e-ISSN: 0976-822X, p-ISSN:2961-6042

Available online on http://www.ijcpr.com/

International Journal of Current Pharmaceutical Review and Research 2024; 16(5); 439-443

Original Research Article

Association of Auditory P300 Latency Waves with Severity of OCD: A Comparative Analysis between OCD Patients and Healthy Controls

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Received: 10-03-2024 / Revised: 16-04-2024 / Accepted: 24-05-2024
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Conflict of interest: Nil

Abstract

Background: OCD is characterized by disruptions in brain circuits impacting cognitive and metacognitive functions. The neuroanatomical hypothesis suggests that irregular activity in fronto-striatal networks contributes to OCD symptoms.

Methodology: This cross-sectional comparative study enrolled 30 OCD patients and 30 matched controls. Participants were evaluated using the Y-BOCS scale and P300 auditory event-related potentials. Ethical considerations and statistical analyses were addressed meticulously.

Results: Significant differences emerged between case and control groups in family history of OCD (36.7% vs 10%, p = 0.015). OCD patients exhibited shorter mean P300 latencies compared to controls (248.743 vs 295.399, p=0.011). Moreover, correlations were observed between P300 latencies and illness duration and YBOCS scores.

Discussion: Demographic characteristics in the case group aligned with previous studies, indicating a diverse representation. Notably, the study found a higher prevalence of OCD patients from rural backgrounds, possibly indicating increased psychiatric awareness. The severity of OCD symptoms correlated with P300 latencies, implying cognitive alterations in patients. Familial OCD history also demonstrated an impact on cognitive processing.

Conclusion: OCD patients exhibit cognitive processing differences reflected in shorter P300 latencies. P300 latency variations relate to illness duration and severity. Emphasizes investigating cognitive markers for understanding OCD and potential clinical implications.

Keywords: cognitive processing, y-bocs, cstc circuits, p300 latency, ocd

Introduction

Obsessive-compulsive disorder (OCD) is a psychiatric disorder involving neurobiological dysfunctions of front striatal neural networks. It has been seen that OCD is caused by abnormal activity in the corticostriato-thalamo-cortical (CSTC) circuits which includes the orbitofrontal cortex (OFC), the striatum within basal ganglia and the thalamus [1,2] that is summarised as the neuroanatomical hypothesis. It was assumed that OCD symptoms may be related to increased activity in the OFC due to diminished inhibitory effects of the striatum on the thalamus. Furthermore, this hypothesis suggests that OCD could be related to dysfunctional cognitive and metacognitive processing. It is proposed that P300 is generated in the medial temporal lobe, OFC and cingulate cortex. So P300 component of auditory event-related potentials (ERPs) could be a suitable tool to investigate the proposed OFC hyperactivity in OCD patients [3].

We propose the hypothesis that a change in latency P300 wave indicates that the subject is not cognitively processing the evoking stimulus appropriately. In OCD patients have difficulty paying attention and concentrating only on target stimuli because of problems in frontal inhibitory control which may result in an abnormal latency P300 wave. Treatment with serotoninergic drugs may improve cognitive processing that results in a latency P300 wave similar to that of normal controls. The purpose of the present study was to investigate the potential change of latency P 300 in OCD patients, compared to healthy controls.

Materials and Methods

Study Design:

The present study is a cross-sectional comparative hospital-based study which was conducted in the Psychiatry and Physiology Department of the Institute of Medical Sciences, Banaras Hindu University, Varanasi. The sample was collected from 1 January 2020 to 30 March 2021. The subjects were taken from the outdoor and indoor services of the Department of Psychiatry, IMS, BHU, Varanasi. The sample included 30 subjects of OCD as cases and 30 subjects as control were taken from persons accompanying the patient but were not relatives of the patients. All the subjects were self-referred and were taken into the study after they met the exclusion and inclusion criteria. The data were collected using the convenience sampling method. The study was a part of the MD thesis, which had a specific time limit so the sample size was limited.

Ethical Consideration: The Institute of Medical Sciences at Banaras Hindu University in Varanasi provided ethical guidance, requiring participants to give consent before data collection, and maintaining privacy and confidentiality throughout the investigation.

Inclusion Criteria: Age 16 to 40, duration of illness greater than six months, and minimum education up to the tenth grade were all agreed upon by the patients when giving their consent.

Control Group: 30 normal control subjects were selected from patients' attendants matching the study group for age, gender, and years of education.

Exclusion Criteria: Patients having co-morbid physical, organic or other psychotic disorders.

Instruments and Tools: Age, sex, religion, marital status, education, occupation, monthly income, and domicile were among the sociodemographic characteristics that were gathered using a semi-structured sociodemographic proforma. The interviewer created the study's interview schedule. The assessment of the study subjects' clinical symptoms was done using a clinical profile sheet.

Yale-Brown Obsessive-Compulsive Scale (Y-BOCS) [4]: The obsessions subscale and the compulsions subscale are the two sections of the scale, each consisting of five questions. Five elements of pathology—time spent, degree of interference, distress, resistance, and perceived control over the symptoms—are scored on a 4-point scale for each subscale, with 0 representing no symptoms and 4 representing severe symptoms.

P 300 [5]: An association between attention, discrimination, stimulus detection, and memory processing is the P300 event-related potential, a late cognitive-related potential. It was carried out utilising the odd-ball paradigm methodology on the Nicolet Viking IV evoked response apparatus. Patients were periodically exposed to a stimulus with a varying pitch or strength in addition to receiving auditory stimuli at regular intervals. To differentiate and count the uncommon stimuli was required by them. Ear lobule or mastoid reference was used to record responses from the Fz, Cz, and Pz electrodes on the scalp using the standard 10-20 international system. P300 latency was noted and marked to calculate average responses to 400 stimuli (in milliseconds).

Method: The individuals were screened from psychiatry OPD IMS, BHU, Varanasi, and cases meeting ICD-10 criteria of OCD. The subjects were split into case and control groups. After meeting the inclusion and exclusion requirements, subjects were ultimately chosen. The Physiology Lab evaluated the P300 latency wave after the Psychiatry section applied the Y-BOCS scale.

Statistical analysis: The data was analysed using SPSS version 23.0 for the window, and comparison tests, whether parametric or nonparametric, were employed. A value of $P < 0.05$ was considered statistically significant.

Results

There were 60 individuals in all (30 in the case group and 30 in the control group). The case and control groups had a preponderance of male participants (53.3 % and 66.6 %), single participants (53.3 % and 66.6 %), participants from rural backgrounds (56.6 % and 53.3 %), participants who identified as Hindu (90 % and 93.3 %), participants who belonged to nuclear families (73.3 % and 56.6 %), students (33.3 %), and participants with middle-class socioeconomic status (73.3 % and 90 %), respectively. The patient and control groups' family histories of OCD differed statistically significantly (36.7 % vs. 10 %, $p = 0.015$). (Table 1).

The case group's participants were mostly in the moderate YBOCS category (60 %), with severe YBOCS (33.3 %) and mild YBOCS (6.67 %). The mean P-300 latencies in the case and control groups

differed statistically significantly (248.743 vs. 295.399, p = 0.011). (Table 2).

A statistically significant decrease in mean P-300 latencies was seen in the duration of illness, 260.5623 for one to five years, 198.7100 for more

than five years, and less than a year (276.1444) (p = 0.010). A statistically non-significant negative connection was seen between the mean P-value of 300 latencies and the severity of the YBOCS score. Patients with light scores had mean P-300 latencies of 295.495; those with moderate scores, 257.3694; and those with severe scores, 223.865 (P = 0.178). (Table 3)

Table 1: Socio-demographic profile of participant		**Case**		**Control**		**P value**
		N	**%**	**N**	**%**	
Gender	Male	16	53.3	20	66.6	0.292
Marital	Single	16	53.3	20	66.6	0.292
	Married	14	46.6	10	33.3	
Domicile	Urban	13	43.3	14	46.6	0.795
	Rural	17	56.6	16	53.3	
Religion	Hindu	27	90	28	93.3	0.640
	Muslim	3	10	2	6.7	
Family type	Nuclear	22	73.3	17	56.6	0.273
	Joint	8	26.7	13	43.3	
Education	High-school	14	46.6	11	36.6	0.698
	Intermediate	11	36.6	14	46.6	
	Graduate	5	16.6	5	16.6	
Occupation	Unemployed	2	6.6	5	16.6	0.192
	Student	10	33.3	11	36.3	
	Homemaker	10	33.3	6	20	
	Farmer	5	16.6	3	10	
	Skilled worker	1	3.3	1	3.3	
	Shopkeeper	2	6.6	3	10	
	Professionals	0	0	1	3.3	
Socio-economic status	Upper	0	0	0	0	0.192
	Upper middle	6	20	10	33.3	
	Lower middle	16	53.3	17	56.6	
	Upper lower	8	26.6	3	10	
H/o Substance abuse- present		5	16.6	6	20	0.488
Family H/O OCD -present		11	36.7	3	10	0.015
Family support -present		25	83.3	30	100	0.020

Table 2: Clinical characteristics of patients and control subjects		**Case (30)**		**Control (30)**		**P value**
		N	**%**	**N**	**%**	
YBOCS Score	Normal	0	0	30	100	0.000
	Mild	2	6.67	0	0	
	Moderate	18	60	0	0	
	Severe	10	33.33	0	0	
P 300 Latencies Mean with standard deviation (milli second)		248.7430±58.49980		295.3993±77.45874		0.011

Table 3: Mean P300 latencies with severity of illness		N	Mean P 300 Latencies with Standard Deviation (milli second)	P value
Duration of illness	< 1 year	9	276.1444 ± 23.07852	0.01
	1- 5 years	13	260.5623 ± 73.05250	
	>5 years	8	198.7100 ± 8.29757	
YBOCS Score	Mild	2	295.4950 ± 1.02530	0.178
	Moderate	18	257.3694 ± 67.81249	
	Severe	10	223.8650 ± 31.91715	

Discussion

In our study, 53.3 % of participants were male and 46.6 % were female in the case group, compared to 66.6 % male and 33.3 % female in the control group (p= 0.292). According to a Kim et al. study, the OCD and control groups differed in terms of mean age, years of schooling, and parental SES [6].

Our research revealed that 36.7% of individuals in the case group and 10% of participants in the control group, respectively, had a family history of OCD. It implies a strong hereditary predisposition to OCD. Numerous prior research has demonstrated that first-degree relatives are more likely than the overall population to experience OCD, which validates our findings. Black et al. [7] discovered that first-degree relatives had a far higher incidence of OCD than did normal control subjects (10 % vs 1.9 %). Based on our research, 83.3 % of participants in the group had family support, and 16.7 % did not have any, whereas 100% of participants in the control group had family support. This result might be explained by the community's lack of knowledge about OCD and the association some people made between religious concerns and their compulsive cleaning and washing habits.

Using the Yale-Brown Obsessive-Compulsive Scale, the participants' OCD severity was evaluated. Within the case group, the YBOCS scale revealed that 60% of participants had mild grade severity, 33% had severe grades, and 6% had moderate grade severity. In the control group, all participants fell into the normal category. Corresponding results have been shown by Kumar et al [8].

The mean P 300 latency in the case group was 248.743, but the control group's mean P 300 latency was 295.399 (p=0.011), according to our research. Our research revealed that during an auditory oddball test, OCD participants had a shorter P300 latency than normal subjects. Our results corroborate those of earlier ERP research conducted on OCD patients by Towey et al [9].

Our research indicates that the mean p300 latency among OCD patients is negatively correlated with the duration of their illness. Within the case group, p300 latency was found to be 276.144 for 30% of patients with a duration of illness less than a year, 260.562 for 43.3 % of cases with a duration of illness between 1 and 5 years, and 198.710 (p=0.010) for 26.6 % of cases with a duration of illness greater than 5 years. The study conducted by Andreou et al. demonstrated a correlation between disrupted P300 activity and electrical activity in brain regions that are thought to have a negative role in the pathophysiology of OCD [10].

The severity of illness within cases and mean p300 delay did not significantly correlate, according to our research. In the case group, 6.6% of cases with mild severity in the YBOCS score had a mean p300 latency of 295.495, 60% of cases belong to moderate severity in the YBOCS scale with a mean p300 latency of 257.495 and 33.3% of cases belong to the severe category in YBOCS scale with mean p 300 latency of 223.865. (p=0.031). Likewise, Miyata et al. [11] could not discover any connection between the intensity of OCD symptoms and ERP abnormalities

Strength of the study: The use of recognised and standardised instruments is one of the study's advantages (YBOCS and mean P300 latency). Since a single investigator conducted the study, any potential for investigator bias was reduced. We properly specified the study's purpose and research query in our investigation.

Limitation of the study: Since we used samples from patients on regular medication or who were being monitored, the impact of the medicine on cognition was not ruled out in our investigation. Many other neuropsychological tests could not be used because of time and resource constraints. The majority of the individuals in the clinic sample for the study were receiving regular medication and follow-up, thus it's possible that these results cannot be applied to other OCD patients who are drug-naive.

Conclusion

Patients with OCD experience substantial disruptions in their ability to absorb information, making it impossible for them to recognise pertinent cues. Our research, which shows that an earlier P300 latency wave appeared in comparison to the control groups, supports this. Additionally, notable variations in P300 latency were observed in the

duration and severity of OCD patients; these results were consistent with the cognitive abnormalities observed in OCD patients with the parameters mentioned above.

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