Laparoscopic Adjustable Gastric Banding Surgery for Morbid Obesity: Imaging of Normal Anatomic Features and Postoperative Gastrointestinal Complications

OBJECTIVE. The purpose of this essay is to describe the normal anatomic findings after laparoscopic adjustable gastric banding surgery and the imaging findings of postoperative gastrointestinal complications.

CONCLUSION. With the increasing prevalence of morbid obesity, laparoscopic adjustable gastric banding surgery has evolved to be a leading surgical technique. Radiologists need to be familiar with the normal anatomic findings after laparoscopic adjustable gastric banding surgery and with the imaging findings of postoperative complications.

Morbid obesity is a national health problem in most Western industrialized countries and is increasing in prevalence. It is defined as a body mass index of 35 with comorbidity or of 40 without comorbidity. Morbid obesity is difficult to manage with medical or behavioral therapy. Surgical methods of weight control (bariatric surgery), however, have been found to provide immediate and long-term reduction in weight for most patients. There are two main approaches to surgical treatment: bypass procedures based on bypassing part of the digestive tract to generate malabsorption and restrictive procedures based on stomach volume restriction. Surgical procedures are usually performed with a laparoscopic approach. The most widely accepted procedures are laparoscopic roux-en-Y gastric bypass and laparoscopic adjustable gastric banding, both of which have been endorsed by a National Institutes of Health consensus conference [1]. Laparoscopic adjustable gastric banding is the least invasive surgical procedure and has been proposed as a primary operation for morbid obesity [2]. The technique is simple, safe, effective, and has relatively few complications.

Between November 1996 and December 2003, 2,134 patients underwent laparoscopic adjustable gastric banding surgery at our institution. The purpose of this pictorial essay is to familiarize radiologists with the normal postoperative anatomic features and the imaging findings of postoperative gastrointestinal complications of laparoscopic adjustable gastric banding surgery.

Postoperative Anatomic Features and Imaging After Laparoscopic Adjustable Gastric Banding Surgery

In laparoscopic adjustable gastric banding surgery, the stomach is divided into two pouches by placement of an adjustable silicone gastric band 2 cm below the gastroesophageal junction to make a small gastric pouch with a volume of approximately 15 mL. The inner part of the band is a sleeve connected to a subcutaneous port in the left abdominal wall that enables adjustment of the band diameter (Fig. 1).

Because of the possible long-term complications and because clinical symptoms are not reliable indicators, annual follow-up esophagography is recommended. Patients are also referred to the radiologist if weight loss is not satisfactory or if symptoms develop. Esophagography is usually performed with barium unless the study is performed immediately postoperatively or when there is high clinical suspicion of a leak. In such cases water-soluble contrast medium is used initially. If no leak is detected, barium is used for better evaluation.
Normal findings on esophagography with water-soluble contrast medium (Fig. 2) are the presence of the adjustable band, catheter, and subcutaneous port and a small proximal pouch with narrow passage of contrast material through the stoma to the stomach. CT (Fig. 2) is used when small-bowel obstruction, port infection, intra-abdominal leak, or abscess is suspected. Use of multiplanar reconstruction with MDCT enables accurate delineation of the gastric band and visualization of band slippage and migration.

Gastrointestinal Complications of Laparoscopic Adjustable Gastric Banding Surgery

Stomal Stenosis

The most common complication after laparoscopic adjustable gastric banding is gastric stomal stenosis and obstruction. In acute stomal stenosis, patients have vomiting, nausea, and upper abdominal discomfort that may result from blockage of the stoma by food or from postoperative stomal edema. Narrowing of the gastric stoma and slow passage of contrast material are visualized on barium esophagography (Fig. 3). If the band remains in an appropriate position, the treatment is conservative. The radiologist performing esophagography deflates the band and refers the patient to the surgeon.

If the stomal blockage is insidious and chronic, patients experience stabilization of the weight loss curve and gastroesophageal reflux. Weight stabilization can be caused by food accumulation in the esophagus, and the result is increasing insensitivity to distention of the pouch or esophagus. Chronic stomal stenosis can be caused by overfilling or too tight fastening of the band at surgery or by the radiologist after surgery. Subsequent tissue reaction to the silicone band causes perigastric fibrosis. Chronic pouch dilatation can be caused by pouch overfilling if patients do not alter their nutritional habits. Although this complication occurs in as many as 26% of patients [3], the incidence of chronic pouch dilatation usually ranges from 3% to 8% [4, 5]. Barium esophagography shows slow passage or lack of passage of contrast material through the stoma and concentric dilatation of the upper pouch (Fig. 4). The esophagus also can dilate as a result of chronic obstruction (Fig. 5). Stomal stenosis with pouch dilatation is initially managed with band deflation to allow widening of the stoma and improve emptying. Follow-up esophagography within 3–6 weeks is performed to assess improvement. If there is no improvement after band deflation, or if the pouch dilatation is severe and accompanied by severe reflux, surgical intervention may be needed.

In evaluation of the distal portion of the esophagus, it is important to carefully inspect filling defects. Although these defects are most commonly food debris (Fig. 6), we found two cases of metastatic melanoma (Fig. 7) and esophageal carcinoma.

Slippage of the Gastric Band

Another common cause of chronic stomal stenosis is band slippage, which has been found in 4–13% of patients [4, 6–10]. Band slippage can be caused by recurrent vomiting or faulty surgical technique and can be posterior (82% of our cases) or anterior (18% of our cases) [11]. Posterior slippage is associated with upward herniation of the posterior stomach wall through the band. In anterior slippage the higher pressure in the upper pouch pushes the band downward over the anterior aspect of the stomach. Both complications manifest as vomiting, regurgitation, and food intolerance, but the conditions have different radiologic findings. Barium esophagography shows horizontal orientation of the gastric band and delayed passage of contrast material through the gastric stoma. Eccentric upper gastric pouch dilatation occurs, and the pouch is usually posterior and inferior in posterior slippage (Fig. 8) and anterior and superior in anterior slippage (Fig. 9). Severe band slippage can be complicated by bleeding, gastric volvulus (Fig. 10), infarction, and perforation. In these cases patients have abdominal pain and signs of peritonitis. In our series of 125 patients with band slippage, the band was removed in 70 (56%) of the patients, whereas in 55 (44%) of the patients, the band was repositioned or replaced immediately and successfully.

Acute Gastric Perforation

Gastric perforation occurs in 0.1–0.8% of cases [5, 6, 9, 10, 12], has an extremely variable clinical presentation, and can lead to life-threatening sepsis. Patients usually present soon after surgery with fever and abdominal pain or with less specific signs of sepsis, such as tachycardia and anxiety. Patients with suspected gastric perforation should be evaluated with CT, which may depict the perforation and abscess. CT findings indicative of perforation include free or loculated extraluminal air and extraluminal contrast material with infiltration of the mesenteric fat (Fig. 11). CT also shows intra-abdominal fluid collections and abscesses and enables guided drainage, obviating difficult surgery (Fig. 12).

Band Erosion and Chronic Gastric Perforation

Chronic gastric perforation can be caused by transmural band erosion [6] and occurs in 1–3% of patients [3, 7, 8, 13, 14]. The erosion can be the result of continuous pressure of the band against the gastric wall, faulty surgical technique, and abuse of nonsteroidal antiinflammatory drugs. The time from primary operation to diagnosis of band erosion in our series ranged from 3 weeks to 45 months (mean, 19 months). Patients may present with chronic infection of the port site (40% of our patients), weight gain (12%), hematemesis, and sometimes peritonitis or subphrenic abscess due to leak of stomach contents or of saline solution from the port–band system. At radiography and CT, contrast material may be visualized around the intragastric part of the band (Fig. 13). Urgent surgery is usually performed.

Port and Band Complications

Port and band complications are reported in 0–7% of cases [4, 7, 8, 14] and include malfunction of the catheter, the port–catheter connection, and the catheter–band connection. Ninety-one (7.1%) of 1,272 patients available for a mean follow-up period of 37 months had port complications, and 103 (8.1%) of the patients needed remedial operations. Sixty-two patients had system leaks, 19 had infectious problems, and 10 had miscellaneous problems that led to the corrective operation. Band removal was needed by only six patients (0.5%) and band replacement by one patient.

Patients with port and band complications present with decreasing weight loss and report no change in ability to eat after the procedure. Port and band complications may be diagnosed on plain radiography or with injection of 5 mL of nonionic contrast material into the band through the subcutaneous port (portogram). In band disconnection (Fig. 14) and in cases of leakage, contrast material can be seen leaking from the port–catheter connection (Fig. 15) or from the catheter–gastric band connection (Fig. 16). The band also can inflate in a nonuniform manner (Fig. 17), causing ineffective narrowing of the stomach by the band. A leaking band or a disconnected port must be surgically removed and replaced. The subcutaneous port can become infected, and an abscess can form. Because of the body habitus of the patients, subcutaneous infection can be difficult to diagnose, and CT or sonography may be needed for diagnosis (Fig. 18).
Summary
With the increasing prevalence of morbid obesity, laparoscopic adjustable gastric banding surgery has evolved to be a leading surgical technique. Radiologists need to be familiar with the postoperative normal anatomic features and with the imaging findings of postoperative complications.

References

Fig. 1—Laparoscopic adjustable gastric banding device. A, Photograph shows adjustable band with inflatable sleeve (black arrow) connected through catheter to subcutaneous port (white arrow). B, Unenhanced abdominal radiograph shows inflatable sleeve (black arrow) connected through catheter to subcutaneous port (white arrow).
Imaging After Gastric Banding Surgery

Fig. 2—56-year-old woman with normal anatomic findings after laparoscopic adjustable gastric banding. 
A, Esophagogram shows contrast material passing through esophagus (E) and stoma into stomach (S). Band (arrow) is properly located. 
B, Axial CT section at level of band (arrow) shows small gastric pouch (GP) and contrast material in stomach.

Fig. 3—26-year-old woman with acute stomal stenosis 7 months after laparoscopic adjustable gastric banding surgery. Symptom was recurrent vomiting that increased in severity. 
A, Esophagogram shows dilated upper pouch (P) and minute passage of contrast material through narrow stoma (arrow). 
B, Esophagogram after band deflation shows normal passage of contrast material (arrow) from esophagus (E) to stomach (S).

Fig. 4—32-year-old woman with chronic stomal stenosis with concentric dilatation 1 year after surgery. Symptoms were intermittent vomiting and weight gain. Esophagogram shows markedly dilated pouch (black arrows) containing food debris. Band (white arrow) has migrated inferiorly and is located just below diaphragm.
Fig. 5—57-year-old woman with severe chronic stomal stenosis necessitating band removal, after which symptoms eventually resolved. Esophagogram shows markedly dilated and tortuous sigmoid esophagus (E) with no passage of contrast material through slightly malpositioned band (arrow).

Fig. 6—50-year-old woman with heartburn and difficulty swallowing. Gastroscopy revealed presence of meat and dried fruit residue. Esophagogram shows constant filling defect (black arrow) in distal esophagus (E) just above band with normal passage of contrast material (white arrow) to stomach (S).

Fig. 7—65-year-old man with filling defect due to tumor. Symptom was weight gain; no obstructive symptoms occurred. Biopsy at gastroscopy showed metastasis of malignant melanoma. Esophagogram shows large filling defect (thin white arrow) in distal esophagus (E). Irregularity of esophageal wall (thick arrow) and normal passage of contrast material through band (black arrow) into stomach (S) are evident.

Fig. 8—42-year-old woman with posterior band slippage 8 months after surgery. Symptoms were recurrent vomiting, abdominal pain, regurgitation, and chronic cough due to recurrent aspiration. A, Esophagogram shows posterior slippage of proximal pouch (P) inferior in relation to vertically malpositioned band (arrow). E = esophagus. B, Coronal multiplanar CT reconstruction shows band (arrow) has slipped from its normal position immediately below gastroesophageal junction. Gastric pouch (GP) is larger than expected. S = stomach.
Fig. 9—50-year-old woman with anterior band slippage with recurrent vomiting and upper abdominal discomfort. Esophagram shows proximal pouch (P) is superior in relation to inferiorly positioned band (arrow). E = esophagus.

Fig. 10—40-year-old woman with band slippage, persistent vomiting due to posterior band slippage, and surgically proven gastric volvulus. Barium esophagogram shows lateral position of band (thick arrow) with inferiorly dilated pouch (P) consistent with posterior slippage. Distal part of stomach (S) is above band, and because of gastric volvulus, greater curvature (thin arrow) is superior in relation to lesser curvature.

Fig. 11—51-year-old man with band perforation and peritonitis 2 weeks after surgery. Symptoms were fever and abdominal pain.
A, Axial CT scan shows extraluminal air (thin arrow) adjacent to band (white thick arrow) and proximal stomach. Free perisplenic air and fluid (black thick arrow) are evident.
B, Esophagogram shows free air (thin arrows) surrounding band and catheter. Extraluminal contrast material (thick arrow) around band and passage of contrast medium through band from esophagus (E) into stomach (S) are evident.
Fig. 12—46-year-old man with large left subphrenic abscess managed with CT-guided abdominal abscess drainage.

A, Axial CT scan at level of gastric band (arrow) shows large perisplenic fluid collection (C). S = stomach, SP = spleen.

B, Axial CT scan at same level as A after successful drainage of abscess. Pigtail catheter (thin arrow) in remaining fluid collection and intraperitoneal portion of catheter (thick arrow) are evident. S = stomach, SP = spleen.

Fig. 13—47-year-old woman with band erosion and sustained weight gain 2 years after surgery. Esophagogram shows contrast material (arrow) passing around band instead of through it, suggesting intragastric band location. E = esophagus.

Fig. 14—21-year-old man with port disconnection. Symptom was recent weight gain after maintenance of 30-kg weight loss since surgery. Radiograph of abdomen shows port end of catheter (thin arrow) disconnected from catheter (thick arrow).

Fig. 15—27-year-old woman with catheter leakage 5 weeks after surgery. Radiograph obtained after injection of contrast material through port (thick arrow) shows leakage of contrast material from catheter into peritoneal cavity (thin arrows).
Fig. 16—40-year-old man with band leakage 6 months after surgery. Symptom was weight gain despite previous inflation of cuff. Fluoroscopic image with contrast material injected through port shows extravasation of contrast material from band (thick arrow). Contrast material (thin arrows) is evident in peritoneal cavity.

Fig. 17—38-year-old woman with “aneurysm” of band 1 year after surgery. Symptom was nonspecific upper abdominal discomfort developing over previous 3 months and more apparent after eating. Radiograph obtained after injection of contrast material through port (black thick arrow) shows uneven inflation of sleeve inside band (white thick arrow) resembling aneurysmal dilatation due to technical failure. Clips (thin arrow) from cholecystectomy are evident.

Fig. 18—45-year-old woman with port infection. Symptom was pain in port area. Port puncture yielded turbid fluid drawn from port–catheter system. Axial CT scan shows fluid and infiltration of subcutaneous fat surrounding port (thin arrows) and catheter (thick arrow).