

MANAGING COMMON AND UNCOMMON COMPLICATION OF ANESTHETIZED PATIENTS

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SAFE ANESTHESIA DOES NOT EXIST

- Complications and side effects from the process of anesthesia occur
 - Can compromise patient's health
 - Can result in death
- Many can be avoided or minimized



ANESTHESIA

- Vigilant patient monitoring
 - Avoidance techniques
- Early identification of complications is essential to minimize impact
- Knowledge of common complications and side effects of drugs is essential

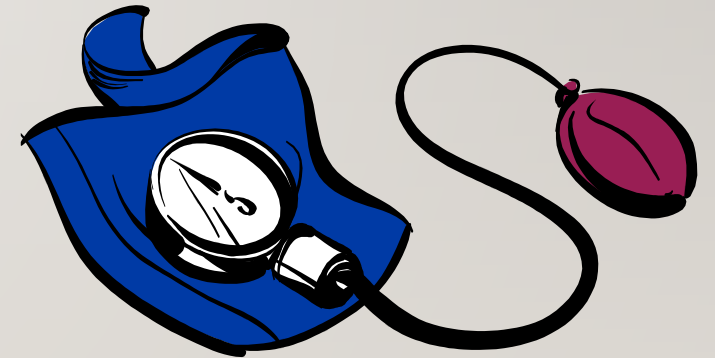
COMMON COMPLICATIONS

- The “Big 5”
 - Hypotension
 - Hypothermia
 - Hypoventilation
 - Bradycardia
 - Pain
- All patients undergoing anesthesia are at risk



HYPOTENSION

- Abnormally low blood pressure
 - BP is the measure of the force driving tissue perfusion
 - MAP greater than 60 mm Hg is necessary for perfusion
 - Brain, heart, kidneys, etc...
 - Hypoperfusion of vital organs and tissues
 - Inadequate tissue delivery of oxygen
 - Removal of waste products
 - Clinical signs of shock
 - Organ dysfunction



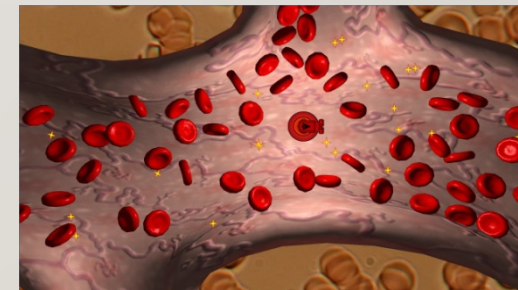
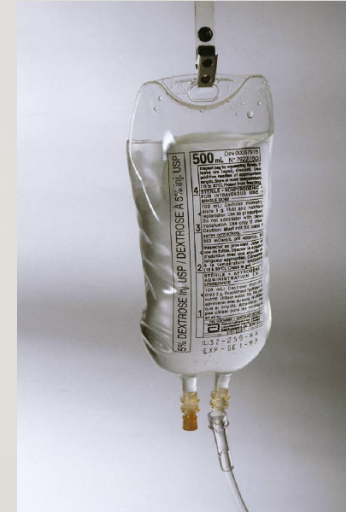
HYPOTENSION

- Causes
 - Hypovolemia
 - Vasodilation
 - Myocardial depression
 - Cardiac arrhythmias
 - Decreased venous return



HYPOTENSION

- Hypovolemia
 - A state of decreased blood volume
 - Hemorrhage
 - Pre-existing fluid deficits
 - Fluid loss to third spaces
 - Relative secondary to vasodilation
 - Inadequate intraoperative fluids



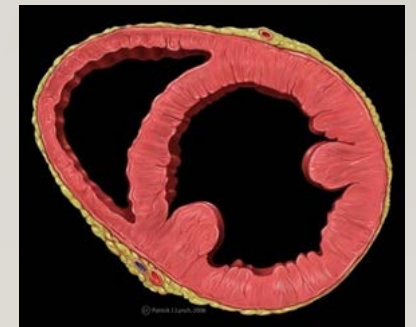
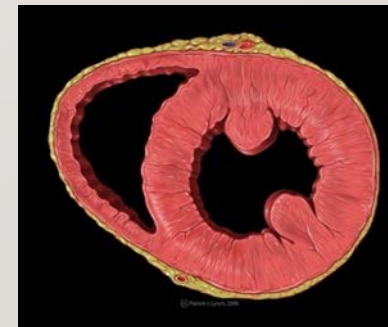
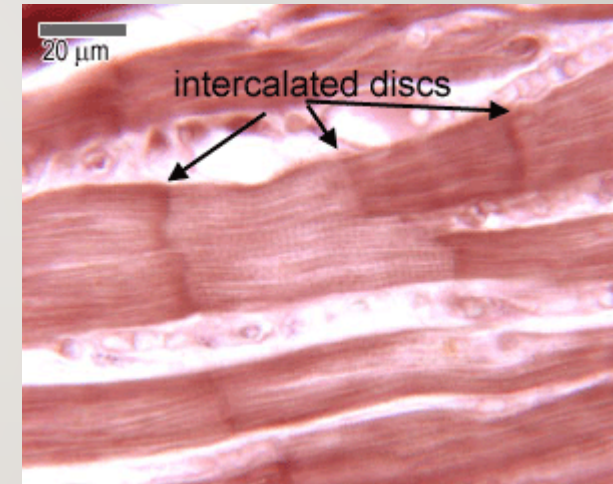
HYPOTENSION

- Vasodilation
 - Widening of blood vessels from relaxation of smooth muscle within vessel walls
- Drug induced
 - Inhalants, propofol, acepromazine
- Severe acidosis and/or hypoxemia
- Endotoxemia/septicemia
- Anaphylaxis



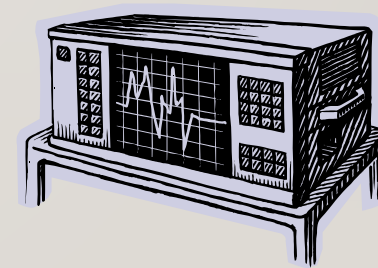
HYPOTENSION

- Myocardial depression
 - Decreased shortening of myocardial fibers
 - Drug-induced
 - Hypoxemia or ischemia
 - Acid-base imbalance
 - Endotoxemia/sepsis
 - Cardiomyopathy
 - Catecholamine depression



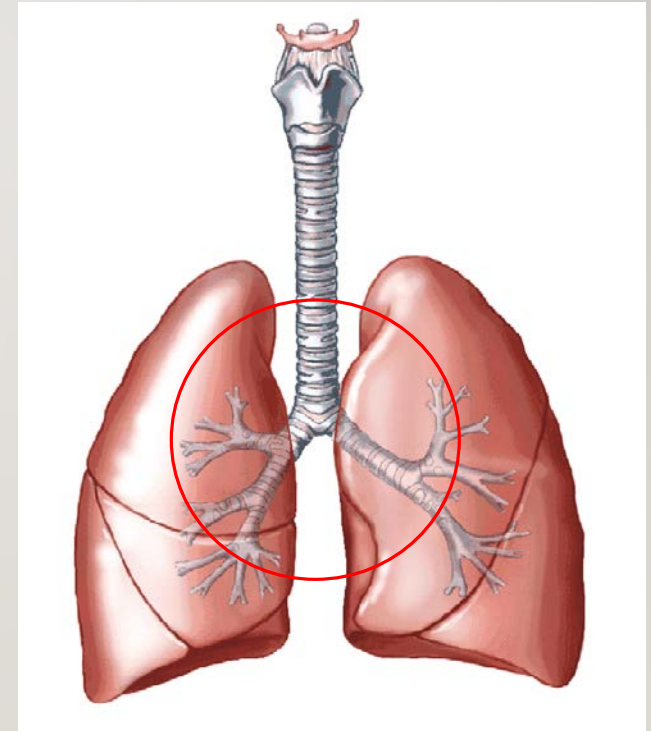
HYPOTENSION

- Cardiac arrhythmias
 - Changes reducing cardiac output
 - Bradycardia
 - A-V block
 - Tachycardia
 - Atrial fibrillation
 - Ventricular tachycardia



HYPOTENSION

- Decreased venous return
 - Decrease diastolic filling reducing CO
- IPPV
- Pericardial effusion
- Tumors
- Pneumothorax
- Surgery – packing or retraction



HYPOTENSION

- Treatment
 - Reduce inhalant anesthetic
 - Use anesthetic sparing drugs – opioids
 - Correct hypovolemia
 - Peri-anesthetic crystalloid fluids (5-10 ml/kg/hr)
 - Fluid boluses
 - Crystalloids 10-30 ml/kg
 - Colloids up to 20 ml/kg
 - Correct acid-base and electrolyte imbalances
 - Hemostasis and reduce visceral traction
 - Reduce tidal volume of PPV

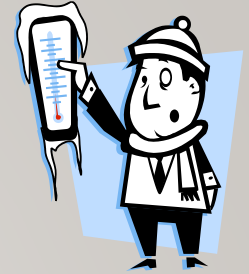


HYPOTENSION

- Treatment
 - Sympathomimetic support
 - Atropine/glycopyrrolate
 - Dopamine 2.5-10 $\mu\text{g/kg/min}$
 - Dobutamine 2.5-10 $\mu\text{g/kg/min}$
 - Ephedrine 0.2 mg/kg
 - Phenylephrine 5-10 $\mu\text{g/kg}$
 - Vasopressin 0.02-0.2 U/kg once



HYPOTHERMIA



- When core temperature drops below the required temperature for normal metabolism and body functions
- Causes
 - Conditions that increased heat loss, decrease heat production, or disrupt normal thermoregulation
 - Anesthetic/analgesic drugs
 - Delivery gases
 - Surgical procedure
- Any anesthetic procedure lasting longer than 20 minutes requires supplemental heat!!

HYPOTHERMIA

- Mechanisms
 - Convection*
 - Transfer of heat from body to surrounding air
 - Conduction*
 - Transfer of heat from body to objects in contact
 - Radiation
 - Transfer of heat from body to objects not in contact
 - Evaporation
 - Heat lost to moisture



HYPOTHERMIA

- Side effects
 - Cardiovascular
 - Bradycardia, hypotension, arrhythmias, decreased cardiac output, asystole
 - Respiratory
 - Decreased rate and depth of breathing, pulmonary tissue injury, oxygen dissociation disturbances
 - Neurologic
 - Delayed recovery
 - Other
 - Cold diuresis, acid base, coagulopathy, decreased healing, immunosuppression, shivering

HYPOTHERMIA

- Treatment
 - Passive warming
 - Use of animals own body heat
 - Blankets, towels, bubble wrap
 - Active warming
 - Circulating warm water blankets
 - Electric blankets
 - Forced warm air blankets
 - Fluid warmers
 - Hot water bottles
 - Warm fluid lavage
 - Heat production
 - IV infusion of amino acids

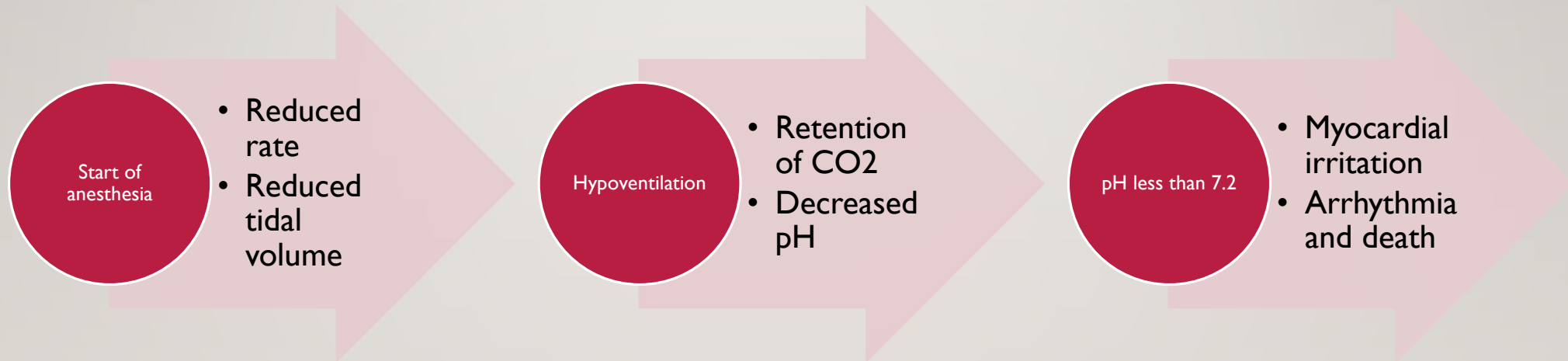


HYPOVENTILATION

- AKA respiratory depression
- Ventilation inadequate to meet needed gas exchange
 - Reduced minute ventilation
 - Reduced tidal volume
 - Reduced respiratory rate
 - $p\text{CO}_2 > \text{than } 50 \text{ mm Hg}$
 - ETCO_2 monitoring helpful
- Probably one of the most common causes of anesthetic death in the unmonitored patient
 - Commonly blamed as a “reaction to anesthesia”



HYPOVENTILATION



HYPOVENTILATION

- Causes
 - Drugs affecting respiratory centers in brain stem
 - Opioids
 - Propofol
 - Ketamine
 - Inhalant anesthetics
 - Induction of anesthesia
 - Body position
 - Abdominal distention
 - Thoracic injury/pneumothorax
 - Partial obstruction of airway



HYPOVENTILATION

- Treatment
 - Endotracheal intubation
 - Mechanical ventilation
 - Lighten anesthetic plane
 - Reverse depressant drugs
 - Relieve abdominal distention
 - Thoracocentesis
 - Oxygen therapy



BRADYCARDIA

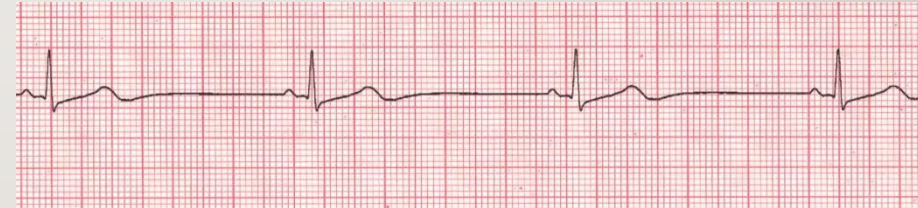
- Slow heart rate
 - Severe bradycardia can reduce cardiac output
 - $CO = HR \times SV$
 - Decreased perfusion
 - Decreased blood pressure
- During anesthesia
 - Sinus bradycardia
 - A-V block
 - Sinus arrest
 - Atrial standstill

BRADYCARDIA

- Causes

- Drug effects (common)

- Opioids, alpha 2 agonists
 - AV block
 - Increased vagal tone
 - Inhalants, propofol
 - Sinus bradycardia
 - Direct effect



- Rates

- Dogs

- Less than 40 to 80 beats/minute

- Cats

- Less than 80 to 100 beats/minute



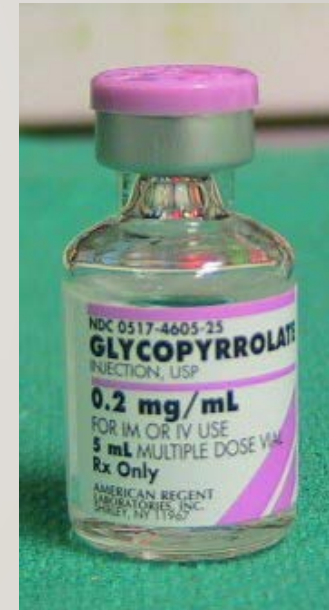
BRADYCARDIA

- Causes
 - CNS disease
 - Increased intracranial pressure
 - Hypothermia
 - High vagal tone
 - Brachycephalic breeds
 - Vagal stimulation
 - During surgery
 - hyperkalemia



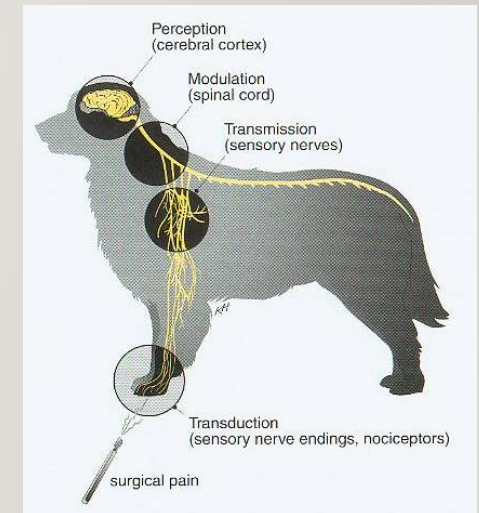
BRADYCARDIA

- Treatment
 - Identify underlying cause and target treatment
 - Anticholinergics
 - Atropine, glycopyrrolate
 - Reversal
 - Naloxone, atipamezole
 - Supplemental warmth



PAIN

- An unpleasant sensory and emotional experience (perception) associated with actual or potential tissue damage or is described in terms of such damage



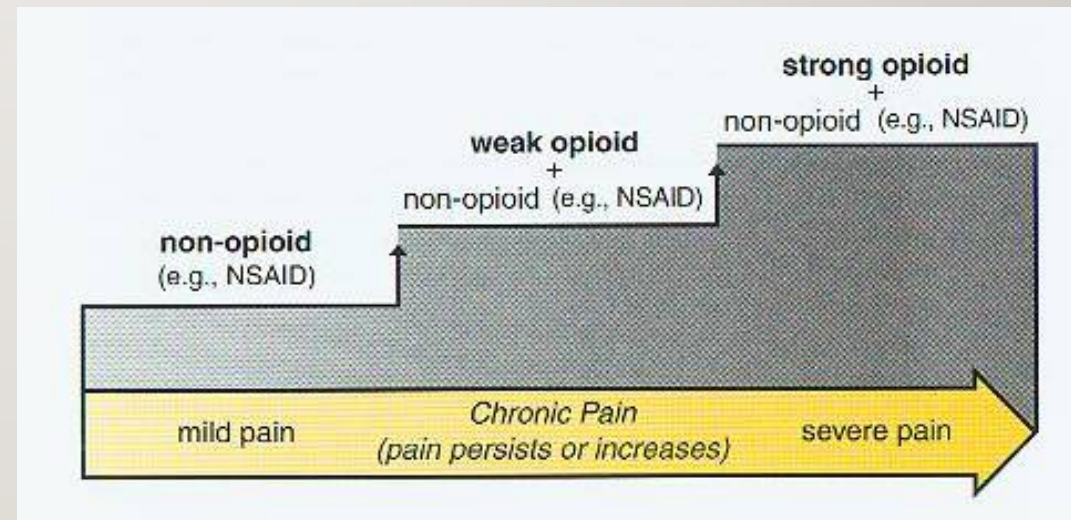
PAIN

- Detrimental effects of pain
 - Increased catecholamine
 - Increased cortisol
 - Decreased wound healing
 - Increased oxygen demand
 - Increased risk of infection
 - Increased hospital stay
 - Decreased food consumption
 - Increased morbidity and mortality



PAIN

- Treatment
 - Analgesic drug therapy
 - Opioids
 - NSAIDs
 - Other therapeutics



UNCOMMON COMPLICATIONS

- Often related to underlying disease
 - Can be anticipated based on individual patient disease stability
 - Through physical exam
 - Understanding of pathophysiology
 - Effect of disease on drug actions
 - Effect of drug actions on compromised physiology

RESPIRATORY COMPLICATIONS

- Hypoxemia
 - Arterial oxygen tension < 60 mm Hg
 - Causes
 - V/Q mismatch
 - Hypoventilation
 - Decreased FIO₂
 - Shunt
 - Anemia
 - Decreased cardiac output
- Unusual in patient on 100% oxygen. Common in patients without supplemental oxygen

RESPIRATORY COMPLICATIONS

- Hypoxemia
 - Clinical signs
 - Restlessness
 - Dysphoria
 - Tachycardia
 - Arrhythmias
 - Hypertension
 - Irregular breathing patterns
 - Cyanotic mucous membranes
 - Only when 15 g/l of hemoglobin is unsaturated

RESPIRATORY COMPLICATIONS

- Hypoxemia
 - Rare occurrence during anesthesia in intubated patients on 100% oxygen
 - Treatments/preventatives
 - Preoxygenate for 5 minutes prior to induction
 - Positive pressure ventilation
 - Supplemental oxygen during recovery
 - Alveolar recruitment maneuver
 - Thoracocentesis
 - Treat underlying disease
 - Transfusion
 - Decrease oxygen consumption



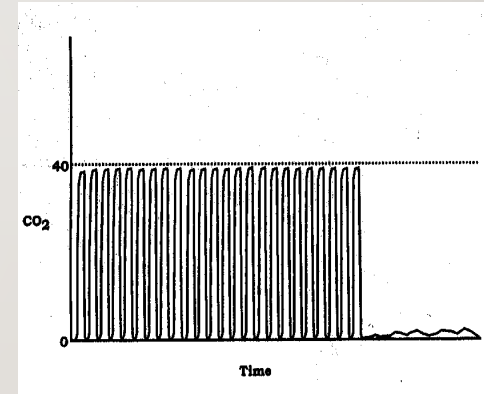
RESPIRATORY COMPLICATIONS

- Airway obstruction
 - Increased resistance of the airway that reduces the amount of air inhaled in each breath and the oxygen that reaches the alveoli
 - Causes
 - Laryngeal spasm/paralysis
 - Laryngeal inflammation/edema
 - Tracheal fluid/foreign body
 - Tracheal collapse
 - Brachycephalic syndrome
 - Kinked or blocked ET tube
 - Machine error



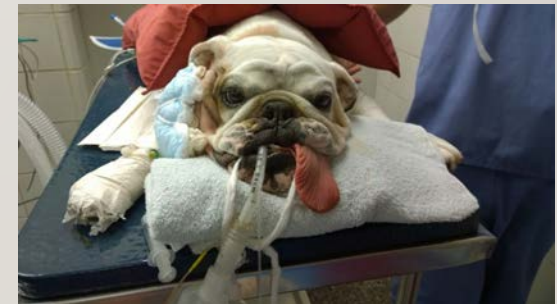
RESPIRATORY COMPLICATIONS

- Airway obstruction
 - Clinical signs
 - Altered breathing patterns
 - Paradoxical breathing
 - Changes in ETCO₂ and pattern
 - Hypoxemia
 - Pulmonary edema
 - Lung injury



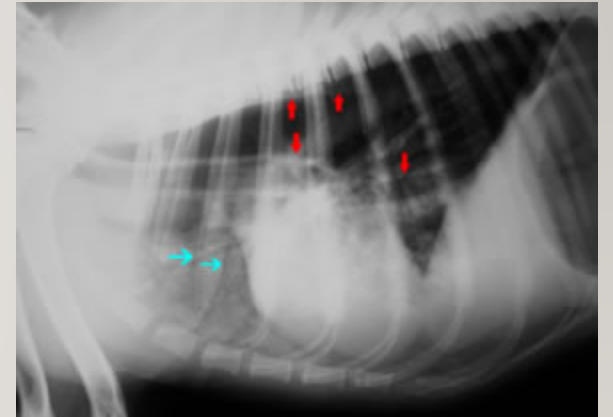
RESPIRATORY COMPLICATIONS

- Airway obstruction
 - Treatments – Identify cause
 - Extend head and neck and pull tongue forward
 - Provide supplemental oxygen
 - Suction airway
 - Intubation or tracheotomy
 - Steroids and diuretics
 - Sternal recumbency
 - Post anesthesia sedation



RESPIRATORY COMPLICATIONS

- Aspiration
 - Entry of secretions or foreign material into the trachea and lungs
 - Stomach contents
 - Blood, mucous, dental debris, saliva
 - Silent
 - Inflammation associated with material may be of greater concern than bacteria



RESPIRATORY COMPLICATIONS

- Aspiration
 - Predisposing factors
 - Lack of fasting
 - Delayed gastric emptying
 - Stress, medications, pain
 - Increased intra-abdominal pressure
 - Obesity, pregnancy, neoplasia
 - Body position
 - Prolonged anesthesia
 - Unprotected airway
 - Diseases – megaesophagus
 - Anatomic abnormalities – brachycephalic breeds

RESPIRATORY COMPLICATIONS

- Aspiration
 - Treatment
 - Ensure proper ET tube placement and cuff inflation
 - Position head lower than thorax to promote drainage
 - Rinse and suction pharynx
 - Lavage esophagus
 - Suction pharynx again prior to extubation
 - Extubate with cuff slightly inflated
 - Post anesthesia oxygen therapy
 - Broad spectrum anti-biotics
 - Anti-inflammatory medications

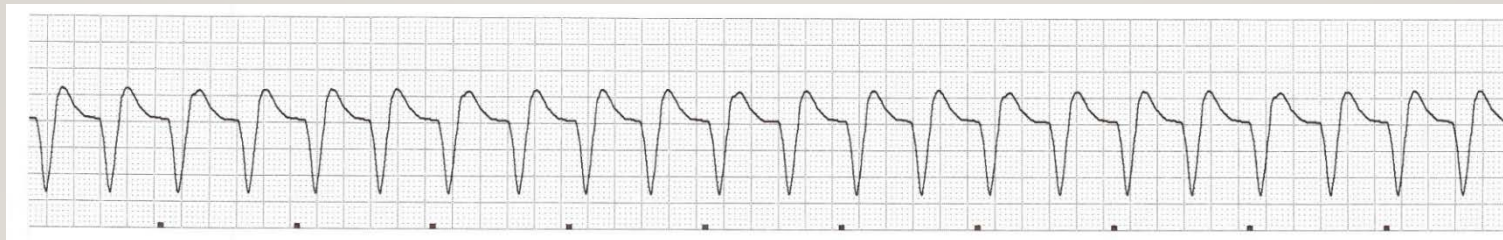
RESPIRATORY COMPLICATIONS

- Aspiration
 - Prevention
 - Pre-anesthetic fasting
 - Anti-emesis medications
 - Rapid induction and use of appropriate sized ET tube
 - Lubricant use on ET tube
 - In at risk patients
 - Pretreatment with metaclopramide and H2 blocker night before and morning of anesthesia
 - Metaclopramide 0.2 – 1.0 mg/kg, SC, IM, or slow IV
 - Maintain head up position during induction and intubation



CARDIOVASCULAR COMPLICATIONS

- Tachycardia
 - A heart rate that exceeds the normal range for a resting heart rate
 - Types
 - Sinus
 - Atrial
 - Ventricular
 - Danger in reduced diastolic time and ventricular filling resulting in reduced cardiac output



CARDIOVASCULAR COMPLICATIONS

- Tachycardia
 - Causes
 - Pain
 - Light anesthesia
 - Hyperthermia
 - Hypotension/hypovolemia
 - Hypoxemia
 - Hypercapnia
 - Hyperthyroidism
 - Anemia
 - Myocardial disease
- Electrolyte disorders
- Acid-base disorders
- GDV
- Splenic disease
- Drug effects
- Etc...

CARDIOVASCULAR COMPLICATIONS

- Tachycardia
 - Treatment
 - Identify and treat underlying condition
 - Administer analgesics
 - Adjust anesthetic plane
 - Medications
 - Supraventricular tachycardia
 - Beta-blockers, calcium channel blockers
 - Ventricular tachycardia
 - Lidocaine, procainamide



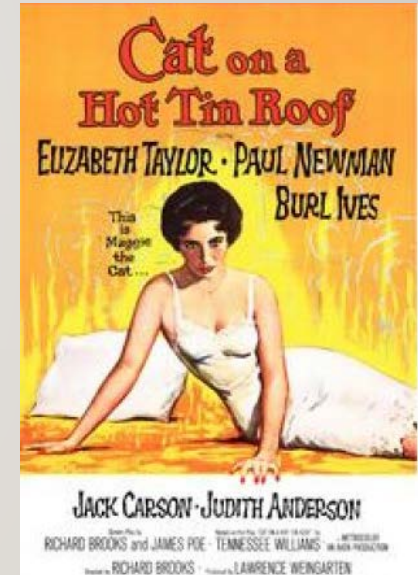
OTHER COMPLICATIONS

- Excitement/dysphoric recovery
 - A state characterized by anxiety, depression, or unease
 - Causes
 - Pain
 - Full urinary bladder
 - Hypoxemia
 - Hypotension
 - Acidosis
 - Ketamine
 - Opioid
 - Treatments
 - Sedatives, reversal of opioids, treat underlying conditions



OTHER COMPLICATIONS

- Hyperthermia
 - Elevated body temperature due to failed thermoregulation
 - Causes
 - Overheating
 - Heavy-coated/arctic breed dogs
 - Opioid use in cats



OTHER COMPLICATIONS

- Oliguria or anuria
 - Low or absent urine output
 - Causes during anesthesia
 - Reduced renal blood flow and GFR
 - Pre-existing renal disease
 - Inadequate fluid therapy
 - Hypotension
 - NSAID use during hypotension and renal hypoperfusion
 - Treatments
 - Fluid therapy
 - Mannitol
 - Dopamine?

OTHER COMPLICATIONS

- Prolonged recovery
 - Causes
 - Hypoventilation
 - Hypercapnia
 - Hypoxemia
 - Metabolic acidosis
 - Hypoglycemia
 - Hypotension
 - Treatments
 - Reverse drugs
 - Ventilation

QUESTIONS?

