Role of exercise in Heart Failure

Limitations of people with heart failure

Psychological: reduced quality of life
Central: dyspnea, fatigue
Peripheral: fatigue, reduced activity tolerance

Mortality ↓ Morbidity ↑ Cost
Ventilatory and Heart Rate Responses to Exercise
Better Predictors of Heart Failure Mortality Than Peak Oxygen Consumption

Mark Robbins, MD, Gary Franks, MD, Fradique J. Pacheco, MD, Claire E. Smiler, MA,
Kathy Hendren, RN, James B. Young, MD, Michael S. Lauer, MD

Background: An abnormal ventilatory response and an abnormal heart rate response (PNE > 900) to exercise are common in patients with severe heart failure, but their relative prognostic impact has not been well studied.

Methods and Results: Consecutive patients with heart failure referred for metabolic stress testing who were not taking pharmacologic or nonpharmacologic therapy (<4%) were followed for 2 years. The ventilatory data was evaluated with peak V̇O₂ and V̇O₂ at 90% (V̇O₂, 0.9). The ventilatory data and peak V̇O₂ were considered abnormal if the lower 2.5th percentile of the patient cohort, whereas V̇O₂, 0.9 was considered abnormal if it was the highest 5th percentile. For comparative purposes a group of 17 healthy controls underwent metabolic testing as well. Compared with controls, heart failure patients had markedly abnormal ventilatory and chronotropic responses to exercise. In the heart failure cohort, there were 73 deaths. In univariate analysis, peak oxygen consumption (PNE > 900), low chronotropic index, low V̇O₂ at 90%, low resting systolic blood pressure, and older age were predictive of death. Independent predictive value of the ventilatory and chronotropic responses to exercise were determined. In a stepwise multivariate analysis, the only independent predictors of death were peak V̇O₂, peak V̇O₂ at 90%, and low chronotropic index (adjusted R² 0.54, 0.23, and 0.35, respectively).

Conclusion: Ventilatory and chronotropic responses to exercise are powerful and independent predictors of heart failure mortality. (Circulation, 1999;99:2412-2417)

Key Words: heart failure • mortality • exercise • heart rate • ventilation

Below 900 pg/ml.

![Graph showing ventilatory and heart rate responses to exercise]

Continued on next page.
Neurohormonal activation
- norepinephrine
- renin
- aldosterone
- atrial natriuretic peptides
- arginine vasopressin
- sodium: a surrogate measure for renin.
- angiotensin.
- aldosterone activation
- endothelin

Compensatory mechanisms
- Activate when left ventricular function is depress
- activate to maintain an adequate cardiac output
- benefit is the short term
- contribute to progressive ventricular and vascular dysfunction

Compensatory mechanism
- Cardiac adjustment
  - Lt. Ventricular dilatation and concentric hypertrophy *
  - inc. end-diastolic volume resulting in inc. SV *
  - Ventricular remodeling from myocyte loss, interstitial fibrosis, myocardial slippage, and myocyte hyperthrophy
  - Inc. wall stress dec. systolic function
Compensatory mechanism

- Increased passive wall stiffness and slowed energy-dependent myocyte relaxation result in diastolic dysfunction
- Impaired ability to regenerate high energy phosphate
- Direct effects from some substances: endothelin, angiotensin-II
- Increased TNF, IL-6
- Increase in free fatty acid mobilization via neurohormonal stimulation
- Blood ketones body elevated

High risk cardiac patient

- Myocardial ischemia
- Infarct size
- Myocardial tissue at risk
- Occurrence of ventricular fibrillation or tachycardia
- Neurohormonal factors
  - Plasma concentration of various peptides: NE, renin, aldosterone, atrial natriuretic peptide, endothelin
  - Plasma sodium concentrations
- Psychosocial factors

AHA Scientific Statement

Team Management of Patients With Heart Failure
A Statement for Healthcare Professionals From the Cardiovascular Nursing Council of the American Heart Association

Heart failure is estimated to affect 4 to 5 million Americans, with 500,000 new cases reported annually. In the United States, 1 in 5 adults has heart failure, with the incidence of heart failure having increased. Factors that have contributed to this increase are the aging of the population and improved survival rates in patients with cardiovascular disease due to advances in diagnostic techniques and medical and surgical therapies. Heart failure is a chronic, progressive disease that is characterized by frequent hospital admissions and ultimately high mortality rates. Because of its high medical resource consumption, heart failure is the most costly cardiovascular disease in the United States.

Advances in the treatment of heart failure and early intervention to prevent decompensation by early detection, prevention, and management of patients' underlying disease processes and implementation of standard development of an integrated approach to heart failure management.

Pathophysiology and Definition of Heart Failure

Heart failure is a result of complex disorders affecting the heart's ability to pump blood effectively. There are several pathophysiologic mechanisms that are involved in heart failure, but the common denominator is that the heart's ability to pump blood is more than likely curtailed by a variety of different factors, such as neurohormonal systems, neurohormonal factors, and other disease processes. Even though these conditions are related, a single disease process should be considered.
สาเหตุการเสียชีวิตฉับพลันในกลุ่มนี้ (6-9 เท่า)

- Ventricular tachycardia
- Ventricular fibrillation
- Bradycardia
- Pump failure
- Recurrent ischemia
- Electromechanical dissociation
- Strokes/embolic phenomenon
- Pulmonary/renal complication

Clinical stability

- Clinical cardiovascular criteria
- Stability of noncardiovascular disease
- Laboratory criteria
- Psychosocial criteria

Cardiovascular criteria

- Improved activity since previous visit, walk >1 city block
- No limitation during dressing
- Freedom from evidence of congestion
- Absent of angina or present in stable exertional patterns
- No syncope or recurrent symptomatic arrhythmias
- Stable fluid balance with an increase in diuretic dose of not more often than once a week
Cardiovascular criteria

- Stable vital signs
  - Blood pressure
    - Systolic heart failure: Systolic pressure > 80 mmHg, no symptoms of postural hypotension, and proportional pulse pressure of > 25 %
    - Heart failure with “preserved EF”: control of hypertension
  - Heart rate
    - Sinus rhythm generally < 85 BPM at rest
    - AF generally > 85 BPM at rest, < 110 bpm with routine activity

Noncardiovascular disease

- control of pulmonary disease with lowest possible doses of systemic corticosteroids and inhaled beta-adrenergic agents
- control of hyperglycemia without hypoglycemia
- effective therapy of chronic blood loss or anemia

Laboratory criteria

- stable renal function, generally with serum Cr < 2.0 mg/dL and BUN < 50 mg/dL, may be higher in patients with known intrinsic renal disease
- stable serum sodium, generally > 134 mEq/L
Psychosocial criteria

- Compliance with medical regimen
- Social support
- Absence of serious depression or dementia
Role of Exercise Training in HF

- Exercise Capacity **
- Catecholamines *
- Ventilatory Responses **
- Endothelial Function *
- Myocardial Adaptations ?
- Mortality ?
- Quality of Life ?

Role of Exercise Training in HF

- Adaptations are mostly peripheral
- Activation of neuro-hormonal system
- Central adaptation
**Exercise Program**

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<th>Intensity</th>
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<td>80%</td>
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<tr>
<td>Swimming</td>
<td>70%</td>
<td>90%</td>
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*Notes: 50% of participants achieved target heart rate*.

**Implant**

- **Pacemaker**
- **ICD**
- **CRT-D**
- **CRT-P**

<table>
<thead>
<tr>
<th>Author</th>
<th>Year of Publication</th>
<th>Exercise Program</th>
<th>Implant</th>
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<td>Goldman et al. (2012)</td>
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**AHA/ACC Conference Proceedings**

** Evaluating Quality of Care for Patients With Heart Failure**

Earle M. Knox, MD, Chair; David W. Baker, MD, MPH, Cochair; Carol M. Atroshi, MD, Sandra B. Danowski, RN, DNSc, Denise C. Finegan, MD, Edward P. Hernandez, MD, Mark A. Hlatky, MD, Marvin Komaroff, MD, Diana L. Ornstein, Berna L. Pinto, MD, Norman Pickering, MD, John A. Spielman, MD, MPH

The American College of Cardiology and the American Heart Association have joined forces to assess care for patients with heart failure (HF) and reduce recommendations about quality measures. The working group includes healthcare professionals (cardiologists, general internists, and nurses) from academia, representatives from governmental agencies, industry, and healthcare systems also have been invited. The group has expertise in the treatment of HF and quality improvement. Several panel members participated in writing guidelines for managing patients with HF. The focus of the conference proceedings is to highlight the evidence for management of patients with HF and to inform ongoing guidelines and national programs.

This conference is supported by the Agency for Healthcare Research and Quality (AHRQ) as part of the Agency for Healthcare Research and Quality (AHRQ) as part of the Agency for Healthcare Research and Quality's (AHRQ) efforts to improve the quality, safety, efficiency, and effectiveness of healthcare-based cardiac catheterization.
Exercise testing

- Due to limitation of FC < 5 METs
- Use Naughton protocol / ramp protocol with increment 0.2 – 0.4 METs per second or 1-2 METs/stage
- Gas exchange measurements should be used when feasible
Exercise recommendation

- assessment and management of possible limitations to exercise
- optimal pharmacology
- nutritional support

Exercise recommendation

- dyspnea management (supplemental oxygen, mobilization of secretions)
- Ventilatory breathing exercise
  - purse lip breathing
  - inspiratory muscle training
  - diaphragmatic breathing
  - inhibition of accessory muscle
Risks

- Very low
  Activities performed with continuous ECG monitoring have the lowest rates of sudden cardiac arrest compared with those that are unmonitored or only intermittently monitored.
- High risk: MI, VF, Poor systolic response, survival of CPR

### Contraindications or delay in initiating

- Recent hospitalization for, or clinically unstable, heart failure
- Heart failure medication not optimized
- Severe stenotic or primary regurgitant valvular heart disease
- Significant intercurrent illness, not substantially resolved
- Recent procedure that requires delay in starting exercise training (ICD)
Contraindications or delay in initiating

- Exercise testing results that would preclude safe exercise training
- Uncertain, New York Heart Association functional class IV, secondary severe mitral or tricuspid regurgitation, uncontrolled atrial fibrillation

Exercise prescription

- No guidelines, usually go for submaximal 40%-50% of Vo2 max = 65% of HR max
- No exercise in patients with severe mitral or tricuspid regurgitation
- RPE = 12-13
- Resistance training in stable cases with low weight(1-2 lbs) and dynamic exercise

Exercise prescription

- Special precaution and strict to criteria
- For diastolic dysfunction avoid resting vigorous heart rate
- For systolic dysfunction avoid isometric and heavy work load even the heart rate is not raise
**Exercise prescription**

- status change very quickly, pt. Should reevaluate every exercise session
- warm up and cool down should be prolonged
- use low intensity/long duration sessions
- PRE and dyspnea scales are very useful

<table>
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<td>1-2</td>
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</table>
Exercise prescription

- Avoid isometric exercise
- ECG monitors in Hx of V tach, cardiac arrest, or exertional hypotension
- Consider investigation to developing exercise program, do not exceed work load that produces wall motion abnormalities, a drop in EF, a pulmonary wedge pressure > 20 mmHg, or above ventilatory threshold

Relative criteria for participation in an exercise program

- **ability to speak without signs and symptoms of dyspnea**: able to speak comfortably with RR < 30 beat/min
- **not more than moderate fatigue by subjective clinical impression**
- Crackles present in less than one half of the lungs
- **cardiac index > 2L/min/m² or CVP < 12 mmHg**

Indicators for modifying or termination of exercise in CHF patients

- **marked dyspnea of fatigue**: (RPE > 3/10 or 15/20) RR > 40 BPM
- Development of S3 or pulmonary crackles
- Increase in pulmonary crackles
- **Significant increase in the sound of the second component of the second heart sound (P2)**
Indicators for modifying or termination of exercise in CHF patients

- Poor pulse pressure < 10 mmHg
- Decrease in HR or BP > 10 BPM or mmHg
- Increasing supraventricular or ventricular ectopy
- Diaphoresis, pallor, or confusion

Conventional wisdom excluded the role of exercise training in the management of heart failure.

Studies of exercise training suggest some beneficial effects.
Conclusions.

So, is heart failure and exercise training contradictory or conventional?

Looking forward to the likely beneficial effect of exercise training, as well as additional beneficial therapies available to treat heart failure, we may one day look upon such a patient and say, “This is not a heart failure patient.”

Wrap Up messages

- HF is best candidate to exercise
- HF is safe to exercise
- Consider risk group & optimal management before start exercise program
- Exercise prescription is related to FC