ROUTINE CARE OF THE PATIENT WITH A TRACHEOSTOMY

The Tracheostomy Care Bundle (6 Elements)

I.	Humidification
II.	Suctioning
III.	Cleaning of the tracheostomy inner tube
IV.	Stoma care
V.	Cuff pressure
VI.	Emergency equipment

I. Humidification

A tracheostomy bypasses the normal upper airway mechanisms for humidification, filtration and warming of inspired gases. It is vital that a method of artificial humidification is utilised when a tracheostomy tube is in situ or in patients who have a laryngectomy.

Inadequate humidification may lead to:

- impaired mucociliary transport
- retained secretions
- inflammation of epithelium
- keratinisation and ulceration of the tracheal mucosa
- atelectasis/pneumonia
- impaired gas exchange
- potential life-threatening blockage of the tracheostomy with tenacious sputum

The provision of adequate humidification of inspired gases is therefore essential in all tracheostomy/laryngectomy patients.

There are various methods to provide supplementary humidification according to patient's individual needs, however it is most important to ensure the patient has adequate systemic hydration. If the patient has been assessed as having a competent swallow they may be able to maintain some or all of their own hydration through drinking, otherwise hydration should be ensured via enteral or parenteral route.

Humidification can be classed as active or passive. Active humidification is adding a humidifier (cold or heated) to the inspired gases e.g. Fischer Paykel. Passive humidification is preventing the loss of humidified air from the tracheobronchial tree e.g. HME. The ability of any device, regardless of operation, to prevent drying of secretions depends on delivered gas temperature and relative humidity. However, the device should help to maintain body temperature, be convenient and cost effective and suited to the patient. However assessing the adequacy of humidification is very difficult. Therefore observation of adequacy of humidification should include:

- evidence of airway obstruction
- increased need to clean inner cannulae
- need for oxygen
- respiratory rate
- ability to cough
- need for suctioning
- tenacity of secretions

Those with pre-existing respiratory disease - COPD, CF, bronchiectasis etc, who have a tracheostomy are at an increased risk of thick tenacious secretions and should be closely monitored for respiratory deterioration. Ideally active heated humidification for these patients should be available at all times.

Methods of humidification for tracheostomy ventilated patients (critical care areas)

Action	Rationale
All patients receive humidified circuit with Fisher & Paykel™ water system.	Warmed water carries a greater relative humidity.
For patients with thick secretions, ensure 4 -6 hourly prescription of saline nebulisers.	To loosen secretions, to prevent atelectasis and sputum thickening.
In patients with very difficult to clear secretions, use nebulisers and mucolytics as indicated: • Mucokinetics (Hypertonic Saline >2.7%) • Mucolytics (acetylcysteine, DNA-ase) • Bronchodilators	To improve mobility of secretions, loosen secretions, to prevent atelectasis and sputum thickening and improve expiratory flow.
Ensure adequate systemic hydration via oral, enteral or parenteral route	To prevent dehydration and decrease thickening of secretions

Self - ventilating patients tracheostomy requiring oxygen therapy

Action	Rationale
All patients to receive humidification via Fisher & Paykel™ circuit.	Warmed water carries a greater relative humidity.
For patients with thick secretions, ensure 4-6 hourly prescription of saline nebulisers.	To loosen and thin secretions, to prevent atelectasis and sputum consolidation.
In patients with very difficult to clear secretions, use nebulisers and mucolytics as indicated: • Mucokinetics (Hypertonic Saline >2.7%) • Mucolytics (acetylcysteine, DNA-ase) • Bronchodilators • Oral carbocysteine	To improve mobility of secretions, loosen secretions, to prevent atelectasis and sputum thickening and improve expiratory flow.
Ensure adequate systemic hydration via oral, enteral or parenteral route	To prevent dehydration and decrease thickening of secretions

Self-ventilating patients not requiring oxygen therapy

Action	Rationale
For all patients with loose or no evidence of secretions use a HME. The Swedish nose protector should be used.	To moisten inspired gases by trapping and rebreathing humidity, to prevent inhalation of particulate matter.
Replace HME 24 hourly or more frequently if contaminated by secretions.	To maintain effectiveness and reduce infection risk.
For patients with thick / dry secretions, ensure 4-6 hourly prescription of saline nebulisers.	To loosen and thin secretions, to prevent atelectasis and sputum consolidation.
Review need daily	To highlight problem and introduce early intervention where required.
In patients with very difficult to clear secretions, use nebulisers and mucolytics as indicated: • Mucokinetics (Hypertonic Saline >2.7%) • Mucolytics (acetylcysteine, DNA-ase) • Bronchodilators • Oral carbocysteine	To improve mobility of secretions, loosen secretions, to prevent atelectasis and sputum thickening and improve expiratory flow.
Ensure adequate systemic hydration via oral, enteral or parenteral route	To prevent dehydration and decrease thickening of secretions

Types of Humidification

Listed below are the types of humidification available within South Tees Hospitals FT.

1. Active Heated Humidification

Fisher & Paykel™ MR 880 - Aims to provide optimal humidity for invasive ventilation, noninvasive ventilation, Humidified High Flow Oxygen Therapy

These devices increase the heat and water vapour of inspired gas closer to body temeprature. In tracheostomy patients, the ideal humidifier temperature is 37 degrees (where close to 100% relative humidity is achieved) but this is often only achieved in sealed ventilatory circuits i.e. mechanically ventilated patients.

Fisher & Paykel™ MR 810 - Simple System for Non-invasive and Oxygen Therapy Applications. Not for invasive ventilation.

Fisher & Paykel™ Airvo

For delivering high-flow therapy to patients with integrated fl :n delivery system. For self ventilating patients.

Kendall™ Aerodyne 15904/Respiflo

Nebulised warm water for self-ventilating patients.

2. Cold Water Humidification

These devices bubble gas through cold water at ambient temperatures and thus deliver only 50% relative humidity. For effective humidification, wide bore/"elephant" tubing must be utilised. Please note "bubble through" humidifiers e.g. Respiflo with green oxygen tubing DO NOT provide adequate humidification for tracheostomy patients and should not be used.

3. Heat and Moisture Exchanger (HME)

These products contain a condenser element to conserve heat and moisture on expiration. They can be placed directly on the tracheostomy e.g. Portex thermovent or in a breathing circuit e.g. flexicare HME. They need to be regular checked for secretions and damage and must be changed every 24 hours. Some can be used to deliver oxygen.

Flexicare Ventilator Circuit HME

ATOX Trachphone

Portex Thermovent "Swedish nose"

4. Nebulisers

These convert a liquid (saline, bronchodilators etc) into a supersaturated aerosol which penetrate the lung and moisten the airway. They can be used in ventilated and self ventilating patients and a flow rate of 6-8 lpm from a gas source (usually oxygen) is required to drive the nebuliser. The nebuliser must be delivered to the trachesotomy via an appropriate tracheostomy mask (as shown) or via a T-piece in the ventilator circuit on the inspiratory limb.

Tracheostomy mask

5. Bibs

These are largely used for long-term tracheostomy patients and laryngectomy patients. They contain a foam layer which absorbs moisture from expired gases, similar to an HME, but are more conspicuous and less bulky and thus are better tolerated

Buchanan bib

Other methods of improving secretion management

Mobilisation of patients (regular position change, sitting upright, transferring to a chair, mobilising with assistance or independently) will aid in secretion movement and clearance and should be considered alongside humidification with all tracheostomy patients. Safety precautions should always be undertaken to ensure stability of the tracheostomy tube, particularly in mechanically ventilated patients and recent tracheal surgery.

Instilled Saline: patients with thick, tenacious secretions that cannot be removed with adequate humidification, nebulisation and suction, instillation of 2-5 mls of 0.9% saline may be beneficial to prevent airway occlusion and stimulate a cough. However, it is stressed that this should not be done routinely and should only be undertaken by those experienced in management of tracheostomy patients.

II. Suctioning

Suctioning the airway is an essential part of routine care of a tracheostomy. The health of the lower respiratory tract is usually maintained by a mucus blanket which is transported up to the larynx by the ciliated mucosa of the trachea. The mucus blanket is disturbed following a tracheostomy for several reasons:

- The loss of normal humidification from the nasal airway
- The post-surgical inflammation produces a more tenacious mucus blanket
- The presence of the tracheostomy tube paralyses the cilia in contact with it
- The loss of a normal cough mechanism

This usually results in the tracheal mucus collecting at the lower end of the tracheostomy tube. Although some patients may be able to project the mucus through the tube by forced expirations/coughing, it will often need removal by suctioning.

Patient assessment

Suctioning is not a benign process and may cause:

- Hypoxia
- Cardiac arrhythmias
- Trauma
- Atelectasis
- Infection

It is therefore essential for the practitioner to assess whether the patient requires suctioning. Indications that the patient may require suctioning include:

- Noisy respirations
- Palpable fremitus
- Increased respiratory rate
- Restlessness
- Reduced oxygen saturation levels/ deteriorating paO2 on ABG.
- Increased or ineffective coughing
- Increased use of accessory muscles
- Patient request
- Later signs may include cardiovascular instability

Sedated or ventilated patients may have deep secretions which may not be immediately obvious. These secretions may need to be mobilised by physiotherapy and require additional humidification before suctioning is effective.

With an awake, co-operative patient, it will often be possible to encourage them to cough up the secretions, thereby reducing the need for excessive suction.

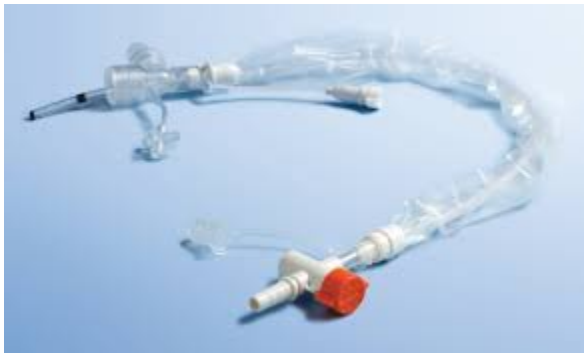
Types of Tracheal Suctioning

Passing a suction catheter to the tip of the tracheostomy tube can be considered 'shallow' suctioning. This is often all that is required if the patient has reasonably loose secretions which can be coughed towards the end of the tube. Passing a suction catheter any further than this can be considered as 'deep' suctioning and may be required if more shallow suctioning does not clear the secretions adequately.

In patients requiring a tracheostomy for ventilator weaning 'deep' suction past the end of the tracheostomy tube may be necessary in order to effectively clear secretions. This deeper suction however can paralyse the cilia, aggravate the issue of retained secretions and cause possible trauma. In order to minimise this, patients who are able to cough secretions into the tracheostomy tube, should be encouraged to do this and shallow suction should only be performed (to the end of the tracheostomy tube). In some long-term tracheostomy patients there may indeed be specific instructions to only suction to a certain catheter depth in order to minimise permanent damage.

Suctioning systems can be 'open' or 'closed'. Open suction involves using single-use catheters inserted via the open end of the tracheostomy tube, whilst closed suction systems allow the same catheter to be used multiple times. Closed systems are especially useful in the critical care setting where repeated disconnection of the circuit could be detrimental (e.g. in patients with high FiO2 requirements and high ventilator pressures) or in patients with copious secretions.

Closed suction systems should be cleaned following use with sterile saline to reduce risk of occluding the catheter and also permit more accurate estimation of secretion volume. The systems should be changed every 72 hours, unless contraindicated by the patient's clinical condition. Although the closed systems have several clinical advantages, they do add a degree of weight to the breathing circuit and a risk of getting caught accidentally, which may lead to inadvertent disconnection or tube displacement.



Closed suction system

Different Colour coded different sized open suction catheters

Suction catheter selection

Tracheal damage and hypoxia during tracheal suction can be minimised by using the appropriate sized suction catheter. If the catheter is too large the suction it creates can cause damage and may also partially occlude the tracheal tube leading to hypoxaemia. It has been recommended that the diameter of the catheter should be no more than half the internal diameter of the tracheal tube. If the catheter is too small however it will be inadequate to remove secretions.

A guide to choosing the correct size of catheter was proposed by Odell and others (1993):

(Size of endotracheal or tracheostomy tube – 2) x 2 = Correct French gauge

The table below illustrates this.

Inner diameter of tracheostomy tube (mm)	**Suction catheter size (French Gauge or mm)** **FG** **(mm)**
10mm	14 (4.5)
9mm	12 (4.0)
8mm	12 (4.0)
7mm	12* (4.0)
6mm	10 (3.3)
5mm	8 (2.6)

* It is more appropriate to use a size 12 catheter as, although it is slightly larger than ½ diameter, it is more effective for secretion removal.

The frequency of suctioning

There is no clear consensus on how frequently a patient should receive suction and will depend upon the individual. Attempting tracheal suction at least once per 8 hours strikes a reasonable practical balance and will ensure that the tube remains patent. Failure to pass a suction catheter is a 'Red Flag' warning that the tube may be blocked or displaced and should be promptly assessed by an appropriately trained individual.

The pressures for suctioning

Choosing the correct pressure is a balance of effectiveness of clearing secretions against limiting the potential for damage, either by directly traumatising the tissues or by aspirating oxygen from the trachea and contributing to hypoxia. Pressures used effectively in the literature range from as little as -80 mmHg to -300mmHg. Most would agree that a pressure of no greater than -150 mmHg (-20kPa) is appropriate for most patients.

The table below summarises key actions related to suctioning and their rationales (adapted from NPSA expert working group)

Action	Rationale
Explain the procedure to the patient	Relieve patient anxieties
Consider analgesia prior to or following suctioning	Suctioning can be a painful procedure
Switch suction unit on and check that the suction pressure on circuit occlusion does not exceed-150 mm Hg or 20kPa pressure	To ensure the machine is working correctly. Too great a suction pressure can cause trauma, hypoxaemia and atelectasis
Wash hands, put on gloves, apron and goggles	Reduce the risk of cross infection
Ensure that an appropriate non-fenestrated inner tube is in place	Larger fenestrations allow the suction catheter to pass through causing trauma totracheal wall or giving the false impression that the catheter will not pass
Consider pre-oxygenation if receiving oxygen or ventilated	To prevent hypoxaemia
Remove tracheostomy devices prior to open suctioning	To allow access for sterile suction catheter tip
Connect suction catheter keeping catheter tip covered (sterile)	To reduce the risk of transferring infection from the hands to the suction tubing.
Place top 'double' glove on dominant hand	To aide removal and replacement of fresh gloves per each suction episode
Do not apply suction whilst introducing the catheter, or push against resistance at any time	Suctioning while introducing the catheter causes mucosal irritation, damage & hypoxia

Action	Rationale
Occlude suction port with gloved thumb and suction on removal of suction catheter (no need to rotate on removal as catheters have circumferential holes)	Prolonged suctioning can result in hypoxia and trauma
Period of suction should not exceed 10 seconds	To reduce risk of mucosal damage and hypoxaemia
Suctioning should be continuous not intermittent	Intermittent suctioning does not reduce trauma and is less effective
Observe the patient throughout the procedure to ensure their general condition is not affected.	Tracheal suction may cause vagal stimulation leading to bradycardia, hypoxia and may stimulate bronchospasm
For patients requiring oxygen therapy, reattach O2 within 10 seconds.	To limit hypoxia
Remove the glove from the dominant hand by inverting it over the used catheter & dispose clinical waste bag	To minimise the risk of infection
Assess the patient's respiratory rate, skin colour and/or oxygen saturation to ensure they have not been compromised by the procedure and determine if they need further suction	Suction should be performed only when needed and not as part of a routine, so that damage to the trachea is avoided
It is recommended that no more than 3 episodes of suctioning are carried out in succession	To limit side effects and maximise recovery period
If O2 delivery was increased, review for return to previous level.	To prevent unnecessary oxygen delivery
Flush through the connection tubing with the clean water. Empty water receptacle and ensure this is ready for further use. Wash hands.	To minimise the risk of infection
If the patient needs further suction, repeat the above actions using new glove & a new catheter	

Difficulties in suctioning tenacious mucus may be due to inadequate humidification. Try a more effective humidifier and consider the use of nebulizer, mucolytics and concurrent physiotherapy. Saline instillation may be useful in some situations such as deep bronchial suction and bronchial lavage.

III. Tracheostomy Inner Tube Cleaning

The aim of cleaning the inner tube is to remove secretions thereby reducing the risk of obstruction and also the risk of infection. Secretions can adhere to the internal lumen of a tracheostomy tube and severely reduce the inner lumen diameter over time. This can potentially increase the work of breathing and/or obstruct the patient's airway.

The inner cannula should be removed and inspected at least every four hours. This may need to be performed more frequently if the patient has excessive secretions or shows signs of respiratory distress such as:

- Sudden increase in respiratory rate
- Fall in oxygen saturations
- Audible secretions in the tracheostomy tube
- Stridor
- Increased work of breathing/ use of accessory muscles

For those patients undergoing mechanical ventilation, it may not be safe to repeatedly disconnect the ventilator circuit and change the inner tube routinely. Cleaning or changing an inner tube should always represent the best balance of risks to the patient. If an inner tube is not changed, then it should be clearly documented and communicated, along with the rationale (National Tracheostomy Safety Project).

Some makes of tracheostomy tube (*Cook™*) have disposable inner cannula and when visibly contaminated these should be thrown away rather than cleaned. Most of the other makes the inner cannulas are re-usable after thorough cleaning following the steps below. The procedure for cleaning of the inner cannula has been reviewed and approved by the Trust Infection and Prevention Control team.

Equipment required

- Clean, disposable gloves, apron and goggles
- Spare clean and dry replacement inner cannula ready for use
- Tracheostomy cleaning swab (*Kapitex trachi-swab™*)
- Dressing pack
- Sterile water (bottle, sachets)
- Self-seal bag to hold the clean and dry spare inner tube

Procedure / Action	Rationale
Explain and discuss procedure with the patient as appropriate	To relieve patient anxieties and gain patient consent and co- operation.
Clean your hands immediately prior to donning, gloves, goggles, and apron	To reduce the risk of cross infection
Perform tracheal suction if necessary	To ensure airway is clear prior to procedure commencing
With one hand stabilise the outside of the tracheostomy tube as per the manufacturer's instructions. This may necessitate firm removal of inner cannula whilst anchoring the tracheostomy tube side flange in a friction locked device, or rotation of the inner cannula to release it in preparation for removal. With the other hand remove the inner cannula in an outward and downward direction.	To aid easy removal of the tube and cause minimal movement of the tube on inner cannula removal
If the inner tube is clean and clear of secretions, reinsert using an upward and forward movement and secure the inner cannula as per the manufacturer's instructions.	Discomfort and trauma are reduced if the inner tube is reinserted following the contour of the outer tracheostomy tube.
If there is difficulty in removing the inner tube call for help from an appropriately trained healthcare professional.	Dry tenacious secretions or granulation may prevent the inner tube from being removed which requires prompt attention
If inner tube requires cleaning, replace with clean/spare inner cannula whilst cleaning is taking place	The tracheostomy tube should always have an inner cannula in place to prevent tube blockage.
If the inner tube is fully or partially blocked with secretions, immerse in sterile water in the disposable bowl provided and if necessary use a tracheostomy cleaning swab to loosen and remove any secretions	To remove debris that may block the tube as this may become a source of infection. Cleaning devices should be used with caution and care not to cause abrasion to inner surface of inner cannula.
If tube is coated with dried- on secretions, it may need to be disposed of and a replacement cannula placed at bedside	Excessive cleaning can damage the cannula and they should not be left to soak, as it is an infection risk.
When clean, still holding it over the bowl rinse the inner cannula through with sterile water from the bottle	To remove secretions and reduce infection risk
Shake excess water off inner cannula, dry with a clean swab and place in the self seal bag	To ensure a clean and dry inner cannula is available for use.

IV. Stoma Care

The management of a tracheostomy stoma depends to some degree on the type of surgical procedure used to create the tracheostomy tract. Traditionally tracheostomy was created through a linear incision in the front of the neck and commonly leads to a larger surface wound compared with percutaneous procedures. The stoma associated with a tracheostomy or laryngectomy can be considered as a full thickness, open wound, but one that is complicated by the moisture and mucus associated with respiratory secretions. When we add a large foreign body which slides about every time the patient moves, the potential for stoma problems is evident.

Secretions may ooze out of the surgical excision and stoma site which can result in wetness and cause irritation of the skin and can lead to skin maceration and excoriation. This moist environment may also act as a medium for bacterial growth and can prevent the stoma site from healing. The aim of stoma care is therefore to keep the area clean and dry, reducing the risk of skin irritation and infection.

Various types of dressing are available for the stoma. Dressings placed at the tracheostomy site should always be pre-cut by the manufacturers to avoid loose fibres from a cut dressing edge entering into the airway. Thicker dressings will absorb more secretions (e.g. Lyofoam™ Allevyn™) than some of the thinner, less obtrusive varieties available (e.g. Metalline™).

V. Cuff Pressure

These guidelines are suitable for all critical care patients with cuffed endotracheal or tracheostomy tubes in place.

Background

High intra-tracheal cuff pressures are common and may predispose patients to tracheal necrosis and stenosis. Endotracheal and tracheostomy tubes are made with high volume, low-pressure softer cuffs. This should reduce, but not completely eliminate the risk of pressure trauma. These must only be inflated to the minimal desired occlusion volume. Over inflation will cause short and long term consequences to the mucosal wall.

When an inflated cuff is used air should gradually be inserted at 0.2 - 0.5 ml increments with a 10 ml syringe into the endotracheal / tracheostomy tube cuff. Apply a stethoscope to just below the thyroid cartilage and listen for air leaks. When no air leak is heard for greater accuracy withdraw 0.5 - 1.0 ml of air until an air leak is heard and then gradually re-inflate until no air leak is audible.

It is recommended that cuff pressures are measured using a hand pressure manometer. This will measure the pressure exerted by the cuff on the tracheal wall.

The Hi – Lo Hand Pressure Gauge should only be used with tracheal tubes with high volume low pressure cuffs. Before use check the pressure gauge by tightening the screw on the hand pressure gauge, occlude the connecting piece with a finger and inflate the balloon to 120cm H_2O The valve must be constant for 2-3 seconds.

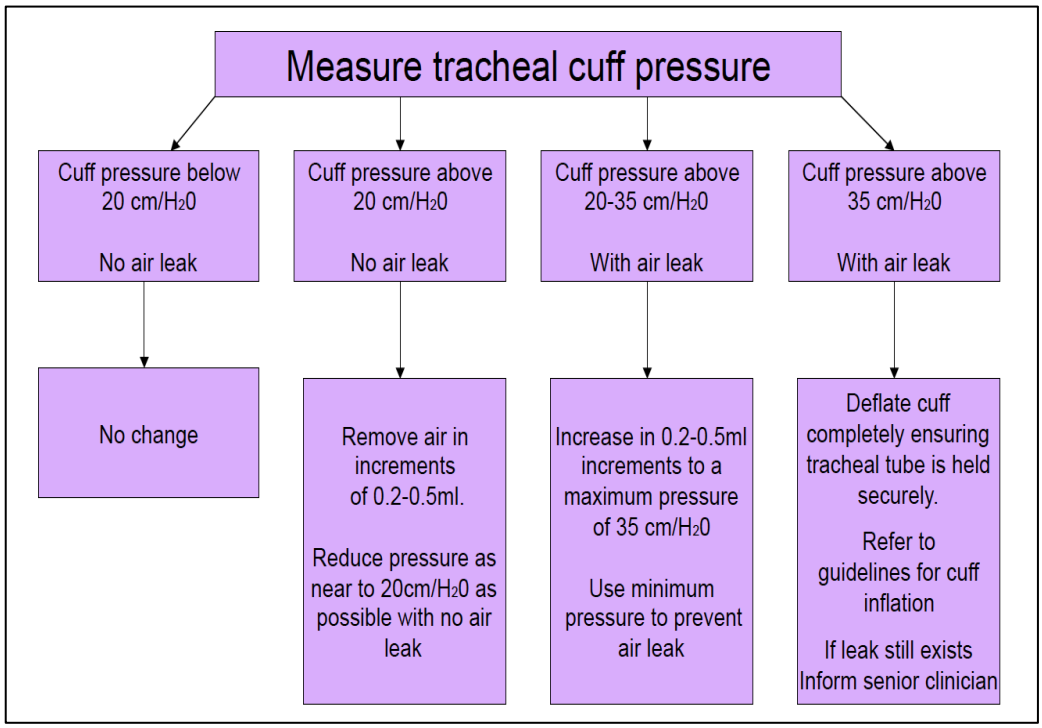
The Minimal Occlusion Volume (MOV) is the smallest volume of air in the tracheal tube cuff to abolish an air leak on inspiration.

Each shift or each time the cuff is re-inflated the cuff pressure should be checked using a hand pressure gauge following the steps below:

- Explain to the patient your intention to measure the cuff pressure.
- Wash your hands and apply a clean pair of gloves.
- All secretions from the back of the patients' mouth should be cleared under direct vision with a soft suction catheter to avoid aspiration.
- Tighten the screw on the hand pressure gauge
- Connect the Hand Pressure Gauge to the inflation line with a three way tap attached.
- Connect the three way tap to the cuff on the endotracheal or tracheostomy tube
- Inflate the cuff by means of an air filled syringe attached to the three way tap in increments of 0.2 - 0.5 ml
- Close the tap to the syringe
- Note the pressure indicated on the gauge.
- The cuff inflation pressures should not exceed 25 mmHg in the expiratory phase and should be maintained between 15 and 25 cm of H20.
- If cuff pressures are equal to the recommended level and an air leak persists, senior medical advice should be sought prior to inserting more air in the cuff.
- Document both the volume of air inserted and the highest cuff pressure on the critical care chart (the measured cuff pressure will vary during the respiratory cycle).

When an inflated cuff is in-situ and an audible leak heard air should gradually be inserted at 0.2 - 0.5 ml increments with a 10 ml syringe into the endotracheal / tracheostomy tube cuff. Apply a stethoscope to just below the thyroid cartilage and listen for air leaks. When no air leak is heard for greater accuracy withdraw 0.5 - 1.0 ml of air until an air leak is heard and then gradually re-inflate until no air leak is audible.

Cuff pressures should be measured following significant changes or procedures, such as re-intubation, tracheostomy, intra or inter hospital transfer, turning supine or prone. The routine checking of tracheal cuff pressures for patients with known airway difficulties should be discussed with senior medical staff prior to commencement. Examples are difficult intubations, patients with head or neck trauma or surgery and facial burns. The manometer should be kept for sole use in individual bed areas. The external parts of the manometer should be cleaned before use with a multi-purpose pre-soaked surface wipe or soapy water.



Measuring and managing cuff pressure

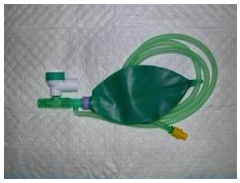
VI. Emergency Equipment

The minimum emergency equipment to care for a patient with a tracheostomy should be available at all times by the patient bedside as well as when the patient is not on the ward, for example if patient is transferred to radiology for investigation or procedure.

The emergency equipment comprises the emergency tracheostomy box (see chapter 5 for contents of emergency box), availability of oxygen port (wall or portable oxygen), oxygen delivery system (self-inflated Ambu bag or Mapleson C / Water's circuit with appropriate mask), suction apparatus and suction catheters.

As part of the emergency management of a patient with tracheostomy, the bedside documentation and emergency management algorithms should be kept in the area where the patient is.

Emergency tracheostomy care box



Mapleson C circuit

Face mask

Ambu bag