Revised analysis of neuromuscular electrical stimulation for dysphagia management : A Systematic Review

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Abstract

Introduction: Parkinson's disease is characterized by a motor syndrome that includes bradykinesia, rest tremors, and rigidity, coupled with changes in posture and gait.Dysphagia or swallowing difficulties are commonly seen in parkinson's disease. These are primarily linked to the oral and pharyngeal phases, leading to issues such as improper bolus formation, a delayed swallowing reflex, and the need for repeated swallows to clear the throat. PD-inspired dysphagia aspiration is associated with serious complications such as pneumonia, malnutrition, dehydration, and increased mortality.The pathophysiology of PD dysphagia is complex and includes the stiffness of the oropharyngeal muscles and bradykinesia , aspiration pneumonia, decrease in coordination of swallowing stages, and loss of voluntary control over swallowing , decreased hyoid bone movement and increased oropharyngeal transit time . Methodology: A comprehensive literature review was performed, identifying 30 relevant studies, out of which 10 met the inclusion criteria. These studies involved varied populations and intervention approaches, highlighting the benefits of Neuromuscular Electrical Stimulation (NMES) in improving swallowing ability, diet intake and improving the overall quality of life in individuals with dysphagia. Discussion: This review analyzes the outcomes of the selected studies, highlighting the effectiveness of Neuromuscular Electrical Stimulation (NMES). It also identifies limitations such as small sample sizes and the lack of direct comparative studies. The findings emphasize the need for further research to establish standardized treatment protocols and assess these interventions in broader and more diverse populations. Conclusion: The findings of this study suggest that the Neuromuscular Electrical Stimulation (NMES) is an effective intervention for patients with dysphagia in improving swallowing ability, diet intake and quality of life. Participants who underwent NMES demonstrated significant improvements in swallowing ability.

Keywords: *dysphagia, NMES, swallowing ability*

1. Introduction

Parkinson's disease is characterized by a motor syndrome that includes bradykinesia, rest tremors, and rigidity, coupled with changes in posture and gait. Dysphagia or swallowing difficulties are commonly seen in parkinson's disease. These are primarily linked to the oral and pharyngeal phases, leading to issues such as improper bolus formation, a delayed swallowing reflex, and the need for repeated swallows to clear the throat. PD-inspired dysphagia aspiration is associated with serious complications such as pneumonia, malnutrition, dehydration, and increased mortality Dysphagia is a debilitating condition that affects normal deglutition leading to difficulty in swallowing food due to problems with nerve, muscle or neuro-muscular junction that can happen as a consequence of a variety of ailments. Dysphagia is associated with an increased risk of complications such as aspiration pneumonia, dehydration

and malnutrition and others including pharyngeal residue, frustration, anxiety at mealtime and avoid eating with others, loss of appetite along with depression and social isolation, with an increase in the socio-economic burden due to the frequent need for hospitalization. All this leads to decreased quality of life and reduces the survival rate of patients with dysphagia.
The severity of dysphagia varies widely, from some people having a mild difficulty that may result in the avoidance of certain foods or eating situations; to those with severe cases rendering a patient unable to safely eat or drink orally at all, thus requiring consideration of clinically assisted artificial nutrition and hydration. Patients with dysphagia ordinarily show diminished function of the oropharyngeal muscles like suprahyoid muscles, which leads to not only oral dysfunction but also aspiration in the pharyngeal phase. Furthermore, suprahyoid muscle weakness directly affects hyolaryngeal movements, resulting in pharyngeal dysphagia.

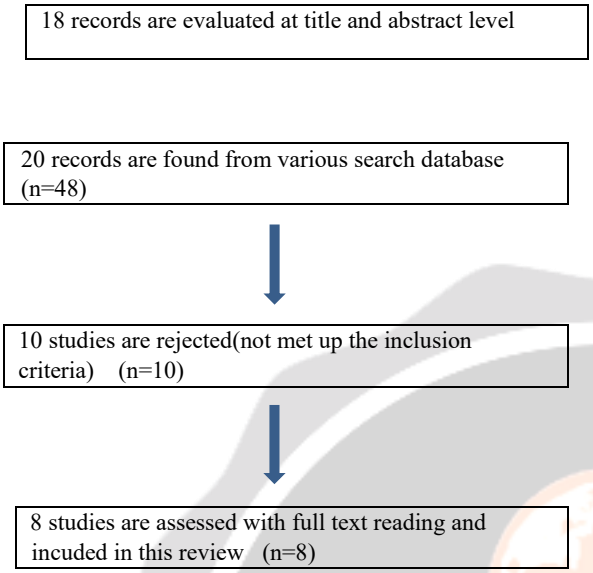
There are various medical management available including capsaicin, nifedipine, botulinum toxin and tong yan spray which have shown significant differences in recovery of the swallowing function.[6]

Dysphagia rehabilitation techniques include tongue strengthening exercise, Mendelsohn maneuver, supraglottic and super-supraglottic swallow, effortful swallow, chin tuck against resistance, Masako exercise, Shaker exercise, NMES, EMG biofeedback, expiratory muscle training, PNF based short neck flexion exercises and oral strengthening exercise.

In this study, the aim is to comparing the effectiveness of NMES vs. compensatory rehabilitation methods in improving the Management task of swallowing in patients with PD. Rehabilitation interventions for dysphagia in Parkinson's Disease (PD) nowadays can be broadly classified into two categories: neuromuscular electrical stimulation (NMES) and compensatory rehabilitation interventions. As a result, enhanced hyoid bone movement, reduced pharyngeal residue, and decreased aspiration were noted.The electrode positioning is centered around the hyoid bone and targets specific muscle groups.

Compensatory rehabilitation interventions, however, include a range of behavioural interventions like the Lee Silverman Voice Treatment (LSVT), expiratory muscle strength training (EMST), and traditional swallowing and speech therapy . LSVT is an evidence-based intervention aimed at enhancing vocal loudness and voice articulation by recalibrating the sensorimotor perception of vocal intensity. Video fluoroscopic Swallowing Study (VFSS) and Fiberoptic Endoscopic Evaluation of Swallowing (FEES) are gold-standard tools for assessing swallowing function, providing objective measures such as penetration-aspiration scores and residue severity, which are critical for evaluating intervention efficacy in PD dysphagia . VFSS offers insights into bolus flow, organ movement, and anatomical structures. In contrast, a FEES is capable of identifying silent aspiration of saliva. Although both methods are prevalent in clinical practice, direct comparative evidence of their effectiveness for dysphagia rehabilitation in PD is not currently available.

2. Method



Studies were search from the following search engine PubMed, Google scholar, Research Gate and Cochrane Library to review the literature. Studies include that Investigate effectiveness of NMES in dysphagia patients. Keyword used to search studies are NMES , dysphagia, swallowing ability .Several studies have shown that NMES helps in dysphagia patients, in improving swallowing ability, quality of life and diet intake.

Author, journal, Year	Objective	Design	Characteristics of participants sample size	Method	Outcome measures	Results
2011	To compares the effects of traditional logopedic dysphagia treatment with those of neuromuscular electrical stimulation (NMES) as adjunct to therapy on the quality of life in patients with Parkinson's disease and oropharyngeal dysphagia.	Comparative Experimental	88 individuals, aged between 40 and 80 years	Participants were randomly assigned to one of three groups: **Group A:** Received traditional Dysphagia treatment **Group B:** Received traditional dysphagia treatment combined with NMES of suprahyoid musculature at motor level. **Group C:** Received traditional dysphagia treatment combined with NMES of suprahyoid musculature at sensory level.	To evaluate diet the Functional Oral Intake Scale was used. Quality of life was assesed using SWAL-QOL and MD Anderson Dysphagia Inventory (MDADI)	After 3 months of treatment sessions, all groups showed significant improvement Dysphagia Severity Scale and restricted positive effects on quality of life.Minimal group differences were found.

2013	To evaluate whether combined NMES, FEES, and traditional swallowing rehabilitation can improve swallowing functions in stroke patients with moderate to severe dysphagia.	Experimental	32 participants, aged between 20 and 85years	A Randomised Controlled Trial was conducted. Patients received 12 sessions of NMES for 1 h/day, 5days/week within a period of 2–3 weeks. FEES was done before and after NMES for evaluation and to guide dysphagic therapy. All patients subsequently received 12 sessions of traditional swallowing rehabilitation (50 min/day, 3 days/week) for 4 weeks.	Dietry intake was assesed using Functional Oral Intake Scale (FOIS). The degree of dysphagia was assesed ueing clinical degree of dysphagia .Swallowing ability was assesed using Visual analogue scale(VAS).	This preliminary case series demonstrated that combined NMES, FEES, and traditional swallowing rehabilitation showed promise for improving swallowing functions in stroke patients with moderate-to-severe dysphagia.

2016	To evaluate the effectiveness of inspiratory/expiratory muscle training (IEMT) and neuromuscular electrical stimulation (NMES) to improve dysphagia in stroke.	Experimental Single-blind, randomized-controlled trial	62 participants	Participants were randomly assigned to one of three groups: Group A: Standrd swallow therapy (SST) Group B: Standard swallow therapy + inspiratory / expiratory muscle training (IEMT) Group C: SST+IEMT+NMES	Dysphagia severity, Respiratory muscle strength	Both IEMT and NMES were associated with improvement in pharyngeal swallowing security signs at the end of the intervention.

2016	The aim of this study was to evaluate the role of neuromuscular electrical stimulation (NMES) in tube-fed patients with severe and chronic dysphagia refractory to traditional swallowing therapy (TT).	Prospective study	11 participants	Each patient received NMES for 30 min and TT for 30 min, twice a day, 5 days per week for 4 weeks. In order to evaluate the swallowing impairment, each patient underwent a fiberoptic endoscopic examination of swallowing immediately before the beginning of the treatment, after 2 weeks and after 4 weeks.	Swallowing function	NMES as adjunctive treatment to TT may offer a new possibility for the management of tube-fed patients who are refractory to TT.

2019	To describe the acceptability, safety and effectiveness of neuromuscular electrical stimulation (NMES) in infants and young children with neurological impairment (NI) who have severe dysphagia.	Prospective Pilot study	10 infants and young children (0-24 months)	NMES treatments lasting 20–45 min twice weekly for the duration of 2–4 months. The NMES was administered during feeding therapy sessions by a trained OT	VFSS	This prospective pilot study of NMES in seven neurologically impaired infants and young children with severe dysphagia suggests that NMES is safe, acceptable to parents and has potential efficacy.

2020	To evaluate the effectiveness and safety of an exercised-based swallowing therapy (McNeill Dysphagia Therapy: MDTP) +NMES for dysphagia rehabilitation following stroke.	Experimental Randomized, double – blind, placebo controlled clinical trial	53 individuals Age 26 year	Stroke patients with dysphagia admitted to subacute rehabilitation hospital were randomized to MDTP+NMES [NMES], MDTP+ sham NMES [MDTP] or usual care [UC] swallowing therapy groups.	MASA score, FOIS score	Greater benefit (e.g. reduction in dysphagia severity, improved oral intake, and earlier return to pre-stroke diet) resulted from a program of MDTP alone vs. NMES or UC.

2021	To evaluate the effects of synchronized NMES on the submental muscles during ingestion of a specified volume of soft food in patients with mild-to-moderate dysphagia following stroke.	Experimental	83 participants Aged between 40-80 years	Participants randomly divided into 3 groups **Group A :** Coventional training **Group B :** Eating training +individual feeding **Group C :** Intensive swallowing training + synchronized NMES	Modified barium swallow ,Dysphagia outcome and severity scale	Feeding a specified volume of soft food plus synchronized NMES of the submental muscles can improve the swallowing function of patients with mild-to-moderate dysphagia following stroke and it reduces their risk of food aspiration.

3. Discussion

The purpose of this systematic review was to compare the effectiveness of Neuromuscular electrical stimulation (NMES) versus Compensatory Rehabilitation merthods in Parkinson's patients with dysphagia.

The present study aimed to evaluate the effectiveness of the Neuromuscular electrical stimulation (NMES) in managing aspiration, disease severity and functional measures in patients with dysphagia. The results indicate that NMES significantly improve the swallowing functionby targeting the specif muscle group. Swallowing function could be improved by stimulating the suprahyoid and infrahyoid muscle groups or single stimulating infrahyoid muscle.

The results revealed that assisting conventional swallowing therapy with instrumental treatments such as NMES and tDCS in the treatment of swallowing disorders increases effciency. The efectiveness of NMES therapy, frequently used in dysphagia treatments, is a widely accepted fact.

However, certain limitations must be considered. The study was conducted over a relatively short duration, and long-term effects of NMES on dysphagia remain uncertain. Additionally, the sample size was limited, and factors such as

individual variations could have influenced the results. Future research with larger populations, longer follow-up periods, and comparisons with other physiotherapeutic interventions will help establish a more comprehensive understanding of NMES effectiveness in managing dysphagia.

Despite these limitations, the study supports the use of NMES as a safe and effective technique for addressing swallowing difficulties and quality of life in patients with dysphagia. Clinicians may consider incorporating NMES into rehabilitation protocols to optimize patient outcomes and enhance mobility while minimizing discomfort.

However, certain limitations were observed across the studies. One major concern was the small sample sizes, which reduce the applicability of the findings to a larger population. Some limitations were noted across the studies. The variability in intervention protocols across studies also posed a challenge in drawing definitive conclusions. Moreover, most studies had short follow-up durations, making it difficult to assess the long-term effects of the treatments.

4. Conclusion

This systematic review supports the effectiveness of NMES in the management of dysphagia. The findings indicate that NMES provides significant improvements in swallowing ability, diet intake and quality of life in dysphagia pateints. These results highlight NMES as a promising intervention for dysphagia patients.
The findings of this study suggest that the Neuromuscular Electrical Stimulation (NMES) is an effective intervention for patients with dysphagia in improving swallowing ability and quality of life. Participants who underwent NMES demonstrated significant improvements in swallowing ability.

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