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Effect of combined treadmill training and magnetic stimulation on spasticity and gait impairments following cervical spinal cord injury (C-SCI).

Hou J[1], Nelson R, Nissim N, Parmer R, Thompson FJ, Bose PK.
Author information

Abstract

Spasticity and gait impairments are two common disabilities following C-SCI. In this study, we tested the therapeutic effects of early treadmill locomotor training (Tm) initiated at post-operative (PO) day 8 and continued for 6 weeks with injury site transcranial magnetic stimulation (TMSsc) on spasticity and gait impairments following low C6/7 moderate contusion C-SCI in a rat model. The combined treatment group (Tm+TMSsc) showed the most robust decreases in velocity-dependent ankle torques (VDAT) and triceps surae EMG burst amplitudes that were time-locked to the initial phase of lengthening, and the most improvement in limb coordination quantitated using 3D-kinematics and Catwalk gait analyses compared to the control or single treatment groups. These significant treatment associated decreases in measures of spasticity and gait impairment were also accompanied by marked treatment-associated up-regulation of dopamine beta-hydroxylase (DβH), glutamic acid decarboxylase 67 (GAD67), GABAb receptor, and Brain-derived neurotrophic factor (BDNF) in the lumbar spinal cord (SC) segments of the treatment groups compared to tissues from the C-SCI non-treated animals. The aAuthors propose that the treatment-induced up-regulation of these systems enhanced the adaptive plasticity in the SC, in part through enhanced expression of pre- and post-synaptic reflex regulatory processes. Further, the authors propose that locomotor exercise in the setting of C-SCI may decrease aspects of the spontaneous maladaptive segmental and descending plasticity. Accordingly, the TMSsc treatment is characterized as an adjuvant stimulation that may further enhance this capacity. These data are the first to suggest that a combination of Tm and TMSsc across the injury site can be an effective treatment modality for C-SCI-induced spasticity and gait impairments, and provided a pre-clinical demonstration for feasibility and efficacy of early TMSsc intervention following C-SCI.

Front Psychol. 2014 Feb 4;5:37. doi: 10.3389/fpsyg.2014.00037. eCollection 2014.

Augmenting melodic intonation therapy with non-invasive brain stimulation to treat impaired left-hemisphere function: two case studies.

Al-Janabi S[1], Nickels LA[2], Sowman PF[1], Burianová H[3], Merrett DL[4], Thompson WF[5].
Author information

Abstract

The purpose of this study was to investigate whether or not the right hemisphere can be engaged using Melodic Intonation Therapy (MIT) and excitatory repetitive transcranial magnetic stimulation (rTMS) to improve language function in people with aphasia. The two participants in this study (GOE and AMC) have chronic non-fluent aphasia. A functional Magnetic Resonance Imaging (fMRI) task was used to localize the right Broca's homolog area in the inferior frontal gyrus for rTMS coil placement. The treatment protocol included an rTMS phase, which consisted of 3 treatment sessions that used an excitatory stimulation method known as intermittent theta burst stimulation, and a sham-rTMS phase, which consisted of 3 treatment sessions that used a sham coil. Each treatment session was followed by 40 min of MIT. A linguistic battery was administered after each session. Our findings show that one participant, GOE, improved in verbal fluency and the repetition of phrases when treated with MIT in combination with TMS. However, AMC showed no evidence of behavioral benefit from this brief treatment trial. Post-treatment neural activity changes were observed for both participants in the left Broca's area and right Broca's homolog. These case studies indicate that a combination of MIT and rTMS applied to the right Broca's homolog has the potential to improve speech and language outcomes for at least some people with post-stroke aphasia.

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Interaction of transcutaneous spinal stimulation and transcranial magnetic stimulation in human leg muscles.

Roy FD[1], Bosgra D, Stein RB.
Author information

Abstract

Transcutaneous spinal stimulation is a noninvasive method that can activate dorsal and/or ventral roots depending on the location and intensity ofstimulation. Reflex root-evoked potentials (REPs) were studied in muscles that traditionally evoke large (soleus) and small H-reflexes (tibialis anterior), as well as muscles where H-reflexes are difficult to study (hamstrings). This study characterizes the interaction of the REP and the motor-evoked potential (MEP). Transcranial magnetic stimulation (TMS) delivered 11-25 ms before spinal stimulation resulted in more than linear summation of the two responses. Because of overlap, the modulation was quantified after subtracting the contribution of the conditioning MEP or REP. At rest, the mean-rectified soleus response was facilitated by up to ~250 μV (21-times the MEP or 161 % of the REP). The increases were more reliable during a voluntary contraction (up to ~300 μV, 517 % of the MEP or 181 % of the REP). At the 13-ms interval, the mean-rectified response in the pre-contracted hamstrings was increased by 227 % of the MEP or 300 % of the REP. In some subjects, TMS could also eliminate the post-activation depression produced using two spinal stimuli, confirming that the interaction can extend to presynaptic spinal neurons. The spatiotemporal facilitation in tibialis anterior was not significant. However, the large MEP was facilitated when the spinal stimulus preceded TMS by 100-150 ms, presumably because of rebound excitation. These strong interactions may be important for inducing motor plasticity and improved training procedures for recovery after neurological damage.

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Cognitive effects of repetitive transcranial magnetic stimulation in patients with neurodegenerative diseases - Clinician's perspective.

Anderkova L[1], Rektorova I[2].
Author information

Abstract

Repetitive transcranial magnetic stimulation (rTMS) represents a promising tool for studying and influencing cognition in people with neurodegenerative diseases. This procedure is noninvasive and painless, and it does not require the use of anesthesia or pharmacological substances. In this systematic critical review we report outcomes from research focused on behavioral cognitive effects induced by rTMS in patients with Alzheimer's disease (AD), Parkinson's disease (PD), and mild cognitive impairment (MCI) preceding AD. There are still major limitations to rTMS use, such as a poor understanding of its after-effects and inter-individual variability in their magnitude, discrepancies in stimulation protocols and study designs, varied selection of the specific stimulated areas and control procedures, and neuropsychological methods for assessment of after-effects; hence, the results of the present research can only be considered preliminary. The future directions are discussed.

Neurol Sci. 2014 Feb 2. [Epub ahead of print]

Repetitive transcranial magnetic stimulation in restless legs syndrome: preliminary results.

Altunrende B[1], Yildiz S, Cevik A, Yildiz N.
Author information

Abstract

Our aim was to compare the effect of high-frequency repetitive transcranial magnetic stimulation (rTMS) over supplementary motor area with that of sham stimulation in restless legs syndrome (RLS). In this prospective study, patients were randomly assigned to either real stimulation group (11 patients), or sham stimulation group (8 patients) in a double-blinded fashion. Five patients, who were initially in the sham stimulation group, received real stimulation 1 month after the sham stimulation. One session of intervention was performed once every 3 days and total of ten sessions were done in each group. The International RLS-Rating Scale (IRLS-RS) was assessed at baseline and after 5th and 10th sessions in both groups and also in five patients in whom both sham and real stimulation were performed. A statistically significant difference was seen in the IRLS scores between real (n = 11) and sham stimulation (n = 8) after 5th and 10th sessions. The real stimulation significantly improved the IRLS-RS scores although they were unaffected by the sham stimulation. In five patients, in whom both sham and real stimulation were performed, a statistically significant improvement was seen in the IRLS-RS scores with the real stimulation and a statistically significant difference was seen in the IRLS scores between real and sham stimulation after 10th session. In conclusion, this method is safe and non-invasive, and the results of this pilot study may support that rTMS has the potential to be used in the treatment of RLS, which should be verified in larger series.

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The Persistent and Broadly Modulating Effect of Inhibitory rTMS in Nonfluent Aphasic Patients: A Sham-Controlled, Double-Blind Study.

Tsai PY[1], Wang CP, Ko JS, Chung YM, Chang YW, Wang JX.

Author information

Abstract

BACKGROUND:

. While prior preliminary studies have broadened our understanding of how repetitive transcranial magnetic stimulation (rTMS) improves language outcomes in stroke patients with nonfluent aphasia, the evidence base of the effectiveness of this method remains inadequate.

OBJECTIVE:

. In this study, we aimed to strengthen the evidence that this approach improves language performance and to identify characteristics of patients predisposed to benefit most from this treatment.

METHODS:

. Fifty-six stroke patients with nonfluent aphasia were randomly allocated to a real or a sham stimulation group: Group A (n = 33), who underwent 10 sessions of 1-Hz rTMS over the contralesional pars triangularis (PTr), and Group B (n = 23), who received sham 1-Hz stimulation. We performed the Picture Naming Test and the Concise Chinese Aphasia Test (CCAT) at the baseline, post-rTMS intervention, and at 3-month follow-up.

RESULTS:

. Group A showed significantly greater improvement than Group B in CCAT scoring (P < .001), object-naming accuracy (P = .01), and naming reaction time (P = .004). The CCAT scoring and naming testing changes for Group A were persistent at 3 months following intervention (P = .008). Patients who had a lower contralesional rest motor threshold (rMT) were predisposed to a favorable therapeutic outcome (P = .006), independent of aphasia type, severity, and duration.

CONCLUSIONS:

. The results of this study provide evidence that inhibitory rTMS, through downregulating the circuitry of the right pars triangularis (PTr), achieves a persistent and broadly modulating effect, irrespective of aphasia severity and subtype. Patients who show lower rMT in the right motor system would seem to benefit the most from inhibitory rTMS.

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Dual-Hemisphere Repetitive Transcranial Magnetic Stimulation for Rehabilitation of Poststroke Aphasia: A Randomized, Double-Blind Clinical Trial.

Khedr EM[1], Abo El-Fetoh N, Ali AM, El-Hammady DH, Khalifa H, Atta H, Karim AA.

Author information

Abstract

BACKGROUND:

. Recent neuroimaging studies on poststroke aphasia revealed maladaptive cortical changes in both hemispheres, yet their functional contribution in language recovery remains elusive. The aim of this study was to evaluate the long-term efficacy of dual-hemisphere repetitivetranscranial magnetic stimulation (rTMS) on poststroke aphasia.

METHODS:

. Thirty patients with subacute poststroke nonfluent aphasia were randomly allocated to receive real or sham rTMS. Each patient received 1000 rTMS pulses (1 Hz at 110% of resting motor threshold [rMT] over the right unaffected Broca's area and 1000 pulses (20 Hz at 80% rMT) over the left affected Broca's area for 10 consecutive days followed by speech/language training. The language section of the Hemispheric Stroke Scale (HSS), the Stroke Aphasic Depression Questionnaire-Hospital Version (SADQ-H), and the National Institutes of Health Stroke Scale (NIHSS) were measured before, immediately after the 10 sessions, and 1 and 2 months after the last session.

RESULTS:

. At baseline, there were no significant differences between groups in demographic and clinical rating scales. However, there was a significantly greater improvement in the HSS language score as well as in the SADQ-H after real rTMS compared with sham rTMS, which remained significant 2 months after the end of the treatment sessions.

CONCLUSION:

. This is the first clinical study of dual-hemisphere rTMS in poststroke aphasia. Combining dual-hemisphere rTMS with language training might be a feasible treatment for nonfluent aphasia; further multicenter studies are needed to confirm this result.

KEYWORDS:

Broca’s area, aphasia, cortical plasticity, hemispheric role, neurorehabilitation, stroke, transcranial magnetic stimulation (TMS)

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Effects of Repetitive Transcranial Magnetic Stimulation on Hand Function Recovery and Excitability of the Motor Cortex After Stroke: A Meta-Analysis.

Le Q[1], Qu Y, Tao Y, Zhu S.

Author information

Abstract

OBJECTIVE:

The purpose of this article was to investigate the effects of repetitive transcranial magnetic stimulation (rTMS) on hand function recovery and the plasticity of the cortex in stroke patients.

DESIGN:

A search was conducted in electronic databases for randomized controlled trials exploring the effects of rTMS on hand motor function rehabilitation published from 1990 to January 30, 2012. The authors summarized the effect size on finger coordination, hand function, cortical excitement, and activities of daily living by calculating the standardized mean difference. Adverse effects were also discussed.

RESULTS:

Of 1668 articles identified, 8 articles (N = 273) were included in this study. The summary effect size indicated positive effects of rTMS on finger motor ability (standardized mean difference, 0.58) and hand function (standardized mean difference, -0.82). However, this study showed that the changes of neurophysiologic measurements were not significant in the included studies. Even so, the trend of these changes was positive. Few adverse events were observed.

CONCLUSIONS:

rTMS can improve patients' recovery after stroke. The authors suggest that future trials can concentrate on the effects of rTMS for different types of stroke patients in response to stimulation at different sites and explore optimal rTMS parameters for individual treatment.