

- Congestive Heart Failure
  - What's New?
    - Bill Saxon
  - ACVECC, ACVIM
    - Idexx

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## What IS CHF?

- Our definition – pulmonary venous congestion and/or edema
- This is a radiographic diagnosis
- Echocardiography for determination of underlying cardiac abnormality
  - PULMONARY HYPERTENSION
- NTproBNP
- Electrocardiogram for rate/rhythm assessment
  - Normal ECG does not rule out heart disease

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## Congestive Heart Failure – Size Matters

- Small breed dogs
  - Degenerative mitral valve disease (DMVD)
- Large breed dogs
  - Dilated cardiomyopathy
- Cats
  - Hypertrophic cardiomyopathy

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## Eight-year-old toy poodle. Cough for 6 months. No murmur. Top differentials?

- Mitral valve degeneration with atrial dilation compressing mainstem bronchi
- Mitral valve degeneration with congestive heart failure
- Chronic bronchitis
- Collapsing trachea
- Heartworm disease

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## Diagnostics?



Coughing dog → Radiographs

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## History: Dog with congestive heart failure

- Tachypnea/dyspnea
- Previous cough—softer cough. Chronic, hacking cough more likely indicative of pulmonary disease
- Restless at night
- Decreased appetite
- Developing ascites

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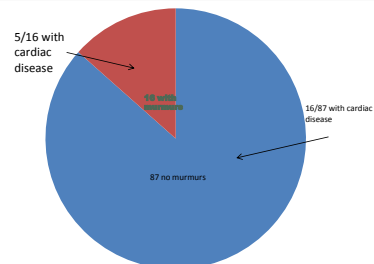
## History: Cat with congestive heart failure

- Hiding from owners for a couple days
- Then, dyspnea and/or tachypnea
- Can present with pleural effusion or pulmonary edema (dyspnea vs. tachypnea)
- May or may not have a previous (or current) murmur

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## Prevalence of cardiomyopathy in apparently healthy cats<sup>2</sup>



*Sensitivity of auscultation for detection of cardiac disease 31%; 87% specificity. False CF. About 40% of cats with a murmur. Prevalence of cardiomyopathy in apparently healthy cats. *JAVMA*. 2009;234(11):1398-1403.*

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## Take Home Points...

- Clinically normal cats with murmurs may not have heart disease
- Clinically normal cats without murmurs may have heart disease
- Cats in congestive heart failure may not have murmurs
- Anecdotally a murmur increases the risk of heart disease (though some studies say otherwise)
- A gallop rhythm indicates stiff ventricle and is significant
- Cannot rule out heart disease in a cat if there is no murmur

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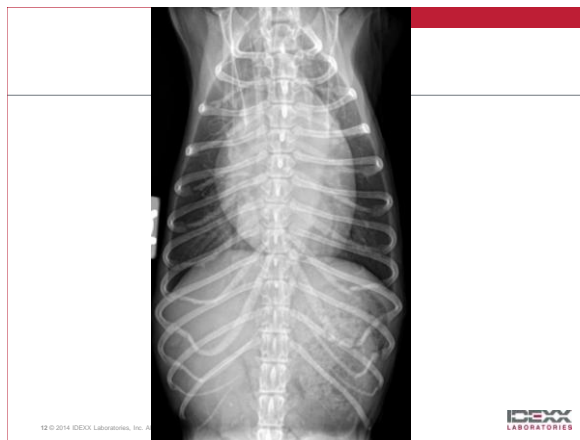
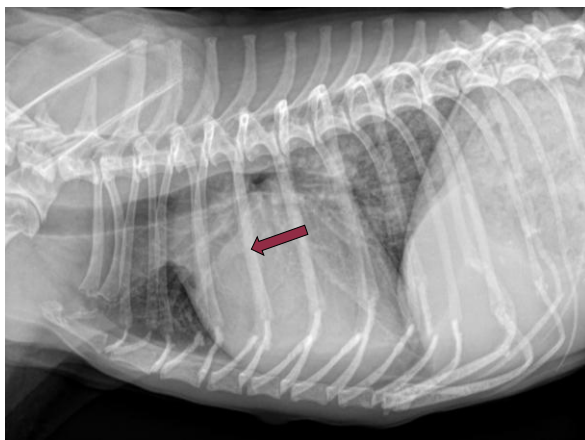
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## Expected thoracic radiographs

- Cardiomegaly with left atrial dilation
- Pulmonary venous distention
- Often, right caudal lung lobe distribution of heavy interstitial to alveolar pattern, but often diffuse, heavier in caudal lung fields
- Cats: sometimes more ventral edema +/- pleural effusion
- Right sided CHF → cardiomegaly, caudal caval dilation, decreased serosal detail +/- pleural effusion

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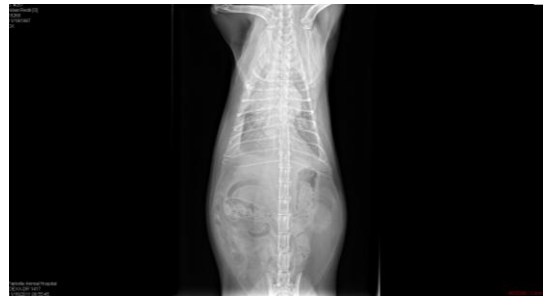
**Eight-year-old DSH. Dyspnea/tachypnea, anorexia and hiding from owners**



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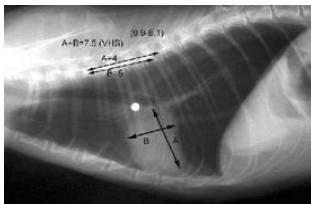
**V/D**



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**Vertebral Heart Score  
N = 7.5 (6.9-8.1)**



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**Treatment for acute congestive heart failure**

- Oxygen
- Sedation – buprenorphine, butorphanol
- Lasix usually helps
  - Initial 2 mg/kg IV dose, followed by Lasix CRI at 1 mg/kg/hr for 4–6 hours. Stop CRI when RR decreases
- Thoracocentesis for pleural effusion
- Nitroglycerin: Venodilator. ¼ inch in pinnae
- Pimobendan (dogs): Oral dobutamine/nitroprusside. 0.2–0.4 mg/kg
- Sedation: Ace/Torb/Valium
- Free access to water

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**Acute congestive heart failure**

- Monitor RR and RE every hour until improvement.
- Stop Lasix CRI once significant improvement in RR/RE
- If no improvement on previous meds:
  - Dobutamine (dogs)
  - Nitroprusside (dogs)
  - Ventilation

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**Chronic treatment**

- Lasix: 1–2 mg/kg BID
- ACE inhibitor: 0.5 mg/kg BID
- Pimobendan: 0.2–0.4 mg/kg BID
- Spironolactone: 1 mg/kg SID
- +/- further afterload reduction: amlodipine/hydralazine
- Recheck renal profile, BP every 3 months

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## Cats And CHF Treatment

- Remember the basics
- Above all do no harm
- Less is often more – minimize stress
- Treatment always trumps diagnostics if you have to choose
- The only time oxygen cage won't help is with upper airway obstruction (nasopharyngeal polyp, mass...)
- First question to ask owner 'Any coughing?'

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## Initial Treatment Based on Confidence

- If confident, treat what you think you are dealing with
  - Previous diagnosis of heart or lower airway disease
  - Clinical 'gut feeling' - don't ignore (or be blinded by) this
- If not sure – cover both in least harmful way
  - OXYGEN
  - Lasix, 1-2 (up to 4) mg/kg, least stressful route of injection
  - DexSP, 0.1-0.15 mg/kg
  - Aminophylline, 5-10 mg/kg
- No albuterol or terbutaline – may worsen heart disease

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## Acute CHF Treatment

- Same regardless of specific cardiac disease
  - Most have both systolic and diastolic component
- Oxygen
- Thoracocentesis if pleural effusion
- Lasix, 1-2 (up to 4) mg/kg least stressful route
- Butorphanol/buprenorphine
- Jugular venous distention useful physical examination finding
  - Quick clip of neck, examine jugular, if distended = heart disease

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## Maintenance Treatment CHF

- Atenolol, 6.25 mg/kg sid-bid
  - Calcium channel blocker only if supraventricular arrhythmia
  - Cardizem CD® 10 mg/kg PO q24h
  - Dilacor® 30 mg (1/2 inner 60 mg tab) PO q12-24h
- Enalapril/benazepril, 0.25-0.5 mg/kg SID-BID
- +/- Spironolactone
- Pimobendan, 5 mg/kg divided BID
  - Off label in cats – safe/effective
  - Pro-systolic, pro-diastolic, vasodilatory effects
  - Probably best to avoid with LVOTO
  - If refractory, use it, maybe sooner...

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## Thoracocentesis

- If muffled heart and/or lung sounds
  - Especially if muffled when take big breath
- If inspiratory dyspnea (r/o upper airway dz)
  - Sometimes just rapid shallow breathing
- If in doubt – unlikely to cause harm
- IMMEDIATE improvement and best treatment for any pleural space disease
  - Lasix less effective with cardiac effusion than edema
- 7-8<sup>th</sup> intercostal space, slightly below costochondral jxn
  - Sternal, minimal restraint, sedation rarely necessary

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## New Ideas

- Torsemide
  - More potent and longer acting than furosemide
  - Give 1/10<sup>th</sup> furosemide dose q12 h
  - More likely to cause prerenal azotemia than furosemide
- Pimobendan
  - May delay onset of CHF in DMVD (EPIC trial)
  - Use in cats becoming more common
  - Not just as last resort
  - Improves diastolic function

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## New Ideas – Pulmonary Hypertension

- Increased frequency of diagnosis
- Estimated from echocardiogram
  - Velocity of tricuspid regurgitation jet
  - $4 \times V^2$
- Present with severe CHF
- Sildenafil
  - 1 mg/kg q8 hr, titrated to 3 mg/kg q8 hr

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## Twelve-year-old golden retriever. Acute collapse. Diagnosis?



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## Pericardial effusion

- Causes: Idiopathic, right atrial hemangiosarcoma, chemodectoma
- Idiopathic: Goldens, labs, larger breeds
- Hemangiosarcoma: Goldens
- Chemodectoma: Brachycephalic breeds



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## Diagnosis and treatment

- Typical breed and age
- 2 general presentations: Acute collapse/low output vs. ascites
- Globoid cardiac silhouette on radiographs
- Electrical alternans
- Tachycardic with pulsus paradoxus
- Echocardiographic exam recommended while pericardial effusion present unless the patient is unstable



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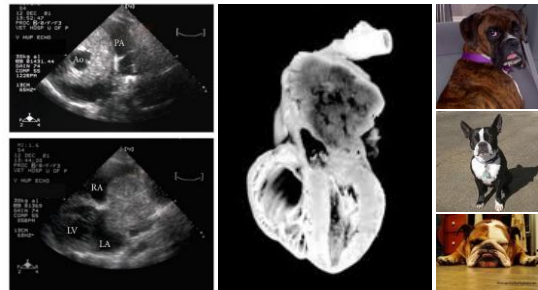
## Diagnosis and treatment

- Idiopathic: Approximately 1/2 of cases will recur after the first tap. If the patient requires a second pericardiocentesis, recommend pericardectomy
- Hemangiosarcoma: Hard to recommend aggressive treatment given the lack of success with surgery and chemo (6 months). Repeat pericardiocentesis as necessary
- Chemodectoma: Pericardectomy +/- radiation therapy

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## Chemodectoma



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## Pericardiocentesis technique

- IV catheter, continuous ECG monitoring, sedation if necessary
- Left lateral recumbency
- Clip and prep area of rib space 3–5 (elbow trick)
- Block the rib space and skin with lidocaine
- Stab incision
- 14- or 16-gauge long VenoCath, fenestrated twice, syringe on the end
- Smooth but confident insertion into pericardial space while applying negative pressure on syringe
- Once you get effusion, slide the catheter off the needle into the pericardial space and drain



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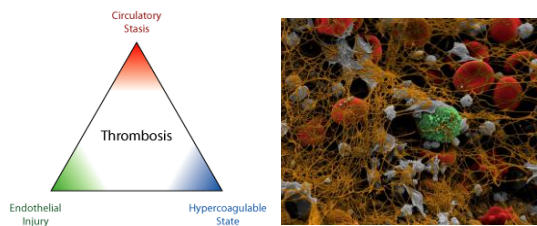
## Saddle thrombus



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## Virchow's triad



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## Ischemia-reperfusion injury

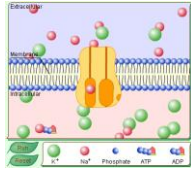
- Factors determining extent of damage
  - Size of vessel affected
  - Amount of collateral flow
    - Progressive obstruction has less chance of life-threatening I-R injury as collaterals will develop over time. Therefore, healthy arteries more at risk
  - Degree of obstruction
    - Clot progression and growth with stasis of blood secondary to thrombus

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## Hyperkalemia

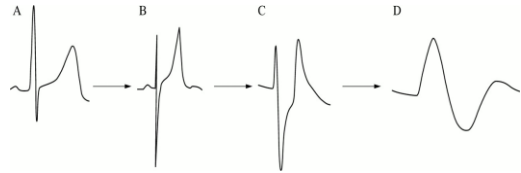
- 95% of potassium is intracellular
- ECG changes can be nonspecific repolarization abnormalities, to sine-wave rhythm, ventricular tachycardia/fibrillation



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## Progressive ECG changes



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## Risk factors for ATE in cats

- All forms of cardiomyopathy in cats
- Reported in 12%—41% (necropsy) of cats with HCM
- Pulmonary neoplasia, particularly pulmonary carcinoma (tumor embolism)



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## Clinical signs

- Ataxia to complete paralysis
- Pain: 89% of cats with no radiographic evidence of CHF had open mouth breathing or tachypnea only due to pain → radiographs
- CHF 40–66% of case
- No murmur/gallop reported in 30%–43% cases from different studies

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## Management

- Analgesia: Ideal not to give the IM pain meds in the hind limbs
- Improve systemic perfusion
  - Heat support only if perfusion is adequate as will cause vasodilation and shunt blood from vital organs
  - Positive inotropes, fluids if no CHF and used with caution
- Treat CHF
  - Radiographs, diuretics, thoracocentesis, O<sub>2</sub>
- Treatment of hyperkalemia if indicated (Dextrose / Insulin)
- Clopidogrel ¼ of 75 mg tablet q24 h (FAT-CAT trial)

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## Treatment of hyperkalemia

- Membrane stabilization: Calcium gluconate
- Promote potassium influx into cells
  - Insulin: Stimulates Na-K ATPase pump which moves K<sup>+</sup> intracellularly
  - Dextrose: Combat hypoglycemia from insulin or if given by itself, will promote normal insulin secretion
  - Sodium bicarbonate: Increase blood pH and therefore cause intracellular shift of K<sup>+</sup>. Used if concurrent acidemia present

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