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Original Article

Effect of acupuncture and exercise rehabilitation on quality of life in acute coronary syndrome patients after percutaneous coronary intervention

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Abstract: Objective: This study assessed the impact of acupuncture combined with exercise rehabilitation on the quality of life in patients with acute coronary syndrome (ACS) undergoing percutaneous coronary intervention (PCI). Methods: In a retrospective study at the Affiliated Hospital of Shaanxi University of Traditional Chinese Medicine, 114 post-PCI ACS patients were analyzed from March 2021 to June 2023. Fifty-five underwent exercise rehabilitation (control group), while 59 received both acupuncture and exercise rehabilitation (joint group). Propensity score matching reduced each group to 38 patients. Traditional Chinese Medicine (TCM) scores, 6-minute walk distance, cardiac function, and biochemical indices were evaluated pre- and post-intervention. The Minnesota Living with Heart Failure Questionnaire (MLHFQ) measured quality of life changes, categorizing scores <24 as good and ≥24 as poor. Logistic regression identified factors affecting quality of life. Results: The joint group showed significant improvements in TCM scores, 6-minute walk distance, left ventricular end-diastolic diameter, left ventricular ejection fraction, cardiac output, cardiac index, and levels of CK-MB, cTnT, and homocysteine compared to the control group ($P<0.05$). MLHFQ scores for physical limitations and disease symptoms decreased significantly in the joint group, with no marked changes in social relationship scores ($P>0.05$). Conclusions: Acupuncture alongside exercise rehabilitation significantly improves quality of life, cardiac function, and biochemical markers in ACS patients post-PCI, surpassing the effects of rehabilitation alone. This combination approach notably diminishes symptoms and improves daily functioning.

Keywords: Acupuncture, exercise rehabilitation, acute coronary syndrome, percutaneous coronary intervention

Introduction

Acute coronary syndrome (ACS) is a major concern in cardiovascular disease, characterized by its rapid progression, high mortality, and significant morbidity [1]. The China Cardiovascular Report 2020 indicated an alarming increase in acute myocardial infarction (AMI) mortality rates in rural China, reaching 78.47 per 100,000 people in 2018, up by 2.43 cases from the previous year [2]. In the United States, ACS results in over one million hospitalizations annually [3].

Percutaneous coronary intervention (PCI) is a key treatment for ACS, addressing coronary stenosis symptoms. However, limitations such as thrombosis risk and in-stent restenosis, affecting 16% to 44% of patients, still remain [4]. Post-PCI, many patients suffer recurrent angina and hospitalizations, adversely impacting their quality of life [5]. Although PCI is crucial for ACS management, it falls short in improving long-term quality of life and reducing rehospitalization rate [6]. Integrating traditional and modern therapies, such as acupuncture and exercise rehabilitation, has proven effective in treating various diseases [7]. Zhou et al.'s meta-analysis indicated that combining acupuncture with rehabilitation yields an outcome for post-stroke cognitive dysfunction superior to rehabilitation alone [8]. Similarly, Zhan et al. observed that combining Bo's abdominal acupuncture with rehabilitation sig-

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nificantly alleviated post-stroke shoulder-hand syndrome symptoms compared to rehabilitation only [9]. Acupuncture is renowned for its analgesic, anti-inflammatory, and circulatory benefits [10], whereas exercise rehabilitation enhances muscle strength, cardiorespiratory fitness, and overall health, benefiting conditions like chronic back pain, stroke, and diabetes [11].

Although current treatments for ACS PCI effectively manage acute care aspects, they fall short in enhancing long-term quality of life, particularly in psychological and emotional recovery. The combined effects of acupuncture and exercise rehabilitation on post-PCI ACS patients' quality of life have shown promise but need further investigation. Our retrospective study presents an innovative approach, merging acupuncture's traditional benefits with contemporary exercise rehabilitation, aiming for holistic recovery and improved quality of life. This integrated treatment strategy seeks to overcome conventional treatment limitations, enhance patient engagement and compliance, and promote long-term health in post-PCI ACS patients, thus addressing a crucial research gap and offering valuable clinical insight for comprehensive patient rehabilitation.

Materials and methods

Clinical data collection

We performed a retrospective analysis of ACS patients treated at the Affiliated Hospital of Shaanxi University of Traditional Chinese Medicine from March 2021 to June 2023, approved by the Medical Ethics Committee of Affiliated Hospital of Shaanxi University of Traditional Chinese Medicine's (Ethical approval number: 2023017).

Inclusion and exclusion criteria

Inclusion criteria included: (1) ACS diagnosis confirmed by coronary angiography [4]; (2) first-time PCI candidates; (3) New York Heart Association (NYHA) class II-III; (4) undergoing exercise rehabilitation or combined acupuncture and exercise rehabilitation; and (5) complete medical and follow-up records available [12]. Exclusion criteria included postoperative complications, other cardiac diseases, severe organ dysfunction (e.g., liver or kidney failure), and inability of self-care.

Case selection and grouping

Out of 194 potential participants, 114 met the selection criteria. They were divided into two groups: 55 in the control group received exercise rehabilitation only and 59 in the joint group received acupuncture plus exercise rehabilitation. Propensity score matching reduced each group to 38 patients.

Patient data, sourced from electronic medical records and outpatient reviews, encompassed clinical details, laboratory values, and functional scores. Clinical data included age, sex, disease duration, NYHA class, per capita monthly household income, diabetes mellitus history, and smoking history. Laboratory parameters covered pre- and post-intervention metrics: left ventricular end-diastolic diameter (LVEDD), left ventricular ejection fraction (LVEF), cardiac output (CO), cardiac index (CI), creatine kinase-MB (CK-MB), cardiac troponin T (cTnT), and homocysteine (Hcy). Functional assessments were the Traditional Chinese Medicine (TCM) score, 6-minute walk distance, and the Minnesota Living with Heart Failure Questionnaire (MLHFQ). Cardiac function was gauged using an APOGEE800 Doppler ultrasound system (ATL Company, USA), CK-MB and cTnT via ELISA (biotech ELx800, USA), and Hcy with a Cobas e601 electrochemiluminescence analyzer (Roche, Switzerland).

Treatment plan

Post-PCI, all patients received standard care, including antiplatelet and lipid-lowering medications following current clinical guidelines [2]. The rehabilitation program included Exercise Rehabilitation Training and Acupuncture Treatment. Exercise training began with a 6-minute walk test to determine initial capacity. The starting walking distance was 15% to 25% of the maximum distance achieved during this test, with a target increase to 3,000-5,000 meters daily over 40 minutes by the second week. Based on the NYHA class, Class II patients performed exercises such as single arm raises, lunges, and knee lifts with leg abductions for 30 minutes, 20-30 repetitions per set, three to four times a week; Class III patients did exercises including gastrocnemius

Table 1. Comparison of baseline data

Consideration		Control group (n = 38)	Joint group (n = 38)	χ^2/t value	*P*-value
Age		65.24±3.23	64.87±3.94	-0.446	0.657
Gender					
Male		18	21	0.474	0.491
Female		20	17		
Course of disease		5.71±1.74	5.68±2.03	-0.061	0.952
NYHA					
Class	II	16	16	0.000	1.000
	III	22	22		
Monthly household income (yuan)					
≥3000		11	15	0.935	0.333
<3000		27	23		
History of diabetes					
Yes		8	10	0.291	0.589
No		30	28		
Smoking history					
Yes		18	17	0.053	0.818
No		20	21		

Note: NYHA, New York Heart Function Classification.

strengthening and one-arm bends for 10-20 minutes, 10-20 repetitions per set, two to three times weekly. Both included relaxation and stretching to conclude each session, over a four-week period. Acupuncture treatment targeted specific acupoints, including Jiequan and Quchi for upper limbs and Guanzhong and Shusanli for lower limbs, using techniques like straight and lifting-inserting stabbing with 1.5 to 3-inch needles. Sessions lasted 20-30 minutes, conducted five times a week for four weeks. This integrated rehabilitation protocol aimed to improve recovery and overall quality of life in post-PCI patients.

Functionality evaluation

The TCM Score, based on a 32-point scale, assesses symptom severity, with higher scores indicating more severe symptoms [13]. The 6-minute walk test measures cardiorespiratory endurance [14], and the MLHFQ evaluates heart failure's impact on patients' lives, with higher scores denoting greater impact [15].

Observation indicators

Primary outcomes were the pre- and post-intervention MLHFQ scores, classifying patients with scores <24 as having good and ≥24 as poor quality of life, following Behlouli's study [16]. Secondary outcomes involved changes in TCM scores, 6-minute walk distance, cardiac function, and biochemical indices.

Statistical analysis

Data were analyzed using SPSS 26.0. The Shapiro-Wilk test assessed data normality. Normally distributed data were expressed as mean ± SD, analyzed with independent and paired t-tests. Non-normal data were reported as quartiles and assessed using the rank-sum test. Categorical data, shown as n (%), underwent X^2 test comparisons. Logistic regression analyzed quality of life risk factors, with ROC curves identifying logistic regression cutoffs. Propensity score matching adjusted baseline data using logistic regression, with variables including age, sex, disease duration, income, diabetes, and smoking history, employing nearest neighbor matching (caliper = 0.02) at a 1:1 ratio. *P*-values <0.05 were significant.

Results

Comparison of baseline data

No significant differences were found in age, sex, disease duration, NYHA class, monthly household income, diabetes history, or smoking history between the control and joint groups initially (**Table 1**, P>0.05).

Chinese medicine evidence score and 6-minute walk distance

Pre-intervention, the TCM evidence scores and 6-minute walk distances were comparable between groups (P>0.05). Post-intervention, both groups saw significant improvements in these measures (P<0.001), with the joint group showing greater enhancement than the control group (P<0.05, **Table 2**).

Table 2. Comparison of patients' TCM evidence scores and 6-min distance of walking

Cluster	TCM score		6 min walking distance (m)	
	Pre-intervention	Post-intervention	Pre-intervention	Post-intervention
Joint group (n = 38)	15.00 [13.00, 19.00]	8.95±3.35*	229.76±13.43	370.45±17.26*
Control group (n = 38)	17.50 [14.25, 19.00]	11.00±2.95*	232.87±13.76	325.32±16.09*
t/Z value	-0.727	-2.833	-0.995	11.791
P-value	0.469	0.006	0.323	<0.001

Note: * indicates P<0.05 compared with pre-intervention; NYHA, New York Heart Function Classification; TCM, Traditional Chinese Medicine.

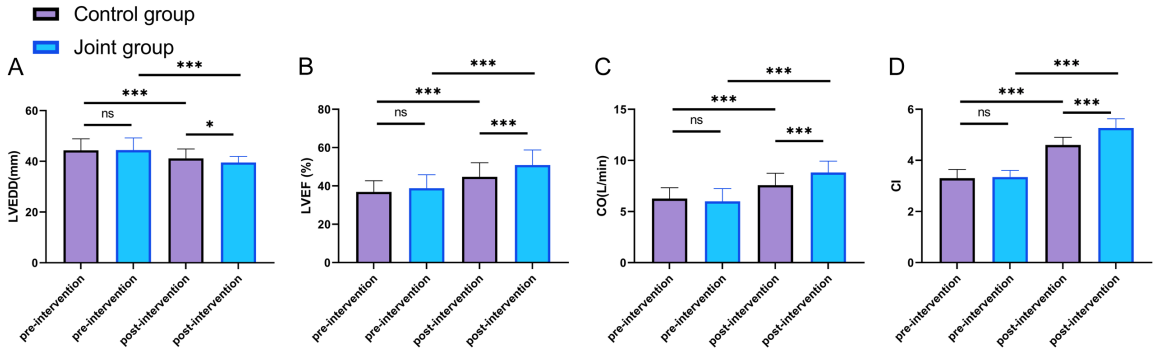

Figure 1. Changes in cardiac function before and after intervention. A. Comparison of changes in LVEDD. B. Comparison of LVEF changes. C. Comparison of CO changes. D. Comparison of CI changes. Note: nsP>0.05, *P<0.05, ***P<0.001. LVEDD, Left Ventricular End-Diastolic Diameter; LVEF, Left Ventricular Ejection Fraction; CO, Cardiac Output; CI, Cardiac Index.

Table 3. Comparison of cardiac biochemical monitoring indicators in patients

Cluster	CK-MB (U/L)		cTnT (ng/mL)		Hcy (μmol/L)	
	Pre-intervention	Post-intervention	Pre-intervention	Post-intervention	Pre-intervention	Post-intervention
Joint group (n = 38)	103.47±7.89	66.32±5.33*	0.82±0.12	0.38±0.08*	19.14±3.53	7.78±1.69*
Control group (n = 38)	103.44±6.80	80.21±7.18*	0.82±0.12	0.47±0.10*	19.28±3.97	12.31±2.17*
t/Z value	0.019	-9.574	0.187	-4.599	-0.159	-10.144
P-value	0.985	<0.001	0.852	<0.001	0.874	<0.001

Note: * indicates P<0.05 compared with pre-intervention; CK-MB, Creatine Kinase-MB; cTnT, Cardiac Troponin T; Hcy, Homocysteine.

Comparison of cardiac function indices

LVEDD, LVEF, CO, and CI were similar between groups before intervention (P>0.05). Post-intervention, significant improvements were noted in these indices (P<0.001), with the joint group exhibiting greater enhancement (P<0.05, **Figure 1**).

Biochemical cardiac monitoring indices

CK-MB, cTnT, and Hcy levels were initially similar between groups (P>0.05). Post-intervention, significant reductions in these levels were observed (P<0.001), with the joint group showing lower levels than the control group (P<0.05, **Table 3**).

MLHFQ scales

Before intervention, MLHFQ scores for physical limitations, disease symptoms, social relationships, and total scores were similar between the groups (P>0.05). After intervention, significant score reductions were noted (P<0.001), with the joint group scoring lower in physical limitations, disease symptoms, and total scores compared to the control group (P<0.05, **Figure 2**). No significant post-intervention dif-

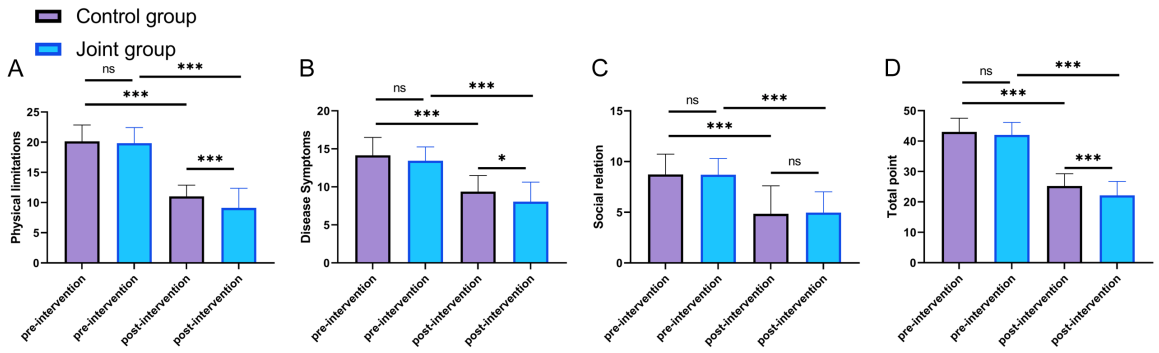

Figure 2. Changes in MLHFQ scale of patients before and after intervention. A. Comparison of changes in physical limitations. B. Comparison of changes in disease symptoms. C. Comparison of changes in social relationships. D. Comparison of changes in total scores. Note: nsP>0.05, *P<0.05, ***P<0.001. MLHFQ, Minnesota Cardiac Insufficiency Quality of Life Scale.

ference in social relationship scores was found (P>0.05, **Figure 2**).

Factors influencing quality of life

Post-intervention, patients were categorized into good (n = 35, score <24) and poor (n = 41, score ≥24) quality of life groups. Differences in age, disease duration, NYHA class, monthly household income, and treatment regimen were statistically significant between these groups (P<0.05, **Tables 4**, **5**). Multivariate regression analysis, incorporating NYHA class, monthly household income, disease duration, and treatment regimen, identified age and NYHA class as independent predictors of quality of life (P<0.05, **Table 6**).

Discussion

This study compared the effects of combined acupuncture and exercise rehabilitation with exercise rehabilitation alone on quality of life in ACS patients. The findings demonstrate significant improvements in both groups post-treatment, with superior outcomes in the joint group, evidenced by better TCM symptom scores and 6-minute walk distances. Additionally, enhancements in cardiac function and biochemical indices were more pronounced in the joint group, aligning with the MLHFQ scale results which indicated an overall quality of life improvement, especially in the joint group.

Exercise rehabilitation is essential for enhancing cardiorespiratory endurance and muscular strength, thus improving cardiac function and daily activity function [17]. However, it may not fully address the psychological and emotional challenges of cardiovascular disease. Acupuncture, known for its pain relief, anti-inflammatory properties, and circulatory benefits, can complement these physical therapies by addressing additional aspects of patient well-being [18]. The combination of acupuncture and exercise rehabilitation has been shown to offer greater benefits in psychological health, symptom alleviation, and quality of life enhancement. Studies by Zhang et al. [19] and subsequent researchers [20] have confirmed that integrating acupuncture with rehabilitation training substantially enhances quality of life and hastens functional recovery across diverse patient groups. This evidence supports the effectiveness and advantages of this combined therapy for ACS patients.

The observed improvements in cardiac function markers (LVEDD, LVEF, CO, CI) and reductions in CK-MB, cTnT, and Hcy levels suggest that integrated therapy positively impacts cardiac health. These changes indicate decreased myocardial damage and enhanced cardiac metabolic efficiency, reflecting cardiac function recovery and a reduced risk of cardiac events. This supports previous research, such as studies by Wang et al., which highlighted the benefits of combining acupuncture with conventional rehabilitation or medical treatment to improve metabolic and cardiac functions in various patient groups [21, 22].

Quality of life often deteriorates following an ACS event, impacting physical, mental, and social well-being. This decline can lead to fur-

Table 4. Comparison of patient data between the good and impaired quality of life groups

Consideration	Good quality of life group (n = 35)	Poor quality of life group (n = 41)	χ^2/t value	*P*-value
Age	64.00 [62.00, 66.00]	67.00 [63.00, 70.00]	-2.36	0.018
Gender				
Male	18	21	0.000	0.985
Female	17	20		
Course of disease	5.93±1.90	5.43±1.84	1.160	0.250
NYHA				
II	18	14	2.313	0.128
III	17	27		
Monthly household income (yuan)				
≥3000	14	12	0.966	0.326
<3000	21	29		
History of diabetes				
Yes	5	13	3.171	0.075
No	30	28		
Smoking history				
Yes	14	21	0.957	0.328
No	21	20		
Treatment plan				
Control subjects	14	24	2.595	0.107
CGU	21	17		
Pre-intervention Chinese medicine evidence score	16.05±3.57	17.00±4.72	-0.977	0.332
Pre-intervention 6 min walking distance (m)	229.98±14.26	232.89±12.81	-0.937	0.352
Pre-intervention LVEDD (mm)	43.56±4.64	45.37±4.52	-1.719	0.090
Pre-intervention LVEF (%)	38.00 [34.00, 43.00]	39.00 [35.50, 40.50]	-0.005	>0.999
Pre-intervention CO (L/min)	6.12±1.23	6.15±1.10	-0.083	0.934
Pre-intervention CI	3.26±0.30	3.40±0.29	-1.95	0.055
Pre-intervention CK-MB (U/L)	103.37±6.27	103.55±8.47	-0.107	0.915
Pre-intervention cTnT (ng/mL)	0.84±0.10	0.80±0.13	1.265	0.211
Pre-intervention Hcy (μmol/L)	19.80±3.73	18.52±3.67	1.501	0.138

Note: NYHA, New York Heart Function Classification; LVEDD, Left Ventricular End-Diastolic Diameter; LVEF, Left Ventricular Ejection Fraction; CO, Cardiac Output; CI, Cardiac Index; CK-MB, Creatine Kinase-MB; cTnT, Cardiac Troponin T; Hcy, Homocysteine; MLHFQ, Minnesota Cardiac Insufficiency Quality of Life Scale.

Table 5. Factor assignment table

Consideration	Designated points
Age	≥66.5 = 1, <66.5 = 0
Disease duration	≥5.5 = 1, <5.5 = 0
Treatment plan	Control group = 1, joint group = 0
NYHA	II = 1, III = 0
Monthly per capita household income	≥3000 = 1, <3000 = 0
Quality of life	Good group = 0, poor group = 1

Note: NYHA, New York Heart Function Classification.

ther health deterioration and increased rehospitalization risk [23]. Enhancing quality of life is crucial for patient recovery. In our study, MLHFQ scores were used to differentiate between good and poor quality of life groups, revealing age, NYHA class, and monthly household income as independent risk factors. Older patients often encounter cardiovascular and psychosocial challenges, that negatively affect their quality of life. Reduced cardiac function can restrict daily activities, causing psychological stress and lowering quality of life. While acupuncture and rehabilitation training positively influenced quality of life, they were not identi-

Table 6. Logistic regression analysis

Consideration	β	SE	Chi-square value	*P*-value	OR value	95% CI	
						Lower limit	Limit
Age	-0.24	0.081	8.794	0.003	0.787	0.671	0.922
Disease duration	0.063	0.146	0.185	0.667	1.065	0.799	1.419
Treatment plan	0.94	0.518	3.296	0.069	2.56	0.928	7.062
NYHA	-1.115	0.541	4.242	0.039	0.328	0.113	0.947
Monthly household income	-0.746	0.567	1.73	0.188	0.474	0.156	1.442

Note: NYHA, New York Heart Function Classification.

fied as independent risk factors, likely due to intervention effectiveness variability related to individual patient factors, disease severity, comorbidities, and socioeconomic conditions [24, 25]. A holistic treatment approach and sustained management are necessary to enhance quality of life, which may extend beyond the scope of a single intervention.

Study limitations include the small sample size, brief intervention duration, and short follow-up period, which might impact result accuracy and generalizability. Future research should expand sample size and diversity, and prolong intervention and follow-up durations to better ascertain long-term treatment impacts on QoL. This will offer more comprehensive treatment insight and clinical guidance.

Conclusion

Acupuncture in conjunction with exercise rehabilitation notably improved the quality of life post-PCI in ACS patients, surpassing exercise rehabilitation alone. This combined therapy enhanced cardiac and biochemical measurements, alleviated symptoms, and ameliorated daily activity levels, demonstrating its effectiveness in post-ACS patient care.

Disclosure of conflict of interest

None.

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