One-Lung Ventilation Via Tracheostomy and Left Endobronchial Microlaryngeal Tube

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ONE-LUNG VENTILATION (OLV) can be achieved through several methods when a tracheostomy is present. Chen et al described using a Foley catheter for lung isolation in a patient with a tracheostomy.[1] A commercially available bronchial blocker (BB) often is used for OLV in the setting of a tracheostomy.[2–5] Although they are appropriate for many cases, BBs have disadvantages including technical difficulties related to right bronchial anatomy, frequent dislodgement, limited ability to suction, and slow lung collapse. It is possible to place a double-lumen endotracheal tube (DLT) into a tracheostomy stoma.[6] DLTs avoid many of the problems associated with BBs but require removal of the tracheostomy tube, which, in the case of a recent percutaneous tracheostomy, carries a risk of false passage and failed airway. In this case report, the authors describe a simple and effective method for achieving lung isolation in a patient with a recent percutaneous tracheostomy.

CASE REPORT

A 36-year-old, 98-kg, 158-cm female was admitted to the intensive care unit for necrotizing pneumonia. During her hospitalization, multiple thoracostomy tubes were placed bilaterally for evacuation of bilateral spontaneous pneumothoraces and pleural effusions. The patient could not be weaned from mechanical ventilation, and a percutaneous dilatational tracheostomy (PDT) was performed. Seven days later, the consulting thoracic surgeon scheduled a right thoracotomy and lung decortication. On the day prior to surgery, bleeding was noted around the tracheostomy site.

The patient was transported to the operating room and anesthesia was induced with sevoflurane, fentanyl, and rocuronium. Fiberoptic bronchoscopy through the 7.6-mm ID/12.2-mm OD cuffed tracheostomy tube revealed limited air exchange to the left lower lobe.

Direct laryngoscopy was performed, and the trachea was intubated with a 5.0-mm ID/6.9-mm OD microlaryngeal tube (Mallinckrodt microlaryngeal MLT tube, Covidien LLC, Mansfield, MA). The tracheostomy tube cuff was deflated, and the microlaryngeal tube was advanced gently beyond the tracheostomy tube. The microlaryngeal tube was positioned in the left main bronchus using a hand-held fiberoptic scope (Olympus LF-GP, Olympus America Inc., Center Valley, PA), and the tracheostomy cuff was reinflated. The left endobronchial tube (EBT) was secured, and the cuff was inflated. A double-swivel connector assembly (Sheridan SHER-I-SWIV, Teleflex Medical, Research Triangle Park, NC) was used to connect the tracheostomy tube and EBT to the anesthesia circuit. Because the end of the tracheostomy was some distance from the EBT, a conduit was constructed to connect the double-swivel adapter to the tracheostomy tube (Fig 1).

After the ability to provide selective ventilation was confirmed, the patient was positioned in the left lateral decubitus position and surgery proceeded with excellent lung isolation. During OLV, the patient developed arterial hypoxemia that likely was related to her left lower lobe consolidation. The hypoxemia easily was corrected with continuous positive airway pressure (CPAP) to the right lung. After the operation, the EBT was removed, and the patient was transported back to the intensive care unit in good condition.

DISCUSSION

For a patient with a tracheostomy, OLV usually is managed with a BB or DLT.[5] BBs can be placed through the existing tracheostomy tube, through an endotracheal tube (ETT) placed through the tracheostomy stoma, or by the orotracheal route. DLTs can be placed through the tracheostomy stoma if it is large enough. If the larynx is intact, it is also possible to remove the tracheostomy tube and place a DLT via the orotracheal route.

BBs have a small working channel lumen, which results in a number of disadvantages. As compared to a DLT, a BB results in slower lung collapse, and assisted suction often is required.[7] Although the lumen of the BB can be used for aspiration of gas or application of CPAP, it is too small to effectively handle blood, pus, and secretions. Since it is not possible to adequately suction secretions that accumulate distal to the BB during OLV, the dependent lung can be contaminated by pooled secretions upon cuff deflation.[8] BBs generally are less desirable when right-sided placement is required because of difficulties placing them in the right main bronchus without causing obstruction of the right upper lobe. In addition, right-sided BBs are prone to dislodgement.

DLTs provide rapid lung collapse, result in absolute lung isolation, and allow for bilateral suctioning of blood and secretions. In order to place a DLT, an existing tracheostomy tube must be removed. When considering this maneuver, the potential for complications such as false passage and failed airway must be considered. Fiberoptic guidance during DLT insertion may reduce the likelihood of creating a false passage. Likewise, many physicians will keep a guidewire in the tracheostomy stoma to reduce the risk of false passage during tube reinsertion. These maneuvers are not necessary in the setting of a well-healed surgical tracheostomy. However, a recently-placed PDT probably represents more risk. The most common causes of PDT-related mortality are hemorrhage and airway complications. PDT-related fatalities are commonly within 7 days of the procedure, and dislocation of the tracheal cannula is the most common reason for death due to airway complication.[9]

In the case described, a right-sided BB and left DLT were considered for lung isolation. A BB was considered undesirable because of technical problems related to placement on the right side, problems with dislodgement, and inability to suction pus and thick secretions. Placing a DLT would have required removal of the tracheostomy tube, which the authors considered unsafe because it had been placed recently by the percutaneous dilatation approach, and bleeding had been noted

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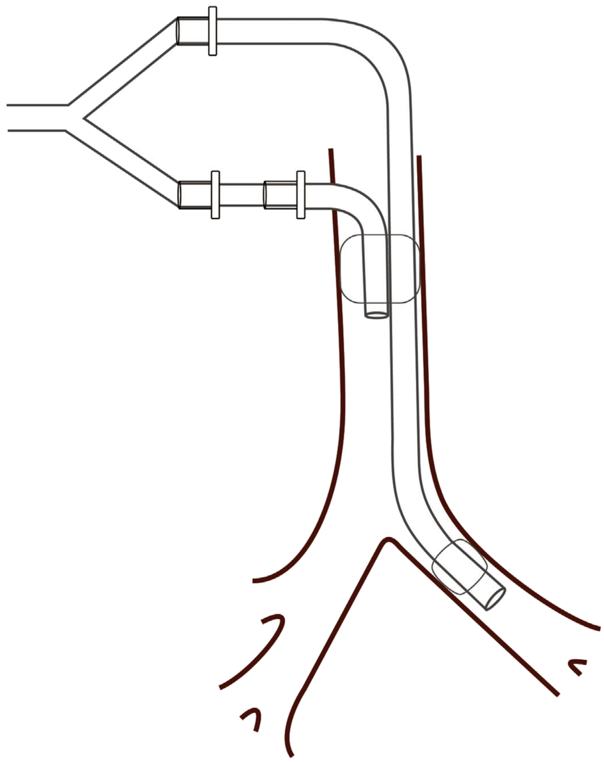

Fig 1. **Line drawing showing double-swivel connector assembly connected to microlaryngeal endotracheal tube in left main bronchus and tracheostomy tube. A conduit connects the double-swivel connector assembly to the tracheostomy tube.**

from the site. Due to the disadvantages of both standard approaches, the authors considered alternative lung isolation strategies.

The authors' novel approach was to leave the tracheostomy tube in situ and orally insert a microlaryngeal tube into the left main bronchus to act as an EBT. A similar lung isolation technique was described by Au et al, who performed double endobronchial intubation with microlaryngeal tubes to manage a patient with a tracheoesophageal fistula near the carina.[10] Using an endobronchial microlaryngeal tube plus a tracheostomy tube for lung isolation is contingent upon the ability of the tracheal cuff to make an adequate seal against the microlaryngeal tube and tracheal wall. In the authors' case, an adequate tracheal seal was obtained easily. Otherwise, they would have been forced to pursue other lung isolation techniques such as a BB.

Table 1. Common Tracheostomy Tubes and Sizes

Brand	Size Number	Inner Diameter (mm)	Outer Diameter (mm)
Shiley	4	5	9.4
	6	6.4	10.8
	8	7.6	12.2
	10	8.9	13.8
Portex	6	6	8.3
	7	7	9.7
	8	8	11
	9	9	12.4
Rusch	7	7	10.8
	8	8	11.8
	9	9	12.8
Biovona	6	6	8.7
	7	7	10
	8	8	11
	9	9	12.3

Table 2. Common Microlaryngeal Tubes and Sizes

Brand	Inner Diameter (mm)	Outer Diameter (mm)	Length (mm)
Rusch	4	6.0	360*
	5	7.3	360*
	6	8.7	360*
Mallinkrodt	4	5.6	368*
	5	6.9	368*
	6	8.2	368*
Sheridan	4	5.8	330
	5	7.1	330
	6	8.5	330
Portex	5	7.2 (reinforced 7.3)	320
P3	4	5.4	368*
	5	6.9	368*
	6	8.2	368*

*Measurement includes endotracheal tube connector; subtract approximately 30 mm for length without connector.

The authors selected a 5.0-ID microlaryngeal ETT for several reasons. This tube accommodates a fiberoptic bronchoscope, and based on imaging studies, this tube was narrow enough to be placed beside the existing tracheostomy tube. A CT scan of the patient's chest at the level of the tracheostomy cuff showed an anterior-posterior tracheal diameter of 23 mm and transverse diameter of 21 mm. Because the combined outer diameter of the tracheostomy tube and microlaryngeal tube was 19.1 mm, the authors reasoned that the patient's trachea would safely accommodate both tubes (Table 1). An ETT that was larger diameter may have put the patient at risk for tracheal perforation, laceration or rupture. The length of the microlaryngeal tube was adequate to serve as a left EBT for this patient, being positioned at approximately 31 cm at the lip. If significantly deeper placement had been required, a longer tube would have been necessary (Table 2).

To summarize, OLV can be challenging when a patient has a tracheostomy. BBs and DLTs are used most commonly in this situation, but both devices have disadvantages. The authors have described a case that was managed successfully using a recent percutaneous tracheostomy tube and a microlaryngeal tube in the left main bronchus. This novel approach did not require removal of the tracheostomy tube and yielded lung isolation equivalent to a DLT. If this lung isolation technique is used, the endobronchial tube must have a sufficiently small diameter to allow for placement beside the tracheostomy tube and be long enough to reach the mainstem bronchus.

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