

# GUIDELINES FOR ANESTHESIA AND ANALGESIA IN LABORATORY ANIMALS

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## 1. Background

Federal regulations mandate that animals undergoing potentially painful procedures be provided with adequate anesthesia and analgesia. The standard of care at UC Berkeley is to prevent animal pain whenever possible and to treat animal pain whenever diagnosed. Exceptions to these principles are permitted only if scientific justification is provided in the Animal Use Protocol (AUP) and approved by the Animal Care and Use Committee (ACUC).

## 2. Training

All personnel who perform anesthesia and surgery must be appropriately trained. The Principal Investigator (PI) is responsible for assuring that research personnel receive appropriate training and certification prior to performing any procedure. New anesthetists are trained and supervised by the PI, or appropriate designated personnel, until they are competent to perform the procedure independently. All new anesthetists, including PIs, must be observed by OLAC veterinary staff and their competency certified to the ACUC prior to working independently. The Office of Laboratory Animal Care (OLAC) veterinary staff is available to provide assistance with, or training in, aseptic technique and the proper administration of anesthesia, analgesia, and euthanasia.

## 3. Anesthetics

For the use of any anesthetic agent, the Office of Laboratory Animal Care (OLAC) veterinarians should be consulted regarding the appropriate agent and dose for the species being used and the procedure being performed.

- Inhalant anesthetics (i.e., isoflurane) – Delivery of inhaled anesthetics by mask or endotracheal tube via a precision vaporizer is recommended for all non-aquatic species. Adjusting the inhaled percentage of anesthetic gas to deepen anesthesia is far safer than repeated re-dosing of injected drugs. Volatile anesthetics are easier to decrease as well, even compared to drugs for which there is an injectable antagonist or reversal agent. A disadvantage of the inhalant anesthetic agents is the lack of residual analgesia once the vaporizer has been turned off; pre-emptive analgesia is necessary. Contact OLAC veterinary staff at 642-9232 for information regarding vaporizer availability and training.
- Injectable anesthetics (e.g., ketamine combinations, dexmedetomidine) – Injectable anesthetics are appropriate for many procedures. There is, however, a great deal of variation in depth and duration of anesthesia among rodent strains and individual animals.
- Immersion anesthetics (i.e., buffered MS-222) – Immersion anesthetics are appropriate for aquatic species, such as amphibians and fish. Different solution strengths may be appropriate for induction and maintenance of anesthesia.
- Local anesthetics (i.e., lidocaine, bupivacaine) – Local anesthetics are usually injected at the site of the incision and may be appropriate to consider as supplements to either inhalant or injectable anesthetics.
- Please visit the [OLAC website](#) or consult the suggested formularies below for appropriate dosages and routes of administration by drug for some common laboratory animals.

#### 4. Analgesics

For the use of any analgesic agent, OLAC veterinarians should be consulted regarding the appropriate agent and dose for the species being used and the procedure being performed.

- Opioids (i.e., buprenorphine, morphine) – Opioids are very effective analgesics for surgical pain but may have effects on cardiovascular function and can be sedating.
- Non-steroidal anti-inflammatory agents (i.e., meloxicam, carprofen, ketoprofen) – Newer, longer-lasting non-steroidal anti-inflammatory analgesics (NSAIDs) may have longer durations of action than available opioids. These drugs are frequently co-administered with an opioid to combine potency of effect with duration of action.
- Please visit the OLAC website or consult the suggested formularies below for appropriate dosages and routes and frequency of administration by drug for some common laboratory animals.

## 5. Best Practices

- Multi-modal drug administration – Using a combination of agents (multi-modal anesthesia and analgesia) is recommended. This practice can help maximize the desired effects while minimizing the side effects that occur with over-reliance on a single agent.
- Pre-emptive analgesia – Pre-emptive analgesia or administration of pain relief *before* the painful stimulus is recommended:
  - To ensure that pain is being treated as the general anesthetic is wearing off;
  - To lower the overall amount of general anesthetic required; and,
  - To prevent sensitization of pain mechanisms (“ramp up”).
- Frequency of analgesic administration – Analgesic doses and frequencies should be carefully considered. Careful planning is required for overnight pain management. Many analgesics administered at 5 pm will wear off before 8 am the next morning. Multimodal analgesia is recommended to combine potency of effect with duration of action.
- Additional supportive care – Non-pharmaceutical methods to enhance the administration of anesthetic and analgesic agents should be used and include:
  - Keeping the animal warm during and after anesthetic procedures
  - Fluid administration
  - Keeping recovering animals isolated in a quiet area
  - Providing supplemental foods

Contact the veterinary staff for additional information on supportive care.

## 6. Monitoring

- Euthermic animals (mammals) should never be left alone during anesthesia.
- The depth of anesthesia and analgesia should be monitored at least every 15 minutes during most procedures and recorded.
- Plans for intra- and post-operative monitoring must be included in the AUP. Monitoring of respiratory rate and character is facilitated by the use of transparent drapes. Although resting heart rate for rodents is rapid (typically more than 300 beats per minute), heart beat should be checked periodically for significant changes in rate or rhythm. Heartbeat can be palpated through a sterile drape by the surgeon or underneath the drape by a second person who is not performing sterile procedures. Monitoring anesthesia also includes responsiveness to painful stimuli, respiration, and skin or mucous membrane color as seen by observing the ears, tail, and oral mucosa or foot pads. Pedal withdrawal reflex (toe pinch) is recommended for

assuring adequate depth of anesthesia prior to first incision and as a repeated check throughout the procedure.

- Depending on the procedure, other monitoring may be indicated such as heart rate, blood pressure, body temperature, and tissue oxygenation. Monitoring should be recorded through the post-operative period to complete recovery.
- Dose ranges and titration – All drugs, dose ranges, and routes of administration must be listed in the AUP. Dose ranges are starting points which must be titrated up or down for the individual animal, or for the particular application (procedures conducted, animal age and strain differences). When laboratory experience finds that recommended dose ranges are consistently too high or too low for the particular application, the veterinarian should be informed, and a protocol amendment submitted to the ACUC. Anesthetics are always titrated to effect. It is not acceptable to conduct surgical procedures unless the animal is fully anesthetized.

## 7. Recordkeeping

- Administration of anesthesia and analgesia and peri-operative monitoring should be recorded. Depending on the species, records may be kept in the animal's individual medical record, or in laboratory records and on blue post-operative cage cards.
- Please refer to ACUC Guidelines on [Recordkeeping for Surgical Procedures on Laboratory Animals](#) for additional information.

## 8. Controlled Substances

- Several commonly used anesthetics and analgesics (i.e., opioids, ketamine) are controlled substances and require special authorization and procedures to be completed prior to use in animal research.
- More information can be found at the Office of Environment, Health & Safety (EH&S) website (<http://www.ehs.berkeley.edu/controlled-substances>)
- Once they are obtained, controlled substances carry special storage and record keeping requirements.

## 9. Suggested Formularies

- For mice: <http://www.iacuc.ucsf.edu/Proc/awMouseFrm.asp>
- For rats: <http://www.iacuc.ucsf.edu/Proc/awRatFrm.asp>

## 10. References

- Carpenter, J.W. (2005). *Exotic Animal Formulary*. (3<sup>rd</sup> Ed.). Philadelphia, PA: Elsevier Saunders.
- Hawk, C.T., Leary, S., & Morris, T. (2005). *Formulary for Laboratory Animals*. (3<sup>rd</sup> Ed.). Ames, Iowa: Blackwell Publishing  
([http://www3.research.usf.edu/cm/docs/Formulary\\_for\\_Lab\\_Animals\\_3rd\\_ed.pdf](http://www3.research.usf.edu/cm/docs/Formulary_for_Lab_Animals_3rd_ed.pdf))

**Call 3-VETS if there is an animal emergency  
(510-643-8387)**