

TRACHEOSTOMY CARE HANDBOOK

A Guide for the Health Care Provider



This TRACHEOSTOMY CARE HANDBOOK is published by SIMS Portex Inc., and contains technical and clinical information essential to tracheostomy care.

The handbook is intended as a guide to tracheostomy care and is not intended to be a complete text.

It is hoped the handbook will be of value and assistance in instructing students and other personnel involved in care of the tracheostomy patient.

History of Tracheostomy

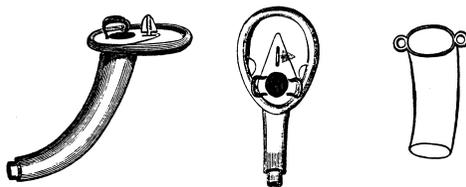
There is evidence that surgical incision into the trachea in an attempt to establish an artificial airway was performed by a Roman physician 124 years before the birth of Christ. Three hundred years later, two physicians, Aretaeus and Galen, gave inflammation of the tonsils and larynx as indications for surgical tracheostomy.

There are few references to tracheostomy before the 11th century, but one must remember that this was during the Dark Ages. During the 11th century, Albucasis of Cordova successfully sutured the trachea of a servant who had attempted suicide by cutting her throat.

The first record of a tracheostomy being performed in Europe was in the 16th century when Antonius Musa Brasavola saved a patient who was suffering from acute edema of the larynx and was in severe respiratory distress. In 1540, Vesalius recorded his success in positive pressure ventilation of an animal through a tracheostomy.

As popularity of the operation increased, it was found that although asphyxia was immediately relieved, better long-term results were achieved if the stoma was kept patent for several days. To maintain an open airway, a simple cannula was designed by Fabricius of Aquapendente. This early tracheostomy tube consisted of a short, straight cannula having two wings to prevent it from slipping into the trachea and to secure it around the neck with tapes. The tube was left in place for three or four days.

Casseri, a student of Fabricius, suggested using a curved cannula to fit the anatomy of the throat. By the 19th century, successful operations had been reported for trauma, foreign bodies,



Tracheostomy tube circa 1860-1865.

or inflammation to the airway causing acute obstruction of the upper airway.

During the diphtheria epidemic in France in 1825, tracheostomies gained further recognition. Improvements followed: In 1852 Bourdillat developed a primitive pilot tube; in 1869 Durham introduced the famous lobster-tail tube; and in 1880 the first pediatric tracheostomy tube was introduced by Parker.

Tracheostomies were performed for patients with severe burns and scalds of the face and neck and for other operative procedures, but diphtheria remained the most important indication until 1936, when Davidson described this procedure for poliomyelitis.

With early recognition of respiratory failure, improved surgical technique, modern tracheostomy tubes, ventilators, and improved nursing care in state-of-the-art intensive care units, this procedure has become commonplace.

In the mid-1980s, the first significant advancement in the surgical management of the airway in 90 years was introduced. This procedure, percutaneous tracheostomy, had been described in 1957 by Sheldon, and it has just recently gained in popularity and may soon become the preferred technique for managing the airway. Percutaneous tracheostomy has all but eliminated the complications that are common with the surgical tracheostomy. This relatively new procedure has been shown to have many advantages over translaryngeal intubation and the surgical approach to tracheostomy.

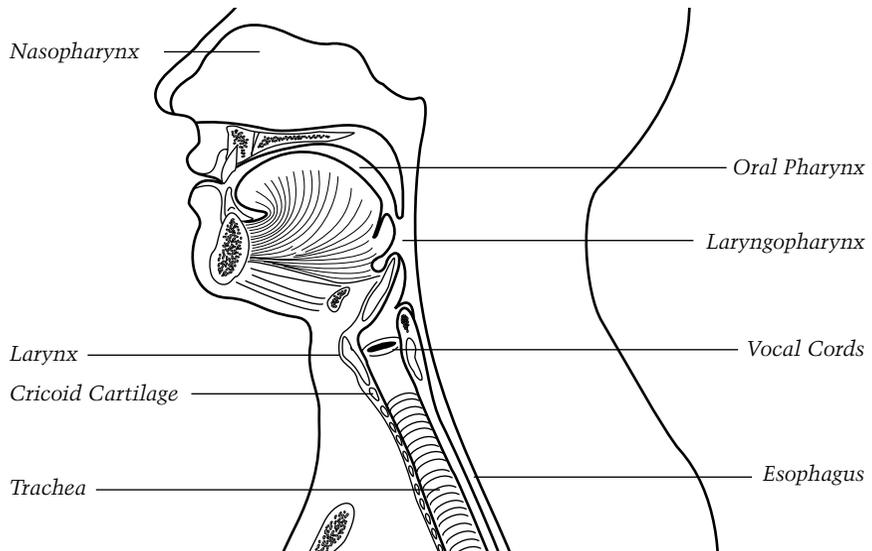
Anatomy and Physiology

A knowledge of the anatomy and physiology of the respiratory system is necessary to the health care provider who is involved in the care of the tracheostomized patient.

The Upper Airway

The nose plays a very important role in the upper airway. As air enters the nostrils large particles of dust and dirt are filtered. The mucus membranes of the nasopharynx further filter this air, warm or cool the inspired air, and humidify it.

The column of inspired air travels down through the oral pharynx to the laryngopharynx. Here it passes through the larynx where the vocal cords are located. The larynx is located at the top of the trachea. When a person breathes in, the vocal cords open, allowing air to pass freely into the trachea.



Normal anatomy of the upper airway.

The larynx is composed of nine cartilage structures: three large single cartilages and three paired cartilages. The three large single cartilages are the epiglottis, the thyroid, and the cricoid. The three paired cartilages are the smaller arytenoids, cuneiforms, and the corniculates. The cricoid cartilage is the only circumferential cartilage of the trachea, and is an important landmark used during tracheostomy.

The trachea is a tubular structure 10–14 cm in length in an adult. It extends from the larynx through the neck to the thorax, where it terminates at the carina, dividing into the right and left main stem bronchi.

The trachea joins with the larynx at the level of the 6th cervical vertebra; it bifurcates at the carina at about the level of the 5th thoracic vertebra. Within the thorax the trachea lies in the mediastinum, its lower position being directly behind the heart and its large vessels.

It is constructed of 15 to 20 C-shaped cartilaginous rings separated by fibrous muscular tissue which form the supporting framework. Each cartilage is incomplete dorsally where it is adjacent to the esophagus. A fibro-elastic membrane containing smooth transverse fibers of muscle extends across the open portion of the trachea where the cartilages are incomplete dorsally. The anterior cartilage provides the rigidity necessary to maintain patency of the tube.

The tracheal structure consist of four layers: mucosa, submucosa, cartilage, and adventitia. The inner layer, the mucosa, has ciliated pseudo-stratified columnar epithelium with goblet cells. Mucus excreted from the goblet cells helps trap inhaled particles of dust and the cilia sweep it upward into the laryngopharynx where it can be swallowed or coughed out.

The submucosa is loose connective tissue containing glands that secrete mucus.

The trachea ends by dividing into the right and left main stem bronchi which extend to the lungs. Each bronchus enters its own respective lung through the hilus (an opening through which nerves, vessels, etc. enter or exit an organ). The right main stem bronchus is shorter, wider, and more vertical than the left. Consequently, this

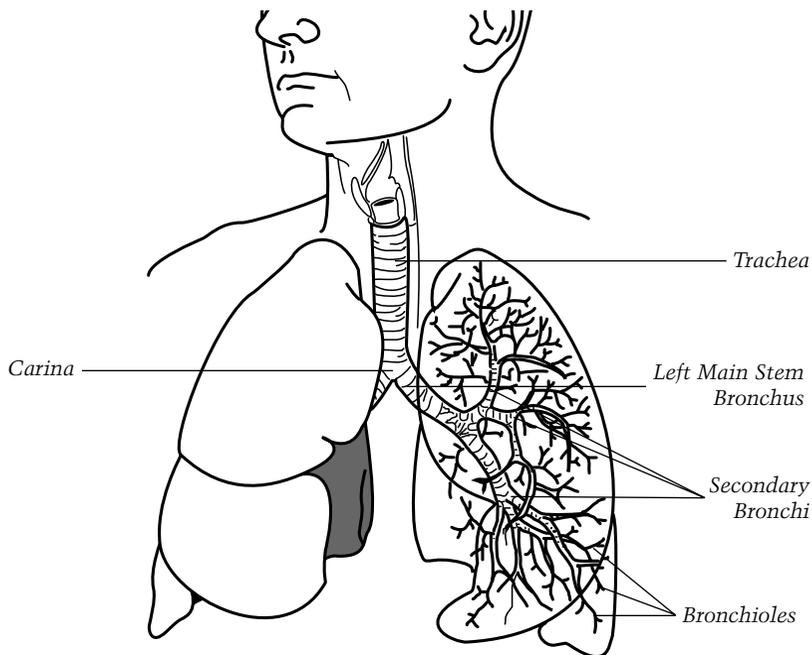
bronchus is more easily intubated, suctioned, and foreign bodies more frequently end up in the right bronchus.

The Lower Airway

As soon as the bronchi enter each lung they branch to form smaller or secondary bronchi, one for each lobe of the lung (three lobes on the right and two on the left). The secondary bronchi continue to branch to form still smaller tubes or bronchioles.

Structurally, the bronchi are very similar to the trachea. Their walls have cartilaginous rings and are lined with ciliated mucus membrane. However, as they become smaller and smaller, less and less cartilage is present in their walls, and more and more smooth muscle appears.

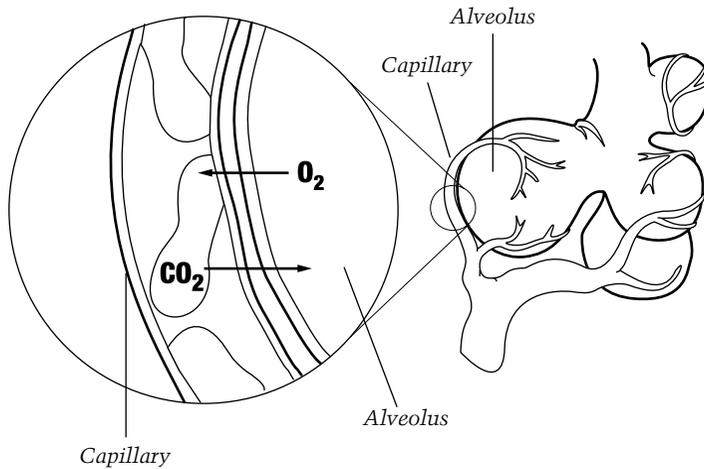
The lungs are truly the organs of respiration where exchange of gases between blood and air takes place.



Normal anatomy of the lower airway.

The lungs are made up of light spongy tissue. Within this spongy tissue lie the secondary bronchi and bronchioles, which conduct air to and from the respiratory units (alveoli) of the lung.

Fissures divide each lobe of the lung. The right lung has three lobes and the left lung has two. Each lobe is further divided into lobules. Lobules are irregular in size and shape, but each is supplied with air by a bronchiole. As the bronchioles enter the lobules they divide repeatedly to form very small airways called terminal bronchioles and then the smallest airways, the respiratory bronchioles. These smallest of airways finally reach the functional unit of the lung, the alveoli. It is here within the alveoli that the exchange of oxygen and carbon dioxide takes place.



Alveola/capillary exchange.

Tracheostomy

The Operative Procedure

General Indications

There are four main indications or goals for a tracheostomy. The procedure may be required to achieve any one or combination of these four.

Heading the list is the assurance of a patent airway. As long as the tracheostomy tube itself is not blocked and it extends below the level of any site of blockage, the upper airway is virtually assured of being open. Obstruction in the upper airway caused by edema of the glottis or by carcinoma of the larynx are just two of many indications for tracheostomy.

Another important goal is protection of the lungs from potential threats such as obstruction or aspiration.

Tracheostomy may be indicated for more effective removal of secretions from the trachea and lower airways. Patients with sputum retention may be candidates for standard or mini-tracheostomy.

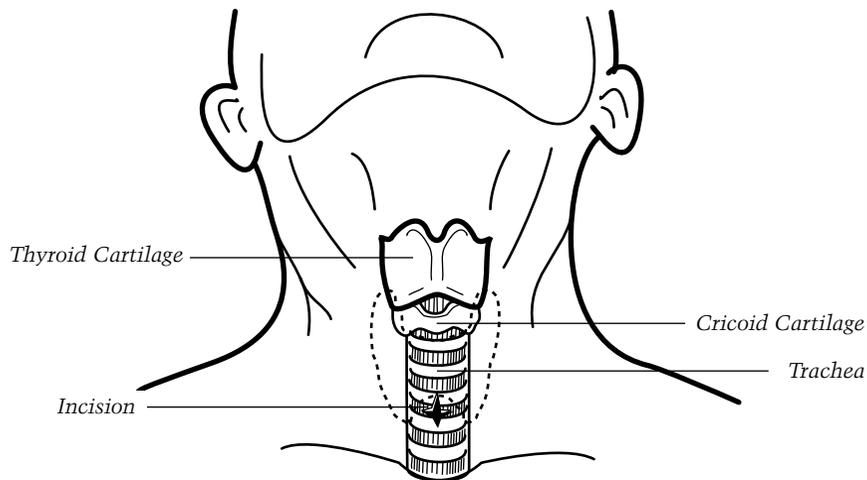
A final and very common indication for tracheostomy is to permit long-term ventilatory support. There are several advantages: the anatomical dead space is reduced, the ventilator may be easily attached directly to the tracheostomy tube, the airway is protected, a convenient access to the airway for suctioning is available, ventilatory support or tracheostomy tube dependency can be reduced, improved communication and nutritional support is also provided.

The Procedure

Tracheostomy should rarely be considered for emergency access and control of the airway. It is best performed with access gained to the trachea with an endotracheal tube in place. Rapid access to the airway is possible in less than one minute via oral or nasal intubation of the trachea, or cricothyrotomy. Little equipment is required for these routes; most emergency cricothyrotomy need only a large bore needle or scalpel.

Tracheostomy, on the other hand, is a procedure that requires more sophisticated skills and equipment. Tracheostomy is used infrequently as the initial route to gain access to the airway.

Surgical tracheostomy is usually performed in the operating room or less commonly in an intensive care unit under general or local anesthesia.



Surgical tracheostomy.

With the patient positioned with the neck hyperextended, the skin area is prepared and an incision is made below the cricoid cartilage. The trachea is located with blunt dissection, bleeding is controlled if necessary, and an incision (one of many types) is made through the 2nd, 3rd, or 4th tracheal cartilage. A cuffed tracheostomy tube of proper size and length is inserted through the anterior wall of the trachea as the endotracheal tube is slid above the ostomy site. The tracheostomy tube is gently positioned and ventilation is confirmed.

through the tube. The tube is secured and the skin incision may be loosely sutured or left open.

Surgical Complications of Tracheostomy

Tracheostomy has definite surgical risk associated with it. The four most important immediate surgical complications are:

1. Bleeding from the operative site
2. Subcutaneous emphysema, mediastinal emphysema, and pneumothorax
3. Aspiration of blood in the airway
4. Cardiac arrest secondary to hypoxia, acidosis, or sudden electrolyte shifts.

Most of these complications can be avoided by establishing an airway prior to the procedure and by correcting hypoxia and hypercarbia prior to surgery. Meticulous control of bleeding is essential.

Percutaneous Tracheostomy

With the advent of the percutaneous approach to tracheostomy, many of the complications associated with surgical tracheostomy have been avoided. This technique offers both the clinician and the patient many advantages. Because this procedure is most frequently performed at the patient's bedside, there are no delays often associated with scheduling a surgical procedure. Significant bleeding is rare, post-procedural infections are almost nonexistent, and costs are drastically reduced. When compared to prolonged transtracheal intubation or surgical tracheostomy, the risks and complications are low. Many clinicians now favor early tracheostomy with two to three days post-transtracheal intubation over prolonged maintenance of an endotracheal tube.

The Procedure

Percutaneous tracheostomy is not indicated for gaining access to the airway in emergency situations and should not be confused with cricothyroid puncture. The procedure is most commonly performed at

the bedside in the intensive care unit with the patient sedated and fully monitored. The patient does not have to be transported to the surgical suite with all the equipment and monitoring systems required for critically ill patients. This is a distinct safety advantage.

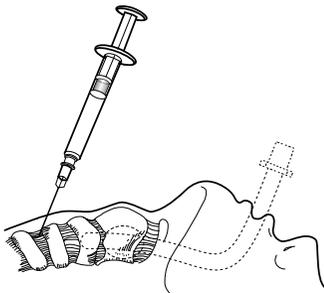
At the bedside the patient is placed in the supine position with a blanket roll or pillow positioned beneath the shoulders to extend the neck as much as possible. The skin of the anterior neck is prepped with an antiseptic soap.

Most patients will benefit from intravenous sedation with a narcotic and/or benzodiazepine agent. The procedure is performed under local anesthesia with the drug of choice being lidocaine with epinephrine.

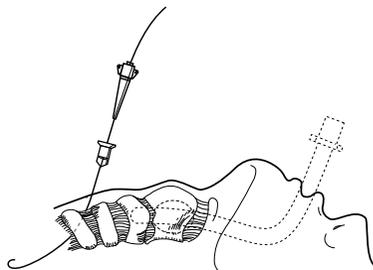
Ideally the procedure involves three clinicians: the physician performing the tracheostomy, a nurse assistant, and a respiratory therapist to manage the airway during the procedure.

Following setup, skin prep, administration of medications, and anesthesia, the airway is prepared by withdrawing the endotracheal tube to the level just below the cords where the cuff is inflated and the airway maintained during the tracheostomy. A large bore needle is inserted into the trachea and a Seldinger-type guide wire is placed into the lumen of the airway. The stoma is then created by passing a series of dilators over the wire and a guiding catheter. The tracheostomy tube is then placed on a obturator/dilator and passed into the trachea. With the removal of the obturator/dilator, the guiding catheter, and the

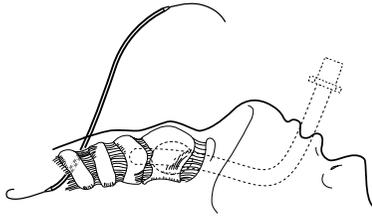
Per-fit™ percutaneous tracheostomy technique.



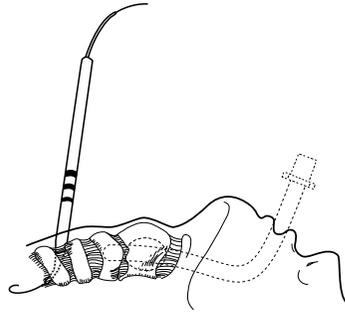
Introduction of tracheal needle.



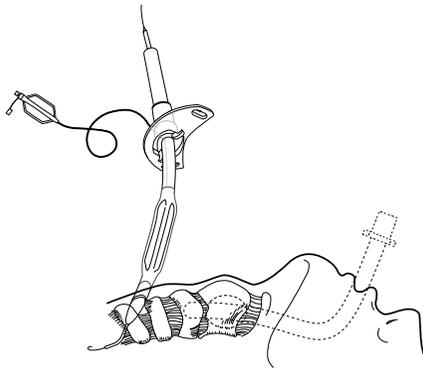
Placement of guide wire.



Insertion of guiding catheter.



Serial dilation.



Placement of tracheostomy tube.

guide wire, the procedure is complete. The average time to perform a percutaneous tracheostomy varies from 3–15 minutes.

Complications of Percutaneous Tracheostomy

As previously mentioned, complications of percutaneous technique are not common but may include false passage of the tracheostomy tube, pneumothorax, delayed bleeding, puncture of the posterior tracheal wall, or premature extubation during the procedure and loss of the airway. A clinical guide and Per-fit video is available for review. Contact customer service or your SIMS Portex Inc. sales representative.

Tracheostomy Tubes

Features of Portex® Tracheostomy Tubes

Portex tracheostomy tubes are available in neonatal, pediatric, and adult sizes. All three are available in an uncuffed style and the adult sizes are available in cuffed tubes with and without inner cannulae, in a disposable inner cannula style, and with a reusable inner cannula. All of the tubes are made of a safe nontoxic compound that is kink-resistant and conforms at body temperature. Lo-Profile™ is made of a rigid compound with a reusable, interchangeable inner cannula.

Portex tubes are fitted with strong, high-volume, low intracuff pressure cuffs which inflate symmetrically to decrease the risk of herniation. They are individually packaged and sterilized with a Velcro® tracheostomy holder and a one-way inflation valve.

All Portex tracheostomy tubes are considered single-use disposable products. However, the Lo-Profile tube has a reusable, single patient use inner cannula. All adult Portex tubes come supplied with an obturator to ease insertion.

Portex Blue Line® Neonatal and Pediatric Tracheostomy Tubes

Portex Blue Line neonatal and pediatric tracheostomy tubes are made of an implant-tested material. They are available in uncuffed styles only and are anatomically correct by design. A winged flange secures the tube to minimize motion and reduce trauma to the neonatal airway. The tubes are available with or without an angled 15 mm connector.

Portex Blue Line Tracheostomy Tubes

Portex Blue Line adult tracheostomy tubes are made of a compliant material which readily softens at body temperature and conforms to the anatomy of the airway. These two features greatly reduce trauma and increase patient comfort. The adult cuffed tracheostomy tubes feature Profile cuffs with a high-volume, low intracuff pressure seal. The tubes also feature flexible flanges to minimize motion and torque.

Blue Line tubes are available in cuffed, uncuffed, fenestrated, and non-fenestrated styles.

Portex D.I.C.™ Tracheostomy Tubes

The Portex D.I.C. tracheostomy tube with disposable inner cannula is available in two styles: the rigid outer cannula and the flexible outer cannula styles. Tubes with disposable inner cannula have many features not found with other brands. The flexible outer cannula offers many features to patients who are not able to tolerate rigid-style tubes.

Both styles of tube offer a flexible flange with large openings for improved stoma care. The 15 mm connector is an integral part of the tracheostomy tube—not on the inner cannula—which allows for ventilation with or without the inner cannula in place. The obturator design increases efficiency during insertion and reduces trauma associated with this procedure. The disposable inner cannula improves tracheostomy care and reduces nursing care time. The broad range of sizes that are available ensures a proper fit. Disposable inner cannulae are color-coded for easy identification. The disposable inner cannulae are available in color-coded boxes of 20.

Portex Specialty Tubes

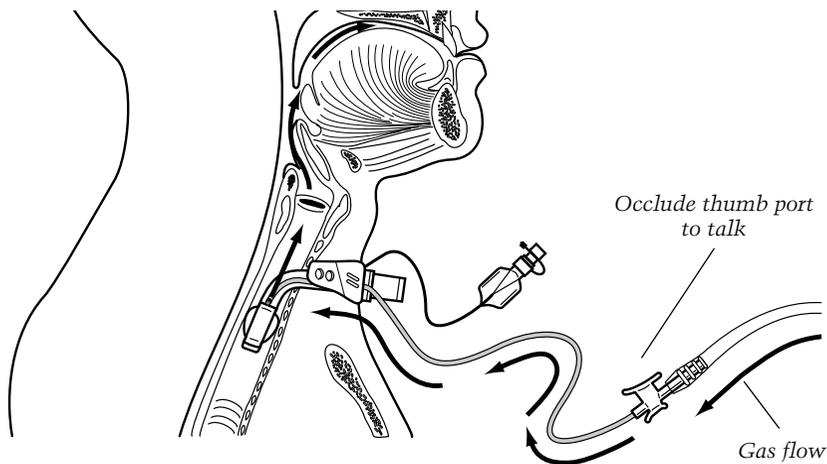
Portex Laryngectomy Tubes

The Portex D.I.C. laryngectomy tube is designed to maintain a patient's airway following a laryngectomy. The laryngectomy tube is available in three sizes with corresponding disposable inner cannula. The soft flange and 15 mm connector are an integral part of the outer cannula.

Portex Trach-Talk™ Tracheostomy Tubes

The Portex Trach-Talk tracheostomy tube was designed to assist the patient to speak in a low whispered voice. When the cuff is inflated to effect a seal on the tracheal wall, a gas line with a thumb port is connected to an air or oxygen source. The flow of gas is adjusted to 4–6 liters per minute and the thumb port is occluded by the patient or caregiver; gas passes through the larynx, allowing the patient to speak

in a soft whisper. The Trach-Talk helps to eliminate the psychological and communication barriers common to all tracheostomy patients.



Portex Trach-Talk™ tube.

Extra Horizontal Length Tracheostomy Tubes

These tubes were designed with the patient with a “bull neck” in mind. The extra length on the horizontal axis allows airway accessibility in the anatomically large patient. The tube also features a radiopaque line to facilitate confirmation of proper placement.

Portex Mini-Trach® II

Mini-tracheostomy with the Portex Mini-Trach II kit is a simple surgical procedure in which a small bore cannula (4.0 mm I.D.) is inserted into the trachea through the cricothyroid membrane, using a scalpel and introducer. When placed, the tracheal cannula allows suction to be performed as often as required using a 10fr suction catheter. The cannula is also suitable for administration of oxygen, nebulized drugs, and bronchial lavage. Mini-tracheostomy is indicated primarily for patients with sputum retention problems.

Lo-Profile™ Tracheostomy Tubes

The Lo-Profile tracheostomy tube has been developed with the concerns of the long-term tracheostomy patient in mind. Cosmetic features, patient safety, ease of use, and durability of the tube were all major factors addressed during the design of this tube.

The tube is designed with three parts. The outer cannula is constructed of a very durable material with the inner cannula provided in two forms. One inner cannula offers a low-profile locking connector that is constructed of a clear, cosmetically pleasing material. It should be noted that this style of inner cannula is not intended for ventilatory support. The other inner cannula is fitted with a standard 15 mm connector that allows easy attachment to oxygen, humidification, or ventilatory equipment. Both styles of inner cannulae provide for limited reuse (see the TRACHEOSTOMY CARE AT HOME handbook). The flexible, clear, low-profile flange is also designed with patient comfort and cosmetics in mind.

The Lo-Profile tracheostomy tube is available in four styles and five sizes that will meet the needs of most patients.

Portex Per-fit™ Percutaneous Tracheostomy Kit

The Portex Per-fit tracheostomy kit is a procedural tray that is complete with all necessary components required to perform a serial dilation percutaneous tracheostomy. The kit features two very unique features: the specially designed Portex tracheostomy tube with a low-profile cuff to facilitate easy insertion through a serially dilated stoma and a straight obturator/dilator system. The specially designed and patented tracheostomy tube features a beveled tip that further reduces tracheostomy tube insertion force. The straight dilators allow complete rotation during insertion, decreasing the force required and the tissue trauma associated with dilating a percutaneous stoma. The complete kit is designed to provide the clinician with a safe and efficient method of performing percutaneous tracheostomy. Replacement tubes and replacement inner cannula are available.

Post-Tracheostomy Complications

Complications associated with tracheostomy can be divided into two categories: immediate surgical complications and late complications. The most frequent causes of death in tracheostomy patients are obstruction and hemorrhage. Many of the early complications have already been mentioned elsewhere in this text and we will now consider the late complications that are frequently encountered.

Hemorrhage

Massive bleeding may occur a few days to several weeks after a tracheostomy. The most common cause of delayed hemorrhage is erosion of the anterior tracheal wall and a major vessel crossing it (frequently the innominate artery) by the tip of the tube. Predisposing factors may include a low tracheal incision, tube size selection, an excessively long or curved tube, and infection.

Wound Infection

Minor infection of an open tracheostomy site is common and usually responds to local treatment. If it fails to respond, a wound culture and sensitivity should be obtained and the appropriate systemic antibiotic administered. Serious mediastinitis can result from an untreated tracheostomy wound infection.

Tracheitis

A dry tracheitis will develop if humidification of the airway is inadequate. Treatment of any secondary infections will require administration of antibiotics. Instillation of normal saline during suctioning procedures may help to keep the airway moist.

Pneumonia

The development of pneumonia or lung abscess is prevented by employing aseptic technique during the surgery and postoperative care of the tube. It is especially important to avoid bacterial contamination of the respiratory tract by contaminated suction catheters. The use of

sterile disposable catheters or closed suction systems will prevent many of the associated problems.

Subglottic Edema

If the surgical opening into the trachea is made through the first or second tracheal cartilage, edema of the subglottic area can develop. The swelling of the mucosa will restrict the airway above the tube and may lead to difficult decannulation. This is especially true in infants and small children.

Tracheal Stenosis

Narrowing of the trachea by stenotic granular tissue (scar tissue) may occur at the tracheal orifice, cuff site, or at the position of tube tip. In children and infants stenosis at the tracheal orifice can be avoided by not removing any tracheal cartilage; in adults this problem is most frequently associated with a high position of the opening, through the first or second tracheal ring. Frequently, granulation may occur at the cuff site if careful attention is not paid to cuff inflation volumes and design. This problem is best avoided by monitoring the inflation volume and by using a tracheostomy tube with a high-volume cuff such as the Portex Profile® cuff. Erosion of the tracheal wall by the tip of the tube, which will lead to stenosis, is avoided by selection of a tracheostomy tube that is of proper length, size, and curvature. Tubes that soften slightly at body temperature and have movable neck plates conform better to the trachea. Portex Blue Line, D.I.C.™, and Flexible D.I.C. tracheostomy tubes incorporate all of these features.

Tracheoesophageal Fistula

Erosion of the posterior wall of the trachea can be caused by a poorly fitted tube or by excessive cuff volume. A communicating channel between the esophagus and trachea can result. This complication is potentially fatal but is fortunately rare. It is treated by inserting a longer cuffed tube with surgical correction when the patient's condition permits. Monitoring and recording cuff volumes will help reduce this possibility. Minimizing torque transmission of connections to the distal tip of the tracheostomy tube is also clinically significant.

Guidelines for Nursing Care of the Tracheostomy Patient

Three major factors must be considered in the care of the tracheostomy patient:

1. Humidification
2. Mobilization of secretions
3. Airway patency.

Humidity

The importance of humidification can not be overemphasized. The nasopharynx, which provides the natural humidification mechanism for the airway, has been bypassed by tracheostomy. It is absolutely essential that adequate humidity be provided to keep the airway moist.

In the immediate postoperative period, humidity is usually supplied via a heated gas vapor generator on a mechanical ventilator or via a heated aerosol supplied to the patient utilizing a T-piece attached directly to the tracheostomy tube, or a tracheostomy mask.

The patient must be properly hydrated with oral or I.V. fluids to permit the mucosal surface to remain moist and to ensure that the viscid secretions remain atop the cilia. This will make the secretions thinner and more mobile.

Instillation of sterile saline directly into the tracheostomy tube at intervals, usually before and during suctioning, may aid in loosening and keeping secretions moist.

The patient's own moisture may be conserved by the use of a simple condenser humidifier. As the patient exhales water vapor, it condenses on a pleated paper filter and is revaporized on inhalation. SIMS Portex Inc. has a heat and moisture device (Thermovent® T) available for the tracheostomy patient. Supplemental oxygen can be added to the inspired air with a special adapter (Thermovent O₂).

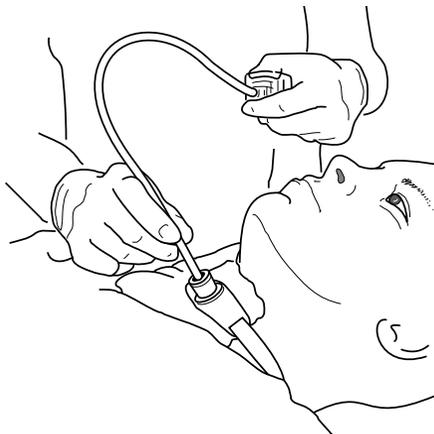
Mobilization of Secretions

Many of the nursing skills employed are aimed at the mobilization of pulmonary secretions. Frequent turning, encouragement of deep breathing, and ambulation are important in the prevention of pulmonary complications.

Regular chest physiotherapy and postural drainage are both very effective in the mobilization of secretions and should be used routinely during the postoperative period. Manual ventilation (bagging) along with tracheal instillation of normal saline may also aid in the mobilization of secretions.

Suctioning

Suctioning is at best an uncomfortable procedure and is usually a frightening one for the patient. It is a procedure where both psychological and physiological defensive reflexes will come into play for the protection of the airway. It is essential to remember several things when suctioning a patient:



Suctioning procedure.

1. A tracheostomy is an open surgical wound and strict asepsis and universal precautions should be observed.
2. A clear explanation of the procedure with reassurance will help to decrease the patient's anxiety and fears.
3. Partial occlusion of the airway by the suction catheter, combined with aspiration of air from the lung while using an open suction system, can result in severe hypoxia, cardiac arrhythmia, and even cardiac arrest. Suctioning procedures must NEVER exceed 15 seconds even if no visible signs of stress are noted. The O.D. of the suction catheter should not exceed 50% of the I.D. of the lumen being suctioned.
4. The upper airway is lined with delicate tissue and care must be taken to avoid damage to these tissues during suctioning. For this reason, suction is applied only intermittently and with catheter rotation to avoid trauma to the mucosal walls of the trachea and bronchi.

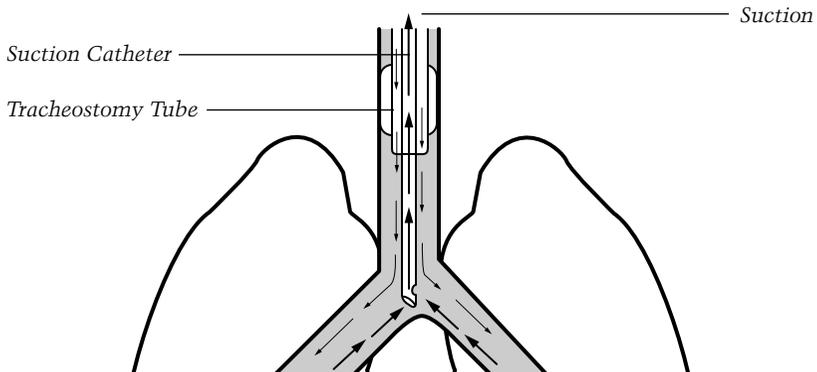


Figure 1.

5. Suction is applied ONLY during withdrawal in order to decrease the volume of air removed from the lungs and decrease the hypoxic effect and trauma to the airway.
6. The outer diameter of the suction catheter should be, at a maximum, one half ($\frac{1}{2}$) the inner diameter of the tracheostomy tube. A suction catheter of greater diameter could lead to obstruction to the air flow around the catheter during the procedure. When a closed suction system is used, this atmosphere will be oxygen enriched or will be supplied by the ventilator (*see figure 1*).

The following chart is included for reference. It relates the approximate size suction catheter to be used in conjunction with tracheostomy and endotracheal tubes.

Suction Catheter Sizing to Tracheostomy Tubes

TRACH TUBE (I.D.) mm	SUCTION CATH.
2.5	5fr.
3.0	6fr.
3.5	8fr.
4.0	8fr.
4.5	8fr.
5.0	10fr.
6.0	10fr.
7.0	12fr.
8.0	14fr.
9.0	16fr.
10.0	16fr.

Suction Catheters

SIMS Portex Inc. offers suction catheters in several styles and in various kit forms. The following is a guide for the practitioner to the various features of each of these styles:

Maxi-Flo® Suction Catheter Kits

The Maxi-Flo suction catheters feature a catheter tip design which maximizes suction efficiency and minimizes trauma to the airway. The soft leading edge of the catheter reduces the possibility of damage to the carina associated with repeated suctioning. The large opening of the distal tip provides for easy and efficient removal of secretions. The lateral eyes are soft and close to the tip which increases suction efficiency. This catheter is available in several kit configurations as well as a single catheter package. The Maxi-Flo suction catheter maximizes efficiency and minimizes airway trauma.

Cathmark® Suction Catheter Kits

Cathmark suction catheters offer a method for safer neonatal and pediatric suctioning, as the chart on each package guides the clinician in determining the proper distance for catheter insertion. The graduations (every 2 cm) enable the clinician to advance the catheter accordingly, providing a margin of safety and potentially reducing the incidence of pneumothorax.

No Pour Pak® Suction Catheter Kits

No Pour Pak suction catheter kits are available in two different forms: the No Pour Pak II and the Economy No Pour Pak II.

The No Pour suction catheter kits all help to minimize the risk of nosocomial infections, protecting the patient and clinician from exposure to contaminated material when the suction procedure is completed. No Pour Pak II features a snap-on lid and resealable water basin allowing for total containment of the catheter, gloves, and solution for safe disposal at the completion of the suction procedure. The Economy No Pour Pak II contains many of the features of the No Pour Pak II yet is more economical because it has vinyl gloves and does not include a containment lid.

Coudé Suction Catheter Kit

Clinical studies have shown that angled coudé catheters ensure almost 100% entrance into the right main stem bronchus and approximately 45% entrance into the left main stem bronchus. Straight catheters enter the left main bronchus less than 10% of the time, regardless of the head position (*see figure 2*). For ease and accuracy of entering and suctioning the left bronchus, coudé (angled) catheters are advocated (*see figure 3*).

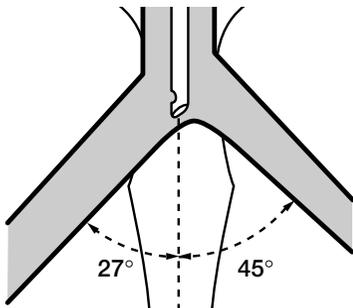


Figure 2.

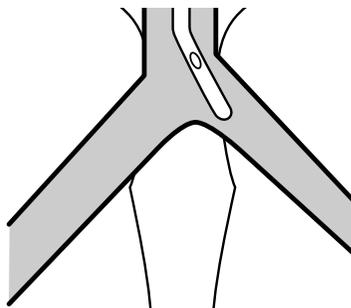


Figure 3.

Irri-Cath® Suction System

The exclusive Irri-Cath suction system combines continuous irrigation and suction to significantly increase efficiency and effectiveness of secretion removal. It provides an alternative to the fiberoptic bronchoscopy for bronchial alveolar lavage as a diagnostic aid.

Irri-Cath allows for continuous irrigation to the exact suction site which reduces the viscosity of secretions, permitting immediate removal. More efficient removal of secretions with Irri-Cath decreases the frequency of necessary suctioning.

Steri-Cath® Closed Ventilation Suction System

The Steri-Cath closed ventilation suction system catheter allows the clinician to maintain mechanical ventilation during the suction procedures. Suctioning without disconnecting the patient from the

ventilator reduces many of the problems associated with open suction systems. This system reduces the possibility of cross-contamination, protecting both the patient and clinician with an enclosed catheter and thumb valve. The dual lumen system offers ease of instilling saline for lavage and irrigation as well as for the administration of intratracheal medications through a separate inner lumen. The lightweight T-connector and swivel eliminates torque associated with connecting closed suction systems directly to endotracheal or tracheostomy tubes.

A closed ventilation suction system has been designed for the tracheostomy patient. It contains all the features of the standard closed ventilation system but features a 14fr catheter 30 cm in length.

Psychological Care

Many tracheostomy patients are totally dependent upon the caregivers and can do little for themselves. The alert patient will initially be apprehensive and frightened. Since the patient, especially with an inflated cuffed tube, will be unable to speak, every word and action of the staff is carefully observed. It is imperative that an atmosphere of calmness and confidence be created for the patient since emotional status will influence breathing pattern and acceptance of mechanical ventilation.

Most patients should be continually reminded that their inability to speak is only temporary. It is difficult, frustrating, tiring, and disheartening for a tracheostomized patient to attempt to talk. Other forms of communication such as a pad and pencil, a communication board, or the use of a specialty tracheostomy tube (Trach-Talk™) should be considered. The ability to communicate becomes imperative.

Caregivers should also provide encouragement and reassurance to the patient during attempts to swallow or eat, since the patient may be afraid of choking.

The apprehensive family may be reassured by pointing out to them such things as the call bell that is easily accessible, and the close proximity of a trained professional medical staff.

Suctioning

Suctioning a patient should never be considered routine. Your decision to suction your patient should be based upon several observations: increasing airway pressures, increasing patient apprehension, or rhonchi heard by auscultation. Both sides of the chest should be routinely auscultated with a stethoscope. To suction a patient just because an hour has passed is insufficient reason, but to wait until there are secretions evident in the bronchial tree may not be appropriate.

When you have gathered all of the equipment, take time to reassure and explain the procedure to your patient. Remember, with the tracheostomized patient, communication is quite difficult. Give the patient pencil and paper, or word your questions so that the patient can indicate “Yes” or “No” by nodding his/her head or blinking his/her eyes.

Always remember to preoxygenate your patient before the suction procedure. Constantly observe clinical signs that may indicate hypoxia.

Supplies:

1. Portable suction pump or tracheal wall suction
2. Disposable suction catheter kits of appropriate size or single disposable suction catheters
3. Gloves
4. Basin
5. Small jar of sterile normal saline.

NOTE: All necessary equipment, gloves, catheter, basin, and sterile saline are available from SIMS Portex Inc. in several kit forms.

Procedure:

1. Gather your supplies and equipment.
2. Explain the procedure to your patient.
3. Wash your hands with surgical soap.
4. Prepare equipment, open kit or catheter pack, saline, etc.
5. Put on sterile gloves.

NOTE: Sterile technique is to be followed throughout procedure.

6. Remove sterile suction catheter from package.
7. Lubricate tip of catheter by dipping tip in sterile saline or by rolling in sterile water-soluble lubricant.
8. Be sure patient is preoxygenated.
9. Open suction port on swivel. If the patient is not on mechanical ventilation, disconnect from the supplemental oxygen source and humidifier.
10. If the patient is cooperative, ask him/her to take a deep breath and quickly but gently insert the catheter into the trachea. If resistance is felt, withdraw the catheter slightly. The catheter control valve is left open or not depressed during insertion so that no suction is applied during insertion.
11. Apply intermittent suction. Rotate the catheter between your thumb and forefinger during withdrawal.

NOTE: The suction procedure should not take any longer than 15 seconds from insertion to completion of withdrawal.

12. As soon as the catheter is withdrawn, reconnect to the ventilator, or oxygen supply source. Reoxygenate the patient.

13. Clear the catheter with saline.
14. Repeat procedure if necessary until airway is clear of secretions.

NOTE: The patient's chest should be auscultated frequently to determine if suctioning of the airways is required. Suctioning should never be considered a routine procedure and should be employed only on an as-needed basis.

At the completion of tracheal suctioning, the oral pharynx and laryngopharynx may be suctioned to remove secretions that are present.

15. Clear secretions from catheter and suction tubing and discard catheter, gloves, and saline.

Record and Report:

1. Quantity, color, and consistency of secretions
2. Number of times the patient required suctioning per shift
3. Patient's tolerance
4. Condition of skin around the tracheostomy site
5. Any complications associated with the suctioning procedure
6. The volume of air required to obtain a cuff seal.

NOTE: Make sure that the cuff is not overinflated.

Changing Tracheostomy Dressings

It is very important to change tracheostomy dressings as soon as they become soiled.

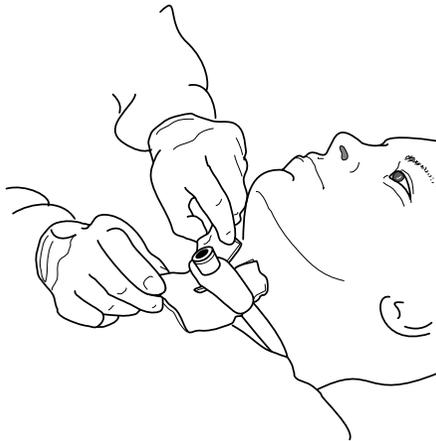
While changing the tracheostomy ties or holders, one clinician holds the tube in place while the other removes the old ties or holders and replaces them with new. NEVER tie tracheostomy ties with a bow. Ties should always be tied with a square knot.

Supplies:

1. Tracheostomy dressings

NOTE: Plain sterile gauze pads should not be used to create tracheostomy dressings, as fibers that become loose may be aspirated into the airway.

2. Clean tracheostomy ties or a Velcro® tracheostomy tube holder
3. ½-strength hydrogen peroxide
4. Dry sterile pad or towel.



Tracheostomy dressing change.

Procedure:

1. Remove old dressing, being careful to keep tracheostomy tube in place.
2. Clean around tube at stoma site with hydrogen peroxide solution.
3. Place clean tracheostomy dressing under the flange, inserted from below.
4. Change tracheostomy ties as necessary.
5. Change dressing as necessary.

Skin Care

The care of the skin around the stoma site should be considered one of the more important procedures in the care of the tracheostomy patient. The new surgical site needs to be cleaned and dressed frequently as it heals. As the incision heals, the frequency will decrease.

Supplies:

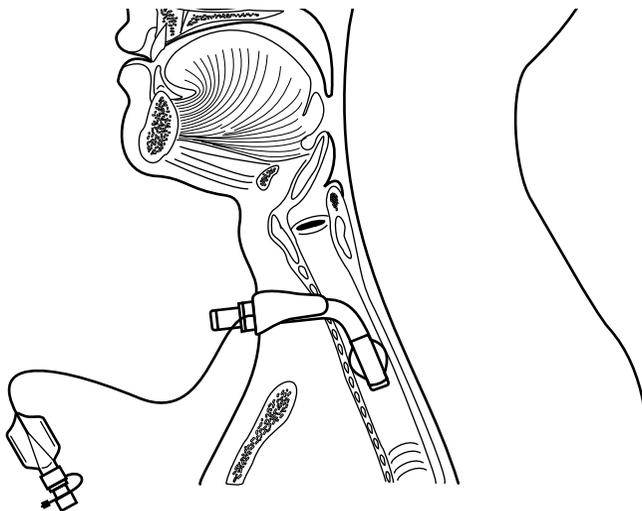
1. Cotton-tipped swabs
2. Normal saline or ½-strength hydrogen peroxide.

Procedure:

1. Gather all necessary supplies.
2. Wash your hands with surgical soap and water.
3. Inspect the site around the tracheostomy stoma for signs of skin breakdown, infection, or irritation.
4. Moisten the swabs in either the peroxide solution or with normal saline.

5. With a rolling motion, clean the skin area around the stoma and under the flange of the tube.
6. Pat dry with a clean dry swab or pad.
7. Replace tracheostomy dressing.

Patient Care with a Cuffed Tracheostomy Tube



Cuff to tracheal wall pressures must be constantly lower than capillary perfusion pressure to avoid tracheal necrosis.

The high-volume, low intracuff pressure Profile® cuffs on Portex® tracheostomy tubes provide a closed system for mechanical ventilation and protection of the airway from aspiration. The Profile cuffs have been designed to provide these features with minimal trauma to the mucosa and trachea.

Cuff inflation is necessary to provide a seal for mechanical ventilation of your patient. It is also indicated to protect the lower airway from the aspiration of gastric contents.

Inflation of the cuff is accomplished by slowly injecting air into the inflation line that leads to the cuff. A standard luer tip syringe may be used, as all Portex tracheostomy tubes are supplied with an integral pilot balloon and luer inflation valve.

Cuffs should be inflated with the minimum amount of air that is required to obtain adequate ventilatory parameters. The Profile cuff is cylindrical, 2.4 cm long, and 3.0 cm in diameter when inflated to a

pressure of 1 cm H₂O. At this point the Profile cuff is not stretched and the volume is about 12 cc. This cuff diameter is greater than the normal adult trachea and provides for a low intracuff pressure while maintaining a cuff seal.

It is recommended that a minimal occlusive volume technique be employed in inflating cuffs. The volume of air injected into the cuff is only that volume that is required to obtain an occlusive volume.

Caring for Tubes with Inner Cannulae

Inner Cannula Care

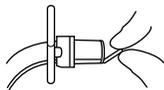
In an effort to decrease the time that is required in the nursing care of the tracheostomy patient and to help reduce the infection rate that is associated with tracheostomies, SIMS Portex Inc. has designed two tubes with disposable inner cannula: the D.I.C.[™] tracheostomy tube and the Flexible D.I.C. tracheostomy tube. Lo-Profile[™], a low-profile, rigid tracheostomy tube with a reusable inner cannula, has also been developed for the patient that will be discharged home with a tracheostomy tube in place.

D.I.C. and Lo-Profile tracheostomy tubes are available in five sizes; the D.I.C. tubes come with color-coded inner cannulae for ease of identification.

Changing the D.I.C. Inner Cannula

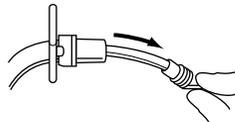
Supplies:

1. Disposable inner cannula (correct size)
2. Two vinyl examination gloves
3. Two sterile gloves.



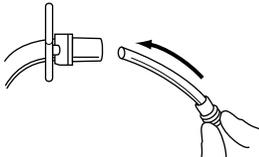
Grasp the "ring pull."

Removal

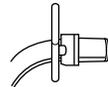


Remove the inner cannula.

Insertion



Hold as shown and gently insert into tracheostomy tube.



Gently seat the inner cannula into the connector until it clicks into place.

Procedure:

1. Gather supplies.
2. Explain procedure to the patient.
3. Wash hands well with surgical soap and water.
4. Open disposable inner cannula package, maintaining sterility.
5. Glove, with nonsterile vinyl gloves, and gently remove old inner cannula.

NOTE: Place thumb and index finger on tracheostomy tube to prevent movement; using free hand, grasp small plastic ring of inner cannula and remove.

6. Discard gloves and cannula.
7. Glove, using sterile gloves.
8. Insert new sterile disposable inner cannula into tube.

NOTE: Place thumb and index finger on tracheostomy tube to prevent movement; using free hand, insert sterile inner cannula. The cannula should click into place.

Cleaning Reusable Inner Cannula

The inner cannula is one of the most important parts of the three-part tracheostomy tube. Its presence in the outer tube ensures that the tube is kept clear of secretion buildup, since it can be removed and cleaned. Generally, it should be removed and cleaned every two to three hours for the first two days after tracheostomy and at least every four hours thereafter. For patients that are unable to tolerate being off the ventilator during the time which is required for cleaning, Lo-Profile tracheostomy tubes are designed with the 15 mm ventilator connector as an integral part of one of the inner cannulae.

Inner cannula care always requires strict aseptic technique.

Supplies:

1. Sterile gloves
2. Tracheostomy brush or sterile pipe cleaners
3. Basin
4. Gauze sponges
5. Sterile water
6. Hydrogen peroxide.

NOTE: SIMS Portex Inc. has disposable tracheostomy care kits available, such as the standard 6950, 6952, 6954, and 6970 kits and the 6956, 6957, 6958, 6959, and 6960 kits with disposable inner cannula.

Procedure:

1. Gather equipment and supplies.
2. Explain procedure to the patient.
3. Wash hands well with surgical soap and water.
4. Glove with sterile gloves.
5. Remove the inner cannula and reattach the patient to the ventilator or supplemental oxygen.
6. Using a sterile basin, pour hydrogen peroxide through the inner cannula to loosen secretions.
7. Gently remove encrustations and mucus using a sterile trach brush or sterile pipe cleaners.
8. Rinse the inner cannula thoroughly with sterile water.
9. Dry the inner cannula using a sterile gauze sponge.
10. Disconnect the ventilator and reinsert the inner cannula. Reconnect the ventilator.

Changing the Tracheostomy Tube

The initial tracheostomy tube changes are usually done by the physician until the stoma and tracheal tract are well established. After the tract is established, changes are performed as the physician specifies. If the tracheostomy tube comes out, the patient's tracheostomy site should be sealed by placing sterile gauze over it and the patient may then be ventilated by bag/mask if necessary. It also may call for the patient to be intubated orally before the tracheostomy tube is reinserted.

Routine tracheostomy tube changes are frequently carried out by the nursing or respiratory care staff after the tracheal tract is established. This procedure should be performed according to hospital protocol.

Supplies:

1. Sterile tracheostomy tube of the correct size and type
2. Twill ties or a Velcro® tracheostomy tube holder
3. Sterile gloves
4. Sterile towel or drape
5. Water-soluble lubricant
6. Sterile gauze pads (4 x 4)
7. Scissors
8. 10 cc syringe
9. Precut tracheostomy dressing.

Procedure:

1. Gather all equipment and supplies.
2. Explain the procedure to the patient.
3. Wash hands well with surgical soap and water.
4. Glove with sterile gloves.

5. Remove the tracheostomy tube from the package and remove the inner cannula using aseptic technique.
6. Thread the outer cannula with neck tapes.
7. Test inflate the cuff on cuffed tubes.
8. As you are deflating the cuff, taper back the cuff to ease insertion.
9. Place the obturator into the outer cannula.
10. Lubricate the tip of the tube and the obturator with water-soluble lubricant to ease insertion.
11. If the patient has a cuffed tube in place, deflate the cuff before removing the tube.
12. When the new tube is fully ready for insertion, cut the tapes on the old tube.
13. Grasp the old tube by the neck flange and remove it in a downward motion.
14. When the old tube is out, immediately insert the new tube using gentle inward pressure.
15. IMMEDIATELY remove the obturator, inflate cuff, and record volume used.
16. Secure the neck tapes with a square knot with enough space between the neck and the tie to allow one finger space.
17. Insert the new inner cannula and lock in place.
18. Dispose of the old tube properly.

Decannulation Procedure

When the patient is being weaned from mechanical ventilation or from the tracheostomy tube itself, the use of a fenestrated tracheostomy tube may facilitate the decannulation procedure.

The design of the tube allows the patient to gradually become used to handling secretions and breathing on his/her own. The tube can also provide the protection of a cuff if the patient should require supportive ventilation.

When it is desired to have the patient breathe through his/her upper airway, the inner cannula is removed, the cuff deflated, and the outer cannula occluded by the decannulation cap. The capped outer tube with the cuff deflated will assist the patient to speak. ALWAYS REMEMBER TO DEFLATE THE CUFF, AS TOTAL AIRWAY OBSTRUCTION WILL OCCUR IF CUFF IS NOT DEFLATED! (See figure 4.)

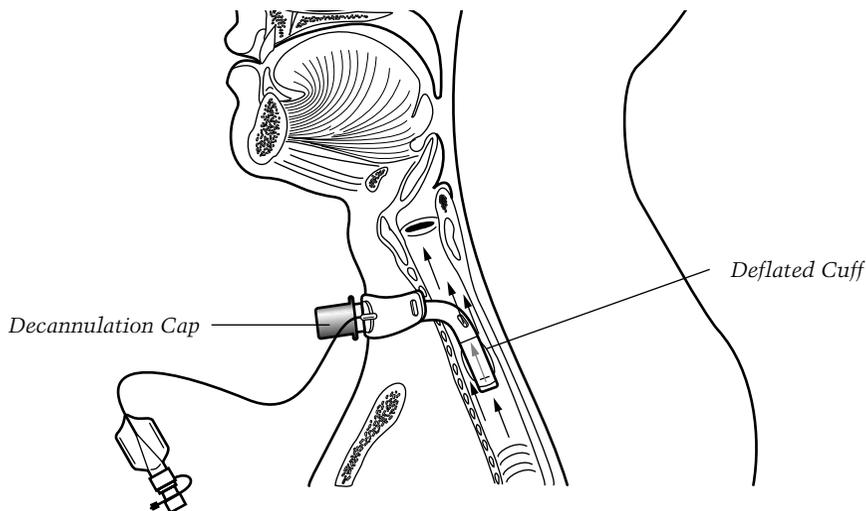


Figure 4.

Procedure:

1. Suction the airway.
2. Remove the inner cannula.
3. Always deflate the cuff.

4. Place the decannulation cap on the outer tube.
5. Observe the patient closely for respiratory distress.
6. Remove the decannulation cap and replace the inner cannula if respiratory distress is observed.
7. Only use the decannulation cap during waking hours.

Conclusion

We hope that this TRACHEOSTOMY CARE HANDBOOK will meet the needs of the respiratory care practitioner and nursing staff. Handbooks are also available on PEDIATRIC TRACHEOSTOMY HOME CARE and TRACHEOSTOMY CARE AT HOME for the adult patient.

For more information please contact SIMS Portex Inc. at 1-800-258-5361.

Glossary

Acidosis

A disturbance in the acid-base balance of the body in which there is accumulation of acids.

Alkalosis

An increase in the bicarbonate content in the blood.

Alveolus

An air cell, one of the terminal dilations of the bronchioles in the lungs.

Apnea

Cessation of respirations, usually of a temporary nature.

Asphyxia

Suffocation causing excessive accumulation of carbon dioxide, fixed acids, and anoxia.

Auscultation

The act of listening for sounds within the body; employed as a diagnostic method.

Bronchiole

One of the smaller subdivisions of the bronchi.

Bronchus

One of the two main branches of the airway leading from the trachea to the lungs. (*pl* bronchi)

Carina

The point of division of the trachea into the two main stem bronchi.

Cilia

Hairlike processes projecting from epithelial cells in the bronchi which wave, moving mucus and dust particles upward in the airway.

Cricoid Cartilage

The lowermost cartilage of the larynx.

Cyanosis

A bluish tinge of color of the mucus membranes and skin due to the presence of excessive amounts of oxygen-reduced hemoglobin in the blood.

Decannulation Cap

A small occlusive cap that is used to obstruct the opening of a tracheostomy tube during the weaning process of a patient from the mechanical airway.

Dyspnea

Air hunger resulting from labored or difficult breathing.

Edema

Excessive accumulation of fluids in the tissue spaces; swelling.

Hemostasis

Coagulation of blood; arrest of flow of blood.

Hypercarbia

An excess of carbon dioxide in the blood.

Hypoxia

An oxygen level in the blood lower than the metabolic needs of the tissues.

Laryngopharynx

Lower portion of the pharynx that extends from the beginning of the larynx to the lower border of the cricoid cartilage.

Lumen

The space in the interior of a tubular structure or device.

Mucus

The viscid watery secretion of the mucous gland; it contains water, mucin, epithelial cells, leukocytes, and inorganic salts.

Necrosis

Local death of tissue.

Nosocomial Infection

Infection acquired in a hospital.

Oximeter

An instrument for measuring the oxygen saturation of hemoglobin.

Parenchyma

The functional elements of an organ as distinguished from its framework or stoma.

Pectoral

Pertaining to the breast or chest.

Rales

Abnormal sound arising within the lungs or airway caused by the accumulation of fluid.

Rhonchi

Abnormal sound arising within the lungs or airway caused by the narrowing of the passages by mucoid secretions.

Stenosis

Narrowing or stricture of a duct or canal.

Stricture

A circumscribed narrowing of a tubular structure.

Tachycardia

Abnormal rapidity of the heart rate.

Tracheostomy

The surgical formation of an opening into the trachea through the neck to allow passage of air.

Ventilator

A mechanical device for moving gases into and out of the lungs and artificially breathing for a patient.

Viscid

Adhesive, glutinous, sticky.

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