

Tightening the band around the obesity epidemic : A pictorial review of complications for the radiologist

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Abstract

Obesity is rapidly increasing in the developed world with a corresponding rise in bariatric surgery. Laparoscopic adjustable gastric banding (LAGB) in specialist centres has excellent results and is a common surgical option in Europe. Increasing numbers of post-operative patients will present with both early and late complications to specialist centres and general hospitals. Radiologists will be asked to investigate these patients and need to be familiar with post-operative appearances. This review describes normal appearances on radiological examinations and common complications that may occur. The incidence of complications is outlined and appropriate simple therapeutic manoeuvres for general radiologists in emergency situations are described.

Keywords

Bariatric surgery; Gastric banding; Surgical complications

Introduction

In 2010, 12 million UK adults were clinically obese (Body Mass Index over 30) with 1-2% of the population being morbidly obese (BMI over 40).¹ Obesity is associated with numerous medical problems including diabetes, hypertension, hepatic steatosis and malignancy. It is of paramount public health importance to prevent and treat the obesity epidemic by dietary education, lifestyle modification and medical therapy. Bariatric surgery is reserved for motivated patients with high body mass index and co-morbidity who are refractory to other interventions. Indications include adult patients with BMI over 35 and morbidity associated with obesity including type II diabetes or hypertension, or a BMI over 40 without co-morbidity. Surgery is associated with prolonged weight loss, reduced morbidity and decreased mortality.²⁻⁴ Careful patient selection is essential and patients undergo extensive psychological, metabolic and anatomical assessment (including endoscopy and oesophageal manometry) prior to surgery.

Surgical procedures performed in the UK and Europe commonly include laparoscopic adjustable gastric banding (LAGB) and laparoscopic gastric bypass (usually Roux-en-Y). In LAGB, gastric bands are placed around the upper gastric body to produce

a small proximal pouch that rapidly distends on eating and assists in limiting calorific intake. These bands can be filled or emptied via a subcutaneous port and individually titrated to weight and symptoms (Figure 1). A band that is overly tight may produce dysphagia, discomfort, reflux and regurgitation a loose band results in inadequate weight loss.

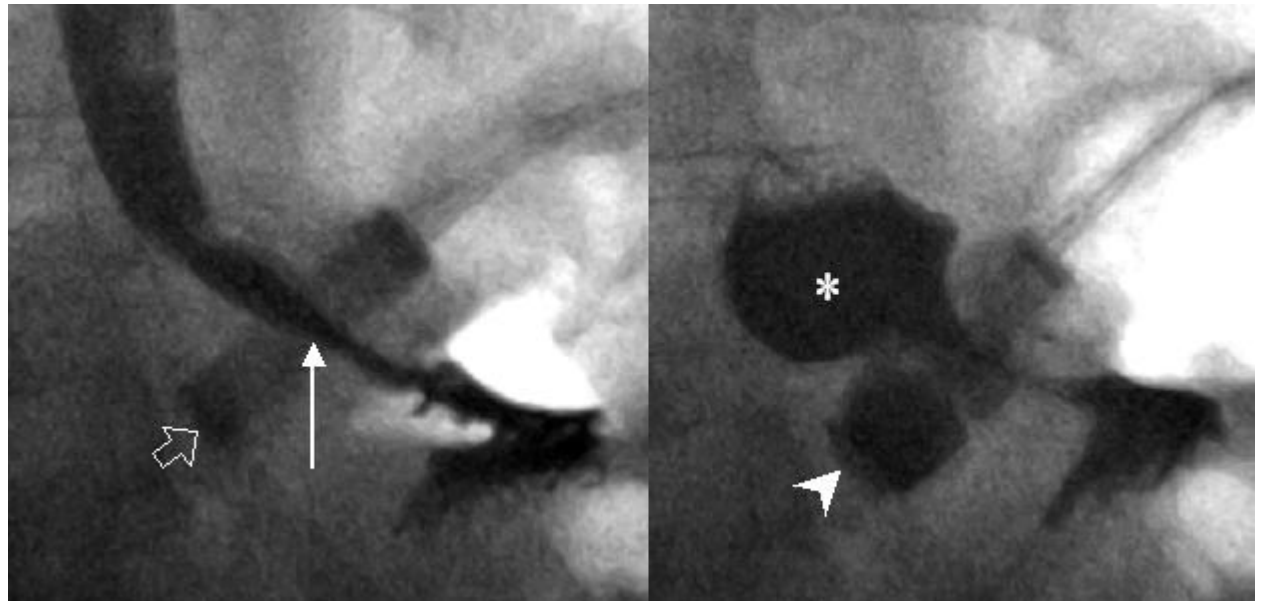


Figure 1 - AP view of gastric band before (left) and after filling with contrast (right). Empty band (open arrow) with no pouch and unrestricted flow through a wide stoma (line arrow); this was associated with no change in weight. Following filling of band with contrast (arrowhead) there is now a satisfactory appearance with a proximal pouch (asterisk) and contrast passing through the stoma.

In our practice, band adjustments are usually performed by a specialist bariatric nurse with monitoring by symptom control alone. If there is clinical doubt adjustments are performed under fluoroscopic guidance. Radiographic contrast can be instilled or removed from the band using a non-coring, 22G Huber needle (MID, Limonest, France). In the case of an emergency a non-coring 'spinal' needle or a green hypodermic needle may be used.

Water-soluble contrast swallow can be used to diagnose most of the common problems associated with laparoscopic gastric banding. These dynamic investigations are perfectly suited to demonstrate dysmotility aggravated by the band and gastric obstruction at the level of the stoma. Band complications include malposition (surgical error, migration or band slip), component failure (unclipped band or leak), infection and gastric perforation. Obese individuals undergoing surgery are also at risk of systemic complications such as venous thromboembolism. In the present pictorial review we provide radiological images of band complications.

Patients and Technique

Patients undergo laparoscopic insertion of a gastric band via the pars flaccida approach and connected to a subcutaneous port in the anterior abdominal wall. Band patency is tested with radiographic contrast and left deflated. We routinely assess the post-operative appearances with a water-soluble contrast swallow

within 24 hours. Further examinations are guided by symptoms, weight loss and the clinical situation. Water soluble contrast is preferred as these patients remain at risk of visceral perforation and aspiration in the long-term. Double contrast with carbon dioxide is contraindicated as this can cause painful distension and retching which can dislodge the implant.

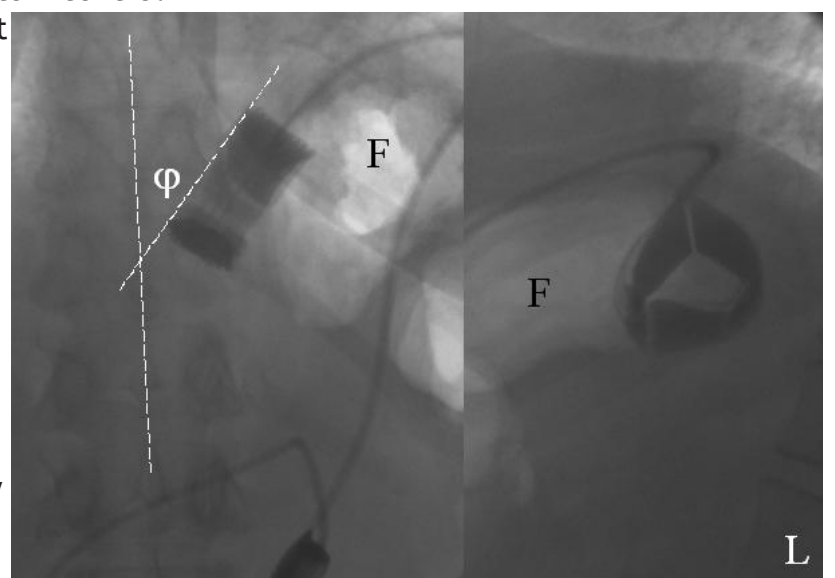


Figure 2 -AP and lateral views of band with normal orientation to the median sagittal plane (j) of 30°. The lateral view demonstrates a complete band with lumbar spine posteriorly (L) and gas-filled fundus (F).

We utilise AP and lateral views with oblique views as required: views can be difficult due to the large size and scatter associated with these patients. Control films should demonstrate correct band position and adequate closure of the device: the band should be within 5-45° of the median sagittal plane (θ angle) and form a complete ring (Figure 2).

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Simple swallow examinations usually suffice and should demonstrate a proximal pouch with minimal hold-up at the band "stoma" (Figure 1). The band may appear to be placed at the gastro-oesophageal junction, but usually this is seen a few centimetres proximal to the band on dynamic images (Figure 1). Motility studies can be obtained and occasionally solid material (porridge or mashed potato) may be required. Bulky solids can block the band stoma and therefore marshmallows or similar agents should not be used. CT with oral contrast can be helpful if the anatomy is difficult to delineate or there is possible infection or leak.

Abnormal Band Position

Patients undergoing gastric banding are challenging laparoscopic candidates and it may be difficult to identify normal anatomy. A large anterior gastric fat pad may mimic the stomach, resulting in anterior placement with early absence of restriction (Figure 3).

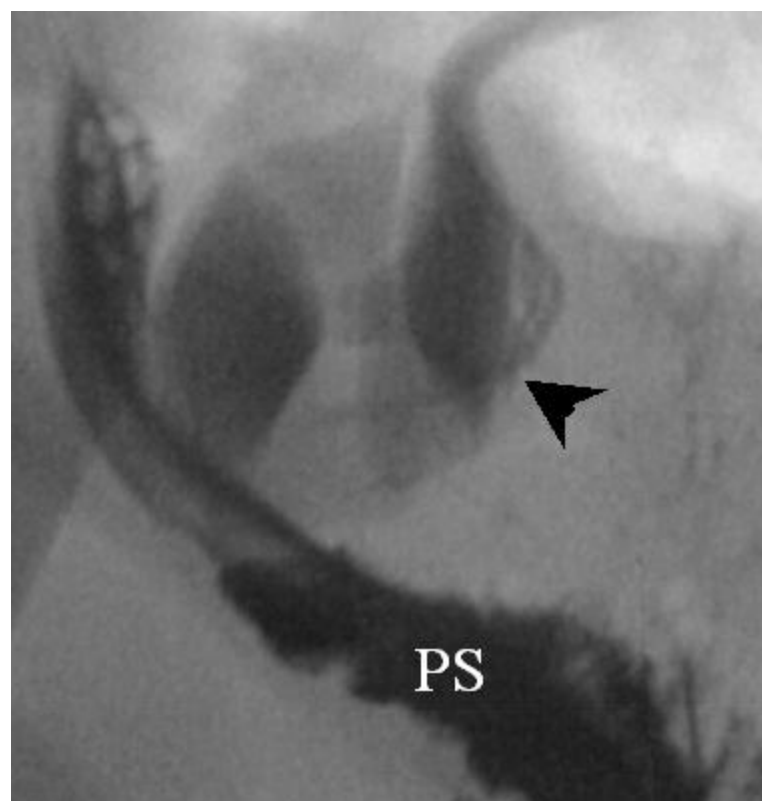


Figure 3 -Gastric band (arrowhead) mistakenly placed anterior to the cardia with contrast flowing into proximal stomach (PS). A thick fat pad can simulate the stomach wall leading to erroneous implantation at laparoscopy. The band was repositioned without ill-effect.

A lateral view is essential as anterior placement can often be clinically occult and undetectable on frontal views. Bands may be placed proximally leading to complete obstruction at the gastro-oesophageal junction. Careful evaluation of the cardia is required to ensure that the band stoma is not simulating the gastro-oesophageal junction, with a normal junction visible superomedially. Distal placement will result in absent restriction with gastric outlet obstruction. These problems often manifest immediately and should be visible at a post-operative contrast study. Incorrect implantation occurs in roughly 1% of cases^{5,6} and will require re-operation.

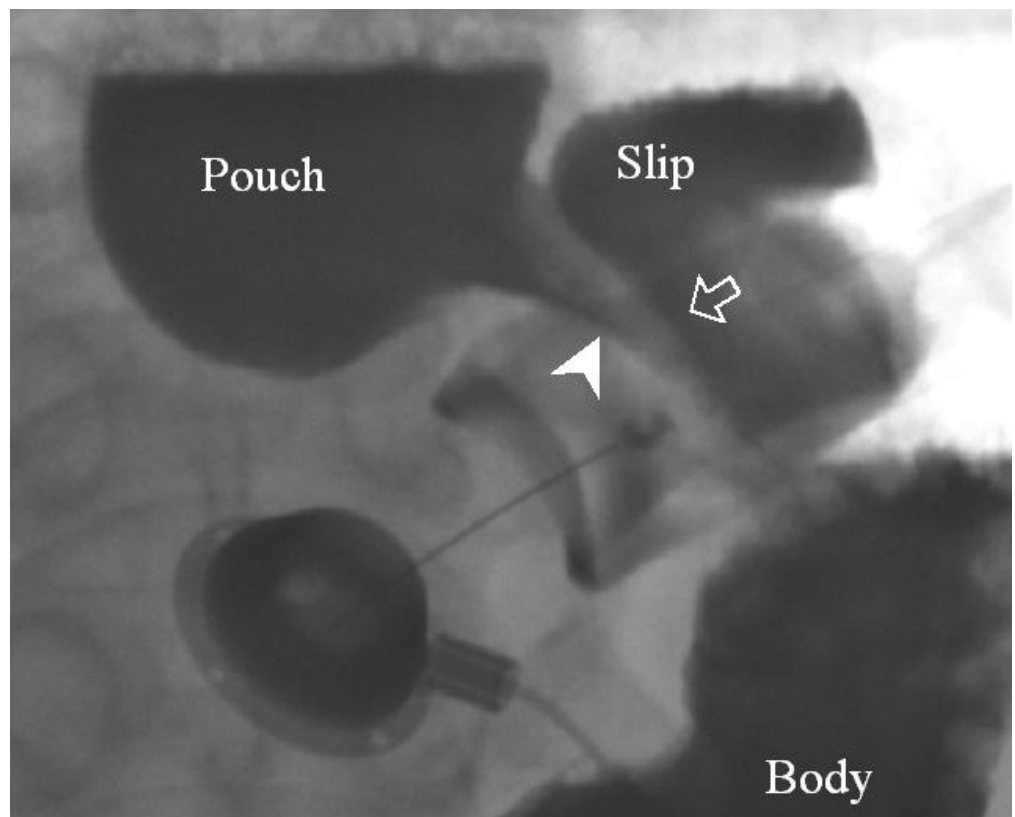
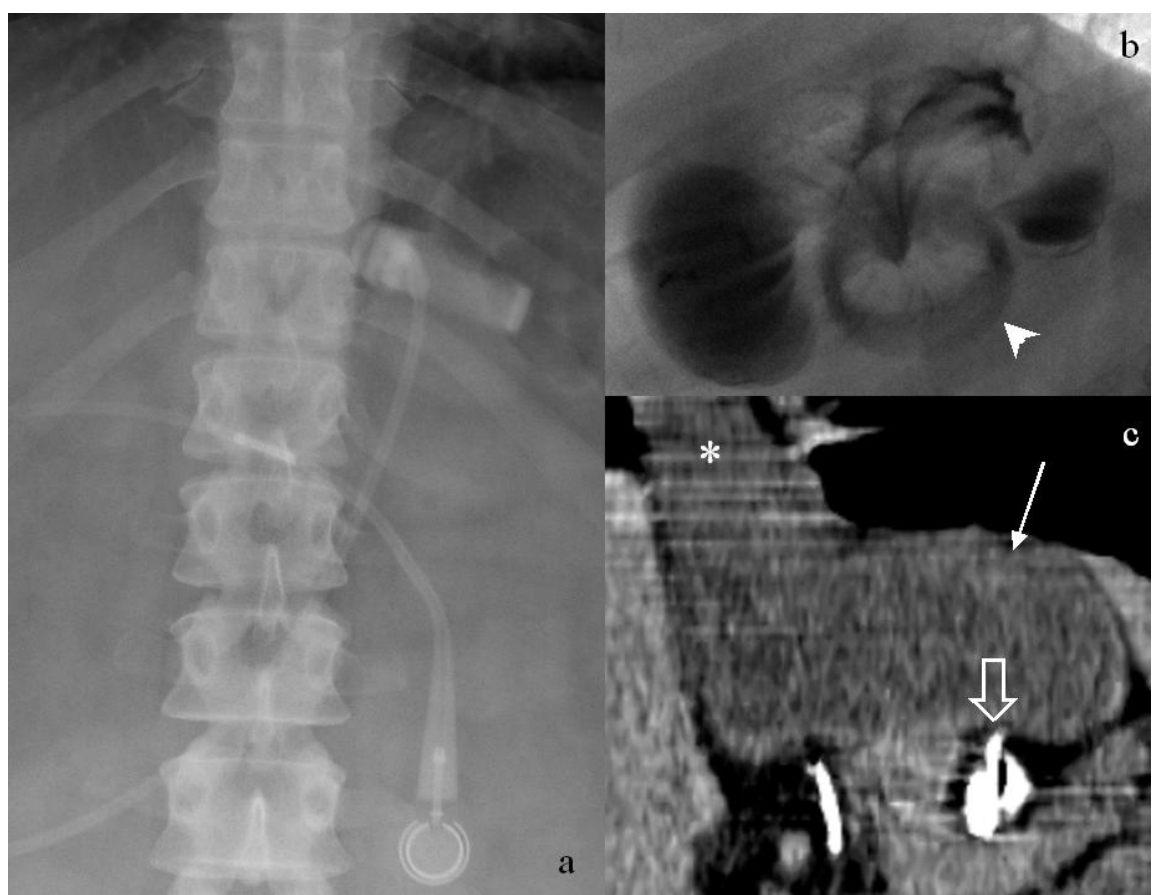


Figure 4 - Herniation of gastric wall through band. The slip and second stoma (open arrow) are seen lateral to the proximal pouch. There is dilatation of the pouch associated with obstruction of the primary stoma (arrowhead) but oral contrast still flows into the gastric body. Note needle in port prior to deflation.

Retching or peristaltic activity of the stomach can lead to migration or rotation of the band in 4-8% of patients.⁶⁻¹⁰ These band migrations/slips can present at any time and may have an acute or insidious history of either obstruction or loss of restriction. Early radiological features include a small postero-lateral herniation of the stomach with a second stoma in the band (Figure 4). This may be associated with obstructive symptoms and may improve with emptying the band. Herniation may progress with a second pouch visible demonstrating mass, a separate fluid level and eventually result in a θ angle over 45° .

An enlarged eccentric pouch may overhang the band with a significant portion of the stomach involved causing complete obstruction (Figure 5). In the patient with acute dysphagia, plain radiographs of the chest and abdomen may be sufficient to diagnose significant slips. A band θ angle over 45° will indicate the urgent need for complete band deflation and elective referral to a specialist centre.

Figure 5 - Plain radiograph during episode of absolute obstruction (a) with rotation of suggesting significant band slip and gastric herniation. Subsequent contrast swallow demonstrates a large obstructed pouch above band (b, arrowhead). Coronal CT (c) demonstrates a large eccentric pouch (line arrow) with a dilated oesophagus (asterix). Pressure of the band against the infero-lateral aspect of the pouch risks pressure necrosis (open arrow).



Tightening the band around the obesity epidemic :

A pictorial review of complications for the radiologist (continued)

Technical Band Failure

The implants are generally reliable with few failures, however bands can occasionally become undone or leak from the various components. Bands that spontaneously undo present with loss of restriction at a variable interval from surgery and will be visible on control views, particularly lateral views (Figure 6A/6B).

Dysmotility-Obstruction

Patients undergoing LAGB surgery often have type 2 diabetes mellitus and can therefore have underlying oesophageal dysmotility. This may be sub-clinical and only manifest post-surgery with the relative obstruction afforded by a gastric band.

Tertiary contractions are not uncommon but can progress to marked oesophageal dilatation with food residue in about 2% of patients¹¹ (Figure 7); aspiration pneumonia can occur. These patients may respond to band deflation but continued obstruction will necessitate elective band removal. Diabetic patients may also have delayed gastric emptying from autonomic neuropathy.

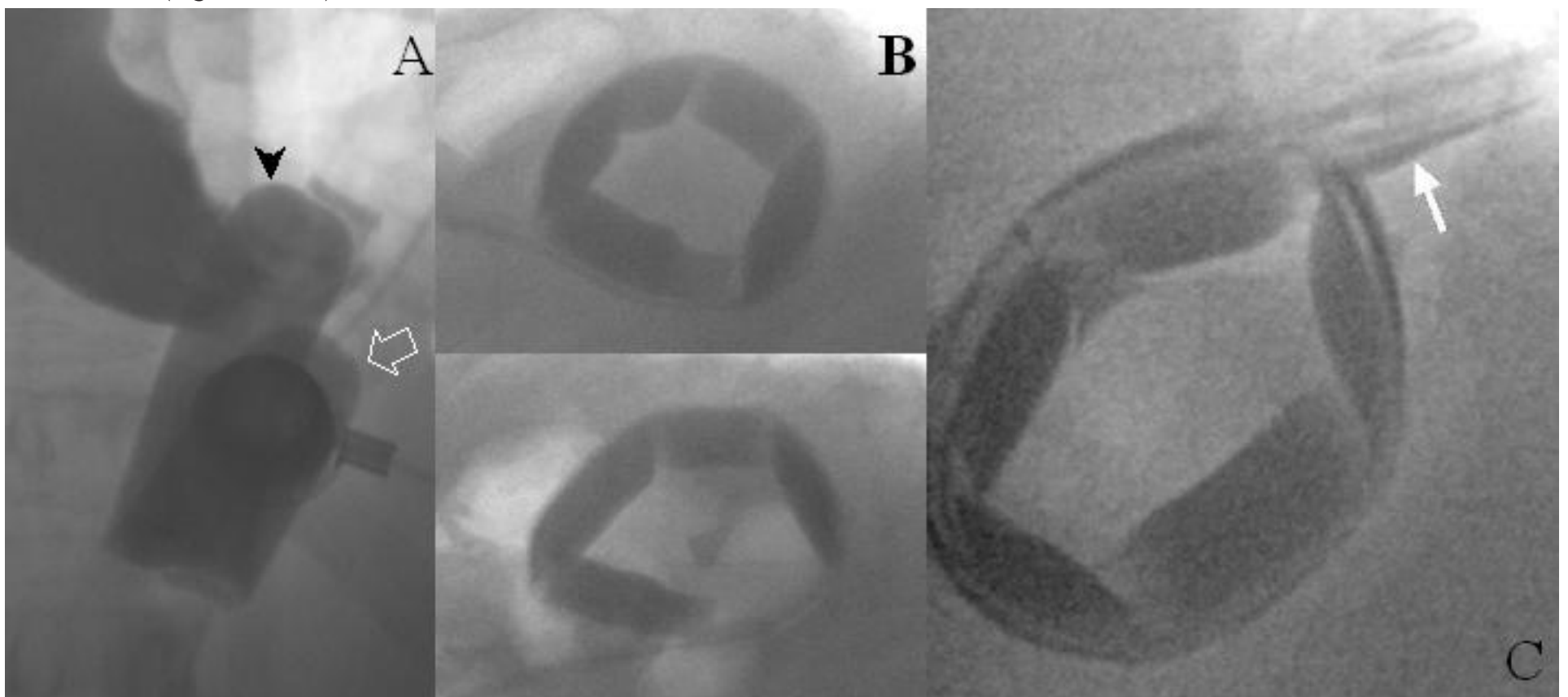


Figure 6 (above)

Panel A: Unclipped Midband” with separation of the two ends (arrowhead and open arrow). Note port projected over band.

Panel B: Lateral view of normal Lapband” (top) with loss of restriction at 1 year (bottom) due to open band.

Panel C: Patient with persistent loss of restriction and a small collection of contrast (white arrow) extending from connection between tubing and band. The tube and port were replaced with resumption of weight loss

Filling the band via the port will not increase restriction and the band will need to be replaced: prosthesis manufacturers may fund the cost of revision surgery.

Different models of bands have different connections and potential sites of weakness: often the junction of tubing with band or subcutaneous port. A leak from the component may lead to loss of restriction. Other sources of component leakage include fatigue of the tubing (repeated flexion or twisting), erroneous puncture of the tubing during filling/emptying and port diaphragm leak. Leaks occur in 1-3% of patients and can present many years after successful surgery.^{6, 8, 11, 12} These can be investigated by high-osmolar contrast instillation under magnified fluoroscopic views (Figure 6C), or occasionally by radionuclide investigation.¹³

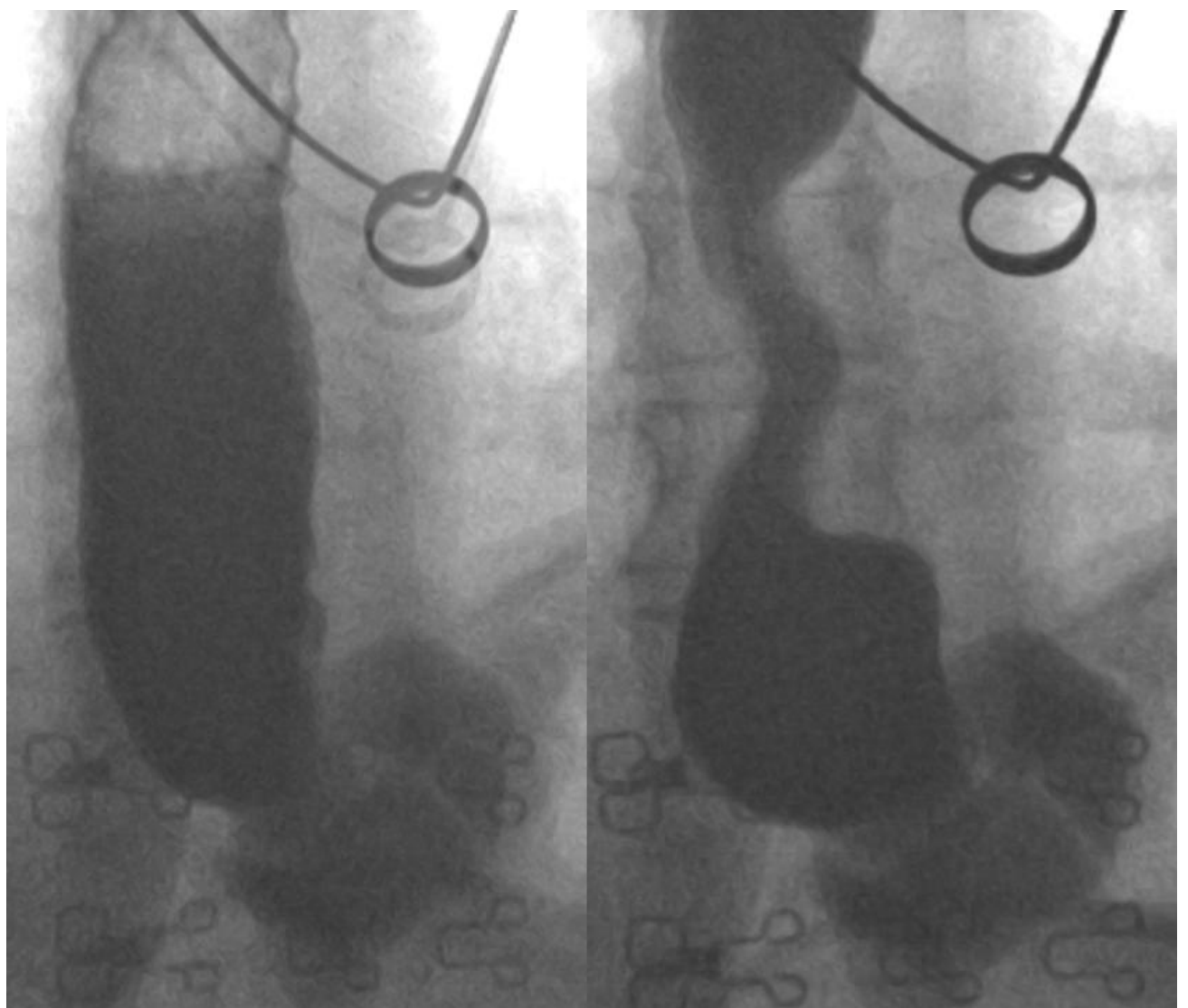


Figure 7

A patient with dysphagia demonstrates oesophageal dilatation associated with reduced transit through the stoma. Tertiary contractions are present with a fluid level and food residue. The patient had no problems pre-operatively and did not respond to band deflation. The band was removed with improvement in symptoms.

Tightening the band around the obesity epidemic :
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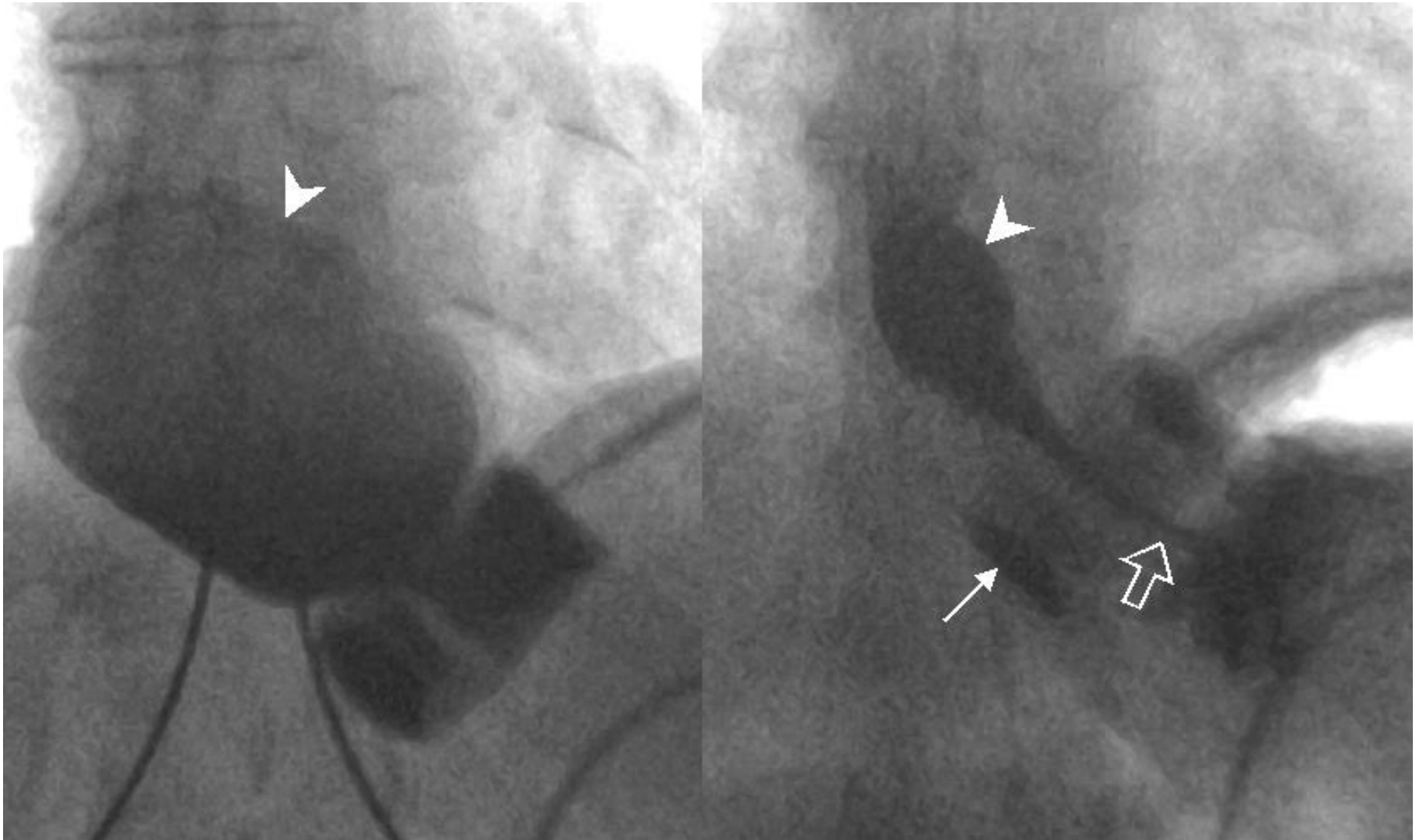


Figure 8 Patient with concentric pouch dilatation (left panel). Following aspiration of contrast from the band (Right panel, line arrow) the pouch has reduced in size (arrowheads) with improved transit through the band (open arrow).

An estimated 3% of patients may develop progressive concentric dilatation of the proximal pouch without evidence of oesophageal changes, band migration or slip.^{6, 8, 14} This may be associated with a plateau in weight loss, dysphagia and regurgitation suggestive of relative narrowing: decompressing the band may relieve symptoms (Figure 8).

Lesser degrees of obstruction may only be revealed by swallowing solids and can be tested with a variety of foodstuffs. There is a fine balance between adequate obstruction to the passage of food versus the peristaltic force generated by the oesophagus and pouch. Individual patients will need individual solutions and therefore it is impossible to define absolute dimensions for the pouch and stoma.

Patients are carefully educated regarding the need to eat small amounts regularly but, due to long-standing dietary habits, inappropriate meals can occasionally result in bolus obstruction of otherwise nor-

mal bands (Figure 9). These may be relieved by emergency deflation of the band or may necessitate endoscopic removal of the bolus. Carbonated drinks should not be used to unblock the band stoma as this will distend the pouch, causing discomfort and retching with the risk of perforation or band slip.

Other adverse patient behaviours include liquefaction of high calorie foods and intermittent deflation of the band by the patient. The need for prolonged dietary and behavioural modification demands

patients who are motivated and well-informed regarding life following gastric band surgery. These psychological problems may simulate loss of restriction but will have normal radiological appearances.

Gastric Perforation

Difficult surgical dissection can lead to visceral damage with early perforation of the stomach (or distal oesophagus) in roughly 0.5-1% of individuals.^{7, 11, 15} Acute perforation can be difficult to diagnose as post-operative patients often have non-specific

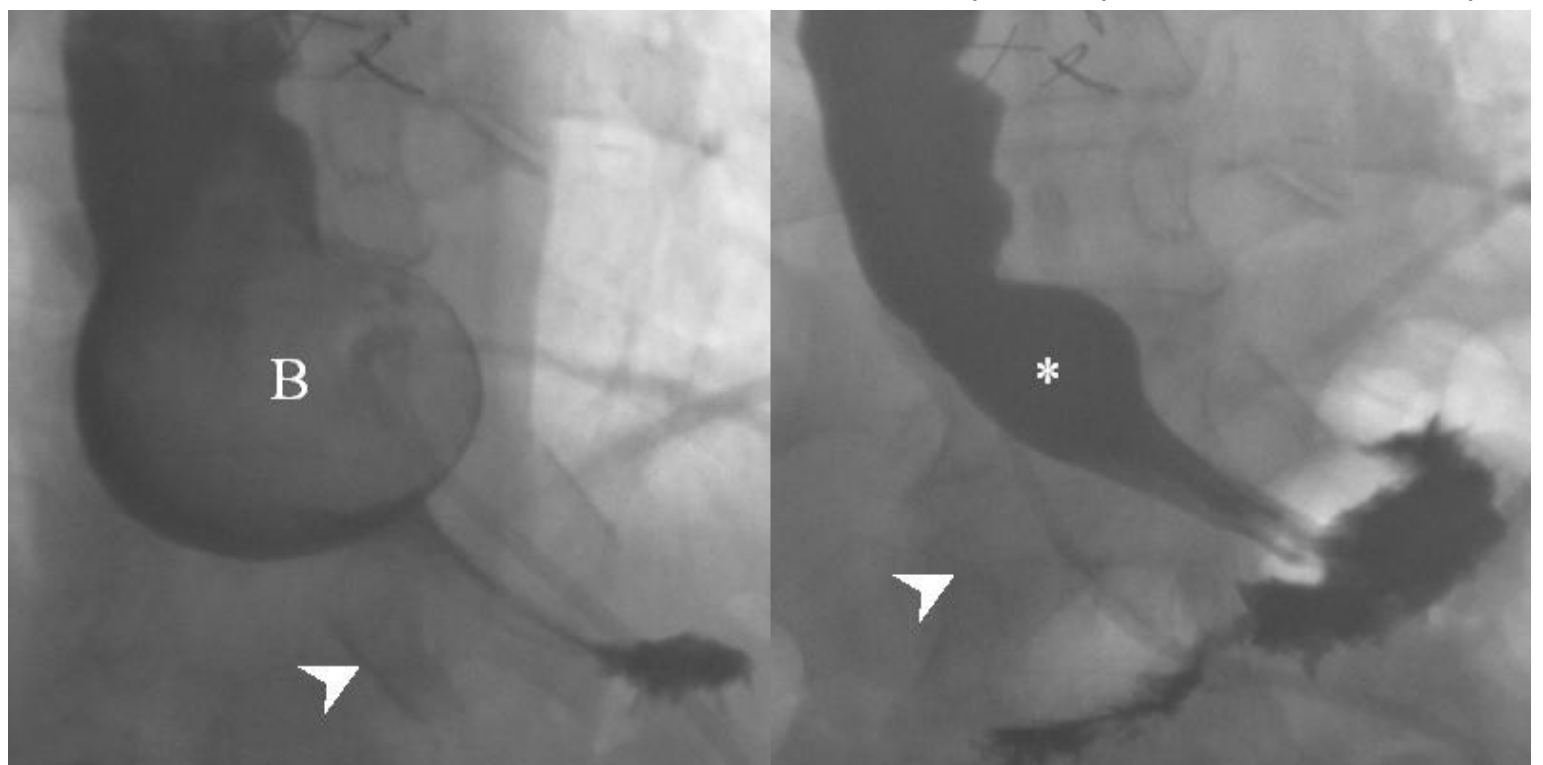


Figure 9 Patient with bolus obstruction of the proximal pouch. The left panel demonstrates the bolus (B) with a dilated pouch and a small trickle of contrast through a deflated band (arrowhead). The right panel demonstrates a normal examination the month before with a normal pouch (asterix) and transit through the empty band (arrowhead). Endoscopy was required to remove the bolus.

symptoms and have confusing radiological appearances from an iatrogenic pneumoperitoneum and post-surgical tissue change. The patient will require emergency re-operation, although the implant may not always be removed.

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A pictorial review of complications for the radiologist (continued)

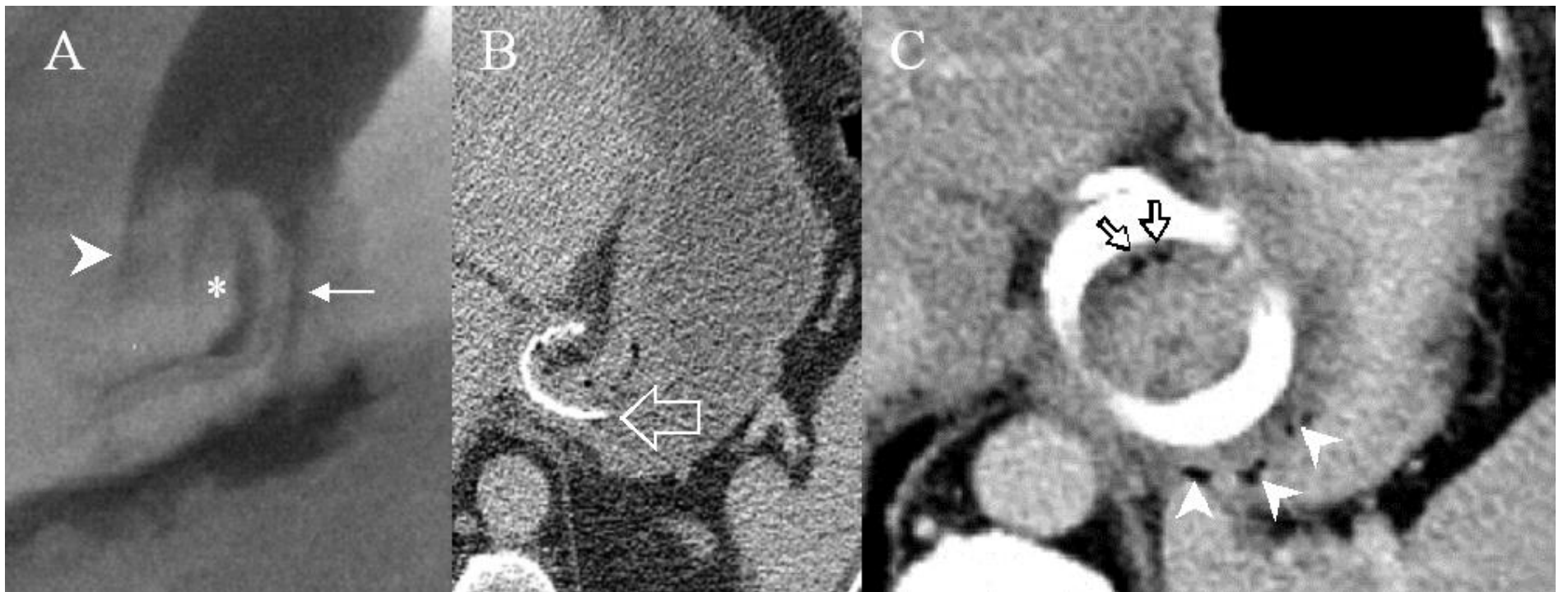


Figure 10 Patient with symptoms of mild dysphagia investigated for possible band slip. Lateral view (Panel A) during water-soluble contrast swallow demonstrating contrast passing behind (line arrow) the posterior aspect of the band (asterisk). Very little contrast passes through the band stoma (arrow-head). Axial CT in the same patient (Panel B) demonstrates the band within lumen of stomach (open arrow). Panel C: Second patient with band infection following surgery outside the UK presenting at 3 months. Axial CT demonstrates extramural locules of gas anteriorly (open arrows) with erosion into the posterior stomach (arrowheads). There was no response to antibiotics and the LABG was removed.

Chronic perforation is found in about 1% of patients^{16, 17} and is caused by erosion of the band through the gastric wall. This may result from local pressure necrosis from an overly tight band, band malposition or chronic infection. Symptoms may be vague but there may be concurrent infection and a local collection. The key finding of perforation on water-soluble contrast swallow is oral contrast flowing outside the band (Figure 10) although intraperitoneal leak is very rare. The band may be seen within the gastric lumen on CT or endoscopy. This will require implant removal, debridement and surgical repair.

Infection and other complications

Prosthetic material can act as a focus of infection, and obesity and diabetes act as further risk factors for septic complications. Infection can occur anywhere along the prosthesis and sterile precautions are necessary during port aspiration. Contrast swallows are likely to be normal in the absence of erosion and therefore CT is preferred. After the first month it is unlikely that there will be residual fluid collections, tissue induration or gas around the implant and these are worrying in suspected sepsis. It is difficult to accurately delineate the incidence of infection but estimates range from 0.5% to 4%.^{5, 12, 15, 18, 19} Antibiotics may be tried for milder cases but abscess formation and fluid collections often require surgery and possibly band removal.

Obese individuals are prone to early post-operative complications such as superficial infection and venous thromboembolism. Even young obese patients may have significant atherosclerotic disease and are at risk of perioperative myocardial infarction and stroke (note previous median sternotomy in Figure 9).

Bariatric surgery is associated with im-

proved long-term outcomes over non-surgical management², however, surgery is associated with specific chronic problems. Poor tissue healing and raised intra-abdominal pressure predispose to hernias through the laparoscopic ports in 1%¹⁵. Adhesions, chronic pain and nutritional deficiencies have been described.²⁰ Occasionally, it is necessary to remove the implant and patients may be unsuitable for repeat LABG and will require laparoscopic gastric bypass (usually Roux-en-Y). This procedure has higher incidence of anastomotic leaks and metabolic complications but results in dramatic weight loss.

Conclusion

The obesity epidemic has resulted in large numbers of patients that meet the criteria for bariatric surgery.¹ Patients who have undergone laparoscopic gastric band surgery will become increasingly common over the next decade. These patients can develop band-related problems such as dysphagia, erosion and infection that may prompt admission to non-specialist hospitals. Radiologists may often be asked to perform examinations under these circumstances and need to understand normal post-operative appearances and common complications.

Plain radiographs may reveal an abnormal band position that is strongly suggestive of a slip. Fluoroscopic screening with oral contrast is a simple initial investigation although patients should not undergo formal gaseous distension (as per double contrast meals) as this may precipitate retching and band slippage. Bands may migrate or rotate causing obstruction to oral contrast and an eccentric pouch. Imbalance between motility proximal to the band and stomal restriction will be associated with oesophageal or pouch dilatation, dysmotile contractions and limited contrast flow. These obstructive problems can be

initially managed by locating the port (using screening if necessary) and aspirating contrast under sterile conditions. Elective referral to the specialist centre can then be undertaken. Erosion and infection may be diagnosed on the basis of clinical features, contrast swallow and CT. These require prompt discussion with the surgical team. Loss of restriction from implant failure does not require emergency treatment and should be investigated electively by the obesity service.

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