Case Report

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Does the Patient Need Lung Protection or Lung Isolation? A Case Report and Literature Review of One-Lung Ventilation Guidelines

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Abstract

A case report of difficult one-lung ventilation (OLV) during open thoracotomy, followed by a discussion of indications for OLV and a proposed algorithm for selecting an OLV device appropriate for patient needs and surgical goals.

Abbreviated Title

One-Lung Ventilation Device-Selection Guidelines

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Introduction

The indications and management guidelines for one-lung ventilation (OLV) techniques are discussed in numerous texts and journals, yet few recommendations exist that detail specific indications for use of one device over another. The following case and discussion reveal deficiencies in OLV guidelines, and an algorithm is proposed that allows for appropriate OLV device selection based on individual patient needs, as well as surgical and anesthetic strategies of care.

Case Report

A 49-year-old man with a history of hypothyroidism, extensive smoking, and alcohol abuse presented with a month-long history of progressive shortness of breath, exertional dyspnea and pleuritic chest pain. CT scan showed significant right-sided empyema and he was scheduled for decortication by open thoracotomy. After induction the patient was intubated with an 8.0 endotracheal tube (ETT) and a Cook-Arndt bronchial blocker (BB) was subsequently placed under fiberoptic guidance. After lateral positioning the blocker's right mainstem position was again confirmed under fiberoptic visualization and OLV was initiated.

Unfortunately, our patient desaturated to 65% SpO₂ within several minutes of OLV initiation. The decision was made to deflate the

balloon secondary to hemodynamic instability. Recruitment maneuvers initially improved oxygen saturation, but we were soon unable to ventilate when a substantial amount of purulent secretions rapidly filled the endotracheal tube and spilled into the circuit, causing the patient to rapidly desaturate yet again. Due to the inability to adequately oxygenate and ventilate the patient, our next decision was to remove the bronchial blocker in order to properly suction the ETT and recover the patient. Unfortunately, these maneuvers resulted in the protected left lung being exposed to contamination from the diseased right lung. Upon recovery of hemodynamic and ventilatory stability, the ETT was advanced into the left mainstem under fiberoptic guidance to provide OLV, allowing the procedure to continue.

Upon completion of the thoracotomy, the patient was again placed in the supine position and the ETT was withdrawn to 24 cm above the carina. A diagnostic bronchoscopy showed purulent secretions bilaterally. The patient remained intubated and was transported back to the ICU where he developed aspiration pneumonitis. With continued supportive care he was successfully extubated on postoperative day #2 and discharged home on postoperative day #9.

Image 1: The preoperative CT (a) showing empyema and the chest X-ray (b) obtained immediately post-thoracotomy. The bilateral opacifications are a result of contamination of the non-diseased lung during surgery.

Image a

image b

Discussion

Indications for OLV are well-documented in the literature, however there is no formal algorithm or guidance regarding appropriate choice of device. When deciding which device is most appropriate for an individual patient, the initial question for every thoracic case should be, “Does the patient need lung isolation (to optimize the surgical field) or does the patient need lung protection (to protect the healthy lung from the diseased lung)?”

Cases in which lung protection is the priority include many of the absolute indications for OLV, such as contamination from purulence or empyema, hemorrhage, or control of the distribution of ventilation, as with bronchopleural fistulae or bullae to protect the non-diseased lung. Ideally, lung protection is achieved with a double lumen tube (DLT). DLTs provide the anesthesiologist with the capability to suction either lung independently while maintaining isolation, as well as the advantage of maintaining a cuff inflated for

sustained protection (Figure 1). Ultimately, a DLT optimizes the management of a patient on OLV, allowing troubleshooting of challenges such as oxygenation, ventilation, and contamination without compromising the protection of the non-diseased lung.

Figure 1: Sustained lung protection with DLT (a) vs. contamination with BB (b).

A lung isolation strategy is ideal for cases with minimal risk of contaminating the non-diseased lung. Appropriate cases include minimally invasive cardiac surgery, VATS, thoracotomies for lobectomy/lung resection, or esophageal surgery. In these cases, device selection is at the discretion of the anesthesiologist and may include bronchial blockers or DLTs. There is an existing need for an algorithm that focuses on these critical issues when deciding which device to ultimately utilize for airway management during one lung ventilation.

Our institutional algorithm (Figure 2) accounts for the particularities of the patient, procedure, and post-operative management. For example, if the patient is unstable, has a history of difficult intubation, or a pre-existing airway, the ability to place a double lumen tube may be limited. The need for post-operative ventilation should also be taken into account. The cohort of patients with a difficult airway includes patients with limited neck range of motion, small mouth opening, patients undergoing nasotracheal intubation, or history of surgery/radiation for head and neck cancer. We advocate for the use of left-sided DLT when possible, as it has a superior margin of safety for placement.

Figure 2: One-lung ventilation device-selection algorithm.

Adapted from Separation of the two lungs: Double-lumen tubes, endobronchial blockers, and endobronchial single lumen tubes, by Sheinbaum R, Moise O, Hammer GB, Cohen E in Benumof and Hagberg's Airway Management: Principles and Practice, 4th edition. Edited by Hagberg CA (in press). Philadelphia, Elsevier. Adapted with permission.

Intraoperatively, there appears to be little difference in the quality of the surgical field with the use of various bronchial blockers or double lumen tubes. Fiberoptic scopes should be utilized to visually confirm placement of all the devices used for one-lung ventilation. Knowledge of endoscopic bronchial anatomy is a critical component for correct placement, and mastery of fiberoptic technique enhances the ability to recognize, diagnose and intervene if

malposition were to occur.

Conclusion

The need for one-lung ventilation (OLV) exists for a wide variety of surgical procedures, and there is an equally wide variety of OLV devices from which to choose. The development and implementation of an OLV device selection algorithm will assist anesthesiologists in selecting the safest and most appropriate OLV device for their patients' particular needs. Ultimately, the goal of the algorithm is to optimize thoracic surgical conditions while simultaneously affording the patient the maximum protection from exacerbation of their disease process. This algorithm may be especially useful for non-cardiothoracic anesthesiologists.

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