Int J Clin Exp Med 2020;13(5):3564-3571
www.ijcem.com /ISSN:1940-5901/IJCEM0108040

Original Article

A comparative study on the clinical efficacy of swallowing function training with and without acupuncture in the treatment of dysphagia after cerebral infarction

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Received January 17, 2020; Accepted February 16, 2020; Epub May 15, 2020; Published May 30, 2020

Abstract: Background: Swallowing dysfunction is a common sequelae in patients with cerebral infarction. Objective: To analyze and compare the effects of swallowing function training with and without acupuncture in cerebral infarction patients with dysphagia. Methods: A total of 120 patients with cerebral infarction were included in the study, and they were equally divided into the control group (swallowing function training by itself) and the observation group (swallowing function training combined with acupuncture). Results: Before intervention, the levels of all the observed indicators in the two groups were similar (P>0.05). After intervention, the two groups of patients in the water swallow test level, AEMG, surface electromyogram peak value, and quality of life score were improved; although the improvement effects in the observation group were significantly better than the control group (P<0.05). Conclusions: Swallowing function training combined with acupuncture can effectively improve the swallowing function of patients with cerebral infarction, promote the compensation or reorganization of the surrounding tissues around the disabled tissues, and improve the clinical treatment effects.

Keywords: Cerebral infarction, swallowing function, acupuncture, functional training, quality of life

Introduction

Swallowing dysfunction is a common sequelae in patients with cerebral infarction [1, 2]. After the appearance of swallowing dysfunction, the patient has difficulty in food intake, and as such is prone to electrolyte imbalance, dehydration, and even malnutrition. Abnormal swallowing function can also lead to the occurrence of choking, cough and aspiration pneumonia, prolonging the treatment duration of patients, and brings a lot of inconvenience into their lives [3]. Studies have shown that when acupuncture is used for the treatment of swallowing dysfunction, acupuncture stimulation of the corresponding acupoints can effectively help patients recover the nerve impulse function of local nerves and muscles, and then assist these nerve impulses to be transmitted to the swallowing center in the brain stem, achieving the remodeling effect [4, 5]. This study, guided by the theory of traditional Chinese medicine, combined acupuncture with swallowing training, took patients with cerebral infarction as the study subjects to evaluate the application effect of Chinese acupuncture combined with swallowing function training in the rehabilitation of patients with cerebral infarction.

Materials and methods

General information

A total of 120 patients with cerebral infarction were included in the study, and the study period was from April 2018 to April 2019. They were randomly divided into a control group and an observation group by the coin toss method, with 60 patients in each group. After comparison, there was no difference in baseline data between the two groups (P>0.05) (see **Table 1**).

Table 1. Analysis of general data level of cerebral infarction patients in the two groups (n=120)

Items	Control group	Observation group	P
Gender			0.893
Male	35	36	
Female	25	24	
Average age (Yr)	61.29±5.38	61.61±5.42	0.798
Mean course of disease (d)	52.76±10.38	53.03±10.41	0.752
Water swallow test level			0.829
III	34	36	
IV	17	16	
V	9	8	
BMI	21.48±1.34	21.44±1.41	0.673
Hypertension			0.835
Yes	51	50	
No	9	10	
Diabetes			0.751
Yes	25	24	
No	35	36	
Hyperlipidaemia			0.649
Yes	41	43	
No	19	17	
Infarction location			0.691
Internal carotid	15	14	
Middle cerebral artery	11	13	
Anterior cerebral artery	15	14	
Posterior cerebral artery	18	19	
Vertebrobasilar artery	16	14	

Note: BMI: body mass index.

The study was approved by the Ethics Committee of The Affiliated Hainan Hospital of Hainan Medical University.

Inclusion criteria

(1) All patients met the diagnostic criteria of cerebrovascular diseases in Neurology (7th edition), and were confirmed by computer tomography (CT) or magnetic resonance imaging (MRI) examination. The assessment of swallowing dysfunction complied with the relevant standards of expert consensus on the evaluation and treatment of dysphagia in China; (2) The patient's course of disease was 2-12 weeks after onset, aged between 35 and 75 years old, and the condition was stable and patients could cooperate with treatment; (3) Patients had a water swallow test level ≥3; (4) All patients included in the study were informed about the study and signed an informed consent.

Exclusion criteria

(1) Patients with severe underlying diseases; (2) Patients with mental disorders or consciousness disorders; (3) Patients with skin ulcers, trauma or damage at the treatment area; (4) Patients with serious hemorrhagic diseases; (5) Patients who were involved in other clinical studies at the same time; (6) Patients with swallowing dysfunction not caused by cerebral infarction; (7) Patients with local lesions of throat or structural abnormalities of the oral cavity, pharynx and esophagus; (8) Patients who were unable to comple the study treatment as required by the therapist; (9) Patients who couldn't tolerate the test and asked to withdraw from the observation.

Methods

Control group: Patients in the control group received rehabilitation training in swallowing function on the basis of routine treatment and rehabilitation management. During the training, the patient was asked to relax the whole body and take a sitting position. After local infiltration anesthesia, a No. 14 latex double chamber catheter was slowly inserted into the esophagus through the cricopharyngeal muscle by nasal feeding intubation. After water was injected into the balloon, the catheter was pulled. After it reached the lower edge of the cricopharyngeal muscle, the water in the balloon was properly extracted, and the amount of water in the balloon was recorded that went through the cricopharyngeal muscle. The catheter was pulled again and the patient was instructed to swallow. One-2 mL water was injected to dilate the cricopharyngeal muscle when the balloon was at the level of the cricopharyngeal muscle, and the water was extracted and the amount of water was controlled at base line after a short time. After completion, all water was extracted and the catheter was withdrawn. During the later training, 0.5-1 mL balloon water could be appropriately in-

creased according to the patient's tolerance, and the maximum water injection did not exceed 12 mL [6]. Training happened 5 times a day, 3 min each time, and several minutes between the two training sessions. After the training, patients were given aerosol inhalation treatment to prevent mucosal edema.

Observation group: On the basis of the control group, patients in the observation group were treated with acupuncture. The acupoints were Fengfu, Yamen, Fengchi (double), Jinjin, Wanggu (double), Lianquan and Yifeng (double). During the treatment, the patient took a sitting position, and the needles used for acupuncture were all No. 30 2-inch filiform needles. The acupuncture methods were mainly twirling supplementation and draining, and appropriate acupuncture methods were selected according to different acupoints. It was appropriate to needle Yifeng and Lianquan acupoints when the patient felt numbness and distention locally. Jinjin acupoint was needled 2-3 times by peck needling, and the needle was retained for 30 min before lifting. Patients in the observation group were given acupuncture once a day and rested for 1 day after 6 days of continuous treatment. Patients in both groups were treated weekly as one course of treatment, for a total of 4 courses of treatment.

Clinical evaluation methods

Clinical evaluation of the degree of swallowing abnormality: By collecting the medical history data of the patients in the two groups, the eating ability and swallowing problems of the patients before and after treatment were obtained, and the degree of swallowing abnormality of the patients was evaluated.

Evaluation method for swallowing dysfunction: (1) Evaluation method of water swallowing test: The time taken for oral administration of 30 mL of room temperature water and any choking coughs in the process of drinking water were observed and recorded for the patients in the two groups. The swallowing dysfunction was classified into level I-V. The higher the level, the more serious the patient's drinking disorder [6, 7]. (2) Standardized Swallowing Assessment (SSA) scale: The swallowing function of patients was evaluated by SSA scale, including the preliminary evaluation of patients (8-23 points), evaluation of patients drinking 5 mL water (5-11 points), and evaluation of patients drinking 60 mL water (5-12 points). The score standard of SSA scale is between 18 and 46 points, and the lower the total score indicates the higher the swallowing function level of patients [8]. (3) Evaluation of surface electromyogram (sEMG): F1exComp Infiniti multi-channel sEMG analysis system was used to collect information about the swallowing status of patients in both groups before and after intervention, including sEMC AEMG and sEMG peak value, and relevant data were recorded and compared. (4) Quality of life: Using the quality of life assessment scale, the quality of life of patients with cerebral infarction before and after swallowing function training was assessed. The assessment contents mainly included: domain scores and total scores in the physical domain, psychological domain, independent domain and environmental domain.

Efficacy determination

After intervention, the clinical efficacy was evaluated by water swallowing test. Significant effect: After a one-month intervention, the results of water swallowing test was 1-2 grades higher than that before intervention, and there was no choking cough or slight choking cough in the process of drinking water. Effective: After intervention, the results of water swallowing test was 1 grade higher than that before intervention, and the choking cough condition in the process of drinking water was improved compared with that before intervention. No effect: The evaluation level of water swallowing test was not improved or decreased. Total effective rate = (significant effect + effective)/ total number of patients * 100%.

Statistical analysis

SPSS 22.0 statistical software was used to process and analyze the relevant data obtained in this study. The measurement data were expressed as mean ± standard deviation ($\bar{x}$ ± sd). The enumeration data was expressed as percentage. For measurement data in line with normal distribution, paired t-test was used for before-after comparison within the group, and chi-square test was used for non-rank enumeration data. There is a significant difference at $P<0.05$.

Results

Standard swallowing function score

There was no difference in SSA score between the two groups before the rehabilitation train-

Table 2. Analysis of SSA scores before and after intervention in patients with cerebral infarction

Group	SSA score		t	P
	Before intervention	After intervention		
Control group (n=60)	36.38±3.18	26.98±3.80	5.784	0.047
Observation group (n=60)	36.31±3.21	21.53±3.37	10.684	0.010
t	1.494	7.481		
P	0.931	0.026		

Note: SSA: Standardized Swallowing Assessment.

Table 3. Analysis of AEMG before and after intervention in the two groups (n=60)

	AEMG (μV)		t	P
	Before intervention	After intervention		
Control group	15.36±2.17	18.93±3.42	3.631	0.065
Observation group	15.41±2.23	22.89±3.52	12.586	0.011
t	1.142	7.195		
P	0.794	0.030		

Note: AEMG: average EMG.

Table 4. Analysis of sEMG peak value before and after intervention in the two groups (n=60)

	sEMG peak value (μV)		t	P
	Before intervention	After intervention		
Control group	27.94±3.11	43.21±3.22	8.381	0.024
Observation group	27.83±3.26	52.47±2.94	13.531	0.003
t	1.086	6.375		
P	0.835	0.036		

Note: sEMG: surface electromyogram.

ing for swallowing function (P>0.05). After intervention, the swallowing function scores of patients in both groups were improved compared with those before intervention, but the improvement effect of SSA scores in the observation group were significantly better than those in the control group (P<0.05), with a significant difference. See **Table 2**.

sEMC detection

Before swallowing function training, there was no significant difference in AEMG and sEMG peak values between the two groups (P>0.05). After intervention, the AEMG and sEMG peak values of patients in the control group were improved over those before intervention, but without significant difference (P>0.05). The improvement effect of the indicators in the observation group was significantly better than that in control group (P<0.05), with a significant difference. See **Tables 3**, **4**.

Water swallowing test

At the beginning of the study, the results of water swallowing test in the two groups were similar (P>0.05). After intervention, the level of water swallowing test was improved in both groups, but the test results in the observation group were significantly better than those in control group (P<0.05), with a significant difference. See **Table 5**; **Figure 1**.

Quality of life

There was no significant difference in the scores of each domain in the quality of life and the total scores between the two groups before the rehabilitation of swallowing function (P> 0.05). After intervention, the scores of each domain in quality of life and total scores in the observation group and control group were improved compared with those before intervention, but the quality of life scores in the

Table 5. Analysis of water swallow test results before and after intervention in the two groups

Group	Before intervention					After intervention					χ^2	P
	I	II	III	IV	V	I	II	III	IV	V		
Control group	0	0	34	17	9	14	31	9	5	1	7.383	0.028
Observation group	0	0	36	16	8	23	31	5	1	0	11.574	0.008
χ^2			1.642					10.683				
P			0.829					0.015				

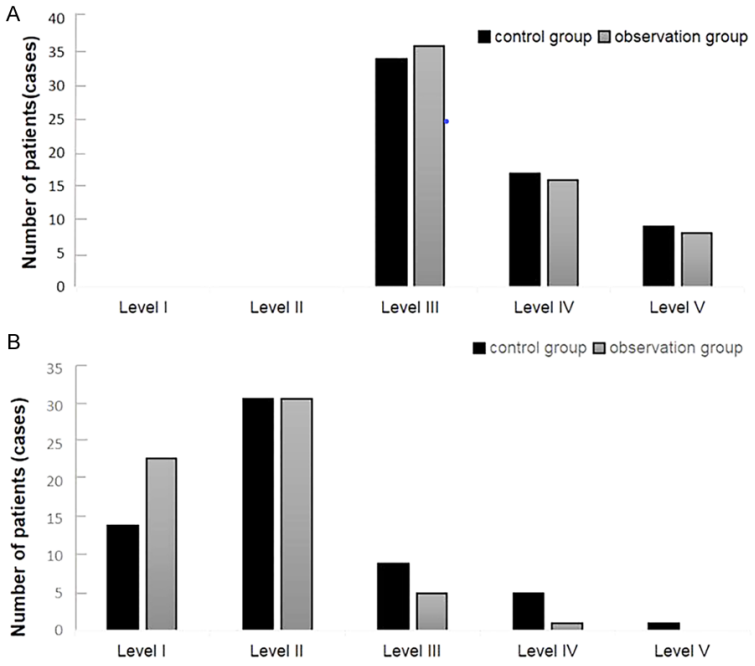

Figure 1. Comparison of water swallowing test results before and after intervention between the two groups.

observation group were better than those in the control group (P<0.05), with a significant difference. See **Tables 6**, **7**.

Therapeutic effect

The therapeutic effects of rehabilitation training in patients with cerebral infarction in the two groups was significantly different after different swallowing function training, indicating that the clinical therapeutic effect of patients in the observation group was significantly better than that of patients in the control group (P<0.05), with a significant difference. See **Table 8**.

Discussion

A large number of studies have shown that cricopharyngeal achalasia is the main cause of abnormal swallowing function in patients with cerebral infarction [9, 10]. In patients with cerebral infarction, the pathway of conduction from the brain stem medullary tract to the cricopharyngeal muscle is abnormal due to disease, and the reflex function of the cricopharyngeal muscle is abnormally increased, which makes it difficult to effectively complete normal relaxation [11]. Cricopharyngeal achalasia mainly causes adverse effects on pharyngeal stage during swallowing in patients with cerebral infarction [12, 13]. In addition, patients with cerebral infarction are in a state of abnormal swallowing function for a long time, which may lead to a fear of eating [14], anorexia and other conditions, increasing the possibility of malnutrition [15]. At present, through the application of VFSS examination, we can visually observe the status of cricopharyngeal muscles in the swallowing process of patients with cerebral infarction, record and save the whole swallowing process of patients, and then facilitate the observation and comparison of the effects of patients in various swallowing stages before and after training, so as to adjust the treatment plan in a real time manner.

Catheter balloon dilatation is a commonly used rehabilitation training method for dysphagia in clinical practice. It can reduce the pressure of the resting state of the cricopharyngeal muscles in patients with cerebral infarction through training, thus prolonging the relaxation time and degree of the cricopharyngeal muscles, and alleviating dysphagia [16]. At pre-

Table 6. Analysis of quality of life before and after intervention in the two groups

	Before intervention		After intervention	
	Control group	Observation group	Control group	Observation group
Physical domain	12.03±1.17	11.99±1.21	15.32±1.31#	18.72±1.46#,*
Psychological domain	11.62±0.74	11.59±0.69	14.67±1.18#	17.87±1.02#,*
Independent domain	12.80±1.05	12.78±1.08	16.46±1.42#	19.69±1.74#,*
Environment domain	12.73±1.16	12.69±1.12	16.78±2.11#	16.95±1.78#

Note: #compared with before intervention, P<0.05; *compared with the control group, P<0.05.

Table 7. Comparison of quality of life total scores before and after intervention between the two groups

	Total score of quality of life		t	P
	Before intervention	After intervention		
Control group	49.22±3.36	64.03±3.58	7.431	0.043
Observation group	49.84±3.43	72.74±3.04	10.684	0.016
t	1.593	8.583		
P	0.785	0.036		

Table 8. Analysis of clinical treatment effects of two groups after intervention (n=60)

	Significant effect	Effective	No effect	Total effective rate
Observation group	42	16	2	96.67%
Control group	30	19	11	81.67%
χ^2	8.521			
P	0.031			

sent, a large number of studies have confirmed that it has a significant effect on the treatment of abnormal swallowing function in cerebral infarction. The central nervous system of the body has certain structural and functional remodeling and recombination effects [17]. The training of catheter balloon dilatation can stimulate the establishment of motor projection areas through stimulating the central nervous system, and promote the compensation and recombination of local tissues around disabled tissues in patients with cerebral infarction. According to relevant studies, catheter balloon dilation can change the diameter of the balloon through water injection, and meanwhile cooperate with the patient's active swallowing action, which can help the cricopharyngeal muscle via repeated mechanical traction and dilation, thus enhance the compliance of swallowing, inhibit local hyperreflexia, and improve the state of achalasia in patients with cerebral infarction.

Modern medicine shows that when acupuncture is used for the treatment of swallowing dysfunction, it can help patients restore the nerve impulse function of local nerves and muscle tissues through acupuncture stimulation on the corresponding acupoints [18], and assist these nerve impulses to be transmitted to the swallowing center in the brain stem to achieve the remodeling effect, and then play an important therapeutic effect in the lesion through the reflex arc. After comprehensive treatment with multiple targets, it can promote the functional reconstruction of the motor cortex responsible for swallowing, stimulate and restore the function of the muscles related to swallowing in patients with cerebral infarction, and help patients restore the swallowing function. Traditional Chinese medicine believes that many meridians of the body are closely related to the tongue and pharynx. After acupuncture treatment, it can not only regulate the channel-qi of tongue and pharynx, but also stimulate the channel-qi of 14 meridians of the body effectively, so as to achieve the purpose of local and overall integration, and then give full play to the therapeutic effect of meridians theory and improve the dysphagia of patients with cerebral infarction. In this study, Fengfu, Yamen, Fengchi (double), Jinjin, Wanggu (double), Lianquan and Yifeng (double) acupoints

were selected to perform the experiment. Fengfu acupoint, also known as the tongue origin, is an important source of tianbu ethos. It has the same Qi and blood as the soft tongue and has the effect of heat dissipation and moisture absorption. Yamen acupoint is a Du meridian, also known as the acupoint of anorexia of the tongue. It is mainly used to treat the symptoms of slow tongue, dumb tongue and vomiting. Fengchi acupoint has the effect of invigorating yang and benefiting Qi. It can transport to all parts of the head along the gallbladder meridian. Jinjin acupoint is located in the oral cavity, which can be used for the treatment of strong tongue, tongue swelling, vomiting and tongue sores. Wanggu acupoint has the effect of dredging the water. Lianquan acupoint, also known as the tongue origin, is mainly used to treat sublingual swelling and pain, strong tongue, apoplectic aphasia, and acute contraction of the tongue root, it is also the place where the water-dampness of Ren meridian gathers and has the effect of collecting Yin fluid. Yifeng acupoint has the effect of benefiting Qi and nourishing yang. It is mainly used to treat a variety of features of diseases in the head and face. In this study, the acupoints of Fengfu, Wanggu, Fengchi, Lianquan, Yifeng are mostly located near the throat or pharynx, and the stimulation of golden needle acupoint method can have a good therapeutic effect on the swallowing function of patients. Lianquan, Jinjin and other acupoints belong to the extraordinary acupoints, which can effectively improve the reduction of tongue and pharynx function, and then improve the clinical treatment effect.

As can be seen from the results of this study, before the intervention of the patients in the two groups, the indicators of the two groups, such as water swallowing test level, AEMG and sEMG peak value, standard swallowing function score and quality of life, were basically close to each other. After the relevant intervention, the levels of all indicators in both groups were improved compared with before intervention. However, after the intervention of catheter balloon dilatation training and acupuncture, the water swallowing test level in the observation group was significantly reduced, the level of evaluation indicators of swallowing function was significantly improved, the quality of life score was significantly increased, and the improvement effect of other indicators was better than that of control group, indicating that the intervention effect of combined therapy was significantly better than that of swallowing function training alone, which was basically the same as other relevant research results [19-21].

In conclusion, swallowing function training combined with acupuncture can effectively improve the swallowing function of patients with cerebral infarction, promote the compensation or reorganization of the surrounding tissue around the disabled tissue, and then improve the quality of life and treatment effect of patients. However, due to the short follow-up time of this study, the results of the study were all short-term intervention effects, which failed to analyze the long-term intervention effects of patients. Therefore, a larger sample size of long-term follow-up survey is needed in the future to complete the study of long-term intervention effects.

Acknowledgements

This work was supported by the Key Research and Development Program of Hainan Province (ZDYF2019191).

Disclosure of conflict of interest

None.

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