Results: Frontocentral mean amplitudes of MMN were reduced significantly by both left-side and right-side rTMS. For left-side stimulation, the pre-rTMS MMN and post-rTMS MMN at FCz were -2.22 (-3.24, -1.74) and -1.55 (-2.31, -0.99) μV(data presented in median (25th percentile, 75th percentile)). For right-side stimulation, the pre-rTMS MMN and post-rTMS MMN at FCz were -1.83 (-2.34, -1.09) and -1.31 (-1.74, -0.35) μV. To the contrary, rTMS didn't exert effects on corresponding waveforms recorded by temporal region electrodes.
Conclusion: This study provided causal evidence that inferior frontal cortices participate in the generation of electroencephalography MMN.
Keywords: TMS, EEG, mismatch negativity

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ASYMMETRIC CONNECTIVITY IN THE HUMAN TEMPORAL LOBE ASSESSED BY CORTICO-CORTICAL EVOKED POTENTIALS

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Introduction: Studies of single pulse electrical stimulation (SPES) in living human brain provide information about cortico-cortical interactions including their directionality, contributing the mapping of functional connectivity between brain regions. Due to a high spatiotemporal resolution, this method allows tracking brain networks that leads to a growing evidence of asymmetrical connectivity between cerebral areas.
Methods: We explored the directed functional (electrophysiological) connectivity among the structures of the human temporal network in 12 non-lesional patients (7 male, mean age 38 years old) with suspected temporal lobe epilepsy, who underwent intracranial recording with multiple depth electrodes for clinical purpose. The investigated structures were temporal pole, hippocampus, amygdala and parahippocampal gyrus. Repeated bipolar single pulse electrical stimulation with biphasic square wave pulses of 2 ms duration between 2 and 4 mA was conducted via two adjoining contacts at the implanted contact pairs; the evoked responses were recorded from the other cortical contacts. Intratemporal cortical connectivity was measured as a function of the amplitude of cortico-cortical evoked potentials (CCEP).
Results: We found reliable reproduction of CCEP with a threshold of 5 SD above pre-stimulus baseline of ongoing activity in all subjects. The obtained evoked potentials displayed asymmetry in the strength of bidirectional information flow among the structures of temporal network. The asymmetry included a stronger connectivity directed from amygdala to hippocampus and from hippocampus to parahippocampal gyrus than in the opposite directions.
Discussion: Our finding corresponds partwise with the data from animal research that prove asymmetrical connections of amygdala, hippocampus and parahippocampal gyrus in tracing studies in rodents and non-human primates. The assessment of functional directionality can contribute to a better understanding of cognitive processing, in particular interaction between hippocampus and its adjacent structures in memory and navigation.
Keywords: functional connectivity; electrical brain stimulation; cortico-cortical evoked potentials; human temporal lobe

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EFFECTS OF TRANSCRANIAL DIRECT CURRENT STIMULATION (TDCS) ON RESTING STATE CONNECTIVITY IN MESIAL TEMPORAL LOBE EPILEPSY ASSOCIATED WITH HIPPOCAMPAL SCLEROSIS

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Objective: The aim of this study is to explore the effect of tDCS on resting state connectivity in patients diagnosed as mesial temporal lobe epilepsy (mTLE).
Methods: This study analyzed the resting state functional MRI data from a homogenous group of mTLE patients with left hippocampal sclerosis using seed-based correlations. 17 drug-resistant unoperated patients with left mTLE participated in this study. Resting fMRI scans were collected with a 3T MRI scanner before and after 2mA cathodal tDCS lasting 20 min over the temporal region (T3), while anode electrode was placed over supra-orbital region. A battery-driven DC-Plus stimulator (NeuroConn) was used for transcranial stimulation. SPM8 was used for data preprocessing. Functional connectivity (FC) analyses were conducted for 23 resting-state network (RSN) nodes with the CONN-fMRI toolbox. The cluster-level FWE corrected results of $p < 0.01$ with a height threshold of $p < 0.001$ are reported.
Results: After cathodal tDCS stimulation, a highly significant FC increase is obtained between the left anterior insula, which is part of the salience network (SN), and neighboring structures including the posterior insula, central and parietal opercular cortices and planum temporale ($p_{FWE} < 0.001$).
Conclusions: According to our preliminary results, cathodal tDCS resulted in significant increase of the resting-state FC among fronto-temporal structures in the seizure side of mTLE patients. This is the first study that explored the effect of tDCS on resting state FC in mTLE. Considering previous reports on reduced FC within the affected hemisphere of mTLE patients, these results may point to potential usability of tDCS in treating mTLE patients.
Keywords: resting-state connectivity, left mesial temporal lobe epilepsy, transcranial direct current stimulation, functional MRI

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THE EFFECTS OF NEUROMUSCULAR ELECTRICAL STIMULATION DURING REPETITIVE TRANSCRANIAL MAGNETIC STIMULATION BEFORE REPETITIVE FACILITATION EXERCISE ON THE HEMIPARETIC HAND IN CHRONIC STROKE PATIENTS

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Objective: Repetitive facilitative exercise (RFE) is a combination of high repetition rate and neurofacilitation. It is a recently developed approach to the rehabilitation of limb impairment in stroke patients. On the other hand, the effects of neuromuscular electrical stimulation (NMES) combined with repetitive transcranial magnetic stimulation (rTMS) on functional recovery of hemiparetic upper limb remain unclear. The purpose of this study is to investigate whether NMES facilitated the effect of rTMS and RFE on the function of hemiparetic hand in stroke patients.
Methods: This randomized double-blinded crossover study divided 20 patients with hemiparesis into two groups and provided treatment on a 4-week, 5 days/week schedule. The NMES-before-sham NMES group, which performed NMES sessions for 2 weeks followed by sham NMES sessions for 2 weeks; or the NMES-following-sham NMES group, which performed conversely. Patients received NMES or sham NMES to the extensor digitorum communis of affected side concurrently with 1Hz rTMS to the unaffected motor cortex for 10 min. The intensity of NMES was adjusted to produce slight contraction. rTMS was applied using a 70-mm figure-of-eight coil with a stimulus intensity of 90% of the resting motor threshold. After NMES or sham NMES and rTMS, patients performed RFE for 60 min. The Fugl-Meyer Assessment (FMA), Action Research Arm Test (ARAT), Box and Block Test (BBT) and Modified Ashworth Scale (MAS) were used for evaluation.
Results: FMA and ARAT improved significantly during both sessions. The gains in the BBT during NMES session were significantly larger than that during sham NMES session. MAS of wrist and finger significantly decreased only during NMES session. MAS of elbow decreased only during sham NMES session.
Conclusions: NMES combined with rTMS might facilitate in part the effects of RFE in improving the motor function and spasticity of the affected upper limb.
Keywords: neuromuscular electrical stimulation, hemiparesis, repetitive facilitative exercise, transcranial magnetic stimulation, stroke