Surgery for Obesity and Related Diseases ∎ (2016) 00–00

SURGERY FOR OBESITY AND RELATED DISEASES

Original article

Fat-free mass is not lower 24 months postbariatric surgery than nonoperated matched controls

Q3

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Q1

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Received February 11, 2016; revised March 2, 2016; accepted March 4, 2016

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Abstract

Q4 **Objective:** Concerns about an excessive loss of fat-free mass (FFM) after bariatric surgery prompted this comparison of operated versus matched nonoperated controls regarding FFM.

Setting: University Hospital and University Research Unit in an urban medical center.

Q5 **Methods:** Body composition with bioelectric impedance (Tanita 310) was measured approximately 2 years after bariatric surgery in weight stable patients and nonoperated weight stable controls matched for body mass index (BMI), gender, and age. *t* tests provided comparisons. Analysis of variance was used to compare FFM changes for 4 procedures. Levene's test evaluated variance.

Results: Patients (n = 252; 24.7 ± 15 mo after surgery) and nonoperated controls (n = 252) were matched for gender (71.8% female), age (44.5 ± 11.0 yr), and BMI (32.8 ± 7.0 kg/m^2). Patients had different surgical procedures: 107 gastric bypasses (RYGBs), 62 biliopancreatic diversions with duodenal switch (BPD/DSs), 40 adjustable gastric bands (AGBs), and 43 sleeve gastrectomies (LSGs). FFM percentage was significantly higher in the operated patients than controls, 66% versus 62%, $P < 0001$. For 3 procedures, the FFM was significantly higher; however, AGBs changed only 7.3 BMI units and FFM was not significantly different from their matched controls, 59.8% versus 58.2%. Across surgical groups, FFM percentage differed, $P < .0001$ (RYGB 66.5 ± 9.2%, BPD/DS 74.0 ± 9.3%, AGB 59.8 ± 7.0%, LSG 59.6 ± 9.3%). Variance was not different ($P = .17$). Q6

Conclusion: Weight-reduced bariatric surgery patients have greater FFM compared with nonoperated matched controls. These findings support surgically assisted weight loss as a physiologic process and in general patients do not suffer from excessive FFM depletion after bariatric procedures. (Surg Obes Relat Dis 2016;∎:00–00.) © 2016 American Society for Metabolic and Bariatric Surgery. All rights reserved.

Keywords: Fat-free mass; Bariatric surgery; Body composition after bariatric surgery; Composition of weight loss; Obesity

Forecasts of obesity in the United States predict that there will be 65 million more obese people by 2030 with concomitant increases in diabetes, heart disease, and stroke, and additional cancers [1]. The combined treatment of these co-morbid diseases is estimated to increase by $48–66 billion/yr in the United States. Bariatric surgery is the most consistent therapeutic option that has produced short- and long-term success for weight loss [2].

One of the objectives of weight loss by lifestyle and dietary changes, medications, or surgery, is reduced weight through loss of fat mass (FM) while limiting the loss of

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http://dx.doi.org/10.1016/j.soard.2016.03.003
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fat-free mass (FFM). Preservation of FFM or, more specifically, skeletal muscle mass, is important to future health since skeletal mass is associated with muscular strength and endurance, improved insulin sensitivity, increased high-density lipoprotein cholesterol, and enhanced psychological well-being [3]. FFM loss or, more specifically, its constituents' skeletal muscle mass and high metabolic rate organ mass have been a focus of continual concern for its possible effect on basal metabolic rate, core body temperature, rate of weight loss, weight regain, and or the possible development of protein deficiency [4, 5]. Therefore assessments of body composition change during the weight loss process, which record substantial changes in FFM, have resulted in strong efforts to increase protein intake and physical exercise in an attempt to limit FFM losses. In fact, a substantive body of literature is available emphasizing the importance of increasing dietary protein and increasing physical exercise in an attempt to maintain FFM in operated patients [6–8]. Because there are no guidelines available to help the differentiation of physiologic versus pathologic losses of FFM, we sought to evaluate the body composition by the same methodology for individuals who had not lost weight, were screened for weight stability, and were matched by body mass index (BMI), gender, and age to a surgically weight reduced population. Although there have been a number of studies on body composition change after various types of weight loss surgery [9–13], there has only been one comparing of body composition changes of post-weight loss surgery patients with nonreduced weight stable controls after 1 procedure, the biliopancreatic diversion [13]. Tacchino reported FFM losses plateaued between 12 and 24 months and were similar to the BMI-matched nonreduced controls.

Because 4 surgical procedures are performed at our surgical center, we compared the effect of those 4 procedures on FFM losses to a nonreduced cohort of individuals who had not lost weight and were matched to our surgically operated patients for BMI, gender, and age to evaluate the effects of the surgery on FFM and ascertain whether the surgical population had a significant reduction in FFM, which might impair functioning.

Methods

At their initial consultation for weight loss surgery, all patients who met the National Institutes of Health guidelines for weight loss surgery gave written consent to our institutional review board–approved data collection project, which included measurement of body composition. All patients were judged to be in sufficient good health to undergo bariatric surgery. At follow-up minimally a year after surgery, patients were studied on an availability basis at a reduced stable weight. The 4 laparoscopic procedures have previously been described [9]. All patients had been advised on postsurgery dietary guidelines with supplements recommended according to their surgical procedure. The nonreduced controls were volunteers from New York Hospital-Weill Cornell employees who were interested in obtaining information about their body composition, other patient evaluations before weight loss surgery, and weight-stable volunteers judged to be in good health who met the criteria of "normal volunteers" and were measured in the Body Composition Unit at the New York Obesity Nutrition Research Center. All patients and controls were evaluated by bioimpedance on identical instruments, the Tanita 310. The bioimpedance analysis is based on a 2-compartment model approach (weight = fat + FFM) [14]. Nonreduced patients were paired with surgical patients of the same age (±3 yr), sex, and BMI (±2 units). No patients were included who were in an active process of weight change or persisted to have surgical problems at the time of the body composition measurement.

A paired *t* test was performed for weight reduced and matched controls and for each surgical type matched to their controls. To establish homogeneity of equal variance among the 4 groups, Levene's test was used. The normality of the data was tested by Kolmogorov–Smirnov. Analysis of variance was used to evaluate surgical group differences. For all tests statistical significance was accepted at $P < .05$.

Results

A total of 252 surgical patients and an equal number of nonreduced, weight-stable controls were matched for BMI, age, and gender. The postsurgery patients included 40 adjustable gastric bands (AGB), 107 gastric bypasses (RYGB), 43 laparoscopic sleeve gastrectomies (LSG), and 62 biliopancreatic diversions with duodenal switches (BPD/DS). After the matching process, as would be expected, the mean age of the surgical patients (44.5 ± 11.1 yr) and the control patients (44.5 ± 10.8 yr) were not different. The gender distribution and BMIs were also not different as shown in Table 1. The 4 surgical groups had similar BMIs and gender distribution presurgery. For the total surgery group, the FFM after weight loss (66%) was greater than the nonoperated controls (62%) who were matched for BMI, age, and gender ($P = < .0001$) (Table 1). As shown, the LSGs, RYGBs, and BPD/DSs have significantly greater FFM than their matched controls. However, it must be noted the AGBs and their matched controls do not significantly differ in FFM (59.8 kg versus 58.3 kg). The AGBs had a limited weight change of 7.3 BMI units in contrast to the other procedures, which were more effective in producing weight change.

With the acknowledged differential capacity to assist in weight loss and at a differential rate of loss, it was observed that the FFM that was retained was significantly different for the 4 procedures ($F = 29.65$, $P < .0001$ by 1-way analysis of variance). Kolmogorov–Smirnov test showed the normality of the data and a *P* value from Levene's test

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