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This review accompanies the relevant episode of the Cutting Edge veterinary podcast. In each episode of this podcast, 3rd year students in the University of Calgary's veterinary medicine program fill you in on the most up-to-date literature and evidence-based practices on topics that matter to you, the practising veterinarian.

Options For Airway Management and Their Application to Different Species

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Airway management is critical during anesthesia. It allows for delivery of oxygen and anesthetic gasses, as well as the removal of carbon dioxide.[1] It is also critical for minimizing the risk of aspiration which can potentially lead to aspiration pneumonia, a serious complication that often requires intensive care. While endotracheal intubation is often considered the gold standard for airway management, it is not always practical. It can be challenging in the field[1], when performing oropharyngeal surgery[2] or when performing anesthesia in species with challenging upper respiratory anatomy, such as rabbits.[3] As a result, clinicians often resort to an airway unsupported or facemask approach. This presentation compares unsupported airways, endotracheal intubation, facemasks, laryngeal mask airways, laryngeal tube airways and other supraglottic airway devices such as the v-gel.

In an airway unsupported approach, the patient breathes through an unchanged airway. This is commonly employed in field anesthetics.[1] While it has the advantages of not requiring any special equipment, skill, or training, it also has numerous disadvantages. Volatile anesthetics cannot be used for maintenance, and intermittent positive-pressure ventilation (IPPV) cannot be provided should the patient stop breathing spontaneously. It also carries an increased risk of aspiration and airway obstruction.[1] Because of this, patient positioning is important (especially in ruminants). Dorsal recumbency should be avoided and the tip of the snout should be positioned below the larynx.[1] With the numerous risks and drawbacks of an unsupported airway, it is important to consider alternative methods for airway support during field anesthetics.

Endotracheal intubation is typically considered the "gold standard" for airway management. Most commonly, orotracheal intubation is performed by passing an endotracheal tube through the mouth and larynx, into the trachea. This is the most common method used in mammals[2] and has been used successfully in a variety of species, including wildlife species such as American Black Bears.[4] Orotracheal intubation provides the best airway control, with the ability to provide IPPV and the greatest protection against aspiration due to its inflatable cuff.[1] Unfortunately, there are many situations where orotracheal intubation is challenging, including in field anesthetics (especially if veterinarians are not present),[5] in species with unique upper

airway anatomy (such as rabbits)[3] or in species where it is difficult to visualize the larynx (such as pigs).[6] In addition, it is time consuming and requires trained personnel and specialized equipment (such as laryngoscopes).[6] There are also many complications that can occur with endotracheal intubation including laryngeal trauma,[7] laryngospasm,[6,7] laryngeal edema,[8] tracheal damage or perforation,[7,8,9] arytenoid tears,[8,9] tracheal stenosis[10] and tracheal strictures.[8] These complications are especially common in certain species such as cats, rabbits and birds.

An alternative method of endotracheal intubation to consider is nasotracheal intubation. In this method, an endotracheal tube of decreased diameter is passed through the ventral meatus while the head is extended and is passed into the trachea.[2] Its use was reported by Bauquier and Golder[2] in a Red Kangaroo with jaw pathology that interfered with the opening of its mouth. It can be used as an alternative to orotracheal intubation in cases where the patient is undergoing oropharyngeal surgery, the patient's mouth cannot be opened, or it is hard to visualize the larynx. While it is beneficial for providing a controlled airway in cases where orotracheal intubation may be difficult, it is also associated with complications such as epistaxis, damage to nasal cavity and submucosal dissection. It is also associated with increased airway resistance due to the requirement of decreased tube diameter.

In cases where endotracheal intubation is not practical, supraglottic airway devices (SGADs) should be considered. These devices sit at or above the glottis to provide airway control,[1] and include facemasks, laryngeal mask airways, laryngeal tube airways and species-specific alternatives such as the v-gel. While these devices still carry a risk of airway obstruction or aspiration, they provide better control than an unsupported airway.[1]

Facemasks are commonly used when endotracheal intubation is difficult or fails in species such as rabbits[7] and great apes,[11] and can also be used for induction in small species.[1] They are easy to place and do not require any training to do so. They can also be used in a wide variety of species, as home-made versions can be created to fit a wide variety of facial conformations. During maintenance, they can provide effective alveolar ventilation in patients breathing spontaneously[7] and can sometimes be used to provide IPPV.[1] While they are often used successfully during anesthetic maintenance, this is not recommended[1] as there is a risk of airway obstruction and no protection of the airway.[7] In addition, they often seal to the face poorly leading to a large amount of dead space, inhalation of room air, environmental pollution with volatiles, and ineffective IPPV. IPPV also carries a risk of gastric tympany, as air can enter the esophagus.[1] While this method is commonly reached for, studies in rabbits show it often leads to inadequate ventilation.[12]

The next device to consider is the laryngeal mask airway (LMA). This device, designed for humans, is like a hybrid between a mask and endotracheal tube, with an inflatable cuff that sits over the larynx attached to a tube exiting the oral cavity[5]. Its use has been evaluated in a wide variety of species, including but not limited to cats, dogs,[13] rabbits,[3] pigs,[6] sheep,[13] calves,[5] gorillas,[11] chimpanzees, gibbons,[14] capybaras[15] and bighorn sheep.[21] The LMA can be placed more easily,[5] faster and more reliably by inexperienced users than endotracheal tubes.[11] In addition, it does not require any special equipment for placement[10] and can be placed at a lighter depth of anesthesia than an endotracheal tube.[6,13] It is especially useful in cases where the larynx is hard to visualize[5] or when concerned about airway trauma, as they generally cause less airway trauma than an endotracheal tube.[14] They have numerous advantages over

facemasks, as they have less dead space,[10] can be used to provide IPPV[5] and provide some protection of the airway. While the LMA has many advantages, it is not without its disadvantages. As it is designed for humans, its use in veterinary species can lead to leakage or volatiles, as well as laryngeal or pharyngeal trauma.[5] There are also numerous complications reported in rabbits, such as lingual cyanosis, gastric tympany and an incomplete airway seal.[12] It also carries a risk of being dislodged during use,[14] potentially compromising airway support. While it is superior to facemasks in terms of airway protection and ability to provide IPPV, it provides inferior airway protection to the endotracheal tube[11] (and thus carries a risk of aspiration) and cannot be used to provide IPPV at pressures > 20 cm H_2O as leaking occurs at lower pressures than endotracheal tubes.[14]

Another alternative is the laryngeal tube airway. This is an angled airway tube with a small distal esophageal cuff, large proximal pharyngeal cuff and ventilation holes to direct air through the larynx.[17] This allows for sealing of both the esophageal inlet (via the esophageal cuff) and the pharyngeal cavity (via the pharyngeal cuff). While its use has not been as widespread as the LMA, it has been used successfully in rabbits and pigs.[17] It is easier to place than the endotracheal tube, and can be easily placed by those without experience.[17] There are several reported advantages over the LMA, including easier placement, provision of an airtight seal and potentially decreased risk of gastroesophageal regurgitation due to the esophageal cuff.[17] However, like the LMA, it was designed for humans, meaning it does not always conform well to the airways of veterinary species. In addition, the airway protection it provides is inferior to that of the endotracheal tube.[17] A study by Birkholz et al.[17] found that placement of the laryngeal tube airway was twice as slow as the LMA. In humans, there are reports of complications such as laryngospasm, sore throat, and dysphagia.[17] This device has shown promise in the species it has been evaluated in. Further research is warranted into its use in other species.

The last device we will discuss is the v-gel. This is a species-specific SGAD manufactured by Docsinnovent. Unlike the human designed LMA and laryngeal tube airway, this device was designed specifically for veterinary species, with a model for cats and rabbits as well as a model for dogs. The v-gel works much like the LMA but provides a non-inflatable seal over the larynx. Much like the LMA, it has numerous advantages over endotracheal intubation, including more rapid insertion (including by inexperienced users),[12] ability to place at a lower anesthetic depth,[12,18-20] less trauma to the airway,[12] lack of special equipment needed for placement[21] and in cats, less stridor[9] and upper airway discomfort on recovery.[19] They can also be used to provide IPPV up to 16 cm H_2O[20] and some studies show evidence of lower leakage than from endotracheal tubes.[19,20] Unlike the LMA, the canine v-gel has a built-in channel allowing for placement of a gastric tube, improving protection from regurgitation. One major potential barrier for the use of these devices is the importance of monitoring with capnography. As these devices have an increased risk of dislodging and potential subsequent obstruction of the airway, it is critical to use capnography to monitor their placement.[18] Studies showed these devices frequently needed to be repositioned during anesthesia.[21] In addition, as the trachea is not sealed, there is an increased risk of aspiration, especially in patients undergoing dental procedures or at an increased risk of gastro-esophageal reflux.[18]

Airway management is critically important for providing anesthetic gas and oxygen, for removing carbon dioxide and for minimizing the risk of complications such as aspiration.

However, it is not always easy. Endotracheal intubation (the gold standard) can be challenging during field anesthetics and anesthesia of non-traditional species and is not without its risks of complications. While clinicians often reach for facemasks or an unsupported approach when intubation is too difficult, these both carry an increased risk of aspiration and airway obstruction, and neither allow for IPPV to be provided should the patient stop spontaneously ventilating. Due to these risks, it is important to consider alternative methods such as nasotracheal intubation, laryngeal mask or laryngeal tube airways, and species-specific supra-glottic airway devices such as the v-gel. When deciding which approach to use, it is important to consider the advantages and disadvantages of each device to determine which will work best for the patient based on the resources available.

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