Effect of aerobic exercise training on red blood cell parameters, vascular endothelial function in elderly patients with coronary heart disease and chronic heart failure

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Objective: To investigate effect of aerobic exercise training combined with conventional drug on red blood cell parameters, vascular endothelial function and cardiac function in elderly patients with coronary heart disease complicated with chronic heart failure.

Methods: A total of 110 elderly patients with coronary heart disease and chronic heart failure according to random data table were divided into control group (n=54) and observation group (n=56). The patients in control group were treated with conventional drug, and patients in the observation group received conventional drug combined with aerobic exercise training. Before and after treatment, levels of red blood cell parameters, vascular endothelial function and cardiac function indexes were compared between the two groups.

Results: Before treatment, the difference of HCT, RDW, RBC, NO, ET-1, LVEF, LVEDD and LVESD levels in the two groups were not significantly. After treatment, HCT and RBC levels in two groups were no statistically significant difference; The levels of RDW, ET-1, LVEDD and LVESD in observation group were significantly lower than those in this group before treatment, and significantly lower than those in the control group after treatment; The levels of NO and LVEF in two groups were significantly higher than those in the group before treatment, and levels of NO and LVEF in the observation group were significantly higher than those in control group after treatment.

Conclusion: The clinical effect of aerobic exercise training combined with conventional drug in treatment of senile coronary heart disease with chronic heart failure was significant, which can effectively increase the RDW level of patients, improve vascular endothelial function and heart function, it has important clinical value.

1. Introduction

Chronic heart failure was terminal stage of cardiovascular disease, with high morbidity and lethality rate, in the meanwhile was one of main factors that caused elderly patients death[1]. Coronary heart disease was the primary factor of chronic heart failure whose occurrence presented increasing trend along with aging[2].

Improving blood microcirculation and protecting cardiac function was main purpose of clinical treatment[3]. Rehabilitation therapy of chronic heart disease included drug therapy and non-drug therapy. Researches have point out that exercise rehabilitation could improve life quality of patients and decrease admission rate and lethality of heart failure, which have been critical scheme that treated chronic heart failure[4,5]. This study was aimed to explore effect of aerobic exercise training combined with conventional drug on red blood cell parameters, vascular endothelial function and cardiac function in elderly patients with coronary heart disease complicated with chronic heart failure. The detailed content was following.
2. Research object and method

2.1. General data

Selected 110 cases of patients with elderly coronary heart disease and chronic heart failure who were admitted in our hospital from September 2015 to February 2017 as research object and divided into control group (n=54) and observation group (n=56) according to random data table. In control group, 35 males, 19 females; aged from 61-78 years old; cardiac function grading 29 cases of grade II, 25 cases of grade III; course of disease was 2-11 years, average was (4.58±2.06) years. In observation group, 38 males, 18 females; aged from 62-77 years old; cardiac function grading 31 cases of grade II, 25 cases of grade III; course of disease was 2-12 years, average was (4.76±1.97) years. Above general data in both groups was no obvious difference (P>0.05). This research was conformed to the hospital ethics committee and was approved.

2.2. Selection criteria

Incorporation criteria: (1) all was conformed to diagnostic criteria of coronary heart disease and chronic heart failure[6,7]; (2) conformed NYHA grading grade II-III; (3) with clinical symptoms of heart failure and LEVF was below 50%; (4) clinical data was complete after admission, patients and their family were informed and signed informed consent, voluntarily took part in treatment.

Exclusion criteria: (1) patients with unstable angina pectoris; (2) patients with osteoarticular disease that affected exercise; (3) except for coronary heart disease, patients with chronic heart failure that resulted from other diseases; (4) systolic pressure <90 mmHg; (5) exercise caused angina and arrhythmia; (6) patients with severe hepatic and renal dysfunction, malignant tumor; (7) patients with bad compliance, fall off in the midway; (8) patients with incomplete clinical data, unwilling to take part in treatment.

2.3. Treatment method

The control group was given conventional therapy including sufficient rest, oxygen uptake, reduce blood glucose and regulate lipid, diuretic, angiotension converting enzyme inhibitor and ß-receptor retardant, in the same time did daily activities. On this basis of control group treatment, observation group was given aerobic exercise rehabilitation, grade III patients was given body massage passive activities, urged patients do flexion – extension activities of upper and lower limbs, proceeded II grade rehabilitation activities until patients reached II grade. Patients who were II grade did proper exercise including warm-up, jogging, walking and reorganization movement, concrete proposal was formulated according to actual heart rate and results of 6 min walking test (6MWT). Warm-up contained muscle stretch training and slow walking, time was 5-10 min; until patients fitted exercise load, started sectioned walking or jogging, exercise time was 30-40 min, ended as 5 min of slow walking. Real time monitoring of change heart rate in all process of exercise, and maintain heart rate in target heart rate range. At last, reorganization movement (muscle stretch training), 1-2 group of movement, every action repeated 15-20 times, exercise time was 3-5 min. Exercise period was 12 weeks, 1 time/d, at least 4 times/week, exercise interval did not exceed 2 d between two time of exercise, properly arranged medicine and exercise time, stopped exercise when appeared discomfort.

2.4. Indexes detection

Extracted 3 mL of fasting periphery venous blood of patients before and after treatment in both groups for detecting red blood cell parameters and vascular endothelial function. Red blood cell parameters was detected by hematology analyzer and related sets of apparatus, indexes including hematocrit (HCT), red blood cell distribution width (RDW) and red blood cell count (RBC). Vascular endothelial function including nitric oxide (NO) and endothelin-1 (ET-1), nitrate reductase method was used for NO detection and radioimmunoassay was used for ET-1. In the meanwhile, color Doppler ultrasonic cardiogram equipment was applied for detecting left ventricular ejection fraction (LVEF), left ventricular end-systole diameter (LVSED) and left ventricular end-diastolic diameter (LVEED). All of index detection was strictly operated according to instruction.

2.5 Statistical method

Statistical Software SPSS 17.0 was used for research data processing and analyzing, red blood cell parameters, vascular endothelial function and cardiac function were in accord with normal distribution, representing methods was , t-test was applied to comparison of two sample averages intra-group before and after treatment and inter-block level, P<0.05 indicated the difference was statistical significant.

3. Results

3.1 Comparison of red blood cell parameters in both groups

Before treatment, there was no difference in HCT, RDW and RBC in control group and observation group (P>0.05). After treatment,
HCT and RBC level in both group was increased at different degree compared with same group before treatment, moreover, these level in observation group were higher than control group, however comparison of HCT and RBC level in same group before and after treatment and inter-group was no statistically significant ($P>0.05$); after treatment, RDW level in control group and observation group was (13.81±1.47)$\%$ and (13.08±1.46)$\%$, compared with intra-group before treatment, this level in control group after treatment was increased mildly ($P>0.05$), however in observation group this level was significantly decreased and this level after treatment in observation group was dramatically lower than control group ($P<0.05$). As shown in Table 1.

### 3.2 Comparison of vascular endothelial function level in both groups

Before treatment, there was no statistical significant difference in NO and ET-1 level in control group and observation group ($P>0.05$). NO in control group and observation group after treatment was (53.85±10.42) µmol/L and (72.84±11.89) µmol/L that was significantly higher than intra-group ($P<0.05$); moreover NO level after treatment in observation group was dramatically higher than control group, the difference was statistical significant ($P<0.05$); ET-1 level after treatment in observation group was (48.31±11.72) ng/L, compared with intragroup before treatment, its level was significantly decreased ($P<0.05$); moreover significantly lower than control group after treatment (55.68±10.89) ng/L, there was significant difference ($P<0.05$). As shown in Table 2.

### 3.3 Comparison of cardiac function level in both groups

Before treatment, there was no statistical significant difference in LVEF, LVESD and LVEDD in control group and observation group ($P>0.05$). After treatment, LVEF level in both groups was obviously higher than intra-group before treatment, moreover, after treatment in observation group it was significantly higher than control group, there was statistically significant ($P<0.05$); LVESD and LVEDD level in observation group after treatment were (48.61±4.52) mm and (35.25±3.77) mm, this two indexes were lower than intra-group before treatment ($P<0.05$), moreover lower than after treatment in control group (52.45±3.94) mm and (39.81±4.14) mm, there was statistically significant ($P<0.05$). As shown in Table 3.

### 4. Discussion

In recent, with aging of people and change of life style, trend of elderly coronary heart disease with chronic heart disease was increasing[8]. Its main feature was that physical activity of patients was limited severely, exercise tolerance decreased, affected life quality of patients[8]. In the past, treatment often put emphasis on relieve clinical symptom, improve sign, usually neglected early rehabilitation of heart failure and rehabilitation therapy after discharge, therefore caused high recurrence rate and rehospitalization rate, increased financial burden of life and society. At present aim of clinical treatment put more attention on increase exercise tolerance and life quality, decrease admission rate and lethality rate, extend life of patients[10,11]. Except for conventional drug therapy, rehabilitation therapy of heart failure involving exercise, psychotherapy, risk factor intervention and other non-drug therapy, in past treatment, on basis of drug therapy, patients should stay in bed and reduce heart load that brought by exercise. Along with further research, related...
research pointed out that staying in bed could promote cardiac function recovery at some degree, reduce heart load, however stayed in bed for a long time would cause muscle atrophy, decrease exercise tolerance, easy to form venous thrombus, which threatened health of patients[12,13]. Exercise rehabilitation therapy was a safe and effective method, in recent, a lot of domestic and overseas research found that early exercise rehabilitation therapy could effectively improve cardiac function of chronic heart failure, significantly shorten hospital stays and reduce death rate and admission rate, therefore exercise training therapy was considered as critical part of early conventional treatment for chronic heart disease[14,15].

Related research had pointed that patient with heart failure usually exist hypercoagulability of blood, hypoxia and blood flow volume increased which made part of nucleated red blood cell and reticulocyte enter in periphery blood in advance, resulted in volume change of red blood cells, chiefly presented RDW increased[16]. RDW was important parameter that reflected heterogeneity of red blood cell volume, it increased presented red blood cell volume in periphery blood was not same. There was obvious relation between RDW level and myocardial damage, RDW was critical factor of death of patients with chronic heart failure and as important index of acute coronary syndrome[17,18]. Research showed that HCT level in patients with chronic heart failure was related to change of cardiac function, its level change might result from inflammatory reaction[19]. This study compared red blood cell parameter after treatment of patient who were given conventional drug and who were treated with conventional drug combined with aerobic exercise found that red blood cell parameter of patients with conventional drug therapy was no obvious change, however combined with aerobic exercise, RDW level of patients after treatment was decreased significantly, its mechanism was not clear, might be related to that regular exercise was able to reduce the inhibited effect on bone marrow haematopoietic function and increase generation rate of red blood cell[20].

When chronic heart failure occurred, multiple tissues appeared ischemia, anoxia, catecholamine increased, and then caused lipid peroxidation, the latter could result in vascular endothelial function and structure injury, in turn vascular endothelial function damage would further aggregated development of chronic heart failure, interacted as both cause and effect, relationship was intimate[21,22]. NO and ET-1 were vascular active factors secreted by endothelial cells, the former had diastole vessels and inhibit endothelial proliferative effect, the latter could contract vessel and promote vascular smooth muscle cell proliferation, both were in dynamic balance maintain normal vascular tension under normal condition, however under pathological condition of chronic heart failure, vascular endothelial dysfunction presented that NO level decreased, ET-1 synthesis release increased[23,24]. This result showed that both therapies could improve vascular endothelial function, and effect of combination of drug and aerobic exercise was better, its reason might be that exercise was able to invert abnormal structure and physiological change of skeletal muscle and enhance shear force of local muscle[25].

In conclusion, aerobic exercise was a kind of easy and economical and practical treatment method, combined with conventional drug therapy could treat elderly coronary heart disease with chronic heart failure and effectively increase RDW level, improve vascular endothelial function and cardiac function, with important clinical significance.

Reference


