

Technical Considerations and Approach to Redo Foregut Surgery

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Abstract

Foregut surgical techniques have advanced significantly over the years and have become increasingly popular. However, new challenges and technical considerations have arisen when dealing with reoperation for complications or surgical failure. This study focuses on the technical considerations and approach when dealing with reoperative foregut surgery, particularly redo hiatal hernia repair. We describe our approach starting from the preoperative workup to the procedural steps of the surgery. The present study describes the main steps for robotic reoperative hiatal hernia repair in a patient who had previously undergone laparoscopic hiatal hernia repair with Nissen fundoplication but did not present a recurrence of reflux and dysphagia symptoms. The patient is positioned supine with arms out and a footboard for steep Trendelenburg. We place six trocars, including an assistant port and a liver retractor port, to facilitate visualization and retraction. After docking the robot, we use a combination of electrocautery and sharp dissection to free the hernia sac and reduce the hiatal hernia. The previous fundoplication is then taken down carefully and the esophagus is mobilized through a transhiatal approach with a combination of blunt and sharp dissection until at least 3 cm of intra-abdominal esophageal length is achieved, after which a leak test is performed. We then perform a crural repair to reapproximate the hiatus with two posterior stitches and one anterior stitch. Lastly, a redo Nissen fundoplication is performed over a bougie, and endoscopy is used to confirm a loose stack-of-coin appearance. By emphasizing the crucial steps of redo hiatal hernia repair, including preoperative evaluation, our goal is to provide an approach for the foregut surgeon to maximize patient outcomes.

Introduction

Over the past century, improvements in the understanding and diagnosis of foregut disorders have led to the evolution of better procedures and surgical approaches. This innovation brings new challenges related to complications and

reoperation for the foregut surgeon. Surgical reinterventions are particularly challenging from a technical perspective due to multiple factors, including dense adhesions, scarring, obliteration of tissue planes, and altered anatomy^{1,2,3,4,5}. These redo foregut surgeries have increased morbidity in patients with higher incidences of esophageal perforation, delayed gastric emptying, and vagal nerve injury^{1,6,7,8}. Mesh repairs at the hiatus complicate reintervention further, having higher rates of major resection requiring complex reconstruction^{9,10}. The advent of advanced endoscopic therapies creates ever-evolving challenges for foregut surgeons when dealing with their associated complications or failures^{11,12,13}. Furthermore, redo foregut operations are associated with worsening success rates and patient satisfaction with successive reoperations compared with primary intervention^{14,15,16,17}. This highlights the importance of patient selection and accurate diagnosis prior to redo surgery for optimal outcomes.

While traditionally performed using an open approach, laparoscopic approaches to redo foregut surgery are safe and efficacious^{14,18}. However, due to the greater difficulty associated with altered anatomy and adhesions, conversion to open surgery is still a possibility. With the emergence of robot-assisted surgery in urology and gynecologic surgery^{19,20}, the superior visualization and dexterity compared to laparoscopy would appear to likely have some benefit in redo foregut surgery as well. Indeed, emerging research has shown safety and improved outcomes, including less conversions to open surgery and decreased hospital stays compared with the laparoscopic approach for redo foregut surgery^{21,22,23}.

Although it is ultimately up to the foregut surgeon to determine the safest procedure, this article aims to demonstrate the

approach and technical considerations for redo foregut surgery to provide a "framework" when confronted with this challenge. While a robotic-assisted approach is described, the principles described could be similarly applied to laparoscopy.

Protocol

The protocol and methods described here were approved and followed the ethical guidelines of the Institutional Review Board (IRB) of the University of Minnesota. Described here is a reoperative hiatal hernia repair and takedown of a previous Nissen fundoplication in a 73-year-old woman. The patient presented to the clinic with a history of laparoscopic hiatal hernia repair and a fundoplication 5 years ago at an outside hospital for epigastric pain and fullness after meals. She also complained of significant reflux and dysphagia with solid food intake. Her symptoms had temporarily resolved after the first surgery but had now recurred. Of note, her body mass index (BMI) at the time of consultation was 40. No previous preoperative workup could be obtained prior to the consultation. The patient provided written informed consent before redo foregut surgery.

1. Patient preparation and operative set-up

1. Preoperative workup and testing
 1. Discuss the possibility of reoperation and proceed with a thorough workup as mentioned:
 1. Perform an esophagram. The esophagram of this patient showed moderate to severe esophageal dysmotility (**Figure 1**).
 2. Perform endoscopy. For this patient, upper endoscopy showed no stenosis or strictures but demonstrated a portion of the stomach

herniating upward through the diaphragm on a retroflexed view, which confirmed a hiatal hernia.

3. Perform computed tomography of the abdomen. This test also confirmed a herniated wrap (**Figure 2**).
4. Perform wireless esophageal pH testing. This showed a DeMeester score^{24,25} of 38.4 with borderline symptom association probability for acid reflux.
5. Perform high-resolution manometry. In this patient, it showed a nonspecific motility disorder.

2. Preoperative planning

1. Ensure initial recommendations include weight loss and hence referral to a bariatric surgeon if needed.
NOTE: The patient did well with the weight loss program and could bring down her weight to a BMI of 32. At this point, she continued to have symptoms, and her case was discussed at the multidisciplinary esophageal conference for operative planning. The consensus was that the manometric findings were likely due to reflux and hernia and that a reoperative hernia repair with a loose fundoplication would be appropriate.

3. Anesthesia

1. Perform anesthesia following institutional guidelines. Intubate the patient with a single lumen endotracheal tube with rapid sequence intubation because of the risk of aspiration from reflux and a hiatal hernia. She had an arterial line for hemodynamic monitoring.

4. Positioning

1. Position the patient supine with her arms out and a footboard to facilitate steep reverse Trendelenburg positioning²⁶. The chest and abdomen are always prepped into the field for foregut surgeries to have adequate access to the abdomen and chest if needed.

5. Port placement and docking

1. Use the open Hasson technique²⁷ to enter the peritoneal cavity in the left supra-umbilical space. Insert the camera port here.
2. Insert two more 8 mm ports in the left upper quadrant and one 8 mm port in the right upper quadrant. Place the ports about 10 cm above the umbilicus and ensure a handbreadth space between the ports.
3. Place the assistant port in the right lower quadrant. Insert the liver retractor (see **Table of Materials**) through a 5 mm port placed in the extreme lateral portion of the right upper quadrant.
NOTE: It is the authors' preference to place a left-sided chest tube during surgery because the hernia sac tends to be tethered to the pleura, especially in reoperative surgeries.
4. Perform this before starting the dissection to minimize the chances of having to undock and reposition during the operation if there are significant hemodynamic changes from a pneumothorax that develops acutely during dissection.
5. Dock the robot (see **Table of Materials**).

2. Surgery procedure

1. Reducing hiatal hernia

1. Remove the adhesions of the bowel to the abdominal wall and open the gastrohepatic ligament using a robotic bipolar surgical energy device.
 2. Open the lesser sac by removing adhesions and additional short gastric artery branches.
 3. Dissect the hernia sac circumferentially at the hiatus using a combination of blunt and electrocautery dissection with the robot.
 4. Dissect the dense adhesions between the liver and stomach carefully with laparoscopic scissors (see **Table of Materials**).
2. Takedown of previous funduplications.

NOTE: Some but not all sutures from the previous wrap were visible.

 1. Perform sharp dissection with laparoscopic scissors and undo the wrap to completely free the stomach.
 2. Carefully stay in the thin scar tissue to avoid damage to the stomach or esophagus.
 3. Esophageal mobilization
 1. Mobilize the esophagus transhiatally in the mediastinum. Perform this with a combination of blunt and sharp dissection and minimize the use of energy close to the esophagus.
 2. Next, confirm at least 3 cm of intraabdominal esophagus length. Use endoscopy to locate the gastroesophageal junction (GEJ) and measure the esophagus from the hiatus to the GEJ to confirm the adequate length.
 4. Leak test
 1. Perform endoscopy and visualize the mucosa clearly to ensure no injuries. Fill the upper abdomen with warm water and insufflate the esophagus and stomach to ensure no air leakage.
5. Hiatal repair
 1. Perform crural repair using 0-silk sutures with two posterior crural stitches and one anterior crural stitch.
 2. Pass a 56 Fr bougie (see **Table of Materials**) into the esophagus, and with the bougie in place, pass a grasper comfortably into the hiatus. This is to ensure that the crural repair was not too tight.
 6. Nissen fundoplication
 1. Bring the fundus across the right side, posterior to the esophagus, and under the vagus nerve.
 2. Pass a 58 Fr bougie (see **Table of Materials**) into the esophagus.
 3. Perform a loose fundoplication over the bougie with three 2-0 silk sutures.

NOTE: Endoscopy confirmed a loose stack of coin-like appearance.
 7. Gastropexy and G tube
 1. Insert a percutaneous endoscopic gastrostomy tube into the stomach to serve as a gastropexy and a venting tube.
- ### 3. Follow-up procedure
1. Postoperatively, administer antiemetics to minimize the risk of postoperative nausea and vomiting as retching can disrupt the hernia repair or cause early recurrence.
 2. Initially, the gastric tube is left open to serve as a vent to prevent gastric distention. Eventually, clamp it on

postoperative day 2 or 3 once the patient is tolerating liquids.

3. Provide the patient with ice chips on the night of surgery. On postoperative day 1, ask the patient to start with sips of clear liquids with the gastric tube still open. On postoperative day 2, initiate a clear liquid diet and if the patient tolerates well, clamp the gastric tube.

NOTE: If tolerating clear liquids while clamped, a full liquid diet is started.

4. Finally, instruct the patient on the advancement to a soft diet after 1 week with plans for clinic follow-up in 4 weeks with an esophagram and plans for gastric tube removal if not requiring significant venting.

Representative Results

The patient had an uneventful postoperative course. She slowly advanced to a full liquid diet over a period of 3 days and was then discharged on a liquid diet with instructions to advance to a soft diet after 1 week.

By virtue of being a quaternary referral center and a major university hospital, we frequently manage patients needing reoperative foregut surgery. Our data from the last 5 years with 43 patients undergoing reoperative hiatal hernia repairs showed a mean length of stay of 7 days and a 23% 30-day complication rate. The outcomes are summarized in **Table 1**. Most published data on reoperative hiatal hernias show similar outcomes^{1,2,6,18}.

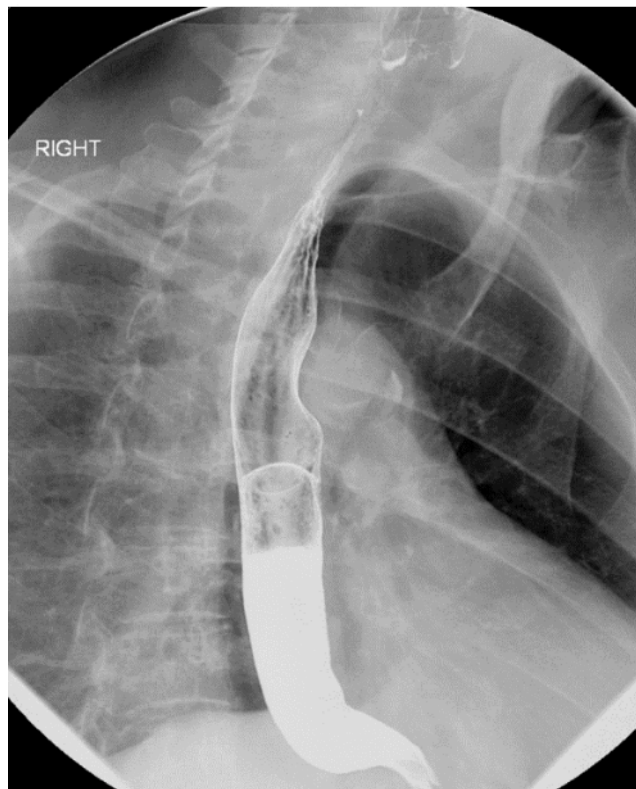


Figure 1: Esophagram demonstrating moderate to severe esophageal dysmotility. [Please click here to view a larger version of this figure.](#)



Figure 2: Abdominal CT scan demonstrating a herniated Nissen fundoplication wrap. [Please click here to view a larger version of this figure.](#)

Value	Total	
<i>N</i>	43	
Age (years)	58.9	± 15.5
Average length of stay (days)	7	± 5.7
30 day mortality (<i>n</i> , %)	1	2.30%
30 day morbidity	10	23.20%
Return to operating room	2	4.70%
Other invasive procedure	2	4.70%
Pneumonia	3	7.00%
Respiratory failure	3	7.00%
Surgical site infection	3	7.00%
Transfusion	4	9.30%
Post-operative atrial fibrillation	2	4.70%
30 readmission rate	4	9.30%
Continuous data summarized as mean ± SD; Categorical data expressed as frequency and percentage		

Table 1: Postoperative outcomes after redoing hiatal hernia repair. Continuous data are summarized as mean ± SD; categorical data are expressed as frequency and percentage.

Discussion

Reoperative foregut surgery is technically challenging but can be performed safely with a well-planned and thoughtful surgical approach. A thorough preoperative evaluation is essential to determine the etiology of symptoms and to guide diagnostic adjuncts. It is of utmost importance to determine the correct diagnosis prior to reintervention in order to determine the proper surgery and approach. For example, in patients undergoing redo anti-reflux surgery (ARS) after Nissen fundoplication, one should understand the primary symptoms the patient is experiencing. In those who have gas-bloat symptoms, pain and dysphagia as their primary

problems, some studies have demonstrated that conversion to a Toupet fundoplication may reduce postoperative dysphagia and gas-bloat symptoms^{28,29}. Similarly, in patients with altered esophageal motility after previous foregut surgery, a partial wrap such as a Toupet may be preferred over a complete wrap like a Nissen³⁰. In another example, when treating pseudoachalasia, one must determine the underlying etiology of dysmotility - if secondary to malignancy, this may involve esophagectomy versus redo anti-reflux surgery in the case of an improperly constructed wrap^{31,32,33}. Failure to recognize this may

result in increased complexity and morbidity, particularly during redo foregut surgery.

Even with a complete preoperative evaluation, it is impossible to predict every challenge that will be faced intraoperatively; therefore, the foregut surgeon must be familiar with various access techniques and surgical approaches. Multiple studies have demonstrated the safety of various redo foregut procedures *via* a minimally invasive approach^{5,6,34,35}. Regardless, the foregut surgeon should be ready to convert to an open approach or consider it from the onset if dictated by the case. In some instances, it may be necessary to use an alternate approach. Using complex recurrent hiatal hernias as an example, in order to achieve adequate intra-abdominal esophageal length, a transthoracic approach, such as a Belsey Mark IV repair, may be necessary to adequately mobilize the esophagus³⁶.

Other times, a different surgical procedure might be necessary depending on previous surgery or intraoperative complications. The hiatal mesh may be associated with a more complex resection, including the esophagus or stomach, and thus require major reconstruction^{9,10}. While redo fundoplication is the most common approach after failed anti-reflux surgery, there is an increased likelihood of alterations in the regional blood supply from previous dissection; therefore, hollow viscus injury, GEJ devascularization, and vagal nerve division are more likely³⁷. Roux-en-Y reconstruction rather than fundoplication may be needed in these cases where there is injury, severe scarring precluding fundoplication, esophageal dysmotility or delayed gastric emptying³⁸.

Endoluminal therapies have become an attractive option for treating foregut diseases such as achalasia and reflux. Although transoral incisionless fundoplication (TIF) has

increased in popularity, it has demonstrated less complete control of GERD versus laparoscopic fundoplication^{12,39} and therefore may require revisional surgery. In TIF, the use of multiple full-thickness fasteners can result in traction diverticula and be a source of leak if removed. To minimize this, these fasteners should be sharply divided rather than pulled out and diverticula resected or imbricated to prevent leaks^{12,13,40}. Although the foregut surgeon may not routinely perform these advanced endoscopic procedures, a thorough understanding is necessary if attempting to revise surgically.

In conclusion, reoperative foregut surgery presents a significant technical challenge. The surgeon must be adept in abdominal and thoracic surgery, open and minimally invasive approaches. Furthermore, with advances in endoscopic techniques, the surgeon must be familiar with these procedures before re-intervention. An exhaustive preoperative workup is essential. It is important to establish a clear indication that reoperation will likely benefit the patient and improve the quality of life.

Disclosures

The authors have nothing to disclose.

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