

1. PURPOSE

This Standard Operating Procedure (SOP) describes procedures for general surgery of large animal species such as swine, dogs, rabbits, cats, non-human primates (NHP).

It outlines pre-, peri- and post-operative procedures for surgery on non-rodent species and therefore does not apply to mice, rats, gerbils, guinea pigs, chinchillas and hamsters.

2. RESPONSIBILITY

Principal investigator (PI) and their research staff, veterinary care staff and all qualified personnel who perform surgery on non-rodent species, or assisting in the procedures.

3. MATERIALS

- 3.1. Analgesics
- 3.2. Anesthetics
- 3.3. Sterile ophthalmic ointment
- 3.4. Electric clipper
- 3.5. Gauze
- 3.6. Antiseptic (e.g., chlorhexidine 2%, hibitane, povidone-iodine solution used alternatively with 70% alcohol; or ready-to-use chlorhexidine-alcohol solution; or one-step surgical prep solution)
- 3.7. Autoclave or gas sterilization equipment
- 3.8. Sterile surgical instruments
- 3.9. Sterile surgical drapes
- 3.10. Suture material
- 3.11. Sterile gauze
- 3.12. Sterile isotonic saline (0.9% saline) or Lactated Ringer's Solution (LRS)
- 3.13. Stethoscope
- 3.14. Monitoring equipment, e.g., thermometer, pulse oximeter, capnograph, blood pressure monitor
- 3.15. Material or equipment to provide or conserve body heat (e.g. warm-water circulating pad)
- 3.16. Clean scrubs, shoe covers, mask or N95 respirator, bonnet
- 3.17. Sterile gown
- 3.18. Sterile gloves
- 3.19. Emergency airway equipment
- 3.20. Xylocaine spray
- 3.21. Sterile lubricant (e.g. water soluble jelly)
- 3.22. Endotracheal tubes, cuffed, various sizes
- 3.23. Laryngoscope
- 3.24. Plain gauze rolls

4. PROCEDURES

4.1. General Surgical Principles

- 4.1.1. Research personnel should be trained to ensure that good surgical technique is practiced. Good surgical technique includes asepsis, gentle tissue handling, minimal dissection of tissue, appropriate use of instruments, effective hemostasis, and correct use of suture materials and patterns.
- 4.1.2. A minimum of two individuals should be present during procedures:
 - 4.1.2.1. The surgeon performing the procedure.
 - 4.1.2.2. The anesthetist inducing, monitoring, maintaining, and adjusting anesthesia.
- 4.1.3. Procedures should be performed under the oversight of the veterinary care staff.
- 4.1.4. Procedures must be performed in an FACC-approved area dedicated for animal use:
 - 4.1.4.1. All surfaces and equipment in the dedicated surgical suite should be cleaned and disinfected prior to each procedure.
 - 4.1.4.2. The area should be uncluttered and free of equipment not related to surgery.
 - 4.1.4.3. Circulation in this area should be kept to a minimum during surgical procedures to prevent unnecessary interruptions and creation of air turbulence and contamination of the surgical field.
 - 4.1.4.4. Pre-operative procedures are performed at a safe distance from the surgical environment in order to prevent contamination with hair.

4.2. Sterilization of instruments:

- 4.2.1. Sterilize all instruments, gauze, drapes, etc. prior to surgery.
- 4.2.2. Clean instruments prior to sterilization to remove organic material.
- 4.2.3. Place instruments to be sterilized in self-sealing sterilization pouches or wrap.
- 4.2.4. The use of internal chemical indicators is recommended to ensure the sterilizing agent has penetrated the packaging material and actually reached the instruments inside. Date the packs upon sterilization and use within six months of that date.
- 4.2.5. Achieve sterilization by autoclaving (steam), or gas sterilization with ethylene oxide.

4.3. Aseptic technique:

- 4.3.1. Surgeon and surgical assistant attire: wear clean scrubs, shoe covers, mask or N95 respirator, bonnet, sterile gown, and sterile gloves.
- 4.3.2. Observers/anesthetist attire: wear clean scrubs, shoe covers, bonnet, and mask or N95 respirator.
- 4.3.3. Avoid touching non-sterile surfaces. Replace instruments and re-glove hands that touch the outside of the surgical field.

4.4. Pre-operative Care

- 4.4.1. Perform a complete veterinary preoperative physical examination.
- 4.4.2. Administer analgesics according to SOP.
- 4.4.3. Pre-operative procedures are performed at a safe distance from the surgical environment in order to prevent contamination with hair.
- 4.4.4. Anesthetize the animal, in an area designated for surgical preparation and anesthesia, according to SOPs.
- 4.4.5. Apply sterile ophthalmic ointment to both eyes to prevent corneal desiccation.
- 4.4.6. Shave an area twice the size of the expected surgical field with an electric clipper. Remove all loose hair and debris from the animal.
- 4.4.7. Clean the surgical area with gauze and a disinfectant scrub (e.g., 2% chlorhexidine solution) to remove the majority of debris from the surgical site.

- 4.4.8. Transfer the patient to the designated surgical suite only after the animal has been shaved and coarsely cleaned with a disinfectant scrub. Perform final preparation of the surgical site after the animal has been positioned on the surgery table.
- 4.4.9. Antiseptic skin preparation:
 - 4.4.9.1. Use aseptic technique when performing skin antiseptics.
 - 4.4.9.2. Start at the center of the surgical site and move to the outside of the prepared area in a circular manner.
 - 4.4.9.3. Perform three scrubs with a non-soap solution (e.g., alcohol, diluted non-soap antiseptic or sterile water) and three alternating rinses with an antiseptic soap solution (e.g. 2% chlorhexidine solution or povidone-iodine solution).
- 4.4.10. Sterile surgical draping:
 - 4.4.10.1. Drape the animal with a sterile, impermeable covering to isolate the disinfected area. This is performed by the gloved and gowned surgical team.
 - 4.4.10.2. Fix the drape in place with clamps.
 - 4.4.10.3. Cover a stand or table with a sterile drape on which sterile instruments, gauze and suture are placed.
- 4.4.11. The use of antibiotics prophylactically is to be established with the clinical veterinarian.
- 4.4.12. Prior to surgery, verify the depth of anesthesia by loss of the palpebral reflex, pedal withdrawal reflex, and jaw tone, heart rate and blood pressure.
- 4.5. Surgical Procedures, Monitoring, and Supportive Care:
 - 4.5.1. Maintain aseptic conditions during all survival procedures.
 - 4.5.2. Continuously monitor physiological parameters, e.g., heart rate and rhythm, blood pressure, respiratory rate and depth, oxygen saturation, temperature, capillary refill time (less than 2 seconds), end tidal CO₂.
 - 4.5.3. Document these parameters at least every 10 minutes.
 - 4.5.4. Maintain normal body temperature by the use of warm circulating water blankets, thermal pads, and/or warm IV fluids. Do not use electric heating pads as they are a less consistent, safe, and reliable source of heat.
 - 4.5.5. Administer IV fluids to maintain adequate hydration and blood pressure.
 - 4.5.6. Adjust the depth of anesthesia according to the monitored parameters (presence of reflexes, respiratory rate and breathing pattern, and heart rate).
 - 4.5.7. In the case of respiratory or cardiac arrest, stop anesthesia, administer oxygen, and begin resuscitation efforts immediately. Calculate the dosage of emergency drugs before the start of anesthesia.
 - 4.5.8. Use efficient surgical planning to decrease surgical time, tissue contamination, and tissue damage.
 - 4.5.9. Handle tissues gently.
 - 4.5.10. Use a scalpel blade or scissors to make the smallest possible incisions.
 - 4.5.11. Use appropriate suture technique:
 - 4.5.11.1. Use absorbable suture if the suture will be buried in tissue.
 - 4.5.11.2. Place sutures evenly and as close to the tissue edge as possible to prevent obstruction of blood flow.
 - 4.5.11.3. Suture size depends on size and activity level of the animal.
 - 4.5.11.4. Close tissue layers separately. Suture the subcutaneous tissues separately from the skin in order to decrease dead space:
 - Peritoneum/abdominal muscle layer: Vicryl, PDS, Polypropylene
 - Subcutaneous tissue: Vicryl, PDS
 - Skin: Polyamide-nylon, PDS, Vicryl, skin staples

- 4.5.11.5. Use an alternative to skin sutures, such as a subcutaneous/intradermal closure technique, if skin sutures are not necessary. Skin sutures can cause an animal to chew or scratch at the incision site.

4.6. Postoperative Care:

- 4.6.1. Postoperative care begins with recovery from anesthesia, and may extend from days to weeks depending on post-surgical outcomes.
- 4.6.2. Place animals in a clean, quiet environment for anesthetic recovery.
- 4.6.3. Continuously observe the animal and monitor temperature, heart rate and respiratory rate until the animal can maintain a patent airway and sternal recumbency. Emergency airway equipment must be available in the anesthetic recovery area. Administer oxygen as needed.
- 4.6.4. Keep the animal warm and dry in order to prevent hypothermia. Care should be taken to not overheat or burn the animal. Over-the-counter heating pads are prone to burning animals and cannot be used for this reason. Examples of surgical thermoregulation devices include:
 - 4.6.4.1. Water-circulated heating pad
 - 4.6.4.2. Air circulating heating blanket
 - 4.6.4.3. Surgical thermal barrier
- 4.6.5. Administer analgesics post-surgically and for the next 72 hours or longer, as outlined in the Analgesia SOP.
- 4.6.6. Determine the need for further supportive care, such as fluids, electrolytes, antibiotics, etc., based on the animal's condition and the procedure performed.
- 4.6.7. Examine the wound daily until completely healed.
- 4.6.8. Remove skin sutures or staples (if any) after 10-14 days.

4.7. Record Keeping:

- 4.7.1. Document surgical procedure in the animal's medical record.

SOP REVISION HISTORY

DATE	NEW VERSION
2015.09.10	4.2.10 The use of antibiotics prophylactically is to be established with the clinical veterinarian.
2017.08.31	4.2.8.3. Perform three scrubs with an antiseptic soap solution (e.g. 2% chlorhexidine solution or povidone-iodine solution) a non-soap solution (e.g. alcohol, diluted non-soap antiseptic or sterile water) and three alternating rinses with a non-soap solution (e.g. alcohol, diluted non-soap antiseptic or sterile water) an antiseptic soap solution (e.g. 2% chlorhexidine solution or povidone-iodine solution).
2018.03.20	4.1.1.1. Research personnel should be trained to ensure that good surgical technique is practiced. Good surgical technique includes asepsis, gentle tissue handling, minimal dissection of tissue, appropriate use of instruments, effective hemostasis, and correct use of suture materials and patterns.
2018.03.20	4.1.1.2 A minimum of two individuals should be present during procedures: <ul style="list-style-type: none"> • The surgeon performing the procedure. • The anesthetist inducing, monitoring, maintaining, and adjusting anesthesia.
2018.03.20	4.1.1.3. Procedures are preferably performed in an area dedicated for animal use: <ul style="list-style-type: none"> • All surfaces and equipment in the dedicated surgical suite should be cleaned and disinfected prior to each procedure. • The area should be uncluttered and free of equipment not related to surgery. • Circulation in this area should be kept to a minimum during surgical procedures to prevent unnecessary interruptions and creation of air turbulence and contamination of the surgical field. • Pre-operative procedures are performed at a safe distance from the surgical environment in order to prevent contamination with hair.
2018.03.20	4.5.1.4 Place instruments to be sterilized in self-sealing sterilization pouches or wrap. 4.5.1.5 The use of internal chemical indicators is recommended to ensure the sterilizing agent has penetrated the packaging material and actually reached the instruments inside. Date the packs upon sterilization and use within six months of that date.
2018.03.20	4.2.3. Pre-operative procedures are performed at a safe distance from the surgical environment in order to prevent contamination with hair.
2018.05.24	4.1.1.3. Procedures are preferably must be performed in an FACC-approved area dedicated for animal use.
2018.05.24	4.1.3. Procedures should be performed under the oversight of the veterinary care staff.
2020.11.17	3.6. Antiseptic (e.g., chlorhexidine 2%, hibitane, povidone-iodine solution, used alternatively with 70% alcohol; or ready-to-use chlorhexidine-alcohol solution; or one-step surgical prep solution)
2020.11.17	3.7. 70% alcohol
2020.11.17	3.7. Dry bead sterilizer or cold sterilization agents (e.g. glutaraldehyde) and 70% alcohol (as a rinsing agent) Autoclave or gas sterilization equipment
2020.11.17	3.15. Thermometer 3.16. Pulse oximeter 3.17. Capnograph 3.18. Blood pressure monitor 3.14. Monitoring equipment, e.g., thermometer, pulse oximeter, capnograph, blood pressure monitor
2020.11.17	4.5.2. Continuously monitor physiological parameters, e.g., heart rate and rhythm, blood pressure, respiratory rate and depth, oxygen saturation, temperature, capillary refill time (less than 2 seconds), end tidal CO ₂ . 4.5.3. Monitor hemodynamic parameters to assure adequate gas exchange: 4.5.3.1. Mucous membranes: pink and moist 4.5.3.2. Capillary refill time: less than 2 seconds 4.5.3.3. Oxygen saturation (SpO₂) 4.5.3.4. End tidal CO₂
2020.11.17	4.5.11.1 Use either absorbable or monofilament suture if the suture will be buried in tissue.
2020.12.07	3.16. Clean scrubs, shoe covers, mask or N95 respirator, bonnet
2020.12.07	4.7.1. Surgeon and surgical assistant attire: wear clean scrubs, shoe covers, mask or N95 respirator, bonnet, sterile gown, and sterile gloves. 4.7.2. Observers/anesthetist attire: wear clean scrubs, shoe covers, bonnet, and mask or N95 respirator.