

Correlations between developmental test of visual perception-adolescent and adult and visual evoked potential in people with multiple sclerosis

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Keywords

Visual Perception; Spatial Processing; Visual Evoked Potential; Multiple Sclerosis

Abstract

Background: Optic neuritis (ON) is a common visual sign in multiple sclerosis (MS). Although ON is recovered in most cases, other visual functions such as visual perception are affected and are not fully recovered. The aim of this study is to investigate the relationship between visual evoked potential (VEP) P100 and N70 latencies and visual perception using the Developmental Test of Visual Perception-Adolescent and Adult (DTVP-A) in people with MS.

Methods: In this cross-sectional study, 24 people with ON due to MS, aged 18-50 years old took part. In order to assess the visual perception and optic nerve conductivity, the DTVP-A and the VEP were accomplished, respectively. Pearson's product-moment

correlation coefficient was used to analyze the data.

Results: There was a significant negative correlation between right VEP P100 latency and total score of DTVP-A ($r = -0.450$, $P < 0.05$) as well as a significant negative correlation between right VEP P100 latency with visual-motor integration (VMI) subtest of DTVP-A ($r = -0.485$, $P < 0.05$).

Conclusion: The visual perception has an important role in safety and independent daily activities. Therefore, determining the related factors is essential. Although the findings of the current study revealed a moderate statistical correlation between visual perception and right VEP P100 latency, the

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small sample size might limit the generalization of our findings; therefore, further study is required to confirm our results.

Introduction

Around the world, more than 2.3 million people suffer from multiple sclerosis (MS), which is an inflammatory disease of the central nervous system (CNS) that damages the axons and myelin sheath in the young and middle-aged population. The clinical features of MS based on the lesion location are sensory, motor, cognitive, and visual impairments.¹

Optic neuritis (ON) is a common symptom that frequently occurs with the preliminary onset of MS. ON is the inflammation of the optic nerve and is characterized by diminished visual acuity, pain experienced during eye movement, blurred vision, and eye irritation.² A noninvasive method for diagnosing and monitoring optic nerve conduction is visual evoked potential (VEP), and the prolonged P100 component in VEP is indicated in MS.³

Another common type of visual impairment associated with MS is visual perception disorders.⁴ Visual perception consists of a variety of abilities related to depth perception, spatial relationships, right/left discrimination, topographic orientation, figure-ground discrimination, and form constancy.⁵ This skill has a vital role in safe independent living and social participation. Evidence on the relationship between ON and visual perception disorders is lacking.⁴ Clinically, early visual perception interventions in MS patients with ON can increase their ability to perform motor activities independently and diminish problems due to visual risk factors.

Obviously, a prerequisite of perception is intact sensory inputs. VEP is used to assess the representation of visual sensory processes and the integrity of visual sensory pathways. Barton et al. indicated that prolonged VEP latency was a biomarker of optic nerve demyelination.³ The main aim of this study is to find out whether the outcome of ON is related to visual perception disorder in MS. So, the correlation between VEP P100 and N70 latencies and scores on the Developmental Test of Visual Perception-Adolescent and Adult (DTVP-A) was investigated.

Materials and Methods

Study design: The study utilized a cross-sectional design and a descriptive quantitative method. In accordance with the Declaration of Helsinki, it was approved by the Ethical Committee of Iran

University of Medical Sciences, Tehran, Iran (IR.IUMS.REC.1397.651). Participants were recruited non-randomly using convenience sampling from the outpatient occupational therapy ward of Rofeideh Rehabilitation Hospital and the neurology clinic of Rasoul Akram Hospital, Tehran, from January 2018 to August 2019.

Participants: An expert neurologist using the 2010 revision of the McDonald criteria⁶ diagnosed and confirmed MS (regardless of subtype) in 24 (19 women and 5 men) participants. The inclusion criteria were: definite diagnosis of ON due to MS made by a neurologist, age between 18-50 years, Mini-Mental State Examination (MMSE) score > 21,⁷ ability to hold a pen, write, and draw, at least three months having elapsed since the final relapse, and normal or corrected-to-normal visual acuity. Subjects with a history of systemic diseases, diabetes, or any other non-MS disease that affects the visual system were excluded. Written informed consent was obtained from all participants prior to assessment.

Instruments: The DTVP-A: This test is appropriate for assessing the visual perceptions of individuals between the ages of 11 and 74.11 years old and is more sensitive to right hemisphere function. It contains six subscales in two domains: motor-reduced visual perception (MRVP) (which assesses the perception of figure-ground, visual closure, and form constancy) and visual-motor integration (VMI) skills (which assesses the perceptions of copying, visual-motor speed, and visual-motor search). DTVP-A discriminates true visual-perceptual deficits from problems with complex perceptual-motor actions or eye-hand dis-coordination. A total DTVP-A or general visual perception (GVP) score of below 90 indicates that more attention is needed to be paid to clinically important indexes.⁵

VEP: Pattern reversal VEP latency was recorded by an expert neurologist using a Natus device (<https://neuro.natus.com/>) at the neurology clinic of Rasoul Akram Hospital. Participants were seated comfortably in a dark and quiet room and instructed to fixate one eye (the other eye was covered with a patch) on a central red spot on a monitor that was kept at a distance of one meter. Participants were allowed to wear their usual spectacles (if they wore any) during the test. Electrode impedances were maintained below 5 k Ω .

Recordings were made using a referential electrode at Fz (10-20 electrode system). The

electrode 5 cm above the inion was Oz and served as an active electrode used for calculating P100 amplitude and latency.⁸ The two hundred stimuli were generated on the monitor by the electronic generator of the evoked potential recorder in a checkerboard pattern; each stimulus appeared for 30 milliseconds at 60 Hz.

In this study, the DTVP-A was administered by an occupational therapist who was blind to the aim of the study; VEP was implicated by a neurologist.

Pearson's product-moment correlation coefficient was applied to investigate the relationship between VEP latencies and DTPV-A by SPSS software (version 16, SPSS Inc., Chicago, IL, USA).

Results

The data of 24 participants [19 (79.16%) women, 5 (20.84%) men] with a mean \pm standard deviation (SD) of age of 37.41 ± 7.13 years (range: 25-50 years) were analyzed. The average time since MS diagnosis was 9 years (range: 4 months to 27 years). The means \pm SDs of right and left VEP P100 latency were 126.37 ± 16.84 milliseconds and 130.08 ± 19.92 milliseconds, respectively. The mean \pm SD of GVP, MRVP, and VMI scores were 91.87 ± 16.14 , 98.16 ± 13.33 , and 86.12 ± 20.52 , respectively.

As table 1 shows, right VEP P100 latency was significantly negatively correlated with GVP, and right VEP P100 latency was significantly negatively correlated with scores on the VMI subtest of DTVP-A, with coefficients of determination of 20% and 24%, respectively. However, there was no significant relationship between left VEP P100 latency and DTVP-A scores.

Discussion

Two notable statistically negative and moderate relationships were found: one between right VEP P100 latency and total DTVP-A scores, another between right VEP P100 latency and VMI. Left VEP was not correlated with DTVP-A scores. To the best of our knowledge, this study is the first to investigate the relationship between optic nerve conduction and visual perception among patients with MS.

Abnormalities in primary visual functions such as impairments in visual acuity, contrast, and color discrimination as well as the prolonged latency of nerve conduction are the characteristics of MS due to ON.^{1,2} These manifestations are sometimes accompanied with higher-order visual perception deficits with or without cognitive disorders.⁴ In the current study, participants with more visual perception disorders had greater P100 delays. This could be due to the reduction of bottom-up connectivity with the right lateral occipital complex (LOC) and visuospatial systems.⁹ Barton et al. reported that prolonged VEP latency was a biomarker of optic nerve demyelination.³ Consistent with Barton et al.³ and Cooray et al.,⁹ the current study indicates that visual input deficiencies may affect visual perceptions.

This study had several limitations. First, the small sample size and non-randomly sampling limit its generalizability. Furthermore, we did not assess visual perceptions using objective measures to monitor brain activity. In addition, our inclusion criteria were based only on a history of blurred vision diagnosed by an expert neurologist. ON diagnosis based on the diffusion tensor imaging of optic radiations and optical coherence tomography (OCT) is recommended for future research.

Conclusion

The findings of this study show a moderate correlation between DTPV-A and VEP P100 latency in people with MS caused by ON. However, more investigations in this issue are needed. This study can be a starting point for research in this field.

Conflict of Interests

The authors declare no conflict of interest in this study.

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Table 1. Correlation between the Developmental Test of Visual Perception-Adolescent and Adult (DTVP-A) and visual evoked potential (VEP) in people with multiple sclerosis (MS) (n = 24)

DTVP-A	VEP		Left P100		Right N70		Left N70	
	r	P	r	P	r	P	r	P
GVP	-0.450	0.03	-0.153	0.48	-0.283	0.18	0.150	0.48
MRVP	-0.240	0.26	0.163	0.45	-0.142	0.51	0.250	0.24
VMI	-0.485	0.01	0.322	0.13	-0.300	0.16	0.050	0.82

VEP: Visual evoked potential; DTVP-A: Developmental Test of Visual Perception-Adolescent and Adult; GVP: General visual perception; MRVP: Motor-reduced visual perception; VMI: Visual-motor integration

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