

## Recommendations for Anesthetics

Below you will find species-specific recommendations for drugs, dosages, and routes of administration for anesthetics proposed for use in approved Frederick National Lab Animal Study Proposals. This list is not meant to be comprehensive and the ACUC and/or veterinary staff may permit alternative drugs/doses/routes as documented in approved Animal Study Proposals. Maximum needle sizes and volumes for injection sites can be found in the guidance *Recommended Needle Sizes, Sites, and Volumes for Injection*. Please contact the LAM veterinary staff [301-846-5577] for additional guidance.

### MOUSE

Drug	Dose	Route
Avertin *	The working solution is administered at 0.4-0.8 ml/mouse [approximately 0.2 ml/10 grams of body weight]	IP
<i>Please refer to the ACUC Guidelines for the Use of Tribromoethanol/Avertin Anesthesia for guidance on preparing the working solution</i>		
Ketamine	200 mg/kg	IM or IP
Ketamine/Xylazine **	Ketamine: 200 mg/kg	IP
	Xylazine: 10 mg/kg	
	1.0 ml Ketamine [100 mg/ml] 0.5 ml Xylazine [20 mg/ml] in 8.5 ml Injectable Saline or Sterile Water [0.1 ml per 10 grams body weight]  <i>Experience has shown this combination to be very effective but the margin of safety is narrow; avoid hypothermia</i>	
Isoflurane ***	To effect	Inhalation
70% CO <sub>2</sub> /30% O <sub>2</sub>	To effect	Inhalation

### RAT

Drug	Dose	Route
Ketamine	100 mg/kg	IM or IP
Ketamine/Xylazine	Ketamine: 90 mg/kg	IM or IP

	Xylazine: 10 mg/kg	
	<p>Outbred Rats  1 ml Ketamine [100 mg/ml]  1 ml Xylazine [20 mg/ml]  in 5 ml sterile water  [3 ml/kg body weight]</p> <p><i>Experience has shown this combination to be very effective but the margin of safety is narrow; avoid hypothermia</i></p>	IP
	<p>Inbred Rats  2 ml Ketamine [100 mg/ml]  1 ml Xylazine [20 mg/ml]  in 10 ml sterile water  [3 ml/kg body weight]</p> <p><i>Experience has shown this combination to be very effective but the margin of safety is narrow; avoid hypothermia</i></p>	IP
Isoflurane	To effect	Inhalation
70% CO2/30% O2	To effect	Inhalation

### **XENOPUS**

Drug	Dose	Route	Notes
Tricaine (MS 222)	500-2000 mg/L bath (buffer with NaH CO <sub>3</sub> ; pH 7-7.5)	Immerse in water with agent added	<ul style="list-style-type: none"> <li>• Induction takes approximately 15-30 minutes</li> <li>• Maintain anesthetic level by moist cloth contact with MS 222 solution</li> <li>• Recovery may take 3-6 hours</li> <li>• Keep animal moist and maintain at 22-26°C</li> </ul>

### **ZEBRAFISH**

Drug	Dose	Route	Notes
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Tricaine (MS 222)	100-200 mg/L (buffer with NaH CO <sub>3</sub> ; pH 7-7.5)	Immerse in water with agent added	<ul style="list-style-type: none"> <li>• Fish are induced rapidly following immersion in a solution containing MS-222 and are recovered by returning them to fresh, well-aerated water. Because most procedures performed on zebrafish are very rapid, the need for a maintenance phase of anesthesia is usually not necessary.</li> <li>• If needed, maintenance anesthesia doses would be lower (50-100 mg/L).</li> <li>• During induction, spontaneous ventilation should be monitored closely and can be used as an indicator to the depth of anesthesia.</li> </ul>
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### ANESTHETIC ADMINISTRATION NOTES

- Fasting rodents is not necessary or recommended
  - Ophthalmic ointment should be applied to the eyes to prevent drying of cornea if mice will be down for more than five minutes.
  - Following anesthesia, animals should be kept dry, insulated, or warmed to prevent excessive loss of body heat. If a heat lamp is used, exercise extreme caution to prevent overheating immobilized animals.
- \* Use of Avertin for rodent anesthesia is not recommended because of variability of anesthetic effectiveness, pathology, morbidity and mortality [Contemporary Topics, Lieggi et al, Vol 44 No. 1 Jan 2005]. The breakdown products are irritating to tissues and can cause abdominal adhesions, peritonitis, ileus, and death. Ketamine/Xylazine combinations are safer alternatives that provide secure and stable anesthesia.
- \*\* Repeating administration for lengthening injectable anesthesia is risky. Xylazine is longer acting than Ketamine. It is critical not to overdose with Xylazine. Supplementation with isoflurane gas anesthesia works well [or boost with an injection of Ketamine only] if additional anesthesia is needed. Dates should be placed on all bottles and only small working volumes should be prepared. Mixtures of Ketamine and Xylazine are not stable and often lose potency within seven days of mixing. Record-keeping with all controlled substances is essential [Ketamine – Class III controlled substance]. Reversal of Xylazine occurs following IP delivery of Yohimbine at 2.0 mg/kg [please make preparations in advance if this is required for your study].
- \*\*\* Isoflurane is generally regarded as the anesthetic of choice for many animal procedures because of its record of safety in most species and because it provides reliable levels of anesthesia and rapid recovery when delivered properly. Less than 0.2% of the inspired dose is metabolized, making it an excellent choice for research studies. Human exposure to trace amounts is also less hazardous than other inhalants like halothane. Isoflurane is delivered to animals using compressed oxygen or air and a precision vaporizer. For training in use of this equipment and in proper monitoring of anesthetized animals, please contact the facility manager or the LAM veterinary staff.

References:      Laboratory Animal Anesthesia: An Introduction for Research Workers and Technicians.

P.A. Flecknell. (San Diego: Academic Press, 1987).

Anesthesia and Analgesia in Laboratory Animals. Kohn et al. (New York: Academic Press, 1997]