Incidental finding of tracheal bronchus complicating the anesthetic management of a left video-assisted thoracoscopic procedure

Shvetank Agarwal, Mark A. Banks, Sanjeev Dalela, William B. Bates¹, Manuel R. Castresana
Departments of Anesthesiology and Perioperative Medicine and ¹Radiology, Georgia Regents University, Augusta, Georgia, USA

Abstract
Congenital abnormalities of the large airways are uncommon, but may occasionally pose significant difficulties for anesthesiologists. The tracheal bronchus is an anatomical variant in which an accessory bronchus originates directly from the trachea rather than distal to the carina, as a takeoff from the right mainstem bronchus. Anesthesiologists should be aware of this uncommon anomaly, its different variants, and its management in order to successfully establish one lung ventilation (OLV) for surgical isolation. In this article, we report the challenges encountered in establishing OLV in a patient with a previously undiagnosed aberrant right upper lobe bronchus arising directly from the trachea.

Key words: Aberrant tracheal anatomy, lung isolation, one lung ventilation tracheal bronchus

Introduction
Congenital abnormalities of the large airways are rare and can pose significant difficulties for anesthesiologists. We report the challenges encountered in establishing one lung ventilation (OLV) in a patient with a previously undiagnosed aberrant right upper lobe (RUL) bronchus arising directly from the trachea. We also present a comprehensive review of the anatomy, varied clinical presentations, and principles of the airway and anesthetic management of this rare anomaly.

Case Report
A 70-year-old man was scheduled for a left video-assisted thoracoscopic surgery. No large airway anomaly was reported on the preoperative computed tomography (CT) scan. After standard uneventful induction, the patient was intubated with a single lumen endotracheal tube (SLT). Fiberoptic bronchoscopy (FOB; Olympus America Inc., Center Valley, PA, USA) was used to aid placement of a 7F Uniblocker (Fuji Systems Corp., Fukushima, Japan) inside the left mainstem bronchus (LMB) and revealed an odd configuration of central airways [Figure 1A]. The initial diagnosis was the inadvertent placement of the SLT in the right mainstem bronchus (RMB). However, after confirming the depth of the tube to be 21 cm and no change in the appearance of the tracheal anatomy on withdrawing the SLT several centimeters, it was realized that the SLT was indeed in the trachea.

The FOB was advanced into the rightmost bronchus, which showed two segmental bronchi. FOB of the middle lumen showed an absence of the RUL bronchus, instead appearing to bifurcate into the right lower and middle lobes similar to...
the bronchus intermedius in normal patients. The leftmost lumen had the same anatomy as a normal left bronchus. After a thorough assessment of the airway anatomy, diagnosis of a low-riding tracheal bronchus (TB) versus tracheal trifurcation was made. To isolate the left lung, the bronchial blocker (BB) was placed in the leftmost lumen, and the surgery was accomplished uneventfully. After the surgery, our attempts to look for the elusive TB in the preoperative axial CT scan images and chest radiograph were not successful. Only after a radiologist performed a minimum intensity projection of coronal reconstruction, were we able to identify the TB that was missed in the preoperative reporting [Figure 1B].

Discussion

Sandifort first described TB in 1785. His original description was of an RUL bronchus originating from the trachea.\cite{1,2,3} The term “TB” is now a mixed bag involving a variety of bronchial anomalies originating from the trachea or main bronchus and finally merging into the upper lobe.\cite{2,3,4} Although a normal variant in pigs,\cite{5} the incidence of “pig bronchus” (bronchus suis) in humans is somewhere in the range of 0.1% and 5%.\cite{2,3,6,8}

Although a TB can originate anywhere between the carina and cricoid cartilage, it is most frequently seen within 2 cm of the carina (commonly described as bronchial trifurcation).\cite{2,3,5,7} It also may arise as high as 6 cm above the carina with a predilection for the right side.\cite{2,3,6}

Clinical implications and management

Challenges with airway due to the presence of TB have been reported for both thoracic and nonthoracic surgeries, as well as ventilation in the intensive care unit.\cite{1,3,6,10} Due to its varied presentation, an undiagnosed TB during thoracic surgeries may interfere with lung isolation and/or ventilation depending on the surgical site and type of OLV device used.\cite{8} We present a comprehensive description of the management of various clinical scenarios in patients with TB. Since left-sided TB is very rare, our discussion will be restricted to the management of the much more common right-sided TB.

Surgery involving the right hemithorax

In patients with normal central airways, right-sided surgery is usually accomplished with the use of either a BB placed in the RMB or a left-sided double lumen tube (DLT) (ventilating the left lung through the bronchial lumen) or right-sided DLT (ventilating the left lung through the tracheal lumen). Right lung isolation can also be achieved by the use of EZ-Blocker (EZB; Teleflex Life Sciences Ltd., Athlone, Ireland) placed through an SLT. The bifid cuffs are directed into each of the main stem bronchi, and the right cuff inflated to facilitate right lung isolation.

However, in patients with TB, a right-sided DLT or a conventional BB approach will not result in adequate lung isolation. One approach would be to place a left DLT with the left lung ventilated through the bronchial lumen [Figure 2A].\cite{17,9} Other alternatives depend on the exact position of the TB.\cite{7} For patients with tracheal trifurcation, an EZB can be passed through a conventional SLT and placed at the false carina, with one cuff in the TB and the other in the RMB; inflation of both balloons will isolate the RUL and the rest of the right lung (middle and lower lobes), respectively [Figure 2B]. For patients in whom the TB arises above the carina, it may be necessary to use two BBs. In such cases, two pediatric 5F Arndt blockers may be placed individually using a pediatric FOB through an SLT [Figure 2C]. Furthermore, a Univent (Fuji Systems Corp., Tokyo, Japan) endotracheal tube can be used in combination with a BB for lung isolation [Figure 2D].\cite{7}

Surgery involving the left hemithorax

In patients with normal anatomy, left lung isolation is usually achieved either by the use of left-sided DLT (ventilating the right lung through the bronchial lumen), right-sided DLT (ventilating the right lung through the bronchial lumen), a conventional BB placed in the LMB, or an EZB (inflating the left bronchial cuff). In patients with TB, left lung isolation is more complex than right lung isolation but can be effectively accomplished with a conventional BB placed in the LMB, as in our patient\cite{8,11} [Figure 3A]. A left-sided DLT may be used in those with tracheal trifurcation [Figure 3B],\cite{6} however, in those with high-riding TB, a left-sided DLT would not be appropriate, as the tracheal cuff of the DLT could obstruct the TB and may cause intraoperative hypoxemia [Figure 3C]. A right-sided DLT would be an absolute contraindication, as the bronchial lumen would have to be placed either in the TB or in the RMB and would therefore not be able to ventilate both.
Conclusion

BBs for lung isolation are always placed under FOB visualization allowing diagnosis of central airway anomalies and permitting corrective action. However, an undiscovered TB after placement of a DLT can be very misleading with the potential for failure of lung isolation and/or adequate ventilation. We, therefore, recommend, during placement of a DLT, to place an FOB through the bronchial lumen immediately after the bronchial lumen is past the vocal cords, in order to assess the central airway anatomy and to identify the bronchus into which the bronchial lumen of the DLT will be sitting, and then to advance the DLT into the correct bronchus over the FOB. Furthermore, the importance of a thorough evaluation of the preoperative scans by the anesthesiologists themselves, instead of simply relying on the radiologist’s reporting, cannot be over-emphasized. However, conventional radiological imaging may not be sufficient in detecting these anomalies, requiring more sophisticated and advanced reconstruction techniques.

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Conflicts of interest
There are no conflicts of interest.

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