

THE VETERINARY TEAM MUST WORK TOGETHER TO DIFFERENTIATE SYNCOPE AND SEIZURES AND EFFECTIVELY DIAGNOSE AND MANAGE PATIENTS WITH CARDIAC ARRHYTHMIAS. CASE MANAGEMENT CAN INVOLVE BOTH INPATIENT AND OUTPATIENT TREATMENT.

# Ventricular Tachycardia

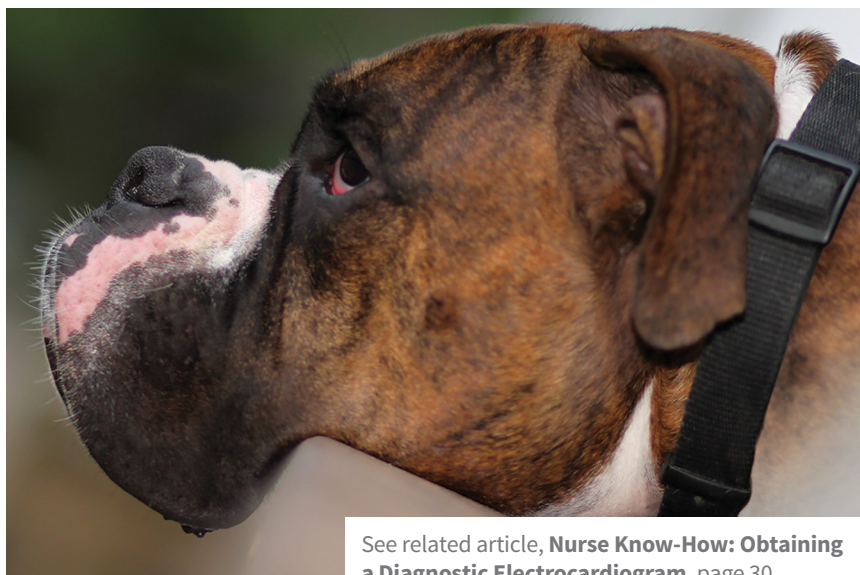
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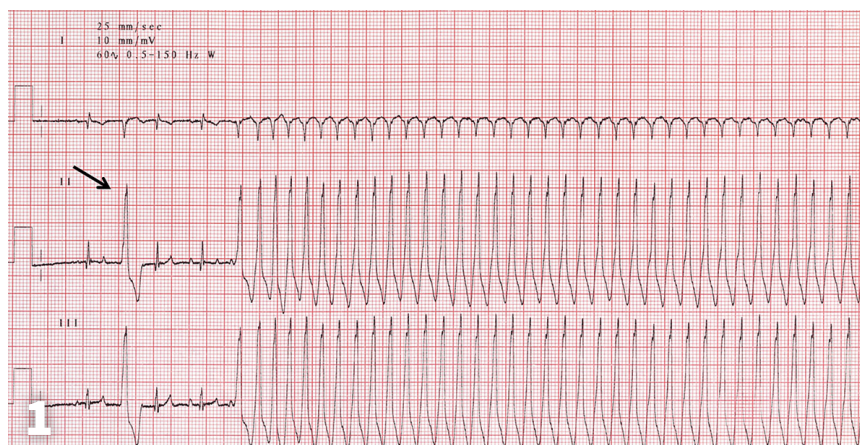
## Case Summary

Tyson, a 6-year-old neutered boxer dog, was presented for evaluation of 3 exercise-induced collapsing episodes over 2 hours. During each episode, Tyson appeared to briefly lose consciousness and then abruptly “woke up.”

On presentation, Tyson appeared depressed, had pale mucous membranes and a prolonged capillary refill time (3 seconds), and was tachycardic (300 bpm), with frequent femoral pulse deficits. No murmurs or abnormal lung sounds were heard on auscultation. An ECG revealed frequent ventricular premature complexes (VPCs) and periods of sustained ventricular tachycardia (VT). (See **Figure 1.**) Differentials for ventricular arrhythmias include primary cardiac disorders (congenital or acquired valvular heart disease, cardiomyopathies, myocarditis,



See related article, **Nurse Know-How: Obtaining a Diagnostic Electrocardiogram**, page 30.



A 3-lead ECG (paper speed, 25 mm/sec; sensitivity, 10 mm/mV) demonstrating a single VPC (arrow) followed by 2 sinus complexes, then an abrupt onset of rapid monomorphic ventricular tachycardia

infiltrative neoplasia), systemic disorders (electrolyte derangements, acid-base imbalances), and intra-abdominal disorders (hepatic/splenic disease, pheochromocytoma). Based on the signalment and morphology of the VPCs, Tyson was presumptively diagnosed with arrhythmogenic right ventricular cardiomyopathy (ARVC).

### Arrhythmogenic Right Ventricular Cardiomyopathy (ARVC)

- ARVC is a familial myocardial disease primarily of boxer dogs characterized by fatty or fibrofatty infiltration of the myocardium resulting in primarily ventricular arrhythmias.<sup>9</sup>
- Ventricular premature complexes typically have an upright QRS morphology in leads II, III, and aVF, indicative of an origination of ectopy from the right ventricular myocardium.<sup>10</sup>
- The prognosis is typically good, though sudden death is always possible even with therapy. Development of myocardial dysfunction and CHF warrants a guarded prognosis.<sup>11</sup>
- The true prevalence of ARVC in boxer dogs is unknown, though 1 study found increased ventricular ectopy in 25% of clinically normal adult boxers.<sup>12</sup>

## Treatment Plan

The primary differentials for acute collapse include syncope and seizures. A detailed history and thorough physical examination are imperative. Even with ancillary diagnostic testing, a definitive diagnosis is not always identified.<sup>1,2</sup> Syncope, a transient loss of consciousness and postural tone caused by decreased cerebral perfusion, is characterized by rapid onset, brief duration, and spontaneous recovery. Causes include both cardiac and noncardiac disorders. (See **Table 1**.)

Auscultatory findings of murmurs, gallops, muffled heart sounds, and arrhythmias can suggest underlying cardiac disease. If no obvious cause is apparent on physical examination, additional diagnostics (eg, CBC, chemistry panel, blood pressure, ECG, thoracic radiographs, echocardiogram) are warranted.

No studies have evaluated the effect of antiarrhythmics on long-term survival or risk reduction for sudden death. The decision to treat ventricular arrhythmias is often dependent on the presence of clinical signs and hemodynamic compromise, as well as the frequency of VPCs and the complexity of the arrhythmia. (See **Table 2**.) IV lidocaine is the preferred treatment for acute management of VT in hemodynamically unstable patients.

TABLE 1 Pathophysiologic Mechanisms for Syncope

Cardiovascular
Arrhythmias <ul style="list-style-type: none"> <li>■ Bradyarrhythmias</li> <li>■ Tachyarrhythmias</li> </ul>
Reduced myocardial contractility <ul style="list-style-type: none"> <li>■ Dilated cardiomyopathy</li> </ul>
Reduced cardiac filling <ul style="list-style-type: none"> <li>■ Pericardial effusion/tamponade</li> <li>■ Hypertrophic cardiomyopathy</li> </ul>
Obstruction to outflow <ul style="list-style-type: none"> <li>■ Valvular stenosis</li> <li>■ Heart base and intracardiac tumors</li> <li>■ Pulmonary hypertension</li> </ul>
Right-to-left cardiac shunts
Metabolic
Anemia
Hypoglycemia
Hypoxia
Electrolyte derangements
Reflexive
Situational syncope <ul style="list-style-type: none"> <li>■ Cough, micturition, defecation</li> </ul>
Vasovagal syncope

TABLE 2 | **Indications for Treatment of Ventricular Arrhythmias**

**Clinical Signs**

Exercise intolerance, fatigue, syncope

**No Clinical Signs (but ECG evidence of either):**

Increased frequency  
 ■ >1000 VPCs/24h

Increased complexity  
 ■ Multiform VPCs  
 ■ Couplets, triplets  
 ■ Ventricular tachycardia  
 ■ R-on-T phenomenon

ECG telemetry is essential for monitoring therapy response. Once VT has resolved, a constant rate infusion (CRI) of lidocaine is necessary because of its short half-life.

For chronic antiarrhythmic management, oral therapy with a  $\beta$ -adrenergic blocker, potassium channel blocker, and/or a sodium channel blocker can be considered. If systolic function is normal, the author prefers single agent therapy with sotalol, a potassium channel blocker with additive  $\beta$ -adrenergic blocking properties. If systolic dysfunction is present, then single agent therapy with a sodium

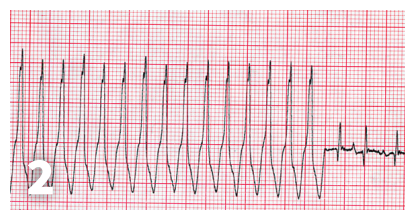
channel blocker such as mexilitine or procainamide is often chosen, as the negative inotropic effects of  $\beta$ -blockers can exacerbate myocardial failure.

When possible, pre-treatment Holter monitoring (ie, 24 hour ambulatory ECG) should be performed to further characterize the arrhythmias and guide therapy, with repeat Holter monitoring 2 to 4 weeks after initiating therapy. Given the high degree of day-to-day variation in the frequency of arrhythmias in boxers with ARVC, greater than 85% reduction in the frequency of ventricular ectopy is required to document efficacy of therapy. If single agent therapy is ineffective at reducing the complexity of arrhythmias or the frequency of VPCs by more than 85%, then additional antiarrhythmic therapy is warranted. Sotalol monotherapy and therapy with a combination of mexilitine with either sotalol or atenolol have all been shown to reduce the frequency of arrhythmias.<sup>3,4</sup> Supplementation with fish oils may also reduce the frequency of arrhythmias.<sup>5</sup> No studies have evaluated the effects of antiarrhythmics on long-term survival or risk reduction for sudden death; however, a recent retrospective study found no difference in survival when using either sotalol, mexilitine and atenolol, or procainamide therapy.<sup>6</sup> Periodic echocardiographic evaluation is also recommended for detection of myocardial dysfunction.

## Outcome

Tyson's VT resolved after he received a lidocaine bolus (2 mg/kg IV over 30 seconds). (See **Figure 2**.) A constant rate infusion (CRI) was subsequently initiated at 40 mcg/kg/min. A proportion of boxers may present with or eventually develop myocardial dysfunction, which may resemble dilated cardiomyopathy and can result in CHF and shorter survival times.<sup>7,8,11</sup> Tyson's echocardiogram revealed no structural abnormalities and his systolic function was normal. Therapy with sotalol at 2 mg/kg PO twice a day was initiated. After 24 hours, the lidocaine CRI was discontinued with no recurrence of ventricular ectopy and Tyson was discharged.

Holter monitoring 3 weeks later revealed only infrequent VPCs. Tyson's arrhythmias appeared adequately controlled and he remains free of clinical signs 3 years post-diagnosis.



A lead II ECG (paper speed, 25 mm/sec; sensitivity, 10 mm/mV) demonstrating conversion of ventricular tachycardia to a sinus rhythm after 2 mg/kg of lidocaine was administered IV

# The Role of Veterinary Nurses in Case Management of Cardiac Arrhythmia

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In small animal practice, the veterinary nurse plays an important role in the case management of a cardiac arrhythmia patient and should be involved in several key steps during the diagnostic and treatment processes.

**1** The veterinary nurse should make initial contact with the patient while triaging and obtaining temperature, pulse, and respiration (TPR) and collecting patient history. The client may indicate that the patient is fainting or collapsing, or has had a seizure. Distinguishing between seizure and syncope can be challenging. Important historical information can be obtained by asking questions like these:

- *How often do the events occur and how long do they last?*

- *Are they associated with exercise or activity (eg, excitement when the client arrives home)?*
- *Does the pet take any medication?*
- *Was there any possible exposure to toxins?*
- *Were the muscles rigid or relaxed during the event?*
- *Did the patient seem confused before or after the event?*

A video of the event made by the client is helpful for the veterinarian to make the diagnosis. A seizure diagnosis is generally made after ruling out syncope.

**2** Once a diagnosis of VT is suspected, the veterinary nurse may assist with diagnostics, including:

- Recording a diagnostic quality 6-lead ECG with the patient in right lateral recumbency. It should include a short strip of leads I, II, III, aVL, aVR, aVF; a strip of lead II recorded at a paper speed of 50 mm/sec; and a long strip of lead II recorded at 25 or 50 mm/sec. The patient's heart rate dictates the appropriate paper speed to easily characterize the ECG complexes.
- Restraining the patient during an echocardiogram.
- Measuring non-invasive blood pressure (BP) that will be used to determine the hemodynamic significance of any arrhythmia. A veterinary nurse skilled in either Doppler or oscillometric BP measurement is needed. An

appropriate BP cuff will be  $\approx 40\%$  as wide as the circumference of the limb to which it is attached.<sup>13</sup>

- Placing an intravenous (IV) catheter. The importance of good vascular access cannot be over-emphasized. The IV catheter will be used to deliver intravenous therapy for the arrhythmia and is often placed at the initial suspicion of VT. "The biggest catheter you can get in" rule does *not* necessarily apply. It is unlikely the patient will need large boluses of fluids quickly. It is more important to have a well-placed, secure catheter that will remain patent for 2 to 3 days.

**3** Continuous ECG monitoring is required for these patients. Any ECG system can be employed, but an ambulatory telemetry system is ideal. Electrodes can be placed on the trunk to allow for normal postural movements. The veterinary nurse can place the white (RA) electrode on the patient's right thorax cranial to the heart in the axilla or the thoracic inlet, and the black (LA) and red (LL) electrodes on the patient's left thorax caudal to the heart. Both electrodes can be placed in close proximity, provided both are caudal to the apical impulse, similarly to the base-apex lead used in large animals. With the ECG monitor set to display lead I or lead II, this will provide essentially a lead II ECG appropriate for identification of arrhythmia. A light bandage can be placed over the thorax to prevent electrodes and wires entangling.

# Client Communication

Clients may call the practice to ask the veterinary nurses questions about their dog's prescribed oral medications. Below are key points about the most common antiarrhythmic drugs (ie, sotalol, mexilitine, atenolol):

- Sotalol and atenolol are  $\beta$ -adrenergic receptor blockers ( $\beta$ -blockers); sotalol also can delay myocardial repolarization. These drugs may cause the dog to be less active and experience hypotension. To limit adverse effects, the dosage of these drugs can be gradually increased over several weeks.
- Mexilitine is similar to lidocaine but is active in an oral form and may cause nausea or vomiting. This drug should be given with a meal, and is typically administered 3 times a day.

Clients should contact a veterinarian if patients experience any adverse effects.

Clients may also call to ask what constitutes an emergency in their pet. An emergency visit is always warranted if syncope events increase in frequency or duration, or new signs develop relating to underlying structural heart disease (ie, cough, increased respiratory rate, loss of appetite, exercise intolerance, distended abdomen).

## Grief Support

Despite therapy, patients with arrhythmia may be at increased risk for sudden death or, if structural heart disease is also present, developing chronic heart failure (CHF). The practice team, including veterinary nurses, should be familiar with grief counseling options and able to share resources with owners who have lost or are facing the loss of their pet. The Association for Pet Loss and Bereavement website ([aplb.org](http://aplb.org)) is a valuable resource. ■

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## TEAM TAKEAWAYS:

**Veterinarians:** Prompt assessment and aggressive treatment for hemodynamically unstable dogs with ventricular tachycardia is necessary, yet most patients will respond favorably to antiarrhythmic therapy.

**Nursing Team:** Veterinary nurses should be skilled at several key steps in the diagnostic and treatment process of a cardiac arrhythmia patient to allow the veterinarian to talk with the client while ECG, BP, and IV catheter procedures are in progress.

**Client Care Team:** Grief counseling or triage may be necessary in the event of a patient emergency situation or sudden death, and the team should have resources available to help the client.