

Evaluation of Visual Electrophysiological and Clinical Test Parameters in Glaucoma

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Abstract : Purpose of the study was to find out the relation between pattern reversal visual evoked potential (PRVEP) which is a non-invasive, low-cost method highly capable of detecting functional abnormalities of visual system and vertical cup : disc ratio (VCDR) which is a simple and relatively strong index of glaucomatous loss of the neuroretinal rim.

33 known primary (both open and angle closure) glaucoma patients from the Glaucoma Clinic at Regional Institute of Ophthalmology (RIO), Medical College Hospital, Kolkata undergone PRVEP testing following the guidelines of International Society for Clinical Electrophysiology of Vision (ISCEV) and optic discs evaluation using the Volk +90D Aspheric lens under Slit – lamp biomicroscope. Our statistically significant finding of strong negative correlation between VCDR and P100 amplitude of the PRVEP and a positive correlation between VCDR and P100 latency lead us to conclude that PRVEP is an effective objective measure of optic nerve function and strongly correlates with other established essential diagnostic parameters of glaucoma like VCDR.

Keywords - pattern reversal visual evoked potential (PRVEP), vertical cup : disc ratio (VCDR), glaucoma

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I. Introduction

According to latest reports in India ; Glaucoma is the third most common cause of preventable blindness with a prevalence of 5.8% among the blind, next to cataract and uncorrected refractive error (1). It carries a 3.4% of prevalence in West Bengal (2)

Glaucoma is a multifactorial optic neuropathy characterized by progressive loss of retinal ganglion cells and their nerve fibers, leading to characteristic loss of visual function. (3,4)

Approximately 25 – 30 % of the ganglion cell fibres can be lost before significant visual defects are observed (5). Certain electrophysiological methods allow an objective localization of functional deficits, as the type of the recording enhances the contribution of specific neurons along the visual pathway (e.g., photoreceptors, bipolar cells, ganglion cells or optic nerve) (6). Transient pattern reversal visual evoked potential (PRVEP) generated in the cortical and sub-cortical visual areas when the retina is stimulated with pattern light is thus a very important, non-invasive, low-cost method and highly objective tool in detecting abnormalities of visual system (7)

The feature that differentiates glaucoma from other causes of visual morbidity is a characteristic pattern of damage to the superior and inferior poles of the optic disc. Thus vertical cup : disc ratio (VCDR) has proved to be a simple and relatively strong index of glaucomatous loss of the neuroretinal rim. Since PRVEP is known to be sensitive to glaucomatous neuropathy so it was thought pertinent to derive association, if any, between PERP and VCDR.

II. Materials and Methods

The study was conducted after proper approval from the Institutional Ethics committee. 55 eyes from 33 known primary (including open and angle closure) glaucoma patients were chosen from the Glaucoma clinic at Regional Institute of Ophthalmology (RIO), Medical College Hospital, Kolkata from April 2016 – March 2017. Briefing of the procedure to be performed was done to the subjects and informed consent was taken. Exclusion criteria included patient suffering from any painful ocular condition, one eyed person, contact lens, history of ocular surgery, LASER therapy, severe systemic disease as assessed by history and clinical evaluation.

In all our patients, the optic discs were evaluated using the Volk +90D Aspheric lens and the Slit – lamp biomicroscope which gave a stereoscopic view. The VCDR ratio indicated the diameter of the cup expressed as a fraction of the diameter of the disc; the vertical rather than the horizontal ratio was taken. In any individual, asymmetry of 0.2 or more between the eyes was also regarded with suspicion, though it was critical to exclude a corresponding difference in overall disc diameter.

We followed the updated International Society for Clinical Electrophysiology of Vision(ISCEV) Standard for clinical PRVEP testing which superseded the 2009 PRVEP Standard (8).The scalp electrodes were placed relative to bony landmarks, in proportion to the size of the head and montages were kept as per 10-20 International System of EEG Electrode placements (9).The anterior / posterior midline measurements were based on the distance between the nasion and the inion over the vertex. The active electrode was placed on the occipital scalp over the visual cortex at Oz with the reference electrode at Fz. A separate electrode was attached and connected to the ground (ground electrode position was at the vertex Cz).

All standard pattern stimuli were high-contrast, black-and-white checkerboards consisting of squares with equal sides whose corners met. The stimuli were generated on a screen, with the viewing distance typically at 100 cm on an average, The study we conducted was an analytical cross-sectional type. We used Microsoft Office Excel 2010, IBM SPSS Statistics and GraphPadPrism7 softwares to analyse our data.

III. Results

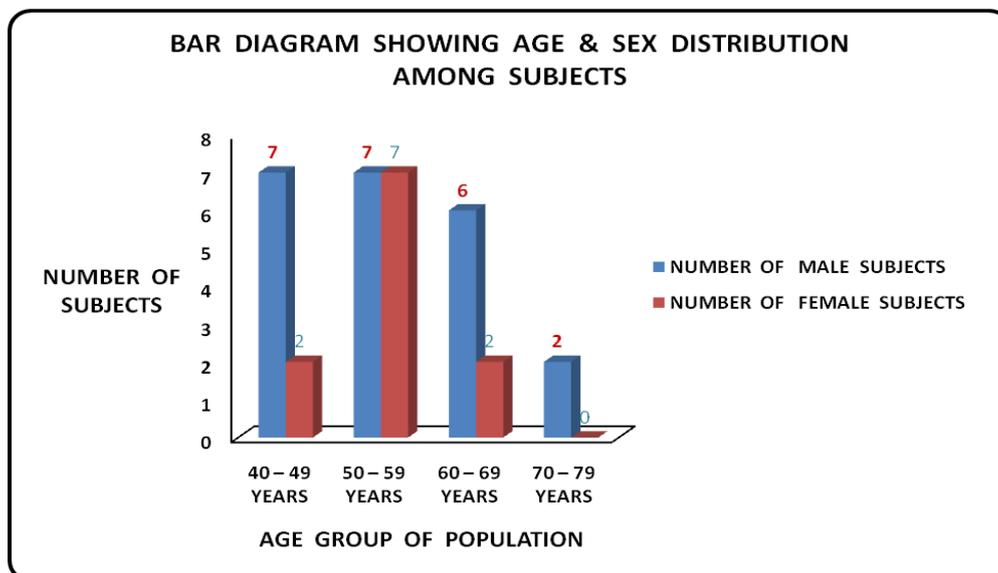


Fig. 1

Table 1. Showing Average Values Of Clinical Parameter

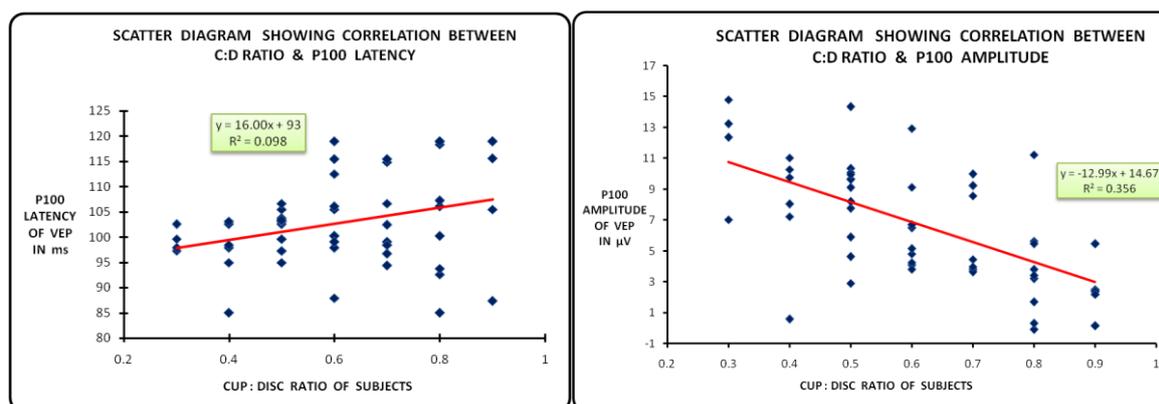
Clinical Parameters	Average Value In Male Subjects	Average Value In Female Subjects	Overall Average Value
Intra Ocular Pressure (In mm Hg)	16.28 ± 3.1	16.84 ± 3.35	16.47 ± 3.17
VCDR	0.65 ± 0.18	0.54 ± 0.14	0.61 ± 0.17

TABLE 2. Showing Average Values Of PRVEP Amplitudes

V.E.P. Latencies	Average Value In Male Subjects (In Ms)	Average Value In Female Subjects (In Ms)	Overall Average Value (In Ms)
N75 Latency	66.13 ± 6.36	65.88 ± 7.69	66.04 ± 6.78
P100 Latency	103.39 ± 10.25	101.62 ± 5.08	102.78 ± 8.8
N135 Latency	142.74 ± 9.63	140.5 ± 8.77	141.96 ± 9.32

Table 3. Showing Average Values Of PRVEP Latencies

V.E.P. Amplitudes	Average Value In Male Subjects (In μv)	Average Value In Female Subjects (In μv)	Overall Average Value (In μv)
N75 Amplitude	-2.14 ± 3.12	-2.06 ± 1.58	-2.05 ± 2.68
P100 Amplitude	6 ± 4.14	8.13 ± 2.46	6.74 ± 3.76
N135 Amplitude	-3.21 ± 3.56	-4.52 ± 2.23	-3.66 ± 3.2



IV. Discussion

The sex composition of our subjects as shown in Fig1. shows a clear male preponderance (Male = 22, Female = 11). This is in concurrence with the findings in the West Bengal Glaucoma Study (WBGs) undertaken by Raychaudhuri A et al in 2005 (2) where they found that, except in people aged 80 years or more, the prevalence of definite glaucoma was higher in males than in females. The ratio of M : F for all types of definite glaucoma in their study was 26 : 16

Considering the age distribution of our subjects, we can see that most of them belonged to the age group 50 – 59 years in both male and female categories. This matches the results obtained in the WBGs (2), where among the subjects that attended for clinical examination 50.6% of males and 45.9% of females belonged to the same age group, as also in subjects who had definite glaucoma, the numbers of male and female persons were highest in the age group 50 – 59 years. Also, in a separate study conducted by Kothari R et al (7), where they correlated the PRVEP parameters with pattern standard deviation (PSD) in POAG patients, maximum number of patients belonged to above mentioned age group.

The average cup – disc ratio in the eyes of our subjects which was calculated to be 0.61 ± 17 is supported by the study conducted by Parisi V and Massimo G B (10). The mean IOP of our subjects' eyes which was 16.47 ± 3.17 mmHg is once again quite close to the observation in the study conducted by Parisi V et al (11),

As far as the latencies (in ms) of the PRVEP waves in our subjects' eyes are concerned, it is seen that our average N75, P100 and N135 latencies which were 66.04 ± 6.78 , 102.78 ± 8.8 and 141.96 ± 9.32 respectively closely approximates the corresponding values obtained in the study by Kothari R et al (7) which were 68.42 ± 8.60 , 101.18 ± 8.06 and 141.48 ± 11.99 .

We found a strong negative correlation (scatter diagram 1) between VCDR and P100 amplitude of the PRVEP, which enables us to compare the net loss of functionality (objective assessment by PRVEP) and the structural damage (evidenced by increased VCDR) due to glaucoma. This finding was unique in the sense that, not many studies were done in this aspect.

The finding of a positive correlation between VCDR and P100 latency (scatter diagram 2) in our subjects' eyes is clearly in agreement with the studies undertaken by Ermers H J M et al (12) and Towle V L et al (13). Here, an increased P100 latency denotes an increased travel time of a visual stimulus from retina to visual cortex which, here, has invariably occurred due to the structural damage to optic nerve fibers by glaucoma.

V. Conclusion

Our present cross sectional study performed on 55 eyes of 33 known primary glaucoma patients lead us to conclude that, PRVEP is a more objective measure of optic nerve function and strongly correlates with other essential diagnostic parameters of glaucoma like VCDR and IOP. PRVEP objectively measures the functional responses of the entire visual pathway from the anterior segment of the eye to the visual cortex and, in this context, may reliably add specific and unique information to glaucoma diagnostic protocols. However, longitudinal studies with greater number of subjects will be required in future to further validate the test.

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