HOW TO STAGE HEART DISEASE, PART II (FELINE HEART MURMURS AND FELINE HEART DISEASE)

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OUTLINE

- Murmurs in asymptomatic cats
- Classification of cardiomyopathy
- Staging of cardiomyopathy
- Update on treatment of cardiomyopathy

MURMUR DIAGNOSIS IN CATS

- Heart disease diagnosis in cats and kittens in general is challenging because:
  - Approximately ½ of systolic cardiac murmurs in cats are benign
  - Approximately ½ of cats with heart disease do not have murmurs
  - Therefore, screening for heart disease by murmur presence alone is not particularly useful
- Additional findings supportive of underlying heart disease

REASONS TO WORK UP THE MURMUR IN A CAT

- Additional historical or clinical signs are present suggestive of heart disease
  - Syncope
  - Gallop sound
  - Arrhythmia
- Murmur is continuous, diastolic or ≥Grade V/VI
- Owner wants a definitive answer of the underlying cause of the murmur
- Animal may be bred

REASONS TO CONSIDER WAIT AND WATCH APPROACH

- Animal is asymptomatic and:
  - Financial limitations
  - Owners would not return it anyway (ie newly acquired pet)
  - Murmur characteristics are suggestive of innocent or physiologic murmur
    - Murmurs that come and go at different exams are usually flow murmurs and more likely to be benign.
    - Murmurs that disappear at lower heart rates are usually flow murmurs and more likely to be benign.

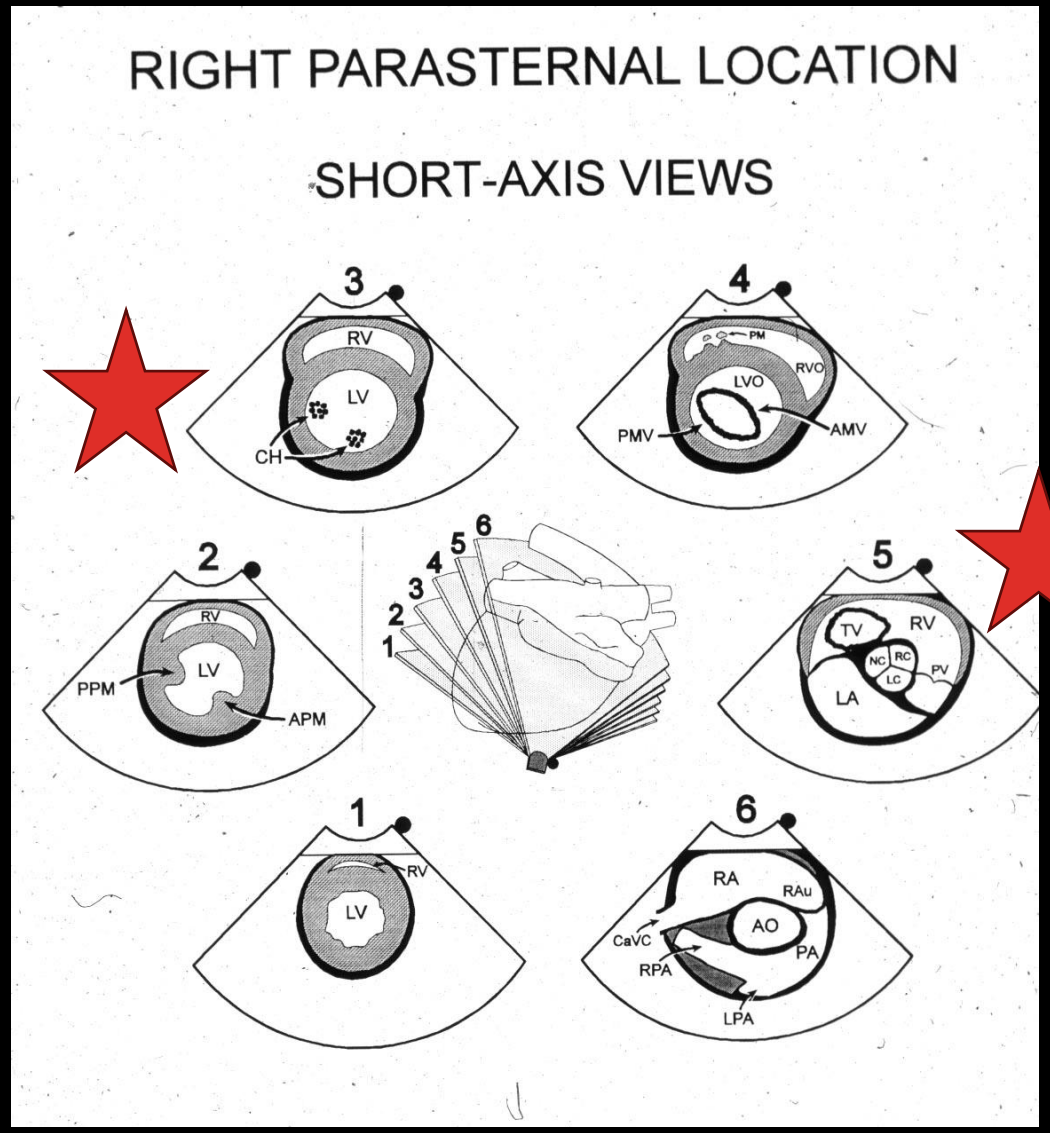
DIAGNOSTICS FOR MURMUR ASSESSMENT

- Echocardiography
  - Gold standard definitive assessment
  - TFAST
- Thoracic radiographs
  - Less sensitive but reasonably specific for clinically significant heart disease (stage B2)
- Cardiac biomarkers
  - Nt-proBNP
  - cTnI

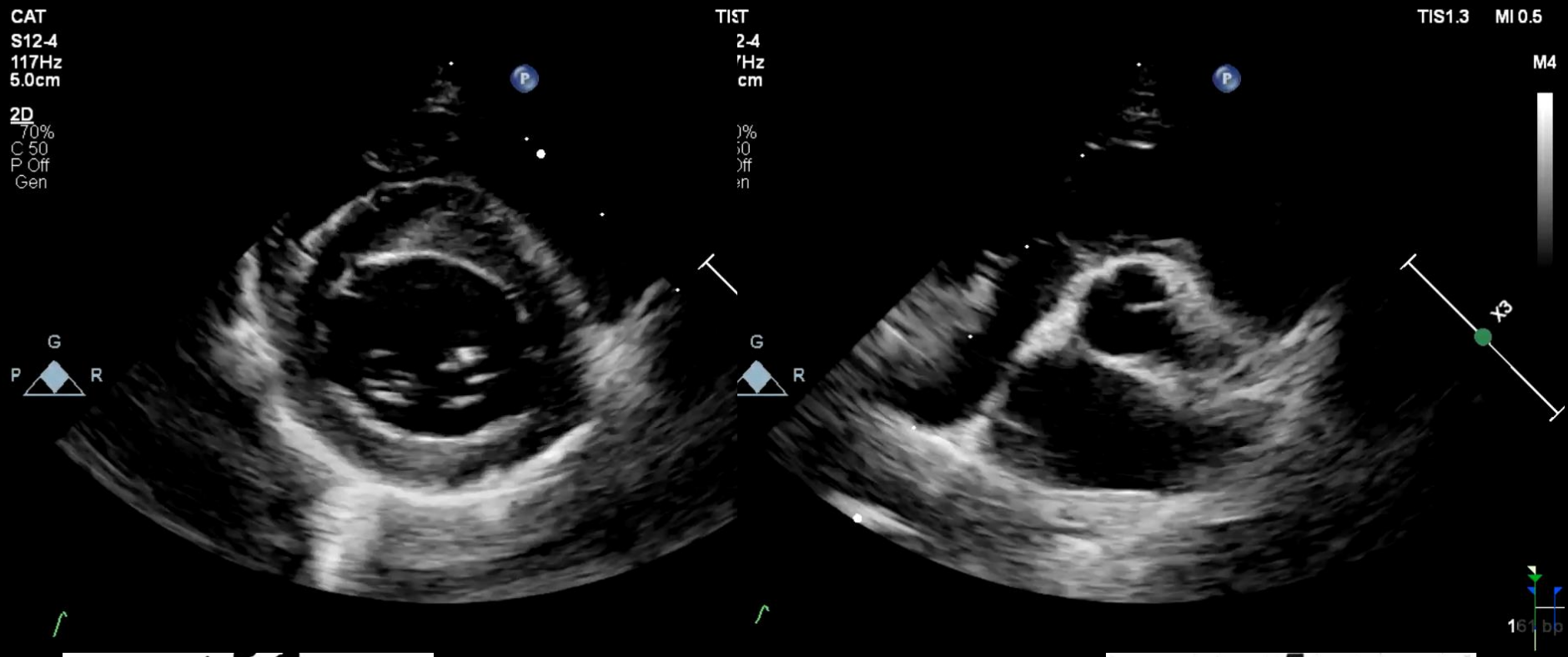
TFAST VS ECHO

Level of scan	Measurements	Qualitative assessment
Focused point-of-care		Note presence of: • Pleural, pericardial effusions • Left atrial size & motion • Pulmonary B-lines • LV systolic function
Standard of care	*M-mode* • IVSd, LVFWd • LVIDd, LVIDs, LV FS% • LA FS% *2D* • IVSd, LVFWd • LVIDd, LVIDs • LA/Ao • LA diameter from RP long axis view	Note presence of: • Papillary muscle hypertrophy • End-systolic LV cavity obliteration • Papillary muscle/mitral leaflet abnormalities • SAM or mid LV obstruction • Dynamic RVOTO • Abnormal cardiac chamber geometry • Presence of spontaneous echo-contrast or thrombus • Regional wall motion abnormalities
Best practice	M-mode and 2D as for standard of care, with the following additional measurements: *Spectral Doppler* • Mitral inflow velocities • Isovolumic relaxation time • LVOT velocities • RVOT velocities • PVF velocities • LAA blood flow velocities *Tissue Doppler imaging* • Lateral and septal mitral annular velocities (pulsed wave Doppler mode).	Qualitative assessment as for standard of care

Heart size and function assessment



Normal cat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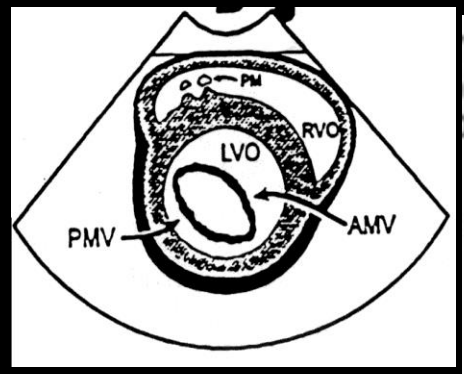
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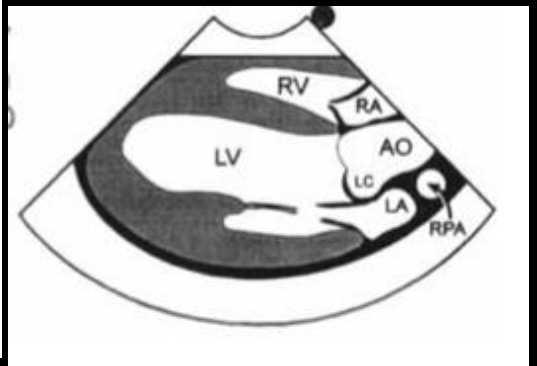
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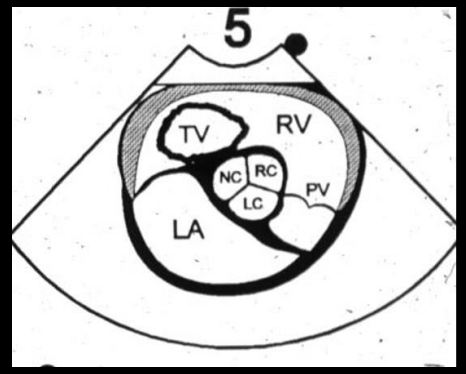
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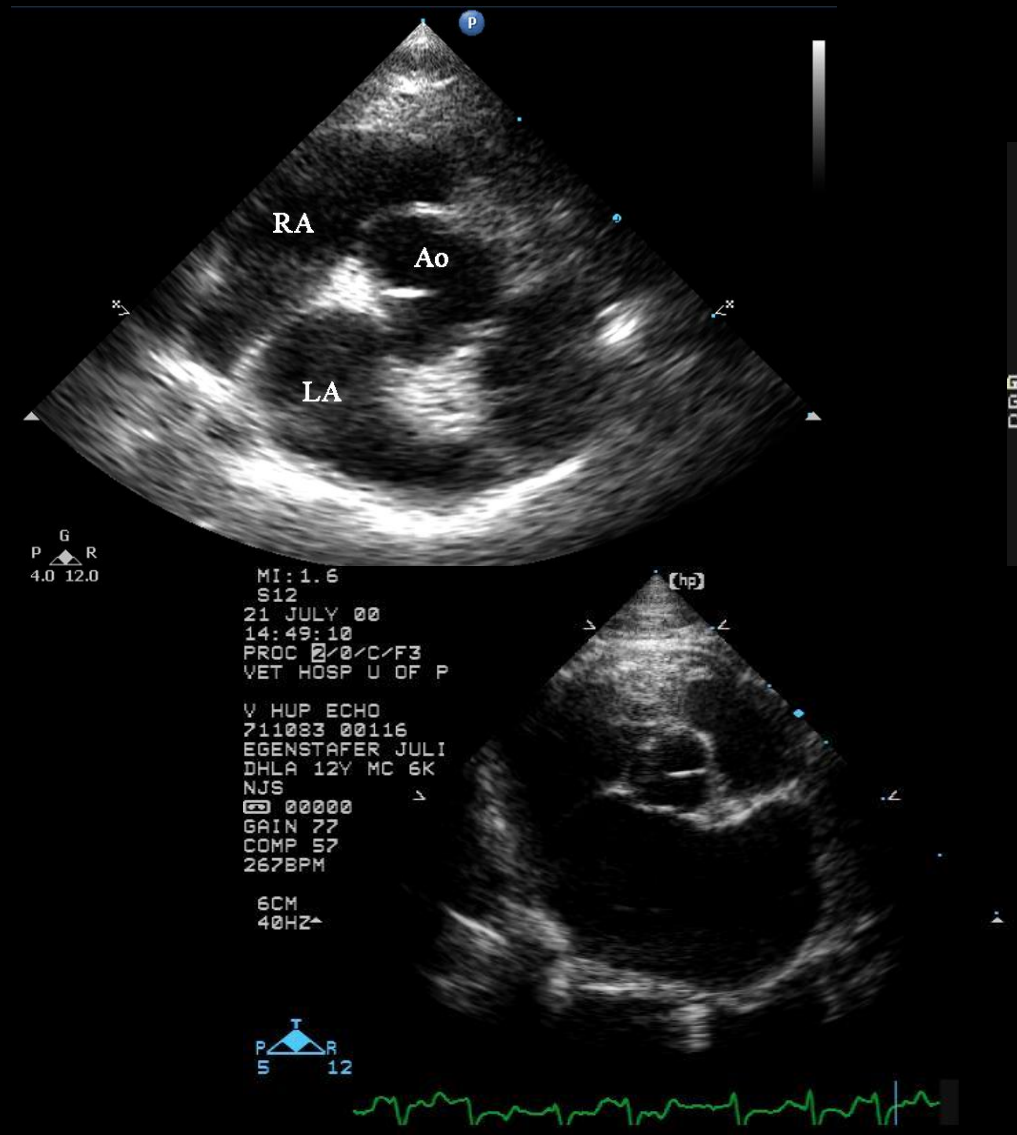

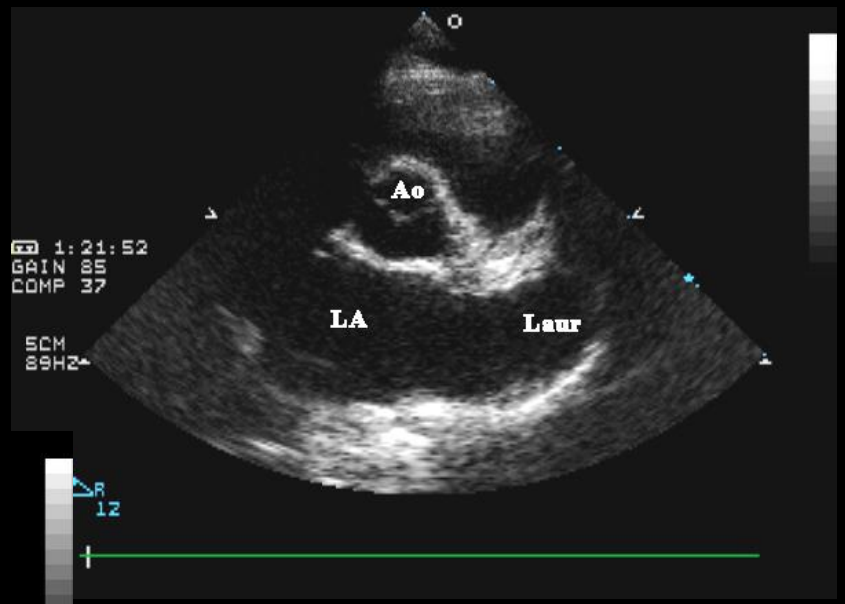

WALL THICKN
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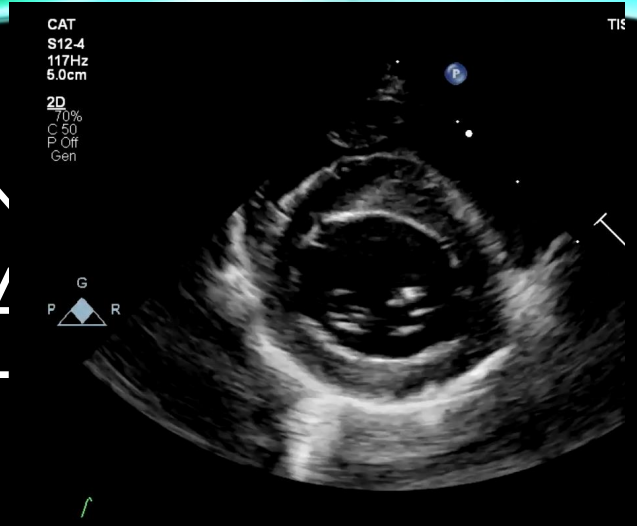
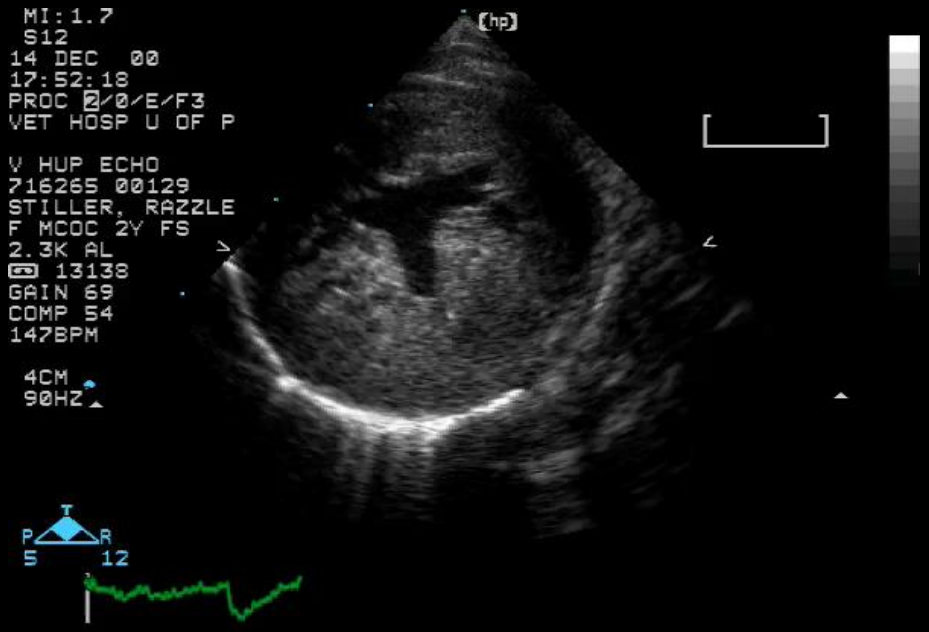
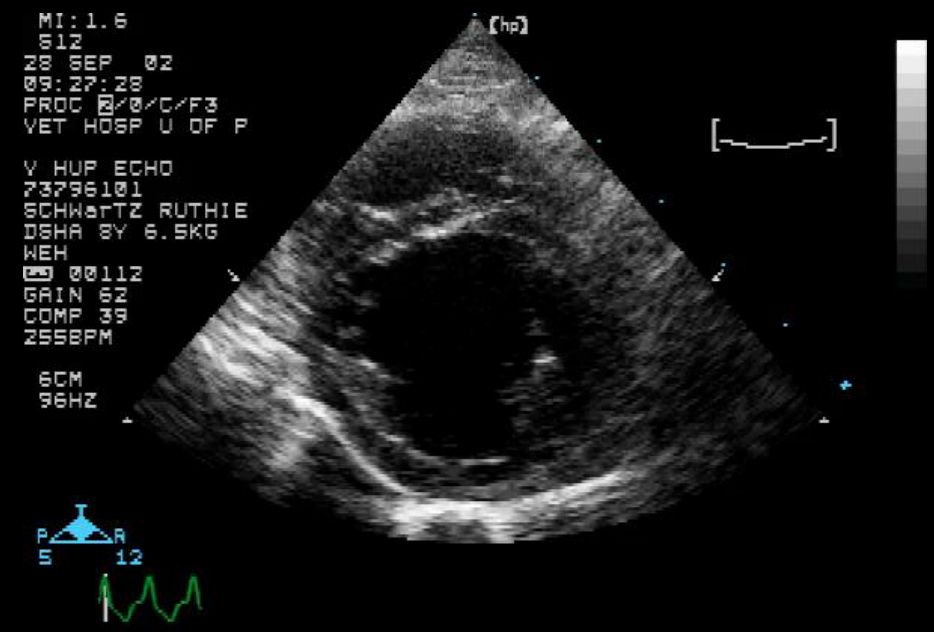
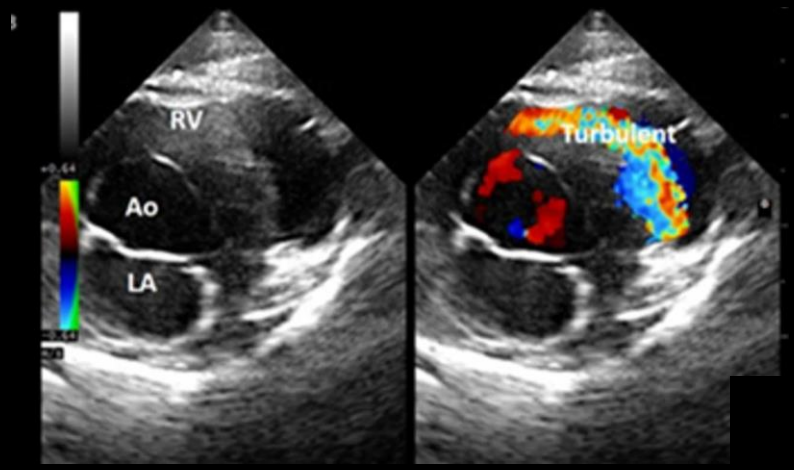
SYSTOLIC FUNCT

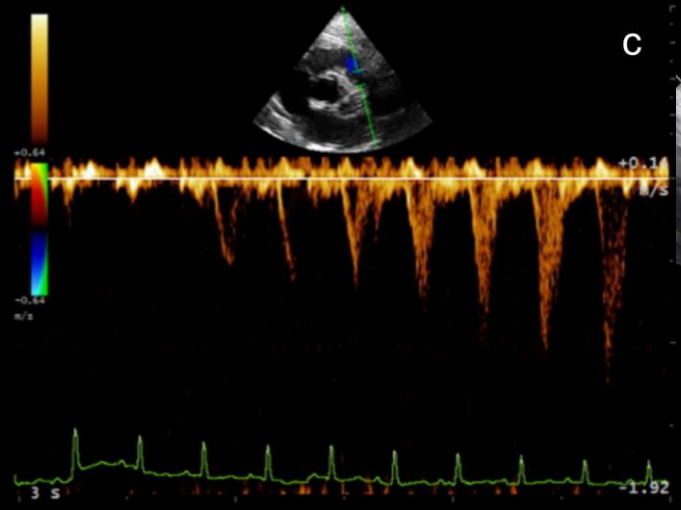


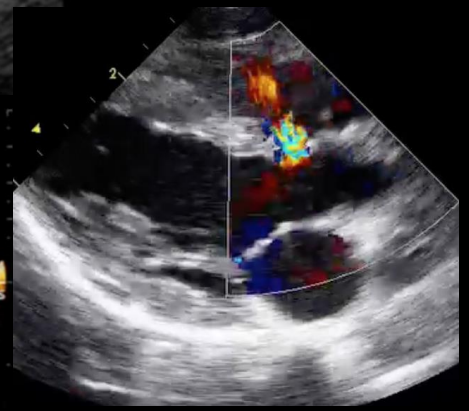


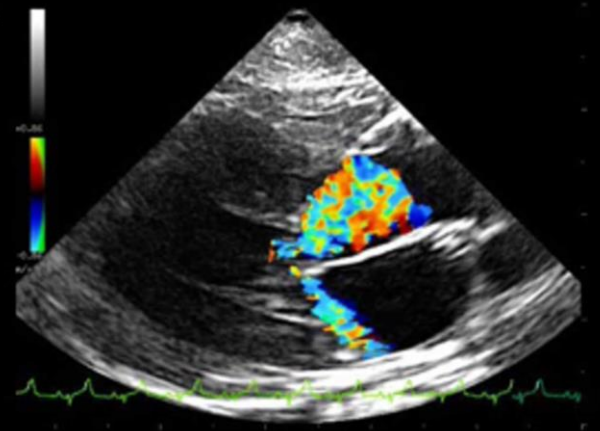


ECHOCARDIOGRAM









THORACIC RADIOGRAPHS

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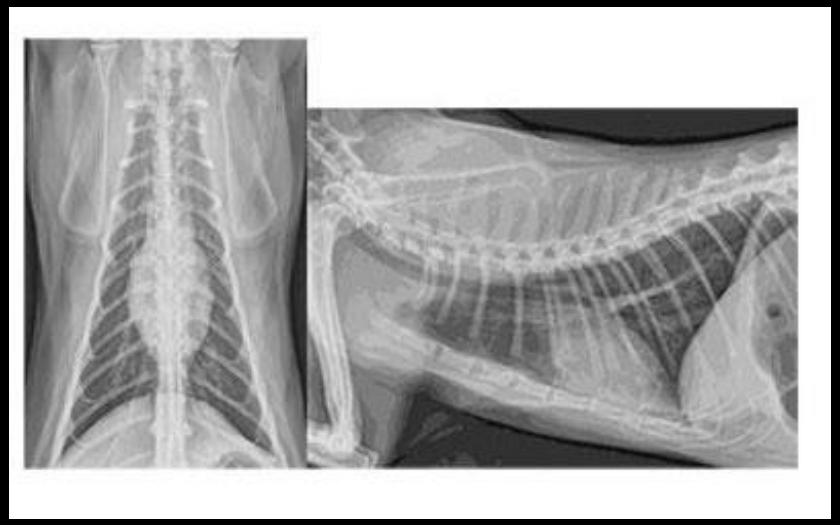
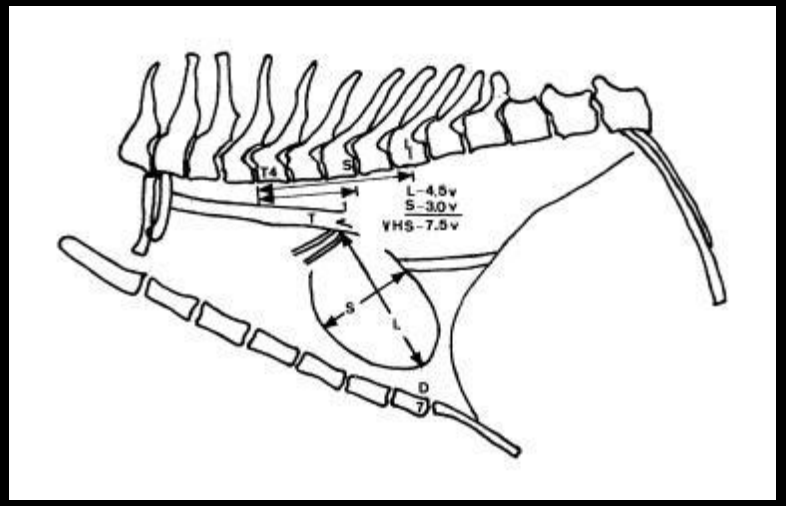
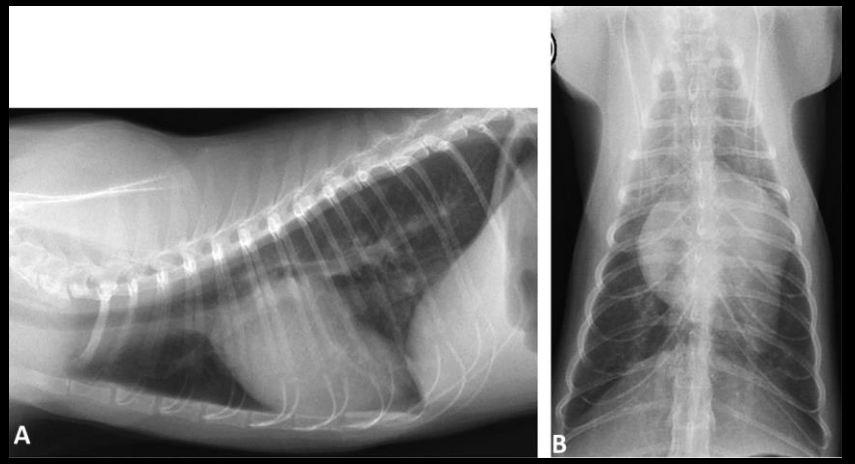






CARDIAC BIOMARKERS

- Nt-proBNP
  - Hormone is released due to increased myocardial wall stress
    - Quantitative feline specific NT-proBNP using plasma or pleural fluid has good accuracy but used to have delayed results
    - Point of care NT-proBNP is reasonably accurate with rapid results
    - Principle value is in differentiating cats with severe subclinical CM from normal cats or cats with only mild disease
- cTnI
  - Protein is released due to myocardial cell lysis
    - High sensitivity (hs) cTnI is useful to discriminate between cardiac and noncardiac causes of respiratory distress (but only when results can be obtained rapidly)

CASE 1

- 12 year old DSH with a grade III/VI parasternal murmur that has not previously been detected (no other abnormalities on PE). Cat has severe gingivitis and needs a dental.
  - Murmur intensity decreases when heart rate slows
- Diagnosis: physiologic flow murmur vs. primary heart disease
- Possible approaches:
  - Echocardiography
  - Nt-proBNP
  - Thoracic radiographs

CASE 1

- 12 year old DSH with a grade III/VI parasternal murmur that has not previously been detected (no other abnormalities on PE). Cat has severe gingivitis and needs a dental.
  - Murmur intensity decreases when heart rate slows
- Diagnosis: physiologic flow murmur vs. primary heart disease
- Possible approaches:
  - Echocardiography
  - Nt-proBNP- 78 pmol/L
  - Thoracic radiographs

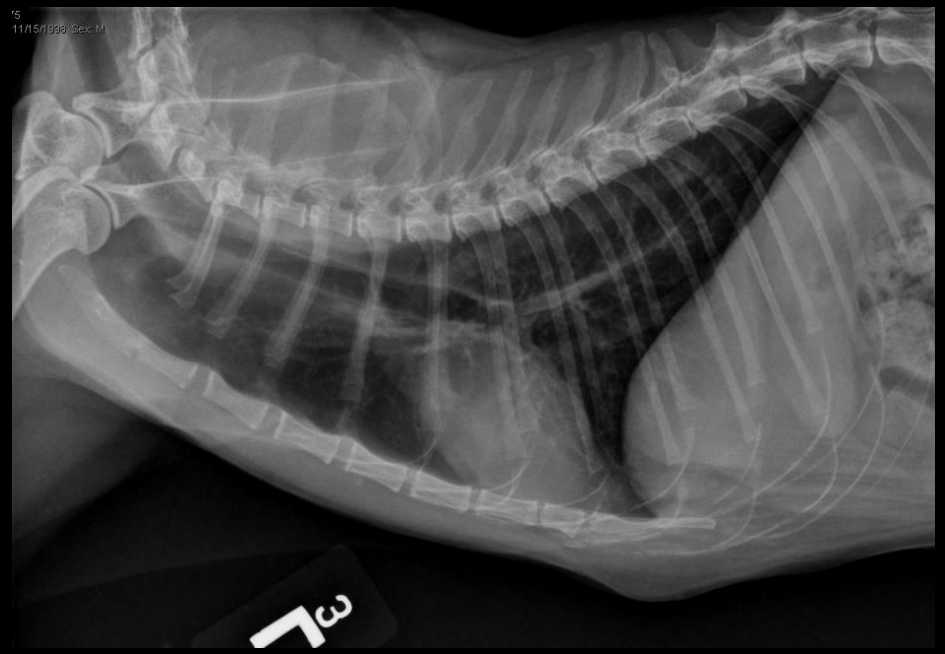
CASE 2

- 12 year old DSH with a grade III/VI parasternal murmur that has not previously been detected (no other abnormalities on PE). Cat has gingivitis and needs a dental.
  - Murmur intensity decreases when heart rate slows
- Diagnosis: physiologic flow murmur vs. primary heart disease
- Possible approaches:
  - Echocardiography
  - Nt-proBNP
  - Thoracic radiographs

CASE 2

- 12 year old DSH with a grade III/VI parasternal murmur that has not previously been detected (no other abnormalities on PE). Cat has gingivitis and needs a dental.
  - Murmur intensity decreases when heart rate slows
- Diagnosis: physiologic flow murmur vs. primary heart disease
- Possible approaches:
  - Echocardiography
  - Nt-proBNP- 290 pmol/L
  - Thoracic radiographs

CASE 2 THORACIC RADIOGRAPHS



Interpretation: VHS-7.8V; Normal heart size and clear lung fields

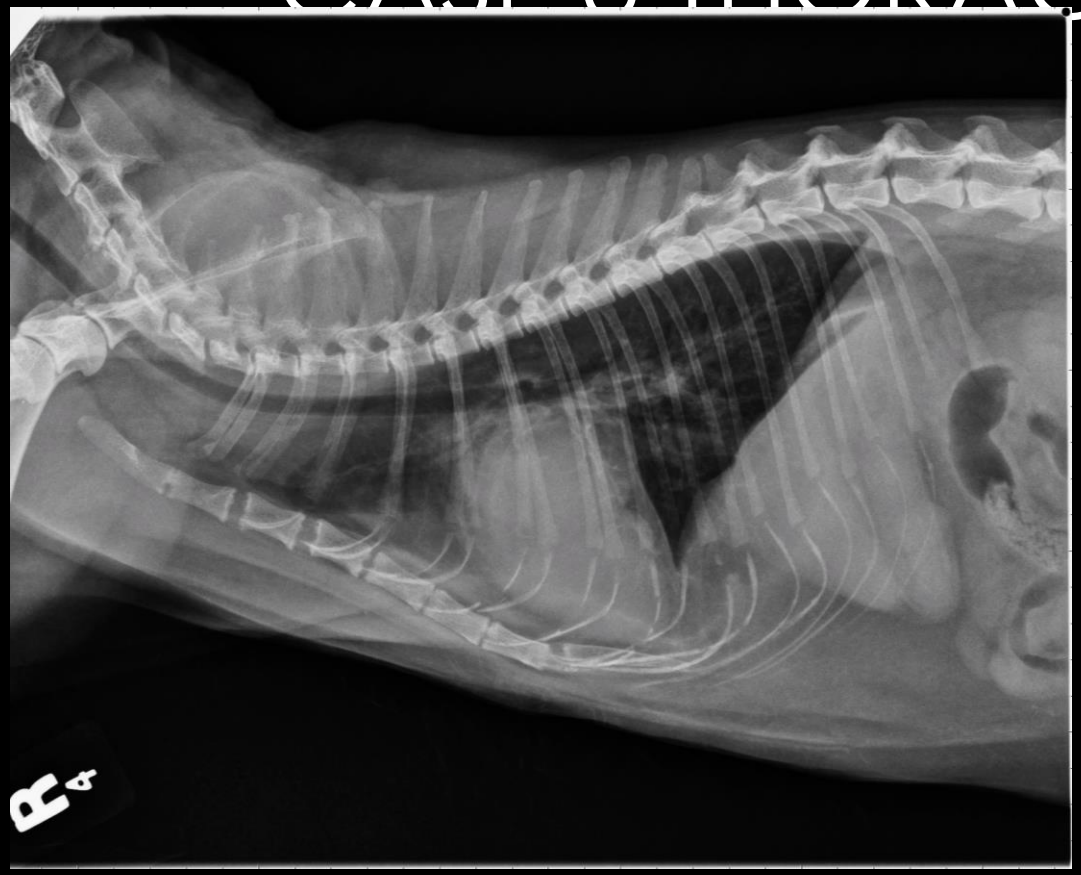
CASE 2

- Diagnosis: Early cardiomyopathy is possible but significant heart enlargement is not present (presumptive stage B1).
- Recommendations
  - No cardiac drugs recommended
  - Echocardiogram would allow definitive diagnosis but if not possible, potential follow up could be yearly thoracic radiographs and nt-proBNP in leiu of echocardiography (perhaps echo will become possible)
  - Client education

CASE 3

- 12 year old DSH with a grade III/VI parasternal murmur that has not previously been detected (no other abnormalities on PE). Cat has gingivitis and needs a dental.
  - Murmur intensity decreases when heart rate slows
- Diagnosis: physiologic flow murmur vs. primary heart disease
- Possible approaches:
  - Echocardiography
  - Nt-proBNP- 290 pmol/L
  - Thoracic radiographs

CASE 3 THORACIC RADIOGRAPHS



Interpretation: VHS= 9.6V; Generalized heart enlargement, particularly left atrium; Clear lung fields

CASE 3

- Diagnosis: presumptive cardiomyopathy; no evidence of congestive heart failure (presumptive stage B2)
- Recommendations
  - Echocardiogram would allow definitive diagnosis of cardiomyopathy type and is highly recommended
  - If an echocardiogram is not possible, treat presumptively for cardiomyopathy with diastolic dysfunction (more common that systolic dysfunction in cats)
    - Anticoagulants
      - Clopidogrel- 18.75 mg once daily
    - Heart rate or rhythm control if necessary
      - Atenolol or diltiazem
    - General client education
      - Resting respiratory log

CASE 4

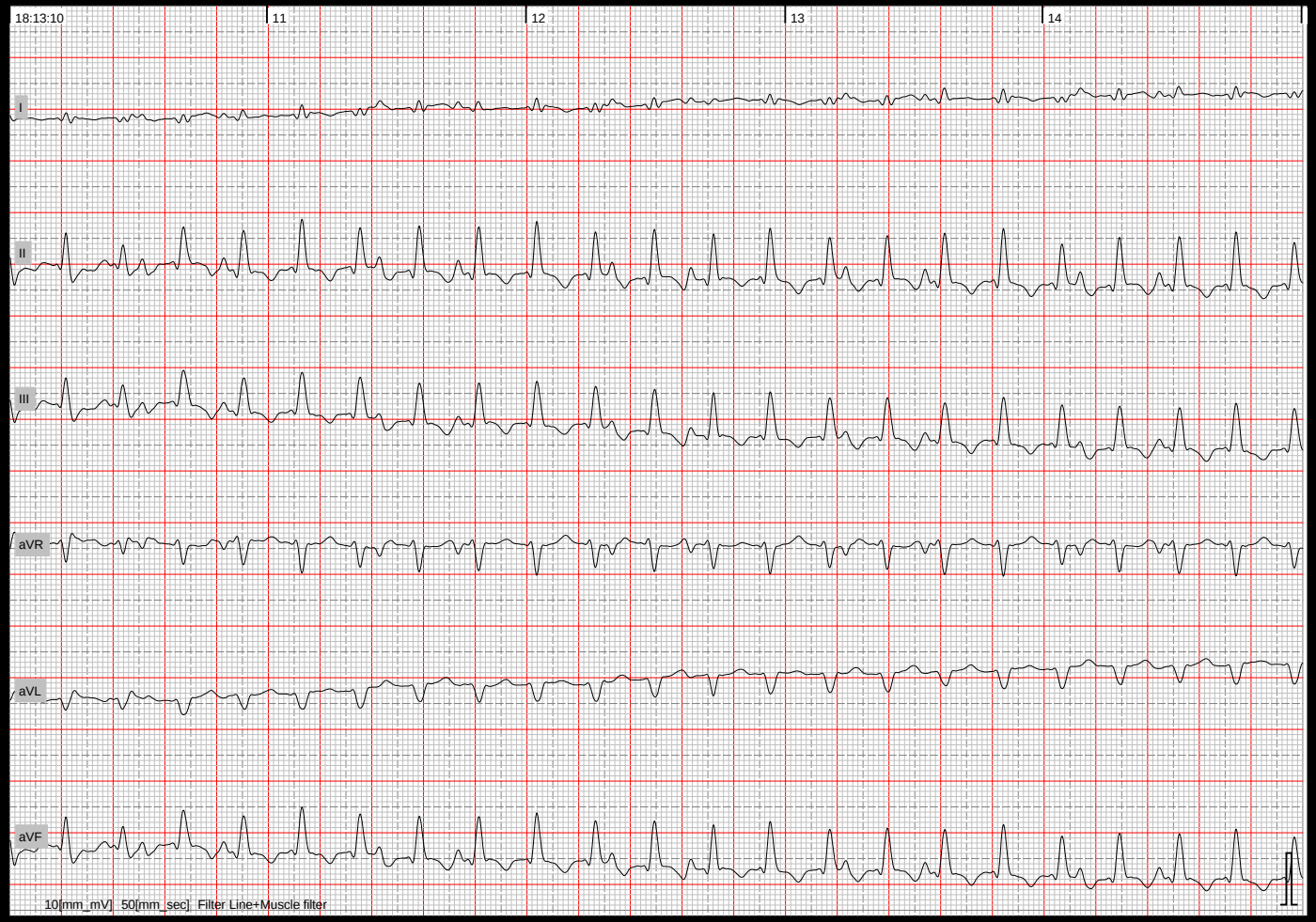
- 6 month old rag doll with a grade V/VI right parasternal murmur; asymptomatic for heart disease
- Diagnosis: cardiomyopathy vs congenital heart disease
- Possible approaches:
  - Echocardiography
  - Nt-proBNP
  - Thoracic radiographs

ECHOCARDIOGRAM

CASE 5

- 9 year old DLH with a grade III/VI parasternal murmur. Owners presenting her for lethargy.
- PE: Irregular rhythm with periods of HR at 280 bpm
- Recommended diagnostics:
  - Electrocardiogram
  - Echocardiogram
  - cTnI
  - +/-Thoracic radiographs

CASE 5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CASE 5

- 9 year old DLH with a grade III/VI parasternal murmur and an irregular cardiac rhythm. Owners have presented her for lethargy.
- Recommended diagnostics:
  - Electrocardiogram- ventricular tachycardia
  - Echocardiogram- normal other than reduced systolic function during tachycardia
  - cTnI
  - +/-Thoracic radiographs

CASE 5

- 9 year old DLH with a grade III/VI parasternal murmur and an irregular cardiac rhythm. Owners have presented her for lethargy.
- Recommended diagnostics:
  - Electrocardiogram- ventricular tachycardia
  - Echocardiogram- normal other than reduced systolic function during tachycardia
  - cTnI
  - +/-Thoracic radiographs

Treatment: 2 mg/kg sotalol twice daily

SUMMARY IN ADULT CATS

- Murmurs are often benign in cats
- Additional clinical signs supportive of primary heart disease include gallop sounds and cardiac arrhythmias
- If the VHS is ≤ 8V, **significant** primary heart disease is unlikely
- Echocardiography is the gold standard for determining the underlying form of heart disease
- At this time, there is no clear evidence that beginning commercially available cardiac medications prior to congestive heart failure alters progression of disease (with exception of clopidogrel)

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

FELINE CARDIOMYOPATHY

HISTORICAL CLASSIFICATION

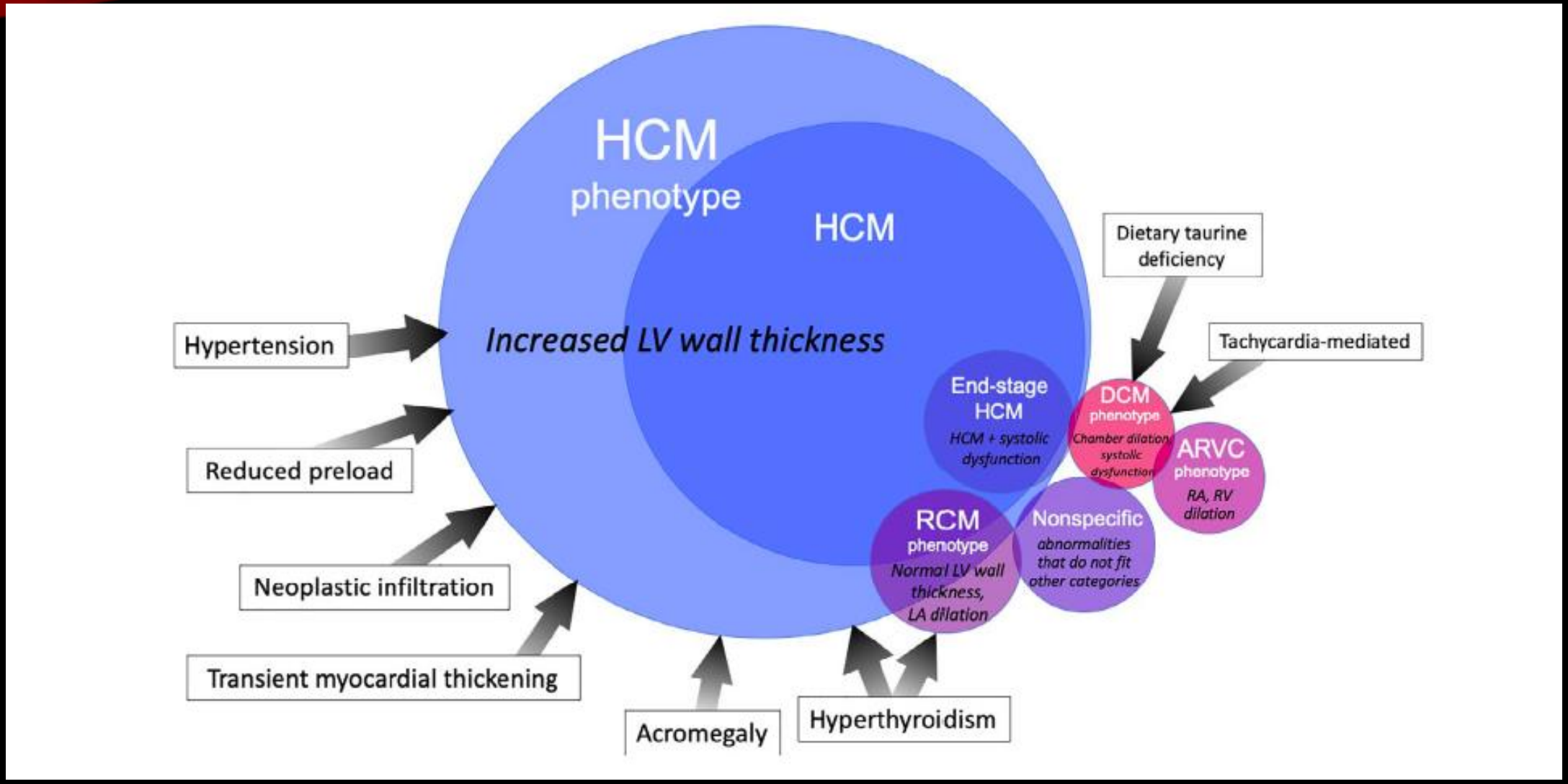
- Primary cardiomyopathies
  - Hypertrophic
  - Restrictive
  - Dilated
  - Unclassified
- Secondary cardiomyopathies
  - Metabolic
  - Infiltrative
  - Toxic
  - Inflammatory

DEFINITION OF CARDIOMYOPATHY PHENOTYPES

Phenotype	Definition
Hypertrophic cardiomyopathy (HCM)	Diffuse or regional increased LV wall thickness with a nondilated LV chamber.
Restrictive cardiomyopathy (RCM)	
Endomyocardial form	Characterized macroscopically by prominent endocardial scar that usually bridges the interventricular septum and LV free wall, and may cause fixed, mid-LV obstruction and often apical LV thinning or aneurysm; LA or biatrial enlargement is generally present.
Myocardial form	Normal LV dimensions (including wall thickness) with LA or biatrial enlargement
Dilated cardiomyopathy (DCM)	LV systolic dysfunction characterized by progressive increase in ventricular dimensions, normal or reduced LV wall thickness, and atrial dilatation.
Arrhythmogenic cardiomyopathy (AC), also known as arrhythmogenic right ventricular cardiomyopathy (ARVC) or dysplasia (ARVD)	Severe RA and RV dilatation and often, RV systolic dysfunction and RV wall thinning. The left heart may also be affected. Arrhythmias and right-sided congestive heart failure are common.
Nonspecific phenotype	A cardiomyopathic phenotype that is not adequately described by the other categories; the cardiac morphology and function should be described in detail

Feline cardiomyopathy consensus statement JVIM 2020

CLASSIFICATION OF CARDIOMYOPATHY PHENOTYPES



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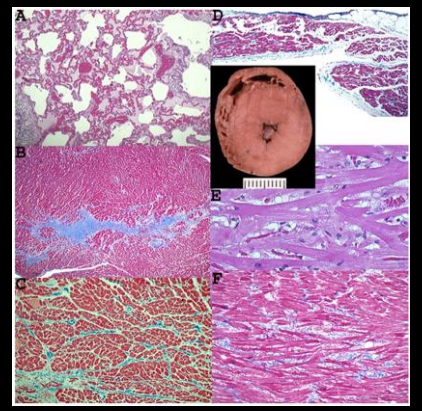
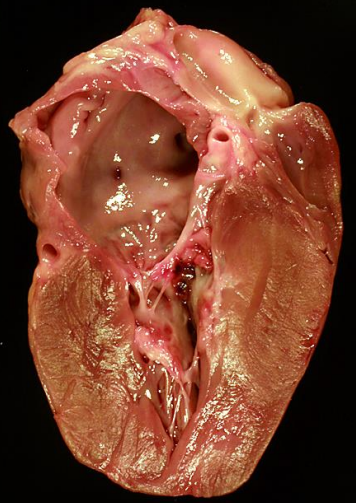
HYPERTROPHIC CARDIOMYOPATHY (HCM)

- Prevalence of approximately 15% in general population and higher in older cats (up to 29% reported)
- Sex: Male > Female
- Breeds: Maine Coon, Ragdoll, Persian, American and British shorthair, Siberian, Norwegian forest cats, Scottish fold, Sphinx, Turkish Van, Himalayan, Birman
- Age: 6 months to 16 years (mean of 6 years)
- Approximately half of cats are asymptomatic and diagnosed incidentally
- Approximately half of cats diagnosed at first heart failure episode, some following a precipitating event
- Most cats have subclinical disease with a 5 year cumulative incidence of cardiac mortality of approximately 23%

HCM- GENETIC SCREENING

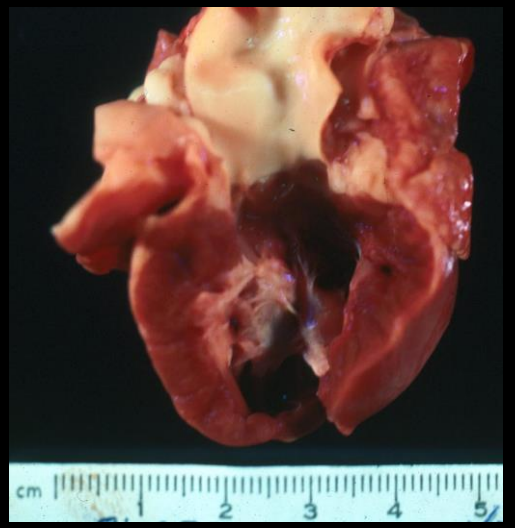
- Causative mutations identified in the Maine coon, Rag doll, Sphinx and domestic short hair breeds
  - Disease tends to be apparent earlier in the pure breed cats
- > 1000 mutations have been recognized in 11 genes in humans





RESTRICTIVE CARDIOMYOPATHY (RCM)

- Endomyocardial form
  - Prominent endomyocardial scar, mid LV obstruction and often apical aneurysm
- Myocardial form
  - Normal LV dimensions (including wall thickness) with LA or biatrial enlargement particularly late in the disease



DILATED CARDIOMYOPATHY (DCM)

- Dilated heart with reduced systolic function
- Taurine deficient DCM is rarely diagnosed currently
- Abyssinian, Burmese and Siamese are over-represented

ARRHYTHMOGENIC CARDIOMYOPATHY (AC)

- Rare form of cardiomyopathy in cats
- Fatty or fibrofatty infiltration of the RA and RV with subsequent dilation
- In case series of 12 cats, middle aged male DSH were most commonly affected
- Right ventricular wall may be thinned
- Ventricular tachyarhythmias are common

MAIN INDICATIONS FOR CARDIOLOGY EXAM

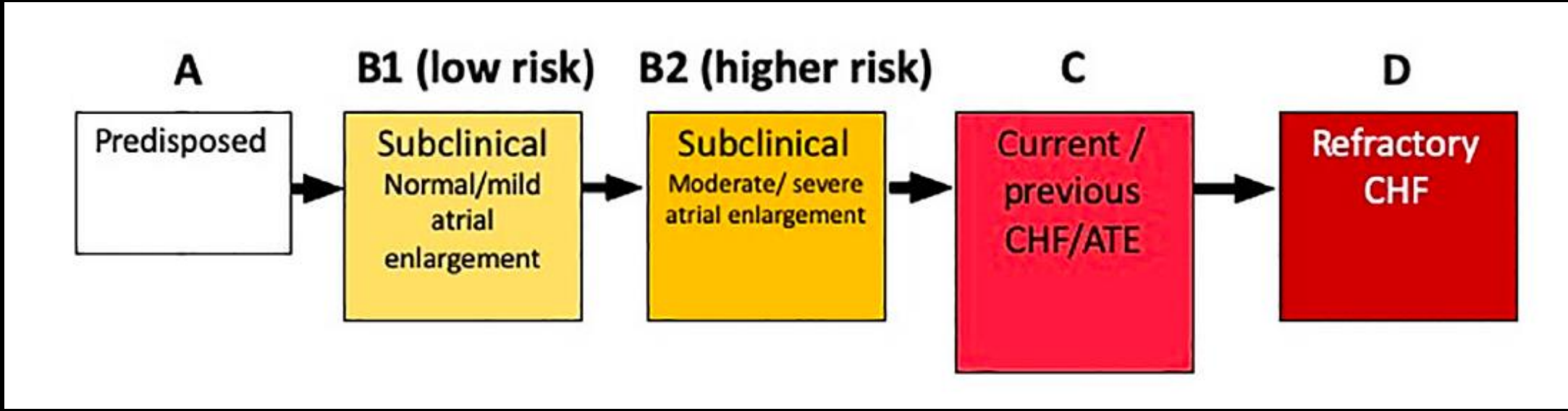
History	Syncope Seizures (in the absence of other neurological abnormalities) Diagnosis of cardiomyopathy in a close relative Weakness Exercise intolerance/open-mouth breathing with exertion Intolerance to parenteral fluid administration Pedigree cat intended for breeding Maine coon or Ragdoll with a MyBPC3 mutation Any endocrinopathy Heartworm positive status Fever of unknown origin
Physical exam	Murmur Gallop sound or systolic click Muffled heart or lung sounds Arrhythmia Tachypnea Pulmonary crackles Jugular venous distention or pulsation Ascites Hypo- or hyperkinetic femoral arterial pulse pressure Acute paresis/paralysis Absent femoral arterial pulses
Cats aged 9 years or older undergoing interventions that could precipitate CHF	General anesthesia Fluid treatment Extended-release glucocorticosteroids

Feline cardiomyopathy consensus statement JVIM

FELINE MURMURS

- Prevalence of heart murmurs in overtly normal cats ranges from 16-44%.
- Between 25% (Bonagura 2000) and 69% (Paige et al. 2009) of cats with murmurs on physical examination have no echocardiographic evidence of heart disease
- Many cats with cardiomyopathy have no auscultatory abnormality

STAGING SYSTEM FOR FELINE CARDIOMYOPATHY



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SEQUELAE OF CARDIOMYOPATHY

- Long subclinical progression (years)
- Congestive heart failure
- Feline arterial thromboembolic disease
- Sudden death

MARKERS OF POOR OUTCOME

- Gallop sound
- Arrhythmia
- Moderate to severe LA enlargement
- Decreased LA fractional shortening
- Extreme LV hypertrophy
- Decreased LV systolic function
- Spontaneous echo contrast or intracardiac thrombus
- Regional wall thinning with hypokinesis
- Restrictive diastolic filling pattern

MARKERS OF LONGER SURVIVAL

- Reduction in nt-proBNP in response to therapy following CHF

CARDIOMYOPATHY- DIAGNOSTICS ELECTROCARDIOGRAPHY

- Cats experiencing episodic weakness and collapse (including seizure-like activity) should undergo a cardiovascular evaluation that includes echocardiography, ECG and telemetric or Holter ECG monitoring if necessary.
- Implantable loop recorders should be considered for cats with intermittent clinical signs that could be due to arrhythmias
- In some cases, use of a portable electrode plate (Kardia Alivecor) in conjunction with a smartphone is reasonable

CARDIOMYOPATHY-ELECTROCARDIOGRAPHY

- Body surface electrocardiogram

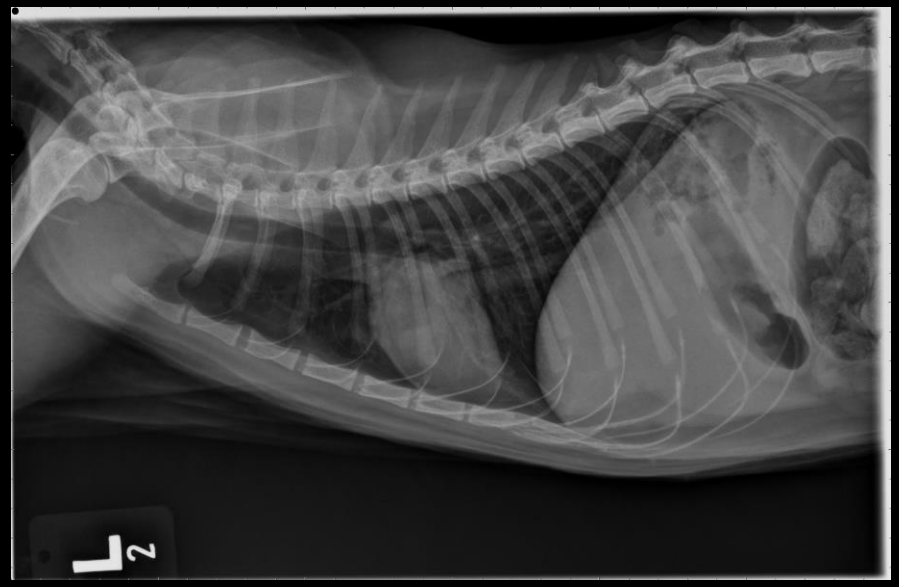
- Loop recorder

- Kardia Alivecor

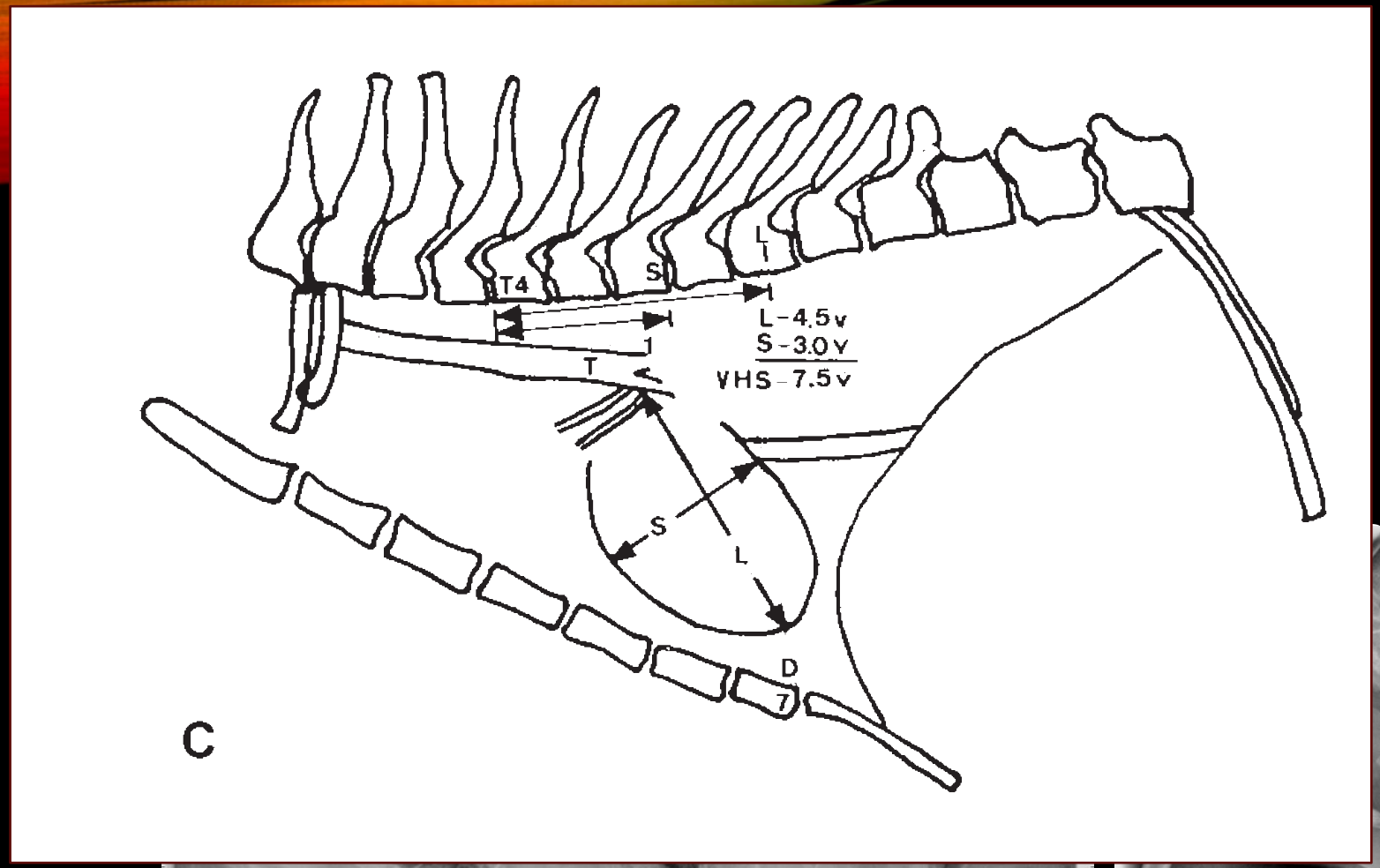
CARDIOMYOPATHY- DIAGNOSTICS RADIOGRAPHY KEY POINTS

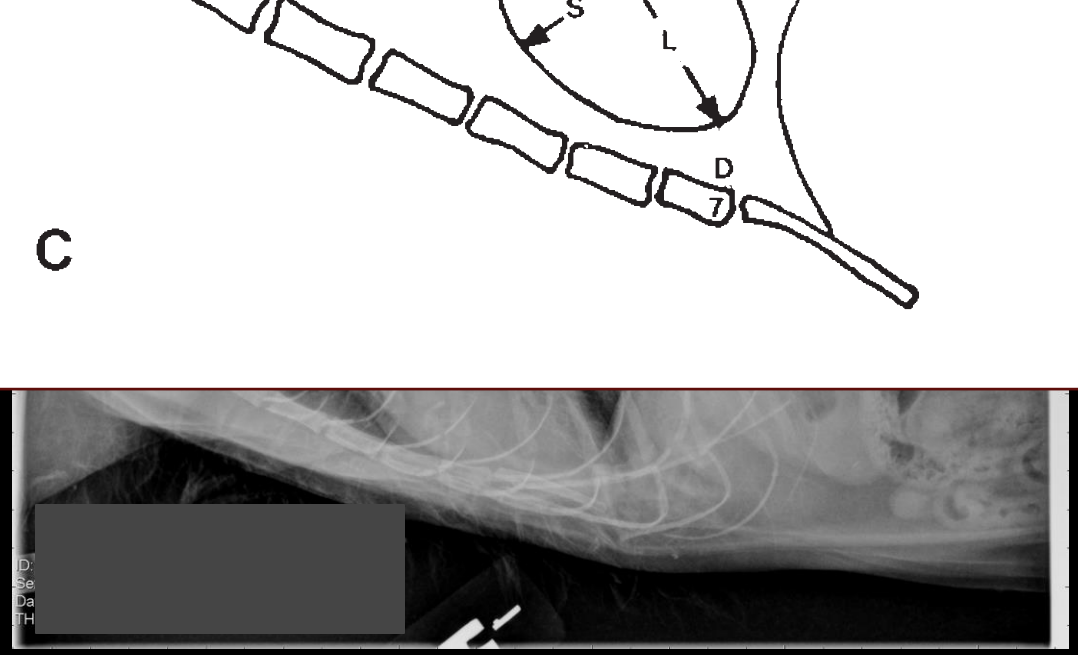
- Thoracic radiographs are insensitive for identification of mild or moderate heart changes in cats, but fairly good at identifying cats with left atrial enlargement (≥stage B2)
- Radiographic pattern associated with cardiogenic pulmonary edema is highly variable in cats
- Restraint for radiographs can be dangerous in unstable patients
- Consider combination of physical exam, point of care ultrasound and point of care nt-proBNP in dyspneic patient (if radiographs not possible)

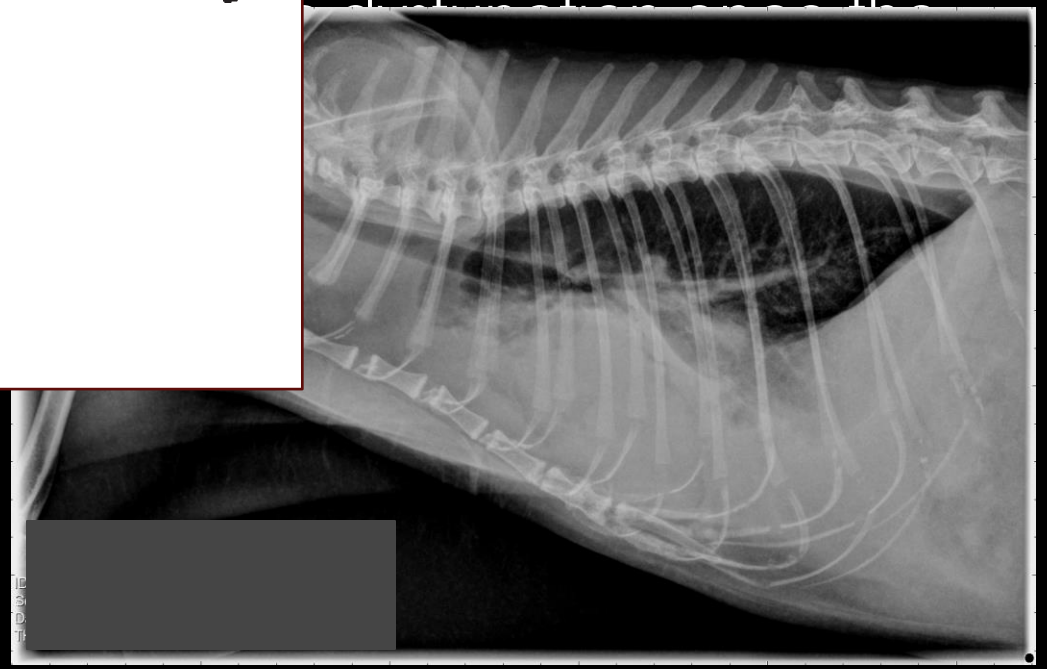
CARDIOMYOPATHY- DIAGNOSTICS RADIOGRAPHY



CONGESTIVE HEART FAILURE







Use of the vertebral heart scale for differentiation of cardiac and noncardiac causes of respiratory distress in cats: 67 cases (2002–2003)

Meg M. Sleeper, VMD, DACVIM; Risa Roland, DVM, DACVIM; Kenneth J. Drobatz, DVM, MSCE, DACVECC, DACVIM

Objective—To assess the effectiveness of the vertebral heart scale (VHS) system to differentiate congestive heart failure from other causes of dyspnea in cats.

Design—Retrospective case series.

Animals—67 cats with acute respiratory distress.

Procedures—Medical records of client-owned cats evaluated on an emergency basis because of acute respiratory distress during a 1-year period were reviewed. For study inclusion, cats must have undergone evaluation with echocardiography and thoracic radiography within 12 hours after hospital admission. The VHS was calculated for each cat by 2 investigators. Signalment, physical examination, and echocardiographic findings were reviewed for each patient.

Results—There was 83% agreement overall between the 2 investigators in assessment of cardiomegaly in cats with dyspnea ($\kappa = 0.49$). The VHS cutpoints were the same for both observers in terms of optimizing sensitivity and specificity. A VHS of > 8.0 vertebrae was the best cutpoint when screening for heart disease, whereas a VHS of > 9.3 vertebrae was very specific for the presence of heart disease. Measurements between 8.0 and 9.3 vertebrae suggested the cause of dyspnea was equivocal (ie, secondary to congestive heart failure or respiratory disease), in which case echocardiography would be most useful in providing additional diagnostic information.

Conclusions and Clinical Relevance—Results suggested that the VHS system may be a useful tool to help differentiate cardiac from noncardiac causes of respiratory distress in cats in an emergency situation when an echocardiogram is not available or is not plausible in an unstable patient. (*J Am Vet Med Assoc* 2013;242:366–371)

CARDIOMYOPATHY- DIAGNOSTICS BIOMARKERS

- Quantitative feline specific NT-proBNP using plasma or pleural fluid has good accuracy but delayed in results
  - Helpful when echocardiogram is not available
- Point of care NT-proBNP is reasonably accurate and provides rapid results
  - Helpful when point of care ultrasound is not available
- Principle value is in differentiating cats with severe subclinical CM from normal cats or cats with only mild disease

CARDIOMYOPATHY- DIAGNOSTICS BIOMARKERS

- cTnI is significantly elevated with myocardial cell membrane lysis (myocarditis)
- High sensitivity (hs) cTnI is useful to discriminate between cardiac and noncardiac causes of respiratory distress (but only when results can be obtained rapidly)

- **At this time, echocardiography remains the gold standard for diagnosis of cardiomyopathy in cats, but biomarkers can give useful information if echo is not available**

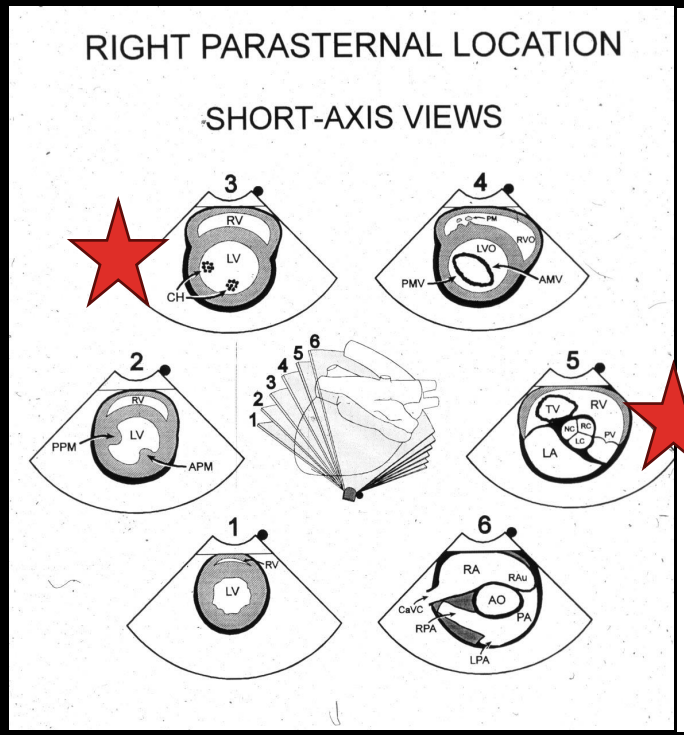
CARDIOMYOPATHY- DIAGNOSTICS ECHOCARDIOGRAPHY

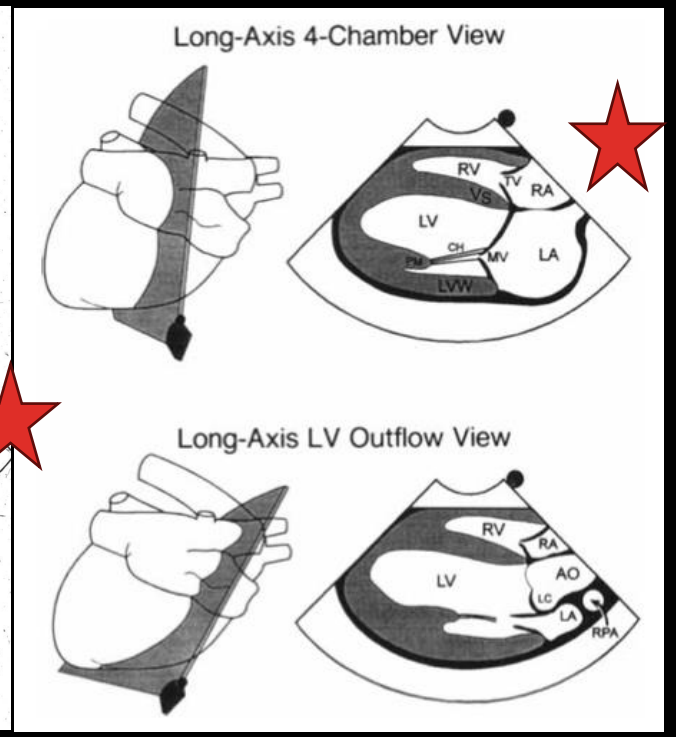
- A focused point-of-care echocardiogram (TFAST) is feasible in first opinion practices with practice and can improve accuracy of diagnosis-especially in cats with more advanced disease
- When echo is unavailable, evaluation of NT-proBNP may be considered as a screening test for identifying advanced cardiomyopathy (normal NT-proBNP indicates low likelihood of cardiomyopathy)
- Positive NT-proBNP should be followed by echocardiogram

ECHO PROTOCOLS FOR CARDIOMYOPATHY

Level of scan	Measurements	Qualitative assessment
Focused point-of-care		Note presence of: • Pleural, pericardial effusions • Left atrial size & motion • Pulmonary B-lines • LV systolic function
Standard of care	*M-mode* • IVSd, LVFWd • LVIDd, LVIDs, LV FS% • LA FS% *2D* • IVSd, LVFWd • LVIDd, LVIDs • LA/Ao • LA diameter from RP long axis view	Note presence of: • Papillary muscle hypertrophy • End-systolic LV cavity obliteration • Papillary muscle/mitral leaflet abnormalities • SAM or mid LV obstruction • Dynamic RVOTO • Abnormal cardiac chamber geometry • Presence of spontaneous echo-contrast or thrombus • Regional wall motion abnormalities
Best practice	M-mode and 2D as for standard of care, with the following additional measurements: *Spectral Doppler* • Mitral inflow velocities • Isovolumic relaxation time • LVOT velocities • RVOT velocities • PVF velocities • LAA blood flow velocities *Tissue Doppler imaging* • Lateral and septal mitral annular velocities (pulsed wave Doppler mode).	Qualitative assessment as for standard of care

ECHOCARDIOGRAM- FOCUSED POINT OF CARE





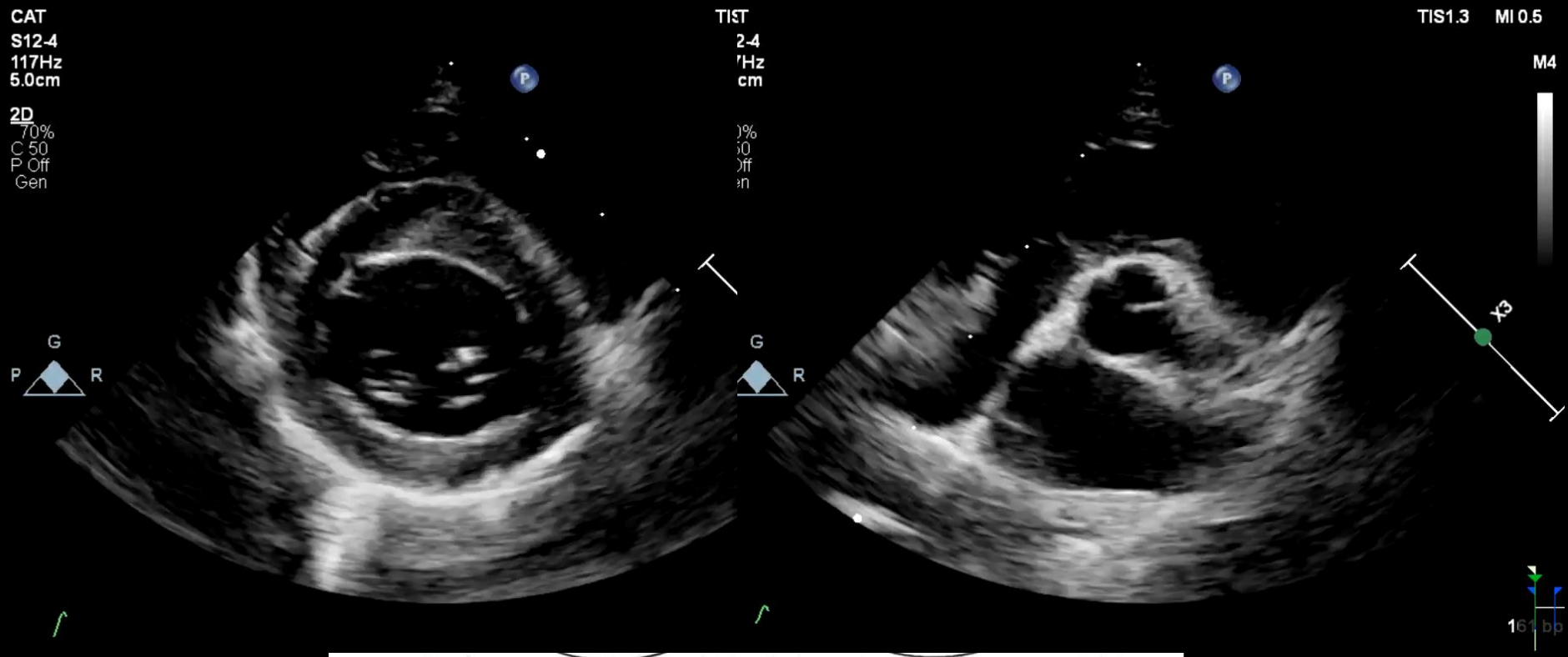
RV=right ventricle
LV=left ventricle
RA=right atrium

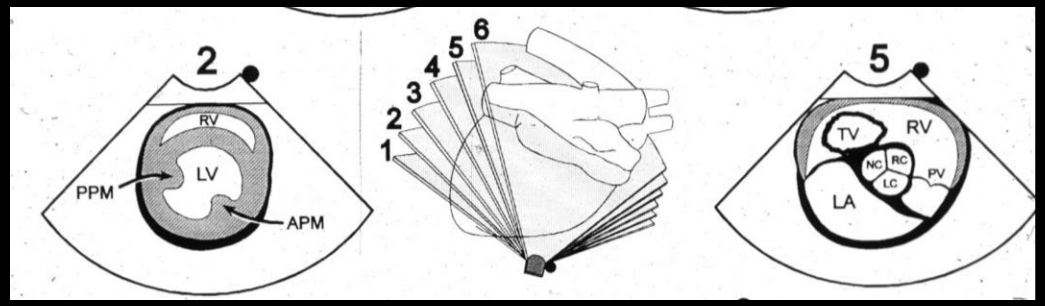
LA=left atrium
AO=aorta

ECHOCARDIOGRAM- FOCUSED POINT OF CARE

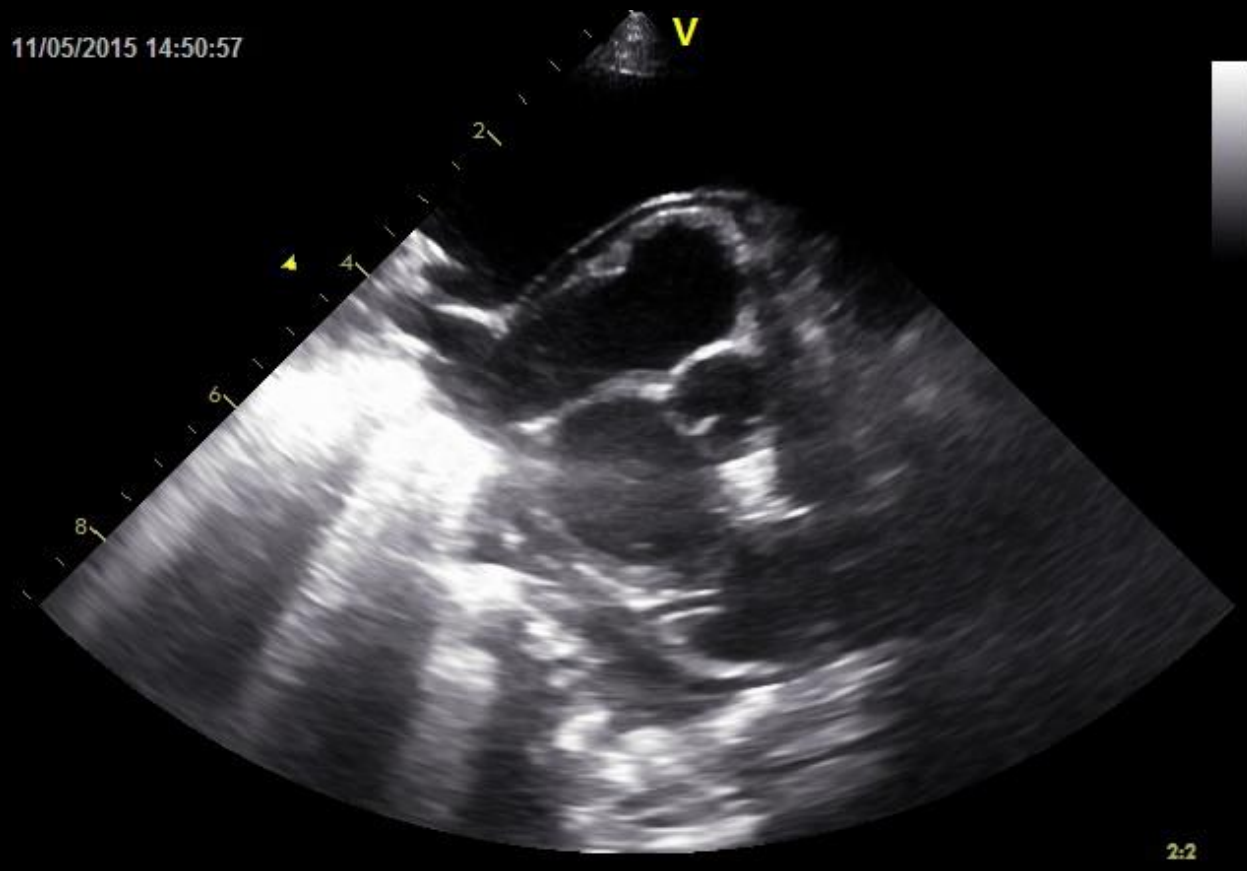
- Note presence of:
  - Pleural, pericardial effusion
  - Left atrial size
  - Pulmonary B lines
  - Left ventricular systolic function and thickness

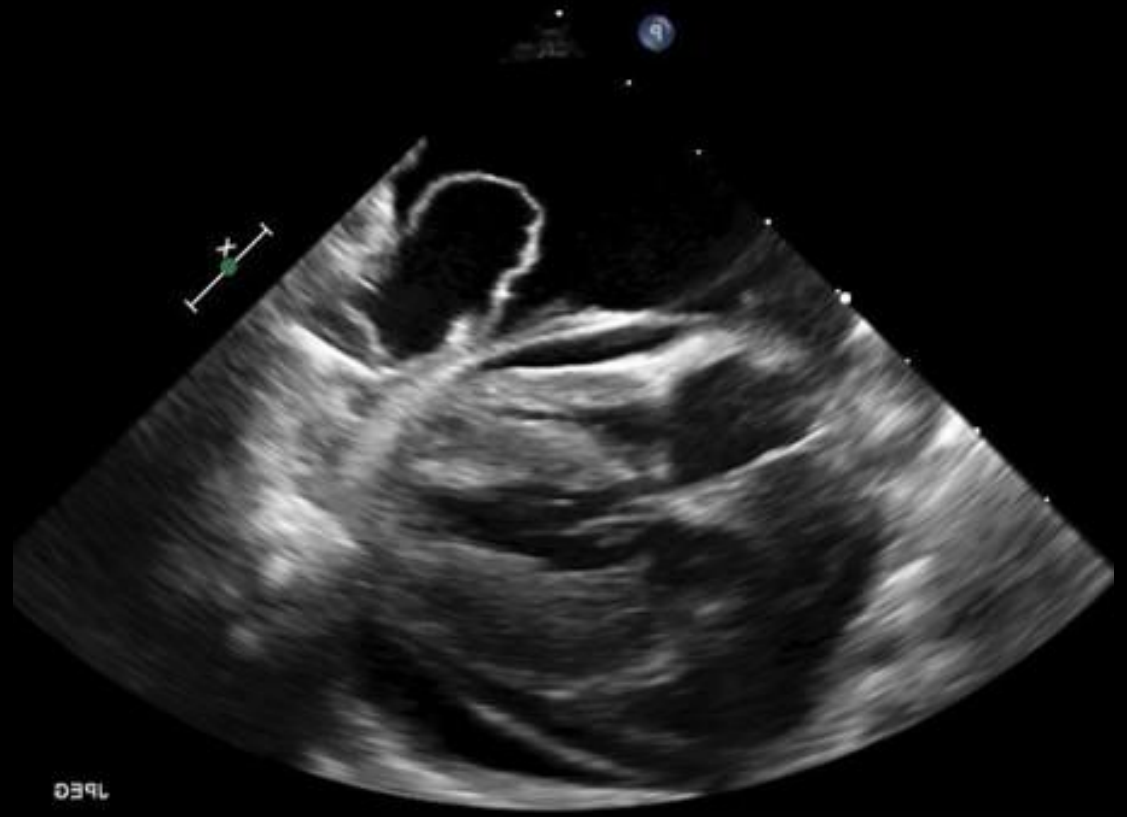
Normal cat


CAT
S12-4
117Hz
5.0cm
2D
70%
C 50
P Off
Gen
G
P
R
TIS1.3
MI 0.5
M4
X3

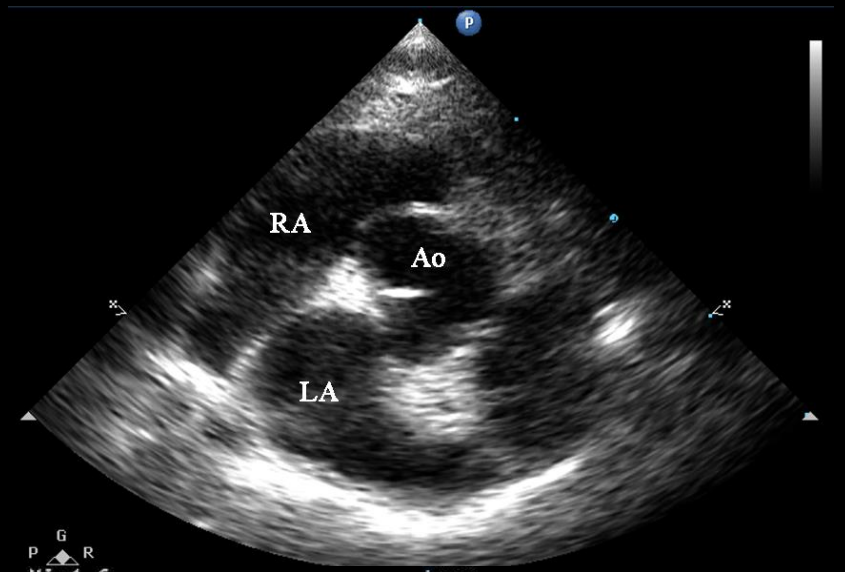

2
RV
LV
PPM
APM
1
2
3
4
5
6
5
TV
RV
NC
RC
LC
PV
LA

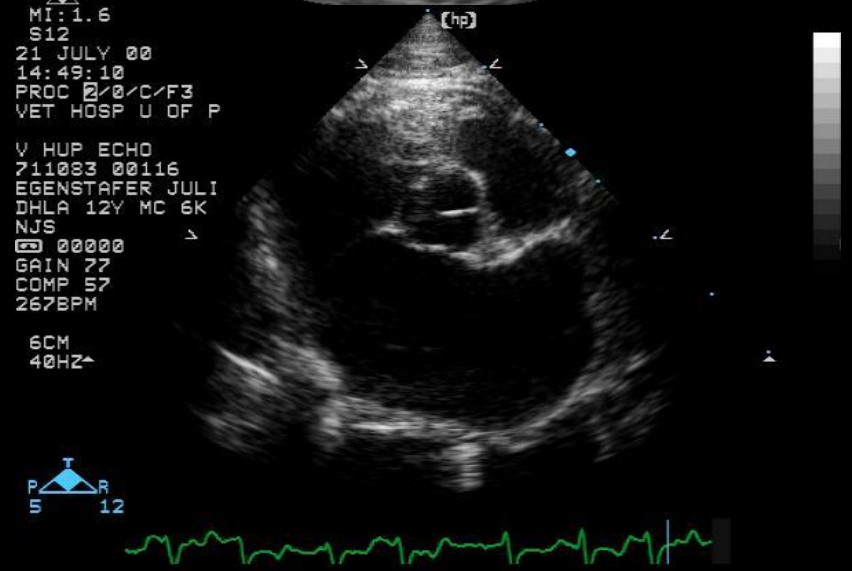
EFFUSIONS

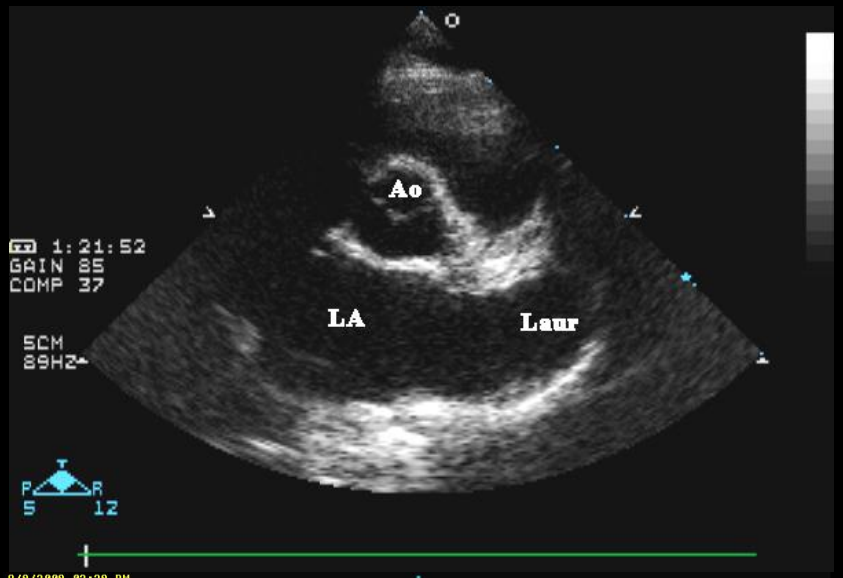


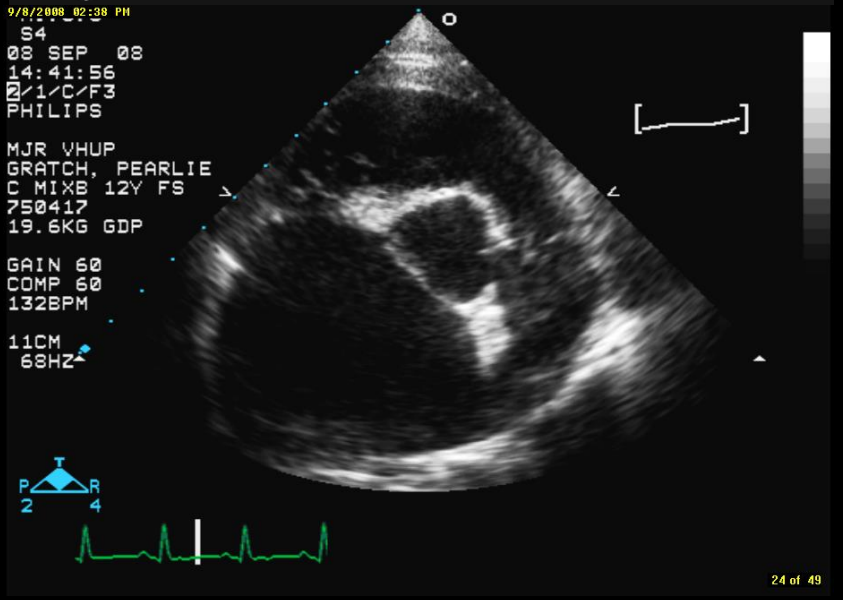


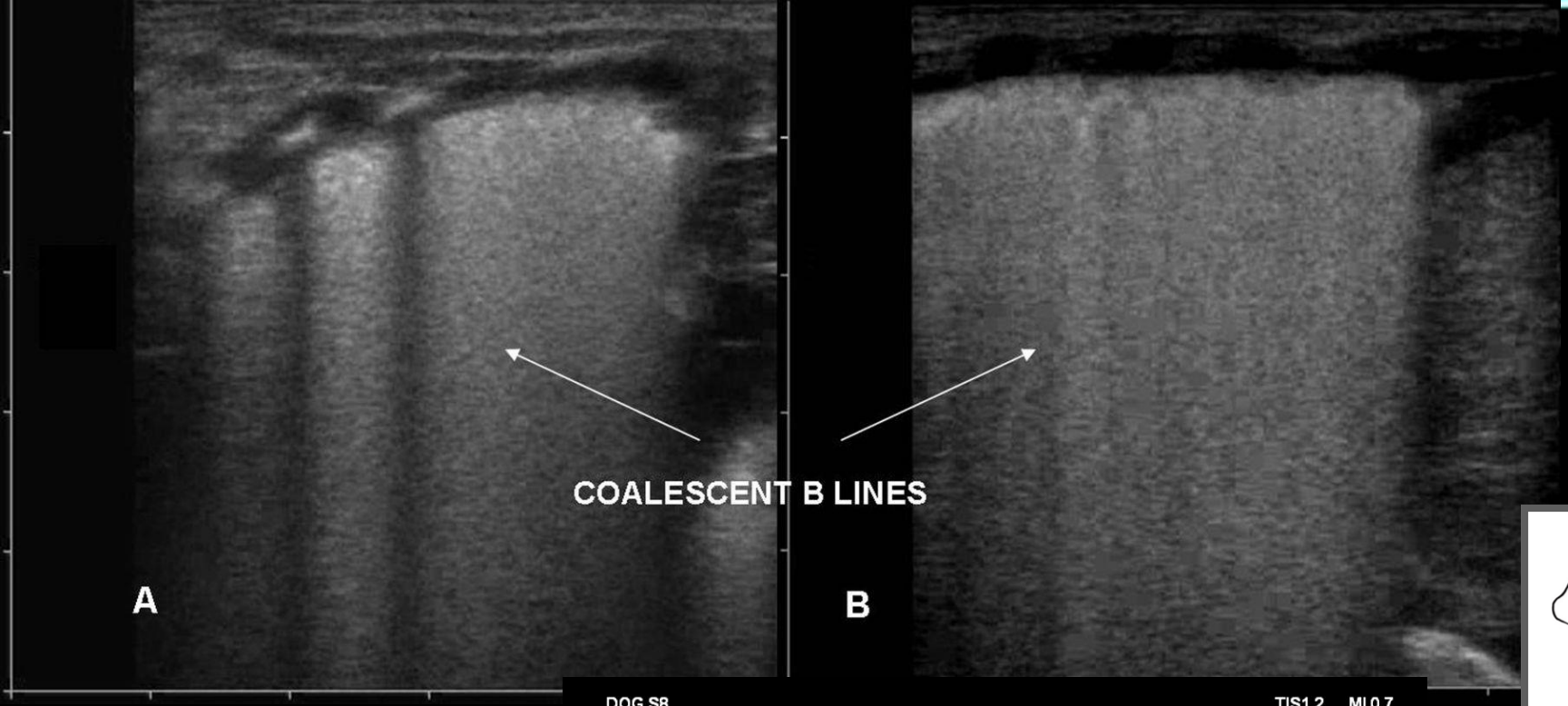
LEFT ATRIAL SIZE

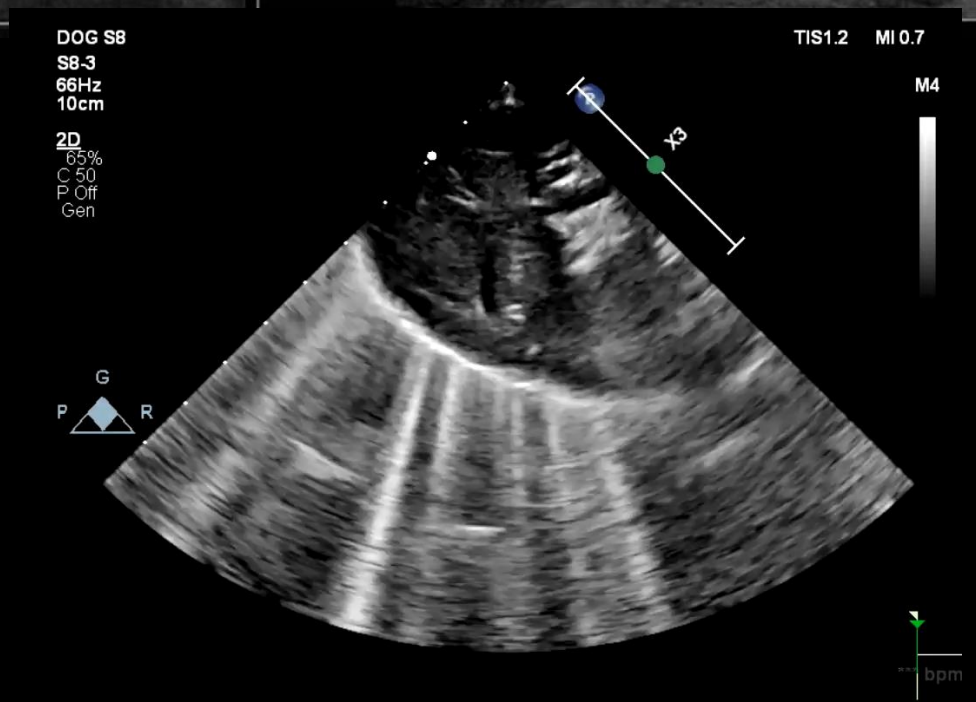


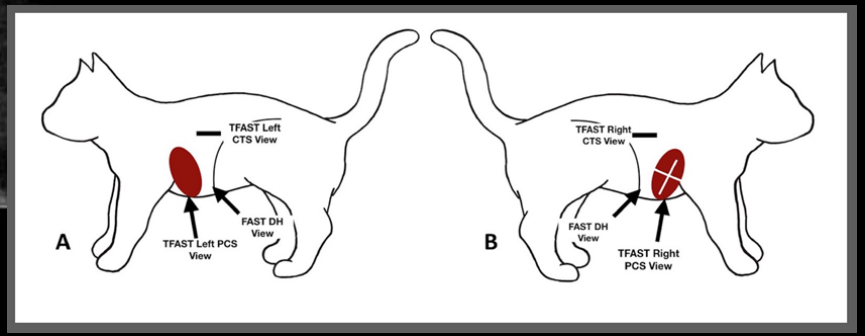




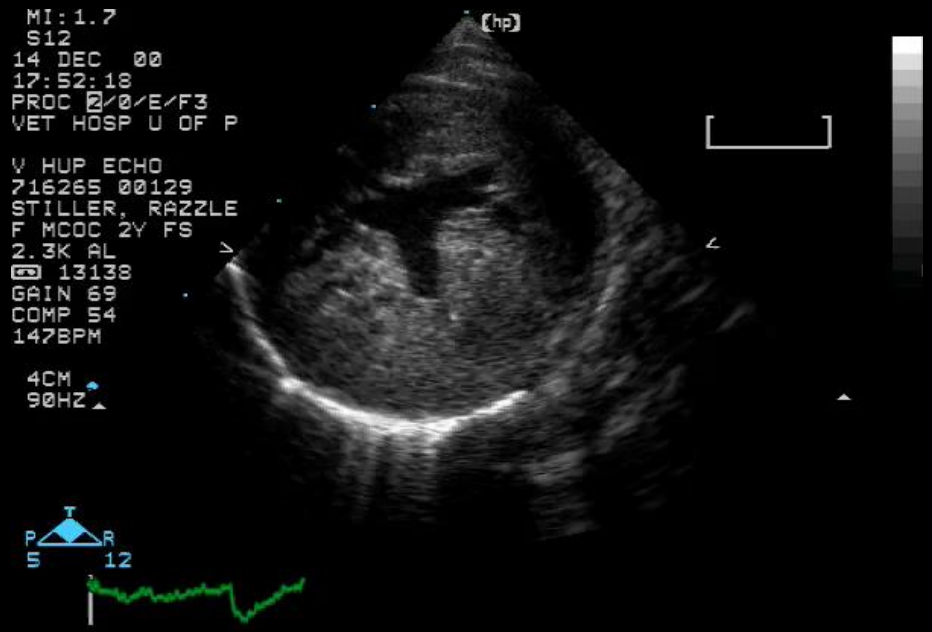


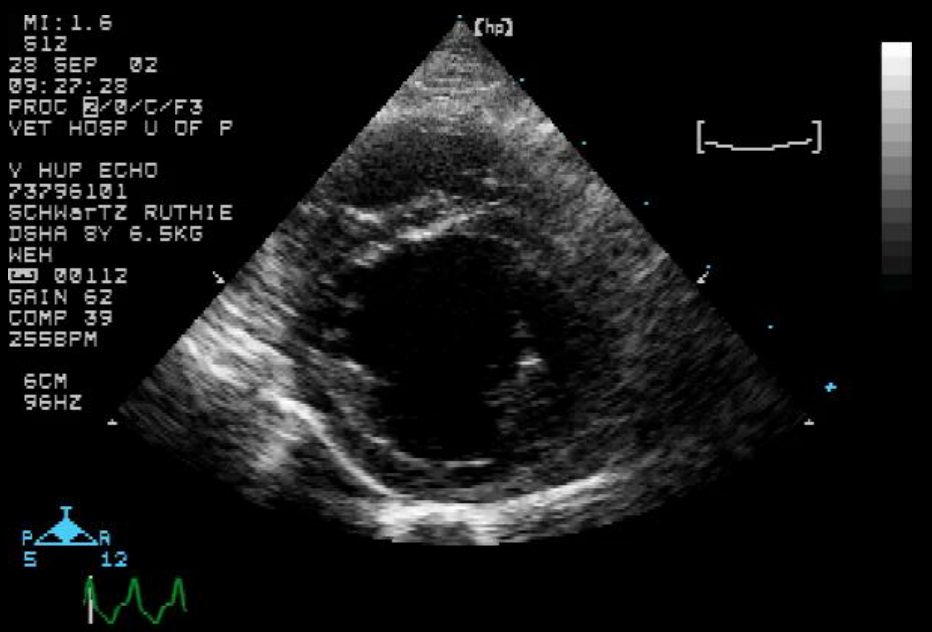

COALESCENT B LINES
A
B


DOG S8
S8-3
66Hz
10cm
2D
65%
C 50
P Off
Gen
TIS1.2
MI 0.7
M4
X3
G
P
R
bpm


A
TFAST Left CTS View
FAST DH View
TFAST Left PCS View
B
TFAST Right CTS View
FAST DH View
TFAST Right PCS View

SYSTOLIC FUNCTION/ WALL THICKNESS





POSSIBLE CARDIOMYOPATHY OUTCOMES

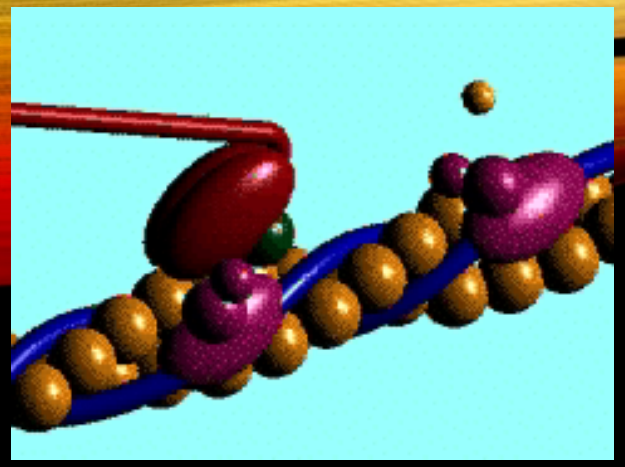
- Long, slowly progressive disease which never becomes symptomatic (or only very late in disease course)
- Sudden death
- Congestive heart failure
- Thromboembolic disease

FELINE CARDIOMYOPATHY-TREATMENT

- **Stage B1 (occult asymptomatic) cats**
  - No currently available medications have been shown to alter progression of disease
  - Monitor annually for progression to stage B2
  - Risk for CHF or ATE is low
  - In specific cases, treatment can be considered
    - Systolic dysfunction or dilated cardiomyopathy>>**pimobendan**
    - Symptomatic arrhythmias

FELINE CARDIOMYOPATHY TREATMENT

- Stage B2 cats (significant left atrial enlargement)
  - If left atrial enlargement is moderate to severe>> **clopidogrel**
  - No other currently available medications alter disease
  - Treat symptomatic arrhythmias
  - Resting respiratory rate monitoring by owner
  - Balance re-examination benefits vs. stress
  - Generally annual exams recommended, but therapy unlikely to change until clinical signs develop



NEW THERAPIES ON THE HORIZON

- Small molecule under investigation
  - Cardiac myosin inhibitors alleviate overactive protein interactions
    - Aficampten; CK 586
    - Mavacampten
  - Cardiac troponin activator
    - CK 136 (Nelutroctiv)
- Rapamycin
  - Rapamycin modulates the mTOR pathway
  - The Dog Aging Project led to a study that showed rapamycin improved age related diastolic and systolic dysfunction in middle aged dogs
  - RAPACAT trial showed that delayed release rapamycin may prevent or delay progressive disease in stage B cats with HCM

CARDIOMYOPATHY- TREATMENT (STAGE C)

- **Symptomatic cats with congestive heart failure**
  - *Acute stage*
    - Furosemide- 1-2 mg/kg every 1-2 hours until RR decreases significantly or CRI
    - Oxygen therapy
    - Sedation with an anxiolytic (eg butorphanol)
    - Minimize stress, hiding box
    - Thoracocentesis if pleural effusion

CARDIOMYOPATHY- TREATMENT (STAGE C)

- **Symptomatic cats with congestive heart failure**
  - *Acute stage (continued)*
    - IV fluid therapy is contraindicated in cats with clinically evident CHF
    - Ideally blood chemistry prior to treatment if possible, but diuretic therapy necessary for CHF regardless of azotemia
    - If low cardiac output signs that do not improve, consider pimobendan or CRI of dobutamine
    - NEVER START BETA BLOCKERS IN ANIMALS WITH UNCONTROLLED CHF

CARDIOMYOPATHY- TREATMENT (STAGE C)

- **Symptomatic cats with congestive heart failure**
  - *Acute stage (following discharge)*
    - Discharge to owners care as soon as possible to minimize stress
    - Owners should be instructed to monitor resting RR and effort
    - Re-examination in 3-7 days to ensure resolution of CHF and to evaluate renal function and electrolytes
      - If normal renal function, consider adding ACE inhibitor

CARDIOMYOPATHY- TREATMENT (STAGE C)

- **Symptomatic cats with congestive heart failure**
  - ***Chronic stage***
    - Furosemide or torsemide
    - ACE inhibitor (enalapril or benazepril)
    - Rhythm control if necessary (atenolol or diltiazem)
    - Continue or start clopidogrel
    - +/- Pimobendan and/or spironolactone (if systolic dysfunction, recurrent CHF, etc)
    - Recheck frequency?

CARDIOMYOPATHY- TREATMENT (STAGE D)

- **Cats with refractory congestive heart failure**
  - ***Chronic stage***
    - **Preload**
      - Torsemide or triple diuretic therapy (add HCTZ)
    - **Contractility**
      - Pimobendan
    - **Heart rate**
      - Rhythm control if necessary (atenolol or diltiazem)
    - Persistence of FATE risk
      - Rivaroxiban; low molecular weight heparin
    - Recheck frequency?

DEALING WITH FUROSEMIDE REFRACTORINESS

- Triple diuretic therapy
  - Loop diuretic + hydrochlorothiazide + spironolactone; aldactazide
    - Hydrochlorothiazide: 1-2 mg/kg S-BID
    - Spironolactone: 0.5-1 mg/kg S-BID
- Torsemide
- Importance of renal function monitoring
- CAUTIOUSLY; significant risk of AKI in cats

COMPOUNDING MEDICATIONS

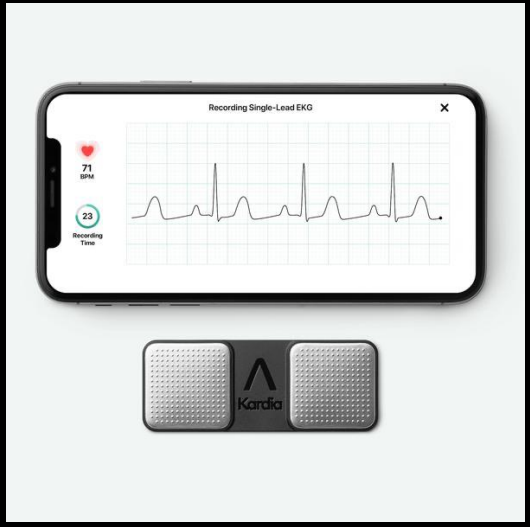
- Transdermal cardiac medications generally cannot be measured systemically and are not recommended
- Combining multiple medications into one liquid medication or tablet
  - Possible loss of efficacy
  - Ease of administration
  - Less confusing for owners

MONITORING HEART RATE

- Atrial fibrillation, feline cardiomyopathy; systolic anterior motion (SAM) in cats
- Monitoring the heart rate at home is difficult for many cat owners but is important for monitoring efficacy of atenolol efficacy (beta blockade)
- Methods to monitor heart rate at home
  - 24 hour Holter monitor
  - Auscultation
  - AliveCor

ALIVECOR

- Device can be used with iphone or android
- Heart rate and rhythm monitoring
- Data can be saved as a pdf and forwarded
- Snap shot heart rate and rhythm assessment



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?