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ANESTHESIA DURING GESTATION AND ITS EFFECTS ON NEWBORN VIABILITY

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***Abstract**:*

During the gestation period, canine females go through physiological changes which can influence the way the anesthetics are absorbed, metabolized and excreted. Furthermore, the pharmacokinetics of the drugs vary from mother to newborn. The drugs administered will pass through the placental barrier and carry across from dam to fetuses. For this reason, choosing the right anesthetic protocol for cesarean section can represent a challenge for a doctor, who has to keep in mind the well-being of both the dam and the fetuses. While choosing the anesthetic protocol to be used, the anesthetist will have to consider all of the above criteria, seeking to minimize the cardiological, vascular and neurological depression of the fetuses. The purpose of this paper is to discuss the different anesthetic protocols which can be used, and to assess the benefits, as well of the disadvantages that each of the available medications and methods can present. The options of anesthetic procedures being considered during the caesarean section in canines are represented by general anesthesia or local anesthesia combined with general anesthesia. Of equal importance are the preoperative assessment and the potential recovery time of the mother, which can influence the immediate maternal care given to the newborns.

***Key words**: anesthesia, dog, effects, gestation, viability.*

INTRODUCTION

During pregnancy, all the surgical non-emergency interventions that need an anesthesia should be postponed. Both elective and emergency cesarean sections are commonly used in preventing or treating dystocia (Ryan, Wagner, 2006). The major goal of anesthesia during cesarean section (CS) is to minimize the effects of anesthetic drugs in order to reduce fetal respiratory, cardiovascular and neurological depression as well as assuring the delivery of live, vigorous puppies. It is equally important to provide adequate analgesia to the dam and prevent anesthesia-related complications such as hypotension, hypoventilation, hypoxemia, hemorrhage and hypothermia, which will increase morbidity and mortality in both mother and puppies (Paddleford, 1992; Kraus, 2016). The risk of complications in pregnant females is also increased by the physiological changes the mother goes through. (Traas, 2008; Vullo et al., 2014). Some of the changes that occur during pregnancy, in cardiovascular function, respiration and in other systems may affect anesthesia. Understanding them may aid in planning a safe anesthetic protocol for pregnant patients (Kushnir, Epstein, 2012). Another criterion is the differing pharmacokinetics and pharmacodynamics between the fetus and dam. (Ryan, Wagner, 2006). The selection of an anesthetic protocol should be optimized for both dam and fetus so that there is minimal neurologic and cardiorespiratory depression (Luna SP, 2004; Wiebe, Howard, 2009). The risk of anesthesia is represented by the fact that the drugs used cross the placenta and the blood-brain barrier, leading to a variable extent of newborn depression (Pascoe, 2001; Raffe, Carpenter, 2007; Clarke et al. 2014; Vullo et al., 2014). Therefore, several studies have been performed to determine the optimal anesthetic protocol during caesarean sections.

MATERNAL PHYSIOLOGIC CHANGES

In mothers, the changes during pregnancy are hormonal, electrolyte and electrocardiographic, which are physiological and can be related to eutocia or can predispose to dystocia (Simões et al., 2016). The nature of cardiovascular changes, include increased blood volume, relative anemia, increased cardiac output, increased cardiac work, and decreased peripheral vascular resistance. Other changes are respiratory, represented by decreased FRC, decreased total lung volume, increased minute ventilation and oxygen consumption, and decreased PaCO2 (Ryan, Wagner, 2006; Lemke, 2007; Branson, 2007). Dams and fetuses have an increased metabolic demand, leading to a maternal blood volume increases of approximately 40%. Plasma volume increase is proportionally greater than the increase in erythrocytes, leading to hemodilution and relative anemia (Seymour, 1999; Pascoe, Moon, 2001). A greater number of fetuses will translate into increased anemia (Kaneko et al., 1993). Pregnant females have elevated gastric acidity. Also, the gravid uterus causes increased intra-abdominal pressure, leading to reduced gastric and lower esophageal sphincter tone. This, in turn, will make regurgitation during anesthesia and possible aspiration or esophagitis more likely (Pascoe, Moon, 2001). Pregnancy induces minor alterations in hepatic function. Plasma protein concentration decreases slightly, but total plasma protein is increased because of the increase in blood volume (Tranquilli et al., 2013). Bilirubin concentration remains the same, while serum enzyme concentrations and sulfobromophthalein sodium retention are increased. Plasma cholinesterase concentration decreases. Despite these alterations, overall liver function is generally well maintained (Ralston, Shnider, 1978). Renal plasma flow and glomerular filtration rate progressively increase, paralleling the changes in blood volume and cardiac output. Due to increases in renal clearances, blood, urea and creatinine levels are all lower than in non-pregnant animals (Tranquilli et al., 2013). The physiological changes that occur during pregnancy significantly alter the pharmacology of most drugs, such as uptake, distribution and disposition of anesthetic agents and must be considered carefully when selecting anesthetics (Raffe, Carpenter, 2007; Wiebe, Howard, 2009).

PLACENTAL TRANSFER OF DRUG

The primary role of the placenta is to act as an interface between dam and fetus. Canines have an endotheliochorial and zonary type of placenta (Miglino et al., 2006; Furukawa et al., 2014). Most anesthetics cross the placenta and the blood-brain barrier of the fetus. The permeability of the placenta differs depending on type of placenta and the physicochemical properties of the drugs. The endotheliochorial placenta present in canines allows close maternal-fetal contact which facilitates the passive passage of drugs. Placental transfer of drugs can occur by several mechanisms; by far, the most important is simple diffusion. Diffusion across the placenta is determined by molecular weight, the degree to which the drug is bound to maternal plasma proteins, lipid solubility, and degree of ionization (Tranquilli et al., 2013; Wiebe , Howard, 2009). Drugs with high lipid solubility are permeable, due to the placental barrier being considered to be a lipoprotein. (Mathews, 2005). Once drugs have crossed the placental barrier, they pass through the fetal liver, then on to the fetal vena cava via the ductus venosus, where there is a dilutional effect occurring from blood from the caudal portion of the body. This provides some degree of protection to the fetus to high concentrations of drug. Some drugs such as propofol are metabolized and cleared rapidly from the maternal blood, limiting exposure to the fetu whilst others like neuromuscular blocking agents and glycopyrrolate (anticholinergic) do not cross the placenta (Proakis, 1978; Dugdale, 2010).

PERIOPERATIVE MANAGEMENT

In order to minimize excitement, the dam must be handled in a calm and quiet manner, thus avoiding the release of catecholamine which leads to decreased blood flow to the uterus and fetus (Gilroy et al., 1986). After a quick but careful examination (measuring body weight, cardiac and respiratory frequencies, pulse, mucosae color, temperature), an intravenous catheter should be placed to allow fluid therapy and administration of the drug during the procedure and the recovery period (Smith, 2012). Any abnormalities in electrolyte, acid-base, calcium or glucose levels will need to be corrected prior to the start of the surgery (Biddle, Macintire, 2000; Pascoe, Moon, 2001; Kushnir, Epstein, 2012). The rate of fluids administered can be between 5-10 ml/kg/hour and it can be increased when the gravid uterus is manipulated or the dam requires (hemorrhage, hypotension, low pulse) (Dugdale, 2010). Before induction, oxygen should be given by mask to prevent arterial desaturation if apnea occurs (Wiebe, Howard, 2009). Regarding medication that can be administered before the premedication of anesthesia, Seymour (1999), recommends a dose of metoclopramide (0.2–0.4 mg/kg i.v. or i.m), cimetidine or anticholinergics due to the risk of regurgitation and vomit. The clinical parameters of the dam need to be assessed during the entire procedure. (Simoes et al., 2016).

TYPES OF ANESTHESIA

Loco-regional techniques

The disadvantages of local anesthesia are represented by the larger amounts of anesthetic agents used, which are absorbed and can create fetal depression, as well as the fact that muscle relaxation and analgesia are less profound or uniform (Tranquilli et al., 2013). Local anesthetics are divided in two groups represented by esters (procaine and tetracaine) and amides (lidocaine, mepivacaine, bupivacaine and ropivacaine) (Gaynor, Muir, 2009). The duration of ester local anesthetics is prolonged in pregnant patients due to plasma cholinesterase activity being reduced. Greater spread and depth of epidural or spinal local anesthetics have also been reported in pregnant patients. Therefore, it is generally recommended that a smaller dose of spinal or epidural local anesthetics is used (Gaynor, Muir, 2009). The use of local anesthesia reduces the required dose of general anesthetics. When the plasma concentration of the drug increases, local anesthetics produce a predictable pattern of neurological excitement and then depression that may lead to apnea and cardiovascular collapse (Gaynor, Muir, 2009). Using epidural anesthesia is recommended because it doesn’t have a negative effect on the puppies, while at the same time allowing the mother to remain awake. This in turn will mean that the mother can take care of the newborns immediately after the procedure (Scarda, Tranquilli, 2007). Another advantage of an epidural is that it can be used without general anesthesia resulting in a reduced effect on neonatal vigor. However, the lack of intubation in the dam leads to an increased risk of hypoxemia, regurgitation, and aspiration pneumonia (Luna et al., 2004; Ryan, Wagner 2006). Epidural anesthesia is a simple, safe and effective way to administer anesthetics and analgesic drugs for caudal abdominal surgeries in canines (Pascal et al., 2015). Lidocaine 2% without epinephrine is the most common local anesthetic administered, and when given as an epidural, neonatal blood concentrations should be minor. Studies have shown that the use of epidural anesthesia with lidocaine, whether accompanied or not by an opioid, has resulted in vigorous newborns. Disadvantages of epidural anesthesia include failure of satisfactory analgesia at the cranial end of the midline incision, movement of the bitch in response to intra-abdominal manipulation and mesenteric traction (Clarke et al., 2014). Hypotension, bradycardia, hypothermia, cord laceration, spontaneous movements of the head and front limbs, and difficulty in epidural needle placement can also occur. In case of respiratory problems, it may not be possible to intubate the mother without the use of a general anesthetic (Wiebe, Howard, 2009).
Compared to a non-pregnant bitch, a 25–35% reduction in amount of anesthetic administered is required (Pascoe, Moon 2001). Epidural anesthesia is preferred to local infiltration or field block techniques.

General anesthesia

Premedication of the dam can have adverse effects on the fetuses. This means that short-acting drugs are preferred. (Ryan, Wagner, 2006). All opioids cross the placenta and can cause significant central nervous system and respiratory depression in neonates. Elimination of opioids can take up to 2 to 6 days. Buprenorphine is not recommended due to the lack of an antagonizing agent. Recent studies investigating the transplacental transfer and metabolism of buprenorphine in the isolated placenta have shown that the use of a single ‘dose’ of buprenorphine has had a limited rate of transfer (Nanovskaya, 2002). Butorphanol can be administered during surgery to achieve mild to moderate levels of sedation and postsurgery analgesia. If significant neurological and respiratory depression occur, naloxone (0.04 mg/kg SC) may be administered as an antagonizing agent (Murrell, 2007). The use of a low dose of morphine (0.1-0.2 mg/kg) or meperidine (1-2 mg/kg) as premedication, may provoke vomiting and ensure gastric emptying. Tranquilizers, sedatives, and analgesics should not be used until the newborns are delivered (Wiebe, Howard, 2009). Premedication with anticholinergic drugs can potentially cause tachyarrhythmia and the production of gastric stasis promoting reflux of gastric contents. For this reason, it has been regarded as a controversial drug (Hall et al., 2001). Glycopyrrolate is not recommended since very little will cross the placental barrier to prevent bradycardia in the fetuses (Ryan, Wagner, 2006). However, anticholinergics have the advantage of reducing salivation and unavoidable excessive vagal tone with uterine traction. (Hall et al., 2001). Phenothiazines are contraindicated in pregnancy because of significant hypotension and reduced blood flow, as well as severe fetal neurological depression which has been observed after premedication with acepromazine (Valerie, 2009). Although some studies have stated that ketamine can be used as an anesthetic, without having any teratogenic or other adverse fetal effects (Briggs, 1998), protocols that included the use of ketamine or xylazine, methoxyflurane were associated with increased risk of puppy deaths. Therefore it's advised that they be avoided for cesarean section (Navarro, Friedman, 1975; Moon , Erb, 2002). Diazepam has been associated with muscle weakness and decreased ability to nurse or maintain body heat in human babies for hours after delivery. Clinical impression is that diazepam administration to the dam has the same effect in puppies and, therefore, should be avoided (Clarke et al., 2014). Benzodiazepines can be used immediately prior to induction and can be counteracted in the fetuses with flumazenil (0.1 mg/kg i.v.) (Ryan, Wagner, 2006). Induction of anesthesia must be tailored to each patient. Fentanyl–droperidol or barbiturate have both been used in the early years as the only injectable induction agents. While fentanyl is still considered to be a useful option, thiopental has been replaced with propofol or alfaxalone in order to produce more vigorous newborns. There have been a lot of studies comparing the effects of alfaxalone and propofol on induction of anesthesia (Ambros, 2008; Metcalfe et al., 2014; Muir, 2008; Doebeli et al., 2013; Maney, 2013). Alfaxalone and propofol are non-barbiturate anesthetic agents characterized by a smooth, rapid onset and short duration of action. Alfaxalone is a synthetic neuroactive steroid that produces unconsciousness and muscle relaxation (Ferre et al., 2006). Propofol has a very similar effect: rapid and smooth induction, good muscle relaxation, and quiet recovery (Morgan, Legge 1989; Ferre et al. 2006). It produces rapid induction of basal narcosis for intubation and inhalation (4-6 mg/kg IV) and should be administered slowly (20 sec) to decrease the incidence of apnea. (Wiebe, Howard, 2009).Neither drug accumulates in tissues at clinical doses so both can be used for total intravenous anesthesia (Ambros et al. 2008). A study of the cardiopulmonary and anesthetic effects of an induction dose of alfaxalone or propofol has been done by Maney (2013) in eight adult female mixed-breed dogs. The results showed that there were no clinically significant differences in cardiopulmonary effects between propofol and alfaxalone. A single bolus of propofol resulted in shorter recovery time and fewer adverse events than a single bolus of alfaxalone (Maney, 2013). Doebeli et al. (2013) studied the effects on newborn puppies of anesthesia induction with propofol (2-6 mg/kg IV) versus alfaxalone (1-2 mg/Kg IV) during the cesarean section. Neonatal viability was assessed using a modified Apgar score that took into account heart rate, respiratory effort, reflex irritability, motility and mucous membrane color (Doebeli et al., 2013). The results indicated that alfaxalone is better suited for anesthesia induction, resulting in improved neonatal Apgar scores compared with propofol induction. Using alfaxalone induction, puppies recovered from anesthesia more quickly (Doebeli et al., 2013; Metcalfe et al. 2014). Compared with alfaxalone, propofol is reported to cause more cardiorespiratory depression and to increase $PaCO_2$ which may negatively influence the puppy viability (Muir, 2008; Ambros, 2008). Anesthetic recovery of the dams was smooth and rapid in both anesthetic agents (Doebeli et al., 2013), compared to Jimenez et al. results (2012), who described poorer recovery quality after alfaxalone induction compared with propofol. However this last study was not made on bitches undergoing a cesarean section. A more recent study, by Metcalfe et al. (2014), also compared the clinical safety and efficacy of alfaxalone and propofol as induction agents in canines. The maintenance was performed with isoflurane and oxygen. A number of 74 bitches were divided in two groups, alfaxalone group and propofol group respectively. They were monitored during the anesthesia and all the variables were recorded, as well the puppy viability. Premedication was not permitted in this study to prevent confounding of premedicant effects on the variables being measured (Metcalfe et al., 2014). After induction and delivery of the puppies, local anesthetics, analgesic, anti-emetic, antibiotic, procoagulant and tocomimetic drugs were administered. NAIN-S drugs were also administered subsequent to delivery (Metcalfe et al., 2014). This study showed that induction of anesthesia in canines undergoing cesarean section with either drug gave equivalent results (Metcalfe et al., 2014).

Propofol followed by isoflurane anesthesia has been proven to be superior to anesthesia with thiopental (Funkquist et al., 1997). Administration of intravenous propofol followed with isoflurane was also found to have increased survival among pups, increased vigor, and increased vocalization (Moon et al., 2000). In cases of severe maternal compromise or maternal cardiac disease, etomidate (1–2 mg/kg i.v.) is used for induction of general anesthesia, and can be used with midazolam to reduce any excitatory side effect (Robertson 1992; Pablo, Bailey 1999). Published reports describe the use of propofol, thiopental, ketamine, thiamylal, xylazine and alfaxalone as injectable induction agents, followed by halothane, methoxyflurane and isoflurane with and without nitrous oxide as inhalational induction agents for caesarean section in bitches (Moon et al., 2000; Moon et al., 2002; Luna et al., 2004; Doebeli et al., 2013). Luna et al. (2004) divided a number of 24 bitches undergoing cesarean section in 4 groups of 6. After a clinical examination the bitches were sedated with 0.5 mg/kg of chlorpromazine intravenously, followed 15 minutes later by either 8 mg/kg of thiopentone, intravenously (group 1), 0.5 mg/kg of midazolam combined with 2 mg/kg of ketamine, intravenously (group 2), or 5 mg/kg of propofol intravenously (group 3). The bitched were intubated immediately after the induction, and anesthesia was maintained with enflurane in 100 ml/kg of oxygen. The bitches of group 4 underwent epidural anesthesia at the lumbosacral space, using 2-5 mg/kg body weight of 2% lidocaine with adrenaline and 0-625 mg/kg of0-5 % bupivacaine with adrenaline (Luna et al., 2004). While the heart rate remained the same for every group of puppies, the respiratory rate was increased in the puppies delivered after epidural anaesthesia, compared to the ones delivered after anaesthesia with propofol/enflurane or midazolam/ketamine /enflurane. Overall, they were less depressed after epidural anaesthesia, followed by propofol/enflurane thiopentone/enflurane and midazolam/ ketamine/enflurane anaesthesia. Epidural anaesthesia produced the least respiratory and neurological depression in the puppies. The use of midazolam or ketamine before enflurane anesthesia induced the most severe neurological depression and also 10 per cent mortality rate. The results of this study suggest that as far as the neurological and respiratory functions of the puppies were concerned, the best anesthetic technique for caesarean section appeared to be epidural anesthesia. In cases for which epidural anesthesia is unsuitable, propofol appeared to be the safest induction agent in terms of puppies neurological reflexes, followed by thiopentone and midazolam/ketamine. It is recommended that the time from induction to delivery of pups be minimized to reduce respiratory depression as a result of their exposure to inhalant anesthetics. Inhalation agents may be used to induce or maintain anesthesia in calm and or depressed dams, resulting in rapid fetal and maternal equilibration (Tranquilli et al., 2013). Deep maternal anesthesia can lead to hypotension, reduced uterine blood flow, and fetal acidosis. Anesthetic substances such as isoflurane, sevoflurane, or desflurane are preferred over halothane because of the faster induction and recovery, but are highly dependent on other agents used for premedication (Valerie, 2009). Isoflurane and other gas anesthetics should be given at the lowest concentration to maintain maternal consciousness (1%-2%). The minimum alveolar concentration of most volatile anesthetics is reduced by approximately 25% during pregnancy. In general, anesthetics can be administered with 100% oxygen. Isoflurane commonly is used to maintain anesthesia for caesarean section in several species, including canines. Its use had been positively associated with puppies' vocalization, a sign of vigour and good Apgar score (Moon-Massat, Erb 2002). Depression of the newborns by inhalation anesthetic is related to the concentration and duration of administration. Additional anesthetics can also be administered once the newborns have been delivered, depending on the anesthetic protocol chosen for the cesarean section. Its purpose would be the closure of the uterus and abdomen. For example, start or increase inhalant administration or injection of an opioid such as butorphanol if none has already been given (Clarke et al., 2014). Sevoflurane has been shown not to reduce puppy vigor (Gendler et al., 2007). Using alfaxalone CRI as a maintaining agent has resulted in a rapid recovery and a good muscle relaxation (Ambros et al. 2008; Suarez et al. 2012). It has a high margin of safety and minimal cardiovascular effects (Rodriguez et al., 2012). Ruiz et al. (2016), compared isoflurane (2%) and alfaxalone on bitches undergoing cesarean section, evaluating the maintenance of anesthesia, recovery from anesthesia and the effects on puppies. All dogs were induced with alfaxalone intravenous, mechanically ventilated, analgesia being administered after the delivery of puppies. The results of this study suggest that maintenance of anesthesia with an alfaxalone CRI during the cesarean section has similar cardiopulmonary effects to isoflurane but induces longer recoveries in the mothers, while puppies are associated with lower Apgar scores. However, survival and mortality were similar to those obtained with isoflurane (Ruiz et al., 2016).

RECOVERY

Following the closure of the skin, pain management is obtained with local infiltration of anesthetics at the surgical incision in the dam, and often lidocaine (2 mg/kg) or bupivacaine (2 mg/kg in combination with lidocaine) are administered (Baltzer, 2013). It is recommended that after having a cesarean section, the administration of NSAIDs be restricted to only one dose, (Mathews, 2005) and be administered only if the dam is normotensive and normovolemic (Costea, 2016). Oxytocin can be administered to aid uterine involution (Dugdale, 2010). Puppy survival and acceptance are directly linked to the length of the period between first breath and first contact with the mother. For this purpose it is preferred that the recovery from caesarean sections be as short as possible (Ruiz et al., 2016).

CARE AND EVALUATION OF NEWBORNS

Loses to neonatal diseases can be managed by identifying the neonates at risk as soon as possible. The development of a protocol for neonatal assessment is therefore fundamental to this identification as well as allowing a greater knowledge of neonatal physiology (Vassalo et al., 2015). More authors evaluated the newborns viability using the Apgar score, which consisted in assessing puppy`s heart rate, respiratory rate, reflex irritability, motility and mucus color (Silva et al., 2009; Veronesi et al., 2009; Groppetti et al., 2010; Batista et al., 2014). Besides this, blood samples were taken and handed for laboratory analysis. There are many factors to consider during evaluation of the newborn. The most important immediate factors are respiration and body temperature. Immediately after delivery, the fetal membranes should be removed from the neonate's face and the umbilical cord is clamped and cut distal to the clamp (Johnson, Casal, 2012). The neonate is cleaned and dried, and stimulated by rubbing with a warm, clean, dry towel. Also, holding the neonate with its head and neck slightly lower than its body will allow fluid in its mouth and pharynx to flow out (Waldemar et al., 2010). The risk of hypothermia is increased in neonates, meaning that maintaining warmth is of great importance. Last but not least, in case the newborn does not breathe spontaneously, it has to be stimulated and oxygenated. The pups can be intubated using a flexible 14 or 18G intravenous catheter or 2.0-3.0 OD endotracheal tube (Kraus, 2016). An aspiration/resuscitation device can be used to clear respiratory tract and stimulates the respiratory reflex. Another method of respiratory stimulation is acupuncture, involving the use of a 25G needle which is inserted into the nasal philtrum until it contacts bone and then twisted. As a final measure, doxapram in a dosage of 1 to 5 mg (approximately 1 to 5 drops from a 20- to 22-gauge needle) can be topically administered to the oral mucosa or injected intramuscularly or subcutaneously. If the neonatal respiratory depression is thought to be related to the dam`s anesthesia or sedation, then naloxone and atipamezole may be used as antagonizing agents (Dugdale, 2010). During fluid therapy, neonates are more predisposed to dehydration or fluid retention (Johnson, Casal, 2012). Fluids may be administered via an IV, IO, intraperitoneal, SC, or oral route. Depending on the circumstances, Ringers`s solution, lactated Ringer's, dextrose-containing solutions, or blood products may all be used (Moon et al., 2001; Lopate, 2009). Newborns are also exposed to hypoglycemia due to more factors, like: poor maternal nutritional status, dystocia, low birth weight, hypothermia, infection, hypoxia, inadequate nutrition, and congenital metabolic disorders (Casal, 1995; Lawler, 2008; Haskins, Casal, 1996; Davidson, 2003). Hypoglycemia is treated by administration of dextrose, to effect (PO, IV, IO, or SC). After improving the newborns' vital signs, suckling and bounding with the dam is essential.

CONCLUSIONS

It is highly important that the anesthetic protocol be tailored to each patient. Therefore, various anesthetics protocols during cesarean section have been studied by a multitude of authors. Due to its limited effects on the fetuses and the short recovery time of the mother, the epidural anesthesia has been proven to be the most successful procedure (Moon et al., 2004; Scarda, Tranquilli, 2007). The downside is represented by the fact that the dam is not intubated, which leads to an increased risk of hypoxemia, regurgitation and aspiration pneumonia (Luna et al., 2004; Ryan, Wagner, 2006). However, most of the authors prefer general anesthesia, with good results being registered after using alfaxalone or propofol as an induction agent. The use of either of the two induction agents has been shown to result in viable and healthy newborns with an increased Apgar score (Doebeli et al., 2013; Metcalfe et al., 2014). Tranquilizers, sedatives and analgesics should ideally be avoided until the newborns have been delivered (Wiebe, Howard, 2009). During the maintenance phase of the anesthetic procedure, isoflurane has been positively associated with the newborns being vocal, which again is a sign of vigour and good survival score (Moon, Erb, 2002). Regardless of the anesthetic protocol used, the main aim is to minimise the length of the entire procedure, and thus reducing the cardiovascular and neurological depression in the newborns. It is also equally important to ensure that the mother has a speedy recovery, allowing her to care for the newborns as soon as possible.

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