

# Difficulty Intubating a Double-Lumen Tube due to a Tracheal Bronchus: A Case Report

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## Case report

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# Abstract

**Background:** Intubation difficulties, hypoxemia, inability to perform a one-lung ventilation, and high airway pressure often occur during double-lumen tube intubation. Tracheal bronchus is a very rare and difficult to find reason. We present a case of tracheal bronchus accidentally discovered during double-lumen tube intubation in a patient undergoing thoracic surgery. We are the first one to summarize the one-lung ventilation strategy for patients with tracheal bronchus.

**Case Presentation:** A 53-year-old man underwent a scheduled thoracoscopic left upper lobectomy. After two unsuccessful attempts to pass the right-sided double-lumen tube through the right mainstem bronchus, fiberoptic bronchoscopy revealed an aberrant tracheal bronchus with an incidence of 0.1%–3%. Finally we used a left-sided DLT to ventilate the right lung. The patient had no airway complications and was discharged 7 days after the operation.

**Conclusions:** This case serves to remind us that preoperative visits must be thorough and careful. Although a computed tomography chest examination was performed before surgery, we just looked at the inspection report and did not look at the images. We also reviewed relevant literature and summarized the one-lung ventilation strategies for patients with tracheal bronchus. For left-lung ventilation, either a left-sided double-lumen tube or a combination of a bronchial blocker and Fogarty artery embolization catheter can be used. For right-lung ventilation, a bronchial blocker or a left-sided double-lumen tube is a good choice.

## Background:

Double-lumen tubes (DLTs) are often used in patients who require one-lung ventilation. However, intubation difficulties, hypoxemia, inability to perform a one-lung ventilation, and high airway pressure often occur during surgery. An ectopic bronchus arising from the trachea to one or several segments of the bronchus is an uncommon reason[1]. We report a case of the difficulty performing a DLT intubation due to a tracheal bronchus (TB). Furthermore, we reviewed the literature and summarized the solutions for one-lung ventilation in cases with TB which has never been previously reported in such detail.

## Case Description:

A 53-year-old man (height: 175 cm; weight: 92 kg) was admitted to the hospital for peripheral lung cancer of the left upper lobe. He was scheduled for a thoracoscopic left upper lobectomy. The patient's preoperative examinations were normal, and there was no history of surgical anesthesia. A 37-Fr right-sided DLT was placed blindly. The tube could not be sent further than 27 cm from the incisor. A fiberoptic bronchoscopy (FOB) examination revealed that there was a view of the three orifices instead of a clear view of the bronchus intermedius. We retrieved the images of the patient's preoperative imaging examination from the computer, and the patient was confirmed to have a TB with an opening in the upper lobe of the right lung that was not described in the report (Fig. 1). After a discussion with the surgical

team, a left 35-Fr DLT was inserted at a depth of 31 cm. Careful examination of the FOB indicated that the cuff of the main lumen of the DLT did not block the TB and did not affect the ventilation of the right upper lobe (Fig. 2). During one-lung ventilation, the right lung breathing sound was normal, and the airway pressure was not high. The patient had no airway complications and was discharged 7 days after the operation.

## Discussion:

TB is an abnormal, accessory, or ectopic bronchial branch that directly originates from the tracheal sidewall above the carina, with an incidence of 0.1–3%[2]. It occurs almost exclusively on the right side, involving the upper lobe of the right lung, and usually replaces the right main bronchus or apical bronchus[3].

While the classification of TB has not yet been fully unified, Conacher[4] proposed a simple classification suitable for anesthesiologists, which describes the anatomical relationship between the TB and carina, and is simply divided into three types: Type I TB,  $\geq 2$  cm from the carina with stenosis of the distal trachea; Type II TB,  $\geq 2$  cm from the carina with a normal distal trachea diameter; Type III TB, appears at or near the level of the carina. Most adults with TB are asymptomatic. However, it is important for the anesthesiologist to be aware of TB in cases requiring airway management and one-lung isolation.

Pribble et al.[5] reported a case of patient with emergency abdominal trauma with hypoxemia and right upper lung atelectasis during surgery. After bronchoscopy, it was found that that TB was located 3 cm above the carina. This finding suggests that if hypoxemia, abnormally increased airway pressure, and increased end-tidal CO<sub>2</sub> occur when general anesthesia with a single-lumen endotracheal tube is performed, the cause, whether by bronchospasm, secretion blockage, catheter twisting, or bronchial intubation, should first be identified. After considering TB[6, 7], intraoperative fiberoptic bronchoscopy is the most important method for diagnosis.

We reviewed papers in English searched through MEDLINE between 1966 and April 2020 and summarized the literature in Table 1.

For patients requiring left-lung ventilation, there are many methods that can be used, and inserting a left-sided DLT is a good choice. Ho et al.[8] conducted a retrospective study and found that a left-sided DLT did not affect one-lung ventilation when the TB was located within 2 cm from the carina (type III). Rosenberg et al.[9] and other researchers have verified this. We found that the left-sided DLT can also meet the requirements of intraoperative left-lung ventilation for type III TB based on the studies by Ikeno[10] and Peragallo[11]. However, the distance from the TB to carina was just 3 cm. We need more studies to assess the one-lung ventilation strategy for type III TB.

The second method is the combined use of a bronchial blocker and a Fogarty artery embolization catheter. Lee et al.[12] reported a case of using a Univent bronchial blocker blocks the right mainstem bronchus, and the Fogarty artery embolization catheter blocks the TB. In the absence of a Univent blocker,

combination of a single-lumen tube and a bronchial blocker and a Fogarty artery embolization catheter can be used instead[1]. However, Kin et al.[13] reported that the cuff of the bronchial blocker can also be used to block the TB when the TB is very close to the right mainstem bronchus.

For patients who need right-lung ventilation, a bronchial blocker placed in the left mainstem is a good method based on the study by Conacher[4] for type III TB. We used a different approach by using a left-sided DLT. After ensuring the left bronchial catheter cuff was well positioned, and the tracheal cuff was high enough not to block the TB; the problem of right-lung ventilation was solved by ventilating the trachea. According to the study by Ho et al.[8] this method of lung isolation is safe. Although, when the surgical site involves the left mainstem bronchus, the left DLT should be used with caution.

There have been reports of TB in the past, but for the treatment of such patients during double-lumen endotracheal intubation, only Yoshimura[14] has described the strategy of right lung isolation. We have evaluated more cases and summarized the isolation strategies of the left and right lungs respectively, which has never been previously reported.

## Conclusions

In summary, for left-lung ventilation, either a left-sided DLT or a combination of a bronchial blocker and Fogarty artery embolization catheter can be used. For right-lung ventilation, a bronchial blocker or a left-sided DLT is a good choice. In addition, this case demonstrated the importance of careful preoperative evaluations. A chest radiograph or chest computed tomography is necessary. Sometimes you cannot just look at the inspection report, it is better to also look at the preoperative images.

## Abbreviations

DLT, double-lumen tube; FOB, fiberoptic bronchoscopy; TB, tracheal bronchus

## Declarations

Ethics approval and consent to participate: We have been approved by the Ethics Committee of Jining No. 1 People's Hospital.

Consent for publication: We obtained the patient's consent to publish the manuscript.

Availability of data and materials: All data generated or analyzed during this study are included in this published article.

Competing interests: The authors of this manuscript report no conflicts of interest.

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Authors' contributions:

WZW cared for the patient, reviewed the literature, and wrote the manuscript. JL cared for the patient and wrote the manuscript. JL revised the manuscript. CWS cared for the patient and revised the manuscript. YNZ cared for the patient and reviewed the literature. All authors read and approved the final manuscript.

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## Tables

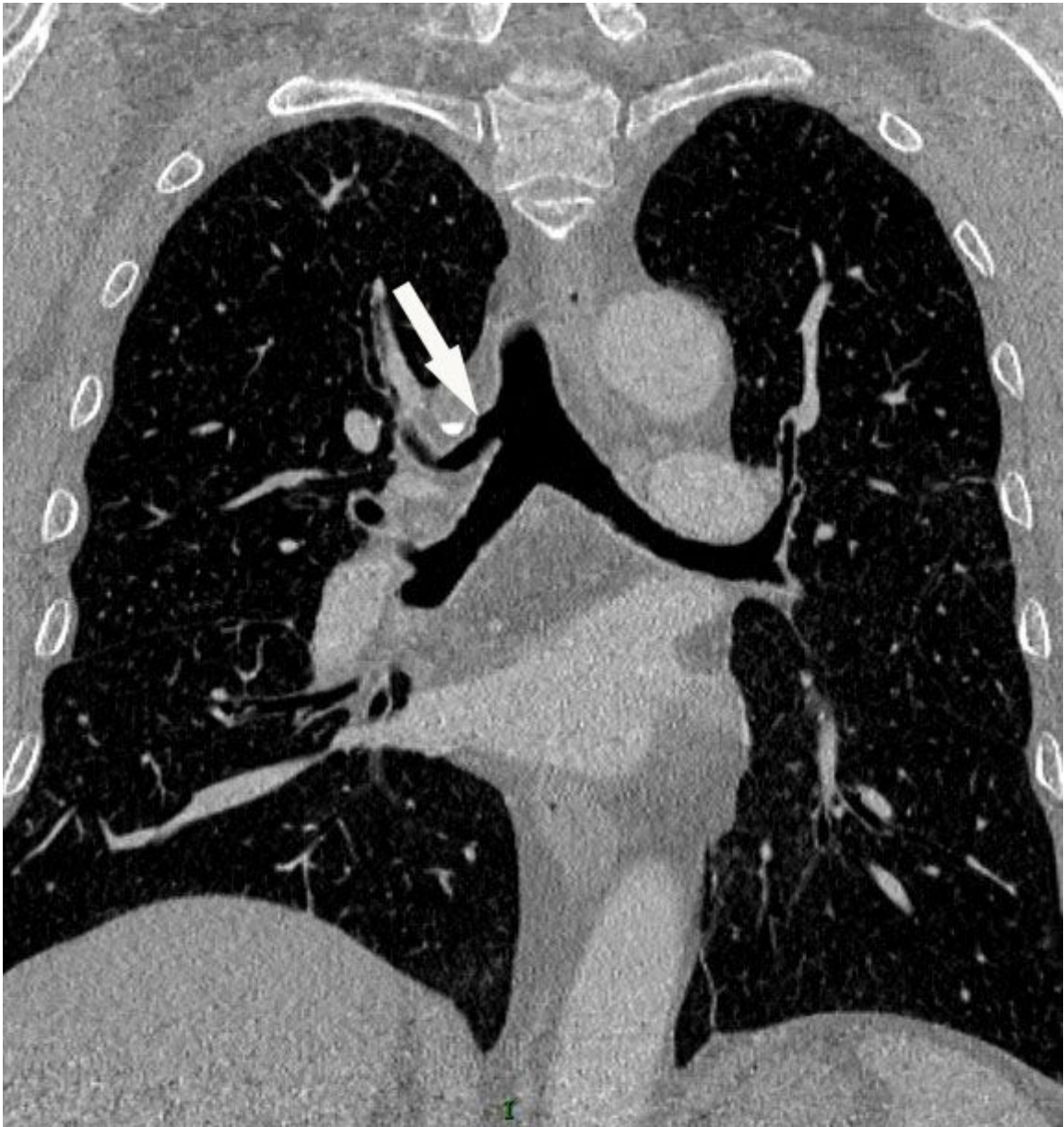
Table 1  
Solutions for One-lung Isolation in Cases with Tracheal Bronchus (TB)

One-lung Ventilation (left/right)	Disease or Surgical Procedure	Process of Finding TB	TB Type	One-lung Isolation Strategy	References
Left	Right middle lobe cancer	TB was detected before intubation	II	Left DLT	Ikeno et al. (1996) [10]
Left	An ostium secundum type atrial septal defect, closure of the defect by using a right thoracotomy approach	Univent bronchial blocker was placed in right mainstem bronchus, then a bronchoscopic examination found the TB.	II	Left DLT	Peragallo et al. (2000) [11]
Left	Esophagectomy	a 37-Fr left-sided DLT was inserted unsuccessful twice, then a single-lumen tube (SLT) was placed without difficulty. A flexible bronchoscope was used to inspect the airway and the TB was found.	III	Left DLT guided by a Cook Airway Exchange Catheter under direct visualization with a GlideScope	Rosenberg et al. (2019) [9]
Left	Esophagectomy	Univent tube and Univent bronchial blocker which blocked right mainstem bronchus. TB was found after FOB inspection.	III	The TB was blocked by inflating a Fogarty catheter.	Lee et al. (2011) [12]
Left	A right extrapleural pneumonectomy for malignant mesothelioma	The trachea was intubated with a SLT. The surgeon performed a bronchoscopy which revealed a tracheal bronchus. After bronchoscopy, a left DLT entered the right mainstem bronchus after multiple attempts	III	SLT and right mainstem bronchus blocker and Fogarty catheter blocking TB	Wiser et al. (2004) [1]

*Abbreviations: DLT, double-lumen tube; FOB, fiberoptic bronchoscopy; SLT, single-lumen tube; TB, tracheal bronchus.*

One-lung Ventilation (left/right)	Disease or Surgical Procedure	Process of Finding TB	TB Type	One-lung Isolation Strategy	References
Left	Thoracoscopic resection of right chest wall tumor	TB was found after DLT failure on the left	III	SLT and bronchus blocker  positioned in right mainstem bronchus with cuff high enough to block TB and right mainstem bronchus	Kin et al. (2000)[13]
Right	Left lung tumor	Right DLT was planned to be placed, TB was found before intubation	III	SLT and bronchial blocker placed in the left mainstem bronchus	Conacher et al. (2000) [4]
Right	Left thoracic tumor	TB was found before intubation	III	SLT and bronchial blocker placed in the left mainstem bronchus	Conacher et al. (2000) [4]
Abbreviations: DLT, double-lumen tube; FOB, fiberoptic bronchoscopy; SLT, single-lumen tube; TB, tracheal bronchus.					

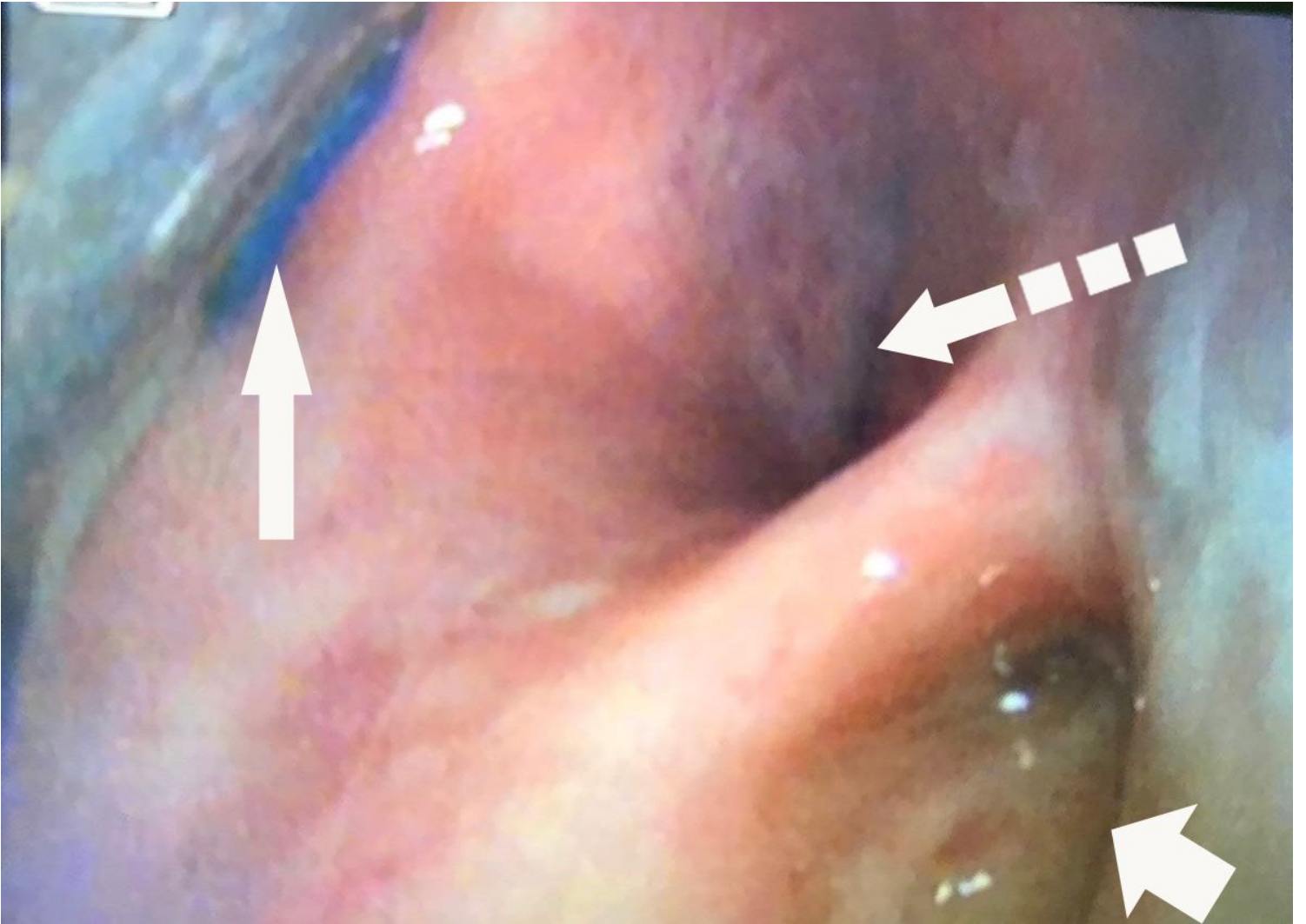
## Figures



**Figure 1**

Preoperative chest enhanced computed tomography. Note the tracheal bronchus (white arrow).





**Figure 2**

Seen under the bronchoscope after the left-sided double-lumen tube was fixed. Note the tracheal bronchus (white wide arrow) and right mainstem bronchus (dotted white arrow) and left bronchial lumen (thin white arrow).