Section A-Research paper

Laparoscopic Management of Esophageal Hiatal Hernia

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Abstract

Background: Hiatal hernia is a condition in which parts of the abdominal contents, mainly the GEJ and the stomach, are proximally displaced above the diaphragm through the esophageal hiatus into the mediastinum. Esophageal hiatus is an elliptically shaped opening most commonly formed by elements of the right diaphragmatic crus that encircles the distal portion of the esophagus in a sling-like fashion. The esophageal hiatus describes the space enclosed by the right and left diaphragmatic crura. In this anatomic position, the crural arches are mostly composed of thickened diaphragm muscle overlain with peritoneum and fibroconnective tissue. As the crura weave posteriorly behind the esophagus, they cross immediately anterior to the aorta to form the median arcuate ligament. Moving further posterior, the right crus anchors into the fibers of the anterior longitudinal ligament of the upper three lumbar vertebrae, while the left anchors into this ligament overlying the upper two lumbar vertebrae. Anteriorly, the arch and shoulders of the crura insert into the central tendon of the diaphragm. GERD is common with sliding hiatal hernia. The aim is to reduce the symptoms of GERD by decreasing gastric acid secretion. Lifestyle modifications are the first line of management and include the following: weight loss, elevating the head of the bed during sleep, avoidance of meals 2-3 hours before bedtime, elimination of "trigger" foods such as chocolate, alcohol, caffeine, spicy foods, citrus, and carbonated drinks. According to the American College of Gastroenterology, an 8-week course of PPI is the therapy of choice for symptom relief in (GERD), with no major differences in the efficacy between the different types of (PPIs). Twice-daily PPI therapy can be recommended for patients with an inadequate symptom response to once-daily PPI. Laparoscopic Nissen fundoplication may have advantages over the traditional open approach, including improved cosmesis, reduced morbidity, shorter hospital stay, decreased respiratory complications, and faster recovery

Keywords: Esophageal Hiatal Hernia, Laparoscopic Management

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Hiatal hernia is a condition in which parts of the abdominal contents, mainly the GEJ and the stomach, are proximally displaced above the diaphragm through the esophageal hiatus into the mediastinum. Esophageal hiatus is an elliptically shaped opening most commonly formed by elements of the right diaphragmatic crus that encircles the distal portion of the esophagus in a sling-like fashion **(1)**.Normally, the distal portion of the esophagus is anchored to the esophageal hiatus by the phrenoesophageal ligament. The phrenoesophageal ligament is inserted circumferentially into the esophageal musculature in the close vicinity of the squamocolumnar junction (**SCJ**). This ligament is essential in maintaining the competence of (**GEJ)** and preventing the migration of (**GEJ)** and/or stomach into the posterior mediastinum by sealing off potential spaces between the esophageal hiatus and the distal portion of the esophagus **(2)**.

The esophageal hiatus describes the space enclosed by the right and left diaphragmatic crura. In this anatomic position, the crural arches are mostly composed of thickened diaphragm muscle overlain with peritoneum

and fibroconnective tissue. As the crura weave posteriorly behind the esophagus, they cross immediately anterior to the aorta to form the median arcuate ligament. Moving further posterior, the right crus anchors into the fibers of the anterior longitudinal ligament of the upper three lumbar vertebrae, while the left anchors into this ligament overlying the upper two lumbar vertebrae. Anteriorly, the arch and shoulders of the crura insert into the central tendon of the diaphragm. **(3)**.

Being overweight and elderly are the key risk factors in its development **(3)**.

Other known risk factors include: multiple pregnancies, history of esophageal surgery, partial or full gastrectomy and certain disorders of the skeletal system associated with bone decalcification and degeneration. Clinical presentation varies, but symptoms include epigastric pain, chest pain, dysphagia, early satiety and regurgitation. In addition, a long lasting hernia may lead to development of obstruction, volvulus and strangulation **(4)**.

Diagnosis:

According to the Society of American Gastrointestinal and Endoscopic Surgeons, only investigations that will have an impact on the clinical management of the patient should be performed. The diagnosis of hiatal hernia can be rather challenging at times due to the shift in the anatomy of the esophagogastric junction during deglutition, respiration and movement. A complete history and physical exam is mandatory, as they may reveal symptoms that were not previously apparent **(1)**.

Upper GI endpscopy has the advantage of real-time analysis of the esophageal mucosa, the mucosa of the stomach and duodenum, unlike Barrium swallow radiography. It is able to detect erosive esophagitis, Barrett's esophagus and even lesions suspicious for malignancy **(5)**.

Presently, the Los Angeles (LA) classification is the endoscopic scoring system most commonly used to grade the severity of reflux esophagitis :

Modified Los Angeles classification (1999)
(6).

Grade A One (or more) mucosal break no longer than 5 mm that does not extend between the tops of two mucosal folds.

Grade B One (or more) mucosal break more than 5 mm long that does not extend between the tops of two mucosal folds.

Grade C One (or more) mucosal break that is continuous between the tops of 2 or more mucosal folds but involves <75% of the circumference.

Grade D One (or more) mucosal break that involves at least 75% of the esophageal circumference

Barium swallow radiography gives valuable information about the size of the herniated stomach and the location of the gastroesophageal junction **(5)**.

Point out the advantage of detecting esophageal motility dysfunction, stenosis and stricture related to (**GERD**) through barium swallow radiography. The method can also help in the diagnosis of short esophagus **(1)**.

Duranceau et al. describe the challenges of providing an accurate endoscopic description of massive hernias, thus it is important to also perform a Barium swallow X-ray in order to decribe the hernia in an exact manner **(7)**.

Esophageal manometry provides valuable information regarding the motility of the esophagus. **(8)**.

Esophageal manometry should be performed especially before undergoing surgery, as it can rule out achalasia or other motility disorders. Before performing fundoplication surgery. it is also essential to verify the integrity of the peristalsis of the esophagus, which can be done using high resolution manometry (HRM) as it provides real time pressure recording **(5)**.

pH testing has proven helpful in providing a quantitative analysis of reflux episodes as it correlates pH level with the patient's complaints of reflux **(7)**.

In Duranceau et al. study, it is considered the gold standard to document acid reflux exposure in the esophageal lumen **(7)**.

Treatment of Hiatal Hernia

Medical management of GERD

GERD is common with sliding hiatal hernia. The aim is to reduce the symptoms of GERD by decreasing gastric acid secretion. Lifestyle modifications are the first line of management and include the following: weight loss, elevating the head of the bed during sleep, avoidance of meals 2-3 hours before bedtime, elimination of "trigger" foods such as chocolate, alcohol, caffeine, spicy foods, citrus, and carbonated drinks. According to the American College of Gastroenterology, an 8-week course of **PPI** is the therapy of choice for symptom relief in (**GERD**), with no major differences in the efficacy between the different types of (**PPIs**). Twice-daily **PPI** therapy can be recommended for patients with an inadequate symptom response to once-daily **PPI (9)**.

Other alternatives include histamine H2 receptor antagonists and antacids. Patients presenting with moderate symptoms can use these treatments on demand, while those with persistent symptoms despite **PPI** treatment should use them as an add-on treatment **(10)**.

Surgical approach:

Surgical approach used in patients with refractory medical treatment for more than six months **(11)**.

The **SAGES** Guidelines strongly recommend not repairing type I hiatal hernia in the absence of reflux disease and symptoms. **(11)**.

With regards to the technical approach, the current standard procedure is laparoscopic fundoplication for sliding hernia. Usually, a Nissen fundoplication (360°) is performed after most hiatal hernia repairs, unless there is a preexisting esophageal dysmotility, in which case the Toupet fundoplication (270°) is preferred. Laparoscopic surgery provides the advantages of a minimally invasive approach, which consist of: shorter hospital stays, faster time of recovery, reduced post-operative pain and reduced pulmonary complications. There are, of course, certain disadvantages of laparoscopic surgery which include two-dimensional imaging, limited motion of laparoscopic instruments and poor ergonomics for surgeons (**12)**.

Laparoscopic Hiatal Hernia Repair with Fundoplication

Dr Rudolf Nissen (1896-1981) described the first fundoplication in the 1950s for treatment of severe reflux esophagitis. His original procedure used a 360^{o} wrap of the fundus of the stomach around the esophagus by plication of both the anterior and posterior walls of the gastric fundus around the lesser curvature. Although the standard Nissen fundoplication has been modified many times, laparoscopic Nissen fundoplication is now considered the standard surgical approach for treatment of (**GERD**). **(13).**

Laparoscopic Nissen fundoplication may have advantages over the traditional open approach, including **Chang** improved cosmesis, reduced morbidity, shorter hospital stay, decreased respiratory complications, and faster recovery

Currently, the laparoscopic approach is favored over an open approach unless it is specifically contraindicated. **(13).**

Indications

Indications for laparoscopic antireflux surgery include the following: **(14)**

- Patient preference (eg, desire for discontinuance of medical therapy because of quality-of-life concerns, financial concerns, or intolerance to medication
- Repeated aspiration pneumonia or asthma related to reflux
- Failed maximal medical therapy
- Unable to take medications due to compliance or side effects
- Sliding or Mixed

Contraindications

Contraindications for laparoscopic antireflux surgery include the following: **(13)**.

- Inability to tolerate general anesthesia**.**

- Advanced cardiopulmonary disease.
- Portal hypertension.
- Relative contraindications include previous upper abdominal surgery
- Achalasia
- Surgeon inexperience.

Laparoscopic Nissen Fundoplication Technique:

Some technical points must be followed to ensure an adequate fundoplication. An extensive esophageal dissection in the abdominal and lower thoracic segments to achieve a 2-4 cm segment of abdominal esophagus is helpful to prevent hernia recurrence. The presence of a long abdominal esophagus is an efficient antireflux mechanism, and careful attention should be taken to avoid damage to the vagal branches that are close to this portion of the esophagus. **(15).**

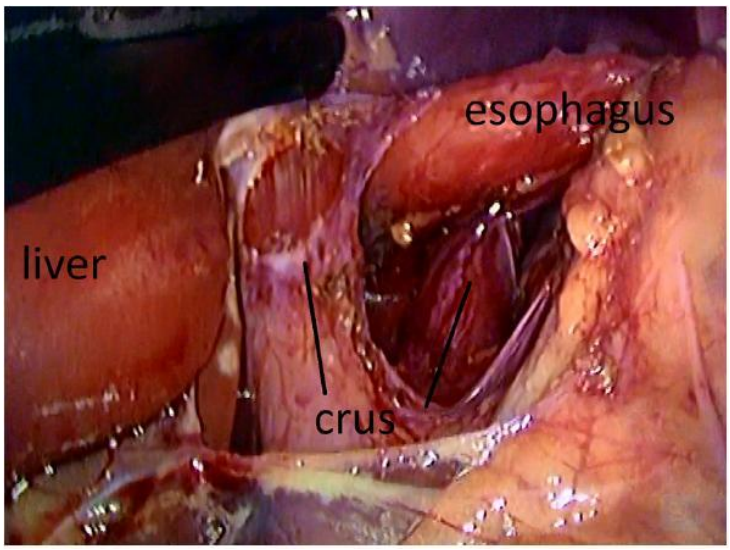


Figure (1): Extensive dissection of the esophagus including the lower mediastinum ensures a long segment of the abdominal esophagus (ideal > 2.5 cm) **(16).**

Hiatal closure is an important part of this operation since the integrity of this muscle barrier exerts synergistic effect with the lower esophageal sphincter at the esophagogastric junction, and prevents herniation of the wrap to the chest. This type of herniation of the stomach (wrap) through the diaphragmatic hiatus is one of the main causes of failure after antireflux surgery. Some propose the use of prosthetic material (mesh) to reinforce the closure of the esophageal hiatus. **(16)**.

While many believe that the use of this material can reduce the failure rates of the hiatal closing, others oppose this practice due to the risks of erosion of abdominal viscera (especially esophagus and stomach). The indication for the hiatal mesh repair should be selective taking into account the tension during crural closure and weakness of hiatal tissue. **(16).**

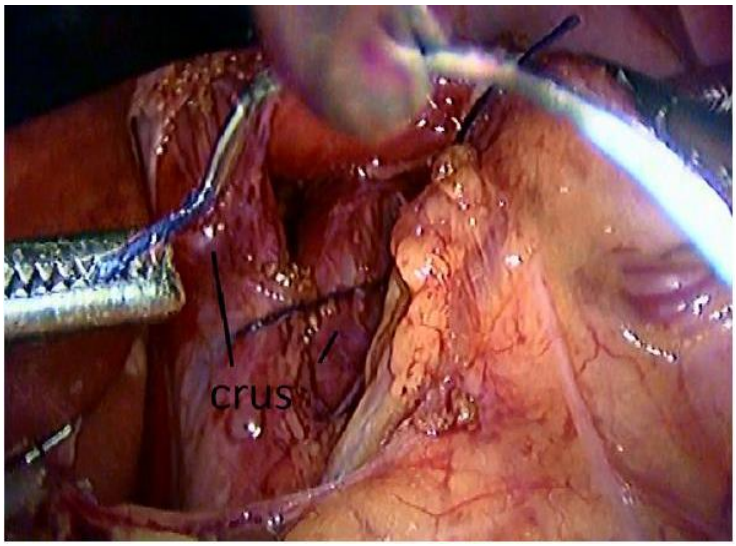


Figure (2): Hiatal closure must be performed with interrupted non-absorbable X-shaped stitches (e.g. 2-0 or 0, polypropylene, mersilene). Stitches must be well anchored in the crus. **(16).**

The fundoplication should be floppy, short, tension-free, and constructed with the fundus of the stomach around the esophagus. An extensive dissection of the posterior attachments of the gastric fundus and an retroesophageal window are essential to make a tension-free fundoplication. Short gastric vessels division may also help attain a floppy fundoplication, since it promotes the decrease of gastric fundus tension **(16).**

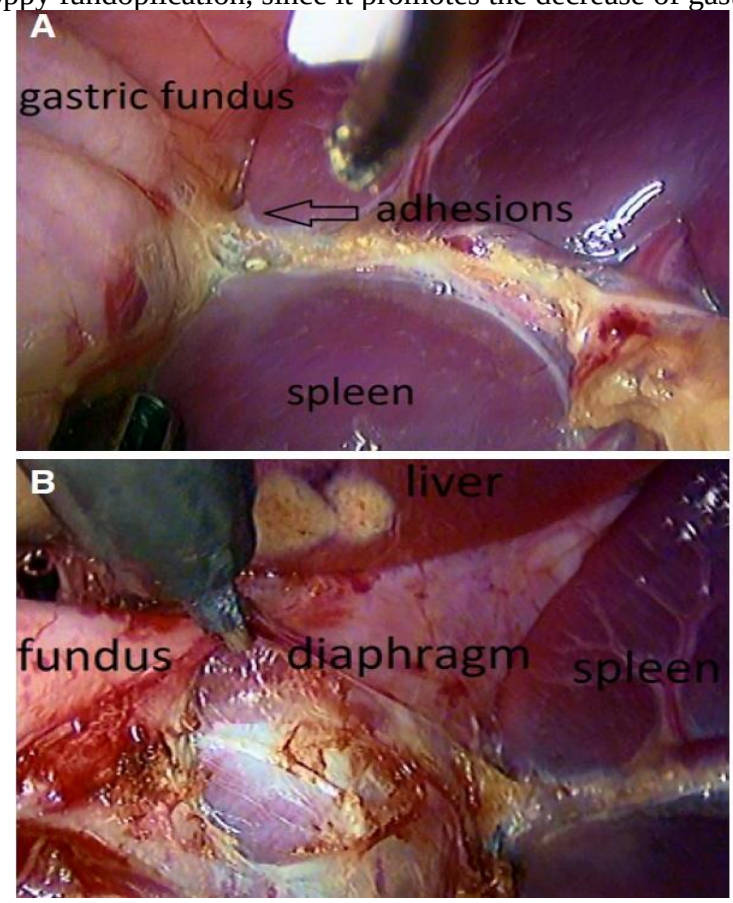


Figure (3): (A) A complete dissection of the gastric fundus ensures a tension-free fundoplication (arrow); (B) adhesiolysis of attachments of the gastric fundus to the spleen, diaphragm and retroperitoneum must be done even after division of the short gastric vessels **(16).**

Another key step in this operation is the choice of the right place to create and position the wrap. Thus, gastro esophageal junction should be well identified, with the removal of the fat pad that is frequently located there. This is done to make sure that the gastric fundus is brought around the esophagus not the stomach. Also, the gastric fundus, not the gastric body should be used to create the fundoplication. **(13)**.

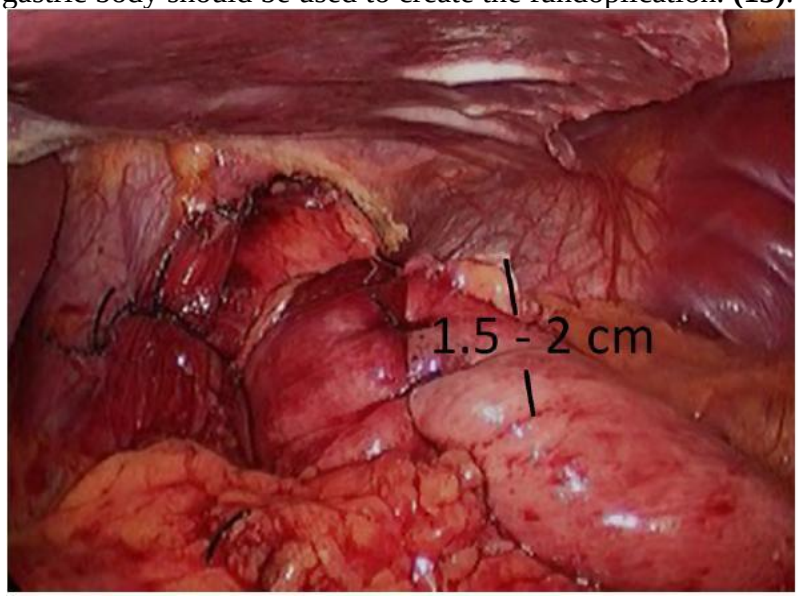


Figure (4): Fundoplication must be short-floppy and using gastric fundus only**.**
(16).

Complications

Intraoperative Complications:

Pneumothorax is a rare complication of (**ARS)** with an incidence of less than 2%.. If a postoperative chest X-ray shows a pneumothorax, it may be managed conservatively with oxygen therapy. Serial chest X-rays are minimally useful. They are only indicated in patients who continue to require oxygen therapy or are symptomatic as in shortness of breath. **(17)**.

A splenic injury may occur during the mobilization of the fundus and division of short gastric vessels intraoperatively **(13)**.

Postoperative Complications:

A feeling of gastric distention, nausea, and even inability to intake liquids following a **(ARS)** can occur, gas bloat syndrome. They involve a mechanical barrier at the gastroesophageal junction that prevents belching as well as vagal nerve fiber injury leading to relative gastroparesis. This is a common postoperative effect, but it persists in few patients. If an individual has persistent nausea with inadequate oral intake, an abdominal X-ray should be obtained. If there is evidence of gastric distention, a nasogastric tube should be placed to decompress the stomach temporarily**.** A temporary mild postoperative dysphagia is expected secondary to the expected postoperative edema at the fundoplication site. However, it is self-limited. Mild dysphagia is normal during the first 2 to 4 weeks postoperatively. If the patient can tolerate liquids in early postoperative care with mild subjective dysphagia, they should be watched without intervention. If the patient cannot tolerate fluids, an upper gastrointestinal endoscopy should be obtained if the upper gastrointestinal is normal, balloon dilation of the gastroesophageal junction should be performed. **(13).**

Laparoscopic Mesh Augmented hiatoplasty without Fundoplication

There are a number of undesirable fundoplication-related side effects, such as gas bloating and dysphagia, which occur in up to 58 % of patients. Due to the presence of persistent side effects in about 20 % of patients **(6)**.

Surgical technique

After 15 mmHg of intra-abdominal pneumoperitoneum, five trocars were inserted: the first, 10 mm in diameter, at midline 3 cm above the umbilicus for the optical system; one 5 mm in sub-xiphoid point for the liver retraction; one 5 mm in the right subcostal medium clavicular line; one 10 mm trocar in the left anterior axillary line and another 10 mm trocar in the left medium clavicular line for working ports.

The proper technique that was employed is described step by step, with additional figures to clarify the maneuvers demonstrating the procedure. This consisted of the following steps :

Dissection of hernia sac

Began 2 cm behind the left crus on the mediastinal reflection, leaving a small portion of the sac adhered to the crus in order to avoid exposure of uncovered muscle fibers. The dissection continued towards the right crus exposing the anterior face of the esophagus, identifying the anterior trunk of the vagus nerve (which must be preserved) in order to obtain complete mobilization of the sac in the lateral, anterior and posterior area of the distal esophagus. Once the lateral and posterior face of the distal esophagus and esophagogastric junction were isolated and could be easily mobilized, they were placed in the abdominal cavity at least 2 cm below the hiatus, completely free of tension (we have never observed a short esophagus). The first short gastric vessels were also divided and, in this manner, both the left and right diaphragmatic crus were clearly exposed. A window through the avascular membrane of the lesser gastric omentum (gastro-hepatic omentum) and another small window above the hepatic branches of the anterior vagus nerve (which remain intact) were performed thus completing the visualization of the dissected right crus **(18)**

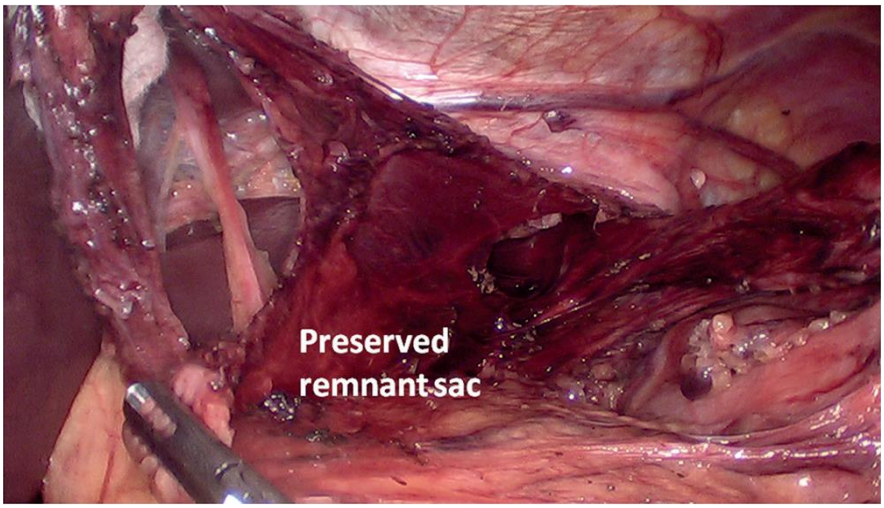


FIGURE 5 - Preservation of hiatal hernia sac: once the sac was completely dissected from the mediastinum, it was brought down from the mediastinum and its blood supply was kept attached to the lesser gastric omentum. **(18)**

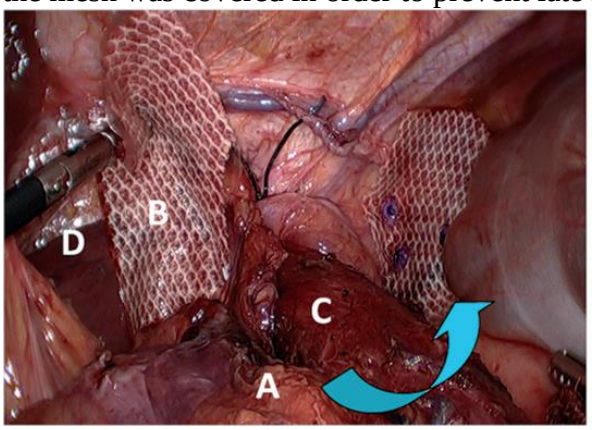
Closure of the hiatus

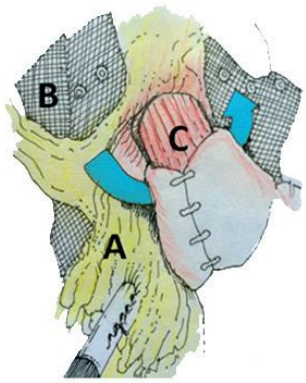
Closure of the diaphragmatic crus with a posterior approach behind the esophagus was performed, using 2 to 3 non-absorbable interrupted sutures. Frequently, anterior closure of the pillars may also be required with additional stitches depending on the hiatus's diameter in order to avoid angulation of the distal esophagus at the hiatal passage. In giant hiatal hernias, an on-lay "U" shaped mesh is placed over the posterior closure of the crura using non-absorbable 5 cm mesh (Parietex® or Ultrapro®). In order to maintain both branches of the mesh separated, the mesh must be fixed with either intracorporeal sutures or tackers (depending on its availability) over the muscle area of both cruses (not over the diaphragm itself in order to avoid pericardial or cardiac injury) **(18)**

Management of hernia sac

In order to cover the mesh, prevent or minimize the risk of esophageal or gastric wall erosion and migration of mesh: a) during dissection, the preserved remnant sac was placed behind the esophagogastric junction. We preserved almost the entire dimension of this sac (at least 5x3 cm, mean area of 15 cm2) which remained

with its vascular supply from the lesser omentum vessels intact; b) this remnant sac was then rotated around to the esophagogastric junction and fixed with sutures that widely covered the mesh surface in this manner, the mesh was covered in order to prevent late migration or erosion of the mesh into the esophagus. **(18)**





A=remnant sac rotation passing behind the esophagus; B=mesh; C=esophagus; D=right crus dissection above the preserved hepatic branches of the anterior vagus nerve.. (18)

Figure 6 - steps prevent or minimize the risk of esophageal or gastric wall erosion and migration of mesh; The arrows show how the preserved hernia sac was rotated and passed behind the esophagogastric junction and over the crura closure in order to cover the mesh. The right branch of mesh was placed lateral to the dissected right crus, behind the hepatic branches of the anterior vagus nerve, which were preserved. In this manner, both branches of the mesh remain separated and covered.

Synthetic mesh

Early reports of using synthetic mesh involved the use of polypropylene mesh, which was associated with visceral adhesions to the mesh, prompting the search for another option for intraperitoneal mesh. One of the first reports of using polytetrafluoroethylene (PTFE) mesh to reinforce the crural closure in hiatal hernias was published by Frantzides and Carlson in 1997.

Regarding the use of synthetic mesh, concerns have arisen as it has been associated with the development of esophageal erosion, stricture, dysphagia, obstruction and esophageal stenosis **(19).**

Absorbable synthetic mesh

Given the outcomes reported from biologic mesh use in LPEHR, the absorbable properties that make biologic mesh appealing for reducing mesh-related complications may also impair its ability to provide a durable hiatal hernia repair. In addition, the relatively high cost of biologic mesh material has limited its routine use for even abdominal wall hernias. Thus, absorbable synthetic mesh material was developed as a potentially more cost-effective option for hernia repair**.** Biophysical properties of absorbable synthetic mesh are encouraging, but whether the results translate to clinical outcomes remains to be seen. However, there are a few published case series that suggest positive results when absorbable synthetic mesh is used for reinforcement during hiatal hernia repair **(20).**

Biologic mesh

In an effort to avoid the complications related to synthetic mesh at the hiatus, when biologic mesh materials hit the market, surgeons began using them as an alternative to synthetic mesh. The theoretic advantage of a biologic prosthesis was that provides a temporary collagen matrix to allow native tissue ingrowth at the hiatal repair with a resulting repair that is stronger than native tissue. Since the biologic scaffold dissolves over time as it is incorporated by the body, the thought was that the mesh could be used to support the hiatal repair during healing while also avoiding complications related to having a permanent foreign body at the hiatus **(21).**

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