

Tracheostomy Decannulation

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The respiratory therapist plays an integral role in tracheostomy tube decannulation. Removal of the tracheostomy tube should be considered only if the original upper-airway obstruction is resolved, if airway secretions are controlled, and if mechanical ventilation is no longer needed. Predictors of success include ability to produce a vigorous cough and the absence of aspiration. Tracheostomy decannulation requires caution, particularly following a prolonged period of tracheostomy use. The tracheostomy tube decannulation process is well suited for therapist-implemented protocols. *Key words: tracheostomy, decannulation, acute respiratory failure, secretion clearance, airway care, artificial airways.* [Respir Care 2005;50(4):538–541. © 2005 Daedalus Enterprises]

Introduction

The respiratory therapist (RT) plays an integral role in tracheostomy-tube decannulation. No matter how frequently a given procedure is performed, it is of great value to have the essential elements distilled to a very practical, simple, and straightforward approach. An article by Heffner¹ presents criteria for tracheostomy tube decannulation and practical measures to prevent failure. In brief, it is advised that one consider decannulation only if the original upper-airway obstruction is resolved, if airway secretions are controlled, and if mechanical ventilation is no longer needed. Additional predictors of success include

ability to produce a vigorous cough and the absence of aspiration. Heffner¹ notes that the presence of purulent secretions may warrant prudent antibiotic therapy. Aspiration can be obvious and overtly disastrous or chronic and subtle. It may be helpful to check for a gag reflex prior to decannulation. However, up to 20% of normal individuals may have no gag reflex.¹ The absence of this reflex does not reliably predict abnormal swallow. A formal swallow evaluation should be considered, particularly in patients with prolonged tracheostomy or those at high risk for aspiration.

Decannulation Decision Making

The decision process prompting decannulation for management of an acute upper-airway obstruction is very different than assessment for removal of a tracheostomy tube that was placed for long-term management of complex airway abnormalities or for prolonged mechanical ventilation (PMV). For example, if tracheostomy was performed for an acute upper-airway obstruction, it may be prudent for the patient to have an upper-airway endoscopic examina-

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Kent L Christopher MD RRT presented a version of this paper at the 20th Annual New Horizons Symposium at the 50th International Respiratory Congress, held December 4–7, 2004, in New Orleans, Louisiana.

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tion to confirm that the abnormality has substantially improved or resolved. If a patent airway is reestablished, prompt decannulation and appropriate post-procedure monitoring and clinical assessment may be the best intervention.

Examples of acute upper-airway obstruction include life-threatening aspirated foreign body, angioedema, and epiglottitis. Occasionally, what seemed to be an acute airway obstruction due to an organic etiology may subsequently be attributed to a nonorganic, psychological disorder. Patients with psychogenic vocal-cord dysfunction may appear to have an acute life-threatening organic upper-airway obstruction² that prompts emergency tracheotomy. Vocal-cord dysfunction should be considered when no organic etiology is identified and post-tracheotomy endoscopic examination is remarkably normal. Clinical experience indicates that tracheotomy is unnecessary in patients with psychogenic vocal-cord dysfunction, and patients tend to have difficulty during the decannulation process with worsening vocal-cord dysfunction signs and symptoms. The clinician should be familiar with the distinct endoscopic glottic findings seen during episodes of vocal-cord dysfunction.²

Decannulation of patients with prolonged tracheostomy is not as straightforward as tube removal following a resolved acute upper-airway obstruction. Patients recently weaned from PMV have prolonged critical illness, multiple medical comorbidities, and a marginal respiratory status. During the post-mechanical-ventilation period, patients are predisposed to respiratory muscle fatigue, abnormal ventilatory drive, and another episode of respiratory failure. Individuals with a long-term tracheostomy are at risk for upper-airway obstruction due to complications of tracheostomy. The numerous upper-airway abnormalities encountered with tracheostomy have been presented by Epstein in the preceding paper.³ Upper-airway complications of tracheostomy or prior endotracheal intubation may make it very difficult to safely decannulate the tracheostomy tube. Under certain clinical conditions it may not be wise to even consider decannulation. Additionally, there may be upper-airway abnormalities that were initially unappreciated or unrecognized at the time of decannulation. Patients may subsequently experience life-threatening airway compromise requiring emergency reinsertion of the tracheostomy tube. The clinician must have a high index of suspicion for these disorders. Routine endoscopic evaluation has been advised by some,⁴ and surgical or medical interventions are often necessary for identified airway obstruction prior to considering decannulation.

Deflated-Cuff Tracheostomy Occlusion Procedure

Over the years, RTs have found the *deflated-cuff tracheostomy occlusion procedure* to be a practical bedside screen for evaluation for upper-airway obstruction. To sum-

marize, the patient should be on an appropriate monitoring device, with pulse oximetry as the recommended minimum. The procedure should be explained to the patient. Following full deflation of the tracheostomy-tube cuff, a gloved finger briefly occludes the tracheostomy-tube opening and the clinician carefully notes if breathing through the mouth and/or nose is present. The clinician should observe for objective signs of respiratory distress and encourage phonation. For patients who have not breathed through the upper airway for a number of weeks or months, it is relatively common for these individuals to have concern about a different breathing sensation. This should be clinically distinguished from distress due to substantial upper-airway obstruction. The presence of stridor, minimal or absent breath sounds upon auscultation over the upper neck, absence of airflow at the nose or mouth, supraclavicular or intercostal retractions, labored breathing, diaphoresis, and prolonged inspiratory phase are signs consistent with potential severe upper-airway obstruction. If findings suggest upper-airway obstruction, promptly return the patient to breathing through the tracheostomy tube, with appropriate supplemental humidified oxygen or mechanical ventilatory support. Endoscopic examination should identify the site of obstruction. If no lesions are present, consider whether the tube may be too large for the trachea to allow for adequate flow through the upper airway; a trial following tracheostomy-tube change may be in order.

Benefits of Decannulation

Though decannulation is not without some risk, there are clear-cut benefits to tracheostomy-tube removal. The tracheostomy tube is a foreign body that may cause bronchorrhea or excessive cough. Tracheostomy tubes may impair swallowing. Normal physiology requires that the trachea is elevated during the swallowing maneuver, allowing the larynx to abut against the epiglottis, thus preventing aspiration of food or secretions. The presence of a tracheostomy tube impairs normal tracheal elevation during swallowing.

Diverting breathing away from the upper airway and through the tracheostomy lumen has substantial deleterious effects. The physiologic benefit of pursed-lips breathing is eliminated. The vocal cords are bypassed, and there is no "laryngeal blast" to facilitate effective cough. Furthermore, the larynx is an important physiologic regulator of breathing. Partial closure of the vocal cords maintains a subglottic pressure referred to as "physiologic PEEP" (positive end-expiratory pressure). Partial glottic closure has been shown to occur in patients with intrathoracic airflow obstruction^{5,6} and appears to be a compensatory mechanism during bronchoconstriction.⁶ Similarly, subglottic

pressure may improve the swallowing mechanism and reduce the risk for aspiration.

Most importantly, patients are unable to speak when the tracheostomy tube bypasses the larynx. There are profound consequences of inability to speak. Aphonia presents a barrier to the patient's participation in care. Care is further compromised when the patient is unable to express symptoms that would normally prompt further investigation or intervention. Clinical assessment is compromised when mental status cannot be appropriately assessed because of the lack of verbal communication. Inability to speak impairs informed consent and patient advance directive. The inability to speak brings a sense of isolation, frustration, anxiety, and depression, particularly in patients recovering from PMV who have been unable to speak for weeks to months. Related agitation is often managed with anxiolytics or hypnotics, which can have a negative impact on rehabilitation and recovery.

Protocol-Guided Decannulation

Evidence-based guidelines have confirmed the benefit of weaning protocols.⁷ RT-implemented weaning protocols have been shown to be efficacious in weaning tracheostomized patients from PMV.⁸ Intuitively it would seem that protocol implementation for decannulation from long-term tracheostomy may have value. Ceriana et al⁹ conducted a prospective outcomes evaluation of implementation of a protocolized decisional flow chart for tracheostomy decannulation following successful liberation from PMV. Remarkably, reintubation rate at 3 months was only 3%.

Over 18 months, a total of 108 patients with diverse causes for ventilator dependence were evaluated. Characteristic of this chronically critically ill PMV population,⁷ 60% had comorbidities, only 60% successfully weaned from PMV, and 33% died while on PMV. Decannulation failures could be attributed to uncontrolled secretions and severe glottic stenosis. Table 1 has been adapted to present the Ceriana et al⁹ criteria for consideration for decannulation.

According to the Ceriana protocol, if all criteria were met, the tracheostomy tube was downsized to a tracheostomy tube with an inner diameter of ≤ 6 mm. The patient was then decannulated after 4 days if arterial blood gases showed a pH of > 7.35 with $< 5\%$ increase in P_{aCO_2} .

Ceriana et al realized that certain patients might meet most criteria to be considered for tracheostomy decannulation, but might have risk indicators that would qualify for decannulation by an alternative path in the protocol. The 2 indicators were poor cough reflex and ability to generate only a marginal peak expiratory pressure, between 20 and 40 cm H₂O. The protocol alternative path called for interim placement of the Minitrach (Portex, Hythe, United Kingdom) for at least one week. Though

Table 1. Protocol Criteria for Tracheostomy Decannulation Attempt Following Successful Liberation From Prolonged Mechanical Ventilation

Absence of distress and stable arterial blood gases on prolonged mechanical ventilation for 5 days
Stable clinical condition indicated by factors such as:
-Hemodynamic stability
-Absence of fever, sepsis, or active infection
- $P_{aCO_2} < 60$ mm Hg
Normal endoscopic examination or revealing stenotic lesions occupying $< 30\%$ of the airway
Absence of delirium or psychiatric disorders
Adequate swallowing evaluated by gag reflex, blue dye, and video fluoroscopy
Patient able to expectorate on request
Maximum expiratory pressure ≥ 40 cm H ₂ O

(Adapted from Reference 9.)

not customarily used in the United States, the Minitrach is a device that is not intended for ventilation, but allows tracheal access for periodic suctioning. The Minitrach was removed if suctioning requirements became < 2 times per day and if the patient was able to demonstrate spontaneous expectoration through the mouth. The alternative path of the protocol underlines Heffner's¹ emphasis on the importance of the mechanical requirements to generate effective cough and the ability to clear secretions.

Physiologic Effects of Decannulation

There are a few studies that have evaluated the physiologic effects of decannulation in tracheostomized patients. Chadda et al¹⁰ evaluated the physiology of decannulation in 9 neuromuscular tracheostomized patients. Selection of patients with neuromuscular disease was an important part of the study design, because confounding factors due to lung, cardiac disease, or upper-airway obstruction were excluded. Breathing through the tracheostomy tube was compared to breathing through the upper airway, with the tracheostomy tube lumen occluded (similar to the common practice of cuff deflation with tracheostomy-tube capping as a trial prior to decannulation). Unfenestrated 7-mm or 8-mm inner diameter tracheostomy tubes were used. Flow, esophageal pressure, expired gas analysis, and arterial blood gas results were measured. Compared to breathing through the tracheostomy tube, results showed an increased tidal volume with breathing through the upper airway (330 mL and 400 mL, respectively) and that ventilation increase was due to an increase in physiologic dead space (156 mL and 230 mL, respectively). There were no changes in upper-airway resistance, dynamic pulmonary compliance, or intrinsic positive end-expiratory pressure when patients were switched from breathing through the tracheostomy

tube to breathing through the upper airway. However, the change from tracheostomy-tube breathing to upper-airway breathing resulted in increased work of breathing (6.9 to 9.1 J/min), transdiaphragmatic pressure (10.4 to 12.5 cm H₂O), diaphragmatic pressure-time product (214 to 271 cm H₂O · s/L), and oxygen uptake (206 to 229 mL/min). This study suggests that tracheal decannulation, in the absence of underlying upper-airway obstruction, results in increased dead space, with no other detectable loading. The authors conclude that work of breathing may be increased by > 30%, due to higher ventilatory requirements.

Pre-Decannulation Steps

For patients with long-term tracheostomy, it is common practice to take an intermediate step prior to completely removing the tracheostomy tube. The interim trial of a “physiologic decannulation” allows the clinician additional time to monitor cough effectiveness, swallow, voice quality, and the patient’s ability to adequately breathe through the upper airway.

Heffner¹ describes the use of the tracheostomy button. Others have been proponents of use of the capped fenestrated tube with the cuff deflated. Hussy and Bishop¹¹ studied an adult trachea and mechanical lung model to compare pressures required to breathe, utilizing a number of different-size fenestrated and unfenestrated, cuff-deflated tracheostomy tubes. Though still a matter of clinical opinion, the authors concluded that the model suggested that effort to breathe in the absence of a fenestrated tube may be substantial. It was also the authors’ opinion that, unless the tube was small (eg, 4 mm inner diameter), a fenestrated tube was recommended. The clinician must be aware that granulation tissue or other tracheal abnormalities may obstruct the fenestrations, defeating the intended design. On occasion, abnormal tissue may herniate through the fenestrations, resulting in trauma and difficulty in inner-cannula insertion and removal, as well as subsequent bleeding.

Another common practice is to use a downsized, cuff-deflated, unfenestrated or fenestrated tube with a standard cap as an intermediate trial prior to decannulation. The clinician should be aware that a downsized tube has a smaller outer diameter and inner diameter and is designed for a patient of smaller stature, with respect to tube length, curvature, and inflated-cuff dimensions. Additionally, unlike thermoplastics that conform to the contour of the patient’s airway, smaller tubes with fixed and rigid plastics designed for patients with larger stature may present problems.

An additional interim step to decannulation is the speaking valve, previously discussed by Hess.¹² Though speech and subglottic pressure are restored, the low-resistance valve may preferentially divert inspiration away from the

upper airway and through the tracheostomy. The trial of a “functional decannulation” may not be achieved, and the clinician may be inappropriately reassured that speech and absence of distress confirm the presence of a patent upper airway.

Summary

The skills and knowledge of the RT are essential to the spectrum from airway management through mechanical ventilation and tracheostomy decannulation. As we start, so must we finish. Based upon experience with liberation from mechanical ventilation, tracheostomy decannulation appears to be ideally positioned for RT-implemented protocols. Additional guidance by scientific insight is sorely needed. Involvement of the RT in a team approach to scientific study of current and new approaches to tracheostomy decannulation is likely to improve quality of care and outcomes.

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