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Results of conversion of gastric banding to gastric bypass in patients between 50 and 60 years of age are similar to those observed in younger patients

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ABSTRACT

Background: The effect of age and gender on outcomes of revisional bariatric surgery has not been assessed.
Methods: A retrospective analysis of patients undergoing revision from laparoscopic adjustable gastric banding (LAGB) to laparoscopic roux en Y gastric bypass (LRYGB) between 2007 and 2017 was performed. Patients were divided according to gender and age (<50 and ≥ 50 years), and the outcomes of the subgroups were compared.
Results: During the study period, 161 revisional LRYGBs were performed. Postoperative percentage of total body weight loss was comparable between the subgroups. No significant difference was observed between the groups in the improvement/resolution of comorbidities. Overall early complication rates were comparable, however major postoperative bleeding was more common in older patients (6.7 vs. 0.9%, p = 0.03). More late complications were demonstrated in females when compared to males (14.3 vs. 2.0%, p = 0.02).
Conclusions: Revisional LRYGB after failed LAGB yields acceptable results, regardless of patient gender and age.

Introduction

In an era in which bariatric surgeons are required to provide solutions to the failures of previously-popular bariatric procedures, the topic of revisional bariatric surgery plays an important role. Procedures such as laparoscopic adjustable gastric banding (LAGB), once commonly performed, are associated with failure rates as high as 40–50% and revisional surgery is required in up to 20–40% of patients.[1–5]

The available literature has not provided a definite answer as to which bariatric procedure is the ideal revisional procedure after failed LAGB, and advocates of laparoscopic roux en Y gastric bypass (LRYGB) and laparoscopic sleeve gastrectomy (LSG) have published data supporting each as the revisional operation of choice.[6–9] Our institution advocates the performance of LRYGB after failed LAGB due to several considerations.[10] First, in LRYGB one can avoid passing a staple line through the scarred area of the band-associated fibrous capsule. Second, LRYGB is an anti-reflux procedure and several patients suffer from gastroesophageal reflux disease (GERD) after failed LAGB. Lastly, as opposed to sleeve gastrectomy, LRYGB adds a malabsorptive element of some extent.

The effect of gender and age on the outcomes of bariatric procedures has been evaluated in the past with variable conclusions.[11–19] To the best of our knowledge, however, the effect of these parameters on the results of revisional bariatric procedures has not been evaluated. The objective of this study was to assess the effect of patient age and gender on the outcomes of revisional LRYGB after failed LAGB.

Materials and methods

Our prospectively-collected bariatric surgery database was retrospectively queried to identify patients who underwent revisional LRYGB after failed LAGB between January 1, 2007 and March

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31, 2017. Patients with revisional LRYGB after other bariatric procedures were excluded from the analysis. The study received approval from our institutional ethics review board. Due to the retrospective nature of the investigation, no informed patient consent was required.

The majority of patients underwent revision due to LAGB failure resulting in weight regain or failure of weight loss, and therefore met the criteria for primary bariatric operations proposed by previously-published guidelines.[20–22] Some however were revised due to band-related complications, and a small proportion of these patients were not morbidly obese at the time of the revisional LRYGB. All patients were thoroughly assessed preoperatively at our multidisciplinary bariatric clinic. The majority of patients underwent one-stage band removal and LRYGB. Reasons for a two-stage revision included acute band slippage, band erosion, surgeon impression of inflamed/distorted gastric tissue that would compromise staple lines, and patient preference. Operative technique included the construction of a 25–35 mL gastric pouch by dividing the stomach 2–3 cm distal and 0.5–1 cm lateral to the band-related fibrous capsule. Alimentary limbs of 150 cm and biliopancreatic limbs of 100 cm were considered standard. A 45 mm linear stapler was used to form the gastrojejunal anastomosis, with a hand-sewn common enterotomy. The jejunojejunal anastomosis was formed using a 60 mm stapler, with stapling of the common enterotomy. Two drains were placed at the end of the procedure, one beside each anastomosis. All patients followed a standardized postoperative protocol, including a gastrografin upper gastrointestinal swallow on the first day after surgery, gradual initiation of diet, discharge on day 3, and clinic follow-up on day 10. Patients were recommended to follow-up at the bariatric clinic 1 month, 6 months, 12 months and yearly thereafter. The standard of care for our bariatric patients did not change throughout the study period.

Data collected included patient demographic information, including age, gender, preoperative co-morbidities, weight and BMI. Indications for revision were cited, and operative and postoperative data were reviewed.

The revisional LRYGB patients were then sub-grouped by gender (male and female) and age (<50 and ≥ 50 years), and outcomes were compared between the sub-groups. The age cut-off 50 was chosen as the highest possible age that maintained an appropriate number of study subjects in each group, thereby permitting the performance of a sound statistical comparison. The primary outcome of the investigation was postoperative weight loss, as expressed by percentage of total body weight loss (%TBWL) and percentage of excess weight loss (%EWL). The baseline weight was considered the weight before the primary bariatric surgery (LAGB insertion). Secondary outcomes included improvement or resolution of comorbidities and complication rates (early and late, defined as within and after a month from surgery, respectively).

Statistical analysis was performed using statistical software (SPSS version 20.0). For comparison between the study groups univariate analysis with *t*-test and chi-square was utilized, and a *p*-value of <0.05 was considered significant.

Results

During the study period, 402 LRYGB operations were performed at our institution, of which 161 (40.0%) were revisional procedures after failed LAGB. The mean age of the revisional patients was 43.1 ± 9.8 (range 18–69) years and 69.1% were females. Their pre-LAGB BMI was 44.0 ± 8.8 kg/m2. Their BMI prior to revisional LRYGB was 42.5 ± 5.9 kg/m^2 and 58.4% had obesity-associated comorbidities. The majority of the patients (75.2%) underwent simultaneous band removal and LRYGB. After a mean follow-up period of 25.6 ± 21.1 months their mean BMI was 32.4 ± 5.3, with an overall %TBWL of 23.7% and EWL of 62.9%. Thirty-nine out of 161 patients (24.2%) were lost to follow-up of >6 months.

The patients were subdivided according to gender and age. Table 1 demonstrates baseline data prior to the performance of gastric bypass. No substantial preoperative differences were demonstrated between females and males. However, patients within the older age group were found to have more obesity-associated co-morbidities than their younger counterparts (88.9 vs. 45.6%, respectively, p < 0.001). Obstructive sleep apnea was more common in males when compared to females (24.5 vs. 2.7%, respectively. P < 0.001). In addition, a larger proportion of patients ≥50 years of age underwent revision due to GERD (24.4 vs.11.2%, respectively, p = 0.03), possibly due to the higher prevalence of a hiatal hernia in this group (11.1 vs. 1.7%, respectively, p = 0.02).

Table 2 summarizes postoperative weight loss and improvement of co-morbidities in the four patient subgroups. It can be noted that the %TBWL and %EWL were similar between the various groups of patients; however, a trend towards superior weight loss can be noticed in females over males (65.4 vs. 56.4% EWL,

Table 1
Baseline preoperative data.

	Gender Subgroups			Age Subgroups		
	Females (N = 112)	Males (N = 49)	P-value	Age <50 (N = 116)	Age ≥50 (N = 45)	P-value
Mean age (years)	43.0 ± 9.9	43.4 ± 9.9	0.98	38.5 ± 7.0	55.2 ± 4.5	<0.001
Pre-LAGB weight (kg)	115.3 ± 17.0	134.8 ± 20.9	<0.001	122.2 ± 20.6	118.8 ± 19.9	0.30
Pre-LAGB BMI	43.2 ± 5.3	43.9 ± 5.7	0.42	43.9 ± 9.0	44.3 ± 8.5	0.79
Pre-LRYGB weight (kg)	112.1 ± 18.1	133.5 ± 23.7	<0.001	119.3 ± 21.8	116.8 ± 23.5	0.64
Pre-LRYGB BMI (kg/m^2)	42.0 ± 5.4	43.5 ± 6.8	0.33	42.3 ± 5.7	43.0 ± 6.5	0.50
Presence of co-morbidities	57.1%	61.2%	0.63	45.6%	88.9%	<0.001
DM	25.9%	26.5%	0.93	19.8%	42.2%	0.003
HTN	27.7%	26.5%	0.88	14.7%	60.0%	<0.001
Hyperlipidemia/Hypercholesterolemia	22.3%	32.7%	0.17	17.2%	46.7%	<0.001
OSA	2.7%	24.5%	<0.001	6.0%	11.1%	0.27
Reason for Revision						
Lack of weight loss or weight regain	66.1%	73.3%	0.88	68.1%	66.7%	0.86
Vomiting	32.1%	32.7%	0.95	33.6%	28.9%	0.57
Slippage	12.5%	12.2%	0.96	13.8%	8.9%	0.40
GERD	11.6%	20.4%	0.14	11.2%	24.4%	0.03
Band leak	5.4%	2.0%	0.35	4.3%	4.4%	0.97
Port infection	4.5%	2.0%	0.46	2.6%	4.4%	0.54
Band erosion	1.8%	0%	0.35	0.9%	2.2%	0.49

LAGB: laparoscopic adjustable gastric banding, BMI: body mass index, LRYGB: laparoscopic roux-en-Y gastric bypass, DM: diabetes mellitus, HTN: hypertension, OSA: obstructive sleep apnea, GERD: gastroesophageal reflux disease. When relevant, the standard deviation is represented as (±SD).

Table 2
Postoperative weight loss and improvement/resolution of co-morbidities.

	Gender Subgroups			Age Subgroups		
	Females (N = 88)	Males (N = 34)	P-value	Age<50 (N = 86)	Age ≥50 (N = 36)	P-value
Mean post-operative weight (kg)	86.2 ± 17.2	100.5 ± 18.7	<0.001	89.7 ± 19.2	91.7 ± 17.7	0.58
Mean post-operative BMI (kg/m^2)	32.1 ± 5.5	33.1 ± 4.9	0.30	31.8 ± 5.3	33.8 ± 5.3	0.06
Change in BMI (kg/m^2)	11.0 ± 10.3	10.1 ± 4.5	0.60	11.0 ± 5.3	9.9 ± 4.6	0.28
Mean %EWL	65.4 ± 37.2	56.4 ± 24.0	0.18	65.4 ± 36.1	56.6 ± 28.4	0.19
Mean %TBWL	25.1 ± 10.8	23.1 ± 9.5	0.34	25.4 ± 10.9	22.5 ± 9.2	0.15
Overall improvement or resolution of at least one co-morbidity	77.8% (35/45)	68.8% (11/16)	0.48	72.7% (24/33)	78.6% (22/28)	0.60
Improvement or resolution of DM	95.8% (23/24)	87.5% (7/8)	0.42	94.1% (16/17)	93.3% (14/15)	0.93
Improvement or resolution of HTN	33.3% (6/18)	28.6% (2/7)	0.83	33.3% (3/9)	31.3% (5/16)	0.92
Improvement or resolution of hyperlipidemia/hypercholesterolemia	50.0% (9/18)	30.0% (3/10)	0.32	46.2% (6/13)	40.0% (6/15)	0.75
Mean follow-up (months)	28.1 ± 22.6	18.8 ± 15.1	0.03	25.7 ± 20.9	25.1 ± 21.9	0.90

BMI: body mass index, %EWL: percentage of excess weight loss, %TBWL: percentage of total body weight loss, DM: diabetes mellitus, HTN: hypertension. When relevant, the standard deviation is represented as (±SD). This table only includes patients with follow-up of more than 6 months, which consisted of 78.6% and 69.4% for females and males, respectively (p = 0.21), and 74.1% and 80.0% for patients <50 and ≥ 50 years of age, respectively (p = 0.44).

respectively, p = 0.182) and in younger patients over older patients (65.4 vs. 56.6% EWL, respectively, p = 0.19). Mean follow-up was shorter in male patients (18.8 vs. 28.1 months, respectively, p = 0.03) but was similar between those younger and older than 50 years of age (25.7 vs. 25.1 months, respectively, p = 0.90). It is to be noted that 75.8% of patients had follow-up of >6 months.

Table 3 demonstrates the early complication rates among the subgroups. Although not reaching statistical significance, a slightly higher overall early complication rate was demonstrated in females compared to males (8.9 vs. 4.1%, respectively, p = 0.28), and in those ≥50 years of age compared to those <50 years (13.3 vs. 5.2%, respectively, p = 0.08). The rate of major postoperative bleeding was significantly higher in the older age group (6.7 vs. 0%, respectively, p = 0.03).

In Table 4, postoperative complications occurring more than one month after the procedure are summarized, demonstrating a significantly higher overall complication rate among females (14.3 vs. 2.0%, respectively, p = 0.02). The rate of postoperative gastro-gastric fistula (GGF) was found to be higher in the older age group (4.4 vs. 0%, p = 0.02). It should be noted that re-hospitalizations not accounted for by complications were due to abdominal pain in patients with normal imaging who were admitted for observation. Only one patient, a 56-year-old female, developed significant malnutrition following the revisional LRYGB.

Discussion

The benefits and risks of bariatric surgery have been a topic of great interest over the past few decades.[23–25] However, only a handful of studies have reported categorical results of each gender and different age groups.[11–19,26]

This study demonstrates a slight trend toward inferior weight loss among males (56.4 vs. 65.4% EWL, p = 0.18, when compared to females) and patients ≥50 years of age (56.6 vs. 65.4% EWL, p = 0.19, when compared to patients <50 years). The shorter length of follow-up in males may have partially contributed to this difference. Although older patients had more co-morbidities preoperatively, their resolution was similar between the groups. The overall early complication rate was statistically similar between the sub-groups, but a trend of more complications could be noticed in females and the older group. Patients ≥50 years demonstrated significantly more postoperative major bleeding episodes. Overall, more late complications were seen in females, although no significant difference in major complications (such as small bowel obstruction or GGF) was demonstrated. In general, this investigation presents satisfactory results of revisional LRYGB in all subgroups, and demonstrates the procedure's safety across both genders and various age groups.

Although the literature lacks reports of gender- and age-specific outcomes for revisional LRYGB, publications comparing results in primary LRYGB can be found. These comparisons yield varying results, without a clear outcome advantage in a particular subgroup. Andrade-Silva et al. studied the effects of primary LRYGB on patients of various age groups and both genders.[18] Patients were divided into 5 age groups and further sub-divided by gender, and similar weight loss was demonstrated among the study groups. Van de Laar published a large database study including 8945 patients that underwent LRYGB, and sub-grouped patients according to gender, age (<40 and ≥ 40 years) and BMI.[16] Female patients and the younger age group were shown to have significantly higher postoperative weight loss, while preoperative BMI did not have an

Table 3
Early postoperative complications (within 30 days postoperatively).

	Gender Subgroups			Age Subgroups		
	Females (N = 112)	Males (N = 49)	P-value	Age <50 (N = 116)	Age ≥50 (N = 45)	P-value
Overall early complication rate	8.9%	4.1%	0.28	5.2%	13.3%	0.08
Intra-operative complications	0%	0%	1.0	0%	0%	1.0
Conversion from laparoscopic to open operation	0%	0%	1.0	0%	0%	1.0
Anastomotic leak	0.9%	0%	0.51	0%	2.2%	0.11
Major bleeding	3.6%	0%	0.18	0.9%	6.7%	0.03
PE	0.9%	0%	0.51	0%	2.2%	0.11
Dysphagia	0%	2.0%	0.13	0.9%	0%	0.54
Bowel obstruction (early)	2.7%	2.0%	0.81	2.6%	2.2%	0.89
Re-operation within 1 month	5.4%	2.0%	0.35	4.3%	6.7%	0.54
Emergency room visits	11.6%	8.2%	0.52	12.1%	6.7%	0.32
Re-hospitalizations	9.8%	8.2%	0.74	10.3%	6.7%	0.47

PE: pulmonary embolism.

Table 4
Late postoperative complications (after 30 days postoperatively).

	Gender Subgroups			Age Subgroups		
	Females (N = 112)	Males (N = 49)	P-value	Age<50 (N = 116)	Age ≥50 (N = 45)	P-value
Overall late complication rate	14.3%	2.0%	0.02	11.2%	8.9%	0.67
Small bowel obstruction	1.8%	0%	0.35	0.9%	2.2%	0.49
Gastro-gastric fistula	1.8%	0%	0.35	0%	4.4%	0.02
Marginal ulcer	3.6%	2.0%	0.61	5.2%	0%	0.12
Documented anemia	5.4%	0%	0.10	4.3%	2.2%	0.53
Emergency room visits	23.2%	10.2%	0.055	19.8%	22.2%	0.98
Re-hospitalizations	21.4%	8.2%	0.04	16.4%	17.8%	0.83

effect. Perrone et al.'s investigation of 162 LSG and 142 LRYGB patients demonstrated a similar percentage of excess BMI loss among males and females undergoing LRYGB (82.6 vs. 82.1%, respectively, $p = 0.07$), while slightly higher excess BMI loss in males undergoing LSG when compared to females (79.1 vs. 76.2%, respectively, $p = 0.004$), after 5 years of follow-up.[12] Mizrahi et al.'s publication from our institution compared 52 patients older than 60 years of age undergoing LSG to a matched cohort of 104 primary sleeve patients younger than 50 years, demonstrating decreased weight loss (62 vs. 75% EWL, respectively, $p = 0.001$) and higher postoperative complication rates in the older age group.[11] In contrast to our data, Stroh et al.'s analysis of 10330 LRYGB procedures demonstrated a higher postoperative complication rate in males when compared with females (7.1 vs. 5.3%, respectively, $p < 0.001$) in addition to a higher mortality rate in this group (0.61 vs. 0.18%, respectively, $p = 0.002$).[14] However, upon multivariate analysis, patients' age and BMI were found to have a larger influence on mortality rate than gender. Overall, upon reviewing the available literature, the exact effect of gender and age on the outcome of bariatric procedures is not entirely clear. The understanding of the effect of demographic factors on patient outcome is of extreme importance, and can largely assist in preoperative counseling. Previous investigations have demonstrated differences in general outcomes when comparing primary and revisional LRYGB.[27] Due to the fact that no prior evaluation of the effect of age and gender on the results of revisional LRYGB has been undertaken, the authors believe this current investigation to be of utmost importance. However, further larger investigations are required to clarify this entity and thereby assist in preoperative patient counseling.

Weight loss following revisional bariatric surgery is generally lower than that after primary procedures. This can be noted in our revisional LRYGB patients, with EWL of 65.4%, 56.4%, 65.4%, and 56.6% in females, males, patients <50 years and patients ≥50 years, respectively. Decreased postoperative weight loss after revisional LRYGB has been previously described. Aarts et al. reported a 60% EWL in patients that underwent revision LRYGB after failed LAGB.[27] Similarly, revisional cases in Slegtenhorst et al.'s publication demonstrated an EWL of 48.4%, significantly lower than those undergoing primary LRYGB (71.6%, $p < 0.0001$).[28]

Upon assessing early postoperative complications, this investigation demonstrated significantly more major bleeding episodes in the older patients, when compared to their younger counterparts (6.7 vs. 0.9%, $p = 0.03$). This could possibly be related to more use of anti-platelet and anti-coagulant medications in this age group. Evaluation of late postoperative complications demonstrated a general higher frequency in females when compared to males (14.3 vs. 2.0%, $p = 0.02$). Although the reason behind slightly more bowel obstructions, GGF, and marginal ulcers in the female subgroup is not clear to the authors, the higher frequency of anemia (5.4 vs 0%, $p = 0.1$), likely correlates with its higher frequency in the female general population.

This investigation has its limitations. The relatively limited sizes of the study subgroups seemed to underpower the statistical calculations, and perhaps if a larger cohort was available, obvious trends among the sub-groups (such as lower %EWL among males and older patients) may prove to be statistically significant. Although our patients are recommended to remain under long-term yearly clinical follow-up, the vast majority of our patient population inconsistently presents for follow-up after one year post-operatively. It is possible that a longer, more comprehensive follow-up period may influence our weight loss results. In addition, the retrospective nature of such investigations leads to obvious limitations in data collection and reporting, and therefore larger, prospective trials are necessary.

Conclusion

This study demonstrated acceptable results of revisional LRYGB in both genders and in both younger and older age groups. The overall early complication rate was similar between the subgroups, while the late complication rate was higher in females. It is to be noted that the majority of the older age group (40/45) were between the ages 50 and 60; therefore, it can be concluded that results of revisional LRYGB in this age group are similar to those in their younger counterparts. This investigation of outcomes of revisional LRYGB according to gender and age is the first of its kind in the literature, and larger prospective trials are necessary to validate its results.

Conflicts of interest

The authors declare no conflicts of interest.

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