Entraînement à haute intensité

Gregory Reychler
Service de Pneumologie
Cliniques universitaires Saint-Luc
Bruxelles
POUR ou contre
Conflit d’intérêt

• Kinésithérapeute hospitalier
Pulmonary rehabilitation is a comprehensive intervention ... which include, but are not limited to, exercise training, education and behavior change, designed to improve the physical and emotional condition of people with chronic respiratory disease and to promote the long-term adherence to health-enhancing behaviors.

Objectifs : réduire les symptômes et améliorer l’état fonctionnel, la qualité de vie et la participation aux AVJ
Limitations à l’effort

- Ventilatoire
- Dysfonction musculaire
- Echanges gazeux
- Cardiaque
Cause d’arrêt de l’exercice

- **Inconfort respiratoire**
  - 61%

- **Inconfort respiratoire et musculaire (MI)**
  - 19%

- **Inconfort musculaire (MI)**
  - 18%
Haute intensité... C’est quoi ça?

Haute intensité c’est ... intensité de 60% ou plus de la capacité maximale déterminée lors d’une EFX
Faisable?
Faisable?

Intensity of Training and Physiologic Adaptation in Patients with Chronic Obstructive Pulmonary Disease
FRANÇOIS MALTAIS, PIERRE LEBLANC, JEAN JOBIN, CHANTAL BÉRUBÉ, JOAN BRUNEAU, LINDA CARRIER, MARIE-JOSÉE BRETON, GENEVIÈVE FALARDEAU, and ROGER BELLEAU

« The purposes of this study were to evaluate: (1) the proportion of patients with moderate to severe COPD in whom high intensity training is feasible... »

<table>
<thead>
<tr>
<th>Age</th>
<th>65.5 ± 7.3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex, M/F</td>
<td>29/13</td>
</tr>
<tr>
<td>Height, m</td>
<td>1.65 ± 0.08</td>
</tr>
<tr>
<td>Weight, kg</td>
<td>67.9 ± 15.2</td>
</tr>
<tr>
<td>FEV₁, L</td>
<td>0.97 ± 0.33</td>
</tr>
<tr>
<td>FEV₁, %pred</td>
<td>38.3 ± 12.6</td>
</tr>
<tr>
<td>FVC, L</td>
<td>2.42 ± 0.75</td>
</tr>
<tr>
<td>FVC, %pred</td>
<td>64.6 ± 17.5</td>
</tr>
<tr>
<td>TLC, %pred</td>
<td>128.0 ± 28.6</td>
</tr>
<tr>
<td>DLco, %pred</td>
<td>69.8 ± 26.1</td>
</tr>
<tr>
<td>PaO₂, mm Hg</td>
<td>79.9 ± 10.9</td>
</tr>
<tr>
<td>PaCO₂, mm Hg</td>
<td>43.8 ± 8.1</td>
</tr>
</tbody>
</table>

At week 12, the mean exercise intensity was only 60% of maximal workrate

High-intensity training was achieved in 0, 3, 5, and 5 patients (/42) at weeks 2, 4, 10, and 12, respectively

Exercice : 25-30’ – 3x/sem – 12 sem
Intensité : 80% Wmax

Am J Respir Crit Care Med 1997;155:555-561
Faisable?

Intensity of Training and Physiologic Adaptation in Patients with Chronic Obstructive Pulmonary Disease

FRANÇOIS MALTAIS, PIERRE LeBLANC, JEAN JOBIN, CHANTAL BÉRUBÉ, JOAN BRUNEAU, LINDA CARRIER, MARIE-JOSÉE BRETON, GENEVIÈVE FALARDEAU, and ROGER BELLEAU

« The purposes of this study were to evaluate: (1) the proportion of patients with moderate to severe COPD in whom high intensity training is feasible... »

Am J Respir Crit Care Med 1997;155:555-561
Le travail à haute intensité, ça fonctionne?
Ca fonctionne?

Exercices : 5x/sem – 8 sem
Intensité : 71W vs 30W
Durée : 45 min/j vs 45 min x high work rate/low work rate)

Plus grand bénéfice pour la haute intensité

Physiological measurements from constant workrate testing, before and after exercise training: blue = high work rate training group; green = low work rate training group.

Ca fonctionne?

An Evaluation of Two Approaches to Exercise Conditioning in Pulmonary Rehabilitation*

Edgar A. Normandin, PhD; Corliss McCusker, RN; MaryLou Connors, RN; Frederick Vale, RRT; Daniel Gerardi, MD, FCCP; and Richard L. ZuWallack, MD, FCCP

Table 3 Changes in selected variables following high and low intensity exercise training (from Normandin et al.18).

<table>
<thead>
<tr>
<th>Variable</th>
<th>High</th>
<th>P versus baseline</th>
<th>Low</th>
<th>P versus baseline</th>
<th>P high versus low</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treadmill endurance (min)</td>
<td>8.4</td>
<td>&lt;0.001</td>
<td>2.7</td>
<td>0.07</td>
<td>0.007*</td>
</tr>
<tr>
<td>VO₂ peak (L min⁻¹)</td>
<td>0.11</td>
<td>0.02</td>
<td>0.00</td>
<td>0.99</td>
<td>0.09</td>
</tr>
<tr>
<td>VE/VO₂ @ 80% of WR</td>
<td>-2.48</td>
<td>0.008</td>
<td>-1.59</td>
<td>0.08</td>
<td>0.48</td>
</tr>
<tr>
<td>VAS dyspnea (% line length)</td>
<td>-45</td>
<td>&lt;0.001</td>
<td>-14</td>
<td>0.12</td>
<td>0.02 *</td>
</tr>
<tr>
<td>Arm lifts (lifts/min)</td>
<td>6.5</td>
<td>0.001</td>
<td>12.2</td>
<td>&lt;0.001</td>
<td>0.04</td>
</tr>
<tr>
<td>CRQ* total score (units)</td>
<td>11.5</td>
<td>&lt;0.001</td>
<td>18.8</td>
<td>&lt;0.001</td>
<td>0.09</td>
</tr>
<tr>
<td>TDI* (units)</td>
<td>2.9</td>
<td>&lt;0.001</td>
<td>3.2</td>
<td>&lt;0.001</td>
<td>0.69</td>
</tr>
</tbody>
</table>

*Chronic Respiratory Disease Questionnaire; bTransition Dyspnea Index.

Exercice : 30’ à 80% – 2x/sem – 8 sem

Chest 2002; 121:1085-91
Interval training as an alternative modality to continuous exercise in patients with COPD

I. Vogiatzis, S. Nanas, C. Roussos

---

Difference (Δ) in physiological responses at baseline peak work-rate (PWR; □) and at an identical work-rate (WR; ■) from initial PWR exercise during the incremental cycle ergometer test.
VO2: oxygen uptake; VCO2: carbon dioxide output; VE: minute ventilation; fR: respiratory frequency; fC: cardiac frequency; dysp.: end-exercise dyspnoea score; LT: lactate threshold; VO2/WR: slope of VO2/WR. *: p<0.05 within group.

---

Ça fonctionne?
Comment la rendre accessible à tous?
Interval training

Dynamic hyperinflation and tolerance to interval exercise in patients with advanced COPD

I. Vogiatzis*, #, S. Nanas*, E. Kastanakis†, O. Georgiadou#, O. Papazahou*, Ch. Roussos*

Data are presented as mean. RF: breathing frequency; HR: cardiac frequency; VO2: oxygen uptake; VE: minute ventilation. *: significant differences between IE and CT

COPD: FEV1<50% pred

Eur Respir J 2004; 24: 385–390
Interval training

Dynamic hyperinflation and tolerance to interval exercise in patients with advanced COPD

I. Vogiatzis*, #, S. Nanas*, E. Kastanakis†, O. Georgiadou*, O. Papazahou*, Ch. Roussos*

a) Oxygen uptake (VO2) and b) minute ventilation (VE) in a patient with severe chronic obstructive pulmonary disease during interval (○) and constant-load (●) exercise protocols. Interval exercise was sustained for 30 s at 100% of peak baseline capacity alternated with 30 s rest, whereas constant-load exercise was sustained at 75% of peak baseline capacity.

--- peak VO2 or maximal voluntary ventilation.
Interval training

Dynamic hyperinflation and tolerance to interval exercise in patients with advanced COPD

I. Vogiatzis*, #, S. Nanas*, E. Kastanakis†, O. Georgiadou#, O. Papazahou*, Ch. Roussos*

Table 4. Responses to interval exercise at temporally matched time points between work and unloaded pedalling phases

<table>
<thead>
<tr>
<th></th>
<th>Work phase</th>
<th>Unloaded phase</th>
<th>Work phase</th>
<th>Unloaded phase</th>
<th>Work phase</th>
<th>Unloaded phase</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>30% total time</td>
<td></td>
<td>60% total time</td>
<td></td>
<td>90% total time</td>
<td></td>
</tr>
<tr>
<td>VO₂ L·min⁻¹</td>
<td>0.74±0.04</td>
<td>0.74±0.04</td>
<td>0.77±0.05</td>
<td>0.77±0.05</td>
<td>0.78±0.04</td>
<td>0.78±0.05</td>
</tr>
<tr>
<td>VE L·min⁻¹</td>
<td>31.1±1.6</td>
<td>31.0±1.5</td>
<td>32.0±1.8</td>
<td>32.0±2.0</td>
<td>32.7±2.2</td>
<td>32.3±2.0</td>
</tr>
<tr>
<td>fC beats·min⁻¹</td>
<td>113±5</td>
<td>114±6</td>
<td>118±5</td>
<td>118±7</td>
<td>120±4</td>
<td>120±5</td>
</tr>
<tr>
<td>IC L</td>
<td>1.55±0.08</td>
<td>1.61±0.08</td>
<td>1.61±0.08</td>
<td>1.61±0.08</td>
<td>1.59±0.08</td>
<td>1.59±0.08</td>
</tr>
<tr>
<td>Dyspnoea Borg</td>
<td>2.9±0.2</td>
<td>3.3±0.3</td>
<td>3.3±0.3</td>
<td>3.3±0.3</td>
<td>4.3±0.4</td>
<td>4.3±0.4</td>
</tr>
<tr>
<td>Leg discomfort Borg</td>
<td>3.1±0.3</td>
<td>3.6±0.4</td>
<td>3.6±0.4</td>
<td>3.6±0.4</td>
<td>4.6±0.5</td>
<td>4.6±0.5</td>
</tr>
</tbody>
</table>

CLE
0.94*
38.4*
128
1.53
4.8
4.9

IC = 1,98L at baseline
Inspiratory Capacity, Dynamic Hyperinflation, Breathlessness, and Exercise Performance during the 6-Minute-Walk Test in Chronic Obstructive Pulmonary Disease

José M. Marin, Santiago J. Carrizo, Manuel Gascon, Andres Sanchez, Beogna Gallego, and Bartolome R. Celli

Relationship between the change in Borg breathlessness rating and change in IC from rest to the end of the 6MWD ($r = -0.49$, $p < 0.00001$)
Hyperinflation et interval training

Puissance (% puissance max)

0%

40%

80%

Interval-training

Charge constante

Hyperinflation dynamique

Air piégé à l’effort
Unité : secondes
Interval training

Skeletal Muscle Adaptations to Interval Training in Patients With Advanced COPD*

Ioannis Vogiatzis, PhD; Gerasimos Terzis, PhD; Serafim Nanos, MD;
Grigoris Stratakos, MD; Davina C. M. Simoes, PhD; Olga Georgiadou, MSc;
Spyros Zakynthinos, MD; and Charis Roussos, MD, PhD

Interval-training
30s/30s – 100% Wmax
3x/sem

Charge constante
60% Wmax
3x/sem

Interval training

**Skeletal Muscle Adaptations to Interval Training in Patients With Advanced COPD**

Ioannis Vogiatzis, PhD; Gerasimos Terzis, PhD; Serafeim Nanas, MD; Grigoris Stratakos, MD; Davina C. M. Simoes, PhD; Olga Georgiadou, MSc; Spyros Zakynthinos, MD; and Charis Roussos, MD, PhD

**Interval-training**
30s/30s – 100% Wmax
3x/sem

**Effet sur la structure**
Changement similaire de la section et de la proportion du type de fibre entre les deux types d’entraînement

Charge constante
60% Wmax
3x/sem

Avantage de l’*Interval training*

**Skeletal Muscle Adaptations to Interval Training in Patients With Advanced COPD**

Ioannis Vogiatzis, PhD; Gerasimos Terzis, PhD; Serafim Nanas, MD; Grigoris Stratakos, MD; Davina C. M. Simoes, PhD; Olga Georgiadou, MSc; Spyros Zakynthinos, MD; and Charis Roussos, MD, PhD

![Graphs showing changes in leg discomfort and dyspnea over training sessions.](image-url)
Bénéfices

QoL

Δ HRQoL (MCID)

Durée du programme (semaines)

Bénéfices

Tolérance à l’effort

• Motivation moindre pour intensité élevée?

• Adhérence meilleure pour intensité faible?
Conclusion

TABLE 2 Practical recommendations for the implementation of continuous and interval endurance training programmes

<table>
<thead>
<tr>
<th></th>
<th>Continuous endurance training</th>
<th>Interval endurance training</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Frequency</strong></td>
<td>3–4 days-week⁻¹</td>
<td>3–4 days-week⁻¹</td>
</tr>
<tr>
<td><strong>Mode</strong></td>
<td>Continuous</td>
<td>Interval modes:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>30 s of exercise, 30 s of rest or</td>
</tr>
<tr>
<td></td>
<td></td>
<td>20 s of exercise, 40 s of rest</td>
</tr>
<tr>
<td><strong>Intensity</strong></td>
<td>Initially 60–70% of PWR</td>
<td>Initially 80–100% of PWR for the first three to four sessions</td>
</tr>
<tr>
<td></td>
<td>Increase work load by 5–10% as tolerated</td>
<td>Increase work load by 5–10% as tolerated</td>
</tr>
<tr>
<td></td>
<td>Progressively try to reach ~80–90% of baseline PWR</td>
<td>Progressively try to reach ~150% of baseline PWR</td>
</tr>
<tr>
<td><strong>Duration</strong></td>
<td>Initially 10–15 min for the first three to four sessions</td>
<td>Initially 15–20 min for the first three to four sessions</td>
</tr>
<tr>
<td></td>
<td>Progressively increase exercise duration to 30–40 min</td>
<td>Progressively increase exercise duration to 45–60 min (including resting time)</td>
</tr>
<tr>
<td><strong>Perceived exertion</strong></td>
<td>Try to aim for a perceived exertion on the 10-point Borg scale of 4 to 6</td>
<td>Try to aim for a perceived exertion on the 10-point Borg scale of 4 to 6</td>
</tr>
<tr>
<td><strong>Breathing technique</strong></td>
<td>Suggest pursed-lip breathing or the use of PEP devices to prevent dynamic hyperinflation and to reduce breathing frequency</td>
<td>Suggest pursed-lip breathing or the use of PEP devices to prevent dynamic hyperinflation and to reduce breathing frequency</td>
</tr>
</tbody>
</table>

PWR: peak work rate; PEP: positive expiratory pressure. Adapted from [30].
Merci... et votez POUR!