

Veterinary Medicine

Clinical Solutions for Companion-Animal Practitioners

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CVC Highlights: Essentials for interpreting ECGs in practice

ECG evaluation needn't be complicated. In fact, this specialist thinks that most practitioners should be running at least one a day—and a rhythm strip such as lead II is all you really need to assess heart rate and arrhythmias.

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Indications for electrocardiography include arrhythmias heard on auscultation, breathing problems, shock, fainting or seizures, cardiac murmurs, and systemic disease that affects the heart (e.g. tumors, kidney dysfunction, heartworm disease).

Electrocardiography is also useful as part of the preoperative work-up in older animals, for monitoring patients during and after surgery, and for evaluating the effects of cardiac drugs. An electrocardiogram (ECG) is the *only* test that can accurately diagnose an arrhythmia or a conduction abnormality. And an ECG will help you decide when other diagnostic tests should be done, including blood pressure measurement, thoracic radiography, or even echocardiography.

Perform electrocardiography on a periodic basis in breeds prone to arrhythmias, especially if clinical signs are present. These breeds include boxers (myocarditis), Doberman pinschers (ventricular arrhythmias and possible cardiomyopathy), German shepherds (congenital ventricular arrhythmias), and miniature schnauzers (sick sinus syndrome and sinus arrest/block).

ECG analysis: A systematic approach

Most veterinarians can interpret their own patients' ECGs by simply focusing on the heart rate and rhythm. The mean electrical axis and the size of the complexes can help identify heart chamber enlargement, but the best way to detect cardiac enlargement in animals is with a thoracic radiograph or an echocardiogram.

It is recommended that practitioners have two electrocardiography machines: an oscilloscope and an electrocardiograph. An oscilloscope is necessary for monitoring patients during surgery, and an electrocardiograph is needed for clinical diagnostic testing. The electrocardiograph linked with a strip recorder or printer provides a permanent record. The ECG can be recorded with the patient in a standing position, or you can use a hand-held unit with the patient in any position. New wireless technology (e.g. Vmed PC Vet—Vmed Technology, Inc.) also allows an ECG to be done without wires connected directly from an animal to the electrocardiograph.

Before examining an ECG, read the tracing before it is cut and mounted; it is important to study long strips of one lead (usually lead II) for an accurate analysis of heart rate and rhythm. Lead II is typically used for the analysis of heart rate and rhythm and for measuring complexes and intervals.

A systematic method for accurate electrocardiographic analysis of a rhythm strip (again, usually lead II) for arrhythmias includes the following steps:

Step 1. Generally inspect the rhythm strip.

First, determine whether the rhythm is normal sinus or is characteristic of a cardiac arrhythmia.

Next, assess whether the heart rate is rapid, slow, or normal. To easily calculate the heart rate (beats/min), count the number of beats (R-R intervals) between two sets of marks in the margin of the ECG paper (3 seconds at 50 mm/sec) and multiply by 20. ECG rulers are also available. This is all the measuring we need to do. Measuring the width and height of P-QRS-T complexes can also be done, but these measurements are not always accurate for a precise diagnosis of heart enlargement.

Step 2. Identify the P-waves.

Determine whether the atrial activity is regular and the P-wave shape uniform.

Step 3. Recognize the QRS complexes.

Evaluate the morphology, uniformity, and regularity of the QRS complexes.

Step 4. Evaluate the relationship between P-waves and QRS complexes.

To assess atrioventricular (AV) conduction, measure the P-R interval, which is the time from the onset of the P wave to the onset of the QRS complex. In patients with normal sinus rhythm, P-R intervals are constant. By evaluating the relationship between the P wave and the QRS complex, you can identify the dominant rhythm.

An abnormally long P-R interval may indicate an AV conduction delay or first-degree heart block. If a QRS complex doesn't follow a P-wave, second-degree heart block is present. A decreased P-R interval may occur with accessory conduction around the AV node.

Step 5. Summarize the findings and classify the arrhythmia.

What is the predominant rhythm? Is the arrhythmia an abnormality of impulse formation or impulse conduction or both? If either or both, what is the site of the abnormality?

To classify arrhythmias, you need to know two things:

1. The site of origin of the abnormal beat (*i.e.* the sinoatrial node, the atrial conduction tissue, the AV node-His bundle junction, or the ventricular conduction tissue [bundle branches and Purkinje fibers]).
2. Deviations from the normal rate of automaticity at that site (*i.e.* tachycardia, bradycardia, block, arrest).

Four types of arrhythmias can be identified on lead II by the following features:

Sinoatrial origin. Increased vagal tone results in sinus arrhythmia and sinus arrest. A lesion in the sinoatrial (SA) node can possibly result in SA block.

Atrial origin. These beats originate from somewhere in the atria other than the SA node. These atrial premature complexes look like a normally conducted beat except their timing is early. A big hint is that the P-wave of the atrial beat is superimposed on the T-wave of the beat before it. Atrial fibrillation (a rapid and irregular heart rate and no P-waves) usually indicates severe heart disease.

Junctional origin. These beats originate near the AV node and have a negative deflection P-wave, or no P-wave, with a normally conducted, short-duration QRS complex.

Ventricular origin. These beats originate somewhere in the ventricles. The QRS complexes are wide and bizarre-appearing and may have positive or negative polarity. Ventricular premature complexes and ventricular tachycardia are the result.

Attendees selected this highlight from CVC lectures. The original paper was published in the proceedings of the 2005 Central Veterinary Conference.