

Effect of Visual Evoked Potential in Myopic Individuals

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Abstract

Background: Visual evoked potentials (VEPs) are electrical potential differences recorded from the scalp in response to visual stimulus. Refractive errors blur the stimuli, causing defocus and tend to affect the VEP parameters [1]. Among the refractive errors, the incidence of myopia is increasing globally, due to the increased usage of illuminated electronic screens.

Objective: To study the changes in latency of VEP waves in myopic individuals and to compare them with normal healthy controls.

Methodology: 30 individuals with myopia in the age group 18-35 years were selected from Ophthalmology OPD and VEP was recorded in the Neurophysiology Lab, Chengalpattu Medical College and were compared with 30 age and gender matched healthy controls. The data was statistically analyzed with student independent unpaired 't' test using SPSS 23.0 version.

Results: As compared with controls the VEP latencies were significantly increased in myopic individuals ($p < 0.05$).

Conclusion: Uncorrected myopia per se can cause prolongation of VEP latencies. So routine VEP recording should be done after correction of myopia to avoid false positive results.

Keywords: Refractive error, Myopia, Visual Evoked Potentials.

Introduction

According to the National Programme for Control of Blindness (NPCB), uncorrected refractive errors are the second most common cause of avoidable blindness in India, accounting for 19.7 percent of the total cases of blindness.² Globally, uncorrected refractive errors are the major cause of visual impairment.³ Among the refractive errors, the prevalence of myopia is increasing globally, with a recent study estimating that around 30% of the current population is myopic.^{4,5} Myopia is defined as a condition in which the spherical equivalent objective refractive error is ≤ -0.05 diopter (≤ -0.05 D) in either eye.⁴ The increase in prevalence of myopia is particularly more in children and young adults, who spend less time outdoors and more time with illuminated electronic gadgets like computers and smart phones.⁶

Visual evoked potentials (VEP) are electrical potential differences recorded from the scalp in response

to visual stimuli.⁷ A normal VEP denotes the integrity of the visual pathway. VEP consists of two negative waves (N) and a positive wave (P). The waves are N_{75} , P_{100} and N_{145} , wherein 75, 100 and 145 are the latencies in millisecond. Of these, P_{100} is the most consistent and least variable peak.⁸ The latency is a more reliable and generally a more useful parameter than the amplitude.⁹

The aim of this study is to evaluate the changes in latency of VEP waves in myopic individuals and to study the correlation between increasing refractive error and latency of P_{100} .

Materials and Method

Thirty stable myopic individuals of both genders in the age group of 18-35 years were selected from the Ophthalmology Outpatient Department of Chengalpattu Medical College. VEP was recorded in the Neurophysiology Lab, Department of Physiology,

Chengalpattu Medical College. The VEP recordings were compared with 30 age and gender matched healthy individuals from the Master Health Checkup Programme. This Case Control study was conducted after obtaining approval from the Institutional Ethics Committee. Written and informed consent was obtained from all the participants. Following a clinical examination, the visual acuity was tested using Snellen's chart and the refractive error was assessed using autorefractometer.

Inclusion Criteria:

Age: 18-35 years

Both genders

Refractive error [Myopia \leq -0.05 D] ⁴

Exclusion Criteria:

Age <18 years and >35 years

Other refractive errors [hypermetropia, astigmatism]

H/O color blindness, glaucoma, cataract, optic neuritis and any other eye pathology

H/O seizures, eye surgery, demyelinating diseases

H/O diabetes mellitus, hypertension, thyroid abnormalities

Known smokers, alcoholics, tobacco chewers

Subjects on barbiturates, neuroleptics, antidepressants

PROCEDURE:

Prerequisites:

Thorough hair washing before the experiment, to render scalp grease free.

Application of oil or any other hair products should be avoided.

Mydriatics and myotics should not be used for a minimum of 12 hours before the procedure.

Removal of glasses or contact lenses during the procedure.

VEP was recorded using Physiopac [Neuroperfect EMG 2000]. The stimulus given was Pattern reversal using a checkerboard monitor.

Technical settings:

Low cut filter: 2Hz

High cut filter: 100Hz

Sweep duration: 350ms

Sweep sensitivity: 10 μ V

Number of epochs: 200

After giving proper instructions, the subjects were asked to sit straight at a distance of 100cm from the stimulus monitor, in a dark room.

Three standard disc electrodes were placed on the scalp, according to the 10-20 International System of EEG electrode placement.

Recording electrode Oz – 3 cm from the inion

Reference electrode Fz – 12 cm from the nasion

Ground electrode Cz – over the forehead.

After cleansing the skin in the area of electrode placement using spirit, the electrodes were fixed using electrode paste.

The subjects were asked to fix their gaze at the red point in the centre of the monitor and monocular stimulation was done.

The latencies of N₇₅, P₁₀₀ and N₁₄₅ were recorded.

The collected data were analysed with IBM.SPSS statistics software 23.0 version using student independent unpaired sample 't' test and Pearson's correlation.

p <0.05 was taken as significant.

p \leq 0.01 was taken as highly significant.

Results

Table 1: Comparison of basic parameters between controls and cases

PARAMETER	CONTROLS (n=30) MEAN \pm SD	CASES (n=30) MEAN \pm SD	p VALUE
AGE	19.8 \pm 1.56	19.8 \pm 1.27	1.000
HEIGHT in cm	167.3 \pm 8.7	166.77 \pm 11.3	0.838
WEIGHT in kg	60.27 \pm 10.95	58.73 \pm 11.37	0.597
BMI	21.53 \pm 3.46	21.01 \pm 3.18	0.548

The basic parameters of age, height, weight and BMI matched between controls and cases.

Comparison of VEP parameters between controls and cases

Table 2: VEP recordings of right eye

VEP PARAMETER	CONTROLS MEAN±SD	CASES MEAN±SD	pVALUE
LATENCY OF N ₇₅ [ms]	73.9±5.61	79.75±6.43	<0.01
LATENCY OF P ₁₀₀ [ms]	100.22±3.11	110.7±4.41	<0.01
LATENCY OF N ₁₄₅ [ms]	145.59±12.54	156.58±11.15	<0.01

TABLE 3: VEP recordings of left eye

VEP PARAMETER	CONTROLS MEAN±SD	CASES MEAN±SD	p VALUE
LATENCY OF N ₇₅ [ms]	74.59±5.12	79.99±5.16	<0.01
LATENCY OF P ₁₀₀ [ms]	100.98±2.79	110.87±4.14	<0.01
LATENCY OF N ₁₄₅ [ms]	145.82±11.57	157.37±12.26	<0.01

There was a highly significant increase in the latencies of N75, P100 and N145 in myopic individuals when compared to the controls for both right and left eye.

Discussion

Visual evoked potential is a non-invasive study that measures the evoked response to visual stimuli.¹⁰ Visual cortex is activated primarily by central visual field. VEP depends on the functional integrity of central vision at any level of visual pathway including the eye, retina, optic nerve, optic radiation and occipital cortex.¹¹ Myopia is a dioptric condition of the eye in which, with the accommodation at rest, incident parallel rays come to a focus anterior to the light sensitive layer of the retina.⁹ In pattern reversal VEP, the stimulus contains clear contours which are markedly affected by any optical blur,⁸ caused by refractive errors like myopia. In this study, latencies of VEP waves were recorded for individuals with myopia and was compared with normal controls. There was a significant increase in the latency of P₁₀₀ in myopic individuals compared to the controls. This was consistent with Kothari *et al*,¹² wherein it was established that myopia significantly increases the latency of P₁₀₀ and decreases the amplitude. Collins *et al*,¹³ illustrated that induced refractive error significantly

increased both absolute and relative latency of P₁₀₀. Winn B J *et al*,¹⁴ observed that simulated refractive errors caused significant centrally located abnormalities, blurring the stimulus.

In our study, the mean latency of P₁₀₀ was significantly prolonged in myopic individuals and as there was a strong positive correlation between increasing refractive error and the latency of P₁₀₀. This is because refractive errors like myopia causes optical blurring of the stimulus, resulting in defocus, which causes prolongation of latency.

This signifies that myopia per se can cause prolongation of P₁₀₀ latency. The prolongation of P₁₀₀ is a clinically significant tool in diagnosis of conditions like optic neuritis and demyelinating diseases like multiple sclerosis. Hence while doing routine diagnostic VEP testing, myopia should be corrected to avoid false positive results.

Conclusion

There is significant delay in the wave pattern of VEP recorded in subjects with myopia. There is significant prolongation of the latency of P100, N75 and N145 in the study group compared to the controls. The change

in amplitude of the waves was not recorded. This study did not include the recording of VEP after the correction of myopia, which would have given a better insight into the impact of blurring vision on the recording of visual evoked potentials. To conclude correction of refractive errors is essential before VEP recordings for clinical investigation.

Limitations:

Small Sample size.

The correlation between uncorrected and corrected refractive error was not studied.

Conflict of Interest: None

Source of Funding: None

Ethical Clearance: The study was approved by the Institutional Ethical Committee, Chengalpattu Medical College, Chengalpattu.

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