Nursing the artificial airway patient

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ABSTRACT: Nursing the artificial airway patient presents many challenges. This article covers identifying patients at risk from airway obstruction who may benefit from an artificial airway and outlines the key considerations of managing these patients, including types of tracheostomy tubes, stoma site care, airway hydration and airway suctioning. Finally, potential complications and their management are considered in order to maximise successful outcomes in these patients.

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Introduction

"The art of successful artificial airway management lies in anticipation, preparation and appropriate action when faced with complication" (Sierra & King, 2012).

A tracheostomy is a temporary or permanent opening established in the trachea which allows the patient to breathe through a tube secured into this opening. The aim of tracheostomy tube management is to maintain a patent airway and to protect the lower respiratory tract, while any upper respiratory tract obstruction is definitively diagnosed and treated (Nicholson & Baines, 2010).

Anticipation

Patients presenting with the following conditions may be at risk from airway obstruction and may subsequently require a tracheostomy tube:

- Brachycephalic Obstructive Airway Syndrome (BOAS)
- Trauma (including surgical trauma)
- Nasal, laryngeal, pharyngeal or cervical tracheal foreign bodies
- Laryngeal paralysis or collapse
- Neoplasia

Rarely, tracheostomy tubes are placed to facilitate lower airway secretion removal where there is compromised cough reflex, for ventilation when orotracheal intubation is not practical or possible (i.e. intraoral surgery) or to reduce airway resistance in patients which have increased intracranial pressure.

Tracheostomy tube placement may be contraindicated in cases which are complicated with the following:

- Uncorrected coagulopathies (such as those induced by vitamin K antagonist rodenticide) and symptomatic thrombocytopenia. Plasma may be given to coagulopathic patients and blood loss should be avoided during tracheostomy tube placement in coagulopathic and thrombocytopenic patients (Mann & Flanders, 2012).
- A mass or tracheal obstruction distal to the site of tracheostomy or a cervical mass that may hinder surgical approach.
- Tracheal collapse distal to the site of tracheostomy or previous tracheal stent placement (Mazzaferro, 2013)
- Increased intracranial pressure or an unstable cervical spine. Careful positioning and cautious manipulation should be performed in patients at risk from cervical or intracranial neurological complications (Mann & Flanders, 2012).

Preparation

When a patient has been identified as being at risk, it is imperative that the equipment required to establish an airway, and if necessary place a tracheostomy tube, is placed beside the patient's kennel (**Table 1** & **Figures 1** and **2**). Oxygen and suction should also be available.

Key considerations for care

Once a tracheostomy tube has been placed the following points should be considered (**Table 2**):

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Table 1. Recommended equipment required for placing a tracheostomy tube

Equipment required	
Laryngoscope	Clippers
Endotracheal tubes (various sizes)	Skin preparation supplies
Tracheostomy tubes (various sizes)	Sterile and non-sterile gloves
Intravenous anaesthesia induction agents	Sterile swabs and cotton tips
Rigid dog urinary catheter	Surgical drape
Umbilical tape	Light source
Scissors	Basic surgical kit (blade holder, needle holders, tissue forceps, scissors, suture material)

Figure 1. A pre-prepared tray of intubation equipment

Figure 2. Suction equipment

Care of the stoma site

The peristomal region should be monitored closely for infection (swelling, heat, excessive discharge and pain) and the stoma site should be aseptically cleaned with 0.9% saline at least once daily.

If additional bandaging materials, e.g. Primapore or Melolin, are used around the stoma site they should be monitored closely to ensure they do not cause tube occlusion; too much bandaging material between the flange of the tracheostomy tube and the stoma may predispose to tube dislodgement.

The bandage securing the tracheostomy tube should be changed daily.

Airway hydration

It is important to consider airway hydration. Dry airways are a significant source of patient discomfort and lead to increased airway secretions, which may form a plug that restricts or occludes the airway. When inspired through the nose, alveolar gas is naturally warmed and humidified and contains 4–6 times the amount of water vapour content of room air; therefore, humidification and warming of inspired air should be considered alongside careful monitoring of the patient's hydration status in order to protect the airways and improve patient comfort. The patient should be weighed daily as gain or loss can help evaluate hydration. Fluid losses are likely to be increased due to evaporation from the respiratory system in tracheostomy patients; and intravenous fluid therapy may be required if there is any concern over the patient's oral intake or hydration status.

One of following options may be adopted to humidify the airways:

- Nebulisation for 5–10 min every 1–4 h initially, reducing the frequency steadily over time while looking out for the formation of any dry crusts that would indicate airway dehydration (Nicholson & Baines, 2010) (**Figure 3**).
- Instil 0.2 ml/kg of sterile saline maybe into the tube every 1–4 h.
- If tolerated by the patient, perform coupage or controlled periods of exercise to help mobilise airway secretions (**Table 3**).
- In human medicine, heat and moisture exchangers (HME) are routinely used to maintain humidification of the airway, and HMEs appear to have a protective effect on the tracheal mucosa (Myer, Hubbell, McDonald, & Stith, 1988). If an HME is used it should be inspected every 4 h and be changed when necessary (increased respiratory effort = HME is blocked

Table 2. Key considerations for care

Monitor patient at all times	A trained staff member must be in close proximity and should be prepared for immediate intervention. Staff should have been shown how to recognise and treat any anticipated complications, including how to manage dislodged tubes, tube obstruction and bradycardia (Nicholson & Baines, 2010)
Cardiopulmonary resuscitation (CPR) training	Staff should have attended CPR training in the last 6 months (Fletcher et al., 2012)
Wear non-sterile gloves	The tracheostomy site is an open wound and requires barrier nursing to prevent infection
Contact clinician in charge if signs of respiratory distress	If a patient is showing signs of respiratory distress, increased respiratory effort, rate or noise, the clinician in charge should be contacted promptly. Be prepared for and consider emergency interventions
Patients should be kept cool and calm	A fan should be available/attached to the front of the kennel to aid this. Rectal temperature should be monitored with minimal stress
Offer water every 1–2 h	Water should not be left in the kennel, to avoid drowning
Prevent occlusion	Make sure the tracheostomy tube of patients with excessive skin-folds around the neck does not get obstructed by the skin
	Excessive bedding or bedding with loose fibres (e.g. vet beds) should be avoided to minimise the risk of contamination and tube of occlusion, especially when the patient is in sternal recumbency
	Do not use cat litter for feline patients. Rather, use incontinence pads or newspaper
	Observe the patient while sleeping as positioning may cause occlusion. Patients may need to be rehabilitated to conform with the new airway. It is important to take time to ease anxiety and coax them to lie in a position that suits
	Do not bath the patient
	Patients should be hand-fed or fed under direct supervision
Do not place in an oxygen cage or sealed kennel	As they may muffle noises and it may go unnoticed it the patient begins to suffer respiratory distress
Consider continuity of care	Ideally the same nurse should be allocated to the patient each day

Figure 3. Nebulising the nervous patient may be challenging

or soiled) but at least every 24 h. HMEs should be avoided in patients producing large amounts of airway secretions (Sierra & King, 2012) as they may become occluded.

Suctioning

Airway suctioning through the tracheostomy tube should be performed as frequently as necessary to maintain patency of the tube. Cats appeared to produce thicker mucus and as a result more frequent saline instillation, suction and nebulisation may be required.

1. Pre-oxygenate the patient via the tracheostomy tube for 3–5 min (Mazzaferro, 2013). A flow-by oxygen flow of at least 2 l/min is recommended (**Figure 4**).
2. Instil 1–3 ml of sterile saline into the trachea. The patient may cough and expectorate mucus/debris from the tracheostomy site after this.
3. Insert a sterile suction catheter to the pre-measured length (length of the tracheostomy tube) and suction. The catheter tip can extend a few millimetres beyond the end of the tracheostomy tube, but not should not touch the mucosa (Nicholson & Baines, 2010).
4. Suction pressure should be no more than 60–80 mmHg (Nicholson & Baines, 2010).
5. The suction should be applied for no more than 10–12 s at a time.
6. Flow-by oxygen should be provided as soon as the suction is completed.

Deep suctioning of the trachea should be avoided as it may cause bradycardia,

Table 3. Instructions on how to perform coupage

Coupage
Position the patient in ventral or lateral recumbency and gently and rapidly slap the chest with a cupped hand
If in sternal recumbency both sides can be done simultaneously, working from caudal to cranial and from ventral thorax upward
If suctioning, perform after coupage

Figure 4. Pre-oxygenation of the patient (photo copyright D. Murgia)

Figure 5. Removing the dirty inner cannula (photo copyright D. Murgia)

Table 4. Warning signs of tube occlusion or displacement

• Abnormal respiratory effort (dyspnoea, tachypnoea, hyperpnoea)
• Coughing
• Pawing at face or tube

atelectasis and damage to the tracheal epithelium.

Types of tracheal tube

There are several types of tracheal tube available. Essentially they are either single- or double-lumen, cuffed or uncuffed.

If a cuffed tube is used, the cuff should only be inflated when positive-pressure ventilation is required (Nicholson & Baines, 2010) or if anaesthetic gases are being administered. It is important to avoid inflating the cuff unnecessarily to minimise the risk of tracheal mucosal damage or necrosis caused by hypoperfusion of the mucosa from prolonged or excessive cuff pressures.

Cuffed tube care

- The cuff should be deflated and reflated every 4 h to allow mucosal reperfusion.
- If an animal has decreased gag reflex or has regular regurgitation, the cuff can be inflated at the discretion of the clinician.

Single-lumen tracheostomy tube care

- The tube is removed and replaced immediately with a clean tube every time when cleaning is required. Only a trained member of staff should be allowed to do this.
- At a minimum, the tube should be replaced twice daily; this may be required as frequently as every 4–6 h.
- Tubes are cleaned and soaked in 2% chlorhexidine solution and rinsed thoroughly with sterile saline before replacement.
- Removal and replacement of the tube may be required if the tube is displaced or occluded.

Double-lumen tracheostomy tube care

- The inner cannula should be changed and replaced immediately with a second inner cannula (new or previously cleaned) at least 4-hourly or more frequent if necessary (**Figure 5**).
- The replacement cannula is cleaned with a brush and 2% chlorhexidine and rinsed thoroughly with sterile saline prior to being used.
- Removal of the whole tracheostomy tube is rarely required. Removal of the whole tracheostomy tube is required when the tube is displaced or is fully/partially obstructed despite repetitive cleaning and suctioning. This should only be performed by trained staff.

Possible complications

Complication rates are high, with 86% of cases having at least one complication (Nicholson & Baines, 2012). The most common complications were found to be obstruction (26%), dislodgement (21%), aspiration pneumonia (21%) and stoma swelling (21%) (Nicholson & Baines, 2012) (**Table 4**).

Conclusion

Nursing the artificial airway patient may appear to present a daunting challenge. However, by using evidence-based practice, tried and tested standard operating procedures based on current literature, receiving appropriate training and by being prepared these cases may also be exceptionally rewarding (**Table 5**).

Table 5. Possible complications and their management

Complication	Cause	Solution
Airway obstruction	Increased mucus production, tube displacement or physical occlusion	Manage with good tube care
Tube displacement	Coughing, dermatitis, poor positioning, active patient	Replace tube
Bradycardia	Deep suctioning and manipulation of the tube	Report to clinician
Haemorrhage	Trauma from suctioning	Reduce suctioning frequency and be more gentle
Infections: pneumonia or stoma site	Inadequate aseptic nursing technique or antibiotic cover	Report to clinician, reassess antibiotic and supportive therapy
Subcutaneous emphysema	Traumatic placement of tube	Report to clinician, observe
Tracheal mucosal injury or necrosis	Trauma from suctioning, tracheostomy tube or cuff	Reduce frequency of suctioning; take care not to advance the suction catheter too far into the trachea
Gastro-oesophageal reflux, regurgitation and aspiration pneumonia	Breed disposition, partial tube occlusion may cause increased inspiratory effort which may cause reflux/regurgitation	Report to clinician, consider gastro-protectants and supportive treatment

References and further reading

Ackerman, N. (2015). Use of nebulisers in small animal practice. *The Veterinary Nurse, 6*, 488–493. doi:10.12968/vetn.2015.6.8.488

Mann, F. A., & Flanders, M. M. (2012). Temporary tracheostomy In J. M. B. Creedon & H. Davis (Eds.), *Advanced monitoring and procedures for small animal emergency and critical care*. Chichester: Wiley-Blackwell.

Sierra, L. K., & King, L. G. (2012). Artificial airway management. In J. M. B. Creedon & H. Davis (Eds.), *Advanced monitoring and procedures for small animal emergency and critical care*. Chichester: Wiley-Blackwell.

Fletcher, D. J., Boller, M., Brainard, B. M., Haskins, S. C., Hopper, K., McMichael, M. A., … Smarick, S. D. (2012). RECOVER evidence and knowledge gap analysis on veterinary CPR. Part 7: Clinical guidelines. *Journal of Veterinary Emergency and Critical Care, 22*, S102–S131. doi: 10.1111/j.1476-4431.2012.00757.x

Mazzaferro, E. M. (2013). Temporary tracheostomy. *Topics in Companion Animal Medicine, 28*, 74–78.

Myer, C. M., Hubbell, R. N., McDonald, J. S., & Stith, J. (1988). Study of humidification potential of a heat and moisture exchanger in tracheotomized dogs. *Annals of Otology, Rhinology & Laryngology, 97*, 322–325. doi:10.1177/000348948809700323

Nicholson, I., & Baines, S. (2010). Indications, placement and management of tracheostomy tubes. *In Practice, 32*, 104–113. doi: 10.1136/inp.c986

Nicholson, I., & Baines, S. (2012). Complications associated with temporary tracheostomy tubes in 42 dogs (1998 to 2007). *Journal of Small Animal Practice, 53*, 103–114. doi: 10.1111/j.1748-5827.2011.01167.x

Randels-Thorp, A. (2015). How to manage tracheostomy tubes. *The Veterinary Nurse, 6*, 494–497. doi: 10.12968/vetn.2015.6.8.494

Multiple Choice Questions

1. Which of the following is not generally a reason for placing a tracheostomy tube?

(a) Laryngeal paralysis or collapse
(b) Hyperventilation
(c) Brachycephalic Obstructive Airway Syndrome
(d) Tracheal foreign body

2. Which of the following would be a contraindication to tracheostomy tube placement?

(a) Coagulopathy
(b) A tracheal obstruction above the tracheostomy site
(c) Trauma
(d) Laryngeal paralysis

3. What should the tracheostomy stoma site be cleaned with?

(a) Povidone iodine
(b) Chlorhexidine gluconate
(c) 0.9% sterile saline solution
(d) Antimicrobial handwash

4. What percentage of cases develop at least one complication associated with tracheostomy tube placement?

(a) 50%
(b) 29%
(c) 75%
(d) 86%

5. Which of the following is not a potential complication of tracheostomy tube placement?

(a) Subcutaneous emphysema
(b) Airway obstruction
(c) Infection of the stoma site
(d) Increased partial pressure of oxygen

6. Suction pressure applied to the airways should be a maximum of:

(a) 80mmHg
(b) 120mmHg
(c) 150mmHg
(d) 100mmHg

7. How often should heat and moisture exchangers be inspected?

(a) Every 8 hours
(b) Every 4 hours
(c) Every 12 hours
(d) Every 24 hours

8. Deep suctioning of the trachea may cause which of the following complications?

(a) Bradycardia
(b) Tachycardia
(c) Subcutaneous emphysema
(d) Hypotension

For the answers to the MCQs, please go to: http://www.bvna.org.uk/publications/veterinary-nursing-journal