
**SOP #:** 603.02

**Title: SOP -** Monitoring the Anesthetized Patient

**Approvals:**

**Attending Veterinarian** _____ **Date:** 03/01/2019

1. Purpose

1.1 Monitoring circulation, oxygenation and ventilation in the anesthetized patient allows the veterinary anesthetist to identify problems early, institute treatment promptly, and thus avoid irreversible adverse outcomes.

2. Responsibility

2.1 ACF Veterinary Staff, Principal Investigators, laboratory technicians.

3. Definitions

3.1 General Anesthesia: anesthesia characterized by unconsciousness, muscle relaxation, and loss of sensation over the entire body, and resulting from the administration of a general anesthetic.

4. Guidelines

4.1 The ACVA published a guideline for standards of monitoring during anesthesia and recovery (JAVAMA 1995). The guideline recommends continuous monitoring of the patient by the anesthetist and adequate record keeping of the procedure.

4.2 General Anesthesia Phases:

4.2.1 General anesthesia can be divided into four progressive phases. The signs relating to a certain phase are based upon the presence or absence of certain reflexes which are progressively lost as the amount of administered anesthetic increases. The time when reflexes are lost varies with the drug used.

4.2.2 Phase I: This is the stage of voluntary excitement marked by struggling and breath holding if induction is slow and by inhalation. Respiratory rate and pulse rate are increased, and the pupils are dilated. Urination and defecation frequently occur. These are signs of the fear response.

4.2.3 Phase II: In this stage, loss of consciousness occurs. Ventilation is irregular and involuntary excitement may occur.

4.2.4 Phase III: The stage of surgical anesthesia. Ventilation is regular. This stage can be loosely divided into three planes of progressive depression of cardiopulmonary function and responsiveness to stimuli.

4.2.4.1 In plane one painful stimulus may cause an increase in heart rate, blood pressure and respiratory rate. The palpebral reflex is present (the palpebral reflex is stimulated by tapping the skin at the medial canthus of the eye or by running the finger along the eyelashes. The reflex disappears in light to medium plane of surgical anesthesia in small animals). Lacrimation is not depressed so the cornea still looks "shiny". In dogs and cats the eyeball is centrally positioned.

4.2.4.2 In plane two, the laryngeal reflex is lost. There is further depression of the cardiopulmonary system. The eyeball rotates down in cats and dogs under halothane, isoflurane, barbiturate and propofol anesthesia. The palpebral reflex is lost. This plane is adequate for nearly all surgical procedures.

4.2.4.3 In plane three, respiration becomes more depressed and the breathing pattern becomes diaphragmatic in cats and dogs. Cardiac contractility and blood pressure is further reduced. In cats and dogs the eyeball becomes central and there is no palpebral reflex. Lacrimation also ceases, and the cornea looks dry. This plane is a warning that the animal is receiving too much anesthetic and should be `lightened'!

4.2.5 Phase IV: (mainly dead) Overdose. Paralysis of the intercostal respiratory muscles occurs, and weak diaphragmatic movements are made. With further deepening these also disappear. The abdomen looks as if it is bulging out and the thorax caving in during inspiration. The pulse becomes weaker. The pupils start to dilate, and the cornea looks very dry. If these warning signs go unheeded there is complete paralysis of the medulla of the brain, and cardiopulmonary collapse. If the anesthetic is withdrawn (inhalational agents) and artificial respiration instituted before profound cardiovascular depression occurs, then recovery is possible. With parenteral anesthetic agent overdose, reversal agents can be used, but not all parenteral drugs have reversal agents.

4.3 The reflex responses used to determine the depth of anesthesia are:

4.3.1 Pedal (digital withdrawal) reflex. The reflex is obtained by firm pressure of the interdigital skin in the dog and rodents. The reflex disappears late in phase III and indicates deep anesthesia. When checking the reflex, the legs should be held in extension. Very useful in monitoring laboratory animals.

4.3.2 Palpebral reflex. The palpebral reflex is stimulated by tapping the skin at the medial canthus of the eye or by running the finger along the eyelashes. The reflex disappears in light to medium plane of surgical anesthesia in small animals.

4.3.3 Corneal reflex. The corneal reflex is obtained by gentle palpation of the lateral aspect of the cornea. This causes reflex closure of the eyelids. The reflex disappears in the deeper levels of phase III, plane II. This reflex is not always reliable in the dog, particularly if the eyeball is markedly rotated.

4.3.4 Lacrimation. Tear formation. Parasympathetic stimulation, usually a sign of light plane of anesthesia

4.3.5 Laryngeal reflex. The laryngeal reflex, which is stimulated by attempting to pass an endotracheal tube, also disappears in light anesthesia.

4.3.6 Anal reflex. The anal reflex is a contraction of the anal sphincter muscle on sudden manipulation of the anus. This reflex disappears in the middle of phase III in the dog and cat.

4.3.7 Pupillary responses. The pupillary responses under anesthesia are heavily influenced by pre-medication. Species variations exist. There is also variability in response to different anesthetics. In general, in un-premedicated patients, the pupil is dilated in the early excitement phase and then becomes progressively constricted as surgical anesthesia occurs. With very deep surgical anesthesia the pupil begins to dilate again and with entry into phase IV, with respiratory and cardiac arrest, the pupil is maximally dilated.

4.3.8 Eyeball position. The position of the eyeball varies markedly depending on anesthetic agent employed and the species of animal. In small animals at a stage of surgical anesthesia with halothane and isoflurane, the eyeball is rotated medially and ventrally. In the early stages and in late stages with very deep anesthesia, the eyeball is centrally placed.

4.3.9 Muscle relaxation tone: moderate to lose, that is most desirable

4.4 Monitored Parameters

4.4.1 Circulation: The objective of monitoring the circulatory system is to ensure adequate blood flow to tissues during all anesthetic procedures.

4.4.2 Oxygenation: The objective of monitoring oxygenation in the anesthetized patient is to ensure adequate oxygen concentration in the patient's arterial blood.

4.4.3 Ventilation: The objective of monitoring ventilation in the anesthetized patient is to ensure adequate ventilation.

4.4.4 In addition, the depth of anesthesia and patient core body temperature should also be monitored during general anesthesia. Normal doses of anesthetics in hypothermic animals will result in anesthetic overdose!

4.5 Monitoring Methods

4.5.1 The anesthetized patient can be monitored using subjective and objective methods of monitoring. Subjective monitoring involves using the anesthetist's visual, touch, and auditory senses to assess the patient's vital signs and the objective methods involves using specialized equipment

4.5.2 Circulation (cardiovascular function)

4.5.2.1 Subjective methods: include palpation of peripheral pulse, palpation of the heartbeat through the chest wall, and auscultation of heartbeat. Use of a regular stethoscope, esophageal stethoscope, or other audible heart sound monitor aids the anesthetist in assessing the "presence", "absence", "regularity" or "irregularity" of a patient's heartbeat. Palpation provides a subjective feeling of "presence" or "absence"; "strong" or "weak"; "regular" or "irregular" peripheral pulse. Assessing capillary refill time provides a subjective assessment of tissue perfusion. A prolonged capillary refill time suggests poor tissue perfusion.

4.5.3 Oxygenation (cardiorespiratory function)

4.5.3.1 Subjective methods: Clinically, the presence of pink mucous membranes in an anesthetized patient is subjectively indicative of acceptable oxygenation. However, oxygenation is either difficult or not possible to assess in anemic patients or patients with peripheral vasoconstriction. These patients usually have pale mucous membranes.

4.5.3.2 Objective methods for evaluating a patient's oxygenation is by use of pulse oximetry. Pulse oximetry provides a non-invasive, continuous detection of pulsatile arterial blood in the tissue bed, calculates the percentage of oxyhemoglobin present in the arterial blood, and provides the pulse rate of the monitored patient. Proper functioning of the pulse oximeter may be affected by

many situations. These include motion artifact (e.g, shivering), ambient light, poor peripheral blood flow from hypotension and vasoconstriction, electrical noise from electrocautery, increased carboxyhemoglobin and methemoglobin levels and dark skin color. Normal pulse oximeter readings in anesthetized animals should be 99-100%. Hypoxemia (insufficient oxygenation of arterial blood) is considered to be present in the anesthetized patient, when the reading is less than 90%.

4.5.4 Ventilation (respiratory function)

4.5.4.1 Subjective evaluation of an anesthetized patient's ventilation efficiency may be done by observing chest wall movement or re-breathing bag excursion when the patient is connected to an anesthesia machine. Auscultation of breathing sound via an esophageal stethoscope or an audible respiratory monitor provides only respiratory rate and the absence or presence of respiration.

5. References

5.1 Lyon Lee, DVM, PhD: Monitoring Anesthetic Depth - Lecture 12 Center for Veterinary Health Sciences, Oklahoma State University

5.2 American College of Veterinary Anesthesiologists (ACVA) Set of guidelines for anesthetic monitoring Journal of American Veterinary Medical Association (JAVMA, Vol. 206, No. 7, 936-937.)

6. Revisions

6.1 Rev 02 (march 2019) – Minor formatting updates