Remission Rates and Achieving Control of Diabetes Following Longitudinal Sleeve Gastrectomy

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Introduction

The prevalence of obesity in the United States has increased from 30.5% in 1999-2000 to 42.4% in 2017-2018. Obesity is associated with many comorbidities, one of them being type 2 diabetes mellitus (T2DM). T2DM places a large financial burden on the US medical system and is associated with many health complications in afflicted patients. It is widely accepted that bariatric surgery has ameliorative effects on T2DM and thus has become an accepted intervention in obese diabetic patients. It has been found to not only contribute to significant weight loss, but also has been found to be better at treating TDDM than medical management alone. Historically, Roux en Y gastric bypass (RYGB) was the most common bariatric operation and allowed a majority of severely obese diabetic individuals to achieve adequate glycemic control without the need for any medication. Studies have demonstrated weight loss dependent and weight loss independent mechanisms for improvement in T2DM following RYGB.

Over the last decade, longitudinal sleeve gastrectomy (LSG) has become the most commonly performed bariatric operation. Its efficacy is not as well studied as RYGB. The transition to LSG can be attributed to ease of performing the procedure, lower long term complication rate, and decreased requirement for vitamin supplementation post-operatively. From studies thus far, LSG does appear to lead to a lower average weight loss, as well as a lower remission rate for T2DM. A study of patients treated at our institution between 2011 and 2015 found T2DM remission rate of 66% following LSG, compared to 83% following RYGB patients (p=0.02). Our aim was to repeat this study to see if remission rates remained consistent, and to identify modifiable factors predictive of T2DM remissions.

Materials and Methods

Table 1: Demographics		LSG (91)
Age (years)		49.9 ± 11.4
% male		24.2%
Weight (lbs)		267.4 ± 59.8
BMI (kg/m2)		44.66 ± 7.8
Hgb-A1c at surgery		6.6± 0.7
DM meds (%)	Insulin	20.9
	GLP1	22
	SGL2	8.8
	Metformin	89
	Sulfonylureas	15.4
	TZDs	0
Number of diabetic medications		1.48 ± 0.8
DIAREM Score		6.3 ± 5.2

Table 1. Demographics of all LSG patients between October 1st 2017 and June 1st, 2020 who had 1- year follow-up data available

This was a retrospective cohort study that included all diabetic patients undergoing bariatric surgery at an academic medical center from October 1, 2017 to June 1st , 2020. Patients were allowed to select between LSG and RYGB after counseling of risks and benefits. Patient's with follow up data at least 1 year post-operatively were included in our analyses.

All patients were evaluated at our multidisciplinary bariatric surgery clinic. This included individual meetings with specialists in nutrition, behavioral medicine, and exercise. All patients attended pre-surgical skills groups in preparation for their surgery. Finally, all subjects received individual counseling from their surgeons. All patients were expected to have adequate glycemic control (HbA1c <7.5%) prior to operative intervention.

Patients were followed at 6 week, 6 month, 1 year, 2 year, and 3 years postoperatively. The primary endpoint for this study was T2DM remission, defined as off of diabetic medications with Hgb-A1c < 6.5%. Preoperative variables studied included age, gender, initial BMI, initial EBW, initial Hgb-A1c, change in BMI preoperatively, change in Hgb-A1c preoperatively, DIAREM score, and type of diabetic medications used. Postoperative factors studies included BMI, % excess body weight loss.

Data was compiled using Microsoft Excel in a database that was confined to the University of Massachusetts Medical Center Intranet for patient confidentiality without patient identifiers. DIAREM scores were calculated for each patient. Statistical analysis were performed using SAS. Continuous data was analyzed using Student T tests and discrete data was analyzed using Fisher's Exact Test.

Results

Table 2: LSG Remitters Vs Nonremitters		Remitters (61)	Nonremitters (30)	p-value
% male		21	30	0.4369
Pre-operative				
Weight loss during program (lbs)		8.34 ± 12.51	10.2 ± 18.8	0.5759
Weight at start of program (lbs)		262.6 ± 65.9	261.1 ± 45.1	0.9109
BMI at time of surgery (kg/m2)		45.1 ± 8.5	43.8 ± 6.7	0.4658
Delta BMI while in program (kg/m2)		0.94 +2.35	1.6 + 2.9	0.2475
Hgb-A1c at time of surgery		6.4 ± 0.7	6.9 ± 0.5	**0.0007**
Delta Hgb-A1c during program		0.02 + 2.32	0.0 + 2.1	0.9683
DM meds (%)				
	Insulin	6.6	50	< 0.00001
	GLP1	18	30	0.281
	SGL2	3.3	20	**0.0143**
	Metformin	90	90	1
	Sulfonylureas	11.5	23.3	0.2417
	TZDs	0	0	1
Number of diabetic medications		1.2 ± 0.56	2.0 ± 0.9	**<0.0001**
DIAREM Score		4.35 ± 3.7	10.1 ± 5.6	**<0.0001**
Post-operative				
Weight loss at 1-year (lbs)		69.3 + 62.7	60.3 + 45.7	0.4862
Delta BMI at 1 year (kg/m2)		9.2 + 5.6	8.7 + 3.9	0.6618
Hgb-A1c at 1 year		5.65 + 0.41	6.4 + 0.7	**<0.0001**
Number of diabetic meds		0	1.2 ± 0.7	

Table 2. Comparison of pre-operative and post-operative metrics between the remission and non-remission groups.

Table 3. Nonremitters Medications		Pre-op	Post-op at 1 year	P-value
DM Meds (%)				
	Insulin	50	20	**0.0292**
	GLP1	30	3.3	**0.0122**
	SGL2	10	6.6	1
	Metformin	90	83.3	0.7065
	Sulfonylureas	23.3	6.6	0.1455
	TZDs	0	0	1
Number of diabetic medications		2.0 ± 0.9	1.2 ± 0.7	**0.0005**
HgbA1c		6.9 ± 0.5	6.4 ± 0.7	**.002337**

Table 3. Comparison of diabetic medications pre and post-operatively for the non- remission group

Only 17 out of 192 patients underwent RYGB. This likely indicates a strong selection bias towards LSG.

Remission rate of T2DM at one year following LSG was 65.9%. Individuals who achieved T2DM remission were less likely to use insulin, less likely to use SGL2 inhibitors, used a lower number of total diabetic medications, and had a better Hgb-A1c preoperatively. The Diarem score was significantly lower in the remission group. Factors such as preoperative change in BMI and preoperative change in Hgb-A1c were not predictive of T2DM remission.

Postoperatively, there is no difference in weight loss, BMI, or % excess body weight lost between non remitters and remitters.

Patients who do not remit manifested reduced number of diabetic medications, reduced use of insulin, reduced use of Glp-1 analogs and improved Hgb-A1c at one year postoperatively as compared to their preoperative levels.

Discussion

Use of insulin, use of SGL2 inhibitors, total diabetic medications used, DIAREM score, and preoperative Hgb-A1c, are associated with T2DM remission following LSG. The DIAREM score, a measure incorporating age, use of insulin, use of sulfonylureas, and Hgb-A1c, is predictive of remission as well. Preoperative improvement in Hgb-A1c, preoperative weight loss, and postoperative weight loss are not associated with T2DM remission. We infer that factors predictive of remission have to do more with progression of T2DM as a disease, and less with weight loss or adoption of healthy habits pre-or post-operatively. This data may allow clinicians and patients to better understand likelihood of remission following LSG.

The group of patient that did not achieve T2DM remission still manifested substantial metabolic benefits. This included including withdrawal of insulin and improved glycemic control. It is likely that this group can still expect a reduction in morbidity and mortality associated with T2DM.

Finally, we identify a selection bias against RYGB at our institution. In the period between 2011 and 2015, patients with severe obesity and T2DM underwent RYGB or LSG in a 1:1 ratio. In the time frame from 2017 to 2020, the ratio has increased to 10:1 in favor of LSG.