTN, otherwise bigger picture would have been cleared; due to resource constraint. Further, the effect of antihypertensive therapy on the parameters of VEP would have been of great information. Due to these limitations, causation relationship between elevated blood pressure and changes in VEP latency cannot be established. Concurrence results of many studies call for more extensive research in this field.

CONCLUSION

There was noticeable rise in the prevalence of HTN over two decades with no obvious improvement in overall management. This rise in number of cases also upsurges its complications in the form of damage to kidney, cardiac, and CNS functions. Hence, along with better advancement of the management of HTN, early detection and treatment is the only hope to prevent magnitude of complications of HTN. VEP is such a test that will help your doctor to diagnose early changes and better understand the complications of HTN. The study explores the new dimension for the use of a simple non-invasive neurophysiological test (VEP) as a screening tool to detect early neuronal changes in eye in patients of HTN. Statistically significant results of the study prove that there is an association between delayed latencies of VEP and elevated blood pressure. One-to-one significant relation was also established in correlation graph except for N75 latency. The delayed P100 latency of VEP can be used as a tool to detect subclinical hypertensive retinopathy and with timely interventions morbidity of disease complications can be reduced.

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