**Jake**

**Signalment**
- 9 year old male Boxer

**Chief Complaint**
- Deep cough when walking in the morning, for about one week
- Appetite is good

**Exam**
- Weight 81.9 – has lost 5 pounds in 3 months (BCS 3)
- Temp 101.4
- Mucous membranes pink, CRT 3.5 seconds
- Subtle dependent edema on the lower legs
- Jugular veins distended
- Harsh lung sounds
- 3/6 holosystolic murmur, PMI left apex
- Heart rate 160 per minute
- Respirations 55 per minute
- Femoral pulses somewhat weak

**Differential Diagnosis - Cough**
- Respiratory Disease
- Cardiovascular Disease
- Both

**Diagnostic Plan (B Client)**
- Blood Pressure
  - 150 mm Hg systolic (Doppler)
- Chest x-rays

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**Diagnostic Plan (B Client)**
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**Diagnostic Plan (B Client)**
- Chest X-rays
  - Massively enlarged heart (VHS 12.5)
  - Enlarged LA, LV (dorsally elevated trachea)
  - Enlarged pulmonary veins
  - Perihilar pulmonary edema
  - Left congestive heart failure

**Immediate Therapeutic Plan (10 am)**
- Furosemide
  - 80 mg IM
- 4 hours later
  - Respiratory rate is 36 per minute

**Diagnostic Plan – 2nd Wave (2 pm)**
- EKG
  - Normal Sinus Rhythm
- Echocardiogram (video)
  - Enlarged LV, myocardium is hardly moving
  - IVS bowed to the right due to LV dilation
  - Measurements confirm LV enlargement, LA enlargement and myocardial failure
    - EF 15%
    - FS 7%
    - LA:Ao 2.1
  
**Diagnoses:**
- Dilated Cardiomyopathy
- with biventricular CHF

**Recommendations**
- Congestive Heart Failure
  - CBC, serum panel and electrolytes
  - Furosemide 80 mg PO BID
  - Enalapril 20 mg PO BID
  - Recheck mini-panel and electrolytes in 3-5 days
  - Recheck chest rads and BP 3-5 days
- Dilated Cardiomyopathy
  - Thyroid panel (TSH, T4, FreeT4)
  - Pimobendan 10 mg PO BID (declined)
  - Carnitine 2 g PO BID
  - Recheck echo, chest rads, BP, EKG, mini-panel/lytes 60 days (sooner if respiratory rate >40 at rest)
**Jake - Bloodwork**

Carnitine for DCM
- Boxers with genetic defect need extra carnitine
- Plasma levels have low sensitivity
- Myocardial biopsy is usually required

CBC, Mini-panel - BUN, creat, glucose, TP, SAP, ALT
- Normal
Electrolytes, Thyroid panel
- Not done

**Jake – Follow-Up**

Recheck – 6 days
- BUN 30 (n 10-29)
- Creat normal
- Electrolytes not done
- Chest x-rays not done

No additional rechecks were done, owner did not monitor respiratory rate at home

**Jake – Follow-Up**

4 months later...
- Chief complaint –
  - Doing well until last week
  - Poor energy, coughing again, not eating
- Heart sounds (audio file)
  - Chaotic heart sounds with pulse deficits on auscultation
  - “tennis shoes in a dryer”

**Interpreting the ECG**
- Heart Rate
- Rhythm
  - Normal Sinus Rhythm
    - Similar P QRS and T for each beat
    - Regular heart rate
  - Respiratory Sinus Arrhythmia
    - Similar P QRS and T for each beat
    - Heart rate increases with inspiration & decreases with expiration
  - Arrhythmia
    - P wave - width and height
    - PR interval - length
    - QRS - width and height

**Jake – Follow-Up**

- "Bic Pen x 10"
  - At 25 mm/sec, 150 mm of ECG = 6 seconds
  - A Bic Pen is 150 mm long
  - So the number of QRS complexes in a Bic Pen x 10 = heart rate

**Jake – Follow-Up**

- Heart Rate
  - 200 bpm (tachycardia)
- Rhythm (NSR, RSA or arrhythmia)
  - Irregularly irregular - arrhythmia
Jake – Follow-Up

• P wave (normal 1 box wide x 4 boxes tall)
  • not present
• PR interval (normal 1.5-3.25 boxes)
  • no P wave – can’t measure
• QRS (normal 1.5 boxes wide x 30 boxes tall)
  • 2 boxes wide x 26 boxes tall
  • Wide QRS = LV enlargement

Diagnosis – Atrial Fibrillation

Jake – Treatment

• Recommended treatment
  • Pimobendan for DCM (declined before)
  • Digitalis for Afib
• Treatment was declined, and Jake was euthanatized 1 week later
  • Most dogs with DCM are gone within 3 months of becoming symptomatic, if treated with furosemide & ACE.
  • Survival is likely much shorter – days to weeks – if untreated.
  • Adding Pimobendan increases mean survival to 130 days.
  • Median survival for dogs with DCM and Afib is 3 weeks, without Pimobendan

Dilated Cardiomyopathy

Common ECG Findings
• Wide P wave
  – LA enlargement
• Tall R wave
  – LV enlargement
• Atrial fibrillation
• VPCs
• Ventricular arrhythmias

Atrial Fibrillation

Why Treat??
• Heart rate around 250 beats per minute
  – Myocardial failure will result within 3-6 weeks
  – Ventricles can not fill properly – forward heart failure

Treatment
• Conversion would be ideal
• But this is not easy to accomplish in very sick hearts
• Can attempt in big dogs with normal hearts and primary Afib, not dogs with DCM
  – Can try medical conversion with quinidine
  – Or Anesthesia and conversion with electric shock
Atrial Fibrillation

Treatment – Afib in unhealthy hearts
- Slow the heart rate at the AV node (goal 150 bpm)
- Digoxin
  - Weak positive inotrope
- Beta blockers
  - Negative inotrope – probably contraindicated if DCM
- Calcium channel blockers
  - Diltiazem SR (Plumb dose)

DON’T USE BETA BLOCKER AND CALCIUM CHANNEL BLOCKER TOGETHER!!

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Tom

5 year old neutered male DSH
Chief Complaint
- Outdoor cat, owners think he was hit by a car
- Tom is laterally recumbent, and breathing hard

Exam
- T 96.5, P- 100, R – 66
- No evidence of trauma

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Tom

ECG 1
- Heart Rate - 120
- Rhythm – regular
- no P waves
- QRS – deep S wave, wide, bizarre QRS

Dx – atrial standstill, L ventricular escape rhythm

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Tom

i-STAT EC8+
- K 10.9 mEq/L, iCa++ 0.96 mmol/L
- pH 7.08, HCO₃ 11 mEq/L
- Grapefruit sized very firm bladder

---

Tom

Treatment
- Place indwelling urinary catheter & IV catheter
- Begin 0.9% NaCl at 15 ml/hr
- 1 unit regular insulin IV
- 5cc 50% dextrose diluted in 15 cc fluids, given over 1 hour; added 5%dextrose to fluids

ECG 2 – 6 minutes later
ECG 2 – 6 minutes later
- Heart rate 140
- No P waves
- QRS less abnormal
- T wave not as tall

ECG 3 – 1 hour after presentation
- Heart rate 120
- No change for the past 45 minutes
Treatment
- Ca-gluconate 2cc IV slowly over 20 minutes

ECG 4 – 2 hours after presentation – T 98.9
- Heart rate 120, normal sinus rhythm
- P waves have returned, but wide and inverted
- QRS and T normal

ECG 5 – 5 hours after presentation
- Heart rate 130
- Normal sinus rhythm
- P waves have returned to normal

Follow-up i-STAT EC8+
- iCa++ normal, K 6.6 mEq/L
- HCO₃⁻ 16.3 mEq/L, pH 7.29
Tom began eating the next day, the urinary catheter was removed, and he was discharged 2 days later.
- He was azotemic on presentation, but this resolved with treatment
Gabby

6 month female DSH  
Presented for OHE

Exam - HR 100  
• No other abnormal findings  
• Preanesthetic bloodwork normal

Gabby

Pre-Anesthetic ECG

• Heart rate  
  – P rate is 160 bpm, QRS rate is 100 bpm  
• Rhythm  
  – no consistent PR interval  
  – P and QRS complexes are disassociated, but each regular

3rd degree AV block

3rd Degree AV block is the most common cause of bradycardia in the cat

Treatment - cats
• Often no treatment needed for cats  
  – AV node pacemaker is 100 per minute  
  – AV node pacemaker is 40-60 per minute in the dog  
• Cats do well unless they undergo anesthesia  
• Avoid drugs that increase vagal tone  
  – Alpha blockers – Dexdomitor, Rompun

Gabby

Gabby was not spayed at 6 months of age  
When she reached 7 years of age, she had her 4th litter  
She was referred to Drs. Miller and Gordon at TAMU for spay  
  – When induced, her heart rate immediately fell to 40 and was progressively dropping  
  – A temporary pacemaker was placed  
  – Gabby was spayed and recovered uneventfully  
  – Gabby turned 17 years old this year

3rd degree AV block in Dogs

• Usually presents for syncope  
• “Cannon wave” jugular pulses (bradycardia)  
• Treated with pacemaker implantation  
• Drug therapy not usually successful  
  – Usually no response to atropine  
  – Atropine often makes 2nd degree block go away  
  – Some have tried theophylline  
• Prognosis poor without pacemaker  
• If lactate is high, emergency pacemaker is needed

Dear Doc,  
Because you took away my favorite pastime,  
I have turned to a life of substance abuse.  
It’s your fault.  
Love, Gabby
3\textsuperscript{rd} degree AV block in Dogs

Pre-Operative ECG
• Atrial rate = 200 per minute
• Ventricular rate = 40 per minute

Post-Operative ECG
• Ventricular rate = 100

Susie

Signalment
• 12 year old spayed miniature schnauzer

Chief Complaint
• Episodes of Confusion

Exam
• G3 dental tartar
• Alternating periods of normal heart rate, tachycardia and bradycardia
• Pulse deficits during tachycardia

Vertebral Heart Size
= 10.7
(normal 8.5-10.5)

Enlarged main pulmonary artery

Work-up
• CBC, panel, electrolytes, UA normal
• Chest x-rays

Susie

Work-up
• CBC, panel, electrolytes, UA normal
• Chest x-rays
• Susie is not on heartworm prevention
Susie

ECG
- Heart Rate
  - Very erratic and impossible to estimate
  - >200 bpm for periods of up to 2-4 seconds
  - Some periods of normal heart rate
  - Periods of asystole for up to 2-4 seconds

Susie

ECG
- Rhythm - arrhythmia
- P wave (normal 1 box wide x 4 boxes tall)
  - Some P waves missing and some inverted
  - Wandering pacemaker, failure of pacemaker and acceleration of pacemaker in the SA node

Susie

ECG
- PR interval - regular and normal
- QRS and T waves - normal

Susie

ECG
- Period of asystole nearly 5 seconds long
- Asystole longer than 2 seconds which resolves is aborted death

Diagnosis: Sick Sinus Syndrome

Sick Sinus Syndrome
- Early in disease, may be responsive to atropine
  - Atropine 0.04 mg/kg PO TID-QID – compounded w/ sweet syrup
  - Not quite as effective:
    - Propantheline
    - Isopropamide
    - Darbazine - prochlorperazine plus isopropamide
  - Mild side effects - mydriasis and constipation
- Pacemaker usually eventually required to control syncope

NTproBNP ELISA

N-terminal pro-B type Natriuretic Peptide
- In clinic test to distinguish cardiac from respiratory dyspnea
- Validated in dogs JACVIM January 2008
- <210 pmol/L – more likely respiratory disease
- >210 pmol/L – more likely cardiac disease
- Falsely elevated by increased creatinine
- Helpful in distinguishing cardiac from respiratory dyspnea when creatinine is not elevated