

# Acquired Myocardial Disease

John E. Rush, DVM, MS, DACVIM (Cardiology), DACVECC  
Cummings School of Veterinary Medicine At Tufts University



# 4 Month Old F Golden Retriever

- Owner claims one episode of collapse or seizure
- Cough for 3 days (R/O Kennel cough by RDVM)
- Started Ab's but no help
- Previously vaccinated
- Never been on heartworm preventative
- Dog next door was diagnosed with heartworm yesterday

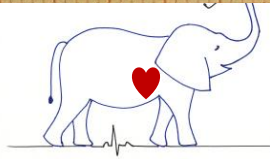
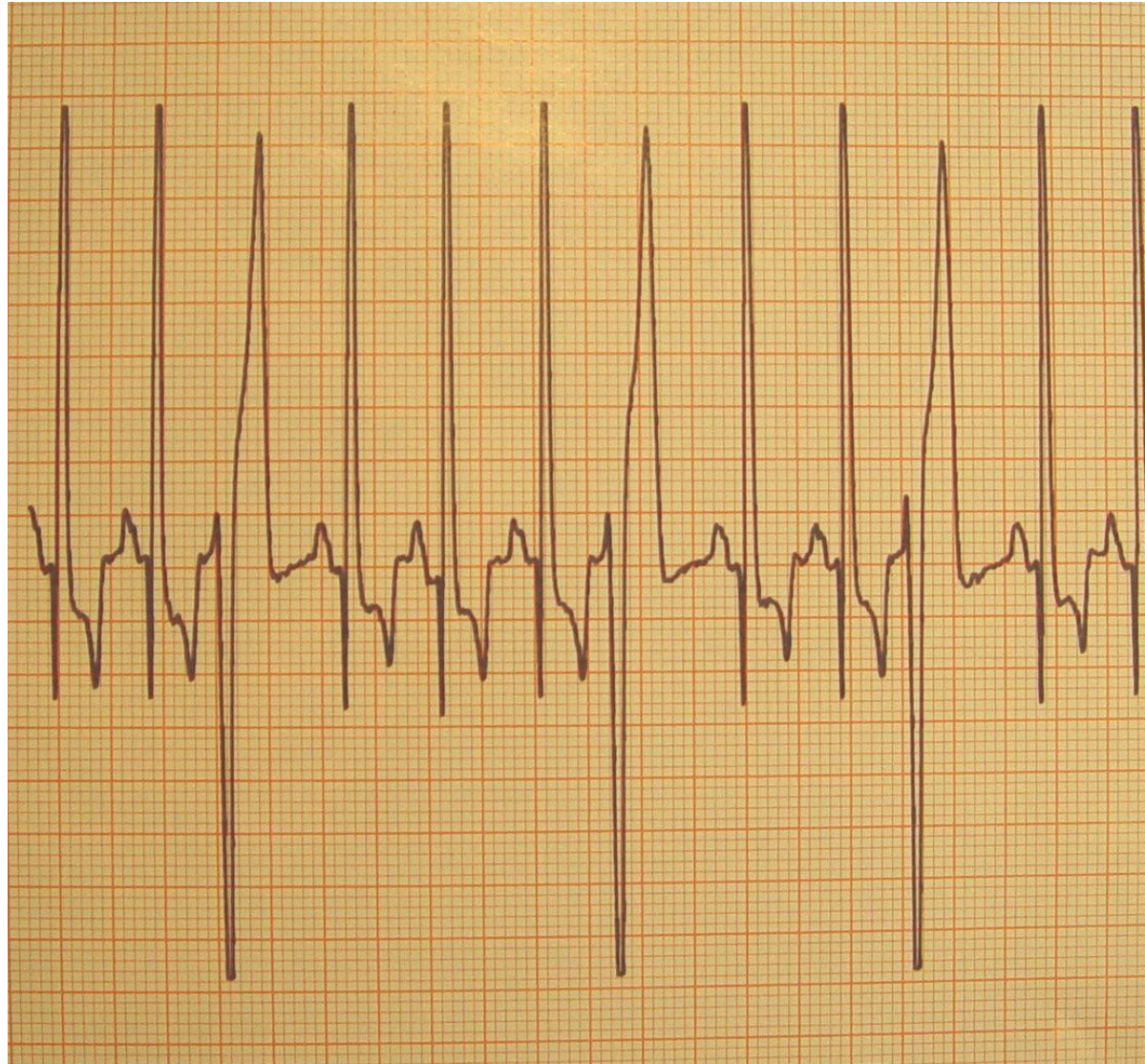




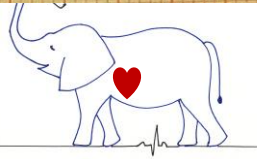
# 4 Month Old F Golden Retriever

- II/VI systolic murmur left apex
- Gallop
- Arrhythmia
- Weak arterial pulses
- Tachypnea with fine crackles in hilar region
- MM pale pink, CRT 2 sec



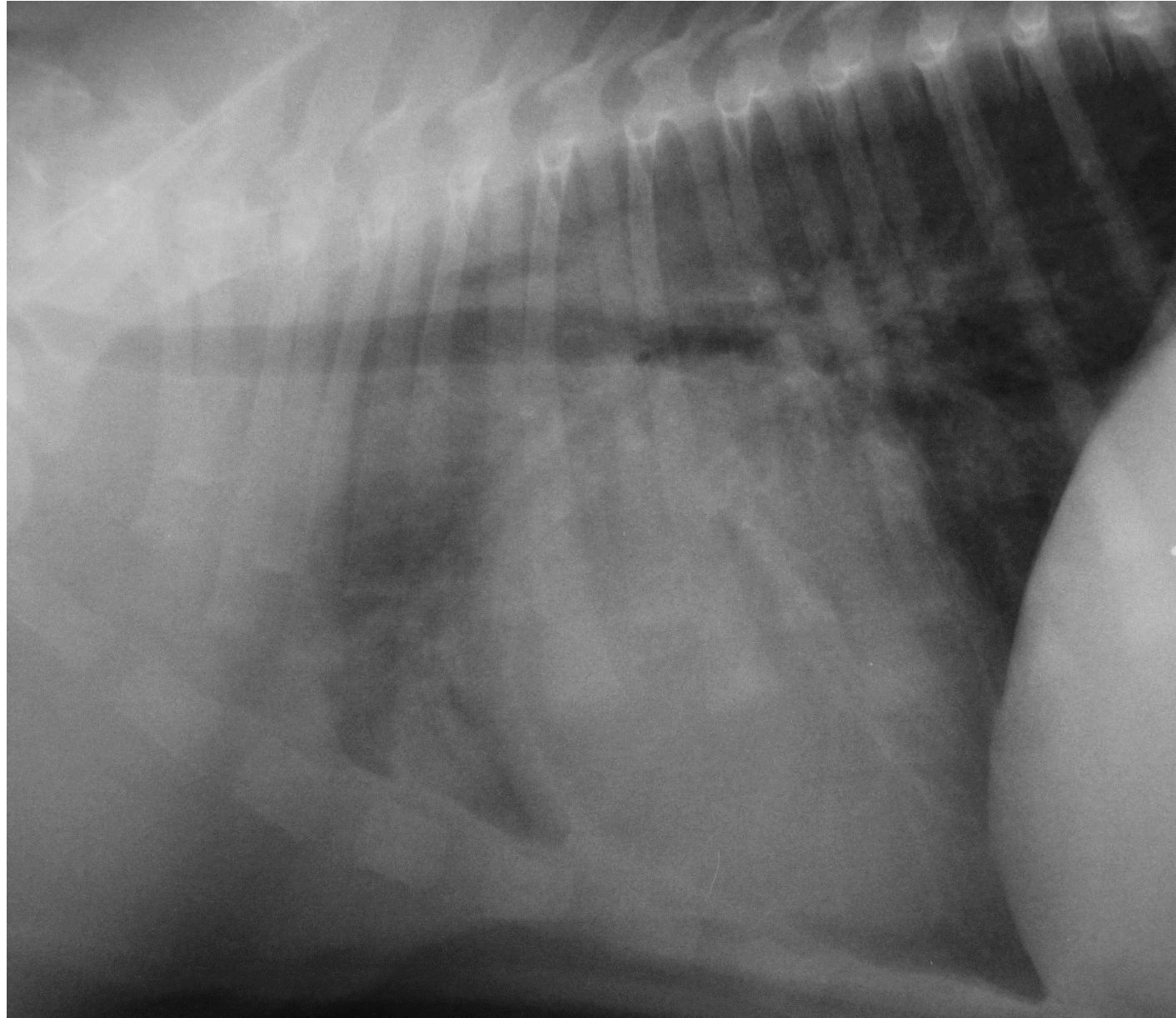


*CardioRush*



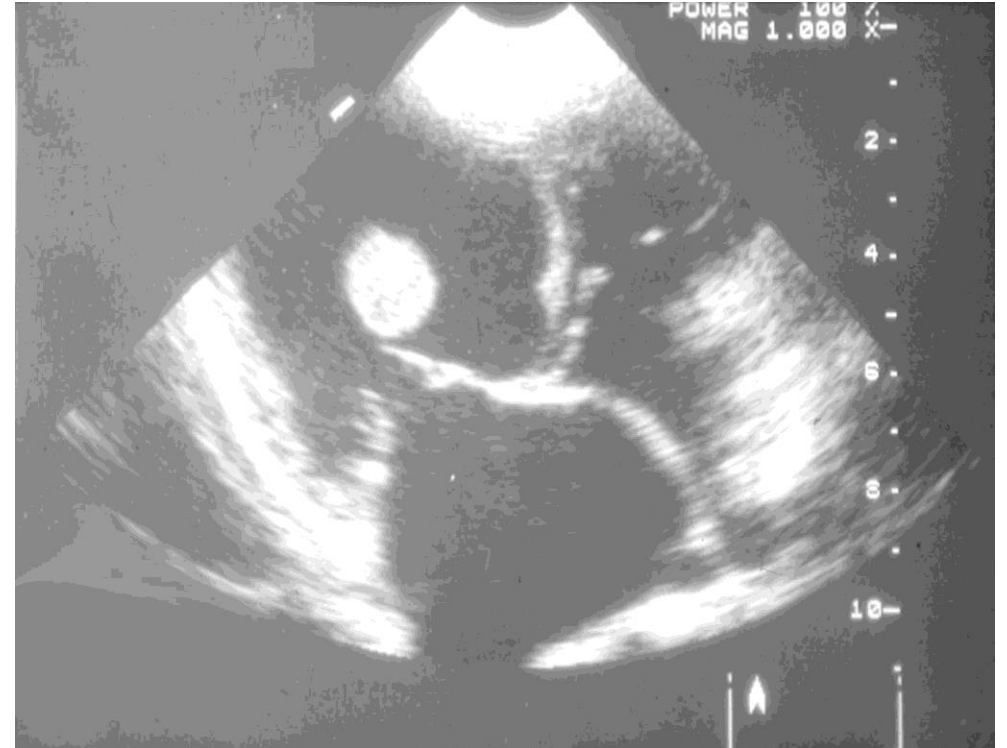
# Thoracic Radiograph

**Dyspnea  
after  
Lateral so  
VD/DV  
not obtained**



# Echocardiography

- All 4 chambers dilated
- LV wall and IVS appear to be thinned
- Reduced LV systolic function
- 1+ mitral regurgitation
- Thrombus in the LV cavity



# 4 Month Old F Golden Retriever Regroup

- What is your ECG diagnosis?
- What are the radiographic findings?
- Does the dog have CHF?
- What is your diagnosis?
- How would you treat the dog?
- What prognosis would you give to the owner?

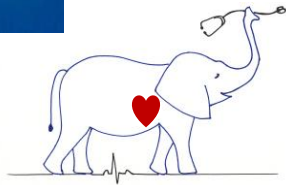
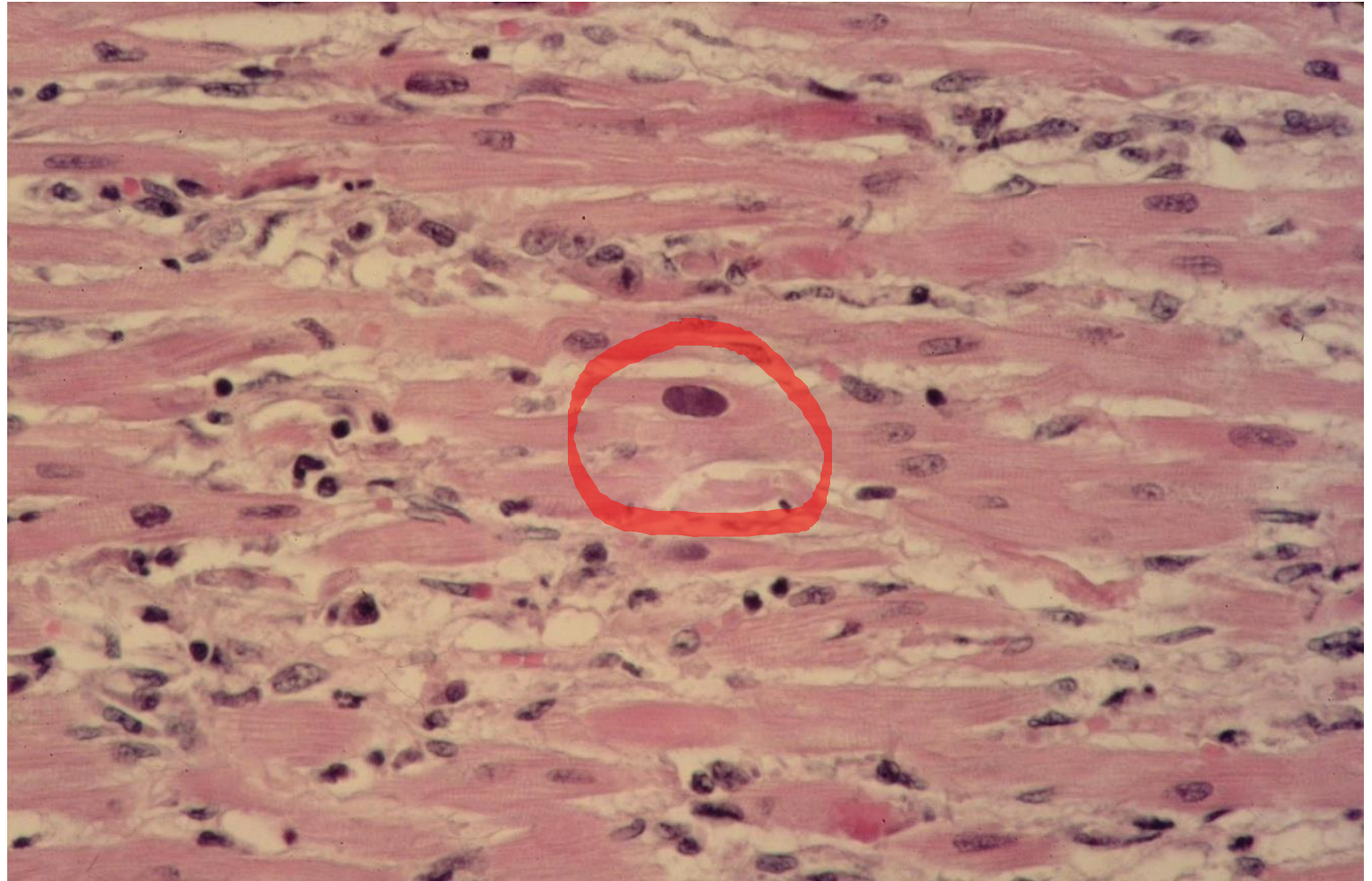
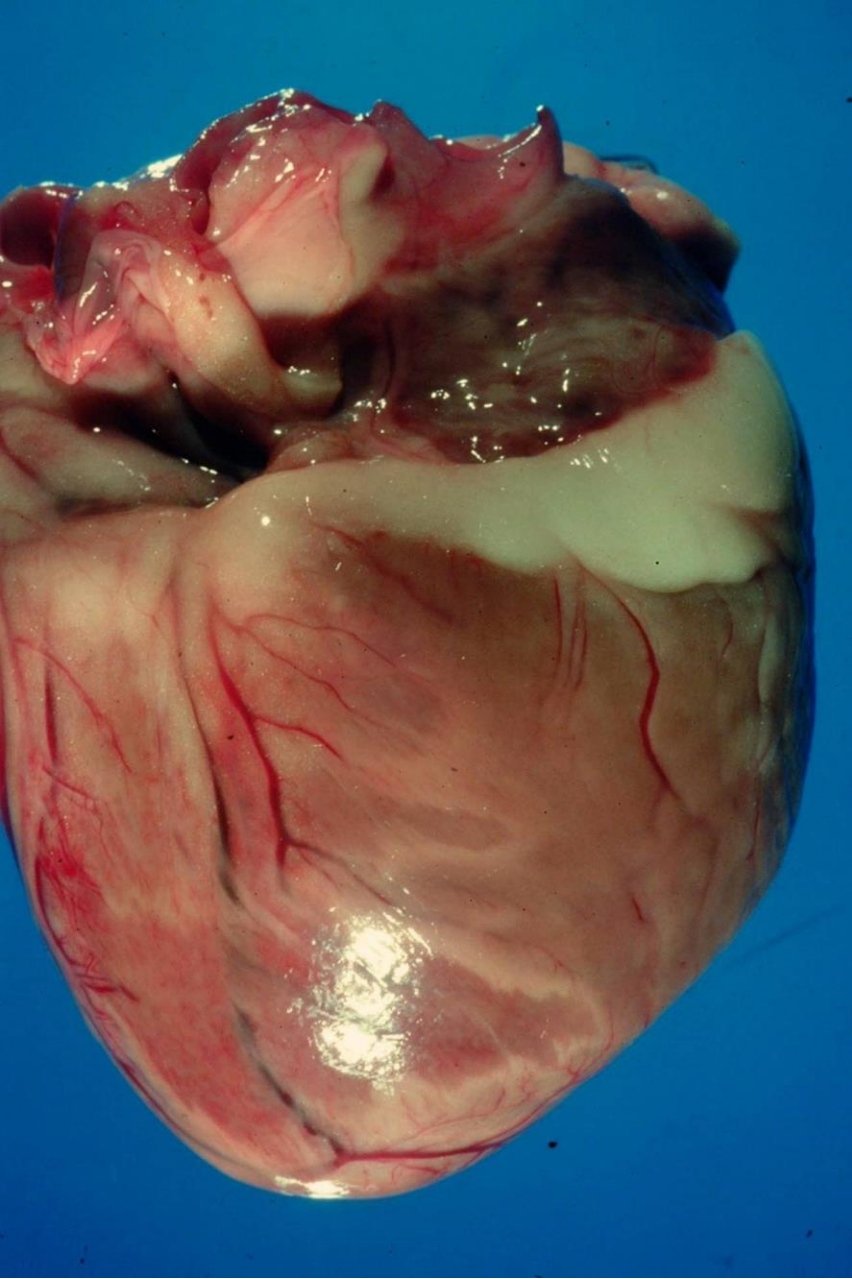




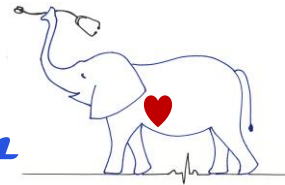
# Necropsy

- Dilation of all 4 chambers
- Pulmonary edema, small volume pleural effusion and ascites
- Large thrombus in the LV
- Myocardial and renal infarction
- Marked inflammatory response indicative of myocarditis
- Inclusion bodies suggestive of Parvovirus myocarditis





*CardioRush*



# Myocarditis

- Viral, bacterial, fungal, parasitic, immune
- Inflammatory response in myocardium
- Common possible features
  - ♥ CHF
  - ♥ Arrhythmias
  - ♥ Thromboembolic disease
- Often the heart is a bystander; other organ systems dominate the clinical picture



# Parvovirus Myocarditis

- Old (1978) - Puppies 3-8 weeks of age
- Current – 2-4+ months of age more often
- Myocardial necrosis, lymphocytic inflammation
- Postulated more often than proved

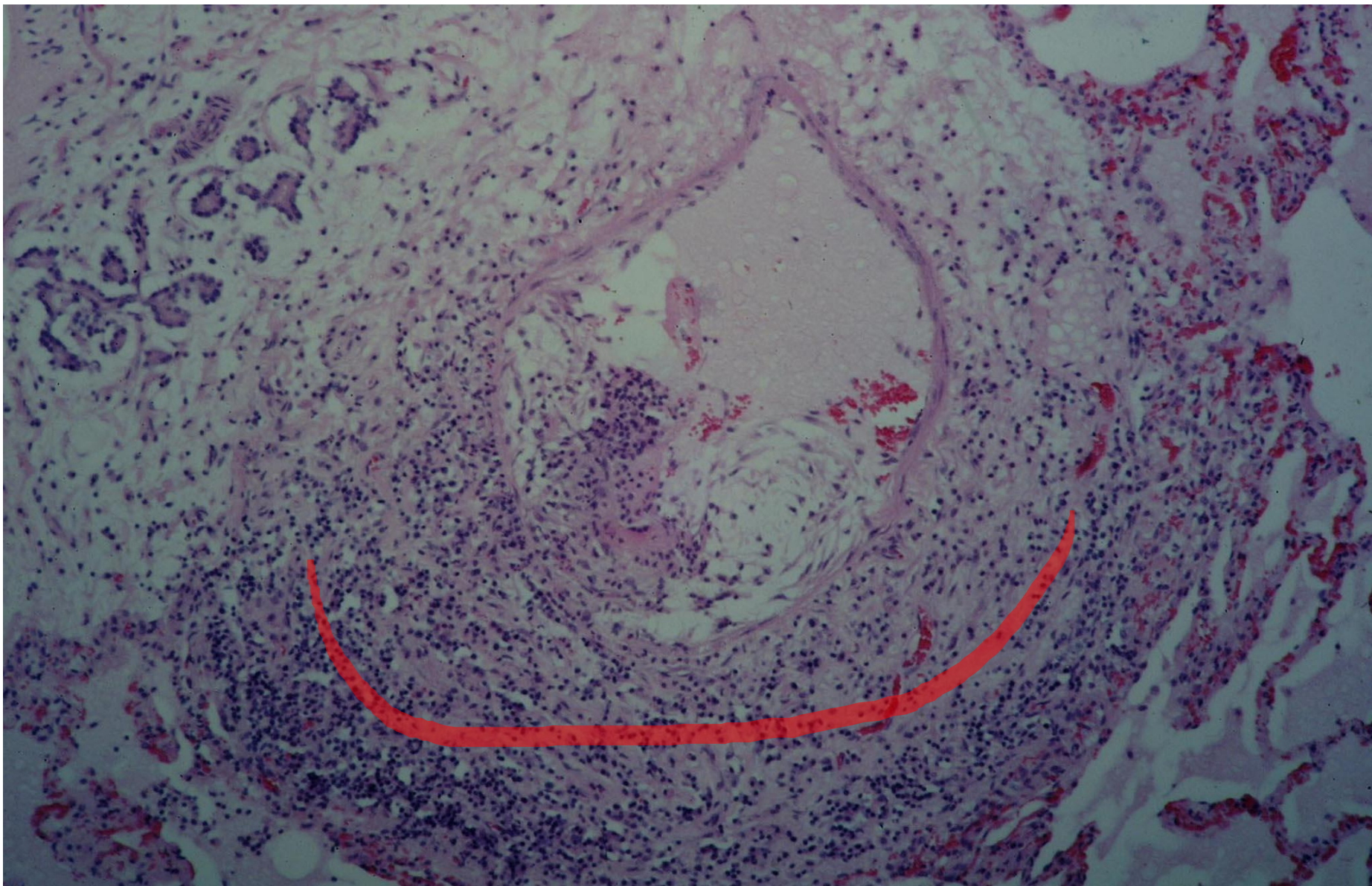


# Viral Myocarditis

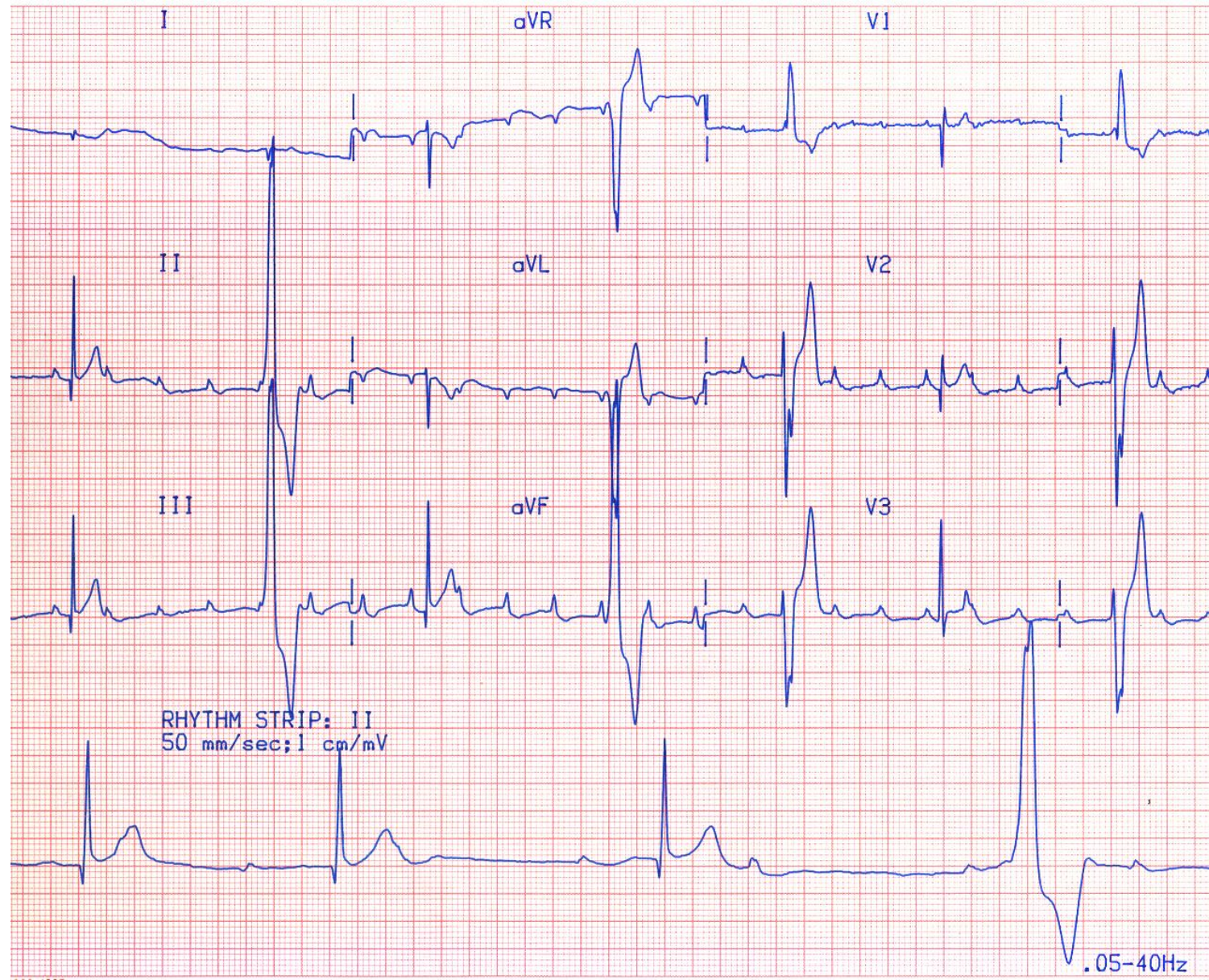
- Humans – more viral etiologies than you can count
- Veterinary
  - ♥ Foot and Mouth disease
  - ♥ Bluetongue virus – Sheep
  - ♥ Encephalomyocarditis virus (pigs, primates, mice)
  - ♥ Equine viral arteritis
  - ♥ Feline infectious peritonitis virus (coronavirus)
  - ♥ FIV in cats



# FIP Vasculitis



# AV Block with Lyme Carditis



# Finnegan

## 5 Month Old Male Lab-x

- Decreased energy and abdominal distension
- Owned for 1 month; rescued from Texas
- 2 littermates and Dam died of unknown causes
- Hepatomegaly, increased LE's, increased NT-proBNP at RDVM
- Prior diarrhea and hookworms; Rx pyrantel pamoate
- UTD on vaccines and Flea/Tick/Heartworm prevention
- Feeding a puppy food (grain free diet)





# Laboratory Testing on Finnegan

- Hematocrit: **22.5** %
- BUN: 24 mg/dl
- Creatinine: 0.7 mg/dl
- Albumin **2.0** g/dl
- Phosphorous **7.6** mg/dl
- ALT **128** U/L
- AST **79** U/L
- NT-proBNP: **6287** pmol/L
- WBC: 16.3 K/ $\mu$ l
- Neutrophils 9.943 K/ $\mu$ l
- Lymphocytes **5.216** K/ $\mu$ l
- Platelet: 156 K/ $\mu$ l
- Sodium: 142 mEq/L
- Potassium: 4.9 mEq/L
- Chloride: 110 mEq/L



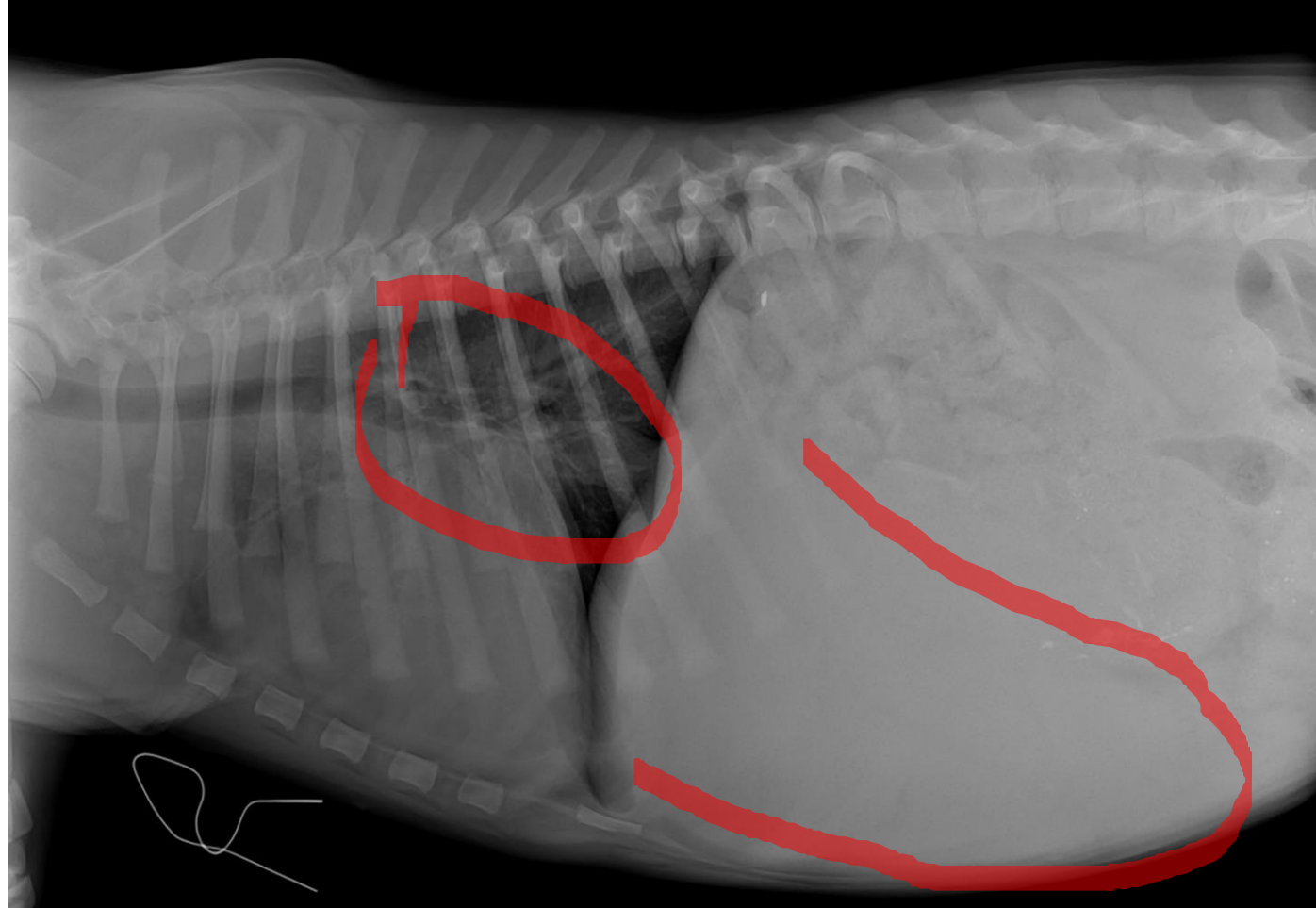
# Finnegan

## 5 Month Old Male Lab-x

- MM pallor
- BCS = 4/9, moderate muscle loss
- Heart rate 300/min, mild tachypnea/dyspnea
- Arrhythmia with pulse deficits
- I/VI systolic murmur left apex; no gallop
- Jugular vein distension
- Fair arterial pulses
- Abdominal distension

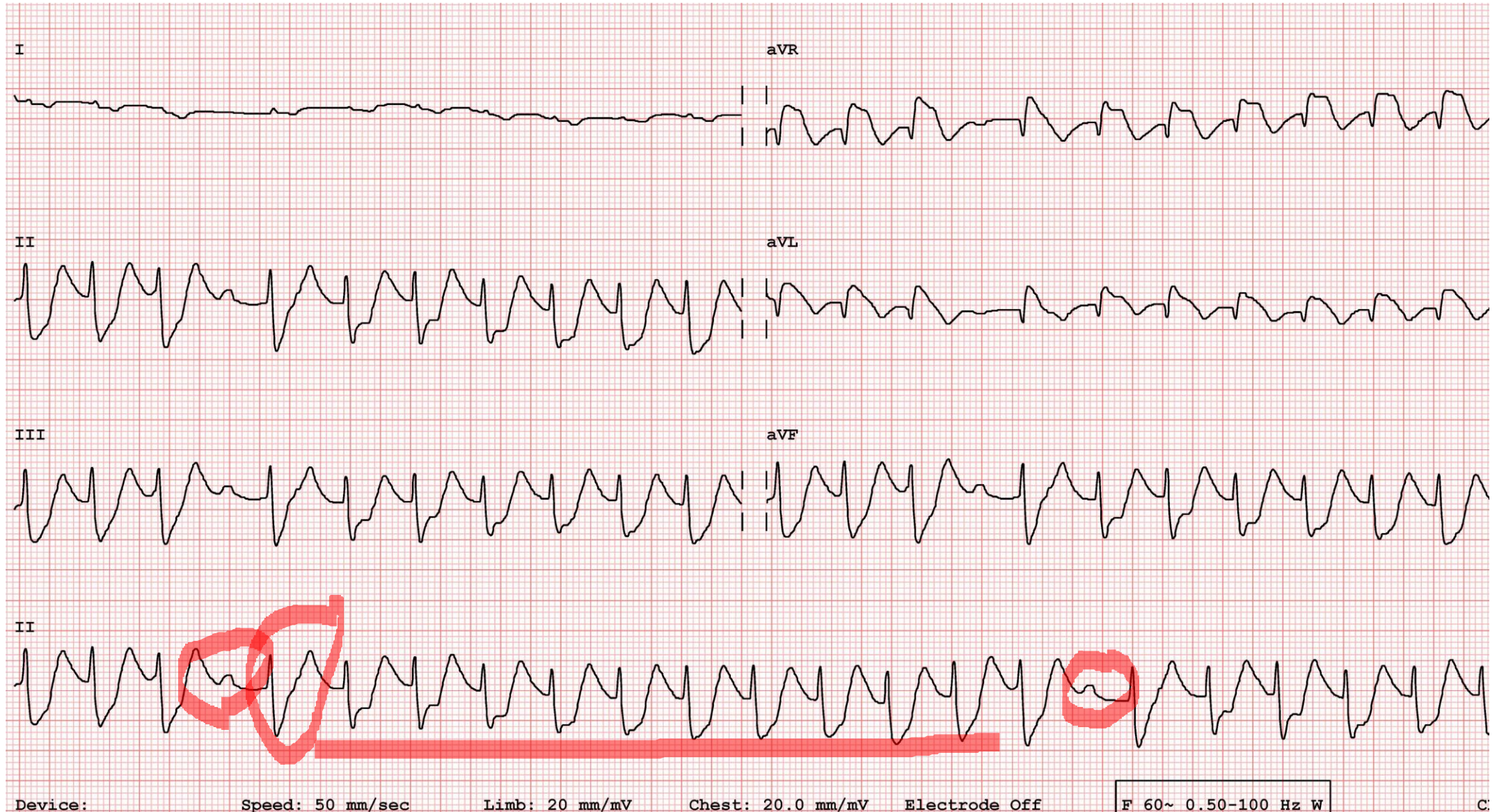


# Finnegan Radiographs

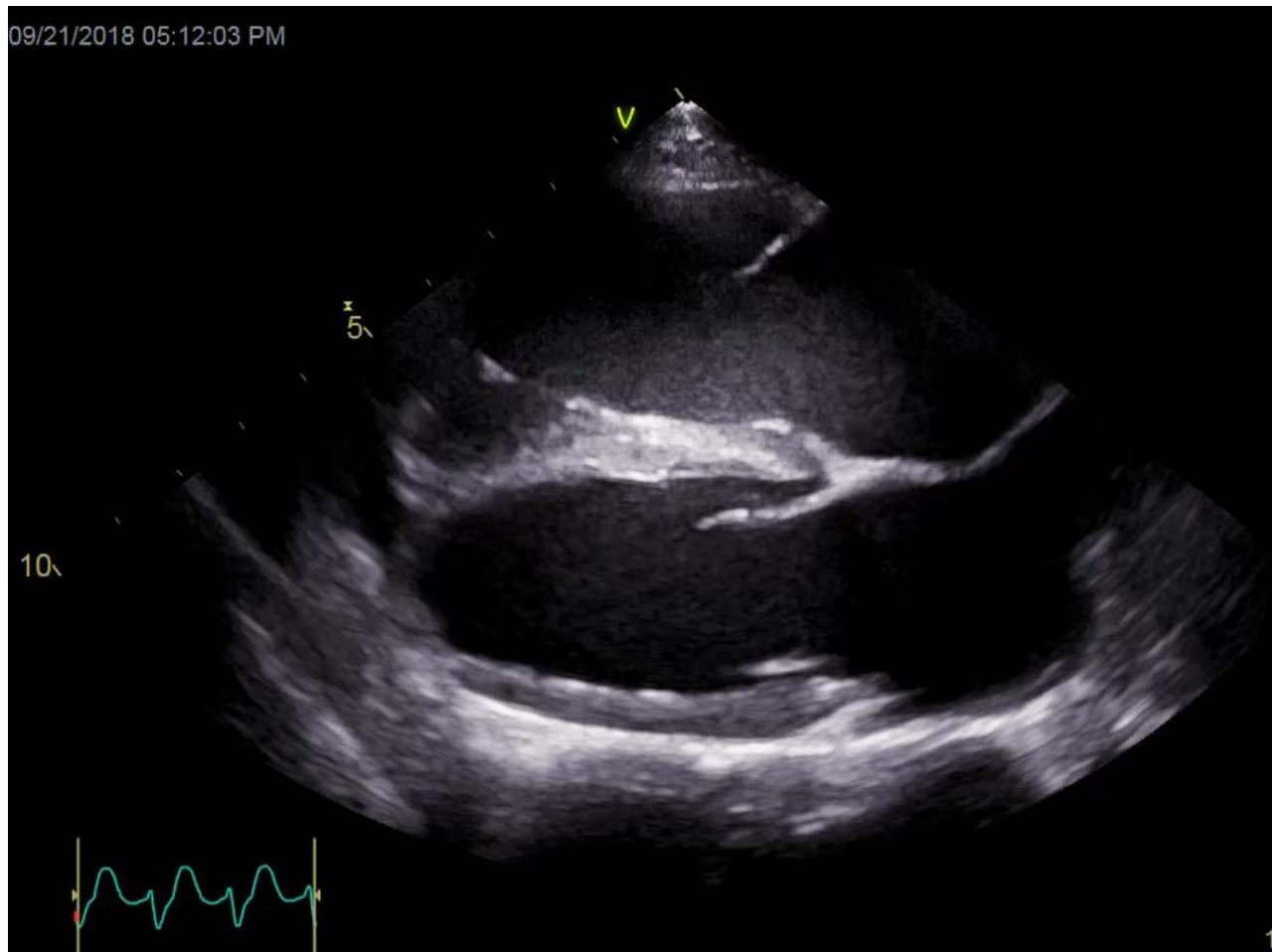
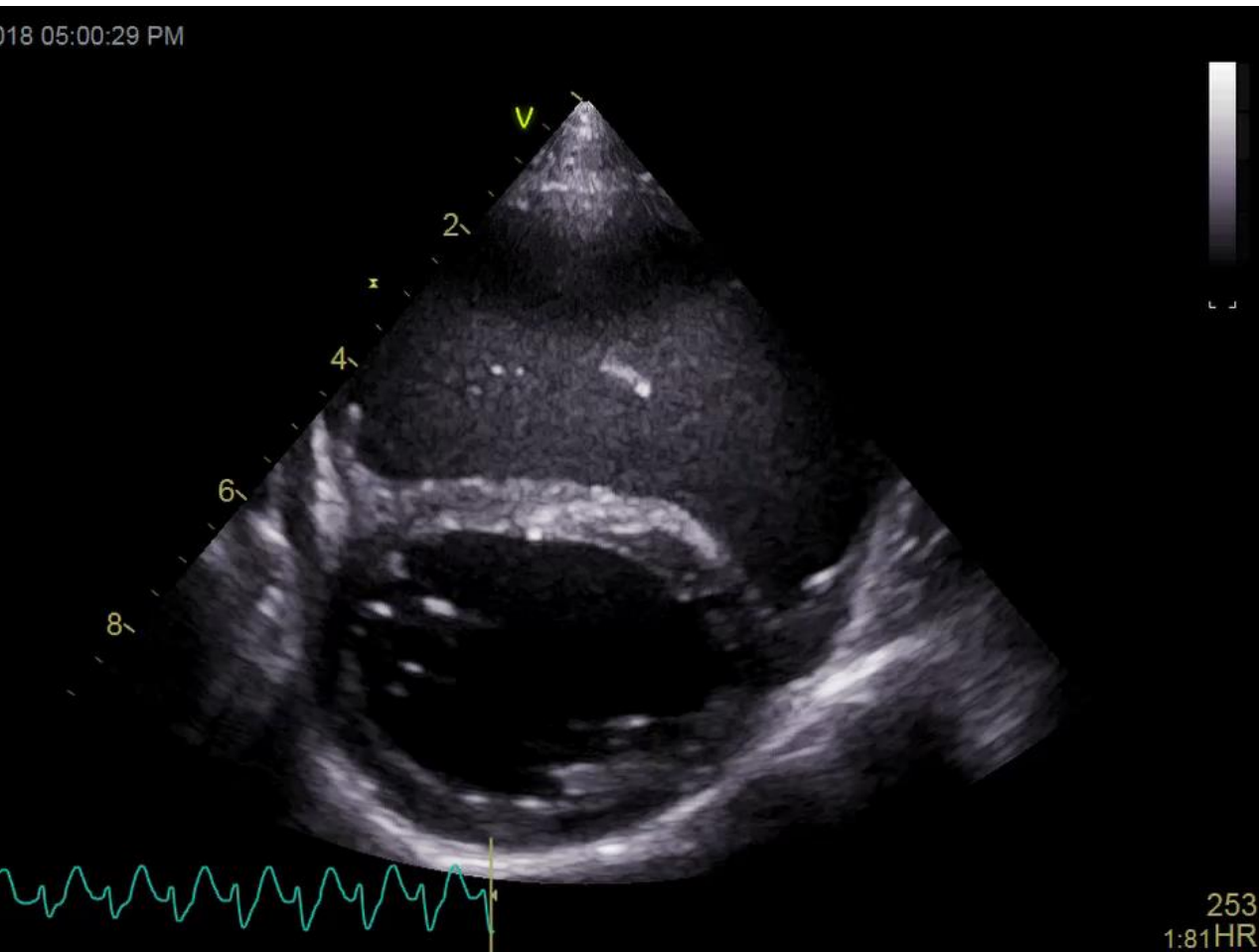


# Finnegan ECG

## Wide Complex Supraventricular Tachycardia with RBBB Morphology



# Finnegan Echo



# Finnegan

Specimen	Test Name	Result	Titers
Finnegan - Mammal - Canidae - Domestic Dog - Male - 5 Months			
Serum - 1	Chagas Disease (IFA - Chagas-6)		>= 1280
Antibodies against <i>Trypanosoma cruzi</i> (the causative agent of Chagas disease) were detected in this sample at a dilution of 1:1280. The routine dilution series for this assay is 1:20 through 1:1280; as such, the titer for this sample is considered greater than or equal to 1280.			

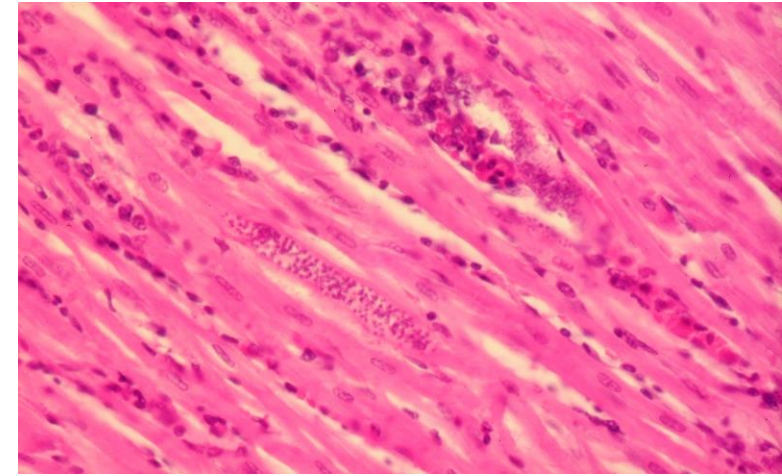
- DCM phenotype with R heart > L heart
  - Dog is young for typical DCM
  - Dietary DCM (taurine deficiency or grain free diet?)
  - Tachycardia-induced cardiomyopathy?
  - Myocarditis? (Texas origin)
- CHF – especially R-CHF
- Supraventricular tachycardia
- Plan:
  - Pimobendan
  - Diuretics
  - Amiodarone
  - Taurine supplementation pending blood taurine levels
  - Itraconazole

Taurine Panel		9/21/2018 6:09:01 PM	Accession ID: 430802	
Test	Results	Reference Range	Units	
TAURINE P	H 187	60 - 120	nmol/mL	
TAURINE WB	288	200 - 350	nmol/mL	



# Trypanosomiasis Chagas Disease

- *Trypanosoma cruzi*
- Reduviidae bug – vector (kissing bug)
- Texas, Mexico, South and Central America
- Severe myocarditis
- Right atrium and ventricle may predominate
- Left sided or Right-sided CHF
- Treatment with Ragonil (benznidazole), but this might not improve cardiac outcomes
- Amiodarone and itraconazole



# Protozoan Myocarditis

- Toxoplasmosis: *Toxoplasma gondii*
  - ♥ Signs from other systems predominate
  - ♥ Cardiac lesions - Necrotizing myocarditis
    - Cardiac disease rarely evident clinically
    - Dogs and cats
- Leishmania: *Leishmania infantum chagasi*
  - ♥ Cardiac lesions – lymphoplasmacytic myocarditis and myocardial necrosis and granulomas
  - ♥ Dogs





# Parasitic disease

- *Trichinella spiralis*
- *Echinococcus*
- *Strongylus* spp. – myocardium possible, but more often vessels

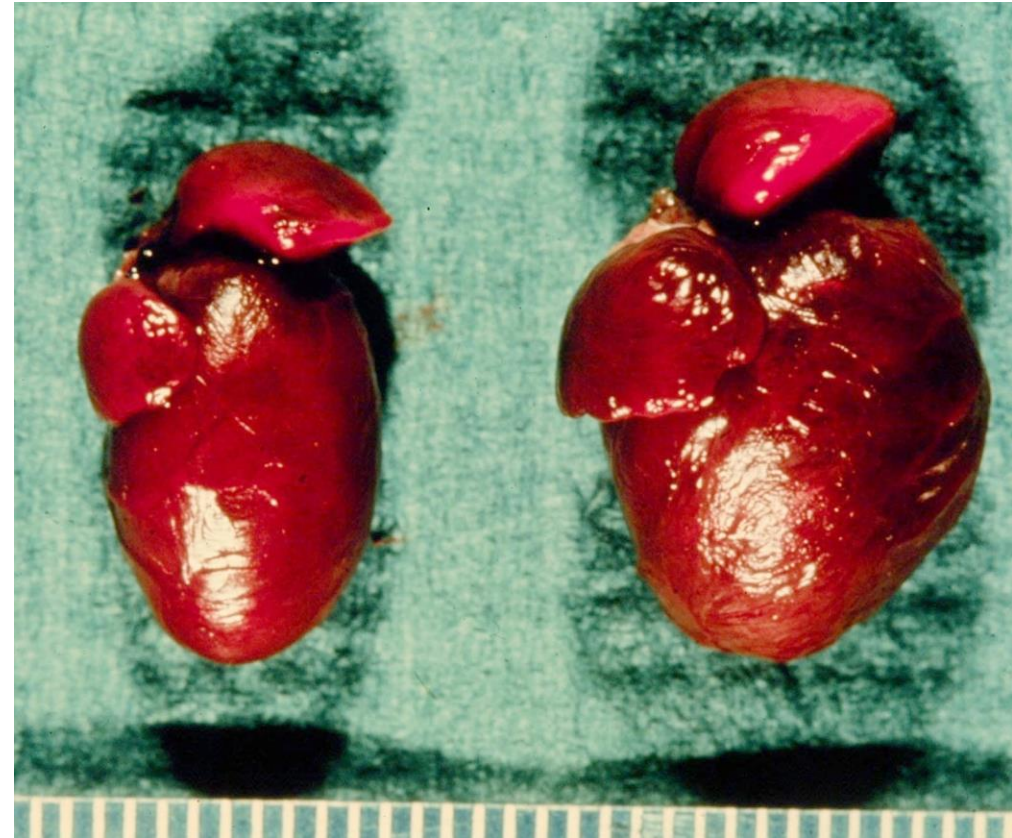
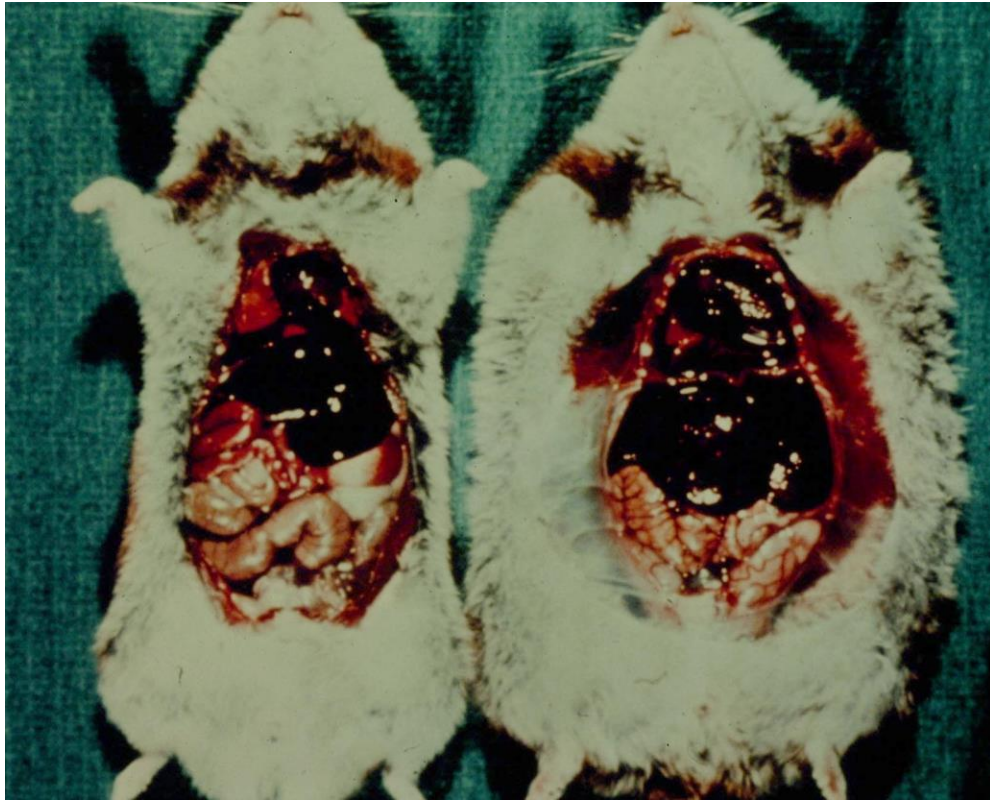


# Non-infectious Acquired Myocardial Disease

- Suspected heritable
- Nutritional deficiency
- Myocardial toxic agents
- Myocardial disease from physical injury or shock
- Myocardial disease with systemic disease



# Hereditary Cardiomyopathy of Syrian Hamsters

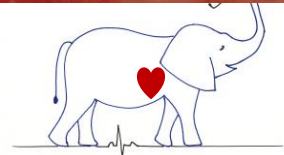
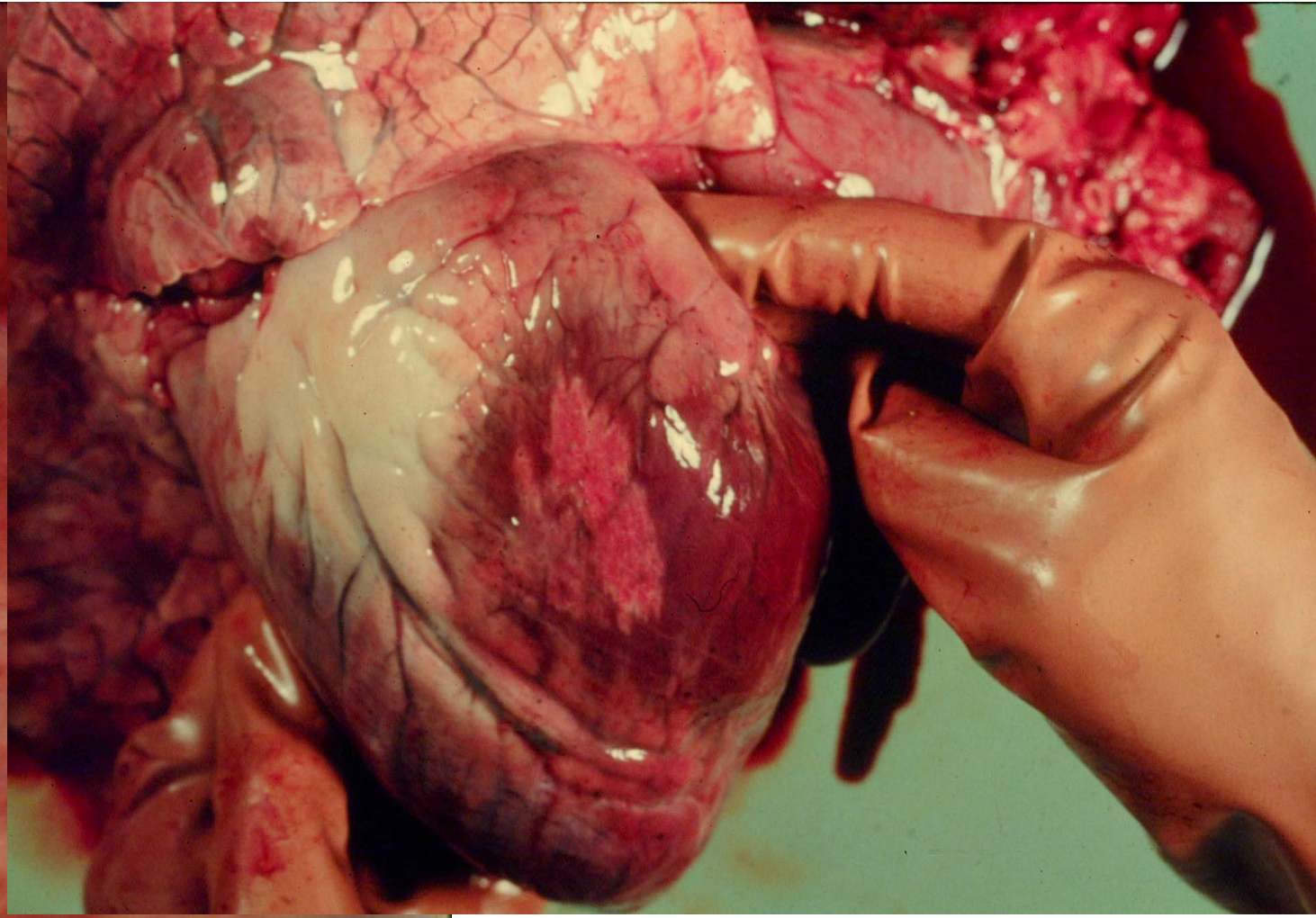
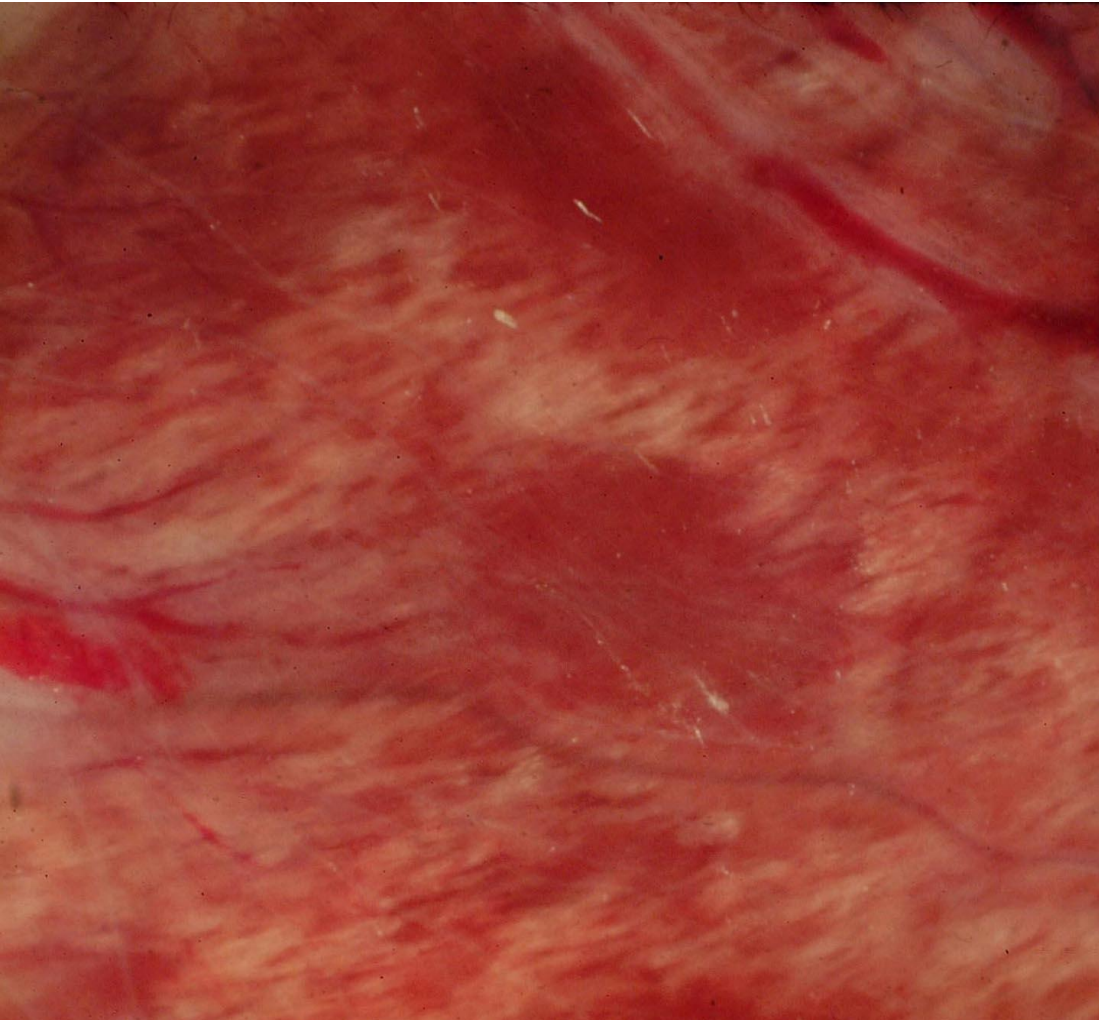


# Other Suspected Heritable

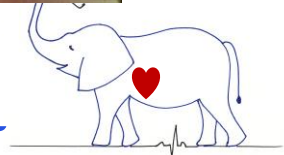
- Glycogen Storage Diseases
- Duchene's muscular dystrophy
- Hereditary cardiomyopathy of turkeys
- Spontaneously hypertensive rats
- HCM in some cats?
- DCM in some dogs?
- DCM in cattle
  - ♥ DCM in Holstein-Friesian cattle in Japan
  - ♥ DCM and woolly haircoat syndrome in Poll Hereford cattle



# Selenium-Vitamin E deficiency White Muscle Disease



*CardioRush*



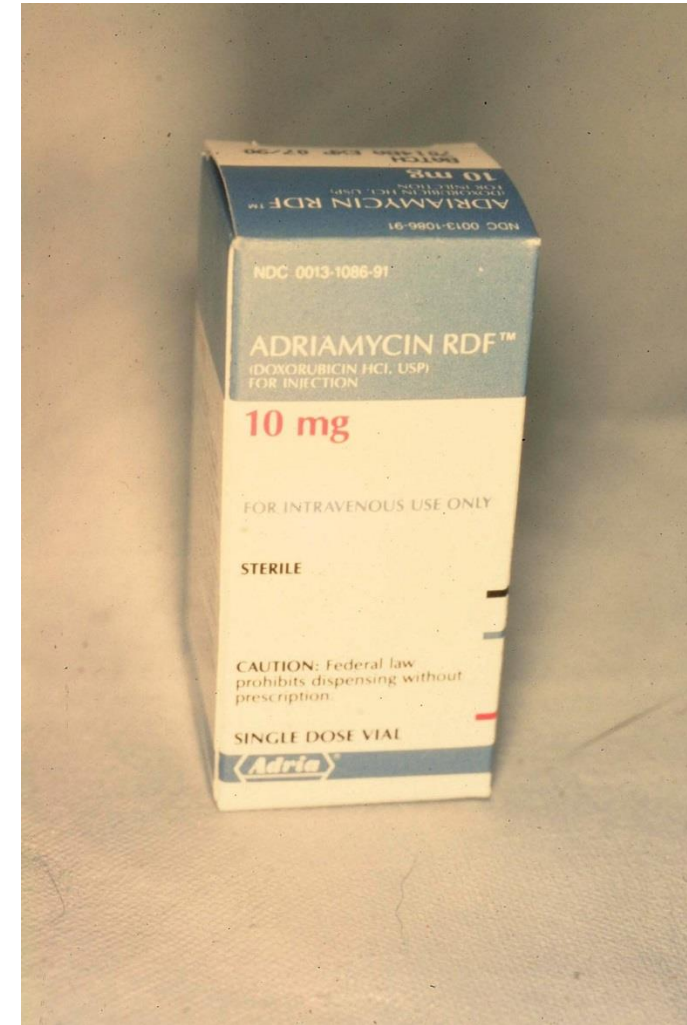
# Other Nutritional Imbalances

- Copper deficiency in cattle
- Thiamine deficiency (Beriberi disease)
  - Causes high output heart failure
- Taurine deficiency in cats (DCM)
- Selenium overdose – cardiotoxicity in horses



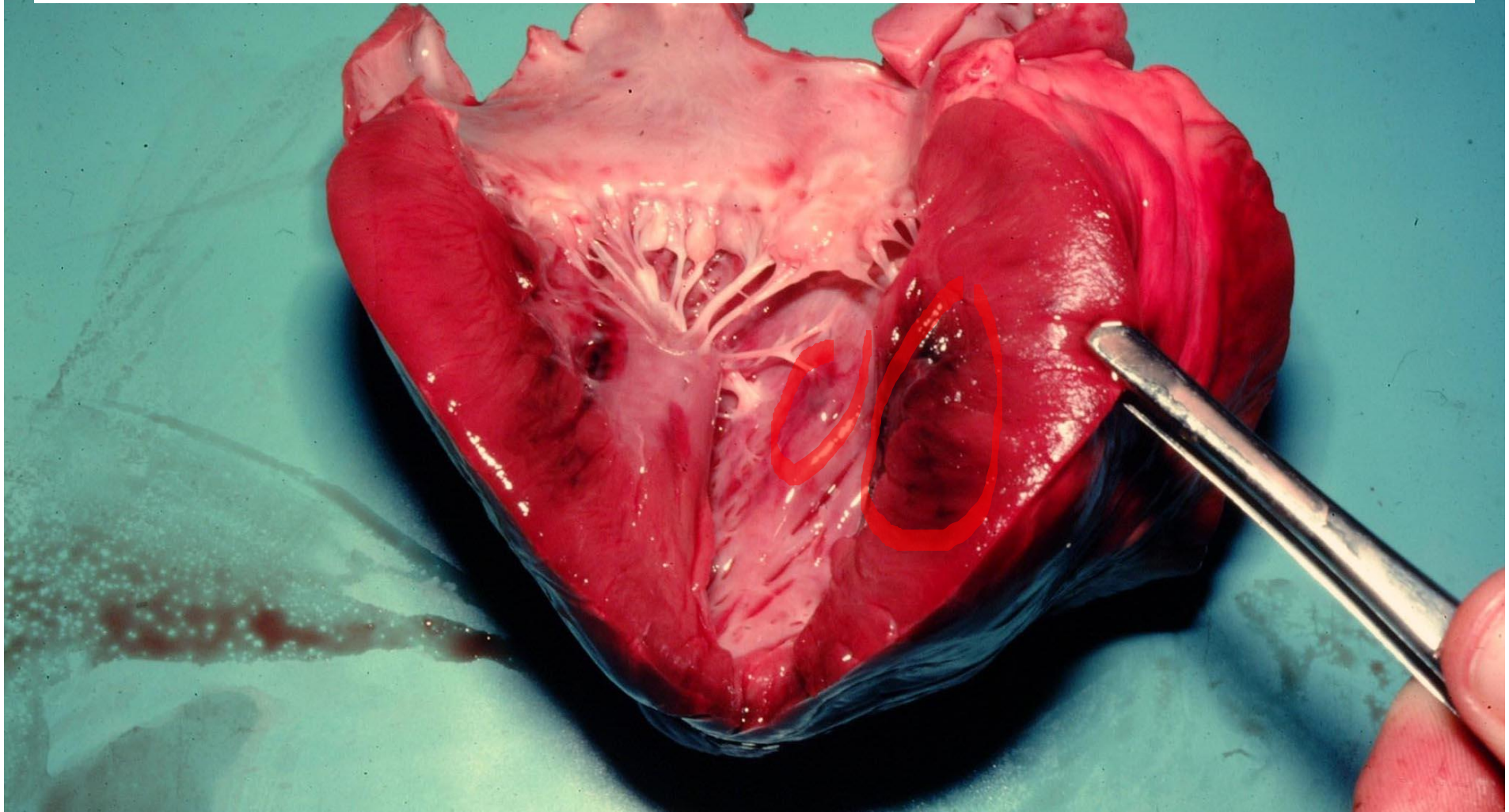
# Doxorubicin Cardiotoxicity (Adriamycin)

- DCM – like syndrome
- Arrhythmias
- Oxidant injury
- Cumulative dose  $>240 \text{ mg/m}^2$  in dogs
- Cats less sensitive
- Caution in dogs predisposed to DCM
- If cardiomyopathy develops, often poor response to Rx



# Catecholamine Cardiotoxicity

Too much catecholamines (this case CPR so chest compressions and defibrillation also occurred) can cause myocardial necrosis, cardiac arrhythmias, subendocardial hemorrhage, and eventually CHF





# Many Additional Cardiotoxicities!!

- Ractopine – myocardial necrosis and cardiac arrhythmias in dogs
  - ♥ Beta-2 agonist feed additive in production medicine to reduce fat
- Minoxidil – Cardiotoxicity in dogs
- Blister beetle – Cantharidin; myocardial necrosis in horses
- Ionophores – Monensin and Lasalocid; myocardial toxicity in horses



**Renal failure may cause:  
Hypertension, myocardial necrosis, pericarditis**

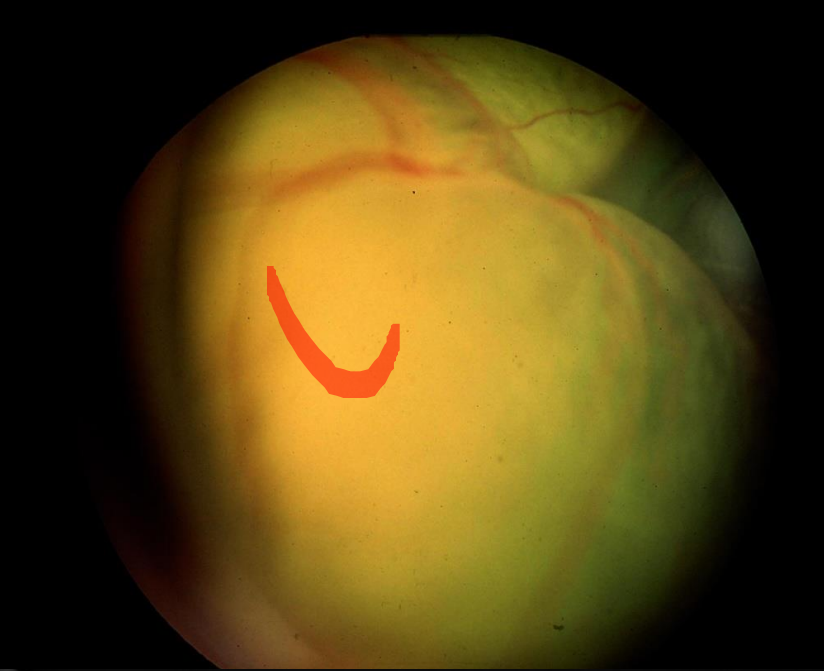


# Systemic Hypertension

- Target End Organ Damage
  - ♥ Heart – Left ventricular hypertrophy, maybe proximal aortic enlargement
  - ♥ Eyes – Retinal hemorrhage and detachment
  - ♥ Kidneys – glomerulosclerosis and progressive renal failure
  - ♥ Brain – Hypertensive encephalopathy or CNS stroke or hemorrhage



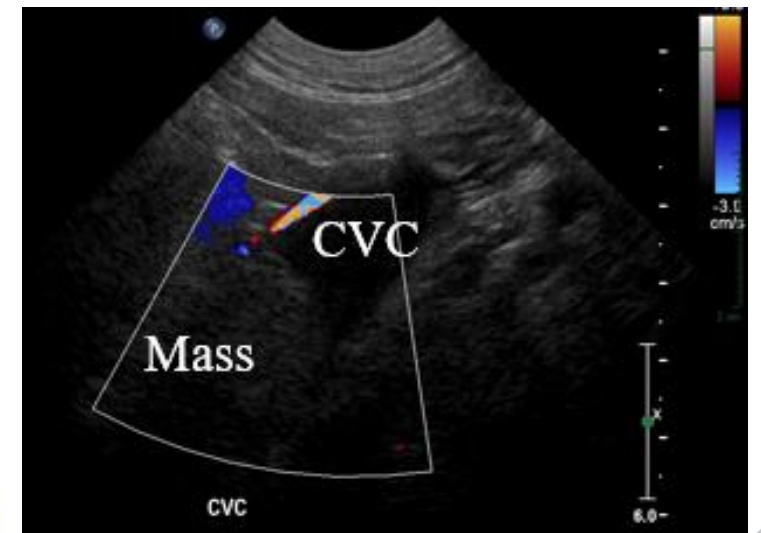
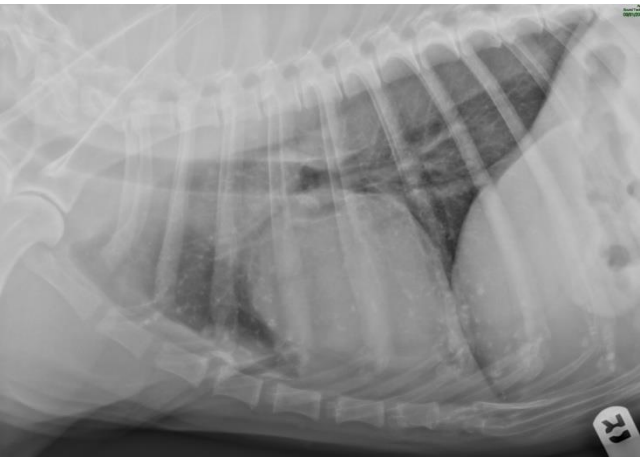
# Systemic Hypertension



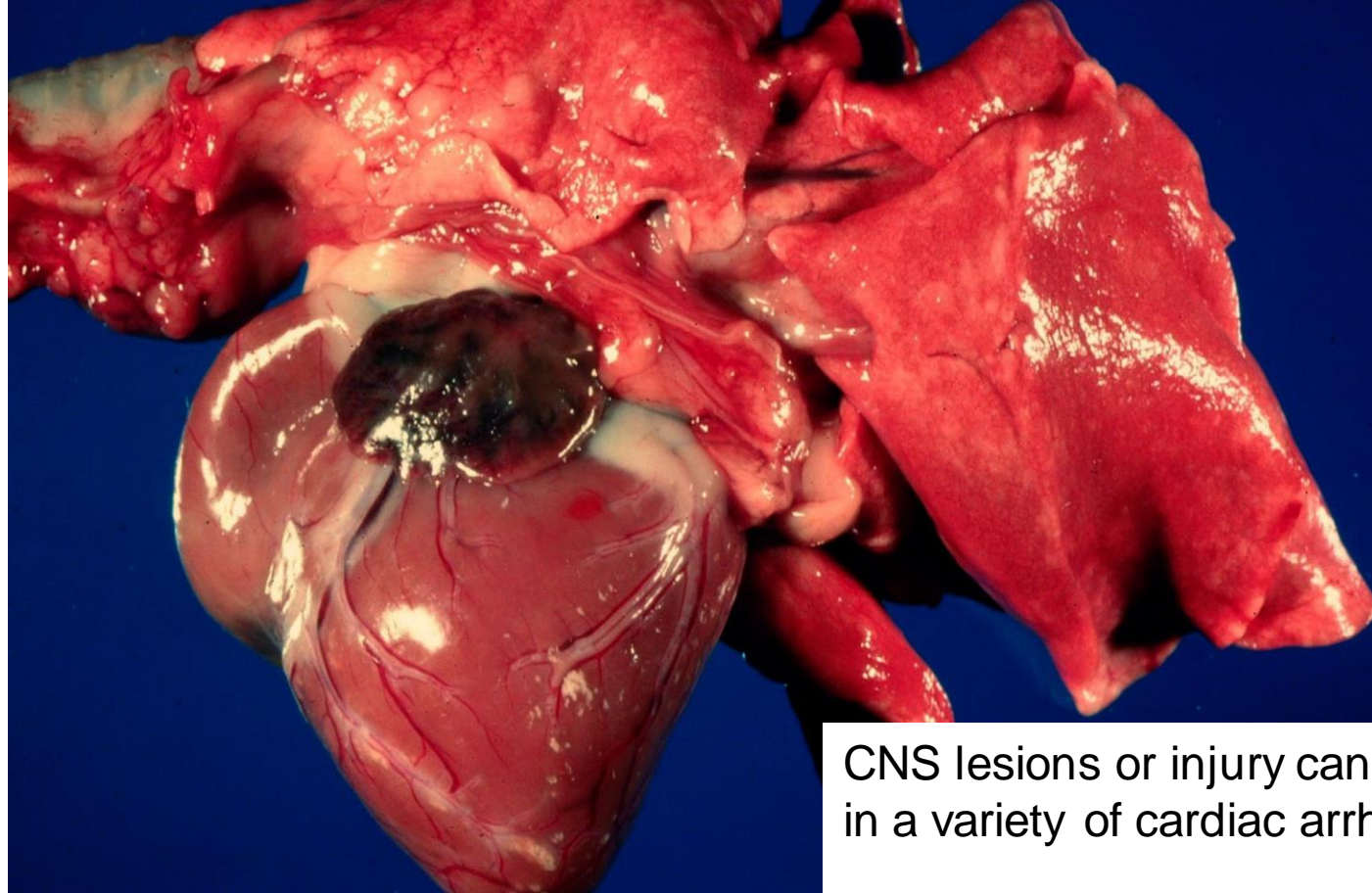
# Pheochromocytoma

- Tachycardia
- Systemic hypertension
- Collapse
- Episodic signs

Large mass obstructing flow in the caudal vena cava is pheochromocytoma



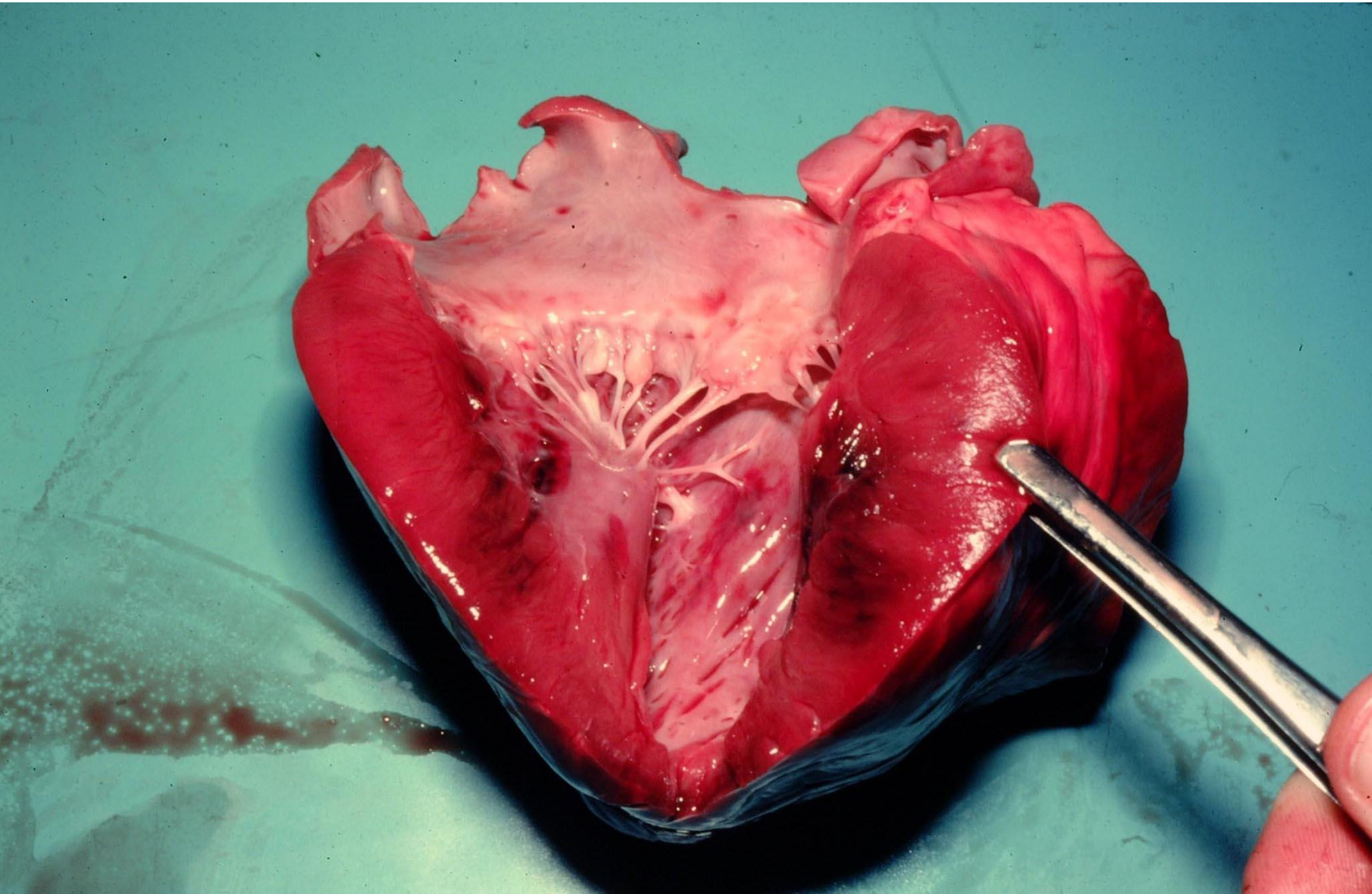
# CNS Lesions “Brain-Heart Syndrome”



CNS lesions or injury can result in a variety of cardiac arrhythmias



# Defibrillation and Electrical Injury



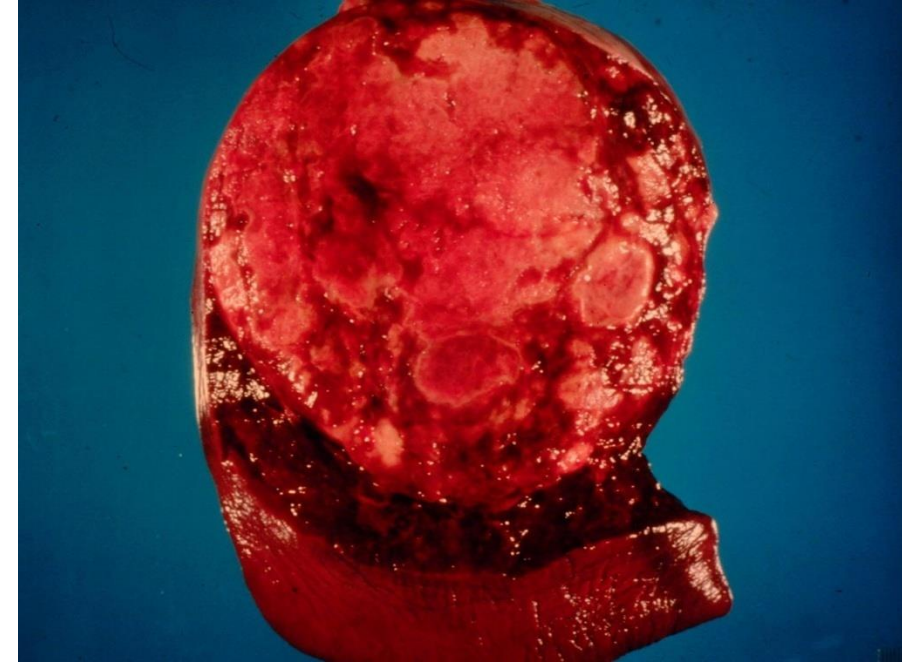
Causes myocardial injury,  
cardiac arrhythmias, and  
subendocardial hemorrhage



# Ventricular Arrhythmias Associated with Shock (Especially in dogs)



Motor vehicle accident,  
GDV, Splenic mass,  
sepsis, pancreatitis,  
IMHA, ITP, etc.





# Ventricular Arrhythmias and Myocardial Damage

- Common in dogs with any form of shock, especially older dogs and large breed dogs
- Also seen in horses with certain acute abdominal diseases, such as strangulating or inflammatory lesions



# Diabetes Mellitus

- Close association between diabetes and heart disease in humans
- Limited association in veterinary species
- Cardiac disease recognized in dogs and cats with diabetes mellitus
  - ♥ CHF is possible
  - ♥ More often in cats than dogs



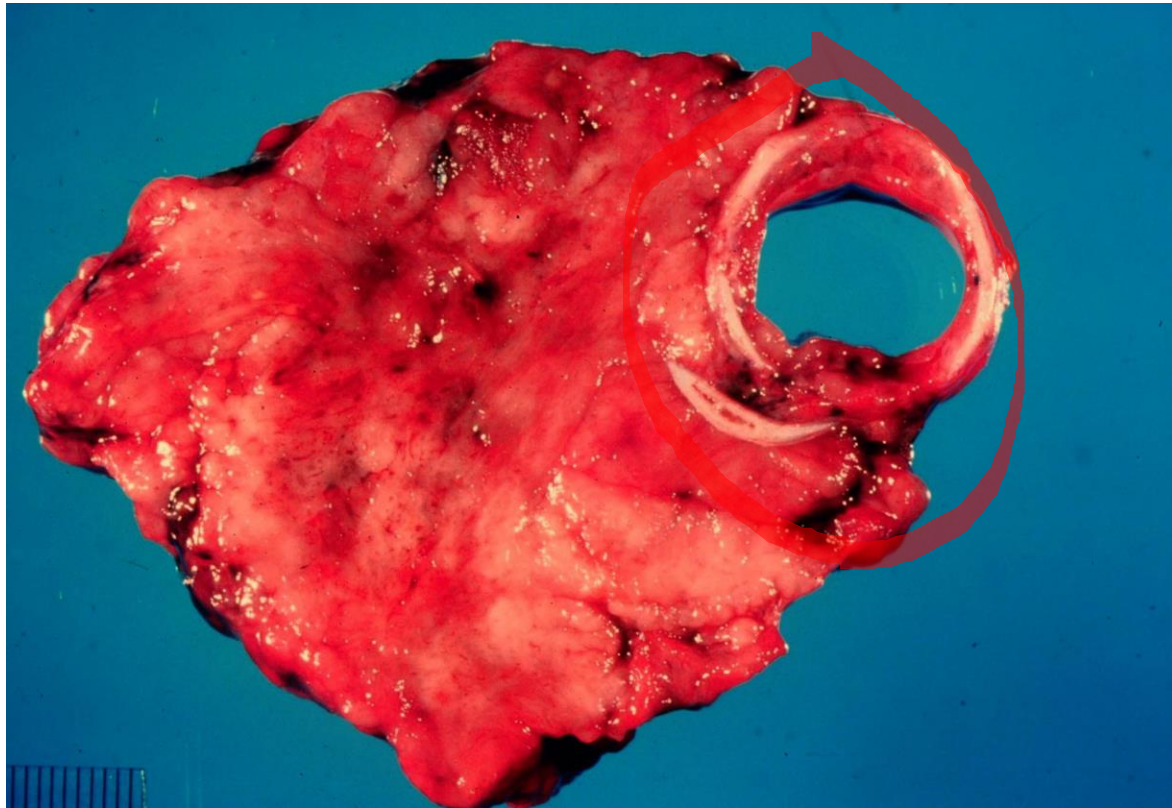
# Hyperthyroidism



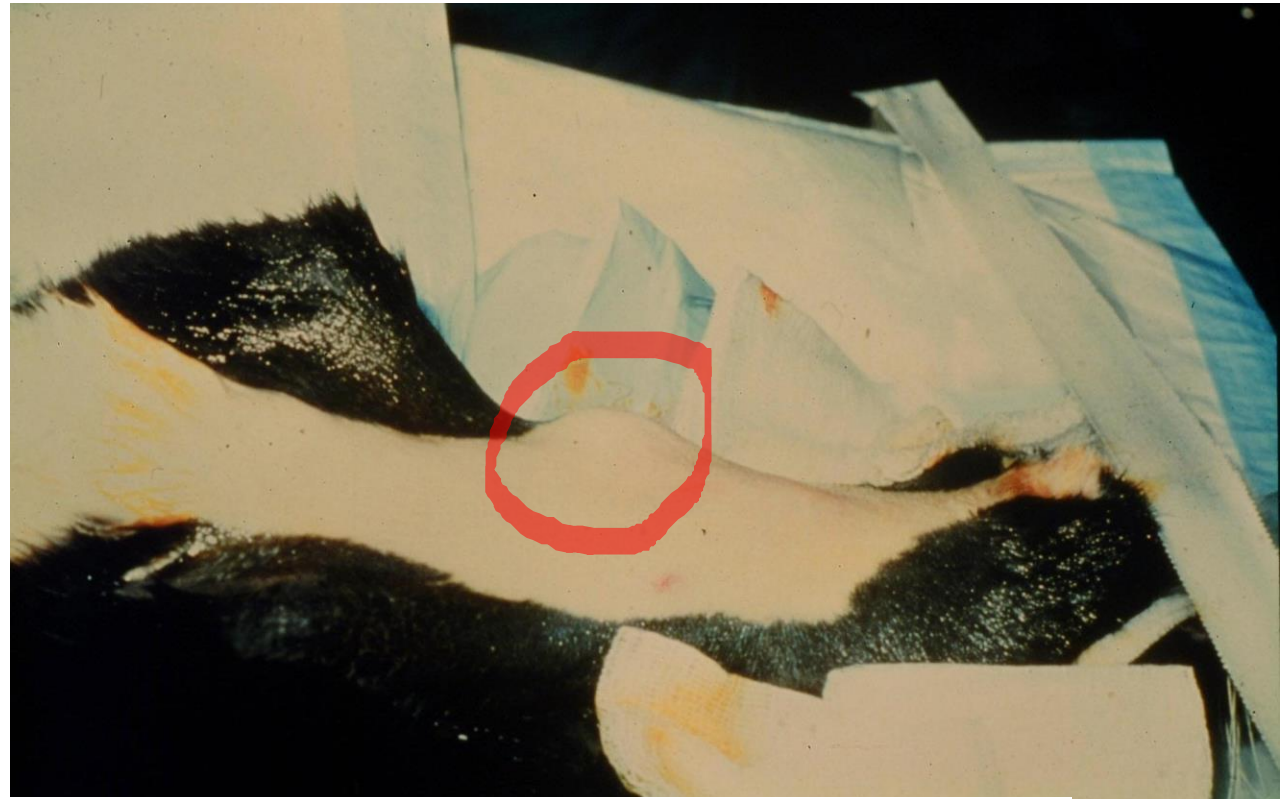
# Hyperthyroidism

Canine = Carcinoma

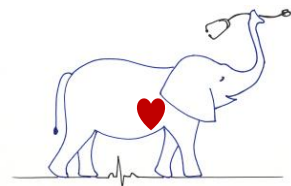
Feline = Adenoma



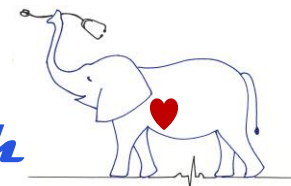
Usually Non-Functional carcinoma, very vascular, often difficult to resect, might metastasize



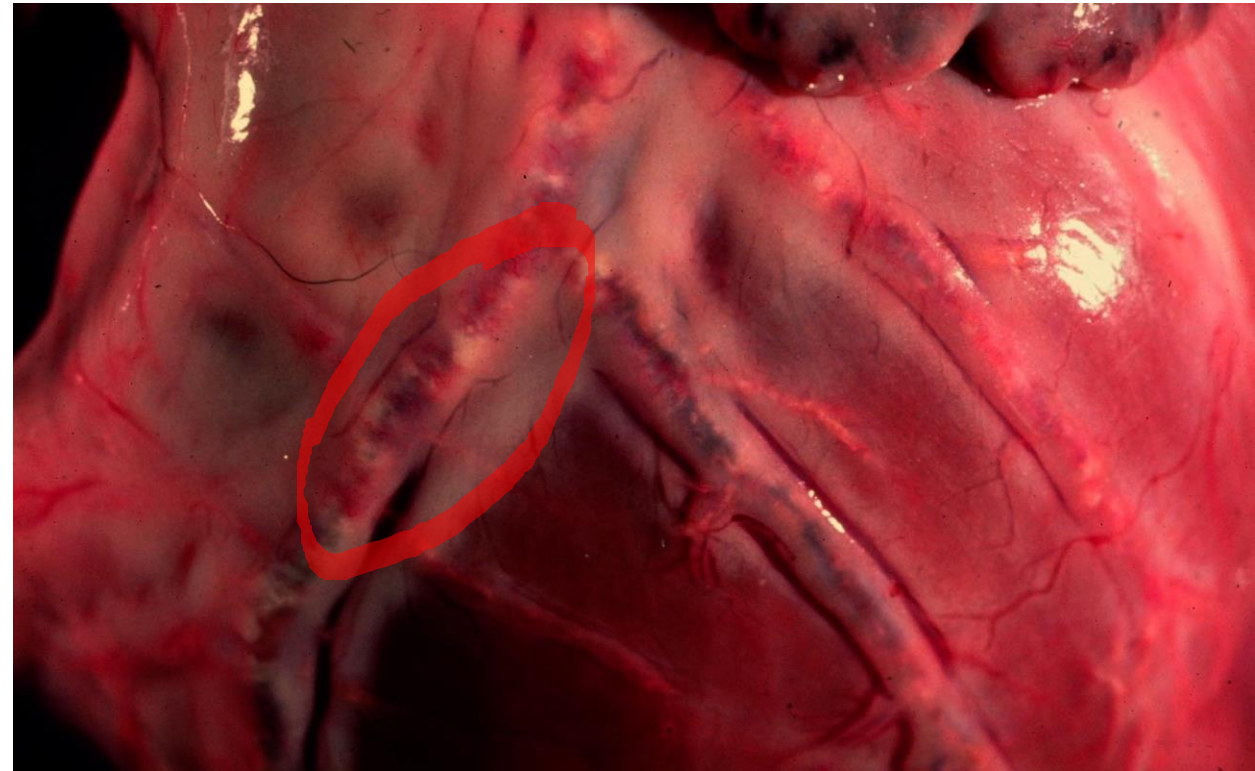
Usually benign but functional mass, creating hyperthyroidism, with tachycardia, arrhythmias, +/- systemic hypertension, sometimes CHF



**CardioRush**



# Hypothyroidism and Atherosclerosis

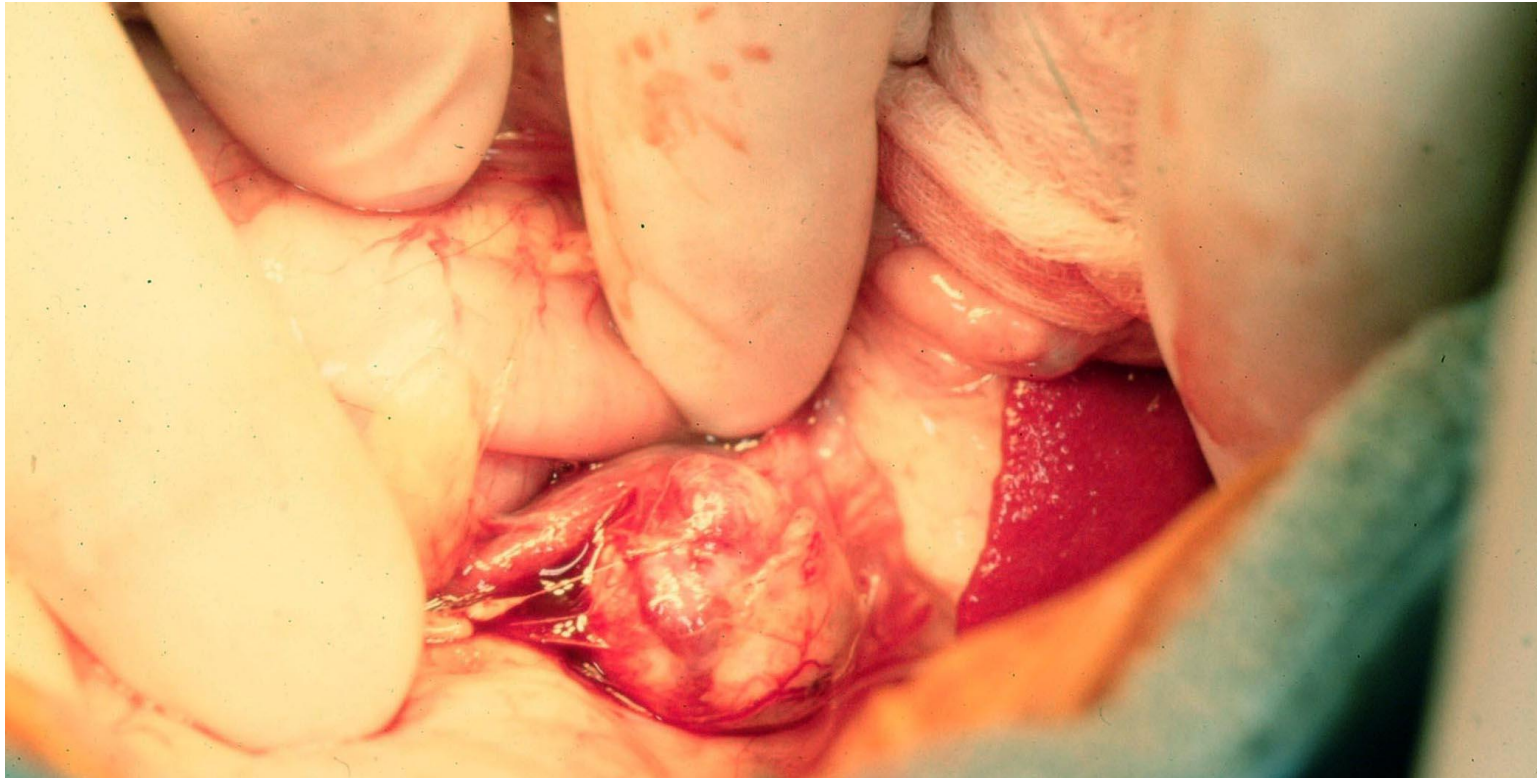


Atherosclerosis is uncommon, except in certain parrots, but may occur in dogs with severe hypothyroidism



# Adrenal Mass

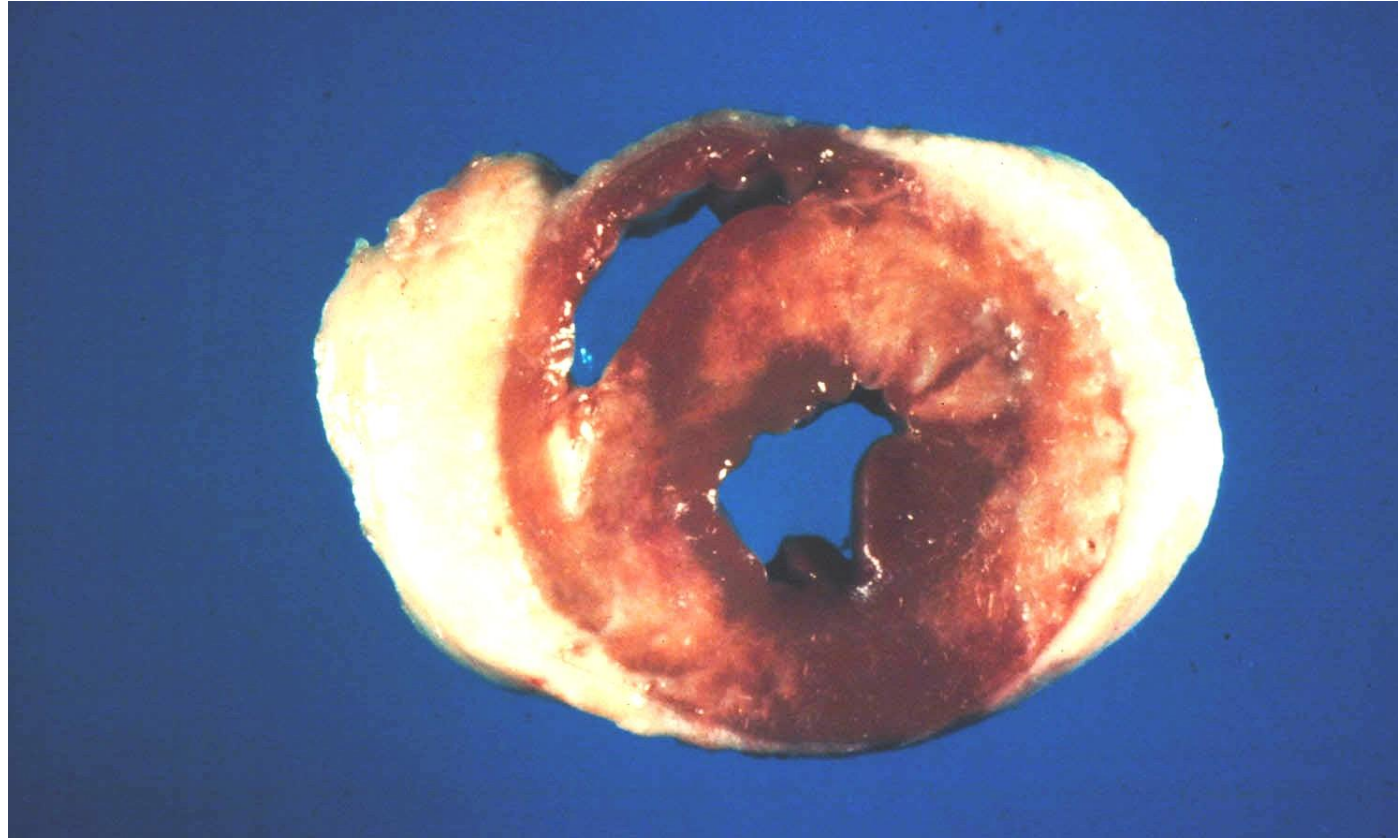
## Hyperaldosteronism



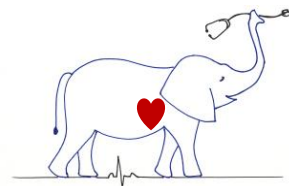
Hypertension, LVH, electrolyte changes



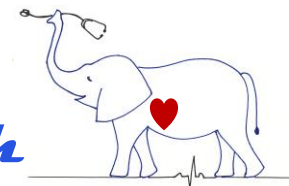
# Infiltrative disease in the myocardium due to lymphoma, eosinophilic disease, or others



Feline Hypereosinophilic Syndrome



*CardioRush*



# Take Home Points

- Myocarditis happens in many veterinary species
  - Can be infectious or immune mediated
    - Might develop CHF, can look like DCM (sometimes HCM in cats)
    - Often cardiac arrhythmias
    - Sometimes thromboembolic disease
    - Often other body systems dominate the clinical picture
- Many toxins, deficiencies or systemic disease affect the heart
  - Chemotherapeutic agents (doxorubicin)
  - Systemic hypertension (kidneys or adrenal glands)
  - Trauma, sepsis or systemic diseases (splenic mass, GDV)

