

Bariatric Emergencies for Non-Bariatric Surgeons: Complications of Laparoscopic Gastric Banding

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Abstract

Background Laparoscopic adjustable gastric banding (LAGB) has gained popularity for treatment of morbid obesity worldwide. With the widespread use of LAGB, an increasing number of medical specialists are dealing with the potentially life-threatening complications of this procedure.

Methods More than 6,000 LAGBs were performed by our surgeons during the past 11 years, during which various complications of LAGB were observed, including band slippage, erosion, gastric pouch dilatation, port infection, and disconnection. Complicated cases requiring emergency surgical intervention were collected. We present and discuss the diagnostic and therapeutic possibilities of these complications.

Results Fourteen cases were identified: six with acute band slippage, two with small bowel obstruction, and one each with band slippage and fetal intrauterine growth restriction during the 36th week of pregnancy, perforated gastric ulcer, upper gastrointestinal bleeding, connecting tube penetration into a stomach ulcer, connecting tube penetration into the colon, and port disconnection. All patients had gastrointestinal symptoms at admission. Band reposition was performed in four cases; eight patients required band removal for band contamination. The band was open and still in place in one case. Open and laparoscopic gastric resections for necrotic stomach were performed in two cases. Suture of perforated gastric ulcer was combined with cesarean section. Connection of disconnected port and suture of colonic and gastric penetrations and perforation of fundus were completed laparoscopically. Small bowel resection and enterotomy

required an additional minimal laparotomic incision. No mortality was observed in our series. Four patients elected to have the LAGB reinserted at a later time.

Conclusion The increasing number of bariatric procedures has resulted in emergency physicians' knowledge of serious complications of LAGB that require urgent surgical intervention. Treatment algorithms require early diagnosis and a surgical approach to solving these conditions.

Keywords Gastric banding · Obesity · Complications · Emergency surgery

Introduction

Bariatric surgery is a currently proven effective treatment for morbid obesity, resulting in satisfactory weight loss, and improved weight-related comorbidities and quality of life. Laparoscopic adjustable gastric banding (LAGB) is one of most popular minimally invasive restrictive procedures. Adjustability of the band, almost complete reversibility, and intact gastrointestinal tract continuity are the main advantages of this approach. LAGB has been shown to be a safe technique with a low incidence of perioperative complications. While perioperative problems are minimal, LAGB has a relatively high reoperation rate compared to other bariatric procedures, mainly related to slippage, pouch dilatation, and gastric erosion [1–4].

The large volume of LAGB results in an increasing number of various medical specialists, such as family physicians, gastroenterologists, internal medicine physicians, emergency room doctors, obstetricians, and general and bariatric surgeons caring for them. These patients are frequent visitors of outpatient clinics and emergency rooms (ER) with various gastrointestinal symptoms, including abdominal pain and

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vomiting. Most post-bariatric patients are referred to a bariatric surgeon for further investigation and treatment. However, more and more potentially life-threatening complications of LAGB requiring emergency surgery have been reported in the literature. These included cases of small bowel obstruction [5–7], massive upper gastrointestinal bleeding [8, 9], pouch necrosis [10, 11], and colon [12] and small bowel penetration [13]. Thus, all clinicians, especially general surgeons, need to be familiar with early prompt diagnosis and treatment of emergencies following complications of LAGB to prevent complications.

Herein, we present a series of patients who had emergency surgery for various band-related complications after LAGB and discuss their management and treatment.

Materials and Methods

Six thousand, three hundred eighty-two LAGBs were performed by surgeons in our department in public and private clinics between April 1998 and June 2009; 487 (7.6%) of these patients underwent surgery for band slippage and 422 (6.6%) of these band repositions were performed for primary slippage. In another 65 patients with recurrent slippage, secondary band repositioning was performed in 48 and band removal in 17 cases. The band was removed in 51 (0.8%) patients with erosion. Fourteen (0.2%) consecutive patients had emergency surgery for band complications. The mean follow-up for this group was 39.7 months (range, 4–90).

Band Description for Non-Bariatric Professionals

Gastric banding is a form of restrictive bariatric procedure. The band is a type of balloon wrapped around the upper part of the stomach and connected with a tube to an injection port (Fig. 1). The upper part of the stomach above the band, called the gastric pouch, is about 50 cm³ in volume. Band adjustment (inflation and deflation) is performed through the port and changes the diameter of gastric input. We preferred a presternal position of the injection port due to the simple approach and port stability in this location. Usually, on plain film, the normal postoperative band position is vertical (Fig. 2). Band and tube contrast on the plain film. Band adjustment is performed with water-soluble contrast. Thus, the position of the band, connecting port, and connecting tube can be identified on the abdominal plain film. Simple use of gastrograffin swallow helps to find band obstruction (slippage).

Initial LAGB was performed by BK, LL, and EA using Swedish, LapBand, or Heliogast. Swedish band was applied in 98% of the patients. All patients were followed by the operating surgeons. The first band adjustment was

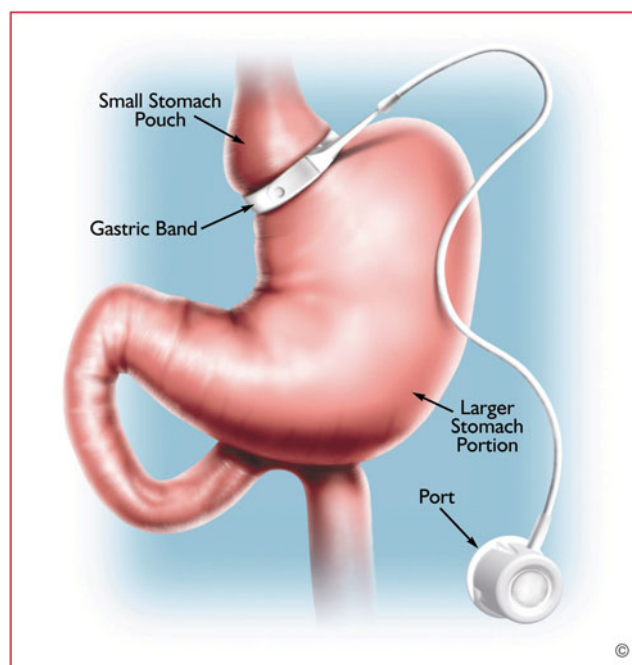


Fig. 1 Illustration of gastric banding

performed under radiographic guidance 1 month after surgery. Additional adjustments were done in outpatient clinics, except in cases with suspected complications. In case of upper gastrointestinal symptoms such as pain or vomiting, patients were referred by their family physician to the surgeon or the ER.

Band deflation was performed as the initial step in all post-LAGB patients admitted to the ER with upper abdominal pain or vomiting. Symptom persistence after band deflation was an indication for chest and abdominal plain films. Band position, connecting tube localization, and continuity with the injection port were controlled on imaging. Near-vertical band position was normal. In case of horizontal or near horizontal band location, gastrograffin swallow was performed (Fig. 3). Small bowel obstruction and band dislocation in the lower abdomen were indications for an additional abdominal CT scan. Patients with upper gastrointestinal bleeding underwent an attempt to stop the bleeding on upper endoscopy. Each case of banding complication was referred to the operating surgeon. The decision for operative treatment was made by the surgeon on call and the bariatric surgeon.

Diagnostic laparoscopy was performed initially in 13 cases using four or five trocars. Band reposition, release (opening), or removal was done in patients with band slippage. Methylene blue dye was infused through the nasogastric tube for leak identification. Mini-laparotomy was added in cases of gastric and bowel resection or enterotomy. Planned re-laparoscopy was performed 24 h later when the viability of the stomach or bowel was still

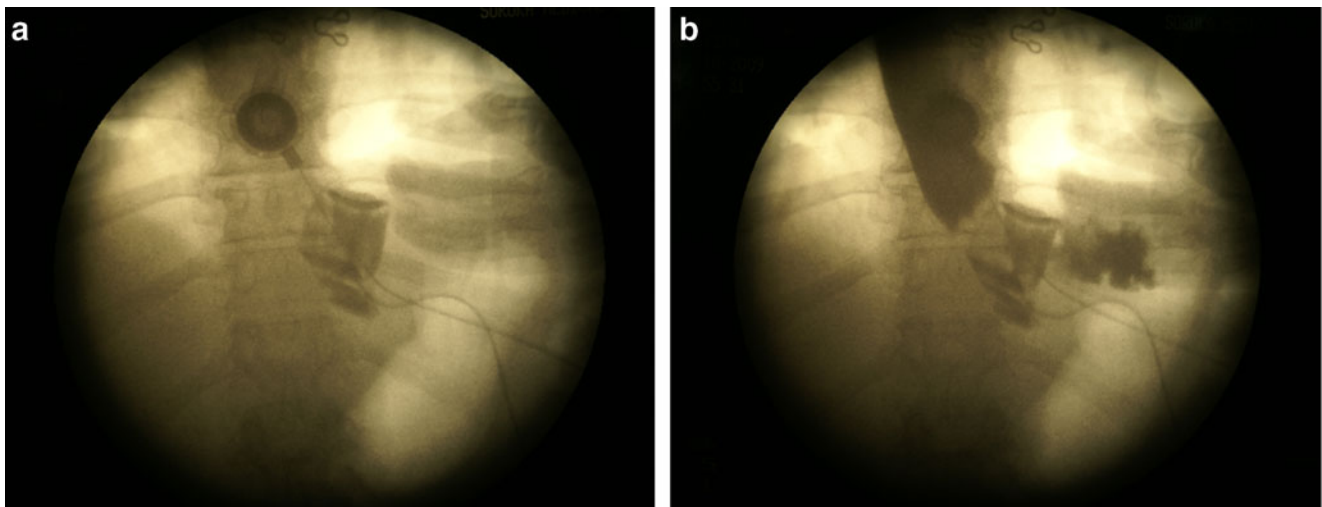


Fig. 2 Normal rentgenological band appearance

questionable during initial surgery, or signs of abdominal sepsis continued.

Laparoscopic gastric banding was reapplied later according to the patient's decision.

Results

Of 14 patients who had emergency surgery for band complications, six were operated on for acute band slippage, two for small bowel obstruction, and one each for band slippage and fetal intrauterine growth restriction (IUGR) during the 36th week of pregnancy, upper gastrointestinal bleeding, perforated gastric ulcer, colonic penetration, and gastric penetration and port disconnection. Patient data are presented in Table 1. The majority were women (79%) with a mean age of 38.4 years. Median time between primary banding and surgery for complications was 19.5 months (range 1–61). Swedish band was applied in 12 patients, LapBand® in one patient, and Heliogast® in one patient. Four patients had previous bariatric revisional surgery for band slippage (band reposition).

Patient presentation, surgery type, and outcome are presented in Table 2.

Case Presentations

Band slippage was a main cause of emergency reoperation. Seven patients were admitted with steady epigastric pain, vomiting, and inability to drink. The pain persisted following band deflation. Two patients required opiate analgesics and did not show any pain improvement. No cases of fever were observed in our series. Abdominal plain film was performed in six patients, and band misposition was found in all of them. Gastrografin swallow found full

stop of contrast dye at band level. Complete obstruction of gastric pouch was observed during an attempt of gastroscopy 24 h after admission of a woman had suffered from constant epigastric pain for 24 h before admission. No signs of mucosal ischemia were present during the procedure. Several hours after endoscopy, she complained of aggravating epigastric pain with upper abdominal tenderness and tachycardia. After release of the strangulated gastric band, partial recovery of the incarcerated part of the gastric wall was observed during laparoscopic exploration. Several hours later, a scheduled laparoscopic second look obtained an accurate demarcation zone and laparoscopic resection using EndoGIA.



Fig. 3 Band slippage on X-ray

Table 1 Data of patients who underwent surgery for urgent complications of LAGB

	Age	Sex	BMI ^a	Comorbidities before LAGB	Year of reoperation	TA (months)	BMI ^b	Band type
1	28	F	42	NIDDM	2001	29	24.9 ^c	SAGB
2	34	F	40.3	Hypertension	2003	2	39.2	Heliogast
3	43	F	42.2		2004	37	24.6	SAGB
4	30	F	56		2005	22	30.3	SAGB
5	22	M	47		2005	17	34	SAGB
6	43	M	40		2005	34	30	SAGB
7	28	F	40.4		2006	4	36.9	SAGB
8	53	F	43.6	Asthma	2006	10	34.5	SAGB
9	41	F	41		2007	3	36.3	SAGB
10	53	F	40.5		2007	61	27.3	SAGB
11	55	F	36.6	Hypertension, ischemic heart disease, asthma, dyslipidemia	2007	29	22.8	SAGB
12	41	F	40		2008	41	26	LAGB
13	32	M	42	CVA, dyslipidemia	2009	1	40	SAGB
14	34	F	41		2009	9	26.6 ^c	SAGB

TA time after gastric banding

^a BMI before LAGB

^b BMI at secondary reoperation

^c BMI prior to pregnancy

Reversible ischemic changes of the gastric pouch were found in another case of band slippage. In both cases, the band was removed.

A 34-year-old woman was operated on for band slippage, prolonged vomiting, and fetal IUGR in the 36th week of her pregnancy. Fetal growth restriction was found during fetal ultrasonography 3 weeks prior to admission (about 2,000 g). She started to drink following complete band deflation, but 24 h later, an inability to pass liquids reappeared. Band slippage without damage of the gastric pouch was found during laparoscopy. The band was released and safe in its channel, posterior to the stomach. She had normal delivery 4 weeks later of a male baby weighing 3,442 g. Uneventful band reposition was performed 3 months later.

Small bowel obstruction by band was observed in two patients: one by an eroded band that migrated into the jejunum, the other was a closed loop obstruction by a connected tube.

A 56-year-old woman 4 years after primary LAGB started to gain weight 3 months prior to admission. She reported the ability to freely eat in addition to nausea and abdominal discomfort. Several outpatient adjustments without X-ray control were performed without any effect on food passage and sense of satiation. She was referred to the emergency room with crampy abdominal pain and vomiting. She had no fever or tachycardia. Abdominal plain film at admission showed a locked gastric band located in the right lower abdomen connected to the port filled with the contrast material and several slightly dilated small bowel loops.

Abdominal CT scan confirmed intrajejunal band location, partially obstructed proximal small bowel dilatation, and a small amount of intra-abdominal fluid. There was no evidence of free gas or air bubbles. Oral contrast passed smoothly down to the rectum. Following fluid resuscitation, laparoscopic exploration the next day revealed intraluminal position of the band and about 200 cm³ of serous-purulent intra-abdominal fluid. The connecting tube was divided just below the intra-abdominal entrance. The band was extracted through a 5-cm mini-laparotomy incision and enterotomy followed by examination of dilated proximal jejunal loops.

Another woman suffered from severe epigastric pain 1 h prior to admission 9 months following LAGB. Her blood pressure was 132/76 mmHg and pulse 89 bpm. Soft and non-distended abdomen was found on physical examination. Gastric dilatation and normal band position without dilated bowel loops were found on abdominal plain film. Blood tests revealed WBC of 14,400/mm³. Band deflation was done, and a nasogastric tube was inserted. A large amount of gastric residual without bile was released through the tube. She still presented with abdominal pain after 10 mg morphine was injected. Free fluid around the pancreas and duodenum was found on abdominal ultrasonography. Gastrograffin swallow found slow stomach emptying with normal air pattern after 3 h. Persistent pain was an indication for emergency surgery. Internal hernia and bowel necrosis around the connecting tube was found during the surgery. Ileocecal resection of nonviable bowel and band removal was performed. She had an uneventful postoperative course.

Table 2 Clinical presentation, preoperative investigations, and surgery outcome

	Clinical presentation	Preoperative investigation	Diagnosis	TTS (hours)	Surgery	HS (days)	Complications
1 ^a	Epigastric pain, vomiting		Perforated gastric ulcer. Pregnancy 35 weeks	4	Caesarian section. Suture of perforation, removal of band	6	
2	Epigastric pain, vomiting	Abdominal plain film	Acute slippage	2	Reposition of band	2	Gastric ulcer 4 weeks later (successful triple therapy)
3	Severe epigastric pain	Abdominal plain film, US, gastroscopy	Acute slippage, necrosis of fundus	48	Removal of band	10	Left pleural effusion—drainage
4	Epigastric pain, vomiting	Abdominal plain film, gastrograffin swallow	Acute slippage	36	Reposition of band	5	Recurrent slippage—reposition 7 months later
5 ^a	Abdominal pain, vomiting		Band penetration to transverse colon	20	Removal of band, suturing of colon	15	
6	Epigastric pain, vomiting		Acute slippage	2	Reposition of band	1	
7	Lower abdominal pain		Band disconnection	3	Port reconnection	4	
8	Vomiting, hemochezia, syncope	Gastroscopy	Upper GI bleeding, band erosion and stomach necrosis	8	Removal of band, partial gastrectomy	18	Wound infection. Subhepatic abscess
9	Epigastric pain, inability to eat	Abdominal plain film	Acute slippage	4	Reposition of band	2	
10	Abdominal pain, vomiting	Abdominal plain film, CT scan	Band erosion and migration, small bowel obstruction	48	Removal of band, enterotomy	8	
11 ^a	Abdominal pain	Abdominal plain film, US	Closed loop obstruction	9	Removal of band, ileo-colic resection	7	
12 ^a	Abdominal pain, vomiting	Abdominal plain film	Acute slippage, ischemia of fundus	22	Removal of band	3	
13	Abdominal pain, melena, anemia	Abdominal plain film, gastroscopy	Penetration of connecting tube into a huge prepiloric ulcer	72	Removal of band, suturing of stomach	6	
14 ^a	Vomiting, fetal intrauterine growth restriction	Abdominal plain film, gastrograffin swallow	Band slippage. Pregnancy 35 weeks.	56	Band opening	5	

HS hospital stay; TTS time from admission to surgery

^a Patient underwent rebanding later

Penetration into the Hollow Viscus

Penetration of the connecting tube into a giant prepyloric peptic ulcer was found during gastroscopy in a patient suffering from severe persistent epigastric pain, melena, and anemia during the week before admission. He was 1 month post-LAGB following band reposition 3 days after primary surgery for acute band slippage. Ulcer biopsy revealed chronic active inflammation. No *Helicobacter pylori* was found in the stomach biopsy. About 2 cm of connecting tube was found inside the stomach during the surgery. Band removal and suture of stomach wall was performed laparoscopically. Surgery was followed by successful PPI anti-ulcer treatment.

A 22-year-old male had epigastric pain and vomiting during the 2 months prior to admission. Ten months earlier, he underwent band revision, and the band was opened and left in the abdominal cavity. No signs of sepsis were observed at admission. Severe fibrosis and adhesions were found during laparoscopic exploration. Changes of band leaf color to brown and erosion of band leaf into the transverse colon was followed by band removal and colon suturing. On the second postoperative day, exploratory laparoscopy was performed for septic signs, fever, and abdominal pain. No colonic leak was found during surgery. Procedure was completed with abdominal lavage.

Perforation of acute gastric ulcer was found in a 27-year-old woman presenting at her 36th gestation week with vomiting and abdominal pain. At admission her blood pressure was 144/92 mmHg, pulse 133 bpm. She had no fever or abdominal tenderness. Two hours after labor augmentation, the patient developed severe abdominal pain and tenderness; acute abdomen was diagnosed. Fetal monitoring demonstrated persistent fetal tachycardia and reduced baseline variability. Exploratory laparotomy combined with cesarean delivery was performed. Perforation of acute gastric ulcer below the band was found. Suture of perforation, omentopexy, and removal of band was done.

Upper Gastrointestinal Bleeding

A 53-year-old woman 10 months after primary LAGB and 1 month after band reposition for slippage was admitted to the emergency room with syncope and history of melena during the last 3 days. She had pallor of the skin. Her blood pressure was 93/54 mmHg, pulse 105 bpm. NG tube released coffee grounds from the stomach. Her hemoglobin was 8 mg/dL. Resuscitation and infusion of two doses of packed cells was performed in the ER. Emergency upper endoscopy was done in the operating room. Chronic gastric ulcer 5 cm in diameter with fresh clot and visible vessel on the lesser curve were found on gastroscopy. Active arterial bleeding of the visible vessel started during the treatment

and was stopped using clips, BICAP, and adrenalin injection. Hypovolemic shock following endoscopy was an indication for surgery. Necrosis of the stomach wall near the fundus with covered perforation required subtotal gastrectomy. Six doses of PC were infused during the surgery. Postoperative period was complicated with wound infection and subhepatic abscess drained percutaneously under CT guidance.

Band Disconnection

Emergency diagnostic laparoscopy was performed in one patient for suspected acute appendicitis presenting with persistent right lower abdominal pain 6 h before admission. Her physical examination revealed local tenderness, without fever and tachycardia. A disconnected tube was found in the right lower abdomen during exploratory laparoscopy performed by the surgeon on call. No signs of peritoneal inflammation were appeared on laparoscopy. Laparoscopic tube reconnection was performed 2 days later by a bariatric surgeon.

Median time from admission to surgery was 14.5 h (range 2–72). Overall, nine of 14 (64%) patients were operated on within 24 h after admission to the hospital.

Preoperative investigations included abdominal plain film in nine patients, gastrograffin swallow in two, CT scan in two, and gastroscopy in two patients. Four patients underwent surgery upon clinical presentation without any additional preoperative evaluation. Band removal was performed in eight patients and reposition in four patients. The band was open and still in place in one case. Two patients underwent partial gastrectomy (one open and one laparoscopic) for stomach necrosis.

Overall, 10 of 14 cases were completed laparoscopically. Conversion was needed for enterotomy for band removal, small bowel resection, and partial gastrectomy. Mean hospital stay was 6.6 days. One woman underwent chest tube drainage of her pleural effusion. Gastroscopy was done in a patient suffering from postprandial epigastric pain 4 weeks after surgery. His gastrointestinal symptoms were successfully relieved with PPI treatment of peptic disease. One wound infection and subhepatic abscess appeared following open partial gastrectomy. The abscess was drained percutaneously under CT guidance. Band reposition for recurrent slippage was performed in one case 7 months after surgery. Four patients elected to have the LAGB reinserted at a later time.

Discussion

Laparoscopic adjustable gastric banding is one of the most commonly performed bariatric procedures worldwide. It is a safe, reversible, minimally invasive procedure with a very low

mortality rate. The major downside to LAGB is the relatively high rate of revisional surgery, reported up to 32% [14]. The common reasons for reoperation are pouch dilatation, band slippage, and erosion. Small bowel obstruction, pouch necrosis, upper gastrointestinal bleeding, and colonic and small bowel perforation by connecting tube were reported in the literature. These complications can occur any time after band placement and must be considered for any patient who develops new-onset gastrointestinal reflux, upper abdominal pain, nausea, vomiting, loss of band restriction, and weight gain. Some of these troublesome complications required basic knowledge and a management algorithm of emergency care physicians and general surgeons for appropriate diagnosis and treatment (Fig. 4).

Band slippage is characterized by dilatation of the upper gastric pouch due to herniation of the stomach through the band. With modification of surgical technique, changes of band circumference, and improved band adjustment protocols, the incidence of slippage decreased from 16.4% to 0.9% [15–17]. These included changes in band placement from perigastric to the pars flaccida; high retrogastric pathway; reduction of the pouch volume; fixation of the fundus to the left hemi-diaphragm; changes in band width, diameter, and configuration; and low pressure gradual long interval (at least 1 month) fluoroscopically guided band adjustments. Using gastro-gastric sutures for band fixation for slippage prevention is still under discussion [15, 16].

Patient noncompliance with diet restrictions and recurrent vomiting can lead to band slippage, as can athletic activity and heavy lifting. Acute gastric band slippage, or severe slippage, should be differentiated from chronic slippage (gastric prolapse) and gastric pouch dilatation. Severe epigastric pain and food intolerance are the main clinical signs of this condition. It usually does not respond to simple complete band deflation. Post-LAGB patients are usually experienced with their band and can deal by themselves with eating overflow or unmasticated food. Usually, they visit the ER in cases of full stoppage of their stomach input or abdominal pain. In the ER, band deflation can be performed gradually in two or three steps (depending on the volume of previous adjustments): first deflation—1 cm³, second—an additional 1 cm³ or more, and last—full deflation of the band. Most of the patients with pouch dilatation or band obstruction respond to the first step of band release, others to the second. Persistent abdominal pain following complete band deflation requires surgical intervention. Injection port malposition and inability to deflate the band require experience with port approach guided X-ray in the Roentgen suite or resolution by a bariatric surgeon. Abdominal plain film can be helpful to define band position. Other than vertical band, position confirms the diagnosis of band slippage. Gastroscopy and single-shot X-ray with water soluble contrast are pointless and time-consuming in appropriate diagnosis of acute pouch

dilatation. Acute cholecystitis can be included in the differential diagnosis. Local tenderness in the right upper quadrant and signs of inflammation are usually present. Urgent surgery is necessary to avoid ischemic necrosis of the dilated gastric pouch, perforation, and peritonitis.

Vomiting and toxicosis may be the cause of band slippage during pregnancy. With the presence of abdominal pain additional to inability to eat and drink after band deflation in pregnant women, band slippage should be considered. We recommend band deflation in early pregnancy to our pregnant patients. Fetal IUGR was an indication for surgery in the third trimester of pregnancy in women with band slippage. Simple and quick laparoscopic band opening allows resolution of the problem of the mother's eating and fetal growth. Several distinct advantages of laparoscopy over the open technique, including better visualization of the abdomen, diagnostic accuracy, decreased surgical trauma, reduced postoperative pain, and faster recovery, can be of benefit in pregnant women. Despite the initial relative contraindication of laparoscopy in pregnancy, increased use of laparoscopic procedures in pregnant women has been reported in the last decade. Several studies have considered the safety, feasibility, and effectiveness of laparoscopic treatment of acute abdominal pathology in pregnancy [18, 19].

Laparoscopic exploration is the best tool for treatment of acute gastric slippage. When simple dilatation is present, band reposition can be performed. In case of necrosis of the stomach wall, the band should be removed and necrotic tissue resected laparoscopically. When stomach perforation is present, the band should be removed and the perforation sutured. In the case of patients with band slippage and necrosis (damage) of stomach, non-bariatric surgeons (without experience) can leave the band in abdomen without stomach damage—the band can be released and kept in the abdominal cavity. Other treatment options, such as conversion to other bariatric procedures, can be performed during the same session after the emergency condition is resolved. Lunca et al. [20] and Weiss et al. [3] reported cases of fundus necrosis treated by conversion to laparotomy, resection, and sleeve gastrectomy.

On our opinion, recurrent band slippage can be treated by additional laparoscopic repositioning of the band. However, this repeated surgery requires bariatric experience. Iatrogenic tear of the stomach wall with appearance of mucosa or blue dye leads to band contamination. Such a procedure should be finished by suture of the tear and band removal. Serosal tears can be repaired by simple absorbable sutures and band replacement. Leaving an open band in the abdominal cavity and its later closure around the stomach is safe and can prevent band erosion.

Perforation of a peptic ulcer during pregnancy is very rare. Severe eclampsia or pre-eclampsia and stress may lead to acute gastric or duodenal ulceration. Severe vomiting in

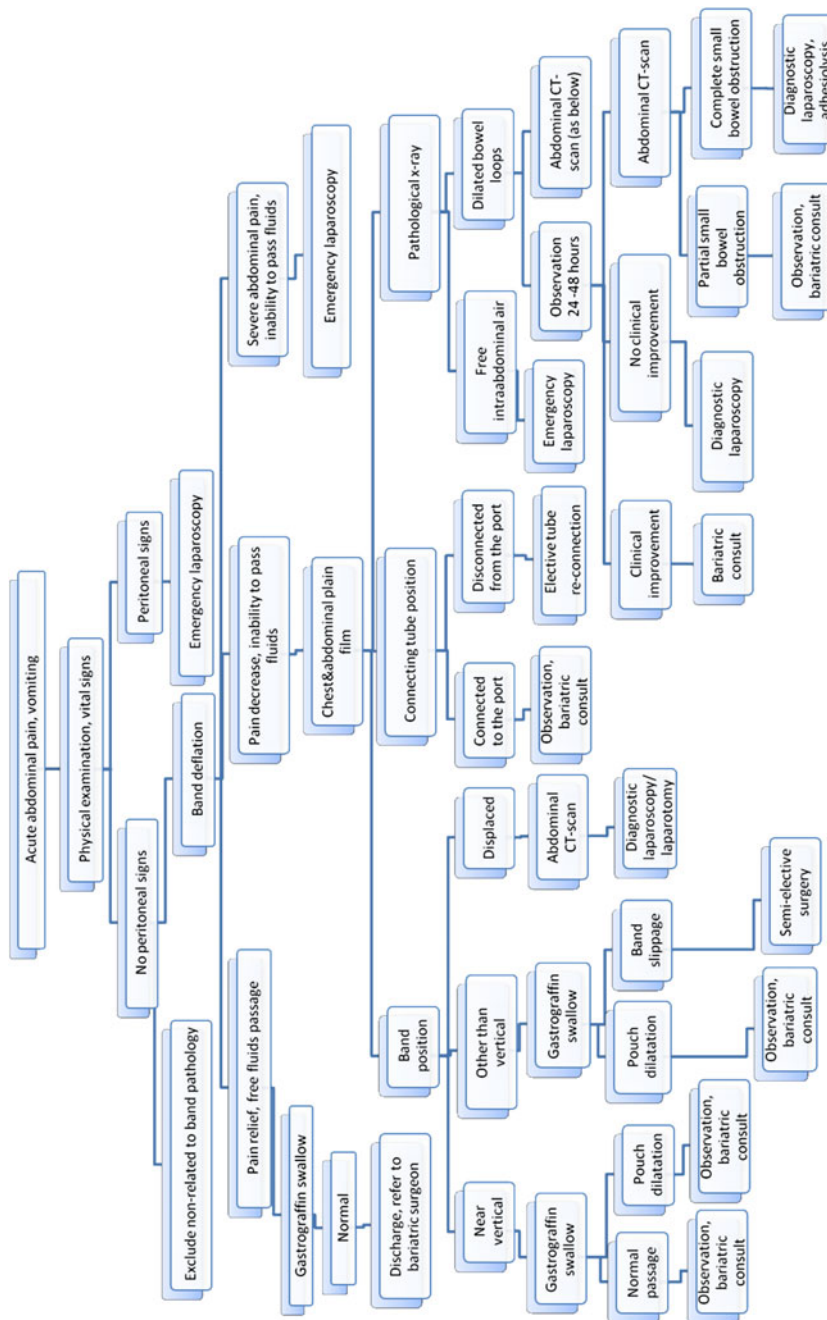


Fig. 4 Algorithm for diagnosis of band complications

pregnant patients following gastric banding can be an etiological factor in peptic ulcer appearance. Band deflation is recommended in pregnant women at the beginning of pregnancy to reduce vomiting. Diagnosis of perforation in the last trimester is difficult, since the enlarged uterus and contractions can mask peritoneal signs. Free air on upright chest X-ray can help in diagnosis. Leaking contrast dye and free air can be diagnostic on abdominal CT scans. Abdominal exploration during cesarean section is a quick and safe tool to reveal intra-abdominal pathology in pregnant women with fetal distress.

LAGB is a surgical procedure during which a gastric band is inserted into the abdominal cavity with a silicone tube. There are two types of gastro-intestinal tract obstructions resulting from band complications: the first is related to band erosion and migration, and the second is related to the connection tube. Gastric outlet obstruction and jejunal obstruction due to migrated band were reported [5, 6, 21]. Usually, the signs of obstruction occur after a period of sudden inability of free food passage related to band erosion. Abdominal plain film reveals band position and dilated small bowel loops. CT scan adds information regarding exact band localization and the site of obstruction. Theoretically, MRI can provide additional information regarding band and tube position. However, we did not find any reports using MRI for diagnosis of band complications. In our hospital, this modality is unavailable for investigation of post-LAGB patients. Presence of a metal port in the patient's body may be contraindicated for MRI performance.

Finally, patients required surgery and removal of the band to prevent bowel ulceration, necrosis, and perforation following prolonged jejunal obstruction with the band. Retrograde band removal can be done through gastrotomy or enterotomy performed by laparoscopic or open technique. Endoscopic band removal is possible and can avoid opening of the gastrointestinal tract. This should be done under laparoscopic guidance to prevent bowel perforation.

Another serious and dangerous complication of LAGB is small bowel obstruction around the connecting tube, which can lead to closed loop obstruction and bowel necrosis. Usually, patients present with cramping abdominal pain with or without vomiting. Severe pain and use of opiates for pain relief can be suspected for bowel ischemia. Abdominal plain film can reveal dilated bowel loops, and CT scan can help to diagnose the site of obstruction and transitional zone. Again, as in the case of acute band slippage, severe abdominal pain is an indication for laparoscopic exploration to prevent bowel ischemia and necrosis. Laparoscopic adhesiolysis and tube release is successful for simple obstructions. Small bowel resection using a small laparotomy incision can be performed in case of bowel necrosis.

Sudden lower abdominal pain is the presenting sign of tube disconnection. It can mimic other acute abdominal pathology such as pelvic inflammatory disease, gynecological problems, renal colic, or acute appendicitis. With mechanical tube contact with the peritoneal surface, contrast dye inside the band can cause abdominal irritation. The possibility of free eating and weight gain are other signs of tube disconnection. There are no septic signs when disconnection is revealed early. Abdominal plain film showing the free end of the connecting tube in the pelvis can confirm diagnosis of port disconnection. CT scan and injection of contrast dye through the port were reported for diagnosis of this complication. In our case, the patient underwent emergency laparoscopy for suspected appendicitis in an emergency setting. Patient and staff information and education about signs of possible complications can prevent unnecessary intervention. Availability of bariatric surgeons for phone consultations by patients and colleagues can be useful in difficult and incomprehensible emergency cases in patients who have undergone LAGB. Most of our patients visited their surgeon "on-demand," so that the problem was identified and solved promptly.

If emergency abdominal procedure in a post-LAGB patient does not identify acute abdominal pathology, the band should be explored for its continuity with connection to the port and signs of inflammation around the band or connection tube. Signs of inflammation around the band require band removal and finding of infection source or gastric erosion. Infusion of methylene blue through a nasogastric tube is helpful for diagnosis of gastric tear or erosion. The intact band can be left in place while postoperative bariatric reassessment is performed.

Connecting tube penetration into the colon, small bowel, and hilus of the kidney have been reported. We described a case of penetration of opened band leaf into the colonic wall and connecting tube into a huge prepyloric ulcer. All reported cases presented with port site infection and abdominal pain. In three patients, the connecting tube was disconnected from the port, and in two, including our case, the band itself was left in the abdominal cavity, resulting in penetration to the adjacent organs. If the band is left opened in the abdominal cavity when band salvage is performed during slippage, it can be placed above the liver and fixed to the peritoneum to prevent contact with other organs. On the other hand, removal of the band from the abdominal cavity can prevent such complications.

The mechanism of tube penetration into the stomach is difficult to explain. Preoperative anamnestic upper gastrointestinal symptoms (abdominal pain, heartburn) before LAGB can suggest peptic disease. Patients with such a clinical picture require upper endoscopy and appropriate treatment prior to the bariatric procedure. Postoperative stress ulceration can be another cause of gastric wall

changes. Permanent contact of the connecting tube with the ulceration can be followed by slow tube penetration into the gastric wall. Early gastroscopy for diagnosis of peptic disease in patients with upper abdominal pain following LAGB can prevent such complications. On the other hand, inaccurate retraction of gastric wall by a coarse instrument or blind insertion of instruments can lead to serosal tear of the gastric wall. Pressure of omentum or other nearby organs on the connecting tube can cause tube penetration too. It is important to check intra-abdominal tube position and leave the tube free during initial surgery.

Acute fulminant exsanguinating hemorrhage from erosion after LAGB has been described [8, 9]. Operative gastric wall trauma and tight band placement may account for early erosion. High band pressure, band overinflation, and dietary noncompliance can cause late band erosion. On the other hand, banal peptic ulcer, Mallory–Weiss tear, erosive gastritis, and esophagitis can be sources of bleeding in patients following LAGB. An upper endoscopy can be helpful for diagnosis of bleeding source and band erosion. However, massive bleeding and the patient's hemodynamic instability are indications for emergency laparotomy. Band removal and suture of the bleeding site usually solve the problem; in our case, gastrectomy was performed for necrosis of the gastric wall. Another weight reduction procedure, such as gastric bypass or biliopancreatic diversion, can be advised after band removal in stable patients.

Four of the 14 patients (29%) in our series had undergone previous band reposition. Superficial serosal tear of the gastric wall during repeated procedures can lead to a decrease in wall completeness and tenderness. This can be the initial mechanism for the occurrence of band-related gastric complications. Biertho et al. [22] reported successful band reposition following band slippage and reserved bypass for failure of the replaced band. Bueter et al. [23] recommended another type of bariatric procedure following failed LAGB in patients with insufficient weight loss. According to our experience in 487 patients who underwent band reposition for slippage, four (0.8%) patients developed serious complications requiring additional surgery. In our opinion, band reposition is the best and simplest choice for patients with band slippage, with benefits in GI tract continuity and band reversibility when needed. Five patients in this series underwent band reposition. In these patients, no signs of gastric leak, necrosis, or band infection were found during surgery. However, band removal can be recommended in such patients for general surgeons without bariatric experience. We performed band retrieval in cases of band erosion or penetration into the gastric, colonic, or small bowel lumen or presence of ischemia as a potential for infection.

With morbidly obese patients, LAGB is still a popular procedure. The number of patients who undergo LAGB is growing, and they are dispersed around the world, not only near their bariatric surgeons. As the number of procedures increases, the number of complications is increasing too and can occur at any time after LAGB. More post-bariatric patients with various complications are admitted to the ER at a time when bariatric surgeons and consultants are away. This is why correct patient management involves time for proper diagnosis and decreased morbidity and mortality from complications of LAGB.

Conclusion

The growing volume of bariatric procedures requires that emergency physicians know about the serious complications of LAGB that require urgent surgical intervention. Treatment algorithms need to provide early diagnosis and surgical approach to solve these conditions.

Conflict of interest The authors declare that they have no conflict of interest.

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