Journal of Science and Medicine in Sport 19 (2016) 611–615

Contents lists available at ScienceDirect

Journal of Science and Medicine in Sport

journal homepage: www.elsevier.com/locate/jsams

Original research

Self-rating level of perceived exertion for guiding exercise intensity during a 12-week cardiac rehabilitation programme and the influence of heart rate reducing medication

Lars H. Tang[a,b,c,d,*], Ann-Dorthe Zwisler[a,e], Rod S. Taylor[f,g], Patrick Doherty[h], Graziella Zangger[a], Selina K. Berg[a], Henning Langberg[b]

[a] Department of Cardiology, The Heart Centre, Rigshospitalet Copenhagen University Hospital, Denmark
[b] CopenRehab, Section of Social Medicine, Department of Public Health, University of Copenhagen, Denmark
[c] Bachelor's Degree Programme in Physiotherapy, Department of Rehabilitation and Nutrition, Faculty of Health and Technology, Metropolitan University College, Denmark
[d] The Centre for Physical Activity Research, Rigshospitalet, University of Copenhagen, Denmark
[e] National Centre for Rehabilitation and Palliative Care, University of Southern Denmark and Odense University Hospital, Denmark
[f] Institute of Health Research, University of Exeter Medical School, United Kingdom
[g] National Institute of Public Health, University of Southern Denmark, Denmark
[h] Department of Health Sciences, University of York, United Kingdom

ARTICLE INFO

Article history:
Received 27 April 2015
Received in revised form 17 August 2015
Accepted 25 August 2015
Available online 10 September 2015

Keywords:
Exercise therapy
Heart rate
Exercise prescription
Atrial fibrillation
Heart valve disease

ABSTRACT

Objectives: To investigate whether self-rating level of perceived exertion can adequately guide exercise intensity during a 12-week cardiac rehabilitation programme.
Design: Linear regression analysis using rehabilitation data from two randomised controlled trials.
Methods: Patients undergoing radiofrequency ablation for atrial fibrillation or following heart valve surgery and participating in exercise-based rehabilitation were included. The 12-week rehabilitation outpatient programme comprised three weekly training sessions, each consisting of 20 min aerobic exercise divided into three steps. Patients were asked to base their exercise intensity for each step on a predefined rating of perceived exertion specified in a training diary. Exercise intensity was objectively measured by heart rate during the last 2 min for each exercise step. Comparative analysis and linear regression of the rating of perceived exertion and heart rate were performed.
Results: A total of 2622 ratings of perceived exertion were collected from 874 training sessions in 97 patients. Heart rate and rating of perceived exertion were associated both across all three exercise steps and individually for each step, with a mean of 6 to7 bpm per 1-point difference in the rating of perceived exertion ($p < 0.001$). Adjusting for rate-reducing medication slightly improved the strength of the association.
Conclusions: The association between change in the rating of perceived exertion and change in heart rate indicates that a diary-led and self-regulated model using rating of perceived exertion can help guide exercise intensity in everyday clinical practice among patients with heart disease, irrespective if they are taking heart rate-reducing medication.

1. Introduction

Physical training, underpinned by prescription and monitoring of aerobic exercise intensity within an adequate intensity range, is a key component of effective cardiac rehabilitation and is associated with improved exercise capacity and reduced adverse cardiac events.[1,2] Objective exercise test methods, such as heart rate (HR) and oxygen uptake, are available for monitoring exercise intensity.[1] However, there is an increasing trend in providing cardiac rehabilitation in the community or at home instead of hospitals which is making approaches to self-monitoring exercise prescription increasingly important. Rating of perceived exertion (RPE)[3] is a frequently applied method of exercise self-monitoring because it is simple and inexpensive.

RPE is an accepted reliable and valid method for monitoring exercise intensity among healthy adults.[4–6] In cardiac

* Corresponding author.
E-mail address: Lars.hermann.tang@regionh.dk (L.H. Tang).

http://dx.doi.org/10.1016/j.jsams.2015.08.004
1440-2440/

rehabilitation, the 15-point Borg RPE scale[3] has traditionally been used. This scale is particularly relevant for patients for which maximum HR is unknown or difficult to estimate for such reasons as arrhythmia or the use of beta-blocker.[1] Whilst, among patients with heart disease, the RPE is generally considered reliable[7] it may on occasions over or underestimate the actual exercise intensity.[8–10] Nevertheless, studies have shown similar beneficial health effects using exercise guidance from RPE compared with other more objective physiological monitoring methods.[11,12]

A small number of studies have investigated the extent to which patients with heart disease can regulate exercise intensity by using RPE and discriminate between RPE values. In a small study, Weiser et al.[13] showed that patients could discriminate between intensity at RPE points 11 and 13 using HR as an objective measure. This finding is consistent with Eston et al.[14] when expressing exercise intensity relative to maximal work load (watts). Aamot et al.[10] showed that patients with heart disease could increase exercise intensity using RPE guidance (RPE 17), although with limited precision. Borg et al.[15] found that patients with heart disease were able to increase RPE by increasing HR, although RPE rose more rapidly with a given increase in HR than among healthy controls.

Previous studies have all been performed in experimental or a standardised setting in which the researcher controlled and encouraged the increments of exercise carried out by patients. This differs from real life, in which patients typically have to perform self-monitored progressive aerobic exercise without strict supervision. That studies investigating home-based exercise programmes have failed to demonstrate any clinical benefits may reflect the inability of patients with heart disease to follow their individualised exercise prescription.[16–18] This study therefore aimed to investigate whether self-rating level of perceived exertion could adequately guide exercise intensity when applied in a 12-week cardiac rehabilitation programme reflecting everyday clinical practice.

2. Methods

This study is based on two randomised controlled trials (CopenHeart), both with a parallel two-group design allocating patients to either rehabilitation with physical exercise and a psycho-educative intervention or to usual care (without supervised physical training).[19,20] The Regional Ethical Committee (j.nr. H-1-2011-135, j.nr. H-1-2011-157) and the Data Protection Agency approved these studies (j.nr. 2007-58-0015).

This study used data for patients assigned to and participating in the rehabilitation intervention 1 month after either radiofrequency ablation for atrial fibrillation or heart valve surgery. The inclusion criteria in the two randomised controlled trials were an age ≥18 years, ability to speak and understand Danish, and no musculoskeletal disorder or other diseases preventing them from participating in exercise training.

Four to six weeks after discharge from hospital, a 12-week progressive exercise programme was introduced combining aerobic and strength training three times a week for approximately 60 min per session. The patients performed each aerobic exercise session on a stationary bike beginning with a warm-up phase followed by a 20-min primary aerobic exercise phase. The primary phase was organised in three incremental steps of exercise intensity based on the 15-point Borg RPE scale.[3] The duration and intensity varied between the three steps. Exercise intensity in the first and third step was set between RPE 11–14 and the second exercise step at RPE 13–17. The first exercise session took place at a tertiary centre hospital (Department of Cardiology); thereafter, each patient could select their training location: the original tertiary hospital centre, a local hospital or municipality (across 29 collaborating training locations) or at home. Before and after the exercise period, all patients underwent a maximum cardiopulmonary exercise test (CPET), performing a ramp protocol on an ergometer bicycle.[19,20]

During the training period, exercise duration and intensity was prescribed with an individual patient training diary developed in collaboration between the CopenHeart research group and CorusFit (Jyväskylä, Finland). The diary also contained general information on the exercise intervention and instructions for the 15-point Borg RPE scale. One of four project physiotherapists introduced patients to the diary and RPE at their first training session. The diary contained preselected RPE intensity levels and the duration of each of the three steps. The preselected RPE intensity was chosen according to current European guidelines for physical exercise in cardiac rehabilitation.[2] The patients were instructed to perform exercise intensity corresponding to the preselected RPE, to report their actual RPE for each of the three exercise steps in their diary, and to note deviation from their exercise prescription. Patients' demographic information, including cardiac drug consumption, was also recorded.

Exercise intensity was objectively assessed as the cardiovascular response to exercise, measured as HR. During all exercise sessions, HR data were obtained with Polar HR RS 400 monitors (Polar Electro, Kempele, Finland) or T-shirts with wireless integrated ECG electrodes (Corus-Fit Cardio and Corus Exercise Assistant, CEA, V.2.0.16). Patient were only instructed to start and stop the HR monitor during the primary aerobic exercise phase and asked not to focus on the HR monitor during training.

Prior to data analysis, training diary data were manually entered into a database. When a patient reported several RPE values for a given exercise step, an average of the lowest and the highest RPE values were calculated and rounded up to the nearest RPE point. Since the duration of each exercise step varied between exercise sessions, only sessions 1–6, 10–12, 16–18, 22–24 and 31–33 were utilised for analysis, because of similar duration (5–10–5 min). A maximum of 18 sessions were therefore available for each patient.

HR and RPE data were synchronised with the dates of exercise training. Training sessions missing either RPE or HR data where excluded. HR was recorded with a maximum 5-second sampling rate and each 20-min recording was manually checked to ensure data quality. Irregular frequency changes with sudden repeated alterations exceeding ≥10 beats per minute (bpm) were not accepted. Clear errors in a HR measurement (such as zero values) were deleted. To best reflect steady-state in exercise intensity, an average HR was calculated over the last 2-min window for each exercise step (Fig. 1a) in accordance with Aamot et al.[10] Two independent investigators (LT and GZ) checked all RPE and HR data to avoid systematic bias in the selection process. Inconsistencies between investigators were reviewed. In cases of inconsistency a third investigator (ADZ) was consulted.

Statistical analyses were performed using SAS Enterprise Guide 5.1 (SAS Institute, Cary, NC, USA). Paired *t*-tests were used to assess the within-subject difference in HR between each exercise step and are presented as mean differences (and 95% confidence intervals (CI)). Wilcoxon signed rank sum tests were used to assess the difference in RPE between each step and are presented as medians (and interquartile ranges (IQR)). Linear regression was used to assess the relationship between RPE and HR during the last 2 min of each exercise step. This regression model considered the repeated-measures (clustering within each patient) nature of the data. We report the intraclass correlation (ICC) for HR and RPE outcomes, comparing the within-patient variance to the total of the between- and within-patient variance in HR and RPE. Models were also run with adjustment for consumption of HR-reducing medications of beta-blockers and calcium antagonists. Spearman's correlation coefficient (rho) and the coefficient of determination (R^2) were calculated for all models. The level of statistical significance was set at $p < 0.05$.