Management of a difficult Airway in Lung Isolation

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A variety of thoracic surgical procedures, such as lobectomy, pneumonectomy, esophago-gastrectomy, pleural decortication, bullectomy and bronchopulmonary lavage are commonly performed. Customarily they are classified either as absolute or as relative. **THE ABSOLUTE INDICATIONS** include life-threatening complications, such as massive bleeding, sepsis and pus, where the non diseased contra lateral lung, must be protected from contamination. Broncho-pleural and broncho-cutaneous fistulae are absolute indications since they offer a low resistance pathway for the delivered tidal volume during positive pressure ventilation. Giant unilateral bullae may rupture under positive pressure and ventilatory exclusion is mandatory. Finally, during bronchopulmonary lavage for alveolar proteinosis or cystic fibrosis, prevention of the contra lateral lung from drowning is necessary. Video assisted thoracoscopy (VAT) brought to the practice of surgery for diagnostic and therapeutic procedures required a well collapse lung and should be included in the absolute indication for OLV category. **RELATIVE INDICATIONS** which includes lobectomies (particularly right upper), pneumonectomy, and thoracic aortic aneurysm repair, are primarily for surgical exposure. Lower or middle lobectomy and esophageal resection are of lower priority. In practice, the majority of the procedures where DLT is used, are in essence relative indication, and only a small fraction are absolute. The use of OLV for relative indications rely on the surgeon-anesthesiologist practice and preference.

**METHODS OF LUNG SEPARATION** : In the past, bronchial blockers and the single-lumen endobronchial tubes have been utilized to achieve lung isolation. These tubes are seldom used today due to technical obstacle, inability to remove secretions from the non-ventilated lung, and less than satisfactory performance. In modern practice, endobronchial double-lumen tubes (DLTs) are most widely employed. These tubes have a fixed curvature, are without a carinal hook to avoid tracheal laceration, and reduce the likelihood of kinking. The original non-disposable Robertshaw red rubber tubes are presently available in small, medium and large sizes. Numerous manufacturers produce clear disposable PVC Robertshaw design DLTs, which are available in French sizes 35-41. (Mallinckrodt, Rusch, Sheridan). Essentially, they consist of similar features and modify in cuff shape and location. A colored bronchial cuff, commonly blue, permits easy identification by fiberoptic bronchoscopy. The right endobronchial cuff is donut-shaped, and allows the right upper lobe ventilation slot to ride over the right upper lobe orifice. Most authors refrain from using right-sided DLT simply to avoid potential obstacle. A 37Fr DLT can be used in most adult female, while 39 Fr are used in the average adult male. These types of PVC tubes are currently considered the foremost and are most extensively used to obtain lung separation. In recent years, 28 F and 32F DLT’s were introduced for small adults.

**Positioning of Double-Lumen Tubes**: Following intubation the tracheal cuff should be inflated first and equal breath sounds should be confirmed. To ensure from mucosal damage from excessive pressure applied by the bronchial cuff, the cuff is inflated with incremental volume to seal air leaks around the bronchial cuff into the tracheal lumen. Inflation of the bronchial cuff seldom requires more than 2 ml of air. Bilateral breath sounds should be re-checked to confirm that the bronchial cuff is not herniating over to impede the ipsilateral lung ventilation. An important step is to verify that the tip of the bronchial lumen is located in the designated bronchus. One simple way to check is to first clamp the **tracheal lumen** (always at the level of the connector!), observe and auscultate. Usually, inspection will reveal unilateral ascent of the ventilated hemithorax. Following proper auscultation, the bronchial lumen is clamped to ventilate the tracheal lumen. Each time a right-sided DLT is used, appropriate ventilation of the right upper lobe should be ensured. This can be accomplished by careful auscultation over the right upper lung field or more accurately by fiberoptic bronchoscope. When a left-sided DLT is used, the risk of occluding the left upper lobe bronchus by the bronchial tip advanced far into the left main bronchus should be kept in mind. If peak airway pressure is of 20 cm H₂O during two-lung ventilation, for the same tidal volume, that pressure should not exceed 40cm H₂O on OLV.

Perhaps the most important advancement in confirming the proper positioning of DLTs is the introduction of fiberoptic bronchoscopy to clinical practice. It has been recently shown that DLTs, thought to be correctly positioned by inspection and auscultation, subsequent fiberoptic bronchoscopy revealed malposition in 20-48%. The simplest method to evaluate proper positioning of a left sided DLT is bronchoscopy via the tracheal lumen.
The carina is then visualized, while only the proximal edge of the endobronchial cuff should be identified just below the tracheal carina. Herniation of the bronchial cuff over the carina to partially occlude the ipsilateral main bronchus should be excluded. The bronchial blue cuff of the clear disposable PVC DLT is easily visualized, while the non-disposable rubber DLTs contains yellow bronchial cuffs somewhat more difficult to recognize. Bronchoscopy should then be performed via the bronchial lumen to identify the patent left upper lobe orifice. When using a right-sided DLT, the carina is visualized through the tracheal lumen. More importantly, the right upper lobe bronchial orifice must be identified while the bronchoscope is passed through the right upper lobe ventilating slot. This is somewhat complex to accomplish and requires a relatively skilled endoscopist. Several sizes of bronroscope are available for clinical use: 5.6, 4.9, and 3.9 mm of external diameter (Olympus Co.). The 3.9mm-diameter bronchoscope can easily pass through a 37 Fr or larger tube, while it a tight fit through a 35 Fr tube.

An airway may be termed difficult when conventional laryngoscopy reveals a grade III view (just epiglottis) or a grade IV view (just soft palate). Furthermore, depending on the type and the length of surgery, the degree of fluid shift during surgery, an airway that initially was not classified as difficult may become difficult secondary to facial edema, the presence of secretion and laryngeal trauma from the initial intubation. A logical approach to lung separation is described in Figure 1. When the separation of the lung is strictly indicated, use of tubes that are difficult to insert such as DLT or a Univent tube cannot be avoided despite the presence of a difficult airway. If the patient has a recognized difficult airway awake intubation with fiberoptic bronchoscopy (FOB) can be attempted using DLT / Univent /or a SLT. The same approach may be use for the patient with an unrecognized difficult airway and a failure to intubate with conventional laryngoscopy. When using a DLT over a fiberoptic bronchoscope (FB) one should keep in mind that it is a bulky tube with a large external diameter, and because the length of the DLT, only a limited part of the FB is available for manipulation. In addition, the mismatch between the flexibility of the FOB and the rigidity of the DLT make it harder to pass over the FOB. (5) The Univent tube has the same bulky external diameter and is also often hard to pass through the vocal cords particularly in an awake patient. In some cases advancing the bronchial blocker of the Univent tube can serve as an introducer to facilitate the passage through the larynx. Following a successful intubation with a DLT or a Univent tube, OLV can be immediately established. If these difficult tubes cannot be inserted over a FOB, than a SLT should be used to establish an airway.

The use of a tube exchanger: Several tube exchangers are available: (Cook Critical Care, Bloomington, IN.). All of these airway guides are commercially made, are depth marked in centimeters, are available in a wide range of ODs, and are easily adapted for either oxygen insulation or jet ventilation. The airway guide may be used for inserting an SLT, changing an SLT to one of the difficult tubes, or simply inserting a difficult tube. Critical details to keep in mind to maximize benefit and minimize risk of airway guides are as follows: First, the size of the airway guide and the size of the difficult tube must be determined and should be tested in vitro before the use of the airway guide. Second, the airway guide should never be inserted against a resistance; the clinician must always be cognizant of the depth of insertion. Two reported perforations of the tracheobronchial tree have occurred. Third, a jet ventilator should be immediately available in case the new tube does not follow the airway guide into the trachea, and the jet ventilator should be preset at 25 psi by the use of an additional in-line regulator. Finally, when passing any tube over an airway guide, a laryngoscope should be used, to facilitate passage of the tube over the airway guide past supraglottic tissues. Because of the potential injury to the bronchial tree from the stiff tip of the tube exchanger, a new catheter is been designed that have a soft tip to reduce the risk of trauma.

![DLT/Airway Exchange Catheter](image-url)
ENDBRONCHIAL BLOCKERS  Over time, it has become clear that modern thoracic anesthesiologists need an alternative to DLT’s. In the past, Fogarty embolectomy catheters were used to achieve lung isolation. Placement may be difficult, due to its lack of directing mechanism and communication channel in the center; therefore suctioning or oxygen insufflation is unachievable. Finally, due to the high pressure low volume spherical shaped cuff, the elliptic shape of the bronchus is poorly occluded. Today, Fogarty catheters have no use in thoracic anesthesia practice.

In modern thoracic anesthesia, three independent 9F endobronchial blockers (EBB) were introduced to clinical practice. The clinical indications for the use of endobronchial blockers are out line in a recent Pro debate by Cohen. (See table). The Arndt blocker (Arndt, Cook Inc., Bloomington IN). The FB is passed through the loop and guided into the desired bronchus than the BB is slide over the FB into the select bronchus. Bronchoscopic visualization confirms blocker placement and occlusion. The string may than removed and a 1.8mm lumen may be used as a suction port or for oxygen insufflation. In the first generation of this device it was not possible to reinsert the string once it have been pulled out losing the ability to redirect the BB if necessary. A recent modification in the string design overcomes the problem. Finally, the external diameter is somewhat larger which requires a large size SLT (at list 8.0 mm) to be able to accommodate the BB. Te Arndt blocker is available in 7F and in a pediatric size. More recently a new endobronchial blocker has been approved by the FDA for clinical use. The Cohen Flexitip Endobronchial Blocker is designed for use as independent BB through a standard ET with a small 4.0 mm fiberoptic bronchoscope. The most important feature of the blocker is that it uses a flexible soft tip that can be deflected to more than 90 degrees and easily directed into the desired bronchus needed to be blocked. As demonstrated by the figure, the deflection of the tip is achieved by rotation of the wheel that is located at the proximal part of the BB. The blocker cuff is a high volume, low-pressure balloon that have appear shape that provides adequate seal of the bronchus. The blocked contain a lumen (1.6mm) that allow suctioning of the lung to facilitate deflation, a limited suctioning of secretion and insufflation of oxygen to the collapsed lung in case of hypoxia. (Cook Inc., Bloomington Indiana)

**INDICATION FOR THE USE OF ENDBRONCHIAL BLOCKERS**

- Lung isolation Vs Lung Separation
- Video Assisted Thoracoscopy ; Increase the Number of Patients Who Required
- Avoid the Need for Tube Exchange

**The Difficult Airway**
- Patients With a Difficult Airway ( Milampani 3 or 4)
- Patients Post Laryngeal/Pharyngeal surgery
- Patients with Tracheotomy
- Patients with Distorted Bronchial anatomy from aneurysm compression or
- Patients who Requires Nasotracheal Intubation
- Patients with a Immobility or Kyphoscoliosis

**Surgical Procedure Non-Evolving the Lung**
- Esophagaeit surgery
- Spine Surgery that Required Transthoracic Approach
- Minimally Invasive Cardiac Surgery

**Management:**
- VAT procedures where a quick look or simple wedge of chest exploration is
- Possible Segmental blockade in patient intolerable to OLV
- Morbidly obese
- Small size adult or pediatrics
- Patients who requires intraoperative lung isolation
- Patients who arrive intubated to the OR from the ICU

**The need to teach the new generation and for practice for the present generation**

**The Univent Tube**: The Univent tube (Univent, Fuji Systems Corp., Tokyo, Japan) is a novel, relatively new means of achieving bronchial blockade. The bronchial blocker technique has been modified so that the bronchial blocker is passed along a single-lumen endobronchial tube. The bronchial blocker is housed in a small anterior lumen containing a thin (2 mm internal diameter) tube with a distal balloon (blocker tube). The Univent tube has the advantage of using a single lumen tube instead of a DLT, and there no need to change over at the end of the procedure if postoperative ventilatory support is required. It is also possible to suction through the blocker lumen or to apply CPAP to improve oxygenation in case of hypoxia. The disadvantages of the tube are: The enteral diameter is relatively large, the blocker can dislocate during surgical manipulation, and satisfactory bronchial seal and lung separation are sometimes hard to achieve. Finally, like other endobronchial blockers, the relative small diameter of the blocker lumen makes it more difficult to remove secretion, and prolong the time required to achieve a compete deflation of the non-dependent lung. The
new generations TCB Univent (Torque control blocker) are made out of silicone are easier to manipulate to the
selected bronchus. The Univent tube blocker is now available as an independent blocker to be inserted through a
standard ET tube (Uniblocker), which is available in 9F and 5F for pediatric patients.

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