Oh No! Troubleshooting Anesthetic Complications and Emergencies

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I. Closed pop-off
   a. Pressure begins to build within the system, even the patient's lungs
   b. With excessive pressure, significant trauma can occur to the patient including barotrauma to the lungs, a ruptured trachea, cardiovascular collapse by impaired venous return, and pneumothorax
   c. If the rebreathing bag is noticed to be enlarged with the creases of the bag taut, the pop-off should be immediately opened or the bag pulled off of the machine
   d. Excess gas will be allowed to escape the system and the pressure released
   e. The patient should then be thoroughly assessed for signs of pneumothorax or cardiovascular collapse and appropriate treatment administered

II. Drug reactions
   a. Rare
   b. Animals can be profoundly affected by a sedative/anesthetic/analgesic and are rarely having a drug reaction
   c. A true reaction is usually accompanied by the characteristic signs of an allergic reaction
   d. The drug should be reversed if a reversal is available
   e. Steps should then be taken to limit an allergic reaction, including the administration of an antihistamine and/or the administration of a corticosteroid

III. Hypothermia
   a. Very common
   b. When hypothermia is severe, approaching 90°, life threatening complications may occur
   c. Hypothermia causes bradycardia and can detrimentally affect cardiac output
   d. Warm water circulating blankets are very effective in preventing heat loss
   e. Warm air blankets are also very effective in maintaining a patient's body temperature
   f. Heating bottles or heating pads should be used with care, as they can burn patients easily and rapidly
   g. Decrease heat loss by using a rebreathing system with a low flow of oxygen heat

IV. Equipment malfunctions
   a. Best addressed by proper equipment maintenance and a thorough knowledge of their operation
   b. Proper monitoring will usually alert the anesthetist to equipment malfunctions before they become problematic

V. Hemorrhage
   a. Initial Trauma
   b. Complications in surgery
   c. Monitoring PCV
   d. Clinical signs can include: pale mucous membranes, prolonged CRT, increased heart rate, thready pulses
   e. Address immediately and aggressively

VI. Arrhythmias
   a. Bradycardia
      i. Can occur from a number of causes; increases in parasympathetic tone/decreased sympathetic tone, hypothermia, electrolyte imbalances, pharmacologic factors, and heart disease
      ii. The concern is the secondary effects the bradycardia has on decreasing cardiac output
      iii. An ECG can then help to characterize the arrhythmia
      iv. Treatment of bradyarrhythmias involves identifying the underlying cause and treating that cause
   b. Tachycardia
      i. Typically occur secondary to an increase in sympathetic tone (pain, excitement, hypoxemia, electrolyte imbalances) or due to administered drugs (ketamine, anticholinergics)
      ii. A decrease in cardiac output secondary to a decrease in ventricular filling time is the primary concern with tachycardias
      iii. Treatment of tachyarrhythmias depends on the underlying cause
   c. Atrial or ventricular arrhythmias, including atrial premature contractions and ventricular premature contractions, are not as common with routine anesthetic procedures

i. Typically associated with conditions such as metabolic disturbances, surgical manipulation, and respiratory gas abnormalities
ii. Diagnosis is based on auscultation and ECG interpretation
iii. Treatment of these arrhythmias depends on their severity and their secondary alterations to blood pressure

VII. Hypotension

a. Very common under general anesthesia
b. Hypotension occurs secondary to a multitude of factors including everything from hypovolemia from anemia to vasodilation from gas anesthetics to hypothermia
c. The causes are numerous and the consequences can be severe; kidney disease and brain damage
d. The diagnosis is based on arterial blood pressure
e. Most references site hypovolemia as a mean arterial blood pressure of 60 mmHg or less
f. The treatment for hypovolemia is dependant on the cause, but typically includes volume replacement
g. A bolus of 5-10 ml/kg of crystalloid fluids will correct mild hypovolemia
h. Methods employed to reduce to amount of gas anesthetics given, including the administration of additional analgesics, will reduce the dose-dependant vasodilatory effects of inhalant anesthetics
i. Colloids can be given
j. If previously mentioned efforts do not improve the mean arterial blood pressure, pressors can be given or the procedure can be stopped and the patient woken up

VIII. Hypertesion

a. Not typically seen under general anesthesia
b. When hypertension is observed, usually defined as a mean arterial blood pressure of 160 mmHg or greater (although concern frequently occurs around a MAP of 120 mmHg or higher), it should be addressed
c. Hypertension is more often than not a sign of a light plane of anesthesia or a painful patient
    i. Increasing the plane of anesthesia or administering supplemental analgesics will aid in reducing the MAP to within the normal range
d. Other, more serious, causes are possible but not common

IX. Cardiac failure

a. Complete cardiac failure, not very common in routine cases, is the worst case scenario for an anesthetic emergency
b. It is diagnosed by weak or absent peripheral pulses, a prolonged capillary refill time, cardiac arrhythmias, cyanosis, possible apnea, and other signs of shock
c. The loss of a carbon dioxide waveform on capnography can aid in the diagnosis of cardiac failure under anesthesia
d. CPR

X. Aspiration

a. Aspiration under anesthesia is best prevented rather than treated
b. The risk of regurgitation, leading to possible aspiration, can be diminished by fasting an animal for at least 8 hours prior to anesthesia
c. The risk of regurgitation can be decreased by adequately anesthetizing an animal prior to attempting intubation
    i. By trying to intubate an animal in stage 2 of anesthesia, the patient is more likely to regurgitate when the larynx is touched by an endotracheal tube.
d. Proper endotracheal tube placement and cuff inflation will limit aspiration should regurgitation occur under anesthesia

XI. Apnea

a. Very common complication of anesthetized animals, especially those induced with propofol
b. Easily addressed by manually or mechanically ventilating the patient to maintain normocapnia

XII. Cyanosis

a. The outward sign that is associated with a patient that is hypoxemic
b. The causes of hypoxemia include; low inspired oxygen, hypoventilation, diffusion impairment, shunting, and ventilation-perfusion mismatch.
c. Because the anesthetize patient is receiving 100% oxygen, a low inspired oxygen level should only occur if there is a machine malfunction
d. The cyanosis should resolve with manual breathes if the cause is hypoventilation

e. The last three causes are more concerning, including severe atelectasis and pulmonary edema, and consideration should be given to waking the patient up and doing further diagnostics to determine the cause of the cyanosis. This should be based on the pros and cons of continuing with anesthesia

XIII. Obstructed airway

a. Generally, this happens when a mucus plug occludes the endotracheal tube
b. An obstructed airway can be diagnosed by the loss of the carbon dioxide waveform on capnography, but more routinely by the difficultly in giving the patient a manual breath
c. Often, the diagnosis comes from the complete inability to give the animal a manual breath.
    i. When this occurs, immediate action must be taken as the patient is not able to inhale oxygen
d. The endotracheal tube cuff should immediately be deflated to allow the possible movement of air around the endotracheal tube
e. The patient should then be extubated, and re-intubated with a new endotracheal tube
f. The act of extubating a patient often dislodges the mucus plug, and the endotracheal tube will no longer be occluded once removed

XIV. Pleural cavity disease

a. Pleural cavity disease is not common under anesthesia without prior knowledge of the disease
b. With any pleural cavity disease, it is best to limit the compression of the lungs prior to anesthetizing the patient (i.e. thoracocentesis to draw off air or fluid in the pleural cavity)
c. It is also very beneficial to pre-oxygenate the patient prior to inducing anesthesia