Cuffed endotracheal tubes in cats

A cuffed endotracheal tube may improve the airway seal in anaesthetised feline patients, compared to use of an uncuffed tube. This may improve capnography and decrease theatre pollution with volatile agents. However, two significant risks are associated with the technique. First, over-inflation of the cuff could occur, with associated iatrogenic tracheal damage; this may be prevented by use of a cuff manometer for inflation. Second, as a result of the improved seal, barotrauma may be more likely with high gas flow rates and assisted ventilation.
https://doi.org/10.12968/coan.2019.0070

David Yates BVSc MRCVS, **Albert Holgate** BSc (Hons) CVN Dip AVN RVN, RSPCA Bolton Clinic, 21 Vernon Street, Bolton BL1 2QB. albert.holgate@rspca.org.uk

Key words: anaesthesia | cat | endotracheal | intubation | cuffed | non-cuffed | manometer

Endotracheal intubation is used to secure the patient's airway allowing delivery of inhalational anaesthesia and supplementation of inspired oxygen to an anesthetised patient. Additionally, the endotracheal (ET) tube protects the airway from aspiration of harmful material should regurgitation occur. The ET tube may be connected to a ventilator to support breathing in a compromised patient, for example one with traumatic brain injury.

Previously, there has been a tendency to use uncuffed rather than cutted ET tubes in small patients such as cats. However, the use of cuffed tubes has advantages even in patients of this size. In human medicine, research over the past several years for paediatric patients has indicated either that cuffed ET tubes are not disadvantageous compared to uncuffed tubes (Chen et al, 2018; de Wit et al, 2018), or that they are advantageous (Mukhopadhyay et al, 2016; Chambers et al, 2018), and their use has increased, although more data are needed (De Orange et al, 2017; Chen et al, 2018).

This short article discusses some of the risks and benefits of using a cuffed ET tube in cats.

Practical aspects

Laryngoscopy is invaluable when performing endotracheal intubation in the cat, whether using a cuffed or uncuffed tube. A cuffed ET tube may be more difficult to pass into the trachea than an uncuffed tube, because of the difficulty of seeing beyond the size and shape of the cuff. Consequently, the internal diameter size of the selected cuffed ET tube may be slightly smaller than the corresponding non-cuffed tube.

After passing the ET tube into the trachea, the cuff should be inflated as necessary to seal the airway. There is a risk of over-inflation of the cuff and potential damage to the tracheal mucosa from this. A cuff manometer is essential to ensure correct filling of the cuff without over-inflation. It is important to note that palpation of the minimum occlusive volume to fill the cuff is unreliable even in experienced hands (White et al, 2017).

The use of a cuff manometer is shown in *Figure 1*. With an intracuff pressure of 30 cm H_2O, the vast majority of cats do not have an audible leak around the cuff (Bird et al, 2018). The American Association of Feline Practitioners Anaesthesia Guidelines (Robertson et al, 2018) recommend an inflation pressure range of 20–30 cm H_2O as being safe for use in cats.

Comparing three methods of cuff inflation

In addition to the cuff manometer method, other methods by which appropriate cuff inflation may be determined are the pilot

Figure 1. Cuff manometer at final inflation pressure. Note the adequate capnography trace. Information regarding cuff inflation devices can be found at tru-cuff.com or cuffill.com

baloon palpation method and the minimal occlusive volume method. While these methds have been in use traditionally, the cuff manometer method is preferable because of its improved consistency, as shown in *Table 1*.

Implications of use of cuffed ET tubes

There are benefits of using cuffed ET tubes; there are also potential drawbacks. Both must be considered when deciding what type of ET tube to use:

- The airway seal of a cuffed ET tube is superior to that of the non-cuffed tube. This is beneficial because it reduces exposure of personnel to volatile agent leakage
  - The disadvantage of a superior seal is the increased risk of barotrauma when combined with factors such as high fresh gas flow rates and assisted ventilation
- A small, uncuffed tube may fail to produce an adequate capnography trace (*Figure 2*)
  - Appropriate inflation of a cuffed tube ensures adequate sampling for capnography.
- Care is needed to deflate the cuff before removing the ET tube.
  - Partial deflation may be used with caution to assist in removal of debris, for example following dental procedures
  - The risk of iatrogenic damage to the tracheal mucosa if withdrawing a cuffed tube while still partially inflated must be weighed against the advantage of removing aspirated foreign material
- Endotracheal intubation is a risk factor for anaesthetic safety. High-volume, low-pressure cuffs should be used rather than traditional red rubber high-pressure, low-volume cuffs. A safe inflation pressure in cats (unlikely to cause tracheal mucosal damage) is 20 cm water (Bird et al, 2019).
- Intubation is likely to take a few seconds longer for a cuffed tube: the time required for initial placement of the tube and the need to inflate the cuff
- Cuffed ET tubes are approximately 20% more expensive than non-cuffed tubes
- If the tubes are used repeatedly, it may be more difficult to clean a cuffed tube than a non-cuffed tube.
- The cuff should be inspected for damage before use.

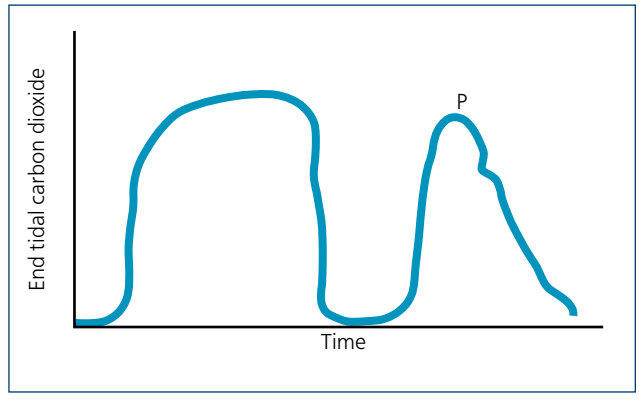

Figure 2. Capnogram from a poor airway seal, as may be obtained from a small non-cuffed endotracheal (ET) tube or a poorly inflated cuffed ET tube. The plateau is lost at point P.

  - An effective check is to leave the cuff inflated after cleaning and check that it has not deflated before use.

Conclusions

Securing the patient airway is an essential part of safe general anaesthesia. In the UK, most feline practitioners will be aware of the simplicity and limitations of a non-cuffed ET tube. A cuffed ET tube may improve the airway 'seal', which is advantageous for both patient and (via reduced leakage of volatile anaesthetic agents) for personnel. However, a cuff manometer is essential to minimise the risk of iatrogenic tracheal damage. CA

Conflict of interest: no conflicts of interest.

References

Bird AR, Bird DJ, McMillan MW. Aspects of in vivo endotracheal tube intracuff pressure in cats. Vet Anaesth Analg. 2019;46(1):55-63. https://doi.org/ 10.1016/j.vaa.2018.06.017

Chambers NA, Ramgolam A, Sommerfield D et al. Cuffed vs. uncuffed tracheal tubes in children: a randomised controlled trial comparing leak, tidal volume and complications. Anaesthesia. 2018;73(2):160–168. https://doi.org/ 10.1111/anae.14113

Chen L, Zhang J, Pan G, Li X, Shi T, He W. Cuffed versus uncuffed endotracheal tubes in pediatrics: a meta-analysis. Open Med (Wars). 2018;13:366-373. https://doi.org/ 10.1515/med-2018-0055

De Orange FA, Andrade RGAC, Lemos A, Borges PSGN, Figueiroa JN, Kovatsis PG.

Table 1. Comparing three methods of cuff inflation

Method	Pilot balloon palpation	Minimum occlusive volume	Cuff manometer
Technique	Digital palpation of the pilot balloon until the anaesthetist feels that the endotracheal tube is safely sealed	Rebreathing bag is set to 50% of full volume. Adjustable pressure limiting valve is closed. Normal breath(s) given. Cuff inflated until no leak audible at mouth	Cuff inflated to 20–30 cm H_2O using a manometer
Consistency	Highly variable	Reasonable	Precise
Additional equipment needed	No additional equipment required	No additional equipment required	Single-use or multi-use syringe device(s) must be purchased

Robertson et al (2018)

Cuffed versus uncuffed endotracheal tubes for general anaesthesia in children aged eight years and under. Cochrane Database of Systematic Reviews 2017(11) CD011954. https://doi.org/ 10.1002/14651858.CD011954.pub2

de Wit M, Peelen LM, van Wolfswinkel L, de Graaff JC. The incidence of postoperative respiratory complications: A retrospective analysis of cuffed vs uncuffed tracheal tubes in children 0-7 years of age. Paediatr Anaesth. 2018 Mar;28(3):210-217. https://doi.org/ 10.1111/pan.13340

Mukhopadhyay S, Mukhopadhyay S, Bhattacharya D, Bandyopadhyay BK, Mukherjee M, Ganguly R. Clinical performance of cuffed versus uncuffed preformed endotracheal tube in pediatric patients undergoing cleft palate surgery. Saudi J Anaesth. 2016;10(2):202-7. https://doi.org/ 10.4103/1658-354X.168842

Robertson SA, Gogolski SM, Pascoe P, Shafford HL, Sager J, Griffenhagen G6. AAFP Feline Anesthesia Guidelines. J Feline Med Surg. 2018;20(7):602-634. doi: 10.1177/1098612X18781391

White DM, Redondo JI, Mair AR, Martinez-Taboada F. The effect of user experience and inflation technique on endotracheal tube cuff pressure using a feline airway simulator. Vet Anaesth Analg. 2017;44(5):1076-1084. https://doi.org/ 10.1016/j.vaa.2016.11.006

KEY POINTS

- Currently uncuffed ET tubes are widely used in feline practice.
- Cuffed ET tubes may offer patient and practitioner benefits such as reliable capnography traces.
- Care should be taken to avoid cuff overinflation and the risk of iatrogenic tracheal damage.
- Use of a cuff manometer is highly recommended to ensure correct cuff inflation.