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Research Paper

The Effectiveness of Transcranial Direct Current Stimulation on the Pattern of Quantitative Electroencephalography and the Symptoms of Patients with Obsessive-Compulsive Disorder

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Abstract

The purpose of this study was the effectiveness of tDCS on the quantitative electroencephalography (QEEG) and the symptoms of patients with obsessive-compulsive disorder (OCD). The study was quasi-experimental, pretest-posttest design with control group. From patients with OCD referred to psychiatric and psychological clinics in Kerman during 2019-2020, 40 patients were selected by available and purposive sampling, were assigned in to experimental and control groups. After recording QEEG data from 19 locations of their brains. In the experimental group, based on QEEG, for each patient was assigned a treatment protocol and this group underwent tDCS treatment, 25 sessions, 60min. Participants were evaluated twice by The Yale-Brown obsessive-compulsive scale and QEEG recording, data were analyzed by covariance analysis and paired-samples t test. The results showed that tDCS was effective in modifying the brain wave pattern and improving the symptoms of OCD patients.

Keywords: Obsessive-Compulsive Disorder, Quantitative Electroencephalography, Transcranial Direct Current Stimulation

Introduction

Due to the high prevalence of obsessive-compulsive disorder (OCD), recently, experts have paid with more attention to the neuropsychological functions of the brain involved in obsessive-compulsive symptoms and assess the abnormalities of brain waves through quantitative electroencephalography (QEEG) (Brunelin, et al., 2018). Studies examining the QEEG pattern of OCD show that in different patients, malfunctioning brain waves are seen in different forms and in different areas of the brain; including hyperactivity in the Orbitofrontal cortex and decreased activity in the pre-supplementary motor area (Green, et al., 2020), and high activity of delta and theta waves in medial frontal cortex (Kamaradova, et al., 2018). Due to the involvement of different areas of the brain with OCD, it is necessary to pay attention to the QEEG of each person to develop a treatment protocol. If the QEEG indices of these people can be changed, it is possible to improve the obsessive-compulsive syndrome of patients; This is possible with transcranial direct current stimulation (tDCS). So far, various protocols of this treatment have been studied to improve OCD; including anodal stimulation over the pre-supplementary motor area with the cathode positioned over the orbitofrontal cortex (Green, et al., 2020), and cathodal stimulation in orbitofrontal cortex and anodal stimulation in O2 (Ensafi, et al., 2019). Although there are different forms of brain wave abnormalities in different regions, in previous studies, regardless of each patient's QEEG and examination of all areas of the brain, the same protocol has been used to tDCS for all patients. Also, the effect of

this treatment on QEEG indices of OCD patients has not been studied in any study. Therefore, in this study, we decided to evaluate the effectiveness of tDCS treatment on QEEG indices and improve the symptoms of people with OCD by considering their QEEG.

Method

It was semi-experimental research with pretest- posttest, along with a control group waiting for treatment. The study population includes all patients with OCD referred to psychology clinics of Kerman in 2019-2020. From the clients of Peivand Counseling Center of Kerman, 40 patients with OCD were selected using available and purposeful sampling and were divided randomly into two groups of 20 individuals, one experimental group and the other control group waiting for treatment later on. After OCD was diagnosed, their brain waves were measured using QEEG. Then in the experimental group, tDCS was performed in 25 sessions of 60 minutes. Due to the malfunctions observed in the QEEG of each patient, the protocols considered in this study included the anodal stimulation in CZ region and the cathodal stimulation in FP1 or FP2 regions, and the anodal stimulation in FZ region and the cathodal stimulation in the FP1 or FP2 regions. In some cases, where abnormalities were not observed in FP1 or FP2 regions, the cathode electrode was placed on the chin (Otmer, 2018). The tools were:

The Yale-Brown Obsessive-Compulsive Scale (Y-BOCS): It consists of 10-items for both obsessive thoughts and compulsive actions. Its reliability with 40 patients was 0.98 and internal consistency coefficient was 0.89. (Wilson and Chambless, 1999). Yaghooti Azari, et al. (2015) reported its validity as 0.78 and the test-retest reliability for two-week as 0.81 to 0.97.

Quantitative electroencephalography (QEEG): Using a neuroscan amplifier and a Electrocap recorded the patient EEG for 19 channels and delta, theta, alpha, beta1, beta2, beta 3 and High beta waves. In this study, the absolute power of QEEG was examined in 5 frequency bands and in 3 anterior, middle and posterior regions (Demos, 2020).

Results

In this study, due to the lack of referral of 3 participants in the control group for re-evaluation in the post-test phase, the study was performed on a total of 37 people (20 individuals in the experimental group and 17 individuals in the control group).

The average scores of post-test in the experimental group are less than average pre-test scores in terms of obsessive thoughts and compulsive actions. The required defaults should be studied for covariance analysis (ANCOVA). Kolmogorov-Smirnov test was utilized to study the normal distribution of variables. The results show the normal distribution of variables ($p>0.05$). Also, Leven's test was utilized to study the homogeneity default of error variances. The results showed that the mentioned default is established ($P>0.05$). The results of regression slope homogeneity analysis showed that there is no significant interaction between associated variables (pre-tests) and dependent variables (post-tests) in operating levels (experimental and control groups) ($P>0.05$). According to the results of univariate analysis of covariance in table 1, by controlling the effect of pre- test, there is a significant difference between the mean scores of post-tests of experimental groups and control group in obsessive –compulsive variable ($\eta^2=0.78$, $p=0.001$, $F_{1,35}= 125.32$).

Table 1. Univariate analysis of covariance the effect of tDCS on obsessive-compulsive disorder

Variable	Total squares	df	Average squares	F	Meaningful	Eta2	Test power
Obsessive-compulsive disorder	1443.93	1	1443.93	125.32	0.001	0.782	1.00

To evaluate the effect of tDCS on QEEG, the results of dependent t-test showed that anodal stimulation of CZ region of 8 individuals and FZ region of 20 individuals in the experimental group significantly reduced the absolute power of delta and theta waves, and significantly increased the absolute power of alpha, standard beta and high beta waves of these areas ($p<0.05$). Cathodal stimulation of FP1 region of 16 individuals and also cathodal stimulation of FP2 region of 16 individuals of experimental group significantly increased the absolute power of alpha wave ($p <0.05$). The results also showed that in the control group, none of the waves in the studied areas of the brain in the post-test stage had significant changes ($p>0.05$).

Discussion and Conclusion

Yale-Brown obsessive-compulsive scale scores and QEEG indices in the post-test phase showed that tDCS was effective in modifying the brain wave pattern and improving the symptoms of OCD patients. These results were consistent with the studies of Green et al. (2020), Insafi et al. (2019) and Brunlin et al. (2018). The limitations of this study was repeated measurement with a questionnaire and no follow-up stage. Long-term follow-up and attention to QEEG pattern are suggested in subsequent studies of tDCS .

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Conflicts of interest

Authors found no conflict of interests.