RABBITS are commonly presented in practice and most practices will have experience at anaesthetising these patients. However, 1.39 per cent of rabbits die under anaesthesia, with most of these deaths due to cardiovascular problems. This compares to an anaesthetic death rate of 0.17 per cent in dogs and 0.00167 per cent in humans (Brodbelt, 2006).

Rabbits undergoing anaesthesia are often assumed to be healthy or having localised disease, but the rabbit may well be in a worse physical state than anticipated and it is worth reviewing the American Society of Anesthesiologists (ASA) physical status classification system, which was developed in 1963 (Table 1).

It is important to evaluate where each patient fits on this scale and many of the assumed healthy rabbits may well be a lower grade. Rabbits identified as grade one to grade two have a 0.73 per cent chance of an anaesthetic death, those of grade three to grade five have a 7.37 per cent chance of anaesthetic-related death (Brodbelt, 2006). Most rabbits undergoing anaesthesia are, in reality, grade two to grade four.

The highest risk period is recovery where 6.4 per cent of anaesthetic deaths occur, with 40 per cent of these being cardiorespiratory in nature (Brodbelt, 2006).

Rabbits are at higher risk for a variety of reasons.

- They are near obligate nasal breathers and open-mouth breathing is a poor prognostic indicator.
- Nasal and sinus disease is common, leading to respiratory compromise. This is particularly evident if the upper airway is blocked with purulent material, which can be easily identified on CT examination of the head (Figure 1).
- Rabbits also suffer from lower respiratory tract disease and cardiac disease.

Table 1: American Society of Anesthesiologists’ physical status classification
1. A normal healthy patient.
2. A patient with mild systemic disease.
3. A patient with severe systemic disease.
4. A patient with a previous systemic disease that is a constant threat to life.
5. A moribund patient who is not expected to survive without the operation.
6. A declared brain-dead patient whose organs are being removed for donor purposes.

They are also very good at hiding underlying pathology and illness.

Medetomidine and ketamine is the most commonly used protocol (59 per cent; Brodbelt, 2006) and rabbits may have the level of sedation deepened with isoflurane or sevoflurane by mask (Brodbelt, 2006; Figure 2). However, one of the most commonly reported adverse drug reactions in rabbits (to the VMDB in the UK) is due to medetomidine or dexmedetomidine and the effects reported were dyspnoea, tachypnoea, apnoea, bradycardia, cardiac arrest and death (Diesel, 2011). The use of medetomidine or dexmedetomidine did not appear to rise the risk of anaesthetic death over other agents in a survey undertaken in the UK (Brodbelt, 2006).

Measuring effective ventilation is much more important than oxygenation. When breathing 100 per cent oxygen, a pulse oximeter will register at least 97 per cent, which is the situation when breathing room air as well. Thus, for pulse oximetry values to fall, the end of the endotracheal tube is important to obtain reliable results (Rich, 1990; Figure 3). Pulse oximetry does not tell us anything about the effective ventilation of the patient. The equipment is also quite insensitive.

An example helps to identify the shortcomings of pulse oximetry. If you had a pulse oximeter attached to your finger and then held your breath it is likely you would become hypercapnic and have to breathe again before the pulse oximeter detected a fall in SPO2 levels. A capnograph, for example, would have immediately detected the breath-holding and the subsequent hypercapnia as a result. For this reason, the authors’ preferred option for anaesthetic monitoring is capnography. Capnography has superseded pulse oximetry and is far more sensitive and “real time”.

Capnography and pulse oximetry can be used on conscious patients, for example, to help in the clinical assessment of hypoxia and hypercapnia as well as murmur membrane colour is unreliable (Figure 4). However, no statistically significant relationship is found between SPO2 and SaO2, although there is between ETCO2 and PaCO2, but a wide range of ETCO2 values were observed for a given PaCO2 due to hypercapnia and rebreathing.

Capnography is totally reliable under anaesthesia although small dead space connectors and measuring close to the endotracheal tube is important to obtain reliable results (Rich, 1990; Figure 5). There is a diffusion gradient of about 5mmHg, which is found in human patients too (Evans, 1977). Capnography does require a secure airway and this can limit its usefulness if the rabbit is not intubated.

Pulse oximetry measures the oxygenation of the patient by the oxygen saturation of the haemoglobin molecules (SpO2). This correlates well with the arterial oxygen (PaO2) levels. Normal values should be 97 per cent or more. Caution is to be advised if alpha two agonists are utilised as poor peripheral perfusion can lead to improper functioning of the unit, as can skin pigmentation when it is placed on the ear. Probes can be difficult to attach on the ear in some of the smaller rabbits, but can be attached to the tongue (Figure 5) or inserted in the rectum avoiding any issues with pigmentation.

Pulse oximetry does not provide information on blood flow of the oxygenation of the rabbit’s tissues (which is the important objective). Many machines are manufactured for human use and are unable to detect heart rates faster than 250 beats per minute. Some machines can record rates up to 450 beats per minute and its very unlikely these rates would be exceeded in rabbits.

Most general practitioners in the UK do not use electronic monitoring for elective rabbit anaesthesia, even if it is present in the practice. The main reason for this appears to be uncertainty associated with interpreting ETCO2 or SpO2 values. It is of value to routinely set up a monitor on all elective procedures to get nurses and other clinical staff used to normal parameters, before their use in a non-elective procedure, where complication rates are considerably higher (Brodbelt, 2006).

Arterial blood gas analysis should be considered a part of the routine pre-operative and intraoperative evaluation of rabbits (Figure 6). This has been shown to be superior to capnography and pulse oximetry in evaluating acid base or electrolyte disturbances, ventilation and oxygenation in a variety of species. Capnography and pulse oximetry are used as non-invasive methods to give near real time results, but lack the accuracy of arterial blood gas analysis. Arterial blood gas analysis is simple to perform in the rabbit.

Arterial blood gas analysis is best used to evaluate the status of the patient over time. Samples are usually taken every 30 minutes to allow for processing and for remedial action to be taken and to evaluate its beneficial effects.

The main limiting factor is not taking the sample, or the cost and time in running a continued on page / 6
Anaesthesia Guidelines for Airway Management in Rabbits

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Near-patient test, but the initial overview involves an arterial blood gas analysis. However, increased availability of these units offered as part of package deals means blood gas analysis can be routine for many patients.

One of the parameters can be measured, but typically include: pH, PCO2, PO2, Na, K, O(2), ICI, Glucose, Ht and Hb.

From these, the HCO3, TCO2 base excess are typically automatically calculated. The dead space fraction, alveolar minute volume and arterial alveolar gradient can be calculated manually.

A number of techniques are employed to assist in the interpretation of blood gas analysis and the necessary remedial action to be taken (Foxall, 2008).

Mask induction with agents such as sevoflurane and isoflurane has been shown to cause marked breath-holding (up to three minutes) and anxiety, leading to failed attempts on many occasions. As a result, sevoflurane, despite its lower lipid solubility compared to isoflurane, does not lead to quicker inductions in rabbits (Flecknell, 1999).

Should mask induction be prolonged then pre-oxygenation of the rabbit for a few breaths first, before adding in the anaesthetic gas. One human study showed a marked improvement in oxygenation after four deep breaths of 100 per cent oxygen immediately prior to induction, one to two minutes is therefore excessive, excessive anxiety (Feuer, 1995).

Wrapping the rabbit in a towel is usually required. This is to help keep the rabbit warm and vocalisation (screaming) may occur. This breath-holding is still evident after premedication or use of sedatives, and additional physical restraint required to enable mask induction may be less, and therefore, some premedication is advised as a minimum (Flecknell, 1999).

Restraint must be secure as even in 100 per cent is used the noxious stimuli from the gaseous agent can still lead to aggression.

In one study, slowly increasing the percentage of anaesthetic gas (every 30 seconds) during induction, did not reduce induction time, nor did it reduce breath-holding, anxiety or struggling. This is a popular technique. The rabbits held their breath for between 30 and 180 seconds when a 100 per cent anaesthetic gas were being administered and started breathing once high concentrations were applied.

If this technique is to be employed then a potential solution would be to apply a low concentration for the first three minutes of induction, prior to incrementally increasing the concentration. Mask induction with isoflurane is usually at five per cent and sevoflurane eight per cent (due to its higher minimum alveolar concentration). Chamber induction leads to similar anxiety, with rabbits elevating their heads to the top of the chamber avoiding the agent, with subsequent struggling and breath-holding once forced to inhale for the anaesthetic gas.

Face masks should be tightly fitting with a membrane over the rabbit’s face. Clear masks allow the rabbit to be viewed during induction. There are face masks that allow for some scavenging of waste gases (either passive or active) to reduce environmental contamination. Great care should be taken to ensure the mask membrane does not rest on the corneal surfaces of the eyes. Rubber straps are available that fit over the head to improve the seal. If these are not available, a bandage tie can be placed around the eyes to prevent the rabbit from opening them. If pushed too far on to the nostrils if pushed too far on to the face.

Intubation

Only 29 per cent of rabbits are intubated in practice (Brodbelt, 2006). Rabbit intubation can be a tricky procedure and it takes time to master. Face mask anaesthesia has been shown to create clinically significant hypoxaemia and hypocapnia and is best avoided (Bateman, 1995). However, significant tracheal haemorrhage, haemoptysis and oedema can occur with poor intubation technique and respiratory arrest is a potential complication, or protracted failing attempts at intubation (Phaneuf, 2006; Grint, 2006). Many dental procedures are failing attempts at intubation occur (such as three) and the rabbit can be intubated in practice (Brodbelt, 2006; Flecknell, 1999).

Techniques such as nasal intubation have been described, but should ideally be abandoned. Chamber intubation is mastered (Delville, 2009).

Techniques such as nasal intubation have been described, but should ideally be abandoned. Chamber intubation is mastered (Delville, 2009). Direct visualisation of the larynx is best as this reduces the risk of tracheal trauma and allows the practitioner to evaluate the oropharynx for food material or foreign bodies.

Endoscopic intubation can also be performed. Essentially, the endotracheal tube is passed over the endoscope and then proximal tracheoscopy is performed with the endotracheal tube then slid off the endoscope. A similar technique involves the endoscope being used to visualise the oropharynx allowing accurate endotracheal tube placement. Blind intubation is also commonly performed. This technique can work well if the veterinarian is skilled in this procedure. Listening to breathing sounds compared to gurgling or swallowing noises guides the clinician to where the tube should be placed. However, visualisation is not possible and foreign bodies or trauma are possible. It is also difficult to ensure local anaesthesia has been achieved and can be seen as a v-shaped incision behind the soft palate. Flicking the soft palate up with the endotracheal tube will lead to breathing sounds being heard up the otoscope and the glottis can be directly visualised (Figure 8). Local anaesthetic (lidocaine) spray can be applied and flicked down the otoscope onto the glottis. The otoscope can be removed and the rabbit oxygenated while this takes effect. Cyanosis is common after the soft palate has been displaced as speed is important, as is oxygenation of the rabbit between attempts.

Some clinicians use an introducer, which is placed via the otoscope into the glottis. The otoscope or laryngoscope is then removed and a pre-measured endotracheal tube is passed over the introducer into the glottis. Suitable introducers can include urinary catheters, orogastric tubes (such as the Flecknell or a Wisconsin blade 0). A long oesophageal tube is used as an alternative by many clinicians (Figure 7). If it malfunctions or cannot be intubated, the endoscope can be autoclaved and used on another patient.

Perfect restraint is needed, although solo intubation is possible with practice. Most rabbits will give a cough response on intubation and many will be quite light by the time they are intubated and some tooth grinding is to be expected. A set time (for example, five minutes) or number of attempts at intubation (such as three) before giving up and resorting to intubating the rabbit, will reduce the risk of tracheal trauma, cyanosis and death.

In intubation, the anaesthesia can be directly visualised (Figure 8). Smoking and the placement of the glottis can be directly visualised (Figure 8). Smoking and the placement of the glottis can be directly visualised (Figure 8). Smoking and the placement of the glottis can be directly visualised (Figure 8).

When other authors prefer to intubate rabbits in dorsal recumbency allowing gravity to facilitate access to the glottis. There are two vascular pleurexies either side of the soft palate, which can be visualised easily. The epiglottis can be seen as a v-shaped incision behind the soft palate. Flicking the soft palate up with the endotracheal tube will lead to breathing sounds being heard up the otoscope and the glottis can be directly visualised (Figure 8). Local anaesthetic (lidocaine) spray can be applied and flicked down the otoscope onto the glottis. The otoscope can be removed and the rabbit oxygenated while this takes effect. Cyanosis is common after the soft palate has been displaced as speed is important, as is oxygenation of the rabbit between attempts.
Plastisol are chemicals added to plastics during manufacturing about the softness of the plastic. Spectrographic analysis of endotracheal tubes demonstrates that loss of plastisilier during cleaning with cold descaling agents (Crotat, 2012). This will result in material loss and increase in trauma risk.

Small bore PVC endotracheal tubes are remarkably clean. Given the potential for cross-infection, directly in the plastic polymers or with the oxygen used to establish the airway. However, it is significantly reduced to essential to create the mouth to establish the airway and to ensure that no fuel material is present. Correct insertion is best checked using a caproscopic analysis of CO2 (Figure 13). They are generally much easier to use than an endotracheal tube, but correct use is still vital to avoid problems. The v-gel device defies the soft palate of the rabbit, so it is not be used on the opposite side of the oral cavity. The v-gel is recommended to be used in a secure airway (Figure 15).

Capnography is recommended. Firstly, as an indicator of a secure airway and secondly, to identify any endotracheal tube when intubated in the airway. The purpose of the v-gel device is that the airway is not obstructed by a foreign body, and the airway is therefore free from obstruction.

Supraglottic devices engage into the pharynx and provide an airway without touching the larynx or trachea. They are usually in human anaesthesia as they offer easy insertion without trauma to the larynx, so allowing recovery without throat pain, soreness or loss of voice (Keijzer et al., 2009).

As supraglottic devices are designed for human use in various veterinary systems, they are usually be used to evaluate the ETCO2 levels. Most clinicians do not use a ventilator, and airway management methods, such as supraglottic airway devices (see below), which do not narrow the airway, may be more appropriate for this species. It is essential to properly sterilise any airway device before use to prevent cross-infection with pathogenic oral or nasopharyngeal bacteria. Small bore endotracheal tubes are very difficult to clean properly and great care must be taken to rinse the inner surfaces of the tube thoroughly, otherwise airway resistance is increased and there is a risk of ingesting plugs of dried mucus or potentially irritating cleaning chemicals. Tracheal stenosis is a possible complication that can occur within 10 days (Figure 11).

V-gel supraglottic airway devices are designed for easy-insertion in a few seconds and ensure a smooth path through the airway. However, it is still essential to check the mouth for any foreign bodies before intubation to ensure that no material is present. Correct insertion is best checked using a caproscopic analysis of CO2 (Figure 13). They are generally much easier to use than an endotracheal tube, but correct use is still vital to avoid problems. The v-gel device defies the soft palate of the rabbit, so it is not be used on the opposite side of the oral cavity. The v-gel is recommended to be used in a secure airway (Figure 15).

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Most intubation procedures carry significantly higher risks of upper airway trauma, laryngeal spasm and trauma to the odontoid process of the atlas. However, if a clinician is skilled in this technique, it is worthwhile to learn one of the techniques allowing direct visualisation of the larynx, as these will reduce the risk of iatrogenic trauma.

Various airway management products are available for rabbits. Although face masks are easy to use, they will leak significant amounts of volatile anaesthetic, increasing staff exposure, will often cause breath-holding and reduce ventilation and give an unreliable airway seal. With training and experience endotracheal tubes can be relatively simple to place. However, the use of small diameter endotracheal tubes presents another problem. There is an inverse power to the fourth relationship between airway diameter and airway resistance. In other words, halving airway diameter will increase airway resistance by a factor of 16.

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