# ANESTHESIA CONSIDERATION FOR THE PREGNANT DOG

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**Abstract.** This material shows a selection of safest and most effective possibilities of anesthesia for pregnant female dogs, a common situation in general practice. Gestation induces a lot of physiological changes to the dam, especially to hematologic, cardiovascular, respiratory and gastrointestinal systems. Premedication can decrease maternal anxiety and stress being preferred agents that can be reversed. All pregnant animals prior to anesthesia should be preoxygenated and fluid therapy is mandatory. Induction of anesthesia is preferred to be performed using propofol or alfaxalone. Choosing a general anesthetic protocol or a regional anesthesia protocol in pregnant females is a personal option based on the experience of each veterinarian. Monitoring vital functions is required throughout the perianaesthetic period to permit early detection and treatment of adverse changes. Resuscitation of newborns is a challenging task, requiring adequate staff and equipment.

**Keywords:** anesthesia, pregnancy, dog

## INTRODUCTION

Anesthetizing pregnant animals is a challenge because the veterinarians need to use a protocol that will assure o good outcome for both female and fetuses. A major feature of anesthetics is to cross the blood brain barrier but this means that they can cross the placenta and exert their effect on the fetuses as well, leading to fetal depression and possible poor survival rate (Clarke et al., 2014). Pregnant females have significant physiological changes that are also an important element in choosing anesthetics. With all these elements, if we add that the anesthesia of pregnant patients is often done in an emergency, without much clinical and paraclinical information, we realize that it is indeed a complicated task. This material covers the main physiological changes and management of anesthesia in pregnant bitches and neonatal resuscitation measures.

***Physiologic changes during pregnancy***

Most information about how gestation influences anesthesia were obtained from the research in humans and goats and were extrapolated to pet animals (Kushnir, 2012). The human fetus at term represents ~ 5% of the mother's weight but in the case of canines this value is on average 16% (Dawes, 1968). The pregnant uterus compresses and displaces the stomach and intestines, which, together with specific hormonal changes, leads to a reduced intestinal transit, lower esophageal tone and high risk of vomiting (Besancon et al., 1998). The possibility of aspiration pneumonitis is well-known complication in pregnant women under surgery, and was reported as a cause of death in bitches (Moon et al., 1998). Pregnancy may cause a mild decrease in liver function, and an increase in glomerular filtration up to 60%, but these changes are most of the time of no clinical importance (Shnider, 1978).

Gestation influences the cardiovascular system by several mechanisms. In women, the productions of red blood cells increase, but not enough to match the increase in plasma volume, the result being pregnancy anemia correlated with the increase of maternal blood volume by 30-40% (Tan, 2013). The same type of changes was also reported in pregnant canines (Allard et al., 1989; Thurmon et al., 1996). Reduction in plasma volume leads to a

decrease in hematocrit, total protein and oncotic pressure, all contributing to a decrease in protein binding of anesthetic drug that may lead to an increase in the free fraction of anesthetics (Branson, 2007; Kushnir, 2012). Up to 25% of the cardiac output during pregnancy is directed to the uterus and placenta. In gestation the cardiac output is increased up to 30-50% above normal which may further increase with an additional 10-25% during labor as a result of blood being extruded from the contracting uterus (Short, 1987; Oana et al., 2011). Although blood volume, heart rate, and cardiac output are elevated during pregnancy, central venous and systemic blood pressures remain relatively unchanged, with mild decrease in systemic vascular resistance due to elevated estrogens (Ken, 1968; Ueland, 1966; Muir, 1995). The elevated abdominal pressure may compress the caudal vena cava, especially when the patient is in dorsal position with decreased venous return and impaired perfusion to the uterus and fetus due to the weight and possible placement of a gravid uterus upon major vessels. (Besancon, 1998; Kerr, 1973; Kushnir, 2012). The dorsal recumbency should be minimized in pregnant females. The described changes above are of major importance if we consider that most anesthetics have a cardiovascular depressant effect.

Perhaps the most important physiological changes during gestation are those of the respiratory system. The high serum level of progesterone causes an increased sensitivity to partial pressure of carbon dioxide in arterial blood (Besancon, 1998). In pregnant females, a mild respiratory alkalosis is recorded, with no consequences on pH as long as renal function is effective. The hyperventilation due to increased respiratory frequency and higher tidal volume associated with a loss of functional residual capacity of the lungs makes arterial oxygen levels to remain similar to non-pregnant patients (Short, 1987). As a result of a decrease in functional residual capacity at a time when oxygen demands are rising, maternal respiratory depression without supplemental oxygen can easily result in hypoxia and hypercapnea (Muir, 1995).

Gestation cause a decrease of inhaled anesthetic requirement, MAC (Minimal Alveolar Concentration - potency of anesthetic gases) is reduced in a progressive way and is about 40% lower at parturition time (Palahniuk, 1974). It is believed that progesterone would have an influence on reducing the need for inhaled anesthetics and local anesthetics for pregnant animals (Paddleford, 1992).

Because of the multitude of physiological changes seen in pregnant animals, they have a much higher anesthetic risk compared to non-pregnant animals that would be under general anesthesia and approximately similar surgery.

***Anesthesia for non-obstetric procedures***

When an anesthesia is performed for non-obstetric reasons, the protocol should be tailored to the specific needs of each patient and possible effects on the fetus. The mother has to provide tissue perfusion, oxygenation and metabolism both for her and for fetus or embryo avoiding teratogens (Gutsche, 1978). The only anesthesic incriminated for teratogenic effects is midazolam, it could produce palatoschizis in children. Some authors indicate that nitrous oxide may also have teratogenic risk (Lane et al., 1980).

For preanesthesia, low doses of acepromazine may be given, adrenergic alpha 2 agonists would be better avoided due to cardiovascular depression and increased uterine tonus. Among opioids the most recommended are pethidine and butorphanol with minimal respiratory depression. Administration of an anticholinergic is indicated rarely, just to increase the heart rate if opioid-induced bradycardia occurs but increased afterload from vasoconstriction, results in increased myocardial oxygen demand (Wheaton, 1989). Benzodiazepines produce good skeletal muscle relaxation and light sedation but they can potentiate respiratory depression when there are associated with opioids (Brock, 2000).

Premedication with metoclopramide or cimetidine has been suggested by some authors to decrease the risk of esophageal reflux and regurgitation (Paddleford, 1992).

For anesthetic induction, in the absence of other contraindications, propofol, etomidate or ketamine may be administered by slow intravenous injection in order to titrate the dose carefully to effect (Kushnir, 2012).

Maintenance of anesthesia can be carried out with inhalation or injectable anesthetics. For the entire perianesthetic period, perfusion, blood pressure, ventilation, oxygenation and temperature must be monitored and every abnormality immediately corrected. For these patients, perianesthetic mortality occurs mostly in the recovery period, for this reason the monitoring and support should continue in this stage also. One of the most characteristic complications of anesthesia for pregnant patients is abortion. It is yet difficult to figure out between abortions induced by the pathology that required anesthesia or the anesthetics and sequels of anesthetics (Kushnir, 2012).

***Anesthesia for cesarean section***

As about 16 % of all pregnant bitches suffer from dystocia when giving birth and more than 60 % of bitches with dystocia end up having a cesarean section, performing an emergency section is a routine procedure of outermost importance in small animal obstetrics (Bergstrom et al., 2006). A satisfactory anesthesia for cesarean section can be achieved in various ways; however, some basic principles must be respected. The most important elements for success in this procedure are short as possible anesthetic and surgery time; prolongation is associated with decreased neonatal viability (Kushnir, 2012; Traas, 2008). Cesarean section can be safe and effective as long as there is familiarity with the particular anesthetic regime, knowledge of the physiological changes that are induced by pregnancy, and anticipation into any possible complications that might be encountered (Besancon, 1998). Prior anesthesia, the female must be stabilized and all identified imbalances must be corrected, especially glucose, fluids and electrolytes. All the preoperative preparation of the dam is to be done while she is awake in order to reduce the time span of anesthesia (Kushnir, 2012). Cesarean can be performed under the effect of general anesthesia or regional anesthesia. Each technique has advantages and disadvantages, most practitioners use general anesthesia because they are more confident and familiar with it compared to the possibility of successful regional anesthesia.

In principle, epidural anesthesia may be ideal for many cases of dystocia, however, but if the anesthetist is not experienced, the administration technique may take too long and the effects are not exactly those expected. Also this procedure is not indicated for females with hypovolemia and sepsis. Due to the increased sensitivity of pregnant females, the local anesthetic doses recommended in epidurals are reduced up to one-third of the usual ones (Raffe, 2007). We do have couple of issues related with epidural anesthesia. The technique is not without risk for the newborn, the main one is vasodilation caused by sympathetic blockade that induce hypotension and hypoperfusion. Sometimes the epidural can be performed under light sedation especially if the dam is exhausted after prolonged labor. Performing cesarean under the epidural effect raises ethical problems because on one hand the restrain of the conscious patient in this intervention does not differ much from that required for an ultrasound examination, but on the other hand, any movements during the operation are difficult to be interpreted as reactions to pain or just discomfort (Kushnir, 2012).

General anesthesia has several advantages when used for cesarean section, including speed of onset and ease of induction, reliability, reproducibility and controllability. General anesthesia provides optimal surgical conditions with muscle relaxation and immobile patient

(Besancon, 1998). The disadvantages associated with general anesthesia for cesarian are greater neonatal depression, ovardosage of dam can occur easily and the release of maternally-derived catecholamines can result in hypertension and decreased uteroplacental perfusion. All of this can lead to fetal and maternal stress, depression of cardiopulmonary function, fetal hypoxia leading to decreased fetal viability (Benson, 1994; Holland, 1991). For premedication it is recommended to use opioids with mild side effects like pethidine and butorphanol, with or without associated with anticholinergics. Alfa 2-agonists and phenotiazine tranquilizers are not recommended for patients undergoing cesarian section due to higher risk of puppy mortality (Moon, 2000). Midazolam is has a shorter duration of action than does diazepam, thus midazolam is the preferred benzodiazepine for cesarean section (Read, 2002).

Preoxygenation for couple of minutes prior to induction is highly recommended. Induction may be performed with all induction agents; however outcomes are better with propofol and alfaxalone (Conde Ruiz et al., 2016). Halogenated agents may be used for induction on sedated animals; nevertheless they offer a slower onset that may be disadvantageous. After the patient has been induced, tracheal intubation should be rapidly performed to have control of the dam airways. Anesthesia maintenance can be managed with isoflurane or sevoflorane and repeated boluses of propofol or alfaxalone. Fluid support should be used in the dam and after delivery of the last puppy the anesthesia, mainly the analgesic depth is increased. For the entire perianesthesic period, monitoring of major functions is extremely important. A balanced protocol with an inhalant and an injectable anesthetic may be ideal, considered almost equal to epidural anesthesia but is technically challenging (Moon et al., 2000).

***Caring for the Newborn***

Before starting cesarean section, several preparations must be made in order to resuscitate the newborns. Assisting staff and sufficient equipments and material should be prepared (oxygen supply, pre-warmed box, dry and warm towels, devices for suction the mouth and nose, haemostatic clamps, small endotracheal tubes, monitoring devices, anesthetic antagonists and respiratory stimulants) (Kushnir, 2012). The dam and puppies should be reunited as soon as clinically possible, with monitoring and support continued as needed (Raffe, 2007; Traas, 2008).

## CONCLUSIONS

Anesthesia for pregnant dogs is performed for a variety of reasons and could be elective or emergency procedure. Regardless of the chosen anesthetic protocol, it must provide optimal maternal and fetal conditions with minimal neurological and cardiovascular depression. If the team is well prepared, having sound knowledge about the physiological changes that take place in the maternal body, having a thorough knowledge about the physiological changes that take place in the maternal body, how they influence anesthesia together with implementation of procedures for resuscitation of the offspring, the outcome should be positive for both dam and puppies.

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