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Cardiology Case Challenges 2017 Mini Series

Session 3: Cardiac arrhythmia case challenges

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Canine and Feline Arrhythmia Case Challenges

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Case 1

- 7 year old MC Boxer 32 kg
- On usual 2 mile walk with owner
- Collapsed and lost consciousness
- Unconscious for only a few seconds
- Limp, flaccid during episode
- Restless and panting following episode but able to continue walk

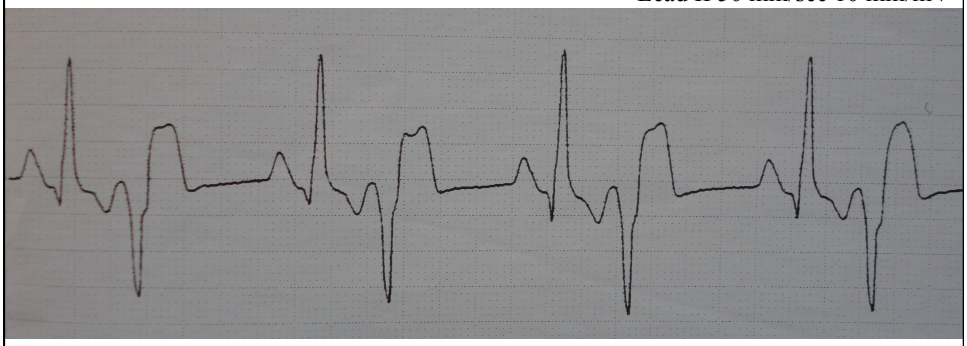
Physical examination (within 1 hour of collapse)

- Irregular heart rhythm
- No heart murmur audible
- Panting and anxious
- Clear lung sounds
- Mucous membranes pale pink
- CRT approx 2 seconds
- Irregular femoral pulse with pulse deficits

Question

What is your ECG diagnosis?

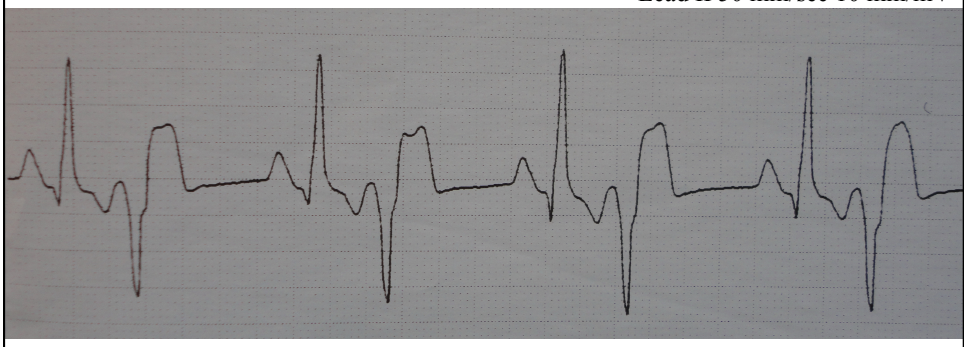
Lead II 50 mm/sec 10 mm/mV



1. Ventricular bigeminy – CORRECT ANSWER
2. Atrial bigeminy
3. Ventricular tachycardia
4. Atrial fibrillation

Ventricular bigeminy

Lead II 50 mm/sec 10 mm/mV



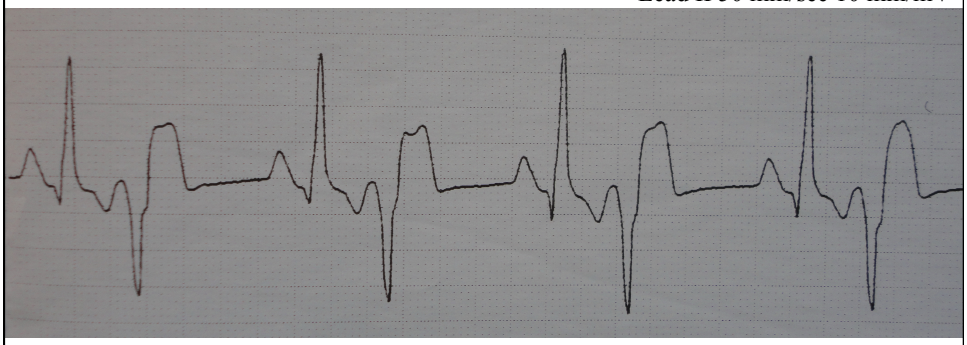
ECG Features:

- Ventricular premature complexes (VPCs) alternating with sinus complexes i.e. sinus, VPC, sinus, VPC etc.
- VPCs have wide, bizarre morphology
- No associated P wave, discordant T wave

Question

Would the arrhythmia documented on this ECG have caused the collapse?

Lead II 50 mm/sec 10 mm/mV



1. Yes
2. No – CORRECT ANSWER (not haemodynamically significant to affect cardiac output)

Question

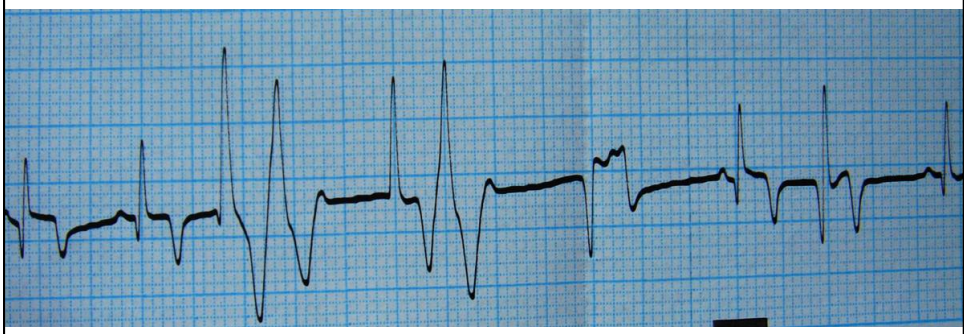
What is your ECG diagnosis?

Lead II 25 mm/sec 10 mm/mV

1. Couplets of atrial premature complexes – CORRECT
2. Atrial tachycardia
3. Couplets of ventricular premature complexes
4. Ventricular tachycardia

VPC couplets

Lead II 25 mm/sec 10 mm/mV



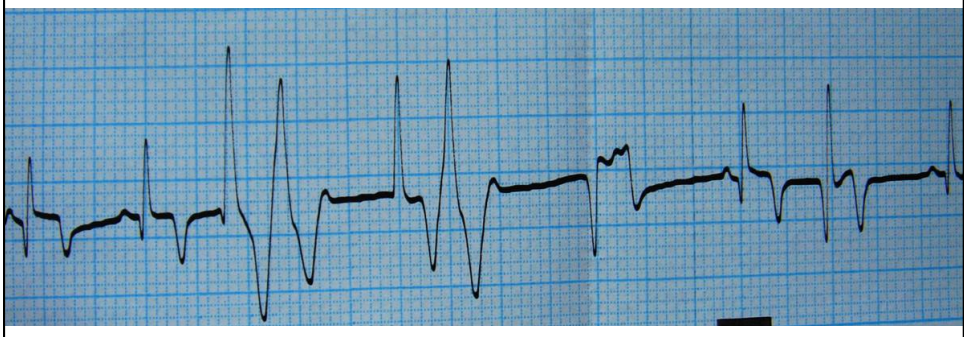
ECG Features:

- VPC couplets (2 examples shown above)
- Close coupled, but not quite R-on-T
- More concerning than single VPCs

Question

Would the arrhythmia documented on this ECG have caused the collapse?

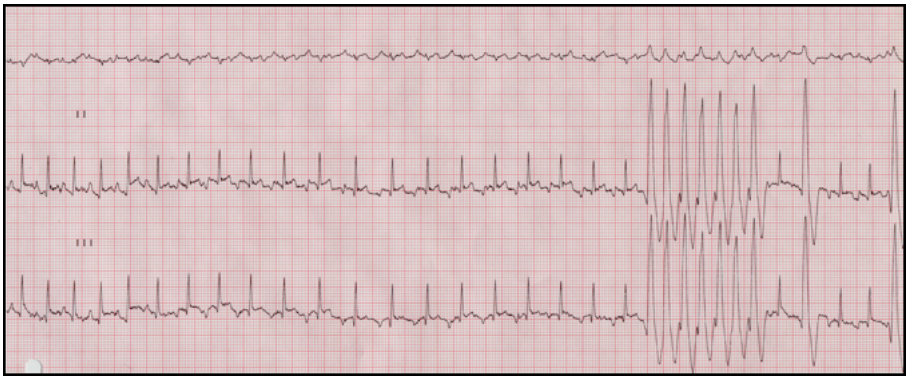
Lead II 25 mm/sec 10 mm/mV



1. Yes
2. No CORRECT ANSWER (not haemodynamically significant to affect cardiac output)

Question

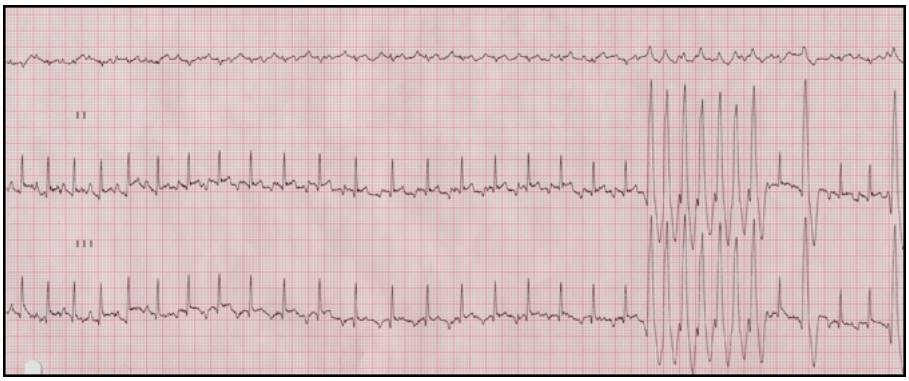
What is your ECG diagnosis?



Leads I, II, III 25 mm/sec 10 mm/mV

1. Atrial tachycardia
2. Ventricular tachycardia – CORRECT ANSWER
3. Atrial fibrillation
4. ECG artifact caused by limb movement

Ventricular tachycardia



Leads I, II, III 25 mm/sec 10 mm/mV

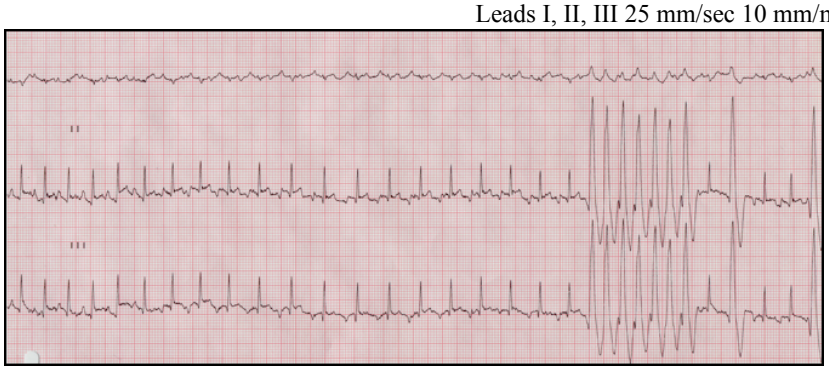
ECG Features:

- Short burst (paroxysm) of rapid VT, not sustained
- VT is defined as more than 3 VPCs occurring consecutively
- Some evidence of R-on-T phenomenon
- This is more concerning than couplets

Question

Would the arrhythmia documented on this ECG have caused the collapse?

Leads I, II, III 25 mm/sec 10 mm/mV



1. Yes
2. No CORRECT ANSWER (not haemodynamically significant to affect cardiac output)

Question

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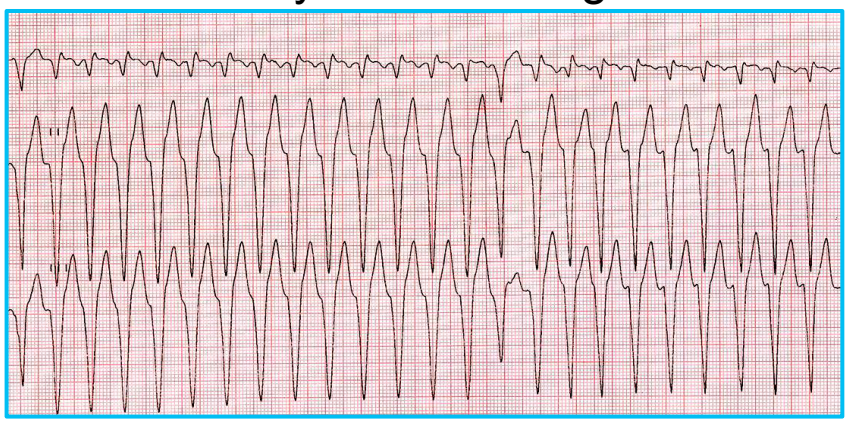
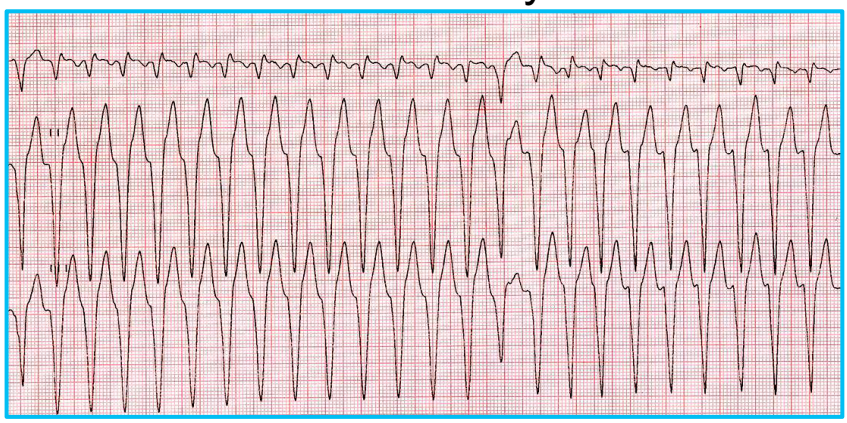


Leads I, II, III 50 mm/sec 10 mm/mV

1. Atrial tachycardia
2. Atrial fibrillation
3. Ventricular tachycardia – CORRECT ANSWER
4. Ventricular fibrillation

Ventricular tachycardia



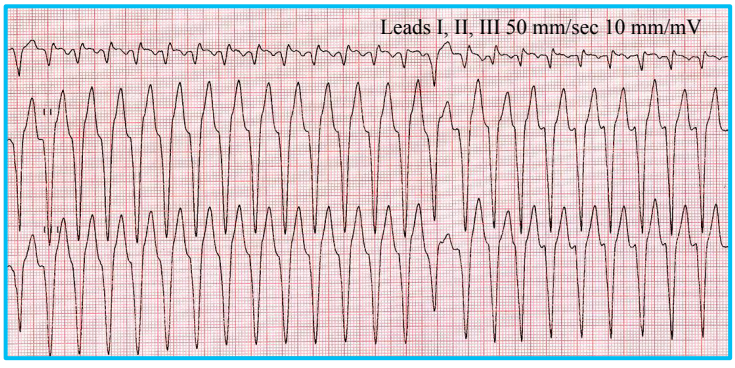
Leads I, II, III 50 mm/sec 10 mm/mV

ECG Features:

- Sustained run of rapid VT, no evidence of sinus rhythm on strip
- Not quite fast enough to display R-on-T phenomenon
- However, sustained VT like this in “at risk” breed is very concerning

Question

Would the arrhythmia documented on this ECG have caused the collapse?



1. Yes – CORRECT ANSWER (cardiac output will decrease dramatically with sustained rapid VT)
2. No

Ventricular tachycardia

Emergency Plan
- IV catheter placement
- IV bolus lignocaine
  - 2 mg/kg IV slow (up to total of 8 mg/kg i.e. 4 boluses)
- Followed by CRI of lignocaine
  - 25-80 mcg/kg/min

Once arrhythmias are stable:
- Wean off lignocaine
- If indicated, sotalol (class III oral antiarrhythmic)
  - 0.5 - 2 mg/kg PO q 12 hr

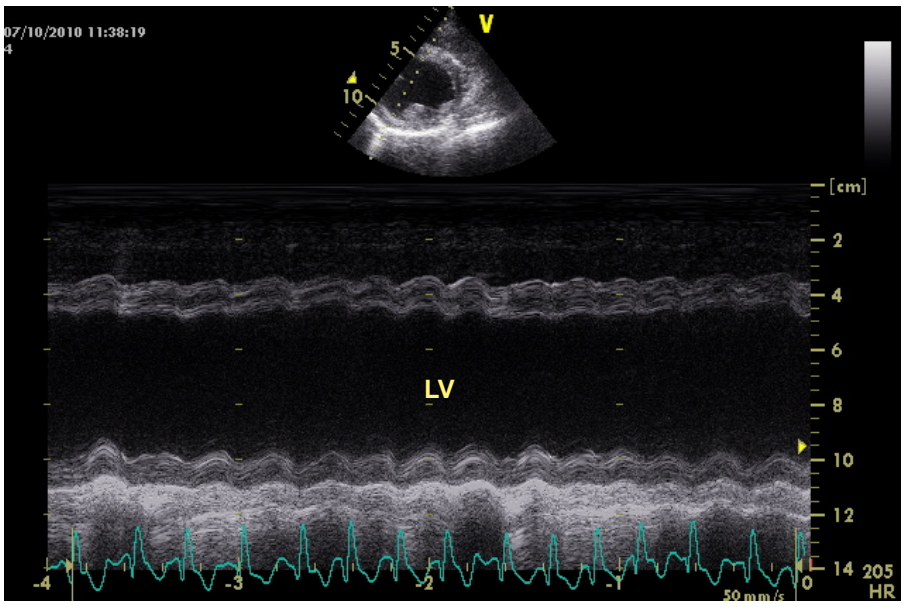
Boxer cardiomyopathy / ARVC

- Inherited form of myocardial disease
- Seems to be similar to Arrhythmogenic Right Ventricular Cardiomyopathy (ARVC) in humans
  - Fatty infiltration of myocardium (especially within RV) on histopath
- Characterised by ventricular tachyarrhythmias, resulting in exercise intolerance, collapse and sudden death

Boxer cardiomyopathy / ARVC

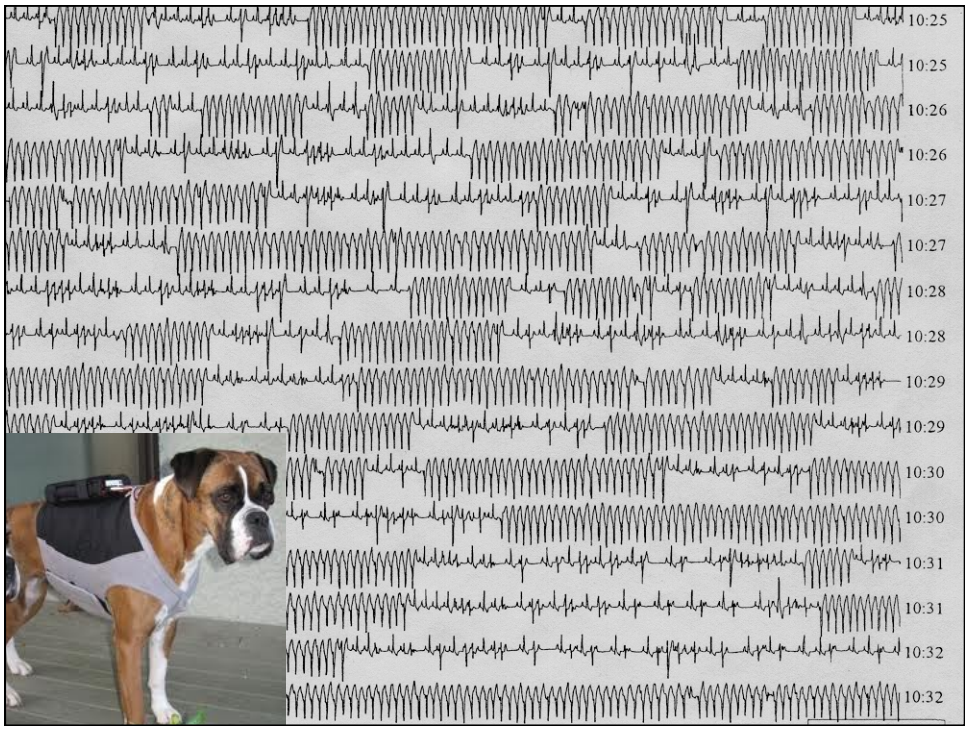
- In Europe, Boxer ARVC commonly associated with some degree of ventricular systolic dysfunction which may lead to CHF
  - In USA, arrhythmogenic form with normal echo is more common
- Variable prognosis
  - Sudden death
  - Death from CHF
  - Some dogs can be managed on antiarrhythmics (+/- intermittent collapse) for years

Echo M-mode: very poor LV systolic function



Holter monitoring

- Clinic ECG gives important information,
  - but may not give <u>enough</u> information
- Importance of Holter monitoring to ensure:
  - Complexity and frequency of arrhythmias over a 24 hour period are documented
  - Appropriate antiarrhythmic therapy is chosen:
    - Considering systolic function, presence of CHF etc
    - E.g. typical first-line ventricular antiarrhythmic for Boxers with ARVC is sotalol (class III), but this drug has beta-blocking properties
  - Chosen antiarrhythmic medication is efficacious initially and remains so over time



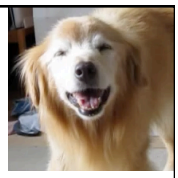
To treat or not to treat?

- Antiarrhythmic drugs can have serious side-effects (cardiac and systemic)
- They can be pro-arrhythmic
- Decision whether or not to treat is typically based on:
  - Haemodynamically significant arrhythmia decreasing cardiac output
  - the presence of clinical signs affecting QOL
  - or a high perceived risk of sudden cardiac death

To treat or not to treat?

- No antiarrhythmic medication can decrease the risk of sudden death by 100%
  - Important to inform owner of this
- Antiarrhythmic therapy requires close follow-up (eg. ECGs, Holter monitoring, blood levels etc)
- Dosage and medication type may need to be changed over time to optimise arrhythmia control

Case 2



- 12 year old FS Mixb 12 kg
- Brief episodes of seeming dazed, weak, stumbling (presyncope) increasing in frequency over past month and now occurring most days
- 2 episodes of syncope (< 20 seconds duration) observed over past 2 weeks
- Dog appears normal between episodes

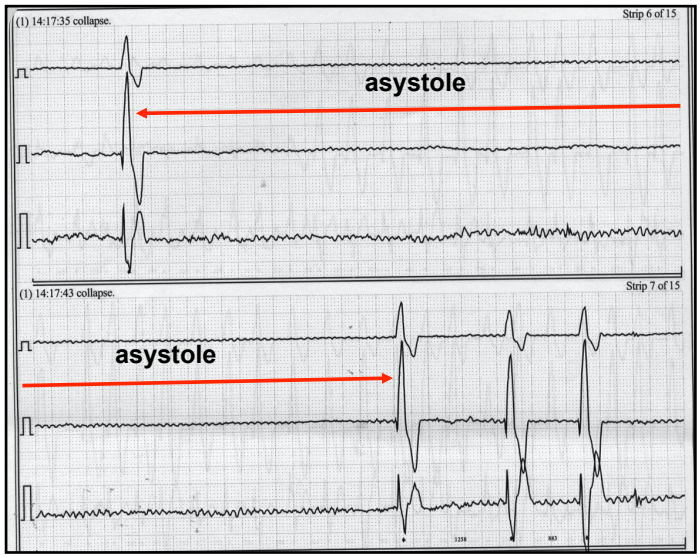
- Intermittently irregular heart rhythm
- Gr 1/6 left apical systolic murmur
- Otherwise normal PE

Presyncopal episodes

Additonal diagnostics

- Clinic ECG: unremarkable
- Thoracic radiographs: normal heart size and clear lung fields
- Bloodwork: Biochem, Haem, T4 normal
- Blood pressure: normal 130/70 mmHg
- Echo: mild MVD, small leak across mitral valve but no heart enlargement (stage B1 MVD)

Holter monitoring -10 secs of asystole!



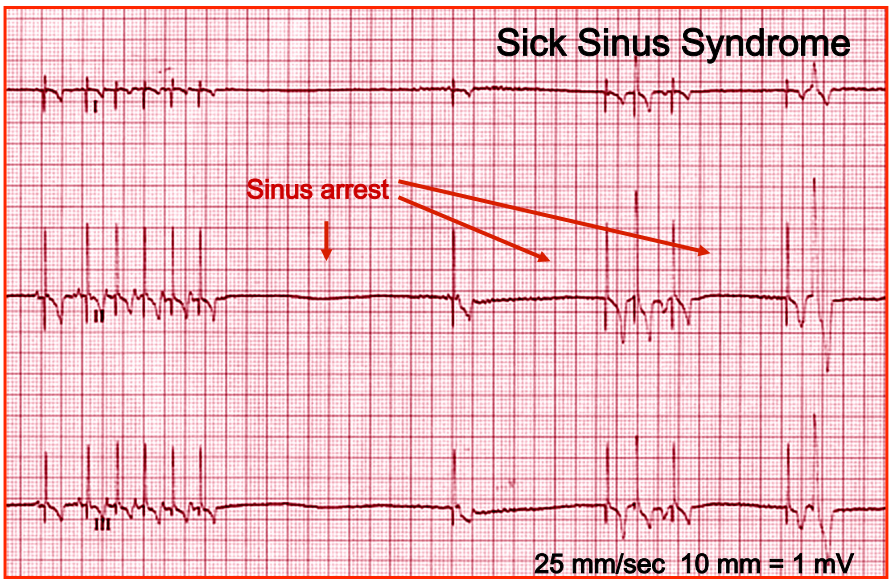
Sick Sinus Syndrome (SSS)

ECG Features:

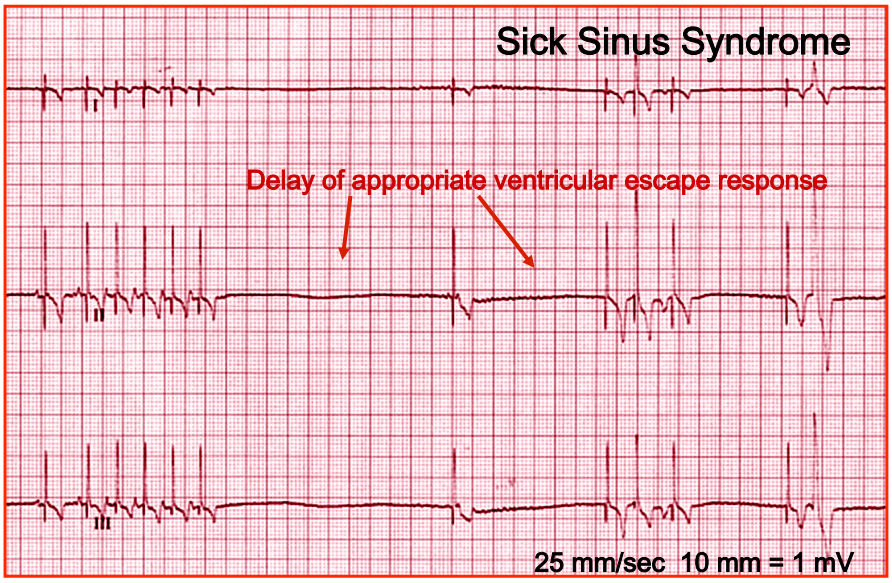
- Sinus arrest
- Non-physiologic sinus bradycardia
- Absence / delay of expected escape rhythms → ventricular asystole
- +/- atrial premature complexes (APCs)
- +/- runs of atrial tachycardia (AT)
- +/- postive response to atropine response test

- Typically seen in older dogs - fibrosis of cardiac conduction system associated with aging?

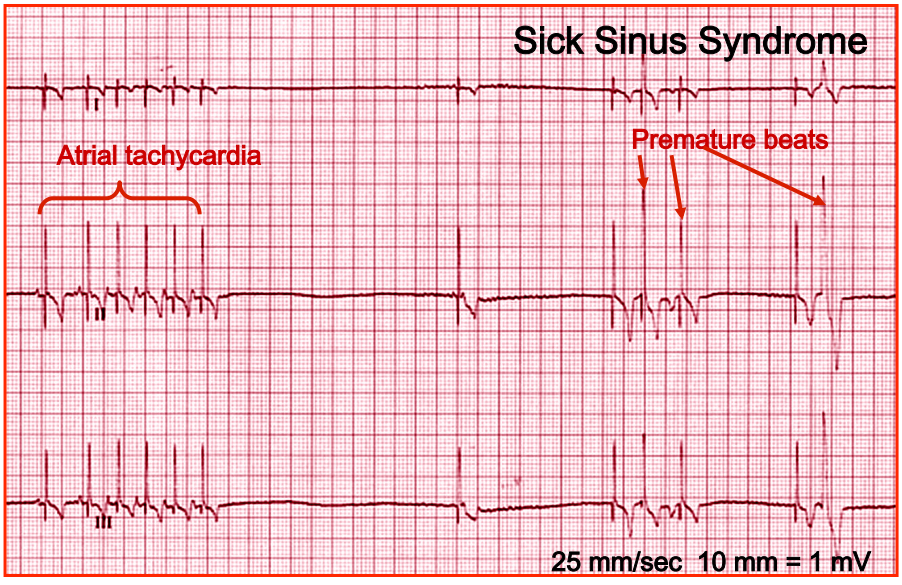
Sick Sinus Syndrome (SSS)



Sick Sinus Syndrome (SSS)

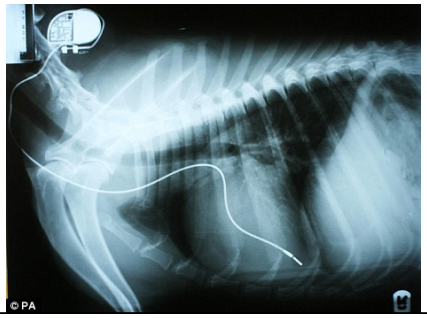


Sick Sinus Syndrome (SSS)



SSS prognosis and therapy

- If positive or partial atropine response, can try medical therapy with sympathomimetic drugs to increase HR (theophylline, terbutaline)
- No atropine response or no response to medical therapy, will need permanent pacemaker implantation
- Good prognosis with permanent pacing (as long as no significant concurrent structural heart disease)

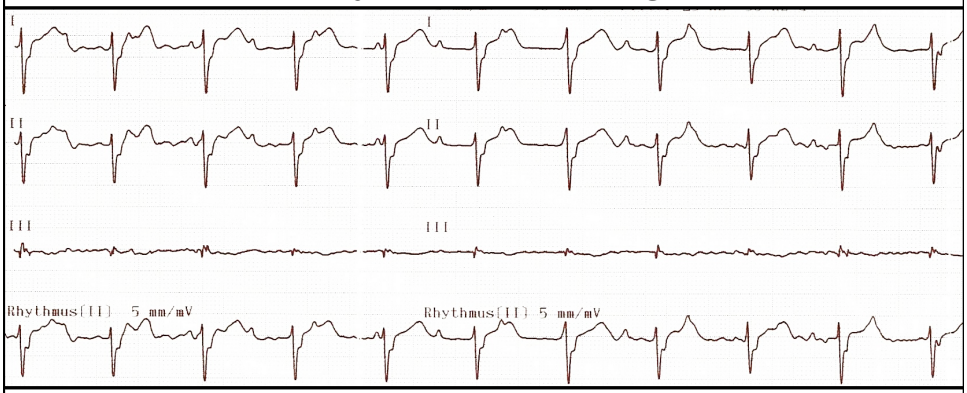


Case 3

- 8 year old neutered female DSH
- Owner has noticed cat is more lethargic over past few weeks, sleeps more
- Yesterday the cat fell off the arm of sofa when chased by other cat in household, seemed unconscious when landed on the floor for 10-20 seconds, flaccid and limp, then recovered consciousness and seemed back to normal after about 30 minutes
- Heart rate 140 bpm in clinic
- Regular rhythm
- No heart murmur

Question

What is your ECG diagnosis?

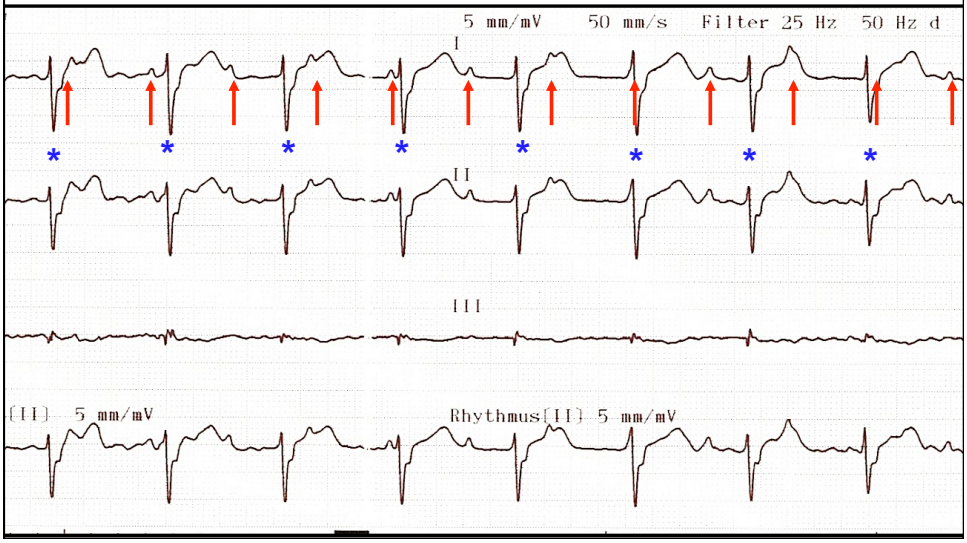


Leads I, II, III 50 mm/sec 5 mm/mV

1. Second degree AV block
2. Third degree (complete) AV block - CORRECT
3. Sinus bradycardia
4. Sinus arrest

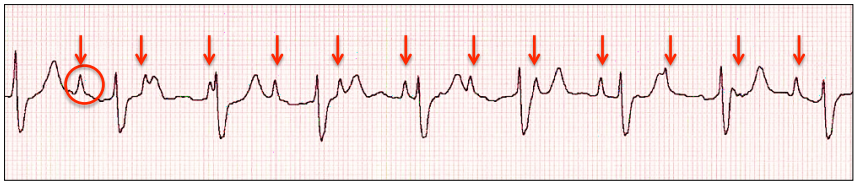
Complete (third degree) AV block

Red arrows point out P waves, blue asterisks point out QRS complexes



Third degree AV Block

Lead II 50 mm/s 10 mm/mV



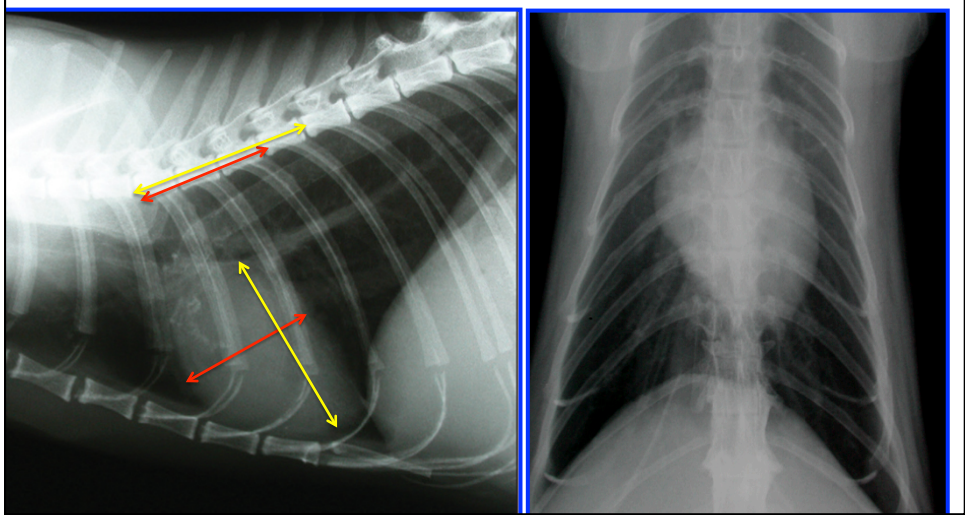
ECG characteristics:

- No association between the P waves and QRS complexes, therefore P-R interval varies
- P wave morphology appears normal
- Wide bizarre QRS complexes of ventricular origin (ventricular escape focus), firing at slow, regular rate

Other investigations

- Clinic ECG on presentation shows HR of 140 bpm, which is not typically slow enough to cause a cat to collapse or be syncopal unless concurrent significant cardiac or systemic disease
- Other investigations are necessary:
  - Thoracic radiographs
  - Bloods (biochem, haem, TT4)
  - Blood pressure
  - Echocardiography
  - Holter monitoring

Thoracic radiographs show clear lung fields and normal sized cardiac silhouette
(VHS = 7.2 (3.1 width + 4.1 length)
(N.B. normal feline VHS = 6.7-8.1 Ref: Lister AL. JAVMA 2000)



Other investigations

- Other investigations are necessary:
  - Thoracic radiographs - normal
  - Bloods (biochem, haem, TT4) - unremarkable
  - Blood pressure – normal

  What next??
  - Holter monitoring to further investigate the cat's arrhythmia
    - Is stable third degree block the whole story?
  - Echocardiography

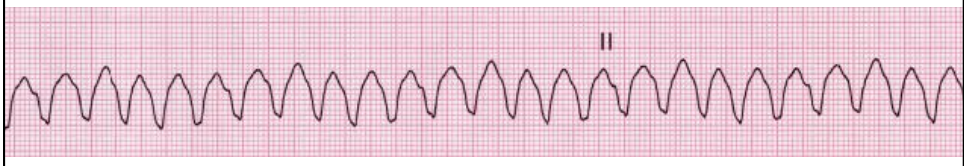
Question

What is your ECG diagnosis?

Lead II 50 mm/sec 10 mm/mV

1. Sinus tachycardia
2. Atrial tachycardia
3. Ventricular tachycardia – CORRECT ANSWER
4. Ventricular fibrillation

Ventricular tachycardia



Lead II 50 mm/sec 10 mm/mV

ECG Features:

- Sustained run of rapid VT (> 400 bpm)
- No evidence of sinus rhythm on strip
- R-on-T phenomenon

Question

Based on our findings so far, what is the likely cause for the syncopal episode in this cat?

1. Third degree AV block
2. Ventricular tachycardia – CORRECT ANSWER (cardiac output will decrease dramatically with sustained rapid VT)
3. Other cardiac arrhythmia or pathology as yet undiagnosed
4. Likely non-cardiac cause

Prognosis and therapy

- Emergency therapy
  - If VT is rapid and sustained and causing haemodynamic compromise, treat with IV lidocaine (caution in cats due to side effects) or IV esmolol (short acting beta blocker)
- Chronic oral therapy
  - Atenolol (bet blocker) or Sotalol (class III)
- Prognosis
  - Guarded as cause for VT has not been found – risk of sudden death
  - Echocardiography (if not done), abdominal ultrasound
  - Holter monitoring for follow-up

Case 4

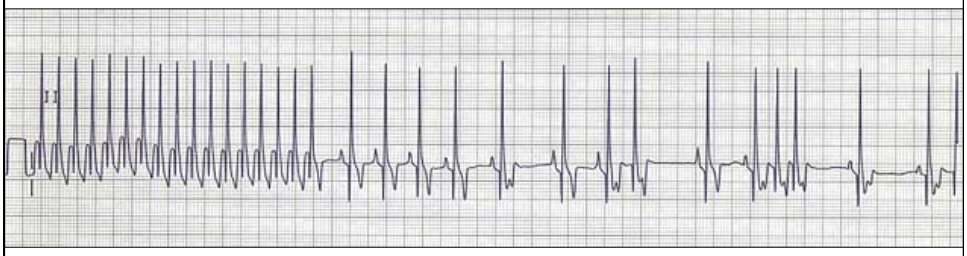
- 9 yo FS Mixbreed 16 kg
- On chronic treatment for advanced MVD and CHF
  - Furosemide, Pimo, ACE-I, Spiro
- Sleeping RR at home = 30-35 breaths / min
- Weakness and lethargy for the past week

Physical examination

- Gr V/VI left apical systolic murmur
- Irregular rhythm
  - Periods of “normal” heart rate interrupted by bursts of very rapid heart rate
- Weak pulses
- No dyspnoea
- Lung fields are clear

Question

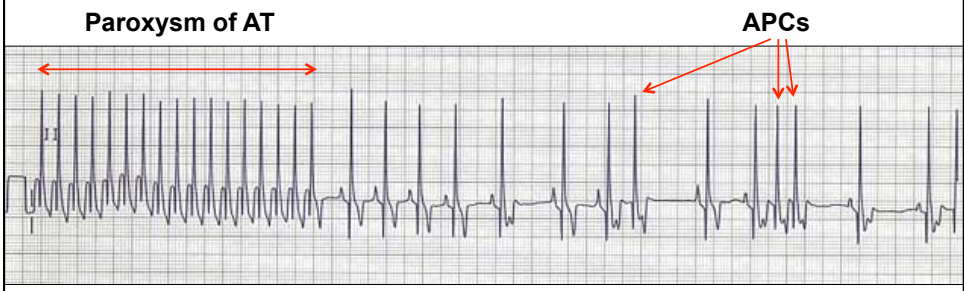
What is your ECG diagnosis?



Lead II 25 mm/sec 10 mm/mV

1. Atrial tachycardia – CORRECT ANSWER
2. Atrial fibrillation
3. Ventricular tachycardia
4. Sinus tachycardia

Atrial tachycardia (AT)

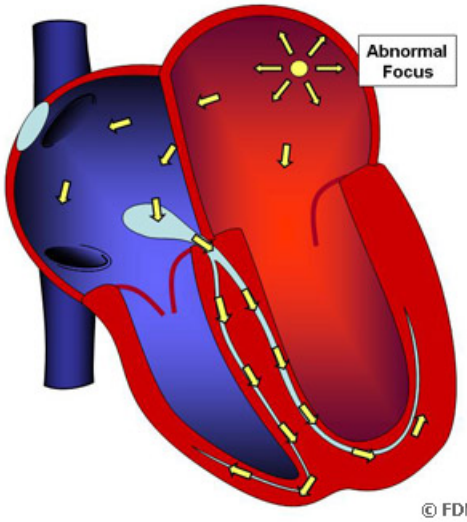


Lead II 25 mm/sec 10 mm/mV

ECG Features:

- Bursts (paroxysms) of regular rapid rhythm (300 bpm)
- Narrow complex tachycardia
- P' waves hidden in preceding T waves
- AT is defined as more than 3 APCs occurring in succession

What antiarrhythmic therapy is indicated?



As this is a supraventricular tachyarrhythmia, we need to slow conduction through the AV node, which will slow HR (i.e. the ventricular response)

What antiarrhythmic therapy is indicated?

- Diltiazem (calcium channel blocker)
  0.5 – 2 mg/kg PO q 8 hr
- Digoxin
  < 22kg: 0.005 - 0.008 mg/kg q 12 hr
  > 22 kg: 0.003 – 0.005 mg/kg q 12 hr
  or 0.22 mg/m^2 PO q 12 hr
- *Or* combination of Diltiazem and Digoxin

- Atenolol (beta blocker)
  0.2 – 1 mg/kg PO q 12-24 hr
  Caution if decreased ventricular systolic function and CHF!

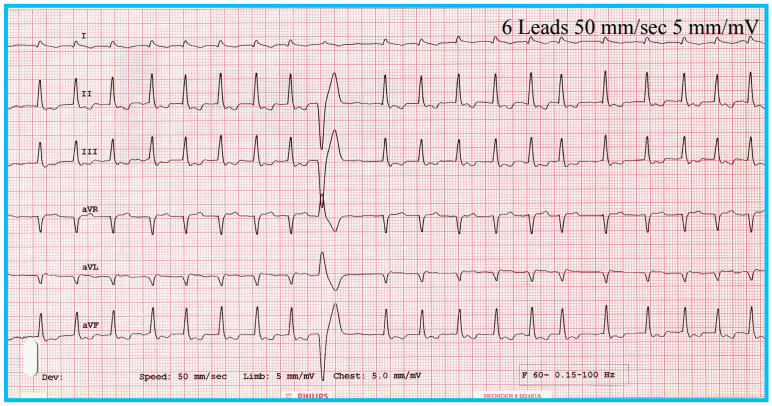
Case 5

- Great Dane 5 yo ME 65kg
- Panting and pacing all night
- Refused to eat breakfast
- No history of known heart disease

- New grade 2/6 systolic left apical heart murmur audible
- Irregularly irregular rapid heart rhythm
- Decreased pulse strength with frequent pulse deficits
- Constant panting

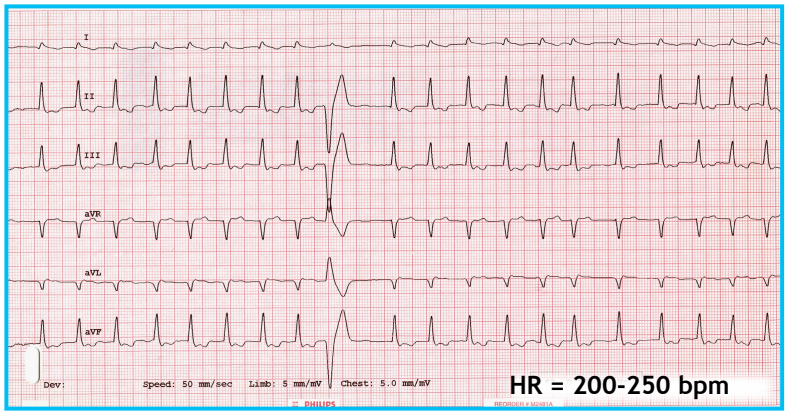
Question

What is your ECG diagnosis?



1. Atrial fibrillation with single VPC – CORRECT ANSWER
2. Sinus arrhythmia
3. Sinus rhythm with single VPC
4. Multifocal ventricular tachycardia

Atrial fibrillation with single VPC



- Irregularly irregular rhythm
- Normal narrow upright QRS complexes
- No P waves present
- Fibrillating baseline (“f waves”)

What next?

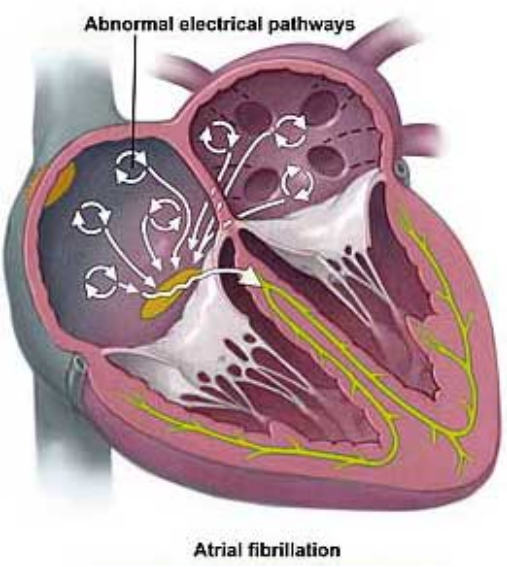
Plan

- Thoracic radiographs to confirm pulmonary oedema / CHF
- Echocardiogram to confirm and stage heart disease (DCM is most likely in this giant breed)
- Bloodwork to assess renal function / electrolytes as baseline

Treatment approach is 2 pronged:

1. CHF therapy
   - Furosemide, Pimobendan, ACE-I…
2. Antiarrhythmic therapy as HR too high

What antiarrhythmic therapy is indicated?



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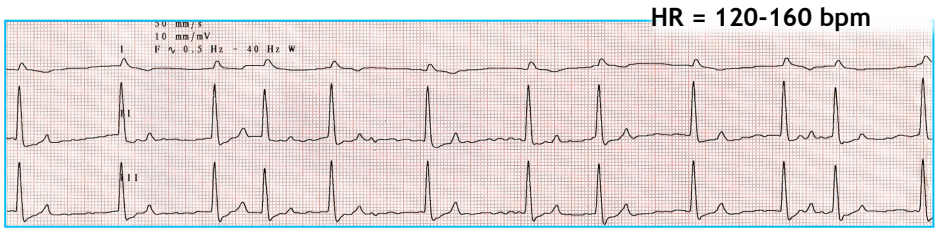
  or 0.22 mg/m^2 PO q 12 hr
- *Or* combination of Diltiazem and Digoxin

- Atenolol (beta blocker)
  0.2 – 1 mg/kg PO q 12-24 hr
  Caution if poor ventricular systolic function and CHF!

What next?

Plan for follow-up

- Recheck ECG and radiographs in 1 week
- Goal is to reduce HR (ventricular response rate to AF) to <140 bpm in hospital
- Once this is achieved, ideally follow-up with 24 hour Holter monitoring to assess HR variability over a full day (in home environment)

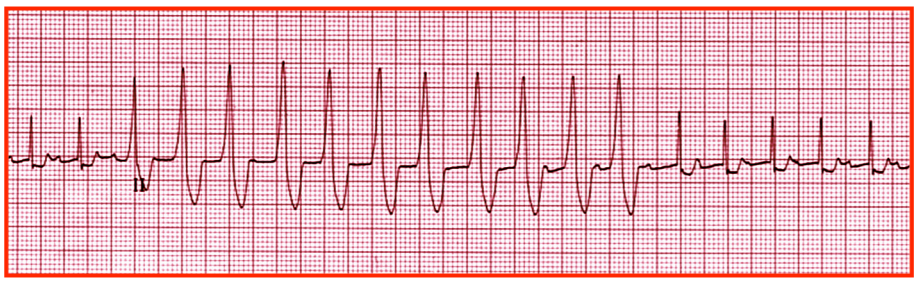


Case 6

- 10 yr old MN GSD 40 kg
- Acute collapse
- Abdominal swelling
- Pale mucus membranes
- Rapid irregular heart rhythm
- Thready pulses
- Suspect haemoabdomen

Question

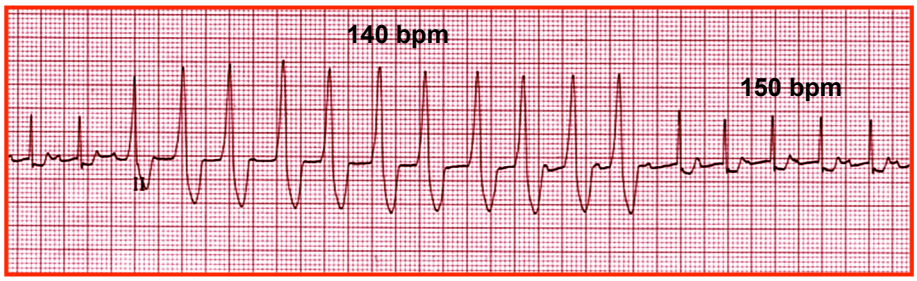
What is your ECG diagnosis?



Lead II 25 mm/sec 5 mm/mV

1. Ventricular tachycardia
2. Second degree AV block
3. Accelerated idioventricular rhythm – CORRECT ANSWER
4. Atrial tachycardia

Accelerated idioventricular rhythm (AIVR)

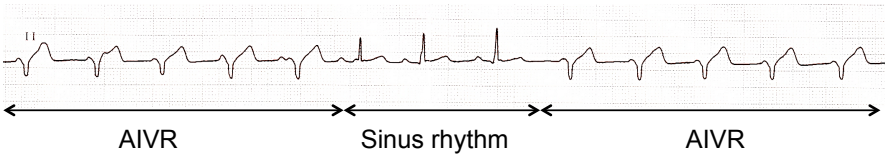


Lead II 25 mm/sec 10 mm/mV

ECG Features:

- Ventricular rhythm is regular and typically arises from a single focus (monomorphic) in the ventricles
- Ventricular rate is similar to underlying sinus rate, therefore they “compete” as sinus rate is affected by autonomic tone
- Typically AIVR rate < 160 bpm so not as fast as VT

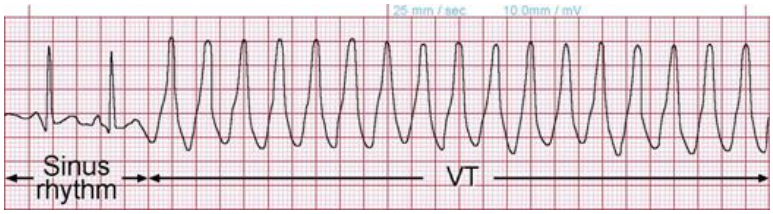
Accelerated idioventricular rhythm (AIVR)



Lead II 50 mm/sec 5 mm/mV

Compare with ventricular tachycardia (VT)…

(VT is faster than AIVR, definitions are based on heart rate)



Lead II 25 mm/sec 10 mm/mV

AIVR treatment and prognosis

- AIVR is frequently seen in animals with significant systemic disease (inflammation, infection, neoplasia etc)
- Cardiac structure and function can be normal
- AIVR will resolve when systemic disease resolves (e.g. removal of spleen and resolution of haemoabdomen)
- Only require antiarrhythmic treatment if AIVR is causing haemodyanmic compromise, but as rate is less than VT, usually just monitor – important to maintain hydration, BP, analgesia, temperature etc
- If AIVR accelerates and becomes VT (definition purely based on heart rate) then may require antiarrhythmic treatment

Questions?


"Don't worry, Mr. Smith...
I used to shear the sheep
on my parents' farm
when I was little..."