Animal Reproduction Science 146 (2014) 218–226

Contents lists available at ScienceDirect

Animal Reproduction Science

journal homepage: www.elsevier.com/locate/anireprosci

Neonatal viability evaluation by Apgar score in puppies delivered by cesarean section in two brachycephalic breeds (English and French bulldog)

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ARTICLE INFO

Article history:
Received 6 July 2013
Received in revised form 17 February 2014
Accepted 12 March 2014
Available online 22 March 2014

Keywords:
Brachycephalic breed
Dog
Neonate
Viability
Apgar score

ABSTRACT

This study tried to define neonatal viability after cesarean section in brachycephalic breeds and the efficacy of an adapted Apgar test to assess newborn survival. Data from 44 cesarean sections and 302 puppies were included. Before surgery (59–61 days after ovulation), an ultrasound evaluation defined the fetal biparietal diameter (BPD). Immediately after the uterine delivery, the pups were evaluated to detect birth defects and then, a modified Apgar score (range: 0–10) was used to define neonatal health at 5 min (Apgar 1) and 60 min (Apgar 2) after neonatal delivery; puppies were classified into three categories: critical neonates (score: 0–3), moderate viability neonates (score: 4–6) and normal viability neonates (score: 7–10). Mean (±SEM) value of BPD was 30.8 ± 0.1 mm and 28.9 ± 0.1 mm in English and French Bull-Dog fetus, respectively. The incidence of spontaneous neonatal mortality (4.98%, 14/281) and birth defects (6.95%) were not influenced by the sex; however, congenital anomalies and neonatal mortality were higher ($p < 0.01$) in those litters with a greater number of neonates. In Apgar 1, the percentage of critical neonates, moderate viability neonates and normal viability neonates were 20.5%, 46.3% and 33.1% respectively; sixty minutes after birth, the critical neonates only represented 10.3% of the total puppies. Almost all neonates (238/239) showing moderate or normal viability at Apgar 1, survived for the first 24 h after birth. The results of the study showed a direct relationship ($p < 0.01$) between the Apgar score and neonatal viability. Therefore, the routine performance of the Apgar score would appear to be essential in the assessment of the status of brachycephalic breed puppies.

1. Introduction

Obstetrics and pediatrics are two inseparable parts of the canine theriogenology. Parturition represents the final act of pregnancy and proper veterinary practice may play a critical role in increasing live births and reducing bitch mortality (Davidson, 2010). In this regard, it is essential to identify when delivery occurs normally and detect those situations requiring veterinary intervention (Pretzer, 2008). Dystocia may result from maternal factors, fetal factors or a combination of both (Johnston et al., 2001; Traas, 2008a). Uterine inertia is the most common maternal cause of dystocia, but other factors such as small pelvic size and congenital or acquired abnormalities of the caudal reproductive tract may also be present (Linde-Forsberg and Persson, 2007; Traas, 2008a; Wydooghe et al., 2013). In addition, the most frequent causes of fetal dystocia are malpresentation, fetal malformations and fetal oversize (Darvelid and Linde-Forsberg, 1984; Gaudet, 1985). Dystocia occurs in approximately 5% of all

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http://dx.doi.org/10.1016/j.anireprosci.2014.03.003
0378-4320/

parturitions in dogs (Linde-Forsberg and Eneroth, 2000). However, brachycephalic breeds have a high prevalence of dystocia due to their anatomical conformation; this increased incidence is very evident in the English bulldog (Wydooghe et al., 2013) and, to a lesser extent, the French bull. Cesarean section is required in approximately 60–80% of cases to solve dystocia in bitches (Gilson, 2003).

Cesarean section is indicated if fetal distress (reduction in fetal heart rate) is detected, or, if a bitch fails to deliver as a result of dystocia from maternal or fetal origin (Traas, 2008a; Davidson, 2010). Cesarean section is a common surgical procedure in small animal practice, (Traas, 2008a) and anesthesia, perioperative and postoperative factors that influence neonatal survival have not been evaluated in depth (Moon et al., 2000; Moon and Erb, 2002). Neonatal depression following cesarean section has two basic causes: the most important cause is newborn hypoxia; the second factor is depression caused by the anesthetic drugs given to the dam (Traas, 2008b). In addition, some studies have reported a negative effect of maternal brachycephalic breeds on the survival of puppies delivered after cesarean sections (Moon et al., 2000; Wydooghe et al., 2013). At this point, an optimal neonatal resuscitation following birth or cesarean section is essential to minimize the immediate newborn mortality and to promote increased survival of neonates during the first weeks of their life (Moon et al., 2001; Davidson, 2010). Therefore, fast and accurate clinical evaluation of puppies immediately after delivery, would define which neonates require immediate assistance and establish an appropriate clinical approach to improve puppy viability.

Neonatal clinical evaluation after normal birth, vaginal dystocia or cesarean section has been reported in bitches (Dumon, 1992; Moon et al., 2001; Davidson, 2003). However, few studies have evaluated the use of an Apgar score (modified for veterinary medicine) to assess neonatal viability and the short-term survival prognosis (Lúcio et al., 2009; Silva et al., 2009; Veronesi et al., 2009; Groppetti et al., 2010). This adapted Apgar score is usually performed immediately puppies are delivered; the assessed neonatal variables are basically heart rate, respiratory rate, mucous membrane color, reflex irritability and mobility (Silva et al., 2009; Veronesi et al., 2009; Groppetti et al., 2010). However, in these studies, the number of puppies born after cesarean section and then assessed by the Apgar score has not been very high. In addition, no studies have been carried out assessing neonatal viability using an Apgar score in puppies of brachycephalic breeds born by cesarean section.

The aims of the present study were to define the neonatal survival and birth defects in puppies delivered by cesarean section in brachycephalic breeds (English Bull Dog, French Bull Dog). In addition, the reliability of an adapted Apgar score as a tool to check newborn viability and to predict neonatal survival was also assessed.

2. Materials and methods

2.1. Animals

For the present study, 302 puppies from 44 litters of 40 bitches (fours bitches delivered twice) were assessed in the present study. All bitches belonging to brachycephalic breeds (English Bulldog, $n = 26$; French BullDog, $n = 14$), that were 1.5–5 years old and weighed between 12 and 29 kg; 12 bitches were primiparae. The bitches belonged to private owners and feeding (dry commercial feed) and sanitary status (properly vaccinated and dewormed) were very similar. All the experimental work was performed according to the Spanish and European laws for animal research and experimentation; in addition, the study was conducted in accordance with the Bioethic Committee of The University of Las Palmas de Gran Canaria (Spain).

2.2. Anesthetic and surgical procedures

Cesarean sections were scheduled at days 59–61 after ovulation and were performed at the University Veterinary Hospital, throughout two consecutive years (2009–2010). Just before surgery, an ultrasound evaluation (5.0–13.0 MHz, linear array transducer, Logiq® P5 Pro, G HealthCare) of the pregnant females was performed, and the fetal heart rate and the fetal biparietal diameter ($n = 220$) were assessed. First, an intravenous catheter was inserted into the cephalic vein and crystalloid fluids (Ringer Lactate®, 2.5 mL/kg/h, Braun, Rubí, Spain) were given to maintain blood pressure during anesthesia and surgery procedures. Premedication included the intramuscular administration of morphine (0.2 mg/kg, Morfina Braun 2%, Rubí, Spain) and the female was shaved, pre-scrubbed, and preoxygenation was provided if the dam cooperated. Fifteen minutes after sedation, anesthesia was induced by IV propofol administration (3 mg/kg; Propovet®, 10 mg/ml, Esteve, Barcelona, Spain) and then the bitches were intubated and given oxygen only where necessary, additional bolus of propofol were administered to maintain the anesthesia. Once the last puppy was delivered, the anesthesia was maintained with isoflurane (1.5–2.5%; Isoflo®, Abbott Animal Health; UK) in oxygen and the intravenous administration of fentanyl (1–2 μg/kg) to reduce the intra-operative pain. The time elapsed between the propofol induction and the start of surgery was approximately 10 min, and another 10–15 additional minutes were needed to extract all the puppies.

A standard surgical approach was performed for cesarean section. The skin, subcutaneous tissue and abdominal ventral midline were incised (8–12 cm long) and the uterine horns and body were carefully exposed. Then, a uterine incision (4–6 cm long) was performed in the uterine body and neonates were delivered as rapidly as possible; fetal membranes were removed by gentle traction. Uterine incision was closed using a monofilament absorbable suture (Monosyn® 3/0, HR22, B. Braun Surgical SA, Rubí, Spain) in a single continuous pattern, avoiding the inclusion of the uterine lumen, and then an inverting pattern (Cushing o Lembert) was done. Immediately after the uterine closure, the abdomen was lavaged with saline solution (33–35 °C) to remove any debris or maternal fluid that may have entered into the abdominal cavity, and then oxytocin was administered (2–4 IU Oxiton®, Ovejero, León, Spain) intravenously to facilitate uterine involution and expulsion of placental membranes that may have