

Postprandial Triglyceride, Glucose and Insulin Levels 10 Years After Bariatric Surgery in Women With Severe Obesity – A Pilot Study: Part 1 – Laparoscopic Greater Curvature Plication

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Summary

The long-term effects of bariatric surgery on postprandial profiles in patients with obesity and type 2 diabetes (T2D) have not yet been investigated. Therefore, this study examined postprandial profiles before laparoscopic greater curvature plication (LGCP), and then at 2 and 10 years after surgery. The studied cohort included 10 women (mean age= 54.4±5 years) with obesity (mean BMI= 42.5±7.8 kg/m²) and T2D who underwent LGCP. All subjects underwent a standardized liquid mixed-meal test. For statistical evaluation, ANOVA with Bonferroni multiple comparison was used. Mean postprandial levels were significantly decreased 2 years after surgery. Responses 10 years after the surgery also remained significantly lower than before surgery. Changes observed during the follow-up were significant: glucose: F=34.5, p<0.001; insulin: F=49.3, p<0.001; triglycerides F=9.2, p<0.001. The long-term favorable effects of bariatric surgery on cardiometabolic health may be partly mediated by reductions in postprandial glucose, insulin, and triglyceride levels.

Keywords

Obesity • Type 2 diabetes mellitus • Laparoscopic greater curvature plication • Postprandial triglyceride • Postprandial glucose • Postprandial insulin

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Introduction

Exaggerated and prolonged postprandial hyperglycemia and hypertriglyceridemia observed in type 2 diabetes mellitus (T2D) are associated with oxidative stress and endothelial dysfunction, and represent serious

cardiovascular risk factors [1]. The pathogenesis of postprandial hypertriglyceridemia and its association with cardiovascular disease has recently been discussed by Lambadiari *et al.* (2020) [2]. The favorable effects of bariatric surgery on cardiometabolic risk factors and on cardiovascular morbidity and mortality in patients with obesity have been clearly demonstrated [3,4]. However, only short-term investigations have reported the effects of bariatric surgery on postprandial glucose and triglyceride levels in patients with obesity and T2D. In our previous studies carried out in patients with obesity and T2D, an improvement in both insulin sensitivity and postprandial glucose and triglyceride levels was demonstrated 6 months after bariatric surgery [5,6].

As the long-term effects of bariatric surgery on postprandial glucose and triglyceride levels have not been investigated in detail, in this pilot study we compared postprandial profiles in patients with obesity and T2D at 2 and 10 years after laparoscopic greater curvature plication with those before surgery.

Materials and Methods

Subjects

Our cohort included 10 women with obesity and T2D (before surgery: mean BMI= 42.5±7.8 kg/m²; mean age = 54.4±5 years). Patients underwent laparoscopic greater curvature plication (LGCP) at the OB Clinic in Prague, between 2009 and 2012. Diet and exercise were individually prescribed taking into account comorbidities.

Patients were examined at baseline (before surgery), and then at 1 month, 6 months, 2 years, 4 years, and 10 years after the procedure. To avoid hypoglycemia the dosage of antidiabetics was appropriately reduced after surgery. Oral antidiabetic drugs were discontinued 3 days before meal tests. Subjects treated with incretin mimetics and/or insulin were excluded from this study. Patients were not treated with any drug that could affect blood glucose levels.

During follow-up, dietary and physical activity records were evaluated by obesity specialists and dietitians. Metabolic and nutritional status was regularly monitored in order to prevent vitamin and micronutrient deficiencies, and appropriate supplementations were provided.

The study was approved by the Ethics Committee of the Institute of Endocrinology in Prague. Subjects signed informed consent in accordance with the Declaration of Helsinki.

Meal test

All subjects underwent a standardized liquid mixed-meal test before surgery, and at 2 and 10 years after LGCP (300 ml: 375 kcal; 1, 581 kJ; 30 % (28.2g) protein, 25 % (10.5 g) fat, and 45 % (42 g) carbohydrate) with blood withdrawal 15 and 10 minutes before the test initiation, at baseline, and at 15, 30, 45, 60, 90, 120, 150 and 180 minutes after the meal ingestion. The meal test protocol has been described in detail elsewhere [5].

Anthropometric Characteristics

Anthropometric parameters were examined at all 6-time points. Height was measured by a stadiometer, and the body mass index (BMI) was calculated. In addition, DEXA scanning (GE LUNAR iDXA, GE Healthcare Technology, USA) was used to assess body composition before surgery and 2, 4, and 10 years after the operation. The percentages of body weight, BMI and fat mass loss were determined.

Biochemical Characteristics

Plasma glucose, insulin, and triglyceride levels were analyzed by standard laboratory procedures using Integra 400+, Modular E170, and Cobas 6000 instrumentation (Roche Diagnostics GmbH, Mannheim, Germany).

Statistical Analysis

Differences in mean postprandial levels of glucose, insulin, and triglyceride were evaluated by ANOVA (Statgraphics Centurion 18 from Stat graphics Technologies (The Plains, Maryland, USA)). Values are presented as means with their 95 % confidence intervals. The ANOVA testing was followed by Bonferroni multiple comparisons.

Results

As shown in Table 1 there was a significant decline in determined anthropometric parameters 2 and 10 years after LGCP in comparison with baseline values.

Each meal test was performed three days after the discontinuation of antidiabetic drugs. Mean plasma glucose, insulin, and triglyceride levels were determined during a standardized liquid mixed-meal test. They significantly decreased 2 years after LGCP and then moderately increased after 10 years, but the measured mean levels of plasma glucose, insulin, and triglycerides still remained significantly lower than the pre-treatment levels (Fig. 1).

Discussion

Postprandial hyperglycemia and hypertriglyceridemia in T2D are associated with serious cardiometabolic risk [1]. Multiple genetic and lifestyle factors, including diseases such as obesity and T2D, may influence postprandial hypertriglyceridemia [7]. On the other hand, changes in triglyceride levels can predict the

Table 1. Anthropometric parameters at baseline and at 2 and 10 years after surgery.

	Baseline			2 years follow-up			10 years follow-up		
	Weight (kg)	BMI (kg/m ²)	Fat mass (% DEXA)	Weight (kg)	BMI (kg/m ²)	Fat mass (% DEXA)	Weight (kg)	BMI (kg/m ²)	Fat mass (% DEXA)
	120.1±13.1	42.45±4.78	57.9±7.3	97.4±5.9*	34.80±2.17*	44.9±4.5*	95.7±8.9*	33.83±2.98*	46.0±3.3*

Values are presented as means±SD. *P-value <0.05 was considered significant – after 2 years or after 10 years compared to baseline.

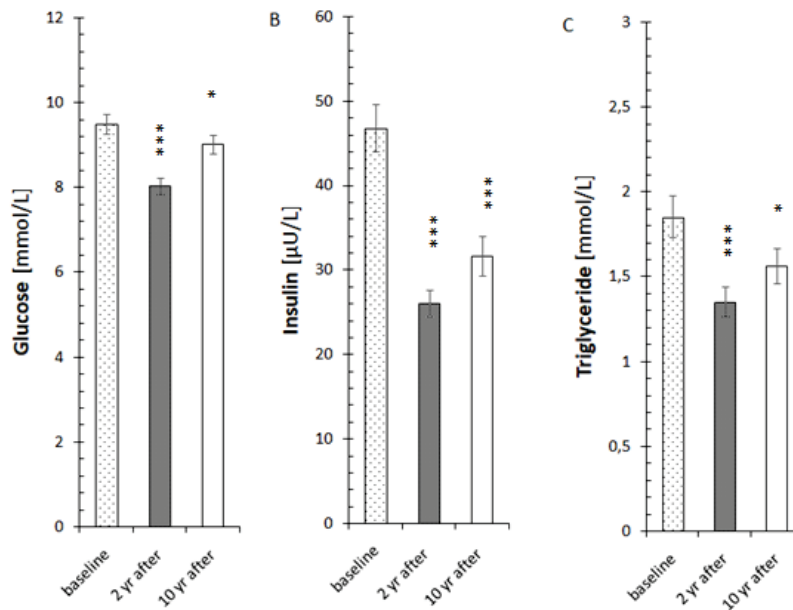


Fig. 1. Mean postprandial levels in response to a standardized liquid mixed-meal test before surgery, and then 2 years and 10 years after LGCP. **A)** Mean plasma glucose levels: $F=34.5$, $p<0.001$. **B)** Mean plasma insulin levels: $F=49.3$, $p<0.001$. **C)** Mean plasma triglyceride levels: $F=11.4$, $p<0.001$. Values are presented as means with 95% confidence intervals shown. Levels of significance compared to baseline: * 0.05, ** 0.01, *** 0.001.

development of T2D [8]. Trico *et al.* recently demonstrated that mild acute hypertriglyceridemia impaired oral glucose tolerance and whole-body insulin sensitivity [9]. Large studies have demonstrated associations between bariatric/metabolic surgery and improvements in cardiometabolic health risks in patients with obesity and T2D [3, 4]. The pathophysiology of long-term weight loss and T2D remission after bariatric surgery has been reviewed [10]. However, only short-term investigations have reported on the effect of bariatric surgery on postprandial responses in plasma glucose and triglyceride levels. We had previously conducted two studies on this topic. Bradnova *et al.* (2014) described statistically significant weight loss and improvements in metabolic parameters in women with T2D at 6 months after surgery [5]. Vrbikova *et al.* (2016) compared the same cohort 1 and 6 months after surgery, and found significant improvements in insulin sensitivity in women with T2D after both biliopancreatic diversion and LGCP [6]. In the current study, we assessed changes in anthropometric parameters and postprandial profiles of glucose, insulin and triglycerides in women with obesity and T2D 2 and 10 years after LGCP. A recent review on LGCP has emphasized that this procedure is less invasive and less expensive than other surgical bariatric procedures [11]. The favorable metabolic effects of LGCP and laparoscopic sleeve gastrectomy are comparable; however, most existing comparative studies report a superiority of laparoscopic sleeve gastrectomy regarding weight loss [11]. In our patients, who underwent LGCP, mean postprandial plasma glucose levels had decreased 2 years after the surgery, while

10 years after the procedure there was a moderate increase; however the levels still remained significantly lower than baseline values ($F=34.5$, $p<0.001$). Similar declines were demonstrated in mean insulin ($F=49.3$, $p<0.001$) and triglyceride ($F=11.4$, $p<0.001$) levels. Padilla *et al.* (2014) studied the mechanisms involved in lipoprotein metabolism after bariatric surgery in patients with obesity and explained the improvements in triglyceride metabolism 6 months after sleeve gastrectomy by both a decrease in triglyceride production rate and an increase in triglyceride catabolism [12]. Moderate increases in postprandial glucose and triglyceride observed 10 years after surgery may also be partly influenced by aging [13].

Limitations of our study include the small sample size and the lack of a control group treated with lifestyle modification and antidiabetic drugs. On the other hand, a particular strength of our study is the evaluation of postprandial glucose, insulin, and triglyceride level as well as body composition during the long-term follow-up after bariatric surgery.

Conclusions

We found that after LGCP, mean postprandial levels of plasma glucose, insulin, and triglyceride significantly decrease 2 years after surgery, and while they slightly increased after 10 years, however the levels still remained significantly lower than before surgery. Long-term improvement in mean postprandial levels may contribute to the reduction of cardiometabolic health risks following bariatric surgery.

Conflict of Interest

There is no conflict of interest.

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Abbreviations

BMI, Body Mass Index; LGCP, Laparoscopic greater curvature plication; T2D, Type 2 diabetes mellitus

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