

Surgical technique and complications during laparoscopic repair of diaphragmatic hernias

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Abstract Diaphragmatic hernias can present as retrocostophoid hernias (RCXH) or diaphragmatic dome hernias. The RCXH include the Larrey hernia (LH), the Morgagni hernia (MH), and the Larrey–Morgagni hernia (LMH). These congenital hernias are usually asymptomatic, and the diagnosis is simplified by two exams: chest X-ray, and thoraco-abdominal computed tomography (CT) scan. The potential risk in this condition is small-bowel incarceration in the hernia defect and subsequent obstruction. We report two cases of LH and one case of LMH treated by laparoscopy between February 2004 and October 2005, with a review of the surgical techniques. Two different laparoscopic techniques were used: the tension-free technique, and resection of the hernia sac with closure of the defect and reinforcement by prosthesis. One patient presented a postoperative cardiac tamponade due to a clip-induced bleeding of an epicardial artery at the inferior surface of the heart. Treatment by laparoscopy is feasible, but a consensus regarding the best laparoscopic repair is needed.

Keywords Larrey hernia · Morgagni hernia · Diaphragmatic hernia · Laparoscopy · Complications

Introduction

Diaphragmatic hernias can presented as retrocostophoid hernia (RCXH) or diaphragmatic dome hernia. The RCXH include the Larrey hernia (LH) if on the right side of the diaphragm, the Morgagni hernia (MH) if on the left side, and the Larrey–Morgagni hernia (LMH) if bilateral. There is confusion in the literature regarding the denomination of each type of RCXH. The diaphragmatic dome hernia is also called the Bochdalek hernia (BH).

The prevalence of the RCXH is 1 per million (new) births, whereas it is 1 per 2,200 for the BH [1]. The RCXH represent 3–5% of all diaphragmatic defects [2–4], with 2% LH, 90% MH, and 8% LMH [5, 6]. RCXH is rarely described as intrapericardiac or posttraumatic [4, 7]. Appearance can be at all ages, but the average age of symptom presentation is 45 years [8]. The RCXH is usually asymptomatic; only in 20–30% of cases is it related with general symptoms such as epigastric pain, dyspnea, or constipation [6, 9, 10]. The condition can become symptomatic due to an increase of intra-abdominal pressure, as in obese patient or during pregnancy or with chronic constipation. Diagnosis can be easily done by two exams: chest X-ray, and thoraco-abdominal computed tomography (CT) scan [11, 12]. These exams allow differentiation of this pathology from other diseases, such as, for example, anterior mediastinal tumor, pulmonary tumour, pleuro-pericardiac cyst, and pulmonary atelectasis. The potential risk due to this defect is the small-bowel incarceration with subsequent obstruction,

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reported in the literature in 14% of children and 12% of adults [13]. We report two cases of LH and one of LMH treated by two different laparoscopic techniques between February 2004 and October 2005.

Materials and methods

First case

An 18-year-old woman in good health underwent a chest X-ray that evidenced an addition shadow in the inferior right part of the thorax. Thoraco-abdominal CT scan showed a small-bowel and colon migration above the right side of the diaphragm without signs of ischemia.

Second case

A 74-year-old man was hospitalized in the emergency room for small-bowel occlusion. The upright abdomen X-ray evidenced the presence of many hydroaeric levels, and the thoraco-abdominal CT scan showed an obstruction due to a small-bowel incarceration in the right diaphragmatic defect.

Third case

A 57-year-old woman, made an invalid by a respiratory insufficiency due to a primary restrictive syndrome, especially with nightly hypoventilation, underwent a chest X-ray that evidenced a round shadow of 7–8 cm located at the antero-inferior part of the right thorax. The three-dimensional (3D) CT scan reconstructions (Fig. 1) showed a right, medial, and left diaphragmatic hernia defect. The polysomnography confirmed the hypopnea syndrome, with alveolar hypoventilation that worsened at night.

Technique

First and second cases

The patients were placed in the supine position with the legs apart; the surgeon stood between the legs, and the assistant was to his left. Four abdominal trocars were used, one of 10 mm for the optical system, and three of 5 mm for the instruments. A 30° angled optical system was placed at the umbilicus and the instruments in right flank, left flank, and under the xiphoid process. The procedure started with the reduction of the small bowel (Fig. 2) occupying the diaphragmatic defect and for the



Fig. 1 Three-dimensional computed tomography (CT) scan reconstruction (third case)

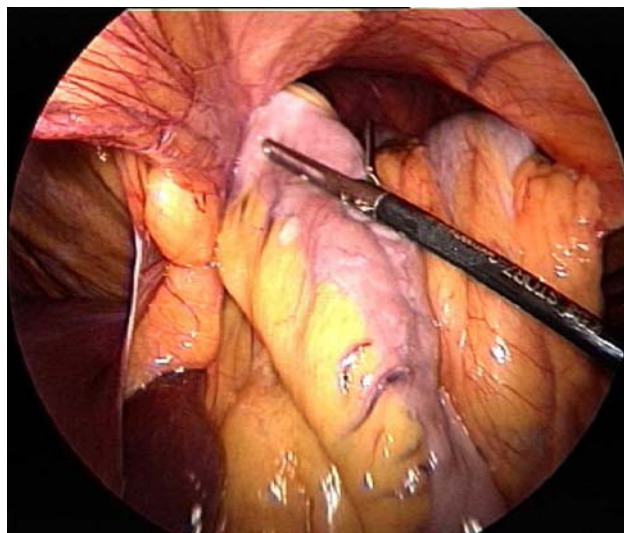


Fig. 2 Laparoscopic bowel loops reduction (first case)

first case also of the greater omentum and right colon. This act permitted visualization of the hernia cavity; the right pleura, the pericardium, and the ascending aorta were exposed (Fig. 3). In the second case, laparoscopy confirmed the absence of intestinal damage at the imprisoned bowel loops. In both cases, the hernia edges were completely freed by coagulating hook and ultrasound scissors dissection (Ultracision, Ethicon Endo-Surgery, Inc. Cincinnati, OH, USA). The hernia sac was not resected, and the hernia defect was not closed by stitches. A DUALMESH prosthesis 16 × 20 cm (W.L. Gore & Associates, Inc. Flagstaff, AZ, USA) was placed as an onlay by the tension-free technique and fixed with

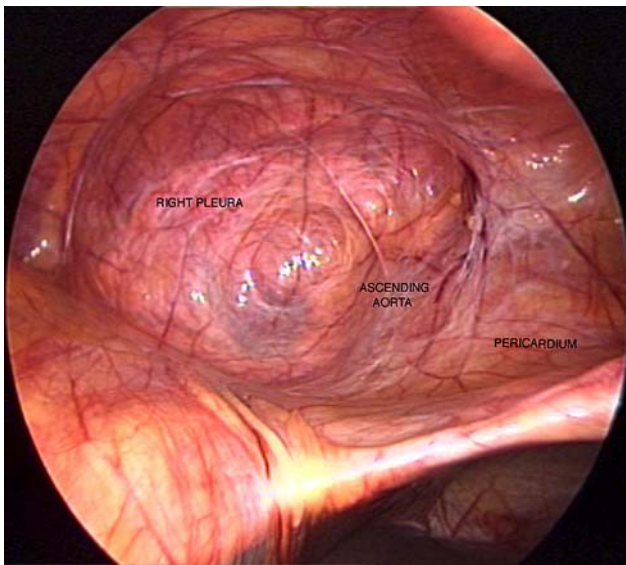


Fig. 3 Laparoscopic exploration of Larrey cavity (first case)

helical hernia stapler clips (Protack, Tyco Healthcare, Norwalk, CT, USA). A minimum overlay of 1 cm was respected (Fig. 4). No drainage was left in the hernia cavity.

Third case

Five abdominal trocars were used: one of 10 mm at the umbilicus for the 30° angled optical system; and four of 5 mm for the instruments, respectively, in the right flank, left flank, left hypochondrium, and under the xiphoid process. After reduction of the small bowel and right colic loops from the diaphragmatic defect, the hernia edges were freed by coagulating scissors and

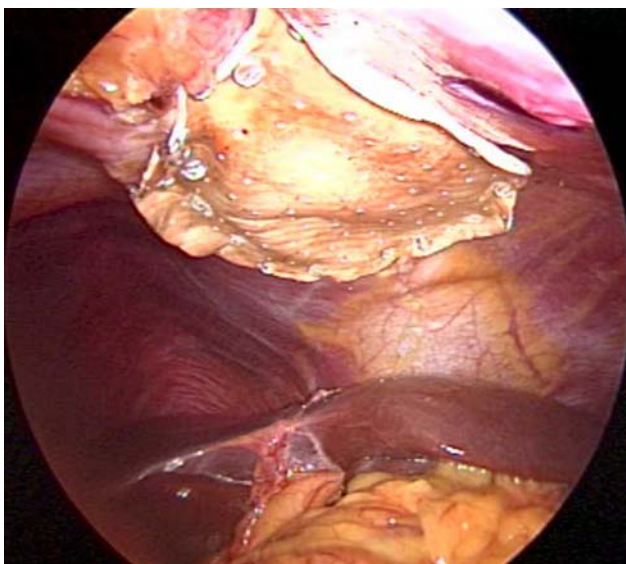


Fig. 4 Final aspect of laparoscopic tension-free repair (first case)

ultrasound scissors dissection. Retraction of the hernia sac by atraumatic graspers permitted an immediate reexpansion of the previously collapsed lung segments. The hernia sac was completely resected using accurate scissors dissection (Fig. 5). The hernia defect was closed by one polypropylene running suture, and a suction drain was left in the hernia cavity (Fig. 6). A Bard Composix E/X mesh 18 × 23 cm (C.R. Hand-barrow, Inc. Cranston, RI, USA) was then placed as an onlay and fixed with helical hernia stapler clips.

Results

There were no perioperative complications, and all procedures were completed by laparoscopy. The first

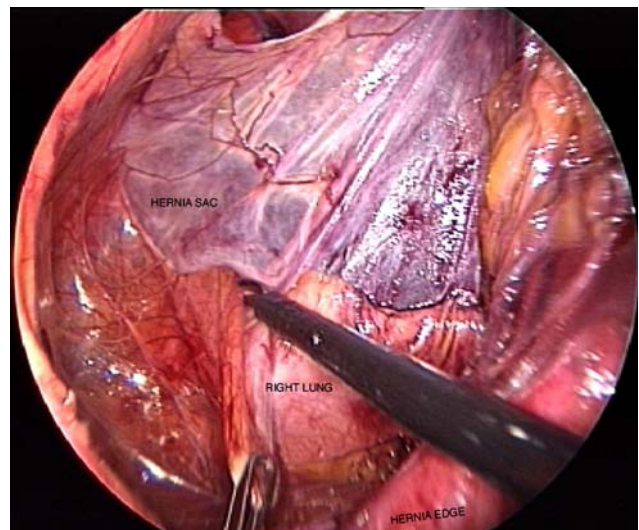


Fig. 5 Hernia sac resection (third case)

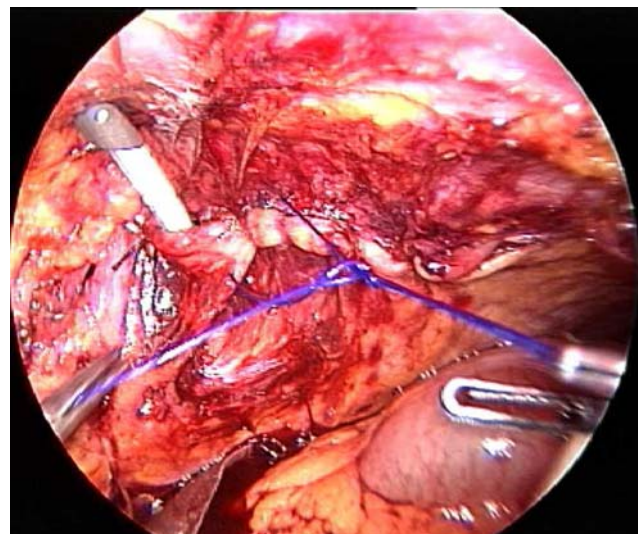


Fig. 6 Hernia defect closed by a running suture (third case)

procedure was completed in 24 min, the second in 85 min, and the third in 92 min. The postoperative stay was uneventful for the first two patients, with discharge from the hospital on the second day for the first patient and on the tenth day for the second patient, who required prolonged hospitalization because he presented cardiac arrhythmia, already known preoperatively, which was treated pharmacologically. The third patient presented a cardiac tamponade on the second day due to clip-induced bleeding of an epicardial artery at the inferior surface of the heart, which required emergency pericardial drainage. The outcome was good, and discharge home was allowed after 1 month. During the mean follow-up of 15.3 (3–24) months, no late complications were registered.

Discussion

The origin of RCXH is an embryonal disorder, with enlargement of the virtual space in the muscular composition of the diaphragm [14, 15]. The lateral part of the diaphragm consists of three different elements, from anterior to posterior: sternal, costal, and lumbar. The space between the sternal and costal sections always allows the passage of the epigastric vessels [15]. In the event of a fusion defect between the sternal and costal sections, this space can remain open, thus creating the diaphragmatic hernia.

Diagnosis of RCXH can be done as early as during pregnancy [16]. Other congenital anomalies can be associated, such as intestinal malrotation (26.7%), congenital cardiac disease (20%), or Down syndrome (20%) [17]. A paraesophageal hernia can be present as well, especially in adults [18]. In a typical LH or LMH, the colon, the small bowel, and the omentum can be herniated [8], as was seen in our first and third cases. In MH, only the small bowel with or without the omentum is included. The clinical presentation of the second of our patients confirms the risk of small-bowel obstruction, as was reported by Loong et al. [13] in 12% of adults. In the literature, the diagnosis of RCXH is well documented [11, 12], and only two exams are necessary: chest X-ray, and thoraco-abdominal CT scan. The possibility of 3D CT scan reconstruction by a specific software permits the exact location of the defect and recognition of the implied viscera (Fig. 1). Another valid possibility is multiplanar magnetic resonance imaging (MRI) with special acquisition [19]. Finally, if the patient presents debilitating respiratory problems, other complementary exams are necessary to study the respiratory function, as was the case for our third patient.

Treatment of RCXH is surgical; most reports describe an abdominal approach [1, 3, 5, 17, 20–30] and only three reports mention a thoracic approach [31–33]. Laparoscopic treatment of RCXH was reported in adults for the first time by Kuster et al. [27] and in children by Lima et al. [3] and Arca et al. [23]. Laparoscopy adds every advantage of a minimally invasive procedure (excellent operative image, minimal trauma, small scars, minimal postoperative pain, short postoperative stay) to the possibility of retracting the herniated viscera under visualization, with subsequent excellent exposure of the hernia cavity. Finally, laparoscopic repair is performed under precise control thanks to the optical zoom. Treatment of RCXH consists of the simple closure of the defect either without [3, 21, 22, 24–27] or with [20–22, 24] prosthesis, or thanks to laparoscopy, use of the tension-free technique [28–30]. We could not find in the literature a description of the ideal overlay space for mesh in this specific field. About 3–5 cm of overlap of all portions of the hernia defect is the most likely safety margin, as recommended by LeBlanc [34] during laparoscopic incision and ventral hernia. Prosthesis fixation by helical clips is valid when the defect is not too close to the pericardium. In this condition, we learned the hard way that it is better to use simple stitches in order to avoid a cardiac tamponade, as reported in the literature [35].

In the literature, there is no a consensus about the need to resect [6, 25] or not to resect the hernia sac [21, 26] because of the danger of creating a pneumothorax or pleural effusion. When the procedure involves the resection of the hernia sac, it is mandatory to leave a drain in the cavity. Also, the decision to close or not to close the openings of the hernia defect with stitches remains optional. It is probably better to perform the latter when the hernia sac is completely resected.

Conclusion

RCXH are congenital diaphragmatic defects, usually asymptomatic, but with a considerable potential of morbidity. Treatment by laparoscopy is feasible, but a consensus regarding the best laparoscopic repair approach is needed.

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