General anaesthetic risks in horses: an update

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ABSTRACT: The Confidential Enquiry into Perioperative Equine Fatalities (CEPEF 1–3) identified certain risk factors for equine patients undergoing general anaesthetic (GA). There have since been significant changes made to equine anaesthetic practice which has prompted a further study CEPEF 4. Although anaesthetic protocols have advanced since the first study, the mortality rates for horses undergoing elective procedures has remained at 0.9%. The RVN can be essential in implementing safety protocols by introducing recovery techniques, surgical safety checklists, stringent monitoring techniques and ensuring that knowledge of CRIS is adopted and implemented.

Keywords: general anaesthetic; anaesthetic risk; fatalities; equine; safety protocols

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Introduction

The Confidential Enquiry into Perioperative Equine Fatalities (CEPEF 1–3) identified certain risk factors for equine patients undergoing general anaesthetic (GA). Since the original CEPEF studies 1–3 were carried out, significant changes have been made to equine anaesthetic practice (Dugdale & Taylor, 2016). This led to plans for further study, and the results of CEPEF 4 are eagerly awaited. Until those results become available, it is appropriate to review the mortality associated with equine GA, and to discuss the developments that have occurred within the two decades since the first CEPEF reports (Dugdale & Taylor, 2016). This article will look at current research into the risks posed to equine patients in relation to GA. The results of this research can be used by Registered Veterinary Nurses (RVNs) when assisting Veterinary Surgeons (VS) to perform and monitor GA, to help to reduce the mortality risk to equine patients and improve the standards of care.

Mortality risk

The CEPEF studies identified the mortality risk for healthy horses undergoing elective procedures as being 0.9%. In a smaller, more recent study Dugdale, Obhrai, and Cripps (2016) demonstrated that the mortality rate for horses undergoing elective procedures remained at 0.9%. Veterinary anaesthesia has advanced considerably over the past 50 years, it is therefore unsettling to see that the relative risk to equine patients has not followed suit (Hopster, 2018). Reasons for this apparent lack of reduction in risk can be attributed to variation between the different studies investigating anaesthetic risk in horses and little consistency in data recording or inclusion/exclusion criteria between the different studies (Hopster, 2018).

Efforts to reduce anaesthetic risk in horses undergoing GA have included better monitoring techniques, the development and widespread adoption of practice guidelines, and other systemic approaches to error reduction (Hopster, 2018). It has been suggested that these improvements have been offset by the development of more complicated and risky surgeries, and that this can explain the lack of reduction in GA risk over the years (Hopster, 2018). Whatever the reason for the apparent lack of reduction in anaesthetic risk, it is clear that there is still a significant role for RVNs to play in reducing the risk of GA to equine patients.

Cardiac arrest

The most frequent cause of death in all horses in the CEPEF studies, intraoperative cardiac arrest (0.33%). Deaths caused by intraoperative cardiac arrest reported in the CEPEF studies, occurred within the first 30 minutes of the anaesthetic period (Dugdale & Taylor, 2016). This was considered to be a result of halothane-induced myocardial sensitisation to catecholamines, which may increase the risk for arrhythmias. Halothane was the most commonly

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used agent in other studies that investigated anaesthetic risk at that time, and this may have influenced the occurrence of adverse intraoperative cardiac events (Dugdale & Taylor, 2016).

In CEPEF 3, overall mortality did not differ between patients anaesthetised with halothane or isoflurane. However, fewer cardiac arrests occurred, especially in high risk cases, when anaesthesia was maintained with isoflurane (Dugdale & Taylor, 2016). It would seem that intraoperative cardiac arrest, although still a considerable risk, may be less frequent now that isoflurane is used more commonly than halothane as an anaesthetic agent.

In the CEPEF studies, there was a marked decrease in risk for cardiac arrest 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. RVNs should assist the VS 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 arrhythmogenic 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.

Fractures during the recovery stage

Post-operative fractures represented nearly one quarter (23.3%) of all deaths in the CEPEF study, and these fractures were not restricted to patients undergoing fracture repair (Johnston, 2005). In more recent research, fractures have been described as responsible for 26–64% of all anaesthetic related fatalities, making catastrophic fractures the greatest cause of recovery associated mortality (Dugdale & Taylor, 2016). Horses undergoing fracture fixation are considered greater risk for sustaining further fractures in recovery. However, such patients only made up a small proportion of the caseload in recent reports. The use of assisted recovery may have an effect on the incidence of fractures in recovery.

Bidwell, Bramlage, and Rood (2007) reported the lowest incidence of mortality (8 out of 17,961 cases, 0.04%) employed assisted recovery for the majority of their cases. Bidwell et al. (2007) concluded that assisted recovery cannot guarantee success, however Wilderjans (2005) reported no fractures in over 7000 non-fracture repair surgeries. Whether rope assisted recovery systems can reduce the incidence of fracture remains to be proven (Kaestner, 2010). However, the RVN should consider the use of assisted recovery in high risk patients, as well as all other patients if the time and the facilities will allow. This decision would be made in consultation with the VS in charge of the anaesthetic. 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 should also consider when assisting the VS to plan a recovery protocol for horses.

Post anaesthetic myopathy

Post Anaesthetic Myopathy (PAM) was found to be the third most common cause of mortality after GA in the CEPEF studies at 7.1%. In more recent studies, PAM was still found to be a significant cause of mortality (Bidwell et al., 2007). PAM is thought to result from inadequate perfusion of muscle tissue under GA, which then causes ischaemic muscle damage (Murrell & Ford-Fennah, 2012).

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 important and this is something that the RVN can get really get involved with and perfect for the patients in their care:

- 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.

(Taylor & Clarke, 2007).

Monitoring of arterial blood pressure (ABP) of equine patients undergoing GA is of 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 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, place the arterial

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

catheter. The blood pressure can then be monitored by the RVN throughout the GA, and progress communicated to the VS in charge of the anaesthetic.

Surgery safety checklists

Surgical safety checklists have been used routinely in human medicine for at least 20 years, and there is strong evidence that checklists reduce complication rates in human patients (McMillan, 2014). Checklists are cognitive aids, designed to protect against human error in the areas of memory and attention, and are often completed by the surgeon, the anaesthetist and a nurse. This involves a combination of key staff in the process, which helps to reduce the chance or errors being made. RVNs are in an ideal position to create tailored checklists, designed specifically for the individual practice, caseload and patients. RVNs can them take on responsibility for the use of the checklist, and this would help to reduce risk to patients undergoing GA.

Critical incidence reporting systems

Critical incidence reporting systems (CIRS) refer to the structured, collation and analysis of incidents (Hopster, 2018). These incident investigations can be performed systematically and can also lead to the development of risk grading techniques. CIRS allow the determination of the impact of an incident, and categorically define what constitutes a minor event progressing up to a serious event. It is important to report critical events, even if the patient was not harmed. This seems counter intuitive as commonly most focus is put on those incidents that actually cause harm or death. The rationale behind this comes from an observation of 550,000 accidents, where it was concluded that for every accident that causes a major injury, there are 29 accidents that cause minor injuries, and 300 accidents that cause no injuries (Hartnack et al., 2013). Therefore, it is much more likely that a precursor of a harmful event will be detected, than the actual harmful event itself (Hartnack et al., 2013). This has obvious implications for patient safety. RVNs are in a good position to get involved with managing CIRS. They spend the majority of their time at the practice, and therefore could take on an overseeing role, identifying incidents that should be reported. They could also be involved with creating and implementing new protocols to improve patient safety.

Conclusion

Horses are high risk candidates for GA, and there are specific areas highlighted by the CEPEF studies, and recent research which warrant particular focus. Although anaesthesia and recovery must be induced and monitored by a VS, review and application of correct GA drugs protocols, recovery techniques, surgical safety checklists, stringent monitoring techniques, and knowledge of CRIS can all be adopted and implemented by RVNs. This will contribute to reducing risk factors for horses undergoing GA.

Disclosure statement

No potential conflict of interest was reported by the author.

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