Anesthetic Considerations During Pregnancy

Physiologic Alterations

- Respiratory System
  - Increased inhalant anesthetic uptake
    - Anesthetic overdose is possible
  - Pressure from growing fetus on diaphragm
    - Reduced functional residual capacity – atelectasis
    - V/Q mismatch
    - Hypoventilation
    - Hypoxemia
    - Preoxygenate and monitor pulse-ox and capnograph
  - Increased oxygen consumption
    - Limited ability to withstand hypoventilation/apnea without hypoxemia is limited
    - Preoxygenate!
- Cardiovascular System
  - Increased Plasma volume, RBC mass, HR, and SV
    - Dilutional physiological anemia, increase in CO
    - Reduced cardiovascular reserve and hypotension can occur easily
    - Reduced blood flow to fetus
    - IV access, address blood loss, monitor HR, ABP and reduce cardiovascular stress by managing pain and anxiety
  - Increased intra-abdominal pressure
    - Aorto-caval syndrome
    - Reduced preload and drop in CO
    - Careful while changing the recumbency of the patient
- Gastrointestinal System
  - Decreased GI motility, increased intragasatric pressure, reduced LES tone
    - Increased GI transit time
    - Vomiting, regurgitation, and aspiration are potential complications along with hypoventilation and hypoxemia
  - Increased gastin levels
    - Gastric acid pH is reduced
    - Chemical pneumonitis from potential aspiration
    - Hypoxemia
    - Hypoventilation
  - Condiserations
    - Preoperatively consider prokinetics and H2 blockers, PPIs
    - Use rapid induction technique with an injectable drug

        - ETT should be inflated properly
        - Monitor capnography and pulse oximetry
        - Extubate when laryngeal reflexes are present
        - Have suction supplies available!
- Nervous System
    - Increased levels of progesterone and endorphins
        - Decreased MAC
        - Anesthetic overdose
        - Watch anesthetic depth closely!
    - Engorgement of blood vessels in fat and epidural space
        - Relative decrease in the side of epidural space
        - Increased cranial spread of drug in epidural space
        - Decrease epidural drug volume by 1/3rd to 1/4th
    - Overall idea is that inhalant anesthetic toxicity can occur due to the physiologic decrease in anesthetic dose and increased anesthetic uptake
- Uterine Blood Flow
    - Fetal oxygen delivery is directly proportional to uterine blood flow
        - Factors leading to reduced uterine blood flow
            - Maternal hypovolemia
                - Fluid therapy
            - General anesthesia
                - Balanced anesthesia
            - Perianesthetic stress, pain, and sympathetic tone
                - Low stress handling
            - Uterine contractions
                - Avoid excessive use of ecbolics
            - Vasodilation
                - Oxytocin can cause vasodilation
            - Hyperventilation
                - Use capnography to monitor

Pharmacological Alterations

Maternal

- MAC reduction
    - Titrate inhalant anesthesia carefully
- Decrease in plasma cholinesterase enzymes
    - Higher sensitivity to ester local anesthetics (procaine, benzocaine, tetracaine)
- Altered drug PK of renally excreted drugs
    - Titrarate drug administration

Fetal

Drugs that cross the BBB can cross the placental barrier
Anesthetized mother = Anesthetized fetus!

- Consider the physiochemical properties of drugs and the concentration gradient between the mother and fetus
    - Ion trapping of basic drugs (opioids and local anesthetics) can occur due the pH gradient between the mother and fetus plasma
    - Placenta type also plays a role
        - Epitheliochorial

Drug	Considerations
Phenothiazine (acepromazine)	Not typically recommended in pregnant animals Can cause profound depression of mother and fetus
Benzodiazepines (midazolam, diazepam)	Significant depression of neurological reflexes May not be an appropriate choice during C-sections
Alpha-2 adrenergic agonists (dexmedetomidine, xylazine)	Profound cardiovascular depression Study showing the use of xylazine in the anesthetic protocol increased the odds of puppy mortality after C-section Use should be carefully evaluated during C-sections
Opioids (butorphanol, morphine, hydromorphone)	Minimal maternal cardiovascular depression Reasonable option for premedication *fetal respiratory depression may occur
Anticholinergics (atropine, glycopyrrolate)	Can be considered if bradycardia is leading to hypotension Atropine can cross the placental barrier but glycopyrrolate does not Glycopyrrolate can increase gastric acid pH which may lead to reduced damage from chemical pneumonitis if regurgitation occurs

Anesthetic Plan

Premedication: Opioids alone are an appropriate choice in most patients

Induction: Propofol, Alfaxalone, Etomidate are all appropriate options. Goal is to achieve quick induction and control of airway with a suitable sized cuffed ET tube to reduce the risk of aspiration. Inhalant induction is NOT recommended! Ketamine is also NOT recommended due to profound fetal depression, poor spontaneous ventilation, and poor neurological reflexes

Maintenance: Isoflurane or sevoflurane have been associated with good neonatal vitality and survival. Maintain the mother on LOW inhalant anesthetic concentrations to minimize cardiovascular depression (reduced MAC in pregnant animals). TIVA has been associated with longer recovery times in the mothers and lower puppy vitality compared to isoflurane.

Locoregional Anesthesia

- Lumbosacral epidural drug administration
- Sole technique or in conjunction with general anesthesia
- Can add an opioid like morphine into the epidural for a prolonged duration
- Cautions
    - If excessive cranial spread occurs, sympathetic nerve root blockaded can occur and result in hypotension
    - Decrease the epidural drug volume up to 1/3rd to 1/4th

Lecture Overview

- Inhalant anesthetic uptake is increased and MAC is reduced
    - Potential for inhalant anesthetic overdose
- Higher susceptibility to hypoxemia
    - Preoxygenation is critical
- Cardiovascular reserve is poor
    - Critical to monitor and support CVS
- Increased risk of vomiting, regurgitation, and aspiration
    - Use pulse-ox and capnography to assess respiratory function
- Most anesthetic drugs cross the placenta
    - Anesthetized mother means anesthetized fetus
- Consider use of epidural anesthesia during C-sections
    - Reduces requirement of inhalant and systemic analgesics
    - Decrease epidural drug volume
- Consider analgesics with low lipophilicity in mother
    - Decreased passage into milk