

Complications of laparoscopic gastric banding: detection and treatment



Ann. Ital. Chir., 2017 88, 3: 206-214
pii: S0003469X17026835

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INTRODUCTION: *Laparoscopic adjustable gastric banding (LAGB) is acknowledged as a popular and effective surgical option in the management of obesity and related metabolic diseases. This procedure is a remarkably safe operation from both a general surgical and bariatric perspective. It facilitates brief hospitalization and can be performed by single incision.*

METHODS: *We analyzed the most common LAGB complications as intraoperative and postoperative gastric perforation, stomach slippage/dilatation, port/tubing complications and intragastric band migration which occurred in our long decades clinical experience. Detection, treatment and rate of presentation of each complication was evaluated.*

RESULTS: *LAGB showed good long term results in terms of weight loss and resolution of obesity related diseases. Moreover, mortality due to obesity and related diseases appeared significantly lower in LAGB patients than in medically treated patients.*

CONCLUSION: *Gastric Banding has a very low rate of early and late complications; these are also less severe when compared to more invasive procedures and are likely to be managed with mini-invasive techniques. In any case referral to a bariatric surgeon is deemed appropriate.*

KEY WORDS: Complication, Laparoscopic gastric banding, Morbid obesity

Introduction

The incidence of obesity is increasing worldwide, due to changes in lifestyle and diet. The non-operative treatment of obesity includes diet, physical exercise and sometimes pharmacological treatment; nevertheless long-term

results have been proved to be widely unsatisfactory. On the other hand, the surgical treatment of obesity is effective in terms of weight reduction both in the short and long-term; it carries a dramatic improvement of co-morbidities leading to an increase in life-expectancy of obese patients. These benefits, added to the reduction of mortality and morbidity achieved through modern laparoscopic surgery, explain why obesity surgery is so widespread.

Bariatric surgery procedures are divided into restrictive (gastric banding, sleeve gastrectomy), malabsorptive (bilio-pancreatic diversion) and mixed (gastric bypass, mini gastric bypass). Actually this classification is considered to be less strict because of different neuro-hormonal mechanisms of action coming up.

In each different geographical area, one technique is preferred over another. For example, while gastric bypass is the preferred operation in the US, sleeve gastrectomy is

Pervenuto in Redazione Dicembre 2016. Accettato per la pubblicazione Marzo 2017

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more favoured in Europe. Many studies have analyzed and compared results and complications of various operations, but it is not yet possible to determine which is the best.

LAGB is an effective and safe operation with decreased peri-operative morbidity and mortality. However, it is essential to be aware of the specific complications of this technique in order to prevent, identify and treat them. In our Institution, we have 20 years of experience in all the bariatric operations in use today, ranging from gastric banding to sleeve gastrectomy (SG), single anastomosis bypass (also known as "mini bypass"), and Roux-en-Y Gastric Bypass. At the same time, we have gathered a considerable experience in revisional surgery. Therefore, the purpose of this paper is to describe and analyze the specific LAGB complications and their treatment from the standpoint of a high-volume Bariatric Surgery Center.

Intraoperative and postoperative esophageal and gastric perforation (0.2-0.8%)

DINDO CLAVIEN CLASSIFICATION III B

Intraoperative perforation

Gastric and esophageal perforation during band placement are more frequent in male patients with high degree of visceral obesity and and/or Belsey fat pad and in patients with hiatal hernia. Perforation occurs during the creation of the retrogastric tunnel; indeed gastric perforation is almost always located along the posterior wall of the stomach, close to the lesser curvature and the angle of Hiss. Usually this area makes intraoperative detection very difficult. Direct visualization of methylene blue leakage is the best method of intraoperative detection. The treatment consists in the suture of the gastric perforation. It is recommended to avoid the implantation of the band because of high risk of infection and migration. If the perforation is not visible and/or suturing is difficult it is worthless to convert to open surgery because laparotomy does not improve visualization; it seems more convenient to place a drainage via laparoscopy route, a nasogastric tube, and avoid *per os* nutrition for at least 6-7 days. A Gastrographin swallow after 6-7 postoperative days is mandatory. An upper gastrointestinal study with gastrographin detects 33% of all fistulae with a specificity of 100%.

Postoperative perforation

Postoperative perforation is generally caused by gastrogastric stitches, and therefore can be considered an intraoperative perforation detected postoperatively. It is rarely responsible of clear peritonitis (abdominal pain,

abdominal defense, fever). It's rather associated with tachycardia (bpm > 120/min) and tachypnea. Gastrographin swallow and CT scan are mandatory in the presence of the above mentioned symptoms. A prompt diagnosis is crucial as any delay considerably increases mortality. Treatment, possibly by laparoscopic route, consists in the identification of the perforation and placement of a Kehr tube or Petzer tube into the perforation with the aim of outsourcing the fistula within 4-6 weeks. A further drainage should be placed close to the site of perforation; a naso-gastric tube is mandatory. Finally the band can be removed. If peritonitis, it is widespread is essential to thoroughly clean the peritoneal cavity with large quantities of saline so as to reduce the bacterial load. The patient is kept in state until the septic state subsides and a contrast X-ray or CT scan demonstrates the absence of leakage from the stomach except through the Petzer or Kher drain; these are removed after 4-6 weeks when the maturation of a gastro-cutaneous fistula is completed.

STOMACH SLIPPAGE (1.0-5.0%)

Dindo Clavien I in case of Band deflation (90%)

Dindo Clavien III b in case of band removal or band repositioning (10%)

Stomach slippage is defined as the upward migration of the gastric body above the band. The incidence is variable ranging between 1-5%, but early banding series reported rates of up to 32%. The adoption of the perigastric technique has dramatically reduced the overall incidence of stomach slippage. Patients with stomach slippage are unable to tolerate solid foods (regurgitation/retching); in severe cases, they may not be able to tolerate either solid foods or fluids; reflux or heartburn especially when lying flat, sleep disturbance, night cough/wheezing are frequent complaints; in some cases, patients with stomach slippage present repeated chest infections. The immediate treatment of slippage is the aspiration of fluid from the band (band deflation) but, if symptoms persist, a barium swallow X-ray is mandatory. If barium cannot make its way through the band easily or at all and the patient suffers from vomit even after the intake of liquids, surgical removal of the band is indicated. Conservative management and review after 4-6 weeks can be an option when the patient at least tolerates water or other fluids. With the repeat barium X-ray at 4-6 weeks a decision can be made as whether to remove the band or continue with the conservative treatment can be made. This therapeutic strategy applies to all the types of slippage described (types 1 to 4), except to type 5 (stomach slippage with necrosis). Five types of stomach slippage have been described, based on clinical and radiological features. A normal image of the upper abdomen after LAGB placement is shown in Fig. 1.

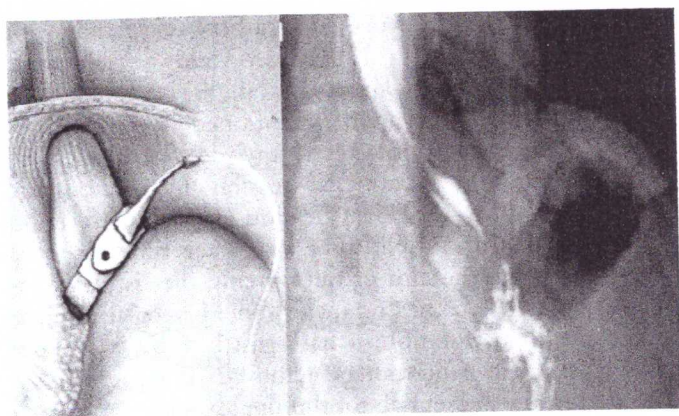


Fig. 1: LAGB: a normal image of the upper abdomen after LAGB.

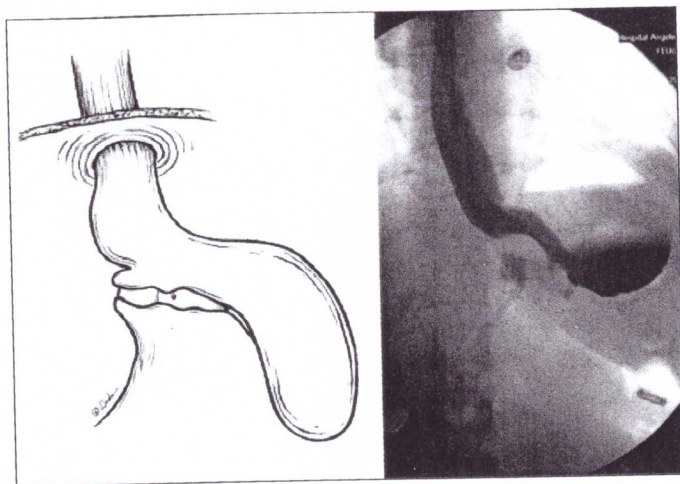


Fig. 2: Type 1 slippage (upward migration of the anterior gastric wall through the band). The band is rotated horizontally or downwards; barium accumulates over the left side of the band with either very little or no flow into the stomach distal.

The band is placed just below the gastroesophageal junction. The size of the pouch is appropriately sized to 50-80 ml. The most appropriate placement of the band is at an approximate 45° angle toward the left shoulder with the medial aspect of the band juxtaposed to the left pedicle of the vertebra. Type 1 slippage results from upward migration of the gastric anterior wall through the band (Fig. 2). The band is rotated horizontally or downwards; barium accumulates over the left side of the band with either very little or no flow into the distal stomach. Type 1 slippage is generally due to insufficient anterior fixation or disruption of the fixation sutures. Another possible cause is an increased pressure in the pouch due to early solid food intake, overeating or early (<4 weeks) band fill. In case of non operative management failure, laparoscopic repositioning is required. Once access to the peritoneal cavity has been gained, the band buckle is detected by placing the tubing under traction. A careful dissection of the gastric wrap around the band is carried out using endoshears and hook cautery. Previous

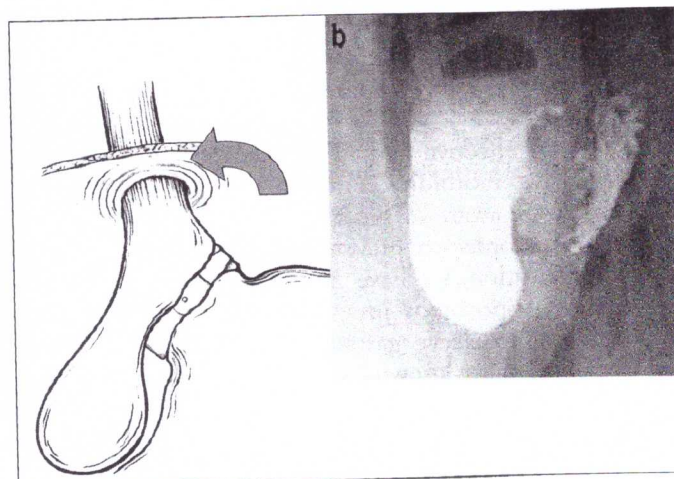


Fig. 3: Type 2 slippage (herniation of the posterior wall of the stomach through the band). The band is rotated into vertical position and often beyond; barium pools on right side of band; no flow (or delayed flow) into the stomach.

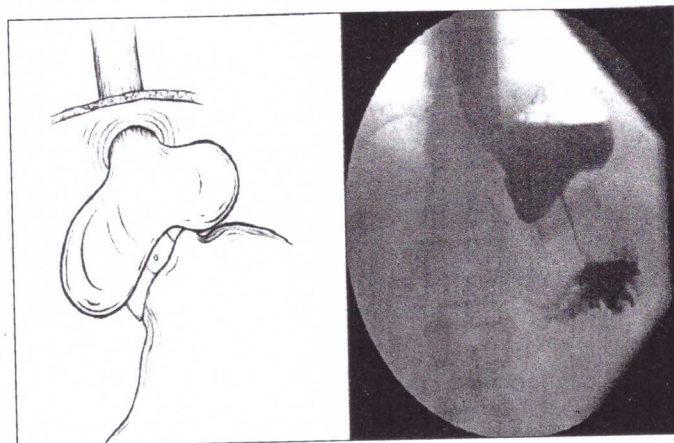


Fig. 4: Type 3 slippage (symmetric dilation of the proximal gastric pouch from an overpressure inside the band). The band is in normal position; the pouch is symmetrically enlarged; x-ray shows pouch pooling of contrast above with poor emptying.

stitches may be divided to release the wrap and open the perigastric tunnel. The slipped pouch is then pulled down through the band using an atraumatic grasper and the band is replaced. Two or three stitches are applied to maintain the band in position by creating a new anterior wrap. The stomach is then tested for leaks with methylene blue injection through the naso-gastric tube. When dense adhesions make the dissection excessively hazardous or when evidence of intra-abdominal infection is present, it is recommended to remove the band only and to place a drain in the surgical field. Type 2 slippage is defined as an herniation of the posterior wall of the stomach through the band (Fig. 3). It is rotated into vertical position and often beyond; on contrast x-ray, barium pools on the right side of the band; no flow (or delayed flow) is detectable into the stomach. This type of slippage is usually a consequence of a suboptimal sur-

gical technique. Fortunately, type 2 slippage is less frequent nowadays with the adoption of the pars flaccida approach instead of the perigastric approach. Its management is similar to that of type 1, generally via the laparoscopic route.

Type 3 slippage is also known as Symmetrical Pouch Dilatation (SPD). It consists in a dilation of the proximal gastric pouch with or without any change in the angle of the band and in the absence of signs of obstruction (Fig. 4). It results from an overpressure into the gastric pouch induced by high inflation or overeating. The patient complains of a lack of satiety, heartburn, regurgitation and occasional chest pain. This complication is likely to be solved non-operatively by band deflation and re-education of the patient who should be advised not to exceed in meal size. If the pouch size is demonstrated on a 4-6 weeks contrast study to be back to normal size, the band can be reinflated. Otherwise, surgical treatment with either band removal or replacement should be considered. Type 4 slippage is defined as an immediate post-operative prolapse and is usually due to placing the band too low on the stomach. Unlike the previous types and type 5, this is a chronic complication. It can be managed non-operatively in the first instance. Only in case of failure, surgical repositioning is needed. Type 5 is a type 1 or 2 slip with gastric necrosis; it is the consequence of an acute pouch dilation and requires a prompt surgical operation (possibly laparoscopy).

PORT AND TUBING COMPLICATION (3%) DINDO CLAVIEN IIIA

Port and tubing leak

Before 2000, the reported rate of port/tubing leaks ranged from 9.7% to 10.6%¹⁻³. More recent studies registered a dramatic decrease of this complication from 0% to 0.35%^{4,5} by virtue of new generations of bands in use and refined surgical technique. A better management of the port based on strict use of the non-coring Huber needle only (for the inflation-deflation procedures) is deemed responsible for the lower complication rate. Leak is the consequence of breakage or damage of the port or tubing (Fig. 5), or tubing disconnection. Almost always this complication occurs in the distal part of the band. Patients complain of poor weight loss and inadequate restriction/satiety following the band cuff adjustment. The restriction exerted by the band following inflation lasts for only 36-48 hours; then a progressive deflation of the band through the leak occurs. When aspirating the band, a less than normal quantity of fluid can be withdrawn (to be noted that a 0.5 ml difference between the quantity injected and the quantity retrieved is within normal limits). The identification of the exact point of breakage is more challenging. A plain abdom-

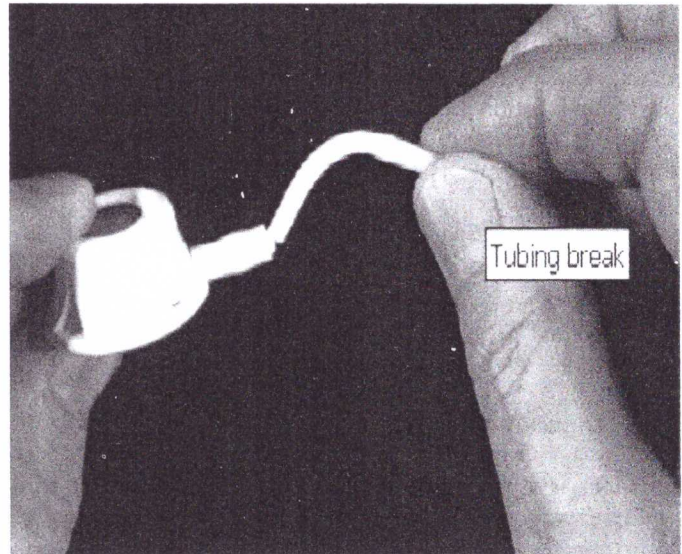


Fig. 5: Port/tubing leak: a near-complete breakage of the tubing.

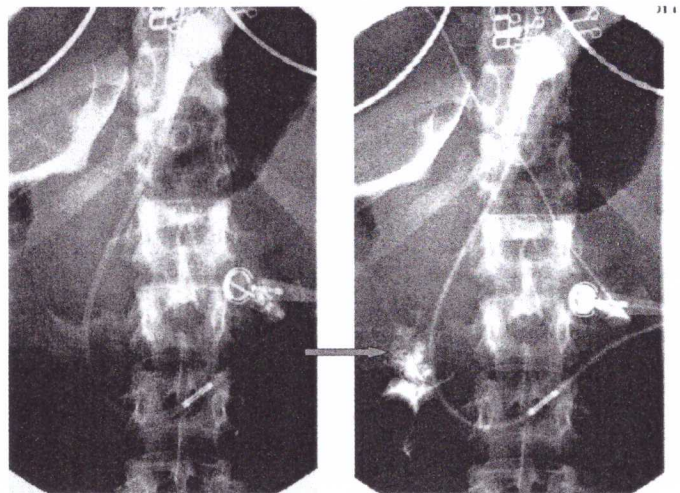


Fig. 6: Port/tubing leak: a leak from the tubing is diagnosed after extravasation of the injected contrast medium.

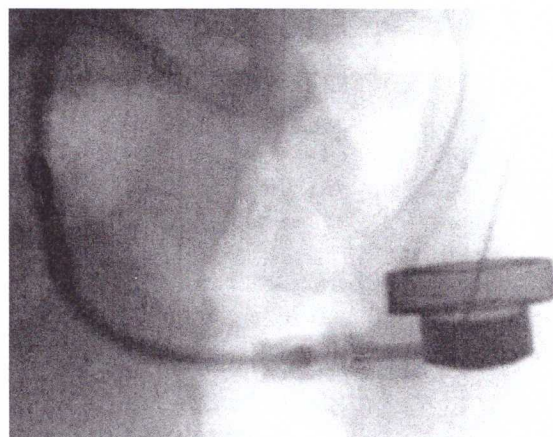


Fig. 7: Port/tubing leaks: a micro-leakage is detected after surgical exploration and injection of saline into the tubing under pressure.

inal X-ray after injection of contrast medium into the port and tubing is rarely helpful because only high flow leakages are visible (Fig. 6). A local exploration of the port site is often necessary (Fig. 7); another approach is to inject diluted methylene blue into the port under direct laparoscopic visualization of the tubing and band. When a leakage is diagnosed, port, tubing or band replacement is usually necessary depending on the site of the leakage and type of band used.

Twist of the port

Another possible complication is the twist of the port. This is a common, minor complication (Fig. 8). When the port is upside down, access to the compressed silicone septum is impossible. To avoid this complication, some surgeons fix the port with stitches or by polypropylene mesh; others avoid fixing the port at all. Regardless of the technique, port twist remains a possible complications. Sometimes the upturned port can be replaced in the top-up position by manipulation under fluoroscopy guidance. In case of failure, surgical repositioning is warranted choosing an easily accessible position to simplify the inflation-deflation procedures.

Port-site infection

Infections of the port can be detected either early or late during the postoperative course. Sometimes a poorly treated infection becomes chronic. The site of acute infection can be superficial with local subcutaneous inflammation; oral antibiotics are the treatment of choice however if infection does not subside, intravenous antibiotics should be considered. If even the antibiotic therapy is ineffective, the infected port must be removed. In case of a deeper infection, still within the abdominal wall, or in case of an abscess, a systemic antibiotic therapy should be straightforwardly established; drainage of the collection is required as soon as possi-

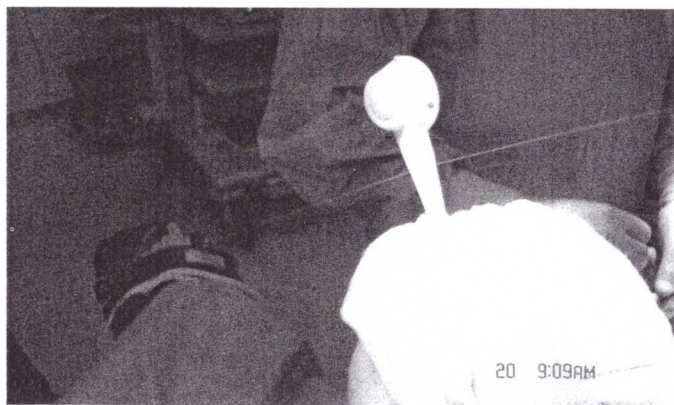


Fig. 8: Twist of the port: a radiologic image showing the upturned port.



Fig. 9: Port-site infection: purulent discharge after drainage in a case of acute infection of the port site.

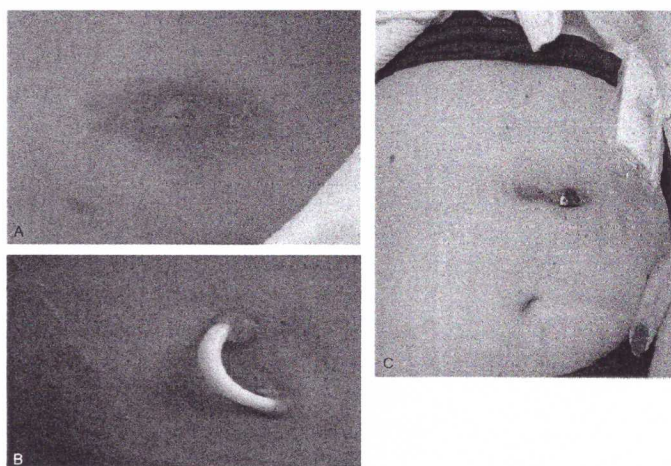


Fig. 10: Port-site infection: eczema-like skin changes and granulomatous tissue formation (A), skin erosion with tube (B) and port (C) rejection secondary to chronic discharge of infected fluids in a case of chronic infection sustained by gastric erosion.

ble (Fig. 9). Some authors advocate to cut the tube far from the infection site, leaving the infection-free end in the abdominal cavity and removing the distal infected one. Once infection is completely resolved and the abdominal wall healed, a new port can be connected to the free end of the tube and left in place under laparoscopic guidance.

Late onset infections are often subsequent to gastric erosion by the band, with the infection that running along the tube towards the skin (Fig. 10). Usually, late onset infections cannot be controlled with antibiotic therapy and can potentially lead to sepsis. In these cases it is wise to assume there is a gastric erosion and to arrange a prompt endoscopy; if erosion is confirmed, removal of the band should be carried out.

INTRAGASTRIC BAND EROSION/BAND MIGRATION (0.8%)

Dindo Clavien III b for band removal by laparotomy vs laparoscopy vs endoscopy (5%)

The band can erode through the stomach wall and migrate into the gastric lumen. The exact incidence of this complication is unknown; recent studies report it to be around 0.8%⁴⁻⁸. It is acknowledged that, over the past decade, there has been a gradual reduction in such an incidence. The etiology may be the result of gastric wall injury during band placement or tight anterior fixation, especially around the band buckle. Diagnosis is often difficult because of an insidious clinical onset such as vague, mild abdominal pain. Some patients are even asymptomatic. Sometimes the patient complains of a reduced sense of restriction and satiety despite band infla-

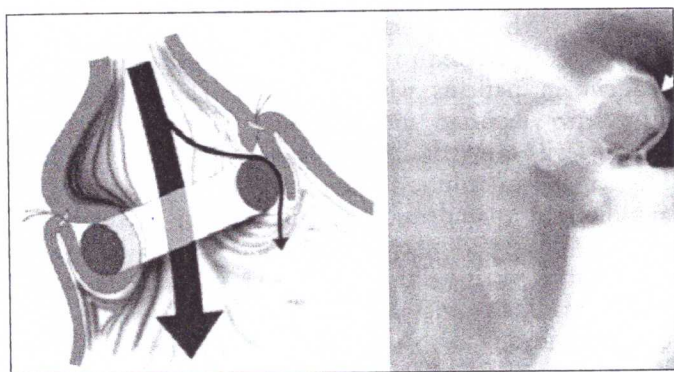


Fig. 11: Gastric erosion: contrast medium outlines the outer surface of the band where it has eroded the gastric wall.

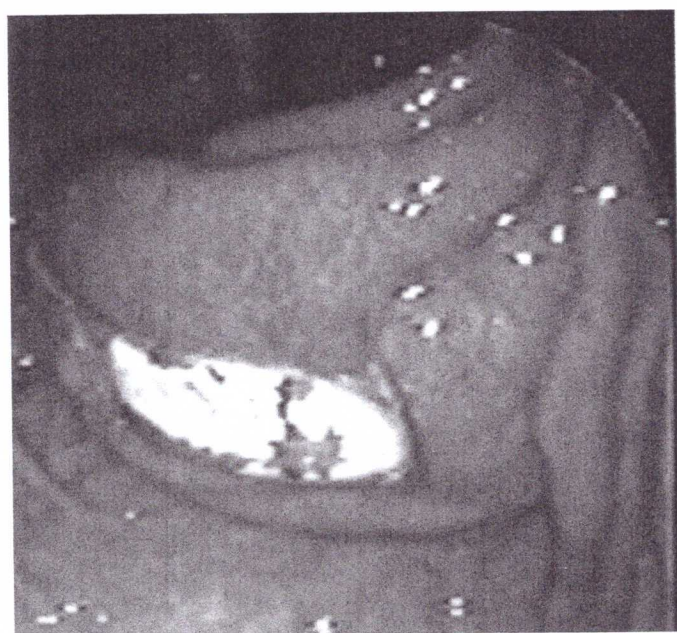


Fig. 12: Gastric erosion: direct visualization by endoscopy of the band eroding the gastric wall.

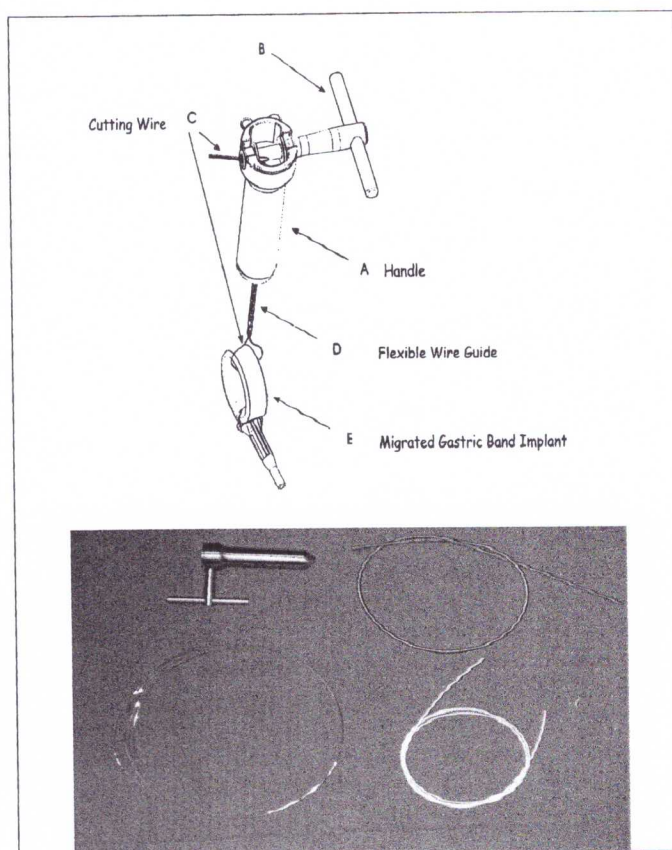


Fig. 13: Gastric erosion: a mini invasive tool for division of the band has been developed so that removal of the band can be carried out by endoscopy (Band-Cutter TM).

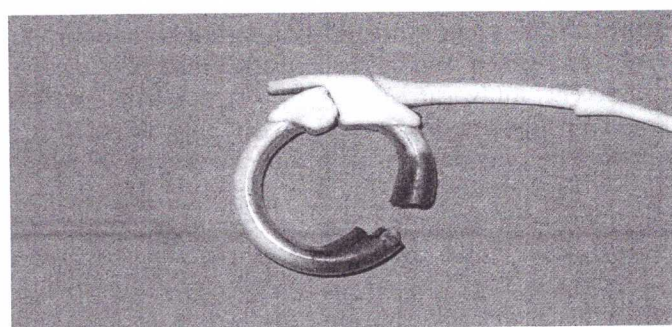


Fig. 14: Gastric erosion: the gastric band after endoscopic division and removal in a case of gastric erosion.

tion and gradual increase in weight. Contrast X-ray can be helpful, with contrast medium outlining the outer surface of the migrated band (Fig. 11).

Upper endoscopy (Fig. 12) has great specificity for the diagnosis but not as much sensibility. Inflammation of the port site can be the only, although late, clue for diagnosis. The treatment involves the removal of the band by laparoscopy (or laparotomy). A mini invasive tool (Fig. 13) for division of the band has been developed so that removal of the band can be carried out by endoscopy (Fig. 14).

Discussion

LAGB represents one of most frequently performed bariatric operations in morbidly obese patients. LAGB is considered to be a safe and effective method to achieve weight loss and resolution of obesity-associated comorbidities. For this reason LAGB is considered by many surgeons an optimal treatment for morbid obesity and it is attractive for the patients because it is less invasive as described by Michieletto⁸. This is in line with the literature review conducted in our Institution but - as described by Launat-Savary- morbidity after bariatric surgery is an underestimated problem⁹. We identified, via electronic search the most relevant papers to date in gastric banding. The search yielded 137 articles. Data regarding reoperation rate and perioperative mortality were extracted from each one. On the whole population of 29,980 patients a perioperative mortality of 0.1% was calculated. This result is similar to that reported in the meta-analysis by Cunneen¹⁰. This outcome highlights that gastric banding can be considered an extremely safe procedure however the reoperation rate ranges from 2.5% to 23.9%. To add more strength to this finding, we carried out, on the same study population a subgroup analysis. We compared the perioperative mortality of two periods: before and after 2000. The hypothesis of this study is that improvements in surgical technique, anaesthesia, patient selection and care have been responsible for a deceptively low mortality. In fact, we found that before 2000, perioperative mortality ranged from 0% to 0.1%¹¹⁻¹² and after 2000 perioperative mortality was between 0% and 0.2% [13-14]. This difference does not reach any statistical significance, indicating that mortality is evenly distributed and is neglectful (Table I). However in a recent study carried out by Gagner based on an anonymous questionnaire sent to the members of the American Society for Bariatric Surgery, it was concluded that late deaths are under-reported¹⁵. They have advanced several scales for pre-operative quantification of mortality risk. Currently the score suggested by De Maria and validated by Canadian and U.S. multi-center studies seems a good solution for stratification of preopera-

tive risk of death¹⁶⁻¹⁸. Nevertheless, some procedure-specific complications can occur. Pouch enlargement, band slippage, band erosion, port site infections and port leak represent the most commonly band associated complications. They require an equally specific assessment and management process. In some cases, particular medical devices such as the Band-CutterTM are mandatory especially in the present mini-invasive era. As a consequence, a dedicated team is warranted. This is confirmed by the literature review we conducted. In fact, we observed a reduction in reoperation rates due to complications after 2000. This reflects the refinement in surgical technique throughout our long-course experience. From the 24.4% described by Tolonen or the lower, but still high 10.5% reported by Belachew, reoperation rate dropped after 2000, to 2.6%-2.1%^{3,12,19,20} (Table II). Port complications are often under-reported because of a short follow-up. The absence of an access-port and the use of Easybandtm as described by Handgraaf is advocated as a solution to this problem²¹. Tog recently reported that complications related to the port or tubing are the most frequent in patients with LAGB²². These authors as Micheletto reported an incidence of 8.7% in 1928 patients with LAGB; 27% of patients required at least 2 or more procedures. Probably the incidence of this complication is underestimated because of a partial follow up²². Migration of gastric banding is a long term complication; it is believed to be the consequence of the chronic trauma to the gastric wall enhanced by the physiological movements of the diaphragm and peristalsis of the stomach. Port infection can be caused by migration of gastric banding. Silecchia et al. reported an incidence of migration of 7.5% and pointed out that patients are often asymptomatic; in most cases, band migration is diagnosed incidentally^{23,24}. Micheletto et al. in our clinical records reported an incidence of migration only of 1.1% but it is explained by not long term of follow-up⁸. Alternatively, when we suspect a band migration, an upper gastrointestinal X-ray is mandatory and is usually diagnostic. One of the reasons of migration is gastric slippage; treatment consists in simple a deflation of the band (90% of the cases) or surgical removal and/or reposi-

TABLE I - Operative mortality after gastric banding: no significative difference over the two study periods (before and after 2000).

Operative Mortality after Gastric Banding			
before 2000	Steffen 0%	824 pts	5 y
	Favretti 0%	1791 pts	12 y
	Belachew 0.1%	763 pts	4 y
after 2000	Parikh 0%	749 pts	3y
	Ren 0.2%	445 pts	1y

TABLE II - Reoperation rate after LAGB: dramatic reduction of reoperation rate over the two study periods (before and after 2000)

Reoperation rate after Gastric Banding				
before 2000	Steffen	major 16.5% - minor 6.8%	824 pts	5 y
	Belachew	10.5%	763 pts	4 y
	Tolonen	24.4%	280 pts	7 y
after 2000	Sarker	2.6%	409 pts	3y
	Singhal	2.1%	1140 pts	3y

tioning of the band (10% of the cases). The prevention of this complication has been clearly described with the apposition of 2 or 3 nonabsorbable sutures between the gastric fundus and left hemidiaphragm. Recently Findlay et al. proposed two simple interventions to reduce this type of complication with good results: band filling protocol and post-operative dietary programme²⁵. Pouch dilatation is a different complication to band slippage as described by Moser et al.²⁶. The etiology of this complication is multifactorial, and the etiologic factors are chronic overeating or overinflation of the band. Band deflation is the most simple treatment. In this period the patient should be instructed to follow a low-calory diet. Surgical treatment should be considered if medical treatment fails. LAGB is a effective option to treat morbid obesity; but the rate of short and long term complications and their specific profile, makes a strict follow-up mostly important to early diagnosis and correct treatment.

Conclusion

From these data, it is possible to draw the conclusion that gastric banding has at least a medium-term efficacy in the treatment of morbid obesity. By virtue of the experience accrued over time, this procedure is now even safer than in the past because of the reduced incidence of complications requiring reoperation. Not least, most of these complications require only minor interventions and often can be treated with mini invasive techniques (such laparoscopy or endoscopy). Nevertheless, it is important for general surgeons to be aware of the common presentations of gastric banding complications as they are procedure-specific and require an equally specific treatment.

Riassunto

INTRODUZIONE: il bendaggio gastrico laparoscopico (LAGB) è riconosciuto regolabile è come un'opzione chirurgica comune ed efficace o nel trattamento dell'obesità e delle relative malattie metaboliche. Questa procedura è un'operazione notevolmente sicura da un punto di vista chirurgico generale sia da un punto di vista bariatrico. Essa facilita un breve degenza e può essere eseguita tramite una sola incisione.

METODI: Abbiamo analizzato le complicanze più comuni del LAGB sia intraoperatoria sia postoperatorie perforazione gastrica, lo slittamento dello stomaco / dilatazione, complicanze del port, la migrazione del bendaggio intragastrico che si sono verificati nei nostri lunghi decenni di esperienza clinica confrontandole con la letteratura.

RISULTATI: LAGB ha mostrato buoni risultati a lungo termine in termini di perdita di peso e di risoluzione di

patologie legate all'obesità. Inoltre, la mortalità dovuta a patologie correlate con l'obesità è apparsa significativamente più bassa nei pazienti LAGB rispetto ai pazienti in terapia farmacologica.

CONCLUSIONE: Il bendaggio gastrico ha un tasso molto basso di complicanze precoci e tardive; queste sono anche meno gravi rispetto alle procedure più invasive e sono suscettibili di una gestione con tecniche mini-invasive. In ogni caso, l'invio di questi casi a un chirurgo con esperienza di chirurgia bariatrica è ritenuta opportuna.

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