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Minimally invasive surgery for intradiaphragmatic bronchogenic cyst

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A cystic lesion appeared when the muscular layer of the diaphragm was divided.

Intradiaphragmatic bronchogenic cyst is a rare benign disease that is difficult to diagnose owing to its location. Accurate preoperative diagnosis by MRI and minimally invasive surgery are ideal.
Introduction

Bronchogenic cysts are common, and the majority of them are found in the mediastinum and lung. However, they may occur rarely in the diaphragm, peritoneum, and abdominal cavity, owing to anomalies during embryonic development. Among them, intradiaphragmatic bronchogenic cysts are difficult to diagnose accurately based on imaging alone, owing to their location. As these cysts are essentially benign, minimally invasive treatment with an accurate preoperative diagnosis and optimal surgical procedure is ideal.

Case summary

A 53-year-old man had a mass in his diaphragm that was detected during a medical checkup. A detailed follow-up at 6 months showed no shrinkage or disappearance of the mass. He was then referred to our hospital for further examinations and treatment. A computed tomography (CT) scan displayed a poorly contrasted mass (54 × 45 × 47 mm) connected to the left diaphragm (Figure 1A). Magnetic resonance imaging (MRI) displayed a high signal on T2-weighted images of the mass (Figure 1B). From the MRI, we identified the mass as a cystic lesion between the diaphragmatic fascia, and suspected it to be an intradiaphragmatic bronchogenic cyst (Figure 1C). We hence planned resection via thoracoscopic surgery.

Resection was performed by 3-port thoracoscopic surgery. The port placement is shown in Figure 2A. Initially, the mass was not exposed to the thoracic cavity but was identifiable as a localized bulge of the diaphragm (Figure 2B). After dividing the adipose tissue, diaphragmatic pleura, and fascia, we divided the muscular layer and identified a white cyst wall. Blunt dissection between the cyst wall and the muscle was possible by
careful manipulation. The cystic mass was removed without cystic wall injury through a minimal incision of the muscle (Figure 2C). The preserved peritoneum was identified deep in the muscular layer. The incision of the diaphragmatic pleura, fascia, and muscle layer was closed by a running suture using a 2-0 nonabsorbable suture (Figure 2D). There were no postoperative complications.

The specimen was 52 × 37 × 30 mm, and the cystic wall was smooth and ranged in color from white to pale yellow. The cyst was filled with pale yellowish, grayish white, and creamy fluid. Histopathological analysis demonstrated that the cyst wall was lined with a ciliated columnar epithelium with a discrete smooth muscle layer, cartilage, and bronchial glands. Additionally, striated muscle tissue from the diaphragm was attached to the cyst wall. No indications of malignancy were identified. Consequently, the final diagnosis was bronchogenic cyst of diaphragmatic origin (Supplementary Figure A–C).

Discussion

Bronchogenic cysts are caused by the separation of the lung buds from the foregut primordium during embryogenesis. When this occurs during the formation of the diaphragm, intradiaphragmatic bronchogenic cysts may form. Accurate preoperative diagnosis of bronchogenic cysts is difficult owing to their location. They are often mistaken as being adrenal masses, posterior mediastinal tumors, or lung masses. The key to their accurate preoperative diagnosis is to know that bronchogenic cysts can arise in the diaphragm. MRI is very useful and essential for the diagnosis of bronchogenic cysts, enabling visualization of the internal structure of the mass and its positional relationship with the diaphragm. In the present case, MRI displayed the subdiaphragmatic fascia to be behind the cyst, which led us to believe that we could resect the mass through the
thoracic cavity and preserve the diaphragm and peritoneum.

Although intradiaphragmatic bronchogenic cysts are essentially benign, there have been reports of malignant cases\(^3\), in which symptoms appeared owing to cyst enlargement\(^4\), or infections owing to rupture\(^5\), and surgical treatment is generally recommended. Various surgical strategies have been performed as a result of the misdiagnosis or unclear diagnosis of these cysts on preoperative imaging. There have been some reports of the treatment of possible bronchogenic cysts by open thoracotomy or laparotomy and en bloc resection with extensive surrounding diaphragm\(^1\). However, as these cysts are essentially benign, invasive procedures should be avoided as much as possible. Laparoscopic surgery could be an effective option. Indeed, the surgeon's expertise will play a role in the decision. However, in terms of operative field, thoracoscopic surgery has an advantage over laparoscopic surgery because the collapsed lung does not obstruct the view. Except for some unusual circumstances, we believe that surgery can be adequately performed by thoracoscopy. To expose the cyst wall, the diaphragm muscle layer should be divided along the direction of the muscle bundles. Once a part of the cyst wall is exposed, the cyst should be removed by dissection along the cyst wall, even if some muscle fibers are attached, while preserving the diaphragm and peritoneum. If the muscle damage is small, repair of the diaphragm with direct suture is easy.

In conclusion, we encountered a very rare case of a patient with an intradiaphragmatic bronchogenic cyst. We performed minimally invasive thoracoscopic surgery and successfully resected the cyst. The key to the correct preoperative diagnosis was knowing that bronchogenic cysts can arise in the diaphragm. MRI was crucial for the diagnosis and for determining a treatment strategy.
Institutional review board approval was not required; written informed consent was obtained from the patient for use of the data for research.
References


Legends

**Video:** The video demonstrates thoracoscopic surgery for an intradiaphragmatic bronchogenic cyst. The cystic mass was removed without wall injury through a minimal incision of the diaphragmatic muscle. The diaphragm was repaired by direct suture.

**Figure 1.** Preoperative imaging of the lesion. (A) Chest computed tomography displaying a mass (54 × 45 × 47 mm) in the diaphragm (white dashed circle). (B) Axial view of magnetic resonance imaging (T2-weighted) of the mass (white dashed circle). (C) Coronal view of magnetic resonance imaging (contrast-enhanced T1-weighted) displaying the diaphragmatic fascia and pleura or peritoneum (white arrows).

**Figure 2.** Operative findings. (A) Port placement on the left chest wall. A 7-mm incision in the 7th intercostal space for the left hand, a 7-mm incision in the 8th intercostal space for thoracoscopy, and a 20-mm incision in the 9th intercostal space for the right hand and assistance. (B) The mass caused a localized bulge in the diaphragm. (C) The mass was removed through an incision in the diaphragmatic fascia and muscle layer. (D) The diaphragm was repaired with 2-0 nonabsorbable sutures.

**Supplementary figure.** Histological findings. (A) Low magnification image of a tissue section of a unilocular cystic mass. Rectangles labeled B and C indicate regions magnified in (B) and (C), respectively. (B) Higher magnification image showing a layer of ciliated columnar epithelium with cartilage, bronchial glands, and smooth muscle. (C) Higher magnification image showing attachment of the striated muscle of the diaphragm to the cystic wall.
Central picture

Dorsal thoracic wall

Cystic lesion

Diaphragm

Pericardium
Figure 2