

Feline Cardiology Mini Series

Session Three: Refresher: Reading the Feline ECG & Case Studies: Managing the Chronic Patient

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Introduction

What is the ECG?

- The ECG is a recording from the body surface of the electrical activity occurring within the heart.
- If the patient is not relaxed (i.e. muscle tremors), electrical activity occurring within skeletal muscles will cause interference with the ECG signal.
- Body conformation and body size can affect the ECG.
 - The electrical signal recorded from the body surface will be damped (decreased) in obese animals compared with thin ones.
 - QRS complexes in cats are typically low amplitude compared with dogs.

Why record an ECG?

- Many canine and feline arrhythmias are hard to discern from auscultation, particularly when the patient presents in a critical state.
 - Auscultation may be difficult due to:
 - Fast heart rates
 - Muffled heart sounds
 - Extraneous noise (i.e. harsh lung sounds, panting, growling, purring).
- Arrhythmias are clinically important.
 - Arrhythmias can cause or exacerbate low cardiac output states.
 - You may not be able to resolve congestive heart failure signs without controlling concurrent arrhythmias.
 - Arrhythmias will contribute to myocardial ischaemia.
- ***The ECG is the only way to diagnose the actual arrhythmia.***
 - ****** Don't assume all rapid regular rates are sinus tachycardia. Sinus tachycardia cannot be differentiated from ventricular tachycardia by auscultation alone! ******
- But remember:
 - The ECG is not sensitive in detecting cardiac chamber enlargement (echocardiography and radiography are MUCH more sensitive).
 - The ECG provides no information about the ability of myocardium to contract.
 - The ECG provides no information about the heart valves or endocardium.

Clinical indications for recording an ECG

- “Quick” Lead II rhythm strip should be performed on all emergency patients.
- A diagnostic ECG should be performed in the following patients:
 - If you detect an arrhythmia on auscultation, or you detect pulse deficits.
 - COUNT the heart rate when auscultating your patient, as you will need the numbers later to judge efficacy of therapy.
 - Be alerted by patients with heart rates outside the normal range i.e. too high or too low
 - E.g. cats with heart rates <160 bpm when obviously ill/stressed. A cat presenting with CHF and bradycardia is not a good sign!
 - Try to always perform simultaneous auscultation and palpation of femoral pulse, as this will increase your chance of detecting pulse deficits.
 - If you detect a heart murmur.
 - Cardiomegaly on thoracic radiographs.
 - Collapsing or fainting patient.
 - Drug effects or toxicities (eg. digoxin toxicity).
 - Electrolyte disturbances (eg. hyperkalaemia caused by urethral obstruction, hyperadrenocorticism).
 - Systemic diseases (eg. thyrotoxicosis, sepsis).
 - During pericardiocentesis.
 - Monitoring (during anaesthesia, critical care eg. GDV, thoracic trauma, raised intracranial pressure)

Recording the ECG

Setting up the ECG machine

- It is important to know how to adjust paper speed and amplitude (sensitivity) to optimise the quality of the ECG recording, to aid the interpretation of arrhythmias and to make it easier to accurately measure ECG intervals.
- For patients with rapid heart rates (e.g. cats), run the ECG at 50 mm/sec to “spread out” the complexes and make it easier to interpret the rhythm
 - High heart rates may obscure the irregularity of the rhythm.
- For patients with small QRS complexes (e.g. cats, patients with pericardial or pleural effusion), increase the amplitude of the ECG to twice sensitivity (20 mm = 1 mV).
- For patients with large QRS complexes (eg. dogs with left ventricular enlargement, or patients with frequent wide bizarre ventricular ectopic complexes), decrease the amplitude of ECG to half sensitivity (5 mm = 1 mV).

Calculating heart rates from the ECG

- There are various methods that you can use:
 - ECG ruler is easiest
 - “Bic pen” method (only applies to Bic biros!)
 - The instantaneous heart rate method (only works if rhythm is regular)

Measuring ECG Amplitudes and Intervals

- PR interval
 - Conduction through the AV node
- QRS duration
 - Ventricular depolarisation - conduction speed through the ventricles
- QT interval
 - Time taken for ventricular depolarisation and repolarisation
- R wave amplitude
 - LV conduction

Choosing which leads to record

- 6 limb leads:
 - I, II, III, aVR, aVL, aVF
 - Arranged around Einthovens triangle
 - A 6 lead ECG is not necessary in an emergency!
A lead II rhythm strip will often be an adequate starting point.

Patient positioning and restraint

- Right lateral recumbency is the standard position if want to compare measured ECG intervals with published reference ranges.
- Standing or sternal recumbency may be preferable and safer in stressed or dyspnoeic patient (if only concerned with rhythm diagnosis).
- Non conductive surface to minimise ECG artefact.
- Patient should be comfortable to minimise struggling, which will produce artefact.
- Right arm of person restraining animal should rest over animal's neck.
- Left arm should rest over hindquarters.
- Legs should be kept parallel with each other but not touching.
- Forelimbs should be kept perpendicular to the long axis of the body.
- With calm, gentle handling, sedation is not usually necessary
- N.B. Anti-arrhythmic effect of some drugs (e.g. diazepam and ketamine hydrochloride)

- Use crocodile clips - quick and easy to apply:
 - RA to right foreleg
 - LA to left foreleg
 - LL to left hindleg
 - N (neutral / ground lead) to right hindleg.
- Correct clip position:
 - Just below elbows on each forelimb.
 - Just below stifles on each hindlimb.
- Flatten or file the jaws of crocodile clips to prevent skin pinching.
- Attach clips directly to skin.
- Moisten skin and electrode.
- Use commercial conductive gel or spirit (gel may be better tolerated by cats than spirit).

Identifying interference and artefacts

- Incorrect lead placement
 - If ECG complexes in Leads I, II, III and aVF are not predominantly positive, check that leads are attached to correct legs – if lead placement is correct, then an axis deviation is present.
 - E.g. with significant right ventricular enlargement (dilation or concentric hypertrophy), deep S waves may be present in leads I, II, III and aVF which will give the QRS complexes in these leads the appearance of having a predominantly negative polarity. This suspicion should be followed up with echocardiography or radiography to confirm this ECG finding.
- Lead dislodgement
- Muscle tremor
 - Make sure the patient is comfortable to minimise struggling
- Electrical interference
 - Turn off all electrical equipment in the room (e.g. fluid pumps, heat blankets)
- Breathing artefacts
 - Ensure no leads are resting on the chest, and that clips are attached to limbs at correct sites, away from torso.
- Purring
 - Tricks to stop cats purring (if only temporarily!) include turning the tap on, blowing gently on their nose, and passing a cotton wool ball soaked in spirit under their nose.