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Tracheotomy and Mechanical Ventilation

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Patients Requiring Tracheotomy and Mechanical Ventilation

A Model for Interdisciplinary Decision-Making

by Carrie Windhorst, Ricque Harth, and Cheryl Wagoner

Learning Objectives

● Identify the role of speech-language pathologists (SLPs) in tracheology patients

● Identify what is meant by co-evaluation and treatment in tracheology patients

● Identify what is meant by one-way speaking valve assessment

● Identify how quality of life is improved by the actions of SLPs

Introduction

Patients with respiratory failure and distress are now surviving with the help of medical advances including tracheostomy tubes and mechanical ventilation. At the Madonna Rehabilitation Hospital in Lincoln, Neb., we accept patients with tracheostomy tubes; in this 185-bed inpatient hospital, the number of patients who require a tracheostomy tube or mechanical ventilation has increased 19% over the last five years. Between July 2007 and June 2008, 188 patients were admitted with tracheostomy tubes, 116 of whom required mechanical ventilation during part or all of their stay. While some acute rehabilitation hospitals do not accept vents, our hospital has a unique program in which we work on trach and vent weaning.

These patients often are medically fragile with a complex variety of diagnoses including respiratory failure, spinal cord injury, cardiac complications, cerebrovascular accident, and neurological disorders. Ages vary but the majority of patients are adults. Speech-language pathologists help these patients regain verbal communication and return to oral intake of food—both quality-of-life issues.

Few SLPs enter the field confident in their knowledge and skills related to working with ventilators and tracheostomy tubes. ASHA has developed position statements and practice guidelines stating that "not all SLPs are equally experienced in the advanced technologies pertinent to these devices during their academic and clinical fellowship years...a significant portion of professional training must be conducted in settings that allow the SLP to gain appropriate background and experience" (*Asha*, 1993, p. 18). ASHA's Code of Ethics requires that SLPs "provide all services competently" (Principle of Ethics I, Rule A, ASHA, 2003). Therefore, SLPs working with individuals with trachs and vents must have appropriate training and experience. Based on our experiences with admissions from other rehabilitation facilities, there is variance in clinical practices for the assessment and treatment of patients with tracheostomy tubes and mechanical ventilation.

Co-evaluation and Treatment

Our communication disorders and pulmonary departments collaborated to develop an interdisciplinary flow chart (Figure 1 [PDF]) that outlines a protocol for assessment and treatment planning for patients who require a tracheostomy tube or mechanical ventilation. The protocol does not include patients with oral or nasal endotracheal tubes.

Figure 1. Flow chart for the assessment and treatment planning for patients requiring a tracheostomy tube or mechanical ventilation.

Madonna Rehabilitation Hospital
Tracheostomy Tube Weaning Pathway
Operational Definition 2096
Initial Patient Evaluation and Assessment Performed by Licensed Respiratory Care Practitioner (LRCP) and Speech-Language Pathologist
"Stop" criteria
- HR ↑ > 20 BMP
- RR > 35
- Spo2 < 90
- FiO2 ≥ 60%
- RPD > 6

I. Tracheostomy tube cuff deflation (performed by LRCP)
"Stop" criteria present:
- YES: LRCP will re-inflate trach cuff. LRCP and SLP will reassess patient and/or consult physician before progressing
- NO: Advance to One-Way Valve Trial.

II. One-way valve trial (valve placed by LRCP)
"Stop" criteria present:
- YES: LRCP will remove valve. LRCP or SLP will consult with physician for possible downsizing of tracheostomy tube
- NO: Advance to One-Way Valve as tolerates

III. One-way valve as tolerates (patient increases use of one-way valve throughout day and evening hours)
"Stop" criteria present:
- YES: Reassess patient to determine barriers
- NO: Advance to Tracheostomy Tube Capping for appropriate patients

IV. Tracheostomy tube capping trials
Appropriate patients include: non-ventilator dependent patients and patients on nocturnal ventilation and/or PRN mechanical ventilation that have met all previously noted criteria.

Repeat steps III and IV using tracheostomy tube cap.

“Stop” criteria present:
 YES: Consider additional trach tube downsizing. Persistent inability to tolerate trach tube capping may require physician consult
 NO: Once patient can tolerate trach cap without interruption for a minimum of 48 hours, LRCP may request physician order to decannulate

The protocol provides objective criteria for patient tolerance of a one-way speaking valve, a critical step in the process of safe, efficient tracheostomy tube weaning. With the placement of a one-way valve, the SLP and licensed respiratory care practitioner (LRCP) can accurately assess the patient's speech, voice, and swallowing, and begin to wean the patient. By following the protocol and "stop" criteria outlined in the flow chart, the SLP and LCRP can determine whether or not the patient safely tolerates the valve and if not, what other steps to take.

The chart is designed to guide the process for tracheostomy tube weaning, and allows for completion of critical assessment by SLPs in evaluating speech, voice, and swallowing. During the past fiscal year, we have used the protocol to wean successfully 58% of patients requiring a tracheostomy tube and 57% of patients requiring mechanical ventilation.

Depending on a patient's specific diagnosis, initial evaluation consists of an assessment of speech, language, cognitive communication, voice, and swallowing. Evaluation of patients with a ventilator and/or tracheostomy tube requires additional steps and more equipment but is otherwise the same as for any other patient.

Standing admission orders call for completion of an initial one-way speaking valve assessment by both an SLP and LRCP within 48 hours. An SLP must complete a one-way speaking valve assessment prior to evaluating speech, voice, and swallowing. The flow chart provides a step-by-step decision-making process, with measurable criteria for documenting a patient's outcome in using the valve. The chart also guides the subsequent treatment plan for documenting a patient's outcome using a one-way speaking valve; these outcomes guide the subsequent treatment plan with the establishment of goals to address noted deficits in speech, voice, and swallow.

The one-way speaking valve assessment is the same for patients who are on a ventilator or have a tracheostomy tube. The SLP should be knowledgeable about ventilator modes, oxygen needs, type and size of the tracheostomy tube, the patient's vital signs—respiratory rate, heart rate, and saturation percentage of oxygen (see glossary [PDF]), and the basic anatomy for speech and swallowing and how it relates to a tracheostomy tube placement.

When a tracheostomy tube is in place, the upper airway is eliminated and patients inhale and exhale through the tracheostomy tube. When the tracheostomy cuff is deflated for placement of a one-way speaking valve, the upper airway is restored, allowing a patient to inhale through the tracheostomy tube and exhale through the mouth and nose. An SLP can then assess secretions, sensation of secretions with the presence or absence of a reflexive throat clear and cough, reflexive swallow response, and ability to phonate. Without a one-way speaking valve, this critical portion of the assessment can not be completed.

Following the protocol, the one-way speaking valve assessment involves four major steps:

1. Initial cuff deflation. The result often is a significant amount of pooled secretions being cleared from the pharynx, which frequently requires additional tracheal and/or oral suction for adequate management. The excess secretions are a natural response to the tracheostomy tube and may be present for several trials with the one-way speaking valve. Patients without tracheostomy tubes typically manage secretions by swallowing or through the evaporation process by breathing. The more time that passes without cuff deflation, the more secretions will pool in the pharynx. The resulting fear of aspiration often leads to recommendations that a patient cannot use a one-way speaking valve. Aspiration—the passage of food or liquid below the level of the vocal folds—can occur if the tracheostomy cuff is inflated or deflated. The SLP's goal is to decrease aspiration risk for patients with tracheostomy tubes by improving secretion management through increased one-way speaking valve use. If no indications lead to a "stop" on the flow chart, the evaluation continues.

2. Placement of the one-way speaking valve inline with the ventilator or on the tracheostomy tube itself after suctioning if needed. The SLP and LRCP again evaluate tolerance of the one-way speaking valve by referring to the "stop" criteria. The SLP next evaluates speech, voice, and swallowing and provides recommendations and referrals for oral/pharyngeal exercises, therapeutic trials, further instrumental swallow study, or ENT consultations as appropriate.

3. Valve toleration. The SLP and LRCP obtain a physician order for the patient to wear the one-way speaking valve as tolerated. The patient wears the valve for increasing amounts of time.

4. Tracheostomy cap trials. The LRCP begins these trials after the patient successfully wears the one-way speaking valve with the ultimate goal of decannulation.

Clinical Benefits

A one-way speaking valve provides numerous clinical benefits. It restores positive airway pressure, creating a more normal respiratory system that allows for louder voice, stronger cough, improved secretion management, and increased oxygenation. It can improve swallowing function and reduce aspiration.

When a tracheostomy tube is in place, the upper airway is bypassed. The patient has decreased airflow through the upper airway with a loss of sensation in the pharynx. With sensation in the pharynx eliminated, so is the need to swallow, resulting in increased secretions and decreased swallowing, often leading to dysphagia. When the tracheostomy cuff is deflated and the one-way speaking valve is placed in line with the ventilator or on the tracheostomy tube, the patient's closed respiratory system is restored, increasing sensation and subglottic air pressure, and allowing the patient more strength in coughing to clear pooled secretions from the pharynx.

Case Studies

Study #1

A 49-year-old male admitted eight weeks after a motorcycle accident had a C1-C2 fracture with tetraplegia. The patient required a tracheostomy tube and mechanical ventilation. He was on a puree diet with thin liquids and communicated by mouthing words, with increased repetition needed for accuracy. The SLP at the transferring hospital found that an eye-gaze computer system allowed him to communicate and had ordered one at an estimated cost of $8,000. Transfer records indicated a one-way speaking valve had never been used to assess his swallowing, speech, and voice.

The LRCP assisted with the initial speech evaluation, deflating the tracheostomy cuff and placing the one-way speaking valve in line with the ventilator tubing. Initially the patient could produce minimal voicing with the one-way speaking valve. The SLP completed a fiberoptic endoscopic evaluation of swallowing (FEES). Results showed the patient was aspirating thin and nectar liquids due to premature transfer and decreased airway protection. We changed his diet to puree solids with honey-thickened liquids.

After several days of using the one-way speaking valve, the patient could communicate independently with adequate voicing. After two weeks of a swallowing exercise program, a second FEES detected no aspiration; his diet was upgraded to thin liquids and mechanical soft solids, as he was edentulous. The patient continued to require long-term mechanical ventilation because of his spinal cord injury.

Study #2

An 18-year-old female admitted four weeks after a car accident had a C6-C7 fracture. The patient required a tracheostomy tube and mechanical ventilation. She was admitted on a thin liquid diet and communicated by mouthing words. Medical records indicated a one-way speaking valve had not been tried.

The LRCP assisted with the initial speech evaluation, deflating the tracheostomy cuff and placing the one-way speaking valve in line with the ventilator tubing. The patient then was able to vocalize adequately at the sentence level. She had decreased vocal intensity due to weak respiratory muscles. A FEES observed no aspiration, indicating a normal swallow with no pharyngeal or laryngeal impairments. We recommended that she start on a regular diet with thin liquids. The patient was successfully weaned off the ventilator and decannulated within four weeks after admission.

Improving Quality of Life

SLPs are in a pivotal role to advocate for ventilator and/or tracheostomy patients to wear their one-way speaking valves. Our protocol provides us the ability to advocate for patients with tracheostomy tubes and mechanical ventilation by providing a consistent decision-making process with objective criteria for patient tolerance of a one-way speaking valve. The goal is for the patient to wear a one-way speaking valve throughout the day and evening hours, as tolerated by the "stop" criteria outlined in the flow chart. If it is not tolerated, the SLP must work with the patient and other team members to move the process forward.

Problem-solving to increase patient tolerance of the one-way speaking valve may include tracheostomy tube downsizing or continued therapeutic trials with implementation of strengthening programs to address respiration, voice, and swallowing.

Support and education are also critical for the patient, family, and/or caregivers as the patient works through the adjustment period and strives to attain identified treatment goals. By restoring verbal communication and safe oral intake, SLPs play a vital role in the patient's recovery and quality of life.

Glossary 1

Aspiration: Material entering the larynx below the true vocal folds

DecannulationK: Removal of tracheostomy tube

Fraction of inspirited oxygen (FiO2):
Percentage of oxygen provided via ventilator or mask

Heart rate (HR): Heart beats per minute (normative range for adults is 60–100)

Mechanical ventilator: A machine attached to a tracheostomy or endotracheal tube that does all of the work of breathing or partially assists with breathing

One-way speaking valve: Valve placed on the tracheostomy tube in line with the ventilator with the tracheostomy tube cuff deflated; the valve remains closed until the patient inhales. The valve closes with exhalation, diverting air through the upper airway and allowing vocalization.

Rate of perceived dyspnea (RPD):
The patient’s perception and rating of difficulty breathing or shortness of breath, expressed as a number (0–10) with written descriptors of each number.

Respiratory rate (RR): Breaths per minute (normative range for adults is 12–20)

Saturation percentage of oxygen (SpO2):
Non-invasive measurement of arterial oxygen saturation achieved through pulse oximetry

Tracheostomy tube: An artificial airway surgically inserted into the trachea, bypassing the upper airway, to provide for basic air exchange and ventilation

Tracheostomy tube cuff: Internal air- or liquid-filled balloon on the distal end of the tracheostomy tube that, when inflated, prevents air from passing through the upper airway

Glossary 2

Glossary
Glossary of commonly used medical terms:

Artificial Airway: Another word for tracheostomy tube

Artificial Nose: Also called HME (heat and moisture exchanger) A device that fits on your tube to warm and moisten the air you breathe.

Bronchoscopy: An examination of the inside of the trachea and of the large air passages leading to the lungs.

Bacteria: Germs

Cyst: A fluid-filled swelling which may occur in the larynx (voice box) and obstruct breathing.

Cuff: The inflatable balloon on some tracheostomy tubes.

Decannulation: This is the term used for removing a tracheostomy tube.

Epiglottis: A flap of cartilage situated immediately behind the root of the tongue. It covers the entrance to the larynx (voice box) during swallowing to stop food or fluid going down the wrong way and getting into the lungs.

Granulation: The presence of excess new tissue or scar tissue

Incision: A cut made during a surgical operation

Lumen: Inside part of the tube, where the air goes in and out.

Larynx: term used to describe the voice box or Adam's apple. It has two important functions: Airway protection and production of voice.

Laryngomalacia: This is a term to describe “ noisy breathing”, which some babies present with after birth. It may cause floppiness of the voice box.

Laryngotracheobronchitis (‘croup') A condition that causes the larynx and tracheobronchial tree to become inflamed and reduces the airway size.

Laryngotracheal reconstruction (LTR) This is an operation sometimes performed to enlarge (widen) an area of narrowing in the upper trachea, often using a piece of rib cartilage.

Microlaryngoscopy: The examination of the inside of the larynx using a microscope.
MLB: Microlaryngoscopy and bronchoscopy.

Mucus: slippery fluid that's produced in the lungs and windpipe.

Neck Flange: The part of the tracheostomy where you attach the tracheostomy ties or tube holder.

Obturator: The semi-rigid stick that is inserted into the tracheostomy tube prior to insertion to help guide it into the opening in the neck.

Papilloma: A type of wart. If it grows very big or there are a lot of them they may interfere with the voice or breathing.

Respiratory tract: Consists of the air passageways involved in breathing. It includes the nose, larynx, trachea and lungs.

Secretions: Another word for mucus.

Stenosis: Narrowing.

Stoma: This term is used to describe the opening in the neck where the tracheostomy tube is inserted.

Stridor: Noisy breathing.

Subglottic stenosis: An abnormal narrowing of the trachea below the glottis(vocal chord)

Trachea: Also known as windpipe. It is a semi rigid structure that extends from the larynx to the lungs.

Tracheomalacia: An area of softening of the trachea which may collapse inwards as the child breathes and may obstruct breathing.

Tracheotomy: The surgical opening of the trachea through the neck.

Tracheostomy: The completed opening leaving an artificial airway.

American Speech-Language-Hearing Association. (1993). Position statement and guidelines for the use of voice prostheses in tracheotomized persons with or without ventilatory dependence. *Asha 35* (*Suppl. 10*), 17–20.

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Manley, S., Frank, E., & Melvin, C. (1999). Preparation of speech-language pathologists to provide services to patients with a tracheostomy tube: A survey. *American Journal of Speech-Language Pathology, 8*, 171–180.

Tracheostomy Care

Rubbing of the trach tube and secretions can irritate the skin around the stoma. Daily care of the trach site is needed to prevent infection and skin breakdown under the tracheostomy tube and ties. Care should be done at least once a day; more often if needed. Children with new trachs or children on ventilators may need trach care more often. Tracheostomy dressings are used if there is drainage from the tracheostomy site or irritation from the tube rubbing on the skin.

It may be helpful to set up a designated spot in your home for equipment and routine tracheostomy care.

Equipment

- Sterile cotton tipped applicators (Q-tips)
- Trach gauze and "unfilled" gauze
- Sterile water
- Hydrogen peroxide (1/2 strength with sterile water)
- Trach ties and scissors (if ties are to be changed)
- Two sterile cups or clean disposable paper cups
- Small blanket or towel roll

Procedure

- Wash your hands.
- Explain procedure in a way appropriate for the child's age and understanding.
- Lay your child in a comfortable position on his/her back with a small blanket or towel roll under his/her shoulders to extend the neck and allow easier visualization and trach care.
- Open Q-tips, trach gauze and regular gauze.
- Cut the trach ties to appropriate length (if trach ties are to be changed).
- Pour 1/2 strength hydrogen peroxide into one cup and sterile water into the other.
- Clean the skin around the trach tube with Q-tips soaked in 1/2 strength hydrogen peroxide. Using a rolling motion, work from the center outward using 4 swabs, one for each quarter around the stoma and under the flange of the tube. Do not allow any liquid to get into trach tube or stoma area under the tube. Note: Some doctors recommend cleaning with just soap and water in home care, using hydrogen peroxide only to remove encrusted secretions. This is because daily use of hydrogen peroxide might irritate the skin of some children.
- Rinse the area with Q-tip soaked in sterile water.
- Pat dry with gauze pad or dry Q-tips.
- Change the trach ties if needed (See Changing a Tracheostomy Tube).
- Check the skin under the trach ties.
- Tuck pre-cut trach gauze around and under the trach tube flush to skin. Do not cut the gauze or use gauze containing cotton because the child may inhale small particles. Use precut tracheostomy gauze or unfilled gauze opened full length and folded into a U shape or use two gauze pads, one placed under each wing of the tube.

- Be sure the trach dressing does not fold over and cover the trach tube opening. Change the dressing when moist, to prevent skin irritation. Tracheostomy dressings may not be needed for older tracheostomies when the skin is in good condition and the stoma is completely healed and free from rash or redness.
- For tracheostomy tubes with cuffs, check with your doctor for specific cuff orders. Check cuff pressure every 4 hours (usual pressure 15 - 20 mm Hg). In general, the cuff pressure should be as low as possible while still maintaining an adequate seal for ventilation.
- Monitor skin for signs of infection. If the stoma area becomes red, swollen, inflamed, warm to touch or has a foul odor, call your doctor.
- Check with the doctor before applying any salves or ointments near the trach. If an antibiotic or antifungal ointment is ordered by the doctor, apply the ointment lightly with a cotton swab in the direction away from the trach stoma.
- Wash your hands after trach care.

Care of the Inner Cannula

Some older children and teens have trach tubes with an inner cannula. Some inner cannulas are disposable (DIC: Disposable Inner Cannula). These should be changed daily, discarding the old cannula. Check with your equipment vendor regarding disposable cannulas.

For the reusable cannulas, the cannula should be cleaned 1 to 3 times a day and more often if needed. Do not leave the inner cannula out for more than 15 minutes.

Equipment

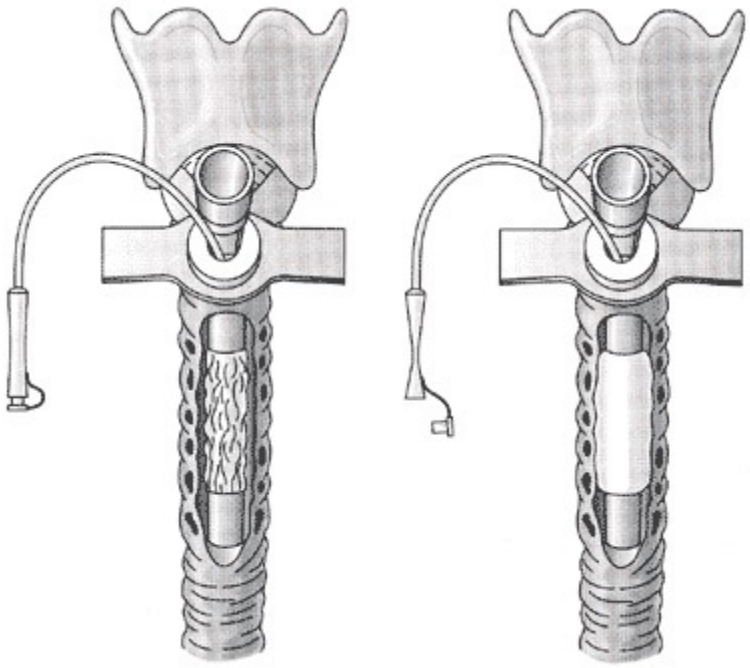
- 1/2 strength hydrogen peroxide
- Sterile water or normal saline
- Two clean or sterile containers (small bowl or cup)
- Inner cannula brush (tracheostomy brush or sterile pipe cleaner)
- Unfilled gauze pad

Cleaning kits are available for inner cannula trach care. Check with your supply vendor.

Procedure

- Wash your hands.
- Explain procedure in a way appropriate for the child's age and understanding.
- Pour 1/2 strength hydrogen peroxide into a bowl or cup and normal saline or sterile water into the other.
- Open the gauze pad
- Remove the inner cannula
- Place the inner cannula into 1/2 strength hydrogen peroxide. Soak it for a few seconds and use the brush to clean secretions on the inside and outside of cannula.
- Place the cannula into normal saline or sterile water solution, soak and rinse.
- Dry off excess water with clean or sterile gauze pad.
- Suction through the outer cannula if needed.
- Replace inner cannula. Be sure the cannula is secure or "locked" in place in the trach tube.
- Wash your hands.

Cuffed Tracheostomy Tubes



Foam-filled Bivona cuff tracheostomy tube
deflated (left), inflated (right)

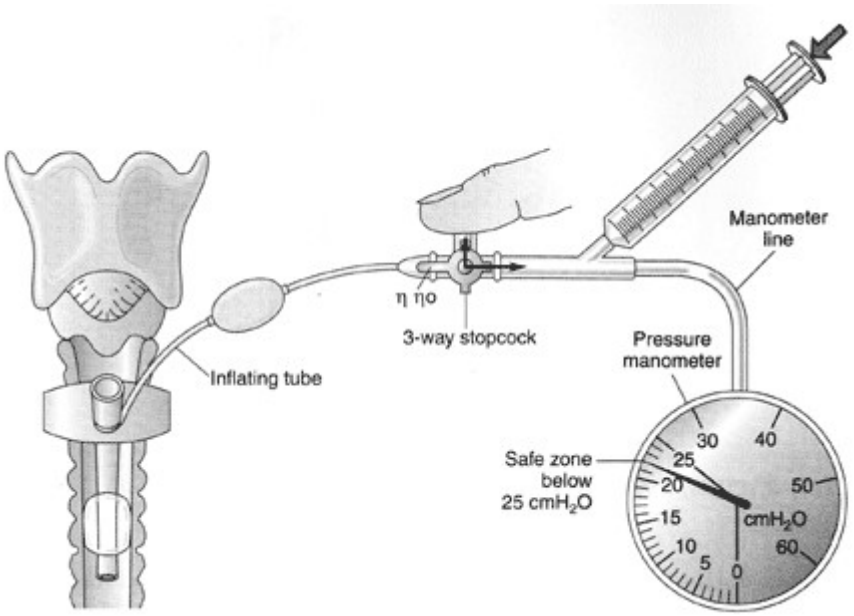
A cuff is a soft balloon around the distal end of the tube that can be inflated to seal the trachea for children needing ventilator support or to help prevent secretions from entering the lungs.

Avoid over inflating the tracheostomy tube cuff. The pressure of the cuff against the wall of the trachea can cause damage if it is too high. Two techniques that can be used to help avoid excess pressure are the minimal occluding volume technique and the minimal leak technique. Suction the trach tube if needed. After suctioning the tube, suction the mouth and above the trach cuff so that secretions do not go into lungs when cuff is deflated.

Cuff Deflation Techniques

> *Minimal Occluding Volume Technique:* Deflate the cuff, then slowly begin re-injecting air (or sterile water depending on the type of tube) with a luer lock syringe. Place a stethoscope to the side of the child's neck near the trach tube. Inject air into the pilot line until you can no longer hear air going past the cuff. This means the airway is sealed. For children that are totally ventilation dependent, provide breaths with manual resuscitator.
> *Minimal Leak Technique:* The same procedure as Minimal Occluding Volume, except that after the airway is sealed, slowly withdraw a small amount (approximately 1cc), so that a slight leak is heard at the end of inspiration.

Periodic measurements of the cuff volume should be noted and any changes reported to the doctor. A pressure manometer may be used to check cuff pressure on balloons filled with air. Generally, cuff pressure should be below 25 cm H2O.



Trach tube with cuff, pilot inflating balloon and pressure manometer

Use and care of an endotracheal/ tracheostomy tube cuff — are intensive care unit staff adequately informed?

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Summary

Background. There is an apparent high incidence of tracheal stenosis in the Bloemfontein area. The aim of this study was to determine intensive care unit (ICU) staff knowledge of the use and care of endotracheal and tracheostomy tube cuffs.

Methods. One hundred and twelve qualified nurses, working in 11 different ICUs, were asked to complete an anonymous questionnaire regarding endotracheal/tracheostomy tube cuffs.

Results. The results highlight the following three areas of concern:
(*i*) there was an overall misconception in 38% of the respondents that the function of the cuff was to secure the tube in position in the trachea to prevent self-extubation;
(*ii*) accurate regulation of cuff pressure was not routine practice in any of the ICUs; and
(*iii*) only half of the respondents felt their training regarding cuff care management was sufficient.

Conclusions. ICU staff had misconceptions regarding the function and care of endotracheal/tracheostomy tube cuffs. The concept of a higher cuff pressure for better stabilization of the tube is probably an important factor that could have caused the increase in tracheal stenosis in the Bloemfontein area. Critical care nursing needs to emphasize the use of current techniques, discourage routine cuff deflation, and encourage collaboration with ICU physicians on standards of care. A protocol that could be used in the ICUs regarding the use and care of an endotracheal/tracheostomy tube cuff is proposed.

A tracheal stenosis can be caused by a direct traumatic injury to the trachea, severe tracheitis, or by factors related to intubation, i.e. cuff pressure, non-stabilized tube and poor hygiene.1-4 Persistent high cuff pressure results in the destruction of the tracheal wall. The careful monitoring of cuff pressures, tube stability and hygiene of an endotracheal or Tracheostomy (ET/TT) tube could play an important role in the prevention of tracheal stenosis.3,4 During the past few years an alarming number of patients have presented with acquired tracheal stenosis in the Bloemfontein area. Most patients were treated in intensive care units (ICUs) in the Free State. Therefore, the aim of this study was to establish whether ICU staff were adequately informed about the use and care of ET/TT tube cuffs.

Method

One hundred and twelve qualified nurses, working in 11 different ICU centers in the Bloemfontein area of the Free State, were asked to complete an anonymous questionnaire regarding the use and care of ET/TT tube cuffs. The nurses had to have been working for at least 6 months in their respective ICUs. The study took place over a 2-week period to ensure that the questions were answered impromptu, thus eliminating the chance of the nurses researching the topic. The ethics committee of the Faculty of Health Sciences, University of the Free State (UFS), approved the study. Results were summarized using frequencies and percentages, or means or percentiles, as appropriate.

Results

The ICUs were not identified and were divided into government (group A) and private (group B) institutions. There were 66 respondents in group A and 46 in group B. The respondents' mean length of service in an ICU was 7 years (range 1 - 20 years) for group A, and 4 years (range 1 - 16 years) for group B. There was no consensus regarding the length of time before an intubated patient, who was being ventilated, should undergo a tracheostomy. Answers ranged from 5 days to 6 weeks (mean 10 - 14 days) in both groups. The answers received from the questionnaire are given in Table 1. More than 90% of all respondents were unaware of the different types of cuffs available. Most (83%) of the respondents (80% in group A and 89% in group B) felt that they were entirely responsible for their patients' cuff care management Most respondents in group A (84%) and more than half of respondents in group B (57%) indicated that they were unaware of any specific protocol regarding the care of tube cuffs in their respective units. The answers regarding stability of the tube/cuff are represented in Table II.

Regarding the care of an ET/TT tube and cuff, 50% of group A respondents were trained by a senior colleague, and 48% of group B respondents were trained at their college/university. Only half of all the respondents thought that the training they had received was adequate.

Most (76%) of group B respondents, but only 7.5% of group A respondents, were aware of an accurate way to measure cuff pressure. The availability of cuff pressure meters in private institutions could account for the difference in answers given by the two groups. The respondents mentioned numerous complications arising from incorrect cuff pressure. Table III highlights these answers more specifically.

Discussion

These results highlight the following three areas of concern: (*i*) there was an overall misconception among 38% of the respondents that the function of the ET/TT tube cuff was to secure the tube in position in the trachea to prevent self-extubation; (*ii*) accurate regulation of cuff pressures was not routine practice in any of the ICUs; and (*iii*) only half of the respondents felt that their training regarding cuff care management was sufficient.

The most frequent cause of tracheal stenosis is iatrogenic (usually from intubation for ventilatory support).1 This form of stenosis occurs with equal frequency in ET and TT tubes, but has become less common with new cuff technology.5 The area of the trachea that is affected is usually 2 cm in length, and involves the anterior and lateral walls. The posterior wall is relatively protected from stenosis because of its ability to distend into the esophagus. However, with a firm nasogastric tube in place, the posterior wall can also be involved.5,6

A tracheal stenosis may present directly, or hours and even months after extubation. Exertional dyspnea is the most common presenting symptom. For adult males, the trachea is D-shaped with a transverse diameter of 23 mm (± 5 mm) and an anterior posterior (AP) diameter of 18 mm (± 3 mm).7 For adult females the transverse diameter is 20 mm with an AP diameter of 15 mm.8 Exertional dyspnea is usually evident when the tracheal lumen has been halved to ± 10 mm.

Dyspnea and stridor at rest only appear when the tracheal lumen is narrowed to 5 mm or less.8 Some authors advocate routine tracheal assessment 6 weeks after extubation for every patient who underwent an event that may have caused a laryngo-tracheal injury. The events include long duration of intubation, excessive cuff pressures, infected tracheal secretions, and severity of hypoxic incidents.

Superficial damage to the tracheal mucosa by the inflated cuff can occur within 15 minutes at a lateral wall pressure of 20 mmHg, but is not progressive.9 At a pressure of 50 mmHg, lasting for 15 minutes, damage to the tracheal mucosa is more extensive and can include partial denudation of the basement membrane. At a pressure of 100 mmHg, lasting for 15 minutes, the basement membrane disintegrates and the mucosal stroma is exposed. Within 4 hours at 100 mmHg, the damage can penetrate to the cartilage causing necrosis, which is then usually accompanied by bacterial invasion.9 The trachea can resist long periods of cuffed intubation as long as the lateral wall pressure exerted by the cuff is kept below 25 mmHg, because venous capillary pressure is impeded at around 30 mmHg.9,10

There is no documented consensus regarding cuff care management and research results with recommendations for cuff care are inconsistent and conflicting.11 The responsibility for cuff care management has shifted to the nursing staff.

With this increasing responsibility, nursing practice should focus on cuff care management skills and include these in their training curriculum of ICU personnel.11 The following three areas of cuff care management are of utmost importance in preventing complications:

1. Stabilization of the ET/TT tube Stabilization of the tube (and cuff) is crucial in tracheal mucosa protection. Pressure necrosis at the site of tracheostomy stoma can be reduced by the use of swivel connectors and ventilator tubing supports that will prevent undue traction on the tracheostomy tube.8,12 The tracheal mucosa is sensitive to the motion at the tip of the tube against the tracheal wall, which can be reduced by correct positioning and securing of the tube.8

2. Local infection control Careful wound care can help prevent local infection that may lead to further destruction of the exposed tracheal stroma or cartilage.8 Although routine cuff deflation is not indicated, it can be used in the following selective situations: to clear the upper airway of secretions, to allow patients to vocalize, and to check for a cuff leak.11

The use of positive pressure when deflating cuffs to prevent aspiration of upper airway secretions is a good technique
that can help to prevent infection.11

TABLE I. FUNCTION OF THE ET/TT CUFF
Group A Group B
Answers given ($N = 66$) ($N = 46$)
Cuff's function:
Secures tube in position (%) 37 41
Prevents self-extubation (%) 46 26
Prevents aspiration (%) 74 86
Seal for mechanical ventilation (%) 48 71
Do not know (%) 14 10

TABLE II. TUBE STABILISATION METHODS
Answers given Group A Group B
Stabilization of tube (methods)
Fully inflate cuff to secure tube (%) 32 4
Correct techniques (strapping, etc.) (%) 54 92
Unaware of any method (%) 14 4

TABLE III. COMPLICATIONS OF INCORRECT CUFF PRESSURES
Answers given Group A Group B
Complications of incorrect pressure
Tracheal necrosis (%) 40 54
Tracheal stenosis (%) 16 21

Miscellaneous (aspiration, dilatation, etc.) (%) 20 16
Not aware of any (%) 24 9

3. Cuff pressure

Most physicians believe that a soft cuff on the ET/TT tube provides adequate protection of the tracheal mucosa. These soft cuffs can, however, produce surprisingly high mucosal pressures and tracheal wall necrosis if the cuff pressure is not controlled.10 The literature recommends both the minimum leak technique (MLT) and the minimum occlusive volume (MOV) for cuff inflation and the monitoring of cuff pressure to prevent tracheal injury.11 The MLT is the smallest volume of air needed in the ET/TT tube cuff, that still *allows* for a small air leak on inspiration.11 The MOV is the smallest volume of air needed in the ET/TT tube cuff to *prevent* an air leak on inspiration.11

In patients receiving mechanical ventilation with increasing airway pressures, the tracheal diameter widens on inspiration, and cuffs require higher cuff volumes and pressures to seal the dilated airway. The phenomenon known as 'chasing the trachea' can occur, which essentially is the scenario where more air volume is required in the cuff as the trachea is gradually 'stretched'.

In this scenario, the cuff is inflated to a recommended safe range during inspiration, when the trachea is normally dilated, but during expiration, when the trachea narrows, the inflated cuff can cause stretching of the tracheal mucosa. Over time cuff pressure decreases and ventilation pressure also decreases because of air volume leaking around the cuff due to the loss of tracheal wall integrity.
Increasing amounts of air are then required in the cuff to seal the trachea and profound dilation of the trachea can occur.

To prevent tracheal injury the ultimate cuff is one that would be partially inflated on inspiration and partially deflated on exhalation.11

Any inflatable cuff, no matter how soft, is potentially hazardous when confined within the tracheal lumen with no safety mechanism for pressure control.10 The volume of air necessary to raise the cuff pressure from the point of seal to an unsafe pressure (greater than 30 mmHg) is only 2 - 3 cc of air.10 It is, however, unrealistic to expect that the inflation volume be monitored so closely in a busy ICU.10

In some modern ICUs there are continuous cuff pressure monitors relayed to the patient's digital display, enabling ICU staff to monitor cuff pressure accurately and continuously. The intra-cuff pressure is measured and this differs slightly from the tracheal mucosal wall pressure that is exposed to the cuff. This measurement is, however, sufficient in obtaining a reference value that can be monitored. In Third-World countries this technology is not readily available and a dynamic cuff system is sought that can safely control cuff pressure by continual measurement in an inexpensive way. The dynamic fluid-filled cuff system is being investigated as a possible option at the Faculty of Health Sciences, UFS, Bloemfontein.

This study has shown that ICU staff had misconceptions regarding the function and care of ET/TT tube cuffs. The concept of a higher cuff pressure for better stabilization of the tube is probably an important factor that could have caused the increase in tracheal stenosis in the Bloemfontein area.

Critical care nursing needs to emphasize use of current techniques (MLT, MOV),11 discourage routine cuff deflation, and encourage collaboration with ICU physicians on standards of care. A protocol that could be used in the ICUs regarding the use and care of an ET/TT tube cuff is proposed in Table IV.

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Tracheotomy and Mechanical Ventilation Examination

Select the ***best*** answer to each of the following items. Mark your responses on the Answer form.

1. Patients with respiratory failure and distress are now surviving with the help of medical advances including _____ and mechanical ventilation.

a. stents
b. tracheostomy tubes
c. cuffs
d. None of the above

2. The protocol provides objective criteria for patient tolerance of a one-way speaking valve, a critical step in the process of safe, efficient tracheostomy tube weaning. With the placement of a one-way valve, the SLP and licensed respiratory care practitioner (LRCP) can accurately assess the patient's _____, and begin to wean the patient.

a. speech
b. voice
c. swallowing
d. All of the above

3. By following the protocol and "stop" criteria outlined in the flow chart, the SLP and LCRP can determine whether or not the patient safely tolerates the valve and if not, what other steps to take.

a. True
b. False

4. Depending on a patient's specific diagnosis, initial evaluation consists of an assessment of speech, language, cognitive communication, voice, and swallowing. Evaluation of patients with a ventilator and/or tracheostomy tube requires additional steps and more equipment but is otherwise the same as for any other patient.

a. True
b. False

5. When a tracheostomy tube is in place, the upper airway is eliminated and patients inhale and exhale through the tracheostomy tube. When the tracheostomy cuff is deflated for placement of a one-way speaking valve, the upper airway is restored, allowing a patient to inhale through the tracheostomy tube and exhale through the mouth and nose.

a. True
b. False

6. Initial cuff deflation**:** The result often is a significant amount of _____being cleared from the pharynx, which frequently requires additional tracheal and/or oral suction for adequate management. The excess secretions are a natural response to the tracheostomy tube and may be present for several trials with the one-way speaking valve.

a. air
b. pooled secretions
c. leakage
d. None of the above

7. Placement of the one-way speaking valve inline with the ventilator or on the tracheostomy tube itself after suctioning if needed**:** The SLP and LRCP again evaluate tolerance of the one-way speaking valve by referring to the "stop" criteria. The SLP next evaluates _____ , and provides recommendations and referrals for oral/pharyngeal exercises, therapeutic trials, further instrumental swallow study, or ENT consultations as appropriate.

a. speech
b. voice
c. swallowing
d. All of the above

8. A one-way speaking valve provides numerous clinical benefits. It restores positive airway pressure, creating a more normal respiratory system that allows for _____, and increased oxygenation. It can improve swallowing function and reduce aspiration.

a. louder voice
b. stronger cough
c. improved secretion management
d. All of the above

9. SLPs are in a pivotal role to advocate for ventilator and/or tracheostomy patients to wear their one-way speaking valves. Our protocol provides us the ability to advocate for patients with tracheostomy tubes and mechanical ventilation by providing a consistent decision-making process with objective criteria for patient tolerance of a one-way speaking valve. The goal is for the patient to wear a one-way speaking valve throughout the day and evening hours, as tolerated by the "stop" criteria outlined in the flow chart.

a. True
b. False

10. Support and education are also critical for the patient, family, and/or caregivers as the patient works through the adjustment period and strives to attain identified treatment goals. By restoring verbal communication and safe oral intake, SLPs play a vital role in the patient's recovery and quality of life.

a. True
b. False

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