



Veterinary Health Center

MANHATTAN, KANSAS

OFFICIAL PROTOCOL

LARGE ANIMAL ANESTHESIA STANDARD OPERATING PROCEDURE MANUAL

Introduction

The intent of this manual is to supplement information you have already received in lecture and laboratories.

You should become familiar with the information contained in this manual. You should also re-familiarize yourself with the pharmacological, physiologic, and technical aspects of the practice of large animal anesthesia by reviewing material from previous courses. There is a file of large animal anesthetic related papers kept in the Anesthesia conference room. The index is in the front of the file box. Feel free to copy any of this material, but return the original to its proper place in the file box as soon as possible.

It is imperative that the equipment and supplies used for anesthetic care be cleaned thoroughly and set back up promptly after each case. After-hours emergency cases are not uncommon, and smooth operation of the emergency service relies on equipment ready for use. If it is your case, you are responsible for clean-up of that case and equipment. Supplies and equipment should be returned to their proper place in functional order to ensure they can be found and used in case of emergencies.

Everyone who rotates through anesthesia will not have the same skills in dealing with large animals. Your personal safety is of utmost importance. It is our intention to instruct you in the proper handling and appropriate care of these animals. Regardless of previous experience, our goal is that you improve your knowledge and skill, and make the commitment to make decisions regarding anesthetic management of your patients. The following notes are intended to help guide you through your anesthesia responsibilities.

DUTIES OF STUDENTS RESPONSIBLE FOR ANESTHESIA

1. The day prior to anesthesia, the cases are typically posted by 4 PM on the schedule board in the small animal nurse’s station. For each case assigned to you, take the yellow copy of the request and leave the white copy on the board.
2. Thoroughly review the animal’s medical record and perform a thorough physical exam. Note the case history, TPR values, any problems (behavioral or medical), previous surgery, and/or previous anesthetic episodes. Confer with the referring service’s student to insure that all medical and scheduling concerns are addressed and resolved. If you are unfamiliar with large animals, or the animal is non-tractable, seek assistance from the student on the referring service. Your safety is paramount.
3. Listen to the heart and palpate a peripheral pulse. Note any abnormalities (i.e. pulse deficits, murmurs, dropped beats, etc.)
4. Auscultate the lungs. Listen to entire lung field bilaterally. Note noises: Increased bronchovesicular noise, moist, rales, etc. Record respiratory rate. Note if the animal was excited at the time of exam.
5. Check mucous membrane color and capillary refill time.
6. Check for intestinal sounds. Check for normal (or abnormal) feces in stall.
7. Check eyes and nose for discharge or other abnormalities.
8. Check lymph nodes for enlargement
9. Assess results of diagnostic tests/procedures performed
10. The referring service is responsible for pre-anesthetic fasting. If there is evidence the animal has been fed the day of anesthesia, notify the anesthesiologist on duty. For mature bovines, feed is usually withheld 24-48 hours prior to anesthesia, water for 12-24 hours. For small ruminants, feed is withheld for 24 hours and water for 12 hours. Water availability is subject to the animal’s needs and climate conditions. Very young foals and calves that are nursing and not on solid feed do not require fasting. Water is not typically withheld from horses.
11. Determine the physiologic compromise of the patient and estimate the anesthetic risk.

Physical Status	Anesthetic Risk
1	Normal healthy animal
2	Patient with mild systemic disturbance (e.g. HYPP, sinus flap, anemia)
3	Patient with moderate systemic disease that limits activity but is not incapacitating (e.g. horse with COPD, simple fracture, ruptured bladder, cervical vertebral instability)

4	Patient with severe incapacitating systemic disease that seriously interferes with the animal's normal activities (e.g. pick LA common disease: colic, long bone fracture)
5	Animal presents to anesthesia in moribund condition (the term moribund implies that medical treatment cannot improve the animal's condition and surgery is required "now")
E	Emergency operation. Any patient falling in the above classifications operated on as an emergency. (all E patients should also have a numerical physical status assigned as well, e.g. 4E)

12. Fill out the anesthetic SOAP form completely and construct an anesthetic plan that addresses the issues that are present. Circle the anesthetic risk category.
13. Present the case and your plan to an anesthesia clinician in rounds the morning of anesthesia. After approval of the plan, the SOAP sheet is signed by the anesthesiologist on duty. No medications are to be administered unless the protocol is signed.

Preinduction:

1. TPR and examine the patient
2. Check to see that all anesthetic equipment and supplies are available and ready for use.
3. **Assemble:**
 - a. Patient record and identification stickers
 - b. Anesthetic drugs – premedication and induction agents (labeled, with 18g needles)
 - c. Heparinized saline
 - d. Endotracheal tubes with functional cuffs and Y-piece adaptors
 - e. Mouth speculum (PVC pipe for equine patients)
 - f. Lubricating jelly on paper towel for endotracheal tube
 - g. Functional anesthetic machine with full vaporizer (check machine for leaks)
 - h. ECG monitor, capnograph, agent monitor, Doppler blood pressure unit if an arterial line is not placed.
 - i. Vented fluids for IV administration
 - j. IV fluid pressure infusion cuffs
 - k. Extra parenteral anesthetic or adjuvant drugs for intra-op supplementation as needed
 - l. Place guaifenesin in pressure bag if being used as part of the induction
 - m. Eye lube

Other Monitoring and support equipment:

- n. Heating pads for foals and small ruminants
- o. Direct blood pressure instrumentation (catheter, T-port, heparinized saline, razor or battery powered clippers, 4x4, towel clamps, transducer, arterial line tubing)
- p. Mechanical ventilator (plug in Drager and be sure it works) Preset Surgivet pneumatic controls to nominal settings
- q. IVAC infusion pump or syringe pump

Recovery:

- r. Nasal tracheal tube
- s. Tube of lubricating jelly
- t. Tape (2 inch)
- u. 60 cc syringe for cuff inflation/deflation
- v. Dry cotton towel
- w. 15 L/min O2 flowmeter with extension tubing and 5-way adapter
- x. Sterile O2 insufflation tubing
- y. Hudson demand valve available

(Become familiar with the supplies on the anesthesia monitoring cart. A thorough list of all the supplies is provided on the cart. Although the nurses and residents will help set up much of the equipment, it is your responsibility to check that everything is in working order and ready for service.)

4. The referring service should bring the patient and the medical record to the induction area at the scheduled "walk down" time.
5. Premedicate the patient (under direction of the anesthesia staff) at the appropriate time depending on when the animal is to be anesthetized and depending on the agents used for premedication. In general, acepromazine is administered 30-60 minutes prior to table time. Xylazine is administered 5 minutes prior to induction. The patient should be in or in close proximity to the induction room prior to xylazine administration.
6. Flush the mouth with the mouth flushing water wand until all foreign material is rinsed from the mouth.

Induction:

1. Once the animal is in the induction stall there should be minimal auditory and visual stimuli and the room should be quiet.
2. Palpate the peripheral pulse and note the rate, rhythm, and quality.
3. Check the IV catheter for patency by drawing blood into the line with a flush syringe.
4. If xylazine is administered, palpate the peripheral pulse and note any change in rate, rhythm, and quality.
5. Observe the patient's attitude and degree of sedation.
6. If ketamine or ketamine and a benzodiazepine is used for induction insure that there is adequate sedation from the alpha 2 agonist before administering the ketamine.
7. If guaifenesin is being used, place a 14g needle on the infusion set and insert into the cap of the catheter. The line should be free of air bubbles and there should be no excessive air in the bag of guaifenesin.
8. The drip chamber should be half full of guaifenesin so you are able to tell how fast the infusion is running.

9. You should evaluate for diminished response to auditory and visual stimuli without ataxia. Have your induction agent ready to inject into the injection port on the IV administration set. Remember it is not desirable for a horse to become recumbent on guaifenesin alone. Try to anticipate the appropriate time to administer your induction agent. Final determination of the amount of induction drug to be given is based on the agent in question and response to previously administered agents.

10. Once the patient is laterally recumbent and anesthetized:
 - ensure that the animal is breathing and a pulse can be palpated
 - place the mouth speculum between the incisors
 - lubricate the distal 1/3 of the endotracheal tube
 - extend the head and neck
 - pass the ET tube into the trachea

Intubation EQUINE:

The tubular mouth speculum is placed between the incisors. Intubation of the horse is accomplished blindly. Always lubricate the tube before attempting intubation. The tube is advanced between the premolars and molars until it bumps into the larynx. Rotate the tube and advance it forward. You should meet minimal resistance as you advance the tube into the trachea. If you get marked resistance or the larynx moves ventrally, you are probably in the esophagus. The tube should be withdrawn into the pharynx and rotated as it is advanced into the trachea. Timing with inspiration may be helpful. Once the tube is positioned in the trachea, inflate the cuff until you get slight back pressure on the syringe.

Nasotracheal intubation is accomplished by using a lubricated tube passed into the ventral meatus and into the pharynx. It is important to pass the tube through the ventral meatus slowly and smoothly to avoid hemorrhage. In adult horses an 18 mm ID or 20 mm ID tube is appropriate. This is also a frequently used intubation technique for the induction of neonatal animals. Nasotracheal tubes for foals range from 8 mm ID to 12 mm ID and are longer than the standard small animal endotracheal tubes.

Endotracheal tube selection will vary from horse to horse. Generally, yearlings (150-250 kg) can accommodate a 20 - 22 mm ID tube, a 300-450 kg horse a 24-26 mm ID, and horses over 450 kg a 26-30 tube. Bovine typically require a smaller tube than a horse of equal weight. Mature cattle usually accommodate a 26 mm ID tube.

Intubation BOVINE:

Keep mature ruminants in sternal recumbency with head up until intubation is complete. Intubation in mature cattle is most commonly accomplished by passing a PVC guide tube through the arytenoids into the trachea. This is done by direct palpation with the arm in the oral cavity and the finger tips depressing the epiglottis, feeling the arytenoids on each side and guiding the tube into the trachea. The operator's arm may be removed from the patient's mouth and an appropriate size endotracheal tube passed over the guide tube into the tracheal lumen. The guide tube is then removed. Immediately inflate the ET tube cuff to prevent aspiration of rumen contents in the event of regurgitation. After the procedure DO NOT deflate the cuff until just before extubation during recovery. Do not extubate a ruminant until it is in sternal recumbency and is capable of lifting its head.

On occasion an experienced operator will intubate a ruminant by direct palpation without use of a guide tube. Students will be more successful using the provided guide tubes.

11. Once the animal is intubated it is your responsibility to protect the patient's head from injury. Don't concern yourself with positioning the animal, your responsibility is to monitor the patient, which includes determining anesthetic depth: if too light the animal may require additional anesthetic to be moved. If you think the animal is light, inform the people working around the patient and work with anesthesia staff to correct the situation.
12. Lubricate the eyes unless otherwise instructed.
13. Turn on the Oxygen flowmeter to 6-10 L/min and connect the patient to the anesthesia machine breathing circuit as soon as possible. Adjust the vaporizer to an appropriate percent of inhalant (isoflurane or sevoflurane).
14. Start administration of IV fluids to the patient. The average 450 kg horse should get 4-5 liters the first hour, and calculated maintenance after the first hour according to physiologic needs. Maintenance fluid rates approximating 5 mL/kg/hr generally used for routine healthy patients.
15. Connect the ECG leads. A base apex lead configuration is typically used. All leads may be positioned on the same side of the horse. On bulls or thick skinned animals, place 22g stainless steel wire through the skin and wrap the stainless steel wires around the alligator clips for good electrical contact.
16. Attach a Doppler blood pressure device for BP measurement. The coccygeal artery is often used. If the Doppler crystal is placed below heart level, adjustments must be made to correct the BP measurement by measuring distance in cm from crystal to level of heart. Convert cm to mmHg (13.6 cm = 10mmHg) and subtract from Doppler value. Any critical case (Physical status 2 etc.) or general anesthetic episode longer than one hour will usually have a direct arterial pressure line placed for continuous measurement of blood pressure.
17. The patient's vital signs (i.e. heart rate, respiratory rate and depth, blood pressure, etc.) are assessed at least every five minutes and recorded. Appropriate comments are also recorded.
18. It is important to monitor the function of the machine as well as the patient. Check for leaks, make sure oxygen is being delivered, check the level of inhalant in the vaporizer, and that the soda lime is not exhausted.
19. Pay attention to the patient – degree of palpebral reflex present, pupil size, mucous membrane color, CRT, etc. Don't over focus on machine and monitors. Observe the patient and all information available.
20. Five minutes prior to moving to recovery, establish spontaneous ventilation if IPPV is being administered. Remove the arterial line and maintain direct pressure with gauze to avoid hematoma formation (about 2-3 minutes). Discontinue fluids, flush IV catheter with hep saline. Remove ECG leads just prior to moving. Take off Doppler cuff and probe.

21. When ready to move, discontinue oxygen and anesthetic, and stabilize the head while transferring the patient to recovery.
22. Ensure that the patient is breathing adequately. NEVER change a tube in a patient that is apneic. A nasotracheal tube will be placed for recovery (usually an 18 or 20 mmID) once in the recovery stall. Oxygen insufflation will be started at 15 L/min of tube until the horse stands or the horse no longer tolerates it. The nasal tracheal tube is inserted into the ventral meatus, and advanced once the oral tube is withdrawn. Approximately 5 inches of tube is left exposed, and is secured with white tape. A sterile insufflation tube is attached to the flowmeter extension tube and is placed into the nasotracheal tube. It is YOUR RESPONSIBILITY to monitor the horse by direct visualization until the patient is standing. DO NOT ENTER the recovery stall unless directed by anesthesia personnel.
23. Once the patient is standing, ask a clinician or technician to enter the stall to extubate the animal. Never leave the door unlatched. Someone should be observing through the door window when anesthesia staff are in the stall. Once the animal is extubated, the referral student should be available to watch the animal and take responsibility for moving it back to its stall.
24. If there is a problem during recovery, DO NOT ENTER THE STALL. Get a clinician to assist with recovery.
25. It is your responsibility to help with clean up after the procedure. This includes the machine, ET tubes, the cart, oxygen insufflation tubes, etc.
26. Complete the anesthesia record. Have it approved by a technician, resident, or clinician. Then place the paper work in the anesthesia conference room.

Monitoring Anesthetic Depth During General Anesthesia

Evaluation of anesthetic depth in horses, cattle, swine, and sheep is the foremost question in most students' minds. Determination of depth is important if one is to appropriately administer anesthetics. If the animal is too light, it may "break-through" and thrash, causing damage to itself, equipment, or staff in the room. Deep anesthesia, on the other hand may impair appropriate physiological response and cause temporary or permanent damage to some of the body's organ systems. There are varying degrees of CNS depression that are caused by the various anesthetic drugs. In general, useful planes of anesthesia may be evaluated in terms of too light, too deep, or appropriate, rather than trying to categorize a specific plane or stage of anesthesia. Appropriate depth is also based on the expected surgical or painful stimulus that the animal may receive.

A variety of parameters are used to assess depth of anesthesia in the horse. The use of different agents or combinations of anesthetic agents may, in general, change some of the signs we associate with a particular depths of anesthesia. These remarks, therefore, should be taken as general overall indications and all the signs or parameters being evaluated should be taken into consideration to determine depth at any one time. Any one sign, without reference to the others, may be misleading about depth. (i.e., evaluate the whole patient). Good judgment will come with experience, practice, and repeated exposures to anesthetized LA patients.

Frequently Used Signs of Anesthetic Depth

1. Movement of the head and neck, and/or gross purposeful movement of the limbs almost invariably indicates excessively light anesthesia. It is important to distinguish muscle twitching, moving the limb, from purposeful movement. Purposeful movement can cause serious harm to the horse, personnel, and could contaminate the surgical field.
2. Active nystagmus is normally associated with excessively light anesthesia and is often a sign of impending movement, particularly if seen in conjunction with a brisk palpebral reflex.
3. The palpebral reflex is diminished during general anesthesia but should always be maintained. If the horse is actively moving his eyelid without stimulus, you don't need to check a palpebral reflex. Over-stimulation of the eye may decrease the palpebral reflex over time. The corneal reflex is not lost unless the animal is very deep. We avoid checking the reflex to avoid damaging the cornea, unless there is serious doubt about the status of the patient.
4. An increase in blood pressure, or increases in ventilatory flow or volume may indicate light anesthesia. It is important to be sure that these increases are not due to other physiologic causes, such as hypoxemia, hypercarbia, toxemia, etc.
5. Tear formation is associated with depth; if the animal is very light there may be very active tearing. Active squinting with tear formation is an indication of light anesthesia. Deep anesthesia usually produces a dry cornea with very little tear formation.
6. Although several factors other than anesthetic depth affect blood pressure, it is generally the case that the deeper the anesthetic plane, the lower the blood pressure. Blood pressure is important to monitor due to its impact on the patient's physiologic wellbeing. In conjunction with other signs, it offers valuable information in regards to anesthetic depth. It should be remembered that horses induced with various induction protocols may be hypotensive early in the procedure, and at the same time be in light anesthetic plane. Low blood pressure may or may not be associated with deep anesthetic planes.
7. If the anesthetist monitors these signs on a continuous basis it is unlikely that the equine patient will suddenly become too light or too deep. If an animal becomes too light and exhibits gross motor movement, it is very likely impending signs were overlooked. The converse is true; animals that are too deep were likely exhibiting signs of excessive anesthesia that were overlooked.

ROUTINE CLEANING OF ANESTHESIA EQUIPMENT AND SUPPLIES

- A. Drager LA anesthesia machine
 1. Unscrew the drain valve on the bottom of the machine and allow the accumulated condensation to drain out. Reclose valve.
 2. Take off the plastic domes and metal valves of the breathing circuit. Wipe them out with clean blue towels. Dry the valves and domes, and replace them on the machine.
- B. Drager **and** Stack Valve Machine

3. Remove the breathing hoses and rebreathing bag. Wash with hot water only. Rinse well! Hang hoses by the Y piece on the wood pegs and the bag by its closed end with the spring clamps on the opposite wall. Replace the hoses and bag on the machine with a clean dry set.
4. Remove the soda lime canister, dump the expended soda lime into a small garbage bag. Refill to the neck of the canister with new soda lime, located in the middle storeroom between the OR's. Replace the canister on the machine, being sure it is seated correctly on the rubber gaskets. Discard used soda lime in the garbage bag into the large outside dumpsters.
5. Refill the vaporizer with the appropriate anesthetic agent. Isoflurane bottles are located in the bottom drawer of the monitor cart.
6. Wipe off the exterior of the machine with a damp cloth. Pressure check the machine, it should be left ready for its next use. Insure the pop-off valve is open.

C. Endotracheal tubes

1. Inflate cuff to half inflation
2. Place chlorhexidine solution inside and outside the tube.
3. Select an appropriate brush to clean debris out the inside length of the tube. Be sure to clean the Murphy eye as well.
4. Rinse thoroughly with water inside and out. Deflate cuff
5. Place ET tube in the tube tray that contains diluted chlorhexidine solution. The tubes should be removed the following morning, rinsed well with water, and hung on the stainless steel racks in the storeroom between the OR's.