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Randomized Controlled Trial

Clinical study on tri-tongue acupuncture combined with low-frequency electrical stimulation for treating post-stroke dysarthria

Bin Man, Wei-Wei Li, Jun-Feng Xu, Qian Wang

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Abstract

BACKGROUND

Few studies have investigated low-frequency electrical stimulation combined with tri-tongue acupuncture for the treatment of post-stroke dysarthria. This randomized clinical study assessed the correlation between the clinical efficacy of low-frequency electrical stimulation combined with tri-tongue acupuncture in patients with post-stroke dysarthria.

AIM

To investigate the clinical effects of tri-tongue acupuncture combined with low-frequency electrical stimulation for treating post-stroke dysarthria.

METHODS

Ninety patients with post-stroke dysarthria, who were admitted to our hospital from December 2019 to June 2021, were selected and equally divided into two groups ($n = 45/\text{group}$) according to the random number table method. Tri-tongue acupuncture was administered in the control group. The treatment group received both tri-tongue acupuncture and low-frequency electrical stimulation. The clinical efficacy, Western Aphasia Battery (WAB) score, general quality of life inventory (GQOLI-74) score, Frenchay Dysarthria Assessment score, and speech function grades were compared and analyzed between both groups.

RESULTS

The overall efficacy in the treatment group was better than that in the control group ($P < 0.05$). Before treatment, the WAB, Frenchay Dysarthria Assessment, or GQOLI-74 scores ($P > 0.05$) did not differ between the groups. After therapy, the WAB, Frenchay Dysarthria Assessment, and GQOLI-74 scores in both groups

increased significantly ($P < 0.05$), and the treatment group exhibited a significantly greater increase than that of the controls ($P < 0.05$). Moreover, the classification of speech function did not differ between the two groups before treatment ($P > 0.05$), whereas significant improvements were observed in both groups after treatment ($P < 0.05$). The degree of improvement in the treatment group was greater than that in the control group ($P < 0.05$).

CONCLUSION

Low-frequency electrical stimulation, in conjunction with tri-tongue acupuncture, exhibits a good clinical effect on post-stroke dysarthria.

Key Words: Low-frequency pulse electrotherapy; Tri-tongue acupuncture; Dysarthria after stroke; Clinical research

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Core Tip: We used low-frequency pulsed electrical stimulation combined with tri-tongue acupuncture to treat post-stroke dysarthria. Low-frequency electrical stimulation in conjunction with tri-tongue acupuncture has a good clinical effect on dysarthria after stroke, not only improving clinical outcomes but also improving patients' speech function and quality of life.

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INTRODUCTION

With an aging population, the morbidity of stroke is increasing every year and has become a major cause of disability and death in elderly people in China[1]. Stroke is often followed by sequelae, particularly dysarthria. The organic lesions of the articulator's neuromuscular region cause abnormal muscle tone, muscle weakness, and uncoordinated movement, resulting in dysarthria in pronunciation, phonation, rhythm, resonance, and other speech motor control disorders[2,3]. Post-stroke dysarthria belongs to the category of "pyretic aphasia with sudamina" in traditional Chinese medicine. Acupuncture therapy, pronunciation electromyography stimulation, speech training, and other treatment methods are used in the clinical treatment of post-stroke dysarthria to improve fluency and the clarity of pronunciation[4,5]. This study evaluated the clinical efficacy of low-frequency electrical stimulation combined with tri-tongue acupuncture for the treatment of post-stroke dysarthria.

MATERIALS AND METHODS

Subjects and grouping

From December 2019 to June 2021, 90 patients with post-stroke dysarthria were treated in our hospital; 49 were men and 41 were women, with a mean age of 54.58 ± 6.71 years. The patients were classified into two groups according to the methodology of the stochastic count sheet, with 45 patients in each cluster. The control group comprised 24 men and 21 women, with a mean age of 54.53 ± 6.72 years. The treatment group comprised 25 men and 20 women, with a mean age of 54.62 ± 6.78 years. The generic data for the twin sets were mathematically equivalent ($P > 0.05$).

Criteria for diagnosis, inclusion, and exclusion

Diagnostic criteria: The diagnostic criteria for dysarthria in Western medicine conform with the diagnostic criteria of *Neurology*[6], accompanied by slow speech, hoarseness, speech with nasal sounds, and unclear pronunciation caused by nasal air leakage during pronunciation. The diagnostic criteria of traditional Chinese medicine (TCM) for dysarthria are in line with the diagnostic criteria of the Criteria and Therapeutic Effect of Diseases and Syndromes in Traditional Chinese Medicine[7]. In TCM, dysarthria is classified as a type of collateral obstruction. The inclusion criteria were patients fulfilling the diagnostic criteria for post-stroke dysarthria. TCM syndrome differentiations are of the collateral obstruction type, and the clinical symptoms include slow speech, hoarseness, and nasal voice. The exclusion criteria were patients with mental illness, severe liver or kidney dysfunction, and who are

lactation or pregnant. Inclusion criteria: The patients met the diagnostic criteria of post-stroke dysarthria. The TCM syndrome differentiation types were all of the choroid obstruction type. The clinical symptoms were slow speech, hoarseness, and nasal voice. Exclusion criteria: Patients with mental illness, severe liver and kidney dysfunction, and who are lactating or pregnant.

Treatment

Participants in the control group underwent tri-tongue acupuncture. The main acupoints included Shanglianquan, Zhongwan, Neiguan, and Waiguan. First, the patients were placed in the supine position and disinfected with alcohol. Researchers then used a Huatuo needle (0.250 mm × 40 mm) with a needling direction of 45° to stimulate the root of the tongue. After obtaining qi, the needles were slowly retracted from the deep layers of the skin to the superficial layer. Once in the superficial skin layer, the researchers changed the direction of the needle tip and inserted it from left to right. When local signs of formication or pain appear, it means that the best curative effects are occurring. These flat reinforcing and reducing manipulations were used to twist and retain them once daily for 30 min. The treatment group was prescribed low-frequency pulse electronic therapy and a swallowing and speech therapy instrument (German PHYSIOMED, model: vocaSTIM Master). To administer swallowing and speech therapy, single-channel low-frequency electrical stimulation was used by placing an auxiliary electrode in the middle of the back of the neck, and then a positive electrode was connected to the auxiliary electrode. The stimulating electrode was placed in the upper and lower jaw triangles of the laryngeal junction and the negative electrode was connected to the stimulating electrode. The laryngeal muscle group was alternately stimulated in the T/R mode, and pulse electrical stimulation was applied for 30 min, twice a day. All patients underwent tri-tongue acupuncture treatment.

Clinical efficacy

The clinical efficacy of speech treatment[8] was classified into four stages. Basic recovery was defined as the disappearance of physical signs and clinical symptoms or improvement in speech function by more than three grades after treatment. Significantly effective treatment is defined as speech function improvement by two grades after treatment. Effective treatment is defined as speech function improvement by one grade after treatment. Not effective treatment is defined as no change in speech function after treatment.

The effective rate was calculated as follows: Effective rate = basic cure rate + significantly effectiveness + effective rate.

Observation index

The classification of speech function[9], based on the Methods of Dysarthria Examination formulated by the China Rehabilitation Center, was used to evaluate the grade of dysarthria in the two groups. The parameters were as follows: level 5, complete communication ability, normal volume, fluent speech, clear expression of content; level 4, full communication ability, small volume, fluent speech, and ability to express content clearly; level 3, incomplete communication ability, slight weakness of volume, non-fluent speech, and unclear content; level 2, loss of communication ability, weak volume, inability to hear clearly, unclear content, and intermittent speech; and level 1, no speech.

The Western Aphasia Battery (WAB) score[10] was used to evaluate the language features of the two groups before and after treatment. The instrument comprises eight items: serial speech, repetition, naming, short-sentence understanding, color recognition, writing, application, and structural ability. Each item is scored from 1 to 10, with a maximum of 80 points. Higher scores reflect better language skills. The General Quality of Life Inventory (GQOLI-74) scale[11] was used to assess quality of life before and immediately after therapy in both groups. This scale evaluates mental health, physical health, social relations, and living environment, with a maximum of 100 points for each item and a maximum score of 400 points in total. A higher score indicates a better quality of life. The Frenchay Dysarthria Assessment Scale[12] was used to assess dysarthria at the time of treatment. The higher the score, the better the improvement in the symptoms.

Statistical analyses

SPSS 20.0 statistical software (IBM SPSS Statistics for Windows, Version 22.0. Armonk, NY: IBM Corp.) was adopted for data acquisition. The observed data are indicated as mean and standard deviation. Independent two-sample *t*-tests and paired-sample tests were conducted. Enumeration data was represented with “%”. Comparison between groups was made using the chi-squared test. A value of *P* < 0.05 was considered statistically significant.

RESULTS

Comparison of clinical efficacy between the two groups

The total efficacy rate was significantly higher in the treatment group than that in the control group (*P*

< 0.05) (Table 1).

Comparison of WAB, GQOLI-74, and Frenchay Dysarthria Assessment Scale scores between the groups

The WAB, Frenchay Dysarthria Assessment Scale, and GQOLI-74 scores did not differ between the groups before treatment ($P > 0.05$). However, significant increases were observed in the WAB, Frenchay Dysarthria Assessment Scale, and GQOLI-74 scores of both groups ($P < 0.05$), with the treatment group showing a greater increase ($P < 0.05$) (Table 2).

Comparison of speech function between the two groups

The speech features did not significantly differ between the two groups before treatment ($P > 0.05$). However, both groups showed significant improvement in speech function at the end of treatment ($P < 0.05$). In addition, the treatment group exhibited greater improvement than did the control group ($P < 0.05$) (Table 3).

DISCUSSION

Post-stroke, dysarthria after stroke is defined as "Aphasia" in TCM. The main causes are the patient's wind, fire, blood stasis, phlegm, and other pathogenic factors. These include blocking of the heart meridian, wind evil, phlegm disturbing or disturbing the brain along the meridian, kidney essence deficiency or blood stasis blocking the veins, qi deficiency and blood stasis or aphasia, and speech astringency[13]. Its pathogenesis includes obstruction of the tongue orifices, a strong tongue, and an inability to speak. The acupoints of the tri-tongue needle are located near the root of the tongue. As the meridians of the liver, heart, Ren, kidney, and spleen all pass through the tongue in different ways, tri-tongue acupuncture can move local qi and blood, dredge meridians, and regulate viscera[14]. Tongue needle I acupunctures at the Shanglianquan point, whereas tongue needles II and III are located on the left and right sides of the Lianquan point. These three points are located where the qi of the Ren meridian terminates. As the root of the tongue is rich in terms qi and blood, stimulating it with a tri-tongue needle can promote the recovery of language dysfunction by passing through the Ren, pericardium, and spleen meridians.

In modern medicine, the thyroid cartilage is anatomically located between the root of the tongue and the thyroid cartilage. The vagus, glossopharyngeal, mandibular hyoid muscle, and hypoglossal nerves and its branches are also located there. Among them, the mandibular hyoid and hypoglossal nerves control the function of the vocal cords and pharyngeal muscles[15,16]. Patients in the treatment group received low-frequency pulse electronic therapy, a physical therapy widely used in rehabilitation treatment after stroke. This therapy can produce action potentials by stimulating nerve and muscle cells [17]. The external stimulation signal can then stimulate and affect brain tissue reflexively and directly. Therefore, electroencephalogram activity can be improved, and the excitation and inhibition processes of regional nerve cells can be regulated. Simultaneously, low-frequency electrical stimulation improves the reabsorption of excess fluid in brain edema, thus improving the nutritional status and blood supply of the brain tissue. This helps the brain function's rapid recovery and stimulates brain language functions by affecting the compensatory aspect of the lesion[18].

Studies have shown that low-frequency electrical stimulation combined with acupuncture therapy can effectively improve the symptoms of dysarthria in post-stroke patients and improve clinical efficacy [19,20]. Our study adopted low-frequency pulsed electrical stimulation combined with tri-tongue acupuncture to treat post-stroke dysarthria. After treatment, the total effective rate of the treatment group was 95.56%, significantly higher than that of the control group at 82.22% ($P < 0.05$), suggesting that the combination of low-frequency pulsed electrical stimulation can improve clinical efficacy.

The efficacy and safety of acupuncture in treating dysarthria in stroke patients were evaluated by meta-analysis, and acupuncture combined with conventional speech therapy significantly improved dysarthria in stroke patients[21]. The WAB scores improved in both groups after treatment, and the speech function classification also improved in both groups, with the improvement being more significant in the treatment group ($P < 0.05$), suggesting that acupuncture therapy can improve patients' speech function, and the effect of combining low-frequency electrical stimulation was more significant. This may be due to the fact that low-frequency electrical stimulation can directly stimulate the laryngeal nerve and its corresponding muscle groups, improve laryngeal nerve paralysis, enhance the contraction force of the laryngeal muscle groups, and improve the flexibility and coordination of the pharyngeal articulatory organs. The Frenchay scores of the control and treatment groups were significantly higher than those before the intervention, and the Frenchay scores of the treatment group were higher than those of the control group after the intervention, which was consistent with Xue's study, indicating that low-frequency electrical stimulation intervention given on the basis of acupuncture was more effective in improving the dysarthria symptoms of the patients[22]. The GQOLI-74 scores increased in both groups after treatment, and the scores were higher in the treatment group ($P < 0.05$), indicating that acupuncture combined with low-frequency electrical stimulation can correct the abnormal state of the

Table 1 Comparison of total effective rate between the two groups (n, %)

Group	Sample	Basic recovery	Significantly effective	Effective	Not effective	Total effective rate
Control group	45	16	12	9	8	37 (82.22%)
Treatment group	45	18	15	10	2	43 (95.56%)
χ^2 value						4.050
P value						0.044

Table 2 Comparison of WAB, Frenchay Dysarthria Assessment Scale, and GQOLI-74 scores between the two groups

Group	WAB scoring		GQOLI-74 scoring		Frenchay Dysarthria Assessment Scale scoring	
	Pre-treatment	Post-treatment	Pre-treatment	Post-treatment	Pre-treatment	Post-treatment
Control group	36.42 ± 5.71	53.16 ± 7.57	248.82 ± 32.28	307.53 ± 37.26	6.46 ± 0.85	8.51 ± 1.13
Treatment group	36.27 ± 5.64	62.49 ± 9.13	248.13 ± 32.43	341.57 ± 43.19	6.31 ± 0.83	11.29 ± 1.62
t value	0.125	5.277	0.101	4.003	0.847	9.442
P value	0.901	< 0.001	0.920	< 0.001	0.399	< 0.001

WAB: Western Aphasia Battery; GQOLI-74: General quality of life inventory.

Table 3 Comparison of speech function grades between the two groups

Group	Grade 1		Grade 2		Grade 3		Grade 4		Grade 5	
	Pre-treatment, %	Post-treatment, %	Pre-treatment, %	Post-treatment, %	Pre-treatment, %	Post-treatment, %	Pre-treatment, %	Post-treatment, %	Pre-treatment, %	Post-treatment, %
Control group (n = 45)	13 (28.89)	5 (11.11) ^a	23 (51.11)	13 (28.89) ^a	6 (13.33)	11 (24.44) ^a	3 (6.67)	14 (31.11) ^a	0 (0)	2 (4.44) ^a
Treatment group (n = 45)	14 (31.11)	0 (0) ^{a,b}	21 (46.67)	2 (4.44) ^{a,b}	7 (15.56)	17 (37.78) ^{a,b}	2 (4.44)	19 (42.22) ^{a,b}	1 (2.22)	7 (15.56) ^{a,b}

^aP < 0.05, comparison with status before treatment.

^bP < 0.05, comparison with the control group.

dysarthria muscle, effectively improving the symptoms of dysarthria, promoting the recovery of their speech function, and improving the quality of life of patients[23].

CONCLUSION

In summary, low-frequency electrical stimulation combined with tri-tongue acupuncture provides excellent therapeutic benefits for post-stroke dysarthria.

ARTICLE HIGHLIGHTS

Research background

Related studies have shown that acupuncture therapy, electrical stimulation of articulatory muscles, and speech training can improve the fluency and intelligibility of articulation in patients with post-stroke dysarthria. There is a relative lack of research on tri-tongue acupuncture with low-frequency electrical stimulation for the treatment of post-stroke dysarthria. We aim to improve speech function and clinical efficacy in patients with post-stroke dysarthria.

Research motivation

Whether low-frequency current stimulation combined with trigeminal acupuncture can improve the treatment effect of dysarthria in post-stroke patients remains unclear.

Research objectives

To investigate the clinical effects of tri-tongue acupuncture combined with low-frequency electrical stimulation in the treatment of dysarthria after stroke.

Research methods

We conducted a randomized clinical trial. The control group was treated with triple tongue acupuncture and the treatment group was treated with both tri-tongue acupuncture and low-frequency electrical stimulation.

Research results

The overall efficacy in the treatment group was better than that in the control group ($P < 0.05$). After therapy, the Western Aphasia Battery (WAB) scores, Frenchay Dysarthria Assessment, and General Quality of Life Inventory (GQOLI-74) scores in the two groups significantly increased ($P < 0.05$), and the treatment group increased more significantly than that in the controls ($P < 0.05$).

Research conclusions

Low-frequency electrical stimulation combined with tri-tongue acupuncture intervention can effectively ameliorate the symptoms of dysarthria in post-stroke patients and improve their quality of life and clinical efficacy.

Research perspectives

Future studies should expand the sample size, standardize the selection of acupuncture points and manipulation techniques, and unify the criteria for evaluating the treatment efficacy.

FOOTNOTES

Author contributions: Man B proposed the research topics, designed the research protocols, and wrote the manuscript; Li WW participated in experimental data analysis; Xu JF revised key theories and other major elements of the manuscript; and Wang Q participated in the data collection; all authors reviewed and approved the final version to be published.

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