Management of Congenital Hernias in Adults: Foramen of Morgagni Hernia

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KEYWORDS

• Morgagni hernia • Diaphragm • Surgery • Robotic

KEY POINTS

- Morgagni hernias are defects in the anterior diaphragm due to a malformation in the fibrotendinous elements that fuse behind the sternum.
- Most patients are asymptomatic, but symptoms can be severe based on the size of the defect and the contents of the hernia.
- Repairs are often completed successfully using a laparoscopic approach despite large hernia contents, but alternative approaches may be necessary in complex clinical situations.
- Mesh is rarely needed when transfascial repair sutures are utilized, but may be required for larger defects.

INTRODUCTION

The Morgagni hernia, a defect named after the famed Italian anatomist Giovanni Battista Morgagni, occurs through the sternocostal triangle. Although the Morgagni hernia itself will be the focus of this review, one does not simply gloss over Morgagni's name without paying a few lines of special tribute to a giant in the history of medicine, and someone who is considered the father of modern Anatomic Pathology.[1,2] Born in Italy in 1682, Morgagni had an illustrious 56-year career as a professor of anatomy at the prestigious University of Padua. His career was flanked by other giants in the history of medicine—he was the pupil of Antonio Valsalva and the professor to Antonio Scarpa. Prior to Morgagni, normal human anatomy had been exhaustively described; however, a systematic description of anatomy with a focus on diseased organs had never been performed, which is Morgagni's most notable legacy. In 1761, Morgagni published his greatest work, *De Sedibus et Causis Morborum per Anatomen Indagatis (The Seats and Causes of Diseases Investigated by Anatomy),* containing records of 640 different dissections. In it, he highlighted the importance of diagnosis, prognosis, and treatment on a comprehensive knowledge of anatomic conditions.[3,4] Eponymous structures from the sinuses of the pharynx to the columnar folds of the anal canal bare Morgagni's name, including the foramen of Morgagni (sternocostal triangle) through which Morgagni hernias occur. Given the special tribute to Giovanni Morgagni, the authors first will begin the review with an anatomic description of the diaphragm and the anatomic defects leading to hernia pathology, followed by clinical presentation, evaluation, and current surgical treatments for Morgagni hernias, including robotic approaches to repair.

ANATOMY

The anatomic details pertinent to Morgagni hernias are reviewed herein, for more comprehensive details

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regarding diaphragmatic anatomy, please refer to Chapter 1. The sternocostal triangle, or Foramen of Morgagni, is a space behind the sternum in between the lateral edge of the diaphragm and the sternocostal attachments where a defect may form due to incomplete fusion of the septum transversum and the sternum.[5] This failure of fusion of the fibrotendinous elements often leads to a right-sided hernia (90% of Morgagni hernia patients) due to pericardial attachments on the left preventing herniation.[6] A left- sided sternocostal triangle hernia is often referred to as a Larrey Hernia.[7] This eponym is given from Napoleon's famed war surgeon, Dominque-Jean Larrey, who described a surgical approach to the pericardial cavity through a left anterior diaphragmatic defect.[8] Overall, Morgagni hernia makes up less than 3% of all congenital diaphragmatic hernias.[9] These hernias are generally not associated with other malformations or hernias in adults, and many are asymptomatic. Morgagni famously wrote:

> *…whenever the stomach is carried up through the diaphragm into the thorax…it does not always happen through a passage open'd by a wounding instrument…thus also, anteriorly, betwixt the fibres that come from the xyphoid cartilage and the neighbouring fibres, there generally is an interval through which something similar may happen: and I even suspect this to have happen'd in a husbandman in whom part of the intestine colon carried up through the middle and anterior part of the diaphragm…*[10,11]

PRESENTATION

The presentation of a Morgagni hernia is varied, and depends on the size of hernia and contents protruding into the thorax.[6,12–14] The majority of patients are asymptomatic, presenting only after incidental discovery on chest X-ray or computed tomography (CT) scan performed for alternative reason.[15] These patients often have omentum or a small piece of non-incarcerated bowel protruding through the defect. When the hernia contains a larger portion of the intestine or stomach or a smaller/tighter defect, gastrointestinal symptoms may occur.[6,9,16,17] If a large portion of the hemithorax is compromised by hernia contents, respiratory complaints are common. Chest pain is a usual manifestation in those who are symptomatic, due to irritation of the epigastric plane.

EVALUATION AND TREATMENT

The clinical presentation and complexity of an operation will depend on the size of the hernia defect and the contents protruding into the mediastinum and thorax. To facilitate our discussion of the broad range of presentations and surgical management of Morgagni hernias, the authors have chosen 3 separate case scenarios with progressive degrees of complexity that will highlight some of the important nuances in surgical management.

Case 1—Simple Morgagni Hernia

A 68-year-old male presented with an incidental finding of Morgagni hernia after undergoing a chest X-ray during work up for a viral respiratory infection. A subsequent CT scan revealed an anterior fat-filled diaphragmatic hernia (**Fig. 1**). Initially surveilled due to pending recovery from his viral infection, the patient eventually developed intermittent epigastric pain which he attributed to the hernia. He subsequently opted to undergo repair.

In the modern era of surgical technique, a minimally invasive approach should be the standard option for repair—this may be either conventional laparoscopy or robotically assisted.[18–21] If utilizing a robotic approach with the da Vinci XI system (Intuitive Surgical; California), standard port placement for upper gastrointestinal laparoscopic surgery is utilized, with four 8-mm working ports. An accessory port for assistance and introduction of sutures is optional. **Fig. 2** shows intraoperative photos during repair of this simple fat-containing Morgagni hernia. Hernia contents are first identified (see **Fig. 2**A) and subsequently reduced to allow visualization of the anterior defect (see **Fig. 2**B). A liver retractor is not necessary, as the defect sits anterior to the liver. As with other diaphragmatic hernias, it is imperative to remove the entirety of the hernia sac from the defect prior to closure. These hernias are a direct failure of fusion between the diaphragm and posterior portion of the sternum. Therefore, there will not be any rim of diaphragm anteriorly for reconstruction. If small, as in this case, the diaphragm can be reapproximated to the sternum and costal cartilage. Braided non-absorbable polyester suture is utilized on felt pledgets and passed through the diaphragmatic edge in an interrupted mattress fashion. The sutures are brought through the fascia of the abdominal wall, the ends delivered through small 2 mm individual skin incisions and the sutures secured (see **Fig. 2**C). Critically, the diaphragm should not be under undue tension and complete closure achieved (see **Fig. 2**D).

A suture passer facilitates the placement of the transfascial stitches and many simple Morgagni hernia defects can be closed efficiently in this manner.

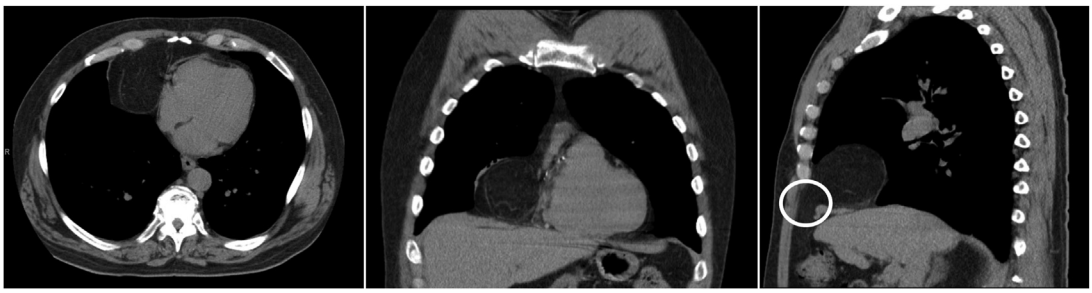

Fig. 1. CT imaging of simple right-sided fat-containing Morgagni hernia. White circle depicts anterior hernia defect.

This technique has been described throughout the literature with repeated success.[18,20–22]

The preoperative chest X-ray is shown in Fig. 3, with classic ovoid opacity just to the right of the sternum (3a), and the subsequent resolution after repair (3b).

Case 2—Difficult Morgagni Hernia

When significant portions of the abdominal viscera and contents protrude through a Morgagni hernia, patients may present with pain or gastrointestinal symptoms such as intermittent obstruction. The mobilization of larger, longer standing hernias increases some complexity along with a larger size of hernia; however, despite this, repair can often be performed in the same manner as a simple Morgagni hernia.

A 45-year-old female presented to the emergency room with progressive shortness of breath and dyspnea on exertion. She noted a history of epigastric pain which she contributed to gastrointestinal reflux disease. A CT chest was performed, which noted a large Morgagni diaphragmatic defect (Fig. 4A: axial, B: sagittal, C: Coronal). Hernia contents included abdominal fat and the transverse colon occupying the majority of the right hemithorax. There was also cranial displacement of her distal stomach due to the dispositioned colon. No volvulus or obstruction was seen.

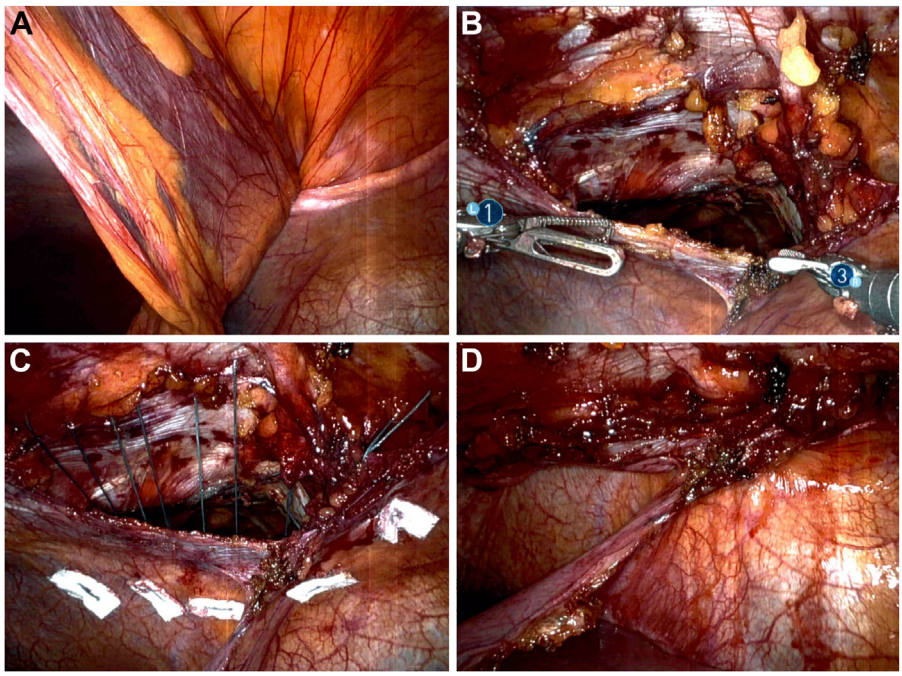

Fig. 2. Operative photos of simple Morgagni hernia. (*A*) Omentum protruding into mediastinum via hernia defect. (*B*) Hernia has been reduced, anterior defect visualized. (*C*) Transfascial mattress sutures placed with felt pledgets for repair. (*D*) Repaired hernia.

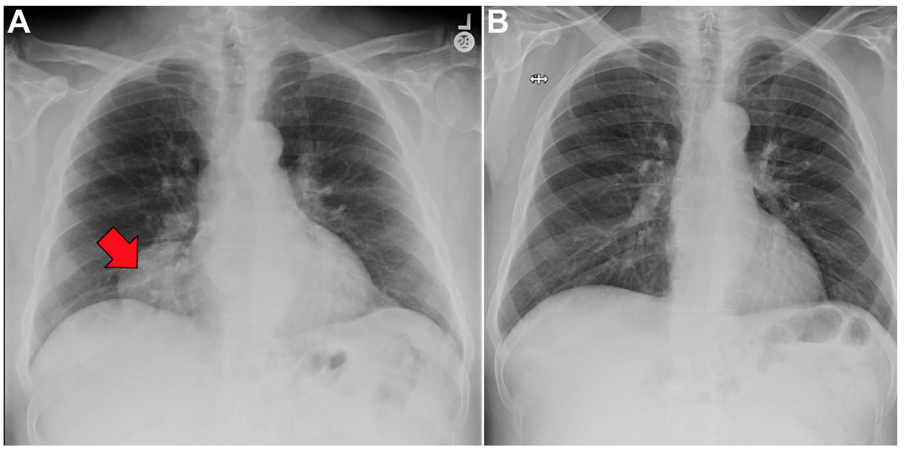

Fig. 3. Preoperative (*A*) and Postoperative (*B*) chest X-rays from repaired simple Morgagni hernia. Red arrow shows mediastinal hernia contents before repair.

Similar to the simple Morgagni repair, a minimally invasive approach should be attempted. By insufflating the abdomen, the defect routinely expands leading to easy reduction of the hernia contents. Reduced contents should be examined for injury and the hernia must be carefully examined to ensure completeness of reduction and resection of any hernia sac (Fig. 5A). Once reduced (Fig. 5B), a standard repair using transfascial buttressed sutures in a mattresses fashion can be utilized to reapproximate the diaphragm (Fig. 5C).

A Morgagni hernia with large volume of intra-abdominal contents can be misinterpreted for diaphragmatic elevation on chest X-ray alone. As seen in this patient's preoperative X-ray (Fig. 6A), it is difficult to interpret the location of abdominal contents without a lateral view of other more detailed imaging such as CT scan. A postoperative chest X-ray after reduction of abdominal contents and defect repair is also shown (Fig. 6B).

The primary repair of Morgagni hernias-containing bowel via laparoscopic approach has been similarly described.[12,23] The method of repair is at the surgeon's discretion and should be determined based on size of the hernia defect and ability to reapproximate diaphragm directly to the anterior abdominal wall behind the sternum. If a primary repair results in undue tension or cannot be accomplished, use of mesh is appropriate. In some cases, a primary closure can be accomplished for the majority of the defect and mesh used to patch the remaining opening.[24–26] Like with a suture-repair, there is no anterior rim of diaphragm to which the mesh can be attached and transfascial sutures will be required for anterior anchoring of the patch.

Case 3—Convoluted Decision Making with a Gigantic Morgagni–Larrey Hernia

When a gigantic Morgagni hernia is combined with other urgent surgical problems, dilemmas may arise that require novel solutions.

A 63-year-old male with a history of Loeys–Dietz syndrome presented to the cardiac surgery

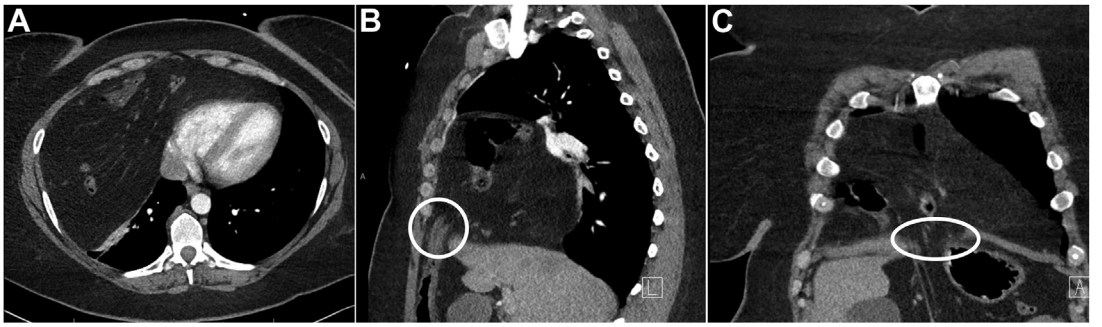

Fig. 4. CT imaging of complex right-sided Morgagni hernia containing omentum, small intestine, and large intestine. (*A*) Axial, (*B*) Sagittal, (*C*) Coronal. White circle depicts anterior hernia defect.

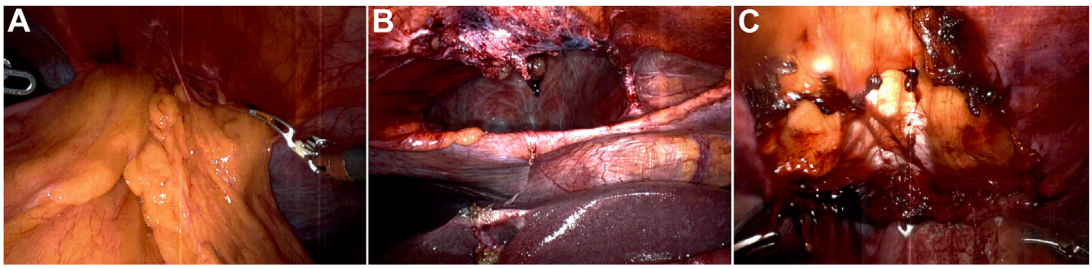

Fig. 5. Operative photos showing large complex Morgagni hernia containing intestine (*A*), reduced hernia with visualized anterior defect (*B*), and repaired hernia (*C*).

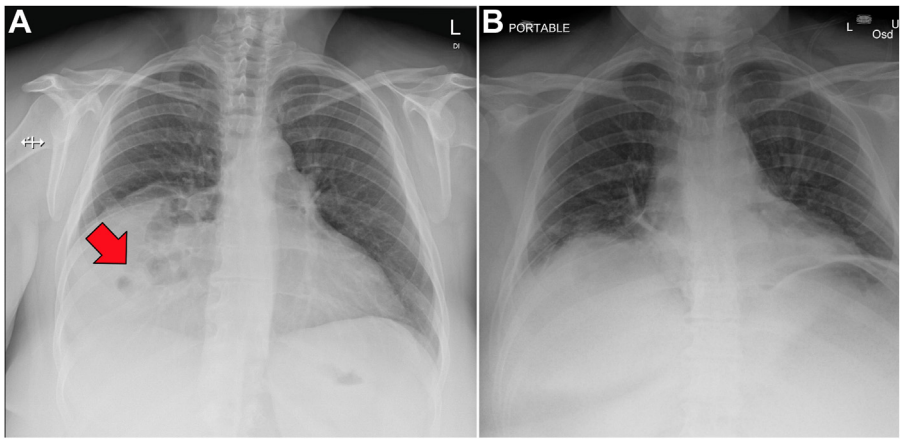

Fig. 6. Preoperative (*A*) and Postoperative (*B*) chest X-rays from repaired complex Morgagni hernia. Red arrow depicts right-sided hernia contents containing small and large intestines.

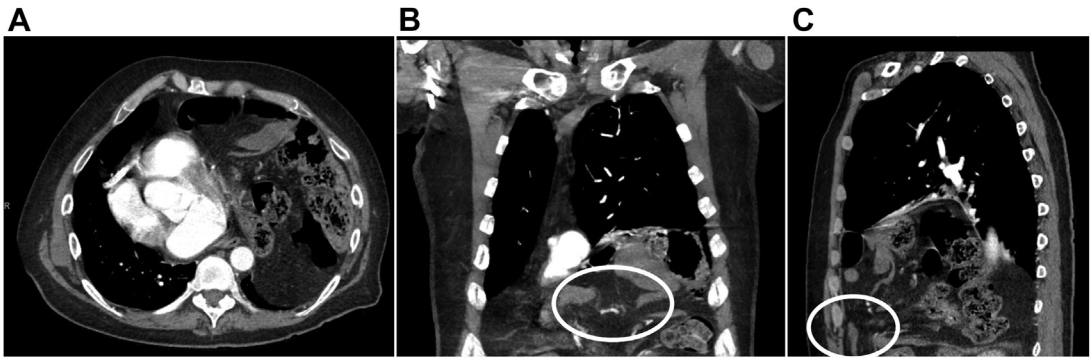

Fig. 7. CT imaging of gigantic complex left-sided Morgagni hernia containing small intestine, large intestine, and portion of the pancreas and spleen. (*A*) Axial, (*B*) Coronal, (*C*) Sagittal. White circle depicts a large anterior diaphragmatic defect.

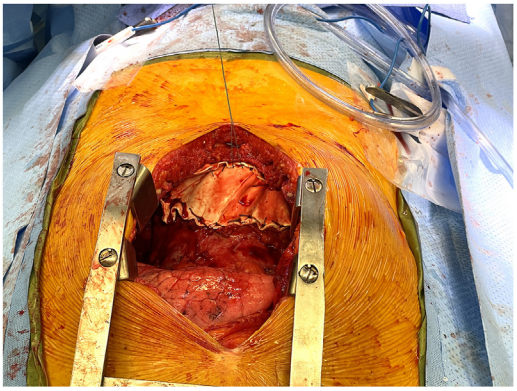

Fig. 8. Intraoperative photo showing repaired gigantic Morgagni–Larrey Hernia with Gore-Tex mesh via sternotomy. Head is oriented toward the bottom of the photo.

service with a bicuspid aortic valve and a dilated aortic root to 6.2 cm. This connective tissue disorder can often lead to recurrent hernias as well as arterial aneurysms. The patient had significant shortness of breath and unstable angina. On workup, he was found to have a gigantic Morgagni–Larrey hernia with the entirety of his transverse colon protruding into the left hemithorax (Fig. 7A: axial, B: coronal, C: sagittal). His cardiac surgery team determined that he needed urgent aortic root replacement, and the decision was made to fix his hernia via sternotomy at the time of his aortic operation.

After sternotomy, a large hernia sac containing both large and small intestine was identified protruding into the mediastinum and left hemithorax. This finding reinforces the dynamic and unpredictable nature of diaphragmatic hernias—imaging findings may change throughout the same hospitalization and differ from findings at the time of surgical exploration. After reducing all the contacts with hernia sac back into the abdomen, the defect was measured and found to be 20 cm × 15 cm. This may have been partially due to stretching from the sternal retractor as there was substantial discordance with the preoperative imaging. Using a 2-mm thick Gore-Tex mesh, the defect was repaired with interrupted braided suture. Similar to laparoscopic repairs, the anterior rim of the defect was reapproximated to the abdominal wall by passing sutures transfascially and burying the knots beneath small skin incisions (Fig. 8). As described earlier, preoperative chest X-ray alone may misidentify large diaphragmatic hernias as an elevated hemidiaphragm (Fig. 9A). Postoperatively, chest X-ray and CT scan showed a completely reduced hernia with intact mesh (Fig. 9B and C).

When presented with non-standard scenarios, novel techniques must be utilized to facilitate safe repair. Hoyuela and colleagues described the use of cyanoacrylate glue for fixation of mesh to buttress primary repair in Morgagni hernias.[27] When presented with a combination of surgical issues, such as aortic disease and Morgagni hernia, multidisciplinary decision-making is essential in determining best course of care. Meng and colleagues describe the challenging decision-making in selecting order of procedures, approach of procedures, and detail a case of transcatheter aortic valve implantation to avoid the operating room for a patient with aortic stenosis and large Morgagni hernia.[28]

In patients with a contraindication to an abdominal approach, uncertain pathology, or the need for simultaneous chest surgery, video-assisted thoracoscopic or open trans-thoracic surgery may be utilized to repair anterior diaphragmatic hernias.[29,30]

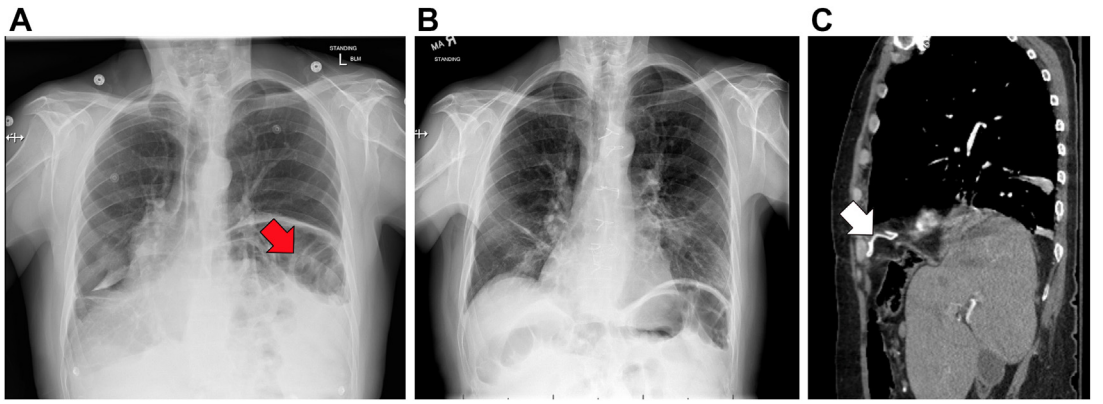

Fig. 9. Preoperative (*A*) and Postoperative (*B*) chest X-rays of gigantic complex left-sided Morgagni hernia. *Red arrow* depicts hernia. Sagittal CT scan after repair (*C*) with white arrow depicting Gore-Tex mesh repair of defect.

SUMMARY

Morgagni hernias are rare and often asymptomatic. They may be misinterpreted on standard chest X-ray, but are easily identifiable on CT scan. The standard approach in the modern era is laparoscopy, with or without robotic assistance. Often, primary repair can be accomplished utilizing transfascial sutures with excellent recurrence rates; however, mesh may be utilized in more complex scenarios.

CLINICS CARE POINTS

- When primarily reapproximating the diaphragm to the anterior abdominal wall, utilize interrupted sutures in a mattresses fashion with pledgets for longevity and strength.
- If unable to primarily repair the defect, a synthetic mesh such as 2-mm Gore-Tex should be used.
- While defects may be small, be prepared for large portions of the abdominal contents which may have herniated into the chest.

DISCLOSURE

B. Mitzman; Proctor for Intuitive Surgical.

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