Exploring the effects of cerebellar transcranial direct-current stimulation on thalamo-cortical networks during command-following

Davide Aloi, Roja Jalali, R Chris Miall, Davinia Fernández-Espejo
School of Psychology, University of Birmingham, B15 2TT, Birmingham, UK
Centre for Human Brain Health, University of Birmingham, B15 2TT, Birmingham, UK

Background & Hypothesis

• Therapeutic options for patients with prolonged disorder of consciousness (PDOC) are limited;
• Some PDOC patients show a dissociation between cognitive functioning and behavioural responsiveness (1, 3);
• This dissociation seems to be associated with structural connectivity impairments within the motor system -> reduced thalamo-cortical coupling (3);
• Cerebellum exerts inhibitory tone on the motor cortex (Fig. 1) and plays fundamental role in motor control (4)

Hypothesis: ctDCS can modulate thalamo-cortical connectivity during command following.

Methods

• **Participants**: 21 healthy participants completed all 3 sessions; 14 female, 7 male; mean age = 27.1 (4.2).
• **Design**: within-subjects; 3 ctDCS sessions (anodal/cathodal/sham, counterbalanced)
• **Montage**: right cerebellum (active electrode), right cheek (return electrode),
• **Intensity**: 1.85mA
• at least 6 days between sessions;

Command-following task:

• simple **thumb movements** in response to auditory cues;
• auditory stimuli were grouped in blocks of ~ 20 seconds;
• total time: **5min 30 sec**;
• Motion tracker device (reaction time, velocity, peak acceleration)

Motion tracking results

No interaction (polarity X time) found

Brain activation

• Interaction (polarityXtime, p<0.001 unc)
• Pairwise interactions (p<0.05FWE, k=10):
  1) Increases after **cathodal** stimulation as compared to **sham**:
  2) No significant increases after **anodal** stimulation as compared to **cathodal**
  3) No significant increases after **anodal** stimulation as compared to **sham**

Effective connectivity analysis

• (free-energy Pp>.99)

Conclusions

• ctDCS has long-range polarity-specific effects on thalamo-cortical connectivity
• Cathodal ctDCS increases thalamo-M1 excitation
• Anodal ctDCS leads to increased inhibition in M1 and thalamus

In conclusion, ctDCS can modulate cerebellar-brain inhibition during command following in a polarity-specific manner. This supports its potential to restore some degree of responsiveness in patients with PDOC.

References


Contact: dxa869@student.bham.ac.uk