Magnetic Resonant Therapy for Non-Invasive Neuromodulation of Minimally Conscious State – A Report of 2 Cases

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Introduction

DBS has been hypothesized to activate arousal input to the cortex to revive comatose patients. However, clinical trials have been inconsistent (Schiff, 2007). We hypothesize that minimally conscious state (MCS) represents regression of the brain's default state (Buzsaki, 2011) that can no longer be perturbed by the normal ascending arousal input. We report our experience with EKG-EEG modulated neurostimulation (Magnetic Resonant Therapy, MRT) to the cortex at sites of functional disruption to treat 2 comatose patients.

Methods

Two adolescent with TBI and MCS were treated with MRT. Case I: 19 yo male with initial GCS 3 and GCS 4t at 7 months. Case 2: 15 year old male with initial GCS 3, improving to E2M4Vt at 8 months. EEGs were recorded at treatment start, week 1 end, and each month's end. MRT was delivered with a MagPro R30 (MagVenture, Denmark) at stimulation intensity 80% motor threshold and rate modulated by patients' EKG and EEG. 3D EEG was used to determine treatment area, as the area of maximal EEG
power deviation from normal controls. In both patients, treatment was administered
for 6 sec/min, 30min/session/day.

Results

Case 1: Patient received 4 months of treatment as of report date. Patient responded to verbal commands at 2 weeks, continuing to improve. At four months, patient began walking and communicating verbally, performing simple calculations, and showing appropriate emotional responses.

Case 2: Patient received 6 weeks of treatment as of report date. After 4 weeks, patient could imitate manual movement and respond to simple verbal commands. At 6 weeks, patient could perform basic movements to cooperate with his care, with GCS improving to E4M5Vt. Both Patients had increased posterior alpha activity and reduced delta activity by EEG.

Conclusions

MRT resulted in clinical improvements in TBI patients in MCS with positive EEG changes and similar improvement patterns, perhaps by recapitulating an arousal effect similar to subcortical input in the cortical/subcortical coupling model.

Learning Objectives

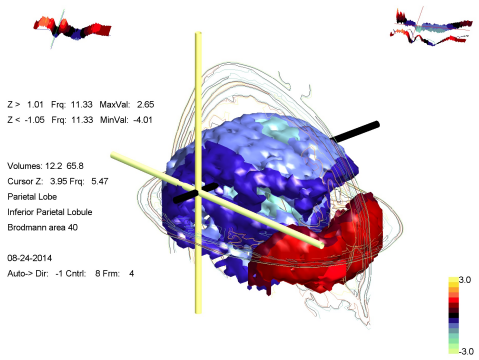
Understand the cortical/subcortical coupling model of coma and neuromodulation for treatment.

References

Buzsaki G. "Rhythms of the Brain". Oxford University Press, 2011.

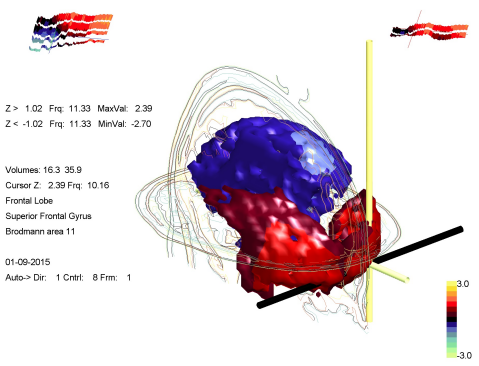
Schiff ND, Giacino JT, Kalmar K, et al. Behavioural improvements with thalamic stimulation after severe traumatic brain injury. Nature. Aug 2 2007;448(7153):600-603.

Initial 3-D EEG of Patient 1

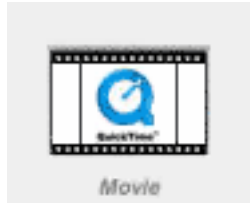


Z-score of activity at 11.3 Hz compared to normative database. Areas in blue indicate deficits in activity as compared to normals. At time of this EEG, patient was GCS 9 with spastic right hemiplegia.

6 month follow-up EEG of patient 1



Z-score of activity at 11.3 Hz. 6 months post MRT treatment. EEG shows normalization of some areas previously "blue," or those areas deficient in activity at this peak frequency. Patient is now GCS 15, ambulatory with assist, but some residual right-sided weakness.



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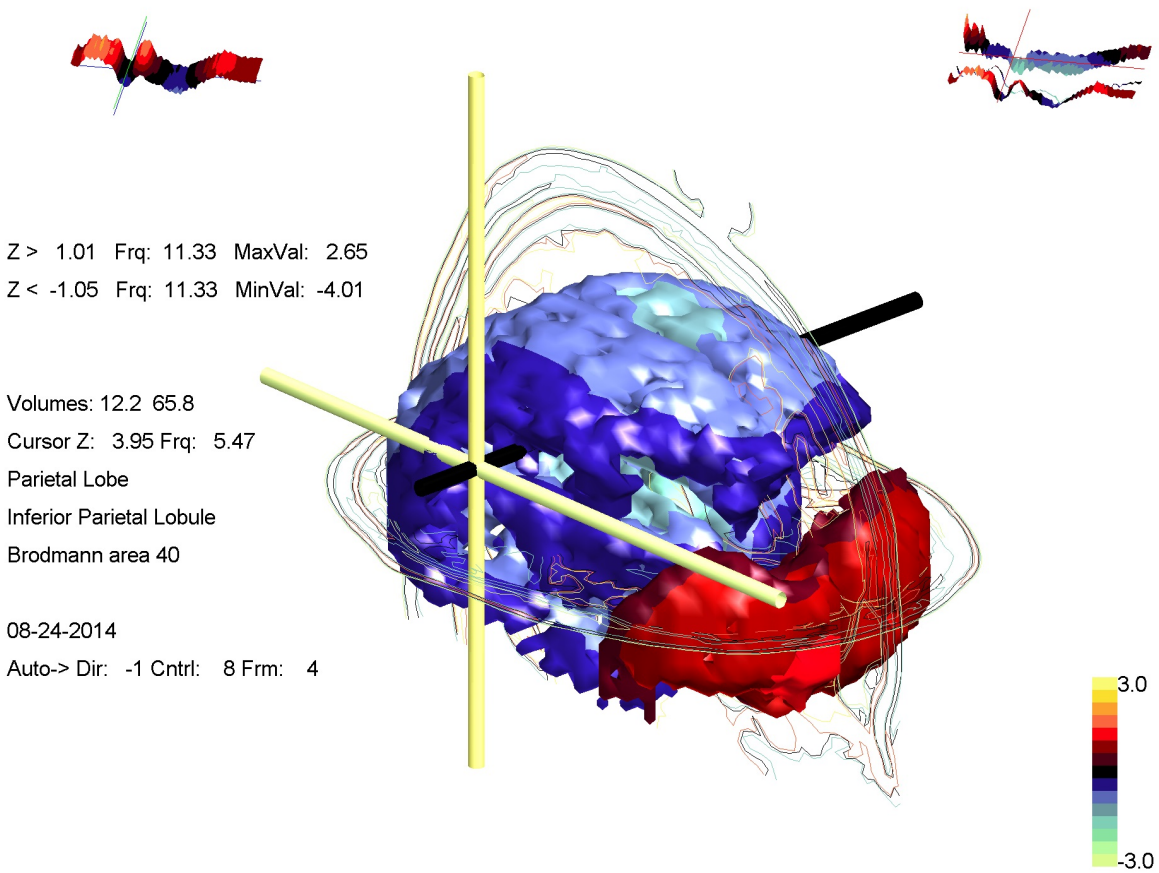

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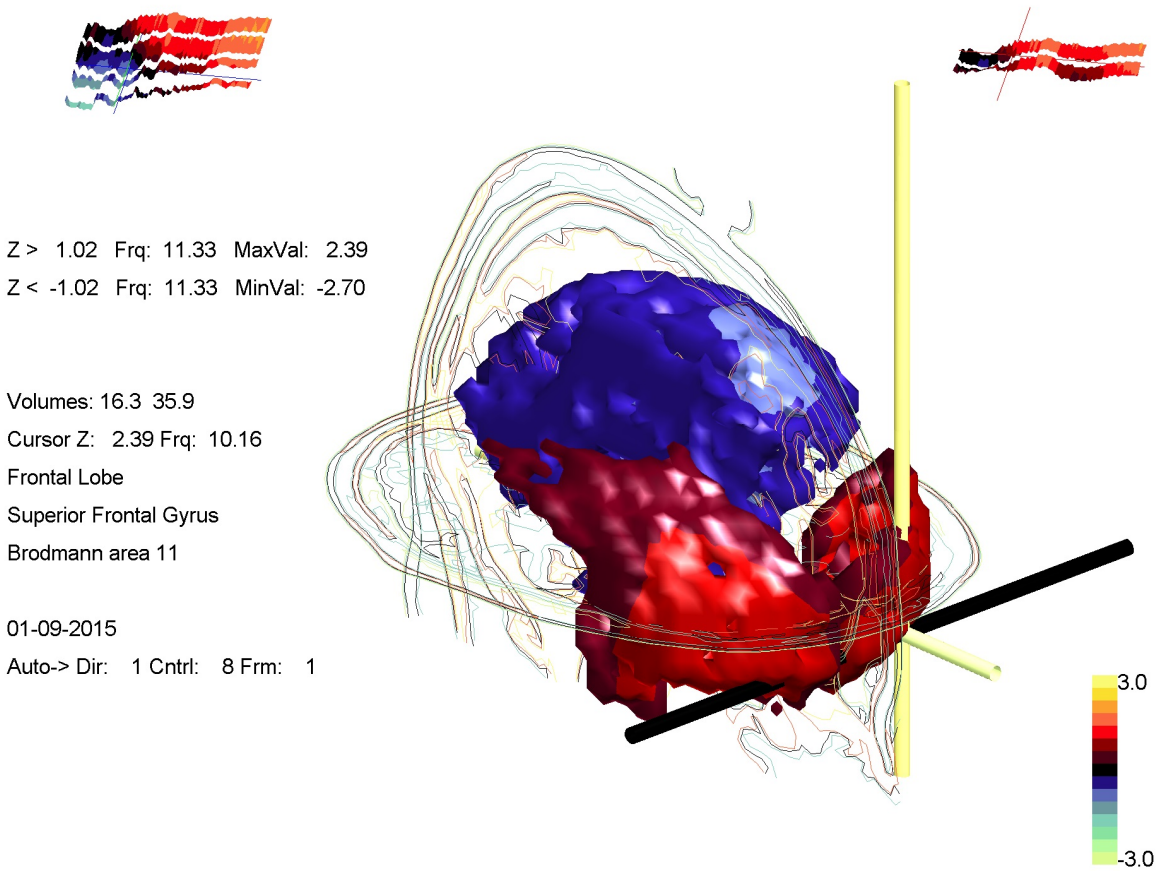

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