

## **Suggested Regimes for Anesthesia, Analgesia, and Sedation of Laboratory Animals**

It is important that all scientists using animals in research meet ethical and legal responsibilities to avoid unnecessary pain and distress in the animals. The following guidelines contain recommendations developed by the veterinary staff for common procedures performed in laboratory species. If an alternative is required, please contact a BRL veterinarian to discuss options.

Controlled substances should be purchased from the narcotics section of the UIC Ambulatory Care Pharmacy (Ext. 6-6887) with federal and state controlled substance licenses. Non-controlled drugs may be purchased through the BRL Central Surgical Facility (6-6857). Anesthetic agents used in animals must be non-expired, pharmaceutical grade compounds.

Abbreviations used in this document:

Route of Administration	Frequency of Administration
PO – per os (orally)	SID – once per day
SQ – subcutaneous	BID – twice per day
IM – intramuscular	
IP – intraperitoneal	
IV – intravenous	

## **MICE AND RATS**

Please refer to the [Rodent Surgical Classifications and Analgesic Guidelines](#) for further information on anesthesia and analgesia requirements.

### **Chemical restraint/minimally invasive procedures**

Blood collection via tail vein, tail vein injections	
<b>Option 1</b>	<b>Ketamine</b> 60 mg/kg + <b>Xylazine</b> 3mg/kg IP
<b>Option 2</b>	<b>Fentanyl</b> 0.4mg/kg IP
<b>Option 3</b>	<b>Isoflurane</b> (chamber induction at 5%) inhaled

### **Invasive or surgical procedures**

Blood collection via jugular vein (rats), retro-orbital, or cardiac puncture; retro-orbital injections; surgery	
<b>Option 1</b>	<b>Isoflurane</b> (1-3%) inhaled
<b>Option 2</b>	<p><b>Ketamine</b> 100mg/kg + <b>Xylazine</b> 5-10mg/kg IP</p> <p>Ketamine and xylazine are diluted prior to administration in <u>mice</u>. Mix 1 ml of 100 mg/kg ketamine with 9 ml sterile 0.9% saline for a solution of 10mg/ml ketamine. Mix 1 ml of 20 mg/ml xylazine with 9ml sterile 0.9% saline for a solution of 2 mg/ml. The volume administered is based on the dosage and weight of the animal.</p>

### **Analgesia**

<b>Drug</b>	<b>Rat</b>	<b>Mouse</b>
<b>Buprenorphine</b>	0.1 mg/kg SQ BID	0.1 mg/kg SQ BID
<b>Buprenorphine SR LAB<sup>1</sup></b>	1.0 mg/kg SQ once perioperatively	1.0 mg/kg SQ once perioperatively
<b>Meloxicam</b>	1 mg/kg SQ SID	2 mg/kg SQ SID
<b>Bupivacaine<sup>2</sup></b>	2 mg/kg max dose SQ	2 mg/kg max dose SQ

<sup>1</sup> Buprenorphine SR™ LAB is the formulation developed and recommended for use in laboratory mice and rats. It is critical that investigator follow the procedures for administration in the document [Buprenorphine SR LAB Administration Instructions](#) found on the BRL website

<sup>2</sup> Bupivacaine (Marcaine™ or Sensorcaine™) is a local anesthetic which provides perioperative analgesia when injected subcutaneously at the surgical incision site. DO NOT EXCEED 2mg/kg to avoid toxicity which may result in central nervous system signs (seizures) and/or cardiac dysrhythmias. For use in rodents, prepare a 0.125% (1.25 mg/ml) solution by purchasing 0.25% (2.5 mg/ml) bupivacaine and dilute it 50:50 with sterile water or 0.9% saline. Inject a volume not to exceed 2 mg/kg SQ at the site of the incision. Using

this preparation, the maximum volume for a 300g rat is 0.5 ml and for a 30g mouse is 0.05 ml. Wait a minimum of 5 minutes before making the incision.

Other considerations:

- If using **isoflurane**, meloxicam or buprenorphine must be administered *pre-operatively*.
- If using **ketamine + xylazine**, analgesics must be administered *post-operatively*.
- For thoracotomy, either **buprenorphine** must be administered *pre-operatively* or **bupivacaine** injected into local tissue *pre-operatively*.

# RABBITS

## Chemical restraint

Blood collection, percutaneous catheterization	
<b>Buprenorphine</b> 0.02 mg/kg SQ + <b>Acepromazine</b> 1.0 mg/kg SQ	Sedation

## Minimally invasive procedures

Imaging, ocular injection		
<b>Option 1</b>	<b>Ketamine</b> 45 mg/kg + <b>Xylazine</b> 5 mg/kg SQ	Anesthesia
<b>Option 2</b>	<b>Ketamine</b> 30 mg/kg + <b>Dexmedetomidine</b> 0.1 mg/kg SQ	

## Major surgical procedures

The standard intra-operative antibiotic for rabbits is <b>Baytril</b> 5 mg/kg IM or SQ.		
<b>Option 1</b>	<b>Ketamine</b> 45 mg/kg + <b>Xylazine</b> 5 mg/kg SQ	Anesthetic induction
<b>Option 2</b>	<b>Ketamine</b> 30 mg/kg + <b>Dexmedetomidine</b> 0.1 mg/kg SQ	
<b>Hydromorphone</b> 0.1 mg/kg IV		Pre-operative analgesia Given IV every 2 hours during surgery.
<b>Buprenorphine</b> 0.02-0.05 mg/kg SQ or IM		Intraoperative analgesia
<b>Isoflurane</b> 1-3% in 2 L O <sub>2</sub>		Anesthesia
<b>Bupivacaine</b> 1-2 mg/kg SQ		Infiltrated prior to incision or splash block upon skin closure.
<b>Meloxicam</b> 1 mg/kg SQ or PO SID		Postoperative analgesia
<b>Sustained-release buprenorphine</b> 0.15 mg/kg SQ		Postoperative analgesia (3-day duration)

# DOGS

## Chemical restraint/minimally invasive procedures

Imaging	
<b>Option 1</b>	<b>Hydromorphone</b> 0.1 mg/kg + <b>Acepromazine</b> 0.05 mg/kg SQ or IM
<b>Option 2</b>	<b>Hydromorphone</b> 0.1 mg/kg + <b>Dexmedetomidine</b> 0.005 mg/kg SQ or IM

## Major surgical procedures

The standard perioperative antibiotic for dogs is <b>Cefazolin</b> 25 mg/kg IV prior to surgery and every 2 hours during surgery.												
<b>Option 1</b>	<b>Hydromorphone</b> 0.1 mg/kg + <b>Acepromazine</b> 0.05 mg/kg SQ	Pre-anesthetic sedation										
<b>Option 2</b>	<b>Buprenorphine</b> 0.01-0.02 mg/kg + <b>Acepromazine</b> 0.05 mg/kg SQ											
<b>Option 1</b>	<b>Ketamine</b> 5 mg/kg + <b>Diazepam</b> 0.25 mg/kg IV	Anesthetic induction										
<b>Option 2</b>	<b>Ketamine</b> 5 mg/kg + <b>Midazolam</b> 0.25 mg/kg IV											
<b>Hydromorphone</b> 0.1 mg/kg IV		Intra-operative analgesia Given IV every 2 hours during surgery.										
<b>Isoflurane</b> 1-3% in 1 L/min O <sub>2</sub>		Anesthesia										
<b>Bupivacaine</b> 1-2 mg/kg SQ		Infiltrated prior to incision or splash block upon skin closure.										
<b>Meloxicam</b> 0.1-0.2 mg/kg SQ or PO SID		Postoperative analgesia										
<b>Fentanyl patch</b> <table border="1" style="margin-left: 20px;"> <thead> <tr> <th>Body Weight</th> <th>Fentanyl Patch Dose</th> </tr> </thead> <tbody> <tr> <td>&lt; 10 kg</td> <td>25 mcg/hr</td> </tr> <tr> <td>10-20 kg</td> <td>50 mcg/hr</td> </tr> <tr> <td>20-30 kg</td> <td>75 mcg/hr</td> </tr> <tr> <td>&gt;30 kg</td> <td>100 mcg/hr</td> </tr> </tbody> </table>		Body Weight	Fentanyl Patch Dose	< 10 kg	25 mcg/hr	10-20 kg	50 mcg/hr	20-30 kg	75 mcg/hr	>30 kg	100 mcg/hr	Postoperative analgesia (3-day duration) Patch must be placed at least 12 hours before the procedure.
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# PIGS

## Chemical restraint/minimally invasive procedures

Imaging, blood draws, biopsy

**Telazol** 4.4 mg/kg + **Xylazine** 2.2 mg/kg IM

## Major surgical procedures

The standard perioperative antibiotic for pigs is **Cefazolin** 25 mg/kg IV prior to surgery and every 2 hours during surgery.

<b>Telazol</b> 4.4 mg/kg + <b>Xylazine</b> 2.2 mg/kg IM	Anesthetic induction										
<b>Hydromorphone</b> 0.1 mg/kg IV	Pre-operative analgesia Given IV every 2 hours during surgery.										
<b>Isoflurane</b> 1-3 % in 1 L/min O <sub>2</sub>	Anesthesia										
<b>Bupivacaine</b> 1-2 mg/kg SQ	Infiltrated prior to incision or splash block upon skin closure.										
<b>Meloxicam</b> 0.4 mg/kg mg/kg IM or PO	Postoperative analgesia										
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# **NONHUMAN PRIMATES**

## **Chemical restraint**

Blood collection, drug dosing, oral gavage, catheterization		
<b>Option 1</b>	<b>Ketamine</b> 7-10 mg/kg IM	Lowers seizure threshold, resulting in apparent resistance to sedative effect.
<b>Option 2</b>	<b>Midazolam</b> 3 mg/kg IM + <b>Dexmedetomidine</b> 0.03 mg/kg IM	Alternative to ketamine

## **Minimally invasive procedures**

Skin and rectal biopsies, bronchoalveolar lavage, bone marrow aspiration or biopsy		
<b>Option 1</b>	<b>Ketamine</b> 7-10 mg/kg + <b>Xylazine</b> 1-2 mg/kg IM	Anesthesia
<b>Option 2</b>	<b>Ketamine</b> 3-5 mg/kg + <b>Dexmedetomidine</b> 0.02-0.04 mg/kg IM	
<b>Option 1</b>	<b>Meloxicam</b> 0.2 mg/kg SQ	Post-procedure analgesia
<b>Option 2</b>	<b>Buprenorphine</b> 0.01-0.03 mg/kg IM	

## **Major surgical procedures**

The standard perioperative antibiotic for nonhuman primates is <b>CEFAZOLIN</b> 25 mg/kg IV prior to surgery and every 2 hours during surgery.	
<b>Ketamine</b> 10 mg/kg IM	Pre-anesthetic sedation
<b>Propofol</b> 2-4 mg/kg IV to effect	Anesthetic induction
<b>Hydromorphone</b> 0.1 mg/kg IM	Pre-operative analgesia Given IV every 2 hours during surgery.
<b>Isoflurane</b> 0.5-1.0% in 1 L/min O <sub>2</sub>	Anesthesia
<b>Bupivacaine</b> 1-2 mg/kg SQ	Infiltrated prior to incision or splash block upon skin closure.
<b>Sustained-release buprenorphine</b> 0.2 mg/kg SQ	Postoperative analgesia (3-5 day duration)
<b>Sustained-release meloxicam</b> 0.6 mg/kg SQ	Postoperative analgesia (3-day duration)

# AMPHIBIANS

## Surgical procedures

Oocyte collection		
<b>Tricaine methane sulfonate (MS-222)</b>	Tadpoles and newts: 200-500 mg/L water Frogs: 500 mg/L - 2 g/L water Toads: 1-3 g/L water	MS-222 solutions are acidic. Solutions must be buffered with <b>Sodium bicarbonate</b> (10-25 meq/L) or <b>0.5M Na<sub>2</sub>HPO<sub>4</sub></b> (34 ml per 2 L of 1 g/L stock solution).
The water used to make the MS-222 solution should be of similar make up and temperature as the water in the animal's enclosure. Following anesthesia, the animal should be recovered in a separate enclosure using fresh water with a similar make up and temperature as the animal's enclosure.		
<b>Flunixin meglumine</b>	25 mg/kg injected into dorsal lymph sac, once	Postoperative analgesia