



ISM-VET-16 啮齿动物存活手术良好操作规范

Best Practices for Rodent Survival Surgery

简介 Introduction

强烈建议在外科模型开发和精化和选择适当的镇痛方面咨询兽医的专业知识。此外，他们还可以为 IACUC 提供有关协议/修正提交的指导。Veterinary Consultation is strongly recommended due to their expertise in the areas of surgical model development and refinement and selection of appropriate analgesia. Furthermore, they can provide guidance regarding protocol/amendment submissions to IACUC.

除了查询啮齿动物存活手术良好操作规范外，强烈建议项目组人员接受良好的手术操作培训。中心提供免费的培训服务，请联系 ism_asc@163.com。建议术者开展手术前完成以下内容。In addition to reviewing the IACUC policy for Rodent Survival Surgery and Best Practices, it is recommended that research team members arrange for hands on survival surgery training. Training is available Free of Charge and such arrangements can be made by emailing ism_asc@163.com. Prior to performing surgery it is also recommend that the surgeon complete the following tasks:

- Create checklist and surgery record for documentation (see example)
- Confirm that all surgical supplies and solutions used for injectable anesthetics, fluids, and analgesics are sterile and in date
- Perfect the procedure on deceased animals before moving to a live model

手术记录保存 Record Keeping

Investigators are responsible for maintaining accurate records of anesthesia, surgery, and post-operative care (including analgesic administration). Information may be noted on the cage card or within a lab notebook but records must be maintained and available during semi-annual IACUC inspection. Surgery and post-operative records are also available for download. These forms serve as examples only and can be modified as needed to fit your surgical manipulation. New cage level records are also available through ASC and are highly encouraged. The card (see image on right) is designed to sit directly behind the cage card and can serve as both the surgery and post op record. The research team would be required to

SURGERY/POST-OP RECORD				
Date	Time	Initials	Analgesia Given	Score

Date/Procedure/Surgeon: _____
Analgesia: _____
Score: 1= normal mouse & incision, 2= abnormal mouse and/or incision, details on back, 3= euthanized



maintain the card following recovery for documentation purposes (we suggest you staple the card into your lab notebook).

麻醉与止痛 Anesthesia/Analgesia

The selection of an anesthetic regimen is based on the type of procedure to be performed, species of animal, compatibility with the experimental design and availability of appropriate equipment/facilities. Pain adversely impacts the welfare of animals and if not controlled, is a variable that can confound the interpretation of experimental results. Anesthesia provides a loss of feeling or pain during surgical procedure but does not provide residual pain relief. Analgesic medication must be provided to animals that are likely to experience post procedural pain. The withholding of analgesic agents must be approved by the IACUC. Veterinary consultation regarding anesthesia and analgesia selection is available at all times and all agents must be listed in your IACUC protocol.

- [Approved Analgesia Plans for Rodent Survival Surgery](#)
- [Approved Anesthetic Plans for Rodent Survival Surgery](#)
- [Rat analgesia](#)
- [Mouse analgesia](#)

术前评估 Pre-Surgical Animal Evaluation

An animal should be healthy and acclimated to its environment to be considered an acceptable surgical candidate. Overly stressed and/or unhealthy animals make poor surgical subjects and are more likely to develop anesthetic or post-surgical complications. It is recommended that all rodents to be used in survival surgical procedures be allowed a minimum 48-hour acclimation period after shipping prior to surgery.

Note: Food and water withholding is not necessary in rodents because they cannot vomit.

无菌操作 Aseptic Technique

Aseptic technique refers to methods used to reduce microbial contamination to the lowest possible practical level. No procedure, piece of equipment, or germicide alone can achieve that objective as it requires the input and cooperation of everyone who enters the surgery area. This technique includes preparation of the patient and surgeon, sterilization of the instruments, supplies, and implanted materials, and the use of intraoperative techniques to reduce the likelihood of infection.

Preparation of the Surgical Environment



The area used should be made of a nonporous material that may be easily cleaned and disinfected. The area should also be away from windows, fans, air vents, and traffic, since these may introduce dust or other contaminants into the surgical area.

Preparation of the Surgical Equipment

Many supplies such as surgical suture, gloves, catheters, and syringes, are commercially available in sterilized packs; however, it is generally necessary to arrange for the sterilization of surgical instruments, drapes, and other equipment. For sterilization options, see Disinfectant and Sterilization Recommendations. The IACUC policy **Autoclave verification and validation for Survival Surgery Equipment** provides additional details and expectations for sterile packs. In order to maintain the status post sterilization, all sterile instruments and equipment must be placed on a sterile surface, such as a drape or open peel pouch. This creates a sterile workspace for the surgeon. If instrument tips contact a non-sterile surface, a new sterile pack of instruments must be opened or instrument tips must be wiped clean of blood and/or tissue and placed in a hot bead sterilizer for 10-20 seconds (at 240-270° C)

Preparation of the Surgeon

The surgeon must wear a surgical face mask, and a clean surgical gown, scrub top, or lab coat for all rodent surgeries. Before donning gloves, the surgeon should wash his/her hands. Sterile gloves or standard latex/nitrile gloves can be used. If standard gloves are to be used they must be disinfected using Sporklenz prior to starting surgery, after touching a non-sterile surface, and in-between surgeries. Allow 3-5 minutes for gloves to dry before use or wipe-down with a sterile surgical towel. Alternatively, nitrile gloves can be autoclaved.¹

Preparation of the Animal

An ophthalmic lubricant (e.g. Puralube®) should be applied to the animal's eyes after sedation to prevent drying of the cornea. Hair should be removed from at least 1 cm on all sides of the intended surgical site. Note that a separate area should be designated for surgical preparation so as to prevent contamination of the surgical area with hair. Hair may be removed with electric clippers, a razor, or depilatory cream. When scrubbing the surgical site, begin at the center of the site and circle out toward the periphery. It is recommended that a cotton-tipped applicator is used for this process to avoid excessively wetting the animal. Draping is recommended to assist in maintaining a sterile field. In small rodents a surgical drape can be made from sterile gauze pads or cut pieces of a sterile blue towel/surgical drape. The drape can be placed directly in a surgical instrument pack for autoclaving. In addition, Press-N-Seal has also been found to be a convenient option for draping but requires special handling of the product.



术中动物照料 Intra-operative Animal Care

Hypothermia is the most common complication in rodent surgery. To prevent hypothermia, the animal should be laid on an insulated material, such as a clean surgical towel, for surgery preparation, surgery, and recovery. A circulating warm water or microwavable heating pad can be used underneath the towel or drape to provide heat support. Do not use electric heating pads on animals during surgery because of their irregular heating and potential to cause thermal burns to the animals.

Anesthetic depth of the animal during surgery must be closely monitored. A general indicator of adequate anesthesia is the animal's lack of response to painful stimuli. To test whether a rodent is still responsive to pain, one should pinch the toe/foot and watch for a response prior to making a surgical incision and through-out the procedure. It is recommended to measure temperature and heart-rate in rodents, but at a minimum, respirations (chest cavity excursions) should be closely monitored.

创口闭合材料 Wound Closure Materials

Suture, stainless steel wound clips and skin glue are the most common wound closure material used in rodents. Wound clips are used in the skin only and must be removed with the appropriate instrument once the incision has healed. Skin glue can be used for non-tension bearing skin incisions.

If you are unfamiliar with wound closure and suture materials, please review the [Rodent Surgical Incisions Closure Guidelines and Recommendations](#)

术后动物照料 Post-Operative Animal Care

Rodents recovering from anesthesia should not be placed in cages with alert and mobile animals, since they may injure non-responsive cage-mates. If all members of a cage have been anesthetized, they may be housed together while recovering as long as they are monitored closely.

Loose bedding should be covered (e.g. with a drape or paper towel) or removed from the cage until animals are fully recovered to prevent suffocation or aspiration of bedding.

If the period of anesthesia is >20min, the animal(s) should be kept warm during recovery. A microwavable heating pad may be placed under a portion of the recovery cage such that the animal can rest either over the heated portion or unheated portion. Heat lamps are discouraged because they heat the entire cage and make it difficult for the animals to escape the heat if they become too hot.



If blood loss or hypothermia is suspected, warmed (~37 degrees Celsius) sterile 0.9% NaCl may be administered subcutaneously or intra-peritoneally before, during, or after the surgery. Post-operative analgesics are recommended for all animals undergoing surgery and must be provided, unless contraindicated and withholding has been approved in the IACUC protocol. For recommendations, see [Approved Analgesia Plans for Rodent Survival Surgery](#).

Following surgery, a laboratory member should observe animals daily until the sutures or wound clips are removed. All skin sutures and wound clips should be removed between 10-14 days. Sutures that are not removed serve as a nidus for infection. Daily observations should be recorded. Important post-surgical clinical signs that warrant intervention include:

- Incisions that are red, swollen and/or have a discharge or odor
- Animals showing a hunched posture, dehydration, labored breathing, decreased activity, rough hair coat, porphyrin staining, or weight-loss

Upon observing signs of pain or discomfort in an animal, analgesic dosing and administration should be adjusted to relieve and minimize pain as stated in the IACUC protocol. Such adjustments, when not specifically noted in the protocol do require consultation with a ULAR veterinarian.

多重啮齿动物手术 Multiple Rodent Surgeries

Multiple rodent surgeries or “batch” surgeries are an efficient way to perform identical surgeries on multiple rodents while optimizing supplies and time. The same set of instruments can be used on multiple animals of the same health status as long as care is taken to maintain the sterility of the instruments and the surgeon’s hands. Between surgeries, any part of the instrument that has come in contact with the animal should be cleaned of organic material using sterile supplies and sterilized via glass bead sterilization. Alternatively, instruments can be soaked for 2 minutes in 70% isopropyl alcohol between surgeries once organic material has been removed using sterile supplies (wipes and water/saline must be sterile).² In general, instruments should not be used on more than five animals before re-sterilization (heat/autoclave or using cold sterilization products) must be performed. The surgeon should change gloves or wipe gloves with Spor-Klenz between animals. If at any time the sterility of an instrument has been compromised (placed on a non-sterile surface or touched by non-sterile gloves), the instrument must not be used and must be replaced by one that has been autoclaved.

附件 APPENDIX

1. Record of Surgery, Anesthesia and post operative care
2. Anesthesia, operation care program



参考文献 REFERENCES:

1. LeMoine DM, Bergdall VK, Freed C. *Performance analysis of exam gloves used for aseptic rodent surgery*. JAALAS 54(3):311-6. 2015
2. Keen JN, Austin M, Huang L, Messing S, Wyatt JD. *Efficacy of Soaking in 70% Isopropyl Alcohol on Aerobic Bacterial Decontamination of Surgical Instruments and Gloves for Serial Mouse Laparotomies*. JAALAS 49(6) p. 832 – 837. 2010



麻醉、手术护理方案

Anesthesia, operation care program

术中观察与护理/Intra-operative Observation and care					
保温 Warm up with heating lamp:		润滑角膜 Lubricate cornea		呼吸频率及疼痛观察 Breath rate & pain monitor:	
手术中麻醉药追加及安乐死记录 Anesthetic supplementation and Euthanasia record					
日期 Date		护理人 Staff in charge		见证人 Witness	
术后观察与护理/Postoperative Observation and care					
护理内容 Content	观察及护理时间点 Observation timestamp				
	手术结束至苏醒 until recovery	苏醒后 3h 3 hours after recovery	苏醒后 24h 24 hours after recovery	苏醒后 48h 48 hours after recovery	苏醒后 72h 72 hours after recovery
保温 Warm up with heating lamp:					
给水 Supply water:					
伤口观察 Wound monitor					
呼吸频率及疼痛 观察 breath rate & pain monitor:					
排泄观察 Urination and defaecation monitor:					
消炎 Diminish inflammation					
镇痛 Easy pain					
日期 Date		护理人 Staff in charge		见证人 Witness	
抗生素 Antibiotic:			镇痛剂 Analgesic:		
浓度 Concentration:			浓度 Concentration:		
剂量 Dose:			剂量 Dose:		
给药途径 Dosing route:			给药途径 Dosing route:		
术后进行安乐死的记录 Euthanasia record:					