ECG: Heart rhythm during episodes of collapse in dogs

Collaps e is a common presenting sign in dogs and may be associated with dysrhythmias. This article contains electrocardiograms recorded from dogs during episodes of collapse using a non-invasive ambulatory electrocardiograph (Holter monitor). Dysrhythmias that can cause syncope in dogs are illustrated and followed by a brief discussion of treatment.

Key words: ECG, collapse, Holter monitor, ambulatory ECG, canine, tachyarrhythmia, bradyarrhythmia

Introduction

Intermittent collapse is a common problem in dogs and can be caused by a myriad of underlying conditions including cardiac, neurological, metabolic and endocrine diseases. The intermittent nature of clinical signs coupled with the broad differential diagnosis list can make these cases challenging. Additionally, collapse is understandably upsetting for owners as, especially with cardiac disease, the collapsing episodes may be sudden and dramatic in onset with the dog looking as though it may be dead for a short time.

The prognosis for these cases ranges from being favourable if the underlying issue is relatively benign, for example neurocardiogenic syncope but, conversely, there may be a risk of sudden death if structural heart disease such as arrhythmogenic right ventricular cardiomyopathy is present.

This article will illustrate some of the information that was obtained using an ambulatory electrocardiograph (Holter monitor) during the investigation of these cases and will also show examples of dysrhythmias that resulted in collapse in dogs.

Investigation of intermittent collapse

A key step is obtaining a careful history as this will help to guide further investigation depending on whether the events sound more typical of syncope, seizure or intermittent recumbency without loss of consciousness. A clinical approach to cases with suspected syncope is described in chapter three of the BSAVA Manual of Canine and Feline Cardiorespiratory Medicine.

In cases where an intermittent dysrhythmia is suspected, a 1–7 day ambulatory ECG can be invaluable for obtaining further information about heart rate and rhythm. A Holter monitor provides a non-invasive way of obtaining this information whilst the dog is at home performing normal daily activities. Figure 1A shows how a Holter monitor is attached to the dog using three adhesive electrodes – two on the left hemithorax are visible in the photo and there is one more on the right hemithorax. The monitor weighs about 150g, is approximately the same size and shape as a mobile phone and is positioned on the dog’s back. The dog wears a vest (see Figure 1B) which contains a pocket to hold the monitor for the duration of the recording and also to prevent the dog interfering with the leads that connect the monitor to the electrodes.
Clinical Refresher – ECGs

The electrocardiograph is a machine that measures electrical activity at the body surface and therefore will detect electrical currents flowing in cardiac tissue and also in muscle tissue. Hence it is important to have the patient as still as possible to prevent muscle movement interfering with the trace (Figure 2A).

Figure 2A: Baseline movement artefact caused by trembling

Figure 2B shows the schematic anatomy of the cardiac conduction system, with the atria at the top of the image and the ventricles in the lower half of the diagram:

If we consider lead II of a standard ECG tracing:
- The positive electrode is located on the left hindlimb (the lower right hand corner of figure 2B)
- The negative electrode is on the right forelimb (the upper left hand corner of figure 2B).

Sequence of events:
- A normal cardiac impulse starts with spontaneous depolarisation of the sinoatrial node which is then transmitted from cell to cell, resulting in movement of current from left to right across the atria in Figure 2B. 
- As this is towards the positive electrode, it results in a small positive deflection on the electrocardiogram (ECG) known as the P wave (Figure 2C).
- When this impulse reaches the atrioventricular node there is a slight delay in conduction which is physiologically useful as it gives the atria time to contract and fill the ventricles prior to ventricular contraction – this slight delay is the cause of the PQ interval on the ECG (Figure 2C).
- The wave of depolarisation is then carried via the Bundle of His and left and right bundle branches into the ventricles.
- The large mass of muscle tissue which depolarises from the atrioventricular node downwards creates a vector of current directed towards the positive electrode of lead II thereby creating a large positive deflection – the R wave. Repolarisation of the ventricle creates a small flow of current whose direction is variable therefore the T wave in dogs can be positive, negative or biphasic.

Figure 2C: Single lead of a normal dog ECG with labelling of the P-QRS-T components

The normal heart rhythms in dogs are sinus rhythm (a regular rhythm with the rate appropriate for the level of activity; Figure 2D) and also sinus arrhythmia where the heart rate is generally <140bpm and there are regular rhythmic fluctuations in the R-R interval associated with physiological fluctuation in vagal tone, for example associated with breathing (Figure 2E).

Figure 2D: Sinus rhythm