

The Efficacy of Electromyographic Biofeedback Combined with Swallowing Training on Post-Stroke Dysphagia

Le Wang¹, Yu Zhang², Xiaohui Wang¹, Zhi Li¹, Sha Chang^{1*}

¹Department of Neurology, Shaanxi Provincial People's Hospital, Xi'an 710068, Shaanxi, China

²Department of Gynecology, Shaanxi Provincial People's Hospital, Xi'an 710068, Shaanxi, China

*Corresponding author: Sha Chang, changsha427@126.com

Copyright: © 2024 Author(s). This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0), permitting distribution and reproduction in any medium, provided the original work is cited.

Abstract: *Objective:* This paper focuses on the research and discussion of the efficacy of electromyographic biofeedback combined with swallowing training on post-stroke dysphagia. *Methods:* This study randomly sampled and analyzed 68 patients with post-stroke dysphagia from January 2023 to December 2023, 34 cases of swallowing training intervention were grouped as the control group, and 34 cases of electromyography biofeedback combined with swallowing training intervention were grouped as the study group, and the clinical therapeutic effects of the two groups of patients after receiving the two different modes of intervention were compared. *Results:* The swallowing function of patients in both groups improved, and the VFSS score of patients in the seminar group was significantly higher than that of the control group, indicating that the clinical efficacy of the seminar group was more significant. The nasal feeding tube extraction rate, extraction time, and quality of life scores of the seminar group were better than those of the control group ($P < 0.05$), which is of research value. *Conclusion:* For patients with post-stroke dysphagia, treatment with electromyography biofeedback combined with swallowing training mode can significantly improve their swallowing function. This effective intervention can not only shorten the time for patients to remove the nasal feeding tube but also help to improve the quality of life of patients, which is worth using.

Keywords: Electromyographic biofeedback; Stroke; Swallowing training

Online publication: June 25, 2024

1. Introduction

Currently, the incidence of stroke in China is in the range of 0.12% to 0.18%, and the number of new patients reaches 2 million per year. Among these patients, about two-thirds will face different degrees of functional impairment, and dysphagia is one of the important symptoms^[1]. Dysphagia not only hinders patients' ability to ingest food and water normally, further exacerbating the risk of malnutrition and aspiration pneumonia, but also, in severe cases, may even threaten patients' lives, with far-reaching adverse effects on their quality of life^[2,3]. Therefore, it is of great significance to provide effective treatments for enhancing patients' swallowing

function. Some relevant studies have shown that EMG biofeedback is a safe, simple, and non-invasive therapy that has achieved significant results in optimizing patients' swallowing function^[4]. Given this, the present study included 68 post-stroke dysphagia patients in our hospital for an in-depth study to explore the application value of EMG biofeedback combined with swallowing training intervention mode.

2. Materials and methods

2.1. General information

A total of 68 cases of post-stroke dysphagia patients in Shaanxi Provincial People's Hospital were randomly selected to be analyzed and studied from January 2023 to December 2023. Among the 68 cases of patients, there were 35 males and 33 females, and the duration of the patient's disease was 7–30 years, with an average of (18.67 ± 1.26) years. All 68 patients were divided into two groups, 34 cases implementing swallowing training intervention were grouped as the control group, aged 45–75 years old with an average age of 60.21 ± 2.12 years old, while 34 cases implementing EMG biofeedback combined with swallowing training intervention were grouped as the study group, aged 46–74 years old with an average age of 60.32 ± 2.33 years old. The study data had a P -value > 0.05 , showing that the data were comparable and the study could be carried out.

2.2. Methods

The 34 cases of post-stroke dysphagia patients in the control group received swallowing training intervention, and the patients in the study group received both the swallowing training intervention combined with EMG biofeedback therapy.

2.2.1. EMG biofeedback

A one-channel dysphagia biofeedback therapeutic instrument produced by Triple A Medical was used, and the stimulation duration was 4 seconds under the specified stimulation frequency (50 Hz) and intensity (200 VA), followed by a 6-second intermittent period. The patient will receive two treatments per day, each lasting 20 minutes, and the treatment program will last for 15 days^[5,6]. During the treatment, the patient will be seated in a sitting position, and the treatment environment will be kept clean and quiet. Three surface electrodes were placed between the thyroid cartilage and the hyoid bone. During the whole process, the stimulation intensity is adjusted according to the patient's tolerance level to ensure the safety and effectiveness of the treatment^[7].

2.2.2. Swallowing training

- (1) Oral and lip atresia training: The correct training method is clearly demonstrated to the patient. Subsequently, the patient should practice according to the demonstration, while the professional staff provides necessary guidance and advice from the side;
- (2) Mandibular movement training: The patient should try to expand the mouth to keep the jaw in a relaxed state and perform the movement of both sides^[8];
- (3) Tongue movement training: The patient is instructed to stick out the tongue, and it is necessary to make sure that the tongue sticks out in the direction of the front as well as the two sides. Subsequently, the patient is instructed to retract the tongue;
- (4) Swallowing reflex training: The patient is massaged from the thyroid cartilage to the mandibular region to guide the regular up and down movement of the mandible, which helps the patient to realize the swallowing action;
- (5) Respiratory training: The patient is instructed to carry out abdominal respiration, and the mouth is

retracted in the process of respiration to enhance the effect of the atresia of the vocal folds;

- (6) Ingesting training: During the eating process, the patient is required to gradually adapt to solid food from pasty food, and at the same time, the patient is required to gradually adapt to solid food. During the feeding process, patients should gradually adapt from paste food to solid food, and at the same time ensure that the body is maintained in the position of 0° to 90°, and pay special attention to maintaining the posture of the neck forward flexion to prevent the occurrence of aspiration ^[9,10].

2.3. Observation indicators

The swallowing function scale (VFSS) was adopted to assess the swallowing function of the two groups of patients before and after intervention. Covering the esophageal phase, oral phase, and pharyngeal phase, the higher score indicates the better; observe and count the nasogastric tube extubation rate and extubation time of the two groups of patients; adopt the Short Form of Health Survey (SF-36) to assess the quality of life of the two groups of patients. It covers cognitive function, social function, role function, and somatic function, and higher scores indicate better; the results of the Kubota drinking water test were used to assess and compare the clinical efficacy of the two groups of patients, with grade 1 indicating no swallowing disorders, as remarkable effect, grade 2 indicating improvement in swallowing function, as effective, and grade 3 indicating no significant change in swallowing function, as ineffective.

2.4. Statistical analysis

All research data were analyzed by SPSS 23.0 software. Data were expressed as either mean ± standard deviation (SD) or [n (%)] and the differences between the two groups were compared by using *t* and χ^2 tests. If $P < 0.05$, it indicates that the difference is statistically significant.

3. Results

3.1. Comparison of swallowing function, nasogastric tube extubation rate, and extubation time between the two groups

Table 1 shows that after the intervention, the study group had a significantly higher VFSS score, a significantly higher nasal feeding tube extraction rate, and a significantly shorter nasogastric tube extraction time as compared to the control group ($P < 0.05$).

Table 1. Comparison of VFSS score, nasal feeding tube extraction rate, and extraction time between the two groups of patients (mean ± SD; [n (%)])

Group	VFSS score		Nasogastric tube extraction rate (%)	Nasogastric tube extraction time (d)
	Pre-intervention	Post-intervention		
Control group (n = 34)	4.23 ± 1.13	6.97 ± 0.56	13 (38.23)	20.97 ± 4.34
Study group (n = 34)	4.54 ± 1.18	8.01 ± 0.43	20 (58.82)	16.87 ± 4.62
<i>P</i> -value	> 0.05	< 0.05	< 0.05	< 0.05

3.2. Comparison of quality of life between the two groups

As shown in **Table 2**, the quality of life score of patients in the study group was better than that of the control group ($P < 0.05$).

Table 2. Comparison of the quality of life scores of patients in the two groups (mean \pm SD)

Group	Cognitive function	Social function	Role function	Somatic function
Control group ($n = 34$)	1.45 \pm 0.71	1.98 \pm 0.34	2.42 \pm 0.31	2.32 \pm 0.41
Study group ($n = 34$)	2.67 \pm 0.35	2.88 \pm 0.75	3.76 \pm 0.26	3.99 \pm 0.62
<i>P</i> -value	< 0.05	< 0.05	< 0.05	< 0.05

3.3. Comparison of the clinical efficacy of the two groups

Table 3 shows that the clinical efficacy of patients in the study group is significantly higher than that of the control group ($P < 0.05$).

Table 3. Comparison of the clinical efficacy of the two groups of patients (%)

Group	Remarkable effect	Effective	Ineffective	Overall effective rate
Control group ($n = 34$)	16	10	8	26 (76.47)
Study group ($n = 34$)	20	13	1	33 (97.05)
<i>P</i> -value				< 0.05

4. Discussion

The main cause of post-stroke dysphagia is the damage of swallowing and other related neural structures. Its clinical manifestations are diverse, specifically manifested as a pharyngeal reflex disorder, increased difficulty in swallowing at the base of the tongue, difficulty in eating and drinking, and food outflow, which not only lead to serious damage to the patient's physical health but also a significant decline in their quality of life ^[11]. More seriously, patients are also at risk of inducing aspiration pneumonia, or even fatal consequences due to large pieces of food blocking the airway ^[12]. At this stage, conventional swallowing training measures are the mainstream treatment modality in the clinical management of post-stroke dysphagia. These measures cover a variety of training methods such as orofacial atresia, mandibular movement, tongue movement, swallowing reflex, respiration, and ingestion. The core purpose of these exercises is to strengthen the swallowing reflex and promote the recovery of the motor functions of the mouth, face, tongue, and jaw to regain the active contraction ability of these parts, and then effectively improve the dysphagia. However, in the actual clinical application, it is observed that this method has the problems of delayed effect and insufficient targeting, so its therapeutic effect does not reach the expected ideal state ^[13]. EMG biofeedback therapy optimizes the therapeutic effect by adjusting the electromyographic signals generated by muscles during contraction and relaxation and converting these signals into audible and visual forms. The therapy has excellent effectiveness in precisely regulating the patient's swallowing movements, improving the fun of swallowing training, and making it more intuitive and easier to understand through visualization and concretization. At the same time, with the help of conditioned reflexes, it realizes the optimization and reorganization of brain functions, and then greatly improves the activity of the cortical swallowing center. This therapeutic method not only provides the necessary physiological and psychological support for patients but also effectively improves the degree of cooperation with the treatment of patients, thus shortening the process of disease recovery ^[14,15].

The results of this study showed that the clinical efficacy, VFSS, and quality of life scores of the study group demonstrated a trend of superiority over the control group. Further in-depth study revealed that the nasal tube extraction rate and extraction time of the study group were also superior to those of the control group ($P < 0.05$). These data indicate that the use of EMG biofeedback combined with swallowing rehabilitation training

mode for patients with post-stroke swallowing disorders can effectively improve their swallowing function and optimize the therapeutic effect. In addition, this program also helps patients remove the nasal feeding tube earlier, thus improving their quality of life and accelerating their rehabilitation process.

In summary, the implementation of the intervention mode combining electromyographic biofeedback and swallowing training for patients with post-stroke dysphagia can achieve significant therapeutic effects. This method is simple to operate, effectively promotes the rehabilitation process of patients' swallowing function, and realizes the comprehensive improvement of their quality of life, which is worthy of clinical promotion and application.

Disclosure statement

The authors declare no conflict of interest.

References

- [1] Wu C, Zhu X, 2022, Clinical Study on the Treatment of Post-Stroke Dysphagia with Shenmai Injection Combined with Electromyographic Biofeedback Training. *New Chinese Medicine*, 54(6): 88–91.
- [2] Hu Z, Gu X, Wang Y, et al., 2022, Effects of Acupuncture Combined with Surface EMG Biofeedback Therapy and Shaker Training on Swallowing Function and Quality of Life of Patients with Dysphagia After Radiotherapy for Nasopharyngeal Carcinoma. *Shanghai Journal of Acupuncture and Moxibustion*, 41(11): 1095–1099.
- [3] Ma X, Wang P, Niu B, 2023, Study on the Effect of Respiratory Exercise Combined with Electromyographic Biofeedback on Swallowing in Patients with Cerebral Hemorrhage During Rehabilitation. *Qingdao Medicine and Health*, 55(1): 41–44.
- [4] Zhao Y, 2023, Surface EMG Biofeedback Combined with Game Training in the Treatment of Early Post-Stroke Dysphagia, thesis, Hebei Medical University.
- [5] Wu J, Zhang W, Chen Y, et al., 2023, Clinical Study of Bilateral Repetitive Transcranial Magnetic Stimulation Combined with Electromyographic Biofeedback for the Treatment of Dysphagia in Stroke. *China Rehabilitation*, 38(6): 323–327.
- [6] Cheng Q, Chen B, Xiao X, et al., 2023, Effects of Electromyographic Biofeedback and Electrical Stimulation Therapy on Clinical Efficacy and Swallowing Function in Patients with Dysphagia After Acute Hemorrhagic Stroke. *Journal of Practical Hospital Clinics*, 20(4): 59–63.
- [7] Wang Y, 2023, Effect of Myoelectric Biofeedback Therapy with Conventional Swallowing Training in Patients with Post-Stroke Dysphagia and Its Effect on FOIS Score. *Clinical Medicine Research and Practice*, 8(26): 158–161.
- [8] Xiong W, Qin X, Du W, et al., 2023, Rehabilitation Effect of Electromyographic Biofeedback Combined with Tongue Pressure Resistance Feedback Training in Patients with Dysphagia After Cerebral Infarction. *Hebei Medicine*, 45(20): 3128–3131.
- [9] Liu HN, 2022, Myoelectric Biofeedback Combined with Acupuncture Improves Swallowing Function in Patients Recovering From Cerebral Infarction – A Review of Cerebral Infarction Therapeutics. *Chinese Journal of Experimental Formulary*, 28(3): 67.
- [10] Gu Y, Shu J, 2021, Effects of Surface EMG Biofeedback and Neuromuscular Electrical Stimulation on the Efficacy and Quality of Life of Dysphagia in Stroke. *China Rehabilitation*, 36(10): 599–603.
- [11] Liao C, Gao L, 2023, Observation on the Efficacy of Progressive Swallowing Training in the Treatment of Dysphagia in Stroke. *Journal of Taizhou Institute of Vocational Technology*, 23(4): 75–77 + 96.
- [12] Zhao G, 2023, Effects of Early Specialized Rehabilitation Training on Motor Function, Swallowing Function, and

Quality of Life of Stroke Patients. *Hebei Medicine*, 45(15): 2398–2400.

- [13] Lin X, Pang D, 2023, Effects of Early Swallowing Function Training on Patients with Dysphagia After Stroke. *Chinese and Foreign Medicine Research*, 21(21): 123–126.
- [14] Zhang W, 2023, Observation on the Effect of Swallowing Therapeutic Instrument for Stroke Patients with Dysphagia. *China Medical Device Information*, 29(12): 146–148.
- [15] Zhao ZP, 2023, Effects of Rehabilitation Training Based on Standardized Swallowing Function Assessment on Patients with Swallowing Dysfunction in Stroke. *China Standardization*, 2023(12): 277–280.

Publisher's note

Bio-Byword Scientific Publishing remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.