Objectives

Upon completion of this training, you will be able to:

• Understand basic considerations of inhalant and injectable anesthesia
• Utilize methods of induction and maintenance
• Implement scavenging devices (inhalant methods)
• Differentiate analgesic from anesthesia
Outline

• Inhalational Anesthesia
  – Equipment & Circuits
  – Induction & Maintenance
  – Scavenging
  – Monitoring – physical methods

• Injectable Anesthesia and Analgesia:
  – Injectable methods of anesthesia
  – Pre-emptive analgesia
Inhalational Anesthesia

- Mice metabolize drugs rapidly, therefore, many anesthetic agents have brief durations of effect
- An anesthetic regimen should match the duration of drug effects to the length of the procedure
- Gas anesthesia is often chosen to sustain uniformly adequate levels of anesthesia
**Inhalational Anesthesia**

- Inhalation agents support:
  - rapid recovery
  - depth of anesthesia
  - more readily controlled

- An anesthetic induction chamber is the easiest way to induce a mouse that will be maintained on gas anesthesia
  - chamber should match the size of animal
  - surplus gas should be scavenged

**Images:**
- **Rat & Mouse Chambers**
- **Mouse Chamber with Active Scavenging**
- **Four Separate Induction Chambers**
- **Passive Scavenging Canister**
Inhalational Anesthesia

- Rapid respiratory rate in mice = rapid induction
  - A nose cone delivers gas following removal from induction box
- Anesthetic gas should be delivered with 500 ml oxygen per minute using an open circuit
  - gas is delivered via the inner tubing, waste gas evacuated through outer tubing
Many nose cones allow for gas/O2 to leak and this mixture flows over the eye

- Prolonged exposure can cause permanent damage
- Always use eye lubricant before putting on a nose cone
Intraoperative Monitoring

- Anesthetic agents depress respiration, so it is critical to closely monitor the respiratory rate.
- Respirations can be observed by watching the movement of the chest wall or gross changes in rate or character of breathing.
- Take care when draping and positioning:
  - Do not over stretch limbs or press too hard with clear bio-occlusive drapes (e.g. “sticky drapes”)
  - Carefully monitor when using blue drape material.
Intraoperative Monitoring

- COLOR!
- Observe the ears, muzzle and mucus membranes/tongue
- Generally the rule of thumb is:
  - blue = poor oxygenation (respiratory related)
  - pale = poor blood perfusion (heart rate is slowing)
  - pink = healthy
Intraoperative Monitoring

- A more refined method of assessing respiratory function is the use of a pulse oximeter
  - tongue, leg, tail or paw clips and cuffs available
- Body temperature should be also closely monitored for rapid changes
  - rectal temperature probe designed for use in mice
Intraoperative Monitoring

• Anesthetic depth can also be accessed via a toe pinch

• Provision of a source of warmth from onset thru recovery is suggested
  – Human-grade electric heating pads are not recommended because they can become too hot and cause burns
Intraoperative Monitoring

- Animals must be monitored until capable of purposeful movement following cessation of anesthesia
- Provide moistened food on cage bottom as appropriate
SOP 909 Anesthetic Gas Monitoring and Safety Practices…..”Isoflurane is a common halogenated anesthetic gas. Halogenated anesthetics are typically clear, colorless, highly volatile liquids at ordinary pressure and temperature…..odor is not an adequate indication of overexposure…..”
• Inhalant anesthetics must be used with scavenging devices

• Acceptable scavenging methods include
  – downdraft table
  – chemical fume hoods
  – charcoal canisters
  – Type IIB2 biosafety cabinets (vented to the outside)

• Note that charcoal canisters must be weighed before, and after each use
  – the canister should also be weighed during especially long procedures
Isoflurane vaporizer is driven by an oxygen source with flow meter.

Anesthetic vapor is administered to either an induction chamber or to the patient via nose mask.

Excess anesthetic vapor is scavenged away from the patient via the outer tube of the mask.

The excess anesthetic vapor is drawn through a canister of activated charcoal, which absorbs the excess anesthetic gas or is exhausted directly to the facility house-vacuum.
Analgesics

• The proper use of anesthetics and analgesics in all research animals is both a scientific and ethical imperative.

• It should be assumed that procedures that cause pain in humans also cause pain in animals.

• Literature shows that rodents that receive analgesics engage in species-typical behaviors more rapidly than control animals.
Analgesics

The hunched postures and rough hair coat of these animals could indicate pain

- Analgesics should be chosen for:
  - their ability to relieve specific types of pain (i.e., local acting agents for superficial skin pain vs. more potent centrally acting agents for visceral pain)
  - the duration of action

- Consideration should be given to administering the analgesic preemptively to prevent the stimulation of pain receptors
  - shown to reduce the severity and duration of pain following a surgical procedure in humans and other species
  - mice have been shown to return to a state of normal behavior and food consumption more quickly if given preemptive
Analgesics fall into two available drug types
  – Opioids
    • Buprenorphine, Butorphanol
  – nonsteroidal anti-inflammatory drugs (NSAIDs)
    • Carprofen, Meloxicam, and Ketoprofen

The rapid clearance of many of these = an increased frequency of administration
Injectable Anesthesia

- Injectable anesthetics associated with:
  - lower margin of safety
  - respiratory depression
  - prolonged recoveries
  - hard to control anesthetic depth

- Generally used in a “cocktail” mixed with sedatives and analgesics
Injectable Anesthesia

• Bolus injections (IP or SC) may produce a surgical level of anesthesia for periods ranging from 20 to 45 minutes
  – duration affected by the strain/stock of mouse
  – repeated dosage is not recommended
  – is good choice to accommodate special equipment

  e.g.: stereotaxic procedures can limit accessibility / use of gas anesthesia because of nose bars used to position
Injectable Anesthesia

- The weight of the mouse must be accurately determined when using injectable anesthetic agents
  - weighed immediately before the procedure
- Injectable agents often have to be diluted to obtain a measurable volume for injection
- Titration of anesthesia
  - additional doses of 20-25% of the original dose can be administered if the animal fails to achieve or maintain the level of anesthesia necessary
Additional resources:

- Lessons 14, 15, 17. A.L.L. “Working with the Laboratory Mouse”
- SOP 909 “Anesthetic Gas Monitoring and Safety Practices”
- Lessons 1-12 A.L.L. “Post-Procedural Care of Mice and Rats in Research: Minimizing Pain and Distress”
- USF IACUC Principles and Procedures
Quiz Questions

1. Mice metabolize drugs like any other species (e.g.: duration of drug affects are the same).
   - a. true
   - b. false

2. Since mice have such a high respiratory rate, they tend to have a slower induction rate than other slower breathing species.
   - a. true
   - b. false

3. When anesthetizing a mouse, it is always a good idea to use topical ophthalmic ointment such as Puralube to prevent ocular dryness/injury.
   - a. true
   - b. false
Quiz Questions

1. When positioning mice for surgical procedures, it is important to incorporate restraint devices carefully, as they can impact the mouse’s ability to breathe properly.
   a. true
   b. false

2. Color is a good indicator of patient status during anesthetic event; which of the following statements below is correct.
   a. Pink is too much oxygen, blue is poor oxygenation
   b. Blue is poor oxygenation, paleness is poor blood perfusion
   c. Pink is normal, pale is of little concern in dark mice

3. Mucus membrane, ear, muzzle, tail and tongue color are useful observations in
   a. White mice only
   b. Dark mice only
   c. All mice can be observed this way
Quiz Questions

1. Appropriate scavenging methods for waste anesthetic gas are:
   a. Down draft table, chemical fume hoods
   b. Charcoal canisters, type II biosafety cabinets
   c. All of the above

2. Analgesics should ideally be given at what point
   a. Pre-emptively
   b. During recovery phase
   c. The next day as needed

3. Animals must be monitored until capable of purposeful movement following anesthetic episode.
   a. true
   b. false