Exercise Prescription for Athletic Cardiac Rehabilitation Patients

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DISCLOSURE

Presenter(s):
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Relevant financial relationship(s) with industry:
None

References to off-label usage(s) of pharmaceuticals or instruments:
None
Who is an “Athletic CR Patient”?

U.S. Running Event Finishers 1990-2015

<table>
<thead>
<tr>
<th>Year</th>
<th>Females</th>
<th>Males</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990</td>
<td>1,199,200</td>
<td>3,597,800</td>
<td>4,797,000</td>
</tr>
<tr>
<td>1995</td>
<td>2,215,500</td>
<td>4,708,000</td>
<td>6,923,500</td>
</tr>
<tr>
<td>2000</td>
<td>3,696,000</td>
<td>4,998,400</td>
<td>8,694,400</td>
</tr>
<tr>
<td>2005</td>
<td>4,494,400</td>
<td>4,947,600</td>
<td>9,442,000</td>
</tr>
<tr>
<td>2010</td>
<td>6,929,000</td>
<td>6,071,000</td>
<td>13,000,000</td>
</tr>
<tr>
<td>2011</td>
<td>7,685,700</td>
<td>6,288,300</td>
<td>13,974,000</td>
</tr>
<tr>
<td>2012</td>
<td>8,699,000</td>
<td>6,835,000</td>
<td>15,534,000</td>
</tr>
<tr>
<td>2013</td>
<td>10,844,200</td>
<td>8,180,800</td>
<td>19,025,000</td>
</tr>
<tr>
<td>2014</td>
<td>10,687,500</td>
<td>8,062,500</td>
<td>18,749,500</td>
</tr>
<tr>
<td>2015</td>
<td>9,755,500</td>
<td>7,359,300</td>
<td>17,114,800</td>
</tr>
</tbody>
</table>
Who is an “Athletic CR Patient”?

<table>
<thead>
<tr>
<th>Distance</th>
<th>2015 Totals: Finishers</th>
<th>% of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>5K</td>
<td>7,643,600</td>
<td>45%</td>
</tr>
<tr>
<td>Half-Marathon</td>
<td>1,986,600</td>
<td>12%</td>
</tr>
<tr>
<td>10K</td>
<td>1,275,600</td>
<td>7%</td>
</tr>
<tr>
<td>Marathon</td>
<td>509,000</td>
<td>3%</td>
</tr>
<tr>
<td>Other Distances</td>
<td>5,700,000</td>
<td>33%</td>
</tr>
<tr>
<td>Total</td>
<td>17,114,800</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Female</th>
<th>Male</th>
<th>Overall</th>
</tr>
</thead>
<tbody>
<tr>
<td>6-17 years old</td>
<td>9%</td>
<td>12%</td>
<td>10%</td>
</tr>
<tr>
<td>18-24 years old</td>
<td>9%</td>
<td>7%</td>
<td>8%</td>
</tr>
<tr>
<td>25-34 years old</td>
<td>27%</td>
<td>22%</td>
<td>25%</td>
</tr>
<tr>
<td>35-44 years old</td>
<td>27%</td>
<td>24%</td>
<td>26%</td>
</tr>
<tr>
<td>45-54 years old</td>
<td>18%</td>
<td>20%</td>
<td>19%</td>
</tr>
<tr>
<td>55-64 years old</td>
<td>8%</td>
<td>11%</td>
<td>9%</td>
</tr>
<tr>
<td>65+ years old</td>
<td>2%</td>
<td>4%</td>
<td>3%</td>
</tr>
</tbody>
</table>

~31% of participants over the age of 45.
What does “other distances” mean?

- 15K
- 20K
- 1 mile fun run
- 10 mile
- 20 mile
- Mud Run / Obstacle course?
Case Study – Mr. Runsalot
Case Study #1 – Mr. Runsalot

• Demographics
  • Male
  • 58 years old
  • Never smoked
  • No known heart disease
  • BMI = 26.5 kg/m²
  • Blood pressure = 110/70 mmHg (controlled hypertension)
  • Heart rate = 62 bpm

• Medications
  • Carvedilol – 6.25 mg twice daily
  • Lisinopril – 10 mg per day
Case Study #1 – Mr. Runsalot

• History / Purpose for Visit / Symptoms
  • Presenting with progressive fatigue of 8-9 months duration
  • Distance runner now unable to exercise
    • Training program included ~35-40 miles / week
    • Runs 7:30 min/mile
  • Family history of CAD (Father – MI @ 54 y.o.)

• Sent for stress test to rule out ischemia / coronary disease
Case Study #1 – Mr. Runsalot

RESTING ECG – (HR = 58 bpm)
Case Study #1 – Mr. Runsalot

PEAK EXERCISE ECG – (HR = 80 bpm)

ST Elevation
Case Study #1 – Mr. Runsalot

- **Standard Treadmill Results**
  - 0.9 minutes
  - 1.7 mph at 10% grade (Bruce protocol)
  - FAC = 9.4% predicted

- **Heart rate response**
  - $58_{\text{(rest)}} \rightarrow 80_{\text{(peak)}}$ bpm

- **Blood pressure response**
  - $114/76_{\text{(rest)}} \rightarrow 124/80_{\text{(peak)}}$ mmHg

- **ECG**
  - Positive for ischemia
  - ~2.0 mm ST elevation in inferior leads and V5-V6

- **Symptoms**
  - RPE 18/20 / Dyspnea 7/10 / Similar fatigue that initiated his visit to the doctor
Case Study #1 – Mr. Runsalot

• Treatment:
  • Sent to Cath Lab

CORONARY SUMMARY
Coronary artery dominance is right. Normal left main coronary artery and left circumflex artery.
The middle left anterior descending artery is 20% obstructed by multiple discrete lesions and 30% obstructed by diffuse disease. Distal segment is normal size, diseased.
The right posterolateral segment is 90% obstructed by multiple discrete lesions. Distal segment is normal size.

PTCA SUMMARY
Successful PTCA of the right posterolateral segment. The predilatation stenosis was 90%. The postdilatation stenosis was 40%. No complications.

STENT PLACEMENT SUMMARY
Successful stent deployment in the right posterolateral segment. The predeployment stenosis was 40%. The postdeployment stenosis was 0%. No complications.
Case Study #1 – Mr. Runsalot

RESTING ECG – (HR = 53 bpm)
Case Study #1 – Mr. Runsalot

PEAK EXERCISE ECG – (HR = 168 bpm)
Case Study #1 – Mr. Runsalot

• **Standard Treadmill Results**
  • 13.6 minutes
  • 5.0 mph at 18% grade (Bruce protocol)
  • FAC = 142% predicted

• **Heart rate response**
  • $53_{(rest)} \rightarrow 168_{(peak)}$ bpm

• **Blood pressure response**
  • $120/80_{(rest)} \rightarrow 178/82_{(peak)}$ mmHg

• **ECG**
  • Negative for ischemia / No dysrhythmias

• **Symptoms**
  • RPE 18/20 / Dyspnea 2/10
Case Study #1 – Mr. Runsalot

• Referral to cardiac rehabilitation
  • Now what?
  • Remember – this patient is/was a runner
    • Training program included ~35-40 miles / week
    • Runs 7:30 min/mile (~8.0 mph on treadmill)
  • New medication list
    • Carvedilol – 10 mg twice daily
    • Lisinopril – 10 mg per day
    • Aspirin – 81 mg daily
    • Clopidogrel – 75 mg daily (12 months)
    • Nitroglycerin – 0.4 mg table sublingual – p.r.n.
Exercise Prescription

• FITT Principle
  • Frequency
    • How often is the patient exercising?
  • Intensity
    • How hard is the patient working during the exercise session?
  • Time
    • How much time is being spent doing each exercise / activity?
  • Type
    • What type of exercise / activity is the patient doing?
Exercise Prescription

- Intensity of training is directly linked to both:
  - The amount of improvement in exercise capacity
  - The risk of adverse events during exercise

- Importantly, exercise intensity is directly related to duration and frequency of exercise sessions
  - Higher intensity of exercise results in lower duration of exercise session
  - Frequency of exercise sessions may be dependent on the intensity of individual sessions
Exercise Prescription
Determining the appropriate intensity

Table 5. Evidence-based prescribable aerobic exercise intensity in cardiac patient groups

<table>
<thead>
<tr>
<th>Exercise intensity domains</th>
<th>Light to moderate</th>
<th>Moderate to high</th>
<th>High to severe</th>
<th>Severe to exercise</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stable angina pectoris</td>
<td>□ a</td>
<td>□ a</td>
<td>□ a</td>
<td></td>
</tr>
<tr>
<td>Light stable CAD (no residual ischaemia)</td>
<td>□</td>
<td>□</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>PCI</td>
<td>□</td>
<td>□</td>
<td>□</td>
<td></td>
</tr>
<tr>
<td>Pacemaker</td>
<td>□</td>
<td>□</td>
<td>□</td>
<td></td>
</tr>
<tr>
<td>ICD</td>
<td>□</td>
<td>□</td>
<td>□</td>
<td></td>
</tr>
<tr>
<td>Chronic AF</td>
<td>□ b</td>
<td>□ b</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CABG</td>
<td>□</td>
<td>□</td>
<td>□</td>
<td></td>
</tr>
<tr>
<td>Valve repair/replacement</td>
<td>□</td>
<td>□</td>
<td>□</td>
<td></td>
</tr>
<tr>
<td>CHF</td>
<td>□</td>
<td>□</td>
<td>□</td>
<td></td>
</tr>
<tr>
<td>LVAD</td>
<td>□</td>
<td>□</td>
<td>□</td>
<td></td>
</tr>
<tr>
<td>Heart transplantation</td>
<td>□ c</td>
<td>□ c</td>
<td>□ c</td>
<td></td>
</tr>
</tbody>
</table>

The grey areas identify intensity domains for which no scientific evidence is available in a specific population; CAD: coronary artery disease; PCI: percutaneous coronary intervention; ICD: implantable cardioverter defibrillator; AF: atrial fibrillation; CABG: coronary artery by-pass grafting; CHF: chronic heart failure; LVAD: left ventricular assist device; aHeart rate and/or work rate must in any case be lower than those corresponding to the ischaemic threshold; bHeart rate may not be usable due to highly variable chronotropic response; cHeart rate may not be usable due to denervation-related blunted chronotropic response.
A new method for detecting anaerobic threshold by gas exchange

Exercise Prescription

Using anaerobic threshold


Exercise Prescription
Using anaerobic threshold

Exercise Prescription
Other methods for classifying intensity

• A “target heart rate range” is a common method for determining exercise intensity.
  • Typically 70-85% peak HR in healthy individuals

Compared to…
• 50-85% peak HR in patients with cardiac disease
• This equates to ~40-80% peak VO₂

But…
• What do we do when you don’t have VO₂ data and/or the patient is on rate modulating drugs???
Exercise Prescription

Other methods for classifying intensity

- **Rating of Perceived Exertion**
  - Commonly used as an adjunct for determining exercise intensity
  - Particularly valuable in patients who have difficulty obtaining a reliable HR
    - Beta-blockers
    - Autonomic denervation
    - Chronotropic incompetence
    - Pacemakers
  - And useful for comparison across modes of exercise…
    - Cycle vs. Elliptical vs. etc…

- **Average RPE that is associated with positive adaptation is 13–16**
  - Loosely associated with 65-90% peak HR and 55-85% peak \( \text{VO}_2 \)

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**Table 2. ACSM classification of exercise relative intensity**

<table>
<thead>
<tr>
<th>Intensity</th>
<th>%HRR or ( \text{VO}_2\text{R} )</th>
<th>%peak ( \text{VO}_2 )</th>
<th>%peak HR</th>
<th>RPE Borg scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very light</td>
<td>&lt;20</td>
<td>&lt;25</td>
<td>&lt;35</td>
<td>&lt;10</td>
</tr>
<tr>
<td>Light</td>
<td>20–39</td>
<td>25–44</td>
<td>35–54</td>
<td>10–11</td>
</tr>
<tr>
<td>Moderate</td>
<td>40–59</td>
<td>45–59</td>
<td>55–69</td>
<td>12–13</td>
</tr>
<tr>
<td>Heavy</td>
<td>60–84</td>
<td>60–84</td>
<td>70–89</td>
<td>14–16</td>
</tr>
<tr>
<td>Very heavy</td>
<td>≥85</td>
<td>≥85</td>
<td>≥90</td>
<td>17–19</td>
</tr>
<tr>
<td>Maximal</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>20</td>
</tr>
</tbody>
</table>

Modified from Tipton et al.\(^{43}\); ACSM: American College of Sports Medicine; HRR: heart rate reserve; \( \text{VO}_2\text{R} \): \( \text{VO}_2 \) reserve; HR: heart rate; RPE: rating of perceived exertion.

Exercise Prescription
Continuous exercise vs. interval training?

<table>
<thead>
<tr>
<th>Time</th>
<th>Continuous Exercise</th>
<th>Interval Training</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>160</td>
<td>17</td>
</tr>
<tr>
<td>10</td>
<td>140</td>
<td>16</td>
</tr>
<tr>
<td>20</td>
<td>120</td>
<td>15</td>
</tr>
<tr>
<td>30</td>
<td>100</td>
<td>14</td>
</tr>
</tbody>
</table>

Rating of Perceived Exertion
Exercise Prescription

Interval training

- Warm-up
  - 60–70%
  - 85–95%
  - 8–10 minutes
  - 4 minutes

- Interval
  - RPE 12-13
  - 85–95%
  - 8–10 minutes
  - 4 minutes

- Interval
  - RPE 16-17
  - 85–95%
  - 8–10 minutes
  - 4 minutes

- Interval
  - RPE 16-17
  - 85–95%
  - 8–10 minutes
  - 4 minutes

- Interval
  - RPE 16-17
  - 85–95%
  - 8–10 minutes
  - 4 minutes

- Cool-down
  - 60–70%
  - 3–5 minutes

Figure 5. The 4 x 4 min aerobic interval training model. Intensity is given as percentage of peak heart rate.

Total Duration = 36 – 40 minutes

BUT…duration of intervals are modifiable to meet the needs of the patient.
Aerobic Interval Training (AIT) improves peak VO$_2$ in patients with coronary artery disease and patients with heart failure.
What should we do with Mr. Runsalot?

- Cardiovascular exercise
  - Continuous vs. Interval?
  - What intensity?
- Strength training
  - Considering his interest in distance running should he do anything?
Exercise Prescription
Mr. Runcsalot

- **Frequency**
  - Planning on attending CR 3 days/week (M/W/F)
  - Also plans on attending Yoga and Tai Chi classes (Tu/Sa) at local YMCA

- **Intensity**
  - VO$_2$ peak – 40-80% (85%?)
  - Heart rate peak – 50-85% (90%?)
  - RPE – 13-16 (17?)

- **Time**
  - 30-40 minutes of aerobic based exercise

- **Type**
  - Treadmill
  - Upright cycle
  - Elliptical trainer

*Alternating continuous exercise training with interval training every other visit

Is this safe? …YES…

1. Exercise testing and training is safe in low risk post PCI patients less than 2 weeks after acute PCI for STEMI.

2. High-intensity interval training reduces in-stent restenosis following PCI with stent implantation.

3. Early intense exercise training reduces inflammation and improves exercise capacity in PCI with stent implantation.
• **Sport Specific Training**
  • Individualize the training program to include specific exercise for the event the patient wants to do…
  • Examples for distance running:
    • Prone opposites (Back extensions)
Exercise Prescription

Key Concepts

• Understand barriers to exercise
  • Time
  • Access
  • Tolerance
  • Psychological factors

• Goal Setting
  • What does the patient really want to get out of the program?

• Maximize Motivation
  • Set realistic goals
  • Create peer groups and social support network

• HAVE FUN!
  • Both the staff and patient should see this as an enjoyable experience
Questions?

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“To prevent a heart attack, take one aspirin every day. Take it out for a run, then take it to the gym, then take it for a bike ride...”
Every morning in Africa, a gazelle wakes up. It knows it must outrun the fastest lion or it will be killed. Every morning in Africa, a lion wakes up. It knows it must outrun the slowest gazelle, or it will starve. **It doesn't matter whether you're a lion or gazelle – when the sun comes up, start running.**
1.4.2 High Intensity

Breivens 1995 35 24.74 18 4 14.10 10 6.4% 1.47 [0.70, 2.24]
Subtotal (95%) 35 18 10 0.5% 1.47 [0.70, 2.24]
Heterogeneity: Tau² = 0.10; Q = 9.00; df = 9 (P = 0.140); I² = 35%
Test for overall effect: Z = 3.30 (P = 0.001)

1.5 Longer Duration

Boven 1996 35 24.74 18 4 14.10 10 6.4% 1.47 [0.70, 2.24]
Bueno 1992 15.03 11.41 9 11.75 22.56 10 6.0% 0.41 [0.15, 1.13]
Davies 1990 5.04 12.24 42 -0.3 9.93 15 9.3% 0.45 [0.16, 1.00]
McManus 1990 7.16 10.33 6 6.71 21.19 14 8.5% 0.33 [0.10, 0.98]
Parsons 2001 65.45 44.93 7 28.66 49.37 8 3.1% 0.32 [0.01, 0.98]
Schuld 2000 10.4 42.71 17 5.66 42.17 21 8.4% 0.11 [0.03, 0.70]
Stewart 1996 15 12.17 17 6 9.36 5.2% 0.85 [0.02, 17.02]
Stewart 1996 15.45 21.03 12 20.93 33.34 11 5.4% 0.57 [0.10, 3.06]
Wilke 1991 26.4 30.12 12 14.22 29.22 12 5.9% 0.62 [0.30, 1.23]
Subtotal (95%) 35 294 190 55.0% 0.36 [0.20, 0.70]
Heterogeneity: Tau² = 0.10; Q = 9.00; df = 9 (P = 0.14); I² = 35%
Test for overall effect: Z = 4.14 (P = 0.001)

Total (95%) 272 270 100.0% 0.66 [0.43, 0.97]
Heterogeneity: Tau² = 0.16; Q = 15.24; df = 15 (P = 0.020); I² = 22%
Test for overall effect: Z = 5.74 (P = 0.000)
Test for subgroups: difference: CI = 0.16; df = 15 (P = 0.030); I² = 0%
Questions

1. Which type of cardiac rehabilitation patient should engage in interval training?
   a) Heart failure patients.
   b) Athletes with known competitive experience.
   c) Patients with metabolic syndrome.
   d) Patients who plan to engage in athletic/sporting events in the future.
   e) All of the above.

2. Historical trends for adult participation in recreational sporting events is:
   a) Increasing
   b) Decreasing
   c) About the same

3. Exercise prescription within cardiac rehabilitation should be individualized to meet each patients’ needs.
   a) True
   b) False