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Thoracoscopic right anterior basal segmentectomy with unique anatomic variation: a case report and literature review

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Background: Anatomic basal segmentectomy is often regarded as a complex procedure, particularly in the presence of complex anatomical variations.

Case report: Herein, we present a case of a 55-year-old female patient diagnosed with invasive lung adenocarcinoma. Three-dimensional computed tomography bronchography and angiography (3D-CTBA) displayed a unique combined variation in the basal segment of right lower lobe (RLL): The medial basal subsegmental bronchi (BX⁷a+BX⁷t) originated from both the anterior and posterior segmental bronchi; The medial basal subsegmental arteries emanated from the anterior and posterior basal segmental arteries; The medial anterior segmental vein shared a trunk with both the anterior basal and lateral basal subsegmental veins. With precise preoperative planning, thoracoscopic anterior basal segmentectomy was successfully executed.

Conclusion: This case again highlights the importance of 3D-reconstruction in pulmonary segmentectomy. Detailed understanding of anatomic features of segmental bronchi and vessels is imperative for those with complex anatomical variations.

KEYWORDS

three-dimensional computed tomography bronchography and angiography, anatomical variation, basal segment, anatomic segmentectomy, lung cancer

Introduction

Thoracoscopic basal segmentectomy presents formidable technical challenges for thoracic surgeons due to frequent anatomical variations (1). Preoperative understanding of segmental anatomy is crucial for surgeons to perform precise operations (2). Although numerous variations of the basal segment have been reported by Zhang M et al. (3), the type of variant in this case has rarely been previously reported. With meticulous preoperative planning and accurate intraoperative judgment, thoracoscopic right anterior basal segment (RS⁸) segmentectomy was successfully performed.

Case report

A 55-year-old woman was admitted to our department with a subsolid nodule in the right lower lobe (RLL), which had been under surveillance for five years following its initial detection. The high-resolution computed tomography (HRCT) revealed a 13 mm nodule in the RS⁸ (Figure 1A). The patient presented no history of malignant tumors, no disease symptoms, and no family history of lung cancer. No distant metastases were detected. The pulmonary function was normal. A unique variation in the right basal segment was identified via three-dimensional computed tomography bronchography and angiography (3D-CTBA). CT scan was performed using Toshiba Aquillion One 320-row Dual-Source CT, while 3D reconstruction was performed with Vitrea Extend 6.7 graphic analysis system. The prominent features including: (1) Two branches of the medial basal segmental artery, AX⁷a and AX⁷t, emanated from the anterior segmental artery (A⁸) and the posterior segmental artery (A¹⁰), respectively (Figure 2A). (2) The medial basal subsegmental bronchi, classified as BX⁷a+BX⁷t according to Zhang M et al., originated from both the anterior (B⁸) and posterior (B¹⁰) segmental bronchi (Figure 2B). (3) The medial basal segmental vein (V⁷) shared a trunk with the anterior basal

segmental vein (V⁸) and the lateral basal subsegmental vein (V⁹a) (Figure 2C).

The tumor was diagnosed as stage cIA2 (cT1bN0M0). Anatomical pulmonary segmentectomy was the preferred protocol according to the National Comprehensive Cancer Network (NCCN) lung cancer guidelines (V2.2024). Based on detailed preoperative planning, thoracoscopic RS⁸ segmentectomy was performed precisely. Initially, the A⁸ and AX⁷a were clearly exposed after opening the interlobar fissure; the A⁸ was dissected using silk, while the AX⁷a was preserved (Figure 2A). Subsequently, after removing the lymph nodes surrounding the bronchi, the B⁸ was dissected using a stapler, and the BX⁷a was protected (Figure 2B). Thereafter, the V⁸ locating posterior to the B⁸ was exposed and ligated with silk (Figure 2C). Finally, the RS⁸ was divided using endostaplers, with the RS⁷a being successfully retained. The tumor was located 2.5 cm away from the incisional margin (Figure 1B). Intraoperative pathology analysis identified invasive adenocarcinoma, with intrapulmonary lymph nodes and surgical margins negative. Postoperative pathology analysis confirmed invasive adenocarcinoma with no involvement of the surrounding lymph nodes. The immunohistochemistry revealed that the Ki-67 index was 15%, which suggests slower tumor growth and more favorable prognosis. Additionally, the TTF-1 expression was strong positivity (+++), which supports the diagnosis of adenocarcinoma and indicates a higher likelihood of responsiveness to targeted therapies, should they be required in the future. The surgical process can be obtained via scanning the QR code (Figure 3). Following discharge, the patient underwent regular follow-up evaluations at six-month intervals. As of the most recent assessment in March 2025, there was no evidence of tumor recurrence or complications related to the surgery.

Discussion

Recently, anatomic pulmonary segmentectomy has been widely performed for early-stage non-small cell lung cancer, in accordance

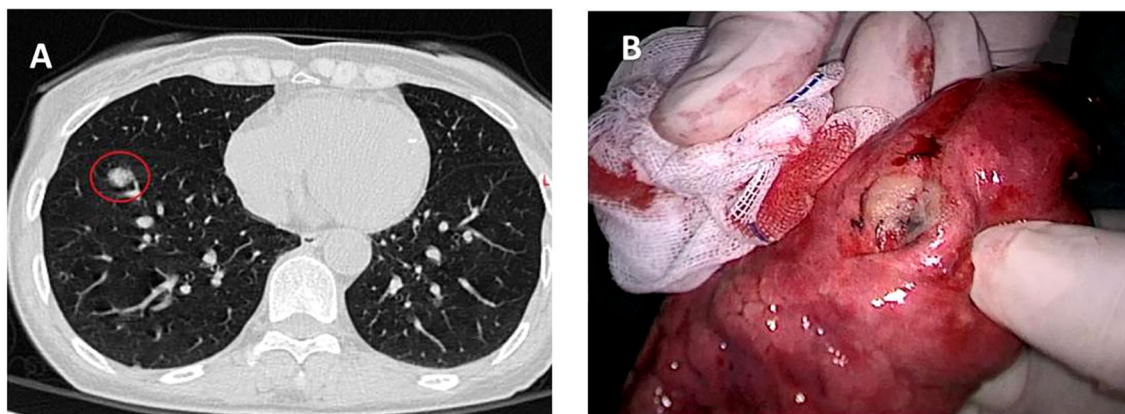


FIGURE 1
Preoperative chest CT scan and the intraoperative specimen. (A) A 13 mm-diameter subsolid nodule in the anterior basal segment of right lower lobe. (B) The tumor was 2.5 cm away from the incisional margin.

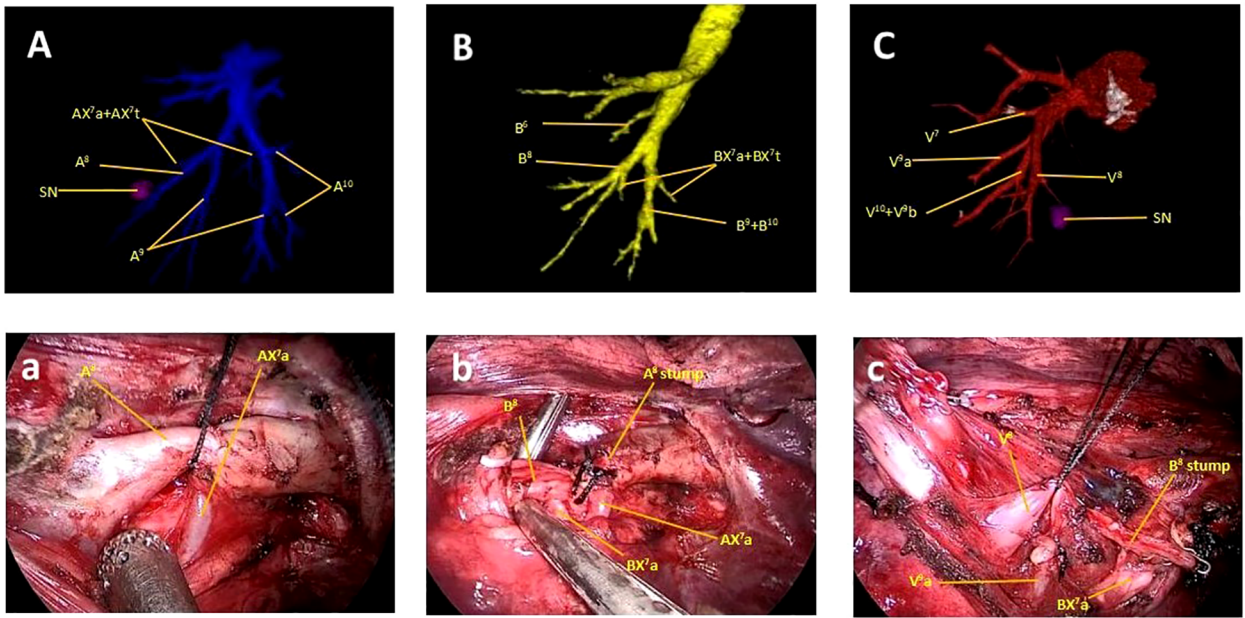


FIGURE 2
Preoperative 3D-CTBA of the right lower lobe and intraoperative findings. (A, a) The AX⁷a emanated from the A⁸. (B, b) BX⁷a originated from the B. (C, c) The V⁷ shared a trunk with the V⁸ and the V⁹a.

to the National Comprehensive Cancer Network (NCCN) lung cancer guidelines (4). Understanding the anatomical structure of the pulmonary segments is essential for surgery, while 3D-CTBA technology has been proved to be highly beneficial in facilitating anatomic pulmonary segmentectomy. As reported by Chen H et al. (5), 3D-CTBA guided surgery demonstrates a reduction in both operation time and surgery-related complications compared to 2D-CT. In addition to that, Zhang M et al. (3) analyzed the economic impact of 3D-CTBA in thoracic surgeries, concluding that its ability

to reduce surgical errors offsets the initial costs associated with imaging technology. Segmentectomy of the S⁸ tends to be considered more simple than other types of basal segmentectomies (6). However, it can also present a major challenge for surgeon when complex anatomical variations involved. This case reported a rare and complex anatomical variation in the basal segment of the RLL. To the best of our knowledge, such variation has rarely been reported. The success of this operation lies in resecting the RS⁸ precisely while preserving the RS⁷a.

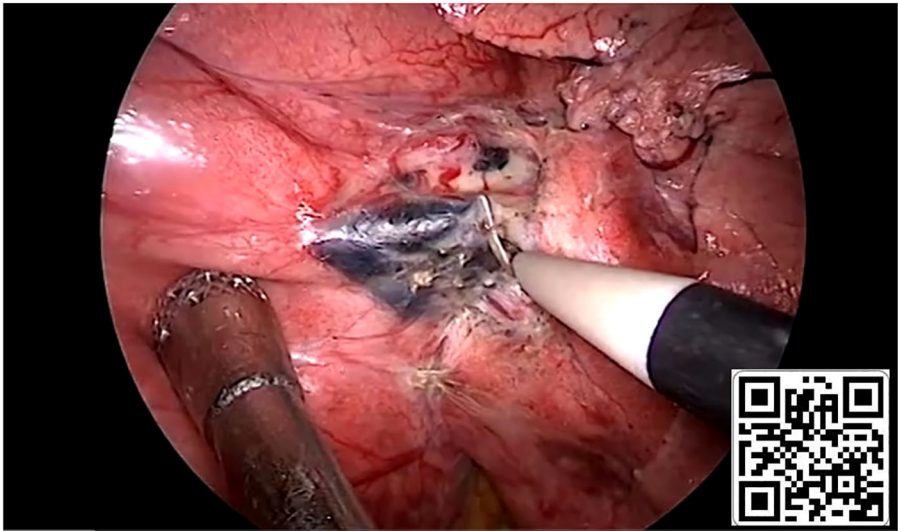


FIGURE 3
QR code for the surgical video. The surgical process can be obtained via scanning the QR code.

The RS⁷ has the smallest volume of all pulmonary segments, but the anatomical structure of RS⁷ has been reported more complicated. Nagashima T et al. (7) classified the branching pattern of the B⁷ into four types: (B⁷a), (B⁷b), (B⁷ab) and (BX⁷). In this classification, the B⁷ is designated as BX⁷ when it does not originate from the base of the basal bronchus. Similarly, the branching pattern of the A⁷ has been divided into four types: (A⁷a), (A⁷b), (A⁷ab) and (AX⁷). Shimizu K et al. (8) reported that the incidence of such combined variant was 5.6% (15 out of 270 cases). Zhang M et al. (3) firstly proposed an alternative classification for B⁷, identifying six distinct types: B⁷a, B⁷p, B⁷o, B⁷t, BX⁷a, and BX⁷t. When BX⁷ originates from B⁸, it is designated as BX⁷a, while when it derives from B¹⁰, it is referred to as BX⁷t. According to this classification, our case was categorized as the type of BX⁷a and BX⁷t. However, the variant we reported was more complex than previously documented. Two branches, designated as BX⁷a and BX⁷t, concurrently exist and originate from B⁸ and B¹⁰, respectively. The BX⁷a traversed anterior to the inferior pulmonary vein (IPV) and shared a trunk with B⁸, whereas BX⁷t passed through the IPV and originated from B¹⁰. Intraoperatively, (B⁸+ BX⁷a) can be easily mistaken for B⁸ because of such unique anatomical variation.

The anatomical variation of pulmonary vessels often coexists with bronchial variation, thereby complicating segmentectomy procedures, as reported by Gossot D et al. (9). This aligns with the current case, where such variations required precise surgical techniques. In this particular case, the A⁷ was composed of AX⁷a and AX⁷t, originating from A⁸ and A¹⁰, while V⁸ shared a trunk with V⁷ and V⁹a. Intraoperatively, such variations can be confusing for surgeons, potentially leading to the inadvertent transection of AX⁷a and V⁹a. The unique anatomical variation reported in this case, specifically the coexistence of BX⁷a and BX⁷t originating from B⁸ and B¹⁰ respectively, increases surgical difficulty due to the complexity of identifying and preserving critical structures like AX⁷a and V⁹a during segmentectomy. Misidentification of BX⁷a as part of B⁸ intraoperatively can lead to inadvertent transection of vital vessels or bronchi, emphasizing the need for meticulous preoperative 3D-CTBA planning and intraoperative judgment. In conclusion, this case presented a unique variation of bronchus and pulmonary vessels in the basal segment of the RUL. With the guidance of detailed preoperative planning, thoroscopic RS8 segmentectomy was performed accurately.

Data availability statement

The original contributions presented in the study are included in the article/Supplementary Material. Further inquiries can be directed to the corresponding authors.

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Ethics statement

Written informed consent was obtained from the individual(s), and minor(s)' legal guardian/next of kin, for the publication of any potentially identifiable images or data included in this article.

Author contributions

TL: Writing – original draft. SH: Writing – original draft. JZ: Writing – review & editing. LJ: Methodology, Writing – review & editing. QS: Funding acquisition, Writing – review & editing.

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Conflict of interest

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