Complications of Adjustable Gastric Banding, a Radiological Pictorial Review

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OBJECTIVE. The purpose of this article is to review the radiologic appearance of complications of the adjustable gastric band.

CONCLUSION. Continuous progress in surgical technique of adjustable gastric banding and the increasing experience of surgeons have decreased the rate of complications. However, because different complications may have the same clinical presentation but require different treatment, to give a definitive diagnosis, the radiologist must be aware of the surgical procedures and possible sequelae.

Morbid obesity is a commonly encountered problem in society. It is usually refractory to conservative treatment, diets, and behavioral therapy. A surgical approach may be required to prevent or treat the associated morbidities. Since its first introduction in 1993, laparoscopic adjustable gastric banding has gained a major role as a first-line surgical treatment for morbid obesity. It is associated with an acceptable success rate and relatively low morbidity. Multiple complications of this laparoscopic technique have been described, both in early and late phases.

Normal Anatomy

The adjustable gastric banding system is composed of three parts: the band, the access port, and the connector tube. Four different systems are available: adjustable silicone lap banding (ASGB) Lap-band (INAMED Health [formerly BioEnterics]), the Swedish Adjustable Gastric Band (SAGB, Obtech), the AMI Soft Gastric Band (C. J. Medical), and the new MIDBAND (Médical Innovation Développement). These differ in a few anatomic characteristics (Fig. 1). The ASGB and the SAGB are commonly used in North America, whereas AMI bands are popular in Europe and Mexico. The ASGB is composed of radiopaque silicone, has a width of 1 cm, and can contain a maximum of 4 mL of fluid for stoma calibration. The SAGB is nonradiopaque, measures 2 cm in width, and can contain a maximum of 8 mL of fluid for stoma calibration [1, 2].
The adjustable band is placed around the upper part of the stomach, approximately 2 cm from the gastroesophageal (GE) junction, thus causing formation of a small pouch or neo-stomach, which limits food intake and slows the emptying process from the stomach into the intestines [3]. The band may also be placed on the esophagus, leaving no pouch at all. This serves as a restrictive device but does not give
the patient a feeling of satiety produced by the stretching of the stomach wall [3]. The access port is placed outside the peritoneal cavity, either within the rectus abdominis muscle sheath or under the external thoracic fascia [4].

In an anteroposterior (AP) projection, the band is inclined 45° to the patient left (phi angle corresponding to the angle between the spinal column and the gastric band has a normal range between 4–58°) and lies about 5 cm below the diaphragm (Fig. 2). After adequate filling with contrast or solid meal, the gastric pouch diameter is normally about 4 cm, which corresponds to a volume of 15–20 mL. The pouch normally shows a grossly regular contour and is concentric in shape [4, 5]. The stoma diameter normally measures 3–4 mm, causing adequate emptying of the pouch within 15 to 20 min [6] (Fig. 3).

Complications Related to the Banding System

Early complications are seen in the immediate postoperative period and include misplacement of the band, perforation, and early slippage with secondary acute pouch dilatation. Late complications include pouch dilatation, band herniation, spontaneous variation in volume, erosion of the gastric wall, and migration of the band.

Misplacement

Misplacement of the band is usually caused by the surgeon’s lack of experience and rarely occurs when the surgeon is experienced [1]. The band may be placed in the perigastric fat (Fig. 4) or in the lower part of the stomach, the latter causing severe gastric outlet obstruction.

Perforation

Early gastric perforation is usually due to surgical trauma to the stomach wall. The patient presents with fever, pain, and leukocytosis. Water-soluble contrast imaging may reveal the leakage from the stomach. However, leakage is
Fig. 6—Band placed at level of gastroesophageal junction just below diaphragm. Phi angle estimated at 78°. No gastric pouch seen; however, distal esophagus dilated with small concentric pouch (arrows) is seen.

Fig. 7—Schematic representation of medial eccentric pouch dilatation with anterior slippage. Note vertical position of band.

Fig. 8—Dilated eccentric lateral pouch with air-fluid level (asterisk). Note position of band with phi angle > 90°. Stoma is markedly narrowed (arrows); no contrast material is passing to rest of stomach. No contrast material reached stomach after 30 min (not shown). Complete obstruction was diagnosed.
Fig. 9—Increased phi angle indicating band slippage in two different patients.  
A, 35-year-old woman. Pouch is lateral eccentric (asterisk) showing air-fluid level (arrowhead) with narrowed stoma of 2 mm (arrows).  
B, Similar findings in 23-year-old man with dilated eccentric pouch (asterisk), increase in phi angle, and narrowed stoma (arrows).

Fig. 10—32-year-old woman.  
A, Oblique image from barium swallow after inflation of band (arrows) with saline shows small concentric pouch (asterisk).  
B, Six months later, patient noticed stabilization of weight. Barium swallow showed band in same position (arrows) with virtual pouch (asterisk) and large stoma, illustrating spontaneous variation in size of stoma.
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not a constant finding [7], and the diagnosis may be delayed for few days. The use of barium has been controversial because it may cause inflammation and fibrosis in these critically ill patients and is probably better avoided if there is definite evidence of leakage [7, 8]. CT is also diagnostic, showing the leakage and the possible associated subphrenic abscess (Fig. 5).

Pouch Dilation

Early pouch dilatation has been described in low-positioned bands [7]. Pouch dilatation is also a common late complication. After

Fig. 11—24-year-old man operated on for abdominal wall abscess with removal of connector tube and access port.
A, No pouch can be identified on barium swallow. Contrast material seen flowing outside band (arrows) is pathognomonic of band erosion.
B, Before removal of band, barium examination shows leak outside stomach into well-defined collection (asterisk).
C, After removal of band, barium examination shows persistent leak outside stomach into described collection (asterisk) where drainage catheter (arrows) is seen.
surgery, the pouch gradually increases in volume but retains a grossly concentric shape. The upper limit of the acceptable volume in these cases is not yet established [5]. Concentric dilatation may be secondary to reactive perigastric fibrosis as a result of tight fastening at surgery or of the natural reaction of the body to foreign implants (silicone) [6]. It may also be secondary to overinflation of the band or to eccentric band herniation that results from focal band weakness [9]. Chronic concentric pouch dilatation, secondary only to chronic nutritional overload, is diagnosed by exclusion [9] (Fig. 6).

Fig. 12—24-year-old woman with normally positioned gastric band (phi angle, 52°). Barium swallow shows contrast material flowing inside (arrowhead) and outside lumen of band (arrows) consistent with erosion.

Medial eccentric pouches are directly related to intraperitoneal band positioning in the transbursal operative technique where dissection is performed through the lesser sac and the band is placed on the stomach near the short gastric vessels. This is in contrast to the new technique, pars flaccida, where minimal dissection is performed and the band is placed in the hepatogastric ligament, leaving the lesser sac untouched. This leads to higher position of the band, away from the peristaltic stomach [5]. In these cases, the axis of the band is oriented to the right of the vertical axis of the spine (phi angle, < 4°), the pouch is dilated and prominent medially, and there is abnormal stasis of the solid food in the pouch for more than 30 min [5, 6] (Fig. 7).

Lateral eccentric pouches are secondary to posterior slippage of the band. Slippage is defined as herniation of the stomach from below the band upward, resulting in pouch enlargement. In such cases, the band is oriented to the left of the vertical line with a phi angle > 58° [5]. This is associated with eccentric lateral dilatation of the neostomach that can show an air-fluid level and delayed emptying. Peternac et al. [5] suggested that this complication is not dependent on the operative technique; rather it results from tears of the anterior seromuscular fixative sutures [5, 10]. Other authors have encountered this complication only in the transbursal approach [9] (Figs. 8 and 9). Eccentric pouches are always abnormal and dilated [5]. In severe eccentric pouch dilatation, the pouch may cause complete obstruction of the stoma. In such cases, gastric volvulus may be encountered [6, 9].

Intermittent slippage due to an unstable band is a difficult diagnosis. It manifests by intermittent obstruction and abnormal band position only after filling the pouch. In these cases, the posterior slippage is discrete and the band returns to its normal position after deflating the system or emptying the pouch [9].

Variation in the Stoma Size

The spontaneous increase in the stoma diameter in the Lap-band is related to the semipermeability of the silicone. The system, therefore, should be filled only with isosmotic, isotonic solution. This will prevent both spontaneous increase in stoma size when using saline and stoma narrowing with pouch dilatation when using hyperosmolar contrast [11] (Fig. 10).
**Erosion**

The clinical presentation of chronic gastric erosion varies between asymptomatic conditions and acute abdominal emergency. Mechanical damage to the wall may be secondary to intraoperative trauma to the muscular layers, inflammatory reaction to foreign bodies, infection, and use of nonsteroidal antiinflammatory medication [3, 9, 12]. The passage of the contrast out of the lumen around the band is a certain indication of band erosion. Gastric erosion is highly likely if an open band is seen. Findings may be associated with a change in band position [12] (Figs. 11–13).
Rotation of the Access Port

Partial rotation of the access port may be most easily corrected by supportive manual compression when the patient is in a supine position. Completely inverted ports require surgical repositioning (Fig. 14).

Disconnection

Disconnection can occur between the proximal and distal parts of the connector tube or at the junction of the connector with the band or with the access port. These disconnections are easily diagnosed on a radiograph (since the connector tube is usually made of silicone). Surgical treatment is mandatory [9] (Fig. 15).

Leakage of the Banding System

Leakage is typically a late complication. It may occur at the level of the band or the connector tube or at the access port. It is first suspected when filling and insufficient deflating volume of the banding system combined with loss of eating restriction are observed [13]. Leakage of contrast material is usually detected while adjusting the band diameter (Figs. 16–19). However, contrast studies sometimes fail to detect the leakage even in typical clinical presentations [2]. In such cases, 99mTc pertechnetate scintigraphy shows strong uptake in the gastric mucosa on delayed images, whereas the tracer has almost cleared from the reservoir [13]. Similar findings are seen with the use of thallium-201 chloride. This examination is limited by its inability to localize the site of the leak. Localizing the leak is possible with the use of 99mTc-albumin, which shows a decrease in the count in the defective part with accumulation of the tracer adjacent to it [2]. Nuclear medicine studies are probably indicated only in extreme cases.

Infection

As around any foreign body, soft-tissue infection around the access port is possible. In addition, even the sterile puncture and adjustment of the stoma size may introduce infection, which then extends along the connector tube and along the band, with possible abscess formation. Infection increases the risk of perforation and fistulization and may necessitate surgical débridement and removal of the band (Figs. 20–23).

Esophageal Dysmotility and Reflux

Esophageal dysmotility represents an early stage of esophageal paresis and dilatation [5]. The extreme form is esophageal gastrification (enhanced reservoir capacity of the esophagus) [5]. This indicates the end point of a successful restrictive bariatric surgery. Secondary achalasia has also been described in association with preoperative lower esophageal sphincter insufficiency [14]. Reflux and regurgitation are common complications associated with pouch dilatation and may be associated with esophagitis (Fig. 24).

Miscellaneous

Food trapping within the stoma has been described [9]. It presents with dysphagia and...
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Fig. 19—40-year-old woman. 
A, Contrast material injected through port outlines gastric lumen (arrows) indicating disconnection of banding system and band erosion into stomach. 
B, Barium examination shows contrast material flowing outside lumen of band (arrows), confirming gastric erosion.

Fig. 20—27-year-old woman. Perisplenic collection (arrowhead) with peripheral enhancement around connector tube (arrow).

Fig. 21—39-year-old man. Whole small bowel filled with oral contrast material. Hypodense collection with peripheral enhancement (arrowhead) seen around connector tube (arrow) in midabdomen.

appears as an intraluminal filling defect within the stoma. The inflammatory reaction around the band may lead to significant fibrosis (Fig. 25). The long intraperitoneal tract of the connector tube may cause small-bowel volvulus and obstruction (Fig. 26). Inflammatory reaction around the connector tube can be extensive, eroding into adjacent organs (Fig. 27).
Fig. 22—21-year-old woman. Streaking and thickening of fat with some free fluid (arrowheads) seen around connector tube (arrows). Minimal free air also noted (curved arrow).

Fig. 23—29-year-old man presented with fever, chills, and abdominal pain. Crescent of air is noted around band (black arrows) consistent with infection.

Fig. 24—Gastric band is placed at level of gastroesophageal junction with dilatation of distal esophagus. Note tertiary contraction or nonperistaltic small waves (white arrows).

Fig. 25—Band removed for erosion into stomach wall. Barium swallow shows deformity of upper stomach (arrowhead) resembling the band and probably related to fibrosis.
Conclusion

Since its introduction in 1993, laparoscopic adjustable gastric banding has been the subject of many studies and evaluations. The continuous progress in surgical technique and increasing experience of surgeons have decreased the rate of many complications. However, because different complications may have the same clinical presentation but require different treatment, to give a definitive diagnosis, the radiologist must be aware of the surgical procedures and possible sequelae.
Fig. 27 (continued)—34-year-old woman presenting with right lower quadrant pain. C and D, Barium examination reveals gastric erosion (arrows), leak toward left upper quadrant (arrowheads). CT slices after swallow shows leak to be within splenic collection. Findings indicate gastric erosion, perforation, and splenic erosion.

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References