Applying electric field modeling to TMS motor mapping

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CO30

Late TMS-EEG responses in epilepsy patients and healthy controls

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Objective.— Diagnosing epilepsy is often time-consuming, partially due to the limited sensitivity of the routine EEG. Therefore, there is a need for additional diagnostic measures. Transcranial magnetic stimulation (TMS) enables quantification of the brain's excitability. When TMS is applied while recording EEG, a characteristic waveform — the TMS evoked potential (TEP) — is induced in the EEG. A previous study showed that TEP consists of an early part, which is always present, and a late part, that was present in 9 out of 11 epilepsy patients and not in healthy subjects [1].
Materials and methods.— TMS/EEG was recorded using a Magstim Rapid2 stimulator and a 64-channel EEG amplifier (ANT Neuro, Enschede). TMS was targeted at the left and right motor cortex. We administered 75 pulses at an intensity of 110% motor threshold for both targets. Trials with eyeblinks or artefacts were manually rejected. For each remaining trial, a bandpass filter from 1—80 Hz was applied and the baseline power (defined as the power from 800 to 200 ms before the pulse) was subtracted from the response power (defined as the power from 400 ms to 1000 ms after the pulse). The power change after the TMS pulse was compared to the baseline value using a student t-test. A late response was defined as a significant increases in power of >1 μV in the electrodes underneath the TMS target.
Results and discussion.— At present, 18 healthy subjects and 10 epilepsy patients have been included. In all healthy controls and epilepsy patients, we found an early TEP. Five out of 10 patients and 9 out of 18 healthy subjects showed a late response. Currently, the data is analysed on single trial level. In addition, frequency analysis is explored as an alternative processing tool to identify high frequency responses.

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CO31

Inhibition of cortical excitability by retigabine: Measurement of intracortical inhibition using transcranial magnetic stimulation

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Transcranial magnetic stimulation is a non-invasive method to measure the excitability of the motor cortex. Using two consecutive stimuli (paired-pulse inhibition) makes it possible to explore the interaction between cortical interneurons and pyramidal cells. The effect of the different classical antiepileptic drugs (AED) on TMS is well known.
Sodium channel blockers have a effect on the motor threshold, Gaba-ergic drugs change the paired-pulse inhibition without changing the threshold. Retigabin is a new antiepileptic drug with a novel mechanism of action based on modulation of potassium channels. Therefore, a new pattern of TMS changes is to be expected.
Patient with epilepsy show a diminished cortical inhibition with TMS. Interestingly, treatment with AED normalises the TMS abnormalities in a part of the patients. Remarkably, the TMS response several weeks after starting a new AED predicts seizure freedom in the next months. This finding is an extra motivation to study the effects of TMS during AED treatment.

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Applying electric field modeling to TMS motor mapping

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Realistic field calculations in transcranial neurostimulation promise a better insight into the position and extent of the affected brain areas and improve the spatial specificity of stimulation. This is underlined by recent work that demonstrated a strong influence of individual gyral geometry on the strength and distribution of the induced electric field [1].
The field calculations are based on fundamental laws of electrodynamics and rely on conductivity model of individual heads, which are based on segmented structural MR images. For the wider application and the general acceptance of electric field modeling for neurostimulation, two steps seem essential:
— a demonstration that the simulated fields correlate with observable effects of neurostimulation (e.g. behavioral or electrophysiological). That is, the simulated fields contribute accurate and relevant information to the experiments;
integration electric field modeling into regular TMS experiments in a user-friendly way.
Methods and results.— We demonstrate the integration of the Simulation for Non-Invasive Brain Stimulation (SimNIBS, www.simnibs.de) software package with neuronavigation tools for

TMS (VISOR from ANT). The coil position and orientation for each TMS pulse is saved by VISOR. These coil positions are automatically converted into the SimNIBS format and used to carry out electric field simulations for each coil position.
First results from TMS-motor mapping show how the simulated electric fields can be correlated with the motor evoked potentials of individual muscles.
Conclusion.— These results demonstrate that advanced electric field simulations can be applied routinely in experiments involving TMS. In addition, the application to TMS-motor mapping allows validating these simulations in a brain system that is well characterized.
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CO33

The use of graph theoretical analysis of EEG signals: Clinical application in schizophrenia

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''Small World'' graph theoretical models have in the recent past been successfully used in psycho-physiological research, and as such may prove to have clinical applicability.
The current study evaluated the use of graph theoretical models as a tool in the identification of response characteristics to treatment in schizophrenia.
We used coherence as a parameter for the connectivity between regions (electrodes) in the different frequency bands. On the basis of a cut-off value, graph theoretical properties were identified.
It proved possible, in a retrospective way with 29 patients, all of them two or more episodes in the past, to approximately separate non-responders versus responders to treatment with neuroleptics (excluding clozapine) on the basis of graph density/characteristic path length and cluster index.
Limitations of the study are the retrospective character, and the limited number of patients available. As such it can only be a pilot study, but it clearly indicates the need for larger datasets, and further analysis of parameters.
If confirmed, this type of simple and non-invasive technique shows promise as a tool in the treatment of schizophrenia and — possibly — related disorders.
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CO34

Long-term effects of early life stress on the brain monoamines level in the rats

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Effects of stress on the monoamines levels in the early life time have been one of the hot topics in neuroscience. The aim of this study was to investigate the deference effects of stresses on the serotonin (5-HT), dopamine (DA), noradrenaline (NA) level in rat's prefrontal cortex. Ninety-four males and females Wistar rats, 22 days age, were divided into five groups: the first group under the mild tension (subcutaneous injection of sodium chloride 0.9% and handling stress) (I + H), the second group subcutaneous injection of sodium chloride 0.9% and handling with noise exposure (I + N), for third group noise exposure (N), the forth group were maternal deprivation (MD) and the fifth group was the control (C). All of the rats were 10 days under the deference stresses. After 4 weeks in the 64 days age, they were decapitated and the monoamines level was measured by the HPLC method. The concentrations of monoamines (expressed in _g/g wet weight, mean ± SEM, $n = 9$) in tissue extracts from the rat prefrontal were shown in the chart 1. The data suggested that maternal deprivation has been decreased 5-HT in the prefrontal cortex in the both of male and female groups ($P < 0.05$) .we found an increase in the DA and decrease in the NA at the second group ($P < 0.05$).
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CO35

Effect of early maternal deprivation with chronic stress on behavior of rats: It's relation to age and sex

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The aim of this study was to investigate the influence of maternal deprivation with different stressors on behavior of male and female rats. Neonatal rats were isolated daily for 5 hours from postnatal day (PND) 1-27. Beginning on PND 27, the animals of maternal deprivation group were divided into four experimental groups as follows: subcutaneous injection of sodium chloride 0.9% and handling stress (I + H), subcutaneous injection of sodium chloride 0.9% and handling with noise exposure (I + N), noise exposure (N) and not stressed (NS)