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ORIGINAL ARTICLE

Benefits of exercise training and the correlation between aerobic capacity and functional outcomes and quality of life in elderly patients with coronary artery disease

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Abstract Cardiopulmonary exercise training is beneficial to people with coronary artery disease (CAD). Nevertheless, the correlation between aerobic capacity, and functional mobility and quality of life in elderly CAD patients is less addressed. The purpose of the current study is to investigate the beneficial effects of exercise training in elderly people with CAD, integrating exercise stress testing, functional mobility, handgrip strength, and health-related quality of life. Elderly people with CAD were enrolled from the outpatient clinic of a cardiac rehabilitation unit in a medical center. Participants were assigned to the exercise training group ($N = 21$) or the usual care group ($N = 15$). A total of 36 sessions of exercise training, completed in 12 weeks, was prescribed. Echocardiography, exercise stress testing, the 6-minute walking test, Timed Up and Go test, and handgrip strength testing were performed, and the Short-Form 36 questionnaire (SF-36) was administered at baseline and at 12-week follow-up. Peak oxygen consumption improved significantly after training. The heart rate recovery improved from 13.90/minute to 16.62/minute after exercise training. Functional mobility and handgrip strength also improved

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after training. Significant improvements were found in SF-36 physical function, social function, role limitation due to emotional problems, and mental health domains. A significant correlation between dynamic cardiopulmonary exercise testing parameters, the 6-minute walking test, Timed Up and Go test, handgrip strength, and SF-36 physical function and general health domains was also detected. Twelve-week, 36-session exercise training, including moderate-intensity cardiopulmonary exercise training, strengthening exercise, and balance training, is beneficial to elderly patients with CAD, and cardiopulmonary exercise testing parameters correlate well with balance and quality of life.

Introduction

Coronary artery disease (CAD) is a leading cause of mortality worldwide. Many modifiable and nonmodifiable risk factors for CAD are well documented [1]. Physical inactivity is one of the major concerns in healthcare. According to the World Health Organization (WHO), in 2009, the global prevalence of physical inactivity was 17%, which accounted for 6% of the burden of CAD [2,3]. This emphasizes the crucial role of physical activity in health enhancement.

Beneficial effects of exercise and physical activity on CAD are generally established [4,5]. The 6-minute walk test (6MWT) is a simple method that evaluates the global response of all the systems involved during exercise and represents the submaximal functional capacity [6]. The 6MWT well predicts the functional capacity of people with heart failure and the benefits from cardiac rehabilitation after CAD, with adequate reproducibility [7—9]. However, the correlation between the 6MWT and quality of life was not clearly identified. Besides, exercise has been shown to improve balance and performance of daily activities [10]. The Timed Up and Go (TUG) test is a quick test that can identify population at risk for falls with good sensitivity and specificity [11,12]. However, the correlation between cardiopulmonary fitness and balance improvement is less identified.

Exercise stress testing using a treadmill or bicycle is a widely accepted method for assessing the functional capacity in people with CAD. For persons with disabilities, handgrip exercise testing is an alternative stress method for the evaluation of CAD, albeit with limited sensitivity for the detection of CAD [13,14]. Mroszczyk-McDonald et al [15] reported improved handgrip strength after cardiac rehabilitation and suggested handgrip strength as a valuable predictor of physical function in elderly people with CAD.

The purpose of this study is to evaluate the benefits of exercise training in older people with CAD, integrating cardiopulmonary exercise testing, functional mobility, handgrip strength, and health-related quality of life. Furthermore, we observed that cardiopulmonary fitness correlated with the aforementioned parameters in elderly people with CAD.

Methods

Participants

Participants were enrolled from the outpatient clinic of the department of physical medicine and rehabilitation in a medical center. The study population focused on the elderly, which refers to participants aged ≥65 years. Elderly people with CAD who underwent either percutaneous transluminal coronary angioplasty or coronary artery bypass graft surgery 3—6 months earlier and who did not receive any exercise training after the procedures were included in the study. The exclusion criteria were unstable angina, decompensated heart failure, unstable blood pressure control, peripheral arterial occlusive disease with claudication, degenerative osteoarthritis interfering with exercise, and other medical conditions that contraindicate exercise. Participants were then assigned to the exercise training group or the usual care group. General demographic features, including age, sex, height, and body weight, were collected during the interview. The study was approved by the Institutional Review Board of Kaohsiung Veterans General Hospital, Kaohsiung, Taiwan (project number: VGHKS 10-CT12-12). Participants gave their informed consent before being enrolled in the study.

Interventions

In the exercise training group, exercise training included 50 minutes of cardiopulmonary exercise training, 30 minutes of strengthening exercise training, and 30 minutes of balance training. For the cardiopulmonary exercise training, a cycle ergometer was used. The training intensity was determined by the heart rate reserve method as described in the study by Scharff-Olson et al [16], at 60—80% of the participant's heart rate reserve. The cardiopulmonary exercise training consisted of 10-minute warm-up, 30-minute endurance training, and 10-minute cool-down. For strengthening exercise training, participants were given low-level, progressive resistance exercise using light free weights and weight machines. The participants performed 12—15 repetitions of the exercise, with a resistance of 40—60% of one-repetition maximum. Balance training focused on exercises related to daily mobility activities, as described in a study by Faber et al [17], which consisted of standing up from a chair, reaching, stepping forward and sideward, heel and toe stands, stepping on and over an obstacle, staircase walking, tandem foot standing, and single-limb standing. All participants received three sessions of exercise training per week for 12 weeks, which was determined to be a more intense exercise program [18]. The whole exercise training program was monitored by a physician and a physical therapist.

In the usual care group, the participants received medical management and made clinic visits as needed.