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Research Article

Uncorrected myopia significantly increases P100 latency and lowers N75–P100 amplitude in visual evoked potentials (VEP)

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ABSTRACT

Background & Objectives: Myopia or short-sightedness is rising globally, particularly among children and young adults with increased screen exposure. Visual evoked potentials (VEPs), measuring latencies and amplitudes, provide an objective assessment of visual pathway. Despite rising prevalence of Myopia, studies investigating its effects on VEPs are very limited in Nepal, adding to the relevance of this study.

Materials and Methods: This case-control study enrolled 30 clinically diagnosed myopic individuals (≤ −0.5 D) and 30 age and sex-matched healthy controls with normal vision were recruited following informed written consent. Anthropometric parameters were recorded. Pattern-reversal VEPs were obtained, with electrodes placed per the 10-20 system of the subjects. Latencies (N75, P100, N145) and amplitudes (N75-P100, P100-N145) were measured. Recordings were done at room temperature (26 ± 2 °C). Data, confirmed to be normally distributed, were analyzed using t-tests in SPSS.

Results: Thirty myopic individuals and 30 age-sex matched emmetropic controls were studied. Compared with controls, the myopic group showed significant ($p \leq 0.05$) increase in P100 latency (93.5 ± 6.3 Vs 88.7 ± 5.2, p=0.03) and decrease in N75–P100 amplitude (6.5 ± 2.1 Vs 8.2 ± 2.4, p=0.04) in right eye and significant increase in P100 latency (94.2 ± 6.5 Vs 89.4 ± 5.0, p=0.02) and decrease in N75–P100 amplitude (6.3 ± 2.3 Vs 8.0 ± 2.5, p=0.03) in left eye. Trends towards increased N75 and N145 latencies and

decreased P100–N145 amplitudes were also observed in the myopic group.

Conclusions: Uncorrected myopia significantly delays P100 latency and lowers N75–P100 amplitude in both eyes, with additional trends of delayed N145, N75 latencies and reduced P100–N145 amplitudes, indicating broader impairment of early cortical visual processing.

Keywords: Myopia, Refractive error, Visual evoked potential

INTRODUCTION

A refractive error is a common eye disorder. It occurs when the eye cannot clearly focus the images from the outside world. Refractive errors occur when the shape of the eye prevents light from focusing directly on the retina. There are four types of refractive errors; Myopia, Hypermetropia Astigmatism and Presbyopia [1].

Myopia also known as short-sightedness is a refractive error in eye where light focuses in front of instead of on the retina[2]. The increase in prevalence of myopia is particularly more in children and young adults, who spend more time with illuminated electronic gadgets like computers and smart phones [3].

Visual evoked potentials (VEP) are electrical potential differences recorded from the scalp in response to visual stimuli. A normal VEP denotes the integrity of the visual pathway [4]. It is generally elicited by monocular stimulation of each eye while other is closed [5-6]. VEP amplitude and latency are applicable to objective assessments of refractive errors [7]. VEP consists amplitudes of N75-P100 and P100-N145. It also consists N75, P100 and N145 latencies in millisecond. Myopia causes optical blurring of the stimulus, resulting in defocus, which causes prolongation of latencies [8].

Several studies have revealed the changes in VEP parameters especially in P100 latency and amplitude in persons having refractive errors [9-10]. Despite rising prevalence of Myopia, studies investigating its effects on VEPs are very limited in Nepal, adding to the relevance of this study. In the present context, this study aims to evaluate the VEP parameters in myopic individuals and compare them with the healthy controls having normal vision.

MATERIALS AND METHODS

This case-control study was conducted in Department of Basic and Clinical Physiology at BPKIHS, Dharan, Nepal from September 2021 to September 2022 in a duration of one year. The ethical approval was obtained from the Institutional Review Committee (reference no. IRC/2145/021) BPKIHS, Dharan, Nepal. The procedure was fully explained and written informed consent was taken from all the subjects recruited for the study. The study was conducted on 30 myopic individuals and 30 age-sex matched healthy subjects with normal vision.

Clinically diagnosed cases of myopia [≤ -0.5 D] were included in the study. Other refractive errors (hypermetropia, astigmatism and presbyopia) with history of color blindness, glaucoma, cataract, optic neuritis, seizures, eye surgery, demyelinating diseases, diabetes mellitus, hypertension, thyroid abnormalities were excluded from the study.

Demographic details including Anthropometric variables were recorded. Visual Evoked Potential (pattern reversal)

was recorded using Nihon Kohden Neuropack MEB: 9400 version 08.33. The electrode placement for the recording was done in 10-20 EEG system. Standard disc silver chloride surface electrodes were used for VEP recording. Skin was prepared by abrading and degreasing. Electrode paste was used to fix the electrodes in position. Electrode impedance was kept below 5 KΩ.

The variables recorded were peaked latencies N75, P100 and N145, and amplitude of N75-P100, P100-145. The room temperature was maintained at 26±2 degree Celsius during recording. The data collected were entered into Microsoft Excel 2007 and then statistically analyzed using statistical package for social sciences (SPSS). Data obtained were normally distributed so, Paired t test was applied. P value < 0.05 was considered statistically significant.

RESULTS

This study enrolled 30(14 males and 16 females) myopic individuals and 30(12 males and 18 females) healthy emmetropic controls. The demographic variables of the subjects are shown in table 1. The comparison of VEP variables between myopic group and control group in right and left eye is shown in table 2 and 3 respectively.

A significant increase in P100 latency was found in myopic group compared to control group in both eyes, a significant decrease in N75–P100 amplitude of was also found in myopic group compared to control group in both eyes. N145 and N75 latencies were also found in increasing trend in myopic group compared to control group whereas P100–N145 amplitude was also found in decreasing trend in myopic group compared to control

Table 1: Comparison of demographic variables between Myopic and Control Groups

Variables	Myopia (n = 30) Mean ± SD	Control (n = 30) Mean ± SD	P-value
Age (years)	24.4 ± 2.8	23.7 ± 2.6	0.32
Height (cm)	165.4 ± 7.8	166.1 ± 8.2	0.74
Weight (kg)	62.7 ± 9.5	63.9 ± 10.1	0.64
Body Mass Index (kg/m^2)	22.9 ± 3.1	23.2 ± 3.4	0.72

Table 2: Comparison of Visual Evoked Potential variables between Myopic and Control group in Right eye

VEP variables	Myopic Group (n=30)	Control Group (n=30)	p-value (Two-tailed)
N75 Latency (ms)	75.2 ± 5.1	72.5 ± 4.8	0.08
P100 Latency (ms)	93.5 ± 6.3	88.7 ± 5.2	**0.03**
N145 Latency (ms)	145.1 ± 7.2	140.2 ± 6.5	0.06
N75-P100 Amplitude (μV)	6.5 ± 2.1	8.2 ± 2.4	**0.04**
P100-N145 Amplitude (μV)	5.3 ± 1.9	6.7 ± 2.0	0.09

Table 3: Comparison of Visual Evoked Potential variables between Myopic and Control group in Left eye

VEP Parameter	Myopic Group (n=30)	Control Group (n=30)	p-value (Two-tailed)
N75 Latency (ms)	75.8 ± 4.9	73.0 ± 4.6	0.06
P100 Latency (ms)	94.2 ± 6.5	89.4 ± 5.0	**0.02**
N145 Latency (ms)	146.0 ± 7.5	141.5 ± 6.3	0.08
N75-P100 Amplitude (μV)	6.3 ± 2.3	8.0 ± 2.5	**0.03**
P100-N145 Amplitude (μV)	5.1 ± 2.0	6.4 ± 2.1	0.10

group.

DISCUSSION

Our findings demonstrated a significant increase in P100 latency and a concomitant decrease in N75–P100 amplitude in myopic subjects compared to controls which suggests slower neural conduction and weaker signal passing along the visual pathway up to the visual cortex, reflecting a reproducible effect of refractive error on VEP measurements. Notably, we also observed trends toward prolonged N145 and N75 latencies and reduced P100–N145 amplitudes in myopic individuals, consistent across both eyes.

These results strongly align with existing evidence that uncorrected myopia induces measurable delays in cortical visual responses and diminishes waveform amplitude [11-12]. Lee et al. reported that uncorrected myopes (mean refraction –4.27 D) showed a significantly longer P100 latency (~100.59 ms) compared to controls. They also noted that the P100 latency increased further with increasing severity of myopia. [13]. Next study in Indian myopics Kothari et al. demonstrated significant increase in P100 latency and reduced amplitude in Indian, both with ($P < 0.05$) and without ($P < 0.001$) correction, compared to controls [10]. Complementing this, Agrawal et al. found that both unaided and aided myopic eyes exhibit longer P100 latencies and reduced amplitudes, with severity of myopia significantly affecting latency ($P < 0.05$) [14]. Anand et al.'s experimental induction of refractive errors in emmetropic subjects also demonstrated strong correlations between induced myopia or hypermetropia and alterations in P100 latency and amplitude, highlighting the direct effect of image blur on cortical responses [5]. This can be attributed to optical blur diminishes retinal image contrast, leading to slower cortical processing and increased P100 latency in pattern-reversal VEPs, particularly with high spatial frequency stimuli [10].

Our observations of increased N145 and N75 latencies, along with decreased P100–N145 amplitude in myopic patients, further support the notion that myopia-induced blur degrades early visual signal quality, delaying and dampening subsequent cortical responses. Although less frequently emphasized in the literature, changes in N75 and N145 latencies reflecting neural activity occurring before and after the cortical P100 peak, respectively indicate that the influence of myopia extends beyond the commonly examined P100 component and affects multiple stages of the visual processing pathway [14-15].

This study insights the critical importance of ensuring optimal visual correction during VEP testing. Even minor refractive errors can significantly alter VEP outcomes, leading to potential misinterpretations as neurological deficits [16]. Therefore, achieving a visual acuity of at least 0.8 ensures that the patient can perceive the pattern-reversal stimulus with sufficient clarity and contrast, allowing the VEP to reflect true neural pathway function, which is essential to accurately assess cortical function and avoid inaccurate diagnoses of optic nerve disorders, demyelinating diseases, or other visual pathway abnormalities. [9, 15-16].

CONCLUSIONS

Our study effectively demonstrates that uncorrected myopia significantly alters early cortical visual responses, manifested as prolonged P100 latency and reduced N75–

P100 amplitude, consistent across both eyes. This effect is further echoed in the observed trends of delayed N145 and N75 components and diminished P100–N145 amplitudes, reinforcing the notion that optical blur impairs not only the classical P100 peak but also upstream visual processing elements.

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