Anesthesia and Analgesia

Anna Goodroe DVM DACLAM
Anesthesia and Analgesia

- Routinely utilized for clinical and research procedures

- Adaptions for marmosets
  - Small size
  - Elevated metabolic rate
  - Pharmacokinetics and dynamics

- Current trends in drug selection for sedation, anesthesia, and analgesia
Anesthesia and Sedation

• **Anesthesia**: state of temporary induced loss of sensation or awareness
  - Sedation < general anesthesia < surgical general anesthesia

• Drug Selection
  - Inhalant
  - Injectable
Injectable Anesthesia Regimens

- **Single drug**
  - **Ketamine**
    - 20-40 mg/kg IM, sedation
    - 40-50 mg/kg IM, general anesthesia
  - **Alfaxalone**
    - 5-7 mg/kg IM, sedation
    - 7-15 mg/kg IM, general anesthesia
  - Reduced doses can be utilized IV

- **Combinations**
  - **Ketamine 10-20 mg/kg IM**
    - Midazolam 0.1-0.4 mg/kg IM
    - Acepromazine 0.1-0.5 mg/kg IM
    - Dexmedetomidine 0.02-0.03 mg/kg IM
    - Xylazine 1-3 mg/kg IM
  - **Alfaxalone 4-10 mg/kg IM**
    - Ketamine 20-30 mg/kg IM
    - Midazolam 0.3-0.5 mg/kg IM
  - **Ketamine 30-40 mg/kg IM**
    - Alfaxalone 2-4 mg/kg IM
  - **Propofol 2-4 mg/kg IV**
    - CRI 0.6-1.0 mg/kg/min
    - CRI 0.3 mg/kg/min + fentanyl 10-20 ug/kg/h
  - **Midazolam 0.5 mg/kg, butorphanol 0.5 mg/kg, medetomidine 0.05 mg/kg IM**
Inhalant Anesthesia Regimens

• Isoflurane or Sevoflurane

• Provision
  • Mask
  • Endotracheal tube
Intubation

An alternative method of endotracheal intubation of common marmosets (*Callithrix jacchus*)

A A Thomas, M C Leach and P A Flecknell
Anesthetic Gas Delivery
Intravenous Access
Physiological Monitoring

• Muscle tone
• Temperature
• Heart rate and rhythm
• Hemoglobin saturation with oxygen
• Blood pressure
• Respiratory rate, rhythm, and effort
• End tidal carbon dioxide
• Blood gas analysis
Physiological Monitoring

- Muscle tone
- Temperature
- **Heart rate and rhythm**
- Hemoglobin saturation with oxygen
- Blood pressure
- Respiratory rate, rhythm, and effort
- End tidal carbon dioxide
- Blood gas analysis
Physiological Monitoring

• Muscle tone
• Temperature
• Heart rate and rhythm
• Hemoglobin saturation with oxygen
• Blood pressure
• Respiratory rate, rhythm, and effort
• End tidal carbon dioxide
• Blood gas analysis
Physiological Monitoring

• Muscle tone
• Temperature
• Heart rate and rhythm
• Hemoglobin saturation with oxygen
• **Blood pressure**
• Respiratory rate, rhythm, and effort
• End tidal carbon dioxide
• Blood gas analysis
Physiological Monitoring

- Muscle tone
- Temperature
- Heart rate and rhythm
- Hemoglobin saturation with oxygen
- Blood pressure
- Respiratory rate, rhythm, and effort
- End tidal carbon dioxide
- Blood gas analysis
Physiological Monitoring

- Muscle tone
- Temperature
- Heart rate and rhythm
- Hemoglobin saturation with oxygen
- Blood pressure
- Respiratory rate, rhythm, and effort
- End tidal carbon dioxide
- **Blood gas analysis**
Physiological Support

• **Intra procedure**
  • Thermoregulation
  • Hydration/ cardiovascular support
  • Position

• **Post procedure**
  • Recovery environment
  • Nutritional support
  • Symptomatic therapies
Recovery Environment
Nutritional

- Palatable, energy dense, easy to consume
  - Primary diet mixed with favored liquid
  - Alternative complete diet
  - Addition of favored food items
Supportive therapies

• Gastric acid reduction
  • Histamine receptor antagonists (ex famotidine)
  • Proton pump inhibitor (ex omeprazole)
  • Bismuth subsalicylate (ie Pepto bismal)

• Nausea
  • Maropitant

• Gastric motility
  • Metclopramide

• Ulcer treatment
  • Sulcralfate
Analgesic Overview

- **Analgesia**: absence of pain in response to stimulation which would normally be painful

- Local anesthetics
- Non steroidal anti-inflammatory drugs (NSAIDS)
- Opioids
- Additional therapies
Local Anesthetics

• Tissue infiltration, topical application
• Lidocaine 2-4 mg/kg
• Bupivacaine 1-2 mg/kg
Non steroidal anti-inflammatory drugs (NSAIDS)

- Meloxicam 0.1-0.2 mg/kg q24h SC, IM, PO
- Keptoprofen 2-5 mg/kg q12-24h SC
- Carprofen 2.2-4.4 mg/kg q12-24h SC, PO
- Meloxicam SR 0.6 mg/kg SC
Opioids

• Buprenorphine 0.005-0.02 mg/kg IM, SC q6-12h
• Buprenorphine SR
  • 0.03 mg/kg SC
  • 0.12 mg/kg SC
  • 0.15 mg/kg SC
  • 0.2 mg/kg SC
• Butorphanol 0.03-0.2 mg/kg IM
• Fentanyl 1 mcg/kg IV bolus followed by CRI 5-10 mcg/kg IV
Additional Therapies

• Low-level laser therapy
Summary

• Adaptions to accommodate unique physiology

• Limited publications

• Communication is key
The Salk Institute for Biological Studies
Sean Adams
Mathias LeBlanc

Johns Hopkins University
Jessica Izzi
Eric Hutchinson

Biomedical Primate Research Center
Jaco Bakker

University of Utah
Mary Dickerson

University of Pittsburgh
Julia Klara Oluoch

University of California San Diego
Cory Miller

Massachusetts Institute of Technology
Monika Burns

NIMH
Krystal Allen-Worthington

SNPRC
Donna Layne Colon
Melissa De La Garza
Kathy Brasky

Central Institute for Experimental Animals
Erika Sasaki
Takshi Inoue
References

• Ansel, “The Effect of Anesthesia on Blood Pressure Measured Noninvasively by Using the Tail-Cuff Method in Marmosets (Callithrix jacchus)” JAALAS, September 2016.
• Bakker, “Comparison of three different sedative-anaesthetic protocols (ketamine, ketamine-medetomidine and alphaxalone) in common marmosets (Callithrix jacchus)” BC Veterinary Research 2013.
• Bakker, “Effects of buprenorphine, butorphanol, or tramadol premedication on anesthetic induction with alfaxalone in common marmosets (Callithrix jacchus)”, Veterinary Anaesthesia and Analgesia 2018, p 309-319.
• Mansfield, “Clinical Care and Diseases of the Common Marmoset (Callithrix jacchus)” Comparative Medicine, August 2003, p 369-382.
• Thomas, “An alternative method of endotracheal intubation of common marmosets (Callithrix jacchus)”, Laboratory Animals 2012, 46: 71-76.

• Photo Credits
  • Wang Lab, Johns Hopkins University
  • Southwest National Primate Research Center
  • Wisconsin National Primate Research Center
  • Massachusetts Institute of Technology