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RESEARCH ARTICLE

Ten Years Experience with Laparoscopic Adjustable Gastric Banding

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Abstract
Background Gastric banding is a safe and efficient bariatric procedure. We report here the results of 591 consecutive gastric bandings in terms of excess weight loss with up to 10 years follow-up and the complications.
Methods Between June 1996 and September 2006, 591 patients underwent laparoscopic adjustable gastric banding (LAGB) by the same surgeon (JB). Of these patients, 69.2% were women. Mean age was 33.6 years±10.7 and mean BMI was 41.95 kg/m^2±8.7. Patients were reviewed monthly for the first 6 months, every 2 months for the next 6 months, and yearly thereafter. Excess weight loss was calculated at 6 months and 1, 2, 4, 6, 8, and 10 years.
Results Six hundred eleven bands were implanted in 591 patients. Fifty-one patients (8.6%) had band removal due to a complication. Mean follow-up was 35±2 months. Percentage of excess weight loss was 45.8%±27.4 at 6 months, 66.7%±30.3 at 1 year, 72.6%±28.8 at 2 years, 75.9%±27.4 at 4 years, 82.8%±32.6 at 6 years, 82.3%±25.1 at 8 years, and 82.7%±4.2 at 10 years. Complications encountered were band failure (9.3%), slippage (5.3%), erosion (4.6%), infection (2.4%), high band position (1.9%), and others (2.8%). Complication rate was 23.3% overall but dropped to 2.5% when calculated on the second half of the patients.
Conclusion LAGB is a safe and efficient bariatric procedure. With experience, the complication rate drops to a very low level. Close follow-up can further increase its efficacy.

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Keywords Morbid obesity · Bariatric surgery · Laparoscopic gastric banding · Long-term outcome · Complications

Introduction

Laparoscopic adjustable gastric banding (LAGB) is the most commonly performed bariatric operation in Europe, Australia, and South America [1]. Since the Food and Drug Administration approval of LAGB in June 2001, the number of LAGB procedures performed in the USA has increased exponentially [2]. LAGB was shown to be a safe and effective procedure for the management of morbidly obese patients between 18 and 60 years old on the short, medium, and long term [3–6]. It was later reported to be efficient in superobese patients (BMI>50) [7, 8], obese adolescents [9, 10], and elderly people (>60 years old) [11]. This paper reports the results of 591 consecutive LAGB in a single surgeon practice as to excess weight loss (EWL) and complications. Moreover, it aims to emphasize the importance of the close follow-up of the patients.

Materials and Methods

Patients

A retrospective review was conducted on 591 consecutive morbidly obese patients who underwent LAGB by one surgeon (JB) in the same hospital (Saint Joseph Hospital, Beirut, Lebanon) during the period from June 1996 to September 2006. The preoperative characteristics of the patients are listed in Table 1. The indication for surgery was a BMI>40 kg/m^2 or a BMI>35 kg/m^2 with a related co-morbidity in 573 patients; 18 patients (3%) had a BMI<

Table 1 The preoperatively recorded characteristics of the 591 patients who underwent LAGB

Characteristic	Value
Sex (female/male)	409 (69.2%)/182 (30.8%)
Mean age (years)	33.6±10.7 (13–67)
Mean height (meters)	1.68±0.09 (1.46–1.96)
Mean weight (kg)	119.23±29.8 (76–290)
Mean BMI (kg/m^2)	41.95±8.7 (29–91)
Mean excess weight to lose (kg)	52.5±26.3 (12–204)

35 kg/m^2 operated for psychosocial reasons. The ideal weight of the patients was calculated according to the "Metropolitan Life" height and weight tables for women and men (medium frame, 1983), and accordingly, the EWL was calculated.

Technique

LAGB was routinely performed using the five trocars standard technique. A conversion rate of 12% was observed during the first 100 LAGB. No conversion was noted during the last 350 procedures. From 1996 until 2000, we used the Lowate bands (a first generation of bands), from 2000 to 2003 we used randomly the Lap-band and the Obtech band, and since 2003 we have been using the Lap-band and the Regular Minimizer with preference to the Lap-band in males with high BMI. The perigastric (PG) dissection was used in 18% of the patients and the pars flaccida (PF) technique in 82% of the patients. Our standard technique in the last 5 years combines the PF approach to avoid posterior slippage and the passage under direct vision to avoid gastric injury. The space between the left crus and the band is closed to avoid lateral slippage by a stitch between the greater curvature and the left crus. We insisted on a 20-ml gastric pouch, which we consider important for the satiety sensation. The pouch was secured by numerous gastro–gastric stitches around the band (5–7 stitches). The Weiner technique – a two-step technique that consists of removing the fat from the lesser curvature to have more space inside the band and to prevent early gastric stenosis – was used in 92 patients [12].

Postoperative Management

The patients were followed by the same surgeon (JB) every 4 weeks for the first 6 months, every 2 months for the next 6 months, and whenever needed. Liquid diet was recommended for the first week and a normal diet was introduced progressively thereafter. During each visit, weight was recorded, alimentary habits were discussed, and dietary advice was given. After a 10-min conversation with the patient, the band was adjusted in the surgeon's office using a progressive filling policy aiming to reach 4 to 7 kg weight loss per month. The injection volume was decided according to the weight lost and the tolerance the patient. Fluoroscopy to localize the port was rarely used.

Results

Between June 1996 and September 2006, 591 patients underwent a gastric banding procedure. A total of 611 bands were used in 591 patients because 20 patients required a band replacement due to various complications. The different types of bands used are recorded in Table 2. The number of procedures performed annually is illustrated in Fig. 1.

Nine intraoperative complications were encountered: two gastric perforations that were repaired after conversion to an open surgery, one small bowel perforation, and six spleen lacerations: splenectomy was done in two out of the three patients who required conversion to an open surgery and in one of the patients who were treated laparoscopically. There were eight patients who had early postoperative complications: six gastric stenosis in our early experience with the PF technique, one perforated duodenal ulcer, and one sudden death on the 13th postoperative day to which no cause was established. Of the six gastric stenoses, four were reoperated after failure of conservative treatment. Because we used the Weiner technique when the band was assessed to be tight, this complication disappeared. The mean hospital stay was 2±1 day. Apart from the sudden death on postoperative day 13, there was no surgical mortality in our entire series of 591 patients.

Twenty-five patients were lost to follow-up after the surgery. A total of 155 postoperative complications were encountered in 132 patients (23.3%) (Table 2). The band was removed in 51 patients: 11 with gastric erosion, 11 with infection, 9 with band failure, 8 with gastric slippage, and 8 with esophageal dilatation and psychological intoler-

Table 2 Gastric erosion and band failure rate according to the band type

Band type	No. of patients	Gastric erosion	Band failure
Lap-band	369 (60.4%)	5 (1.3%)	8 (2.1%)
9.75	31 (5.1%)		
10	267 (43.7%)		
11	71 (11.6%)		
Lowate band	153 (25%)	8 (5.2%)	42 (27.4%)
Obtech band	66 (10.8%)	15 (22.7%)	5 (7.5%)
Regular minimizer band	23 (3.8%)	0	0

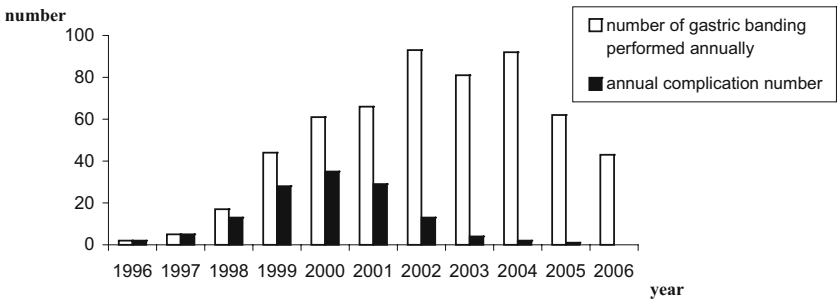

Fig. 1 Annual complications and gastric band insertion number

ance. Of the late complications, 87% occurred between 6 and 36 months after the surgery. Figure 1 gives the annual number of complications and shows the dramatic decrease in the complication rate from 70% (the first 30 patients) to 2.5% during the last 4 years (8 patients out of 320 patients). Major complications such as gastric slippage and erosion constitute 19.3% and 18.1% of the complications, respectively, while band failure, which is considered to be a minor complication, accounts for 35.5% of the complications (Table 3). We considered a "band failure" to be any lock failure and every leakage at any site from the balloon to the port.

Gastric slippage was reported in 30 patients (Table 4). In 20 of them, the PG dissection was used, resulting in a slippage rate of 18%. Once the PF technique was adopted, the slippage rate dropped to 2% (10 patients out of 485) ($p<0.0001$). The rate of erosion and band failure varied with the type of band used (Table 2). Band failure was responsible of 14 out of the 21 complications (66.7%) reported in the first 30 patients. There were no complications with the 23 Regular Minimizer bands used in the last 2 years of this study.

From the 566 patients included in the study for complications and weight loss, 515 patients still have a functional band. The follow-up rate at 1 year was 93%. Table 5 illustrates the number of LAGB performed throughout the years with their respective follow-up rates. The mean follow-up time was 35 months±2. In 236 patients, the mean follow-up time was >4 years (follow up-rate of 74.5%). It was >6 years in 71 patients. The mean adjustment number was of 6.3±3.8 times per patient.

The EWL was 45.8%±27.4 at 6 months, 66.7%±30.2 at 1 year, and 72.6%±28.8 at 2 years. At that time, 4.3% of the patients had an EWL<25%. The EWL was 75.9%± 27.4 at 4 years, 82.8%±32.6 at 6 years, 82.3%±25.1 at 8 years, and 82.7%±4.2 at 10 years (Fig. 2). The Wilcoxon matched pair test yields an extremely significant difference in EWL up to 2 years. Afterwards, the difference in the EWL between 2 and 4 years and 2 and 6 years is not significant ($p=0.68$ and 0.51, respectively). Considering weight loss, we did not find any difference between the different types of bands.

Discussion

LAGB has been shown to be a safe and efficient bariatric procedure, superior to intensive medical programs [6, 13–17]. In our practice, the results obtained over 10 years in terms of complications and EWL attest to these features. LAGB procedures were conducted in 591 patients. The majority of these patients were female, which is in line with many previous studies [6, 11, 16, 18–20]. However, our patients were younger and less obese than those previously reported. This might be attributed to local social reasons.

Over time, the complication rates decreased (Fig. 1). From 70% (in the first 30 patients), complications dropped to 2.5% in the 320 patients operated on during the last 4 years. In addition to the learning curve, the drop in the

Table 3 LAGB complications

	No. of complications	% of the complication
Band failure	55 (9.7%)	35.5
Gastric slippage	30 (5.3%)	19.3
Gastric erosion	28 (4.9%)	18.1
Infection	14 (2.4%)	9.1
High band position (cardia)	12 (2.1%)	7.8
Psychological intolerance and esophageal dilatation	16 (2.8%)	10.3

Table 4 Gastric slippage according to the band type and technique used

	Perigastric dissection	Pars Flacida approach
LapBand	7/23	2/346
Lowate	13/76	8/77
Obtech	0/7	0/59
Minimizer	0/0	0/23
Total	20 slippages/ 106 bands (19%)	10 slippages/ 505 bands (2%)

Table 5 LAGB: number of procedures and follow-up rate to 10 years

Time	No. of LAGB performed	Patients excluded	Follow-up years	Total LAGB performed	Total patients excluded	No. of patients followed-up	Follow-up rate (%)
Year 1	7	0	10	7	0	2	28.6
Year 2–3	26	1	8	33	1	7	21.9
Year 4–5	125	3	6	158	4	71	46.1
Year 6–7	169	6	4	327	10	236	74.5
Year 8–9	181	7	2	508	17	417	84.6
Year 10	83	8	1	591	25	516	91.2

complication rate can be due to several reasons, including the switch from the PG dissection technique to the PF technique with, consequently, a better lateral and anterior band fixation, and the introduction of the new band generations. In fact, a decrease in the slippage rate from 18% to 2% was observed after the switch to the PF technique with careful lateral and anterior fixation. The advantage of the PF technique concerning slippage rate was already shown in various studies [14, 21]. In our opinion, the PF technique decreases the posterior slippage rate and the closure of the space between the left crus and the band prevents lateral slippage. In our experience, this stitch between the greater curvature and the crus did not induce left shoulder pain.

The type of band used seems to be of a particular importance. The 1.3% erosion rate observed with the Lap-bands differs significantly from the 22.7% erosion rate observed with the Obtech band. Two possible personal technical reasons might have led to the high erosion rate in the Obtech band: tight gastro–gastric sutures and the location of the lock, as it was placed on the left in some patients. The balloon fold seen in the Obtech band after inflation might also be responsible for the erosion because it gives a hard point of contact with the stomach. A wider gastric canal and a band without a sharp fold might be the solution for the gastric erosion. Tube-port disconnection, which accounted for half of the band failure cases reported with the use of the Lap-bands, was resolved with the new port design. The benign nature of this procedure is further enhanced by a very low mortality rate (one nonrelated death in 591 consecutive patients). Its total reversibility seems to be of particular importance, especially in the cases of psychological intolerance.

Concerning the EWL, the literature reports an EWL that varies between 34% and 42% at 6 months [9, 10, 15, 22, 23] and between 30% and 63% at 1 year, with a majority included in the 47–58% range [9, 15, 20, 22–24] The efficiency of LAGB was established by worldwide reports of a sustained EWL>50% at 3 to 5 years [5, 25]. A meta-analysis conducted by O'Brien in 2006 [5] reported a gradual progression of weight loss for the first 3 years after LAGB followed by a stable level of weight loss out to 8 years with no detectable rebound. %EWL was found to be of 52.9, 57.9, and 59.3 at, respectively, 2, 4, and 8 years. A more recent study published by Favretti [6] on the 12-year results of LAGB in 1,791 patients reported an EWL of 43.7%±19.7 at 2 years, 38.6%±24.4 at 4 years, and 37.7%±26.7 at 6 years.

In our series of 591 patients, the EWL was 66.7%±30.3 at 1 year and increased to 72.6%±28.8 at 2 years, and continued increasing, reaching 82.3%±25.1 at 8 years (Fig. 2). The follow-up rate of 91.2% at 1 year and 84.6% at 2 years provides reliable data. Thus, according to our data, LAGB results in a continuous weight loss during the first 2 years that is sustained for up to 10 years. These results are in concordance with the O'Brien meta-analysis [5] concerning the weight loss pattern. The EWL

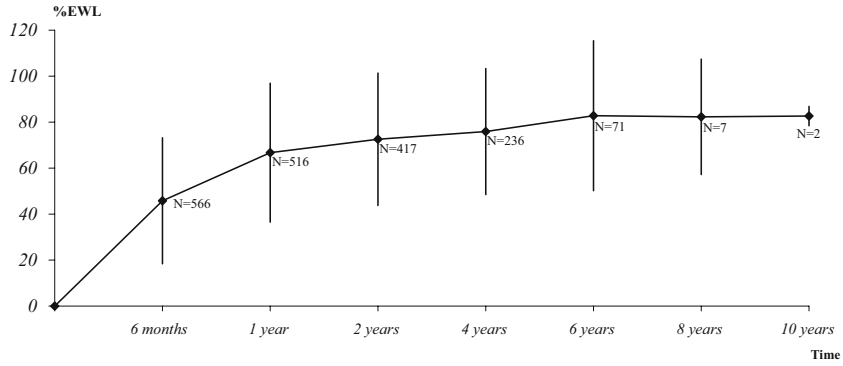

Fig. 2 %EWL after gastric banding up to 10 years

percentages that we present here are, however, higher than those previously reported in the literature. We believe that the 72.6% EWL at 2 years sustained up to 10 years is the result of an aggressive band adjustment policy and a close follow-up conducted by the surgeon. Teamwork is important, but close follow-up by the surgeon proves to be efficient.

Conclusion

When conducted by an experienced surgeon using the standard technique and the new generations of bands, the LAGB procedures prove to be safe and very efficient. The importance of an aggressive, close follow-up conducted by the surgeon is emphasized because it has led to improved EWL results.

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