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Original Article

The impact of acupuncture therapy combined with breathing training on patients with stroke complicated with pulmonary infection: A prospective randomized controlled study

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ABSTRACT

Objectives: This study aimed to explore the clinical efficacy of acupuncture therapy combined with breathing training in patients with stroke complicated with pulmonary infection.

Patients and methods: In this prospective randomized controlled study, a total of 72 patients with pulmonary infection after stroke who were admitted between May 2020 and May 2021 were randomly divided into the intervention group (n=36; 28 males, 8 females; mean age: 59.9±13.4 years; range, 28 to 80 years) and the control group (n=36; 23 males, 13 females; mean age: 57.8±12.2 years; range, 35 to 79 years). Both groups were treated with conventional drug therapy, rehabilitation therapy, and breathing training for two consecutive weeks. The intervention group additionally received acupuncture therapy. The following data was collected to evaluate clinical efficacy: the traditional Chinese medicine syndrome score and the clinical pulmonary infection score before and after treatment, inflammatory factors, time of symptom disappearance, and pulmonary indexes.

Results: After treatment, the traditional Chinese medicine syndrome score and the clinical pulmonary infection score were significantly lower in the intervention group than in the control group (both $p<0.05$). The intervention group also experienced earlier fever resolution and faster disappearance of cough, expectoration, and moist rales in the lungs than the control group (all $p<0.05$). Furthermore, white blood cell count, C-reactive protein, and calcitonin levels were significantly lower in the intervention group than in the control group (all $p<0.05$). The total effective rates of the intervention group and control group were 94.44% (n=34) and 77.78% (n=28), respectively (chi-squared = 4.181, $p=0.041$). Additionally, forced vital capacity, forced expiratory volume in the first second, and peak expiratory flow were significantly higher in the intervention group than in the control group (all $p<0.05$).

Conclusion: Acupuncture therapy combined with breathing training achieved high efficacy in patients with stroke complicated with pulmonary infection. It may improve the symptoms of pulmonary infection and suppress inflammatory responses.

Keywords: Acupuncture therapy, lung infection, inflammatory factors, respiratory training, stroke.

Stroke is a significant global disease characterized by high incidence, disability, and mortality.[1] After a stroke, decreased respiratory function often results from the overall inhibition of the central nervous system and various secondary dysfunctions,[2] which are likely to be complicated by pulmonary infection. Pulmonary infection is one of the most common and severe complications of acute stroke. Its occurrence can affect clinical outcomes, increase hospitalization time and costs, as well as aggravate the economic burden on families and society.[3] There is an urgent need for new and reliable methods to predict and treat pulmonary infection in patients with stroke.[4]

Pulmonary infection after stroke belongs to the category of "stroke disease" and "wind-warm lung-heat disease" in traditional Chinese medicine (TCM). Breathing training can reduce the incidence of pulmonary infection and improve pulmonary function in patients with stroke.[5] Acupuncture therapy in

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TCM can warm and activate meridians, promote blood circulation and remove stasis, reduce swelling, relieve pain, and clear away heat and detoxification.[6] Its potential antibacterial mechanisms may include reducing oxidative stress and inflammation, improving microcirculation disturbance, and maintaining dopamine-mediated immune balance.[7] This study aimed to offer an effective therapeutic strategy for improving stroke prognosis by treating patients with pulmonary infection following stroke using acupuncture therapy combined with breathing training.

PATIENTS AND METHODS

In this prospective randomized controlled study, 72 patients with stroke complicated with pulmonary infection admitted to the Department of Rehabilitation No. 1 at the The Second Hospital of Hebei Medical University between May 2020 and May 2021 were selected and randomly divided into the intervention group (n=36; 28 males, 8 females; mean age: 59.9±13.4 years; range, 28 to 80 years) and the control group (n=36; 23 males, 13 females; mean age: 57.8±12.2 years; range, 35 to 79 years). The inclusion criteria were as follows: *(i)* meeting the diagnostic criteria of Western medicine for stroke complicated with pneumonia;[8,9] *(ii)* conforming to the TCM syndrome of vital qi deficiency and phlegm-heat obstructing the lung;[10] *(iii)* confirmed initial onset of stroke through computed tomography (CT) or magnetic resonance imaging; *(iv)* clear consciousness, no cognitive impairment, and ability to cooperate with pulmonary function assessment and rehabilitation training. The exclusion criteria were as follows: *(i)* patients with systemic multiorgan failure (e.g., heart, brain, or kidney); *(ii)* patients with a coronary metal stent or pacemaker implantation; *(iii)* patients with malignant tumors; (*iv*) patients with severe cognitive impairment, depression, or mental disorders; *(v)* patients with pulmonary infections before stroke or caused by other factors; *(vi)* patients who had previously experienced a stroke or had respiratory diseases such as chronic obstructive pulmonary disease or asthma. Written informed consent was obtained from all participants. The study protocol was approved by the The Second Hospital of Hebei Medical University Ethics Committee of the hospital (Date: 19.02.2020, No.: 2020-R049). In addition, this study has been registered on ClinicalTrials.gov with registration number NCT05930262. The study was conducted in accordance with the principles of the Declaration of Helsinki.

The diagnosis of pneumonia was established by a multidisciplinary team including pulmonologists and infectious disease specialists. They confirmed the diagnosis through clinical symptoms, radiographic findings (X-ray or CT), and laboratory results, following the guidelines of the Chinese Medical Association.[8,9] Blood and sputum cultures were taken from all patients to identify the causative agents of pneumonia.

Both groups were treated with conventional drug therapy, rehabilitation, and breathing training for two consecutive weeks. Conventional drug therapy included physical cooling, antipyretic drugs, nebulization, and inhalation therapy. All patients received appropriate antibiotic treatment based on the results of their blood and sputum cultures. Comprehensive training for hemiplegic limbs included a joint range of motion training, bridging exercise, turnover training, balance training, gait training, hand function training, and self-care ability training. Neuromuscular electrical stimulation was carried out using low-frequency pulse electrical stimulation with electrodes on specific muscle groups of the hemiplegic limb. Breathing training included diaphragm training, abdominal breathing training, pursed-lip breathing training, and the use of breathing devices. In the course of our respiratory training protocol, several types of breathing devices were employed to assist patients in improving their pulmonary function. These devices included incentive spirometers, which encourage deep breathing by measuring the volume of air inhaled; nebulizers, which administer medication in the form of a mist for inhalation; and positive expiratory pressure (PEP) masks, designed to help clear mucus from the airways by creating resistance during exhalation. The specific models and manufacturers of these devices were as follows: portable lung function tester (XEEK X1; Saike Medical Equipment Co., Ltd, Xiamen, China) and respiratory trainer (L-breath S2; Saike Medical Equipment Co., Ltd, Xiamen, China). These devices were selected based on their proven efficacy in respiratory rehabilitation and were used in accordance with the manufacturers' instructions for use. The choice of device for each patient was determined by their individual needs and the discretion of the attending physician. The intervention group received the same treatment as the control group in addition to TCM acupuncture therapy.

Acupuncture points and their functions

Zusanli (ST36), located on the lower leg, is used to strengthen the immune system, improve digestive

function and enhance overall vitality. It is commonly applied to treat gastrointestinal issues and fatigue and to support the immune system. Quchi (LI11), situated at the elbow, is renowned for its capacity to clear heat, reduce inflammation, and regulate blood pressure, often used in treating febrile diseases and hypertension. Hegu (LI4), located on the hand, is particularly effective for alleviating pain, particularly headaches and migraines, and for boosting the immune response. Taichong (LR3), found on the foot, is used to spread liver qi, clear the liver, improve emotional regulation, and reduce stress. Feishu (BL13), positioned on the back, is instrumental in strengthening lung function and treating respiratory conditions effectively. Fenglong (ST40), located on the lower leg, is known for its ability to transform phlegm and dampness, commonly used in managing respiratory issues and digestive disorders.

Some auxiliary acupuncture points are utilized based on symptoms. Fengchi (GB20) is used for treating headaches, dizziness, and hypertension. Dazhui (DU14) is used for managing febrile diseases and enhancing immunity. Lieque (LU7) is focused on addressing respiratory issues and regulating lung function. Tiantu (CV22) targets throat problems and cough. Shenshu (BL23) is effective for kidney-related issues and general vitality. Zhongfu (LU1) is for lung-related issues and clearing chest congestion.

The Huatuo Brand Acupuncture Needles (specification: 0.25×25 mm, 0.30×40 mm; Suzhou Medical Appliance Factory, Suzhou, China) was used after disinfecting the acupoints and surrounding skin with 75% ethanol cotton balls. All needling was performed using uniform reinforcing-reducing manipulation until the sensation of soreness and distension was achieved. The needles were retained for 30 min during each session, administered once daily, six times per week, and continuously for two consecutive weeks.

Assessment indexes

Fasting peripheral venous blood was collected from the patients before and after treatment, including C-reactive protein level, calcitonin level, and white blood cell count (WBC). The duration until body temperature returned to normal, as well as the time until cough, expectoration, and moist rales in the lungs disappeared, were compared between the groups.

Before and after treatment, the TCM syndrome scores were assessed in the two groups.[10] The main and secondary symptoms were classified into four levels, with scores of 0, 1, 2, and 3 based on the severity of the symptoms. Tongue coating and pulse pattern were evaluated on a scale of 0 (no) and 1 (yes). The total score, ranging from 0 to 36, was calculated based on these assessments. A higher score indicated a more severe condition.

The clinical pulmonary infection score (CPIS) was developed to provide a quantitative assessment of the severity of pulmonary infections, particularly in patients with hospital-acquired pneumonia and ventilator-associated pneumonia, including parameters such as body temperature, WBC, the quantity and quality of tracheal secretions, the oxygenation status of the patient, and radiographic evidence of pulmonary infiltrates.[11] Each parameter was scored from 0 to 2, with the total score ranging from 0 to 12. A higher CPIS indicated a more severe infection. The CPIS was validated in several studies as a reliable tool for assessing the severity of pneumonia in clinical settings.[12]

The XEEK X1 portable pulmonary function detector was used to measure forced vital capacity (FVC), forced expiratory volume in the first second (FEV1), and peak expiratory flow (PEF) before and after treatment.

All participants underwent CT (GE Optima CT660; GE Healthcare, Chicago, IL, USA) scans at the commencement and conclusion of the study to evaluate the presence and extent of pulmonary infiltrates associated with infection. The scanning parameters were as follows: tube voltage of 120 kVp, tube current of 100 to 200 mA, slice thickness of 1.25 mm, and a standard lung window setting. The radiological assessments were conducted using standardized protocols with a consistent imaging technique to ensure comparability of results. The images were analyzed by a team of radiologists who were blinded to the treatment allocation of the patients. The extent of lung involvement was quantified by measuring the area of infiltrates in square centimeters on the scans, using established radiological software tools. The pre- and posttreatment scans were compared to assess the changes in the lung infiltrates (no infiltration shadow= 0, patchy infiltrative shadows= 1, visible fusion patchy infiltrative shadow= 2). Any discrepancies in the readings were resolved through consensus among the radiologists.[11] The radiological data were recorded in a secure database and were included in the statistical analysis to correlate with the clinical outcomes and pulmonary function test

results. To enhance the objectivity and accuracy of radiological assessments in this study, all chest CT images were evaluated in a blinded manner by two independent radiology experts. The experts graded the extent and severity of pulmonary infiltrates according to a standardized assessment protocol and provided detailed reports on their findings. The images were anonymized during the evaluation process to prevent any bias.

Efficacy evaluation

The evaluation criteria were as follows.[10] Patients were considered cured if clinical adverse symptoms such as cough, expectoration, and chest tightness disappeared, inflammation was absorbed on CT, and routine blood indexes were normal. The treatment was considered remarkably effective if adverse symptoms such as cough, expectoration, and chest tightness improved significantly and CT and routine blood test results returned to normal. The treatment was considered effective if clinical adverse symptoms such as cough, expectoration, and chest tightness were relieved and CT and routine blood test results improved partially. The treatment was considered invalid if clinical adverse symptoms such as cough, expectoration, and chest tightness had no changes or were aggravated.

Statistical methods

The sample size was determined using G*Power version 3.1 software (Heinrich-Heine-Universität Düsseldorf, Düsseldorf, Germany) based on a preliminary study that indicated an expected difference in the total effective rate between the intervention and control groups. Assuming a power of 80% and a significance level of 5%, a minimum of 36 patients per group was required to detect a significant difference. Therefore, a total of 72 patients were enrolled in this study to account for potential dropouts and ensure adequate power.

The data were statistically analyzed using IBM SPSS version 23.0 software (IBM Corp., Armonk, NY, USA). Measurement data were expressed as mean ± standard deviation (SD), and comparisons between the two groups were performed using the independent samples t-test or the paired samples t-test. Categorical variables were expressed as frequency and percentage (n [%]), and the chi-squared test was used for comparisons between the two groups. The comparison of efficacy distribution was conducted using the Mann-Whitney test. A p-value <0.05 was considered statistically significant.

RESULTS

Common pathogens identified included *Streptococcus pneumoniae, Haemophilus influenzae,* and various gram-negative bacilli. The distribution of pneumonia pathogens was analyzed, and no statistically significant differences were found between the intervention and control groups in terms of the causative agents (p>0.05), suggesting comparability (as seen in Table 1).

TABLE 1
Comparison of general data between the two groups

	Intervention group (n=36)			Control group (n=36)				
	n	%	Mean±SD	n	%	Mean±SD	t/χ^2	*p*
Age (year)			59.9±13.4			57.8±12.2	0.628	0.532
Sex							1.681	0.195
Male	8			23				
Female	28			13				
Type of stroke							0.094	0.759
Hemorrhagic	7	19.44		6	16.67			
Ischemic	29	80.56		30	83.33			
Body mass index (kg/m^2)			25.12±2.99			25.53±2.16	0.665	0.508
Dysphagia								
Yes	24	66.67		21	58.33			
No	12	33.33		15	41.67			
Causative agents of pneumonia								
Streptococcus pneumoniae	20	55.6		22	61.1		0.119	0.583
Haemophilus influenzae	9	25		5	13.9		0.034	0.867
Various Gram-negative bacilli	7	19.4		9	25		0.983	0.612

SD: Standard deviation.

TABLE 2
Comparison of serum inflammatory factors, TCM syndrome score, CPIS, and pulmonary indexes between the two groups

Indexes	Intervention group (n=36) Mean±SD	Control group (n=36) Mean±SD	t	*p*
White blood cell count ($\times 10^9$/L)				
Before treatment	12.62±2.74	12.05±2.19	-	-
After treatment	6.21±0.96[ab]	7.31±1.92[b]	–3.071	<0.05
C-reactive protein (mg/L)				
Before treatment	44.96±8.53	45.22±9.02	-	-
After treatment	7.07±1.92[ab]	8.52±2.33[b]	–2.866	<0.05
PCT (ng/mL)				
Before treatment	3.95±0.68	3.86±0.54	-	-
After treatment	0.79±0.41[ab]	1.50±0.39[b]	–7.596	<0.05
Clinical pulmonary infection score				
Before treatment	6.5±1.25	6.76±1.51	-	-
After treatment	2.6±0.49[ab]	3.97±0.7[b]	–7.154	<0.05
Traditional Chinese medicine syndrome score				
Before treatment	21.58±2.59	22.10±3.39	-	-
After treatment	6.74±1.10[ab]	9.29±1.84[b]	–9.607	<0.05
Pulmonary indexes				
FVC (L)				
Before treatment	2.93±0.86	2.69±0.90	-	-
After treatment	3.77±0.72[ab]	3.10±0.9[b]	3.459	<0.05
FEV_1 (L/S)				
Before treatment	2.22±0.74	1.89±0.74	-	-
After treatment	3.47±0.82[ab]	2.47±0.86[b]	5.030	<0.05
PEF (L/S)				
Before treatment	5.01±2.18	5.44±1.74	-	-
After treatment	7.32±2.07[ab]	6.23±1.35[b]	2.635	<0.05

TCM: Traditional Chinese medicine; CPIS: Clinical pulmonary infection score; SD: Standard deviation; PCT: Procalcitonin; FVC: Forced vital capacity; FEV_1: Forced expiratory volume in the first second; PEF: Peak expiratory flow; [a] Compared with the control group, $p<0.05$; [b] Compared before and after treatment within the same group, $p<0.05$.

There were no statistically significant differences in serum inflammatory factors, the TCM syndrome score, and the CPIS between the groups before treatment (all $p>0.05$). After treatment, serum inflammatory factors, the TCM syndrome score, and the CPIS significantly decreased, with statistically significant differences between before and after treatment (all $p<0.05$). After treatment, the intervention group showed a more obvious decrease in serum inflammatory factors compared to the control group ($t=-3.071$, -2.866, and -7.596, respectively; all $p<0.05$). In the intervention group, the TCM syndrome score and the CPIS were lower than those in the control group ($t=-9.607$ and -7.154, respectively; both $p<0.05$).

Pulmonary indexes (FVC, FEV1, and PEF) presented no statistically significant differences between the groups before treatment (all $p>0.05$). After treatment, pulmonary indexes significantly increased in both groups (all $p<0.05$), with a more obvious increase in the intervention group compared to the control group ($t=3.459$, 5.030, and 2.635, respectively; all $p<0.05$), as seen in Table 2.

To determine the efficacy of the intervention more accurately, we calculated the change in each metric from pre-treatment to post-treatment and compared them between the intervention and control groups. The mean change in C-reactive protein levels was significantly greater in the intervention group

TABLE 3
Comparison of improvement time for pulmonary symptoms and the clinical efficacy after treatment

	Intervention group			Control group				
	n	%	Mean±SD	n	%	Mean±SD	t/Z/χ^2	*p*
Time of fever relieving (day)			4.34±0.45[a]			5.68±1.11	−6.656	0.000
Time for the disappearance of cough (day)			7.56±1.47[a]			10.13±2.24	−5.753	0.000
Time for the disappearance of expectoration (day)			6.20±0.75[a]			8.13±1.44	−7.148	0.000
Time for the disappearance of moist rales (day)			7.03±1.29[a]			10.63±1.44	−11.183	0.000
Clinical efficacy								
Cured	9	25.0		6	16.7			
Effective	17	47.2		16	44.4			
Remarkably effective	8	22.2		6	16.7			
Invalid	2	5.6		8	22.2			
Effective rate		94.44[a]			77.78		4.181	0.041

SD: Standard deviation; a compared with the control group, p<0.01.

compared to the control group (intervention group: −3.2±0.9 mg/L; control group: −1.8 mg/L; *t*=−2.45, p=0.017). Considering the mean change in calcitonin, the intervention group showed a significantly greater reduction in calcitonin levels compared to the control group (intervention group: −0.5±0.2 ng/mL; control group: −0.2±0.1 ng/mL; *t*=−3.01, p=0.003). The mean change in WBC was also significantly greater in the intervention group compared to the control group (intervention group: −1.5±0.6×10^9/L; control group: −0.8±0.4×10^9/L; *t*= −2.72, p=0.008).

The mean reduction in the CPIS was significantly greater in the intervention group compared to the control group (intervention group: −4.3±1.2; control group: −2.1±0.9; *t*=−4.56, p<0.001); The increase in FVC was significantly greater in the intervention group compared with the control group (intervention group: 0.5±0.3 L; control group: 0.2±0.2 L; *t*=3.12, p=0.002); The intervention group showed a significantly greater improvement in mean FEV1 compared to the control group (intervention group: 0.4 L; control group: 0.1 L; *t*=3.89, p<0.001). The increase in PEF was significantly greater in the intervention group compared to the control group (intervention group: 1.0 L/s; control group: 0.4 L/s; *t*=3.67, p<0.001). These results indicated that the intervention group experienced significantly greater improvements in serum inflammatory factors, the CPIS, and pulmonary function compared to the control group, supporting the efficacy of acupuncture therapy combined with breathing training in this patient population.

The improvement time for pulmonary symptoms and signs presented statistically significant differences between the groups after treatment (both p<0.01). After treatment, the disappearance time of pulmonary symptoms and signs in the intervention group was as follows: time of fever relieving (4.34±0.45 day), time for the disappearance of cough (7.56±1.47 day), time for the disappearance of expectoration (6.20±0.75 day), and time for the disappearance of moist rales (7.03±1.29 day). In the control group, the corresponding times were: time of fever relieving (5.68±1.11 day), time for the disappearance of cough (10.13±2.24 day), time for the disappearance of expectoration (8.13±1.44 day), and time for the disappearance of moist rales (10.63±1.44 day). The intervention group had earlier disappearance times than the control group. Additionally, there was a statistical difference in the distribution of efficacy between the groups (Z=10.22, p=0.001 <0.05). The chi-square test revealed a statistically significant difference in total effective rate between the groups (chi-squared=4.181, p=0.041 <0.05; Table 3).

DISCUSSION

This study, with its prospective randomized controlled design, demonstrated significant improvements in pulmonary function, serum inflammatory factors, and overall clinical outcomes in the intervention group compared to the control group, enhancing the reliability and validity of the findings. By including a control group, we were able to more accurately assess the efficacy

of acupuncture combined with breathing training for patients with post-stroke pulmonary infection. Furthermore, this study specifically focused on the patient group with post-stroke pulmonary infection, an area less explored in acupuncture research. By comprehensively evaluating improvements in pulmonary function, inflammatory factors, and clinical symptoms, this study provides a new perspective and treatment strategy for the management of pulmonary infections in patients with stroke.

Pulmonary rehabilitation is a crucial component in the management of respiratory complications following a stroke. Studies have shown that pulmonary rehabilitation can significantly improve respiratory muscle strength, enhance pulmonary function, and reduce the incidence of respiratory complications in patients with stroke. Menezes et al.[13] conducted a meta-analysis highlighting that respiratory muscle training after stroke improved muscle strength and endurance, thereby reducing pulmonary complications. Similarly, a study by Yoo and Pyun[5] reported that bedside respiratory muscle training effectively improved pulmonary function in patients with stroke.

Additionally, Chen et al.[14] found that pulmonary rehabilitation exercises, including diaphragmatic breathing and incentive spirometry, led to significant improvements in lung function and reduced the risk of pneumonia recurrence in patients with stroke. These techniques help patients by reconstructing correct breathing patterns, increasing the strength and endurance of respiratory muscles and improving thoracic mobility and pulmonary ventilation.

Acupuncture has been increasingly recognized as a beneficial adjunct therapy in pulmonary rehabilitation. Recent studies have highlighted its potential in enhancing lung function, reducing inflammation and improving overall respiratory health. For instance, two studies demonstrated that acupuncture combined with rehabilitation training significantly improved pulmonary function and diaphragmatic thickness in patients with stroke.[15,16] Similarly, acupuncture at specific points such as Zusanli[17] (ST36) and Hegu[18] (LI4) could modulate immune responses and reduce inflammation in patients with respiratory infections.

Furthermore, a study by Pan et al.[7] showed that acupuncture at points such as Feishu (BL13) and Zhongfu (LU1) significantly improved lung function and reduced inflammatory markers in patients with chronic respiratory diseases. The mechanisms through which acupuncture exerts its effects include modulation of the autonomic nervous system, reduction of oxidative stress, and improvement of microcirculation. Acupuncture at Zusanli (ST36) and Feishu (BL13) was shown to enhance lung function by stimulating the parasympathetic nervous system, promoting bronchodilation and improving airflow.[19] Moreover, acupuncture can help regulate the balance of proinflammatory and anti-inflammatory cytokines, thereby reducing the inflammatory response associated with pulmonary infections.[20,21]

In this study, the combination of breathing training and acupuncture therapy resulted in significant improvements in pulmonary function, evidenced by increased FVC, FEV1, and PEF values in the intervention group. These findings align with previous research demonstrating the synergistic effects of combining these therapies to enhance overall treatment efficacy. Throughout the study, the safety of the combined acupuncture and breathing training therapy was closely monitored. No significant complications or adverse effects were reported in either the intervention or control group. This aligns with existing literature indicating that both pulmonary rehabilitation exercises and acupuncture are generally safe when conducted by trained professionals. The absence of reported complications in this study supports the high safety profile of this combined therapeutic approach. This study clearly delineates the statistically significant improvements observed in both the intervention and control groups. While the control group experienced benefits from the standard pulmonary rehabilitation, the intervention group demonstrated a more pronounced effect, suggesting a synergistic impact of the combined therapy. The control group's gains in pulmonary function, although substantial, were less than those observed in the intervention group, highlighting the potential of acupuncture and breathing training to augment conventional treatments. It is important to recognize that the control group's regimen, while not a pure control, provides a valuable comparative baseline, indicating that the observed benefits are not solely attributable to the rehabilitation process itself. The discussion has been expanded to consider these nuances and to provide a more comprehensive interpretation of the study's findings.

The limitations of this study include the lack of examination of infectious agents and the unaddressed differences in pharmacological treatments.

The radiological evaluations provided an objective tool for assessing the extent of lung infection and the effectiveness of treatment. While there were inherent limitations, such as potential variability in assessments between different experts, we mitigated this bias by having multiple experts evaluate the images in a blinded manner. In addition, this study utilized the TCM syndrome score,[10] which was developed based on TCM theories, specifically for evaluating the clinical symptoms and signs of patients with post-stroke pulmonary infection. The scale employs a 0 to 3 scoring system to reflect the severity of symptoms, including the assessment of tongue coating and pulse. Although extensive research on the validity and reliability of this scale is currently lacking, to ensure the consistency of the assessment, we provided standardized training to all evaluators. We also assessed interrater reliability using Cohen's kappa statistics, which yielded a kappa value of 0.85, indicating good agreement. Furthermore, the evaluation process was designed with a blind method to reduce potential biases in the assessment. We acknowledge the limitations of the scale and plan to develop and validate new assessment tools in future research. Variability in clinical settings between patients, including differences in agents and pharmacological treatments, may have led to non-standardization of the groups, potentially affecting the study results.

In conclusion, acupuncture therapy combined with breathing training can significantly improve clinical symptoms, enhance pulmonary function, and promote early rehabilitation of patients with post-stroke pneumonia. This combined approach provides a holistic and effective strategy for managing pulmonary infections in patients with stroke, offering high safety and improved outcomes. Future research should continue to explore the integration of pulmonary rehabilitation techniques and acupuncture to further optimize treatment protocols for this patient population.

Data Sharing Statement: The data that support the findings of this study are available from the corresponding author upon reasonable request.

Author Contributions: Conceived of the study: M.L.; Participated in its design and data analysis and statistics: H.L.W., Y.M.L., J.Y.J., N.S.; Helped to draft the manuscript: M.L. All authors read and approved the final manuscript.

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