How to train the cardiovascular patient?

Physical activity in patients with heart disease: how much is good enough?

Per Anton Sirnes
MD.PhD.FESC

Moss, Norway

Chair, ESC Council on Cardiology Practice
Conflicts of interest

• No fee from speakers bureau
• No advisory board participation
• No financial industry interest
• Institutional research contribution as clinical investigator from
  – Sanofi-Aventis, Bayer, MSD, Boehringer
ESC  Council of Cardiology Practice (CCP)

- created to bring together practicing cardiologists with common interest in the field of cardiovascular medicine
- promote education and training of cardiologists in clinical practice
- develop standards for training, continuous education and professional conduct.
2nd European Meeting of Cardiology Practice
29-30 April  EHH, Nice

- Program starts Friday morning and ends Saturday at noon
- Top experts will discuss the recent ESC guidelines with emphasis on the viewpoint form cardiology practice
- See info at the council’s web pages www.escardio.org/Practice
- On line registration on the web
Different patients and different training

- Post AMI
- Post PCI
- Post CABG
- Heart Failure
- Hypertension
- Perif Artery Disease
- Metabolic syndrome
- Chronic Stable CAD

**RESISTANCE**
- Concentric
- Eccentric
- Isotonic
- No of rep
- % of MR

**AEROBIC**
- Continuous low / moderate
- High level interval
- Combinations
Training Cardiovascular Patients

- Why train?
- Who to train?
- How to train?
- When to train?
Why train?

• Decreased mortality
• Decreased morbidity
  – Angina symptoms
  – Heart failure symptoms
  – Claudication symptoms
• Increased fitness level
• Increased general well-being
Low fitness is a major risk factor for all-cause mortality

Blair et al. JAMA 1996;276:205.
A clear relation between physical fitness and the risk of sudden cardiac death.

Proportions of SCD According to Achieved METs During Maximal Exercise Testing

2,368 men 42 to 60 years of age. Followed for 17 years.

The oxygen transport system

Aerobic metabolism → Pulmonary ventilation → Hemoglobin concentration → Oxygen Transport System → Peripheral blood flow

Blood volume and cardiac output

ATP + H₂O $\xrightarrow{\text{ATPase}}$ ADP + P₃ $\Delta G = 7.3$ kCal·mol⁻¹

ESC Council for Cardiology Practice
Secondary prevention through cardiac rehabilitation: physical activity counselling and exercise training

Key components of the position paper from the Cardiac Rehabilitation Section of the European Association of Cardiovascular Prevention and Rehabilitation

EACPR Committee for Science Guidelines: Ugo Corrà (Chairperson), Massimo F. Piepoli, François Carré; Peter Heuschmann; Uwe Hoffmann; Monique Verschuren; Julian Halcox
Document Reviewers: Pantaleo Giannuzzi, Hugo Saner, David Wood

Massimo F. Piepoli*, Ugo Corrà, Werner Benzer, Birna Bjarnason-Wehrens, Paul Dendale, Dan Gaita, Hannah McGee, Miguel Mendes, Josef Niebauer, Ann-Dorthe Olsen Zwisler, and Jean-Paul Schmid
Proposed algorithm for functional evaluation in exercise prescription after cardiac surgery, i.e.

1. **Patient after cardiac surgery**
   - Postpone exercise test
   - Clinical, haemodynamic, and rhythm instability
     - Yes
     - Reversible HB < 10 g/dL and/or instability of the sternum and/or muscular/skeletal discomfort
       - No
       - Incomplete coronary revascularization (#) and/or LVEF < 40%, and/or deconditioning
         - Yes
         - No
   - Physical activity before surgery: sedentary
     - Yes
     - 6 min walking test
     - No
     - 6 min submaximal steady-state exercise test (*)
   - Physical activity before surgery: sedentary
     - Yes
     - Submaximal incremental exercise test ($) (§)
     - No
     - Symptom-limited exercise test
Proposed algorithm for functional evaluation in exercise prescription in coronary artery disease (CAD) patients not treated with cardiac surgery.

CAD patient (no surgery)

Postpone exercise test

Yes

Clinical, haemodynamic, and rhythm instability

No

Incomplete coronary revascularization and/or LVEF< 40%

Yes

Physical activity before PCI: sedentary

No

Physical activity before PCI: sedentary

Yes

6 min walking test

No

6 min submaximal steady-state exercise test (*)

Submaximal incremental exercise test (§)

No

Symptom-limited exercise test

Effect of Intensity of Aerobic Training on VO2max

Italian Diabetes and Exercise Study (IDES)

- for 12 months study of 606 pts in 22 outpatient diabetes clinics across Italy randomized by center, age, and diabetes treatment
- twice-a-week supervised aerobic and resistance training plus structured exercise counseling (exercise group)
- counseling alone (control group)
- Significant improvement
  - HBA1c,
  - Blood pressure,
  - Glucose
  - cholesterol level;
  - waist circumference);
  - body mass index;
  - insulin resistance;
  - Inflammation markers

Balducci et al Arch Intern Med. 2010; 8;170(20):1794-803..
What intensity of endurance training is recommended for cardiac patients?

EACPR position paper:

• individualized approach after careful clinical evaluation
• 150 min/week ideally 3–4 h/week Sub-maximal endurance training,
• Start at 50% and gradually increasing to 50-70% of maximal HR
• 50% HRmax in high-risk patients
  – left ventricular dysfunction,
  – coronary disease severity,
  – co-morbidities,
  – ageing

ACSM: 40-80% of HR max or HR rest + 20
What is maximal Heart Rate?

- HR max should be measured directly at maximal ex test
- Influence of drugs (beta blockers)
- 10% higher on treadmill
- Formula 220-Age not useful: large SD(12-15)
- 206.9-0.67*Age better

<table>
<thead>
<tr>
<th>Percentage HR&lt;sub&gt;max&lt;/sub&gt;</th>
<th>Percentage VO&lt;sub&gt;2max&lt;/sub&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>50</td>
<td>28</td>
</tr>
<tr>
<td>60</td>
<td>40</td>
</tr>
<tr>
<td>70</td>
<td>58</td>
</tr>
<tr>
<td>80</td>
<td>70</td>
</tr>
<tr>
<td>90</td>
<td>83</td>
</tr>
<tr>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

www.escardio.org
High level interval training in heart failure

**Exercise Physiology**

*Superior Cardiovascular Effect of Aerobic Interval Training Versus Moderate Continuous Training in Heart Failure Patients*
*A Randomized Study*

- 27 pts with HF, mena EF 30% LVIDD67mm
- high intensity interval training or isocaloric continuous training
- High intensity group:
  - Warm up for 10 minutes at 60-70% of peak HR
  - Four 4-minute intervals at 90% to 95% of peak HR
  - Each interval was separated by 3-minute active rest intervals

Wisløff et al *Circulation. 2007;115:3086-3094*
Effect of interval training on the LVEF in heart failure patients

Effects on endothelial function and VO2Max

Interval and Strength Training in CAD Patients

20 pts randomized to endurance interval training or resistance training. CO measured at rest and peak exercise through a single breath gas technique, Cardiac volumes by MR.

Fig. 1 Peak stroke volume before and after training, in the aerobic interval training (AIT) and the maximal strength training group (MST). *P < 0.05 changes within group before vs. after training. †P < 0.05 changes in the AIT group vs. the MST group.

Fig. 2 Percent change in maximal leg strength (1RM), rate of force development (RFD) and walking mechanical efficiency from before to after training in the maximal strength training group (MST) and the aerobic interval training (AIT) group. * P<0.05 changes within group before vs. after training, † P<0.05 changes in the MST group vs. the AIT group.

Helgerud . Et al. Int J Sport Med Nov 2010,
Effects of aerobic interval training vs. continuous exercise in metabolic syndrome

- 35 pts random, to 70% HRmax continuous exercise (isocaloric) or aerobic interval 90% HRmax or control group 3/week 16 weeks

<table>
<thead>
<tr>
<th></th>
<th>Control</th>
<th>Continuous</th>
<th>Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>No with METS</td>
<td>100%</td>
<td>63%</td>
<td>54%</td>
</tr>
<tr>
<td>Blood Pressure</td>
<td>≈</td>
<td>↓</td>
<td>↓</td>
</tr>
<tr>
<td>HDL</td>
<td>≈</td>
<td>↑</td>
<td>↑</td>
</tr>
<tr>
<td>Insulin sensitivity</td>
<td>≈</td>
<td>↑</td>
<td>↑</td>
</tr>
<tr>
<td>Waist and weight</td>
<td>≈</td>
<td>↓</td>
<td>↓</td>
</tr>
<tr>
<td>Microalbuminuria</td>
<td>≈</td>
<td>↓</td>
<td>↓</td>
</tr>
</tbody>
</table>

VO2max

Expression of PCG-1α in vastus lateralis

Max re-uptake of Ca into sarcoplasmatic reticulum

FMD – brachial artery
High Intensity Aerobic Interval Training

- Best performed on treadmill walking upwards or on bicycle
- Warm up at least 5 min 60-70% of $HR_{\text{max}}$
- 4 min intervals at 90-95% of $HR_{\text{max}}$
- 3 min active “rest” at 60% of $HR_{\text{max}}$
- 3-4 times a week
- **Readjust** the load as the aerobic capacity improves
- Heart rate must be followed regularly
- Now experience with > 2000 sessions without serious incidences
- Large randomized HF training study is ongoing
Resistance training
Relation between grip strength and functional limitations 25 years later
Resistance training

• During the pressor phase
  – Abrupt increase in blood pressure and afterload
  – Modest increase in heart rate
  – Acute strain on the heart and vessels
    • Aware of aortic dilatation
  – What number of rep and %RM is best for the cardiovascular patient?
Resistance training - How much how fast?

Original Scientific Paper

Acute cardiovascular response to resistance training during cardiac rehabilitation: effect of repetition speed and rest periods
Michel Lamotte, Fany Fleury, Melissa Pirard, Alexander Jamon and Philippe van de Borne

Department of Cardiology, Erasme Hospital, Free University of Brussel, Belgium

Varying resistance training

- 17 male cardiac patients
- Hemodynamic measurement by task force monitor system
- Varying pause 3 x 10 repetitions 75% RM separated by 30, 60, 90 or 120 s.
- Progressive drift of HR, BP and CO with slow contractions and short recovery time between
Recommendations resistance training

On the basis of this research and earlier works, we can suggest this following RT protocol:

• Three sets of 10 repetitions
• 70–75% of 1RM
• at fast speed of repetitions
• with a recovery time of 90 s
Which cardiac patients should NOT exercise heavily?

- Acute coronary syndromes
- ?days after AMI
- Obstructive cardiomyopathy
- Severe aortic stenosis
- Aortic root dilatation (not resistance tr)
- AF with uncontrolled rate
- Uncompensated heart failure with congestion
- Peri- and myocarditis
Physical activity in patients with heart disease: how much is good enough?

• Most patients benefit from regular physical exercise

• Endurance training, especially high intense interval training may increase cardiac performance and endothelial and muscular function

• Adding resistance training may strengthen muscles and improve basis for endurance training but should be performed with 70%RM and fast repetitions with intervals
Physical exercise as a therapeutic option in CVD

- Underestimated
- Underused
- Underfinanced
- No industry promotion
- Limited reimbursement
- But is perhaps one of the most important therapeutic actions we can take besides basal guideline-based medical treatment
Thank you for the attention!