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Visual evoked potential in Parkinson's Disease Patients

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Abstract:

Introduction: Individuals suffering from Parkinson's Disease (PD) frequently complain about their inability to perform visual tasks like using maps and navigating around everyday environments, which negatively impacts their life quality.

Aim of the study: Assessment of visual pathway using visual evoked potential (VEP) and correlate its parameters with the clinical data of the patients.

Subjects and Methods: Thirty PD patients and thirty genders and age-matched normal individuals were included for comparison. A full history taking, a comprehensive neurological and general examination, and an evaluation of the disease severity utilizing the Unified Parkinson's Disease Rating Scale (UPDRT) were performed on each patient. PD patients and the control group were subjected to an assessment of the evoked potential changes using VEP.

Results: lower mean amplitude and higher mean latency of P100 of VEP among patients with PD. No statistically significant difference in P 100 (amplitude and latency) in different genders, in different sides of onset, in different clinical phenotypes, and the age of PD patients. There was a statistically significant positive correlation between P100 latency and the duration of disease as well as disease severity assessed by total UPDRS. On the other hand, no statistically significant correlation between P100 amplitude and duration or severity of disease was found.

Conclusions: In patients with PD visual pathway is impaired. this impairment is more with disease severity and with increased disease duration. visual evoked potential assessment (P100 Latency) can be used as a marker for PD severity and progression.

Keywords: visual evoked potential; Parkinson's disease; P100.

1. Introduction

Reduced life quality secondary to non-motor symptoms in patients suffering from PD is now widely recognized. Furthermore, to symptoms related to gastrointestinal, cognitive, and autonomic dysfunction, visual symptoms are commonly reported [1,2].

According to questionnaire research, 78% of PD patients reported one visual symptom at least, such as reading difficulties, as well as inaccurate perception of distances and objects [3,4].

Parkinson's disease also frequently causes visual hallucinations, with a reported incidence of up to 74% after 20 years of disease onset [5]. Despite numerous theories, the fundamental mechanisms are still not fully understood [6].

Parkinson's disease dementia is known to cause visuoperceptual issues, yet there is rising evidence that the disease may alter visual processing earlier in its course [1].

The alterations in the visual cortex that follow retinal exposure to light stimuli are known as the visual evoked potential, and they reflect the integrity state of the visual pathway. Compared to VEP amplitude, VEP latency appears to be a more reliable indicator of foveal electrical status and is less impacted by dopaminergic medications. Conduction delay in visual pathways impacted by demyelination and/or plaque can be the cause of abnormal latency. Because of the relatively small individual variability, the P100 latency of VEP is typically utilized to diagnose problems of the visual pathway [7].

The current research aims to assess visual pathways using visual evoked potential (VEP) and correlate its parameters with the clinical data of the patients.

2. Subjects and Methods

2.1. Subjects

Between March 2019 and January 2021, a case-control cross-sectional study was carried out at Fayoum University Hospital, Department of Neurology. In this research, thirty PD patients of both sexes participated. Thirty healthy volunteers who were matched for age and sex were chosen as the comparative group.

Inclusion and Exclusion criteria

PD Participants in this research were diagnosed according to the United Kingdom Parkinson's Disease Society Brain Bank [8].

Participants with marked visual impairment that interferes with PR-VEP assessment were excluded.

2.2. Study design

Patients were classified into two groups depending on their major motor sign: group 1 was known as a bradykinesia-rigidity dominant phenotype (BRD), and group 2 was known as a tremor dominant (TD) phenotype [9].

A full history taking, a comprehensive neurological and general examination, and an evaluation of the disease severity utilizing the Unified Parkinson's Disease Rating Scale (UPDRT) were performed on each patient. PD patients and the control group were subjected to visually evoked potential recordings using the Nicolet Viking Quest evoked potential system. We evaluated the peak latency of the point of maximal positivity (P100) and its amplitudes. The amplitude was estimated from the previous negative peak (N75) to the trough of P100 [10].

2.3. Statistical Methods

Before being input into Microsoft Access and analyzed using SPSS V22 (SPSS Inc., Chicago, Illinois, USA), the data were gathered and coded to enhance data processing. The qualitative data was subjected to a basic descriptive analysis, using percentages and numerical values. The p-value has a statistical significance of 0.05. The standard deviation was used to quantify the quantitative parametric data, whereas the dispersion arithmetic mean was utilized to assess the central tendency. Before undertaking inferential statistical analysis, the researchers used the one-sample Kolmogorov-Smirnov test to evaluate the

normality of the quantitative data within each study group. The bivariate Pearson correlation test was utilized by the investigators to evaluate the association between the parameters.

3. Results

This study included thirty PD cases of both genders and thirty healthy subjects matched for age and sex as a comparison group. The disease started on the right side in 17 (56.7%) patients, and in 13 patients (43.3%) it started on the left side. Other baseline characteristics in our study are illustrated in **Table 1** and **Figure 1**.

Table 1. Demographic data of the participants and baseline characteristics.

Variables		Range	Mean ±SD
Age (years)	Case	51 -77	53.6 ±12.9
	Control	34 -78	55.4 ±13
Unified Parkinson's Disease rating scale	MBM	1 -9	3.5 ±2.1
	DLA	5 -30	14.3 ±6.8
	Motor	9 -78	34.1 ±20.5
	Complication	0 -11	4.2 ±2.5
	UPDRS	18 -117	56.7 ±29.5
Duration of disease (years)		0.5 -9	3.5 ±2.8
Latency of VEP	Case	109.4 -130.95	119.6 ±6.2
	Control	84.6 -98.05	91.5 ±4.2
Amplitude of VEP	Case	3.35 -8.04	5.7 ±1.4
	Control	5.5 -9.04	7.8 ±1.9

MBM: Mentation, behavior, and mood scale, DLA: Daily Living activities, UPDRS: Unified Parkinson's Disease Rating Scale.

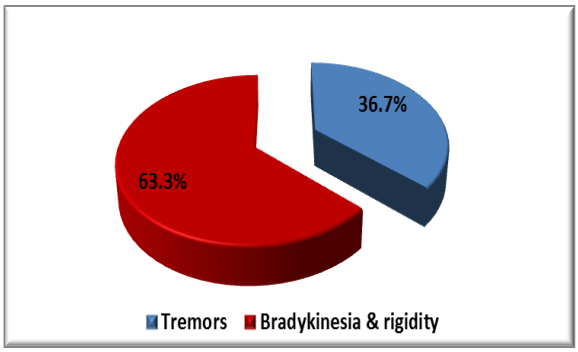

Figure 1: Clinical phenotype among cases.

Comparing VEP (P100 latency and amplitude) among the patients and the controls illustrated statistically significant variations with mean P100 latency being higher and P100 amplitude being lower among PD patients **(Table 2).**

Table 2. Comparisons of VEP parameters in different study groups.

VEP	Cases (N=30)	Control (N=30)	*P*-value
P100 amplitude	5.7 ±1.4	7.8 ±1.9	<0.001*
P100 latency	119.6 ±6.2	91.5 ±4.2	<0.001*

** significant.*

Comparing VEP (P100 amplitude and latency) between the patients as regards Clinical characteristics of the disease and demographic distribution revealed no statistically significant variations (**Table 3**).

Table 3: Comparisons of VEP as regards Clinical characteristics of the disease and demographic distribution.

Variables		P100 amplitude	*P*-value	P100 latency	*P*-value
Sex	Male	5.4 ±1.3	0.4	119.8 ±6.9	0.8
	Female	5.9 ±1.6		119.4 ±5.8	
Side of onset	Right	5.7 ±1.5	0.9	119.3 ±5.9	0.8
	Left	5.7 ±1.4		119.9 ±6.7	
Clinical phenotypes	Tremors	6.4 ±1.2	0.06	116.7 ±7.5	0.06
	Bradykinesia & rigidity	5.3 ±1.5		121.2 ±4.8	

The age of the cases showed no statistically obvious relationship with the VEP (P100 amplitude and latency). A statistically obvious positive connection was seen between the duration of the disease and P100 latency (**Table 4**).

Table 4: Correlation between VEP and PD patients.

Variable	P100 amplitude		P100 latency	
	R	***P*-value**	R	***P*-value**
Age (years)	-0.10	0.6	0.33	0.07
Duration of disease (years)	0.008	0.9	0.63	<0.001*

** significant.*

A statistically significant positive connection (p <0.05) was found between P 100 latency and the severity of the disease determined by the overall UPDRS and its subscales. There was a statistically marked negative connection between P100 amplitude and the motor subscale's assessment of disease severity **(Table 5 and Figure 2).**

Table 5: Correlation between VEP (P 100 amplitude and latency) and severity of the disease.

Variables	VEP			
	P100 amplitude		P100 latency	
	R	P-value	R	P-value
Unified Parkinson's Disease rating scale				
MBM	-0.18	0.4	0.66	<0.001*
DLA	-0.25	0.2	0.77	<0.001*
Motor	-0.37	0.04*	0.89	<0.001*
Complication	-0.32	0.09	0.68	<0.001*
UPDRS	-0.36	0.06	0.91	<0.001*

MBM: Mentation, behavior, and mood scale, DLA: Daily Living activities, UPDRS: Unified Parkinson's Disease Rating Scale.

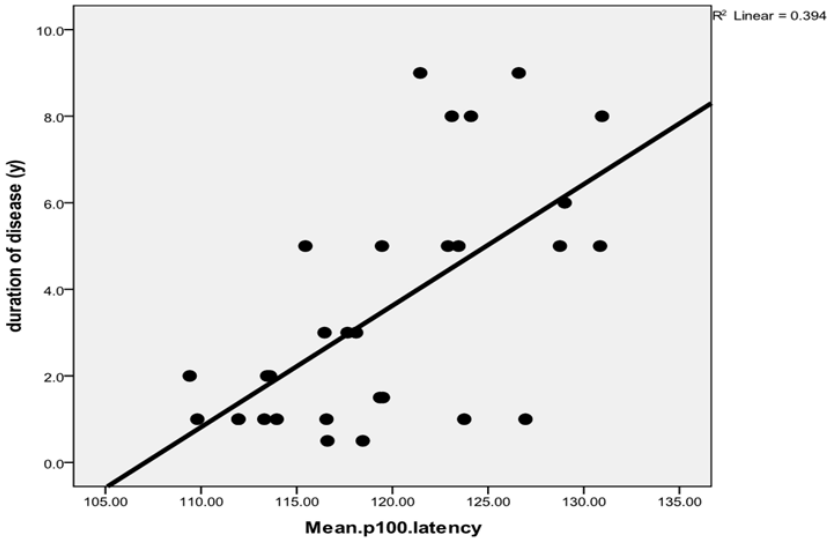

Figure 2: Correlation between mean p 100 latency and duration of the disease.

4. Discussion

Visual dysfunction is frequently reported in PD patients. The minimal visual impairment associated with PD may be readily identified using electrophysiological testing, like the visual evoked potential (VEP) [11]. It was suggested that retinal dopamine deficit was the major source of these visual disorders in PD; nevertheless, the specific core pathogenesis remains unclear [12]. In this study, PD patients were found to have a statistically significant delayed P100 latency and lower amplitude than controls in agreement with Liu]10] and Nassar [13] who reported delayed latency of P100 in PD patients relative to healthy controls and Pari [14], Hasanov [15] who found low P100 amplitude in PD patients.

Retinal dopamine lack in PD patients [12], a decrease in dopaminergic activity in the visual cortex and a reduction in the visual cortex's metabolism could all account for these VEP abnormalities [14].

The present study observed no statistically significant difference in P100 (latency and amplitude) in different sides of onset or different genders, in concordance with Sener [16], who discovered no variation in VEP latency or amplitude between patients with various sides of onset, and with Talebi [17] who discovered no meaningful correlation between the PD patients' gender and VEP results. Dopaminergic neurons degenerate

throughout the brain in PD, particularly in regions like the retinal ganglion cells and dopaminergic amacrine cells [18]. This explains motor symptoms and associated VEP changes which are not dependent on the patient gender or side of onset.

This study showed no statistically significant correlation between P100 (amplitude and latency) and the age of PD patients in contrast to Pari [14] and Sener [16]. This contradiction could be explained by different sample sizes with different ages included in those studies, longitudinal studies with larger sample sizes and more variable ages may yield more information.

In this study, in agreement with Garcia-Martin [18] and Nassar [13], it was found that there was a statistically significant positive association between P100 latency and PD duration. This could be attributed to associated progressive degenerative alteration in the retinal amacrine cells in PD patients with longer PD duration [19].

However, this research could not detect any statistically significant association between P100 amplitude and disease duration in contrast to Nassar [13] who found a negative correlation between disease duration and reduced P100 amplitude. This research could not also detect any significant association between P 100 amplitude and the disease severity evaluated by severity scales in contrast to Nassar [13] who found a statistically significant negative association between P 100 amplitude and the disease severity. This contrast could be explained by the cross-sectional design of our research may limit the findings that could be obtained. Prospective longitudinal research with long-term follow-up, to determine any correlation between disease duration, severity, and P100 amplitude would be better to perform

Patients with PD can be classified into non-tremor-dominant and tremor-dominant subgroups based on the primary motor symptoms [8]. This research could not identify any significant variation between VEP (amplitude or latency) and patients presented mainly with tremor and those presented mainly with bradykinesia and rigidity in contrast to Sener [16] who found a significant positive correlation with P100 amplitude and bradykinesia. This contrast could be attributed to the different sample sizes included in both studies.

5. Conclusion

In patients with PD visual pathway is impaired. this impairment is more with disease severity and with increased disease duration. visual evoked potential assessment (P100 Latency) can be used as a marker for PD severity and progression.

Further studies with larger sample sizes of healthy subjects and PD patients are recommended to explore the possibility of VEP assessment as a reliable marker of disease severity and progression.

Ethical approval and consent to participate: February 17, 2019, by the study Ethical Committee of the Faculty of Medicine at Fayoum University, with session number D192.The participants were supplied with detailed information on the objectives, evaluations, and research inquiries, and all of them gave written, informed consent. The confidentiality of personal information and the right to decline participation in the study were considered.

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Conflicts of Interest: All authors declare they have no conflicts of interest.

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