Exercise Therapy in Heart Transplant Patients

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Outlines

- Physical Capacity
- Cardiac Rehabilitation Definition and Aims
- Rehabilitation in CHF patients and before heart transplantation
- Rehabilitation after heart transplantation

Physical Capacity

- The gold standard measurement of physical capacity is VO2peak (peak oxygen uptake)
- VO2peak; maximum ability of the cardiovascular system to deliver oxygen to exercising muscles and of the exercising muscle to extract oxygen from the blood
- VO2peak is a strong predictor of survival in general populations, among patients with CAD, and in patients with severe HF.

Physical Capacity

- Based on two large cohorts of men and women with confirmed CVD, baseline VO2peak was a powerful predictor of cardiovascular and all cause mortality.
- The cutoff points above which there was a marked survival benefit were 13 mL/kg/min(3.7 METs) in women and 15 mL/kg/min(4.3 METs) in men.
- A 1 metabolic equivalent (1 MET = 3.5 mL/kg/min) increase in exercise capacity has been shown to translate into a 12% improvement in survival in people with existing cardiovascular disease.

Heart Transplantation Candidates

- The HF patients with VO2peak < 12 mL/kg/min are considered to have the worst prognosis and can be appropriate candidates for heart transplantation.

Cardiac Rehabilitation

- International guidelines on the management of coronary heart disease and heart failure, consistently recommend cardiac rehabilitation as an effective and safe intervention.

Cardiac Rehabilitation Key Concept

- The coordinated sum of activities required to influence favorably the underlying cause of cardiovascular disease, as well as to provide the best possible physical, mental and social conditions, so that the patients may, by their own efforts, preserve or resume optimal functioning in their community and through improved health behavior, slow or reverse progression of disease.

Comprehensive Cardiac Rehabilitation

- Comprehensive Cardiac Rehabilitation involves a variety of therapies, including exercise, risk factor management and lifestyle education, behavior change, psychological support, and strategies that are aimed at targeting traditional risk factors for cardiovascular disease.

Contraindications

- Unstable angina
- Uncontrolled hypertension; resting SBP > 180 mm Hg and/or resting DBP > 110 mm Hg
- Orthostatic BP drop of > 20 mm Hg with symptoms
- Significant aortic stenosis (aortic valve area < 1.0 cm2)
- Uncontrolled atrial or ventricular arrhythmias
- Uncontrolled sinus tachycardia (HR > 120)
- *Uncompensated heart failure;* increased dyspnea, nocturnal cough, leg edema, pulmonary wheezes or rales, orthopnea, paroxysmal nocturnal dyspnea

Contraindications

- Third-degree atrioventricular (AV) block without pacemaker
- Active pericarditis or myocarditis
- Recent embolism
- Acute thrombophlebitis
- Systemic illness or fever
- Uncontrolled diabetes mellitus
- Severe orthopedic conditions that would prohibit exercise
- Other metabolic conditions, such as acute thyroiditis, hypokalemia,
- hyperkalemia, or hypovolemia (until adequately treated)

Cardiac Rehabilitation in CHF patients and before heart transplantation

Evidence

- Current evidence indicates that moderately intense aerobic exercise safely improves exercise tolerance in patients with heart failure , partially reverses much of the abnormal pathophysiology that accompanies the disease, and improves health-related quality of life and several important clinical outcomes.

Evidence

- Although aerobic exercise remains the main stay of clinical training programs, resistance training has been shown to increase muscle strength and endurance, reduce symptoms, and improve quality of life.

- Exercise training in patients with heart failure is generally well tolerated and safe.

Exercise Prescription in CHF Patients (FITT)
Aerobic Exercise

- **F**requency; at least 3 d/wk
- **I**ntensity;
  - Warm-up and cool-down; static stretching, ROM, and light intensity aerobic training (<40% HRR)
  - Constant training; 40% - 80% HRR / RPE 11-16
  - Interval training; 4 minutes 80%- 90% HRR + 3 minutes 40%-50% HRR (recovery)
- **T**ime; 20-60 minutes
  - Warm-up and cool-down 5- 10 min
- **T**ype;

Exercise Prescription in CHF Patients(FITT) Aerobic Exercise

- **T**ype;
- Arm ergometer
- Combination of upper or lower (dual action) extremity cycle ergometer
- Upright and recumbent cycle ergometer
- Recumbent stepper
- Rower
- Elliptical
- Stair climber
- Treadmill for walking

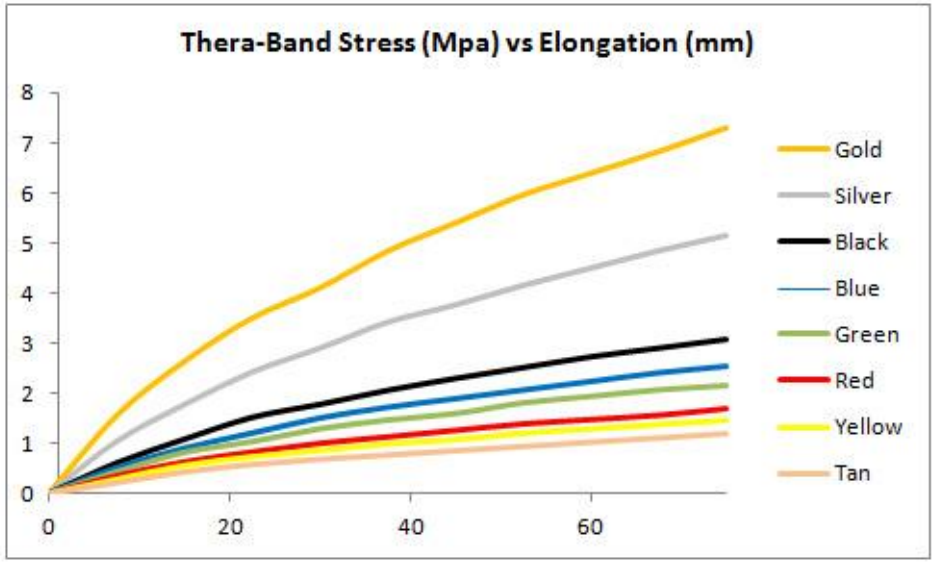

STAIRWAY

Exercise Prescription
Resistance Exercise

- **F**requency; 2-3 d /wk, at least 48 h separating training sessions for the same muscle group
- **I**ntensity; over several weeks from 30%-40% to 70% of l -RM (Initial load should allow 10- 15 repetitions that can be lifted without straining)
- RPE 11-14 (fairly light to somewhat hard)
- **T**ime; 30-60 min
- 1-4 sets each major muscle group
- **T**ype;

Exercise Prescription
Resistance Exercise

- **T**ype (equipment);
  - Elastic bands
  - Free weights
  - Cuff and hand weights
  - Machines
  - All major muscle groups; chest, shoulder, arms, abdomen, back, hips, legs


Thera-Band Stress (Mpa) vs Elongation (mm)
8
7
6
5
4
3
2
1
0
0
20
40
60
Gold
Silver
Black
Blue
Green
Red
Yellow
Tan

Inspiratory Muscle Weakness

- Inspiratory muscle weakness is a key factor responsible for abnormal ventilation in HF.
- There is an approved relationship between inspiratory muscle weakness and;
  - Symptoms
  - Exercise intolerance
  - Abnormal cardiopulmonary exercise testing (CPET) results

Inspiratory Muscle Training Techniques

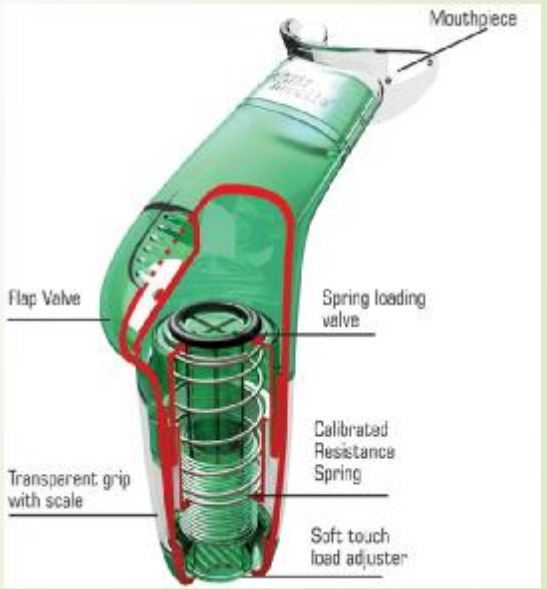
- Incentive Spirometry
- Pressure Threshold Loading
- Voluntary Isocapnic Hyperpnea
- Flow Resistive Loading
- Variable Flow Resistive Loading

Pressure Threshold loading

Incentive Spirometer

Pressure Threshold Loading

- Producing negative pressure to overcome a threshold load and initiate inspiration
- Increasing inspiratory muscle's maximal:
  - Ø Force production
  - Ø Velocity
  - Ø Endurance



Inspiratory muscle training with visual feed-back

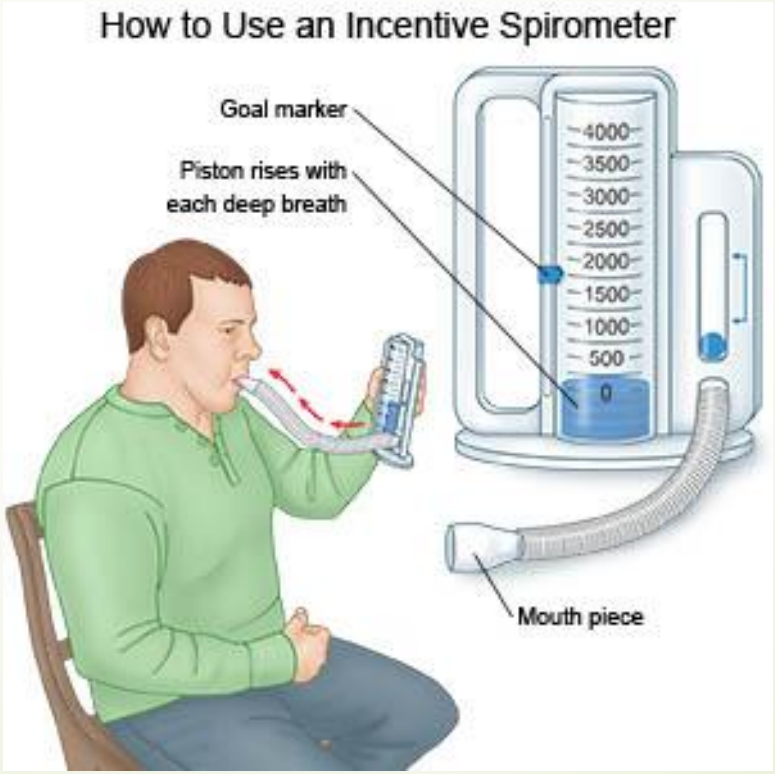
Inspiratory Muscle Training

- Mode: Threshold inspiratory muscle trainer
- Intensity: approximately 30% of MIP,
- Average duration 30 min/d for 12 weeks, 7 days per week.
- Progression;
  - Maintain the same duration or increase it slightly
  - Maintain the same training intensity at 30% to 40% of MIP by weekly reassessment of MIP.

Improvements by IMT in HF patients

- Dyspnea
- Ventilation
- Peak VO2
- Quality of life
- Balance
- Peripheral muscle strength and blood flow
- Heart rate
- Respiratory rate
- 6-minute walk test distance

Incentive Spirometer



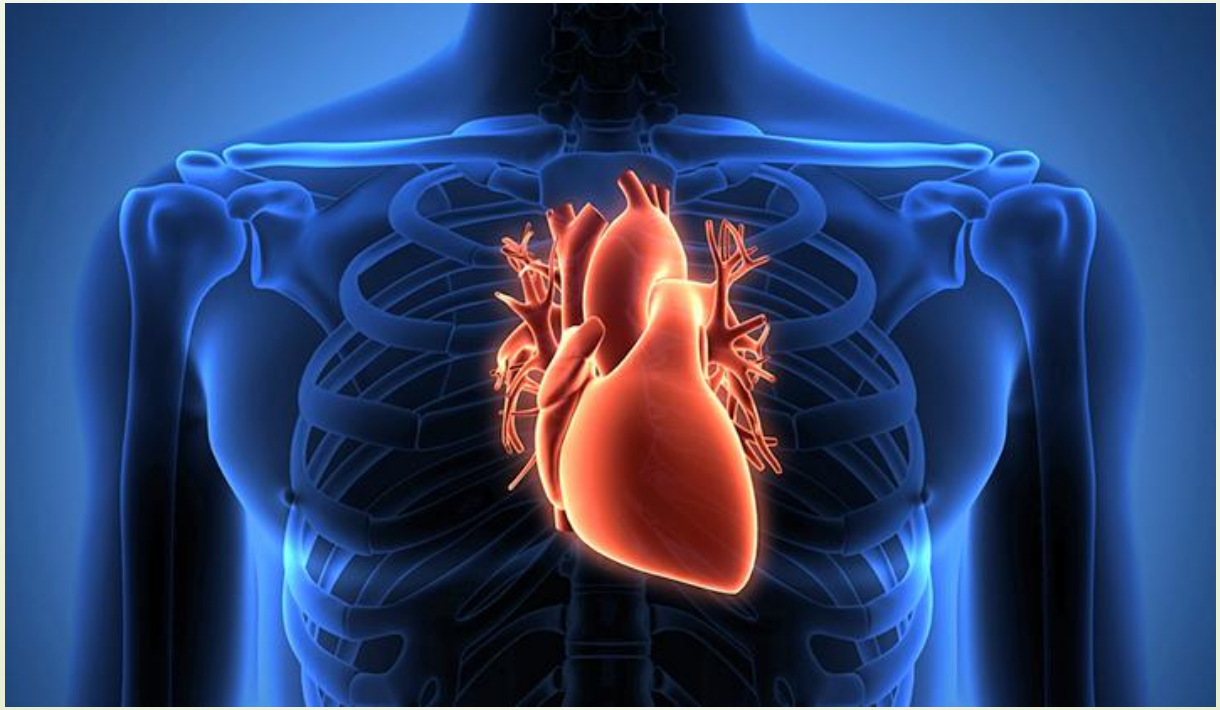
Measurements During Rehabilitation Session

- BP; at rest, during exercise, after each exercise station
- Heart rate; at rest, during exercise, during recovery
- Blood sugar in diabetic patients
- ECG monitoring
- Oxygen saturation
- Subjective rating (Borg scale)
- Signs and symptoms


NEC
0:00
144
0:00
95


ergoline

Cardiac Rehabilitation after Heart Transplantation



Importance of Rehabilitation after HTx

- Cardiac transplant recipients continue to experience exercise intolerance after surgery that is about 40%-50% below that of age-matched normal individuals.
- Causes of exercise intolerance;
  - Absence of efferent sympathetic innervation of the myocardium, affecting HR and contractility responses
  - residual skeletal muscle abnormalities developed before transplantation because of heart failure
  - decreased skeletal muscle strength

Evidence

- exercise-based cardiac rehabilitation improves exercise capacity [15-40%] in heart transplant recipients.
- Cardiac rehabilitation appears to be safe in this population.
- High-intensity interval training is safe in heart transplant recipients and leads to superior improvements in peak oxygen uptake compared with moderate exercise.

Special Considerations after HTx

- Because of the denervated myocardium in cardiac transplant recipients (especially during the first year);

- Elevated resting HR (often > 90 bpm)
- Elevated systolic and diastolic BP at rest
- Attenuated increase in HR during submaximal work
- Lower peak HR and peak stroke volume
- Greater increase in plasma norepinephrine during exercise
- Delayed slowing of HR in recovery

Special Considerations after HTx

- Restrict upper-body resistance exercises until sternum is healed (8-12 wks).
- Start resistance training 6-12 wks after transplant.
- Start arm ergometry 4-8 wks after transplant.

Inpatient Rehabilitation after HTx

- **F**requency**:** 2 to 4 times per day

  mobilization during the first 3 days of the hospital stay
- **I**ntensity**:** RPE ≤ 13
- **T**ime**:** Begin with intermittent walking bouts 3- 5 min as tolerated and slowly progress the duration
- **T**ype**:** Walking/ stair climbing after 9 days
- Progression**:** When continuous exercise duration reaches 10-15 min, increase intensity as tolerated within the recommended RPE limits.

Incentive spirometer 10 times each hour

Inpatient Rehabilitation after HTx

- 1st to 2nd day (ICU): breathing exercises, active range of motion exercises for upper and lower extremities in supine and sitting positions, supine-to-stand transfer training;
- 3rd to 5th day (exercise room): breathing exercises, active range of motion exercises for upper and lower extremities in sitting, postural re-education exercises.
- After 6th to 9th (exercise room): active range of motion exercises for upper and lower extremities in sitting and standing positions, gait training, stair climbing.

Cardiac Rehabilitation Home Exercise Program

- walking on level surfaces. Walking slowly if you do walk on hilly terrain.
- Spacing patient's activities. Waiting at least 1hour after eating a heavy meal or bathing,before exercising.
- Avoidance of exercising in extremely hot/humid weather
- Avoidance of exercising in extremely cold/damp weather
- If patient feels ill, he must not exercise. When he feels better, he can start his program again slowly.

Outpatient Exercise Prescription after HTx

Aerobic Exercise

- **F**requency; 3 d/wk
- **I**ntensity;
  - Warm-up and cool-down; static stretching, ROM, and light intensity aerobic training (RPE<11)
  - Constant training; RPE 11-14
  - Interval training; 4 minutes RPE 14 + 3 minutes RPE 11(recovery)
- **T**ime; 20-60 minutes
  - Warm-up and cool-down at least 5- 10 min
- **T**ype;

Outpatient Exercise Prescription after HTx Resistance Exercise

- **F**requency; 2 d /wk, at least 48 h separating training sessions for the same muscle group
- **I**ntensity; over several weeks from 30%-40% to 70% of l -RM (Initial load should allow 10- 15 repetitions that can be lifted without straining)
- RPE 11-14 (fairly light to somewhat hard)
- **T**ime; final goal; 30-60 min
- 1-4 sets each major muscle group
- **T**ype; 7-10 exercises that focus on the legs, back, arms, and shoulders


Thank You