Transcranial direct current stimulation for progressive supranuclear palsy

Case series

Alexoudi et al. conducted a pilot study in order to evaluate the effect of transcranial direct current stimulation over the motor cortex and premotor cortex in patients with progressive supranuclear palsy, with a particular emphasis on cognitive dysfunction. Eight patients affected by PSP were included (4 males and 4 females with mean age 67.4±7.4 years, range: 55-80 years and mean disease duration: 4.6±3.3 years, range: 1-11 years). The mean Unified Parkinson's Disease Rating Scale Part III (UPDRS III) was 49±16.1 and the mean Hoehn & Yahr (H&Y) scale was 3.9±1 at baseline. All pharmacological treatments (L-dopa, pramipexole, rotigotine, rasagiline, amantadine) were maintained stable during the study. They aimed at evaluating along with the motor outcome (as it is reflected on a disease-specific rating scale), the post-tDCS cognitive status after the completion of the intervention. The clinical evaluation involved the PSP-Rating Scale, the UPDRS III, and the Timed Up and Go test. The neuropsychological assessment focused on auditory-verbal memory and learning, episodic memory, visuomotor coordination and speed of information processing, executive functions and verbal fluency (phonemic and semantic). Anodal tDCS was applied over primary motor and pre-motor cortices in 10 daily sessions. During the tDCS stimulation, a constant current of 2 mA was delivered for 30 minutes. Clinical evaluations were performed at baseline, day 11, day 30 and at day 90. The PSP-Rating score (total and sections I & III) improved significantly on day 11 compared to baseline and similarly on day 30. A positive effect was also seen in action tremor. In addition to the global mental status improvement, patients showed increases in neuropsychological performance in the domains of visuomotor coordination and processing speed, auditory-verbal learning, episodic memory, phonological and semantic fluency (access and retrieval from lexical memory, selective inhibition, and lexical access speed). The results suggest that tDCS has a beneficial effect on Progressive Supranuclear Palsy patients' bulbar and motor symptoms, cognitive dysfunction, as well as daily activities, which lasts beyond the duration of the treatment [1)].

A sham-controlled double-blind crossover design to assess the efficiency of tDCS over the DLPFC in a cohort of 12 patients with PSP. In 3 separate sessions, we evaluated the ability to boost the left DLPFC via left-anodal (excitatory) and right-cathodal (inhibitory) tDCS, while comparing them to sham tDCS. Tasks assessing lexical access (letter fluency task) and semantic access (category judgment task) were applied immediately before and after the tDCS sessions to provide a marker of potential language modulation.

The comparison with healthy controls showed that patients with PSP were impaired on both tasks at baseline. Contrasting poststimulation vs prestimulation performance across tDCS conditions revealed language improvement in the category judgment task following right-cathodal tDCS, and in the letter fluency task following left-anodal tDCS. A computational finite element model of current distribution corroborated the intended effect of left-anodal and right-cathodal tDCS on the targeted DLPFC.

The results demonstrate tDCS-driven language improvement in PSP. They provide proof-of-concept for the use of tDCS in PSP and set the stage for future multiday stimulation regimens, which might lead to longer-lasting therapeutic effects promoted by neuroplasticity.

This study provides Class III evidence that for patients with PSP, tDCS over the DLPFC improves performance in some language tasks [2].

Case reports

Madden et al. report the case of KN, who presented with reduced verbal fluency and connected speech production in the context of PSP. KN completed a set of language tasks, followed by an alternate version of the tasks in conjunction with either sham or active tDCS over the left dorsolateral prefrontal cortex (DLPFC) across four sessions. Results showed improved performance with active stimulation compared to sham stimulation for phonemic fluency and action naming, as well as mixed results suggesting possible benefits for connected speech production. There were no benefits of active stimulation for control tasks, indicating that tDCS can produce specific benefits for phonemic fluency, action naming, and connected speech production in PSP. These promising, preliminary findings warrant further investigation into whether these benefits of tDCS can be a useful therapeutic tool for PSP patients to maintain language [3].

References

1)
Alexoudi A, Patrikelis P, Deftereos S, Fasilis T, Karakalos D, Verentzioti A, Korfias S, Sakas D, Gatzonis S. Effects of anodal transcranial direct current stimulation on cognitive dysfunction in patients with progressive supranuclear palsy. Psychiatriki. 2019 Oct-Dec;30(4):320-328. doi: 10.22365/jpsych.2019.304.320. PubMed PMID: 32283535.

2)
Valero-Cabré A, Sanches C, Godard J, Fracchia O, Dubois B, Levy R, Truong DQ, Bikson M, Teichmann M. Language boosting by transcranial stimulation in progressive supranuclear palsy. Neurology. 2019 Aug 6;93(6):e537-e547. doi: 10.1212/WNL.0000000000007893. Epub 2019 Jul 3. PubMed PMID: 31270217; PubMed Central PMCID: PMC6709997.

3)
Madden DL, Sale MV, O'Sullivan J, Robinson GA. Improved language production with transcranial direct current stimulation in progressive supranuclear palsy. Neuropsychologia. 2019 Apr;127:148-157. doi: 10.1016/j.neuropsychologia.2019.02.022. Epub 2019 Mar 2. PubMed PMID: 30836131.