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NEW CONCEPT

Technical Details and Result of a Minimally Invasive Management of Gastric Band Erosions: a Series of 47 Patients

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Abstract

Introduction Laparoscopic adjustable gastric banding (LAGB) is proven to be a safe and effective treatment option for obesity in the long term. However, in recent decades, LAGB prevalence progressively decreased worldwide principally due to the incidence and the management of the complications. Understanding the optimal management of the complications becomes therefore of primary importance. The aim of this study is to describe a personal technical, laparoscopic solution of band erosion and to analyze outcomes in 47 patients.

Methods From October 1995 to January 2019, 3697 LAGB were performed at our institution. Since November 2011, an original laparoscopic gastric banding removal technique was introduced. All the bands placed in these patients were Lap-Band AP System (Allergan, Irvin, CA). The data of the patients who underwent gastric band removal because of band erosion were retrieved from a prospectively collected institutional database, and used for the present retrospective evaluation.

Result Ninety-four patients (2.5% of the entire casuistic) with eroded band were diagnosed and treated at our institution. Forty-seven patients were treated with the laparoscopic gastric banding removal technique introduced in November 2011. All the operations have been performed laparoscopically with no conversion or intraoperative complications. There were neither major complications nor peri-operative (30 days) mortality.

Conclusion Proper preoperative management and a standardized minimally invasive technique could help to cope with erosion, the most frightening complication of LAGB. Understanding the optimal management of complications and safe reoperation techniques can contribute to a rational use of the LAGB, reversing the current declining tendency.

Keywords Laparoscopic adjustable gastric banding · Erosion · Minimally invasive surgery · Complications · Laparoscopic gastric band removal

Introduction

Laparoscopic adjustable gastric banding (LAGB) is proven to be a safe and effective treatment option for obesity in the long term [1–3]. However, in recent decades, LAGB prevalence progressively decreased worldwide. In the American Society for Metabolic and Bariatric Surgery's estimate of bariatric surgery numbers, LAGB represented only 2.8% of all bariatric procedures in the USA in 2017 compared to 35.4% in 2011 [4]. This trend reflects what is happening in the rest of the world, although less clearly.

A series of more or less clear reasons, led to this decrease of LAGB: one of them, which underlies the LAGB decrease, is the incidence and management of the complications. Thus, understanding the optimal management of the complications becomes of primary importance.

The main complications of LAGB are late events, mainly represented by herniation-dilation of the gastric pouch and/or of the esophagus, band erosion, and port system dysfunction; all of them can require re-do surgery and cause weight loss failure. Anyway, the most critical complication of the LAGB remains band erosion [5–9]. The broad spectrum of symptoms associated with band

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erosion ranges from asymptomatic conditions to non-specific abdominal pain, loss of satiety and stalled weight loss, weight regain, and retrograde port infection. Clear knowledge of the clinical consequences, of the diagnostic pathway, and of the treatment algorithm is mandatory to propose a reassuring, safe solution.

The incidence of the erosion has gone down over the years, but it still remained vary variable in the literature, ranging from 0.2 to 32.7% [8, 10]. To date, there is neither universally accepted pathogenesis nor standardized technique for the management of the band erosion. Several different approaches to the problem were proposed, but an optimal management has not been identified. The only key point in the treatment of band erosion is the removal of the band. The two most popular methods are laparoscopic and endoscopic band removal, but other hybrid procedures or even open approaches are reported [5, 7, 10–13].

The aim of this study was to describe the technical details of our laparoscopic management of band erosion. An original technique fit for the most widespread Lap-Band AP (Advanced Platform) System (Allergan, Irvin, CA) reopening characteristics was proposed, and indications, perioperative, and late outcomes of the procedure were evaluated.

Materials and Methods

The data from a prospective-collected database were retrospectively analyzed including all the patients who had undergone Lap-Band as first surgical bariatric procedure at our institution from October 1995 to January 2019. All the operations were performed by a single surgeon with over 15 years of experience in bariatric surgery (FF). The original laparoscopic gastric banding removal technique has been performed since November 2011 in patients with an eroded Lap-Band AP System.

In the study analysis, only patients that underwent gastric band removal because of band erosion were evaluated. The number of erosions, onset time, preoperative symptoms, diagnostic method used, relation with weight loss (if present), the main characteristics of the patients, and intraoperative findings were assessed. The diagnoses were supported by clinical data, fluoroscopic exams, ultrasonography (US), and pivotal endoscopy. All the eroded bands were removed respecting the timing and the codified technique. Postoperative outcomes, such as length of hospitalization, complications, 30-day reoperations, readmissions, and mortality were also analyzed.

The study was approved by the Medical Center Institutional Review Board. The patients were informed regarding both the benefits and potential complications of the surgical procedure, and they signed the informed consent.

Diagnostic Peculiarities

The following diagnostic management was applied to identify direct or indirect signs of band erosion: (1) clinical examination of the port site looking for inflammation signs, (2) contrast media (Gastrografin®) fluoroscopy of the upper digestive tract, (3) US of the abdomen to examine the presence of fluid collections or abdominal/pleural effusion, and (4) gastroscopy, the cornerstone to confirm the presence of band erosion and to evaluate the amount of erosion and the position of the buckle.

Strategy of Treatment (summarized in Fig. 1)

In no case, band erosion was a surgical urgency or emergency, in fact, no free perforation or abdominal sepsis was recorded. The timing of the revision surgery was usually established based on the presence or absence of acute inflammation, and, if the latter was present, according to its severity (local or systemic inflammation).

In asymptomatic patients, who lost their satiety, ceased to lose weight or showed weight regain, the band was generally removed within 1–2 months in agreement with patients' compliance. The endoscopic findings of the progressive erosion of the buckle facilitating the removal could also suggest the timing.

As to the patients who showed port site inflammation, the first step in the management of the eroded band was the removal of the port under local anesthesia; the tube was drawn back from the subcutaneous tissue and left outside the skin as the most effective drainage. Antibiotic therapy, according to the result of the microbiological examination, was administrated. The timing of the band removal was defined according to the evolution of the local and/or systemic infection.

Operative Technique (Fig. 2)

In all cases, a laparoscopic approach was performed according to the codified technique. The patient was placed in a supine position with abducted lower limbs. Trocars were positioned as for the standard LAGB procedure. All patients showed a more or less significant, chronic inflammation surrounding the band but no abdominal spillage. The first step of the surgical procedure was to identify and follow the connecting tube to scrutinize whether the closure system was visible, according to the amount of migration inside the gastric wall. In fact, the closure system of the band is the key factor during the removal. Due to its dimension and irregular surface, it often remains blocked inside the gastric wall. Moreover, the continuity with the connecting tube, which is the natural drainage pathway of the erosion, leads to the development of strongly inflamed and sclerotic tissues around the closure system.

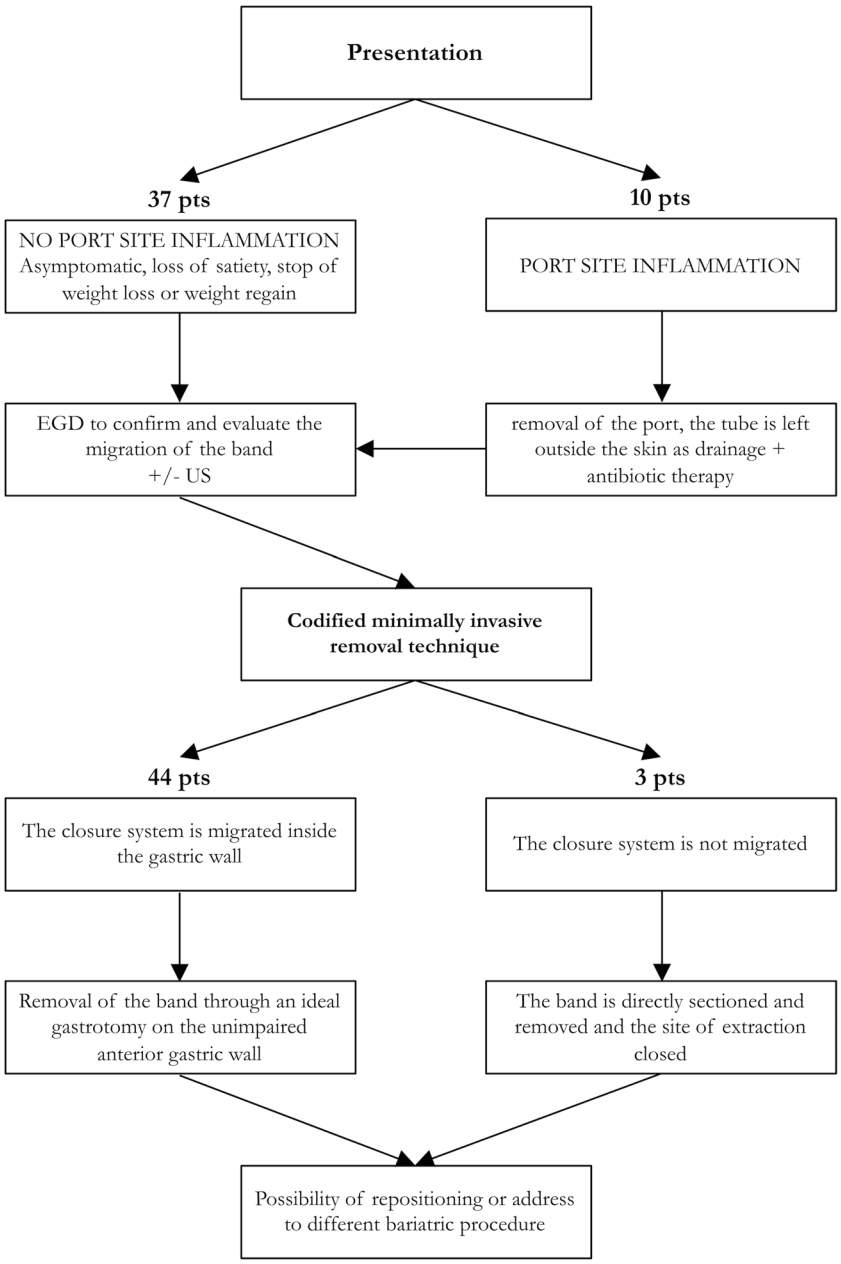

Fig. 1 Algorithm of the treatment management

There are two possible conditions based on the position of the closure system, with their specific solutions:

– Closure system inside the gastric wall, covered with firm tissue. As to this more demanding and frequent situation, a specific technique addressing the Lap-Band AP characteristics was proposed. The connecting tube, covered with omentum, was freed-up with the electrified hook to expose, section (Fig. 2a) and remove the "funnel-shaped section" peculiar of the Lap-Band AP, which was located about 5 cm from the buckle. This step is important because the "funnel-shaped section," if not removed, will prevent the band from slipping out in the next phases. An ideal gastrotomy was performed on the unimpaired anterior gastric wall at the level of the fundus, where the migrated band was reachable with the grasp, far away from any inflamed, sclerotic tissue (Fig. 2b). Through the gastrotomy, the band inside the gastric cavity was grasped and sectioned (Fig. 2c). Pulling out the posterior branch of the band was essential to determine the spontaneous re-opening of the closure system blocked by the scar tissue inside the gastric wall (Fig. 2d). The posterior branch came out easily and then the anterior branch was drawn outside (Fig. 2e). Finally, the ideal gastrotomy on the unimpaired anterior gastric wall was safely closed (Fig. 2f). This access was also used when the entire closure system had migrated inside the gastric cavity.

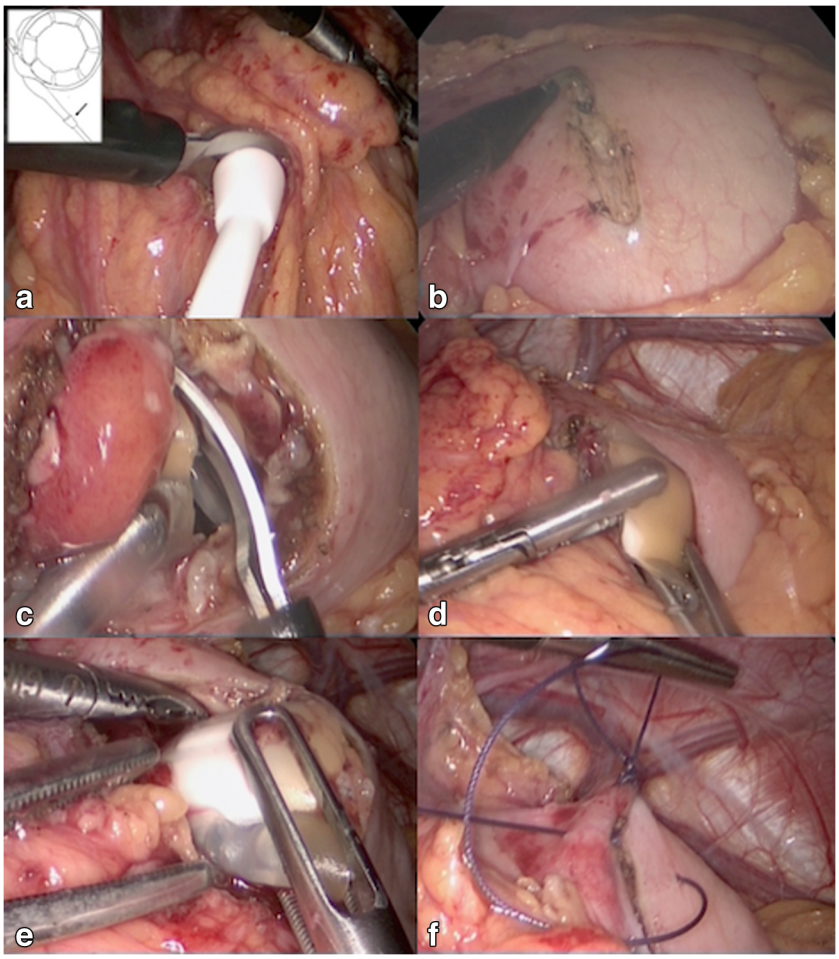

Fig. 2 Operative technique. **a**) Sectioning of the "funnel-shaped section". **b** Ideal gastrotomy on the unimpaired anterior gastric wall at the level of the fundus. **c** Sectioning of the band. **d** Extraction of the band posterior branch which determines the spontaneous re-opening of the closure system. **e** Retraction of the anterior branch. **f** Closure of the ideal gastrotomy

– No-migrated closure system. The connecting tube was followed as far as the "no-migrated" closure system. The closure system was then isolated. The band was sectioned and removed. Finally, the site of extraction was closed with stitches.

The band was always removed inside an endobag.

Results

Ninety-four patients (2.5% of the entire series) with eroded band were diagnosed and treated at our institution from October 1995 to January 2019. They were all treated by laparoscopic removal with the exception of only one case in which the endoscopic solution was performed, without specific complications.

Due to the technical improvement and the technological advancements, the incidence of erosion had been decreased over the time. In particular, by considering 2006, when the Lap-Band AP version was introduced, the erosion rate dropped from 3.1 to 2.3%, in our institution. In 2011, the new removal approach, proposed in this retrospective study, was applied. From November 2011, the new minimally invasive technique has been performed in 47 patients, who had all developed erosion of the Lap-Band AP System.

All patients underwent endoscopy to confirm the diagnosis before revision surgery. Patients' preoperative characteristics are summarized in Table 1.

In 26 asymptomatic patients (55.3%), the diagnosis was performed during the scheduled examinations. The "worrisome features" suggesting band erosion were unusual position of the band (or the interruption in the port-tube system detected by X-Ray examination), the passage of the contrast media (Gastrografin®) outside the band, and the medium was not affected by band restriction during the upper digestive tract fluoroscopy exam. As to this group of patients, all of them presented loss of satiety, stalled weight loss, or weight regain in the last months. In 6 patients (12.8%), these very symptoms guided the inspection.

In 10 (21.3%) patients, the onset was with the inflammation of the port site. No patient was an urgency case because of peritonitis or generalized sepsis. Only 5 patients did present with epigastric/non-specific abdominal pain.

The mean time between placement and band removal was 70.68 months. The mean time between diagnosis and

Table 1 Patients' characteristics

Total laparoscopic adjustable gastric banding	3697
Total erosions, *n* (%)	94 (2.5%)
Patients included in the study, *n*	47 (38 F; 9 M)
Positioning technique: pars flaccida/perigastric, *n* (%)	33 (70.2%)/14 (29.8%)
BMI at the primary LAGB (kg/m^2)	40.42 ± 5.54
BMI at the removal of the band (kg/m^2)	32.06 ± 5.67
EBMIL% at the removal of the band	53.98 ± 35.74

reoperation for the removal of the band was 33.47 days. All the operations were performed laparoscopically with no conversion or intraoperative complications. All patients received clear liquids between the first and second postoperative day. None of the patients had a band replacement or a conversion to another bariatric procedure at the time of the eroded band removal. The mean operating time was 73.46 min and ranged from 50 to 95 min. The mean length of postoperative hospitalization was 5.36 days and ranged from 3 to 11 days. No major complications, perioperative mortality (30 days), readmission, or 30-day reoperation were recorded (Table 2).

The port site flogosis required postoperative drainage and outpatient care for 25 patients. Eight patients underwent gastric plication after band removal, with a mean interval between band removal and conversion to gastric plication of 22.13 ± 15.79 months.

Discussion

The minor efficacy on weight-loss when compared to today's most widespread bariatric procedures (Roux-en-Y gastric bypass–RYGB and sleeve gastrectomy–SG) as well as the incidence of long-term complications are considered the main weaknesses of the LAGB. Although uncommon, the most critical complication of LAGB is band erosion.

In the literature, acknowledged key points in the management of band erosion are the diagnosis confirmation by endoscopic preoperative evaluation and the removal of the band. Though, there is no consensus on the best strategy to remove the band which may be performed by endoscopic, laparoscopic, and even open techniques [5, 7, 10–17]. Furthermore, no consensus is reached on the surgical timing and the postoperative bariatric treatment of the patient.

As to the surgical timing, some authors proposed to remove the band as soon as possible, after the diagnosis, in order to reduce the risk of further complications, to have the patients' resume daily activity faster and resolve anxiety or symptoms. Others proposed a delayed endoscopic or laparoscopic treatment if no surgical urgency or emergency was present [7, 14, 18, 19]. This second approach, called "watch and wait," aimed to an adequate migration of the buckle of the band inside the stomach (confirmed by endoscopic evaluation) to facilitate endoscopic or laparoscopic removal. As to the post-removal bariatric treatments, different approaches were proposed: primary repair and immediate replacement, removal and repair with delayed replacement, removal without further replacement, or conversions to another procedure (e.g., RYGB) [20–23].

In our study, the band erosion rate was 2.5%; this value was in agreement with the ones in the literature, close to the inferior range limit reported [5, 10]. To manage band erosion, the "watch and wait" approach was the first strategy proposed, agreeing on by the patient; this approach was fundamental to balance the surgical advantages against patient compliance. None of the patients had a band replacement or a conversion to another bariatric procedure at the time of the removal of the eroded band. Any post-removal bariatric procedure was proposed after a delay of about 6 months.

The removal strategy was the most important issue to consider. In our opinion, the laparoscopic approach was the best, as to technical feasibility, safety, and replicability. In about

Table 2 Presentation, intraoperative, and postoperative data

Primary symptom of erosion	
Asymptomatic, suspected at scheduled examinations, *n* (%)	26 (55.3%)
Loss of satiety, stalled weight loss, or weight regain, *n* (%)	6 (12.8%)
Port site inflammation, *n* (%)	10 (21.3%)
Nonspecific/epigastric abdominal pain, *n* (%)	5 (10.6%)
Time from the first operation to the band removal (months)	70.68 ± 34.94
Time from the diagnosis to the reoperation (days)	33.47 ± 37.37
Operative time (min)	73.46 ± 14.91
Postoperative hospital stay (days)	5.36 ± 1.66

half of cases, the removal technique of the eroded band had to take into account the expectancies of asymptomatic patients. In fact, the band erosion is a chronic benign process, which may not determine patient discomfort due to the slow progressive erosion balanced by an effective repair of the gastric wall. Thus, the therapeutic target was to slip out the band with a little invasive as possible technique, in order not to aggravate this asymptomatic situation.

The position of the band buckle represented the major concern in the removal technique, because of its dimension and continuity with the connecting tube. Only when the buckle had completely migrated, can the gastrotomy be safely carried out, to access section, and slip out the eroded band. In fact, the suture required during the procedure was performed outside the inflamed tissues [7]. This infrequent situation also allowed endoscopic removal. In all the remaining cases, the buckle, blocked inside the gastric wall, required a laparoscopic or open approach to sever the tissues from the band after exposing the closing system [11, 13, 14]. The closure of this inflamed extraction site was the major concern as to the efficacy of primary repair through stitches or the omental plug [17].

The lack of a well-codified technique in the band removal procedure might be considered a major weakness of LAGB, which is, on the other hand, a perfectly codified technique. In case of port site inflammation as a consequence of band erosion, the inflammatory process was treated and solved first, to reduce the operative risks and technical difficulties associated with acute inflammation. Our long-term experience in LAGB made us to devise a laparoscopic technique combining the advantages of a less invasive technique and the particular re-opening mechanism of the band AP. In fact, the Lap-band AP System has a particular shape that allows its re-opening by keeping the closing system fixed and pulling the posterior branch (Fig. 3). Exploiting the immobility caused by the migration of the closure system inside the gastric wall, by pulling the posterior branch, the AP Lap-band re-opening was obtained. Subsequently, the removal of the band appeared very simple. To perform these steps, the gastrotomy performed on the unimpaired anterior wall of the stomach was perfect for grasping the band, sectioning, and pulling it back. Actually, the sectioning of the band was not required, but it allowed to pull out the posterior branch easily. The unimpaired gastric wall, far from the inflamed tissue, can be safety sutured, differently from the inflamed gastric wall which always leaves some doubts about the firmness of the stitches. This minimally invasive standard approach was also proposed when the band migration was almost complete. That situation made the procedure even easier.

On the contrary, when the closure system had not migrated at all, the direct approach on the closure system was the selected method. In this case, the band could be dissected and removed directly. In fact, the band was accessible because the inflamed tissue was still poorly represented, allowing the section and a secure suture of the extraction site.

Some authors described the feasibility and the potential advantages of the endoscopic management of the band erosions [14, 15]. In our opinion, endoscopic

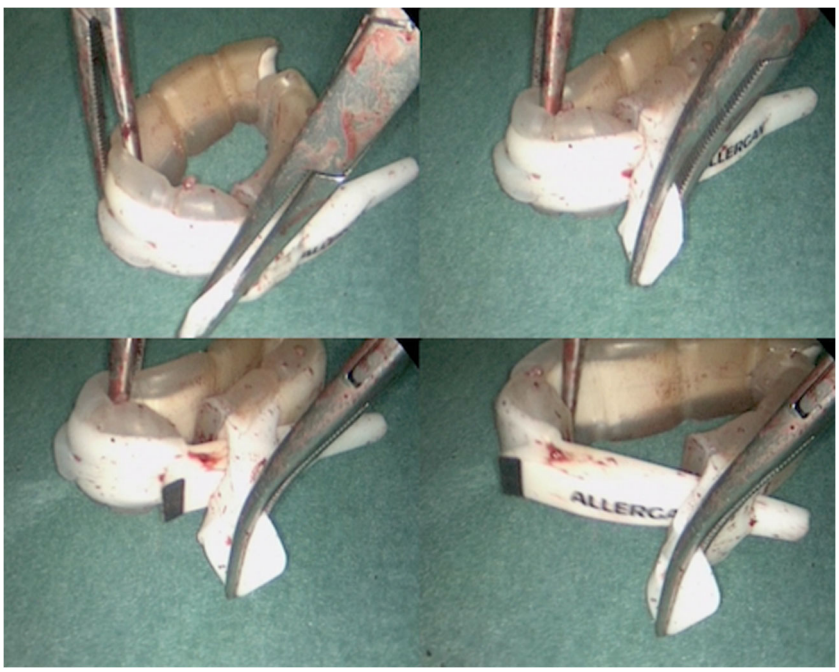

Fig. 3 Simulation of the re-opening mechanism

extraction remains a possible option in selected cases, when the band was migrated completely and the closure system is inside the gastric cavity. In fact, the endoscopic technique implies that 50% or more of the band, together with its closure system, have migrated into the gastric cavity. However, waiting for the entire band to be located within the stomach lumen often takes a lot of time. Although this waiting period is not dangerous, it is often not well accepted by the patient due to the risk of weight regain. Furthermore, the endoscopic removal of the band can be challenging, and a combined technique is necessary in many cases to dissect and remove the "funnel-shaped section" of the connecting tube [15]. Therefore, the laparoscopic approach is our first choice in all cases of band erosion, mostly since the standardization of the removal technique.

The main limitation of the present study is that it is based on the experience of a single skilled surgeon; thus, this study did not allow to evaluate the variability among surgeons. On the other hand, the introduction of a codified band removal technique gives the opportunity to manage the band erosion also to surgeons with different degree of experience in the bariatric field.

Conclusions

The experience combined with the particular opening mechanism of the Lap-Band AP System allowed us to develop a safe laparoscopic reintervention technique for erosion.

Proper preoperative management and a standardized minimally invasive technique could help to cope with erosion, the most frightening complication of LAGB. Understanding the optimal management of complications and safe reoperation techniques can back up a rational use of the LAGB technique, currently declining all over the world.

Compliance with Ethical Standards

Conflict of Interest Dr Furbetta Niccolò, Dr Gragnani Francesca, Dr Cervelli Rosa, and Dr Guidi Francesco have no conflicts of interest or financial ties to disclose. Dr Furbetta Francesco reports personal fees from Apollo Endosurgery, outside the submitted work.

Ethical Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. For this type of study, formal consent is not required.

Informed Consent Informed consent was obtained from all individual participants included in the study.

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