WVU IACUC POLICY:
Peri-Operative Care, General Anesthesia, & Invasive Procedures for USDA-Regulated Species

General Duties and Responsibilities

The objectives of the pre- and post-operative care are to diagnose, treat, prevent disease, and minimize pain, discomfort or distress to USDA regulated species that have experienced general anesthesia for invasive or other procedures at WVU. All research procedures and medications must be part of an animal use protocol approved by the WVU IACUC.

While the University veterinarians and veterinary technicians oversee and support all aspects of this program, the procedures and guidelines described below are the responsibility of anyone directly involved in caring for research animals undergoing general anesthesia as detailed in their protocol. In some situations, arrangements can be made for care to be supplied by veterinary and/or animal care staff. When this is not the case, members of the research team are expected to deliver the same level of diligence and quality care.

Acclimation Period

The Guide for the Care and Use of Laboratory Animals (NRC 2011. 8th ed) states that newly received animals should be given time for physiological, psychological and nutritional stabilization before use. This is known as the acclimation period. Fasting and withholding of water may be required, particularly in non-rodents or rabbits, and could occur toward the end of the species specific acclimation period, as defined in the IACUC policy on acclimation.

Training

The PI is responsible for assuring adequate training of personnel under their supervision to operate using aseptic technique, including proper surgical pack and supplies preparation, proper surgeon preparation and gowning, pre-anesthetic considerations, anesthetic monitoring, surgical procedural training, and post-operative anesthetic and surgical follow-up. In instances where relevant, the Davis College or OLAR veterinary personnel may contribute as warranted to this training, however the PI remains responsible for the proper performance of relevant duties by her/his group.

Recordkeeping Requirements

A surgical record sheet should be used for recording all manipulations done and the time these manipulations are done to each animal during any anesthesia/surgical procedure and should contain at a minimum, the following information: the Principal Investigator's name, protocol #, species, animal ID, a short description of the procedure, and date.

Other data that should be included; all medications given (including route/dose/times), any changes in anesthesia (e.g. increasing isoflurane delivery, or administration of additional parenteral anesthetics), observations and monitoring parameters for anesthetic depth and physiologic status (checked every 15 minutes.
at minimum) should be recorded on this sheet and should match what is listed in your protocol where applicable, unless a veterinary recommendation for a specific animal has been made allowing the use of a medication not listed on your protocol.

*Abbreviations can be used if they are defined somewhere on the form. Some uniformity is expected so the records can be understood by anyone reading them.*

**NOTE:** All anesthetic, surgical, and post-operative care records must stay associated with the animal throughout the period of time when the animal is on study. After final disposition (death, euthanasia, shipment, transfer, etc.) of the animal, health records must be retained for at least 3 years, either by the researcher or the veterinary staff, but must be readily available for inspection by the USDA, IACUC and other regulatory personnel. One way this can be easily accomplished is to supply copies of all records to OLAR for safe keeping.

**Animal Surgery Cards**

Animal surgery cards supplied by OLAR will be required if PI’s using vivarium enclosures in the HSC, LSB, BRNI for USDA regulated rodents (e.g. hamsters, guinea pigs, gerbils, chinchillas, wild rodents of any kind, etc.). When larger non-rodent USDA regulated species are used, full surgery, anesthetic and daily records should be maintained on a per animal basis (above). These cards will be filled out and updated by the PI/research staff. This card will include PI name, protocol number, animal id, surgery procedure name/type, contact person (emergency) phone and email, post-operative analgesic name, frequency, dose and duration, and suture removal date. The card is also provides space for logging daily observations during post-operative monitoring. If more room is needed, another card should be completely filled out and the cards identified 1 of 2, 2 of 2, etc.

**Personal Protective Equipment (PPE)**

All personnel handling the animals must minimally wear a lab coat or disposable gown, face mask, bouffant and gloves, or wear site dedicated clothing, laundered at that location so it never leaves (e.g. FARF). The risk of allergies may not be sufficiently mitigated with this garb, so additional steps to protect lab personnel may be warranted as required by Occupational Medicine (e.g. AHQ or IBC).

**Pre-Anesthesia**

A physical exam of the patient, any relevant blood work (CBC, chemistries, etc.), body condition scoring (for sheep, BCS not < 3.0) or other procedures the veterinary staff believes is warranted must be performed within 72 hours of a major planned (e.g. significant surgery, anesthesia over 20 minutes, or where patient health may be suspect) anesthetic or surgical procedure to confirm that the animal is healthy enough to survive anesthesia. This should include a current body weight when possible, so that dosing of anesthetics and other drugs is accurate, and so that body weight changes can be used as a measure of health status post-operatively. All such information is listed for review in the animal’s record.

*Note: Eye lubricant should be applied any time that the eyelids do not close under anesthesia.*

**Aseptic Technique**

Survival surgery must be conducted in a dedicated surgical suite with a separate areas for surgeon preparation, sterile surgical supplies preparation, animal preparation, and post-surgical recovery. Hair must be removed from the surgical site using clippers and/or a depilatory agent (or final razor shaving), and a complete sterile
preparation performed after the site is cleaned to remove all visible dirt (as needed). Surgical preparation consists of 3 alternating wipes with solution soaked 4 x 4’s or 2 x 2’s (smaller species) cotton pads, or cotton swabs (if very small) with a disinfectant scrub (e.g. Betadine Scrub®, Novasan scrub® soaps are acceptable) alternating with alcohol (ethanol or isopropyl 70% or more [stored in a flammables cabinet when not in use] or a sole agent such as Hibiclens® or Betasept®) alternating with sterile water, followed by application of betadine solution to protect the site until surgery begins.

All surgical instruments and supplies must be sterilized, have sterilization indicators both outside and inside packs verified that sterilization is complete, and are required to be dated with the date of sterilization. Surgery packs should be properly made so the surgeon opening them is only touching sterile internal surfaces. All such sterilized dated materials must be used within 6 months of sterilization date. Sterilization can be completed by any acceptable method based on the physical characteristics of the material to be sterilized (cold, autoclave, ethylene oxide, and low temperature vaporized hydrogen peroxide). Sterilization indicators should be placed on the outside and the inside of each pack to verify sterilization is complete when the pack is used.

The surgeon must don a head cover and facemask, and must wash his/her hands with an scrub soap (e.g. scrub 10x/surface in the proper order in a dedicated sink for this purpose, hands up at all times) laden scrub brushes, in preparation prior to hand drying (towel inside the pack or dropped separately), donning a sterile gown and surgical gloves (open or closed gloving technique). The surgical pack cannot be opened or covered if opened until surgery. Fluid addition to the surgery pack is done aseptically, and no reaching over the prepared/draped surgery site or an open surgery pack is allowed. Once the animal is properly situated to allow surgery and monitoring to occur properly, and before draping or opening surgical packs, all personnel must have at least a surgical mask bouffant, dedicated clean scrubs and a surgical gown covering themselves to be in the room, all room entrants must likewise observe this requirement by donning necessary PPE at the point of entry. Contact OLAR if training is needed to properly implement aseptic technique. Those doing surgery are responsible for knowing how to assure aseptic technique at all times.

**Peri/Post-Operative Monitoring and Care**

Monitoring is required during the entire period that an animal is unconscious. Frequency of monitoring depends on patient size, patient condition, and invasiveness of the procedure and could range from continuous to once every 15 minutes at a minimum. Ideally, monitoring equipment can be used so that parameters such as heart rate, respiratory rate, body temperature, arterial oxygen saturation, blood pressure, and/or ECG can be easily monitored. Without equipment beyond a stethoscope, at least heart rate, respiratory rate, body temperature and pain response must be checked. Other clinical parameters that can be used to assess the animal’s cardiovascular and respiratory status include character of respirations and heart sounds, mucus membrane color, capillary refill time, responsiveness to pain or reflexes, and hydration state. Great care is needed to keep the head elevated or in a position at all times in ruminants and camelids to avoid regurgitation and aspiration under anesthesia, especially when xylazine-like (alpha2 agonist) drugs are used. Animals should be provided external heat supplementation and other methods to retain body heat for any anesthetic procedure lasting longer than 15 minutes, and rate of heat loss should be monitored and controlled to diminish the likelihood of adverse outcomes. If the animal is still intubated, it must be continuously monitored until swallowing reflexes/chewing (sheep) returns and the animal is extubated after the cuff is deflated. In smaller animals, optimal endotracheal tubes without cuffs are often preferred. However, if cuffed tubes are used, they should not be over inflated (relatively soft inflation bulb not hard—especially in smaller animals). After the animal regains its swallowing reflex and is extubated, the monitoring requirements remain until the animal is self-righting or shows other species-specific behaviors indicative of consciousness (e.g. ability to maintain itself in the sternal position with head up (sheep)). If a sheep cannot stay in the sternal position, it should not be left alone as the risk of regurgitation is high if it falls over. Until the animal can stand and move about, it is still at risk of self-trauma (whack head), cardiovascular collapse, vomiting and aspiration (for some species), or self-injury due to ataxia.
Therefore, careful monitoring is still necessary and a written assessment should be recorded at least once every 15 minutes. When animals refuse to rise, flipping them from side to side every 30 minutes and continued supplemental heat and TPR monitoring to assure improvement is often required to prevent ventilation/perfusion mismatch of the dependent lung; additional stimulation by frequent rubbing the body vigorously can be beneficial, unless contraindicated due to a prior surgical procedure. Animals with chest tubes or IV lines in place might be propped into sternal recumbency, but need essentially continuous supervision if the lines are unprotected. Supplemental oxygen may also be helpful and should be recorded. Large animal recovery (e. g. ICU) cages are beneficial. Once the animal is fully awake and able to hold itself at least in a sternal sitting position and/or hold its head up without support, it may be returned to its home cage or enclosure. In animals with the ability to chew such a ruminants, when recovered, any bedding or other materials they might ingest should be removed. An exception must be made for species such as non-human primates, which are potentially hazardous to handle once conscious. These species should be returned to their home cage prior to regaining full consciousness.

Post-operative Period

For purposes of this policy, this period is defined as from the end of the acute post-operative period when the animal can be left unsupervised, until the animal is eating and drinking normally, and incisional wound healing is stable. During this period, animals should be checked at least once daily. If the surgery is major (e. g. brain manipulation; chest entry, abdominal, bowel resection, etc.) or >1 multiple major surgeries are performed, especially in a larger animal (e. g. primate, dog, cat, sheep, pig, rabbit), checking the animal’s status at least twice daily for at least 3 days is required. Things specifically to focus on are incision line integrity, signs of pain, fever, return to normal mentation, normal ambulation, eating and drinking etc. After this period, animals should continue to be assessed for attitude, activity, food and water consumption, and normal urine and feces production daily. Body temperature should be measured if hardware is placed, or if an infection is suspected (e. g. anorexia) or experimentally induced and placed in the clinical record until normal mentation, food and water consumption, and activity resume. In addition, the incision, if present, should be evaluated for any problems such as dehiscence, swelling, or inflammation until sutures are removed. Any indications of pain or distress should be noted. If the musculoskeletal or neurological systems were impaired as a result of the procedure, there should be some specific parameters evaluated to assess these systems.

Written records should include the time of observations, any abnormal findings, administration of any drugs (name, dose, route), and the observer's name or initials. Notes should be brief and to the point and legible. Proper medical terminology should be used. Blue or black ink should be used and if a mistake is made, it should be crossed out with a single line, and initialed. Any abnormal findings should include a follow up plan of action and resolution.

Treatment plans, coordinated between the researcher and veterinary staff, should include a diagnosis, type, frequency, and duration of any treatment, and a schedule for re-evaluation. Veterinary recommendations concerning activity or dietary restrictions should also be included. At the end of the post-operative period, if the animal has returned to normal, it is considered "discharged" from the peri-operative care program of close monitoring. But daily assessment and observation for all animals are expected to be continued by the research and OLAR staff. Normal housing may be resumed. Animal care staff will inform the researcher in charge of any change in the animal's condition, however, the PI is still responsible for responding to research related complications. Any ongoing care of surgical wounds must be attended to when necessary by the research staff. The timing of suture (staples) removal should be in the PI’s protocol, but the duration cannot be longer than 21 d. Animals euthanized before this time need not have their sutures removed. Any problems noted during this period of time will be recorded on the vivarium facility animal health report by the PI, OLAR or the veterinary staff.
Any time complications are noted, the PI should be notified immediately, and the veterinary staff as well. In the case of an animal medical problem or emergency (seizures, neurological signs, incision line failure, anorexia for more than 2 d, etc.) the veterinary staff must be contacted.

**Non-Survival (Acute Use only) Surgery**

All animals must be sufficiently anesthetized prior to surgery such that they are completely unconscious and show no reaction to pain-eliciting procedures. For most animals, a lack of response to toe pinching and loss of eyelid or corneal reflexes prior to surgical incision or other painful procedures are indicative of adequate general anesthesia. Instruments and work surfaces do not need to be sterile but must be clean. The surgical site should be free of hair. Clean but not sterile gloves and surgical instruments, and full PPE are required. **All animals must be euthanized before recovery from anesthesia.** Drugs, suture and gloves may be used even though expired, and they are labeled as such with either “Acute Use Only”, or “For Non-survival Use Only”. However, expired drugs CAN NOT BE USED for **anesthetics, analgesics or tranquilizers/sedatives.** Contact the veterinary staff for anesthetic and analgesic doses for novel species or situations.

**REFERENCES**


*Guide for the Care and Use of Laboratory Animals* Ch.3, National Academies Press, Washington DC, 8th Ed. 2010.
APPENDIX 1:

GENERAL DRUG ADMINISTRATION GUIDELINES

Analgesics:

If analgesics were not administered pre-operatively, the appropriate analgesic as designated in the approved IACUC protocol should be given prior to return to full consciousness with enough time to allow them to be effective before consciousness returns. In some cases (where the major cause of pain is the skin and body wall), use of a local anesthetic at the incision line may allow systemic analgesics to be given after consciousness returns. At a minimum, analgesics are administered for the first 3 days post-operatively and as needed thereafter. First line analgesics are fentanyl patches, buprenorphine BID-TID, injectable Ketoprofen q 24 hr.; Banamine (e. g. 2 mg/kg q 24 h im or iv in sheep) and incisional bupivacaine (not to exceed 2 mg/kg total dose). Actual doses depend on species. If a fentanyl patch is needed, it is placed on the dorsal neck or ventral aspect of the pinna in rabbits, and on the dorsum or lateral thorax of dogs, swine, and other species. Use of a long-acting local anesthetic such as bupivacaine is considered an adjunct to analgesia, and in some cases, is not adequate as the sole method of pain relief. Combinations of analgesics by class are optimal.

Antibiotics:

Given when determined necessary by the veterinary staff or as prescribed in the animal use protocol. If given prophylactically, should begin dosing prior to (e.g. IM delivery given 2 hr. before, PO delivery given day before (ruminants may not work), and IV delivery done at least 30 minutes before) a surgical incision, and may be continued as appropriate. If being used to treat a surgical infection, an antibiotic of choice should be administered daily at least 72 hours after the infection resolves (no pus or fever). Good daily wound care should be performed in conjunction with antibiotic therapy. Choice of antibiotic and a viable dosing regimen should be based on drug pharmacokinetics when available, bacterial culture results and sensitivity testing. If you are uncertain of an appropriate antibiotic for research purposes, consult the veterinary staff.

Antipyretics:

May be used when body temperature > 104 °F to control fever. Non-steroidal anti-inflammatory (NSAID) (e.g. banamine, ketoprofen, acetaminophen, etc.) may be used. A veterinarian should be consulted.

Fluids:

Fluids may be given if body fluid loss was significant during surgery (>5% dehydration) or the anesthetic period is likely to be prolonged (e. g. > 2 hours). In ruminants held off water for 24 hours or where multiple surgeries are planned, they should receive at least 1 L of fluids intraoperatively (sq or iv). During surgical procedures longer than one hour, a replacement fluid solution such as Lactated Ringers Solution (LRS), Normosol®, or 0.9% saline, should often be given at a rate of 10-20 ml/kg/hr, depending on body size. Although a mild in effect, saline may exacerbate respiratory acidosis associated with hypoventilation during anesthesia, thus some prefer lactated ringers solution. During the post-operative period, any animal with > 5% dehydration may require additional fluid support. This can be provided orally by tube feeding (e. g. sheep), rabbits). As a first approximation, total daily fluid volumes should not exceed the fluid lost (% dehydration X body weight in kg) plus half daily maintenance (e. g. half of~30 ml/kg/day in sheep; 70 mg/kg/day in rabbits) depending on size. Signs of dehydration can vary with species but often can be detected as abnormal skin tenting, dull character, reduced urine output, peripheral vasoconstriction, cold extremities, increased plasma creatinine, BUN, TS (refractive index), TP or HCT, dry mouth, sunken eyes, or a combination of features.