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BRIEF REPORT

Failed Surgical Weight Loss Does Not Necessarily Mean Failed Metabolic Effects

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Abstract

The metabolic profile of patients after a failed surgical weight loss procedure is unknown. Long-term clinical outcomes of 31 obese diabetes patients with post–bariatric surgery excess weight loss of ≤25% were assessed. At a median follow-up of 6 years (range, 5–9 years) after surgery, remission and clinical improvement of diabetes occurred in seven (23%) and 13 (42%) patients, respectively. A long-term mean total weight loss of 7.0 ± 4.7% and excess weight loss of 13.7 ± 8.5% were associated with a mean reduction in fasting blood glucose level, from 158.9 ± 66.7 to 128.4 ± 35.3 mg/dL ($P = 0.03$), and a significant decrease in diabetes medication requirements ($P < 0.001$). A significant decrease in systolic blood pressure (11.1 ± 23.4 mm Hg, $P = 0.01$) and level of circulating triglycerides (35.7 ± 73.4 mg/dL, $P = 0.04$) was also observed after surgery. A modest surgical weight loss in the range of 5–10% of initial weight was associated with significant improvement in cardiometabolic risk factors of morbidly obese diabetes patients. The markedly improved glycemic control (65% remission or clinical improvement) may be partly explained by weight-independent antidiabetes mechanisms of certain bariatric surgical procedures.

In addition to achieving durable weight loss, bariatric surgery ameliorates diabetes,[1] dyslipidemia,[2] and hypertension in a substantial number of morbidly obese patients.[3,4] Mechanisms underlying the beneficial cardiometabolic effects of bariatric surgery are still under investigation.

There is a growing body of literature about patients undergoing reoperative bariatric surgery.[5] Apart from complications related to the adjustable gastric band, inadequate weight loss constitutes the single most common reason for reoperative bariatric surgery in most of these studies.[6] The preoperative incidence of diabetes in patients undergoing reoperative bariatric surgery is around 12–14%.[7,8] This is lower than the >70% preoperative prevalence of diabetes and prediabetes in patients presenting for bariatric surgery.[9] Thus, there is indirect evidence to suggest that failure of bariatric surgery, most commonly due to failure to lose weight, or weight regain does not universally lead to recurrence of metabolic problems.

Although indirect conclusions regarding resolution of metabolic syndrome can be drawn based on the literature, we are not aware of any research that has evaluated the status of cardiometabolic risk factors in patients who, in the long term, failed to maintain weight loss after primary bariatric surgery. The goal of this study was to examine the metabolic profile of a cohort of morbidly obese diabetes patients who experienced poor weight loss after bariatric surgery.

The Institutional Review Board approved this retrospective study. The study cohort included 31 morbidly obese patients with type 2 diabetes who underwent bariatric surgery in a 4-year period (2004–2007) at the Bariatric and Metabolic Institute of the Cleveland Clinic (Cleveland, OH) and met the criteria of failed surgical weight loss. A failed bariatric surgery was defined as a procedure with ≤25% excess weight loss (EWL) at ≥5 years. Long-term (≥5 years) metabolic parameters and clinical outcomes including glycemic control, blood pressure, and lipid status were assessed.

Remission of diabetes (partial or complete) was defined as a glycated hemoglobin (A1C) level of <6.5% and fasting blood glucose level of <126 mg/dL when off antidiabetes medications. Clinical improvement of diabetes was defined as significant reduction in A1C (by >1%), fasting blood glucose (by >25 mg/dL), or diabetes medication requirement (by discontinuation of insulin or one oral agent) at long term.[1]

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Treatment goals were defined based on the American Diabetes Association criteria for control of diabetes (A1C <7%), blood pressure (<130/80 mm Hg), and cholesterol (low-density lipoprotein <100 mg/dL). Percentage EWL was calculated as ([operative weight – follow-up weight]/[operative weight – ideal weight]) × 100. Ideal weight was based on a body mass index of 25 kg/m^2. Percentage total weight loss was defined as ([operative weight – follow-up weight]/operative weight) × 100.

Normally distributed continuous variables, variables with non-normal distribution, and categorical variables were reported as mean ± SD, median (interquartile range), and frequencies (%), respectively. A paired *t* test and Wilcoxon signed-rank test were used to calculate the differences between the last follow-up point and baseline at the time of surgery. Two dependent proportions were compared with the *Z* test. All analyses were performed using SPSS version 17.0 software (SPSS, Inc., Chicago, IL).

At baseline, patients had a male to female ratio of 9:22, a mean age of 51.4 ± 11.9 years (range, 33–71 years), a mean body mass index of 51.9 ± 8.2 kg/m^2 (range, 37–71 kg/m^2), and a mean duration of diabetes of 8.4 ± 6.9 years (range, 1–30 years). Laparoscopic bariatric procedures included adjustable gastric banding ($n = 15$, 48%), Roux-en-Y gastric bypass ($n = 13$, 42%), and sleeve gastrectomy ($n = 3$, 10%).

At a median follow-up of 6 years (range, 5–9 years) after surgery, remission and clinical improvement of diabetes occurred in 7 (23%) and 13 (42%) patients, respectively. A long-term mean total weight loss of 7.0 ± 4.7% and EWL of 13.7 ± 8.5% were associated with a mean reduction in fasting blood glucose level from 158.9 ± 66.7 to 128.4 ± 35.3 mg/dL ($P = 0.03$) and a significant decrease in diabetes medication requirements ($P < 0.001$). The observed reduction in A1C (0.4 ± 1.9%) was not statistically significant (Table 1).

In addition, a significant decrease in systolic blood pressure (11.1 ± 23.4 mm Hg, $P = 0.01$) and triglyceride levels (35.7 ± 73.4 mg/dL, $P = 0.04$) was observed after surgery. However, the observed favorable postoperative changes in diastolic blood pressure, low-density lipoprotein, and high-density lipoprotein did not reach a level of statistical significance, probably because of the relatively small sample size (Table 1).

The proportions of patients meeting the American Diabetes Association targets of blood pressure and low-density lipoprotein at long term were 58% and 68%, respectively. These data were statistically significant when compared with preoperative rates. However, A1C levels at baseline and at the last follow-up were within the recommended range in 48% and 61% of patients, respectively, which was not statistically significant (Table 1).

In this study of patients with long-term EWL ≤ 25% after bariatric surgery, we found significant and enduring clinical improvement in multiple cardiometabolic parameters, including diabetes, hypertension, and hyperlipidemia, compared with presurgical values. Although our cohort represents patients who did not maintain long-term EWL of greater than 25%, they still had a mean EWL of 13.7 ± 8.5%. The extent to which this modest weight loss contributed to the beneficial effects on blood pressure, triglyceride level, fasting blood glucose level, and number of diabetes medications is unclear. Studies of supervised lifestyle intervention have found that modest weight loss in the range of 5–10% at 1 year following the institution of lifestyle changes was beneficial in terms of reducing cardiovascular risk factors.[10] Even a weight loss of 2–5% was strongly associated with improvement in measures for glycemic control. The Look AHEAD study showed improvement in multiple metabolic parameters, including hypertension and hyperlipidemia, with a modest weight loss.[10,11] To what extent the weight loss in our cohort of patients, which is comparable to studies of lifestyle intervention, contributed to the sustained improvement in their metabolic profile as opposed to the role of neurohormonal pathways cannot be discerned from the present data.

Our study may provide indirect evidence supporting the theory that the mechanism of diabetes resolution post–bariatric surgery is not solely dependent on weight loss, although it is clear that weight loss in turn can lead to improved insulin sensitivity and β-cell function.[12,13] However,

Table 1. Long-Term Metabolic Profile of Patients with Poor Surgical Weight Loss ($N = 31$)

	Baseline	*Long term*	P *value*
Metabolic parameters			
BMI (kg/m^2)	51.9 ± 8.2	48.3 ± 7.6	< 0.001
A1C (%)	7.6 ± 1.7	7.2 ± 1.2	0.312
FBG (mg/dL)	158.9 ± 66.7	128.4 ± 35.3	0.031
LDL cholesterol (mg/dL)	103.4 ± 31.5	93.1 ± 35.7	0.097
HDL cholesterol (mg/dL)	49.5 ± 10.4	52.1 ± 10.7	0.117
Triglycerides (mg/dL)	152.1 ± 80.3	116.4 ± 44.0	0.037
Systolic BP (mm Hg)	135.4 ± 19.2	124.3 ± 13.4	0.014
Diastolic BP (mm Hg)	77.3 ± 10.9	74.1 ± 9.7	0.149
Number of diabetes medications [median (IQR)]	1 (1–2)	1 (0–1)	< 0.001
Without diabetes medications [*n* (%)]	1 (3)	13 (42)	< 0.001
American Diabetes Association goals			
A1C <7% [*n* (%)]	15 (48)	19 (61)	0.307
BP <130/80 mm Hg [*n* (%)]	7 (23)	18 (58)	0.003
LDL <100 mg/dL [*n*/total (%)]	10/25 (40)	17/25 (68)	0.023

Data are mean ± SD values, except where specified otherwise.

A1C, glycated hemoglobin; BMI, body mass index; BP, blood pressure; FBG, fasting blood glucose; HDL, high-density lipoprotein; IQR, interquartile range; LDL, low-density lipoprotein.

there are multiple theories explaining diabetes resolution post–bariatric surgery, including change in gut hormones, gut microbiota, and bile acids.[13–15] Various central nervous system mechanisms are also thought to change after bariatric surgery, possibly playing a role in diabetes resolution.[16] Because these neurohormonal changes are independent of weight loss, they may provide an alternative explanation for the resolution of diabetes in patients who fail to lose weight after bariatric surgery.

Limitations of our study include its retrospective design, the limited sample size, the loss to follow-up rate of 20%, lack of accurate cardiovascular medication data, and the inability to examine the varied influence of restrictive versus metabolic (sleeve, gastric bypass) procedures. However, as far as the authors are aware this is the only study that has examined cardiometabolic outcomes in a cohort of surgical patients with inadequate weight loss. It could be argued that patients who are available for long-term follow-up may be self-selected toward better long-term metabolic outcomes because they have remained engaged with their medical team. How this influences the generalizability of our results is not clear.

In conclusion, the results of our study indicate that long-term improvements in multiple metabolic diseases associated with obesity may occur independent of significant weight loss (mean total weight loss of 7%) after bariatric surgery. The mechanism is unclear, but weight-independent physiologic changes following bariatric surgery could contribute to sustained cardiometabolic benefits. Future research focusing on the neurohormonal profile of these patients may help define the underlying mechanisms of sustained improvement in metabolic profile in these patients despite modest weight loss.

Author Disclosure Statement

No competing financial interests exist.

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