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The role of bilateral repetitive transcranial magnetic stimulation in stroke patients

Repetitive transcranial magnetic stimulation is non-invasive brain stimulation to the motor cortex. It can alter excitability of the brain after stroke by modulating cortical activity. At low frequencies (1 HZ or less), it has an inhibitory effect, whereas at high frequencies (5-25 HZ), it is able to enhance cortical excitability. As it produces long-lasting effects which persist past the initial period of stimulation through long-term potentiating (LTP) and long-term depression (LTD) (*Chen et al., 2008*).

Following stroke, the brain undergoes various stages of recovery where the central nervous system can reorganize neural circuits (neuroplasticity) both spontaneously and with the aid of behavioral rehabilitation and non-invasive brain stimulation (*Auriat, et al., 2015*).

Motor deficits in patients after stroke are due to a reduced output from the affected hemisphere and excess transcallosal inhibition of the affected hemisphere from the unaffected hemisphere. Therefore, using rTMS, could improve motor deficits by increasing the excitability of the affected hemisphere or inhibition of the unaffected hemisphere and so the interhemispheric inhibition, through increasing or decreasing the excitability of the neuronal circuits, which is called neuroplascity and so motor recovery after stroke (*Murase et al.,2004*).

Cortical plasticity can be manipulated to improve stroke outcome by numerous techniques such as task-oriented physiotherapy. Task oriented exercise is assumed to learn patients (depending on the idea that learning is the basis of neuroplasticity) by allowing them to try solving problems actively by providing them with a functional task, instead of having them repetitively practice the normal patterns of movements. It is an approach suggested to be an efficient treatment method, it consists of tasks that encourage various functional activities and help enhance patient's ability to perform daily activities and thus helping motor recovery after stroke (*Yoo and Park, 2015*). For continuous motor improvement, it is important to impart additional motor training while repetitive trans cranial magnetic stimulation modulates the neural network between both hemispheres and remodels work in the affected hemisphere (*Takeuchi and izumi., 2012*).

Researchers have tested the efficacy of HF rTMS over the affected hemisphere and efficacy of LF-rTMS over the unaffected hemisphere for patients post stroke (Khedr *et al.,* 2009; Emara et al., 2010; Chang *et al.,* 2010). Takeuchi *et al.,* (2009) and Sung *et al.,* (2013) hypothesized the safety, feasibility and efficacy of applying bilateral rTMS; HF- and LF-rTMS in patients with chronic stroke.

In the present study we hypothesized that the combined application of HF-rTMS over the affected hemisphere and LF-rTMS over the unaffected hemisphere as bilateral rTMS may facilitate motor functional recovery in patients with acute stroke. The present study was conducted on different types; ischemic, hemorrhagic and embolic stroke, different sites; supra and infratentorial stroke and associated co-morbidities; ischemic heart disease, vasculitis and atherosclerosis.

Fifty-five patients with subacute stroke (2 weeks to 6 months) were divided into four groups: bilateral, inhibitory, stimulatory and control groups. Bilateral group received five sessions of high-frequency 5Hz rTMS over the affected hemisphere alternating with low-frequency 1 Hz rTMS over the unaffected hemisphere. Inhibitory group received low frequency 1 Hz rTMS over the unaffected hemisphere alternated by sham 5 Hz rTMS over the affected hemisphere. Stimulatory group received high frequency 5 Hz rTMS over the affected hemisphere alternated by sham 1 Hz rTMS over the unaffected hemisphere. Control group received sham stimulatory rTMS over the affected hemisphere alternated by sham inhibitory rTMS over the unaffected. All sessions were associated with task-oriented physiotherapy from day one of treatment till one month. Assessment from before to after sessions then after one month was done by FMA and WMFT to assess the motor performance, modified Ashworth scale for spasticity and MEP for cortical plasticity.

All groups showed statistically significant improvement of the motor disability of the paretic upper limb post stroke assessed by FMA, WMFT and change in excitability assessed by MEP, from before to after sessions and after one month. When groups were compared with each other, bilateral group showed the best improvement of spasticity measured by the modified ashworth scale, while all other groups failed to change the Ashworth scale. Control group failed to show change in the MEP and stimulatory group failed to change the MEP of the healthy hemisphere and its effect was on the unhealthy hemisphere only.

Conclusion: According to the finding yielded from this study, it can be concluded that five daily sessions of bilateral rTMS combined with one month of task-oriented physiotherapy, improves motor disability of the paretic upper limb after stroke. Inhibitory and stimulatory rTMS show nearly same efficacy as bilateral protocol, however bilateral stimulation is superior in spasticity. No correlation was found between improvement in motor power and stroke duration, site and extent of neurologic deficit. Presenting patients with different types, sites of stroke and associated comorbidities will help for future studying; it will open a new trend in rTMS research and help optimizing the best rTMS module for each patient according to type and site of stroke and associated comorbidities.

Biography

Ann Ali Abdelkader Hanafy has completed her MD at the age of 30 years from Cairo University and postdoctoral studies from Cairo University School of Medicine. She is a Professor of Clinical Neurophysiology and the President of Egyptian Clinical Neurophysiology Society. She has published more than 100 papers in local and international journals.

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