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Case Report

Significant Improvement of the Functional Capacity and the Left Ventricular Systolic Function in Patient with Chronic Heart Failure After 10-Weeks of Exercise Training Program did Sedentary Lifestyle and Specific Training Prescription Formula Matter?

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Abstract

Cardiac rehabilitation is strongly recommended for patients with chronic heart failure (CHF) with preserved, or reduced left ventricular ejection fraction (LVEF) A cardiac rehabilitation program is combination of physical exercise, diet counseling, educational lectures on lifestyle changes, and disease management as well as psychosocial support. Exercise training remains core component of the comprehensive cardiac rehabilitation program and is strongly recommended in combination with pharmacological treatment to patients with CHF. Exercise-based cardiac rehabilitation affects positively functional capacity, exercise tolerance, and quality of life in CHF patients due to cardiorespiratory, metabolic, and autonomic response. The physical inactivity rate in the Kingdom of Saudi Arabia is still extremely high, due to weather conditions and sociocultural barriers. We present a case that demonstrates tremendous improvement in the physical capacity and the left ventricular systolic function of a patient with CHF and review of literature.

Keywords: Cardiac Rehabilitation; Chronic Heart Failure; Heart Rate Reserve; Interval Training; Functional Capacity

Introduction

Cardiac rehabilitation (CR), according to the World Health Organization guidelines, is defined as "the comprehensive and coordinated use of medical, social, educational and professional resources to accommodate patients to a new lifestyle and enable them to achieve the best performance" [1]. The cardiac rehabilitation program typically consists of physical exercise sessions, dietary counseling, educational lectures on lifestyle changes, and psychosocial support to patients and their families. Supervised exercise training still remains a core component of the cardiac rehabilitation program, focusing on cardiopulmonary (aerobic), resistance, neuromotor and flexibility components. Exercise training is strongly recommended for patients with chronic heart failure (CHF) at a class 1 evidence level [2]. The benefits of cardiac rehabilitation have been widely recognized [3]. The exercise-based program has positive effects on reduction of the re-hospitalization rates and mortality [4].Many studies of CHF patients have demonstrated improvements of 18% to 25% in peak oxygen uptake [5]. In a study by Martin, 5,400 patients with CHF were categorized into low,_moderate and high cardiorespiratory fitness groups based on an initial exercise test. After 12-weeks of exercise training, a greatest improvement has been found in the lowest fitness group [6]. The rate of habitual physical inactivity in Saudi Arabia still remains high and little is known about functional capacity improvement and changes in the left ventricular systolic function in Saudi patients with CHF after exercise training program.-based. We observed a marked improvement of functional capacity (by 7.0 MET) and the left ventricular ejection fraction (by 8%) in patient with CHF and severe impairment of the left ventricular systolic function (LVEF of 25%).

Case Report

A 38-year-old male patient, an active smoker (20 cigarettes a day), diagnosed with dilated cardiomyopathy, arterial Hypertension and dyslipidemia was referred to the Cardiac Rehabilitation Unit at Prince Sultan Cardiac Center, Riyadh. He complained of shortness of Breath at New York Heart Association (NYHA) class III on presentation in October 2019. His daily physical activity was limited to 5-minutes' walk within a home. The patient's medication regimen included Betaloc 50 mg twice a day, Aldactone 12.5mg once a day, Lasix 20 mg once a day, Entresto 200 mg twice a day, Aspirin 81 mg once a day, and Ezetrol 10 mg once a day. The patient has been clinically stable on this treatment for the preceding two months. On physical examination, his heart rate, blood pressure, and oxygen saturation were within normal limits (blood pres-

sure 125/80mmHg, heart rate 71beats per minute, oxygen saturation 99% in room air).The lung examination showed no crepitations or rales. Chest x-ray revealed cardiomegaly, without interstitial edema or pleural effusion. The transthoracic echocardiography revealed a moderately dilated left ventricle and severe impairment of left ventricular systolic function (severe global hypokinesis, end-diastolic volume of 169 ml, end-systolic volume of 126 ml, left ventricular fractional shortening 16 %, left ventricular ejection fraction of 25 %.). The initial graded stress test on a treadmill according to a modified Bruce protocol had been stopped due to significant shortness of breath after reaching 7.3 METs. The patient's exercise training program included moderate intensity aerobic interval training and stretching exercises. Resistance training was implemented after 2 weeks of well-tolerated aerobic component. Aerobic training consisted of 5 minutes of warm-up exercise, followed by interval training on treadmill, with a subsequent 5-minute cool-down. The duration of the aerobic sessions was increased from 25 min in the first session to 60 min after 10 weeks. The duration of active and recovery phases were 4 minutes and 2 minutes respectively. After reaching 60 minutes of total training duration, further training progression included increase in speed for active phases of up to 6.0 km/h (starting from 3.5 km/h).The calculated training heart rate zone during active phases was narrow (98-102 beats per minute). Training was monitored in terms of the patient's heart rate, electrocardiogram, and symptoms. Resistance training was initiated after 2 weeks and included an initial work-to-rest ratio of 1:2, i.e. 30–60 seconds of exercise with a subsequent 1–2-minute rest. Full resistance training progression was reached after 4 weeks. Following the 10-weeks exercise training program, both physical capacity and echocardiographic parameters of the left ventricular systolic function significantly improved. The control echocardiogram revealed end-diastolic volume of 163 ml, end-systolic volume of 108 ml, left ventricular fractional shortening of 21%, and left ventricular ejection fraction of 33%. Control graded stress test on treadmill utilizing the modified Bruce protocol had been terminated due to significant shortness of breath after reaching 14.3 METs. Both exercise tests were terminated at similar heart rate levels (130 bpm and 133 bpm, respectively).

Discussion / Review of Literature

Physical function impairment in a patient with heart failure is well documented and is a result of impaired cardiac output response to exertion, impaired vasodilation, and increased systemic vascular resistance [7]. Skeletal muscle dysfunction also contributes to the increased fatigue and exercise intolerance in this group. Exercise training is strongly recommended for patients with CHF; and as the non-pharmacological intervention has become widely accepted. Regular exercise trainings in patients with CHF are associated with reduced sympathetic activity and increased parasympathetic tone. Besides, regular physical activity improves endothelium-dependent vasodilatation and has anti-inflammatory effect [8]. Both increase in the maximal oxygen uptake by (2.1 ml/kg/min), and in peak work (by 15 Watts) after cardiac rehabilitation in patients with CHF have been documented [9]. Appropriate exercise prescription in patients with CHF requires knowledge about underlying causes, recent pharmacotherapy, and the current status of the patient's functional capacity. The initial exercise intensity prescription should be based on the cardiopulmonary exercise test (CPET) with an initial training intensity set at 40%–50% of peak oxygen uptake, with a further progression to 70%–80%. If CPET is unavailable, an intensity at 40%–70% of the heart rate reserve (HRR) and Borg scale 10–14 are recommended. Adequate training heart rate zone is crucial. In case of interval training mode. Training intensity can be increased as increase in the total training time, a change of intensity during active phase or as change in the work-to-recovery time ratio. As mentioned earlier, studies in CHF patients have demonstrated improvements of 18% to 25% in peak oxygen consumption with improvement in symptoms, functional class, and quality of life [10]. Exercise training in patients with CHF and reduced left ventricular ejection fraction (<35%) was associated with a reduced incidence (by 11%) of the combined all-cause mortality or hospitalization [11]. It has been documented that aerobic exercise can lead to improvement of LVEF by 2.5% [12]. In the case of our patient, aerobic training had been interval in nature, which is consistent with the finding that the interval training group showed higher oxygen consumption, more pronounced reverse left ventricular remodeling, or an increase in LVEF compared to continuous moderate-intensity exercise training in CHF patients [13]. After 10 weeks of exercise training, the functional capacity of the patient tremendously increased from 7.3 to 14.3 METs. There was also a significant improvement of left ventricular systolic function (LVEF improved by 8%). One of the potential reasons for these positive effects of training could be adequate training formula itself with an intentional narrow training heart rate zone, as an individual, precisely calculated heart rate reserve; but in our opinion the more important contributing factor was habitual physical inactivity of patient, typical feature of local population. The physical inactivity rate in the Kingdom of Saudi Arabia still remains extremely high, with, specifically, 61% of males and 73% of females being physically inactive [14]. Two of the most reported barriers to physical activity are weather and sociocultural barriers. Therefore exercise training of habitually physically inactive individuals may result in more pronounced improvement of physical capacity and the left ventricular systolic function. The development of cardiac rehabilitation services throughout the Kingdom of Saudi Arabia could be a real milestone in the treatment of patients with cardiovascular diseases.

Conclusion

It has been documented that regular physical exercise can lead to improvement of functional capacity (usually by 20-35%) and left ventricular systolic performance in patients with CHF. We have demonstrated tremendous improvement of physical capacity (by 100%) of patient with CHF and severely impaired left ventricular ejection fraction. In

addition left ventricular systolic function improved markedly (by 8%). As mentioned earlier, it has been documented that patients with a low functional capacity eg. Individuals living sedentary lifestyle can achieve greater improvement of physical fitness after 10-12-weeks of exercise training. Nevertheless, adequate individually calculated and strictly controlled training heart rate zone, utilizing proper protocols and reasonable training progress are crucial and contributed significantly in case of our patient.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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