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A 3-year experience with laparoscopic gastric banding for obesity

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Abstract
Background: The introduction of laparoscopic techniques—especially that of gastric banding—and the fact that conservative management does not provide satisfactory long-term results in patients with morbid obesity has resulted in a marked increase in the demand for bariatric surgery in our department since 1995. In this paper, we present our experience during the first 3 years with this approach.
Methods: Data for all patients who had bariatric surgery at our institution were collected prospectively. They were analyzed for the purpose of this study.
Results: A total of 150 patients were operated on between December 1995 and December 1998 (37 months). There were 130 women and 20 men, with a mean age of 37.5 years (range, 19–62). The mean initial excess body weight was 102.9% (range, 58–191%), and the mean initial body mass index (BMI) was 44.6 kg/m^2 (range, 35.1–64.1). A Lapband was used in 101 cases and a SAGB in 47 cases. In two patients in whom conversion was necessary, we performed a vertical banded gastroplasty. Duration of surgery decreased over time from 210 min (first 20 cases) to 73 min (last 20 cases). Six patients (4%) developed major complications, one of whom died. The median duration of postoperative hospital stay was 3 days. The mean follow-up was 17 months. In all, 24 patients (16%) developed late complications, and 22 (14.6%) required reoperation, mainly for band slippage and/or pouch dilatation (14 cases). An incorrect surgical technique used for the first 30 patients (Lapband within the lesser sac) was responsible for more than half of these complications. The mean excess weight loss was 34% at 6 months, 55% at 1 year, and 56% at 2 years. Compared to vertical banded gastroplasty (197 cases between 1981 and 1995), postoperative morbidity was greatly decreased, late morbidity was similar, and weight loss was equivalent.
Conclusions: Laparoscopic gastric banding is followed by a weight reduction that is similar to that observed after vertical banded gastroplasty, with a much lower postoperative morbidity, a shorter hospital stay, and an earlier resumption of normal activities. If these results can be confirmed by long-term follow-up, laparoscopic gastric banding will be confirmed as the restrictive procedure of choice for morbid obesity.

Key words: Bariatric surgery — Gastric banding — Laparoscopy — Morbid obesity

Obesity is increasingly recognized as a major medical, social, and economic problem. In Switzerland, >20% of the adult population is overweight. Morbid obesity, defined by a body mass index (BMI) exceeding 40 kg/m^2, is associated with numerous comorbid conditions and a significantly reduced life expectancy [1, 2, 6]. In these severe forms of obesity, conservative therapy almost inevitably fails to provide long-lasting weight reduction, and surgical treatment is usually recommended. Vertical banded gastroplasty and Roux-en-Y gastric bypass are regarded as the procedures of choice because they do not create severe metabolic side effects and are associated with a satisfactory weight reduction that can be maintained over the years [6]. Despite good results with these operations, bariatric surgery has long been disregarded because of its relatively high morbidity, especially after intestinal bypass procedures.

Since the development of laparoscopic techniques for gastric banding [3, 11], the popularity of bariatric surgery has increased markedly, both among obese patients and their referring physicians. After a 15-year experience with vertical banded gastroplasty in 197 patients, we introduced laparoscopic gastric banding (LGB) in December 1995. The number of referrals increased rapidly. In this paper, we present our experience with the initial 150 patients during the first 3 years.

Materials and methods

In our department, obese patients are routinely evaluated by a multidisciplinary team that includes an endocrinologist, a psychiatrist, a dietician, a

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bariatric surgeon, an anesthesiologist, and sometimes a gastroenterologist and a pneumologist. Bariatric surgery is performed after complete evaluation if one of the following criteria is met: body mass index (BMI) exceeding 40 kg/m^2 (morbid obesity), or BMI exceeding 35 kg/m^2 with at least one comorbidity (severe obesity). Contraindications are essentially of a psychiatric nature (psychosis, drug or alcohol dependence).

Data from patients undergoing bariatric surgery have been entered prospectively in a database since the first laparoscopic gastric banding in December 1995. These include demographic and morphologic data, comorbidities, operative data, and follow-up data. Major complications are defined as complications leading to death or reoperation, major sequellae, or problems that more than double the duration of hospital stay.

Results are evaluated on the basis of the percentage of excess weight loss or of the BMI at the last follow-up visit. According to Reinhold's criteria [14], the result is excellent if the percentage of excess weight lost is >75%. It is good between 50 and 75%, fair between 25 and 50%, and poor below 25%. With respect to BMI, the result is excellent if the BMI is <30 kg/m^2, good between 30 and 35 kg/m^2, fair from 35 to 40 kg/m^2, and poor above 40 kg/m^2. This is because the risks associated with obesity increase significantly when the BMI exceeds 35 kg/m^2.

Prophylactic perioperative antibiotic therapy (one dose) is used for each patient in both groups. All patients are given postoperative low-molecular-weight heparin. The first dose of heparin is administered at the induction of anesthesia. Since May 1996, prophylaxis has been continued until the end of the 4th postoperative week.

LGB is performed through five operating ports (three 10-mm ports, one 15-mm port [to introduce the ring], and one 5-mm port). The camera is placed in the lower midline port and the liver retractor in the subxyphoidal port. A grasping forceps is introduced through the lateral port in the left upper quadrant, and the two remaining ports are used as operating ports.

Dissection is initiated at the upper end of the gastrophrenic ligament, just left of the left crus of the diaphragm, and the retrogastric space above the bursa omentalis is entered. In patients in whom a Lapband (Adjustable Silicone Gastric Banding; Bioenterics, Carpinteria, CA, USA) is placed, a tunnel is then created between the lesser omentum and the upper lesser curvature, at the equator of a specially designed intragastric balloon inflated with air to 25 ml. For the first 30 patients, the dissection progressed until the lesser sac was opened; however, we have avoided the lesser sac and remained above it since patient number 31. A grasping instrument is then passed from right to left behind the upper stomach. The balloon is deflated to 15 ml, and the Lapband is placed around the stomach just below the balloon. Four or five gastro-gastric seromuscular nonabsorbable sutures are then placed to tunnelize the anterior aspect of the band. The catheter is extracted through the left lateral port and connected to the port, which is sutured to the aponeurosis through this same incision.

In patients in whom Swedish Adjustable Gastric Banding (SAGB) (Obtech Medical, 6301 Zug, Switzerland) is placed, dissection is the same at the top of the greater curvature. The pars flaccida of the lesser omentum is then opened, and dissection is initiated at the base of the right crus of the diaphragm. A tunnel is created from this point to the left with a specially designed instrument (Goldfinger, Obtech Medical). A gastric tube with a balloon inflated to 15 ml is then placed at the cardia, and the ring is placed immediately below this balloon. Closure of the ring is insured with two nonabsorbable sutures, and the ring is secured in the same manner as for the Lapband using four or five nonabsorbable sutures. The catheter is dealt with similarly.

Follow-up visits are scheduled at monthly intervals during the 1st semester, every 2 months during the 2nd semester, quarterly during the second year, and at 6-month intervals thereafter. Both the surgical team and the medical team participate actively in the follow-up.

The band is left deflated at the end of the procedure. The patients remain on a semi-liquid diet during the 1st postoperative month, after which the diameter of the ring is adjusted under fluoroscopic control to ensure its proper position and to provide an image for further comparison. The Lapband is usually filled with 3 ml and the SAGB with 3.5 ml of Isovist 300 (Schering AG, Schlieren, Switzerland). The patients are instructed to follow a solid diet as of the 2nd postoperative month and to eat very slowly with prolonged chewing. Further adjustments are performed according to degree of weight loss and individual eating capacities. Fluoroscopic controls are routinely performed after 6–12 months and then yearly, or if warranted by clinical evolution.

Results

Between December 1995 and December 1998, we operated on 150 obese patients; their clinical data are summarized in Table 1. A total of 115 of these patients had at least one comorbidity related to obesity. A Lapband was implanted in 101 patients, and Swedish Adjustable Gastric Banding (SAGB) was used in 47 cases. In two patients in whom conversion was necessary in our early experience, a vertical banded gastroplasty was performed. Because of the "intention to treat" rule, these two patients were included in the analysis of operative and postoperative early results. They were, however, excluded from long-term analysis regarding weight loss and long-term complications.

Table 1. Patient characteristics expressed as mean (range)

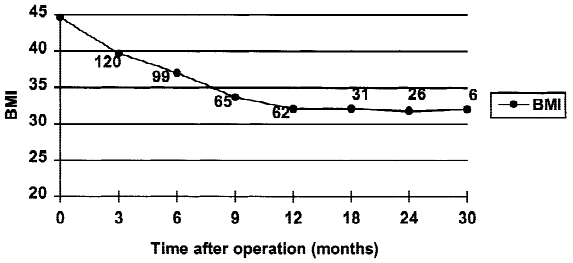
Male/female	20/130
Age (yr)	37.5 (19–62)
Preoperative weight	123.6 (93.5–179)
BMI (kg/m^2)	44.6 (35.1–64.1)
Comorbidity	115 (76%)
% ideal body weight	102.9% (58–191%)

Twenty-eight patients had one or more associated procedures; there were 19 laparoscopic cholecystectomies, seven abdominoplasties, two cases of extensive adhesiolysis, and one tubal ligation. Except for abdominoplasty, these procedures were all performed laparoscopically. Duration of the procedure ranged from 45 to 365 min, with a mean of 127 min. There was a significant shortening over time. The mean operative time before January 1, 1997 was 209 min; it was 126 min during the year 1997, 101 min in 1998, and 73 min for the last 20 cases.

Conversion was necessary in eight patients. Five of them occurred among the first 10 patients, and two more before the 30th. The Veress needle could not be inserted safely in two cases. In three patients, the left lobe of the liver was too large to allow for a sufficient exposure. In the remaining three patients, gastric perforation occurred during dissection of the lesser curvature. In one of the latter cases, hemorrhage along the lesser curvature prevented safe dissection.

There were four intraoperative complications. Three patients incurred a gastric perforation, as already mentioned, and one developed a severe bronchospasm due to a drug allergy after induction of anesthesia. Twelve patients (8%) developed postoperative complications. Nine (6%) had major complications (Table 2). One patient with a preoperative BMI of 64 kg/m^2 who was given 7.5 mg of morphine subcutaneously developed prolonged apnea on the 2nd postoperative day and died 5 days later as a consequence of cerebral ischemia. Duration of hospital stay ranged from 1 to 37 days, with a median of 3 days.

Duration of follow-up ranged from 5 to 36 months, with a mean of 17 months. The evolution of BMI and excess weight loss are shown in Figs. 1 and 2. The number of patients available for follow-up at each time interval are given below the curves, and the total number of patients at each term are at the bottom of the graph. The mean percentage of excess weight loss was 55.1% after 1 year and did not change significantly later on. According to Reinhold's criteria, 57% of the patients with a follow-up of >6 months had an excellent or good result, 39% had a fair result, and 4% had a poor result. With respect to BMI, 70% of the patients who had a follow-up of >6 months had an excellent or good result, 24% had a fair result, and 6% had a poor result.



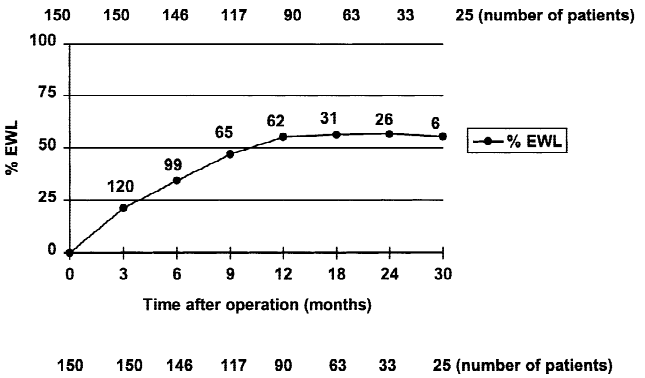


Fig. 1. Change in BMI after gastric banding over time in months. Numbers along the curve represent the number of patients available for follow-up; numbers at the bottom represent the total number of patients at each term.

Fig. 2. Change in percentage of excess weight loss during follow-up in months. Numbers along the curve represent the number of patients available for follow-up; numbers at the bottom represent the total number of patients at each term.

Table 2. Postoperative complications

Type of complication	Number
Thrombosis/lung embolism	2
Septicemia	1
Arterial embolism (allergy to heparin)	1
Urinary tract infection	2
Severe hypertension	1
Bronchopneumonia	1
Seroma (after abdominoplasty)	3
Hematoma	1
Prolonged apnea	1
Total patients with complications	12 (8%)
Total major complications	6 (4%)
Mortality	1 (0.6%)

Twenty-four patients (16%) developed complications during follow-up (Table 3). The most frequent of them was dilatation of the pouch with slippage of the band. Interestingly, this complication was seen essentially among the first 30 patients of our series, in whom the band was placed within the lesser omental sac. Only two patients (1.6%) with the band above the lesser sac developed pouch dilatation. Pouch dilatation manifested itself clinically by an increase in eating capacities and/or low dysphagia.

Five patients developed a leak along the catheter, all with the Lapband. In one of them, rupture was secondary to direct trauma during a car accident 7 months postoperatively. In another patient, the leak developed 3 months after laparoscopic band repositioning and was attributed to operative trauma to the catheter. Band penetration into the stomach was noted in three cases. In one of them, the band had been repositioned laparoscopically 9 months before erosion occurred. These three patients observed an increase in their eating capacities, and one of them complained of back pain not related to food intake.

Table 3. Complications during follow-up

Type of complication	No. of patients
Dilatation and/or slippage	16 (10.6%)
Leak	5 (3.3%)
Port infection	1 (0.6%)
Band erosion	3 (2%)
Psychological intolerance	1 (0.3%)
Incisional hernia (after conversion)	1 (0.3%)
Total patients with complication(s)	24 (16%)

In 22 patients (14.6%), a total of 27 reoperations were necessary (Table 4). Fourteen patients with pouch dilatation required reoperation. The band was repositioned laparoscopically in nine cases; the five other patients underwent laparotomy. The band was repositioned in one and changed in another one. It was removed in two patients, and a vertical banded gastroplasty was constructed. One of the latter patient required two further laparotomies for leakage from the vertical staple line. In the most recent case, the band was removed, and a Roux-en-Y gastric bypass was done. Two patients with pouch dilatation have refused reoperation so far, despite their failure to keep losing weight. In patients with a ruptured catheter, laparoscopy was used to retrieve the catheter from the abdominal cavity, and reconnection was done through the port incision. Two patients with band erosion underwent laparotomy and one laparoscopy; the band was simply removed in the latter case, whereas a Roux-en-Y gastric bypass was constructed in the other two.

Discussion

Excess weight is an increasingly common problem in Western societies, with a prevalence of 20–30%. In recent years, there has been an increasing awareness that severe obesity (BMI >35 kg/m^2) or morbid obesity (BMI >40 kg/m^2) are associated with major comorbidities and a significantly reduced life expectancy. It also has been recognized that conservative therapy in these situations is rarely effective, with long-term success rates of <5%, and that surgery represents the only form of effective long-term therapy. The introduction of laparoscopy, and especially of LGB, has considerably increased the popularity of bariatric surgery among patients and referring physicians, as shown by the increasing demand that we have encountered over the past few years. Following our initial experience with open vertical banded gastroplasty in 197 patients over a 15-year period, we performed 150 LGB within 3 years.

Our data show that LGB is followed by a reduction of excess weight exceeding 50% in 57% of patients whose follow-up is >6 months and in 59% of patients followed for 1 year or more. Seventy percent of our patients reached a BMI of <35 kg/m^2 after at least 6 months. Weight reduction is a little slower than in our series of vertical banded gastroplasty, but it progresses for a longer period [16]. Other

Table 4. Reoperations

Type of procedure	No. of patients
Band repositioning	
laparoscopy	9
laparotomy	1
Band removal	
alone	3
with vertical banded gastroplasty	2
with Roux-en-Y gastric bypass	2
Band change	1
Removal of the port	1
Catheter reconnection	5
Incisional hernia repair	1
Miscellaneous	2
Total patients with reoperation(s)	22 (14.6%)

series with a follow-up of >1 year have shown similar results, with a mean percentage of excess weight loss between 48 and 70% [5, 8, 9, 12, 13, 15].

Interestingly, O'Brien recently showed that weight reduction can progress for up to 4 years after the initial rapid fall usually seen following bariatric surgery [13]. This might be due to the fact that repeated adjustments of the internal diameter of the band are possible over a prolonged period. The limiting effect on food intake can therefore be adjusted to the individual, until the desired weight reduction is achieved.

Intraoperative complications and seven of eight conversions occurred only in our early experience. Visibility is sometimes significantly reduced in morbidly obese patients, especially if the left lobe of the liver is markedly enlarged. In these cases, dissection in the area of the hiatus and creation of a high retrogastric tunnel may be very cumbersome, and conversion is sometimes necessary even in the most experienced hands. As for any other operation, there is a learning curve for LGB. We did not encounter any intraoperative complications or difficulties leading to conversion after the 30th case.

Open bariatric surgery is usually associated with a relatively high incidence of postoperative complications. The low morbidity in this series reflects the minimally invasive character of LGB, in which the stomach is not divided or stapled. The relatively short duration of surgery, rapid recovery, and early ambulation probably also account for these good results. Postoperative pain is usually mild and can be controlled easily with paracetamol or nonsteroidal anti-inflammatory drugs. Opiates should be avoided because of their depressing effect on respiration. The only patient who died in this series was a 160-kg woman (BMI, 64 kg/m^2) with sleep apnea syndrome who was given 7.5 mg of morphine subcutaneously and suffered a prolonged respiratory arrest with irreversible cerebral ischemia.

Long-term complications developed in a total of 24 patients. Most of them required one or more reoperations. More than half of these complications can be attributed to faulty surgical technique in the early period of this study, and their incidence decreased significantly after technical improvements. The band was placed within the lesser omental sac in our first 30 patients. Among them, 14 (46%) developed a pouch dilatation or a combination of pouch dilatation and band slippage. Twelve had to be reoperated. The band was repositioned in most of them laparoscopically.

The high incidence of pouch dilatation/slippage with the band in the lesser sac has been described in several papers [4, 7, 10]. Some authors have proposed a posterior fixation of the band [4]. Others stressed the importance of placing the band above the lesser sac [7], or even placing the band posteriorly at the esophagogastric junction [12]. We have modified our technique according to these reports and now place the band above the lesser sac. This provides posterior fixation and prevents band slippage. Only two cases (1.6%) of slippage have been noted in 120 patients since the introduction of this modification.

Rupture of the catheter was seen only with the Lapband system. In four cases, rupture occurred at the end of the metal tube that connects the port to the catheter, at the point where the catheter crosses the abdominal muscles, and repeated mechanical stress was probably responsible for the rupture. We therefore always try to give the catheter a regular curve and place the connection within the subcutaneous fat at a distance from the point of entrance into the muscles.

Band erosion was seen in three cases with the Lapband. In one, the band had been repositioned a year earlier because of pouch dilatation; tight fixation of the band on both the anterior and posterior aspects of the stomach may have played a role. No causative factor could be found in the other two cases. Forsell et al. recently have shown that overinflation of the SAGB dramatically increases the risk of late band penetration [8]. They stressed that the band should not be inflated with >9 ml, according to the manufacturer's recommendations. No similar data exist for the Lapband, but common sense suggests that overinflation also implies an increased risk of penetration, especially because the Lapband is a high-pressure system.

Follow-up after LGB is of paramount importance, as for any bariatric procedure, and involves the same multidisciplinary team that evaluated the patient before surgery. The patients are instructed to eat three meals a day, take small pieces of food, chew well, eat very slowly, and avoid snacks completely. According to the eating capacities of the patients and the degree of their weight loss, the band is narrowed to allow for a weight loss of 2–5 kg a month. Occasional food regurgitation is almost inevitable, but it should not become a daily event, because repeated vomiting is associated with a higher risk of pouch dilatation. Dietary counselling can help to achieve optimal weight reduction. Regular physical activities are encouraged. Close monitoring of the comorbidities is mandatory, and their treatment must be adapted accordingly. Iron and vitamin deficiencies (B12, folic acid, D3) may develop and must be compensated for, as required.

In conclusion, LGB is associated with good to very good results in terms of weight loss in roughly two-thirds of the patients. The operative morbidity is acceptable. With proper operative technique, and once the learning curve is over, the risk of conversion is slim, and the long-term morbidity is low compared to other techniques, such as vertical banded gastroplasty [16]. Longer follow-up is clearly necessary to define the exact role of LGB in bariatric surgery. If the satisfactory results shown in this series are maintained over the years, LGB could become the restrictive procedure of choice for morbid obesity.

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