



Choosing the best approach for paraesophageal hiatal hernia repair: a narrative review

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Abstract: The optimal approach for repairing large paraesophageal hernia (PEH) is unclear. Historically, these were initially approached through a transthoracic incision, then shifted to a laparotomy. Now laparoscopy has been the most common approach for at least the past decade, during which time the robotic approach has also increased in utilization. This article reviews the pros and cons of the different approaches, including recurrence rates, morbidity, and mortality. Using this information, we propose a general framework for the utilization of each approach as a reference for surgeons in their clinical decision making and operative planning. Laparoscopic (and/or robotic) approaches are best suited for small PEHs or cases of reflux alone. Robotic technology can aid in crural repair and potentially reduce long-term recurrence compared to traditional laparoscopy, while maintaining the benefits of quicker recovery. A laparotomy should generally be reserved for patients with recurrent PEH and severe intra-abdominal adhesions or urgent situations such as obstruction, gangrene, or conversion from laparoscopy. Due to the high risk of recurrence, patients with larger PEHs (type III or IV) or risk factors for recurrence (obesity, shortened esophagus, chronic cough, or constipation), should be strongly considered for a transthoracic approach. It is unclear if mesh offers benefits long term, but there is a small incidence of catastrophic mesh complications that should also be considered. Non-operative management of PEH, though occasionally utilized for asymptomatic patients, should generally be avoided due to a high risk of PEH-related complications and mortality.

Keywords: Hiatal hernia; paraesophageal; transthoracic; laparoscopic; robotic

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Introduction

All symptomatic patients with paraesophageal hernia (PEH) are recommended to undergo repair (1,2), but there remains a great deal of debate on which operation provides the best outcomes and lowest comorbidities. Large PEHs were traditionally repaired through a thoracotomy or laparotomy.

The laparoscopic approach to PEH repair was first published in 1992 (3). Laparoscopy is now widely accepted as the gold standard and default approach for most patients. The proportion of PEH repairs performed laparoscopically increased 8-fold over a decade, from 10% in 2002 to 80% in 2012 (4). As a result of the growth of laparoscopic PEH repairs, the transthoracic technique is a skill set that has

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Table 1 Summary of approaches to PEH repair

Surgical approach	Pro	Con	Who should get this repair?
Laparoscopic	Broad familiarity Low morbidity	High recurrence rate	Small to moderate hernias
Robotic-assisted laparoscopic	Improved visualization and dexterity Low morbidity	Higher Costs Limited data on long-term outcomes	Small to moderate hernias Recurrent repairs
Open transabdominal	Broad familiarity Rapid conversion from minimally invasive approach	High morbidity	Conversion from minimally invasive approach Intra-abdominal adhesions Emergent situations
Open transthoracic	Optimal access to mediastinum and crura Low long-term recurrence rate	High morbidity Post-thoracotomy pain Decreased experience	Large (type III and IV) hernias High recurrence risk Intra-abdominal adhesions

paraesophageal hernia (PEH).

been lost for general surgeons and even most cardiothoracic surgeons. Nevertheless, the transthoracic approach remains an important option for a select set of patients for both primary repairs and re-operative situations. In addition, robotic equipment has made intracorporeal suturing easier and has potential benefits over the laparoscopic repair.

Our institution is a quaternary care academic medical center that has been the local center of expertise for repair of large PEH and recurrent hiatal hernias of all sizes. We perform 80–100 operations per year by transthoracic, laparoscopic, and robotic laparoscopic approaches. We always perform an anti-reflux operation, use biologic mesh sparingly and only with the laparoscopic approaches. In this report, we draw on our combined clinical experience and the existing literature to compare the pros and cons of the various approaches for large PEH repair, including laparoscopy, robot-assisted laparoscopy, laparotomy, and thoracotomy. We propose a general framework for the utilization of each approach as a reference for surgeons in their clinical decision making and operative planning (*Table 1*). We present the following article in accordance with the Narrative Review reporting checklist (available at <https://vats.amegroups.com/article/view/10.21037/vats-21-13/rc>).

Methods

A literature review was conducting using PubMed. The

database was searched for English-language studies from 1973 to March 2021 using the term “paraesophageal hiatal hernia repair” combined, using the Boolean operator AND, with “transthoracic”, “laparoscopic”, “open”, “robotic”, “mesh”, or “long-term outcomes”. Abstracts were reviewed for relevance. Only articles discussing the repair of giant PEH were considered. Case reports, animal studies, pediatric studies, and studies focused exclusively on repair of recurrent PEH or PEH repair in patients with morbid obesity were not considered for this review. Video-assisted thoracoscopic (VATS) PEH repair was not considered for this review, as it has not been significantly adopted and is the subject of only a single case series (5).

Laparoscopic repair

Since the first published cases in 1992 (3), laparoscopic repair has become the most common method for approaching PEH. The proportion of repairs performed laparoscopically increased from 9.8% in 2002 to 79.6% in 2012 (4). From 2010 to 2017, that proportion continued to increase to 91.3% of all repairs (6).

Pros

One of the major benefits of laparoscopic PEH repair is its safety and excellent perioperative outcomes. This has

been documented in numerous studies using nationwide databases [American College of Surgeons National Surgical Quality Improvement Program (NSQIP) (6-8), Nationwide Inpatient Sample (NIS) (4,9), and the University HealthSystem Consortium (10)]. They consistently find the laparoscopic approach to be associated with shorter length of stay (LOS) (4,6-10), lower rates of readmission (6,7,10), fewer reoperations (6,7), decreased need for intensive care (10), lower hospital costs (10), decreased morbidity (4,6-8,10), and decreased mortality (4,6-9) compared to open approaches. These outcomes persist when limiting the analysis to certain subgroups: patients with only minor comorbid conditions (10), patients who present with obstruction or gangrene (10), patients undergoing elective PEH repairs (11), and urgent/emergent PEH repairs (11). Dubina *et al.* performed a multivariate regression analysis, controlling for patient comorbidities and preoperative disease severity, and found that laparoscopy was associated with decreased morbidity (7).

Cons

The long-term outcomes of laparoscopic PEH repair—typically defined as symptom resolution and recurrence—are variable. Three studies have followed patients out to nearly 10 years with rates of radiologic recurrence from 32–66%. There is considerable debate over the importance of radiologic recurrence. One group found that patients with recurrence had significantly lower Gastrointestinal Quality-of-Life Index (GIQLI) scores (12), another study found recurrence to only be associated with heartburn (13), and the third study found no significant relationship between recurrence and symptoms (14). The rates of reoperation in these studies were 3–6%. It is important to note that these studies include data from the relatively early years of laparoscopic PEH repair. Future published recurrence rates may decrease as patients from the past decade, when laparoscopy was widely adopted for PEH repairs, continue to be followed long term.

It has been thought that these high recurrence rates in laparoscopic PEH may be reduced by the use of mesh cruroplasty, though the strongest evidence in support of mesh is limited to outcomes at 6–12 months of follow-up (15-18). This short-term benefit of mesh appears to fade in the long term. One randomized trial compared laparoscopic PEH repair with primary crural repair versus biologic mesh (porcine small intestine). Recurrence rates were lower with biologic mesh cruroplasty at 6 months (9% *vs.* 24%) (18) but

similar to primary repair after 5 years (54% *vs.* 59%) (19). Another non-randomized study found a significant increase in radiologic recurrence rates after repair with absorbable mesh from 16% at 1 year post-op to 39% at 5 years post-op (20). These studies were performed with absorbable mesh, but long-term outcomes using non-absorbable synthetic mesh with laparoscopic PEH repair found that mesh cruroplasty had similar recurrence rates to primary repair (64% *vs.* 67%) at a median follow-up of 8 years (14).

Any potential benefit of mesh in laparoscopic PEH repair must be weighed against its potential risks. Esophageal stenosis and dysphagia can occur in up to 13–62% of patients after mesh repair (1,12) and require dilations or reoperation. The most feared complication of mesh cruroplasty is erosion of the mesh into surrounding organs, most commonly the esophagus or stomach (21). The true incidence of mesh erosion is not well understood and may be higher than it appears in the literature (21,22). Erosion can result in severe morbidity, often requiring reoperation and occasionally leading to prolonged tube feeding or organ resection (21,22). The authors' institutional bias is to avoid mesh due to a lack of convincing long-term benefit and our consistent referrals for mesh complications.

Who should get a laparoscopic repair?

The safety and efficacy of the laparoscopic approach have appropriately made it the gold-standard repair for most patients with PEH. Given the broad familiarity with laparoscopic techniques among general and thoracic surgeons, laparoscopy should be the default approach for most patients with small to moderate first-time repairs of PEH. However, patients should be counseled that long-term recurrence rates are relatively high, though the effect of recurrence on quality of life and need for additional surgery is variable. Larger hernias can be approached laparoscopically but strict attention to risk factors such as obesity, chronic cough, and constipation should force the surgeon to consider other approaches that can provide better long-term crural repairs.

Robot-assisted laparoscopic repair

Robotic surgery was initially conceived as a method of remotely delivering highly skilled surgical care to wounded soldiers at the front line and astronauts in space (23). It was first widely adopted in the US for urologic and gynecologic surgery (23) and has subsequently grown in utilization

among surgeons, including for PEH repair.

Pros

Many surgeons suggest that the robot-assisted laparoscopic (robotic) repair provides improved visualization, dexterity, and reach, making the operation technically easier to perform compared to laparoscopy (24). In many of the studies comparing the robotic and laparoscopic approaches, the robotic groups include a higher number of recurrent repairs (25-27), suggesting that surgeons in these studies perceive an advantage to using the robot in more complicated repairs in order to achieve similar outcomes to traditional laparoscopy.

Most of the existing data suggest that robotic repair shares many of the safety benefits of laparoscopic repair (25-27). The largest published review of robotic PEH repair found that thirty-day complication and mortality rates from robotic repair were similar to laparoscopic repair (24). Robotic repair was associated with fewer esophageal lengthening procedures, a lower rate of conversion to an open approach, and a shorter LOS compared to laparoscopic repairs.

Cons

One major concern about the use of the robot for PEH repair is the presumed higher cost compared to laparoscopy. The largest series to include cost data for PEH repair found that intra-operative equipment costs were slightly higher for robotic repair compared to laparoscopy (\$2,147 *vs.* \$2,058) (24). Robotic repair is also thought to require longer operative times. While this may be true in the early phase of learning the technique (28), operative time has been shown to be similar to (25) or shorter than (24) laparoscopic repair for groups with extensive robotic experience.

Another limitation of the robotic approach to PEH repair is the lack of data on long-term outcomes. Gerull *et al.* prospectively following 145 patients for 5 years after robotic PEH repair (29). They demonstrated a 91% satisfaction rate at 5 years and persistent significant improvement in GERD-HRQL scores. They also found a low radiographic recurrence rate of 9%, with only 2 patients (1.4%) requiring reoperation. A second study found a 1-year radiographic recurrence rate of 13.3% after robotic PEH repair (25), which is lower than most published data on radiographic recurrence rates after laparoscopic repair. More long-term data are needed, ideally including comparative studies

between the robotic and laparoscopic repairs.

Who should get a robotic laparoscopic repair?

The robotic laparoscopic approach to PEH repair appears to have perioperative and short-term outcomes that are comparable to those of traditional laparoscopy with potentially lower recurrence rates. We favor the robotic approach due to the technical improvements for any patient with PEH who is a candidate for laparoscopic repair. The robotic approach may provide added value over traditional laparoscopy for patients with previous PEH repairs or other foregut surgery. Patients should be counseled that long-term outcomes and recurrence rates, though promising, have not yet been well characterized due to limited data.

Open transabdominal repair

PEH repair has historically been performed through a laparotomy or thoracotomy. With growing expertise in laparoscopy, the utilization of the open transabdominal approach has dramatically decreased, now making up about 10-25% of all cases performed (6,7).

Pros

The transabdominal approach has the benefit of being more familiar to most general surgeons and is likely the easiest and fastest technique for conversion from laparoscopy due to technical difficulties or intraoperative complications. An anti-reflux procedure can be incorporated into this approach.

The longest-term comparison between the open abdominal and laparoscopic approaches was performed by Lazar *et al.*, who surveyed patients at a mean follow-up of 7 years (30). Reoperation rates (5.3% and 9.9%) and subjective gastroesophageal reflux disease (GERD) symptom improvement (90% *vs.* 95%) were similar between the two approaches; however, significantly fewer patients in the open group required anti-reflux medication (26% *vs.* 54%).

Cons

As discussed above, the main drawback to the open abdominal approach is its notably worse perioperative outcomes compared to the minimally invasive approaches. It has been consistently associated with increased rates of morbidity and mortality as well as longer LOS than

laparoscopic repair (6,7,10).

Who should get an open transabdominal repair?

For patients with a recurrent PEH and abdominal adhesions, a laparotomy is likely a safer technique for entering the abdomen and approaching the hiatus than a minimally invasive technique. Though the laparoscopic approach has been demonstrated to be feasible for obstructed or gangrenous PEH, many surgeons may feel more comfortable managing these emergent situations through a laparotomy. Additionally, the open abdominal approach is the most straightforward method for conversion in the event of an intraoperative complication or technical challenges during a minimally invasive laparoscopic approach.

Open transthoracic repair

The open transthoracic approach to PEH repair has historically been one of the primary approaches to PEH repair. With the widespread utilization of laparoscopy in the last 30 years, open transthoracic repair has become the least common approach to PEH repair, making up 1–2% of all PEH repairs (6,8).

Pros

The open transthoracic approach has the benefit of optimal access to the mediastinum and crura, facilitating complete esophageal mobilization, easy esophageal lengthening, and a straightforward crural closure. Additionally, approaching from the chest allows the surgeon to avoid the abdomen in cases where a patient's history of previous abdominal operations may limit visualization and safety. In the case of short esophagus despite maximal esophageal mobilization, a Collis gastroplasty can be performed much more easily through the transthoracic approach than through an open or laparoscopic transabdominal approach. Pain control, which was historically a major concern, is now better alleviated with thoracic epidurals and intercostal nerve blocks (31), allowing for safer post-operative pulmonary hygiene and patient ambulation.

One of the primary benefits of transthoracic PEH repair is the low long-term recurrence rate, demonstrated by a number of single-center series. At 2–8 years of follow-up, patients report “good” or “excellent” results in 83–93% of cases. Radiologic recurrence rates are under 10% and the

reoperation rates are under 3% (32–36).

The transthoracic approach may also provide advantages in more complicated PEH cases. This is demonstrated by two studies comparing the transthoracic and laparoscopic approaches. In one study, all of the patients in the transthoracic group were deemed by preoperative barium study to have intrathoracic stomach ($\geq 75\%$ of stomach above the diaphragm) compared to 45% of the laparoscopic group. At up to 10 years of follow-up, recurrence rates and quality of life were similar between the two groups, but reoperation (9.3% *vs.* 2.5%) and leak (6.8% *vs.* 0%) were both higher in the laparoscopic group despite having smaller hernias (37). In a second study, patients selected for transthoracic approach had a larger hiatal hernia (4.2 *vs.* 1.1 cm) and a higher incidence of Barrett's esophagus (55% *vs.* 17%) and esophageal stricture (18% *vs.* 4%). Despite the more severe disease in the transthoracic group, at 2 years of follow-up, fewer patients in the transthoracic group endorsed GERD symptoms or were taking acid-suppression medications (38).

Cons

The primary downside of the transthoracic approach is the significant morbidity associated with a thoracotomy and open surgery. In the 5 largest transthoracic series discussed above, the complication rate was 19–42% (32–36). The increased morbidity of the transthoracic approach has also been consistently demonstrated in retrospective studies of national databases comparing it with the laparoscopic approach (8,9). Though studies comparing open transthoracic with open transabdominal PEH repair are limited, one study found the two open approaches to be similar in terms of LOS, morbidity, and 30-day mortality (8).

Thoracotomy pain has not been well studied in this population but has been well described with other surgeries (39). As mentioned above, the use of thoracic epidurals and intercostal cryo-ablation in our institution's practice has reduced this pain and its effects on pulmonary hygiene in the peri-operative period.

Who should get an open transthoracic repair?

Transthoracic repair remains an important technique in the management of PEH, especially for patients with a high risk of recurrence due to large hernia size or comorbidities that increase intra-abdominal pressure such as pulmonary disease or constipation. In these situations, the risk of reoperation after laparoscopic repair is likely increased

such that the increased LOS and slightly higher morbidity of a transthoracic approach are warranted to achieve a more durable repair. We would suggest that type IV and large type III PEHs should strongly be considered for a transthoracic repair, given the evidence of equal outcomes in more complex cases for transthoracic *vs.* laparoscopic repair (37,38). Disease-specific factors to consider include the degree of intrathoracic stomach, the size of the hiatal hernia, and the severity of GERD (as determined by the presence of Barrett's esophagus or esophageal stricture). Specific comorbidities that could increase the risk of recurrence and thus favor a transthoracic approach include pulmonary disease associated with chronic cough (40), chronic constipation, and any other condition associated with increased intraabdominal pressure (41). Patients with morbid obesity (BMI >35 kg/m²) are also at higher risk of recurrence (42-44) and thus may benefit from a transthoracic approach; however, they could also be considered for other management strategies such as concurrent hiatal hernia repair and bariatric surgery, which are outside the scope of this review (45-47). Other circumstances that may favor a transthoracic approach include a previous history of multiple abdominal surgeries and concerns for adhesions, thus increasing the risk of injury from entry into the abdomen; short esophagus, requiring extensive mediastinal mobilization; and intrathoracic rupture of hernia contents, in which case the transthoracic approach provides the most direct access to contain the contamination.

Though the transthoracic approach may provide patients with the highest likelihood of a durable repair, they should be counseled about the higher rates of morbidity and mortality as well as the increased length of stay associated with this approach.

Non-operative management

In general, any patient presenting with PEH and associated symptoms should undergo repair using the approach as outlined above. There is disagreement, however, about how to manage asymptomatic patients with PEH. On the one hand, there is evidence that any patient who is in the surgeon's office is nearly certain to have symptoms associated with their PEH that can be revealed with thorough examination (48). If a patient is indeed asymptomatic or only mildly symptomatic, some advocate for watching, but in our high-volume practice with a number of referrals for urgent repair each year, we

favor elective repair. Non-operative management of PEH is associated with a 1.6% 5-year risk of mortality, an 8.1% risk of hernia related complications, and a 1.1% risk of emergency surgery (49,50). About 7% can be expected to have symptom progression that will ultimately require surgical repair (50).

Age alone should not be considered an absolute or even relative contraindication to repair. Elderly patients (generally defined as >80 years old) have been shown to have mortality rates (51,52), recurrence rates (51), and quality-of-life outcomes (52) that are comparable to younger patients.

Conclusions

There is no "optimal" way to repair large PEHs, as there are trade-offs between peri-operative risks and long-term outcomes. Given the comfort level that most surgeons today have with laparoscopy, we feel that a laparoscopic approach is reasonable for most small to medium PEHs. We feel that robot-assisted laparoscopic approaches offer improvements and should be used primarily for medium to large PEHs. Laparotomy clearly is still an essential method but could be reserved for conversions from laparoscopy. Although open transthoracic approaches are less common, we feel that this should be the preferred approach for larger PEHs, especially in patients with risk factors for recurrence, and also is optimal for recurrent operations when there are increased intra-abdominal adhesions.

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Footnote

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Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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