Tracheostomy Care and Complications in the Intensive Care Unit

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Tracheotomy is a common procedure in intensive care units, and nurses must provide proper care to tracheostomy patients to prevent complications. One of the most important considerations is effective mobilization of secretions, and a suction catheter is the most important tool for that purpose. Each bedside should be equipped with a functional suctioning system, an oxygen source, a manual resuscitation bag, and a complete tracheostomy kit, which should accompany patients wherever they go in the hospital. Complications include infection, tracheomalacia, skin breakdown, and tracheoesophageal fistula. Tracheostomy emergencies include hemorrhage, tube dislodgement and loss of airway, and tube obstruction; such emergencies are managed more effectively when all necessary supplies are readily available at the bedside. This article describes how to provide proper care in the intensive care unit, strategies for preventing complications, and management of tracheostomy emergencies. (*Critical Care Nurse.* 2013;33[5]:18-22,24-31)

Tracheotomy is a common procedure for multiple medical indications.[1] To provide safe and competent care, nursing staff must understand the immediate postoperative and long-term management of tracheostomy patients. Each institution should have its own standard policies and procedures for caring for these patients. Basic minimal care usually consists of cleaning or changing the inner cannula, caring for the stoma, and suctioning at least 3 times a day. Depending on the thickness and quantity of secretions, more frequent inspection of the inner cannula may be necessary.

Tracheostomy tubes are made from various materials. Mitchell et al[2] recommend that a plastic tracheostomy tube be used for initial placement. Metal tracheostomy tubes are rigid, lack a cuff, and cannot be attached to a ventilator or a bag-valve mask. For these reasons and the cost of materials and production, metal tubes are not commonly used in hospitals today.[3] Some plastic tracheostomy tubes

CNE Continuing Nursing Education

This article has been designated for CNE credit. A closed-book, multiple-choice examination follows this article, which tests your knowledge of the following objectives:

1. Identify evidence-based recommendations for care, indications for placement, and general types of tracheostomies
2. Describe postoperative care of patients with a new tracheostomy
3. Describe the assessment and emergency interventions for patients with tracheostomy

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conform to a patient's anatomy as the plastic softens at body temperature, and silicone tracheostomy tubes can conform to the size and shape of a patient's trachea.[3]

In this article, we discuss management in the intensive care unit (ICU) of patients with a new tracheostomy. We include indications for tracheostomy, tube placement, patient care, prevention of complications, and emergency management.

Indications for Tracheotomy

Indications for placing tracheostomy tubes can be grouped into 4 general categories: ventilation, airway obstruction, airway protection, and secretions. The first category applies to patients who require long-term mechanical ventilation because of chronic respiratory failure, who cannot maintain respiratory function unassisted, or who cannot be weaned from ventilatory support. Numerous studies[4-9] have been done to determine the optimal interval from orotracheal intubation to placement of a tracheostomy tube, but no definitive recommendations have been made because of varied results in different populations of patients and in patients with different comorbid conditions. The American College of Chest Physicians[10] recommends consideration of a tracheostomy for patients who require an endotracheal tube for more than 21 days. Benefits of establishing a tracheostomy rather than using an endotracheal tube include decreasing direct laryngeal injury, improving comfort, and improving activities of daily living such as mobility, speech, and eating.[11]

Patients who have tumors within the airway, paralyzed vocal cords, swelling, stricture, or unusual airway anatomy are another category for tracheostomy because of airway obstruction that compromises normal respiration. A third category includes patients who cannot protect their airway and patients with an inefficient swallow and/or cough mechanism, common situations in patients who have a high spinal cord injury, cerebrovascular accident, or traumatic brain injury. Last, patients who cannot mobilize or manage their secretions may also require a tracheostomy.

Tracheostomy Placement

A tracheostomy tube may be placed surgically or percutaneously. Surgical placement is done in the operating room or at the bedside, generally with use of general anesthesia. A stoma is created by using an open surgical technique. Landmarks are identified, and a skin incision is made below the cricoid cartilage. The isthmus of the thyroid gland is exposed, cross-clamped, and ligated. The trachea can then be visualized. A common technique is to create a "trap door" (Björk flap) in which a small part of the tracheal cartilage is pulled down and sutured to the skin. This flap is thought to facilitate reinsertion of the tracheostomy tube if accidental decannulation occurs, especially in patients with difficult anatomy or obesity.[12,13]

Indications for placing tracheostomy tubes can be grouped into 4 general categories: ventilation, airway obstruction, airway protection, and secretions.

Percutaneous tracheotomy is generally performed solely on intubated patients and, unlike surgical tracheotomy, can be performed without direct visualization of the trachea. Bronchoscopy is used to guide and confirm placement of the tracheostomy tube within the trachea and is considered standard of care.[13] In contrast to an open surgical incision, a small opening is created with a needle and then dilated.[13] Contraindications to percutaneous tracheotomy include uncorrected coagulopathy, infection at the incision site, high ratio of positive end-expiratory pressure to fraction of inspired oxygen, elevated intracranial pressure, tracheal obstruction, unusual neck anatomy, and the need for emergency airway management.[11,14]

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Postoperative Care

Immediate postoperative priorities of care for a patient with a new tracheostomy include ensuring that the tracheostomy tube is securely in place and is patent. Routine care, as well as prompt management of postoperative complications, can be facilitated by ensuring that proper equipment and supplies are quickly available. Table 1 lists the contents of a tracheostomy kit that should be present at the patient's bedside and, per recommendations, should accompany the patient whenever he or she is away from the ICU.[2,15,16]

The American Academy of Otolaryngology Head and Neck Surgery recently published consensus statements for tracheostomy care.[2] These statements were developed by a multidisciplinary panel of experts on care of patients with a tracheostomy. Using a modified Delphi method, the panel members completed surveys on various aspects of care. Consensus was reached on 77 statements that address the initial change of the tracheostomy tube, management of emergencies and complications, prerequisites for decannulation, management of tube cuffs and communication devices, and specific needs of patients and the patients' caregivers. These statements are an important document because few randomized studies have addressed these issues, possibly because of the difficulty in study design and recruitment and because of ethical concerns. Table 2 provides some of these important statements.

Table 1 Bedside tracheostomy kit

- Tracheostomy tube of the same size and type currently in place
- Tracheostomy tube 1 size smaller than the one currently in place
- Obturator
- Suction catheters (usually 12F or 14F)
- Yankauer suction catheter
- Functional suctioning system, canister
- Manual resuscitation bag and oxygen
- Endotracheal tube of appropriate size
- Tracheostomy cleaning kit
- Disposable inner cannulas (not required for single-cannula tubes)
- 10-mL syringe (not required for cuffless tubes)
- Tracheostomy holder or ties
- Drain sponges
- Hydrogen peroxide
- Physiological saline
- Intubation equipment
- Oxygen source

Scheduled Changes of Tracheostomy Tubes

Currently, no empirical evidence indicates a standardized time for changing a tracheostomy tube, and changes are typically done according to the preference of the health care provider. White et al[17] suggest that indications for changing a tracheostomy tube include the need for a different size tube, tube malfunction, need for a different type of tube, and routine changes for ongoing airway management and prevention of infection. They suggest that a tracheostomy tube should be changed every 7 to 14 days after initial insertion, but they acknowledge that no evidence supports that recommendation. Mitchell et al[2] recommend replacing the initial tracheostomy tube within 10 to 14 days after placement if a percutaneous procedure was used to establish the tracheostomy and within 3 to 7 days if a

Table 2 Consensus statements for tracheostomy care

1. All supplies to replace a tracheostomy tube should be at the bedside or within reach.
2. If no aspiration, tracheostomy tube cuffs should be deflated when a patient no longer requires mechanical ventilation.
3. The first change of a tracheostomy tube should normally be performed by an experienced physician with assistance from another clinician.
4. Use of a defined tracheostomy care protocol for patient and caregiver education before discharge will improve patients' outcomes and decrease complications.
5. Patients and their caregivers should be informed of what to do in an emergency before discharge.
6. In an emergency, a dislodged tube from a mature tracheostomy should be replaced with the same size tube or a tube 1 size smaller or an endotracheal tube through the tracheostomy wound.
7. In an emergency, patients with a dislodged tracheostomy tube that cannot be reinserted should be intubated.
8. A patient should not be discharged from the hospital with the tracheostomy tube sutured in place.
9. Acute occlusion of a tracheostomy tube is most likely caused by a mucous plug, obstructing granuloma, or insertion of the tube into a false track.
10. A patient can be turned in bed once the security of the tube has been assessed to avoid accidental decannulation.

surgical procedure was used. A tracheostomy tube inserted percutaneously fits more tightly within the stoma than does a tube that was inserted through a surgical incision. If a tracheostomy tube is changed prematurely, the tissue of the dilated stoma tract is more likely to recoil than it would if the change were done later.[18] In addition, Mitchell et al[2] recommend that patients should not be discharged from the hospital with the tracheostomy tube sutured in place because the first tracheostomy tube change should be done before discharge.

Changing tracheostomy tubes can correct problems that cause ventilator asynchrony, improve comfort by reducing tube size, and correct a cuff leak due to tracheomalacia or malposition or fracture of the tracheostomy tube or flange.[17] Most manufacturers recommend changing the tubes every 1 to 2 months; however, Yaremchuk[19] found that routine tube changes every 2 weeks decreased the formation of granulation tissue. In a study by Björling et al,[20] electron micrographs of plastic tubes revealed visible surface changes after 30 days in all types of tubes studied: polyvinyl chloride, silicone, and polyurethane.

Cleaning and Replacing the Inner Cannula

The primary purpose of the inner cannula is to prevent tube obstruction by allowing regular cleaning or replacement. Many episodes of tube obstruction can be prevented with simple inspection and cleaning or changing of the inner cannula. Many plastic tubes are cleaned with a solution of full- or half-strength hydrogen peroxide and sterile water,[21-23] but some sources[24] recommend using physiological saline alone. Silicone tubes and metal tubes can be damaged by using hydrogen peroxide. The connection joints in metal tubes can be damaged by hydrogen peroxide and by enzyme cleaners, so these tubes should be cleaned by soaking in warm water with mild dishwashing liquid to soften secretions and then using a tracheal brush. Silicone tends to absorb cleaning products, so physiological saline alone should be used to clean silicone tubes. For these reasons, it is important to check manufacturers' instructions for cleaning tracheostomy tubes.[25]

No studies have been done to determine the optimal frequency for cleaning the inner cannula; however, the cannula should be inspected regularly, perhaps at least 3 times per day, depending on the volume and thickness of the patient's secretions.[21,25] Burns et al[26] maintain that inner cannulas do not need to be changed at all; however, their study had some limitations and was restricted to surgical patients who may not have had common comorbid conditions such as pneumonia.

Figure 1 Shiley tracheostomy tube cuffed with disposable inner cannula (DCT).

Image used by permission from Nellcor Puritan Bennett LLC, Boulder, Colorado, doing business as Covidien.

Some inner cannulas are designed to be disposable. These cannulas usually have a different method of attachment than nondisposable tubes do, and different types of disposable cannulas are not interchangeable (Figure 1). The ease of use of disposable cannulas (simple removal and replacement) makes them favored by nurses, but cost may be a factor for patients at home.[25,27] Table 3 gives the approximate costs of tracheostomy supplies. These costs vary widely on the basis of the materials and cost of production. For patients with a

Table 3 Approximate cost of tracheostomy supplies (2013)[a]

Item	Cost, $
Tracheostomy tubes:	
Plastic tubes	40-500
Silicone tubes	80-500
Stainless steel tubes	80-300
Silver tubes	300-2000
Custom tubes	500-5000
Disposable inner cannulas (plastic)	3-5
Tracheostomy ties	3-5
Speaking valves	60-150
Suction catheters	0.30-0.50
Drain sponges	0.25
Tracheostomy care kits	2-12

[a] Adapted from Parson and Morris.[28] Reproduced with the permission of Springer Publishing Company, LLC, New York, NY 10036.

long-term tracheostomy, inquiring about the care the patients receive at home is a good idea. The information should include the last time the tube was completely changed, use of inner cannulas, and suctioning at home.

With certain tubes, such as the DCT (disposable inner cannula), LPC (low-pressure cuffed), XLT (extended length) by Shiley (Covidien), or the TRACOE Twist (TRACOE Medical GmbH), patients cannot receive ventilatory support via a manual resuscitation bag or a mechanical ventilator when the inner cannula is not in place (Figure 2). In these tubes, the 15-mm connector, the standard connector for all respiratory equipment, is part of the inner cannula. A temporary inner cannula can be used while the standard inner cannula is being cleaned.

Cleansing the Stoma

The stoma should be cleaned every 4 to 8 hours.[23] The skin should be inspected for indications of irritation or infection, such as erythema, pain, or dried secretions. Erythema often occurs because of the continued presence of moisture against the skin. Patients with copious secretions often require frequent dressing changes to keep the skin dry and prevent maceration of tissue and skin breakdown. Gloves should be worn for cleansing the stoma. Cotton-tipped swabs or a gauze pad and physiological saline are applied in semicircular motion, inward to outward. Dried secretions can be loosened with diluted hydrogen peroxide and then rinsed away with physiological saline.[16]

A program of progressive mobility can help mobilize secretions and prevent deconditioning that often occurs in the intensive care unit.

Replacing the Tracheostomy Ties

Tracheostomy ties should be replaced as needed, according to facility-specific policy. To avoid inadvertent dislodgement of the tracheostomy tube, one person should hold the tube in place while a second person performs the tie exchange. Once the old ties are removed, the skin underneath the ties should be assessed. When the new ties are secure, only 1 finger should fit between the tie and the neck.[21,25]

Mobilization of Secretions

One of the most important aspects of care for any patient with a tracheostomy is mobilization of secretions.

Figure 2 Shiley low-pressure cuffed (LPC) tracheostomy tube without inner cannula.

Image used by permission from Nellcor Puritan Bennett LLC, Boulder, Colorado, doing business as Covidien.

Mobilization consists of 3 primary factors: adequate hydration, physical mobility, and removal of secretions.

Adequate hydration is necessary to keep secretions thin and mobile. Humidified tracheostomy collars provide some moisture but are not a source of hydration. An open tracheostomy usually requires added humidity to provide comfort and prevent drying of mucous membranes and thickening of secretions. For hospitalized patients, humidity can be provided by using a heat and moisture exchanger, a T-piece, or a tracheostomy mask.[23] A capped tracheostomy tube restores the natural moisture of the upper part of the airway.

Deconditioning is a common problem in ICU patients with a tracheostomy and can be prevented with regular physical mobility.[29] A program of progressive mobility, combined with range-of-motion exercises, especially of the upper extremities, will also help mobilize secretions.[25] Having the patient sit in a chair helps maintain a position of function; the diaphragm is used more effectively, allowing a more effective cough.

Removal of secretions can be achieved by suctioning and allowing the patient to cough. Suctioning should be an integral part of the assessment of tracheostomy patients. Easy passage of the suction catheter and return of tracheal secretions confirms proper placement of the tracheostomy

tube. Shapiro et al[30] established that vital capacity should be at least 15 mL/kg to clear secretions. When cough strength is less than 15 mL/kg, or the cough reflex is diminished, more frequent suctioning may be required.

Cuff Pressure

The purpose of the cuff is to provide a closed system to allow effective ventilation and/or airway protection. Cuff pressure should be 20 to 25 cm H_2O with most tracheostomy tubes.[21,25] Monitoring cuff pressure is important because underinflation of the cuff promotes leakage of secretions around the cuff, a situation that can contribute to ventilator-associated pneumonia.[25] However, overinflation of the cuff can cause numerous long-term complications, including tracheomalacia, tracheoinnominate artery fistula, tracheal ulcerations, fibrosis, tracheal stenosis, and tracheoesophageal fistula.[21]

If a leak around the cuff persists, the pilot balloon maybe ineffective in sealing the airway or the trachea may have lost its rigid composition. A persistent leak will be manifested by audible noises around the tracheostomy tube and loss of returned volumes with ventilation. For example, if the tidal volume is set at 700 mL, and the returned volumes are only 500 mL, the patient is not getting the benefit of the entire tidal volume. If the cuff continues to require more air to seal the airway, the pilot balloon may be ineffective,[25] the tracheostomy tube may be too small for the airway, or tracheomalacia may have developed.[31]

Patient education on care of the tracheostomy tube and stoma is of utmost importance in preventing many complications.

Patient and Caregiver Education

Patient education on care of the tracheostomy tube and stoma is of utmost importance in preventing many complications. The Joint Commission[32] has identified the safety implications of patient education. Patients and caregivers should be taught how to perform basic care of the tracheostomy, including the importance of changing the tracheotomy tube as scheduled, cleaning or replacing the inner cannula, cleansing the stoma, and replacing the tracheostomy holder or ties.

The clinical consensus statements on tracheostomy care[2] recommend that when possible patient and family education should begin before the tracheostomy is done. Before discharge, patients and their caregivers should receive a checklist of supplies that should be taken with the patient at all times. Patients and caregivers should be evaluated before discharge to assess their competency in caring for the tracheostomy. They should know what to do in an emergency. They should be informed of the type, size, and length of the tracheostomy tube; how and when to use suctioning; how to clean the stoma and the tube itself; how to change the ties; indications of respiratory distress; how to use all home equipment; and signs and symptoms of infection and skin breakdown. Finally, a home care instruction manual should be given to patients and caregivers before the patient is discharged.[2] Most manufacturers of tracheostomy tubes provide a home care manual for their products. Otherwise, Northwest Memorial Hospital in Chicago has published an instruction manual[33] that can be downloaded from the Internet. Emergencies at home are an essential part of the discharge discussion. Possible home emergencies should be discussed before discharge, ideally allowing patients and their family members to discuss and demonstrate key skills such as suctioning, use of the manual resuscitation bag, and reinsertion of the tracheostomy tube.

Tracheostomy Emergencies

The 3 most common tracheostomy emergencies are hemorrhage, tube dislodgement, and tube obstruction (Table 4).

Hemorrhage

Perioperative complications of a new tracheostomy include hemorrhage at the stoma or into the trachea itself. Bleeding at the site and the vessels surrounding the incision may be a concern. A small amount of bleeding is expected after the initial procedure and after every tracheostomy tube change. This small amount of bleeding is normally self-limited. If bleeding is more than minimal or if it continues, the surgeon should be contacted. Such

Table 4 Tracheostomy emergencies and complications

Emergencies	Complications
Hemorrhage (tracheoinnominate artery fistula)	Infection
Tube dislodgement and loss of airway	Bleeding
Tube obstruction	Tracheomalacia
	Skin breakdown
	Tracheoesophageal fistula

bleeding may indicate that the site should be explored, and a vessel may require ligation.[34]

Fortunately, one of the most deadly complications, tracheoinnominate fistula, is rare. In this complication, the innominate artery is eroded through the trachea, causing exsanguination within minutes. The reported incidence[35] is 0.7%, and the mortality rate[36-38] is almost 100%. This massive hemorrhage can be due to pressure necrosis from cuffs with high pressures, improper placement of the cannula tip (from direct weight or torque on the tracheostomy tube from the ventilator circuit), low placement of the tube, hyperextension of the head, radiotherapy, and steroid use. Most often, the complication occurs 3 to 4 weeks after the surgery.[37] Management includes oxygenation, cuff overinflation to tamponade the bleeding, and translaryngeal intubation with direct digital compression,[39] followed by immediate surgery for repair.[40] In some studies[37,41] the fistula was successfully treated with endovascular embolization.

Tube Dislodgement and Loss of Airway

Another potentially deadly complication is tube displacement during the early postoperative period before the stoma has healed. Tubes can be displaced completely (decannulation) or partially (dislodgement) when the tip of the tube lies within a false passage anterior to the trachea (Figure 3). Predisposing factors include loose ties, edema of the neck, airway edema, excessive coughing, agitation, undersedation, morbid obesity, a tracheostomy tube that is too short for the tract, the technique used to place the tracheostomy tube, and downward traction caused by the weight of the ventilator circuit.[40,43,44]

Complete healing of the stoma typically takes approximately 1 week, and the stoma can quickly collapse if the tube is dislodged or inadvertently removed before that time. Dislodgement of the tracheal tube during the first postoperative week is considered a medical emergency; therefore, tube security is a priority. If a tracheostomy tube is inadvertently dislodged shortly after surgery, the tissue planes are likely to collapse, making simple replacement of the tube impossible.[44,45] If a tube is dislodged, supplies, including suctioning equipment, a new tracheostomy tube with obturator, oxygen, and equipment for inserting an endotracheal tube, should be readily available at the bedside to manage the situation.[23]

When dislodgement occurs, quick recognition and prompt action are key to success. If a suction catheter

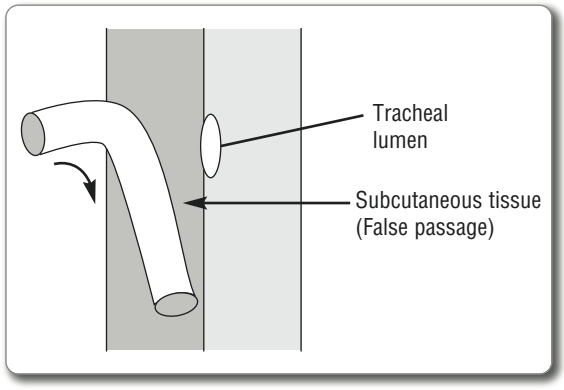

Figure 3 Tracheostomy tube is placed anterior to trachea within a false passage.

Adapted from Morris.[42] Reproduced with the permission of Springer Publishing Company, LLC, New York, NY 10036.

cannot be inserted, the tube could be located within a false passage or obstructed by a mucous plug. Table 5 describes the differences between tube dislodgement in a patient who is receiving mechanical ventilation and a patient who is breathing spontaneously in no acute distress. Subcutaneous emphysema or crepitus can occur within the initial incision and move through the stoma into the trachea, allowing air to escape in between the 2 openings. Subcutaneous emphysema, which feels like bubble wrap when palpated, can also be palpated in an inadvertent dislodgement when positive pressure is applied to the tube within a false passage.

Efforts to prevent tube dislodgements will help avoid catastrophic consequences. Preventive measures include keeping tracheostomy ties secure and snug (no more than a single finger should fit under the ties), removing added weight and traction from the ventilator circuit, keeping the tracheostomy tube in a midline and neutral position, and minimizing transport of the patient as much as possible. Tube security should be checked frequently and always before the patient is moved in any way.[43]

When dislodgement occurs, quick recognition and prompt action are key to success.

Complete decannulation occurs when the tube is completely withdrawn from the stoma. Quick recognition is important because the stoma will begin to close; the newer the stoma, the more quickly it will close. Proper management depends on the maturity of the stoma. An immature stoma (<1 week old) will close quickly, so the

Table 5 Indications of tracheostomy tube dislodgement in a patient receiving mechanical ventilation compared with a patient who is breathing spontaneously[a]

Feature	Patient receiving mechanical ventilation	Patient breathing spontaneously
Ventilator alarms	High-pressure alarm sounds	Not applicable
Use of manual resuscitation bag	Great resistance	Great resistance
Passage of suction catheter	Inability to pass suction catheter more than 5-7 cm (length of tube)	Inability to pass suction catheter more than 5-7 cm (length of tube)
Placement of tracheostomy tube	Neck flange not flush with the neck (displaced 1-2 cm)	Neck flange not flush with the neck (displaced 1-2 cm)
Ability to manipulate tube	Inability to manipulate tracheostomy tube so that neck flange lies flush with neck	Inability to manipulate tracheostomy tube so that neck flange lies flush with neck
Saturation	Usually rapid desaturation	Depends on patient's ability to breathe around the tube
Subcutaneous emphysema	May occur with forceful use of manual resuscitation bag	May occur with forceful use of manual resuscitation bag
Patient's voice	May be heard if patient can breathe around the tube	May be heard if patient can breathe around the tube

[a] Adapted from Morris and Afifi.[45]

likelihood of successful tube replacement within the stoma is very low.[46] Immediate treatment in complete decannulation includes mask ventilation and then orotracheal intubation.[44-47]

In complete decannulation in a patient with a mature stoma (>1 week old), the rate of closure of the stoma depends on how long the tube has been decannulated. If the problem is discovered quickly, the tube can usually be easily replaced. However, with time, the stoma will begin to close. In general, a mature stoma can close up to 50% within 12 hours and up to 90% within 24 hours; complete closure may take up to 2 weeks. For that reason, it is important to keep a tube of the same size and one a size smaller at the bedside at all times. Replacement of the tube is done by first removing the inner cannula and inserting the obturator into the outer cannula. The purpose of the obturator is to cushion the tip of the tube upon insertion. In some instances, the tube itself may be quite flexible, and the obturator can also act as a stylet to provide structure and control as the tube is reinserted.

The tube is initially inserted at a 90° angle to decrease the likelihood of entering a false passage. Then the tube in angled downward 90° more into position on the vertical plane and the obturator is removed.[42]

Tube Obstruction

Figure 4 is an algorithm for managing tube obstruction. The first step in caring for a tracheostomy patient in respiratory distress is to remove and inspect the inner cannula. If the cannula is clogged with secretions, it can be quickly cleaned and/or replaced with a new one. If the patient remains in distress, the nurse should immediately call for help and then attempt to insert a suction catheter. Easy passage of the suction catheter with return of tracheal secretions confirms that the tube is in proper position. If resistance is encountered during passage of the suction catheter, the tube may be partially obstructed with secretions. If a suction catheter cannot be passed, or can be passed only a few centimeters (the length of the tracheostomy tube), the tube may be clogged with secretions or lodged within a false passage. At that point, management differs, depending on the maturity of the stoma. In a patient with a mature stoma, the entire tube should be replaced.[43] When the stoma is immature, mask ventilation with the cuff *deflated* is usually the best intervention, and then an orotracheal tube should be inserted.[48] After the airway is secure, the tracheostomy can be revised under more controlled circumstances.

Other Tracheostomy Complications

Other tracheostomy complications include infection, bleeding, tracheomalacia, skin breakdown, and tracheoesophageal fistula. When a patient has a tracheostomy, the natural functions of warming, filtering, and humidifying the airway are also lost. In addition, intrinsic positive end-expiratory pressure is lost because of the loss

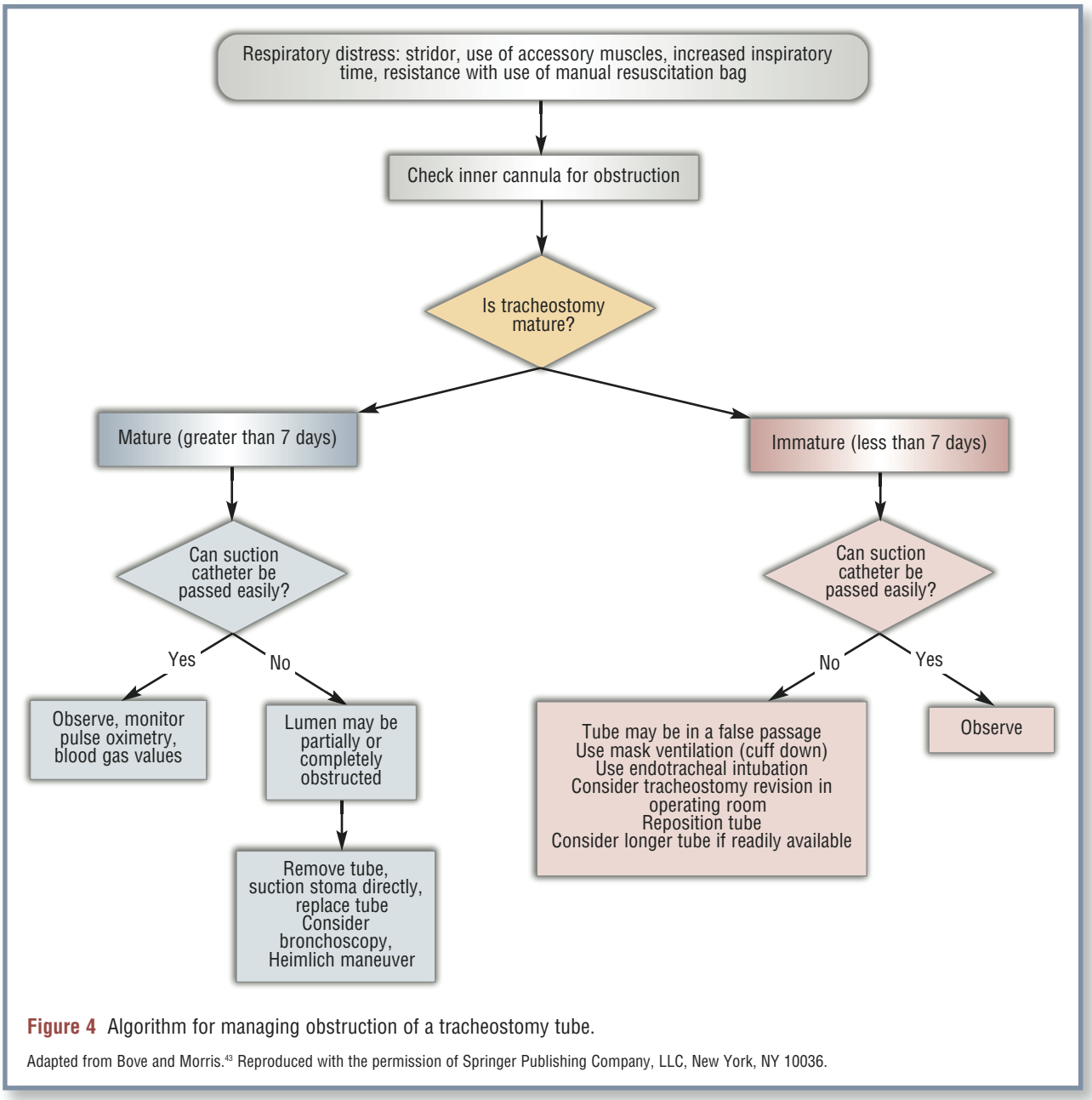

Figure 4 Algorithm for managing obstruction of a tracheostomy tube.

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of subglottic pressure.[49] Without these natural mechanisms, patients are prone to infection. Loss of the natural filtration and humidification can lead to production of thick sputum, which makes mucous plugs more likely.

Infection

Measures to prevent ventilator-associated pneumonia should be in place, including elevation of the head of the bed, mouth care, and gastrointestinal prophylaxis. Lung infections are treated with appropriate antibiotics. Cuff pressure should be optimized to ensure that no leakage of secretions around the cuff occurs. However, the cuff should not be overinflated, because overinflation can contribute to the development of tracheomalacia and tracheal stenosis.[38,43]

The tracheostomy site should be inspected for indications of inflammation and infection, such as increased redness, swelling, odor, and drainage. Stomal infections can be stubborn, but they can be effectively treated locally with silver-infused products such as primary wound dressings made from sodium carboxymethylcellulose containing 1.2% silver in an ionic form (Aquacel Ag), silver-impregnated nylon dressings (Silverlon), or colloidal silver gel.[31]

Bleeding

Because of tracheal irritation, patients who require frequent suctioning may experience bloody or blood-tinged secretions.[23] Many clinicians tend to suction less often in response to bloody secretions; however, less frequent suctioning could lead to accumulation of thicker secretions, making mucous plugs a concern. A better choice is to switch to red rubber suction catheters. The soft blunt tip of a rubber catheter does not irritate the tracheal wall, and tracheal healing is more rapid than with a regular suction catheter. Red rubber catheters cannot, however, be used in patients with a latex allergy because latex is a product of rubber.

Tracheomalacia

As mentioned earlier, tracheomalacia can occur with sustained overinflation of a cuffed tracheostomy tube and can be definitively diagnosed by using bronchoscopy. Tracheomalacia is the breakdown of the natural rigid structure of the trachea that leads to a flaccid airway in the affected area.[31,38,50] Tracheomalacia is common in the ICU and can occur in tracheostomy patients beginning 1 week after the tracheotomy procedure. It is manifested by the presence of a cuff leak (air escaping around the cuff) combined with overinflation of the cuff and high cuff pressures. Another contributing factor is traction from the weight of the ventilator circuit, including in-line devices such as suction systems, heat-moisture exchangers, and filters. Methods to prevent tracheomalacia are directed toward the cause: keep the tracheostomy tube in neutral position, limit traction against the tube, and avoid overinflation of the cuff. Short-term treatment for tracheomalacia is placement of a longer tracheostomy tube to bypass the affected area.[31,50]

The first step in caring for a tracheostomy patient in respiratory distress is to remove and inspect the inner cannula.

Skin Breakdown

Downward traction of the tracheostomy tube can occur with too much weight pulling down on it, as discussed previously. Traction against the tube can be directed out and downward by pulling against the tube or inward, with the neck flange digging into the neck. These traction forces must be prevented and the tube kept in a neutral position. In addition to tracheomalacia, tube dislodgement, and inadvertent decannulation, traction can also be a factor in skin breakdown. Inward traction can contribute to skin erosion under the neck flange; outward traction can contribute to erosion, dislodgement, decannulation, and enlargement of the stoma from the inside.

Skin integrity can be compromised at any time in a patient with a tracheostomy. Regular skin inspection is important to prevent complications. Keeping the site as dry as possible with drain sponges or skin barrier dressings such as those made from carboxymethylcellulose (Aquacel), polyurethane foam (Lyofoam), or silicone foam (Mepilex) can prevent skin breakdown and prevent infection. Skin care may be difficult while the sutures remain in place until the stoma matures. The use of cotton-tip applicators can help in reaching the tight places. When a cotton-tip applicator is soaked with hydrogen peroxide and sterile physiological saline, dried blood and secretions can be more easily removed, especially from tight spaces.

Maintaining the tracheostomy tube in a continuous neutral position can ensure skin integrity while a patient is receiving oxygen via mechanical ventilation or some other delivery device. A continuous neutral position can be achieved by making sure the oxygen delivery devices are not putting any weight on or pulling on or twisting the tracheostomy tube or by placing a bolster (rolled towel) under the ventilator circuit. Areas of skin breakdown should be staged and treated as necessary. Protective dressings can be used as needed to provide a cushion, collect secretions, and encourage timely healing. Several dressing products are available that guard against skin breakdown from flange pressure and are extraabsorbent to soak up excessive tracheal secretions. However, packaged precut tracheostomy gauze is often sufficient to protect the peristomal skin. The gauze should not cover the opening of the tracheostomy tube.[21] Table 6 lists types of stomal dressings and indications for their use.

Tracheoesophageal Fistula

Tracheoesophogeal fistula occurs when the trachea and the esophagus communicate through an adjacent perforation in each. A hallmark of tracheoesophageal fistula is the presence of tube feedings within the tracheostomy tube. This type of fistula can be due to overinflation of the cuff in patients who also have a feeding tube or to direct trauma during the tracheotomy procedure.

Table 6 Stomal dressings

Type of dressing	Condition used to treat
Gauze drain sponges	Minimal to moderate secretions (manageable)
Polyurethane foam (Lyofoam)	Copious secretions
Hydrocolloid (DuoDERM) (Can be used as a platform to protect skin, then covered with drain sponge to collect secretions)	Copious secretions Potential skin breakdown Actual skin breakdown
Silicone foam (Mepilex) (Can be used as a platform to protect skin, then covered with drain sponge to collect secretions)	Copious secretions Cushioning skin from neck flange Potential skin breakdown Actual skin breakdown
Carboxymethylcellulose impregnated with ionic silver (Aquacel Ag)	Stomal infection (local)
Nylon impregnated with silver (Silverlon)	Stomal infection (local)

Signs and symptoms include copious secretions, dyspnea, signs and symptoms of aspiration, cuff leak, and gastric distention.[38,43] Tracheoesophageal fistula is diagnosed on the basis of findings on computed tomography or barium esophagography. Treatment includes placement of a double stent in both esophagus and trachea or surgical repair.[50,51]

Nursing Strategies

ICU nurses have an instrumental role in preventing complications in patients with tracheostomies and in identifying problems before the problems become emergencies.

1. A suction catheter is the most important tool. Passing a suction catheter well beyond the length of the tube ensures that the tube is in the proper position, and suctioning removes secretions and stimulates a strong cough, which can mobilize more secretions.

2. The stoma should be kept clean and dry to prevent skin breakdown. Cotton-tipped swabs should be used to clean the stoma behind the neck flange at least once per shift.

3. The tracheostomy tube should be kept in a neutral position. Traction forces should be removed and the tube supported as necessary by using the ventilator support arms, or a strategically placed towel roll.

4. If inserting a suction catheter is difficult, a tracheostomy evaluation should be requested, even if the patient is in no distress. Recognizing potential problems before an emergency develops is important.

Table 7 Information to include in hand-off of patients with tracheostomy

Date tracheostomy tube was placed
Tracheostomy tube type
Tracheostomy tube size
Cuffed or cuffless If cuffed, type of cuff (low pressure or high pressure)
Cuff status (inflated or deflated)
Cuff pressure
Secretions: type, amount, color, odor
Frequency of suctioning
Last time inner cannula was changed or cleaned
Last time entire tracheostomy tube was changed
Last time the tube was suctioned

5. After the patient no longer requires ventilatory support, cuffs should be deflated and remain deflated, unless airway protection is a concern. Furthermore, because an inflated cuff interferes with the swallow mechanism, patients with an inflated cuff should not be fed orally.[52]

6. Each time bedside report is given, information pertinent to the tracheostomy should be passed on to the next shift. This information is summarized in Table 7.

Conclusion

Placement of a tracheostomy is a common procedure that can help liberate a patient from mechanical ventilation. Consistent tracheostomy care is essential to prevent complications and includes cleaning or replacing the inner cannula, cleaning the stoma, and changing tube ties as needed. Suctioning is an essential part of the routine assessment of a patient with a tracheostomy to confirm proper placement of the tracheostomy tube, stimulate production of secretions, and facilitate removal of secretions. CCN

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To learn more about caring for patients with a tracheostomy, read "Peak Flow Rate During Induced Cough: A Predictor of Successful Decannulation of a Tracheotomy Tube in Neurosurgical Patients" by Chanet al in the *American Journal of Critical Care*, 2010;19:278-284. Available at **www.ajcconline.org**.

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