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HD-tDCS in a Patient with Intellectual Disability and Focal Epilepsy: Case Report

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Abstract

HD-tDCS is a new non-invasive brain stimulation method that improves current focality and intensity. In this study, the aim was to report a patient with intellectual disability and refractory focal epilepsy who participated in HD-tDCS intervention for his seizure control and assessing the quality of cognitive function variation. Five days LTM evaluation results show that there was a distinct focal epileptogenic lesion in the C4. We recorded EEG and used IVA+test in three steps; before the HD-tDCS sessions (10 sessions), at the end of the last stimulation and one month after. Attention performance showed little improvement in scores with regard to the IVA+test. The EEG studies showed a short-term benefit in reducing the generalized epilepsy severity. However, this effect did not last up to a one-month evaluation. More studies needed to be done in this area.

Keywords: HD-tDCS; Intellectual disability; Focal epilepsy; Attention performance

Introduction

The tDCS induces cortical plasticity non-invasively with the way of sub threshold neuronal membrane polarization with constant weak direct currents [1]. Anodal stimulation results in excitability enhancement, while cathodal tDCS decreases it. When tDCS is applied for a sufficient duration, cortical function could remain altered beyond the stimulation period [2]. In many ways, the effects resemble long-term depression. Consequently, directly targeting seizure foci with parameters of stimulation that induce long-term depression such as phenomena might reverse (or at least counteract) the hyperexcitable state in the focal epilepsy [3]. High-definition tDCS (HD-tDCS) is a new non-invasive technique that improves current focality and intensity of stimulation [4]. In this article, the aim is to report a patient with intellectual disability and refractory epilepsy that participated in HD-tDCS intervention study for probability of his seizure control.

Case Presentation

Mr. MA is a 30-year-old left-handed male. His first seizure occurred when he was only 6 months old without any provocation. The patient is the product of a normal gestation and his early development was normal. The patient had learning disabilities and difficulty with concentration. There is no history of CNS infection or CNS trauma with loss of consciousness. There is no history of epilepsy in the family. He lives with his parents and at the moment he has no job and no history of tobacco, alcohol, or illicit drug use. The latest MRI showed a few nonspecific high signal areas in the subcortical white matter of both centrum semiovale. Moreover, left sided hippocampal malformation was reported. Current medications are Valproate 1,500 mg/d; Lamotrigine 300 mg/d; 300 mg/d and Carbamazepine 1,200 mg/d. Five day LTM and sleep records demonstrated sharp and slow waves coming from the right central leads (C4,P4). These findings suggested that the patient suffered from a generalized epileptic disorder and a discrete epileptogenic focus which is most probably located in C4 region.

Procedure

Firstly, the process for the patient and his family was explained and their consents were gotten. The patient and his parents were taught how to make epilepsy dairy. The baseline EEG was recorded. Then patient's attention elements were assessed by IVA+test. The stimulations started the next day with 4 × 1 electrode connected to a tDCS device (Activa dose II). Ag/AgCl ring electrodes were held in plastic casings that were filled with a conductive gel that embedded in a modular EEG recording cap. The center electrode (cathode) over C4 has been positioned based on the International 10/20

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Table 1: IVA+Test findings.

IVA+Test	Before stimulation	After last stimulation	4th weeks after last stimulation
visual focus attention quotient score	19	50	
Visual Response Control	0	23	
Visual Attention	0	4	
Consistency Visual	0	66	
stamina Visual	81	85	
Vigilance visual	0	0	
Speed Visual	64	64	

Table 2: EEG findings.

EEG	Step 1	Step 2	Step 3
Generalized spike slow (s/hr)	56	40	127
focal right central spike-slow (s/hr)	17	19	14

EEG System, and the other on F4, P4, Cz and T4 (anode). During each session (10 day stimulation with 2 day off in between), DC was gradually ramped up over a period of 15 seconds until it reached to 2.0 mA, which was delivered for 20 minutes [5]. After the last stimulation, neuropsychological tests and EEG were repeated. The patient was followed for a month after the last stimulation.

Outcomes

IVA+test findings

This patient did not validly respond to auditory test stimuli of IVA+. Only the Primary Visual quotient scale scores could be validly interpreted (Table 1).

EEG findings

According to the patient's EEGs, he had a reactive 8 HZ PDR and two types of epileptiform discharges; the frequent generalized slow spike-slow waves (2.5 Hz) maximum bifrontal and the focal sharp waves in the right hemisphere (Table 2).

After assessment of the three recordings, it was found that the focal epileptiform discharges had no significant changes. Although the generalized epileptiform discharges were reduced immediately after the stimulation sessions, they were increased after one month to more than twice the baseline rate.

After the stimulation the patient's physical and neurological reexamination had no change. The patient did not suffer from any adverse reaction, like a headache, vomiting, paresthesia, mood change, aggression or insomnia (Table 3). As the findings reveal, the patient's focal seizure frequency and duration increased during and after our stimulation totally. Albeit, there seemed to be a decline in the generalized seizure frequency and duration during the intervention, this effect was reversed immediately after the stimulations and backed to the baseline in the following weeks.

Discussion

The tDCS modifies the synaptic microenvironment, for example, by modifying synaptic strength NMDA receptor in a dependent way or altering GABAergic activity [6,7]. The impacts of tDCS may be similar to those observed in a Long-Term Potentiation (LTP), as shown by a recent animal study that applied anodal motor cortex stimulation and showed a lasting increase in postsynaptic excitatory potentials [8]. Learning ability in people with intellectual disability is very low and thus neuronal connections and the ability to remain are

Table 3: Seizure frequency and severity.

	Before stimulation	During stimulation	First week After stimulation	2nd to 4th weeks after stimulation
Number of seizures/ week	1-3	6	5	5
Generalized atonic seizure frequency/ week	1	0.5	3	1
Focal right clonic seizure frequency/ week	2	5.5	2	4
mean seizure duration	1.7 min	1.16 min	2.2 min	2 min

limited. These characteristics are the result of the loss of nerve cells, reducing the number and quality of synaptic connections occurs, causing an inability to create LTP and LTD in this patients.

Regarding the patient, the baseline cognitive tests showed severe impairment of cognitive function that intervention had low improved the scores with regard to the attention test. The EEG studies showed a short term benefit in reducing the generalized epilepsy severity (seizure frequency & epileptiform discharges). However, this effect did not last up to the one month evaluation. On the other hand, the focal seizure severity (seizure frequency, epileptiform discharges) was increased dramatically even if temporarily. There was no other significant adverse event with this intervention and the patient could tolerate it well and found it feasible.

These findings showed that tDCS may decrease the generalized epileptic activity during the stimulation period, although this effect reversed after the stimulation is withdrawn. There is a possibility of exacerbation of the focal epileptic activity during the stimulation sessions which is also temporary and reversible. It is noteworthy that the observed changes may be coincidental and due to natural clustering of the epileptic activity. This can be assessed by more frequent sampling of EEG during a certain period of time.

Conclusion

Can this method also be useful for people with intellectual disability? Due to the consequences of uncontrolled seizures refractory to medication in these patients, which leads to a weak performance in creating new connections to the cerebral cortex, for selection of patients for HD-tDCS, it is important to consider the quality of their performance on IQ tests. All the same, the lack of significant adverse events or deterioration of cognitive functions and decrease of generalized epileptic activities implies that this intervention did not convey serious harmful effects and in short-term, the patient may benefit from a mild temporary reduction in generalized epileptic discharges. As expected, dramatic changes like seizure reduction and cognitive performance improvement were not achieved with common stimulation methods and more studies needed to be done in this area.

References

1. Priori A, Berardelli A, Rona S, Accornero N, Manfredi M. Polarization of the human motor cortex through the scalp. Neuroreport. 1998;9(10):2257-60.

2. Nitsche MA, Nitsche MS, Klein CC, Tergau F, Rothwell JC, Paulus W. Level of action of cathodal DC polarisation induced inhibition of the human motor cortex. Clin Neurophysiol. 2003;114(4):600-4.

3. Felipe F, Pascual-Leone A. Technology insight: Noninvasive brain stimulation in neurology: Perspectives on the therapeutic potential of rTMS and tDCS. Nat Clin Pract Neurol. 2007;3(7):383-93.

4. Datta A, Bansal V, Diaz J, Patel J, Reato D, Bikson M. Gyri-precise head model of transcranial direct current stimulation: Improved spatial focality using a ring electrode versus conventional rectangular pad. Brain Stimul. 2009;2(4):201-7.

5. Borckardt JJ, Bikson M, Frohman H, Reeves ST, Datta A, Bansal V, et al. A pilot study of the tolerability and effects of high-definition transcranial direct current stimulation (HD-tDCS) on pain perception. J Pain. 2012;13(2):112-20.

6. Liebetanz D, Nitsche MA, Tergau F, Paulus W. Pharmacological approach to the mechanisms of transcranial DC-stimulation-induced after-effects of human motor cortex excitability. Brain. 2002;125(Pt 10):2238-47.

7. Stagg CJ, Best JG, Stephenson MC, O'Shea J, Wylezinska M, Kincses ZT, et al. Polarity-sensitive modulation of cortical neurotransmitters by transcranial stimulation. J Neurosci. 2009;29(16):5202-6.

8. Fritsch B, Reis J, Martinowich K, Schambra HM, Ji Y, Cohen LG, et al. Direct current stimulation promotes BDNF-dependent synaptic plasticity: Potential implications for motor learning. Neuron. 2010;66(2):198-204.