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Original article

Resting metabolic rate and weight loss after bariatric surgery

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Abstract

Background: There is an increased interest in understanding how variation in body composition (BC) and energy expenditure is related to successful weight loss after surgery. It has been suggested that low resting metabolic rate (RMR) could be associated with poor weight loss.
Objectives: To determine the relation among changes in BC, RMR, and weight loss after bariatric surgery.
Setting: University tertiary care hospital, Brazil.
Methods: A cohort of 45 patients submitted to bariatric surgery was prospectively studied. BC was evaluated by bioelectrical impedance analysis and RMR by indirect calorimetry before and 6 months after surgery. The RMR value was adjusted per kilogram of weight (RMR/kg). The patients were divided in 4 groups, based on patterns of change in the RMR/kg after surgery. The RMR/kg could decrease (group 1), remain stable (group 2), have a small increase (group 3), or have a major increase (group 4).
Results: A significant relation between fat-free mass and RMR for both pre- ($P < .01$) and postoperative periods ($P < .01$) was observed. Excess weight loss had a significantly correlation only with post-RMR/kg ($P < .01$). The pattern of change in RMR/kg was strongly correlated with weight loss, considering an excess weight loss >50% a successful weight loss: No patients achieved success in group 1; 61% of patients did in group 2; 80% di in group 3; and all patients in group 4 had successful weight loss.
Conclusions: We demonstrate a clearly correlation between the postoperative RMR and weight loss. The increase in RMR/kg after surgery is a major factor related to a satisfactory excess weight loss after surgery. (Surg Obes Relat Dis 2018;▮:00–00.) © 2018 American Society for Metabolic and Bariatric Surgery. All rights reserved.

Keywords: Obesity; Bariatric surgery; Roux-in-Y gastric bypass; Energy expenditure; Resting metabolic rate; Body composition analysis

Severe obesity (body mass index [BMI] >35 kg/m^2) is a chronic disease that has become epidemic, and currently it is estimated that >1.9 billion adults worldwide are overweight and >600 million are obese [1]. Bariatric surgery is considered the only intervention with long-term results because it provides substantial weight loss and improvement of associated diseases [2]. Nevertheless, there is a subset of patients who fail to lose weight or present weight regain after bariatric surgery [3].

Therefore, there is an increased interest in understanding how variation in body composition (BC) and energy expenditure (EE) are related to successful weight loss after

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surgery. The primary components of the total daily EE are the resting metabolic rate (RMR), diet-induced thermogenesis, and activity thermogenesis, including exercise and nonexercise activity [4]. RMR, the major component of EE (60%–75%), is the energy required for maintenance of essential vital function, and fat-free mass (FFM) is the most important determinant of RMR [5].

Moreover, there is evidence that RMR presents distinguished patterns after weight loss with or without bariatric surgery. RMR was suppressed to a greater degree in caloric-restriction patients compared with those who underwent Roux-en-Y gastric bypass (RYGB) despite similar amounts of weight loss [6]. Other studies showed an increase in RMR/kg after bariatric surgery [7].

This study was designed to evaluate the correlation between RMR and FFM before and after bariatric surgery and how changes in RMR could affect excess weight loss (EWL) after bariatric surgery.

Methods

Patients

An observational prospective study evaluating BC assessment and RMR was conducted in patients (aged 18–60 yr) with severe obesity undergoing bariatric surgery between July 2015 and September 2015 in the Bariatric and Metabolic Surgical Unit, Hospital das Clínicas, University of São Paulo Medical School. Patients with a pacemaker, acute or chronic disease (congestive heart failure, chronic renal failure, and liver failure) associated with excessive water retention, treatment with steroid medication for any reason, or use of artificial devices (orthosis or prosthesis) or who did not agree to participate in this study were excluded.

Informed consent was obtained from all individual participants included in the study. All procedures performed were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments. This study was approved by Hospital das Clínicas Ethical Committee, University of São Paulo Medical School.

Study design

BC and RMR were evaluated in 45 patients with severe obesity before and 6 months after RYGB surgery. The weight, BMI, and EWL were also assessed 6 months after surgery. The same group of surgeons performed the surgical procedures with the following technical aspects: laparotomy, small gastric pouch between 25 and 40 mL, biliopancreatic limb with 75 cm, and alimentary limb with 100 cm. No major complications or mortality were recorded.

Anthropometric data and body mass composition

Weight was measured in a high-precision electronic balance. The measurement of the height was performed on the closest millimeter with a fixed millimeter stadiometer. The BMI (kg/m^2) was obtained using the formula (weight [kg] / height [m^2]).

Body composition

BC was determined by segmental bioelectrical impedance analysis under constant conditions (proper hydration and same time of day) with InBody 230 (Biospace Co., Seoul, Korea; GE Healthcare, USA) impedance device. The participant was positioned in orthostatic position on a platform with lower electrodes for feet and upper electrodes for hands. Data output was calculated in percentage values and included fat mass (FM) and FFM.

Resting metabolic rate

The patients were instructed to avoid all foods and beverages for 6 hours and coffee for at least 24 hours before data collection and to avoid physical exertion on the day of data collection. All tests were performed in the morning between 8 AM and 10 AM with participants resting in a supine position. They had 20 minutes to rest before data collection, 10 minutes of data acquisition on the device for adaptation, and 10 minutes for energy expenditure calculation. RMR was measured using the MedGraphics System, Ultima CPX (Medgraphics, St. Paul, MN, USA). Caloric expenditure was calculated according to the Weir formula. After the results, RMR value was adjusted per kilogram of BW to obtain RMR/kg (kcal/kg).

To compare the distinctive patterns of change in the RMR/kg before and after surgery, we divided the patients in 4 groups. We considered the RMR/kg stable when the difference between pre- and postoperative measure (Dif. RMR) was <2 kcal/kg. Thus, patients with a decrease in RMR/kg of >2 kcal/kg were grouped in group 1 (decrease). The patients with a variation between -2 and 2 kcal/kg formed group 2 (stable). Among the patients who had increased RMR/kg after surgery, some had a small increase and others had a major increase. We considered a small increase to include those who increased 2 to 6 kcal/kg after surgery, forming group 3 (small increase). Finally, those with an increase in RMR/kg >6 kcal/kg formed group 4 (important increase).

Excess weight loss

To assess EWL, we used weight based on a BMI of 25 as the ideal. Six months after surgery, we considered satisfactory an EWL $>50\%$.