

**Drexel University**  
**University Laboratory Animal Resources**

**Drug Formulary**  
**of**  
**Anesthetic and Analgesic Agents**  
**for**  
**Laboratory Animals**

**Refer to IACUC Policy for use of Non-Pharmaceutical Grade Drugs – Cocktails**

**<http://drexel.edu/research/animal-research/IACUC/Policies%20and%20Procedures/>**

## Notes:

- All controlled substances must be logged per dose in a drug log book.

## Mice

### Anesthetics

Drug Name	Dose (mg/kg)	Route	Frequency	Notes
Isoflurane	4-5% (induction) 1-3% (maintenance)	Inhalant	Continuous	Rapid induction and recovery Must provide supplemental analgesic for invasive survival procedures prior to beginning surgical procedure; must use precision vaporizer
Ketamine/Xylazine	80-100 (ketamine) + 5-20 (xylazine) [in same syringe]	IP	Once at induction, with additional doses as needed	Ketamine is a <b>controlled substance</b> . Additional doses must be given at ½ strength. <b>Dilute with sterile saline to make each dose volume 1.0ml.</b>
Ketamine/Xylazine/Acepromazine	70-100 (ketamine) + 10-20 (xylazine) + 2-3 (acepromazine) [in same syringe]	IP	Once at induction, with additional doses as needed	Ketamine is a <b>controlled substance</b> . Additional doses must be given at ½ strength. <b>Dilute with sterile saline to make each dose volume 1.0ml.</b>
Sodium Pentobarbital (Nembutal)	40-50	IP	Once at induction	<b>Controlled substance.</b> Recommended for terminal/acute procedures; must provide supplemental analgesic for invasive survival procedures Difficult to obtain. Narrow margin of safety.
Tribromoethanol (Avertin) (2.5% Solution)	250-500	IP	Once at induction	Not recommended. Non-pharmaceutical grade drug, its use must be justified in the protocol due to scientific reasons. Diluted solution must be properly stored and used within 30 days of initial preparation. <b>*see note below</b>

## **AVERTIN**

### **100% stock Avertin (Tribromoethanol)**

*Mix: add tribromoethanol to tertiary amyl alcohol and dissolve by heating and stirring. Add distilled water and continue until the solution is well mixed. Store wrapped in foil (light sensitive solution, okay to use brown glass bottle), 4°C. Solution may have to be warmed to dissolve. Mixture should be clear. 10g tribromoethyl alcohol (2, 2, 2 tribromoethanol), Aldrich T4, 840-2 10ml tertiary amyl alcohol (2 methyl-2-butanol), Aldrich 24, 048-6*

**Warning! Decomposition can result from improper storage. 2.5% diluted Avertin solution must be used within 30 days of initial preparation and be properly stored. Be sure to label the container with the date of preparation.**

*For use in mice, dilute the 100% to 2.5% (1:40) using diluent, water or isotonic saline. Diluent recipe: 0.8% NaCl 1mM Tris (pH 7.4) 0.25mM EDTA Check the pH. Adjust to pH 7.4. To make 50 ml 2.5% Avertin, add 1.25 ml 100% to 48.75 ml liquid (diluent, water or saline) Filter .22 micron Store at 4° C, away from light in foil wrap or brown bottle Dosage for mice may vary with different preparations of Avertin. Dosage should be recalculated each time a 100% stock is made up. Test for best effect in a few mice before choosing dose. Allow 5-10 min to take effect.*

### **Anesthetic Reversal Agents**

<b>Drug Name</b>	<b>Dose (mg/kg)</b>	<b>Route</b>	<b>Frequency</b>	<b>Notes</b>
Yohimbine	1.0-2.0	SC or IP	When needing to reverse the effects of Xylazine	Yohimbine DOES NOT reverse the effects of Ketamine

### Analgesics – Non-steroidal anti-inflammatories (NSAID)

*\*Note: prolonged use of NSAIDs may cause renal, gastrointestinal, or other problems*

Drug Name	Dose (mg/kg)	Route	Frequency	Notes
Meloxicam (Metacam)	5-10	PO or SC	Once pre-operatively then every 8-12 hours as needed	Depending on the procedure, may be used as sole analgesic, or as multi-modal analgesia with buprenorphine.
Carprofen (Rimadyl)	5 20	SC	Once pre-operatively 5 mg every 12 hours, 20 mg every 24 hours	Depending on the procedure, may be used as sole analgesic, or as multi-modal analgesia with buprenorphine.
Ketoprofen (Ketofen)	2-5	SC	Once pre-operatively then every 12-24 hours as needed	Depending on the procedure, may be used as sole analgesic, or as multi-modal analgesia with buprenorphine.

### Analgesics – Opioids (controlled substances)

Drug Name	Dose (mg/kg)	Route	Frequency	Notes
Buprenorphine	0.1-0.5	SC or IP	Once pre-operatively for preemptive analgesia and postoperatively every 4-6 hrs	When used as sole analgesic, typical regimen is: once at time of procedure, second dose will be administered 4-6 hours later. Additional doses every 4-6 hrs as needed. Consider multi-modal analgesia with NSAID and local analgesic.
Buprenorphine Sustained-Release Lab (Bup SR Lab) 1mg/ml	0.5-1.0 (recommend 0.6 to start)	SC	Once pre-operatively for preemptive analgesia	Provides 48 hours of pain relief; sedation may be seen for duration of effect Must be prescribed by the Attending Vet DO NOT DILUTE

## Analgesics – Local Anesthetic/Analgesics

Drug Name	Dose (mg/kg)	Route	Frequency	Notes
Bupivacaine (Marcaine, Sensorcaine)	Dilute to 0.25%; do not exceed 8 mg/kg total dose	SC or intradermal surrounding incision	Locally before making surgical incision, or before final skin closure	4-8 hour duration of action Can be used with inhalants if other analgesics cannot be administered before animals awaken from isoflurane
Lidocaine Hydrochloride	Dilute to 0.5%; do not exceed 7mg/kg total dose	SC or intradermal surrounding incision	Locally before making surgical incision, or before final skin closure	Faster onset than Bupivacaine, but short (<1 hour) duration of action

**Refer to ULAR Recommendations on Use of Bupivacaine for Perioperative Analgesia**

**[Bupivacaine \(Marcaine\) Recommendations for Use in Perioperative Analgesia](#)**

## Rats

### Anesthetics

Drug Name	Dose (mg/kg)	Route	Frequency	Notes
Isoflurane	4-5% (induction) 1-3% (maintenance)	Inhalant	Continuous	Rapid induction and recovery Must provide supplemental analgesic for invasive survival procedures prior to beginning surgical procedure; must use precision vaporizer
Ketamine/Xylazine	80-100 (ketamine) + 5-10 (xylazine) [in same syringe]	IP	Once at induction, with additional doses as needed	Ketamine is a <b>controlled substance</b> . Additional doses must be given at ½ strength
Ketamine/Xylazine/Acepromazine	75-100 (ketamine) + 2-6 (xylazine) + 1-2 (acepromazine) [in same syringe]	IP	Once at induction, with additional doses as needed	Ketamine is a <b>controlled substance</b> . Additional doses must be given at ½ strength
Sodium Pentobarbital (Nembutal)	40-50	IP	Once at induction	<b>Controlled substance</b> . Recommended for terminal/acute procedures; must provide supplemental analgesic for invasive survival procedures Difficult to obtain. Narrow margin of safety.
Propofol	10	IV	Once as induction before general anesthesia, or as a constant rate infusion	Respiratory depression is possible upon induction Soon to be registered as a controlled substance.
Urethane	1-2g/kg	IP	Once at induction	For non-survival procedures only Non-pharmaceutical grade drug, its use must be justified in the protocol due to scientific reasons. Due to potential human carcinogenicity, must be reviewed by the biosafety committee

## Anesthetic Reversal Agents

Drug Name	Dose (mg/kg)	Route	Frequency	Notes
Yohimbine	1.0-2.0	SC or IP	When needing to reverse the effects of Xylazine	Yohimbine DOES NOT reverse the effects of Ketamine

## Analgesics – Non-steroidal anti-inflammatories (NSAID)

*\*Note: prolonged use of NSAIDs may cause renal, gastrointestinal, or other problems*

Drug Name	Dose (mg/kg)	Route	Frequency	Notes
Meloxicam (Metacam)	1	PO or SC	Once pre-operatively then every 12-24 hours as needed	Depending on the procedure, may be used as sole analgesic, or as multi-modal analgesia with buprenorphine.
Carprofen (Rimadyl)	5	SC	Once pre-operatively then every 24 hours as needed	Depending on the procedure, may be used as sole analgesic, or as multi-modal analgesia with buprenorphine.

## Analgesics – Opioids (controlled substances)

Drug Name	Dose (mg/kg)	Route	Frequency	Notes
Buprenorphine	0.05	SC or IP	Once pre-operatively for preemptive analgesia and postoperatively every 6-8 hours	When used as sole analgesic, typical regimen is: once at time of procedure, second dose will be administered 4-6 hours later. Additional doses every 6-8 hrs as needed. Consider multi-modal analgesia with NSAID and local analgesic.
Buprenorphine Sustained-Release Lab (Bup SR Lab) 1mg/ml	0.5	SC	Once pre-operatively for preemptive analgesia	Provides 48 hours of pain relief; sedation may be seen for duration of effect Must be prescribed by the Attending Vet DO NOT DILUTE

## Analgesics – Local Anesthetic/Analgesics

Drug Name	Dose (mg/kg)	Route	Frequency	Notes
Bupivacaine (Marcaine, Sensorcaine)	Dilute to 0.25%; do not exceed 8 mg/kg total dose	SC or intradermal surrounding incision	Locally before making surgical incision, or before final skin closure	4-8 hour duration of action Can be used with inhalants if other analgesics cannot be administered before animals awaken from isoflurane
Lidocaine Hydrochloride	Dilute to 0.5%; do not exceed 7mg/kg total dose	SC or intradermal surrounding incision	Locally before making surgical incision, or before final skin closure	Faster onset than Bupivacaine, but short (<1 hour) duration of action

Refer to ULAR Recommendations on Use of Bupivacaine for Perioperative Analgesia

### [Bupivacaine \(Marcaine\) Recommendations for Use in Perioperative Analgesia](#)

## Rabbits

### Anesthetics

Drug Name	Dose (mg/kg)	Route	Frequency	Notes
Isoflurane	4-5% (induction) 1-3% (maintenance)	Inhalant	Continuous	Rapid induction and recovery Must provide supplemental analgesic for invasive survival procedures prior to beginning surgical procedure; must use precision vaporizer
Ketamine/Xylazine	35-50 (ketamine) + 5-10 (xylazine) [in same syringe]	IM or SC	Once at induction, with additional doses as needed	Ketamine is a <b>controlled substance</b> . IM injections of Ketamine often sting upon injection. Additional doses must be given at ½ strength



## Anesthetic Reversal Agents

Drug Name	Dose (mg/kg)	Route	Frequency	Notes
Yohimbine	~0.2	IV or SC	When needing to reverse the effects of Xylazine	Yohimbine DOES NOT reverse the effects of Ketamine

## Analgesics – Non-steroidal anti-inflammatories (NSAID)

*\*Note: prolonged use of NSAIDs may cause renal, gastrointestinal, or other problems*

Drug Name	Dose (mg/kg)	Route	Frequency	Notes
Meloxicam (Metacam)	0.1-0.3	PO, IM or SC	Once pre-operatively then every 24 hours for up to 4 days	Depending on the procedure, may be used as sole analgesic, or as multi-modal analgesia with buprenorphine.
Carprofen (Rimadyl)	4-5	SC	Once pre-operatively then every 12-24 hours as needed	Depending on the procedure, may be used as sole analgesic, or as multi-modal analgesia with buprenorphine.

## Analgesics – Opioids (controlled substances)

Drug Name	Dose (mg/kg)	Route	Frequency	Notes
Buprenorphine	0.05-0.1	SC or IP	Once pre-operatively for preemptive analgesia and postoperatively every 4-12 hours	When used as sole analgesic, typical regimen is: once at time of procedure, second dose will be administered 4-6 hours later. Additional doses every 8-12hrs as needed. Consider multi-modal analgesia with NSAID and local analgesic.
Buprenorphine SR (3mg/ml)	0.1-0.3	SC	Once pre-operatively for preemptive analgesia	Provides 72 hours of pain relief Must be prescribed by the Attending Vet

## Cat

### Anesthetics

Drug Name	Dose (mg/kg)	Route	Frequency	Notes
Isoflurane	4-5% (induction) 1-3% (maintenance)	Inhalant	Continuous	Rapid induction and recovery Must provide supplemental analgesic for invasive survival procedures prior to beginning surgical procedure; must use precision vaporizer
Ketamine	10-30	IM or IV	Once at induction	Ketamine is a <b>controlled substance</b> . IM injections of Ketamine often sting upon injection. Anesthetic plane is maintained with inhalant anesthesia.

### Analgesics – Opioids (**controlled substances**)

Drug Name	Dose (mg/kg)	Route	Frequency	Notes
Buprenorphine	0.05-0.1	SC	Once pre-operatively for preemptive analgesia and postoperatively every 4- 12 hours	When used as sole analgesic, typical regimen is: once at time of procedure, second dose will be administered 4-6 hours later. Additional doses every 8-12hrs as needed. Consider multi-modal analgesia with NSAID and local analgesic.
Fentanyl	25 mcg/hr for cats >3kg	Transdermal patch	Once pre-operatively; change every 72 hours. Takes up to 12 hours to reach blood levels after patch placement	Can be given as sole analgesic 12 hours before surgery, or in conjunction with buprenorphine given at time of surgery.

## Analgesics – Local Anesthetic/Analgesics

Drug Name	Dose (mg/kg)	Route	Frequency	Notes
Bupivacaine (Marcaine, Sensorcaine)	May dilute to 0.25-0.5%; may be mixed in same syringe with lidocaine	SC or intradermal surrounding incision	Locally before making surgical incision, or before final skin closure	4-8 hour duration of action
Lidocaine Hydrochloride	May dilute to 0.5-1% (~10mg/ml); may be mixed in same syringe with bupivacaine	SC or intradermal surrounding incision	Locally before making surgical incision, or before final skin closure	Faster onset than Bupivacaine, but short (<1 hour) duration of action

Refer to ULAR Recommendations on Use of Bupivacaine for Perioperative Analgesia

## [Bupivacaine \(Marcaine\) Recommendations for Use in Perioperative Analgesia](#)

## Swine

### Anesthetics

Drug Name	Dose (mg/kg)	Route	Frequency	Notes
Isoflurane	4-5% (induction) 1-3% (maintenance)	Inhalant	Continuous	Rapid induction and recovery Must provide supplemental analgesic for invasive survival procedures prior to beginning surgical procedure; must use precision vaporizer.
Telazol® Tiletamine	6-8	IM	Once at induction for sedation or pre-anesthesia	Telazol is a <b>controlled substance</b> and must be stored refrigerated after reconstitution.
Propofol	16-22	IV	As induction agent, prior to general anesthesia or as Constant Rate Infusion	Respiratory depression upon induction is possible. Soon to be registered as a controlled substance.

## Analgesics – Non-steroidal anti-inflammatories (NSAID)

*\*Note: prolonged use of NSAIDs may cause renal, gastrointestinal, or other problems*

Drug Name	Dose (mg/kg)	Route	Frequency	Notes
Meloxicam (Metacam)	0.1-0.3	PO, IM or SC	Once pre-operatively then every 24 hours for up to 4 days	Depending on the procedure, may be used as sole analgesic, or as multi-modal analgesia with buprenorphine.
Carprofen (Rimadyl)	4-5	SC	Once pre-operatively then every 12-24 hours as needed	Depending on the procedure, may be used as sole analgesic, or as multi-modal analgesia with buprenorphine.

## Analgesics – Opioids (controlled substances)

Drug Name	Dose (mg/kg)	Route	Frequency	Notes
Buprenorphine	0.05-0.1	SC	Once pre-operatively for preemptive analgesia and postoperatively every 4-12 hours	When used as sole analgesic, typical regimen is: once at time of procedure, second dose will be administered 4-6 hours later. Additional doses every 8-12hrs as needed. Consider multi-modal analgesia with NSAID and local analgesic.
Buprenorphine SR (3mg/ml)	0.1	SC	Once pre-operatively for preemptive analgesia	Provides 72 hours of pain relief Must be prescribed by the Attending Vet

## Fish

### Anesthetics

Drug Name	Dose (mg/kg)	Route	Frequency	Notes
Eugenol (Clove Oil)	40-100mg/L	Submersion	Continuous	Dosage dependent on fish species and desired anesthetic depth.

## Frogs

### Anesthetics

Drug Name	Dose (mg/kg)	Route	Frequency	Notes
MS222	500-2000mg/L buffered with NaHCO <sub>3</sub>	Submersion	Continuous	Ensure pharmaceutical grade is used. Finquel® <a href="https://www.drugs.com/vet/finquel-ms-222-tricaine-methanesulfonate.html">https://www.drugs.com/vet/finquel-ms-222-tricaine-methanesulfonate.html</a>
Benzocaine	200-300mg/L	Submersion	Continuous	

### Reference:

Foley, Kendall, Turner. Clinical Management of Pain in Rodents. Comparative Medicine, Vol 69 (6) December 2019, p. 468-489.

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