Chapter 13
Laparoscopic Surgery for Para-esophageal Hernias

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Abstract Surgical management of paraesophageal hernias has changed dramatically during the past two decades. Elective laparoscopic paraesophageal hernia repair is now the standard approach to the patient with a symptomatic paraesophageal hernia. The operation is technically challenging and requires numerous intra-operative and peri-operative considerations. Here, we will highlight the key points in the peri-operative and intra-operative management of para-esophageal hernias, emphasizing the operative goals of reduction of the hernia contents, excision of the hernia sac, a tension free repair with complete esophageal mobilization, crural repair, and fundoplication.

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Indications

Immediate open repair of all paraesophageal hernias, irrespective of symptoms, was standard practice for many years. This pre-emptive approach was based on the surgical dogma that paraesophageal hernias were at high risk for life-threatening gastric volvulus and gastric necrosis [1]. However, this practice is no longer recommended, as it is now known that the annual risk of paraesophageal hernias progressing to life-threatening gastric volvulus and necrosis is low at approximately 1 % [2]. Therefore, these hernias can be managed on an elective basis when not incarcerated.

Patients with asymptomatic paraesophageal hernias identified incidentally can be offered watchful waiting as a treatment option; though elective repair is an option in patients with appropriate performance status. Common presenting symptoms of paraesophageal hernias include early satiety, gastroesophageal reflux symptoms such as dysphagia, heartburn or regurgitation; epigastric discomfort, dyspnea, recurrent pneumonia (secondary to chronic reflux and aspiration), and anemia [3]. Anemia develops secondary to Cameron's ulcers: linear gastric ulcers that form as a result of diaphragmatic compression of the stomach at the hiatus. Notably, this anemia reliably resolves following surgical treatment of paraesophageal hernias [4].

Gastric volvulus with incarceration is a rare emergency in which the stomach can rotate on either the long axis (organoaxial) or short axis (mesenteroaxial) and become ischemic [5]. An influential study by Drs. David Skinner and Ronald Belsey in 1967 reported that 29 % (6 of 21) patients with documented paraesophageal hernias and minimal symptoms died of gastric strangulation, perforation, or bleeding

[1]. However, subsequent studies have documented a much lower rate of lethal complications [2, 6], thus changing surgical practice to allow elective repair or watchful waiting of asymptomatic patients. Although uncommon, gastric volvulus with incarceration is typically seen in elderly patients and is a true emergency. Typical presenting symptoms include severe chest pain, vomiting, and epigastric distention [5]. If endoscopic decompression is unsuccessful patients should be taken to the operating room emergently for laparoscopic versus open reduction and repair. The urgency of an operation for paraesophageal hernia is a significant predictor of morbidity, especially with respect to pulmonary complications and mortality [7, 8].

Classification

There are four types of hiatal hernias (Fig. 13.1): sliding hiatal hernia (type I), and para-esophageal hernias types II, III and IV. Normally, the phreno-esophageal membrane is attached to the diaphragm and acts as an anchor, maintaining the gastroesophageal junction (GEJ), angle of His, and stomach in position (Fig. 13.1, top left). Sliding hiatal hernias (type 1) are the most common (95 %) and occur when the GEJ and the proximal stomach move above diaphragm. Sliding hernias (Fig. 13.1, top middle) and are repaired only when patients have surgery for recalcitrant gastroesophageal reflux disease [5]. Type II paraesophageal hernias (also referred to as “rolling” or “true” paraesophageal hernias) occur when the gastric fundus moves into the chest alongside a normally positioned GEJ (Fig. 13.1, top right). Type III paraesophageal hernias are characterized by the herniation of both GEJ and the variable portion of the stomach to an intra-thoracic position and account for the majority of the paraesophageal hiatal hernias (Fig. 13.1, bottom left) [5]. Most authors would call a hiatal hernia a Type III paraesophageal hernia when at least 50 % of the stomach is herniated into the chest. Finally, Type IV paraesophageal hernias are defined as the

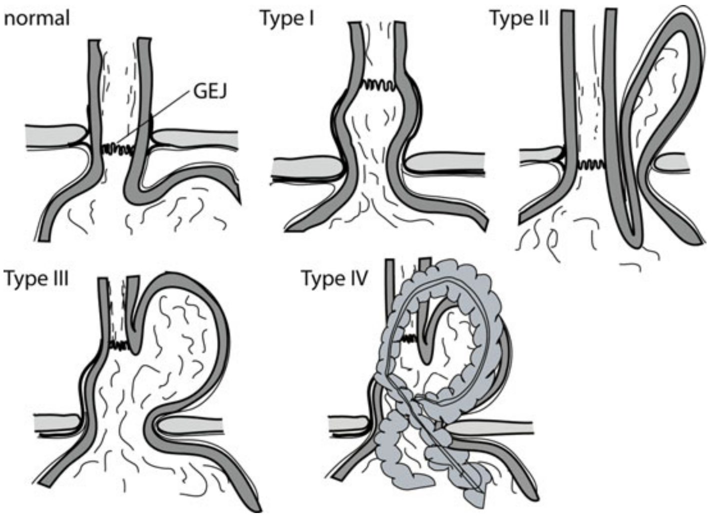


FIGURE 13.1 Types of hiatal hernia (Illustration by Clinton T. Morgan, M.D.)

herniation of other viscera such as colon, small bowel, or others alongside a Type III paraesophageal hernia (Fig. 13.1, bottom right).

Preoperative Preparation

Pre-operative management varies according to patient presentation. For the symptomatic patient seeking surgical intervention, a thorough pre-operative evaluation is recommended. Patients are generally older and often have significant co-morbidities requiring cardiopulmonary evaluation. Patients should undergo a barium esophagram [9] in order to define the anatomy, assess for volvulus, and evaluate for esophageal shortening, esophageal bolus transport and gastric emptying. Figure 13.2 shows a barium esophagram of a patient with a large type III para-esophageal hiatal hernia with all the stomach in the chest and with an organoaxial

FIGURE 13.2 Barium esophagram showing large type III para-esophageal hiatal hernia with organoaxial volvulus of the intrathoracic stomach

volvulus of the intrathoracic stomach. Upper endoscopy with biopsy is also routinely performed (preferably by the operating surgeon). Esophageal manometry can be attempted to assess esophageal motility to guide the surgeon's operative planning with regard to the type of fundoplication and rule out esophageal motility disorders. High-resolution computed tomography, although not required pre-operatively, can depict the anatomical abnormalities well (Fig. 13.3).

Positioning and Anesthesia

All patients should undergo induction of general anesthesia with endotracheal intubation using techniques to prevent aspiration. The patient should be placed in either the supine

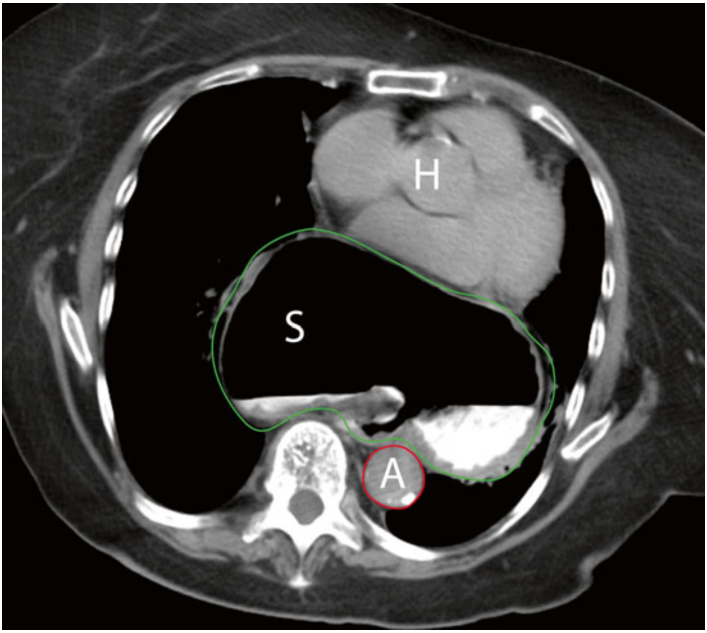


FIGURE 13.3 Computed tomography of the chest showing a paraesophageal hernia. A large portion of the stomach *S* green outline, is noted high in the mediastinum, at the level of the heart *H* note the proximity of the posterior aspect of the hernia to the aorta (*A* red outline)

position or on a split-leg table. The arms are secured on padded arm boards at a 90° angle to the body's axis. A footboard is placed and the patient secured to the bed in anticipation of a steep reverse Trendelenburg position during the case. An orogastric or nasogastric Levine tube can be placed as needed to decompress the stomach. Our preference is to introduce the Levine tube after the stomach is reduced and gastro-esophageal junction is under direct visualization. Sequential compression devices should be placed on the lower legs bilaterally and subcutaneous heparin can be administered for deep vein thrombosis prophylaxis. A foley catheter can be considered for close monitoring of urine output if the procedure is emergent or the patient has multiple comorbidities. The skin of the abdomen should be widely prepped after hair has been clipped short using an atraumatic electric clipper [10]. A single dose of antibiotics should be administered within 1 h of incision [11], typically a second-generation cephalosporin.

Operative Approach

Paraesophageal hernias can be repaired using laparoscopic, open trans-abdominal, or trans-thoracic (via a left thoracotomy) approaches. The laparoscopic approach is currently preferred in most centers. The possible benefits of the trans-thoracic approach include direct visualization of the sac and hernia, complete mobilization of the esophagus to the aortic arch and the ease of a relaxing incision on the left hemidiaphragm [3, 9]. Disadvantages include the pain of a thoracotomy, higher risk of peri-operative complications and the extended length of hospital stay [3, 9]. Most centers in the U.S. favor the use of laparoscopic techniques as complication rates seem lower than open approaches and recurrence rates with laparoscopic techniques seem similar to the ones obtained with the trans-thoracic and open abdominal approach [12, 13].

The laparoscopic approach to repair of paraesophageal hernias was first described in 1992 and emphasized crural approximation and fundoplication [14]. Five steps are essential components of a laparoscopic repair of a paraesophageal hernia:

1. reduction of the hernia contents
2. excision of the hernia sac,
3. complete esophageal mobilization,
4. crural repair, and
5. fundoplication [9, 14].

One of the most important aspects of successful paraesophageal hernia repair is to create a tension-free repair. Axial tension can be addressed with mediastinal esophageal mobilization in most cases. Occasionally, a Collis gastroplasty may be necessary. Lateral tension, due to a large diaphragmatic defect, is usually addressed by using appropriate technique for crural closure or an absorbable synthetic or biologic mesh. However, in selected cases relaxing incisions with or without absorbable mesh placement may be beneficial [9, 12, 15]. Only absorbable synthetic or biologic mesh should be used at the hiatus. Non-absorbable meshes should be avoided as they have potential to erode into the esophagus. However, even the use of absorbable synthetic or biologic mesh is controversial since its efficacy in long-term objective recurrence has not been demonstrated [12]. Reduction of early recurrences with biologic mesh placement, however, may be one advantage over primary repair [16].

Laparoscopic repair is associated with less blood loss, fewer intraoperative complications, faster diet advancement, and shorter hospital stays [3, 17]. Unfortunately, the radiographic recurrence rate is still quite high, ranging from 23 to 50 % in selected series [15, 17–20]. However most radiographic recurrence are small recurrences of a small portion of the proximal stomach and the vast majority are asymptomatic, thus of little clinical significance and needing no treatment [18, 20].

Laparoscopic port sites are positioned in a configuration similar to that of a standard Nissen fundoplication. An additional 5 mm port in the left lower quadrant may be beneficial to assist with retraction and dissection. After inspection of the abdominal contents, the left lobe of the liver is retracted cephalad with a self-retaining laparoscopic retractor, exposing the hiatal defect and hernia (Fig. 13.4).

Description of the Laparoscopic Procedure

Reduction of Hernia Contents and Esophageal Hiatus Dissection

It is our preference to start the dissection at the gastrohepatic ligament, which is bluntly grasped and divided with the harmonic scalpel (Fig. 13.5). Care should be taken to identify

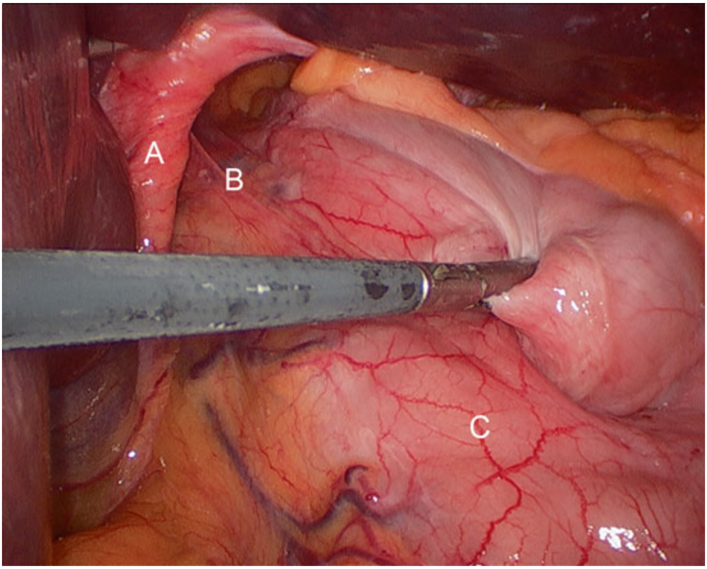


FIGURE 13.4 Reducing the stomach into the abdomen (*A* right crus, *B* preno-esophageal membrane, *C* stomach)

and, if present, preserve a replaced left hepatic artery arising from the left gastric artery and traversing the gastrohepatic ligament. Next, the phrenoesophageal ligament is identified at the right crus. The ligament is grasped with an atraumatic grasper and pulled caudally. It is then divided with the harmonic scalpel, exposing an avascular plane while delivering the hiatal hernia sac medially (Fig. 13.6). Blunt dissection allows development of this avascular plane, which is extended cephalad into the thoracic cavity (Figs. 13.7 and 13.8). The dissection is then extended circumferentially in a clockwise fashion to the left crus. Then, the peritoneal coverage of the right crus is opened and the avascular plane dissected to release the hernia sac in that location (Figs. 13.9, 13.10 and 13.11). Care is taken to identify and avoid entry into the pleura both the right and left side. Figure 13.12 shows the dissection to the base of the right crus and in proximity to

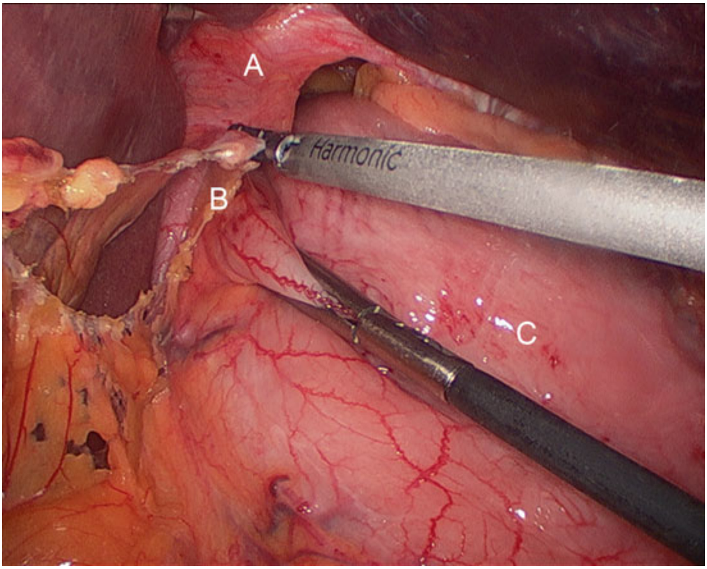


FIGURE 13.5 Division of the gastrohepatic ligament (*A* right crus, *B* gastrohepatic ligament, *C* stomach)

the left gastric vessels. Dissection on the left side is facilitated by reduction of the gastric fundus (Fig. 13.13), opening the gastro-colic ligament, entering the lesser sac, and dividing the short gastric vessels (Figs. 13.14, 13.15, 13.16, 13.17, and 13.18). Some surgeons prefer to start the operation by identifying the left crus (as opposed to the right crus as described above) and then move to the right side. For this portion of the operation, we employ the harmonic scalpel. Clips should be placed on the larger and more proximal short gastric vessels (Fig. 13.17). Division of the short gastric vessels and

FIGURE 13.7 Dissection of the anterior aspect of the hernia sac (*A* hernia sac *B* gastric fundus *C* left crus)

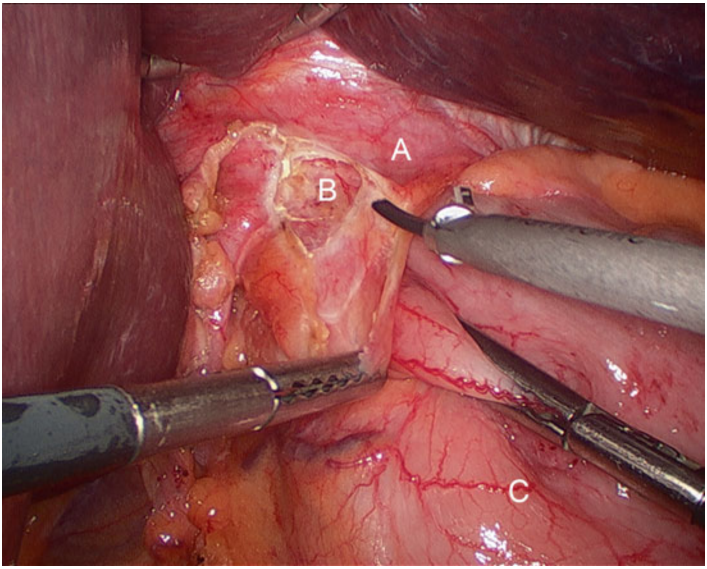
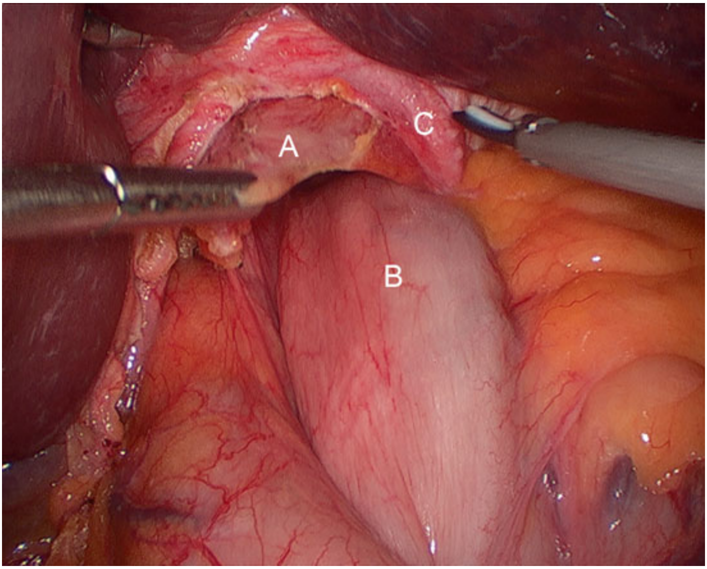


FIGURE 13.6 Division of the phrenoesophageal membrane (*A* phrenoesophageal membrane, *B* hernia sac, *C* stomach)



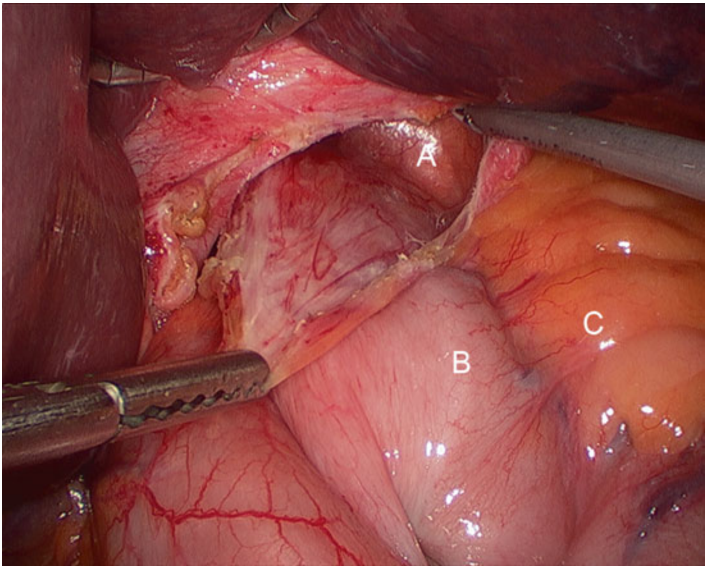
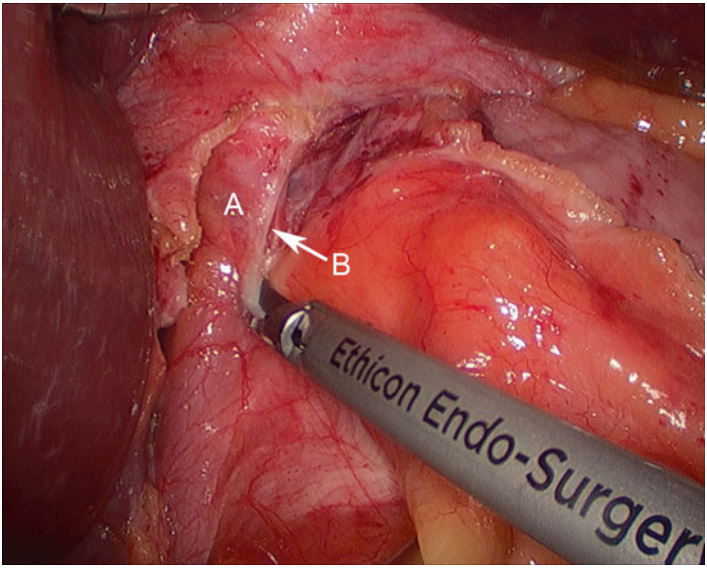


FIGURE 13.8 Opening the hernia sac laterally (*A* areolar tissue inside hernia sac, *B* gastric fundus, *C* gastrosplenic ligament)



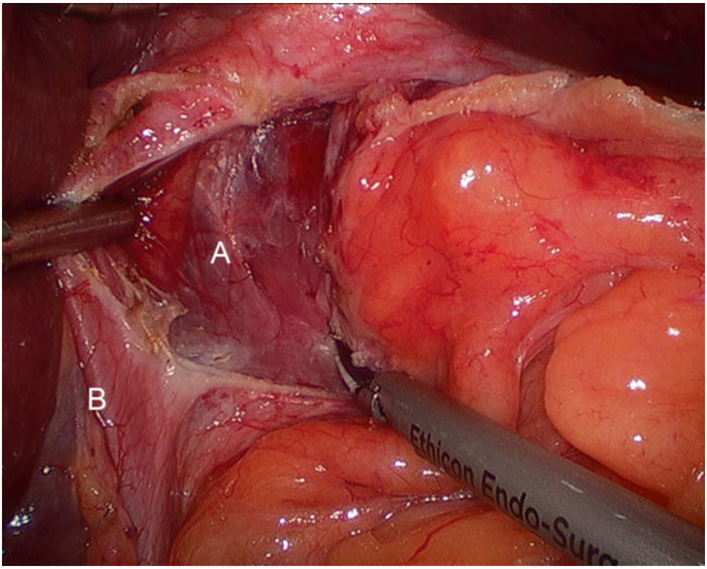


FIGURE 13.10 Dissecting the avascular space in between right crus and the hernia sac (*A* avascular space, *B* right crus)

mobilization of the stomach aids in complete circumferential dissection of the hernia sac (Figs. 13.19 and 13.20) and will facilitate the creation of a proper fundoplication, which is performed later in the operation.

Excision of the Hernia Sac

Once the stomach is reduced and the hernia sac has been opened circumferentially around the crura, the hernia sac dissection is extended further into the mediastinum (Fig. 13.20). Much of this dissection can be accomplished by blunt

FIGURE 13.9 Incising the peritoneal coverage of the right crus (*A* right crus, *B* entering the avascular space to access the hernia sac)

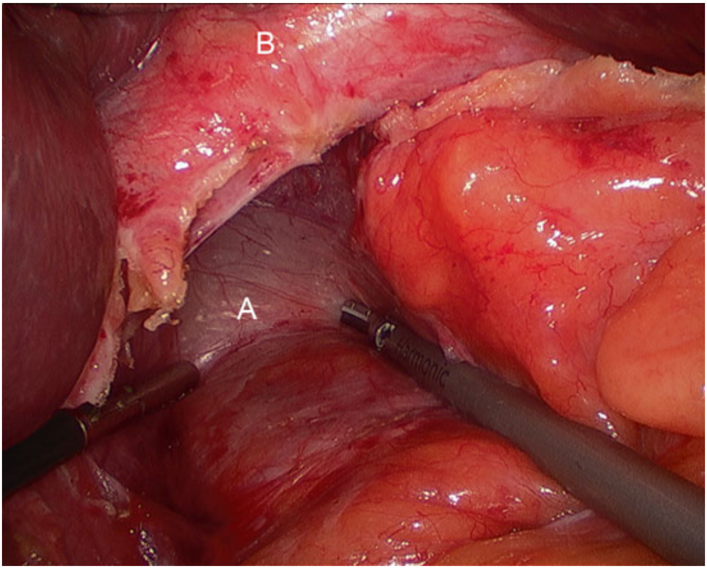
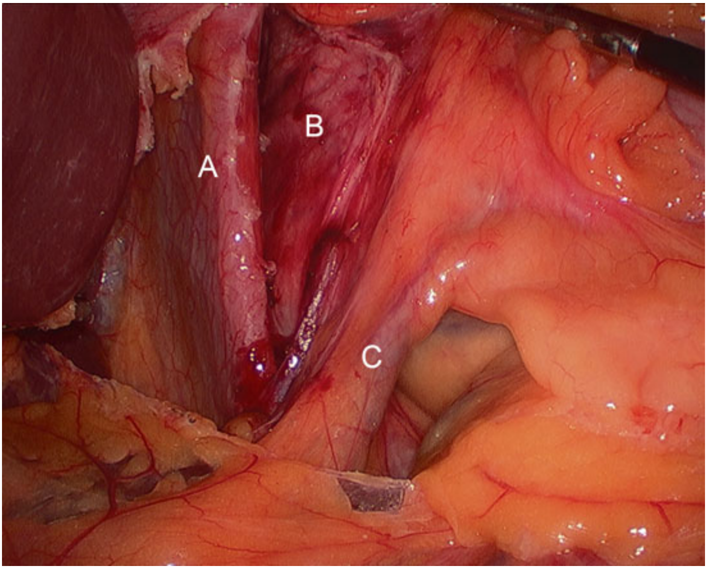


FIGURE 13.11 Dissecting the avascular space in between right crus and the hernia sac (*A* avascular space, *B* right crus)



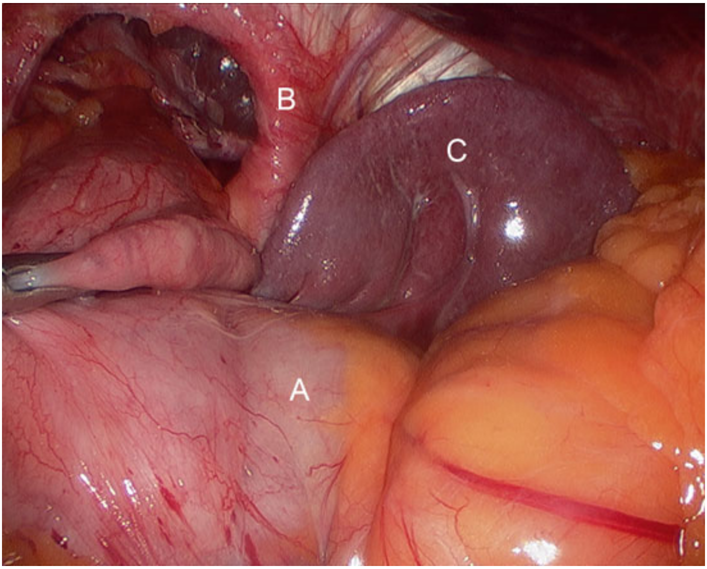


FIGURE 13.13 Exposure of gastroesplenic ligament for dissection (*A* stomach, *B* left crus, *C* spleen)

dissection in the avascular plane. We frequently employ rolled 4 x 4” gauze to aid blunt dissection. Critically, the right and left pleura, inferior vena cava, and aorta must be identified early and protected during the procedure. Complete dissection of the hernia sac is an essential component of the operation [21]. Dissection of the hernia sac proceeds by alternating between the left anterior and right anterior thoracic cavity until the sac has been circumferentially released from its intrathoracic attachments. Placement of a Penrose around the esophagus near the GEJ facilitates alternating the direction of retraction during this dissection. Once the hernia

FIGURE 13.12 Left gastric vessels (*C*) at the base of the hernia sac dissection (*A* right crus, *B* hernia sac)

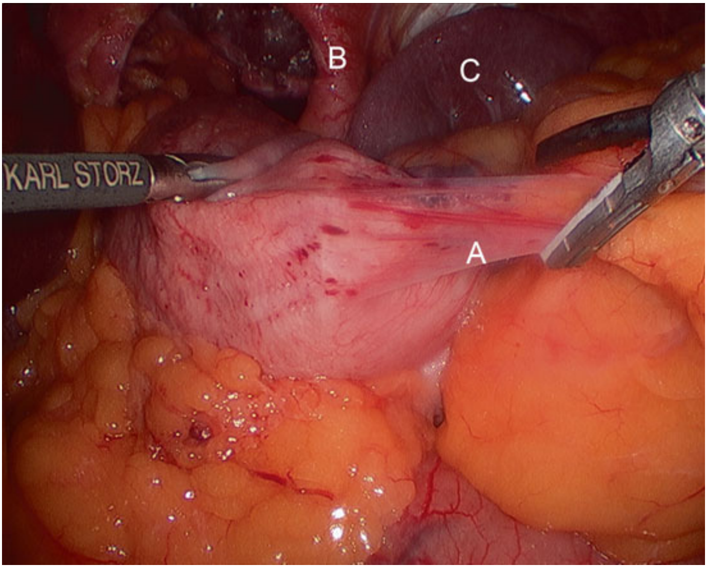
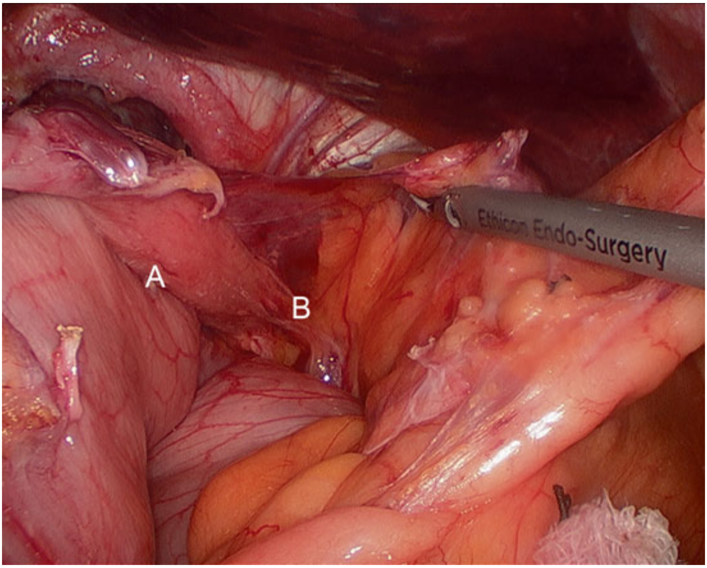


FIGURE 13.14 Division of the short gastric vessels (SGV) for mobilization of the gastric fundus (*A* SGV, *B* left crus, *C* spleen)



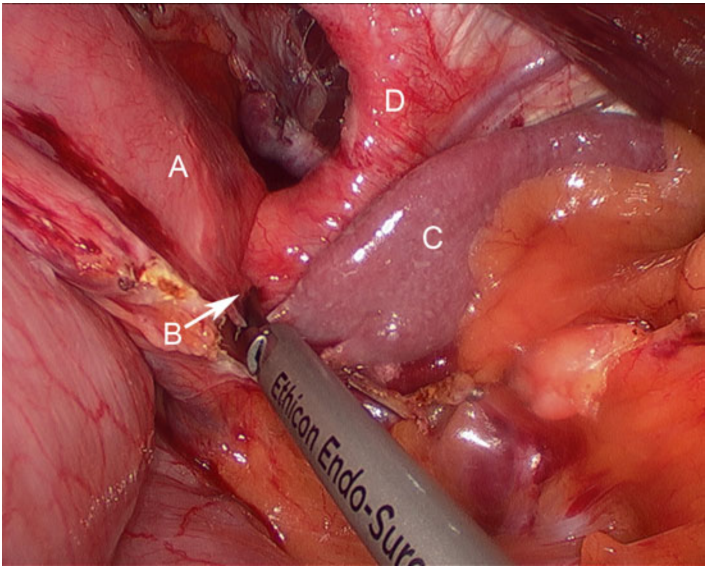


FIGURE 13.16 Division of the short gastric vessels and mobilization of the stomach up to the angle of his (*A* stomach, *B* angle of his, *C* spleen, *D* left crus)

sac is dissected off all intra-thoracic attachments it can be retracted into the abdomen and excised (Fig. 13.21). Care is taken to identify and preserve the anterior and posterior Vagus nerves during the dissection and excision of the sac. The excision of the sac maybe omitted if the presence of the sac would not interfere with the fundoplication. It is our preference to excise the hernia sac as it allows for a clearer identification of the gastroesophageal junction and the distal esophagus.

FIGURE 13.15 Division of the short gastric vessels and mobilization of the stomach (*A* stomach, *B* SGV)

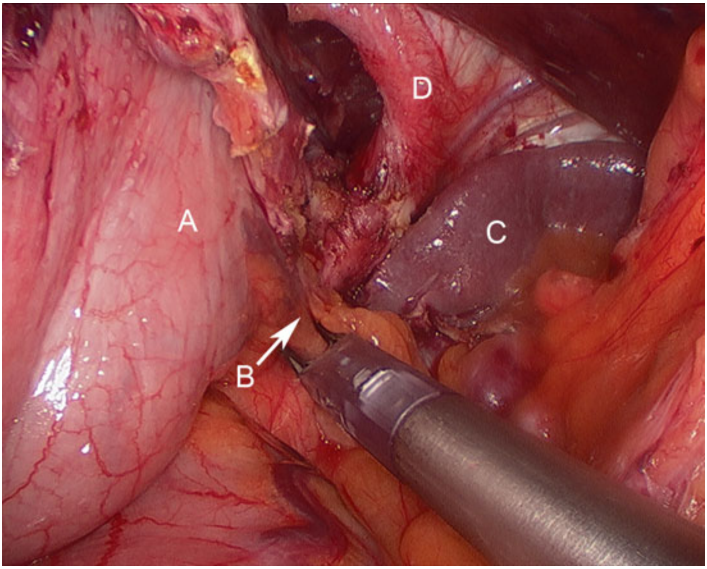


FIGURE 13.17 Applying a clip on a more posterior and superior short gastric vessel (*A* stomach, *B* SGV, *C* spleen, *D* left crus)

Crural Repair

Once the hernia sac has been excised, we turn our attention to repair of the hiatal defect. The right crus and left crus are approximated with sutures (Fig. 13.22). It is our preference to use interrupted zero braided polyester sutures in a figure of eight configuration. The number of sutures place will vary according to the size of the defect. The goal is to close the diaphragmatic defect while allowing only a 1–2 cm space in between the esophagus and the crural closure. If there is excessive lateral tension on the crural approximation, reducing CO_2 insufflation from 15 mmHg to 10 or 12 mmHg may assist in allowing closure without tension.

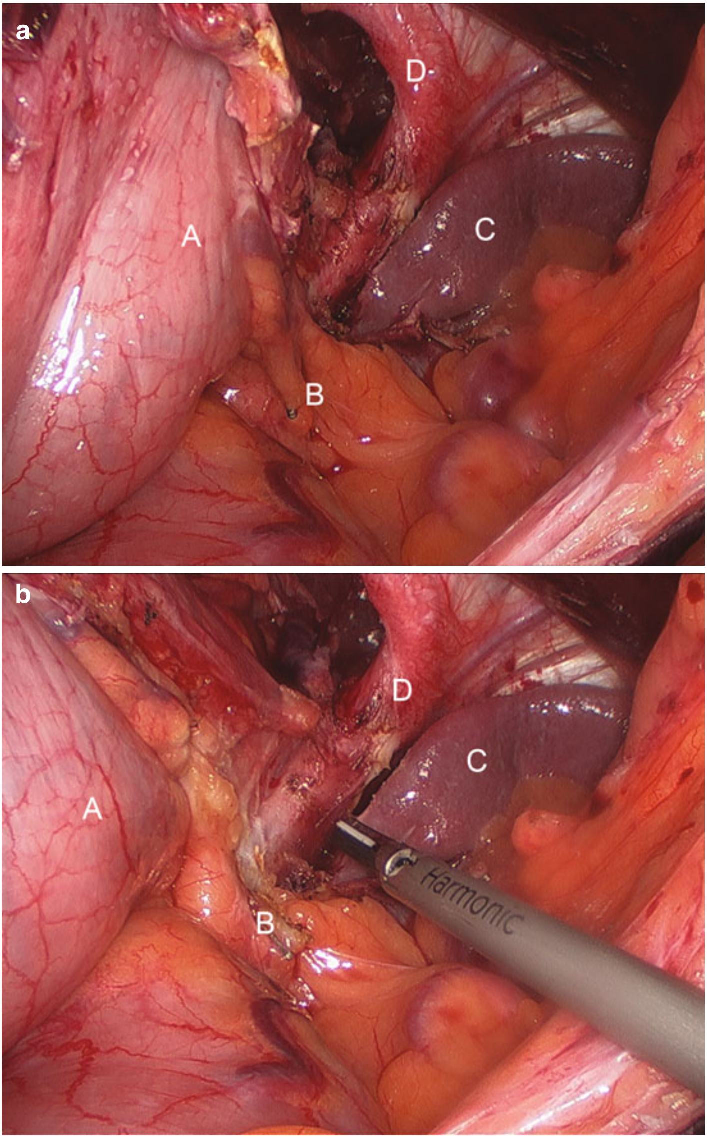


FIGURE 13.18 Completed SGV and stomach greater curvature mobilization (*A* stomach, *B* SGV, *C* spleen, *D* left crus)

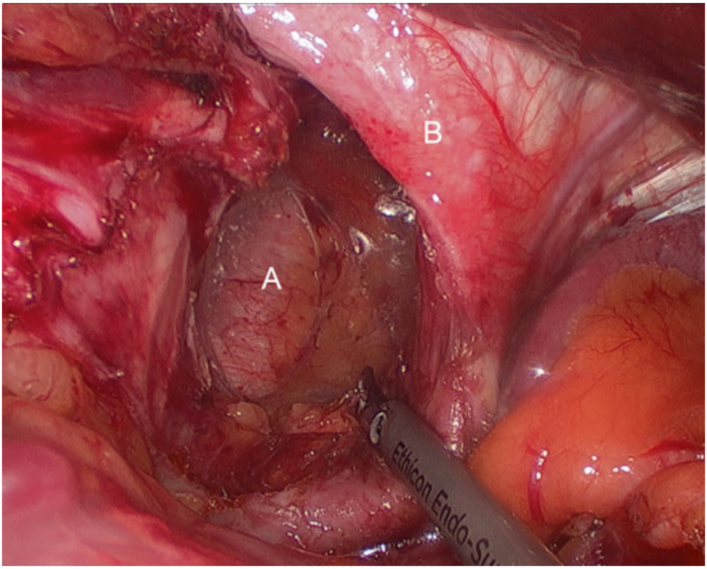
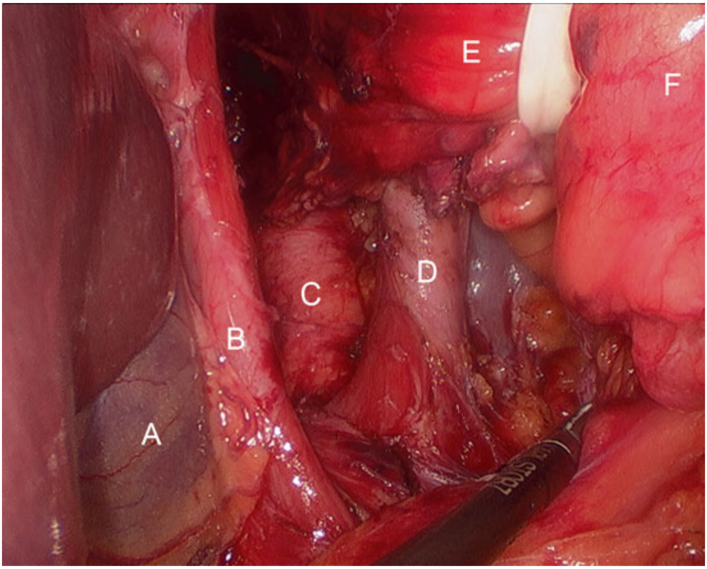


FIGURE 13.19 Left lateral and inferior dissection of the hernia sac (*A* aorta, *B* left crus)



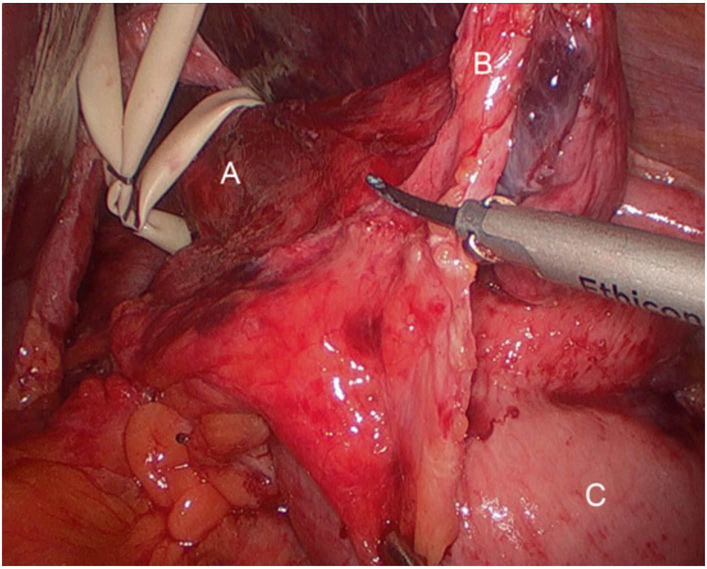


FIGURE 13.21 Excision of the hernia sac (*A* GE junction, *B* hernia sac, *C* stomach)

Absorbable Synthetic and Biological Mesh Placement

The use of mesh to reinforce the crural closure during repair large hiatal hernia has been used in an attempt to reduce the relatively high recurrence rates observed after the repair of these hernias [22]. Radiologic, objective recurrence rates (re-herniation >than 2 cm) have been reported to occur in approximately 40–60 % of patients after laparoscopic repair of paraesophageal hernia [20, 23], however, most patients with noted recurrences report no return of symptoms. Studies

FIGURE 13.20 Final aspect of dissection and retroesophageal window (*A*, *B* right crus, *C* aorta *D* left crus *E* esophagus *F* stomach)

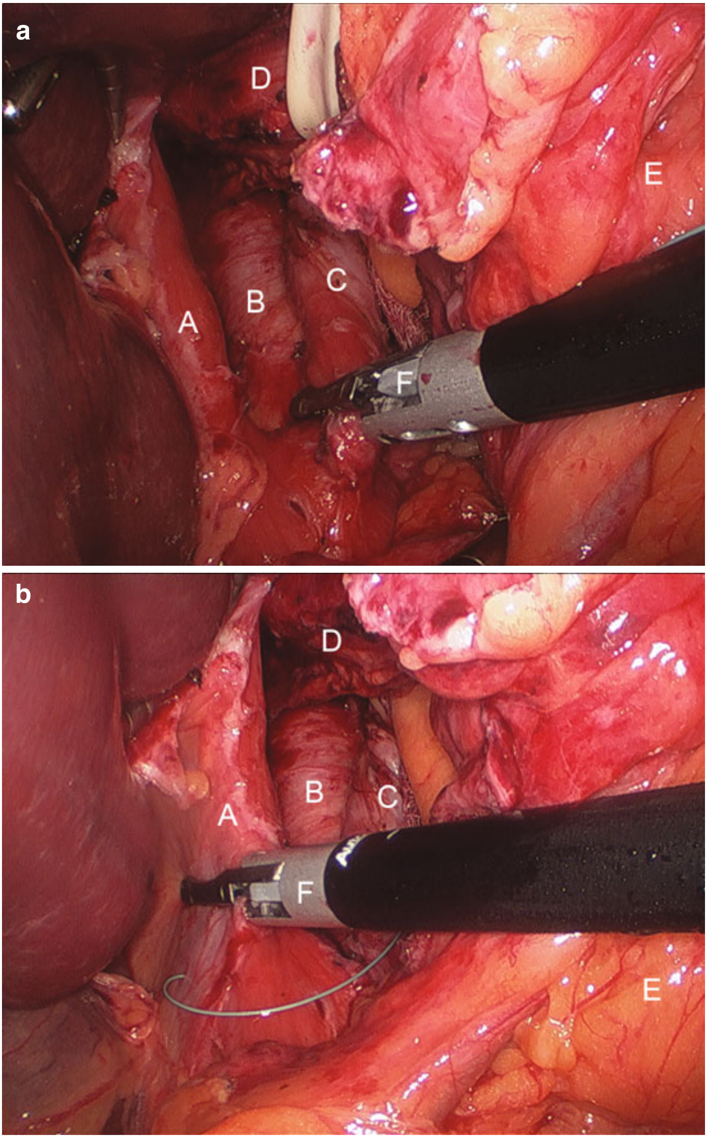


FIGURE 13.22 (**a**, **b**, **c**, **d**) Closure of the crura (*A* right crus, *B* aorta, *C* left crus, *D* esophagus, *E* stomach, *F* suturing device, *G* suture)

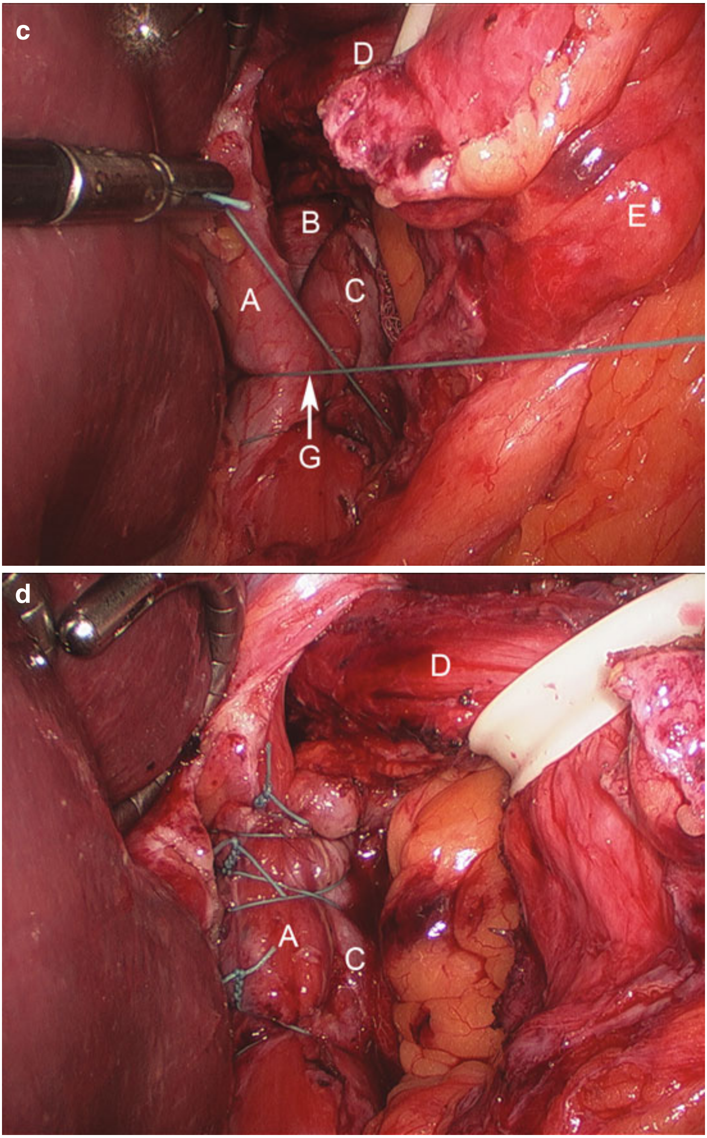


FIGURE 13.22 (continued)

report long-term relief of symptoms in 75–87 % of patients and a 61–91 % satisfaction rate with the result of the procedure [16, 22–24]. The only randomized controlled trial comparing the use of biologic mesh to no mesh with both 6 month and 2 year results suggest that the objective success rate seems to be improved with mesh over non-mesh repair in the short term [16, 25]. However, appropriate long-term follow-up is lacking and objective recurrence tends to increase over time [22, 24, 25]. Notably, the complications from non-absorbable mesh usage can be severe, including esophageal erosion (0.2 %) and extensive hiatal fibrosis (0.5 %) [3, 22, 26]. For these reasons, absorbable mesh is advised [16, 24]. Despite radiographic evidence of recurrence after a large hiatal hernia repair, most patients report enduring and dramatic symptomatic improvement [24, 25].

Despite the lack of level I evidence that the use of mesh reduces recurrence rates, newer biological and absorbable synthetic products that are less expensive are commonly used in practice. We place a U-shaped absorbable mesh around the esophagus at the level of the hiatus. The mesh onlay is placed posteriorly, with the esophagus cupped by the U and the approximated hiatus covered (Fig. 13.23). The mesh may be secured in place with fibrin glue or sutures.

Fundoplication

A gastric fundoplication around the distal esophagus is recommended after the closure of the hiatal defect to prevent de-novo or recurrent GERD symptoms after surgery. Some types of fundoplication also assist in securing the gastric fundus to the esophagus and diaphragm. The choice of a posterior complete (360° Nissen), posterior partial (270° Toupet), or anterior partial (180° Dor) fundoplication is based on individual patient characteristics and surgeon preferences. In the US, the most commonly used fundoplication is the posterior complete 360° Nissen fundoplication. However, many centers in Europe and also in North America favor the

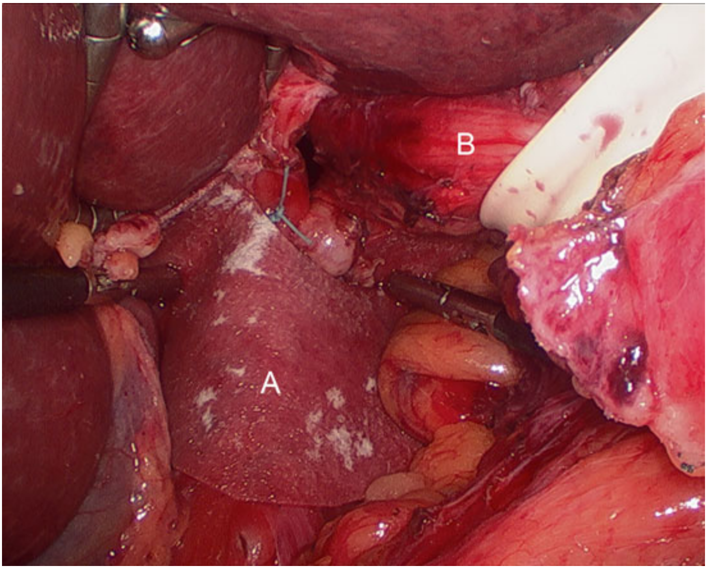


FIGURE 13.23 Absorbable synthetic Mesh (*A* covering the crural repair, *B* esophagus)

Toupet or Dor fundoplications, as they have been associated with lower rates of post-operative side effect such as gas bloat, dysphagia, and need for additional interventions in recent randomized controlled trials [27–29].

We favor a partial fundoplication as most of these patients have reflux as the main presenting symptom, and most have inherent esophageal motility dysfunction related to advanced age or the chronic nature of the partial obstruction caused by the paraesophageal herniation. A completed anterior 180° Dor fundoplication is shown in Fig 13.24. The technical steps for the creation of the Nissen, Toupet and Dor fundoplications can be found in the "Laparoscopic Antireflux Surgery" chapter of this book.

Occasionally, a "short esophagus" may be encountered and such a condition is diagnosed when less than 2.5 cm of intra-abdominal esophageal length is attainable. In these

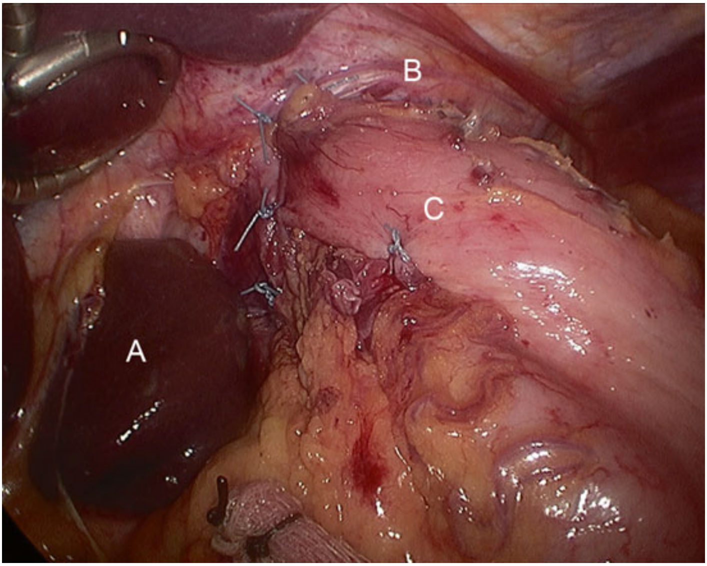


Figure 13.24 Final aspect of a Dor fundoplication (*A* diaphragm, *B* fundoplication, *C* caudate lobe of the liver)

cases, a Collis gastroplasty may be performed in conjunction with a fundoplication [3, 30–32]. Finally, the addition of a wedge fundectomy to Collis gastroplasty should be considered when a short esophagus is encountered as this procedure has recently been shown to have a lower prevalence of post-operative dysphagia and esophagitis [33].

Post-operative Care and Complications

Due to extensive mediastinal dissection, subcutaneous emphysema is commonly observed. This is rarely of clinical significance as long as the anesthesiologist has been attentive to the patient's PCO_2 during the procedure. Another relatively common intra-operative complication is a pleural tear. This is usually managed by communication with the anesthesiologist and altering the ventilation mode without the need for any intervention. Other peri-operative complications include atrial fibrillation, bleeding, deep venous thrombosis, and pneumonia, among others. Most patients can begin with a clear liquid meal within the first 24 h of the operation. Patients rapidly advance to a pureed or soft diet and remain on this diet for about 2 weeks. Most patients can be discharged on post-operative day number 1 or 2.

Summary

Elective repair is recommended for patients with symptomatic para-esophageal hiatal hernia that are not acutely incarcerated and laparoscopic repair is the standard of care. We describe the operative approach to achieve the critical goals of paraesophageal hernia repair:

1. reduction of the hernia contents
2. excision of the hernia sac,
3. complete esophageal mobilization,
4. crural repair, and
5. fundoplication

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