

Efficacy of Neurofeedback training in Improving Psychopathology and Social Functions in a Patient with Schizophrenia: A Case Study

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Abstract- Researchers have consistently shown that individuals with schizophrenia experience cognitive impairment throughout the last few decades. Cognitive deficits cause functional impairment in patients. Neuro-feedback has been found to aid in symptom reduction as well as functional improvement. AB After being diagnosed with paranoid schizophrenia by a qualified psychiatrist from the outpatient department of the Institute of Mental Health and Hospital Agra, a 29-year-old man who is right-handed, a graduate, single, and from a middle socioeconomic background was referred for cognitive evaluation and rehabilitation. He currently lives with his parents in Agra. A cognitive evaluation of the patient showed impairment in executive skills, memory, and attention. For thirty sessions, six days a week, he received Neuro-feedback; each session lasted roughly twenty minutes. Significant progress was observed in all areas of social and cognitive functioning in the post-intervention scores.

Index Terms- Schizophrenia, Neurofeedback, Neuropsychological Functioning

I. INTRODUCTION

Schizophrenia affects 1 in 300 people worldwide, or around 0.32% of the world's population [1], and is one of the top 10 causes of disability [2]. From high levels of functionality to severe disruptions, this syndrome can induce a wide spectrum of functional disturbances [3]. It has been discovered that premorbid adjustment and psychosocial function are higher in women. Compared to males, they experience less unpleasant symptoms, especially those related to expressiveness rather than amotivation [4]. Current study is focused on the strong relationship between brain changes and symptoms of schizophrenia. The co-occurrence of positive symptoms and poor impulse control,

followed by violence, has a neurobiological foundation. Decreases in inferior parietal lobule volume and internal capsule integrity, as well as in total cortical volume, global white matter integrity, and additional dorsolateral prefrontal cortex (DLPFC) volume, are associated with increased intensity of positive symptoms and worse impulse control [5]. Negative symptoms appear to be associated with the neurobiological basis of hypofrontality, specifically the cortical thinning of the medial orbitofrontal cortex [6] and the hypoactivation of the ventrolateral prefrontal cortex and ventral striatum [7]. Cognitive symptoms are an important therapeutic target because they have a substantial impact on memory, execution function, processing speed, and functionality [8]. Abnormally reduced functional connectivity between the thalamic, frontal, temporal, occipital, and cerebellar areas has been associated to cognitive processes [9]. Despite taking antipsychotic medication, over 30% of people still have pleasant symptoms, such as visual and auditory hallucinations. Even though clozapine is the recommended treatment for psychopharmacological therapy of resistant kinds, up to 60% of patients showed poor response to it [10].

Therefore, alternative methods are needed to deal with treatment-resistant cases. Recent developments in computational neurobiology have reignited interest in neurofeedback (NF), a new therapy approach that involves self-regulation or neuromodulation, as a means of potentially reducing cognitive symptoms in individuals with schizophrenia. During treatment, the patient receives real-time input through a brain-machine interface. NF utilizes Pavlovian operant conditioning, which allows patients to receive real-time feedback and directly perceive specific neuronal

events using a visual or auditory representation of their own brain activity while performing a cognitive task, in order to modulate the brain waves and rhythms in the area of interest and, consequently, optimize cognitive strategies to achieve neuromodulation [11]. In conclusion, NF uses a variety of stimuli to bring the subconscious processes into the conscious realm, giving the person control over them. This treatment may be based on various neuronal activity-collecting techniques, including hemoencephalography (HEG), functional magnetic resonance imaging (fMRI), electroencephalogram (EEG), and functional near-infrared spectroscopy (fNIRS)[12]. Many people with schizophrenia still experience social dysfunctions and treatment-resistant AVH despite recent advancements in antipsychotics. According to recent research, real-time NFB may help patients manage their own speech-related and language-related networks, giving them more control over their AVH [13]

II. DESIGN

Pre-post interventional single case study design was adapted.

III. CASE REPORT

AB was a 29-year-old man from Agra who was right-handed, had graduated, was single, and lived with his parents. The clinical psychology department was consulted for psychosocial assistance after the psychiatry department diagnosed paranoid schizophrenia.

AB had been suffering from episodic schizophrenia for five years. Delusions, hallucinations, and the negative symptoms of apathy, social disengagement, and muted affect had been the hallmarks of the

episodes. His social functioning was also compromised, as seen by his poor social skills, communication difficulties, and interpersonal interactions. No history of psychiatric illness was present in the family. The patient had been a calm child in terms of temperament.

A suitable dosage of antipsychotic medication (Risperidone, 4 mg BD) was being administered to AB. When AB first arrived to the clinical psychology department, he complained of having no friends, bad interpersonal relationships with family, difficulty remembering what he had learned, difficulty doing household chores, and difficulty going shopping on his own. While muted affect, poor abstraction, emotional withdrawal, and social disengagement were unfavorable symptoms at the time of presentation, AB did not exhibit any good symptoms.

A semi-structured socio-demographic and clinical data sheet was used to gather information during the clinical interview. The following measures were subjected to neuropsychological evaluation before and after cognitive rehabilitation: Positive and Negative Syndrome Scale[14], Cognitive Symptom Checklist[15], Digit Symbol Substitution[16], PGI Memory Scale[17], Trail Making Test[18] and Wisconsin Card Sorting Test[19].

Intervention

Targeting particular brain waves that have been demonstrated to enhance cognitive abilities in a variety of clinical settings, electroencephalograph neurofeedback training (EEG NFT) is a noninvasive brain wave training method. The patient had 20 sessions of the alpha/theta treatment with C3, C4 scalp locations training, which lasted 20 minutes each and was conducted six days a week for 30 sessions.

Table 1: Pre and Post intervention scores on different neuropsychological test

Neuropsychological Test		Pre-Assessment	Post-Assessment
PANSS	Positive	15	9
	Negative	32	15
	General	54	32
Cognitive Symptom Checklist	Attention / Concentration	34	10
	Executive Function	56	17
	Memory	47	27
	Visual Processing	12	7
	Language	14	5

Digit Symbol Substitution Test		18	37
PGI Memory Scale		21	12
Trail Making Test	Trail Making Part- A	167	68
	Trail Making Part- B	269	102
Wisconsin Card Sorting Test	Number of trials Administered	128	128
	Total Number of Correct	61	82
	Total Number of Errors	67	46
	Percent Errors	52	35
	Perseverative Responses	40	19
	Percent Perseverative Responses	31	16
	Perseverative Errors	37	19
	Percent Perseverative Errors	29	16
	Non-perseverative Errors	29	16
	Percent Non-perseverative Errors	25	13
	Conceptual Level Responses	37	74
	Percent Conceptual Level Responses	29	62
	Number of Categories Completed	1	5
Trials to Complete First Category	67	26	

IV. DISCUSSION

The case study provides insight into the use of neurofeedback as an intervention for a patient suffering from a debilitating psychiatric illness. By employing fMRI, fNIRS, and EEG/MEG to modulate their own speech-related/language-related networks, such as the superior temporal gyrus (STG) and anterior cingulate cortex (ACC), NFB is a promising approach that gives patients control over their AVH. Pharmacological intervention programs combined with neurofeedback training were found to improve psychopathology and cognitive functioning in a patient with schizophrenia. In order to use EEG NF as a therapy target, it is necessary to identify the area of the brain or electrical activity linked to a specific set of behaviors. Furthermore, the target is a component of a brain circuit whose functioning is somewhat understood in healthy individuals and compromised in diseased ones. In contrast to conventional therapies, these focus on treating a constellation of behaviors resulting from a neural network damage rather than syndromes or groups of symptoms. As a result, neuromodulation therapies offer chances to improve mechanistic understanding of illnesses in addition to providing treatment. In this

regard, NF enhances a person's capacity to master how their brains process information in a certain neural network.

The present case study highlights an improved functioning in each aspect, according to the test results obtained after the intervention. Neurofeedback training enhances brain waves by boosting neural plasticity, which helps patients learn and carry out social and professional responsibilities. The patient's mood, family relationships, and occupational recuperation all improve as a result. Additionally, improved relationships within the family and with society are evidently noted.

The case report's findings are in good agreement with a prior case study in which both participants demonstrated the capacity to control SMR, beta, theta, and alpha activity following NF training. Additionally, neuropsychological tests (Go/No-go, GAF, and PANSS) showed that both patients' negative symptoms had significantly improved [20]. In patients with auditory visual hallucinations, the EEG NF has also been shown to be effective in reducing both positive and negative symptoms. Working memory and positive and negative symptoms of schizophrenia both significantly improved after the post-assessment, and

these improvements persisted for 22 months [21]. Emotion control is another important function of the EEG NF. According to one study, the NF group's frontal delta asymmetry was much lower than that of the control group. Additionally, compared to the control group, patients in the therapy group outperformed them on an International Affective Picture System task [22]. During the WCST, abnormal perfusion in the prefrontal cortex known as "hypofrontality" has been noted [23]. The enhanced performance in WCST may have resulted from the down-regulation of delta power, which may have altered the Dorso-Lateral Pre Frontal Cortex's function thought to facilitate cognitive control [24]. Therefore, it may be said that individuals with schizophrenia are capable of learning to control their bioelectrical activity and using it in different contexts when necessary.

Electroencephalograms (EEGs) were frequently utilized in the past for NFB, but their quality was poor due to flaws in the equipment and processing methods. But when it comes to temporal resolution in the millisecond range, which is essential for real-time NFB, EEG and MEG clearly have an advantage [25, 26]. Furthermore, the assessment of brain activity in particular frequencies and the associated functions during tasks and rest (spontaneous activity) has been made possible by time-frequency analysis [2, 26, 13]. Thus, in addition to fMRI-NFB, real-time EEG/MEG-based NFB may be the best NFB system as an alternate therapy strategy for AVH in patients with schizophrenia, considering the dynamic character of AVH.

V. CONCLUSION

Neurofeedback training has been demonstrated to benefit individuals with schizophrenia. Neurofeedback training improves cognitive processes. It improves social and professional functioning. When used in conjunction with psychosocial intervention, interpersonal relationships improve. Subjectively, the patient reported significant improvements in their focus, patience, and attentiveness.

VI. FINANCIAL SUPPORT AND SPONSORSHIP

Nil.

VII. CONFLICTS OF INTEREST

There are no conflicts of interest.

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