

Efficacy of Stepwise Cardiac Rehabilitation Guided by Cardiopulmonary Exercise Testing in Patients with Chronic Heart Failure

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Abstract: **Objective:** To analyze the rehabilitation benefits brought by stepwise cardiac rehabilitation guided by cardiopulmonary exercise testing (CPET) for patients diagnosed with chronic heart failure. **Methods:** Retrospective analysis was conducted on clinical data of 56 patients receiving routine rehabilitation care (control group) and another 56 patients receiving CPET-guided stepwise cardiac rehabilitation (observation group), all admitted between January and December 2025. Cardiac function and daily living ability were compared between the two cohorts. **Results:** After intervention, the observation group obtained superior cardiac function indicators and stronger daily living capacity relative to the control group (all $P < 0.05$). **Conclusion:** Stepwise cardiac rehabilitation formulated under the guidance of cardiopulmonary exercise testing facilitates the recovery of impaired cardiac function and improves daily activity performance among chronic heart failure patients.

Keywords: Cardiopulmonary Exercise Testing; Stepwise Cardiac Rehabilitation Training; Chronic Heart Failure

1. Introduction

Chronic heart failure is the most common type of cardiovascular disease with a high incidence. It has a long disease cycle and reduced cardiac pump function is the main clinical manifestation of this part of patients^[1-2]. With the continuous development of the disease, it will directly affect the normal daily life of patients. In the course of treatment for patients with chronic heart failure, combined with the changes in the patient's condition, a targeted rehabilitation training program was developed for the patient, which indirectly helped the patient's damaged cardiac function to recover. The step-by-step cardiac rehabilitation training under the guidance of

cardiopulmonary exercise test is a new scheme for the current clinical rehabilitation training for patients with chronic heart failure. Based on the results of cardiopulmonary exercise test, the cardiac rehabilitation training program for patients can be formulated, which can promote all aspects of cardiac rehabilitation training measures to be more in line with the actual situation of patients and increase the pertinence of rehabilitation training programs^[3-4]. This study mainly focuses on the value of the rehabilitation training program to improve the cardiac function and living ability of patients.

2. Materials and Methods

2.1 General Data

Clinical records of patients treated from January to December 2025 were retrospectively collected. Fifty-six patients receiving conventional rehabilitation nursing were assigned to the control group, while another 56 patients receiving CPET-guided stepwise cardiac rehabilitation formed the observation group.

In the control group, there were 30 males and 26 females, aged 54 to 78 years old with an average age of (63.45 ± 2.33) years.

The observation group included 31 males and 25 females, whose age ranged from 53 to 77 years, with a mean age of (62.34 ± 2.64) years.

Statistical comparison revealed no significant inter-group differences in baseline demographic data ($P > 0.05$).

2.2 Methods

The patients in the control group received routine nursing during the recovery process, paid close attention to the changes of the patients' condition, and guided the patients to actively participate in rehabilitation training. Walking exercises should be carried out with the assistance of family members, once 30 min, once a day. And gradually carry out up and down stairs training, training volume combined with

patient tolerance control. In the process of rehabilitation training, the observation group needs to formulate a step-by-step rehabilitation training program based on the results of the patient's cardiopulmonary exercise test. (1) Adaptive training (1 ~ 4 weeks). The anaerobic threshold of patients was measured by cardiopulmonary exercise test. Firstly, the patients were guided to carry out short-distance aerobic walking training, 20 minutes each time, once a day. And guide the patients to deep breathing training, a single 15 min, 3 ~ 5 times a day. (2) Intensity increasing period (5 ~ 10 weeks). The rehabilitation exercise intensity of patients at this stage should be set to 80 % of the anaerobic threshold. Conduct wall push-up training, 10 times as a group, 3 groups per day. The patients were instructed to take brisk walking training, 30 minutes each time, twice a day. During the training process, the heart rate should be measured to avoid exceeding the set intensity value. Encourage patients to reasonably increase the training intensity or extend the single training time according to their own tolerance. (3) Maintenance period (11 ~ 12 weeks). The exercise intensity was set to an anaerobic threshold of 90 %. The patients were instructed to take brisk walking training or jogging training for 10 ~ 15 minutes each time, 2 ~ 3 times each time. Also need to pay attention to the heart rate control, shall not exceed the set strength value. Starting resistance training, the use of small size sandbags to increase the load, in accordance with the principle of gradual

increase, to avoid excessive single exercise.

2.3 Observation Indicators

Cardiac function indicators: Echocardiography was implemented to measure cardiac function parameters before and after the entire rehabilitation intervention.

Daily living ability: The Modified Barthel Index (MBI) was adopted to evaluate patients' capacity for daily self-care, where higher scores corresponded to stronger independent living ability. A six-minute walking test was also conducted to quantify overall exercise tolerance.

2.4 Statistical Methods

SPSS 25.0 software was used for all statistical analyses. Measurement data including cardiac function metrics and MBI scores were presented as mean \pm standard deviation and compared by independent t-test. Count data were expressed as percentages and analyzed via Chi-square test. A P-value less than 0.05 indicated statistically significant differences.

3. Results

3.1 Inter-Group Comparison of Cardiac Function

After rehabilitation, all cardiac function indicators of the observation group were significantly better than those of the control group ($P < 0.05$). Detailed data are displayed in Table 1.

Table 1. Comparison of Cardiac Function Indicators Between Two Groups ($\bar{x} \pm s$)

Group	Number of Cases	Left Ventricular End-Diastolic Diameter (mm)		Left Ventricular End-Systolic Diameter (mm)	
		Before Nursing	After Nursing	Before Nursing	After Nursing
Observation	56	60.45 \pm 1.68	50.45 \pm 2.34	57.68 \pm 1.68	50.36 \pm 2.34
Control	56	60.36 \pm 1.74	54.26 \pm 2.15	57.75 \pm 1.75	53.17 \pm 2.15
t	-	0.279	8.972	0.216	6.617
P	-	0.781	<0.001	0.829	<0.001

3.2 Inter-group Comparison of Daily Living Ability

Markedly improved daily living capacity was

observed in the observation group after intervention, with statistical significance against the control group ($P < 0.05$). See Table 2.

Table 2. Comparison of Daily Living Ability Between Two Groups ($\bar{x} \pm s$)

Group	Number of Cases	MBI Score		6-Minute Walking Distance (m)	
		Before Nursing	After Nursing	Before Nursing	After Nursing
Observation	56	50.36 \pm 2.45	68.45 \pm 2.05	358.45 \pm 10.68	401.25 \pm 12.68
Control	56	50.67 \pm 2.23	53.67 \pm 2.16	361.26 \pm 10.74	386.37 \pm 12.74
t	-	0.700	37.141	1.388	6.195
P	-	0.485	<0.001	0.168	<0.001

4. Discussion

The treatment cycle of patients with chronic

heart failure is long. In the process of rehabilitation, patients are accurately guided to carry out rehabilitation training. In the process of

rehabilitation training, it can improve the systolic and diastolic function of the heart and improve the cardiac function of the patients. Under the action of conventional rehabilitation training programs, although it can help patients recover their damaged functions, the personalization and pertinence of rehabilitation training programs need to be improved^[5-6].

The step-by-step cardiac rehabilitation training under the guidance of cardiopulmonary exercise test is based on the cardiopulmonary exercise test of the patient, judging the patient's tolerance and formulating the step-by-step cardiac rehabilitation training program, which can ensure that the patient's rehabilitation training content and training intensity in each recovery stage can be more in line with the patient's specific situation and avoid excessive training^[7]. At the same time, according to the principle of gradual and gradual adjustment of training programs and training intensity, can achieve a steady improvement in patients with cardiac function. In this study, the level of cardiac function in the observation group was significantly improved and higher than that in the control group, and the ability of life activities was higher than that in the control group. It shows that under the action of the rehabilitation training program, it can help the patients to recover the damaged cardiac function, improve the daily activity ability of the patients, and help to comprehensively guarantee the rehabilitation training effect of the patients.

In a comprehensive study, step-by-step cardiac rehabilitation training under the guidance of cardiopulmonary exercise test for patients with chronic heart failure can promote the recovery of cardiac function.

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