TRACHEAL RESECTION AND RECONSTRUCTION

Moderators: Kristin Richards M.D., Neha Patel M.D.

Institution: Children’s Hospital Los Angeles/USC

Objectives:

- Discuss preoperative evaluation and preparation for patients who have tracheal stenosis
- Discuss different airway management techniques for patients going for tracheal reconstruction
- Describe anesthetic challenges associated with surgery for tracheal reconstruction
- Identify the postoperative complications and prognosis of patients after tracheal surgery
- Discuss new techniques in tracheal reconstruction and anesthetic implications

Case history:

A 15 year old, 108 kg, presents for bronchoscopy with possible tracheal resection and reconstruction. He has a history of morbid obesity and depression.

He had a recent suicide attempt that resulted in presumed tracheal stenosis after a traumatic intubation. There is no history of asthma, rhino-sinusitis, vasculitis, connective tissue disease or irradiation. He denies any possibility of inhalational injury. He also has a history of bipolar disorder and anxiety.

Questions:

What are common causes of tracheal stenosis? What other information would you like? What co-existing medical problems are you concerned about? If this patient is chronically on steroids would your management of this patient change? How about if he had severe reflux?

Case history and physical examination (continued):

Physical examination: obese male with a cough, expiratory stridor and dyspnea with supine positioning, Vital signs: HR 90, BP 165/75, RR 40, Oxygen saturation 92% on 2L nasal cannula oxygen. He has a large tongue and thick neck. (Mallampati score: III).

Questions:

What other information would you like to know? What imaging would you request prior to the procedure? Is a CXR sufficient? CT scan? Flexible bronchoscopy? Would PFTs be
of benefit? What would you expect of the flow volume loop? Could innominate artery compression be a cause of his stridor? Is a room air blood gas necessary?

Preoperative studies:

A CT demonstrated tracheal stenosis 4 cm long with the narrowest portion of the trachea being 0.5 cm. His echocardiogram had moderate concentric left ventricular hypertrophy. ABG was remarkable for hypocarbia. PFTs were not available and bedside flexible laryngoscopy demonstrated proximal tracheal stenosis.

Questions:

Would you delay surgery for PFTs? What do you think about the hypocarbia? If he were hypercarbic would you more concerned? Why would this patient have LVH? Are there any other studies desired prior to proceeding to surgery? Would you like a sleep study? EKG? Can you further optimize this patient?

Intra-operative care:

What equipment would you have ready prior in the operating room? Rigid bronchoscope? ECMO? Cardiopulmonary bypass? What would be your anesthetic plan? Would you sedate him preoperatively? Is he a candidate for an awake intubation? Would you give muscle relaxant?

You have the operating room prepared with emergency airway equipment including different sizes of endotracheal tubes, an LMA and flexible and rigid bronchoscopes. The surgeon is in the operating room but ECMO is not set up.

Standard monitors are placed and the patient is given a lidocaine nebulizer treatment and undergoes airway topicalization but does not cooperate with an awake intubation. Due to this patients severe anxiety you sedate with dexmedetomidine. Would you perform any airway blocks? Which ones would be of benefit to anesthetize the mouth the oropharynx? Would a glossopharyngel nerve block be of benefit in obliterating the gag reflex?

Ketamine is added for additional sedation for the bronchoscopy and a 5.0 uncuffed ETT is placed 1 cm past the vocal cords.

Current vitals: HR 80, BP 165/75, RR 40, Oxygen saturation 90% at the time of ETT placement.

How can airway management be optimized in this scenario? Would a tracheostomy be of benefit at this time? Would you administer muscle relaxant at this time? Place an arterial line?
The surgeons decide to proceed with tracheal resection and reconstruction. The groin is prepped into the surgical field with a bypass machine now available in the operating room, should the need arise.

Any concerns with inhalational agent for this portion of the procedure? Is there a role for jet ventilation?

The patient is maintained on dexmedetomidine, propofol and remifentanil infusions. Inhalation agent is not used as the airway will be opened for portions of the case. The case commences without event and then abruptly end tidal CO2 is lost.

What should be the first step in management? The surgeon confirms he has made no change in the surgical field. All connections on the CO2 sampling line are tight.

Current vitals: HR 70, BP 135/75, oxygen saturation 88% and the patient is now on 100% FiO2.

What is your first step in management? Auscultate? Suction? Albuterol? Laryngoscopy? A direct laryngoscopy is done and the ETT is above the vocal cords. It is advanced back into position and ventilation resumes. If this had been due to a disconnect, what would be the first monitor to alarm?

The surgeon announces that he is opening the airway to begin the resection, are any changes indicated in the anesthetic management at this time? The patient has been on room air since the ETT was re-advanced. The airway is opened and an endotracheal tube is placed directly into the trachea by the surgeon and the oral tube is removed. Would you administer muscle relaxant now, if you have not yet done so?

The procedure continues without event and the patient tolerates the remainder of the procedure well.

What are the benefits to early extubation in this patient? Are there benefits to spontaneous ventilation postoperatively? Is a post procedure bronchoscopy of value? What are your postoperative concerns? Does this patient need ICU or is PACU appropriate?

He is extubated in the operating room and transported to ICU on facemask O2.

**Discussion:**

The anesthetic management of a tracheal resection and reconstruction procedure can be complicated for multiple reasons. First, there are unavoidable episodes of ventilatory insufficiency. Secondly, ensuring adequate gas exchange with an open trachea in the surgical field and lastly, tailoring the anesthetic plan for extubation at the conclusion, of
an often times prolonged, procedure all complicate the management of these cases. Communication between the anesthesia and surgical teams is crucial.

The etiology of tracheal stenosis includes both congenital and acquired causes. Tumors, intubation, vascular lesions, penetrating or blunt trauma, infections such as tuberculosis, autoimmune disorders such as sarcoid, Wegener’s granulomatosis, amyloidosis are all potential causes. Additionally, tracheal stenosis may also develop after radiation therapy to the neck or chest.

The site of the stenosis can vary depending on whether the patient is intubated orally, nasally or has a tracheostomy tube in place.

These patients present clinically with non-specific symptoms such as wheezing, hoarseness, coughing or chest congestion and this can often time delay the diagnosis as they are diagnosed with viral illnesses or asthma initially. As the airway narrows, dyspnea on effort is noted. Severe degrees of obstruction may occur before the clinical symptoms become obvious. Ultimately, these patients develop progressive exercise intolerance, stridor, persistent cough, recurrent pneumonia and even cyanosis. Stridor at rest usually occurs when the tracheal diameter is less than 6-7 mm in the adult patient.

Classically, an upper tracheal obstruction that is extrathoracic will present with inspiratory stridor and a low intrathoracic stenosis with expiratory wheezing. As the airway becomes more narrow it becomes more difficult to clear secretions and mucous plugs can occur resulting in episodes of worsened obstruction. These episodes of transient obstruction usually imply tracheal diameter less than 5 mm in diameter.

CT and is helpful in defining the exact location of the lesion but bronchoscopy is the gold standard. Fluoroscopy is beneficial to assess glottic function and detect tracheomalacia. Pulmonary function tests can be helpful to differentiate intrathoracic vs extrathoracic obstruction.

Once tracheal stenosis is confirmed the goal is to determine the location and extent of the lesion.

Preoperative sedation should be carefully considered prior to administration. Preparation is key during this type of procedure.

Anesthetic management techniques include:
1. Local anesthesia
2. Standard oro/orotracheal intubation above stenosis and spontaneous breathing patient distal to stenosis
3. Standard orotracheal intubation through the stenosis
4. Intermittent jet ventilation
5. Cardiopulmonary bypass
If placing an arterial line, place in the left arm to avoid compression of the innominate artery. Having multiple sizes of ETTs as well as a rigid bronchoscope is a necessity. If unable to advance the ETT potential options include: tube exchanger, retrograde intubation, LMA or cardiopulmonary bypass. Jet ventilation is also a potential option.

Effectiveness of jet ventilation should be determined by chest rise, ABG and oxygen saturation. Disadvantages include hypercarbia, air trapping, blood and debris being entrained into the distal trachea and disruption of the surgical field.

There are few case reports of patients maintaining spontaneous ventilation for the duration of the procedure.

For the procedure, the patient is supine, neck extended with a shoulder roll and arms tucked. Surgical incision depends on the location of the lesion. Proximal lesions are approached via a small transverse cervical incision. Distal lesions can be approached via thoracotomy. The airway is opened and the oral ETT is pulled back after the suture line is placed. A new ETT or surgical airway is then placed directly into the trachea in the surgical field. At this time it is beneficial to have a sterile circuit prepared to attach from the field to the ventilator. At times this will require alternating times of surgical work and ventilation.

At the conclusion of the procedure, early extubation is desirable as post operative intubation carries the potential risk of an endotracheal tube cuff lying at the site of a fresh anastomosis and positive pressure ventilation that can lead to wound dehisance or necrosis.

At emergence, it is important to maintain neck flexion, assess tracheal bleeding and obstruction, laryngeal swelling and vocal cord dysfunction. Antiemetics, suctioning and an elevated head of bed can help to optimize the postoperative period. For airway swelling racemic epinephrine can be beneficial.

In conclusion, tracheal resection and reconstruction surgery can be safely performed with prior preparation, communication with the surgical team and meticulous attention to the airway. It is important to note, however, that tracheal resection and reconstruction is not a life saving operation. If significant comorbidities or difficulties are present the procedure should be replaced with a laryngotracheal resection combined with a tracheostomy, if indicated.

References:

