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# Anomalous V<sup>2</sup> of the left pulmonary vein detected using three-dimensional computed tomography in a patient with lung cancer: A case report

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## ABSTRACT

We report one of the rare anatomical variations of the pulmonary vein wherein the left V<sup>2</sup> drained into the inferior pulmonary vein. A 63-year-old man was referred to our hospital because of an abnormal shadow in the left lower lung field that was noted on chest X-ray. Computed tomography (CT) revealed a tumor in the left lower lobe. A biopsied tumor specimen was diagnosed as an adenocarcinoma, and thus, left lower lobectomy was performed. Preoperative three-dimensional CT revealed that an anomalous V<sup>2</sup> of the left lung drained from the superior segment into the inferior pulmonary vein. This variation type was confirmed during thoracoscopic left lower lobectomy. We were able to perform left lower lobectomy with the preservation of the anomalous V<sup>2</sup>. The postoperative course was uneventful, and the patient was discharged on postoperative day 12. It is important to identify anatomical variations of the pulmonary vein and reliably preserve and process the affected area to prevent postoperative complications.

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## 1. Introduction

Advances in three-dimensional computed tomography (3D-CT) have made it easier to identify and understand anomalous blood vessels before surgery. There are many reports regarding the type and frequency of anatomical variations of the pulmonary vessels [1–3]. However, there are some types that remain to be not identified. We report a case of abnormal pulmonary vein wherein the left V<sup>2</sup> drained into the inferior pulmonary veins. To date, this variation type has not been reported, and thus, our case is the first. We were able to safely perform surgery safely because it was possible to preoperatively diagnose the abnormality. A report regarding intraoperative imaging is also included. The work has been reported in line with the SCARE criteria [4].

## 2. Presentation of case

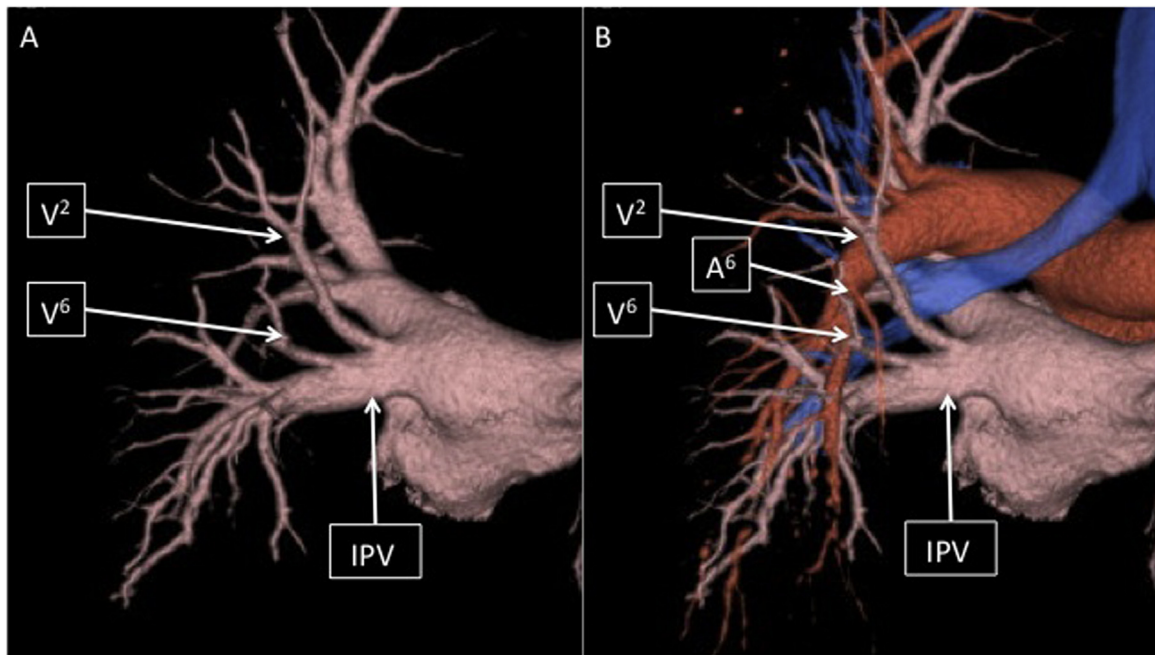
A 63-year-old man was examined at our department after an abnormal chest shadow was identified during a regular health checkup. He had no history of past illness and no relevant family history. He quite smoking 10 years ago, but he has a history

of smoking for 20 pack years. His laboratory data were normal, including tumor markers such as CEA, SCC, and CYFRA. Chest X-ray revealed an abnormal shadow in the left lower lung field, and chest CT revealed a tumor, measuring 26 × 25 mm, in segment 8 of the left lower lobe. Fluorine-18-fluorodeoxyglucose positron emission tomography revealed an abnormal uptake in the nodule with a standardized uptake value of 9.9. Based on trans-bronchial biopsy, a pathological diagnosis of adenocarcinoma was made. Preoperative 3D-CT revealed that an anomalous V<sup>2</sup> vein that drained from the superior segment in the left upper lobe into the upper side of the inferior pulmonary vein (Fig. 1). TNM classification and clinical stage were cT1bN0M0 and stage IA, respectively, and a left lower lobectomy was scheduled.

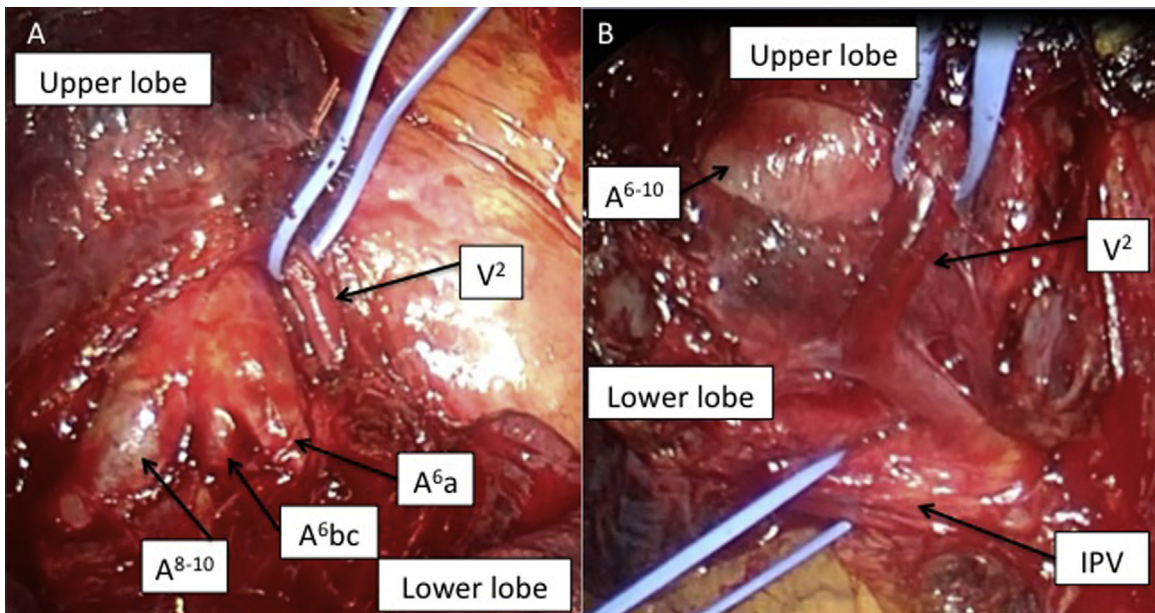
First, the inferior pulmonary vein was isolated through an incision in the posterior side of the mediastinal pleura. By peeling under the entire circumference of the inferior pulmonary vein, we were able to confirm that the central side of V<sup>2</sup> was present on the superior side of V<sup>6</sup>. Next, the interlobar fissure was dissected, and the pulmonary artery was confirmed and isolated. The posterior interlobar fissure was divided using a linear stapler, and the peripheral side of V<sup>2</sup> was confirmed. V<sup>2</sup> had joined the superior side of the inferior pulmonary vein and was running on the posterior side of the pulmonary artery and the bronchus from the upper lobe (Fig. 2). Without 3D-CT images, the anomalous V<sup>2</sup> might have been divided during the lower lobectomy when dividing the lung between the upper and lower lobes. Left lower lobectomy was safely performed, and the operation time and amount of bleeding were 154 min and

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**Fig. 1.** Three-dimensional computed tomography image of the anomalous V2 pulmonary vein, which drained into the superior side of the inferior pulmonary vein (IPV). A: image of the left pulmonary vein, B: image of the left bronchus, pulmonary artery, and pulmonary vein.



**Fig. 2.** Thoracoscopic view. A: A view from interlobar fissure. The anomalous V<sup>2</sup> vein drained from the left upper lobe running on the dorsal side of the pulmonary artery. B: The inferior pulmonary vein. The left lower lobe (LLL) and left upper lobe (LUL) are retracted toward the ventral side. The anomalous V<sup>2</sup> vein drained into the inferior pulmonary vein (IPV).

200 ml, respectively. The postoperative course was uneventful, and the patient was discharged 12 days after surgery.

The pathological diagnosis of the specimen was adenocarcinoma with lymph node metastasis (pT2N1M0, stage IIA). The patient received adjuvant chemotherapy for three months, and 2 years after resection, he was disease-free from a lung cancer.

### 3. Discussion

Advanced CT technology has made it possible to easily and rapidly confirm the structure of pulmonary vessels before a surgery,

even if the vessels have rare anatomical variations. Nowadays, in many facilities, 3D-CT of the pulmonary vessels and bronchus is preoperatively performed for respiratory surgery. There have been reports regarding the usefulness of preoperative simulation, identification of variations in the pulmonary blood vessels and bronchi in patients who have undergone pulmonary segmental resection, and application to intraoperative navigation. Furthermore, imaging and analysis methods can be adjusted to obtain precise images with a visualization rate of 98% [5–8]. Thoracoscopic pulmonary lobectomy is performed at many institutions; therefore, it has become a stable and safe procedure. Hence, we believe that some institu-

tions selectively perform 3D-CT after considering various operative procedures, rather than performing it on all cases. Anomalous pulmonary venous return is often encountered in routine medical practice. According to Yamashita (1), when observing the left lung alone, the lingular segment veins return to the inferior pulmonary veins in 10.7% of cases and V<sup>6</sup> returns to the upper pulmonary veins in 2.7% of cases. There have also been reports regarding anomalous pulmonary veins [2,3]. However, we believe that this is the first study to report regarding anomalous pulmonary venous return in which V<sup>2</sup> passes through the dorsal part of the bronchus and returns to the inferior pulmonary veins. This present case is a very rare variation of pulmonary vein. Ligation of segment branches of pulmonary artery has not serious complication over lung parenchyma (except in gases exchange ratio). However, a venous ligation of a residual segment or lobe might cause infarction and necrosis of the remaining lung tissue. From the perspective of this, upper lobectomy and inferior lobectomy present slightly different issues in cases of anomalous pulmonary venous return, as exemplified by our case wherein the upper lobe pulmonary veins returned to the inferior pulmonary veins. In upper lobectomy, anatomical variation of pulmonary vein can cause unexpected intraoperative bleeding. In inferior lobectomy, however, in addition to bleeding, it can cause the postoperative complications and the dysfunction of the residual lung when this abnormal V<sup>2</sup> was dissected for reasons of the above. Therefore, we believe that the inferior lobe should be preserved as much as possible. More cases of previously unreported anatomical variations of the pulmonary vessels are required in the future. Moreover, in lung surgery, 3D-CT plays a vital role in gaining a preoperative understanding of variations of pulmonary vessels and reliably preventing avoidable complications.

#### 4. Conclusion

This is the first study to report regarding the treatment of a case in which the left V<sup>2</sup> returned to the inferior pulmonary veins. It is important to preoperatively identify anatomical variations of the pulmonary vein and reliably preserve and process the affected area to prevent postoperative complications. It is possible that there are unreported abnormal cases, therefore, the use of 3D-CT for preoperative, detailed examination of anomaly pulmonary vein should be emphasized.

#### Conflicts of interest

The authors declare having no conflicts of interest for this article.

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#### Ethical approval

Consent for publication was obtained from the patient and is available for review.

#### Consent

Informed consent obtained from patient.

#### Author contribution

Aragaki M: He wrote the paper.

Aragaki M, Iimura Y, Yoshida Y and Hasegawa N: Surgeons performed the operation and follow-up.

#### Guarantor

Masato Aragaki MD, PhD.

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