CASE REPORTS

Thoracoscopic lung resection for lung cancers in right upper lobe with anomalous structures (displaced B2 and Uvpbi): Report of two cases

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ABSTRACT

We present two patients with lung adenocarcinomas in the right upper S2 (posterior segment) with anomalous structures (a displaced B2 and the upper lobe vein posterior to the bronchus intermedius), who underwent thoracoscopic right posterior-segment segmentectomy (case 1) and thoracoscopic right upper lobectomy (case 2). Sufficient preoperative examination can significantly aid thoracoscopic surgery (TS). To the best of our knowledge, this is the first report of a TS together with an anomalous vein and displaced bronchus.

Key Words: Anomaly, Thoracoscopic segmentectomy, Video-assisted thoracoscopic surgery, Segmentectomy, Displaced B2, Right upper lobe vein posterior to the bronchus intermedius

1. INTRODUCTION

Bronchus abnormalities and the pulmonary vein anomalies are relatively rare, and the coexistence of such anomalous structures in a single clinical case is even less common. However, with the spread of thoracoscopic surgery (TS) for lung cancer in recent years, it has become important for surgeons to understand the area where the divergence of the bronchus forms and also how the pulmonary artery is distributed before performing a pulmonary operation. On occasions when such operations are performed, sufficient preoperative understanding of the exact intrapulmonary structures enables surgeons to evade unnecessary bleeding, thus ensuring a safe operation. In our two cases, preoperative identification of the individuals' bronchus and vascular configuration is useful for ensuring safe and infallible TS even if the anatomy differs from the normal.

In this report, we reported two cases with anomalous structures found in the right upper lobe during TS. Preoperative identification of these anomalies was performed using multidetector row computed tomography (MDCT), which is a safe and accurate method. Here we describe in detail our procedures and schemes for TS segmentectomy and lobectomy in the upper lobe with anatomical structures.

2. CASE PRESENTATION

2.1 Case 1

A 61-year-old man underwent annual CT screening. Ground-glass opacity (GGO) was observed in the right upper lobe on

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MDCT (see Figure 1a). The preoperative sagittal view from the MDCT showed the following characteristics: (a) the maximum size of the object was 10 mm for the lung window and 0 mm for the mediastinal window (slice width = 1.25 mm); (b) the right upper lobe vein posterior to the bronchus intermedius (UVPBI) flowed into the inferior pulmonary vein (see Figure 1a, b); (c) translocation of B2 from the bronchus intermedius was also present (see Figure 1b); (d) the dorsal major fissure was incomplete, and both "basal segment and S6" and "posterior segment (S2) and S3" demonstrated signs of hypersegmentation. We confirmed the displaced B2 using a bronchofiber scope (see Figure 1c) and depicted the branching patterns of the pulmonary artery and vein (see Figure 1a). A right S2 segmentectomy was performed. Our intraoperative advisory notes and work scheme are as follows (see Figure 1d-f): (1) V2 (the branch of the UVPBI) and A2 were detected from the dorsal side and interlobar fissure; (2) forceps were transferred from the peripheral side of the displaced B2 to the dorsal side while observing the UVPBI on the monitor, enabling us to distinguish between V6 and V2; (3) the UVPBI was preserved because it was sufficiently away from the tumor; (4) the exposure of V2a (S1 and S2) and V2c (S2 and S3) and the identification of the hypersegmentation (S2 and S3) enabled us to form the S2 plane, enabling the identification of the inflated–deflated (ID) line. The final pathological diagnosis was minimally invasive adenocarcinoma.

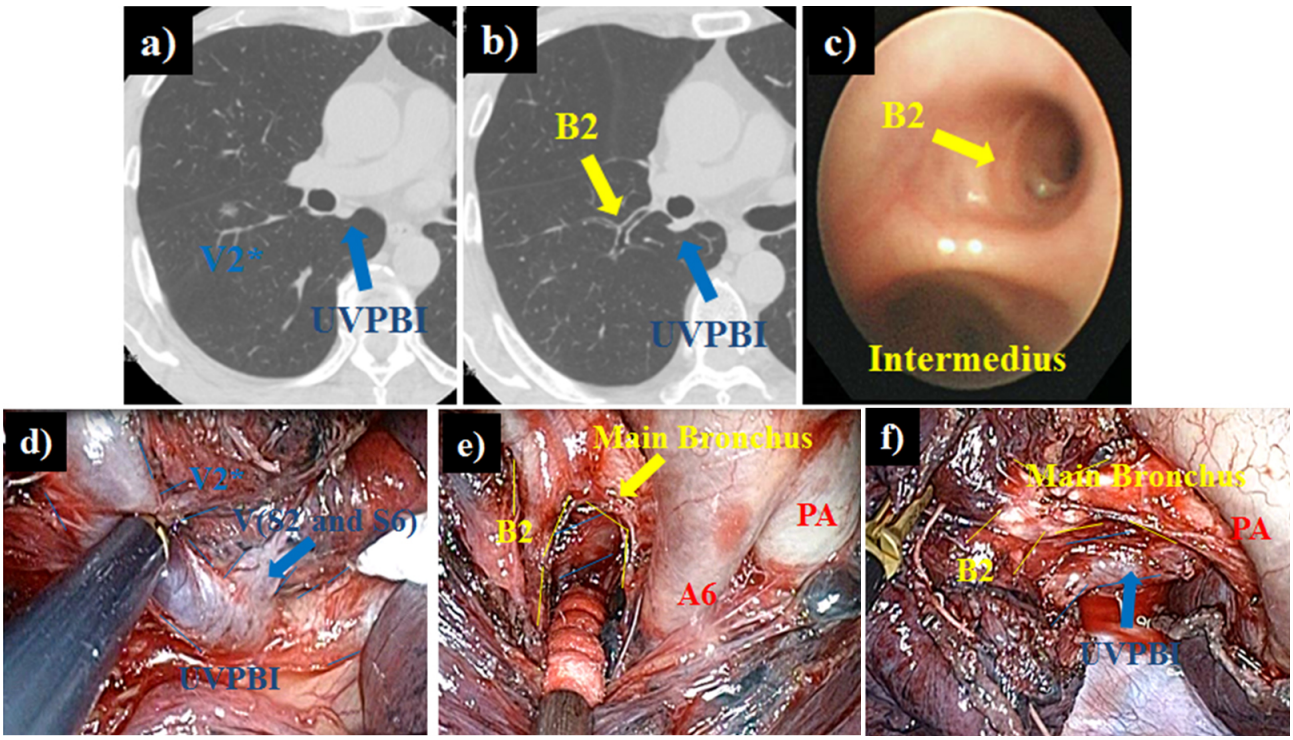

Figure 1. Thoracoscopic right S2 segmentectomy

a) Chest CT showing ground-glass opacity in the right S2 and the UVPBI running posterior to the bronchus intermedius (blue arrow); b) Chest CT showing the displaced B2 (yellow arrow) and UVPBI (blue arrow); c) Bronchoscopic finding of the displaced B2 diverging from the bronchus intermedius (yellow arrow); d) Intraoperative dorsal finding showing the inter-lobe vein (S2 and S6) (blue arrow) and V2 from the UVPBI. The UVPBI flows into the inferior pulmonary vein; e) Intraoperative inter-lobe finding showing the position of the UVPBI through the peripheral side of the displaced B2 to the dorsal side; f) Intraoperative inter-lobe finding showing the displaced B2 and UVPBI.*

2.2 Case 2

A 54-year-old man was referred to our institution because of an abnormal shadow observed on a chest CT. The preoperative sagittal view on MDCT was as follows: (a) the maximum size was 27.6 mm for the lung window and 4.3 mm for the mediastinal window (slice width = 1.00 mm) (see Figure 2a); (b) the UVPBI directly flowed into the left atrium as the segmental vein (see Figure 2b); (c) translocation of B2 from the bronchus intermedius was also present (see Figure 2c). We confirmed the displaced B2 by only 3D-CT reconstruction (see Figure 2c). A right upper lobectomy and lymphadenectomy was performed. Our intraoperative advisory notes and work scheme are as follows (see Figure 2d, e): (1) forceps were transferred from the peripheral side of the

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displaced B2 to the dorsal side while observing the UVPBI on monitor, enabling the formation of the major fissure; (2) the UVPBI was removed surgically within the formation of the dorsal major fissure because of its direct flow into the left atrium. The final pathological diagnosis was an invasive adenocarcinoma of a predominantly papillary nature.

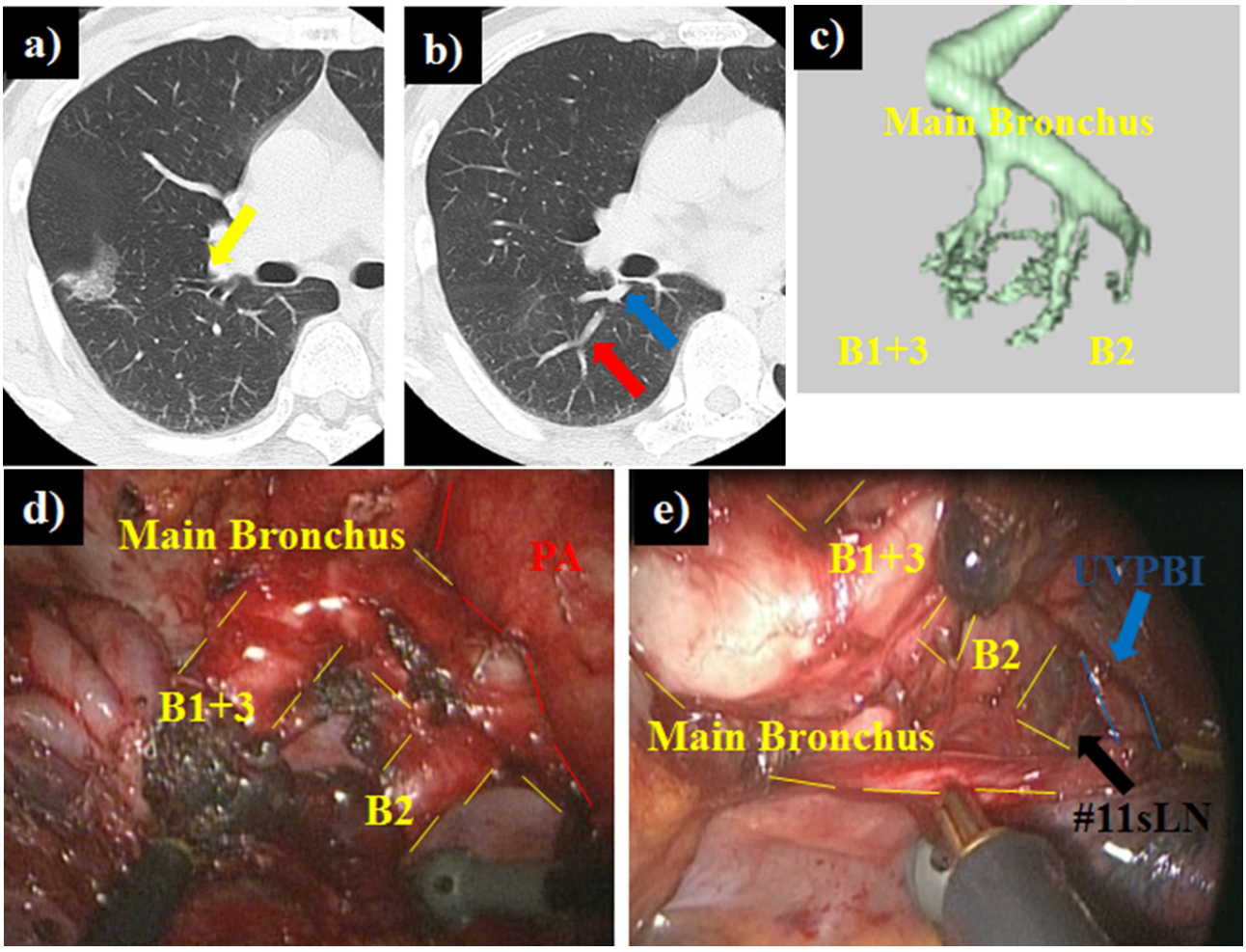

Figure 2. Thoracoscopic right upper lobectomy

a) Chest CT showing A2 (red arrow) and the UVPBI running posterior to the bronchus intermedius (blue arrow); b) Chest CT showing ground-glass opacity, a core in the right S2, and the displaced B2 (yellow arrow); c) 3D schema showing the displaced B2 diverging from the bronchus intermedius; d) Intraoperative inter-lobe finding showing B1 + 3 and B2 together, which is compatible with the preoperative 3D schema; e) Intraoperative dorsal finding showing B1 + 3 and B2 together and the UVPBI running along the peripheral side of the inter-lobe (#11s) lymph node.

3. Discussion

Some authors have encountered venous variations and recommended both a perioperative and operative evaluation of the vessels.[1,2] Among these variations, the UVPBI is not a rare case. Asai *et al.* reported that variations in the UVPBI were found in 41 (5.7%) of 725 CT cases and in 9 (3.9%) of 230 right thoracotomy cases.[3] Three venous drainage sites were observed: (a) the superior pulmonary vein group, 55%; (b) the inferior pulmonary vein group, 41%; and (c) the superior segmental vein group, 4%. In this case, the anomalous vein is equivalent to (b) in case 1 and (c) in case 2.

Displacement of the bronchus represents about 75% of bronchus-related abnormalities.[4] Among them, three bronchus abnormalities are well-known: (a) the right upper lobe related anomalies, 70%; (b) B1 + 2 branches from the left main bronchus, 20%; and (c) B6a branches from the intermediates, 10%. Feofilov *et al.* reported that approximately 10% of individuals demonstrate discrete forms of proximal or distal displacement of segmental or subsegmental bronchi in the same lobe, which are easily recognized by

CT.[5] In our two cases, B2 was found to bifurcate from the proximal side of the intermediate bronchus, and the S2 was ventilated by the displaced bronchus, which remained normal. The Japanese series based on the Foster–Carter classification reported that the frequency of bronchial abnormalities was 0.3% to 0.68%, with significant divergence abnormalities focusing around the right upper lobe in particular (63% to 80%).[4,6] Ohta *et al.* reported that the frequency of B1 + 3 originating from the right main bronchus first was 13.6% in the displaced segmental bronchus.[4]

In our experience, preoperative MDCT evaluation to identify anomalies is useful before performing TS. We were able to detect the pulmonary vessels without medium contrast. However, when 3D-CT is used, a more detailed understanding can be achieved. We considered that the most probable TS-causing UVPBI injury is the formation of the posterior aspect of the major fissure. In case 1, Segmental veins (V2 and V6) can be easily approached from the dorsal side of the upper lobe. However, the lung tissue of S2 has to be resected from the interlobar fissure because it is located within the lateral portion of the right upper lobe and the identification of the incomplete lobar fissure. In our novel technique of TS, we approached the UVPBI from the interlobar fissure, followed by tunneling along the V2 peripheral side of the vessel wall and segmental veins to the interlobar fissure, enabling the combined resection of S6 and S2 to be both simple and safe. In contrast, in case 2, we approached the UVPBI from the interlobar fissure, followed by tunneling along V2 through the central side of the vessel wall using the inter-lobe lymph node (#11LN) as a waypoint, enabling the combined resection of V2 and formation of the major fissure. In addition, the use of new technology, such as using an iPad to report the 3D-CT during TS, might help to more precisely perform an anatomical segmentectomy, particularly in unusual cases.

In conclusion, anomalies of the pulmonary vein, artery, and bronchus are not rare. Preoperative consideration of the axial view on the MDCT and complete analysis of the sagittal and coronal views provides enough information on the pulmonary vessels and bronchus. Moreover, anomalous findings are not an exception. Therefore, sufficient preoperative investigation of the procedure and discussion with surgeons concerning unexpected events can help accomplish complete TS. To the best of our knowledge, this is the first report of a TS with the UVPBI and a displaced B2.

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