Marie Rippingale BSc (Hons), REVN, G-SQP, DipHE CVN, DipAVN (Equine)

Marie obtained a First Class Honours Degree in Equine Sports Science in 2005. Marie has worked at Scarsdale Vets in Derby since 2003 and qualified as an REVN with merit in 2007. In 2012, Marie completed the Diploma in Higher Education Clinical Veterinary Nursing (Dip HE CVN) and obtained the RCVS Diploma in Advanced Veterinary Nursing (Dip AVN) in equine context, with distinction. Marie has been lecturing on the Veterinary Nursing Diploma course since 2010 at Bottle Green Training in Melbourne. Marie has had articles published in a number of veterinary journals including *The Veterinary Nurse* and *Veterinary Practice Today.* Marie's special interests include foal nursing, bandaging, radiography, anaesthesia and intravenous catheter care.

Email: mariediddles@gmail.com

General anaesthetic risks in horses – what evidence is available, and what can Registered Veterinary Nurses do to help?

Marie Rippingale BSc (Hons), REVN, G-SQP, DipHE CVN, DipAVN (Equine)

Scarsdale Vets, Markeaton Lane, Markeaton, Derby DE22 4NH, UK

ABSTRACT: The risk of mortality or serious morbidity is particularly high in horses undergoing general anaesthesia (GA). GA is unfortunately generally not something that Registered Veterinary Nurses (RVNs) have a lot of involvement with in equine practice. This is a shame, as certain risk factors for equine patients undergoing GA have been identified by a series of studies known as The Confidential Enquiry into Perioperative Equine Fatalities (CEPEF 1–3) (2002–2004). RVNs are in a unique position to use the information gained from the CEPEF studies to improve the welfare of their patients.

Introduction

The risk of mortality or serious morbidity is particularly high in horses undergoing general anaesthesia (GA) (Taylor & Clarke, 2007). GA is unfortunately generally not something that Registered Veterinary Nurses (RVNs) have a lot of involvement with in equine practice. This is a shame, as certain risk factors for equine patients undergoing GA have been identified by a series of studies known as The Confidential Enquiry into Perioperative Equine Fatalities (CEPEF 1–3) (2002–2004). RVNs are in a unique position to use the information gained from the CEPEF studies to improve the welfare of their patients. The Royal College of Veterinary Surgeons (RCVS) equine practice standards scheme dictates that all anaesthetics and anaesthetic recoveries must be induced and maintained by a Member of the Royal College of Veterinary Surgeons (MRCVS) (RCVS, 2015). However, RVNs can have an important role in assisting and supporting the MRCVS performing the GA, and this could help to reduce the mortality risk to equine patients and improve the standards of care.

Anaesthetic risks in horses

It has been suggested following the results of the CEPEF studies that horses usually have a high risk of mortality as a result of undergoing GA when compared to other species. Records of 41,787 operations under GA were submitted by 149 clinics from 19 countries from 1991 to 1996. The total mortality from perioperative complications was 1.9%. This is in comparison to mortality rates reported for humans, cats and dogs undergoing GA a < 1% (Johnston, 2005). CEPEF reported the death rate in the 35,927 non-colic operations was 0.9%, and in 5833 colic operations was 7.9%. Twenty-two different causes of death were identified in non-colic operations, of which the most common were cardiac arrest (32.8%), fracture (23.3%) and post-anaesthetic myopathy (PAM) (7.1%).

DOI: 10.1080/17415349.2016.1251367

Cardiac arrest

The most frequent cause of death in all horses in the CEPEF study, intraoperative cardiac arrest (0.33%), was examined in greater detail in non-colic operations. In particular, after adjusting for other variables, there was a marked decrease in risk when acepromazine alone or acepromazine and an alpha2 agonist were used for premedication (Johnston, 2005). The actions and side effects associated with these drugs are summarised in **Table 1**. It would therefore seem logical as an RVN to ensure that an alpha2 and acepromazine are included in the anaesthetic protocol for equine patients. RVNs should assist the MRCVS in putting the anaesthetic protocol together, as this will contribute towards the best anaesthetic experience for the patients. Indeed, combining drugs classes such as these has been recognised for some time as being more effective than using one single drug class on its own. This technique is known as multimodal anaesthesia and should also include analgesic drugs to have the most beneficial effect for the patient (Murrell & Ford-Fennah, 2012). Reducing pain and therefore stress in equine patients could also reduce the risk of catecholamines being released, which can have an arrhythmagenic effect on the heart. This could further reduce the risk of cardiac arrest in equine patients undergoing GA. Good equine handling techniques, e.g. calming the patient and making them feel at ease, would also be of utmost importance before GA is induced.

The CEPEF study also found a marked increase in risk for patients that were anaesthetised using inhalational induction. An additional finding was that total inhalational anaesthesia (i.e. when inhalational induction was followed by inhalational maintenance, as is sometimes used in foals) was associated with a nearly threefold increase in the death rate compared with patients receiving intravenous (IV) induction followed by inhalational maintenance (Johnston, 2005). There was also a significant reduction in the number of patients that died from a cardiac arrest whose anaesthesia was maintained using IV maintenance. One way of maintaining GA with IV agents in the horse is to use the "triple drip". This involves administering a combination of an alpha2 agonist, usually xylazine or detomidine, with guaiphenesin and ketamine. This technique still requires oxygen supplementation as respiratory depression may still occur (Taylor & Clarke, 2007). The "triple drip" should be restricted to procedures lasting less than 2 hours, as beyond this, the guaiphenesin accumulates, leading to an ataxic recovery. The RVN would need to consult with the case vet to weigh up the merits of reducing the risk of cardiac arrest against potentially causing undesirable effects in recovery, before the method of maintenance is decided upon.

Fractures during the recovery stage

It is worth noting that post-operative fractures represented nearly one-quarter (23.3%) of all deaths in the CEPEF study, and that these fractures were not restricted to patients undergoing fracture repair (Johnston, 2005). Many horses attempt to rise prematurely in the recovery period, particularly if stimulated by pain or extraneous noise, and occasionally these patients succumb to limb fractures, especially if recovery is violent or uncoordinated (Flaherty, Nolan, & Reid, 2005). Sedation with an alpha2 agonist will delay recovery from anaesthesia and is widely used to reduce the risk of fractures in equine patients recovering from a GA (Murrell & Ford-Fennah, 2012). This is something that an RVN must consider when assisting the MRCVS to plan a recovery protocol for horses.

Assisted recoveries can be used to attempt to reduce the risk of fractures occurring during recovery from GA in horses. Some control is essential after major orthopaedic surgery, where the surgical repair can be fatally ruined by one false or uncoordinated move (Taylor & Clarke, 2007). A rope recovery system using head and tail ropes pulled through rings high in the wall is most commonly used. This system allows assistance to be given in lifting the horse without risk of injury to human handlers as they remain safely outside the recovery box (Taylor & Clarke, 2007). The tail rope must be under maximum tension when the horse is lying down. When the horse starts to stand, the assistant helps to lift the hindquarters by pulling on the tail rope. The head is controlled but not pulled up. Once the horse is standing, both head and tail ropes should stabilise the horse and support it against the wall of the recovery box until it can stand unaided, without any ataxia (Taylor & Clarke, 2007).

The assisted recovery technique is becoming more commonly practiced within the equine industry. Wohlfender et al. (2015) found that 40% of equine vets who took part in a survey mentioned that they routinely applied assisted recovery techniques when recovering horses from GA, while 31.5% reported to use this method in selected case scenarios only and 28.5% reported they did not assist recovery at all. Among the selected cases mentioned were: horses after fracture repair, other orthopaedic procedures and emergency colic surgery. This suggests that the RVN should consider the use of assisted recovery in high-risk patients as well as all

Table 1. Actions and side effects of alpha2s and phenothiazines (Murrell & Ford-Fennah, 2012)

Class of agent	Mechanism of action	Clinical effects	Side effects	Metabolism
Alpha2-Agonists, e.g. detomidine, romifidine, xylazine	• Activation of alpha2 adrenoceptors in the CNS. • Analgesia is mediated by action at central and peripheral adrenoreceptors.	• Potent sedation. • Muscle relaxation. • Analgesia.	• Initial hypertension followed by normotension. • Bradycardia. • Respiratory system depression • Sweating • Ataxia.	Liver metabolism and renal excretion.
Phenothiazines, e.g. acepromazine maleate	• Dopamine antagonist. • Inhibition of catecholamine activity in the CNS.	• Calming. • Anti-arrhythmic. • Antihistamine.	• Hypotension. • Hypothermia. • Penile protrusion. • Use reduced doses in foals and animals with liver dysfunction/cardiovascular compromise.	Liver metabolism and renal excretion

other patients if the time and the facilities will allow. This decision would be made in consultation with the MRCVS in charge of the anaesthetic.

PAM

PAM was found to be the third most common cause of mortality after GA in the CEPEF studies at 7.1%. PAM is thought to result from inadequate perfusion of muscle tissue under GA, which then causes ischaemic muscle damage (Murrell & Ford-Fennah, 2012). Clinical signs include:

- Stiffness and pain on walking.
- Hard, painful, swollen muscles, usually in the gluteal area.
- Persistent recumbency.
- Serum biochemistry demonstrates elevated levels of lactate, creatine kinase and aspartate aminotransferase.
- Myogloburia.

(Murrell & Ford-Fennah, 2012)

Johnston (2005) reported that the duration of operation (patients undergoing operations lasting > 90 mins were 10 times more likely to develop myopathy) and lateral body position were both significantly associated with increased risk of PAM. There are a number of things the RVN can proactively do to help to reduce the risk of PAM in equine patients. To try to reduce anaesthetic time and ideally keep it under 90 minutes, the surgery site can be clipped and prepared with the patient standing, in the preparation area, before GA is induced. Positioning is also very important and this is something that the RVN can get really get involved with and perfect for the patients in their care (**Figure 1**):

- The horse should be placed on the operating table in a position that does not put any part of the body under strain.
- Limbs should be allowed to settle naturally and be secured without force.
- In lateral recumbency the dependant limb should be pulled forwards to take the pressure off the lower triceps.
- Padding cannot reduce the weight of the horse, but it can help to spread the load over as large an area of the body surface as possible. This will help to reduce the pressure at any one site.
- The padding needs to be deep enough to prevent the body pressing down on the table at any point.
- Good padding can be achieved with a mattress and thick, foam-sealed, waterproof covers.
- Air mattresses must not be fully inflated when in use as they become hard and will not support a large area.

(Taylor & Clarke, 2007)

Preventing hypotension is also important and this can be achieved by following three approaches: reducing the amount of volatile agent used, ensuring adequate fluid infusion during the anaesthetic and using inotropes such as dobutamine (Taylor & Clarke, 2007). Monitoring of arterial blood pressure (ABP) of equine patients undergoing GA is of the utmost importance in the prevention of PAM. ABP provides invaluable information about perfusion and the depth of anaesthesia. Mean ABP should be maintained at or above 70 mmHg and is most accurately measured using the direct monitoring technique, where a catheter is inserted

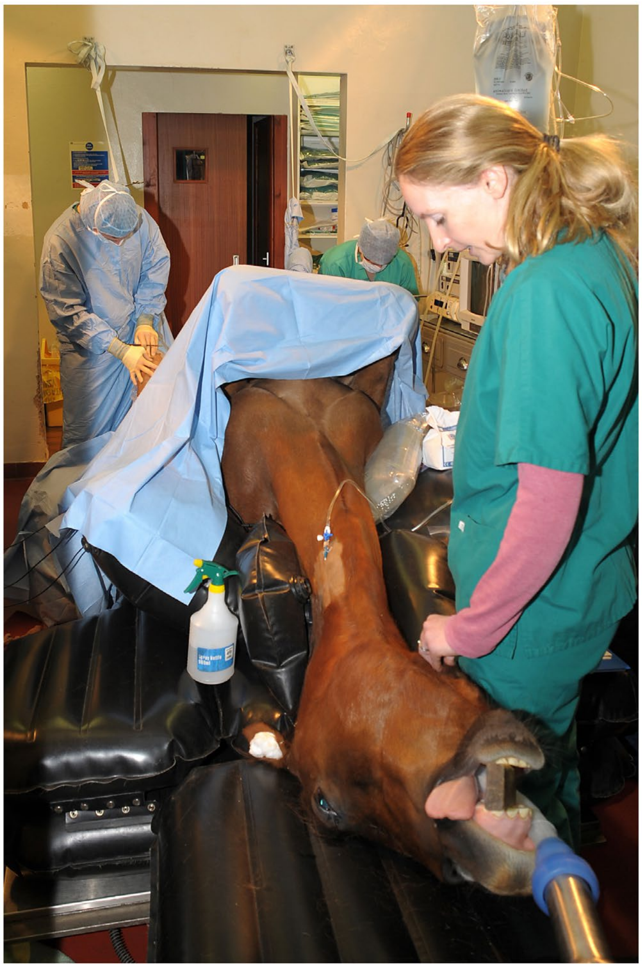

Figure 1. RVNs can get involved with the correct positioning for equine patients under GA. This can help to reduce post anaesthetic complications

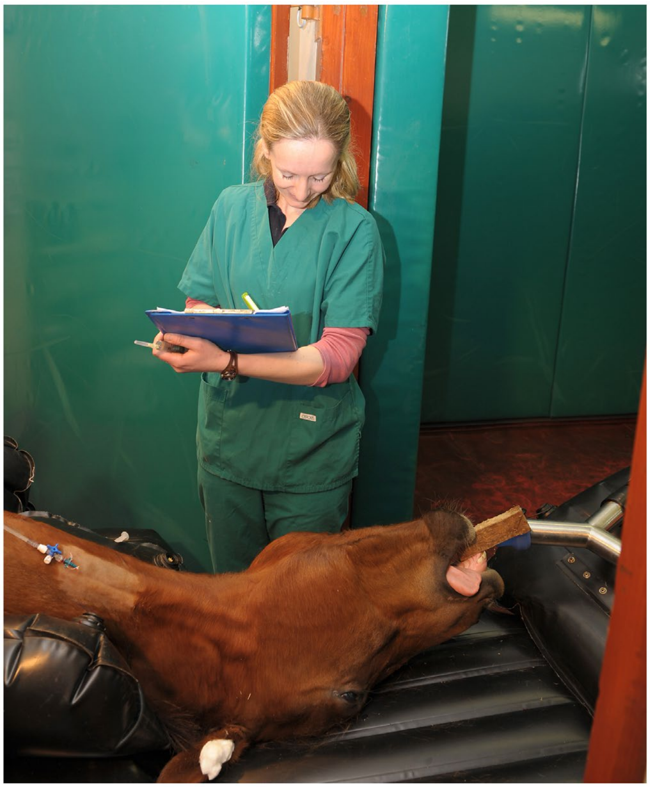

Figure 2. RVNs can assist an MRCVS with taking readings from the patient during the GA. Any readings taken must be recorded correctly on the anaesthetic chart

into an artery (Taylor & Clarke, 2007). The RVN could take on the role of checking and preparing the blood pressure monitor, clipping and scrubbing the catheter site (aseptic precautions are required) and, ideally, placing the arterial catheter themselves. The blood pressure can then be monitored by the RVN throughout the GA and progress can be communicated to the MRCVS performing and monitoring the anaesthetic.

The importance of palpating the pulse should not be overlooked, however. Although this cannot provide direct measurements regarding peripheral perfusion, pulse quality does provide some information regarding peripheral circulation and, indirectly, about cardiac contractility (Taylor & Clarke, 2007). The pulse should be palpated every 5 minutes, although ideally the RVN could palpate the pulse continuously throughout the GA and relay information and readings back to the MRCVS conducting the anaesthetic. Any readings taken should be recorded on the anaesthetic chart (**Figure 2**).

Conclusion

Horses are high-risk candidates for GA, and there are specific areas highlighted by the CEPEF studies which warrant particular focus. Although anaesthesia and recovery must be induced and monitored by an MRCVS, review and application of correct GA drugs protocols, recovery techniques, proactive preparation of equipment and stringent monitoring techniques can all be adopted by RVNs in order for them to take ownership and responsibility for patient safety along with the MRCVS in charge of the anaesthetic and recovery. This will contribute to reducing risk factors for horses undergoing GA. The current CEPEF studies (1–3) can be used as an evidence base to guide preventative strategies until the much-anticipated arrival of CEPEF 4 in the hopefully not too distant future.

References

Flaherty, D., Nolan, A., & Reid, J. (2005). Complications during recovery from anaesthesia in the equine patient. *Equine Veterinary Education, 7*, 53–59.

Johnston, G. M. (2005). Findings from the CEPEF epidemiological studies into equine perioperative complications. *Equine Veterinary Education, 7*, 64–68.

Murrell, J. C., & Ford-Fennah, V. (2012). Anaesthesia. In K. Coumbe (Ed.), *Equine veterinary nursing* (2nd ed. pp. 433–457). West Sussex: Wiley.

RCVS. (2015). *Practice standards scheme: Equine*. Retrieved August 27, 2016, from http://www.rcvs.org.uk/document-library/draft-pss-equine-modules

Taylor, P. M., & Clarke, K. W. (2007). *Handbook of equine anaesthesia* (2nd ed.). Philadelphia, PA: Saunders Elsevier.

Wohlfender, F. D., Doherr, M. G., Driessen, B., Hartnack, S., Johnston, G. M., & Bettschart-Wolfensberger, R. (2015). International online survey to assess current practice in equine anaesthesia. *Equine Veterinary Journal, 47*, 65–71.