

IACUC POLICIES, PROCEDURES and GUIDELINES

RODENT SURGERY

Purpose:

This document provides information and guidance for the performance of surgical procedures in rodents (guinea pigs, gerbils, hamsters, rats, mice, etc.) The minimum requirements for surgical procedures are detailed in the Animal Welfare Regulations (AWR's) [9 CFR, Chapter 1, Subchapter A - Animal Welfare] and the *Guide for the Care and Use of Laboratory Animals (Guide)* [National Academy Press, 1996].

Definitions:

Nonsurvival Surgery (Terminal Surgery): A nonsurvival surgical procedure is a procedure where the subject animal is placed in a surgical plane of anesthesia prior to starting the procedure and maintained in the surgical plane of anesthesia until the animal is euthanized at the termination of the procedure. At no point during the procedure is the animal permitted to regain any level of pain perception.

Survival Surgery: Survival surgery is any surgical procedure where the animal is permitted to regain any level of pain perception either during or after completion of the surgical procedure.

Minor Survival Surgery: "Minor survival surgery does not expose a body cavity and causes little or no physical impairment" (*Guide* p 61). Examples of minor surgical procedures include skin biopsies, vascular catheter implantation, subcutaneous implants (osmotic minipumps, tumor cells, etc.) and wound suturing. When conducted with proper care, these techniques present few difficulties. "Minor procedures are often performed under less stringent conditions than major procedures but still require aseptic technique and instruments and appropriate anesthesia (*Guide* p 62). Some minor surgical procedures such as chronic vascular catheter implantation and subcutaneous minipump implantations require strict adherence to aseptic technique as they have a high potential for chronic postoperative infection.

Major Survival Surgery: "Major survival surgery penetrates and exposes a body cavity or produces substantial impairment of physical or physiologic functions (such as laparotomy, thoracotomy, craniotomy, joint replacement, and limb amputation)" (*Guide* p 61). Strict attention to aseptic surgical technique is required to prevent postoperative infections and resulting animal pain and distress. Consultation with the attending or clinical laboratory animal veterinarian is encouraged if you have questions regarding appropriate techniques, anesthesia, aftercare, or other aspects of the procedure.

Multiple Major Survival Surgery: Multiple major survival surgeries involve two or more temporally separate major survival surgical procedures on the same animal. "Multiple major survival surgical procedures on a single animal are discouraged but may be permitted if scientifically justified by the user and approved by the IACUC" (*Guide* p 12). The increased stress and pain associated with these procedures requires that additional care and attention must be allotted to the animal's health and well-being.

Disinfection: Disinfection is a process that reduces the number of organisms on inert surfaces to a level that is not harmful to health. Disinfection does not necessarily eliminate all organisms nor does it necessarily reduce the numbers of very resistant organisms (spores, *Mycobacterium spp.*, enteroviruses, prions, etc.) **Disinfectants** are chemicals capable of inactivating susceptible organisms on inert surfaces under use conditions. Disinfectants are generally too harsh and toxic to be used on skin, wound surfaces, etc.

High Level Disinfection: High level disinfection includes the killing or removal of critical resistant organisms, specifically *Mycobacterium tuberculosis* and enteroviruses. It does not necessarily include the killing of other mycobacterial species, spores, or prions. **High level disinfectants** are capable of inactivating *Mycobacterium tuberculosis* and enteroviruses under use conditions.

Antiseptis: Antiseptis is a process that reduces the number of organisms on skin and wound surfaces to level that is not harmful. **Antiseptics** are agents that reduce or kill germs chemically and are applied to skin and wound surfaces.

Sterilization: Sterilization is a process intended to render an object free of all viable microorganisms with the possible exception of prions. **Sterilants** are chemicals capable of inactivating all microorganisms, with the possible exception of prions, under use conditions.

Asepsis: Asepsis is the practice to reduce or eliminate contaminants (such as bacteria, viruses, fungi, and parasites) from entering the operative field in surgery or medicine to prevent infection. Ideally, aseptic practices result in a sterile operative field, free of any contamination.

Animal (Surgical) Preparation: The presurgical preparation of the animal is a critical component of aseptic surgical technique. Removal of pelage by clipping or the use of depilatories is an essential step in preparing the surgical incision site. The use of effective antiseptic agents with an appropriate technique to reduce the presence of potentially infectious microorganisms at the skin incision site is a major factor in obtaining a successful surgical outcome with a minimum of postsurgical animal pain and distress.

Postsurgical Anesthetic Recovery Period: The postsurgical anesthetic recovery period begins at the completion of the surgical procedure and continues until the animal has substantially recovered from the anesthetic effects, generally indicated by the ability of the animal to maintain walk, rise, and ambulate normally. The intensity of monitoring necessary will vary with the species and the procedure and will likely be greater during the immediate anesthetic recovery period than later in postoperative recovery. "During the anesthetic-recovery period, the animal should be in a clean, dry area where it can be observed often by trained personnel. Particular attention should be given to thermoregulation, cardiovascular and respiratory function, and postoperative pain or discomfort during recovery from anesthesia. Additional care might be warranted, including administration of parenteral fluids for maintenance of water and electrolyte balance, analgesics, and other drugs; care for surgical incisions; and maintenance of appropriate medical records." (*Guide* p 63). Animals must be frequently observed during the postsurgical period (at least every 5-10 minutes) and may not be returned to the animal holding room unattended.

Postsurgical Period: The postsurgical period begins immediately after the animal has substantially recovered from the anesthesia and continues until the surgical intervention has healed. This is usually a 5-10 day period (dependent upon the surgical procedure) or when the sutures are removed, if applicable. Monitoring during this period is often less intense than during the postsurgical anesthetic recovery period but “should include attention to basic biologic functions of intake and elimination and behavioral signs of postoperative pain, monitoring for postsurgical infections, monitoring of the surgical incision, bandaging as appropriate, and timely removal of skin sutures, clips, or staples” (*Guide* p. 64). Specific monitoring requirements should be specified in your approved animal use protocol. Maintaining complete postsurgical monitoring records is a regulatory requirement.

Physical Requirements for the Surgery Location:

The requirements of any surgery site are dictated by the need to maintain an aseptic surgical field designed to minimize the potential of postsurgical infections. This is accomplished by separating the various activities associated with surgery to prevent contamination of the surgical site. In larger animals this requires a dedicated surgical suite consisting of separate rooms or areas for animal clipping and preparation, surgeon scrub, animal recovery, and the actual surgery room.

While a dedicated surgery suite is not a requirement for conducting survival surgery on rodents, isolation of surgery-related activities from the actual surgery area is an important requirement to prevent postsurgical infections. The actual surgery location should be dedicated to that purpose during the procedure with other adjacent or nearby activities minimized to reduce the potential for airborne contamination. The nearby movement of personnel or the performance of other laboratory activities will result in air turbulence and the suspension of dust particles into the air which could potentially contaminate the surgical site. The performance of rodent surgery within HEPA filtered laminar flow hoods greatly minimizes this potential and is strongly recommended. The actual surgery location should be constructed of smooth impermeable surfaces capable of repeated disinfection. Equipment in the immediate surgery area should be limited to that which is essential for the procedure and easily sanitized, sterilized, or disposable. The available lighting should be bright and adequate for the type of procedure intended. If inhalant anesthetics are to be used, a method for both delivery of the anesthetic and scavenging of the waste anesthetic gases must be addressed. In long procedures supplemental heat sources should be provided to maintain animal body temperature. The surgery site should be completely prepared with all needed equipment present prior to bringing the animal to the site.

The animal preparation for surgery is often associated with the clipping of the animal's hair and should be located remote from the actual surgery location to minimize airborne contamination. Clipping the animal's hair at the same location where the surgery will be performed greatly increases the potential for postsurgical infections and is not acceptable. While the use of a separate room for animal preparation would be ideal, it is not essential. The use of HEPA-filtered vacuums to immediately collect clipped hair is recommended (the use of non-HEPA filtered vacuums results in the dispersal of rodent allergens and a serious potential occupational health issue).

Surgeon scrubbing and animal recovery are two additional essential functions associated with a surgical program. The animal recovery area is ideally near to and within easy sight of the surgical preparation and surgical areas to permit frequent evaluation of animals recovering from surgery and anesthesia. A source of supplemental heat is generally required during the postsurgical period so access to electrical outlets is generally a requirement for the recovery area. The surgeon scrub area requires the presence of a sink and the appropriate antiseptic soaps and while it should be within the area to minimize contamination of the surgeon, location is generally not critical.

Overall, the rodent surgery area should be carefully designed to minimize the potential of surgical contamination and infection. Final design is heavily dependent upon the species used, intended procedures, and resulting equipment required.

Sterilization of Equipment, Instruments, and Supplies:

All equipment, instruments, and supplies that come into contact with the open surgical site must be sterile. Heat sterilization (dry heat or steam autoclave) is ideal for heat-resistant surgical equipment (stainless steel, glass, ceramics, and some plastics). For heat sensitive materials, gas sterilization with ethylene oxide, chlorine dioxide, or hydrogen peroxide is an excellent alternative. Liquid sterilants such as chlorine dioxide or glutaraldehydes can be used for cold sterilization though contact time is quite lengthy and the materials must be rinsed with sterile saline or water to remove the liquid sterilants prior to use. Catheters and implants can be sterilized using ionizing radiation though this is usually limited to commercial situations.

Autoclaving – Steam Sterilization

Moist heat is an extremely effective means of sterilization for items that are tolerant of both heat and moisture. The steam autoclave uses a combination of heat and pressure to force steam into contact with items to be sterilized. Steam autoclaves use different methods to displace the air in the chamber with steam and the effectiveness of the autoclave in sterilizing different materials is partially dependent upon the method used.

Gravity displacement autoclaves slowly enter steam into the chamber which displaces the air downward (steam is lighter than the air) until the air is expelled through the chamber drain. Many trays and instrument boxes have perforated or wire bottoms since containers with solid bottoms will trap the air and delay the sterilization in a gravity displacement autoclave. All steam autoclaves are capable of performing a gravity displacement cycle since this is the only method usable with aqueous liquids.

Pressure pulsing and vacuum autoclaves actively remove the chamber air using a generated vacuum. The vacuum autoclave generally uses a single large vacuum cycle to remove the air followed by refilling of the chamber with steam. Pressure pulsing autoclaves generally use multiple alternating cycles of mild to moderate vacuum with steam repressurization of the chamber. Pressure pulsing and vacuum cycles cannot be used to autoclave liquids.

The “Flash” cycle on an autoclave is intended for use on instruments that are critically needed. This cycle uses mass displacement to replace the air in the chamber. Flash cycles are designed

for non-wrapped small items since the cycle has an inefficient air removal process and a very short cycle length. Flash cycles are also very energy inefficient and should be only rarely used and never for liquids.

The effectiveness of the steam autoclave is dependent upon the contact of the heated steam with the material being sterilized. Closed containers and products wrapped in moisture-resistant materials may prevent the penetration of steam essentially turning the steam autoclave into a much less efficient dry heat sterilizer. Large items, tightly packed loads, and heavily wrapped products may slow the penetration of the steam, especially in gravity displacement autoclaves, necessitating an increased cycle exposure length.

Aqueous liquids may be steam autoclaved though the cycle exposure length must be adjusted to ensure that the entire contents reach the required sterilization temperature. Large volumes of liquid and liquids that are refrigerated prior to steam autoclaving required much longer exposure times. Liquid cycles will be additionally lengthened by the long cooling cycle time required to prevent boiling of the aqueous materials.

In all cases, the use of appropriate autoclave controls (sterility indicators) within the autoclave load is essential to ensure the effectiveness of steam autoclaving. Controls may be biological controls or chemical controls. Chemical controls (tape, strips, cards, etc.) provide instant notification of failures to reach the required autoclave cycle temperatures. Biological controls are much more sensitive and accurate but require a period of incubation to indicate whether effectiveness of the autoclave cycle.

Autoclaving – Dry Heat Sterilization

Dry heat sterilization is a much less effective method of sterilization than moist heat and is generally reserved for materials that either cannot be saturated with steam (powders, oils, and moisture sensitive materials) or materials that might be adversely affected by steam autoclaving (assemble glass syringes, needles, surgical instruments with cutting edges, etc.) Dry heat sterilization is usually accomplished in a hot air oven with cycles designed to heat the item to 160° C. for 2 hours.

Glass Bead Sterilizers – Dry Heat Sterilization

Bead sterilizers are specialized sterilizers designed to sterilize the tips of materials placed into the heated glass beads. These units are extremely useful for surgical instruments that are to be used during repeated surgical procedures (“batch surgery”) on rodents where the portions of the instrument actually contacting the surgical site can be sterilized repeatedly. The surgical instruments should first be rinsed clean of organic material using sterile water and carefully dried with sterile gauze. Then the surgical instruments are placed into a container of small 1-1.5 mm glass beads that are heated to over 200° C. Sterilization of the surfaces in contact with the glass beads occurs in approximately 15 seconds and the instruments are removed and allowed to cool on a sterile surface prior to use. Many units have integral timers to alert the operator after 15 seconds since heating of the entire instrument may result in a serious burn to the operator if the instrument remains in the sterilizer for a longer period.

Glass bead sterilizers are not FDA approved for use in human medicine or dentistry. They should not be used as the sole means of instrument sterilization but rather as an adjunct method to re-sterilize instruments between animals. Surgical instruments should be steam autoclaved prior to the initiation of rodent “batch” surgical procedures.

Gas Sterilization

Gas sterilization is the process of using a gaseous chemical to sterilize material. While ethylene oxide is the best known of the gaseous sterilants, it was not the first nor is it the only. Gas sterilants can be classified as either alkylating agents (ethylene oxide, formaldehyde, β -propiolactone, methylbromide, etc.) or oxidizing agents (chlorine, chlorine dioxide, hydrogen peroxide, peracetic acid, etc.) Each agent and system for exposure has inherent advantages, disadvantages, applications, and personnel risks.

Chemical Sterilization

Liquid chemical sterilants may be required for heat labile or sensitive materials where heat or gaseous sterilization is unacceptable or unavailable. Liquid sterilants generally require extended immersion times for sterilization (often hours) and require that the liquid sterilants be rinsed from the instruments or materials with sterile water or saline after sterilization. Stability of the liquid sterilants, presence of organic matter, temperature, and time of exposure are all important determinants for effectiveness. The use of chemical sterilants is usually necessitated by a lack of alternatives, not a desire or preference for their use.

Irradiation

γ -irradiation is an extremely effective method of sterilization. Irradiation can be used for materials that are moisture and heat sensitive as well as for materials that may not be easily sterilized with other methods. Many of the sterile disposable products used today are γ -irradiated. This effective method, however, requires extensive monitoring and oversight and is generally restricted to commercial applications.

RECOMMENDED INSTRUMENT STERILANTS Always follow manufacturer's instructions.

AGENTS	EXAMPLES *	COMMENTS
Steam sterilization (moist heat)	Autoclave	Effectiveness dependent upon load, temperature, pressure and time (e.g., 121°C for 15 min. vs 131°C for 3 min). Heavily wrapped instruments or supplies and large items require increased exposure time for steam penetration and sterilization.
Dry Heat	Oven	Much longer exposure or higher temperature required than with moist heat.

AGENTS	EXAMPLES *	COMMENTS
	Dry Chamber	
Dry Heat	Glass Bead Sterilizer	Used only to sterilize instrument tips and working surfaces. Highly recommended for batch surgical procedures. Fast – 15 seconds. Instruments must be cooled before contacting tissue.
Ionizing radiation	Gamma Radiation	Requires special equipment.
Gas sterilization	Ethylene Oxide	Requires 30% or greater relative humidity for effectiveness against spores. Gas is irritating to tissue; all materials require safe airing time. Carcinogenic.
Hydrogen Peroxide	(Sterad®)	Not useful for "Delicate" items. Requires special equipment
Chlorine ¹	Chlorine Dioxide (Clidox®, Alcide®)	A minimum of 6 hours required for sterilization. Presence of organic matter reduces activity. Must be freshly made (<14 days). Available as either liquid or gaseous sterilant.
Aldehydes ¹	Formaldehyde (6% sol.) Glutaraldehyde	For all aldehydes: many hours required for sterilization. Corrosive and irritating. Consult safety representative on proper use. Glutaraldehyde is less irritating and less corrosive than formaldehyde
Peracetic Acid ¹	Spor - Klenz®	Corrosive to instrument surfaces.

* The use of common brand names as examples does not indicate a product endorsement.

¹ Instruments must be rinsed thoroughly with sterile water or saline to remove chemical sterilants before being used.

Pre-Surgical Animal Evaluation:

Animals scheduled for experimental surgical procedures should be healthy and acclimated to their environment prior to surgery. Animals received from other institutions or approved vendors are generally stressed from the shipment and require a period of acclimation and stabilization prior to experimental use. Each animal should receive a pre-surgical evaluation to ensure that they are not overtly ill. Since regurgitation is not typical of rodents, the withholding of food is not necessary unless specifically mandated by the protocol or surgical procedure. Water should **NOT** be withheld unless required by the protocol. Due to the high metabolic demands in rodents, withholding of food for more than six hours should be discussed with a veterinarian.

Preparation of the Surgery Area:

Proper preparation of the surgery area with the needed equipment and supplies is a critical step in a successful surgical outcome. A checklist of all needed supplies is often quite beneficial in ensuring that all the needed equipment and supplies are readily available and properly prepared prior to beginning the procedure. Once the surgery has begun the surgeon should restrict their activities to the immediate surgical area and obtaining any equipment that is not readily available will require either an assistant or the necessity of regloving by the surgeon.

All hard surfaces (table, stereotaxic apparatus, etc.) in the immediate area of the surgery should be disinfected prior to anesthetizing the rodent. The animal itself should generally be placed on a sterile towel or paper drape if practical. Placing the animal on a hard stainless steel or laminate will accelerate the development of hypothermia.

RECOMMENDED HARD SURFACE DISINFECTANTS (e.g., table tops, equipment) Always follow manufacturer's instructions.

NAME	EXAMPLES *	COMMENTS
Alcohols	70% ethyl alcohol 70% - 99% isopropyl alcohol	Contact time required is 15 minutes. Contaminated surfaces take longer to disinfect. Remove gross contamination before using. NOT A HIGH LEVEL DISINFECTANT. Cannot be used to sterilize instruments or supplies. Flammable.
Quaternary Ammonium	Roccal®, Cetylcode®, TBQ®	Inherent detergent properties. Compounds may support growth of gram negative bacteria. Variable resistance to inactivation by organic materials and "hard" water.
Chlorine	Sodium hypochlorite (Clorox® 10% solution) Chlorine dioxide (Clidox®, Alcide®)	Corrosive. Presence of organic matter reduces activity. Chlorine dioxide must be fresh (<14 Days old); kills vegetative organisms within 3 minutes of contact. High level disinfectant.
Aldehydes	Glutaraldehyde (Cidex®, Cide Wipes®)	Rapidly disinfects surfaces. Toxic. Exposure limits have been set by OSHA. High level disinfectant
Phenolics	Lysol®	Less affected by organic material than other disinfectants.
Chlorhexidine	Nolvasan®, Hibiclens®	Presence of blood does not interfere with activity. Rapidly bactericidal and persistent. Effective against many viruses.

* The use of common brand names as examples does not indicate a product endorsement.

Rodent Anesthesia:

Anesthesia and anesthetic monitoring are critical components in all surgical procedures including those in rodents. Anesthesia and anesthetic monitoring is extensively discussed in other standard operating procedures. Anesthetic and surgical monitoring in rodents during surgery is critical. Monitoring of anesthetic depth is usually of first importance and it varies somewhat based upon the anesthetic agent. A failure to respond to painful stimuli is the best indicator of adequate anesthetic depth. Maintaining body temperature is critical in smaller animals and is often a major complication of surgery procedures and unrecognized as the cause of significant surgical mortality. Supplemental heat must be provided during all but very brief surgical procedures. Monitoring of body core temperature is strongly recommended for surgical procedures over 20 minutes in length.

Rodent Surgical Preparation:

Preparation of the animal should include applying artificial tears ointment, and clipping or shaving the surgical site with enough border to keep hair from contaminating the incision (hair removal should be performed in a location remote from the surgical area). If a depilatory product is used, care should be taken to prevent contact of the depilatory with mucous membranes.

The surgical site should be scrubbed at least twice with a germicidal scrub being careful to scrub from the center of the site toward the periphery. The site can then be rinsed with 70% alcohol or dilute iodine solution. Prewarming the scrub solutions will help minimize hypothermia (70% alcohol will contribute to hypothermia if liberally used).

RECOMMENDED SKIN DISINFECTANTS Alternating disinfectants is more effective than using a single agent. For instance, an iodophore scrub can be alternated 3 times with an alcohol, followed by a final soaking with a disinfectant solution.

NAME	EXAMPLES *	COMMENTS
Iodophors	Betadine®, Prepodyne®, Wescodyne®	Reduced activity in presence of organic matter. Wide range of microbicidal action. Works best in pH 6-7.
Chlorhexidine	Nolvasan®, Hibiclens®	Presence of blood does not interfere with activity. Rapidly bactericidal and persistent. Effective against many viruses. Excellent for use on skin.
Alcohols	70% ethyl alcohol 70-99% isopropyl alcohol	NOT ADEQUATE ALONE FOR SKIN PREPARATION! Not a high level disinfectant. Not a sterilant. Flammable. The evaporation of alcohol or alcohol based products can induce hypothermia in small animals.

The use of common brand names as examples does not indicate a product endorsement.

Surgeon Preparation:

The garments worn by the surgeon must be clean, either a clean lab coat or clean surgical scrubs. The use of a surgical mask and cap is required unless the surgical procedure is being conducted in a laminar flow cabinet. The surgeon must thoroughly scrub his or her hands with a bactericidal scrub (see above list of recommended skin disinfectants) prior to donning sterile surgical gloves. The use of sterile surgical gloves is mandatory and the gloves should be changed if worn for other activities prior to surgery.

Multiple Rodent Surgical Procedures (“Batch” surgery):

Rodent “batch” surgery is a process where multiple individual animals are subjected to the identical surgical procedure. Batch surgery is an efficient method to perform the same surgical procedure on multiple animals with the minimum expenditure of time, effort, and supplies. Rodent batch surgery requires at least two individuals to effectively accomplish. A single individual is not capable of preparing, anesthetizing, performing surgery, and monitoring recovery of multiple animals.

In the case of multiple surgical procedures (“batch” surgery) surgical instruments, gloves and other paraphernalia may be used on more than one animal if extreme care is taken to maintain asepsis. Any item used on multiple animals **must** be carefully cleaned and sterilized between animals. Alternating two or more sets of instruments is one way to allow sufficient time for instruments to cool after bead sterilization or for instruments to soak in the sterilant solution for the required period of time to be effectively sterilized. Batch surgeries in rodents typically use the “tips-only” technique where only the sterilized surfaces of instruments are permitted to come into contact with the opened surgical site. Surgical gloves and other supplies may be reused if they are not contaminated between animals.

Wound Closure:

The method used to close the surgical wound varies based upon the tissue type, the tension placed on the tissue, and the experimental goals. Materials are generally classified as either “absorbable” or “non-absorbable.” Consultation with the attending veterinarian concerning the proper or ideal suture selection is recommended.

MATERIAL*	CHARACTERISTICS AND FREQUENT USES
Polyglactin 910 (Vicryl®), Polyglycolic acid (Dexon®)	Absorbable; 60-90 days. Ligate or suture tissues where an absorbable suture is desirable.
Polydioxanone (PDS®) or, Polyglyconate (Maxon®)	Absorbable; 6 months. Ligate or suture tissues especially where an absorbable suture and extended wound support is desirable
Chromic Gut	Absorbable. Versatile material. Tissue reactive.
Polypropylene (Prolene®)	Nonabsorbable. Inert.
Nylon (Ethilon®)	Nonabsorbable. Inert. General closure.

MATERIAL*	CHARACTERISTICS AND FREQUENT USES
Silk	Nonabsorbable. Excellent handling. Preferred for cardiovascular procedures. (Caution: Tissue reactive and may wick microorganisms into the wound, <i>so silk is not recommended for skin closure</i>).
Monofilament Stainless Steel	Nonabsorbable. Inert. Resists removal by animal chewing.
Stainless Steel Wound Clips, Staples	Nonabsorbable. Requires instrument for removal.
Cyanoacrylate (Vetbond®, Nexaband®)	Skin glue. For non-tension bearing wounds.

* The use of common brand names as examples does not indicate a product endorsement.

Suture gauge selection: Use the smallest gauge suture material that will perform adequately.

Cutting and reverse cutting needles: Provide edges that will cut through dense, difficult to penetrate tissue, such as skin.

Non-cutting, taper point or round needles: Have no edges to cut through tissue; used primarily for suturing easily torn tissues such as peritoneum or intestine.

Post-Operative Recovery:

Post-surgical anesthetic recovery period

Frequent and documented observation of animals during the post-surgical anesthetic recovery period is important. The animal, in or out of its cage, must be kept warm. Warm water pads, blankets, or the blue "diaper" pads work well. The use of electric heat pads or heat lamps may overheat the animal and their use is discouraged. If electric heat pads or heat lamps must be used, provision must be made to make frequent observations and turning of a somnolent animal so that the animal will not be overheated. Provision must also be made so that an awake animal can escape the heat source when it becomes too warm. Warmed fluids can be administered subcutaneously, intravenously, or intra-peritoneally if there is any suspicion the animal may be dehydrated. A recovering animal should be watched very closely until securely in sternal recumbency, and able to move around without plugging its nostrils with bedding. Some rodents left overnight on pads or paper bedding will eat that bedding.

Post-surgical period

Daily postsurgical observations should, at a minimum include observations of the condition of the animal and the surgical site. Sutures and/or staples need to be removed by two weeks following surgery, if the rodent has not already done so. Any foreign substance, including sutures, catheters, implants, etc., left in the incision for long period of time can serve as a nidus of irritation and infection. A veterinarian should examine incisions that do not appear to be healing.

Animals found dead during the post-surgical period should be submitted for diagnostic necropsy. Rapid identification of infectious diseases, post-surgical infections, surgical problems, etc.,

permits responses by the veterinary or research staff to improve the surgical outcomes, minimize variability, and enhance the research results.

Medical Records:

The maintenance of appropriate research and medical records is both a regulatory and ethical responsibility as well as a mandatory component of any reputable research laboratory. In addition to their value in documenting research activities, medical records provide both a means of documenting observations and treatments regarding animal research subjects as well as a means of communicating animal health and treatment status to others. Records may be maintained either with the animal or in the research laboratory but in either case they must be readily available when needed. It is recommended that rodent surgical and post-surgical records be maintained with the animal and readily available until such time as they are no longer pertinent to the animal's daily care.

Approved and Adopted by the
Institutional Animal Care and Use Committee
July 16, 2008

POST OPERATIVE EVALUATION

Animal # _____ Species _____ Date of Operation _____
Pre-operative weight _____ (g or kg) Procedure _____

Date					
Day post-procedure					
Time					
EXTERNAL OBSERVATIONS					
Active?					
Inquisitive?					
Rough hair coat?					
Crusty red eyes?					
Eating?					
Drinking?					
Feces?					
Urine?					
PHYSICAL EXAMINATION					
* Rate & type of breathing?					
Normal gait/paralysis?					
Fecal/urine soiling of coat?					
Diarrhea?					
** Dehydration?					
Bony/thin appearance?					
Vocalization?					
Body weight?					
% change from pre-op weight					
SUTURE/STAPLE LINE					
Wound edges red?					
Swelling around incision?					
Swelling under incision?					
Sutures/staples missing?					
Exudate from incision?					
Sutures/staples removed? (date)					
OBSERVER INITIALS					

* N=normal, L=labored, R=rapid, S=shallow

** Gently pinch up a fold of skin. Skin of dehydrated animals will stay pinched up.