

## Outcomes of Post Laparoscopic Repair for Patients with Typical and Atypical Presentations of Hiatal Hernia

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**Abstract: Background:** Hiatal hernia is a common condition with chronic symptoms that may affect the quality of life, usually with delayed diagnosis due to a wide spectrum of symptoms that may similar with other conditions. Few studies have been done about hiatal hernia in the last few years, so I will made this research to evaluate hiatal hernia symptoms and the efficacy of laparoscopic repair in our country. **Objectives:** to evaluate the outcomes of post-laparoscopic hiatal hernia repair regarding typical and atypical clinical manifestations. **Patients and method:** The prospective cohort study for a total of 275 patients who were operated on between 17 March 2021 and 14 July 2023 by laparoscopic approach of hiatal hernia repair. All the data was retrieved from hospital information systems of AL-IRAQI Center private hospital, AL-GADEER private hospital in AL-NAJAF city, direct communication or phone calls of the patients. **Result:** This study evaluates the demographic characteristics, clinical manifestations, diagnostic findings, and surgical outcomes of patients with GERD-related hiatal hernia, dividing them into typical and atypical presentation groups. The study revealed no significant gender differences between the groups; however, a notable age difference was observed, with the typical group being younger (median age 28.4 years) compared to the atypical group (median age 49 years). Typical symptoms such as heartburn and regurgitation were prevalent, while atypical symptoms included chronic cough, chronic laryngitis, asthma symptoms, and dental erosion. Diagnostic evaluations indicated that atypical cases exhibited more severe esophageal motility issues and complex hernia types. Surgical outcomes demonstrated that atypical cases required more complex and longer operative procedures. Immediate postoperative complications, particularly dysphagia, were common but generally resolved within six months. The study underscored the efficacy of surgical intervention, with significant improvements in both typical and atypical symptoms over time. Notably, the resolution rates for typical and atypical symptoms were 91.7% and 45.9%, respectively, indicating the need for tailored postoperative care. These findings highlight the importance of recognizing the diverse clinical presentations of hiatal hernia to ensure timely diagnosis and effective management. **Conclusions:** The study emphasizes the diverse clinical presentations of GERD-related hiatal hernia and underscores the efficacy of the surgical intervention in improving symptoms. It highlights the need for recognizing both typical and atypical symptoms to facilitate timely diagnosis and appropriate management strategies.

**Keywords:** hiatal hernia , typical and atypical symptoms , gastro-esophageal reflux disease laparoscopic outcomes.

## INTRODUCTION

### Background of Hiatal Hernia (HH)

Hiatal hernias were initially documented by Henry Ingersoll Bowditch in Boston in 1853 and later categorized into three types by Swedish radiologist Ake Akerlund in 1926 (Arafat, F. O. *et al.*, 2012; Auyang, E. *et al.*, 2013). A hiatal hernia (HH) is generally characterized by the expansion of the gap between the diaphragmatic crura, allowing ascending of the stomach and other abdominal organs into the mediastinum (Oleynikov, D. *et al.*, 2014).

### Etiology

The etiology of hiatal hernias is primarily related to raised intra-abdominal pressure, which creates a trans-diaphragmatic pressure gradient between the thoracic and abdominal cavities at the gastroesophageal junction (GEJ) (Oleynikov, D. *et al.*, 2014). This pressure gradient produces the weakening of the phreno-esophageal membrane and the enlargement of the diaphragmatic hiatus

aperture. Additionally, a potential genetic component has been identified in the formation of hiatal hernias. Distinct familial clusters across multiple generations suggest a possible autosomal dominant mode of inheritance. Evidence has implicated the collagen-encoding COL3A1 gene and an altered collagen-remodeling mechanism in the development of hiatal hernias (Tiwari, M. *et al.*, 2011). Thus, both genetic and acquired factors appear to contribute to the formation of hiatal hernias (Watson, T. J. *et al.*, 2022).

### Incidence

Determining the true prevalence of hiatal hernias (HH) is challenging due to the asymptomatic nature of many cases and the variability in diagnostic criteria (Luketich, J. D. *et al.*, 2010). Hiatal hernias, including Para-esophageal hernias (PEHs), are more commonly observed in women. In the largest published series on the treatment of PEH, 75% of the patients were female (Argyrou,

A. et al., 2018). Types I HH are most often asymptomatic. When symptomatic, patients will commonly present with symptoms of Gastroesophageal reflux disease (GERD) (Dunn, C. P). Type II–IV hernias can be asymptomatic or symptomatic. It has been estimated that roughly 50% of patients with type II-IV hiatal hernias are asymptomatic (Dunn, C. P. et al., 2020).

#### Classification of HH :

The most popular anatomical classification includes four types:-

I. Type I (Sliding Hernias): characterized by the symmetrical upward movement of the stomach through the diaphragmatic hiatus aperture. Type I hernias account for more than 90% of hiatal hernia cases

Type II (Pure PEH): a section of the gastric fundus protrudes through the diaphragmatic hiatus next to the esophagus, while the gastro-esophageal junction remains in its usual anatomical position.

Type III hernias combine features of both types I and II, where both the fundus of the stomach and the GEJ herniate through the hiatal aperture, with the fundus positioned above GEJ.

Type IV hernias involve the herniation of structures beside the stomach into the thoracic cavity, such as the small bowel, colon, omentum, peritoneum, or spleen.

Types II to IV collectively were referred to as Para-esophageal hernias ( PEH ) (Sugimoto, M. et al., 2016 - Menezes, M. A. et al., 2017).

**Clinical presentations** Gastroesophageal reflux disease is a condition where the retrograde flow of the stomach contents other than air into or through the esophagus that produce frequent symptoms or result in damage or dysfunction of esophageal mucosa or contiguous organ of upper aerodigestive tract (Kamboj, A. K. et al., 2024). It ranks among the most prevalent digestive disorders in the US, affecting approximately 20% of the population and imposing a substantial economic burden through direct and indirect costs while significantly impacting quality of life (El-Serag, H. B. et al., 2014). Clinically, GERD commonly presents with typical symptoms such as heartburn and regurgitation. It can also manifest atypically with extra-esophageal symptoms including chest pain, dental erosions, chronic cough, laryngitis, or asthma (Hom, C. et al., 2013; Vakil, N. et al., 2006).

Based on endoscopic and histopathological findings, GERD is classified into three main phenotypes: non-erosive reflux disease (NERD),

erosive esophagitis (EE), and Barrett esophagus (BE) (Fass, R. et al., 2002). NERD is the most popular phenotype, observed in 60-70% of patients, with erosive esophagitis and BE, which are seen in 30% and 6-12% of GERD patients, respectively (Fass, R. et al., 2002; Fass, R. et al., 2007). Sleep disturbances related to symptoms of reflux are frequent, particularly in patients with functional dyspepsia who lack GERD symptoms, and become more prevalent with increased severity and frequency of reflux symptoms (Vakil, N. et al., 2016).

Advanced hiatal hernias that present solely with chest pain and reflux, known as **reflux chest pain**, are less commonly encountered. In patients with higher risk factors of cardiac disease, diagnosing chest pain may initially lean towards acute coronary syndrome due to its similarity to ischemic cardiac pain, sometimes occurring without concurrent heartburn or regurgitation (Khan, M. Z. et al., 2020). The typical GERD symptoms of reflux and chest pain may or may not correlate with esophageal mucosal injury visible on endoscopy (Kazakova, T. et al., 2023).

Esophageal strictures, a less common complication of GERD, are found in less than 5% of patients and are recognized by persistent dysphagia (Vakil, N. et al., 2006). Among patients with Barrett's esophagus, the hiatal hernia prevalence rate ranges between 72% to 96% (Zagari, R. M. et al., 2008). The relationship between hiatal hernia and reflux symptoms, reflux esophagitis, stricture, Barrett's esophagus, and esophageal malignancy are attributed to disruptions in anti-reflux mechanisms and increased esophageal acid exposure due to progressive herniation (Hyun, J. J. et al., 2011).

The significant association between hiatal hernia and GERD syndromes implies that many unusual manifestations of GERD may appear in patients with a hiatal hernia, notably as extra-esophageal symptoms. Extensive population-based studies have highlighted an increased likelihood of atypical symptoms among individuals diagnosed with reflux or esophagitis syndromes (Cesario, S. et al., 2018).

**Obstructive Gastrointestinal symptoms**, hiatal hernias can interfere with gastrointestinal filling, receptive relaxation, or continuity, leading to different obstructive symptoms (Goodwin, M. L. et al., 2021). Typical obstructive symptoms encompass early satiety, nausea, and gas bloating, often aggravated by oral intake. Dysphagia and

postprandial fullness arise due to esophageal compression by a gradual increase in the size of the herniated stomach. As the hernia ascends into the chest, it can alter the angle of the His, contributing to typical symptoms more commonly associated with Para-esophageal hernias (Goodwin, M. L. et al., 2021). Less frequently, atypical gastrointestinal obstructive manifestations of hiatal hernia include gastric outlet obstruction, gastric volvulus, or intestinal obstruction, resulting from progressive herniation of stomach and other abdominal structures. Organo-axial gastric volvulus associated with Para-esophageal hernias is the most common orientation observed which may manifest in acute or chronic pattern (Rashid, F. et al., 2010).

Additional atypical presentation of hiatal hernias, gastrointestinal bleeding linked with hiatal hernias may derive from gastric ischemia in instances of strangulation or acute secondary gastric volvulus (Dietrich, C. G. et al., 2021). Another distinct cause of gastric bleeding associated with hiatal hernias is **Cameron lesions**, characterized by linear ulcerations in the mucosa of the fundus or body of the stomach. The genesis of Cameron lesions is attributed to factors such as repeated trauma from contraction of the diaphragm on the herniated stomach, exposure to gastric acid, and local decrease in blood supply (ischemia) (Brar, H. S. et al., 2023). Cameron lesions are identifiable in approximately 5% of patients with diagnosed hiatal hernia through upper endoscopic evaluation (Brar, H. S. et al., 2023). More commonly, however, hemorrhage associated with hiatal hernias can be occult and manifest as iron deficiency anemia (IDA) (Zullo, A. et al., 2018). IDA is still considered an atypical presentation of hiatal hernias in the absence of Cameron lesions (Carrott, P. W. et al., 2013). A cohort study examining patients undergoing primary surgical repair of hiatal hernias found that 27% of the patients presented with anemia, which was associated with heightened postoperative complications (Chevrollier, G. S. et al., 2019).

**Pulmonary and Cardiac Manifestations of Hiatal Hernias**, as a hiatal hernia expands and a large portion of the stomach or other abdominal structures migrate into the mediastinum, respiratory symptoms may become more prominent (Serhane, H. et al., 2016). Typical respiratory manifestations of hiatal hernias encompass dyspnea and atelectasis due to pulmonary compression. Patients may experience exertional dyspnea or reduced exercise capacity

because of decreased forced vital capacity (FVC) (24). Atypical respiratory manifestations like pulmonary fibrosis are also linked to hiatal hernias, likely due to the increased prevalence of GERD in these patients (24). A recent study found that 53% of patients with idiopathic pulmonary fibrosis (IPF) had a hiatal hernia (HH) on computed tomography (CT) scans (Tossier, C. et al., 2016). This retrospective study also noted significantly higher respiratory-related mortality in IPF patients with a hiatal hernia (HH) compared to those without (Tossier, C. et al., 2016). A study with large sample size revealed a higher prevalence rate of atrial fibrillation (AF) in patients with HH, particularly notable rise in younger patients: a 17.5 fold rise in men and a 19 fold rise in women under 55 compared to the general population (Roy, R. R. et al., 2013).

#### **Pre-Operative Evaluation:-**

The Society of American Gastrointestinal and Endoscopic Surgeons (SAGES) emphasizes that pre-operative investigations should be limited to symptomatic patients and limited to investigations that directly influence clinical management plans (Kohn, G. P. et al., 2013).

**1. Barium Swallow Radiography:** This diagnostic method is valuable for assessing the size of the herniated stomach and the position of the GEJ (Andolfi, C. et al., 2016). It remains an important tool in hiatal hernia diagnosis, as evidenced by numerous studies. Siegal, et al., indicate that hiatal hernias can be identified using this technique if the axial herniation exceeds 2 cm (Siegal, S. R. et al., 2017). They also advocate for video-esophagram due to its additional benefit of evaluating bolus transit. According to Oleynikov, et al., barium swallow radiography is advantageous in detecting abnormal esophageal motility, stenosis, and strictures associated with GERD (Oleynikov, D. et al., 2015). It is also a useful tool for diagnosing a short esophagus (Kohn, G. P. et al., 2013).

**2. Esophagogastroduodenoscopy (EGD):** EGD allows for real-time visualization of the esophageal, gastric, and duodenal mucosa, which is not possible with barium swallow radiography. It is capable of identifying conditions such as erosive esophagitis, Barrett's esophagus, Cameron's ulcer, and lesions that may be indicative of malignancy (Andolfi, C. et al., 2016). However, it often fails to adequately visualize large hiatal hernias, particularly those involving organo-axial rotation of the stomach (Collet, D. et

al., 2013). Duranceau, *et al.*, discuss the difficulties in providing reliable endoscopic characterization of massive hernias, underscoring the importance of also performing a barium swallow X-ray for precise characterization (Duranceau, A. *et al.*, 2016). Roman, *et al.*, caution that excessive air insufflation during endoscopy can overestimate the perceived size of the hernia (Roman, S. *et al.*, 2014).

**3. Esophageal Manometer:** This technique provides critical information about esophageal motility. A separation of 2 cm or more between the crural diaphragm and the lower esophageal sphincter (LES) is considered diagnostic for hiatal hernia(HH) (Philpott, H. *et al.*, 2017). Andolfi, *et al.*, recommend esophageal manometry, particularly pre-operative, to exclude achalasia and other motility disorders. High-resolution manometry (HRM) is essential for verifying esophageal peristalsis before fundoplication surgery, as it offers real-time pressure recordings (Roman, S. *et al.*, 2014; Yu, H. X. *et al.*, 2018)

**4. 24-hour pH Testing:** While not required for diagnosing hiatal hernia, this test is useful for quantitatively analyzing reflux episodes by correlating pH levels with reflux symptoms (Oleynikov, D. *et al.*, 2015). Duranceau, *et al.*, regard it as the gold standard for documenting acid exposure in the esophageal lumen (Duranceau, A. *et al.*, 2016).

**5. Computed Tomography (CT) with oral contrast:** Although it's not routinely required for diagnosis, CT scans can provide extra data about the location and type of hiatal hernia. Often, hiatal hernias are incidentally visualized during CT scans conducted for other reasons (41). CT is particularly useful for evaluating gastric volvulus in patients with PEH (44).

Oleynikov, *et al.*, Duranceau, *et al.*, and Andolfi, *et al.*, have established that barium swallow X-ray, upper endoscopy, and manometer are crucial for the preoperative assessment of patients with suspected hiatal hernia (Andolfi, C. *et al.*, 2016; Oleynikov, D. *et al.*, 2015; Duranceau, A. *et al.*, 2016). Additionally, Weitzendorfer, *et al.*, emphasize that to reliably exclude the presence of a hiatal hernia before treatment, it is necessary to conduct all three investigations (Weitzendorfer, M. *et al.*, 2017).

#### **Management of hiatal hernia:-**

Treatment can be challenging at times, depending on the existence of complications. The most recent

guideline regarding the management of hiatal hernia was released by the Society of American Gastrointestinal and Endoscopic Surgeons (SAGES) in the year 2013 (Sfara, A. *et al.*, 2019).

#### **A. Medical Approach:**

Changes in lifestyle constitute the initial management strategy for hiatal hernias, encompassing weight reduction, raising the head of the bed by 8 inches while sleeping, avoiding meals 2–3 hours before going to bed and avoiding food that may aggravate symptoms of GERD such as chocolate, alcohol, caffeine, spicy foods, citrus, and carbonated drinks (Kahrilas, P. J. *et al.*, 2008; Katz, P. O. *et al.*, 2013). The American College of Gastroenterology (ACG) advocates an 8-week course of proton pump inhibitors (PPIs) as the preferred treatment for GERD symptoms, with no significant differences in efficacy among various types of PPIs (49). For patients with insufficient symptom relief from PPI one time per day, PPI two times per day therapy can be advised (Kahrilas, P. J. *et al.*, 2008). The current guideline suggests using the minimal effective dose of PPI necessary to relieve symptoms (Roman, S. *et al.*, 20214).

Patients with symptomatic Para-esophageal hernias typically experience minimal to no relief of symptoms from medications such as PPIs, histamine receptor antagonists, or antacids (Oleynikov, D. *et al.*, 2015). While these medications may alleviate symptoms, the most effective and definitive treatment for Para-esophageal hernias(PEH) remains surgical intervention (Sfara, A. *et al.*, 2019). Prokinetic drugs are not advocated either as monotherapy or as an adjunct treatment for GERD symptoms in patients with hiatal hernia (HH), as current guidelines do not support their efficacy (Kahrilas, P. J. *et al.*, 2008; 50).

#### **B. Surgical Approach**

Surgical intervention is recommended for symptomatic patients with Para-esophageal hernia , particularly those experiencing obstructive symptoms and gastric volvulus necessitating urgent intervention (Katz, P. O. *et al.*, 2013). In cases of sliding hernia and GERD symptoms unresponsive to PPI treatment, surgical intervention may be considered especially in patients with persistent regurgitation (Roman, S. *et al.*, 2014). The guidelines advocate against repairing sliding hiatal hernias when reflux disease and symptoms are absent, a stance supported by various authors (Siegal, S. R. *et al.*, 2017; Roman,

S. et al., 2014). Additionally, combining hiatal hernia repair with procedures like sleeve gastrectomy and gastric bypass surgery is recommended. Recent studies, including one by Mahawar, et al., highlight sleeve gastrectomy as a favorable option for obese patients with HH and/or GERD, demonstrating its safety alongside hiatal hernia repair (Mahawar, K. K. et al., 2015).

Technically, hiatal hernia repair can be approached trans-abdominally or via the left chest (transthoracic) or robotic surgery. Robotic fundoplication is considered a novel approach in treating GERD with large Paraesophageal hiatal hernia. Laparoscopic fundoplication, typically Nissen (360°), is the standard procedure for both type I and PEH (Vasudevan, V. et al., 2018), except in cases of preexisting esophageal dysmotility where Toupet (270°) fundoplication is the best option (Siegal, S. R. et al., 2017).

Mesh reinforcement in PEH repair remains controversial. SAGES guidelines do not definitively recommend for or against mesh due to inadequate long-term data (Kohn, G. P. et al., 2013). However, there is growing support for mesh reinforcement, as studies like those by Zaman, et al., indicate reduced recurrence rates with both synthetic and biologic mesh (Zaman, J. A. et al., 2016). Concerns exist regarding the use of synthetic mesh, which has been linked to complications such as esophageal erosion, stricture, dysphagia, obstruction, and stenosis (Yu, H. X. et al., 2018, Zaman, J. A. et al., 2016; Rochefort, M. et al., 2018). Studies by Zhang, Huddy, and Tam report lower hernia recurrence rates with mesh reinforcement in comparison with Cruroplasty in short-term follow-ups (up to 12 months) (Zhang, C. et al., 2017; Huddy, J. et al., 2016; Tam, V. et al., 2016)

**LARS was Judged to have Failed in any of the following Cases:-** (Vittori, A. et al., 2023)

1. GERD symptom recurrence (SS >10, i.e.: the 10th percentile of preoperative symptoms calculated on the patient population as a whole).
2. recurrence (or persistence) of Grade B or higher reflux esophagitis identified on endoscopy.
3. HH recurrence or slipped fundoplication (even in asymptomatic patients, if noted on a barium swallow or endoscopy).
4. pathological 24-hour pH monitoring (De Meester score >14.72), even in asymptomatic patients.
5. Postoperative onset of dysphagia (balloon dilatation or Toupet fundoplication).

6. BE progression or onset of esophageal adenocarcinoma.

### Aim of Study

1. To determine the percentage of typical and atypical presentations in patients with hiatal hernia.
2. To evaluate patients pre-operatively and intra-operatively including demographic characteristics, findings from pre-operative investigations, type of hernia, operative time and technique, and intra-operative complications and mortality rates in both typical and atypical groups.
3. To assess post-operative outcomes, including symptom resolution in both groups and the development of new symptoms not present pre-operatively.

### METHOD

#### Study Design

This study enrolled patients who underwent laparoscopic surgery for hiatal hernia (HH), characterized by the protrusion of part of the stomach through the diaphragm into the chest, encompassing both typical and atypical presentations. This prospective cohort study included a total of 275 patients who underwent surgery between March 17, 2021, and July 14, 2023, at two private hospitals: AL-IRAQI Center and AL-GADEER Hospital in AL-NAJAF City. All surgery is operated by a single authorized senior or under his supervision. Among these, 265 patients underwent primary surgery, while 10 underwent revision surgery ( nine of them in whom primary surgery done by other doctors ). Data were obtained from hospital information systems, direct communication, or phone calls with the patients.

#### Study Population

The study population comprised individuals aged 16 to 85 years, predominantly of Middle-Eastern descent, diagnosed with hiatal hernia. **Inclusion criteria** encompassed all patients diagnosed with hiatal hernia, both typical and atypical presentations, who underwent laparoscopic repair. **Exclusion criteria** included patients operated on via open methods, those non-compliant with follow-up visits or unresponsive after three phone calls, individuals with concurrent achalasia and hiatal hernia, and cases where hiatal hernia repair was performed during bariatric procedures.

#### Study Procedure

Patients underwent detailed history taking and physical examination. Patients divided into two

groups : **A.** patients with typical symptoms include heartburn , regurgitation, dysphagia , belching , bloating and epigastric pain **B.** patients with atypical symptoms include chronic cough, chronic laryngitis, asthma, dental erosion, intermittent gastric volvulus, transverse colonic obstruction, iron deficiency anemia ( IDA ), recurrent pneumonia, idiopathic pulmonary fibrosis ( IPF ), and chest pain with arrhythmia . Basic preoperative investigations including BMI , complete blood count (CBC), viral screening, renal function tests (RFT), random blood sugar (RBS), general urine examination (GUE), and liver function tests (LFT), were send in all patients. Specific investigations related to hiatal hernia, such as 24-hour pH monitoring, esophageal manometer, esophagogastroduodenoscopy (EGD) , barium esophagoram, and CT with oral contrast, were conducted as indicated. Intraoperative data were gathered from surgical records or directly from attending surgeons. Median follow-up duration ranged from 6 months to 2.3 years, during which postoperative symptom severity was assessed using modified DeMeester clinical scores and a visual analog scale (VAS ranging from 1 to 10).

#### Data Collection and Analysis

Data analysis was performed using SPSS version 28 for Microsoft Windows. A total of 275 patients who underwent laparoscopic hiatal hernia repair were included in the final analysis. The significance of the difference of different means (quantitative data) was tested using the Students-t-test for the difference between two independent means or Paired-t-test for the difference between paired observations (or two dependent means), chi-square test was used to test the difference between two categorical variables. Statistical significance was considered whenever the P-value was equal to or less than (0.05).

#### Ethical Considerations

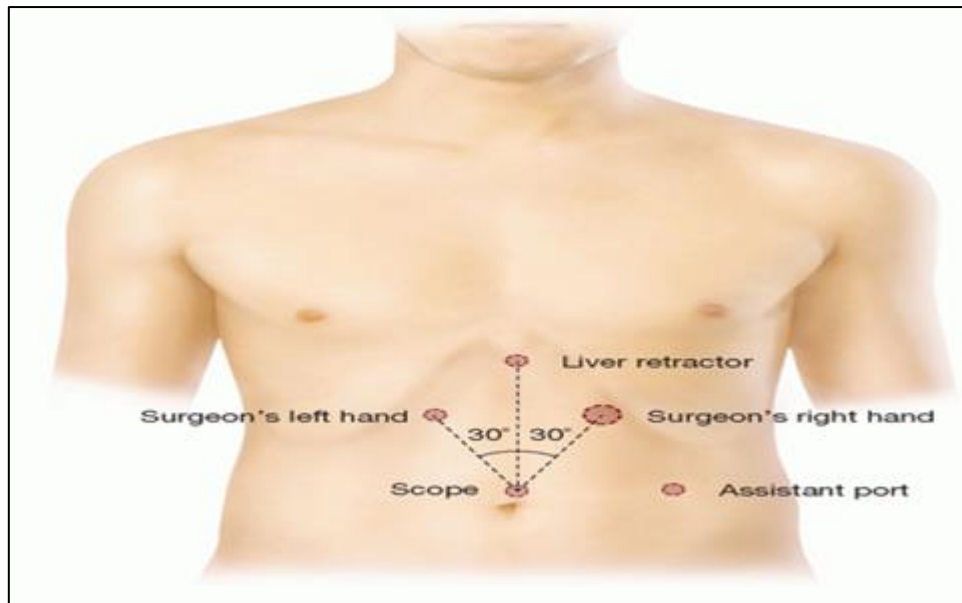
This study received approval from the Arabic Board Committee at AL-Sadar Medical City. Informed consent was obtained from all patients after a detailed explanation by physicians or research trainers, covering the study objectives, confidentiality of personal data, surgical procedures, potential complications, and

anticipated benefits.

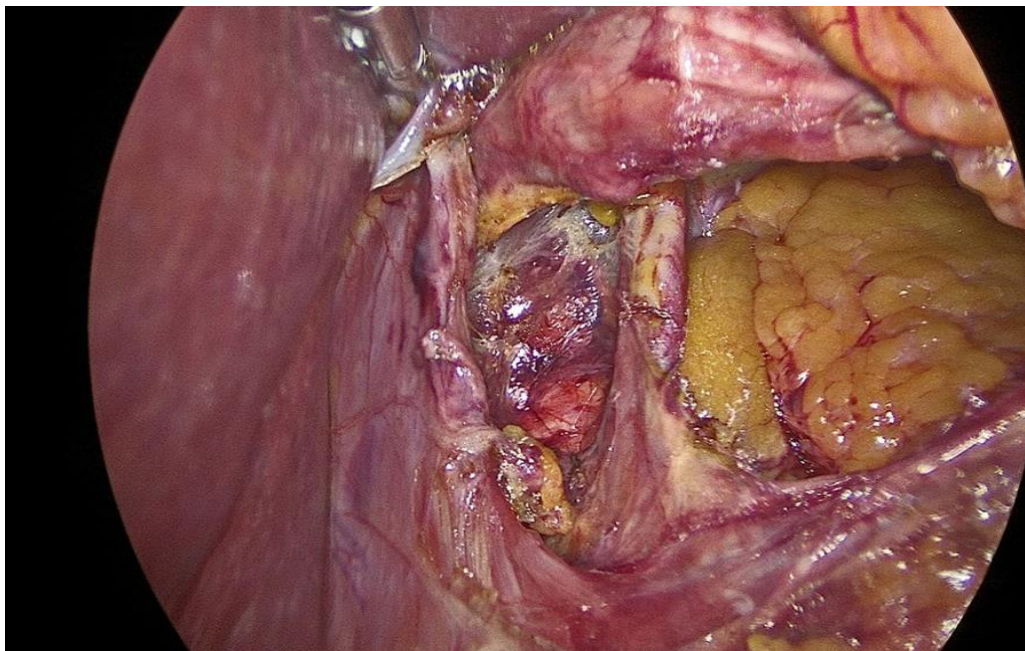
#### Surgical Technique :

**Laparoscopic Approach – Operative Technique**  
**Position and Incision:** The patient is positioned in a steep reverse Trendelenburg position with their legs apart. The surgeon stands between the patient's legs, with the first assistant on the patient's left and the nurse responsible for the instrument on the right. Ports are positioned in the following manner: a (10 mm) port in the left rectus sheath superior to the umbilicus and (10 mm) port in the left mid-clavicular line; (5 mm) ports are positioned in the left flank and right mid-clavicular line. Creation of pneumoperitoneum by veress needle at palmer point. Ports site during laparoscopic HH repair summarized in **figure (1)**.

**Sac Excision:** The dissection is bordered by the pleura laterally, pericardium anteriorly, and aorta posteriorly. Circumferential mobilization aids in reducing the whole hernia sac into the abdomen which permits the stomach to come back to normal anatomical position. The Pars flaccida is divided, providing entrance to the posterior part of the sac from the right side. The short gastric vessels are totally divided, and the gastro-esophageal fat pad is completely released to visualize the gastro-esophageal junction (GEJ) (**Fig. 2**). The anterior and posterior vagus nerves are visualized and preserved. The GEJ is assessed to ensure there is a sufficient length of intra-abdominal esophagus. Once the hernia sac is totally reduced and the mediastinum is clear, at least (2.5 cm) of tension-free intra-abdominal esophageal length is necessary. If a shortened esophagus is detected, extended circumferential mobilization of the intra-thoracic esophagus is accomplished to achieve the desired esophageal length. For a truly shortened esophagus, a wedge gastropasty over a large bougie is performed. A point (3 cm) below the angle of His is marked, and a transverse staple line is made using two to three applications of a linear end-GIA stapler. Once the esophageal dilator is reached, a vertical staple line along the bougie forms a 3- to 4-cm new esophagus, and the gastric wedge is pulled out from the abdomen . The new esophagus is made with wedge gastropasty, and a Nissen fundoplication is created. Collis gastropasty may also be used.



**Figure (1):** Show ports site during laparoscopic hiatal hernia repair

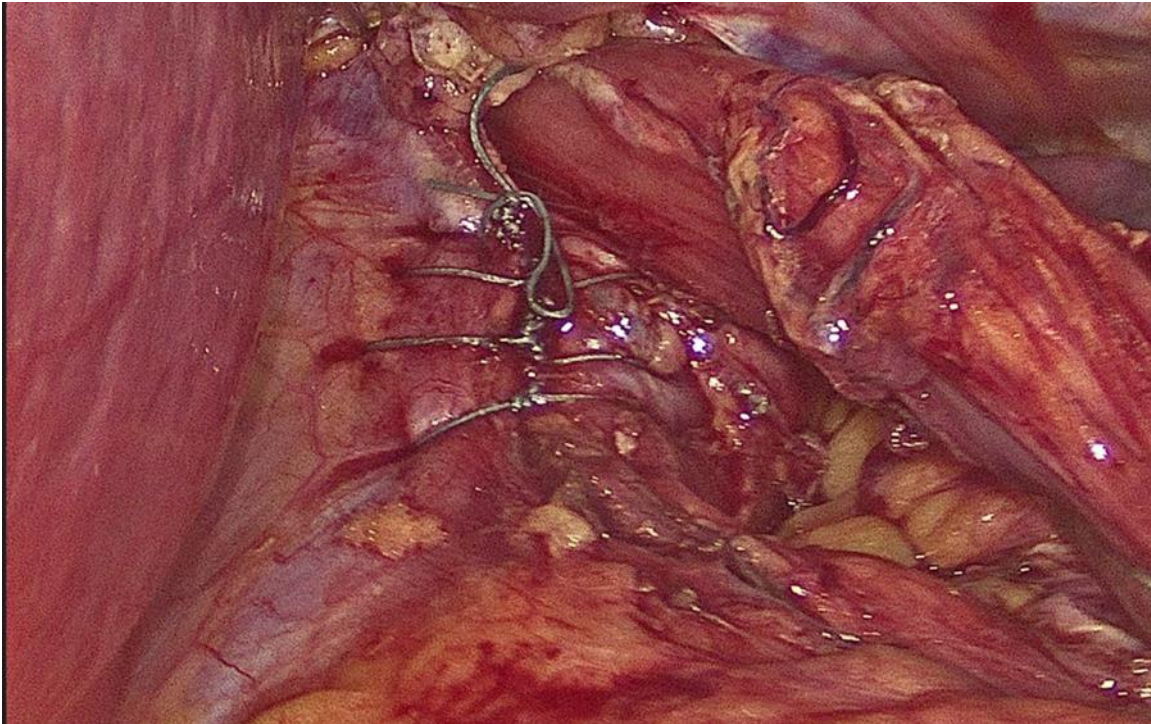


**Figure (2):** show circumferential mobilization of the hernia sac( in AL-Iraqi center private hospital)

### Repair of the Crura

The repair of the crura involves performing a posterior Cruroplasty with interrupted, braided, non-absorbable sutures, such as polypropylene (**Fig. 3**). When the crura are attenuated, it is advisable to use pledged sutures to distribute the tension and minimize the risk of tearing the crural fibers. Upon completion, the adequacy of the crural closure should be tested by passing a 56 to 60 French Maloney dilator through the new hiatal

aperture to ensure it is adequately filled. However, if this size of bougie is unavailable, as in our hospital, a size 42 bougie can be used, leaving a 5 mm space after closure. If the diaphragmatic repair seems to "pinch" the esophagus when the dilator is in place, a suture should be removed. Conversely, if the closure appears loose, the dilator should be withdrawn into the upper esophagus and an additional suture should be placed.

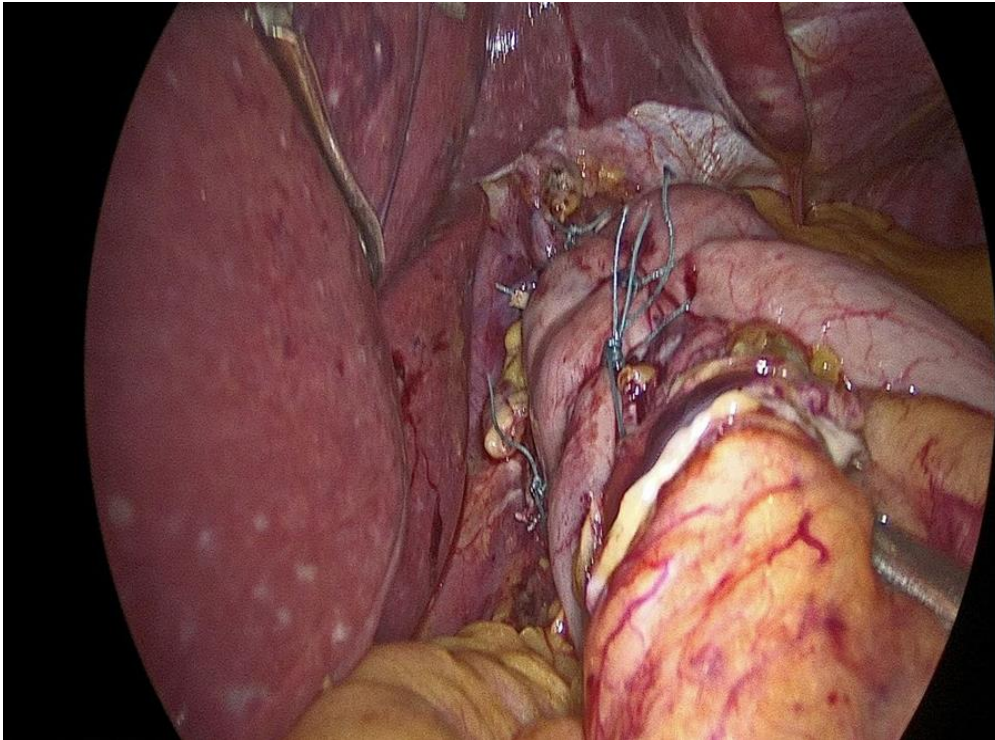


**Figure (3):** show hiatal hernia orifice after Cruroplasty ( in AL-Iraqi center private hospital )

**Fundoplication:-** Following the completion of the crural repair, we routinely perform an anti-reflux procedure. Typically, a Nissen fundoplication (**figure 4**) is conducted unless the patient has an abnormal manometry which would necessitate a partial fundoplication. If manometry results are unavailable or if intraoperative findings reveal friable esophageal muscle, a 270-degree posterior (Toupet) fundoplication is preferred, this approach provides effective fixation of the stomach and distal esophagus within the abdomen, offering good reflux control while minimizing the risk of postoperative dysphagia. A 42 French bougie is inserted into the stomach through the mouth after

the fundus has been successfully positioned behind the esophagus to minimize the risk of esophageal perforation. When a wedge gastroplasty is performed, the staple line is aligned with the stomach wall, and the most cephalic stitch of the fundoplication is positioned on the true esophagus above the new esophagus, verifying no gastric mucosa positioned above the fundoplication. The fundoplication is constructed using three 2-0 polypropylene sutures, each stitch incorporates the stomach and esophagus. More suture may be taken from the left postero-lateral portion of the wrap to the esophagus for more stability.





**Figure (4):** show 360° Nissen fundoplication ( in AL-Iraqi center private hospital)

**Closure:-** Jackson Pratt drain was inserted sub-hepatic and ports more than 5 mm were close by stich passer. skin closure was done using nylon suture (2-0).

#### **Postoperative Management:**

Patients are hospitalized post-surgery, with aggressive management of nausea using scheduled anti-emetics to prevent retching, which could lead to early hernia recurrence or disruption of the fundoplication. Initially, a clear liquid diet was introduced on postoperative day 2, progressing to full liquids on day 3 and a soft diet on day 7. A soft food diet was maintained for 3 weeks, after which patients can gradually return to a regular diet as tolerated. Typically, patients remain in the hospital for 1 to 2 days, ensuring adequate fluid intake and pain management before discharge. Upon discharge, patients were prescribed a third-generation cephalosporin, full-liquid diet, stool softeners, PPI, and antiemetic medications as necessary.

#### **Postoperative Assessment:**

Patients are examined at the outpatient clinic for 10 days, 1 month, 2 months, 3 months, 6 months, and 1 year, and then all patients are contacted by a WhatsApp application group for new complaints requiring new visits. At each visit, pre-operative symptoms are assessed with the same scoring methods applied pre-operatively and any resumption of PPI will be recorded. New onset

symptoms were also recorded with assessments of symptoms severity were conducted. Symptoms other than heartburn, regurgitation and dysphagia was subjectively assessed using a visual analog scale (self-assessment by patients with 0 being no symptoms and 10 being the worst symptoms they could imagine) pre-operatively and at least 12 months post-operatively. DeMeester symptom scores were used to assess the severity of heartburn, regurgitation and dysphagia. Each symptom was scored 0–3 in order of increasing severity. For heartburn and regurgitation absence of the symptom scored zero, an occasional non-troublesome symptom scored 1, a score of 2 was allocated for a symptom occurring more than once per week, and 3 was allocated for daily, or nocturnal symptoms requiring long-term PPI therapy. For dysphagia, a score of 2 is allocated for difficulty swallowing requiring liquids to clear two or more times per week, and 3 is for bolus obstruction requiring medical intervention, or the need to avoid certain foods altogether. A score of 2 or 3 is considered to be clinically significant. Patient satisfaction with laparoscopic fundoplication at 1 year was assessed by asking them whether they would go through the operation again given their experience with it.

Additional data required for research obtained by phone call, to maximize response rates, patients who did not initially respond are contacted by phone up to three times. Additional 24-hour PH

monitoring, manometry, and endoscopes are sent for patients not responded to lifestyle modification after 6 months. Patients with BE entered the follow-up protocols recommended by international guidelines. Resolution rate is defined as the complete absence of symptoms while good control men symptoms mean symptoms occurrence once per month or less frequently.

A total number of (265) patients were operated by first do surgery for hiatal hernia (HH). Male/Female Ratio , there were 66 males and 114 females in the typical group (36.666% / 63.333%), and 36 males and 49 females in the atypical group (42.352% / 57.647%). Median Age the typical

group had a median age of 28.448 years (range 25-35 years), while the atypical group had a median age of 48.96 years (range 45-55 years). Median BMI in the typical group was 20.678, and in the atypical group, it was 25.009. PPI Usage Duration , all participants in the typical group (100%) used PPIs, with usage durations ranging from 9 months to 18 years. In the atypical group, (44.705%) used PPIs for 1-5 months. These results indicate that there were no statistically significant differences between the typical and atypical groups across these parameters (P value more than 0.05). Demographic characteristics of patient with first do surgery are summarized in **table (1)**.

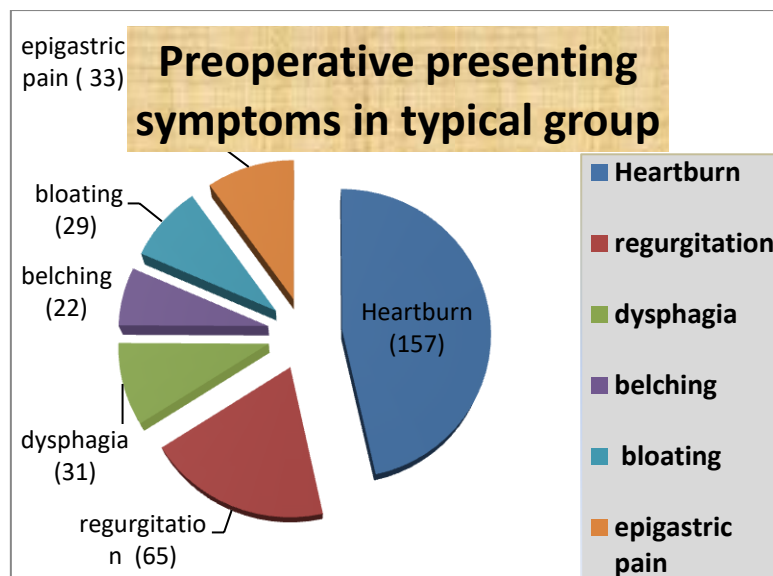
**Table (1):** Demographic characteristics of patient with first do surgery

Overall (n=265)	Typical(n=180) (67.924%)		Atypical (n=85) (32.075%)		P value
	No	%	No	%	
Male / Female ratio	66/114	36.666% / 63.333%	36 / 49	42.352% / 57.647%	0.752
Median age	28.448 (25-35 y)		48.96 (45-55 y)		0.274
Median BMI	20.678		25.009		0.382
PPI usage	(180) 100%		(38) 44.705%		0.337
Duration of usage	9 months to 18 Y		1-5 month		

BMI body mass index, PPI proton pump inhibitor.

A comparison of symptoms between typical (n=180) and atypical (n=85) manifestations of hiatal hernia in patients who underwent first do surgery revealed distinct clinical profiles. In the typical manifestation group, the most prevalent symptoms included heartburn (87.222%),

regurgitation (36.111%), dysphagia (17.222%), belching (12.222%), gas bloating (16.111%), and epigastric abdominal pain (18.333%). Data regarding typical symptoms pre-operatively are summarized in **figure (5)**.

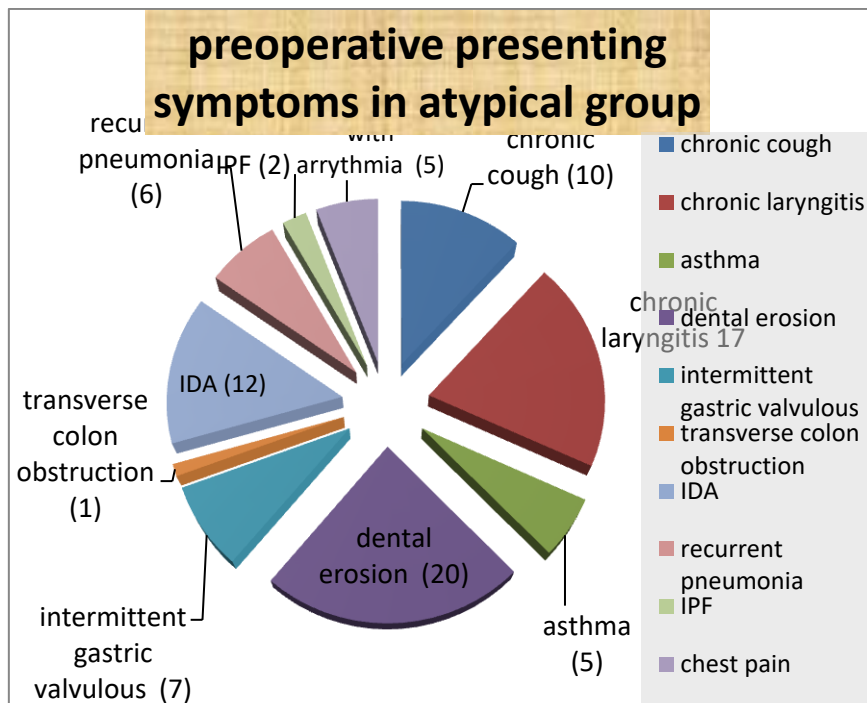


\*Total No. of patient with typical symptoms (180) , one patient may present with more than one symptom.

**Figure 5:** show preoperative presenting symptoms in typical group.

Conversely, patients with atypical manifestations exhibited a different symptomatology characterized by chronic cough (11.764%), chronic laryngitis (20.00%), asthma (5.882%), dental erosion (23.529%), intermittent gastric volvulus (8.235%), and transverse colon obstruction

(1.176%). Less frequently reported symptoms included iron deficiency anemia (6.667%), recurrent pneumonia (3.333%), idiopathic pulmonary fibrosis (1.111%), and chest pain with arrhythmia (2.778%). Pre-operative presenting symptoms data are summarized in **figure (6)**



\* total No. (85), each patient experience one atypical symptoms

**Fig. 6:** show preoperative presenting symptoms in atypical group

### Regarding pre-operative evaluations tools

**1. Manometry:** Manometry was performed in 225 patients, with 146 typical and 79 atypical cases. Of the typical cases, 34 (18.888%) did not undergo manometry, while 6 (7.0588%) of the atypical cases did not. Among those who underwent manometry, 18 (12.328%) of the 146 typical cases exhibited abnormal motility, compared to 26 (32.911%) of the 79 atypical cases. Normal motility was observed in 128 (87.671%) of the typical cases and 53 (67.088%) of the atypical cases. The results of the manometry ( $p < 0.001$ ) were statistically significant.

**2. OGD (Esophagogastroduodenoscopy):** All patients underwent OGD. Among the typical cases, 10 had Barrett's esophagus, 2 had esophageal strictures, 66 had esophagitis, and 4 had esophageal ulcerations. Among the atypical cases, 19 had esophagitis and 5 cases of Cameron ulcer.

**Type of Hiatal Hernia:** The majority of typical cases 167/180 (92.777%) were classified as Type I hiatal hernias, compared to 64/85 (75.294%) of the atypical cases. No cases of Type II hiatal hernias

were observed in either group. Type III hiatal hernias were observed in 13/180 (7.222%) of the typical cases and 19/85 (22.352%) of the atypical cases. Additionally, 2/85 (2.352%) of the atypical cases were classified as Type IV, with no Type IV cases among the typical cases. The differences in the type of hiatal hernia were statistically significant ( $p = 0.012$ ).

**3. 24-hour pH Monitoring:** 24-hour pH monitoring was not performed in 33/180 (18.333%) of the typical cases and 23/85 (27.058%) of the atypical cases. The remaining patients did undergo the test. Of those tested, 142/147 (96.598 %) of the typical cases had a positive reflux episode with symptomatic correlation, compared to 54/62 (87.096 %) of the atypical cases. The difference in the result was statistically significant ( $p = 0.036$ ).

**4. Barium Swallow:** Barium swallow was performed in 33/180 (18.333%) of the typical cases and 23/85 (27.058%) of the atypical cases. All patients who underwent the test exhibited normal esophageal motility, with one case of short esophagus observed in each group. The difference

in the rate of testing was statistically significant ( $p = 0.017$ )

**5. CT with Oral Contrast:** CT with oral contrast was performed in 13/180 (7.222%) of the typical cases and 23/85 (27.058%) of the atypical cases. Among the typical cases, the hernia sizes were as follows: 2 cases were less than 5 cm, 9 cases were between 5-10 cm, and 2 cases were greater than 10 cm. In the atypical cases, the sizes were distributed

as 3 cases less than 5 cm, 14 cases between 5-10 cm, and 6 cases greater than 10 cm. The difference in hernia sizes was statistically significant ( $p = 0.003$ ). Additionally, other viscera involvement was noted in 2 atypical cases, while none was observed in the typical cases ( $p = 0.882$ ). Diagnostic and Clinical Parameters in Typical and Atypical Manifestations of Hiatal Hernia are summarized in **table (2)**

**Table (2):** Diagnostic and Clinical Parameters in Typical and Atypical Manifestations of Hiatal Hernia

	Typical	Atypical	P value
1-Manometry			
Not send	34 (18.888 %)	6 (7.0588%)	<0.001
Send	146 (81.111 %)	79 (92.941%)	
Result	18/146 (12.328%) abnormal motility  128/146 (87.671%) Normal motility	26/79 (32.911%) abnormal motility  53/79 (67.088%) Normal motility	
2. OGD (all patients send for OGD )			
Result	(10) cases of Barrett's esophagus (2) cases of esophageal stricture (4) cases of esophageal ulceration (66) cases of esophagitis	(5) cases of Cameron ulcers (19) case of esophagitis	0.756
Type of hiatal hernia			
Type I	167/180 (92.777%)	64/85 (75.294 %)	0.012
Type II	Zero	Zero	
Type III	13/180 (7.222%)	19/85 (22.352%)	
Type IV	Zero	2/85 (2.352%)	
3. 24 PH monitoring			
Not send	33/180 (18.333%) 147 /180 (81.666%)	23/85 (27.058%)	0.036
Send	142 ( 96.598%) +ve reflux episode with symptomatic Correlation	62 /85 (72.941%)	
Result		54 (87.096%) +ve reflux episode with symptomatic correlation	
4. Barium swallow			
Send	33/180 (18.333%)	23/85 (27.058%)	0.017
Not send	147/180 (81.666%)	62/85 (72.941 %)	

Result	Short esophagus (1), with normal esophageal motility for all patients	Short esophagus (1) with normal esophageal motility for all patients	
5. CT with oral contrast			
Send	13/ 180 (7.222 %) 167/180 (92.777%)	23/ 85 (27.058%) 62/85	
Not send		(72.941 %)	
Result	2 <5 cm	3 < 5cm	0.003
I. Size of hernia	9 5-10 cm	14 5-10cm	
II. Other viscera	2 >10cm	6 >10 cm	0.882
	0	2	

Surgical Outcomes and Procedural Details in Typical and Atypical Manifestations of Hiatal Hernia show elective surgeries were performed in all cases of typical hiatal hernia (100.0%), whereas emergency surgeries were not required. In contrast, (98.823%) of atypical cases were elective, with emergency surgery accounting for (1.176%). Cruroplasty without mesh: employed in (96.666%) of typical cases and (91.764%) of atypical cases whereas Cruroplasty with mesh Utilized in (3.333%) of typical cases and (8.235%) of atypical cases. Number of sutures in Cruroplasty typically ranged from 2 to 4 in typical while more suture may needed in atypical cases. Median Operative Time Varied from 60 to 90 minutes for typical cases and 60 to 180 minutes for atypical

cases. Nissen fundoplication performed in (71.111%) of typical cases and (62.352%) of atypical cases while Toupet fundoplication implemented in (28.888%) of typical cases and (37.647%) of atypical cases. Mortality and Conversion Rates were zero. **Operative complications** were documented as follows: **Pleural Injury:** Occurred in 4 typical cases and 1 atypical cases. **Vagal Injury:** Noted in 3 typical cases and 0 atypical case. **Minor Esophageal Laceration:** Reported in 4 typical cases and 2 cases in atypical instances. **Bleeding:** Recorded in 3 typical cases and 1 atypical cases. Failure rate was (3.3%) in typical and (0.0%) in atypical group. Data regarding operative details summarized in **table (3)**

**Table (3):** Surgical Outcomes and Procedural Details in Typical and Atypical Manifestations of Hiatal Hernia

	Typical	Atypical
<b>Surgery type</b>	180/180 (100.0%)	84/85 (98.823%)
Elective	0 /180 (0.00%)	1/85 (1.176%)
Emergency		
<b>Hiatal closure</b>	174/180 (96.666%)	78/85 (91.764%)
Cruroplasty without mesh	6/180 (3.333%)	7/85 (8.235%)
Cruroplasty with Mesh		
<b>No. of suture in Cruroplasty</b>	2-4	2-7
<b>Median operative time</b>	60-90 min	60-180 min
<b>Types of fundoplication</b>		
Nissen	128/180 (71.111%)	53/85 (62.352%)
Toupet	52/180 (28.888%)	32/85 (37.647%)
<b>Mortality rate</b>	0	0
<b>Conversion rate</b>	0	0
<b>Operative complication</b>		
Pleura injury	4	1
Vagal injury	3	0
(Minor) esophageal laceration	4	2
Bleeding	3	1
<b>Failure rate</b>	6 (3.333%)	(0.00%)

The findings illustrate the varying persistence rates of typical symptoms following surgical intervention for hiatal hernia. follow up result show persistence rate of heartburn immediately

post-operative (12.738%) and (3.184 %) after 6 month. Persistence rate of dysphagia and epigastric pain immediately post-operative were high ( 80.545% )and (100%) respectively. The result

for pre-operative follow up in patients with typical presentation summarized in **table (4)**.

**Table (4):** Post-operative symptoms follow up for patients with typical presentations

Typical Symptoms	Persistence symptoms post-operative		
	Immediately post-operative	2-6 months	≥ 6 months
Heartburn	20/157 (12.738%)	7/157 (4.458%)	5/157(3.184%)
Dysphagia	25/31 (80.645%)	1/31 (3.225%)	0/31 (0.00%)
Regurgitation	2/65 (3.076%)	2/65 (3.076%)	2/65 (3.076%)
Gas bloating	19/29(65.517%)	13/29(44.827%)	8/29(27.586%)
Belching	0/22(0.00%)	0/22(0.00%)	0/22(0.00%)
Epigastric pain	33/33(100%)	5/33(15.151%)	33(0.00%)
Resolution rate / 1y	165 (91.666 % )		
Good control / 1y	175 (97.222%)		
Patient satisfication / 1y	172 (95.555%)		

The findings provide insights into the varying degrees of atypical symptom persistence following surgical treatment of hiatal hernia. Chronic Cough, chronic laryngitis and IPF following surgical intervention for hiatal hernia show persistence rates of (100%) immediately post-operatively and persistence rate of (20%) , (58.823% ) and (100%) after 6 months . Persistence rate were (0.00%) for intermittent

gastric volvulus and transverse colonic obstruction immediately post-operative. Symptoms of progressive dental erosion showed consistent rates of persistence immediately post-operative and after 6 month (10%). Persistence rates of iron deficiency anemia were observed as immediately post-operative (58.333%) while only (8.333%) after 6 month. Data regarding post-operative symptoms follow up summarized in **table (5)**.

**Table (5):** post-operative symptom follow-up for patients with atypical presentation

Atypical symptoms	Persistence of symptoms post-operative		
	Immediately	2-6 months post-operative	≥ 6 months
Chronic cough	10/10 (100%)	6/10 (60%)	2/10 (20%)
Chronic laryngitis	17/17 (100%)	14/17(82.352%)	10/17(58.823%)
Asthma	2/5 (40%)	1/5 (20%)	1/5 (20%)
Progressive dental erosion	2/20 (10%)	2/20 (10%)	2/20 (10%)
Intermittent gastric volvulus	0/7 (0.00%)	0/7 (0.00%)	0/7 (0.00%)
Transverse colonic obstruction	0/1 (0.00%)	0/1 (0.00%)	0/1 (0.00%)
IDA	7/12(58.333%)	1/12 (8.333%)	1/12 (8.333%)
Recurrent pneumonia	5/6 (83.333%)	2/6 (33.333%)	2/6 (33.333%)
IPF	2/2(100%)	2/2(100%)	2/2(100%)
Chest pain with arrhythmia	2/5(40%)	1/5 (20%)	1/5 (20%)
Resolution rate / 1y	(54.117 %)		
Good control / 1y	(75.294%)		
Patients satisfication / 1 y	71 (83.529%)		

Regarding newly discovered symptoms post-operative , (0.00%) heartburn or regurgitation observed post-operative. Dysphagia was observed in 77 out of 275 patients (28%) postoperatively. Immediately after surgery, all patients reported dysphagia, Persistence rate 5.194% at ≥ 6 months. Epigastric pain was prevalent in 171 out of 275 patients (62.218%) immediately after surgery. However, there was complete resolution of

symptoms in all patients by ≥ 6 months postoperatively. Inability to belch or vomit affected 114 out of 275 patients (41.454%) postoperatively. Immediately after surgery, all patients experienced this symptom, which persisted in (62.280%) at 2-6 months and in (14.921%) at ≥ 6 months. All data regarding newly discovered symptoms postoperatively summarized in **table (6)**.

**Table (6):** Newly discovered symptoms postoperatively

Symptoms	No./275	Follow up		
		Immediately post-operative	2-6 months	≥ 6 months
Heartburn	0/275 (0.00%)	(0.00%)	(0.00%)	(0.00%)
Regurgitation	0/275 (0.00%)	(0.00%)	(0.00%)	(0.00%)
Dysphagia	77/275 (28%)	77/77 (100%)	6/77 (7.792%)	4/77 (5.194%)
Epigastric pain	171/275 (62.218%)	171/171 (100%)	13/171 (7.602%)	0/171 (0.00%)
Inability to belch or vomit	114/275 (41.454%)	114/114 (100%)	71/114 (62.280%)	17/114 (14.912%)

Regarding re-do surgery, a total of 10 out of 275 patients (3.363%) required reoperation following initial surgical intervention for hiatal hernia. (4) patients underwent re-do operation because of

gastro-gastric fundoplication, whereas (8) patients show recurrent hiatal hernia. **The result regarding reoperation surgery summarized in table (7).**

**Table (7):** causes of reoperation and management

Causes of reoperation	Total No.(10) 10/275 (3.363%)	Management
1. gastro-gastric fundoplication with recurrent hiatal hernia	4	Re-do surgery with repositioning of the fundoplication on proper site with mesh used for one patient
2. Short wrap	1	Re-do surgery with take down the old fundoplication and repositioning on proper site
3. tight fundoplication and recurrent hiatal hernia	2	Re-do surgery with take down the old fundoplication and re-do Nissen fundoplication with repair of the hiatal hernia
4. rupture crus suture	2	Re-do Cruroplasty with Nissen fundoplication
5. ineffective esophageal motility on new manometry	1	Take down the old fundoplication and replaced with Toupet fundoplication

## DISCUSSION

Hiatal hernia is a frequently occurring condition commonly linked with GERD. Laparoscopic hiatal hernia repair (LHR) has become a standard surgical method for treatment, offering lower perioperative morbidity and shorter hospital stays compared to the open approach (Chang, C. G, 2015). While it is well known that anti-reflux surgery effectively alleviates typical symptoms, it remains uncertain whether atypical symptoms predict less favorable outcomes following laparoscopic anti-reflux surgery (LARS) (Vittori, A. et al., 2023). The aim of this study was to determine the percentage of typical and atypical presentation in patients with hiatal hernia, evaluation of the patient's pre-operative and intra-operative regarding the patient's characteristics, pre-operative investigations findings, type of hernia, operative time and technique and intra-operative complications and mortality rate in typical and atypical group and post-operatively

assessment regarding symptoms resolved in typical and atypical group and development of new symptoms that not present preoperatively.

## Demographics and Characteristics of the Study Population

The study shows a balanced gender distribution across both typical and atypical presentations of hiatal hernia. In the typical group, there were more females (63.333%) than males (36.666%), whereas in the atypical group, the distribution was also relatively balanced with (57.647%) females and (42.352%) males. The lack of significant difference (p-value = 0.752) suggests that gender may not strongly influence the manifestation of hiatal hernia types in this cohort study. A notable finding is the significant difference in median age between patients with typical and atypical hiatal hernia. Patients with typical symptoms had a much lower median age of 28.448 years (25-35 years), whereas those with atypical symptoms were notably older, with a median age of 48.96 years

(45-55 years). This difference was statistically significant ( $p = 0.274$ ), indicating that age could be a relevant factor in the presentation and possibly the progression of hiatal hernia to atypical forms. The median BMI values were 20.678 for typical cases and 25.009 for atypical cases, although this difference was not statistically significant ( $p = 0.382c$ ), lower BMI values in the typical group suggest a potential fear of food which aggravates GERD symptoms. The findings on the male-to-female ratio in the current study align with Addo AJ, *et al.*, research. However, discrepancies were noted concerning the median age and BMI compared to Addo AJ, *et al.*, which show no difference regarding this parameter between typical and atypical groups (Addo, A. J. *et al.*, 2023).

Hiatal hernia is associated with a spectrum of symptoms, typical symptoms like heartburn and regurgitation, were prevalent among the typical group, with (87.22%) and (36.11%) experiencing these symptoms, respectively. These findings align with Cesario S, *et al.*, highlighting heartburn as a hallmark symptom of hiatal hernia, attributed to the reflux of gastric contents into the esophagus (Cesario, S. *et al.*, 2018). In comparison with study done in Maastricht university, we report a higher percentage of typical manifestations in patients with hiatal hernia (Castelijns, P. S. S. *et al.*, 2018).

In contrast, atypical symptoms, while less frequent, also exhibited notable prevalence rates among the study cohort. Chronic cough and chronic laryngitis were reported by (11.76%) and (20.00%) of participants, respectively. Our study reports a lower percentage of chronic cough and chronic laryngitis in comparison with Dowgiallo, *et al.*, study and Mosli M, *et al.*, respectively (Dowgiało-Gornowicz, N. *et al.*, 2021; Mosli, M. *et al.*, 2018).

Further analysis reveals additional atypical symptoms, including asthma (5.88%), and dental erosion (23.53%). The dental erosion and asthma observed in our study are consistent with findings reported in Pauwels, A. *et al.*, (Pauwels, A. *et al.*, 2015).

Our findings indicate substantial differences in both the utilization and outcomes of various diagnostic modalities, shedding light on the complexity and heterogeneity of hiatal hernia presentations.

**Manometry:** In our study (76.71%) of typical cases underwent manometry compared to (92.94%) of atypical cases. The incidence of abnormal motility was significantly higher in atypical cases (35.62%) compared to typical cases (16.07%) ( $p < 0.001$ ). This suggests that esophageal motility disorders are more prevalent in atypical presentations, potentially contributing to their complex symptomatology.

**Esophagogastroduodenoscopy (OGD):** OGD results revealed a diverse range of esophageal pathologies among typical and atypical cases. The prevalence of esophagitis was markedly more common in typical cases (66 cases) than in atypical cases (19 cases). This underscores the association of esophagitis with typical symptoms, which is comparable result with data obtained from Cesario, S, *et al.*, study. The distribution of hiatal hernia types differed significantly between typical and atypical cases ( $p = 0.012$ ). Type I hiatal hernias were predominantly observed in typical cases (92.78%), while atypical cases exhibited a higher prevalence of Type III (22.35%) and Type IV (2.35%) hernias. This variation suggests that atypical symptoms may be linked to more severe anatomical abnormalities, potentially complicating clinical presentation and management. In contrast, Addo, A.J. *et al.*, 2023 papers show type iii hiatal hernia is more common in the typical group.

**24-hour pH Monitoring:** A higher proportion of typical cases demonstrated positive reflux episodes (96.596 %) compared to atypical cases (87.096 %). This disparity might indicate that while reflux is a prominent feature in typical cases, atypical cases may present with symptoms less directly attributable to acid reflux, necessitating further diagnostic scrutiny.

**CT with Oral Contrast:** The utilization of CT with oral contrast was significantly greater in atypical cases (27.06%) compared to typical cases (7.22%) ( $p = 0.003$ ). The distribution of hernia sizes further differentiated the groups, with larger hernias more common in atypical cases. Additionally, other viscera involvement was noted exclusively in atypical cases, although this difference was not statistically significant ( $p = 0.882$ ). These findings may imply that atypical presentations may be associated with more complex anatomical and pathological features, warranting advanced imaging for comprehensive assessment.



The surgical outcomes indicate several noteworthy differences between typical and atypical hiatal hernia cases. All typical cases underwent elective surgery, whereas a small percentage of atypical cases required emergency intervention, this suggests that the atypical group may be present with more acute or severe symptoms necessitating urgent surgical attention.

Use of mesh in Cruroplasty was more frequent in atypical cases (8.235%) compared to typical cases (3.333%), this could may reflect the complexity and severity of hernias in atypical cases, requiring additional reinforcement. The median operative time was longer for atypical cases (60-180 minutes) compared to typical cases (60-90 minutes), again indicating more complex surgical procedures in the atypical group. The choice of hiatal closure method, use of fundoplication type, and management of operative complications will depend on the health status of the patients, pre-operative investigation, and intra-operative assessment. Failure rates were (3.333%), and all were in typical patients ( four of them showed new onset dysphagia while 2 showed persistence of pre-operative regurgitation). The absence of mortality and conversion rates in both groups were zero underscores the safety and efficacy of surgical interventions for hiatal hernia, irrespective of symptomatology. The findings align with Castelijns, *et al.*, 2018 findings , indicating lower complication rates, shorter operative times, lower conversion rates, and reduced mortality. Our study shows a lower failure rate corresponding to Vittori A, *et al.*, 2023, which reports (36%) failure rate (58), perhaps linked to advancements in laparoscopic surgery techniques over recent years.

The persistence of symptoms post-operatively provides important insights into the efficacy and limitations of surgical interventions for hiatal hernia. The incidence of heartburn significantly decreased following surgical intervention, with the prevalence dropping from (12.7%) immediately post-operative to (4.5%) at 2-6 months and further down to (3.184 %) at  $\geq 6$  months. For patients with heartburn that persists after 6 months, all experienced mild to moderate attacks and were kept on low doses of PPI on demand after the exclusion of etiological causes. Dysphagia presented a high immediate post-operative prevalence of (80.6%), which sharply decreased to (3.2%) at 2-6 months and resolved completely by  $\geq 6$  months. This pattern suggests that while dysphagia is a common immediate postoperative complication, it is largely transient and resolves as

the patient recovers from surgery, demonstrating the long-term efficacy of surgical intervention in managing this symptom. Regurgitation rates remained relatively unchanged (3.1%) for patients experiencing this symptom immediately post-operative, at 2-6 months, and at  $\geq 6$  months. For those 2 patients, OGD showed normal results but the patient unfortunately refused 24-ph monitoring , so kept on lifestyle modification and diet management with good results. Epigastric pain affected all patients immediately after surgery (100%), but by 2-6 months, the prevalence decreased to (15.2%), and no cases were reported at  $\geq 6$  months. This indicates a rapid improvement in epigastric pain following surgery, with most patients experiencing relief during the early recovery phase. Our study shows a higher resolution rate (91.666%) in corresponding to the Vittori, A. *et al.*, study, which shows a resolution rate of (58%), with comparable good control of symptoms rate (97.222%) and (93.5%) respectively(58). Regarding Barrett's esophagus, (6) of them show complete resolution while (4) of them refuse to do OGD postoperatively. The high-resolution rate and good control rate suggest that the surgery effectively manages typical symptoms, contributing to high patient satisfaction (95.555%) at one year which is slightly higher than Frankel, *et al.*, 2023 study that shows a satisfistification rate (94%).

In patients with atypical manifestations, chronic cough decreases from (100%) persistence rate immediately post-operative to (20%) after 6 months, and chronic laryngitis decreases from (100%) to (58.823%) in the same period. This suggests that while surgery is initially effective, some patients continue to experience these symptoms in the long term. Asthma The persistence of asthma symptoms decreases from (40%) immediately post-operative to (20%) after 6 months, indicating partial improvement but also highlighting the chronic nature of this condition in the context of hiatal hernia. The persistence rate of dental erosion remains constant at (10%) across all time points, suggesting that this symptom is less responsive to surgical intervention and may require additional dental management. There is a marked reduction in IDA from (58.333%) immediately post-operative to (8.333%) at  $\geq 6$  months, reflecting a significant improvement and suggesting effective correction of bleeding or malabsorption issues through surgery. The resolution rate of symptoms in the atypical group was (54.117%) while good control in (75.294%) of

patients. The findings on resolution rate in the current study align with those reported in Farrel TM, *et al.*, research, which show resolution rate less than (50%)(68). Patient satisfaction at one year (83.529%) reflects partial improvement, with room for enhanced management of atypical symptoms which is again higher in comparison with Frankel, *et al.*, 2023, study which shows (67%) of patients' satisfaction. Patients presenting with laryngopulmonary symptoms constitute a significant proportion of those who express dissatisfaction in atypical group.

Regardless of preoperative presentation many patients post-operative developed symptoms that were not present before. Post-operatively, none of the patients experienced heartburn or regurgitation (0.00%). dysphagia was experienced in (28%) (n=77) of patients post-operative. The persistence rate of dysphagia beyond six months was (5.194%) (n=4), indicating a significant decrease over time. This finding aligns with Walle KV, *et al.*, study, that mention rate of (25.9%) (69). Two of them underwent re-do surgery for conversion from Nissen to Toupet fundoplication, one responded to balloon dilatation and the last one responded well to diet management. The inability to belch or vomit was observed in (41.454%) (114 out of 275) of patients postoperatively. All patients who initially experienced this symptom, show persistence rates of (62.280%) at 2-6 months and (14.921%) at  $\geq 6$  months. This finding indicates that while this symptom is prevalent immediately after surgery, it significantly decreases over time, though a notable minority of patients continue to experience it beyond six months. This finding is comparable with the finding of Anvari, *et al.*, 2001, who showed gas bloating syndrome post-operative in (54%).

## LIMITATIONS OF THE STUDY

1. Sample Size and Selection Bias: The sample size might not be large enough to capture all variations in presentation and outcomes, and there could be inherent selection bias in choosing patients for surgical intervention.
2. Follow-up Duration: The duration of follow-up may not be sufficient to fully capture long-term outcomes and complications associated with hiatal hernia surgery, especially for atypical symptoms.
3. Heterogeneous Treatment Protocols: The study may have included patients treated with different surgical techniques or approaches (e.g., laparoscopic vs. open surgery, different types of fundoplication), which could introduce variability

in outcomes that are not accounted for in the analysis.

4. Limited Ethnic or Geographic Diversity: The study population may have lacked diversity in terms of ethnicity or geographic location, which limits the generalizability of findings to more diverse or global populations with potentially different disease presentations and outcomes.
5. Short-term Focus: The study predominantly focuses on short- to medium-term outcomes (up to 6 months post-operatively), which may not capture all relevant long-term complications or outcomes associated with hiatal hernia surgery, such as hernia recurrence or late-onset complications.

## Strengths:

1. Comprehensive Data Collection: The study includes detailed pre-operative evaluations, intra-operative findings, and extensive post-operative assessments, providing a comprehensive view of both typical and atypical presentations of hiatal hernia.
2. Senior Author Supervision: All procedures were conducted or supervised by a senior author, ensuring consistency and reliability in surgical techniques and data interpretation.
3. Operative Technique Consistency: With all procedures performed or supervised by a single senior author, there is likely a high degree of consistency in the operative techniques, reducing variability and making the outcomes more reliable.
4. Detailed Symptom Resolution Analysis: The study offers detailed insights into the resolution of both typical and atypical symptoms post-operatively, contributing valuable information to the field of hiatal hernia management.
5. Comparison with Existing Literature: The study compares its findings with those reported in other research studies, enhancing the context and relevance of its conclusions within the broader scientific literature.
6. Longitudinal Symptom Tracking: The study tracks symptom changes over time, from immediate post-operative to  $\geq 6$  months, providing a comprehensive view of the short- and medium-term efficacy of the interventions.
7. Specific Focus on Atypical Symptoms: The inclusion and detailed analysis of atypical symptoms like chronic cough, chronic laryngitis, asthma, and dental erosion provide a broader understanding of hiatal hernia's clinical spectrum, which is often underrepresented in studies focusing solely on typical symptoms.

## CONCLUSION

Hiatal hernias may present in variety of ways, both typical and atypical symptoms. Through a comprehensive analysis of various diagnostic modalities, we identified significant disparities in test utilization and outcomes between the two groups. Atypical cases were more frequently subjected to advanced diagnostic evaluations reflecting the diagnostic challenges posed by their complex symptomatology

Post-operatively, the study observed a significant reduction in typical GERD symptoms, with most patients experiencing complete resolution of heartburn and regurgitation. However, new symptoms not present preoperatively, such as dysphagia and inability to belch or vomit, were noted in a substantial number of patients, underscoring the need for comprehensive post-operative care and management.

In conclusion, while surgical intervention for hiatal hernia generally leads to significant improvement in typical GERD symptoms, the persistence of some atypical symptoms post-operatively suggests ongoing challenges in managing these complex cases.

## RECOMMENDATIONS

### Clinical Practice Recommendations

1. Individualized Treatment Plans: Develop and implement individualized treatment plans for patients with hiatal hernia, taking into account age, symptom presentation (typical vs. atypical), and diagnostic findings to optimize surgical outcomes.
2. Enhanced Pre-Operative Assessment: Utilize comprehensive pre-operative diagnostic tools, such as manometry and 24-hour pH monitoring, to better characterize the type and severity of hiatal hernia and guide surgical planning.
3. Post-Operative Monitoring: Establish a structured follow-up program to monitor and manage post-operative symptoms, with specific attention to the persistence of atypical symptoms and the development of new symptoms.
4. Patient Education: Provide thorough education to patients regarding potential post-operative symptoms, including the possibility of transient dysphagia and the inability to belch or vomit, to set realistic expectations and improve patient satisfaction.
5. Multidisciplinary Approach: Implement a multidisciplinary approach involving gastroenterologists, surgeons, dietitians, and possibly dentists (for patients with dental erosion) to address the broad spectrum of symptoms associated with hiatal hernia.

6. Psychosocial Support: Provide psychosocial support to help patients cope with the physical and emotional challenges associated with hiatal hernia and its surgical treatment

### Research Recommendations

1. Multi-Center Studies: Conduct multi-center studies to increase the generalizability of findings and to account for variations in clinical practice and patient populations.
2. Larger Sample Sizes: Include larger sample sizes to enhance the statistical power of the study and allow for more detailed subgroup analyses.
3. Long-Term Follow-Up: Extend the follow-up period beyond 6 months to capture long-term outcomes, recurrence rates, and late-onset complications associated with hiatal hernia surgery.
4. Quality of Life Assessments: Incorporate validated quality of life assessments to better understand the impact of surgical intervention on patients' overall well-being and daily functioning.

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