

Recommendations for monitoring anesthetized veterinary patients

Position Statement

The American College of Veterinary Anesthesiologists (ACVA) has revised the set of guidelines for anesthetic monitoring that were originally developed in 1994 and published in 1995¹. Since then many factors have caused a shift in the benchmark used to measure a successful anesthetic outcome, moving from the lack of anesthetic mortality toward decreased anesthetic morbidity.

This shift toward minimizing anesthetic morbidity has been facilitated by more objective definition and earlier detection of pathophysiologic conditions such as hypotension, hypoxemia and severe hypercapnia. This has resulted from the incorporation of newer monitoring modalities by skilled attentive personnel during anesthesia.

The ACVA recognizes that it is possible to adequately monitor and manage anesthetized patients without specialized equipment and that some of these modalities may be impractical in certain clinical settings. Furthermore, the ACVA does not suggest that using any or all the modalities will ensure any specific patient outcome, or that failure to use them will result in poor outcome.

However, as the standard of veterinary care advances and client expectations expand, revised guidelines are necessary to reflect the importance of vigilant monitoring. The goal of the ACVA guidelines is to improve the level of anesthesia care for veterinary patients. Frequent and continuous monitoring and recording of vital signs in the peri-anesthetic period by trained personnel and the intelligent use of various monitors are requirements for advancing the quality of anesthesia care of veterinary patients.

1. JAVMA 1995;206(7): 936-937.

Circulation

Objective: to ensure adequate circulatory function.

Methods:

- 1) Palpation of peripheral pulse to determine rate, rhythm and quality, and evaluation of mucous membrane (MM) color and capillary refill time (CRT).
- 2) Auscultation of heart beat (stethoscope; esophageal stethoscope or other audible heart monitor). Continuous (audible heart or pulse monitor) or intermittent monitoring of the heart rate and rhythm.
- 3) Pulse oximetry to determine the % hemoglobin saturation.
- 4) Electrocardiogram (ECG) continuous display for detection of arrhythmias.
- 5) Blood pressure:
 - a. Non-invasive (indirect): oscillometric method: Doppler ultrasonic flow detector
 - b. Invasive (direct): arterial catheter connected to an aneroid manometer or to a transducer and oscilloscope.

Recommendations:

Continuous awareness of heart rate and rhythm during anesthesia, along with gross assessment of peripheral perfusion (pulse quality, mm color and CRT) are mandatory. Arterial blood pressure and ECG should also be monitored. There may be some situations where these may be temporarily impractical, e.g. movement of an anesthetized patient to a different area of the hospital.

Oxygenation

Objective: to ensure adequate oxygenation of the patient's arterial blood.

Methods:

- (1) Pulse oximetry (non-invasive estimation of hemoglobin saturation).
- (2) Arterial blood gas analysis for oxygen partial pressure (PaO₂).

Recommendations:

Assessment of oxygenation should be done whenever possible by pulse oximetry, with blood gas analysis being employed when necessary for more critically ill patients.

Ventilation

Objective: to ensure that the patient's ventilation is adequately maintained.

Methods:

- (1) Observation of thoracic wall movement or observation of breathing bag movement when thoracic wall movement cannot be assessed.
- (2) Auscultation of breath sounds with an external stethoscope, an esophageal stethoscope, or an audible respiratory monitor.
- (3) Capnography (end-expired CO₂ measurement).
- (4) Arterial blood gas analysis for carbon dioxide partial pressure (PaCO₂).
- (5) Respirometry (tidal volume measurement).

Recommendations:

Qualitative assessment of ventilation is essential as outlined in either 1 or 2 above, and capnography is recommended, with blood gas analysis as necessary.

Temperature

Objective: to ensure that patients do not encounter serious deviations from normal body temperature.

Methods:

- (1) Rectal thermometer for intermittent measurement.
- (2) Rectal or esophageal temperature probe for continuous measurement.

Recommendations:

Temperature should be measured periodically during anesthesia and recovery and if possible checked within a few hours after return to the wards.

Neuromuscular Blockade

Objective: to assess the intensity of and recovery from neuromuscular blockade.

Methods:

- (1) Hand-held peripheral nerve stimulator.
- (2) Spirometer.

Recommendations

For any patient in which neuromuscular blockade is used, it is essential to control ventilation, monitor closely for signs of awareness, and be certain of recovery of blockade prior to anesthesia recovery. Recovery of neuromuscular function may be assumed if the evoked response (twitch and/or tetanic fade) to a nerve stimulus, and respiratory tidal volume as measured with a spirometer, return to at least 70% of pre-blockade status. End tidal CO₂ may also be used as an indication of adequate ventilation in spontaneously ventilating patients.

Record Keeping

Objectives:

- (1) To maintain a legal record of significant events related to the anesthetic period.
- (2) To enhance recognition of significant trends or unusual values for physiologic parameters and allow assessment of the response to intervention.

Recommendations:

- (1) Record all drugs administered to each patient in the peri-anesthetic period and in early recovery, noting the dose, time, and route of administration, as well as any adverse reaction to a drug or drug combination.
- (2) Record monitored variables on a regular basis (minimum every 5 to 10 minutes) during anesthesia. The minimum variables that should be recorded are heart rate and respiratory rate, as well as oxygenation status and blood pressure if these were monitored.
- (3) Record heart rate, respiratory rate, and temperature in the early recovery phase.
- (4) Any untoward events or unusual circumstances should be recorded for legal reasons, and for reference should the patient require anesthesia in the future.

Recovery period

Objective: to ensure a safe and comfortable recovery from anesthesia.

Methods:

- (1) Observation of respiratory pattern.
- (2) Observation of mucous membrane color and CRT.
- (3) Palpation of pulse rate and quality.
- (4) Measurement of body temperature, with appropriate warming or cooling methods applied if indicated.
- (5) Observation of any behavior that indicates pain, with appropriate pharmaceutical intervention as necessary.
- (6) Other measurements as indicated by patient's medical status, e.g. blood glucose, pulse oximetry, PCV, TP, blood gases, etc.

Recommendations

Monitoring in recovery should include *at the minimum* evaluation of pulse rate and quality, mucous membrane color, respiratory pattern, signs of pain, and temperature.

Personnel

Objective: to ensure that a responsible individual is aware of the patient's status at all times during anesthesia and recovery, and is prepared either to intervene when indicated, or to alert the veterinarian in charge about changes in the patient's condition.

Recommendations:

- (1) Ideally, a veterinarian, technician, or other responsible person should remain with the patient continuously and be dedicated to that patient only
- (2) If this is not possible, a reliable and knowledgeable person should check the patient's status on a regular basis (at least every 5 minutes) during anesthesia and recovery
- (3) A responsible person may be present in the same room, although not necessarily solely occupied with the anesthetized patient (for instance, the surgeon may also be responsible for overseeing anesthesia)
- (4) In either of (2) or (3) above, audible heart and respiratory monitors must be available.
- (5) A responsible person, solely dedicated to managing and caring for the anesthetized patient during anesthesia, remains with the patient continuously until the end of the anesthetic period.(a, b)

a) Recommended for all patients assessed as ASA status III, IV, or V

b) Recommended for horses anesthetized with inhalation anesthetics and/or horses anesthetized for longer than 45 minutes

SEDATION without General Anesthesia

Sedation is a state characterized by central depression accompanied by drowsiness during which the patient is generally unaware of its surroundings but responsive to noxious manipulation.

(Thurmon JC, Short CE (2007) History and Overview of Veterinary Anesthesia. In: Lumb & Jones' Veterinary Anesthesia and Analgesia. (4th edn). Tranquilli WJ, Thurmon JC, Grimm KA (eds). Blackwell Publishing, Ames Iowa, p. 5)

If a sedated patient is sufficiently obtunded to lose control of protective airway reflexes, it should be monitored as under general anesthesia.

Objective: to ensure adequate oxygenation and hemodynamic stability in the obtunded patient.

Methods

- (1) Palpation of pulse rate, rhythm, and quality.
- (2) Observation of mucous membrane color and CRT.
- (3) Observation of respiratory rate and pattern.
- (4) Auscultation.
- (5) Pulse oximetry.
- (6) Oxygen supplementation.

Recommendation

Intermittent monitoring of basic respiratory and cardiovascular parameters in the heavily sedated animal should be routine. Supplemental oxygen, an endotracheal tube, and materials for IV catheterization should always be readily available. Particular attention should be paid to brachycephalic breeds that are particularly at risk for airway obstruction under heavy sedation.