Imaging Following Mini-Gastric Bypass and Sleeve Gastrectomy: what every radiologists need to know

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Learning objectives

1. To demonstrate postsurgical normal anatomy on Upper Gastrointestinal Series (UGI) and emphasize some pitfalls causing misdiagnosis.

2. To show complications of these commonly performed novel bariatric procedures.
Background

Obesity has been a serious problem over the past few decades particularly in developed countries and bariatric surgery has become popular treatment of morbid obesity, which is accepted as a only long-lasting treatment (1). Radiologists encounter patients with bariatric surgery much more than past in their daily practice. In this regard, radiologists must know postoperative anatomy and findings, associated complications of the various bariatric procedures in order to accurately interpret.

The aim of this pictorial essay is to familiarize radiologists with surgical techniques, the normal postoperative anatomic features and the imaging findings of associated complications of mini gastric bypass and sleeve gastrectomy.
Findings and procedure details

LAPAROSCOPIC SLEEVE GASTRECTOMY

Laparoscopic sleeve gastrectomy is a relatively new, introduced in 1999, and increasingly used bariatric surgery technique (2). The technique consists of greater curvature gastrectomy to create a narrow gastric pouch along with lesser curvature of stomach. The procedure promotes weight loss by means of restrictive effect while maintaining of normal pathway of food. Technique has no any risk for malabsorption in contrast to other techniques but this procedure is irreversible.

Surgical Procedure

The procedure includes dividing the stomach along its long axis and resecting the great curvature of fundus, body and proximal antrum to create a long tubular gastric remnant (2,3) (Fig1). Remaining stomach volume is only about 100 ml, causing the patient to experience early satiety and weight loss (4).

Imaging

The UGI examination is usually performed 1 to 2 days after surgery to rule out staple line leak and sleeve obstruction before starting oral intake. A normal postoperative examination demonstrates tubular-shaped of remnant stomach (Fig 2,3). As distal antrum is left it is possible that widened segment is seen at the distal end of pouch and sometimes outpouching from a residual portion of gastric fundus can mimic the appearance of a leak (5).

CT scan is performed only in condition that a complication is suspected including staple line dehiscense, abcess, perforation and other complications such as splenic injury or infarction. CT examination displays a tubular narrowed stomach and staple line identified along greater curvature of remaining stomach. Abundant mesenteric fat is seen in the expecting location of the resected stomach.

Complications

Main complications of the technique are fistula or leak, bleeding of staple line and abcesses. Leaks usually occur at proximal end of the staple line near the
gastroesophagial junction (Fig 4). Both UGI examinations and CT it is detected as extraluminal water soluble contrast material or collections in the left upper quadrant (Fig 4,5).

Abscess is usually secondary to leak. CT may demonstrate site of the leakage and the presence of abscess in this region. The presence of the oral contrast material within the abscess confirms its origin (Fig 6).

In addition, strangulated herni through the trocar orifice, an abdominal wall hematoma and splenic injury might be seen rarely (Fig 7,8).

MINI-GASTRIC BYPASS

Mini-gastric bypass is a relatively new and simple bariatric surgery technique and is now being performed more frequently. Laparascopic mini gastric bypass is a safe alternative to laparoscopic Roux-en-Y gastric bypass due to the its simplicity and lower complication rate. In addition ,the technique has similar efficacy on weight loss and control of diabetes mellitus (7,8).

Mini-gastric bypass is also accepted to be a wise option to choose as a complementary or revisional bariatric surgery technique when other techniques, especially vertical banding or adjustable band gastroplasty, fail. As the second operation will be more risky when adhesions and other postoperative changes are considered, mini-gastric bypass can be performed more successfully when compared to more difficult surgical techniques, such as Roux-N-Y gastric bypass.

Surgical Procedure

To create a narrow and long gastric tube firstly stomach is divided through the lesser curvature with the help of surgical staplers, stapler line extends from angle of His to 2 cm proximal to the pylorus. Then jejunal segment located approximately 200 cm distal to the ligament of Treitz is anastomozed to the gastric pouch, side-to-side, forming a long afferent loop (Fig 9). The gastric antrum, the duodenum and proximal jejunum are consequently bypassed. As other bariatric bypass surgeries, afferent loop length is considered to be not only postoperative successful weight loss but some complications. Longer afferent limbs may be anastomosed in patients with higher body mass in order to achieve more weight loss.

Imaging
UGI studies show relatively easy and fast passage of oral contrast via side-to-side gastroenterostomy anastomosis and subsequent filling of both afferent and efferent loops with contrast resembling an omega shape (Fig 10). Oral contrast passage might be a little bit slow in early postoperative period due to various factors such as edema around anastomosis line, postoperative transient motility disorders and ileus. The opacification in the afferent loop is seldom because of the angulation at the afferent loop made by anchoring suture to prevent reflux from bypassed segments.

CT imaging remains as a problem solving diagnostic tool that demonstrates postoperative anatomical relationships and complications.

**Complications**

Stricture or stenosis at the gastrojejunostomy site is a relatively common complication of the procedure (Fig 11). Postoperative edema also obstruct the passage which is transient and recovery is expected within two weeks.

Anastomotic leaks are uncommon but very essential complications and occur in only 0.5-1.9% of patients (7-9). Leak is typically occurs at gastrojejunostomy site (Fig 12).

Ulcers at the gastrojejunal anastomosis are important complications which occur 0.6-8% of the patients following gastric bypass surgery. The causes of marginal ulcers are exposure to acid and large gastric tube. Detecting marginal ulcers on a UGI study or CT scan less reliable than endoscopy. However findings of scar or fibrosis might be identified on CT images.
Fig. 1: Schematic representation of sleeve gastrectomy

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Fig. 2: Sleeve gastrectomy. Normal anatomy on UGI.

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Fig. 3: UGI series show long tubular gastric pouch following the sleeve gastrectomy.

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**Fig. 4:** UGI series show a staple line leak just below the esophagogastric junction which is common site of leak.

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Fig. 5: CT scan shows extravasation of contrast suggesting with leak.

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**Fig. 6:** Common site of abscess. Axial CT image show an abscess adjacent to the upper part of staple line.

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Fig. 7: Abdominal wall hematoma. Axial CT image shows an abdominal wall hematoma (arrow) over the trocar insertion site.

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Fig. 8: Splenic infarction. Axial CT image shows a regular peripherally based low attenuation triangular area in keeping with splenic infarction (arrow).

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**Fig. 9:** Schematic representation of mini-gastric bypass.

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**Fig. 10:** Mini-gastric bypass. Normal anatomy on UGI study.

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Fig. 11: Stricture. UGI study shows marked narrowing in gastric pouch (arrow) following mini-gastric bypass. Also noted dilatation of stomach.

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Conclusion

Laparoscopic mini-gastric bypass and sleeve gastrectomy are two novel bariatric procedures that are being increasingly performed by the bariatric surgeon. Radiologists should be familiar with these surgical procedures, postoperative normal anatomy and associated complications.
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