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Single-Lumen Endotracheal Tube and Bronchial Blocker for Airway Management During Tracheobronchoplasty for Tracheobronchomalacia: A Case Report

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We present a case of a 69-year-old man who underwent tracheobronchoplasty for tracheobronchomalacia using a single-lumen endotracheal tube and a Y-shaped bronchial blocker for airway management. Tracheobronchoplasty is performed by sewing mesh to plicate the posterior, membranous wall of the distal trachea and main bronchi through a right posterolateral thoracotomy. The goals of airway management include continuous left-lung ventilation and lung protection from aspiration. Ideally, only conventional airway management tools are used. This case demonstrates that a single-lumen endotracheal tube with a bronchial blocker can be a straightforward strategy for airway management during tracheobronchoplasty. (A&A Practice. 2019;13:236–9.)

GLOSSARY

CT = computed tomography; **GERD** = gastroesophageal reflux disease; **VATS** = video-assisted thoracic surgery

Acquired tracheobronchomalacia in adults is an airway abnormality in which the posterior, membranous wall of the trachea and main bronchi weaken and collapse during exhalation.[1] Patients report dyspnea on exertion, a barking cough, and recurrent respiratory infections. Diagnosis is made by bronchoscopy or a dynamic airway computed tomography (CT) scan of the chest, and it is often delayed during an extensive evaluation for other etiologies of these symptoms.

Tracheobronchomalacia is generally considered mild, moderate, or severe, at 70%–80%, 80%–90%, or >90% airway collapse during exhalation, respectively.[2] Tracheobronchoplasty is performed for patients with debilitating symptoms attributed to moderate to severe tracheobronchomalacia. The operation is performed through a right posterolateral thoracotomy, although minimally invasive approaches have been described. Mesh is sewn to the posterior, membranous wall of the distal trachea and main bronchi, splinting them open and preventing airway collapse.[3,4]

The goals of airway management during tracheobronchoplasty include continuous left-lung ventilation and lung protection from aspiration. Ideally, only conventional airway management tools are used. Any cuff within an airway must be deflated during suture placement in that airway to reduce the risk of rupture. At the end of the case, flexible bronchoscopy is performed to ensure that the airway has not been narrowed and there are no visible sutures. This completion bronchoscopy is best performed through a single-lumen endotracheal tube in the proximal trachea or laryngeal mask airway to allow inspection of the entire distal trachea and main bronchi.

Several airway management strategies have been described, but many are quite complicated or do not fulfill the goals above.[2–11] We present a case of a 69-year-old man who underwent tracheobronchoplasty with a single-lumen endotracheal tube and a Y-shaped bronchial blocker. This strategy has not been described before for airway management during tracheobronchoplasty. The patient provided written consent to publish this case report.

DESCRIPTION OF THE CASE

The patient is a 69-year-old man, former smoker with asthma and gastroesophageal reflux disease (GERD), who presented with a chronic cough for several years. He had been treated for pneumonia several times with antibiotics, including one episode that required hospitalization. His cough improved after each course of antibiotics, but never resolved completely. He was also treated with inhalers and prednisone for presumed asthma exacerbation, as well as a proton pump inhibitor for GERD, without improvement. Chest radiograph and pulmonary function tests were normal. Diagnostic nasal endoscopy and flexible fiberoptic laryngoscopy were normal, with no clear etiology of his cough.

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Finally, under moderate sedation, flexible bronchoscopy was performed, which showed tracheobronchomalacia with 50%–75% collapse of the distal trachea and main bronchi on exhalation. Dynamic airway CT scan of the chest[12] confirmed moderate to severe tracheobronchomalacia, with 80% distal trachea, 86% right main bronchus, and 98% left main bronchus narrowing from inhalation to exhalation (Figure 1). He underwent a Y silicone stent trial for 2 weeks, during which he noted decreased shortness of breath and resolution of his cough. He agreed to the proposed right thoracotomy and tracheobronchoplasty.

After a thoracic epidural was placed and general anesthesia was induced, the patient was intubated with a single-lumen endotracheal tube with the cuff in the proximal trachea. Bronchoscopy was performed to confirm that the length of the right main bronchus was >1 cm. A Y-shaped bronchial blocker (EZ-Blocker Endobronchial Blocker; Teleflex, Raleigh, NC)[13] was advanced into the trachea through a multiport adapter using bronchoscopic guidance. The yoke of the blocker was positioned at the carina, with the distal extensions in the main bronchi (Figure 2).

For the majority of the case, the bronchial blocker cuff in the right main bronchus remained inflated, and only the left lung was ventilated. When the mesh was sewn to the right main bronchus, the cuff was intermittently deflated, and ventilation intermittently paused. Flexible bronchoscopy at the end of the case showed the bronchial blocker in place, with indentations in the posterior trachea where the mesh had been sewn, and no visible sutures (Figure 3).

The patient was extubated in the operating room and transferred to the intensive care unit for close monitoring of his ventilatory status. He had no postoperative complications and was discharged home on room air on postoperative day 6. He was seen in the clinic 20 days and 6 months after surgery, and he reported complete resolution of his cough and greatly improved quality of life.

DISCUSSION

Tracheobronchoplasty is performed for moderate to severe, symptomatic tracheobronchomalacia, most commonly through a right posterolateral thoracotomy, with the patient in the left lateral decubitus position. We present a case in which a standard single-lumen endotracheal tube and a bronchial blocker were used for airway management.

There are several advantages of this approach. First, the equipment is readily available, and no modification is needed. We used a Y-shaped bronchial blocker with 2 distal extensions, and we suspect that any bronchial blocker would work as well. Second, the bronchial blocker has a low profile, so it causes no distortion of the distal trachea

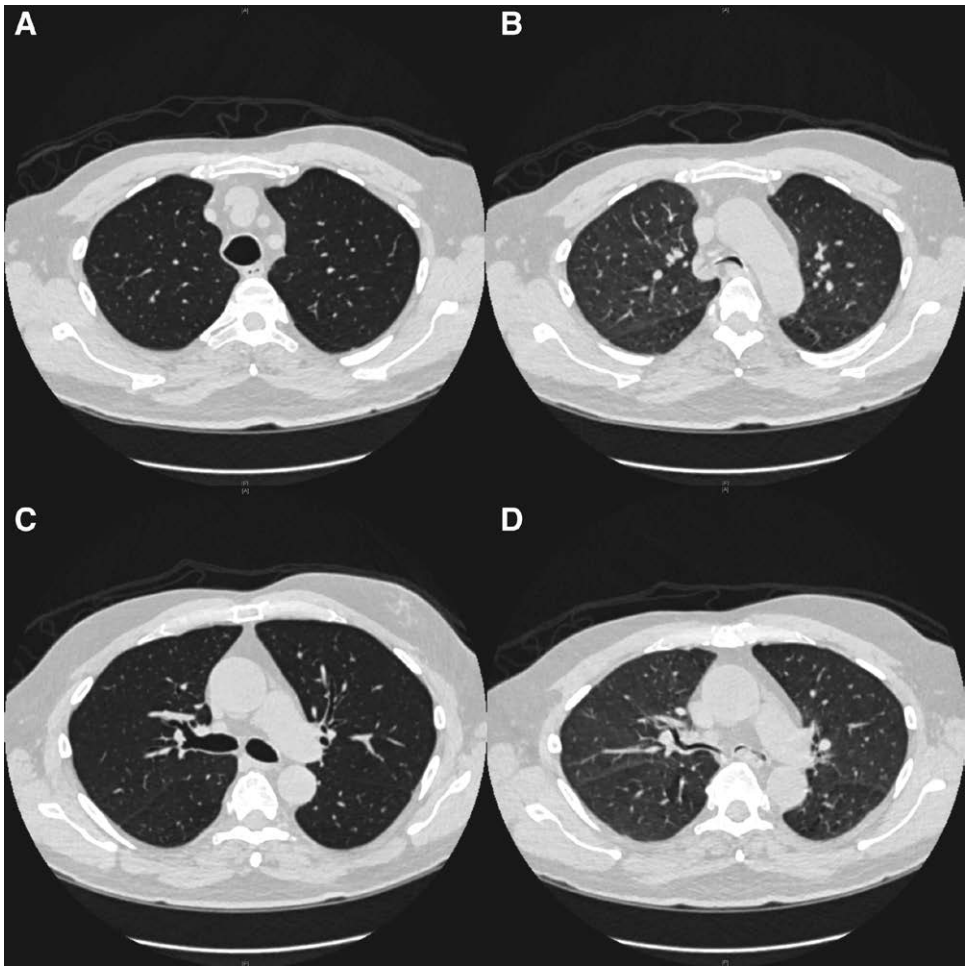

Figure 1. Axial images of a dynamic computed tomography of the chest, with 80% distal trachea narrowing from inhalation (A) to exhalation (B), and 86% right and 98% left main bronchus narrowing from inhalation (C) to exhalation (D).

Figure 2. A Y-shaped bronchial blocker within a standard single-lumen endotracheal tube. The bronchial blocker has a low profile, so it causes no distortion of the distal trachea, and minimal distortion of the main bronchi when the cuffs are deflated. This allows accurate placement of the mesh and lowers the risk that it would be inadvertently sutured in place.

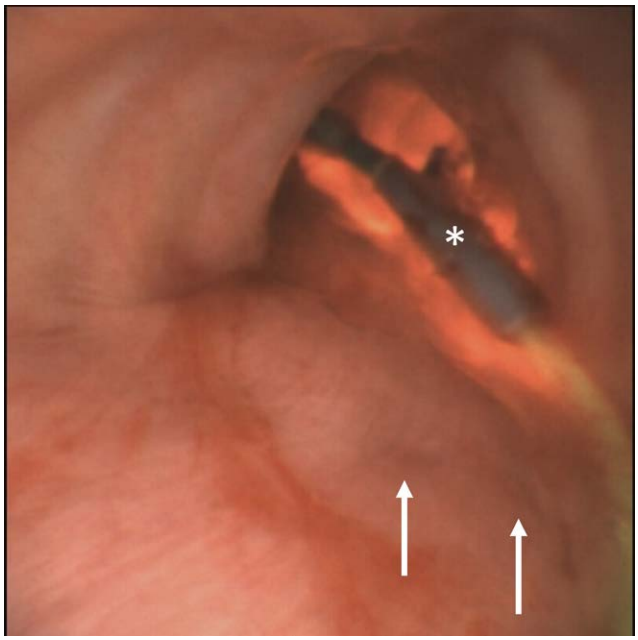

Figure 3. Bronchoscopic view of the distal trachea and carina with the Y-shaped bronchial blocker with 2 distal extensions in place (asterisk). Indentations can be seen where mesh has been sewn to the posterior trachea (arrows), and there are no visible sutures.

and minimal distortion of the main bronchi when the cuffs are deflated. Third, the airway is protected from aspiration with the single-lumen endotracheal tube cuff. Finally, flexible bronchoscopy can be performed at the end of the case without moving the endotracheal tube, decreasing the risk of accidental extubation.

One important consideration is that ventilation must be paused intermittently while the mesh is sewn to the right main bronchus. Intermittent ventilation is required because the bronchial blocker cuff must be deflated during suturing to minimize the risk of puncturing it or suturing it to the airway. Fortunately, there is low risk of puncturing the cuff of the endotracheal tube because it is placed in the proximal trachea, and only the intrathoracic, distal trachea is sutured.

Several other airway management strategies have been described. Gangadharan et al[4] reported the largest series of patients who underwent tracheobronchoplasty. An early article from their institution described using a single-lumen endotracheal tube positioned in the left main bronchus, with completion bronchoscopy performed through the retracted endotracheal tube.[5] A subsequent article described modifying a double-lumen endotracheal tube by shaving off the tracheal lumen.[2] Completion bronchoscopy was performed before chest closure to ensure the airway was not narrowed, and any visible sutures were removed to prevent mesh infection.[4] Unfortunately, this latter strategy requires modification of existing equipment to prevent airway distortion. In addition, completion bronchoscopy must be performed with a smaller bronchoscope that will fit in a double-lumen endotracheal tube.

Wright[3] used an extra-long, wire-reinforced, single-lumen endotracheal tube (Fuji Wire Reinforced Endotracheal Tube [WRETT]; Ambu Inc, Columbia, MD) positioned in the left main bronchus. These endotracheal tubes are 40-cm long and have a short cuff, so they can reach and seal in the left main bronchus.[6] While the mesh was sewn to the left main bronchus, the cuff was temporarily deflated and ventilation stopped so that the cuff would not be inadvertently sutured.[3] Completion bronchoscopy was performed through the retracted endotracheal tube.[7] The disadvantage of this approach is that this specialized endotracheal tube may not be readily available at all institutions. In addition, retraction of the endotracheal tube for completion bronchoscopy may lead to accidental extubation. Damle and Mitchell[8] described trying several techniques for airway management before settling on this same approach, although they do not mention using a specialized endotracheal tube.

Lazzaro et al[9] described the largest series of patients who underwent tracheobronchoplasty with a robotic approach, and Tse et al[10] described 2 patients who underwent tracheobronchoplasty with a video-assisted thoracic surgery (VATS) approach. They both described using a double-lumen endotracheal tube. Tse et al[10] described placing the tracheal sutures after deflation of the tracheal cuff and replacing the double-lumen endotracheal tube with a single-lumen tube to perform completion bronchoscopy at the end of the case. Unfortunately, even a small double-lumen endotracheal tube is still larger than a large single-lumen endotracheal tube, causing more airway distortion. In addition, it may be risky to replace the endotracheal tube to perform completion bronchoscopy.

McLaurin et al[11] described the only airway management strategy that allows for continuous left lung ventilation throughout the case; although it is quite complicated. They made a "supertube" by attaching 2 size 6.5 single-lumen endotracheal tubes end to end and positioning it in the left main bronchus. They then placed a 9-French bronchial blocker in the trachea alongside the endotracheal tube. In this configuration, the mesh was sewn to the trachea and right main bronchus. The left lung was ventilated, but only the left lung was protected from aspiration. Then, the supertube was retracted into the trachea, and the bronchial blocker was positioned and inflated in the right main bronchus. In this configuration, the mesh was sewn to the left main bronchus. The left lung was ventilated, and both lungs were protected from aspiration. They found that supertubes made from larger endotracheal tubes, as well as smaller bronchial blockers, were more likely to become dislodged.

This case demonstrated the use of a standard single-lumen endotracheal tube and a Y-shaped bronchial blocker for airway management during tracheobronchoplasty. It is straightforward, and should be considered when managing these patients.

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