Imaging of gastric bands and their complications: an educational pictorial review

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Learning objectives

Gastric banding is a restrictive type of gastric surgery in which a band is placed around the proximal portion of the stomach. Since its introduction into clinical practice in Europe in 1993 (1), gastric banding has gained a central role in the surgical management of obesity.

The purpose of this review is to describe:

1. The indications for laparoscopic adjustable gastric banding.
2. The radiological appearance of a typical gastric band.
3. The procedure by which a gastric band is adjusted.
Background

Obesity is now recognized by the World Health Organization as a global epidemic. (2) A person with a body mass index (BMI) of 25 kg/m$^2$ or greater is considered overweight while a person with a BMI of 30 kg/m$^2$ or more is obese.

Obesity is a major risk factor for a number of chronic diseases, including diabetes, hypertension, metabolic syndrome, stroke, cardiovascular disease, and cancer. The World Health Organization reports that 1.5 billion adults worldwide are overweight with 200 million men and nearly 300 million women being clinically obese. (3) Although once only considered a problem only in high-income countries, obesity rates are increasing significantly in low- and middle-income countries, particularly in the urban setting.

The use of diet and behavioral therapy in the treatment of obesity often prove unsuccessful with a bariatric surgical approach being indicated in many patients.

Laparoscopic adjustable gastric banding is now a first-line surgical treatment for the management of obesity with high success rates being reported in recent years. It offers several advantages over conventional bariatric surgical procedures in that it is minimally invasive, the bowel is not incised, the degree of restriction can be altered, postoperative morbidity rates are lower, and the band can be readily removed. A report by Hutter et al found that laparoscopic adjustable gastric banding had lower risk-adjusted morbidity, readmission, and reoperation rates than laparoscopic sleeve gastrectomy, laparoscopic Roux-en-Y gastric bypass, and open Roux-en-Y gastric bypass. (4)

The current indications for laparoscopic gastric banding are patients with a BMI of greater than 40 kg/m$^2$ or a BMI between 30 and 40 kg/m$^2$ and who have at least one comorbidity that is associated with obesity. Furthermore, prior to consideration for banding, patients should have attempted, without success, to lose an appropriate amount of weight through supervised dietary changes. Contraindications to laparoscopic gastric banding include inflammatory diseases of the gastrointestinal tract, hepatic cirrhosis, oesophageal or gastric varices, severe cardiac or pulmonary disease, previous gastric perforation near the site of band placement or previous gastrostomy. (5)

Multiple complications of gastric bands have been described in the literature, occurring both early and late. The radiologist plays a central role in detecting and diagnosing complications as well as adjusting the device.
Findings and procedure details

We conducted a review of all patients with adjustable gastric band devices presenting to our tertiary referral hospital for the radiological investigation of possible complications over a three-year period.

A conventional laparoscopic adjustable gastric band consists of three components; an inflatable gastric band, a reservoir port, and a catheter that connects the port to the gastric band. (6)

The band is placed around the proximal portion of the stomach to create a small pouch proximally. Its aim is to slow food consumption to allow the release of peptide YY to create a sense of satiety, and thus the overall quantity of food consumed by the patient. The band does not have an effect on the gastric emptying time. Several different types of adjustable band are available commercially. In general, the band is composed of radiopaque silicone and can have a bandwidth ranging from 1 to 2 cm and a capacity of 4 to 10 ml. The instilling port is composed of titanium. The port access needle is a special needle with a lateral hole that allows for non-cutting punctures of the port septum. (7) The Swedish adjustable gastric banding (SAG-BAND; Obtech Medical, Baar, Switzerland), is not visible fluoroscopically and thus contrast injection is required to evaluate the position of the gastric band.

The surgical procedure involves the laparoscopic placement of the silicone band around the fundus of the stomach to create a small proximal gastric pouch with a stoma to the body of the stomach. Sutures are placed between the serosa of the stomach proximally and distally to keep the band in position. The band is inflated or deflated via a radiopaque access port that is connected to the band with a thin silicone connecting tubing. The instillation port is sutured in the anterior rectus sheath to anchor it in position. (8).

The stoma diameter between the small proximal pouch and the remainder of the stomach is adjusted by inflating the inner surface of the band by puncturing the access port percutaneously and injecting or withdrawing fluid solution.

Due to the presence of stomal oedema in the early postoperative period that may temporarily decrease stoma size, the band is left empty initially to allow the oedema to resolve. (8) In general, the first adjustment takes places 3-4 weeks following surgery, and is optimally performed under fluoroscopic guidance.

A control image is obtained initially to access gastric band position, port position and to look for any obvious mechanical issues such as connecting tubing disconnection or kinkage. A single-contrast upper gastrointestinal study with liquid barium sulfate suspension is then performed. This aim of this is to evaluate the volume of the proximal pouch, the current stoma size, and to look for complications such as stoma occlusion or intrinsic abnormalities of the upper gastrointestinal tract. The instillation port is then
localized fluoroscopically and accessed with a non-coring needle under standard aseptic conditions. Low osmolar contrast medium is injected under fluoroscopic guidance to demonstrate the port, connecting tubing and gastric band. A tube leak may be detected at this point. Liquid medium is then injected or withdrawn from the system to adjust the band, narrow the stoma and give the optimum degree of restriction. The band capacity can vary from 4 to 10 ml, depending on the manufacturer. Adjustment sessions are scheduled depending on the patient's ability to eat and weight loss curve. A diagnostic session is carried out if a potential complication is suspected due to patient vomiting, gastroesophageal reflux, dysphagia or a failure to lose weight.

Potential complications including band migration, connecting tube disconnection or fracture, gastric band leakage, gastric erosion/perforation and gastric obstruction. One review of 218 consecutive morbidly obese patients undergoing laparoscopic band insertion reported band misplacement in 5 patients, band slippage in 17 patients, pouch enlargement in 8 patients, port inversion in 3 patients, device leakage in 2 patients, and esophagitis in 11 patients. (8)
**Fig. 4:** Upper gastrointestinal tract barium study demonstrates complete occlusion of the stoma in a 31-year-old female patient with a laparoscopic adjustable gastric band.

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Fig. 5: Fluoroscopic-guided low osmolar contrast injection of a laparoscopic adjustable gastric band in a 39 year-old male patient demonstrates leakage of contrast material from the midpoint of the connecting tubing.

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**Fig. 6:** Fluoroscopic-guided low osmolar contrast injection of a laparoscopic adjustable gastric band in a 42 year-old female patient demonstrates leakage of contrast material from the connecting tubing.

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Fig. 7: Fluoroscopic image of an adjustable laparoscopic gastric band in a 25 year-old female patient demonstrates disconnection of the connecting tubing from the instillation port. The port is also rotated.

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Fig. 8: Upper gastrointestinal tract barium study demonstrates complete occlusion of the stoma due to band overinflation in a 41-year-old female patient with a laparoscopic adjustable gastric band.

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Fig. 1: Fluoroscopic image of the normal appearance of an adjustable laparoscopic gastric band in a 32-year-old female patient. The phi angle (angle between the vertical axis and the gastric band) is within normal limits estimated at 49 degrees.

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**Fig. 9:** Fluoroscopic guided low osmolar contrast injection of a laparoscopic adjustable gastric band in a 27 year-old male patient demonstrates leakage of contrast material from the connecting tubing.

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**Fig. 10:** Fluoroscopic-guided low osmolar contrast injection of a laparoscopic adjustable gastric band in a 41 year-old female patient demonstrates leakage of contrast material at the junction of the instillation port and the connecting tubing.

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**Fig. 11:** Fluoroscopic-guided low osmolar contrast injection of a laparoscopic adjustable gastric band in a 45 year-old female patient demonstrates leakage of contrast material from both the proximal and midpoint of the connecting tubing.

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**Fig. 12:** Fluoroscopic image of a laparoscopic adjustable gastric band in a 33 year-old female patient demonstrates normal position of the band without evidence of tube disconnection of fracture.

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**Fig. 13:** Fluoroscopic-guided low osmolar contrast injection of a laparoscopic adjustable gastric band in a 33 year-old female patient demonstrates leakage of contrast material from the connection point of the port with the tubing.

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Fig. 14: Upper gastrointestinal tract barium study in a 36-year-old female patient with a laparoscopic adjustable gastric band demonstrates migration of the band with the lack of formation of a pouch.

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Fig. 15: Upper gastrointestinal tract barium study in a 27-year-old female patient with a laparoscopic adjustable gastric band demonstrates migration of the band with the lack of formation of a pouch.

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**Fig. 2:** Fluoroscopic-guided low osmolar contrast injection of a laparoscopic adjustable gastric band in a 29 year-old female patient demonstrates normal band position without tube leakage or disconnection.

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Fig. 3: Magnified fluoroscopic-guided low osmolar contrast injection of a laparoscopic adjustable gastric band in a 29 year-old female patient demonstrates normal band position and expansion.

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Conclusion

Gastric band devices are increasingly encountered in the radiological setting and familiarity with their normal appearance and possible complications is essential for the reporting radiologist.

Increased familiarity of surgeons with gastric band insertion has lead to a reduction in both the early and late complications associated with gastric banding. However, complications are still commonly observed in the radiological setting and the radiologist must have knowledge of the device, adjustment technique and complications for the patient to obtain optimal benefit from the procedure.
2. Obesity and overweight”. World Health Organization.