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Letter to the Editor

Does Electrical Brain Stimulation with Transcranial Direct Current Stimulation (TDCS) Technique Reduce Blood Sugar in Patients with Type 2 Diabetes?

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Dear Editor-in-Chief

The relationship between Transcranial Direct Current Stimulation (tDCS) and its effect on blood sugar has been both the subject of limited research efforts. Most studies have focused on animal samples (1), and healthy or non-diabetic people (2-5). For example, in interesting research effort in alloxan-induced diabetic rats, transcranial electrical stimulation of brain endorphinergic structures activated reparative regeneration of damaged beta-cells in pancreatic islets of Langerhans (1). Consecutive tDCS treatments for depressed patients could be beneficial in improving glucose absorption, lowering blood sugar, increasing brain phosphate levels, and reducing cortisol hormone levels in the patients (5). Only one study investigated the effect of transcranial electrical stimulation (by CES method) on the blood sugar level in patients with diabetes (type 2), which indicated reduction of blood sugar of the participants (6).

These findings look promising, because in addition to helping to understand glucose processing, the possibility of glucose modulation by tDCS can be suggested for the development of new therapeutic approaches for the treatment of patients with diabetes.

Therefore, the present study, which was done in the form of a clinical neuropsychology postdoctoral project, aimed to investigate the pure and combined effects of primary motor cortex (M1) and left dorsolateral prefrontal cortex (F3) anodic tDCS in reducing blood sugar in patients with type 2 diabetes with neuropathic pain. In the study, monitoring of bio-physiological status of the participants during the research was among the specific goals of the study.

The present study was a four-group, double-blind, randomized clinical trial conducted in the 2021-2022 in the Diabetes Association of Bonab City, southern Iran. The research sample was 48 patients aged 45 to 65 yr selected in a purposeful sampling and based on the inclusion and exclusion criteria. Having a history of diabetes for more than 10 years, having Hb A1c above 7.5 at the beginning of treatment, and having neuropathic pain were among the inclusion criteria of the treatment. Moreover, having a pacemaker and the need to change or increase the drugs used according to the diabetes specialist were among the exclusion criteria.

After selecting the subjects, they were randomly assigned to 4 groups (group A; stimulation of

M1, group B; stimulation of F3, group C; stimulation of M1 and F3, group D; Sham stimulation). Patients in 4 groups received their related interventions for 15 sessions, three times a week. The data were extracted from the blood test results of the patients' hand. The collected data were analyzed with SPSS-26 software (IBM Corp., Armonk, NY, USA) and SPANOVA test. *P* values less than 0.05 were considered statistically significant.

The protocols of the study were approved by the Iranian Clinical Trials Review Committee by the Iran University of Medical Sciences with the clinical trial code of IRCT20210214050363N1.

Considering the pre-test scores for all variables as covariance variables, revised Bonferroni's paired comparisons test showed that in compared with the sham group, the effect of all three interventions in reducing Hb A1c was significant. For reduction FBS, only the intervention of stimulation of F3, had a significant effect. However, no significant changes were observed in insulin, cortisol, white blood cell, red blood cell, and platelet count, body temperature, and blood oxygen level. This indicates the therapeutic potential of tDCS in order to improve glucose tolerance in patients with diabetes.

In this research, in addition to reducing pain, the systolic and diastolic blood pressure of the patients were also regulated and adjusted in the post-test and two-month follow-up stages, and this may have occurred through the improvement of the stress axis. Of course, the researchers of this article are looking for a stronger protocol with a more stable effect in a newer project that is being conducted on a wider sample of patients with diabetes (type 1 & type 2) and they are facing promising results in the current project. However, further studies are still necessary because there are very few studies and on the other hand, observing the structural and functional status of pancreatic beta cells in human samples - before and after stimulation - is associated with many ethical and technological limitations.

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Conflict of interest

The authors declare that there is no conflict of interest.

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