Beyond Belsey: complex laparoscopic hiatus and diaphragmatic hernia repair

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ABSTRACT

BACKGROUND Diaphragmatic and hiatus hernias can cause mild chronic symptoms or have an acute presentation with gastric volvulus and obstruction. Elective or emergency surgery is indicated in symptomatic patients and nowadays is generally performed laparoscopically.

METHODS We report four different types of hernias: a giant hiatus hernia following a gastric pull-up for recurrent congenital diaphragmatic hernia; a Bochdalek hernia in a pregnant young woman; concomitant hiatus and Morgagni hernias; and a giant hiatus hernia occupying the right chest. All were approached laparoscopically, either electively or as an emergency.

RESULTS Surgery led to a resolution of symptoms in all the cases. We had no any intraoperative complications. Two patients developed minor postoperative complications (chest infection). No recurrences were found during a mean follow-up of 18 months.

CONCLUSIONS Transabdominal laparoscopic approach is a safe and feasible approach to all cases of symptomatic hiatus and diaphragmatic hernia.

KEYWORDS

hiatus hernia – diaphragmatic hernia – congenital hernia – Morgagni hernia – Bochdalek hernia

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Introduction

Hiatus hernia, defined as the herniation of abdominal contents through the oesophageal hiatus of the diaphragm, is classified into four types based on the underlying physiological mechanisms (Fig 1). Type I (sliding) is the most common type of hiatus hernia. It is considered to be a consequence of the progressive disruption of the phreno-oesophageal ligament, with subsequent migration of the anatomical gastro-oesophageal junction (GOJ) into the mediastinum. Type II and III hernias are collectively known as 'para-oesophageal hernia'. Type II (rolling) is very rare. It is a true anatomical hiatus hernia in which the GOJ lies below the diaphragm in its normal position. The proximal or the distal stomach migrates in the mediastinum alongside the oesophagus through a defect in any of the anchoring structures with a complete peritoneal sac. Type III (mixed) usually represents a progression in size of a type I sliding hernia that, over time, develops a para-oesophageal component, until the whole GOJ is in the chest. Eventually the whole stomach may migrate into the mediastinum, where it assumes an upside down position. In type IV hernias, other abdominal viscera (typically transverse colon and greater omentum, small bowel, spleen and pancreas) may follow the stomach and migrate into the chest through the hiatus. Congenital (Bochdalek and

Morgagni) and traumatic diaphragmatic hernias are rare but may have life-threatening complications if not diagnosed.

A number of factors have been implicated in the aetiology of hiatus hernia. A meta-analysis found that the prevalence of hiatus hernia increases with age, as a result of fibromuscular degeneration and the consequent loss of elasticity of the structures around the diaphragmatic hiatus.¹ Obesity can cause an increase in intra-abdominal pressure, resulting in axial pressure strain through the diaphragm, which in turn promotes the development of hiatus hernia. Pregnancy is another potential factor that may weaken fibromuscular structures around the GOJ through raised intra-abdominal pressures.² Chronic obstructive pulmonary disease, trauma, heavy physical labour or straining exercise (as in weight lifting) and even chronic constipation may all favour the development of massive hiatus hernias.³ Hiatus hernia is commonly associated with male sex,² while a female predominance of this condition has been reported in other studies.⁴

Diaphragmatic hernia and hiatus hernia can present with a wide range of symptoms. Some patients present with reflux because of the anatomical disruption of the GOJ associated with hiatus hernia.⁵ A significant proportion of symptoms result from gastric overdistension, mechanical obstruction, ischaemia and poor emptying. The

Figure 1 Classification of hiatus hernias.

chronic manifestations and symptoms vary from vague dyspepsia and early satiety, associated with regurgitation and acid reflux, through mild abdominal or chest pain, shortness of breath and dysphagia, to severe retching and vomiting. Chronic bleeding is frequently documented by unexplained anaemia. A poorly emptying herniated gastric pouch, localised gastritis or erosions and ulcerations of the herniated pouch at the rim of the enlarged hiatus (Cameron's ulcers) may explain this blood loss.⁵ Often patients remain totally asymptomatic, resulting in an unpredictability of acute presentation and complications. Borchardt was the first to describe a triad for gastric volvulus consisting of epigastric pain, retching without vomiting and inability to pass a nasogastric tube.⁶ The true prevalence of the acute presentation with complications is not known. The first symptom suggesting gastric volvulus is dysphagia with acute obstruction and inability to vomit. The subsequent evolution, occurring if the stomach cannot be decompressed, is vascular compromise of the herniated stomach and accompanying organs, resulting in pain, bleeding, ischaemia and eventually perforation and sepsis.⁵

In hiatus hernia, there is a progressive disruption of the diaphragmatic sphincter proportional to the extent of axial herniation. This results in the loss of the 'pinchcock' effect of crural contraction, which strengthens the anti-reflux barrier.⁷ Manoeuvres that result in an increase in intra-abdominal pressure, such as bending and coughing, result in reflux episodes.⁸ Hiatus hernia may in turn diminish lower oesophageal sphincter pressure and also results in prolonged oesophageal acid clearance.^{9,10}

The diagnosis can be an accidental finding on imaging performed for other reasons (i.e. x-ray of the chest) or may be suggested by the patient's symptoms and confirmed by oesophagogastroduodenoscopy (OGD), contrast study (barium meal) and computed tomography (CT) with double contrast (intravenous and oral). In type II hernias, a separate orifice adjacent to the GOJ may be seen at endoscopy, with gastric folds extending into the opening. When a bigger portion of stomach is herniated, passing the scope through the hiatus may be difficult, while identifying and traversing the pylorus may not be possible (especially in complete volvulus of the stomach). OGD also allows checking the presence of gastro-oesophageal reflux disease, sometimes associated with hiatus hernia. The gastric anatomy of hiatus hernia is usually well defined by a barium meal, while CT can help in delineating the neck of the diaphragmatic hernia, as well as documenting the presence and position of additional organs within the thoracic cavity.

The main indication for surgery is the severity of symptoms, but diaphragmatic hernia and massive hiatus hernia (types II, III and IV with more than 50% of the stomach herniated) may need immediate correction to treat complications such as gastric volvulus, obstruction, infarction and perforation. The presence of gastro-oesophageal reflux disease, pulmonary complications, cardiac symptoms or bowel obstruction can also become indications for correction. Minimising morbidity and mortality while demonstrating real improvements in symptoms, quality of life and durability of results remain the hallmarks of surgical treatment. Published studies led to propose prophylactic repair of type II or III hiatus hernia even in the absence of symptoms because of the potential for the development of life threatening complications.^{11–14}

The main steps of the surgical approach to diaphragmatic hernia are reducing the herniated organs to the abdominal cavity and repairing the diaphragmatic defect. Fixing a hiatus hernia involves different measures: repairing a disrupted diaphragmatic hiatus, return the lower oesophageal sphincter to its normal anatomical position (below the diaphragm) and adding a fundoplication to prevent reflux and as gastropexy.

The open Belsey Mark IV, performed via a left posterolateral thoracotomy, remained for many years the gold standard procedure for hiatus hernia repair. With the proliferation of transabdominal approach and minimally invasive surgery, the role of the Belsey Mark IV has diminished, with the laparoscopic approach now being the standard procedure for both hiatus hernia and diaphragmatic hernia repair.¹¹ With continuous improvements in laparoscopic equipment and experience, it is not unusual to find reports of complex diaphragmatic hernia and giant hiatus hernia managed laparoscopically.^{15–17}

The reported recurrence rate varies between 15% and 66%, with either para-oesophageal herniation, sliding herniation or wrap migration. Hernia type, surgical experience and technique, obesity, heavy lifting, vomiting, chronic obstructive pulmonary disease, retention of the hernia sac

and a shortened oesophagus have all been cited as factors influencing the recurrence rate.³

In this study, we present four different cases of complex hiatus and diaphragmatic hernias, all approached laparoscopically and repaired with mesh insertion.

Materials and methods

We report the treatment of four patients with different types of diaphragmatic hernia and hiatus hernia, who underwent both elective and emergency laparoscopic repair at St Thomas' Hospital, London, in the period 2015–2016. Patient demographic data included age, sex, clinical presentation and diagnostic investigations performed. Details on surgical technique, timing of the procedure (elective or emergency), intra- and postoperative complications (including readmissions or recurrence), length of hospital stay and follow-up were also reported.

Results

Patient 1

This 69-year-old woman was under the care of the gastroenterologist for a long history of gastro-oesophageal reflux disease. She had several operations as a child due to a congenital diaphragmatic hernia and oesophageal stricture. She subsequently underwent an oesophago-gastrectomy and gastric pull-up. Some of these procedures were performed by Mr Ronald Belsey in Bristol. During an OGD in 2010 she was found to have a long (7-cm) segment of Barrett's, and biopsies in 2014 showed low-grade dysplasia. CT revealed a dilated gastric conduit and part of the transverse colon herniated into her left chest. Her main symptoms were severe nocturnal regurgitation, resulting in coughing and choking, persistent epigastric and retrosternal pain. After discussed at our upper-gastrointestinal benign multidisciplinary meeting, surgery was advised. An elective laparoscopic revision of hiatus hernia repair was performed. The transverse colon was reduced into the abdomen; the hiatus repaired with Ethibond® sutures and Ultrapro® mesh (Ethicon), fixed with Securestrap® (Ethicon). A Roux-en-Y biliary diversion was also performed as anti-reflux procedure. The stomach was transected at the pylorus and an 80-cm antecolic loop anastomosed to the remnant gastric body. A transabdominal mediastinal drain was placed. The patient had a prolonged hospital stay due to eating difficulties, which required total parenteral nutrition. The patient progressed to a soft diet after one week. Her postoperative recovery was complicated by chest infection (treated with antibiotics) and left arm deep venous thrombosis at the site of peripheral inserted central catheter line (treated with dalteparin). She was discharged 32 days after surgery. At OGD performed eight months later the gastrojejunostomy was widely patent. CT at one year showed no signs of recurrence and her gastric conduit appeared less distended than before (Fig 2). At her 18-month follow-up she was completely asymptomatic, except for occasional episodes of regurgitation. Her heartburn was controlled with proton pump inhibitor.

Figure 2 Patient 1 pre-(A) and postoperative (B) computed tomography. Follow-up images (B) show no recurrence and a less distended gastric conduit.

Patient 2

When this patient presented at her local hospital with chest pain and shortness of breath, she was 20 years old and 18 weeks pregnant. She had undergone a congenital right diaphragmatic hernia repair when she was 12 days old. Magnetic resonance imaging revealed a recurrence of the hernia, with right kidney, right colon and part of the small bowel migrated posterior to the liver into her chest (Fig 3). After a multidisciplinary team discussion with obstetricians, a semi-elective joint procedure with urology was carried out: rigid cystoscopy and right ureter stenting under ultrasound guidance were performed first, followed by a laparoscopic approach to the recurrent hernia. Both the large and small bowel, together with the kidney, were mobilised from the chest; a small pneumothorax was controlled intraoperatively with chest drain insertion. The diaphragmatic defect was repaired with a sub-lay Ventalight® mesh (Bard), secured with titanium staples (Protack®, Medtronic). She was reviewed by the obstetric team several time to follow-up her pregnancy and discharged on postoperative day 10. The ureteric stent was

Figure 3 Patient 2 magnetic resonance imaging. The image on the left shows the herniated right kidney; on the right, the migration of part of the small bowel and the right colon is also visible.

removed six weeks later. CT performed seven months after surgery showed no signs of recurrence. When she was seen in clinic nine months later, the patient was clinically well and mother to a healthy baby girl.

Patient 3

This 63-year-old woman was referred by her general practitioner to the gastroenterologist with a long history of dyspepsia, associated with recent onset of epigastric pain, belching and weight loss. An OGD and barium swallow revealed a large complex para-oesophageal hernia as cause of her symptoms. She was therefore referred for a surgical opinion. CT confirmed the large para-oesophageal hernia (50% of her stomach was in the chest) and revealed also an anterior Morgagni type diaphragmatic hernia, with the omentum lying into the chest to the right side of the heart (Fig 4). An elective laparoscopic approach to both hernias was then performed. The omentum and stomach were reduced into the abdomen; both the hiatus and the anterior diaphragmatic defects were repaired with Ethibond sutures. A 15 × 10-cm sublay Ventralight mesh secured with Securestrap was used for the Morgagni hernia. A 360-degree fundopexy was also performed and a transabdominal mediastinal drain placed, which was removed after two days. There were no intra- or postoperative complications and the patient was discharged on postoperative day four. A couple of weeks later the patient was readmitted with abdominal pain. CT did not show any recurrence or collections and the patient was discharged. She presented at her follow-up three months after surgery clinically well, complaining only of mild epigastric discomfort on movement (probably related to the stapled mesh).

Patient 4

This 73-year-old woman presented to the emergency department of her local hospital with a two-week history of vomiting and shortness of breath. CT revealed a large hiatus hernia, with all the stomach herniated into the right chest and a organo-axial gastric volvulus (Fig 5). An naso-gastric tube was inserted while the patient was waiting to be transferred to our centre for the surgical treatment. An

Figure 4 Patient 3 preoperative computed tomography. A large para-oesophageal hernia (A) and an anterior Morgagni hernia (B) are revealed.

Figure 5 Patient 4 preoperative computed tomography. The right chest is almost entirely occupied by the herniated stomach.

emergency laparoscopic hiatus hernia repair was performed at the weekend. Once the stomach was reduced into the abdomen it looked viable. The hiatus was repaired with Ethibond sutures but, given the size of the defect and the weakened diaphragmatic muscles, an Ultrapro® mesh (Ethicon), fixed with Securestrap, was used as reinforcement. A 360-degree fundopexy was then performed and a transabdominal mediastinal drain placed. Total parenteral nutrition was continued for five days until satisfactory gastric emptying resumed. Postoperative recovery was complicated by chest infection, which was treated with antibiotics. As she progressively increased her oral intake, parenteral nutrition was stopped and the patient was discharged on postoperative day seven. At her follow-up four months after surgery she was clinically well, reporting improvement in her symptoms and eating without problems.

Discussion

In the 1950s, Ronald Belsey, a British thoracic surgeon, significantly advanced hiatus hernia surgery through a trans-thoracic approach. After complete mobilisation, an anterior wrap was performed by placing interrupted silk mattress sutures between the gastric fundus (2 cm below the GOJ), through the distal oesophagus (2 cm above the GOJ). This was reduced back into the abdomen and the hiatus was then repaired with interrupted silk sutures, placed posterior to the oesophagus, from the medial to lateral crus of the diaphragm.

Over the years a transabdominal approach has become more popular and, with the development of minimally

invasive techniques, the Belsey Mark IV became obsolete, promoting laparoscopic surgery as the gold standard in hiatus hernia and diaphragmatic hernia repair.

In our short series, we approached four patients with different diaphragmatic hernia and hiatus hernia with a laparoscopic approach (both elective and emergency procedures), utilising mesh, without major complications.

There is still controversy regarding which technique should be used for the repair of very large hiatus hernias. There is no agreement about whether or not to use a mesh and, if it is used, what type (biological or synthetic), which configuration (completely or partially encircling the oesophagus) and what method of fixation should be used (absorbable or non-absorbable tackler).

Three randomised trials have examined the impact of mesh repair of the oesophageal hiatus, two in the context of very large hiatus hernia. In their study, Frantzides *et al* enrolled 72 patients to undergo repair with sutures versus a piece of polypropylene mesh encircling the oesophagus.¹⁸ The results at median 2.5-year follow-up showed a reduction in hernia recurrence from 22% to 0%. In another study, Oelschlager *et al* reported six-month outcomes from a multicentre trial of 108 patients who underwent repair with sutures compared with an absorbable mesh positioned posteriorly and around the sides of the oesophagus.¹⁹ Hernia recurrence was reduced from 24% to 9% at six-month follow-up. Longer-term follow-up, however, revealed no outcome differences.²⁰ The outcomes from one randomised controlled trial differ from those reported by the previous published studies.²¹ The study compared suture, absorbable mesh and non-absorbable mesh repair, concluding that no significant differences were seen for recurrent hiatus hernia between the three groups and that the overall outcomes after sutured repair were similar to mesh repair.²¹

Although good results have been reported, there are still some concerns about its potential complications such as mesh migration, infection, dysphagia and erosion into the oesophageal lumen.²² While we normally employ a selective approach to the use of mesh for diaphragmatic hernia and hiatus hernia repair, all the cases presented in this study where complex and associated with large size defects. For these reasons, even after satisfactory closure of the defects with sutures, the diaphragmatic repairs were reinforced with onlay meshes to prevent early recurrences. We used partially absorbable mesh for the hiatus and non-absorbable mesh for the diaphragmatic defects. In all cases but one, we used an absorbable stapler to fix the mesh to the diaphragm.

A gastropexy is usually performed to minimise the risk of recurrence. Different methods have been described to fix the anterior wall of the stomach to the abdominal wall, including percutaneous endoscopic gastrostomy gastropexy, cardiopexy and fundoplication. The latter (partial or total) is usually the standard choice, owing to its advantage in preventing reflux as well. A German randomised controlled study of 40 patients compared a laparoscopic mesh-augmented hiatoplasty with simple cardiophrenicopexy (LMAH-C) compared with a laparoscopic mesh-augmented

hiatoplasty with fundoplication. Recurrence rates were similar between the two groups (33% and 21%, respectively), but a new onset of gastroesophageal reflux disease occurred in a significant amount of patients who underwent LMAH-C (53%) in comparison with those who underwent LMAH-F (17%). The study therefore suggested that a fundoplication should be added to all repairs.²³

Fundoplication and crural repair can be lengthy and difficult, especially in patients who have very large defects. Mere fixation of the stomach to the anterior abdominal wall by single or double percutaneous endoscopic gastrostomies through a laparoscopic assisted technique has also been described.^{24–28} Although it protects against subsequent gastric volvulus, the procedure does not represent a formal hernia repair and, if used alone, it has an increased risk of recurrent herniation. For these reasons this procedure should be considered as a valid option only in patients with a high risk of morbidity and mortality.²⁹

We prefer a total fundopexy (360 degrees) but in this series, owing to their complexity, we have tailored the procedure to each patient. In patient 1, who had a recurrent hernia with associated Barrett's oesophagus, we opted for a Roux-en-Y biliary diversion. In patient 2, owing to the already complex operation and her pregnant status, we decided not to perform fundopexy or anti-reflux procedure to avoid further increase in the surgical time and reduce the risk of postoperative complications.

The long-term outcome after diaphragmatic hernia and hiatus hernia repair relates mainly to symptoms resolution and hernia recurrence. Most small hernia recurrences are asymptomatic and of no clinical consequences. Patient-reported outcomes (such as symptom questionnaires) can be used to assess the results of the operation. However, they do not provide the anatomical evidence for an appropriate repair or the adequate reduction of the herniated organs. For the above reasons, radiology, pH studies and endoscopy with biopsies remain the most objective reporting methods to quantify results of hiatus or diaphragmatic hernia repairs.⁵ We did not use a formal symptoms scoring method, but in our four cases, the patients were all asymptomatic after surgery. The anatomical success of the repair was documented either with endoscopy or CT during the first 12 months of follow-up.

Conclusion

After Belsey's pioneering transthoracic surgery in the 1950s, there is ample evidence in the surgical literature that laparoscopic hiatus hernia repair and fundoplication is currently the technique of choice. Reporting our experience with four complex elective and emergency cases, we emphasise this, suggesting that laparoscopic approach is a safe and feasible method that could be considered in all cases of symptomatic hiatus and diaphragmatic hernias.

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