

# Rare Location and Drainage Pattern of Right Pulmonary Veins and Aberrant Right Upper Lobe Bronchial Branch: a Case Report

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## Case report

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# Abstract

## Background

Complex aberration in lung is rare, which may increase risk of vascular injury and cause ligation of wrong pulmonary vein or bronchus by mistake during lung surgery, and result in severe complication like pulmonary congestion or atelectasis.

## Case presentation

In this case, a 44-year-old female was admitted for ground glass nodule (maximum diameter, 24mm) in right upper lobe. During operation, it was found that extremely rare aberrations of right prearterial bronchus, right upper lobe vein behind pulmonary artery and right middle lobe vein drained into left atrium occurred in this patient simultaneously. Video-assisted thoracoscopic right upper lobectomy with lymph nodes dissection was performed for adenocarcinoma shown by frozen section. The patient was well recovered and discharged at the postoperative-day 4. Based on the literature review, such complex aberrations of pulmonary vessels and bronchus had seldom been reported before.

## Conclusion

Preoperatively, three-dimensional reconstruction can help to identify inconspicuous variation of pulmonary vessels and bronchus effectively. During lung surgery, if anatomic aberration is suspected, careful dissection of vessels and bronchus will help to confirm whether there is an aberration or not.

## Background

Aberrations of pulmonary vessels and bronchus are troublesome and potentially dangerous which may increase risk of vascular injury and dissection of wrong bronchus during operation(1–3). Due to the increasing number of lung cancer and lung surgery(4, 5), preoperative identification of anatomic variation in lung is much important for the operation safety.

The contrasted thin-slice chest computed tomography (CT) are widely applied to assess the pulmonary vessels and bronchus(6, 7). Moreover, three-dimensional (3D) reconstruction for bronchus and vessels can show pulmonary vessels and bronchus visual. Hence, it is more effective to identify the anatomic aberration with 3D reconstruction, especially for inconspicuous aberration.

It was reported in previous research that anomalies of pulmonary vessels and bronchus identified simultaneously in one patient are quite rare(8). In this case, we reported an extremely rare case that infrequent location of right upper lobe vein, rare right pulmonary venous drainage pattern and unusual right prearterial bronchus were discovered at the same time in one patient.

## Case Report

A 44 years old female patient was admitted to hospital for diagnosed with mixed ground-glass nodule (GGN) with maximum diameter of 24 mm in right upper lobe showed by thin-slice CT for 1 month. She had no pulmonary symptom. Cranial and abdominal CT with contrast and bone scan with single photon emission computed tomography (SPECT) showed no sign of metastasis. We thus planned to perform VATS right upper lobectomy and lymph node dissection, if necessary.

After general anesthesia with one lung ventilation, the patient was placed in the left lateral recumbent position. Camera port was in midaxillary line in the 6th intercostal space (ICS) and other two ports were in posterior axillary line in the 9th ICS and in anterior axillary line in the 4th ICS separately for manipulation. There was no obvious aberration when we explored the thoracic cavity with thoracoscope at the beginning. We dissected mediastinal pleura on ventral side of the hilum. Afterward, right pulmonary artery was shown but there was no right upper lobe vein (RULV). We then divided the horizontal fissure and finally the RULV was shown on dorsal side of right pulmonary artery (RPA) (Fig. 1). We then stapled A<sup>2</sup> and A<sup>3</sup>. To identify the right middle lobe vein (RMLV), we retraced the course of RULV to dorsal side of right descending interlobar artery. While the venous convergence of RMLV and RULV can't be found. Then we stapled RULV and A<sup>1</sup> to show up the right upper lobe bronchus. Instead of arising from right upper lobe bronchus, B<sup>1</sup> in this case was directly arose from right main bronchus (RMB), which was also named as right prearterial bronchus(6) (Fig. 2). B<sup>2+3</sup> was then arising as one trunk from right main bronchus below B<sup>1</sup>. After stapling the B<sup>1</sup> and B<sup>2+3</sup>, right upper lobectomy was complete. Intraoperative frozen section revealed the GGN was adenocarcinoma and systematic lymph node dissection was performed.

Postoperatively, we reconstructed 3D mode of pulmonary vessels and bronchus and reviewed thin-section chest CT carefully. The results showed that RULV lay behind RPA and drained into left atrium (LA) alone. The right middle lobe vein joined right lower lobe vein to form a short common trunk and drained into LA(Fig. 1A). In addition, the B<sup>1</sup> arose from RMB alone and B<sup>2+3</sup> arose from right main bronchus below B<sup>1</sup>(Fig. 2E).

The thoracic tube was removed at the postoperative-day (POD) 3. No postoperative complication was occurred. The patient discharged at the POD 4.

## Discussion

As reported in published researches, anatomic variations in number and course of pulmonary vessels are not rare(7, 9). However, complex anatomic aberrations, such as abnormal location of pulmonary vein(8) and prearterial bronchus(6), are quite unusual. In this case, infrequent prearterial bronchus and aberrations in course and location of pulmonary veins were found in one patient at the same time. Although the aberrations were not quite obvious to be identify in axial images preoperatively, we found such aberrations and avoided wrong ligation of vessels and bronchus during operation by careful dissection. Meanwhile, such aberrations were confirmed with postoperative 3D reconstruction visually. Based on the literature review, such complex aberrations of pulmonary vessels and bronchus had not been reported before.

According to the summaries for drainage patterns of pulmonary veins with chest CT imaging (7, 10, 11), it was only in 2–3% of patients that middle lobe vein joins lower lobe vein to form one common trunk vein drained into LA. However, it's worth noting that aberrant right pulmonary venous drainage patterns, such as three atrial ostia for upper, middle and lower lobe veins, are various(10, 11). Abnormal pulmonary venous drainage patterns may occur in 32% of patients according to Dr. Marom(7). Ligation of wrong pulmonary vein by mistake can result in severe complication like congestion of remnant lung.

Although the aberrant course of pulmonary vein is not unusual, abnormal location of entire RULV behind RPA is extremely rare(3). Based on the literature review, there were only 3 cases reported such aberration before. The aberration was found during operation in one of the three cases and found with 3D reconstruction preoperatively in the rest two cases(3, 12, 13). This anomaly caused several difficulties based on our experience. First, right pulmonary trunk in this case located in the usual site of right pulmonary vein which was also wrapped by pericardium. Consequently, right pulmonary trunk or its branch wrapped by pericardium might be identified wrongly as RULV and then ligated or stapled by mistake. Furthermore, due to the RPA in front of RULV, even after we divided the right upper lobe artery, the RPA still covered the proximal part of RULV, which was a challenge for surgeons to consider whether the middle lobe vein is secured when stapling RULV.

In addition, aberrant right prearterial bronchus was also found in this case. Dr. Chassagnon reported that the right prearterial bronchus occurred in only 0.9% of people in a study of 1200 bronchograms(6). Interestingly, Dr. Yurugi had also reported an unusual right tracheal bronchus combined with abnormal location of RULV behind RPA(13). In this case, we dissected fissure firstly and divided the pulmonary artery and vein afterwards. So, the bronchus could be exposed optimally. But if we performed the single-direction thoracoscopic lobectomy and undermine fissure in the last stage, anomalous bronchus might cause difficulty of dissection.

The chest CT scan is the most popular preoperative imagological examination(14). But some anatomic aberrations are difficult to identify in axial images(15). Thus, 3D reconstruction is more suitable and effective to identify anatomic variations(1, 16). Many surgeons found the anatomic aberrations preoperatively with 3D reconstruction and avoided wrong ligation of pulmonary vessels and bronchus(3, 8, 17). Meanwhile, some researchers applied 3D reconstruction to summarize the variations of pulmonary vessels and bronchus(6, 10, 16). In this case, we confirmed such complex aberrations that we found during operation with 3D reconstruction visually and effectively.

In conclusion, we reported an extremely rare case of anatomic aberrations in course and location of right pulmonary veins and right prearterial bronchus occurred simultaneously in one patient. Preoperative three-dimensional reconstruction and making full use of contrasted thin-slice CT and is effective for identification of the anatomic variations. Furthermore, careful dissection of vessels and bronchus can help to confirm the aberration and avoid wrong dissection or vascular injury during operation.

## Abbreviations

3D: Three-dimension

CT: Computerized tomography

GGN: Ground-glass nodule

LA: Left atrium

POD: Post-operative day

RPA: Right pulmonary artery

RULV: Right upper lobe vein

RMLV: Right middle lobe vein

RLLV: Right lower lobe vein

RMB: Right main bronchus

## **Declarations**

### **Ethics approval and consent to participate**

All procedures performed in studies involving human participants were in accordance with the ethical standards of the Ethics Committee of West China Hospital of Sichuan University and with the Helsinki Declaration (as revised in 2013). Written informed consent was obtained from the patient.

### **Consent for publication**

Informed written consent was obtained from the family of the patient for publication of this report and any accompanying images.

### **Availability of data and materials**

Not applicable.

### **Competing interests**

The authors have no conflicts of interest to declare.

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### **Authors' contributions**

FW drafted the manuscript. RZ participated in the operation. HZ conducted the 3D reconstruction. Yunhai Mo, Yu Zheng and Guanghao Qiu was involved in acquisition of data and preparing the figures. YW performed the operation and revised the manuscript. All authors have read and approved the final manuscript.

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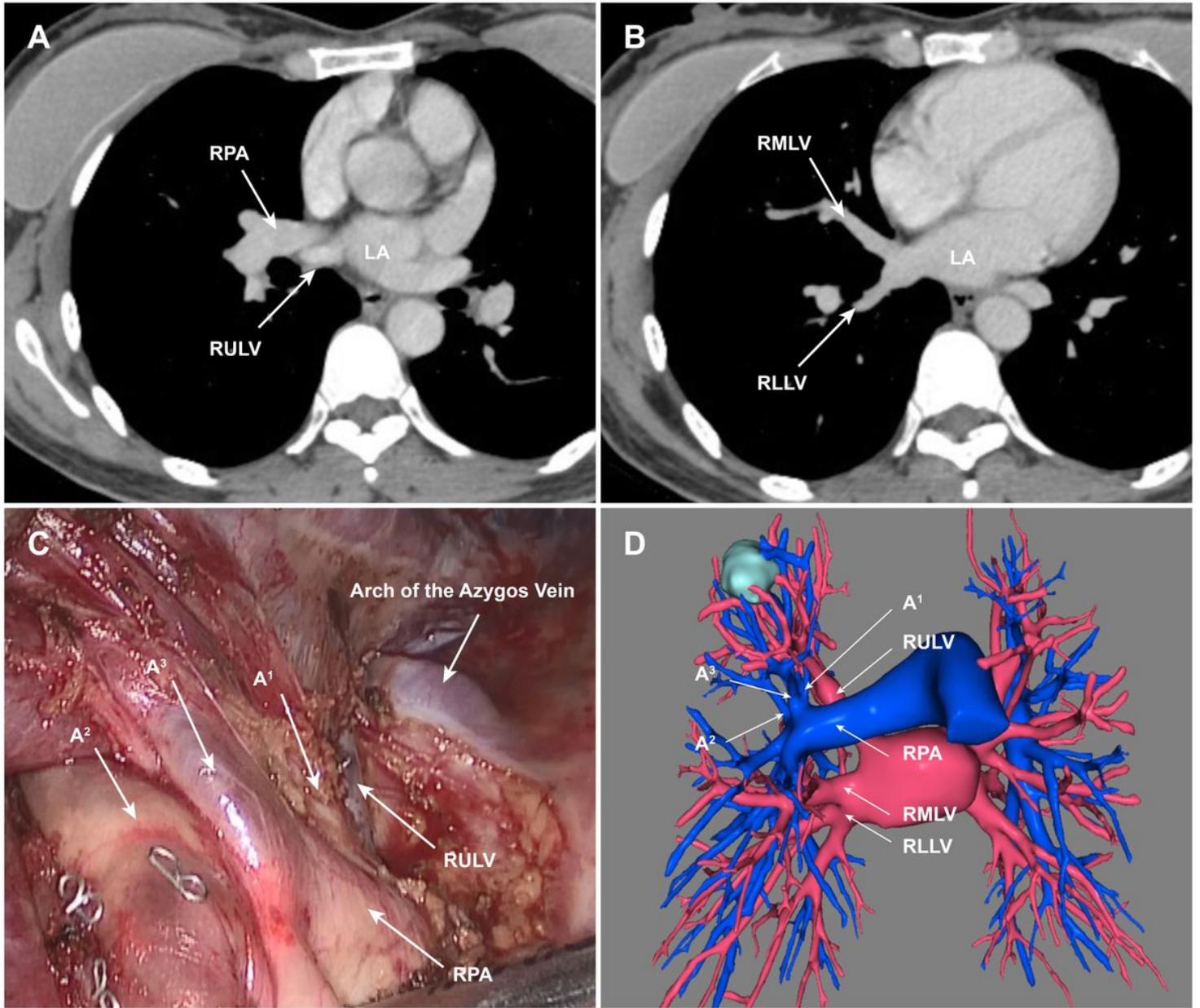
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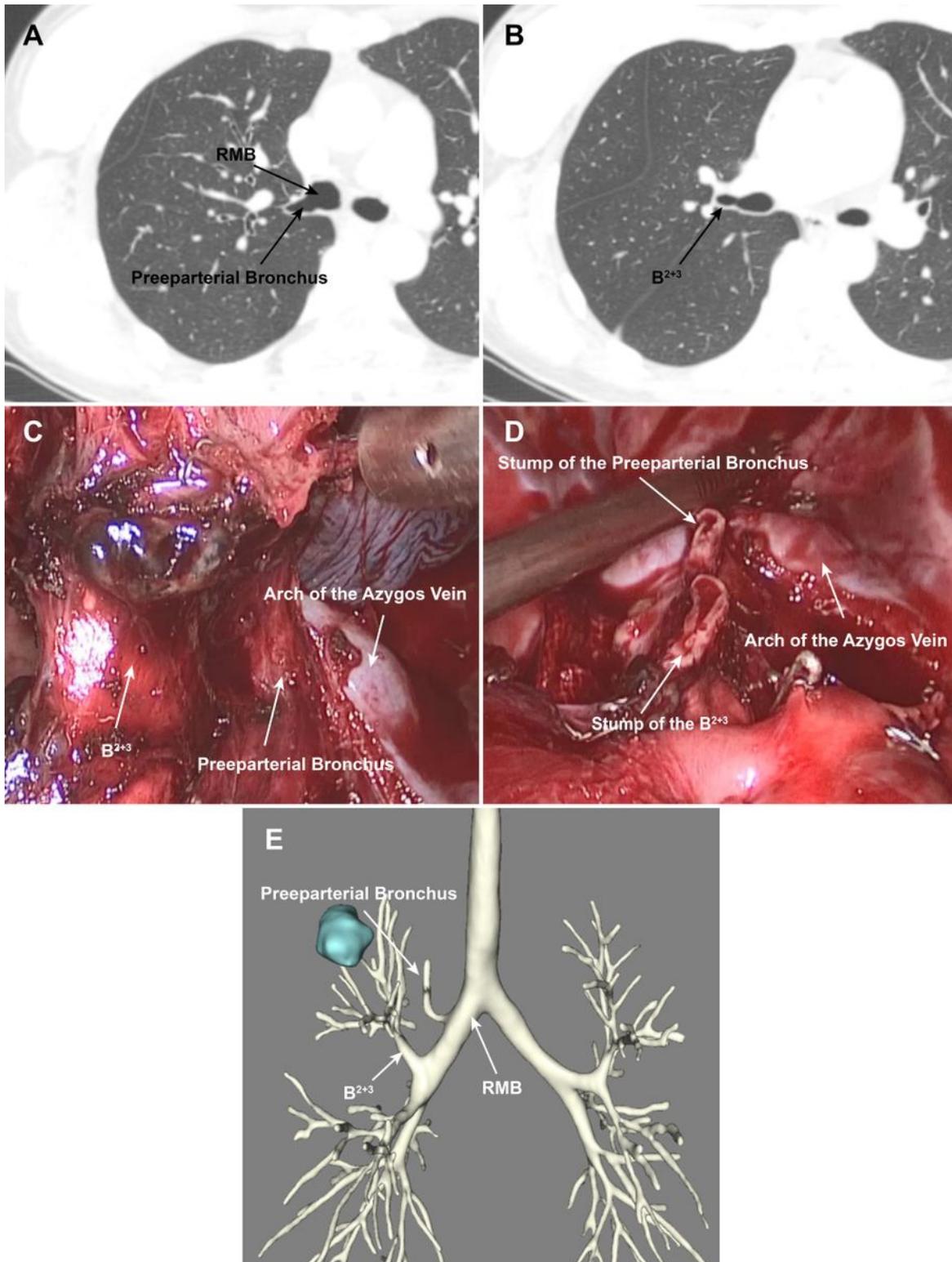
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## Figures



**Figure 1**

Anatomic aberration of pulmonary vessels Fig 1A. RULV lies behind RPA in thin-slice CT; Fig 1B. RMLV joins RLLV to form one common trunk vein drained into LA in thin-slice CT; Fig 1C. RULV lies behind RPA under thoracoscope; Fig 1D. Three-dimensional reconstruction of pulmonary vessels. LA: Left atrium, RPA: Right pulmonary artery, RULV: Right upper lobe vein, RMLV: Right middle lobe vein, RLLV: Right lower lobe vein.



**Figure 2**

Abnormal right prearterial bronchus Fig 2A. Right prearterial bronchus arose from right main bronchus alone in thin-slice CT, Fig 2B. B<sup>2+3</sup> arose below right prearterial bronchus from RMB, Fig 2C. Right prearterial bronchus and B<sup>2+3</sup> under thoracoscope, Fig 2D. Stump of right prearterial bronchus after stapling and B<sup>2+3</sup> under thoracoscope, Fig 2E. Three-dimensional reconstruction of trachea and bronchus. RMB: right main bronchus.