Improving responsiveness to non-invasive brain stimulation in minimally conscious state patients: a closed-loop approach

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Introduction

- Transcranial direct current stimulation (tDCS) over left dorsolateral prefrontal cortex (DLPFC) efficient for recovery of conscious awareness in patients in minimally conscious state (MCS)¹.
- Vigilance cycles of ~70 min measured by EEG spectral entropy in MCS ².
- Selectively stimulating at high and low vigilance states (closed-loop) to improve tDCS response.

Methods

- 12 patients
- Randomized controlled crossover
- Preliminary 4-hour EEG recording
- 3 tDCS sessions (bilateral DLPFC 20 min. 2 mA (4 mA total)
  - active tDCS – high vigilance
  - active tDCS – low vigilance
  - sham tDCS – random vigilance
- Baseline CRS-R + after tDCS

Fig. 1: Spectral entropy time course (in black) and time course of the main oscillation identified by wavelet analysis (in red) of a MCS patient ² (Piarulli et al. 2016)

Fig. 2: tDCS-EEG Closed-loop model based on individual vigilance thresholds measured by spectral entropy

Fig. 3: Closed-loop architecture (left) and closed-loop model (right) as developed by Starlab Barcelona. NIC= software interface for Startsim® control; CLM= Closed-loop manager for EEG monitoring and tCS management

Conclusion

This unique and novel approach will provide new insights for the identification of tDCS responders and provide treatment options for the challenging population of patients with disorders of consciousness.

References