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Case Report

Effectiveness of repetitive transcranial magnetic stimulation on hypomimia induced sialorrhea among Parkinsons: a case study

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ABSTRACT

Excessive drooling (sialorrhea) in Parkinson's disease (PD) affects quality of life, often linked to hypomimia. Conventional treatments have limitations, while repetitive transcranial magnetic stimulation (rTMS) shows promise but remains understudied for sialorrhea. A 74-year-old male with PD underwent rTMS and exercise therapy for eight weeks. Pre-treatment scores were 63 in sialorrhea clinical scale for PD and 7 on the Radboud oral motor inventory for PD (ROMP), improving to 48 and 5. Surface electromyography (SEMG) showed increased zygomaticus major activity (10.5 µV to 16.2 µV) and corrugator supercilii (17.3 µV to 22.7 µV), suggesting rTMS may improve sialorrhea and orofacial function in PD.

Keywords: Hypomimia, Parkinson's, Radboud oral motor inventory for PD, Sialorrhea clinical scale for PD, Transcranial magnetic stimulation

INTRODUCTION

Parkinson's disease (PD) is a progressive neurodegenerative disorder that affects mobility, characterized by motor symptoms such as rigidity, bradykinesia, and tremors.[1] It is primarily caused by the accumulation of alpha-synuclein in the substantia nigra, leading to dopaminergic neuron degeneration and dopamine decline. In India, the prevalence of PD ranges from 33 to 328 per 100,000 people, with variations due to genetic, ethnic, and environmental factors. Recent studies link PD to intestinal inflammation, which increases gut permeability and allows harmful microbes to enter the bloodstream, potentially contributing to disease progression.[2] PD motor symptoms include postural instability, tremors, muscle rigidity, and balance deficits, often leading to postural deformities such as scoliosis, thoracic hyperkyphosis, and cervical spine flexion.[3]

Oro-buccal symptoms like dysphagia, dysarthria, and sialorrhea affect 30% to 100% of PD patients. Approximately 70% experience drooling, a non-motor symptom caused by reduced swallowing frequency and oropharyngeal dysfunction. This leads to oropharyngeal secretion accumulation, increasing the risk of aspiration pneumonia-a major cause of death in PD patients. Factors contributing to sialorrhea include male gender, severe motor symptoms, daytime sleepiness, and postural changes like anteflexion and impaired lip closure due to hypomimia. Diurnal hypersalivation generally develops over three years, indicating that drooling is not an early PD symptom.[4]

Hypomimia, or reduced facial expression, is a common PD feature but remains poorly understood. Research suggests a strong link between impaired facial muscle control and an inability to regulate salivary flow. Traditionally, sialorrhea management relies on oral medications, but these often cause significant adverse effects. Botulinum toxin injections (Botox A and B) are effective alternatives, though anticholinergic drugs remain poorly tolerated due to PD-related autonomic dysfunction, causing dry mouth, behavioural changes, sleep disturbances, constipation, and urinary retention.[5]

rTMS is a non-invasive brain stimulation technique that modifies cortical excitability. It generates a magnetic field that depolarizes superficial axons, activating neural networks in the cerebral cortex. Since rTMS bypasses extracerebral tissues, its effects remain relatively undistorted. From a therapeutic standpoint, rTMS is valuable because its clinical effects persist beyond stimulation. Repeated sessions can provide prolonged benefits lasting minutes to days.[6]

Although several studies have explored rTMS for PD, debate continues regarding its efficacy compared to conventional therapies. This study aims to evaluate the effects of rTMS on facial expression and drooling in PD patients by analyzing pre- and post-treatment changes. The findings will help determine whether rTMS can serve as a viable alternative to traditional treatments.

CASE REPORT

A 74 year old male retired defence officer was admitted to hospital for rehabilitation for post surgically. The patient is a known alcoholic, who had his last drink on 14/7/24, had alleged history of slip from a step and hit his head on the compound wall on the morning of 14/7/24. On 14/7/24 evening, patient was drowsy and went to sleep. He aspirated some water, was snoring with decreased responsiveness, and was taken to nearby hospital. Moreover, on 15/7/24 morning where he was endotracheal intubation was performed due to moderate Glasgow coma scale score (8/15). Computed topography brain showed extradural hematoma and subdural hematoma of fronto temporal parietal lobes in the size of 4.5 mm (acute on chronic) with midline shift of 3 mm to left with dubfalcine herniation, right midsulcal herniation, left sub arachnoid haemorrhage. Patient was taken for further management and was taken up form emergency was hematoma evacuation. Shifted to intensive care unit for post-operative care. On arrival at intensive care unit, patient intubated and sedated, the patient was shifted to rehabilitation ward on 26/08/2024. Upon arrival to the rehabilitation ward, the patients GCS was 12/15.

The patient was unable to perform daily activities independently and required support. Attempting these activities on his own often resulted in fails. The patient explained about the procedure for rehabilitation training. After getting the informed consent from the patient's attender, patient underwent the intervention. The patient was assessed before the starting of the intervention. There was no difficulty in assessing the patient pre and post intervention. The assessment tools are listed below.

Sialorrhea clinical scale for PD evaluated the correlation between mealtimes and sialorrhea, drooling intensity during the day and night, speaking or eating difficulties, frequency of intense drooling, and social discomfort. The intensity scale ranged from 0 (lowest) to 21 (highest). This study aimed to assess three main aspects: (a) social handicap due to sialorrhea; (b) existence, intensity, and duration of drooling; (c) correlation between dietary habits and sialorrhea.[7]

ROMP is a patient-rated questionnaire assessing speaking, swallowing, and saliva control. It reflects the patient's perception of changes in these abilities.[8]

SEMG is widely used to study motor functions and movement disorders. This study focuses on the zygomaticus major and corrugator supercilii muscles. Electrode placement was optimized by maximizing the distance from nearby muscles. Since facial motor systems have widely distributed neuromuscular connections, insertion zones were not considered. Instead, muscle palpation during contraction confirmed accurate electrode positioning.[9]

The patient was given rTMS focused for the dorsolateral prefrontal cortex. A figure-of-eight coil (or comparable) with a diameter of 70 mm was linked. The scalp has been determined to be the left and right M1 location where motor evoked potentials of the TMS emerged. The highest amplitude in the opposite side abductor policis brevis. Resting motor threshold was investigated using the M1 on the left. The prefrontal left site was situated five centimetres in front of the ideal left, where the placement for the thumb or abductor pollicis brevis (Figure 1). This course consisted of daily sessions of two thousand stimulations for the left dorso lateral prefrontal cortex and thousand stimulations for each M1 (50 bursts of 40 stimuli at 10 Hertz for 2 months), there was no changes in the treatment procedure throughout the study duration.[10] In addition to rTMS, the patient underwent targeted facial expression exercises before the stimulation. These exercises comprised three key components:

Proprioceptive training

The patient was guided to focus on specific facial landmarks while a physiotherapist (PT) applied light touch with an index finger. The PT then assisted the patient in gradually feeling the range of motion in different facial areas, initially passively and later actively. To enhance proprioception, the PT placed objects of varying shapes on different facial regions and asked the patient to identify them with eyes closed.

Emotion recognition training

The patient imitated facial expressions of emotions and identified emotions using Osgood's facial expression scale. The PT then presented hemi-faces of these images, asking the patient to recognize emotions from partial facial cues.

Emotion expression training

Patients were shown images of various facial expressions and asked to relate them to personal experiences. They then narrated these experiences while replicating the corresponding facial expressions.[11]

The above treatment both rTMS and targeted facial expression exercises were given to the patient for a course of eight weeks with each week of five sessions and each session of 120 minutes and the patient was also under regular rehabilitation. The patient's regular attendance at the eight-week, five-day-a-week rTMS sessions and rehabilitation was used to evaluate adherence to the treatment. The therapist, noted if the patient arrived on time, engaged in active participation, and finished the exercises as directed, recorded each session. Given the severity of rTMS, the patient's input was also taken into account to make sure they were comfortable and tolerant of the treatment plan. Since the patient reported little discomfort during the surgery and no serious side effects during the duration of therapy, tolerability was evaluated based on the lack of adverse reactions.

After obtaining clearance from the ethical committee, the case study was prepared using CARE guidelines. The patient reported a positive experience with rTMS and exercise therapy. Initially uncertain about the non-invasive treatment, he soon noticed improvements in drooling and facial muscle control. He felt relief after the initial sessions and experienced minimal discomfort, which became more tolerable over time. The patient was satisfied with the combined treatment, noting that it reduced sialorrhea and improved mobility and daily function. There were no unanticipated events or any adverse events during the course of the treatment.

Figure 1: Treatment using rTMS while patient in supine.

Table 1: Values of the outcome measure pre and post intervention.

Variables	Pre intervention	Post intervention
Sialorrhea clinical scale for PD	63	48
Radboud oral motor inventory for PD	7	5
SEMG of zygomaticus major	10.5 µV	16.2 µV
SEMG of corrugator supercilii	17.3 µV	22.7 µV

*µV-microvolts; PD-Parkinson’s disease

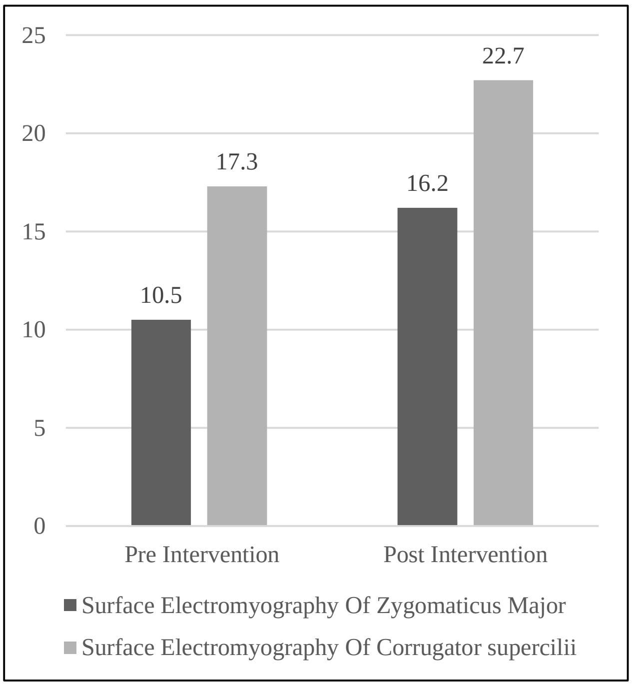

Figure 2: Pre-post comparison of surface EMG.

Post-intervention, improvements were observed in all parameters (Table 1). The sialorrhea clinical scale for PD score decreased from 63 to 48, and ROMP improved from 7 to 5, indicating better saliva control. SEMG of the zygomaticus major increased from 10.5 µV to 16.2 µV, and corrugator Supercilii from 17.3 µV to 22.7 µV shown in Figure 2, reflecting enhanced facial muscle activation. These findings suggest that rTMS combined with exercise therapy effectively reduced sialorrhea and improved orofacial function, highlighting its potential as a rehabilitative approach for PD.

DISCUSSION

This case highlights the benefits of rTMS with exercise therapy for managing sialorrhea in PD. The patient underwent medical and post-operative pharmacological management for craniotomy. Sialorrhea is a common but often overlooked symptom in PD, affecting speech, swallowing, and overall well-being. Addressing it early can prevent complications, but more research is needed for conclusive evidence.

Another study, which included the treatment of dysphagia with subacute unilateral stroke, has been administered using 1 Hz rTMS, electrical stimulation (NMES), and standard dysphagia therapy CDT. Two distinct kinds of food have been given to the patients: semisolid and liquid, respectively. VFSS and several swallowing dysfunction scales evaluated the effectiveness in the end as participants were given fluids, findings showed substantial improvements in FDS and PAS in the rTMS is and NMES groups as compared to the CDT group. That being said, there wasn't any discernible changes among the rTMS and NMES groups. All three patient groups improved on all parameters when given semisolids, although there were no between-group differences.[12]

The hypothalamus pituitary-adrenal axis for exhaustion is represented by salivary cortisol. A study found that there have been various hypothesised pathophysiologies, definitions of exhaustion, no precise diagnostic instrument for fatigue, and an unclear picture of how fatigue symptoms differ in men and women. The plasma-free cortisol is a helpful biomarker measure for fatigue. In those with PD, increased dawn cortisol levels were linked to a lower quality of life and increased impairment. Exercise has also been demonstrated to lower cortisol levels, that may lower the chance of Parkinson's disease developing more quickly.[13]

A brain region with a sustained decrease in postsynaptic activity thus lowering activity levels would lower a "modification threshold," favoring the onset of long-term potentiation, according to a study. On the other hand, the modification threshold would rise in a brain region that experienced a sustained increase in postsynaptic activity, leading to higher levels of activity and a preference for inducing long-term depression. Contrast to healthy controls, PD patients and animal models have been shown to have higher levels of activity in the prefrontal cortex and SMA than do controls.[14]

Recently a study was performed upon l30 performed a direct comparison of low-frequency (1 Hz) and high-frequency (10 Hz) rTMS over the SMA in PD patients. Their findings showed that low-frequency rTMS directed at the SMA had a long-lasting positive effect, while high-frequency rTMS directed at the identical brain region did not show a meaningful benefit.[15]

CONCLUSION

This case study concluded that after the 8 weeks of intervention with repetitive transcranial management along with the exercise, offer substantial benefits in reducing sialorhhea and improving the orofacial functions in the Parkinson's patient.

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REFERENCES

1. Cabreira V, Massano J. Doença de Parkinson: Revisão clínica e atualização. Acta Médica Portug. 2019;32(10):661-70.
2. Deepa S, Suganthirababu P, Ramana K, Vishnuram S, Srinivasan V. A need to reconsider the rehabilitation protocol in patients with idiopathic Parkinson's disease: Review analysis. Biomedicine. 2022;42(4):657-60.
3. Chen QQ, Haikal C, Li W, Li JY. Gut inflammation in association with pathogenesis of Parkinson's disease. Front Mol Neurosci. 2019;12:218.
4. Gayathri S, Kumaresan A, Babu PS, Srinivasan V, Vishnuram S, Priyadharshini K, Alagesan J. Effectiveness of mindfulness yoga and progressive resistance exercises on anxiety and depression among Parkinson's disease. Indian J Physiotherapy Occupat Therapy. 2024;18(1):506-11.
5. McGeachan AJ, McDermott CJ. Management of oral secretions in neurological disease. Pract Neurol. 2017;17(2):96-103.
6. Miller N, Walshe M, Walker RW. Sialorrhea in Parkinson's disease: Prevalence, impact and management strategies. Res Rev Parkinsonism. 2019;9:17-28.
7. Perez Lloret S, Pirán Arce G, Rossi M, Caivano Nemet ML, Salsamendi P, Merello M. Validation of a new scale for the evaluation of sialorrhea in patients with Parkinson's disease. Movement Disord. 2007;22(1):107-11.
8. Gamage PH, Mohideen MS, Galhena P, Weerasinghe N, Kumbukage MP, Herath T, et al. Adaptation and validation of a Sinhala version of the Radboud Oral Motor Inventory (ROMP) for Parkinson's disease. Ann Indian Academy Neurol. 2022;25(4):688-91.
9. Ravier P, Buttelli O, Jennane R, Couratier P. An EMG fractal indicator having different sensitivities to changes in force and muscle fatigue during voluntary static muscle contractions. J Electromyography Kinesiol. 2005;15(2):210-21.
10. González-García N, Armony JL, Soto J, Trejo D, Alegría MA, Drucker-Colín R. Effects of rTMS on Parkinson's disease: A longitudinal fMRI study. J Neurol. 2011;258:1268-80.
11. Hastorf AH, Osgood CE, Ono H. The semantics of facial expressions and the prediction of the meanings of stereoscopically fused facial expressions. Scandinavian J Psychol. 1966;7(1):179-88.
12. Siebner HR, Lang N, Rizzo V, Nitsche MA, Paulus W, Lemon RN, et al. Preconditioning of low-frequency repetitive transcranial magnetic stimulation with transcranial direct current stimulation: Evidence for homeostatic plasticity in the human motor cortex. J Neurosci. 2004;24(13):3379-85.

13. Nambu A, Tokuno H, Inase M, Takada M. Corticosubthalamic input zones from forelimb representations of the dorsal and ventral divisions of the premotor cortex in the macaque monkey: Comparison with the input zones from the primary motor cortex and the supplementary motor area. Neurosc Letters. 1997;239(1):13-6.
14. Liu J, Zhuo H, Sun M. Rehabilitation of post-stroke swallowing dysfunction with repeated transcranial magnetic stimulation (rTMS) based on tomographic images. Contrast Media Molecular Imaging. 2022;(1):1118745.
15. Hershey T, Revilla FJ, Wernle AR, McGee-Minnich L, Antenor JV, Videen TO, et al. Cortical and subcortical blood flow effects of subthalamic nucleus stimulation in PD. Neurology. 2003;61(6):816-21.

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