Frontoparietal tDCS in Patients with Disorders of Consciousness: Double Blind Randomized Controlled Clinical Trial

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Objectives

In this randomized double blind sham controlled cross-over study, we aimed to assess the effects of frontoparietal transcranial direct current stimulation (tDCS)[1] on the level of consciousness in patients with disorders of consciousness (**Fig. 1**).

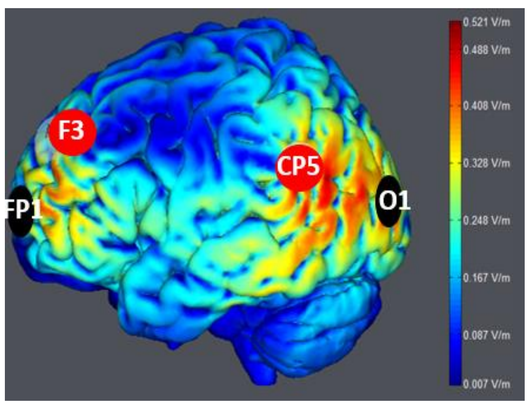

Fig. 1: The electric field induced by tDCS is shown in yellow.

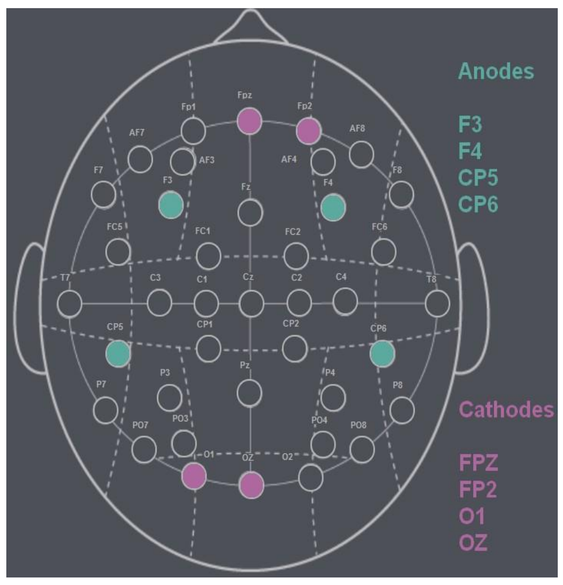

Fig. 2 : 4 anodes are located on F3, F4, CP5, CP6 and 4 cathodes on FPZ, FP2, O1, OZ

Methods

This study was performed on patients in unresponsive wakefulness syndrome (UWS), minimally conscious state (MCS) and emergence of MCS (EMCS). 23 patients (UWS=8, MCS=14, EMCS=1; mean age: 45±12 years; 17 men; interval since insult: 4.5±7 years; 11 traumatic etiologies) underwent two tDCS sessions, either anodal or sham in a randomized order. Frontoparietal areas were stimulated using a current of 1 mA during 20 minutes (**Fig. 2**). Consciousness was assessed by the Coma Recovery Scale-Revised[2] (CRS-R) before and after each stimulation (**Fig. 3**).

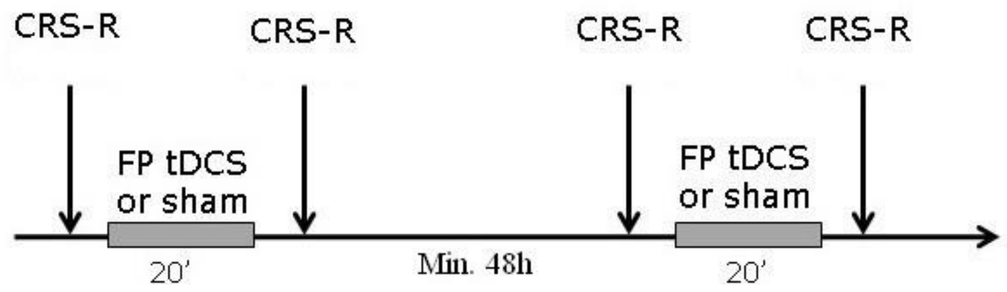

Fig. 3: Study protocol. CRS-R = Coma Recorey Scale-Revised, FP = Frontoparieteal, tDCS = transcranial direct current stimulation

Results

We did not observe any treatment effect in the whole population (p=0.121) but a significant treatment effect was found for the subgroup of MCS patients (p=0.019) while no significant effect was observed for the UWS patients (p=0.345; **Fig. 4**). We found a significant difference in the total CRS-R score before and after the real session (p=0.042) with no significant difference for the sham session (p=0.826; **Fig. 5**). We did not observe any tDCS related side effect (e.g. epilepsy, sign of pain, drowsiness).

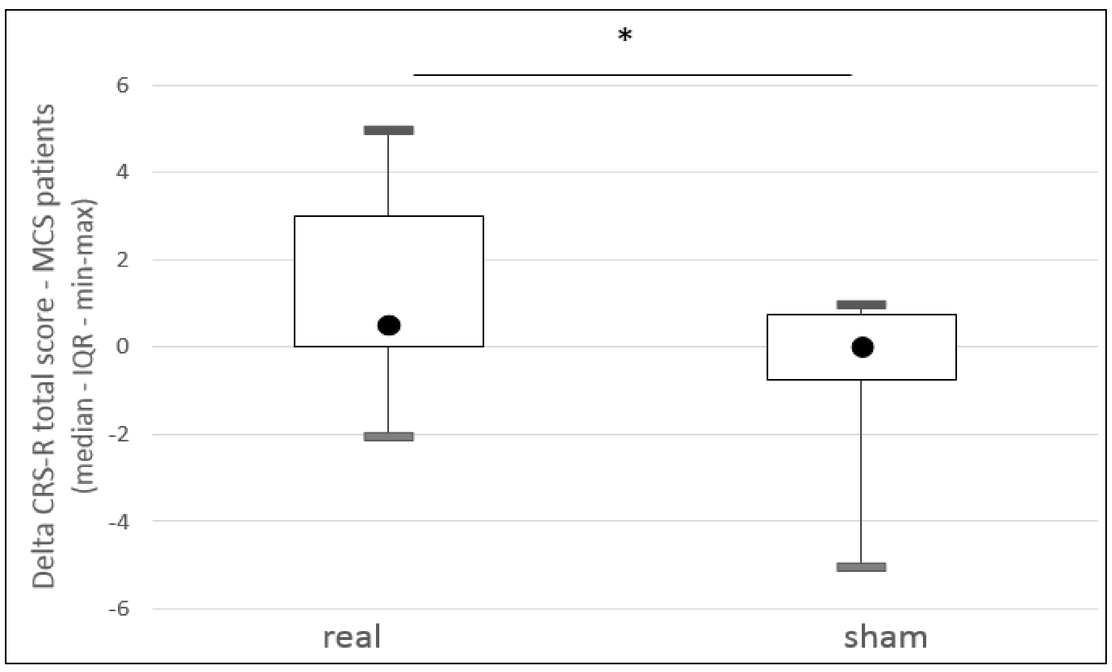

Fig. 4: Boxplot of the total score difference after real (left) and sham (right) sessions in MCS patients (n=14)

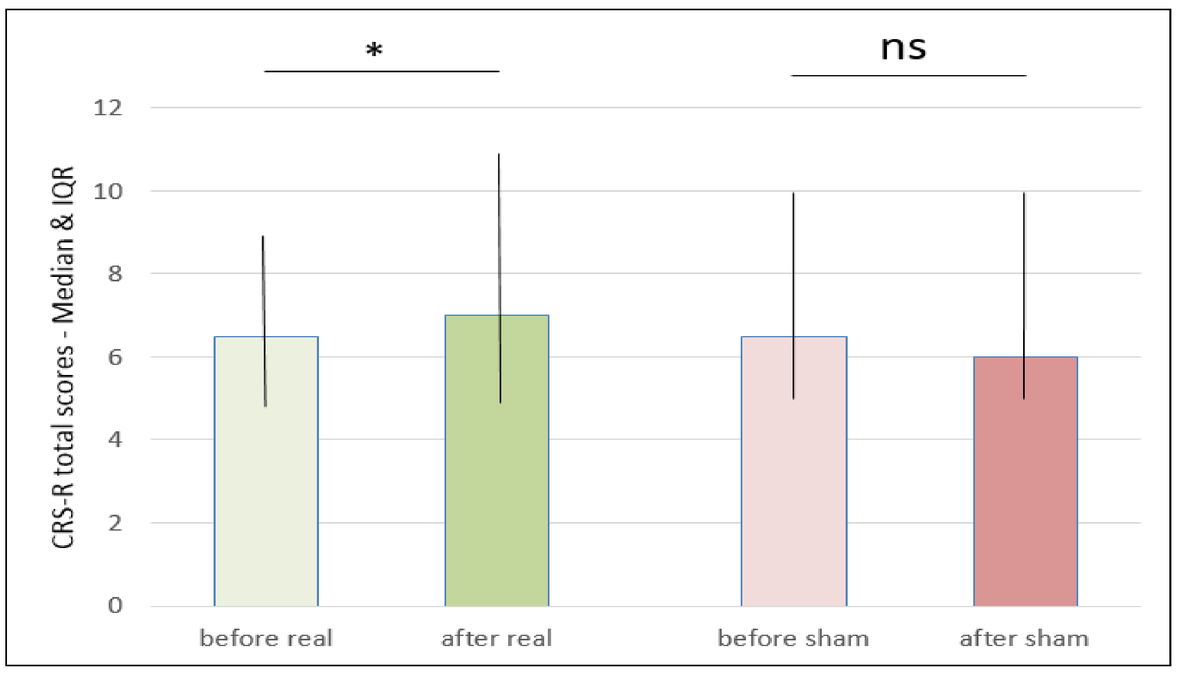

Fig. 5: Total CRS-R scores before and after the real session (left) and the sham session (right) in the whole sample (n=23)

Conclusion

Our results showed that frontoparietal anodal tDCS is safe and might improve the level of consciousness in half of MCS patients. This non-invasive brain stimulation technique could be useful to improve MCS patients' rehabilitation.

REFERENCES
1 Thibaut A, Bruno MA, Ledoux D, Demertzi A, Laureys S; tDCS in patients with disorders of consciousness; Neurology 2014;82:1–7
2 Giacino JT, Kalmar K and Whyte J; The JFK Coma Recovery Scale-Revised: measurement characteristics and diagnostic utility; Arch Phys Med Rehabil 2004; 85(12): p. 2020-2029