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Acupuncture Can Promote the Rehabilitation of Swallowing Function in Post-Stroke Dysphagia and Improve the Success Rate of Nasogastric Tube Removal

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ABSTRACT

Background: Post-stroke dysphagia (PSD) is a common complication occurring in 37% to 78% of stroke cases. In the acute phase, many patients with PSD require nasogastric (NG) tube intervention; however, long-term enteral feeding can lead to various complications, including mucosal edema in the nasal passages, pharynx, and esophagus, as well as atrophy of the pharyngeal muscle due to lack of use. Previous clinical studies have shown that acupuncture can improve the swallowing function in patients following a stroke. Nevertheless, no prior study has investigated the effect of acupuncture treatment specifically on the removal of nasogastric tubes. In the present study, we investigate the removal rate of NG tubes in patients with PSD who receive acupuncture treatment. We also analyze clinical data to identify factors associated with successfully removing nasogastric tubes.

Methods: We gathered clinical data from patients with PSD between November 2012 and June 2015. All enrolled patients underwent a four-week course of acupuncture treatment during their hospital stay. A range of clinical data were analyzed both during hospitalization and throughout a five-month follow-up period. The primary outcome measure was the rate of NG tube removal, while the secondary outcomes included factors influencing the removal of the NG tube.

Results: We recruited 330 patients with PSD; among them, 89 received an NG tube upon admission and were followed up over a five-month period. In 40 patients, the NG tube was removed four weeks after treatment; in another 71 patients, the NG tube was removed five months after treatment. The total tube removal rate was 79.76%, with a median duration of treatment lasting 31 (inter-quartile range: 22 - 50) days. Logistic multi-factor regression analysis revealed that the Modified Barthel Index (mBI) score significantly influenced the likelihood of NG tube removal following acupuncture treatment (P=0.046).

Conclusion: Compared with other rehabilitation methods reported in the previous literature, acupuncture may help promote the recovery of swallowing function after stroke and improve the extubation rate.

Introduction

Dysphagia commonly develops as a complication following a stroke. Patients who are suffering from post-stroke dysphagia (PSD) often experience paralysis in the muscle groups and nerves that are essential for swallowing due to stroke-related injuries to the brain stem and bilateral cortical bulbar tract. These injuries lead to palatopharyngeal insufficiency and disturb the coordination of the lingual muscles, resulting in difficulties initiating swallowing, eating challenges, and increased risk of aspiration. As a consequence, several complications may arise in these patients, including malnutrition, metabolic disorders, dehydration, and aspiration pneumonia. Such complications can significantly diminish a patient's quality of life and may even pose life-threatening risks. A previous study has indicated that PSD occurs in 37% to 78% of all stroke cases, with the incidence of pulmonary infections due to aspiration ranging from 37% to 55% among dysphagia patients who do not receive intervention [1]. Furthermore, more than half of all patients with PSD are either malnourished or at an increased risk of malnutrition

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[2]. These conditions are linked to poor prognoses, prolonged hospital stays, and increased medical costs [3,4]. Nasogastric (NG) tube feeding is a straightforward and direct method for providing adequate nutrition to patients with PSD. However, prolonged use of this method can lead to atrophy of the pharyngeal muscles. This serious condition may cause patients to lose their ability to eat, digest, and absorb nutrients independently. Therefore, PSD patients must receive timely and effective interventions to remove the NG tube and promote independent eating. International interventions for PSD currently include behavioral therapy, rehabilitation training, pharmaceuticals, and neuromuscular electrical stimulation primarily [5]. However, a Cochrane Collaboration review indicates that only acupuncture and behavioral therapy significantly positively affected swallowing disorders [6]. It is important to note that rehabilitation training is a recommended approach for managing dysphagia. The Cochrane Collaboration categorized the management of post-stroke dysphagia into two distinct types: (1) the management of dysphagia, which includes modifications to food and fluid, changes in posture, and the adoption of various swallowing strategies, often supplemented by rehabilitative techniques, and (2) medical management, which includes therapist-delivered interventions, behavioral therapies, acupuncture, electrical or magnetic stimulation, and pharmaceuticals. While there is no definitive medical treatment for post-stroke dysphagia, it is clear that behavioral therapy and acupuncture, among the medical management options, have shown beneficial effects. Additionally, rehabilitation techniques are classified under dysphagia management rather than medical management. The Tongguan Liqiao acupuncture method, developed by Academician Shi Xuemin for PSD, targets specific acupoints, including *Fengchi* (GB20 bilateral), *Wangu* (GB12 bilateral), and *Yifeng* (SJ17 bilateral) acupoints. This technique involves deep needling directed toward the Adam's apple. Previous observational and experimental clinical studies have preliminarily confirmed the Tongguan Liqiao acupuncture's efficacy in improving swallowing function and enhancing quality of life [7-11]. However, there is a lack of research specifically addressing the removal of NG tubes, which is closely linked to the recovery of swallowing ability. We hypothesized that acupuncture might be essential in NG tube removal after PSD. In this study, we conducted an observational and retrospective study to observe the rate of NG tube removal after PSD based on an existing clinical database. We also analyzed various factors that could potentially influence NG tube removal. Our aimed to provide a foundation for clinical research and managing swallowing disorders after stroke.

Methods and Patients:

This research study received support from the industry research project of the National Administration of Traditional Chinese Medicine (Reference: 201207001). This study's data originated from the "Research Database on Diagnosis and Treatment Information of PSD Treated by Acupuncture," which was established on a dedicated platform. The analysis focused on hospitalized patients diagnosed with cerebral infarction at the First Affiliated Hospital of Tianjin University of Chinese Medicine. Patients were considered to be involved in post-ischemic stroke swallowing disorders if the admission medical records contained descriptions such as "cough and choking after drinking water," "occasional choking after drinking water," "dysphagia," or related terms. Stringent standardized medical record practices were applied, followed by a five-month follow-up. All patients received acupuncture alongside routine basic treatments during the first four weeks of admission. The database includes electronic medical records from hospitalization, clinical assessments of swallowing disorders, and data from post-discharge follow-up. The clinical observation aspect of this study involved three assessment points: pre-treatment, four week's post-treatment, and five month's post-treatment. The study examined patients admitted to the Department of Acupuncture and Moxibustion at the First Affiliated Hospital of Tianjin University of Chinese Medicine between November 2012 and June 2015, specifically focusing on swallowing disorders that occurred after ischemic stroke. The proportion of patients with complete datasets exceeded 90%. Ultimately, 330 cases were included as research subjects. The First Affiliated Hospital Ethics Committee of Tianjin University of Chinese Medicine granted ethical approval for this study. (Approval reference number: TYLL2012[K]002).

Data Collection:

We collated a range of information for each patient, including age, gender, height, weight, occupation, Oxfordshire Community Stroke Project (OCSP) classification, medical history, timing of acupuncture intervention, swallowing scale score (including the Kubota Water Swallowing Test, Fujishima Dysphagia Scale, and Standardized Swallowing Assessment [SSA]), modified Barthel Index (mBI), serum protein levels, serum albumin levels, the incidence of NG tube usage during hospitalization, incidents of pulmonary infection, and NG tube removal rate during hospitalization and five months after treatment. The diagnosis of pulmonary infection refers to the identification of new or progressing pulmonary invasive lesions on chest imaging post-stroke, coupled with at least two of the following clinical infection symptoms: (1) fever of 38℃ or higher; (2) emerging cough, expectoration, or the worsening of existing respiratory symptoms, with or without chest pain; (3) indications of lung consolidation and /or moist rales; and (4) peripheral blood white blood cell count of ≥10×10^9/L or ≤4×10^9/L, with or without nuclear-left shift. The exclusion criteria included diseases similar to pneumonia, such as pulmonary tuberculosis, lung tumors, non-infectious pulmonary interstitial diseases, pulmonary edema, atelectasis, and pulmonary embolism [12]. The diagnostic criteria for hypoproteinemia were a plasma protein level < 60 g/L and/or a plasma albumin level < 30g/L.

Intervention:

Besides standard essential internal medicine treatments, all patients were treated with Tongguan Liqiao acupuncture. This involved daily sessions, with needles kept in place for 30 minutes each time. These sessions were conducted five to six times per week for four weeks. If patients were discharged within two weeks, they continued receiving acupuncture treatment in the outpatient clinic of the First Affiliated Hospital of Tianjin University of Traditional Chinese Medicine. Evaluation points were performed before treatment, four weeks after treatment, and five months post-treatment. Patients or their family members were surveyed to determine the dietary method used (oral feeding, tube feeding, or combination feeding) during the follow-up period. The primary acupuncture points included *Neiguan* (PC6 bilateral), *Renzhong* (DU26), *Sanyinjjao* (SP6 bilateral), *Fengchi* (GB20 bilateral), *Wangu* (GB12 bilateral), and *Yifeng* (SJ17 bilateral). Additional points were utilized for specific conditions. The Lianquan (RN23) acupoint was added for tongue body movement disorders, and scatter thorns were placed on the tongue's surface. For patients with incomplete lip closure and limited chewing movement, the following acupoints were added on the affected side: *Yingxiang* (LI20), *Xiaguan* (ST7), *Dicang* (ST4), and *Jiache* (ST6). Thorns were applied to the posterior pharyngeal wall for slow pharyngeal reflexes. In cases of dysarthria, collateral bloodletting was performed at the *Jinjin* (EX-HN12) and *Yuye* (EX-HN13) acupoints. The acupuncture started with the initial stimulation of the PC6 acupoint by inserting a needle to a depth of 0.5-1cun using a combination of twisting, lifting, and thrusting techniques. The hand technique was applied for one minute. The DU26 acupoint was then stimulated by gently inserting the needle at an oblique angle towards the nasal septum, reaching a depth of approximately 0.3-0.5 cm while using light tapping motions until moisture appeared in the eyes or tears flowed. Next, the SP6 acupoint was stimulated by insertion needles at a 45°angle along the medial aspect of the tibia to a depth of 1-1.5cun. Lifting and thrusting methods were used to induce contractions in the triceps of the affected lower limb. For the GB20, GB12, and SJ17 acupoints, needles were inserted bilaterally towards the Adam's apple and gradually vibrated to a depth of 2-2.5cun, utilizing a small range of high-frequency twisting techniques (twisting angle < 90°and frequency of 120-160 rotations per minute). The desired effect was to achieve a swollen and numb sensation in the throat. Hand techniques were applied for 1 minute on each acupoint. At the RN23 acupoint, the needle was inserted deeply towards the base of the tongue to the depth of 2cun until the needle sensation reached that area. For the stimulation of the posterior pharyngeal wall point, the patient was asked to open their mouth, and a tongue depressor was used to press down the tongue; after that, the posterior pharyngeal wall was fully exposed for stimulation. Bloodletting was performed on EX-HN12 and EX-HN13 acupoints, with a blood volume of 1-2 ml. For all the above procedures, we used disposable, stainless steel and sterile acupuncture needles (Suzhou Medical Equipment Factory, Suzhou, China), with specifications of 0.30 × 75mm and 0.25 × 40mm, respectively.

Statistical Analysis:

SPSS version 21.0 statistical software (IBM Corp., Armonk, NY, USA) was used for all statistical analysis. Variables normally distributed are expressed as means ± standard deviation and analyzed using t-tests. In contrast, those that did not conform to a normal distribution are expressed as medians with interquartile intervals (Q25, Q75) and analyzed using non-parametric tests. For non-normally distributed data, the Mann-Whitney U test was used for continuous variables, and the chi-squared test was used for categorical variables. The time elapsed until NG tube removal

was analyzed using the Kaplan-Meier method. A multivariate logistic regression model was used to identify factors that affected the removal of the NG tube. The significance level was 5%, and P values < 0.05 were considered statistically significant.

Results:

Participant Characteristics and Demographics:

A total of 330 cases were included in this study; consisting of 224 males and 106 females, with a mean age of 64.34±9.58 years. More than 50% of the patients had a normal body mass index (BMI). Approximately 83% of the patients were engaged in non-manual work. Among the total cohort, 123 patients (37.27%) had PACI, 40 (12.12%) had TACI, 119 (36.06%) had POCI, and 48 (14.55%) had LACI. Most patients received acupuncture treatment within 30 days. During the observation period, 49 patients (14.85%) developed pulmonary infection post-stroke, and 59 patients (17.88%) developed hypoproteinemia (Table 1). A total of 89 patients (26.97%) underwent NG tube catheterization at admission. During the observation period, among those fitted with an NG tube, the majority were classified as POCI; the proportion of POCI cases was significantly higher than that of other forms of stroke which (P<0.05). Swallowing function and daily life abilities were both significantly lower in these patients compared to overall cohort of PSD patients (P<0.01). Patients with an NG tube had a significantly higher risk of pulmonary infection and hypoproteinemia (P <0.01; Table 1).

Table 1. General information and baseline data of the participants.

	All cases (330)	NG tube cases (89)	P
Age (year)	64.34±9.58	63.36±10.23	0.401
Sex			
Male	224(67.88%)	64(71.91%)	0.467
Female	106(32.12%)	25(28.09%)	
BMI			
Thin (<18.5)	12(3.64%)	4(4.49%)	0.364
Normal (18.5-23.9)	179(54.24%)	56(62.92%)	
Overweight (24-26.9)	100(30.30%)	19(21.35%)	
Obese (27)	39(11.82%)	10(11.24%)	
Occupation			
Manual labor	55(16.67)	15(16.85%)	0.966
Non-manual work	275(83.33)	74(83.15%)	
OCSP Clinical Classification			
PACI	123(37.27%)	21(23.59%)	0.013*
TACI	40(12.12%)	13(14.61%)	
POCI	119(36.06%)	47(52.81%)	
LACI	48(14.55%)	8(8.99%)	
Anamnesis			
Hypertension	183(55.45%)	51(57.30%)	0.755
Coronary artery disease	166(50.30%)	46(51.69%)	0.817
Atrial fibrillation	30(9.09%)	14(15.73%)	0.070
Diabetes mellitus	87(26.36%)	20(22.47%)	0.455
Cerebral infarction	17(5.15%)	5(5.62%)	0.861
Hyperlipemia	17(5.15%)	7(7.87%)	0.328
Needle intervention time			
15-30 days	211(63.94%)	64(71.91%)	0.160
> 30 days	119(36.06%)	25(28.09%)	
Water swallow test			
Level 3 below	73(22.12%)	6(6.74%)	0.000*
Level 4	148(44.85%)	16(17.98%)	
Level 5	109(33.03%)	67(75.28%)	
Fujishima Dysphagia Scale	7(4,7)	2(2,4)	0.000*
SSA	28(25,30)	29(27,32)	0.000*
mBI	35(20,55)	20(10,42.5)	0.000*
Pulmonary infection	49(14.85%)	26(29.21%)	0.002*
Hypoproteinemia	59(17.88%)	31(34.83%)	0.001*

Abbreviations: NG: nasogastric; BMI: Body Mass Index; OCSP: Oxford shire Community Stroke Project; PACI: Partial anterior circulation infract; TACI: Total anterior circulation infarct; POCI: Posterior circulation infarct; LACI: Lacunar cerebral infarct; SSA: Standardized Swallowing Assessment; mBI: modified Barthel Index. *P < 0.05.

NG Tube Removal Rates

Analysis of the Factors Affecting Extubation of the NG Tube:

After four weeks of treatment, 40 patients had their NG tubes removed, while an additional 71 patients had their NG tubes removed after five months post-treatment. The overall tube removal rate was 79.76%, and the median duration of treatment was 31 (interquartile range: 22-50) days. The extraction rate gradually declined as time progressed, eventually reaching a plateau at approximately 60 days (Figure 1). There were no significant differences in age, sex, BMI, occupation, medical history, or needle intervention time between the patients who had their NG tubes removed and those who didn't. However, compared to those who had their NG tubes removed, there were significantly more cases with POCI classification among patients who failed to achieve NG tube removal during the observation period ($P< 0.05$). In addition, the Standardized Swallowing Assessment (SSA) score in patients who did not have their NG tube removed was significantly higher than that of those who did ($P< 0.05$). The mBI score upon admission was significantly lower ($P<0.05$). These findings indicate that patients who did not have their NG tube removed faced more severe difficulties with swallowing and daily activities. However, there were no statistically significant differences in the incidence of pulmonary infection and hypoproteinemia between the two groups ($P> 0.05$) (Table 2).

Table 2. Analysis of factors affecting extubating.

	Cases (71)	No cases (18)	P
Age (year)	63.23±10.50	63.89±9.37	0.807
Sex			
male	51(71.83%)	13(72.22%)	0.974
female	20(28.17%)	5(27.78%)	
BMI			
Thin (<18.5)	3(4.22%)	1(5.55%)	0.950
Normal (18.5-23.9)	44(61.97%)	12(66.67%)	
Overweight (24-26.9)	16(22.54%)	3(16.67%)	
Obese (27)	8(11.27%)	2(11.11%)	
Occupation			
Manual labor	10(14.08%)	5(27.78%)	0.166
Non-manual work	61(85.92%)	13(72.22%)	
OCSP Clinical Classification			
PACI	19(26.76%)	2(11.11%)	0.047*
TACI	8(11.27%)	5(27.78%)	
POCI	36(50.70%)	11(61.11%)	
LACI	8(11.27%)	0(0)	
Anamnesis			
Hypertension	38(53.52%)	13(72.22%)	0.152
Coronary artery disease	37(52.11%)	9(50%)	0.873
Atrial fibrillation	11(15.49%)	3(16.67%)	1.000
Diabetes mellitus	15(21.13%)	5(27.78%)	0.774
Cerebral infarction	3(4.23%)	2(11.11%)	0.575
Hyperlipemia	7(9.86%)	0(0)	
Needle intervention time			
15 – 30 days	48(67.61%)	16(88.89%)	0.073
> 30 days	23(32.39%)	2(11.11%)	
Water swallow test			
Level 3 below	5(7.04%)	1(5.56%)	0.637
Level 4	14(19.72%)	2(11.11%)	
Level 5	52(73.24%)	15(83.33%)	
Fujishima Dysphagia Scale	2(2,4)	2(1.75,4)	0.489
SSA	29(26,31)	31(28.75,33)	0.042*
mBI	25(15,45)	17.5(0,26.25)	0.015*
pulmonary infection	20(28.17%)	6(33.33%)	0.667
Hypoproteinemia	25(35.21%)	6(33.33%)	0.881

Key: NG: nasogastric; BMI: Body Mass Index; OCSP: Oxfordshire Community Stroke Project; PACI: Partial anterior circulation infarct; TACI: Total anterior circulation infarct; POCI: Posterior circulation infarct; LACI: Lacunar cerebral infarct; SSA: Standardized Swallowing Assessment; mBI: modified Barthel Index. ***P < 0.05**

Logistic multivariate analysis revealed that the mBI score significantly influenced NG tube removal following acupuncture treatment. The proportion of patients with an mBI score > 20 was 3.169-fold lower than that of patients with an mBI < 20 (P=0.046; Table 3).

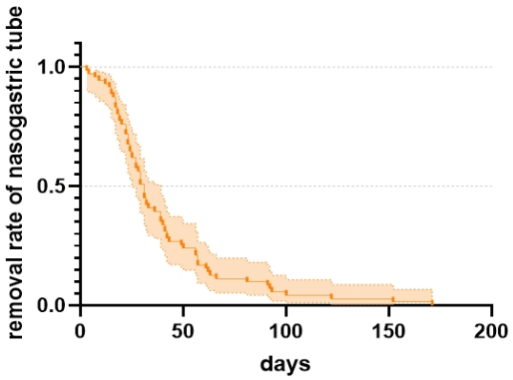

Figure1: Nasogastric (NG) tube removal over time.

Table 3. Results of multivariate analysis.

	OR (95% CI)	P
mBI (>20)	3.169 (1.021,9.833)	0.046*

Key: Mbi: modified Barthel Index; OR: odds ratio; CI, confidence interval. *P < 0.05

Discussion:

The principal objective of this study was to observe the removal rate of NG tubes in patients with PSD who received acupuncture treatment and to analyze clinical data to identify factors associated with NG tube removal. In our study, 89 of the 330 patients with PSD received NG tube therapy at admission, accounting for 26.97% of the total number of patients investigated. After four weeks, 40 patients had their NG tubes removed, accounting for 44.94% of the total. In contrast, 71 patients had their NG tubes removed after five months of treatment, constituting 79.76% of the total patients. Our findings showed that the gastric tube removal rate was higher than that reported by Wilmskoetter, *et al.* [13] (70%), in which the feeding regimen was adjusted according to swallowing conditions. Additionally, our removal rate was also higher than the 68% reported by Dan *et al.* [14], who combined the Gugging Swallowing Screen (GUSS) for assessing swallowing function with feeding training; this was significantly higher than the 20.83% rate observed in the absence of rehabilitation and feeding intervention. Several studies have indicated that long-term placement of NG tubes is linked with potential complications, such as pneumonia and a poorer prognosis, which may contribute to increased mortality rates [15]. First, such placement can damage the mucosal nasal passages, pharynx, larynx, and esophagus, which may lead to edema [16]. Second, prolonged nasal feeding can lead to disuse atrophy of the pharyngeal muscles and impaired sensation in the pharynx; these effects can weaken the contractile response during swallowing movements and diminish the cough reflex. Consequently, patients may lose their ability to consume food independently and experience food retention in the paranasal sinuses and pharyngeal lumen [17]. In addition, prolonged NG tube placement may interfere with the synergistic movement of the various swallowing muscles [18]. This interference can lead to several complications, including aspiration and respiratory tract infections. A large retrospective cohort study found that concurrent respiratory infections in acute stroke patients were strongly associated with nasal feeding; specifically, the total incidence of respiratory tract infection in 536 stroke patients within seven days before the onset of the disease was 11%, and the rate of infection increased to 17% in PSD patients with NG tube [19]. Another study reported that the use of tube feeding at hospital discharge significantly increased the risk of mortality (OR: 9.79; CI: 2.21-43.4; p=0.003) within 90 days of stroke [20]. The number of NG tube insertions could even influence the prognosis of PSD patients; compared to patients receiving < 2 NG tube applications, those receiving ≥2 NG tube applications within one year of stroke had a 1.73-fold greater risk of respiratory events, a 2-fold greater risk of pneumonia, and a 1.61-fold greater likelihood of death, all demonstrating statistically significant disparities. Within 5 years of stroke, patients receiving ≥2 NG tube applications had a 1.53-fold more significant risk of respiratory events, a 1.72-fold more significant risk of pneumonia, and a 1.54-fold greater

likelihood of death when compared to those patients receiving < 2 NG tube applications [21]. Therefore, the timely removal of the gastric tube is essential to restore voluntary feeding and reduce the incidence of respiratory infections in patients with post-stroke dysphagia. The results were similar to our study. 29.21% of patients with NG tubes developed pulmonary infection compared to 14.85% of all PSD patients. Furthermore, 34.83% of patients with NG tubes developed hypoproteinemia, compared to 17.88% of all PSD patients. However, we were fortunate to show that the incidences of pulmonary infection and malnutrition of PSD patients receiving acupuncture treatment were lower than those reported in the literature for non-acupuncture intervention [22-23]. Overall, our data suggest that Tongguan Liqiao acupuncture may play an essential role in promoting the removal of NG tubes and reducing the incidence of adverse events than other therapies. Previous clinical studies have only initially confirmed the efficacy of acupuncture treatment from the perspective of swallowing function and quality of life; no prior research has focused on the timing of NG tube removal and associated adverse events. In this study, we focused on the use of Tongguan Liqiao acupuncture, a method initially proposed by the Academician Shi Xuemin for the treatment of dysphagia. We evaluated the curative effect of acupuncture on dysphagia with NG tube removal as the endpoint. This acupuncture method primarily focuses on *Fengchi* (GB20), *Wangu* (GB12), and *Yifeng* (TE17) as the primary acupoints. Previous researchers used data mining techniques to investigate acupoint selection patterns for treating swallowing disorders based on data collated by multiple databases between 1990 and 2021. These data mining techniques revealed that the most commonly used acupoints were in the head, face, neck, and cervical regions, accounting for 79.78% of the total number of acupoints utilized. Among these acupoints, *Fengchi* (GB20) was ranked first, *Yifeng* (TE17) was ranked third, and *Wangu* (GB12) was ranked sixth in terms of frequency [24]. Previous studies indicated that acupuncture on acupoints in the neck and cervical regions can exert several effects [25-27]. On one hand, this method can improve blood supply to the vertebral-basilar artery and enhance circulation in the peri-infarct penumbra, thereby improving blood circulation in the brainstem. Increased cerebral blood flow enhances the regulatory effect on neural reflexes, which is beneficial for repairing and reconstructing the swallowing reflex arc. On the other hand, by stimulating the local glossopharyngeal nerve, vagus nerve, and hypoglossal nerve, as well as needling the pharyngeal constrictor and tongue muscles related to swallowing, can transmit acupuncture signals through the corticobulbar tract to higher brain neurons. This promotes functional repair and reorganization of neurons in the brain tissue and enhances the reconstruction of the neural reflex arc, improving swallowing function. In addition to some swallowing scale scores, some acupuncture studies evaluate objective indicators of swallowing, such as electromyography and hyoid muscle displacement. In a series of studies, Gao et al. used swallowing ultrasonography to investigate the immediate effects of needling on the *Fengchi* (GB20) acupoint [28-30]. These authors reported that needling *Fengchi* (GB20) acupoint led to an immediate increase in genioglossus muscle displacement, a reduction in bolus retention time during the oral and pharyngeal phases, and a reduction in the overall swallowing time ($P < 0.05$). In addition, they used surface electromyography to investigate the immediate effects of needling the *Fengchi* (GB20) acupoint [15]. They observed a significant shortening of swallowing time in both the geniohyoid and hyoglossus muscle groups, along with a notable increase in the mean amplitude of swallowing within these muscle groups compared to pre-needling measurements ($P < 0.05$). Zhao et al. [31] demonstrated that deep acupuncture on the bilateral *Fengchi* (GB20) and *Yifeng* (TE17) acupoints increased the surface electromyography amplitude of the genioglossus muscle group. Meanwhile, needling was applied at the Fengchi (GB20), Wangu (GB12), and Yifeng (SJ17) acupoints, increasing the maximum amplitude of pharyngeal surface electromyography (sEMG). [32-33]. In our study, the median duration of NG tube therapy was 31 (22,50) days in PSD patients treated with Tongguan Liqiao acupuncture treatment. We found that the NG tube removal rate reached a plateau around 60 days after the stroke onset. This is a unique observation and represents valuable information as some PSD patients did not receive acupuncture or rehabilitation interventions in the early stages; this may cause them to miss the optimal recovery time and prolong the use of NG tubes. Furthermore, in our present study, multivariate analysis demonstrated that the most significant factor associated with the rate of NG tube removal was the mBI on admission, which may reflect the final outcome based on a patient's baseline status and acute stroke severity. Some limitations to this research need to be considered when interpreting our results. First, this was a retrospective and observational study without a non-acupuncture control group; this may have influenced our results. Second, we did not incorporate data on the patient's state of consciousness, cognitive status, the use of sedative drugs, or other confounding factors that may affect NG tube removal; this was because data were retrieved retrospectively from a database that did not feature a complete dataset. Further studies should investigate the effect of these factors on NG tube retention rate. Third, in our hospital, inpatients receive acupuncture therapy five to six times weekly for four weeks. Our analysis did not investigate the impact of rehabilitation training at home on NG tube withdrawal after discharge. Finally, our small sample was based in a single center, the National Clinical Research Center of Acupuncture and Moxibustion of Traditional Chinese Medicine. Our findings must be confirmed with larger sample sizes in multicenter and randomized controlled studies.

Conclusion:

Tongguan Liqiao acupuncture can contribute to the recovery of swallowing function, increase the rate of extubation, reduce the incidence of adverse events associated with the long-term insertion of NG tubes (such as lung infection and the risk of malnutrition), reduce the pain experienced by patients, and improve their overall quality of life.

Conflict of Interests: None of the authors have any conflicts of interest to declare.

Clinical Trial Registration Number: ChiCTR2200065836

Statement of Informed Consent: Written informed consent was obtained from the patient to publish this clinical study.

State of Human Rights: The intervention conformed to the ethical criteria.

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