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Case Report

Use of Brain Stimulation to Improve Swallowing in a Brainstem Stroke Patient with Cricopharyngeal Spasm: Case Report

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ABSTRACT

In India, post-stroke dysphagia affects between 37 and 78 percent of people. In recent years, research into transcranial magnetic stimulation has enhanced our understanding of the neurological aspects of swallowing, thanks in great part to Hamdy and colleagues' pioneering work. TMS has been shown to help with depressive symptoms, anxiety, and parkinsonian symptoms, however, there is no study on how it can help with swallowing. This case study looked at the effects of transcranial magnetic stimulation and transcranial direct current stimulation in combination with standard swallowing training on swallowing function in brainstem stroke patients with cricopharyngeal spasms.

Keywords: Brain stimulation; cricopharyngeal spasm; Dysphagia; Efficacy

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INTRODUCTION

Stroke is a major cause of mortality and morbidity in both developed and developing countries, as well as in low- and middle-income countries (LMIC). LMICs account for 70% of all strokes, and their illness burden is higher than that of high-income nations. In India, life expectancy has lately risen to above 60 years, resulting in an increase in age-related non-communicable diseases such as stroke, which is now the country's fourth major cause of death and the fifth leading cause of disability.[1] According to other research, the prevalence of post-stroke dysphagia ranges from 37 percent to 78 percent.[2] Compensatory treatments are common for dysphagia, but rehabilitation strategies aimed at reducing the impairment are limited and poorly supported by research. transcranial magnetic stimulation (TMS), PETand MEG investigations have aided our understanding of the brain anatomy and physiology of swallowing in the last ten years, largely due to work pioneered by Hamdy and colleagues.[3-5] TMS has proven to be effective in improving depressive symptoms, anxiety, and parkinsonian symptoms however there is limited research on the role of TMS in improving swallowing. Transcranial magnetic stimulation is a relatively new treatment option for post-stroke dysphagia that has been shown to improve swallowing function in both healthy adults and patients[3] by stimulating the pharyngeal motor cortex area. The benefits of transcranial direct current stimulation (tDCS) in combination with traditional swallowing training on swallowing function in brainstem stroke patients with cricopharyngeal spasms were studied in this case report. The manuscript adheres to the ethical standards according to the declaration of Helsinki. Ethical approval was obtained from All India Institute of Speech andHearing (AIISH) Review Board (ref: AIISH/20-2021: SLP_06).

 # CASE REPORT

A 38-year-old male was admitted to the hospital following acute lateral medullary infarct and lacunar infarct in the left ganglio-capsular region on 30 October 2021. The location of the stroke was confirmed by brain magnetic resonance imaging, and the diagnosis of the brainstem stroke was made according to the World Health Organization's definition of a stroke (MRI). He had persistent severe oropharyngeal dysphagia for the next 31 days. He would constantly complain of something being stuck in his throat and spit his saliva every few seconds. He had a poor range of motion of the tongue, lips, and jaw. Deviation of the angle of the mouth towards the right side was observed. When the patient was given a command to dry swallow, it was very effortful for him, and took multiple attempts to swallow. The speech-language pathologist who came to see the patient every day started a set of traditional voice and swallowing exercises such as resonant voice therapy, Masako maneuver, chin tuck and swallow, effortful swallow, Shaker's exercise, and Mendelson maneuver. Videofluoroscopic Swallowing Study (VFSS) was conducted which confirmed oropharyngeal dysphagia with severe cricopharyngeal spasm (fig. 1).

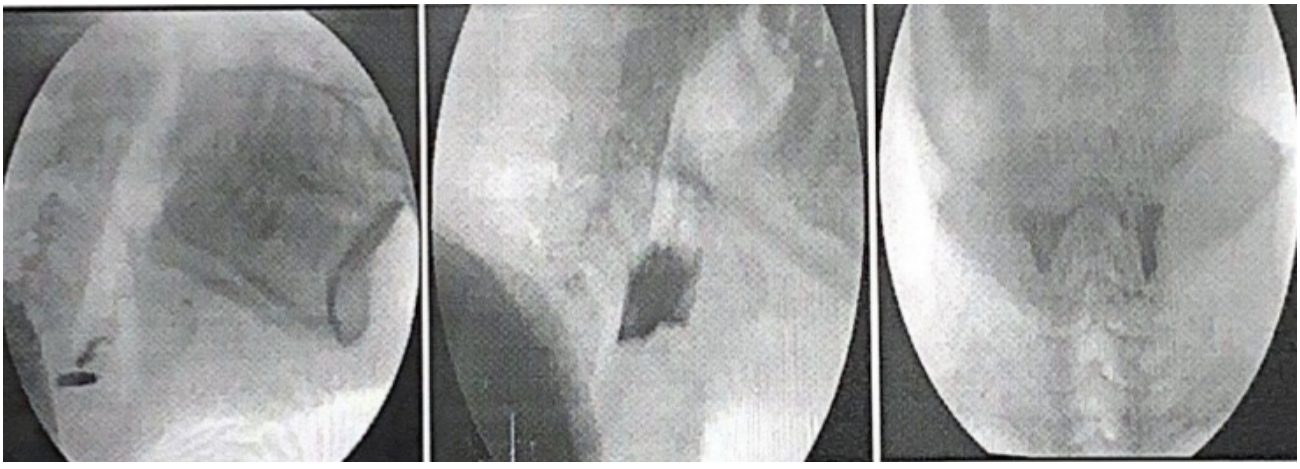

Figure 1 A-C (Left to right): VFSS findings of the patient showing inability to swallow due to cricopharyngeal spasm. In the images, the semi-thick liquid was used as a bolus. The patient is instructed to hold the bolus inside the mouth before swallowing **(A)** Bolus is passed down the pharyngeal region when instructed to swallow in the lateral view **(B)** Patient experiences backflow as a bolus is unable to pass below the cricopharyngeal space as observed in anteroposterior view **(C)**

Penetration Aspiration Scale suggested a score of 2. He was kept on enteral nutrition and fed through Ryle's tube (Functional Oral Intake Scale-1). Nasal regurgitation was observed for thin liquids (water). The base of tongue movement was found to be inadequate. The hyolaryngeal excursion was also noted to be reduced. Other than dysphagia, there was a motor disability for which a physiotherapist provided rehabilitation. After VFSS, the patient was suggested to opt for cricopharyngeal myotomy, botox injection, and catheter dilatation in order to treat the cricopharyngeal spasm in conjunction with traditional swallowing treatment.

The patient and his family members were reluctant to receive botox treatment as it is an invasive procedure although with a good success rate. Therefore, the possibility of repetitive TMS was tDCS was explored as a treatment option for this patient. He had no contraindications to magnetic stimulation, nor did he have any confounding variables such as previous swallowing problems or the usage of central nervous system medications. The research ethics committee of the All India Institute of Speech and Hearing collected written informed permission and gave ethical approval.

The patient received both tDCS and rTMS sessions simultaneously first 6 sessions a week, and later 3 sessions a week for two weeks. The brain driver, a direct current stimulator, was used in conjunction with two saline-soaked sponge surface electrodes (dimensions of 5 cm x 5 cm for both the anode and reference electrodes). The anodal electrode was inserted 3 cm anterior and 6 cm lateral to the vertex, with stimuli aimed at the oesophageal cortical region. Over the contralesional supraorbital area, a reference electrode was inserted. The direct current was gradually increased to 1 mA within 5 seconds for the tDCS group and then sustained for 20 minutes. Each hemisphere was stimulated for 20 minutes in a row, with a 30-minute break in between.rTMS was given via a figure-of-eight coil coupled to a Magstim super rapid stimulator (The Magstim Company) at a frequency of 10 Hz with 250 pulses at 90 percent thenar resting motor threshold. The coil was placed across the pharyngeal motor representation of the cortex.

Post rTMS and tDCS, the patient was able to eat and drink normally all consistencies except thin liquids such as water, as confirmed by VFSS. VFSS was repeated after three weeks of brain stimulation combined with traditional swallowing therapy. The base of tongue movement and hyolaryngeal excursion had improved. The patient could tolerate only sips of water. The patient was advised to eat slowly, take smaller quantities of bolus at a time, and cough out the bolus if it felt stuck in the throat.

DISCUSSION

This case study highlights the future use of rTMS and tDCS for improving swallowing function in brainstem stroke patients having cricopharyngeal dysfunction. The improvement in swallowing can be attributed to bilateral activation of cortical swallowing

motor regions enhancing the excitability of corticobulbar projections to brainstem swallowing nuclei, resulting in better swallowing.[6]This remarkable response may be due in part to the fact that swallowing control is frequently bilateral, whereas the lesion in lateral medullary infarct is typically unilateral. As a result, the surviving ipsilateral premotor neurons and the contralateral centre in the medulla oblongata may finally begin to function, overcoming the severity and long-term persistence of dysphagia. If this is the case, the functional recovery seen in our patients could be attributed to rTMS speeding up the normal recovery process. However, we cannot rule out the possibility that other impacts on less direct pathways from the cortex to the brainstem contributed to the recovery in our patients, especially those in the brainstem infarct grouping with bilateral lesions.

There is a dearth of literature on the effectiveness of rTMS and tDCS in improving swallowing function. It may not be the first choice of treatment recommended by speech-language pathologists who address swallowing issues due to a lack of awareness about brain stimulation and its benefits. A study done by Wang et al also showed an improvement in swallowing by using tDCS with brainstem stroke patients.[6] Another study used rTMS in a group of patients having brainstem stroke and suggested the usefulness of brain stimulation in the treatment of dysphagia.[7]

CONCLUSIONS

This study combines the usage of both rTMS and tDCS along with traditional swallowing therapy to help a patient recover from oropharyngeal dysphagia with cricopharyngeal spasm. Although the findings imply that rTMS could be a valuable adjuvant therapy in addition to traditional treatment for dysphagia, the case report is inadequate, and more research is needed to confirm the findings before the technology can be used more widely.

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