Balanced Anesthesia in Horses

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Intravenous anesthesia (IVA) coadministered with inhalant anesthesia produces better hemodynamic effects than inhalation anesthesia alone. Authors’ Address: The Ohio State University, Dept. of Veterinary Clinical Sciences, 601 Tharp St., Columbus, OH 43210-1089. © 2000 AAEP.

Introduction
The phrase “balanced anesthesia” originated from the coadministration of drugs to produce an “ideal” anesthetic state. Today the ideal anesthetic state implies adequate hypnosis, analgesia, muscle relaxation, and relief from stress. The last of these attributes, relief from stress, has been the focus of several investigations conducted in horses in order to determine the magnitude of the stress response; anesthetic drugs and anesthetic techniques, which either limit or promote the stress response, and therapies which are effective in limiting or preventing the stress response. Toward this end the development and clinical use of total intravenous anesthesia (TIVA) techniques have been advocated as an alternative to inhalant anesthesia or used in conjunction with inhalant anesthesia to produce the ideal anesthetic state in adult horses.1–3 One of the principle advantages of intravenous anesthesia (IVA) in modifying or limiting the stress response derives from the maintenance of a higher arterial blood pressure during the maintenance phase of anesthesia.4,5 This factor combined with added analgesia may account for the majority of the stress alleviating benefits reported for most IVA preparations.

Most, if not all, IVA drug combinations are prepared by combining an alpha-2 agonist (xylazine, detomidine, medetomidine, romifidine) with a centrally acting muscle relaxant (guaifenesin) and a dissociative anesthetic (ketamine, Telazol®). Since this anesthetic cocktail is generally prepared from three separate drugs they are commonly referred to as “triple drip.” It is important to remember that not all triple drip drug combinations contain the same drugs or drug concentrations.1,5 One triple drip drug combination, xylazine, guaifenesin, and ketamine has been demonstrated to produce relatively rapid and uneventful induction to anesthesia, a stable maintenance phase of anesthesia and quiet uncomplicated recovery from anesthesia.1 It is important to note, however, that most experimental studies and clinical evaluations of IVA have been for relatively short periods of time (<1 hr) and that longer periods of anesthesia would result in greater total drug load, which could predispose to lingering drug effects and prolonged and potentially poor quality recovery from anesthesia. We decided to investigate the advantages and disadvantages of a “triple drip” drug combination administered in conjunction with inhalant anesthesia for maintenance of anesthesia in the adult horse.
Materials and Methods

One hundred twenty clinically healthy adult horses admitted for elective surgical procedures were divided into one of six different groups (20 horses per group). Horses received halothane, isoflurane, or sevoflurane as the primary means of maintaining anesthesia (Groups 1–3) or a “triple drip” drug combination (medetomidine, 1.25 mg; guaifenesin, 25 g; ketamine, 1 g; 0.5 ml/kg/hr) in conjunction with one of the inhalant anesthetics (Groups 4–6) as the primary means of maintaining anesthesia. Only surgical procedures lasting greater than 1 hr but less than 3 hr were included in the data analysis.

Results

The coadministration of this “triple drip” combination (IVA + inhalant) provided safe and effective anesthesia. Anesthesia was characterized by excellent muscle relaxation and analgesia, a more uneventful maintenance phase of anesthesia (lower requirement for additional drugs to maintain anesthesia), stable cardiorespiratory status (less requirement for drugs to support blood pressure), and similar quality and comparable duration of recovery from anesthesia (lower requirement for resedation during the recovery period), than with the inhalant anesthetics alone. The combination of IVA with inhalant anesthetic reduced the requirement for the inhalant anesthetic by 30–50% depending upon the inhalant (halothane, isoflurane, sevoflurane) selected. What was particularly noteworthy was the 50% decrease in the requirement for additional drugs (ephedrine, dobutamine) to support blood pressure during the maintenance phase of anesthesia during IVA + inhalant anesthesia compared to inhalant anesthesia alone. Mean arterial blood pressure was maintained at approximately 78 ± 5 mmHg in IVA + inhalant anesthesia and 64 ± 7 mmHg receiving inhalant alone in horses that did not require drugs to support blood pressure. The average recovery time was decreased from an overall average of 43 ± 15 minutes in horses receiving inhalant anesthetic alone to 33 ± 18 minutes in horses receiving IVA + inhalant anesthetic.

Discussion

Medetomidine is an alpha-2 agonist similar to but more potent than either xylazine or detomidine and is noted for its sedative, analgesic, and muscle relaxant properties. Guaifenesin is a central nervous system muscle relaxant that produces excellent muscle relaxation and mild sedation in horses. Ketamine is a dissociative anesthetic noted for its ability to produce minimal cardiovascular depressant effects.

The most obvious explanation for the superior results of IVA + inhalant versus inhalant alone was the ability to decrease the maintenance inhalant anesthetic concentration and by so doing reduce inhalant anesthetic cardiovascular depressant effects. Similarly, the presence of the inhalant anesthetic reduced the IVA infusion dose, thereby reducing the total injectable drug load, thereby decreasing the potential for prolonged drug effects and excessive elimination times. Our study in conjunction with previous investigations demonstrating the stress alleviating effects of similar IVA drug combinations suggest that all phases (induction, maintenance, recovery) of equine anesthesia can be improved by combining appropriate injectable and inhalant anesthetic techniques and that the need for additional drugs to support hemodynamics (cardiac output, arterial blood pressure) or improve the recovery period can be reduced. Although in routine use, in many equine surgical facilities the use of ephedrine and dobutamine are not without consequence since they are both capable of producing hypertension, cardiac arrhythmias, and hemorrhage at the surgical site. Further studies are being conducted in high-risk patients to determine if similar results will be observed.

References