Placement, care and maintenance of temporary tracheostomy tubes in dogs

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ABSTRACT: A temporary tracheostomy tube can be placed to provide short term opening into the airway when the upper aspect of the respiratory system is affected. The upper airway can be affected by trauma, neoplasia, foreign bodies, medical conditions, or anatomical issues for brachycephalic breeds. Nursing care is vitally important to prevent post placement issues and to keep the patient comfortable until the temporary tracheostomy tube can be removed once the patient is suitably recovered.

Keywords: tracheostomy tube; temporary tracheostomy tube; airway; upper airway; respiratory; nursing care; brachycephalic

Definition

A tracheostomy is an artificial opening into the trachea. A tracheotomy is the surgical procedure (Black's Veterinary Dictionary, 2005) in which an incision is made into the trachea in order to relieve an obstruction to breathing ability. This opening between the skin and the tracheal lumen allows air to bypass the nasal and oral cavities but still enter the lower aspect of the respiratory tract (Tillson, 2004).

Indications

A temporary tracheostomy tube is placed to restore a functioning airway when the upper part of the respiratory system is negatively affected. The upper airway may become obstructed by trauma, neoplasia, foreign bodies, surgery involving or near to the upper airway, conditions such as laryngeal paralysis or due to the anatomical problems associated with brachycephalic breeds. Tracheostomy tubes are rarely placed in a true emergency situation as some form of endotracheal intubation (traditional, direct placement; endoscopic placement; guidewire placement) is usually manageable (Sumner & Rozanski, 2013). Temporary tracheostomy tubes can be placed pre-operatively to give clearer access to a surgical site which involves the oral and upper airway regions as it removes the need to place a traditional endotracheal tube. They can also be placed post-operatively if the surgical site becomes inflamed and impacts on the patient's ability to breathe. Brachycephalic obstructive airway syndrome (BOAS) and related corrective surgeries are thought to be the most common cause for post-operative placement of a tracheostomy (Fawcett et al., 2018).

Types of tube

Tubes can be made from soft, flexible silicone, single use polyvinylchloride or re-usable, rigid metal such as stainless steel. They can come with or without an inflatable cuff. The table below discusses benefits and risks of cuffed and uncuffed tubes (Table 1).

The selected tube should be the length of 6–7 cartilage rings and have a diameter of no more than 50% of the lumen of the trachea at the placement site (Caron, 2016).

Tracheostomy tubes are either single or double lumen depending on the tube diameter. Tubes with a larger diameter have an inner cannula that can be removed for cleaning without compromising the airway, however they do require a larger incision to be made for placement (Fudge, 2009). Tracheostomy tube size is based upon the diameter of the airway. This can be estimated by taking lateral cervical radiographs and looking at the inner diameter of the trachea (Fudge, 2009).

Anaesthetic considerations

General anaesthesia is preferable for a tracheotomy procedure as it allows for full

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Table 1. Table of pros and cons of cuffed vs uncuffed tracheostomy tubes.

	Pros	Cons
Cuffed Tracheostomy Tubes	• Can be used if mechanical ventilation is required whilst under anaesthetic • High volume, low pressure cuff. This reduces the risk of damage to the trachea leading to stenosis and necrosis • Can be used with the cuff inflated or deflated • Can be inflated after 24 hours to reduce risk of aspiration when eating and drinking • Can be used in patients that may need intermittent positive pressure ventilation (IPPV) and/or to be maintained under anaesthetic with an inhalation agent	• Overinflation of the cuff can lead to damage to the trachea • Cuff needs to be deflated and moved regularly to prevent damage to the tracheal wall
Un-cuffed Tracheostomy Tubes	• Less pressure on the tracheal walls reducing risk of tracheal stenosis or necrosis as no inflated cuff	• Increased risk of aspiration pneumonia as no cuff to block foreign materials from entering the lungs • Cannot be used as a secure airway if the patient needs to be anaesthetised as inhalation agent could leak around the tube • Cannot be used in patients that may need intermittent positive pressure ventilation (IPPV) due to the lack of seal within the airway

(Sumner & Rozanski, 2013) (Fudge, 2009) (Kinnerney, 2019)

control of the airway, allowing for endotracheal tube placement and manual or mechanical ventilation if necessary. It is also considered less stressful for the patient than sedation. In patients that are unable to be placed under general anaesthetic, local anaesthesia could be considered. All patients suffering with respiratory distress should be preoxygenated prior to anaesthesia, ideally with a face mask if tolerated as this has a better effect on oxygen saturation than flow by oxygenation. Patients given face mask oxygenation saw an increased $PaCO_2$ in arterial samples (371.3 mmHg) versus those of patients who were administered flow by oxygenation (182.2 mmHg) (Wong, et al., 2019).

Intramuscular premedication can be given before intravenous catheter placement. Acepromazine, medetomidine and an opioid in low doses could be suitable as a premedication combination; the acepromazine has lasting sedative effects, medetomidine can be antagonised and provides some analgesia and an opioid will provide the main component of the analgesia pre-operatively (O'Dwyer, 2017). Propofol or alfaxalone can be used for induction of the patient into anaesthesia due to their rapid onset of action (Fawcett, et al., 2018). A combination of ketamine and diazepam could also be used as a co-induction as this combination maintains laryngeal function (Seim, 2006); this is important as the larynx regulates airflow in and out of the respiratory system as well as protecting the lower airway from aspiration of foreign material (Kirby, 2016). Induction should be smooth and rapid so that the patient does not become stressed. Premedication and induction drugs should ideally compromise the cardiovascular system as little as possible (Flaherty, 2009).

Whilst under anaesthetic, full monitoring including capnography, pulse oximetry and electrocardiogram (ECG) should be used. Respiratory depressed patients can exhibit hyperventilation with a low tidal volume which can lead to hypercapnia and respiratory acidosis. Inhalation anaesthetic agents can have reduced uptake due to hyperventilation so manual or mechanical ventilation should be administered (Fawcett et al., 2018).

Placement

A small kit containing basic surgical instruments, scalpel blades, small self-retaining retractors (such as gelpies), along with sterile swabs and drapes are required. Large sized monofilament, non-absorbable suture material is used. A suitable sized tracheostomy tube and elasticated ties or string to hold the tube in place are also added to the kit. A right-angled adaptor may also be useful to prevent the anaesthetic circuit from pulling on the tracheostomy tube when in place.

The patient should be induced into anaesthesia and an endotracheal tube should be placed. The patient should be placed into dorsal recumbency with a rolled towel underneath the neck, ready for the placement procedure (Allen, 2015).

A transverse approach is the most popular placement technique due to the lower risk of causing tracheal stenosis, but a vertical approach can also be used. The surgeon makes a 2–5 cm incision on the ventral midline from the cricoid cartilage towards the sternum to expose tracheal rings 3–5. The sternohyoid muscles are blunt dissected and retracted. The annular ligament between either the third and fourth or the fourth and fifth tracheal rings and a loop of suture is placed around each ring on the cranial and caudal sides of the chosen space. These suture loops can remain in place for as long as the tracheostomy is required and can help replacement of the tube after cleaning. The suture loops can then be used to apply gentle traction away from each other whilst the tracheostomy tube is placed. The endotracheal tube is removed, and the tracheostomy tube inserted. The anaesthetic circuit is then connected to the newly place tracheostomy tube to maintain anaesthesia. The elasticated band is then tied to each side of the tube and can then be tied at the dorsal aspect of the neck to secure the tube in place (Fudge, 2009).

The incision is not usually closed, it is left to close by second intention (Kellet-Gregory & King, 2014) (Figures 1–3).

Complications

Patients with a temporary tracheostomy tube should be under observation 24 hours a day as the risk of complications is high. Around 86% of patients with tracheostomy tubes placed will suffer complications, with approximately 10% of these going on to be euthanised. Underlying disease is a major factor in increased likelihood of complications (Caron, 2016). The main risk associated with tracheostomy tubes is occlusion or dislodgement of the tube and therefore, occlusion of the airway. Patients, such as bulldogs, with lots of loose skin can accidentally occlude their tubes when lying down or sleeping. The placement of the tubes also causes the body to secrete large amounts of thick mucous due to the insertion of a foreign object into the airway and damage to the mucosa caused by the presence of the tube (Kellet-Gregory & King, 2014). As the tracheostomy site causes the patient to bypass the nasal cavities, inhaled air is not filtered, warmed or humidified which also

increases mucous secretions (Hill, 2009). Single lumen tubes are more likely to become blocked via secretions as there is no inner cannula to remove for cleaning. Stenosis of the trachea is a long-term complication that can be seen in patients following tracheostomy tube placement, however should not dramatically impair quality of life once the tube has been removed (Caron, 2016). Longer periods of having a tracheostomy tube in situ leads to more complications; 58% of cases with tubes in for four or more days have complications versus 11% complication rate for those with tubes in for 1–3 days (Bird et al., 2018) (Table 2).

Nursing care

There are many ways in which the veterinary nurse can provide suitable care to those patients with temporary tracheostomy tubes. Patients should be monitored closely throughout the post-operative period and until the tube is removed to minimise the risk of complications. Patients should be placed in a suitable ward to provide instant, easy access for observations and emergency situations. Quiet wards allow for breathing sounds to be clearly observed and changes to be more easily detected. Many brachycephalic breeds, which have more potential to require tracheostomy tubes following airway surgeries, are often sleep deprived, with up to 56% reported as being affected in a recent survey (Fawcett et al., 2018). Therefore, quiet and low-lit wards can often provide some periods of rest and respite for affected patients.

Regular checks should be carried out on the tracheostomy tube site to check for swelling, irritation or infection of the wound. Cleaning of the wound should also be carried out on a regular basis, every two hours, along with the cleaning of the inside of the tube itself.

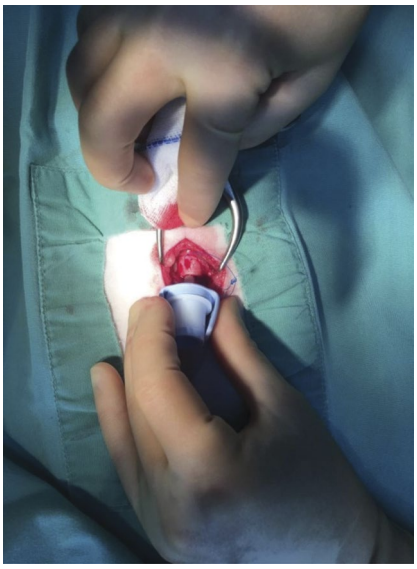

Figure 1. Tracheostomy tube placement. Credit to Megan Prendergast and James Colver for this image.

Figure 2. Tracheostomy tube placement. Credit to Magdalena Macios for this image.

Figure 3. Equipment required for surgical placement of temporary tracheostomy tubes. Credit to Author for this image.

Regular or continuous nebulisation with sterile 0.9% saline can benefit patients (Downing & Gibson, 2018). The main aim of nebulisation is to improve tidal capacity of the lungs by clearing pulmonary secretions that affect availability of space in which gas exchange can occur across the membranes of the lungs. Nebulisers produce micro droplets of saline and help by moistening the epithelium of the airway and helping to soften and clear mucous secretions (Kellet-Gregory & King, 2014). Nebulisation is recommended for 15 minutes per session every 4–6 hours (Sierra, 2020). Epinephrine can also be added when nebulising; this causes vasoconstriction and a reduction in laryngeal oedema (Downing & Gibson, 2018). ECG monitoring should be used when nebulising with higher doses in patients with pre-existing cardiac conditions. Humidification, the saturation of air with water vapour, can also be of assistance.

Coupage is a form of respiratory physiotherapy that aids with the clearance of excessive secretions by loosening any secretions trapped within the airway and encouraging the patient's cough reflex which helps to improve tidal capacity of the lungs. However, if the cough reflex is too powerful, the tracheostomy tube can become dislodged so caution should be used (Gwynne, 2011).

With the patient in sternal recumbency or stood, cupped hands should be used to pat both sides of the chest in a steady rhythm for up to ten minutes. The coupage should be performed from the caudal thorax up towards the cranial thorax to encourage the forward movement of the loosened secretions (Gwynne, 2011). This can be done 3–5 times a day, usually following nebulisation which also helps to loosen secretions (Kellet-Gregory & King, 2014).

A short walk following nebulisation and coupage can help to increase the patient's tidal volume and airway capacity as well as encouraging the cough reflex (Sierra, 2020).

If patients are dehydrated, airway secretion clearance can be affected. Suitable intravenous fluid therapy (IVFT) can be provided to maintain the patient's hydration status. Maintaining hydration also means that pulmonary secretions, which are 90% water based, are kept watery and are not too viscous to be expelled via the cough reflex

Table 2. Table of complications and causes (Lam, 2015).

Complication	Cause
Aspiration pneumonia, pneumothorax, pneumomediastinum, subcutaneous emphysema	Enlarged airway stoma
Infections of the tube site, infections of the trachea, tracheal necrosis	Lower part of the airway is not being protected by the filtration system of the nasal cavity
Tracheal stenosis, tracheal necrosis	Poor technique during surgical placement, pressure put on the trachea due to over inflation of the cuff, too large a diameter lumen selected

up through the narrow trachea and out of the body (Gwynne, 2011).

Keeping the airway unobstructed are the main focuses of nursing care. Patients should be kept on lint free bedding to reduce the risk of small material foreign bodies becoming inhaled. The patient's head should also be propped up and extended as much as is comfortable to keep the airway straight and allow for easier breathing. This can also help prevent the tracheostomy tube from becoming blocked by the patient lying on it and obstructing it when sleeping (Fudge, 2009). Allowing the patient to position themselves and then adapting bedding and head to support to their chosen position can be well tolerated in the longer term with patients happier to settle in a suitable position (Sierra, 2020). Breeds such as British bulldogs are more at risk of obstructing their tube sites due to excessive loose skin folds around the neck.

Efforts should be made to keep tracheostomy patients cool to prevent hyperventilation. Excessive panting can cause the tube to become dislodged and it also causes increased movement of respiratory secretions which can cause obstruction. Cooling methods can include decreasing room temperature, cooling mats, fans or alcohol on the pads of feet (Sumner & Rozanski, 2013). Some patients may pant excessively due to the stress of the kennel environment and mild sedation could be considered. Continuous monitoring should be provided to any patient given sedative drugs to prevent them from lying down in a position which obstructs the tracheostomy site.

Medications

Medications such as bronchodilators or antitussives are useful if appropriate for the patient. Bronchodilators, such as terbutaline which is a beta-2 agonist, work by activating receptors sites on smooth muscle cells which causes relaxation of the lower airway. This causes the smallest parts of the lungs to expand slightly allowing for increased gas exchange. This can have positive impacts on the patient's oxygen saturation levels. Albuterol is a bronchodilator that can be used during nebulisation or administered via an inhaler (Johnson, 2012).

Antitussives can be used to increase the threshold at which coughing starts and suppressing the cough itself (Church, 2006), this can decrease the risk of manual dislodgment of the tube caused by the patient excessively coughing. However, this would also decrease the success of coupage and nebulisation to help facilitate the removal of pulmonary secretions.

Mucolytics such as Acetylcysteine, can be used to decrease the viscosity of airway secretions (Church, 2006). Broad spectrum antibiotics may also be prescribed to help counteract stoma site infections, bacterial pneumonias caused by tube placement and prevent hospital acquired infections whilst the patient is kept hospitalised (Sumner & Rozanski, 2013). This, along with maintaining good hygiene of the stoma and tube itself can lead to a much lower risk of infection related complications.

Regurgitation can cause aspiration related issues. Drugs such as omeprazole and metoclopramide administered pre-operatively before an elective tracheostomy can reduce this risk. Metoclopramide can also be used in a constant rate infusion (CRI) peri-operatively (Fawcett et al., 2018).

Cleaning of tracheostomy tube & site

Cleaning the stoma and tube itself should be done every 4–6 hours (Kinnerney, 2019). Most patients can have their tube cleaned whilst conscious, however some patients may benefit from a mild sedation.

- Where possible, patients should be monitored with an electrocardiogram (ECG) and pulse oximetry throughout cleaning and suctioning. If during monitoring there are signs of low SPO_2 or bradycardia, cleaning should be paused whilst further oxygen therapy is supplied or terminated all together.
- Preoxygenation with 100% oxygen should be carried out for a minimum of 3–5 minutes. This can be via flow by, face mask or oxygen tent. The method best tolerated by the patient should be chosen.
- Nebulisation can also be carried out prior to suctioning.
- The procedure should be carried out in a sterile manner by one individual, whilst another restrains the patient in a suitable, calm manner. The patient should be kept either in sternal recumbency, stood or sat up.
- The stoma site should be cleaned with sterile swabs and a solution of 0.05% chlorhexidine solution. It can then be given a final wipe with sterile water and dried.
- Elastic ties that have become contaminated can be replaced.
- If the tube has an inner cannula, this can be removed and cleaned in a solution of 0.05% chlorhexidine, before being rinsed thoroughly with saline or sterile water. If two inner cannulas are available, a new one can replace the used one with the used one kept soaking in 0.05% chlorhexidine solution until the next cleaning session. Single cannula tubes should be fully replaced every 24 hours.
- The suction catheter should be inserted, twisting it around the inner lumen of the tube. It should not be inserted further than a couple of centimetres past the caudal end of the tube. It should be in the lumen for no longer than 15 seconds each time. This can be repeated until most secretions have been removed but up to a maximum of three times. Low pressure settings should be used when first suctioning and can be increased as needed.
- Oxygen therapy can be given between each suction episode and following completion of the cleaning of the site.

Over suctioning of the tube can cause coughing, vomiting, bronchial spasms and stimulation of the vagal nerve (Sierra, 2020) (Figures 4 and 5).

Removal

Once the airway has returned to a stage that allows normal breathing to occur, the tracheostomy tube can be removed. This can take several hours to several weeks following placement (Bird, et al., 2018). The elastic is untied, and the tube simply pulled out in a swift motion. The stoma is left to close via second intention and allowing the tissues to granulate and epithelialisation to occur. This allows the stoma to remain whilst the

Tube care equipment

- Sterile gloves
- Suction unit with tubing
- Sterile suction catheter
- Sterile saline
- Syringes
- Sterile swabs
- Nebuliser
- Monitoring equipment eg pulse ox, ECG
- Oxygen supply with suitable circuit
- Replacement elasticated ties
- Replacement inner cannula if using a double lumen tube
- Sterile bowls to soak and rinse the tube
- Antiseptic solution for soaking the tube

Figure 4. Tube care equipment checklist.

trachea heals and helps to prevent air getting trapped under surrounding skin and causing subcutaneous emphysema (Sumner & Rozanski, 2013). The trachea usually seals itself within 2–3 days and the stoma is usually healed within two weeks.

Conclusion

5% of dogs undergoing Brachycephalic obstructive airway syndrome (BOAS) surgery require a temporary tracheostomy tube placement during the post-operative period due to ongoing respiratory distress (Bird et al., 2018). A recently study at Dick White Referrals showed that although the risk of major complication, which included clinical signs such as cyanosis and dyspnoea, was shown in 83% of cases where a temporary tracheostomy tube had to be placed either electively or in an emergency following BOAS correction surgery; 41 out of 42 dogs (97.6%) included in the study were considered to have successful tube management (Stordalen et al., 2020).

In conclusion, patients with temporary tracheostomy tubes are now a more regular occurrence in practices carrying out BOAS procedures. These cases require more intense nursing care due to the associated risks of infection, aspiration, and occlusion. These patients can be extremely rewarding to provide nursing care to due to the amount of time spent directly with the patient and the high likelihood of a successful outcome.

Figure 5. Whippet with temporary tracheostomy tube. Credit to Robert Van Goor for this image.

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