# Tracheostomy Decannulation

Heidi H O'Connor MD and Alexander C White MD



**Tracheostomy tubes are placed for a variety of reasons, including failure to wean from mechanical ventilation, inability to protect the airway due to impaired mental status, inability to manage excessive secretions, and upper-airway obstruction. A tracheostomy tube is required in approximately 10% of patients receiving mechanical ventilation and allows the patient to move to a step-down unit or long-term care hospital. The presence of a tracheostomy tube in the trachea can cause complications, including tracheal stenosis, bleeding, infection, aspiration pneumonia, and fistula formation from the trachea to either the esophagus or the innominate artery. Final removal of the tracheostomy tube is an important step in the recovery from chronic critical illness and can usually be done once the indication for the tube placement has resolved.** *Key words: mechanical ventilation; tracheostomy; decannulation; speaking valve; noninvasive ventilation; long-term care hospital.* [Respir Care 2010;55(8):1076–1081. © 2010 Daedalus Enterprises]

## Introduction

The indications for placement of a tracheostomy tube include failure to wean from mechanical ventilation, impaired neurologic status, an inability to handle excessive secretions, and the need to bypass an upper-airway obstruction.[1-3] Decannulation describes the process of tracheostomy tube removal once the need for the tube has resolved. There are many advantages to decannulation, including improved vocal cord and swallowing function. Discharging patients home or to another care facility is an easier process if the patient or their caregivers do not need to learn how to manage a tracheostomy tube. In addition, decannulation improves patient comfort and perceived physical appearance. Patients may also wish to undergo decannulation as part of end-of-life decision making.

## Process of Weaning and Routine Decannulation

The placement of a tracheostomy tube facilitates the transfer of the patient from the intensive care unit to a weaning facility such as a step-down unit or a long-term care hospital.[4] In weaning facilities a multidisciplinary team manages medical care, rehabilitation, and weaning the patient from prolonged mechanical ventilation. Chronic comorbidities and the lack of evidence-based weaning and

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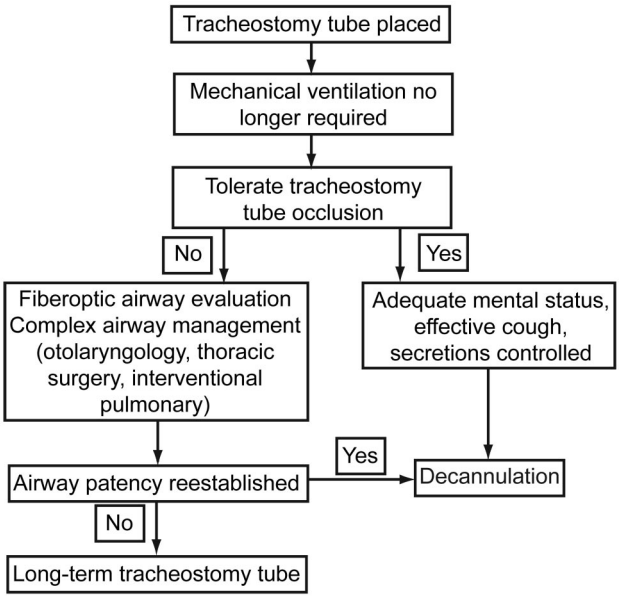


Fig. 1. Decannulation assessment.

decannulation guidelines make it difficult to predict weaning outcomes of individual patients.[5-7] Clinically stable patients undergoing prolonged mechanical ventilation usually begin the weaning process by spending increasing amounts of time on a spontaneous breathing trial via humidified tracheostomy mask. Therapist-driven weaning protocols, such as those involving spontaneous breathing trials or decreasing levels of pressure support, have been implemented in the post-acute-care setting and have been shown to shorten the time taken to wean patients from prolonged mechanical ventilation.[8,9]

Not all patients are suitable for a weaning protocol, and some need an individualized approach given the complexity of the patient population. The presence of respiratory muscle weakness, slow recovery from chronic critical illness with multi-organ dysfunction, anxiety from prolonged ventilator dependence, chronic anemia, or cardiac dysfunction may necessitate a more gradual weaning strategy. One method involves gradually decreasing the amount of pressure-support ventilation prior to withdrawal of full ventilator support. All patients undergoing weaning from mechanical ventilation should be carefully monitored using continuous pulse oximetry and cardiac telemetry.

A system for patient assessment prior to decannulation is outlined in Figure 1. Once a patient demonstrates the ability to tolerate a tracheostomy mask, it is important to establish that the upper airway (ie, glottis, vocal cords, and subglottic space) is patent. The presence of a tracheostomy tube can cause complications that may result in upper-airway obstruction.[10] The upper airway can be checked noninvasively by fully deflating the cuff on the tracheostomy tube and placing a gloved finger over the tracheostomy tube opening to deflect air through the upper airway and vocal cords, allowing phonation.[11] Alternatively, tracheostomy tube manometry may be used to obtain objective measurements of airway pressures during the use of a speaking valve or cap. This technique helps identify patients who can tolerate occlusion of the tracheostomy tube and also those who may benefit from having a tracheostomy tube with a smaller external diameter.[12]

If the patient is unable to phonate, has stridor or labored breathing, or manifests any respiratory distress, a thorough endoscopic examination of the airway, including the vocal cords and subglottic space, is recommended.[10] If the airway patency is compromised by stenosis, granulation tissue, or abnormal vocal cord movement, otolaryngology should be consulted for further evaluation and treatment. The initial tracheostomy tube placed can be up to 8 mm inner diameter to facilitate fiberoptic bronchoscopy. If no pathology is found on endoscopy, the tube may be downsized and changed to a tight-to-shaft (fully deflated) cuff to enhance air flow around the occluded tube.

Mechanical ventilation impairs communication between the patient and caregivers and family, and reduces quality of life.[11,13] In particular, a tracheostomy tube diverts air flow away from the vocal cords and results in aphonia. A substantial percentage of patients recovering from chronic critical illness also suffer from depression, which may influence their perception of mechanical ventilation and treatment decisions.[14] Allowing a patient to regain the function of speech can significantly improve quality of life in patients who require prolonged mechanical ventilation. In a spontaneously breathing patient who tolerates occlusion of the tracheostomy tube as described above, a one-way speaking valve may be placed onto the tracheostomy tube with a fully deflated cuff. This allows for air flow into the tube during inspiration; however, air flow now exits through the upper airway and vocal cords upon exhalation, producing speech (Fig. 2). For those patients who still require full mechanical ventilation and are unable to wean, either an "in-line" speaking valve or volume-compensation speech may be used to allow phonation.[11]

Endoscopic inspection of the airway, although not essential prior to decannulation, can be helpful. In one study, 67% of patients with tracheostomies were found to have airway abnormalities during airway endoscopy. Findings included tracheal granulomas, tracheomalacia, tracheostenosis, and vocal cord dysfunction.[15] Inspection of the airway with the tracheostomy tube removed allows for visualization of the subglottic space and stoma.[16] This is performed by retroflexing a fiberoptic rhinolaryngoscope into the subglottic space. Some of the abnormalities visualized, such as minor mucosal trauma from the tracheostomy tube or suction catheter, may not be clinically important and usually do not prevent decannulation. It has been demonstrated that patients who successfully pass a

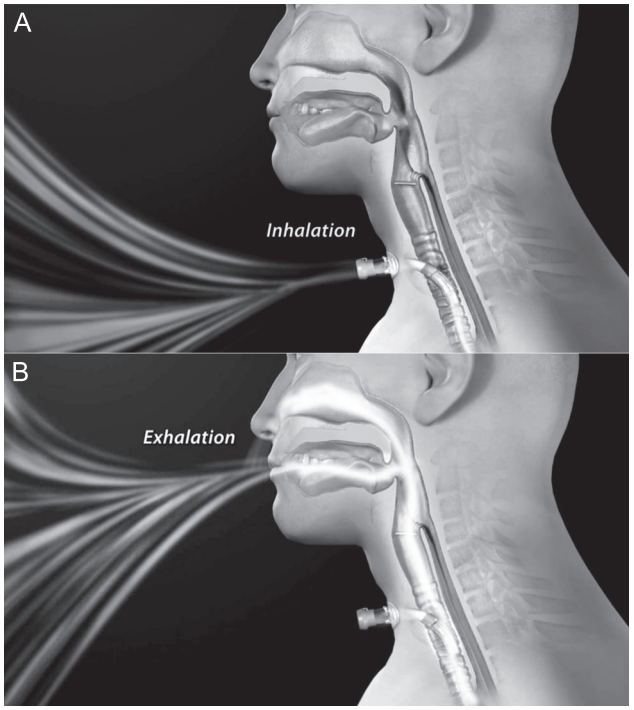


Fig. 2. Biased closed position speaking valve. A: Upon inspiration the valve opens and air passes through the speaking valve, down the tracheostomy tube and into the lungs. B: At the end of inspiration the speaking valve returns to a closed position and all exhaled air is redirected through the upper airway, passing through the vocal cords and allowing the patient to speak. (Courtesy of Passy-Muir.)

tracheostomy-tube-occlusion protocol can be safely decannulated without first undergoing fiberoptic bronchoscopy.[17] It is our current practice to routinely inspect the stoma, trachea, subglottic space, and vocal cords either at the time of a tracheostomy tube change or prior to decannulation (Fig. 3). The procedure is safe, requires only topical anesthesia, and in a substantial number of patients identifies pathology that warrants further otolaryngology or thoracic surgery input prior to safe decannulation.

### Managing Accidental Decannulation

Accidental tracheostomy decannulation is well described in the pediatric population, but less well recognized in the adult population. It may be uneventful if the tracheostomy tube has been in for some time, the tract has matured, and the tube can be easily replaced. However, accidental decannulation may result in serious consequences if the tracheostomy tube was recently placed or if the patient has a "difficult" airway.[18,19] We have explored factors associated with accidental decannulation and have found it may be related to altered mental status, increased secretions, patient turning, lack of clinically indicated restraints, or a poorly secured tracheostomy tube (Table 1) (unpublished data). Education of staff regarding risk factors for accidental decannulation along with targeted high-risk-patient monitoring can be effective tools in decreasing the accidental decannulation rate in a long-term care hospital. Identification of patients with difficult airways, having a spare tracheostomy tube at the bedside, and use of an algorithm for orotracheal intubation may reduce the morbidity and mortality associated with accidental decannulation (Fig. 4).

Table 1. Conditions Associated With Accidental Tracheostomy Decannulation

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|---|
| Altered mental status |
| Increased pulmonary secretions |
| Patient changing position in bed |
| Lack of clinically indicated limb restraints |
| Inadequately secured tracheostomy tube |

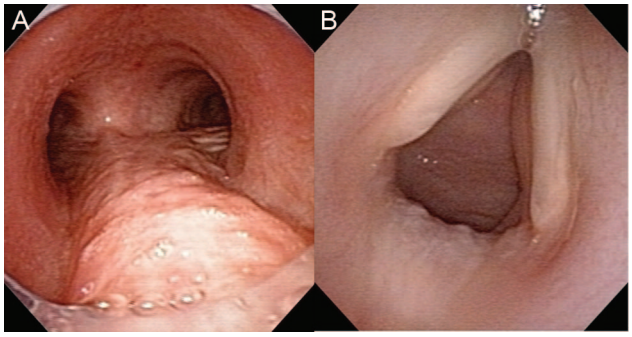


Fig. 3. Fiberoptic inspection of the trachea (A) and the subglottic space and vocal cords (B) prior to decannulation.

The length of time a tracheostomy tube has been in place is an important variable in deciding how to best proceed after an accidental decannulation occurs. The tracheocutaneous tract of a "fresh" tracheostomy tube takes up to 7 days to fully form. If during tube reinsertion the caudal turn is done prematurely, the tube may be inadvertently placed into the anterior mediastinal space, bypassing the airway. This is more likely to occur if the change is being performed within 7 days of placement. Patients with an increased neck circumference or short neck are higher risk of this occurring. Therefore, when an accidental decannulation occurs within 7 days of placement, translaryngeal intubation may be needed to secure the airway. In some settings, a skilled provider may be able to rapidly reinsert the tracheostomy tube into the airway with fiberoptic guidance and avoid the need for translaryngeal intubation. Tracheostomy tubes that have been in place for more than 7 days can usually be easily reinserted and placement confirmed with fiberoptic inspection of the airway.

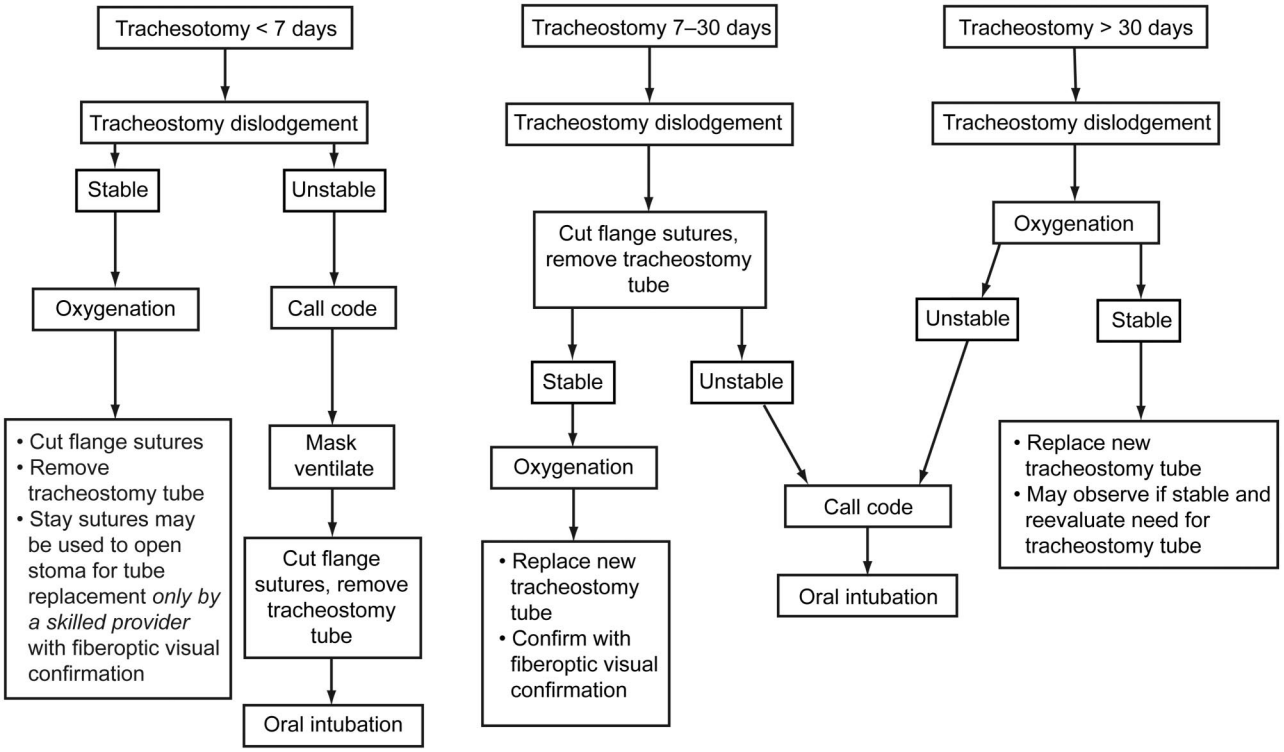


Fig. 4. Algorithm for managing unplanned tracheostomy tube dislodgement. (Adapted from illustrations courtesy of Stanley Nasraway MD, Tufts Medical Center, Boston, Massachusetts.)

### Post-Decannulation Monitoring

Prior to a patient undergoing decannulation it is important to assess a number of factors to ensure readiness. These include level of consciousness, cough effectiveness, volume of pulmonary and oral secretions, oxygen requirements, swallowing function, and ability to tolerate tracheostomy tube occlusion (Table 2).[20] When the evaluation is complete and the patient is ready for decannulation, the tracheostomy tube is removed and the stoma is covered with sterile gauze. Following decannulation, the patient requires continuous telemetry and oximetry monitoring for at least 24 hours to monitor for unexpected airway compromise. For a patient living at home with a tracheostomy the process of decannulation and subsequent monitoring is best performed during a brief hospital admission.

A patient may exhibit reduced voice quality due to airflow diversion through the healing stoma on exhalation. Vocalization may be enhanced by gently placing 2 fingers over the gauze-covered stoma during speech to minimize leak and maximize air flow to the vocal cords. Vocalization will usually return to normal once the stoma has closed completely. The tracheostomy stoma heals by secondary intention within 5–7 days in the majority of patients. However, tracheostomy-stoma-closure rates are variable and closure may occur in a single day or may take weeks. A persistent tracheocutaneous fistula may remain in some patients and may require surgical closure. In a substantial number of patients a linear scar approximately one inch in size remains following decannulation.[21] This scar may be cosmetically bothersome and contribute to dysphagia from

Table 2. Patient Assessment Prior to Decannulation

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|---|
| Resolution of condition that necessitated tracheostomy tube |
| Adequate level of consciousness |
| Effective cough |
| Ability to manage secretions |
| Adequate oxygenation |
| Swallowing function |
| Ability to tolerate tracheostomy-tube occlusion |

Data from Reference 20.

Table 3. Failure to Decannulate: Alternative Interventions

| |
|---|
| Long-term tracheostomy tube with inner cannula |
| Sleep-apnea tube |
| Surgical treatment for tracheal obstruction |
| Vocal cord surgery |
| Noninvasive ventilation with a capped tracheostomy tube |
| Placement of an airway stent for tracheomalacia |

Fig. 5. Noninvasive ventilation via nasal pillows with a capped tracheostomy tube. (With patient permission.)

skin adherence to the trachea, and may be amenable to surgical correction.[22]

### Decannulation Failure and Alternatives to Decannulation

The acceptable decannulation failure rate is reported to range from 2–5%.[23] Failure may be apparent within 48–96 hours, and a stoma that has not fully closed may be reopened using serial dilators, or a mini-tracheostomy may be placed for suctioning and short-term ventilation.[19] Despite being fully weaned from mechanical ventilation and tolerant of capping of their tracheostomy tubes, a subset of patients may not be safe for decannulation. Table 3 lists some of the alternative options available to patients who cannot be successfully decannulated.

Some individuals have significant and persistent orotracheal secretions or are at risk for aspiration and therefore may benefit from a tracheostomy tube.[24] These patients may be safe for home discharge with either a long-term tracheostomy tube with an inner cannula or a sleep-apnea tube to maintain a route for suctioning. Surgical approaches, such as injection laryngoplasty, may be useful in treating vocal fold paralysis or dysfunction.[25] Patients with chronic obstructive or restrictive lung disease may be successfully weaned off mechanical ventilation during the day, but may still require nocturnal ventilation via tracheostomy to manage nocturnal hypoventilation and improve respiratory muscle function. Patients with obstructive sleep apnea and underlying COPD (the so called "overlap syndrome") may develop respiratory failure with hypercapnia.[26] These patients may be successfully transitioned to noninvasive positive-pressure ventilation at night via a nasal or full-face mask with a capped tracheostomy tube (Fig. 5) and ultimately decannulated.[27,28]

Tracheobronchomalacia is an abnormal collapse of the tracheal and bronchial walls and can contribute to symptoms such as dyspnea, cough, wheezing, the inability to clear secretions, recurrent infections, and persistent respiratory failure. Dynamic airway collapse is increasingly identified via bronchoscopy in patients with underlying COPD and chronic respiratory failure, and may be amenable to stenting to improve respiratory function.[29,30] A multidisciplinary approach is usually needed to optimize airway function in those patients who fail decannulation.

### Summary

Decannulation is usually well tolerated. A systematic approach to patient evaluation, along with judicious use of airway endoscopy, can help identify barriers to decannulation. Following decannulation, patients require close monitoring to identify signs of airway compromise. Practice guidelines may help improve quality of care and help optimize outcomes following tracheostomy decannulation.

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