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Apgar score after induction of anesthesia for canine cesarean section with alfaxalone versus propofol

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ABSTRACT

The effects of alfaxalone and propofol on neonatal vitality were studied in 22 bitches and 81 puppies after their use as anesthetic induction agents for emergency cesarean section. After assessment that surgery was indicated, bitches were randomly allocated to receive alfaxalone 1 to 2 mg/kg body weight or propofol 2 to 6 mg/kg body weight for anesthetic induction. Both drugs were administered intravenously to effect to allow endotracheal intubation, and anesthesia was maintained with isoflurane in oxygen. Neonatal vitality was assessed using a modified Apgar score that took into account heart rate, respiratory effort, reflex irritability, motility, and mucous membrane color (maximum score = 10); scores were assigned at 5, 15, and 60 minutes after delivery. Neither the number of puppies delivered nor the proportion of surviving puppies up to 3 months after delivery differed between groups. Anesthetic induction drug and time of scoring were associated with the Apgar score, but delivery time was not. Apgar scores in the alfaxalone group were greater than those in the propofol group at 5, 15, and 60 minutes after delivery; the overall estimated score difference between the groups was 3.3 (confidence interval 95%: 1.6–4.9; $P < 0.001$). In conclusion, both alfaxalone and propofol can be safely used for induction of anesthesia in bitches undergoing emergency cesarean section. Although puppy survival was similar after the use of these drugs, alfaxalone was associated with better neonatal vitality during the first 60 minutes after delivery.

1. Introduction

Approximately 16% of all bitches suffer from dystocia, and greater than 60% of bitches with dystocia need a cesarean section (C-section). Performing an emergency C-section is a common procedure in small animal obstetrics [1,2], and various anesthetic techniques have been reported [2–5]. All anesthetic drugs, including inhalant anesthetic agents, cross the placenta and the blood-brain barrier of the fetus, leading to a variable extent of neonatal depression [3–5]. The anesthetic protocol selected should be optimized for dam and fetus with minimal neurologic and cardiorespiratory depression [4]. Maternal lethargy and reduced neonatal vitality during the critical first postoperative hours result in reduced colostrum intake and increased mortality rate of the puppies [3,5–7]. Currently, many veterinarians use propofol followed by isoflurane for induction and maintenance of anesthesia for C-section [2,6–9].

Anesthetic induction with propofol and maintenance with isoflurane improves puppy vigor and newborn survival rates compared with other general anesthetic protocols and is considered almost equal to epidural anesthesia [6–8]. Recovery from propofol anesthesia is normally rapid and smooth because of rapid redistribution and metabolism. Although propofol crosses the placental barrier, it is rapidly cleared from the neonatal circulation [5,10,11]. The neuroactive steroidal combination saffan (a mixture of alfaxalone

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and alfadolone solubilized in 20% of a polyoxyethylated castor oil called Cremophor EL) was used widely in the late 20th century in cats and was considered to be a very safe agent for anesthesia induction and short surgical procedures [12]. In dogs, its use was limited because of Cremophor EL–induced histamine release that resulted in decreased arterial blood pressure, urticaria and skin erythema, and serious anaphylactic reactions [13]. However, after preanesthetic medication with an antihistaminic agent, Bomzon [14] reported saffan to be a safe and predictable anesthetic agent for dogs undergoing C-section and to be superior to thiopental. In the previous decade, a new Cremophor EL–free formulation of alfaxalone was developed for use in small animals (Alfaxan, Vétoquinol, UK). The new formulation uses a cyclodextrin base (HPCD) as solubilizing agent and does not cause histamine release [15,16]. Alfaxalone was shown to provide rapid and smooth induction of anesthesia with rapid recovery of consciousness and minimal respiratory depression. It also has a wide margin of safety and short total body clearance and mean plasma terminal half-life [16,17]. Although alfaxalone is currently routinely used for induction of anesthesia in dogs and cats in many countries, it has never been evaluated in regard to its safety for C-section.

The objectives of this study were to evaluate, in a clinical setting, the effects of alfaxalone as an anesthetic induction agent for dogs undergoing emergency C-section and to compare neonatal vitality after alfaxalone or propofol anesthetic induction.

2. Materials and methods

2.1. Animals

The local ethics committee approved the study. Twenty-two bitches presented to the Clinic for Reproductive Medicine of the University of Zurich were used in this study. The group receiving alfaxalone (N = 11) consisted of three Chihuahuas, two West Highland White Terriers, and one Poodle, Dachshund, Yorkshire Terrier, Eurasian Dog, Bichon Frisè, and small Mixed Breed dog. The group receiving propofol (N = 11) consisted of two Chihuahuas, two French Bulldogs, and one Yorkshire Terrier, Pug, Bernese Mountain Dog, Bolonka Zwetna, Australian Cattle Dog, Golden Retriever, and small Mixed Breed dog. Age of the bitches ranged from 1 to 11 years (3.0, 1.3–6.2 years; mean, 10–90 percentile range) and body weight (BW) ranged from 1.6 to 51 kg (7.3, 2.1–28.4 kg). Cesarean section was indicated because of dystocia in all cases attributed to poor general condition of the dam, birth canal obstruction, fetomaternal disproportion, fetal malposition, fetal heart rate of less than 180 bpm over several minutes in one or more puppies, dystocia with more than two puppies remaining to deliver, and/or unsuccessful medical management of dystocia [18].

2.2. Anesthesia

All bitches started to receive intravenous fluids immediately after presentation (Lactated Ringer's solution, 10–20 mL/kg BW/h); in case of poor general condition or severe dehydration, HAES-steril 10% (Fresenius Kabi, Germany) was added (1–2 mL/kg BW/h). Infusion was maintained until the bitch had fully recovered from anesthesia. Before induction of anesthesia, bitches were preoxygenated for 5 minutes using flow-by oxygen at 2 L/minute and received a single intravenous dose of cefazolin 20 mg/kg BW (Kefzol; Teva Pharma, Switzerland). Sedatives and analgesics were not administered until all puppies were delivered. For anesthesia induction, bitches were randomly assigned to received alfaxalone (Alfaxan; Vétoquinol, UK) 1 to 2 mg/kg BW or propofol (Propofol 1% MCT; Fresenius Kabi, Germany) 2 to 6 mg/kg BW for anesthetic induction. Both drugs were administered intravenously to allow endotracheal intubation. The surgeons and the observer who performed the evaluations after anesthesia induction were blind to the agent used.

After intubation, anesthesia was maintained using isoflurane (Isoflo; Abbott, Dr E. Graeub AG, Switzerland) in oxygen at the dosage to effect. Immediately after delivery of the last puppy, a continuous-rate intravenous infusion of fentanyl (Sintetica SA, Switzerland) 5 mcg/kg BW/h was started and stopped at the end of surgery. All bitches received intravenous buprenorphine (Temgesic; Reckitt Benckiser, Switzerland) 14 mcg/kg BW and carprofen (Rimadyl; Pfizer AG, Switzerland) 4 mg/kg BW 20 minutes before the end of surgery. Total duration of anesthesia was defined as time from anesthetic induction until the stop of isoflurane inhalation. Delivery time was defined as time from anesthetic induction until delivery of the last puppy.

2.3. Neonatal care and assessment after delivery

Immediately after delivery, puppies had fluid cleared from the upper airways using suctioning and were rubbed and blow-dried on warm bedding. All puppies were oxygenated using flow-by oxygen at 2 L/minute. If breathing did not start immediately, gentle mouth-to-nose breathing was performed to expand the lungs. If breathing was still inadequate, a centrally acting analeptic was administered (Respirot; Novartis Tiergesundheit AG, Switzerland) at a dosage of one to two drops given orally and the puppy received a single subcutaneous bolus of warmed glucose 5% (3–5 mL/100 g BW). Resuscitation was attempted for at least 30 minutes if a heartbeat was detected. The umbilical cord was ligated 0.5 to 1 cm from the abdominal wall, and the umbilical stalks were disinfected with a weak iodine solution. Body weight was recorded and a detailed clinical examination was performed. After stabilization, puppies were transferred to a newborn incubator (see ref. [2] for details).

A modified Apgar score developed by Veronesi et al. [9] for puppies was used to objectively assess neonatal vitality. The following parameters were evaluated: heart rate, respiratory effort (respiratory rate and type of crying), reflex irritability, motility, and mucous membrane color. Each parameter was rated as 0 (absent), 1 (detectable, weak), or 2 (detectable, strong). The sum of all parameters, up to a maximum of 10, provided the total Apgar score. Puppies were assessed at 5, 15, and 60 minutes after delivery.

2.4. Statistical analysis

Statistical analysis was performed using Stat View 5.0 (SAS Institute Inc., Cary, NC, USA). Linear mixed models were performed with R (team 2010) and the package nlme