

Recent advances in the treatment of patients with disorders of consciousness: a review of transcranial direct current stimulation efficacy

Martens G., Barra A., Gosseries O., Laureys S., Thibaut A.

Coma Science Group – GIGA Consciousness, University and University Hospital of Liège

Introduction

Severe brain injured patients with disorders of consciousness (DOC) represent a challenging population to treat. Transcranial direct current stimulation (tDCS) can transiently improve the level of consciousness of DOC patients, as measured with the Coma Recovery Scale-Revised (CRS-R). However, it is still unclear how long the effects can last and which brain region represent the best area to target. We therefore reviewed tDCS-based clinical trials on DOC.

Methods & Results

We screened the PubMed online database in June 2018 using the terms tDCS, non-invasive brain stimulation, disorders of consciousness, vegetative state, unresponsive wakefulness syndrome and minimally conscious state. We included randomized controlled trials published in English, using tDCS as a therapeutic intervention on DOC patients and reporting outcomes including the CRS-R. We also included studies conducted by our group and submitted for publication. The retrieved studies are presented in Table 1 and a summary of the montages efficacy in Fig. 1.

| Author and year of publication | Target area | N sessions | Time since onset | Sample size | N responders | Effect size |
|-------------------------------------|---|------------|------------------|-------------|--------------|-------------|
| 1. Thibaut et al., 2014 | Left DLPFC (F3) | 1 | 36 months | N=55 | 15/55 | 0.38 |
| 2. Martens et al., (Submitted 2018) | Primary motor (C3 or C4) | 1 | 9 months | N=10 | 1/10 | 0.12 |
| 3. Martens et al., (In Prep 2018) | Frontoparietal network (F3, F4, CP5, CP6) | 1 | 38 months | N=46 | 6/46 | 0.12 |
| 4. Estraneo et al., 2017 | Left DLPFC (F3) | 5 | 3 months | N=13 | 5/13 | 0.30 |
| 5. Huang et al., 2017 | Posterior Parietal (Pz) | 5 | 5 months | N=33 | 9/33 | 0.31 |
| 6. Martens et al., 2018 | Left DLPFC (F3) | 20 | 9 years | N=22 | 6/22 | 0.53 |
| 7. Thibaut et al., 2017 | Left DLPFC (F3) | 5 | 3 months | N=16 | 9/16 | 0.43 |
| 8. Zhang et al., 2017 | Left DLPFC (F3) | 10 | 5 months | N=26 | 10/26 | 2.22 |

Table 1. Methods and results of the included studies: In the target column the anodal electrode is between parenthesis according to 10-20 EEG standard ¹. Number of responders is given out of the whole sample with no information about MCS/UWS. Effect size is calculated with Cohen's d index.

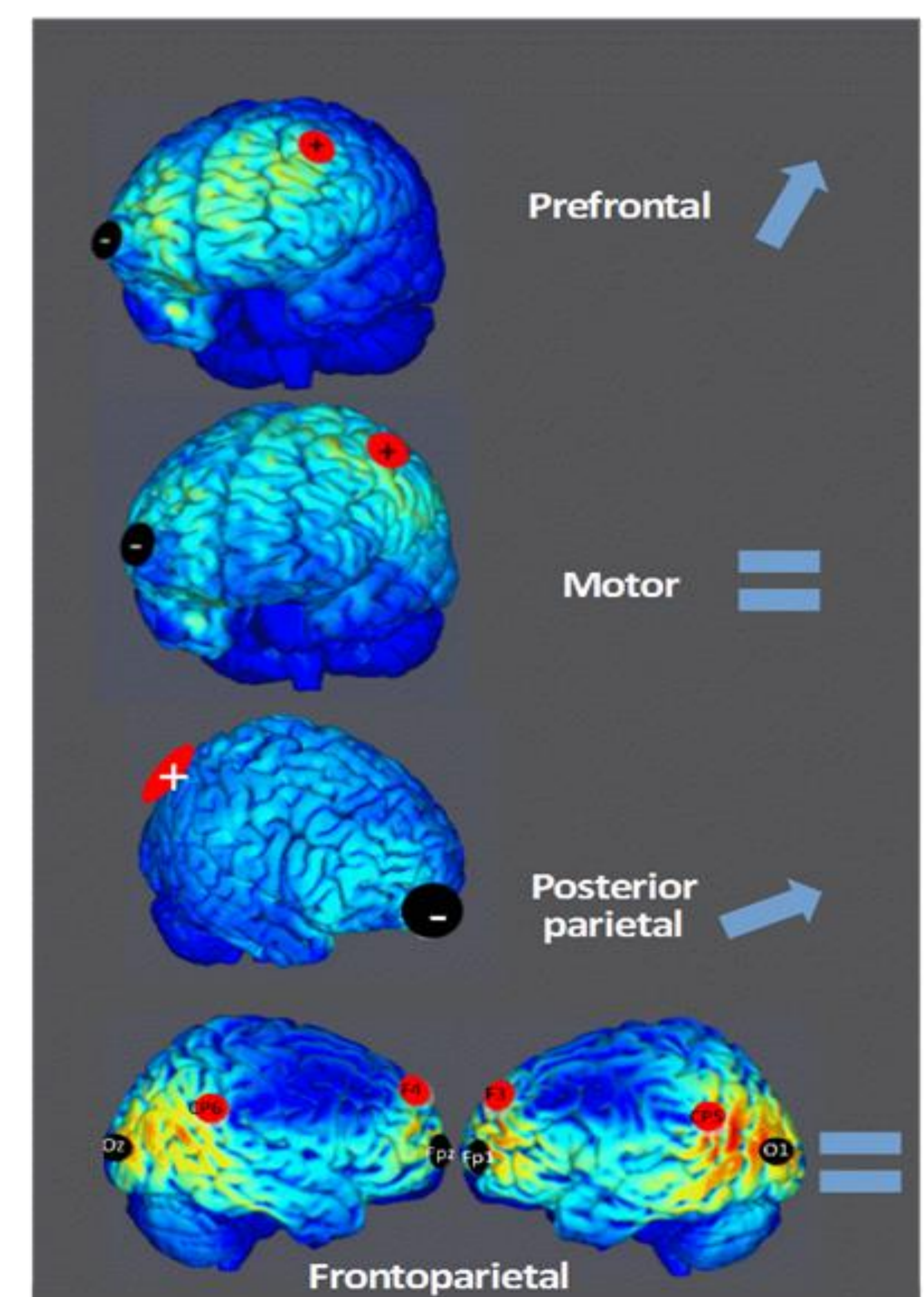


Fig 1. Visualization of targets effectiveness

Repeated session studies generally show larger effect size of tDCS treatment and significantly more responders as compared to single session ($p=0.0125$).

Conclusion

From this retrospective exploration of tDCS clinical trials, it emerged that the left DLPFC seems to be the most powerful and promising target to improve behavioral responsiveness of DOC patients whereas the strength and duration of tDCS aftereffects seems to increase with the number of sessions.