Anesthesia for Pregnancy & C - Section

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ACVAA
FOUNDED IN 1975

AMERICAN COLLEGE OF VETERINARY ANESTHESIA AND ANALGESIA

Big picture

- Physiologic changes that impact anesthesia
- Anesthetic drugs and suggested techniques
- Safe anesthetic practices and successful outcomes

Changes in Pregnancy

- Physiologic changes
  - CV
  - Pulmonary
  - CNS
  - GI

Maternal Physiology - Cardiovascular

- Physiologic changes optimize nutrient delivery to fetus
  - Inc HR (55%)
  - Inc SV
  - HR x SV = CO
  - Inc CO (30-40%)
  - Uterine BF increases by 20-40x
  - CO needs to meet demand!

Maternal Physiology - Cardiovascular

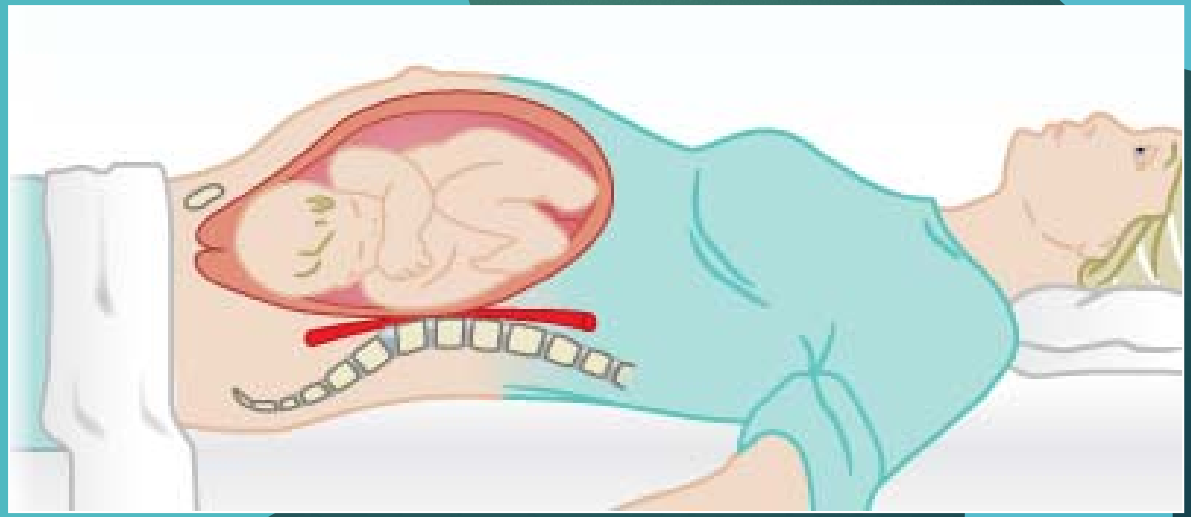
- Decreased blood pressure (10%)
  - MAP = CO x SVR
  - Vasodilation = decreased SVR
  - Progesterone, nitric oxide, prostaglandins

Maternal Blood Changes

- Increased circulating volume (25-35%)
  - Increased aldosterone = **vasodilation**
  - Increase in volume **>** increase in blood components → dilutional **anemia**
  - Decreased albumin
  - Increase in total body water
  - Normal O2 delivery
  - Electrolytes unchanged

Maternal Supine Hypotension

- Compression of aorta, vena cava
- Concern in small animals?
  - Not evident in hemodynamically normal small-medium sized dogs
- Elevate right hip



Maternal Physiology- Pulmonary

- Decreased FRC (20%)
  - Uterus impinging diaphragm
- Mild decrease in total lung capacity (5%)
- Increased RR & TV
  - Increased minute ventilation (70%)
- Chronic respiratory alkalosis
  - $PaCO_2 \sim 30$ mmHg
- Increased oxygen consumption (VO_2)

Maternal Physiology- Gastrointestinal

- Increased risk of reflux & aspiration
  - Prolonged gastric emptying, SI transit time
  - Decreased esophageal sphincter tone
  - Increased intra-abdominal/intra-gastric pressure
  - Increased gastrin production → acidity
- Hepatic function tests increased

Maternal Physiology-Renal

- Increased blood flow (80%)
- Increased GFR (50%)
  - Decreased BUN, creatinine
- Increased bicarbonate excretion
  - Compensatory metabolic acidosis
- Post-partum diuresis
  - Plasma volume normal

Maternal Physiology - CNS

- Decrease in MAC (16-40%)
- Reduced volume of epidural space
  - Increased size of epidural veins
- Decrease volume of CSF
- Increased sensitivity to local anesthetics

Pharmacology and pregnancy

- Few controlled studies exist
- Extrapolated from human, rodent data

Anesthetic drugs and the placenta

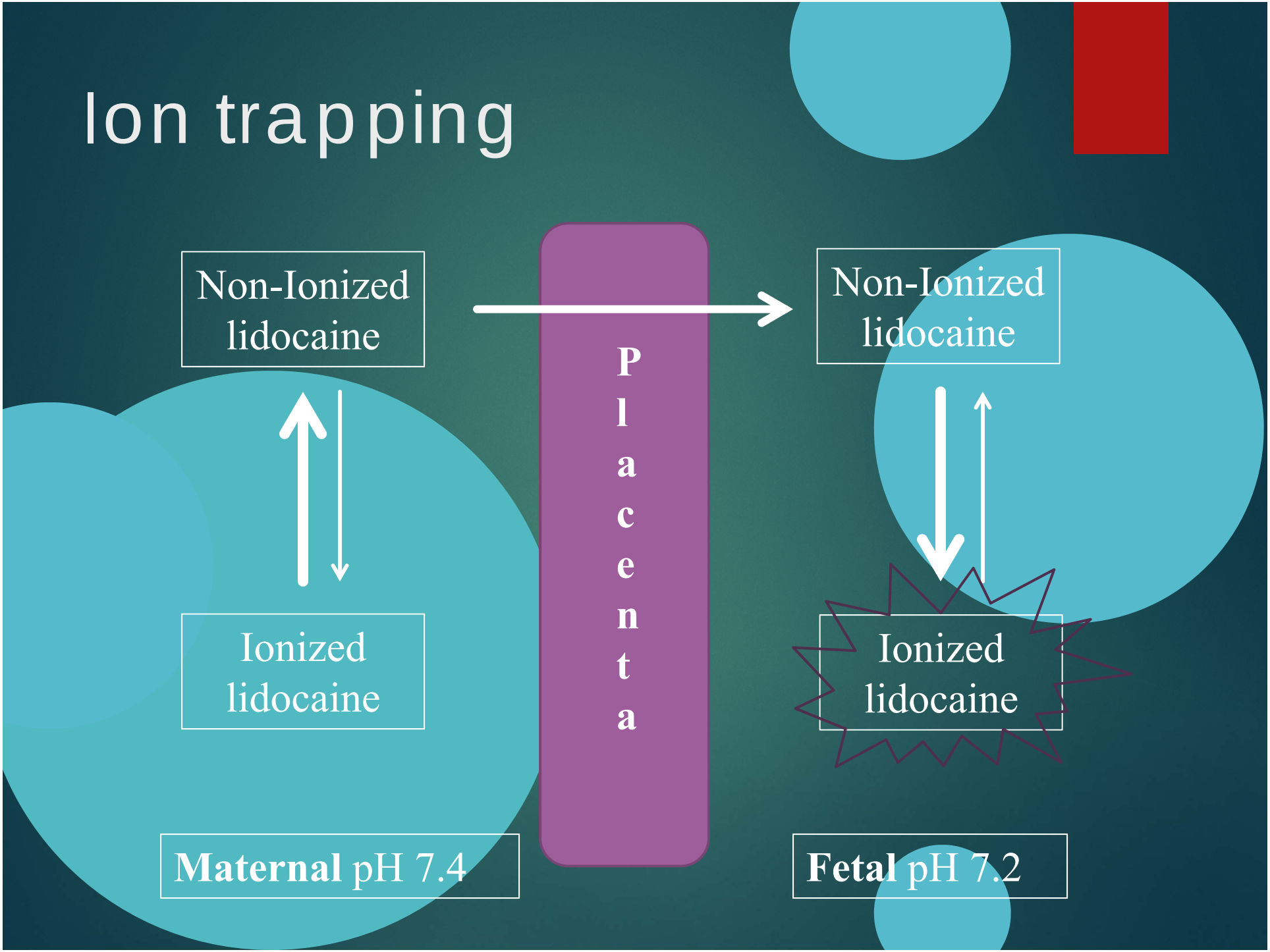
- Lipid soluble
- Size/Molecular weight (<600 Da)
- Non-ionized
- Non-protein bound

- Diffusion gradients to fetus
- Most anesthetic drugs
  - <300Da, highly lipid soluble

Fetal ion trapping

- Non-ionized drugs cross placenta
- Fetal blood more acidic
- Drug pK = pH
- Weak bases (opioids, *systemic* LA, ketamine) become ionized
- Cannot cross back into mother for elimination

Ion trapping



Anesthetic goals

- Maintain oral reflexes
  - Rapid intubation
- Maintain uterine blood flow
  - NO autoregulation
- Maintain PaO2
- Minimize fetal concentrations of drugs that cause respiratory, cardiovascular and CNS depressant effects

Anesthetic agents and pregnancy - Anticholinergics

- Atropine
  - Placental transfer
  - Tachycardia
  - Use with opioids to avoid fetal bradycardia
- Glycopyrrolate
  - NO placental transfer
  - Large molecular weight

Anesthetic agents and pregnancy - Acepromazine

- Slow placental transfer
- HYPOtension could decrease UBF
- Study in cattle failed to demonstrate
- Not associated with increase in maternal or neonatal mortality
- Long lasting, no antagonist
- LOW doses

Anesthetic agents and pregnancy - Benzodiazepines

- Diazepam, midazolam, zolazepam
  - Placental transfer
  - Potential for teratogenesis
    - Increased risk of cleft palate in 1st trimester
  - 'floppy infant syndrome' near term
  - Minimal cardiovascular depression
- Nice in LOW doses
  - Antagonist available

Anesthetic agents and pregnancy - Alpha-2 agonists

- Xylazine / detomidine / dexmedetomidine, etc
  - Rapid placental transfer
  - Significantly decreased UBF
  - Increased intrauterine pressure
  - Increased uterine motility
  - Decreased CO
  - Potentially decreased PaO2
  - Increased likelihood of survival in c-section pups when xylazine NOT used
  - Etc, etc, etc.....
- NOT recommended
  - Use with caution in mares during pregnancy
  - Informed consent!!

Anesthetic agents and pregnancy - Opioids

- Placental transfer
- Fetal depression
  - Dose dependent, more significant in newborn
- Nice in LOW doses
  - Antagonist available

Anesthetic agents and pregnancy - Opioids

- Systemic opioids
  - Fentanyl readily crosses placenta
    - Persists in fetus long after clearing maternal circulation
  - Morphine slower to cross placenta
  - Hydromorphone = intermediate speed
  - Buprenorphine: only 10% reaches fetus
    - BUT NOT EASILY ANTAGONIZED

Anesthetic agents and pregnancy - Ketamine

- Associated with decreased puppy vigor
- Neurotoxicity in 2nd trimester in rats
- Higher neonatal mortality and neurologic depression in puppies
- Increased uterine tone, contractions in early human pregnancies
- No antagonist
- Not recommended in SA

Anesthetic agents and pregnancy – Propofol, Alfaxalone

- Short acting, rapid distribution
- Maternal hypotension
- May dilate placental vessels
- Higher APGAR scores with Alfaxalone
- Safe choices

Anesthetic agents and pregnancy - Inhalants

- Decreased MAC in parturients (16-40%)
- Minimally metabolized
- Rapidly cleared by neonate
  - If breathing!
- Isoflurane, sevoflurane, desflurane all considered safe choices

Anesthetic agents and pregnancy - Blood pressure support

- Ephedrine
  - Increases BP without decreasing UBF in ewes
- Dopamine, Dobutamine
  - Increase BP, decrease UBF
  - Dose dependent
  - Dopamine > dobutamine

Anesthetic agents and pregnancy - Muscle Relaxants

- GG
  - Placental transfer
  - Little effect on foal
- NMBD
  - Little to no placental transfer
  - Not necessary

Considerations for pregnant patients

- High regurgitation risk
  - Avoid excessive sedation
  - Rapidly secure airway
  - Suction
  - PPI, prokinetic, H2 antagonist?
- Avoid preterm labor
  - Avoid stress/catecholamine release
  - Avoid alpha 2 agonists
  - Delay if elective

Considerations for pregnant patients

- Avoid fetal asphyxia
  - Maintain maternal PaO_2
    - Pre, post-oxygenate – ALWAYS!
    - Avoid apnea, atelectasis
  - Maintain maternal $PaCO_2$
    - Use capnography
    - Assist ventilation
  - Maintain uterine blood flow
    - MAP > 70 mmHg

Suggested techniques

- Dog/Cat
  - Alfaxalone/propofol induction + inhalant + epidural
    - maternal opioid after puppies delivered
  - Opioid/propofol/alfaxalone induction + inhalant + line block
    - prepared to reverse opioid in puppies
      - Naloxone
        - Sublingually
        - 1 drop of 0.4 mg/mL OR
        - 1mL/min of 0.04 mg/mL IV
  - One dose post-op NSAIDs
  - Avoid ketamine/midazolam, thiopental
    - Luna 2004, Moon 2002

Suggested techniques

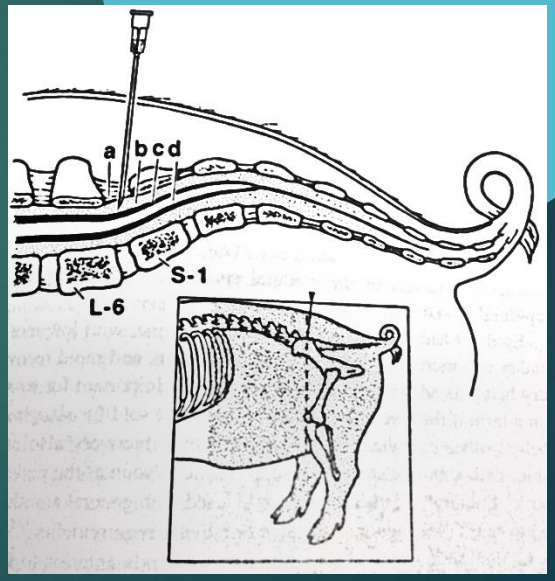
- Local anesthesia
  - Line block
    - SC infiltration 1 mg/kg 0.5% bupivacaine OR
    - 2-4 mg/kg 2% lidocaine
    - Questionable efficacy
- Epidural
  - Least neurological or respiratory depression of puppies (Luna 2004)
  - Dose adjustments for LA!

Suggested techniques

- Horse
  - GG/ketamine induction + inhalant + one dose post-op NSAIDs
    - Maternal opioid after delivery of foal
  - Ketamine/propofol induction + inhalant + one dose post-op NSAIDS
    - Maternal opioid after delivery of foal
  - TIME!!

Suggested techniques

- Cow
  - Epidural or paravertebral regional anesthesia
- Swine
  - Epidural
  - xylazine/ketamine + inhalant



Neonatal resuscitation

- PREPARATION!
  - Bodies
  - Warm towels
  - Pre-warmed incubator
  - ETT, laryngoscopes, airway masks, catheters
  - Oxygen
  - Emergency drugs, pre-calculate dosages
  - Checklists!
  - Video

Neonatal Resuscitation = ABCD's

- Airway
- Breathing
- Cardiac/circulation
- Drugs

Neonatal Resuscitation = ABCD's

- Airway
  - Suction bulb
  - Intubate/mask
- Breathing
  - Supply tactile stimulation
    - Perineal, abdominal areas
    - Doxapram
      - 1 drop

Neonatal Resuscitation = ABCD's

- Cardiac/circulation
  - Check heart rate
    - OXYGEN!
    - Epinephrine 0.1 mcg/kg
- Drugs
  - Reversal agents
    - Naloxone
    - Flumazenil

Neonatal Resuscitation

- Umbilical cord
  - ligate
- WARMTH

Neonatal Resuscitation

- Congenital abnormalities
  - cleft palate
  - limb deformities
  - spinal deformities

Recovery of Mom

- Do not continue narcotics
  - use locals for analgesia
- Alert
  - avoid harm to the babies
- Clean mammary area
- Discharge ASAP

Summary

- Physiologic changes that impact anesthesia
- Anesthetic drugs and suggested techniques
- Safe anesthetic practices and successful outcomes