How Imaging Can Rule Out Complications After Surgery

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The risk of complications related to the effects of surgery and general anaesthesia is increased in the high-risk, obese population. These include chest and wound infections as well as an increased risk of deep vein thrombosis and pulmonary emboli. Complications which occur as a direct result of the bariatric surgery itself include haemorrhage, anastomotic leakage and localised trauma to the liver and spleen as a result of traction injuries. Late complications of surgery include port-site herniae and small bowel obstruction from internal herniation and adhesions.

The risk of surgical complications also increases in those patients who have undergone previous bariatric surgical procedures.

The commonest surgical procedure now performed in the developed world for the management of morbid obesity is the Roux-en-Y gastric bypass (RYGB) which is usually performed laparoscopically (Fig. 5.1).

The stomach is divided and there is a band of staples which occludes the proximal stomach. The proximal retrained gastric pouch has a volume of approximately 20–30 mL.

The jejunum is divided approximately 30–40 cm distal from the ligament of Treitz, and a side-to-side gastro-jejunostomy is performed with the proximal gastric pouch. As a result of the side-to-side anastomosis, a small afferent, "blind" loop is left in situ.

A distal jejuno-jejunal anastomosis is created approximately 100–150 cm distal to the proximal gastro-jejunostomy. This procedure provides a combination of both restriction and malabsorption. Early complications include anastomotic leaks from one of the two surgical anastomosis, i.e. from the gastro-jejunal anastomosis or the jejuno-jejunal anastomosis. Leaks can also occur from the two staple lines at the divided stomach or the short, blind ending of the afferent jejunal limb. Late complications include small bowel obstruction and marginal ulcer formation. The risk of complications increases in those patients who have had previous failed bariatric surgery such as a laparoscopic band where there may be fibrosis or scarring around the gastric fundus.

Common complications of the Roux-en-Y gastric bypass procedure are as follows [4–10]:

- Intestinal hernias (incisional or internal) in 6–17% of cases
- G-J or J-J anastomotic strictures in 3–9%
- Anastomotic leak in 3–9%
- Small bowel obstruction in 1–5%
- Marginal ulceration in 0.5–13%

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Contrast studies with CT and/or fluorosopy have been shown to have a sensitivity and specificity of around 50% in the diagnosis of complications following bariatric surgery. Routine postoperative imaging has not been shown to be of significant value [2–5] in improving patient outcome.

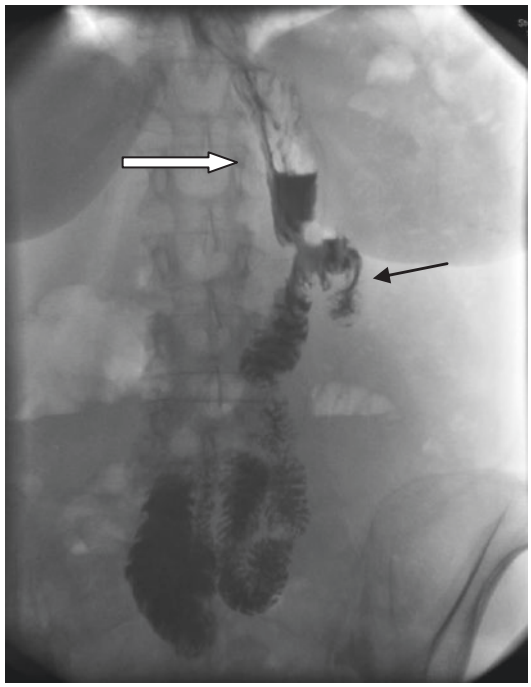

Fig. 5.1 shows gastric pouch (*white arrow*) and short proximal, blind-ending afferent jejunal limb (*black arrow*)

Postoperative complications are best demonstrated by a combination of CT and/or oral contrast studies. One of the most common and potentially fatal complications is that of a postoperative leak which occurred in 5.3% of cases in a series of 906 patients who underwent Rouxen-Y gastric bypass surgery of which 77% occurred at the gastro-jejunal anastomosis (Fig. 5.2 a, b) [7].

Contained leaks can be treated by percutaneous catheter drainage, whereas larger leaks with clinical signs of peritonitis will require open or laparoscopic surgery with a peritoneal washout together with repair of the leak and placement of a surgical drain.

Small bowel obstruction may occur as a result of stricture formation at the distal jejunojejunal anastomosis or by internal herniation (Fig. 5.3a, b) through the mesocolic window via the roux loop (Petersen's space). Diagnosis is often difficult and may require a combination of barium follow through studies and CT scanning and occasionally can only be determined by way of laparotomy. Patients present with typical symptoms of small bowel obstruction.

Normal appearance of end-to-side gastrojejunal anastomosis (Fig. 5.4a) with short blind-ending afferent loop (arrow).

A rare complication which can result in persistent gastro-oesophageal reflux and vomiting

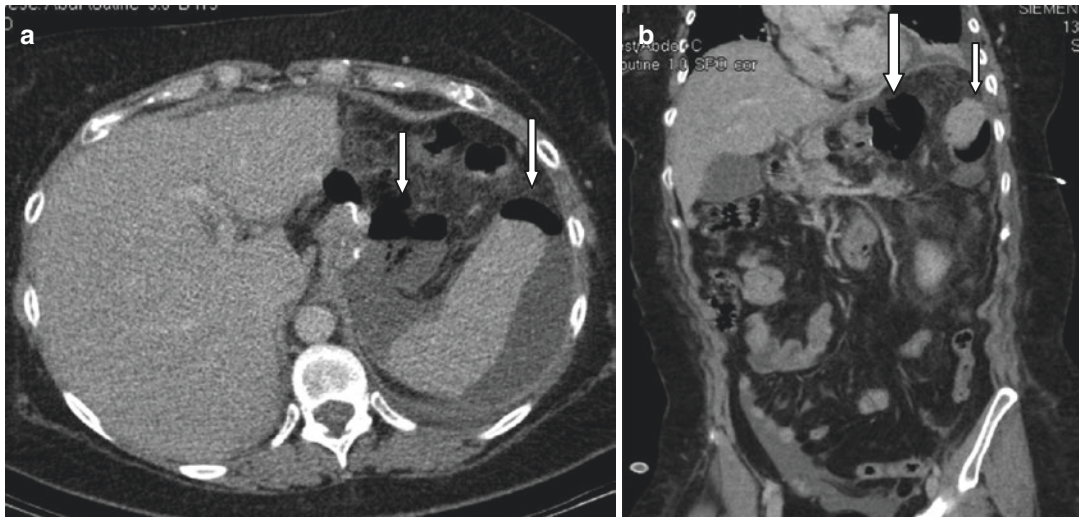

Fig. 5.2 (**a** and **b**) Axial and coronal views showing gas and fluid (*arrows*) from leak at G-J anastomosis

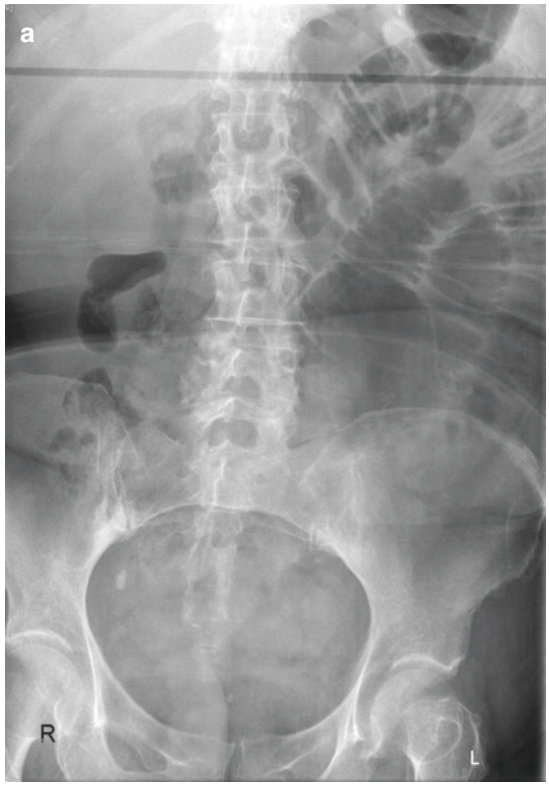

Fig. 5.3 (**a**) Abdominal X-ray showing proximal small bowel obstruction with dilated jejunal loops in the upper left side of the abdomen. (**b**) Corresponding CT scan showing dilated, fluid-filled loops of jejunum (*blue arrow*) on the left side of the abdomen lateral to the descending colon (*white arrow*)

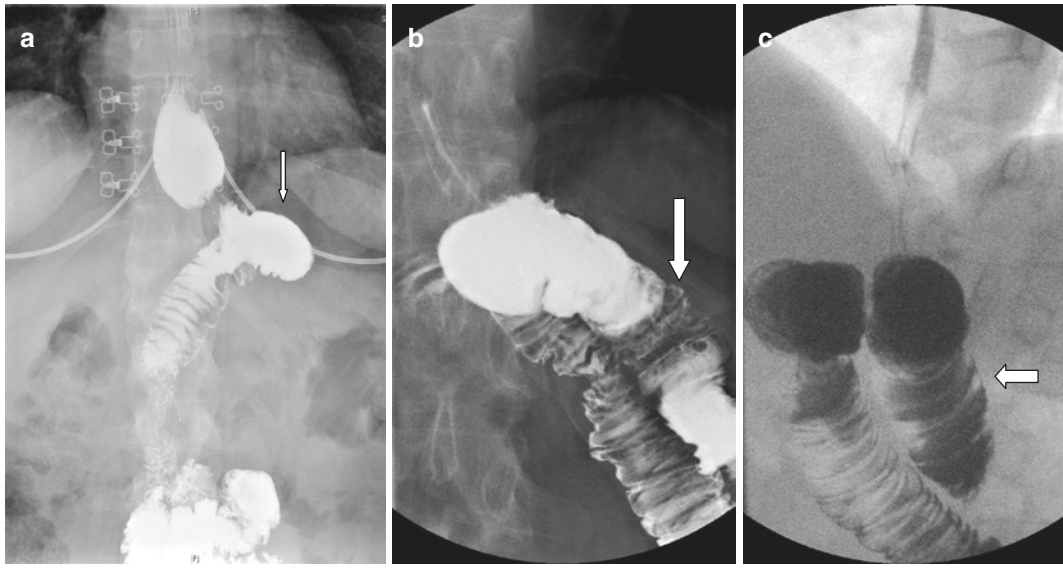

Fig. 5.4 (**a**) Normal appearance of end-to-side gastro-jejunal anastomosis with short blind-ending afferent loop (*arrow*). (**b** and **c**) Excessively formed long afferent jejunal loop (*arrows*)

is due to a long afferent proximal blind-ending jejunal loop, the so-called "candy cane" or "hockey stick" appearance (Fig. 5.4b and c).

Strictures at the gastro-jejunal anastomosis are due to the presence of fibrosis and patients present with reflux and vomiting which can be treated by endoscopic dilatation. They tend to appear in the later stages after surgery and have been reported in up to 9% of cases [8] (Fig. 5.5).

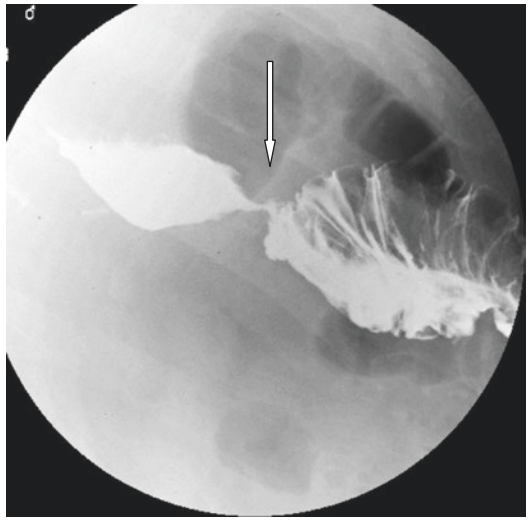

Fig. 5.5 Gastro-jejunal stricture (*arrow*) post-RYGB

5.1 Ulceration at the Gastro-Jejunal Anastomosis

Patients present with epigastric pain and bleeding Treatment is usually conservative with appropriate proton pump inhibitors (Fig. 5.6).

Ulceration and oedema can also rarely develop in the more distal jejunum, usually as a result of ischaemic damage to the mucosa.

5.2 Laparoscopic Adjustable Gastric Banding (LAGB)

This procedure provides restriction only and is more commonly used for patients with less severe obesity.

Early complications are usually a direct result of the surgery such as ileus or haemorrhage.

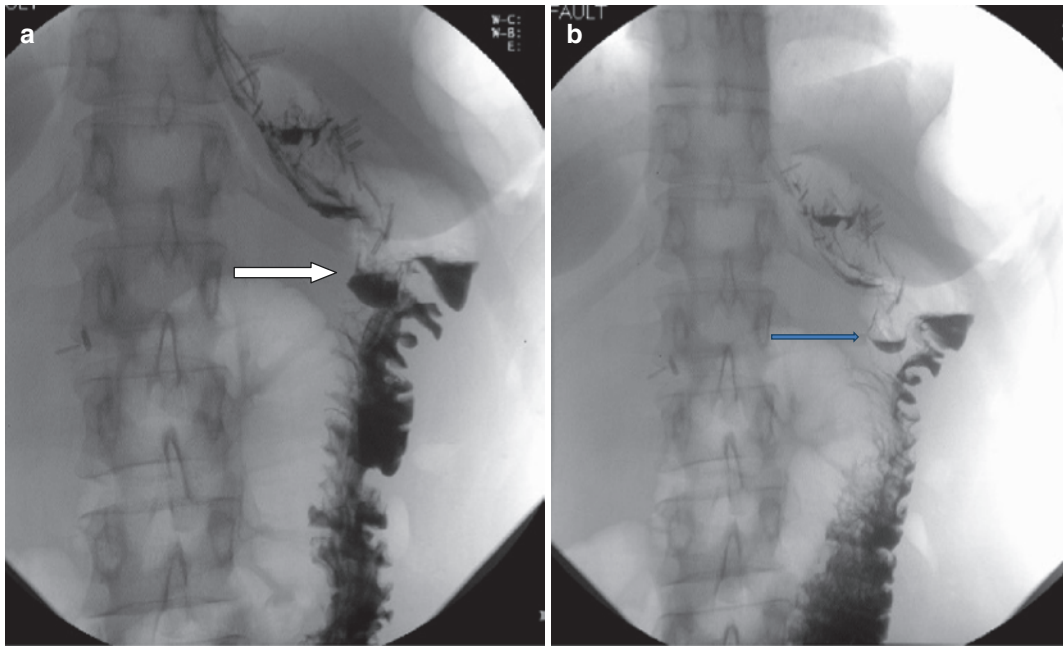

Fig. 5.6 (**a** and **b**) shows a large marginal ulcer (*arrow*)

There are multiple late complications which can occur, the commonest of which is due to pouch dilatation which occurs in 3–10% of patients and band slippage in up to 13% of patients.

The reported long-term results of LAGB are not as good as LAPG or sleeve gastrectomy with a 3-year failure rate reported to be up to 40%.

5.3 Pouch Dilatation

This complication occurs due to a combination of overeating in the presence of a tight band. The patient can usually be adequately treated without resort to surgery by full or partial deflation of the band under fluoroscopic guidance. Patients may present with acid reflux and waterbrash which is usually worse when lying down at night or with a failure to lose weight as the dilated gastric pouch acts as a reservoir for undigested food.

Barium study show showing a persistently dilated gastric pouch (arrow) pre- (Fig 5.7a) and post-band (Fig. 5.7b) deflation.

Pouch dilatation can progress to band slippage and increasing pouch dilatation. This can be diagnosed by demonstrating a transverse lie of the band on plain abdominal X-ray (Fig. 5.8) and a large overhanging pouch on barium studies (Fig. 5.9).

CT scanning can also demonstrate a slipped band (Fig. 5.10a and b), but this is not usually performed unless there are other worrying symptoms present.

Treatment of band slippage is by surgical revision with repositioning of the band or removal of the band.

Band slippage can progress to massive gastric dilatation (Fig. 5.11a and b). This occurs in up to 13% of LABG patients and is due to a combination of a chronically tight band with overeating resulting in band slippage and increasing dilatation of the proximal gastric pouch.

The common causes of late vomiting following LAGB are as follows:

- Overeating
- Excessive tightening of the band
- Long haul air travel
- Stress and hyperacidity
- Effects of the menstrual cycle

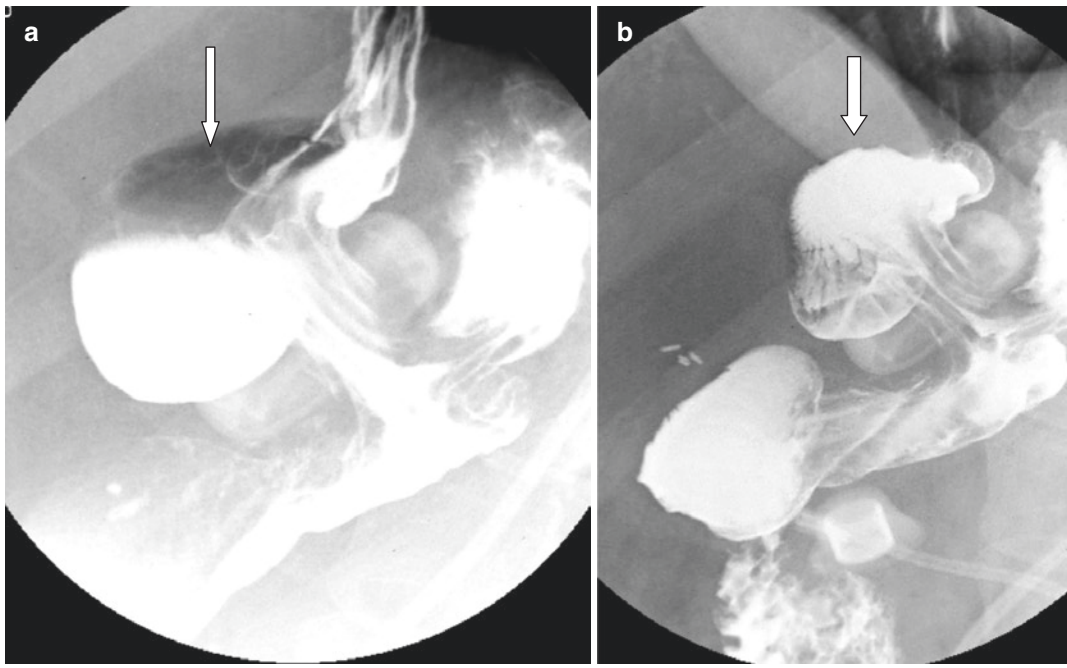

Fig. 5.7 Barium study show showing a persistently dilated gastric pouch (*arrow*) pre- (**a**) and post-band (**b**) deflation

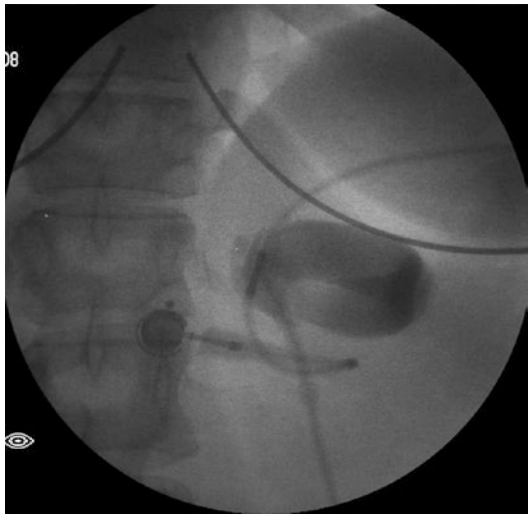

Fig. 5.8 shows a transversely lying band due to band slippage

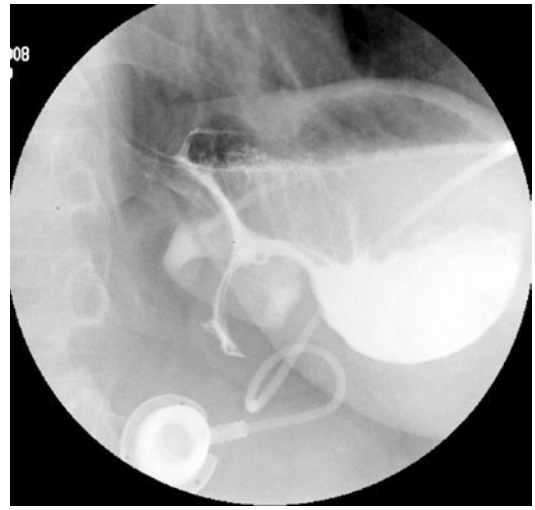

Fig. 5.9 showing a large, fluid-filled proximal gastric pouch which overhangs the band

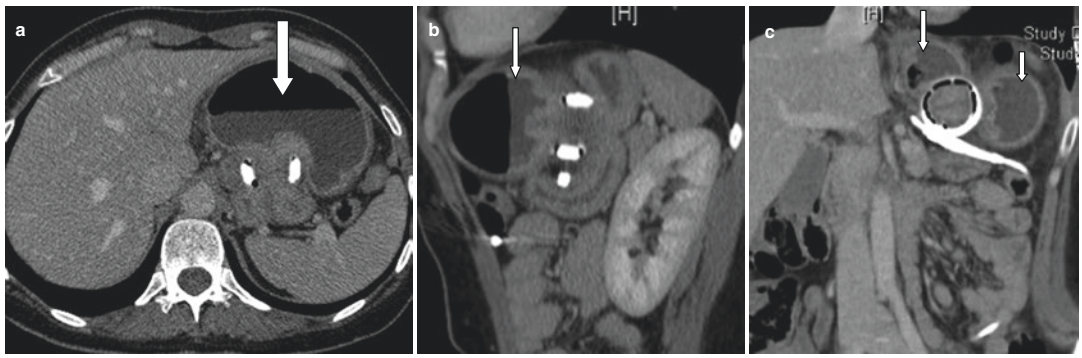

Fig. 5.10 (**a**)showing fluid-filled dilated, overhanging gastric pouch (*arrow*) with a transverse lying band, indicating a slipped band. (**b** and **c**) showing a sagittal and coronal reformat with the same dilated gastric pouch above the slipped band (*arrows*)

Treatment is by band deflation, either partial or full, followed by a period of rest, usually 4–6 weeks, with a delayed band reinflation, as requested by the patient.

A chronically tight band can also lead to fibrosis and scarring around the gastric fundus at the level of the band which may result in a persistent stricture, despite full band deflation, causing mechanical obstruction. This will usually require surgical division at the time of revisional surgery.

Oesophageal dilatation (Fig. 5.13) and *dysmotility* (Fig. 5.14) are also fairly common complications and can occur from a combination of a tight band with excessive eating causing dilatation of the oesophagus. The oesophagus then acts as a reservoir. Patients complain of failure to gain weight or excessive food intake with a lack of satiety. Oesophageal dysmotility is more common in the over 50 age group and in thos patients with long term band placements. Management of this group of patients is by deflating the band in order that the oesophagus can return to a more normal function.

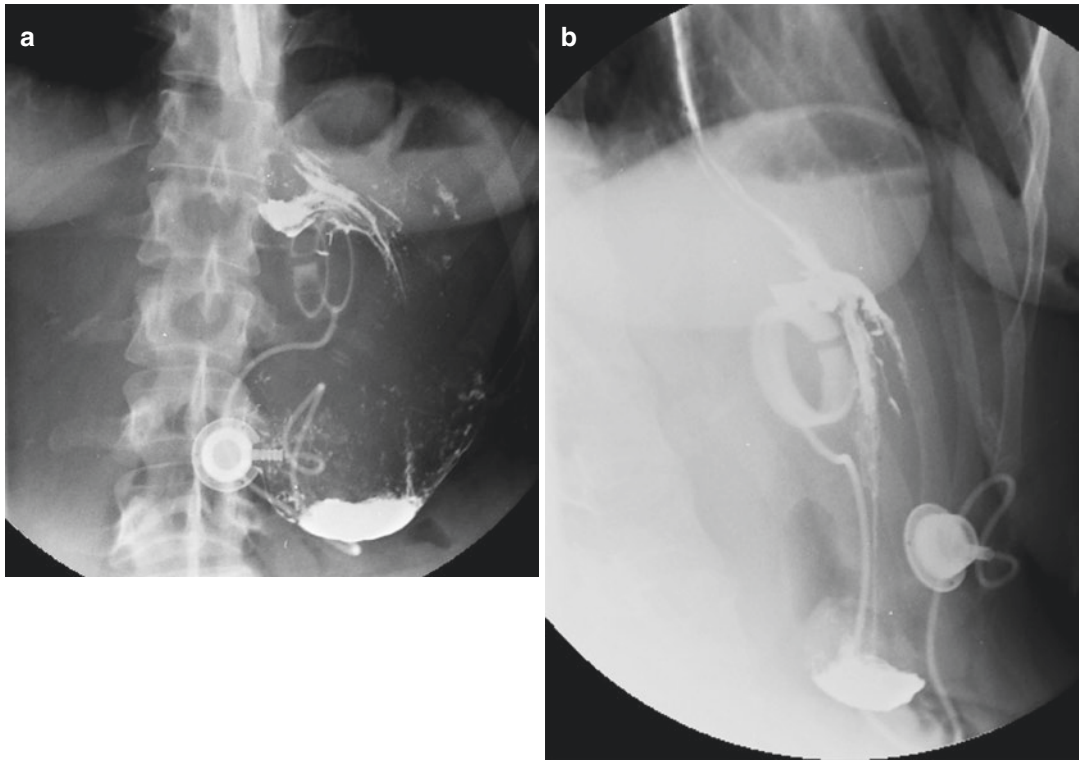

Fig. 5.11 (**a** and **b**) showing massive proximal gastric dilatation with band slippage. There is a large fluid level in the stomach. Note the vertical orientation of the band which has slipped from the horizontal to the vertical position

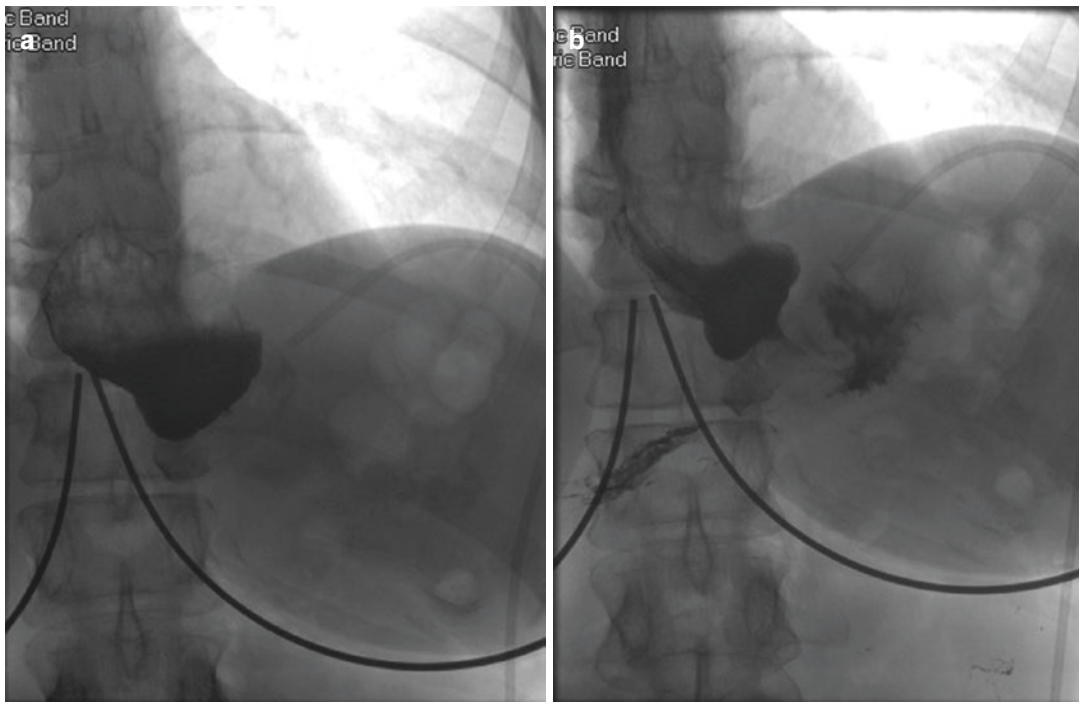

Fig. 5.12 (**a**) shows a tight band with complete obstruction. (**b**) shows a persistent stricture at the level of the band despite full deflation

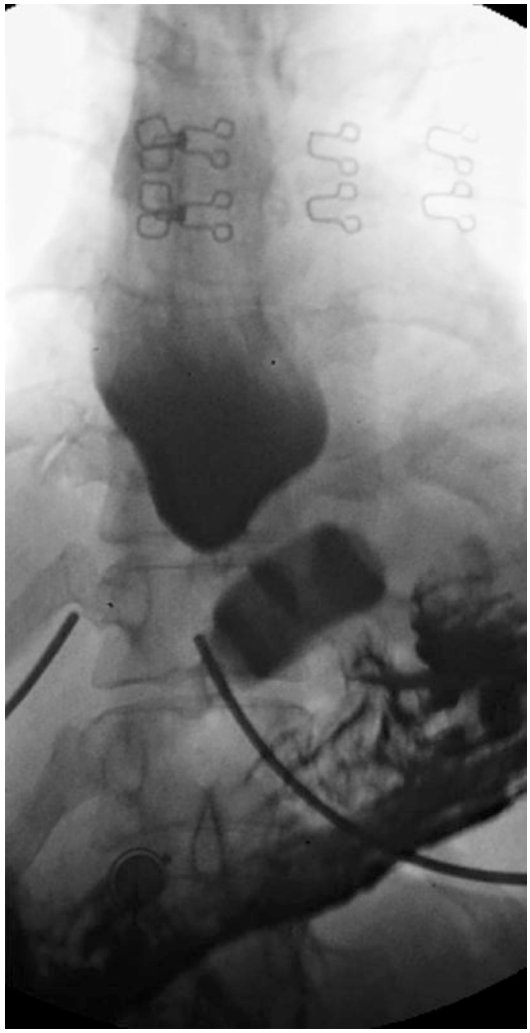

Fig. 5.13 shows a dilated, fluid-filled oesophagus with a tight band

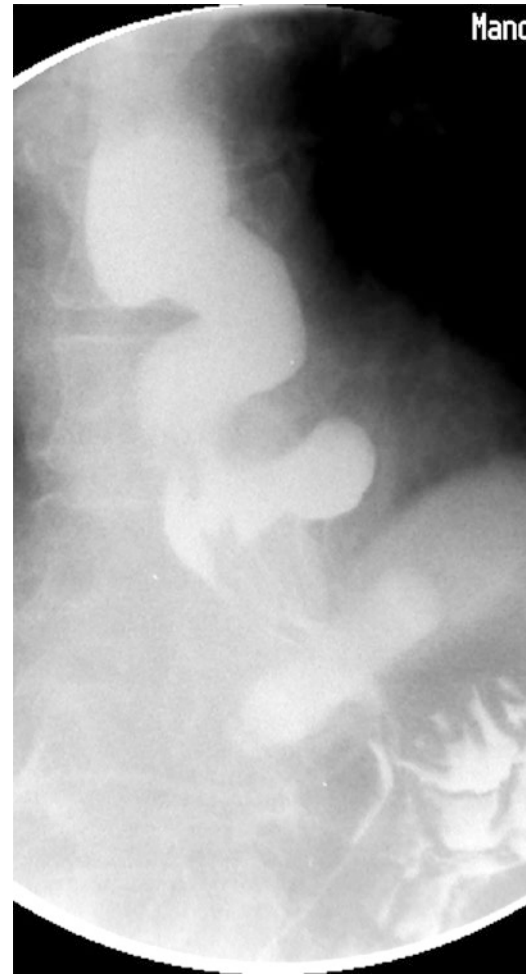

Fig. 5.14 shows gross oesophageal dysmotility with a "corkscrew"-like appearance in a 56-year-old lady.

5.4 Leaking Band/Port Site has Been Reported in Up to 5% of Band Placements

Tube leakage can occur by repeated needling of the port site causing damage to the port or from disruption or partial separation at the metal-tubing connection (Fig. 5.15a). This can occur spontaneously or from poor surgical placement.

Port site leakage may occur as a result of direct needle trauma as a result of multiple blind attempts at needle placement (Fig. 5.15b).

This complication can be detected by aspirating air and sometimes yellow stained fluid as a result of contamination and/or infection from the port site when the patient attends for a band fill. A leak of contrast can usually be readily seen on radiological screening when full-strength contrast is best used to detect such a leak.

Slow leaks can be much more difficult to diagnose, and the patient may require repeated attendance in order to assess the volume of fluid in the band. Careful screening is required to demonstrate these subtle leaks which occasionally may only be confirmed at the time of surgical band revision.

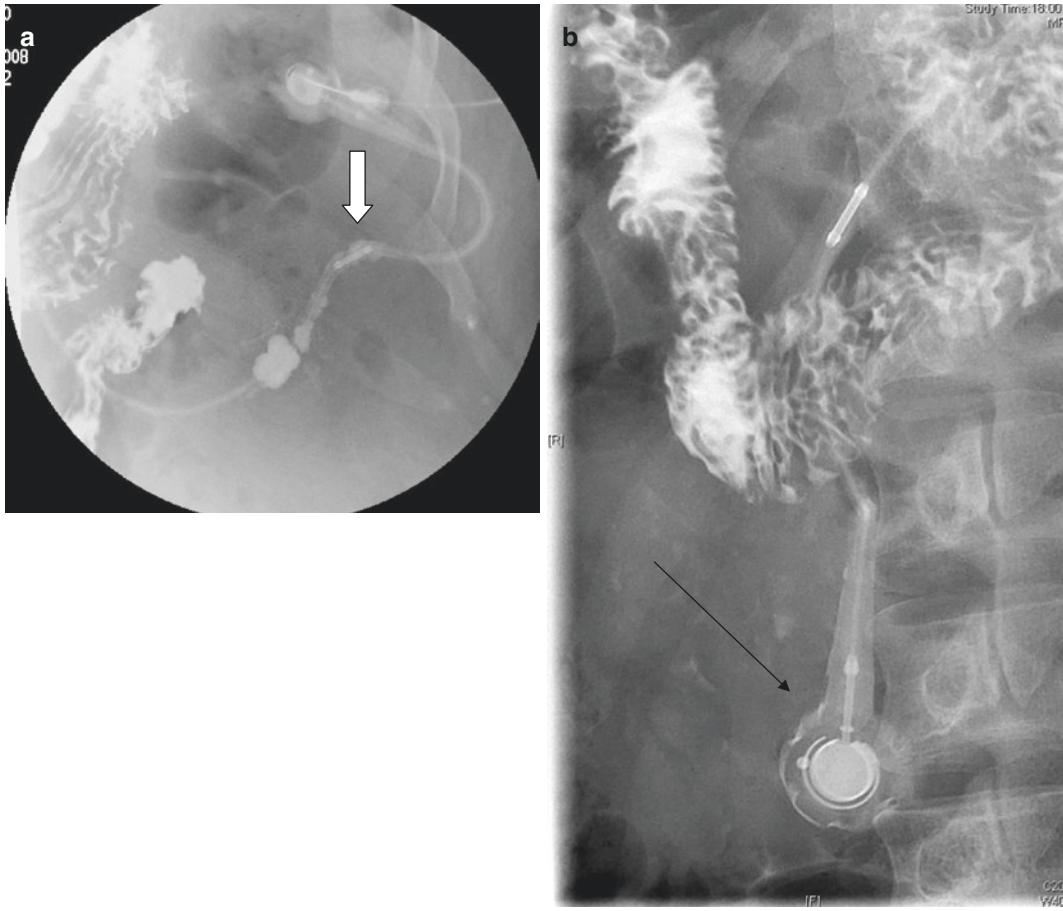

Fig. 5.15 (**a**) showing contrast leak from tubing at the catheter/metal junction (*arrow*). (**b**) showing contrast leak from port site which outlines the port and proximal tubing (*arrow*)

5.4.1 Food Bolus Impaction

This occurs with a tight band when the patient ingests a large food bolus such as meat. Contrast studies show the food bolus stuck above the band (Fig. 5.16).

This can easily be managed by fully deflating the band and allowing the bolus to pass through the band and then partially reinflating the band to allow continued restriction. Endoscopy is usually not necessary to remove the impacted bolus.

5.4.2 Detached Tubing

Patients present with loss of band restriction. Abdominal x-ray or radiological screening shows the loss of continuity of the tubing (Fig. 5.17) usually at the metal catheter interface. If the port site is cannulated (as with a leaking band), there is little or no fluid in the band, and aspiration reveals air only.

5.5 Intraluminal Band Erosion

Band erosion has been reported in up to 3% of patients. The aetiology is not certain but can occur as a result of a chronically over inflated band and is usually asymptomatic but can result in haematemesis. Patients usually complain of lack of restriction and weight gain as food passes around the band into the stomach. Confirmation of the radiological findings is by way of endoscopy, and the band will require removal.

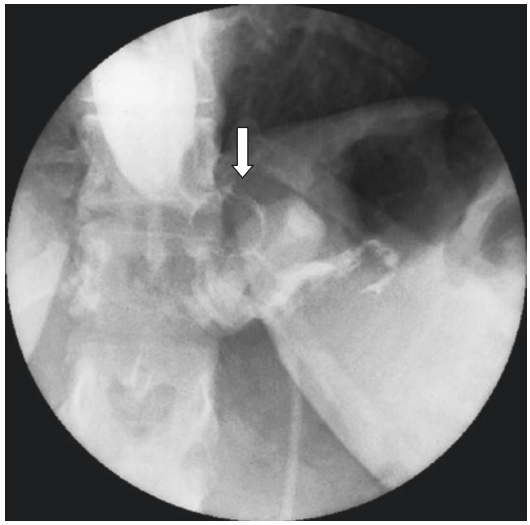

Fig. 5.16 shows food bolus impaction above the band (*arrow*)

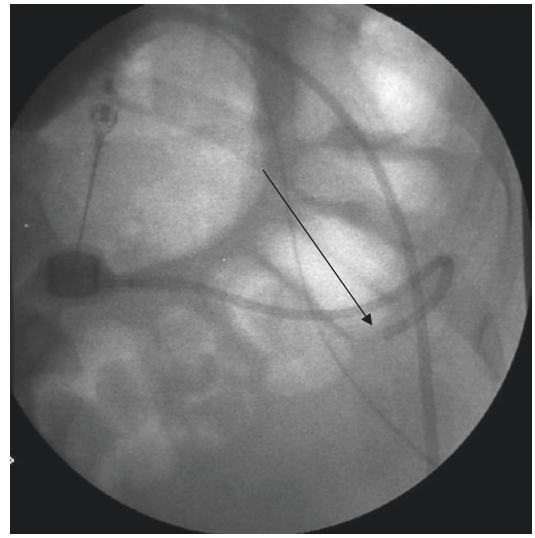

Fig. 5.17 shows detached tubing (*arrow*)

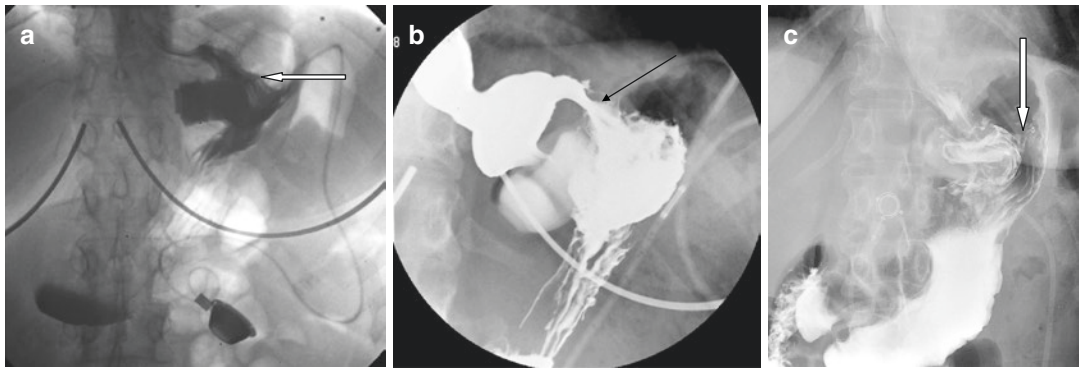

Fig. 5.18 (**a**-**c**) shows band erosion with barium (*arrows*) passing around the band rather than through the middle of the band

Multiple oblique views during contrast screening are important to demonstrate contrast passing around the band (Fig. 5.18a–c) and also to demonstrate the position of the band in relationship to the gastric fundus. This can be a subtle finding and be difficult to demonstrate and confirmation with endoscopy is usually required.

Unclipped band can occur spontaneously or as a result of overfilling the band. Patients present with sudden loss of restriction. The band requires deflation followed by surgical re-clipping.

The diagnosis is made during fluoroscopic screening with oblique views (Fig. 5.19).

Malpositioned band at the time of the initial surgery. This should be an uncommon occurrence and can only be diagnosed at the time of barium studies (Fig. 5.20).

Port site complications include mobile or inverted ports which are difficult to access

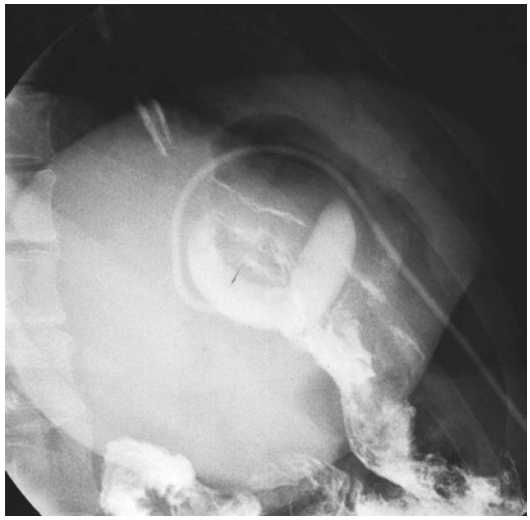

Fig. 5.19 showing a "horseshoe" appearance to the band where it has become unclipped

Fig. 5.20 shows the band lying completely outside the line of the oesophagus and stomach

percutaneously. This complication has been reported to occur in up to 5% of cases and will require revisional surgery to reposition or fix the band to the rectus muscle.

Port site infection can be diagnosed by aspirating the band or surrounding soft tissues and sending a specimen for microbiological analyses. If the band fluid is discoloured (usually yellowish) or if infection is confirmed on testing, then the band will require removal. Infections usually arise from poor aseptic technique during fills.

Management of the failing LAGB patient can be difficult, and this can sometimes fall within the remit of the radiologist who has to make a decision whether or not the failure to lose weight is due to difficulties with the patient's dietary intake or whether the failure to lose weight is due to a complication related to the band. It is important for the radiologist to not only be aware of the potential complications but to discuss the pros and cons of appropriate band adjustment in order that the patient can achieve the best short- and long-term outcomes. This may require a frank discussion between the patient, radiologist and surgeon to decide whether or not revisional surgery is required in order to achieve adequate weight loss or whether other dietary factors need addressing.

5.6 Sleeve Gastrectomy

Early complications include leakage from the gastric staple line resulting in abscess formation and/or peritonitis. Leaks have been reported in up to 1.3% of cases [5] and can result in both abscess and fistula formations. These complications will require a combination of CT with contrast imaging to demonstrate the leak or fistula which is often managed conservatively where possible by percutaneous catheter drainage (Fig. 5.21).

Late complications include gastric stricture formation and stenosis as a result of fibrosis (Fig. 5.22a and b).

In summary, radiologists must be aware of the normal findings of the common bariatric surgical procedures and their complications. A combination of CT and careful fluoroscopic contrast studies is used to detect the

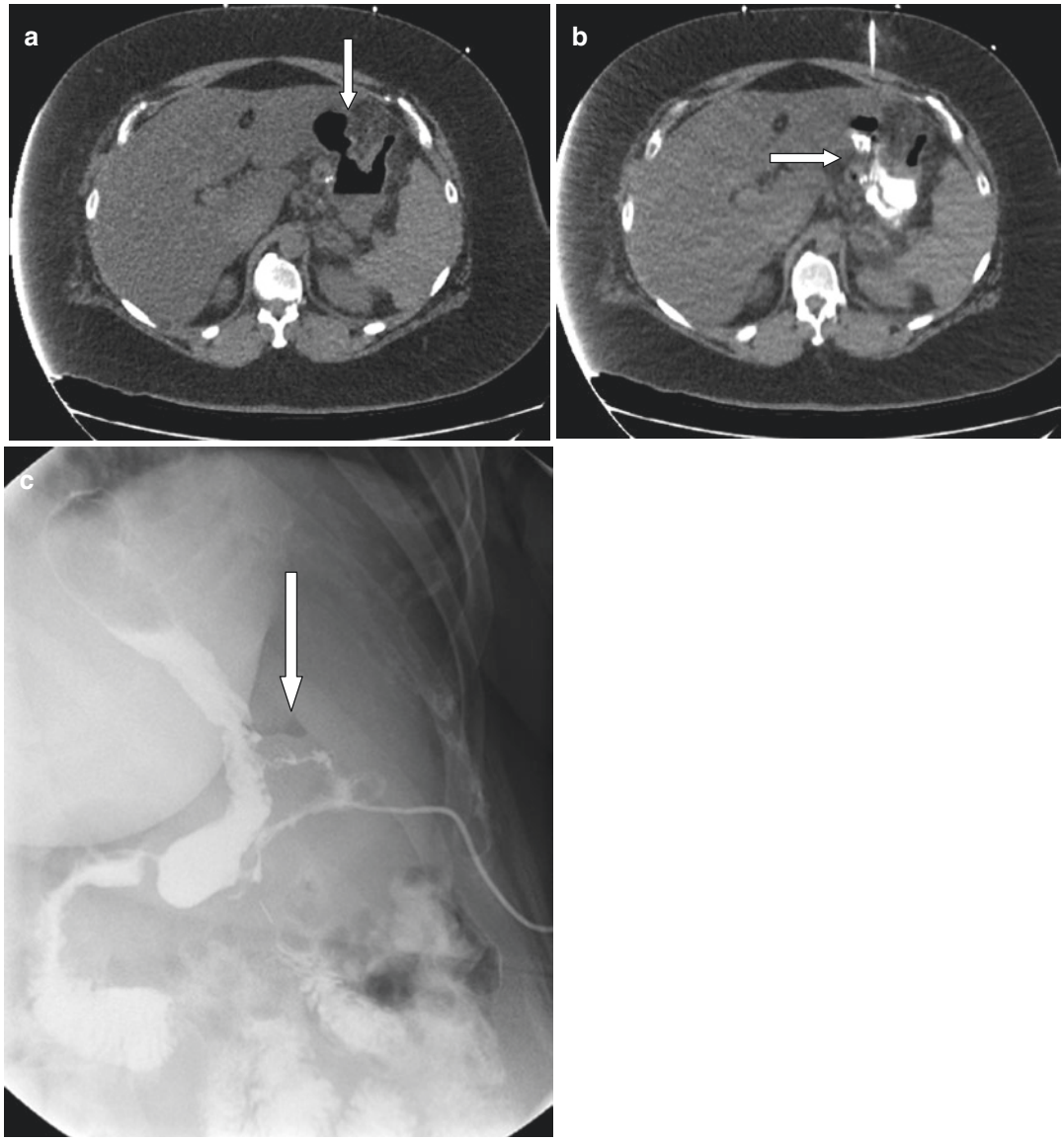

Fig. 5.21 (**a**-**b**) shows a CT scan showing gas within postoperative collection before and during percutaneous catheter drainage. (**c**) shows corresponding contrast study demonstrating leak of contrast into cavity with radiologically placed drain in place

complications of RYGB, LAGB and sleeve gastrectomy. There is an important role for the radiologist in diagnosing and managing the complications following laparoscopic banding as well as dealing with the "failing" band patient.

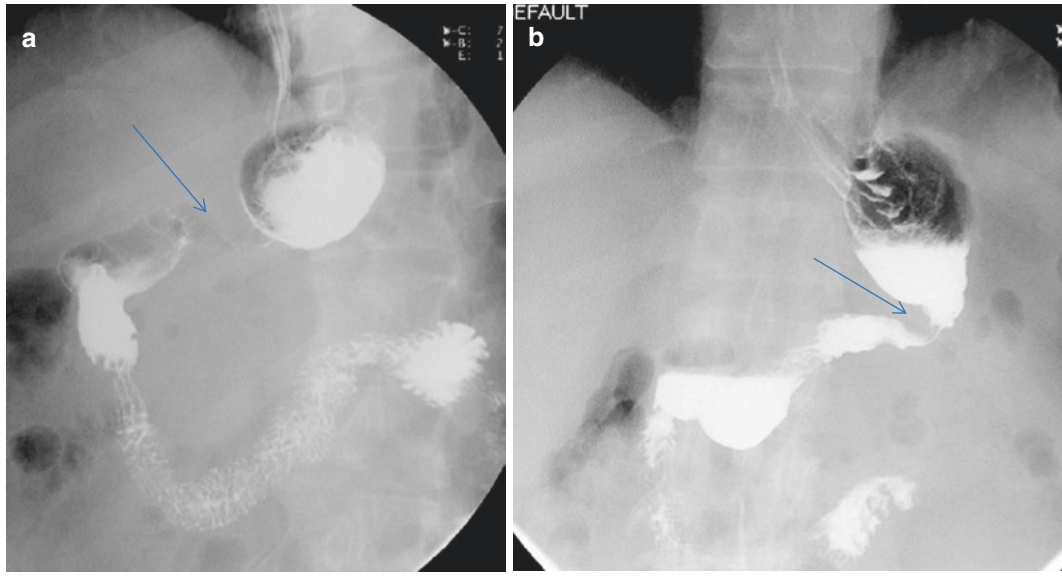

Fig. 5.22 (**a** and **b**) shows a mid-body gastric stenosis (*arrow*)

Key Points

1. Contrast studies with CT and/or fluoroscopy have been shown to have a sensitivity and specificity of around 50% in the diagnosis of complications following bariatric surgery. Routine postoperative imaging has not been shown to be of value.
2. Postoperative complications are best demonstrated by a combination of CT and/or oral contrast studies.
3. CT is the imaging modality of choice for the evaluation of suspected complications after Roux-en-Y gastric bypass (RYGB) and sleeve gastrectomy.
4. CT is not recommended for the evaluation of suspected complications after laparoscopic adjustable gastric banding (LAGB). In this setting fluoroscopy can also be used to guide the treatment of such complications.

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