Concurrent treatment of motor deficits, cognitive deficits, and depression using transcranial direct current stimulation in a patient with stroke: A case study

Dear Editor,

Several patients with stroke (cerebrovascular accident) develop depression following the stroke, which is often called poststroke depression (PSD). PSD is often difficult to treat and adds to the disability experienced due to the motor deficits developed after stroke.[1] Neuromodulation has emerged as a promising intervention, demonstrating positive outcomes in improving both motor deficits and PSD management. A recent systematic review and meta-analysis evaluated the relevance of transcranial direct current stimulation (tDCS) in cognitive rehabilitation in stroke.[2] In this analysis, 820 participants from 15 studies were included and it was found that there was improvement in general cognitive performance and attention following the tDCS treatment with minimal improvement in memory performance.[2] In contrast, a recent multicentric, randomized, double-blind, placebo-controlled trial targeting ipsilesional motor cortex stimulation with anodal tDCS showed no significant recovery in motor functions compared to sam treatment.[3] With regard to the efficacy of tDCS in PSD, a systematic review found that tDCS significantly reduces the severity of PSD.[4] The left dorsolateral prefrontal cortex (DLPFC) was targeted for stimulation (anodal stimulation) for cognitive and depressive symptoms.[2,4] However, another systematic review, while reporting a significant pooled effect size for PSD improvement (standardized mean difference = 1.61) found no significant differences in subgroup analyses comparing high- versus low-intensity stimulation or left DLPFC versus primary motor cortex stimulation.[5] These mixed findings underscore the need for further research to optimize tDCS protocols and parameters for the treatment. This case study highlights areas for further development in clinical practice and research while demonstrating the promise of tDCS as a multimodal therapeutic addressing the motor, depressive, and cognitive problems presented in a stroke patient.

A 59-year-old male with a history of stroke in 2020 that resulted in right-sided hemiplegia visited the neuropsychiatry specialty clinic with complaints of low mood, loss of interest in previously pleasurable activities, decreased interaction, hopelessness, worthlessness, disturbed sleep, crying spells, and frequent anger outbursts for 6 months. These symptoms were persistently present most of the day and would interfere with his day-to-day functioning significantly. Family members reported that there was an increase in forgetfulness over the past 6 months. There was a history of chewable tobacco use for 15 years before stroke and he was abstinent from tobacco for the past 4 years. Recovering from deficits in multiple domains involving right hemiparesis, incomprehensible and slurred speech, drooling of saliva, and cognitive decline (inability to identify family members, inability to perform simple tasks, etc.). The baseline score for depression, anxiety, and stress were 11, 11, and 6, respectively, on Depression, Anxiety, Stress Scale (DASS-21). The score on the mini–mental status examination (MMSE) was 25/30. He was diagnosed with PSD and was initiated on sertraline 25 mg/day, which was increased up to 100 mg/day within 4 weeks duration. As the patient was reporting increased salivation leading to drooling of saliva, amitriptyline 10 mg/day was started, which later increased to 25 mg/day. He was also receiving antioxidants, multivitamins, and rosuvastatin 10 mg/day. Simultaneously, tDCS sessions were scheduled for the patient as an adjuvant neuromodulatory technique to augment the positive effects of neurorehabilitation. The anode was placed over the Left DLPFC and the Cathode over the right motor area (M2) with current strength of 2 mA for 20 min with a ramp time of 10 s. The patient reported improvements in crying spells and impaired speech after 40 sessions. After 40 sessions of tDCS, the DASS-21 was reapplied, which revealed a score of 6 in depression, 5 in anxiety, 2 in stress, and MMSE score of 28/30. Recovery tracking was done with Modified Rankin scale, in which score improved from 5 to 4. Following tDCS and physiotherapy sessions, the family members observed an improvement in the paretic limb's motor function.

In our patient, there were deficits in multiple domains, which were targeted concurrently. tDCS device conventionally has two electrodes (cathode and anode), whose placement produces different changes in the underlying cortex (cathode producing inhibitory effect and anode producing stimulatory effect). Given this

fact, electrodes were positioned with the anode over the left DLPFC and the cathode over the contralesional motor cortex, which is the motor area on the right side. It was hypothesized that stimulation of the left DLPFC will improve the depressive and cognitive symptoms, whereas inhibition of the contralesional motor cortex will inhibit the area, which interferes with motor recovery. Following stroke or any form of insult to the cerebral cortex, several neurophysiological changes occur in the brain, which is commonly referred to as cortical reorganization. Around the area of trauma/insult, the neurons become hyperactive to compensate for the deficits incurred and similarly, changes happen in the corresponding areas of the opposite cerebral cortex.[6,7] These compensatory changes are mostly intended to facilitate recovery from stroke; however, they may also interfere with the recovery process due to the development of aberrant connections. Neuromodulation techniques like tDCS may help in correcting these neurological dysfunctions; hence, considered an efficient tool in stroke rehabilitation.[6] A recent Cochrane systematic review involving 67 studies over 1,729 patients with stroke found that the existing evidence regarding the effectiveness of tDCS on activities of daily living, cognitive function and motor function is of low to moderate quality.[8] Add-on physiotherapy (physical therapy) along with tDCS was found to be a helpful strategy for stroke rehabilitation focusing on motor symptoms.[9] Our patient received physiotherapy for a longer duration with minimal benefits in motor function; however, add-on tDCS improved motor function (particularly in the lower limb). In a triple-blind, randomized, sham-controlled, multicentre trial, tDCS was not found helpful as an add to selective serotonin reuptake inhibitors (SSRIs); in contrast to this, our study demonstrated the role of tDCS in improving depressive symptoms as an add-on to SSRIs.[10] Patients with stroke often present with deficits in multiple domains and one particular brain area might be responsible for multiple functions. Appropriate selection of target areas during neuromodulation treatment may facilitate the improvement of multiple domains of symptoms. In our case, we targeted left DLPFC, whose stimulation is expected to produce improvement in cognitive as well as affective symptoms. With the increasing use of tDCS in clinical practice in recent days, the windows are opening for including tDCS for concurrent depressive, cognitive, and motor symptoms associated with stroke.

Author contributions

Conceptualization: Sujita Kumar Kar; Case management; Project administration; Data evaluation: Sujita Kumar Kar, Rahul Prajapati, Babli Kumari, Priyanshi Chaudhary, Mohita Joshi; Manuscript writing and editing: Mohita Joshi, Sujita Kumar Kar.

Ethical policy and institutional review board statement

The study was performed in accordance with the Declaration of Helsinki.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given his consent for his images and other clinical information to be reported in the journal. The patient understands that his name and initials will not be published and due efforts will be made to conceal his identity, but anonymity cannot be guaranteed.

Data availability statement

All data generated and/or analyzed during this study are included in this published article.

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Conflicts of interest

There are no conflicts of interest.

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