FLEXIBLE BRONCHOSCOPY

Surgical Specialty:	Pulmonology
Authors:	Jacob Heninger, DO, and Anthony Tantoco, M.D., Ann and Robert H. Lurie Children's Hospital of Chicago, Chicago, IL

Background:

- General Considerations
  - During a flexible bronchoscopy, the proceduralist inserts a flexible video bronchoscope through the patient's mouth or nares to visualize the upper and lower airway. A saline lavage is often performed potentially worsening the patient's respiratory status.
  - Common indications for this procedure include evaluation of stridor, pulmonary aspiration, dysphagia, dysphonia, croup, recurrent pneumonia, or removal of aspirated foreign bodies.
    - It may be performed in conjunction with an esophagogastroduodenoscopy (EGD), direct laryngoscopy/rigid bronchoscopy, and or chest CT as part of a multidisciplinary workup of aerodigestive disorders.
- Patient Considerations
  - Associated Comorbidities/Syndromes
    - Younger children typically present with stridor, choking, dysphagia caused by a congenital anomaly.
    - Older children, especially patients with cystic fibrosis, present more often for evaluation of pneumonia.

Anesthetic Planning:

- Pre-Anesthetic Evaluation
  - Conduct a thorough pre-anesthetic evaluation, often in conjunction with the multi-disciplinary aerodigestive team to identify and optimize the patient's medical conditions.
    - Evaluate baseline respiratory status and oxygen requirements.
  - Discussions to have with surgeon/family
    - Discuss the likelihood of worsening respiratory status and expected disposition after the procedure.
- Specific or Unique Room Set-Up Requirements
  - Airway
    - Supraglottic airway (SGA): this device is often preferred for flexible bronchoscopy as it provides a conduit for the flexible bronchoscope and allows for dynamic examination of the airways during spontaneous

ventilation. However, this device may not be ideal in patients with underlying lung pathology with high positive end-expiratory pressure (PEEP) requirements, poor pulmonary toilet, or patients with full stomach considerations[1,2]
        - Endotracheal tube (ETT): Patients with tenuous respiratory status may require flexibile bronchoscopy through an ETT to maintain adequate oxygen saturations. However, this is commonly limited by patient size and whether the ETT will allow the passage of the bronchoscope while also providing adequate oxygenation and ventilation.
    - Drugs/Infusions
        - Steroids
            - Dexamethasone 0.5 mg/kg (10-12 mg maximal dose)
        - Inhaled beta-agonist
            - Preoperative nebulizer or intraoperative administration for bronchospasm.
        - Racemic epinephrine
            - Consider for emergence or in recovery in the setting of stridor.
                - Patients receiving racemic epinephrine require extended monitoring in the recovery room to ensure respiratory compromise does not recur as the medication effect wanes.
        - Lidocaine
            - Sprayed on the vocal cords and carina to minimize laryngospasm risk and coughing, respectively.
        - PONV & emergence delirium prophylaxis
            - Ondansetron and dexmedetomidine
        - Many options for maintenance (institutional practice varies greatly)
    - Monitors
        - Standard American Society of Anesthesiologists monitors
        - $EtCO_2$ is potentially unreliable when using a swivel adapter.
            - Focus attention on chest movement and pulse oximetry .
            - Monitor for apnea (absent chest rise) and light anesthesia (paradoxical chest movement, increase in HR, laryngospasm).
    - Blood Availability
        - Usually not required.
    - PICU Bed Availability
        - May be required depending on the patient's condition.
        - Airway edema is a concern.
        - Respiratory status often worsens following the procedure due to saline lavage and underlying pulmonary disease.

Intraoperative Considerations:

- General
    - Ensure adequate depth of anesthesia to tolerate airway stimulation.
    - Discuss with proceduralist whether spontaneous ventilation and evaluation of the larynx is requested (i.e., SGA vs. ETT as airway device)
    - Children can tolerate significant periods of hypercapnia.[3]
    - Be aware of the risk of air trapping and tension pneumothorax.
- Induction
    - Typically inhalation induction to maintain spontaneous ventilation
- Positioning

    - Supine position. The bed may be turned 90 degrees.
- Maintenance
    - Sevoflurane delivery to the patient is inconsistent when the airway is obstructed by a bronchoscope and may leak around the swivel adaptor. This may make it difficult for older children/teenagers to be maintained on volatile agents alone. Intravenous boluses/infusions of propofol, short-acting opioids, dexmedetomidine, ketamine, may be used to maintain an adequate anesthetic depth.
- Hemodynamic/Physiologic goals
    - Adequate oxygenation and ventilation in light of a stimulating airway procedure.
    - Monitor for laryngospasm, bronchospasm, and airway edema.
- Surgical Considerations
    - The patient's head may be turned sideways to facilitate the entry of the bronchoscope into either bronchi.
    - There is a potential for injury to teeth/lips.
    - Local anesthetic is administered through the working channel of the flexible scope to anesthetize the carina (calculate maximum dose)
    - Saline bronchoalveolar lavage is performed and may lead to patient coughing, bronchospasm, and acute worsening of respiratory status.
    - A prolonged procedure may cause significant airway edema.
    - Subacute bacterial endocarditis prophylaxis is not required for BAL.[4]
- Emergence/Disposition
    - Awake vs deep extubation
        - Varies by institution, clinician preference and patient characteristics.
    - PICU level care may be needed in the setting of severe bronchospasm, airway edema, irritating foreign body, and need for postoperative ventilation.
- Post-op Care
    - Postoperative pain is usually mild
    - Key issues are related to airway reactivity and swelling
    - Nebulized racemic epinephrine can be given for stridor
    - Be prepared to reintubate the trachea.

Case-Specific Complications/Pitfalls

- Airway foreign body
    - See separate SPA case guide on this topic for more detailed considerations
    - Risk of total airway obstruction
        - Push the foreign body into either mainstem bronchus to relieve a complete tracheal blockage.
- Laryngospasm
    - Occurs during planes of light anesthesia and airway stimulation.
    - Recognize and treat promptly with increasing depth of anesthesia, jaw thrust, continuous positive airway pressure and succinylcholine administration.
- Bronchospasm
    - Increase sevoflurane (bronchodilator) as hemodynamically tolerated or ketamine if appropriate.
    - Albuterol’s effectiveness may be limited
    - IV Epinephrine 1 mcg/kg
        - Have a low threshold to administer
- Airway edema
    - Prophylaxis with dexamethasone.

  - Racemic epinephrine on emergence.
- Pulmonary hypertensive crisis
  - Hypoxia, hypercarbia, and acidosis increase pulmonary vascular resistance
  - Patients with pre-existing pulmonary hypertension and congenital cardiac disease may not tolerate transient hypercarbia associated with ineffective ventilation during the bronchoscopy.

References

1. Collins, C. Anesthesia for Pediatric Airway Surgery: Recommendations and review from a Pediatric Referral Center. Anesthesiology Clinics. 2010. Vol 28 (3), 505-517. PubMed Link
2. Badr, A., Tobias, J.D., Rasmussen, G.E., Stokes, D.C. and Neblett, W.W., III (1996), Bronchoscopic airway evaluation facilitated by the laryngeal mask airway in pediatric patients. Pediatr. Pulmonol., 21: 57-61. PubMed Link
3. Riva T, Pedersen TH, Seiler S, et al. Transnasal humidified rapid insufflation ventilatory exchange for oxygenation of children during apnea: a prospective randomized controlled trial. Br J Anaesth. 2018; 120:592-599. PubMed Link
4. Schramm D, Freitag N, Nicolai T, et al. Pediatric Airway Endoscopy: Recommendations of the Society for Pediatric Pneumology. Respiration. 2021;100(11):1128-1145. doi:10.1159/000517125 PubMed Link

---

Reviewed by:

Reviewer #1: Kamie Yang, MD, University of Michigan

Reviewer #2: Priti G. Dalal, MD, FRCA, Penn State Health Children's Hospital

Reviewer #3: Marla Ferschl, MD, University of California- San Francisco

---

Created: 7/8/22; Last revised: 10/16/22