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Influences of long-term aerobic exercise combined with resistance training on the cardiac function, exercise tolerance, and living quality of patients with myocardial ischemia induced by coronary heart disease.

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Abstract

Objective: This study aims to explore the influences of long-term aerobic exercise combined with resistance training on the cardiac function, exercise tolerance, and living quality of patients with myocardial ischemia induced by Coronary Heart Disease (CHD).
Methods: A total of 100 patients with CHD-induced myocardial ischemia treated in our hospital from February 2015 to February 2016 were chosen. These patients were divided into control and experimental groups through the random number method. Both groups were given conventional drug therapy. Then, the control group received a 3-month resistance training period, whereas the experimental group received a 3-month combined aerobic exercise-resistance training regimen. The cardiac function, exercise tolerance, and living quality of the two groups were then compared.
Results: After the 3-month training period, the experimental group is found superior to the control group in all of the cardiac function indexes. The walking distance in 6 min is longer and the living quality score is significantly lower than those of the control group (P<0.05).
Conclusions: Long-term aerobic exercise combined with resistance training can improve the cardiac function, exercise tolerance, and living quality of patients with CHD-induced myocardial ischemia. Hence, this exercise program holds wide applications.

Keywords: Long-term aerobic exercises, Resistance training, CHD-induced myocardial ischemia.

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Introduction

Coronary Heart Disease (CHD)-induced myocardial ischemia is a common heart condition in clinics. Patients with CHD suffer from atherosclerosis and coronary artery stenosis and thus experience insufficient coronary arterial blood supply and reduced myocardial blood flow. The main clinical symptoms include chest pain, shortness of breath, palpitations, chest heaviness, and weakness, which seriously threaten the life safety and living quality of patients [1]. Aerobic exercises and resistance training in clinics are effective means to improve the cardiac function, exercise tolerance, and living quality of patients with CHD-induced myocardial ischemia [2]. A total of 100 patients with CHD-induced myocardial ischemia treated in our hospital from February 2015 to February 2016 were recruited to our study. Then, the influences of long-term aerobic exercise combined with resistance training on their cardiac function, exercise tolerance, and living quality were explored. The results are reported in the following text.

General Information and Method

General information

A total of 100 patients with CHD-induced myocardial ischemia treated in our hospital from February 2015 to February 2016 were gathered, and they were divided into control and experimental groups by the random number method. The diagnoses of all the selected respondents were conformed to the "Naming and Diagnosis Standard of Ischemic Heart Disease" of the World Health Organization. The Left Ventricular Ejection Fraction (LVEF) of the ultrasonic cardiogram was smaller than 40%. The patients with absolute contraindication against cardiopulmonary exercise testing as regulated strictly by the New York Heart Disease Academy of America, serious organ complications or motor neuromuscular disorder, acute myocardial infarction and severe arrhythmia in 1 month, and serious metabolic diseases were eliminated. The experimental group involved 50 patients aged 31.4-76.9 years old and 61.7 ± 4.7 years old on average. The cardiac functions were graded into levels II (24 patients) and III (16 patients). The control group involved 50 patients aged 30.5-76.4 years old and 62.4 ± 4.4 on average. In this group, the cardiac functions were graded into levels II (25 patients) and III (15 patients). All the patients and family members participated in this study voluntarily. All the patients were comparable in gender, age, and physical conditions (P>0.05).

Sample selection

The inclusion criteria are as follows: age over 30 years old; myocardial ischemia caused by valvular disease, cardiac damage, and heart overload; stable state of the illness; levels II-III of cardiac functions; and LVEF smaller than 40%.

The exclusion criteria are as follows: with absolute contraindication against cardiopulmonary exercise testing as regulated strictly by the New York Heart Disease Academy of America, serious organ complications or motor neuromuscular disorder, history of acute myocardial infarction and severe arrhythmia in the past 1 month, and serious metabolic diseases.

Method

Both groups were given conventional drug therapy. Prior to the training process, the safety of the patients' rehabilitation exercise was evaluated comprehensively in accordance with the specific conditions. Individual recovery prescriptions were also provided. Prior to exercise rehabilitation, each doctor patiently explained the operational principles. Furthermore, skills and notes were introduced to the patients or family members.

The control group received resistance training. The experimental group received resistance training combined with long-term aerobic exercise. The details are described as follows.

Resistance training

Prior to resistance training, individual training programs were formulated with consideration of the different physical conditions of patients based on the one Reception Maximum (1 RM) and ten Reception Maximum (10 RM) of isotonic contraction of the training muscle group. The program mainly trained the lower back, abdominal muscle group, and upper- and lower-limb muscle groups. After 1 week of operation, non-weight-bearing isotonic contraction of quadriceps femoris in bed began under the assistance of family members as follows: 10 s muscle tightening and 15 s relaxation at 200 cycles daily. After 2-5 weeks of operation, joint exercises, such as initiative bending of knees and hips, were commenced under the assistance of family members or by holding the wall for 15 min each exercise and 10 times daily. The training strengths and times were increased gradually. At 6-12 weeks of operation, additional chest press, shoulder press, muscle triceps brachial stretching, and muscle biceps brachial buckling were initiated. Each exercise was maintained for at least 3 s. Every exercise was maintained for 20 min and repeated three times daily. The main training modes included earth bags, dumbbells, elastic belts, and weight training facilities.

Aerobic exercises

The maximum oxygen consumption and anaerobic threshold of patients were evaluated to determine the exercise intensity. In the first 1 week after the operation, leg lift exercises were started. The affected leg was lifted gradually until the thigh left the bed. The pose was kept for 10 s and conducted 10 times as one group and five groups daily. The distance between the affected leg and the bed was increased gradually. At 2-5 weeks after the operation, seat training and knee-joint stretching exercises were adopted. Then, exercise strength was increased gradually. At 6-12 weeks after the operation, the patients were asked to walk normally for 10 min every time and four times daily. The adjustment of step length and walking speed was then monitored closely. Exercise times and walking distance (from 100 m to 500 m) were increased gradually.

Assessment method

Cardiac function: The Left Ventricular End Diastolic Diameter (LVEDD), Left Ventricle End-Systolic Diameter (LVESD), and LVEF of patients were examined by color Doppler ultrasonic cardiogram to test the cardiac function.

Exercise tolerance: The exercise tolerance of the patients was evaluated by walking distance in 6 min. A long distance means a strong exercise tolerance.

Living quality: The Minnesota scale for living quality investigation of cardiac failure was used to assess living quality. The scale covers 21 contents, mainly including physiology, psychology, activity, and living quality. It uses a five-level Likert score (0-105) method. A high score means a poor living quality.

Statistical method

The collected data were analysed using the SPSS 18.0 software. One-way ANOVA was used to analyse the normally distributed data. By contrast, pairwise comparison based on the LSD method was employed to determine the statistical difference between data. P<0.05 was adopted to indicate statistically significant difference.

Results

Comparison of cardiac function

After the 3-month exercises, the experimental group is found superior to the control group in LVEDD, LVESD, and LVEF (P<0.05) (Table 1).

Comparison of walking distance in 6 min and living quality

The experimental group presents higher walking distances in minutes and lower scores of living quality than those of the control group (P<0.05). A statistically significant difference is found between groups (Table 2).

Table 1. *Comparison of cardiac functions.*

Groups	Number of patients	LVEDD (mm)	LVESD (mm)	LVEF (%)
Experimental group	50	54.2 ± 7.8	45.3 ± 7.7	39.1 ± 10.5
Control group	50	59.2 ± 7.3	49.8 ± 7.1	29.8 ± 10.3
t	/	4.26	4.13	11.52
P	/	<0.05	<0.05	<0.05

Table 2. *Comparison of walking distance in 6 min and score of living quality.*

Groups	Number of patients	Walking distance in 6 min (m)	Score of living quality
Experimental group	50	569.3 ± 52.8	30.1 ± 9.5
Control group	50	413.6 ± 58.5	48.4 ± 8.1
t	/	9.58	6.17
P	/	<0.05	<0.05

Discussion

CHD refers to the myocardium dysfunction or organic pathologic changes caused by coronary artery stenosis and insufficient blood supply. This condition is also called ischemic heart disease. The main clinical symptoms of CHD are myocardial ischemia and anoxia. CHD is due to two phenomena: one is that the direct blood supply to the heart is reduced as reduction in blood pressure and aortic blood supply and occlusion of coronary arteries occur; the other is that the cardiac blood supply is decreased because of valvular disease, blood viscosity changes, and myocardial lesions [3,4]. Another situation involves unaffected cardiac blood supply but increased oxygen demand and is referred to as relative myocardial ischemia. The vessel that supplies blood to the heart is called the coronary artery, and its open mouth is in the aorta ascendens. Stenocardia, arrhythmia, myocardial infarction, and even large-scale myocardial necrosis are common CHDs, which threaten human life [5,6]. With the intensifying population aging, increasing working and life stresses, as well as changes in dietary structures and living habits, the population of patients with CHD-induced myocardial ischemia has increased significantly. The cardiac function, exercise tolerance, and living quality of patients are thus affected significantly [7].

Some works discovered that aerobic exercise can improve the hemodynamics, oxidase activity of heart cells, and the neurocrine effect in patients [8] and can thus enable increases in heart rate, maximum stroke volume, and stroke volume of the patients. Aerobic exercise can also ameliorate symptoms (e.g., shortness of breath) and enhance the daily self-help ability of patients. Resistance training can boost the cardiac function, skeletal muscle function, muscular strength, and tolerance of patients [9,10]. Therefore, the clinical combination of aerobic exercise and resistance training not only improves patient cardiac function but also easily arouses patient interest. With diversified training methods, patients readily accept training programs and become increasingly active in training. As a result, a substantial training effect is achieved, and the patients' living quality is enhanced. Exercise methods are chosen on the basis of living habits, physical conditions, and living climate of the patients. During exercise training, patients pay attention to the examination of cardiac functions before the movement. The patients with cardiovascular system complications are not allowed to participate in exercise training. Appropriate exercise modes and strengths are selected under physician consultation to ensure the effectiveness and safety of rehabilitation exercises. Patients choose exercises on the basis of their abilities and should be aware of the progressive and persistent process entailed. Elderly patients must use proper attires during exercise, such as antiskid, soft-soled and loose shoes, loose and well-ventilated clothes, and appropriately thick and highly water-absorbent socks. Notably, silk socks must not be worn during such exercises. Resistance training can enhance the cardiac functions, skeletal muscle functions, muscular strength, and tolerance of patients. The main exercises include flexion–extension exercises to the shoulder, elbow, hips, and knees. Exercise strength is controlled within approximately 65%-70% of 1RM. Clinically, aerobic exercise and resistance training are often combined to improve the cardiac function and living quality of patients. In this study, the experimental group is found superior to the control group in terms of all the cardiac functional indices. The group attains longer walking distances in 6 min and significantly lower living quality scores than those of the control ($P<0.05$).

Conclusion

In summary, long-term aerobic exercise combined with resistance training can enhance the cardiac function of patients with CHD-induced myocardial ischemia and increase their exercise tolerance and living quality. This combination program holds potential to be widely applied in clinics.

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