Open Tracheostomy Procedure

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KEYWORDS

• Tracheostomy • Tracheotomy • Surgical airway • Emergent airway • Tracheostomy care • Tracheostomy complications

KEY POINTS

- Open tracheostomy allows for visualization of critical structures in the neck.
- Visualization of important structures is a major advantage of the open tracheotomy procedure.
- Midline dissection and frequent orientation to surrounding anatomic structures during open tracheotomy is key to avoiding operative complications.
- Diligent tracheostomy care and postoperative management is critical to preventing complications.

Video of a tracheostomy demonstration accompanies this article at http://www.oralmaxsurgeryatlas.theclinics.com/

Introduction: nature of the problem

Tracheotomy[1] remains an important method for managing the airway of patients in the acute setting as well as providing a safe airway for patients who cannot otherwise protect their own airway. In critically ill patients who are ventilator dependent because of respiratory failure of various types (neurologic, musculoskeletal, pulmonary, or otherwise), a tracheostomy continues to provide ventilator support with fewer adverse effects to the patient compared with prolonged endotracheal intubation. It also allows the patient to be weaned of sedating medications and facilitates transfer from the intensive care unit (ICU). Patients with a tracheostomy tube are able to have improved pulmonary toilet compared with those with endotracheal tubes. Tracheotomy is also used as part of the airway management during a variety of surgeries involving the head and neck and can, in certain circumstances, be a lifesaving step used to secure an urgent airway in the case of upper airway obstruction.

The tracheostomy tube airway is superior to an endotracheal tube in the setting of long-term ventilator dependence or airway management for many reasons. In general, tracheostomy placement allows for the patient to be weaned from the ventilator more quickly and requires less pharmacologic sedation, as the tracheostomy tube sits below the larynx and does not stimulate the gag and cough reflex as much as an endotracheal tube that passes through the pharynx and vocal cords. Patients with a long-standing tracheostomy tube can, if otherwise without neurologic or anatomic abnormalities, learn to speak, swallow, and eat when not connected to the ventilator. In addition, in comparison to long-term endotracheal intubation, tracheostomy tubes have fewer glottic and subglottic tracheal complications.[1,2]

There are several variations on the standard open tracheotomy operation. Some patients may be candidates for percutaneous tracheotomy (see Percutaneous Dilatational Tracheostomy by Liao and Myers elsewhere in this issue for additional information and details on the percutaneous tracheotomy procedure). In an emergent airway situation, especially in trauma, the airway can be secured by way of a cricothyroidotomy, taking advantage of the palpable midline landmarks of the cricoid and thyroid cartilages, reducing the time required to secure the airway and reducing the risk of bleeding from the thyroid tissues by placing a surgical airway through the cricothyroid membrane. This method is a good way of securing a surgical airway quickly in an emergent situation; however, it is typically not considered ideal for longer-term use and should be converted to a formal tracheostomy once the patient has been stabilized.[3] An awake tracheotomy is indicated when the patient requires a tracheostomy to secure a safe airway but is not safe to be intubated or sedated for the procedure. This situation is often true in the case of patients with upper airway obstruction, such as in the case of oropharyngeal tumors or progressive swelling from Ludwig angina. The awake tracheotomy procedure can, in certain situations, be used when there is an urgent need to establish the airway because of upper airway obstruction but should be used only when the patient is able to maintain the airway sufficiently for transport to the operating room.[4]

Compared with these variations on the surgical airway, one main advantage of the standard open tracheotomy procedure is the ability to more clearly identify surrounding structures and completely visualize adjacent anatomic landmark structures. This article focuses on the open tracheotomy procedure as performed during a planned operation.

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[1] The terms tracheostomy and tracheotomy are often used interchangeably in the health care setting; however, as noted in the American Academy of Otolaryngology Clinical Consensus Statement on Tracheostomy Care,[7] the correct terms are as follows: tracheotomy refers to the actual procedure of creating a tracheostomy or stoma in the trachea.

Brief history of the tracheostomy

The earliest procedures involving tracheal incisions date back to around 2000 BC as described by Hindu writings. The Egyptians in the time of Imhotep used tracheotomy incisions to resolve upper airway obstruction. Later, around 300 BC, Alexander the Great was reported to have used his sword to cut open a solder's trachea after he had aspirated a bone. Since the 1500s, there have been several reports of creating a surgical airway, but it was not consistently used or recognized as a standard procedure until the early 1900s. In 1799, George Washington died of upper airway obstruction after developing bacterial epiglottitis. He was tended to by multiple physicians at the time of his death, including one who was aware of the tracheotomy procedure; however, this was not performed as it was thought to be too late to perform this novel procedure.[5]

Although the tracheotomy procedure has a robust historical basis dating back thousands of years, it was not until recently that the literature established a standard for performing operative tracheostomy placement. The first successful modern tracheotomy was performed in the United States in 1852. In 1909, Dr Chevalier Jackson, who is considered to be the father of laryngology, published a landmark paper describing the surgical technique. This paper continues to form the basis on which current practices of the modern tracheostomy operation are based.[5]

Surgical technique

Preoperative planning

Indications for tracheostomy

Ventilator dependence

Tracheostomy placement is commonly performed in the case of respiratory failure with prolonged ventilator dependence. Adult patients requiring ventilator support for 7 days or longer meet this criteria. Tracheostomy placement should be performed in critically ill patients who have had prolonged periods of intubation or require ventilator support beyond this length of time (Box 1). These patients frequently have failed to demonstrate appropriate extubation criteria after multiple spontaneous breathing trials or have failed extubation attempts and required reintubation. Patients who are unable to protect their own airway, as in the case of neurotrauma or stroke, or who are unable to generate sufficient respirations, as in the case of diaphragm paralysis or paresis from neuromuscular disorders such as Guillain-Barré syndrome, also meet criteria for tracheostomy placement.[1,2,6,7] Criteria for infants and children are different and are discussed elsewhere in this issue.

Box 1. Indications for tracheostomy placement

- Ventilator dependence/respiratory failure
  - Prolonged intubation (>1 week)
  - Inability to protect airway
  - Inability to generate sufficient respiration
- Upper airway obstruction
- Definitive therapy of obstructive sleep apnea and obesity hypoventilation syndrome

Upper airway obstruction

Patients presenting with trauma to the head and neck, such as hemorrhage from the pharynx or oral cavity, obstructing hematoma, facial or cervical fractures, or injuries to the upper aerodigestive tract, may not be safe for orotracheal intubation. Likewise, patients at risk of laryngotracheal separation, such as those with clothesline injuries, can rapidly deteriorate with intubation attempts that complete the laryngotracheal separation. In these patients, a surgical airway may be secured in both urgent scenarios and in planned operations. Masses of the head and neck can also cause upper airway obstruction. Examples include a variety of malignant and nonmalignant tumors involving the head and neck, congenital anomalies, and infections. Infections, in particular, are a frequent source of airway compromise. Often, these involve the parapharyngeal spaces, larynx, or supraglottic larynx. Often fulminant in nature, such as in the case of Ludwig angina, these infections can make securing an airway difficult for even experienced individuals.[1,2,7]

Obstructive sleep apnea and obesity hypoventilation

Patients with obstructive sleep apnea (OSA) are typically treated with nonsurgical methods such as continuous positive airway pressure (CPAP) before pursuing surgical options. In the case of severe or refractory OSA, and particularly when patients present with the obesity hypoventilation syndrome, a tracheostomy tube bypasses the upper airway obstruction and also allows for improved positive pressure ventilator (PPV) support as needed. Tracheostomy tube placement for this subset of patients should be pursued when other therapies have failed, and patients must be counseled appropriately as they may require lifelong tracheostomy.[1,2,7,8]

Informed consent

All patients undergoing tracheotomy and/or their family members and medical surrogates should be informed of the risks of surgical tracheostomy placement (Table 1). Typical risks discussed with patients include the standard surgical risks (pain, infection, bleeding, need for additional procedures, damage to surrounding structures in the neck, scar). Tracheostomy-specific risks include hemopneumothorax, damage to trachea or esophagus, tracheoesophageal fistula, tracheal stenosis, tracheoinnominate fistula, inability to decannulate,

Table 1 Risks of tracheostomy placement

Standard Surgical Risks	Tracheostomy-Specific Risks
Pain	Hemopneumothorax
Infection	Damage to trachea or esophagus (including tracheoesophageal fistula)
Bleeding	Tracheal stenosis
Need for additional procedures	Inability to decannulate/lifelong trach
Damage to surrounding structures	Mucous plug
Scar	Tracheoinnominate fistula/erosion