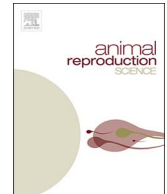




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Comparison of 3 anesthetic protocols for the elective cesarean-section in the dog: Effects on the bitch and the newborn puppies

José M. Vilar, M. Batista*, R. Pérez, A. Zagorskaia, E. Jouanisson, L. Díaz-Bertrana, S. Rosales

Department of Animal Pathology, Veterinary Faculty, University of Las Palmas de Gran Canaria, Transmontaña s/n 35416, Arucas, Las Palmas, Spain

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ABSTRACT

This study assessed the influence of 3 different anesthetic protocols based on the quality of anesthesia induction and maintenance in four dog breeds (French Bulldog, $n = 13$; Yorkshire terrier, $n = 12$; Chihuahua, $n = 10$; Bull Terrier, $n = 10$) subjected to cesarean section. Neonatal mortality, birth defects and newborn viability were assessed. All females were pre-medicated with morphine (IM), and then were assigned to three different anesthetic protocols: group P ($n = 17$), anesthesia was induced with propofol (IV) and then also maintained with propofol until the complete delivery of puppies and then anesthesia was maintained afterwards with sevoflurane; group PS ($n = 14$), anesthesia was induced with IV propofol, and maintenance of the anesthetic plan was performed with sevoflurane; group PES ($n = 14$) the females were induced by propofol and an epidural anesthesia was then performed, anesthesia was then maintained with propofol until the complete extraction of all puppies and then anesthesia was maintained afterwards with sevoflurane. Throughout the surgery, group PES required a lower concentration of sevoflurane ($p < 0.05$), and extra doses of propofol or fentanyl during inhalatory anesthesia were not required. Mean values of heart rate ($p < 0.01$) were higher in females from groups P and PS. Mean values of blood pressure values were lower ($p < 0.01$) in group PES as compared with the other two groups. Birth defects were detected in 3.1% (5/162) of the neonates, with a significantly higher incidence ($p < 0.05$) in French bulldog puppies. Neonatal viability was assessed using a modified Apgar score model; Apgar score was defined immediately after delivery (Apgar0) and a second score was assessed 60 min after delivery (Apgar60). Apgar0 scores were significantly different between the groups, showing neonates of group PES the highest values ($p < 0.05$). In Apgar60, more than 94% of puppies were already classified as normal viability neonates (7–10 score) and no differences were observed between groups. This study confirmed that females of group PES showed a higher quality of anesthesia during surgery and a vitality of puppies immediately after delivery. Regardless of the anesthetic protocol used, French bulldog females and puppies required more clinical care than other breeds.

1. Introduction

Most bitches complete labor without complications, but sometimes there are difficulties that may prevent delivery which develops into dystocia. Dystocia occurs when there is any impediment to initiate or complete labor, which are due to both maternal and fetal causes, occurring independently or in combination (Johnston et al., 2001; Traas, 2008a). The incidence of dystocia in bitches is

* Corresponding author.

E-mail addresses: jose.vilar@ulpgc.es (J.M. Vilar), miguel.batista@ulpgc.es (M. Batista).

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estimated between 2 and 16% (Linde-Forsberg and Eneroth, 2000; Bergström et al., 2006; Doebeli et al., 2013) but a higher incidence of dystocia has been observed in brachycephalic breeds, such the English bulldog, French bulldog and Boston terrier (Bergström et al., 2006; Wydooghe et al., 2013). Approximately 60–80% of dystocia in bitches require a surgical treatment (cesarean section) in order to be resolved (Darvelid and Linde-Forsberg, 1994; Gilson, 2003).

Cesarean section is a common surgical procedure in small animal obstetrics (Moon et al., 2000, 2001; Traas, 2008a) and the choice of the anesthetic technique should provide optimal and safe conditions both for the bitch and the foetus (Conde Ruiz et al., 2016). Therefore, minimum amount of anesthetic agents (injectable and inhalant) necessary to maintain anesthesia should be used until all fetuses are removed (Lopate, 2012). Nevertheless, all anesthetic drugs, and especially inhalant anesthetic agents, cross through the placenta and the foetus blood-brain barrier, generating a variable extent of neonatal depression when administered to the dam (Pascoe and Moon, 2001; Traas, 2008b). Different anesthetic techniques have been used to determine the optimal anesthetic protocol during C-section (Luna et al., 2004; Traas, 2008b; Doebeli et al., 2013; Conde Ruiz et al., 2016). A typical protocol includes induction with propofol, followed by intubation and maintenance with isoflurane or sevoflurane (Luna et al., 2004; Lopate, 2012). Traas (2008b) proposed the induction with propofol, followed by intubation and maintenance with a propofol continuous release, followed by inhalant anesthetic after the last fetus is delivered. Recent studies (Doebeli et al., 2013; Conde Ruiz et al., 2016) have shown the efficacy of administration of alfaxalone, alone or in combination with isoflurane, for both induction and maintenance of anesthesia in bitches undergoing cesarean sections. Some authors (Traas, 2008b; Lopate, 2012) have proposed using an epidural anesthesia to perform a cesarean section; epidural anesthesia has the advantage of requiring no systemic drugs, but also have several disadvantages, including the inability to intubate and ventilate the bitch, resulting in decreased oxygenation of the fetuses during surgery and difficulties with bitch anxiety and in most cases, intravenous or inhalatory anesthesia is required during surgery (Traas, 2008b; Lopate, 2012).

Neonatal mortality and puppy's viability after cesarean sections have been assessed in other studies (Moon et al., 2000; Moon and Erb, 2002; Luna et al., 2004). In previous years, an Apgar scoring system adapted for veterinary medicine has been used to assess the newborn viability and short-term survival prognosis after normal birth, vaginal dystocia or cesarean section (Silva et al., 2009; Veronesi et al., 2009; Groppetti et al., 2010; Doebeli et al., 2013; Batista et al., 2014; Veronesi, 2016; Bolis et al., 2017). Based on the Apgar assessment, most studies (Veronesi et al., 2009; Doebeli et al., 2013; Batista et al., 2014; Vassalo et al., 2015; Veronesi, 2016; Bolis et al., 2017) ranked puppies in three degrees of viability: critical neonates (severely distressed), moderate viability neonates and normal viability neonates (newborns without distress). Different studies have assessed the influence of different anesthetic protocols over neonatal viability (Luna et al., 2004; Batista et al., 2014; Conde Ruiz et al., 2016) but, to the best of our knowledge, no studies have assessed simultaneously, the use of three different anesthetic protocols and their effects over cardiovascular parameters in the dam during surgery as well as their effects over neonatal viability as assessed by an Apgar scoring.

The aims this study were to assess the influence of three different anesthetic protocols over the quality of anesthesia induction and maintenance, and on the cardiorespiratory findings in bitches of four different breeds subjected to cesarean section. In addition, the study assessed and evaluated neonatal mortality, birth defects and newborn viability using an Apgar scoring method.

2. Material and methods

2.1. Animals

Forty-five privately owned females of four different breeds: (French bulldog, n = 13; Yorkshire terrier, n = 12; Chihuahua, n = 10; Bull terrier, n = 10) and 162 puppies were enrolled in the present study. Bitch weight ranged between 2.5 and 26 kg and aged between 2 and 5.5 years; 14 females were primiparae. Sanitary status (properly vaccinated and dewormed) was very similar. All females underwent an elective cesarean section at the Veterinary Hospital at the University of Las Palmas de Gran Canaria during 2014 and 2015. This study was developed according to the European laws for animal research and experimentation and followed the guidelines of the Bioethic Committee at the University of Las Palmas de Gran Canaria (Spain).

2.2. Experimental design

The bitches were assigned uniformly to three experimental groups according to breed (French bulldog –FB-, Yorkshire terrier –YT-, Chihuahua –C-, Bull terrier –BT-), age and weight: group P (Propofol), group PS (Propofol *plus* Sevoflurane) and group PES (Propofol *plus* Epidural *plus* Sevoflurane). In group P (n = 17, 5 FB, 4 YT, 4C, 4 BT), females were pre-medicated with the IM administration of morphine and 10 min after sedation, anesthesia was induced with IV propofol administration; additional boluses of propofol were administered to maintain the anesthesia until the complete delivery of puppies and then anesthesia was maintained afterwards with sevoflurane. In group PS (n = 14, 4 FB, 4 YT, 3C, 3 BT), females were pre-medicated similarly to group P and ten minutes later, anesthesia was induced with IV propofol, and maintenance of the anesthetic plan was performed with sevoflurane. Females in group PES (n = 14, 4 FB, 4 YT, 3C, 3 BT) were pre-medicated and induced similarly to the other two groups, then an epidural analgesia was performed through the administration of lidocaine, and anesthesia was then maintained with propofol boluses until the complete extraction of all puppies. Peri-operative physiological parameters were recorded in the dams, whereas the viability and a modified Apgar score were evaluated in the neonates.

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