I. General:

- The definition of “survival surgery” applies to any situation where surgical procedures are conducted and the animal recovers from anesthesia, regardless of the anesthetic time interval. The use of good surgical technique to improve experimental outcomes is well established in the reduction of post-surgical complications, including infections, improved survival rates, and a more rapid return to basal physiological state.
- This document is intended to assist principle investigators (PIs) conducting survival surgery and is consistent with those described in the Guide for the Care and Use of Laboratory Animals (The Guide), the USDA Animal Welfare Act/Regulations (AWA/AWR), and Public Health Service Policy on Humane Care and Use of Laboratory Animals.

II. Requirements:

A. Planning Prior to Protocol Submission to the Institutional Animal Care and Use Committee (IACUC):

A veterinarian must be involved with the planning of all surgical procedures; this is most effectively done before the animal care protocol is submitted to the IACUC. It is suggested that the initial consultation be held while drafting the protocol. The purpose of this discussion will be to identify the roles of individual personnel and any training requirements; drugs, equipment and other supplies; the location for conducting the surgeries and what provisions may need to be made; pre-operative assessment and post-operative care; and the surgery schedule.

The plans for the survival surgical procedures conducted in rodents should include a detailed description for each of the following:
- Perioperative care and support including pre-operative medications, hypothermic prevention, ophthalmic protection (ointment).
• Aseptic techniques including hair clipping and skin disinfection.
• Anesthetics and tranquilizers.
• Perioperative analgesics and/or anti-inflammatory agents (NSAIDS), as a method of preemptive pain management.
• Nursing care and/or other treatments.
• Location where the surgery will be conducted.
• Qualifications and training of personnel who perform perioperative care and survival surgical procedures in rodents.

B. Requirements for Principal Investigators (PIs):
• Assure that all personnel are adequately trained in anesthesia regimen and techniques, aseptic technique, good surgical technique, post-procedure support during the recovery period and record keeping.
• Provide appropriate pre-operative and post-operative care of animals in accordance with established veterinary medical and nursing practices. The veterinarian will provide guidance as to acceptable practices and procedures.
• Conduct all survival surgical procedures in a designated surgery area in the laboratory, which is uncluttered and not being used at the same time for other laboratory procedures. Alternatively, Animal Care Facility (ACF) procedure or surgical areas may be scheduled for use.
• Use aseptic procedures for all survival surgeries, regardless of the interval of survival.
• Conduct a continuing and thorough assessment of the surgical outcomes to assure that the appropriate procedures are followed and potential complications are detected and addressed. In the event of untoward outcomes, consultation with the Attending Veterinarian (A.V.) or designated alternate is followed by taking appropriate corrective action including amending the approved IACUC protocol.

C. Expected Practice for Aseptic Surgery:
• Attire:
  o Surgical mask, clean attire and sterile gloves.
• Instruments:
  o Instruments must be sterilized (e.g., steam, ethylene oxide or other approved sterilant). If surgery will be performed on multiple animals then the sterilized instruments must be maintained on an aseptic field and at a minimum “tips only” sterilized between animals.
• Implants:
  o All implanted devices, e.g., catheters, osmotic pumps, cannulae, and electrodes must be sterilized; the method of sterilization selected will depend on the composition of the implant.
• Equipment:
  o Equipment such as stereotaxic or restraint devices, monitoring equipment, etc. that are required in the surgical field must be disinfected prior to the initiation of surgery and between animals when multiple animal surgeries are conducted.
Any questions regarding aseptic procedures or permissible deviations from aseptic technique must be directed to the veterinarians.

D. Training:
The PI and all personnel responsible for or performing rodent survival surgery must be trained in the below listed essential elements of good surgical technique. This training can be provided by qualified personnel in the laboratory, by a veterinarian, or by a veterinary technician.

- Asepsis.
- Gentle tissue handling including minimal dissection to avoid excessive tissue trauma.
- Appropriate maintenance and handling of surgical instruments.
- Effective hemostasis.
- Correct use of suture materials and patterns.

III. Procedures:

A. Pre-Operative:
1. Conduct all survival surgical procedures in an approved surgery or designated area of the laboratory that is disinfected and uncluttered (see Appendix 1, Table 1).
2. Prepare the animal by removing hair from the surgical site. Perform this procedure in an area separate from where the surgery is to be conducted.
3. Prepare the surgical site(s) with an appropriate skin disinfectant (see Appendix 1, Table 2).
4. Sanitize your hands with a surgical scrub solution and dry them before aseptically donning sterile surgical gloves.

B. Operative:
1. Place an external heat source, such as recirculating water blanket, computer monitored and regulated heating pad or heat lamp or "Deltaphase® Isothermic Pads" (Braintree Scientific) specifically designed for rodent surgery and cover with a clean absorbent pad; to reduce the risk of burns, the heat source should never be in direct contact with the animal. The pad is then covered with a sterile surgical drape to define the sterile field; it is critical to maintain sterility of the surgical drape, particularly if you anticipate setting sterile instrument on it.
   - Note: non-regulated heat lamps and commercial household-type heating pads are not permitted during surgery to avoid tissue desiccation and injury. Hypothermia may not be a significant issue with short duration surgery and may not require a supportive heat source; consult a veterinarian.
2. Anesthetize and maintain the animal in a surgical plane of anesthesia throughout the procedure (see Appendix 1, Table 6). Apply a bland ophthalmic ointment to each cornea to protect from drying or abrasion.
3. Begin surgery with sterile instruments and handle instruments aseptically (see Appendix 1, Table 3). When multiple survival surgeries are planned, it is
recommended, when reasonable, to begin with at least (2) sets of sterilized instruments.

- When using “tips-only” technique, maintain the sterility of the instrument tips throughout the procedure. Note: a pack of sterile instruments can be used on multiple animals, however, it is required that all instruments be sterile prior to the initiation of a surgical secession and replaced at a prudent interval to minimize the potential for contamination.
- When performing a series of similar surgeries keep instruments on an aseptic surface and replace surgical gloves at a prudent interval to minimize the potential for contamination (see Appendix 1, Table 4).

4. Monitor and/or maintain the animal's vital signs.
5. Close surgical wounds using appropriate techniques and materials (see Appendix 1, Table 5). Proper wound closure is essential to avoid wound dehiscence. Wounds that enter a body cavity must be closed using a multi-layer closure in which the body wall is closed separately from the skin.

C. Post-Operative:
   1. Move the animal to a warm, dry area and monitor and record observations at least every 15 minutes during recovery. Keep the animal warm until fully ambulatory: place the cage partially over a heating pad or alternately use an infrared heating lamp. To minimize the risk of overheating the animal, monitor the ambient temperature at the animal’s level and maintain at 35 – 37° C or rectal temperature of 38 - 39° C. Return the animal to its routine housing only after it has fully recovered from anesthesia.
   2. A sedated rodent should not be placed in a cage with other rodents until it is fairly ambulatory to avoid injury and even cannibalization of unresponsive cage-mates. This can even be an issue with a cage of animals that were anesthetized at the same time since individuals can recover at different rates. Animals can be housed together prior to recovery if they are under continual observation by laboratory personnel.
   3. Provide analgesics as appropriate and approved in your IACUC protocol (see Appendix 1, Table 8) and monitor for indications of discomfort: abnormal posture or movement, inappetence, increased attention to surgical site. Report unusual findings to the veterinarians.
   4. Remove skin closures 10 to 14 days post-operatively. (The veterinarian may recommend a longer interval, depending on the nature of the surgery.)
D. Record Keeping Requirements:
Records must be readily available for review by the IACUC or their designee, the attending veterinarian, and representative of regulatory and accrediting organizations. All rodent anesthesia and surgery records must be retained for a minimum of one (1) year.

1. Records documenting any survival surgery and any anesthetic procedure are to be retained by the lab. The following information must be included in the records:
   • PI name and protocol number
   • Title of procedure performed
   • Species and total number of animals
   • Name or Initials of Surgeon
   • Date of Surgery
   • Name and dose/dosage of all agents administered before, during, and after anesthesia and/or surgery. This includes anesthetics, analgesics, therapeutics, and any experimental agents delivered
   • Any complications (e.g. respiratory distress, bleeding, prolonged recovery or unanticipated mortality) that occurred during or after the procedure

2. Records documenting post-operative monitoring and procedures are to be retained by the lab. The following information must be included in the records:
   • Any analgesic used and the dosage
   • Observations of the post-surgical recovery of the animal (commonly used abbreviations – BAR, bright alert and responsive are acceptable). The frequency of monitoring must adhere to what is described in your approved IACUC protocol. Typically this is a minimum of once daily monitoring for three consecutive days following the date of the surgery. Post-operative complications such as wound dehiscence or weight loss may require extended monitoring periods which should be documented
   • Additional comments for any variations from the normal and expected events during the recovery period. This may include any notations on actions taken and the animal’s response to these actions as well as any actions taken to alleviate pain and distress
   • Weights of animals must be recorded if included in the IACUC protocol

   Note: This is done for a minimum of three (3) days for all rodent surgeries. If there is any indication that the animal is not doing well, the record must extend beyond this period.

IV. Definitions:

• Survival Surgery - a surgical procedure from which an animal is expected to regain consciousness.
- **Non-Survival Surgery** - a surgical procedure from which an animal is euthanized before regaining consciousness.

- **Major Surgery** - any surgical intervention that penetrates and exposes a body cavity; any procedure that has the potential for producing permanent or significant physical or physiological impairment.

- **Minor Surgery** - any surgical intervention that neither penetrates nor exposes a body cavity nor produces permanent or significant impairment of physical or physiologic function. Examples are superficial vascular cut down, and percutaneous biopsy.

- **Aseptic Surgical Procedures** - surgery performed using procedures that limit microbial contamination.

- **Sterilization** - the process whereby all viable microorganisms are eliminated or destroyed. The criterion of sterilization is the failure of organisms to grow if a growth supporting medium is supplied.

- **Disinfection** - the chemical or physical process that involves the destruction of pathogenic organisms. Disinfectants are effective against vegetative forms of organisms, but not necessarily spores.

**References**


---

1 Note: Template records are available through the Animal Care Facility