Delayed Iatrogenic Diaphragmatic Hernia after Left Lower Lobectomy

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A 66-year-old patient undergoing regular follow-up at Samsung Medical Center after left lower lobectomy visited the emergency department around 9 months postoperatively because of nausea and vomiting after routine esophagogastroduodenoscopy at a local clinic. Abdominal computed tomography showed the stomach herniating into the left thoracic cavity. We explored the pleural cavity via video-assisted thoracic surgery (VATS). Adhesiolysis around the herniated stomach and laparotomic reduction under video assistance were successfully performed. The diaphragmatic defect was repaired via VATS. The postoperative course was uneventful, and he was discharged with resolved digestive tract symptoms.

Key words: 1. Lung surgery
2. Complication
3. Diaphragm
4. Hernia

Case report

A 66-year-old male patient receiving regular follow-up after lung cancer surgery was admitted to the emergency department with a chief complaint of nausea and vomiting. His symptoms started 2 days previously, after routine esophagogastroduodenoscopy (EGD) at a local clinic. His initial vital signs were 150/90 mm Hg, 87 beats/min, 20 breaths/min, and 36.7°C. A physical examination revealed no signs of peritoneal irritation (e.g., rebound tenderness). In the laboratory tests, his white blood cell count was slightly elevated; however, the C-reactive protein level was normal. On the initial chest radiograph (Fig. 1A), the left hemidiaphragm was elevated, and the air-fluid level inside the stomach was observed without evidence of free gas.

Approximately 9 months previously, the patient had been diagnosed with lung cancer and underwent a preoperative evaluation. Chest computed tomography (CT) (Fig. 2A) showed a 5-cm mass in the medial basal segment of the left lower lobe and combined consolidation with obstructive atelectasis. These findings suggested a possible pleural adhesion. He underwent left lower lobectomy with systematic mediastinal lymph node dissection. No intraoperative events occurred, except for conversion to thoracotomy from video-assisted thoracic surgery (VATS) owing to a diffuse, dense adhesion. The final pathologic finding was squamous cell carcinoma (pT2bN0M0), and the patient was discharged on postoperative day 5 without any specific complications. After surgery, he was followed up at the outpatient clinic without any complaints. Follow-up chest CT showed no evidence of tumor recurrence.

We performed abdominal chest CT under the impression...
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Fig. 1. Chest radiographs. (A) Initial chest radiograph in the emergency department, revealing an elevated left hemidiaphragm and air-fluid level inside the herniated stomach. (B) Chest radiograph at discharge revealing a reduced stomach.

Fig. 2. CT scans. (A) Preoperative chest CT image showing a 5-cm mass in the medial basal segment of the left lower lobe and combined consolidation with obstructive atelectasis (arrows). (B) Abdominal CT image revealing gastric herniation into the thoracic cavity and resultant passage obstruction with a markedly dilated stomach and air-fluid level in the thorax (arrows). CT, computed tomography.

of acute gastroenteritis or iatrogenic gastrointestinal perforation after EGD. CT showed gastric herniation into the thoracic cavity with resultant passage obstruction, as well as a markedly dilated stomach and air-fluid level in the thorax (Fig. 2B). The enhancement of the herniated stomach wall appeared relatively well preserved. After L-tube insertion, a small amount of dark-brown gastric content was drained, and the symptoms slightly improved. Our impression was symptomatic iatrogenic diaphragmatic stomach hernia, without signs of strangulation. We then performed an urgent operation, both to reduce the stomach volume and to repair the diaphragmatic defect.

Considering the adhesion that might have formed 9 months postoperatively, the transthoracic approach was selected for the operation, and VATS was attempted to take advantage of the scope, if possible. To prepare for laparotomy at the same time, the operation was performed in a semilateral position with an abdominal area preparation. As expected before the operation, the lung, stomach, and diaphragm were all stuck together as a single lump (Fig. 3A). Because the gastric wall had a normal pinkish color, the blood supply was considered to have been relatively well maintained. After adhesiolysis, stomach reduction was attempted with VATS; however, it was difficult to perform with VATS alone. Eventually, an upper-half laparotomy of the 7-cm incision was added. Thereafter, the diaphragmatic defect was extended anteriorly and posteriorly, and laparotomic gastric reduction with video assistance was performed. Finally,
Fig. 3. Intraoperative findings. (A) Adhesion between the LUL of the lung and the herniated stomach. (B) Diaphragmatic defect repair using multiple interrupted Prolene sutures. LUL, left upper lobe.

The diaphragmatic defect was successfully repaired using multiple interrupted 1-0 Prolene sutures, followed by reinforcement with 1-0 black silk (Fig. 3B).

The patient’s postoperative course was uneventful, and he was discharged on postoperative day 6 with a normal diet without any gastrointestinal symptoms. The chest radiograph (Fig. 1B) at discharge showed improvements compared with the chest radiograph obtained at admission (Fig. 1A). He was in good condition at the outpatient clinic after the operation.

Discussion

Screening and diagnosis for early-stage lung cancer have recently become more common, and complications after pulmonary resection are expected to occur consistently in the future [1,2]. To date, reports related to iatrogenic diaphragmatic hernia after pulmonary resection are extremely rare. To our knowledge, no such reports have been published in Korea, and even worldwide, only 1 case report was published by Pan et al. [3] in 2016.

The mechanism of diaphragmatic hernia is believed to involve the failure to find a small injury or perforation formed by dissecting the adhesion between the lower lobe and diaphragm. Postoperative chest suction might increase the pressure gradient through the diaphragm and prevent healing. It is reasonable to assume that the defect might gradually grow during several months, and overt symptoms can begin after the injection of a large amount of air during EGD. This can be expected to occur more frequently in patients with a severe adhesion between the left lower lobe and diaphragm.

In the short term, this complication might be associated with an increased mortality rate due to sepsis, if strangulated; in the medium to long term, weight loss, deconditioning, and malnutrition can be triggered or exacerbated [4]. This delayed complication is particularly problematic in patients undergoing or scheduled to undergo adjuvant treatment. Therefore, both prevention and early recognition are essential. For prevention, intraoperative detection during pulmonary resection is considered critical. Therefore, the possibility of diaphragmatic injury should be considered after a left-sided thoracic procedure in a patient with an adhesion, and thorough exploration of the diaphragm before chest closure is recommended. In addition, physicians should not ignore any digestive tract symptoms reported in the context of outpatient follow-up, in order to ensure that any such complications are diagnosed promptly. Moreover, when a patient complains of nausea or vomiting several months later, the possibility of this complication should be considered. In particular, endoscopic procedures, such as gastroscopy, can trigger these symptoms through the injection of large amounts of air.

It is important to examine both the coronal and axial views when follow-up CT is performed in outpatient settings. Most thoracic surgeons probably focus on the axial view, which is useful for detecting tumor recurrence. However, we believe that coronal CT scans are more advantageous for identifying diaphragmatic hernias. Physicians are prone to miss this complication because postlobectomy space remodeling (e.g., diaphragmatic elevation) occurs a few months after pulmonary resection [5]. By only checking the axial images of CT scans and chest radiographs, physicians can easily mistake an elevated hemidiaphragm and stomach for natural postoperative findings.

Among the surgical approaches, access through the abdominal or thoracic cavity and open access or access through a scope are all theoretically possible.
The approach should be carefully selected, considering the advantages and disadvantages of each possibility. Although we used the VATS approach, another case report used the abdominal approach with a choledochoscope [3]. Although it is difficult to consider one approach to be superior to the other, we believe that the thoracic approach is more advantageous in cases where a long duration has passed after the thoracic procedure, for the following reasons: (1) the thoracic approach is more advantageous than the transabdominal approach for dissecting adhesions; (2) the thoracotomy wound that was used in the pulmonary resection can be used again; and (3) the blood flow in the herniated stomach in the thoracic cavity might be reduced in comparison with the normal stomach, making it more vulnerable to injuries during reduction, and the thoracic approach allows more direct and gentle manipulation of the stomach.

In summary, we suggest that thoracic surgeons pay attention to diaphragmatic injuries during lower lobe resection and consider the possibility of an iatrogenic diaphragmatic hernia in patients with late-onset nausea or vomiting, especially after a left-sided thoracic procedure. In our experience, the transthoracic approach with or without laparotomy is feasible for hernia repair, and has several advantages. Careful review of coronal CT images and their correlation with delayed digestive tract symptoms might help in the early detection of this rare, problematic complication.

**Conflict of interest**

No potential conflict of interest relevant to this article was reported.

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