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Difficult Case
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Panel Discussion

Considerations for Tracheal Resection

Objectives

At the conclusion of this session, the participant will be able to:

1. Describe the surgical anatomy and methods of upper (tracheal) and lower (carinal) airway resection and reconstruction
2. Discuss anesthetic challenges, including preoperative assessment, airway management, endotracheal and endobronchial tube choice and intubation, modes of ventilation, emergence and post-anesthesia care management

Difficult Case

A 32-year-old female with poorly controlled IDDM presents with several months of progressive stridor and dyspnea. She had been first treated for adult onset asthma without effect. A chest CT showed severe tracheal narrowing. The patient underwent a flexible and rigid bronchoscopy with general anesthesia. Bronchoscopy showed normal subglottic opening, normal vocal cords and a discrete tight tracheal stenosis with an appearance of a mature scar at approximately 4 cm below the carina. Past medical history is significant for morbid obesity (156 cm and 118kg) and an episode of sepsis, respiratory failure from a perforated diverticulitis, which required ICU admission and intubation. Current medications are prednisone, insulin, Combivent and Advair. Tracheal resection and reconstruction was scheduled.

Tracheal resection is most often performed for postintubation stenosis or tumor resection. Risk factors for postintubation stenosis include duration of intubation, ETT cuff overinflation, ETT repetitive movement, hypotension, infection and comorbid conditions (diabetes). Other indications for stenosis include congenital lesions, infectious/inflammatory pathology. Postintubation Tracheal Stenosis is an iatrogenic lesion caused by cicatricial healing of an area of transmural injury to the airway. Etiologically intubation of the airway resulting in local ischemia or necrosis and subsequent stenosis during the phase of healing by secondary intention and has an incidence up to 20%. It is caused by the cuff of the endotracheal tube or pressure from the rigid endotracheal or tracheostomy tube. As the blood supply of the trachea is segmental, blood vessels perforate the tracheal wall at each interannular space and arborize the submucosa compression of the submucosa can thus cause regional ischemia of the cartilaginous ring. Ventilated patients have frequently decreased systemic

perfusion pressure, which can be a contributing factor. With the removal of the tube healing by secondary intention leads to cicatrization and local stricture, typically in 3-6 weeks. New more compliant, D-shaped, high-volume, low-pressure cuffs have been shown to greatly reduce the incidence of airway injury. In addition it has become the standard of care to routinely monitor intracuff pressure and maintain it below 30 mmHg, or as low as needed to create an adequate seal for ventilation.

Anesthetic setup and considerations

Typical monitoring includes standard ASA monitors but reliable pulse oximetry is particularly important. An intra-arterial catheter is useful for continuous blood pressure monitoring and for additional periodic monitoring of oxygenation and CO₂ retention. Since the innominate artery lies anterior to the trachea, a left arm or femoral cannulation is desired to avoid conflicting readings from compression or ligation of the artery.

Required Anesthesia equipment

- Anesthesia machine capable of delivering 20 L/min O₂
- ETT: size 4mm uncuffed to 8 cuffed, flexible armored tubes (sterile and unsterile various sizes), extra-long ETTs (customized or standardized)
- High frequent positive pressure ventilator – optional
- Automated jet ventilator or type of manual jet ventilation capabilities (high frequency and low frequency) with catheters
- Extra anesthesia circuits - sterile
- Second anesthesia machine
- Fluid warmer
- Warming blanket
- NG tube

Central line access is typically not indicated unless mandated by the patient's history. Neck and chest access may not be ideal sites for central line access. Reliable IV access is necessary with typically two peripheral IVs, one in each arm. A decision-making algorithm is helpful in determining anesthetic management with open communication between the surgeon and anesthesiologist.

Anesthesia Induction

Premedication and induction needs to take into consideration the extent of tracheal stenosis. Preoperative sedation should be managed carefully to avoid total airway obstruction. This might be best avoided until the patient is in the operating room with preparation made for induction. Non-particulate antacids and metoclopramide and histamine-2 blockers should be administered in patients with reflux. However not administering anti-sialagogues can be considered as they may create thickening of secretions and form mucus plugs causing further obstruction. Proper positioning of the

head and neck extension with shoulder elevation are critical for manipulation of the airway with rigid bronchoscopy. The eyes should be properly protected. If an awake examination or intubation is required, topical anesthesia minimizes the response to instrumentation. Structures anesthetized include the tongue, posterior pharynx, epiglottis, glottis, and infraglottic airway. The major nerves of the airway are branches of the trigeminal nerve and glossopharyngeal nerve, superior laryngeal nerve, and recurrent laryngeal nerve. Nebulized 4% lidocaine usually provides topical anesthesia for most of these structures. More intense block to the tongue, pharynx, and superior epiglottis occurs with intraoral glossopharyngeal nerve block and superior laryngeal nerve block. Topical anesthesia to the lower airway can be accomplished with transtracheal block, spray injection via fiberoptic bronchoscope or inhalation of nebulized local anesthetic. Medications for IV sedation include judicious use of benzodiazepines, dexmedetomidine, propofol and opioids such as remifentanyl. If an awake intubation is needed, induction of anesthesia is avoided until an airway (ETT) has passed the obstruction or if the obstruction is unlikely based on direct visualization. Less severe obstructions allow for an inhalational induction typically with sevoflurane with the patient spontaneously breathing. This is performed after aggressive denitrogenation with 100% oxygen for 5 minutes or more. If ventilation is compromised the patient is awakened. Placement of an LMA for flexible bronchoscopy can be performed or the anesthetic may be deepened to allow rigid bronchoscopy without paralysis. Blood pressure support may be with a vasopressor. An LMA can be placed to facilitate oxygenation and ventilation during bronchoscopic evaluation and treatment of proximal lesions (balloon dilatation). Regardless of the mode of induction, a physician or surgeon adept at rigid bronchoscopy must be available to control the airway. Once the obstruction is examined by rigid bronchoscopy and selective dilation is performed a more secure airway is established. If the obstruction is proximal to the carina, an ETT is placed with the tip above the lesion. In high lesions a small ETT is placed through the narrowing. In minimal airway compromise, IV induction after pre-oxygenation may be appropriate. Once the airway is controlled beyond the obstruction and positive pressure ventilation is adequate, neuromuscular blockers may be given. Cardiopulmonary bypass or extracorporeal membrane oxygenation have been used prophylactically or during airway catastrophes. Proper planning must be performed for potential cannulation strategies.

Emergence and Extubation

Rapid extubation is always the primary goal to avoid anastomotic failure from mechanical positive pressure ventilation. Complete reversal of neuromuscular blockade is critical. During extubation it is important to minimize coughing, gagging, and neck extension. Cervical flexion is desired as it allows for maximum amount of approximation of the trachea. The surgeon will place a guardian stitch to prevent head and neck extension. Additionally pillows placed behind the head support neck flexion. Anxiolysis upon emergence may be combated with dexmedetomidine, or low doses of propofol or remifentanyl, and allows for a smooth transition and cooperative patient. Criteria for extubation must be met with the patient following commands. If controlled ventilation

must be continued, repositioning of the ETT cuff distal to the anastomotic site is desirable. If extubation is delayed, spontaneous ventilation is the desired ventilator mode. Pain management can be performed with minimizing the use of opioid narcotics. Analgesics that do not depress respiration such as acetaminophen, ketamine, and ketorolac are considered good alternatives. Oxygen via mask should be provided immediately after extubation. Phonation is elicited to determine potential laryngeal nerve damage. If reintubation is required, minimizing head extension is important to prevent tension on the anastomosis. The most ideal method of reintubation is with oral or nasal fiberoptic bronchoscopy. Typically an uncuffed ETT is reasonable to minimize contact with the anastomosis. Cuffed ETTs should be positioned with the cuff distal to the anastomosis. During reintubation, examination of the anastomotic site is performed and vocal cord dysfunction can be identified.