When to Change a Tracheostomy Tube

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Knowing when to change a tracheostomy tube is important for optimal management of all patients with tracheostomy tubes. The first tracheostomy tube change, performed 1–2 weeks after placement, carries some risk and should be performed by a skilled operator in a safe environment. The risk associated with changing the tracheostomy tube then usually diminishes over time as the tracheo-cutaneous tract matures. A malpositioned tube can be a source of patient distress and patient-ventilator asynchrony, and is important to recognize and correct. Airway endoscopy can be helpful to ensure optimal positioning of a replacement tracheostomy tube. Some of the specialized tracheostomy tubes available on the market are discussed. There are few data available to guide the timing of routine tracheostomy tube changes. Some guidelines are suggested. *Key words: tracheostomy tube; change; malposition; routine.* [Respir Care 2010;55(8):1069–1075. © 2010 Daedalus Enterprises]

Introduction

The placement of a tracheostomy tube secures the airway for patients who require prolonged invasive mechanical ventilation,[1,2] have upper-airway obstruction, have undergone a laryngectomy, or have difficulty managing secretions and as a result are prone to recurrent aspiration pneumonia. The use of high-volume low-pressure cuffs, along with a tendency to place a tracheostomy tube early in the course of mechanical ventilation, appears to have improved outcomes in those patients receiving prolonged mechanical ventilation.[3,4] A tracheostomy tube has advantages over an endotracheal tube, including a reduction in work of breathing, less laryngeal injury, and improved oral hygiene, and may allow for oral intake of calories.[5]

The proper management of a tracheostomy tube is essential for patient comfort and communication. There are a number of indications for changing a tracheostomy tube (Table 1), including the need for a size change (either decreased as part of weaning from mechanical ventilation and to facilitate vocalization and swallowing, or increased to allow passage of a bronchoscope into the airway); tube malfunction (eg, fractured flange or nonfunctional cuff); need for a different type of tube (eg, the need for a tube with an inner cannula); and routine changing as part of

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Table 1. Examples of Indications for Changing a Tracheostomy Tube

First change (7–14 days after placement)
To reduce the size of the tube
Routine change (every 60–90 days)
Malpositioned tube due to incorrect length or size
Patient-ventilator asynchrony, tracheostomy tube problem suspected
Cuff leak
Tube or flange fracture
To allow passage of a bronchoscope (needs at least a 7.5 mm inner diameter)
To change the type of tube

ongoing airway management. This article will review the timing of and indications for changing a tracheostomy tube. The information provided here is obtained from the limited literature on the topic and also from expert opinion. Areas covered include the first tracheostomy change, changing a malpositioned tube, some information on less commonly used tracheostomy tubes, factors that can make it difficult to safely change a tracheostomy tube, and routine tracheostomy tube change.

The First Tracheostomy Tube Change

The first tracheostomy tube change is performed once the tracheotomy tract has matured. The indications for a first tracheostomy tube change include downsizing the tube to improve patient comfort, to reduce pressure on the tracheal mucosa by reducing the tube external diameter, and to facilitate speech. In some patients the original tracheostomy tube may have been the wrong size or length for the patient.[6] Conventional practice recommends changing the tube 7–14 days[5] following placement; however, there are no data to support that time frame, which was suggested to allow time for a stable endotracheal-cutaneous tract to form. Data from children suggest a much shorter time to change might be reasonable.[7] A survey of chief residents from otorhinolaryngology programs in the United States revealed a mean time interval between the tracheostomy placement and first tube change of 5.3 days (range 3–7 d).[8] The first tube change in that study was performed in the intensive care unit, step-down unit, or on a regular ward.[8] A tracheostomy tube is placed using either an open surgical approach or the percutaneous approach, usually under bronchoscopic guidance using a tapered dilator.[9] The percutaneous approach has been associated with fewer complications, such as wound infections; however, there can be a substantial learning curve for the procedure.[10]

A surgically placed tracheostomy tube can include the creation of a Björk cartilaginous flap, and the tube is secured in the neck by placing sutures through the flanges to the skin in addition to the tracheostomy ties. Stay sutures are usually placed to facilitate opening the stoma in the event of accidental decannulation, and can be life-saving in the event of a decannulation occurring in an obese patient with increased neck circumference. All sutures are usually removed at the time of the first tube change.

The process of changing a tracheostomy tube is straightforward in the majority of patients, but should be performed only by someone skilled in the procedure. In general, it is advisable to have 2 people present for any tracheostomy tube change. Prior to removing the old tube, all components of the new tracheostomy tube should be checked for integrity, an obturator should be available to help guide placement (usually present in the kit), and the cuff (in patients undergoing mechanical ventilation) inflated to check for leaks and then deflated prior to insertion. One end of the securing tie may also be inserted through the slit in the flange on the outer cannula to facilitate tying the tube after it is positioned. The patient is placed either supine or semi-recumbent, with the neck extended and free of any clothing that could obstruct the stoma. The retaining sutures are removed, the tube gently withdrawn, the new tracheostomy tube inserted, and the obturator removed. Removal of a tube through a tight stoma with a bulky cuff can be facilitated using 0.5–1 mL of lidocaine jelly (1%) inserted around the stoma/tube interface.

The size and type of new tube inserted will depend on the clinical circumstances. It is important to make sure the inner and outer diameters of the new tracheostomy tube are sized appropriately for the patient. The dimensions of tracheostomy tubes (inner and outer diameter and length) differ both with manufacturer and according to whether the tube has an inner cannula, and these measurements must be taken into account when selecting a replacement tube. The shape of the trachea has considerable normal variability but is usually not a problem when selecting a tube. The trachea does, however, have a smaller inner diameter in adult females, compared with adult males. This is because the female trachea has attained its full size by age 14 years, whereas the male trachea continues to enlarge in diameter until growth is complete at age 17–18 years.[11] The male trachea attains an average cross-sectional area of 2.3 $\times$ 1.8 cm, and the female trachea 2.0 $\times$ 1.4 cm. Therefore, in females a tracheostomy tube with an inner diameter of 6.0–6.5 mm is usually adequate. A slightly larger tube, with inner diameter 7.0–7.5 mm, is adequate in males. If bronchoscopic airway evaluation is anticipated, a 7.5-mm inner-diameter tube is required, and sometimes even larger diameter tubes are needed, depending on the diameter of the bronchoscope. The smaller tracheoscope can usually be passed easily through a 6-mm inner-diameter tube, but these smaller endoscopes do not always have a suction channel and are useful only for visualizing the airway.

Fig. 1. Tracheostomy tube changer.

It is important to remember that the first tracheostomy tube change can be associated with some risk. In a recent survey, surgical residents reported loss of airway in 42% and death in up to 15% of first tube changes.[8] Patients with increased neck circumference, unusual airway anatomy, or with an elevated body mass index are at increased risk of having the tube placed into a false passage in the anterior mediastinum, especially if the caudal turn during insertion is made prematurely. If this happens the airway can be lost and the patient can develop massive subcutaneous emphysema, pneumomediastinum, and cardiac arrest. Innominate artery rupture can also occur during a tracheostomy change, but this complication is very rare. Loss of the airway during a tracheostomy tube change with the development of respiratory failure may require the placement of an endotracheal tube before any further attempts are made to reinsert the tracheostomy tube (see the companion article on tracheostomy decannulation.[12]

Some patients may be fully anticoagulated, and this may need to be reversed if a difficult change is anticipated. Prophylactic doses of heparin used for deep venous thrombosis prophylaxis are usually not a problem for a tracheostomy change. If a difficult change is anticipated, a person skilled in airway management should be present and intubation equipment should be readily available. The use of a tube changer (Fig. 1) can help reduce but not eliminate the risk of airway loss and may be useful for patients in whom problems with tracheostomy change are anticipated (eg, a patient with an obese neck, known difficult airway, or granulation tissue). The tube changer is passed through the existing tracheostomy tube into the trachea. The tracheostomy tube is then withdrawn while keeping the tube changer in place, and the new tube is then passed over the tube changer into the trachea.

A fiberoptic tracheoscope can be very helpful to ensure correct placement of a tracheostomy tube (Fig. 2) and in addition allows for visual inspection of the airway anatomy, including the subglottic space. Patients with tracheostomy tubes may receive their care in long-term care hospitals, which do not always have easy access to anesthesia or surgery. These facilities need to be cautious in accepting patients in the first few days following tracheostomy placement and should have staff on site trained in management of the complex airway. Videolaryngoscopy

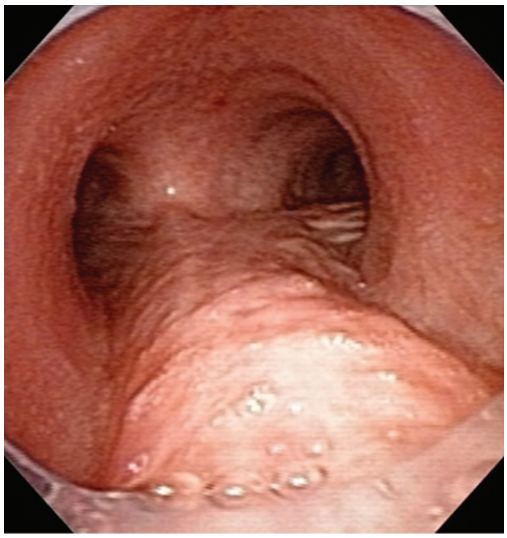

Fig. 2. Endoscopic view showing a correctly positioned tracheostomy tube.

Fig. 3. Mini-tracheostomy tube. (Courtesy of Smiths.)

can be helpful in intubating patients with complex airways in emergencies. A mini-tracheostomy tube (Fig. 3), with an inner-cannula diameter of 4 mm, can be useful in an emergency situation when accessing the stoma is difficult. These small-diameter tubes are easily placed through a small stoma and allow a manual resuscitator be attached to the tube to provide assisted ventilation.

The time taken for a tracheostomy stoma to close following removal of a tracheostomy tube is quite variable. Rapid stoma closure can make emergency reinsertion of a prematurely removed tracheostomy tube technically difficult. Dilators (Fig. 4), used carefully, may be helpful in reestablishing stoma patency for replacement of a tracheostomy tube that was prematurely removed. These should be used only by skilled personnel reinserting a tracheostomy tube in patients who fail recent decannulation.

Changing a Malpositioned Tracheostomy Tube

A malpositioned tracheostomy tube can have important clinical implications and may require the tube to be changed. Rumbak et al examined the role of tracheostomy tube occlusion in preventing weaning from mechanical venti-

Fig. 4. Dilators to enlarge a pre-existing tracheostomy stoma.

lation in a case series of 37 patients.[13] Tube malposition was found in about 5% of patients. The presentation of tube malposition included failure to wean, inability to pass a suction catheter down the tracheostomy tube, and intermittent high peak airway pressures recorded during mechanical ventilation. Changing to a tracheostomy tube with a longer length or inserting a tracheal stent allowed weaning to progress in 94% of the cases reported. Malpositioned percutaneously placed tracheostomy tubes have been reported, with tubes abutting either the lateral or membranous tracheal wall[14-16] following placement. Reorienting the bevel from lateral to posterior (in a small non-randomized study) appeared to correct the problem.[14]

In a more recent retrospective chart review of tracheostomy tubes malposition, by Schmidt et al,[6] 10% were found to be malpositioned. Time to discovery of malposition was about 12 days, and they suggested that the malposition can be "unmasked" during weaning from mechanical ventilation, as weaning may reduce the airway-dilating effect of positive pressure mechanical ventilation on the trachea. The most common finding in that study was partial or complete occlusion of the distal end of the tracheostomy tube by the posterior wall of the trachea.[6] Other causes of tracheostomy tube malfunction included granulation tissue occluding the airway, the tube being of incorrect size for the airway (either too short or too long), or the cuff not positioned correctly in the airway.[6] The incidence of tracheal granulomata, tracheomalacia, and tracheal stenosis was lower in that study, as compared with data in a prior study.[17] That was probably due to the longer duration of tracheostomy tube placement in the latter study.

The investigators also explored the clinical response to a malpositioned tube.[6] In 80% of cases, once malposition was discovered the tube was changed. Other responses to tracheostomy tube malposition included reinstituting mechanical ventilation or increasing the driving pressure in a patient already undergoing mechanical ventilation. In some cases, the malpositioned tube was successfully repositioned without the need for a change. Factors associated with tube malposition included lower patient height and placement by non-thoracic-specialty surgeons. A malpositioned tube was associated with a longer duration of mechanical ventilation (25 days, as compared with 15 days) but was not associated with any difference in hospital stay or overall mortality.

Fig. 5. Uncuffed tracheostomy tube.

These data reinforce the importance of the tracheostomy tube being visualized as being in the correct position, especially during mechanical ventilation and weaning from mechanical ventilation. Practitioners should have a low threshold for confirming correct positioning of the tracheostomy tube within the airway in those patients who are demonstrating increased work of breathing either during mechanical ventilation or during the process of weaning from mechanical ventilation.

Less Commonly Used Tracheostomy Tubes

In most patients a cuffed tracheostomy tube will suffice for their airway needs with the cuff deflated when not in use. However, other types of tubes are also available and can be useful in specific circumstances. Uncuffed tracheostomy tubes (Fig. 5) are used when there is a need for access to the airway but mechanical ventilation is not required. For example a patient with focal tracheomalacia who has a tracheostomy tube serving as an airway stent may be managed with an uncuffed tracheostomy tube. Sleep apnea tubes (Fig. 6) have a lower profile than regular tracheostomy tubes, are made of flexible silicone, and are more easily concealed from view than a tracheostomy tube. The sleep apnea tube may be capped when not in use. The button can be removed either to allow a suction catheter be passed into the trachea to remove secretions in patients who require intermittent suction for pulmonary hygiene, or to bypass the upper airway in patients with obstructive sleep apnea who cannot tolerate continuous

Fig. 6. Sleep apnea tube.

positive airway pressure via a face mask. The sleep apnea tube is also useful as a means to keep the tracheostomy stoma patent in a patient not deemed quite ready for decannulation but who no longer needs to be attached to a mechanical ventilator.

A tracheostomy tube with an adjustable flange (Fig. 7) can allow the distal end of the tracheostomy tube to be adjusted without having to replace the tube with one of the desired length. For example, in patients with pathology within the airway, such as granulation tissue or tumor, who are not candidates for further intervention, an adjustable-flange tube can allow the tube length to be easily increased over time to maintain a patent airway and palliate airway obstruction (Fig. 8). It is important to ensure the locking device on the flange is well secured after adjusting the tube length, to avoid the tube moving out of position and becoming occluded. By filling out a detailed order form, custom-made tubes of special size and length can also be ordered directly from some manufacturers for patients with specific airway needs. In some centers specially made plastic molds can be adapted to the flange of a tracheostomy tube to seal the tracheostomy stoma in a patient with a stoma leak that cannot be corrected surgically. Tracheostomy tubes with a suction port just above the cuff are available to help clear subglottic secretions and, theoretically, prevent aspiration pneumonia (Fig. 9). The efficacy of this method of removing secretions can be limited with thick tenacious secretions, which can easily block the tubing. To our knowledge the efficacy of this type of device in preventing ventilator-associated pneumonia has not been tested in randomized trials.

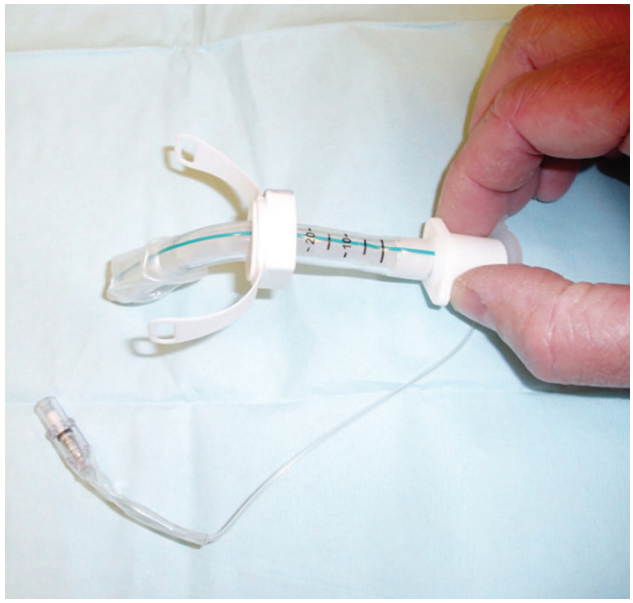

Fig. 7. Tracheostomy tube with an adjustable flange.

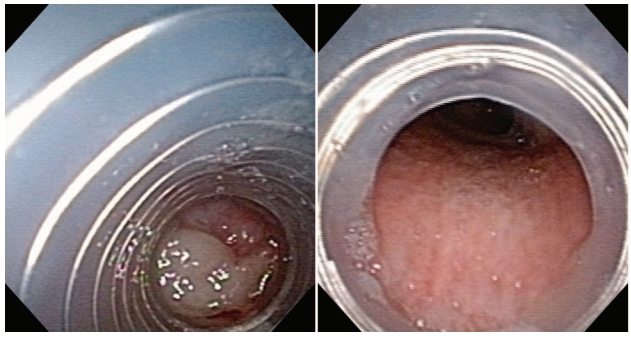

Fig. 8. Advancing a tracheostomy tube with an adjustable flange to bypass granulation tissue in the trachea.

Fig. 9. Tracheostomy tube with a suction port above the cuff.

Routine Tracheostomy Changes

There is little evidence to guide clinicians on when to change a long-term tracheostomy tube. There appears to be considerable variability in practice from one institution to another. Some of the reasons that are often considered to support routine tracheostomy tube changes include: prevention of granulation tissue formation around the tracheostomy tube,[18] prevention of the tube blocking from excessive secretions, and to facilitate weaning or speech by changing the size or type of tracheostomy tube. In an observational study,[18] fewer complications due to granulation tissue were reported after implementation of a policy where tracheostomy tubes were changed every 2 weeks. However, based on a Swedish study of 3 different types of polymeric tracheostomy tubes, those authors recommended routinely changing tracheostomy tubes every 3 months.[19] They based that recommendation on their findings of biofilm formation on the tracheostomy tube, which can affect the structural integrity of the tube and cause damage. Substantial surface degradation was observed on tracheostomy tubes kept in place for 3 or 6 months, as compared to that seen after one month. Whether that increase in biofilm formation causes an increase in pulmonary infections is still not clear.

Manufacturers include recommendations for routine changes of tracheostomy tubes in their product data sheets. The Shiley corporation recommends changing their polyvinyl chloride (PVC) tracheostomy tubes every 29 days. Similarly, the Portex Blue Line package insert recommends 30 days as the maximum recommended period of use. The Portex Bivona tube package insert recommends it be used for up to 29 days. Furthermore, many manufacturers recommend that a tube with an inner cannula should not remain in situ for more than 30 days.

The American Thoracic Society last published guidelines on care of a child with a long-term tracheostomy over a decade ago.[20] However the society has not published any guidelines on the frequency of changing a tracheostomy tube in an adult. PVC tracheostomy tubes (eg, Shiley) become progressively more rigid with use. Based on the guidelines, flexible PVC tubes may be used for 3 to 4 months before they stiffen. Alternatively, a metal tracheostomy tube may be used indefinitely, as long as there is no cracking of the soldered joint. The guidelines for a child with a tracheostomy could be extrapolated to adults, but there are no adult guidelines available to date.

Where should the tracheostomy tube be changed? In general, routine tracheostomy tube changes should be performed in the clinic, with periodic endoscopic airway inspection performed to check for granulation tissue, malposition of the tube, or other complications. High-risk patients with vulnerable airways and the need for home mechanical ventilation may need to have the procedure performed in the operating room. A growing number of patients with tracheostomy tubes are managed at home, some of whom require mechanical ventilation. In rare circumstances, for example in patients unable to travel to clinic due to comorbid diseases or other hardships, caregivers can be trained in how to change the tracheostomy. These patients must be selected carefully, and the caregivers who will be performing the change must be trained. Patients who rapidly decompensate when the tube is removed should not have the tube changed at home. Even in the most stable patient with well trained caregivers some risk associated with a home tracheostomy tube change will persist, and the risk/benefit ratio of the home tracheostomy tube change must be understood and accepted by all concerned. In our tracheostomy tube clinic we have discovered tracheostomy tubes placed in the anterior mediastinum following a change in a non-hospital setting that by report went smoothly. A CO_2 detector might be useful in the home setting to confirm correct tube placement under these circumstances but would require additional training in the interpretation of the color change on the device. Failure to replace the tube at the time of a routine change can rapidly create an emergency with loss of the airway. Figure 10 shows a suggested algorithm to help guide practitioners when this occurs. As a general rule we recommend changing tracheostomy tubes in the clinic and discourage the practice of changing them in the home.

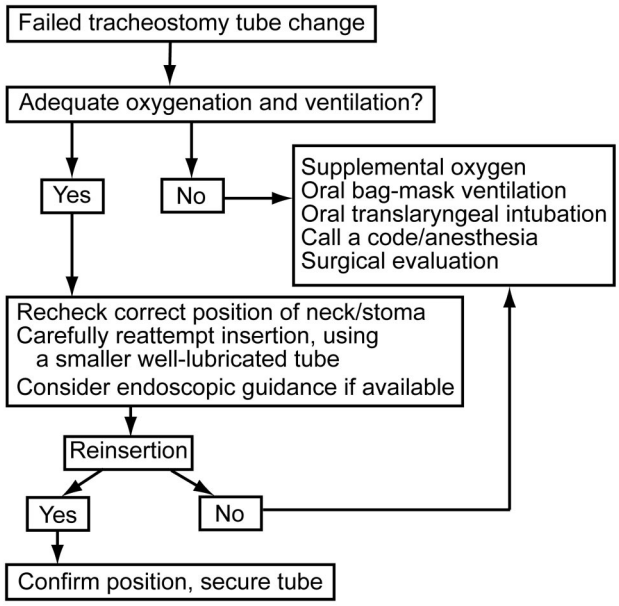

Fig. 10. Algorithm to manage failure to replace a tracheostomy tube during a routine change.

Based on current available information, for an inpatient, a PVC tube may be changed every 8 weeks, and silicone tube may be changed every 4 weeks. For an outpatient a tracheostomy tube may be changed every 8 to

12 weeks. It must be noted that "too" frequent changes of the tracheostomy tube may cause the stoma to stretch, especially with a cuffed tube.[20] Other problems that may occur include the creation of a false passage into the anterior mediastinum, bleeding at the site, and the patient may feel substantial discomfort.[20] An Australian study by Donnelly et al highlighted the patient sensation of undergoing a tracheostomy change as being more complex than simply a physical sensation.[21] There are additional risks associated with the tracheostomy tube change that are listed in the section discussing the first tube change above.

There is a risk of tracheostomy dislodgement during the tie placement, and it is important that one person maintain the airway by securing the tracheostomy tube in place, while the other person secures the tie. There is no consensus on the fit of the tie. A common rule of thumb is "tight enough to slip one finger beneath the tie."[20] The tie must be tight enough to secure the tube and loose enough to avoid skin breakdown and vascular obstruction. The tracheostomy tie changes should be performed as required, if they become wet or soiled (eg, due to secretions) to maintain skin integrity.

After a routine tracheostomy tube change it is imperative to document the date of change and the size of the tube in the clinical documentation if the procedure is done in an out-patient clinic. If the patient is in a hospital or long-term acute-care facility, this information should be documented at the bedside. Any patient with a tracheostomy tube should have a spare tube available in case of an emergency.

Summary

Changing an established tracheostomy tube is usually safe and easily done. The first tracheostomy tube change carries increased risk and should be performed by skilled providers. Airway endoscopy can help confirm the appropriately sized tracheostomy tube is in the correct position and help minimize complications.

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