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CLINICAL RESEARCH

Gastric Band Erosion in 63 Cases: Endoscopic Removal and Rebanding Evaluated

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Abstract
Background Laparoscopic adjustable gastric banding (LAGB) remains the most popular bariatric procedure performed in Australia and Europe. Gastric band erosion is a significant complication that results in band removal. The aim of this study is to assess the prevalence of band erosion and its subsequent management with a particular focus on rebanding results.
Methods Patients who underwent LAGB in a prospective cohort study from August 1996 to October 2010 were evaluated. Patients that developed band erosion were identified and clinical presentations, band characteristics and subsequent management were evaluated.
Results One thousand eight hundred seventy-four morbidly obese patients underwent LAGB. Band erosion developed in 63 patients (3.4%). Median preoperative BMI was 41.5 kg/m^2 (range 30–61 kg/m^2). Median time from operation to diagnosis was 39 months (range 6–132 months). Twenty nine patients (46%) were asymptomatic (sudden loss of restriction, weight gain, turbid fluid, or absence of fluid). Symptoms included abdominal pain in 24 (38%), obstruction in 7 (11%), recurrent port infection in 5 (8%), reflux symptoms in 2 (3%) and sepsis in 2 (3%). Fourteen patients (22%) had discolouration of the fluid in their band. Endoscopic removal was attempted in 50 patients with successful removal in 46 (92%). Median number of endoscopies prior to removal was 1.0 (range 1–5). The median duration of the procedure was 46 min (range 17–118 min). Rebanding was performed in 29 patients and 5 (17%) experienced a second erosion. Mean percentage excess weight loss was 54% in the remaining 22 patients with at least 3 months follow-up.
Conclusions Band erosion prevalence was 3.4%. Endoscopic removal of eroded gastric bands was proven safe and effective. Band erosion is now preferably managed endoscopically in our institution. Rebanding following erosion results in acceptable weight loss but an unacceptable reerosion rate.

Keywords Morbid obesity · Laparoscopic gastric banding · Erosion

Introduction

Band erosion is a complication following laparoscopic adjustable gastric banding (LAGB) for morbid obesity. Band removal is always necessary. The prevalence varies in published series from 0.9% to 3.8% [1, 2]. In the majority of cases, band erosion is associated with few clinical symptoms. However, in a small percentage of patients, it can present with life-threatening symptoms and signs which require urgent treatment [3, 4]. Upper endoscopy confirms the diagnosis of band erosion, Gastrografin® meal is unreliable for making the diagnosis [5].

There have been a number of theories regarding the cause of band erosion. They include infection of the injection port [6], over distension of the band producing ischaemia [7] and extensive gastric adhesions resulting from widespread dissection with subsequent impaired blood supply thus making the stomach more susceptible to pressure necrosis [8]. Another theory suggests serosal

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damage at the initial insertion of the band resulting in a local inflammatory reaction and subsequent erosion [6].

Although the usual treatment for the eroded gastric band is laparoscopic or open removal, endoscopic management has been demonstrated as a safe alternative [2, 5, 9, 10].

The purpose of this study was to review our experience with band erosion and the outcomes following endoscopic, laparoscopic and open removal. We also reviewed outcomes of gastric rebanding following erosion.

Materials and Methods

A prospective database of 1,874 consecutive patients who underwent LAGB from August 1996 to September 2010 was reviewed. Surgery was indicated based on the criteria defined by the National Health and Medical Research Council [11]. This included BMI (> 40 or >35 with 1 or more comorbidity), previous attempts to lose weight conservatively and the presence of comorbidities. Patients with a BMI between 30 and 35 were included if they had developed obesity related comorbidities such as type 2 diabetes mellitus and obstructive sleep apnoea and weight control could not be achieved through nonsurgical means. Patients were excluded from bariatric surgery if they were unable to understand the nature of the operation and the need for intensive follow-up. Patients were also excluded if they suffered from psychiatric disorders and alcohol and/or drug abuse [12]. All patients were enrolled in a multidisciplinary bariatric surgical programme at Circle of Care, Adelaide, South Australia and were operated on by the same surgical team. The operative technique was the pars flaccida approach using the Swedish Adjustable Gastric Band (SAGB) except in the first 58 patients where the perigastric technique was used. A more detailed description of our technique has been published previously [13]. The buckle of the band was placed along the greater curvature of the stomach away from the imbricated stomach. We created the fundoplication with no more than three gastrogastric sutures using 2/0 Ethibond®. All patients have been followed up for at least 3 months from their date of surgery. Only 1% of patients were lost to follow-up long-term (>3 years).

Patients were seen 6 weeks after their operation when typically an initial volume of 3 ml would be inserted into the band. A further 2 ml was inserted 6 weeks after the first adjustment if required. An extra 1 ml was inserted at each subsequent six weekly visit if required depending on the rate of weight loss and the degree of restriction. The SAGB can be filled up to a maximum of 9 ml.

All patients with band erosion were included in this study. Band erosion was defined as any portion of the band visible intraluminally at endoscopy. Demographic data, clinical presentation and management of band erosion were evaluated. Information regarding time of diagnosis, past or current port infection and volume of fluid in the band at diagnosis were recorded. Patients who had gastric bands reinserted following an erosion were also evaluated. Percentage excess weight loss (%EWL) and reerosion rates were measured. If reerosion occurred subsequent alternate management was evaluated.

In those patients where the band was removed endoscopically, it was performed with a gastric band cutter (AMI® Gastric Band Cutter, Agency for Medical Innovation GmbH, Götzis, Austria). The procedure was performed under general anaesthesia. This technique has been described by Lattuada et al. [5].

The injection port is removed and the tubing was allowed to fall into the abdomen. An Olympus® gastroscope series 160 was then passed into the stomach and the cutting wire introduced through the working channel. The gastroscope is then removed leaving one end of the wire in the stomach before the scope is reintroduced. When the endoscope is reinserted it is passed outside the eroded portion of the band and a snare is then used to grasp the end of the wire. Both ends of the wire are then exteriorised. The endoscope is reintroduced and an over tube is passed over both wires until it sits against the band. The wire is then pulled taut using a winch system until a “give” is felt and the band is seen to divide. The band is then removed along with what is left of the tubing using a snare. A Gastrografin® Swallow is performed the next day to exclude any leak prior to discharge.

Laparoscopic removal involved five routine port placements. Adhesions were divided as necessary to allow retraction of the liver. The tubing was identified and followed down to the band itself. This often required careful dissection along the tubing using a diathermy hook. This led to the clasp which could then be safely divided, freeing the band and allowing it to be removed from its capsule. A drain was then left in the capsule and the opening reduced in size through the placement of laparoscopic sutures. The port was removed. A Gastrografin® meal was done on day 2 and the drain tube was removed if there was no leak.

Laparoscopic removal could prove difficult for several reasons. Adhesions from previous surgery made it difficult to safely identify the anatomy. If the clasp of the band had rotated posteriorly it was difficult to free the clasp laparoscopically. If a significant portion of the band had eroded into the stomach it might require a laparoscopic gastrotomy or open approach to remove the band. This circumstance was encountered in cases prior to the introduction of the endoscopic removal technique.

Open removal of an eroded band involved an upper midline incision, identification of the tubing and dissection

down to the clasp. The clasp was then divided and the band removed from its capsule. A drain was placed within the capsule and the opening reduced through two to three sutures. Again, the drain was removed on day 2 after a Gastrografin® meal showed no evidence of a leak.

Results

Of the 1,874 patients who underwent LAGB, band erosion into the stomach occurred in 63 (3.4%) patients. Fifty nine were female and four were male. Median age at insertion of the gastric band was 40 years (range 18–59 years), and median preoperative BMI was 41.5 kg/m^2 (range 30.0–60.7 kg/m^2). The median time to diagnosis of band erosion was 39 months (range 6–132 months) following surgery to insert the band. One patient had her band inserted using the perigastric technique (1.7%) while the remainder had the band inserted using the pars flaccida approach (3.4%). All patients had laparoscopic insertion except for three. Two of these patients had open procedures due to dense adhesions between the inferior surface of the liver and stomach from previous open vertical banded gastroplasty. The third patient had an open procedure due to adhesions from a previous laparotomy for small bowel infarction. In all patients, the SAGB (Ethicon Endosurgery®, Cincinatti, OH) gastric band was used.

Clinical presentation of erosion was variable with patients often demonstrating multiple symptoms (Table 1). Twenty-nine patients (46%) were asymptomatic and suspicion of band erosion was based on loss of restriction, weight gain, absence of fluid from the port or the aspiration of turbid fluid. Thirty-four patients (54%) presented with symptoms including abdominal pain, obstruction, recurrent port infection, or reflux. Fifteen (24%) patients had discoloured fluid in their band.

All patients required an endoscopy to confirm the diagnosis. Barium meal was done in five patients but none were suggestive of erosion. CT scan was performed in seven patients with only one suggesting erosion. Three patients also had ultrasound, none of which suggested an erosion.

In patients diagnosed with band erosion, there were 11 (17%) that previously had port infection requiring removal of the port. This compared with a published overall port infection rate of 5% [14]. It was not routine practice to endoscope patients after they developed port infection. Culture results were available in two patients and both grew *Staphylococcus aureus*. The median volume of fluid within the band at the time of diagnosis of erosion was 7.0 ml (range 0–12.0 ml).

Removal of the eroded band via an endoscopic approach was the preferred treatment. Endoscopic removal was attempted in 50 patients. It was successful in 46 (92%). The median duration of endoscopic removal of the gastric band was 46 min (range 17–118 min). The median number of endoscopies performed (including the initial diagnostic endoscopy) before endoscopic removal was possible was 1.0 (range 1–5). During our initial experience, three patients needed conversion to an open (two) or laparoscopic (one) operation due to incomplete erosion (buckle not visible within the stomach). Thereafter, endoscopic removal was only attempted when the buckle of the band was seen inside the stomach. In the patient who had converted to a laparoscopic procedure, it was decided that the band was again unable to be removed, this time due to adhesions. It was decided not to convert to open removal due to significant cardiac comorbidities. The eroded gastric band remains in situ after 5 years with no ill effect. In another patient, the wire snapped twice during endoscopic removal and became stuck in the abutting tube. This patient went on to have open removal of the eroded gastric band.

There were five complications (10%) following endoscopic removal. Two patients required a laparoscopy to release a symptomatic pneumoperitoneum. One patient developed a wound infection at the port site requiring surgical debridement and drainage. One patient developed subcutaneous emphysema in the neck and face. This resolved without intervention within 48 h. One patient had a right vertebral artery thromboembolism and made a complete recovery.

A total of nine patients had open removal of their eroded gastric band. Three patients had open removal due to inadequate erosion with persistent abdominal pain. Three patients had open removal due to sepsis secondary to a splenic abscess. In one patient, the band had eroded completely into the stomach and was causing a small bowel obstruction at the level of the midjejunum. This required 40 cm of small bowel to be resected due to stercoral ulcers produced by the tubing. One patient had open removal performed at another institution where the endoscope approach was not available. One patient had open removal due to a liver abscess above the left lobe and adjacent to the band. There were no complications following open removal.

A total of four patients had laparoscopic removal of their gastric band as the initial procedure. Two of these were performed before the introduction of endoscopic removal. One of these had to be converted to open as the omentum was adherent to the angle of His and the clasp of the band was within the stomach. This would have been well suited to endoscopic removal. A third patient had laparoscopic removal performed in another institution where endoscopic removal was not available. The fourth patient had laparoscopic removal due to persistent epigastric pain. The buckle was not visible endoscopically.

Table 1 Clinical presentation of band erosion: patients may have had more than one symptom

	Number of patients		Number of patients
Asymptomatic	29 (46%)	Symptomatic	34 (54%)
Loss of restriction	26	Abdominal pain	24
Weight gain	24	Obstruction	8
Turbid fluid	8	Turbid fluid	7
Absence of fluid	1	Weight gain	7
		Loss of restriction	6
		Recurrent port infection	4
		Reflux	3
		Fever	2
		Sepsis/splenic abscess	2
		Absence of fluid	1
		Back pain with swallowing	1
		Bloatedness	1
		Iron deficiency anaemia	1

There were two complications following laparoscopic removal. One patient developed an oesophageal leak and a left subphrenic collection which required drainage and total parenteral nutrition to resolve. One patient developed a splenic abscess after laparoscopic removal which required an open splenectomy.

There were no deaths in this series following any procedures related to gastric band erosion.

Attempted reinsertion of a second gastric band was performed in 33 patients. Twenty nine had previous endoscopic removal and four open removal. Following endoscopic removal 27 (93%) had successful reinsertion of the gastric band (26 laparoscopic, 1 open). In two patients, reinsertion failed due to adhesions. After open removal, two patients (50%) had successful reinsertion of a gastric band (one open, one laparoscopic). Therefore a total of 29 patients had a successful reinsertion of a second gastric band following erosion. There were no complications associated with rebanding either laparoscopic or open.

There were 5 reerosions of the second band out of the 29 patients (17%). The median period between insertion of the second band and diagnosis of the second erosion was 23 months (range 14–34 months). Endoscopy was the method of diagnosis in each reerosion. The median number of endoscopies performed (including the initial diagnostic endoscopy) before endoscopic removal was possible was 1.0 (range 1–2). All five reerosions were removed endoscopically. The median duration of these endoscopic removals was 71 min (range 39–97 min).

This left 24 patients with their second gastric band still in place. Twenty two of these patients had at least 3 months follow-up in terms of weight loss. The median follow-up of these patients was 21.5 months (range 3–64 months). These patients, although small in number, demonstrated mean percentage EWL of 54% (see Fig. 1).

Three patients had attempted reinsertion of a third gastric band. Two of these were successful laparoscopically. One patient had EWL of 34% at 1 year and the other patient had 69% EWL at 6 months. The third patient had an attempted open reinsertion but a perforation was discovered at the front of the stomach and the procedure was abandoned. The patient subsequently developed a gastrocutaneous fistula which was successfully treated with total parenteral nutrition. The fourth patient underwent an open gastric bypass with 60% EWL at 1 year. The fifth patient elected not to have a further bariatric procedure.

The initial cost of the AMI® Gastric Band Cutter was A$4450. The total cost for consumables and sterilisation for laparoscopic removal of the eroded gastric band was A$1,871 versus A$1,215 for endoscopic removal. The private health funds recognised the reduced cost of the endoscopic removal by rebating the hospital A$4,500 for laparoscopic removal versus A$3,500 for the endoscopic removal.

Discussion

The prevalence of band erosion in this series was 3.4%. This is similar to other reported series [1, 2]. The time of diagnosis ranged from months to years (6–132 months) following the initial surgery. Nearly half of the patients with band erosion were asymptomatic (46%). Symptoms of band erosion included abdominal pain, bowel obstruction, or reflux. The presentations were not life threatening and free intraperitoneal perforation was rare, probably due to adhesion formation prior to complete penetration of the

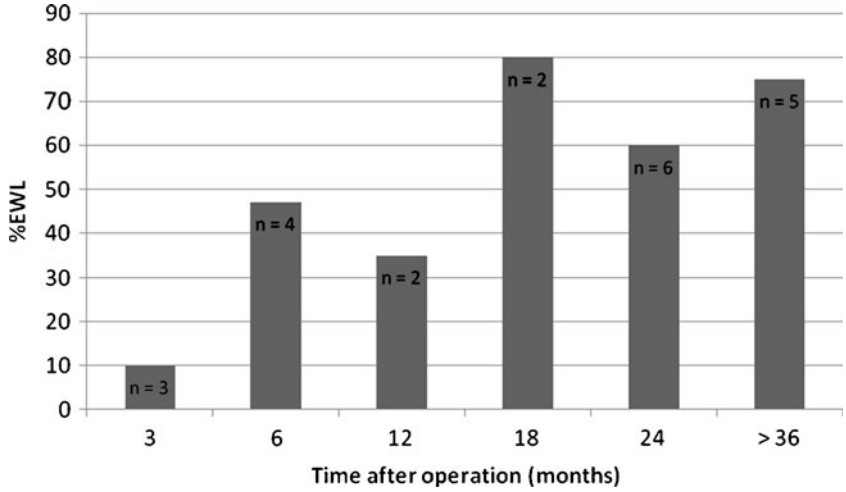

Fig. 1 Excess weight loss over time after rebanding

gastric wall. Nevertheless, some patients presented acutely with peritonitis, bowel obstruction, or sepsis that warranted urgent intervention. A high index of suspicion is important in diagnosing this complication, particularly in those who did well with weight loss but suddenly struggled to control food intake despite adequate volume of fluid in the band. Another interesting observation was the presence of yellowish tinged fluid in the band (24%) as a clue to band erosion. This may be due to gastric fluid passing into the band as a result of its exposure to gastric acid.

The aetiology of band erosion is multifactorial. Chronic ischaemia of the stomach wall caused by direct pressure of the band may gradually lead to band erosion. It is postulated that early erosions may be secondary to undiagnosed gastric perforations during surgery or early infection, while late erosions are due to gastric wall ischaemia from high pressure [8]. It has also been postulated that the infection at the port site was due to the migration of bacteria from the stomach via the tubing to the port area [8]. There certainly was a higher prevalence of port infection in this series compared with our overall port infection rate. Whilst we did not have cultures from all patients, in the two whom cultures were available, a skin organism was detected.

In this series the incidence of band erosion is almost constant. There was no pattern which can be attributed to technique or experience. In one series of similar prevalence [15], erosion occurred in their first 500 patients and no erosion in their subsequent 650 patients. They attributed this to their learning curve and refinement of technique in band placement. However the length of follow-up for the subsequent 650 patients may not have included late erosion. Small, undetected injuries to the gastric wall during band placement may progress later to actual erosion or necrosis due to pressure of the band [8]. One consideration during surgery is to avoid placement of gastrogastric sutures over the buckle as this area protrudes and can cause pressure necrosis to the fundus that covers it [16].

There is disagreement about the appropriate treatment of band erosion. In one series of 24 cases of band erosion [14], all but 1 of these patients was treated conservatively with the band remaining in situ. In our series, almost all eroded bands were removed, the majority by the endoscopic approach. This technique is minimally invasive. It prevents unnecessary dissection which can cause more adhesions to form and make any further surgery difficult or even impossible.

Few believed that enough eroded band would be visible endoscopically to allow removal through this approach. Laparoscopic removal subsequently became the procedure of choice. This would then be followed by a delay of at least 3 months before considering reimplantation of another band to allow any inflammation to settle [4]. However, there are those who prefer laparoscopic removal with placement of another band at the same time with good results [15].

To achieve successful removal endoscopically, based on our experience, the buckle must be visible. In addition, a skilled endoscopist is mandatory along with the appropriate gastric band cutter. In Australia where surgeons are trained in endoscopy, those who placed the band can readily learn the skills to remove it endoscopically. Endoscopic removal proved to be a safe procedure with only minor complications which resolved without major intervention. There was no death following any procedure dealing with band erosion.

Once the eroded band is removed the majority of patients will regain their weight and will often request further bariatric surgery. Patients who had good weight loss with the band were offered another band placement. All patients who subsequently underwent rebanding gradually lost weight. A similar result was demonstrated by Niville et al. [17] who had excellent weight loss after rebanding. Niville et al. however demonstrated no reerosions in ten patients with a mean follow-up of 48 months. In our series,

we have experienced a reerosion rate of 17%. This high reerosion rate is likely to be due to relative ischaemia of the tissues as a result of the previous erosion. As a result, we are now reluctant to offer a rebanding procedure. Another bariatric procedure should be considered.

Conclusion

Gastric band erosion is an uncommon late complication of LAGB. It usually presents with few specific symptoms but occasionally its presentation can be life threatening. Endoscopic approach is an attractive option for band removal. It has become the procedure of choice to treat gastric band erosion in our unit. Laparoscopic rebanding is safe and feasible with acceptable weight loss but is associated with a high reerosion rate.

Conflicts of Interest The authors declare that they have no conflict of interest.

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