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Effect of new cardiac rehabilitation mode on cardiac function, mental state and quality of life of postoperative patients with acute myocardial infarction treated with atorvastatin calcium tablet

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Abstract. – OBJECTIVE: The purpose of this study was to explore the effect of a new cardiac rehabilitation mode on the cardiac function, mental state and quality of life of patients with acute myocardial infarction (AMI) after percutaneous coronary intervention (PCI) with atorvastatin calcium tablets.

PATIENTS AND METHODS: A total of 120 AMI patients treated with PCI and atorvastatin calcium tablets between January 2018 and January 2019 were recruited and assigned 1:1 to receive either novel cardiac rehabilitation (experimental group) or conventional cardiac rehabilitation (control group), with 60 cases in each group. Outcome measures for evaluating the effectiveness of the novel cardiac rehabilitation mode included cardiac function indices, 6 minutes walking distance test (6MWD), adverse mental state, quality of life (QOL), incidence of complications, and satisfaction on recovery.

RESULTS: Patients after novel cardiac rehabilitation care showed better cardiac function than those with conventional care ($p<0.001$). Patients had longer 6MWD and higher QOL after novel cardiac rehabilitation care vs. those given conventional care ($p<0.001$). The lower scores of adverse mental state in the experimental group suggested a better psychological status of patients after receiving novel cardiac rehabilitation care when compared with those with conventional care ($p<0.001$). Patients were also more satisfied with the novel modality of cardiac rehabilitation care than with conventional care ($p<0.05$).

CONCLUSIONS: The new cardiac rehabilitation mode can effectively improve the cardiac function of AMI patients after PCI plus atorvastatin calcium tablets, enhance their cardiac function, mitigate their negative emotions, and reduce the risk of complications. Further trials are required prior to clinical promotion.

Key Words:
Cardiac rehabilitation, Atorvastatin, Acute myocardial infarction.

Introduction

Patients with acute myocardial infarction (AMI) mostly present with chest pain or arrhythmias, which seriously compromise their quality of life. Currently, percutaneous coronary intervention (PCI) is the mainstay of treatment for AMI as it rapidly relieves the patient's myocardial ischemia, whereas it may cause side effects such as arterial perforation[1], which may lead to hemorrhage, cardiac crush, coronary artery dissection, or even acute myocardial infarction[2]. Complications, such as hematoma or bleeding at the puncture site and pseudoaneurysm, and post-PCI anxiety have also been reported[3]. To prevent disease recurrence in patients with PCI, additional atorvastatin therapy is usually incorporated to improve the long-term prognosis[4-6]. Atorvastatin tablets are mostly prescribed for patients with simple hyperlipidemia, coronary artery disease, cerebrovascular disease, lower limb atherosclerosis, and other atherosclerotic cardiovascular diseases[7]. The drug can lower low-density lipoprotein cholesterol (LDL-C) and delay the progression of atherosclerotic plaques[8]. Cardiac rehabilitation is an effective alternative to improve postoperative effect of PCI by enhancing cardiac function and reducing the occurrence of adverse cardiovascular events[9]. In the present study, a new cardiac rehabilitation care mode was introduced to evaluate the cardiac function, mental state and quality of life of AMI patients receiving PCI plus atorvastatin calcium tablets.

Patients and Methods

General Information

A total of 183 patients was initially enrolled in this clinical study, and finally 120 eligible patients with AMI receiving PCI combined with atorvastatin calcium tablets in our hospital from

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Table I. Comparison of general information.

Groups	Experimental group (n=60)	Control group (n=60)	χ^2/t	*p*
Gender			0.034	0.855
Male	32	33		
Female	28	27		
Age (years)	55.21±6.20	55.32±6.01	0.099	0.922
Hypertension	25	24	0.035	0.853
Diabetes	18	18	0.000	1.000
hyperlipemia	21	22	0.036	0.849
Body mass index (kg/m^2)	23.15±3.02	23.21±3.56	0.100	0.921
Area of infarction				
Inferior myocardium	25	26	0.034	0.853
Anterior-between myocardium	15	14	0.046	0.831
Lateral myocardium	12	10	0.223	0.637
Anterior myocardium	8	10	0.261	0.609

January 2018 to January 2019 were recruited for analysis after excluding 63 patients who failed to meet the inclusion criteria. The eligible patients were assigned 1:1 to receive either novel cardiac rehabilitation (experimental group) or conventional cardiac rehabilitation (control group), with 60 cases in each group. This experiment has been approved by the Ethics Committee of the Fifth People's Hospital of Wuhu and all patients signed informed consent forms. The two arms were well-balanced in terms of baseline patient profiles (p>0.05), as shown in Table I and Figure 1.

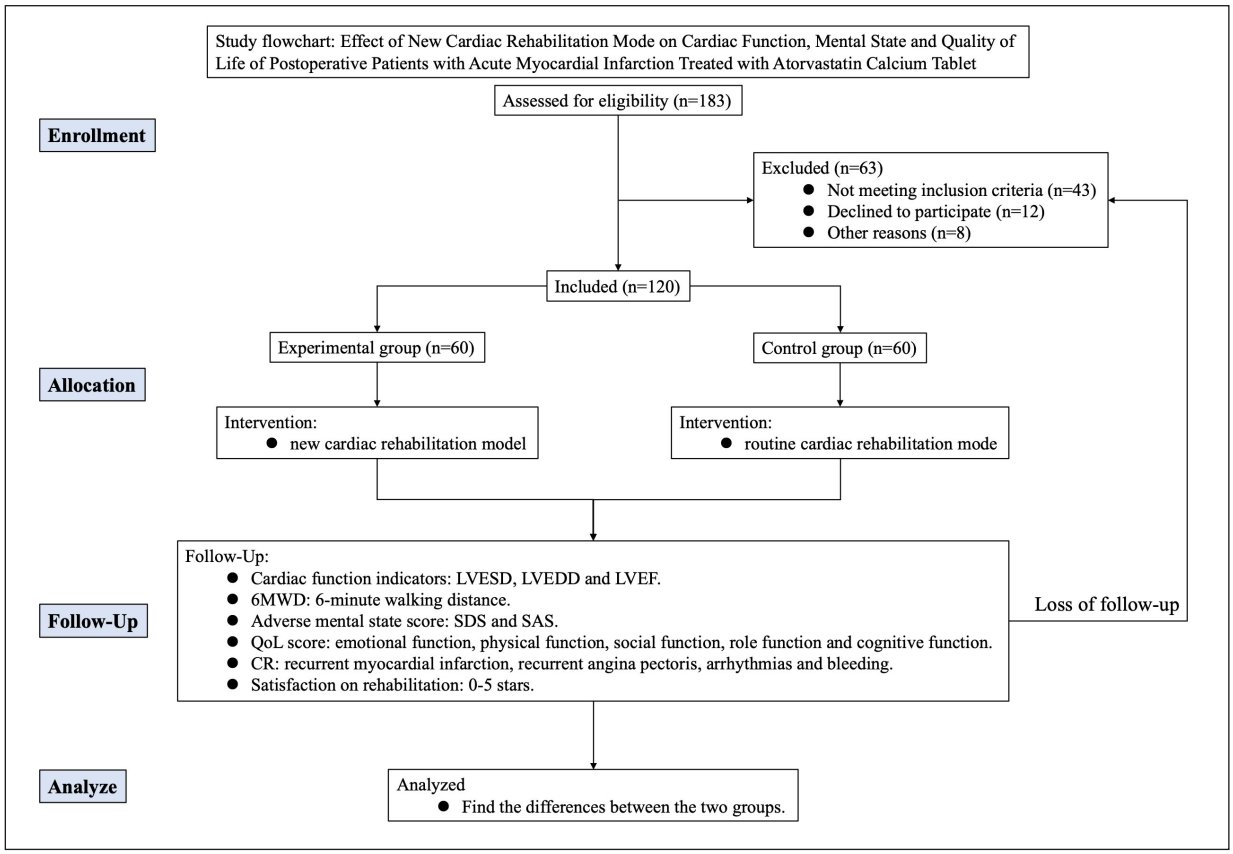

Figure 1. Study flowchart.

Inclusion Criteria

Patients or their family members fully recognized the study procedures and signed the informed form;

Patients diagnosed with AMI[10];

Patients with successful PCI treatment;

Patients with atorvastatin calcium tablets.

Exclusion Criteria

Angina pectoris after PCI;

Mental problems that prevented cooperation with this study;

Other organic diseases;

Immobility;

Life expectancy less than 1 year.

Termination Criteria

(1) Discontinuation of treatment during the experiment;

(2) Death;

(3) Patients who rescinded their consent;

(4) Patients who required other treatments or surgery during the experiment.

Methods

The control group was treated with conventional cardiac rehabilitation care.

The corresponding program was developed based on the guidelines for cardiac rehabilitation after PCI[11].

Patients were instructed to conduct simple off-bed activities and given health education.

The progress of patient's rehabilitation was recorded. Relevant activities were discontinued immediately in the event of chest tightness, angina, and other symptoms, followed by proper adjustment of the rehabilitation protocol.

Patients were given discharge instructions and home exercise instructions, and were advised to receive hospital examinations in the event of severe symptoms.

The experimental group was treated with new cardiac rehabilitation care on the basis of treatment for control group.

An individualized cardiac rehabilitation program was developed based on the patients' condition and on inquiries about their exercise and dietary habits.

On the first day after PCI, exercises at 2 metabolic equivalent (METs) were adopted and were focused on the large muscle groups of the legs[12-14].

On the second day, exercises at METS were adopted and were focused on the major muscle groups.

On the third day, exercises were maintained at 3 METS and designed for the training of major muscle groups.

From the fourth day to one week after PCI, exercises at 5 METS were adopted, and aerobic exercises were allowed.

One week after PCI, exercises at 6 METS were adopted, and the difficulty of exercise was increased to enhance patient's endurance based on their recovery.

The duration of cardiac rehabilitation care was 6 months.

Observation Criteria

(1) Cardiac function indicators[15]: cardiac function indices included left ventricular end-systolic internal meridian (LVESD), left ventricular end-diastolic internal diameter (LVEDD), and left ventricular ejection fraction (LVEF) before rehabilitation and 6 months after PCI. Echocardiography was performed to obtain the above parameters.

(2) 6-minute walking distance (6MWD) test: the 6MWD before and after rehabilitation intervention was compared between the two groups.

(3) Adverse mental state score[16]: the patients' psychological status was evaluated using the Self-Rating Depression Scale (SDS) and Self-Rating Anxiety Scale (SAS). The higher the score, the more severe the negative emotions.

(4) Quality of life (QOL) score[17]: the European Organisation for Research and Treatment of Cancer Quality of Life Questionnaire Core 30 (EORTC QLQ-C30) scale was used to evaluate the quality of life of the patients for the following aspects including emotional function, physical function, social function, role function and cognitive function. The lower the score, the worse the patient's QOL.

(5) Complications: complications included recurrent myocardial infarction, recurrent angina pectoris, arrhythmias and bleeding.

(6) Satisfaction on rehabilitation: the satisfaction on the rehabilitation care protocol was assessed, and the satisfaction scale was rated between 0 and 5 stars, with 5 stars indicating highly satisfied, 3-4 stars indicating satisfied, 2 stars and below indicating dissatisfied. The number of patients with satisfaction was recorded.

Statistical Analysis

SPSS 20.0 software (IBM Corp., Armonk, NY, USA) was used for data analyses, and GraphPad Prism 7 (GraphPad Software, La Jolla, CA, USA) was employed to plot the graphics. The measurement data were expressed as mean ± standard deviation ($\bar{x}\pm s$). Data not conforming to normal distribution were analyzed using the Mann-Whitney

U test. Data conforming to normal distribution were examined using the *t*-test. The count data were expressed as n (%) and analyzed using the Chi-square () test. $p<0.05$ signified that there was statistically significant difference.

Results

Comparison of Cardiac Function Indexes

After rehabilitation, LVESD was 34.12±2.58 mm in the experimental group and 39.54±2.65 mm in the control group ($p<0.001$). LVEDD was 52.23±3.45 mm in experimental group and 58.67±3.14 mm in the control group ($p<0.001$). LVEF of the experimental group was (70.23±5.36)%, and that of the control group was (63.25±6.14)% ($p<0.001$). In addition, after rehabilitation, LVESD, LVEDD and LVEF in control group and experimental group were significantly improved compared with those before rehabilitation ($p<0.05$) (Table II).

Comparison of 6MWD

After rehabilitation, the 6-minute walking distance of the experimental group was 501.41±30.23 m, and that of the control group was 451.21±30.45 m. Patients had longer 6MWD after novel cardiac rehabilitation care *vs.* those given conventional care ($p<0.001$) (Figure 2).

Table II. Comparison on cardiac function indexes ($\bar{x} \pm s$).

Category	Experimental group		Control group		*t*	*p*
LVESD (mm)	Before rehabilitation	40.56±3.45	Before rehabilitation	40.89±3.25	0.539	0.591
	After rehabilitation	34.12±2.58	After rehabilitation	39.54±2.65	11.351	0.000
	t	11.579	*t*	2.494		
	p	0.000	*p*	0.014		
LVEDD (mm)	Before rehabilitation	68.12±5.23	Before rehabilitation	68.87±5.41	0.772	0.442
	After rehabilitation	52.23±3.45	After rehabilitation	58.67±3.14	10.693	0.000
	t	19.645	*t*	12.631		
	p	0.000	*p*	0.000		
LVEF (%)	Before rehabilitation	53.45±5.48	Before rehabilitation	53.52±5.65	0.069	0.945
	After rehabilitation	70.23±5.36	After rehabilitation	63.25±6.14	6.634	0.000
	t	16.956	*t*	9.033		
	p	0.000	*p*	0.000		

Left ventricular end-systolic internal meridian (LVESD), left ventricular end-diastolic internal diameter (LVEDD), left ventricular ejection fraction (LVEF).

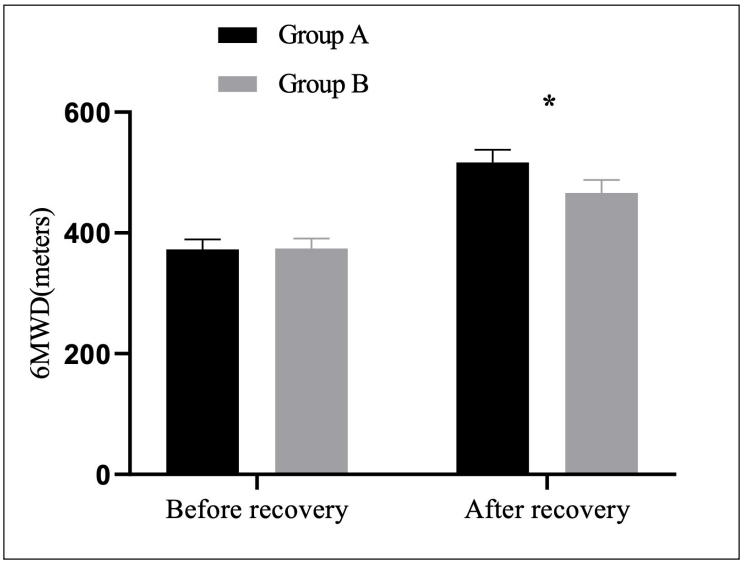

Figure 2. Comparison on 6 MWD ($\bar{\chi} \pm s$, m). The horizontal axis shows the timing of before and after rehabilitation, while the vertical axis displays the 6-minute walking distance (meters). It was the 6MWD of the experimental group before treatment was (361.20±23.12) m, and (362.56±23.45) m for control group. After treatment, such data of experimental group was (501.41±30.23) m and (451.21±30.45) m for control group. * indicated $p < 0.001$.

Comparison of Adverse Mental State Scores

Before rehabilitation, there was no significant difference in Self-Rating Anxiety Scale (SAS) and Self-Rating Depression Scale (SDS) scores between the two groups. After rehabilitation, SAS score and SDS score were 22.56±4.15 and 26.21±3.10 in the experimental group. In the control group, SAS scores were 37.56±4.10 and SDS scores were 38.41±4.26. The lower scores of adverse mental state in experimental group suggested a better psychological status of patients after receiving novel cardiac rehabilitation care when compared with those with conventional care (p<0.001) (Table III).

Comparison of QOL Scores

After rehabilitation, the scores of emotional function, physiological function, social function, role function and cognitive function of the experimental group were significantly higher than those of the control group (p<0.001), indicating a better quality of life of patients (Figure 3).

Comparison of CR

The incidence of adverse events in the experimental group was 6.7%, among which the incidence of recurrent myocardial infarction, recurrent angina pectoris and arrhythmia was 1.7%, 1.7% and 3.3%. The incidence of adverse events in the control group was 20.0%, among which the incidence of recurrent myocardial infarction, recurrent angina pectoris, arrhythmia and bleeding was 5.0%, 8.3%, 5.0% and 1.7% (Figure 4).

Comparison on Satisfaction with Rehabilitation

In the experimental group, 30 patients were highly satisfied with the rehabilitation results, 28

Table III. Comparison of adverse mental state scores ($\bar{x}$ ± s).

Groups	Before rehabilitation		After rehabilitation	
	SAS	SDS	SAS	SDS
Experimental group	54.50±4.32	56.41±4.20	22.56±4.15	26.21±3.10
Control group	54.59±4.30	56.10±4.15	37.56±4.10	38.41±4.26
t	0.114	0.407	19.917	17.937
p	0.909	0.685	0.000	0.000

t Self-Rating Depression Scale (SDS), Self-Rating Anxiety Scale (SAS)

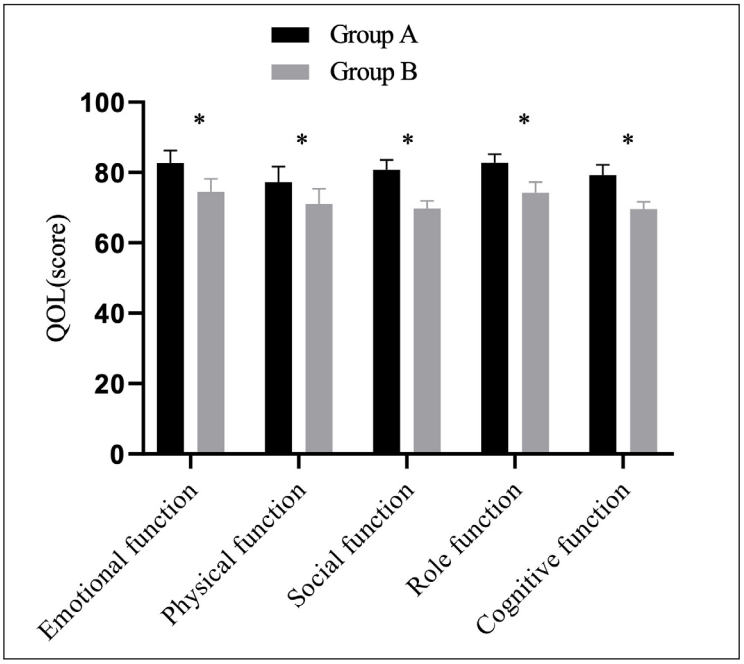

Figure 3. Comparison on QOL scores ($\bar{\chi}$ ± s). The horizontal axis states the scores of emotional function, physical function, social function, role function and cognitive function from left to right, and the vertical axis presents the quality of life (points). The score of emotional function in experimental group was (80.12±5.12), and that in control group was (72.02±5.10); The scores of physical function in experimental group and control group were (74.20±6.21) and (68.10±6.01) respectively; experimental group got the score of social function (78.81±4.02) while control group obtained (68.22±3.10); The role function score of experimental group was (81.12±3.41) while (72.23±4.16) for control group; The score of cognitive function in experimental group and control group were respectively (77.20±4.12) and (68.10±3.00). *indicated p < 0.001.

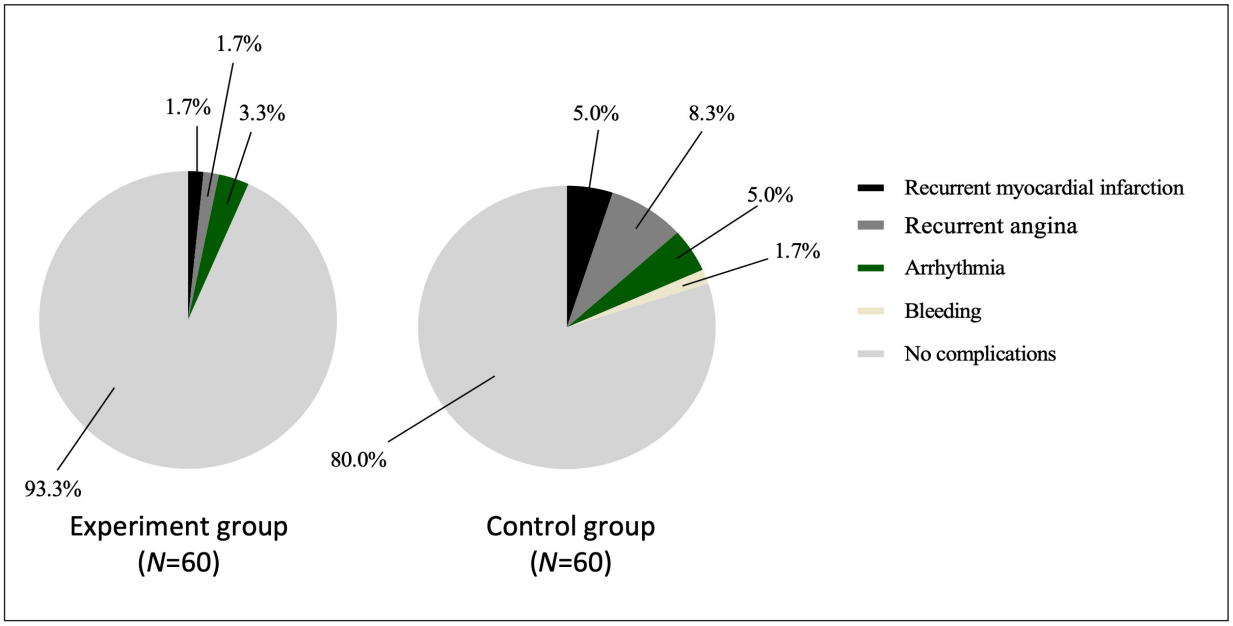

Figure 4. Comparison on CR [n(%)]. The black areas were recurrent myocardial infarction, areas in dark gray indicated recurrent angina, green areas showed arrhythmias, yellow area meant bleeding, and areas in light gray stated that no complications occurred. It was detected that 1 case (1.7%) of the experimental group and 3 cases (5.0%) of the control group had recurrent myocardial infarction; Recurrences of angina pectoris occurred to 1 patient (1.7%) in the experimental group and 5 patients (8.3%) in the control group; Arrhythmia occurred to 2 patients (3.3%) in the experimental group while 3 patients (5.0%) in the control group; Bleeding reoccurred to no cases (0.0%) of the experimental group and 1 case (1.7%) of the control group; There were 56 patients (93.3%) in the experimental group and 48 patients (80.0%) in the control group without complications.

were satisfied, 2 were dissatisfied, and the overall satisfaction rate was 96.7%. In the control group, 15 patients were highly satisfied with the rehabilitation results, 33 patients were satisfied, 12 patients were dissatisfied, and the overall satisfaction rate was 80.0%. Patients were also more satisfied with the novel modality of cardiac rehabilitation care than with the conventional care (p<0.05) (Table IV).

Discussion

Acute myocardial infarction is an acute coronary syndrome that results in myocardial ischemia and necrosis due to acute blockage of the coronary arteries[18]. The study found that patients after novel cardiac rehabilitation care showed better cardiac function than those with conventional care (p<0.001), indicating that individualized aerobic training program reduced the blood lipid levels in patients, enhanced their muscle density[19-21], and restored the myocardial blood supply. Patients had longer 6MWD and higher QOL after novel cardiac rehabilitation care *vs.* those given conventional care. Bateman et al[22] found that 60 AMI patients receiving the new cardiac rehabilitation treatment showed a 6MWD result of 503.21+30.12 meters, compared with that of 451.21+30.45 meters of the control group with the traditional cardiac rehabilitation treatment, which was consistent with the results obtained in the present study. Moreover, the lower scores of adverse

Table IV. Comparison on satisfaction with rehabilitation.

Groups	Highly satisfied (cases)	Satisfied (cases)	Dissatisfied (cases)	Overall satisfaction (%)
Experimental group	30	28	2	96.7 (58/60)
Control group	15	33	12	80.0 (48/60)
χ^2	8.000	0.834	8.086	8.086
p	0.005	0.361	0.004	8.086

mental state in experimental group suggested a better psychological status of patients after receiving novel cardiac rehabilitation care when compared with those with conventional care ($p<0.001$). The reason for this is that patients who received the new cardiac rehabilitation care recovered well, becoming more active and optimistic as a result of good exercise habits that increased dopamine levels. As a result, patients were also more satisfied with the novel modality of cardiac rehabilitation care than with the conventional care ($p<0.05$).

Acute myocardial infarction is caused by myocardial necrosis due to an imbalance in the supply and demand for oxygen as a result of an obstruction in the blood supply to the heart[23]. Influencing factors of AMI include thrombosis, intravascular plaque dislodgement, coronary artery spasm, or stenosis[24]. Common triggers of AMI in daily life include strenuous exercise, excessive fatigue, poor lifestyle habits, and mood swings. Since 2002, the overall incidence of acute myocardial infarction has been on the rise[25].

PCI is clinically recommended for the management of AMI. However, it only improves patients' cardiac condition in the short term with a high incidence of disease relapse, for which drug therapy or exercise therapy are necessary to enhance the long-term efficacy[26-29]. With the advancement of clinical care concepts, a new cardiac rehabilitation therapy has replaced the traditional cardiac rehabilitation treatment, as it promotes long-term effect of PCI and provides patients with better sports endurance, thereby improving their quality of life[30-32]. Medical evidence[33] suggests that cardiac rehabilitation can improve the quality of life and prognosis of patients with cardiovascular disease. Comprehensive cardiac rehabilitation, which includes exercise training, risk management, psychosocial support, patient education and clinical assessment, aims to ensure the return of patients with chronic or acute heart disease to an optimal physical, psychological and social state[34]. Psychological support is an important component of cardiac rehabilitation and can be effective in alleviating psychological stress in patients[35]. Studies in literature have shown that exercise-based cardiac rehabilitation can relieve anxiety and depression, while cardiac rehabilitation with psychological support offers more benefits in alleviating the patients' stress.

In Chinese medicine, it is believed that myocardial infarction is attributed to old age, physical weakness, stagnation of breath power, and blood stasis, which result in blood stagnation in the chest[36]. Therefore, to treat myocardial infarction, the key to treatment is to invigorate the blood, resolve blood stasis and regulate Qi to relieve pain[37]. Herbs such as peach kernel, safflower, red peony, bupleurum, angelica, dihuang and licorice are effective in promoting blood circulation and relieving pain for the management of AMI[38]. Moreover, *Panax ginseng*, *Salvia miltiorrhiza* and *Radix et Rhizoma Ginseng* can effectively facilitate to invigorate blood stasis, benefit breath power and nourish Yin[39]. Non-pharmacological treatments including acupuncture, Gua Sha, and acupressure during remission play a role in preventing angina attacks[40]. There are also some exercise therapies with TCM characteristics, such as five-animal play and Tai Chi, which are gentle exercises that are beneficial for the rehabilitation of patients[41-43].

Limitations

However, there are limitations to our experiment. Firstly, the sample size of our experiment was small and the scientific referability to clinical reference requires further improvement. Secondly, the mechanism of the new model of cardiac rehabilitation on the enhancement and prognostic effect of the treatment is unclear, and further investigations are required.

Conclusions

The new cardiac rehabilitation mode can effectively improve the cardiac function of AMI patients after PCI plus atorvastatin calcium tablets, enhance their cardiac function, mitigate their negative emotions and reduce the risk of complications. Further trails are required prior to clinical promotion.

Conflict of Interest

The authors declare that they have no conflict of interest.

Acknowledgements

Not applicable.

Ethics Approval

This experiment has been approved by the Ethics Committee of Anhui Wannan rehabilitation hospital, No. 5197191.

Informed Consent

Patients involved in this study signed an informed consent.

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