



Title: Anesthesia

SOP Number: 020

Purpose: This document was created by the ACS staff as a guideline for anesthesia monitoring during surgery, anesthesia and sedation. This is not intended to be an inclusive tutorial on all possible methods and all equipment available for anesthesia monitoring. Current veterinary anesthesia standards of care focus on reducing anesthetic morbidity. Adverse changes in normal animal physiology can be detected and corrected early through responsible use of anesthesia monitoring equipment and trained personnel dedicated to anesthesia monitoring.

IACUC POLICY

It is the policy of the ACUC that appropriate sedative, analgesic or anesthetic agents be administered to animals utilized in approved research and teaching protocols according to the accompanying standard operating procedures. Different anesthetics may be utilized if approved by the Clinical or Attending Veterinarian. The AV or the CV should be involved in protocol formulation for those projects involving anesthesia or analgesia.

DEFINITIONS

- A. Anesthesia: Temporarily induces loss of sensation with or without loss of consciousness.
 - 1. Anesthetics do NOT typically provide pain relief. While certain anesthetics do have limited analgesic properties, approval of painful procedures without use of analgesics must be justified through the animal use protocol.
 - 2. Local Anesthesia: is any technique to induce the absence of sensation in part of the body, generally for the aim of inducing local analgesia, that is, local insensitivity to pain, although other local senses may be affected as well. It allows patients to undergo minor surgical and dental procedures with reduced pain and distress.
 - 3. General anesthesia: is a medically induced coma and loss of protective reflexes resulting from the administration of one or more anesthetic agents. A variety of medications may be administered, with the overall aim of ensuring sleep, amnesia, analgesia, relaxation of skeletal muscles, and loss of control of reflexes of the autonomic nervous system.
- B. Analgesia
 - 1. Provides pain relief without loss of consciousness.
- C. Sedation:
 - 1. A mild degree of central depression in which the patient is awake but calm.
 - 2. Sedation is not sufficient for invasive surgical procedures

ANESTHETIC DELIVERY METHODS

- A. For anesthesia delivery, precision vaporizers and monitoring equipment increase the safety and choices of anesthetic agents for use in rodents and other small species.
- B. For injectable anesthetic protocols, specific reversal agents can minimize the incidence of some side effects related to prolonged recovery and recumbency.
- C. Guidelines for the selection and proper use of analgesic and anesthetic drugs should be developed and periodically reviewed and updated as standards and techniques are refined.
- D. Agents that provide anesthesia and analgesia must be used before their expiration dates and should be acquired, stored, their use recorded, and disposed of legally and safely.
- E. Bell jar technique of anesthetic delivery to rodents must be justified and approved by the IACUC. Justification may include field studies or areas in which a precision vaporizer is not available. It may also be appropriate to use the bell jar technique for terminal studies, but this must be performed within a BSC or chemical fume hood.

PROCEDURES

- A. Surgical Anesthesia Expectations:
 - 1. Procedures must meet current veterinary anesthesia standards of care.
 - 2. Personnel are expected to maintain aseptic technique while providing appropriate anesthetic monitoring. Typically, this requires one person dedicated to surgery and a separate person dedicated to anesthesia monitoring.
 - 3. A pulse oximeter should be used to monitor blood oxygenation saturation throughout the surgical procedure.
- B. Non-Rodent Recovery Surgical Anesthesia and Monitoring
 - 1. Pre-surgical examination:
 - a. A physical examination should be performed including:
 - b. Heart rate and rhythm
 - c. Mucous membrane color (normal = pink)
 - d. Capillary refill time (normal <2 seconds)
 - e. Respiratory sounds and rate
 - f. Temperature
 - 2. Pre-surgical examination findings should be documented and included with the anesthetic and sedation monitoring sheet according to the "Anesthesia for Animal Medical Records" to be included in the animal's file.
 - 3. Monitoring:
 - a. Monitoring must be performed throughout the anesthetic episode and until the animal is ambulatory.

- b. Monitoring frequency must be at a minimum of every 15 minutes.
- c. More frequent monitoring of every 5-10 minutes is highly recommended.
- d. Minimal monitoring requirements include:
 - 1) Cardiovascular System:
 - a) Heart rate or pulse rate must be monitored
 - b) Heart rate can be monitored by palpating the chest wall, placement of an esophageal stethoscope, or use of a standard stethoscope.
 - c) Pulse rate can be monitored by palpating a pulse on the extremities or through monitoring equipment such as a doppler ultrasound, pulse oximetry or direct arterial blood pressure.
 - d) Peripheral perfusion must be assessed by capillary refill time (normal < 2 seconds) or mucous membrane color (normal = pink).
 - e) Prolonged capillary refill time or pale mucous membranes are indicative of decreased blood volume, decreased perfusion or respiratory distress
 - 2) Respiratory System:
 - a) Respiratory rate must be monitored.
 - b) Respiratory rate can be assessed by visually counting chest wall inflations, utilizing a stethoscope, or monitoring rebreathing bag movements.
 - 3) Body Temperature:
 - a) Body temperature must be monitored during anesthesia and recovery to prevent serious changes from normal. Thermal support should be supplemented depending on species, procedure, and duration of procedure.
 - b) Warming devices should provide gentle heat only (maximum of 102°F). A thermometer can be placed next to the supplemental heat source to verify temperatures are < 102.
 - c) An insulated pad or folded drape must be placed between the animal and the heat source. A heating pad must never be used on the high setting.
 - d) Additional information can be found at: AALAS Learning Library – Treatment of Hypothermia.
- 4. Anesthetic Depth:
 - a. Adequate anesthetic depth must be evaluated during anesthetic period and can be assessed by the following:
 - 1) Loss of response to stimulation including toe, ear, or tail pinch
 - 2) Loose mandibular jaw tone
 - 3) Absent blink reflex

- 4) Eye position
 - a) Non-ruminants – Eyes rotate rostro-ventrally
 - i. Central eye position indicates depth too deep or too light
 - b) Ruminants – Eyes rotate ventrally and only sclera is seen
 - i. Central eye position indicates depth too deep or too light

- 5. Records: Each surgical procedure must have a record of parameters monitored throughout the procedure. Each record must include the name of the surgery, the duration of the surgery, the anesthetic administered, the dose, and the values of all parameters monitored during the surgery and recovery periods.

C. Rodent Recovery Surgical Anesthesia and Monitoring

- 1. Pre-surgical:
 - a. Once the rodent is anesthetized, the anesthetic depth must be evaluated prior to initiating surgical procedure. Appropriate anesthetic depth is determined by absence of painful response, such as pedal or toe pinch.
- 2. Monitoring:
 - a. Monitoring is recommended throughout the anesthetic event every 15 minutes.
 - b. Rodents must be monitored until they are fully awake and ambulating.
- 3. Cardiovascular System:
 - a. Tail, foot, tongue or ear color can be monitored for pale or blue membranes which is indicative of decreased blood volume, decreased perfusion or respiratory distress.
- 4. Respiratory System:
 - a. Small rodents have respiratory rates too quick to accurately count.
 - 1) Instead, an assessment of the breathing pattern should be made. (e.g., regular vs. irregular breaths).
- 5. Body Temperature:
 - a. Rodents have a high body surface area to mass ratio, which causes them to heat up quickly when distressed and lose body heat quickly when chilled. As a result, rodents are prone to overheating when high temperature heating systems are used and hypothermia if supplemental heat is not provided.
 - b. Both thermal excess and thermal deficit, can quickly lead to serious injury or death.
 - c. During recovery, heating devices can be placed under the rodent cage so half of the cage is on the pad and half off the pad. This will allow animals to escape the heat source if they become too hot.

- d. Warming devices should provide gentle heat only (maximum of 102°F). A thermometer can be placed next to the supplemental heat source to verify temperatures are < 102.
 - 1) An insulated pad or folded drape must be placed between the animal and the direct heat source to avoid thermal injury.
 - 2) Extreme caution must be taken when using commercial human electric heating pads – maximum temperatures are not well regulated and uneven surface temperature gradients exist, risking thermal injury burns to the animal.
 - 3) If commercial human electric heating pads are used, do not use in direct contact with the rodents. Always provide a layer of protection between the animal and the pad.
 - 4) Always monitor the animals while the pad is in use.
 - 5) Commercial electric heating pads can be used to safely provide heat to a cage of rodents as long as one half of the cage is left off of the heat source.

D. Sedation Without General Anesthesia

1. Monitoring:

- a. Cardiovascular, respiratory, and temperature monitoring guidelines are similar to surgical anesthesia monitoring.

2. Oxygen should be supplemented by facemask.

- a. For heavy sedation, intubation equipment (laryngoscope and endotracheal tube) should be available in case protective airway reflexes are lost.

E. Non-Recovery Surgery

1. Pre-surgical Examination:

- a. A physical examination should be performed including heart rate and rhythm, mucous membrane color (normal = pink), capillary refill time (normal < 2 seconds), respiratory sounds and rate, and temperature.

2. Records:

- a. Cardiovascular, respiratory, and body temperature monitoring requirements are similar to surgical anesthesia monitoring.

1) Cardiovascular System:

- a) Pulse Oximeter: Non-invasive method to accurately measure oxygenation (SaPO₂) along with pulse rate.
 - i. Can be placed on the tongue, ear, and skin folds between the pedal digits, nostrils, or commissures of the mouth.
 - ii. Can be placed on the whole paw of small rodents.
 - iii. Once placed, confirmation of accurate measurements can be made by comparing heart rate determined by the oximeter with the pulse rate of the animal.

- iv. Placement of the probe on areas of heavily pigmented skin should be avoided as this can cause erroneous results.
- v. Ideal SaPO₂ > 95%
- vi. SaPO₂ < 90% = hypoxia
- vii. Verify probe placement is correct and investigate signs of hypoxia such as low oxygen tank, hypoventilation, or ventilation-perfusion mismatch.

3. Respiratory System:

- a. Small rodents have respiratory rates too quick to accurately count.
- b. Instead, an assessment of the breathing pattern should be made. (e.g., regular vs. irregular breaths).

F. Post-operative Care Guidelines

1. Post-operative monitoring and care can be divided into two phases.

- a. Phase one (I) includes recovery from anesthesia, when the animal should be observed no less than every fifteen minutes. The animal should not be returned to his home cage until in sternal recumbency.
- b. During Phase two (II), the animal has been returned to, and is monitored in, the home cage.

2. Phase I

- a. Provide the animal a quiet, warm place to recover until fully ambulatory.
- b. Do not supply bowls of food or water until the animal is fully ambulatory.
- c. If an endotracheal tube was used, extubate the animal only when swallowing reflexes have completely returned.
- d. Place most species in lateral recumbency (ruminants should be propped up in sternal recumbency).
- e. Rotate the body every fifteen minutes to avoid atelectasis.
- f. Maintain records: fluids, analgesia, any treatments, and animal's behavior. Rodent records may be kept in "batch" form, but individual records must be kept for USDA covered species.
- g. Check physiological parameters (heart rate, temperature, capillary refill etc.) and record in individual large animal records.
- h. All procedures deemed painful by the IACUC require post-operative analgesia, unless the IACUC has approved a scientific justification that explains why you can't administer analgesia

3. Phase II

- a. Phase II starts after the animal is in sternal recumbency and has been returned to the home cage. Monitoring at this point depends on the surgical procedure (eg: how invasive was the procedure?). The following items should be considered:
- b. Check the animal several times a day if the procedure was invasive. Pay close attention to the animal's behavior, e.g. food/water intake, amount of urination and defecation. Any abnormal behavior or physiological changes should be reported to the ACS veterinary technical staff.
- c. Check the incision site daily (look for swelling, infection and dehiscence).
- d. Note the animal's hydration. This can be achieved by pinching the skin. Skin that remains tented or is slow to return to rest indicates dehydration. Warm fluids should be given if the animal is dehydrated.
- e. If the animal does not seem to be recovering as expected, report this to ACS Staff
- f. Remove sutures, staples or wound clips 7 to 14 days post-surgery.

Guidelines for the Use of Anesthetics Agents

1. Refer to tables available online at www.depts.ttu.edu/acuc