Effects of Weight Loss Induced by Bariatric Surgery on the Prevalence of Metabolic Syndrome

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Summary

Background: Metabolic Syndrome (MS) is often linked to overweight/obesity and can improve after weight loss, such improvement is expected to be proportional to the intensity of weight loss.

Objective: The aim of this study was to evaluate the impact of weight loss induced by bariatric surgery (BS) on the prevalence of MS in a middle-term period.

Methods: Thirty-five (35) patients who underwent surgical Roux`s Y gastrojejunal by-pass from October 2001 until October 2005 in our University Hospital were evaluated. 88.5% were female, with a mean age at the time of surgery of 37.8±11.1 years and a mean BMI of 45.0±6.2 Kg/m². During the first stage of our study demographic and clinical-anthropomorphic data were collected prior to the BC procedure, including those criteria needed for the diagnosis of MS, according to the guidelines of the US NCEP. The second stage consisted of reevaluation of those patients in the post-surgical period in order to determine the prevalence of MS in an outpatient setting.

Results: Prior to surgery, MS was diagnosed in 27 patients (77.1%). When those patients were reevaluated 34.4±15 months after surgery, a reduction of mean BMI to 28.3±5.0 Kg/m² and MS was identified in only two patients (5.7%) (p<0.001). Prevalence of individual criteria such as abdominal circumference, fasting glucose levels, arterial blood pressure, HDL-cholesterol and triglycerides had a reduction of 45.8%, 83%, 87.5%, 57.13% and 94% respectively.

Conclusion: MS is a rather common feature in obese patients enrolled for BS and this procedure has been proved to be extremely efficient reversing the metabolic syndrome, with an expressive reduction of prevalence of each and all of the NCEP criteria. (Arq Bras Cardiol 2009; 92(6) : 418-422)

Key words: Metabolic syndrome; prevalence; obesity; bariatric surgery.

Introduction

The term metabolic syndrome (MS) is used to describe a disorder that is more prevalent in the so-called civilized countries and whose manifestations are android (abdominal) obesity, diabetes mellitus type 2, arterial hypertension and disorders of lipid metabolism that can be summarized as the occurrence of small and dense LDL-cholesterol particles, low levels of HDL-cholesterol and elevated serum levels of triglycerides. An estimated 20% up to 30% of middle aged and elderly population is affected by MS[1,2]. Its importance remains in its association with a significant increase in the risk of morbidity obesity and cardiovascular mortality[3].

Obesity, especially abdominal adiposity, may be fundamental for the development of the syndrome by inducing peripheral resistance to insulin, which, in turn, seems to quick-start the development of the other disorders previously described[1]. Epidemiological studies have shown that overweight is responsible for 78% of the cases of hypertension in male patients and for 65% of females[4], as well as an elevation of the risk of developing diabetes mellitus type 2 10 times higher than in non-obese subjects[5]. Furthermore, a body index > 35 Kg/m² elevates the risk of developing diabetes mellitus 93 times in male subjects and 42 times in females[5]. These are quite alarming data, as the prevalence of obesity has increased unchecked in the developed countries[6].

The benefits of changes of live style, such as following a hypocaloric diet and regular sport activity, resulting in weight loss have been extensively documented[7]. In those persons who have morbid obesity refractory clinical measures, surgical stomach reduction (bariatric surgery) has allowed them to loose weight in significant amounts, with subsequent increase in quality of life and an overall improvement of comorbities[8].

The Swedish Obese Subjects (SOS) study, which has been published recently, followed 4,047 obese subjects for 10 years, with 2,010 subjects undergoing bariatric surgery and the remaining 2,037 following conventional clinical

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treatment (control group), demonstrated that mortality rates for each individual cause were smaller in the surgical group. Although this study was non-randomized, it provided additional evidence regarding safety issues and benefits of bariatric surgery [9].

Specifically regarding MS, small initial studies with a follow-up period of up to one year after laparoscopic gastric *by-pass* or adjustable gastric banding have showed a significant reduction of its prevalence[10-12].

Despite the fact that these are all preliminary studies, these results provide adequate support to the hypothesis that MS might be attenuated, or ever reverted, after bariatric surgery. However, it is unknown whether the favorable effects of bariatric surgery may persist for an indeterminate period. Our study aims are to confirm in our population the favorable impact of significant weight loss induced by bariatric surgery on MS, as well as to see for how long these benefic results remain unchanged in a longer follow-up period.

Method

The studied sample was made of 35 patients who underwent Roux`s Y gastrojejunal *by-pass* through open surgery (Bariatric Surgery), from October 2001 until October 2005, at the Obesity Surgery Service of our Universitary Hospital (UH). Patients were mostly female (88.5%), with a mean age at the time of surgery of 37.8±11.1 years, 42.9% were Caucasian, 11.4% were black (African-Brazilian) and the remaining 45.7% were had a mixed ethnic background. Subjects had been previously diagnosed with arterial hypertension and diabetes mellitus in 32.4% and 11.4% respectively. Exclusion criteria included clinical disorders that might affect the features needed for diagnosing MS (pregnancy, hypothyroidism and thyrotoxicosis) and/or death; nevertheless, none of the evaluated subjects had any of those criteria.

In order to diagnose MS, we used the criteria of the United States' National Cholesterol Education Program (NCEP), as published in their 3rd guideline[13]. According to the NCEP, MS is diagnosed if the patient has one or more of the following features: abdominal obesity (as characterized by an abdominal circumference > 102 cm for male subjects and > 88 cm for females), high triglyceride serum levels (≥ 150 mg/dl), low HDL-cholesterol levels (< 40 mg/dl for males and < 50 mg/dl for females), abnormal fasting glucose (≥ 110 mg/dl) or use of oral hypoglicemiants and arterial blood pressure ≥ 130 x 85 mmHg or use of anti-hypertensive medications.

During the first stage of the study a check-list with demographic and clinical-anthropometric data, including those criteria needed for the diagnosis of MS, was completed for each patient by reviewing their hospital files prior to the surgical intervention (bariatric surgery). The second phase was performed after surgery, when the patients were seen in an outpatient setting in order to reevaluate those parameters needed for the diagnosis of MS. All the laboratory tests used in this study were performed at the Central Clinical Analysis Laboratory of our UH. Prevalence of MS at the time of reevaluation was compared to that of the pre-surgical phase.

The Epi Info 2007 program was used for statistical analysis. Qualitative variables were studied by analysis of relative frequency (%) and continuous variables were expressed as mean values and standard deviation. The chi-square test was used for analysis of significance when comparing proportions and the Wilcoxon's test for comparison of mean values. A significance cut-off value of 5% ($p<0.05$) was adopted.

Results

During the basal period the mean Body Mass Index (BMI) was 44.9±6.2 Kg/m², ranging from 35.6 to 64.9 Kg/m², and MS was diagnosed in 27 subjects (77.1%). At the time of re-evaluation 34.4±15 months after surgery a decrease in BMI to 28.3±5.0 Kg/m² ($p=0.466$) (range 17.9 to 39.9 Kg/m²) could be observed and MS was diagnosed in just two patients (5.7%) ($p<0.001$) (table 1). Therefore, a mean reduction of 36.7% in BMI and a reduction of 92.6% of the prevalence of MS occurred as a result of BS.

Of all the diagnostic criteria of MS, according to the NCEP, during baseline the more prevalent were abdominal circumference, which was observed in all subjects, and low levels of HDL-cholesterol, found in 27 subjects (77.1%) (Figure 1). In the follow-up evaluation there was an expressive reduction of all the NCEP criteria (Figure 1) There was a marked reduction in the prevalence of abdominal circumference, glycemia, arterial blood pressure, HDL-cholesterol levels and triglycerides levels of 45.8%, 83%, 87.5%, 57.13% and 94%, respectively (Figure 2). Abdominal circumference and low serum levels of HDL-cholesterol remained the more prevalent criteria, as they were identified in 54.3% and 34.3% of patients at follow-up.

Discussion

In spite of the fact that study population was comprised of relatively young patients, MS proved to be highly prevalent, leading to an early increased cardiovascular risk in these subjects. Considering the difficulties usually found in traditional measures for obtaining weight loss, bariatric surgery is currently a highly efficient method for obtaining substantial and sustained weight-loss in morbidly obese patients[8].

There are evidences that even smaller amount of weight loss, as small as 5% and 10% of original weight, result in clinically significant benefits, such as reduction of arterial blood pressure levels and fasting glucose levels[14,15]. Roux`s Y gastrojejunal *by-pass* lead to sustained significant weight-loss that can be as substantial as 35% to 40% of initial weight[16]. A sensible supposition is that this more intense weight-loss may lead to even higher clinical benefits. Actively searching

Table 1 – BMI and prevalence of MS before and 34.4±15 months after bariatric surgery was performed

	Basal period	Post-bariatric surgery
BMI (Kg/m²)	44.9±6.4	28.3±5.0
Prevalence of MS (%)*	77.1	5.7

*$p < 0.001$

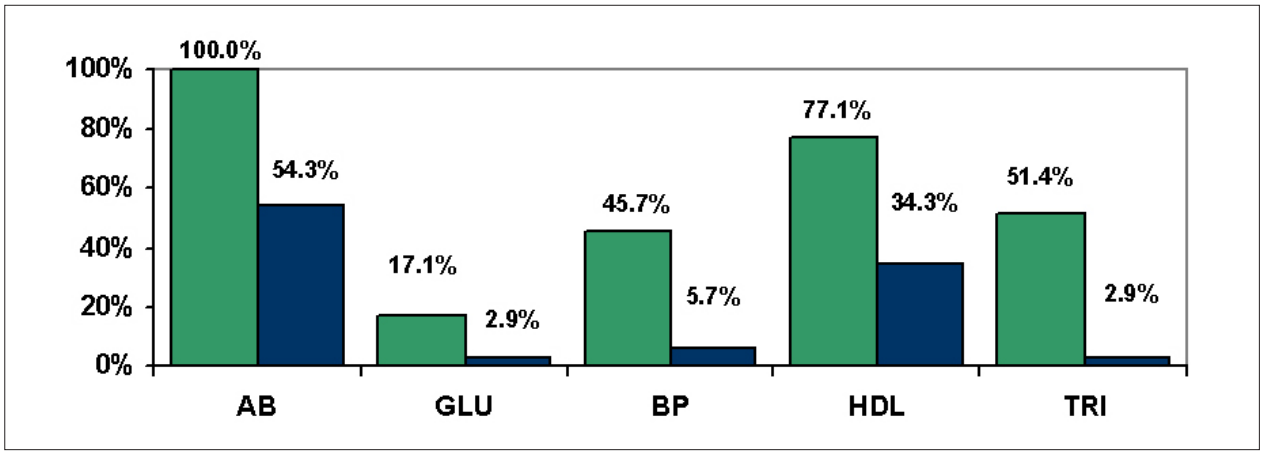

Figure 1 - Prevalence of NCEP criteria before and 34.5±15 months after bariatric surgery; AB - abdominal circumference; GLU - fasting glucose; BP - arterial blood pressure; HDL - HDL-cholesterol; TRI – triglycerides.

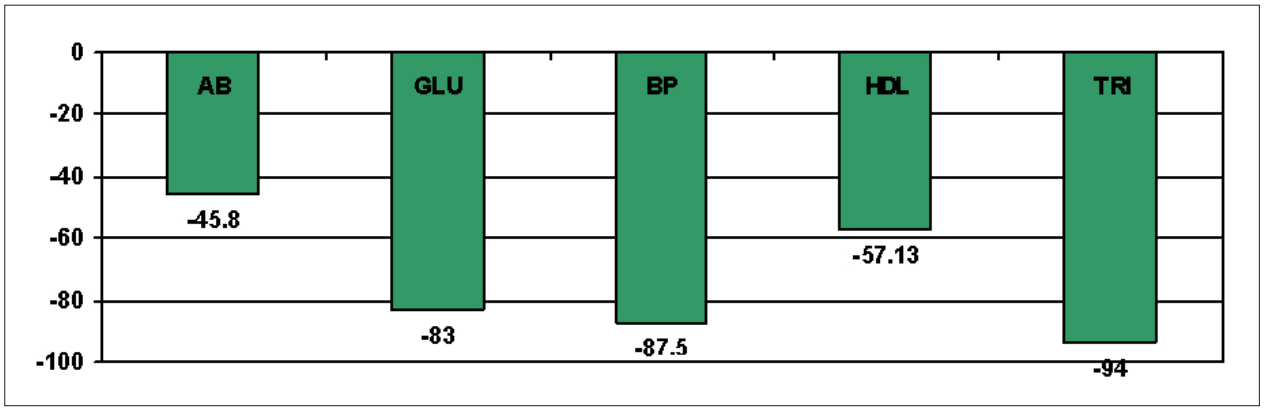

Figure 2 - Proportional reduction of prevalence of each criterion of the NCEP after bariatric surgery; AB - abdominal circumference; GLU - fasting glucose; BP - arterial blood pressure; HDL - HDL-cholesterol; TRI – triglycerides.

for MS, widely known to be associated with an increased risk of cardiovascular events[3], was one of the end-points adopted in this study as a simple and objective measure in order toe valuate the benefits of bariatric surgery.

The favorable effects of either Roux`s Y gastrojejunal *by-pass* or adjustable gastric banding on the regression of MS had been reported in other samples with a follow-up as long as 12 months[10-12,17]. As ethnical features might affect the prevalence of MS, it was unknown whether these results could be extrapolated to our population. In addition, it was unclear if this benefit would be sustained over a more prolonged period of time.

Similar to other results previously published, in this study bariatric surgery led to significant mid-term weight loss (mean 36.7% reduction). As hypothesized, the weight loss resulted in a significant reduction of the prevalence of MS (92.6%) in the study population in the follow-up evaluation mean period of three years following the surgical procedure. An important reduction of all the five diagnostic criteria of MS, according ton the NCEP, was also observed, and we highlight the marked reduction of fasting glucose levels, arterial blood pressure and triglyceride levels. Conversely, the remaining criteria; abdominal circumference and HDL- cholesterol, remained the most prevalent criteria in the late follow-up reevaluation.

The benefits obtained after bariatric surgery might be due not only to the marked weight loss, but also to a change in the nutritional/alimentary profile, as a result of alimentary reeducation, as well as a more active life-style[18,19]. Several studies have shown that obesity, especially abdominal adiposity, had a defining role in the genesis of insulin-resistance, a physiopathological substrate for all the metabolic changes of MS[20-22]. Whichever the determining factors and mechanisms involved might be, the marked improvement of the metabolic profile observed in these patients strongly suggests that an important reduction of insulin-resistance, or even its reversal, may occur[23].

In addition, some authors have observed a significant improvement and even reversal/cure of diabetes mellitus type 2 quite early after bariatric surgery, even before significant weight-loss becomes evident, thus leading to the supposition that other alternative mechanisms might be responsible for this particular finding[24-26].

Recently incretines, peptides produced in the intestine, have been recognized as having a major role in the physiopathology

of diabetes mellitus type 2. These substances, whose main representatives are GIP (gastric inhibitory peptide), which is secreted by K-cells in the proximal segment of the small-intestine, and GLP-1 (glucagon-like peptide-1), secreted by L-cells of the distal segment of the small intestine, have their secretion induced by direct contact of the alimentary bolus on the intestine. Once released, they act on the pancreas, stimulating the secretion of insulin. Other anti-diabetogenenic effects have been attributed to GLP-1, such as a slowing of gastric emptying, appetite reduction, glucagon inhibition and an improvement in the sensibility to insulin. However, type 2 diabetic patients have a reduced secretion of these substances following the alimentary stimulus. Thus, it has been hypothesized that Roux`s Y gastrojejunal *by-pass*, by anatomically approaching the stomach and the ileum, leading to an earlier contact of the alimentary bolus with the distal intestine, would lead to an increase in the production of incretines. This, in turn, would explain the improvement or even reversal of diabetes mellitus type 2 by an additional mechanism other than weight loss. In fact, small preliminary studies have shown an early increase in the production of incretines following bariatric surgery, which may be confirmed in larger future studies[24-28].

Therefore, routine evaluation of patients who are candidates for bariatric surgery should include an active search for MS, due to its high prevalence, as shown in our study. Also, as a rather easy to perform evaluation, it should also be part of mid-term and long-term follow-up protocols, as an important parameter of the benefits of bariatric surgery in these individuals. Further studies should be able to demonstrate whether the favorable impact of bariatric surgery on MS is an effective tool in the reduction of long-term cardiovascular events.

Potential Conflict of Interest

No potential conflict of interest relevant to this article was reported.

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Study Association

This study is not associated with any post-graduation program.

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