World Academy of Science, Engineering and Technology
International Journal of Biomedical and Biological Engineering
Vol:18, No:04, 2024

Effect of Cerebellar High Frequency rTMS on the Balance of Multiple Sclerosis Patients with Ataxia

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Abstract : Background: Multiple sclerosis (MS) is a chronic, inflammatory, mainly demyelinating disease of the central nervous system, more common in young adults. Cerebellar involvement is one of the most disabling lesions in MS and is usually a sign of disease progression. It plays a major role in the planning, initiation, and organization of movement via its influence on the motor cortex and corticospinal outputs. Therefore, it contributes to controlling movement, motor adaptation, and motor learning, in addition to its vast connections with other major pathways controlling balance, such as the cerebellopropriospinal pathways and cerebellovestibular pathways. Hence, trying to stimulate the cerebellum by facilitatory protocols will add to our motor control and balance function. Non-invasive brain stimulation, both repetitive transcranial magnetic stimulation (rTMS) and transcranial direct current stimulation (tDCS), has recently emerged as effective neuromodulators to influence motor and nonmotor functions of the brain. Anodal tDCS has been shown to improve motor skill learning and motor performance beyond the training period. Similarly, rTMS, when used at high frequency (>5 Hz), has a facilitatory effect on the motor cortex. Objective: Our aim was to determine the effect of high-frequency rTMS over the cerebellum in improving balance and functional ambulation of multiple sclerosis patients with Ataxia. Patients and methods: This was a randomized single-blinded placebo-controlled prospective trial on 40 patients. The active group (N=20) received real rTMS sessions, and the control group (N=20) received Sham rTMS using a placebo program designed for this treatment. Both groups received 12 sessions of high-frequency rTMS over the cerebellum, followed by an intensive exercise training program. Sessions were given three times per week for four weeks. The active group protocol had a frequency of 10 Hz rTMS over the cerebellar vermis, work period 5S, number of trains 25, and intertrain interval 25s. The total number of pulses was 1250 pulses per session. The control group received Sham rTMS using a placebo program designed for this treatment. Both groups of patients received an intensive exercise program, which included generalized strengthening exercises, endurance and aerobic training, trunk abdominal exercises, generalized balance training exercises, and task-oriented training such as Boxing. As a primary outcome measure the Modified ICARS was used. Static Posturography was done with: Patients were tested both with open and closed eyes. Secondary outcome measures included the expanded Disability Status Scale (EDSS) and 8 Meter walk test (8MWT). Results: The active group showed significant improvements in all the functional scales, modified ICARS, EDSS, and 8-meter walk test, in addition to significant differences in static Posturography with open eyes, while the control group did not show such differences. Conclusion: Cerebellar high-frequency rTMS could be effective in the functional improvement of balance in MS patients with ataxia.

Keywords : brain neuromodulation, high frequency rTMS, cerebellar stimulation, multiple sclerosis, balance rehabilitation
Conference Title : ICNR 2024 : International Conference on Neurorehabilitation
Conference Location : Tokyo, Japan
Conference Dates : April 22-23, 2024