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ORIGINAL PAPER

A one-step conversion from gastric banding to laparoscopic Roux-en-Y gastric bypass is as safe as a two-step conversion: A comparative analysis of 885 patients

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ABSTRACT

Aims: To achieve additional weight loss or to resolve band-related problems, a laparoscopic adjustable gastric banding (LAGB) can be converted to a laparoscopic Roux-en-Y gastric bypass (RYGB). There is limited data on the feasibility and safety of routinely performing a single-step conversion. We assessed the efficacy of this revisional approach in a large cohort of patients operated in a high-volume bariatric institution.

Methods: Between October 2004 and December 2015, a total of 885 patients who underwent LAGB removal with RYGB were identified from a prospectively collected database. In all cases, a single-stage conversion procedure was planned. The feasibility of this approach and peri-operative outcomes of these patients were evaluated and analyzed.

Results: A single-step approach was successfully achieved in 738 (83.4%) of the 885 patients. During the study period, there was a significant increase in performing the conversion from LAGB to RYGB single-staged. No mortality or anastomotic leakage was observed in both groups. Only 45 patients (5.1%) had a 30-d complication: most commonly hemorrhage ($N = 20/45$), with no significant difference between the groups.

Conclusion: Converting a LAGB to RYGB can be performed with a very low morbidity and zero-mortality in a high-volume revisional bariatric center. With increasing experience and full standardization of the conversion, the vast majority of operations can be performed as a single-stage procedure. Only a migrated band remains a formal contraindication for a one-step approach.

KEYWORDS

Revisional bariatric surgery; conversion; gastric banding; gastric bypass; one-step; two-step; high volume center

Introduction

Despite the former ubiquity of the less invasive laparoscopic adjustable gastric banding (LAGB) as a technique for achieving weight loss in the morbidly obese, this procedure is associated with a significant amount of complications and a high incidence of failure to achieve long-term weight results.[1] As a consequence, a significant proportion of patients may require a second surgical procedure. To date, a number of potential salvage interventions have been described including re-banding,[2] or conversion to another bariatric procedure such as sleeve gastrectomy (SG),[3,4] duodenal switch,[5] or Roux-en-Y gastric bypass (RYGB).[6–15]

Our preference is to convert failed gastric band cases to a RYGB. Although this conversion has been described in different studies (see Table 3), there is considerable controversy regarding efficacy and

safety. While some groups claim that a secondary RYGB is as safe and effective as a primary one,[8] others report a substantial higher complication rate compared with primary surgery.[16] Moreover, it is unclear whether performing this conversion as a one- or two-stage procedure would influence the complication rate.[9]

In this study, we prospectively evaluated a consecutive cohort of 885 patients undergoing conversion of LAGB to RYGB to assess the 30-d morbidity and mortality, and the influence on it in performing this conversion in one or two steps.

Patients and methods

Study design and preoperative work-up

The Center of Obesity Surgery in the AZ Sint-Jan Hospital in Bruges (Belgium) is a high volume, referral bariatric surgical unit currently performing

over 1400 bariatric procedures per year. The amount of revisional cases increases year by year; especially conversional procedures from former pure restrictive procedures as the LABG or Vertical Banded Gastroplasty (VBG).[17] From October 2004 to December 2015, 10,749 laparoscopic RYGB had been performed in our department. Using a database collected prospectively during this study period, 1169 patients were identified who underwent a RYGB at our institution and had previously undergone gastric banding. Of these, 284 patients that had their band removed prior to referral to our unit were excluded in the analysis.

The remaining 885 patients had the gastric band *in situ* at the time of referral to our unit and were subsequently included in this study. All patients underwent upper gastro-intestinal (GI) endoscopy with *Helicobacter pylori* testing \pm eradication and upper GI contrast studies as part of their preoperative evaluation. The aim of these examinations was to locate the position of the band, to evaluate the anatomy at the level of the esophagus and the upper GI region, and to screen for possible band-related complications. Most bands were deflated months prior to surgery to decrease the pressure of the band on the gastric tissue and to normalize the size of the gastric pouch in case of band slippage or pouch dilation. Patients with a migrated band at referral were excluded from the study. Detailed dietary history was obtained by a bariatric dietician in all cases and patients were required to keep food logs for review. Assessment by the multidisciplinary team was carried out prior to each operation and the revisional procedure was performed upon their approval.

Operative technique

All operations were conducted under the supervision of a single surgeon (B. Dillemans) utilizing a standardized surgical approach which has been previously described.[18] In brief, the specific technical aspects of the conversion of LABG to RYGB were as follows:

Removal of the band

Adhesiolysis was performed to release the entire left upper quadrant. After removal of the band, the fibrous capsule of the band was dissected longitudinally and partially excised. If present, gastro-gastric sutures were separated up to the angle of His by sharp dissection, in order to entirely open the

anterior gastric wall constructed over the band and restore the upper GI anatomy.

Single-stage versus two-stage conversion

Following band removal, an intra-operative decision was made whether to proceed with a simultaneous single-stage conversion or to perform the RYGB in a later stage. Major indications for a two-step approach included the presence of a grossly dilated pouch (after slippage), and iatrogenic lesions or perforations of the gastric wall during band removal.

Creation of the gastric pouch

Before constructing the gastric pouch with linear staplers, the exact location where to create the circular stapled gastrojejunostomy (GJ) was determined. A careful check-up was necessary to evaluate whether healthy, unscarred gastric tissue would be included in the GJ. Only in grossly dilated pouches the new gastric pouch was fashioned above the previous position of the band; in all other cases the dissection started distal to it. A small window was made along the lesser curvature of the stomach to place the first linear stapler [(Endo GIATM Universal Stapler System/Tri-StapleTM Technology (Covidien[®], Covidien, Irvine, CA) or Echelon Flex EndopathTM Stapler (Ethicon[®], Ethicon, Inc., Cincinnati, OH)] and the stomach was sectioned horizontally over a distance of 60 mm. Stapler height was mostly 3.5 mm but if the gastric wall was considerably thicker, a cartridge with a higher stapler height was utilized. During the next step, a second linear 60 mm stapler was introduced and fired to vertically transect the stomach using a 34 Fr orogastric tube as a guide. The angle of His was opened anteriorly and posteriorly to create a window, and the posterior band capsule was transected to fully liberate the pouch from the left crus. Finally, the pouch was completed by vertically firing additional 60 mm cartridges – the staple height in this vertical transection varied according to the perceived thickness of the gastric tissue.

Completion of the gastric bypass

The ante-colic, ante-gastric gastrojejunostomy was made with a circular stapler device (diameter 25 mm) (DST SeriesTM EEATM, Covidien[®], Covidien, Irvine, CA). Again, depending on the thickness of the gastric tissue, a 3.5 mm or 4.8 mm stapler height was chosen. The jejunogastrojejunostomy was

fashioned with a linear stapler using the technique previously described by our group.[18]

Post-operative management

On the first post-operative day, patients were kept nil by mouth. No routine upper GI imaging series were performed. Oral intake was restarted on the second post-operative day and the patients were discharged on the second or the third post-operative day with specific dietary instructions. To prevent deep venous thrombosis, patients received a daily subcutaneous injection with low-molecular-weight heparin for 14 days post-operatively. In addition, a proton pump inhibitor (PPI) (omeprazole 20 mg) was started and continued for 3 months (40 mg lifelong for smokers) to prevent marginal ulcer formation. The first follow-up visit was scheduled for 6 weeks. Thereafter, visits were planned after 6 months, after 12 months, and then annually.

Data analysis

Patient data were gathered from the hospital's prospectively collected electronic database along with the paper record, and from telephone interview. The data included patient demographics, operation technical details, hospital stay, complications, and 30-d morbidity and mortality.

Statistical analysis was performed using Statistical Package for Social Sciences version 20 (SPSS, Chicago, IL). A comparison of the continuous data was done using a Student's *t*-test or Mann-Whitney *U*-test as appropriate, and a Fisher exact test or Chi-squared test for categorical data. Data were expressed as means, medians or percentages respectively. A *p* value <0.05 was considered to be significant.

Results

Pre-operative demographics

A total of 885 patients could be included during the study period. The female to male ratio was 723/162 with a mean age of 43.3 years. The

detailed patient demographics at reoperation are listed in Table 1. No major differences were observed between the group receiving a conversion of LAGB to RYGB in a one-step or a two-step approach.

Of the 885 patients in our cohort, 557 had the Belgian nationality (62.9%) and 328 were foreigners (37.1%). The majority of the patients received the LAGB in another centre (88.9%), whereas 98 patients were originally operated in our centre (11.1%). In total, seven (0.8%) patients had an open placement of the LAGB: four patients were operated in the 1-step group and three patients in the 2-step group. Ninety-eight (11.0%) patients had already undergone a reintervention (rebanding or band repositioning) prior to being referred for conversion to RYGB, of which 74 patients could receive a RYGB in one stage and 24 patients needed a staged conversion to RYGB.

Prior to banding, mean BMI was $42.2 \pm 6.7 \text{ kg/m}^2$, and this reduced to a minimum BMI of $31.6 \pm 6.8 \text{ kg/m}^2$. At time of the conversion to RYGB, the mean BMI of the cohort was $39.6 \pm 6.6 \text{ kg/m}^2$ with 80 patients (9.0%) classified as super obese ($\text{BMI} \geq 50 \text{ kg/m}^2$). Overall, in 87.0% ($N = 769$) of the cases, the main reason for conversion was weight regain or insufficient weight loss (defined as <25% excess weight loss (% EWL) or $\text{BMI} > 35 \text{ kg/m}^2$). However, in 62.8% of the patients band-related complications and/or band intolerance were described ($N = 553$).

Peri-operative data

A one-step conversion from LAGB to a RYGB was successfully achieved in 738 patients (83.4%), while

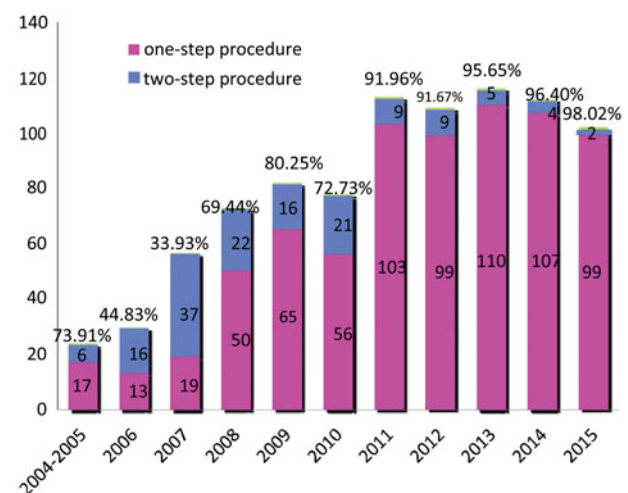


Figure 1. Graphic presentation of numbers of one- and two-step conversion to RYGB in patients with failed LAGB. A clear increase of % one-step procedures is seen from 2011 on. (% one-step/all conversions)

Table 1. Demographic and operative data.

Characteristics (N = 885)	1 step (N = 738)	2 step (N = 147)	p-value
Age (year)	43.5 ± 10.5	42.2 ± 11.0 (15–72)	P = 0.219
Gender (F/M)	606/132	117/30	P = 0.913
BMI at redo (kg/m ²)	39.7 ± 6.8	39.5 ± 6.6	P = 0.485
Weight at redo (kg)	111.9 ± 23.1	112.2 ± 22.4	P = 0.376

147 patients required a two-step procedure (16.6%). The total number of one- and two-stage conversions year-on-year is depicted in Figure 1. Over the study period an increase in the overall number of cases and an evolution towards more single-staged procedures was noticed: between 2004 and 2010, 65.1% of the interventions were single-step versus 94.7% of the cases in the period 2011–2015.

In one patient, a conversion to laparotomy (0.1%) was mandatory, because of an iatrogenic perforation with the orogastric tube during leakage test necessitating a manual gastrojejunostomy reconstruction.

Post-operative hospital stay

The mean length of hospital stay (LOS) was 3.8 ± 0.9 d (2–12). Of all patients, 787 (88.9%) were discharged before or on the 3th post-operative day. There was a statistically significant difference in LOS between the one-step versus two-step conversion group, which was 3.7 ± 0.8 d versus 4.1 ± 1.1 days (Mann Whitney U-test, $p \leq 0.001$).

Post-operative complications

A total of 45 early (<30 d) complications (5.1%) were documented. Thirty of these complications were in-hospital, and 15 after discharge, requiring readmission. The complication rate was 4.9% in the one-stage conversion group versus 6.1% in the two-stage group (Fisher's exact test, $p = 0.470$). The details of the complications are summarized in Table 2. Both mortality and anastomotic or staple

line leak rate were zero. The most common complication was hemorrhage (20 cases, 2.3%). Of Fifteen patients suffered from an intraluminal bleeding of which 12 were treated conservatively by means of careful hemodynamic monitoring with or without blood transfusion. Two intraluminal bleedings were endoscopically clipped and in one patient a blood bezoar required a laparoscopic evacuation. Five patients had an extraluminal intra-abdominal or abdominal wall bleeding, necessitating revision laparoscopy in two cases. No significant difference was found in the occurrence of hemorrhage between the one and two stage groups (2.2% versus 2.7%, respectively; Fisher's exact test, $p = 0.790$).

In total, 10 patients underwent a reintervention due to an early post-operative complication (1.1%): three cases of post-operative bleeding, four lateral entrapments at a trocar site, one removal of a part of the band that was still *in situ*, one repair of an iatrogenic small bowel perforation, and one obstruction at the jejuno-jejunal anastomosis for which an alignment stitch had to be placed.

Discussion

Although the LABG was believed to be a reversible, non-invasive and safe technique for treating morbid obesity several years ago, Altieri et al. [19] reported recently on a large cohort of more than 19,000 patients with revision or removal rates of LABG as high as 34%, and sometimes associated high complication rates. This is why gradually the popularity of the LABG faded, comparable with the declining trend of the VBG in the early twenty-first century. There is no strict consensus regarding the optimal conversion method for patients who need a reintervention of their LABG procedure. Proposed options include repositioning of the band or conversion to SG, BPD/DS, or RYBG. All these options have been shown to be feasible, but there is emerging evidence to suggest that conversion to RYBG is a superior long-term strategy to both band repositioning [20,21] and SG.[22–24] Although the SG is becoming the most performed primary bariatric procedure, there is still an important reluctance in performing the SG as the conversion procedure of choice for failed restrictive procedures. High complication rates, such as leakage and esophageal motility disorders, have been reported especially in single-staged procedures,[25] as well as less optimal medium-term results concerning weight loss.[23,24]

We believe that conversion from LABG to RYBG is a reliable, and maybe the best option. Overall,

Table 2. 30-D complication-rate.)

	1-step (N = 738) N (%)	2-step (N = 147) N (%)	p-value
Early complications (Clavien–Dindo classification)			
Total	36 (4.9)	9 (6.1)	$P = 0.470$
GRADE I			
Infection	11 (1.3)	2 (1.4)	$P = 0.852$
Upper respiratory tract	3	2	
Wound infection	3	0	
Other infection	5	0	
Varia	3 (0.4)	1 (0.7)	$P = 0.972$
DVT, thrombophlebitis	2	0	
Brachialis plexopathy	0	1	
Re-entry tachycardia	1	0	
GRADE II			
Bleeding conservatively treated	12 (3.2)	3 (2.0)	$P = 0.563$
GRADE IIIa			
Endoscopy for bleeding	2 (0.2)	0	$P = 1$
Stenosis GJ anastomosis	1 (0.1)	0	$P = 1$
GRADE IIIb			
Laparoscopy for bleeding	2 (0.2)	1 (0.7)	$P = 0.984$
Trocar incisional hernia	3 (0.4)	1 (0.7)	$P = 0.972$
Obstruction JJ anastomosis	0	1 (0.7)	$P = 1$
Iatrogenic small bowel perforation	1 (0.1)	0	$P = 1$
Removal corpus alienum	1 (0.1)	0	$P = 1$

there are no clear guidelines about converting a LAGB to RYGB in a single step, due to the lack of evidence and the heterogeneous number of patients included in sometimes small series published so far.[6–10] With a total of 885 patients, our study represents the largest reported series of secondary RYGB after failed LAGB in a single center. The absence of mortality and anastomotic leakage, and a low early morbidity rate of 5.1% with a reintervention rate of only 1.1% in the studied population, is remarkable.

In our opinion, the complete absence of leak and the low complication rate in our series can be attributed mainly to the attention for perioperative details including the complete standardization of the procedure and full rationalization of every laparoscopic maneuver as described previously by our group [18] (see Methods section). The gastro-jejunostomy is always made with a circular stapler device, and depending of the thickness of the gastric tissue, the 3.5 mm or 4.8 mm stapler height is chosen. We prefer to construct a circular stapled gastro-jejunal anastomosis with transabdominal introduction of the stapler device. The anastomosis is created at the left lateral corner of the pouch to guarantee a wide vascular inflow, as technically described previously in VBG patients.[17] Another advantage of this type of anastomosis is that it is made in a transverse plane, which allows the surgeon to incorporate only “healthy”, non-scarred and homogenous tissue. In that way, a safe anastomosis can be performed with an equal distribution of forces, limiting the traction, which can be bothersome in cases of a short gastric pouch. Making a sagittal gastro-jejunal anastomosis with a linear stapler could be more hazardous since inhomogeneous tissues could be included in the stapler line. Moreover, with the linear stapled anastomosis, the most cranial part of this linear staple line could receive excessive traction, especially in pouches constructed above the band, leading to potential weak spots.

Whether to perform staged conversions from LABG to RYGB or not, some authors have advocated a routine two stage procedure with LAGB removal followed by conversion to a RYGB during a second operation after 3 months to permit “gastric remodeling” and tissue healing.[9,26] However, this view was challenged by Spivak et al. [6] who reported no theoretical or practical advantages in performing the revisional procedure in two-steps. Moreover, by potentially preventing the development of further adhesions, Cadière et al. [16] concluded that a one-step procedure was preferable to a two-stage approach in appropriately selected cases.

Van Nieuwenhove et al. [9] also noted that two-stage conversions had significant resource implications for hospitals with an increased total operating time and hospital stay. Our study demonstrates the feasibility and safety of attempting to perform a single-stage conversion, with only 4% of cases requiring a two-stage procedure in the last 2 years of the study.

In Table 3, we depicted other studies reporting on the safety and feasibility of performing one-step conversions from LAGB to RYGB. Studies with relatively small numbers reported important 30 d-complication rates up to 30.9% [8] and re-operation rates of up to 13%.[12] A volume-effect was seen in some larger study groups [13–15] describing generally lower major complication and reintervention rates, despite the high amount of one-step conversions. More specifically, in our study, the peroperative analysis and triage of patients in performing a one- versus two-step conversion group resulted in a very favorable safety profile of the single staged procedures compared to other studies (early complications, 4.9%; and reinterventions, 0.9%).

At the start of one’s specialized training and the beginning of the learning curve of revision bariatric procedures, we emphasize that one should not hesitate to perform a two-step approach in case of doubt with fragile gastric scar tissue or when the

Table 3. Articles concerning one-stage conversion of failed LAGB to RYGB.

Author	Total No. of patients (N)	Total morbidity rate (%)	Total reintervention rate (%)	1-step
Spivak et al.[6]	33	3.0	3.0	100%
Langer et al. [7]	25	4.0	NA	100%
te Riele et al. [8]	55 (open)	30.9	9.1	90.9%
Van Nieuwenhove et al. [9]	37	5.4	NA	62.1%
Robert et al. [10]	85	7.0	2.4	96%
Perathoner et al. [11]	108	10.2	8.3	52%
Apers et al. [12]	107 (21 VBG)	20	13	59%
Emous et al. [13]	257	4.6	1.9	85.6%
Aarts et al. [14]	195	9	4	100%
Fournier et al. [15]	642	9.6	NA	60.2%
Dillemans et al., 2016	885	5.1	1.1	83.4%

initial dissection proves difficulty. In such cases a low threshold for “bailing-out” is to be preferred, rather than attempting to perform heroic but potentially hazardous single-stage surgery.

Despite the size of the studied population and the power of the results, we remark some limitations. Whether the RYGB is the procedure of choice on the long term in this population with a failed LAGB is unsure, as long-term outcome data were incomplete at time of publication. Future work will reveal the long-term complications, and co-morbidity and weight evolution in our study group. Furthermore, when interpreting the results we should be aware that an inherent bias was created between the two study groups, as the two-stage approach was essentially a surrogate marker of technical difficulty (early complications, 6.1%; and reinterventions, 2.0%). Consequently, this paper does not address the debate as to the relative safety of routine single-stage versus routine two-stage conversion from LAGB to RYGB. Nonetheless this the largest prospective series published in the literature on patients undergoing planned single-staged conversion from a failed LAGB to RYGB.

Conclusion

In this single center study, we analyzed the 30-d mortality and morbidity in 885 patients who underwent a conversion from a failed or complicated gastric band into a RYGB. No mortalities were observed, the early complication rate was 5.1% with a surgical revision rate of 1.1%. We believe that this favorable safety profile can be explained by the accumulated expertise of the surgical team in a high-volume institution with meticulous attention to important technical aspects. In our experience, a one-step approach does not influence the short-term morbidity outcome, and is, therefore, considered as a possible routine but deliberate option.

Disclosure statement

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of this article.

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