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Laparoscopic adjustable silicone gastric banding: radiological appearances of a new surgical treatment for morbid obesity

B. Hainaux,[1] E. Coppens,[1] A. Sattari,[1] M. Vertruyen,[2] G. Hubloux,[1] G.-B. Cadière[2]

[1]Department of Radiology, CHU Saint-Pierre, Université Libre de Bruxelles, 322, rue Haute, 1000 Brussels, Belgium
[2]Department of Gastrointestinal Surgery, CHU Saint-Pierre, Université Libre de Bruxelles, 322, rue Haute, 1000 Brussels, Belgium

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Abstract

Background: The purpose of this report is to describe the radiologic appearances of laparoscopic adjustable silicone gastric banding (LASGB), a new surgical treatment for morbid obesity. In this procedure, a silicone band is fastened around the fundus, delimitating a small proximal gastric pouch and stoma. The inner surface of the band is inflatable and connected by a thin silicone tube to an access port. This allows postoperative stoma size adjustment by puncturing the port and injecting or withdrawing saline solution.

Methods: One hundred eighty patients underwent LASGB. A radiologic study protocol was established and performed in all patients, including preoperative double-contrast upper gastrointestinal (GI) series and single-contrast upper GI series on the first postoperative day and 1 month after surgery. Radiologic evaluation was also performed at each band adjustment and in case of persistent vomiting or inadequate weight loss.

Results: Postoperative stoma adjustment was performed in all patients. The optimal volume of saline was 1–4.5 mL. Percutaneous puncture of the port was impossible in three patients because of an inverted port. We observed 15 cases of pouch dilatation with stomal obstruction requiring reoperation. There were also nine cases of spontaneous band deflation caused by leaking reservoir in five cases and by disconnection between the connecting tube and the port in the other four cases.

Conclusions: Because radiologic evaluation is necessary after surgery and for band adjustments, radiologists are involved in the postoperative follow-up and may be asked to perform those adjustments themselves.

Key words: Adjustable gastric banding—Gastroplasty—Obesity, surgery—Stomach, surgery.

Correspondence to: B. Hainaux

Laparoscopic adjustable silicone gastric banding (LASGB) is a gastric restrictive surgical procedure designed to induce weight loss in morbidly obese patients by limiting food consumption. This technique has been developed in Europe, where more than 7000 patients underwent this procedure. In the United States, FDA trials are in progress for this device. We describe the normal and abnormal radiographic appearances of this new surgical technique and how to perform the postoperative adjustment of the band.

Materials and methods

Between July 1994 and September 1997, 180 patients underwent laparoscopic adjustable silicone gastric banding (LASGB) with a band specifically designed for laparoscopic surgery (Lap-Band, BioEnterics, Carpintera, CA).

In this gastric restrictive procedure, a silicone band is looped around the fundus. Slipping of the band is prevented by seroserosal stitches. The band creates a channel between the small pouch above and the distal stomach below. The inner surface of the band is inflatable and connected by silicone tubing to an access port (Fig. 1). The port is sutured in the anterior rectus sheath just below the distal part of the left ribcage to allow the postoperative percutaneous adjustment of the band by puncturing the access port and injecting or aspirating saline to decrease or increase the stoma size.

Patients having failed the dietary regimen were selected on basis of the criteria of the American Society of Bariatric Surgery [1]. Among the 180 patients, there were 161 women and 19 men. Average values of the clinical parameters were an age of 40 years (range = 18–65 years), body weight of 120 kg (80–202 kg), body mass index of 44 kg/m^2 (37–65 kg/m^2), and percentage of 198% (155–278%) excess body weight as compared with ideal weight.

A preoperative evaluation was performed in all patients, including laboratory tests, gastroscopy, and double-contrast upper gastrointestinal (GI) series, to rule out endocrinologic and organic diseases or hiatal hernia. Psychiatric and nutritional evaluations were also carried out before surgery.

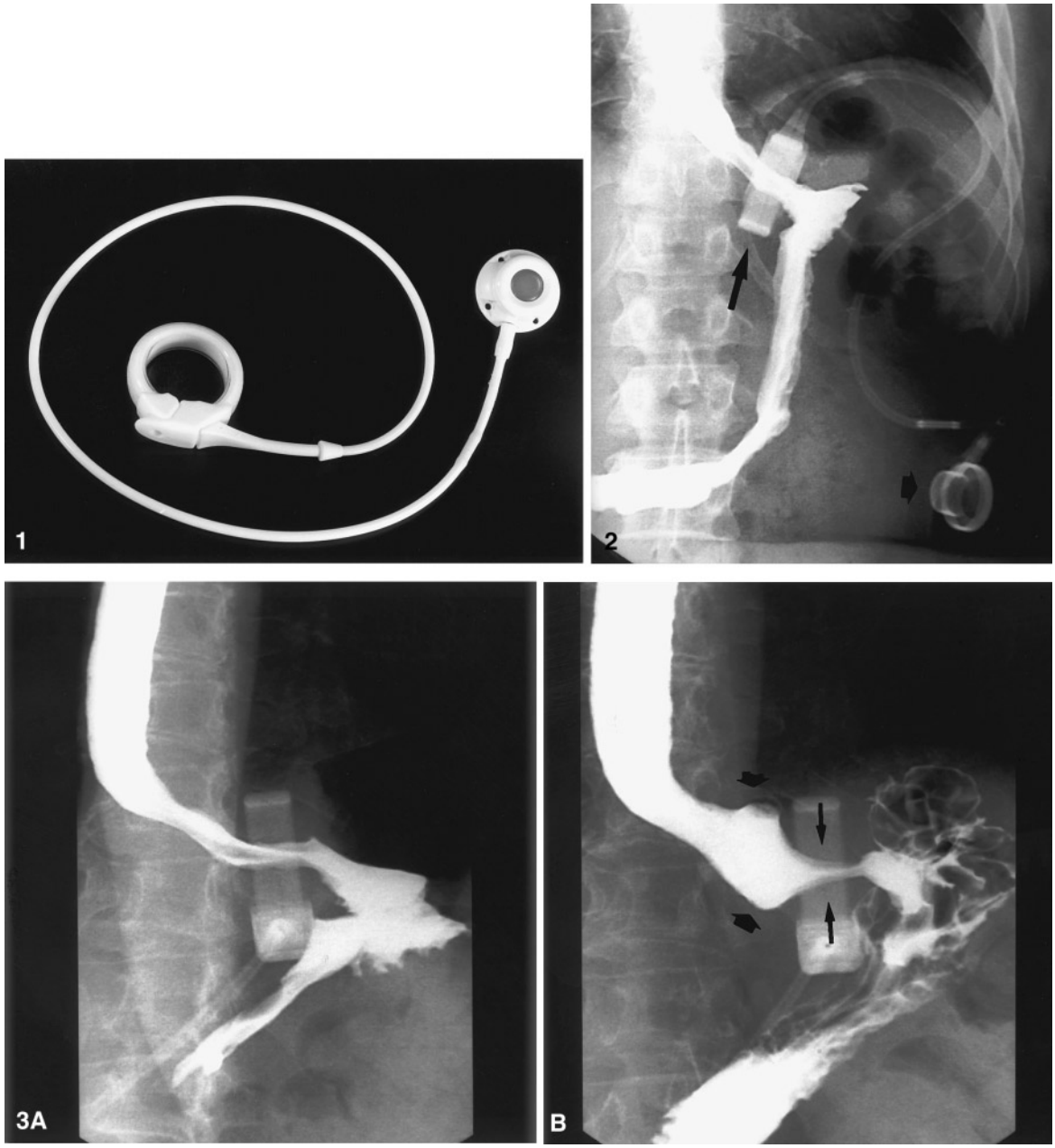

Fig. 1. The Lap-Band laparoscopic adjustable gastric band is a silicone gastric band with an inflatable inner surface connected by silicone tubing to an access port.

Fig. 2. Radiologic appearance of the laparoscopic adjustable gastric band on the first postoperative day. The gastric band (*arrow*) is fastened around the proximal part of the fundus. Upper gastrointestinal series shows contrast passing through the stoma band into the stomach. Also note the silicone tubing and access port (*arrowhead*).

Fig. 3. Postoperative stoma adjustment. **A** Radiologic appearance of a noninflated band. **B** Upper gastrointestinal radiograph of the same patient after inflation with 2 mL of saline shows reduction in stoma size (*arrows*); the upper gastric pouch is clearly visible (*arrowheads*).

On the first postoperative day, an upper GI study using water-soluble contrast medium was performed in all patients to check the position of the band, the passage through the stoma, and the absence of extragastric leak (Fig. 2).

Because postoperative stomal edema may temporarily decrease stoma size, the bands were left empty at surgery and inflated only 3 or 4 weeks after placement. Stoma size adjustment by puncturing the access port was performed in all patients. During placement of the band, the initial pouch and stoma sizes were controlled through the use of a calibration tube. Stoma size was calibrated at 12 mm and pouch volume at 15 mL. According to the manufacturer's information, the stoma size may be decreased by 0.5 mm by adding an additional 0.4 mL of saline. To prevent overinflation and pouch dilatation, we were very careful with the first patients and injected only 1 mL of saline solution at each

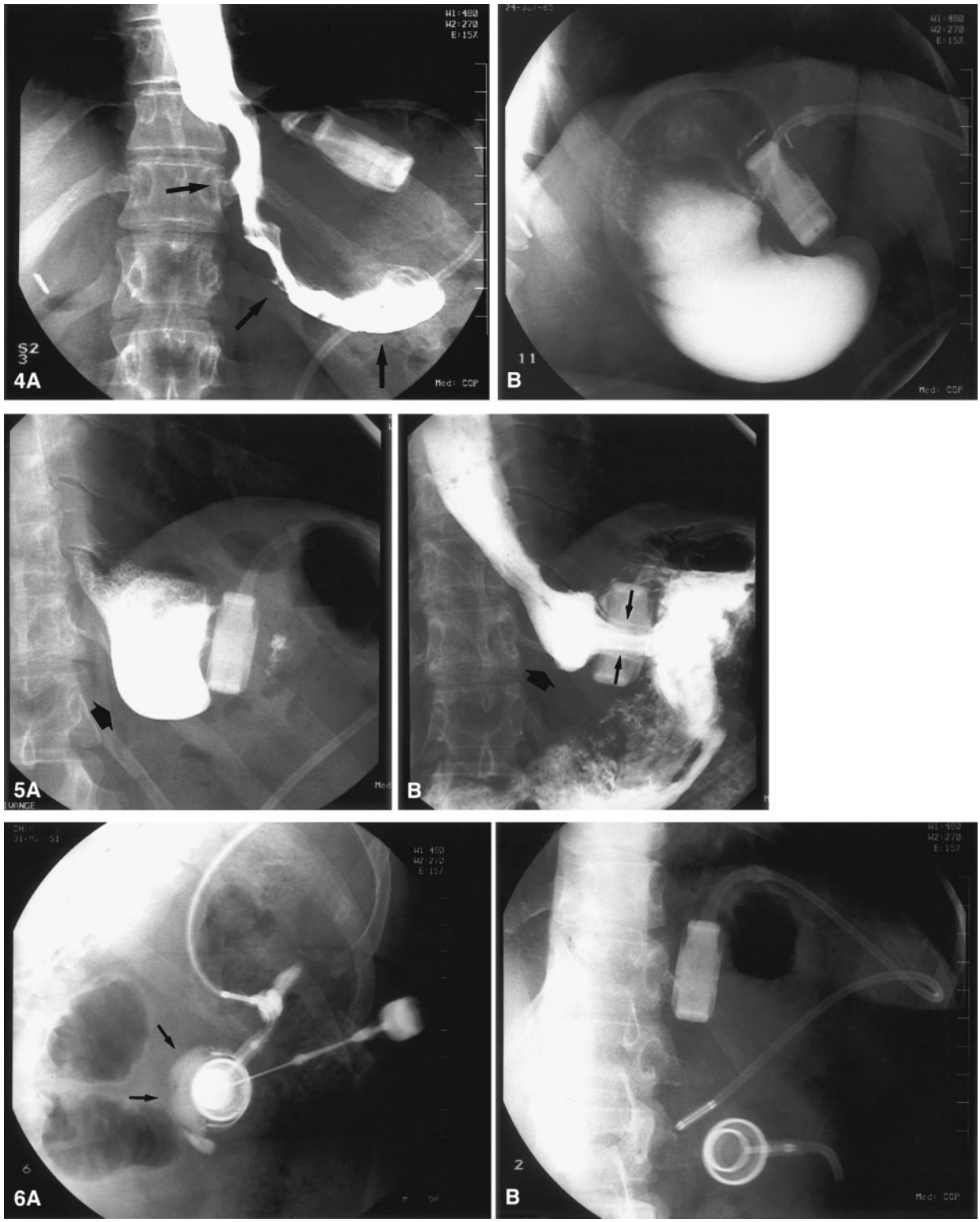

Fig. 4. Pouch dilatation. **A** Large upper pouch dilatation (*arrows*), above the gastric band, seen during early contrast filling. **B** The same patient with larger contrast volume showing total stoma obstruction. No contrast passes through the gastric band.

Fig. 5. Reduction of pouch dilatation after band deflation. **A** Large pouch dilatation (*arrow*) with almost no passage of contrast through the stoma of the band. **B** Immediate radiologic improvement after band deflation is shown by decreased volume of the upper gastric pouch (*arrowhead*) and easy passage of the contrast agent through the band because of increased stoma size (*arrows*).

Fig. 6. Spontaneous band deflation as a late complication. **A** Deflation of the band due to leakage from the port. Leakage (*arrows*) is confirmed by injection of ionic contrast medium in the port. **B** Deflation of the band due to spontaneous disconnection between the connecting tube and the access port.

Table 1. Complications and therapeutic interventions in patients who underwent laparoscopic adjustable silicone gastric banding

Complications	No. of patients	%	Therapy
Pouch dilatation requiring reoperation	15	8.3	Surgical repositioning of the band (10 cases), removal of the band (five cases)
Pouch dilatation without reoperation	4	2.2	Deflation of the band with long-term good results
Leaking reservoir	5	2.7	Reservoir substituted
Disconnection of the port	4	2.2	Reconnection

adjustment. With increasing experience, we inject 2 mL of saline at the first postoperative adjustment (Fig. 3). Further adjustments are done according to individual patient's weight loss.

The postoperative adjustments were performed in the X-ray department. The skin was cleaned with an antiseptic solution before percutaneous puncture of the reservoir and injection of saline. A 20-gauge access port needle was used, without preliminary local anesthesia. The needle was pushed into the port, and its correct position was confirmed by injection and aspiration of the saline solution. If necessary, the puncture was guided fluoroscopically.

Because overinflation of the band may result in a closed stoma, we systematically evaluated the stoma size before and after each adjustment with a radiologic examination. These examinations were performed on a digital fluoroscopy unit with the same magnification in all cases. The patients were examined in an upright position. The optimal patient position to evaluate the stoma size and the pouch was anteroposterior or slightly left or right posterior oblique. Views were taken when the patient had swallowed one mouthful of a 50% barium solution, which allowed the proper evaluation of the stoma and established a baseline comparison for subsequent radiologic explorations.

Results

Normal findings

The band may be adjusted several times in case of inadequate weight reduction. We performed, at the request of the surgeons, an average of three adjustments for each patient. The relatively high number of adjustments was due in part to inexperience with the first patients and to the absence of previous data in the literature because of the novelty of the technique. With experience, the frequency of postoperative adjustments has decreased.

The puncture was usually easy but, in a few cases, the port rotated on its side, making the puncture more difficult. In three patients, puncture was impossible because of complete inversion of the access port, necessitating its surgical reposition.

Women who became pregnant also had the band deflated, without fluoroscopic guidance. Deflation was easily done in two patients.

The optimal volume of saline in the band varied from one patient to another, i.e., 1–4.5 mL, with an average of 2.5 mL. The range of diameter of the stoma was 6–11 mm (average = 9 mm).

In terms of weight loss, LASGB generates results comparable with those obtained when using other procedures. In our series, loss of excess body weight was 28% at 6 months, 38% at 12 months, and 43% at 2 years.

Complications

Data concerning complications are summarized in Table 1. In 15 of 180 patients, we observed pouch dilatation with stomal obstruction requiring reoperation. In 10 of these cases, surgical repositioning of the band was performed. In the five other cases, the band had to be removed. These patients presented with vomiting and had dysphagia. Radiologic examinations showed in all cases a large pouch dilatation and a complete obstruction of the stoma (Fig. 4).

Pouch dilatation can be managed successfully by band deflation if this is done soon after the obstruction. This was the case with 11 patients, with immediate good results (Fig. 5). However, for seven patients, pouch dilatation recurred several weeks later, requiring reoperation. These seven patients are included in the 15 reoperated patients mentioned above.

No gastric perforation was found after placement of the band. However, GI studies demonstrated two gastric perforations after surgical repositioning of the band.

Deflation of the band due to leakage from the port was observed in five patients. The diagnosis was confirmed by puncturing the port and injecting ionic contrast medium (Fig. 6A). The leaking reservoir was changed in all cases. Four other cases of spontaneous band deflation were observed several months after surgery because of disconnection between the tube and the port as shown on plain abdominal film (Fig. 6B).

Discussion

The health implications of severe obesity include increased risk for cardiovascular diseases, dyslipidemia, diabetes mellitus, gallbladder disease, and joint disease leading to increased morbidity and mortality. Treatments such as dietary regimen, exercise, and behavioral modification have a high failure rate. It is now widely admitted that surgery is the only effective approach for weight loss in the morbidly obese patient. Potential candidates, as

established in 1991 by the National Institute of Health consensus development conference on gastrointestinal surgery for severe obesity, are those with a body mass index (BMI, kg/m^2) equal to or greater than 40 kg/m^2. Surgery may also be recommended for less severely obese patients (BMI 35–40 kg/m^2) with high-risk comorbid conditions [1].

The first widely used surgical procedure for the treatment of obesity was the jejunoileal bypass, which exerts its weight-loss effect through malabsorption. This technique was abandonned because of serious metabolic complications. Two procedures have dominated practice since the early 1990s: gastric bypass and vertical banded gastroplasty [2]. In 1986, Kuzmak introduced a new technique called adjustable silicone gastric banding (ASGB) [3].

This technique is the least invasive surgical procedure for morbid obesity. No cutting or stapling of the stomach is required, and there is no bypassing of any portion of the stomach or intestines. ASGB generates weight loss comparable with that obtained by using other gastric restriction procedures [3]. Since 1992, a laparoscopic approach has been feasible (LASGB) [4], which is particularly favorable for the postoperative outcome of obese patients.

Radiologic appearances of normal ASGB and its complications have been reported previously in only one paper and was based on only a few patients [5]. A very recent paper has reported on the preliminary results of 23 patients with LASGB [6]. We present our experience with 180 patients who underwent the laparoscopic approach of this technique. Furthermore, we propose a radiologic study protocol for these patients: (a) preoperative double-contrast upper GI study, (b) upper GI series using water-soluble contrast medium on the first postoperative day, and (c) postoperative adjustment of the band 1 month after surgery with radiologic control before discharging the patient. Radiologic evaluation is also necessary in cases of persistent vomiting or because of inadequate weight loss.

The most important complication of LASGB, as in any other gastric restrictive surgery procedure, is pouch dilatation with stomal obstruction. A comparative study between vertical banded gastroplasty and ASGB showed 6% of stomal obstruction in the group with ASGB [7]. In our series of 180 LASGB, there were 15 stoma obstructions (8.3%) requiring surgery. In cases of pouch dilatation, after radiologic confirmation we deflate the band, which immediately produces good results in most cases. However, dilatation recurred in more than half of these patients.

The mechanism of pouch dilatation is slippage of the posterior gastric wall from below to above the band. Slippage may be due to overeating, episodes of vomiting, or absence of adhesions in the laparoscopic approach. To prevent this complication, some surgeons have suggested not only anterior gastrogastric stitches but also posterior fixation [8].

Several investigators have proposed different mathematical formulas to calculate the volume of the gastric pouch from upper GI radiographs after bariatric surgical procedures [9]. We consider the exact volume of the pouch, which is approximately 15 mL, depending on the surgical technique, not to be important if there is no clinical or radiologic sign of stoma obstruction. Therefore, the postoperative adjustment of the band is completed each time by radiologic evaluation to check the passage of barium through the restricted stoma.

In summary, we report on the normal and complicated radiologic appearances of LASGB, a new surgical treatment for morbid obesity. Moreover, because X-ray examinations are necessary after surgery and for postoperative band adjustments, radiologists may be asked to perform those adjustments themselves, as currently performed in our institution.

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