ANESTHETIC MONITORING

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MONITORING ANESTHETIC DEPTH

- The central nervousrA

ANESTHETIC MONITORING OF PHYSIOLOGIC FUNCTION

- The primary goal of monitoring anesthetized animals is to ensure adequate tissue perfusion with oxygenated blood.
- Monitoring circulation, oxygenation, ventilation and body temperature in the anesthetized

Electrocardiography (ECG)

- Measures electrical activity of cardiac cells
- Other circulatory information including blood pressure, stroke volume and cardiac output is not provided by the ECG.
- The ECG leads are positioned usually near the elbow and stifle using a three lead configuration.
- Alligator clips are used most commonly to attach the electrode tips to the patient. These can be very traumatic when they are attached for prolonged period of time.
- Body position and precise lead placement are not important for monitoring purposes when the primary objective is to describe the electrical pattern in a general manner and monitor for changes that may signal the deterioration of the patient.
- In the horse the right arm lead is placed over the heart (right or left side), while the exact location is not important, the left leg and left arm leads are placed in the jugular furrow and the point of the shoulder.
- There must be a good contact between the ECG leads and skin, and gels are applied to increase the conduction of the electrical signals.
- Alcohol provides for good contact but it evaporates so rapidly as to require frequent

- The disadvantage of oscillometric detector is decreased accuracy or unreliability

Figure 1. The oxyhemoglobin dissociation curve.

- Normal pulse oximeter readings in anesthetized animals should be 99-100%.
- Hemoglobin oxygen saturation (SpO_2) of 90% corresponds to P_aO_2 of 60 mmHg which provides definition of hypoxemia if lower than this value.
- In the clinical setting, P_aO_2
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- A respirometer (or respirometry) is an instrument that measures the amount of volume of expired gases.
- The device is usually placed between the expiratory limb of an anesthetic machine and the anesthetic breathing hose.
- Alternatively, a respirometer connected to a face mask may be used to assess ventilation efficiency in a non-intubated anesthetized patient, although the accuracy is reduced due to air leaks around the mask.
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Figure 2. Four distinct phases of capnogram

A-B: exhalation of CO_2 free gas contained in dead space at the beginning of exhalation. **Phase I**

B-C: respiratory upstroke, representing the emptying of connecting airways & the beginning of emptying of alveoli. **Phase II**

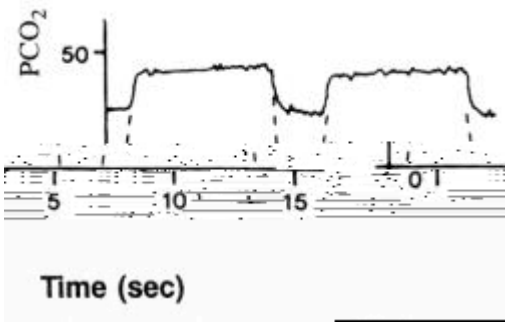
C-D: Expiratory (or alveolar) plateau, representing of emptying of alveoli - due to uneven emptying of alveoli, the slope continues to rise gradually during the expiratory pause. **Phase III**

D: End-tidal CO_2 level - the best approximation of alveolar CO_2 level

D-E: Inspiratory downstroke, as the patient begins to inhale fresh gas. **Phase IV**

E-A: Inspiratory pause, where CO_2 remains at 0

- Any deviations from the above normal shape of capnogram should be investigated.
- Figure 3. The capnogram below shows a rebreathing of CO2 due to a possibility of incompetent expiratory valve or exhaustion of soda lime.



- Figure 4. This capnogram below shows a kinked endotracheal tube. Note the prolonged expiratory upstroke (A) and a slanted expiratory plateau (B) due to the

- Rebreathing CO_2 can be due to soda lime exhaustion, incompetent expiratory valve on the anesthetic machine allowing exhaled CO_2 to be re-inhaled (even with normal function of soda lime), or intravenous bicarbonate injection.
- Decreased or abolished end tidal CO_2 concentrations may be due to hyperventilation, low cardiac output (low blood volume delivery to the lungs), respiratory arrest (no alveolar ventilation), or cardiac arrest (no circulation).
- Capnogram monitoring in anesthetized patients, also provides vital information regarding the patient's airway patency.
- A depressed or absent capnogram may be due to a dislodged endotracheal tube, misplaced endotracheal tube (i.e., esophageal intubation), obstructed endotracheal tube or airway, a leak around endotracheal tube cuff or, disconnection of the endotracheal tube from the anesthetic machine.

Urine Output monitoring

- Urine output is to be measured in patients with renal insufficiency and patients susceptible to decreased cardiac output and blood pressure using a closed collection system (sterile urinary catheterization required).
- The primary purpose of monitoring includes to avoid excessive distension of the bladder, as an indicator of renal perfusion, adequacy of blood and fluid therapy.
- Urine output should be maintained at 1-2 ml/kg/hour.
- If urine output is inadequate, ensure that the collection system is functioning properly.
- Oliguria may be treated with one, or in combination of the following agents;
  - fluids (e.g. lactate Linger solution) at 15-40 ml/kg/hr
  - furosemide at 2-5 mg/kg IV or 1 mg/kg/hr
  - mannitol or dextrose at 0.25-0.5 g/kg IV over 5-15 minutes
  - dopamine at 1-5 mcg/kg/min IV

Temperature monitoring

- Patient body temperature should also be monitored during general anesthesia to avoid accidental hypothermia or detect malignant hyperthermia.
- Small patients lose body heat very rapidly when anesthetized and precautions should be taken to avoid this.
- Body temperature should always be monitored during prolonged surgery of the body cavities. Electronic thermistor probe is commonly placed either in rectum or esophagus for continuous temperature monitoring.
- Low body temperature decreases body metabolic rate and impairs the pharmakokinetic profile of drugs on board during anesthesia potentially prolonging recovery.
- The temperature should be checked at the end of anesthesia to see whether external heating is required.
- The animal in low body temperature will increase muscle contraction to raise body temperature at the time of recovery, a process increasing oxygen demand at the worst time when the tissues need to preserve it most.

ANESTHETIC RECORD KEEPING

- In order to achieve the best out of monitoring equipment it is advisable to maintain a written record of every anesthetic procedure.
- Minimal data to be entered into an anesthesia record are patient identification, operative procedure, significant preoperative findings in patient's record, amount and route of anesthetic agents and other drugs, monitoring of heart rate and breathing rate, and complications.
- Anesthetic records are useful for four main reasons.
    - Trends in patient variables to be noticed, at an early stage.
    - An archive of anesthetic records will be useful to compare similar cases and establish statistical analysis
    - Record keeping will aid the inexperienced personnel concentrate and improve their standard of patient monitoring.
    - In cases where the anesthetic management of a case needs to be defended, an anesthetic record is of enormous worth both as a reminder of the details of the individual cases and as evidence of the general standard of care given by the veterinary practice. To be admissible anesthetic record must be contemporaneous i.e. it must have been made at the same time that the anesthetic was given.