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The beneficial effects of the herbal medicine di-huang-yin-zi (DHYZ) on patients with moderate volume of basal ganglia hemorrhage: A randomized, double-blind, placebo-controlled study

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Abstract

Objective: In China, Di-Huang-Yin-Zi (DHYZ) 地黄饮子, a traditional polyherbal formula with rehmannia as its key ingredient, has been applied in treating neurological disorders since the Song dynasty, around 900 years ago. This study aimed to explore the safety and efficacy of DHYZ in treating patients with moderate basal ganglia hemorrhage. *Method:* This double-blind, placebo-controlled trial randomly assigned patients with moderate basal ganglia hemorrhage to receive either DHYZ (n = 40) or placebo (n = 40) for 8 weeks. Both groups concurrently underwent rehabilitation therapy. Fugl-Meyer assessment (FMA), activities of daily living (ADL), functional walking scale (FAC), and Modified Rankin Scale (MRS) were evaluated at the 4th, 6th, and 8th weeks of treatment. *Results:* At the study's conclusion, the DHYZ group demonstrated significantly higher scores on the FMA, ADL, FAC, and MRS compared to the placebo group (all $P<0.05$). Additionally, no drug-related serious adverse events were recorded.
Conclusion: DHYZ enhanced neurological function in patients with moderate basal ganglia hemorrhage and could serve as an effective adjunctive treatment to promote functional recovery.

Keywords: Chinese medicine, Di Huang Yin Zi, rehabilitation therapy, basal ganglia hemorrhage.

INTRODUCTION

The basal ganglia, integral to multiple neuronal pathways, are crucial for the pyramidal and extrapyramidal systems. Hemorrhage here often causes limb weakness and long-term disability.[1] Basal ganglia spontaneous intracerebral hemorrhage (ICH) accounts for 50%-70% of all ICH cases.[2] Though moderate basal ganglia hematomas rarely cause brain herniation, the internal capsule within this region, rich in white matter fibers, is vulnerable to direct hematoma pressure and hematotoxic damage, leading to sequelae like hemiplegia, hemianopia, and sensory deficits. Early internal capsule decompression and other active strategies aim to break the hematoma's harmful chain reaction. Current standard treatments include early hematoma removal, neuroprotective agents, and early rehabilitation.[3]

It has been found that thrombin generated after ICH significantly contributes to the development of brain edema and subsequent secondary injury.[4] Additionally, it has been confirmed that minimally invasive techniques for hematoma evacuation have the potential to mitigate neurological deficits and enhance patient outcomes.[5] In clinical practice, minimally invasive surgical procedures, such as computed tomography (CT) - guided stereotactic puncture aspiration or endoscopic hematoma evacuation, are increasingly being employed.[6] Moreover, studies have reported that ultra - early stereotactic aspiration, carried out within 6 hours of cerebral hemorrhage onset, can effectively improve neurological function and prognosis.[7] Besides surgical management for ICH patients, some investigators have, over the past few decades, explored a diverse array of drugs hypothesized

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to offer neuroprotective benefits.[8] These drugs include Nox inhibitors, magnesium sulfate, radical scavengers, and cytokine antagonists, among others.[9]

Despite their potential in preclinical studies, these drugs have failed to demonstrate neuroprotective effects in ICH patients. Thus, many patients still experience neurological dysfunction post - surgery with conventional treatment. To address this, alternative therapies are being explored for better functional recovery. Studies have confirmed that herbal medicine therapy for acute ICH can improve neurological deficits, reduce hematoma volume, and lower mortality.[10] It also promotes hematoma absorption and neurological recovery.[11] For example, honokiol treatment in ICH rats alleviates neurological deficits, reduces histopathological damage and cell apoptosis, and restores ATP levels.[12] Additionally, curcumin mitigates ICH damage in mouse models by preventing blood - brain barrier damage and brain edema.[13]

Di-Huang-Yin-Zi (DHYZ) 地黄饮子, a traditional Chinese polyherbal formula with rehmannia as the key ingredient, has been used to treat neurological disorders since the Song dynasty, about 900 years ago. Its therapeutic effects have been validated in various neurological studies;for example, DHYZ extract relieves symptoms and improves function in post - stroke depression rats[14], and animal studies show it reduces dopaminergic neuron loss and boosts glial - derived neurotrophic factor expression.[15] Our prior study found DHYZ enhances neurological function in ischemic stroke patients.[16] However,no studies have reported its use in ICH. Thus, this double-blind, randomized, placebo-controlled clinical trial aims to assess DHYZ's impact on neurological recovery after ICH.

METHODS

Ethics and informed consent

This study was conducted at the Tian-He Hospital of Shandong province, China, between September 10, 2021 and January 31, 2024. The study protocol was approved by the Medical Ethical Committee of Tian-He Hospital (trial registration number TRCT202108005) in conformity with the Declaration of Helsinki and its subsequent amendment.All participants signed an informed consent document before entering the study.

Patients recruitment

A total of 80 patients with moderate volume of basal ganglia hemorrhage were recruited to the study (Figure 1), and the treatment period lasted 8 weeks. Each patient was evaluated by a neurologist specialized in clinical and rehabilitation assessment. The diagnosis of ICH was confirmed by computerized tomography (CT) scan of the head. The formula height × width × length × 0.5 according to the CT scan was used to calculate the hematoma volume.

Inclusion criteria: (1) 40–70 years old; (2) hematoma volume between 25 and 40 ml, located from the frontotemporal cortex surface >1.5 cm, hematoma did not entered into the ventricle; (3) a recent hemorrhage in the basal ganglia (<30 days);(4) without intraventricular hemorrhage or hydrocephalus.(5) is conscious with a Glasgow Coma Scale score of 15.

Exclusion criteria: (1) hemorrhage associated with aneurysm, cerebrovascular malformation, moyamoya disease, or trauma. MRA screening were performed to rule out these diseases; (2) patients with severe organ dysfunction and abnormal coagulation function; (3) patients with previous cerebral hemorrhage or cerebral infarction; (4) other postoperative diseases affect the rehabilitation of patients; (5) a Mini-Mental State Examination score <23, seizure, history of previous stroke, severe aphasia, severe dysphagia, pneumonia, urinary tract infections, atrial fibrillation, deep vein thrombosis.

Randomization and blinding

Patients who met all inclusion criteria, stratified by FMA score (moderate or severe), sex, age (<50 years and ≥50 years old), were randomly allocated to DHYZ(n= 40) or a placebo group (n= 40) in a 1:1 ratio, and no randomization seed was specified. The general baseline characteristics of the patients are shown in Table 1.

An independent assistant, who was not involved in the design or conduct of the study, managed the randomization process by using SAS version 9.4 statistical software. Allocation concealment was achieved using opaque sealed envelopes to prevent patients, rehabilitation physicians, rehabilitation therapists, and outcome assessors from knowing the full grouping sequence in advance. During the double-blind treatment phase of the study, all study personnel involved in recruitment, implementation,

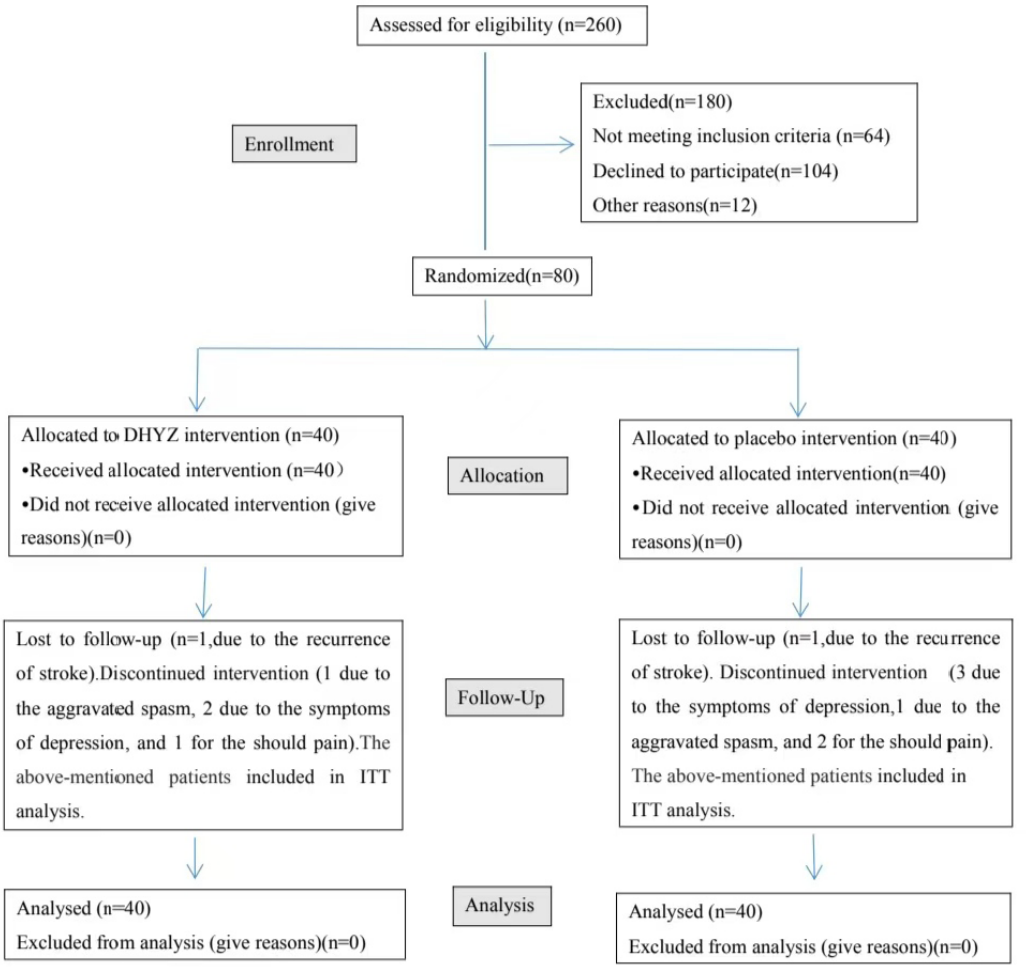

Fig. 1. CONSORT Flowchart of DHYZ on the treatment of basal ganglia hemorrhage

data collection, and analysis were blinded to the group allocation until the final study data were collected; furthermore, all the enrolled participants were blinded throughout the study period unless a participant experienced serious adverse events that warranted a code-breaking procedure. To evaluate the adequacy of blinding procedures, participants were asked for their perceptions of which group they were allocated to at the end of treatment. At the end of the statistical analysis, it was revealed that Group 02 received DHYZ, while Group 01 received the placebo, as indicated by the unblinding of the randomization codes.

Preparation of herbal medicine and placebo

DHYZ is a combination of 13 herbal drugs. The quality of the constituent herbs was in accordance with the standards set out in the Pharmacopoeia of the People's Republic of China, 2020 edition.[17] The content of known chemical constituents in DHYZ derived from crude herbal mixture was evaluated by high-performance liquid chromatography with electrochemical detection (Table 2). The shelf life of DHYZ is 1 year. The placebo and DHYZ were prepared by Jinan Pharmaceutical (Jinan, Shandong, China) as described by Zhang *et al*.[18]

The water extract of the crude herbal materials was processed as described in the Pharmacopoeia of the People's Republic of

Table 1: Baseline characteristics in patients with basal ganglia

Characteristic	DHYZ (n=40)	Placebo (n=40)
Age (years)	55.4±10.3	56.7±8.9
M/F (n)	22/18	25/15
Condition and treatment overview of patients		
Glasgow Coma Scale	10.35±1.41	10.78±1.49
Basal ganglia bleeding volume (ml)	29.4±3.0	29.8±2.9
Systolic blood pressure (SBP, mmHg)	173.6±10.1	171.4±9.5
Diastolic blood pressure (DBP, mmHg)	113.6±8.0	117.9±8.8
Stereotactic puncture and drainage Surgery (n)	23	21
intensive care (n)	18	20
Ventilation (n)	8	6
Previous history of cerebrovascular event		
TIA (n)	5	4
lacunar infarction (n)	12	13
Medical history of:		
Hypertension (n)	37	36
Diabetes (n)	20	19
Hyperlipidemia (n)	26	27
Myocardial infarction (n)	1	1
Angina cordis (n)	4	3
Stroke onset to randomization (days)	19.6±4.7	20.3±3.7
FMA grade		
Severe (0–50)	18	17
Moderate (51–84)	22	23
Baseline FMA score	45.43±11.90	46.40±12.08
Baseline BI score	40.63±8.02	41.25±7.23
Baseline FAC score	1.45±0.71	1.68±0.76
Baseline MRS score	4.23±0.48	4.13±0.52

Notes: Data presented as mean ± SD or n of patients. DHYZ, Di HuangYi Zi; BI, Barthel Index; FMA, Fugl-Meyer assessment; FAC, The Functional Walking Scale; MRS, Modified Rankin Scale.

China, 2020 edition.[17] The resulting powder was formed into tablets, each tablet containing 3 g of the crude herbal mixture. The main ingredients of placebo are medical starch, edible caramel pigment (correcting color agent), bitter agent (the flavoring agent), both the placebo and herbal tablets were identical in shape, size, color and taste. Furthermore, to minimize the effect of the distinctive smell of herbal preparations on double blinding, the herbal tablets and placebo were all contained in blister packs made from plastic film and aluminium foil, with six tablets in each blister pack. The packs were distributed to the patients by a physician who was not involved in the study. The study investigators and patients were not aware of the identity of the administered medications.

Interventions

All patients were treated with the standard regimen including anti hypertensive, anti diabetic and lipid-lowering medications. Patients also received comprehensive rehabilitation programs consisted of 2 sessions of physical therapy and 2 sessions of occupational therapy per day. Each session lasted 40 minutes and was conducted 6 days a week for 12 weeks. For physical therapy,

Table 2: The formulation of DHYZ

Full scientific name mg/tablet	Herbal materials	%	Chemical constituen	
Radix Rehmanniae preparata	Dry root	17	Catalpol	6.2
Radix Aconiti Lateralis Preparata (Zhi-Fuzi)	Dry root	4.3	Aconitine	0.16
Cortex Cinnamomi	Dry bark	4.3	Cinnamic aldehyde	3.1
Radix Ginseng	Dry root	8.5	Ginsenoside	6.6
Cornus officinalis	Dry sarcocarp	6.4	cornel iridoid glycoside	5.4
Ramulus Loranthi	Dry stem with leaf	8.5	Oleanolic acid	3.8
Poria cocos Wolf	Dry sclerotium	8.5	Pachyman	114.8
Rhizoma Alismatis	Dry root	6.4	Alismol	0.23
Cortex Eucommiae	Dry bark	6.4		
Angelica Sinensis	Dry root	8.5	Ferulic acid	13.8
Radix Ophiopogonis	Dry root	8.5	Ophiopogonin	18.4
Fructus Schisandrae Chinensis	Dry fruit	10.6	Schizandrin B	1.1
Glycyrrhiza uralensis Fisch	Dry root	2.1	Glycyrrhizic acid	0.53

joint range of motion training, muscle tone reduction training and muscle strength training were performed for 10 minutes, 10 minutes and 20 minutes; while standing balance training and gait training were a total of 40 minutes in the afternoon. For occupational therapy, sensory and vibration stimulation training and fine motor training of the hemiplegic side limb were performed for 40 minutes in the morning, while bimanual ADL training was practiced for 40 minutes in the afternoon.

On top of rehabilitation and standard treatment, patients involved in this study received either DHYZ (18 g, twice daily) or placebo (18 g, twice daily) for 12 weeks.

Evaluation of patients

Patients were assessed at baseline and after 4, 6 and 8 weeks' treatment with DHYZ or placebo. The motor function scores of patients were assessed by the Fugl-Meyer assessment (FMA) scale. The maximum score is 66 points for the upper extremity, 34 points for the lower extremity. Patients were categorized into 3 grades according to their baseline FMA score at the initiation of this trial: severe (0–50), moderate (50–84), and mild (85–99).[19] Activities of daily living (ADL), which were scored by Barthel index (BI, range 0–100; the higher the score, the greater the independence in ADL), were also assessed.[20]

The Functional Walking Scale (FAC) is graded 0 - 5 based on walking ability, with scores 0 - 5[21]. Its six levels are:（1） FAC 0 (Non-functional Ambulator): Can only walk in parallel bars or needs help from over one person outside them.（2） FAC 1 (Ambulator-Dependent for Physical Assistance - Level II): Requires continuous manual contact from one person for weight support and balance during walking.（3） FAC 2 (Ambulator-Dependent for Physical Assistance - Level I): Needs light touch from one person, continuous or intermittent, for balance and coordination while walking.（4） FAC 3 (Ambulator-Dependent for Supervision): Walks on flat surfaces without manual help but needs one person on standby for safety.（5） FAC 4 (Ambulator-Independent, Level Surfaces Only): Walks independently on flat ground but needs supervision or assistance on stairs, slopes, or uneven surfaces.（6） FAC 5 (Ambulator-Independent): Walks independently on all surfaces, including stairs and slopes.

In addition, the Modified Rankin Scale (MRS) for assessing functional disability after neurological events:（1）a score of zero: No symptoms; full recovery.（2）a score of 1: Minimal symptoms; independent in daily life.（3）a score of 2: Slight disability; independent living, some difficulty with complex tasks.（4） a score of 3: Moderate disability; needs help with daily activities, can walk unaided.（5）a score

of 4: Moderately severe disability; dependent, needs assistive device to move.（6）a score of 5: Severe disability; almost fully dependent, bedridden.（7）a score of 6: Death.

Two physical therapists who are not involved in patient treatment and this study will evaluate the FAC. If the scores are different, one physical therapist will consult with another physical therapist and the two will decide on one score.

All patients underwent electrocardiogram, blood routine, urine routine, renal function test, liver function test, electrolytes, prothrombin time (PT), and partial thromboplastin time (PTT) at first and every 4 weeks. Patients were assessed at baseline and after 4, 6 and 8 weeks of treatment with DHYZ or placebo. The FMA, BI, FAC and MRS scores were assessed by two rehabilitation physicians and two licensed therapists; furthermore, side effects and tolerability were also assessed at each visit. All adverse events were documented on a case report form, including details such as onset date and time, duration, severity, relationship to the study drug, and actions taken.

Statistical analysis

Data were analyzed using SPSS(Version 22.0, Chicago, IL, USA). Before the treatment, the comparison between DHYZ group and placebo group on FMA, BI, FAC and MRS were performed by T-test. In the course of treatment, the comparison between the two groups regarding the effect of interventions on FMA, BI, FAC and MRS were performed by repeated measures analysis of variance (ANOVA); and the missing data from 12 discontinued participants were handled by last observation carried forward (LOCF)for continuous outcomes. when a significant F value is found, the Bonferroni post hoc test was used to conduct multiple comparisons between different time points within and between groups. Continuous variables were expressed by mean ± standard deviation (x ± S.D). A significance level of P <0.05 was used for statistical significance.

RESULTS

All analyses adhered to intention-to-treat principles. Consequently, 40 patients in the DHYZ group and 40 in the placebo group were included in the analysis, despite 12 dropouts (5 and 7 patients, respectively, Figure 1). Two cerebrovascular recurrence-related serious adverse events (SAEs) requiring hospitalization were reported during the trial (DHYZ:1, placebo:1). Blinded independent adjudication confirmed these events were attributed to natural disease progression, with no causal relationship to treatment. No drug-related SAEs were identified in either group; however, 6 patients in the DHYZ group complained of nausea for several days, but this side effect disappeared later, and 5 patients in the placebo group reported nausea. The drug-induced nausea was attenuated by massage, and no patients in either group left the study due to side effects of the medication.

Repeated measures ANOVA was employed to examine the impact of DHYZ and placebo on FMA scores across three time periods in the two groups. The analysis revealed a significant increase in FMA scores at different measurement time points (F=29.4, P<0.001). Bonferroni post-hoc tests further showed that there were no significant differences in FMA scores between the fourth and sixth weeks post-intervention. However, a significant difference was observed at the eighth week (t=3.151, P = 0.045), indicating a notable divergence in motor scores between the two groups following treatment (Table 3).

There was also a significant difference in BI scores between the DHYZ group and placebo group during the treatment period (F=17.7, P < 0.001). Besides, the BI scores were significantly higher in the DHYZ group than in the placebo group at week 8(t=3.746, P < 0.01, Table 4).

Furthermore, a statistically significant

Table 3: FMA outcomes: DHYZ vs placebo in patients with basal ganglia ICH

Weeks of treatment	DHYZ (n=40)	Placebo (n=40)	t value	P value
0	45.43±11.90	46.40±12.08	-0.364	1.000
4	49.85±11.54 [a]	50.33±11.76 [a]	-0.182	1.000
6	58.28±9.20 [a]	53.70±11.95 [a]	1.918	0.543
8	63.73±8.96 [a,b]	56.30±11.91 [a]	3.151	0.045

Notes：a indicates P<0.05 compared with week 0, b indicates P<0.05 compared with placebo group.

Table 4: BI outcomes: DHYZ vs placebo in patients with basal ganglia ICH

Weeks of treatment	DHYZ (n=40)	Placebo (n=40)	t value	P value
0	40.63±8.02	41.25±7.23	-0.366	1.000
4	6.38±8.70 [a]	45.88±7.59 [a]	0.274	1.000
6	54.50±8.38 [a]	50.75±7.73 [a]	2.081	0.436
8	63.75±9.25 [a,b]	56.13±8.95 [a]	3.746	0.008

Notes：a indicates P<0.05 compared with week 0, b indicates P<0.05 compared with placebo group.

disparity in FAC scores was observed between the two groups (F=6.45, P < 0.001). Specifically, at week 8, the DHYZ group demonstrated significantly higher FAC scores than the placebo group (t=3.329, P= 0.028; Table 5).

Additionally, a statistically significant difference in MRS scores was observed between the two groups (F=7.78, P<0.001). Notably, at week 8, the DHYZ group exhibited significantly lower MRS scores compared to the placebo group.(t= -3.131, P= 0.048, Table 6).

There were no significant differences in the results of blood routine, urine routine, liver function, renal function, electrocardiogram, prothrombin time (PT), and partial thromboplastin time (PTT) in both groups of patients before and after treatment.

DISCUSSION

Patients with basal ganglia ICH typically exhibit sensorimotor deficits secondary to internal capsule injury.[22] Elevated intracranial pressure, hypoperfusion, and cerebral edema can induce compression or structural damage to white matter tracts, particularly the corticospinal tract (CST), a pivotal neural pathway for motor control.[23] Such CST impairment disrupts both axonal membrane integrity and myelin sheath organization within fiber bundles. Our findings demonstrate that DHYZ therapy may enhance white matter repair following ICH.

DHYZ may enhance angiogenesis and promote blood vessel regeneration around the hematoma

The Normal function of white and gray matter relies on blood - supplied nutrients. ICH stimulates angiogenesis, with increased vascular endothelial growth factor (VEGF) expression in cerebral endothelial cells at the hemorrhage site, and elevated VEGF mRNA persisting for 28 days.[24] Thus, regulating angiogenesis via VEGF expression could aid white matter fiber tract repair.

Radix Rehmanniae promotes VEGF - mediated angiogenesis in zebrafish embryos and rat aortic rings[25] and aids diabetic foot ulcer healing in rats.[26] Ginseng boosts VEGF expression to enhance angiogenesis and blood flow.[27] Cornel iridoid glycoside from Cornus officinalis promotes angiogenesis and improves neurological function post-ischemia in rats by increasing brain VEGF.[28] Poria cocos extract accelerates diabetic wound healing and angiogenesis while reducing inflammation.[29] Angelica sinensis extract offers neuroprotection through angiogenic and anti-apoptotic activation.[30] Shengmai injection, containing Ginseng, Ophiopogonis, and Schisandrae, reduces apoptosis and enhances angiogenesis after myocardial ischemia-reperfusion injury in rats.[31] In summary, components of DHYZ may enhance angiogenesis around the hematoma, facilitating oxygen exchange, white matter restoration, and functional improvement.

Table 5: FAC outcomes: DHYZ vs placebo in patients with basal ganglia ICH

Weeks of treatment	DHYZ (n=40)	Placebo (n=40)	t value	P value
0	1.45±0.71	1.68±0.76	-1.360	0.877
4	2.28±0.78 [a]	2.05±0.64	1.407	0.851
6	2.83±0.68 [a]	2.40±0.67 [a]	2.822	0.104
8	3.10±0.59 [a,b]	2.60±0.74 [a]	3.329	0.028

Notes：a indicates P<0.05 compared with week 0, b indicates P<0.05 compared with placebo group.

Table 6: MRS outcomes: DHYZ vs placebo in patients with basal ganglia ICH

Weeks of treatment	DHYZ (n=40)	Placebo (n=40)	t value	P value
0	4.23±0.48	4.13±0.52	0.898	0.985
4	4.05±0.55[a]	4.08±0.47	-0.217	1.000
6	3.63±0.54[a]	3.83±0.45[a]	-1.805	0.619
8	3.13±0.52[a,b]	3.50±0.55[a]	-3.131	0.048

Notes：a indicates P<0.05 compared with week 0, b indicates P<0.05 compared with placebo group.

DHYZ may suppress post-ICH oxidative stress

Duan XC *et al*. reviewed ICH post-antioxidant stress treatments.[32] Intraperitoneal isoliquiritigenin in acute ICH mitigates brain damage and neurological deficits by regulating reactive oxygen species through antioxidant systems.[33]

Rehmanniae radix preparata and Catalpol offer antioxidant, anti - inflammatory, and neuroprotective effects, increasing brain-derived neurotrophic factor and reducing neuronal apoptosis and energy metabolism failure.[34] Ginseng root extract provides neuroprotection and antioxidant effects, enhancing catalase activity and decreasing reactive oxygen species, with its mechanism tied to oxidative stress reduction.[35] Radix Aconiti Lateralis Preparata shows antioxidative and immunomodulatory activities, promoting macrophage function.[36] Cinnamomi cortex extract inhibits inducible nitric oxide synthase for antioxidant action.[37] Cornel iridoid glycoside reduces lipid peroxidation and raises antioxidant levels to ease neuroinflammation.[38] Poria cocos extract protects neurons by suppressing oxidative stress and apoptosis via Bcl-2 upregulation.[39] Studies also confirm Angelica sinensis, Cortex Eucommiae, and Radix Ophiopogonis protect nerve cells from oxidative stress.[40-42] These suggest some DHYZ ingredients can curb ICH - induced oxidative stress.

DHYZ may upregulate nerve growth factor (NGF) expression

NGF,a key bioactive neurotrophic factor in central and peripheral nervous systems, vital for neuronal protection, regeneration, axonal growth, and synapse reconstruction.[43] Studies show NGF protects damaged nerve cells, aids neuron survival, and promotes brain neurological function recovery.[44] Ginsenoside in ginseng root boosts NGF expression and secretion in Schwann Cells.[45] CIG protects against traumatic brain injury by inhibiting acute-stage apoptosis and promoting chronic-stage NGF expression[46], and also reduces disease severity in autoimmune encephalomyelitis mice by preventing NGF downregulation.[47] A traditional Chinese medicine mixture with Rehmannia root, Rhizoma Alismatis, Poria sclerotium, and Cinnamon bark can induce neurite outgrowth with NGF-like neurotrophic effects.[48] In brief, this study implies DHYZ may enhance NGF and improve neurogenesis after ICH.

In conclusion, DHYZ is a widely used clinical drug in East Asia due to its availability, affordability and versatility.In this study, no serious adverse effects were observed, confirming its safety for basal ganglia ICH patients. The significant functional improvement in the DHYZ group compared to the placebo group suggests that DHYZ may effectively enhance neurological function during the subacute stage of basal ganglia hemorrhage.

In this study, although our randomization successfully ensured baseline covariate balance, the univariate analytical method restricts the ability to comprehensively adjust for potential confounding factors. For future large-scale clinical trials, it is advisable to employ multivariable regression models that incorporate prognostic factors along with clinical covariates such as age, hemorrhage volume, and baseline GCS scores. This approach can enhance the causal inference of traditional medicine interventions. Another shortcoming of this study is the exclusion of patients with a large volume of basal ganglia hemorrhage. This exclusion was due to the well-documented poor prognosis for neurological and functional recovery in such patients. Nevertheless, the therapeutic outcomes of this study are promising, justifying further exploration of the therapeutic potential of DHYZ in patients with a large volume of basal ganglia hemorrhage.

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DISCLOSURE

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