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Original Article

Effect of evidence-based nursing combined with exercise rehabilitation in patients with acute myocardial infarction after percutaneous coronary intervention

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Abstract: Objective: To explore the effect of evidence-based nursing combined with exercise rehabilitation on cardiac function indices, self-care ability and incidence of adverse reactions in patients with acute myocardial infarction (AMI) after percutaneous coronary intervention (PCI). Methods: In this retrospective study, the medical records of 200 AMI patients undergoing PCI in Ganzhou People's Hospital from June 2020 to September 2021 were retrospectively analyzed, and the patients were divided into a control group (n=100) and a study group (n=100) according to the nursing methods after PCI. The cardiac function index, 6-minute walking distance (6MWD), behavioral self-management, physiological index, angina questionnaire and postoperative complications were compared between the two groups. Results: After intervention, the study group exhibited significantly higher left ventricular ejection fraction and lower pro-B-type natriuretic peptide index than the control group (P<0.05). At 1, 3 and 6 months postoperative, the study group exhibited significantly longer 6MWD than the control group (P<0.05). At 3 and 6 months postoperative, the total Coronary Artery Disease Self-Management Scale scores except for emotional management were significantly higher in the study group than those in the control group (P<0.05). At 3- and 6-month postoperative visits, systolic and diastolic blood pressure, fasting blood glucose, total cholesterol, triglyceride and low-density lipoprotein in the study group were significantly lower than those in control group (P<0.05). The study group showed higher scores of Seattle Angina Questionnaire and lower incidence of complications than the control group (P<0.05). Conclusion: Evidence-based nursing combined with exercise rehabilitation can ameliorate cardiac function and physiological indices, increase treatment compliance and satisfaction, reduce the incidence of postoperative complications, and improve the quality of life in patients with AMI after PCI.

Keywords: Evidence-based nursing, exercise rehabilitation, acute myocardial infarction, percutaneous coronary intervention

Introduction

With rapid socioeconomic development and changes in lifestyles, cardiovascular diseases (CVD) have become the leading cause of death worldwide and account for about 40% of the total deaths in China [1, 2]. Data showed that 3.97 million people died from CVD in China in 2016, indicating an increase of 1.46 million from 1990 [3]. Coronary heart disease (CHD) refers to the atherosclerosis of the blood vessels in the coronary arteries, which leads to narrowing or even blockage of the vessel lumen, causing myocardial ischemia, hypoxia or necrosis. Acute myocardial infarction (AMI), as the most serious type of CHD, is myocardial necrosis resulted from acute and continuous ischemia and hypoxia in the coronary arteries, and its clinical manifestations are heart failure, malignant arrhythmias and cardiogenic shock, etc., with characteristics of rapid onset and high mortality [4]. It has been found that the incidence of AMI is increasing in young adults, which brings heavy care and economic burden to patients and the society [5].

Percutaneous coronary intervention (PCI) can restore blood flow rapidly to open the blocked

coronary vessels, relieve the symptoms of ischemia and hypoxia and save patients' lives [6]. Many patients believe that PCI can cure AMI, but in fact, the coronary atherosclerosis continues after PCI. PCI is not the end of treatment for patients with AMI, and patients may still suffer from in-stent restenosis, thrombosis, and postoperative complications, which affect the prognosis and postoperative quality of life of patients. Risk factors such as low treatment compliance, poor lifestyle and low awareness may accelerate the occurrence of coronary restenosis [7]. Scientific management of patients after PCI, complemented by moderate exercise, can improve cardiac function, promote healthy behaviors and reduce the risk of AMI recurrence [8].

The concept of evidence-based nursing (EBN) was first proposed by Alba Diconso et al. in 1991. EBN, as an important branch of evidence-based medicine, combines evidence, caregiver experience and patient condition to develop optimal nursing plans [9]. EBN can compensate for the shortcomings in conventional nursing, promote the ability of nurses and improve the prognosis of patients. In an analysis of 9036 articles on EBN published by 13808 authors in China, Zhao et al. showed that the application of EBN in patients with CVDs has become a research hotspot in the last five years [10].

This study applied EBN combined with exercise rehabilitation guidance for AMI patients after PCI, and aimed to analyze the effects of this nursing mode on patients' postoperative cardiac function indices, self-care ability and the incidence of adverse events, so as to provide a theoretical basis for improving postoperative effect and reducing the recurrence rates in AMI patients.

Materials and methods

General data

In this retrospective study, the medical records of 200 AMI patients undergoing PCI in Ganzhou People's Hospital from June 2020 to September 2021 were retrospectively analyzed, and the patients were divided into a control group (n=100) and a study group (n=100) according to nursing methods after PCI.

Inclusion criteria: (1) patients who aged 18-75 years; (2) those who underwent PCI within 12 h after the onset of AMI; (3) those with Killip classification I or II [11]; (4) those who met the diagnostic criteria for coronary heart disease and myocardial infarction in the 8th edition of Internal Medicine; (5) those with left ventricular ejection fraction (LVEF) >35% by echocardiography; those with systolic blood pressure <150 mmHg and diastolic blood pressure <90 mmHg; (6) those with normal chest X-ray image and without respiratory system disease; (7) those with normal joint movement and without history of arthritis and bone disease.

Exclusion criteria: (1) patients with hyperthermia or the presence of severe infection; (2) those who suffered from other immune diseases; (3) those who suffered from malignancy; (4) those with severe hepatic or renal insufficiency; (5) those with other basic medical and surgical diseases; (6) those with incomplete data; (7) those with unstable conditions after AMI; (8) those with unstable angina; (9) those with uncontrolled arrhythmia.

The study was reviewed and approved by the Ethics Committee of Ganzhou People's Hospital. All patients or their families provided signed informed consent.

Nursing mode

Patients in the control group received routine nursing. Health education was provided upon admission. Patients were instructed to prepare for surgery and given dietary and medication guidance. At discharge, nursing manuals were distributed.

Patients in the study group received EBN combined with exercise rehabilitation. Nurses were taught the theoretical knowledge of evidence-based medicine and EBN and assessed by the head nurse and department director. A professional EBN team was established by those who passed the assessment.

Survey: A questionnaire was prepared, including knowledge related to CHD, postoperative psychological state, pain intensity, dietary habits and functional exercise, etc. The questionnaire was distributed to the patients 1 day after surgery and returned on the same day.

The results of the questionnaire were compiled with comprehensive analysis of patients' admission assessment and possible problems in daily care. The main problems of patients were lack of theoretical knowledge, fear of reoccurrence of obstruction, resistance to postoperative functional exercise and lack of effective self-care ability.

Evidence: Using keywords such as coronary heart disease, acute myocardial infarction, percutaneous coronary intervention and evidence-based nursing for retrieving in PubMed, Embase and CBM, etc., the issues were collected and summarized, and a specific nursing plan was developed.

EBN: (1) Health education: Health education was carried out through distribution of brochures, group lectures, push notifications and video teaching, etc. Patients were taught the etiology and theoretical knowledge of CHD and informed about the precautions to be taken after PCI so as to have a correct understanding of the disease. (2) Psychological counseling: Patients with CHD are most concerned about poor postoperative recovery and recurrence of coronary atherosclerosis. Nurses should pay attention to the emotional changes of patients and communicate with patients' regularly to eliminate their anxiety, fear and other adverse emotional reactions. Meanwhile, doctors should communicate with the patient's families, so that the families can give more care and support to the patients. (3) Dietary guidance: According to patient's conditions, an individual diet plan was developed, such as low-fat and low-cholesterol diet without spicy and irritating food, to improve the patient's unhealthy habits. Adequate fluid intake was ensured every day to prevent urinary retention and constipation. (4) Medication instruction: The patient was explained the importance of using thrombolytic and anticoagulant drugs, and instructed to follow the doctor's advice and take medication regularly. The patients' concerns were addressed in a timely manner during daily medication administration. (5) Pain management: In daily life, music, movies, operas, etc. were accessible for patients to improve their mood. The family members of the patients learned to massage and provided the patients with body and partial massages to relieve postoperative pain and improve sleep quality.

Exercise rehabilitation: After 3 days, the patient can perform passive movements in bed with the assistance of nurses. According to the physical conditions, the patients were instructed to perform activities such as standing at bedside and walking around the ward. The duration of each session was 10-15 min. During the rehabilitation activities, nurses need to closely monitor the patient's cardiac function and blood pressure. After discharge, the patients were instructed to practice Tai Chi, Baduanjin and other exercises for a long time to promote cardiac rehabilitation.

Outcomes measurement

Cardiac function indices

LVEF is related to the myocardial contractility. When the myocardial contractility is weakened, the stroke volume is less, and the ejection fraction is smaller. N-terminal pro-B-type natriuretic peptide (NT-proBNP) is predominantly secreted from the heart in response to hemodynamic stress mediated by volume and pressure overload. When pro-B-type natriuretic peptide (pro-BNP) increases in the blood, the patient is prone to heart failure. Before nursing (1 d postoperative), 1 month, 3 months, and 6 months postoperative, LVEF and left ventricular end-diastolic diameter (LVEDD) were measured using two-dimensional echocardiography (EDAN ultrasound diagnostic system, Acclarix LX86, Edan Instruments, Inc., Shenzhen, China), and serum pro-BNP was determined using a dry fluorescence immunoassay analyzer (FS-205, Guangzhou Wondfo Biotech Co., Ltd., China) in both groups to assess the cardiac function [12].

The 6-min walk test (6MWT)

6MWT is indicative of the patient's cardiac functional status through patient's exercise endurance. 6MWT was used to determine the 6-min walking distance (6MWD) of patients, and longer walking distance indicates better cardiac function [13].

Self-management behavior

The Coronary Artery Disease Self-Management Scale (CSMS) was developed by Professor Ren Hongyan to measure the ability of self-manage-

Table 1. Comparison of baseline data ($\bar{x}$±sd)/[n (%)]

Baseline data	Control group (n=100)	Study group (n=100)	t/χ^2	*P*
Sex			0.333	0.564
Male	58	62		
Female	42	38		
Mean age (years)	59.6±7.4	61.5±8.3	0.152	0.735
Site myocardial infarction			0.639	0.887
Anterior wall	20	24		
Inferior wall	26	27		
Anteroseptal	16	14		
Posterior wall	38	35		
Killip classification			0.500	0.479
Class I	47	52		
Class II	53	48		

ment behaviors in patients with CHD in the past 3 months. The scale covers 7 aspects: bad habits, symptoms, emotions, first aid, disease knowledge, daily life and treatment compliance, with 27 items on a 5-Likerd scale, with higher scores suggesting better self-management behavior [14]. The ability of self-management behavior was assessed before nursing (1 d postoperative), 3 months and 6 months postoperative using the CSMS scale.

Physiological indicators

Systolic blood pressure (SBP) and diastolic blood pressure (DBP) were measured using Philips Intellivue MP20 Patient Monitor (Koninklijke Philips Electronics N.V., the Netherlands) before nursing (1 d postoperative), 3 months and 6 months postoperative. Besides, 5 mL of venous blood was drawn from patients in the early morning to measure fasting blood glucose (FBG, mmol/L) using glucose oxidase method, and to measure total cholesterol (TC, mmol/L), triglyceride (TG, mmol/L), high-density lipoprotein (HDL, mmol/L) and low-density lipoprotein (LDL, mmol/L) using enzymic method with an automatic biochemical analyzer (Beckman Coulter Commercial Enterprise Co., Ltd., Shanghai, China).

Angina pectoris questionnaire

The Seattle Angina Questionnaire (SAQ) questionnaire was developed by Spertus et al. and is often used to evaluate the functional and prognostic outcomes of patients with CHD. The questionnaire covers five aspects, physical limitation, angina stability, angina frequency, treatment satisfaction and disease perception, with 19 items and 100 points for each item. Higher scores suggest better quality of life [15, 16].

Statistical methods

SPSS 21.0 software was used for data analysis. Measurement data conforming to normal distribution were described by mean ± standard deviation (SD), and t-test or repeated measures analysis of variance (ANOVA) followed by LSD test were used for comparison between the study group and the control group. Categorical variables and enumeration data were described by n (%), and comparison was performed by Chi-square test. $P<0.05$ was considered statistically significant.

Results

Comparison of baseline data

Clinical data such as sex, age, site of myocardial infarction and Killip classification showed no significant difference between the two groups ($P>0.05$), so the two groups were comparable (**Table 1**).

Comparative analysis of cardiac function

LVEF, LVEDD and pro-BNP showed no significant difference between the two groups before nursing ($P>0.05$). At 1, 3 and 6 months postoperative, the LVEF indices of both groups were higher than those before nursing, and LVEDD and pro-BNP indices of both groups were lower than those before nursing ($P<0.05$). At 3 and 6 months postoperative, LVEF indices in the study group were significantly higher than those in the control group ($P<0.05$), and pro-BNP indices were significantly lower than those in the control group ($P<0.05$) (**Figure 1**).

Comparative analysis of 6MWD

The 6MWD showed no significant difference between the two groups before nursing (*P*>

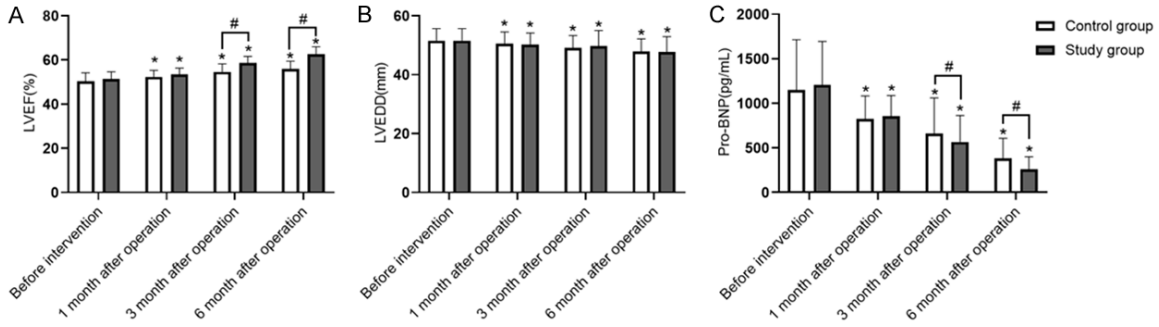

Figure 1. Comparison of cardiac function. A: LVEF, Left Ventricular Ejection Fraction; B: LVEDD, Left Ventricular End-Diastolic Diameter; C: Pro-BNP, Pro-B-Type Natriuretic Peptide. Compared with before intervention, $^{*}P<0.05$; comparison between the two groups, $^{\#}P<0.05$.

Table 2. Comparison of 6MWD (m) ($\bar{x}$±sd)

6MWD	Control group (n=100)	Study group (n=100)	*t*	*P*
Before intervention	247.46±27.83	252.96±26.53	0.786	0.482
1 month postoperatively	267.69±24.39*	278.66±22.09*	1.045	0.068
3 months postoperatively	271.64±25.77*	323.15±27.35*	10.324	0.000
6 months postoperatively	289.26±36.21*	373.16±33.24*	6.278	0.000

6MWD: The 6-Min Walk Distance. Compared with before intervention, $^{*}P<0.05$.

0.05). At 3 and 6 months postoperative, the 6MWD in both groups increased significantly compared with those before nursing ($P<0.05$), and the 6MWD at 3 and 6 months postoperative were significantly longer in the study group than those in the control group ($P<0.05$) (**Table 2**).

Comparative analysis of self-management behavior scores

The scores of self-management behavior showed no significant difference between the two groups before nursing ($P>0.05$). At 3 and 6 months postoperative, the total CSMS scores of patients in both groups increased compared with those before nursing, and the total CSMS scores except emotional management in the study group were significantly higher than those in the control group ($P<0.05$) (**Figure 2**).

Comparative analysis of physiological indicators

The physiological indicators such as blood pressure, blood glucose and blood lipids exhibited no significant difference between the two groups before nursing ($P>0.05$). At 3 and 6 months postoperative, the levels of SBP, DBP, FBG, TC, TG, HDL and LDL were decreased in both groups compared with those before nursing, and the SBP, DBP, FBG, TC, TG and LDL of patients in the study group were significantly lower than those in the control group at 3-month and 6-month postoperative visits ($P<0.05$) (**Figure 3**).

Comparative analysis of angina questionnaire scores

The scores of SAQ questionnaire exhibited no significant difference between the two groups before nursing ($P>0.05$). Compared with before nursing, the score of each aspect of SAQ questionnaire increased in both groups after nursing, and the scores in the study group were significantly higher than those in the control group ($P<0.05$) (**Figure 4**).

Comparative analysis of postoperative complications

The incidence of postoperative complications such as cardiogenic shock, angina pectoris, arrhythmia, heart failure and hypotension in the study group (4%) was significantly lower than that in the control group (13%) ($P<0.05$) (**Table 3**).

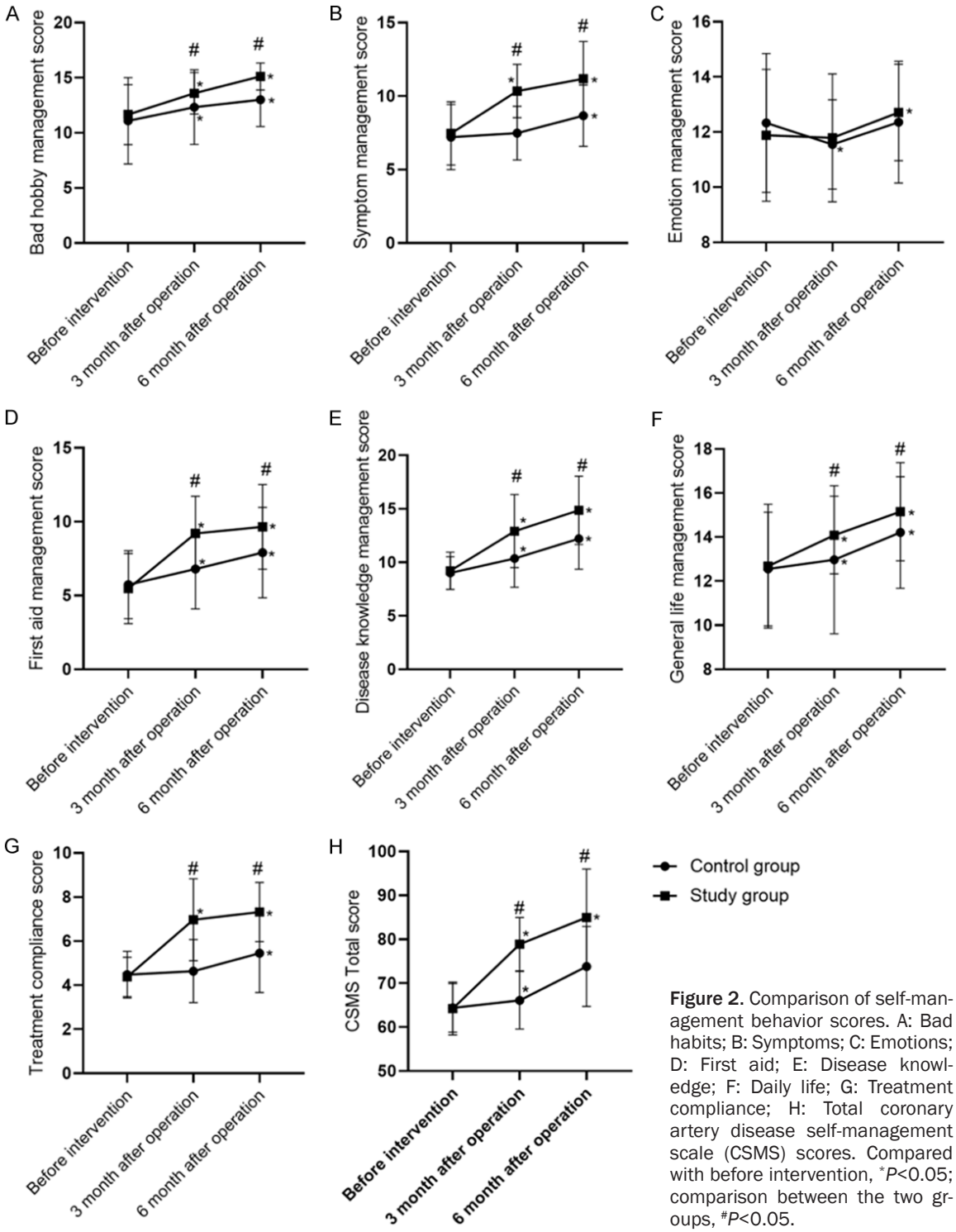

Figure 2. Comparison of self-management behavior scores. A: Bad habits; B: Symptoms; C: Emotions; D: First aid; E: Disease knowledge; F: Daily life; G: Treatment compliance; H: Total coronary artery disease self-management scale (CSMS) scores. Compared with before intervention, $^{*}P<0.05$; comparison between the two groups, $^{\#}P<0.05$.

Discussion

PCI is less invasive and more effective, and able to rapidly revascularize AMI patients in emergency condition and facilitate postoperative recovery, so it has become the standard treatment option for AMI [17]. However, AMI patients have low awareness of risk factors, resulting in 20-30% incidence of postoperative in-stent restenosis and even sudden cardiac death in severe cases [18]. The Interventional Nurses Council developed a definition of inter-

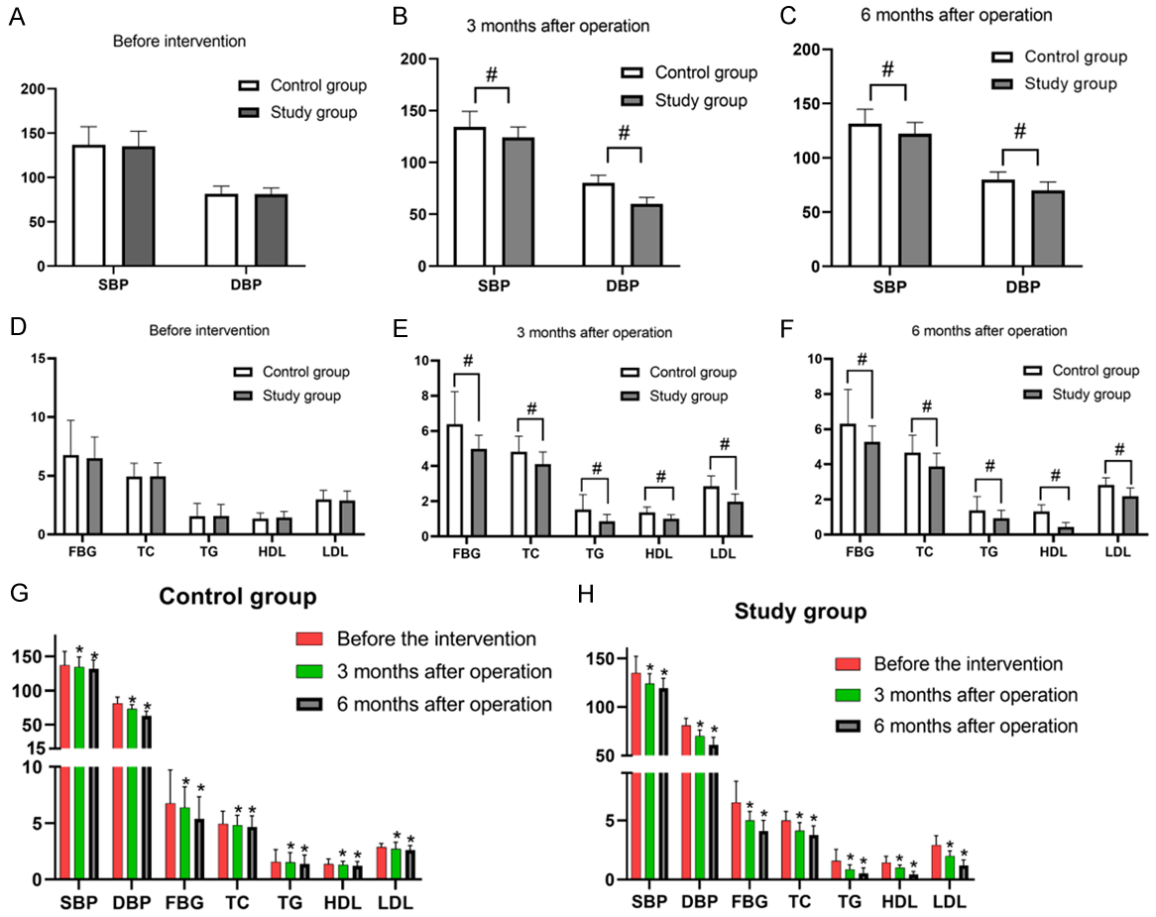

Figure 3. Comparison of physiological indicators. A-C: Blood pressure before intervention, at 3 months postoperative and at 6 months postoperative. D-F: Blood glucose and lipids before intervention, at 3 months postoperative and at 6 months postoperative. G, H: The changes of SBP, DBP, FBG, TC, TG, HDL and LDL over time were compared between the study group and the control group. Compared with before intervention, $^{*}P<0.05$; comparison between the two groups, $^{\#}P<0.05$. SBP: Systolic Blood Pressure; DBP: Diastolic Blood Pressure; FBG: Fasting Blood Glucose; TC: Total Cholesterol; TG: Triglyceride; HDL: High-Density Lipoprotein; LDL: Low-Density Lipoprotein.

ventional cardiac nursing (ICN's) in 2013. White et al. conducted a search and analysis of literature and confirmed that ICN's could improve treatment outcomes [19]. Liu et al. performed continuous nursing interventions for AMI patients after PCI, and improved the patients' psychological state and medication compliance [20]. Therefore, scientific nursing methods can improve the negative emotions and the medication compliance of AMI patients after PCI, which in turn can improve the efficiency.

LVEF is positively correlated with myocardial contractility, and postoperative regular aerobic exercise can reduce myocardial oxygen consumption, restore coronary artery elasticity, enhance myocardial contractility and improve LVEF levels [21]. Zhang et al. confirmed that community-based nursing after PCI could increase cardiac ejection fraction and exercise tolerance and improve the quality of life of AMI patients, and the rehabilitation group achieved the goal in 6MWD and aerobic exercise time [21]. In this study, no significant difference was observed in LVEF between the two groups at 1 month postoperative, which may be related to the unstable postoperative cardiac function of patients. Over time, LVEF in the study group was significantly higher than that in the control group at 3 and 6 months postoperative. After intervention, LVEDD in both groups were significantly reduced compared with those before nursing, but the differences between the two groups were not significant, which may be due

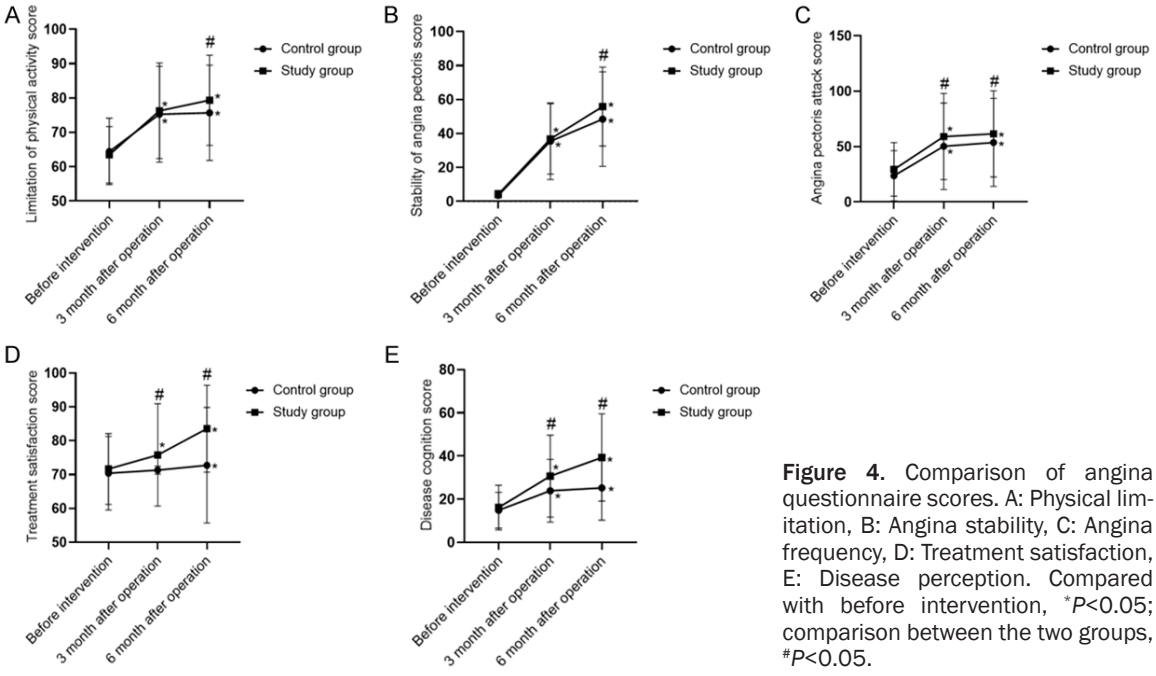

Figure 4. Comparison of angina questionnaire scores. A: Physical limitation, B: Angina stability, C: Angina frequency, D: Treatment satisfaction, E: Disease perception. Compared with before intervention, $^{*}P<0.05$; comparison between the two groups, $^{\#}P<0.05$.

Table 3. Comparison of postoperative complications [n (%)]

Complications	Control group (n=100)	Study group (n=100)	*t*	*P*
Cardiogenic shock	2	1	-	-
Angina pectoris	3	2	-	-
Arrhythmia	1	1	-	-
Heart failure	3	0	-	-
Hypotension	4	0	-	-
Incidence	13%	4%	7.976	0.158

to the short observation window. BNP concentration is correlated with infarct size. After intervention, the pro-BNP levels in both groups were significantly lower than those before nursing, and the decrease in the study group was more significant than that in the control group. In terms of LVEF, LVEDD and pro-BNP, patients in the study group had significant postoperative rehabilitation and better recovery of cardiac function. Therefore, in AMI patients after PCI, EBN combined with exercise rehabilitation guidance is worthy of popularization and application.

The 6MWT is currently recognized as the main method for evaluating the exercise capacity in patients with CVD. In this study, the 6MWD of patients in the study group at 3 and 6 months postoperative were improved significantly compared with those of the patients in the control group, indicating that patients in the study group had better recovery of cardiac function. Yeh et al. demonstrated that Tai Chi was a beneficial adjunctive therapy and that after 12 weeks of Tai Chi training in 30 patients with heart failure, the patients' 6MWD increased by 135 m, showing improved cardiac function, and the findings of this study are similar to those of Yeh et al. [22, 23].

The self-management ability of patients was significantly improved in all areas, which may be due to the fact that with the intervention of EBN combined with exercise rehabilitation, patients were guided in diet, medication and exercise, so their understanding of the disease was greatly improved. After discharge, nurses promptly answered the patients' questions during follow-up to eliminate their concerns and improve their self-management abilities. However, patients' mood fluctuated with many external factors, which were not easy to improve in a short period of time. The blood pressure, blood glucose and blood lipids in the study group were significantly lower than those in the control group at 3-month and 6-month postoperative visits. This may be because the patients participated in aerobic exercise in daily life with exercise guidance, which improved the body's sensitivity to insulin, glucose and lipid metabo-

lism and the metabolic rate, which accelerated fat consumption and decomposition. Through scientific dietary guidance, the intakes of high-calorie and high-fat food were reduced, which lowered the blood lipid level. This is in line with the findings of Rahmati et al., who conducted a meta-analysis and found that dietary and exercise interventions improved blood pressure, blood glucose and lipid indices in patients, thereby reducing the risk of CVD [24]. A pooled analysis of several published articles conducted by Zhang et al. found a significantly lower incidence of angina and restenosis in exercise group [25]. Anderson et al. demonstrated that exercise reduced the risk of death in patients with CVD and significantly improved their quality of life [26]. In this study, patients in the study group had significantly higher SAQ scores.

However, this research has some shortcomings. First, the exercise rehabilitation guidance method used in this study is relatively simple, and the included samples are insufficient. Second, the study period is short, and the patients have not been followed up for continuous prognosis, which might affect the accuracy of the research results. Last, elderly patients often have underlying diseases, which interfered with the progress of the study. Therefore, it is necessary for future study to improve the eligible criteria, extend the study period, conduct continuous prognostic follow-up of patients, and refer to more information and nursing experience, so as to construct a more scientific and reasonable exercise rehabilitation program and better improve the quality of life of patients after surgery.

In conclusion, EBV combined with exercise rehabilitation could significantly improve the patient's cardiac function and lower blood glucose, blood lipids and blood pressure. Patients' concerns and fears were eliminated, and treatment compliance was improved.

Disclosure of conflict of interest

None.

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