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Original article

The relation between pro-oxidant antioxidant balance and glycolipid profile, 6 months after gastric bypass surgery

Vahideh Banazadeh[a], Mohsen Nematy[a], Majid Ghayour Mobarhan[b], Shima Tavallaieb[d], Habibollah Esmaili[c], Ali Jangjoo[d,*]

[a]Department of Nutritional Sciences, Faculty of Medicine, Mashhad University of Medical Sciences, Mashhad, Iran
[b]Metabolic Syndrome Research Center, Faculty of Medicine, Mashhad University of Medical Science, Mashhad, Iran
[c]Department of Biostatistics and Epidemiology, Faculty of Medicine, Mashhad University of Medical Sciences, Mashhad, Iran
[d]Surgical Oncology Research Center, Mashhad University of Medical Sciences, Mashhad, Iran

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Abstract

Background: Morbid obesity is a chronic disease that contributes to increased oxidative stress. Gastric bypass surgery is the gold standard method in treating co-morbidities.

Objectives: The objective of this study was to evaluate the relation between pro-oxidant antioxidant balance (PAB) as one measure of oxidative stress and glycolipid profile 6 months after gastric bypass surgery.

Setting: Imam Reza Hospital, Mashhad University of Medical Sciences, Mashhad, Iran.

Methods: Thirty-five morbidly obese patients with body mass index ≥35 kg/m^2 with co-morbidities or ≤40 kg/m^2 were randomly recruited. The PAB assay was used to estimate oxidative stress. Anthropometrics and glycolipid profile were collected at recruitment and 6 months after surgery. Statistical analysis was performed using SPSS 16 software.

Results: The study showed a significant postoperative reduction in serum PAB values compared with the baseline ($P < .001$). All anthropometric and several glycolipid parameters significantly reduced after surgery ($P < .001$), while serum high-density lipoprotein cholesterol was unaffected. Repeated measures analysis of variance showed that postoperative PAB values were affected by gastric bypass surgery ($F = 12.51$, $P = .001$). Regression analysis demonstrated medication usage controlling co-morbidities ($\hat{\beta} = -.6$, $P = .002$) and fasting blood glucose ($\hat{\beta} = .41$, $P = .04$) as independent factors in predicting PAB values 6 months after surgery.

Conclusions: Gastric bypass surgery can reduce PAB values in favor of antioxidants 6 months after the operation. Accordingly, fasting blood glucose after gastric bypass surgery can be an independent factor in predicting PAB values. (Surg Obes Relat Dis 2017;▮:00–00.)

Keywords: Obesity; Morbid; Oxidative stress; Gastric bypass; Pro-oxidant antioxidant balance

The prevalence of obesity and its complications are globally increasing [1]. Extreme or class III obesity is a chronic disease with a body mass index (BMI) ≥40 or ≥35 kg/m^2 with co-morbidities, in which gastric bypass surgery is the gold standard treatment method [2].

According to the World Health Organization's report in 2015, while nearly 28% of adults were obese worldwide, approximately 26% of the Iranian adult population suffered from obesity [3]. Although oxidative stress can be a consequence of obesity, it can also be a trigger of obesity

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*Correspondence: Ali Jangjoo, Surgical Oncology Research Center, Imam Reza Hospital, Faculty of Medicine, Mashhad University of Medical Sciences, Mashhad, Iran.

E-mail: JangjooA@mums.ac.ir

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[4]. Several studies demonstrated that people after weight reduction associated with increased physical activity had lower levels of oxidative stress because of a reduction in tissue insulin sensitivity [5,6]. In addition, a direct association among oxidative stress markers, inflammatory markers, hyperglycemia, and hyperlipidemia has been reported [7,8].

Although surgery may potentially contribute to an increased production of proinflammatory cytokines and reactive oxygen species [9], reduction in oxidative stress has been reported within the first week after surgery [10]. There are several methods to determine antioxidant or oxidant status in human body. Evaluating plasma concentrations of individual antioxidant molecules and total antioxidant capacity [11], direct assessment of free radical production [12], or estimating the end products of oxidative damage [13] have all been used. These surveys have only evaluated one part of the total pro-oxidant and antioxidant capacities and are indirect, time wasting, and expensive [14]. According to the main definition of oxidative stress [15], pro-oxidant antioxidant balance (PAB) assay (an inexpensive and easy to perform method) evaluates the pro-oxidant burden and the antioxidant capacity in 2 varied oxidation–reduction reactions and identical circumference coincidently [16]. It has been validated previously [17]. In an enzymatic reaction, the colorless 3, 3′, 5, 5′- tetra methyl benzidine is oxidized to its colored cation by peroxides; in a chemical reaction, reduction of its colored cation to the colorless compound by antioxidants occurs. The photometric absorbance is then compared with the absorbance given by a series of standard solutions that are made by mixing different proportions of hydrogen peroxide as a representative of pro-oxidant with uric acid as a representative of antioxidant reference [16].

To our knowledge, this is the first study in which serum pro-oxidant antioxidant balance has been determined in morbidly obese patients before and after gastric bypass surgery. We also tried to ascertain the effects of certain predictors on 6-month postoperative PAB values.

Methods

The Ethics Committee of Mashhad University of Medical Sciences approved the protocol for this pilot study. Data sampling was randomly conducted. Written informed consent was obtained from all participants.

Thirty-five morbidly obese patients, who were candidates for Roux-en-Y gastric bypass surgery, were admitted via the Surgery Clinic of Imam Reza Hospital, Mashhad, Iran, between September 2014 and February 2015. Inclusion criteria were in accordance with the indications for gastric bypass surgery [18]. Exclusion criteria were women who were planning to become pregnant within 12 months, lactating women, patients with autoimmune disease, those taking immunosuppressive or anti-inflammatory agents, smokers, alcoholic individuals, those who were following a specific diet or supplementation program 1 month before the surgery, and professional athletes because of their high metabolic status.

Two weeks before the planned surgical date and 6 months after surgery, blood samples were collected after a 12-hour fast. Biochemical tests including fasting blood glucose (FBG), serum lipid profile, and high-sensitivity C-reactive protein (hs-CRP) were determined by routine laboratory testing. To calculate insulin resistance, we used the homeostatic model assessment for insulin resistance algorithm (FBG mg/dL × Insulin mIU/L) / 405). A further blood sample (.5 mL) was collected from each participant and kept under refrigeration at −20°C to be compared with the samples that to be obtained 6 months after surgery.

Blood samples were centrifuged at 2000*g* for 15 minutes; the serum aliquots were separated and stored. The novel PAB assay was previously described by Alamdari et al. [16]. To compare oxidant burden and antioxidant capacity of each serum sample, we prepared 2 major solutions, standard and working. The standard solutions were prepared by mixing different proportions (0%–100%) of 500 μM hydrogen peroxide with 3 mM uric acid (in 10 mM NaOH).

The working solution was prepared by mixing specific amounts of tetra methyl benzidine, and its cation was immediately used. Two hundred milliliters of the working solution was added into the wells containing 10 mL of each sample, standard or blank (distilled water), and incubated in a dark place for 12 minutes at 37°C. Then, 50 μL of 2 M HCl was added into each well to stop the enzymatic reaction. The ELISA reader was used to measure the absorbance at 450 nm (with a reference of 570 or 620 nm wavelength). A standard curve was drawn for the standard samples and expressed as arbitrary Hamidi Koliakos unit, which shows the percentage of hydrogen peroxide in the standard solutions. The values of the measured samples were calculated in comparison to the values of standard curve and expressed as Hamidi Koliakos units [19]. In women of childbearing age, blood sampling was collected during the first week after the menstrual period [20]. Because gastric bypass patients have to take an appropriate multivitamin/ mineral supplement at least for 5 days a week [21], they were asked to discontinue their supplement 2 days before the second blood sampling.

Height and waist circumferences were measured using a standard protocol. Weight (in light clothes without shoes), BMI, and body composition were measured by bioelectrical impedance analyzer, Tanita-BC 418 (Tanita Corp., Tokyo, Japan). Six months after surgery, excess weight loss and excess BMI loss were calculated according to the described method [22].

Roux-en-Y laparoscopic gastric bypass surgery was performed by the same surgeon using a standard procedure [23]. Thirty days after surgery, for all patients a similar multivitamin/mineral supplement (Pharmaton, SA, Lugano,