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Repetitive Transcranial Magnetic Stimulation for Limb-Kinetic Apraxia in Parkinson's Disease

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Dear Editor,

Apraxia refers to the inability to perform skilled or learned movements, and is frequently seen in neurodegenerative diseases such as Parkinson's disease (PD) or Alzheimer's dementia.[1] Previous studies have shown that apraxia can be disabling and negatively affect quality of life.[2,3] Limb-kinetic apraxia is a subtype of apraxia characterized by the loss of the ability to make precise, independent, and coordinated finger and hand movements.[4] Although apraxia is commonly overlooked and may be interpreted as impaired dexterity due to clumsiness or slowness, recent studies have shown that limb-kinetic apraxia does not correlate with bradykinesia in PD patients, suggesting that apraxia is an independent phenomenon.[4] While there is no specific treatment for apraxia, efforts to treat this condition are ongoing, using noninvasive brain stimulation.[5,6]

Recent studies using transcranial direct current stimulation, a type of noninvasive brain stimulation technique, have shown improvement in ideomotor apraxia by targeting the posterior parietal cortices.[5,6] We extended these findings to a group of PD patients, in whom we attempted high-frequency (10 Hz) repetitive transcranial magnetic stimulation (rTMS) of the left primary motor cortex (M1) as treatment for limb-kinetic apraxia. The left M1 was chosen as this is a brain region that is presumed to be relevant in praxis, an accessible stimulation site that can be identified functionally via transcranial magnetic stimulation and electromyography. The time to perform sequential buttoning and unbuttoning was chosen as the primary outcome measure, as this daily task has been previously found to reflect limb-kinetic apraxia in PD patients.[4]

We studied six patients with PD [mean age: 70.3 years, standard error (SE): 3.3 years, M:F= 1:2] who underwent rTMS. The average Hoehn and Yahr stage was 2.75, and average disease duration was approximately 5.4 years. Prior to stimulation, all patients were assessed using the Unified Parkinson Disease Rating Scale (UPDRS), the Apraxia Screen of TULIA (AST), and performed sequential buttoning and unbuttoning. Patients sequentially buttoned and unbuttoned their gown, which had five buttons aligned vertically (button diameter: 1.9 mm, 9.5 cm inter-button distance). The average total time to button and unbutton was 88.4 seconds (standard error 21.1 seconds) in the medication-off (OFF) state and 65.8 seconds (SE 7 seconds) in the medication-on (ON) state. We confirmed the absence of ideomotor apraxia in the OFF state using the AST, which all patients scored in the normal range (four patients scored 12 out of 12: 5/5 points for imitation and 7/7 points for pantomiming, and two patients scored 11 out of 12).

A 20-minute rTMS session of the left M1 was performed (frequency of 10 Hz, stimulation intensity of 80% resting motor threshold, 10 seconds/train and 20 trains with 50 seconds as the inter-train interval). Patients took their medication per their usual regimen, and underwent rTMS in the relaxed, sitting state. The time for sequential buttoning and unbuttoning performed in the ON state was 51 seconds (SE 2.9 seconds) immediately following

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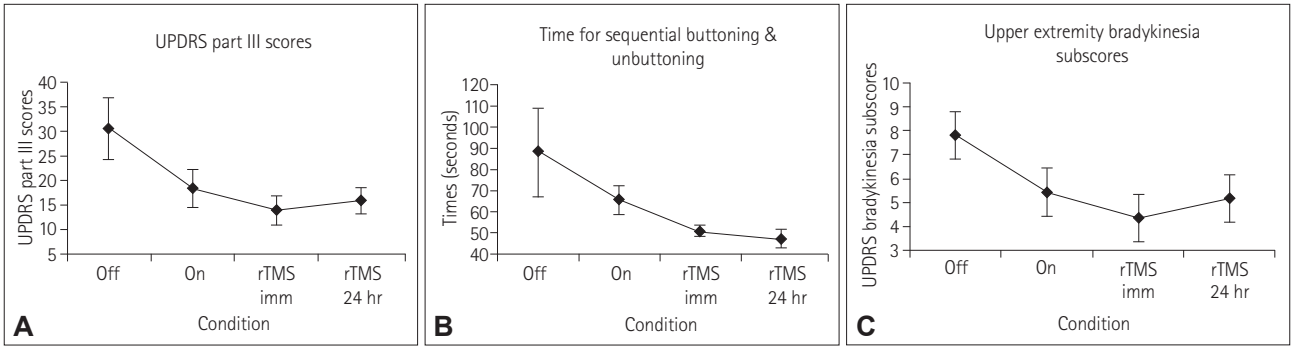

Fig. 1. UPDRS part III scores (A), upper extremity bradykinesia subscores (C) and time to perform sequential buttoning and unbuttoning (B) are shown. The time for buttoning and unbuttoning was noted to decrease both immediately following rTMS and at 24 hours, whereas UPDRS part III and bradykinesia scores were largely unchanged. rTMS: repetitive transcranial magnetic stimulation, UPDRS: Unified Parkinson Disease Rating Scale.

rTMS and 47.3 seconds (SE 4.6 seconds) at 24 hours. Patients were assessed in the ON state immediately following rTMS and at 24 hours. Fig. 1 illustrates the UPDRS part III scores, upper extremity bradykinesia subscores, and time for sequential buttoning and unbuttoning which were measured in the OFF, ON, post-rTMS-immediate and at 24 hours.

In summary, our findings suggest that limb-kinetic apraxia in PD immediately improves with high-frequency rTMS of the primary motor cortex, with lasting benefit at 24 hours. The degree of bradykinesia, measured by the UPDRS part III, improved minimally immediately after rTMS (Fig. 1C), and at 24 hours, was largely unchanged from the nonstimulated, ON state. Limb-kinetic apraxia, reflected by the buttoning/unbuttoning time, was markedly improved immediately after rTMS. This improvement in limb-kinetic apraxia was further maintained at 24 hours following rTMS, with no further improvement in the bradykinesia subscore. Therefore, our findings suggest that limb-kinetic apraxia is an independent phenomenon, which may be amenable to rTMS.

Noninvasive brain stimulation techniques are being increasingly used for the treatment of neurological disorders. These stimulation methods are often well-tolerated with minimal or no side effects, and therefore holds potential to be clinically applicable. Examples of widely-used methods include rTMS, transcranial direct current stimulation(tDCS), and paired associative stimulation. Recent anodal tDCS studies have shown that stimulation of the motor and parietal cortices may be beneficial in alleviating ideomotor apraxia. Anodal tDCS and high-frequency rTMS are analogous in that both are postulated to result in a net effect of excitation.[7] Based on the aforementioned studies, excitatory stimulation targeted towards brain areas considered to be involved in praxis may therefore be promising in treating apraxic disorders. Such praxis-relevant brain areas include the left premotor, motor, parietal and temporal cortices.[8] This is the first report in the literature on the beneficial effects of high-frequency rTMS targeting the left primary motor cortex on limb-kinetic apraxia. Our findings are limited in that this is a small-scale, observational study and therefore future studies are needed to further determine if rTMS of the primary motor cortex is truly efficacious in the treatment of this disorder.

Conflicts of Interest

The author has no financial conflicts of interest.

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