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Original article

# Should metabolic surgery be offered in morbidly obese patients with type I diabetes?

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## Abstract

**Background:** Bariatric surgery has recently been endorsed as an effective treatment of type 2 diabetes (T2D) in severely obese patients. Little is known about its metabolic effects in type 1 diabetes (T1D). The objectives were to assess bariatric surgery outcomes in T1D obese patients who underwent either a biliopancreatic diversion (BPD) or a sleeve gastrectomy (SG) and who were matched with T2D obese patients requiring insulin therapy. The study setting was at a university-affiliated tertiary care center.

**Methods:** Through retrospective analysis of prospectively collected data, ten patients with T1D (7 BPD, 3 SG) were matched with 20 patients with T2D (14 BPD, 6 SG) according to age, gender, type of surgery, initial Body Mass Index and insulin requirements (1:2 matching). Weight loss, diabetes control, and remission of co-morbidities were compared.

**Results:** Mean follow-up was 55.1 months. Mean Excess BMI Loss% tended to be greater in T1D patients compared to T2D (77.1% versus 68.3%,  $P = .14$ ). The remission and improvement rates of T2D were 55% and 45% versus 0% and 90% for T1D. The remission rate of T2D was significantly greater after BPD (71.43%) compared to SG (16.67%,  $P = .04$ ). Insulin requirements were significantly reduced in both groups after surgery (T1D:  $.44 \pm .24$  versus  $1.09 \pm .7$  units/kg/d,  $P = 0.03$ , T2D:  $.03 \pm .12$  versus  $.89 \pm .77$  units/kg/d,  $P = .0001$ ). Remission rates of hypertension and dyslipidemia were similar for T1D and T2D (66.7% versus 62.5%,  $P = .63$  and 88.9% versus 75%,  $P = .23$ ).

**Conclusions:** Even if metabolic surgery has limited effect on glycemic control in T1D, it improves insulin sensitivity and other co-morbidities. It should be considered as a therapeutic option in selected obese patients with metabolic syndrome and high cardio-vascular risk. (*Surg Obes Relat Dis* 2015;■:00–00.) © 2015 American Society for Metabolic and Bariatric Surgery. All rights reserved.

## Keywords:

Type 1 diabetes; Obesity; Metabolic surgery; Glycemic control; Insulin requirements; Weight loss; Biliopancreatic diversion; Sleeve gastrectomy

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Bariatric surgery has recently been endorsed as an effective treatment for type 2 diabetes (T2D) in severely obese patients, first by the American Diabetes Association [1] and then by the International Diabetes Federation [2]. Indeed, literature data reported a T2D remission rate of

74.6%, reaching 95.9% after biliopancreatic diversion [3]. In 2013, 2 randomized clinical trials demonstrated that bariatric surgery was more effective than medical therapy alone to achieve T2D remission [4,5], data that were recently confirmed at 3 years of follow-up [6]. Several mechanisms have been involved to explain diabetes remission including weight loss, gut hormone changes, modifications in gut microbiota, and bile acids metabolism [7–9].

The prevalence of obesity is now growing in type 1 diabetes population, making it more difficult to achieve good glycemic control [10]. The increase of insulin requirement results in further weight gain and the occurrence of comorbidities, leading to a higher cardiovascular risk. Therefore, the management of these patients not only requires a lowering of glycemia but also metabolic syndrome control, leading to change in the therapeutic strategies. The option of bariatric surgery has rarely been considered and data are remarkably scarce.

The aim of this study was to assess bariatric surgery outcomes in T1D obese patients. From a series of ten T1D patients who underwent either a biliopancreatic diversion with duodenal switch (BPD/DS) or a sleeve gastrectomy (SG), and matched with 20 T2D obese patients requiring insulin, we sought to analyze the impact of the type of diabetes and the type of surgical procedure on weight loss results, diabetes control and remission of co-morbidities.

## Methods

### Population and study design

From 2004 to May 2013, 3365 obese patients underwent a bariatric procedure in the department of bariatric surgery of the Quebec Heart and Lung Institute, Canada: 2662 BPD, 703 SG. We selected T1D patients (n = 10) from our prospective electronic database dedicated to bariatric surgery.

The diagnosis of T1D was made by endocrinologists, either by the presence of autoantibodies against glutamic

acid decarboxylase (GAD) (n = 2) or, when diabetes was diagnosed in adolescence, by an array of clinical symptoms suggestive of T1D (ketoacidosis as initial presentation, n = 2), a family history of T1D and abnormal glucose level that required immediate treatment with insulin. The median age at diagnosis was 13.8 years (SD = 11.4). It is worth noting that among the patients with autoantibodies, one woman had a late diagnosis of diabetes, at 39 years old. She was on high dose of insulin from the beginning of the disease (390 units of insulin per day) and was diagnosed as latent autoimmune diabetes in adults.

American Diabetes Criteria were used to define type 2 diabetes: HbA1c  $\geq 6.5\%$ , fasting plasma glucose  $\geq 126$  mg/dL, 2 hours plasma glucose  $> 200$  mg/dL during an OGTT, classic symptoms of hyperglycemia or hyperglycemic crisis, random plasma glucose  $\geq 200$  mg/dL [11]. These patients had relative insulin deficiency and were on both oral antidiabetic drugs (mean of 1.6 antidiabetic drugs, range 1–3) and high dose of insulin (mean of 124.9 units per day  $\pm 106.1$ ). Mean duration of the disease was  $7.3 \pm 3.6$  years.

Each of the 10 immune-mediated diabetes patients were matched with 2 obese T2D patients on insulin (n = 20), according to age, gender, type of surgery, initial body mass index (BMI) and insulin requirements (1:2 matching). The aim of our study was to compare bariatric surgery outcomes in both types of diabetes, not only regarding diabetes control but also in terms of weight loss outcomes and evolution of other co-morbidities (obstructive sleep apnea syndrome, arterial hypertension, dyslipidemia). Baseline characteristics of the study groups are shown in Table 1.

### Surgical Techniques

**Laparoscopic Sleeve Gastrectomy.** A 5-port technique was used. A long and narrow gastric tube calibrated with a 34French bougie was performed using a linear stapler and began at 5 cm from the pylorus up to the angle of His.

Table 1  
Baseline characteristics of the study groups (1:2 matching)

	Type 1 Diabetes n = 10	Type 2 Diabetes n = 20	P
BPD ratio*	7/10	14/20	1
Mean Age at surgery (years)†	39.2 $\pm$ 5.3	40.9 $\pm$ 4.2	.34
Female ratio*	8/10	16/20	1
Mean initial BMI (kg/m <sup>2</sup> )†	46.9 $\pm$ 6.3	49.4 $\pm$ 5.5	.28
Mean Preoperative Insulin units‡	141.4 $\pm$ 94.2	124.9 $\pm$ 106.1	.38
Preoperative HbA1c (%)‡	7.5 $\pm$ 1.9	8.1 $\pm$ 0.8	.73
Preoperative fasting plasma glucose (mmol/l)†	10.5 $\pm$ 3.4	8.7 $\pm$ 3.1	.17
Mean age at diagnosis (years)†	13.8 $\pm$ 11.4	33.6 $\pm$ 6.6	<.0001
Mean duration of diabetes (years)‡	23.1 $\pm$ 11.8	7.3 $\pm$ 3.6	.0009

Abbreviation: BMI = Body mass index.

Data are expressed as mean  $\pm$  SD where applicable.

\*Chi-square analysis.

†Student's t test.

‡Wilcoxon test.

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