Anesthesia Considerations in Rodent Biomedical Research

Marcel Perret-Gentil, DVM, MS

University Veterinarian & Director
U. of Texas at San Antonio
marcel.perret@utsa.edu

President
PLAVS
mperret1@gmail.com
www.plavs.net

Anesthesia Types in Rodents

- Injectable (e.g. ketamine cocktails)
- Volatile gas (e.g. isoflurane, sevoflurane)
- Physical (e.g. hypothermia)

Why Anesthetize an Animal

- Avoid pain (loss of sensation)
- Immobilize (muscle relaxation)
- Avoid distress (loss of consciousness)

Injectable or Inhalation Anesthesia?

Injectable - Advantages

- Simple
- Cheap
- Minimal equipment

Injectable Anesthetics - Disadvantages

- Higher morbidity & mortality
  - Hypoxic state
- Easier to overdose
- Slower induction and recovery
- Variable effects - Strain and gender differences
Pentobarbital 60 mg/kg

**Gas - Advantages**
- Precise control over anesthetic depth
- Rapid induction/recovery
- Involves O₂
- Greater consistency between strains and genders = experimental consistency

**Gas - Disadvantages**
- Anesthetic delivery system - $$$???
- Requires a scavenging system
- Yearly calibration
  - Kent Scientific’s SomnoSuite and SomnoFlow never require calibration

**Gas Anesthetics**
- Ether
- Halothane
- Methoxyflurane
- Enflurane
- Desflurane
- Isoflurane
- Sevoflurane

**Isoflurane - Advantages**
- Rapid induction/recovery
- Nearly 100% eliminated in exhaled air...
- Minimal cardiovascular depression
- Inexpensive... eventually!!!
Sevoflurane - Advantages

• Faster induction & recovery than isoflurane

Sevoflurane - Disadvantages

• Greater hepatic metabolism than isoflurane

Anesthetic Gas Recovery as Metabolite

- Methoxyflurane: 50%
- Halothane: 20-25%
- Enflurane: 2.4%
- Sevoflurane: 2-5%
- Isoflurane: 0.17%
- Desflurane: 0.02-0.2%

Somnosuite (Kent Scientific)

- Digital vaporizer
- Pre-warmed gas delivery
- Can deliver isoflurane and sevoflurane
- Temperature control
- Measures
  - Heart rate
  - Respiration rate
  - O₂ & CO₂
- No calibration required
Somnosuite
- 6 lbs
  Warm gas

Typical Anesthesia System
- 30+ lbs
  Cold gas

The Savings

<table>
<thead>
<tr>
<th>Somnosuite</th>
<th>Traditional</th>
</tr>
</thead>
<tbody>
<tr>
<td>Isoflurane</td>
<td>Isoflurane</td>
</tr>
<tr>
<td>Waste Gas Canister</td>
<td>Waste Gas Canister</td>
</tr>
<tr>
<td>1:38</td>
<td>1:36</td>
</tr>
</tbody>
</table>

Kent Scientific

These two replace Somnosuite

Physiosuite

Somnoflow

Open Drop Method of Isoflurane & Sevoflurane Administration
Open Drop

Pathology cassette with isoflurane or sevoflurane soaked material
Centrifuge tube
Depth of anesthesia can be controlled by moving the nose cone closer or farther away from the nostrils
Wire or plastic grate
Absorbent material soaked with anesthetic

Open Drop

Quite useful & easy to apply, but...
- Must be vented out
- Prolonged use = deaths
- Used for very short-term anesthesia (minutes)

Injectable Anesthetics

Ketamine

- Cleared by hepatic metabolism
- By itself - poor anesthetic and analgesic in rodents
- Mix with other tranquilizers or sedatives (‘cocktail’)

Ketamine ‘Cocktails’

- Safer, more ‘balanced’ anesthesia than pentobarbital or ketamine alone
  - Ketamine/xyazine
  - Ketamine/dexmedetomidine
  - Ketamine/xyazine/acepromazine

Ketamine ‘Cocktail’ Reversal

- Atipamezole shortens recovery time of ketamine/xyazine & ketamine/dexmedetomidine
- Atipamezole (0.5-1 mg/kg SC, IP, IM, IV) reverses xylazine & dexmedetomidine (not ketamine)
- Early reversal (10-20 minutes after induction) associated with undesirable behavioral disturbances due to effects of ketamine
Injectables

- Give lowest possible dose
- Supplement with oxygen

Ketamine/Medetomidine Reversal with Atipamezole

Courtesy of Dr. Paul Flecknell

Video Mouse - Anesthetic recovery w Atipamezole reversal

Anesthetic recovery

Urethane

Urethane - Advantages

- IP Administration results in long-lasting unconsciousness of 6-10 hr
- Cardiopulmonary functions minimally affected, including blood pressure due to effects on catecholamine release
- Good analgesia for surgery in rodents

Urethane - Disadvantages

- Peritoneal effusion & hemolysis
- Mutagen/carcinogen
- Readily absorbed through skin
  - pre-neoplastic changes in skin
  - targets multiple organs
  - suppresses bone marrow
  - readily crosses the placenta
  - fetal tumor formation (in utero)
Urethane

- Strict guidelines (gloves, mask, prepare in fume hood)
- Not used for survival surgeries

Resources

Presentations, References & Useful Notes
https://research.utsa.edu/compliance/larc/training.html
www.plavs.net

Marcel Perret-Gentil, DVM, MS
University Veterinarian & Director
The University of Texas at San Antonio
San Antonio, Texas

President
Perret-Gentil Lab Animal Veterinary Services
mperret1@gmail.com
www.plavs.net