Heart Failure and exercise: new questions

Which modalities of exercise?

S.KUBAS
Bois Gibert - Ballan Mire (F)
I currently have no conflict of interest for this presentation
HF-Action: Cardiovascular events and training «dose»

Keteyrian S. J Am Coll Cardiol, 2012
Exercise training for systolic HF: cochrane systematic review and meta-analysis

- 3647 patients
- LVEF < 40%
- 2 groups: exercise group and control group
  → Reduced HF related hospitalisation (-28%)
  → Increased quality of life

E. Davies, European journal of Heart Failure, 2010
Recommendations for exercise prescription and multidisciplinary management

<table>
<thead>
<tr>
<th>Recommendations</th>
<th>Class&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Level&lt;sup&gt;b&lt;/sup&gt;</th>
<th>Ref&lt;sup&gt;c&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>It is recommended that regular aerobic exercise is encouraged in patients with heart failure to improve functional capacity and symptoms.</td>
<td>I</td>
<td>A</td>
<td>262, 263</td>
</tr>
</tbody>
</table>
Exercise training for heart failure patients

How?

Type
Endurance ?  Resistance ?  Both ?

Method
Continuous ?  Intermittent ?

Intensity
Aerobic ?  Anaerobic ?

Application
Systemic ?  Regional?  Respiratory muscles?

Setting
Centre-based?  Home-based?

Control
Supervised?  Nonsupervised ?
Exercise training for heart failure patients

How?

• No universal agreement on exercise prescription
• FITT Principle
• Individual approach with careful evaluation

Desired benefits from exercise training

Controled of the related risk
Endurance: Continuous aerobic training?

Cycle or treadmill = most investigated, recommended

<table>
<thead>
<tr>
<th>Phases in training</th>
<th>Protocol</th>
</tr>
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<tbody>
<tr>
<td>Starting</td>
<td>40-50% VO2 peak</td>
</tr>
<tr>
<td></td>
<td>10-15 minutes</td>
</tr>
<tr>
<td></td>
<td>Borg &lt; 15</td>
</tr>
<tr>
<td>Progression in training</td>
<td>50-70% VO2peak</td>
</tr>
<tr>
<td></td>
<td>15-30 minutes</td>
</tr>
</tbody>
</table>

Vanhees L. Eur J Prev Cardiol, 2012
Piepoli MF. Eur J Heart Failure, 2011
Endurance: Interval training?

Endothelial function

Maximal oxygen uptake

Control

MCT

AIT

Baseline  Follow-up  Baseline  Follow-up

FMD (%)  FMD (%)  ml·kg⁻¹  ml·kg⁻¹·min⁻¹

NS  P < 0.01  NS  P < 0.01

P < 0.01  §  P < 0.01  §

Wisloff U. Circulation, 2007
Endurance : Interval training ?

Cardiac rehabilitation in Chronic HF: Effect of an 8-week, High-Intensity IT vs Continuous training

26 patients, LVEF < 40%
8 weeks
2 groups : IT (30 sec 80% max workload), CT (VT1)

<table>
<thead>
<tr>
<th>Parameters</th>
<th>CT group</th>
<th>IT group</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>VO2 (ml/kg/min)</td>
<td>2%</td>
<td>27%</td>
<td>&lt; 0.01</td>
</tr>
<tr>
<td>Exercise test duration (min)</td>
<td>12</td>
<td>47</td>
<td>&lt; 0.01</td>
</tr>
<tr>
<td>6MWT distance (m)</td>
<td>6</td>
<td>12</td>
<td>&lt; 0.01</td>
</tr>
</tbody>
</table>

Freyssin C. Arch Phys Med Rehabil, 2012
Endurance : Interval training ?

Controlled study of myocardial recovery after IT in heart failure : SMARTEX-HF, One year follow up data

215 patients, 12 weeks
3 groups :
- Moderate continuous
- High intensity IT
- Recommendations of regular exercise

Europrevent 2015
Interval training?

**SMARTEX-HF, One year follow up data - Europrevent 2015**

### Left ventricular function after 1 yr of intervention

<table>
<thead>
<tr>
<th></th>
<th>RRE (n=68)</th>
<th>MCT (n=59)</th>
<th>HII T (n=68)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Resting HR from ECG</strong></td>
<td>69 (65-70)</td>
<td>66 (63-69)</td>
<td>70 (67-73)</td>
<td>0.15</td>
</tr>
<tr>
<td><strong>Systolic function</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LVEDD</td>
<td>66 (64-67)</td>
<td>64 (62-66)</td>
<td>63 (62-66)</td>
<td>0.43</td>
</tr>
<tr>
<td>LVEF</td>
<td>0.28 (0.27-0.32)</td>
<td>0.33 (0.26-0.37)</td>
<td>0.28 (0.26-0.32)</td>
<td>0.72</td>
</tr>
<tr>
<td><strong>Diastolic function</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E</td>
<td>65 (58-72)</td>
<td>65 (57-72)</td>
<td>71 (63-80)</td>
<td>0.40</td>
</tr>
<tr>
<td>e'</td>
<td>6 (6-7)</td>
<td>6 (6-7)</td>
<td>6 (6-7)</td>
<td>0.31</td>
</tr>
<tr>
<td>Dec-t</td>
<td>166 (156-189)</td>
<td>180 (161-204)</td>
<td>186 (160-196)</td>
<td>0.43</td>
</tr>
<tr>
<td>E/e'</td>
<td>11 (10-14)</td>
<td>11 (9-12)</td>
<td>11 (10-12)</td>
<td>0.48</td>
</tr>
</tbody>
</table>
Interval training?

SMARTEX-HF, One year follow up data - Europrevent 2015

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<tr>
<th></th>
<th>RRE (n=68)</th>
<th>MCT (n=59)</th>
<th>HII T (n=68)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peak VO₂ ml/kg/min</td>
<td>18.2 (15.8-20.0)</td>
<td>16.4 (15.0-18.6)</td>
<td>17.2 (15.6-18.8)</td>
<td>0.63</td>
</tr>
<tr>
<td>Peak oxygen uptake l/min</td>
<td>1.51 (1.39-1.62)</td>
<td>1.51 (1.29-1.57)</td>
<td>1.51 (1.41-1.64)</td>
<td>0.89</td>
</tr>
<tr>
<td>RER at VO₂ peak (VCO₂/VO₂)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rest</td>
<td>0.84 (0.82-0.86)</td>
<td>0.85 (0.84-0.89)</td>
<td>0.83 (0.82-0.87)</td>
<td>0.16</td>
</tr>
<tr>
<td>Peak</td>
<td>1.11 (1.09-1.13)</td>
<td>1.12 (1.10-1.17)</td>
<td>1.13 (1.09-1.14)</td>
<td>0.43</td>
</tr>
<tr>
<td>Lactate</td>
<td>4.7 (4.3-6.2)</td>
<td>4.2 (3.6-5.4)</td>
<td>5.0 (4.4-6.3)</td>
<td>0.25</td>
</tr>
<tr>
<td>Work load</td>
<td>110 (90-120)</td>
<td>100 (99-120)</td>
<td>120 (100-130)</td>
<td>0.61</td>
</tr>
</tbody>
</table>
Endurance : Intensity?

Fig. 1. Four training protocols of high-intensity interval exercise (A, B, C, and D). PPO, peak power output.
Endurance: Interval training?

- How?

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<th>Protocol</th>
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<tr>
<td>Starting</td>
<td>50 % peak capacity</td>
</tr>
<tr>
<td></td>
<td>10 sec/80 sec</td>
</tr>
<tr>
<td></td>
<td>5-10 minutes</td>
</tr>
<tr>
<td>Progression in training</td>
<td>30 sec/60 sec</td>
</tr>
<tr>
<td></td>
<td>60-100 % peak capacity</td>
</tr>
<tr>
<td></td>
<td>15-30 min</td>
</tr>
<tr>
<td>Intensity target</td>
<td>Borg &lt; 15</td>
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</tbody>
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*Piepoli MF. Eur Jour of Heart Failure, 2011*
Resistance – Strength training?

Muscle contraction against a specific opposing force

- **Why?**
  - Functional alterations in skeleton muscle in HF patients
  - Decline in skeleton muscle mass in elderly patients

- **Determination of intensity?**
  - 1-RM
  - Graded stress test (10 repetitions without abdominal strining)
Resistance – Strength training?

Effects?

The effect of resistance training on left ventricular function and structure of patients with chronic heart failure

- Improvement of the capacity to perform activities of daily living → Improvement of QOL
- Increased aerobic and exercise capacity
- No adverse event
- Unchanged LV volumes

Levinger and al., Int J Cardiol. 2005 Jul
Resistance – Strength training?

• How?
  - Smaller muscle groups
  - No Valsalva manoeuvres

<table>
<thead>
<tr>
<th>Phases in training</th>
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<tr>
<td>Starting</td>
<td>&lt;30% 1-RM</td>
</tr>
<tr>
<td></td>
<td>5-10 repetitions</td>
</tr>
<tr>
<td></td>
<td>2-3 /week</td>
</tr>
<tr>
<td>Progression in training</td>
<td>30-50% 1-RM</td>
</tr>
<tr>
<td></td>
<td>15-25 repetitions</td>
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<tr>
<td></td>
<td>2-3/week</td>
</tr>
<tr>
<td>Intensity target</td>
<td>Borg &lt; 15</td>
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*Piepoli MF. Eur Jour of Heart Failure, 2011*
Combined training?

Cardiovascular effects of high-intensity IT combined with strength exercise in patients with chronic HF. A randomized phase III clinical trial

72 patients, LVEF < 50%
12 weeks
2 groups:
- Aerobic interval training (AIT)
- Combined AIT + strength training (COM)

→ Improvement of diastolic function
→ Improvement of VO2 peak and 6MWT
→ Improvement of QOL

Chrysohoou C, Int J Cardiol 2015
Combined training?

Robot-assisted training for HF patients—a small pilot study

5 patients, LVEF < 45%
4 weeks
Aerobic training + dynamic resistance training of lower limbs (Lokomat)
→ No adverse events
→ Increased VO2, oxygen pulse
→ Increased QOL
→ Reduction of NT-ProBNP and inflammatory biomarkers

Schoenrath F. Acta Cardiol 2015
Inspiratory muscle training

• Why?
  Respiratory muscle dysfonction
  < muscle fibre atrophy
  < impaired mitochondrial oxidative capacity

• How?
  20-30 min/days, 2-3 weeks
  Start at 30% PI max
  Readjust intensity every 7-10 days up to 60%

*Threshold Inspiratory Muscle Trainer®, Power Breathe®, Trainair®*
Adjunctive technics

- **Water gymnastic**

  - **Effects ?**
  Sensation of Well being
  Improved exercise capacity and muscle strength
  Increased nitrates products (shear stress effect)

- **How ?**
In stabilized patients
In Standing position with mid-chest water height
Thermo neutral water $T^\circ$ (32-33 C)
Slow movements


*Adsett JA. Aquatic exercise training and stable heart failure : a systematic review and meta-analysis. Int J Cardiol 2015*
Electromyostimulation (EMS)

- Low frequency EMS is **safe** in CHF patients
- EMS in addition to Ex Training demonstrate **no significant additional improvement**
- EMS of skeletal lower limbs = an effective training alternative suitable for patients who cannot perform conventional exercise training programs.
Adjunctive technics

• **Electrically assisted cycling**

No study with HF patients
As safety as classic bicycles
= moderate-intensity physical activity

One Center experience:
well tolerated
Possible even if limited capacities
Increased QOL

*Schepers JP. The safety of electrically assisted bicycles compared to classic bicycles. Accid anal prev, 2014.*

*Simons M. Electrically assisted cycling: a new mode for meeting physical activity guidelines? Med Sci Sports exerc, 2009*
Setting: hospital based vs Home based

ESC Guidelines for the diagnosis and treatment of acute and chronic heart failure, 2012

It is recommended that patients with heart failure are enrolled in a multidisciplinary-care management programme to reduce the risk of heart failure hospitalization.

Supervised and Center-Based programmes are:
- Safe
- Effective
- Reassurance of patients
- Education

BUT THE MAIN ISSUE = THE PRESERVATION OF THE GAINED BENEFITS
Heart Failure with Preserved EF

Exercise intolerance such as HF and reduced EF

Effect of endurance Exercise Training on endothelial function and arterial stiffness in older patients with HF and preserved EF: a randomized, controlled, single-blind trial

- 63 patients
- 16 weeks
- Exercise training vs control group
- Increased VO2 peak and QOL
- No change in endothelial function

Kitzman DW. J Am Coll Cardiol, 2013
Right heart failure

- Increased hemodynamic load on the RV vs LV during exercise → Exercise intolerance

Exercise training improves VO2 and hemodynamics in patients with severe pulmonary arterial hypertension and inoperable chronic thrombo-embolic pulmonary hypertension: a prospective, randomized, controlled trial

- 87 patients pulmonary arterial hypertension and inoperable chronic TE PH
- 15 weeks, low dose exercise training
- Improvement of VO2 peak
- Improvement of QOL, 6MWT, exercise capacity in training group
- Decreased of pulmonary arterial pressure at rest

Ehlken N. Eur Heart Journal, 2016
Conclusion

- Exercise training in HF patients is:
  - safe
  - improve LVEF and QOL
  - reduce hospitalization
  - need careful evaluation for **individual approach**

- Protocols combine:
  - **Endurance** with continuous training and/or interval training
  - **Resistance / strength**
  - **Inspiratory muscle training**

- Adjunctive technics
  - → Progression in training

**Primary aim** = Remain active for an indefinite period of time