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Original article

Temporal changes in plasma markers of oxidative stress following laparoscopic sleeve gastrectomy in subjects with impaired glucose regulation

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Abstract

Background: Laparoscopic sleeve gastrectomy (LSG) is an effective treatment for obesity and associated metabolic complications. Obesity and type 2 diabetes are associated with increased oxidative stress. Previous studies have examined changes in plasma oxidative stress after laparoscopic Roux-en-Y gastric bypass, but there is limited evidence of the effects of LSG.

Objectives: To examine the effects of LSG on plasma thiobarbituric acid reactive substances (TBARS) and total antioxidant status (TAOS) at 1 and 6 months after LSG in patients with obesity and impaired glucose regulation.

Setting: University hospital, United Kingdom.

Methods: Twenty-two participants with impaired glucose homeostasis undergoing LSG (body mass index 50.1 kg/m^2, glycated hemoglobin 53 mmol/mol) were studied. Measurements of fasting and 120-minute TBARS and TAOS were performed during an oral glucose tolerance test preoperatively and postoperatively.

Results: Compared with preoperative levels, significant decreases were seen 6 months postoperatively in fasting TBARS (61.0 ± 17.9 versus 39.4 ± 13.8 ng/mL, $P = .04$) and 120-minute TBARS (76.0 ± 29.5 versus 46.5 ± 16.3 ng/mL, $P = .02$). No significant changes were observed in plasma TAOS. No significant association was observed between changes in TBARS and other clinical or biochemical measures.

Conclusion: We observed a significant reduction in TBARS, a global measure of lipid peroxidation 6 months after LSG in participants with obesity and impaired glucose regulation. (Surg Obes Relat Dis 2016;▮:00–00.) Crown Copyright © 2016 Published by Elsevier Inc. on behalf of American Society for Metabolic and Bariatric Surgery. All rights reserved.

Keywords: Obesity; Type 2 diabetes; Laparoscopic sleeve gastrectomy; Oxidative stress

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Obesity and related impaired glucose homeostasis are associated with increased circulating and tissue levels of reactive oxygen species (ROS) [1,2] and oxidative damage. ROS are associated with systemic inflammation, vascular and endothelial dysfunction [3], β-cell dysfunction [4–6], insulin resistance, type 2 diabetes (T2D), and associated complications [7,8] Fig. 1.

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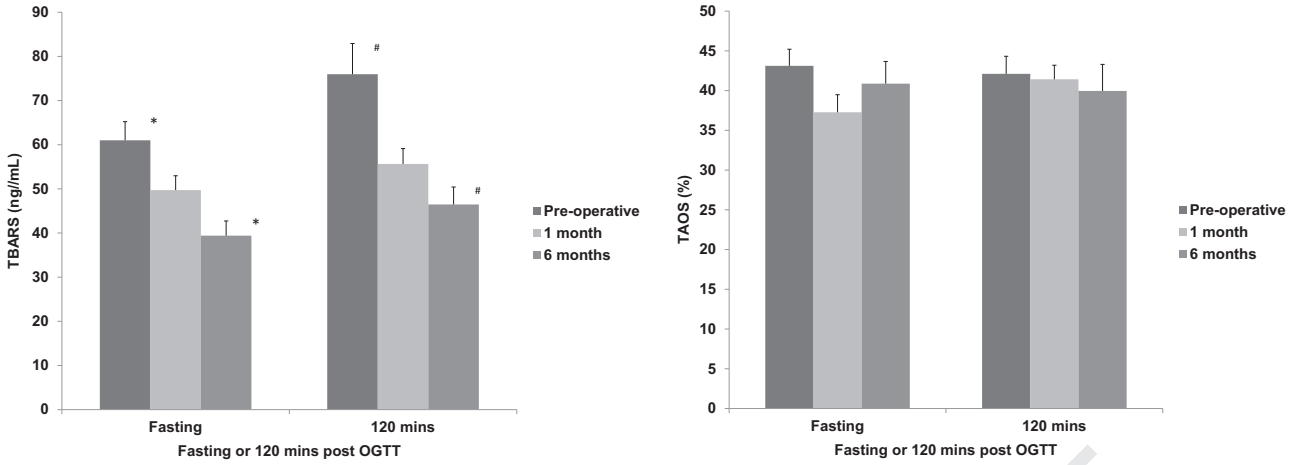

Fig. 1. Temporal changes in inflammatory biomarkers after laparoscopic sleeve gastrectomy. (A) Thiobarbituric acid reactive substances. Geometric mean and standard error shown. Significant changes relative to baseline: $^{*}P = .04$, $^{\#}P = .02$. See also Table 2. (B) Total antioxidant status. Mean and standard error shown.

Bariatric surgery is an effective treatment for obesity and obesity-associated impaired glucose homeostasis (impaired glucose tolerance and T2D) [9]. This is likely related to reductions in adipose tissue mass and subsequent improvements in systemic inflammation [10,11] and oxidative stress [12,13]. Previous publications have reported reductions in systemic measures of inflammation after laparoscopic Roux-en-Y gastric bypass (RYGB) [14–17] and laparoscopic sleeve gastrectomy (LSG) [17–20]. LSG is an established and recognized standalone bariatric procedure with an established safety profile comparable to other bariatric procedures [21,22].

There are few published studies examining changes in plasma markers of oxidative stress after bariatric surgery, especially LSG. In relation to RYGB, Ueda et al. observed reductions in plasma levels of F_2-isoprostane (8-*iso*-PGF2 α) and an increase in glutathione peroxidise (GPX) in 14 patients within the first week of surgery [23]. These changes were also associated with changes in adipocyte levels of 8-*iso*-PGF2 α and an increase in the adipocyte expression of GPX-3. Carbrear et al. reported significant reductions in plasma superoxide dismutase (SOD) and malondialdehyde (MDA) and increases in glutathione and total reactive antioxidant potential (TRAP) in 20 patients 12 months after surgery [24]. Two other studies have shown that weight reduction per se was associated with improvements in plasma measures of oxidative stress after RYGB [12,13]. Kelly et al. reported significant improvements in markers of both inflammation and oxidative stress, but this was in a combined cohort of both RYGB and vertical sleeve gastrectomy [17]. Our aim was to specifically examine the temporal changes in fasting and 120 minute plasma thiobarbituric acid reactive substances (TBARS) and total antioxidant status (TAOS) after a glucose load (an oral glucose tolerance test) preoperatively and 1 and 6 months after LSG in a sample of patients with impaired glucose tolerance or T2D. These measures provide a global plasma measure of oxidative stress (TAOS) and a specific measure of lipid peroxidation (TBARS).

Methods

Study participants

Approval for the study was obtained from the local research ethics committee and the joint scientific research committee. Participants were identified and recruited from patients undergoing a planned bariatric surgical procedure at our center. Entry criteria at the outset of the study included age 20–60 years, body mass index [BMI] >40 kg/m^2, and adequate and physical fitness for surgery. Patients of both genders were included. Participants with any acute concurrent illness were excluded. Participants with pre-existing T2D treated with diet, oral agents, or insulin were included. Participants with impaired glucose regulation were those with either impaired fasting glycaemia (5.6–6.9 mmol/L) or impaired glucose tolerance (2-hour glucose 7.8–11.0 mmol/L) [25]. Participants with normal fasting glucose values or a normal glucose tolerance test before recruitment were excluded. At the time of recruitment, no participant was known to be taking any form of vitamin supplementation, and no vitamin supplementations are given routinely after LSG. No participant had any diagnosed or clinically manifest systemic immune or inflammatory disorder. Informed consent was obtained from all participants included in the study.

Study design

Participants with a planned LSG were recruited prospectively and consecutively from the bariatric surgical clinic. The LSG was a standard sleeve (sleeve fashioned around a 32 F bougie taken from 5 cm proximal to the pylorus and up to the left crus). All participants were recruited

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