uptake after tDCS in the bilateral precentral gyri, the bilateral postcentral gyri, the left cingulate, and the left SMA (p(FWE) < 0.028). These results suggest that perceptions of fatigue and QoL, but not objective performance fatigability, play a prominent role in Post-COVID-19-Fatigue and that tDCS might alter cerebral FDG uptake in fatigue-related brain regions in these patients.
Keywords: COVID-19, Fatigue, Glucose Metabolism, tDCS

P3.013

TRANSCUTANEOUS AURICULAR VAGUS NERVE STIMULATION AMELIORATES CHRONIC PAIN IN PATIENTS WITH SYSTEMIC SCLEROSIS: RESULTS FROM A PILOT INTERVENTIONAL TRIAL

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Abstract

A randomized interventional cross-over trial with transcutaneous auricular vagus nerve stimulation (tVNS) was performed on 13 adult Systemic sclerosis (SSc) patients with chronic moderate-to-severe pain from the Scleroderma Unit of Policlinico Hospital in Milan. Patients were randomly assigned to the interventional group with tVNS (25 Hz) or to the control group based on sham stimulation (1 Hz) for 4 not consecutively hours/day for one month. Each group shifted to the opposite arm after a 4-weeks wash-out period. Pain was assessed by Numeric Rating Scale (NRS) and 10-minute ECG was recorded at rest before and after real tVNS and sham. Symbolic Heart Rate Variability (HRV) analysis was performed on ECG to assess the cardiovascular autonomic control.

ANCOVA test correcting for baseline values, age, disease duration and month of treatment was used to evaluate NRS or HRV changes after tVNS and sham stimulation. For HRV statistical analysis, cardiac ejection fraction and systolic pulmonary artery pressure were also included as covariates. A linear regression model, correcting for covariates as described above, was performed to evaluate the occurrence of minimal clinically important difference (at least $\geq$ 2 points on NRS). Partial correlation analysis was used to estimate the relationship between NRS and HRV changes after correction for covariates.

Statistical analysis showed a significant improvement of NRS score after tVNS with an estimated reduction of 2.051 NRS points ($p<0.001$). No significant variation in HRV parameters were observed. Partial correlation analysis showed that greater reductions in pain were associated with greater increases in parasympathetic modulation ($r= -0.483$; $p=0.04$).

Therefore, tVNS resulted in a clinically significant reduction in chronic pain. This non-invasive neurostimulation technique could represent an important tool for improving the health-related quality of life of subjects suffering from chronic diseases with a high inflammatory profile.
Keywords: Transcutaneous auricular vagus nerve stimulation, Heart rate variability , Systemic sclerosis, Cardiovascular autonomic control

P3.014

THE EFFECT OF AGING ON INTER-LIMB COORDINATION: ESTABLISHING A NOVEL TRANSCRANIAL ALTERNATING CURRENT STIMULATION (TACS) PROTOCOL BY MEANS OF ELECTROENCEPHALOGRAPHY (EEG)

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Abstract

Healthy aging is a societal challenge with a significant socioeconomic impact. Gaining knowledge about neurodegenerative changes that impact functional independence is thus of high scientific importance. Age-related structural and functional neural changes have consequences for inter-limb coordination, which forms an intrinsic part of everyday life (e.g., driving, buttoning a shirt). Research has demonstrated that transcranial alternating current stimulation (tACS) targeting neural oscillations can alter behavioral performance. Nevertheless, profound understanding of tACS in the context of inter-limb coordination is yet to be achieved. In order to accomplish this, a more thorough understanding of the neural oscillations underlying inter-limb coordination is of utmost importance. The current study used electroencephalography (EEG) in healthy right-handed participants during two inter-limb coordination tasks; the bimanual tracking task (BTT) and the multi-limb reaction time task (MLT). The BTT consists of rotating two dials with both hands in a coordinated fashion. Three conditions were used, differing in left- and right-hand movement frequency. The MLT requires participants to lift multiple limbs in a correct manner. Six conditions were used, differing in required motor response (e.g., lifting right arm and left leg, lifting left arm and both legs). Twenty healthy right-handed young adults (age: 22.3 $\pm$ 1.0 (mean $\pm$ standard deviation)) and nineteen older adults (age: 70.7 $\pm$ 3.0) participated. Laplacian filtered EEG data will be analyzed in the time-frequency domain using morlet wavelet convolution. EEG time-frequency data between 4 and 35 hertz will be analyzed by means of repeated measures ANOVA, investigating differences across conditions and groups for each task respectively. In addition, bivariate channel-level functional connectivity will be analyzed using inter-site phase clustering. Behavioral data will be analyzed with a mixed model approach. These insights will be used to establish novel tACS protocols. If significant differences between young and older adults are present, these findings can lead to age-adapted tACS protocols.
Keywords: Electroencephalography, Transcranial alternating current stimulation, Ageing, Functional connectivity

P3.015

AN IN-SILICO MODELING APPROACH TO DETERMINE OPTIMAL ELECTRODE CONFIGURATIONS FOR INTERFERENTIAL DEEP BRAIN STIMULATION USING EPICRANIAL ELECTRODES

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Abstract

Background: Transcranial electric stimulation (TES) is a non-invasive neuromodulation technique that uses head electrodes to deliver electric current to the brain. However, the electric field reaching deep brain regions can be relatively low, with the highest magnitudes being in the cortex. To overcome that and target deep brain regions, a novel non-invasive method, interferential stimulation (IFS), has been suggested. During IFS, two high, but slightly different, frequencies (e.g. 1000 Hz and 1001 Hz) are applied between two scalp electrodes. They interfere to generate a low frequency field (i.e. 1 Hz) at a target deep brain region. On the other hand, epicranial current stimulation (ECS) using electrodes placed under the scalp has been proposed as a minimally invasive technique to deliver stronger fields to the brain.

Objectives: Use in-silico modelling to test the hypothesis that ECS configuration would produce stronger and more focused, interferential and non-interferential, brain fields than TES configuration.

Methods: An in-silico MRI based human head model with 19 TES and 19 ECS disc electrodes was first developed before the volumetric mesh was generated. Then using COMSOL, the electric field distribution was calculated for each electrode separately. Finally, deep brain targets were defined and the optimal electrodes configurations were calculated for each of the TES and ECS electrodes using a custom written Matlab script. This optimization method aims to maximize the electric field at the target point and minimize it elsewhere in the brain.

Results: As hypothesized, the results show that non-interferential and IFS using ECS electrodes can deliver stronger and more focused electric fields than when using TES.

Conclusion: Combining IFS with ECS is a promising approach for delivering minimally invasive deep brain stimulation.