Hiatal Hernia Surgery

An Evidence Based Approach

Muhammad Ashraf Memon
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Chapter 1
Utility of Endoscopy in the Diagnosis of Hiatus Hernia and Correlation with GERD

Francesca M. Dimou, Candace Gonzalez, and Vic Velanovich

1.1 Introduction

A hiatal hernia is a condition involving herniation of abdominal contents into the mediastinum via the diaphragmatic hiatus. Anatomically, there is proximal displacement of the gastroesophageal junction causing the intrinsic sphincter to lie proximal to the esophageal hiatus; this is likely secondary to weakening or disruption of the phrenoesophageal ligament (fascia of Laimer) [1] and widening of the diaphragmatic crura. The true prevalence of hiatal hernias is difficult to discern because many individuals are asymptomatic and, therefore, never diagnosed and the diagnostic criteria are somewhat subjective. Estimated prevalence in studies range widely from 10% to 80% in the United States [2], but is generally correlated with obesity and increasing age. Although, hiatal hernias may remain asymptomatic in most patients and diagnosed incidentally, if at all; they are frequently associated with gastroesophageal reflux disease as an incompetent lower esophageal sphincter may be a consequence of a hiatal hernia. Other patients, in whom paraesophageal hernias develop, may progress to significant symptoms including obstruction, ischemia, bleeding, and volvulus. In the asymptomatic patient, pursuing a diagnosis of hiatal hernia is not indicated, but those experiencing symptoms warrant evaluation and possible surgical intervention. Understanding the risk factors and types of hiatal hernias are vital in managing patients once they are diagnosed.

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1.2 Risk Factors

Although, the underlying cause of hiatal hernias are not well understood; elevated body mass index, higher abdominal pressure, and other aspects of sedentary lifestyle have been reported as contributing factors [3]. In fact, studies have shown that patients with a body-mass index (BMI) exceeding 25 are far more likely to be diagnosed with a hiatal hernia [4]. Thoracic deformities (kyphosis, osteoporosis, scoliosis) that occur in older patients and that cause an increase in anterior-posterior diameter of the thorax also correlate with the occurrence of hiatal hernias [5]. Furthermore, with increasing age there becomes an increased laxity of the phrenoesophageal ligament resulting in an increased risk of developing a hiatal hernia [4]. Congenital defects in children are the most common cause and sometimes may be associated with other embryologic anomalies such as intestinal malrotation [4].

1.3 Classification

Hiatal hernias can be described as either sliding hernias or paraesophageal hernias. They are classified into four types, I–IV (Table 1.1; Fig. 1.1a–d). Type I hiatal hernia is the sliding hernia in which the gastroesophageal junction is displaced proximally superior to the diaphragm; it accounts for about 95% of hiatal hernias [6]. This occurs when there is widening of the esophageal hiatus and laxity of the phrenoesophageal ligament. Type II hiatal hernias are the classic "paraesophageal hernias," with widening of the diaphragmatic hiatus resulting defect in the anterior and lateral aspect of the phrenoesophageal membrane, but with the gastroesophageal junction still fixed in the abdomen. The fundus or body of the stomach herniates through this defect while the cardia of the stomach and the gastroesophageal junction do not [7]. This is a relatively rare hernia, accounting for less that 1% of all hiatal hernias. Type III hiatal hernia is the most common of the paraesophageal hiatal hernias and they compromise approximately 5% of all hiatal hernias [8]. Type III has features of both type I and type II hernias. The phrenoesophageal membrane is lax and stretched, the esophagogastric junction is displaced into the chest as in a sliding hiatal hernia, and there is a defect in the anterolateral portion of the membrane that allows the stomach to rotate into the mediastinum as in a paraesophageal hernia [6]. Type IV hiatal

Table 1.1 Classification of hiatal hernia with regards to gastroesophageal junction location (GEJ) and symptomatology associated with each type

Type	Location of GEJ	Incidence	Symptoms
I	Above diaphragmatic hiatus	>90%	Asymptomatic or GERD
II	Normal anatomic position	<1%	Asymptomatic but may become strangulated or incarcerated
III	Above diaphragmatic	5%	Reflux and possible incarceration
IV	Above diaphragmatic hiatus	<1%	Risk of volvulus, obstruction and/or bleeding

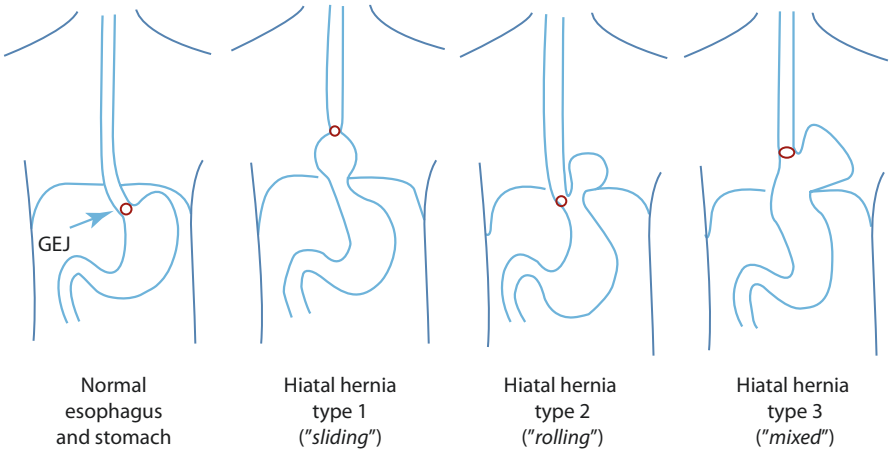

Fig. 1.1 The definitions of the four types of hiatal hernias

hernias are the least common, accounting for about 0.1% hiatal hernias [8]. They are characterized by a large defect in the diaphragmatic hiatus and an excessive laxity of the phrenoesophageal membrane. In addition to the stomach, other intra-abdominal organs are herniated into the chest [8]. Small and large intestine with associated omentum are the most common organs herniated in a type IV paraesophageal hernia; the spleen, pancreas and liver have also been found. Herniation of the stomach, specifically, can result in gastric volvulus. Rotation of the stomach along the long axis of the stomach is known as organoaxial rotation and occurs in approximately 60% of cases. Rotation in the short axis of the stomach is known as mesenteroaxial rotation where the greater curvature of the stomach is flipped anterior to the cardia and fundus and is sometimes referred to as an "upside-down" stomach [9].

Any symptomatic hiatal hernia should be considered for surgical repair, including Type I hernias that are associated with GERD. The symptomatic hernia should be repaired especially if there are obstructive symptoms or volvulus [10]. Anemia can occur in up to 20% of patients with paraesophageal hernias, especially in the presence of Cameron's lesions, and should also be an indication for repair [11]. There is debate whether an asymptomatic hiatal hernia or those causing only minimal symptoms should be repaired; considerations for surgical repair in these patients should include overall clinical presentation, patient's co-morbidities, and age.

1.4 Endoscopy in the Evaluation of Hiatal Hernia and GERD

The use of endoscopy in evaluation of the upper gastrointestinal tract has become commonplace. Its use in the diagnosis of hiatal hernia is not necessarily mandatory, as contrast radiographic images can be used to evaluate patients with suspected hiatal hernias. However, given the increased utilization of endoscopy, hiatal hernias are

frequently found when endoscopy is done for other symptoms and/or conditions. Hiatal hernias are associated with GERD and this can lead to other esophageal pathology for which endoscopy can determine the presence and extent. Endoscopy can determine the size of the hiatal hernia, extent of esophagitis, presence of neoplasia and suggest the existence of delayed gastric emptying. Specifically, understanding these clinical components and using endoscopy as a tool for diagnosis and management will better help the physicians devise a management plan of their patients.

1.5 Endoscopic Assessment of Hiatal Hernia

Despite increased use of endoscopy as an adjunct in evaluating patients with a hiatal hernia, the diagnostic criteria remain unclear. The most commonly accepted definition in the literature is identification of proximal dislocation of the gastroesophageal junction (GEJ) >2 cm above the diaphragmatic indentation. This definition seems to provide a systematic method of diagnosing and reporting size of a hiatal hernia, but the confusion lies in the reference mark for the GEJ.

There are three anatomic possibilities used to assess the position of the GEJ: the squamocolumnar junction (SCJ), the upper margin of the gastric folds, and the distal margin of the palisade zone. Clarification of the endoscopic reference for the GEJ needs to be undertaken for several reasons. The SCJ, also known as the transition zone or "Z-line" is not consistent across all patients [11]. The contour and length varies, especially in those with Barrett esophagus because the junction extends cranially and is, thus, unreliable in these patients. This is important given many patients with hiatal hernias may have Barrett esophagus and may affect the estimation of the axially dimension of the hernia. Identification of the upper gastric folds is another marker that has been used as a reference of the GEJ, but may be difficult to clearly define if the stomach is not fully insufflated and anatomy is not clearly delineated endoscopically. Studies have demonstrated operator variability with regards to this measurement for hiatal hernias even in healthy individuals [12].

Another proposed system for assessing the GEJ is the Hill classification [13]. This approach evaluates the GEJ and hiatal integrity based on a "flap-valve" mechanism which is also used to predict reflux [13]. In this classification scheme, grade I flap-valve is consider the "normal" configuration. It demonstrates close adherence of the SCJ to the shaft of the endoscope with a "ridge" of tissue corresponding to the angle of His. There is no hiatal hernia (Fig. 1.2a). In grade II, the adherence of the GEJ to the endoscope is less well-defined and there is effacement of the angle of His ridge (Fig. 1.2b). Hill grade III flap valve demonstrates incomplete closure of the GEJ around the endoscope, with esophageal mucosa frequently visible and complete effacement of the angle of His ridge (Fig. 1.2c). These are frequently associated with sliding hiatal hernias. Lastly, Hill grade IV is always associated with a hiatal hernia with the diaphragmatic hiatus seen making and extrinsic compression

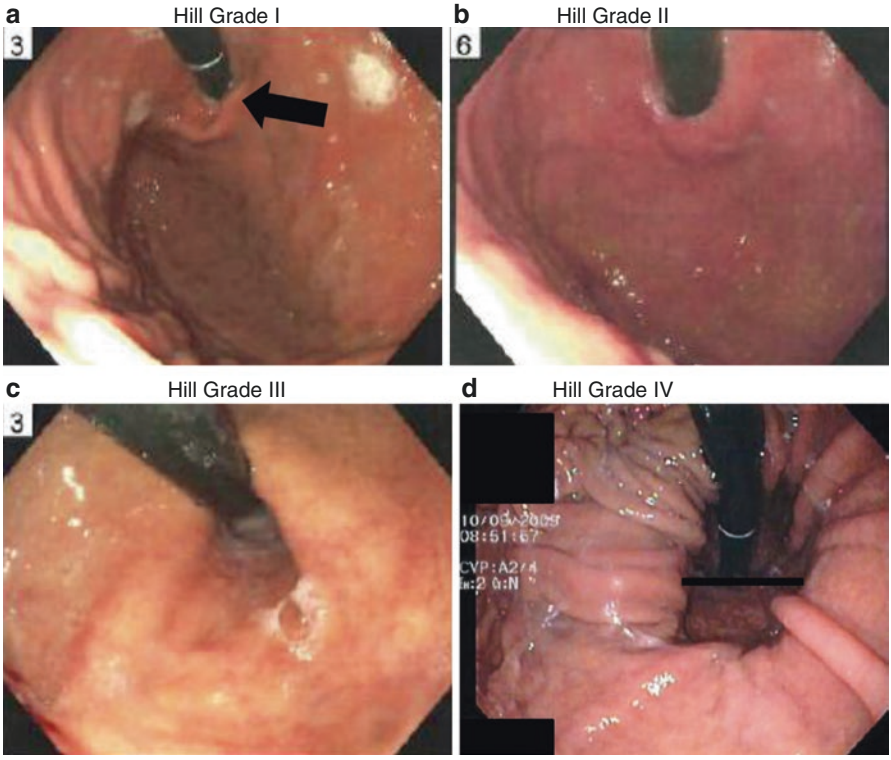

Fig. 1.2 The Hill classification of the gastroesophageal junction flap valve. *Black arrow* in (**a**) shows a normal angle of His ridge of a competent valve. *Black line* in (**d**) shows the transverse diameter of the hiatal hernia

on the gastric mucosa. There no GEJ adherence to the shaft of the endoscope and the squamous epithelium of the distal esophagus can be readily seen (Fig. 1.2d). A population-based study evaluating the concordance with hiatal hernia size and Hill classification included 334 subjects and demonstrated the Hill classification was slightly better at measuring a hiatal hernia but was not necessarily a stronger predictor [12]. The reproducibility of these results in an objective, accurate manner have yet to be elucidated.

Once it is determined that a hiatal hernia is present, there are two dimensions that determine its size. One is the axially dimension as measured from the GEJ to the "pinch" of the diaphragmatic hiatus around the stomach (Fig. 1.3). The other is the transverse dimension, as measured from the impression of the left crura against the herniated stomach to the impression of the right crura against the herniated stomach. These are measurements that are frequently not made during routine endoscopy. In patients with paraesophageal hernias, a twisting of the stomach within the hernia may be seen suggesting volvulus (Fig. 1.4).

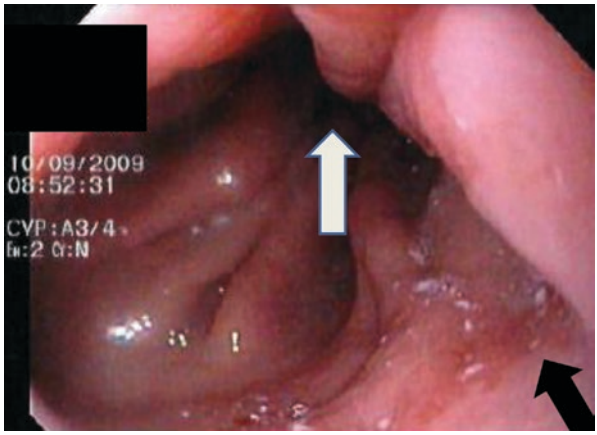

Fig. 1.3 The determination of the axial length of a sliding (type I) hiatal hernia from the Z-line (gastroesophageal junction, *black arrow*) to the "pinch" of the diaphragmatic hiatus around the stomach (*white arrow*). In conjunction with the transverse diameter (Fig. 1.2d), the size of the hiatal hernia can be determined

Fig. 1.4 Twisting of the stomach within a paraesophageal hernia suggesting gastric volvulus

1.6 Endoscopic Evaluation of the Esophageal Mucosa

1.6.1 Esophagitis

When evaluating patients for hiatal hernia it is also important to note the esophageal mucosa and any abnormalities. Specifically, the presence of erosive or non-erosive esophagitis needs to be determined. The severity of erosive esophagitis is graded based on the Los Angeles Classification (LA Classes) [14]. Grade A is the presence of one or more mucosal breaks that are ≤5 mm in length; Grade B is the presence of one or more mucosal breaks that are >5 mm; Grade C includes one or more mucosal breaks that

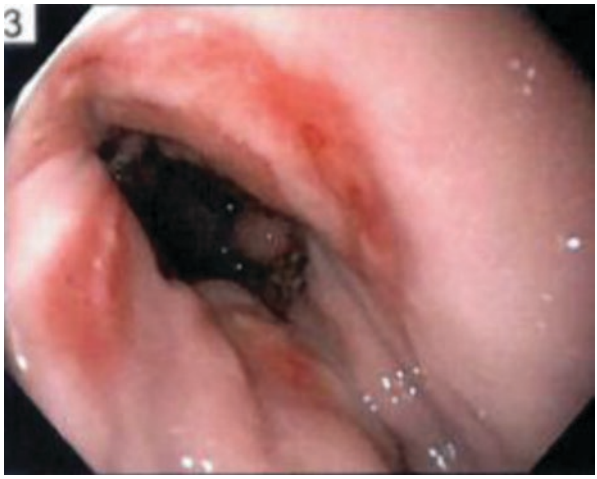

Fig. 1.5 An example of Los Angeles grade D esophagitis. Description of grades A, B and C in text

interconnect between the apices of two or more mucosal folds, but encompass <75% of the esophageal circumference. Grade D is the most extensive and includes continuous breaks within the mucosa that exceeds 75% of the esophageal circumference (Fig. 1.5). Biopsies of the area of esophagitis, in the absence of suspicion for neoplasia, appear not to have any additional value to endoscopic examination [15].

Conversely, non-erosive esophagitis is more difficult to diagnose via endoscopy and primarily diagnosed via biopsy. The presences of eosinophils, lymphocytes, balloon cells, and polymorphonuclear leukocytes have been seen on microscopy but have poor sensitivity and specificity if only one of these histologic abnormalities is identified. Specificity is increased if there are three or more of these abnormalities on microscopy but, consequently, sensitivity is decreased [16]. Nonetheless, the routine use of endoscopic biopsies in the setting of otherwise normal appearing esophageal mucosa is not recommended.

1.6.2 Barrett Esophagus

Barrett esophagus is defined as a change in the normal mucosa of the esophagus from squamous epithelium to metaplasia columnar epithelium. Barrett esophagus is a result of damage to the esophageal mucosa from persistent reflux disease. Under endoscopic visualization, it appears as salmon colored mucosa projecting proximally into the distal esophagus from the normal SCJ (Fig. 1.6a). With narrow-band imaging there is enhanced visualization of the GE junction in addition to mucosal abnormalities such as Barrett metaplasia (Fig. 1.6b). Suspicious areas seen on endoscopy and/or narrow-band imaging must be biopsied to confirm or rule out mucosal abnormalities; specifically, biopsies need to determine the presence of intestinal metaplasia and goblet cells. In the presence of esophagitis, patients need to be treated with proton pump inhibitors to enhance histologic evaluation of the Barrett metaplasia.

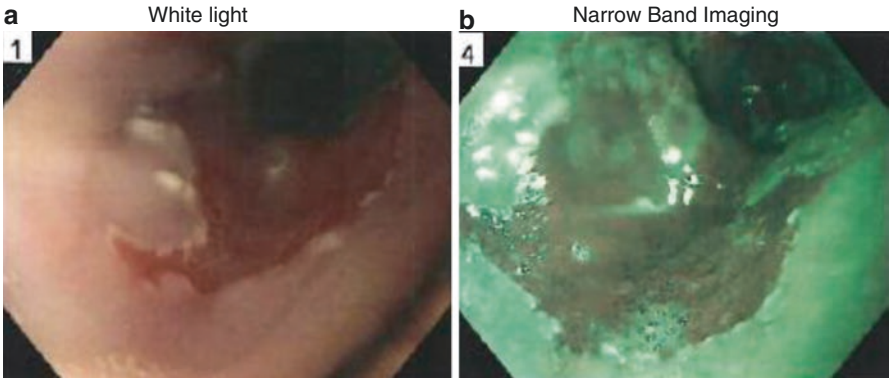

Fig. 1.6 Barrett esophagus as seen by white light (**a**) and narrow band imaging (**b**). Narrow band imaging enhances the difference between the area of normal squamous epithelium and metaplastic epithelium

Obtaining endoscopic biopsies of the esophagus that are concerning for Barrett esophagus typically follow the Seattle protocol; this is defined as four quadrant biopsies taken every 1 cm over the length of the Barrett esophagus [17]. The extent or severity of Barrett's is then further classified based on the Prague classification. This incorporates then length of circumference (Denoted as "C") of Barrett and the total length of the esophagus that includes Barrett's (Denoted as "M") [18]. For example, if a 2 cm circumferential portion of esophagus was involved and included 5 cm non-circumferential Barrett, this would be documented as C2M5.

The length and circumference is an important classification system for Barrett, but the presence of the type of metaplasia and/or dysplasia is also clinically important. Non-nodular Barrett or flat dysplasia is typically biopsied; depending on size and grade of dysplasia this is commonly managed with endoscopic eradication. This applies in the case of nodular metaplasia as well. Ulceration of the columnar epithelium and/or Barrett segment can be found in up to 60% of patients [19]. These are typically found incidentally, but may be complicated by bleeding or even perforation. There have been rare reports of fistula formation due to ulceration of Barrett esophagus [19]. Development of these findings is concerning for underlying malignancies and if seen endoscopically should be managed as such.

1.6.3 Esophageal Neoplasia

Endoscopy certainly plays a curative role in treating select patients with esophageal carcinoma. Primarily, endoscopic therapy is used for mucosal cancers. Endoscopic approaches can be divided into ablative and resection techniques. In the latter, endoscopic mucosal resection (EMR) offers the advantage of obtaining

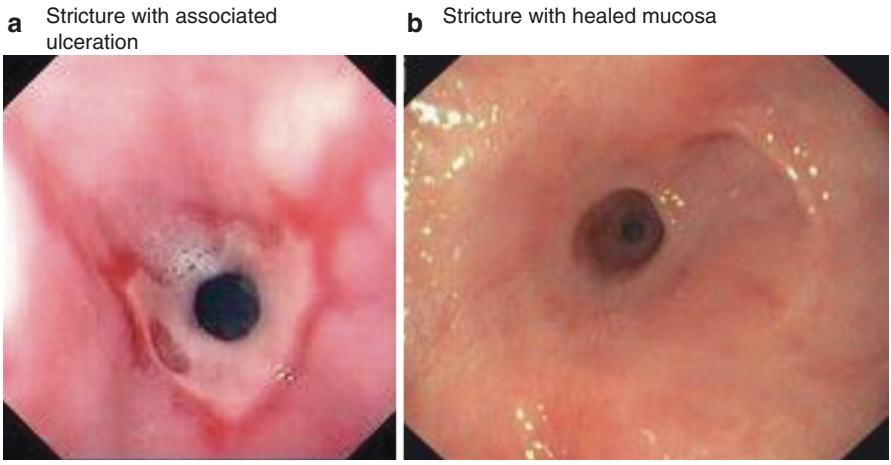

Fig. 1.7 Esophageal peptic stricture with (**a**) and without (**b**) ulceration

more tissue for appropriate cancer staging and even adequate treatment (Fig. 1.7a, b). EMR is primarily used in nodular Barrett's esophagus, T1a esophageal adenocarcinoma lesions, and in some instances, flat Barrett's esophagus with high-grade dysplasia [20]. Curative rates for EMR have reported ranges between 60% and 100%; one of the largest studies included 349 patients with high grade neoplasia or mucosal adenocarcinoma; with a follow-up of 5 years reported long-term eradication was 95% [21]. Although there has been no comparison to surgical resection, EMR offers a promising alternative to minimally invasive resection of these lesions. Complications of this intervention includes bleeding, perforation, and stricture formation.

Ablation techniques include photodynamic therapy, cryotherapy, argon plasma coagulation, heater probe treatment, and radiofrequency ablation. These techniques may be used alone or in combination with EMR. Successful treatment of Barrett esophagus or intramucosal carcinomas have been reported using ablative techniques, however, these are primarily limited to small case series and likely biased secondary to patient selection [20].

For malignancies that are greater than T1a or encompass larger areas of the esophagus, another possible endoscopic therapy is endoscopic submucosal dissection (ESD). Specifically, ESD is used for areas of dysplasia >2 cm or T1b lesions that are confined to the submucosa [20]. A recent study reported on ESD in 46 patients wither either HDG or intramucosal adenocarcinoma and a curative resection of 70%; similar curative rates have been reported [22]. However, it is important to note that this technique can be difficult given the piecemeal dissection/resection of these lesions. ESD solely for curative purposes can be done in highly selected patients, but larger sample sizes are necessary to determine its full utility.

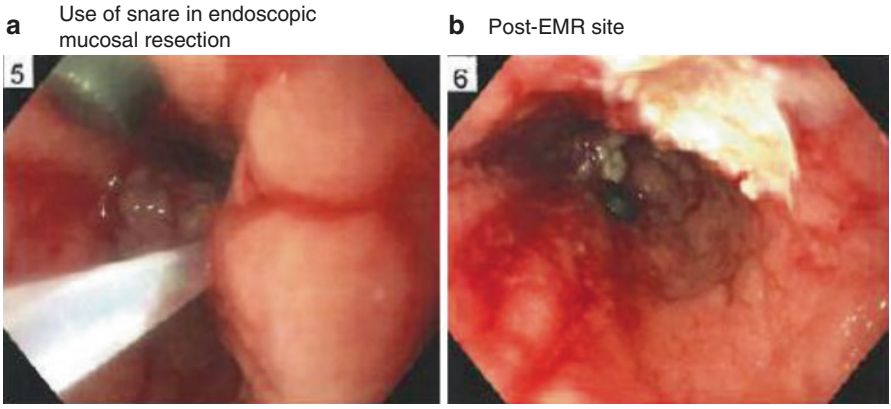

Fig. 1.8 An example of endoscopic mucosal resection of a T1a esophageal adenocarcinoma within a nodule of Barrett esophagus with high-grade dysplasia

1.6.4 Esophageal Peptic Stricture

Esophageal peptic strictures primarily occur secondary to repetitive exposure of the esophagus mucosa to stomach acid. Reportedly 7–23% of patients with reflux esophagitis develop peptic stricture [23]. Endoscopically, these strictures are defined as narrowing at the esophagus near the squamocolumnar junction and typically measure 1–4 cm in length (Fig. 1.8). This may result in esophageal narrowing up to 13 mm. Typically these strictures result in dysphagia and when visualized on endoscopy should be biopsied to ensure there is no underlying malignancy.

1.7 Intraoperative Evaluation of Newly Constructed Fundoplications

1.7.1 Perforation

Use of intraoperative endoscopy is a valuable tool for surgeons who routinely do minimally invasive foregut surgery. Trans-illuminating the gastroesophageal junction with the endoscope can help the surgeon identify the esophagus and stomach during difficult cases, such as re-do fundoplications. After the fundoplication is constructed, the endoscope is typically passed into the esophagus and stomach following creation of a fundoplication. There is visualization of the esophagus as the scope enters into the stomach. Time is also taken to visualize the GEJ to ensure no mucosal abnormalities. Once the scope is passed into the stomach, the scope is retroflexed and the GEJ is visualized as well as the newly created fundoplication. Tears or perforations may be seen with small mucosal slits or tears (Fig. 1.9). This can be either seen via the endoscope or light from the endoscope is visualized within the abdomen, which would signify a perforation. Once diagnosed, the perforation can be repaired primarily intraoperatively.

Fig. 1.9 An esophageal perforation as identified by endoscopy

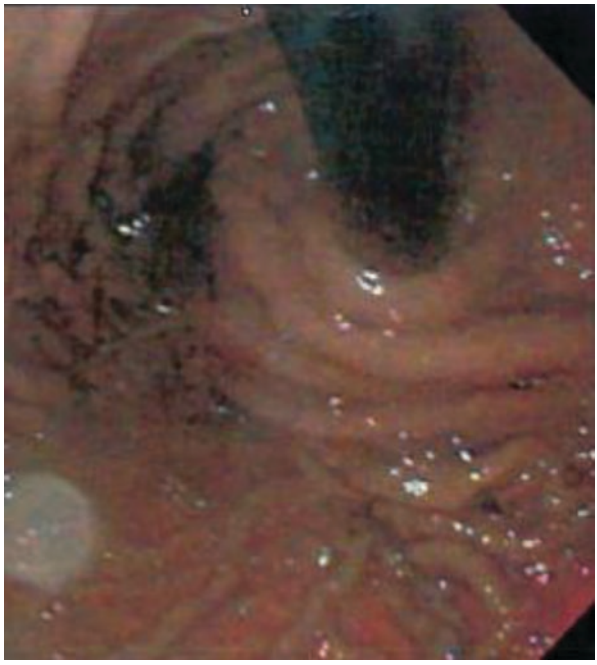

Fig. 1.10 An example of a normally constructed fundoplication immediately visualized intraoperatively. Note the "stacked coils" appearance of the wrap

1.7.2 Fundoplication Construction

The ideal construction of a fundoplication is commonly classified based on the definition derived from Jobe et al. [24] This includes: tight adherence to the scope, circumferences of the cardia <35 mm, no cardia dilatation, valve length 3–4 cm, nipple or coil type, and an intra-abdominal location of the stomach. The wrap should have a "stacked coils" appearance (Fig. 1.10). If these criteria are not met, there is

concern for failed fundoplication construction and intraoperative evaluation of the newly constructed wrap should be undertaken to ensure there were no technical errors made.

1.8 Endoscopic Evaluation of Postoperative Adverse Events

Although antireflux surgery has high success rates, recurrent symptoms do occur approximately 5% of the time and may be disabling [25]. Conversely, anatomic abnormalities have been described in as many as 25% of cases with the use of endoscopy [25]. Therefore, endoscopy is important in determining the etiology for a patient's recurrent symptoms and whether their symptomology is a result of surgical failure.

1.8.1 Perforation

Perforation postoperatively is not a common event, but can happen and have severe consequences to the patient resulting in peritonitis, sepsis, and even death. Timely diagnosis is of the utmost importance and endoscopy aids in a timely diagnosis. Visualization of a tear or perforation can be seen within the mucosa on endoscopy (Fig. 1.9). Depending on the stability of the patient and severity of the tear, perforations may be repaired via endoscopic interventions including endoscopic clips, negative therapy devices, and esophageal stents. Success of these interventions has been reported to be above 80% from small case series, but with appropriate patient selection it may provide a minimally invasive treatment alternative for treating this postoperative complication.

1.8.2 Tight Fundoplication

A tight fundoplication typically refers to obstruction of the distal esophagus when the wrap was made either too tight or too long. This results in dysphagia, bloating, or regurgitation that persists several weeks after the procedure. This would be seen with a narrowing at the level of the distal esophagus and can be treated with esophageal dilation. If this fails, surgical revision may be necessary. In a normal fundoplication, the gastric mucosa is seen wrapped circumferentially around the shaft of the endoscope whereas a tight wrap results in the gastric mucosa being stretched and wrapped tightly around the shaft without laxity or visibility of the gastric folds (Fig. 1.11a).

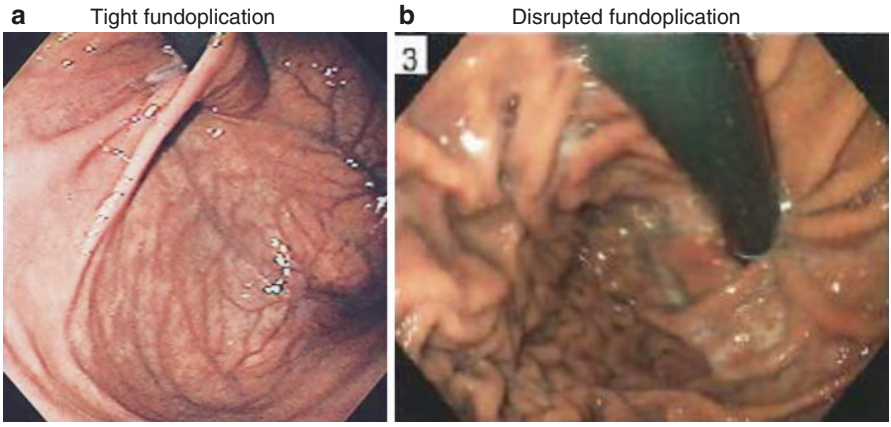

Fig. 1.11 Examples of postfundoplication problems. (**a**) a tight wrap causing dysphagia. Note the tethering of the gastric mucosa. (**b**) a disrupted wrap. Note that the mucosal folds have lost the stacked coils appearance

1.8.3 Disrupted/Loose Fundoplication

Disruption of the fundoplication involves partial or complete breakdown of the wrap; disruption commonly results in recurrence of a hiatal hernia. This complication may be secondary to inadequate suture technique and/or insufficient mobilization of the stomach fundus. Endoscopically, the gastric mucosal folds are not well-adhered to the shaft of the endoscope and essentially no evidence of a wrap is present on endoscopy, again indicating a loose or disrupted fundoplication (Fig. 1.11b).

1.8.4 Slipped Fundoplication

In the case of stomach slippage, the wrap remains below the level of the diaphragm but the proximal stomach slips and enters the chest. This may be otherwise referred to as an hourglass deformity because the stomach resides both above and below the newly created fundoplication. The herniated stomach may then become compressed by the diaphragmatic crura or a recurrent paraesophageal hernia may develop. Slippage may be secondary to breakdown of sutures or incorrect placement of the wrap around the esophagus. Conversely, slippage of the proximal stomach through an unbroken wrap creates a pouch below the diaphragm without development of a recurrent hiatal hernia. This is seen when the location of the wrap is inferior the level of the Z-line, indicating migration of the gastroesophageal junction superior to the wrap into the thoracic cavity (Fig. 1.12a).

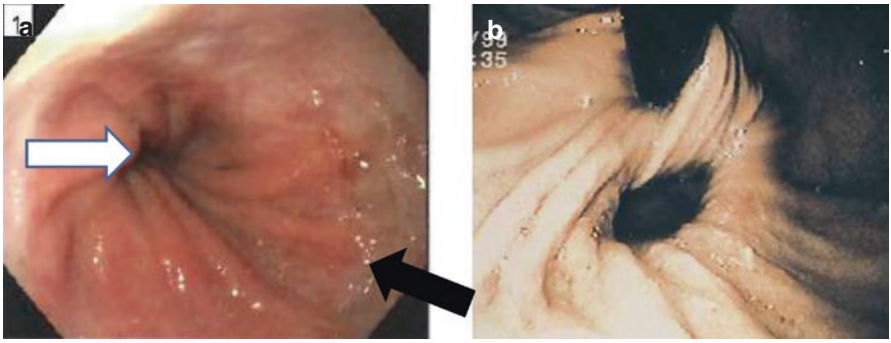

Fig. 1.12 Examples of recurrent hiatal hernias. (**a**) shows an esophageal view of a slipped Nissen fundoplication. The *black arrow* shows the gastroesophageal junction and the *white arrow* the position of the wrap. (**b**) shows a recurrent paraesophageal hernia with the wrap being pulled into the hernia

1.8.5 Recurrent Hiatal Hernia

Recurrence of a hiatal hernia is another possible surgical failure following antireflux surgery. In this case, through retroflexion a herniated pouch of stomach is typically seen next to the fundoplication fold indicating the presence of a recurrent hiatal hernia (Fig. 1.12b).

1.8.6 Twisted or Malconstructed Fundoplication

A twisted or malconstructed fundoplication may occur secondary to improper mobilization of the gastric fundus (lack of mobilizing the fundus, not ligating the short gastric vessels). Lack of mobility of the stomach fundus causing tension on the GEJ that ultimately causes rotation of the esophagus and fundoplication. Endoscopically there is a spiral-type of deformity that is seen when the scope is retroflexed to visualize the wrap.

1.9 Conclusions

Hiatal hernias occur when there is a herniation of abdominal contents in to the mediastinum via the diaphragm. Their prevalence is correlated with increasing age and obesity. Many times they are asymptomatic while other times they can have significant symptoms some of which include GERD, dysphagia, obstructive symptoms, to volvulus. Hiatal hernias are classified as either sliding or paraesophageal and are further classified into four subtypes. Symptomatic hernias need to be

repaired and there is still an ongoing debate on whether an asymptomatic hernia requires repair. Although the relationship between hiatal hernias and GERD has long been debated, there is indeed a relationship between the two. One of the main clinical concerns that hiatal hernias pose is the progression to high grade dysplasia and carcinoma as a result of progression from Barrett's esophagus. Endoscopy can be an invaluable tool in the evaluation of hiatal hernias as well as postoperative evaluation in patients who may be experiencing complications following antireflux surgery.

Current Knowledge and Future Directions

- Endoscopy is an important tool that aids in the diagnosis of hiatal hernia and reflux disease
- Endoscopic criteria for measuring hiatal hernias remain vague and further studies should be done to determine a clear consensus for diagnosing and measuring hiatal hernias
- Endoscopic mucosal resection offers a minimal invasive intervention for Barrett esophagus but efficacy and curative rates are limited to small single institution studies
- Complications following fundoplication can be diagnosed and treated using endoscopy in select patients
- Larger studies comparing endoclips, vacuum devices, and other approaches are needed to determine the best management approaches for patients with complications following fundoplication construction
- Endoscopy offers a variety of options for managing patients with foregut pathology and understanding its utility provides the surgeon with a powerful diagnostic and treatment tool

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