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Tracheostomy management

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Key points

- A tracheostomy may be performed by a percutaneous or surgical technique.
- Standard and specialized varieties of tracheostomy tubes are available and the appropriate type is determined by patient anatomy and the indication for the tracheostomy.
- Ward-based tracheostomy weaning should be guided by a patient-centred multidisciplinary approach.
- Fibreoptic endoscopic evaluation of swallowing should be considered in assessment of bulbar function and tracheostomy weaning.
- A patient with a tracheostomy who develops respiratory distress during the ward weaning process should be investigated for upper airway pathology.

Insertion of a tracheostomy device is a common procedure in the operating theatre and critical care unit. As a consequence, patients with a tracheostomy are now often seen in the ward and outpatient environments. This review provides an overview of critical care and ward-based tracheostomy management and weaning.

Why, when, and how?

There is evidence that tracheostomy was first performed as long ago as 2000 BC, although the first clearly documented tracheostomy was in the 15th century. The surgical tracheostomy procedure became increasingly common through the latter half of the 20th century. In the last 60 yr, percutaneous tracheostomy methods have been developed, some with very high complication rates. In the 1980s, an American surgeon developed a Seldinger technique using a guide wire for performing percutaneous tracheostomy that had lower complication rates than earlier techniques. This forms the basis of percutaneous tracheostomy today.

The formation of a tracheostomy may be an emergency or an elective procedure. Techniques for performing tracheostomy include needle cricothryoidotomy, mini tracheostomy, percutaneous tracheostomy, and surgical tracheostomy. The indications for performing a tracheostomy are multiple (Table 1), the most common being expected prolonged mechanical ventilation.

In the case of an elective tracheostomy procedure performed in the intensive care unit, there remains debate about the timing of insertion.[1] Current evidence suggests that there are no significant differences in critical care or hospital length of stay associated with an early (<10 days) *vs* a late (>10 days) tracheostomy procedure, although the number of sedation days is reduced in patients in whom an early tracheostomy is performed. Coupled with this, a tracheostomy provides many other beneficial effects for the patient when compared with tracheal intubation. These include allowance of speech, increased comfort with oral hygiene care and suctioning, and earlier commencement of oral nutrition. An elective tracheostomy may be inserted as a percutaneous or open surgical technique.

Types of tracheostomy tube

There are many different types and manufacturers of tracheostomy tubes and it is important to assess each patient carefully before planning a tracheostomy procedure. Further, when assessing a patient with a tracheostomy *in situ*, knowledge of several key elements about the tracheostomy tube is crucial:

- Is the tube a single lumen or double cannula tube? A double cannula tracheostomy tube refers to a tube with both an outer and inner cannula, the latter being removable for cleaning to minimize the risk of blockage by encrusted secretions.

Table 1 Indications for tracheostomy

Failure of extubation/ prolonged mechanical ventilation
Upper airway obstruction
Secretion removal/bronchial toilet
Airway protection, e.g. bulbar palsy

- Is the tube cuffed or cuffless?
- If the tube is of the double cannula type, is the outer cannula fenestrated or unfenestrated? If the outer tube is fenestrated, is the inner tube fenestrated or unfenestrated?

It is important to note the actual outer diameter dimensions rather than the notional size of the tube because different manufacturers produce tubes with different outer diameters. For example, a size 7 tube always refers to an internal diameter of 7 mm, but the outer diameter will depend on the manufacturer. This is of particular consequence when changing the tracheostomy tube.

Patients with certain diseases may have specialized tracheostomy tube requirements. For example, in the increasingly obese population, longer length tubes, such as the Bivona or Portex adjustable flange tubes, are commonly required. These have a moveable flange that allows the distance between the skin surface and distal end of the tube to be adjusted according to an individual patient's neck anatomy, so that the tube tip sits at an appropriate position in the trachea. Such tubes are usually of the single-lumen variety, although double cannula longer length adjustable flange tubes are now being produced. A double cannula tube, with an inner cannula that can be removed for cleaning, should be placed whenever possible because it is far less likely to become blocked than a single-lumen tube. In addition to adjustable flange tubes, longer length standard double cannula tubes, such as the Traceotwist plus™ tube, are also available. These can be used in patients with large necks and also have the additional options of both inner cannulae, fenestrations, and may be cuffed or cuffless to aid weaning.

Other commonly used specialized tubes include:

(i) Moore tube: This device is a soft cuffless tube that lies flush with a patient's skin surface (Fig. 1). It is used as an airway after tracheal reconstruction and in patients with tracheal stenosis.

(ii) Montgomery T tube: This is a silicone T tube, used in specialist ENT surgery, which acts as both an airway and a tracheal stent. Like the Moore tube, it will not fit a standard catheter mount or other connectors, and therefore requires specialist knowledge and care to maintain its function (Fig. 2).

(iii) Long-term tracheostomy tubes: Some patients require softer, shorter cuffed or uncuffed tracheostomy tubes to facilitate management in the community or long-stay institutions. The most commonly used are the Tracoe comfort™ long-term tube, which is made of a soft, flexible PVC material and provides options of fenestrated and cuffless varieties, and the silver Negus cuffless tube which is a thin walled sterling silver cuffless tube that provides an option for an inbuilt speaking valve and fenestrations.

Managing and weaning a tracheostomy

To minimize the risk of blockage, national guidance dictates that single-lumen tubes should be changed every 10–14 days, and double-lumen tubes monthly unless they are specifically designed for long-term use (e.g. the silver tracheostomy tubes).[2]

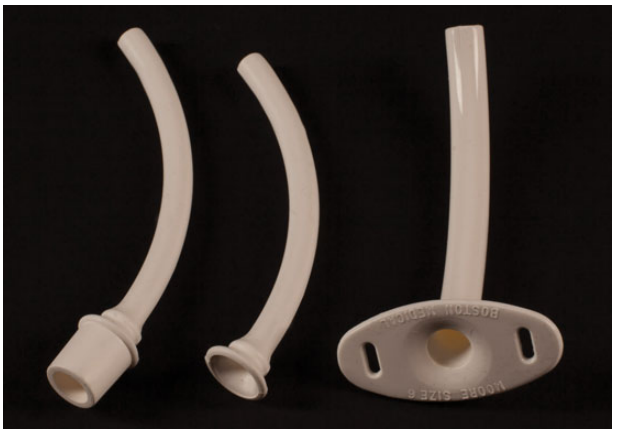

Fig 1 Moore tracheostomy tube (photograph produced by authors).

Fig 2 Montgomery T tracheostomy tube (photograph produced by authors).

Systematic, multidisciplinary, ward-based tracheostomy care is internationally recognized to minimize tracheostomy-related complications and improve patient outcomes, particularly by reducing the number of days to achieve decannulation.[3] Weaning a patient from a tracheostomy tube requires excellent multidisciplinary cooperation within a designated team with specialist, advanced skills. Planned weekly multidisciplinary tracheostomy ward rounds enable optimal timing of tracheostomy tube changes or decannulation when appropriate staff support is available. A tracheostomy team ideally comprises a physician (e.g. anaesthetist or ENT specialist), physiotherapist, speech and language therapist, and nurse. Close liaison should be maintained with the critical care outreach team and other multidisciplinary team members such as the dietician. Different institutions should determine the appropriate members for their teams. During ward rounds, a multidisciplinary discussion is held to consider the patient's performance in the weaning programme and to set goals for the following week. Tracheostomy care and equipment available on the wards and at the bed space can also be monitored and audited. A tracheostomy policy which reflects national guidelines but is also appropriate to the local patient group is essential to set standards of care and provide a benchmark for audit.

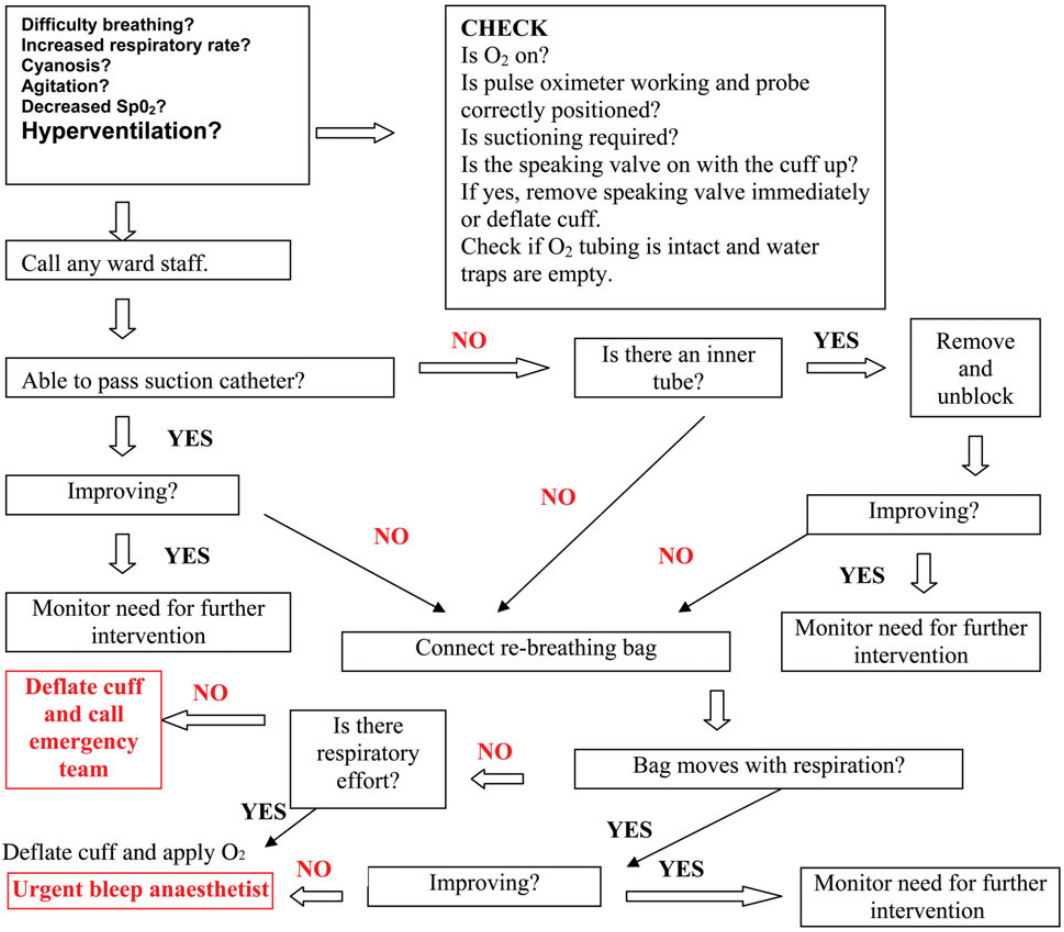

Fig 3 Emergency protocol.

Many tracheostomy teams have developed core tracheostomy competencies to enable different team members to trouble shoot around the clock. This includes early identification of airflow obstruction or stridor, cuff management, and emergency protocols for a blocked tracheostomy tube (Fig. 3). Roles which encompass an extended scope of practice have also been developed. For example, speech and language therapists may perform tracheal suction, and nurses, physiotherapists, and speech and language therapists may be able to change tubes and decannulate. Alongside such innovative examples of evolving practice, it is imperative that skills are maintained and monitored, and that different team members work within their respective professional society guidelines and an evidence-based practice framework.

Tracheostomy weaning

Weaning involves a set pathway of care which is tailored to individual patient's abilities in line with their presenting condition and prognosis. The steps in a typical tracheostomy weaning programme are cuff deflation, restitution of supraglottic airway through the use of a one-way valve and/or cap, and decannulation (Table 2). A cap occludes the tracheostomy and restores normal airflow, whereas a one-way valve opens during inspiration to allow inhalation of air via the tracheostomy tube and closes during expiration to allow air to be shunted supraglottically. Having distinct steps in a weaning pathway enables the patient to be carefully exposed to a stepped reduction in tracheostomy dependency.

Tolerance of cuff deflation depends on cough strength and bulbar function, particularly spontaneous saliva swallow function. The modified Evans blue dye test (where blue dye is given orally or in food/fluid) has been shown to yield false negatives for aspiration, and is therefore no longer routinely used as a sole assessment of bulbar function.[4] An instrumental technique, fibreoptic endoscopic evaluation of swallowing, is a bedside procedure that can be used to detect the presence of pharyngolaryngeal secretions which may be undetected with normal bedside (clinical) assessment.[5] This method yields a more accurate diagnosis of the extent of bulbar dysfunction and guides clinicians with regard to weaning goals. It is most commonly performed by ENT specialists and speech and language therapists in collaboration.

Weaning from a tracheostomy ideally starts in the critical care unit. It may begin while the patient is still receiving some ventilatory support, provided the effects of cuff deflation trials on patient comfort and work of breathing are taken into account.[6] The appropriateness of adjustment of certain ventilator parameters, such as reduction in pressure support, to assist with tolerance of cuff deflation and placement of a Passy-Muir one-way valve in-line should be determined on an individual patient basis. It is with the introduction of such early trials of cuff deflation that bulbar dysfunction can be assessed and factored into predictions regarding the success and timing of ventilator and tracheostomy weaning. Early restitution of speech, where possible, also provides immediate benefit to the patient in terms of ease of communication with family and nursing staff.

Table 2 Tracheostomy weaning protocol

Patient has good cough, manages own secretions adequately, suctioning requirement is minimal, or is reducing		
If yes to all these, progress through steps 1–4 as per the patient tolerates		
	Signs of failure	**Action**
1. Cuff deflation	Desaturation Fatigue Cardiovascular instability Inadequate airway protection No swallow Constant oral drooling	Reinflate cuff and reassess If ++ drooling, consider drying agents
2. Progressive deflation and progressive use of the one-way valve to achieve 24 h cuff deflation	Difficulty breathing round tube Respiratory distress Desaturation Increased work of breathing Stridor Voice is gurgly and 'wet'	Access ENT advice and/or scope sub- and supraglottic region Consider downsizing and/or fenestrated tube and/or cuffless tube
3. Cap off tracheostomy tube and agree length of time the cap is to be tolerated (may include overnight)	Difficulty breathing Respiratory distress in prone Desaturation Increased work of breathing Stridor	Access ENT advice and/or scope sub- and supraglottic region Consider downsizing and/or fenestrated tube and/or cuffless tube
4. Decannulate	Respiratory distress Decreased oxygenation Increased WOB Stridor Central cyanosis	Follow local emergency loss of airway protocol

The timing of each step of the tracheostomy weaning process, and the length of time a patient takes to progress onto the next step, is individual dependent. Some patients may be decannulated within a few days of initial cuff deflation, whereas others may take weeks or months to progress to 24 h cuff deflation. The progress through a weaning pathway depends on a number of factors such as cough strength, bulbar function, airway patency, endurance, and fatigue. Optimal pulmonary hygiene, inspired gas humidification, and oxygenation are critical to provide the most favourable conditions for weaning.

Some weaning steps merge into each other. For example, patients are often on a cuff deflation regime for a few hours each day at the same time as placement of a one-way valve. The valve is an integral part of a cuff deflation programme as it enables patients to achieve supraglottic expiratory airflow and improved subglottic pressure when coughing. If a patient cannot tolerate a one-way valve (i.e. supraglottic airflow is restricted or absent), early trouble shooting should occur to determine the reason for airflow obstruction, that is, whether this is due to tube size or laryngeal/airway pathology. The use of a one-way valve without providing external humidification may cause secretions to dry up and appropriate humidification must be provided. Patients who are tolerating cuff deflation may have alternating periods of using either a cap or one-way valve to build up respiratory strength during the course of the day while avoiding fatigue. When using a cap, it is imperative to assess for any stridor caused by airway turbulence around the tube. As with a one-way valve, failure to tolerate a cap should be investigated to determine whether this is related to tube size or airway/laryngeal pathology.

Decannulation can normally be considered when the patient tolerates a cap for a set period of time, there is sufficient bulbar function to swallow saliva safely, cough strength is sufficient to expectorate and/or swallow secretions, and there are no planned surgical interventions requiring an artificial airway. By breaking down the weaning pathway into achievable goals, it is possible to identify and treat factors which may indicate that decannulation would be unsuccessful at that time. For example, poor tolerance of cuff deflation would necessitate assessment of saliva swallow function alongside consideration of whether any drying agents are required. Topical glycopyrrolate, sublingual atropine drops, or hyoscine patches may be considered as temporary measures in the acute weaning of a patient who drools and coughs excessively on cuff deflation. Reduced supraglottic airflow on placement of a one-way valve or cap should trigger a referral to ENT and/or endoscopy of the supra- and subglottic areas, and prompt consideration of downsizing of the tracheostomy tube to allow more space for supraglottic air flow. Endoscopy will determine whether there is any laryngeal or upper airway pathology which may be masked by the presence of the tracheostomy tube. Some patients require longer term use of a cuffless tube to facilitate airway suctioning, and to give time for recovery of respiratory strength or saliva swallow function before decannulation is considered.

It is imperative that, where specialized tubes are required, advice is sought from colleagues with airway expertise, such as anaesthetists or ENT specialists, and speech and language therapists.[7] If bulbar function is assessed to be poor pre-tracheostomy insertion, a suction-aid tube may be useful to assist with suctioning of saliva that becomes pooled above the cuff. Such devices may increase the tolerance of cuff deflation trials and enable the weaning process to be commenced earlier. A combination of fenestrated, smaller tracheostomy tubes, or both may be selected to assist with supraglottic airflow in some patients.

It is important that outcome measurement in tracheostomy care is shaped to reflect particular patient groups. For example, for acute conditions, the usual aim of the tracheostomy weaning programme is decannulation. Therefore, outcome measurement could include factors such as speed of decannulation, complications, and recannulation rate. For chronic conditions, acceptable outcomes could be maintenance of airway patency, good pulmonary hygiene, and safe tolerance of an appropriate tube, such as a cuffless tube.

Conclusion

Advances in the last three decades have helped to refine the techniques of insertion, maintenance, and weaning of tracheostomy tubes. It is hoped that recent work nationally, for example, the TracMan study and the National Confidential Enquiry into Patient Outcome and Death, will continue to distil the processes and skills required to ensure optimal care for this vulnerable patient group.

Declaration of interest

None declared.

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