

**University of Cincinnati
Animal Care and Use Program**

Survival Surgery

These guidelines apply to all survival surgical procedures performed on vertebrate animals at the University of Cincinnati.

Questions: Contact [LAMS Veterinary Staff](#) or 513-558-5174.

Definitions

1. **Survival Surgery** – a surgical procedure from which an animal receives and is allowed to recover from anesthesia.
 - a. **Major** – any surgical procedure that penetrates and exposes a body cavity or has potential to produce permanent/significant physical or physiological impairment.
 - b. **Minor** – any surgical procedure that does not penetrate or expose a body cavity or does not produce permanent/significant impairment of physical or physiological function.
2. **Multiple** – two or more surgical procedures conducted as separate anesthetic events.
3. **Aseptic Technique** – limiting microorganism contamination of a clean environment.
4. **Cleaning** – physically removes most germs, dirt, and impurities from objects and surfaces.
5. **Sanitation** – reduction of the number of germs on objects and surfaces to levels considered safe.
6. **Disinfection** – elimination or destruction of most viable microorganisms (effective against vegetative organisms, but not necessarily spores).
7. **Sterilization** – elimination or destruction of all viable microorganisms.

Required Training

1. Researchers performing or assisting in survival surgery or post-operative care must complete all required training per [ACUP training policy](#).
2. Surgeon should be trained and proficient in the surgery they are performing. Principal Investigators (PI) are responsible for ensuring proficiency of staff on their protocol.
3. Lab should keep all records of internal surgical/procedural trainings in accordance with federal, state (Ohio-5 years) and UC requirements.

Surgical Area/Room Requirements

1. Non-USDA species (e.g. rodents, ectotherms)
 - a. Procedures should be performed in a clean, uncluttered, and organized dedicated surgical space with minimal foot traffic.
 - b. During surgery, non-animal procedures may not be performed in this dedicated space.
 - c. Surgeries may be performed in the same room as surgical participant and initial animal preparation, but the room must have dedicated areas for each activity.
 - d. In multi-use areas e.g. lab benchtop- surgical area must be sanitized with appropriate disinfectant (see **Disinfectants Recommended for Preparation of the Surgical Area/Room**) prior to surgery and maintained aseptically during surgery.

- e. Assessment of the efficacy of the sanitation process via ATP swab may be requested and/or conducted by Animal Care and Use Program (ACUP) to determine whether alteration of the sanitation procedure or practices is needed.
2. USDA (non-rodent) covered species
 - a. Initial animal preparation should be done in a room separate from the animal surgery.
 - b. Major operative procedures on animals, other than rodents and birds, will be conducted only in facilities intended for that purpose which shall be operated and maintained under aseptic conditions (9 CFR AWA, Part 2, Subpart C).
 - c. Dedicated surgical areas must be operated under positive pressure to the surrounding area.
 3. Sanitation expectations
 - a. Monthly sanitation of active, dedicated surgical rooms/facilities
 - b. Quarterly for animal preparation rooms/facilities
 - c. Room/area must be sanitized prior to survival surgery
 - If the room is used for a different purpose (e.g. non-survival surgery)
 - inactive for over one month
 - between species/different investigators
 - d. Verification of sanitation of surgical areas
 - Verification of the sanitation of is performed by ATP swab analysis **at the time of sanitation** based on the listed expectations and schedule.
 - Records of assessment of the efficacy of the sanitation process will be maintained by the lab and available for ACUP/inspectors/site visitors upon request.
 4. **Disinfectants Recommended for Preparation of the Surgical Area/Room**

Detailed information on disinfectants that can be used in surgical areas can be found at [CDC Infection Control Chemical Disinfectants](#). Examples: Chlorine compounds, Ortho-phthalaldehyde (OPA), Peracetic Acid, Hydrogen Peroxide).

 - a. Follow linked guidance and manufacturer's instructions for appropriate handling and use.
 - b. Detailed instructions (e.g. SOP), including agent type, preparation, exposure time, and safety requirements, etc.is required for use and must be maintained and available for ACUP/inspectors/site visitors.
 - c. Contact [EH&S](#) for SOP safety review, training, chemical inventory, and hazardous waste disposal etc.

Preparation of the Surgical Equipment (refer to [Sterilization of Animal Research-Related Supplies Guidance](#))

1. Surgical equipment must be sterilized prior to surgery and handled aseptically and maintained within an aseptic field during surgical procedures.
 - a. Steam sterilization most commonly used, but gas or chemical/cold sterilization may be used instead depending on the materials/equipment required for the procedure.
 - Each autoclaved pack or peel pouch containing instruments for survival surgical procedures must use external (autoclave tape) and internal (chemical indicator) indicators within each pack.

- The sterilization date and expiration date must be noted on each equipment pack. Pack must be re-sterilized if damaged or unused within 6 months of the sterilization date.
- b. Chemical sterilization:
 - Chemical must be classified and labelled as a [FDA-Cleared Sterilant](#).
 - Detailed instructions (e.g. SOP), including agent type, safety requirements, preparation, exposure time, how long the sterilant is active, and how long items are considered sterile, etc. is required for use and must be maintained and available for ACUP/inspectors/site visitors.
 - Remove blood/tissues (if any) off of the instrument prior to immersion.
 - Leave instruments in the chemical sterilizer for the required contact time. according to manufacturer's recommendations.
 - After removing instrument from the chemical sterilizer, instruments must be rinsed with sterile water or sterile saline and dried with sterile absorbent material (e.g. gauze) prior to touching animal tissue.
 - Contact [EH&S](#) for SOP safety review training, chemical inventory, and hazardous waste disposal etc.
- 2. Surgeries (major or minor) conducted on multiple rodents or ectotherms in a single session may use one sterile instrument pack **for no more than 5 animals**.
 - a. Instruments must be sterilized between each animal. Glass bead sterilization is recommended, but chemical sterilization may be used (see above section).
 - b. Aseptic technique must be maintained.
 - c. Glass bead sterilization:
 - Turn on unit and allow to heat up to appropriate temperature (at least 20 minutes) with cover off and bead well appropriately filled.
 - Wipe the blood/tissues (if any) off the instrument tip with sterile gauze and sterile saline (if needed) and dip in the bead sterilizer.
 - Submerge instrument tips in the heated glass beads for approved manufacturer time (generally 30-60 seconds, but longer for larger instruments), and do not place too many instruments in the sterilizer at one time.
 - Remove and allow time to cool before touching animal tissue.
 - Cover the glass beads when not in use.
 - Replace glass beads as per manufacturer recommendation.

Preparation of the Animal

1. Fast animals (if applicable) and administer pre-emptive analgesics, anesthetics, and other drugs according to the approved IACUC protocol or as prescribed by a LAMS veterinarian.
2. Hair must be removed from the planned incision site and surrounding area to prevent contamination of the surgical field.
 - a. This may be accomplished with animal clippers, a razor, a depilatory agent or a combination of these methods. Note: Depilatory agents must be rinsed/removed completely using sterile water or saline and gauze to prevent dermatitis or chemical burns.
 - b. For large animal species, the surgical area then receives an initial cleaning to remove visible debris using povidone iodine or chlorhexidine scrub followed by rinsing with alcohol until there is no visible debris.

3. After hair removal, the animal should be placed on a clean, absorbent surface, such as an absorbent pad, to minimize heat loss during surgery.
4. A non-medicated ophthalmic ointment (e.g. Puralube®) must be applied to both eyes to prevent corneal drying and trauma.
5. Place animal on a recirculating warm water blanket or self-regulating heating pad for the duration of anesthesia.
 - a. It is recommended to keep animals on the heat source until fully recovered to facilitate a smoother and quicker recovery.
6. Animal should then be moved to dedicated surgical area.
7. Skin of the surgical area should be prepared with alternating scrubs of povidone iodine or chlorhexidine followed by 70% ethanol, repeated a minimum of 3 times. One-step patient preparation systems can also be used.
8. Animal should be covered with a sterile drape to help minimize contamination of the surgical site.

Preparation of the Surgeon

1. At a minimum, surgical participants should prepare for surgery by washing hands with soap and drying them before aseptically donning sterile surgical gloves.
 - a. **If operating on USDA (non-rodent) covered species:** surgical participants must complete a 5-minute hand and lower arm surgical scrub (or comparable process) prior to aseptically donning sterile personal protective equipment (PPE).
2. All surgical participants are required to don PPE. If a type of PPE is not required for a specific species, it is still *recommended best practice* to wear it.

Types of PPE	Required For
Dedicated, clean surgical attire <i>e.g. lab coat, surgical scrubs, disposable gown</i>	All species
Face mask or respirator	All species
Sterile surgical gloves	All species
Hair bonnet/cap	All species
Sterile gown	USDA covered species only

Operative Procedures

1. Survival surgery must be performed using aseptic technique during the procedure.
2. The animal must be maintained at an appropriate depth of anesthesia before the surgical procedure is initiated and must be monitored for surgical plane of anesthesia (negative response to a painful stimulus) throughout the procedure.
 - a. If the animal responds to a noxious stimulus at any point during the procedure, the procedure must be paused and anesthetics and/or analgesics adjusted until the animal is once again at a surgical plane of anesthesia before proceeding.
 - b. If animals are anesthetized with injectable agents only, it is recommended to provide oxygen support throughout the procedure to prevent hypoxic events.
3. Animal's status must be monitored throughout the entire anesthetic event until recovered.
 - a. Monitoring will be based on the species of the animal, the equipment used for monitoring, and the procedure performed.
 - b. At minimum, animals should be monitored for respiratory abnormalities, perfusion and depth of anesthesia. Every 5 minutes is recommended.
4. **For USDA (non-rodent) covered species, document in anesthetic record at least every 15 minutes.**
5. Anesthetized animals must never be left alone.

6. When the procedure is completed, the surgical site must be closed per IACUC-approved protocol.
 - a. This may include sutures, tissue glue, or wound clips/staples.
 - b. The surgical site may be covered with appropriate wound dressing, such as Tegaderm.

Post-Operative Procedures

1. All post-operative monitoring and documentation are the responsibility of the research staff unless prior arrangements are made with LAMS Veterinary Staff.
2. After surgery, move the animal to a warm, dry area and monitor until recovered/sternal.
3. Recovering an animal from anesthesia:
 - a. An animal is not considered recovered until they are ambulatory and able to access feed and water without causing injury to themselves.
 - b. It is important to ensure that animals are not placed in bedding while still sedated as they can suffocate on bedding materials (bedding may be pushed to the side of the cage/pen).
 - c. If animals are group housed, a sedated animal should not be placed with other animals that were not anesthetized unless monitored until recovery due to the risk of aggression to the anesthetized animal.
4. Once recovered from anesthesia, it's recommended to provide supportive care (e.g.: water bottle/rehydration supplements, nutritional support with moistened floor chow or diet gel, warmed subcutaneous fluids) to promote hydration and recovery.
5. Post-operative analgesics must be provided according to the approved IACUC protocol and documented in the surgical record. Refer to associated documents:
 - a. [Mouse Standard Analgesics and Anesthetics](#)
 - b. [Rat Standard Analgesics and Anesthetics](#)
 - c. [Minimum Analgesic Period by Pain Level](#)
6. General animal condition must be evaluated and documented, and any adverse reactions/abnormalities promptly reported to LAMS Veterinary Staff.

Required frequency of post-operative observation and documentation:

- a. **Minor surgery**
 - Procedures with minimal (Level 0) pain: at least once daily for a minimum of 1 day of post procedural monitoring
 - Procedures with mild (Level 1) pain: at least once daily for at least 2 days of post procedural monitoring
- b. **Major surgery**
 - Procedures with moderate (Level 2) pain: at least once daily for at least 3 days of post procedural monitoring
 - Procedures with severe (Level 3) pain: at least once daily for at least 5 days of post procedural monitoring

Number of days is the minimum requirement. If animal is still experiencing adverse effects from the surgery, monitoring must be continued as long as necessary.

7. Post-op medication (i.e. analgesia and/or antibiotics) will be provided as long as necessary as per veterinarian recommendation.
8. LAMS Veterinary staff must be consulted if there are any clinical concerns or adverse events.
9. Sutures and/or staples must be removed 10-14 days after surgery unless otherwise noted in the approved IACUC protocol. This includes animals arriving post-operation from another institution or vendor.

Surgical Records

1. Animals arriving post-operation from another institution or vendor must document the previous surgery date, procedure performed, and name of institution/vendor on the LAMS barcoded cage card upon arrival, as well as a copy of the animal's individual animal health record for USDA species.
2. Surgical records must be available for inspection while the animal is alive and must be retained as per UC record retention policy.
3. Surgical records must be legible, written in English, and maintained in a surgical log or cage card.
 - a. LAMS Rodent Anesthesia/Surgery Cards should be used for all rodent (including USDA covered rodents) and ectotherms (see example card below)
 - b. USDA covered species (non-rodent) should have an individual record
4. Records must contain:
 - a. IACUC protocol number and Principal Investigator's name
 - b. Surgery date and type
 - c. Surgery start time
 - d. Surgeon's name or initials
 - e. Animal species
 - f. Animal identification (e.g. barcode ID)
 - g. Presurgical body weight and condition
 - h. Anesthetics, analgesics and additional drugs or supportive fluids administered with route, dose, concentration and time
 - i. Post-procedural care (see **Post-Operative Procedures**)
 - j. Suture removal date
 - k. **USDA Large animal only:** description of surgical procedure and anesthetic record documenting vital signs (e.g. temperature, heart and respiratory rates, mucous membrane color)
5. **Non-USDA animals surviving 6 hours or less post-operation:** minimal surgical documentation is required and must include (on LAMS barcoded cage card) the surgery date and time, procedure performed, and surgeon's initials.

LAMS - RODENT ANESTHESIA / SURGERY CARD (check one):		
☐ Survival Surgery ☐ Anesthesia only		
Date/Time:	Surgeon:	
Barcode/ID#:	Procedure Name:	
Pre-surgical weight:	Suture/Wound Clip Removal Date:	
Pain level (check mark):	☐ Minimal (1 day) ☐ Mild (2-3 days) ☐ Moderate (3-5 days) ☐ Severe (5-7 days)	
Check mark medications:	Dose/Concentration	Route/Time
☐ Isoflurane ☐ Ketamine/Xylazine ☐ Ketamine/Xylazine/Acepromazine		
☐ Buprenex ☐ Buprenex Polymer ☐ Ethiqs ☐ Meloxicam ☐ Meloxicam Polymer ☐ Carprofen		
Other:		

LAMS - RODENT POSTOPERATIVE RECORD					
Date	Time	*Surgical Site	Pain Assessment (+/-)	Comments Drug (Name/Route)	Initials
Study / Comments:					
*Surgical Site: N = normal; AB = abnormal Submit ER animal health notice for abnormal surgical site, + pain assessment or any inactive/moribund animal					

Frog Oocyte Collection

1. Multiple survival surgeries for frog oocyte collection may be approved by the IACUC if there is adequate scientific justification.
2. The total number of laparotomies should be limited and will depend on the condition of the animal, quality of the oocytes, life span of the animal and the duration of egg production. Up to four recovery surgeries (the 5th would be terminal) per animal are acceptable. There should be at least 4 weeks between surgeries, and the procedure should only be done if the animal is physically normal with complete healing from the previous surgery. This minimizes individual animal distress while reducing the total number of frogs required for this procedure.
3. Animals must be properly identified; surgical records and post-operative monitoring must be properly documented to ensure compliance with regulatory requirements and adequate veterinary care.

Related Policies and Guidelines

- [Rodent Anesthesia and System Inspection Guideline](#)
- [Mouse Standard Analgesics and Anesthetics](#)
- [Rat Standard Analgesics and Anesthetics](#)
- [Minimum Analgesic Period by Pain Level](#)
- [Policy 105 – Expired Materials & Non-Pharmaceutical Grade Substances](#)
- [Sterilization of Animal Research-Related Supplies](#)
- [EH&S Advisory 8.5 Anesthetic Gas Use \(Research\)](#)

References

- [FDA-Cleared Sterilant](#)
- [CDC-Clean, Sanitize, Disinfect](#)
- [CDC Guidelines for Disinfecting Agents](#)
- [NIH OACU Guidelines for Rodent Survival Surgery](#)
- [Holdridge JA, Nichols MS, Dupont WD, Jones CP, Shuster KA. The Effectiveness of Hot Bead Sterilization in Maintaining Sterile Surgical Instrument Tips across Sequential Mouse Surgeries. J Am Assoc Lab Anim Sci. 2021 PMID: 34749843; PMCID: PMC8628527.](#)