

Institutional Animal Care and Use Committee

Recommended Rodent Anesthetics and Analgesics

Note: Doses provided are approximations and must be titrated to the animal’s strain, age, sex, individual responses, and use of other concurrently administered drugs. Significant departures from these doses should be discussed with a CMRU veterinarian.

All doses are listed as milligrams per kilogram (mg/kg) unless otherwise noted. Dilution of injected drugs allows more precise dosing, but dilution must be performed using pharmaceutical grade diluents in sterile, diaphragmed ([example](#)) bottles. Please see IACUC Policy Use and Labelling of Drug Compounds, Dilutions, and Chronic-Use Fluids. Note: PBS is not considered a pharmaceutical grade diluent. Exceptions to recommendations may be study specific and must be described and justified. Additionally, not all anesthetics and analgesics are appropriate for all studies or experiments. Regulations require veterinary consultation regarding anesthesia and analgesia for potentially painful procedures and the *Guide for the Care & Use of Research Animals* states in part “The selection of appropriate analgesics and anesthetics should reflect professional veterinary judgement as to which best meets clinical and humane requirements as well as the needs of the research protocol.” All drugs must be approved in a UofL IACUC *Proposal* prior to use.

Multimodal analgesia is recommended by CMRU veterinarians and is standard practice. Multimodal analgesia is defined as the use of a combination of analgesic drugs from different classes, typically one NSAID and one opioid, and/or local anesthesia in lieu of an NSAID or opioid if one of those classes of drugs would interfere with the study. Multimodal analgesia may allow for reduced dosages of these drugs, as well as minimize potential adverse effects of the analgesics. For further information, please see [IACUC Policy Use of Postoperative Analgesia](#).

Anesthetic and Analgesic agents have been associated with nausea in a small subset of all mammalian species including rodents^{2,24,30}. Common signs of nausea in rodents include a facial grimace²³, excessive self-licking/gnawing of forepaws³⁰, and pica behavior^{2,24}. Onset of behavior can occur for up to 3 days post administration. If symptoms of nausea are noticed, please contact a CMRU veterinarian for treatment options.

Please note that recent literature^{3,18,21} has shown that oxygen supplementation is required to prevent hypoxia in anesthetized rodents. CMRU veterinarians *recommend* supplemental oxygen to all anesthetized rodents unless oxygenation status is being monitored (ie. pulse oximeter) with oxygen supplementation being administered as needed.

Abbreviations:

IM = intramuscularly
SC = subcutaneously

IP = intraperitoneally
h = hour(s)

PO = *per os* (by mouth)
q = every

Anesthetics:

Drug Name	Dose (mg/kg) & Route	Frequency	Notes
<i>Inhalation anesthetics</i>			
Isoflurane	Up to 5% for induction; 1-3% (to effect for maintenance)	Duration of anesthetic period	<i>Highly recommended</i> ; survival surgery should have concurrent pre-emptive analgesia; precision vaporizer usually required.

<i>Ketamine Combinations for Injection</i>			
Ketamine - Dexmedetomidine	<i>Mouse:</i> 50-100mg/kg + 0.5-1.0mg/kg IP <i>Rat:</i> 75-100mg/kg + 0.5-1.0mg/kg IP	As needed; expected duration 30-45 minutes	May be mixed in the same syringe; if re-dosing, use 1/4-1/2 dose of ketamine alone; dexmedetomidine may be partially reversed with <i>atipamezole</i> . Survival surgery should have concurrent pre-emptive analgesia.
Ketamine - Xylazine	<i>Mouse:</i> 80-100mg/kg + 5-10mg/kg IP <i>Rat:</i> 75-100mg/kg + 5-10mg/kg IP	As needed; expected duration 30-45 minutes	May be mixed in the same syringe; if re-dosing, use 1/4-1/2 dose of ketamine alone; xylazine may be partially reversed with <i>atipamezole</i> . Survival surgery should have concurrent pre-emptive analgesia.
Ketamine – Xylazine - Acepromazine	<i>Mouse:</i> 70-100mg/kg + 5-10mg/kg + 2-3mg/kg IP <i>Rat:</i> 75-100mg/kg + 2-6mg/kg + 1-2mg/kg IP	As needed; expected duration 30-45 minutes	May be mixed in the same syringe; if re-dosing, use 1/4-1/2 dose of ketamine alone; xylazine may be partially reversed with <i>atipamezole</i> . Survival surgery should have concurrent pre-emptive analgesia.

<i>Reversal agents</i>			
Atipamezole	<i>Mouse or Rat:</i> 0.5-1.0mg/kg SC or IP	Once	Most specific for <i>dexmedetomidine</i> , but may also be used for <i>xylazine</i> .

<i>Other injectable anesthetics</i>			
Pentobarbital (Nembutal®)	<i>Mouse or Rat:</i> 40-50mg/kg IP	As needed; expected duration 20-40 minutes	Recommended for terminal/acute procedures only, with booster doses as needed, although may occasionally be appropriate for survival procedures; consider supplemental analgesia (opioid or NSAID) for invasive procedures, especially when used for survival surgery.

Analgesics:

<i>Opioids</i>			
EthiqaxR (buprenorphine extended-release)	<i>Mouse:</i> 3.25mg/kg SC <i>Rat:</i> 0.65mg/kg SC	q72h Recommend administration prior to surgery	<i>Strongly recommended;</i> EthiqaxR is an FDA-indexed extended release buprenorphine and is similar to buprenorphine HCl except will not need to be redosed unless needed for >72h. More information can be found at www.ethiqaxr.com
Compounded-buprenorphine (i.e. in Polymer, ER, SR) **	<i>Mouse:</i> 0.5-1mg/kg SC <i>Rat:</i> 1-1.2mg/kg SC	q48h Recommend administration prior to surgery	<i>Highly recommended;</i> ** Compounded-buprenorphine (Wedgewood – Buprenorphine in Polymer; i.e. ER or SR) is similar to buprenorphine HCl except will not need to be redosed unless needed for >48h.† Compounded-buprenorphine : Dosing from the same bottle may be extended to 6 months, which is extra-label use. ³⁰ Please contact CMRU veterinarian for specific information about ordering/storing Compounded-buprenorphine if unfamiliar.
Buprenorphine HCl	<i>Mouse:</i> 0.1-0.5mg/kg SC <i>Rat:</i> 0.05-0.1mg/kg SC or IP	q4-8h Recommend first dose prior to surgery.	Recent literature shows that this drug requires more frequent dosing than 12-hour intervals† consider multimodal analgesia with an NSAID or administration of sustained-release buprenorphine; high doses of buprenorphine may lead to pica and sedation in rats.

† Buprenorphine has been shown to provide variable/inconsistent analgesia for rodents. Regular buprenorphine in mice may only last 4 to 6 hours^{9,15,16,17,18}. Compounded-buprenorphine (i.e. in Polymer, ER, SR) may only provide adequate analgesia in mice for as little as 12 hours⁹ and up to 48 hours in other instances^{17,18}. Compounded-buprenorphine (i.e. in Polymer, ER, SR) in rats has been determined to be effective for 48 hours²⁴ up to 72 hours⁶. Because of the varying clinical efficacies, it is recommended that frequent cageside observation of body posture, activity level, appetite, overall appearance, and scoring of facial grimace be employed as practical methods for assessing adequate analgesia in rodents. Rodents may need to be observed more often than once daily depending on the analgesic regimen used, procedure performed, and the potential for breakthrough pain.

<i>Non-Steroidal Anti-Inflammatory Drugs (NSAID)</i>			
Carprofen	<i>Mouse: 10-20mg/kg SC</i> <i>Rat: 5mg/kg SC</i>	q12h (10 mg/kg) mice Q24h (10-20 mg/kg) mice q24h rats Recommend first dose prior to surgery.	<i>Highly recommended;</i> depending on the procedure, may be used as sole analgesic, or as part of a multimodal analgesic plan.
Meloxicam	<i>Mouse: 10-20mg/kg SC</i> <i>Rat: 1-5mg/kg SC</i>	q12h (10 mg/kg) mice q24h (10-20 mg/kg) mice q24h rats Recommend first dose prior to surgery.	<i>Highly recommended;</i> depending on the procedure, may be used as sole analgesic, or as part of a multimodal analgesic plan.

Note: Carprofen or Meloxicam doses must not exceed a cumulative daily dose of 20 mg/kg. Prolonged use of NSAIDs may be associated with renal, gastrointestinal, or other adverse effects. It is recommended to administer NSAIDs with additional sterile saline or physiologic fluids to aid in proper hydration and to reduce adverse effects.

<i>Local anesthetic/analgesics</i>			
Bupivacaine liposome injectable suspension§	<i>Mouse and Rat: Dilute appropriately, do not exceed 5.3mg/kg total dose, SC or intra-incisional</i>	Once for 72h duration of action	<i>Highly recommended;</i> § NOCITA (bupivacaine liposome injectable suspension) is similar to bupivacaine with the exception of 72h duration of action. Dosing from the same bottle may be extended to 4 days, which is extra-label use ⁴ . Please contact a CMRU veterinarian for specific information about ordering/storing/administering NOCITA if unfamiliar.
Lidocaine hydrochloride	<i>Mouse and Rat: Dilute appropriately do not exceed 10 mg/kg total dose, SC or intra-incisional</i>	Use locally before making surgical incision	Faster onset than bupivacaine but short (<1 hour) duration of action

Bupivacaine or Ropivacaine	<i>Mouse and Rat:</i> Dilute appropriately, do not exceed 3 mg/kg total dose, SC or intra-incisional	Use locally before making surgical incision	Slower onset than lidocaine but longer (~4-8 hour) duration of action
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Recommended analgesia/post procedure plans:

<i>Procedure Type:</i>	<i>Non-painful procedure</i>	<i>Minor surgery/procedure</i>	<i>Major surgery/procedure</i>
Examples:	Imaging (ultrasound, CT, MRI, etc)	Surgical catheter placement, SC minipump placement, SC surgical tumor placement, minor skin incisions, intratracheal injections	Laparotomy, thoracotomy, procedures involving bone, craniotomy or cranial implant
Recommended analgesia	No analgesic recommended	Local anesthetic (if applicable), one NSAID and/or Opioid	Local anesthetic (if applicable), one NSAID and Opioid
Duration of analgesia recommended	N/A	48h	48-72h
Monitoring frequency recommended	N/A	Once daily	Twice daily
Other:	Provide supplemental heat. SC or IP fluids if warranted (prolonged anesthetic event; >1h)	Provide supplemental heat. SC or IP fluids, cage alteration (food on floor, gel diet) if warranted	Provide supplemental heat. SC or IP fluids, cage alteration (food on floor, gel diet) and frequent checking when possible.

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