Emergency Medicine/Critical Care

- Snake Bite
- Bloat (GDV)
- Heat Stroke
- Open Fracture

- Difficulty Breathing
- Excessive Bleeding
- Paralysis

Priority 2

Triage

LIKELY TO SURVIVE IF CARE IS GIVEN WITHIN HOURS

EXAMPLE:

- Closed Fractures
- Diarrhea
- Acute Vomiting

- Birthing Difficulti

What is Triage

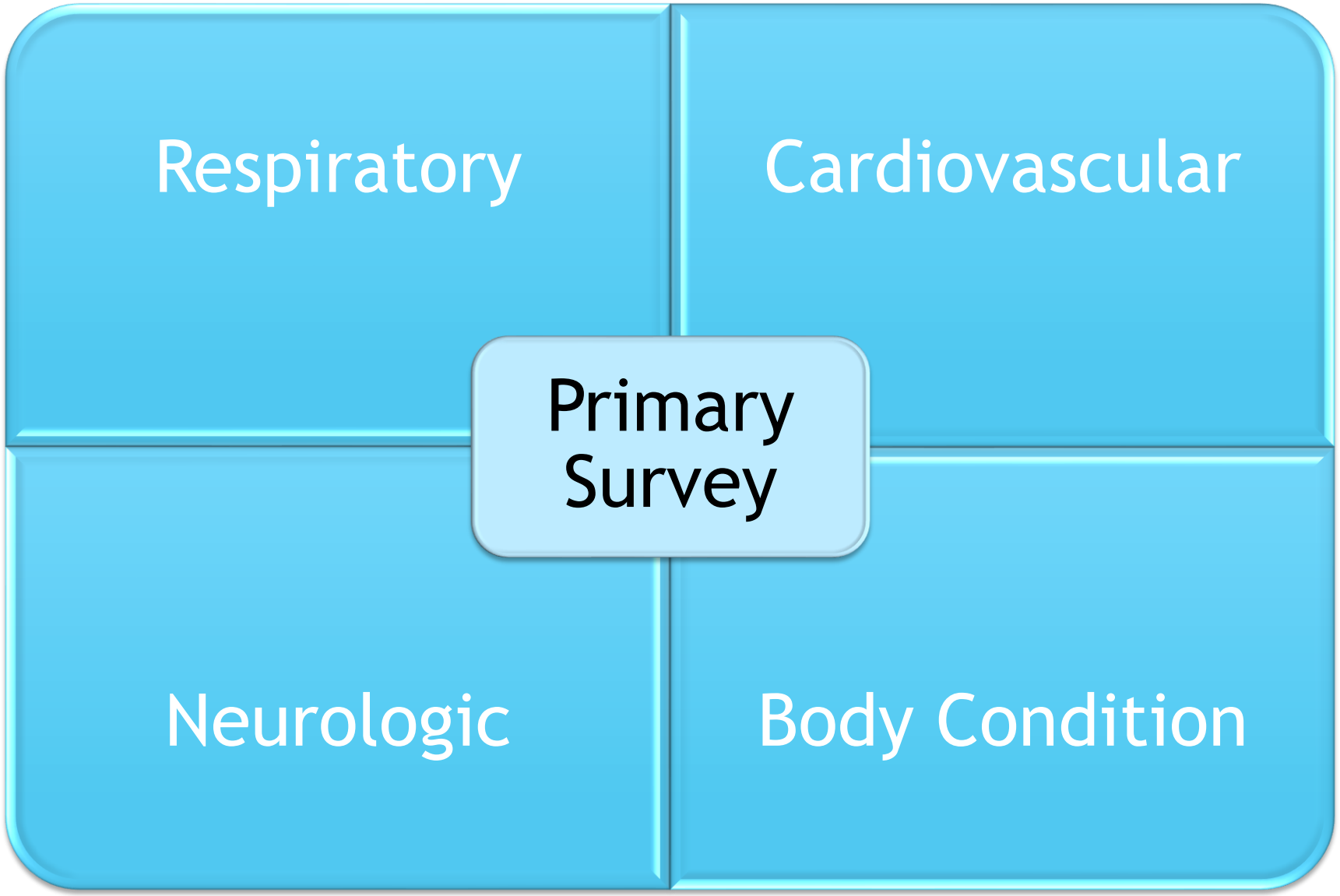
- The assignment of degrees of urgency to wounds or illnesses to decide the order of treatment of a large number of patients

Telephone Triage

- The initial triage may occur over the phone
- Why does the pet need to be seen?
  - Trouble breathing, active bleeding, loss of consciousness, open wounds, seizures, inability to urinate, abdominal distension, exposed fracture, hit by car, dog attack
  - Gather signalment!
  - Determine if urgent or emergent

The Primary Survey

- Should be completed in the first 30 to 60 seconds
- Animal should be approached from the front and quickly surveyed:
  - Level of consciousness
  - Breathing and respiratory pattern
  - Abnormal body or limb posture
  - The presence of blood or other organic debris
  - Gross abnormalities

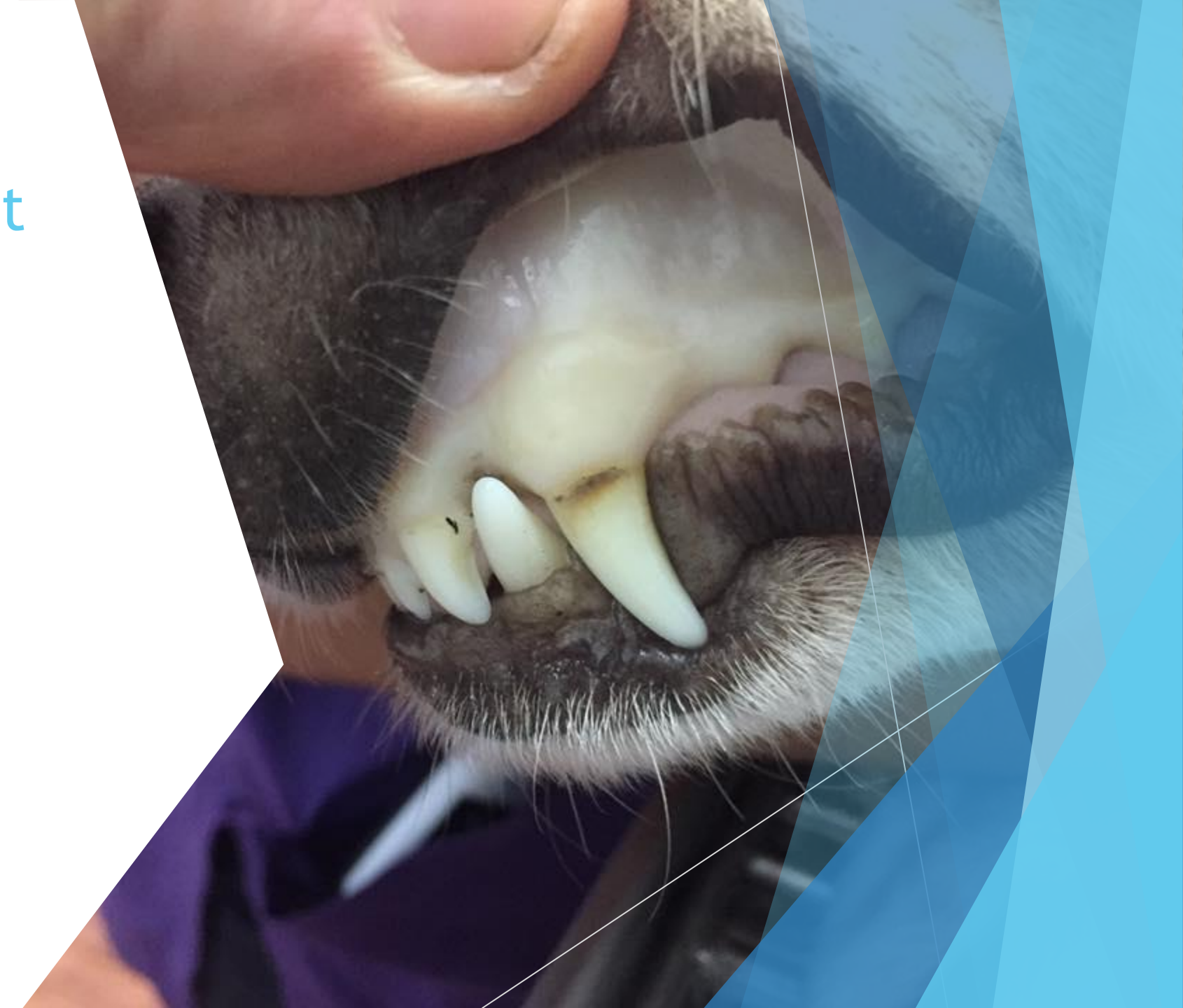

Respiratory
Cardiovascular
Primary Survey
Neurologic
Body Condition

Respiratory System Assessment

- Respiratory rate
- Respiratory effort
- Evidence of thoracic trauma
- MM color
- Thoracic auscultation

Cardiovascular System Assessment

- Heart rate
- Pulse quality
- CRT
- Thoracic auscultation
- Core body temperature

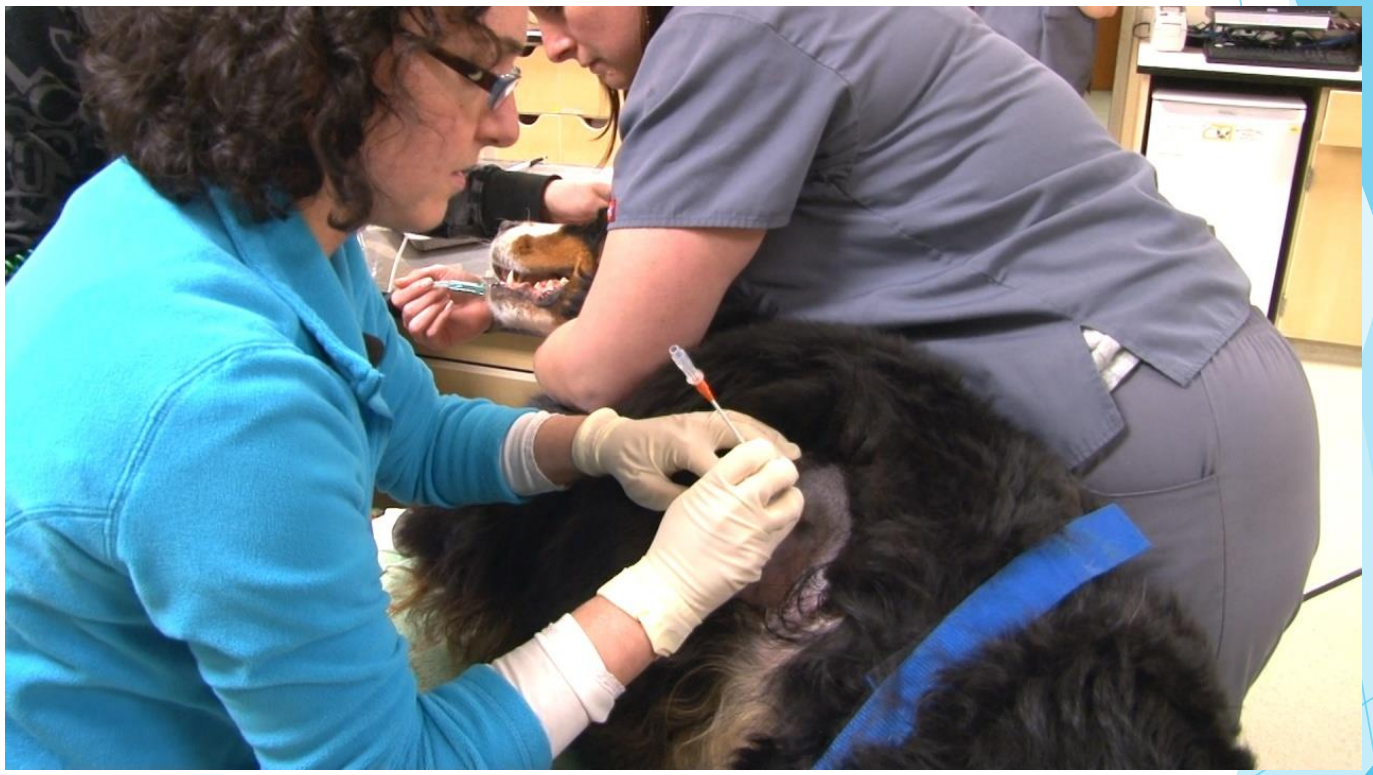


Neurologic Assessment

- Mentation
  - LOC
- Pupil size
- Pupil symmetry
- Pupil responsiveness
- Gait assessment
- Evidence of head trauma

Abdominal Examination

- Pain on palpation
  - Splinting
- Tympany
  - Percussion sound
- Fluid wave



Hydration Status

- Skin Turgor
- MM
- Blood loss
- Percent dehydration

Percent Dehydration

5% Dehydration

- MM-mildly dry/tacky

7% Dehydration

- MM-dry
- Mild loss of skin turgor
- Mild tachycardia

10% Dehydration

- MM-dry
- Pronounced skin turgor
- Weak pulses

>10% Dehydration

- Severe loss of skin turgor
- Sunken eyes
- Shock
- Coma
- Death

Initial Diagnostics

PCV/TP

Indications

- Dehydration
- Anemia
- Trauma
- Shock
- Hypoproteinemia
- Severe inflammation

- Normal adult dogs
  - 37%-55%
  - Puppies will have lower values
  - Sighthounds will have higher values
- Normal adult cats
  - 30%-45%
  - Kittens will have lower values
- TP/TS
  - Normal values 5.4-7.5 g/dL (dogs)
  - Normal values 5.7-7.6 g/dL (cats)

PCV/TP Interpretation

High PCV with the following:

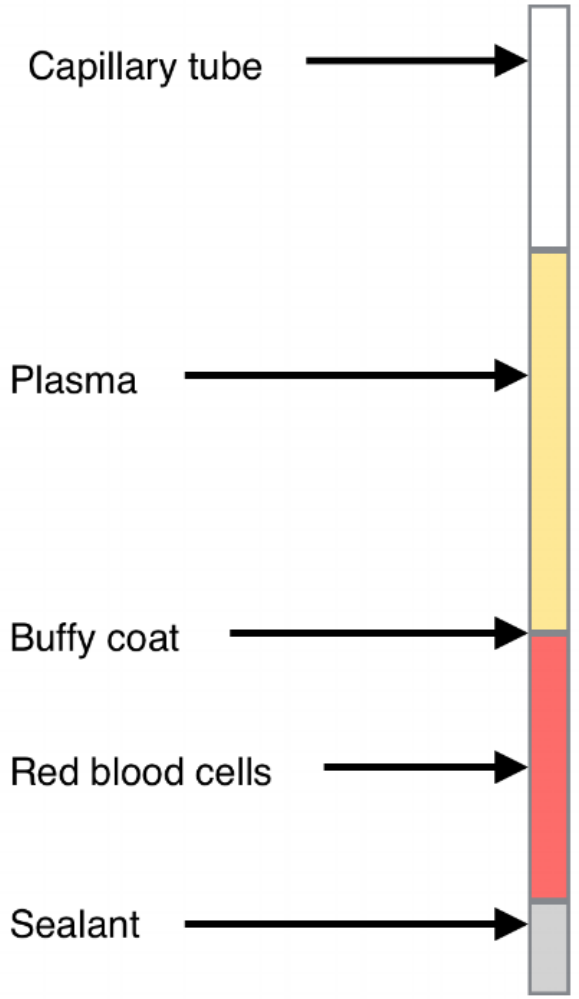
- Normal TP
  - Splenic contraction
  - Breed related high normal
- Low TP
  - Protein loss
  - Decreased RBC production with splenic contraction and dehydration

Low PCV with the following:

- Normal TP
  - Anemia from RBC destruction or decreased production
- Low TP
  - Blood loss
  - IVF dilution
- High TP
  - Protein overproduction with anemia

PCV/TP Interpretation

- Normal PCV with the following:
- Low TP
  - Decreased protein production
  - Increased loss from GI or urinary tract
- High TP
  - Dehydration with anemia
  - Increased globulin production



Blood Glucose (BG)

Indications

- Sepsis
- Seizures
- Unresponsive puppies and kittens
- Toxin ingestion
  - Xylitol
- DKA
- Diabetics
- Neurologic

- Normal dogs
  - 80-120 mg/dL
- Normal cats
  - 80-120 mg/dL

BG Interpretation

Low BG (hypoglycemia)

- Neoplasia/insulinoma
- Sepsis
- Xylitol ingestion/toxin ingestion
- Hypoglycemic crisis
  - Symptomatic at BG <50 mg/dL
- Status epilepticus
- Nutritional deficiencies
  - Failure to thrive
  - Starvation
- Insulin overdose
- Addisonian crisis
- Liver failure

High BG (hyperglycemia)

- Hyperglycemic Hyperosmolar Syndrome (HHS)
- DKA
- Primary diabetes
- Increased catecholamines (stress response)
- Inflammatory mediators/critical illness
- Pancreatitis

Blood Gas Analysis

Indications

- Respiratory Emergencies
  - Pulmonary thromboembolism
  - Pneumonia
  - CHF
- Metabolic Emergencies
  - Urethral obstruction
  - DKA or HHS
  - Eclampsia
  - Addison's Dz
  - Antifreeze ingestion
  - Shock (any form)

Normal Blood Gas Values

Sample	pH	pCO2	HCO3	pO2
Dog venous	7.35-7.45	40-50 mm HG	20-24 mm HG	30-42 mm HG
Dog arterial	7.35-7.45	35-45 mm HG	20-24 mm HG	90-100 mm HG
Cat venous	7.3-7.38	41.8-50.8 mm HG	19.4-23.4 mm HG	38.6-49.6 mm HG
Cat arterial	7.34-7.44	33.6-40.6 mmHG	17.5-20.5 mm HG	102.9-117.9 mm HG

Lactate

Indications

- Shock or suspected shock
- Circulatory disturbances
  - Heart failure
  - Thrombosis
  - GDV
- Trauma
  - ESPECIALLY crush injuries

- Normal dogs
  - < 2.5 mmol/L
- Normal cats
  - < 1.5 mmol/L

Lactate Interpretation

- Mild Increase
  - 3-5 mmol/L
- Moderate Increase
  - 5-10 mmol/L
- Severe Increase
  - > 10 mmol/L

- Blood cannot sit > 30 minutes
  - Will directly affect the results
- Serial measurements are a must!

Lactate Interpretation

Lactic Acidosis Type A

- Tissue hypoxia
- Poor tissue perfusion
- Shock
  - GDV
  - Septic abdomen secondary to intestinal perforation

Lactic Acidosis Type B

- Systemic Illness
  - Diastolic murmur
  - Infection
  - Leukemia
- Drugs and toxins
  - Ethanol
  - Salicylates
  - Methanol

Pulse Oximetry (SpO2)

- Calculates oxyhemoglobin using spectrophotometry
  - Tissue oxygen delivery
  - Measures the amount of deoxyhemoglobin and oxyhemoglobin
  - Calculates a percent of Hb saturated with O2
- Pulse oximeters display
  - Strength of the pulsatile signal
  - SpO2 percentage

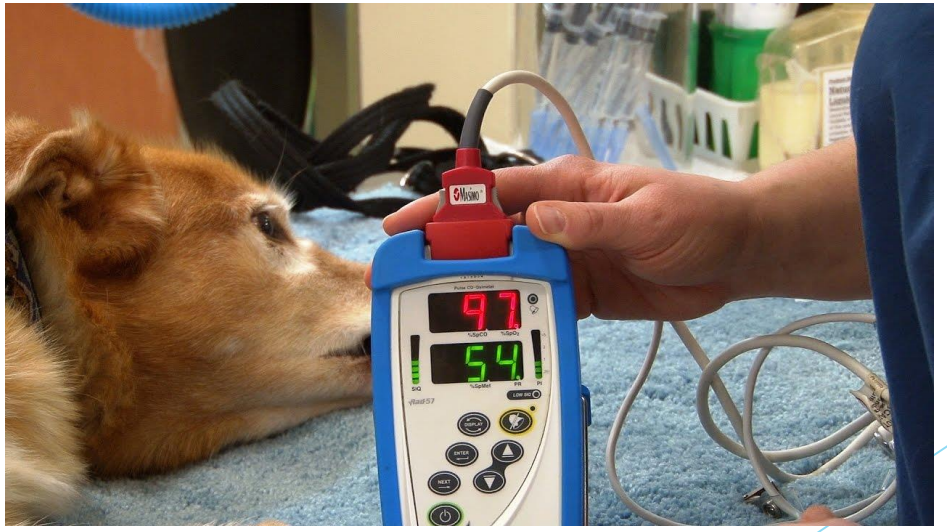
Pulse Oximetry

Indications

Animals at risk for hypoxemia

- Tachypnea
- Dyspnea
- Anesthesia
- Critically ill
- Rapidly declining condition
- Oxygen therapy monitoring

- Normal lung function breathing room air
  - > 95% (dog/cat)



SpO2 Interpretation

- 90%-95% = hypoxemic patient
- 90% = needed therapy
- <85% for >30 seconds is a medical emergency
- 75% = cyanosis [pending respiratory arrest]

THERAPY?

OXYGEN!

Blood Pressure (BP)

Systolic Arterial Pressure

- When the left ventricle contracts, blood is pushed into the aorta creating SAP

Diastolic Arterial Pressure

- The left ventricle empties, relaxes, and begins to fill again, and aortic pressure falls, creating DAP

Mean Arterial Pressure

- MAP is calculated from the systolic and diastolic values
  - MAP = DAP + 1/3 (SAP–DAP)

Blood pressure drives perfusion, which is the delivery of blood and oxygen to organs (eg, brain, heart, lungs, kidneys), as well as tissue beds within the body

Blood Pressure

Direct BP

- Considered the gold standard for monitoring—uses an arterial catheter and allows continuous monitoring of patient SAP, DAP, and MAP

Indirect BP

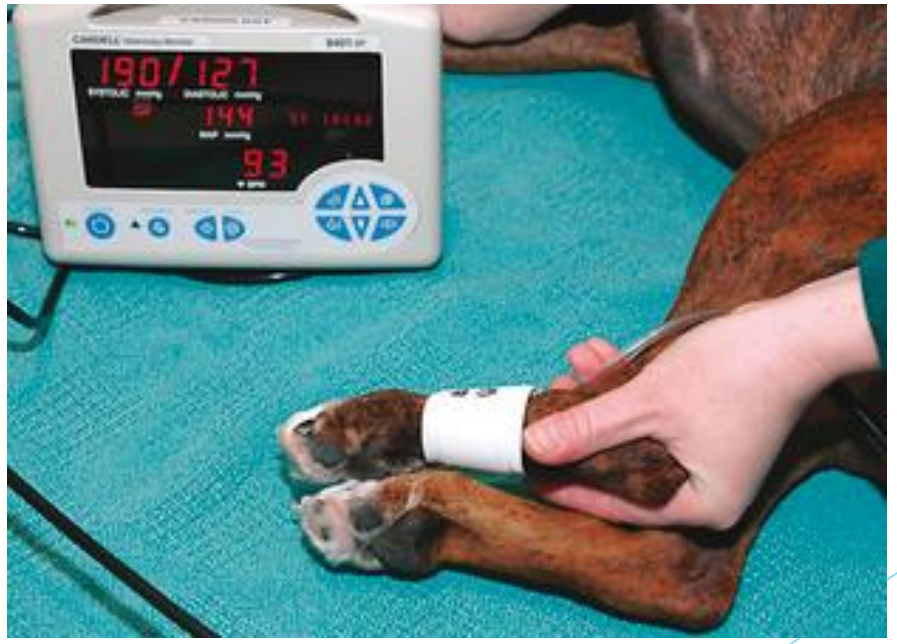
- Relies on detection of arterial blood flow or vessel wall movement in a peripheral artery, using Doppler or oscillometric methods

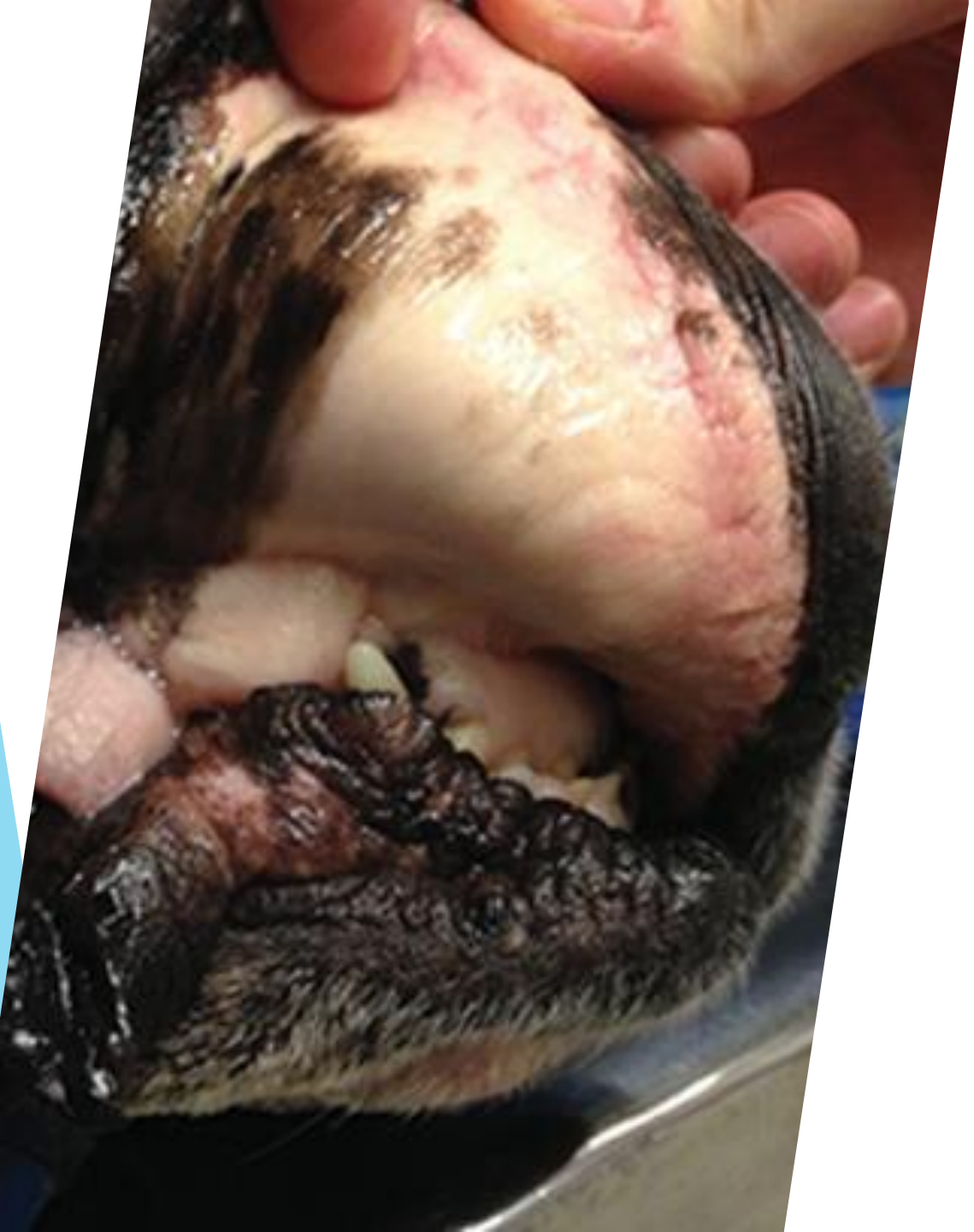
Blood Pressure

Indications

- Shock
- Heart disease
- Systemic inflammatory response syndrome (SIRS)
- Multiple organ dysfunction syndrome (MODS)
- Rapidly changing clinical status
- Anesthesia
- Mechanical ventilation
- Diseases associated with hypertension
  - CRF/AKI
  - Hyperthyroidism
  - Cushing's Disease

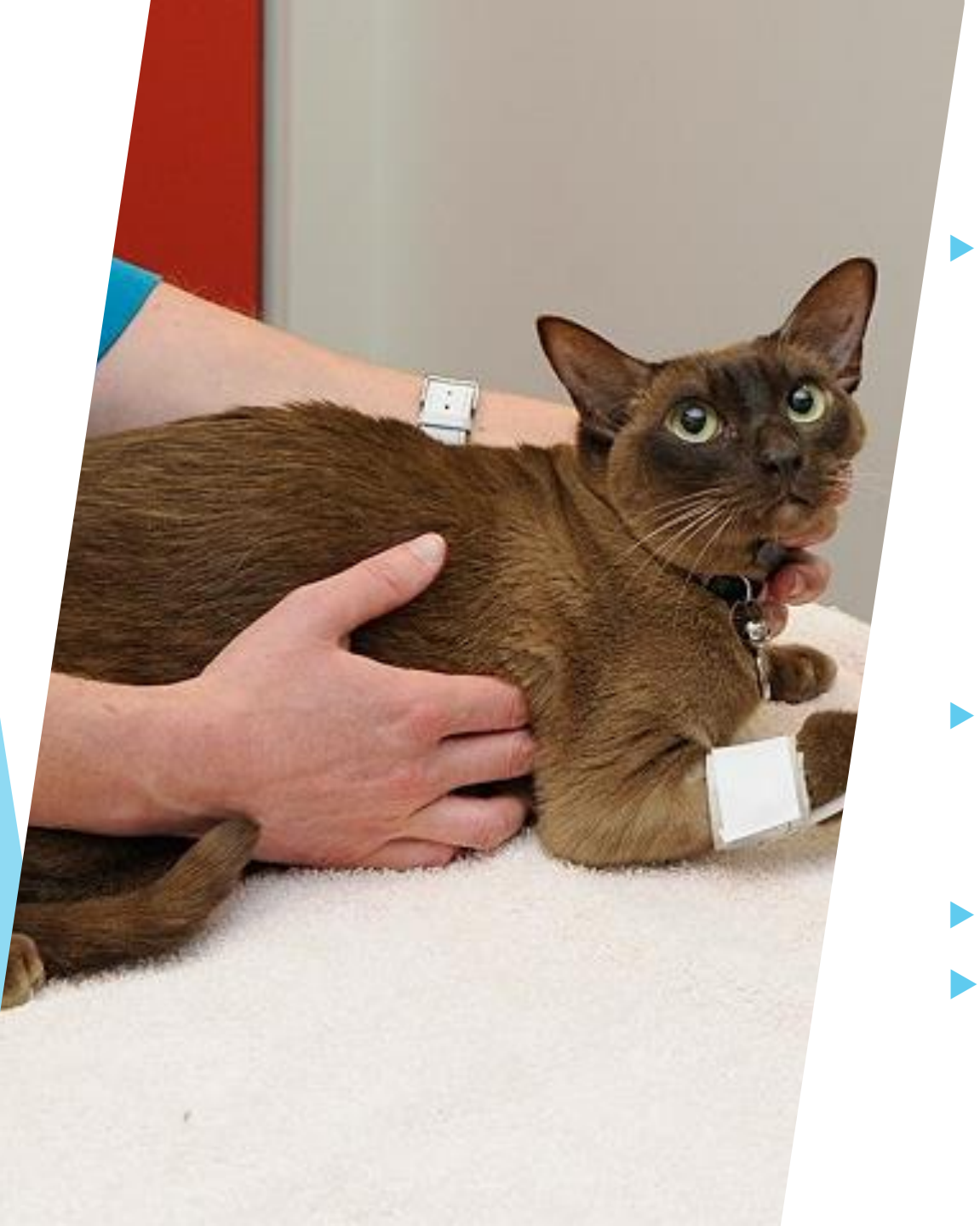
- Normal Values (dog/cat)
  - SAP 100-160 mm HG
  - DAP 50-70 mm HG
  - MAP 60-90 mm HG





Diagnosis/Hypotension

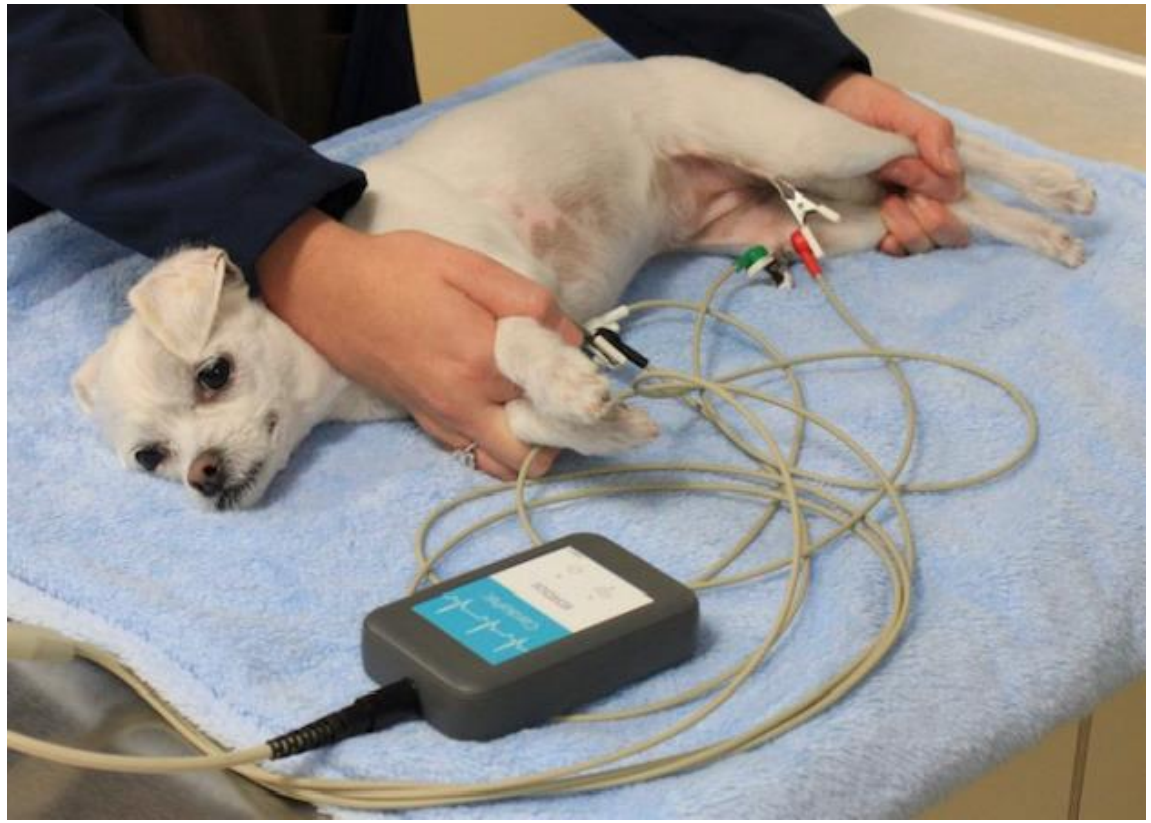
- PE
  - Pale MM
  - Evident blood loss
  - Arrythmia
  - Tachycardia (compensating)
  - Bradycardia (decompensating)
  - CRT prolonged
  - Cool extremities
  - Pulse quality
  - Mentation
- Bloodwork
  - PCV, TP, blood gas, CBC, electrolyte imbalance, lactate
- BP measurement
  - MAP is < 60 mm Hg
  - SAP is < 90 to 100 mm Hg
- Drugs Administered
  - Anesthetics, opioids, epidural administration of LA
- Diagnostic Tools
  - Rads, U/S and ECG for tumors, GDV, pericardial effusion, peritonitis
- Technical Errors
  - Cuff size and position



Diagnosis/Hypertension

- Common Diseases:
  - Chronic or acute kidney disease
  - Hyperthyroidism
  - Cushings
  - DM
  - Pheochromocytoma
  - Hyperaldosteronism
- Conduct at least 2 measurement sessions, separated by 30 minutes or more, before concluding that an animal needs antihypertensive therapy
- Dogs: SAP/DAP > 150/95 mm Hg
- Cats: SAP > 150 mm Hg

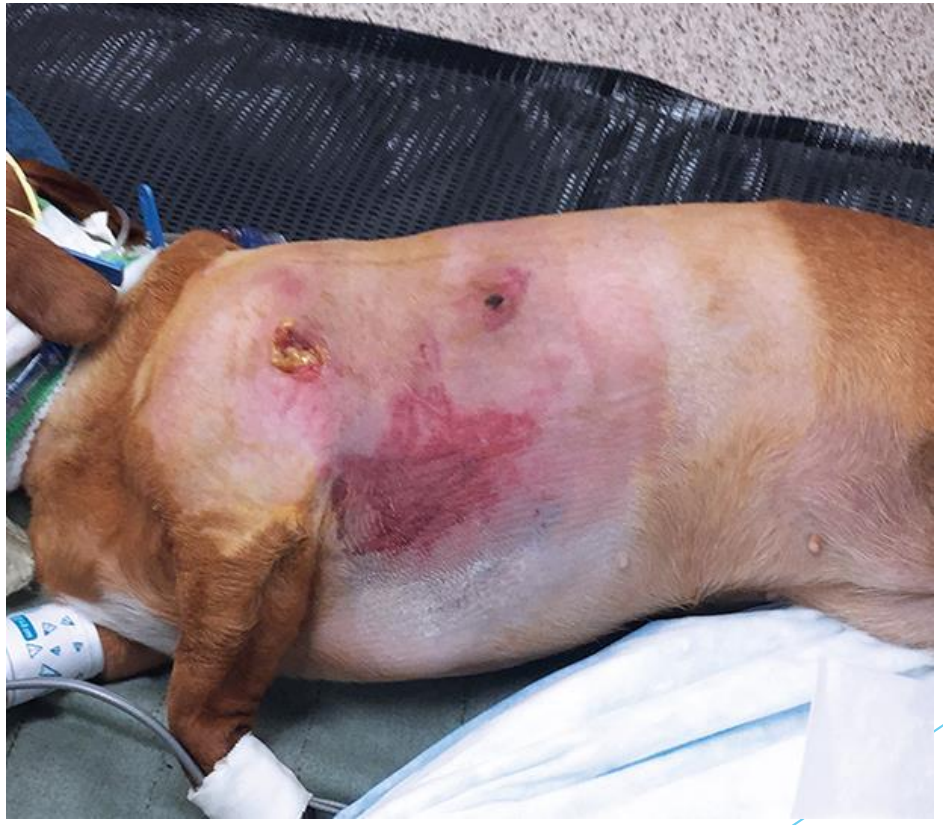
Electrocardiogram (ECG)



- Record of electrical activity of the heart muscle
- Monitors heart rhythm
  - Arrythmias

Electrocardiogram

- **Indications**
- Trauma
  - Significant hemorrhage
  - Thoracic cavity trauma
- Shock
- SIRS or MODS
- Syncope or collapse
- Anesthesia
- Poisoning/intoxication
- CPR
- Cardiac or pulmonic disease
- Any auscultated arrhythmia
- During IV infusions or bolus of drugs that can produce arrhythmias



AFAST/TFAST

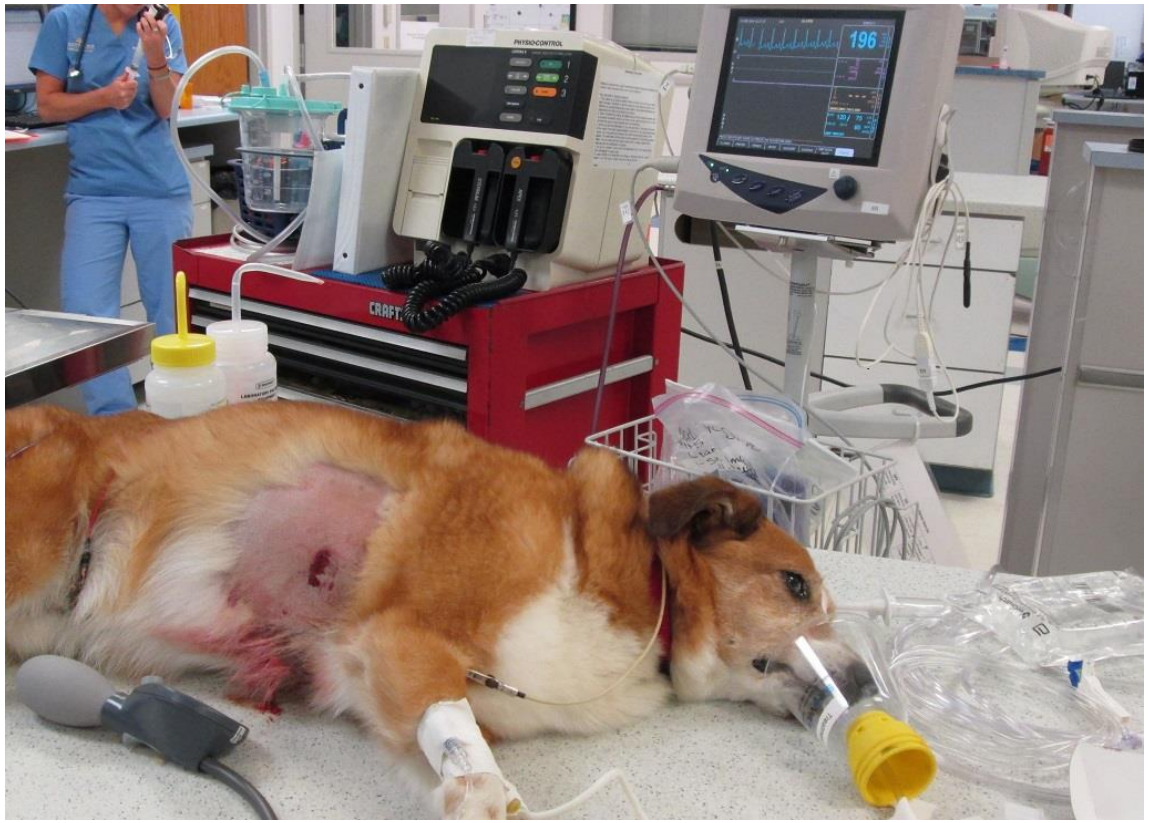
- Abdominal and thoracic focused assessment with sonography for trauma, triage, and tracking
- Limited ultrasound
  - Identifies the presence of fluid within the peritoneal, pleural, and pericardial spaces
  - Examination findings are used to direct immediate patient stabilization efforts, and serial studies can be used to monitor hospitalized patients

Shock

What is shock?

- Shock can be defined as inadequate cellular energy production
- It can also be defined as a condition in which tissue and cellular oxygen delivery does not meet oxygen demand
  - Shock occurs secondary to poor tissue perfusion
  - Poor oxygen delivery to vital tissues
- Shock isn't a single entity, but rather the result of an underlying insult

Initial Assessment & Recognition of Shock



- Historical information and physical exam findings help in diagnosing shock
- Physical assessment should focus on the six perfusion parameters
  - Mentation
  - Heart rate
  - Pulse quality
  - Mucous membrane color
  - Capillary refill time
  - Extremity temperature

Clinical signs-*Compensatory*

- Mild changes in mentation
- Tachycardia
  - Heart working harder to maintain cardiac output
- Prolonged capillary refill time
  - Vasoconstriction
- Tachypnea
  - Decreased oxygen
- Normal to bounding pulse quality
  - Heart trying to maintain perfusion
- Normal blood pressure
  - Vasoconstriction and tachycardia

Clinical signs- *Decompensatory*

- Clinical signs include:
  - Moderate to severe depression in mentation
  - Moderate to severe tachycardia
  - Poor pulse quality
  - Pale mucous membranes
  - Hypotension
  - Cool extremities

Types of shock

- Hypovolemic
  - Most common type seen in SA
- Distributive
- Obstructive
- Cardiogenic
- Can experience >1 type of shock
- Regardless of the type, the goal of addressing shock is to optimize oxygen delivery to tissues

Hypovolemic shock

- Decrease in circulating blood volume
- Hypovolemia occurs most commonly from blood loss (hemorrhage), gastrointestinal loss (vomiting, diarrhea), urinary loss (polyuria), burn wounds, third-spacing of fluids or decreased intake of fluids
- The loss of circulating blood volume results in decreased venous return to the heart (preload), which decreases cardiac output
  - Decreases BP→decreases perfusion→decreases oxygen delivery to tissues

Distributive shock

- Ineffective or inappropriate circulation and distribution of blood volume
  - There is adequate blood volume, but inadequate perfusion of said blood volume
- This leads to a maldistribution of blood flow, in which vessels dilate and create peripheral blood pooling
  - During vasodilation, the vessels expand, making the normal blood volume insufficient and causing the blood to be displaced away from the heart and central circulation
- Distributive shock occurs most commonly from vasodilatory states, such as sepsis, systemic inflammatory response syndrome (SIRS), anaphylaxis, heatstroke, or adverse drug reactions.

Treatment

- The goal in treating of hypovo ive shock states is administer fluid resuscitation
  - Increase intravascul
  - Improve systemic pe
  - Restore oxygen deli
- During each therapeutic inter t should be reassessed to determine the next steps in tr
  - Oxygen perfusion parameters

Place a large gauge, short length IV catheter in the cephalic vein

Fluid therapy

- Intravenous isotonic crystalloids are the mainstay fluid type for treating these shock states, as they have the most similar composition to the patient's extracellular fluid compartment
  - LRS; 0.9% NaCl
  - DOGS: 60 to 90ml/kg
  - CATS: 45 to 60ml/kg
  - When delivering crystalloids, you should start with aliquots, such as ¼ or ½ the shock dose, and then reassess the patient
  - IV crystalloids should be administered as rapidly, over 10-15 minutes

Fluid therapy

- Synthetic colloids are also a fluid option during shock resuscitation
  - VetStarch
  - DOG: 5mL/kg bolus
  - CAT: 2.5-3mL/kg bolus
- Colloid solutions contain large molecules suspended in crystalloid solutions that help maintain intravascular volume because they don't as readily cross the blood vessel barrier
- Controversy and debate about the use of synthetic colloids in fluid resuscitation

Fluids aren’t working!

- Patients who are nonresponsive to shock doses of fluid resuscitation may require additional pharmacologic intervention
- Other agents that can be used include:
  - Vasopressors (norepinephrine, vasopressin)
  - Catecholamines (epinephrine)
  - Sympathomimetics (dopamine, dobutamine)
- These agents work on receptors throughout the body to promote arterioconstriction and vasoconstriction (increasing blood pressure and heart rate), as well as improved heart contractility

OXYGEN DELIVERY RESTORATION PARAMETERS

- Normal heart rate (dogs, 100-140 bpm; cats, >160 bpm)
- Pink mucous membranes
- Normal capillary refill time (<2 seconds)
- Normal peripheral pulses
- Improved mentation
- Improved blood pressure (100-140 mm Hg systolic)
- Improved serum lactate (1-2.5 mmol/L)

Cardiogenic shock

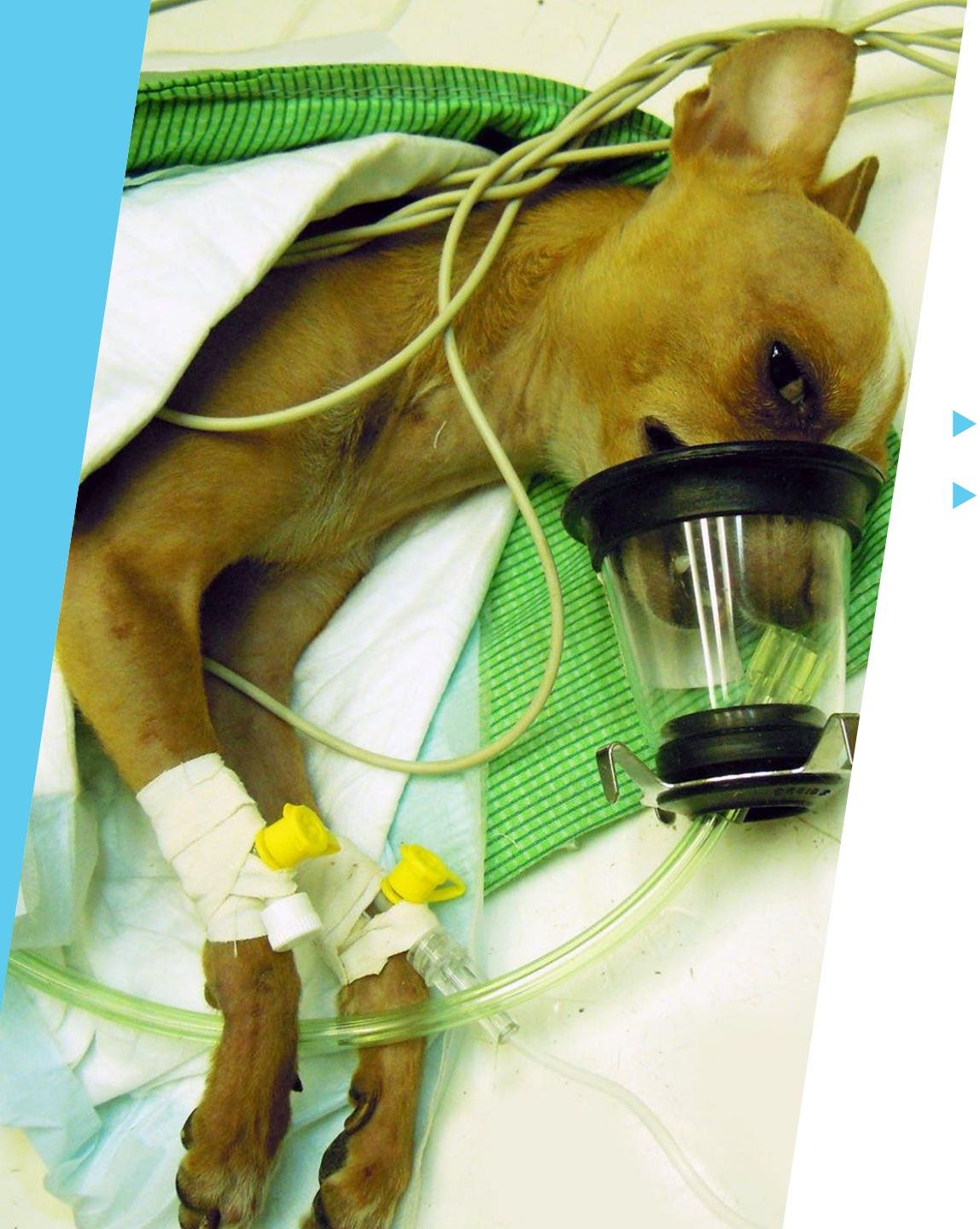
- RARE in SA
- Cardiac pump failure causing failure of forward blood flow
- This occurs when there is adequate blood volume but reduced cardiac output from cardiac dysfunction
- Forward flow failure refers to decreased venous return to the aorta and systemic circulation
- Without a normal functioning heart pump, tissue ischemia results from lack of blood perfusion and circulation

Cardiogenic shock

- Causes of cardiac dysfunction occurs from:
  - Dysrhythmias
  - Poor contractility
  - Valvular disease
  - Structural or anatomical defects
  - CHF
- Cardiac dysfunction results in an increased heart rate, decreased stroke volume, decreased cardiac output, decreased blood pressure, increased systemic vascular resistance and increases in pulmonary pressures.
- The main sign associated with cardiogenic shock is respiratory in nature.

Treatment

- The goal of treating the cardiogenic shock state is to improve oxygenation and restore adequate tissue perfusion
- Treatment of cardiogenic shock differs from the other types of shock, and these patients are more susceptible to rapid decompensation



Treatment

- OXYGEN!!!!
- Oxygen can be delivered by flow-by face mask initially and can continue supportively as either nasal cannula or oxygen cage delivery system

Treatm

Furos

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- Furosemide
  which is one of

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excretion

stive heart failure,
ardiogenic shock

Remember to treat the underlying cause attributing to the cardiogenic shock state.

Other pharmacologic intervention is most likely warranted depending on whatever heart condition is also present.

Advanced Emergency Techniques

Abdominocentesis

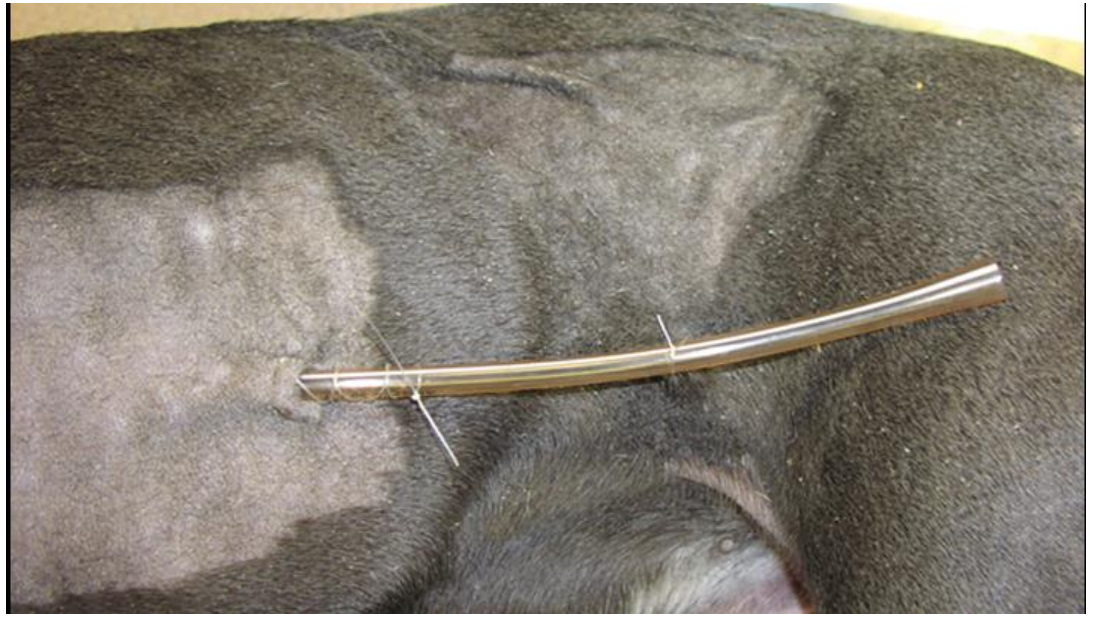
- Therapeutic or diagnostic
  - Ascites
  - Hemoabdomen
  - Effusion gross examination and cytology
- Patient needs to be in left lateral recumbency
- Clip and prep ventral abdomen
  - Aseptic surgical prep
- Needle inserted into abdomen in 4 locations around the umbilicus

Thoracocentesis

- Therapeutic or diagnostic
  - Pleural effusion
  - Pneumothorax
  - Pyothorax
  - Effusion gross examination and cytology
- Left or right lateral or sternal
- Clip and prep
  - Aseptic surgical prep
  - 7-9th intercostal space
- Needle insertion
  - Pneumothorax-dorsal third of thorax
  - Pleural effusion-ventral third of thorax
- Cranial aspect of the rib

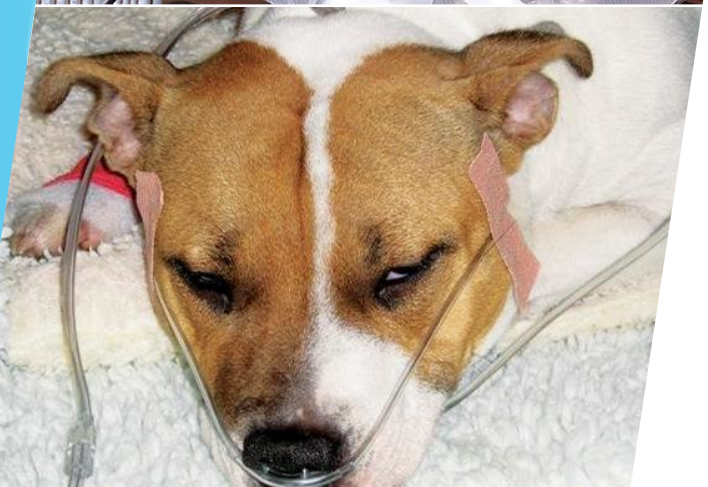
Thoracic Drain Placement

- Therapeutic
  - Remove air and fluid
- Clip and prep
  - Aseptic surgical prep
  - 7-9th intercostal space
- Local block before insertion
- Cranial aspect of the rib



Respiratory System Support-*Definitions*

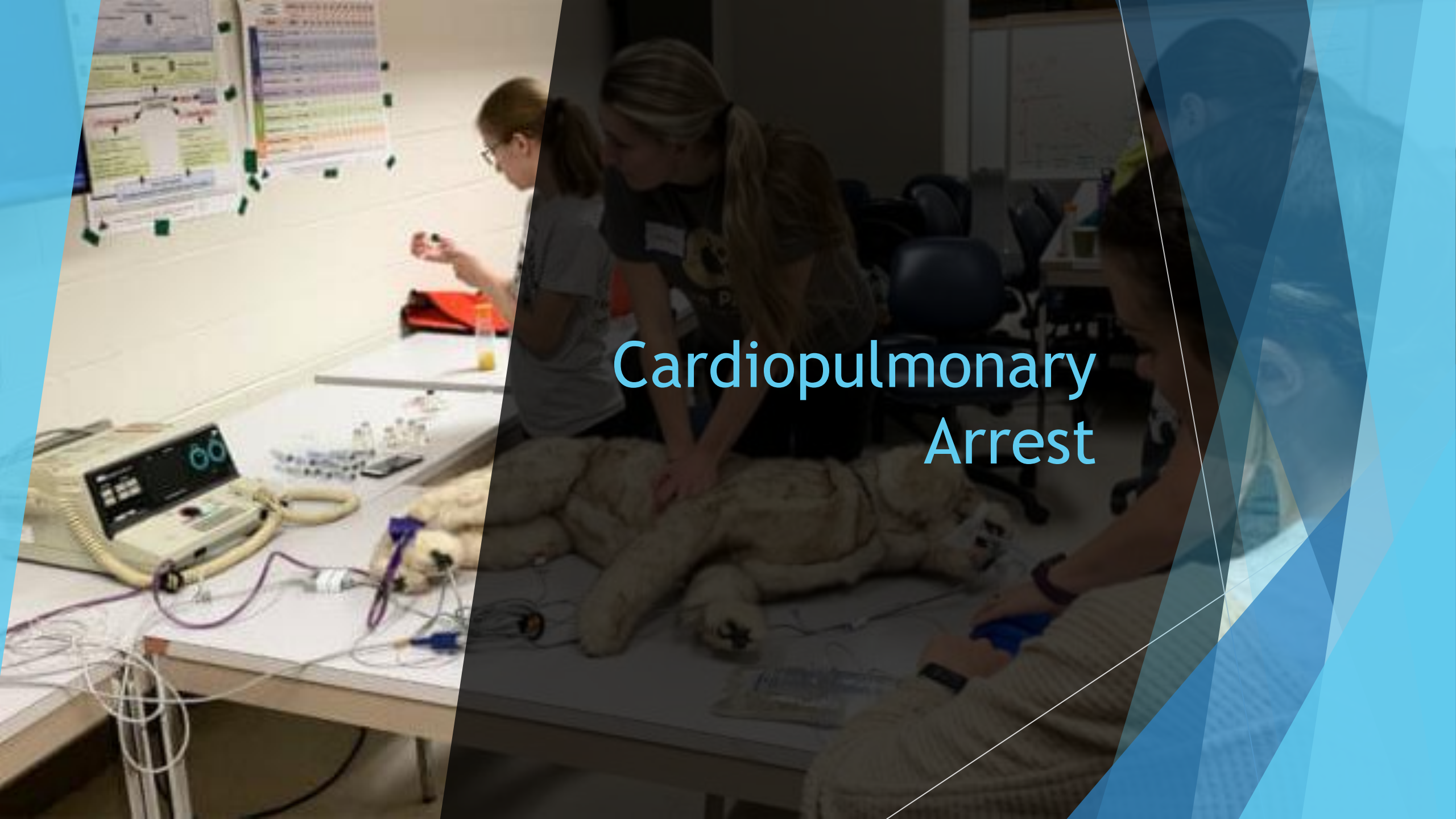
- Hypoxemia
  - PaO2 of < 80mm HG
  - Severe < 60mm HG
- SpO2
  - Percent of Hb saturated with O2
- PaO2
  - Partial pressure of O2 in arterial blood
- PvO2
  - Partial pressure of O2 in venous blood
- FiO2
  - Fraction of inspired O2 (room air 21%)



O2 Therapy

Oxygen Administration Techniques

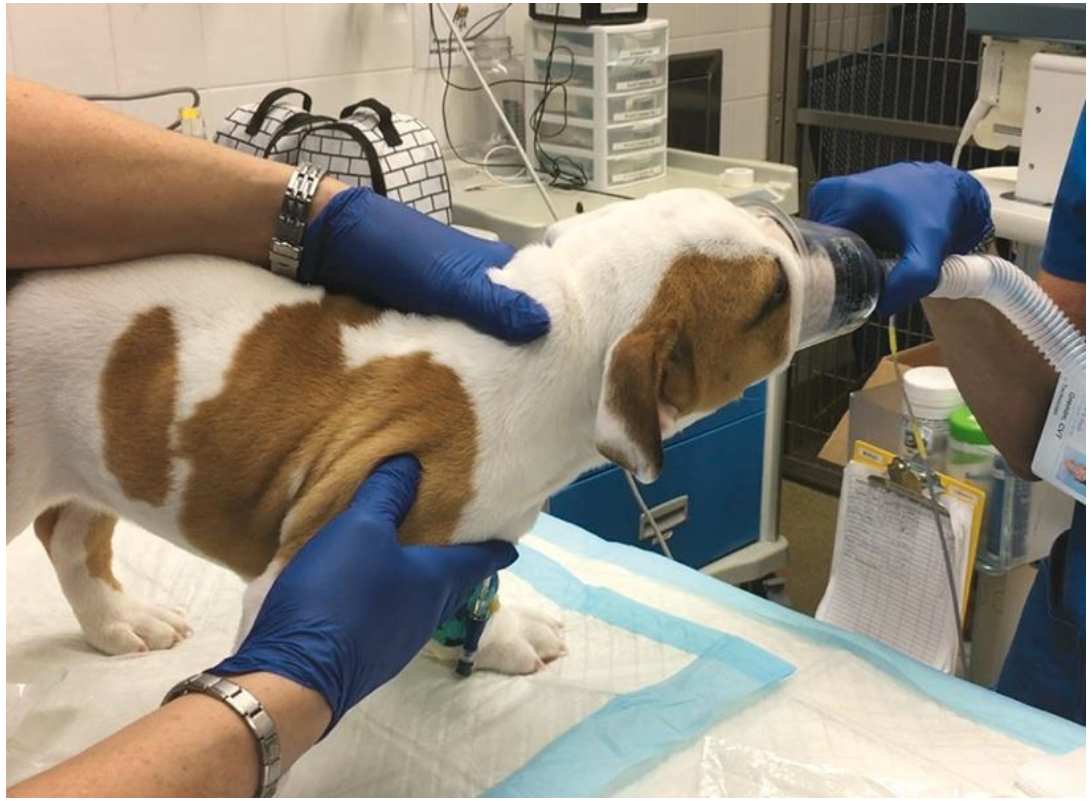
- Nasal cannulas
  - 50-100mL/kg/min =40-60% FiO2
- Flow-by
  - 100-150mL/kg/min =40% FiO2
- Face mask
- Oxygen cage
  - 5-10L/min
- Hood
- Mechanical ventilation
  - Endotracheal intubation
  - Anesthesia



Cardiopulmonary Arrest

Risk for CPA

- Underlying cardiac disorders
- Respiratory disease
- Severe trauma (polytrauma)
- Shock
- Acid-base disturbance
- Electrolyte disturbance
- Seizures (status)
- Anemia



CPR

- Objectives
  - Provide adequate ventilatory and circulatory support until spontaneous function returns.
- CPR has three phases
  - Basic life support
  - Advanced life support
  - Prolonged life support

CPR Tasks

Responsibility	Task
Cardiovascular Management	Compress chest
Airway Management	Establish airway Ventilate
Monitor Effectiveness	Attach ECG Attach EtCO2
Lifeline	Check IV for patency Place IV lines Start IVF (ONLY if hypovolemic)-↑ right atrial pressure; ↓ perfusion to brain and heart
Drug Administration	Administer reversal agents Administer drugs based upon cardiac rhythm Document drugs given and response

CPR—CAB

- Circulation
  - Can be accomplished through external or internal cardiac compression.
  - The effectiveness of cardiac compression depends on the transmission of force to the heart and intrathoracic vessels.
- External cardiac compression
  - Patient in lateral or dorsal (barrel chested dogs) recumbency
  - Lateral recumbency both hands are placed on the lateral thoracic wall over the widest portion of the chest.
    - In larger patients (>10 kg) the arms should be kept extended and locked
    - The compressive force is applied by bending at the waist
    - The person delivering the chest compressions should not compress the chest by bending the elbows; it is difficult to generate an appropriate force to affect perfusion.

CPR—CAB

- Chest Compression Techniques
  - Most dogs-compressions over the widest portion of the chest to maximally employ the thoracic pump theory.
    - Left or right lateral recumbency are acceptable
  - Keel-chested (deep, narrow chested [greyhounds]) do compressions with hands directly over the heart to employ the cardiac pump theory.
    - Left or right lateral are acceptable
  - Barrel chested dogs (Bulldogs) sternal compressions directly over the heart with the patient in dorsal recumbency to employ the cardiac pump mechanism.

Chest Compression Techniques

- Small dogs and cats (<22lbs)
  - 1-hand technique to accomplish circumferential chest compressions with the hand wrapped around the sternum directly over heart
  - 2-handed technique directly over the heart to employ the cardiac pump mechanism
    - This technique may be considered in larger cats and small dogs with lower thoracic compliance

CPR—CAB

- It has been suggested that the compressions to be delivered with enough force to displace the thorax by 25% to 33% of its diameter.
- Rate of compressions ranges from 100 to 120 per minute
- EtCO2 will read 10-15 during compressions
    - This is your goal
    - If EtCO2 is <15—increase the strength of your compressions

CPR—CAB

Airway

- Endotracheal tube is inserted to ensure a patent airway
  - May need to consider a tracheostomy
- Cardiac compressions DO NOT stop!

Breathing

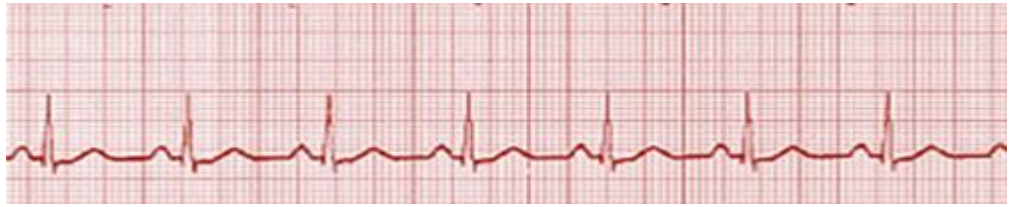
- Patient is attached to a breathing source that delivers 100% oxygen
  - Ambu-Bag
  - Anesthetic machine
- Initially the patient is given two quick breaths of 1 to 1.5 seconds in duration and ventilated once every 6 seconds [10 BREATHS/MINUTE]
- Vt 10mL/kg

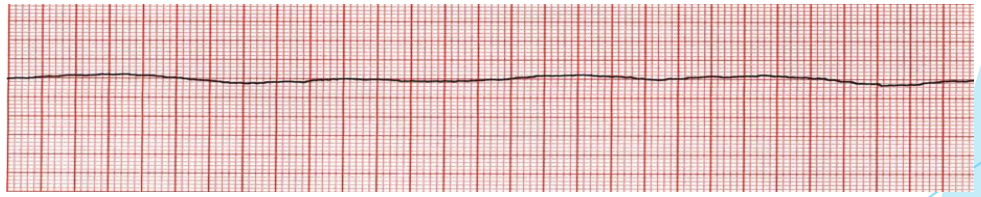
Rescue Medications

Epinephrine

- α-adrenergic and ß-adrenergic properties
- α-adrenergic = arterial vasoconstriction
  - DAP increases results in augmented coronary and cerebral blood flow
- High dose epi (0.1mg/kg) results in a faster ROSC
  - Not associated with increased survival
- Low dose epi (0.01mg/kg) should be used and given every other 2-minute cycle
- After prolonged CPR (>10 minutes) high dose epi may be used

- Used to treat non-shockable rhythms
  - PEA
  - Asystole



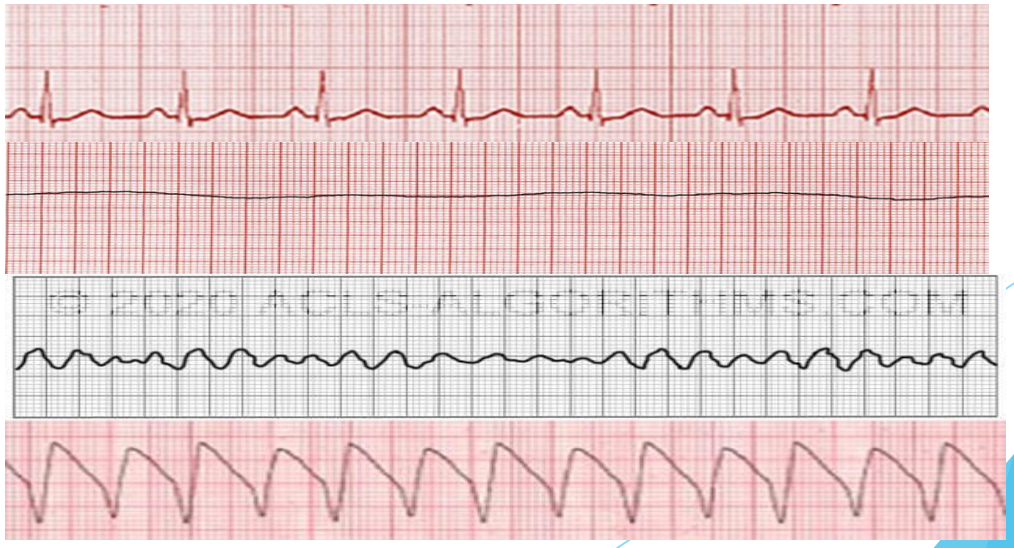


Rescue Medications

Vasopressin

- Naturally occurring antidiuretic hormone
- Higher doses acts as a direct peripheral smooth muscle vasoconstrictor
- 0.8U/kg every other cycle

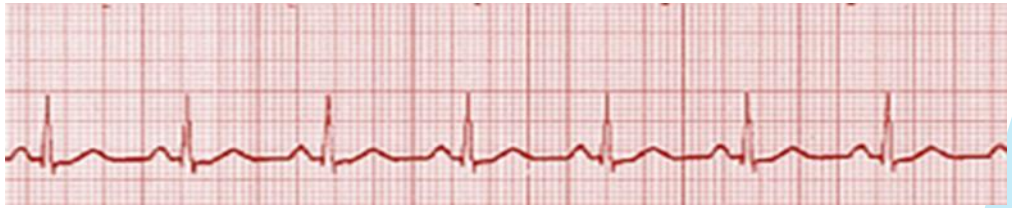
- Used to treat all arresting rhythms
  - PEA
  - Asystole
  - Ventricular fibrillation
  - Pulseless ventricular tacycardia

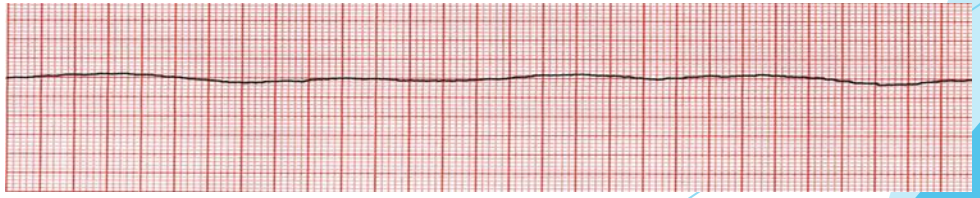


Rescue Medications

- Atropine
  - Parasympatholytic effects
  - Vagolytic action
  - 0.04mg/kg once if CPA was initiated by an intense vagal response
  - Can be repeated every other cycle

- Used to treat non shockable rhythms associated with vagal response
  - PEA
  - Asystole





Rescue Medications—Intratracheal

- A—atropine
- E—epinephrine
- V—vasopressin
- Double the dose when giving IT

Defibrillation

- Eliminates chaotic asynchronous electrical activity of the fibrillating heart
- Passes a current through the heart
  - Cardiac cells depolarize (and it is hoped) to repolarize in a uniform manner with organized and coordinated electrical and contractile activity

- Dorsal recumbency
- Paddles are placed firmly over the heart on each side of the chest after a contact gel has been applied
- Energy required for external defibrillation
  - 4-6J/kg—monophasic
  - 2-4J/kg—biphasic
- Internal defibrillation
  - 0.5-1J/kg—monophasic
  - 0.2-0.4J/kg—biphasic
- Increase energy by 50% every cycle—max 10J/kg

Survival Stats

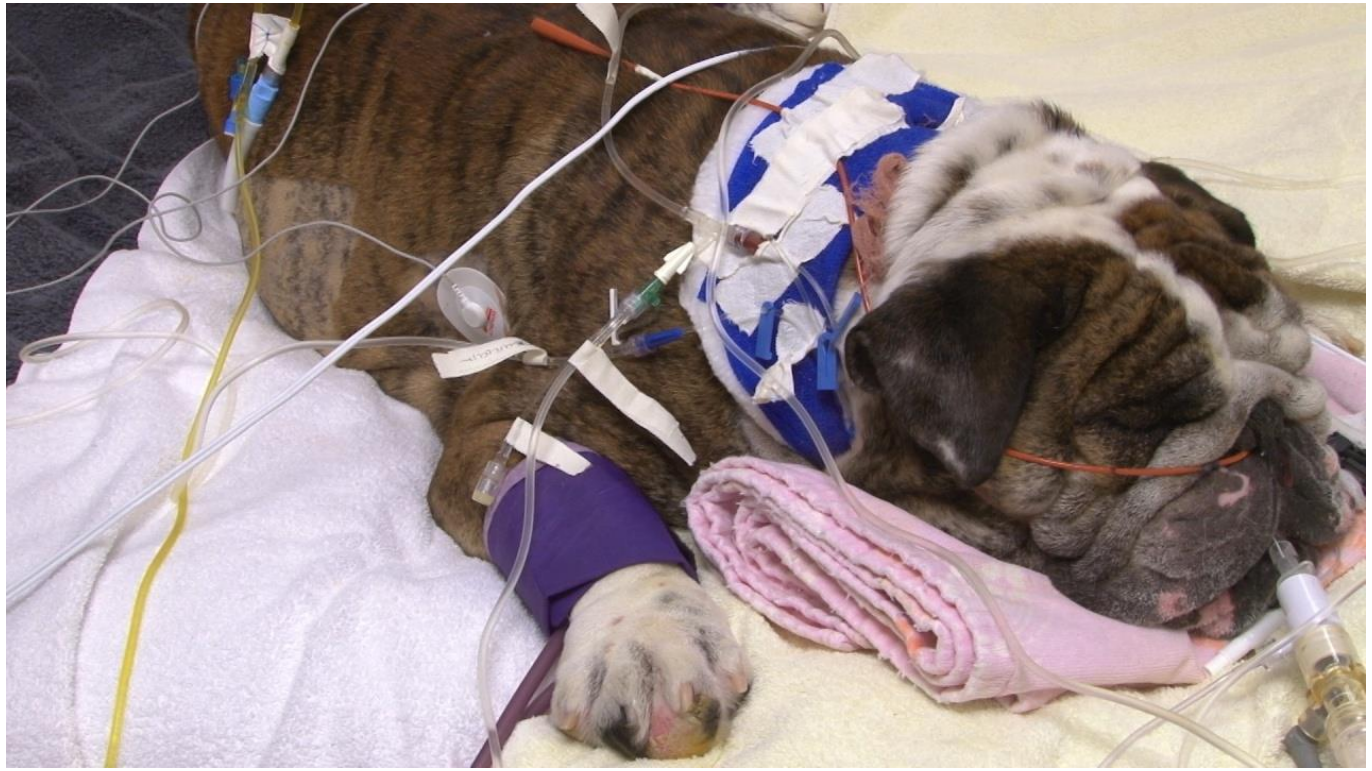
- Stats of survival
  - There is 50% chance that the medical team can resuscitate if a patient was to code.
  - In the event that a patient codes there is < 8% that the patient will not suffer brain damage.
  - Human studies indicate that human CPR is <6% chance of no prolonged brain damage.
  - Brain damage = coma; coding again; and lack of full recovery

Post resuscitation Care

- High rate of reoccurrence
  - Keep patient intubated, use sedation as necessary
  - Aggressive therapy/intensive monitoring
- Elevate head (entire body) 30°
- Oxygen supplementation
- Maintain normal blood pressure
  - IVF
- Maintain normal ventilation
- Hypothermia
  - Questionable, probably best to not aggressively warm if >97°

ROSC—What to anticipate?

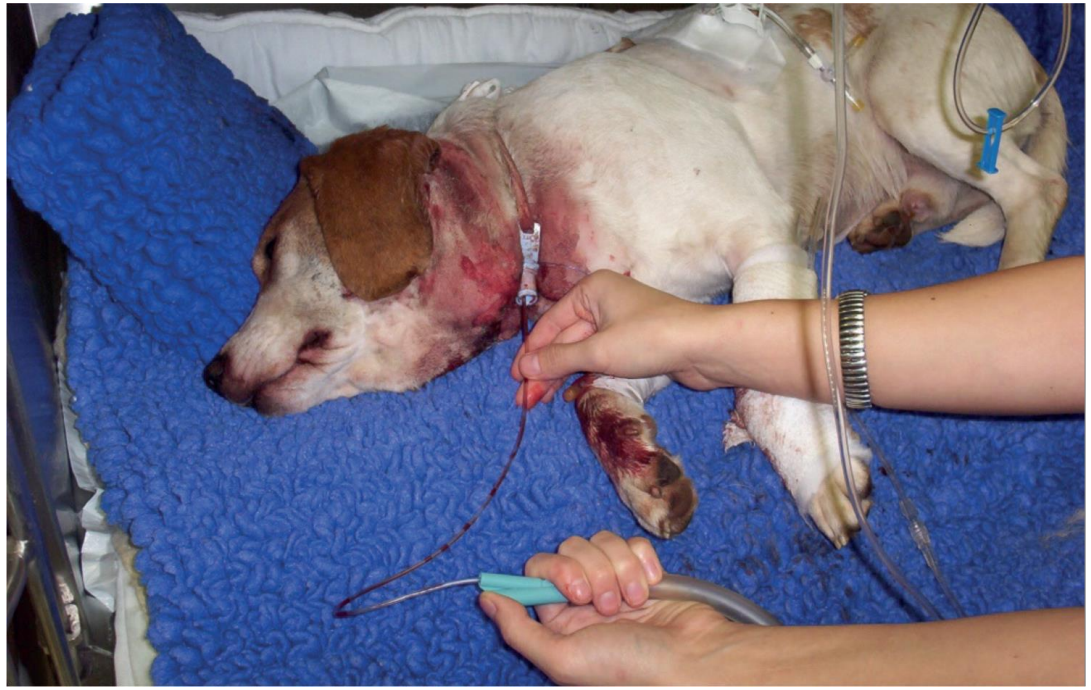
- AKI is possible
- Compromise of GI mucosal barrier secondary to hypoperfusion
- Coagulopathies
- Multiorgan dysfunction
- Transient cerebral dysfunction
- Often need mechanical ventilation
  - Patient is often hypoventilating
- Expect trauma
  - Rib fractures, pulmonary contusions
- Blindness
  - Often resolves in hours to weeks



Recumbent Patient Care

Airway and Endotracheal/Tracheostomy Tube Care

- Humidification
  - Prevents desiccation of the sol layer and the mucosa
- Sterile suctioning of the airways
  - Removes secretions that may clog the ET tube
- Repositioning of the ET tube
  - Prevent pressure necrosis
- Changing the ET daily
- Cytologic examinations of airway secretions
  - Monitor flora and signals the need to improve sterile technique or change antibiotics

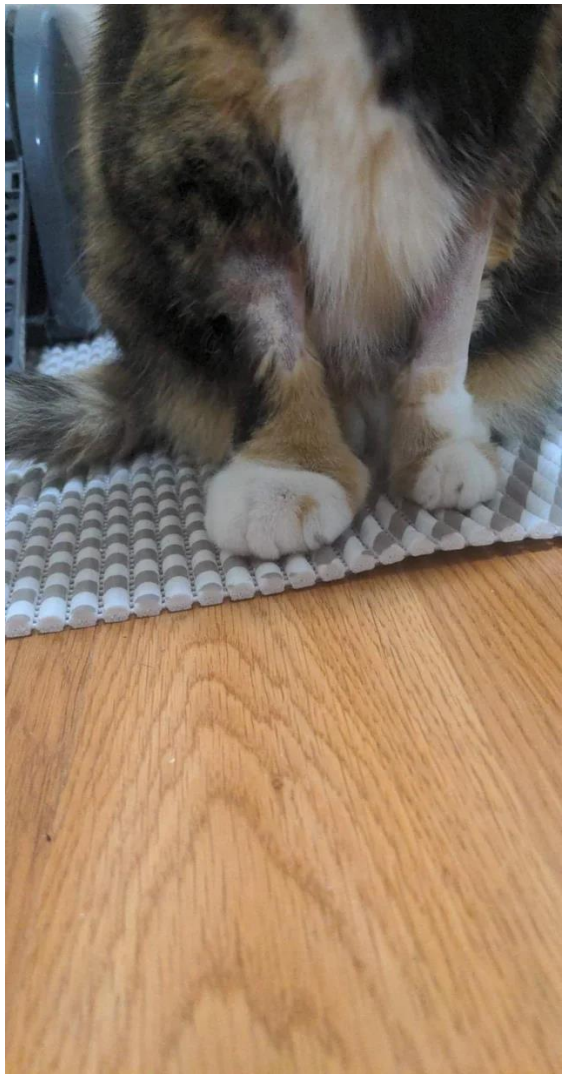


Patient Comfort

- Appropriate bedding
  - Absorbent
  - Easily cleaned
  - Adequate padding
- Personal toys and blankets
  - Provides familiarity
- Appropriate analgesia

IVC Care

- Patency
- Evidence of infection
- Phlebitis
- Flushing (if not in use)
- Catheter care should be done at least once daily

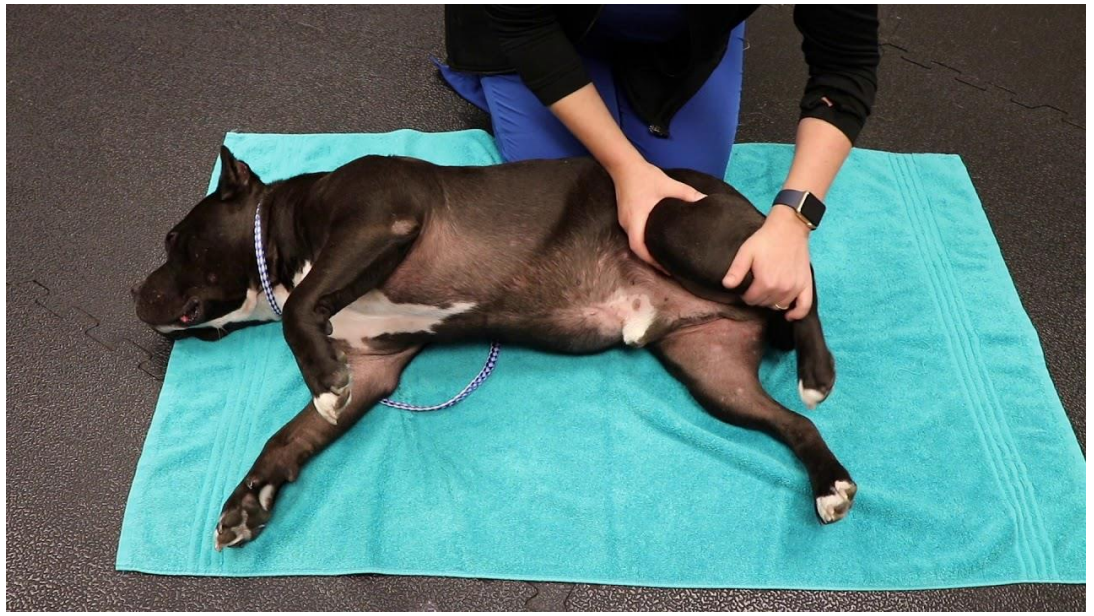


Nutrition and Hydration

- Adequate enteral or parenteral nutrition is important
  - Supports metabolism
  - Albumin production
  - Immune function
  - GI integrity
  - Prevents catabolism
  - Prevents refeeding syndrome
- Hydration status should be checked daily and adjusted as needed

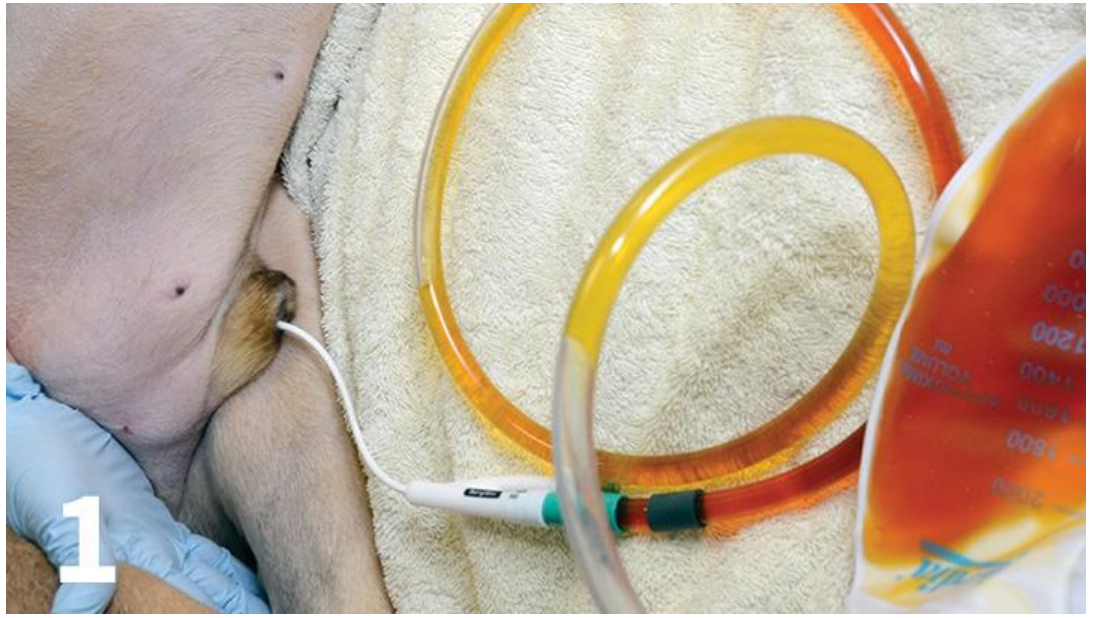
Range of Motion

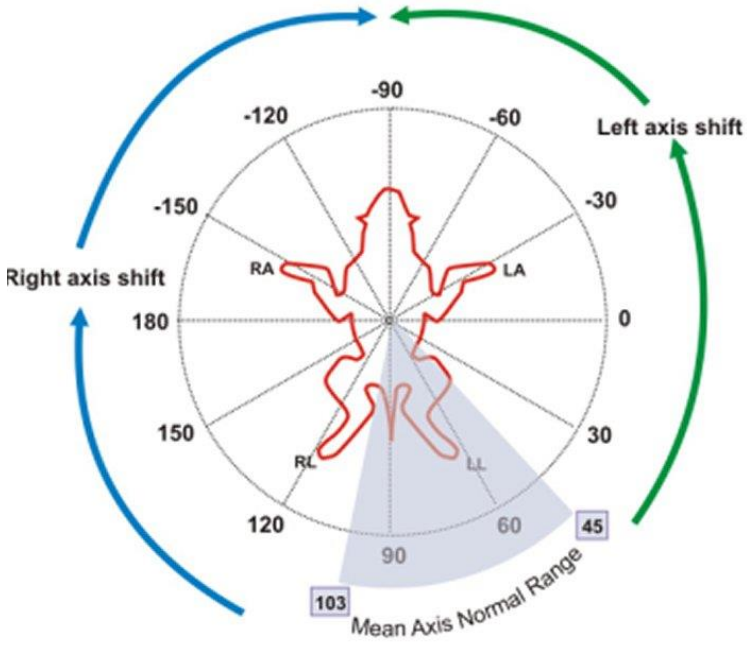
- Perform at least 4x per day
  - Decrease peripheral edema
  - Prevent contracture of muscles
  - Prevent muscle atrophy



Urinary Catheter Placement

- Patient cleanliness
  - Reduces the risk of urine scald
- Monitors urine output
- Allows for daily USG
- Cleaning the prepuce or vulva with dilute chlorhexidine solution 3x daily will decrease the risk of ascending UTI from U cath placement ***

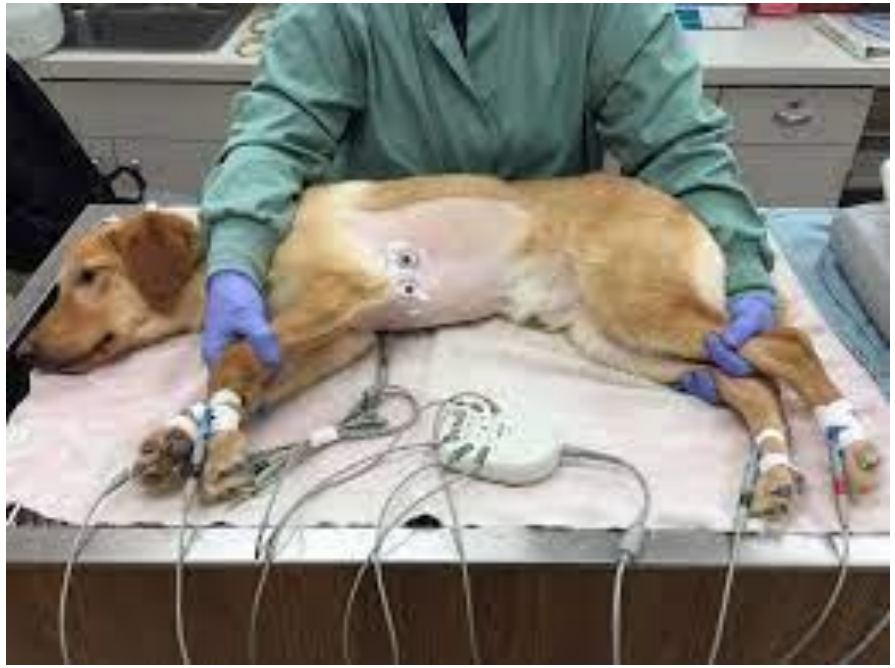




Electrocardiography

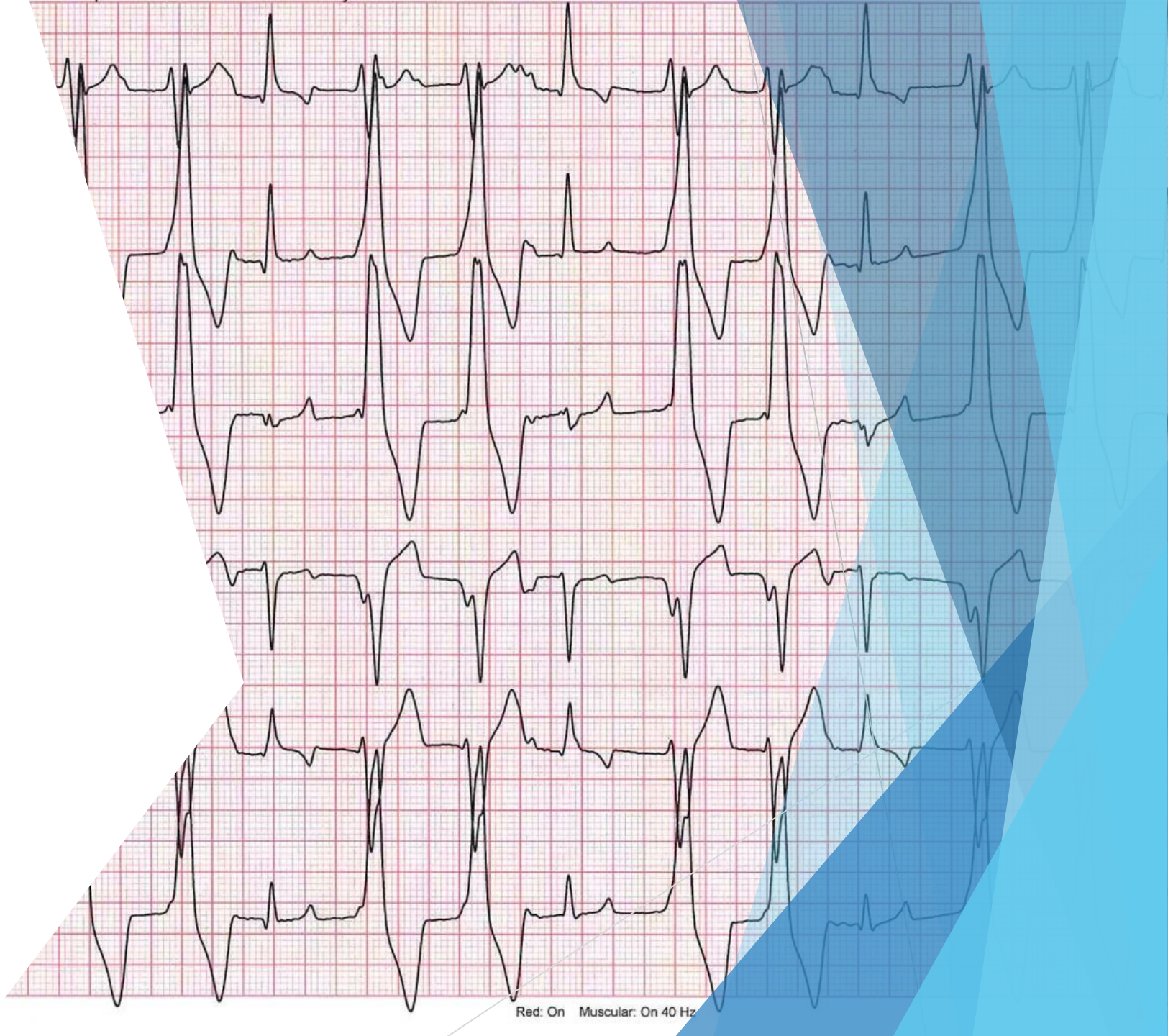
Canine and Feline Electrocardiography

- ECG
- Diagnostic tool that records electrical impulses
  - Generated by the conduction system of the heart during each heartbeat



Indications

- Arrythmia investigation
- Bradycardia
- Tachycardia
- Patients with syncopal episodes



Electrocardiography

ECG Monitor

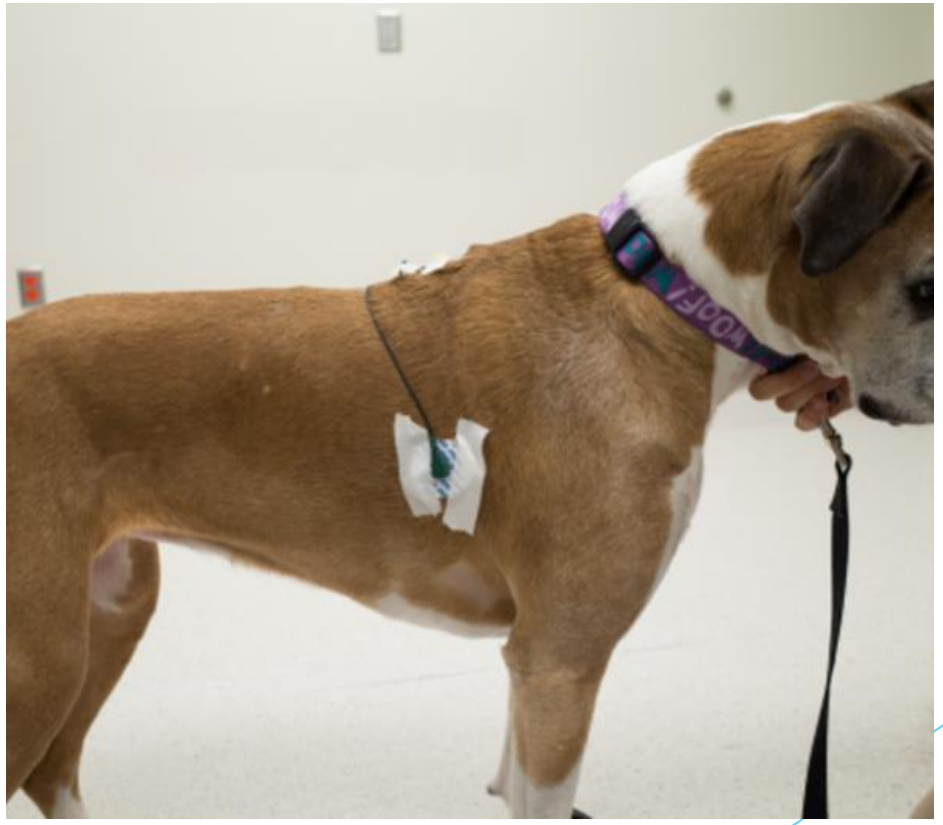
- Records cardiac rhythm for a short time
  - 1-5 minutes
  - Intermittent arrythmias may not be detected

Holter Monitor

- Digitally records the ECG measurement of a patient
  - > 24-48 hours
  - Used to diagnose suspected arrythmia
  - Further characterize the frequency and severity of arrythmias detected by routine ECG
  - Investigate cause of syncope or collapse
  - Monitor treatment of cardiac arrythmia

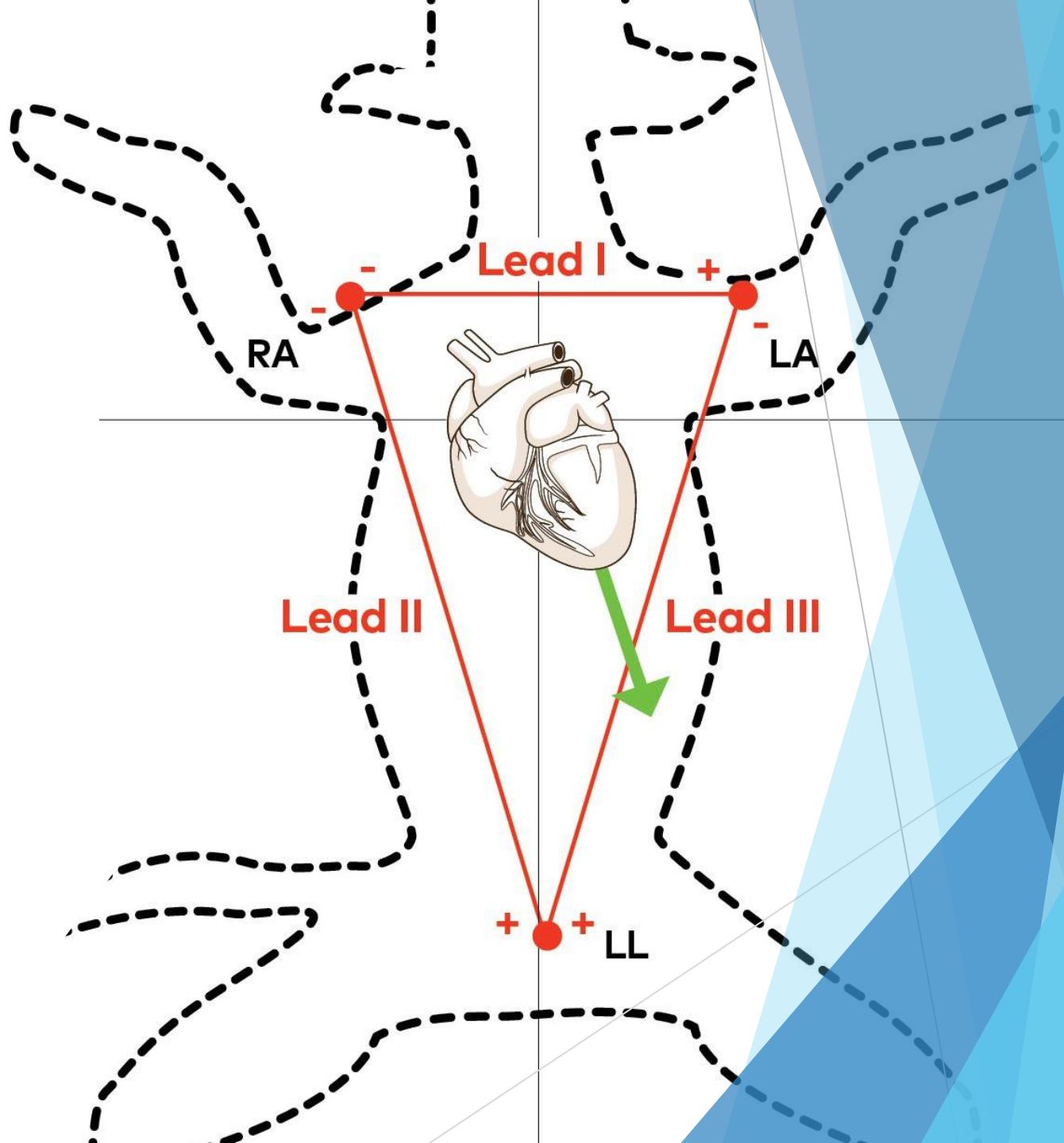
Information Provided

- Cardiac chamber enlargement
- Electrolyte abnormalities
- Drug toxicities
- Guides medication choices



ECG

- ECG records electrical activity of the heart using leads that consist of positive (+) and negative (-) electrodes attached to the skin
- Multiple leads are used to obtain different views of cardiac depolorization
  - I, II, III, aVR, aVL, aVF
- Leads I, II, and III are bipolar leads that record electrical activity between a (+) and (-) electrode in different locations



ECG

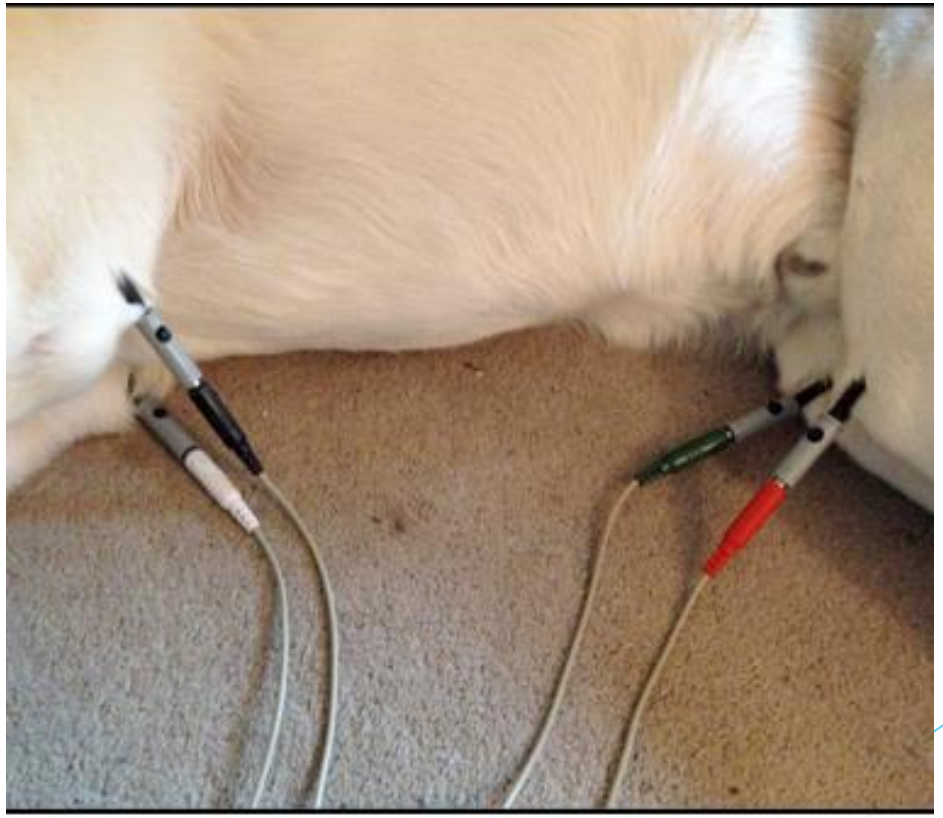
White electrode on the (RA)

Black electrode on the (LA)

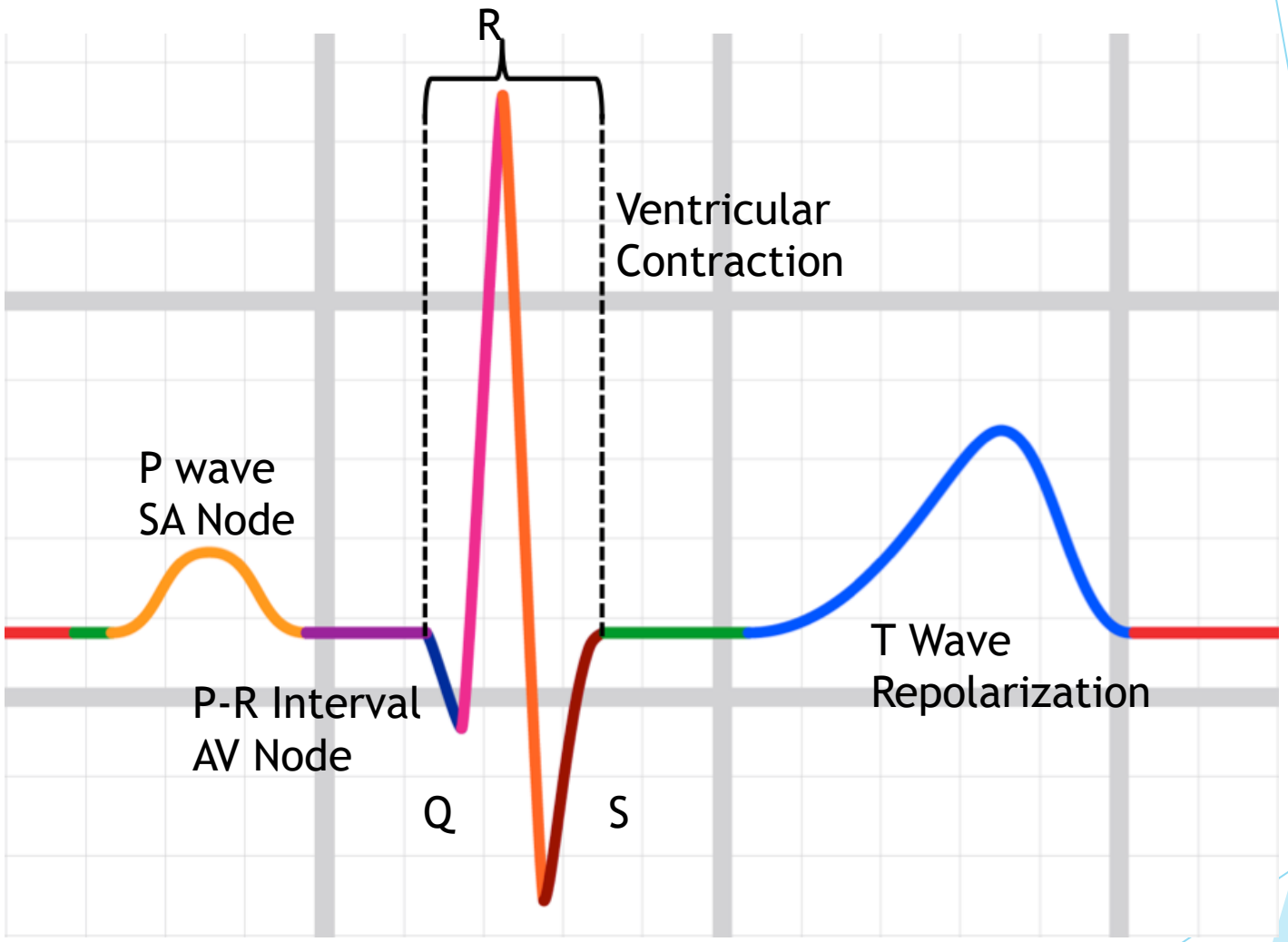
Red electrode on (LL)

Green electrode (RL)

- Right lateral recumbency
- Alcohol or ultrasound gel for conduction
- No metal tables or grates
- Minimize patient movement



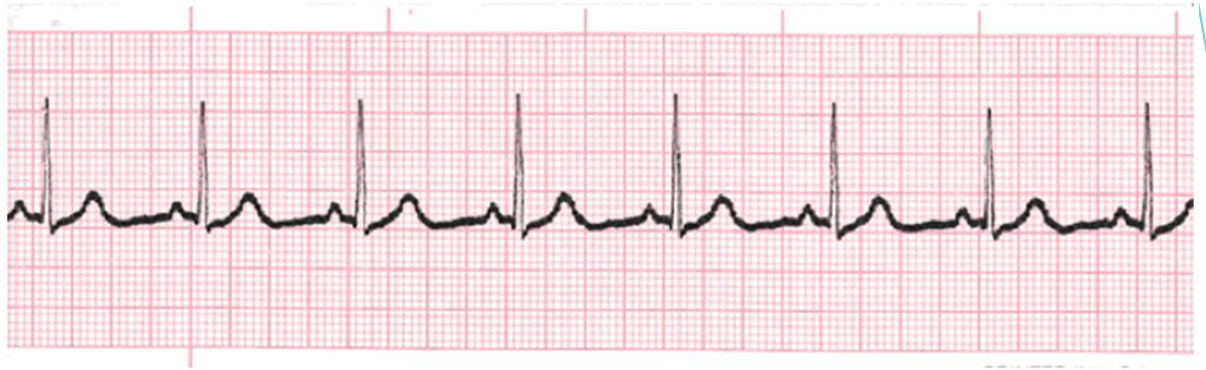
- Electrical signal is released from the SA node through the atria (upper chambers of the heart)
  - Atrial depolarization-P wave-triggering atrial contraction
- Electrical signal then travels through atrioventricular node (AV node)→bundle of His→right and left bundle branches→Purkinje fibers→and ventricular muscle cells
  - Ventricular depolarization-QRS complex-ventricular contraction
- T wave-ventricles return to a resting state (ventricular repolarization)


R
Ventricular
Contraction
P wave
SA Node
P-R Interval
AV Node
Q
S
T Wave
Repolarization

Normal Rhythms

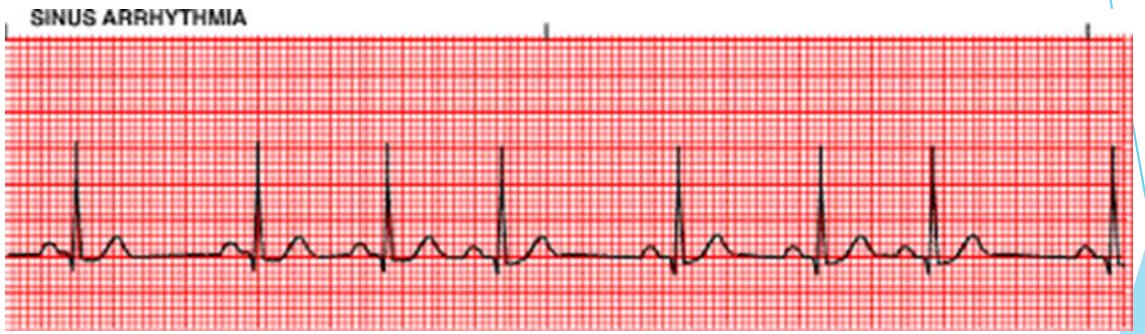
Normal Sinus Rhythm

- Normal HR
  - 70-160 Toy Breed
  - 70-140 Standard Breed
  - 60-120 Giant Breed
  - 120-220 Cat
- Regular rhythm
- Consistent associations between P waves and QRS complexes



Sinus Arrythmia

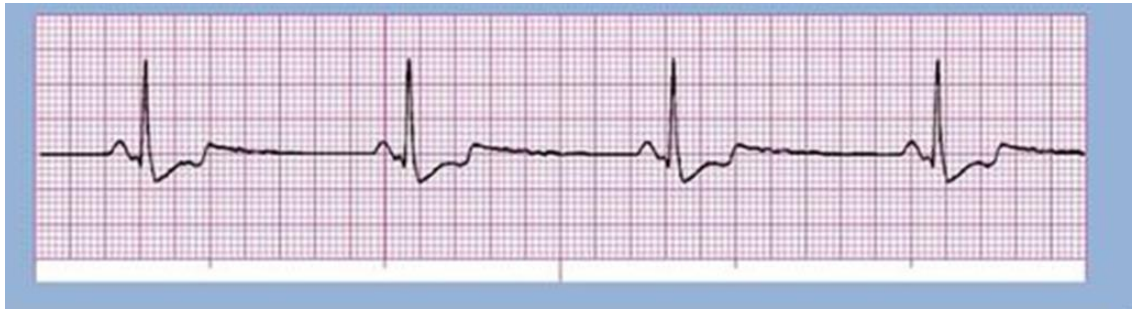
- Normal rhythm in dogs
- Associated with high vagal tone and/or breathing
- HR increases with inhalation
- Decreases with exhalation
- Not normal in cats
  - Excessive vagal tone
  - CNS disease
  - Respiratory/cardiac disease
  - GI disease



Sinus Bradycardia

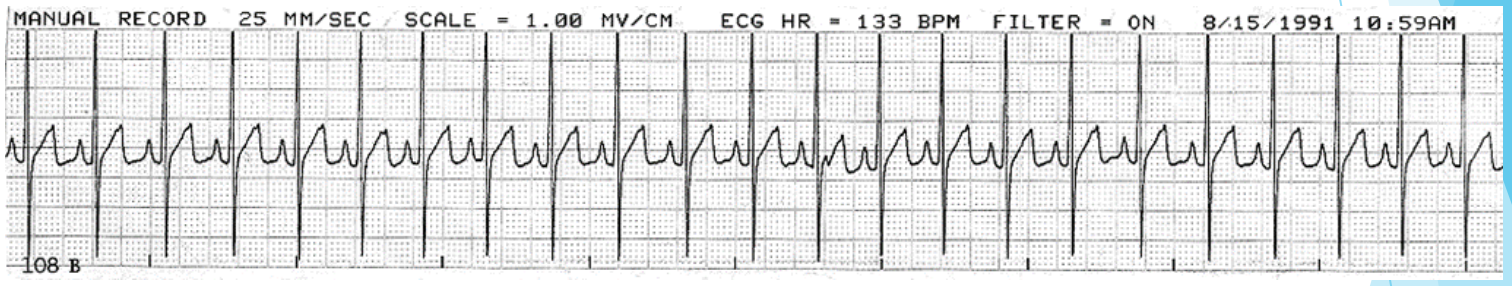
- Regular rhythm
- < 60 bpm DOG
- < 100 bpm CAT
- Originates from the SA node and is slower than normal
- High vagal tone
- Medications
  - Anesthetics
  - CCB
  - BB
- Systemic disease
  - Hypothermia
  - Hypothyroidism

Can be treated with anticholinergics



Sinus Tachycardia

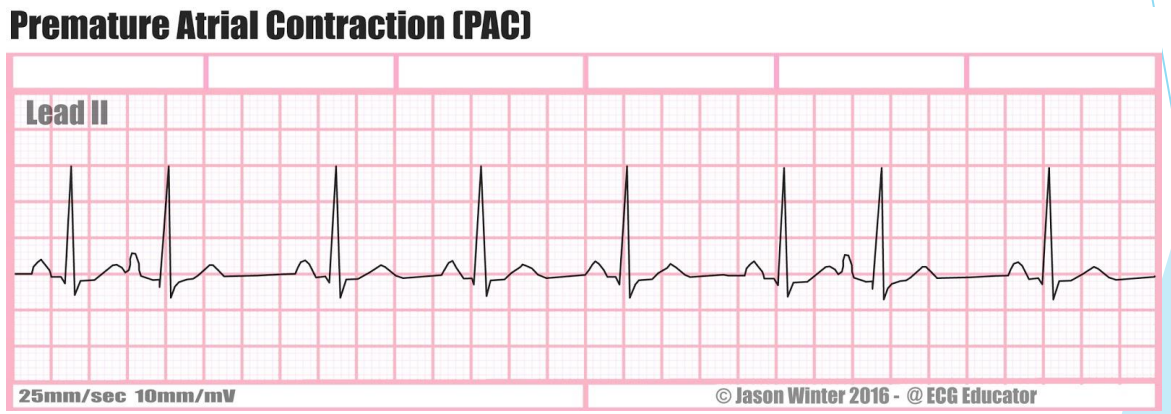
- Regular rhythm
- > 140 bpm DOG
- > 160 bpm Small DOG
- > 200 bpm CAT
- Originates from the SA node
- High sympathetic tone
  - Pain
  - Excitement
  - Stress/anxiety
  - Medications
    - Anticholinergics
    - Methylxanthines
    - Catecholamines
- Fever
- Shock
- Hemorrhage/anemia
- Hypoxia
- CHF



Disturbances of Supraventricular Impulse Formation

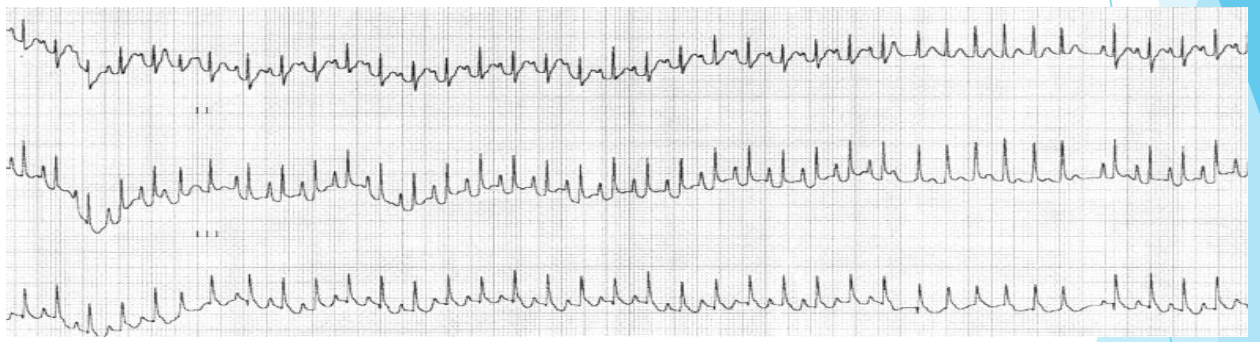
Atrial Premature Complexes

- Abnormal impulses originating from the atrial myocardium instead of SA node
- Atrial enlargement
  - Structural cardiac disease
- Atrial neoplasia
- Hyperthyroidism
- Hypoxia



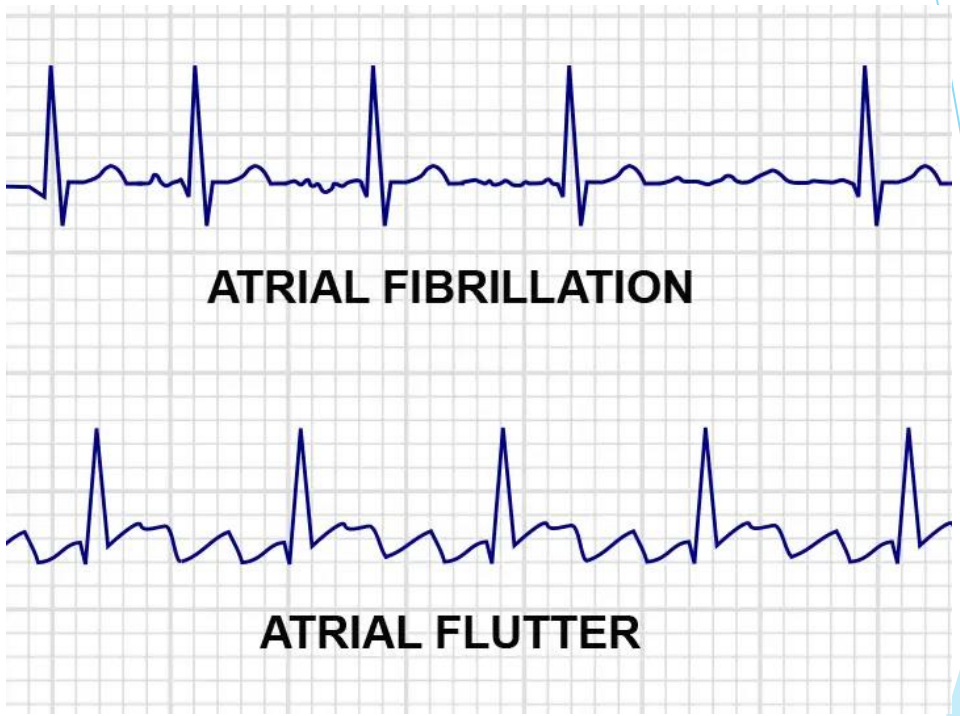
Atrial Tachycardia

- Defined as >4 APC in succession
- Sudden onset and sudden termination
- Regular rhythm
- HR >200-300 bpm
- Antiarrhythmic medications are indicated
  - Hypotensive
  - Weak
  - Collapse
- SVT commonly used to describe both atrial and junctional tachycardia
  - Indistinguishable on ECG



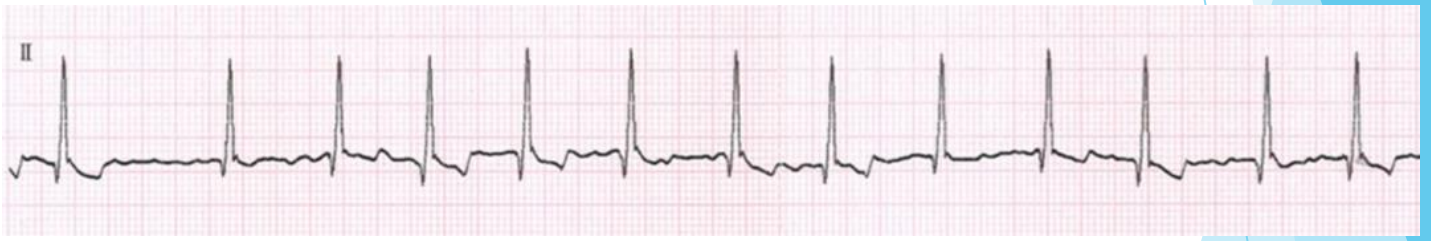
Atrial Flutter

- Rapid rhythm
- Supraventricular QRS complexes
- Saw-tooth flutter waves (F-Waves)
  - No P waves
- Severe left atrial enlargement
  - Degenerates into A Fib



Atrial Fibrillation (Afib)

- Rapid
- Irregularly irregular rhythm
- Supraventricular QRS complexes
- No P wave
- F waves
- Severe atrial enlargement
  - Structural cardiac disease
    - Advanced valve disease
    - DCM
- Sudden onset of this rapid arrythmia and loss of atrial contraction may cause collapse

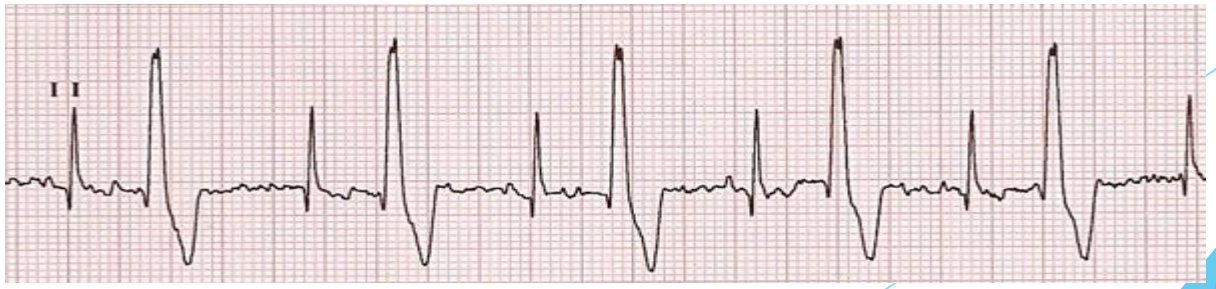


Disturbances of Ventricular Impulse Formation

Ventricular Premature Complexes (VPC)

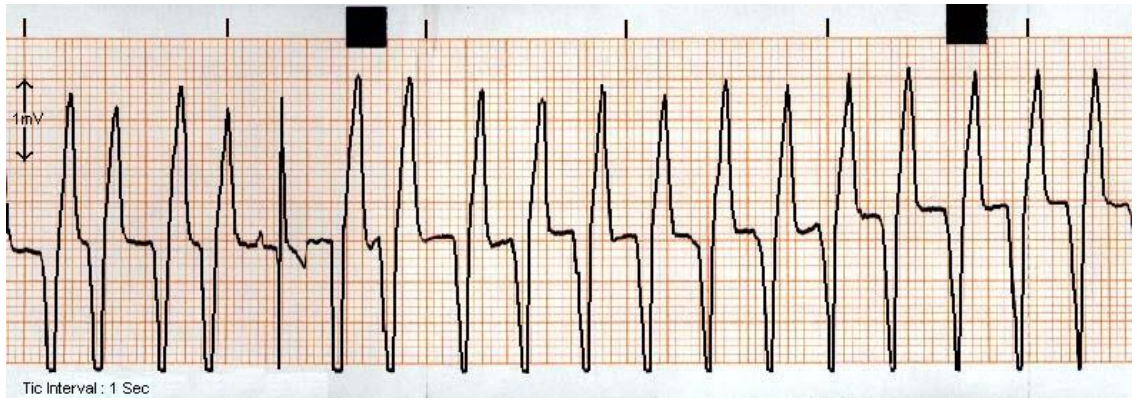
- Abnormal beats originating from the ventricular myocardium
- Wide and bizarre
  - Positive or negative
- May appear as a single beat
- Two in a row
  - Couplets
- Three in a row
  - Triplets
- A rhythm in which every other beat is a VPC
  - Bigeminy
- Every third beat
  - Trigeminy

- Structural cardiac disease
- Arrhythmogenic right ventricular cardiomyopathy
- GDV
- Splenic disease
- Trauma
- Sepsis
- Drugs/toxins
- Electrolyte abnormalities
- Hyperthyroidism
- Excessive catecholamines



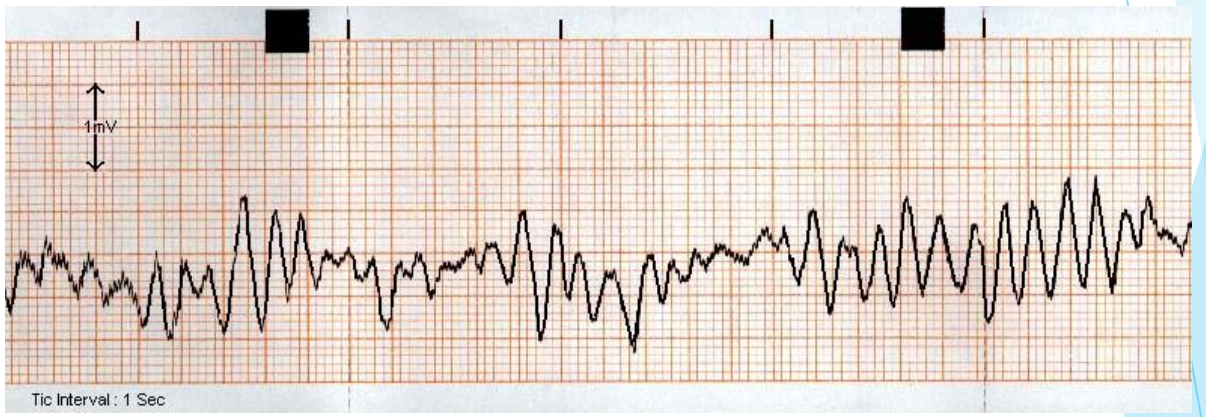
Ventricular Tachycardia (Vtach)

- >4 VPCs in a row with a rapid rate
  - >180 bpm
- Sustained
  - > 30 seconds
- Nonsustained
  - < 30 seconds
- Requires emergency treatment
  - Risk of sudden death
  - Lidocaine



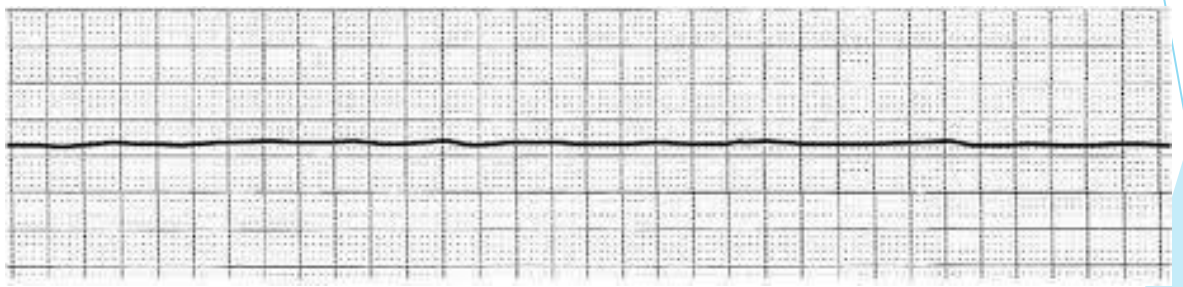
Ventricular Fibrillation (Vfib)

- Life threatening arrest rhythm
- Chaotic, irregular waves
  - Lack of organized ventricular activity
- Electric defibrillation should be performed



Ventricular Asystole

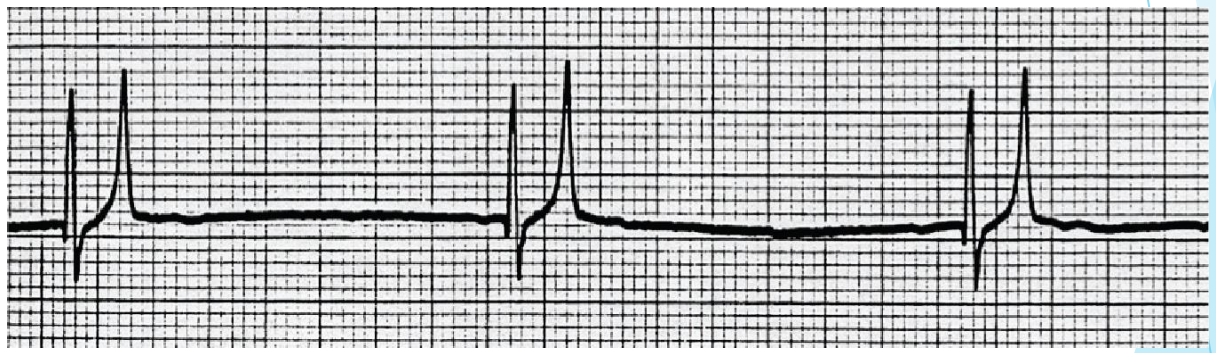
- Absence of any ventricular activity
- Flatline
- Arresting rhythm



Disturbances of Impulse Conduction

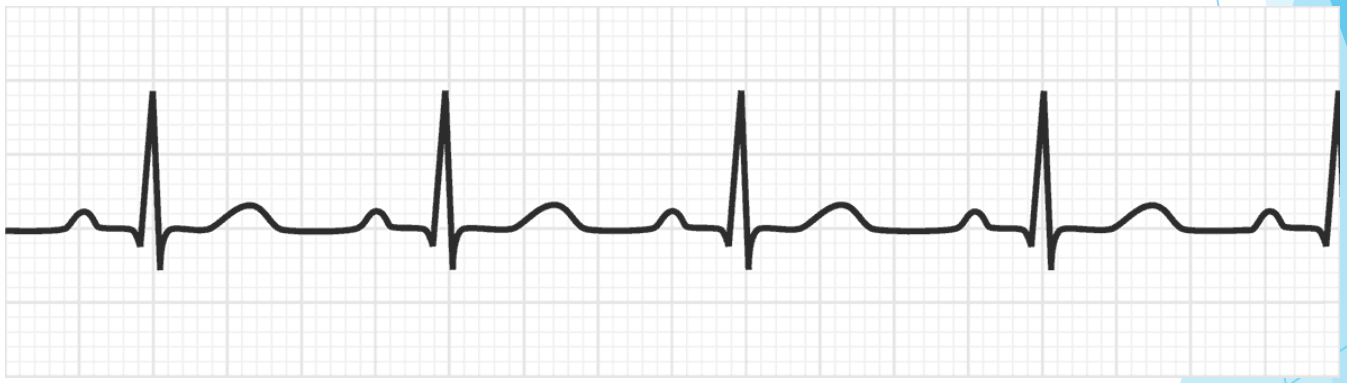
Atrial Standstill

- Atrial depolarization does not occur when the SA node discharges
- No P waves
- Flat baseline
- Bradycardia
- Hyperkalemia
  - Tented T waves
- Atrial standstill with normal K
  - Replacement fibrosis (persistent atrial standstill)



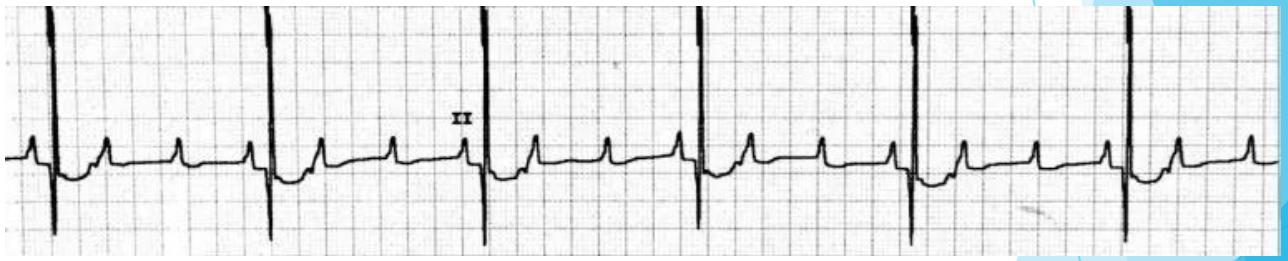
First Degree AV Block

- Conduction through the AV node is delayed
  - Prolonged P-R interval
- Sinus rhythm is maintained
- HR is normal
- Elevated vagal tone
- AV node fibrosis
- Medications
- Idiopathic



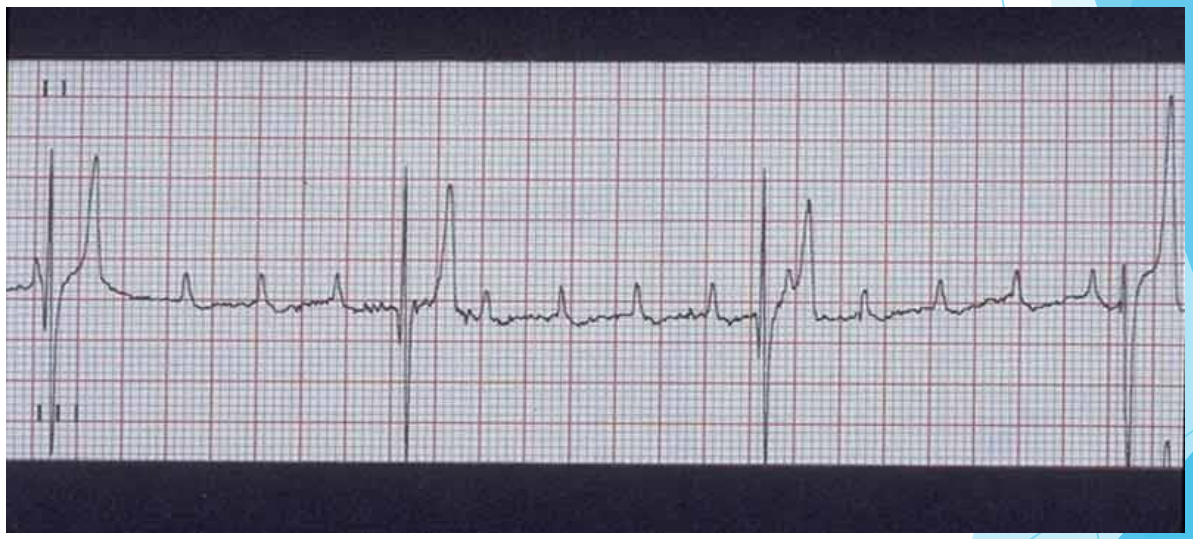
Second Degree AV Block

- Intermittent disruption of AV nodal conduction
- Mobitz Type I-*Wenckebach*
  - Progressive prolongation of the P-R interval until block occurs
- Mobitz II
  - Some P waves are seen to be followed By QRS complexes while others are not
  - Considered more serious



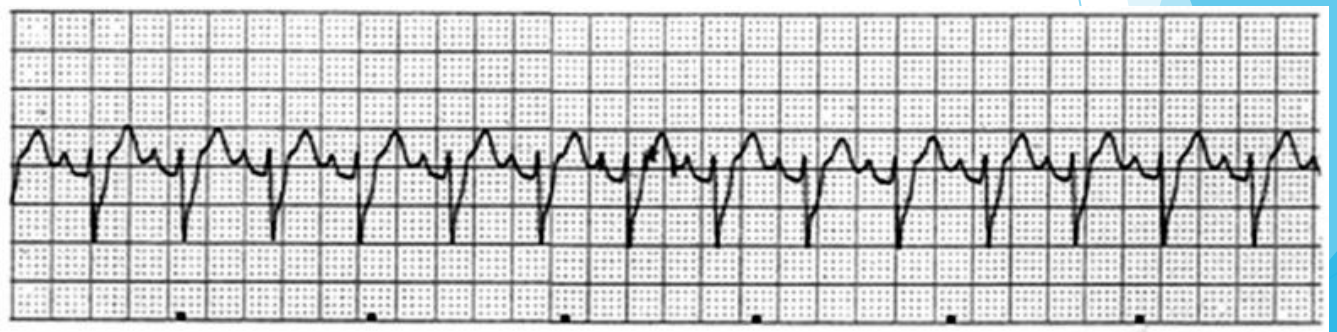
Third Degree AV Block

- Complete heart block
- No conduction of sinus impulses through the AV node
- Rhythm is maintained through escape beats
- 30-60 bpm
- Degeneration and fibrosis of the AV node
- Medications
- Infiltrative myocardial disease
- Myocarditis



Bundle Branch Block

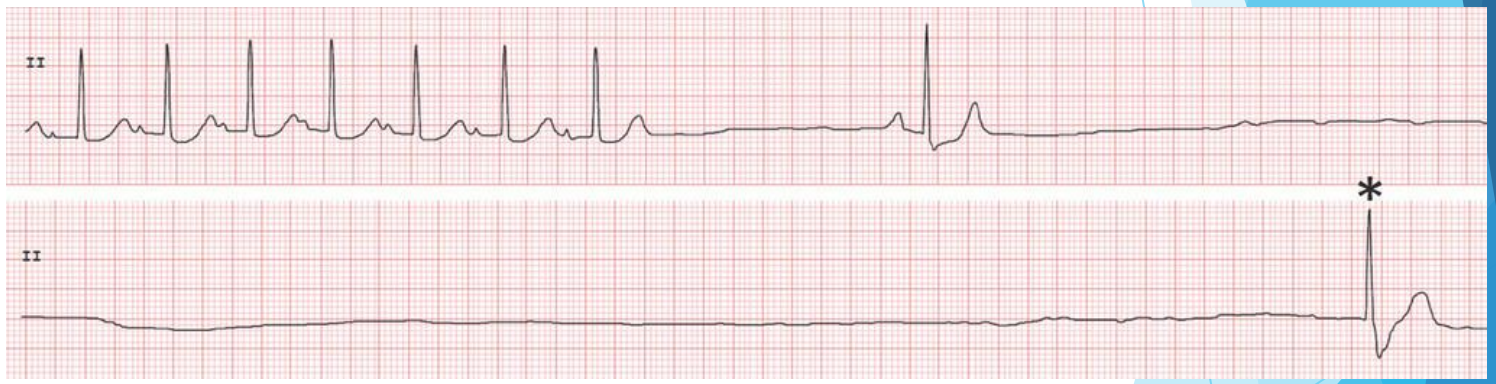
- Cardiac impulse is blocked at the level of the left or right bundle branch but is conducted normally through the other branch
- QRS wider than normal
  - Left bundle branch QRS is positive
  - Right bundle branch QRS is negative
- Usually not treated



Disturbances of Impulse Formation and Conduction

Sick Sinus Syndrome

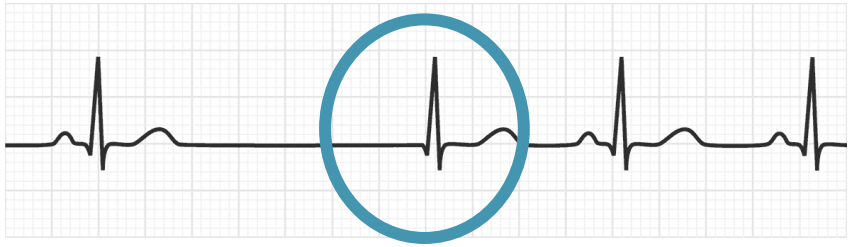
- Abnormal sinus impulse formation and conduction causing a combination of arrythmias
  - Sinus arrest
  - Sinus bradycardia
  - Atrial tachycardia
  - AV nodal block
  - Intermittent escape beats
- “Bradycardia-Tachycardia Syndrome”



Escape Beats

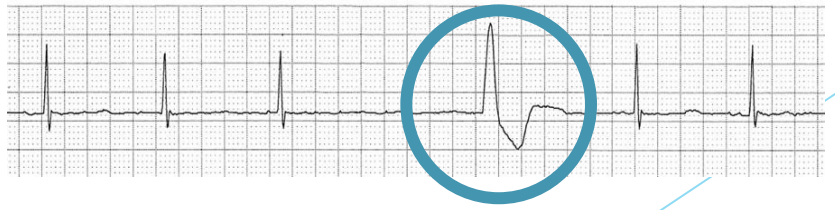
Junctional Escape Beats

- AV node acts as a subsidiary pacemaker if a sinus impulse is not generated or conducted
- Narrow QRS
- Occurs after a sinus pause of > 1 second



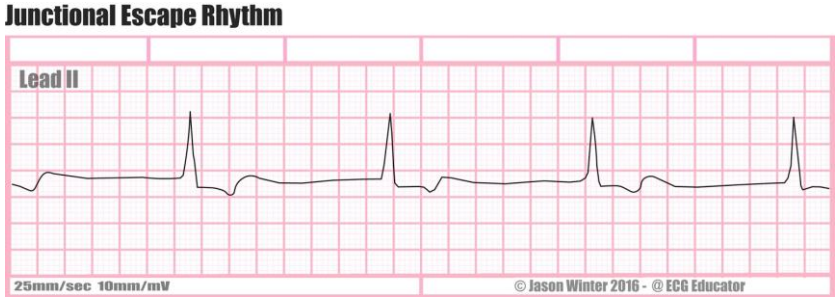
Ventricular Escape Beats

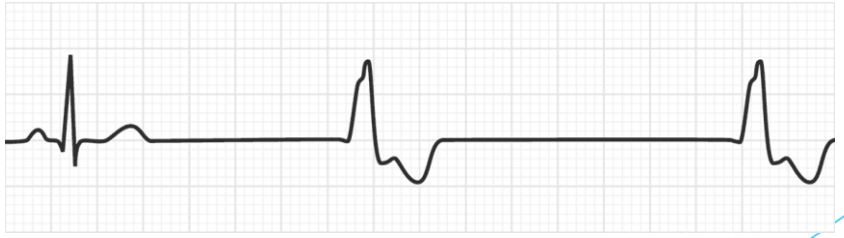
- Bundle of HIS and/or Purkinje fibers act as a subsidiary pacemaker if a sinus or junctional impulse is not generated or conducted
- Wide bizarre complex
- Occurs after a sinus pause of > 2 seconds



Escape Rhythm

- Prolonged failure of higher pacemaker sites will result in “rescue” of the heart rhythm by an escape rhythm
- Junctional escape rhythms
  - 40-60 bpm
- Ventricular escape rhythms
  - 30-40 bpm
- NO ANTIARRYTHMIC MEDICATION
  - Results in death!





Fluid Therapy and Transfusion Medicine

Clinical Indications for IVF

- Maintenance hydration
- Replacing fluid deficit
- Replacing ongoing fluid losses
- Treating decreased oncotic pressure
- Treating hypovolemia
- Treating shock states
- Improving urine production
- Correcting acid-base or electrolyte disorders
- Maintaining IV access
- Delivering medications

Blood Volume

- DOGS
  - 80-90 mL/kg TOTAL
- CATS
  - 40-60 mL/kg TOTAL
- HORSE
  - 80 mL/kg TOTAL
- Cannot lose > 40%
  - Will lead to anemia/hypovolemia

Types of Fluids

- Crystalloids
  - Contain various electrolytes in water
  - Characterized by osmolality compared with the osmolality of blood
- Hypotonic
  - Osmolality < then blood
  - Provides water in greater proportions than electrolytes
  - 5% dextrose (D5W)
  - 0.45% NaCl
  - Norm-M
  - Plasmalyte
- Utilized to treat free water deficit
- Hypernatremia
- Cardiac patients that are less tolerate of sodium load
- NEVER use in fluid resuscitation
  - Ineffective at expanding intravascular volume

Crystalloids

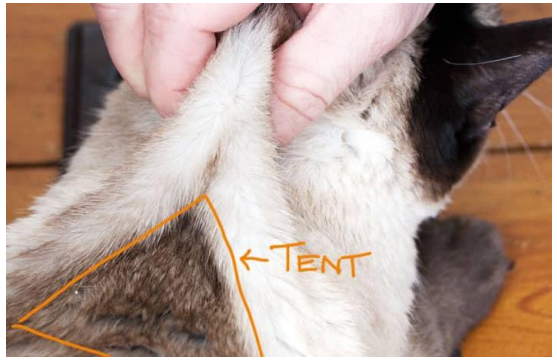
- Isotonic
  - Osmolality equal to blood
  - Provides water in equal proportions to electrolytes
  - 0.9% NaCl
  - Norm-R
  - LRS
- Fluid resuscitation
- Rehydration
- Replacement of ongoing losses
- Isotonic crystalloid fluid administration will result in 25%-35% of fluids remaining in the intravascular department for 20-30 minutes!

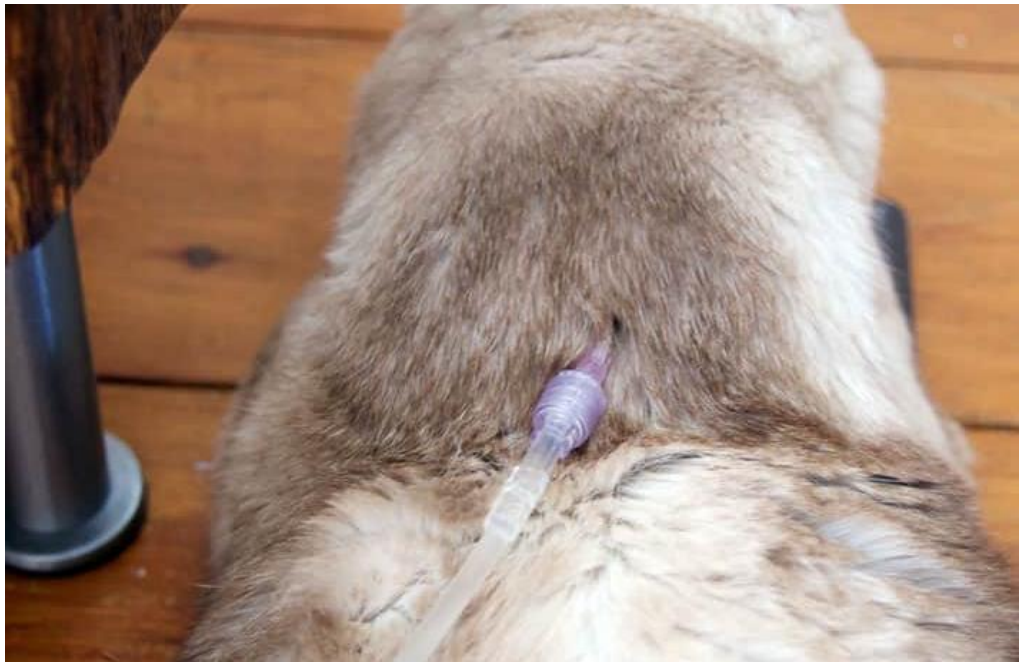
Crystalloids

- Hypertonic
  - Osmolality > than blood
  - Provides electrolytes in > proportion than water
  - 3% and 7% hypertonic saline
  - Will cause a fluid shift from the interstitium to the intravascular space
    - Promoting volume expansion
    - Lasts 20-30 minutes
- Osmotic effects
  - Used in THI
  - Draws fluid out of the cerebral interstitium
    - Increasing intravascular volume and BP
- Do NOT administer faster than 0.5-1 mL/kg/minute
  - Rapid volume expansion can trigger bradycardia

Types of Fluids

- Colloids
  - High molecular weight molecules suspended in an isotonic crystalloid
  - Higher molecular Daltons remain in the intravascular space longer
  - Affects oncotic pressure
  - Can be classified
    - Natural (FFP; FP; pRBC; WB; FWB; Albumin)
    - Synthetic (Hetastarch; Vetstarch)
      - Coagulopathy? Vetstarch safer?
      - AKI? Not proven in SA
- Used as a resuscitation treatment
- Hypoproteinemia





Routes of Administration

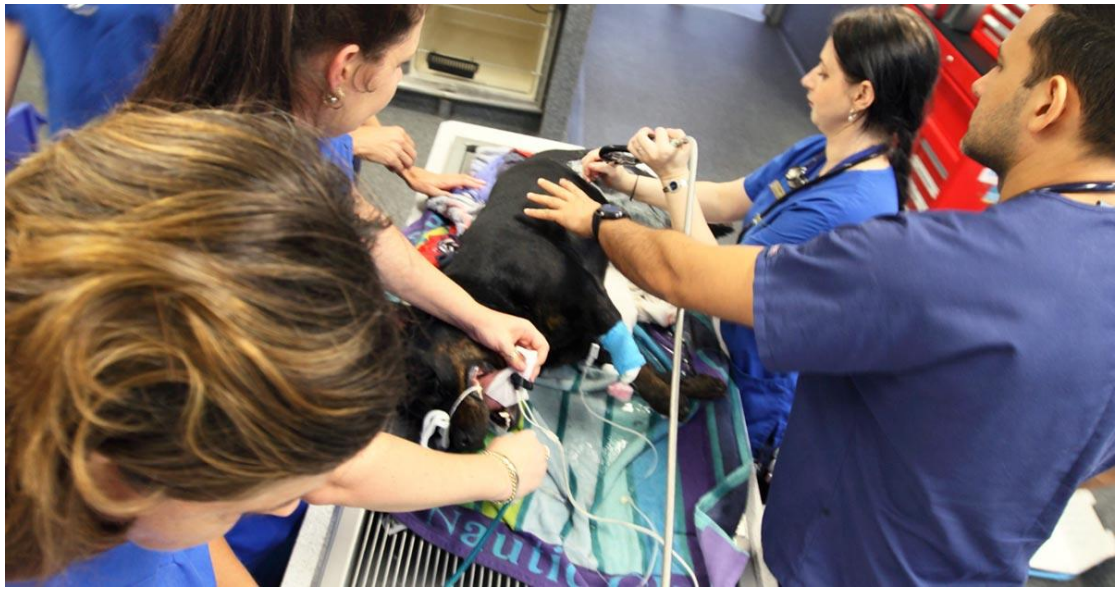
- Intravenous (IV)
- Subcutaneous (SQ)
- Intraosseous (IO)
- Enteral (PO; via E-Tube)

Phases of Therapy

PHASE 1: RESUSCITATION AND EMERGENCY THERAPY

- Requires immediate resuscitation during life-threatening fluid deficits that result from acute changes in fluid balance and cause decreased tissue perfusion, leading to hypoxemia and shock
- Caused by severe dehydration, hemorrhage, or shock
- Typically requires large fluid volumes at high rates
- The goal is to expand and support intravascular volume and increase blood flow and cardiac output to restore tissue perfusion and oxygen delivery to tissues

Shock Fluid DOSES



- Crystalloid
  - DOG 90mL/kg
  - CAT 45-60 mL/kg
  - HORSE 80-90 mL/kg
- Hypertonic crystalloid
  - DOG 3-6 mL/kg
  - CAT 2-4 mL/kg
- Colloid
  - DOG 20-30 mL/kg
  - CAT 10-15 mL/kg

Phases of Therapy

PHASE 2: REPLACEMENT THERAPY

- Previous, ongoing, or anticipated losses
  - Vomiting
  - Diarrhea
  - Diuresis leading to dehydration
- Fluid deficits are typically replaced over 4 to 24 hours, depending on the patient's hydration status

The goal of treating dehydration:

- Restore homeostasis and prevent shock and clinical decompensation
- Replacement Fluid Rate
  - Dehydration + ongoing losses + Maintenance
  - 30kg(0.08) = 2.4L/4-24 hours

Phases of Therapy

PHASE 3: MAINTENANCE THERAPY

- Involves maintaining:
  - Tissue perfusion
  - Electrolyte balance
  - Cellular metabolism and function in an ill patient
- Indications for maintenance fluid therapy include:
  - Anesthesia
  - Continued fluid losses after rehydration
  - Decreased intake

Maintenance Fluid Rates
40-60mL/kg/day

Serum K	KCL to add to 1L of fluids	MAX fluid infusion rate, mL/kg/hr
< 2	80	6
2.1-2.5	60	8
2.6-3.0	40	12
3.1-3.5	28	18
3.6-5.0	20	25

Fluid Additives

- Potassium
  - Potassium Chloride (2meq/mL)
  - Potassium Phosphate (4.36meq/mL)
- K should not be delivered > 0.5mEq/kg/hr!
  - Result in adverse cardiac effects

Fluid Additives

- Dextrose
  - 50% Solution
    - 0.5g/mL
    - 500mg/mL
- < 5% dextrose CRIs can be delivered via peripheral vessel
- > 5% dextrose CRIs should not be delivered via peripheral vessel
  - Phlebitis
  - Osmotic injury

Fluid Additives

- Sodium Bicarbonate
  - TX metabolic acidosis
    - Lactic acidosis
    - DKA
    - CRF
- Only provides temporary improvement in acid-base balance
  - Must determine underlying cause
- Should only be used in severe acidosis
  - pH < 7.1
- TX severe hyperkalemia (>10 mEq/L)
  - Promotes a shift of K into cells in exchange for hydrogen ions
  - 1-2mEq/kg > 5-10 minutes
- Never administer to a patient in respiratory acidosis
  - Will worsen!

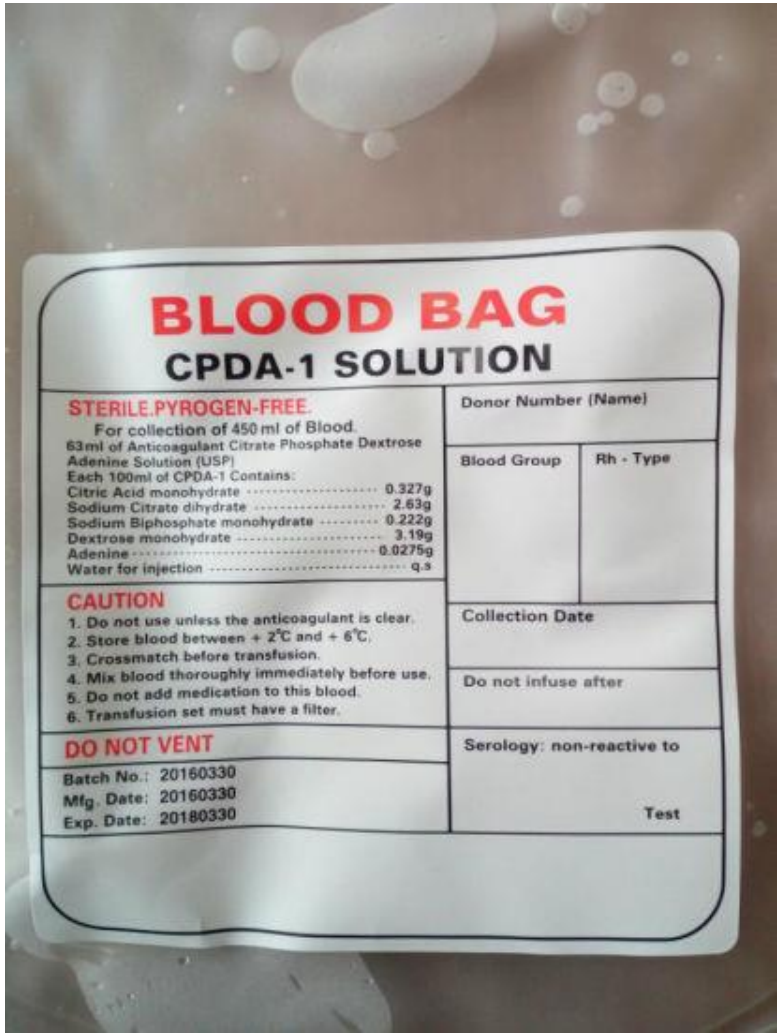
Complication of Fluid Therapy

- Volume overload
- Pulmonary edema/crackles
- Cavitary effusion
- Peripheral edema
- Dilution Coagulopathy
- Electrolyte imbalances

Transfusion Medicine

Transfusion Terminology

- FWB—*Fresh Whole Blood*
- WB—*Whole Blood*
- PRBCs—*Packed Red Blood Cells*
- FFP—*Fresh Frozen Plasma*
- FP—*Frozen Plasma*
- CRYO—*Cryoprecipitate*
- PRP—*Platelet Rich Plasma*
- CPDA—*Citrate-phosphate-dextrose-adenine*



FWB—*Fresh Whole Blood*

- Initial collection
- Defined as FWB for up to 8 hours after collection
- Provides:
  - RBCs
  - WBCs
  - Platelets [approx. HCT 40%]
  - Plasma proteins
  - Coagulation factors

FWB Uses

- Actively bleeding
- Hypovolemic shock
- Anemia with coagulopathies
  - Thromboctyopenia or thrombopathia with active bleeding
- Massive hemorrhage
  - Defined as a loss approaching or exceeding one total blood volume with a 24-hour period

WB—*Whole Blood*

- FWB→WB after 8 hours
- Must be refrigerated within 8 hours of collection
- After 24 hours of storage:
  - Platelet function is lost
  - Concentration of labile coagulation factors decreases (F-V and F-VIII)
- Provides:
  - RBCs
  - The more stable coagulation factors
  - Other plasma proteins (albumin and globulins)
  - [approx. HCT 40%]

WB USES

- Patients that require oxygen-carrying support
- Intravascular blood volume expansion
  - Hypovolemic shock
- Anemia with hypoproteinemia
- **Not recommended** in chronically anemic patients
  - May have a reduced red cell mass but have compensated over time by increasing their plasma volume to meet total blood volume
  - At risk for fluid overload (cardiac disease and/or renal compromised)

PRBCs—*Packed Red Blood Cells*

- Harvested from a unit of WB after centrifugation
- Stored in refrigerator for approximately 1 month
- [Approx. HCT 80%]

PRBCs uses

- Oxygen-carrying support
- Choice for increasing RBC mass
  - Symptomatic anemia
- NOT recommended:
  - Well compensated anemia
    - CRF

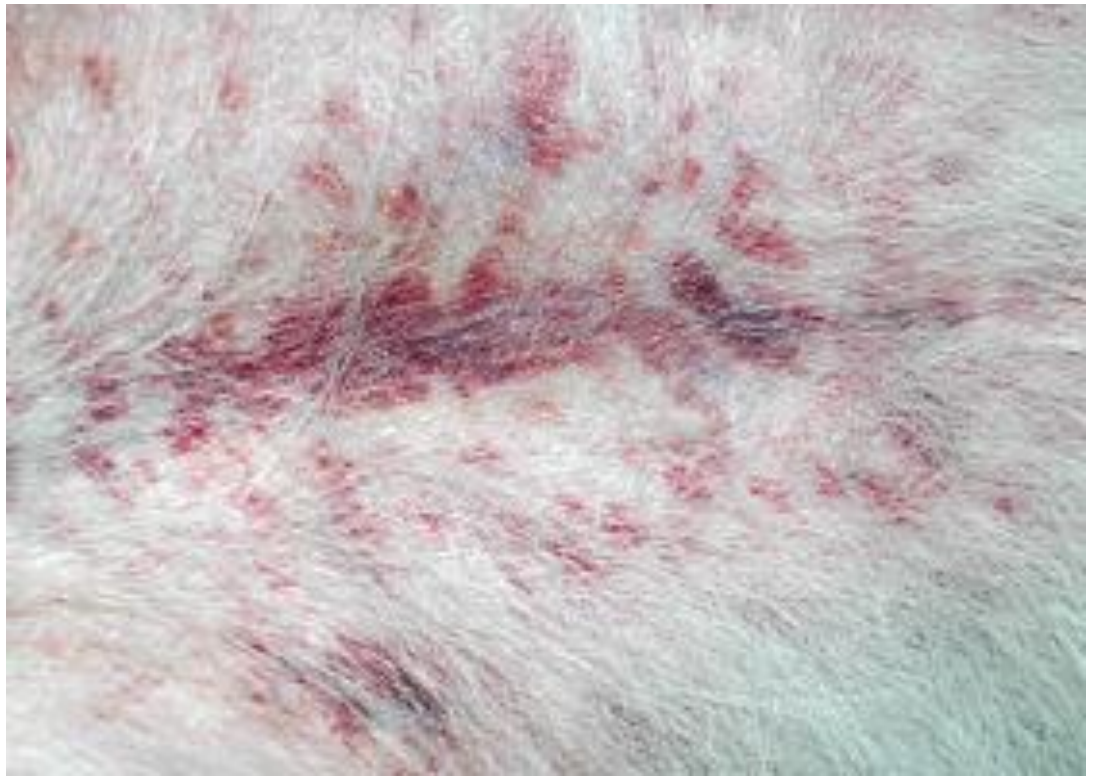
- The decision to transfuse PRBC should never be based solely on HCT; PCV; hemoglobin levels
  - PCV 15-20%
- Treat the patient—not the numbers
  - Respiratory compromise
  - Tachycardia
  - Poor pulse quality

FFP—*Fresh frozen plasma*

- Harvested from a unit of WB within 8 hours of initial collection and frozen
- FFP will retain its coagulation factor efficacy for 12 months
  - Must be kept frozen!
- Provides:
  - Water
  - Electrolytes
  - Albumin
  - Globulins
  - Coagulation factors

FFP uses

- Uses:
  - Coagulation factor deficiencies
    - DIC
    - Liver disease
    - Anticoagulant rodenticide
    - Heredity coagulopathies



FP—*Frozen Plasma*

- FFP→FP after 12 months
- FP is good for 4 years
  - Must be kept frozen
- Provides:
  - Coagulation factors (more stable)
  - Albumin
  - DOES NOT contain functional platelets or clotting factors V and VIII

FP uses

- Stable clotting deficiencies
- Acute hypoproteinemia
  - Parvoenteritis
- With severe chronic protein deficiencies; plasma must be administered in large volumes to have a measurable effect in managing the acute effects of hypoproteinemia
- Recommend synthetic colloid—more effective at increasing oncotic pressure

Cryo—*Cryoprecipitate*

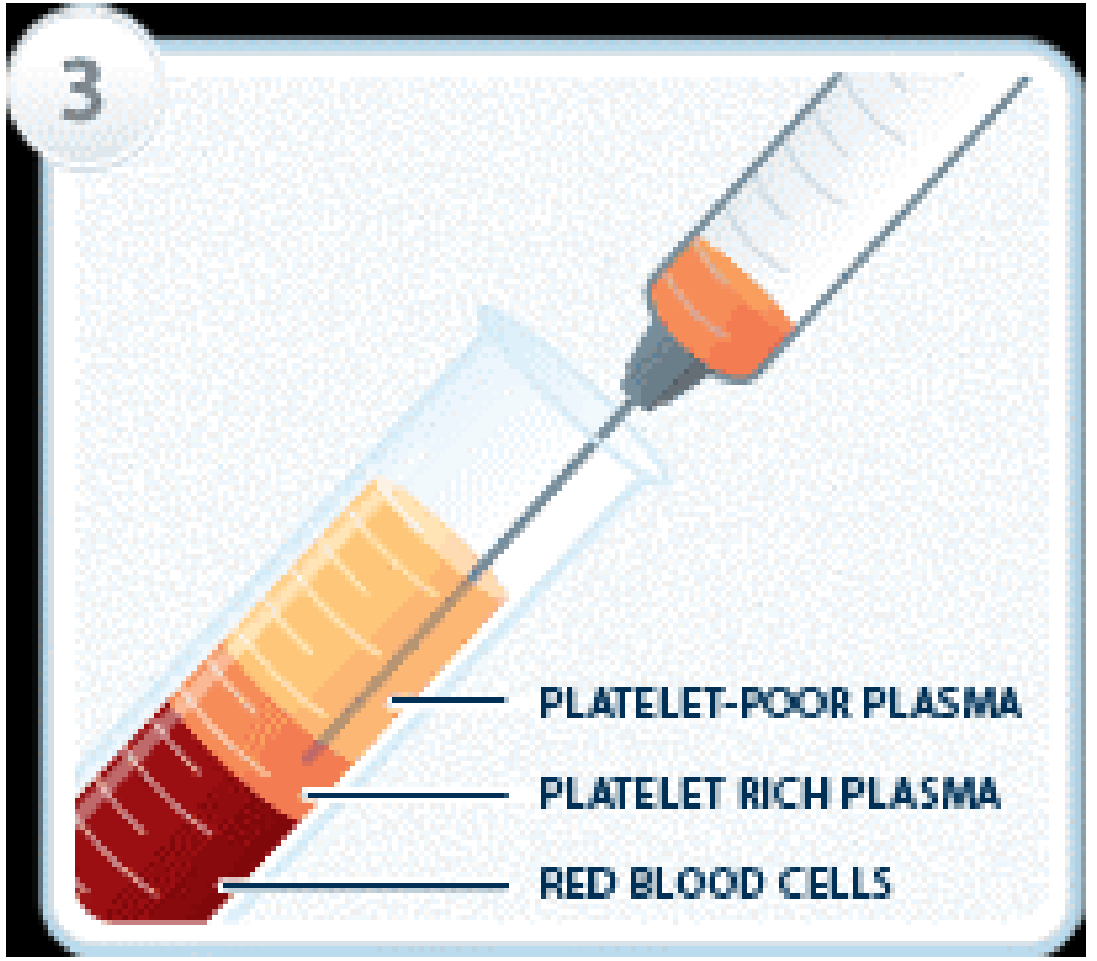
- Cold-insoluable portion of plasma that precipitates after FFP has been slowly thawed.
- Precipitated material contains concentrated amounts of von Willebrand's factor (VIII); fibrinogen; fibronectin
- Shelf life of 1 year—FROZEN

Cryo uses

- Von Willebrand's
- Hemophilia A
- Fibrinogen deficiency

PRP—*Platelet Rich plasma*

- Harvested from a unit of FWB that is less than 8 hours old and that has not been cooled below 20° C
- Cold platelets do not maintain function or viability as well as platelets at room temperature
- Must be transfused immediately—DO NOT refrigerate



PRP uses

- Stop severe, uncontrolled, life-threatening bleeding in patients with decreased platelet number, function, or both
- Acute bleed into a vital structure
- Massive hemorrhage

Equine Hyperimmune Plasma

- USDA regulated product
- Shelf life 2-3 years
- Collected via plasmapheresis
  - Minimizes RBC contamination
- 20mL/kg of plasma may be harvested every 30 days

Canine Blood Typing

- Blood types are genetic markers on the surface of RBCs
  - Specific to each species
  - Antigenic
- > 12 blood group systems
  - DEA [dog erythrocyte antigen] followed by a number
  - Positive or negative
- DEA 1 system—2 subtypes
  - DEA 1.1 (*A1*)
  - DEA 1.2 (*A2*)
- DEA 1.1 negative (or positive)
- DEA 1.2 (positive (or negative)
- DEA 3—RARE
- DEA 4—Common

DEA 1.1 Antigen

- DEA 1.1 antigen
  - Clinically most severe antigen-antibody reaction
- *Significant* natural occurring alloantibodies are NOT seen in the dog
  - Antigen-antibody reactions are not likely to occur on initial transfusion
- DEA 1.1 negative can develop alloantibodies to DEA 1.1 from mismatched transfusion
- Anti-DEA 1.1 antibodies can develop within 9 days of transfusion—on first transfusion
  - Destroying donor RBCs

DEA 1.1 Antigen

- 2nd transfusion DEA 1.1 negative recipient
  - Acute hemolytic reaction after receiving DEA 1.1 positive donor blood
- Reactions can occur on 2nd transfusions if recipient receives blood that is mismatched for ANY red cell antigen other than DEA 1.1
  - As early as 4 days post transfusion
- Strong antigenicity of DEA 1.1
  - Typing is STRONGLY recommended
- Blood typing kits are available [in-house]
  - Classifies dogs as DEA 1.1 negative or positive

DEA 1.1 Antigen

- Blood from DEA 1.1 negative donor can be given to a DEA 1.1 negative and DEA 1.1 positive patients
- DEA 1.1 positive can be given to DEA 1.1 positive patients ONLY

Feline Blood Typing

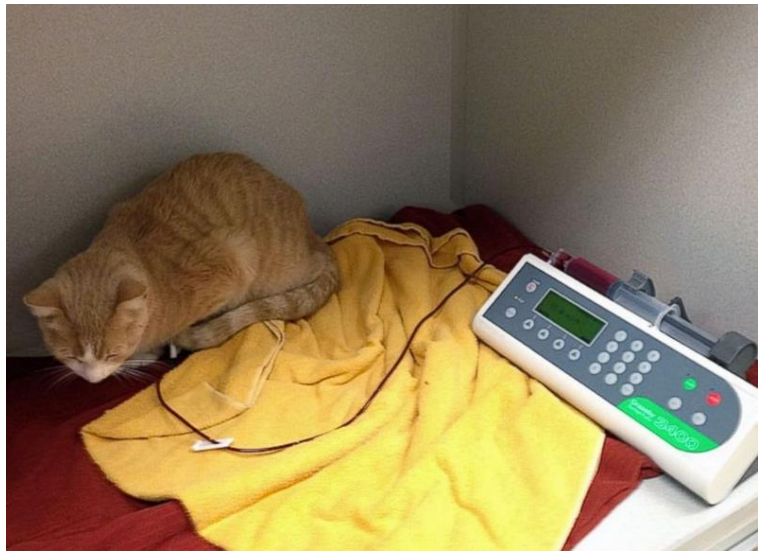
- One blood group system
  - AB system
- AB system
  - A [nearly all DSH and DLH]
  - B [mostly purebred cats]
  - AB [extremely RARE]
    - AB blood has both A and B on red cell surface

- Cats have *significant* naturally occurring alloantibodies against other blood groups
- Type B have very strong naturally occurring anti-A alloantibodies
- Type A have weak anti-B alloantibodies

Feline Blood Type

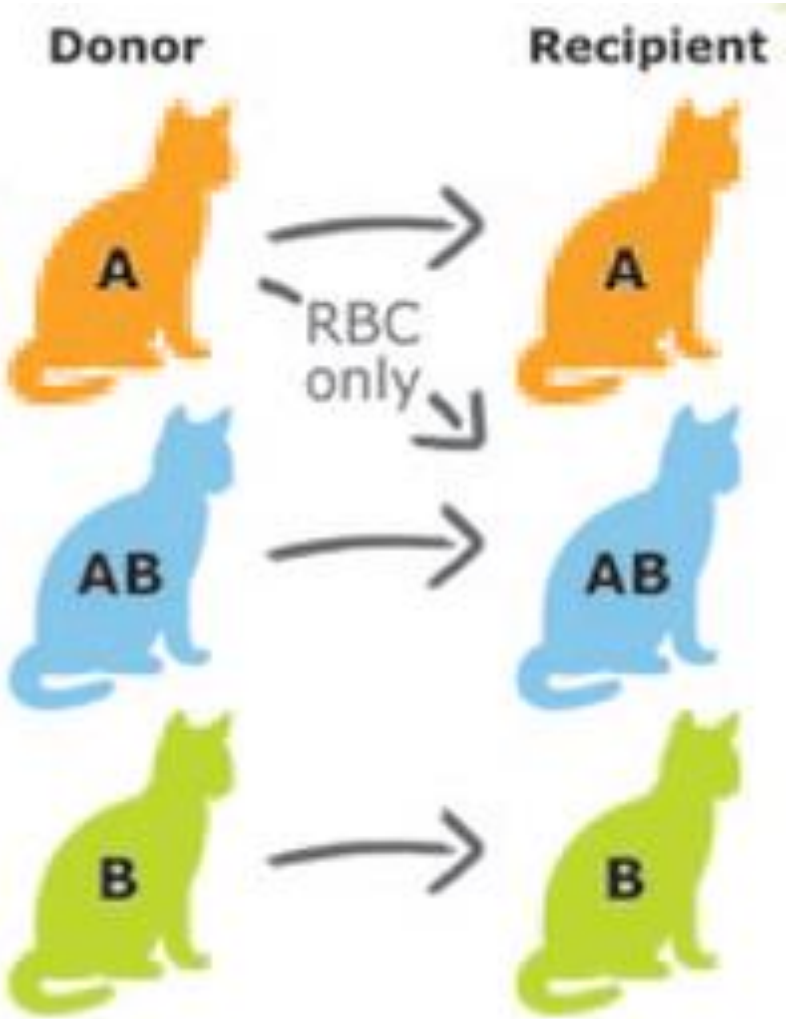
TRANSFUSION REACTIONS

- Cats with Type B can experience FATAL reactions if they receive Type A
- Cats with Type A receiving Type B may not exhibit clinical signs of reaction
  - Half-life of Type B cells will be short and transfusion ineffective



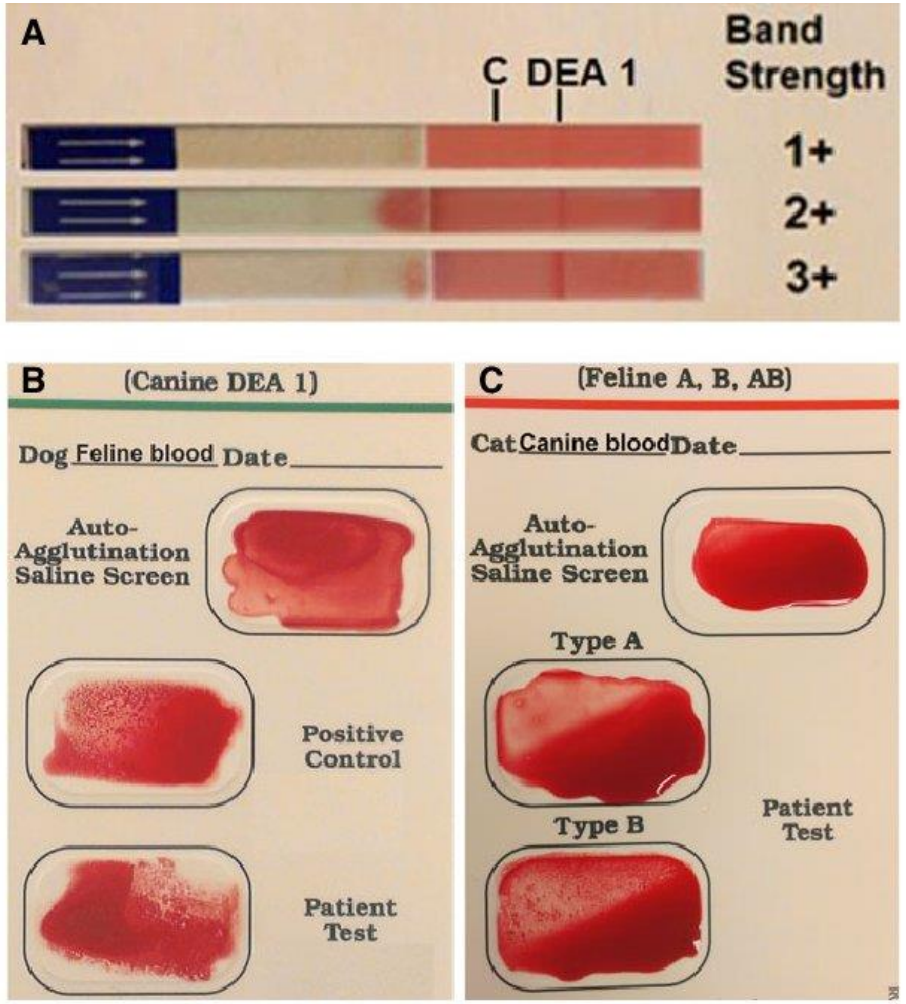
Feline Blood Type

- Type B donor to Type A
  - RBCs are destroyed within 2 days
- Type A donor to Type B
  - RBCs are destroyed within minutes to hours with severe clinical reaction signs [fatality]
- Type A donor to Type AB
- Type B donor to Type B recipient
- Type A donor to Type A recipient



Blood compatibility

- Pretransfusion testing is necessary
- Compatibility testing includes:
  - Testing of the donor
  - Selection of appropriate blood units based on patient's blood type
  - BCM [blood crossmatch]



Blood Compatibility

- Blood Typing
  - Agglutination determines type on blood typing cards
- Ideally all canine blood donors and all recipients should be blood typed for DEA 1.1
- DEA 1.1 negative→DEA 1.1 negative AND positive
- DEA 1.1 positive→DEA 1.1 positive ONLY
- ALL feline donors and recipients MUST be typed
- AB donors will agglutinate in both A and B wells

Blood Crossmatch

- Detect serologic incompatibility by identifying antibodies in donor or recipient plasma against recipient or donor RBCs
- BCM has two parts
  - Major
  - Minor

BCM

MAJOR

- Consists of mixing the patients plasma with the donor's RBCs
- More important in determining survival of transfused RBCs

MINOR

- Consists of mixing the donor's plasma with the patient's RBCs

BCM

- Dogs lack significant naturally occurring alloantibodies
  - Can be safely transfused without BCM before first transfusion
  - All dogs that have received RBC transfusions > 4 days previously must be crossmatched before receiving additional transfusions
- Cats have *significant* naturally occurring alloantibodies
- May experience a severe reaction or even death upon their first transfusion
- BCM MUST be performed if blood typing is not available
- If type is known—cats do not need a BCM for first transfusions

BCM Results

- An auto control with recipient's RBCs and plasma is ran because some recipients may have autoagglutination that interferes with the BCM
- If patient control is positive (agglutination is present)—the results are inconclusive
- Any hemolysis or agglutination, or both in the MAJOR or MINOR but not in the control indicate an incompatibility
- A compatible BCM does not prevent reactions; it simply indicates that at the present time no antibodies against the RBCs are detected

BCM FFP

CANINE

- BCM not required for plasma transfusions
- Donor plasma should not contain significant antibodies
- If patient has had multiple transfusions
  - MINOR BCM can be performed

FELINE

- MUST receive type-specific plasma
- BCM not required as long as type is known and matched

Transfusion Reactions

IMMUNE MEDIATED

- Hemolytic in origin
- Acute
  - Preexisting alloantibodies
- Delayed
  - >4 days post transfusion
- Most serious—but less common
- Mismatched donor→recipient

CLINICAL SIGNS

- Fever
- Tachycardia
- Weakness
- Muscle tremors
- Vomiting
- Collapse
- Hemoglobinemia/hemoglobinuria

Transfusion Reactions

NONHEMOLYTIC IMMUNE MEDIATED

- Antibodies to:
  - WBCs
  - Platelets
  - Plasma proteins
- Transient
  - Non-life threatening

CLINICAL SIGNS

- Urticaria
- Pruritus
- Pyrexia
- Vomiting

Transfusion reactions

NONIMMUNE-MEDIATED

- Any type of trauma to RBCs [hemolysis]
  - Overheating RBC products
  - Freezing RBCs
  - Mixing RBCs with nonisotonic solutions causing cellular damage [LRS]
  - Warming then rechilling blood products
  - Collecting or transfusing through small needles/catheters
- Transfusion-associated circulatory overload (TACO)
- Transfusion-related acute lung injury
- Hemolysis
- Bacterial contamination
- Hypocalcemia*
- Coagulopathy
- Embolism

Hypocalcemia

- Citrate intoxication
  - Citrate/blood volume ratio is disproportionate
  - Massively transfused patients
    - Liver dysfunction
- Confirmed by obtaining iCa
- Clinical signs
  - Involuntary muscle tremors
  - Cardiac arrythmias
  - Decreased cardiac output
- Treatment
  - Discontinue transfusion
  - Ca Glu administered

KEEP CALM

AND

ACE YOUR VTNE