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Research Article

Morgagni Hernia Laparoscopic Repair in Children: Tips and Tricks Learned in 20 Years' Experience at a Tertiary Pediatric Center

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Abstract

Background: Morgagni Hernia (MH) is a congenital diaphragmatic defect located in the retrosternal region. This study aims to report and analyze 20 years of experience in the diagnosis and management of MH at a tertiary pediatric center.

Methods: We conducted a retrospective review of patients who underwent laparoscopic MH repair from 2002 to 2022. Data on symptoms, defect location, surgical techniques, complications, and recurrences were analyzed.

Results: Fifty-five children were included in the study. Thirty-two (58%) were male. Mean age at surgery was 36 months (3 days-11 years). The mean follow-up was 45.16 months (8-110 months). The majority of hernias were discovered incidentally (61.8%). Nineteen patients (34.6%) had upper respiratory tract symptoms and a history of recurrent lung infection. Two patients (3.6%) presented with intestinal occlusion. Fifteen patients (27.2%) had Down syndrome, and seven (12.7%) had cardiac defects. The repair technique involved transabdominal laparoscopic-assisted repair with percutaneous sutures and extracorporeal knotting. Reoperation due to recurrence was necessary in 2 patients (3.6%), one of whom needed two redo procedures.

Conclusion: The transabdominal laparoscopic-assisted technique with percutaneous sutures and extracorporeal knotting is effective for MH repair. It offers a low recurrence rate and minimal complications. Emphasizing the technical aspects, including tips and tricks, may further benefit the readership.

Keywords: Morgagni hernia; Diaphragmatic hernia; Pediatric; Minimally invasive; Laparoscopic

Highlights

- Morgagni hernia (MH) is a rare congenital defect found in less than 6% of pediatric diaphragmatic hernias.
- Laparoscopic repair with extracorporeal knotting and percutaneous sutures is effective with low recurrence rates.
- Detailed technical insights and tips can enhance the understanding and applicability of the technique.

Introduction

Morgagni Hernia (MH) is a congenital diaphragmatic defect located in the retrosternal region. Two muscle bundles from the tendon of the diaphragm are attached to the anterior xiphoid. Lateral to these bundles, there is a gap between the sternal and costal fibers of the diaphragm (Larrey region). Herniation of intra-abdominal organs through this space is termed a parasternal hernia or MH [1,2]. It was first described by Giovani Morgagni in 1769 and has unique features in terms of clinical presentation and associated anomalies [3,4].

Morgagni hernia is a rare condition, accounting for less than 6% of all surgically treated diaphragmatic hernias in the pediatric population [5,6]. It is often asymptomatic and discovered incidentally [6,7]. Since the advent of minimally invasive surgery, various laparoscopic techniques for MH repair have been documented. Lima et al. [8] recommended primary closure with a continuous suture; Fernandez et al. [9] advocated for interrupted sutures with intracorporeal knot tying; and Ramachandran et al. [10] suggested the use of a mesh. Patkowski et al. [11] defined the transabdominal extracorporeal wall closure technique in 2006, and Karadag et al. [2] presented one of the largest published series of 22 patients.

This study aims to report on 20 years of experience with laparoscopic MH repair, focusing on technical aspects, complications, and outcomes. The laparoscopic approach, particularly with extracorporeal knotting and percutaneous sutures, has shown promise but warrants detailed discussion of its technical nuances.

Materials and Methods

We conducted a retrospective review of medical records for patients with MH who underwent laparoscopic surgery at our institution from 2002 to 2022. Variables analyzed included demographic data, symptoms, defect location, surgical technique, postoperative complications, and recurrence. Preoperative assessments included anterior-posterior and lateral chest X-rays for all patients, with CT scans and contrast studies used in selected cases.

Surgical technique

Patient and surgical team position: Laparoscopy was the initial

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approach in all cases. For minimally invasive surgery, the patient is positioned in reverse Trendelenburg position, with the surgeon at the foot of the table and the assistant on the right.

Trocar placement: A 5 or 10-mm trocar was placed infraumbilically using Hasson's technique, and pneumoperitoneum was established at 8 to 12 mm Hg with a flow rate of 4 to 8 L/min. A 30° 5- or 10-mm telescope was inserted through the umbilical port. Two 3 or 5-mm working ports were placed on both flanks.

Identification and removal of the sack: The hernia sac was identified, and hernia contents were reduced (Figure 1). The falciform ligament was resected for better defect exposure, and the defect edges were scored with electrocautery (Figure 2). An attempt was made to excise the sac in all cases, and the defect edges are scored with electrocautery (Figure 3).

Suture technique: A stab incision is made in the skin where the stitch will be placed. A small subcutaneous pocket is created directly over the portion of the defect to be corrected. The defect is repaired with 2-0 Ethibond sutures (Ethicone, Johnson & Johnson, USA), which are passed percutaneously through the full thickness of the anterior abdominal wall into the abdominal cavity, grasped with a laparoscopic needle holder, and then passed through the posterior edge of the defect as a U suture before being withdrawn through the anterior abdominal wall and exiting subcutaneously a few milli meters lateral to the entry point (Figure 4). After applying all the required sutures, complete closure of the defect is tested under laparoscopic visualization without pneumoperitoneum (Figure 5). Sutures are then tied within the subcutaneous plane. Finally, a reinforcing continuous suture is performed with Ethibond 3-0 (Ethicon, Johnson & Johnson, USA) or a barbed suture (V-Loc, Covidien) along the entire length of the defect. The residual pneumoperitoneum is evacuated and the skin incisions are closed.

The surgery was performed by the chief resident or a senior resident in all cases and supervised by the same staff surgeon in almost all cases.

Follow-up

Patients were followed up with regular appointments and chest X-rays at 1, 3, 6, and 12 months postoperatively, and annually thereafter. Continuous variables are presented as medians (ranges), and categorical variables as absolute values and percentages.

Results

Between 2002 and 2022, 55 patients with MH underwent surgery at our institution. Thirty-two were male (58%), with a mean age at

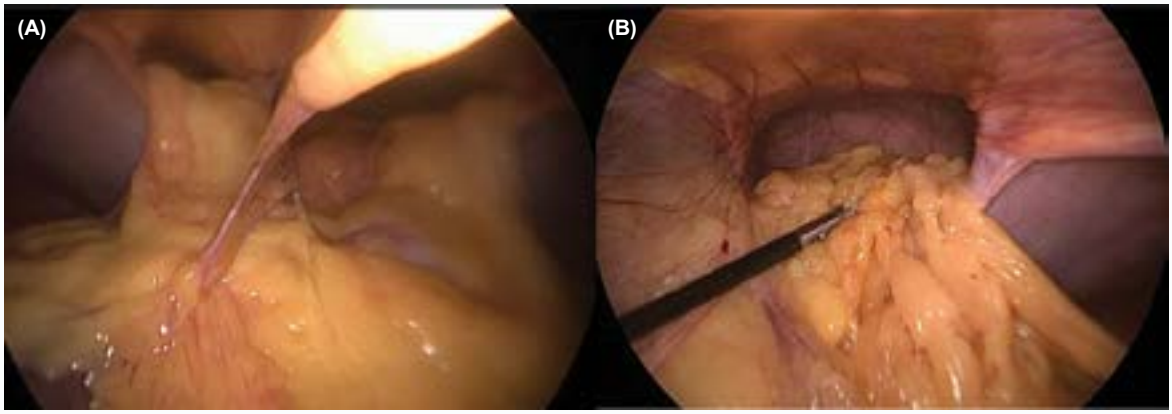

Figure 1: Identification and Reduction of Hernia Content. A): Laparoscopic view showing the bilateral defect in the diaphragm, with the hernia sac visible on both sides. The arrows indicate the margins of the defect. B): Reduction of hernia content into the abdominal cavity. The laparoscopic instrument is shown grasping the omentum.

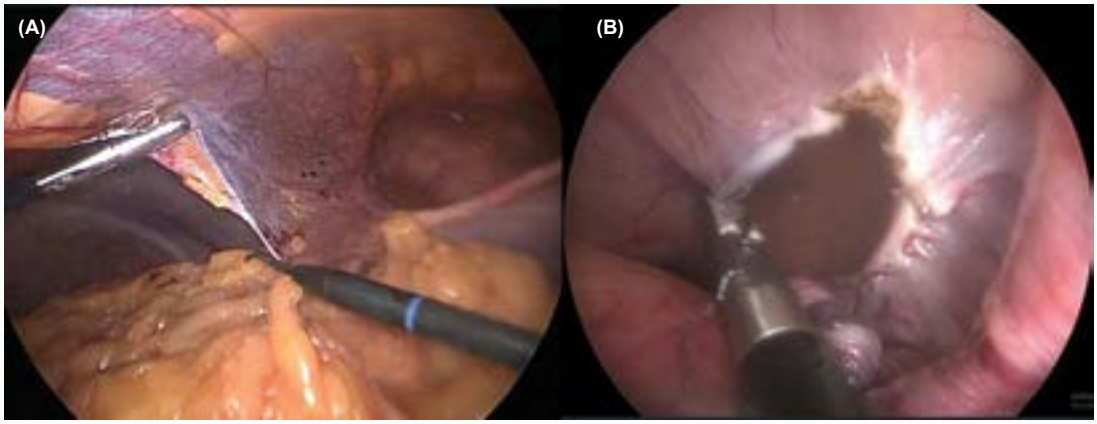

Figure 2: Resection Procedures. A): Removal of the falciform ligament, with the laparoscopic instrument shown grasping and cutting the ligament. This step is crucial to gain access to the hernia sac and defect area. B): Resection of the hernia sac, where the sac is being dissected and excised from the defect site. The image highlights the hernia sac being detached and prepared for removal.

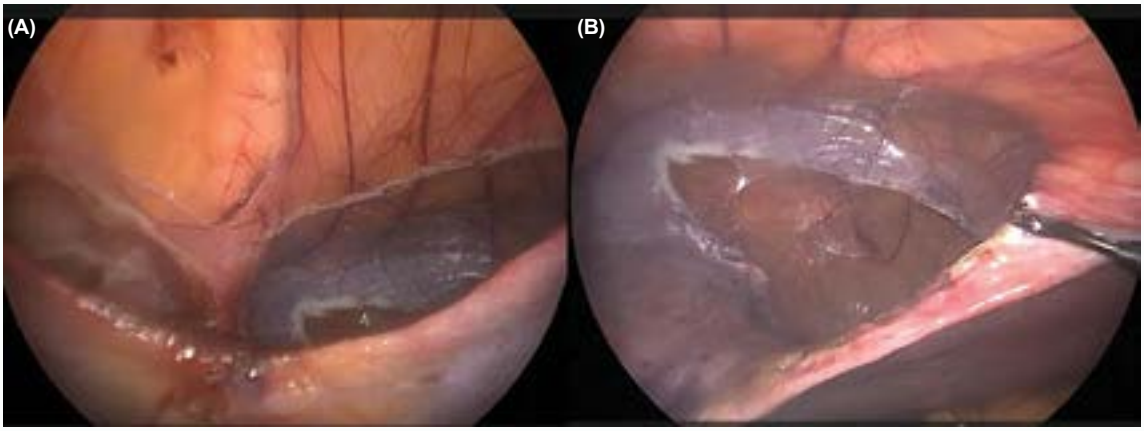

Figure 3: Defect Visualization and Preparation. A): Complete visualization of the defect site after the resection of the falciform ligament and hernia sac. The image shows a clear view of the defect's edges, which are now fully exposed. B): Defect edges scored with electrocautery, illustrating the process of cauterizing the edges to promote adhesion and reduce recurrence. The scoring marks are visible along the defect margins.

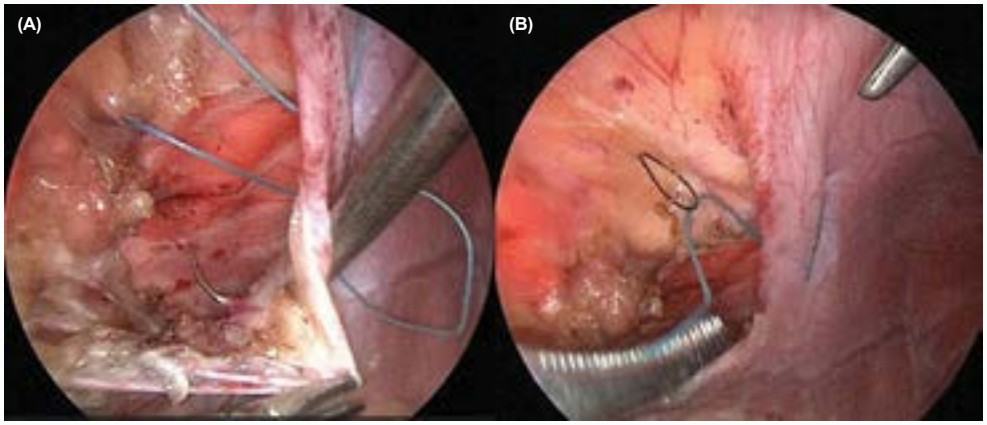

Figure 4: Suture Techniques. A): Sutures being passed through the posterior edge of the defect as a U-suture. The image captures the suturing process with the needle and suture material inserted from the posterior aspect. B): The suture being withdrawn through the anterior abdominal wall using a loop. This image demonstrates the technique of securing the suture and drawing it through the defect for effective closure.

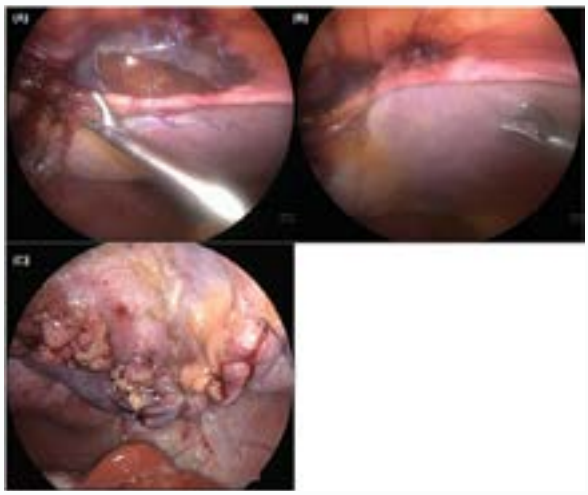

Figure 5: Completion of the Repair. A): All sutures applied, showing the defect with sutures in place. The image provides a detailed view of the completed suture pattern before final closure. B): Testing of complete closure of the defect under laparoscopic visualization, ensuring that all sutures are properly placed and the defect is adequately closed. C): Final image of the repaired defect, demonstrating the defect completely closed and securely repaired after all sutures have been applied and tested.

surgery of 36 months (range, 3 days to 11 years). The mean follow-up was 45.16 months (8-110 months).

In 34 patients (61.8%), the hernia was detected incidentally in imaging studies. Nineteen patients (34.6%) had upper respiratory tract symptoms and a history of recurrent lung infection, while two patients (3.6%) presented with intestinal occlusion. The mean age at presentation of symptoms was 22.3 (1 month-9 years). The diagnosis was achieved with X-ray in 38 patients (69.1%), esophagogastroduodenal contrast study in 8 (14.5%), colon contrast study in 5 (9.1%), and CT scan in 4 (7.3%).

Fifteen patients (27.2%) had Down syndrome, seven (12.7%) had cardiac defects (4 ventricular septal defect, 2 Fallot tetralogy, and 1 atrial septal defect), and three patients (5.4%) had genetic disorders. Two patients (3.6%) had duodenal atresia, and two (3.6%) had undergone a Ladd procedure due to malrotation. One patient (1.8%) had two previous Bochdalek hernia repairs at another institution.

All repairs were performed using the transabdominal laparoscopic-assisted technique. Conversion to laparotomy occurred in only 1 patient (1.8%) due to a very large defect. This patient required a Gore-Tex mesh (W. L. Gore & Associates, Inc.) and had a history of two previous surgeries for Bochdalek hernia repair at another

institution. Nine patients (16.4%) had right-sided hernia, 12 (21.8%) left-sided and 34 (61.8%) had bilateral hernia. The falciform ligament was removed in all cases to improve defect visualization, and defect edges were scored for easier healing. The hernia sac was removed in 54 patients (98.2%). The contents varied: colon alone in 19 patients (34.6%), omentum alone in 12 (21.8%), omentum and colon in 8 (14.5%), small bowel in 6 (10.9%), liver in 5 (9.1%), and combinations of colon with small bowel or liver in 5 patients (9.1%).

Reoperation due to recurrence was necessary in 2 patients (3.6%), one of whom required two redo procedures. Although the same technique was used in all our patients, these two cases were managed by a surgical team that was not familiar with the procedure. The first patient experienced abdominal pain 50 months after the surgery, and an x-ray was used for diagnosis. The approach in this case was laparoscopic. The hernia content included colon, small bowel and omentum; the defect was repaired with transabdominal Ethibond 2-0 (Ethicone, Johnson & Johnson, USA) suture and a Goretex patch (Dualmesh).

In the second patient, the diagnosis of recurrence was made 3 months after surgery using an x-ray during follow-up. The second redo occurred 17 months later, presenting abdominal pain and vomiting as symptoms, and a new x-ray was conducted for diagnosis. Both redos were performed laparoscopically. In the first redo, the hernia content was omentum, and in the second one, small bowel. The defect was repaired with transabdominal Ethibond 2-0 (Ethicone, Johnson & Johnson, USA) in both opportunities.

Discussion

Summary of findings

Morgagni hernia is a rare congenital diaphragmatic defect, accounting for less than 6% of pediatric diaphragmatic hernias [5,6]. Our 20-year study evaluated 55 patients who underwent laparoscopic repair of MH. The majority of cases (62.5%) were discovered incidentally, often during imaging for unrelated reasons. The laparoscopic transabdominal repair technique utilized extracorporeal knotting and percutaneous sutures, which demonstrated a low recurrence rate (3.6%) and minimal complications, underscoring the technique's effectiveness and safety.

Morgagni hernia operations can be performed through open, laparoscopic, or abdominal approaches. Although high success rates have been reported for all these methods, laparoscopic repair has advantages, such as a short hospital stay, good cosmetic results, and early nutrition [11]. Our series included 55 cases that underwent laparoscopic transabdominal repair [12,13]. Lim et al. [14] reported 15 cases operated transabdominally and repaired with extracorporeal knotting. Karadag et al. [2] presented 22 patients who underwent laparoscopic repair. This study is among the largest and longest follow-up series using this method. The distribution of our cases was similar to the series reported in the literature [15,16]. The mean age of the patients was 36 months (range, 3 days -11 years), consistent with the literature. Morgagni hernia is more common in boys in the literature [16]. Our series also consisted of 24 girls (42.8%) and 32 boys (57.2%).

Patients are generally asymptomatic, and the hernia is often discovered incidentally during chest or abdominal X-rays undertaken for unrelated reasons. Morgagni Hernia has a wide variety of clinical presentations, such as cough, Upper Respiratory Tract Symptoms (URTS), fever, vomiting, or even ileus [17]. In the literature, URTS has been reported as one of the main symptoms of MH [2,4]. In our study, 19 cases presented with URTS. The most common presentation in our series was an incidental finding, differing from Karadag et al. [2], who reported 4 out of 22 patients as asymptomatic. Despite being asymptomatic, patients with Morgagni hernia should be operated on due to potential complications such as intestinal occlusion. In our series, we presented 2 patients with this initial symptom; in both cases, there was no need for intestinal resection.

Chromosomal and cardiac defects are common in MH. Fifteen of our cases had Down syndrome, and seven patients had a cardiac anomaly. These additional anomalies did not have any effect on the surgical technique. Although 90% of MH cases are on the right side according to the literature, only 16% of our cases were right-sided. In our series, the defect was predominantly bilateral. We believe that removing the falciform ligament allows a proper assessment of the defect.

Technical considerations

Laparoscopic technique and suture methods: Our study confirms the efficacy of laparoscopic transabdominal repair for MH, particularly with extracorporeal knotting. This method offers the advantages of the laparoscopic approach. The extracorporeal knotting technique, which involves suturing from outside the body, has been shown to enhance repair strength by engaging the full thickness of the abdominal wall [2,14]. This approach also simplifies the procedure compared to intracorporeal knotting, as it avoids complex in-cavity maneuvers. In contrast to intracorporeal knotting, extracorporeal knotting is more intuitive and less prone to errors [11]. Intracorporeal techniques often require advanced skill and experience due to the limited working space within the abdominal cavity. Our findings align with those of Lim et al. [14] and Karadag et al. [2], who reported successful outcomes using similar techniques.

Hernia sac management: The removal of the hernia sac during surgery is a debated issue. Ergun et al. [18] advocate for sac removal, suggesting it reduces recurrence rates, while other studies [19] have found no significant impact on recurrence from sac removal. However, Karadag et al. [2] presented a large series where the hernia sac was not removed, and no recurrences were reported. In our cohort, we removed the sac in 54 out of 55 patients. Notably, the patient with an unremoved sac experienced recurrence 3 months after the initial surgery, supporting the notion that sac removal may be beneficial in preventing recurrence. This finding is consistent with the viewpoint that sac removal can contribute to a more durable repair [18].

Conversion rate and mesh use: Our study's conversion rate to laparotomy was 1.8%, which is lower than the 9% reported by Karadag et al. [2]. This suggests that our approach effectively manages most cases laparoscopically. Additionally, the use of Gore-Tex mesh was required in only one patient with an exceptionally large defect and two previous repairs for a Bochdalek hernia, indicating that mesh reinforcement may be reserved for select cases rather than a routine necessity.

Comparison with literature: Our results are generally consistent with existing literature on laparoscopic MH repair. Recurrence of the hernia is a reported complication [20-22]. The recurrence rate in our study (3.6%) is comparable to that reported by Bawazir et al. [20] but lower than the 42% recurrence rate observed by Garriboli et al. [22]. The absence of recurrences in the studies by Karadag et al. [2] and Anadolulu et al. [4] may reflect differences in surgical experience, as our two recurrence cases were managed by a less experienced surgical

team. This suggests that surgical proficiency may influence recurrence outcomes.

Our study's results underscore the efficacy of laparoscopic repair using extracorporeal knotting for MH. This technique has demonstrated significant benefits in terms of reduced recurrence rates, shorter operation times, and lower complication rates [11]. The percutaneous internal ring suturing technique described by Patkowski et al. [11] is particularly relevant, as it highlights the simplicity and effectiveness of using external knot-tying methods in minimally invasive surgeries. The integration of these techniques into routine practice can enhance surgical outcomes and optimize patient recovery.

Limitations

This study's retrospective design and the involvement of multiple surgeons, despite adherence to a standardized protocol, could introduce variability in outcomes. Additionally, the rarity of MH limits the generalizability of our findings, highlighting the need for larger studies to confirm our results.

Future Directions

Prospective, multicenter studies are essential to validate our findings and further refine surgical techniques. Future research should focus on comparing different repair methods, evaluating long-term outcomes, and assessing the impact of sac management strategies on recurrence rates.

Conclusions

Laparoscopic transabdominal repair of Morgagni hernia, utilizing extracorporeal knotting and percutaneous sutures, proves to be an effective method with low complication and recurrence rates. This approach simplifies the surgical technique and enhances repair strength by engaging the full thickness of the abdominal wall. Given these benefits, laparoscopic repair should be considered as a feasible technique for managing Morgagni hernia.

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