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Original article

Laparoscopic sleeve gastrectomy as a revisional procedure for failed gastric banding: lessons from 300 consecutive cases

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Abstract

Background: Laparoscopic adjustable gastric banding (LAGB) is a common bariatric procedure associated with a high rate of weight loss failure and/or complications in the long term. The objective of this study was to test the hypothesis that the conversion of failed LAGB into laparoscopic sleeve gastrectomy (LSG) is not associated with an increased risk of postoperative complications and leads to weight loss results that are comparable to those obtained with a primary LSG.

Methods: We retrospectively analyzed the results of a prospective series of 1360 LSG regarding patient demographics, the indication for revision morbidity, the percentage of excess weight loss, and the rate of postoperative complications.

Results: The primary LSG group contained 1060 patients and the LAGB to LSG group contained 300 patients. The rate of postoperative complications was 4.5% in the primary LSG group and 2% in the LAGB to LSG group. Two patients died in the LSG group (1 pulmonary embolus, 1 myocardial infarction). There was no significant difference with respect to the rate of leak, which was 1% in the LAGB to LSG group and 1.6% in the primary LSG group. There was a greater weight loss after primary LSG, mean % excess weight loss of 75.9% ± 21.4 at a mean interval of 29 ± 19.8 months, versus 62.6% ± 22.2 at a mean interval of 35 ± 24 months after LAGB to LSG ($P = .008$). There were 72.1% and 59.2% of patients available for follow-up after primary LSG at 24 and 60 months respectively, versus 69.3% and 55.4% after LAGB to LSG.

Conclusion: This study indicates that the risk of leak after LSG was not increased after conversion failed LAGB into LSG when performed as a 2-step procedure. (Surg Obes Relat Dis 2014;▮:00–00.)

Keywords: Failed gastric banding; Revision procedure; Laparoscopic sleeve gastrectomy

Laparoscopic adjustable gastric banding (LAGB) is a very common bariatric procedure, not only because it is a relatively simple and straightforward surgical technique, but also because it is associated with the lowest risk of immediate postoperative complications and mortality [1,2]. However, several studies have shown that gastric banding is associated with a high failure rate, either due to complications and/or insufficient weight loss [3,4]. A few surgical options exist to revise a failed gastric banding [5]. It is possible to replace the band with a new band in a very limited category of patients [6], but conversion into a

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Roux-en-Y gastric bypass (RYGB) is considered by most as the procedure of choice [7]. Over the last few decades, the laparoscopic sleeve gastrectomy (LSG) has emerged as a third option [8,9]. However, this procedure has been associated with an increased risk of postoperative complications compared with a primary LSG [10,11].

To test the hypothesis that the conversion of failed LAGB into LSG is not associated with an increased risk of postoperative complications and leads to weight loss results that are comparable to those obtained with a primary LSG, we retrospectively analyzed the results of a prospective series of 1,360 consecutive LSG, of which 300 were conversion from a failed LAGB.

Methods

Data on LSG were extracted from a prospective database of morbidly obese patients undergoing bariatric surgery for morbid obesity according to the National Institute of Health consensus conference [12] between December 2005 and March 2013. All patients were informed of the risks inherent in primary and revisional bariatric surgery, as well as the potential benefits and alternatives to it, and signed a preoperative written consent for surgery.

Variables extracted from the database were age, gender, type of procedure (primary LSG versus conversion of failed LAGB to LSG), body mass index (BMI), indications for revision, postoperative complication and mortality, reintervention rate, length of hospital stay, and weight loss over time (excess weight loss [EWL], excess BMI loss, [EBL]). Patients were divided into 2 groups: primary LSG and LAGB to LSG. Three hundred patients undergoing LSG as a revisional procedure for failed gastric banding (LAGB to LSG group) were compared to the remaining 1,060 patients undergoing LSG as a primary procedure (primary LSG group).

The ideal weight in kilograms was calculated as follows: 50 + 2.3 * [(height in cm/2.54) - 60] for men and 45.5 + 2.3 * [(height in cm/2.54) - 50] for women [13]. Excess weight was calculated as the preoperative weight minus the ideal weight. Weight loss was expressed as the percentage of excess weight loss (%EWL) over time. The %EWL was calculated as follows: (preoperative weight - postoperative weight)/(preoperative weight – ideal weight) * 100)). Excess BMI was calculated as the preoperative BMI minus 25. Weight loss was expressed as the %EBL over time. The % EBL was calculated as follows: (preoperative BMI - postoperative BMI)/(preoperative BMI – 25) * 100)). LSG failure was defined as a % EWL < 50% beyond 1 year. Gastroesophageal reflux (GERD) was defined based on heartburn symptoms associated with endoscopically proven esophagitis. Conversion of LSG to laparoscopic RYGB was done in patients with GERD symptoms resistant to a proton pump inhibitor. Band erosion was defined based on upper gastrointestinal endoscopy that could identify the band in the lumen of the stomach.

Surgical technique of conversion of LAGB to LSG

All patients underwent a 2-step conversion procedure. First, the band was removed laparoscopically and a minimum 3-month interval was required before conversion to LSG. Patients were put in the French position with the surgeon standing between the patient's legs. A 3-port laparoscopic procedure was performed as previously described [14]. The ports included a 5-mm port for the 30° camera on the supraumbilical midline, 10 cm under the xiphoid and 2 cm to the left to avoid the round ligament, a 12-mm port in the right upper quadrant for the stapler (Echelon 60 Endopath, Ethicon EndoSurgery, Cincinnati, OH or EndoGIA 60 Tristapler, Covidien Surgical, Mansfield, MA) and a 5-mm port on the left midclavicular line. Occasionally, an additional 5-mm port was introduced to expose the stomach in case of a huge left liver lobe. The greater curvature of the stomach was freed starting 6-cm proximal to the pylorus up to the angle of His with a Harmonic scalpel (Ethicon EndoSurgery, Cincinnati, OH). The lateral border of the left crus was exposed to remove the entire gastric fundus, which is susceptible to dilation over time if left in place. No attempt was made to remove the residual scar tissue around the stomach. The gastric sleeve was constructed over a 37.5-Fr bougie (MIDSleeve, Dardilly, France) introduced along the lesser curvature up to the pylorus. The stomach was transected with green cartridges (Echelon 60 Endopath, Ethicon Endosurgery, Cincinnati, OH) or purple cartridges (EndoGIA 60 Tristapler, Covidien Surgical, Mansfield, MA) and the last transection was 5–10 mm lateral to the esophagus. No drains were left in place at the end of the procedure. Patients were started on oral fluids on the first postoperative day after an upper gastrointestinal series was negative for leak. Prophylaxis with subcutaneous low molecular weight heparin against deep venous thrombosis was initiated the next morning. Initially the protocol included enoxaparine 4000 IU twice a day, and then it was modified to enoxaparine 6000 IU/d for the remaining patients. They were discharged on postoperative day 3.

Statistical analysis

The data are presented as the mean ± standard deviation. The t test and χ^2 tests were used to compare the groups of patients. For all statistical tests, a P value < .05 was considered significant. All statistical analysis was done using NCSS 2007 (NCSS Statistical Software, Kayesville, UT).

Literature review

A search in PubMed MEDLINE (National Library of Medicine) was performed for English-language articles published from 2006, the year of publication of the first conversion of LAGB to LSG until January 2013, using the

Table 1
Patients' demographic characteristics in the LAGB to sleeve gastrectomy (SG) group compared to the primary SG

		LAGB to SG (n = 300)	SG (n = 1060)	*P* value
Age (yr)	Mean +/- SD	43.3 ± 11	40 ± 12	.0003
	Range	22–76	17–76	
Gender	Female / Male	261 (87%) / 39 (13%)	792 (74.7%) / 268 (25.3%)	.003
Weight (kg)	Mean +/- SD	117 ± 22.3	121 ± 23	.004
	range	75–220	65–240	
BMI (kg/m$^{2]}$	Mean +/- SD	43 ± 7	44 ± 6.4	.012
	range	25–78	27–77	
Excess weight (kg)	Mean +/- SD	55.2 ± 20.2	59 ± 19	0.003
	range	7.3–156	13.6–157.8	

BMI = Body mass index; SD = standard deviation

key words, "laparoscopic", "obesity", "sleeve gastrectomy", and "gastric banding". Then, a search using the key words, "conversion", "redo surgery", and "bariatric" was performed. A full text copy of each publication was obtained. Only papers reporting on conversion of LAGB to LSG were considered. Any series on LSG with cases of conversion of LAGB to LSG was excluded. When multiple reports were found from a single institution, only the most recent report, with the highest number of patients, was considered. The following data were collected for each article: study type, number of patients, postoperative complications and incidence of leak, and interval of time between LAGB and conversion to LSG.

Results

There were 792 (74.7%) women and 268 (25.3%) men, with a mean age of 40 ± 12 (17–76) years in the primary LSG group and 261 (87%) women and 39 (13%) men, with a mean age of 43 ± 11 (22–76) years in the band to LSG group ($P = .0003$). Before surgery, mean initial BMI was 44 ± 6.4 (27–77) kg/m^2 and 43 ± 7 (25–78) kg/m^2 ($P = .012$), mean EW was 59 ± 19 (13.6–157.8) kg and 55.2 ± 20.2 (7.3–156) kg ($P = .003$) in the primary LSG group and in the LAGB to LSG group, respectively (Table 1). Indications for band removal were insufficient EWL for 185 patients (61.7%), complications such as pouch dilation for 97 patients (32.3%), band slippage for 15 patients (5%), and gastric erosion in 3 patients (1%).

Morbidity and mortality

Two patients died in the primary LSG group. One died of a pulmonary embolus on postoperative day 15 and 1 of myocardial infarction on postoperative day 12 (overall mortality .19%). There were no deaths in the LAGB to LSG group.

The rate of postoperative complications was 4.5% in the primary LSG group and 2% in the LAGB to LSG group (Table 2). There was no significant difference with respect to the rate of leak, which was 1% in the LAGB to LSG group and 1.6% in the primary LSG group. Four patients (1.3%) required reoperation in the LAGB to LSG group and 20 (1.9%) in the primary LSG group ($P = .55$) (Table 3). Three leaks in the LAGB to LSG group and 9 leaks and 1 abdominal abscess in the primary LSG group were treated by laparoscopic lavage and drainage. In 2 patients of the primary LSG group this procedure was followed by an endoluminal stenting. The remaining leaks in the primary LSG group were treated by an endoluminal stent (1 patient) or percutaneous drainage (7 patients). An endoluminal stent

Table 2
Complications in the LAGB to sleeve gastrectomy (SG) group compared to the primary SG

Complication	SG	LAGB to SG	*P* value
Leak	17 (1.6%)	3 (1%)	.47
Intra-abdominal abscess	4 (.38%)	0	.29
Stenosis	2 (.19%)	2 (.67%)	.168
Bleeding	19 (1.79%)	1 (.33%)	.069
Pancreatitis	1 (.09%)	0	.6
Humeral vein thrombosis	1 (.09%)	0	.6
Portal thrombosis	1 (.09%)	0	.6
Portal phlebitis	1 (.09%)	0	.6
Twist	1 (.09%)	0	.6
Pleural effusion	1 (.09%)	0	.6
Total	48 (4.53%)	6 (2%)	.055

Table 3
Reoperation rate in the LAGB to sleeve gastrectomy (SG) group compared to the primary SG

Complication		LAGB to SG n (%)	SG n (%)	*P* value
Leak		3 (1%)	17 (1.6%)	.47
	Reoperation	3 (100%)	9 (52.94%)	
Intra-abdominal abscess		0	4 (.38%)	.29
	Reoperation	0	1 (25%)	
Stenosis		2 (.67%)	2 (.19%)	.168
	Reoperation	1 (50%)	0	
Bleeding		1 (.33%)	19 (1.79%)	.069
	Reoperation	0	10 (52.63%)	

was put in place in 2 patients after laparoscopic lavage and drainage in the primary LSG group. Fig. 1 shows the distribution of the leaks over time for the LAGB to LSG group and the primary LSG group. All 3 cases of leaks in the revisional group occurred within the first 30 cases and were during the first 150 cases of the whole series. The distribution of the leaks in the primary group was spread over the first 600 cases and no more leaks were recorded thereafter.

Furthermore, 10 patients underwent laparoscopic surgical exploration for bleeding in the primary LSG group and 1 stenosis was converted to RYGB laparoscopically after failed endoscopic dilation in the LAGB to LSG group. The second stenosis in the LAGB to LSG group was treated by endoscopic dilation. The 2 stenosis in the primary LSG group were treated by an endoluminal stent. Overall, an endoluminal stent was put in place in 2 patients in the revisional LSG group and in 5 patients in the primary LSG group ($P = .8$). No patient complained of GERD at follow-up visits. No conversion to open surgery was required in the entire series.

Weight loss

Weight loss after surgery was different in the 2 groups. The primary LSG group had a mean BMI of 28 ± 5.9 (17.7–51.7) kg/m^2, a mean %EWL of 75.9 ± 21.4% (16.5–39.4), and % EBL of 88 ± 26% (18–169.8) at a mean interval of 29 ± 19.8 (1–92) months. The LAGB to LSG group had a mean BMI of 30 ± 4.9 (22.4–44.5) kg/m^2, a mean %EWL of 62.6% ± 22.2% (24–100.7), and % EBL of 72.4 ± 25.8% (26.5–121) at a mean interval of 35 ± 24 (1–90) months ($P = .008$) (Fig. 2). There were 72.1% and 59.2% of patients available for follow-up after primary LSG at 24 and 60 months, respectively, versus 69.3% and 55.4% after LAGB to LSG. There was no statistical difference in the rate of failure beyond 2 years follow-up in the 2 groups (Table 4).

Discussion

An increasing number of patients with LAGB will benefit from a second bariatric procedure for insufficient excess weight loss or because of complications related to the band [4]. This study demonstrates that LSG is a valuable option in case of LAGB failure, as it results in a similar rate of

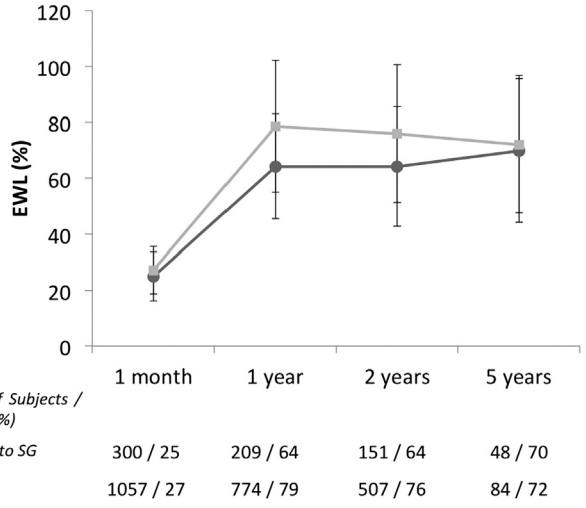

Fig. 2. Postsurgical weight loss. Mean excess weight loss (EWL) (%) in the LAGB to sleeve gastrectomy (SG) group (round mark) compared to the primary SG group (square mark) during their follow-up periods.

postoperative complications and weight loss compared with primary LSG. LSG has been proposed as an alternative to more complex surgical procedures such as the RYGB or the duodenal switch. The Achilles' heel of the LSG is the risk of a leak that may occur in up to 5% of the cases [15]. A history of LAGB is considered by most to increase the risk of leak for several reasons (Table 5). The scar tissue around the LAGB may impair stapling and interfere with the healing of the stapled stomach. Furthermore, the LAGB may also jeopardize the tiny vascular supply of the esophagogastric junction where most leaks occur. Our policy consists in removing the gastric band first and doing the LSG after an interval of at least 3 months. The rational underlying the 2-step approach is that the scar tissue around the stomach progressively disappears once the band has been removed, rendering the LSG technically easier and safer. Indeed, we believe that the regression of the thick scar tissue around the stomach diminishes the risk of staple line failure due to incomplete staple closure that, in turn, may be at the origin of the leak. The 2-step approach also facilitates the undoing of the gastrogastric tunnel at the time of band removal, eliminating the risk of stapling over a plicated stomach and renders the gastric fundus mobilization easier at the time of the second step. As there is no consensus on the timing of conversion after failed LAGB, i.e., band removal and secondary conversion (2-step approach) versus

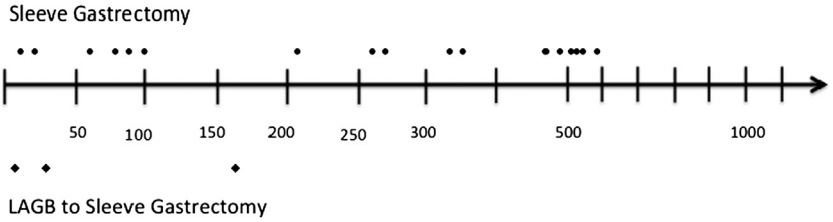

Fig. 1. Distribution of the leaks over time for the LAGB to sleeve gastrectomy (SG) group and the primary SG group.

Table 4
Studies reporting revisional surgery after LAGB

Study	1-step n of patients /n of leaks (%)	2-step n of patients /n of leaks (%)	Mean interval (mo)	Complications rate n (%)	Leak rate n (%)
Bernante et al. [16]	8	0	NA	0	0
Tucker et al. [19]	10 / 1 (10)	0	NA	2 (20)	1 (10)
Acholonu et al. [17]	13 / 1(7.7)	2	12	2 (13.3)	1 (6.7)
Berry et al. [18]	9	0	NA	0	0
Dapri et al. [20]	27	0	NA	1 (3.7)	0
Iannelli et al. [31]	0	41 / 1 (2.4)	3	5 (12.2)	1 (2.4)
Uglioni et al. [22]	29	0	NA	1 (3.4)	0
Foletto et al. [23]	36 (NR)	16 (NR)	3	4 (7.7)	1 (1.9)
Gagnière et al. [24]	14 / 2 (14.3)	17 / 3 (17.6)	6	10 (32.3)	5 (16.1)
Goitein et al. [21]	26 / 2 (7.7)	20	24	3 (6.5)	2 (4.3)
Jacobs et al. [25]	26	0	NA	0	0
Berende et al. [11]	15 / 5 (33.3)	13	3	9 (32.1)	5 (17.9)
Rebibo et al. [26]	46	0	NA	4 (8.7)	2 (4.3)
Yazbek et al. [27]	90 / 5 (5.6)	0	NA	8 (8.9)	5 (5.5)
Kahn et al. [29]	17 / 2 (11.8)	3	3	3 (15)	2 (10)
Alqahtani et al. [28]	56	0	NA	2 (3.6)	0
Present series, 2013	0	293 / 3 (1)	3	6 (2.1)	3 (1)
Total	422 (18)	405 (7)		60 (7.3)	28 (3.4)
Mean leak rate	4.3 %*	1.7 %*			

NA = not applicable; NR = not reported.
Only studies reporting clearly which approach (1-step or 2-step) was chosen were included in the review of the literature.
*$P < .05$

band removal and simultaneous conversion (1-step approach) an exhaustive literature review to compare the 2 alternative approaches with regard to the rate of post-operative complications and leaks was undertaken. There were 16 studies reporting conversion of failed LAGB to LSG with either a 1-step or a 2-step approach. There were 15 studies reporting on the 1-step approach with a total number of 422 patients and a leak rate of 4.3%. There were 8 studies, including the present series, reporting on the 2-step approach with a total number 405 patients and a leak rate of 1.7%. This data indicates that the 2-step approach may reduce the risk of leak ($P = .033$) (Table 4) [10,11,16–29].

Recently Rebibo et al. [26] reported comparative rates of leak in patients undergoing simultaneous band removal and LSG (4.8%) compared with patients undergoing LSG on previously nonoperated stomach (4.2%). However, the leak rate recorded in the present series of 1% is 4 times lower than the leak rate reported by Rebibo et al. [26], Alqahtani et al. [28] reported a series of 56 patients undergoing the 1-step approach with no leaks, compared to 128 patients undergoing primary LSG (1 leak).

The frequency of leaks decreased over time, consistent with a strong learning curve effect [30]. The refinement of technical details, including the interval of time between the staple closure and firing, avoiding cross stapling and a looser calibration of the gastric tube to avoid lateral traction may account for the low rate of leak recorded in this study in both the LAGB to LSG and the LSG groups. This indicates that the phenomenon of leak cannot be explained solely by the fact that the LSG transforms the stomach into a tube with increased intraluminal pressure; some technical issues are probably also involved. Indeed, Parikh et al. [30] recently investigated the role of bougie diameter as a risk factor for leak and found that a diameter smaller than 40Fr was associated with an increased risk of leak. Although a 36Fr was used in the present series, the tube was used to guide the gastric stapling without lateral traction on the stomach, resulting in a loose calibration of the plasty. No staple line reinforcement was used in this series.

The difference in the EWL between the 2 groups recorded at 1 and 2 years after surgery was no more significant than 5 years after surgery. This difference corresponded to a significant difference in the rate of weight loss failure between the 2 groups (Table 5). Interestingly, the rate of failure is stable in the LAGB to LSG group at about 25% and increases overtime in the primary LSG group and becomes identical at 5 years. This tendency in weight loss failure may account for the differences observed between the weight loss curves at 1 and 2 years that are no more different at 5 years (Fig. 2). The most plausible explanation relies in the fact that the LAGB to LSG group includes patients that evolve more rapidly toward the failure

Table 5
Failure rate (% EWL < 50%) in the LAGB to sleeve gastrectomy (SG) group compared to the primary SG

	LAGB to SG (%)	SG (%)	*P* value
1 yr	26.7	7.3	.001
2 yr	27.9	12.6	.028
5 yr	23.1	25	.865

Percentage of excess weight loss (%EWL).

as they have already experienced the effect of surgery-induced restriction and develop eating strategies to overcome the effects of surgery. These data show that LSG as a revisional procedure for failed LAGB most probably gives the same anatomic results as a primary LSG. In other words, the potential risk of leaving part of the gastric fundus that may be responsible for a dilation of the gastric tube with a consequent weight regain seems to be minimal [31].

Although this study reports the largest series of LSG for failed gastric banding, there are 2 limitations. First, the anticoagulation protocol was also modified during the study period and it probably accounted for the high rate of staple line bleeding that required laparoscopic surgical exploration. Second, the hypothesis that splitting the procedure into 2 steps to reduce the rate of complication was chosen only on the basis of our review of the literature. We did not have a control group of patients undergoing a 1-step revisional LSG. All of these issues should be addressed in a large randomized trial with sufficient statistical power to define precise guidelines to adopt for patients undergoing conversion of a failed LAGB to LSG.

Conclusion

This study indicates that the conversion of failed LAGB to LSG is a safe and effective procedure. Data from the present series and those published in the literature are in favor of a 2-step approach with a minimum interval of 3 months between the 2 steps to the reduce the risk of leak associated with the LSG.

Disclosures

Michel Gagner, M.D., F.R.C.S.C., F.A.C.S., declares the following conflict of interests: Honorarium (Speaker's bureau): Ethicon Endosurgery, GORE, Covidien, MID, Transenterix, Boehringers laboratories, Cinemed; Equity: Transenterix. The other authors declare no conflict of interest.

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