Indications for and Timing of Tracheostomy

Charles G Durbin Jr MD FAARC

Tracheostomy is one of the most common intensive care unit procedures performed. The advantages include patient comfort, safety, ability to communicate, and better oral and airway care. Patients may have shorter intensive care unit stays, days of mechanical ventilation, and hospital stays. There are risks, long-term and acute, and the timing of when to do a tracheostomy must be individualized. As soon as the need for prolonged airway access is identified, the tracheostomy should be considered. Generally, this decision can be made within 7–10 days. Bedside techniques allow rapid tracheostomy with low morbidity. *Key words: tracheostomy, acute respiratory failure, mechanical ventilation, weaning, artificial airway.* [Respir Care 2005;50(4):483–487.

Introduction

Advances and improvements in treatment of critical illness has resulted in more patients who require prolonged airway and ventilatory support.[1] Many of these patients will benefit from prolonged support programs and will eventually be weaned from mechanical ventilation.[2,3] Management of respiratory failure due to worsening chronic obstructive pulmonary disease and congestive heart failure, without an artificial airway, using noninvasive ventilation, is often successful, avoiding the need for invasive airway support.[4] In selected patients, noninvasive ventilation is well-tolerated and carries a lower mortality than invasive ventilation.[5] Early extubation to noninvasive ventilation as part of a weaning strategy has been suggested as a way of avoiding prolonged intubation, but this approach is not always successful.[6] Despite the advances in noninvasive ventilation, most patients with respiratory failure will require intubation, and the question of whether (and when) to perform tracheostomy will need to be addressed. A comparison of advantages and disadvantages of translaryngeal intubation and tracheostomy is presented in Table 1.[7–13]

When to Place a Tracheostomy?

The decision to place a tracheostomy should be individualized, balancing the patient's wishes, expected recovery course, risk of continued translaryngeal intubation, and surgical risks of tracheostomy. Medical indications for tracheostomy include unrelieved upper-airway obstruction, need for prolonged mechanical ventilation, airway protection, need for airway access for secretion removal, avoid-

Charles G Durbin Jr MD FAARC is affiliated with the Department of Anesthesiology, University of Virginia Health Science Center, Charlottesville, Virginia.

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Correspondence: Charles G Durbin Jr MD FAARC, Department of Anesthesiology, University of Virginia Health Science Center, PO Box 800710, Charlottesville VA 22908-0170. E-mail: cgd8v@virginia.edu.

Table 1. Comparison of Translaryngeal Intubation With Tracheostomy*

Advantages of Translaryngeal Intubation	Advantages of Tracheostomy
Easy and rapid initial placement of the airway device	Ease of reinsertion if displaced (after the tract has matured)
Avoids acute surgical complications	• Allows less skilled care
• Bleeding	Reduced laryngeal damage
• Posterior tracheal wall injury	• Reduced laryngeal stenosis
• Barotrauma	• Less voice damage
Lower initial cost (only considering placement, not cost of maintenance)	Better secretion removal with suctioning
Avoids late surgical complications	Lower incidence of tube obstruction
• Wound infections	Less oral injury (tongue, teeth, palate)
• Recurrent laryngeal nerve injury	Improved patient comfort[7]
• Stomal stenosis	• Less sedation/analgesia required
	Better oral hygiene
	Improved ability to communicate
	• Improved lip reading
	• Allows speaking valve
	Preservation of glottic competence
	• Less aspiration risk
	• Lower incidence of ventilator-associated pneumonia
	Better preserved swallowing, which allows earlier oral feeding[8–13]
	Lower resistance to gas flow
	Less tube dead space
	Lower work of spontaneous breathing
	More rapid weaning from mechanical ventilation

*Data from References 7–13.

ance of complications from translaryngeal intubation, improvement of patient comfort, facilitating progression of care in and outside the intensive care unit (ICU), and increasing patient safety. Usually a tracheostomy is performed with a secured translaryngeal airway already in place. However, emergency situations may require a life-saving surgical airway in a patient without a secured or even patent airway. The usual approach for such an emergency is transtracheal catheter placement for insufflation of oxygen to prevent death while a tracheostomy or cricothyroidotomy is performed. Tracheostomy performed under emergency conditions is time consuming, difficult, and often associated with a poorer outcome, and a cricothyroidotomy is usually preferred. Recently, percutaneous dilational tracheostomy has been reported to be successful under these emergency circumstances; however, it is premature to recommend its use in all emergency situations.[14]

Increased demand, coupled with a lack of availability of critical care resources, has resulted in placing the more stable patients outside of traditional ICUs. Airway security and safety are paramount in the non-ICU environment, where personnel skilled in airway management and intubation may not be immediately available. The belief that a tracheostomy is safer than a translaryngeal airway has led to earlier tracheostomy and early placement of these patients on acute medical floors. This belief of increased safety may not be correct. In a study of patients intubated and with tracheostomies cared for in an ICU, the incidence of airway problems was 10-fold greater in patients with tracheostomies.[15] Of even more concern in this report was that the importance of these airway problems was greater, including several deaths, in the patients with tracheostomies. Tracheostomy is a safer choice in patients where reintubation may be difficult or impossible.[16] Newer, simpler, safer methods of performing tracheostomy at the bedside have become common and have also contributed to performing tracheostomy earlier in the course of care.

Changes in Timing of Tracheostomy

The timing of tracheostomy has changed over recent years. Tracheostomy in the1980s was considered "early" if it was performed before 21 days of translaryngeal intubation. In the otorhinolaryngology literature, however, the performance of tracheostomy to protect the larynx from intubation damage has been recommended within 3 days of intubation. This recommendation is based on the fact that the visually observed mucosal damage to the larynx and vocal cords is maximal in 3–7 days. If the tube is removed from the larynx within several days, complete healing of these injuries is the rule.[17] If translaryngeal intubation is continued, the visually assessed damage progresses, with scar formation, and functional abnormalities (voice changes) occur with increasing frequency if

the tube is left in place longer than 1 week.[18] These observations occurred when the materials used for endotracheal tubes (ETTs) were considerably more toxic to tissues. The 3-week time limit of translaryngeal intubation in critically ill patients was based on the belief that the risk ratio (laryngeal risk vs surgical tracheostomy risk) was excessive if the ETT was left much longer than a month. There is little useful, current, objective information to support this belief. Many earlier patients reported with complications were so ill and required such high levels of ventilatory support that it was felt that transport to the operating room and performance of tracheostomy would result in mortality and substantial morbidity. Newer ETTs made of less toxic plastics probably are less damaging to the upper airway and larynx and are unlikely to cause as severe injuries as the older tubes. Because of the growth of the trachea in childhood, the long-term airway consequences of surgical tracheostomy in children are more important than in adults.[19–21] Translaryngeal intubation is usually continued much longer in small children than adults, rather than subjecting them to the serious risks of tracheostomy. The outcome of prolonged translaryngeal intubation in children does not appear to have important long-term airway consequences.

With the demands for ICU beds increasing and the clinical changes mentioned above, tracheostomy is now being performed earlier in the course of treatment of airway compromise and ventilatory failure. Besides the perceived lower risks of bedside tracheostomy, the beneficial effects on patient comfort, patient safety, ability to communicate and eat, and incidence of ventilator-associated pneumonia (VAP) are additional arguments for this approach.[22,23] While these claims are undoubtedly true, the data supporting these benefits are generally anecdotal.

Risks of Tracheostomy

In order to make an informed decision, accurate determination of acute surgical and long-term risks of the procedure must be known, as well as those patient factors that influence and modify these risks. These are not well studied for current tracheostomy techniques. A detailed comparison of complications from traditional open and percutaneous tracheostomy is presented in subsequent papers of this series. In addition to the acute risks of bleeding, airway loss, and infection, the procedural risk must include estimation of the mortality and morbidity of treating patients who develop tracheal stenosis at the tracheostomy stoma site. The incidence and consequences of this complication have not been well studied in critically ill patients. The newer, percutaneous procedures may have a lower incidence of stomal stenosis, but their early mortality may actually be increased over that of open tracheostomy.[24] While tracheostomy is a very frequently performed procedure, very little systematic information has been gathered regarding its risks and benefits.[25]

Tracheostomy and Weaning From Mechanical Ventilation

One of the purported advantages of tracheostomy is in facilitating weaning from mechanical ventilation.[22] Some patients who were making no progress toward extubation are occasionally weaned from mechanical ventilation soon after tracheostomy. This may be due to lower resistance to breathing, less dead space, better secretion removal, improved patient comfort, or need for less sedation. However, no prospective, systematic study of this issue has been performed. Patients may just appear to wean faster with a tracheostomy because the patient with an ETT "needs" to be attached to a mechanical ventilator while a "trached" patient does not. The unsubstantiated belief that the work of breathing (WOB) through an ETT is too high for a marginal patient to tolerate is widespread, even among experienced clinicians.[26] Nathans et al, investigating various techniques to overcome the ventilator-circuit-imposed WOB, found that WOB was significantly higher following extubation (1.04 J/L) than while spontaneously breathing through a translaryngeal ETT attached to a T-piece (0.74 J/L). Six of 7 study patients experienced an increased WOB following successful and sustained extubation.[27] Even excellent clinicians are often unable to predict when a patient is dependent on mechanical ventilation. For example, when trying to identify patients in need of "weaning" (to be entered into clinical trials comparing weaning methods), as many as 50% of patients believed to be ventilator-dependent, when given a spontaneous breathing trial, passed the trial.[28,29] The concern about excessive WOB through an artificial airway seems to be forgotten when the tracheostomy tube is placed and patients who were able but not allowed to sustain themselves without mechanical support while breathing through the ETT are now allowed to breath without support through the tracheostomy tube. They appear to have been "weaned" simply by changing the method of intubation.

As mentioned above, there are mechanical factors about breathing through a shorter tracheostomy tube, compared to the longer ETT, that may reduce WOB and facilitate weaning. These factors are analyzed in detail in a recent publication of RESPIRATORY CARE.[30] They are unlikely to explain why patients appear to wean faster following tracheostomy.

Ventilator-Associated Pneumonia

Another suggested advantage of a tracheostomy over translaryngeal intubation is prevention of VAP. The presumed etiology of VAP is aspiration of oral secretions into

the larynx and then past the tracheal cuff, into the lungs. Since glottic competence is maintained by tracheostomy, early tracheostomy may prevent or lower the incidence of VAP.[31] Earlier reports suggested that tracheostomy might actually result in a higher incidence of pneumonia than translaryngeal intubation.[32,33] More recent evaluations suggest either no effect on VAP or possibly a reduction following tracheostomy.[34] Although not a prospective trial, a report by Barret et al demonstrated that in burned children the incidence of lung infections was lower in children who underwent tracheostomy before day 10 than in those receiving a tracheostomy later or those never receiving a tracheostomy.[35] A difficulty in evaluating this issue is that most patients receiving tracheostomy have also been intubated from above for a substantial and variable period of time. Separating the risk of VAP from translaryngeal intubation and protection from VAP afforded by tracheostomy requires delineation of these 2 issues. No definitive evidence has been reported in this regard; however, the trend seems to be that earlier tracheostomy reduces the incidence of late development of VAP. To resolve this issue will require study of a large collection of patients, such as a registry.[36]

Summary

Newer, bedside techniques for placement of tracheostomy and reported benefits of this airway device have led to performance of elective tracheostomy earlier in the course of critical illness. Tracheostomy should be performed as soon as the need for prolonged airway support is recognized. Patients with respiratory failure who cannot be weaned within 7–10 days are candidates for tracheostomy. Most severely injured trauma patients requiring intubation longer than 5 days will require airway support and will benefit from early tracheostomy.[37] Patients with supratentorial intracranial bleeds who do not awaken within 3–5 days will most likely require a tracheostomy if they survive.[15,38] Delay of tracheostomy in these groups of patients is associated with longer hospital length of stay and more pneumonia. The advantages of patient comfort and improved ability to communicate should not be underestimated as important values in proceeding with tracheostomy in some situations. Patient and family goals should be considered as well as medical concerns, and the timing should be individualized.

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