Anesthesia and Pain Management in Pregnancy

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Maternal Physiology
Pregnancy causes maternal physiologic and anatomic adaptations associated with the increased metabolic demand imposed by the growing fetal and uterine mass. Many or most of these adaptations impact anesthetic management of the periparturient, particularly those management aspects related to cardiorespiratory, gastrointestinal, and hematological systems.

Cardiac changes
During pregnancy, oxygen consumption increases to meet the increased metabolic demand associated with the growing fetus(es) resulting in a compensatory blood volume increase and total red blood cell count increase. However, the packed cell volume, plasma protein, and colloid osmotic pressure decrease. Cardiac output, heart rate, and stroke volume all increase by 30 to 50% resulting in increased chamber size of the heart and increased cardiac mass. Atrial stretching can result in arrhythmias in pregnant patients. Systolic arterial blood pressure typically is decreased due to the vasodilatory effects of progesterone. Blood flow distribution changes in pregnancy with an increase in blood flow to the skin, uterus, kidneys, and mammary tissue and decreased skeletal muscle and visceral blood flow. As much as 20-25% of total cardiac output is to the uterus.

Respiratory changes
Maternal respiratory changes are often due to the enlargement of the abdomen. Total lung capacity, chest wall compliance, and functional residual capacity (FRC) all decrease. However tidal volume and minute volume increase. Long periods of apnea can more readily result in hypoxemia and hemoglobin desaturation due to the decreased FRC and the increased oxygen consumption associated with pregnancy. Because of this preoxygenation prior to anesthetic induction is advisable and apnea should be aggressively avoided during anesthesia.

Gastrointestinal changes
Progesterone causes a decrease in lower esophageal sphincter tone, increased gastrin production by the fetus and placenta resulted in increased gastric acid production, and the enlargement of the abdomen causes physical outflow obstruction prolonging gastric emptying and increased intragastric pressure. The result is acid reflux into the esophagus and an increased likelihood for regurgitation and potential aspiration during anesthetic induction and maintenance.

Renal changes
Glomerular filtration rate increase and serum creatinine concentrations are decreased during pregnancy. Hemodilution and proteinuria are commonly observed in pregnant patients.

Pregnancy and pain
Increased progesterone and its metabolites (pregnanolone and pregnanedione) results in decreases in anesthetic drug requirements (MAC decreases 25-40% during pregnancy).

Management of patients for cesarean section
Pregnant animals should be pre-oxygenated when possible. Some animals may be resistant to the placement of a facemask; therefore preoxygenation may not be possible. In either case, it is important to intubate pregnant animals as soon as possible following anesthetic induction due to the increased potential for regurgitation and aspiration.
Most cesarean sections in dogs and cats are performed on unpremedicated animals because all commonly used anesthetic drugs will cross the placenta. Sedatives and tranquilizers have cardiovascular and respiratory side effects for the dam and fetus that can result in increased fetal mortality. Pre-anesthetic sedation should be avoided to minimize cardiorespiratory depression in the fetus(es).

Propofol is the drug of choice for anesthetic induction for cesarean section. Propofol has a short half-life, rapid hepatic and extrahepatic metabolism, and manageable respiratory and cardiovascular side effects. Fetal mortality has been demonstrated to be equivalent with propofol as with mask induction using isoflurane and without the rough induction characteristics associated with inhalant anesthetic inductions.

It is recommended to maintain as light a plane of anesthesia as possible to minimize inhalant delivery across the placenta.

Infiltration of local anesthetic along the line of the incision may be helpful to reduce inhalant concentrations and minimize systemic effects of inhalants. Some patients will even allow the anesthetist to perform this line block prior to induction of general anesthesia.

Cardiovascular and respiratory parameters of the dam should be monitored during general anesthesia, consisting of heart rate, blood pressure, and hemoglobin saturation. These parameters are important as indirect indices of uteroplacental perfusion.

Pain management should be provided to cesarean section patients. Typical signs of pain in these patients include lack of appetite, not allowing nursing, immobility, difficulty rising, and vocalization during activity. Many veterinarians administer a dose of opioids once the fetus(es) have been surgically removed. Buprenorphine is often used for this purpose since it has a long duration of action and has minimal cardiovascular and respiratory side effects to the dam. However, milk transfer has not been evaluated for any of the opioids in lactating bitches or queens. Administration of NSAIDs in pregnant dogs and cats has not been evaluated, have not been evaluated in puppies younger than 4 to 6 weeks. Milk transfer of these drugs is also possible, though unlikely.

**Key points for cesarean section**

It is important to minimize the time from drug administration to delivery of the fetus(es), and minimize anesthesia and surgical time. Choose drugs that neither induce nor prevent uterine contractions, and minimally cross the placenta. Prevention of maternal hypoxemia or hypotension will result in less fetal depression at delivery. It is also important to minimize postoperative maternal depression to ensure care of the neonates.

Choice of anesthetic technique should be influenced by familiarity and avoidance of excessive maternal and fetal CNS depression. Intubation and intravenous catheterization should be performed in all animals having cesarean section.