Evidence-based approach to exercise prescription in chronic heart failure

Steve E Selig, David L Hare

The benefits of moderate exercise appear to outweigh the risks

The hallmark symptoms of chronic heart failure (CHF) are fatigue and breathlessness, leading to impaired quality of life and capacity for activities of daily living (ADLs). Exercise training has the potential to delay the onset of fatigue and breathlessness, not just in patients with CHF, but in all people who exercise regularly. However, cardiologists have been concerned with recommending exercise to their patients with CHF, owing to perceptions that habitual exercise training may accelerate the disease process via cardiac hypertrophy and remodelling, deterioration in central haemodynamics and neurohormonal overactivity. All of these have strong associations with increased morbidity and mortality in these patients. A further concern has been that of sudden death from exercise-induced arrhythmias and, to a lesser extent, severe perturbations in blood pressure. Exercise training in patients with CHF is a relatively recent development, and studies to date have generally been limited to clinically stable, younger (<65 years) and less complicated cases.¹ Very few women have been studied. The mortality outcome data so far are limited to less than 20 studies of a total of approximately 1000 individuals. The purpose of this Leader is to provide an overview of the benefits, or otherwise, of exercise training for people with stable CHF in terms of its intermediate clinical influences on central haemodynamics, intracardiac volumes and pressures, and autonomic balance, and on their longer-term associations with symptom progression and mortality.

There have been no reports of sudden death or the need for cardiac life support during supervised exercise in clinical trials of exercise training in patients with heart failure (HF), although this may be partly attributed to the relatively low number of patient-hours accumulated to date, and the closely controlled conditions of these trials, including biases in volunteer inclusion. There is a small but growing body of evidence showing lower mortality in patients with CHF who exercise, compared with inactive controls. A meta-analysis of nine randomised clinical trials for a total of 801 patients² involved in exercise training

yielded a number needed to treat of 17 patients to prevent one death every 2 years. This compares favourably with a number needed to treat of 19 for the first-line HF drug class of ACE inhibitors,³ underscoring the clinical significance of exercise for patients with HF. The relative risk ratio of mortality for exercising patients to that for inactive controls was 0.65 (95% CI of 0.42 to 0.92).² Larger-scale mortality outcome studies are currently underway to expand this limited evidence base.⁴

Six months of aerobic exercise training at moderate intensities (60–70% of $\text{VO}_{2\text{peak}}$) and volumes (≤ 150 min per week) were associated with small but significant improvements (falls) in end-diastolic volume and end-systolic volume^{5,6} in patients with CHF, whereas these volumes increased in the inactive CHF volunteers, indicating that moderate-intensity exercise training for up to 6 months is safe and may also promote reverse remodelling of the left ventricle in CHF. Exercise training in CHF improves cardiac vagal influence,^{7,8} and this may protect the heart during acute exercise from arrhythmias, and during chronic exercise by retarding the development of cardiomegaly.⁹ Intense exercise regimens (both aerobic and strength) are associated with sharp increases in platelet reactivity, whereas moderate-intensity training is associated with relatively counterbalanced stimuli to the thrombogenic and fibrinolytic systems. Therefore, patients with CHF, particularly those with (a history of) atrial fibrillation, unstable atherosclerotic plaque or shortly after coronary artery stenting, should avoid high-intensity exercise.¹⁰ For many other reasons, high-intensity exercise should not normally be included in exercise programmes for patients with CHF. Pragmatically, a sedentary lifestyle often contributes to the development of CHF, with many individuals harbouring long-term aversions to exercise. It is more likely that they will accept, and then enthusiastically adopt, healthful enduring exercise if that exercise is at relatively comfortable intensities. As a guide, moderate intensity exercise approximates to 60–70% of $\text{VO}_{2\text{peak}}$ (aerobic) and 60–70% of 3RM (strength:

maximum load that can be lifted for 3, but not 4, repetitions). CHF is characterised by a myopathy syndrome, manifested by a loss of strength in mild cases through to cachexia in severe cases. The goal for including resistance (strength) training for patients with CHF is to (partially) reverse the deficits of muscle wasting and weakness. An associated goal is to improve the capacity for ADLs and quality of life, since most ADLs involve strength more than endurance. Moderate-intensity strength training also improves aerobic capacity,⁸ partly via improvements to skeletal muscle mitochondrial ATP production rates.¹¹ High-intensity strength training may engender valsalva effects, with central haemodynamic compromise, and so moderate-intensity training is preferred. The goals for including aerobic training include benefits to endothelial integrity and function (anti-inflammatory, anti-atherogenic, anti-thrombogenic), decreasing fat mass in those who need to do so, improving mood and alleviating depression and improving aerobic capacity. Although the latter is strongly linked to improved mortality outcomes,¹² the results of large mortality outcome training studies are awaited.

SUMMARY

Combinations of moderate-intensity aerobic and strength training programmes for patients with CHF improve aerobic capacity, skeletal muscle structure and function, peripheral blood flow, and neurohormonal and endothelial function, with some evidence for improvements in central haemodynamics, cardiac volumes and mortality. Larger studies are underway for morbidity and mortality outcomes, and more studies are needed to examine the safety versus efficacy for patients with more advanced and complicated disease. Patients need to be medically assessed before referral to clinically qualified exercise physiologists who are trained to recognise adverse signs and symptoms and intervene appropriately. The evidence to date points to benefits outweighing the risks for moderate-intensity exercise training in people living with CHF.

Br J Sports Med 2007;**41**:407–408.

doi: 10.1136/bjsm.2006.028803

Authors' affiliations

Steve E Selig, Centre for Ageing, Rehabilitation, Exercise and Sport (CARES), Victoria University, Melbourne, Victoria, Australia

David L Hare, Department of Cardiology, Austin Health, University of Melbourne, Melbourne, Victoria, Australia

Correspondence to: Dr S E Selig, Centre for Ageing, Rehabilitation, Exercise and Sport (CARES), Victoria University, Melbourne, Victoria 8001, Australia; steve.selig@vu.edu.au

Accepted 21 January 2007

Published Online First 8 February 2007

Competing interests: None declared.

REFERENCES

- 1 Rees K, Taylor RS, Singh S, *et al.* Exercise based rehabilitation for heart failure. *Cochrane Database Syst Rev* 2004;(3):CD003331.
- 2 Piepoli MF, Davos C, Francis DP, *et al.* Exercise training meta-analysis of trials in patients with chronic heart failure (ExTraMATCH). *BMJ* 2004;**328**:189–95.
- 3 Krum H, Jelinek MV, Stewart S, *et al.* Guidelines for the prevention, detection and management of people with chronic heart failure in Australia 2006. *Med J Aust* 2006;**185**:549–56.
- 4 Pina IL, Apstein CS, Balady GJ, *et al.* Exercise and heart failure: a statement from the American Heart Association Committee on exercise, rehabilitation, and prevention. *Circulation* 2003;**107**:1210–25.
- 5 Giannuzzi P, Temporelli PL, Corra U, *et al.* Antiremodeling effect of long-term exercise training in patients with stable chronic heart failure: results of the exercise in left ventricular dysfunction and chronic heart failure (ELVD-CHF) trial. *Circulation* 2003;**108**:554–9.
- 6 Hambrecht R, Gielen S, Linke A, *et al.* Effects of exercise training on left ventricular function and peripheral resistance in patients with chronic heart failure: a randomized trial. *JAMA* 2000;**283**:3095–101.
- 7 Coats AJ, Adamopoulos S, Radaelli A, *et al.* Controlled trial of physical training in chronic heart failure: exercise performance, haemodynamics, ventilation, and autonomic function. *Circulation* 1992;**85**:2119–31.
- 8 Selig S, Carey M, Menzies D, *et al.* Moderate-intensity resistance exercise training in patients with chronic heart failure improves strength, endurance, heart rate variability and forearm blood flow. *J Card Fail* 2004;**10**:21–30.
- 9 Buch AN, Coote JH, Townend JN. Mortality, cardiac vagal control and physical training—what's the link? *Exp Physiol* 2002;**87**:423–35.
- 10 Koenig W, Ernst E. Exercise and thrombosis. *Coron Artery Dis* 2000;**11**:123–7.
- 11 Williams AD, Selig SE, Carey MF, *et al.* Circuit resistance training in chronic heart failure improves skeletal muscle mitochondrial atp production rate – a randomised controlled trial. *J Card Fail* 2007;**13**:79–85.
- 12 Bittner V, Weiner DH, Yusuf S, *et al.* Prediction of mortality and morbidity with a six minute walk test with left ventricular dysfunction. *J Am Med Assoc* 1993;**270**:1702–7.

EDITORIAL BOARD MEMBER

Peter Fricker

Professor Peter Fricker is a highly respected leader in Australian sport, on both domestic and international platforms, and has been director of the AIS since May 2005.

Peter was also the medical director of Australian teams participating in the Manchester Commonwealth Games and the Athens Olympics, revisiting the role for this year's Commonwealth Games in Melbourne. His authority is qualified by former memberships of the Australian Sports Drug Medical Advisory Committee and national Anti-doping Research Panel, as well as past presidency of the Australasian College of Sports Physicians and a position as Adjunct Professor of Sports Medicine at Australian National University's Faculty of Medicine.

Peter has been critical to the success of the AIS and the resurgence of Australia as a sporting power. Official commendations include a Medal of the Order of Australia (1993) and the Australian Sports Medal (2001).

The AIS is the pre-eminent elite sports training institution in Australia with world-class facilities and support services. It is widely acknowledged, in Australia and internationally, as a leader in elite athlete development.

Figure 1 Peter Fricker.