The place of exercise in the patient with chronic stable angina

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Abstract

Exercise is an often overlooked but highly valuable non pharmacological treatment for patients with chronic stable angina. Regular exercise is associated with several cardioprotective effects, including improving endothelial function and reducing systemic inflammation. In addition, regular exercise leads to better control of major coronary risk factors. On a symptomatic level, exercise training reduces myocardial ischemia and the frequency of anginal attacks while also improving functional capacity and long-term outcomes. Patients with angina pectoris should be encouraged to engage in regular physical activity as part of a comprehensive lifestyle intervention for the secondary prevention of coronary heart disease.

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Introduction

The past few decades have led to a major increase in the understanding of the pathogenic mechanisms underlying atherosclerosis, and the beneficial role that regular exercise can play in the treatment of coronary heart disease (CHD) and angina pectoris. The benefits of regular exercise in patients with chronic stable angina are multifaceted. Exercise training leads to better control of risk factors for CHD. In addition, chronic exercise leads to reductions in endothelial dysfunction and systemic inflammation, both of which are known to be paramount in the development and progression of atherosclerosis. On a more practical level, regular exercise has been shown to improve functional capacity and increase the anginal threshold, leading to a reduction in the frequency of anginal attacks. This article will review the cardioprotective mechanisms of exercise training and the effects of physical activity and physical fitness on symptoms and prognosis, and provide recommendations regarding initiation of an exercise program in the patient with chronic stable angina.

Cardioprotective mechanisms of exercise

Endothelial dysfunction is known to be the precursor of atherosclerosis [1,2]. Both acute and chronic exercise have been shown to improve endothelial function by increasing shear stress-induced flow-mediated arterial vasodilatation [3,4]. Increased shear stress on the arterial wall during exercise leads to increased production and release of nitric oxide from endothelial cells [5]; nitric oxide is responsible for endothelium-dependent vasodilatation of the coronary arteries [6]. This vasoactive substance also has numerous antiatherosclerotic and antithrombotic effects [7].

A single bout of vigorous exercise was recently shown to improve endothelial function in the rat, with regular exercise for 6 weeks further improving endothelial function [3]. In humans, 4 weeks of intense physical training was shown to improve coronary endothelial function and coronary blood flow in patients with stable CHD [4].

Inflammation has a major role in the pathogenesis of atherosclerosis and CHD [8]. A very sensitive marker of inflammation, and one of the most studied biomarkers in patients with CHD, is the acute-phase reactant, C-reactive protein [9]. Increased concentrations of C-reactive protein are associated with a significantly greater risk of morbidity and mortality in otherwise healthy men and women [10,11]. A 12-week aerobic exercise training program has been shown to produce a significant reduction in concentrations of several markers of inflammation, including C-reactive protein, in patients with stable CHD [10]. Exercise training and high physical fitness are also associated with lower concentrations of markers of inflammation in individuals without known CHD [12,13].

Chronic exercise is also believed to improve the health of patients with angina pectoris by improving the control of risk factors. Regular exercise may result in weight loss, or the prevention of weight gain, although the dose–response effect between exercise and body weight may vary from individual to individual and between patient populations [14]. Similarly, long-term exercise training reduces body weight, the prevalence of insulin resistance, and the metabolic syndrome in patients with CHD who have this condition [15]. A comprehensive lifestyle intervention with regular exercise was shown to reduce the incidence of new-onset diabetes by 50% in individuals with impaired glucose tolerance [16]. Aerobic exercise training has also been shown to improve the lipid profile, primarily by increasing high-density lipoprotein cholesterol concentrations and decreasing those of triglycerides [14,17]. In a meta-analysis of 54 randomized trials, aerobic exercise training was shown to decrease both systolic and diastolic blood pressure by 3–4 mm Hg, with a greater blood pressure-decreasing effect noted in hypertensive patients [18]. Exercise training has also been shown to have antithrombotic effects, leading to decreased platelet aggregation and increased fibrinolytic activity [19].

Regular exercise may also provide benefit to the individual with chronic angina by increasing the tolerance of the myocardium to prolonged ischemia, thereby reducing the degree of myocardial injury, a phenomenon known as ischemic preconditioning [20]. Ischemic preconditioning may not only prevent or reduce myocardial damage during an episode of prolonged ischemia, but may also reduce the risk of fatal ventricular arrhythmias that may occur during reperfusion when blood flow is restored to the injured myocardium [20].

Table I. Cardioprotective effects of exercise training.

1. Improved endothelial function
2. Reduction in systemic inflammation
3. Improvement in risk factor control
   a. Reduction in body weight
   b. Improved glucose metabolism
   c. Reduction in blood pressure
   d. Increase in HDL-cholesterol concentrations
   e. Reduction in triglyceride concentrations
4. Antithrombotic effects
   a. Decreased platelet aggregation
   b. Increased fibrinolytic activity
5. Ischemic preconditioning
   a. Reduced myocardial damage during prolonged ischemia
   b. Prevention of reperfusion-induced ventricular arrhythmias

HDL = high-density lipoprotein

The cardioprotective effects of exercise training are summarized in Table I.

Effects of exercise on symptoms and prognosis

It is well recognized that exercise training improves functional capacity and reduces myocardial ischemia and anginal symptoms in patients with stable CHD [21]. In addition to improving symptoms, regular exercise has also been shown to improve long-term prognosis. In a meta-analysis of 48 randomized trials of up to 6 months duration, which included 8940 patients with stable CHD, exercise training was associated with a 20% reduction in total mortality and a 26% reduction in cardiac mortality relative to a usual-care strategy [22]. In a clinical trial in which 100 patients with stable angina were allocated randomly to groups to receive percutaneous coronary intervention or exercise training for 12 months, exercise training was associated with better functional capacity and a greater event-free survival at the end of the follow-up period [23].

Exercise recommendations for patients with angina pectoris

Although the benefits of regular exercise outweigh its potential risks in patient with stable angina pectoris, it is also recognized that habitually sedentary patients with CHD who engage in strenuous physically activity are at increased risk of myocardial infarction and sudden cardiac death [24]. For this reason, patients with angina who are not routinely active should initially engage in low-intensity activities before engaging in more vigorous physical activity. In addition, patients with CHD who are initiating an exercise

program should avoid physical exertion in very cold or hot, humid conditions that might increase the risk of an acute coronary event. Studies performed in supervised exercise programs suggest the risk of major cardiovascular events during exercise training to be between 1/50 000 and 1/120 000 patient-hours of exercise in patients with CHD [25].

Patients with stable angina pectoris should undergo a medical evaluation, including an exercise stress test, for exercise prescription before embarking on an exercise program. General recommendations include low-intensity aerobic training (<40% of maximum aerobic capacity; 50–70% of maximum heart rate) three times per week at the outset. Exercise intensity may progressively be increased as tolerated. Should ischemia or anginal symptoms occur during exercise testing, the target heart rate should generally be fixed at 10 beats/min below the observed ischemic threshold. Each exercise session should consist of three components: (i) a 10 min warm-up period consisting of stretching and low-level calisthenics, (ii) a 20–30 min period of aerobic exercise, and (iii) a 10 min cool-down period also involving low-level calisthenics and walking. Aerobic exercise (for example, fast walking, jogging, swimming) should be the mainstay of exercise training in patients with CHD. Supervised exercise training programs are also beneficial, especially during the initiation period. They ensure that patients are exercising safely, and permit one to assess progress. The reader is invited to consult exercise training guidelines for more complete details regarding exercise prescription in patients with angina pectoris [25].

Conclusions

Exercise training is beneficial in patients with chronic stable angina and is associated with an improvement in exercise tolerance, a reduction in anginal symptoms, and improved long-term survival. Regular exercise is associated with numerous cardioprotective mechanisms, including effects on endothelial function, inflammation, and improved risk factor control. Patients with angina pectoris should be encouraged to engage in regular physical activity as part of a comprehensive lifestyle intervention for the secondary prevention of CHD. ■

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