Anesthesia considerations for advanced bronchoscopy: a narrative review

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Background and Objective: Advanced diagnostic and therapeutic bronchoscopy describe an increasingly complex set of pulmonary procedures. With the integration of newer technologies in bronchoscopic procedures, there is a growing necessity for optimal anesthesia strategies to ensure procedural success. This relies on strong partnership between the proceduralist and anesthesiologist. This narrative review delves into the anesthesia approach in different key procedures.

Methods: This narrative review aims to provide a comprehensive synthesis of existing literature on anesthesia considerations in both flexible and rigid bronchoscopy for diagnostic and therapeutic purposes. The authors queried PubMed and EMBASE to identify relevant articles.

Key Content and Findings: Collaboration in decision-making regarding artificial airway selection, medication administration routes and agents, ventilation strategies and patient positioning are paramount to procedure success. These considerations subject to customization based on patient profile, indication and planned procedure.

Conclusions: Flexible and rigid bronchoscopy are an efficient and safe approach for the diagnosis and treatment of pulmonary disease. By utilizing a team-based approach for advanced diagnostic, interventional, and therapeutic procedures the anesthesiologist and proceduralist can increase the safety and potentially the diagnostic yield of advanced procedures. Given that anesthesiologists and bronchoscopists share the same working field, communication is key.

Keywords: Anesthesia; rigid bronchoscopy; whole lung lavage (WLL); peripheral bronchoscopy; bronchoscopic lung volume reduction (BLVR)

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Introduction

Flexible bronchoscopy allows visualization of the upper airway and tracheobronchial tree for diagnostic and therapeutic purposes. An estimated 500,000 bronchoscopic procedures are performed annually in the United States alone (1). A thorough pre-procedure assessment should include the patient's past medical and surgical history including evaluation of cardiac and pulmonary comorbidities, medications, and airway exam. The anesthetic strategy is determined based on these patient factors and the planned procedure. Both the bronchoscopist and the anesthesiologist must agree on the plan, which includes topical anesthesia, regional anesthesia, and intravenous medications as well as strategies for airway management such as nasopharyngeal trumpets, non-invasive ventilation, oral intubation with a laryngeal mask airway

(LMA), endotracheal tube, or rigid bronchoscope and the ventilatory approach to be used. In this narrative review, we will review the medication strategies available for advanced bronchoscopy as well as the anesthetic strategy including the data to support alterations in patient positioning, ventilatory settings such as tidal volume and fractional inspired oxygen, and airway management selection including the use of a rigid bronchoscope of double lumen endotracheal tube. We present this article in accordance with the Narrative Review reporting checklist (available at https://amj.amegroups.com/article/view/10.21037/amj-23-98/rc).

Methods

This narrative review aims to provide a comprehensive synthesis of existing literature on anesthesia considerations for flexible and rigid bronchoscopy. The following section outlines the methods employed for the identification, selection, and analysis of relevant literature.

Literature search strategy

To gather relevant articles for this narrative review, a systematic search was conducted across multiple electronic databases, including PubMed (Medline) and EMBASE. The search strategy employed a combination of keywords, subject headings, and author, with recognized experts in the field to ensure a comprehensive and focused retrieval of literature. The search terms included bronchoscopy AND sedation, bronchoscopy AND medication, navigational bronchoscopy AND peripheral pulmonary lesions, CT-to-body divergence, anesthesia AND navigational bronchoscopy, atelectasis AND navigational bronchoscopy, bronchoscopic lung volume reduction AND anesthesia, pneumothorax AND bronchoscopic lung volume reduction, anesthesia AND whole lung lavage, Abdelmalak AND whole lung lavage, Galway AND bronchoscopy, rigid bronchoscopy AND anesthesia, rigid bronchoscopy AND ventilation, ECMO AND bronchoscopy and were adapted to the requirements and features of each database.

Study selection criteria

The inclusion and exclusion criteria were established to ensure the selection of studies that met the objectives and scope of the review. The following criteria were applied:

(I) Inclusion criteria: (i) articles published in peer-reviewed journals; (ii) studies written in English; (iii) literature published between January 1, 2000 and May 31, 2023, with the exception of articles related to whole lung lavage (WLL) which were not limited by publication date.

(II) Exclusion criteria: (i) non-peer-reviewed article; (ii) studies not written in English; (iii) literature outside the specified time frame; (iv) studies that are not directly relevant to the scope of the review.

Study selection process

Two independent reviewers screened the titles and abstracts of the retrieved articles to assess their relevance to the review objectives. Full-text articles were obtained for potentially relevant studies and further assessed against the inclusion and exclusion criteria.

Quality assessment

The quality of the included studies was assessed to evaluate the strength of evidence and the risk of bias. The quality assessment considered factors such as expertise, study design, methodology, sample size, data analysis, and reporting.

Data analysis and presentation

The findings from the selected studies were thematically analyzed to identify recurring patterns, emerging trends, and areas of consensus or controversy. The results were synthesized and presented in a narrative format.

Limitations

This narrative review has several limitations. Firstly, it relies on the available literature and may not include unpublished or inaccessible sources. Secondly, the review process is susceptible to selection bias, despite efforts to minimize it through rigorous inclusion and exclusion criteria. Lastly, the narrative synthesis may introduce subjectivity in interpreting and summarizing the findings.

Summary

The methods described above were employed to conduct a comprehensive narrative review on the anesthesia considerations for bronchoscopy. By systematically searching and analyzing the literature, this review provides an overview of the current state of knowledge, identifies

Table 1 The search strategy summary

Items	Specification
Date of search	May 1, 2023
Databases and other sources searched	PubMed (Medline) and EMBASE
Search terms used	bronchoscopy AND sedation, bronchoscopy AND medication, navigational bronchoscopy AND peripheral pulmonary lesions, CT-to-body divergence, anesthesia AND navigational bronchoscopy, atelectasis AND navigational bronchoscopy, bronchoscopic lung volume reduction AND anesthesia, pneumothorax AND bronchoscopic lung volume reduction, anesthesia AND whole lung lavage, Abdelmalak AND whole lung lavage, Galway AND bronchoscopy, rigid bronchoscopy AND anesthesia, rigid bronchoscopy AND ventilation, ECMO AND bronchoscopy
Timeframe	January 1, 2000 to May 31, 2023, except whole lung lavage which was September 1977 to April 30, 2023
Inclusion criteria	(I) Articles published in peer-reviewed journals. (II) Studies written in English. (III) Literature published between January of 2000 and May 31, 2023, with the exception of articles related to whole lung lavage which were not limited by publication date
Selection process	Two independent reviewers screened the titles and abstracts
Any additional considerations	Content experts from anesthesiology heavily involved in bronchoscopic procedures and education were also used as search terms, as listed above

gaps, and highlights areas for future research (*Table 1*).

Discussion

Medications

Topical anesthesia, typically with lidocaine, is often used for local anesthesia of the oropharynx or laryngopharynx. This is accomplished via a lidocaine gargle, nebulizer, or atomizer with additional topicalization via the working channel of the bronchoscope during the procedure. The total lidocaine dose must be tracked to avoid toxicity, with 1% lidocaine providing similar procedural satisfaction as higher concentrations however with less toxicity (2). The care team must allow sufficient recovery time post-procedure if lidocaine is used before allowing oral intake given the risk of aspiration (3). Topical anesthesia is often used in conjunction with moderate sedation and may also be used with monitored anesthesia care (MAC) or total intravenous anesthesia (TIVA) when procedures are performed with anesthesia support.

Another anesthesia technique which is less commonly used is regional anesthesia via a superior laryngeal nerve block (more commonly used for the management of chronic cough). Nerve block blunts the cough reflex, which is very sensitive to airway irritation. Potential complications include tracheal injection, arterial/nerve injection, thyroid injection, and hematoma (4). Nearly all anesthesia for bronchoscopy involves the administration of intravenous medications for moderate sedation or deep sedation with an inhaled anesthetic or via TIVA. Consistent with guidelines from the American Society of Anesthesiologists, monitors should always be used (pulse oximeter, electrocardiography (ECG), blood pressure device, and a temperature monitor) (3). Commonly used medications are midazolam, fentanyl, remifentanil, propofol, dexmedetomidine, and ketamine with medications often used in conjunction for sedative-hypnotic effect and for adjuvant effect and analgesia. The most common combination is propofol and fentanyl (5). Neuromuscular blockade may also be used for intubation and longer-acting paralysis may be performed with vecuronium, rocuronium, or cisatracurium depending on the surgical procedure. Unlike inhalational anesthesia with sevoflurane or isoflurane, TIVA offers the advantage of an anesthetic agent that is administered independently of ventilation, which is particularly important in bronchoscopy techniques which utilize an open circuit.

Diagnostic bronchoscopy

Guided bronchoscopy

Advanced guided bronchoscopy is a minimally invasive procedure used to diagnose peripheral pulmonary lesions.

Since the introduction of electromagnetic navigational bronchoscopy platforms in the early 2000s, there has been a rapid emergence of new technology and adjunct tools to aid in peripheral endobronchial navigation (6). However, there is still a significant gap between lesion localization and diagnostic yield, more so in smaller lesions (7). In a recently updated meta-analysis, Nadig et.al reported no significant improvement in the diagnostic yield of guided bronchoscopy in the past decade, with a pooled diagnostic yield of 69% (8).

Regardless of the platform utilized, navigational bronchoscopy—including the new robot-assisted bronchoscopy platforms, relies on the use of a pre-procedural CT scan in virtual airway mapping. However, the virtual target may not always represent the true location of the lesion (9). Reference CT scans are taken at full inspiration, which approximates a respiratory state at total lung capacity. In contrast, lung volumes during bronchoscopy are likely close to tidal volume breathing. The difference between the generated virtual airway map and the actual lung anatomy at the time of the procedure known as CT-to-body divergence (10). To overcome CT-to-body divergence, real-time confirmation of the biopsy tool position in the target lesion has been increasingly used and has shown to improve diagnostic yield of the procedure (11). Unfortunately, the more widely available radial-probe endobronchial ultrasound (RP-EBUS) has significant limitations, including false-positive results due to mimics such as atelectasis and bleeding. The intraprocedural use of cone-beam CT has addressed this challenge. Furthermore, it has led to the discovery of development of atelectasis, which is believed to be a major contributor of CT-to-body divergence in addition to respiratory motion during the procedure (12).

Although atelectasis is a well-known pulmonary complication of general anesthesia, its consequential impact on the actual location of the target lesion has only been recently described. Prior studies have shown that close to 90% of patients who undergo general anesthesia develop atelectasis within minutes of induction, regardless of age, sex or anesthesia used (13). The I-LOCATE trial reported a high incidence of atelectasis in dependent areas in patients who underwent peripheral bronchoscopy. Eighty-nine percent of patients had atelectasis in at least one evaluated segment, and over half of the patients had atelectasis in 5 evaluated segments. The number of affected segments was higher in patients with higher body mass index (BMI) and those who underwent a longer procedure (14). Casal *et al.* noted that recruitment maneuvers such as increasing positive end-expiratory pressure (PEEP) and tidal volumes failed to resolve atelectasis, emphasizing the importance of preventing atelectasis even before it begins to develop (12).

As a result of advanced bronchoscopic techniques and subsequently longer procedure times, there has been a shift towards using general anesthesia (15). The collaboration between anesthesiologists and interventional pulmonologists is therefore crucial in preventing atelectasis and achieving procedural success.

General anesthesia with TIVA as well as paralysis to minimize respiratory motion is used during the guided bronchoscopy. Expeditious intubation (instead of the traditional rapid-sequence intubation) is done to minimize atelectasis (16). The largest endotracheal tube size (typically size 8.5–9.0 mm) suitable to patient's anatomy is then used to allow simultaneous ventilation around the bronchoscope, which ranges in diameter from 5.9 to 6.3 mm). An endotracheal tube is preferred over an LMA as it can accommodate higher airway pressures and therefore larger tidal volumes and higher PEEP. Additionally, using an LMA has a higher risk of gastric insufflation as well as aspiration (15). Although bronchoscopies are typically performed in the supine position, patients may be placed in a lateral decubitus position after intubation with the lobe with the target lesion up. This may be an option for patients with a higher BMI whose target lesions are in the posterior outer one-third of the lung (17).

Pre-oxygenation with 100% FiO_2 prior to intubation is widely accepted and desirable as difficulties with ventilation and intubation may be unpredictable. However, absorption and compression atelectasis are the most common side effect of preoxygenation (18). During normal breathing, the presence of nitrogen in the alveolar space prevents the complete emptying of the lungs as it is poorly soluble. With pre-oxygenation, the rapid washout of nitrogen by O_2 promotes the diffusion of gas from the lungs into the bloodstream and subsequently accelerates the collapse of airways leading to atelectasis (19). In the setting of peripheral bronchoscopy, modest oxygenation with the lowest tolerable FiO_2 is preferred for preoxygenation and throughout the procedure as the patient's oxygen saturation permits (20).

Following intubation, recruitment maneuvers are recommended at plateau pressures of 30–40 cmH_2O to reverse any induction-related atelectasis and to assess hemodynamic tolerance of high airway pressures (20). In a retrospective trial examining a dedicated lung navigation ventilation protocol (LNVP), a pressure control/volume guaranteed strategy was utilized to ensure a mandatory tidal volume while applying minimal pressure. Patients received tidal volumes of 10–12 mL/kg of ideal body weight and PEEP of 10–15 and 15–20 cmH_2O for lesions in the upper/middle lobes and lower lobes respectively (16). Higher PEEP strategies were employed in obese patients given the higher risk of atelectasis with a lower functional residual capacity. In the same study, Bhadra *et al.* reported a significantly lower incidence of dependent atelectasis by cone beam CT (64–68% *vs.* 16–36%, P=0.0001) and a higher diagnostic yield in the LNVP group (70% *vs.* 90%, P=0.08) (16). Allowing a higher PEEP and using higher tidal volumes throughout the procedure will maintain optimal lung inflation in the small airways of peripheral lungs. In a more recent prospective randomized control trial, the VESPA trial employed slightly lower pressures with tidal volumes of 6–8 mL/kg of ideal body weight and PEEP of 8–10 cmH_2O. Results mirror prior studies in with lower incidence of atelectasis in the VESPA group (84.2% *vs.* 28.9%, P<0.0001). Additionally, there were no difference in complication rates between the two groups (21). This may be an alternative strategy to the more aggressive ventilator protocols in prior studies.

Therapeutic bronchoscopy

Bronchoscopic lung volume reduction (BLVR)

BLVR is a procedure performed in selected patients with severe chronic obstructive lung disease characterized by significant emphysema and hyperinflation (22). It has been shown to improve pulmonary function, exercise capacity and quality of life in patients with little to no collateral ventilation (23,24). By decreasing hyperinflation in diseased lung, healthy parenchyma is then able to expand and mechanical ventilatory load on the diaphragm is decreased (25).

Achieving optimal anesthesia and sedation during the procedure is a challenge as the patient should be sufficiently sedated to avoid coughing. However, adequate ventilation must also be maintained to validate the Chartis evaluation for patients undergoing Pulmonx endobronchial valves and to avoid excessive hypercapnia (26). General anesthesia with either an endotracheal tube or supraglottic airway as well as moderate sedation have been well tolerated in previous reports (23,24,27). A recommendation from an expert panel advocate for general anesthesia with endotracheal tube as it offers a more secure airway, better ventilation, shorter procedure time and less distortion during Chartis evaluation (26-28). The addition of topical airway anesthetics and anticholinergics may also reduce coughing and production of secretions (27).

Patients with advanced emphysema who undergo general anesthesia are at increased risk of developing dynamic hyperinflation. Subsequent ventilation-perfusion mismatch and impaired venous return can lead to hypoxemia and hypotension (29). Additionally, manipulation of the bronchoscope in the airway can increase airway resistance and further compromise ventilation. Management should aim to prevent further air trapping and auto-PEEP by using relatively lower tidal volumes, decreasing respiratory rate and decreasing inspiratory to expiratory (I:E) ratio to allow time for a full exhalation (29).

The most common complication of BLVR is a pneumothorax, occurring in 4–34% on patients (22). A possible mechanism that can lead to its development involve the rapid expansion of the ipsilateral nontargeted lobe, which in some cases exceeds its elasticity and causes a bronchopleural fistula. The presence of pleural adhesions may increase the risk of pneumothorax (30). Low *et al.* sought to decrease the rate of absorption atelectasis by decreasing FiO_2 as tolerated by patient's oxygen saturation. The study reported a lower incidence of post-procedure pneumothorax in patients who received a lower FiO_2 (17% *vs.* 83%) (31).

WLL

Pulmonary alveolar proteinosis is a rare lung disease caused by the increased accumulation and impaired clearance of surfactant by alveolar macrophages. This leads to impaired gas exchange and in severe cases respiratory failure. WLL is essentially a large-volume bronchoalveolar lavage that removes the proteinaceous material, thereby restoring effective oxygenation and ventilation and was introduced by Ramirez-Riviera in the 1960s. Initial cases were performed under local, and subsequently under general anesthesia, with a double-lumen endotracheal tube (DLT) in a technique which was published in 1965 (32). The modern technique of WLL was not described until 1994 (33).

WLL for correction of abnormal gas exchange remains the gold standard. WLL involves washing out 1 whole lung at a time either days apart or sequentially in 1 session. It is performed under general anesthesia with one lung ventilation (OLV). In cases where a double-lumen tube cannot be placed, lung isolation can be achieved using an endobronchial blocker or with two cuffed tracheal tubes connected to the angled and Y-connectors from a standard DLT set (34). The volume of saline used for WLL generally about 10 to 15 L and can be up to two to three times that per lung (35).

OLV for WLL is more complex than when used for thoracic procedures given the risk of spillage, inability to ventilate the contralateral lung if hypoxemia occurs, and the presence of bilateral lung disease (36). A left-sided DLT is frequently selected. Right-sided DLT is more technically challenging to place and also blocks the right upper lobe takeoff. Proper placement of the DLT should be verified bronchoscopically (35).

Most centers prefer to treat the more diseased lung (determined by chest imaging) first. After ensuring a sealed circuit and toleration of single lung ventilation, a degassing procedure prior to initial lavage may be performed to create a more homogeneous distribution of fluid. Forced lung deflation with negative airway pressure after 100% oxygen ventilation followed by airway occlusion for ten to fifteen minutes to complete absorptive atelectasis effectively degasses the target lung. The healthier lung then instilled with warmed normal saline in 0.5 to 1 L aliquots. Warm saline is used to avoid inducing hypothermia (37).

The total lavage fluid recovered is continuously monitored to assess for spillage and lavage continues until the returned fluid is essentially clear. The patient is then allowed to ventilate with both lungs. A bronchoscopy is performed and any remaining fluid not drained by gravity is suctioned from tracheobronchial tree. The second lung may be lavaged during the same procedure or days later. Performing a lavage on the second lung in the same anesthetic event is more challenging because the lung has poor compliance and impaired ventilatory exchange. If the second lung is lavaged sequentially, Smith *et al.* recommend suction of the lavaged lung followed by lung recruitment maneuvers before proceeding with lavage on the contralateral lung (38).

At the end of the procedure, the DLT is changed to a single lumen tube as most patients are not extubated in the operating room. An airway exchange catheter should be used to accomplish this step as reintubation is made more challenging by the presence of residual lavage fluid and proteinaceous material resulting in a frothy airway (35).

Patient positioning during WLL is guided by operator experience and institutional preference with potential advantages to both supine and lateral decubitus positioning. A fully lateral position reduces the risk of spillage. A fully supine position reduces the risk of DLT displacement. An alternating lateral decubitus position may also be used which relies on gravity to assist with instillation and avoid spillage and then following rotation may assist with more effective drainage. Positioning may also be used in the event of hypoxemia, after fluid spillage and hydropneumothorax have been ruled out. By placing the lavaged lung up, the dependent lung's perfusion is increased thereby reducing pulmonary shunting and improving gas exchange (39).

Rigid bronchoscopy

Gustav Killian first described rigid bronchoscopy for therapeutic airway indications in Germany in 1895, using a rigid bronchoscope to remove a pork bone from the bronchus of a farmer. At the same time, Chevalier Jackson was developing the foundations for the modern rigid bronchoscope with the development of an endoscope with a small light at the distal end (40). This paved the way for the endobronchial treatment of tuberculosis and airway tumors and was the foundation of the airway interventions performed in the current era of rigid bronchoscopy. Rigid bronchoscopy remains an important technique for the management of central airway obstruction, foreign body aspiration and massive hemoptysis a century later.

Multiple rigid bronchoscopes are commercially available but none have significantly changed from the equipment developed by Jackson (41). The rigid bronchoscope is a straight, hollow stainless-steel tube. At the proximal end of the bronchoscope, there is a central opening and side ports which allow for the connection of jet ventilation or conventional ventilation devices, an optical port, and instrument ports for suction or laser fibers. Slits in the distal aspect of the rigid bronchoscope allow contralateral ventilation during intubation of a main bronchus, a feature which is unnecessary in the shorter tracheoscope.

Anesthesia for rigid bronchoscopy presents a unique challenge as the bronchoscopist and anesthesiologist share what is often an airway significantly compromised by the underlying disease. The procedure is performed with general anesthesia with or without neuromuscular blockade. Although a balanced anesthetic technique with short-acting neuromuscular blocking agents may be more desirable to decrease anesthetic dose, minimize airway injury, reduce cardiovascular side effects. Ventilation is achieved with spontaneous ventilation with manual assistance, jet ventilation, inhalation ventilation, or mechanical ventilation. In patients with airway obstruction, jet ventilation risks barotrauma as the expiratory phase is limited. Ventilation through the rigid scope can be challenging, as the distal end of the rigid tracheoscope or bronchoscope has no balloon to seal the airway and may result in significant leak. A semiclosed circuit can be achieved by placing silicone caps on the multifunctional head and packing the oropharynx with moist gauze and occlusion of the nostrils (42). While this reduces the leak, end tidal CO_2 and tidal volume monitoring may not be accurate.

The ventilation mode is typically determined by the experience and comfort level of the anesthesiologist and bronchoscopist. The most commonly chosen ventilation mode is the controlled mode (42). However, due to a leak, the ventilator bellows will commonly collapse which prompts the activation of the intermittent oxygen flush and the anesthesiologist may need to hand ventilate when a large leak is present. A simple, self-inflating bag (e.g., Ambu) is far more effective than a typical "anesthesia" ventilator at compensating for a circuit leak. The elasticity of the self-inflating bag rapidly recharges the reservoir for delivery of the next breath (43). A significant downside of this system is that it does not allow for control of FiO_2, which is important in airway cases using heat-based therapies. Some institutions use jet ventilation via the rigid bronchoscope as their preferred ventilation mode. Common complications of jet ventilation include hypercarbia, hypoxia and hypotension. Associated risk factors include baseline oxygen saturation of <95% on room air, American Society of Anesthesiologist (ASA) score of IV, obesity and restrictive lung disease (43). Barotrauma-associated injuries including pneumothorax, pneumomediastinum and subcutaneous emphysema may occur. Measures to ameliorate these complications include keeping the expiratory pathway of the rigid barrel unobstructed and limiting inspiratory duration to 30–40% of respiratory cycle. If jet ventilation is used, adequacy of ventilation is assessed by sufficient chest rise and continuous transcutaneous CO_2 measurement (44).

Neuromuscular blockade must be reversed prior to emergence from rigid bronchoscopy due to the limited respiratory reserve in patients requiring therapeutic airway interventions (3). The oropharynx is suctioned before the rigid scope is withdrawn, and after oral packing is removed if it is used. Once the rigid bronchoscope is withdrawn, a LMA or endotracheal tube may be placed, or the patient may be manually mask ventilated until breathing spontaneously. The artificial airway is removed when the patient shows adequate signs of sufficient spontaneous ventilation, muscle strength, and level of consciousness (42).

Extracorporeal membrane oxygenation (ECMO)

In rare cases, short-term ECMO may be used as a bridge to provide support until a therapeutic intervention can be performed. In these cases, ECMO avoids a "can't ventilate, can't oxygenate" scenario. ECMO may be used for high-risk critical central airway obstruction and as salvage for life threatening hemoptysis. Given the infrequency of these cases, the data is currently limited to case series. In one such series, Park *et al.* describe the use of veno-venous ECMO in patients with critical airway obstruction (45). In this series of high-risk procedures, all patients were able to be weaned from ECMO. The complications noted in this series were not related to the bronchoscopic procedure, however, 12% of patients did have complications related to their cannula.

ECMO is infrequently viewed as a means of support in life-threatening hemoptysis given concerns about the need for systemic anticoagulation. Recently, heparin-coated circuits and oxygen membranes have been developed. Heparin-free ECMO use has been described in case reports with both short term and more prolonged applications in thoracic trauma or traumatic brain injury. Ryu *et al.* describe its short-term use in a patient with significant chest trauma requiring surgical repair (46). The decision to utilize ECMO as a bridge to intervention requires significant collaboration, often involving the proceduralist, anesthesiologist, cardiothoracic surgeon, and perfusionist as dictated by the institutional practice.

Conclusions

Flexible and rigid bronchoscopy has been demonstrated to be an efficient and safe strategy for the diagnosis and treatment of pulmonary disease. Using a team-based approach for advanced diagnostic, interventional, and therapeutic procedures the anesthesiologist and bronchoscopist can increase the safety and potentially the diagnostic yield of advanced procedures. Communication should relate to patient positioning, artificial airway choice or alternative means of support, ventilatory strategy including the FiO_2, tidal volume, and PEEP, and any anticipated challenges for the patient recovery. Given that the anesthesiologist and bronchoscopist share the working field, constant communication is needed.

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