Giant Hiatal Hernia

Mohi O. Mitiek, MD, and Rafael S. Andrade, MD

Department of Surgery, Division of General Thoracic and Foregut Surgery, University of Minnesota, Minneapolis, Minnesota

A giant hiatal hernia (HH) is a hernia that includes at least 30% of the stomach in the chest, although a uniform definition does not exist; most commonly, a giant HH is a type III hernia with a sliding and paraesophageal component. The etiology of giant HH is not entirely clear, and two potential mechanisms exist: (1) gastroesophageal reflux disease (GERD) leads to esophageal scarring and shortening with resulting traction on the gastroesophageal junction and gastric herniation; and (2) chronic positive pressure on the diaphragmatic hiatus combined with a propensity to herniation leads to gastric displacement into the chest, resulting in GERD. The short esophagus and GERD are key concepts to understanding the pathophysiology of giant HH, and these concepts are critical to address this problem appropriately. A successful repair of giant HH requires adherence to basic hernia repair principles (ie, hernia sac excision, tension-free repair), recognition and correction of a short esophagus, and a well-performed antireflux procedure. Recurrence rates for open giant HH repairs in expert hands range between 2% and 12%; large series have demonstrated that meticulous laparoscopic surgical technique can emulate the results of open giant HH repair.

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Historical Aspects of Surgical Repair of Hiatal Hernia

Bowditch first published a description of a hiatal hernia (HH) in 1853. In 1919, Soresi was the first to surgically reduce a HH, and approximate the crura. During the first half of the 20th century [1], the link between gastroesophageal reflux disease (GERD) and HH was gradually established. In 1956, Nissen [2] described fundoplication for the first time, and in 1957, Collis [3] published his work on transthoracic gastroplasty as an esophageal lengthening procedure. Skinner [4], in 1967, emphasized the importance of the intraabdominal esophagus as part of the antireflux valve and reported a high HH recurrence rate in the presence of a shortened esophagus, and established the modern concept of surgery for hiatal hernia. It was not until 1998 that Maziak and colleagues [5] published the first meticulous modern report on the surgical treatment of giant HH with routine Collis gastroplasty and fundoplication. Finally, also in 1998, Johnson and associates [6] first described the totally laparoscopic Collis gastroplasty in combination with a Nissen fundoplication.

Definition

A HH is classified by type as follows: type I indicates sliding hernia; type II, paraesophageal hernia (≤5%); type III, mixed sliding and paraesophageal hernia; and type IV, herniation of additional organs (eg, colon, omentum, spleen) [7]. No uniform definition exists for giant HH; some authors define it as herniation of more than 30% of the stomach, and others as herniation of more than 50%; certainly, any hernia with more than half of the stomach herniated into the chest should be considered a giant HH (Fig 1). The association of GERD and HH has long been established and is irrefutable; patients with HH may have esophagitis or Barrett's esophagus [8, 9]. The recognition of this relationship is the basis for the performance of an antireflux procedure after hernia reduction.

The short esophagus is intraoperatively defined as less than 2 cm to 2.5 cm of intraabdominal esophageal length after intraoperative mobilization; any nonoperative method of estimation of esophageal length is imprecise [10]. A true short esophagus is the result of longitudinal scarring secondary to severe chronic GERD [4, 11]. Ample anatomic, physiologic, and clinical evidence indicates that true esophageal shortening is a distinct entity.

Horvath and colleagues [11] defined three types of esophageal shortening: (1) apparent short esophagus; (2) true, reducible short esophagus; and (3) true, nonreducible short esophagus. Apparent short esophagus is the result of longitudinal compression of the esophagus in the mediastinum, but the esophagus is of normal length. True, reducible short esophagus is defined as an esophagus that is indeed shortened, but with proper mediastinal mobilization the esophagus has an intraabdominal length of at least 2.5 cm. True, nonreducible short esophagus does not allow for an intraabdominal length of 2.5 cm or more, despite appropriate mediastinal dissection,

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Address correspondence to Dr Andrade, Division of General Thoracic and Foregut Surgery, Department of Surgery, University of Minnesota, 420 Delaware St SE, MMC207, Minneapolis, MN 55455; e-mail: andr0119@umn.edu.

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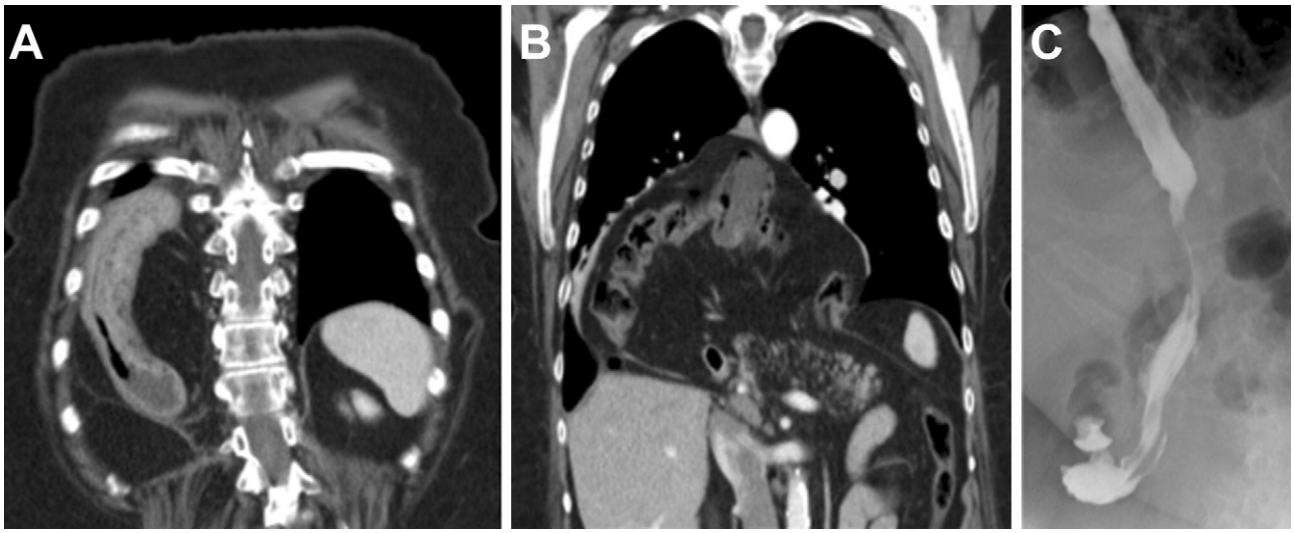

Fig 1. (A and B) Coronal computed tomography scan images of a patient with a type IV hiatal hernia. (C) Barium esophagogram after laparoscopic repair with wedge gastroplasty.

and requires a gastroplasty, namely, surgical tubularization of the cardia to serve as a neoesophagus. The relevance of an esophageal intraabdominal length of 2.5 cm or more is critical to accomplish a tension-free hernia repair [11]. The successful surgical repair of a giant HH can only be accomplished with this concept in mind.

Incidence

The prevalence of hiatal hernia in patients undergoing a Nissen fundoplication is approximately 9% [12], and giant HH represents from 0.3% to 15% of all HH. The prevalence of short esophagus (defined by the need of extensive mediastinal mobilization or a Collis gastroplasty or both) varies between 1.5% and 19% of patients undergoing surgery for GERD [6, 8–16]. It is not possible to provide more precise estimates of the incidence or prevalence of giant HH, as a consensus on the definition of giant HH and short esophagus is lacking.

Clinical Evaluation of Patients With Giant HH

Patients with a giant HH generally present with pain, heartburn or a history of heartburn, dysphagia, vomiting, and anemia (in order of decreasing frequency) [4, 5, 16–19]; however, the chronicity of symptoms leads patients to underestimate severity. The incidence of true incarceration and even strangulation, though a matter of speculation, is low.

The workup of a patient with a giant HH should include (1) a barium esophagogram to assess the size of the hernia as well as the presence of axial or longitudinal rotation and strictures, and (2) an upper endoscopy to measure the distance from the gastroesophageal junction to the crural impression (ie, hernia size) and to thoroughly examine the mucosa. (Any mucosal abnormalities should be biopsied.) Often times, a classic retrocardiac air bubble may be seen on routine posteroanterior chest roentgenogram.

Manometry may help to identify patients with motility disorders that may alter the surgical plan; however, manometry is not always technically possible in giant hernias with rotation. Some researchers use manometric length (distance from upper esophageal sphincter to lower esophageal sphincter) as a measure of esophageal length, but this method is inaccurate [5, 15]. Computed tomography scan can be helpful, but is not routinely required. Finally, pH monitoring and gastric emptying studies are unnecessary or are unreliable in the setting of a giant HH.

Indications for Surgery

Any patient with a giant HH should be considered a surgical candidate unless comorbidities are prohibitive. Symptoms are the main indication to operate; on purposeful interrogation, the vast majority of patients report symptoms. The potential risk of incarceration and strangulation is often quoted as an indication for surgery, particularly in type II hernias. Skinner [4] found that type II hernias carry a mortality of 29% if treated medically, regardless of symptoms. However, Allen and coworkers [16] reported that 4 of 23 patients (17%) with giant HH (>75% of stomach herniated) treated medically had progressive symptoms without gastric strangulation, and 1 patient (4%) died of aspiration pneumonia. This discrepancy is likely due to advancements in medical care over the decades. Although the risk of strangulation is a concern, particularly in type II hernias, the decision to operate tends to be based on symptoms. Generally, patients who present with an incarcerated hernia have had progressive symptoms for days or weeks, which have been ignored or misdiagnosed.

Surgical Principles of Giant HH Repair

The repair of giant HH mandates the observation of three basic surgical principles: (1) hernia repair consisting of complete reduction of HH, sac excision, and tension-free crural repair; (2) assessment of esophageal length by intraoperative evaluation of esophageal length and appropriate use of esophageal lengthening procedures; and (3) GERD management with an antireflux procedure. The best clinical results are reported in open and laparoscopic surgical series that adhere to these three principles. The interpretation of published reports on giant HH repair requires close attention to the type of follow-up performed. This review will focus mostly on reports with anatomic follow-up (ie, esophagogram, endoscopy) in addition to symptomatic follow-up, because symptoms and anatomic recurrence and progression of mucosal abnormalities do not correlate well [4, 5, 8, 9, 12, 17, 19, 29].

Open Surgical Approach to HH

Fundoplication under tension due to esophageal shortening leads to a recurrence rate of nearly 40% [4]. Two large studies of transthoracic repair of giant HH apply the three key surgical principles and provide long-term anatomic and symptomatic follow-up data. Maziak and coworkers [5] published the first comprehensive report on repair of giant HH in 94 patients. In this study, the authors reduced the hernia, extensively mobilized the esophagus, used a Collis gastroplasty in 80% of cases, and performed a Belsey antireflux procedure. At a median follow-up of 6 years using barium esophagogram and symptom survey, the anatomic recurrence rate was 2% (2 patients who had not undergone a gastroplasty), and patient satisfaction was 94%.

The second study, published by Patel and associates [17] reported data on 240 patients with giant HH treated with a transthoracic approach using a Collis-Nissen fundoplication in 96% of patients. At an average follow-up of 42 months, the anatomic recurrence rate was 12.4%, and patient satisfaction was 86%; four late recurrences required reoperation 13 to 51 months after the initial repair.

These reports represent the gold standard for proper repair and postoperative follow-up of patients with large HH. (Table 1 summarizes the results.) Other large series of transthoracic repair of giant HH do not provide anatomic follow-up; hence, results are difficult to interpret [20, 21].

Mattar and colleagues [19] have reported the importance of hernia sac excision to minimize the potential for postoperative mediastinal seroma. Primary crural closure (with or without pledgets) is a critical component of the operation, and only rarely is a prosthetic patch required. Finally, the importance of an antireflux operation is irrefutable after reduction of the HH and proper intraoperative management of a shortened esophagus. Persistent GERD will result if an antireflux operation is not performed because most of the anatomic components of the antireflux valve are compromised as a result of the disease and the extensive dissection [1, 14]. Recently, D'Journo and colleagues [35] described their results in a group of 26 patients undergoing an open, transthoracic cut elongation gastroplasty (modified Collis) with a transverse widening fundoplasty; meticulous long-term objective follow-up revealed no recurrences. This approach can be of value in a select group of patients with particularly challenging anatomy.

Table 1. Results From Studies of Open Transthoracic Repair of Large Hiatal Hernia With Collis Gastroplasty

	Maziak (1998) [5] Collis-Belsey Technique	Patel (2004) [17] Collis-Nissen Technique
Patients	94	240
Operating room time, minutes	—	—
Length of stay, days	—	7[a]
Morbidity, %	19	22
Mortality, %	2	2
Mean follow-up, months	94	42
Follow-up method	Esophagogram, symptoms	Esophagogram, symptoms
Anatomic recurrence, %	2	12
Patient satisfaction, %	94	86

[a] Median value.

OR = operating room.

Evolution of Laparoscopic Approaches to HH Repair

The evolution of laparoscopic repair of HH has hinged mainly on the recognition and treatment of the short esophagus. Current laparoscopic techniques allow elongation of the short esophagus, with encouraging results. In an effort to optimize results and to standardize a laparoscopic approach to esophageal shortening, O'Rourke and colleagues [25] emphasized the importance of laparoscopic transhiatal esophageal mobilization as a key step to achieve proper intraabdominal esophageal length (≥2.5 cm). Gradual circumferential blunt and harmonic scalpel esophageal dissection in the mediastinum is carried out with progressive advancement of the laparoscope through the hiatus into the chest; dissection can be safely carried out to the level of the carina [11].

The use of a porcine small intestinal submucosa patch has been proposed for reinforcement of the crural repair [22]. A multicenter, prospective, randomized trial of laparoscopic giant HH (ie, >5 cm) repair comparing primary crural repair (n = 57) versus primary crural repair reinforced with porcine small intestinal submucosa (n = 51) revealed a 6-month recurrence rate of 24% versus 9%, respectively ($p = 0.04$) [23]. This study is the only clinical trial to date to study any aspect of hiatal hernia repair and does demonstrate a beneficial effect of biologic prosthetic reinforced crural repair. Nonetheless, a 9% short-term recurrence rate appears high, which could be partially secondary to the low proportion of Collis gastroplasties performed in this trial (4% and 5% of patients in the respective groups). Conversely, follow-up was more meticulous than in most open and laparoscopic

series, suggesting that anatomic subclinical recurrences happen more frequently than reported to date.

Minimally invasive Collis or wedge gastroplasty has evolved through several techniques including a mostly abandoned combined thoracoscopic-assisted laparoscopic gastroplasty with the use of a linear transthoracic stapler [14, 26]; a technically challenging totally laparoscopic Collis gastroplasty using a circular and linear stapler [6, 18, 27]; and finally, a relatively straightforward wedge gastroplasty exclusively with linear staplers (see following text) [28, 29]. Of note, a Collis gastroplasty should not replace extensive mediastinal mobilization and should be used only if absolutely necessary: a portion of tubularized stomach may remain above the fundoplication and expose the distal esophagus to acid as well as dilate over time.

Laparoscopic Repair of Giant HH: University of Minnesota Technique

The surgical technique used at the University of Minnesota for laparoscopic repair of giant HH, wedge gastroplasty, and fundoplication emphasizes the following points [29]: (1) hernia sac reduction and excision; (2) extensive mediastinal esophageal dissection with vagal preservation; (3) gastroesophageal junction fat pad dissection; (4) evaluation of intraabdominal esophageal length (with no traction); (5) wedge gastroplasty for severely shortened esophagus (<2.5 cm intraabdominal length); (6) pledget-reinforced crural repair; and (7) Nissen fundoplication.

Our wedge gastroplasty technique is based on the original procedure used by Champion [28] and others [29] for laparoscopic vertical banded gastroplasty. We reinforce crural repairs with a biologic prosthesis (porcine small intestinal submucosa) only if patients are considered at high risk for recurrence (ie, body mass index >35, chronic cough, friable crura).

Results of Laparoscopic HH Repair

Laparoscopic Repair of HH Without Gastroplasty

Several studies of laparoscopic repair of HH without a Collis gastroplasty have been reported. Results have been inconsistent and often disappointing, which can be attributed partially to a steep learning curve for a challenging operation, and more importantly, to failure to consistently address the problem of esophageal shortening. Recurrence rates have ranged from 0% to 42%, and patient satisfaction has ranged from 77% to 100% [23, 24, 30, 31]. These discouraging results led some surgeons to suggest that giant HH should not be repaired laparoscopically.

Laparoscopic Repair of HH With Gastroplasty

Results of laparoscopic repair of giant HH with a Collis or wedge gastroplasty in experienced centers have consistently reproduced the results of open giant HH repair, with recurrence rates ranging between 2% and 13%. Clear advantages to laparoscopic series are a shorter hospital stay and likely fewer complications. The main limitation of all series to date has been a shorter follow-up than with open series. Table 2 summarizes the

Table 2. Results of Laparoscopic Repair of Large Hiatal Hernia With Gastroplasty

	Swanstrom (1996) [14]	Johnson (1998) [6]	Jobe (1998) [8]	Awad (2000) [26]	Pierre (2002) [18]	Whitson (2006) [29]	Luketich (2009) [32]
Technique	VATS-Assisted Collis-Nissen	Collis-Nissen	Collis-Nissen	VATS-Assisted Collis-Nissen or Toupet	Collis-Nissen (55%), Nissen	Collis-Nissen	Collis-Nissen (63%), Nissen
Patients, n	3	9	15	8	202	61	662
OR time, minutes	257[a]	297[a]	252[a]	—	200[b]	274[b]	—
Length of stay, days	2[a]	3[a]	2[a]	3[a]	3[b]	4[b]	3[b]
Morbidity, %	0	22	15	50 (minor)	28	8	Leak 2.5
Mortality, %	0	0	0	0	0.5	1.7	1.7
Follow-up, months	8[a]	—	14[a]	20[a]	18[b]	8[b]	30[b]
Follow-up method	Endoscopy, 24-hour pH, manometry, symptoms	Endoscopy, symptoms	Endoscopy, 24-hour pH, manometry, biopsy, symptoms	Symptoms	Symptoms	Esophagram, symptoms	Esophagram, symptoms
Anatomic recurrence, %	0	11	0	13	2.5[f]	4.7	15.7[c] (reoperation: 3.2%)
Patient satisfaction, %	100	89	100	88	92	98	90

[a] Mean value. [b] Median value. [c] Recurrence requiring reoperation.

OR = operating room; VATS = video-assisted thoracoscopic surgery.

results of minimally invasive gastroplasty-fundoplication series.

Follow-Up of Patients After Collis Gastroplasty and Antireflux Operation

No guidelines exist for follow-up of patients after the repair of an HH with or without the use of an esophageal lengthening procedure. However, it is clear that many patients have preoperative mucosal abnormalities (esophagitis, stricture, or Barrett's esophagus), that postoperative symptoms correlate poorly with objective abnormalities, that recurrences tend to occur within the first 2 years after surgery (but may occur several years after the repair), and that mucosal pathology may persist or even progress [4, 8, 9, 12, 19, 29]. Development of Barrett's esophagus, high-grade dysplasia, and adenocarcinoma have been reported during the follow-up of patients after HH repair with a Collis gastroplasty [5, 9, 17].

In view of these facts, patients should be followed routinely after the surgical repair of an HH. The suggested follow-up protocol includes (1) validated symptom questionnaire every year for 5 years; (2) anatomic evaluation (radiographic or endoscopic) every year for 5 years; (3) patients with preoperative esophagitis, stricture, or Barrett's esophagus should be endoscopically evaluated within a year after surgery; and (4) persistent or progressive esophageal mucosal abnormalities without anatomic recurrence should be followed long term.

It is not clear whether every patient with preoperative mucosal pathology should be treated postoperatively with proton pump inhibitors until a normal postoperative pH study or regression has been documented. The authors favor the use of proton pump inhibitors for asymptomatic patients who have esophagitis, stricture, or Barrett's esophagus at the time of surgery at least until the first follow-up endoscopy (within 1 year after surgery); and for patients who have esophagitis, stricture, or Barrett's esophagus at the time of surgery that persist or progress (these patients need thorough reevaluation).

Giant HH in the Obese Patient

A special comment is pertinent for patients with a body mass index greater than 35 and a large HH. Under these circumstances, the HH and GERD are just one more of a multitude of comorbidities, and the ideal treatment should be focused on weight loss. Whether a body mass index greater than 35 predicts a higher recurrence rate seems logical; however, it is still controversial. The authors prefer to perform a laparoscopic Roux-en-Y gastric bypass to address most of the obesity-related problems, including the HH and GERD. Several small series have shown excellent results in this patient population [33, 34]. Recurrence is very unlikely, since the Roux limb holds the gastric pouch in the abdomen and the separated gastric remnant is no longer at risk to herniate.

Summary

The laparoscopic repair of giant HH mandates the observation of three surgical principles: (1) hernia repair consisting of complete reduction of HH, sac excision, and tension-free crural repair; (2) assessment of esophageal length intraoperatively and appropriate use of esophageal lengthening procedures; and (3) GERD management with an antireflux procedure. The best clinical results are reported in surgical series that adhere to these three principles. Patients should be followed with a regimented protocol for at least 5 years to assess results.

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