CASE REPORT

Oculomotor Dysfunction in Parkinson's Disease

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Abstract

Parkinson's disease and associated wide variety of ocular features are very common. One of the most notable findings includes oculomotor. Since reading includes a proper synchronization of accommodation, vergence and versional movements, thus, a defect in any of this system will impair one's ability to read and track letters while reading and writing. A comprehensive oculomotor assessment is an essential element in diagnosing any underlying oculomotor defect in Parkinson's disease.

Keywords: Parkinson's disease, reading difficulty, Developmental Eye Movement test

Introduction

Parkinson's disease is a neurodegenerative disorder associated with a wide spectrum of motor symptoms which includes tremor, bradykinesia, rigidity and non-motor symptoms which includes cognitive impairment, sensory dysfunction and visual hallucinations (1-3). Visual problems associated with Parkinson's are very common and can either be linked with retinal dopamine depletion or reduced dopaminergic innervation of the visual cortex (4,5). The dopamine also has an effect in various vision processes such as oculomotor control, colour vision, contrast sensitivity and spatial working memory (6,7). The oculomotor function of one's eye is responsible for various activities like reading, focusing an object at distance and near, seeing objects in an around. Any disturbance to this network would have an impact of daily activities.

Case Report

Fifty nine year old female reported to the outpatient department with a complaint of losing track while reading and difficulty performing tasks in dim illumination. She denied any history of ocular and head trauma. No surgery history was also noted. She reported being diagnosed with Parkinson's disease since past one year of visit and was under medications for the same. She was also on physiotherapy and speech therapy for the same. On observation it was noticed that she had a mild tremor on her hands, bradykinesia and slurring of speech. Informed consent was obtained from her prior proceeding to the testings. Her best corrected visual acuity was 20/20 with a distance correction of +1.75DS/-0.50DC x 90 in both eyes. Near visual acuity was N6 with an addition of +2.75D. Cover test revealed a near exophoria. Extra-ocular motility showed a restriction in the up gaze, dextroelevation and levoelevation. On measuring the convergence amplitude with an accommodative target along with her habitual prescription, a poor convergence amplitude was found i.e. >30 centi-meter and on measuring the same with red-green glass it was noted that the patient did not appreciate red and green lights together and had actually suppressed one eye due to poor convergence. Saccades and pursuits were poor based on Northeastern State University College of Optometry scores. Developmental eye movement (DEM) test showed delayed horizontal and vertical test timing and an abnormal ratio scores. Pupillary assessment revealed normal reacting pupil in both eyes with no afferent pupillary defect being present. Slit lamp examination showed normal ocular adnexas. Intra-ocular pressure of both eyes was within normal limits. No visual field defect was noted. Dilated fundus examination showed normal appearing fundus and normal cup-disc ratio. The oculomotor evaluation values are tabulated in Table 1. The diagnosis of oculomotor deficit secondary to Parkinson's was made due to reduced convergence ability, poor saccades and pursuits, reduced DEM scores and reading ability.

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Table 1. Oculomotor evaluation of the patient	
Diagnostic tests	**Values**
Cover test-distance	Orthophoia
Cover test-near	8 exophoria
Convergence amplitude (accommodative target)	23 cm
Convergence amplitude (red-green target)	>30 cm
Reading rate with English text	23 words/minute
Reading rate with local language	29 words/minute
Saccades NSUCO grading-ability Saccades NSUCO grading-accuracy Saccades NSUCO grading-head movements Saccades NSUCO grading-body movements	3 3 3 4
Pursuits NSUCO grading-ability Pursuits NSUCO grading-accuracy Pursuits NSUCO grading-head movements Pursuits NSUCO grading-body movements	2 2 3 4
DEM vertical time (test A+B)	58 seconds (<1%, percentile score)
DEM horizontal time (test C)	74 seconds (<1%, percentile score)
DEM ratio score	1.27 (4%, percentile score)
NSUCO: North-eastern State University College of Optometry, DEM: Developmental eye movement	

The patient was then trained with home based vision therapy to enhance the convergence amplitude as well as to improve the saccadic and pursuit pattern. A follow-up of 6 months was also scheduled.

Discussion

The novelty of this case is to highlight the necessary oculomotor testing pattern in a patient with Parkinson's. Despite using a proper refractive correction, the patient experiences reading problem. Slowing in the reading pattern might be attributed due to poor accommodation and vergence as well as eye movements. A longer duration of fixations and poor saccades in patients with Parkinson's has been reported to contribute towards poor reading (8). A study by Jehangir et al. (9) revealed that patients with Parkinson's exhibit a slower saccadic reading. In contrast to this, in this case the patient also exhibited a poor saccadic and pursuit ability and accuracy. The pursuit ability is the number of rotations made on pursuits and the saccadic ability is the number of saccadic round trips made on saccades. Similarly the accuracy of saccades is the amount of overshooting and undershooting, while the accuracy of pursuits implies the number of target losses or refixations on making a pursuit movement. The head and body movements are the qualitative grading made during the measurements. The responses were noted on a scale of five where five being the highest score with good eye movements and one for the least. This gave an indication of the hampered oculomotor system where the ability and accuracy were extremely poor.

Similarly in DEM testing the percentile scores of horizontal and vertical time as well as the ratio score was below the mean

percentile rank (<1% for horizontal and vertical time and 4% for ratio score). Assessment of vertical time is important since it determines the naming speed or automaticity of an individual. Likewise, the horizontal time evaluates the naming ability in a horizontal spatial array. The horizontal time, vertical time and the ratio score of the patient were below the age level i.e. for highest grade level, the patient's performance is lower than the expected age level with impaired level scores that indicates a deficiency in both automaticity and oculomotor skills, thus influencing her reading rate too.

On the other hand convergence insufficiency also has an impact on reading performance of an individual. Poor convergence in Parkinson's is well studied in the previous literatures (10,11). A study by Irving et al. (12) have reported a higher prevalence of convergence insufficiency in patients with Parkinson's as compared to the normal. The patients had significant amount of reduced convergence amplitude along with higher exophoria for near and reduced positive fusional vergence when compared to the controls. A similar pattern of reduced convergence amplitude with near exophoria was also seen in this case that contributed towards a poor oculomotor control.

DEM test is a validated and reliable method to measure the indirect oculomotor performance (13). A study by Palomo-Álvarez and Puell. (14) found poor readers have a reduced horizontal test timing in DEM impairing their reading speed. Likewise Adler-Grinberg in their study has also found that poor readers exhibits short saccades, longer fixations and more regressions than the normal (15). Thus a DEM test along with an appropriate measurement of saccades and pursuits provides

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a gross deficit of the oculomotor system and can be useful in conditions affecting the same such as traumatic brain injury, Parkinson's disease, dyslexia and associated binocular vision anomalies.

Ethics

Informed Consent: Informed consent was obtained from her prior proceeding to the testings.

Peer-review: Internally peer-reviewed.

Financial Disclosure: The author declared that this study received no financial support.

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