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RESEARCH ARTICLE

# Clinical observation of effects of ultrashort wave therapy combined with acupuncture and rehabilitation training in the treatment of patients with dysphagia after stroke

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## KEYWORDS

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## ABSTRACT

**Aim:** The present study aimed to assess the clinical effects of ultrashort wave therapy combined with acupuncture and rehabilitation training on patients with dysphagia after stroke.

**Method:** A total of 126 patients with stroke with dysphagia were randomly divided into an acupuncture group (control group: 63 patients) and a comprehensive rehabilitation training group (treatment group: 63 patients). The control group received rehabilitation training and acupuncture, whereas the treatment group received ultrashort wave therapy in addition to rehabilitation training and acupuncture (comprehensive rehabilitation training). The curative effect was evaluated using water-drinking test scores and swallowing quality of life scale (SWAL-QOL) scores before and after intervention. Additionally, the incidence of aspiration pneumonia was assessed in the two groups.

**Results:** The water-drinking test scores in both groups were significantly better after 4 weeks of intervention than before intervention ( $P < 0.01$ ); however, the improvement degree was significantly greater in the treatment group than in the control group ( $P < 0.01$ ). The SWAL-QOL scores in both groups were significantly higher after intervention than before intervention ( $P < 0.05$ ); however, the improvement degree was significantly greater in the treatment group than in the control group ( $P < 0.05$ ). Moreover, the incidence of aspiration pneumonia was significantly lower in the treatment group than in the control group ( $P < 0.05$ ).

**Conclusion:** Comprehensive rehabilitation training can greatly improve dysphagia after stroke and can effectively reduce the incidence of aspiration pneumonia.

## 1 Introduction

The incidence of dysphagia after stroke has been reported to be 37% ~ 78% and dysphagia in the

early stage of stroke can markedly increase the risk of aspiration pneumonia [1]; decrease oral intake, leading to dehydration, electrolyte disturbance, and malnutrition [2]; and increase mortality

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and can confer many adverse effects. Dysphagia after stroke is considered an independent risk factor for malnutrition [3]. With the acceleration of social aging in China, the number of patients with dysphagia after stroke is increasing, and the rehabilitation requirements of the patients are also increasing. For improving the quality of life of patients and reducing the financial burden on families, the application of rehabilitation technology in the treatment of dysphagia after stroke has broad prospects. Ultrashort wave therapy can improve local blood circulation, eliminate nerve edema, relieve nerve compression, and promote nerve function recovery. Thus, the present study aimed to assess the clinical effects of ultrashort wave therapy combined with acupuncture and rehabilitation training on dysphagia after stroke.

## 2 Materials and methods

### 2.1 Patients

The study enrolled patients with acute stroke from our hospital between April 2018 and April 2019. The study subjects included patients with cerebral infarction or cerebral hemorrhage confirmed by computed tomography or magnetic resonance imaging within 10–15 days of onset. Patients had dysphagia symptoms and drinking test scores of  $> 3$  points; all patients met the diagnostic criteria set by the Fourth National Conference on Cerebrovascular Diseases in 1995. Patients were clearly conscious and were able to understand the basic instructions of the therapist. A total of 126 patients were enrolled and were randomly divided into an acupuncture group (control group) and a comprehensive rehabilitation training group (treatment group). The control group included 63 patients (22 male and 41 female patients; mean age,  $57 \pm 8$  years; 39 with cerebral hemorrhage and 24 with cerebral infarction), and the treatment group included 63 patients (21 male

and 42 female patients; mean age,  $56 \pm 9$  years; 36 with cerebral hemorrhage and 27 with cerebral infarction).

### 2.2 Inclusion and exclusion criteria

The inclusion criteria were as follows: (1) age of 40–65 years; (2) disease course of 10–15 days; (3) presence of dysphagia; (4) ability to cooperate for completion of relevant examinations; (5) stable vital signs and no obvious contraindication for rehabilitation training; and (6) signed informed consent form.

The exclusion criteria were as follows: (1) severe mental disorders and cognitive impairment; (2) severe complications such as cardiopulmonary insufficiency and hepatorenal insufficiency; (3) severe infection; (4) severe osteoporosis; and (5) severe cerebral hemorrhage and cerebral infarction.

### 2.3 Methods

The principles and contents of drug treatment in the two groups were similar. Approaches to reduce intracranial pressure, control blood pressure, and provide nutrition to brain cells were adopted in cases of cerebral hemorrhage, and approaches to improve anti-platelet aggregation, anticoagulation, and microcirculation were used in cases of cerebral infarction.

Rehabilitation training involved two parts. In the first part, an electrode sheet of the vocastimaster was placed on the patient's neck and throat, and an electrical diagnosis of the neuromuscular disorder associated with swallowing and speech function was made using the low-frequency current output from the instrument. According to the diagnosis, the instrument automatically generated a treatment prescription, and treatment and training were provided for the symptoms of neurological and muscular disorders, such as dysphagia and dysarthria, thereby improving the functions of the swallowing and

articulating muscles to achieve therapeutic effects.

In the second part, as manual training, exercise training was provided for the mouth, face, and tongue muscles, which involved the following: (1) closed lip, lip extension, and side pull training; (2) jaw opening and closing training; (3) tongue extension, retraction, lateral active movement, and back elevation movement training; (4) knocking with the fingertips and hitting the lips with ice cubes to improve lip closure; (5) cold stimulation for swallowing reflexes (pressing the anterior zygomatic arch, posterior zygomatic arch, soft palate, posterior pharyngeal wall, and posterior part of the tongue with a frozen cotton swab to promote swallowing reflexes); and (6) swallowing training for the glottis (taking a deep breath from the nose and holding it).

In the control group, acupuncture was provided along with rehabilitation training. The acupuncture prescription was as follows: Shuigou, Fengchi, Fengfu, Hurricane, Lianquan, Jialianquan, Jinjin, and Yuye. The oblique needling of Shuigou acupoint was directed towards nasal septum, and the needle was inserted 5~8 mm, with the method of bird-pecking needling and reducing manipulation, degree with wet eyes or tears. Then, acupuncture was performed on the wind pool, wind house, and hurricane points in the forward direction and at 45° to the larynx (needle depth, 8~10 mm), and after noting gas, a transfer needle was placed at 180°~260° for 2~3 min at 60~80 times/min. Acupuncture was performed at a low amplitude and high frequency. If there is no reaction after needling, scoraping method and along the meridian are adopted. Lianquan and Jialianquan involved slanting from the front to the back and to the base of the tongue at 45° to the horizontal, with a 5~8-mm power-on needle and dense wave (double wave and dense wave appear alternately; number of changes is  $10 \pm 3$  times/min; frequencies are dense wave 50 Hz and dredging 2 Hz). The output intensity was tolerable, and the

needle was retained for 30 min. Jinjin involved jade liquid prick. One course lasted for 2 weeks, and continuous treatment involved two courses.

In the treatment group, the therapy for the control group was combined with ultrashort wave therapy. Ultrashort wave therapy was performed using the Dalian (Ori) ultrashort wave electrotherapy machine (frequency, 50 Hz). Two electrodes were placed on both sides of the neck, micro-calorie. The therapy was performed once a day for 20 min. One course lasted for 2 weeks, and continuous treatment involved two courses.

#### 2.4 Testing index

The water-drinking test was performed. In this test, the patients were asked to sit and drink 30 mL of warm water according to their habits. They were graded according to their drinking abilities as follows: grade I (1 point), able to consume 30 mL of warm water in one drink without choking; grade II (2 points), able to consume the water in two drinks without choking; grade III (3 points), able to consume the water in one drink with choking and cough; grade IV (4 points), able to consume the water in two or more drinks with choking and cough; and grade V (5 points), unable to easily swallow the water with repeated choking. Additionally, quality of life was assessed using the swallowing quality of life scale (SWAL-QOL). The score ranges from 0 to 100, with 0 representing poor function and 100 representing completely normal function. Thus, a higher score indicates better swallowing ability and quality of life.

#### 2.5 Statistical methods

Statistical analyses were performed using SPSS 18.0. Measurement data are expressed as mean  $\pm$  SD, and grouped t-test was used for assessment. Counting data are expressed as percentage, and they were compared using the chi-square test. Differences were considered significant at  $P < 0.05$ .

### 3 Results

#### 3.1 Water-drinking test

The water-drinking test scores in the control group and treatment group before intervention and after 4 weeks of intervention are presented in Table 1. The water-drinking test scores in both groups were significantly better after intervention than before intervention ( $P < 0.01$ ). However, the improvement degree was significantly greater in the treatment group than in the control group ( $P < 0.01$ ), indicating that comprehensive rehabilitation training is more beneficial than acupuncture for recovery of the swallowing function after stroke.

#### 3.2 Quality of life after treatment

No significant difference was noted in the SWAL-QOL score before intervention between the control and treatment groups ( $P > 0.05$ ). However, the SWAL-QOL scores in both groups were significantly higher after intervention than before intervention ( $P < 0.05$ ), and the improvement degree was significantly greater in the treatment group than in the control group ( $P < 0.05$ ; Table 2).

#### 3.3 Incidence of aspiration pneumonia

During the intervention period, aspiration pneumonia occurred in 13 (20.63%) patients from the control group and 5 (7.94%) patients from the treatment group. A significant difference was noted in the incidence of aspiration pneumonia between the two groups ( $P < 0.05$ ; Table 3).

**Table 1** Water-drinking test scores before and after intervention in the control and treatment groups (mean  $\pm$  SD).

Groups	Number of cases	Before intervention	After intervention
Control group	63	4.2 $\pm$ 1.3	2.5 $\pm$ 1.2 <sup>#</sup>
Treatment group	63	4.3 $\pm$ 1.1	1.4 $\pm$ 0.8**

<sup>#</sup>, compared with before intervention,  $P < 0.01$ ; \*, compared with the control group,  $P < 0.01$ .

**Table 2** SWAL-QOL scores before and after intervention in the control and treatment groups (mean  $\pm$  SD).

Groups	Number of cases	SWAL-QOL score
Control group	63	
Before intervention		58.45 $\pm$ 10.82
After intervention		82.52 $\pm$ 7.91 <sup>#</sup>
Treatment group	63	
Before intervention		57.11 $\pm$ 12.13
After intervention		94.02 $\pm$ 5.48**

<sup>#</sup>, compared with before intervention,  $P < 0.05$ ; \*, compared with the control group,  $P < 0.05$ . SWAL-QOL, swallowing quality of life scale.

**Table 3** Incidence of aspiration pneumonia in the control and treatment groups.

Groups	Number of cases	Number of occurrences	Incidence (%)
Control group	63	13	20.63
Treatment group	63	5	7.94*

\*, compared with the control group,  $P < 0.05$ .

### 4 Discussion

Dysphagia is a common complication after stroke, and Western medicine considers it to involve true bulbar palsy and pseudobulbar palsy. Its pathogenesis is related to injury of the cranial nerve or motor nucleus of the medulla oblongata involving the trigeminal nerve, facial nerve, glossopharyngeal nerve, vagus nerve, and hypoglossal nerve. Dysphagia caused by bilateral corticomedullary tract injury and pseudobulbar palsy caused by superior motor neuron injury manifests as dysarthria, pharyngeal reflex, and delayed dysarthria [4]. Clinical manifestations include insufficient food chewing, intraoral food delivery difficulties, slow swallowing reflex, weak tongue muscle strength, and dietary cough. Among patients with stroke, secondary aspiration pneumonia and tracheal foreign bodies are the main causes of poor prognoses and even death [5]. Swallowing is a complex physiological activity involving multilevel coordination, and damage at any level can affect the entire nervous

regulatory network and cause dysphagia. Traditional Chinese medicine attributes dysphagia to a stiff tongue, pyretic aphasia with sudamina, pharyngitis, and other conditions, and the pathogenesis is syndrome of deficiency ben and excessive biao. Patients with dysphagia have liver and kidney dysfunction and deficiency of qi and blood. Additionally, wind and fire agitate each other, phlegm obstructs collaterals, and lesions related to the tongue, pharynx, liver, spleen, kidney, and brain. Dysphagia after stroke may be due to excessive damage to the brain and spirit, and it might be useless to alter qi in such cases. Loss of nutrition in the mouth, tongue, pharynx, and larynx affects the swallowing function. Clinical studies have reported that rehabilitation training or acupuncture is commonly used in the treatment of swallowing disorders after stroke. However, the effect of a single treatment method, which has a long therapy cycle, is not ideal, and patient compliance is poor.

In the present study, the treatment group received acupuncture and ultrashort wave therapy in rehabilitation training, as ultrashort waves, which are high-frequency electromagnetic waves, can increase the energy of apolipoproteins in the cell membrane, change ion channel proteins in the cell membranes, improve blood circulation, and accelerate tissue recovery. Moreover, ultrashort waves can dilate blood vessels, improve local blood circulation, eliminate nerve edema, and relieve nerve compression, thus promoting the recovery of nerve function. Furthermore, this therapy has anti-inflammatory and anti-swelling effects and effectively improves the local foreign body sensation among patients [6]. Studies have shown that ultrashort waves can protect neurons [7], promote the recovery of nerve function [8], accelerate the regeneration of injured peripheral nerves [9], and greatly improve nerve conduction velocity [10].

Acupuncture can not only clear the channels and collaterals but also induce resuscitation [11]. The Fengchi acupuncture point is the intersection of the Yangwei Meridian and Foot Shaoyang Meridian, which can reach the qi of the Yang meridians. The Foot Shaoyang Gallbladder Meridian interacts with the Foot Jueyin Liver Meridian, and acupuncture at the Fengchi point can descend yang, calm wind, clear the head, dredge the orifice, clear phlegm, and relieve sore throat. Acupuncture at the Shuigou and Fengfu points can clear the head and dredge the orifice. The Jinjin and Yuye acupuncture points are extra nerve points (“acupuncture dacheng”) and are mainly used for cases of aphasia and laryngeal paralysis. Acupuncture at the Lianquan and Jialianquan points can refresh the mind and clear the throat [12]. Considering the features of these acupuncture points, stimulating them with electrical acupuncture (dense wave) can induce muscle movement or simulate normal autonomous movement for improving or restoring the functions of stimulated muscles or muscle groups. Simultaneously, it can clear channels and collaterals, activate qi, activate blood, promote lesion healing, and compensate the surrounding tissues, which are beneficial for the regeneration of injured neurons and creation of conditions for the establishment of new pathways [13–15]. Modern medical research has shown that acupuncture treatment can effectively promote the recovery of the damaged dendritic morphology of affected nerve fibers, induce the extension of dendrites close to the normal state, and promote the recovery of dendrite diameter and quantity [16], and these are some of the neurobiological bases of acupuncture treatment for nerve injury [16–18]. On the other hand, swallowing function training is a clinically proven effective treatment, and can maximize brain plasticity, accelerate the recovery of swallowing-related muscles, and improve swallowing function.

## 4 Conclusions

The findings of this study indicate that comprehensive rehabilitation training involving the combination of ultrashort wave therapy with acupuncture and swallowing function training can greatly improve the water-drinking test scores and SWAL-QOL scores in patients with dysphagia after stroke, promote recovery of the swallowing function, and greatly reduce the incidences of aspiration pneumonia, disability, and complications. With the continuous development and promotion of traditional Chinese medicine, the combination of traditional Chinese medicine and Western medicine has now become the main clinical approach for the treatment of stroke sequelae. It can greatly improve local blood circulation, promote brain blood circulation, and resolve nerve issues, thereby improving the recovery of limb function among patients. In summary, comprehensive rehabilitation training can greatly improve dysphagia after stroke and can effectively reduce the incidence of aspiration pneumonia. Its curative effect is safe and reliable. Additionally, the approach is easy for patients to accept, can reduce the financial burden on patients, and is beneficial for long-term rehabilitation of patients.

## Conflict of interests

All contributing authors have no conflict of interest.

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