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A comparison between one- and two-stage revisional gastric bypass

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Abstract

Background The safety of performing a one-stage revision from laparoscopic adjustable gastric banding (LAGB) to laparoscopic Roux-en-Y gastric bypass (LRYGB) has been questioned. The objective of this study was to compare safety and outcomes of one-stage versus two-stage revisional LRYGB performed after failed LAGB.

Methods A retrospective analysis of all patients undergoing revisional LRYGB after failed LAGB between January 2007 and March 2017 was performed. Patients undergoing one- and two-stage revisions were compared. The primary outcome assessed was the early complication rate, while secondary outcomes included late complications, weight loss, and improvement of comorbidities.

Results During the study period, 161 revisional LRYGB's were performed, including 121 one-stage and 40 two-stage procedures. Baseline demographic data, BMI and presence of comorbidities were similar between the groups. In patients undergoing a two-stage procedure, band slippage, port infection, and erosion were more commonly cited as indications for revision. Similar early complication rates were demonstrated between the groups. However, late complications were more common in the two-stage group (20.0% vs. 7.4%, $P=0.03$), including higher rates of gastro-gastric fistula (5.0% vs. 0%, $P=0.01$) and anemia (10.0% vs. 1.1%, $P=0.02$). Three-fourths of the cohort had a follow-up of more than 6 months, and the two groups demonstrated similar weight loss results and improvement/resolution of comorbidities.

Conclusion The performance of one-stage revisional LRYGB after failed LAGB seems to be a safe procedure, with noninferior outcomes when compared to a two-stage revisional procedure. It is a valid option, except in cases of mechanical and infectious band complications.

Keywords Revisional gastric bypass · Gastric banding · LRYGB · One-stage · Two-stage · Conversion

Laparoscopic adjustable gastric banding (LAGB), although once a common bariatric procedure, has lost popularity over the last decade. One recent publication reported that LAGB accounted for only 10% of the 468,609 bariatric procedures performed worldwide in 2013 [1]. This trend can be attributed both to the superior weight loss results provided by other surgical procedures, such as laparoscopic sleeve gastrectomy (LSG) and laparoscopic Roux-en-Y gastric bypass (LRYGB), but also to the high failure rate of LAGB, which reaches 40–50% in some series [2–6]. The necessity for re-operation after LAGB is common, and has been reported to be as high as 60% in one publication [7].

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Due to the high failure rate of LAGB, bariatric surgeons are commonly faced with the challenge to provide suitable revisional options for this patient population. There is controversy in the available literature as to whether LRYGB or LSG is the more appropriate procedure for revision [8–11]. Our institutional policy is to perform LRYGB after failed LAGB, for several reasons. The performance of LRYGB instead of LSG permits the avoidance of passing a staple line through the area of the His angle and gastroesophageal junction (GEJ), which is commonly scarred as a result of the prior band. Unlike LSG, LRYGB can serve as an anti-reflux procedure, and a large proportion of patients with failed LAGB suffer from gastroesophageal reflux disease (GERD). Finally, the performance of LRYGB provides an additional mild malabsorptive element, in contrast to LSG. Previous investigations have demonstrated that revisional LRYGB after failed LAGB is as safe as primary LRYGB [12].

Another dilemma is whether to perform the removal of the band and the LRYGB in a one-stage or two-stage operation. Most of the available literature, including one meta-analysis, supports the safety of performing a one-stage operation; however, there are only a handful of large single-institutional investigations that attempt to answer this question by direct comparison of outcomes and complications of the two options [13–21]. The objective of this current investigation was to compare safety and outcomes of one-stage versus two-stage revisional LRYGB performed at our institution after failed LAGB.

Methods

Our prospectively collected institutional bariatric surgery database was queried to identify all consecutive patients who underwent LRYGB following failure of LAGB between January 1, 2007 and March 31, 2017. The investigation received approval from our institution's ethics review board, and the necessity for informed consent was waived due to the retrospective nature of the study.

All study subjects underwent thorough preoperative evaluation at our multidisciplinary bariatric clinic. Routine preoperative anatomic work-up included the performance of a Gastrografin upper gastrointestinal swallow exam. In addition, selective upper endoscopy was performed in patients with clinical suspicion of esophagitis or GERD. A one-stage revision was offered to the majority of our patients. Reasons for a two-stage procedure included patients presenting with acute band slippage, the pre- or intraoperative finding of band erosion, patient preference, and in cases in which the surgeon had the intraoperative impression that unhealthy tissues would possibly compromise the staple lines. Operative technique consisted of forming a 25–35 mL gastric pouch by passing staple lines 2–3 cm below and 0.5–1 cm lateral to the previous band's fibrous capsule, and when necessary forming a slightly larger pouch than in primary gastric bypass so as not to pass a staple like through scar tissue. Biliopancreatic limbs of 100 cm and alimentary limbs of 150 cm were performed. The gastrojejunal anastomosis was formed using a 45-mm linear stapler and the common enterotomy was hand-sewn. A 60 mm linear staple was utilized to form the jejunojejunal anastomosis, with a stapled common enterotomy. The standardized postoperative protocol included a Gastrografin upper gastrointestinal swallow exam on the first postoperative day, gradual restoration of diet, discharge on the third postoperative day, and follow-up at our bariatric clinic at 10 days, 1, 6 months, and 1 year. A subsequent yearly clinic visit was recommended.

Data were retrospectively collected from our electronic database, and included demographic/preoperative information, indications for revision, and operative and postoperative features. The revisional LRYGB cases were then sub-divided into one-stage and two-stage revisions, and a comparison of outcomes was undertaken between the groups. The primary outcome assessed was the early complication rate, defined as complications occurring within the first 30 days postoperatively. Secondary outcomes included late complications (> 30 days postoperatively), weight loss (as expressed by percentage of excess weight loss [%EWL]), and improvement or resolution of comorbidities.

Statistical software (SPSS version 20.0) was utilized to perform statistical analysis. Univariate analysis with *t* test and χ^2, as appropriate, was used for comparison between the study groups, and a *P* value of < 0.05 was considered significant.

Results

Between January 1, 2007 and March 31, 2017, 161 revisional LRYGB procedures after failed LAGB were performed at our institution. Patients' mean age was 43.1 ± 9.8 (range 18–69) years and the majority (69.1%) were females. The patients had a mean preoperative BMI of 42.5 ± 5.9 and 58.4% suffered from obesity-related comorbidities. The patients achieved a %EWL of 59.0% after a mean follow-up period of 22.4 ± 18.4 months. These patients were divided into one-stage ($N = 121$) and two-stage ($N = 40$) groups.

Table 1 presents the groups' baseline preoperative data. It can be noted that the groups were similar with regard to demographic data, BMI (body mass index), and presence of comorbidities. Significant differences between the groups were noticed in the indication for revision, with higher percentages of band slippage, port infection and erosion in the two-stage group. In patients undergoing a staged revision, the mean time between removal of the band to LRYGB was 2.3 ± 2.5 years (range 1 month–8.9 years; median 1.1 years).

Operative time was similar between the two groups (138.1 ± 38.9 vs. 136.7 ± 50.9 min, one-stage vs. two-stage [second operation only], respectively, $P = 0.86$). The overall operative time of the patients in the two-stage group, when considering both operations (band removal + LRYGB), was 197.9 ± 56.8 min ($P < 0.001$ when compared to the operative time of the one-stage group).

Table 2 compares the early complication rates between the groups, with no significant difference shown. Table 3 presents the late complication rates, demonstrating more overall late complications in patients who underwent a two-stage operation, including significantly higher rates of gastro-gastric fistula (GGF) and anemia.

Approximately three-fourths of the patients (76.4%) had documented follow-up of more than 6 months, with a mean follow-up of 21.6 and 25.0 months for the one- and two-stage groups, respectively ($P = 0.38$). Similar weight loss

Table 1 Baseline preoperative data

	One-stage ($N=121$)	Two-stage ($N=40$)	P value
Mean age (years)	42.5 ± 9.2	45.2 ± 11.6	0.13
Females			
Preoperative weight (kg)	118.1 ± 21.8	120.2 ± 23.6	0.61
Preoperative BMI (kg/m^2)	42.0 ± 5.5	44.0 ± 6.8	0.06
Presence of comorbidities	57.0%	62.5%	0.74
DM	27.3%	22.5%	0.55
HTN	24.0%	32.5%	0.29
Hyperlipidemia/hypercholesterolemia	24.0%	27.5%	0.66
OSA	9.9%	7.5%	0.65
Reason for revision			
Lack of weight loss or weight regain	77.7%	37.5%	< 0.001
Vomiting	35.5%	22.5%	0.11
Slippage	4.1%	37.5%	< 0.001
GERD	15.7%	12.5%	0.59
Band leak	5.0%	2.5%	0.50
Port infection	0.8%	10.0%	0.004
Band erosion	0%	5.0%	0.014

BMI body mass index, *DM* diabetes mellitus, *HTN* hypertension, *OSA* obstructive sleep apnea, *GERD* gastroesophageal reflux disease. When relevant, the standard deviation is represented as (± SD)

Table 2 Early postoperative complications (within 30 days postoperatively)

	One-stage ($N=121$) (%)	Two-stage ($N=40$) (%)	P value
Overall early complication rate	6.6	10.0	0.51
Intraoperative complications	0	0	1.0
Conversion from laparoscopic to open operation	0	0	1.0
Anastomotic leak	0	2.5	0.09
Major bleeding	1.7	5.0	0.25
PE	0.8	0	0.56
Dysphagia	0.8	0	0.56
Bowel obstruction (early)	2.5	2.5	0.99
Re-operation within 1 month	4.1	7.5	0.42
Emergency room visits	11.6	7.5	0.45
Re-hospitalizations	9.9	7.5	0.62

PE pulmonary embolism

Table 3 Late postoperative complications (after 30 days postoperatively)

	One-stage ($N=121$) (%)	Two-stage ($N=40$) (%)	P value
Overall late complication rate	7.4	20.0	0.03
Small bowel obstruction	0.8	2.5	0.42
Gastro-gastric fistula	0	5.0	0.01
Marginal ulcer	5.0	0	0.15
Documented anemia	1.7	10.0	0.02
Emergency room visits	18.2	25.0	0.39
Re-hospitalizations	16.5	20.0	0.66

results and improvement/resolution of comorbidities was shown between the two groups (Table 4).

Discussion

Historically, the removal of gastric band and performance of LRYGB in a single stage operation was speculated to be associated with high complication rates [21, 22]. This study, as well as others in the literature, demonstrates the safety of performing revision from LAGB to LRYGB in a one-stage procedure, with similar early complication rates compared to those undergoing a two-stage revision [13, 15–20]. Although this is a topic extensively discussed in the literature, only a few investigations have been from high volume bariatric surgery center with a substantial number of patients who received standardized multidisciplinary care. This present study offers an in-depth and thorough comparison in a homogenous, relatively large group of patients operated at a single center, and therefore adds to the available literature.

In a recently published meta-analysis including 619 one-stage revisional LRYGB's and 226 two-stage procedures, no significant differences were demonstrated between the groups in overall morbidity, leak/fistula rates, abscess formation rates, or postoperative bleeding rates [13]. Stroh et al. published an analysis of the German Bariatric Surgery

Table 4 Postoperative weight loss and improvement/resolution of comorbidities

	One-stage ($N=121$)	Two-stage ($N=40$)	P value
Mean preoperative weight (kg)	118.1 ± 21.8	120.2 ± 23.6	0.61
Mean preoperative BMI (kg/m^2)	42.0 ± 5.5	44.0 ± 6.8	0.06
Mean postoperative weight (kg)	91.0 ± 18.0	90.2 ± 19.3	0.84
Mean postoperative BMI (kg/m^2)	32.4 ± 5.1	33.2 ± 5.6	0.49
Mean %EWL	58.7 ± 30.5	60.0 ± 28.7	0.85
Overall improvement or resolution of at least one comorbidity	77.8% (35/45)	68.8% (11/16)	0.48
Improvement or resolution of DM	92.3% (24/26)	85.7% (6/7)	0.60
Improvement or resolution of HTN	35.7% (5/18)	28.6% (2/7)	0.97
Improvement or resolution of hyperlipidemia/hypercholesterolemia	50.0% (9/18)	44.4% (4/9)	0.80
Mean follow-up (months)	21.6 ± 16.7	25.0 ± 22.7	0.38

BMI body mass index, *%EWL* percentage of excess weight loss, *DM* diabetes mellitus, *HTN* hypertension. When relevant, the standard deviation is represented as (± SD)

Registry, which included 263 one-stage and 116 two-stage revisional LRYGB procedures [17]. The intraoperative complication rates were 3.0 and 7.8% ($P=0.057$) and the overall general postoperative complication rates were 5.7 and 14.7% ($P=0.008$), for one- and two-stage operations, respectively. It is to be noted that in two-stage cases, complications of both operations were combined for these calculations. The rate of surgery-specific postoperative complications was similar between the groups (10.3 vs. 12.1%, respectively, $P=0.594$). Ramly et al. utilized the American College of Surgeons National Surgical Quality Improvement Program Database to compare between 64,866 primary LRYGBs and 1212 one-stage revisional LRYGBs, demonstrating the safety of the procedure [18]. It could be argued, however, that patients included in these large database investigations are heterogenous in nature and are subject to a wide range of pre- and postoperative care standards, and different methods of data collection.

Emous et al. published a single-institutional investigation comparing 220 one-stage revisional LRYGBs with 37 two-stage procedures [20]. No significant difference in the rate of early complications was noticed between the groups. Similarly, in Debergh et al.'s series of 738 one-stage and 147 two-stage operations, no difference in early complication rates was demonstrated between the two groups, and no anastomotic leaks were reported in either group [15]. Fournier et al.'s report from three European centers including 642 revisional LRYGB patients showed no difference in complication rates between one- and two-stage procedures [16].

One of the few, commonly cited publications that suggest an advantage in the two-stage approach is a study by Van Niewenhove et al. in which 23 one-stage revisions were compared to 14 two-stage revisions [14]. The overall complication rate (early and late) was higher in the one-stage group (20 vs. 0%, respectively), although these figures did not reach statistical significance. Three (out of 23) patients in the one-stage group developed strictures in the gastrojejunal anastomosis, compared to none in the two-stage group. The relatively small number of study subjects included in the investigation make its results problematic, and it seems that most other publications (including this current one) support the performance of a one-stage approach when feasible.

Our investigation demonstrated similar early complication rates in the one- and two-stage groups (6.6 vs. 10.0%, respectively, $P=0.51$). We assume that this similarity is derived from the fact that sound clinical judgement was utilized in selecting patients that require a two-stage procedure. This demonstrates the safety of performing a one-stage revision in a suitable patient. However, if a similar one-stage approach were to be taken in ALL patients (such as in patients with erosion or acute slippage), it is very possible that the early complication rate would have been higher.

On the other hand, our study demonstrated higher late complication rates in patients undergoing a two-stage revision (20.0 vs. 7.4%, respectively, $P=0.03$), including the occurrence of more GGFs (5.0 vs. 0%, respectively, $P=0.01$) and higher rates of anemia (10.0 vs. 1.7%, $P=0.02$). The reason behind this finding is not entirely clear. It must be remembered, however, that a larger proportion of patients in the two-stage group underwent revision due to a mechanical or infectious complication of the band. One may hypothesize that this is at least partially due to the baseline differences between the patients. More of the two-stage patients were operated due to acute complications. However, how these acute complications (at band removal) led to more post-revisional late complications (namely GGF and anemia) is not obvious to us. Previous literature has demonstrated a higher complication rate in patients operated following such band-related problems (rather than due to lack of weight loss) and the authors believe this may have possibly contributed to the finding of more late complications in the two-stage group

[21]. That said, despite the statistically significant increase in late complications in the two-stage group, this does not necessarily indicate causality, and multivariate analysis cannot be performed due to the limited cohort numbers.

In this study, the mean operative time of both group was similar (138.1 ± 38.9 vs. 136.7 ± 50.9 min, for the one- and two-stage operations, respectively, $P = 0.86$). The reason behind this finding is unclear to us, but may be related to the fact that a large portion of the two-stage patients had experienced a previous band complication, which may have led to more significant distortion of anatomy and possibly a more difficult LRYGB operation, when compared to their counterparts in the one-stage group.

Differences in intraoperative findings can be observed between one- and two-stage revisional procedures, and it is important that the bariatric surgeon know and anticipate these variations. In patients who have previously undergone band removal and consequently undergo LRYGB (as a second stage), the band-related "fibrous capsule" is not present in the majority of cases. On the other hand, this capsule is almost invariably present in one-stage procedures and it is important to attempt not to pass staple lines through this fibrotic tissue. The surgeon must always remember the option to decide to perform the revision in a subsequent operation when encountering significantly distorted anatomy, even in cases which were pre-planned as one-stage revisions. In addition, there seem to be less upper abdominal adhesions in second stage LRYGB procedures, possibly due to the previous adhesiolysis required to remove the band in the prior operation. Two technical tips pertaining to the performance of one-stage revisional LRYGB are worth mentioning. It is our practice to remove the band only after complete dissection of the area of the diaphragmatic crura and gastroesophageal junction (GEJ). This allows the use of the band itself as a "handle" to appropriately retract the GEJ during dissection. An additional technical issue that is relevant in one-stage LRYGB is the approach utilized during the initiation of the gastric pouch formation. According to the extent and location of adhesions at the lesser curvature, the surgeon can choose between the perigastric versus pars flaccida approach.

The retrospective nature of this study is an obvious limitation, making it difficult to fully understand the clinician's decision-making process involved in deciding between a one- or two-stage revision. In addition, the follow-up reported for these cohorts is only medium-term, and it is possible that upon long-term follow-up, the outcomes may differ. Furthermore, despite the similar preoperative demographic, weight, and comorbidity data, it must be emphasized that the two groups being compared are unequal. The indications for revisional surgery differ significantly between the groups (a bias formed by the patients' baseline condition and the surgeons' decision on timing of revision), making their comparison slightly problematic. However, the ultimate objective of the investigation was to confirm the safety and noninferiority of the one-stage procedure, a task that seems to have been accomplished.

Conclusion

The performance of one-stage revisional LRYGB after failed LAGB seems to be a safe procedure, with noninferior outcomes when compared to a two-stage revisional procedure. It is the authors' conclusion that a one-stage revision from LAGB to LRYGB is a valid option, except in cases of mechanical and infectious band complications.

Compliance with ethical standards

Disclosures Drs. Abbas Al-Kurd, Ronit Grinbaum, Ido Mizrahi, Ala'a Abubeih, Atara Indursky, Hani Abu Hamdan, Haggi Mazeh, and Nahum Beglaibter have no conflicts of interest or financial ties to disclose.

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