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BRIEF NOTE

Stability over time of the level of maximal lipid oxidation during exercise

Stabilité dans le temps du niveau maximal d'oxydation des lipides à l'exercice

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Summary
Introduction. — The level of maximal lipid oxidation at exercise (LIPOXmax or FATmax) is exercise intensity, variable among individuals, at which a steady-state exercise performed over 45—60 minutes uses the greatest lipid/carbohydrate ratio and thus, minimises carbohydrate waste. This level has been demonstrated to be highly reproducible if tested in standardised conditions and is modified by a host of physiological or pathological situations. Whether it is stable over long periods of time remained unknown.
Methods. — We had the possibility to measure this stability in a database of 1600 exercise calorimetries performed in our unit since 1998 and including several patients that did not modify their exercise or eating habits and were re-tested after a mean interval of 30 months. Patients ($n = 11$) represented a wide range of age (28—74 years), body mass index (22 to 46.7 kg/m^2) and aerobic capacity.
Results. — Their LIPOXmax ranged between a power of 18 to 123 watts and their maximal fat oxidation rate (MFO) ranged between 75 and 423 mg/min. There was a remarkable stability of the LIPOXmax expressed in crude power ($r = 0.993$, $P < 0.001$; Bland Altman plots: mean difference −2.36, CI: [−3.33 to 8.06]. MFO was less reproducible over those long periods of time ($r = 0.694$, $P < 0.02$; mean difference 4, CI: [−53 to 61]).

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Conclusion. — Therefore, the power at which lipid oxidation reaches a maximal during exercise remains stable over a mean period of 30 months if diet and exercise habits are not modified.

MOTS CLÉS
Oxydation ;
Lipides ;
LIPOXmax ;
FATmax

Résumé
Introduction. — Le niveau maximal d'oxydation des lipides à l'exercice (LIPOXmax) est la puissance à laquelle le rapport d'utilisation oxydative lipides/glucides est maximal lors d'un exercice à plateau sur 45—60 minutes, minimisant le gaspillage de glucides. Il a été démontré que cette mesure est très reproductible d'un jour à l'autre dans des conditions standardisées, quoiqu'elle soit modifiable par de nombreuses situations physiologiques ou pathologiques. Il restait à évaluer la stabilité de ce paramètre sur de plus longues périodes.
Matériels et méthodes. — Nous avons recherché cette stabilité sur une base de données personnelle de 1600 calorimétries d'effort incluant des patients qui ne modifiaient pas leur exercice ou leurs habitudes alimentaires, re-testés après un intervalle moyen de 30 mois. Les patients ($n = 11$) représentaient une grande variété d'âge (28—74 ans), d'indice de masse corporelle (de 22 à 46,7 kg/m^2) et d'aptitude aérobie.
Résultats. — Leur LIPOXmax variait entre 18 à 123 watts et leur débit maximal d'oxydation des lipides (DMOL) se situait entre 75 et 423 mg/min. On note une stabilité remarquable du LIPOXmax exprimé en puissance brute ($r = 0,993$, $P < 0,001$; Bland Altman : différence moyenne —2,36, intervalle de confiance (IC) : [—3,33 à 8,06]. Le DMOL était moins reproductible au cours de ces longues périodes de temps ($r = 0,694$, $P < 0,02$; différence moyenne 4, IC : [—53 à 61]).
Conclusion. — Par conséquent, la puissance à laquelle l'oxydation des lipides est maximale au cours de l'exercice reste stable sur une période moyenne de 30 mois si les habitudes alimentaires et l'exercice ne sont pas modifiés.

1. Introduction

The level of maximal lipid oxidation during exercise (LIPOXmax) is the power at which the ratio between lipid and carbohydrate oxidation reaches a maximum during a steady-state exercise of 45—60 minutes [1]. This level is spontaneously selected by individuals when they have to exercise for a long time probably because it minimises the waste of carbohydrates. LIPOXmax is interesting for exercise training in obese and diabetic patients because of its ease of implementation in sedentary subjects, its protective effects on lean body mass and its reducing effect on body fat, that can be explained both by an action on mitochondrial function and a satiating effect [1].

It has been shown that this measurement is highly reproducible from one day to another under standardised conditions, although LIPOXmax is modified by many physiological and pathological situations [1]. However, whether this reproducibility reflects stability over longer periods remained unknown. We had the opportunity to investigate this issue on a large database of 1600 exercise calorimetries routinely performed in our outpatient unit of metabolic exploration, and among those, there was a little series of patients re-tested after a few months without changes in exercise or dietary habits.

2. Materials and methods

2.1. Subjects

We investigated this stability on a personal database of 1600 exercise calorimetries including some cases of patients who did not change their exercise and eating habits, and were re-tested after an average interval of 30 months. Patients ($n = 11$) represented a variety of ages (28—74 ans), body mass index (22 to 46.7 kg/m^2) and aerobic fitness.

2.2. Exercise calorimetry

2.2.1. Exercise testing

All subjects were asked to come and perform the test in the morning after an overnight fast (12 hours). As generally used to individualise the increment of exercise intensity during cardiopulmonary exercise testing, the theoretical maximal aerobic power (Pmax), corresponding to the power reached when theoretical VO_2max is reached, was calculated from Wassermann's equations modified for overweight subjects. The test consisted of five-six minutes steady-state workloads at 20, 30, 40, 50, and 60% of Pmax. Consequently, they underwent a test with the same relative incremental workload and were compared at the same percentage of their Pmax.

The subjects performed the test on an electromagnetically braked cycle ergometer (Ergoline Bosch 500). Heart rate and electrocardiographic parameters were monitored continuously throughout the test by standard 12-lead procedures. Metabolic and ventilatory responses were assessed using a digital computer based breath-to-breath exercise analysing system (Jaeger MS-CPX). Thus, we could measure VO_2, VCO_2 (in mL/min).

2.2.2. Calculation of substrate utilisation, COP and LIPOXmax

Lipid oxidation (LIPOX) and carbohydrate utilisation (Glucox) rates were calculated by indirect calorimetry from gas