Unilateral application of cathodal tDCS reduces transcallosal inhibition and improves visual acuity in amblyopic patients

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Amblyopia is a neurodevelopmental disorder characterized by visual acuity and contrast sensitivity loss, refractory to pharmacological and optical treatments in adulthood. We studied the response of the visual cortex to transcranial Direct Current Stimulation (tDCS) applied over the primary visual area (V1) contralateral to the "lazy eye". Visual acuity (logMAR) was assessed before (T0), immediately after (T1) and 60′ following the application of cathodal tDCS (2.0 mA, 20′). At each time point, Visual Evoked Potentials (VEPs) triggered by grating stimuli of different contrasts (K90%, K20%) were recorded in both hemispheres and compared to those obtained in healthy volunteers. Cathodal tDCS improved visual acuity (Holm–Sidak, $p < 0.0001$), whereas sham polarization had no significant effect. tDCS produced an inhibitory effect on VEPs amplitudes in the targeted side and a concurrent facilitation of responses in the hemisphere ipsilateral to the amblyopic eye; the facilitation persisted at T2 for high contrasts (K90%; $p < 0.001$), while the stimulated hemisphere recovered more quickly from inhibition ($p < 0.001$). tDCS is a promising treatment for amblyopia in adults. The recovery of excitability and the persistent transcallosal disinhibition following tDCS support the role of interhemispheric pathways in the pathophysiology of amblyopia.

doi:10.1016/j.clinph.2018.09.034

Does Transcranial Magnetic Stimulation (TMS) primarily target premotor or motor cortex in precentral gyrus?

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TMS can be used to map the corticomotor representations of hand muscles (HMs) in the precentral gyrus (PG), whose spatial peak is often not located in the primary motor hand area ($M1_{HAND}$) but shifts towards the caudal part of dorsal premotor cortex (PMd). We used magnetic resonance imaging (MRI) to test the hypothesis that "hand-knob" of PG shows different structural properties in individuals with a "premotor" representation compared to individuals with a "primary-motor" representation of HMs. Twenty-four volunteers underwent MRI and sulcus-shape-based TMS-mapping of right PG. T1-weighted-MRIs were used for neuronavigation and to calculate cortical-thickness of the PG. We also performed quantitative multiparameter mapping of the longitudinal relaxation rate as an index of cortical myelination and simulated the electric field strength induced by TMS in the hand-knob-region. In 14 out-of 24 individuals (58%), TMS mapping disclosed a spatial peak in the PMd ("PMd-subjects"), whereas the remaining 10 subjects (42%) showed maximal motor response in $M1_{HAND}$ ("$M1_{HAND}$-subjects"). "M1-subjects" displayed a higher electric field strength in the rostral part of the $M1_{HAND}$ ($p = 0.01$). "PMd-subjects" showed an increase of regional-myelination in the PG ($p = 0.033$). The results support the notion of two distinct functional-microstructural phenotypes of corticomotor hand representations in human PG.

doi:10.1016/j.clinph.2018.09.035

Safety, feasibility, and efficacy of transcutaneous vagus nerve stimulation combined with upper-limb robotic rehabilitation after stroke

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The efficacy of standard rehabilitation for improving upper limb functionality after stroke is limited; thus, alternative strategies are needed. Vagus nerve stimulation (VNS) combined with rehabilitation is a promising approach, but the invasiveness of this technique reduces its clinical application. Recently, a non-invasive technique for stimulating vagus nerve has been developed. Aim of this study is to evaluate safety, feasibility, and efficacy of noninvasive VNS combined with robotic rehabilitation for improving upper limb functionality in chronic stroke. We designed a proof-of-principle, double-blind, semi-randomized, sham-controlled trial. Fourteen patients with either ischemic or haemorrhagic chronic stroke were randomized to robot-assisted therapy associated with real or sham VNS, delivered for 10 consecutive working days. Efficacy was evaluated by change in upper extremity Fugl-Meyer score. After intervention, there were no adverse events and Fugl-Meyer scores were significantly better in the real group compared to the sham group. Our pilot study confirms that VNS is feasible in chronic stroke patients and can produce a slight clinical improvement in association to robotic rehabilitation. Compared to traditional stimulation, noninvasive VNS seems to be safer and more tolerable. Further studies are needed to confirm the efficacy of this innovative approach.

doi:10.1016/j.clinph.2018.09.036

Mechanical block of large myelinated fibres in healthy humans to demonstrate that paroxysmal pain is mediated by non-nociceptive fibres

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We aimed at testing whether paroxysmal pain is selectively mediated by large myelinated A-beta fibres. To do so we verified whether the selective block of A-beta fibres suppresses paroxysmal pain elicited by high-frequency, low intensity electrical stimulation. In five healthy participants, we delivered a high-frequency (100 Hz), low-intensity (5–8 mA) electrical stimulation in the radial nerve territory and rated the intensity of perceived pain using a NRS scale (0–10). We then applied a mechanical block of the radial nerve using a rubber band, connected to a 750 g weight at each end, across the distal part of the forearm. We have used quantitative sensory testing and laser evoked potentials to assess afferent nerve fibre function during the mechanical block. After 35 ± 10 min the mechanical block abolished both the paroxysmal painful sensation elicited by high-frequency, low intensity electrical stimulation and the tactile sensation, as assessed with von Frey hairs. Conversely, thermal-pain thresholds and laser evoked potentials were spared. Our data showing that the mechanical block of large myelinated A-beta fibre abolishes paroxysmal pain indicates that this type of pain is selectively mediated by non-nociceptive A-beta fibres.

doi:10.1016/j.clinph.2018.09.037