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Research Article

Effect of Refractive Error on Visual Evoked Potential in Myopic Males and Females

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Abstract

Introduction: Visual Evoked Potentials are summated electrical signals generated by occipital regions of cortex in response to visual stimuli and recorded from human scalp. Visual evoked potential measures the conduction time of neuronal activity from retina to occipital cortex, the measure of integrity and function of visual pathway. The amplitude and latency of visual evoked potential are affected by variety of physiological factors like refractive errors, age, gender, eye movement and also the techniques like check size, color, distance to pattern etc. To find out the effect of myopia on visual evoked potential, this study was conducted on males and females.

Methods: 50 controls [25 males, 25 females] and 50 myopic [25males, 25 females] aged between 18-30 years with refractive error in range of -0.5D to -5.00 D were participated with cylindrical component less than -1.00 D with no significant difference in spherical equivalent between the eyes. VEP was measured using full field pattern reversal checkerboard pattern as stimuli and refractive error as measured both objectively and subjectively.

Results: Statistical analysis showed significant prolongation of P100 latency in myopic subjects along with significant reduction in P100 amplitude. When compared according to gender P100 latency significantly increased and the amplitude decrease was also found significant. When Spherical equivalent was co related with VEP latency and amplitude in the whole group, VEP latency showed negative correlation and weak positive correlation for VEP amplitude which was insignificant. When co-relating in males, we found negative correlation for latency and insignificant amplitude whereas in females, latency showed negative correlation with significant amplitude.

Conclusion: As significant changes in VEP was seen in case of myopia in both genders, refractive errors should also be kept in mind while performing VEP for optic pathway evaluations in order to minimize false positive results.

Keywords: VEP - Pattern Reversal; Amplitude; Latency; Myopia; BMI

Abbreviations

VEP: Visual Evoked Potential; L: Latency; A: Amplitude; BMI: Body Mass Index; SE: Spherical Equivalent.

Introduction

Visual evoked potential are summated electrical signals generated by the occipital region of cortex in response to visual stimuli and recorded from human scalp [8]. VEP is non invasive procedure widely used to asses the visual function, neuronal conduction time from retina to the occipital cortex [5,8,9]. Many different stimuli can be used to evoke VEP like unstructured flashes of light, structured stimuli as checkerboard patterns. International society for clinical electrophysiology of vision ISCEB has published guidelines for covering electrodes placement, stimulus parameters, patient

protocol, equipment specification. Multiples of variables such as age, gender, eye dominance, drugs, refractive errors may affect VEP.

Refractive errors are vision problems that happen when our eyes doesn't refract the light properly. Assuming that the refractive errors cause defocus which blurs the stimulus and it has been shown to decrease the amplitude and prolong latency of conventional pattern reversal VEP [16]. Shorter latency and larger amplitude have been observed in normal females while normal males have comparatively longer latency due to larger head size, body mass index, low core body temperature. BMI is the measure of weight adjusted for height, calculated as weight in kilograms divided by the square of height in meters. Kg/m^2 [25]. Normal BMI ranges From 18.5 to 24.9. The cause for larger amplitude in females is unclear, however hormonal influences have been suggested.

To determine whether results of VEP amplitude and latency in given subjects are normal or not, the result of VEP studies in normal and myopic subjects should be available in the laboratory. It is therefore recommended that each evoked potential laboratory should preferably have its own normative data. Therefore present study was conducted to determine the effect on P100 latency and amplitude of VEP in myopic males and females.

Materials and Methods

The study was conducted in NETHRADHAMA SUPERSPECIALITY EYE HOSPITAL, BANGALORE from January 2018 to June 2018. And the type of study was Cross sectional analytical prospective study. 50 healthy emmetropic and 50 myopic individuals of age ranged 18-30 (50 males, 50 females) were the study population. We enrolled the subjects based on our inclusion and exclusion criteria. Inclusion criteria being cooperative subjects with normal fundus, age group considered, myopia with spherical equivalent between –o.5 D to -5.00 D. Pupil size not taken into consideration, subjects on anti depressants, presence of manifest squint, amblyopia, color vision abnormalities, contact lens users, head traumas, neuromuscular disorder, history of cerebrovascular accidents or other disease that might affect visual acuity were excluded.

Refractive error was measured both subjectively and objectively in each subject. Anthropometric parameters like weight, height, head circumference and BMI was calculated for each subject.

Informed written consent was obtained from all participants and experimental protocol was approved by the ethical committee. We gave our subjects pre – instructions as avoiding any hairsprays, not to use any eye drops [miotics or mydriatics] 12 hours before the test.

The visual evoked potential was recorded by using a pattern reversal checkerboard method with subjects comfortably seated at 72 cm away from the VEP screen monitor. Electrode placement was carried according to the 10- 20 international systems based on measurement of head size [Jasper, 1958] or Queen Square system. Active electrode Oz was placed on midline 2cm above inion, the reference electrode Fz was 12 cm above nasion and ground electrode Cz was placed on the earlobe. Each subjects were exposed to full field monocular stimulation for right and left eye separately during the test. The recording was done in quiet, dark room with constant temperature. The signals recorded were filtered through a band spread of 2-100 Hz. Response to 200 stimuli were averaged for each eye. After of 2 trials with well defined pattern reversal VEP was obtained for P 100 latency and P 100 amplitude.

Statistical analysis

Statistical analysis was carried out with SPSS PC Software version 1.0. Spherical equivalent refraction between right and left eye along with spherical equivalent between males and females were analyzed by students paired ' t' test. P100 latency and amplitude of control group with myopic subjects were analyzed by paired test. VEP amplitude and latency were correlated with SE refraction by Pearson's correlation coefficient.

Result

The mean age of the study and control group was 22.88 years and 22.28 years respectively. Mean head size of males was 21.68 inch and females was 21.245 inch. Similarly, mean BMI recorded for males and females was 20.91 and 20.21 respectively. The mean spherical equivalent was -2.290 in the right eye and -2.2425 in the left eye. There was no significant difference in the SE between the right eye and left eye, $p = 0.448$ (paired test table 1).

There was no significant difference in spherical equivalent refraction between males and females $p = 0.481$ (paired t test table 2)

SE Dioptres [D]		
	Mean + SD	P
Right	-2.290 ± 1.40549	0.448
Left	-2.2425 ± 1.34544	

Table 1: Spherical Equivalent in Right and Left eye [n = 50].

SE Dioptres [D]		
	Mean + SD	P
Male	-2.4073 ± 1.44709	0.481
Female	-2.100 ± 1.30977	

Table 2: Spherical Equivalent of males and females [n = 50].

The mean and SD of VEP latency and amplitude of myopic subjects and control were compared. Longer latency and amplitude reduction was found with significant p value when comparing with the control population (Table 3).

Parameters	Mean	SD	P
P 100 latency [ms]			
Control [n = 50]	100.5590	1.44648	0.00
Myope [n = 50]	105.1760	2.99444	
P 100 Amplitude [μV]			
Control [n = 50]	15.9589	3.35887	0.00
Myope [n = 50]	11.4242	1.61032	

Table 3: P 100 Latency and Amplitude in Myopic and Control.

The results when compared separately for boys and girls. P100 Latency was extremely significant for both males and females. And P 100 Amplitude reduction was also observed with a significant p value in both genders (Table 4).

Parameters	Mean	SD	P
P 100 Latency [ms]			
Boys [Control =25]	101.2280	1.23812	0.00
Boys [Myopic =25]	105.7420	2.98575	
Girls [Control =25]	99.89	1.34405	0.00
Girls [Myopic =25]	104.61	2.95378	
P 100 Amplitude [μV]			
Boys [Control =25]	14.9598	2.43571	0.00
Boys [Myopic =25]	11.1064	1.77253	
Girls [Control =25]	16.9580	3.87580	0.00
Girls [Myopic =25]	11.7420	1.39356	

Table 4: P 100 Latency and Amplitude in Myopic males and females with Control.

When SE was correlated with VEP latency and amplitude in whole group, latency showed negative correlation at $p < 0.05$ whereas amplitude showed weak positive correlation at $p = 0.06$, which was insignificant. When correlation was done separately in males, we found negative correlation at $p = 0.00$ for latency and amplitude was insignificant. In females latency showed negative correlation at $p < 0.05$ and amplitude was significant (Table 5).

WAVES	Whole group [n = 50]SE		Males [n = 25] SE		Females [n = 25] SE	
	Pearson's correlation [r]	P value	Pearson's correlation [r]	P value	Pearson's correlation [r]	P value
VEP L [ms]	-0.789	0.00	-0.769	0.00	-0.808	0.00
VEP-amp [μV]	0.010	0.06	0.284	0.169	0.416	0.039

Table 5: SE comparison in whole myopic group along with males and females.

Discussion

Lee., *et al*. evaluated P100 latency in myopia and found significant negative correlation between refraction and P100 latency. They suggested that refraction should be considered during VEP examination [4].

Vinodha., *et al*. found that P100 latency was extremely longer and significant difference also existed in relation to amplitude between the myopic and control subjects [15].

Ludlam., *et al*. observed that visual evoked response [VER] amplitude decreased by approximately 25% per dioptre defocus, and effect was recognizable for 0.25 D [17].

Ruchi Kothari., *et al*. found that P100 latency was increased and amplitude decreased in both myopia and hyperopia with and without correction of refractive error [2].

Anand., *et al*. found induced myopia and hypermetropia correlated strongly with P100 L and P100 A. P100 A progressively decreased and P100 L progressively increased with an increase in both induced myopia and hypermetropia [26].

Rubi Sharma., *et al*. reported that there is a definite gender difference in VEP parameters with females showing shorter P100 latency and higher amplitude [27].

Celesia., *et al*. observed shorter latency and larger amplitude of VEP in normal female [5].

The studies in the past have reported that P100 latency is longer in males as compared with females [19-21]. This difference is because of larger head size and low core body temperature in males [22].

In this study we compared P100 latency and amplitude between myopia and control to know the influence of refractive error on VEP response and found that P100 latency was extremely longer and significant difference also existed in relation to amplitude. As shorter latency and larger amplitude of VEP has been observed in normal females [5,18], the results were compared separately for males and females. P100 L was longer and extremely significant in myopic males and female, with regard to amplitude significant reduction in amplitude were seen in both myopic males and myopic females when compared with control. The increase in VEP amplitude of females has been suggested attributing to hormonal differences when compared with males [23]. Pearson correlation study revealed negative correlation for VEP- L and Weak positive correlation for VEP – A.

Conclusion

Prolongation of latency and decreased amplitude of P100 has been often found in case of multiple sclerosis, optic neuritis, ischemic optic neuropathy and so many other neuropathic diseases which involves optic pathway. Our results suggested that there were significant changes in VEP in cases of myopia in both genders. So while performing VEP for optic pathway evaluation, refractive error should be kept in mind in order to minimize false positive results.

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Conflict of Interest

Nil.

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