How to Use Sevoflurane Anesthesia in Horses

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Sevoflurane is a newer inhalant anesthetic characterized by cardiovascular stability similar to isoflurane but which produces smoother recoveries than are seen with isoflurane. Depth of anesthesia can be rapidly adjusted, which makes it useful for high-risk cases. Practitioners are often reluctant to change anesthetic agents because this may require adjustments with which they are not familiar. The purpose of this article is to outline the specific steps for using sevoflurane in adult horses, as well as the benefits of using a newer, more expensive agent. Author’s address: Department of Small Animal Medicine and Surgery, Texas A&M University, College Station, TX 77843-4474. © 2001 AAEP.

1. Introduction
Sevoflurane is a newer inhalant agent approved for use in humans and for veterinary use in dogs in the U.S. It has been widely used in horses in Japan for several years where several studies have determined the minimum alveolar concentration (MAC-value), cardiopulmonary characteristics, and recovery characteristics in horses. Additional studies in the U.S. have outlined the cardiorespiratory effects, use in clinical cases, and recovery characteristics. The advantages of sevoflurane are that it produces rapid inductions and recoveries, and depth of anesthesia can be changed more rapidly than other more soluble inhalants (i.e., halothane and isoflurane). It is also better accepted by mask induction than isoflurane, making it useful for rapid inductions in young foals. Additionally, in horses the character of recoveries is faster than that seen with halothane or isoflurane, but smoother and more satisfactory in quality. Although most equine practitioners are comfortable using halothane for anesthesia, one disadvantage is that halothane sensitizes the myocardium to catecholamines, which can lead to fatal dysrhythmias during anesthesia. Sevoflurane and isoflurane appear to be much safer in this respect. This article describes how we have used sevoflurane for maintenance of anesthesia in the majority of equine clinical patients over the past 3 years, focusing on equine patients from the calendar year 2000.

2. Materials and Methods
A total of 571 horses were anesthetized with sevoflurane for a wide variety of surgical procedures including orthopedic and soft tissue procedures, both scheduled and on an emergency basis. Anesthesia time ranged from 1 to 8 h and patients ranged in age from a few days of age to 30 yr. A wide variety of breeds were anesthetized including donkeys, mules, and a zebra.

Anesthesia was induced with a variety of drugs, including standard equine doses of xylazine-ketamine, xylazine-guaifenesin-ketamine or inhalant agent only (administered by face mask or nasotracheal intubation). Anesthesia was maintained with a large animal anesthesia machine equipped with a sevoflurane vaporizer. Since the vapor
pressure of sevoflurane is different than that of halothane or isoflurane, it requires a vaporizer calibrated for the agent. We always preload the anesthesia circuit with 5–6% sevoflurane in oxygen (while anesthesia is being induced), which minimizes induction time once the horse is connected to the machine. Using an initial oxygen setting of 5 l/min (for an adult horse), the vaporizer setting may be decreased within about 15–20 min (based on monitoring palpebral and corneal eye reflexes and blood pressure). Further decreases in vaporizer setting can be made based on continued monitoring of the patient (usually at 5–10-min intervals). Since sevoflurane is less soluble than other inhalants, depth of anesthesia can be changed more quickly; therefore closer monitoring of anesthetic depth is necessary.

Depth of anesthesia was reduced slightly towards the end of the procedure, but this was minimized since the horses had to be moved to recovery and hoisted into the recovery stall. Again, since recovery will be more rapid with sevoflurane than with isoflurane or halothane, the horse may tend to awaken during the 5 min required for transport (if transport is necessary, which will vary from hospital to hospital). Small doses of xylazine (50–150 mg total dose) were used if necessary to sedate the horse during the first minutes in the recovery stall. Additional doses of xylazine (50–100 mg total dose) were used if the horse made attempts to move while still showing pronounced nystagmus in recovery.

3. Results
No deaths from anesthesia were encountered, although 27 horses were euthanized during surgery due to their poor prognosis. These included 22 undergoing exploratory laparotomy, 2 inguinal hernias, 1 ruptured bladder, 1 mandibular fracture, and 1 abdominal laceration. Complications which occurred were similar to those seen with other inhalant anesthetics and were managed as appropriate. Hypotension was treated with decreasing the vaporizer setting and dobutamine infusions, whereas hypoventilation was treated with assisted or controlled ventilation as needed. Occasionally, small boluses of ketamine (50–100 mg) were given to stop a horse from moving; however, because depth of anesthesia can be more quickly adjusted with sevoflurane, we have needed to do this less than with halothane or isoflurane. Nasal oxygen was generally provided during recovery. Some horses were assisted to stand in the recovery stall depending on the surgical procedure and preference of the surgeon. Length of recovery varied with horse, duration of anesthesia, and amount of xylazine given in recovery. Generally, recoveries ranged from about 20 to 60 min. However, one Percheron, which had undergone 4.5 h of anesthesia for colic surgery, was weak and required a tracheostomy to maintain an airway and another colic which had undergone 7 h of anesthesia required 3 h to stand.

4. Discussion
The risk of perioperative mortality in equid species appears to be higher than in other species. A large recent study reported a mortality rate of 0.9% in noncolic patients with the most common cause of death reported as intraoperative cardiac arrest. This study also reported a significant reduction in the rate of cardiovascular associated mortality when isoflurane was used compared to halothane. However, since isoflurane has been associated with rougher recoveries and more excitement in recovery than that seen with halothane, it has never met with widespread use in practice. Since sevoflurane has been shown to produce cardiovascular stability comparable to isoflurane, but with shorter and smoother recoveries, it would appear that sevoflurane might be more satisfactory and gain acceptance despite its higher cost. It would appear to be particularly useful for outpatient procedures, geriatrics, high-risk patients, prolonged procedures, and foals. Despite the higher drug cost, we have chosen to use sevoflurane anesthesia in approximately 95% of our caseload because of good intraoperative patient stability and good quality recoveries. The remaining 5% of our caseload are short procedures which are managed with injectable anesthetics (i.e., castrations). We are not aware of any contraindications to the use of sevoflurane where inhalant anesthesia is indicated. However, no single agent will produce perfect anesthesia in every horse. Good case management and monitoring are still essential components to successful equine anesthesia.

References and Footnotes

*aSevotec 4. Anesco, Inc., Waukesha, WI, 53186; Sevotec 5. Ohmeda, BOC HealthCare, West Yorkshire, UK.