How to Use Propofol as an Adjunct to General Anesthesia in Foals

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1. Introduction
Foal anesthesia can be challenging in both field and hospital settings. Often, maintaining adequate blood pressure requires minimizing the use of α2 adrenergic agonist drugs, phenothiazines, or inhalant anesthetics. Boluses of ketaminea are often used during a procedure to maintain a surgical depth of anesthesia, although onset of effect takes approximately 45 seconds. Unfortunately, recovery can be prolonged or rough if boluses of ketamine are administered after induction and specifically if near the recovery period. An alternative drug that maintains anesthesia while producing rapid, smooth recovery is advantageous. Propofolb is a hypnotic anesthetic that produces rapid recumbency with short-duration general anesthesia commonly used in small animal patients and humans. Propofol is sold in 20-mL vials and is provided as an oil-in-water emulsion in a 10-mg/mL concentration that costs approximately $6.00 per 20-mL vial. The veterinary formulation is labeled for use in dogs and cats. A recent change in the formulation of the drug added benzyl alcohol as a preservative. The previous formulation had a shelf life of only 6 hours once the bottle was openedc but the new formulation can be used up to 28 days after the bottle is punctured. Studies have found that 2 mg/kg propofol IV after premedication using xylazine and butorphanol produces smooth induction in foals with short-duration anesthesia and a mean anesthetic time of 12.3 minutes as compared with 19.7 minutes with ketamine. Additionally, after induction with 2 mg/kg propofol IV, anesthesia can be maintained using a constant rate infusion of propofol at 0.26 to 0.47 mg/kg per minute, resulting in recovery within 30 minutes after discontinuation of the infusion. In these studies, foal heart rate was slightly elevated and blood pressure was within an acceptable range. Propofol has been examined in adult horses, but the cost and volume required can be limiting. Respiratory depression or apnea is common in small animal patients after bolus administration of propofol, but it is not a common occurrence in foals and ponies when using the recommended dosing.

2. Materials and Methods
Fourteen healthy Thoroughbred foals between the ages of 3 weeks and 2 months that presented for elective surgical procedures to an equine surgical facility in Lexington, Kentucky, in 2011 received the selected anesthetic protocol. After sedation with xylazine at 0.8 mg/kg IV followed by ketamine at 2.2 mg/kg IV combined...
with diazepam\(^f\) at 0.08 mg/kg IV. A surgical plane of anesthesia was maintained using isoflurane\(^g\) in 100% oxygen between 1.0% and 3.0% with intravenous boluses of propofol at 0.05 mg/kg as needed when arousal occurred. Direct arterial blood pressure was monitored and mean arterial pressure was maintained above 70 mm Hg by minimizing inhalant anesthetic and if that was not effective, the administration of an infusion of dobutamine.\(^h\) Average surgical time for procedures was 22 minutes.

3. Results
All of the foals were administered an average of 2 boluses (range, 1–5) of propofol to maintain a surgical plane of anesthesia (as an alternative to increasing the anesthetic concentration) or to move the foal into recovery from the surgical theater. Ventilation, heart rate, and blood pressure did not change markedly after bolus administration during the procedure. Ventilation was maintained in foals administered a bolus while being moved to the recovery stall. Recovery quality was based on number of attempts to stand and time to standing. Foals were assisted in recovery by a single handler. In 11 of the 14 foals, standing occurred after the first attempt. The other 3 foals made between 2 and 3 attempts before achieving a standing position. Recovery occurred between 5 and 12 minutes after being placed on the recovery mat. Mild ataxia occurred in 8 of 14 foals after standing, and 4 of the 14 foals were alert and prepared to return to the dam immediately after standing.

4. Discussion
Propofol boluses were effective as an adjunct for maintaining a surgical plane of anesthesia or recency when moving foals to the recovery stall. Recovery was quick, with few attempts to stand and minimal ataxia once standing. From experience, additional ketamine boluses before recovery can produce rough recovery in foals, with multiple uncoordinated attempts to stand. Propofol appears to be a safe alternative as an anesthetic adjunct in healthy foals.

References and Footnotes

\(^a\)Ketaset, Fort Dodge Animal Health (Pfizer Animal Health), Fort Dodge, IA 50501.
\(^c\)Rompun, Bayer Animal Health, Shawnee, KS 66201.
\(^d\)Tobugesic, Fort Dodge Animal Health (Pfizer Animal Health), Fort Dodge, IA 50501.
\(^e\)Valium, Abbott Laboratories, Abbott Park, IL 60064.
\(^f\)Isoflurane USP, Halocarbon Products, River Edge, NJ 07661.
\(^g\)Dobutrex, Gensia Laboratories, Ltd, Irvine, CA 92618.
\(^h\)IACUC approval was not sought, as this technique is part of the established anesthetic protocol in this practice.