Lesson from clinical practice

A challenging case of tracheal bronchus with concurrent tracheal stenosis for one lung ventilation

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Abstract

Background: Tracheal bronchus is a rare congenital anomaly that may remain asymptomatic or present with symptoms that mimic other respiratory diseases. We present a particularly challenging case of tracheal bronchus combined with tracheal stenosis that had remained asymptomatic until it was diagnosed incidentally.

Objective: To describe our findings in a 66-year-old lady who presented for an elective resection of lung tumour.

Methods: The medical and surgical records plus biomedical images were reviewed together with a literature search on the subject.

Results: We describe a patient found to have tracheal stenosis with a large tracheal bronchus during right lower lobectomy. Attempts to isolate and collapse the right lung failed with both double lumen tube (DLT) and bronchial blocker. A CT Scan done preoperatively showed a right upper lobe bronchus originating high in the trachea and interestingly a reconstructed three dimensional (3-D) image later, revealed an unusually large tracheal bronchus with a stenotic remnant of the trachea before the true carina begins.

Conclusion: There are many anatomical variations of tracheal bronchus but none so far describes an entirely asymptomatic anomaly with concurrent tracheal stenosis. Specific CT imaging to reconstruct tracheobronchial anomalies in a 3-D view is suggested whenever the diagnosis is detected during staging CT. A plain description on its own would not suffice in estimating the depth or parameters of the structures involved to allow adequate pre operative planning of any airway intervention especially when ventilating one lung is the strategy.

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1. Introduction

Tracheal bronchus is a congenital anomaly described in 0.1–3% of the general population [1,2]. They can present as an incidental finding on bronchoscopy in adulthood or during childhood. Patients may present with stridor, cough, asthmatic symptoms or recurrent right-sided pneumonia mimicking foreign body aspiration [3,4]. Bronchoscopic finding would typically show a small bronchus arising at a site ranging from mid-trachea to just above the bifurcation of the carina. As the site of origin invariably results in a spectrum of anomalies and a diverse list of descriptions, some authors have put simple and easy to use classifications of just Types I, II and III [5]. The presence of such an anatomical deviation can lead to unexpected difficulty in ventilating an otherwise asymptomatic patient when a conventional tracheal tube occludes the tracheal bronchus and causes unexplained desaturation during ventilation [6]. Apart from that, one lung ventilation (OLV) requiring collapse of the right lung will also be technically more difficult to achieve.

This report represents a challenging case for OLV because of a tracheal bronchus and the co-existence of a tracheal stenosis. The patient had graciously given her written consent for this write-up.
2. Case report

A 66-year-old lady presented with an incidental finding of elevated levels of serum CEA on her routine medical check up. Madam X’s first CT Scan showed a lesion in her right lower lobe for which an elective lobectomy was scheduled. In the report, the existence of a tracheal bronchus was briefly mentioned. Other comorbidities included an asymptomatic severe aortic stenosis with an aortic valvar area of 1 cm² and a recovered hemorrhagic stroke. She was a petite lady of 43 kg with a small frame of 147 cm. During her preoperative review, several features of difficulty in intubation were noted such as a small chin with reduced thyromental distance and crowded teeth especially on her lower jaw. Before induction of anaesthesia, both standard monitoring as well as more invasive modalities with a radial arterial line and right internal jugular central line were instituted under local infiltration and small amounts of sedation. A combination of benzodiazepines, TCI propofol using the Marsh model and TCI remifentanil with Minto model targeting effect site (Injectomat® TIVA Agilia, Fresenius Kabi, Brezins, France) were administered for induction and continued as maintenance of anaesthesia.

The first attempt for OLV was planned using a 35Fr left sided double lumen tube (DLT) (Sumi® Sulejówek, Poland). Several attempts were made to angulate and advance the 35Fr DLT pass the vocal cords. Although she was a Cormack Lehane Grade II, her teeth and small jaw caused an acute angle that proved difficult to maneuver and reach the vocal cords. A bougie was used as an introducer technique again. Although the lumen of the smaller 28Fr left sided DLT (Sumi® Sulejówek, Poland) using the bougie introducer technique again, the maximum length of the 28Fr DLT had already been reached at the first bifurcation on the left. It meant the FOB proved difficult for the scope to advance and guide the bronchial lumen of the blocker deeper with the FOB proved futile because of resistance. Moreover, the maximum length of the 28Fr DLT had already been reached at patient’s teeth and so, there was no more length to advance the DLT any further. Manual ventilation via a well fitting face mask was employed during this attempt but once the DLT was inserted, IPPV could be instituted through both its tracheal and bronchial lumens. The overall time taken reached 60 minutes and consideration of a last attempt to isolate the right lung was made with a much smaller 28Fr left sided DLT (Sumi® Sulejówek, Poland) using the bougie introducer technique again. Although the lumen of the bronchial blocker was sited well into the right lung individually. The observed bronchoscopic anatomy could be described as a large right bronchial branch, which was the tracheal bronchus and a much smaller narrowed left main (Please refer to Fig. 1(b)). It proved difficult for the scope to advance and guide the blocker beyond the first bifurcation into the left. It meant the FOB had to stop short at the tracheal stenotic region to the left of the large tracheal bronchus. Failing which the blocker had to be eventually removed. During this period, intermittent positive pressure ventilation (IPPV) was maintained with the tracheal tube.

Subsequently, she was intubated with a conventional single lumen tracheal tube (Unomedical® Kedah, Malaysia) Size 7.0 with the intention of inserting a 7.0Fr/65 cm Arndt bronchial blocker with spherical balloon from Cook® Medical (Bjaeverskov, Denmark) guided by a fibreoptic bronchoscope (FOB) (Olympus® LF-GP Japan, Size 4). At that point in time, the aim was to collapse the right lower lobe individually. The observed bronchoscopic anatomy could be described as a large right bronchial branch, which was the tracheal bronchus and a much smaller narrowed left main (Please refer to Fig. 1(b)). It proved difficult for the scope to advance and guide the blocker beyond the first bifurcation into the left. It meant the FOB had to stop short at the tracheal stenotic region to the left of the large tracheal bronchus. Failing which the blocker had to be eventually removed. During this period, intermittent positive pressure ventilation (IPPV) was maintained with the tracheal tube.

A last attempt to isolate the right lung was made with a much smaller 28Fr left sided DLT (Sumi® Sulejówek, Poland) using the bougie introducer technique again. Although the lumen of the bronchial blocker was sited well into the first bifurcation on the left in the bronchoscopic view (Olympus LF-GP Japan, Size 2), clinical examination revealed no successful collapse of the right lung. Further attempts to guide the bronchial lumen of the blocker deeper with the FOB proved futile because of resistance. Moreover, the maximum length of the 28Fr DLT had already been reached at patient’s teeth and so, there was no more length to advance the DLT any further. Manual ventilation via a well fitting face mask was employed during this attempt but once the DLT was inserted, IPPV could be instituted through both its tracheal and bronchial lumens. The overall time taken reached 60 minutes and consideration was given to patient safety and difficulty in securing the airway. Throughout this period, oxygenation was maintained and there

Fig. 1. Haemodynamic measurements and vasopressor drugs given from baseline (Time 0) to extubation at the end of surgery (Time 3.75).

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were no recorded episodes of desaturation below 97%. Her hemodynamics remained stable with occasional boluses of vaso-pressors and low dose of noradrenaline infusion (See Fig. 1). In the end, a decision was made to avoid further tries to secure and isolate the right lower lobe. So, surgery proceeded with IPPV aiming for a low tidal volume of 6 ml/kg and intermittently timed collapse of both lungs. Arterial blood gases were monitored hourly and showed no abnormalities in her gas exchange.

Intraoperatively, there was a mass in the right lower lobe. The minor fissure was almost incomplete and the right middle lobe appeared to be part of the upper lobe. The remaining right lower lobe was noted to be relatively small. Despite not collapsing the right lung and only using the technique of intermittent suspension of ventilation, a right lower lobectomy and lymph node clearance was successfully done and she was extubated immediately after completion of the surgery. She made an uneventful recovery in the intensive care unit overnight and was discharged at day five following surgery. At 2 weeks follow up she was well and the histopathology revealed a stage 1A adenocarcinoma of the lung.

Fig. 2(a) and (b) are the CT image of Madam X’s tracheobronchial tree and a reconstructed 3-D view from her CT scans respectively. The distance from Madam X’s incisors to carina is 29.0 cm and incisor to tracheal bronchus 26.5 cm based on measurements on her CT images.

3. Discussion

The inability to isolate the lungs and its associated difficulty in patients with tracheal bronchus is not new [7–9]. Furthermore, some authors had advocated DLT for intubation as a better choice over bronchial blockers in patients requiring OLV [10]. This report shows it may be otherwise; a bronchial blocker may have been a better choice for a patient who has a large tracheal bronchus. However, when a stenotic trachea is also present, both methods may be impossible unless a smaller FOB of probably size 2 may be able to guide the blocker past the narrowing. Unfortunately, in this case the last modality mentioned could not be explored because of the time taken and safety concerns.

During the anaesthesia of Madam X, the tracheal bronchus was reported briefly in the first CT with neither elaboration nor reconstruction of its images. All attempts to secure OLV with a double lumen tube or bronchial blocker failed because of two unexpected combined anomalies in this case. Although a preliminary CT scan for the surgical diagnosis had been done, early CT images were essentially used for staging of the suspected lung malignancy and not specific of the airway. This explained the severe difficulty experienced to collapse the right lung for OLV; a complication associated with tracheal bronchus that had been previously reported [10]. In the end, planning would have been particularly difficult with a single CT Scan report without 3D reconstruction as the former would not emphasize nor estimate the relative size and distance of soft tissues.

The bronchoscopic view by itself is an unreliable method for identifying a large tracheal bronchus in proportion to the carina if the diagnosis was not previously noted. The tracheal bronchus of such a caliber would likely include the bronchus intermedius resulting in the first bifurcation to resemble the carina and be easily mistaken for it. Therefore we recommend in our discussion, an additional single helical acquisition from base of skull to carina to be obtained in patients with suspected or known tracheobronchial anomalies when it is detected in staging CT. A 3-dimensional CT or even virtual bronchoscopy would have provided a better estimation of the structure as described in a previous study by Wendy Wai et al. [11] Reconstructed images will allow for adequate pre operative planning of an airway or tracheobronchial tree intervention. There have been no studies so far to suggest cost effectiveness or benefits in screening of patients for such a rare anomaly prior to specific thoracic surgeries.

Furthermore, we would like to highlight the unique anatomy of having a severely stenotic trachea combined with a large tracheal bronchus. In the literature, reports of tracheal bronchus, a right bronchus existing in a spectrum of anatomical sites and sizes proximal to the carina bifurcation are rampant [12]. However, such a large tracheal bronchus combined with a stenotic remnant of the carina that bifurcates into right lower lobe bronchus and the left main bronchus is rare. Despite the appearance of a severely stenotic trachea, she has remained asymptomatic all these years indicating that functionally, there was no obstruction to cause any respiratory problems. Even her respiratory function test had produced normal results prior to surgery. This could possibly be explained by the dominant nature of the tracheal bronchus where both her right upper and middle lobe originated from (Fig. 2(b)).

From the surgical point of view, in the event if OLV could not be achieved, the willingness of the surgeon to perform lung resection
with conventional ventilation plays an important role. Precise incisions will need to be timed and conveyed to the anaesthetic team continually to ensure a successful completion of the procedure with minimal complications.

4. Conclusion

There is a lesson to be learned here that no doubt the preoperative CT Scan mention of a tracheal bronchus was too brief and inadequate to foresee such difficulties in securing OLV. The main reason for failing to do so was because of the severely stenotic trachea and large dominant tracheal bronchus. Performing a reconstructed 3D image and having a radiology conference to discuss necessary interventional techniques would be more appropriate and needs to be emphasized in this report. It is also unusual to have these two anomalies remaining asymptomatic hence undiagnosed until its incidental discovery when OLV is required. Should she have undergone a different kind of procedure, Madam X could possibly have remained undiagnosed with conventional methods of ventilation. As such, we believe that there will be a number of patients like her who may remain undiagnosed in our population and present only during their surgeries with unexpected problems or difficulties in securing OLV. When that happens, this diagnosis although rare should not be overlooked.

Conflict of interests

None declared.

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Appendix A. Supplementary data

Supplementary data related to this article can be found at http://dx.doi.org/10.1016/j.tacc.2015.09.003

References