| IACUC Guidance: | **TAMU-G-049** | Title: | **Guidelines for Performing Surgery in Amphibians and Reptiles** |
|---|---|---|---|

| Location | Effective Date | Review By |
|---|---|---|
| **College Station/Dallas/Galveston/Kingsville** | 11/01/2022 | 10/31/2025 |
| **Houston** | N/A | N/A |

## 1. PURPOSE

1.1. To define surgical standards and best practices when planning and performing common surgical procedures on amphibian and reptile species used for research, teaching, or other purposes at Texas A&M University.

## 2. SCOPE

2.1. Applies to amphibian and reptile species undergoing surgical procedures at Texas A&M University
  2.1.1. Field conditions may require protocol-specific exemptions
2.2. Does not contain a complete discussion of MS222, see TAMU-G-021
2.3. These guidelines are general recommendations and consequently do not factor in specific research associated concerns.

## 3. RESPONSIBILITY

3.1. Performing amphibian/reptile surgery requires a knowledge and skill set that differ from that for mammalian surgery in a number of ways. Survival surgery in these species should not be attempted unless personnel have been properly trained and are competent to perform the procedures.
3.2. The **PI** is responsible for:
  3.2.1. Following these guidelines for approval of protocols which include surgery.
  3.2.2. Listing participants, with their qualifications to perform the activities or procedures selected, on the AUP when initially submitted.
  3.2.3. Ensuring that AUP personnel complete all training and BOHP enrollment activities as outlined in TAMU-G-029 and maintaining documentation of training.
  3.2.4. Training personnel of the potential for toxicity of the species with which they are working, as applicable.
  3.2.5. Awareness of the regulatory status of the species they intend to use in their studies. Regulations governing endangered species may be reviewed in Title 50 of the Code of Federal Regulations, part 17 for ESA regulations and part 23 for CITES (Convention on International Trade in Endangered Species of Flora and Fauna).
  3.2.6. Obtaining the necessary permits for wildlife studies.
3.3. The **IACUC** is responsible for Inspecting and approving all surgical areas and procedure rooms (where surgery will occur) prior to use.
3.4. The **IACUC** and the **AV** are responsible for:
  3.4.1. Determining the categorization of surgery as major or minor and the impact on the animal's well-being; and
  3.4.2. Reviewing the stated experience and qualification of protocol participants and identifying any needed additional training requirements.
3.5. The **PI** and the **AV** share responsibility for ensuring that postsurgical care is appropriate.
3.6. **PI** and **Surgeon**: Responsible for ensuring appropriate surgical preparation, technique and monitoring for each animal, as well as oversight of the animal's post-operative recovery period.

## 4. DEFINITIONS AND/OR ACRONYMS

4.1. **Analgesia:** Provides pain relief without loss of consciousness
4.2. **Analgesic**: Drug used to relieve pain
4.3. **Anesthesia**: Temporarily induces loss of sensation with or without loss of consciousness. Typically does NOT provide adequate post-procedural pain relief.

4.4. **Aseptic Surgical Techniques**: Well-established methods used to avoid the introduction of microbial contamination into tissues exposed and/or manipulated during surgery.
4.5. **AUP:** Animal Use Protocol. Document submitted by the PI indicating the housing and research procedures involving animals.
4.6. **AV:** Attending Veterinarian. Individual designated by Texas A&M University to fulfil the regulatory role of AV. May also describe veterinary staff who report directly to, and have delegated authority from, the AV.
4.7. **BOHP**: Biosafety Occupational Health Program. Provides occupational health services to personnel at risk of exposure to animals or infectious biohazards in the course of their participation in IBC or IACUC permitted research, teaching or diagnostic activities.
4.8. **The *Guide*:** The *Guide for the Care and Use of Laboratory Animals*. Primary reference document for meeting the needs and requirements of animals used in biomedical research. The PHS Policy requires institutions to use the *Guide* as a basis for developing and implementing an institutional program for activities involving animals.
4.9. **Immersion:** A method of delivering drugs via direct contact with the skin in a bath.
4.10. **Major Surgery:** Usually penetrates and exposes a body cavity and includes the potential for significant impairment of physical or physiologic functions or involves extensive tissue dissection or transection. Examples: laparotomy, thoracotomy, joint replacement, and limb amputation.
4.11. **Minor Surgery:** Minor surgery usually does not expose a body cavity and causes little or no physical impairment; Examples include suturing superficial wounds, peripheral vessel cannulation, percutaneous biopsy, intracranial injection, subcutaneous osmotic pump implant, routine agricultural animal procedures such as castration.
4.12. **MS222**: Tricaine methanesulfate is an FDA-approved drug ("Tricaine-S") for temporary immobilization (sedation, anesthesia) of finfish, amphibians, and other aquatic, cold-blooded animals.
4.13. **Multiple Survival Surgery:** Multiple anesthetic events or more than one survival surgery (major or minor) on a single animal.
4.14. **Non-survival surgery**: A surgery in which animals are euthanized under general anesthesia prior to anesthetic recovery.
4.15. **OLAW:** Office of Laboratory Animal Welfare. Provides guidance and interpretation of the Public Health Service (PHS) Policy on the Humane Care and Use of Laboratory Animals (Policy) for PHS-funded research and monitors compliance with the Policy by Assured Institutions.
4.16. **Orthostatic Hypotension**: A significant fall in blood pressure within minutes of positional changes
4.17. **Parenteral Anesthesia:** Anesthesia induced by some route other than through the alimentary canal, such as subcutaneous, intramuscular, or intravenous injection.
4.18. **PI**: Principal Investigator. The individual who has ultimate administrative and programmatic responsibility for the design, execution, and management of a project utilizing vertebrate animals.
4.19. **Preemptive Analgesia**: The administration of preoperative and/or intraoperative analgesia that is intended to take effect before the experience of pain.
4.20. **Sedation**: Central depression causing stupor where the animal is unaware of its surroundings but still responsive to painful procedures.
4.21. **Surgery**: Cutting into the body through the use of a tool such as a scalpel blade, surgical scissors, laser, or other suitable device. May also refer to an invasive measurement under anesthesia.
4.22. **Survival surgery**: A surgery in which animals are expected to recover from anesthesia following the procedure.

## 5. GUIDELINES OR PROCEDURE

5.1. **Handling and Restraint**
5.1.1. **Amphibian** skin is easily damaged by handling, therefore it is recommended that all personnel wear pre-moistened powder-free latex gloves whenever they handle these animals.
5.1.2. **Reptiles**

5.1.2.1. Small lizards can be restrained either in bags or towels.
5.1.2.2. Inappropriate tail restraint in many lizard species will elicit the antipredator response of tail shedding.
5.1.2.3. Lizards may bite. Large lizards also can scratch and whip the handler with their tails. Handlers should practice caution when handling large lizards including the use of gloves (if appropriate).
5.1.2.4. Appropriate experience and techniques are required for venomous species.
5.1.2.5. Snake tubes are made of clear, shatterproof plastic and are used for restraint during either physical examination or anesthetic induction.

5.2. **Anesthesia**
5.2.1. All animals should have a pre-surgical assessment to ensure they are not overtly ill.
5.2.2. Hypothermic anesthesia is considered **inappropriate** for amphibians and reptiles.
5.2.3. **Amphibians**
5.2.3.1. Small amphibians should be fasted before surgery for a minimum of 4 hours, and larger insectivorous amphibians for 48 hours. For species-specific recommendation, consult the AV or designee.
5.2.3.2. Adequate pre-surgical hydration is essential for a successful surgical outcome, therefore soaking the amphibian patient in water for 1 hour before surgery is recommended.
5.2.3.3. Amphibians are poikilothermic. When they are kept either above or below their preferred optimal temperature zone, these animals may exhibit signs of anorexia and immunosuppression.
5.2.3.4. In almost all instances, the anesthetic of choice for amphibian surgery is buffered MS222. Injectable anesthetics such as propofol, ketamine and immersion in clove oil are alternatives that can be discussed with the AV or designee, and described in the AUP if selected.
5.2.4. **Reptiles**
5.2.4.1. Although regurgitation and aspiration are unlikely, perioperative fasting is recommended because of impaired digestion.
5.2.4.2. Ambient temperature and decreased metabolic rate can have profound effects on reptilian anesthesia. Since temperature will affect dose, rate of induction and recovery time, care should be taken to maintain the animal at its preferred body temperature.
5.2.4.3. Parenteral anesthesia should not be relied upon in venomous snakes to produce complete immobility.
5.2.4.4. Once restrained, management of fangs may include covering in a syringe case (or similar) to prevent accidental envenomation.
5.2.4.5. Inhalation anesthesia is the preferred method for reptiles. However, volatile anesthetics are slower to take effect in reptiles because of their ability to hold their breath. Species that breath-hold may be sedated or anesthetized via an injectable anesthetic and then intubated and maintained on inhalant anesthesia.
5.2.4.6. For some species, the glottis may be desensitized with topical anesthetic to facilitate intubation. In aquatic species, sufficient time (≥3-4 h) is needed for the effect of the local anesthetic to wear off before reintroducing the animal back to water. This is done to prevent water aspiration and possible drowning.
5.2.4.7. Propofol is an injectable anesthetic that must be administered either intravenously or by intraosseous injection in reptiles. For species-specific recommendations on injectable anesthetics, consult with the AV or designee.
5.2.4.8. Local anesthesia (lidocaine/bupivacaine) may provide a good alternative to general anesthesia in reptiles that are easily restrained. Local anesthesia can be used in conjunction with systemic agents to enhance analgesia at incision sites. Since the skin of reptiles is relatively impermeable,

the effectiveness of topical application of anesthetics is reduced. It is recommended that small volume syringes and small gauge needles be used to infiltrate the anesthetic locally with care, for the toxic dosage of local anesthetics is not well known in reptiles.

5.3. **Anesthetic Monitoring and Support**

5.3.1. **Amphibians**

5.3.1.1. When using MS222 in amphibian patients, a light plane of anesthesia is indicated by the loss of the righting and corneal reflexes. A deep plane of anesthesia is indicated when the withdrawal reflex to deep pain is lost. Once MS222 anesthesia is successfully induced, a brief but thorough rinsing in fresh water to remove residual anesthetic will reduce the risk of complications. If the amphibian patient begins to recover before the completion of the surgical procedure, it is advisable to deepen anesthesia by returning the animal to a 50% dilution of the induction solution.

5.3.1.2. Terrestrial Species

5.3.1.2.1. Once the animal has been anesthetized, and until it is fully recovered care must be taken to ensure that it does not drown.

5.3.1.2.2. In some cases, anesthesia with MS222 can be maintained by dripping a dilute solution of this drug over the skin or by covering animals with a paper towel moistened with the anesthetic.

5.3.1.2.3. After procedures are completed and skin has been rinsed, place animals in a container lined with un-medicated wet towels.

5.3.1.3. In addition to lungs and/or gills, most amphibians also respire through their skin. In anesthetized animals, in which lung respiration is reduced or interrupted, the body skin should always be kept moist with a thin layer of wet tissue or gauze in order to allow respiration through the skin.

5.3.1.4. The length of time required for recovery from anesthesia depends on the life stage, anesthetic, temperature, species and depth of anesthesia. Usually, amphibians recover from MS222 within 30 to 90 minutes after being rinsed in fresh water (untreated water from the home environment is best).

5.3.1.5. While recovering, amphibians should be placed in fresh water at ambient temperature and kept away from direct sunlight and temperatures greater than 25°C/77°F. When an animal can swim or walk normally, it may be released, or returned to housing.

5.3.1.6. It is advisable to bubble 100% oxygen into the water during the surgical procedure to assist the amphibian's cutaneous respiration.

5.3.1.7. Large amphibians may be intubated and ventilated for prolonged procedures. If the heart rate of the amphibian patient drops 20% or greater from baseline, it is necessary to remove the animal from the anesthetic solution and to recover the patient.

5.3.2. **Reptiles**

5.3.2.1. Increasing depth toward a surgical plane of anesthesia is assumed when muscle tone (e.g., jaw muscle, cloacal sphincter) decreases, palpebral and corneal reflexes are obtunded, and respiration pattern becomes regular and even.

5.3.2.2. During inhalant anesthetic induction, snakes relax from the head to tail and recover in the opposite direction. Hence, the absence of a response to either a tail or cloacal pinch is suggestive of an adequate surgical anesthetic plane. Similarly, the toe and cloacal pinch response is used to monitor anesthetic depth in lizards, tortoises, and turtles. The palpebral or corneal response also can be used in chelonians and most lizards. The palpebral and corneal reflexes are not elicited in snakes and some lizard species because the spectacle protects the cornea and prevents blinking.

5.3.2.3. Reptiles are ectotherms and therefore depend on external heat sources for thermoregulation. They maintain their body either at a specific set-point temperature or within the range between

an upper and a lower set-point (preferred optimal temperature). Set-point temperatures change seasonally and differ between the sexes. This is assessed by cloacal temperature measurement. It is recommended that body temperatures definitely not exceed 40°C, and preferably not 35°C.

5.3.2.4. Subcutaneous administration of fluids is not appropriate for correction of deficits or hemorrhage in the peri-anesthetic period. Fluid absorption is minimal because subcutaneous tissues are poorly vascularized. Seek clinical care from the AV or designee for vascular access.

5.3.2.5. Balanced electrolyte solutions (e.g., 0.9% NaCl, lactated Ringer's solution) are used for routine fluid administration; however, an argument has been made against the use of lactated Ringer's solution in reptiles because of the prolonged half-life of lactate.

5.3.2.6. Most reptiles appear to develop either apnea or marked bradypnea and hypoventilation when anesthetized. It is usually necessary to provide ventilation during anesthesia.

5.3.2.7. A moist paper towel between the stethoscope and the skin (or the use of an esophageal stethoscope) may aid in the respiratory monitoring of species with scales and shells.

5.3.2.8. Following surgery, the snake should be kept in a warm holding area for a minimum of 24 hours. If no feeding or drinking is observed, intracoelomic fluids (sterile normal saline) of a volume equal to 2% of the snakes body weight could be administered intraperitoneally (i.p.) to ensure the snake is well hydrated.

5.3.2.9. Opportunities for thermoregulation should be provided in the form of a thermal gradient. Many reptiles need access to full spectrum light, including UV wavelengths, to maintain healthy skin.

5.4. **Analgesia**

5.4.1. Currently, there is a lack of concordant information regarding the effects of analgesics on amphibians and reptiles.

5.4.2. **Amphibians**

5.4.2.1. Pain perception in amphibians is likely to be analogous to that in mammals. Invasive, potentially painful procedures should be accompanied by both analgesia and anesthesia.

5.4.2.2. Some of the analgesics that are recommended for amphibian patients include the following: buprenorphine (38 mg/kg SC), butorphanol (0.2–0.4 mg/kg IM), fentanyl (0.5 mg/kg SC), meperidine (49 mg/kg SC), morphine (38–42 mg/kg SC), and nalorphine (122 mg/kg SC).

5.4.3. **Reptiles**

5.4.3.1. Nonsteroidal anti-inflammatory drugs, such as flunixin meglumine, may provide pain relief in reptiles. There is data to demonstrate that opioid and opioid-like analgesics, particularly morphine, fentanyl, and tramadol, appear to be the most promising analgesics for reptile use.

5.4.3.2. Drugs may need less frequent dosing because of prolonged drug clearance. Consult the AV or designee for recommendations.

5.5. **Emergency Management**

5.5.1. A fixed, dilated pupil, unresponsive to light, and with no corneal reflex is a cross-species indicator of either excessive anesthetic depth or brainstem hypoperfusion/ischemia.

5.5.2. Amphibians are highly resistant to hypoxia so simple unresponsiveness should not necessarily be equated with death. Attempts to resuscitate an unresponsive amphibian may be effective.

5.5.3. There are reports of reptiles recovering after many hours of cardiovascular arrest with supportive care (ie, heat, oxygen, and fluids).

5.5.4. Contact the AV or designee immediately for emergency treatments.

5.6. **Asepsis**

5.6.1. The Guide and PHS Policy require survival surgery to be conducted using aseptic technique.

5.6.2. Instruments must be sterilized for survival surgery.

5.6.3. In cases where multiple surgeries will occur and instruments are reused, the instruments should be cleaned, soaked in a sterilizing solution (with adequate contact time) such as Cidex ™, and then rinsed in sterile saline/water to reduce tissue irritation.
5.6.4. Hot bead sterilizers may also be used to re-sterilize instruments. Ideally, a sufficient quantity of surgical instruments should be prepared so a sterile pack is available for each surgery.
5.6.5. Cap, mask, sterile gloves, and in some cases, sterile gown are recommended during surgery.
5.6.6. **Amphibians**
5.6.6.1. The wet environment required for amphibian surgery makes sterile surgery a challenge, and these procedures are generally considered to be clean-contaminated.
5.6.6.2. Prior to preparation of the surgical site, a commercially available artificial slime can be used to coat the skin of amphibians.
5.6.6.3. Surgical scrubs that contain soaps, detergents, isopropyl alcohol, or iodine products are contraindicated in amphibians. The recommended presurgical disinfectant is 0.75% chlorhexidine solution. It is necessary for sterile gauze soaked in the chlorhexidine to have direct contact with the surgical site for at least 10 minutes before surgery, and then for personnel to rinse the site with sterile saline. Some investigators report success prepping amphibian skin using copious irrigation with sterile water or saline.
5.6.6.4. Aquatic amphibians having gills can be placed on a Styrofoam board with a section cut out for the head, and with the board floating in a solution of MS222, the head is placed in the solution.
5.6.6.5. Sterile cloth soaked in an anesthetic solution of MS222 can be used to cover the body of terrestrial amphibians (except for the surgical site).
5.6.6.6. A plastic drape then can be used to completely cover the amphibian. Adhesive drapes should **never** be used on amphibian skin.
5.6.7. **Reptiles**
5.6.7.1. Surgical scrubs and organic iodines, both solutions and soaps, are routinely used in reptiles.
5.6.7.2. Any skin preparations must not contain alcohol as it is absorbed through the skin and dissolves surface secretions that provide protection from dehydration and infection.
5.6.7.3. The turtle shell should be cleansed and degreased.
5.6.7.4. Reptile skin is easily draped using either cloth drapes or plastic drapes. Clear drapes are preferred.

5.7. **Surgical Technique**
5.7.1. Gut suture material, especially chromic gut is to be avoided since it induces a major inflammatory response in amphibians and reptiles.
5.7.2. **Amphibians**
5.7.2.1. Skin incisions in amphibian patients are best made with a number 15 or number 11 scalpel blade. Everting suture patterns are recommended for skin closure, and interrupted patterns are preferred over continuous patterns. Alternatively, it is possible to use cyanoacrylate tissue adhesives for skin closure in some instances.
5.7.2.2. Absorbable suture such as polyglactin (Vicryl, Ethicon, Somerville, NJ), polydioxanone (PDS, Ethicon, Somerville, NJ), and polyglycolic acid (Dexon, United States Surgical, Norwalk, CT) are appropriate for internal use including muscle. Non-absorbable monofilament suture such as nylon should be used for skin closure; 3–0 or 4–0 suture is generally adequate. Taper needles are preferable to cutting needles, and it is *usually* possible to remove sutures after 14 days (should be removed by day 30).
5.7.3. **Reptiles**
5.7.3.1. In most situations, nylon and polypropylene can be used to close reptiles' wounds.

5.7.3.2. Owning to their relatively stronger skin, closure with a continuous pattern is safe and effective in reptile skin. Everting suture patterns are recommended (horizontal and vertical mattress). Staples are also appropriate. Suture removal should be done 4-6 weeks after surgery.

5.7.3.3. Given slower rates of absorption (compared to birds/mammals), absorbable material used for closing skin, may also require removal after healing.

5.7.3.4. Suture removal may need to be delayed (in some species) until after skin-shedding.

5.8. **Post Procedural Care and Monitoring**

5.8.1. **Amphibians**

5.8.1.1. If the amphibian patient is still in a MS222 solution at the conclusion of surgery, it is essential to transfer the animal to a warm, anesthetic-free bath and to rinse it copiously with fresh, well-oxygenated water. Recovery from anesthesia may be hastened by maintaining ambient temperature from 72 degrees to 85 degrees F, keeping the skin moist and humidity greater than 70%.

5.8.1.2. Amphibians should be observed until they are fully ambulatory. After recovery, they should be checked at least daily.

5.8.1.3. Antibiotic therapy is routinely recommended prophylactically before and after surgical procedures in amphibians.

5.8.1.4. Subcutaneous or intracoelomic postoperative fluids.

5.8.1.4.1. Two easily formulated solutions for use in amphibian patients are (1) one part of saline (0.9% NaCl) mixed with two parts of 5% dextrose, and (2) seven parts of saline mixed with one part of sterile water. An appropriate dose of either solution is 25 mL/kg of body weight.

5.8.1.5. An important adjunct to maintain hydration and restore the health of ill amphibians is to soak the animals in balanced electrolyte solutions. Example:

5.8.1.5.1. Amphibian Ringer's solution (may be stored for up to 7 day, longer if autoclaved and stored in sterile containers): 6.6 g NaCl, 0.15 g $CaCl_2$, 0.15 g KCl, and 0.2 g $NaHCO_3$ per liter of distilled/dechlorinated water [as appropriate]).

5.8.1.6. It may be necessary to assist the amphibian patient with feeding for a brief period after any surgical procedure. Suitable choices for nutritional support in amphibians that are not self-feeding include the following: A/D Prescription Diet (Hill' s Pet Nutrition, Topeka, KS); and a slurry made of ReptoMin pellets (Tetra, Blacksburg, VA) (Hadfield and Whittaker 2005). After gastrotomy, it is essential to withhold feeding for 1 week and to offer only small meals for the next month.

5.8.2. **Reptiles**

5.8.2.1. Care should be taken to prevent orthostatic hypotension by maintaining the animal horizontally and avoiding rapid changes in body position.

5.9. **Multiple Survival Surgery (in same animal)**

5.9.1. The PI must describe in the AUP when multiple survival surgical procedures are performed on the same animal to meet the objectives of the study, project, or class

5.9.2. The performance of multiple major survival surgery (MMSS) on a single animal is acceptable when included on a single project and scientifically justified by the PI in the AUP

5.9.2.1. Cost savings alone is not an adequate reason for performing MMSS

5.9.2.2. The conduct of MMSS on a single animal used in separate projects or AUPs is discouraged and must be clearly indicated in the AUPs impacted

5.9.2.3. Some procedures characterized as minor may induce substantial postprocedural pain or impairment and should similarly be scientifically justified if performed more than once in a single animal

5.10. **Surgical Records.** Records are required for every animal that has undergone surgery, must be maintained for the duration of AUP approval, and should contain:
- 5.10.1. Date of procedure
- 5.10.2. Protocol number
- 5.10.3. Identification of the type of surgery performed; e.g. “laparotomy”
- 5.10.4. Species and animal or cage identifier
- 5.10.5. The name of the surgeon and any assistants
- 5.10.6. Pre-surgical assessment
- 5.10.7. Pre-op preparation, as applicable
  - 5.10.7.1. Surgical scrub or site preparation
- 5.10.8. Event times or total time under anesthesia
- 5.10.9. Vital parameters monitored and times of monitoring
- 5.10.10. A notation of any complication or abnormality identified
- 5.10.11. Drugs administered: dose, route and frequency of administration
- 5.10.12. When DEA controlled substances are used, the date and drug usage volumes recorded in the controlled substance log and the dates and amounts recorded in the animal surgery records should match.
- 5.10.13. Records for survival surgery should include recovery and post-operative monitoring performed until wound closure removal (if applicable), or timeframe established in the AUP, including:
  - 5.10.13.1. Date and time of monitoring
  - 5.10.13.2. General observations which may include assessment of wound closure(s), signs of pain/discomfort, complications, or abnormalities including need for early performance of euthanasia
  - 5.10.13.3. Drugs administered: dose, route, date and time of administration
  - 5.10.13.4. Date of wound closure removal (if applicable)

## 6. EXCEPTIONS

6.1. The PI may request an exception to the above standards by describing the departure in the AUP

6.2. For programmatic exceptions, the facility director or manager may submit a request for the exception using TAMU-F-013

## 7. REFERENCES, MATERIALS, AND/OR ADDITIONAL INFORMATION

7.1. References:
- 7.1.1. CMP: https://vpr.tamu.edu/directory/comparative-medicine-program
- 7.1.2. CITI:
  - 7.1.2.1. Web page: https://about.citiprogram.org/en/homepage/
  - 7.1.2.2. Instructions: https://rcb.tamu.edu/animals/training
  - 7.1.2.3. CITI Working with Amphibians in Research Settings
  - 7.1.2.4. CITI Working with Reptiles in Research Settings
- 7.1.3. Guidelines for Use of Live Amphibians and Reptiles in Field and Laboratory Research from the American Society of Ichthyologists and Herpetologists.
- 7.1.4. CCAC species-specific recommendations
- 7.1.5. Amphibian Ringer’s Solution (200–250 mOsm) (cshlp.org)
- 7.1.6. Veterinary Clinics of North America: Exotic Animal Practice
- 7.1.7. Heard, D.J. Volume 4, Issue 1, January 2001, Pages 83-117 https://doi.org/10.1016/S1094-9194(17)30053-1
- 7.1.8. Use of Amphibians in the Research, Laboratory, or Classroom Setting, ILAR Journal Volume 48(3) from ILAR

7.2. Resources:

7.2.1. Smith SA . 2007 . Compendium of drugs and compounds used in amphibians. ILAR J 48 : 297 – 300
7.2.2. Sherril L. Green in The Laboratory XENOPUS sp. (CRC Press, Boca Raton, FL, 2010)
7.2.3. Additional information on flow rates may be found in Stetter MD. Fish and Amphibian Anesthesia. Veterinary Clinics of North America: Exotic Animal Practice. 2001,4(1):69-82.
7.2.4. IACUC/AWO Referenced Documents: (requires TAMU NetID authentication)
7.2.4.1. TAMU-F-013 Request for Programmatic Exception from Animal Welfare Standards
7.2.4.2. TAMU-G-021 Guidelines for the Use of MS222
7.2.4.3. TAMU-G-029 Guidelines for Animal Use Protocol Participation and Handling

7.3. Acknowledgements

7.3.1. This document was partially prepared using materials obtained from the University of Michigan.

## 8. HISTORY

| Effective Date | Version # | Description |
|---|---|---|
| 12/01/2021 | 000 | College Station/Galveston: New Document |
| 03/24/2022 | 001 | College Station/Dallas/Galveston: Merging of Dallas animal care and use program with College Station/Galveston |
| 11/01/2022 | 002 | College Station/Dallas/Galveston/Kingsville: Renewal; incorporation of Kingsville campus, updated responsibility and definitions, addition of multiple survival surgery and updated record keeping requirements. Reviewed and approved via email. |