Anesthesia Considerations in Rodent Biomedical Research

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Anesthesia Types in Rodents

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

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Why Anesthetize an Animal

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

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Injectable or Inhalation Anesthesia?

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Injectable - Advantages

- Simple
- Cheap
- Minimal equipment

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Injectable Anesthetics - Disadvantages

- Higher morbidity & mortality
  - Hypoxic state
- Easier to overdose
- Slower induction and recovery
- Variable effects - Strain and gender differences

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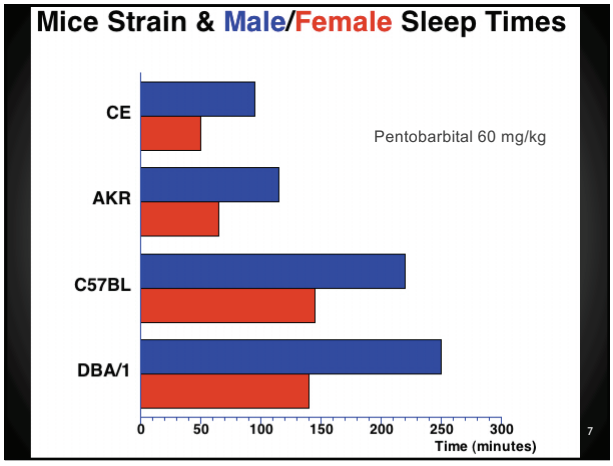

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Gas - Advantages

- Precise control over anesthetic depth
- Rapid induction/recovery
- Involves O_2
- Greater consistency between strains and genders = experimental consistency

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Gas - Disadvantages

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

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Gas Anesthetics

- Ether
- Halothane
- Methoxyflurane
- Enflurane
- Desflurane
- Isoflurane
- Sevoflurane

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Isoflurane - Advantages

- Rapid induction/recovery
- Nearly 100% eliminated in exhaled air…
- Minimal cardiovascular depression
- Inexpensive… eventually!!!

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Isoflurane - Disadvantages

- Some respiratory depression
- Pungent odor may lead to breath holding in rabbits

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Sevoflurane - Advantages

- Faster induction & recovery than isoflurane

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Sevoflurane - Disadvantages

- Greater hepatic metabolism than isoflurane

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Anesthetic Gas Recovery as Metabolite[1]

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

[1]Humans

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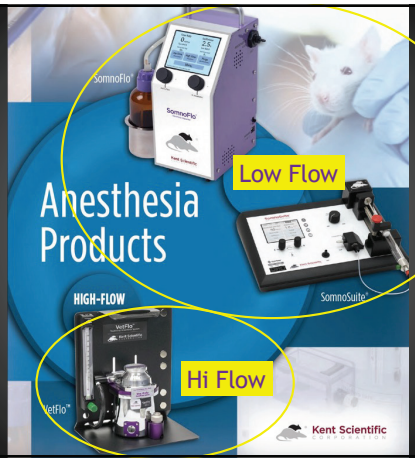

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Somnosuite (Kent Scientific)

- Digital vaporizer
- Pre-warmed gas delivery
- Can deliver isoflurane and sevoflurane
- Temperature control
- Measures
  - Heart rate
  - Respiration rate
  - O_2 & CO_2

No calibration required

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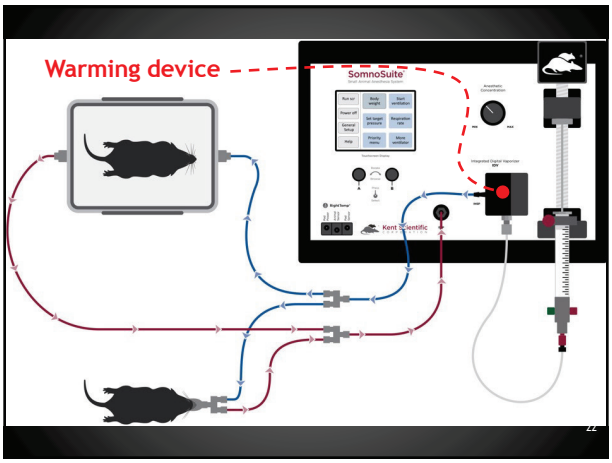

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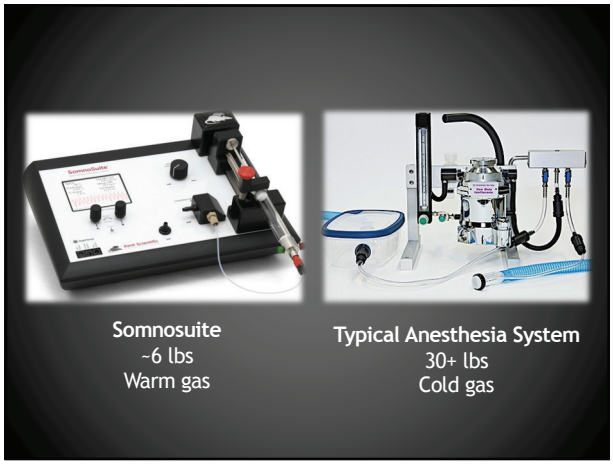

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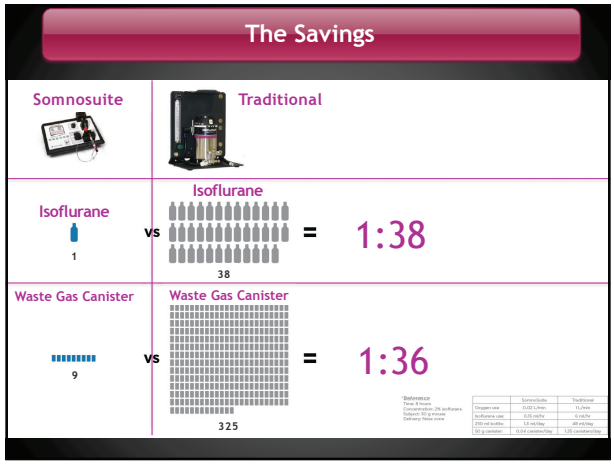

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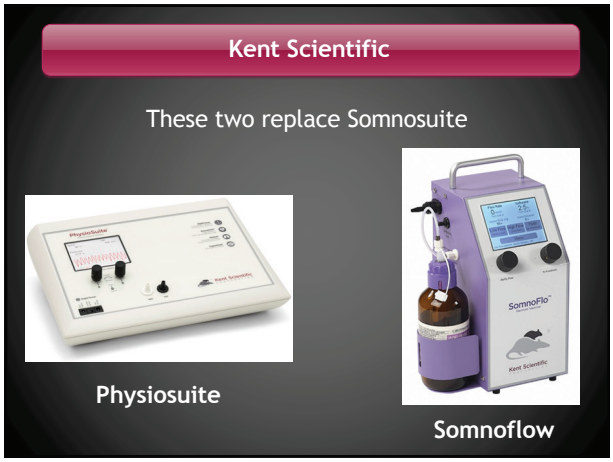

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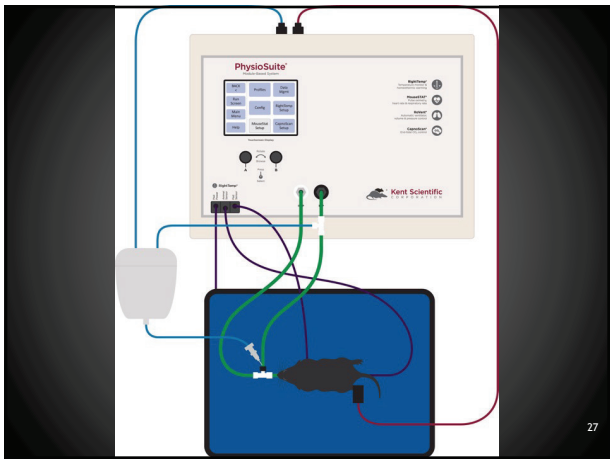

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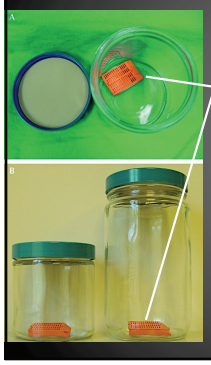
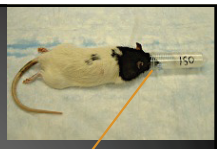
Open Drop



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

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Open Drop

Quite useful & easy to apply, but…

- Must be vented out
- Prolonged use = deaths
- Used for very short-term anesthesia (minutes)

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Injectable Anesthetics

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Ketamine

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

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Ketamine 'Cocktails'

- Safer, more 'balanced' anesthesia than pentobarbital or ketamine alone
  - Ketamine/xylazine
  - Ketamine/dexmedetomidine
  - Ketamine/xylazine/acepromazine

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Ketamine 'Cocktail' Reversal

- Atipamezole shortens recovery time of ketamine/xylazine & 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

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Injectables

- Give lowest possible dose
- Supplement with oxygen

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Ketamine/Medetomidine Reversal with Atipamezole

Courtesy of Dr. Paul Flecknell

Video Mouse - Anesthetic recovery w Atimepazole reversal

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Anesthetic recovery

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Urethane

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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

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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*)

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Urethane

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

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Resources

Presentations, References & Useful Notes

https://research.utsa.edu/compliance/larc/training.html

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