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Incarcerated Small-Bowel Pericardial Diaphragmatic Hernia After Pericardio-Peritoneal Window Creation: Report of a Rare Case

Authors' Contribution:

Study Design A
Data Collection B
Statistical Analysis C
Data Interpretation D
Manuscript Preparation E
Literature Search F
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Patient: Female, 84-year-old
Final Diagnosis: Diaphragmatic hernia • small bowel obstruction
Symptoms: Abdominal pain
Medication: —
Clinical Procedure: Laparoscopic surgery
Specialty: Surgery

Objective: Rare disease

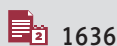
Background: Pericardio-peritoneal windows are surgically created to treat symptomatic pericardial effusion, usually of oncological origin, to alleviate cardiac tamponade-like symptoms. Common complications include infection, failure to drain the fluid correctly, and arrhythmias. There are few published cases of intra-abdominal complications due to these interventions. This report discusses pericardial diaphragmatic incarcerated hernia, which is one such complication.

Case Report: We report the case of an 84-year-old woman with advanced non-small cell lung carcinoma, who recently underwent surgery to create a pericardio-peritoneal window to treat a chronic malignant pericardial effusion. The patient presented in our Emergency Department because of abdominal pain with absence of flatus and stool for more than 4 days. Computed tomography scanning confirmed a proximal small-bowel obstruction due to incarcerated small bowel into the pericardial window. Reduction of the hernia was performed laparoscopically. After a bowel viability assessment by indocyanine green angiography, the pericardial window was covered by a noncovered macroporous mesh to avoid recurrence and to allow continuous pericardial fluid drainage.

Conclusions: In case of abdominal pain after the creation of a pericardio-peritoneal window, we suggest the prompt use of computed tomography after initial examination. Indeed, although rare, a pericardial diaphragmatic hernia is possible and requires surgical exploration if there is a risk of bowel strangulation. The operation can be done laparoscopically, and the hernia repair should involve the placement of a nonabsorbable and noncovered macroporous mesh. This should prevent hernia recurrence, while also allowing adequate drainage of the pericardial effusion.

Keywords: Hernia, Diaphragmatic • Herniorrhaphy • Indocyanine Green • Intestinal Obstruction • Laparoscopy • Pericardial Window Techniques

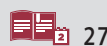
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Background

Surgically created pericardio-peritoneal windows are done to treat symptomatic pericardial effusions, usually of oncological or inflammatory origin, to alleviate and prevent tamponade-like symptoms. There are few published cases of intra-abdominal complications due to these interventions. Pericardial diaphragmatic incarcerated hernia (PDIH) is one such complication.

We report the case of a patient presenting a small-bowel obstruction (SBO) due to a PDIH. The aim of this report is to highlight this rare complication in order to prompt physician encountering this situation to consider the possibility of PDIH and promptly refer the patient for a surgical evaluation if necessary.

Case Report

We report the case of an 84-year-old woman with advanced non-small cell carcinoma of the right lung diagnosed 6 years earlier. She had been treated with neoadjuvant chemotherapy, right upper lobectomy, and adjuvant chemotherapy. At the time of presentation in our Emergency Department, she was under immunotherapy and recently underwent surgery to create a pericardio-peritoneal window to treat a chronic malignant pericardial effusion. No other method of drainage was used before. Seven days after surgery, the patient presented in our Emergency Department because of diffuse abdominal pain with absence of flatus and stool for more than 4 days.

Clinical examination revealed pain in the middle and upper abdomen with no signs of peritonitis. Blood tests revealed a mild inflammatory process with a C-reactive protein of 29 mg/L (normal <5 mg/L) and no leukocytosis.

Thoraco-abdomino-pelvic computed tomography (TAP CT) was performed and showed a SBO with a closed loop sign in the anterior mediastinum, thus revealing an incarcerated hernia through the pericardio-peritoneal window with no signs of bowel ischemia (**Figures 1, 2**).

The patient was initially treated conservatively with fasting, insertion of a nasogastric tube, and administration of Gastrografin® (100 mL, bolus, enteral). Nevertheless, due to increasing discomfort as well as the lack of progression of the contrast material beyond the hernia during the follow-up X-ray imaging, the patient was quickly referred for surgical exploration. Surgery was performed laparoscopically. Initial exploration showed the incarcerated small-bowel loop in the 3×4-cm pericardial window (**Figure 3**).

Reduction was easily performed, and following the routine process in our center, we performed indocyanine green (ICG)



Figure 1. A coronal computed tomography view of the incarcerated pericardial small-bowel hernia causing obstruction. The arrow shows the diaphragmatic hernia just next to the left liver lobe.



Figure 2. The transverse computed tomography view of the pericardial hernia. As shown by the arrow, the involved bowel mesenteric vessels present an incomplete "whirlpool sign" due to traction on the vascular pedicle.

angiography using our in-hospital ICG protocol. This protocol consists of a single intravenous injection of 7.5 mg of ICG solution to assess the perfusion of the affected small bowel (**Figure 4**). An excellent ICG signal appeared, showing a homogeneous vascularization of the entire small bowel.

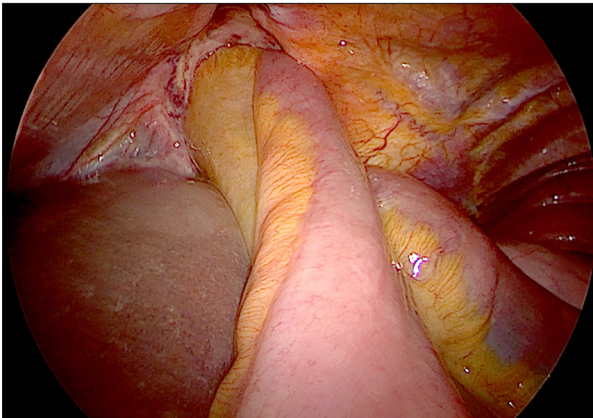


Figure 3. An intraoperative view of the incarcerated “closed loop type” small-bowel obstruction within the pericardio-peritoneal window.

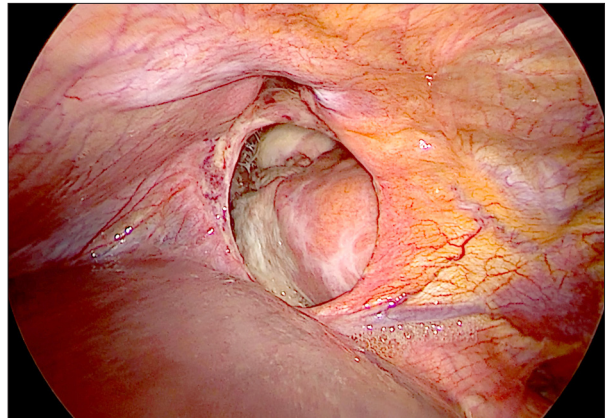


Figure 5. Pericardio-peritoneal window as a defect before closure with the mesh.

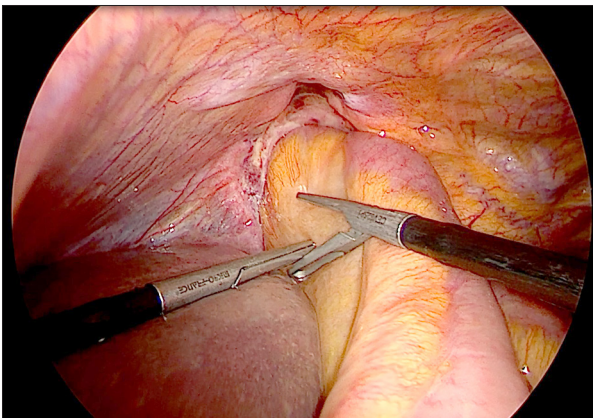


Figure 4. Laparoscopic reduction of the incarcerated pericardial hernia.

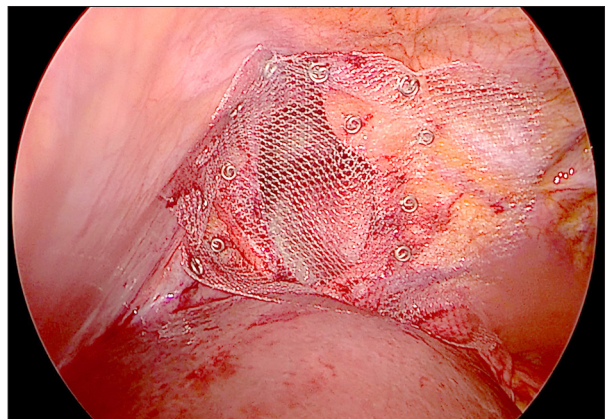


Figure 6. Final image of the nonabsorbable, noncovered mesh placement with nonabsorbable laparoscopic tackers fixation.

A direct closure of the window was not possible due to the tension on the tissues. We decided to cover the defect with a noncovered macroporous mesh (Parietene®) with nonabsorbable tackers (ProTack™) fixation to prevent any recurrence (**Figures 5, 6**).

After surgery, the patient was allowed to start drinking and eating as tolerated. At postoperative day 1, the patient was not experiencing pain and showed no signs of complications. She passed stool on postoperative day 2, allowing discharge on the same day.

Nevertheless, the patient presented herself again 2 days after discharge (postoperative day 4) due to acute epigastric pain. Clinical examination revealed a painful upper abdomen. The electrocardiogram showed a rapid ventricular responding auricular fibrillation. Blood tests showed a slight inflammatory syndrome. Owing to the recent events, a new TAP CT scan was performed, which revealed some free air and liquid due to the recent surgery but no obvious acute intra-abdominal complications.

Further investigations were performed, including an echocardiography that confirmed atrial fibrillation with no signs of acute ventricular dysfunction or pericardial effusion. The patient was ultimately treated with beta-blockers, which allowed better rate control and led to the resolution of the epigastric pain.

At a 30-days postoperative follow-up, the patient had no residual pain and the abdominal examination was normal. Therefore, no further surgical follow-up was required.

Discussion

Pericardial effusion is a common finding with a wide spectrum of etiologies. Malignant pericardial effusion is a known complication of advanced malignancies, such as lung cancer as in our case. These patients have a poor prognosis, and the aim of drainage is to reduce the symptoms and improve quality of life quickly and for as long as possible. Drainage can be done either by a percutaneous or a surgical approach. Two main

surgical approaches to create a pericardial window have been described: the transpleural approach (via thoracotomy or thoracoscopy) and the subxiphoid approach [1]. It is still unknown which technique is the best. According to Langdon et al [2], the subxiphoid technique is associated with less postoperative pain, but the thoracotomy approach may be more effective at preventing effusion recurrence. According to Balla et al [1], these 2 techniques seem to be equivalent in midterm efficacy. In the subxiphoid approach, which was the technique used in our case, a connection between the pericardium and the peritoneal cavity (pericardio-peritoneal window) is created to allow passive drainage of the effusion into the abdominal cavity [3]. This is a simple, safe, and effective procedure applicable to most patients with malignant pericardial effusion [4]. Common complications include infection, failure of the fluid to drain correctly, and arrhythmias. Herniation of abdominal content through the window is a rare but described complication. As a risk factor for the latter in our case, we could identify a chronic obstructive pulmonary disease (GOLD 3) with chronic cough.

PDIH is a rare entity, as illustrated by Larrieu et al [5] in a systematic literature review in 1970 that found only 27 cases, all of them attributable to either a congenital defect or trauma. More recently, iatrogenic hernias have been described following coronary artery bypass [6], subxiphoid epicardial pacemaker insertion [7], and very rarely after pericardio-peritoneal window creation [8]. We have found only 10 cases of the latter described in adults in the literature [8-17], with 7 of these cases involving the small bowel.

SBO is one of the leading causes of admission to a surgical facility and one of the most frequent indications for urgent abdominal surgery [18]. Adhesions are the most common cause of SBO. Others etiologies vary from one study to another, but incarcerated hernias and tumors are often described as second and third causes [19]. Depending on the cause of the obstruction and the presence of signs of peritonitis, hemodynamic instability, or other acute complications, the treatment can be either conservative or surgical. Laparoscopic surgery is feasible most of the time and is associated with similar adverse event rates as open surgery, making it the most recommended approach [18]. As already mentioned, PDIH is an extremely rare cause of SBO, and management has therefore not been standardized.

Among the 10 published cases we found, 2 involved conservative treatment [13,14], 6 were addressed with an exploratory laparotomy with mesh repair [8-12] or a direct closure [16], and only 2 cases involved an exploratory laparoscopy with mesh repair [15,17]. The treatment of other types of diaphragmatic hernias that are slightly more frequent, such as congenital (Morgagni, Bochdalek) or traumatic hernias, has been better

described. Laparoscopy is mentioned as a safe surgical approach [20,21] with a low morbidity and a shorter hospital stay [20]. To avoid tension, the use of prosthetic meshes in defects larger than 20-30 cm² or even in all adults' cases has been recommended [20].

In our case, a similarity to hiatal hernias can be noted, as the same portion of the diaphragm was involved. A meta-analysis and systematic review of randomized controlled trials concluded that mesh hiatal hernioplasty may be superior to suture cruroplasty for the repair of large hiatal hernias based on a lower risk of revisional surgery and extremely low overall mesh-related complications [22]. In our case, we decided to perform a laparoscopy, as the clinical situation allowed it. Laparoscopic exploration clearly showed the herniated bowel as well as the diaphragmatic defect. Reduction of the affected small-bowel loop was easy, and the defect could be covered with a mesh, which seemed to be the best way to avoid recurrence. In addition, we had to deal with the specific issue of not completely sealing the repair, due to the risk of recurrence of the malignant pericardial effusion. Therefore, we used an uncovered macroporous mesh to preserve fluid drainage through the mesh while preventing any hernia recurrence. At 30 days of follow-up, our patient presented no signs of recurrence of the effusion or the hernia.

Although pericardial hernias are rare, they can lead to lethal complications, either by mass effect on cardiac structures leading to tamponade [23] or by strangulation of the hernial contents [24]. ICG angiography is currently used to assess the viability of the bowel in such cases. The use of ICG has been described for medical applications for over 50 years. Combined with near-infrared fluorescence technology, it is now one of the most functional tools to assess *in vivo* perfusion of tissues and organs. Intraoperative ICG angiography is thus routinely performed in a broad spectrum of surgical procedures. Patients and surgeons benefit from the increasing use of ICG, a fast, cost-effective, and nontoxic method that allows a more organ-sparing surgery [25-27]. In our case, an excellent and homogeneous ICG signal was obtained, allowing us to confirm good bowel tissue perfusion and thus excluding the necessity of a bowel resection.

Conclusions

In case of upper abdominal symptoms following the creation of a pericardio-peritoneal window, we suggest promptly conducting a TAP CT scan after the initial examination. Indeed, although rare, a PDIH is possible and surgical exploration is advised if there is any risk of bowel strangulation. The operation can be done laparoscopically, and the use of modern technology such as ICG angiography is useful in the evaluation of

intestinal viability. Hernia repair should involve the placement of a nonabsorbable and noncovered mesh to prevent hernia recurrence, while also allowing adequate drainage from the pericardial cavity into the peritoneal cavity to avoid recurrence of a symptomatic pericardial effusion and the risk of tamponade.

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Conflict of Interest

None.