Thoracoscopic S1+2 and S6 bisegmentectomy with 3-dimensional imaging simulation to manage an advanced interlobar tumor

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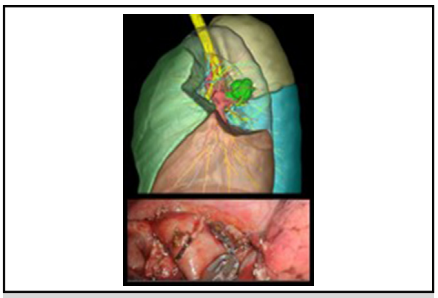


Bisegmentectomy of left S1+2 and S6 for interlobar tumor under preoperative 3D simulation.

CENTRAL MESSAGE

A case with an interlobar tumor was diagnosed with lung adenocarcinoma. We performed bisegmentectomy of S1+2 and S6 instead of pneumonectomy to preserve the volume and enhance quality of life.

▶ Video clip is available online.

In 2002, Li and colleagues[1] reported that video-assisted thoracic surgery is valuable for the treatment of non–small cell lung cancer (NSCLC). Lobectomy is the standard lung cancer treatment, with thoracoscopic lobectomy being safe and advantageous. The Japan Clinical Oncology Group trial (JCOG0802) compared thoracoscopic lobectomy and segmentectomy for clinical stage IA NSCLC and found segmentectomy to be the preferred approach.[2] Based on the general criteria in JCOG0802 trial, our selection of these patients for segmentectomy are an early-stage NSCLC (tumor size $\leq$2 cm, negative nodal metastasis) located in the peripheral third of lung parenchyma or a tumor measuring 2 to 3 cm with a consolidation-to-tumor ratio <0.5. We describe a case of lung adenocarcinoma in which a tumor invaded the left upper lobe from the left lower lobe across the major fissure. The tumor in this case was >3 cm in size and did not meet the standard criteria of segmentectomy. However, due to the special location of the tumor involving 2 lobes of the left lung, a bilobectomy (on the left, pneumonectomy) would be considered as standard procedure. Therefore, to retain more lung volume for the patient, we considered bisegmentectomy to anatomically resect this tumor. This case report in our institute (Changhua Christian Hospital, Changhua, Taiwan) was approved by our institutional review board (IRB-230503) on May 19, 2023; patient consent was waived.

CASE PRESENTATION

A 52-year-old woman with no symptoms presented. She had no smoking history but a family history of lung adenocarcinoma in her father. A routine check found a 3.7-cm mass on computed tomography (CT) of the chest with left hilar lymph node enlargement. The mass was mostly in S6 but extended beyond the major fissure, invading S1+2 segment (Figure 1, *A*). She had various assessments confirming surgery suitability, including lung function tests, abdominal sonography, magnetic resonance imaging of the brain, and whole-body bone scans. The clinical stage was cT2aN1M0. To plan surgery, 3-dimensional (3D) reconstruction of her left lung and its vessels using commercial software (Ziostation2; Ziosoft) was done based on CT images (Figure 1, *B*).

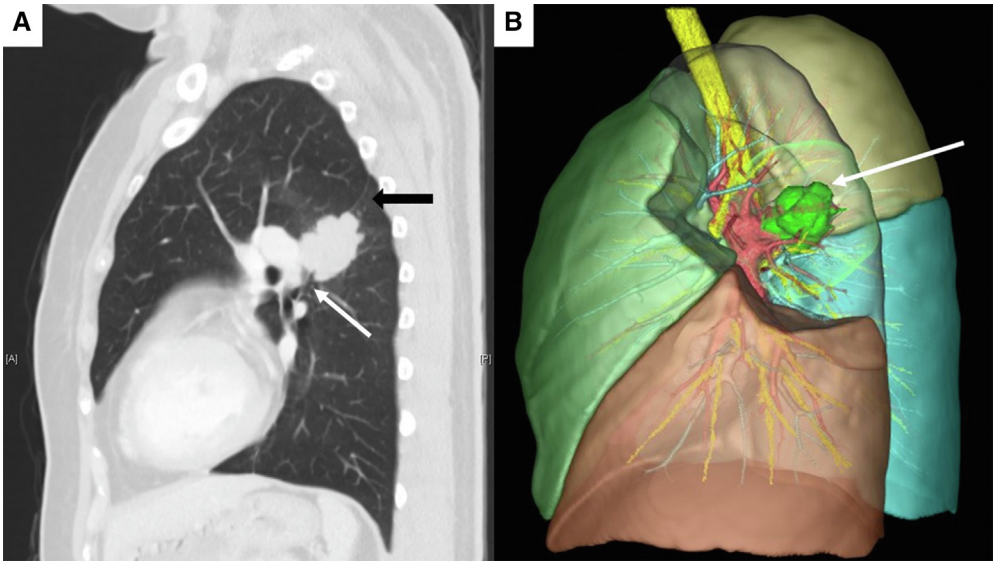
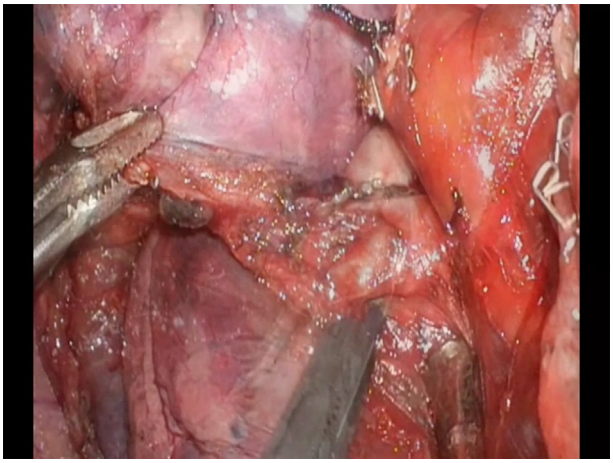


FIGURE 1. A, A preoperative computed tomography scan of the chest showed a 3.7 × 2.8-cm interlobar lung mass between the apicoposterior (S1+2) and superior (S6) segments. The *black arrow* indicates an incomplete fissure. The *white arrow* indicates the bronchus to S6. B, Three-dimensional reconstruction image of the interlobar lung lesion (*white arrow*) from the preoperative computed tomography scan of the chest.

SURGICAL TECHNIQUE

Under general anesthesia, the patient had a double-lumen endotracheal tube for one-lung ventilation. Positioned on the right side, a 4-cm single incision was made in the fifth intercostal space for video-assisted thoracic surgery. Using ultrasonic scalpel, the mediastinal and hilar pleura were incised, and subcarinal, aortopulmonary window, and hilar lymph nodes were dissected.

Thoracoscopic imaging revealed the complete major fissure and the tumor's connection between upper and lower lobes. The procedure is demonstrated in Video 1, and the postoperative view of the hilum, compared with the 3D image, can be seen in Figure 2.



VIDEO 1. We performed single-port thoracoscopic bisegmentectomy of left S6 and S1+2 for advanced interlobar lung tumor. The division sequence was V6, A6, B6, A1+2, B1+2, then V1+2. Following the demarcation line established by the inflation and deflation method, the S6 and S1+2 segments were meticulously divided using a stapler. Video available at: https://www.jtcvs.org/article/S2666-2507(23)00404-2/fulltext.

The length of the procedure was 3 hours and 10 minutes, with minimal blood loss of 10 mL. The chest tube was removed on postoperative day 4, and the patient was discharged the following day. Pathologic analysis revealed invasive nonmucinous adenocarcinoma of the tumor type with one interlobar lymph node metastasis (pT2bN1). The tumor in S6 measured 3.2 × 2.7 × 1.7 cm in size and was located 0.5 cm from the parenchyma margin. The tumor in S1+2 measured 3.1 × 1.7 × 1.4 cm in size and was located 2 cm from the bronchial margin and less than 0.1 cm beneath the pleura. There was no involvement of the bronchus and no invasion into the pulmonary arteries or veins observed.

COMMENTS

Minimally invasive thoracic surgery is favored for early lung cancer due to technological advancements. Thoracoscopic lobectomy has favorable outcomes for locally advanced lung cancer,[3,4] but segmentectomy's efficacy for advanced lung tumors remains uncertain, especially interlobar or intersegmental cases.

Since both portions of the tumor in upper and lower lobes met the standard criteria for lobectomy, and the remaining lung volume in the segments 3 to 5 was inadequate, we decided to deviate from the standard practice to preserve lung volume as much as possible. Consequently, the option of lower lobectomy + left upper lobe segmentectomy was not considered favorable.

We report a challenging case of a large tumor between upper and lower lung lobes. Preoperative methods, like

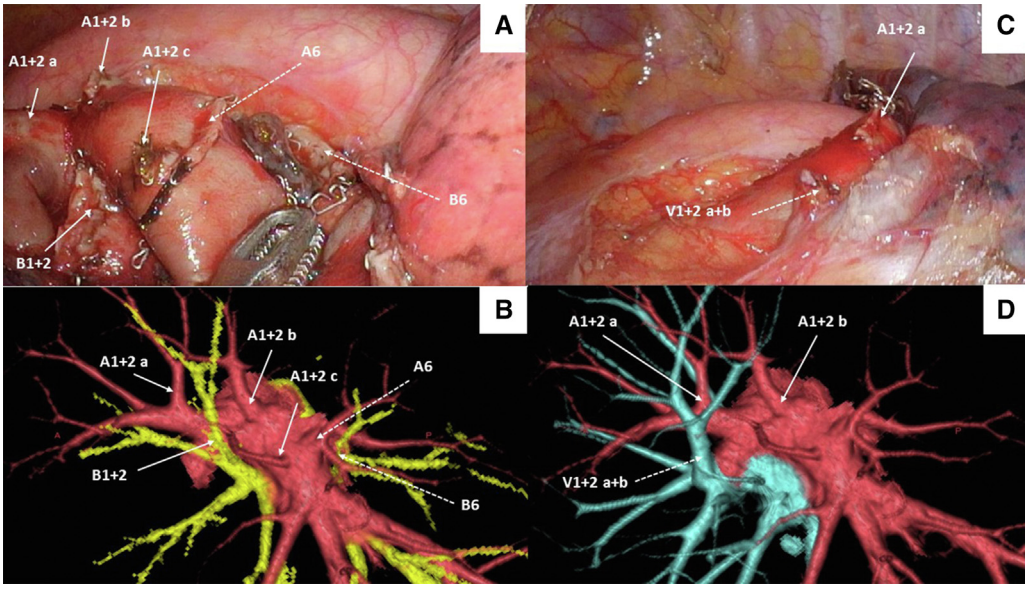


FIGURE 2. A, The posterior view of hilum after division. The *white dotted arrows* indicate the stumps of A6 and B6. The *white solid arrows* indicate the stumps of A1+2 a, A1+2 b, A1+2 c, and B1+2. B, The 3-dimensional reconstruction of arteries and bronchus from preoperative CT for simulation. C, The anterior view of hilum after division. The *dotted arrow* indicates the stump of V1+2 a+b. The *solid arrow* indicates the stump of A1+2 a. D, The 3-dimensional reconstruction of A1+2 a, A1+2 b, and V1+2 a+b from preoperative CT for simulation.

CT-guided marking, aid visualization.[5] Preoperative 3D imaging not only provides a clear view of the tumor's appearance, location, and its margin to the pleura but also assists the surgeon in simulating the identification of major vessels and bronchi within specific segments. In this unique case, 3D imaging help us to clarify the portions of tumor in upper and lower lobes, allowing us to determine which lobe was primarily affected by the tumor. This technique can lead to a more accurate resection and reduced operative time. A single-port thoracoscopic left S1+2 and S6 bisegmentectomy, using preoperative 3D imaging for precision, led to a satisfactory outcome with a 5-day hospital stay.

Conflict of Interest Statement

The authors reported no conflicts of interest.

The *Journal* policy requires editors and reviewers to disclose conflicts of interest and to decline handling or reviewing manuscripts for which they may have a conflict of interest. The editors and reviewers of this article have no conflicts of interest.

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