Laparoscopic Repair of Hiatus Hernia

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INTRODUCTION

The esophageal hiatus is an elliptical opening in the diaphragmatic muscular portion. The crura of diaphragm originate from the anterior surface of the first four lumbar vertebrae on the right and L2–L3 on the left to insert anteriorly into the transverse ligament of the central portion of diaphragm.

Hiatal hernia is an opening in the diaphragm through which stomach or omentum is forced into the chest cavity. A hiatus hernia can exist without any symptom.

ANATOMY AND PHYSIOLOGY OF THE GASTROESOPHAGEAL JUNCTION

Distal esophagus is anchored to the diaphragm by the phrenoesophageal membrane, formed by the fused endothoracic and endoabdominal fascia (**Fig. 1**). Phrenoesophageal membrane inserts circumferentially into the esophageal musculature, very close to the squamocolumnar junction, which resides within the diaphragmatic hiatus.

This configuration in lower esophagus altered during swallow-initiated peristalsis. With contraction of the esophageal longitudinal muscle, the esophagus shortens and the phrenoesophageal membrane is stretched; its elastic recoil is then responsible for pulling the squamocolumnar junction back to its normal position following each swallow. Gastroesophageal (GE) junction serves to minimize GE reflux and antegrade propulsive function.

Severe stress of swallowing, as well as that associated with abdominal straining and episodes of vomiting, subjects the phrenoesophageal membrane to substantial wear and tear and in due course of time make it a plausible target of age-related degeneration. Repetitive tonic contraction of the esophageal longitudinal muscle induced by GE reflux and mucosal acidification is also a potential source of stress on the phrenoesophageal membrane.

Type I or Sliding Hernia

A type I or sliding hiatus hernia is characterized by the displacement of the GE junction above the diaphragm. GE junction migrates above the esophageal hiatus. It is the most common type of hiatus hernia (80%). This results in loss of the cardiac angle of His and commonly incompetence of the cardioesophageal junction. The symptoms and complications of this type of hernia are those which are consequence of GE reflux and reflux esophagitis (chronic blood loss, stricture, Barrett's epithelium, etc.).

Type II, III, IV: Paraesophageal Hernias

Paraesophageal hernia is a true hernia with a hernia sac and is characterized by an upward dislocation of the gastric fundus through a defect in the phrenoesophageal membrane. True paraesophageal hernia is characterized by normally positioned GE junction and an intrathoracically migrated stomach. The fundus of the stomach rotates in front of the esophagus and herniates through the hiatus into

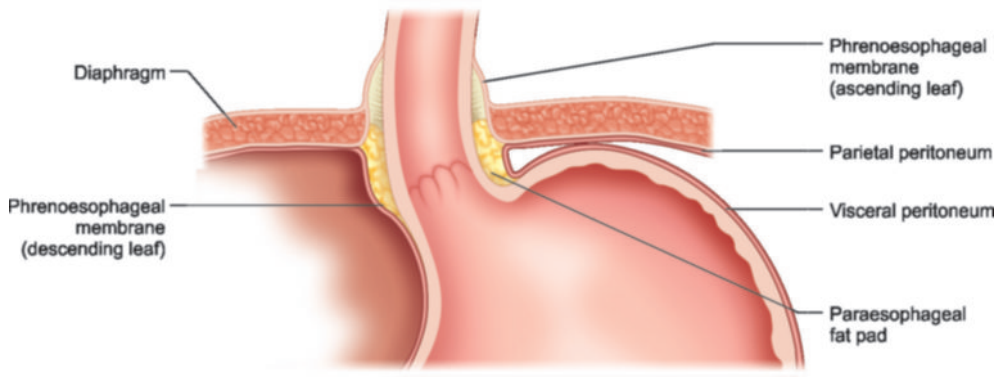
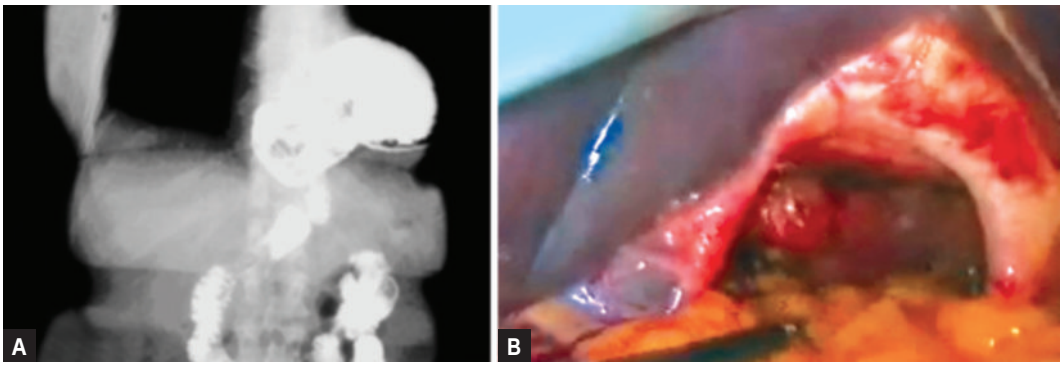


Fig. 1: Phrenoesophageal membrane.



Figs. 2A and B: Hiatus hernia.

the mediastinum **(Figs. 2A and B)**. As the cardioesophageal junction remains in situ within the abdomen, cardiac incompetence and reflux are not usually encountered. These hernias account for 8–10% of cases and is found predominantly in the elderly patients. These types of hernias are prone to incarceration and strangulation with infarction and perforation of the stomach.

Type II hernia results from a localized defect in the phrenoesophageal membrane where the gastric fundus serves as a lead point of herniation, while the GE junction remains fixed to the preaortic fascia and the median arcuate ligament.

Type III hernias have elements of both types I and II hernias and are characterized by both the GE junction and the fundus herniating through the hiatus. The fundus lies above the GE junction.

Type IV hiatus hernia is associated with a large defect in the phrenoesophageal membrane and is characterized by the presence of organs other than the stomach in the hernia sac. It may contain colon, spleen, pancreas, or small intestine.

Mixed Hernia

Mixed hernias are those with both sliding and paraesophageal component. This resembles a large paraesophageal hernia, but GE junction is also herniated above the diaphragm. Mixed hernias have features and complications of both types I and II hernias. It is found in 10% of patients.

There are rare instances of post-traumatic herniation of the stomach through the hiatus and these must be differentiated from traumatic rupture of diaphragm. In majority of cases, the development of hiatus hernia is spontaneous. Gallstone and colonic diverticular disease are commonly present in patients with a hiatus hernia (Saint's triad).

Symptoms of Type II Hiatus Hernia

- Typical heartburn (47%)
- Dysphagia (35%)
- Epigastric pain (26%)
- Vomiting (23%)
- Anemia (21%)
- Barrett's epithelium (13%)
- Aspiration (7%).

Symptomatic gastroesophageal reflux disease (GERD) is frequently associated with finding of a sliding hernia. A number of procedures such as Nissen fundoplication and its modification (the Toupet procedure), Hill procedure, and Belsey transthoracic repair have been described for its management. Nissen fundoplication is, however, the simplest and most effective. Success has been achieved in performing laparoscopically these procedures of Nissen fundoplication, Hill repair, and Toupet procedure as well as thoracoscopic Belsey Mark IV. Laparoscopic Nissen fundoplication shows the most progress and has the potential of becoming gold standard. It offers the opportunity for correction of the underlying anatomical and functional defect associated with GERD with lessened discomfort and hospitalization.

The indications are:

- Severe heartburn
- Refractory to medical therapy—symptoms present even 12 weeks after therapy
- Noncompliance with therapy
- Development of complications such as aspiration
- A type of hiatal hernia where the stomach is at risk of getting stuck in the chest or twisting on itself (paraesophageal hernia)
- Bleeding
- Barrett's mucosa
- Stricture.

Relative contraindications include:

- Previous hiatal or upper abdominal surgery
- Morbid obesity with left hepatomegaly
- Shortened esophagus
- Aperistalsis of esophagus (achalasia, scleroderma, and end-stage GERD).

Appropriate preoperative evaluation of esophagogastric junction is essential prior to performing laparoscopic fundoplication. Failure of surgery to control symptoms occurs in up to 10% of cases. It is a reflection that antireflux

surgery has been inadvertently utilized for unrecognized cardiac, hepatobiliary, or other esophageal and gastric etiologies.

PREOPERATIVE EVALUATION

Preoperative investigation can be divided into mandatory and selective tests.

Mandatory

- Endoscopy upper gastrointestinal (UGI) with/without biopsy
- Esophageal manometry.

Selective

- Barium swallow
- 24 hours pH monitoring
- Gastric studies.

OPERATIVE MANAGEMENT OF HIATUS HERNIA

Surgical repair of an asymptomatic type I hiatal hernia is not indicated. Management of patients with a symptomatic sliding hiatus hernia consists of management of GERD. Most common is laparoscopic fundoplication, which is discussed separately in fundoplication chapter of this book.

Surgical repair is indicated in patients with a symptomatic paraesophageal hernia. Paraesophageal hernias can be repaired transabdominally or transthoracically. Transabdominal repairs can be performed open or laparoscopically. Emergent repair is required in patients with a gastric volvulus, uncontrolled bleeding, obstruction, strangulation, perforation, and respiratory compromise secondary to a paraesophageal hernia. Reoperation for a symptomatic paraesophageal hernia presents a significant technical challenge, especially if mesh has been placed at the time of the initial operation. These procedures should be performed by very experienced surgeons.

Port Position

The patient is positioned supine on the operating table, and the surgeon works from the right side or many surgeons prefer position of the surgeon in between the legs of the patient with the assistant on the left **(Fig. 2C)**.

A laparoscopic paraesophageal hernia repair (PEHR) usually requires placement of five ports in the following positions:

- The first port, used for the laparoscope, is placed approximately 14 cm distal to the xiphoid process and 3 cm to the left of the midline.
- The second and third ports, used for stomach and liver retractors, are placed lateral to the first port in the left and right midclavicular line.
- The last two ports, used for the surgeon's dissection and suturing instruments, are placed approximately 6 cm from midline under the costal margins.

Four 5 mm and one 10 mm laparoscopic ports are placed in the upper abdomen **(Fig. 2D)**. Positioning of liver retractor is shown in **Figure 2E**.

The dissection of the hernia sac begins with gentle reduction of the stomach and any other organs from the hernia sac.

- Dissection of the hernia sac requires great care to avoid injury to adjacent organs such as mediastinal pleura, pericardium, and aortic adventitia, which could cause bleeding or pneumothorax.
- An incarcerated stomach, if present, can be friable and should be handled with care.
- The dissection of the hernia sac is performed within the plane between the hernia sac and the adjacent tissues.
- The peritoneal covering of the crus on the abdominal side is preserved when dividing the gastrohepatic omentum from the right crus of the diaphragm.
- A drain is placed around the esophagus to facilitate the dissection of the posterior portion of the hernia sac. Using gentle upward traction on the Penrose drain, the dissection begins at the right crus and proceeds posteriorly to the left crus.

The hernia sac must be completely removed from the mediastinum.

Injury or transection of the vagal nerves should be avoided to reduce the risk of delayed gastric emptying.

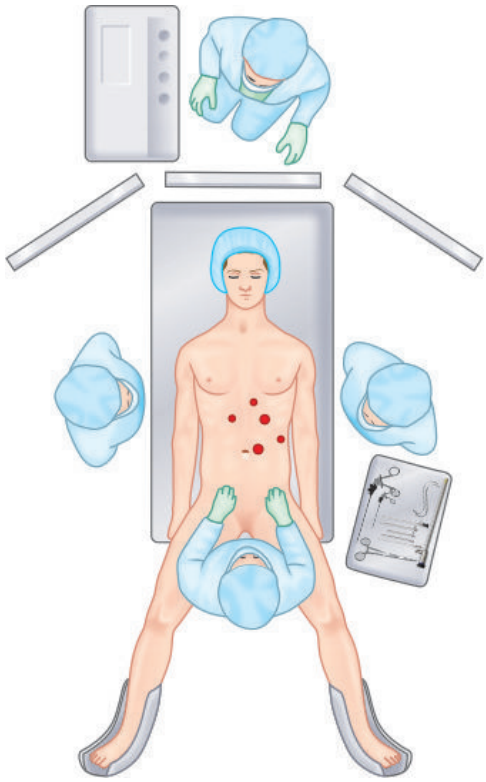
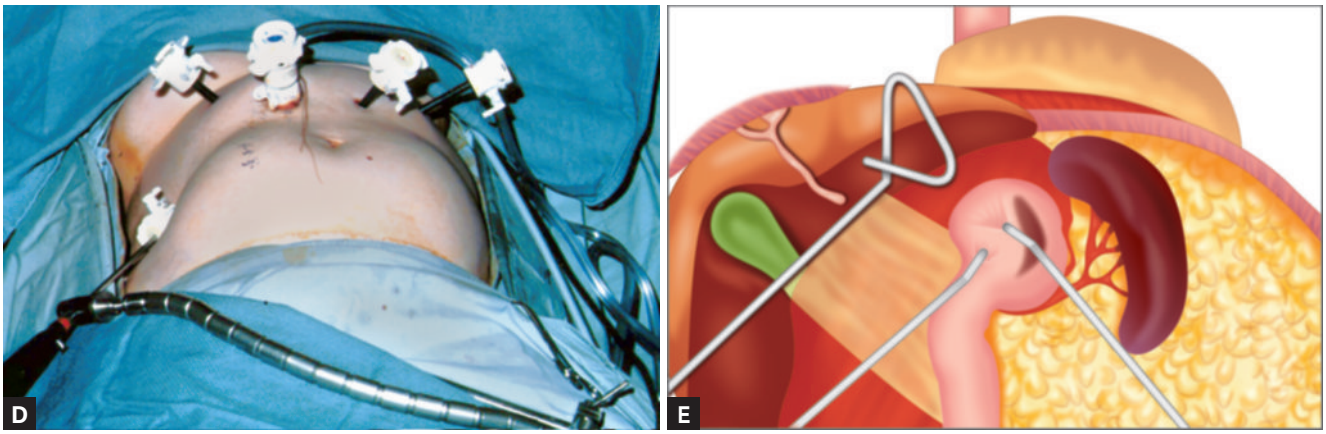


Fig. 2C: Position of surgical team during hiatus hernia surgery.



Figs. 2D and E: (D) Port position in hiatus hernia; (E) Liver retractor.

- Dividing the short gastric vessels will increase mobilization of the stomach, facilitate a fundoplication, and improve exposure of the operative site.

Esophageal Mobilization

At least 3–5 cm of esophagus must be mobilized inside the abdomen to ensure adequate intra-abdominal length for fixation **(Fig. 3)**. In order to prevent reherniation, a proper PEHR requires the complete dissection and removal of the hernia sac from the mediastinum, rather than the mere reduction of hernia contents from the sac.

The use of electrocautery should be limited when mobilizing the esophagus since the potential risk of cautery damage to the esophagus is high. A sling should be used to give downward traction of esophagus **(Figs. 4A and B)**.

The esophagus must be mobilized to the level of the aortic arch or until ≥4 cm of intra-abdominal esophagus has been freed without tension. If adequate intra-abdominal esophageal length cannot be achieved with esophageal mobilization alone, an esophageal-lengthening procedure such as Collis gastroplasty may be required. Although shortened esophagus is not common. Short esophagus is found in <1% of patients. The failure to lengthen a shortened esophagus can lead to hernia recurrence as it produces tension on the repair. Collis procedure entails the creation of a gastric tube by vertically stapling the proximal stomach from the angle of His, parallel to a large bougie placed along the lesser curvature of the stomach. The newly created gastric tube becomes an extension or elongation of the native esophagus such that the new esophagogastric junction can be located intra-abdominally.

Closure of Hiatal Defect

The crura are approximated with 2–3 nonabsorbable sutures of No. Zero **(Figs. 5A to D)**. The short gastric vessels are routinely divided along the upper one-third of stomach using harmonic scalpel. After complete dissection of the esophagus, the pillars of the crura of the diaphragm are

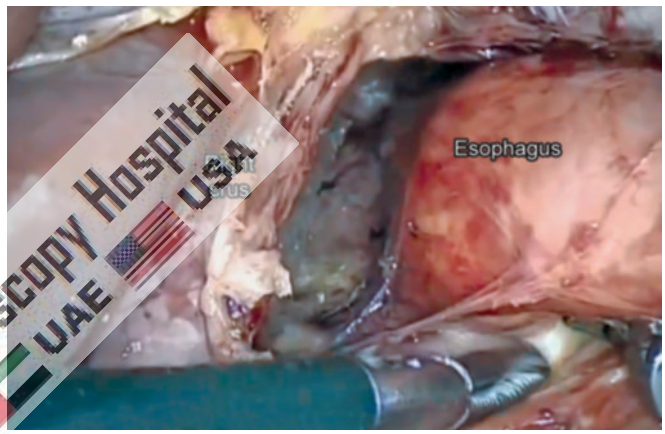


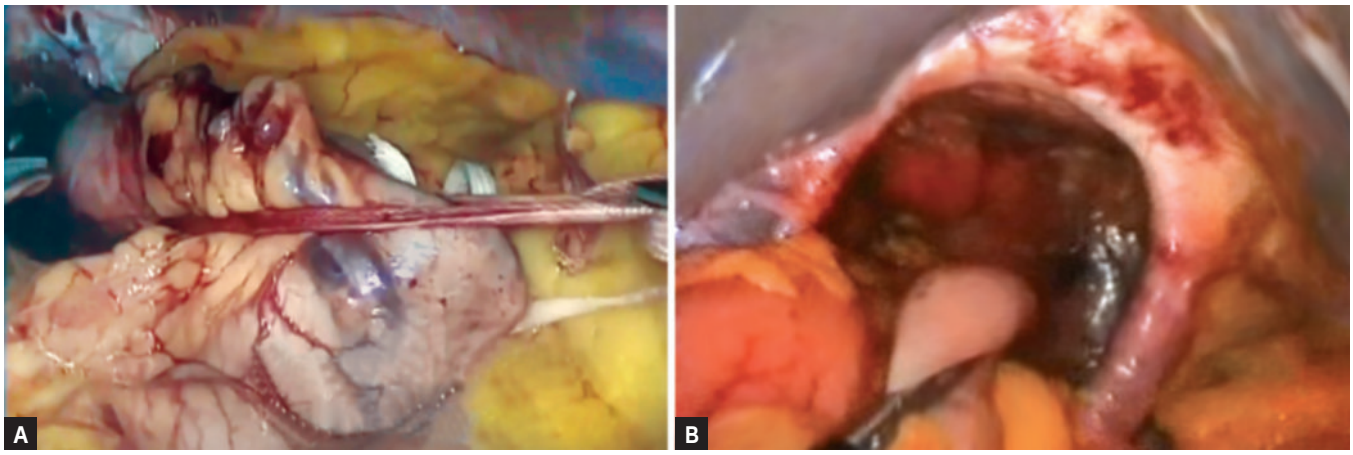
Fig. 3: Esophageal mobilization.

closed inferiorly and posteriorly to the esophagus. The repair of crura must be tension free and can be performed as a primary suture repair or with mesh in case of giant hernia. We suggest against the routine use of mesh during PEHR. Routine use of mesh should be avoided. Both permanent and biologic meshes have been shown to be effective in reducing recurrences in separate randomized trials. Mesh should be used selectively during PEHR because mesh can cause serious complications such as intraluminal mesh erosion, esophageal stenosis, dense fibrosis, and the need for reoperations (e.g., esophagectomies, partial and total gastrectomies, and esophageal stent placement).

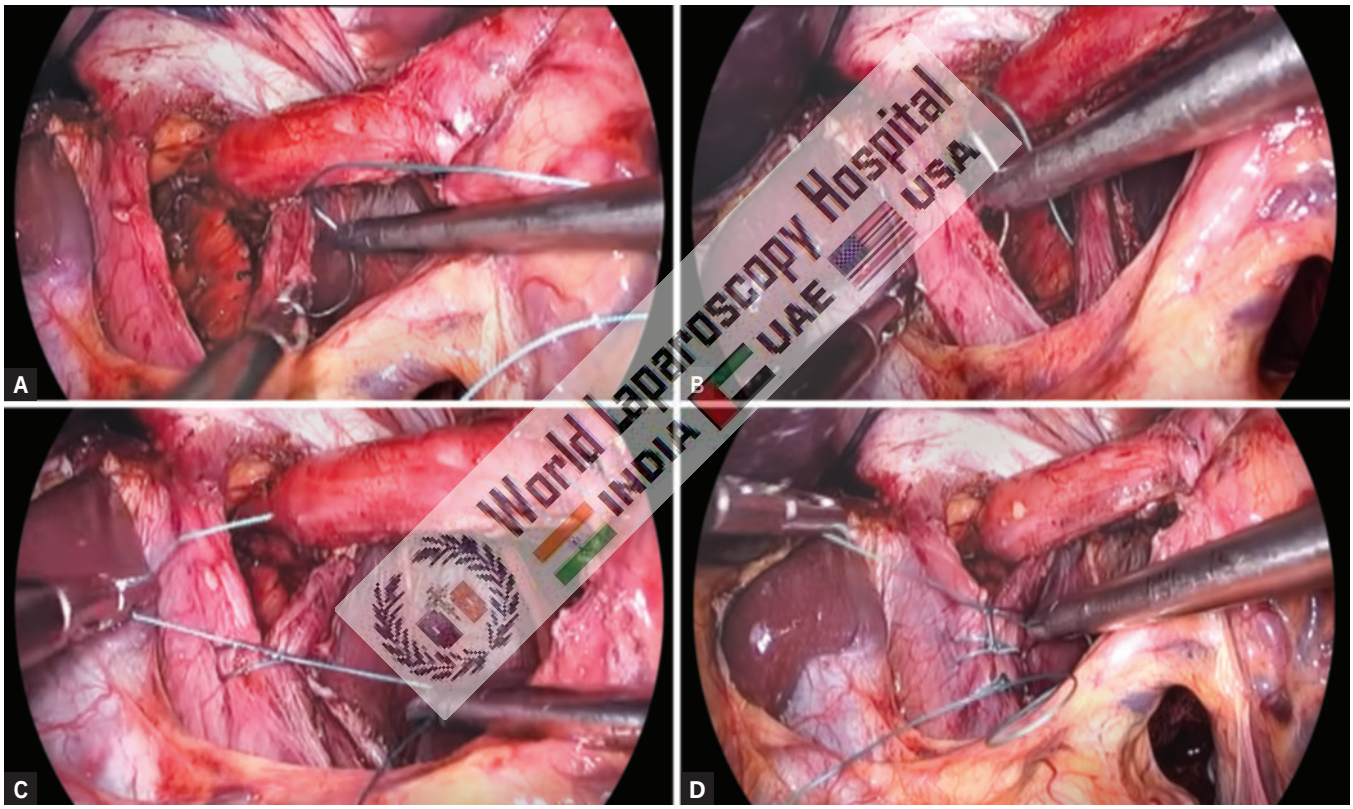
Fundoplication

After the closure of hiatal defect, Nissen fundoplication should be performed, except in patients with severe preoperative dysphagia **(Figs. 6A and B)**, for whom we perform a partial fundoplication to minimize the potential for worsening dysphagia postoperatively. The detail of the steps of laparoscopic fundoplication can be found in the fundoplication chapter of this book.

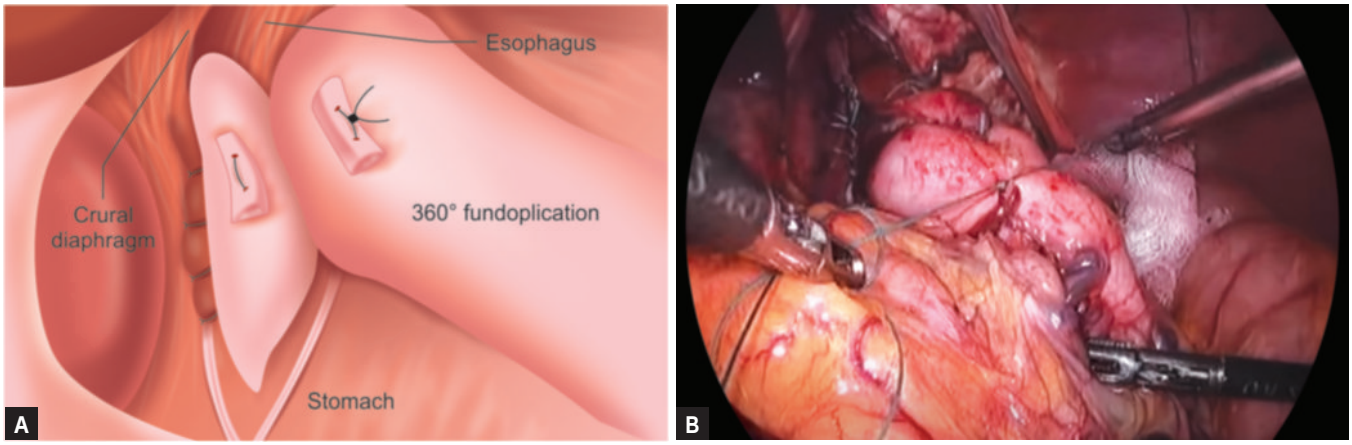
Postoperatively, a chest X-ray is obtained in the recovery room to exclude a pneumothorax. Patients are kept on clear liquids on the day of surgery and soft diet the



Figs. 4A and B: (A) Use of sling to give downward traction to esophagus; (B) Pulling the content of hernia sac.



Figs. 5A to D: Crural approximation by suturing.



Figs. 6A and B: Nissen fundoplication after repair of hernia.

following day. Average length of stay is 2 days. Intraoperative complications may include injury to visceral organs, bleeding, pneumothorax, and vagal injury. Postoperative complications include wrap slippage. An anterior gastropexy can be used to reduce the risk of gastric reherniation into the thoracic cavity. The stomach can be fixated to the abdominal wall with sutures or percutaneous endoscopic gastrostomy (PEG) tubes depending upon whether a primary repair of paraesophageal hernia has been performed.

OPERATIVE PROCEDURE OF GIANT PARAESOPHAGEAL HERNIA

After exposing the hiatus, the herniated stomach is reduced into the abdomen using atraumatic graspers in a "hand-over-hand" fashion **(Figs. 4A and B)**. Dissection is started for exposing the right and left crura of the diaphragm and mobilizing the esophagus. Sling is applied to retract the esophagus, which facilitate mobilization of esophagus posteriorly **(Fig. 7)**. Once the dissection is complete, appropriate size of mesh should be taken and sutured from below the level of esophagus to repair the defect **(Figs. 8A to I)**.

Barium swallow study on the first postoperative day should be performed to assess for possible esophageal leak and early hernia recurrence and to evaluate gastric emptying and motility. Patients with a long-standing paraesophageal hernia often have delayed gastric emptying after the repair, mediated by possible mechanisms of an atrophic gastric musculature or vagal neurapraxia from the dissection. If the barium swallow study shows an adequate repair, patients are started on a clear liquid diet and advanced to soft solids as tolerated.

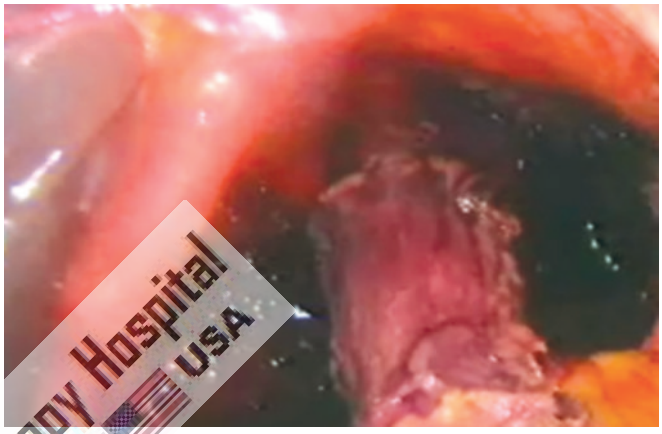
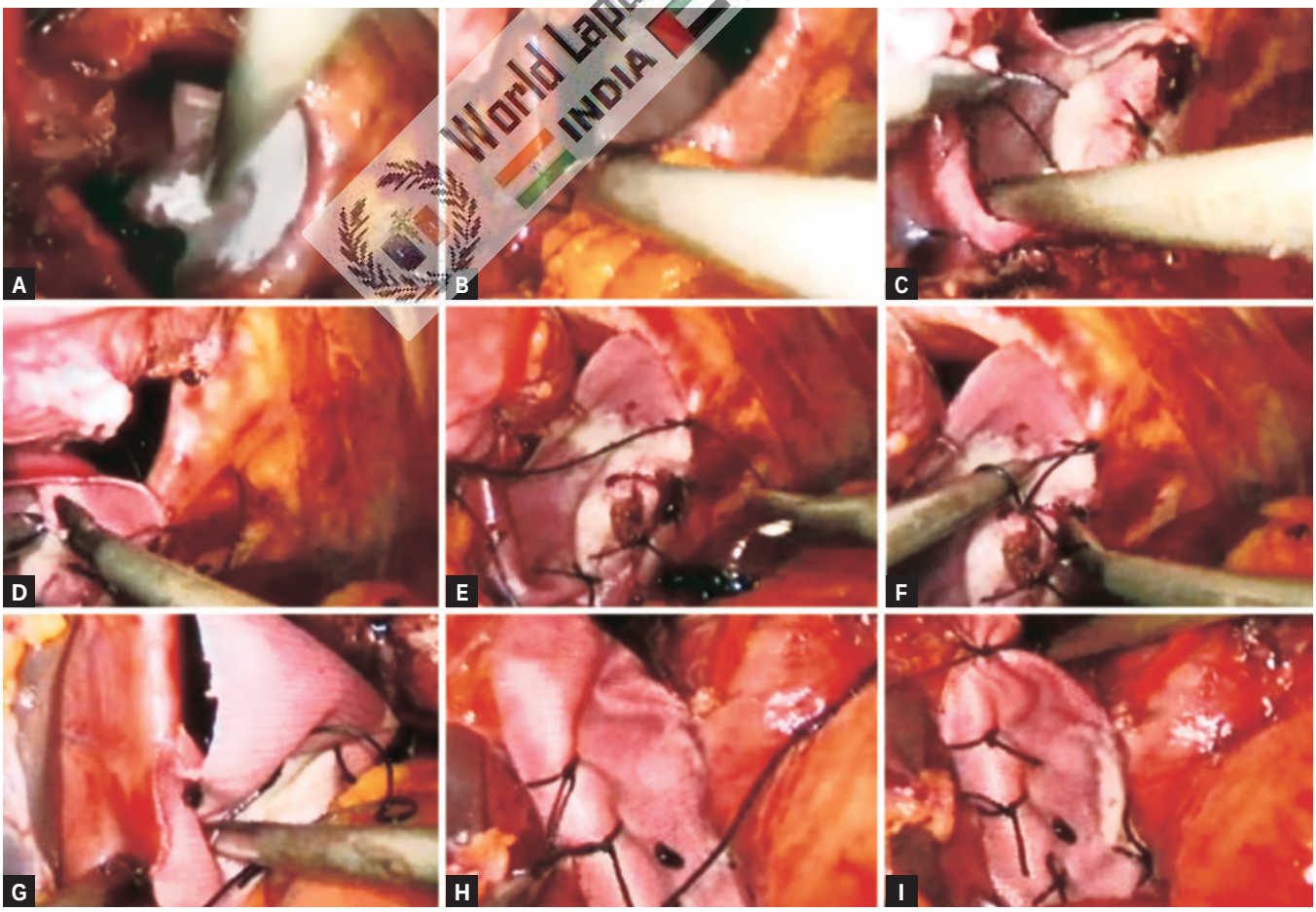


Fig. 7: Mobilization of esophagus.



Figs. 8A to I: Fixation of mesh in paraesophageal hiatus hernia.

The overall mortality and morbidity rates associated with laparoscopic PEHR are 1.7 and 0.8%, respectively. The reported major complications include pneumonia (4.0%), pulmonary embolism (3.4%), heart failure (2.6%), and postoperative leak (2.5%). The mortality and morbidity rates are higher in patients who are ≥70 years of age, those who require emergency surgery, and those who have one or more comorbid illnesses.

RECOMMENDATIONS TO AVOID COMPLICATION

- Ports should be placed high on the abdomen since much of the stomach will be up in the mediastinum.
- Compression stockings and subcutaneous heparin should be used to prevent deep venous thrombosis.
- Intra-abdominal pressures <15 mm Hg should be used.
- Prefer the bipolar for mobilization of the anterior GE fat pad.
- It is important to remove the hernia sac from the mediastinum while avoiding entry into the pleural spaces.
- Stomach should be handled gently with graspers—the chronically herniated stomach has a tendency to perforate relatively easily.
- At the end of surgery, perforations or leaks during dissection should be watched carefully.

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