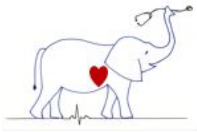
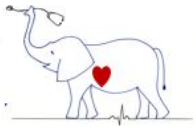




Large Animal Cardiology
Created by V'22 cardio group revised from Dr. Suzanne Cunningham

History and Exam

History and Observation

- Information that may indicate a cardiovascular problem
    - Reduced performance: more often will be attributed to musculoskeletal or respiratory issue
    - Cough
    - Dyspnea
    - Stunted growth
    - Lethargy
    - Collapse
- Observe from a distance prior to physical exam. Note the following -
    - Animal's disposition
    - Alert, dull, nervous, or quiet
    - Dyspnea present?
    - Any peripheral edema?
    - Jugular pulsation or distension?
        - Some degree of pulsation = normal in large animals
        - If animal lowers head to graze → head is lower than right atrium → distension of entire jugular occurs
            - This is NOT pathologic
        - To determine pathologic distension: observe jugular vein when animal's head is in normal position
            - Pathologic = jugular vein pulsating beyond lower 1/3 of the neck → jugular distension. Consider pericardial or cardiac disease

Cardiovascular Exam

- Mucous membrane color and capillary refill time (CRT)
    - Normal = moist, pink, CRT < 2 seconds
- Peripheral pulse
    - Facial artery: rostroventral border of the mandible
    - Transverse facial artery: caudal to the lateral canthus of the eye, ventral to the zygomatic arch
    - Brachial artery: high on the medial aspect of the forelimb (also used for pulse detection)
- Cardiac apex beat palpate thorax wall with flat of hand. Useful in detecting thrills
    - Thrill: a palpable vibration caused by turbulent blood flow. Present in murmurs graded V-VI/VI
- Auscultation of all regions of heart on left and right side of thorax

Cardiac Auscultation

- Entire precordium should be auscultated during exam
- Point of maximum intensity (PMI) of valves
    - Mitral valve: left 5th ICS, dorsal to olecranon (*cardiac apex*)
    - Aortic valve: left 3rd ICS, below point of shoulder and medial to triceps muscle mass (*heart base*)
    - Pulmonic valve: slightly cranioventral to aortic valve at left heart base
    - Tricuspid valve: right 3rd – 4th ICS medial to triceps just above olecranon

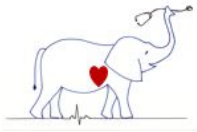
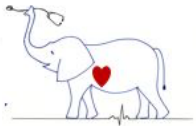
Valve locations for auscultation (P = pulmonic, A = aortic, M = Mitral, T = Tricuspid)

- Heart rate and rhythm assessment
    - Horse: 44 BPM (23-48 range)
    - Cow: 30 BPM (60-80 range)
    - Sheep: 75 BPM (60-120 range)
    - Goat: 90 BPM (70-120 range)
    - Swine: 68 BPM (58-86 range)
- <u>It is normal</u> to hear 2, 3, or 4 heart sounds in <u>horse & cow</u>!
    - S1 = closure of mitral and tricuspid valve
        - Systole occurs between S1 & S2
    - S2 = closure of aortic and pulmonic valve
    - S3 = vibrations resulting from termination of rapid ventricular filling in early diastole
    - S4 = late diastole, during atrial contraction

Diagnostic Procedures

Electrocardiography (ECG)

- Use in large animals is limited to determination of heart rate and rhythm

    - CANNOT get accurate information about chamber enlargement or mean electrical axis because of the "category B" distribution pattern of Purkinje fibers in ventricles of horse/cow – depolarization happens in single "burst" of activation, so multiple lead tracings are not accurate
- Can use single lead system (base-apex lead)
    - Right forelimb (white) electrode → along jugular groove on right side of neck
    - Ground (green) electrode → right base of neck
    - Left limb (black and red) electrodes → over left precordium behind olecranon (left apex)

Echocardiography

- Non-invasive diagnostic technique allowing for real-time evaluation of blood flow and movement of walls/valves of heart
- Can measure wall thickness and luminal dimensions
- Best non-invasive diagnostic test for congenital and acquired heart disease
- When is an echo indicated?
    - New/loud murmur
    - Arrhythmia detected
    - To rule out CHF
    - Impaired athletic performance after musculoskeletal and respiratory disease are excluded
    - Fever of unknown origin

Radiography

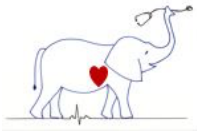
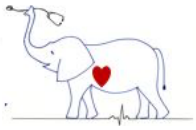
- Most helpful in foals: lateral AND dorsoventral views possible
- Angiography to identify congenital lesions
- Provides limited information from large adult horses
    - Can only obtain lateral views
    - Cardiac enlargement must be significant to detect
    - +/- information about pulmonary infiltrates to aid in diagnosis of CHF

Bloodwork

- CBC: helpful to look for signs of infectious disease
    - Endocarditis
    - Bacterial pericarditis
- Serum chemistry: electrolytes, liver and kidney values, etc.
- Arterial blood gas: information about oxygenation and intracardiac shunts
- Serum cardiac Troponin I (cTnI): evaluate myocardial damage

Blood Pressure

- Dinamap indirect BP measurement on coccygeal artery (OR metatarsal in foals)
- Direct BP measurement = gold standard
    - Requires arterial catheterization

- Useful for monitoring patient on cardioactive drug (i.e. Hydralazine – arterial vasodilator)

Cardiac Catheterization

- Not common in large animals
- Useful for critical care patients or diagnostic challenges
- Can demonstrate…
  - Cardiac output
  - Pulmonary hypertension
  - Pressure profiles
  - Oxygen contents of different cardiac chambers
- Pacemakers sometimes needed in donkeys & horses with symptomatic high grade AV block

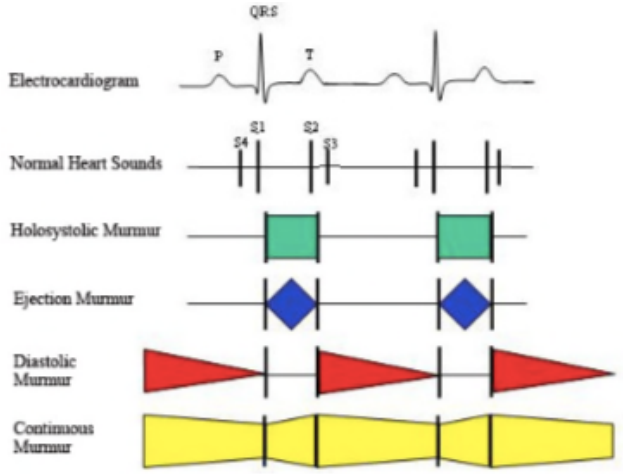
Cardiac Murmurs

- Clinical causes include
  - Valvular disease
    - Stenosis
    - Insufficiencies
  - Intra- or extra-cardiac shunts
    - Septal defects
    - PDA
    - Sinus of Valsalva rupture
  - Conditions → increased cardiac output
  - Conditions → increased velocity of blood flow
    - Anemia
    - Fever
    - High adrenergic tone
- Diastole = longest phase of cardiac cycle, therefore, longer murmurs are more likely to be diastolic
  - Diastolic murmurs = MUCH more common in horses than small animals
    - Aortic insufficiency = common finding in older horses

Murmur Description

Grade I: Soft murmur, heard while listening in a quiet room/stall after listening for a prolonged period of time
Grade II: Soft murmur that can be heard almost immediately
Grade III: Low – moderate intensity murmur
Grade IV: Moderately intense murmur without a palpable thrill
Grade V: Loud murmur with the presence of a palpable precordial thrill

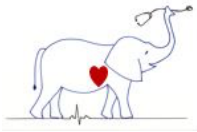
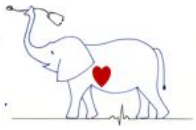
Grade VI: Loud murmur, palpable thrill. The murmur is audible with the stethoscope removed from the thorax



Congenital Murmurs

- Clinical signs of congenital defects = dependent upon severity of hemodynamic derangement
    - Asymptomatic, reduced exercise tolerance → cyanosis and death
- <u>VSD = most common defect seen in foal & calf</u>
- Valvular defects = next in frequency

1. Ventricular Septal Defect (VSD)
    a. Most common cardiac defect in horse/cattle
    b. Harsh, holosystolic murmur overriding S2; PMI = right side, +/- additional murmur over pulmonic region (= relative pulmonic stenosis)
    c. Cardiac cath – elevated RV pressures and PO2
    d. Echo – may visualize defect; agitated saline injection may show bubbles in BOTH R & L ventricles (bubble study)
2. Patent Ductus Arteriosus (PDA)
    a. Continuous, machinery murmur; PMI = L base of heart, murmur radiates to manubrium of sternum & R cardiac base
    b. Uncommon to auscult continuous murmur in foal (systolic murmur = more common). <u>If a murmur does NOT disappear by day 4 of life = pathologic/abnormal murmur</u>
3. Tetralogy of Fallot
    a. Systolic murmur transmitted widely over R & L thoracic wall
    b. Radiographs – RVE
    c. Cardiac cath – elevated RV pressure, lower pulmonary arterial pressure
    d. Stunting of growth, cyanosis, dyspnea
4. Misc. defects

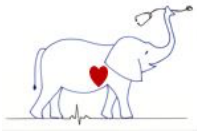
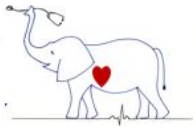



a. Persistent truncus arteriosus
b. Atrial septal defects
c. Atrioventricular septal defects
d. Valvular dysplasia or stenosis
e. Other complex congenital lesions

Acquired Murmurs (valvular disease)

- Most valvular lesions do not halt athletic horses, however, it's possible performance may decrease over time
    - Exception: ruptured chordae tendinae → profound effect on performance
- Survival prognosis = good

1. Functional (physiologic) murmur
    a. Benign, typically high frequency, low intensity, grade I-II/VI at rest (intensity can increase > III/VI if horse is excited or w/ colic)
    b. Usually crescendo-decrescendo; PMI = pulmonic/aortic valve (heart base)
    c. Common in young/athletic horses
    d. Functional murmurs disappear at rest
2. Aortic Stenosis (AS)
    a. Crescendo-decrescendo (ejection quality) systolic murmur; PMI = Ao valve region
    b. Most outflow tract murmur in horse = Ao valve > pulmonic valve
    c. MOST likely of clinical significance if…
        i. Grade III/VI or louder
        ii. Heard on both sides of chest
    d. <u>Acquired AS is more common than congenital (subaortic) AS in horses</u>
3. Mitral insufficiency/regurgitation (MR)
    a. Holosystolic, plateau murmur; PMI = mitral area, may radiate towards aortic valve
    b. <u>Second most common acquired valvular disease in horses</u>, cattle, pigs
    c. Severe MR can → LCHF w/ coughing, exercise intolerance, dyspnea
    d. Mild MR may not be associated w/ clinical signs
    e. Acutely ruptured chordae tendinae → CV collapse w/ fulminant pulmonary edema
4. Ruptured chordae tendinae
    a. Results in marked prolapse of MV leaflets w/ severe regurgitation
    b. Widely radiating pansystolic murmur
    c. Increased LA pressure → more pronounced/prolonged S3
    d. +/- Acute dyspnea, frothy nasal discharge due to pulmonary edema
5. Tricuspid Insufficiency
    a. Harsh, holosystolic plateau murmur; PMI = right AV valve
    b. <u>Most common acquired murmur in cattle</u>, pigs, sheep (secondary to endocarditis)

   c. TR occasionally produces murmur in horse (common in standardbred racehorses)
   d. +/- Prominent jugular pulsations
   e. May be associated w/ high altitude disease in cattle or other causes of PHT
6. Aortic Insufficiency
   a. Long diastolic decrescendo murmur; PMI = left hemothorax. Musical sounding
   b. The most common acquired valvular defect in aged horses
   c. Severe AI may → bounding, "waterhammer" arterial pulses due to diastolic runoff
   d. Echo: guarded – poor prognosis if…
      i. Fractional shortening < 30%
      ii. LA > 16 cm diameter
      iii. Pulmonary artery > aorta
7. Pulmonic insufficiency and stenosis: rare in large animals

Cardiac Arrhythmias

NORMAL Equine ECG

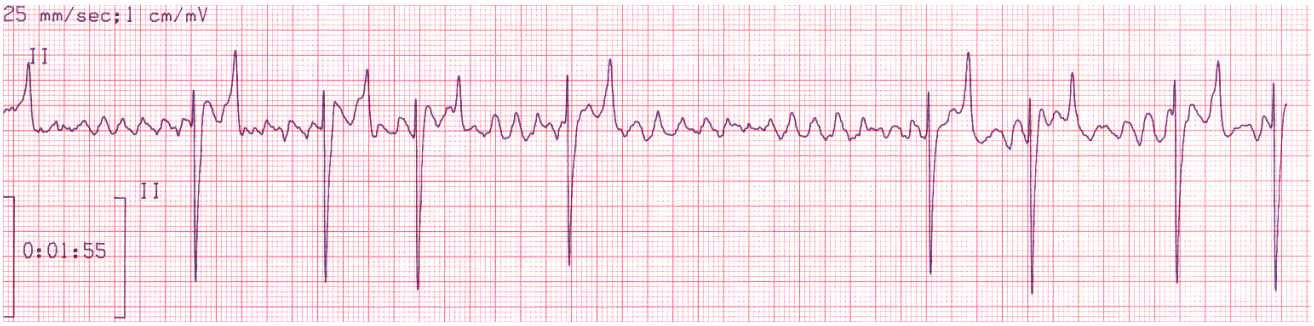
- Heart rate = 30 – 45 BPM at rest
- P Wave: bifid in lead II (can be single/polyphasic, too). Maximum amplitude ~ 0.5 mV. Duration 0.08 – 0.2 seconds
- PR Interval: duration 0.22 – 0.56 seconds
- QRS Complex: lower amplitude and more variation than in the dog. Not enough definitive diagnostic criteria to diagnose ventricular enlargement patterns
- T Wave: usually positive (leads III & aVF) or biphasic (lead II, aVR, aVF). Changes in T waves in normal horses with exercise or excitement
  - T wave changes & ST segment changes: hypoxia, shock, septicemia, toxemia

Normal VARIATIONS in Equine ECG

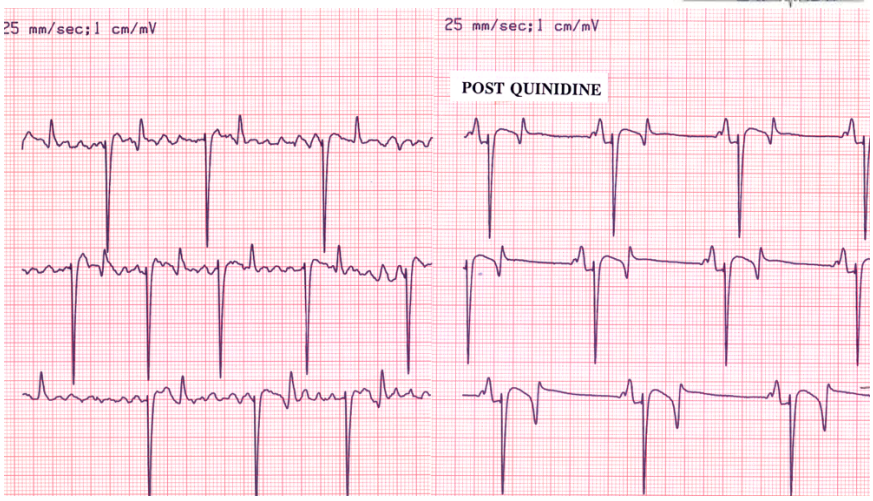
- Sinus Arrhythmia and Wandering Pacemaker: occur in <30% normal horses at rest. Associated with high vagal tone, disappear with exercise or atropine. Not associated with respiration (like in dog)
- Low grade AV block: 1st degree AV block (PR interval > 0.40 sec) & Mobitz Type I (Wenckebach) 2nd degree AV block occurs in <20% of normal resting horses
  - Are considered normal and due to high vagal tone if there are NO associated clinical signs and the rhythm returns to sinus rhythm with exercise, excitement, or atropine
  - High-grade AV block or AV block that persists with exercise = pathologic. Dropping of every other beat/ 2+ beats in succession is NOT normal
- Sinus arrest and Sinoatrial Block: occasional pauses or breaks in normal sinus rhythm (NSR). Pauses usually disappear with exercise or atropine and do NOT require therapy
  - Prolonged sinus arrest can → syncope, sometimes necessitating pacemaker placement

ABNORMAL Rhythms

- Atrial Fibrillation: common in horses, develops in two different populations of horses: (1) young horses of racing age without evidence of other cardiovascular disease, and (2) older horses with loud murmurs and significant cardiac pathology found upon necropsy

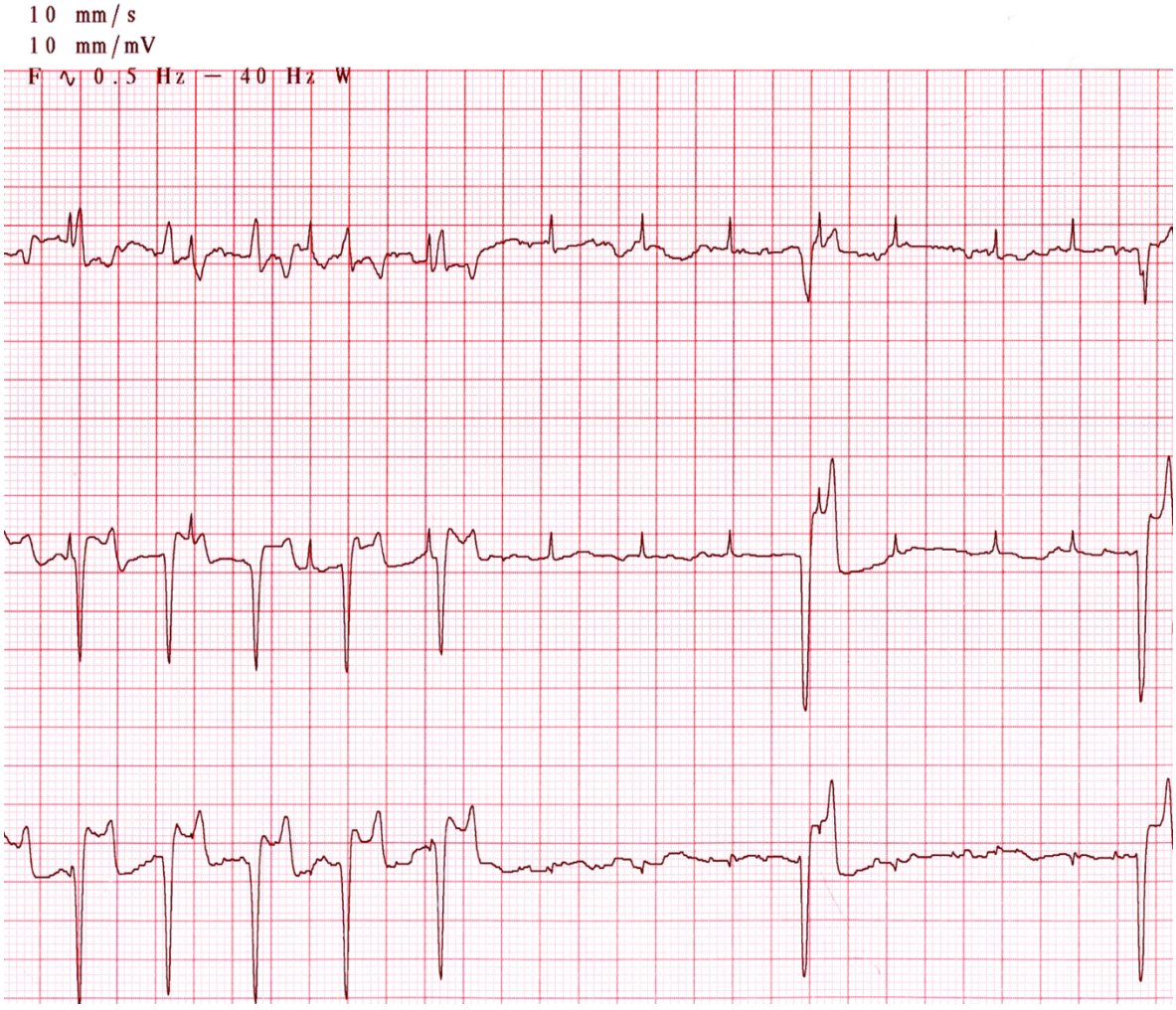


  - Idiopathic atrial fibrillation: young horses, racing age. Present with sudden (an unexplained) loss of stamina
    - Slow and irregular heart rate – may be confused with 2nd degree AV block or sinus arrest on auscultation
    - Absent – soft murmur, usually without signs of heart failure early on
    - Good prognosis for return to NSR with treatment
  - Atrial fibrillation with concurrent heart disease: older horses, usually with loud murmurs of MR or TR
    - Often evidence of heart failure
    - Heart rate tends to be fast (70 – 100 BPM)
    - May present for exercise intolerance, dyspnea, edema, weakness, or collapse
  - Diagnosis: based on physical exam, detection of an irregular heartbeat & pulse. Confirmed by ECG. Evaluate for presence of underlying heart disease via echo
  - Treatment
    - When heart disease is absent – mild: conversion of atrial fibrillation to NSR via Quinidine
      - Decreases automaticity, slows conduction, prolongs effective refractory period of atrial cells
      - Negative inotrope with anti-vagal effects (like atropine)
      - Well absorbed via PO administration through a nasogastric tube
      - New techniques of transvenous cardioversion of atrial fibrillation in horses are beginning to replace oral cardioversion with Quinidine
      - Possible SE: tachycardia, depression, urticaria, edema of nasal mucosa, anorexia, colic, diarrhea, laminitis, seizures, ventricular arrhythmias
      - ONLY give Quinidine if animal has no systemic illness or CHF present



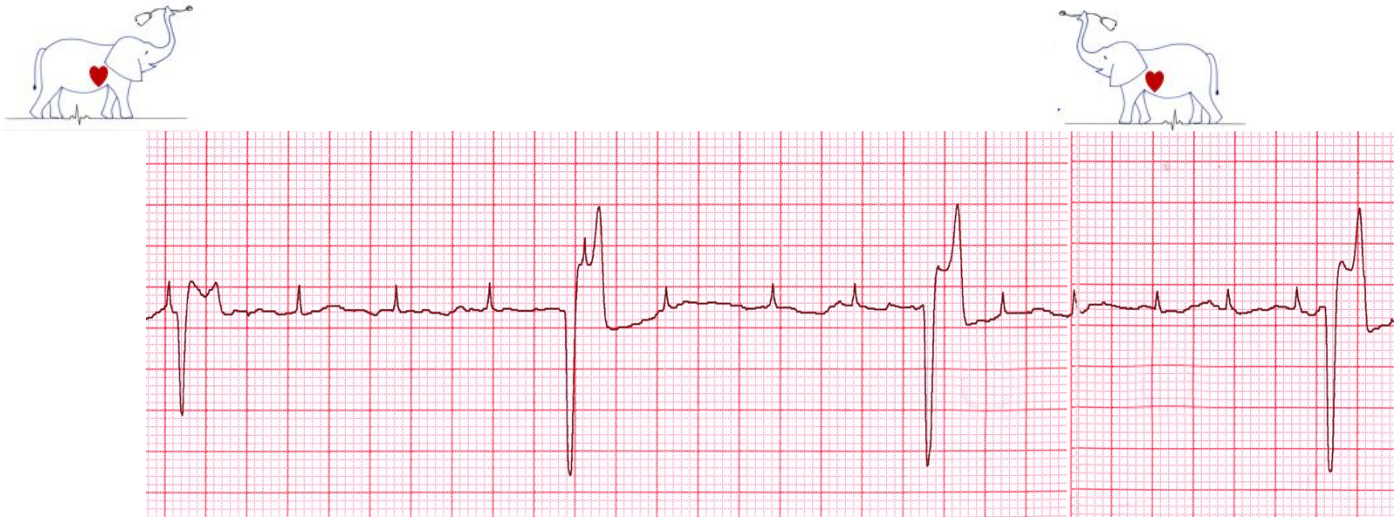
        - When heart disease is present: initiate treatment to relieve signs of CHF and control the ventricular response rate to the fibrillating atria
            - Administer Furosemide IV or IM (0.5 – 1.0 mg/kg) to control edema
            - Maintenance Digoxin BID
    - Prognosis: fair – good when onset is recent and loud murmurs/signs of CHF are absent
        - 75 – 85% of horses with atrial fibrillation will convert to NSR
        - 20 – 30% of converted cases may revert back to atrial fibrillation
        - Prognosis is dependent upon underlying heart disease
        - The longer a horse has been in atrial fibrillation, the greater chance of recurrence (even after cardioversion)
- Atrial and ventricular arrhythmias
    - If consistent or frequent – signs of heart disease (i.e. myocarditis). Can also be associated with…
        - Septicemia
        - Toxemia
        - Acute GI disease
        - Viral or bacterial diseases specific to horses
    - Disease associations in horses
        - Atrial tachycardia develops with myocardial disease
        - Ventricular tachycardia develops with septicemia, toxemia, GI disturbances (non-cardiac causes)
- Atrial Tachycardias
    - Usually managed by digitalization supplemented with Quinidine in refractory cases
    - Lidocaine: causes convulsions in horses so ONLY used at very low doses (0.25-0.5 mg/kg slow IV) if necessary, for ventricular tachycardia (VT)
        - Ensure serum potassium levels are normal prior to administration

- Hypokalemia decreases the effectiveness of lidocaine
  - Magnesium is used to treat quinidine induced torsades de pointes and also refractory ventricular tachycardia



Ventricular tachycardia to third degree AVB in a donkey

- Heart block in Horses
  - Advanced (high grade) 2nd or 3rd degree block = occasional cause of syncope in horses
  - High grade AV block is more common in donkeys/mules (syncope is often mistaken for seizures)



Third degree AV block in a donkey, lead II

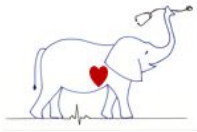
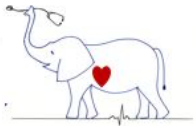
Congenital Heart Defects - EQUINE

Ventricular Septal Defect

- Varies in size, often located in the upper, membranous septum
- Is NOT typically accompanied by another congenital defect (different than bovine VSD)
- Clinical signs are dependent on the severity of the defect
    - Stunted growth
    - Exercise intolerance
    - Heart failure
    - +/- Normal longevity (small defects)
- Physical findings
    - Harsh, holosystolic murmur. Usually accompanied by a thrill
    - PMI = Right 2-4 ICS, radiates
    - +/- Signs of LV failure
    - A high, large VSD can undermine the support of the aortic valve → Aortic Regurgitation → <u>diastolic murmur in addition to the systolic murmur of the VSD</u>
- ECG: normal or suggestive of LVE
- Radiographs
    - Variable, often WNL
    - +/- Generalized cardiac enlargement
    - +/- Enlarged MPA
    - +/- Vascular pattern from pulmonary overcirculation associated with left-to-right shunting
- Cardiac Catheterization
    - Significant shunting
    - Oxygen saturation of the pulmonary artery blood >>>> oxygen saturation of the RA blood
    - Severe cases: RV and pulmonary artery pressures elevated (reactive PHT)

Tetralogy of Fallot

- Clinical presentation

    - Stunting of growth
    - Cyanosis
    - Dyspnea
    - Exercise intolerance
- Physical findings
    - Systolic murmur radiating widely over cardiac area
- ECG: RVE
- Radiographs: RVE
- Cardiac catheterization
    - Elevated RV pressure
    - Normal – low pulmonary artery pressure
    - Low aortic blood oxygenation

Patent Ductus Arteriosus

- Foals: grade II-III/VI continuous murmur, PMI = 3rd – 4th left ICS at level of point of shoulder
    - Heard until 4 - 5 days post birth

Other defects

- Complex cardiac defects reported in Arabian foals
- Atrial septal defect
- Endocardial cushion defects

Congenital Heart Defects – BOVINE

Ventricular Septal Defect

- Often coexists with another heart defect (i.e. truncus arteriosus) – unlike horses
- Two-dimensional and Doppler echo = diagnostic
- Cardiac cath is rarely performed

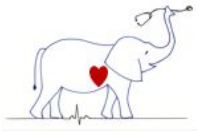
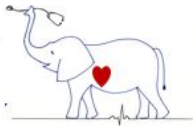
Other defects

- Ectopia cordis: the heart is located most often in the neck
- PDA: usually diagnosed based on characteristic murmur

Acquired Cardiac Diseases

Aortic Valve Insufficiency in the Horse

- Pathology
    - Diffusely thickened aortic valve OR nodules/bands affecting valve
    - Nodules = most common, loose fibrous connective tissue, fibroblast abundant
- Clinical Signs
    - Diastolic decrescendo murmur, PMI = L heart base
    - +/- Bounding pulses

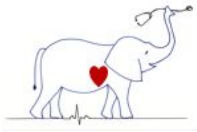
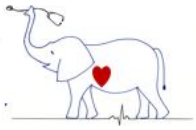
    - CHF & cardiomegaly in <u>older</u> animals (after peak working years)
- Diagnosis
    - Based on physical exam
    - ECG suggestive of L heart enlargement
    - Echo to document aortic insufficiency
    - Presence of fever/leukocytosis/peripheral embolization → <u>consider bacterial endocarditis</u>
- Treatment
    - Most affected horses are NOT symptomatic, are old and not being worked
    - No adequate therapy
    - If CHF - Digitalis and diuretics
- Aortic valve more commonly affected than mitral valve

Mitral Valve Insufficiency in the Horse

- Pathology
    - Localized or diffuse thickening, nodular thickening OR combination of lesions
    - Diffuse fibrous thickening = most common
- Clinical Signs
    - Most affected horses are asymptomatic
    - Middle – older age: can be severe enough to → exercise intolerance +/- CHF
    - Grade III+/VI plateau-shaped holosystolic murmur, PMI = mitral area, radiating to right side
- Diagnosis
    - Based on physical exam
    - Echo to support: L heart volume overload <u>in absence of AI</u>
    - Normal Thoroughbreds: small amount of MR/TR present, especially after training
    - Mitral valve prolapse can occur with MR (less severe than degenerative valvular disease)
- Prognosis
    - Good: mitral insufficiency rarely → CHF in horse
    - If progression to CHF occurs = poor prognosis
        - Poor oral absorption of diuretics & ACE-inhibitors

Ruptured Chordae Tendinae in the Horse

- Chordae tendinae: anchor valve cusps to papillary muscles
- Rupture → grossly incompetent valve
- Large volume of blood regurgitated into LA during systole → decreased CO, increased LVEDV & LVEDP → pulmonary congestion & fulminant life-threatening edema = LCHF
- +/- Sudden death
- Causes of ruptured MV chordae
    - Blunt trauma
    - Severe physical exertion
    - Underlying primary MVD

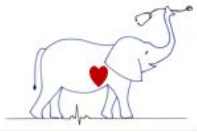
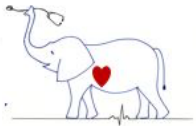
- Clinical signs
    - Acute dyspnea with white foamy discharge from nostrils
    - Loud pansystolic murmur, PMI = MV, usually with palpable thrill
    - Decreased CO → signs of low output heart failure or CV collapse
- Diagnosis
    - Echo to visualize severe MR and a flail MV leaflet
    - Radiographs may show pulmonary infiltrates from LCHF
- Prognosis
    - Grave: most animals will be euthanized for fulminant CHF

Aorto-Cardiac Fistula (Ruptured Sinus of Valsalva) in the Horse

- Acquired cardiac fistula
- Middle-aged, breeding stallions
- Occurs suddenly → rapid death or severe distress
- Clinical signs
    - Acute collapse
    - Respiratory distress
    - Severe exercise intolerance
    - Continuous (PDA-like) murmur, PMI = R 4th ICS
- Diagnosis
    - Rupture should be suspected in breeding stallions with characteristic continuous murmur and appropriate clinical signs
    - Echo to confirm diagnosis: visualize fistula from R aortic sinus with continuous left→ right shunting from LVOT → RV or RA
    - ECG may show unifocal ventricular tachycardia
- Treatment
    - Supportive therapy – complete rest
    - Furosemide
    - Ventricular antiarrhythmics or digoxin
- Prognosis
    - Usually grave: survival time = 24 hr. – 4 yr. (if able to stabilize)
    - Sudden death possible

Bacterial Endocarditis in Ruminants

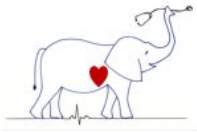
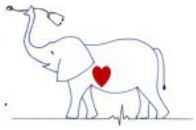
- Degenerative valvular disease = uncommon in ruminants
- In ruminants: bacterial endocarditis appears as vegetative lesions, mostly on the right side of circulation – Tricuspid and Pulmonic valves
- Pathogenic Organisms (vary w/ species)
    - Horse: *Streptococcus, Actinobacillus, Pasturella*
    - Cattle & Goats: *Arcanobacterium pyogenes, Streptococci*
    - Swine: *Erysipelothrix rhysiopathiae, Streptococci*
    - Lambs: *Enterococci*
- Clinical Signs

  - Recurrent fever
  - Anorexia
  - Weight loss
  - Poor milk production
  - Shifting leg lameness
  - Tachycardia
  - Tachypnea
  - History of traumatic reticuloperitonitis or pneumonia
  - 1/6 cases admitted with primary complaint of heart disease
- Physical Examination: nonspecific and non-localizing
  - Systolic murmur *may* be present over TV and PV
  - Diastolic murmur of PI *may* be present
  - Jugular distension & jugular pulses together with distension of mammary veins *may* be observed → development of ventral edema, ascites, cachexia
- Diagnosis
  - History, physical signs (murmur, fever), positive blood cultures
  - Echo visualization of vegetative lesions
  - Leukocytosis
  - Neutrophilia
  - Lymphopenia
  - Hyperglobulinemia
  - Anemia due to chronic infection
- Treatment
  - High dose antibiotics 4-6 wk. (penicillin or ampicillin) unless c/s indicate otherwise
- Prognosis
  - Varies with stage of disease
    - Early (no heart failure): fair
    - Heart failure present: guarded – poor

Myocardial Disease in the Horse

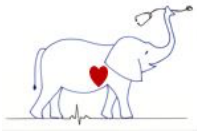
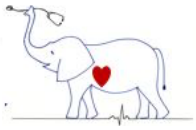
- Primary myocardial disease = cardiomyopathy, not well documented in horses
- Myocardial failure in the horse = most commonly from ingestion of monensin
- Myocarditis (w/o CHF) = most frequently recognized myocardial disease in the horse
- <u>Myocarditis</u>
  - Inflammatory or degenerative myocardial lesions found in 2-15% necropsied horses
  - Bacterial, viral, or parasitic causes (*Streptococcus equi*, influenza, purpura hemorrhagica, equine infectious anemia, strongyle larvae)
    - Strongyle larvae damage aortic root → microemboli → arteriosclerosis & myocardial necrosis
  - Other causes: endocarditis, thoracic/abdominal abscessation, guttural pouch infections, colic, toxemias

    - EHV-1 → myocarditis = well documented in aborted equine fetuses
    - Clinical signs = often absent
        - Decreased performance
        - Dyspnea on exertion
        - Tachycardia disproportionate to fever
        - Arrhythmias
        - Murmurs
        - Loud gallop sounds
        - Fainting/collapse
        - Sudden death: reported in horses recently recovered from strangles/influenza
        - Development of CHF
    - Treatment: directed at primary illness (cause of myocarditis)
        - Stall rest for 4 – 6 mo.
        - Antiarrhythmic therapy if serious arrhythmia is detected
        - Digitalis & diuretics if CHF present
- <u>Monensin toxicosis</u>
    - Horses = more sensitive to monensin than cattle, develop cardiac signs if ingest treated cattle feed
    - Clinical signs
        - Acutely affected
            - Abdominal pain
            - Diarrhea
            - Acute circulatory failure
            - Death
        - Delayed syndrome: 3 – 6 mo. post-ingestion
        - Necropsy
            - Myocardial degeneration
            - Pericardial effusion
            - Evidence of heart failure
    - Treatment: supportive, myocardial damage is irreversible
- <u>White snakeroot intoxication</u>
    - Ingestion → severe myocardial degeneration, hemorrhages, infarcts
    - Arrhythmias & sudden death = frequent sequelae

Myocardial Disease in Cattle

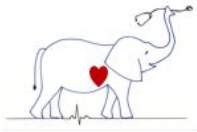
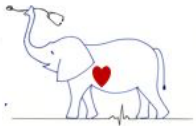
- Cardiomyopathy is rare in cattle
    - Bovine DCM reported in some breeds
- Myocardial disease in cattle is typically secondary to…
    - Systemic infection
        - Pneumonia
        - Traumatic reticulopericarditis

        - Neonatal infection
        - Mastitis
    - Nutritional deficiency
        - Vitamin E
        - Selenium
    - Neoplastic infiltration
        - Lymphosarcoma
    - Ingestion of toxins
        - Monensin
        - Gossypol
        - White snakeroot
        - Cassia occidentalis
- Clinical syndromes will vary (sudden death – chronic CHF)

Traumatic Pericarditis in Cattle

- Most common cause of CHF in cattle
- Perforation or migration of a foreign body (i.e. wire) into the pericardial sac. Disease course varies from few d. – few wk./mo.
- Pathology
    - Significantly thickened pericardial sac
    - Adhesions between pericardium & diaphragm and pericardium & epicardium
    - +/- Visualize foreign body
    - Variable amounts of pus, fibrin, gas
- Clinical signs: signs reflect presence of infection due to reticuloperitonitis with evidence of cardiac tamponade
    - Depression, anorexia, weight loss
    - Diarrhea, constipation, rumen atony
    - Decreased milk production
    - Arched back, abducted elbows, pain
    - Fever, tachycardia, tachypnea
    - Venous distension of the jugular and mammary veins
    - Ventral and cervical edema, ascites later in disease course
- Physical findings
    - Early in disease: pericardial friction rub may be present
    - Later in disease
        - Pericardial effusion develops → muffled heart sounds
        - Gas and fluid accumulate → splashing, tinkling, gurgling sounds synchronous with heartbeat
- Diagnosis
    - Rule outs
        - Heart failure from congenital defects
        - Infective endocarditis
        - Altitude sickness (PHT)

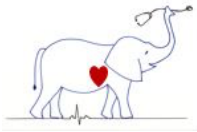
        - Lymphosarcoma
        - Other myocardial diseases
    - To confirm diagnosis
        - Echo
        - Pericardiocentesis at 4^{th} – 5^{th} ICS on Left side (idiopathic effusions can occur and will often resolve)
- Treatment
    - Drain pericardial sac when heart failure is present
        - Pericardiocentesis
        - Instillation of antibiotics, debriding enzymes, placement of pericardial drain/surgical exposure and drainage
- Prognosis = poor

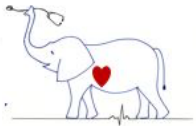
Pericardial Disease in the Horse

- An "epidemic" of pericarditis and mare reproductive loss in Spring-Summer of 2001 in Kentucky (previously very rare). *Actinobacillus* sp. were the principal isolates
    - Cause of outbreak: "Septic penetrating setal emboli (SPSE)" from infestation of eastern tent caterpillars
- Clinical signs
    - Fever, anorexia, lethargy
    - Muffled heart sounds +/- pericardial friction rub
    - Signs of RCHF
        - Jugular distension
        - Jugular pulses
        - Ventral edema
        - Ascites
        - Pleural effusion
        - Tachycardia
- Diagnosis
    - Rule out other causes of RCHF
    - Rule out pleural effusion due to pleuritis
    - Echo or successful pericardiocentesis to confirm diagnosis
    - Can measure RA pressure before and after pericardiocentesis
    - +/- Low voltage QRS complexes or electrical alternans on ECG (not as helpful in diagnosing as in small animals)
- Treatment
    - Signs of systemic congestion: drain and lavage pericardial sac
    - Systemic antibiotics, sometimes even if negative culture
    - If large number of eosinophils OR if infectious etiology is excluded → consider corticosteroid therapy

Neoplasia

- Lymphosarcoma = most common neoplasia of the heart in cattle





- Consider as a differential diagnosis for most cardiac diseases in cattle
- Less frequent in horse – if it occurs, may include heart