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Original Article

Correlation Between VEP Latency, CDR and PSD On Standard Automated Perimetry In Newly Diagnosed POAG Cases

*Shikha Baisakhiya, *Gurdev Lal Goyal, **Punita Garg, ***Zahid Khan

*Department of Physiology, **Department of Ophthalmology, ***Department of Community Medicine
M.M. Institute of Medical Sciences and Research, M.M. University, Mullana (Ambala), Haryana, India

Abstract

Aim and Objective:- *The current study was conducted to find out the correlation between Pattern reversal VEP (visual evoked potential) parameters, standard automated perimeter parameters and cup disc ratio (CDR) in newly diagnosed cases of POAG (primary open angle glaucoma).*

Materials and Methods:- *The study included 72 individuals of both the genders. The subjects underwent routine ophthalmic examination of anterior and posterior segment, IOP (intraocular pressure) measurement, visual field testing by Humphery's automated perimeter and Pattern reversal VEP (visual evoked potential) testing. The subjects were classified into mild, moderate and severe based on MD (Mean deviation).*

Results:- *In our study, the mean PSD (pattern standard deviation) and CDR (cup disc ratio) value increased with increase in the severity of glaucoma. The findings of our study also showed that increased PSD and CDR mirrored with increase in P100, N75 and N145 latency and decrease in P100 amplitude. The PSD was positively correlated with the latencies of VEP and negatively correlated with the amplitude of VEP waves (p<0.001).*

Conclusion:- *We conclude that VEP can be used as a reliable tool for monitoring the progression of glaucoma.*

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Keywords: *VEP latency, primary open angle glaucoma (POAG), pattern standard deviation (PSD), cup-to-disc ratio (CDR)*

Introduction

Primary open-angle glaucoma is a chronic progressive optic neuropathy of multifactorial origin.[1] The diagnostic criteria of POAG is a triad of raised IOP, characteristic visual field defect and cupping of optic nerve head with presence of open angles and absence of any secondary cause of raised IOP.[2,3] Visual evoked potential (VEP) is an important diagnostic tool that can be used to study the optic nerve head and visual field changes in cases of POAG. Increased latencies and decreased amplitude of VEP both have been documented in cases of glaucoma.[4] The results of the previous studies show a statistically significant correlation between magnitude of change in VEP parameters and PSD on automated static perimetry. The above correlation suggests slowing of neural conduction from retina to the visual cortex in the brain. It also supports the reliability of the usage of VEP test in cases of glaucoma. Researchers suggest that the glaucomatous visual field defect could be attributed to damage of the retinal ganglion cells and their axons. VEP test is compatible with the functions of retinal ganglion cells so it provides specific information. Visual field testing does not selectively reveal the structures of visual pathway involved in the etiopathogenesis of glaucoma.[5] The current goal of treatment of glaucoma patients is neuroprotection. The neuroprotective drugs can help in survival of nonfunctional retinal ganglion cells that are still alive. VEP testing can be used as a diagnostic tool to detect these abnormal nonfunctional retinal ganglion cells and monitor the effect of neuroprotective treatment.[6] The latency of response of retinal ganglion cells is the indicator of their health which can be studied by VEP.[7,8]

As currently existing glaucoma detecting techniques are non-specific, costly, time consuming and subjective in nature so ophthalmologists are always in search of specific and reliable low cost technique. VEP can be used as a potential tool for early diagnosis and follow up of cases of glaucoma. The present study was conducted to find out the correlation between Pattern reversal VEP parameters, standard automated perimeter parameters and cup disc ratio in newly diagnosed cases of POAG and in turn, prove the validity of VEP testing in the diagnosis and follow up of cases of glaucoma.

Methodology

The prospective observational study was conducted on 72 newly diagnosed cases of POAG. The study included subjects of both the genders. The age group of the subjects was above 35 years. The study was undertaken by prior approval from institutional ethics committee. The subjects were selected by random sampling technique. Informed consent was obtained from all the subjects. The inclusion criteria were newly diagnosed cases of POAG having no other ocular abnormality.

Exclusion Criteria

Subjects with any ocular abnormality, undergone any ocular surgery, on any ocular medication, systemic medication which can affect the IOP, congenital ocular abnormality, history of ocular trauma, inflammation, small pupil size, ,high refractive errors were excluded from the study. Patients not cooperative for visual field testing and VEP recording were also excluded from the study.

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Table 1: Mean PSD, CDR and VEP Parameters of the Three Groups

Category	No	Mean PSD	Mean CDR	Mean P100 Latency (ms)	Mean N75 Latency (ms)	Mean N145 Latency (ms)	Amplitude (μv)
Mild	27	3.47±0.88	0.64±0.035	105.96±6.81	64.60±2.95	135.21±4.07	6.02 ±0.70
Moderate	20	4.55±0.78	0.76±0.063	115.71±6.33	75.93±4.67	142.72s±6.37	5.58±0.83
Severe	25	7.8±0.63	0.89±0.064	128.61±5.46	85.39±4.89	146.63±9.11	3.24±0.90

Experimental Design

A detailed personal history including biodata, habits, past history of diseases, family history were procured from all the subjects. All the subjects underwent complete ophthalmic examination including visual acuity; slit lamp biomicroscopy, optic nerve head examination with 90 D lens IOP measurement with Goldmann Applanation tonometer, pattern reversal VEP recording and 24-2 standard automated perimetry with Humphery visual field analyzer. The reliability criteria for the visual field were false positive and false negative <33% and fixation losses <20%.[2] The cases were diagnosed as glaucomatous based on optic nerve head abnormality like: asymmetry with the fellow eye (>0.2), cup disc ratio > 0.6, rim notching, retinal nerve fibre layer defect and abnormal GHT (Glaucoma hemifield test). The MD (Mean deviation) and PSD (pattern standard deviation) were used as index of severity of glaucomatous damage.[9] As per Hoddap Parrisch Anderson's criteria, MD between 0 and -6db is mild glaucomatous damaga,-6 to -12 db is moderate glaucomatous damage and >-12db is severe glaucomatous damage. The subjects were categorized as mild, moderate and severe based on MD values. The pattern reversal VEP was performed using 8 by 8 black and white checkboard pattern with red dot in the centre. Responses of 200 stimuli were amplified and averaged. The VEP latency was noted by checking for repeatability on two separate sessions and then averaging the values.

Results

There were total 72 subjects diagnosed with primary open angle glaucoma included in the study. Based on the value of mean deviation (MD), the subjects were classified into mild, moderate and severe glaucoma cases. There were total 27 mild cases, 20 moderate cases and 25 severe cases. The mean CDR of mild glaucoma cases was 0.64±0.035 and the mean PSD was3.47±0.88. The mean value of P100 latency was 105.96±6.81 ms, the mean N75 latency was 64.60±2.95 ms and mean P145 latency was 135.21±4.07ms. The mean amplitude was 6.02 ±0.70 μv. The mean CDR of moderate glaucoma cases was 0.76±0.063 and the mean PSD was4.55±0.78. The mean value of P100 latency was 115.71±6.33ms, the mean N75 latency was 75.93±4.67 ms and mean P145 latency was

Table 1: Mean PSD, CDR and VEP Parameters of the Three Groups

		CDR	PSD	P100 (Lat)	N75 (Lat)	N145	Amplitude
CDR	Pearson Correlation	1	.846	.803	.899	.649	-.750
	Sig. (2-tailed)		.000	.000	.000	.000	.000
	N	72	72	72	72	72	72
PSD	Pearson Correlation	.846	1	.877	.864	.613	-.849
	Sig. (2-tailed)	.000		.000	.000	.000	.000
	N	72	72	72	72	72	72
P100 (Lat)	Pearson Correlation	.803	.877	1	.850	.655	-.811
	Sig. (2-tailed)	.000	.000		.000	.000	.000
	N	72	72	72	72	72	72
N75 (Lat)	Pearson Correlation	.899	.864	.850	1	.735	-.787
	Sig. (2-tailed)	.000	.000	.000		.000	.000
	N	72	72	72	72	72	72
N145	Pearson Correlation	.649	.613	.655	.735	1	-.696
	Sig. (2-tailed)	.000	.000	.000	.000		.000
	N	72	72	72	72	72	72
Amplitude	Pearson Correlation	-.750	-.849	-.811	-.787	-.696	1
	Sig. (2-tailed)	.000	.000	.000	.000	.000	
	N	72	72	72	72	72	72

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142.72s±6.37 ms. The mean amplitude was 5.58±0.83μv. The mean CDR of severe glaucoma cases was 0.89±0.064 and the mean PSD was7.8±0.63. The mean value of P100 latency was128.61±5.46 ms, the mean N75 latency was 85.39±4.89ms and mean P145 latency was 146.63±9.11ms. The mean amplitude was 3.24±0.90 μv (Table 1) (p<0.001). On Pearson's correlation, CDR was positively correlated with PSD (r=0.846, P<0.001),P100 Latency (r=0.803, p<0.001), N75 latency (r=0.899, p<0.001), N145 Latency (r=0.649, p<0.001) and negatively correlated with amplitude (r=-0.750, p<0.001). On Pearson's correlation, PSD was positively correlated P100 Latency (r=0.877, p<0.001), N75 latency (r=0.864, p<0.001), N145 Latency (r=0.613, p<0.001) and negatively correlated with amplitude (r=-0.849,p<0.001) (Table 2) (Figure 1 & 2).

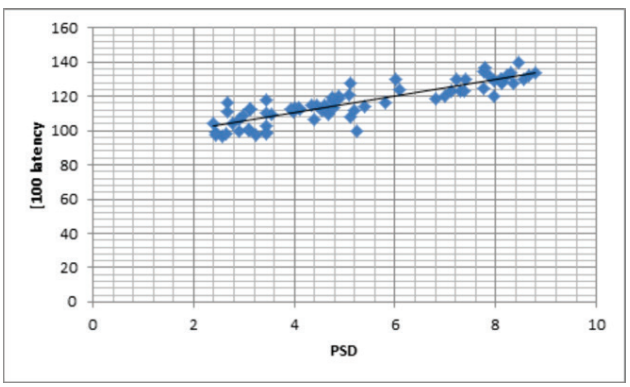

Figure 1: *The scatter diagram showing Positive correlation between P100 latency and CDR*

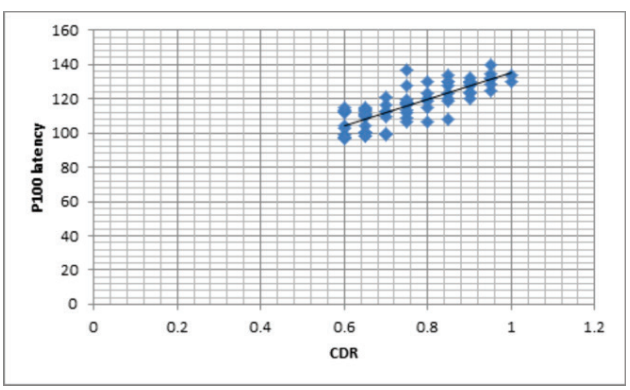

Figure 2: *The scatter diagram showing Positive correlation between P100 latency and PSD*

Discussion

In our study, the mean PSD value increased with increase in the severity of glaucoma. The CDR also increased with increase in the severity of glaucoma. The findings of our study suggest that increased PSD and raised CDR mirrored with increase in P100, N75 and N145 latency and decrease in P100 amplitude. The PSD and CDR values were positively correlated with the latencies of VEP and negatively correlated with the amplitude of VEP waveform (p<0.001).

Primary open angle glaucoma is the most common form of glaucoma in India. It is the second largest cause of blindness worldwide[1,10] The disease is characterized by a triad of raised intraocular pressure, visual field defect and optic disc cupping. Raised IOP tends to compress the retinal ganglion cells which enter into the optic nerve. The increased latency on VEP is a marker of reversible ganglion cell loss.[11] The severity of global reduction in visual field is indicated by the values of MD and focal reduction is indicated by value of PSD on standard automated perimetry. Visual evoked potential is an important electrophysiological objective tool which can be used for the evaluation of visual field defects in primary open-angle glaucoma.[3] The severity of visual field defect can lead to delay in the neural conduction from the retina to the visual cortex. The positive correlation between MD, PSD and VEP latencies in cases of glaucoma confirms it. Further on, this also confirms the validity of VEP in testing the progression of glaucoma. The results of our study also reconfirm the above correlation.

VEP testing uses three types of stimulus: flash, full-field pattern reversal, and half-field pattern reversal. The full-field pattern reversal stimulus is used as a usual stimulus in most of the cases, the half-field pattern reversal is used for localization of lesions behind the optic chiasma. Flash VEP is used for uncooperative patients and small children and its latencies are more variable than the pattern reversal type. We have used the full field pattern reversal stimulus in all cases. Subjects not cooperative for VEP testing by pattern reversal method were excluded from the study[12] The VEP is an excellent non-invasive objective measure to evaluate visual function, although it is not specific at detecting the exact etiology of the defect.[13] VEP can be used as a tool to measure early glaucomatous damage evidenced by delay in conduction and recorded as increased latencies before retinal ganglion cell death occurs.[14]

Kothari et al in their study on 90 POAG subjects found that Visual field index MD (mean deviation) is negatively correlated with P100 latency. POAG affected Pattern reversal VEP by both ways, by increasing the latency of P100, N70 and N135 and decreasing the amplitude N70-P100.[11] In the current study, we also recorded both increase in latency and decrease in amplitude of pattern reversal VEP as the severity of glaucoma increased. The findings of Towle et al suggest a positive correlation between VEP latency, degree of visual field defect, cupping and pallor in optic nerve head.[4] The findings of our study were in accordance with them. The positive correlation was seen between MD and PRVEP latency in a study done by Horn et al and our findings supported their results as well.[5,15] In a study done by Jha et al, it was observed that the Pattern reversal VEP parameters deteriorated in cases of POAG as measured by increase in the latency, although a variable effect was seen on amplitude by pattern reversal and flash methods.[7] We also observed in our study an increased latency of Pattern reversal VEP parameters with increasing severity of glaucomatous damage as depicted by MD and PSD on visual field testing and increased CDR of optic nerve.

Limitations

We have not included all other types of glaucoma like primary angle closure glaucoma in our study and we have

also not studied the efficacy of other methods of VEP testing i.e. Flash method.

Future Perspective

Future studies can include all types of glaucoma. Comparision can be made between the parameters of VEP by both flash and pattern reversal methods. Longitudinal studies are required for further validation of reliability and efficacy of VEP as a tool for monitoring the progress of glaucoma.

Conclusion

The visual field changes as depicted by MD and PSD values and optic nerve head changes depicted by CDR mirror the delay of conduction to the cortex depicted by VEP latencies. From these observations, we conclude that VEP can be used as a reliable tool for monitoring the progression of glaucoma

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Address for correspondence

Shikha Baisakhiya DOMS, MD
Assistant Professor,
Department of Physiology,
M.M. Institute of Medical Sciences & Research, Mullana (Ambala), Haryana, India
Email id: nitishikha2478@rediffmail.com

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