Research Article

Laparoscopic Anatomy of Giant Hiatal Hernia in Pediatrics.

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Abstract

Knowledge of the normal and pathologic laparoscopic anatomy is essential for safe dissection around the esophageal hiatus. Familiarity with the technical nuances of endosurgical instrumentation and the general conduct of laparoscopic surgical approaches are vital prerequisites before attempting laparoscopic repair of paraesophageal hernias. **Patients& methods:** ٢٠ Patients selected of type IV Giant hiatual hernia of patients below ١٤ years of age during the period from October ٢٠١٠ to January ٢٠١٤. All patients were followed up in the early postoperative period (within ٣٠ days), at ٦ months postoperatively, and annually with questioning and examination. Symptomatic evaluation was performed using a visual analogue scale. Patients and/or their parents were asked to grade their lifestyle and sense of well-being and their symptoms of heartburn, regurgitation, dysphagia and chest pain, gas bloat, and diarrhea on a scale of ١ to ١٠. **Results:** *Mean age for the study was ١٧.٩٧ months (١.٥ years)* **.**Hospital stay **r**anged from ٢ to ٥ days with mean stay ١.٥ days,. Mean Operative time was ١٤٥ minutes. Post operative follow up in our study showed a satisfaction rate of ٩٨.٥. **Conclusions:** Laparoscopic repair of paraesophageal hernia is a technically challenging procedure in relatively high risk patients, The exposure of the hiatus and gastric anatomy is unparalleled. And so, The Laparoscopic approach has become our procedure of choice.

Key words: Paraesophageal hernia, Laparoscopy, Neonates and Hernias

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Introduction

The wide patient acceptance of hiatal and gastroesophageal surgery performed by laparoscopy has suddenly generated a large volume of procedures frequently done by surgeons with limited experience in this area. This has resulted in an excessive number of complications[١].

Knowledge of the normal and pathologic laparoscopic anatomy is essential for safe dissection around the esophageal hiatus[٢].

Experience gained with laparoscopic cholecyst-ectomy has demonstrated that knowledge of the anatomy and its variations, as well as the distortions resulting from disease, is essential to anticipate and prevent technical complications[٣]

A HH is classified by type as follows: type I indicates sliding hernia; type II, paraesophageal hernia (٥٪); type III, mixed sliding and paraesophageal hernia; and type IV, herniation of additional organs[٤].

A giant hiatal hernia (HH) is a hernia that includes at least ٣٠٪ of the stomach in the chest, although a uniform definition does not exist; most commonly, a giant HH is a type III hernia with a sliding and Para esophageal component.

The etiology of giant HH is not entirely clear, and two potential mechanisms exist: (A) Gastro esophageal reflux disease (GERD) leads to esophageal scarring and shortening with resulting traction on the gastro esophageal junction and gastric herniation.
(B) Chronic positive pressure on the diaphra-gmatic hiatus combined with a propensity to

herniation leads to gastric displacement into the chest, resulting in GERD.

Incidence:

- The prevalence of hiatal hernia in patients undergoing a Nissen Fundoplication is approximately ٩٪.[٥]
- Giant HH represents from ٠.٣٪ to ١٥٪ of all HH.
- The prevalence of short esophagus varies between ١.٥٪ and ١٩٪ of patients undergoing surgery for GERD.[٦,٧]

- The typical paraesophageal hernias encountered in infancy and childhoods have several components. The defect is within the esophageal hiatus and is lined by a peritoneal sac, usually extending anteriorly and to the right of the esophagus as well as into the posterior mediastinum. The esophagogastric junction is assumed to be in the normal intraabdominal position, and the mobile components of the stomach (fundus, body, antrum, greater curvature, and pylorus) subsequently migrate cephalad through the defect and come to lie predominantly in the posterior mediastinum and right extrapleural thoracic space. During this migrating process, the stomach tends to rotate around its organoaxial axis, which can theoretically lead to partial or complete gastric obstruction between the distal esophagus above and the duodenum below.[٧]
- Paraesophageal hernias in childhood are thought to be caused by a congenital abnormality that can be explained on an embryologic basis. During the development of the human diaphragm, ٢ small coelomic spaces, called pneumoenteric recesses, develop on either side of the midline in the mediastinum. With the fusion of the sides of the pleuroperitoneal canals, the larger recess becomes isolated as the infracardiac bursa.[٨] The recess on the left side is transitory. Persistence of the recess on the right creates a flattened and elongated mesothelial lined space within the esophageal hiatus (ie, the postulated congenital predisposition for the development of a paraesophageal hernia).[٩]

Patients and methods

Twenty Patients selected of type IV Giant hiatual hernia of patients below ١٤ years of age during the period from October ٢٠١٠ to January ٢٠١٤ at Minia University hospital and New Children's Hospital of Cairo University. Full history was taken.

Patients with a giant HH generally presented with pain, heartburn, dysphagia, vomiting, and anemia the chronicity of symptoms leads patients to underestimate severity.

Clinical Workout:

- **Chest X-ray:**

All cases had had a chest x-ray and a shadow of the stomach was found in the mediastinum.

- **Upper Gastro-Intestinal Study (UGI Study)**

Gastrografin study via nasogastric tube was done in all cases in Trendlenburg position and grading of the hernia was achieved.

- **CAT Scan**

CT scan was done in ١٦ cases as a sure preoperative diagnosis; it was a unique diagnostic method for a complicated gastric volvulus in one case, and as a routine diagnostic maneuver in one institution.

- **PH Manometry**

Preoperative manometry and prolonged esophageal pH testing was performed in ١٠ of ٢٠ (٥٠٪) patients.

- **Upper GI Endoscopy:**

Preoperative endoscopic evaluation of the esophagus, stomach, and duodenum was done in ١٥ cases, performed by the operating surgeon after the induction of general anesthesia. Care was taken to aspirate all air from the stomach upon completion of this endoscopic examination to avoid potential trochar injury to a distended stomach.

- **CBC (Complete Blood count):**

CBC was routinely done as a preoperative investigation, only one case done a CBC prior to the diagnosis of the case.

Surgical Technique:

Familiarity with the technical nuances of endosurgical instrumentation and the general conduct of laparoscopic surgical approaches are vital prerequisites before attempting laparoscopic repair of paraesophageal hernias.

Likewise, the surgeon should be experienced with the "open surgical" approaches to repair of paraesophageal hernias, as the technical . The surgeon must also be prepared to convert to an open surgical approach when the operative conditions preclude a safe or effective surgical repair of the paraesophageal hernia.

Laparoscopic techniques can be readily applied in the management of paraesophageal herniation.

- **Position:**

The child is placed in the reverse Trendelenburg position at the end of the table.

- **Anaesthesia:**

General Endotracheal intubation.

- **Pre operative Preparations:**

Nasogastric tube was placed in ٦ cases.
Prophylactic antibiotics (wide spectrum) were taken on the morning of the surgery day.

- **Insufflation:**

The abdomen is insufflated up to ١٠ mm Hg of pressure with the use of a Veress needle.

- **Trocar sites:**

The trochar access utilized to conduct the laparoscopic intervention. Five sites of trochar access are routinely employed. These same trochar sites are also utilized by us for the laparoscopic approach to fundoplication in the management of pathologic gastroesophageal disease**:**

a) A ٥-mm Step trocar is initially placed in the umbilicus.
b) A ٣-mm Step trocar is placed in the right upper quadrant for the surgeon's left hand.
c) A ٥-mm Step trocar port was placed in the left upper quadrant for the surgeon's right hand.
d) A second ٣-mm Step trocar was placed laterally in the left upper quadrant for the assistant.
e) A stab incision is made in the lateral right upper quadrant for a ٣ mm liver retractor.

- **Identification of the hiatal area:**

We should identify the anatomy of the hiatus opening and the major surrounding relations as the left lobe of the liver, the herniated stomach, the Vagus nerve and if any aberrant vessels existed.

standards of "open surgical" management must be maintained to avoid suboptimal results

The sac excision and Vagus preservation are the major difficulties in Laparoscopic repair; we use certain steps to avoid pitfalls of repair:

a) The stomach is left alone, and no attempt to reduce it is made, owing to the increased risk of gastric injury during such procedure. Instead, the apex of the hernia sac is grasped vigorously and inverted by pulling caudally, and the sac is then opened well away from the crural edge. The dissection is then carried into the mediastinal areolar tissue plane, which is easy to free, and, after this procedure, the stomach essentially drops back into the abdomen. It cannot be overemphasized that there must be a wide margin between the crura and the sac incision in order to preserve an adequate margin of tissue for covering the crura.

b) Maintenance of crural integrity is emphasized as a fundamental objective. This entails avoidance of stripping the peritoneum and other connective tissues from the surface of the crural muscles. After division of the sac, the tissue overlying the crura should appear as a smooth and glistening surface without exposed muscle fibers.

After sac division, the fat pad is dissected circumferentially, with care taken to stay just on the surface of the muscle fibers of the stomach and esophagus. By hugging the esophagus and stomach closely, the vagal nerves should be successfully preserved, because, in essence, one has performed a highly selective vagotomy over the area of the EGJ (esophagogastric junction).

c) The crura are then closed in an interrupted fashion, using polytetra-fluoroethylene pledgets for a reinforced repair, until they are closed appro-ximately two thirds of the way from anteriorly to posteriorly . The closure is performed using No. ٢-٠ Ethibond suture on CT needles with intracor-poreal knot tying. The use of standard suture and needles allows for appropriately sized, full-thickness crural

bites, replicating the same closure that would be obtained during an open operation. ٢ stitches posterior to the esophagus and two stitches on both sides at ٣ and ٩ O'clock. A fifth stitch may be needed as a collar stitch if opening is too wide.

d) The esophagus is then assessed for adequate length. If it is found to be short (ie, <٢.٥ cm), we perform a wedge Collis gastroplasty over a ٢٢F bougie . The gastroplasty is begun with a blue stapler load brought in from the left upper quadrant port. With the greater curve of the stomach held anteriorly and inferiorly, the stapler can be brought in nearly perpendicular to the direction of the bougie. With closure of the stapler, the device can be felt to ''pop'' over the edge of the bougie. One additional stapler load is necessary from this angle. Next, the final ١ or ٢ staple loads are brought in from the right paramedian port, and, by firmly pressing the stapler atop the esophagus and bougie.

e) A fundoplication is next performed over a ٢٠-٤٠F bougie (Table ١). The Nissen fundoplication is constructed with ٣ stitches of ٢-٠ silk, with each stitch incorporating a moderate bite of esophageal musculature. The critical point is to ensure that the fundus is wrapped around the esophagus snugly but not overly so. By holding the tip of the fundus in the surgeon's left hand and bringing the greater curve over to the tip of the fundus, one can judge the tightness of the wrap around the esophagus. The main error at this point is to have the wrap be too loose, leading to ineffective fundoplication. If the wrap is too tight, when the bougie is removed, one can identify this problem, because the fundus will appear as though it is under tension relative to the greater curve, as if the ٢ structures were trying to pull apart. Also, with a properly constructed wrap, after removal of the bougie, the greater curve edge of the wrap should be able to be lifted up, allowing room for a grasper to be easily inserted between the stomach and esophagus. Finally, after wrap construction, to anchor the wrap to the crura, ٣ stitches of ٣-٠ silk are used to sew the top of the fundus to the crura.

f) The repair is completed with a biologic mesh Surgesis (Porcine SIS Gold mesh) buttressing of the closed hiatal defect in ١٤ cases and ٢ cases we used a prosthetic PTFE (Polytetrafluro ethylene), because multiple studies have suggested a lower recurrence rate with the use of mesh. A simple square is cut, placed over the crural closure, and secured in place with absorbable tacks.

Hospital stay:

Ranged from ٢ to ٥ days with mean stay ١.٥ days, usually, feeding started at evening of the day of operation with liquid meals and discharge the day after if no complications discovered.

All patients were followed up in the early postoperative period (within ٣٠ days), at ٦ months postoperatively, and annually with questioning and examination. Symptomatic evaluation was performed using a visual analogue scale. Patients and/or their parents were asked to grade their lifestyle and sense of well-being and their symptoms of heartburn, regurgitation, dysphagia and chest pain, gas bloat, and diarrhea on a scale of ١ to ١٠.

These symptoms at ١ month, ٦ months, and annually were compared with the preoperative symptoms. A hiatal hernia symptom score similar to the system described by Jamieson and Duranceau was also used to characterize the patients' symptom before and after repair of their paraesophageal hernias.

The frequency of symptoms is added to the duration of symptoms and the sum is multiplied by the severity of symptoms.
A minimum score of ٠ and a maximum score of ٣٢ is available and the percent change was calculated (Table ٢).

Symptom classification includes mild (١ to ٧), moderate (٨ to ١٥), marked (١٦ to ٢٣), and severe (٢٤ to ٣٢).

Results

١٣ male cases and ٧ females were selected for this research according to the inclusion criteria mentioned in our protocol study.

Mean age for the study was ١٧.٩٧ months (١.٥ years).

Clinical presentations were as Reflux symptoms were found in ١٦ cases (٨٠٪) in the form of persistent non-bilious emesis in ٨ cases and failure to thrive in ٥ cases, one case with Obstruction and severe dysphagia and ٢ cases presented with regurgitation. Pain presented in ٥ cases only as they were above

Table ١: Laparoscopic Giant Paraesophageal Hernia Repair Symptom Score, Jamieson GG, Duranceau AC et al., ١٩٨٨

	٠ Points	١ Points	٢ Points	٣ Points	٤ Points
(I) Frequency	None	Occasional: not as often as once a month	More often than once a month but not as often as once a week	More often than once a week but not as often as once a day	Daily
(II) Duration	No symptoms	Less than ٦ months	More than ٦ months but less than ٢٤ months	More than ٢٤ months but less than ٦٠ months	More than ٦٠ months
(III) Severity	Absent	Mild: nuisance value only	Moderate: spoils enjoyment of life	Marked: interferes with living a normal life	Severe: worst thing ever experienced

The age of ٢ years and complaint could be known. It was a postprandial epigastric type, very severe in two cases, one of them due to obstruction and other due to gastric volvulus and finally, Respiratory symptoms in ١٠ cases, ٨ presented by recurrent chest diseases and ٢ presented with apnea during lying flat or after meals. While, Asymptomatic presentation in one case only, discovered accidently due to chronic Microcytic anemia.

Clinical work out:

- Chest X-ray:

All cases subjected to chest X-ray, ١٨ cases showed a stomach (Fundus Gas) and ٢ cases had a transverse colon.

- Upper Gastro-Intestinal Study (UGI Study)

All cases had done UGI Study by Gastrograffin dye and it showed a stomach in chest cavity and wide hiatus opening.

- **CAT Scan:**

١٤ cases in The USA were having it as a routine diagnostic investigation and two cases as in the other centers as a confirmative method.

- **PH Manometry:**

١٠ cases had done this study, revealing mean peristalsis of ٧٧.٥±٤٠.٦ mm Hg, mean lower esophageal sphincter (LES) of ١٥.٥±٨.٢, and mean percent of time during ٢٤ hours with a pH less than ٤ of ١٣.٧٪±١٠.٩٪.

- **Upper GI Endoscopy:**

١٥ cases in the two institutions shared in this study had done upper GI Endoscopy preoperatively .

- **Complete Blood Count (CBC):**

٧ cases had a microcytic anaemia, ٦ cases with other symptoms and one case incidentally discovered.

Mean operative time was ١٤٥ minutes, Mesh insertion was done routinely in one institute in ١٤ cases with biological mesh and ٢ cases used a prosthetic mesh type in selected cases of the other two institutes.

Follow-up contrast radiographic studies of the stomach and esophagus were performed in ١٢ of ٢٠ (٦٠٪), and follow-up manometry and prolonged pH testing were performed in ٦ of ٢٠ (٣٠٪) patients.

Complications:

- **Intra-Operative complications:**

Only two cases had minor complications, one case had a bleeding from the short gastric vessels and the other case had a tiny perforation of an ischaemic stomach patch and repaired by two simple sutures with ٣-٠ non absorbable sutures with ٢nd layer continuous.

- **Post- Operative complications:**

Early complications as low grade fever (٣٨°C) during ١st ٢٤ hours, in one case managed conservatively with antipyretic infusion.
Dysphagia for liquids occurred in a single case and managed conservatively.
Moderate chest infection in one case after one week of hospital leave required a readmission and hospitalized for three days.
Wound infection in one case treated with local antibiotics and follow up.

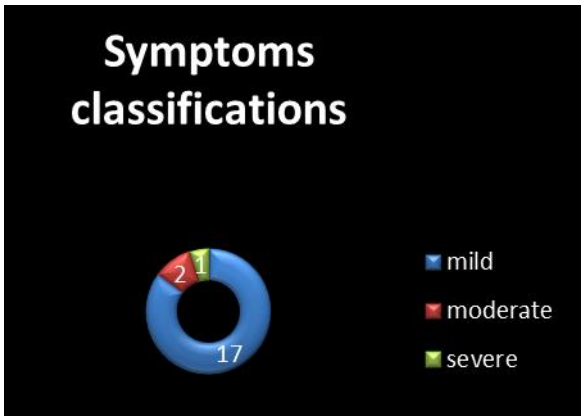

Chart: Post operative Symptoms Classifications.

Table (٢): Complications

Type	Number
Intra operative complication	٢
Early post operative complications	١
Late Post operative complication	٣
Conversion to open surgery	٠

Discussion

This study was done on ٢٠ patients suffering of Giant hiatal hernia, ١٣ males and ٧ females were candidates for the research with a ratio nearly ٢:١ respectively, close to the normal ratio varies ٢.٥:١ to ٣:١ in other studies, Although it seems to be a small number of research, but the very low incidence of type IV hiatal hernia makes it acceptable, Imamoglu et al., made a research study on ٥ cases only of Giant Paraeophageal hernia on period between ١٩٩٢ and ٢٠٠٤[١٠], Wiechmann succeeded in the period between ١٩٩٢ and ٢٠٠٢ to enroll ٥٢ cases in ٣ big centers in USA.[١١]

Symptomatic patients were ٩٥٪, compared with the study done by Carrott et al., on ٢٧٠ cases with ٩٩٪ came with at least one presentation.[١٢]

Reflux symptoms were in ٨٠٪ in our study and ٦٠٪ in other study by Imamoglu et al., in ٢٠٠٥, and ٥٢٪ in study by Karpelowsky et al., ٢٠٠٨.[١٣]

Chest infections were in ٥٠٪ of cases, similar to other studies done by Imamoglu, karpelowsky and Wiechmann ٢٠٠٢.[١٠, ١٣, ١١]

In our study, we performed a routine chest X-ray and upper GI Study to diagnose. The

presence of an abnormality is established by chest radiograph, J.S. Karpelowsky et al., published in his series, he mentioned that all patients had an easily Primary paraesophageal hernia in children (٥٩ cases) identifiable cystic mass in the posterior mediastinum. An air-fluid level was seen in ٣٢٪ of the patients.[١٣]

Mean Operative time was ١٤٥ minutes in our study, compared to other studies done by Swanstorm on ١٩٩٧ it was ٢٥٧ minutes , Pierre et al., (٢٠٠٢) was ٢٠٠ minutes on ٢٠٢ cases and Whitson et al., (٢٠٠٦) it was ٢٧٤ minutes on ٦١ cases.[١٤]

Open laparoscopic mean time was ١٥٠ minutes in study done by Allen et al., on ١٩٩٣ and it was ٢٠٤ minutes in Philip R. Schauer et al., study on ٢٥ cases in ١٩٩٨.[١٥, ١٦]

There have been few comparisons between open and laparoscopic approaches to surgical correction of paraesophageal herniation. The most commonly noted comparison is that of Hashemi and coauthors.[١٧], this group reviewed the outcomes of ٥٤ patients who had giant paraesophageal hernias managed by laparotomy, thoracotomy, or laparoscopic approaches. Half of these patients underwent laparoscopic repair, at a mean follow-up of ١٧ months, ٤٢٪ of the laparoscopically managed patients had some evidence of hiatal herniation, compared with ١٥٪ of the patients who had open repairs, and who were followed on average for ٣٥ months. However, it appears that the hiatal hernia recurrence following laparoscopic repair of large paraesophageal hernias may be improving as experience with these approaches expands.

A recent report of laparoscopic management of ١٦٦ patients who had large paraesophageal hernias by Andugar et al., revealed symptomatic improvement in ٩٣٪ of patients at a mean interval of ٢٤ months.[١٨]

The symptomatic outcomes of the open and laparoscopically treated patients were similar. Most of the hiatal hernia recurrences were small and sliding in nature.

This experience contrasts with that of more recent reports of laparoscopic management of paraesophageal hernias. Although the post-operative hernia rate was not evaluated, Schauer and coworkers[١٦] retrospectively compared the perioperative morbidity of paraesophageal hernia patients undergoing open and laparo-scopic repair. These investigators noted a significant reduction in blood loss, intensive care unit stay, ileus, hospital stay, and overall morbidity when the laparoscopic approach was used, compared with open surgical approaches. Others have also come to appreciate the value of the laparoscopic approach to paraesophageal herniation. It is, however, commonly stated that this is a technically demanding intervention, requiring significant laparoscopic surgical experience. A strong fund of knowledge of the pathophysiology of hiatal hernia and GERD is also important for improved results, as is mature surgical judgment regarding the management of such complex disorders of the esophagus.

Laparoscopic fundoplication is successful in preventing reflux in more than ٩٥٪ of patients. However, over time, there appears to be failure of the fundoplication, which is unlikely that medical management will be successful in controlling the reflux symptoms after either wrap breakdown and/or transmigration. Thus, operative repair for control of recurrent symptoms is required in most cases.[١٩]

We used an organic mesh hiatoplasty in our study Porcine SIS (Small Intestine Submucosa) Gold mesh in ١٤ cases and prosthetic PTFE in ٢ cases only. The introduction of biologic mesh materials may provide a superior alternative to prosthetic for hiatal reinforcement.[٢٠]

Surgeons agree that the ideal material would form minimal adhesions, incorporate into the hiatal closure without inducing significant fibrosis, and provide sound closure, with no mesh-related complications.[٢١] In a study done by Müller-Stich in ٢٠٠٨, LMAH (Laparoscopic Mesh Augmented Hernioplasty) seems to be a

safe and feasible potential treatment option for both GERD and symptomatic HH patients.[٢٢]
Hospital stay after laproscopic repair in our study was ٢.٥ days compared to open procedures was ٥.٨ days in study done by Philip R. Schauer in ١٩٩٨, and ٨ days for a study done by Imamoglu in ٢٠٠٥. [١٦, ١٠]

Post operative follow up in our study showed a satisfaction rate of ٩٨.٥٪ (١٧ cases had a score > ٥ in sense of well being symptoms scale), compared to a study done by Müller-Stich on ٢٠٠٨ showed that ٩٠٪ who assessed the surgical result as "good" to "excellent".[٢٢]

These studies have demonstrated that the laparoscopic approach is feasible and effective in treating PEH-related symptoms, but it is technically very challenging and requires advanced laparoscopic skills. In addition, the laparoscopic approach appears to offer advantages over the conventional open repair in terms of reduced postoperative pain, a short hospital stay (٢ to ٥ days), and rapid convalescence (٣ to ٤ weeks).[٢٣,٢٤]

Conclusions

١. Laparoscopic repair of paraesophageal hernia is a technically challenging procedure in relatively high risk patients, thus extensive experience with advanced laparoscopic technique is recommended prior to performing LPHR.
٢. The exposure of the hiatus and gastric anatomy is unparalleled. This allows formation of an anatomically correct wrap, which is under no tension and does not twist or torque the stomach. AND SO…The Laparoscopic approach has become our procedure of choice.

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