

# Laparoscopic Sleeve Gastrectomy Feasible for Bariatric Revision Surgery

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**Abstract** Bariatric revision surgery is associated with several complications that can be attributed to decreased quality of tissue and complexity of the surgery. A laparoscopic sleeve gastrectomy is a simple technique with potential advantages. Therefore, the results of this procedure were evaluated as a revisional option. Fifty-one patients underwent laparoscopic sleeve gastrectomy (LSG). Indications for the LSG were insufficient weight loss (34 patients, group 1) or vomiting (17 patients, group 2) following a laparoscopic adjustable gastric banding (LAGB) or vertical banded gastroplasty (VBG). Patient and procedure characteristics as well as outcome were collected prospectively. From October 2006 to June 2010, 51 patients with a failed prior bariatric procedure (VBG or LAGB) were converted to (L)SG. The conversion rate was zero. The median procedure time was 99 min (range 54–221) and hospital stay was 3 days (range 2–38). There was no mortality after 30 days. Complications included bleeding (six) and leakage of the staple line (seven). Mean follow-up was 13.8 (2–46) months. LSG as revision surgery for insufficient weight loss resulted in extra weight loss of 52.7%, and the overall extra weight loss was 49.3%. When LSG was performed because of vomiting, 82% was able to eat solid food at follow-up. Of the 65 pre-existent comorbidities, 21 were resolved and 18 improved. LSG as a revision procedure is feasible. An additional weight loss and further resolution of co-morbidity seem achievable, however, at the cost of a high number of complications.

Therefore, revision bariatric surgery should be limited to expert tertiary bariatric centers.

**Keywords** Gastric banding · Revision · Sleeve gastrectomy · Failure

## Introduction

In the late 1990s, gastric banding (LAGB) and vertical banded gastroplasty (VBG) were popular bariatric procedures. Initially good results with 54–58% weight loss [1] were reported. However, extended follow-up showed high failure rates (20–56%) [2, 3]. The most common failures are related to pouch dilation or slippage. Other causes could be band erosion, tubing leakage, or port site trouble (inversion, hernia, or pain) [4].

There are several options after a failure of a restrictive procedure such as re-do banding in case of band-related failure, conversion to Roux-en-Y gastric bypass (RYGBP), duodenal switch (DS), or biliopancreatic diversion (BPD) [5]. However, bariatric revision surgery is associated with a higher complication rate than primary procedures [6] independent of the used technique.

In 1998, the first laparoscopic sleeve gastrectomy (LSG) was performed as a component of Hess' biliopancreatic diversion with duodenal switch (BPD-DS) [7]. The effect of sleeve gastrectomy is believed to be based on restriction and reduction of ghrelin by removal of the orexigenic cells and accelerated gastric emptying [8, 9]. It was first used as a two-step procedure for the superobese but showed good weight loss and resolution of co-morbidities with low complication rates [10–12]. Therefore, LSG becomes more popular as a stand-alone procedure and long-term results are promising [13].

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The experience in our center with sleeve gastrectomy as a primary procedure is now over 500 procedures. Because of the advantages of LSG, this procedure was chosen as a revision option after prior LAGB or VBG. These results were evaluated in the present study.

## Methods

### Patients

From October 2006 to June 2010, 51 patients (11 men and 40 women) with a failed prior bariatric procedure (VBG or LAGB) were converted to LSG. Group 1 had insufficient weight loss (34 patients) and group 2 had complaints of passage or vomiting (17 patients).

In group 1, the weight loss after revision surgery was expressed as percentage of excess body mass index (EBMI):

$$\%EBMI \text{ loss} = \frac{\text{preop BMI} - \text{current BMI} \times 100}{\text{preop BMI} - 25}$$

### Operative Technique

All patients received low molecular weight heparin preoperative for venous thromboembolism prophylaxis. Additionally, pneumatic stockings (Sequential Compression Stockings® (Covidien, Elancourt Fr)) were used during the intervention. A second-generation cephalosporin (cephazoline 2.0 g iv) was applied perioperative. The patient was positioned in French position (supine with legs apart and arms abducted) with the surgeon standing between the legs. The abdomen was insufflated with a Veress needle at Palmer's point to a pressure of 18 mmHg. A four or five trocar technique was used. The first 12-mm visiport trocar was placed 20 cm distal to the xiphoid process for the 30° optical system. One 5-mm trocar was placed just below the xiphoid process on the left side and the other two trocars were placed in the mid-clavicular line right and left side 5 cm distal to the costal margin (right 15-mm and left 12-mm trocar). The liver was retracted with a 5-mm liver retractor. If the procedure was post-LAGB, the band was freed of adhesions and the total circumference was exposed by sectioning the gastrogastric tunnel covering the band. Then the band is removed. On the judgement of the surgeon, a one-stage or two-stage strategy is followed (proceed directly to LSG or planned LSG after 3 months). Regardless of the stage, no buttressing was used.

When LSG is done, the greater curvature of the stomach was freed from the greater omentum, starting opposite the

crow's foot, with the LigaSure® (Covidien, Elancourt Fr), dissecting proximally until the left crus and angle of His were reached and distally towards the pylorus sparing 6 cm of the proximal antrum. The stomach was transected with an Endogia®, loaded with one or two green and four blue cartridges (average) (Covidien, Elancourt Fr), under guidance of a 34-F orogastric tube pressed along the lesser curvature. If the procedure was post-VBG, the transaction was up to the former staplers. Band was removed if possible, split if impossible (Marlex®). Due to dilatation of the pouch, a new staple line was again within the old staple line in all cases. The excluded part of the stomach was extracted from the abdomen through the somewhat enlarged 15-mm trocar site. This 15-mm fascia lesion is closed with an EndoClose® (Covidien, Elancourt Fr) with an absorbable suture. The gastric tube was removed, CO<sub>2</sub> released, and trocars removed. Skin was closed intracutaneously.

### Postoperative Management

Usually, patients were discharged at the third postoperative day with liquid diet advised for 3 weeks. All patients received Fragmin® (Pfizer, New York, USA) 5000eh once a day and TED socks (Covidien, Elancourt Fr) for 4 weeks. Meanwhile, 3 months of a PPI once a day was prescribed.

### Data Collection

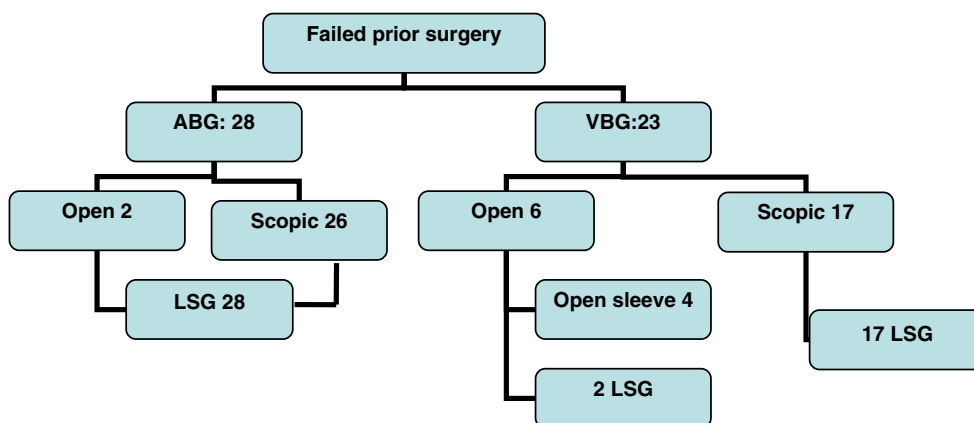
Prospectively collected data were patient and procedure characteristics as well as outcome. In case of incompleteness of data, a questionnaire was sent to the patients and the patients were contacted by telephone. All data are presented as median (range) unless otherwise stated. No statistical evaluation was performed due to the small study population.

## Results

At the time of revision, median age was 39.2 years (range 19–65 years) and median BMI was 41.0 kg/m<sup>2</sup> (25–61 kg/m<sup>2</sup>). The median BMI before the primary surgery was 45.3 kg/m<sup>2</sup> (range 35–77 kg/m<sup>2</sup>) and post-primary surgery was 30.6 kg/m<sup>2</sup> (range 23–61 kg/m<sup>2</sup>).

The median procedure time was 99 min (range 54–221) and hospital stay was 3 days (range 2–38). Mean follow-up was 13.8 (2–46) months.

There was no mortality in this group. Of the 51 patients, 47 procedures were performed laparoscopically of which 4 previously had open surgery, and 4 procedures were performed after prior open surgery. There were no conversions and the open procedures were prior open procedures and were planned open due to expected adhesions (see flow chart).



The main complications were one intraoperative splenic lesion (2.0%), of which a hand-assisted splenectomy was performed, five bleedings (9.8%) (one re-intervention) and seven leakages of the staple line (14%) treated with two re-interventions (3.9%), five (repeated) CT-guided drainages (9.8%), and three endoscopically positioned stents (6%). Extended length of stay associated with leakage was 13 days (median 16 and range 4–38).

In the post-LAGB group (28 patients), in 15 cases (54%) a “one-stage” strategy was followed and 13 times (46%) a “two-stage” strategy. The complication rate in our “two-stage” strategy was 7.7% (one bleeding), which was treated conservatively. No leakage or abscesses occurred. In the “one-stage” strategy, however, three bleedings (20%) and five leakages (33%) occurred which led to five abscesses which were treated by CT-guided drainages and IV antibiotics and in two cases by an endoscopically placed covered stent (see Table 1).

Of the 51 patients, 65 obesity-related co-morbidities, including hypertension in 16 (31%), type II diabetes mellitus in 8 (16%), degenerative joint disease in 27 (49%), hyperlipidemia in 9 (18%), and sleep apnea in 5 (10%) existed.

LSG as a revision surgery for insufficient weight loss resulted in extra weight loss of 52.7%, and the overall extra weight loss was 49.3% (see Table 2). When LSG was performed because of vomiting, 82% of the patients were able to eat solid food at follow-up. Of the 65 pre-existent co-morbidities, 21 were resolved and 18 improved (see Table 3).

**Discussion**

In the 1990s, gastric banding (LAGB) or VBG became popular restrictive bariatric procedures. Initially good results were achieved with a 54–58% weight loss [3]. However, longer follow-up showed high rates of failure (20–56%) [1, 2] demanding revisional surgery. Conversion to RYGBP, DS, or BPD [5] and sleeve gastrectomy (SG) are available techniques following AGB or VBG. Most of these revisions can be done laparoscopically.

LSG itself is a viable option in staged surgery in the (high-risk) superobese and becomes more popular as a definitive single-stage option for morbid obesity [6, 10]. LSG does not alter bowel continuity, and there are no mineral and vitamin deficiencies, except potential vitamin

**Table 1** Complication rates

Former procedure	One stage (n)	Two stage (n)
AGB	15	13
Leakage	5 (33%)	0 (0%)
Bleeding	3 (20%)	1 (7.7%)
VBG	23	
Leakage	2 (8.6%)	–
Bleeding	2 (8.6%)	–
Complication rate	32%	7.7%

**Table 2** Weight loss and BMI

	Total group	Group 1 (insufficient weight loss)
Pre-weight (mean, kg)	120.3	127.6
Post-weight (mean, kg)	99.8	103.7
Weight loss (kg)	20.5	23.9
Pre-BMI (mean)	39.8	43.2
Post-BMI (mean)	32.5	33.6
BMI loss (kg/m <sup>2</sup> )	–7.3	–9.6
% BMI loss	49.3	52.7

**Table 3** Overall resolution of co-morbidities after reoperations (percent)

	Number	Gone	Improved	Stable
Hypertension	16	2 (12%)	6 (38%)	8 (50%)
Hypercholesterolemia	9	2 (22%)	0	7 (78%)
Sleep apnea	5	2 (40%)	1 (20%)	2 (40%)
Diabetes type II	8	3 (38%)	4 (50%)	1 (12%)
Deg. joint disease	27	12 (44%)	7 (26%)	8 (30%)
Total	65	21 (32%)	18 (28%)	26 (40%)

B<sub>12</sub> deficiency [13, 14]. The overall complication rate of primary LSG is very acceptable (5–10%) [15, 16], and the mortality rate associated with this procedure is very low.

In our surgical center, we performed both LRYGBP and LSG as bariatric procedures. In these particular cases where revision is needed, also LRYGBP and LSG are both surgical options. The indications for LSG as a revision option were experience with this procedure, patients personal preference, and relative contra-indications for other techniques such as lots of drug use. The overall complication rate for (L) SG as revision of AGB or VBG is higher compared to LSG as a primary procedure (13–34%) [17–19]. The different complication rates in primary versus revision procedures are probably explained by trauma of the inferior tissue, stapling in inflammatory tissue due to the band, and dissection of former adhesions with possible damage of compromised tissue. Also, a compromised vascular supply of the superior aspect of the staple line, due to dissection of the left crus, may be a factor.

The published expected %EBMI loss after revision LSG is 42–46% at 12 months of follow-up [17, 20]. These results are slightly worse than after RYGPB where up to 60% is achievable [21]. Also co-morbidities will further reduce or even resolve after revision LSG in the majority of the treated patients. This could be as much as 50% improvement [17, 21].

As mentioned in our series, we had a total complication rate of 25% (13/51) with no mortality, which is acceptable compared with literature (13–34%). The leakage rate of our series was 14% (seven), i.e., two (8.7%) following VBG and five following an AGB (17.9%). However, if our “two-stage” strategy (46% of our cases) was performed after AGB, no leakage or abscesses were reported. The only complication in this group was bleeding which was treated conservatively.

In our opinion, a waiting period of 3 months allows tissue to regenerate in order to reduce the risk of leakage. At this moment, there is still no evidence in literature about this.

In group I (insufficient weight loss), the %EBMI loss was 52.7%, and the overall %EBMI loss was 49.3%, which is comparable to earlier published results for LSG as a revisional option [17]. There is still a discussion on the

exact definition of percent excess BMI. Defining a BMI of 25 kg/m<sup>2</sup>, the upper limit of normal in line with current anthropometric definitions of obesity as a target for weight loss remains arbitrary. Using a lower than maximum ideal body weight would decrease the percentage of weight loss. As most other studies use a BMI of 25 as a starting point, the same definition was used in the present study.

In our series, the co-morbidities improved in 28% and even resolved in 32% of the patients. This is as good as earlier published or even slightly better. We had one (2%) uncontrollable bleeding of the spleen that was resolved using a hand-assisted splenectomy. This was after an open AGB with loss of adhesions. Our series is a relatively small retrospective study with an intermediate follow-up of 14 months. But it is still one of the largest published series using SG as a revision option for AGB and VBG.

In summary, we concluded that LSG is a feasible option as a revision procedure after VBG or AGB with a high, but acceptable, complication rate. In our opinion a “two-stage” procedure should be followed to reduce leakage risks after an initial AGB, and revision bariatric surgery should be limited to expert (high volume) tertiary centers.

**Conflicts of Interest** None.

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