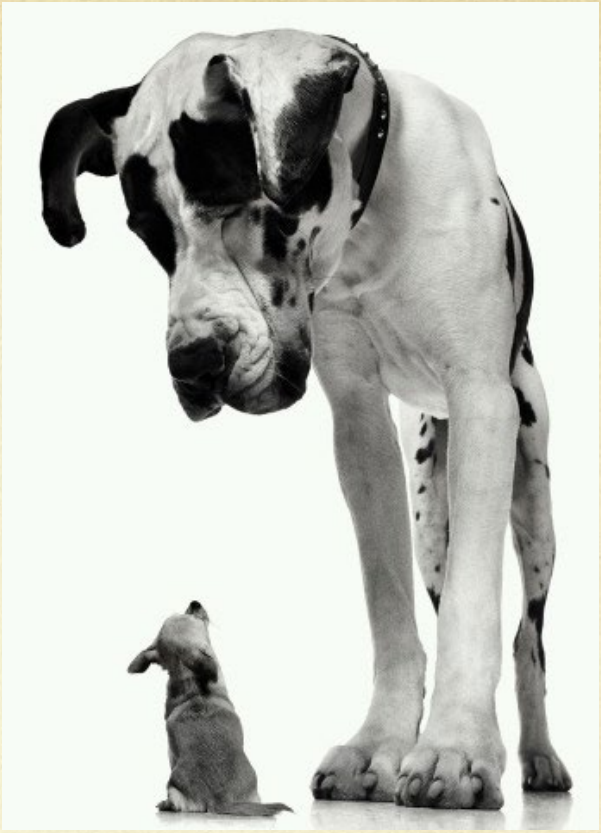

How to stage heart disease, part I

Meg Sleeper VMD, DACVIM (cardiology)
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Murmur diagnosis in dogs

- Unlike cats, a murmur is present in nearly all forms of heart disease in dogs (exception is DCM)
- However, dogs can also develop physiologic or benign murmurs, especially puppies
- The murmur is **likely** to be pathologic if it is:
  - Continuous
  - Diastolic
  - ≥ grade IV/VI

Considerations in a **puppy** with a cardiac murmur

- What are the local puppy lemon laws?
- Do owners plan to breed the dog or is it a pet?
- What is the murmur character?
  - Continuous, diastolic or systolic murmurs with an intensity of Grade IV/VI or louder are nearly always pathologic.
  - Systolic murmurs that are softer than a grade IV/VI may be "puppy" or benign murmurs. Most, but not all benign murmurs will be outgrown by the time the puppy is 4 months old.

If the owners determine to proceed with an echocardiogram, it is reasonable to pursue an echocardiogram prior to ECG and thoracic radiographs. These diagnostics may offer useful ancillary information but often cannot provide a definitive diagnosis of the murmur

Reasons to work up the murmur

- Owner wants a definitive answer of the underlying cause of the murmur
- Animal may be bred
- Murmur persists after the dog is older than 4 months
- Murmur is continuous, diastolic or loud ($\geq$ grade IV/VI)

Reasons to consider wait and watch approach

- Financial
- Owners would not return the animal anyway (if newly acquired)
- Murmur is low intensity (<grade IV/VI)

- If the murmur disappears by the time the dog is 4 months of age, it was very likely a benign puppy murmur and no further evaluation is warranted (asymptomatic animals).
- If the murmur remains:
  - Thoracic radiographs give information regarding underlying cause and prognosis
  - Echocardiography gives definitive diagnosis

Considerations in an **adult** dog with a cardiac murmur

- Is this a new murmur or could it have been missed previously?
- What is the breed?
  - Small breed dogs>>>degenerative valve disease until proven otherwise
  - Medium to large breed dogs>>>degenerative valve disease vs. dilated cardiomyopathy

Considerations in an adult dog **small breed dog** with a cardiac murmur

- What is the murmur character?
  - In an **asymptomatic** dog with a grade I-II/VI systolic murmur that is typical of degenerative mitral valve disease, it is reasonable to hold off on diagnostics, but educate the owner about heart disease and clinical signs that should prompt re-exam
    - Auscultation at yearly exams
  - If the murmur is grade III/VI or louder, if it is not typical of degenerative mitral valve disease, or if the animals is symptomatic, staging of heart disease (thoracic radiographs +/- echocardiography) is warranted.

If dog is symptomatic for heart disease or an arrhythmia is present (other than sinus arrhythmia), then an echocardiogram should be prioritized. Radiographs should be prioritized is respiratory signs.

Thoracic radiographic findings

- Normal heart size (Stage B1 disease)
- An echocardiogram is not necessary for developing treatment plan but systemic blood pressure measurement and minimum data base recommended, particularly in older animals
- Treatment/monitoring plan
  - No cardiac medications
  - Educate owner about valvular heart disease progression (small breed dogs) and general recommendations
    - Fatty acid supplementation
    - Avoid high salt treats
    - Monitor heart remodeling with yearly radiographs
    - Dietary recommendations

Thoracic radiograph findings

- Increased heart size in a pattern consistent with mitral valve disease (Stage B2 disease) in asymptomatic dog
  - An echocardiogram is not necessary for developing treatment plan unless heart enlargement is borderline
  - Evaluate systemic blood pressure and minimum data base
  - Treatment/monitoring plan
    - Fatty acid supplementation
    - +/- pimobendan
    - Begin maintaining a resting respiratory rate log
    - Monitor heart size with thoracic radiographs every 6 months

Thoracic radiograph findings

- Increased heart size in a pattern NOT consistent with mitral valve disease (for example right heart enlargement or generalized cardiomegaly in a medium or large breed dog)
  - Systemic blood pressure and minimum data base
  - Echocardiogram recommended to definitively diagnose disease and develop a specific treatment/monitoring plan

Considerations in an adult dog **medium or large breed dog** with a cardiac murmur

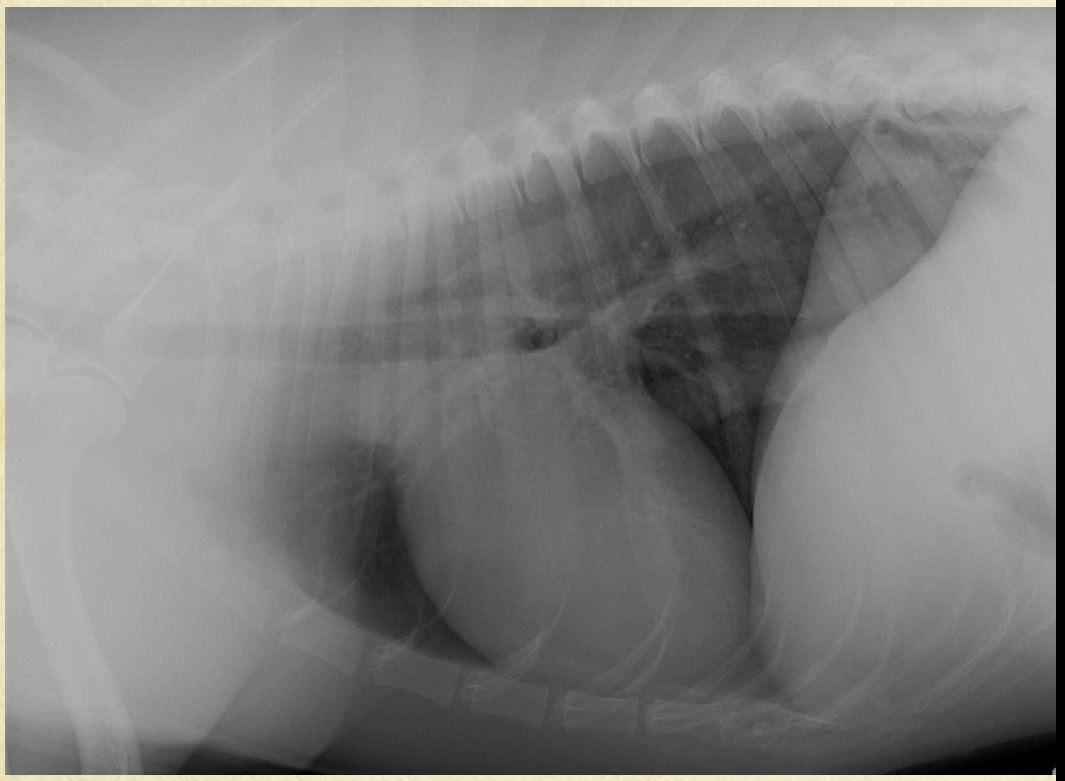
- What is the murmur character?
  - In medium to large size dogs, it is more difficult to differentiate dilated cardiomyopathy from degenerative valve disease and echocardiography is recommended
  - Clues to help determine the underlying disease:

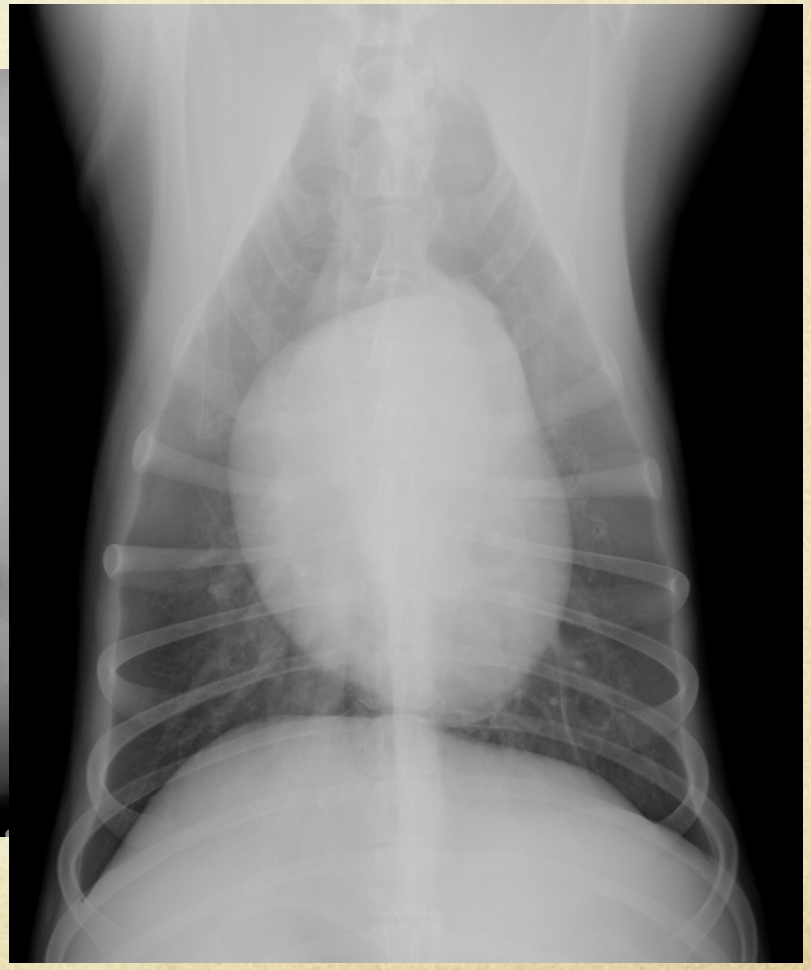
DCM	DVD
Softer intensity murmur	coarser murmur ± thrill
Pulses more likely to be weak	pulses weak late in disease
Radiographic findings:	
Generalized heart enlargement	Primarily left atrial enlargement

Case 1

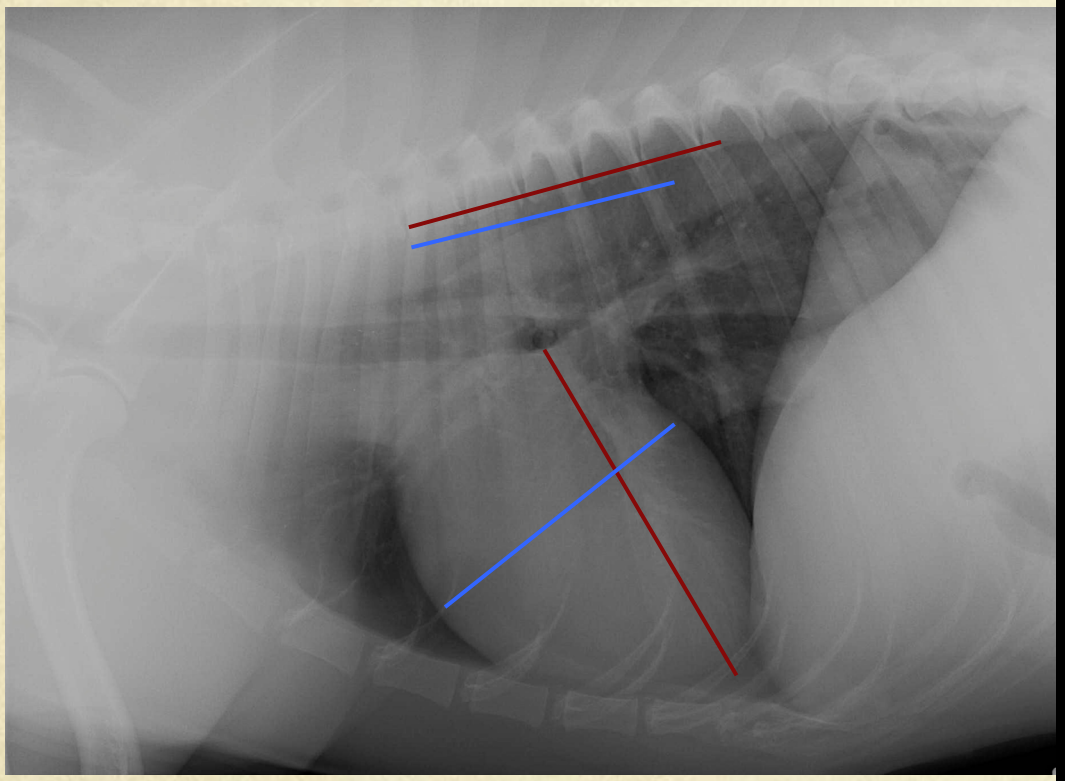
- 10 year old Yorkshire terrier with a new murmur (left apical, systolic, grade III/VI murmur) during routine physical examination. Owners note coughing.
- Diagnosis: degenerative valve disease until proven otherwise
- Recommendations: thoracic radiographs and blood pressure to stage disease

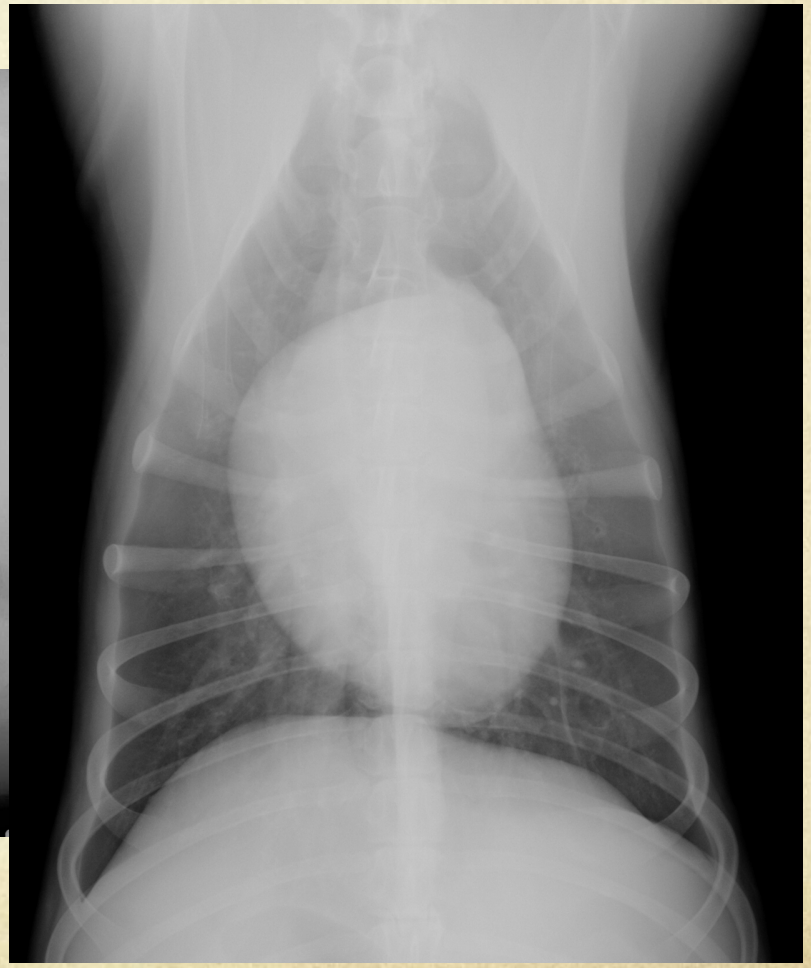
Case 1 thoracic radiographs





Case 1 thoracic radiographs





VHS= 5.2 +4.4= 9.6V

Interpretation: normal heart size; normal lung fields

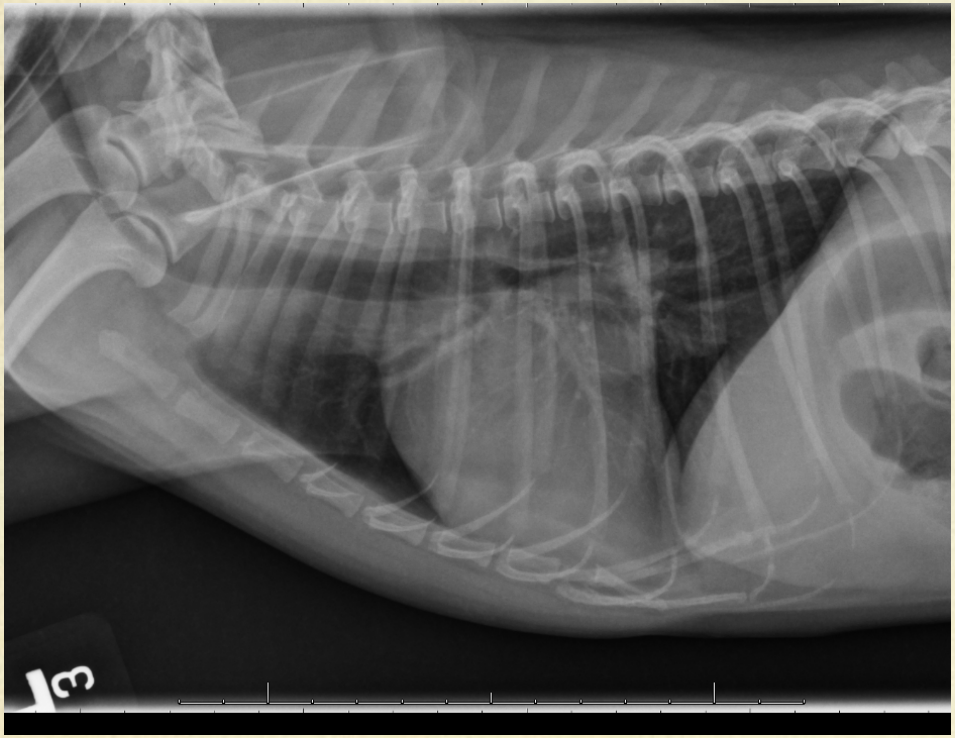
Case 1

- Systolic blood pressure: 130 mmHg
- Diagnosis: Stage B1 valvular heart disease
- Recommendations
  - No cardiac drugs recommended
  - Monitor heart size with yearly thoracic radiographs
  - Monitor blood pressure yearly
  - Discuss the potential clinical signs associated with heart disease although the patient is currently at low risk
  - Consider a fish oil supplement
  - Consider cough suppressant

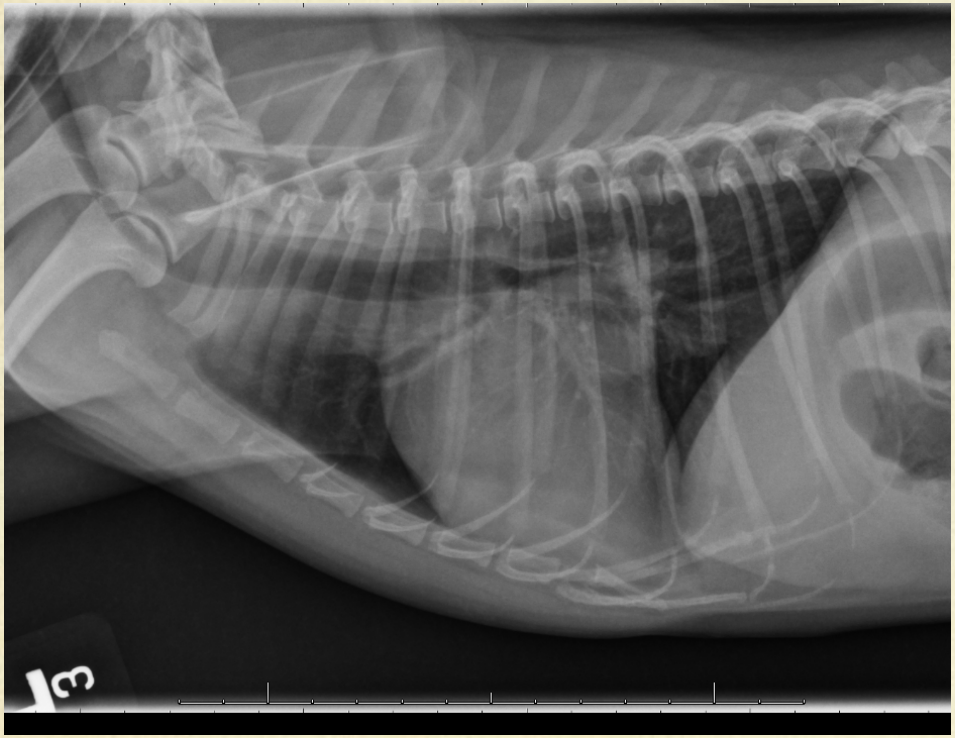
Case 2

- 10 year old toy poodle with a new murmur (left apical, systolic, grade III/VI murmur) during routine physical examination.
- Diagnosis: degenerative valve disease until proven otherwise
- Recommendations: thoracic radiographs and blood pressure to stage disease

Case 2 thoracic radiographs



Case 2 thoracic radiographs



VHS= 11.5V

Interpretation: mild to moderate heart enlargement (primarily the left atrium). Lung fields clear.

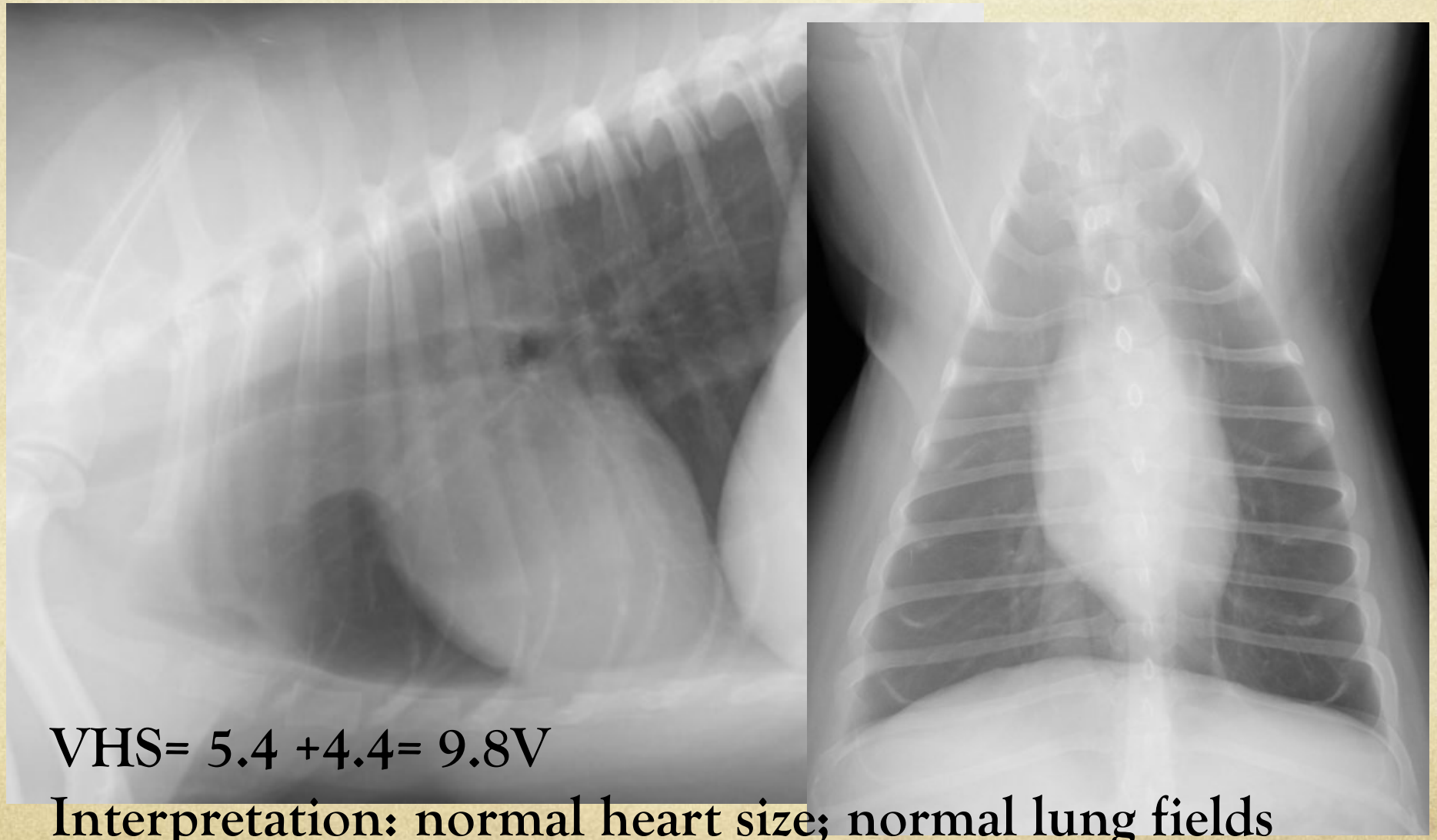
Case 2

- Systolic blood pressure: 180 mmHg
- Diagnosis: Stage B2 valvular heart disease; possible systemic hypertension
- Monitoring recommendations
  - Further evaluate possibility of systemic hypertension
  - Evaluate heart size with thoracic radiographs every 6 months +/- echocardiography
  - Treatment recommendations
    - Fish oil supplementation if not already started
    - Begin pimobendan (0.25-0.3 mg/kg twice daily)
    - Consider amlodipine therapy (0.1 mg/kg once daily)
    - More complete client education:, avoid high salt treats, begin maintaining a resting respiratory log

Case 3

- 10 year old Australian shepherd with a new murmur (left apical, systolic, grade III/VI murmur) during routine physical examination.
- Diagnosis: degenerative valve disease vs. dilated cardiomyopathy
- Recommendations:
  - +/- thoracic radiographs
  - blood pressure
  - +/- echocardiography

Case 3 thoracic radiographs



VHS= 5.4 +4.4= 9.8V

Interpretation: normal heart size; normal lung fields

Case 3

- Systolic blood pressure: 140 mmHg
- Diagnosis: Stage B1 heart disease (valvular vs. dilated cardiomyopathy)
- Recommendations
  - Echocardiogram would allow definitive diagnosis, but DCM is less likely than DVD
  - Evaluate heart size with thoracic radiographs every 12
  - No cardiac medications
  - Fish oil supplement
  - Client education

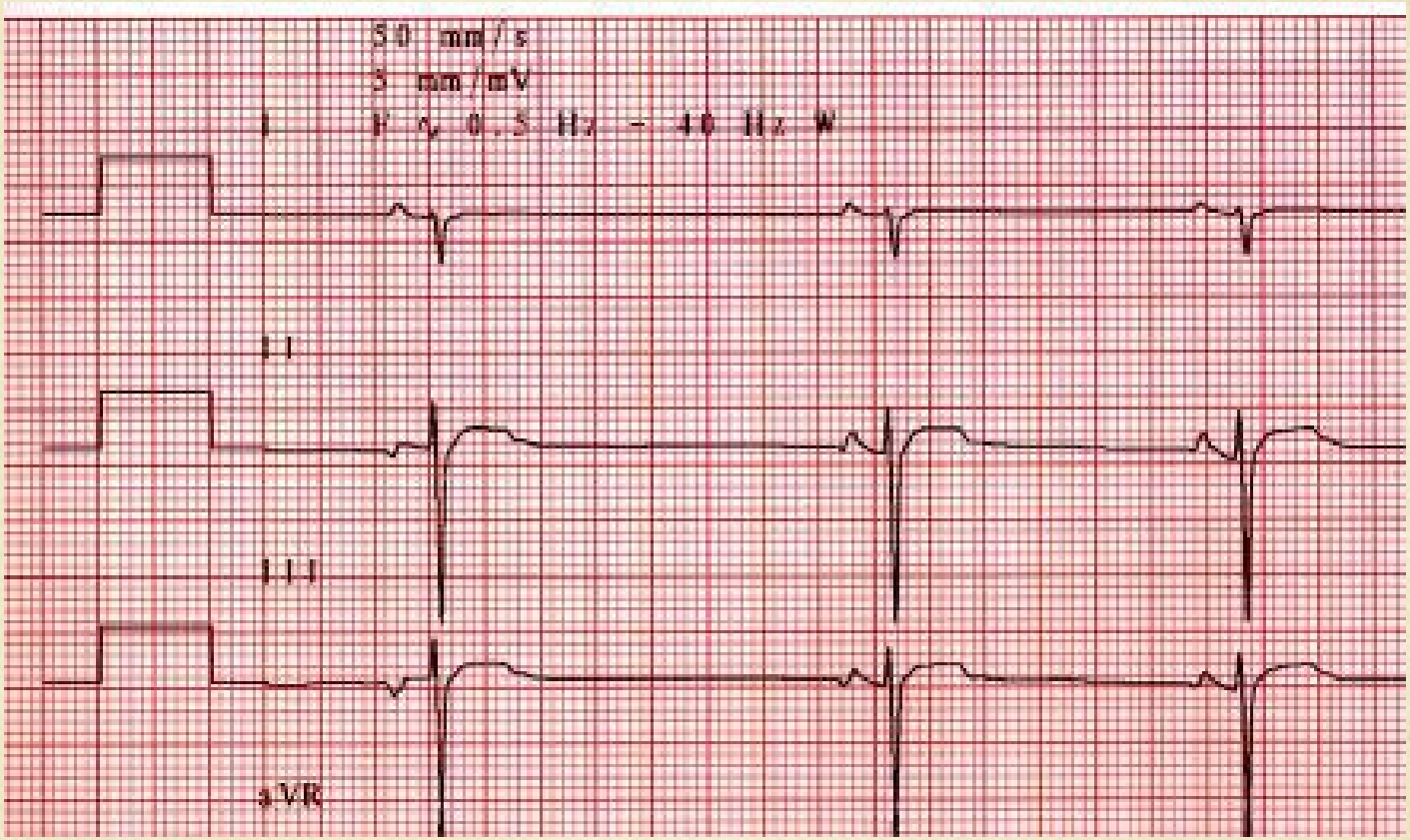
Case 4

- 2 year old mixed breed dog with a murmur (left heart base, systolic, grade V/VI murmur) during routine physical examination after being adopted.
- Diagnosis: Sub-aortic stenosis vs. pulmonic stenosis
- Recommendations: thoracic radiographs vs. electrocardiogram vs. echocardiography

Case 4 thoracic radiographs

Interpretation: right heart enlargement; hypoperfused lung fields

Case 4 Electrocardiogram



Interpretation: Sinus arrhythmia with right axis shift

Case 4

- Diagnosis: Presumptive pulmonic stenosis
- Recommendations
  - Echocardiogram would allow diagnosis of disease severity and whether the patient is a candidate for surgical intervention
  - Client education
  - If the owners would not consider surgical palliation, an echocardiogram to fully evaluate disease may not be essential (but would be informative for medical management considerations)

Summary in adult dogs

- Echocardiogram is most important when disease other than degenerative valve disease may be present
  - Murmur is not typical of DVD
  - Patient signalment is not “classic for DVD”

OR

- Degenerative valve disease is advanced and complications such as pulmonary hypertension are more likely to be present

Summary in juvenile animals

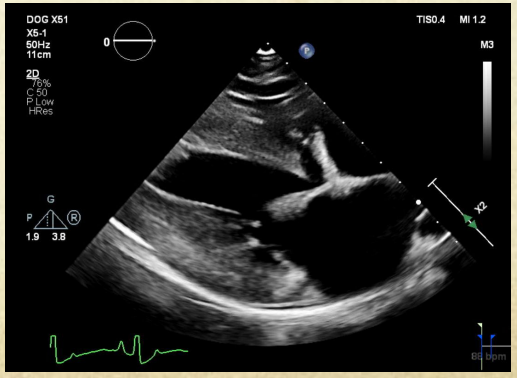
- Echocardiogram is most important when:
  - A cardiac thrill is present
  - The murmur is continuous or diastolic
  - Diagnosis will determine if the animal is returned
  - The animal may be used for breeding purposes
  - Surgical intervention is a possibility
- If the murmur is intermittent or changes with heart rate, it is more likely to be a benign murmur

Update on staging and treatment of degenerative valve disease

Meg Sleeper VMD
University of Florida Veterinary School
Gainesville, Florida

Outline

- Framework for staging heart disease and failure
  - Degenerative valve disease
- Basic physiology and cardiac drug review
- Diagnostic and therapeutic plan in the DVD framework



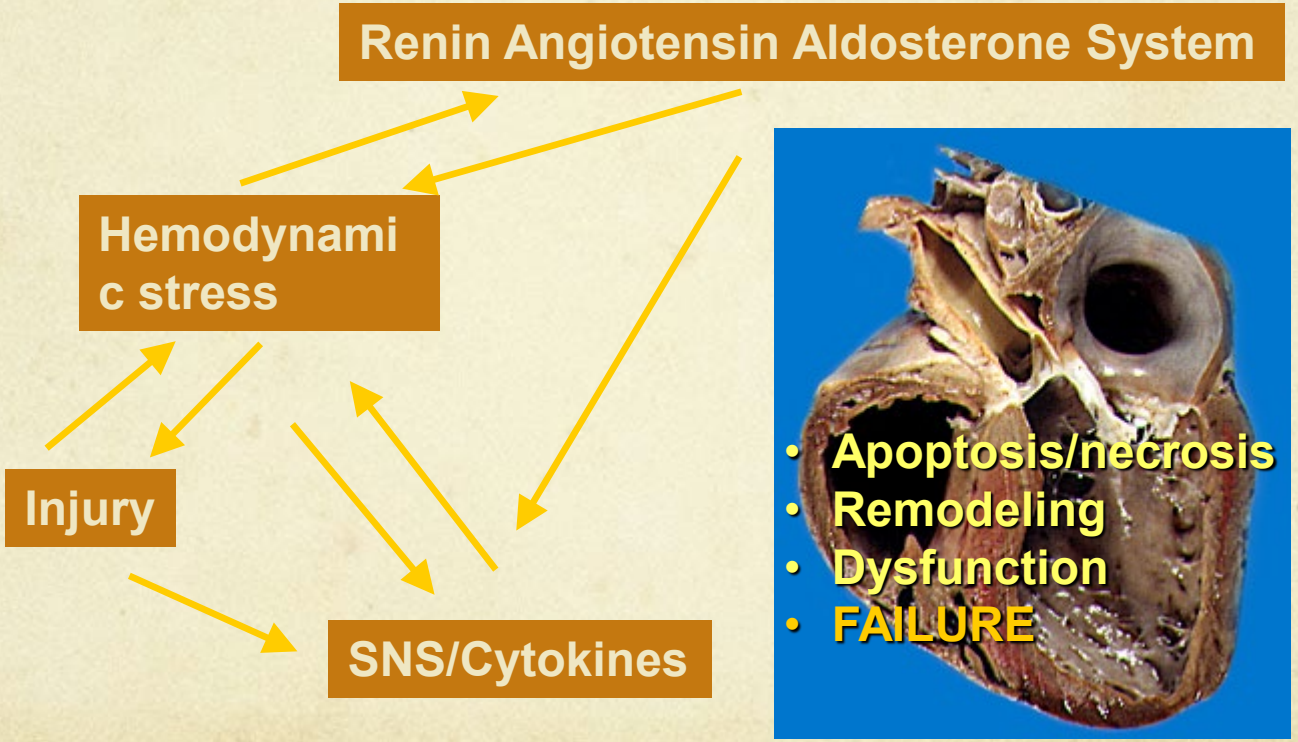
Heart Disease

- The presence of a structural abnormality of the heart
- Depending on its nature and severity, heart disease may or may not cause heart failure

Heart Failure (HF)

- HF is a complex clinical syndrome that can result from any structural or functional cardiac disorder that impairs the ability of the ventricle to fill with or eject blood
- HF results when the heart cannot pump enough blood to meet tissue needs at normal venous pressures

Heart Failure Cascade

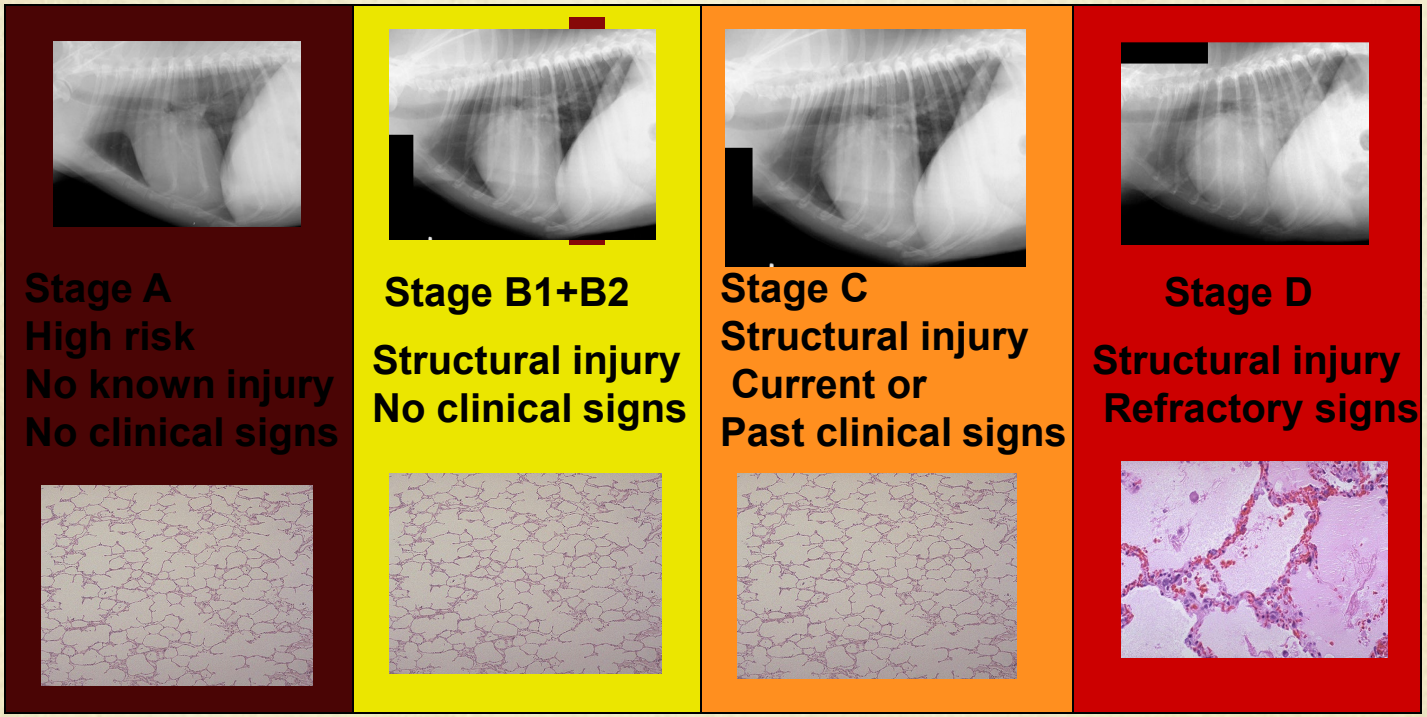


ACC/AHA Classification of Heart Failure

- At risk for heart failure
  - STAGE A — No structural disease, but high risk for developing heart disease
  - STAGE B1 — Asymptomatic disease, no cardia remodeling
  - STAGE B2 — Asymptomatic disease, cardiac remodeling
- Heart failure
  - STAGE C — Past or current signs/symptoms of HF
  - STAGE D — End stage HF, signs refractory to Rx

J Am Coll Cardiol. 2001;38:2101-2113.

Canine Heart Failure



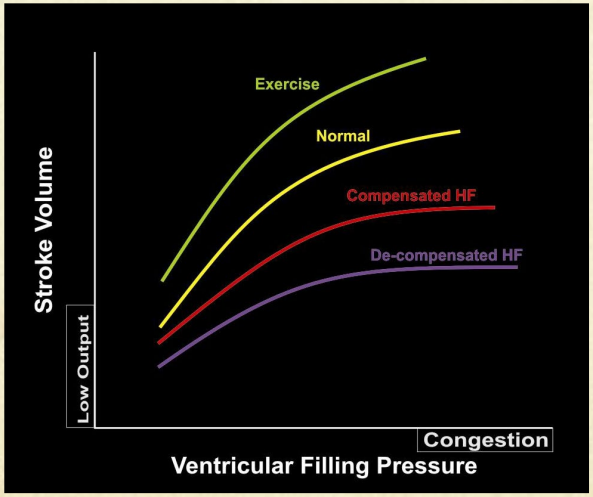
Sites for pharmacologic intervention

- Preload
- Afterload
- Contractility
- Heart rate

Cardiac output = preload X contractility X HR
afterload

Preload

The stretch of the left ventricle just before the onset of contraction (i.e. *end-diastolic volume*).



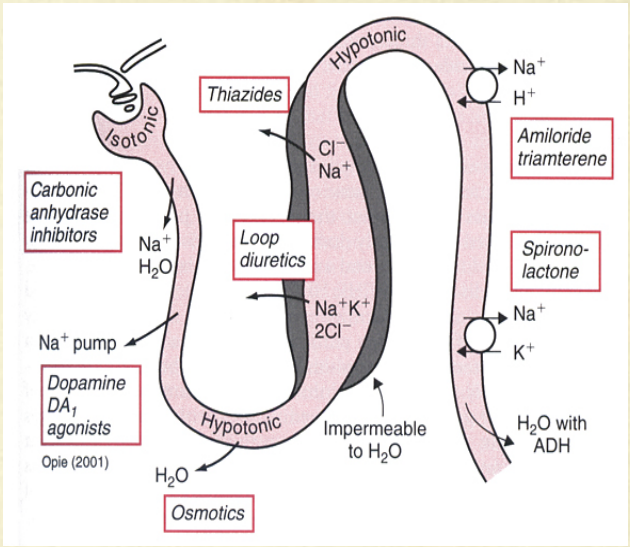
Preload reducers

- Diuretics
  - Loop diuretics
  - Thiazides
  - Spironolactone
- Venodilators
  - nitroglycerine

Diuretics

Three major groups of diuretics used for HF–

- Loop Diuretics (ascending loop of Henle)
- Thiazide Diuretics (early distal tubule)
- Potassium sparing /aldosterone antagonist diuretics (distal tubule and collecting duct)



Furosemide: Indications & Pharmacologic Properties

- Mechanism – inhibits the luminal Na-K-Cl cotransporter in ascending loop of Henle
  - **Initial therapy in acute pulmonary edema**

IV

- Diuresis begins 5-20 min after IV dose
- IV dose peaks at 30 mins
- IV duration is 2 hours

PO

- Oral onset 60 mins
- Peak effects occur in 1-1.5h following oral dose
- Duration 4-6 hours

Furosemide administration route and dose

- Dose (bolus): 1-2 mg/kg
  - For **acute** heart failure
    - Administer IV q 1-2 hours (or CRI dose: 0.66 mg/kg loading dose followed by 0.6 mg/kg/hour)
  - For **chronic** heart failure
    - Administer PO q 8-12 hours
- **Taper to lowest dose that controls clinical signs as soon as possible**

If clinical signs are present with a total daily dose of >6 mg/kg furosemide, alternative preload reducers may be necessary: **Furosemide refractoriness**

Afterload

The load against which the ventricle contracts, i.e. the *resistance to the ejection of blood from the ventricle (myocardial wall stress).*

Determined by:

- Peripheral resistance (blood pressure)
- Heart size (chamber size/wall thickness)

Afterload reducers

- Arteriodilators
  - ACE inhibitors
  - Pimobendan
  - Nitroprusside
  - Hydralazine

ACE Inhibitors: Indications

- Congestive heart failure from any cause
- No benefit in compensated valvular heart disease, regardless of left atrial size
- Most often used in North America: enalapril, benazepril

Myocardial Contractility

Relative ability of the heart to eject a stroke volume at a given afterload and preload

Positive inotropes

- Pimobendan
- Dobutamine
- Digoxin

Pimobendan

Dual Mode of Action ("Inodilation")

Increased contractility

Calcium sensitizer

- Promotes efficient use of existing calcium
- Increases force of contraction
- Does not increase myocardial energy requirements

Balanced vasodilation

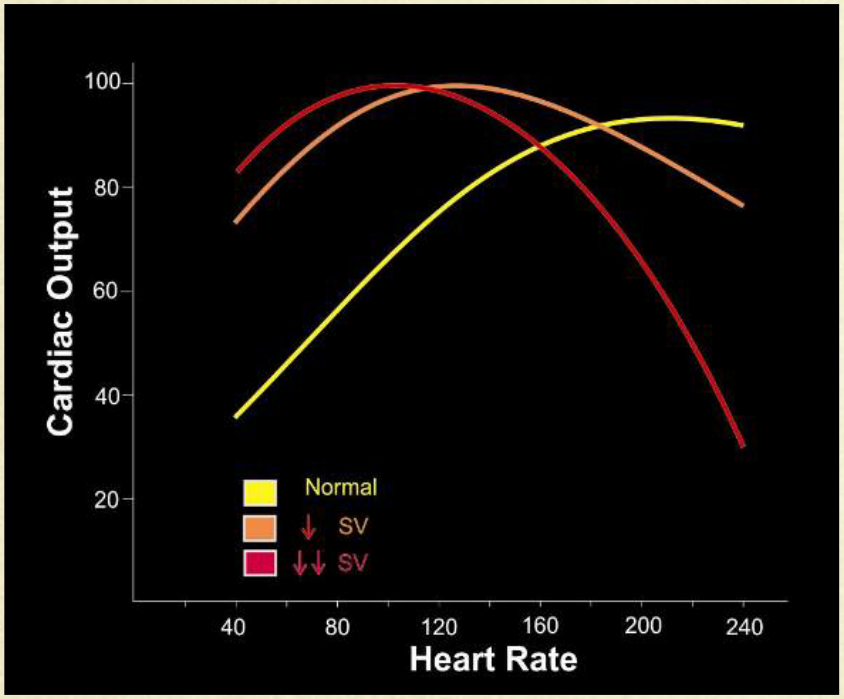
Phosphodiesterase III inhibitor

- Dilates both arterial and venous vessels
- Reduces preload and afterload

Pimobendan

- Rapid absorption
  - Mean peak plasma levels achieved 0.5-1.0 hour after administration of a single oral dose
  - **Compounded formulations have variable absorption**
- Indication
  - Labelled for management of the signs CHF in dogs due to degenerative valve disease or dilated cardiomyopathy
  - Protect and EPIC trial results
- Dose rate
  - 0.25 to 0.3 mg/kg twice daily

Heart Rate: Limitations

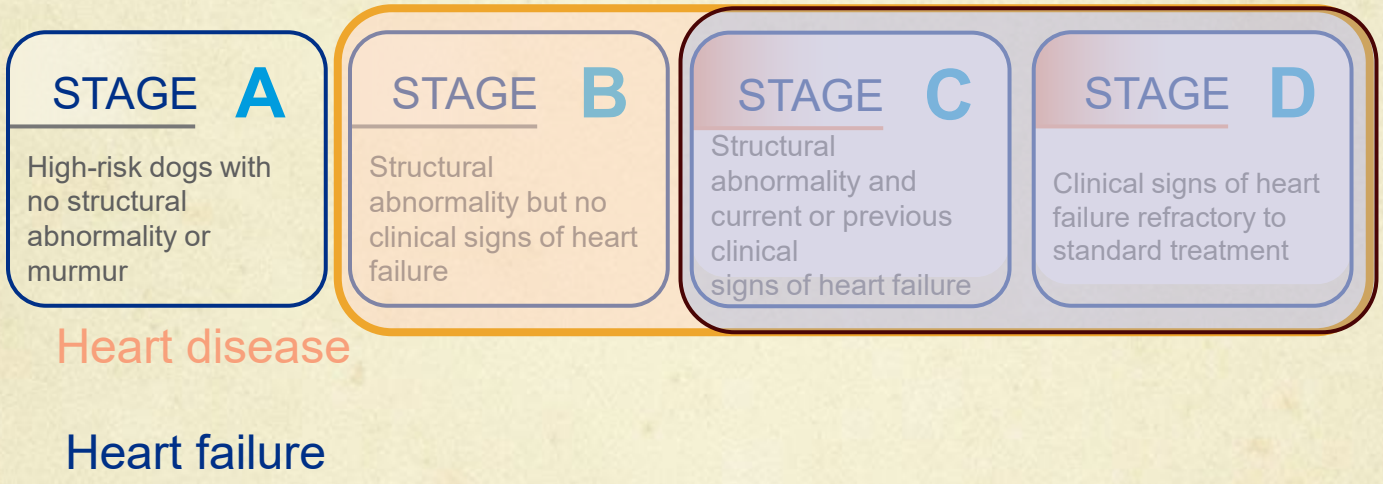


- Inverse force-frequency relationship
- Impaired Diastolic Filling due to elevated HR

Negative chronotropes

- Supraventricular
  - Beta blockers
    - Atenolol, metoprolol, sotalol
  - Calcium channel blockers
    - Diltiazem
  - Digoxin
- Ventricular
  - Sodium channel blockers
    - Lidocaine, procaineamide, mexilitine
  - Potassium channel blockers
    - Sotalol, amiodarone

ACVIM classification of CHF



Recommendations for stage A (degenerative valve disease)

- No drug therapy recommended
- No dietary recommendations
- Potential breeding considerations

Diagnostic recommendations

STAGE B

Dogs with murmurs that have
not yet developed clinical signs of CHF

- Diagnostics to stage the disease
  - Baseline radiograph with VHS
  - Baseline blood work
  - Blood pressure

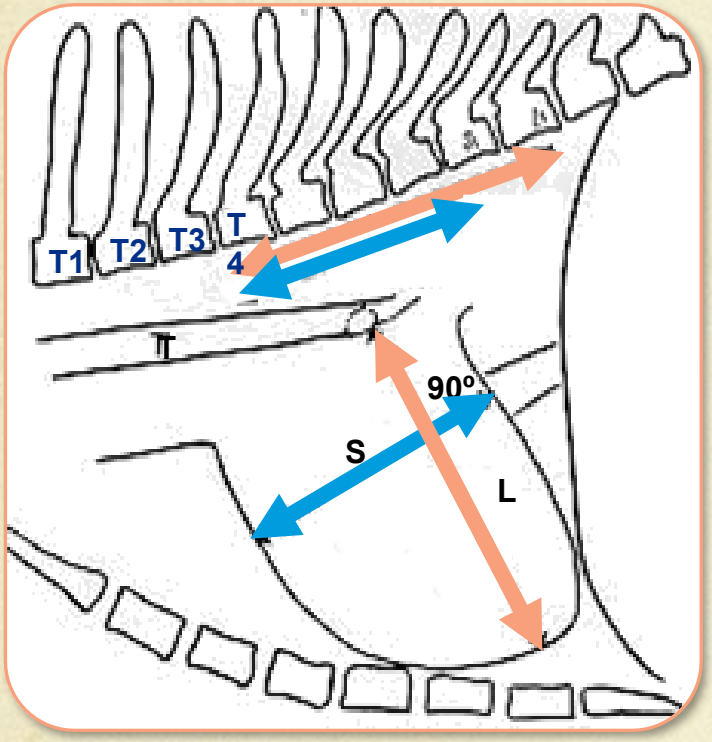
STAGE B1

No cardiac enlargement

STAGE B2

Cardiac enlargement present

Radiographs to assess heart enlargement



CANINE VERTEBRAL HEART SIZE

VHS = L + S

VHS = 6 + 4.5 = 10.5

Normal = 8.7–10.7

Stage B- baseline bloodwork

- Basic laboratory work includes a minimum of
  - Hematocrit
  - Total protein concentration
  - Serum creatinine concentration and
  - Urinalysis

- Baseline parameters will
  - Give you a reference point for hydration and renal function and
  - Concurrent diseases and therapy may effect these values
    - Eg. Diuretics and specific gravity

Blood Pressure Monitoring Recommendations

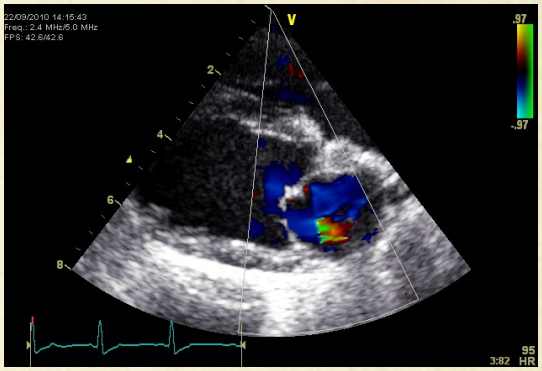
Why Monitor?

- Rule out systemic hypertension
  - From concurrent renal disease
- Progression of disease
  - Increases afterload
  - Increases MV regurgitation
- Systemic hypertension

  is controllable

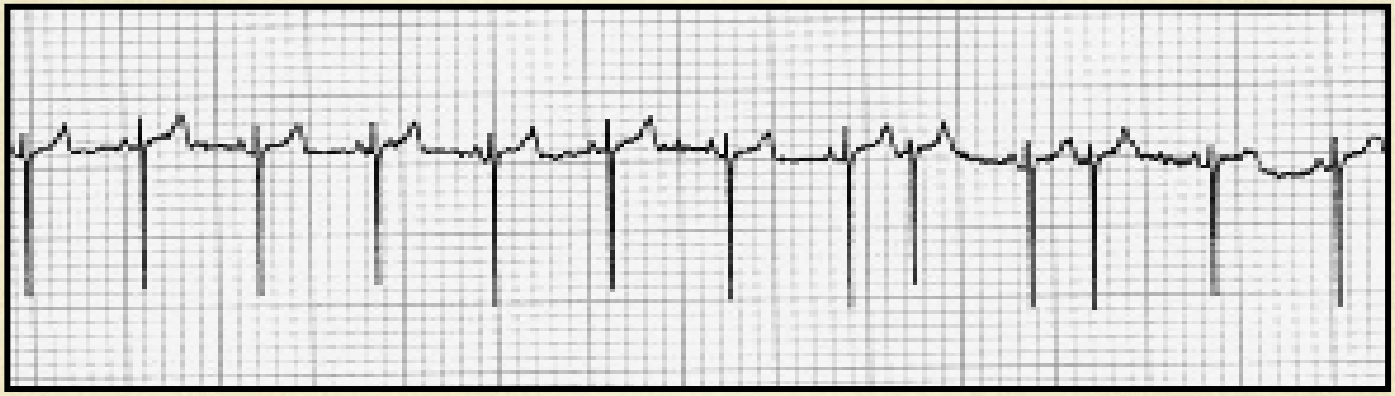
Echocardiography if indicated

- Atypical disease (unusual breed or murmur; heart enlargement pattern)
- Confirming whether dog meets EPIC criteria (and medications should be started)
- Presence of co-morbidities



Baseline ECG- *if indicated*

IF an arrhythmia is present, otherwise no additional benefit



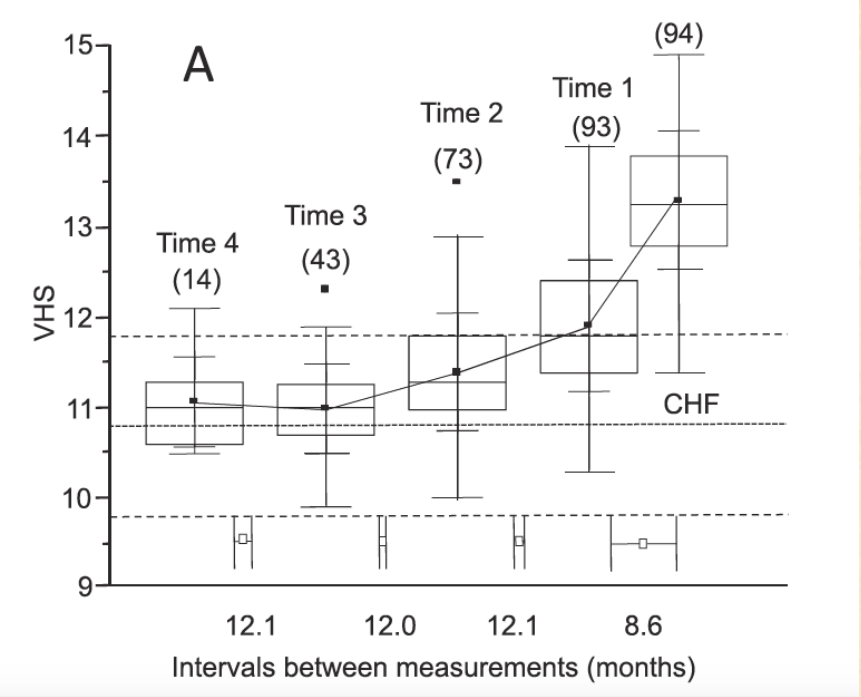
Recommendations for stage B- **Therapy** (DVD)

- B1 (hemodynamically insignificant MR)
  - No drug or dietary recommendations
  - Re-evaluation with radiographs or echocardiography at least yearly
- B2 (hemodynamically significant MR)
  - EPIC trial demonstrated starting pimobendan resulted in a average extension of 15 months to heart failure
  - Re-evaluation with physical examination +/-radiographs or echocardiography every 6-9 months

J Vet Intern Med 2011;25:1312–1319

Radiographic Heart Size and Its Rate of Increase as Tests for Onset of Congestive Heart Failure in Cavalier King Charles Spaniels with Mitral Valve Regurgitation

P.F. Lord, K. Hansson, C. Carnabuci, C. Kvart, and J Häggström



Client Education

- Stage B1 and B2
  - Educate the client about early warning signs
    - Coughing, changes in breathing pattern, sleep behavior
- Stage B2
  - Demonstrate obtaining a respiratory rate and suggest they begin keeping a log of their findings at home.
    - Establish a baseline for normal and give them a cut off
    - Monitor weekly once a patient is B2
  - Omega 3 fatty acid supplementation and discussion about diet

Diagnostic recommendations for stage C-DVD

- Thoracic radiography
- Basic laboratory testing
- ECG if there is an arrhythmia noted
- Echocardiography **once the patient is stable**

Consensus recommendations for stage C- **Therapy** (DVD)

- **Acute CHF**
  - Furosemide (1-2 mg/kg q1-2h with dose depending on severity of clinical signs and response)
  - Pimobendan (0.25-0.3 mg/kg PO q8-12h)
  - Oxygen supplementation
  - Mechanical treatments (i.e. thoracocentesis, etc)
  - Sedation if indicated (Butorphanol-0.2-0.25 mg/kg IM or IV)
  - Nitroprusside for poorly responding patients

Consensus recommendations for stage C- **Therapy** (DVD)

- **Chronic CHF** (home based therapy)
  - **Continue oral furosemide (1-2 mg/kg q 6-12 h; taper to the lowest effective dose)**
  - **Continue or start ACEI (enalapril or benazepril 0.5 mg/kg q12h)**
  - **Continue pimobendan (0.25-0.3 mg/kg PO q12h)**
  - **Begin spironolactone (1-2 mg/kg PO q 24h) within the first 6 months**
  - **Active participation of owner (respiratory rate log)**
  - Aggressive management of anorexia or weight loss to avoid cardiac cachexia
  - Modest salt restriction
  - Monitor serum potassium
  - At 6 month recheck, start spironolactone if hasn't been already started

Consensus recommendations for stage D- **Diagnosis** (DVD)

- By definition stage D heart failure patients are refractory to treatments for stage C.
- Diagnostic steps are similar to those for stage C

Consensus recommendations for stage D-**Therapy** (in addition to those drugs started under stage C)

- Acute
  - In the absence of severe renal failure, increase furosemide dose as needed to control CHF
  - Fluid removal
  - Oxygen supplementation; mechanical ventilation may be useful in some patients
  - More vigorous afterload reduction
    - Nitruprusside, hydralazine, amlodipine, pimobendan

Consensus recommendations for stage D-

Therapy (in addition to those drugs started under stage C)

- Chronic (home based therapy)
  - More vigorous **preload** reduction
    - Increase furosemide dose as needed
    - Consider triple diuretic therapy, sq furosemide or torsemide
  - More vigorous **afterload** reduction
    - Hydralazine, amlodipine
  - Increase inotropes for **contractility**
    - Increase pimobendan
  - Ensure adequate heart rate control
  - Same dietary recommendations as stage C
  - Beta blockade should not be initiated unless clinical signs of CHF are controlled

Questions?

Dealing with furosemide refractoriness

- Use injectable (SQ) furosemide
- Triple diuretic therapy (add hydrochlorothiazide and spironolactone) or aldactazide CAUTIOUSLY
  - Hydrochlorothiazide: 2-4 mg/kg S-BID
  - Spironolactone: 1-2 mg/kg S-BID
- Torsemide
- Importance of renal function monitoring

Torsemide

- Loop diuretic with longer duration of action and decreased susceptibility to resistance than furosemide
- Aldosterone antagonistic effects
- Dose: 1/10 daily furosemide divided into 2 doses per day

Compounding medications

- Transdermal cardiac medications generally cannot be measured systemically and are not recommended
- Combining multiple medications into one liquid medication or tablet
  - Possible loss of efficacy
  - Ease of administration
  - Less confusing for owners

Other medication adjustments

Cardiac output = preload X contractility X HR
afterload

- **Contractility**
  - Increase pimobendan
- **Afterload**
  - Hydralazine, amlodipine
- **Ensure adequate heart rate control**

Dealing with coughing

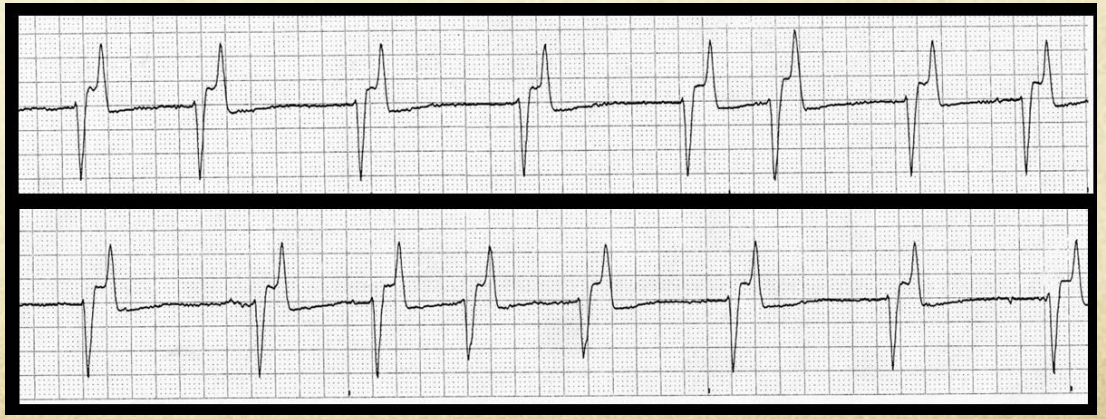
- Cough is very uncommonly associated with heart disease in cats
- In dogs with valve disease, coughing is more likely to be associated with tracheitis than congestive heart failure, particularly if RR is normal
  - Benefit of owners maintaining a respiratory log
- Options for severe tracheitis cases:
  - Hydrocodone
  - Butorphanol
  - Diphenoxylate/Lomotil
  - Maropitant/Cerenia
  - Prednisolone (cautiously)
  - Fluticazone

Monitoring heart rate

- Atrial fibrillation, feline cardiomyopathy
- The optimal heart rate goal for dogs with atrial fibrillation and severe heart disease is poorly defined
  - Some authors have suggested < 140 bpm while others target 90-110 bpm
- Monitoring the heart rate at home is critical to good heart rate control (many dogs with atrial fibrillation require both diltiazem and digoxin for good heart rate control)
- Methods to monitor heart rate at
  - 24 hour Holter monitor
  - Auscultation
  - AliveCor

24 hour Holter monitor

- Gold standard for heart rate assessment
- Allows evaluation of exercising and sleeping heart rate
- Expense of repeated Holters



Auscultation

- Simple and inexpensive
- Auscultatory estimates of heart rate (particularly in A Fib) may be significantly inaccurate
- Snap shot heart rate assessment
  - Impossible to measure exercising heart rate or accurately assess the presence of pauses in heart rhythm

- Device … oid
- Heart …
- Data c… d
- Snap s… ent

Dietary considerations

- Avoid cachexia and obesity
- Monitor potassium and magnesium serum levels
  - Supplementation with potassium and/or magnesium on case by case basis
  - Particularly in patients with **cardiac arrhythmias**
- Omega-3 Fatty Acid
  - 180 mg eicosapentaenoic acid/120 mg docasahexaenoic acid; 1 per 10 pounds BW
- Ensure nutritious diet

Minimize routine re-checks

- Requires appropriate use of respiratory log
- Benefits
  - Decrease owner financial fatigue
  - Decrease risk of decompensation in a fragile patient
- In reality, with the vast majority of dogs and cats, we are treating congestive heart failure rather than the underlying heart disease

Questions?