

Past, Present, and Future Rehabilitation Practice Patterns for Patients with Heart Failure

The European Perspective



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KEYWORDS

• Exercise training • Exercise performance • Peak VO_2 • Cardiopulmonary testing • Ventilation

KEY POINTS

- A recent European Society of Cardiology position paper strongly advises participation of patients with stable heart failure (HF) in structured exercise training (ET) programs.
- Three ET modalities are proposed for HF populations with variable combinations and extent of effects: (1) endurance aerobic (continuous and interval); (2) strength/resistance; (3) respiratory.
- In low-risk and stable HF patients, home-based ET is thought to be as safe and effective as center-based rehabilitation, although long-term adherence may be uncertain.
- In HF patients with only recent clinical stabilization or in the presence of multiple comorbidities, a center-based and supervised setting is preferred.
- Irrespective of ET modalities, most studies have clearly demonstrated significant improvements in exercise physiology (ie, oxygen consumption, muscle function, and ventilation), quality of life, and left ventricular function.

INTRODUCTION

The recent European Society of Cardiology position paper strongly advises participation of patients with stable heart failure (HF) in structured exercise training (ET) programs, and in most recent years considerable efforts have been put onto standardization of exercise prescription.¹

Considering the different HF phenotypes and the wide heterogeneity of ET protocols, an individualized training approach is recommended.¹

Currently, 3 different ET approaches are proposed for HF populations with variable combinations and extent of effects: (1) endurance aerobics (ie, continuous and interval); (2) strength/

resistance; and (3) respiratory. For the 3 approaches, several ET programs are indeed available according to: (1) intensity level (ie, light to moderate, moderate to high, high to severe, and severe to extreme); (2) type (ie, endurance, resistance, and strength); (3) method (ie, continuous and intermittent/interval); (4) application (ie, systemic, regional, and respiratory muscle); (5) mode of exercise (ie, bicycle, treadmill); (6) monitoring (ie, supervised and nonsupervised); (7) setting (ie, hospital/center and home-based); and (8) application (ie, systemic, regional, and respiratory muscle).¹ Although the optimal combination and setting still need to be identified, evidence indicates that

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home-based ET may be as safe and effective as center-based rehabilitation in low-risk and clinically stable patients, although long-term adherence may be uncertain. Conversely, in patients with HF with only recent clinical stabilization or in patients with multiple comorbidities, a center-based and supervised setting is preferred.² The current review provides the European perspective of ET in patients with HF.

CLINICAL EVIDENCE AND APPLICATIONS OF EXERCISE TRAINING PROGRAMS IN HEART FAILURE

The main ET studies performed in Europe with different protocols and ET modalities are summarized in [Table 1](#).^{3–20} The description of results primarily focuses on the ET effects on the maximal exercise response and gas exchange analysis by cardiopulmonary exercise testing.

Endurance Aerobic Exercise Training

Endurance aerobic ET can be either continuous or at an interval of different intensities. Continuous aerobic ET is intended as an exercise session that can be performed for at least 20 minutes with a mild or moderate sense of fatigue and is typically performed at mild-to-moderate or high-exercise intensities in steady-state conditions of aerobic energetic yield, which allows the patient to perform prolonged training sessions, ideally between 30 and 60 minutes in duration. It represents the best described and established form of ET with well-demonstrated efficacy and safety and is thus highly recommended in the European Consensus documents.^{1,2}

In more deconditioned patients, it is recommended to “start low and go slow” (ie, at low intensity for 5–10 min twice a week). If well tolerated, the training duration per session first and the numbers of sessions per day later are increased, aiming at 20 to 60 minutes on 3–5 days per week at moderate-to-high intensity with indefinite program duration.

In contrast with continuous training protocols, aerobic interval training (AIT) requires the patients to perform alternate bouts (<1 min to 4 min) of moderate-to-high-intensity (50%–100% peak exercise capacity) exercise, interspersed with a recovery (<1 min to 3 min) phase, performed at low or no workload.

Since pioneering studies, mild-to-moderate continuous aerobic or endurance training (ie, on a cycle-ergometer or a treadmill) has been shown to produce major improvements in functional capacity (ie, exercise tolerance, peak oxygen consumption [VO_2]) in patients with HF²¹ and is the

most investigated form of ET in this patient population. Such an approach is also recommended as a baseline activity in these patients.¹ In Europe, indoor cycling is usually preferred because it is the most versatile mode of ET for a wide spectrum of patients with HF. Low workloads are possible; power output is reproducible, and the weight of the patient is supported, reducing the risk of injuries. Exercise modes such as running or jogging are traditionally regarded as contraindicated in HF because they may be quite strenuous and often performed without supervision.²

Despite the fact that higher levels of physical activity may reduce cardiovascular events, a certain risk of sudden death and incurring myocardial infarction has to be considered. Thus, most planned studies have taken as reference the first ventilatory anaerobic threshold (1st VAT), occurring at 50% to 60% of peak VO_2 as the reference ET intensity for patients with HF.²²

However, because patients with HF (compared with normal individuals) need a higher percentage of their peak VO_2 to perform daily life activities and because one of the main targets of ET is to allow these patients to perform daily tasks with less effort, training intensities above the 1st VAT have progressively been tested and introduced.²³ Specifically, the 2nd VAT occurs at 65% to 90% of peak VO_2 , at the respiratory compensation point (hyperventilation with respect to carbon dioxide [CO_2] metabolically produced). This level of exercise defines the so-called critical power (theoretic concept of the maximal work rate sustainable in a condition of physiologic aerobic balance),²⁴ which is now accepted as the limit for prolonged aerobic exercise without any additional risk. Accordingly, exercise intensities between 70% and 80% of peak VO_2 are currently being used in some settings.^{23,25,26}

With regard to the mode of exercise testing, it should be noted that the absolute values for peak VO_2 is significantly different on a treadmill compared with a bicycle. Several studies have systematically shown a VO_2 10% to 15% higher with treadmill tests because of the larger muscle mass involved during walking or running.^{27–29}

Several lines of evidence suggest greater efficacy of high-intensity exercise compared with moderate levels in patients with coronary artery disease, pre-HF left ventricular (LV) dysfunction function, and chronic HF as well as in healthy subjects.^{30–32} Nevertheless, in patients with HF with significantly reduced pretraining peak VO_2 and/or high exercise-related risks, aerobic ET intensities as low as 40% of peak VO_2 have been proven to be effective in increasing aerobic capacity, possibly with a more favorable risk/benefit ratio

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