Practical exercise considerations for intermittent claudication

Dr John Buckley
BASES Accredited Exercise Physiologist
BACR
Belfast, 2006

Outline

- Brief review of intermittent claudication (IC) and evidence for exercise
- Potential mechanisms of why exercise works
- Studies on types of exercise in IC
- Simple practical exercise prescription adaptations for the patient with claudication
**Tiberius Claudius Drusus Nero Germanicus**
(b. 10 BC; emperor, 41-54 A.D.)

Latin: claudicare or claud-us = to be lame or limp

---

**Ankle - Brachial Pressure Index**

<table>
<thead>
<tr>
<th>Clinical status</th>
<th>ABPI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Symptom free</td>
<td>1 or more</td>
</tr>
<tr>
<td>Intermittent claudication</td>
<td>0.95 - 0.5</td>
</tr>
<tr>
<td>Rest pain</td>
<td>0.5 - 0.3</td>
</tr>
<tr>
<td>Gangrene and ulceration</td>
<td>&lt;0.2</td>
</tr>
</tbody>
</table>

Pearce *Eur Neurol* 2005; 54: 118 – 119
Epidemiology

**General Prevalence**
- 2 – 6% population under 50 - 60 years of age
- Rising to > 7% in those 70+ years

Foulkes et al. 1991 *Int J Epidemiol* 20:384
Stoffers et al. 1996 *Int J Epidemiol* 25:282

---

Epidemiology

**Prevalence with CHD**
- 40 – 60% of individuals with IC have CHD

Dormandy et al. 1999 *Semin Vasc Surg* 12: 118
Sonecha and Delis 2003, *EJ Vasc Envase Surg* 25: 519
Mortality rates; observational design

Further study is needed to determine whether interventions that increase physical activity during daily life are associated with improved survival.
Cochrane Review; Exercise & IC

Leng et al. 2000

- NOT ONLY a 150% increase in walking time
- BUT
  - Exercise is better, after 12 months, than angioplasty
  - Exercise is better than antiplatelet therapy
  - As good as PA bypass surgery (inc surgery + exercise)
  - Pentoxifylline (1 study): 82% increase walking time vs 62% increase walking group

Cochrane Review; Exercise & IC

Leng et al. 2000

Suggests the walking improvement mechanism, not necessarily related to improved blood flow;

improvement requires skeletal muscle histo-chemical (efficiency) changes through exercise training
In other words

Improving the fuel supply line (arterial flow) is only of benefit if the engine (muscle) is also in good knick

Potential Mechanisms of Improved Walking Performance from Exercise

- **Increased blood flow**
  - Enhanced vasodilatory/endothelial response (Nitric Oxide)
  - Collateralisation (conduit vs microcirculation)

- **Improved muscle metabolism**
  - Increase $O_2$ usage/efficiency
  - Reduced lactic acid production

- **Enhanced pacing and walking performance**
  - Improved pain tolerance/pain perception
  - Improved tolerance to exertional cues
Release of Nitric Oxide from blood flow
shear stress improves with exercise

Arosio et al 1999 *Life Sci* 65:2815

Increased muscle blood flow (collaterals and NO induced vasodilation) conduit & micro-circulation

Summary of conduit blood flow

<table>
<thead>
<tr>
<th>Intervention</th>
<th>Change in conduit blood flow</th>
<th>Walking Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exercise</td>
<td><img src="image" alt="Diagram showing change" /></td>
<td><img src="image" alt="Diagram showing change" /></td>
</tr>
<tr>
<td>Angioplasty</td>
<td><img src="image" alt="Diagram showing change" /></td>
<td><img src="image" alt="Diagram showing change" /></td>
</tr>
<tr>
<td>Surgery</td>
<td><img src="image" alt="Diagram showing change" /></td>
<td><img src="image" alt="Diagram showing change" /></td>
</tr>
</tbody>
</table>

Creasy et al 1990 *Eur J Vasc Surg* 4: 135
Tan et al 2000 *Eur J Vasc Surg* 20:72
Leng et al. 2000 *Cochrane Review*
Brendle et al 2001 *Am J Cardiol* 87: 324
Spronk et al 2005 *Radiology* 235: 833

Muscle metabolism – VO₂

White circles = pre-training
Black squares = 3 months training

Tan et al 2000 *Eur J Vasc Surg* 20:72
Barker et al 2004  
*Clin Sci* 106: 241  
VO$_2$ kinetics is slowed in IC compared to age matched healthy controls

---

**Muscle metabolism - blood lactate**

- White bars = pre-training
- Black bars = 3 months training

Tan et al 2000  *Eur J Vasc Surg* 20:72
Exercise Prescription
Considerations and Adaptations

Rehab-therapy downfall; over-emphasis on specific condition in attempt to fix what is broken

Rehab-therapy ideal; broaden focus to improve what is working well that will counteract limitations of disease system
Exercise Prescription
Considerations and Adaptations

It’s not just about improving walking pain and distance – there is a whole CV system needing improvement.

RPE and CR-10 Scales

Need patients to differentiate between “Pain” symptoms and “Exertional” symptoms.
Exercise choices

- Supervised or non-supervised (home)
- Low versus higher intensity activity
- Weight-bearing vs non-weight bearing activity
- Upper-body vs lower body activity
- Bi-lateral vs unilateral limb activity
- To which activity is patient most likely to adhere

(\textit{do you need to push into the pain?...})

- Painful but potentially more beneficial
- Less painful with some reduced benefit

Cochrane Review

Supervised vs Non-supervised Exercise

Bendermarcher et al. 2006

- 150m > distance covered compared with non-supervised walking group

- Statistically and clinically significant improvements in maximal treadmill walking distance
**Low v higher intensity**


<table>
<thead>
<tr>
<th></th>
<th>Low 40% max capacity</th>
<th>High 80% max capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Onset claud’ distance</td>
<td>+109%</td>
<td>109%</td>
</tr>
<tr>
<td>Max distance</td>
<td>61%</td>
<td>63%</td>
</tr>
</tbody>
</table>

In both groups VO$_2$ peak and HRQOL increased

**Weight-bearing v Non-weight-bearing**


Group A Cycling & Rowing
Group B Treadmill & Stepper
Group C Control

2x/ week x 10 weeks
Borg RPE 12-14
Borg CR-10 pain <4
Weight-bearing v Non-weight-bearing


Group A: Treadmill & Stepper: +4.6 mins
Group B: Cycling & Rowing: +2.4 mins
Group C: Control: +0.6 mins

Weight bearing was better, including 1.9 mins increased time before onset of claudication

However all forms of activity beneficial to CV health and fitness; non-weight bearing more bearable
**Upper vs lower-body exercise**


<table>
<thead>
<tr>
<th>Group</th>
<th>Exercise Type</th>
<th>Duration</th>
<th>Intensity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group A Leg</td>
<td>Cycle</td>
<td>24 weeks</td>
<td>50% - 65% VO(_2)peak</td>
</tr>
<tr>
<td>Group B Arm</td>
<td>Cycle</td>
<td></td>
<td>+31%</td>
</tr>
<tr>
<td>Group C</td>
<td>Control</td>
<td></td>
<td>+29%</td>
</tr>
</tbody>
</table>

**Claud distance**

| Group A Leg | +51%          | Max walk dist |
| Group B Arm | +57%          | +31%          |

Upper limb exercise equal to lower limb exercise in improving walking distance

Increased pain tolerance (Borg CR-10 scale)
BACR-EPG
University of Chester
13th April, 2007

Programme includes: IC & Exercise Symposium
Speakers: G. McGregor; I. Zwierska; P. Roberts; M. Morris

Personal adaptations
Presently being objectively assessed
Bi-lateral vs unilateral activity

Limiting gastrocnemius (calf) usage

Arch of foot on pedal, un-strapped

Crank-leverage reduced with “UniCam” adjustable crank
Summary

- Physical inactivity is a risk factor for IC morbidity & mortality
  - Need for studies on exercise training interventions
- Exercise is as good as medical or surgical therapies
  - Improved “fuel supply lines” (arterial blood) are only as good as the engine (muscle) using the fuel
  - Muscle training needs to accompany medical/surgical intervention

Summary

- Lower intensity activity as beneficial as higher
- Upper body and non-weight bearing activity
  - Are effective in improving both general health related CV fitness and walking performance
  - May be more palatable for long-term adherence to activity compared with weight-bearing exercise (stepping & walking)