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Review Article

A Review of Current Literature Regarding Airway Management during Rabbit Anaesthesia

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Received: August 27, 2020; **Published:** November 28, 2020

Abstract

Veterinary Nurses (VN) and Veterinary Surgeons (VS) must review anaesthetic risks and patient safety during rabbit anaesthesia, as emergencies and fatalities are higher in comparison to cats and dogs. Any patient undergoing general anaesthesia should have an airway management plan adjusted to the patient, procedure and associated risk factors. This article reviews the options for airway management for rabbits undergoing anaesthesia as airway management is a vital part of anaesthesia which is often neglected in exotic patients.

Keywords: *Airway Management; Rabbit Anaesthesia; Endotracheal Intubation*

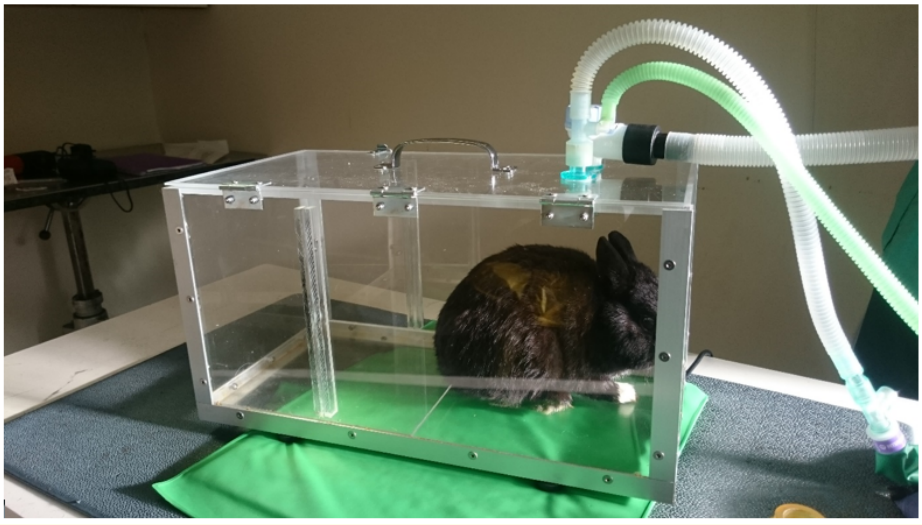
Introduction

Any patient undergoing general anaesthesia should have a form of airway management to provide a patent, secure airway and to allow for effective and reliable inhalation anaesthesia. Upper airway impairment is a well-known factor of anaesthesia and is often dwelled upon when planning airway management for rabbits [1]. VNs and VS often relate increased mortality rates with the use of endotracheal tubes in feline and lagomorph patients [2]. VS may not wish to intubate rabbits after intravenous (IV) induction due to difficulty and to prevent laryngeal spasm. Several studies in rabbits have suggested that to avoid laryngeal collapse, intubation should not be attempted more than three times. Without airway management, rabbits are at risk of reflux, regurgitation and inhalation pneumonia [3].

It is the VS role to provide airway management for rabbits; however, as VNs will often place, maintain and disconnect airway management, it is important that VNs have a thorough understanding of the options available. There are several options for airway management in rabbits including: endotracheal intubation, face masks, induction chambers and supraglottic airway devices (SGAD) (V-Gel®, Docsinnovent Ltd).

Face masks and induction chambers

Face masks and induction chambers are often used as the sole induction and airway management for many exotic patients (Figure 1). Rabbits are the third most popular pet in the UK and are seen frequently in practice (PDSA, 2019). Therefore, veterinary professions should not treat them as exotic patients and should have a wide knowledge of the species and anaesthetic protocols.



Induction via inhalation anaesthesia by face mask and induction chambers is likely to be stressful for rabbits. Exacerbated by the relatively long time required for inhalation anaesthetics to induce unconsciousness; rabbits will intentionally have an apnoeic episode if induced with inhalation anaesthesia alone, causing hypoxia [4]. Studies in canines and felines also show similar results, therefore, veterinary professions should try to standardise care across species including anaesthetic protocols [5,6]. The work of Flecknell [7] explored the differences in stress and resistance to induction anaesthesia comparatively between the facemask and chamber method. Significantly, all the rabbits in this study had periods of apnoea and bradycardia during induction, some resulting in moderate hypercapnia and acidosis before an adequate plane of anaesthesia had been obtained. Flecknell [7] pointed out that all the rabbits in the study avoided inhalation anaesthesia and most of the rabbits struggled violently during induction. The behaviour these rabbits expressed and the rates of post-inhalation anaesthesia apnoea show that these induction methods are stressful and should be avoided [8]. Eatwell and Mancinelli [9] also noted that chamber induction is stressful, as rabbits elevate their heads to the top of the chamber to avoid the inhalation anaesthesia. Rabbits will often 'Buck' and struggle when induced via inhalation anaesthesia by face mask, leading to spinal injuries and limb injuries.

Moreover, facemasks and induction chambers have increased dead space. When an induction chamber is used, it is advisable to remove the rabbit once signs of relaxation appear and continue the inhalation anaesthesia with the use of a facemask. If a nasal or face mask is used, it should be placed deep over the face in order to minimise dead-space. However, facemasks and induction chambers create high levels of atmospheric pollution and veterinary staff safety must be a priority. In 1999, a study by Hoerauf., *et al*. [10] discovered that staff exposure to trace concentrations of isoflurane can cause damage to chromosomes during cell division, the damage recorded was equivalent to effect of smoking 20 cigarettes a day. It has also been well noted that exposure to volatile agents can cause staff to have significantly longer reaction times, poor concentration, coordination and memory [11,12].

Pregnant employees may be exposed to waste anaesthetic gases, the risk of exposure to waste anaesthetic gases is high during inhalation anaesthesia via facemask or induction chamber. It is recommended that pregnant employees avoid exposure to anaesthetic gases as it could lead to developmental anomalies in their offspring [13]. Anaesthetic dosimetry badges are available to measure individual employees' exposure to waste gases which recommended during pregnancy [13].

In order to reduce the risk of potential health damage, the level of contamination at the workplace should be kept at a minimum pollution level with the use of double mask systems, active scavenging and air circulation systems [14,15].

Conversely, face masks and induction chambers are quick and easy to use and may be useful for short procedures. This option is also good for pre-oxygenation; face masks can be used for flow-by oxygen prior to induction. Induction chambers can be filled with blankets to reduce dead space and so that the rabbit feels comfortable. If a rabbit is very stressed when handled, an induction chamber can be a safe way to provide pre-oxygenation.

Endotracheal intubation

Endotracheal intubation is the placement of a tube that extends from the oral cavity into the trachea (Figure 2). Endotracheal intubation is the standard airway management for canine and feline patients, rabbits are often not intubated as veterinary professionals can find it difficult to intubate and often apprehend laryngeal collapse.

Veterinary endotracheal tubes (ETT) are available in three varieties: Red Rubber, Polyvinyl chloride (PVC), and Silicone. Red Rubber tubes are generally not used in human anaesthesia but are still manufactured for veterinary patients and remain in general use. Red rubber tubes are re-usable and can be re-sterilised multiple times, however, with time the rubber can become hardened and cracked which will harbour pathogens [16].

PVC tubes are inexpensive single-use disposable tubes which have been adopted in veterinary medicine. PVC tubes are highly suitable for veterinary patients as they resist kinking by softening with body temperature and the smooth surface reduces tracheal damage and build-up of pathogens on the tube surface. PVC tubes are also transparent which allows respiration or obstruction to be visualised [17]. Silicone tubes are a modern veterinary ETT which can be re-sterilised for multiple uses and have repairable cuffs. However, silicone tubes have no curve and can be difficult to place [17].

To reduce the risk of laryngeal trauma, PCV or Silicone tubes without cuffs should be used when intubating rabbits [18]. As PCV tubes are single use only, the ETT can be included in anaesthetic cost and clients will often accept this extra charge if the risks of not intubating are explained.

It is well-documented that endotracheal intubation is more technically demanding in rabbits than in canine and feline patients [7,19,20]. This may be due to the lagomorph's relatively large tongue, small oropharyngeal cavity and limitation to directly visualise the glottis. ETTs are often not placed in rabbits as veterinary professionals relate increased mortality rates with the use of endotracheal tubes

in feline and lagomorph patients [2]. Brodbelt [20] also noted that failed endotracheal intubation and respiratory obstruction represented a significant cause of death in cats undergoing general anaesthesia. Notably, failed endotracheal intubation, trauma to the upper airway, inadequate ventilation and hypoxemia has all been well documented in lagomorph and feline patients [20,21].

Trauma during intubation is usually associated with poor technique, rough intubation or repeated attempts. All of these factors are very common in rabbits and can cause haematoma formation, lacerations, cartilage damage and tracheal avulsion or rupture. To prevent these injuries, it is recommended to lubricate ETTs, use an appropriately sized ETT (2 mm - 4 mm) and to use very gentle pressure while following recognised techniques [1,22].

Several studies show that endotracheal intubation should not be repeated more than three times to prevent laryngeal trauma, after three attempts a Supraglottic Airway Devises (SGAD) or Facemask should be used [23,24]. It also recommended using a holder such as the D-Grip® (Millpledge Veterinary Supplies) to stabilise the ETT and prevent rotation. ETT may be more applicable for dental or facial procedures, as face masks and v-gels can cause obstruction. ETT are also less likely to cause fluctuation in anaesthetic depth compared to face masks as they are constantly in place and limit workplace pollution.

There are several recognised intubation techniques for rabbits, all techniques will require practice and time to perfect the method. Intubation methods can be divided into two categories: blind intubation or direct visualisation [25-27]. Direct visualisation of the glottis may require specialty equipment such as a rigid endoscope or Semi-rigid endoscope; however, intubation is still achievable with a laryngoscope or otoscope [26]. Eatwell and Mancinelli [9] noted that direct visualisation of the larynx reduces the risk of tracheal trauma and allows food material or foreign bodies to be recognised and cleared. All types of intubation require an adequate depth of anaesthesia prior to intubation, if the patient is intubated in a light plane of anaesthesia, laryngeal spasm is more likely. As rabbits are obligated nasal breathers, local anaesthetic can be applied in a spray or trickled down the otoscope on to the glottis to further desensitise the glottis and to allow the epiglottis to be disengaged.

After intubation, cyanosis of the soft palate is common; therefore, confirmation of the position of the ETT and oxygenation is essential. ETT placement can be confirmed by auscultating both lung fields to check the ETT has not passed the bifurcation causing bronchial intubation [26]. Thoracic movements should result in positive pressure ventilation of the anaesthetic breathing circuit if the ETT is placed correctly. If a PVC or Silicone tube is used, condensation of respiration should appear and capnography can be used to confirm gaseous exchange [9].

Supraglottic airway devices

Supraglottic airway devices (SGAD) (V-Gel) have been recently introduced to the veterinary market; these devices are soft anatomically shaped cuffs that provide an airway seal around the pharyngeal, laryngeal and upper oesophageal structures. Supraglottic airway devices do not enter the trachea or larynx, avoiding cilia damage, tracheal necrosis or tracheal perforation; these factors reduce the risk of laryngospasm, which is a very prevalent and concerning issue amongst veterinary professionals [28].

Docsinnovent Ltd provides free online training on how to use and maintain V-Gels®, including a SGAD certificate and training videos. It is important for veterinary professionals using V-Gels® to undertake CPD on SGADs to build confidence.

Bateman., *et al*. [29] study compared the use of facemasks to laryngeal masks before the introduction of V-Gels; the study found that laryngeal masks provided increased airway patency when compared to facemasks and allowed for intermittent positive pressure ventilation (IPPV). Bateman., *et al*. [29] noted that further research and development of supraglottic devices was necessary for use in veterinary practice. Since the introduction of SGADS (V-Gel), Prasse., *et al*. [30] studied the reliability of controlled IPPV and the environmental pollution risks involved with airway management. SGADs have been shown to provide a gas-tight seal which prevents

the wastage of anaesthetic gases. As discussed earlier, face masks and chambers can cause significant environmental pollution which can increase staff safety risk and increases anaesthetic gas costs. Prasse., *et al*. [30] found that SGADs have significantly less leakage during controlled mechanical ventilation compared with the standard endotracheal tube. Therefore, providing a more superficial and stable level of anaesthesia while reducing environmental pollution risks.

Capnography is the measurement of end-tidal carbon dioxide ($ETCO_2$) which allows for continuous monitoring of the adequacy of ventilation and circulation, it is a valuable tool for the assessment of ventilation, metabolism and circulatory status. Notably, changes in $ETCO_2$ can signify airway obstruction and disconnection from anaesthetic breathing systems. Several studies have shown that SGADs are quick and easy to place in comparison to ETT, often showing that SGADs reduce the time for the first clinically viable capnography to be taken.

Oostrom., *et al*. [31] study compared the use of V-gels with ETT in 9 cats undergoing general anaesthesia. The study found that the time from administration of the induction agent to the first clinically viable capnography reading was significantly shorter than the ETT group. The study found no other significant differences but noted that more research was needed on tracheal trauma, risk of aspiration pneumonia and leakage of volatile anaesthetics.

Engbers., *et al*. [24] studied the use of V-Gels versus blind intubation with an endotracheal tube. The study showed that V-gels are rapid to place and cause minimal trauma to the upper airway. Although, both techniques effectively maintain general anaesthesia in rabbits, blind intubation technique may require multiple attempts, potentially contributing to laryngeal trauma and increased post-operative mortality. Varga [1] also noted how fast and easy v-gels are to use and how reliable they can be when used with capnography. However, v-gels can become dislodged easily if the patient is moved during the anaesthetic procedure which may not be tested in Laboratory studies. It is also worth noting that tongue cyanosis can occur if the v-gel compresses the tongue which can be rectified by gently moving the SGAD and confirming patency [1].

Disconnect ltd recommend that capnography is used to confirm correct placement of SGADs, several studies use capnography as a measure for placement, speed and efficiency of SGADs. Richardson [23] compared the use of endotracheal intubation to supraglottic devices in eight rabbits undergoing elective neutering. Richardson [23] noted how important capnography was during the induction of anaesthesia and used capnography as a tool to measure the rate success rate of intubation. Hypoventilation and subsequent hypercapnia are possible during any rabbit anaesthesia due to a number of factors: age, breed, anaesthetic drug effects. Engbers., *et al*.'s [24] study further supported the use of capnography as the presence of hypercapnia within the study underlines the importance of the option to provide IPPV and to confirm placement of SGADs or ETT. Varga [1] recognised this but also noted that placement can be confirmed by feeling breath at the end of the SGAD and the use of a pulse oximeter can confirm adequate cardiovascular function.

Although, SGADs have been specifically developed and well-researched in rabbits, there are some negatives. SGADs are initially expensive to stock a variety of sizes for cats and rabbits; it could be argued that as rabbits may not be seen in practice as much as canines and felines, then stocking a variety of sizes of SGADs may not benefit the practice.

Furthermore, findings in human medicine have shown an increased risk of gastro-oesophageal reflux and possible aspiration with the use of SGADs, gastric bloating is possible due to insufficient sealing of the glottis [32]. Further research is necessary in veterinary medicine to determine if the same applies to rabbits; veterinary professional should use caution and their own discretion when using SGADs.

Conclusion

To summarise, induction chambers, face masks, ETT tubes and SGADs all have their purpose in small animal practice. Any patient undergoing general anaesthesia should have a form of airway management to provide a patent and safe airway. Several studies have

shown staff safety concerns with induction chambers and facemasks, therefore, ETT and SGAD can be a safer and more reliable option. Facemasks and inductions chambers can be used for pre-oxygenation but inhalation anaesthesia should be avoided to prevent stress and injuries.

Although, ETT are notoriously known for being technically demanding to place in rabbits, with practice and time, ETT's can be a reliable and safe airway option. On the other hand, with the introduction of SGADs, veterinary professionals can now easily and reliably manage rabbit airways with minimal laryngeal problems. SGAD's may not replace ETTs but can provide a superior alternative to face masks and induction chambers.

It is essential that VS and VNs research and review airway management options for each patient and select an appropriate device each time, to allow for gold standard and holistic care.

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Volume 5 Issue 12 December 2020