

Prevention and Management of Complications Following Tracheal Resection



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KEYWORDS

• Outcomes • Complications • Tracheal resection

KEY POINTS

- Tracheal resections are generally performed at specialized centers with experienced teams of thoracic surgeons, anesthesiologists, otolaryngologists, and intensivists.
- Serious complications following tracheal surgery may be avoided by using intraoperative techniques that preserve adequate blood supply and eliminate tension on the tracheal end-to-end anastomosis.
- Careful preoperative evaluation for selecting appropriate surgical candidates and determining optimal timing of surgery is critical to avoiding complications.
- Primary preoperative factors that increase the risk of anastomotic complications after tracheal surgery are reoperation, increased length of resection (with need for release maneuvers), and need for preoperative tracheostomy.
- Strategies to avoid or detect postoperative complications early center on slow diet advancement to prevent aspiration, aggressive clearance of secretions, voice rest (for laryngotracheal resections), guardian chin stitch, and surveillance bronchoscopy.

INTRODUCTION

Techniques of tracheal surgery have advanced significantly over the past 65 years since the initial tracheobronchial resections and reconstructions that were performed in the 1950s. In particular, airway management during tracheal resection and surgical maneuvers to release tension on the end-to-end tracheal anastomosis are the areas of greatest development that have led to improved safety and outcomes. At present, tracheal surgery is typically performed at specialized, high-volume centers where teams of experienced thoracic surgeons, anesthesiologists, otolaryngologists, and

intensivists work together to manage the care of these patients.

The most common indications for tracheal resection and reconstruction are as follows:

- Postintubation or posttracheostomy circumferential tracheal stenosis, which is the result of high-pressure endotracheal or tracheostomy cuffs, inflammation, infection, and necrosis of the trachea.^{1,2}
- Tracheal tumors, both primary and secondary. Squamous cell carcinoma and adenoid cystic carcinoma are the most common primary tracheal malignancies. Secondary

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malignancies invading the trachea usually arise from bronchogenic or thyroid neoplasms.^{3,4}

- Idiopathic laryngotracheal stenosis (ILTS) (laryngotracheal resection) is relatively rare but is seen with increasing frequency. This disease almost entirely affects younger women and primarily involves the cricoid.⁵
- Tracheoesophageal and tracheoinnominate fistulas, also a consequence of long-term high-pressure endotracheal tube and tracheostomy cuffs, which cause areas of granulation, malacia, and eventual erosion into surrounding structures. Fistulas may also occur due to penetrating trauma to the airway.⁶
- Congenital and postinfectious lesions are relatively rare and can represent a wide spectrum of disease from short- or long-segment stenosis, cartilaginous fibrosis, or calcified nodules.

Although many of these indications are serious and if left untreated can progress to detrimental airway compromise, almost none of them signify true emergencies. It is important to emphasize this point because careful and extensive preoperative evaluation and determining the appropriate timing of surgery are key measures to avoiding complications downstream.⁷ The exception is tracheoinnominate fistula, for which immediate and definitive intervention may be necessary to control hemorrhage. Otherwise, the following temporizing measures can be used until the optimal time for elective tracheal resection and reconstruction:

- Rigid bronchoscopy with dilation or tumor coring for airway obstruction
- Flexible bronchoscopy with balloon dilation of airway stenosis
- Therapeutic flexible bronchoscopy for clearance of secretions or hemoptysis
- Tracheostomy, particularly in the situation of tracheoesophageal fistula (TEF) such that the cuff is inflated and occlusive distal to the fistula to protect the airway

Of note, placement of a covered expandable stent in the trachea is not a preferred option for bridging a patient to surgery because of the increase in inflammation and granulation and should be mainly used in palliative circumstances when resection and reconstruction are not possible.⁸

Preoperative evaluation and selection of patients centers on computed tomographic (CT) imaging and flexible and rigid bronchoscopy to assess the length of diseased trachea, laryngeal

involvement, and vocal cord function, as well as presence of secretions, infection, inflammation, granulation, or obstruction. Biopsy is indicated for any endobronchial lesions. Nebulizers and intravenous antibiotics may be used to treat signs of purulent secretions and active infection, and any airway surgery should be postponed in this scenario. Patients should not be ventilator dependent, so as to prevent exposure of a fresh anastomosis to positive pressure ventilation, foreign body, and airway colonization postoperatively. Active airway inflammation may be treated with a course of corticosteroid therapy, but if possible, steroids should be discontinued well before tracheal surgery. Tracheostomy stomas should be mature or well healed before surgery. Radiation therapy in the surgical field should likewise be avoided preoperatively, because it greatly increases the risk of anastomotic separation.⁹ No trials demonstrate any role for neoadjuvant radiation in the treatment of tracheal malignancies, although there is evidence of benefit in the palliative or adjuvant setting, especially in the case of a positive margin or incomplete resection.¹⁰ Any plans for reoperative tracheal surgery should be delayed at least several months after the initial operation, if possible, while the airway may be stabilized with a T-tube.¹¹

SURGICAL TECHNIQUE

The first attempt at tracheal resection and reconstruction is often the best chance at achieving a positive outcome for the patient. The operation can be divided into 4 phases¹²:

Induction

The procedure begins with flexible/rigid bronchoscopy to inspect the airway and clear secretions. The patient is positioned supine with the neck extended if the approach is via a low collar incision or median sternotomy, although lesions near the carina require a right-sided posterolateral thoracotomy in the left lateral decubitus position. Usually, the airway is intubated under direct visualization distal to the lesion if possible with a flexible, armored single-lumen endotracheal tube. A total intravenous anesthetic is preferable throughout the operation, as opposed to inhaled agents.

Resection

The region of interest of the trachea is exposed and dissected carefully so as not to cause injury to the recurrent laryngeal nerves or innominate artery or devascularize the trachea. The oral

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