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Case Report

Determination of the Side Responsible for Bilateral Pneumothorax due to Pleural Communication

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Simultaneous bilateral spontaneous pneumothorax associated with pleuro-pleural communication is a rare but potentially life-threatening condition, most commonly occurring after major thoracic surgery. We report the case of an 81-year-old man with severe emphysema and a history of esophagectomy who presented with sudden-onset dyspnea. Chest computed tomography revealed bilateral pneumothorax with pleuro-pleural communication. Although bilateral chest tube drainage was performed, the primary side of air leakage could not be identified preoperatively. After induction of general anesthesia, a double-lumen endotracheal tube clamping test identified the right pleural cavity as the source of air leakage, thereby enabling appropriate thoracoscopic surgery.

Key words: simultaneous bilateral spontaneous pneumothorax, pleuro-pleural communication

Simultaneous bilateral spontaneous pneumothorax (SBSP) is a relatively rare disease, with a reported incidence of only 1.3% in spontaneous pneumothorax cases [1]. The majority of SBSP cases are secondary to underlying pulmonary or pleural diseases, most commonly chronic obstructive pulmonary disease, as well as cystic fibrosis, interstitial lung disease, and malignant neoplasms [2,3]. Meanwhile, primary spontaneous pneumothorax (PSP), which typically occurs in young individuals without underlying lung disease, has been reported as an important etiology of SBSP [3]. SBSP is also occasionally associated with pleuro-pleural communication between the bilateral thoracic cavities, which typically develops as an iatrogenic consequence of major thoracic surgery for a mediastinal tumor, esophageal cancer, or cardiovascular disease [4,5]. In such cases, the presence of a pleuro-pleural fistula allows air leakage originating from the responsible lung to pass freely into the contralateral thoracic cavity, resulting in SBSP. This distinctive pathophysiological mechanism requires particular attention in both diagnosis and management, especially when surgical intervention is being considered, as accurate identification of the primary source of air leakage is crucial for determining the appropriate operative side. However, in some cases it is challenging to determine which is the primary side of air leakage. Here, we report a case of SBSP associated with a large pleuro-pleural communication that developed after an esophagectomy for esophageal cancer.

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Case Report

An 81-year-old man was transferred to our hospital with sudden-onset dyspnea. He had severe emphysema and a history of esophagectomy for esophageal cancer. The esophagectomy had been performed two years prior to this event by right thoracoscopic surgery, with reconstruction using a gastric conduit through the retrosternal route. Chest computed tomography (CT) revealed bilateral pneumothorax (Fig. 1A and 1B), and bilateral chest tube drainages were urgently performed. The CT scan also indicated pleuro-pleural communication between the bilateral thoracic cavities in the posterior mediastinum above the diaphragm (Fig. 1C). This finding suggested that air leakage originating from one thoracic cavity had spread to the contralateral side through the pleuro-pleural communication, resulting in simultaneous bilateral pneumothorax.

Subsequent surgical intervention was planned; however, it was not possible to determine which thoracic cavity was responsible preoperatively because the degree of air leakage was similar on both sides. The responsible side was thus assessed after induction of general anesthesia and intubation with a double-lumen endotracheal tube (DLT). When one-lung ventilation of the left lung was initiated by clamping the right endobronchial lumen of the DLT, air leakage from both thoracic cavities rapidly ceased. In contrast, one-lung ventilation of the right lung by the same method resulted in persistent bilateral air leakage (Fig. 2A). These findings clearly indicated that the right-sided pneumothorax spread to the left side through the pleuro-pleural communication. Accordingly, right-sided thoracoscopic surgery was performed, and a ruptured bulla at the apex of the right upper lobe was plicated using a polyglycolic acid pledget. The pleuro-pleural communication was identified in the posterior mediastinum above the diaphragm (Fig. 2B). However, this fistula could not be closed because of its large size and the poor surgical field. The postoperative course was uneventful, and no recurrence of pneumothorax was observed during the 6-month follow-up period.

Discussion

SBSP associated with pleuro-pleural communication between bilateral thoracic cavities is a rare clinical condition that most commonly develops after thoracic surgery for a mediastinal tumor, esophageal cancer, or cardiovascular disease [4, 5]. Because SBSP may progress rapidly and become life-threatening, prompt diagnosis and appropriate management are essential. In addition, this distinctive clinical entity requires special consideration with respect to both diagnosis evaluation and therapeutic strategy. One of the most challenging aspects in the management of SBSP with pleuro-pleural communication is identifying the side responsible for air leakage, particularly when the communication is large.

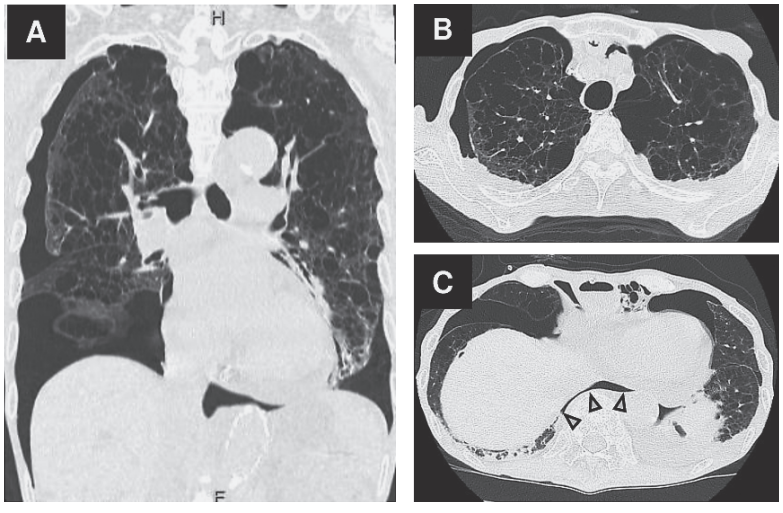

Fig. 1 (A) Chest computed tomography (CT) showing bilateral lung collapse. (B) CT scan showing bilateral pneumothorax and severe bilateral emphysematous bullae. (C) CT scan revealing pleuro-pleural communication between the bilateral thoracic cavities in the posterior mediastinum above the diaphragm (arrow).

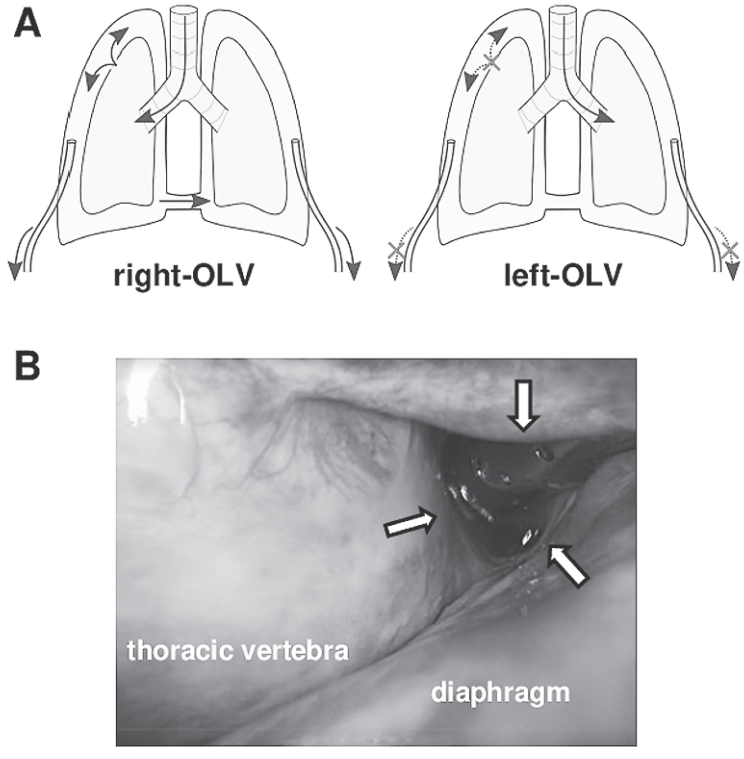

Fig. 2 (A) Schema of the double lumen endotracheal tube clamping test. Air leakage on both sides of thoracic cavity was observed under one-lung ventilation of the right lung (right-OLV); no leakage was observed under one-lung ventilation of the left lung (left-OLV). (B) Intraoperative finding showing a large fistula in the posterior mediastinum above the diaphragm (arrow). A surgical suction tube was inserted into the fistula.

In such cases, bilateral pneumothorax often presents with a similar degree of lung collapse and air leakage, making preoperative determination of the primary source of leakage difficult.

In the present case, the responsible side could not be identified preoperatively and became evident only after anesthetic induction through a DLT clamping test. As an alternative diagnostic approach, a balloon occlusion test of the bronchus using bronchoscopy may be useful for identifying the source of air leakage, particularly in patients who are poor candidates for surgical intervention. This technique enables diagnostic localization of the responsible bronchus and supports subsequent therapeutic decision-making, such as endobronchial Watanabe spigot placement or chemical pleurodesis. In the present case, however, conservative management was considered insufficient, and the patient was deemed to have adequate tolerance for surgery. Therefore, a surgical strategy was planned from the outset, and within this context, the DLT clamping test provided a simple, reliable, and practical method for identifying the responsible side and guiding appropriate surgical management.

It should also be noted that intraoperative assessment of air leakage using a water-sealing test can be unreliable in patients with pleuro-pleural communication. In the lateral decubitus position, irrigation fluid poured into one thoracic cavity may easily escape into the contralateral pleural cavity through a fistula, making it difficult to maintain an appropriate fluid level within a single thoracic cavity, and thus precluding a side-specific water-sealing test. Therefore, assessment of the responsible side using a DLT clamping test before surgical incision may represent a more reliable and practical strategy. Similar caution is required when considering chemical pleurodesis using agents such as minocycline, OK-432, or talc. Shortly after the chemical irritant solution is introduced into the target pleural cavity, part of the solution may flow into the contralateral pleural cavity so that the chemical irritant does not contact all the pleural surfaces of the target side. Furthermore, unintended exposure of the contralateral pleural cavity to chemical irritants may result in unnec-

essary inflammation or adhesion in the non-target pleural cavity, representing a potential disadvantage of chemical pleurodesis.

In the present case, the pleuro-pleural communication was identified intraoperatively but could not be closed because it was located deep in the posterior mediastinum, surrounded by the thoracic vertebrae, diaphragm, and inferior vena cava, resulting in an extremely restricted surgical field. Ideally, closure of the pleuro-pleural communication is desirable to reduce the risk of SBSP recurrence. Previous papers have reported successful obliteration of the communication by direct pleural suturing [4, 5], and some further recommended more definitive treatments, including a surgical pleurectomy or pleurodesis [1, 6]. In the present case, the defect was relatively large, and simple pleural suturing was considered inadequate. Closure using autologous tissue or prosthetic materials may represent promising alternatives for large defects. While such techniques have not been well documented, they may be useful in selected cases. However, secure fixation, particularly on the vertebral side, can be technically challenging. Moreover, even if such closure had been attempted, achieving a completely airtight seal would have remained uncertain and would likely have required an extensive thoracotomy. We therefore judged that the balance between uncertain efficacy and increased surgical invasiveness should be carefully considered. Accordingly, although the pleuro-pleural communication remained untreated, control of the source of air leakage — the ruptured bulla — resulted in a favorable short-term clinical outcome without recurrence during the follow-up period. Nevertheless, persistence of the communication implies a potential long-term risk of SBSP recurrence, and careful long-term surveillance is warranted. Further accumulation of cases is required to clarify feasibility and indications for closure while balancing surgical invasiveness.

In conclusion, SBSP associated with pleuro-pleural communication presents unique diagnostic and therapeutic challenges. When the side responsible for air leakage cannot be determined preoperatively, assessment using a DLT clamping test after anesthetic induction and before surgical incision may provide a safe, simple, and effective method for identifying the correct pleural cavity and guiding appropriate surgical management.

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