GENERAL ANESTHESIA BASICS

INTRODUCTION
The goal in the administration of general anesthesia is to provide a stage of reversible unconsciousness with adequate analgesia and muscle relaxation for surgical procedures in such a way that it does not jeopardize the patient's health. Providing safe anesthesia requires knowledge, technical skill and an astute awareness of the patient's status at all times.

The anesthetist is entirely responsible for patient care under anesthesia and must be continually aware of the patient’s status. The anesthetist is NEVER to leave the patient unattended or allow themselves to become distracted by other activities. Vigilance at all stages of the anesthetic procedure can warn of an impending crisis, usually with adequate time to take preventive or corrective actions.

Any questions or concerns should be brought to the attention of a supervising veterinarian or technician immediately. It is far better to call a 'false alarm' prematurely then to hesitate and risk a patient’s safety.

PREANESTHETIC PERIOD
This is the time immediately preceding anesthesia in which a patient history and physical exam is obtained, anesthetic risk assessments are made, the patient is fasted as appropriate and pre-anesthetic drugs are administered.

Physical Examination
As anesthetist you will be responsible for the welfare of your patient and will act as the patient’s advocate from the time of pre-medication through recovery. You will be expected to be thoroughly familiar with the intake exam findings and medical history and for assessing the animal again prior to anesthesia.

As part of the physical exam process, every surgical patient will be assessed for anesthetic risk factors. Any animal with potential increased risk must be evaluated by a supervisor before being accepted for surgery. A staff veterinarian will evaluate these cases and inform the client of potential risks involved.

Fasting
Food is withheld from the healthy adult patient for 8-12 hours to minimize the risk of vomiting and regurgitation during anesthesia. Fluids need only be withheld for 2 hours.

To avoid complications associated with hypoglycemia, pediatric animals (<4 months of age) are not fasted prior to surgery. Pediatric animals are fed a small meal at intake and the feeding time is recorded in the medical record and on the surgery board.

Pre-anesthetic Medication (see 'Anesthetic Agents' for information on specific medications used)
The most important reasons for the administration of pre-anesthetic agents are:
- To calm or sedate an excited or vicious animal.
- To reduce or eliminate possible adverse effects of general anesthetics.
- To reduce the amount of general anesthetic required to induce anesthesia.
- To decrease pain and discomfort in the postoperative period.

If you are asked to administer a pre-medication (or any drug):
- **Review** the medical record – Be sure medication has not already been administered by another volunteer and that the animal’s condition has not changed since intake.
- **Consider** species, age, weight and condition to be sure that dose is appropriate for the patient
- If you identify any inconsistencies or concerns about the patient’s condition, consult the anesthesia lead before administering the medication.
- **Assess** the patient’s heart rate. If the heart rate is outside normal ranges, consult the anesthesia lead before administering.
- **Administer** the medication as directed.
- **Record** the drug, dosage, route of administration and time (DDRAT) on the patient's record
- The time of pre-medication is also recorded on the surgery board next to the patient's name.
ASSESSMENT AND INDUCTION (see 'Anesthetic Agents' for information on specific medications used)

Assessment Process
- Assess animal (TPR, evaluate Hx) and verify suitability for anesthesia/surgery
- Setup appropriate anesthetic monitoring equipment, breathing circuit and supplemental heat.
- IV catheters are placed in most patients.
- Calculate surgical fluid plan including type, amount and drip rate
- Report physical exam and identifying information to Anesthesia Coordinator. The anesthetist will be expected to be familiar with the patient’s signalment, pertinent physical exam/history findings, current TPR, any medications administered and calculated fluid plan.
- Ax Cleared - Anesthesia Coordinator will approve the patient for surgery or request additional assessment or diagnostics before proceeding. Once the patient has been cleared they can be taken to induction.

General Induction Process – Throughout the induction process the anesthetist assigned to the case is responsible ONLY for ensuring the safety of their patient and for accurate record-keeping. Additional team members will restrain the animal, administer medications, prep the surgery site, etc.
- Report any alerts to Induction Lead who will decide on the anesthetic plan for the patient
- Administer induction agent to effect
- Intubate - All cases except uncomplicated cat neuters are intubated/maintained on isoflurane.
- Turn on oxygen, then connect patient to breathing circuit
- Turn on isoflurane
- STOP - Evaluate patient
- Inflate cuff of endotracheal tube as needed
- Lubricate eyes
- Clip hair and vacuum
- Administer ancillary medications (penicillin, ketoprofen)
- Administer local block as appropriate (castrations are blocked at the spermatic cord or testis)
- Express bladder as needed
- Evaluate patient - If stable, move to surgery table.

Induction agents are generally administered by IV injection and given to effect. The amount of anesthetic administered is titrated to suit the patient's requirements rather than relying solely on a calculated dose.

All anesthetic drugs will be drawn up and dispensed by the Induction Lead. Most of the anesthetic drugs we use are controlled substances and must be logged appropriately. It is the anesthetist's responsibility to ensure that all drugs administered are appropriately recorded in the patient's record.

Close monitoring of the patient is critical throughout the induction period. The heart rate, respiratory rate and depth, mucus membrane color and capillary refill time should be checked frequently. Nothing is more important than patient safety. If you need the clippers turned off to hear a heart beat or have any question as to the patient's status, say so. Do not be afraid to speak up!

MAINTENANCE
During the maintenance period the anesthetist has two responsibilities. First is to monitor the patient closely to ensure that the animal's vital signs remain within acceptable limits. Second, is to maintain the animal at an appropriate anesthetic depth. The key to effective and safe anesthesia is patient monitoring. The anesthetist who closely monitors the animal under anesthesia will receive ample warning of potential problems as they arise.

For information on parameters and techniques in anesthetic monitoring see 'Patient Monitoring'.
For parameters used to assess depth/stage of anesthesia see 'Assessing Anesthetic Depth'
Anesthetic Equipment (see 'Anesthesia Machine' for more information)

It is crucial that you understand the basic mechanisms of all standard anesthetic and monitoring equipment and you are familiar with the layout and functioning of the machine you will be using. It is impossible to trouble-shoot anesthetic complications unless you understand how the anesthetic equipment is assembled and how each part functions. Take time to familiarize yourself with the equipment BEFORE you have a patient anesthetized. If you are unfamiliar with the machine or need to review any part of the equipment function or setup, ask an experienced anesthetist for a review.

Patient Monitoring (see 'Patient Monitoring for more information')

Vital signs are recorded to the surgery record every 5 minutes throughout the anesthetic procedure, but patient monitoring should be a continuous process. The anesthetist should be aware of subtle changes in parameters and prepared to address any issues immediately as they arise.

Parameters to be assessed throughout anesthesia include:
- Respiratory rate, depth and character
- Heart rate, pulse rate and quality
- Mucous membrane color and capillary refill time
- Anesthetic depth/stage of anesthesia (jaw tone, eye position and palpebral reflex activity)
- Anesthetic and Oxygen flow rates
- Ancillary monitoring parameters: Pulse ox, blood pressure, body temperature, etc.

Absolute numbers are important, but often the trend of a change is an early indicator of whether the patient is beginning to decompensate. Do not wait until a patient's monitoring parameters are in the critical range to ask for assistance. The time to act is as soon as you notice a potential problem or trend.

Assisting ventilation (For additional information see 'Responding to Complications')

All patients under anesthesia will hypoventilate and need some ventilatory support. If the patient's respiratory rate and character are within acceptable ranges, 'bagging' the animal a few times every 5 minutes is sufficient to prevent atelectasis.

If the respiratory rate is below the acceptable range (< 8-10 bpm) or breaths are shallow, you may need to ventilate the patient more frequently. First, assess all other parameters to be sure the animal is not too deeply anesthetized. If the animal appears to be at an acceptable plane of anesthesia and all other parameters are normal, provide manual breaths as needed.

If the animal has a respiratory rate less than 8 bpm or appears to have stopped breathing—TURN THE VAPORIZER OFF and GET HELP. Under the direction of an Anesthesia Supervisor, an animal who is not breathing should be given one breath every 4-5 seconds. Periodically stop for a few seconds to assess and give the animal a chance to build up CO\textsubscript{2} and initiate a breath on their own. If the animal does not resume breathing, continue as above.

RECOVERY (see 'RAVS Protocols-Recovery' for more information)

The anesthetic period does not end when the surgery ends. Perioperative support and monitoring continues through the recovery period. The anesthetist MUST stay with their patient until the endotracheal tube has been safely removed, at least one TPR has been recorded, the patient is stable and has been cleared by the Recovery Lead. The anesthetist is responsible for informing the recovery team of any anesthetic or surgical complications that occurred and any special needs before leaving the patient.

Vital signs should be monitored in the recovering animal every 15-20 minutes or as appropriate until the patient is sternal. Then as needed until the animal is ambulatory and able to return to a kennel or released to the client.

If at ANY time you are concerned about the status of a patient's recovery or any parameter—consult a supervising veterinarian or technician.
PROCEDURE FOR ENDOTRACHEAL INTUBATION

PREPARATION
- Gather materials before inducing the patient. Select several endotracheal tubes of varying sizes and check them for leaks, holes or loose connectors.
- Determine appropriate length of the tube requires. By measuring the distance from the incisors to the thoracic inlet. Properly placed, the end of the tube should be half way between the larynx and the thoracic inlet.
- When the animal reaches an appropriate plane of anesthesia, open the mouth to allow intubation. The animal should not be showing any signs of resistance. The animal is restrained in sternal recency with the head and neck extended in a straight line. The restrainer should hold the upper jaw stationary with the lips pulled dorsally and pull the lower jaw down by pulling the tongue forward and down. The restrainer should not push on the animal's ventral neck as this may obscure the laryngeal anatomy.
- All patients should be intubated with the largest endotracheal tube that fits comfortably in the trachea. Resistance to respiration is determined primarily by the diameter of the endotracheal tube. The larger the tube, the less resistance.

INTUBATION
- A laryngoscope can be used to assist intubation by illuminating the pharyngeal area and moving the epiglottis aside to allow visualization of the glottis. The laryngoscope blade is first used to disengage the soft palate from the epiglottis, then gently placed at the back of the tongue to pull the epiglottis forward.
- Insert the endotracheal tube past the vocal folds and in to the trachea. This can be more challenging in cats due to their tendency for laryngospasm. A small amount of lidocaine can be applied to the arytenoids to decrease the sensitivity. Timing the advancement of the tube to coincide with exhalation is necessary to allow successful intubation in the cat. Use caution not to continually stimulate the arytenoids, closing off the airway and preventing the animal from breathing. If you are having difficulty, ask for assistance.
- The tube should not be forced through the vocal cords, but gently rotated, if resistance is encountered. Non-traumatic intubation is very important.
- With smaller tubes, a polypropylene urinary catheter can be used as a stylet to provide more rigidity and allow easier intubation. If a stylet is used, the tip of the stylet should not protrude past the tip of the tube to avoid damage to the trachea. Ensure that the tube enters the trachea and not the esophagus. If you can not visualize the tube entering the trachea, do not assume it is in place. Double check or re-intubate.
- Other ways to verify proper placement:
  - Cough reflex
  - Feel air passing through tube when animal breathes
  - Visualize reservoir bag and unidirectional valves moving during respiration
  - Palpate a single firm tube in throat
  - Vocalization is impossible with tube correctly placed
- Secure the tube in place with a piece of gauze tied around the tube and behind the animal's head or on top of the muzzle.

CUFF INFLATION
- BEFORE inflating the cuff of the endotracheal tube, check for leakage of anesthetic gas around the cuff by gently squeezing the reservoir bag and listening for air around the tube.
- If the tube is of an appropriate size, you do not hear a leak and are able to adequately ventilate the patient, you may need to add little or no air to the inflation balloon.
- If the cuff needs to be inflated, ventilate the patient while you are adding air slowly to the cuff. The cuff should be inflated just until you can no longer hear a loud hiss of air around the tube.
- Over-inflation of the cuff can result in necrosis and sloughing of the tracheal lining.
- The subjective feel of the inflation balloon is not an acceptable method of evaluating the cuff.
SPECIAL NOTES ON PEDIATRIC ANESTHESIA AND RECOVERY

Any animal less than 16 weeks of age will be considered ‘pediatric’. While anesthesia and surgery in younger animals is very similar to that in adult animal, there are some specific considerations to keep in mind when anesthetizing these patients.

- **Stimulation:** Handling before surgery should be minimized to prevent excitement prior to sedation. Excited animals will resist being restrained and become more difficult to sedate.

- **Hypoglycemia** can cause anesthetic complications and slow recovery.
  - Any animals < 4 months of age should be fasted no longer than 3-4 hours
  - A small meal (1-3 lbs of canned food) should be fed at intake or prior to pre-medication
    - Feeding time should be recorded on the medical record and on the surgery board.

- **Hypothermia** can be a serious problem for smaller patients.
  - Only a small area of hair at the surgical site should be clipped
  - Over-wetting during surgical scrub should be avoided
  - Supplemental heat source should be used during surgery
    - ‘Snuggle-safe’ warmers covered by a blanket or towel on the surgical table
    - Heating pads set on low can be used during recovery
    - Warm IV fluids may be administered
  - Monitor closely during recovery. If slow to recover, check the body temperature and rub small amounts of Karo syrup or 50% dextrose on the gums.
  - A small meal should be offered within an hour after anesthetic recovery (as soon as patient is sternal and able to move around).

- **Heart Rate:**
  - Normal pediatric heart rate = K9: 120-180 bpm; Fe: 150-180 bpm (up to 200+ bpm may be seen)
  - Cardiac output in the pediatric animal is primarily rate dependent as the heart is less able to increase contractile force or stroke volume. This means that bradycardia can be a serious problem and should be addressed immediately.

- **Respiration:**
  - Normal pediatric respiratory rate = 15-35 bpm
  - Young animals have a rate of oxygen consumption 2-3 times that of the adult animal - increased respiratory rates are required to meet oxygen demands.

- **Anesthetic Depth:** Pediatric patients will respond more quickly to changes in isoflurane levels. They will have a more rapid induction and recovery and can become too light or too deep very quickly. Close attention to anesthetic depth is essential
  - Jaw tone is a less reliable indicator of anesthetic depth in pediatric animals as it will be lost early in anesthesia.
  - Unlike the adult patient, changes in heart rate and respiratory rate are generally the most reliable parameters in monitoring anesthetic depth in young puppies and kittens – keeping in mind that high heart rates are normal in young animals – trends are more important than single measurements.

- **Anesthetic Protocols:** There are many different drug protocols in the literature for pediatric anesthesia. Specific protocols used will be discussed during anesthesia orientation sessions.
  - Pre-anesthetic administration of anticholinergics (atropine or glycopyrrolate) to stabilize heart rate and thus cardiac output, and to decrease respiratory secretions
  - Phenothiazine tranquilizers (such as acepromazine) are avoided in animals less than 3 months old because of their potential to cause hypotension
  - The use of NSAIDS is generally avoided
  - May be more sensitive to fluid overload – standard surgical fluid rate of 5ml/kg/hr is used

If you are inexperienced with anesthesia in young patients, or have any additional questions, consult a staff veterinarian or technician.