Practical Cardiology
Case Studies

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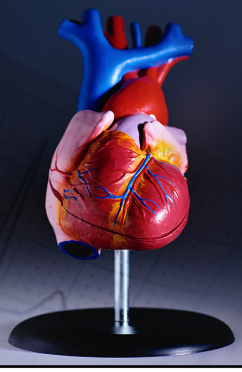


Warner

Signalment
- 10 year old neutered male tabby cat, the grumpy kind

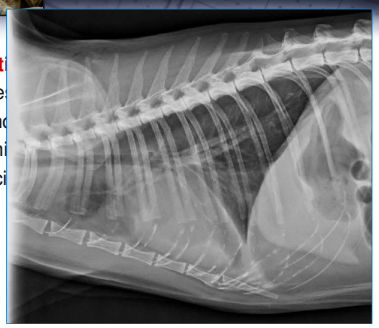
Chief Complaint
- Came to see referring vet because dropping food, and losing weight
- She found on exam neck lesions on the teeth (dental caries) and picked up a murmur on exam (audio)
- RR 24 per minute

Warner

Diagnostics
- Preanesthetic CBC, panel, lytes – unremarkable
- Abdominal radiographs normal
- Thoracic radiographs

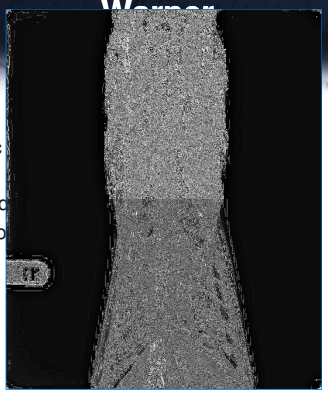
Warner

Diagnost
- Preane
- T4 pend
- Abdomi
- Thoraci



Warner

Diagnostics
- Preanesthetic
- T4 pending
- Abdominal rad
- Thoracic radio



Warner

Diagnostics
- Preanesthetic CBC, panel, lytes – unremarkable
- T4 pending
- Abdominal radiographs normal
- Thoracic radiographs (under sedation)
  - Mild pleural effusion
  - Increased bronchiolar pattern
  - VHS 9.5 (increased)
  - Enlarged atria
- Referred to me for echocardiogram

Warner

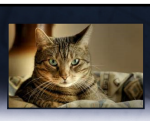
Echcardiogram

- Short Axis - Mushroom view (video)
- Short Axis - Fish Mouth View (video)
- Short Axis - Mercedes Views (video)
- Short Axis – Main Pulmonary Artery View (video)
- Long Axis – 4 Chamber (video)
- Long Axis – LVOT (video)
- Mild to moderate pericardial effusion
- Thick LV, LA may be a little big subjectively
- Mass off the LA at the level of the MV

Warner

Echocardiogram – Mushroom View Measurements

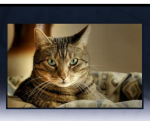
- **IVSd** 6-7 mm above PM, **13.2mm** below PM (n. 3-6)
- **LVIDd** 12mm (n. 10-21mm)
- **LVPWd** 6.5mm above PM, **12.1mm** below PM (n. 3-6)
- **LVIDs 0-1** (n. 4-11)
- **LVPWs** 10.5mm above PM, **12.6mm** below PM (n. 4-10)
- Really hard to measure LVPW even in B mode because I really couldn't get between the PM -- they were right up against each other even in diastole.
- Really big papillary muscles



Warner

Echocardiogram – Mercedes View Measurements

- **LAD 18-18.5mm** (n. 7-15)
- AoS 10.9 mm (n. 6-12)
- **LA:Ao 1.7** (n. 0.8-1.4)

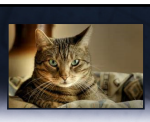


Warner

Diagnosis

Focal thickening of the LV

- DDx HCM, Cardiac Lymphoma
- Would require tapping very small amount of pericardial effusion for cytology
- After 2 weeks on clindamcyin, Warner feels great and is gaining weight, so owner is not keen to do anything else
- Increased fractional shortening makes HCM more likely than LSA
- Enlarged LA and focal LV thickening consistent with both

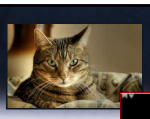


Warner

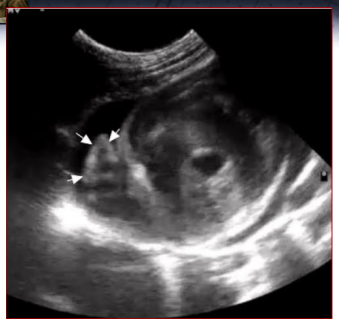
Diagnosis

Focal thickening of the LV

- Pericardial effusion seems focal (on the left 2-3mm adn at the level of the MV)
- Cat in right lateral recumbency, so a tiny amount of pericardial effusion would collect on the upside as the heart falls downward
- Increased echogenicity of the pericardium at the level of the percardial effusion, at the mass off the LA is likely acoustic enhancement due to focal effusion
- Cardiac LSA is almost never diagnosed antemortem



Warner



Warner

Diagnosis

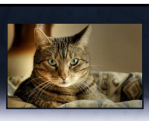
Mass off the LA

- It is the left auricle
- It appears larger and more distinct because of the mild pleural effusion

Warner

Treatment

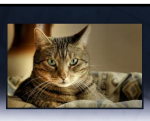
- Is the cat in CHF??
- Pleural effusion and pericardial effusion suggest so
- Lasix is indicated
- Was the episode precipitated by anesthesia for rads??
- Will the cat recompensate??
- Enlarged LA indicates chronic and hemodynamically significant heart disease
- By the way, Warner is nearly impossible to medicate
- How to we deal with the dental caries without killing him??



Warner

Treatment Plan

- Lasix 12.5 mg PO BID
- Anesthesia in 2 weeks for dental
- Premedicate acepromazine + Buprenorphine SR
- Induce Propofol
- No ketamine – positive inotrope and increased myocardial oxygen demand
- No dexdomitor – hypertension not so good for HCM cats
- Dental went well



Warner

Outcome

- Owner gave furosemide for one week after the dental, and quit – she had bandaids on her fingers
- One year later, Warner doing well
- Owner declined recommended follow-up diagnostics
- Presumptive diagnosis is HCM
- If the cat had cardiac LSA, he would no longer be alive

Cardiac Masses

Echocardiographic Features

- Usually at the heart base or in the RA
- Careful not to confuse with
  - Epicardial fat (especially on the AV groove when there is pericardial effusion)
  - Trabeculae on the right auricle when floating in pericardial effusion (Warner!!)

Cardiac Masses

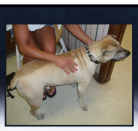
DDx

- Chemodectoma
- HSA
- Myxosarcoma
- Ectopic thyroid carcinoma
- Mesothelioma
- LSA
- Fibrosarcoma
- HCM can be very focal – easy to confuse with a diffuse invasive myocardial neoplasia like LSA

Taz

Signalment
- 7 year old neutered male sharpei
- Annual vaccines 2 weeks ago

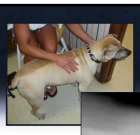
Chief Complaint
- Hasn't felt good since vaccines
- Breathing really hard
- Belly is swelling
- Not eating



Taz

Exam – RR 77, mm pale, CRT 4 sec
- Positive hepatojugular reflux
- Ascites
- Peripheral edema – ventral legs and ventral abdomen
- Muffled heart sounds, but no pleural rubs

CBC, panel, lytes, heartworm test
- No abnormalities noted



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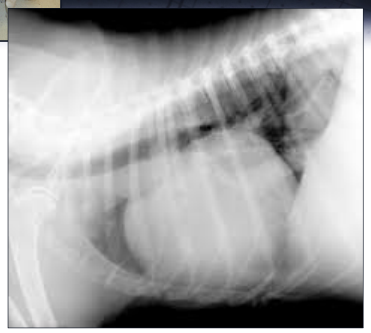

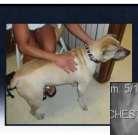

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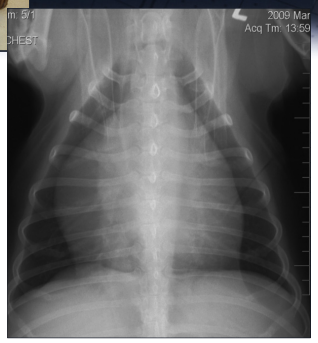
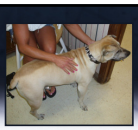


Taz

Echocardiogram (video)
- Pronounced pericardial effusion with cardiac tamponade
- Pericardiocentesis – 1 L fluid that resembles blood
  - Does not clot after 20 minutes
  - PCV 38%, cytology non-septic exudate (hypersegmented neutrophils)
- IV fluid bolus 500 ml, as fluid being tapped
- Echo measurements after tap normal

PT, PTT, ACT
- normal



Taz

Abdominal US
- Normal

Sent pericardial fluid for culture and sensitivity

Emergency Referral to TAMU for Echocardiogram
- Taz was VERY painful on the ride to Bryan
- Small amount of pericardial effusion – not enough to tap
- No cardiac masses detected
- Abdominal ultrasound NSAF
- Discharged with no medications, to recheck in one week

Taz

Recheck 1 week

- Taz doing exceptionally well
- No growth on culture and sensitivity
- Signs of right heart failure have resolved
  - No ascites, dyspnea, peripheral edema, jugular distension
  - Abdominal palpation normal
- Chest x-rays show VHS 11
- Echo shows 2 cm pericardial effusion
- Tapped again and dispensed pain meds
- Rx doxycycline 10 mg/kg PO BID x 3 weeks
- Rx prednisone 0.5 mg/kg PO SID x 2 weeks, then QOD

Taz

Recheck 30 days

- Exam, chest rads and echo are normal
- Taper off prednisone over the next 30 days
- Taz has had no recurrence of pericardial effusion in the past 6 years
- Was eventually euthanized due to amyloidosis and unresponsive renal failure

Pericardial Effusion

Clinical Features

- DDx
  - Pericarditis
  - Chronic CHF (usually RHF)
  - Blood – left atrial tear, HSA, coagulopathy
  - Pericardial cyst
  - Idiopathic
  - 50% are neoplasia – carefully look at RA
- **ECG** – electrical alternans

Pericardial Effusion

Echocardiographic Abnormalities

- Careful not to confuse pericardial fat with pericardial effusion on rads
  - Look at relative echogenicity on rads
  - An ultrasound will solve the mystery
- Careful not to confuse normal anechoic structures with pericardial effusion
  - Descending aorta
  - Enlarged left auricle

Pericardial Effusion

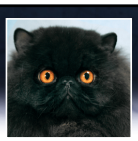
Echocardiographic Abnormalities

- Careful to distinguish pericardial from pleural effusion
  - Pericardium not visualized with pleural effusion
  - Collapsed lung lobes may be seen with pleural effusion (look like liver in US - video)
  - Careful not to confuse consolidated lung with liver in a peritineopericardial diaphragmatic hernia
- Heart may swing back & forth in the pericardium

Pericardial Effusion

Echocardiographic Abnormalities

- Cardiac tamponade
  - Compression of RV
  - Diastolic collapse of RV
  - IVS may be flattened with paradoxical motion
  - Pericardiocentesis is imperative
  - Aggressive diuresis will reduce preload, as long as cause of effusion is not RHF
- Evaluation of heart base tumor prior to pericardiocentesis will be more thorough



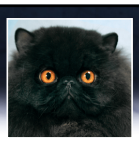
Ike

Signalment

- 7 year old castrated male Persian cat

Chief Complaint

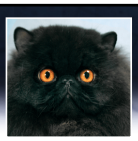
- Recurring anemia
- Episodes of weakness, anorexia, dullness and salivation
- Constipation often associated with episodes
- Tremendous hair loss and 2 lb weight loss over 6 months



Ike

Exam – T 100.3, P 180, R 40, BP 135

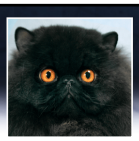
- Fleas++++
- Heart sounds change with time
  - (audio)
  - Gallop rhythm
  - followed by normal heart sounds
  - followed by (audio)
  - 2/6 systolic murmur



Ike

Exam – T 100.3, P 180, R 40, BP 135

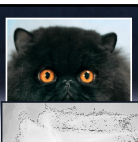
- Hepatomegaly and mild to moderate ascites
- Jugular vein distension
- Did not do hepatojugular reflux test
- Tongue protrudes and tip is dry
- Breathes with mouth open when stressed



Ike

Diagnostics

- **CBC** – normal
- **FeLV/FIV** – negative
- **GHP/electrolytes –**
  - ALT – 218 (n 10-100)
  - Bili – 0.3 (high normal)
  - Albumin 1.7 (n 2.3-3.4)
  - K – 2.5 (n 2.9-4.2)



Ike

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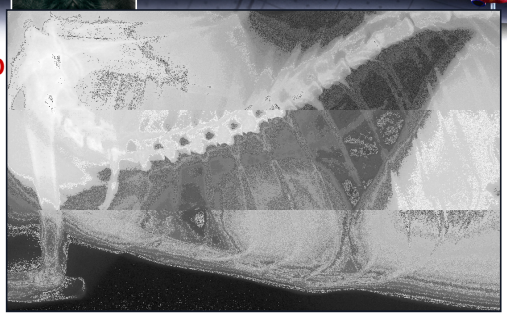
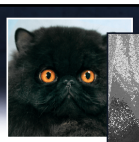
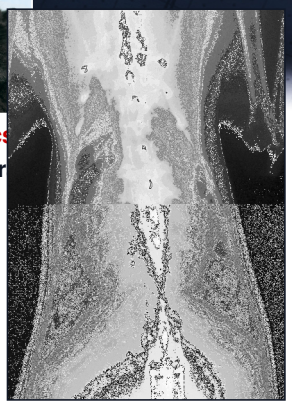
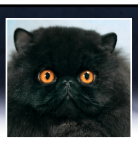




Diagnostics

- **Chest x-r**

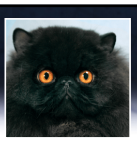




Ike

Diagnostics

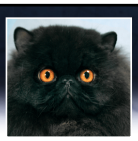
- **Chest x-rays**
  - Elevated trachea (heart enlargement)
  - Generalized cardiomegaly – VHS 9
  - Distended caudal vena cava
  - Hepatomegaly
  - Ascites



Ike

Diagnostics

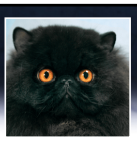
- **Diagnosis -** Right heart failure with cardiomegaly
- **DDx – cardiomegaly**
  - Diaphragmatic hernia
  - pericardial effusion or hernia
  - heart enlargement
    - HCM, DCM, RCM
    - VSD
    - Valvular disease
  - Hypoalbuminemia/liver disease may be contributing to ascites



Ike

DDx Hypoalbuminemia

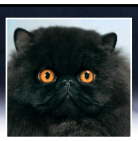
- Liver disease
- PLN
- PLE unlikely with no clinical signs
- Sequestration in ascites



Ike

Initial Treatment

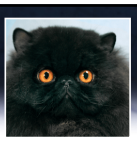
- No echo done because Ike became dyspneic after chest rads
- Furosemide 5 mg PO BID (wt 5 lbs 7 oz)
- Potassium gluconate 2 mEq PO SID
- Metronidazole 625 mg PO SID x 2 weeks



Ike

Recheck Scheduled for 1 week

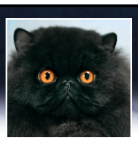
- Echocardiogram
- Electrolytes
- Abdominal US
- UPC
- bile acids
- Fluid analysis if ascites fails to resolve



Ike

Recheck – 1 week - Exam

- Ike tremendously improved
- Weight gain of 5 ounces
- Ascites has resolved
- Hepatomegaly no longer present
- P 160, RR 28, BP 110
- Haircoat seems improved
- 2/6 systolic murmur loudest at the sternum (audio)
- No open mouth breathing or inc RR when stressed

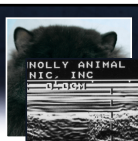


Ike

Recheck – 1 week - Diagnostics

- **Electrolytes** – K 2.7
- **Albumin -** 2.4 (normal)
- **ALT** - 134 (n 10-100)
- **Bili** - 0.3
- **UPC** – 0.5
- **Bile Acids** (fasting) - 157

Ike - Echo



Ike - Echo

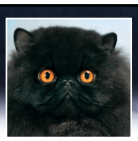
Ike - Echo

Short Axis – LV Apex

- Mild pericardial effusion

Short Axis – LV PM

- Mild pericardial effusion
- LV subjectively thick
- Papillary muscles really big
- No evidence of pericardial hernia



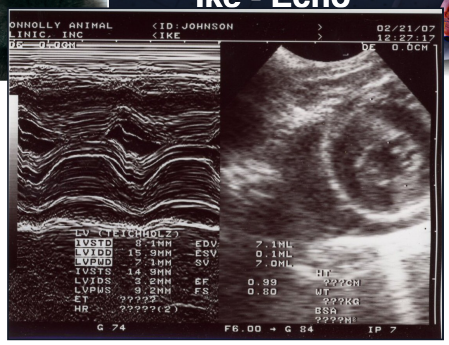
Ike - Echo

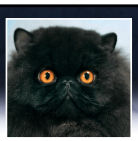
Short Axis – LV PM

- **IVSTD** – 10.2 (n 3-6)
- **LVIDD** – 14.1 (n 10-21)
- **LVPWD** – 6.95 (n 3-6)
- **IVSTS** – 14.85 (4-9)
- **LVIDS** – 3.5 (n 4-10)
- **LVPWS** – 9.6 (n 4-11)
- **FS** – (14.1-3.5)/14.1 = 74.5% **EF** = 98%

Dx – Hypertrophic Cardiomyopathy

Ike - Echo



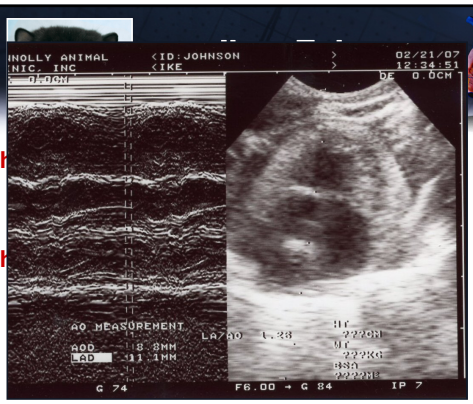


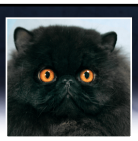
Ike - Echo

Short Axis – LV MV

- **EPSS** – 2 mm

Short Axis – LA/RVOT





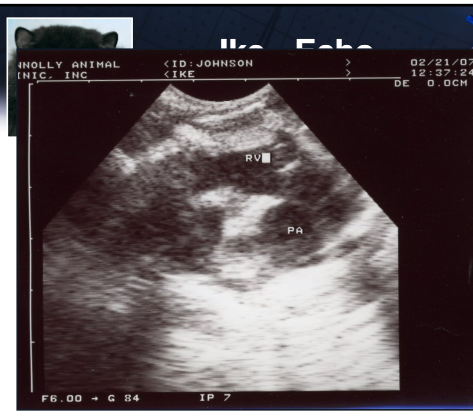
Ike - Echo

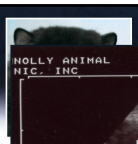
Short Axis – LV MV

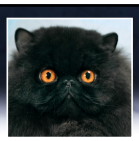
- **EPSS** – 2 mm

Short Axis – LA/RVOT

- RVOT looks subjectively enlarged
- LA and LA normal
- **LA/Ao** = 11.1/8.8 = 1.26 (normal)







Ike - Echo

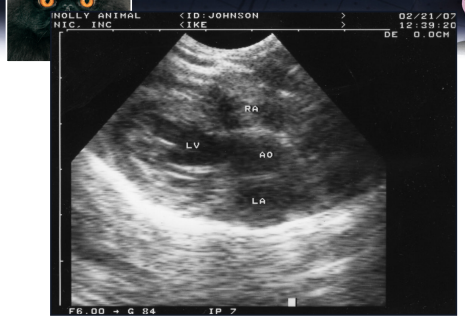
Short Axis – PA

- Enlarged main pulmonary artery
- RV enlarged

Long Axis – 4 Chamber

- No apparent enlargement of LA
- LV thickened

Ike - Echo

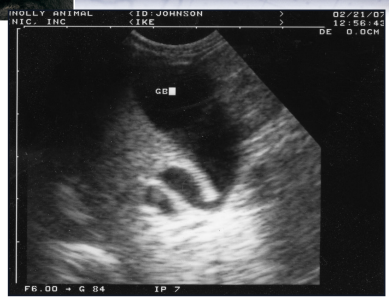


Ike - Echo

Long Axis – LVOT

- No apparent enlargement of LA
- LV thickened

Ike - Echo



Ike - Echo

Abdominal US

- No fluid present in the abdomen
- Main bile duct tortuous
- Pancreas normal
- Did not do liver aspirate because Ike would not tolerate it without general anesthesia

Ike - Echo

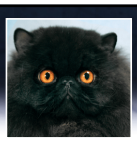
Assessment

- Hypertrophic Cardiomyopathy
  - **Biventricular failure**
  - **Secondary pericardial effusion, ascites, hepatomegaly**
- Enlarged Pulmonary artery of unknown cause (DDx)
  - **Heartworm disease**
  - **Pulmonary hypertension**
- Liver Dysfunction of unknown cause
  - **Probable history of pancreatitis**
  - **Possibly contributed to by passive congestion of RHF**
- Financial Resources for Ike's Diagnosis and Treatment have been depleted

Ike - Echo

Treatment - Update

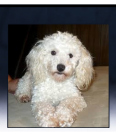
- Finish metronidazole, then start milk thistle
- Increase Kgluconate to 2 mEq PO BID
- Continue furosemide 5 mg PO BID
- Add enalapril 1.25 mg PO SID
  - Recheck BUN/lytes 5 days
  - If OK, increase to BID
  - Recheck BUN/lytes 5 days
- Laxatone PRN for constipation
- Recheck echo, chest rads in 6 months or sooner if RR > 40 at rest



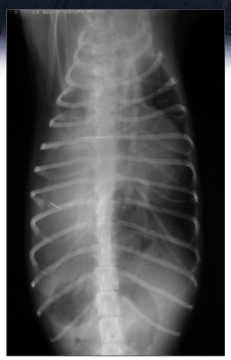
Ike - Echo

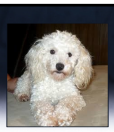
Treatment – Update

- Ike did exceedingly welll for 6 months, regrew hair and was asymptomatic
- He died acutely just prior to his 6 month recheck

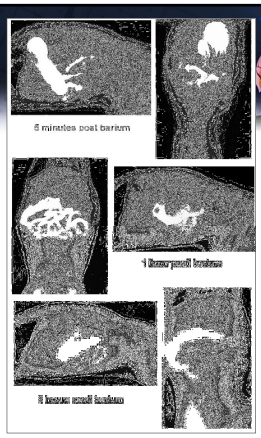


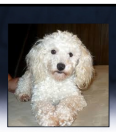
Waddles



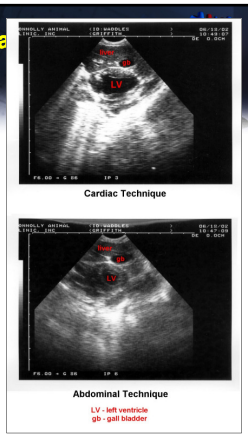


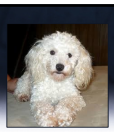
Barium Study





Thoracic Ultrasound



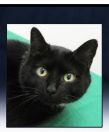


Waddles

Dx – diaphragmatic hernia with one lobe of the liver herniated into the thorax

Tx - Owners chose not to repair surgically, due to financial limitations

Waddles lived a long and productive life as a cryptorchid breeding animal



Inky

Sig: 5 year old CM DSH

CC: hit by a car 2 weeks ago

- Seemed fine immediately after, except mildly increased respirations
- radiologist consult identified peritoneo-pericardial diaphragmatic hernia as an “incidental finding”
- Has been steadily declining
- Stopped eating 2 days ago, lethargic

Exam: BCS 5/9, heart sounds are muffled, lethargic, temp 103.5ºF, RR 42 bpm

Inky

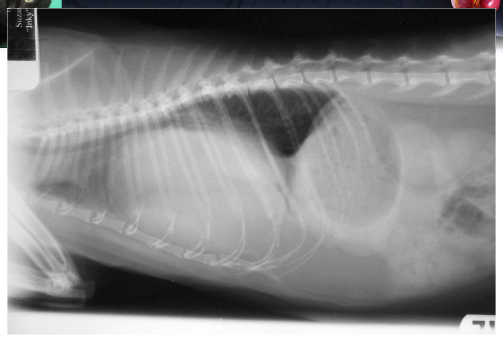
CBC: neutrophils 1,500/ul, 4% band cells

panel: ALT 934 U/L, SAP 1101 U/L, bili 1.0, BUN 43 mg/dl

lytes: K^+ 2.5 mEq/L, Na^+ 160 mEq/L

UA: USG 1.043, bilirubinuria

Inky



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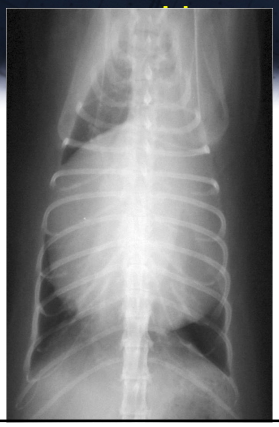

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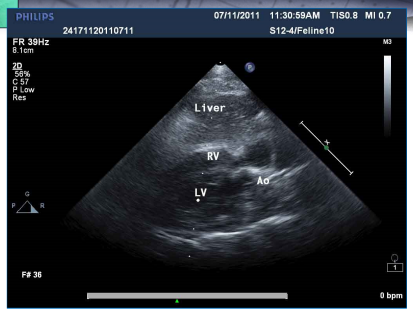


Inky

US thorax: confirmed liver in pericardial sac, with minimal effusion

Abdominal US: small amount of liver in the abdomen

Radiology consult says this is an incidental finding, not requiring emergency surgery

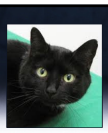
FNA of liver in pericardium – suppurative inflammation, toxic neutrophils

Inky

Owner declined referral due to financial limitations

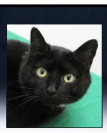
Concerns about surgery:

- Expansion pulmonary edema not likely a concern with <2 week history and lack of pleural compromise
- If chest tube needed, increased risk at facility without 24-hour care
- ****release of septic toxins and crash when possibly necrotic strangulated liver removed from the pericardial sac****



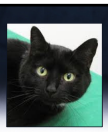
Inky

- Pre-treated with IV fluids, IV ampicillin, IV enrofloxacin
- Pre-surgical venous blood gases and lytes normal
- Mean BP fell from 100 to 50 in 2 minutes after removing liver lobe from the pericardium

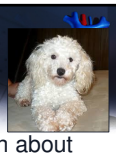


Inky

- IV fluid bolus 9 ml/lb
- Hetastarch 10 mg/kg IV
- Vasopressin 0.4cc IV
- Dexamethasone SP 0.5cc IV, bicarbonate 5 mEq IV
- Respiratory arrest followed by cardiopulmonary arrest, Inky could not be resuscitated



Lessons from Inky & Waddles



- Imaging might not tell much about strangulation of herniated organs
- The only way to know if a hernia is incidental is to look at your patient
- Always interpret lab and consultant reports in light of all data and information available
  - Remember that the consultants are only seeing one very small part of the entire case
- Consider amputation of strangulated organs prior to reduction of the hernia