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Exercise training enhances autonomic function after acute myocardial infarction: A randomized controlled study

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KEYWORDS

Heart rate recovery;
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Abstract

Introduction: Heart rate recovery, defined as the fall in heart rate during the first minute after exercise, is an indicator of autonomic function, and has been found to be an independent predictor of mortality after acute myocardial infarction. Exercise training has several well-known benefits in terms of cardiorespiratory fitness, modifiable cardiovascular risk factors and prognosis after acute coronary events. However, there are no randomized controlled studies in the literature evaluating the effects of exercise training per se, controlling for changes in medication and diet, on heart rate recovery. Thus, this study aims to assess the effects of exercise training on autonomic function in coronary artery disease patients recovering from acute myocardial infarction.

Methods: Thirty-eight patients following a first acute myocardial infarction participated in this prospective randomized clinical trial. Patients were randomized into two groups: exercise training or control. The exercise group participated in an 8-week aerobic exercise program, while the control received standard medical care and follow-up. Changes in hemodynamics at rest and at peak exercise (heart rate, systolic and diastolic blood pressure, and rate pressure product), dietary intake, cardiorespiratory fitness, and heart rate recovery were assessed.

Results: Medication and diet remained unchanged in both groups during the study period. The exercise-training group improved resting hemodynamics, particularly resting heart rate (from 68.0 ± 9.2 to 62.6 ± 8.7 bpm, $p=0.030$) and systolic blood pressure (from 135 ± 7.1 to 125.6 ± 11.3 mmHg, $p=0.012$), cardiorespiratory fitness (from 30.8 ± 7.8 to 33.9 ± 8.3 ml/min/kg, $p=0.016$), and heart rate recovery (from 20 ± 6 to 24 ± 5 bpm, $p=0.007$). No significant changes were observed in the control group.

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PALAVRAS-CHAVE

Frequência cardíaca de recuperação;
Doença das artérias coronárias;
Reabilitação cardíaca;
Dieta;
Exercício

Conclusions: Exercise training improved autonomic function, assessed by heart rate recovery, resting heart rate and systolic blood pressure, in the absence of changes in diet or medication. © 2011 Sociedade Portuguesa de Cardiologia Published by Elsevier España, S.L. All rights reserved.

O exercício físico regular melhora a função autonómica após enfarte agudo do miocárdio: estudo aleatorizado e controlado

Resumo

Introdução: A frequência cardíaca de recuperação, definida como a diminuição na frequência cardíaca durante o primeiro minuto após a cessação do exercício, é indicador da função autonómica e tem sido descrito como preditor independente de mortalidade após enfarte agudo do miocárdio. Os benefícios do exercício regular na capacidade cardiorrespiratória, nos factores de risco tradicionais modificáveis e no prognóstico após evento coronário agudo são bem conhecidos. Contudo, continua a faltar na literatura um estudo randomizado, controlado, avaliando os efeitos do exercício regular per se, controlando para alterações na medicação e dieta, na frequência cardíaca de recuperação. Desta forma, este estudo tem por objectivo avaliar o efeito de um programa de exercício físico na função autonómica em doentes com doença coronária após enfarte agudo do miocárdio.

Métodos: Participaram neste estudo prospectivo, randomizado, controlado 38 doentes após o primeiro enfarte agudo do miocárdio. Os doentes foram divididos em 2 grupos: grupo de exercício e grupo controlo. O grupo de exercício participou num programa de exercício aeróbio com 8 semanas de duração, enquanto o grupo controlo recebeu os cuidados e o seguimento médico habitual. Foram avaliadas as alterações nos parâmetros hemodinâmicos em repouso e no pico de exercício (frequência cardíaca, pressão arterial sistólica e diastólica e duplo produto), dieta, capacidade cardiorrespiratória e frequência cardíaca de recuperação.

Resultados: Durante o estudo a medicação e a dieta não sofreram alterações em ambos os grupos. O grupo de exercício melhorou os parâmetros hemodinâmicos em repouso, nomeadamente a frequência cardíaca (68.0 ± 9.2 para $62,6 \pm 8,7$ bpm, $P=0,030$) e a pressão arterial sistólica (135 ± 7.1 para $125,6 \pm 11.3$ mmHg, $P=0,012$), a capacidade cardiorrespiratória ($30,8 \pm 7,8$ para $33,9 \pm 8,3$ ml/min/kg, $P=0,016$) e frequência cardíaca de recuperação (20 ± 6 para 24 ± 5 bpm, $P=0,007$). Não se observaram diferenças significativas no grupo controlo.

Conclusões: O programa de exercício físico melhorou a função autonómica, avaliada através da frequência cardíaca de recuperação, a frequência cardíaca e a pressão arterial de repouso mesmo na ausência de alterações na dieta e na medicação.

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Introduction

Dysfunction of the autonomic nervous system appears to be implicated in the pathophysiology of coronary artery disease (CAD) and is associated with increased risk of morbidity and mortality.¹⁻³ Autonomic function can be evaluated by measuring resting heart rate (HR), heart rate variability, or heart rate recovery (HRR) following exercise.^{2,3} The effect of exercise training on autonomic function in CAD patients has also been assessed using these indicators.⁴⁻⁶ Nevertheless, measurement of HR variability requires sophisticated software, is not intuitive for most clinicians, and is difficult to implement on a routine clinical basis.² In this context, exercise HRR has emerged as probably the simplest method of assessing autonomic function, particularly parasympathetic tone.³

HRR, defined as the drop in HR during the first minute immediately after exercise, is a strong predictor of mortality in CAD patients,⁷ independent of exercise capacity, left ventricular function, angiographic severity of CAD, myocardial perfusion defects, and changes in HR during exercise.^{7,8}

Exercise-based cardiac rehabilitation has been associated with several positive effects on CAD patients,⁹ including improvements in HRR.^{4-6,10} However, these were not randomized controlled studies,^{4-6,10} evaluate patients with different CAD presentations,^{4,5} and used different methodologies to assess HRR. For instance, one study assessed HRR after submaximal exercise and a 1-min cool-down.⁴ The purpose of the present study was thus to evaluate the effects of exercise training on autonomic function in CAD patients recovering from acute myocardial infarction.

Methods**Study design, sample size and power**

The required sample size for the present single-center prospective, randomized, controlled, parallel-group study was computed in advance based on the effect size calculated from previous studies.^{4,6} The statistical power for the

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