

Laparoscopic Plication for Left Anterior Diaphragmatic Eventration in a Pediatric Patient: A Case Report

Alvin B. Caballes, MD, FPCS^{1,2} and Johann Paulo S. Guzman, MD¹

¹Philippine Children's Medical Center; ²College of Medicine, University of the Philippines Manila

Reported here is the first documented laparoscopic repair of a rare partial diaphragmatic eventration in a pediatric patient. The case involves a three year old female who had recurrent cough. While a Morgagni hernia was the initial impression, an eventration of the left anterior diaphragm was instead found on laparoscopy. Repair was aided by using transcutaneous traction, with plication achieved by intracorporeal sutures. The patient recovered uneventfully and follow-up x-ray after six months demonstrated an intact repair.

Keywords: diaphragmatic eventration, diaphragmatic hernia, laparoscopy

Analogous diaphragmatic anomalies may have divergent clinical manifestations. Bochdalek hernias, while often associated with severe respiratory distress in affected neonates, may also not manifest overtly in other patients. Likewise, different anomalies may have similar clinical presentations. Patients with Morgagni hernias or eventrations, while often asymptomatic, can also present with severe pulmonary and gastrointestinal impairments.¹⁻⁴ The diagnostic uncertainty is highlighted in the present case, wherein a child pre-operatively diagnosed to have a Morgagni hernia was found intra-operatively to have a rare left anterior diaphragmatic eventration.⁵ The laparoscopic approach adopted not only facilitated diagnosis, but was adaptable enough to enable intracorporeal repair for an altered indication.

The Case

A three year old female had recurrent cough, for which antibiotics were administered over the preceding months. On x-ray, bowel loops were incidentally identified in the anteromedial portion of the left thorax (Figure 1a). A subsequent chest CT scan was interpreted as being equivocal for a left-sided diaphragmatic eventration or hernia. The patient was thereafter referred to this pediatric center. Upon admission, the patient, weighing 13kg, was asymptomatic. Based on clinical and radiologic grounds, a diagnosis of Morgagni hernia was arrived at. In consultation with the concerned pediatric service, surgical correction of the condition was recommended.

A laparoscopic approach was opted for and was undertaken electively. The patient was placed in a 30° semi-Fowler's position, following general anesthesia. A 10 mm umbilical port was placed using an open technique, and a 30° 10mm laparoscope was inserted. An insufflation pressure of 10mm Hg was maintained. Upon inspection, a broad concavity was found at the left anterior diaphragm, extending medially from the falciform ligament and laterally to the midclavicular line, with a width of up to three centimeters (Figure 2a). The opaque, whitish and fibrous area was continuous with the rest of the normal-appearing diaphragm. The findings were thus consistent with a congenital partial diaphragmatic eventration. Three 5mm working trocars were added. The falciform ligament was incised. Hook cautery was used to create a small defect in the eventration, allowing the area to drop back for easier manipulation. Four

transcutaneous sutures were placed sequentially at the left anterior subcostal area. These passed through the inner abdominal wall just inferior to the diaphragm insertion, dome of the eventration, and the anterior rim of the normal-appearing diaphragm. These were pulled up, drawing the normal diaphragm anteriorly, and facilitating the placement of additional 2-0 non-absorbable plicating

sutures (Figure 2b). The ends of the traction sutures were later placed intra-corporeally and tied. No chest drains were placed. The entire operation lasted nearly two hours. The patient recovered uneventfully. A follow-up x-ray done after six months showed an intact repair (Figure 1b). Pulmonary function tests could not be completed by the patient.

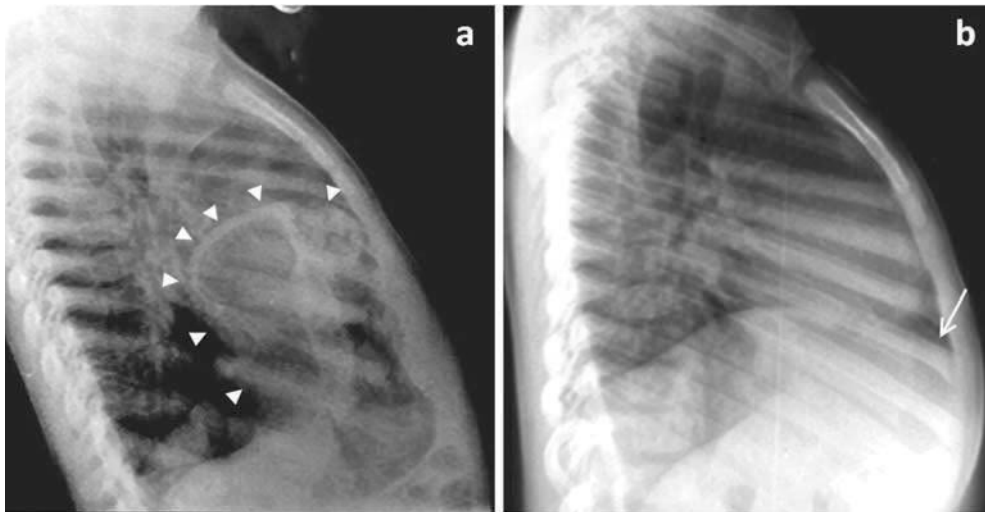


Figure 1 a. Pre-operative chest radiograph, lateral view, showing bowel loops (white arrowheads) in anterior lower thorax; **b.** Chest radiograph, lateral view, taken six months after laparoscopic repair, documenting distinct anterior costophrenic angle (white arrow) and well-demarcated diaphragm outlines.

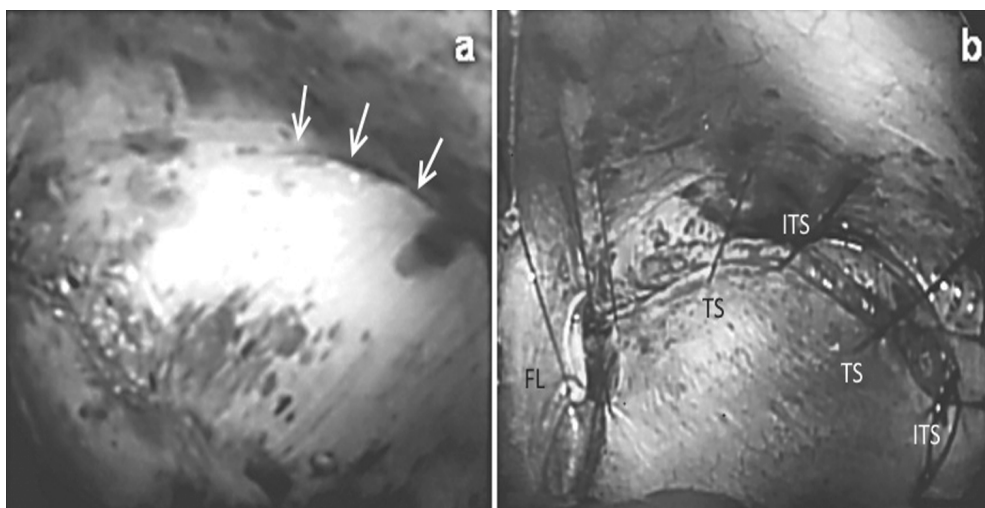


Figure 2a. Laparoscopic view of the partial eventration (white arrows) at the left anterior diaphragm; **b.** Laparoscopic plication, with four transcutaneous sutures (TS) in place, and two intracorporeally-tied sutures (ITS) at the middle and extreme right; incised falciform ligament (FL) is at the left.

Discussion

Structural diaphragmatic anomalies may be congenital or acquired conditions. The former results from the failure of any of its embryonic components - septum transversum, pleuroperitoneal membranes, dorsal mesentery of the esophagus, and body wall muscles - to either fully develop or fuse. Posterolateral Bochdalek hernias are the most common, and retrosternal Morgagni hernias are the least frequent of such defects. The latter occur more frequently on the right, than the left (also referred to as a Larrey's hernia), than bilateral.¹ Eventrations are abnormal elevations of the diaphragm and are due to the arrest of myoblast migration to any of its components. The involvement may, in decreasing frequency, be total or partial at either side, or bilateral.² While there is an equal incidence of laterality for total eventrations, partial anomalies are much more commonly encountered on the right side.³ Diaphragmatic paralysis, due to phrenic denervation with consequent passive elevation of the affected diaphragm, is often differentiated from congenital eventration.⁴

Imaging studies are routinely relied upon for definitive diagnosis. Plain radiographs are highly sensitive in demonstrating either eventrations or hernias, often doing so on an incidental basis. Supplemental studies include fluoroscopy, contrast radiographs, ultrasound, CT scan, and MRI.^{1,2,4,6} However, as exemplified by the present case and also mentioned in previous reports, the distinction based on clinical as well as imaging grounds may not always be clear-cut.^{2,6}

For patients with hernias or eventrations, the integrity of the diaphragm will ultimately need to be re-established. The timing and selection of the appropriate interventions will depend on the magnitude of the functional aftermath of the underlying anomalies. Surgical correction can be done through the abdomen or chest, and by either open or endoscopic techniques.^{2,4}

Given the working diagnosis of a retrosternal hernia, a laparoscopic approach was decided on. The finding of an anterior diaphragmatic hernia did not substantially alter the planned conduct of the surgery. Endoscopic repair of Morgagni hernias in children have mostly been done laparoscopically.^{7,8} Thoracoscopy has been

more widely used for eventration repair.^{4,9} The latter approach provides ample working space and allows identification of the phrenic nerve. However, laparoscopy has also been utilized increasingly in pediatric eventration cases, as it avoids single lung ventilation and intercostal pain while providing additional space, which may be crucial for smaller patients.¹⁰ Laparoscopic repair, however, has a higher eventration recurrence rate.¹⁰ Thoracoscopy was not opted for in the present case inasmuch as there would have been less access to the infra-cardiac area of interest for a presumed Morgagni hernia.

To the best of the authors' knowledge, there has been no previous report of laparoscopic repair for an anterior diaphragmatic eventration in the pediatric age group. Being a left-sided anomaly, with only one specific reference for two such cases retrieved by the authors, makes the underlying defect all the more rare.⁵ The steps employed in the present case, while not novel, provided an opportunity to adopt the laparoscopic techniques earlier used selectively for different conditions. The use of transcuteaneous traction sutures has been mentioned mostly for Morgagni cases.^{7,8} Puncturing and plication of the diaphragm, obviously inapplicable for hernia defects, have been done for eventration cases.^{4,10} All the suture knots were intracorporeal - as with eventration repair - and none were tied subcutaneously, much less were separate skin incisions made for these, as often reported for Morgagni repairs.^{7,8} The thinned-out area of the diaphragm was not excised nor was a chest drain left, as have been done for either indication.^{2,6} The repair was stable on medium-term follow-up.

The case highlights the clinical dilemma given differential diagnoses with overlapping presentations. The added diagnostic value of laparoscopy was beneficial in this regard. The case reemphasizes the flexibility and effectiveness of laparoscopy in appropriate circumstances.

Acknowledgement

The authors are grateful to the patient and her parents for the trust accorded in the provision of care as well as the preparation of this report.

References

1. Loong T, Kocher H. Clinical presentation and operative repair of hernia of Morgagni. *Postgrad Med J* 2005; 81: 41-4.
2. Thomas T. Congenital eventration of the diaphragm. *Ann Thorac Surg* 1970; 10: 180-92.
3. Wu S, Zang N, Zhu J, Pan Z, Wu C. Congenital diaphragmatic eventration in children: 12 years' experience with 177 cases in a single institution. *J Pediatr Surg* 2015; 50: 1088-92.
4. Groth S, Andrade R. Diaphragmatic eventration. *Ann Thorac Surg* 2009; 9: 511-9.
5. Hesselink J, Chung K, Peters M, Crummy A. Congenital partial eventration of the left diaphragm. *Am J Roentgenol* 1978; 131: 417-9.
6. Eren S, Ceviz N, Alper F. Congenital diaphragmatic eventration as a cause of anterior mediastinal mass in the children: imaging modalities and literature review. *Eur J Radiol* 2004; 51: 85-90.
7. Lima M, Lauro V, Domini M, et al. Laparoscopic surgery of diaphragmatic diseases in children: our experience with five cases. *Eur J Pediatr Surg* 2001; 11: 377-81.
8. Mallick M, Alqahtani. Laparoscopic-assisted repair of Morgagni hernia in children. *J Pediatr Surg* 2009; 44: 1621-4.
9. Becmeur F, Talon I, Schaarschmidt K. Thoracoscopic diaphragmatic eventration repair in children: about 10 cases. *J Pediatr Surg* 2005; 40: 1712-5.
10. Miyano G, Yamoto M, Kaneshiro M, et al. Diaphragmatic eventration in children: laparoscopy versus thoracoscopic plication. *J Laparoendosc Adv Surg Tech A* 2015; 25: 331-4.