Efficacy of acupuncture for dysphagia after stroke: a systematic review and meta-analysis

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Background: The risk of dysphagia after stroke is extremely high. The efficacy of acupuncture in the treatment of dysphagia after stroke lacks high-level evidence-based medical support. This study aimed to systematically evaluate the clinical value of acupuncture therapy in patients with dysphagia after stroke.

Methods: A electronic search of six databases were used to screen for randomized controlled trials (RCTs) of acupuncture treatment of patients with dysphagia after stroke. The search time was from the establishment of the database to 18 October 2020, and the search languages were limited to Chinese and English. The literature was screened and the data extracted independently by two researchers. The Cochrane System Evaluation Manual was used to evaluate the quality of the included literature.

Results: A total of 39 RCTs were included, of which 36 studies reported the effective rate of acupuncture treatment for dysphagia. The effective rate of the experimental group was higher than that of the control group [relative risk (RR) =1.23, 95% confidence interval (CI): 1.19 to 1.27, P<0.00001]. The drinking test grading score of patients in the experimental group was lower than that of the control group [mean difference (MD) =−0.75, 95% CI: −1.11 to −0.41, P<0.0001] in 8 studies. The swallowing scores of patients in the experimental group were lower than those in the control group [mean difference (MD) =−4.63, 95% CI: −5.68 to −3.59, P<0.00001] in 8 studies. The Fujishima eating-swallowing rating score of the experimental group was higher than that of the control group [standardized mean difference (SMD) =1.92, 95% CI: 1.30 to 2.54, P<0.00001] in 3 studies. The score of the dysphagia-specific quality of life scale of the experimental group was higher than that of the control group (SMD =2.02, 95% CI: 0.82 to 3.22, P<0.0001) in 5 studies. The VFSS of the experimental group was higher than that of the control group (MD =2.53, 95% CI: 1.89 to 3.17, P<0.00001) in 5 studies.

Conclusions: The existing evidence supports that acupuncture therapy can significantly improve the swallowing function of patients with dysphagia.

Keywords: Stroke; acupuncture therapy; randomized control; meta-analysis; dysphagia

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Introduction

Stroke encompasses both ischemic and hemorrhagic stroke and is the main cause of sudden death or disability worldwide. Ischemic stroke is often considered to be an infarction of the brain, spinal cord, or retina, accounting for about 71% of all strokes (1,2). In some countries or regions, the incidence of ischemic stroke may be higher. An American survey (3) found that ischemic stroke accounts for 87% of all strokes in the United States. Both ischemic stroke and hemorrhagic stroke can cause local hypoxia in the brain tissue, followed by brain damage. For common ischemic strokes, effective thrombolytic therapy is usually required within 4.5 hours after the onset of disease (4). Beyond this time window, the brain may incur more serious damage. After onset of the disease, timely thrombolytic therapy can effectively reduce the complications caused by stroke (5). Common complications of stroke patients include hemiplegia, facial paralysis, speech disorder, and swallowing disorder (6-8). The risk of dysphagia after stroke is very high. Research (9) has reported that the incidence of dysphagia after stroke is about 37–78% which puts patients at high risk of pneumonia, malnutrition and depression. Dysphagia severely affects the life and health of patients, causing pneumonia, dehydration, disability, or even death (10-14). At present, the treatment of swallowing dysfunction after stroke can have a certain effect. The treatment measures mainly include medication, traditional Chinese medicine, acupoint injection, biofeedback, and physical therapy (15-19). Acupuncture therapy in traditional Chinese medicine has been widely used in many diseases, and the efficacy of acupuncture in treating dysphagia after stroke has been reported in some studies (9-16). However, due to the possible differences between the diagnostic indicators and the methods of evaluating the efficacy of clinical researchers, the conclusions reached have all been based on small sample sizes and high-level evidence is lacking. In recent years, many novel studies on this topic have been published (10,16). Therefore, this study aimed to systematically evaluate the efficacy of acupuncture in the treatment of dysphagia after stroke by collecting relevant literature, especially latest studies, so as to provide a theoretical basis for clinicians. We present the following article in accordance with the PRISMA reporting checklist (available at http://dx.doi.org/10.21037/apm-21-499).

Methods

Inclusion and exclusion criteria

The studies included in this meta-analysis were all randomized controlled trials (RCTs). The research participants included in the literature were those who were experiencing swallowing dysfunction after stroke. The intervention measures were mainly acupuncture and swallowing rehabilitation therapy, and the Kubota drinking water test, standardized swallowing assessment (SSA) score, Fujishima feeding-swallowing function grade score, swallowing disorder-specific quality of life scale (SWAL-QOL) score, and video fluoroscopic swallowing study (VFSS) were used to evaluate the clinical efficacy. Literatures were excluded if one of the following criteria were met: (I) unclear research object, and impossible to determine whether it was a patient with dysphagia after stroke treatment; (II) did not contain the outcome indicators of the study; (III) data could not be extracted or the full text was not found; (IV) repeated publication; (V) review, abstract.

Search strategy

The search was conducted using keywords such as “stroke”, “cerebral infarction”, “cerebral hemorrhage”, “acupuncture”, “dysphagia”, “random”, “randomized”.

Literature screening and data extraction

First, two researchers independently screened the retrieved documents according to the inclusion and exclusion criteria, and then any controversial documents were cross-checked by a third reviewer after evaluation and discussion to reach consensus. The two researchers individually extracted relevant information of the included literature, such as author’s area, age, study type, sample size, intervention measures, outcome indicators, and so on.

Literature quality evaluation

As all the included studies were RCTs, the Cochrane System Review Manual was used for quality assessment, including: (I) randomization method; (II) group scheme hiding; (III) blind method; (IV) outcome evaluator and statistics; (V)
risk of incomplete data processing; (VI) risk of selective reporting; (VII) other bias. The included literature was judged at the levels of “low risk”, “high risk”, and “unclear” from the above seven aspects, and drawn into a risk bias distribution map.

### Statistical methods

RevMan 5.3 software (The Cochrane Collaboration, Copenhagen, Denmark) was used to conduct meta-analysis on the data, and the heterogeneity between the studies was determined by $\chi^2$ test combined with $I^2$ quantitative analysis. If $P>0.1$ and $I^2<50\%$, it was considered that there was no obvious heterogeneity among the included studies, and the fixed effects model was used for meta-analysis; if $P<0.1$ and $I^2>50\%$, it was considered that there was obvious heterogeneity among the included studies. The publication bias of the included studies was judged by visual inspection of the symmetry of the funnel chart, and the symmetry of the scatter distribution indicated no obvious publication bias.

### Results

#### Literature

According to the results of the literature search, 3,207 documents were obtained through preliminary examination. After a step-by-step screening, 39 documents were finally included, all of which were RCTs involving 3,078 patients. The literature screening process is shown in **Figure 1**.

**Basic characteristics and quality evaluation of literature**

The basic characteristics of the included studies are shown in **Table 1**. The quality evaluation of the included studies shows that some of the research quality indicators were specified in detail, but there were also cases in the literature that did not explain or clearly explain which made the literature have a high risk of bias. The percentage and distribution diagrams of the risk of bias in the study are shown in **Figures 2** and 3.

**Meta-analysis**

#### Treatment efficacy

A total of 36 studies reported the effective rate of acupuncture therapy in the treatment of dysphagia, 1,433 cases in the experimental group and 1,413 cases in the control group. The 36 included studies were tested for heterogeneity, $I^2=0\%$ and $P=0.80$, indicating that there was no heterogeneity among the included studies. Therefore, a fixed-effect model was used for meta-analysis. The results showed that the experimental group had a higher
<table>
<thead>
<tr>
<th>First author</th>
<th>Year</th>
<th>Age</th>
<th>Sample</th>
<th>Intervention</th>
<th>Outcome</th>
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<tbody>
<tr>
<td>Bai (10)</td>
<td>2020</td>
<td>70.5±1.2</td>
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<td>Acupuncture + Swallowing rehabilitation training</td>
<td>Effective rate</td>
</tr>
<tr>
<td>Chen (11)</td>
<td>2016</td>
<td>61.63±10.78</td>
<td>60.90±10.53</td>
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<td>Chen (12)</td>
<td>2017</td>
<td>32±78</td>
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<td>Chen (13)</td>
<td>2015</td>
<td>63.15±6.32</td>
<td>65.95±7.06</td>
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<td>Chen (14)</td>
<td>2013</td>
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<td>Cheng (15)</td>
<td>2016</td>
<td>61.72±4.08</td>
<td>61.83±4.21</td>
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<td>Water swallowing test, SSA, effective rate</td>
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<td>Dong (16)</td>
<td>2016</td>
<td>35–70</td>
<td>36–68</td>
<td>Acupuncture + Swallowing rehabilitation training</td>
<td>Effective rate</td>
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<tr>
<td>Fu (18)</td>
<td>2014</td>
<td>52.8±10.4</td>
<td>55.4±13.8</td>
<td>Acupuncture + Swallowing rehabilitation training</td>
<td>SSA, SWAL-QOL</td>
</tr>
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<td>Gu (20)</td>
<td>2010</td>
<td>63±10</td>
<td>62±10</td>
<td>Acupuncture + Swallowing rehabilitation training</td>
<td>Effective rate</td>
</tr>
<tr>
<td>Han (21)</td>
<td>2017</td>
<td>75.8±11.2</td>
<td>75.6±11.5</td>
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<td>Effective rate</td>
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<tr>
<td>He (22)</td>
<td>2019</td>
<td>62.16±7.04</td>
<td>61.83±6.81</td>
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<td>Water swallowing test, effective rate</td>
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<td>He (23)</td>
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<td>34</td>
<td>34</td>
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Table 1 (continued)
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<th>Age</th>
<th>Sample</th>
<th>Intervention</th>
<th>Outcome</th>
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<td>Hua (24)</td>
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<td>Huang (25)</td>
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<td>Huang (26)</td>
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<td>Effective rate</td>
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<td>Jia (27)</td>
<td>2006</td>
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<td>42–76</td>
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<td>Effective rate</td>
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<tr>
<td>Li (28)</td>
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<td>57.1±3.7</td>
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<td>Effective rate</td>
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<td>Lian (29)</td>
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<td>46.0±14.7</td>
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<td>Effective rate, water swallowing test</td>
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<td>65.6±4.2</td>
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<td>Water swallowing test, SSA, effective rate</td>
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<td>Qin (31)</td>
<td>2008</td>
<td>58.7±10.5</td>
<td>60.8±9.6</td>
<td>Acupuncture + Swallowing rehabilitation training</td>
<td>Effective rate</td>
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<td>Ran (32)</td>
<td>2019</td>
<td>60.3±8.50</td>
<td>60.7±7.90</td>
<td>Acupuncture + Swallowing rehabilitation training</td>
<td>Effective rate</td>
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<td>Yan (33)</td>
<td>2018</td>
<td>57±18</td>
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<td>Acupuncture + Swallowing rehabilitation training</td>
<td>Effective rate</td>
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<td>Tian (34)</td>
<td>2018</td>
<td>55.38±10.40</td>
<td>55.91±9.84</td>
<td>Acupuncture + Swallowing rehabilitation training</td>
<td>Effective rate, water swallowing test</td>
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<td>Wang (35)</td>
<td>2008</td>
<td>42–75</td>
<td>41–75</td>
<td>Acupuncture + Swallowing rehabilitation training</td>
<td>Effective rate</td>
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<td>Wang (36)</td>
<td>2017</td>
<td>65±4</td>
<td>66±4</td>
<td>Acupuncture + Swallowing rehabilitation training</td>
<td>VFSS, effective rate</td>
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<tr>
<td>Wei (37)</td>
<td>2015</td>
<td>61.5±4.20</td>
<td>62.50±4.90</td>
<td>Acupuncture + Swallowing rehabilitation training</td>
<td>VFSS, effective rate</td>
</tr>
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</table>
effective rate than the control group and the difference was statistically significant [relative risk (RR) = 1.23, 95% confidence interval (CI): 1.19 to 1.27, P<0.00001; Figure 4].

**Drinking water test classification score**
A total of 8 studies reported the grading scores of drinking water test of patients after acupuncture treatment for dysphagia, with 475 cases in the experimental group and 454 cases in the control group. The 8 included studies were tested for heterogeneity, I²=98% and P<0.00001, indicating that there was a high degree of heterogeneity among the included studies, so a random effects model...
was used for meta-analysis. The results revealed that the grading score of drinking water test for the experimental group was lower than the control group, and the difference was statistically significant [mean difference (MD) =−0.75, 95% CI: −1.11 to −0.41, P<0.0001; Figure 5]. Due to the high degree of heterogeneity among the included studies, sensitivity analysis was required. The main source of increased heterogeneity was not found through the method of elimination 1 by 1, and the results obtained after eliminating the literature remained stable and reliable.

Swallowing function score (SSA score)
A total of 8 studies reported on the swallowing function scores of patients after acupuncture treatment for dysphagia, 346 cases in the experimental group and 334 cases in the control group. The 8 included studies were tested for heterogeneity, $I^2=76\%$ and $P=0.0001$, indicating that there was a high degree of heterogeneity among the included studies. Therefore, a random effects model was used to conduct a meta-analysis. The results showed that the score of swallowing function of the experimental group participants was lower than that of those in the control group, and the difference was statistically significant (MD =−4.63, 95% CI: −5.68 to −3.59, P<0.00001; Figure 6). Due to the high degree of heterogeneity among the included studies, sensitivity analysis was required. The main source of increased heterogeneity was not found through the method of elimination 1 by 1, and the results obtained after eliminating the literature were still stable and reliable.

Fujishima feeding-swallowing function rating scale
A total of 3 studies reported the Fujishima eating-swallowing rating scores of patients after acupuncture treatment for dysphagia. There were 141 cases in the experimental group and 134 cases in the control group. The 3 included studies were tested for heterogeneity, $I^2=77\%$ and $P=0.01$, indicating that there was a high degree of heterogeneity among the included studies. Therefore, a random effects model was used for meta-analysis. The results showed that the Fujishima eating-swallowing rating score of the experimental group was higher than that of the control group, and the difference was statistically significant.
Figure 4 Forest plot of effective treatment rates for the two groups of patients. CI, confidence interval.

Figure 5 Forest diagram of the graded scores of the drinking water test after treatment in the two groups. SD, standard deviation; CI, confidence interval.

[standardized mean difference (SMD) = 1.92, 95% CI: 1.30 to 2.54, P < 0.00001, Figure 7]. Due to the high degree of heterogeneity among the included studies, sensitivity analysis was required. Through the elimination method 1 by 1, it was found that Xia Wenguang’s 2016 document was the main source of increased heterogeneity, but after excluding their document, the results obtained remained stable and reliable.

Dysphagia specific quality of life Scale Score
A total of 5 studies reported on the dysphagia-specific quality of life scale scores of patients after acupuncture

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treatment for dysphagia, with 245 cases in the experimental group and 232 cases in the control group. The 5 included studies were tested for heterogeneity, $I^2=97\%$ and $P<0.00001$, indicating that there was a high degree of heterogeneity among the included studies. Therefore, a random effects model was used to conduct a meta-analysis. The results showed that the dysphagia-specific quality of life scale score in the experimental group was higher than that of the control group, and the difference was statistically significant ($SMD = 2.02$, 95% CI: 0.82 to 3.22, $P=0.0001$; Figure 8). Due to the high degree of heterogeneity among the included studies, sensitivity analysis was required. The main source of increased heterogeneity was not found through the method of elimination 1 by 1, and the results obtained after eliminating the literature were still stable and reliable.

TV fluoroscopy swallowing function test
A total of 5 studies reported on the VFSS of patients with dysphagia treated by acupuncture, with 177 cases in the experimental group and 177 cases in the control group. The 5 included studies were tested for heterogeneity, $I^2=65\%$ and $P=0.02$, indicating that there was heterogeneity among the included studies. Therefore, a random effects model was used for meta-analysis. The results showed that the VFSS of the experimental group was higher than that in the control group, the difference was statistically significant ($MD = 2.53$, 95% CI: 1.89 to 3.17, $P<0.00001$; Figure 9). Due to the high degree of heterogeneity among the included studies, sensitivity analysis was required. The main source of increased heterogeneity was not found through the method of elimination 1 by 1, and the results obtained after eliminating the literature remained stable and reliable.

**Publication bias**
Evaluation of publication bias was performed for the included studies that met the indicators of 10 articles.
(treatment effective rate). Through visual inspection of the funnel chart, it was found that the distribution of the points was more symmetrical, and the possibility of publication bias was less, indicating that the included studies were more comprehensive. See Figure 10 for details.

**Discussion**

After a stroke, patients may show dysphagia, which can persist for a long time. Due to long-term food restriction, patients are prone to malnutrition and lung infections. Traditional Chinese medicine respectively classifies dysphagia after stroke into categories with different characteristics. The etiology and pathogenesis of dysphagia after stroke are based on many conditions (49,50). There is a close connection between the meridians of traditional Chinese medicine and the throat. If the meridians are not smooth and the “blood” is insufficient, swallowing disorders will result. Acupuncture has a long history in the treatment of dysphagia after stroke. Through the development and inheritance of generations of Chinese physicians, a wealth of treatment experience has been accumulated. Acupuncture has the functions of dredging the meridians, regulating the qi, running the blood, regulating the internal organs, clearing the throat, and rejuvenating the mind (51). Modern medicine has found that the acupuncture point locations of Fengchi (GB20), Yifeng (TH17), and Lianquan (CV23) are closely related to the nerve endings of the glossopharyngeal, vagus, facial, and hypoglossal nerves of the human body. After acupuncture is used to stimulate the nerve, the nerve impulse released by it can strengthen the corresponding neural reflexes (52). It is precisely because acupuncture therapy has the above-mentioned effects, that so many scholars use acupuncture therapy to treat swallowing disorders after stroke.

This meta-analysis included 39 randomized controlled studies, including 3078 patients. Through the integration of data in the literature, in the case of a large sample size, it was found that acupuncture combined with swallowing rehabilitation training can significantly improve the treatment efficacy of patients, which is consistent with the conclusions of most authors. Modern medicine has found that after acupuncture treatment for patients with dysphagia after stroke, the blood circulation of the vertebrobasilar artery can be significantly improved, and the latency and amplitude of brainstem auditory evoked potentials are also improved (53-55). Acupuncture therapy is effective in treating dysphagia, possibly because acupuncture reestablishes the connection between the upper motor neuron and the medullary motor nerve cell nucleus, and ultimately restores the function of the central nervous system (56). This meta-analysis also evaluated the efficacy of acupuncture in the treatment of dysphagia from multiple aspects. The results of the Kubota drinking water test showed that acupuncture can significantly reduce the time required for patients to drink 30 mL of water or time from drinking to coughing. The SSA scale score, Fujishima feeding-swallowing function rating scale, and SWAL-QOL scale score also reflected that the patient’s swallowing function was significantly improved after acupuncture treatment. Therefore, this meta-analysis further confirmed
the effectiveness of acupuncture therapy in the treatment of dysphagia after stroke by integrating large sample data.

The studies included in this meta-analysis were all RCTs, and the conclusions had high evidence strength, especially in terms of treatment efficacy. However, there were some obvious limitations in this study. In addition to more research on the effective rate of treatment, drinking water test classification, SSA score, Fujishima feeding-swallowing function grade score, and SWAL-QOL score, VFSS and other indicators included relatively few studies, included a small number of patients, and the evidence derived from these data was relatively weak. Since these indicators are scored by the corresponding standard scale, they are particularly important for the evaluation of swallowing dysfunction after stroke. Therefore, follow-up studies are required to design more comprehensively the assessment of improvement in patients' symptoms of dysphagia.

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Footnote

Reporting Checklist: The authors have completed the PRISMA reporting checklist. Available at http://dx.doi.org/10.21037/apm-21-499

Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at http://dx.doi.org/10.21037/apm-21-499). The authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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