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Late Diaphragmatic Laceration Detected as a Result of Spontaneous Pneumothorax

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Injury to the right diaphragm is sometimes missed in the acute stage and is detected only when the rupture becomes more extensive, a diaphragmatic hernia develops, and dyspnea ensues. We report a case in which spontaneous right pneumothorax developed 46 months after blunt trauma due to a fall. Air had leaked into the right pleural cavity, passed through the injured right diaphragm, and entered the abdominal cavity; the patient presented with intraperitoneal emphysema.

Key words: Blunt trauma; Diaphragm; Emergency surgery; Hernia; Pneumothorax

INTRODUCTION

Because injury to the diaphragm associated with blunt trauma is often asymptomatic and there are few radiographic identifiers, it is easy to miss [1]. Particularly because the liver lies just beneath the diaphragm on the peritoneal cavity side, injury to the right diaphragm can be asymptomatic even when there is a transmural laceration, and this type of injury is hard to detect on radiographic images [2]. We report a case of transmural laceration of the right diaphragm that was discovered as a result of spontaneous right pneumothorax 46 months after the patient sustained blunt trauma due to a fall.

CASE REPORT

The patient was a 65-year-old man.

Chief complaint: Sudden onset of breathing difficulty and abdominal distention.

History of the patient's illness: The patient had fallen onto concrete from a height of 6 m during an elevator inspection and had been treated conservatively for pulmonary contusion and hepatic contusion. Elevation of the right diaphragm had been observed on a plain chest roentgenogram.

Forty-six months later, the patient experienced dyspnea and abdominal distention that suddenly increased in severity; 4 hours later he was transported to our institution. Upon arrival, his respiratory rate was 30 breaths per minute, percussion of the right thorax produced tympanic resonance, and no breath sounds were heard upon auscultation. His pulse rate was 110 beats per minute, blood pressure was 196/110 mmHg, and SpO_2 was 98% (during inhalation of 2 L of oxygen). His consciousness was clear. His abdomen was distended, and percussion produced tympanic resonance, but there was no evidence of peritoneal irritation. A chest roentgenogram obtained in the seated position upon arrival showed right pneumothorax and adhesion between the cranial aspect of the right lung and the right parietal pleura. The mediastinal shadow deviated to the left, indicating tension pneumothorax. The shadow was interrupted in the right costophrenic area, and the air that filled the peritoneal cavity outlined the contours of the liver and stomach (Fig. 1).

A right chest drain was inserted immediately, and a large volume of air was released. The abdominal distention was relieved, and right breath sounds became audible. The respiratory rate improved to 18 breaths per minute, and arterial blood gas analysis performed with the patient breathing room air yielded a $PaCO_2$ of 39.0 mmHg and PaO_2 of 77.8 mmHg. Helical computed tomography (CT) of the chest 30 minutes after arrival revealed multiple pulmonary cysts 3 cm in diameter in the apex of the right lung (Fig. 2A). The right diaphragm was interrupted on the ventrolateral side, and free air was seen in the abdomen (Fig. 2B). Leakage of air from the chest drain ceased 4 hours after arrival. Spontaneous right pneumothorax caused suddenly by the right pulmonary cysts and chronic injury to the right diaphragm was diagnosed. Air had leaked out from pulmonary cysts, causing right tension pneumothorax, and then entered the abdominal cavity through the diaphragmatic defect. Insertion of the chest drain restored negative pressure, and the air that had entered the abdominal cavity was immediately removed.

Thoracoscopic surgery on hospital day 4 revealed a tear in the dome of the right diaphragm with herniation of the liver into the right pleural cavity. Because of severe adhesion between the right diaphragm and the liver, we switched to lateral thoracotomy at the level

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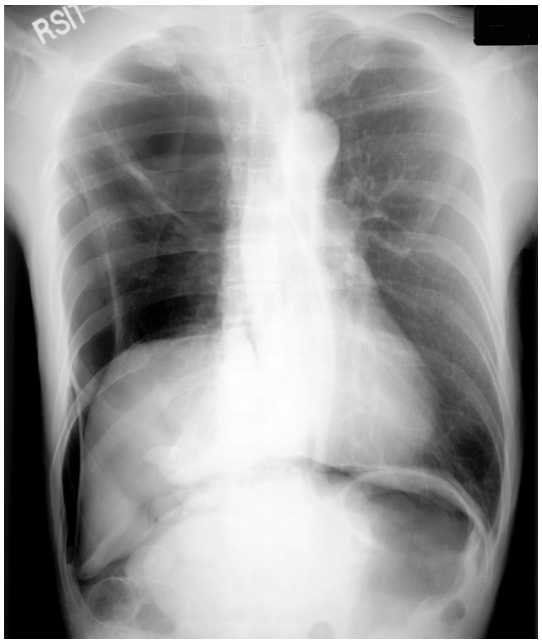

Fig. 1. Plain chest roentgenogram obtained immediately upon arrival (anterior-posterior view in the sitting position). Right pneumothorax and slight leftward deviation of the mediastinal shadow are seen, indicative of tension pneumothorax. The right lung adheres to the parietal pleura. The costodiaphragmatic portion of the shadow of the right diaphragm is absent. Air in the abdominal cavity outlines the contours of the liver and stomach.

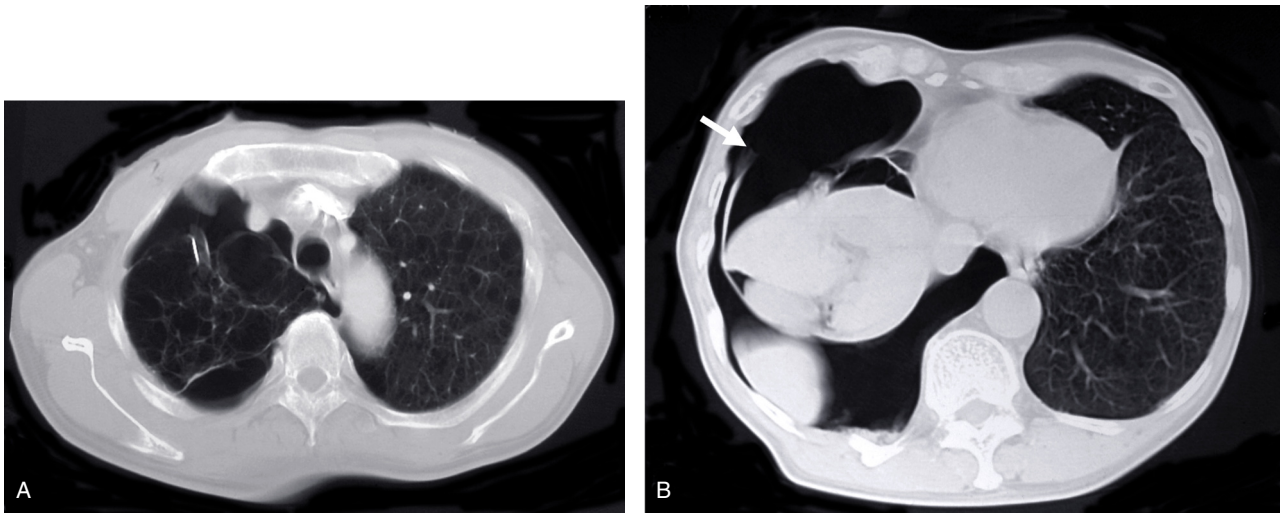

Fig. 2. Helical thoracic computed tomography images obtained after insertion of a chest drain. **A**: Multiple pulmonary cysts 3 cm in diameter are visible in the apex of the right lung. **B**: The right diaphragm is usually depicted in contact with the head side of the liver. The right diaphragm is ruptured and not visible on the abdominal side (arrow), and free air is seen in the peritoneal cavity.

of the sixth intercostal space. We excised the multiple pulmonary cysts in the apex with a stapler and then dissected the adhesion between the right diaphragm and liver. We found a 25-cm long, sagittal transmural laceration in the dome of the right diaphragm. The herniated liver was repositioned within the abdomen, and the injured diaphragm was repaired with double mattress sutures (size 2 Ti-Cron sutures). The patient was discharged on hospital day 10, and 1 month later he returned to work.

DISCUSSION

Recently, Crandall and colleagues [3] reviewed the literature pertaining posttraumatic hernias. Acute diaphragmatic rupture is diagnosed on the initial plain chest roentgenogram in approximately 46% of cases of left-sided injury and 17% of cases of right-sided injury. When helical CT is added, acute diaphragmatic rupture is diagnosed in 50% of left-sided cases and 78% of right-sided cases. When diagnostic laparoscopy has been used to diagnose diaphragmatic injury in the acute phase for hemodynamically stable patients with abdominal injury, the diaphragmatic injury has been repaired at the time of the initial surgery. Patients with undiagnosed diaphragmatic injury usually present with vague chest pain, nonspecific respiratory disorders, and gastrointestinal compromise or with signs and symptoms of obstruction.

Diagnosis of injury to the diaphragm due to blunt trauma is problematic. Rees and colleagues [4] reported the usefulness of multi-detector CT in the coronal and sagittal planes for diagnosing injury to the right diaphragm. Endoscopic diagnosis and repair were reported by Spann and colleagues [5], who used thoracoscopic surgery, and by Matz and colleagues [6], who used laparoscopic surgery.

There have been reports of blunt trauma cases in which air passed between the thoracic cavity and the

abdominal cavity by escaping through the diaphragm. In some of these cases, combined injury to the diaphragm and stomach allowed air and digestive fluid to migrate into the thoracic cavity under negative pressure, resulting in pleurisy [7].

Polychronidis and colleagues [8] reported an acute case in which air passed through the injured right diaphragm and migrated into the peritoneal and retroperitoneal cavities in a patient who sustained blunt trauma and suffered right pneumothorax. However, there have been no reports of cases in which there was delayed diaphragmatic injury and migration of air into the peritoneal cavity following spontaneous pneumothorax. Negative intrathoracic pressure allows air and blood that leak into the abdominal cavity to migrate into the thorax through the injured diaphragm. However, air that leaks from an injured lung increases intrathoracic pressure and results in tension pneumothorax, and when the intrathoracic pressure becomes higher than the intraabdominal pressure, air in the thorax passes through the diaphragm and migrates into the abdominal cavity and retroperitoneal space. Thus, if a chest drain is inserted and tension pneumothorax is relieved by lowering the pressure in the thorax, the clinical manifestations improve immediately.

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