P 1-10

Effects of Dual-site Transcranial Direct Current Stimulation on Motor Function

Heegoo Kim[1*], Junsoo Lee[1], Ahee Lee[1], Jinuk Kim[1], KyungAh Kim[1], Min-A Shin[1], Won Hyuk Chang[1], Yun-Hee Kim[1†]

Sungkyunkwan University, Department of Health Sciences and Technology, Samsung Advanced Institute for Health Science and Technology[1], Samsung Medical Center, Sungkyunkwan University School of Medicine, Department of Physical and Rehabilitation Medicine, Center for Prevention and Rehabilitation, Heart Vascular and Stroke Institute[2]

Objective

This study aimed to investigate the effect of dual-site transcranial direct current stimulation (tDCS) application over the primary motor cortex (M1) and premotor cortex (PMC) on neurophysiologic and hemodynamic changes of motor cortical activity and hand function in healthy young subjects.

Materials and Methods

Twenty-three right-handed healthy subjects (11 females; mean age 29.5±3.92 years) participated in this single-blind, randomized cross-over study. Participants reported no history of neurological or psychiatric symptoms. Stimulation consisted of two channels of a single continuous direct current delivered by two battery-driven stimulators. In each channel, simultaneous anodal tDCS (1 mA, 30 min) was delivered. Four conditions were randomly applied to all participants through 4 experimental sessions with 24 hours of washout period between each session

Condition 1, simultaneous application of anodal tDCS on the Rt. M1 with cathodal tDCS on Lt. M1 and sham tDCS on Rt. PMC; Condition 2, simultaneous application of sham tDCS on bilateral M1 and anodal tDCS on Rt. PMC; Condition 3, simultaneous sham stimulation tDCS on the bilateral M1 and Rt. PMC; Condition 4, simultaneous stimulation on bilateral M1 and Rt. PMC. Changes of motor evoked potentials (MEPs) were examined before (T0), immediately after (T1) and 30 minutes after (T2) the stimulation for each condition. In addition, the hemodynamic responses were recorded as oxyhemoglobin concentration changes by an fNIRS system (NIRScout®, NIRx Medical Technologies, Germany) at T0 and T1. Total 74 channels consisted of 24 sources and detectors mainly covered motor cortical areas. An fNIRS paradigm consisted of alternating resting state and sequential finger tapping task with their non-dominant hand for 6 minutes.

Results

In condition 1, 2, and, 3, increment of MEP amplitudes was observed at T1 and T2 but there was no statistical significance compared to T0. In condition 4, the amplitude of MEP was significantly increased at T2 compared to T0. In fNIRS measurement, single anodal tDCS application on M1 and dual stimulation on M1 and PMC increase the oxyhemoglobin activity over the of stimulation sites.

Conclusions

The dual-site tDCS application on both M1 and PMC showed more long-lasting effect than single site stimulation in neurophysiological measure without additional discomfort. In addition, fNIRS measurement demonstrated more cortical activities in dual-site stimulation than single stimulation. To confirm the potential of dual-site tDCS as a neuromodulation method for neurorehabilitation, its effect on motor function of healthy or diseased subjects are needed to investigate.

Acknowledgment

This research was supported by a grant from the Korea Health Technology R&D Project through the Korea Health Industry Development Institute (KHIDI), funded by the Ministry of Health & Welfare, Republic of Korea (HI17C1501) and NRF (NRF-2017R1A2A1A05000730) funded by the Korean government.