# GUIDELINES ON ANESTHESIA AND ANALGESIA IN LABORATORY ANIMALS

**University of South Florida provides the following guidelines for use by IACUC-certified faculty and staff.**

**CONTENTS** **PAGE**

infusion of local anesthetics, can control mild to moderate pain, in some species, though is contra-indicated in others. Selection of an appropriate route of administration also involves consideration of the recipient species. For example, oral analgesic drug delivery to rodents (e.g., acetaminophen elixir added to the drinking water of rats) may not afford detectable analgesia.

7. In addition to the avoidance and alleviation of pain and discomfort, adequate post-procedural /post-operative animal care also includes efforts to prevent and/or treat post-anesthetic complications, (e.g., aspiration, hypostatic pneumonia, cardiovascular and respiratory depression, dehydration, and infection).

8. Reducing the potential for laboratory animal pain, distress, or discomfort is required by the *U.S. Government Principles for the Utilization and Care of Vertebrate Animals Used in Testing, Research and Training,* the *Guide for the Care and Use of Laboratory Animals (2012 ed.),* and the *Animal Welfare Act (Public Law 89-*

*[(i)3.2(nf)-13. -0f19 31tnnid tse 2012 Gi*

*Red1( R3(at)-131.8(9(i)3.2(2(epr)-6.4(es)-8(-(ar)-du-)*

**Schedule V**

They **do not produce sedation or analgesia**, and must never be used as an anesthetic or analgesic agent (*The Guide for the Care and Use of Laboratory Animal Medicine, 8th ed*). Since these agents paralyze the muscles of respiration, endotracheal intubation and mechanical ventilation are necessary, as is increased monitoring for physiological signs of pain since reflexes can not be assessed for depth of anesthesia. Neuromuscular blocking agents, when used in surgical procedures, are restricted to anesthetized animals.

## H. Monitoring Anesthesia

1. General anesthesia always carries the risk of compromising the patient's vital functions and even death. Animals should be closely monitored during induction, maintenance, and recovery from general anesthesia. Cardiovascular, respiratory, thermo-regulatory functions, and depth of anesthesia must be frequently assessed. This requires observation of both **vital signs** (e.g., heart rate, respiratory rate and depth, color of mucous membranes, capillary refill time, body temperature) and **reflexes** (e.g., toe pinch, tail pinch, eyelid/eyelash, palpebral). Vital signs are indicators of basic homeostatic functions and reflexes help to assess depth of anesthesia. No one parameter is sufficient to assess the effect of anesthesia on a patient. All parameters must be considered in combination to determine the animal's response to anesthesia.

2. Reflexes are absent and muscle tone is relaxed during surgical anesthesia. The pedal withdrawal reflex (i.e., toe pinch), eyelid/eyelash reflex, palpebral reflex, and the tone of jaw and anal sphincter muscles can be readily evaluated in larger mammals such as dogs, cats, and pigs. The pedal withdrawal reflex can be used in all species. In rodents pinching the tail may be used as an alternate if the limbs are inaccessible. Ocular position and pupillary size are unreliable indicators of depth of anesthesia. However, a widely dilated pupil, with little or no iris visible, should always cause concern, since it may be the result of an excessively deep plane of anesthesia, or hypoxia.

3. Respiratory Signs – Anesthetists should monitor the rate, rhythm, and depth of respiration and mucous membrane color. An increase in respiratory depth, regular rhythm, and decrease in respiratory rate signifies surgical anesthesia. Cyanotic mucous membranes indicate hypoxemia from inadequate lung ventilation. Opioids can cause severe respiratory depression, which can be reversed by the administration of naloxone. Respiratory arrest usually precedes cardiovascular collapse.

4. Cardiovascular Signs – A slowing heart rate indicates surgical anesthesia. An increase in rate (tachycardia) during the performance of a surgical procedure often indicates that the depth of anesthesia is not adequate. A decrease of rate (bradycardia) during surgery may signify an excessive dose of anesthetic. Opioids, xylazine, and vagal reflex activity can cause bradycardia. If the depth of anesthesia can be determined to be appropriate using other parameters, the use of anticholinergics can counteract these effects. Pulse strength, rhythm, and rate are readily determined in larger mammals by digital pressure over an accessible site (e.g., femoral artery, tail artery, auricular artery, lingual artery). Capillary refill time (CRT) is an indicator of peripheral perfusion and is normally less than 2 seconds. During lengthy procedures, anesthetized animals may become dehydrated. To help maintain normal hemodynamics, warm, balanced electrolyte solutions should be administered, by continuous intravenous drip, throughout the surgical procedure. Rodents may be administered fluids via the subcutaneous route.

5. Body Temperature – Anesthetics usually cause a depression of body temperature. Body temperature can be measured rectally in most species. Maintaining body temperature at normal levels, usually 37°-39° C (98.6°-102.2° F) allows more rapid metabolism of anesthetic agents. To avoid hypothermia, body temperature should be monitored and maintained throughout the anesthetic process and post-operative period. Conservation of body heat is an integral part of anesthetic management. Core body temperature can fall precipitously during general anesthesia, especially in small animals and, when combined with other factors, can lead to death. To avoid thermal burns, water heating pads rather than electrical pads, should be used.

6. Post-operatively – The anesthetist's responsibility for the animal's welfare extends beyond the completion of the surgical procedure. Monitoring should continue until the animal attains sternal recumbency and exhibits purposeful movement. Some anesthetics and analgesics can affect animals

for days after administration. Therefore, it is important to check animals for signs of anorexia, fever, vomiting, or abnormal respiration or heart rate.

7. Indications of Anesthetic Overdose – r

## J. Comments Regarding Anesthetics and Analgesics

1. Several commonly used or historically used anesthetics and analgesic medications are described briefly below. However, numerous additional agents are available for use in a variety of species. Contact a University of South Florida laboratory animal veterinarian for additional information on drugs not listed here. A veterinary drug formulary and a number of veterinary anesthesia textbooks are available in the Comparative Medicine library.

2. **Acepromazine Maleate** (formerly acetylpromazine), a phenothiazine derivative, is a potent neuroleptic agent with relatively low toxicity. Acepromazine induces tranquilization, muscle relaxation, and a decrease in spontaneous activity. At high doses, sedation occurs. Preanesthetic administration decreases the amount of general anesthetic required. Acepromazine possesses antiemetic,

10. **Volatile anesthetics** include halothane, enflurane, isoflurane, sevoflurane, and desflurane. These agents should be used only with adequate ventilation or scavenging systems. Precision vaporizers should be used for these anesthetic agents because lethal concentrations can easily be reached using the open drop method, or us

6.11
23
22

## Table II. Commonly Used Anesthetics and Analgesics for Mice

University of South Florida provides the following table as a reference only, for use by IACUC-certified faculty and staff only.

| Anesthesia in Mice | Dose & Route | Comments |
|---|---|---|
| Isoflurane (Forane®) | To effect. In general, 3-4% induction, 1-3% maintenance; inhalation | Precision vaporizer, adequate ventilation or scavenging essential |
| Ketamine + Xylazine | 100 mg/kg (K) + 10 mg/kg (X) IP | If animals appear to be responding to touch or awakening, re-dose with 30% of the initial dose of ketamine alone (no additional xylazine). |
| Ketamine + Xylazine + Acepromazine | 100 mg/kg (K) + 20 mg/kg (X) + 3 mg/kg (A) IP | |
| Ketamine + Dexmedetomidine | | |

## Table IV. Commonly Used Anesthetics and Analgesics for Gerbils

University of South Florida provides the following table as a reference only, for use by IACUC-certified faculty and staff only.

| Anesthesia in Gerbils | Dose & Route | Comments |
|---|---|---|
| Isoflurane (Forane®) | To effect. In general, 1-4% | |

## Table V. Commonly Used Anesthetics and Analgesics for Hamsters

University of South Florida provides the following table as a reference only, for use by IACUC-certified faculty and staff only.

| Anesthesia in Hamsters | Dose & Route | Comments |
|---|---|---|
| Isoflurane (Forane®) | To effect. In general, 3-4% induction, 1-2% maintenance; inhalation | Precision vaporizer, adequate ventilation or scavenging essential |
| Pentobarbital | 70 – 90 mg/kg IP | Caution! Potentially significant cardiovascular and respiratory depression, variable response |
| Ketamine + xylazine<br>Ketamine + medetomidine | 80 – 200 mg/kg (K) + 5 – 10 mg/kg (X) IP | 30 – 60 minutes duration |

## Table VIII. Commonly Used Anesthetics and Analgesics for Dogs

University of South Florida provides the following table as a reference only, for use by IACUC-

## Table IX. Commonly Used Anesthetics and Analgesics for Cats

University of South Florida provides the following table as a reference only, for use by IACUC-certified faculty and staff only.

| **Anesthesia in Cats** | **Dose & Route** | **Comments** |
|---|---|---|
| Isoflurane (Forane®) | To effect. In general, 3-4% induction, 1-2% maintenance; inhalation | Precision vaporizer, adequate ventilation or scavenging essential |
| Pentobarbital | 20 – 30 mg/kg IV | Caution! Divide dose and administer ½ as bolus and ½ to effect; between 30 – 45 minutes of anesthesia |
| Ketamine + Diazepam | 10 mg/kg (K) + 0.5 mg/kg (D) IV (anesthesia for minor procedures)<br><br>5.5 mg/kg (K) + 0.3 mg/kg (D) IV (induction of anesthesia) | Premedicate with an anticholinergic<br><br>Anesthesia can be maintained with inhalant anesthetic (e.g., isoflurane) |
| Ketamine + Medetomidine | 7.0 mg/kg (K) + 0.08 mg/kg (M) IM | Minor procedures; up to 45 minutes anesthesia |
| **Analgesia in Cats** | | |
| Morphine | 0.1 mg/kg IM or SC | Up to 4 hours analgesia; caution, mania and excitation with overdose |
| Buprenorpnine (Buprenex®) | 0.005 – 0.01 mg/kg SC or IM | Up to 12 hours analgesia |
| Buprenorphine SR/ER | 0.12 mg/kg | Up to 72 hours (unknown) |
| Oxymorphone | 0.05 – 0.15 mg/kg IM, SC or IV | Between 3 – 5 hours analgesia; Minimal respiratory depression |
| Carprofen | 4.0 mg/kg SC or IV | Up to 24 hours analgesia |
| Meloxicam | 0.05 mg/kg PO (perioperative pain)<br>0.1 once, then 0.05 mg/kg (acute pain) | Up to 24 hours |
| Fentanyl patch | <2.5 kg body weight = ½ of 25 µg/hr patch; >2.5 kg bdy wt = 25 µg/hr patch | Each up to 5 days analgesia; place 8 hours prior to anticipated pain; do not apply heat to patch (e.g., from heating pads) |
| **Sedation in Cats** | | |
| Butorphanol + Acepromazine | 0.1 – 0.4 mg/kg (B) SC, IM or IV + 0.02 – 0.05 mg/kg (A) SC, IM or IV | |
| Ketamine | 10 – 20 mg/kg (K) IM | |
| Acepromazine | 0.05 – 0.1 mg/kg IM or SC | |
| Chlorpromazine | 1.0 – 2.0 mg/kg IM | |
| Midazolam | 0.2 – 0.4 mg/kg IV or IM | |
| Diazepam | 0.2 – 0.4 mg/kg IV or IM | |
| Xylazine | 0.4 – 0.9 mg/kg SC or IM | |

Note: Acetaminophen (Tylenol) may be toxic in cats and should be used with extreme caution in this species. Cats are also sensitive to the toxic effects of aspirin, and fatalities have been reported. Although aspirin can be used in cats, other agents should be considered. Normal values: body temperature 38.0-39.5ºC (100.4-103.1ºF); heart rate 110-140/min; respiration rate, 20-30/min. Anticholinergic medication (e.g., atropine @ 0.02-0.04 mg/kg SC, IM, or glycopyrrolate @ 0.02 mg/kg IM, SC) may be helpful in anesthetized cats to support the heart rate and reduce bronchial secretions, consult a USF veterinarian.

## TableX. Commonly Used Anesthetics and Analgesics for Pigs

University of South Florida provides the following table as a reference only, for use by IACUC-certified faculty and staff only.

| Anesthesia in Pigs | Dose & Route | Comments |
|---|---|---|
| Isoflurane (Forane®) | To effect. In general, 3-4% induction, 1-2% maintenance; inhalation | Precision vaporizer, adequate ventilation or scavenging essential |

## Table XIII. Commonly Used Anesthetics and Analgesics for Birds