Management of and indications for tracheostomy in care of the critically ill patient

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Abstract

Tracheostomy is a procedure that has evolved over many hundreds of years. In the 21st century, the majority of tracheostomies are now inserted by intensivists in the intensive care unit (ICU). Commonly performed to assist in weaning patients from mechanical ventilation, the procedure is performed using a percutaneous dilatational technique. Percutaneous tracheostomy can generally be performed safely in the ICU, although a number of contra-indications and complications do exist. Recent publications have highlighted weaknesses in the quality of care both in the immediate and longer term. Consequently, a number of organizations, based in the UK and internationally, have turned the focus in recent years to improving the quality of care delivered to these patients. Clinicians caring for patients with tracheostomies should not only be familiar with the indications, anatomy and insertion techniques, but also current guidance on routine care and the emergency management of complications.

Keywords Airway; management; obstruction; percutaneous; safety; trachea; tracheostomy; ventilation; weaning

Introduction

Tracheostomy refers to the formation of a surgical airway in the anterior of the neck. The word is derived from the Ancient Greek words 'tracheia' and 'stoma' (meaning 'opening'). While frequently used interchangeably, the word 'tracheotomy' (Ancient Greek 'tome' meaning 'to cut') strictly refers to the surgical procedure that leads to formation of a tracheostomy.

Tracheostomy has been described in the literature for over 3000 years. Two of the oldest medical texts, the *Rig Veda* (written c. 2000–1000 BC) and the *Ebers Papyrus* (c. 1550 BC), both make reference to 'cutting the windpipe'.[1] A number of notable figures including Asclepiades, Aretaeus and Galen have all been described performing the procedure. Alexander the Great (c. 1000 BC) is reported to have performed one of the first emergency tracheostomies with a sword on a soldier who was choking on a bone lodged in his throat.[2] Hippocrates (c. 400 BC) was wary, however, and condemned tracheostomy due to the risk of severing the carotid arteries. By the second century AD, Antyllus had refined the technique of tracheostomy by using a transverse incision and dividing the trachea at the level of the 3rd and 4th tracheal rings.[2]

Subsequently, numerous reports exist of the procedure being performed throughout Europe, the Middle East and India. However, it remained highly controversial for centuries. Brasavola reported the first successful case in a human in 1546 when he saved the life of a patient with an abscess of the upper airway.[2,3] In the 19th century, Trousseau performed over 200 tracheostomies on children with diphtheria. The mortality was high (c. 75%) but the experience and his acknowledgement of the importance of postoperative care legitimized the procedure.[2] Following advances in anaesthesia, the poliomyelitis epidemic of the 1930s led to renewed use of the procedure in severe cases.

The modern era of tracheostomy began in the 1950s, where it has since found its place as a recognized procedure to aid mechanical ventilation (MV) and relieve airway obstruction. The last few decades have seen significant developments. Percutaneous dilatational tracheostomy (PDT) is now commonplace with the majority of tracheostomies now inserted by this method in ICUs. Both in the UK and worldwide, there has been a strong focus in the last few years on improving tracheostomy care. Internationally, the Global Tracheostomy Collaborative (GTC) launched in 2014 and, in the UK, the National Tracheostomy Safety Project (NTSP) and Intensive Care Society (ICS) provide support and guidance for patients and professionals.

This article will focus on the indications, insertion techniques and management of patients undergoing a temporary tracheostomy in critical care. Relevant recent guidance and publications will be considered. While we will focus on the patient with a temporary tracheostomy in the ICU environment, the principles of routine and emergency management are just as applicable to patients who have undergone emergency or elective surgical tracheostomy or laryngectomy.

Tracheal anatomy (Figure 1)

The trachea is a cartilaginous tube of approximately 10–11 cm in length with an internal diameter of 1.5–2 cm. It originates from below the cricoid cartilage (C6) and extends to the carina (T4) where it bifurcates into the right and left main bronchi. In cross-section the trachea is D-shaped and is surrounded by a number of C-shaped rings which are made of thick cartilage and protect the trachea antero-laterally. Structures anterior to the trachea include the thyroid gland (thyroid isthmus at the level of the 2nd–4th tracheal rings), the anterior jugular veins and inferior thyroid veins. The common carotid artery lies just lateral within the carotid sheath. Immediately posterior is the oesophagus.

Indications for tracheostomy

Broadly speaking, in critically ill patients a tracheostomy is indicated for either: (i) airway maintenance/protection or (ii) provision of ventilation/respiratory care. Examples and details are provided in Table 1. It should be noted that surgical tracheostomy (ST) is sometimes performed pre/postoperatively for patients undergoing major head and neck surgery (e.g. laryngectomy); however, this is outside the scope of this article.

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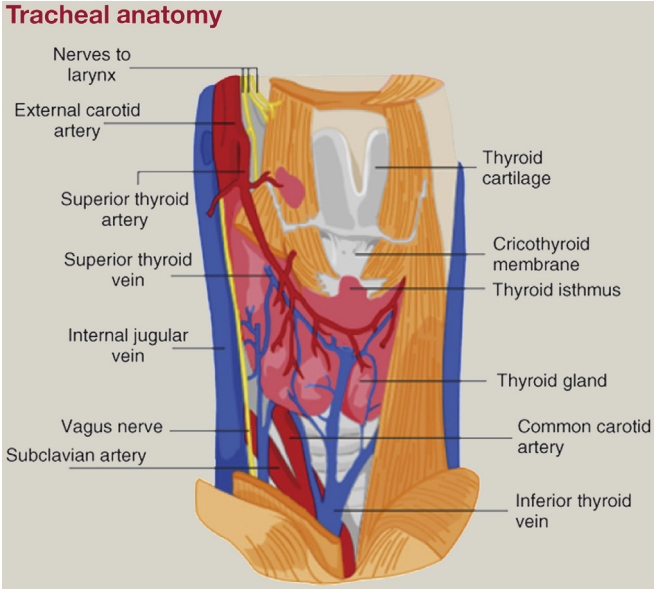

Figure 1 *Reproduced here with permission from e-Learning Anaesthesia (e-LA), Royal College of Anaesthetists.*

Historically, tracheostomies were inserted in ICU patients for the relief of airway obstruction and to mitigate against the adverse side effects of prolonged oral endotracheal intubation on the larynx. However, in recent years tracheostomies are more often than not inserted on a temporary basis — usually to facilitate weaning and effective bronchial suctioning. The reasons for this are twofold: (i) increased experience within the critical care fraternity in the use of PDT and (ii) the general acceptance of the potential benefits of tracheostomy over prolonged endotracheal intubation (Box 1).

Indications for tracheostomy

Airway maintenance/protection	**Example**
Upper airway obstruction	Facial or upper airway trauma
	Foreign b
	Infection (e.g. epiglottitis)
	Anaphylaxis
Unanticipated difficult intubation	
Reduced level of consciousness	Traumatic brain injury
	Intracerebral bleeding
Loss of airway reflexes	Neuromuscular disease
	Guillain-Barre syndrome
	Myasthenia gravis
	Motor neuron disease
Provision of ventilation/ respiratory care	
Prolonged weaning	Severe critical illness
	Multi-organ failure
	Critical illness neuromyopathy
	Nature of premorbid disease (e.g. severe COPD)
Bronchial toilet	Excessive secretions
	Poor swallow/cough

Table 1

Potential benefits of tracheostomy

- Reduced sedation
- Better pulmonary toilet
- Improved expectoration
- Better oral hygiene
- Reduced work of breathing
- Faster weaning from artificial ventilation
- Improved mobility
- Potential for oral intake
- Improved communication
- Improved patient comfort
- Reduced delerium
- Reduced ventilator-associated pneumonia (VAP)
- Reduced mortality
- Reduced ICU/hospital length of stay

Box 1

The advantages of a tracheostomy (compared to translaryngeal intubation) can broadly be divided into those which directly benefit the individual patient (e.g. reduced sedation, reduced work of breathing, faster weaning from MV, improved communication and the potential for nutritional intake) and those which may improve critical care outcomes (e.g. rates of ventilator-associated pneumonia (VAP) and mortality or duration of ICU/hospital length of stay).

Timing

The overall effectiveness of tracheostomy is still the subject of debate. While there is general acceptance of the potential benefits, the procedure itself is not without its risks. This leads to the question of *when* is the correct time to perform a tracheostomy in order to derive the most benefit.

A UK-wide national survey in 2005 indicated a wide variation in practice between performance of early (typically <7 days following ICU admission) and late tracheostomy (typically >7 days following ICU admission).[4] A meta-analysis published in 2005 suggested that there may be a reduced duration of MV and hospital stay in patients who receive an early tracheostomy.[5]

In 2013, the TracMan Trial sought to clarify the situation. This large UK-based, multi-centred trial randomized 909 patients to receive either an early (<4 days) or late tracheostomy (>10 days if still indicated). Early tracheostomy showed no improvement in 30-day mortality. Furthermore, the trial highlighted that the ability of clinicians to predict patients requiring prolonged MV was poor; 55% of patients in the late arm of the study never in fact received a tracheostomy.[6]

A recent Cochrane review incorporating the findings of the TracMan study, however, has left the debate open. While the results are not definitive, this systematic review indicates there is likely a lower risk of mortality following early tracheostomy. The reviewers also suggest that early tracheostomy may lead to a reduced period of MV.[7] It is clear, however, that information with regard to outcomes in specific subgroups is very limited.

It is our experience, therefore, to consider an early tracheostomy only if prolonged MV is *highly* likely (e.g. high C-spine injury). In general, we would advise tracheostomy insertion be

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