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ORIGINAL RESEARCH

Efficacy of Scalp Acupuncture with the Long-Stay Method on Motor Dysfunction in Patients with Acute Ischemic Stroke: A Randomized Controlled Trial

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Background: In China, acupuncture has been widely used in treating cerebrovascular diseases since time immemorial. Scalp acupuncture using the long-stay method is a traditional acupuncture treatment. However, previous studies have concluded that the clinical efficacy of scalp acupuncture for the treatment of stroke remains uncertain. In addition, no randomized controlled trials have been conducted on scalp acupuncture using the long-stay method. This study aimed to evaluate the efficacy and safety of the long-stay method of scalp acupuncture for limb movement dysfunction in patients after acute ischemic stroke (AIS).

Methods: Seventy-two patients with acute strokes were randomly divided into treatment and control groups. The control group received conventional acupuncture with a half-hour needle stay each time, whereas the treatment group underwent scalp needling using a long retention method, with each retention of needles lasting 24 hours. Both groups received acupuncture treatment for 2 weeks and were followed up for 6 months. Cerebrovascular reserve (CVR), breath-holding index (BHI), pulsatility index (PI), Fugl–Meyer, and Barthel index (BI) were assessed at baseline, week 1, week 2, and during follow-up.

Results: Compared with the baseline, both groups showed a significant improvement in CVR, Fugl–Meyer, BI, PI, and BHI ($P < 0.05$). Compared with the control group, the treatment group showed more significant improvements in Fugl–Meyer scores, BI, CVR, PI, and BHI ($P < 0.05$). Correlation analysis showed that Fugl–Meyer and BI scores increased significantly with CVR recovery over the course of treatment.

Conclusion: Scalp acupuncture with the long-stay method can improve neurological deficits and the ability to perform daily activities among AIS patients, which may be related to the improvement of CVR function in patients.

Keywords: scalp acupuncture, stroke, motor dysfunction, cerebrovascular reserve

Introduction

Acute ischemic stroke (AIS) is defined as the sudden loss of blood flow to an area of the brain with a resulting loss of neurologic function.[1] Globally, more than 80 million people have survived a stroke. About 70% of incident strokes are ischemic (9.5 million), and the proportion of ischemic strokes in the United States is estimated to be higher, at 85–87%.[2,3] In China, among adults aged ≥40 years, the estimated overall prevalence, incidence, and mortality rate of stroke in 2020 were 2.6%, 505.2 per 100000 person-years, and 343.4 per 100000 person-years, respectively.[4] The disease is commonly caused by ischemic necrosis or softening of limited brain tissues due to impaired blood supply to the brain and ischemia and hypoxia, which can occur in the ischemic central area. The rapid necrosis of neurons in the ischemic central area and changes such as those in the peripheral ischemic semi-dark zones usually affect the prognosis. Therefore, timely

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rescue of brain tissues in the ischemic semi-dark zone, regulation of cerebral blood flow, establishment of collateral circulation, and improvement of blood supply are important targets for treating the disease in the acute phase.[5]

Cerebrovascular reserve (CVR) refers to the ability of small cerebral arteries and capillaries to compensate for dilation or constriction to maintain normal cerebral blood flow under the effect of physiological or pathological stimuli,[6] and CVR is also an important indicator of ischemic tolerance in the brain.[7,8] Recently, there has been an increasing interest in improving the CVR function as an effective measure in the treatment of acute cerebral infarction, including the application of butylphthalide and simvastatin. However, the adverse effects of these drugs also limit their application to some extent, and patients often prefer to use safer non-pharmacological treatments because of the difficulty in meeting clinical needs.

Acupuncture therapy is an important component of traditional Chinese medicine, and its application in AIS has been recognized. Acupuncture treatment in AIS can effectively improve local blood circulation, promote the recovery of patients' neurological functions, improve their abilities to perform daily activities and motor abilities.[9,10] The current acupuncture treatment is more commonly performed with short needle retention; however, we found that the therapeutic effects can also be achieved with long needle retention, but because of the lack of clinical data on the outcomes of prolonged needle retention for this disease, empirical treatment is still being used. Therefore, we conducted a randomized controlled trial to verify the clinical efficacy of scalp acupuncture with the long retention method in the treatment of limb movement dysfunction in AIS and to provide a new treatment option for improving limb movement in patients with this disease in the future.

Methods

Study Design

Seventy-two patients were recruited from the Department of Neurology, Beijing Fengtai Hospital of Integrated Chinese and Western Medicine, between September 2021 and February 2022. The baseline assessment of the eligible patients was completed 3 days before the treatment. The patients were randomly assigned to the treatment or control group at a ratio of 1:1 using a computer-generated random number table generated by SAS software version 9.2. This trial was approved by the Ethics Committee of Beijing Fengtai Hospital of Integrated Traditional Chinese and Western Medicine (No. sp2020-15) and registered at the Chinese Clinical Trial Registry (No. ChiCTR2200063617).

Participants

We referred to the 2010 Chinese guidelines for the diagnosis and treatment of AIS[11] and confirmed and excluded cases of cerebral hemorrhage by computed tomography (CT) or MRI of the head, ensuring that the patient was conscious and that his condition allowed the performance of transcranial Doppler ultrasound (TCD) examination.

Participants who meet the following criteria were included: (1) those who meet the Western medical diagnosis of AIS; (2) those with stroke within 3 days of onset; (3) those aged 35–75 years; (4) those with a first stroke or with a recurrent stroke who have fully recovered prior to the current disease episode; and (5) patients or their legal representative who signed the informed consent prior to the start of the clinical study.

The exclusion criteria were as follows: (1) patients with intracranial hemorrhagic diseases, such as cerebral hemorrhage and subarachnoid hemorrhage, on cranial CT; (2) patients with severe impairment of consciousness; (3) patients with brain herniation on admission; (4) patients with cognitive impairment; (5) patients with combined severe underlying disease; (6) and patients with other diseases that limit their ability to cooperate in the study.

The drop-out criteria included (1) those with poor compliance who withdrew their study participation on their own during the course of treatment; (2) combined use of treatment methods prohibited by this protocol or changing the treatment methods midway on their own; and (3) serious adverse reactions or complications that make it inappropriate to continue treatment.

Sample Size Calculation

According to the results of the preliminary clinical observation trial, the improvement of CVR due to AIS in the long-stay needle and traditional head needle treatment groups was 15.6 ± 2.6 and 12.9 ± 4.7, respectively. We used PASS software to estimate the sample size, and the ratio of the treatment group to the control group was 1:1. We used the test level of $\alpha = 0.05$, $\beta = 0.20$, combined with a 20% shedding rate, yielded a total of 72 participants in the two groups.

Blinding

The assessors and participants were blinded to the experiments. As practitioners cannot be blinded because of the nature of the intervention, they merely performed acupuncture without having unnecessary conversations or sharing information with other researchers. Participants were scheduled to visit at different times to minimize both the exchange of information and the risk of bias.

Intervention

Both groups were given basic conventional Western medical treatment in the acute phase of cerebral infarction, including treatments for hypotension and cerebrovascular dilation as well as antithrombotic and cranial pressure-lowering agents.

The treatment group received scalp acupuncture with the long-stay method along with basic Western medical treatments, which were as follows: main acupoint zones (parietal perineal ankle zone, upper limb zone [contralateral to the lesion], and lower limb zone [contralateral to the lesion]) and positioning of acupuncture zones (see Zhu's Scalp Acupuncture Medical Practice[12] and Figure 1). The selected specifications were as follows: 0.25×15 mm needles (Suzhou Huanqiu Acupuncture Medical Appliance Co., Ltd.). The upper extremity zone was defined as the region between the fontanelle and the head dimension, starting at 0.5 cun from the opposite side of the directing vessel and extending outward anteriorly at about 1 cun long and 0.5 cun wide oblique bands, one on each side, representing the contralateral upper extremity. The lower extremity zone was defined as the region from the front top to the acupoint of Chengguang (BL6), starting at 0.5 cun from the same side of the directing vessel, crossing the directing vessel, and extending outward anteriorly, about 1.5 cun, with a 0.75 cun wide oblique band, one on each side, representing the contralateral upper extremity. The scalp was disinfected by wiping with 75% alcohol, and the patient was placed in a semi-sitting position. The operation method is shown in Table 1. Each treatment was performed once every 2 days. After deqi, the needles were kept for 24 hours each time (7 times in total).

In the control group, traditional acupuncture was used along with basic Western medical treatment. The main points were the anterior parietotemporal oblique line (contralateral to the lesion; upper 1/5 lower limb paralysis, middle 2/5 upper limb paralysis) and the posterior parietotemporal oblique line (contralateral to the lesion; upper 1/5 lower limb sensory abnormalities, middle 2/5 upper limb sensory abnormalities). For the location of acupuncture points, please see Stabbing Moxibustion Methodology (2) and Figure 1. The selected specifications were as follows: 0.25×15 mm needles (Suzhou Huanqiu Acupuncture Medical Appliance Co., Ltd.). Before needling, the practitioner wipes the skin of the acupuncture point with a 75% alcohol-soaked cotton ball to disinfect the area. The patient was placed in a supine

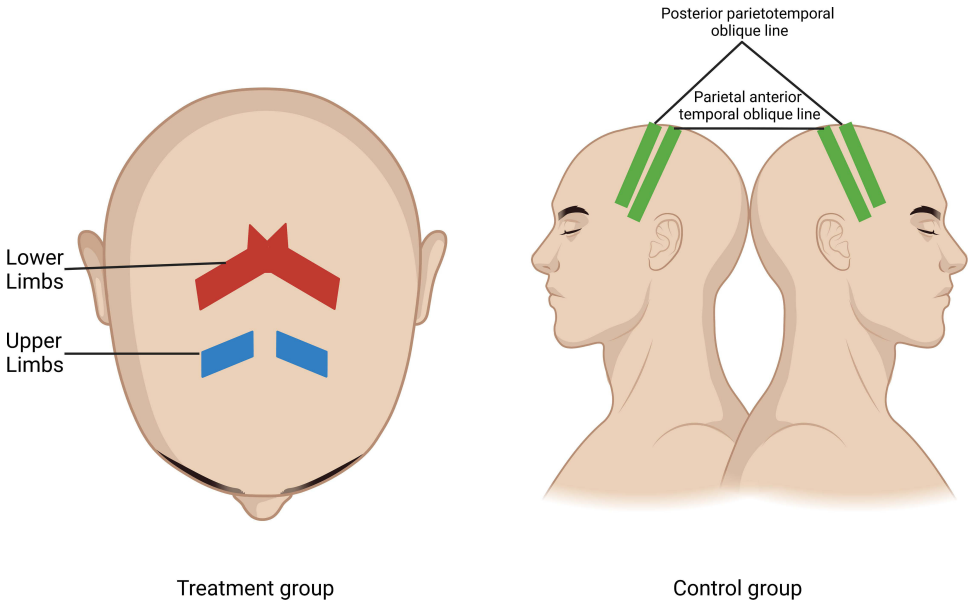

Figure 1 Acupoint location (Created with BioRender.com).

Table 1 Operation of Treatment Group and Control Group

Lesion Side	Acupuncture Site of Treatment Group	Acupuncture Site of Control Group	Number of Needles in Each Group	Depth of Needles in Each Group	Angle of Needles in Each Group
Left upper limb	Right upper limb area	Middle 2/5 of right APOL and middle 2/5 of right PPOL	3	10–12mm	15°
Left lower limb	Right lower limb area	Upper 1/5 of right APOL and upper 1/5 of right PPOL	4	10–12mm	15°
Left upper limb and left lower limb	Right upper limb area and right lower limb area	Middle 2/5 of right APOL, middle 2/5 of right PPOL, upper 1/5 of right APOL and upper 1/5 of right PPOL	7	10–12mm	15°
Right upper limb	Left upper limb area	Middle 2/5 of left APOL and middle 2/5 of left PPOL	3	10–12mm	15°
Right lower limb	Left lower limb area	Upper 1/5 of left APOL and upper 1/5 of left PPOL	4	10–12mm	15°
Right upper limb and right lower limb	Left upper limb area and left lower limb area	Middle 2/5 of left APOL, middle 2/5 of left PPOL, upper 1/5 of left APOL and upper 1/5 of left PPOL	7	10–12mm	15°

Abbreviations: APOL, anterior parietotemporal oblique line; PPOL, posterior parietotemporal oblique line.

position, and "Acupuncture and Moxibustion"[13] was used to determine the direction, depth, and method of acupuncture. The operation method is shown in Table 1. The treatment was performed once per day, for half an hour each time, for 5 times as a course of treatment, with 2 days of rest after each course (10 times in total).

Outcome Measures

To determine the CVR function, the breath-holding test was performed by TCD before treatment and after the 1st and 2nd weeks of treatment using an EMS9W TCD instrument (Nanjing Bangao Medical Equipment Co., Ltd.). The breath-holding method was explained to the study participants. They exercised two times before the start of the test. After lying down and breathing calmly for 5 min, two 2.0-MHz pulsed wave Doppler probes of the TCD instrument were placed in the bilateral temporal windows with a sampling depth of 50–55 mm, and the blood flow velocity of the M1 segment of the middle cerebral artery was measured bilaterally. The mean middle cerebral artery flow velocity (MFV) was recorded in the resting state, and the pulsatility index (PI) was measured. Subsequently, the patient was instructed to hold his breath for at least 15s, and the MFV was recorded. The CVR and breath-holding index (BHI) were calculated as follows: CVR = (MFV after breath-holding − basal MFV)/basal MFV × 100%; and BHI = [(post-breath-hold MFV − basal MFV)/basal MFV] × (100/breath-holding time).

The Fugl–Meyer motor function score is named after the Swedish scholar Fugl–Meyer, who designed a test with 50 different aspects of movement and ability, such as muscle strength, reflexes, and coordination, with scores ranging from 0 to 266. This test is reliable and valid and can be repeated to reflect motor function recovery.[14] The Barthel Index (BI) is a measure of a patient's functional status in performing activities of daily living, with individual scores depending on a series of independent behaviors and a total score ranging from 0 to 100.[15] BI and Fugl–Meyer scale scores were examined by a trained physician at baseline (pretreatment), 1 and 2 weeks after treatment, and 3 and 6 months after treatment.

Statistical Analysis

All statistical analyses were performed using SPSS software (version 25.0, Chicago, IL, USA), and graphs were generated with Origin 9.1. Continuous variables are presented as mean ± standard deviation (x ± s). We tested the normality of the data using the Shapiro–Wilk test. Comparisons between groups were performed using an independent-sample *t*-test when the data were normally distributed; otherwise, we used the Wilcoxon rank-sum test. Categorical data were compared using the χ^2 test. A repeated-measures analysis of variance (ANOVA) was performed to analyze the differences in indicators between different groups over time. We performed a correlation analysis using an *F*-test and Pearson analysis from the normal distribution. When the bilateral *P* value was <0.05, the difference was considered statistically significant.

Results

Participants and Baseline Characteristics

Altogether, 72 patients were included, of whom 65 completed the 2-week intervention (Figure 2). There were no significant differences in patient demographics or other baseline data between the two groups ($P > 0.05$, Table 2). We also summarized the

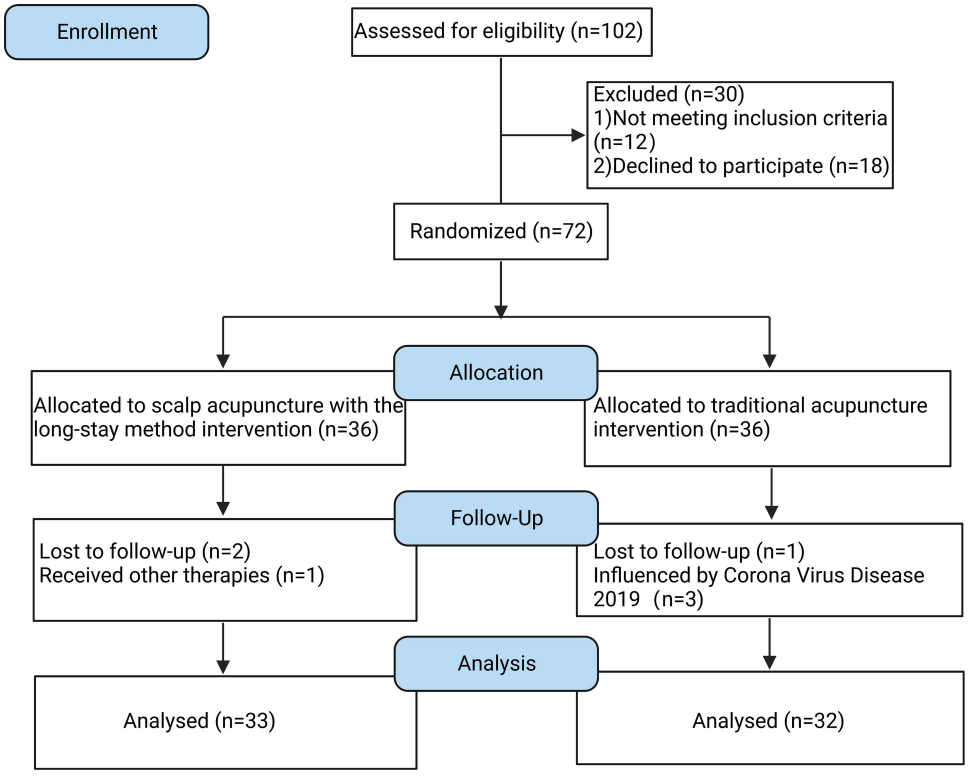

Figure 2 Flowchart of participant recruitment.

lesion sites in the two groups, in which 7 cases in the treatment group were in the cerebral cortex and 26 cases in the basal ganglia. In the control group, there were 13 cases with lesions in the cerebral cortex and 19 cases in the basal ganglia.

Comparison of CVR Between Groups

As shown in Table 3 and Figure 3a, the results of the ANOVA showed that the main effects of group, time, and the interaction effect of time with group were all significant. This indicated that acupuncture therapy and time factors were associated with a statistically significant improvement in CVR, and the degree of improvement in CVR was different at different time points within each group. Multiple comparisons revealed that the CVR values increased sequentially in the treatment group from

Table 2 Comparison of the Baseline Characteristics of Patients Between the Two Groups

Characteristic	Treatment Group(n = 33)	Control Group(n = 32)	*P* value
Mean age (years)	61.8 ± 9.8	62.7 ± 8.0	0.701
Gender(male/female)	20/13	24/8	0.215
Current smoker,(%)	12(36.4%)	10(31.3%)	0.663
Current drinker(%)	8(24.2%)	7(21.9%)	0.821
Systolic pressure (mmHg)	141.8 ± 8.7	140.4 ± 9.0	0.527
Systolic pressure (mmHg)	85.7 ± 7.3	83.5 ± 8.5	0.550
CVR (%)	14.3 ± 3.4	13.3 ± 6.0	0.398
Fugl–Meyer	44.9 ± 14.0	45.1 ± 15.4	0.940
BI	45.0 ± 14.0	47.7 ± 9.7	0.375
PI	1.5 ± 0.3	1.4 ± 0.3	0.277
BHI	0.6 ± 0.1	0.5 ± 0.2	0.400

Table 3 ANOVA Results of Acupuncture Intervention

	Treatment Group	Control Group	Group		Time		Group×Time Interaction	
			F	*P*	*F*	*P*	*F*	*P*
CVR								
Baseline	14.32 ± 3.40	13.29 ± 6.01	8.40	0.005	150.03	<0.001	10.59	<0.001
Week 1	27.82 ± 8.33*$^{\Delta}$	21.29 ± 8.23*						
Week 2	32.06 ± 10.61*$^{\Delta}$	23.5 ± 11.43*						
Fugl–Meyer								
Baseline	44.85 ± 14.04	45.13 ± 15.39	6.10	0.016	230.34	<0.001	4.49	0.022
Week 1	67.94 ± 13.85*$^{\Delta}$	59.69 ± 17.11*						
Week 2	82.21 ± 11.10*$^{\Delta}$	73.34 ± 15.92*						
Month 3	84.73 ± 10.98*$^{\Delta}$	74.88 ± 14.97*						
Month 6	86.21 ± 10.53*$^{\Delta}$	76.34 ± 14.64*						
BI								
Baseline	45.00 ± 13.98	47.66 ± 9.67	3.71	0.059	269.68	<0.001	10.19	<0.001
Week 1	64.85 ± 16.51*	60.63 ± 10.30*						
Week 2	77.58 ± 15.32*$^{\Delta}$	69.22 ± 12.90*						
Month 3	81.21 ± 12.87*$^{\Delta}$	71.72 ± 13.77*						
Month 6	82.58 ± 12.38*$^{\Delta}$	73.44 ± 13.47*						
PI								
Baseline	1.45 ± 0.32	1.37 ± 0.25	0.597	0.443	107.76	<0.001	4.79	0.024
Week 1	1.32 ± 0.31*	1.22 ± 0.26*						
Week 2	1.06 ± 0.18*	1.09 ± 0.26*						
BHI								
Baseline	0.57 ± 0.14	0.53 ± 0.24	8.28	0.005	147.08	<0.001	10.19	<0.001
Week 1	1.11 ± 0.33*$^{\Delta}$	0.85 ± 0.33*						
Week 2	1.28 ± 0.43*$^{\Delta}$	0.94 ± 0.46*						

Notes: *$P < 0.05$ when comparing the baseline and post-treatment in the same group; $^{\Delta}P < 0.05$ when comparing the differences between the treatment and control groups.

baseline to week 1 and week 2, with all values reaching the level of significance ($P < 0.05$). In the control group, the baseline CVR values were significantly lower than week 1 and week 2 values ($P < 0.05$), although there was no significant difference between week 1 and week 2 values ($P > 0.05$). The difference between CVR at 2 weeks of treatment and at baseline was 17.74 ± 9.01 in the treatment group and 10.23 ± 7.92 in the control group. The difference was also statistically significant ($t = 3.57$, $P < 0.05$), indicating that the treatment group was significantly more effective than the control group in improving CVR.

Comparison of the Fugl–Meyer Score Between Groups

As shown in Table 3 and Figure 3b, the main effects of group, time, and the interaction effect of time with group were all significant, which indicated that acupuncture therapy and time factors were associated with a statistically significant improvement in the Fugl–Meyer score, and the degree of improvement was different at different time points within each group. The Fugl–Meyer score increased sequentially in the treatment group from baseline to week 1, week 2, month 3, and month 6, and all values reached the level of significance ($P < 0.05$). In the control group, the Fugl–Meyer scores of week 1, week 2, month 3, and month 6 were significantly higher than at baseline ($P < 0.05$), although there was no significant difference between week 2 and month 3 ($P > 0.05$). The difference between the Fugl–Meyer score at month 6 and baseline was 41.36 ± 14.10 in the treatment group and 31.22 ± 18.34 in the control group, and the difference was statistically significant ($t = 2.51$, $P < 0.05$), indicating that the treatment group was significantly more effective than the control group in improving the Fugl–Meyer score.

Comparison of BI Scores Between Groups

As shown in Table 3 and Figure 3c, the main effects of time and the interaction effect of time with group were significant, indicating that time factors were associated with a statistically significant improvement of the BI score. In addition, the degree

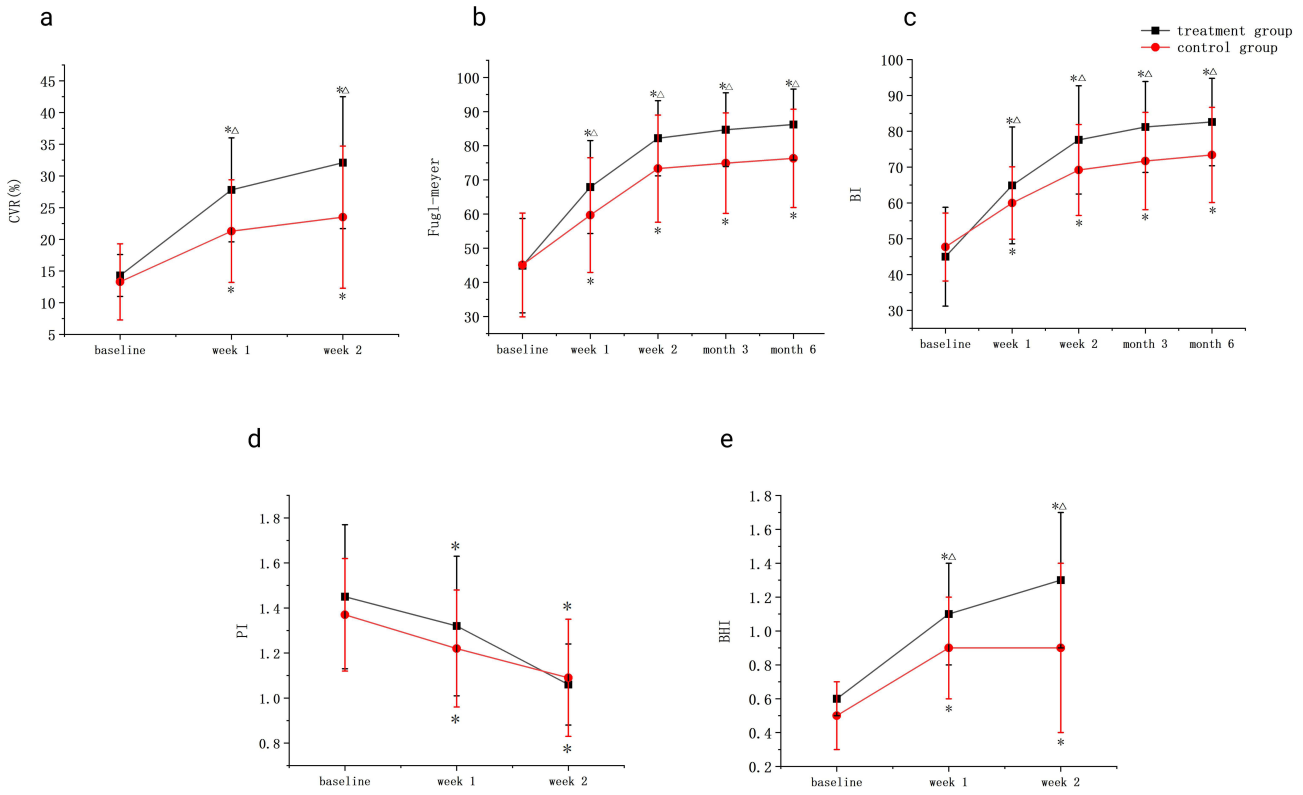

Figure 3 Comparison of CVR, Fugl–Meyer, BI, PI, and BHI between the treatment and control groups; *$P < 0.05$ when comparing the baseline and post-treatment scores in the same group; $^{\Delta}P < 0.05$ when comparing the differences between the treatment and control groups. (a) comparison of CVR between the treatment group and control group; (b) comparison of Fugl-Meyer between the treatment group and control group; (c) comparison of BI between the treatment group and control group; (d) comparison of PI between the treatment group and control group; (e) comparison of BHI between the treatment group and control group.

of improvement was different at different time points within each group ($P < 0.05$). In the treatment group, the BI score sequentially increased from baseline to week 1, week 2, and month 3, and all values reached the level of significance ($P < 0.05$). However, there was no difference between months 3 and 6 ($P > 0.05$). In the control group, the BI score was significantly higher than the baseline score during the treatment and follow-up ($P < 0.05$), but no significant difference was found between week 2 and month 3 ($P > 0.05$). The difference between the BI score at month 6 and at baseline was 37.58 ± 14.15 in the treatment group and 25.78 ± 12.45 in the control group. This difference was statistically significant ($t = 3.56$, $P < 0.05$), indicating that the treatment group was significantly more effective than the control group in improving the BI score.

Comparison of PI Scores Between Groups

As shown in Table 3 and Figure 3d, the main effects of the time and the interaction effect of time with group were significant, indicating that time factors were associated with a statistically significant improvement in PI score. The improvement degree was different at different time points within each group ($P < 0.05$). The PI values decreased sequentially in both groups from the baseline to weeks 1 and 2 ($P < 0.05$), but no significant differences were observed between the two groups at weeks 1 and 2 ($P > 0.05$). The difference between the PI score at week 2 and baseline was −0.38 ± 0.26 in the treatment group and −0.27 ± 0.16 in the control group. The difference was statistically significant ($t = -2.01$, $P = 0.048 < 0.05$), indicating that the treatment group was significantly more effective than the control group in reducing the PI score.

Comparison of BHI Between Groups

As shown in Table 3 and Figure 3e, the main effects of group, time, and the interaction effect of time with group were all significant, which indicated that acupuncture therapy and time factors had statistical significance on the improvement of BHI, and the improvement degree was different at different time points within each group. BHI increased sequentially in

Table 4 Correlation of CVR with Fugl–Meyer and BI in 65 Patients

	Baseline		Week 1		Week 2	
	r	*P*	*r*	*P*	*r*	*P*
Fugl–Meyer	−0.304*	0.014	0.411**	0.001	0.516**	<0.001
BI	−0.002	0.987	0.453**	<0.001	0.416**	0.001

Note: *P<0.05; **P<0.01.

the treatment group from the baseline to weeks 1 and 2 ($P < 0.05$). The BHI in the control group was significantly different at weeks 1 and 2 compared with baseline ($P < 0.05$), although the difference between weeks 1 and 2 was not significant. The difference between the BHI score at week 2 and at baseline was 0.71 ± 0.36 in the treatment group and 0.41 ± 0.32 in the control group. This difference was statistically significant ($t = 3.49$, $P < 0.05$), indicating that the treatment group was significantly more effective than the control group in improving the BHI.

Correlation of CVR with Fugl–Meyer and BI

As shown in Table 4, there were different degrees of correlation between CVR, Fugl–Meyer score, and BI score in 65 patients with this disease during different time periods. Before treatment, CVR was negatively correlated with the Fugl–Meyer score ($P < 0.05$), whereas at weeks 1 and 2, the relationship was significantly positive ($P < 0.01$). Before treatment, CVR was not significantly correlated with the BI score, whereas at weeks 1 and 2, the relationship was significantly positive ($P < 0.01$).

Adverse Effects

Two patients in the treatment group experienced mild dizziness after acupuncture, which disappeared after eating food, and one patient experienced local bleeding after starting acupuncture. Two patients in the control group had mild local pain after needling, but the symptoms disappeared 2 hours after needle removal. No serious adverse reactions occurred in either group.

Discussion

Scalp acupuncture is an acupuncture method that combines traditional Chinese acupuncture with biological holography and neurophysiology.[16] It is based on the anatomical positioning of brain functions and corresponding body projections to determine head acupoints and on assessing the acupuncture stimulation area through cortical functional distribution combined with meridian theory.[17] According to modern anatomical features, the motor and superficial sensory areas of the head are richly distributed with nerves and blood vessels.[18] Most of the body's random motor impulses originate in the frontal lobe and the primitive motor area with its adjacent cortical areas, the lower central connecting pathways. The corticomedullary tract and the spinal cord tract form the nerve centers that regulate random movements.[19] Spastic hemiparesis of the limbs after AIS is a phenomenon in which the lesion spreads to the motor area of the cortical or related conduction pathways, causing spastic hemiparesis of the limbs in their corresponding areas.[20] Acupuncture of scalp acupoints can induce excitation and inhibition of the central nervous system and improve neurologic function.[21] Scalp acupuncture stimulates afferent nervous system reflex loops, promotes recovery of sensory function, promotes neuronal synaptic regeneration through proprioceptive afferent impulses, reorganizes synaptic connections, integrates central nervous system functions, restores central nervous system control, and improves the motor function of the affected limb.[22]

Previous randomized controlled studies have confirmed the efficacy of conventional head acupuncture in the treatment of motor dysfunction in AIS,[23] and the method of its location selection has been described in Chinese medicine textbooks as a norm and guidance.[13] However, with further widespread application, this conventional method has limitations in further enhancing clinical efficacy and improving patients' limb dysfunction. In recent years, Zhu's scalp acupuncture therapy has achieved positive clinical efficacy in the treatment of AIS and poststroke limb dysfunction.[24] All of the treatment sites for this method are on the scalp, which is extremely close to the brain. The

main manifestations in AIS patients are increased muscle tone and unfavorable spastic activity in the affected limb, and acupoints are based in the upper limb area and lower limb area. The combination of the two can unblock the meridians of the upper and lower limbs and strengthen the tendons and bones. Therefore, and also for medical ethical considerations, we used the conventional head acupuncture method to treat the control group in this study. We applied Zhu's scalp acupuncture with long acupuncture retention to treat patients and explore its preliminary efficacy and safety. It is well known that acupuncture has immediate, cumulative, and follow-up effects,[25,26] and many studies have set the follow-up period for AIS treatment at 3 or 6 months to observe the follow-up effects,[27,28] which is consistent with the purpose of our study. To the best of our knowledge, this is the first clinical study in which the long-stay acupuncture method was used to treat motor dysfunction in patients with AIS.

In this study, we used CVR as the main efficacy index. CVR maintains cerebral blood flow stability or regulates cerebral blood flow to maintain brain function through various compensatory mechanisms, including cerebral structural reserve, cerebral blood flow reserve, and cerebral metabolic reserve. Herein, TCD combined with a breath-holding test was used to assess the function of CVR in patients with cerebral infarction, including cerebral vasodilatory reserve, systolic reserve, and overall functional reserve. Studies have shown that a reduction in CVR can significantly increase the risk of ischemic stroke in patients with carotid stenosis or occlusion.[29] Enhancing the CVR function in brain tissue is an effective measure for treating stroke in the acute phase.[30] Additionally, in the present study, the blood flow velocity of the middle cerebral artery was detected mainly through the temporal window, which is thin and can easily obtain a stable blood flow signal, and the TCD combined with breath-holding test is simple, repeatable, and noninvasive. Owing to its limitations, such as poor stability, a physician with advanced technique performed the TCD examination in this study and trained the patients to perform breath-holding tests before the test to ensure data reliability. In addition, many researchers have recommended the Fugl–Meyer score for assessing motor function in AIS.[23] In our study, we focused more on the recovery of motor function in patients with AIS and thus evaluated the change in Fugl–Meyer score and correlated CVR based on Fugl–Meyer and BI scores. As shown in Table 4, our results demonstrated a positive correlation between CVR, Fugl–Meyer scores, and BI scores. In addition, Fugl–Meyer and BI scores increased significantly as CVR improved.

According to the results, both groups had significantly improved Fugl–Meyer and Bl scores after 1 and 2 weeks, and the efficacy of treatments was maintained at 3 and 6 months of follow-up, indicating that both acupuncture methods could improve the patients' ability to perform activities of daily living and confirm cumulative and follow-up effects. However, the treatment group had greater improvements than the control group. Both groups had significantly improved CVR and BHI and reduced PI after 1 and 2 weeks. The treatment group showed significantly improved CVR and BHI than the control group, suggesting that scalp acupuncture with long-retention needles is better compared to conventional scalp acupuncture for treating acute stroke patients. Additionally, no serious adverse effects were observed in either group, which further confirmed that the long-stay scalp acupuncture method was a safe treatment method.

Limitations and Conclusions

This was an exploratory study. We set the follow-up period at 6 months, which might have resulted in confounding factors. This was a shortcoming of the study design, and in future studies, we will add the treatment duration and subsequent continuation of treatment needle selection. Because different areas of lesion in AIS may affect patient recovery, we did not clearly define the inclusion criteria. Our purpose was to initially observe the efficacy of acupuncture on each type of AIS. Because our study was limited by the small sample size, we did not classify the patients into age-specific groups and supplemented the distribution of the patients' lesion areas without stratifying them. The small sample size could have potentially influenced the study results, and future clinical studies with larger samples are needed to provide supporting evidence for our findings.

Our findings provide preliminary clinical evidence for the use of scalp acupuncture combined with the long-stay method in the treatment of motor dysfunction in patients with AIS. We further clarified that the CVR index may influence the recovery of the patient's later limb dysfunction. We also plan to actively explore the specific mechanisms of the method's action in patients with this AIS.

Data Sharing Statement

The raw data supporting the conclusions of this article will be made available by the corresponding author, without undue reservation.

Ethics Statement

Our study complies with the Declaration of Helsinki. The studies involving human participants were reviewed and approved by the Ethics Committee of Beijing Fengtai Hospital of Integrated Traditional Chinese and Western Medicine (No. sp2020-15) and registered at the Chinese Clinical Trial Registry (No. ChiCTR2200063617).

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Disclosure

All authors declare that they have no competing interests in this work.

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