Case Studies in Cardiac Therapy
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Agenda
1st Hour
- End-stage Hypertrophic Cardiomyopathy
- ARVC and Ventricular Arrhythmias
- Patent Ductus Arteriosus
2nd Hour
- Pulmonary Hypertension
- Pericardial Effusion
- K 9 Syncope and Acute CHF

Case 1: Theo
- Signalment
  - 16.5 year old M/C DSH
  - 12 lbs.
- History
  - Has been a patient of CVCA since 2007
  - Initially diagnosed with HOCM in 2007 and treated with Atenolol
  - Progressive left atrial dilation over the next four years
    - Enalapril and aspirin therapy initiated

History Continued
- Severe pancreatitis bout in 2011—went into CHF secondary to metabolic derangement and IV fluid therapy
  - Small dosage of Lasix initiated at this time
  - Did well for about 3+ years
  - Developed hyperthyroidism in the interim
    - Well managed on Methimazole
  - GI small cell LSA diagnosed one year ago
  - Represented about 2-3 weeks ago with dyspnea

Physical Examination
- HR 156 and regular
- Grade II/VI systolic murmur over the left sternal border
- Gallop rhythm
- Breath sounds muffled ventrally
- RR 44 with mild abdominal push
- ABD: NSF—could no longer palpate GI mass; small renal structures

Radiographs
- Right lateral thoracic radiograph
  - Exam Date: 7/28/2014
Diagnosis:

- "Burnt out" hypertrophic cardiomyopathy
- Congestive heart failure: pleural effusion/pericardial effusion
- Hyperthyroidism is likely an exacerbating factor
- Recent labs: BUN 60, CREA 2.7, T4 1.3
- Current medications:
  - Benazepril 2.5 mg SID
  - Clopidogrel 18.75 mg SID
  - Furosemide 5 mg SID
  - Atenolol 3.125 mg SID
  - Prednisone 2.5 mg SID
  - Methimazole 2.5 mg BID

Considerations

- Azotemia
- Hyperthyroid status
- Lymphoma
Therapy
- Thoracocentesis?
- Furosemide: What to do?
- Benazepril: What to do?
- Methimazole: What to do?
- Atenolol, Clopidogrel?
- Pimobendan?

Plan
- Start Pimobendan 1.25 mg BID (or Tinytabs)
- Decrease Benazepril to 1.25 mg SID
- Continue Atenolol and Clopidogrel
- Try to decrease Prednisone
- Increase Lasix to 10 mg BID for 72 hours and then 5 mg BID
- Decrease Methimazole to 2.5 mg SID or 1.25 mg BID
- Recheck renal/T4 and chest rads in 7-10 days
- Owner to closely monitor appetite and RR/RE

Case 2: Corrado
- 6yr M/N Boxer
- History of episodic weakness/“dazed” look with exertion
- Acute onset collapse today at dog park

Physical Exam
- BAR
- MM pink/moist, CRT < 2 sec
- HR 136 bpm, irregular rhythm with frequent extrasystoles
- Pulses strong/symmetrical/deficits associated with extrasystole
- Eupneic, normal BV sounds in all fields

ECG
- Sinus rhythm with frequent singlet and couplets BV origin VPCs
- Non-sustained rapid VT (300 bpm)
- R-on-T phenomenon

Ventricular Ectopy: Causes and Considerations
- Cardiac Disease – ARVC, DCM, HCM, SAS, tumors, etc.
- Drugs
  - Digoxin
  - Pro-arrhythmic effect of anti-arrhythmic
  - Stress/Anxiety (catecholamine release)
- Abdominal disease – splenic mass, adrenal mass, GDV, other
- Hypoxemic states
- Metabolic derangements – acidosis, electrolytes
- Circulating cytokines – neoplasia, SIRS, major illness/trauma
- Myocarditis – traumatic, infectious (tick-borne, toxo, Chagas)
- Idiopathic

Ventricular Ectopy: Causes and Considerations
- Signalment/At-Risk Breed
- Other evidence of cardiac or non-cardiac disease
- Tick exposure
- Hx of exercise intolerance, pre-syncope, syncope
- Diagnostics to Consider:
  - CBC, Chem, UA, T4
  - Echo
  - Chest Radiographs (mets?, general heart size?)
  - Holter
  - Abdominal Ultrasound
  - Tick Titters (prefer NCSU panel, incld. Bartonella)
  - Troponin I (evidence of myocarditis?)
  - Genetic testing
**Presumptive Diagnosis**
- Arrhythmogenic Right Ventricular Cardiomyopathy (ARVC)
- Adult-onset primary myocardial disease
- Myocardium replaced by adipose +/- fibrous tissue
- Autosomal dominant with incomplete penetrance
- Striatri gene mutation (Hum Genet 2010;128:315-324)
- Codes for a protein localized to the intercalated disc that co-labels to several desmosomal proteins

http://www.cvm.ncsu.edu/vhc/csds/vcgl/documents/ARVC.pdf

**ARVC**
- Presents in 1 of 3 forms
  - Concealed
  - Overt
  - DCM phenotype
- Association with striatim mutation
  (JCM 2012;27:1437-1440)
- Definitive Dx = myocardial biopsy
- Presumptive Dx
  - Signalment (Boxer, Bulldog)
  - Family Hx of disease
  - Presence of ventricular tachycardia
  - Clinical signs (syncope, exercise intolerance)
  - Diagnosis of exclusion

**Ventricular Arrhythmia:**
When to Treat? Life-threatening?
- Signs of hemodynamic compromise
  - Pale MM, poor pulse quality
  - Hypotension
  - Lethargy, depression, syncope
- Risk for sudden death due to severity of arrhythmia or presence of structural cardiac disease
- ECG
  - R-on-T phenomenon
  - Rate > 180 bpm
  - Multifocal VPCs
- Holter
  - >5000 VPCs/24hr
  - >20 VPCs/min
  - Complexity of arrhythmia
  - Couplets, Triplets, Runs, VT

**ER Tx of Ventricular Tachycardia**
- Lidocaine (Class Ib)
  - 2 mg/kg IV slow bolus (-1 ml per 20 # with 2% Lidocaine)
  - Can give up to 8 mg/kg total
  - CRI 40-80 mcg/kg/min
  - Side Effects - vomiting, CNS depression or excitation (seizures)
- Procainamide (Class Ia)
  - 5-8 mg/kg over 4-5 min (stop when rhythm converts)
  - Can give up to 20-40 mg/kg
  - CRI 10-50 mcg/kg/min
  - Side Effects - hypotension, AV block, GI upset
- Sotalol (mixed Class III)
  - 1-3 mg/kg PO BID
  - *Ideally lower systolic function
  - Side Effects – bronchospasm, hypotension, lethargy, AV block, vomiting, negative inotropic

**ER Tx Not Effective?**
- VTach vs SVT with aberrancy
- Vagal maneuver change rhythm?
- What is HR? AVRT?
- Lidocaine = use-dependent drug
- Sotalol = reverse-use-dependent drug
- What is potassium?
- Class I drugs less effective when K+ low (or low normal)
- What is magnesium?
- MgSO4 30 mg/kg IV slow
- Other therapy options?
  - Provide supplemental O2
  - Coronary perfusion occurs during diastole, is decreased at rapid HR
  - Esmolol
  - Amiodarone
  - DC Cardioversion

Sinus rhythm with LBBB

**ARVC**
Long-Term Treatment
- Medications
  - Sotalol (1-3 mg/kg PO BID)
  - Mexilitine (5-8 mg/kg PO TID) +/- Atenolol or Sotalol
- JAVMA 2002;221(4):522-527
- Tx with sotalol or mexilitine-atenolol well tolerated and efficacious
  - Tx with procainamide or atenolol not effective
- Omega-3 Fatty Acids (EPA 40 mg/kg/d, DHA 25 mg/kg/d)
- Holter 2-4 weeks after starting therapy, then q6mo.
  - Controlled arrhythmia? Pro-arrhythmic effect?
What if this is the radiograph?
- Mexilitine
  - 5-8 mg/kg TID
- Pimobendan
  - 0.2-0.3 mg/kg BID
- +/- Enalapril
  - 0.5 mg/kg BID
- Omega 3 Fatty Acids
  - EPA 40 mg/kg
  - DHA 25 mg/kg

Syncopal Boxers, The Challenge
- Neurocardiogenic Syncope in Boxers with VT
  - AKA - neurally-mediated, vasovagal, vasodepressor
- Pathophysiology incompletely understood
  - Episodes triggered by activities that result in sympathetic or parasympathetic surge
  - Final common pathway is afferent vagal stimulation of the medullary vasomotor center → sympathetic withdrawal and accentuated vagal efferent traffic
- Treatment is problematic
  - Beta-blockers usually aggravate
  - Avoid instigating situations
  - Pacemaker?
  - Anticholinergics ill-advised in patients with VPCs

6yr Male Boxer
- JVIM 2008;22:931-936
- Several syncopal events between 1-5 yr of age
- Associated with exertion coupled with excitement
- During Holter, collapse associated with sinoatrial arrest
- Tx = Mexiltil and activity restriction

Ventricular Ectopy – Post-Op
- Post Abdominal Surgery
- Routinely misinterpreted
  - Slow ventricular tachycardia (HR 100-160 bpm)
    - AKA Accelerated idioventricular rhythm (AIVR)
    - Typically uniform, consistent coupling, no R-on-T
    - Alternates with NSR of similar rate
    - MOA = Competitive ventricular focus (enhanced automaticity)
- When to treat?
  - Hemodynamic compromise
  - Heart rate >160 bpm and/or R-on-T

What’s your diagnosis?
- Conduction aberrancy - RBBB
- LV depolarizes normally, RV slow to depolarize
- QRS upside down and wide
  - Conduction moves cell-to-cell

Case 3: Daisy
- 10 month old F/I mixed breed dog
- Adopted from shelter
- New murmur at first wellness visit
- Seems more tired than average puppy, otherwise asymptomatic
Physical Exam

- MM pk/moist, CRT <2 sec
- Gr 5/6 continuous murmur PMI left base/axilla
- HR 108, regular rhythm, femoral pulse character hyperdynamic/synchronous/symmetrical
- Eupneic/panting

Radiographs

Echocardiogram

Echocardiogram

Transarterial ductal occlusion using the Amplatz®
Canine Duct Occluder In 40 dogs

ACDO
Post-op Radiograph


A.B. Sanderson, S.C. Gordon, M.M. Beggans, and W.W. Miller

Background: Previous articles regarding survival and long-term outcome following patent ductus arteriosus closure utilized only a small number of patients. The purpose of this study was to quantify the long-term outcome and estimate postoperative survival data in a large number of dogs with PDA closure.

Methods: Medical records of 520 dogs that underwent PDA closure from 1994-2009 were evaluated for survival data. Median survival was calculated for dogs that were included or not included in the study.

Results: Median survival in 24 dogs with uncomplicated PDA was >11.5 years after ductal occlusion. Survival time was significantly longer with PDA closure (168 months) compared with dogs that were not excluded (114 months).


Survival time was significantly longer with PDA closure (168 months) compared with dogs that were not excluded (114 months). J Am Vet Med Assoc 2013;242:1722–1726.

Case 4: Sweet Pea

10yr F West Highland White Terrier

History of mild, progressive exercise intolerance and chronic dry/harsh coughing, usually when first waking in AM and with excitement/activity/exertion

Physical Exam
- MM pink/moist, CRT <2 sec
- HR tachy, regularly irregular rhythm consistent with sinus arrhythmia, femoral pulses SSS, no auscultable murmur
- RR 24, coarse crackles throughout all fields, normal respiratory pattern and effort
- BP 132 mmHg

Radiographs

Normal cardiac silhouette, mild caudal lobar PA dilation, diffuse moderate-severe bronchointerstitial pattern, scalloped lung borders with thickened pleural lining

Cardiac vs Respiratory

<table>
<thead>
<tr>
<th>Cardiac</th>
<th>Respiratory</th>
</tr>
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<tbody>
<tr>
<td>Cough</td>
<td>Soft +/- productive</td>
</tr>
<tr>
<td></td>
<td>Occurs at rest/Wake up to cough</td>
</tr>
<tr>
<td></td>
<td>Hard/barking/hacking</td>
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<tr>
<td></td>
<td>Occurs w/ activity/excitement, 1st AM</td>
</tr>
<tr>
<td>Activity</td>
<td>+/- Exercise intolerance</td>
</tr>
<tr>
<td></td>
<td>Normal</td>
</tr>
<tr>
<td>Weight/BCS</td>
<td>+/- Weight loss</td>
</tr>
<tr>
<td></td>
<td>+/- Obese</td>
</tr>
<tr>
<td>Lungs Sounds</td>
<td>Normal +/- BI sounds</td>
</tr>
<tr>
<td></td>
<td>+/- Soft crackles (dyspneic)</td>
</tr>
<tr>
<td></td>
<td>Normal +/- BV sounds</td>
</tr>
<tr>
<td></td>
<td>+/- Loud crackles (eupneic)</td>
</tr>
<tr>
<td></td>
<td>+/- Wheezes</td>
</tr>
<tr>
<td>RR/RE/Pattern</td>
<td>Usually short, rapid, deep +/- abdominal effort</td>
</tr>
<tr>
<td></td>
<td>Exaggerated, prolonged expiration +/- exp. abd. Puls may be normal</td>
</tr>
<tr>
<td>HR/Rhythm</td>
<td>Normal to Sinus Tachycardia</td>
</tr>
<tr>
<td></td>
<td>Normal - slow</td>
</tr>
<tr>
<td></td>
<td>Normal +/- ESA</td>
</tr>
<tr>
<td>Murmur</td>
<td>Open L apex in dogs</td>
</tr>
<tr>
<td></td>
<td>+/- Cor pulmonale, Concurrent cardiac disease (R vs L?)</td>
</tr>
<tr>
<td>CXR</td>
<td>Interstitial to alveolar pattern</td>
</tr>
<tr>
<td></td>
<td>(Perihilar - Cd-D, R then L - Cr-V)</td>
</tr>
<tr>
<td></td>
<td>LAE</td>
</tr>
<tr>
<td></td>
<td>Bronchial, Broncho-interstitial pattern</td>
</tr>
<tr>
<td></td>
<td>Per-bronchial enhancement</td>
</tr>
<tr>
<td></td>
<td>BHE pattern</td>
</tr>
</tbody>
</table>
Diagnosis

- Echo
  - Normal left cardiac dimensions and systolic function
  - Prominent right heart, mild PA dilation, Type II PA profile
  - Evidence of at least mild pulmonary hypertension
  - Further diagnostics recommended, but declined

- Treatment Plan
  - Doxycycline 5 mg/kg PO BID
  - Theophylline 5 mg/kg PO BID
  - Tussigon 0.25-0.5 mg/kg PO up to QID PRN

Common Causes of PHT

<table>
<thead>
<tr>
<th>Primary</th>
<th>Rare</th>
</tr>
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<tbody>
<tr>
<td>Increased PVR (ie. L-sided heart disease)</td>
<td>L-sided heart disease– increased resistance to pulmonary venous drainage</td>
</tr>
<tr>
<td>Lung disease +/- hypoxemia</td>
<td>COPD Interstitial lung disease</td>
</tr>
<tr>
<td>+/‐ Hypoxemia = potent pulmonary vasoconstrictor</td>
<td></td>
</tr>
<tr>
<td>Thrombotic/Embolic disease</td>
<td>PTE Heartworm disease Neoplasia</td>
</tr>
<tr>
<td>Increased pulmonary blood flow</td>
<td>L-R shunt (ASD, VSD, PDA) Increased CD (anemia, fever, exercise – usually mild PHT)</td>
</tr>
</tbody>
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6mo Later

- Recheck – Symptomatic
  - Progressive exercise intolerance, episode of weakness
  - Cough controlled
  - Mild increase in expiratory RE with slight abdominal push

- Physical Exam
  - New soft Gr 2/6 systolic murmur, PMI TV
  - 3 distinct heart sounds
  - Otherwise stable findings

Estimation of Pulmonary Pressures

- Modified Bernoulli equation, $PG = 4v^2 + P_{RA}$
  - TR Jet – 6.28 m/sec = 158 mmHg
  - PI Jet – 3.48 m/sec = 48 mmHg

Recheck Echo

*Cor pulmonale = pathologic effects of lung dysfunction on the heart, namely the RV (hypertrophy and dilation)*

Updated Treatment Plan

- Continue Theophylline
- Continue Tussigon PRN
- Start Viagra 1-3 mg/kg PO TID
  - Highly selective PDE V inhibitor
  - Pulmonary arterial vasodilator
- Start Plavix 1-3 mg/kg PO QD

- Future Considerations
  - Flovent vs oral prednisone
  - Pimobendan
  - Amlodipine
  - Lasix (R-CHF)
  - Piroxicam (anecdotal)
Case 5: Lily

- 12yr M Golden Retriever
- History of anorexia and exercise intolerance x 2 days
- Today, unable to rise

Physical Exam
- MM pale/moist, CRT 2 sec
- Muffled heart sounds, no obvious murmur
- HR 160, regular tachycardia with femoral pulses variable and weak/synchronous/symmetrical
- Mild tachypnea, normal BV sounds throughout all fields
- Mild abdominal distension and cranial organomegaly
- BP 90 mmHg

Diagnostics

Pericardial Effusion

- Pathophysiology
  - Elevation of diastolic pressures with progressive limitation of filling leading to reduced SV and CO
  - Venous pressure increased to maintain cardiac filling and prevent collapse of chambers
  - Systemic capillaries leaky at 15-20 mmHg → R-CHF
  - Pulmonary capillaries leaky at 25-30 mmHg

PCE DDx

- Dogs
  - Neoplasia (HBT, HSA, pericardial mesothelioma, LSA), idiopathic, LA rupture, CHF, coagulopathy, vasculitis, PPDH
  - Pericardiocentesis CAUTION
    - Acute collapse + hypotension + previously loud murmur no longer auscultable → concern for LA rupture
- Cat
  - FIP, CHF, systemic infection, vasculitis, ARF/CRF, neoplasia, pancreatitis
  - Pericardiocentesis CAUTION
    - CHF – sudden increase in venous return and volume overload resulting in acute (often fulminant) pulmonary edema

Suspected Idiopathic PCE

Heart Base Tumor

(Chemodectoma vs Thyroid Carcinoma vs HSA vs LSA vs Other)
Heart Base Tumor

Normal heart/pulmonary vessels, diffuse bronchointerstitial pattern, dorsal deviation of tracheal cranial to carina with no obvious mass. Skin masses.

Right Atrial Mass

LA Rupture

Pericardial Mass

T-FAST / Echo

- Confirm PCE and tamponade
- User-Dependent
  - High Se/Sp for detection for diagnosis and differentiation of RA mass vs HBT (Cardiologist) (JVIM 2013;27:1092-1096)
  - 82% Se/100% Sp for cardiac mass
  - 82% Se/99% Sp for RA mass
  - 74% Se/98% Sp for heart base mass
- Presumptive Echo Dx of Cardiac Tumor (JVIM 2013;27:1092-1096)
  - HBT (CD, ETC, LSA) – 78% Accurate
  - RA Mass (HSA) – 50% Accurate
PCE Analysis and Cytology

- JAVMA 2009:235(12):1456-1461
  - 13% - Cause identified
  - 5 infective pericarditis, 1 LSA
  - 85% - Classified as hemorrhagic
  - Suppurative inflammation > Pyogranulomatous inflammation > Modified transudate > Chyloous effusion
  - 53% - mesothelial reactivity identified

- JVIM 2014;28:66-71
  - Diagnostic Cytology – 8%
    - Neoplastic - round cell neoplasia (LSA, histiocytic, undetermined), carcinoma, atypical epithelial, hemic neoplasia
    - Infectious – bacterial and fungal
  - Non-diagnostic Cytology – 92%

Cardiac Troponin I (cTnI – pretap)

- Comparison of plasma cTnI among dogs w/ cardiac HSA, non-cardiac HSA, other neoplasms, PCE of non-HSA origin
  (JAVMA 2010;237(7):806-811)
  - cTnI >0.25 ng/mL – used to ID PCE due to cardiac HSA
    - 81% Se and 100% Sp

- Utility of cTnI in differentiating b/w underlying etiologies of PCE in K9 patient
  (ACVIM Forum 2011 Abstract)
  - HSA vs HBT vs Idiopathic
  - cTnI >0.78 ng/mL
    - 67% Se/95% Sp for HSA
  - Not reliable to DDx HBT vs. Idiopathic

Pericardiectomy

- Indications
  - Multiple centesis fail to resolve effusion
  - Pericardial constrictive disease suspected
  - Exploration and biopsy needed

  - Idiopathic PCE
    - Window had shorter DFI and MST compared to subtotal
    - Subtotal 3yr survival - 100% (histologic Dx - pericarditis)
    - Window MST - 13 mo
  - Neoplastic PCE
    - DFI and MST not significantly different
    - Subtotal MST - 4 mo
    - Window MST - 3 mo

- Heart Base Tumors (JAVMA 2001;219(4):485-487)
  - Pericardiectomy provided significantly longer MST compared to medical management
    - 661 days vs 129 days

Case 6: Katie

- 12 yr-old F/S Yorkie
- History of low-grade, chronic cough
- Long-standing heart murmur
- 6 week history of exertional collapse
  - Running up stairs
  - Owners coming home
  - Outside
  - Progressive, now with minimal exertion and coughing
- Presented to neurology for seizure workup

Physical Exam

- Grade 4/6 systolic murmur, PMI MV
- Strong, synchronous, symmetrical femoral pulses
- HR 124 bpm
- RR 28 breaths/min, normal respiratory pattern
- Normal BV sounds throughout all lung fields
**Seizure vs. Syncope**

*Syncope occurs when CBF <30-50%*

<table>
<thead>
<tr>
<th>Seizure</th>
<th>Syncope</th>
</tr>
</thead>
<tbody>
<tr>
<td>No precipitating event</td>
<td>Precipitating event common</td>
</tr>
<tr>
<td>Often occur at rest/sleep</td>
<td>Exercise, stress/startle, cough/gag, deglutition, micturition/defecation, pain</td>
</tr>
<tr>
<td>Tonic/Clonic type seizure with quick loss of consciousness, twitching, rigidity progressing toward overt convulsive behavior/padding</td>
<td>Opisthotonus, Extensor rigidity common Or, Flaccid collapse Usually no paddling – can be mistaken for pet trying to “right” themselves</td>
</tr>
<tr>
<td>Urination/defecation</td>
<td>Occasional urination Defecation, Hypersalivation uncommon</td>
</tr>
<tr>
<td>Post-ictal phase, Disorientation</td>
<td>Usually normal post event, Rapid recovery Slow recovery possible with prolonged cerebral hypoxia</td>
</tr>
<tr>
<td>Slow recovery</td>
<td>&quot;Normal Event&quot;</td>
</tr>
<tr>
<td>Vocalization</td>
<td>Vocalization</td>
</tr>
</tbody>
</table>

**Cardiogenic Syncope**

<table>
<thead>
<tr>
<th>Type</th>
<th>Usual Association</th>
</tr>
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<tbody>
<tr>
<td>Arrhythmia</td>
<td>Sick sinus syndrome, Atrial fibrillation, any SVT V-Tach Heart block Atrial Standstill</td>
</tr>
<tr>
<td>Impaired Cardiac Output</td>
<td>DEM End-stage DVD, HCM Myocarditis Myocardial infarction</td>
</tr>
<tr>
<td>Poor Myocardial Function</td>
<td>HCM, RCM</td>
</tr>
<tr>
<td>Impaired or Obstructed Cardiac Filling</td>
<td>Cardiac tamponade Constrictive pericarditis Tumor</td>
</tr>
<tr>
<td>Outflow Obstruction</td>
<td>SAS/AS or PS HCM Pulmonary hypertension Intracardiac tumor or thrombus</td>
</tr>
</tbody>
</table>

**Reflex-Mediated Syncope**

- Neurocardiogenic, Neurally-mediated, Vaso-vagal, Vaso-depressor
- Rarely fatal
- Cardiovascular reflexes that control circulation become inappropriate
- Results in increased vagal tone and withdrawal of peripheral sympathetic tone leading to vasodilation +/- bradycardia and global cerebral hypoperfusion

<table>
<thead>
<tr>
<th>Type</th>
<th>Usual Association</th>
</tr>
</thead>
<tbody>
<tr>
<td>High Preload</td>
<td>DVD, primarily small breed dogs Exertion/erotion</td>
</tr>
<tr>
<td>&quot;Empty ventricle syndrome&quot;</td>
<td></td>
</tr>
<tr>
<td>Situational</td>
<td>Coughing, gagging, retching Swallowing Vomiting Urination, defecation</td>
</tr>
<tr>
<td>Carotid Sinus Hypersensitivity</td>
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</tr>
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**Collapsing DVD Dogs**

- DDx
- CHF
- Atrial fibrillation, or other arrhythmia
- Pulmonary hypertension
- Reflex-mediated
- Left atrial rupture
Reflex-Mediated Collapse in DVD Dogs

- **Theory 1** – “Empty Ventricle Syndrome”
  - High preload + hyperdynamic function → stimulates mechanoreceptors, or C fibers found in atria, ventricles, pulmonary artery → afferent C fibers project to vagal nucleus → leads to paradoxical withdrawal of peripheral sympathetic tone and increase in vagal tone → vasodilation and bradycardia
- **Theory 2**
  - Sympathetic surge → venoconstriction and increased venous return → vagal afferents at LA-PV junctions are stretched by increased RV outflow → reflex triggered

Therapy for Katie

- **For Cardiac Disease:**
  - ACE inhibitor
  - Pimobendan
  - Lasix, to have available at home for signs of CHF
- **For Syncope:**
  - Control coughing
  - Theophylline 5 mg/kg BID
  - May help if bradycardia contributing to collapse
  - Digoxin
  - Modulates baroreceptor function by causing parasympathetic activation and sympathetic inhibition

Case 7: Robin

- **Signalment**
  - 8 year old F/S CKCS
  - 22 lbs.
- **History**
  - II/VI systolic murmur last year
  - No current medications
  - Acute onset/change to V/VI systolic murmur over the MV region with sudden onset dyspnea/coughing
  - Single syncopal spell when came up deck stairs

Physical Examination

- HR 180
- RR 66 with increased abdominal component
- Crackles R>L hilar region
- BP 90 systolic
- MM slight cyanotic
- Pulse oximetry 93% on room air

Radiographs

Echocardiogram
**Diagnosis**
- Degenerative mitral valve disease with acute chordae tendinae rupture
- Left sided congestive heart failure
- Poor oxygen saturation

**Therapy**
- Oxygen: O2 cage vs. nasal
- Injectable Lasix 2 mg/kg IV/IM q 6-8 hours
- Pimobendan 0.25 – 0.3 mg/kg PO BID
- Monitor blood pressure: if BP continues to decrease, may have to consider Dobutamine/Nitroprusside CRI
- Get baseline renal and electrolyte values
- Offer food/water
- No IV fluids other than CRI PRN

**Therapy continued**
- Repeat BUN/CREA/Lytes in 24 hours
- +/- repeat chest rads
- If O2 saturation and overall work of breathing has normalized, wean off of O2
- Discharge

**Discharge medications**
- Pimobendan 2.5 mg BID
- Lasix/Furosemide 20 mg TID for 3 days, then decrease to 20 mg BID, may be able to further decrease pending response
- In 5 days, provided eating okay, start Enalapril 5 mg tablets at ½ tablet BID for 4 days, then increase to 5 mg BID
- In 10 days, provided patient is feeling well, start Spironolactone 25 mg tablets at 1/4 tablet BID for 4 days, then increase to ½ tablet BID
- Fishoils?

**Followup**
- Recheck renal profile/electrolytes in 2 weeks and then every 4-6 months
- Owner to monitor RR/RE at home—crucial part of discharge instructions to family
- Recheck echocardiogram in 6 months

**Comments / Questions**

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