Introduction:

Patients with tracheostomy are becoming increasingly common and may be found not only on the Intensive Care Unit, but in a variety of locations throughout the hospital and wider community. Although tracheostomy or laryngectomy airway emergencies are rare, any member of staff may find themselves having to deal with an imminent airway crisis which, if not resolved promptly, can lead to significant patient harm or death.

This article will summarise recent guidance on tracheostomy and laryngectomy airway emergencies and provide staff with an emergency algorithm that may be applied during such critical incidents\(^1\)\(^2\).

Background:

A tracheostomy is a stoma or opening between the skin surface and trachea. (Figure 1) This may be temporary or permanent depending on the indication. Most tracheostomies encountered in hospital will have been inserted percutaneously at the bedside on the Intensive Care Unit, the remainder having been inserted surgically. Tracheostomy is carried out for a number of indications: to relieve an upper airway obstruction, to facilitate prolonged ventilation or weaning, to enable secretion clearance, for airway protection, and as formation of a definitive airway following head and neck cancer surgery\(^3\).

There is a wide variety of tracheostomy tubes available. (Figure 2) These include; a simple single cannula or dual cannula consisting of an outer tube and a removable inner tube, allowing regular removal and cleaning of the inner tube. Fenestrated tracheostomy tubes consist of a tube with a hole or series of holes in the wall, which allow exhaled air to pass upwards through the larynx and vocal cords, tracheostomy tubes either with or without inflatable cuffs and tubes with adjustable flanges, which may be adjusted allowing the length of the tube to be tailored to a patient’s individual anatomy. In addition, a number of devices may be attached to the tracheostomy tube including devices which filter...
and humidify the inhaled air, one way valves which allow inspiration but prevent expiration - instead forcing the expired air upwards and through the vocal cords thus allowing the patient to speak, and caps which completely occlude the tracheostomy, allowing the patient to be assessed for tracheostomy removal. It is important to note that if the tracheostomy is occluded the patient cannot breathe unless the cuff is deflated and air-flow around the tube is permitted.

There is a fundamental difference in patients who have undergone permanent tracheostomy following laryngectomy and all other tracheostomy patients. Laryngectomy patients have no communication between their upper airway and lower airway, as the larynx has been removed, compared to other tracheostomy patients who have an intact trachea which connects upper and lower airways. (Figures 3 and 4) This difference can cause confusion if not appreciated, particularly during an emergency.

The most commonly encountered problems in patients with tracheostomy include: blockage, full or partial tube displacement and bleeding. Such complications are stressful events for both staff and the patient. It is important that tracheostomy tubes are secure but comfortable for the patient and that good tracheostomy care is maintained to reduce such complications. A recent publication: National Audit Project 4 (NAP4) by the Royal College of Anaesthetists and Difficult Airway Society identified the ‘displaced tracheostomy’ as the greatest cause of major morbidity and mortality in the intensive care unit, with obese patients being particularly at risk. NAP4 recommended that all patients should have an emergency re-intubation plan.

In 2012, McGrath et al, published some multi-disciplinary guidelines for the management of tracheostomy and laryngectomy airway emergencies, aimed at first responders (Figures 5 & 6). These guidelines were developed from the National Tracheostomy Safety Project advice from leading groups in tracheostomy management (including the Intensive Care Society, the Royal College of Anaesthetists, ENT UK, the British Association of Oral and Maxillofacial Surgery, the College of Emergency Medicine, the Resuscitation Council (UK), the Royal College of Nursing, the Royal College of
Speech and Language Therapists, the Association of Chartered Physiotherapists in Respiratory Care and the National Patient Safety Agency). These guidelines will now be discussed.

**Figure 5** Guideline: Emergency Tracheostomy Management Patent Upper Airway (green)

**Figure 6** Guideline: Emergency Tracheostomy /Laryngectomy Management in patients with a laryngectomy (red)
Tracheostomy Emergency Management:

Tracheostomy with patent upper airway ‘green’

This algorithm assumes the upper airway is connected to the trachea and is potentially patent, theoretically allowing ventilation by this route. The upper airway may be a difficult airway to manage, depending on why the tracheostomy was initially performed. The algorithm is paired with a ‘bed-head’ sign, which if on a ward should be displayed above the patient’s bed. This sign displays information regarding type of tracheostomy, whether the upper airway is potentially patent (green) or not as found in laryngectomy patients (red), surgical or percutaneous insertion, size of tracheostomy tube if present, relevant anaesthetic/ENT airway information such as laryngoscopy grade and difficulty, whether surgical sutures are present, any problems with tracheostomy on insertion and whom to call in an emergency.

On identification of an airway emergency senior help should be called and relevant specialities contacted immediately. According to Trust policy patients with tracheostomy should have a bedside tracheostomy kit (including spare tracheostomy tubes, onesame size and one smaller, sterile water, clean pot for spare inner cannula, dressings, tape, suction catheters, humidification equipment) and access to emergency equipment which is usually located on the resuscitation trolley or brought to an emergency by critical care staff. This includes basic and advanced airway equipment, capnography (the monitoring of the concentration or partial pressure of carbon dioxide in the respiratory gases), bougies, tracheal dilators and a fibroptic scope.

An ABCDE approach to managing tracheostomy emergencies is advised. On assessing the airway, look, listen and feel at both the mouth and tracheostomy opening for air movement and signs of tube obstruction or displacement. If the patient is breathing, place high flow oxygen over the patient’s mouth and tracheostomy site. An anaesthetic Mapleson C Circuit or self-inflating bag and mask may help in assessing airway patency and oxygen delivery. If the patient is not breathing, call the Crash Team (2222) and begin resuscitation/CPR according to the usual life support (ALS) algorithm. Some tracheostomy tubes require the inner tube to be inserted before a breathing circuit can be connected to allow ventilation to be delivered.

When assessing the patency of the tracheostomy remove the speaking valve or cap (if present) and remove the inner tube (if a dual cannula) as this may be partially or completely blocked. Then attempt to insert a flexible suction catheter. Do not ventilate via the tracheostomy tube until it has been assessed as being patent, as ventilation through a partially displaced tube risks exacerbating the situation by causing surgical emphysema. Removing the inner tube alone may resolve the airway crisis if it is blocked. The tracheostomy is deemed patent if the catheter can be passed easily. The tracheostomy should be suctioned as partial obstruction may still exist, and if the patient is not breathing, ventilation administered via the tracheostomy tube as part of ABCDE assessment with the cuff still inflated. Gum-elastic bougies or similar introducers can cause false passages due to their stiffness when compared to soft suction catheters and should be avoided if possible.

If the suction catheter cannot be passed down the tracheostomy tube this indicates that it may be obstructed or displaced. Deflate the cuff if present and again look, listen and feel at the patient’s mouth and tracheostomy site. The use of capnography and/or Mapleson C circuit may be beneficial at this point. If the patient’s airway improves following cuff deflation this suggests that the tracheostomy is partially obstructed or displaced and allowing airflow around the tracheostomy may improve the situation.
If the patient continues to deteriorate despite cuff deflation the tracheostomy tube should be removed. Removal of the tracheostomy tube may dramatically improve the situation, as it is likely that it is obstructed or displaced as reflected by the inability to pass a soft suction catheter and failure to improve on cuff deflation. A non-functioning tracheostomy tube is of no use for oxygenation or ventilation, so the benefit of removal outweighs any risk of doing so. If the patient is breathing and not hypoxic, reinsertion of the tracheostomy tube or oral intubation may not be needed immediately, allowing time to prepare for this procedure and appropriate expertise and equipment to arrive.

If following removal of the tracheostomy, the patient is not breathing CPR should be continued and if not already done so, cardiac arrest team called.

Primary emergency oxygenation involves the use of standard airway manoeuvres including head-tilt chin lift, use of airway adjuncts: oral Guedel airway, nasopharyngeal airway and bag-valve mask ventilation to administer oxygenation and ventilation via the upper airway. It is important to cover the tracheostomy stoma site with a swab or hand to prevent escape of ventilatory gas. Insertion of a supraglottic airway (Laryngeal mask, LMA) may be attempted. If these techniques fail, possibly due to an obstructed upper airway, tracheostomy stoma ventilation should be instigated. This can be achieved by using a paediatric mask over the tracheostomy stoma site or by applying a paediatric LMA to the stoma. CPR and resuscitative efforts should be on-going. Oxygenation is key.

Secondary emergency oxygenation should be attempted if primary efforts fail. These ideally should be conducted by an airway expert (e.g. anaesthetist) familiar with advanced airway techniques. Oral intubation should be attempted, with insertion of an uncut endotracheal tube beyond the stoma to allow effective ventilation. Preparation should be made for a difficult airway with appropriate equipment and support to hand.

An attempt to intubate the tracheostomy stoma should be made if oral intubation fails, or a known difficult upper airway already exists. This involves insertion of either a small tracheostomy tube or a size 6.0 cuffed endotracheal tube. This may be enough to establish a patent airway, although deep stomas may be difficult to secure. A fibreoptic scope may prove useful in facilitating placement of an airway catheter (Aintree Catheter) or bougie to allow an endotracheal tube or tracheostomy tube to be guided into the trachea. In an emergency situation when a fibreoptic scope is not available it is advised that blind or digitally assisted placement of a bougie may be helpful, but risks creation of a false tract. Capnography is important in helping identify effective ventilation and should be made available at an early stage during such an airway critical incident.

**Tracheostomy in patient with laryngectomy ’red’**

Laryngectomy involves either full or partial removal of the larynx and so, in contrast to the first algorithm, the upper airway is considered not to be connected to the trachea, as the trachea ends at the stoma opening. The upper airway is not an option for ventilation. The algorithm in this situation is essentially the same as the first, with ABCDE assessment, but with some small yet significant differences. A red ‘bed-head’ sign should be present to identify laryngectomy patients. This should state the date the laryngectomy was performed, tracheostomy tube size if present and whom to call in an emergency.

On assessment of an airway emergency in a laryngectomy patient first assess whether the patient has a patent airway at both the mouth and laryngectomy stoma. Call for expert airway
help early. If the patient is not breathing, put out a cardiac arrest call (2222) and start CPR if no pulse present. If the patient is breathing apply high flow oxygen (15 litres/min) over the laryngectomy stoma and if in doubt about the upper airway patency apply oxygen to the face also.

Next assess whether the laryngectomy stoma or tracheostomy is patent using a soft suction catheter. Remove the stoma cover and inner tube if present. Do not remove a tracheo-oesophageal puncture (TEP) prosthesis if present. If the suction catheter passes easily this suggests that the laryngectomy is patent and suction should be performed, as partial obstruction may still exist. If the patient is not breathing ventilate the patient via the laryngectomy stoma while continuing resuscitation efforts. If an inner tube had been present this may need to be reinserted to allow connection to a bag-valve mask or Mapleson C Circuit.

If difficulty exists in passing the suction catheter this suggests the presence of an obstruction. Deflate the cuff immediately if a tracheostomy tube is in place and reassess air movement at the laryngectomy stoma. Use of capnography at this stage may prove invaluable in assessing whether a patent airway does indeed exist. Following suction and cuff deflation the patient may begin to improve.

References:


If not remove the tracheostomy tube from the laryngectomy stoma and apply oxygen or ventilation to the stoma. If breathing improves following tracheostomy tube removal continue to assess and assist ventilation via the laryngectomy stoma until expert help arrives.

Primary emergency oxygenation involves ventilating the patient via the laryngectomy stoma with either a paediatric bag-valve mask or paediatric laryngeal mask (LMA). If this fails, secondary emergency oxygenation should be attempted through intubation of the laryngectomy stoma with a small tracheostomy tube or a sized 6.0 endotracheal tube. Again an Aintree Catheter and fibre-optic scope, bougie or alternative airway-exchange catheter may be useful advanced airway adjuncts in this situation.

Summary:

Patients with tracheostomy and/or laryngectomy may be encountered in any department or area of the hospital. It is essential that all medical and nursing staff have a strategy for dealing with rare but potentially fatal airway complications, as the simple steps highlighted may prevent patient harm. It is hoped that this guidance may improve safety and emergency management of this group of patients.