Analysis of the Impact of Different Intensities of Cardiac Exercise Rehabilitation on the Prognosis of Patients with Chronic Heart Failure

Peng Sun†, Yuanyuan Wang†, Meng Tian*, Hongjuan Wang*, Ping Li, Yuan Wei, Miao Sun, Han Liang,

Miao Yu, Yang Li, Pan Li

Affiliated Hospital of Hebei University, Baoding 071000, HeBei, China
†These authors contributed equally to this work and shared the first authorship.

Authors to whom correspondence should be addressed.

Abstract: *Objective:* This study mainly focuses on the impact of different intensities of cardiac exercise rehabilitation on the prognosis of patients with chronic heart failure. *Method:* This study selected 108 patients with chronic heart failure admitted to the hospital between April 2022 and November 2022 as the subjects of this study. The patients were divided into high-intensity interval exercise group HIIT (37 cases), moderate-intensity continuous exercise group MICT (36 cases), and control group 35 cases. Among them, the high-intensity interval exercise group and moderate-intensity continuous exercise group received 6 months and 12 months of exercise rehabilitation intervention, respectively, while the control group did not receive any exercise rehabilitation intervention measures. Then, compare the changes in ejection fraction, six-minute walking distance, NT-proBNP, and other aspects among the three groups of patients. *Result:* Through research, it was found that the LVEF values of the high-intensity interval exercise group and the moderate-intensity continuous exercise group were higher than those of the control group. The six-minute walking distance of the high-intensity interval exercise group and the moderate-intensity continuous exercise group was higher than that of the control group. The values of NT-proBNP in the high-intensity interval exercise group and the moderate-intensity continuous exercise group were lower than those in the control group. The above research results indicate that the difference is statistically significant, $P < 0.05$. *Conclusion:* According to the research results, different intensities of cardiac exercise rehabilitation have a significant impact on the prognosis of patients with chronic heart failure. It can not only improve the LVEF and prolong the six-minute walking distance of patients, but also effectively reduce NT-proBNP. Therefore, it is worthy of clinical application and promotion.

Keywords: High-intensity interval exercise; Moderate intensity continuous exercise; Chronic heart failure patients; Prognosis

1. Introduction

Chronic heart failure (CHF) is a common cardiovascular disease characterized by the inability of the heart to effectively pump blood, leading to poor perfusion of tissues and organs throughout the body. This disease is often accompanied by symptoms such as shortness of breath, fatigue, and edema, which seriously affect the quality of life of patients. In recent years, with the continuous promotion and application of cardiac rehabilitation exercise in clinical practice, more and more studies have shown that cardiac rehabilitation exercise has significant therapeutic effects on the prognosis of patients with chronic heart failure [1]. This study aims to explore the impact of different intensities of cardiac exercise rehabilitation (such as high-intensity interval exercise, moderate-intensity continuous exercise, etc.) on the prognosis of patients with chronic heart failure, to provide a scientific basis for clinical treatment and rehabilitation, help patients improve cardiopulmonary function, enhance myocardial contractility, improve exercise ability and quality of life. The detailed report is as follows.

2. Basic resources and methods

2.1. Basic resources

108 patients with chronic heart failure admitted to the hospital between April 2022 and November 2022 were selected as the subjects of this study, and the patients were divided into high-intensity interval exercise group HIIT (37 cases), moderate-intensity continuous exercise group MICT (36 cases), and control group 35 cases. Among them, there were 22 males and 15 females in the high-intensity interval exercise group. The disease types included 8 patients with hypertension, 12 patients with coronary heart disease, 9 patients with diabetes, and 8 patients with rheumatic heart disease. From the perspective of exercise habits, 9 cases had exercise habits and 28 cases had no exercise habits. 19 cases were classified as grade I, 11 cases as grade II, and 7 cases as grade III. There were 21 males and 15 females in the moderate-intensity continuous exercise group. The disease types included 8 patients with hypertension, 11 patients with coronary heart disease, 8 patients with diabetes, and 9 patients with rheumatic heart disease. From the perspective of exercise habits, 9 cases had exercise habits and 27 cases had no exercise habits. 18 cases were classified as grade I, 11 cases as grade II, and 7 cases as grade III. There were 20 males and 15 females in the control group. The disease types included 7 patients with hypertension, 11 patients with coronary heart disease, 9 patients with diabetes, and 8 patients with rheumatic heart disease. From the perspective of exercise habits, 10 cases had exercise habits and 25 cases had no exercise habits. 17 cases were classified as grade I, 10 cases as grade II, and 8 cases as grade III. The three groups of patients are comparable, and the differences are statistically significant ($P > 0.05$).

Inclusion criteria: (1) Patients must be diagnosed with chronic heart failure, have a relatively stable condition, and be suitable for participating in cardiac rehabilitation exercises; (2) According to the New York Heart Association (NYHA) classification criteria for heart function, patients- included should have heart function between grade I and grade III; (3) Patients need to be able to complete the prescribed intensity and duration of exercise rehabilitation training according to the requirements of the research protocol; and (4) Both the patient and their family members have signed informed consent forms.

Exclusion criteria: (1) Simultaneously suffering from other serious diseases or having exercise contraindications, such as malignant tumors, severe liver and kidney dysfunction, acute myocardial infarction, unstable angina, severe arrhythmia, etc.; (2) Suffering from mental or cognitive disorders; and (3) Patients and their families cannot fully cooperate.

2.2 Method

The control group received routine medication treatment, dietary management, psychological guidance, and exercise guidance.

Based on implementing conventional treatment, the intervention group received exercise rehabilitation intervention.

(1) Guidance on rehabilitation knowledge. After receiving conventional drug treatment, the intervention group needs to use various forms such as lectures, video teaching, and one-on-one consultations to explain in detail the pathological and physiological mechanisms of chronic heart failure, the importance of exercise rehabilitation, expected effects, and possible risks to patients and their families to make patients aware of the importance of exercise rehabilitation before taking corresponding exercise exercises. This will enable patients to have a comprehensive and systematic understanding of it, thereby increasing their participation in exercise rehabilitation.

(2) Assessment before exercise. To ensure the safety of patients during exercise, it is necessary to scientifically evaluate the cardiac function status, exercise endurance, muscle strength, flexibility, balance ability, and other aspects of the intervention group patients. In the evaluation process, objective indicators such as electrocardiogram, echocardiogram, 6-minute walk test, grip strength test, etc. can be used, combined with the patient's subjective feelings for comprehensive evaluation [2].

(3) The process of movement.

(A) From the perspective of exercise types, aerobic exercise (such as walking, jogging, cycling), resistance training (such as dumbbell exercises, elastic band training), or flexibility training should be selected according to the specific situation of the patient;

(B) From the perspective of exercise intensity, different intensities of exercise should be set according to the patient's cardiac function grading and evaluation results, such as medium intensity or high intensity, and the intensity should gradually increase to avoid overexertion;

(C) From the perspective of the exercise process, the high-intensity interval exercise group can start with a maximum exercise load of 20%, then train for 16 minutes to reach a maximum exercise load of 70%, and gradually transition to low intensity after resting for 3 minutes. The moderate-intensity continuous exercise group also starts with a maximum exercise load of 20%, then reaches the predetermined target intensity heart rate, and continues for 35 minutes before decreasing to low intensity. In terms of exercise frequency, it is recommended to exercise 3–5 times a week and maintain a training cycle of one year;

(D) After the exercise, the patient should make an objective and correct self-evaluation based on their actual situation, slowly adjust their breathing rhythm, replenish a small amount of water, relax, and massage the joints. After everything is stable, they can move on to the next step. Fourthly, health guidance after discharge. Develop a post-discharge exercise rehabilitation plan for patients and encourage them to continue exercising to consolidate their rehabilitation during hospitalization. At the same time, through telephone, WeChat, home visits and other methods, regularly understand the patient's exercise rehabilitation situation, answer their questions, and provide necessary guidance and support.

2.3. Observation indicators

Observe and compare the changes in ejection fraction, quality of life score, six-minute walking distance, NT-proBNP, and other aspects among the high-intensity interval exercise group, moderate-intensity continuous exercise group, and control group.

2.4. Statistical methods

Statistical software SPSS 26.0 was used for data analysis and processing, with mean ± standard deviation (SD) representing metric data and K-S representing the normality test. Analysis of variance was used to compare the means between the three groups. The count data was analyzed by χ^2 test, and the difference was statistically significant with $P < 0.05$.

3. Result

3.1. Effect of different intensities of cardiac exercise rehabilitation on LVEF

This study analyzed the results of two-factor repeated measures ANOVA and found that the LVEF levels of the three groups of patients showed an increasing trend with time, with the HIIT group having the highest level and the control group having the lowest. This indicates that different intensities of cardiac exercise rehabilitation have a significant effect on improving patients' ejection fraction, with statistical significance $P < 0.05$ (**Table 1**).

Table 1. Comparison of LVEF among three groups of patients (mean ± SD)

Group	Baseline	12 months	6 months
HIIT group ($n = 37$)	42.28 ± 1.45	44.58 ± 2.37	47.92 ± 2.87
MICT group ($n = 36$)	41.47 ± 1.44	43.77 ± 0.47	44.00 ± 2.13
Control group ($n = 35$)	41.84 ± 1.49	42.54 ± 2.05	43.14 ± 2.05
F-value$_{Time}$		115.43	
P-value$_{Time} < 0.001$			
F-value$_{Group}$		10.14	
P-value$_{Group} < 0.001$			

Note: HIIT refers to the high-intensity interval exercise group; MICT is a moderate-intensity continuous exercise group.

3.2. Effect of different intensities of cardiac exercise rehabilitation on six-minute walking distance

This study analyzed the results of two-factor repeated measures ANOVA and found that the three groups of patients showed an increasing trend in the six-minute walking distance with time, with the HIIT group having the highest level and the control group having the lowest level. This indicates that different intensities of cardiac exercise rehabilitation have a significant effect on extending the six-minute walking distance, with statistical significance $P < 0.05$ (**Table 2**).

Table 2. Comparison of six-minute walking distance among three groups of patients (mean ± SD)

Group	Baseline	12 months	6 months
HIIT group ($n = 37$)	362.53 ± 8.78	405.7±8.04	440.10±9.64

MICT group ($n = 36$)	362.18 ± 11.65	388.04±9.84	434.14±8.01
Control group ($n = 35$)	361.48 ± 1.69	371.95±4.87	378.32±4.28
F-value$_{Time}$		599.12	
P-value$_{Time}$ < 0.001			
F-value$_{Group}$		9422.84	
P-value$_{Group}$ < 0.001			

Note: HIIT refers to the high-intensity interval exercise group; MICT is a moderate-intensity continuous exercise group.

3.3. Effect of different intensities of cardiac exercise rehabilitation on NT-proBNP

This study analyzed the results of two-factor repeated measures ANOVA and found that the three groups of patients showed a decreasing trend in NT-proBNP over time, with the HIIT group having the lowest level and the control group having the highest level. This indicates that different intensities of cardiac exercise rehabilitation have a significant effect on reducing NT-proBNP, with statistical significance $P < 0.05$ (**Table 3**).

Table 3. Comparison of NT-proBNP among three groups of patients (mean ± SD)

Group	Baseline	12 months	6 months
HIIT group ($n = 37$)	2920.48±2125.28	2538.14±28.26	1138.34±29.14
MICT group ($n = 36$)	2856.15±2123.75	2508.04±56.81	1508.13±57.89
Control group ($n = 35$)	2874.52±2126.64	2689.76±53.65	2289.96±54.65
F-value$_{Time}$		95.76[b]	
P-value$_{Time}$ < 0.001			
F-value$_{Group}$		2.84	
P-value$_{Group}$ < 0.001			

Note: HIIT refers to the high-intensity interval exercise group; MICT is a moderate intensity continuous exercise group.

4. Discussion

Heart failure (CHF) is a difficult-to-cure disease that affects the lives of patients. Every year, many patients in the United States are diagnosed with chronic heart failure, which requires high medical costs and a low 5-year survival rate during treatment, posing a significant burden on the country. Heart failure is characterized by symptoms such as difficulty breathing and swelling of the ankle joint [3]. During the attack, the myocardium is damaged, heart function is reduced, and patients need to rest in bed with decreased exercise ability. In order to reduce the incidence of CHF, a multi-level comprehensive intervention evaluation is needed. Studies have found that cardiac rehabilitation (CR) can reduce recurrent cardiac events. Therefore, personalized exercise prescriptions should be developed for stable patients. Continuous training can increase cardiac output, improve left ventricular remodeling, enhance cardiac function while strengthening skeletal muscle strength and joint mobility, and improve exercise tolerance [4].

To clarify the impact of cardiac rehabilitation on patients with chronic heart failure, this study conducted in-depth research on the effects of different intensities of cardiac exercise rehabilitation on the prognosis of patients with chronic heart failure. Through research, it has been found that high-intensity interval exercise and moderate-

intensity continuous exercise have significant therapeutic effects on improving patients' LVEF, extending six-minute walking distance, and effectively reducing NT-proBNP, which can greatly improve patients' quality of life. Although different intensities of cardiac exercise rehabilitation can effectively alleviate the condition of patients with chronic heart failure, it is still necessary to continuously improve the diagnosis and treatment level of heart failure, and strengthen research in the field of cardiac rehabilitation, so that patients can improve their cardiac function through personalized exercise prescriptions and continuous rehabilitation training.

5. Conclusion

In summary, the treatment and rehabilitation of heart failure is a complex and long-term process that requires joint efforts from multiple aspects such as medical care, rehabilitation, and prevention. Related studies have shown that different intensities of cardiac rehabilitation have strong improvement effects on heart failure, greatly improving the quality of life of patients. Therefore, it is worth applying and promoting in clinical practice.

Disclosure statement

The authors declare no conflict of interest.

References

[1] Li X, Wang J, Shao L, et al., 2024, The Impact of Progressive Exercise Rehabilitation Nursing on Exercise Endurance, Quality of Life, and Adverse Cardiac Events in Patients with Chronic Heart Failure. Journal of Rare Diseases, 31(3): 123–124.

[2] Lu W, Liao Y, Deng Y, et al., 2024, The Effect of Individualized Cardiac Exercise Rehabilitation Training Based on Metabolic Equivalents on Patients with Chronic Heart Failure. Heart Journal, 36(2): 166–170.

[3] Miao X, 2023, The Impact of Different Intensities of Cardiac Exercise Rehabilitation on the Prognosis of Patients with Chronic Heart Failure, thesis, North China University of Science and Technology.

[4] Jiang H, 2022, Observation of the Therapeutic Effect of Cardiac Rehabilitation Exercise Training on Patients with Chronic Heart Failure. Modern Drug Application in China, 16(17): 177–179.