DIABETES RESEARCH AND CLINICAL PRACTICE 94 (2011) 395–403

Contents lists available at ScienceDirect

Diabetes Research and Clinical Practice

journal homepage: www.elsevier.com/locate/diabres

Aerobic and resistance training effects compared to aerobic training alone in obese type 2 diabetic patients on diet treatment

Pietro Lucotti [a], *Lucilla D. Monti* [b], *Emanuela Setola* [a], *Elena Galluccio* [b], *Roberto Gatti* [c,d], *Emanuele Bosi* [a,b,d], *PierMarco Piatti* [a,b,d,*]

[a] *San Raffaele Scientific Institute, Cardio-Metabolic and Clinical Trials Unit, Internal Medicine Department, and Metabolic and Cardiovascular Science Division, Milan 20132, Italy*
[b] *San Raffaele Scientific Institute, Cardio-Diabetes and Core-Lab, Metabolic and Cardiovascular Science Division, Milan 20132, Italy*
[c] *San Raffaele Scientific Institute, Laboratory of Movement Analysis, School of Physiotherapy, Milan 20132, Italy*
[d] *San Raffaele Scientific Institute, Vita-Salute San Raffaele University, Milan 20132, Italy*

ARTICLE INFO

Article history:
Received 9 June 2011
Received in revised form
20 July 2011
Accepted 1 August 2011
Published on line 3 September 2011

Keywords:
Insulin resistance
Endothelium
Inflammation
Adipokine
Glucose metabolism

ABSTRACT

Aims: The study was designed to compare a combined aerobic and resistance training (ART) with an aerobic training (AT) over hemodynamic, glucose metabolism and endothelial factors, adipokines and pro-inflammatory marker release in a population of obese type 2 diabetic patients.

Methods: Forty-seven patients were randomly assigned to aerobic (27 patients) or aerobic plus resistance (20 patients) exercise trainings, on the top of a diet regime. Anthropometric, metabolic, hormonal and inflammatory variables were measured at hospitalization and discharge.

Results: Both exercise programs equally improved body weight and fructosamine levels however ART only partially decreased HOMA index compared with AT (ART: −25% vs AT: −54%, $p < 0.01$). Mean blood pressure (AT: −3.6 mmHg vs ART: +0.6 mmHg, $p < 0.05$) and endothelin-1 (ET-1) incremental areas during walking test (AT: −11% vs ART: +30%, $p < 0.001$) decreased after AT while increased after ART. Adiponectin levels increased by 54% after AT while decreased by 13% after ART ($p < 0.0001$) and matrix metalloproteinase-2 (MMP-2), tumor necrosis factor-alpha (TNF-alpha) and monocyte chemoattractan protein-1 (MCP-1) levels significantly decreased in AT while increased in ART group.

Conclusions: Compared with AT, ART similarly enhanced body weight loss but exerted less positive effects on insulin sensitivity and endothelial factors, adipokines and pro-inflammatory marker release.

© 2011 Elsevier Ireland Ltd. All rights reserved.

* *Corresponding author at*: Cardio-Diabetes and Clinical Trials Unit, Internal Medicine Department and Metabolic and Cardiovascular Science Division, Vita-Salute San Raffaele University, Scientific Institute San Raffaele, Via Olgettina 60, Milan 20132, Italy.
Tel.: +39 02 2643 2819; fax: +39 02 2643 3839.
E-mail address: piermarco.piatti@hsr.it (P. Piatti).

Abbreviations: AT, aerobic training; ART, aerobic and resistance training; RT, resistance training; HOMA, homeostasis model assessment; MMP-2, matrix metalloproteinase-2; TNF-alpha, tumor necrosis factor-alpha; MCP-1, monocyte chemoattractan protein-1; FM, fat mass; FFM, fat free mass; NO, nitric oxide; FFA, free fatty acids; ET-1, endothelin-1.

0168-8227/$ – see front matter © 2011 Elsevier Ireland Ltd. All rights reserved.
doi:10.1016/j.diabres.2011.08.002

1. Introduction

Aerobic exercise has shown many positive effects on insulin sensitivity and glucose homeostasis [1]. A chronic aerobic training (AT), even without changes in body composition, improves insulin sensitivity up to 30% both in impaired glucose tolerant (IGT) and type 2 diabetic patients [1]. Exercise intervention in adults with type 2 diabetes induces a mean fall in HbA1c percentage of 0.74 compared with control group, independently to body weight change [2]. In addition it promotes mobilization of visceral adipose tissue so reducing insulin resistance [3]. AT improves as well some cardiovascular risk factors such as hypertension, dyslipidemia and fibrinolytic activity [4]. According to these benefits daily AT was listed in guidelines for exercise in type 2 diabetes [5].

Resistance training (RT) shows potential benefits in rehabilitation, thanks to its ability in avoiding disease-related muscle wasting. Further, muscle contraction increases glucose uptake and improves insulin sensitivity in skeletal muscle thereby providing a rationale for its use in disease like type 2 diabetes [6,7]. RT enhances muscular strength and changes in body composition by increasing lean body mass and decreasing visceral and total body fat [8]. In particular, light to moderate loads (40–60% of 1 RM) are recommended for local muscular endurance training performed at high repetition using short resting period (<90 s) [9]. In addition, 3 days per week (3 d w^{-1}) training frequency has been recently shown to be superior to 1–2 days per week for improving muscular endurance, coordination, balance and cardiorespiratory fitness in older women [10], confirming meta-analytical data showing that strength gains in untrained individuals were highest with a frequency of 3 d w^{-1} [11]. In this light, recently published studies investigating the effect of aerobic and resistance training in patients with cardiovascular disease like chronic heart failure and stroke, adopted a 5 d w^{-1} training frequency in order to provide further evidence for the use of exercise as a clinical therapy in these patients [12,13].

Actually, few studies investigated the effect of a short program (about 3 weeks) of combined high frequency AT plus RT on glucose homeostasis and insulin sensitivity. In particular, there is small evidence of additional benefit from combining RT and AT on some related risk factors for diabetes complications (endothelial function and sub-clinical inflammation) in obese type 2 diabetic patients [14].

Therefore, the present study was designed to evaluate the effects of a short high frequency (5 d w^{-1}) RT and AT added to a program of hypocaloric diet compared with a high frequency AT with a similar program of hypocaloric diet, on fat and lean body mass distribution, glucose levels, insulin levels and sensitivity, endothelial factors, adipokines and pro-inflammatory markers releases in obese type 2 diabetic patients.

2. Subjects

2.1. *Informed consent*

Fifty middle-aged patients (30 males, 20 females) were included in the experimental protocol. All patients gave informed consent to participate into the study that was approved by the local Ethics Committee.

2.2. *Study population*

Patients were severely obese (body mass index, 38.6 ± 5.6; waist circumference, 113.1 ± 12.7 cm), with type 2 diabetes mellitus and metabolic syndrome according to ATPIII [15]. Before hospitalization, all were treated by diet alone for type 2 diabetes and the 2 study groups had comparable treatments for hypertension and dyslipidemia and no changes were made during the study period.

3. Materials and methods

3.1. *Diet program*

Patients were hospitalized for 21 days and submitted to a hypocaloric diet regime that consisted of 1000 kcal/day with 55% carbohydrate, 25–30% fat (saturated fat 7%) and 15–20% protein (animal protein 54 g) subdivided as follows: 15% for breakfast, 50% for lunch and 35% for dinner, administered under a daily supervision of a dietician. Diet was controlled not only for carbohydrate but also for cholesterol and natural fiber content (176 mg and 25 mg, respectively).

The diet provided about 50% of their estimated daily caloric needs, according with [16]. It was previously seen that obese patients who receive 33–70% of their estimated caloric needs during critical illness have better clinical outcomes [17]. The final goal was to induce a superimposable loss in FM and FFM and a minor decrease in insulin resistance as previously demonstrated by our group [18]. All in all, a moderate weight loss (~5%) was achieved in our patients in the attempt not to overshadow the results obtained through different exercise programs on insulin resistance and inflammation. In fact, recent data suggest that there may be a dose–response effect between the degree of weight loss and its capacity to attenuate chronic inflammation. In particular, it was found that at least 10% weight reduction is needed to achieve a significant reduction in C-reactive protein levels [19].

3.2. *Exercise training program*

Patients were randomly assigned to AT or ART group with a 3:2 ratio in order to generate additional metabolic, inflammatory and ET-1 data for AT group. This was done since we considered the possibility to have higher drop-out number in the group submitted to AT treatment during hospitalization, a program usually done in a home setting. The tests consisted in two different 3-weeks exercise program: AT alone (30 patients) and aerobic plus resistance exercise training (ART, 20 patients). AT program consisted of 30 min bid session of whole body exercise for 5 days a week. Each training session consisted in 30 min of aerobic exercise divided into row ergometer (15 min) and bicycle ergometer (15 min). The training program was performed at 70% of the individual age-predicted HR_{max} according to Tanaka et al. [20]. Patients exercised under the supervision of a physician. ART program consisted in 45 min bid session composed by an aerobic session comparable to

Download English Version:

https://daneshyari.com/en/article/5900120

Download Persian Version:

https://daneshyari.com/article/5900120

Daneshyari.com