

Prevalence of cardiac arrhythmias and conduction disturbances in dogs and cats in Botucatu, Brazil (2003-2007)

Prevalência das arritmias cardíacas e distúrbios de condução em cães e gatos em Botucatu, Brasil (2003-2007)

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Abstract

Cardiac arrhythmias are important electrocardiographic disorders in small animal medicine since some of them can cause serious situations, such as cardiac arrest and death. It's essential to recognize ECG abnormalities and the frequency they occur to improve the therapy. The aim of this study was to determine the prevalence of cardiac arrhythmias in dogs from January 2003 to April 2007 by retrospective analysis of ECGs obtained at the Veterinary Hospital at UNESP – Botucatu – SP. The most common rhythm disturbances in this population were sinus tachycardia and ventricular premature complexes in dogs and sinoventricular rhythm in cats.

Keywords: Eletrocardiography. Rhythm disturbances. Dogs. Cats. Arrhythmias.

Resumo

As arritmias cardíacas são anormalidades eletrocardiográficas de importância na clínica de pequenos animais, visto que algumas delas podem ocasionar situações graves, podendo desencadear parada cardíaca e morte. Para uma melhor conduta terapêutica, torna-se indispensável o reconhecimento dessas alterações e da frequência com que elas ocorrem. Este estudo teve como objetivo determinar a prevalência das arritmias cardíacas em cães e gatos no período de janeiro de 2003 a abril de 2007, por meio da avaliação retrospectiva dos exames eletrocardiográficos registrados neste período no Hospital Veterinário da UNESP – Botucatu - SP. Na população estudada, os distúrbios de ritmo mais comuns foram a taquicardia sinusal e complexos ventriculares prematuros em cães e ritmo sinoventricular em gatos.

Palavras-chave: Eletrocardiografia. Distúrbios do ritmo. Cães. Gatos. Arritmias.

Introduction

Cardiac arrhythmia is defined as a disturbance in heart rate or rhythm, as well as abnormalities of impulse formation and impulse conduction (either alone or in combination)^{1,2}. Impulse conduction may or may not change heart rhythm. The electrocardiogram (ECG) is essential for diagnosing most cardiac arrhythmias and conduction disturbances and it can be used to aid cardiac evaluation to establish a cause, an anatomic and physiologic diagnosis and a prognosis. Also, it is recommended preoperatively in older animals³.

In 1960, Patterson et al.⁴ showed that among 3000 dogs which were brought to one veterinary clinic dur-

ing 18 months, 124 had disturbances of rhythm and 15 different arrhythmias were detected. Larsson and Schwartz⁵ observed 106 cases of cardiac arrhythmias among 533 dogs with cardiac disease. Schwartz et al.⁶ analyzed 353 ECGs of dogs and showed 27 different

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combinations of rhythms. In 1996, 700 healthy dogs were submitted to ECG evaluation and 49 of them showed electrocardiographic abnormalities⁷.

The objective of this study was to assess the type and frequency of cardiac arrhythmias and conduction disturbances occurring spontaneously in dogs and cats brought to a Veterinary Teaching Hospital in a period of 52 months, without considering the underlying disease process.

Material and Method

A total of 1426 electrocardiogram tracings of dogs and cats performed in the Veterinary Hospital at the School of Veterinary Medicine and Animal Science at São Paulo State University, Botucatu - SP from January/2003 until April/2007 were retrospectively analyzed. Tracings were printed for interpretation from previously recorded ECGs from a commercially available computerized ECG analyzer and software program (ECG-PC TEB®, Brazil). All animals had been positioned in right lateral recumbency with standard ECG leads on the limbs in agreement with Tilley's³ recommendation. Breed, age and gender were not considered, as some ECGs did not have the complete identification.

The heart rate, rhythm, mean electrical axis, QRS complexes and PR intervals duration and the relationship between P waves and QRS complexes were determined in order to classify the rhythm or conduction disturbance. Measurements of QT interval, alterations in ST segment and T wave were not considered in this study.

All ECGs of dogs and cats were analyzed, regardless of the primary disease presented by the animal. Only the first electrocardiographic exam was used for animals that had more than one ECG tracing. ECGs showing many artifacts that affected the analysis were excluded, as well as ECGs without any animal identification information were not used. ECG tracings were accessed by each of three authors separately and the

results were compared and discussed. The results were submitted to descriptive statistical analysis.

Results

There was not disagreement between ECGs interpretation by the authors. A total of 1,426 ECGs were evaluated and 1,368 (96%) were from dogs and 58 (4%) were from cats. A total of 24 different arrhythmias were recorded in dogs whereas nine types of arrhythmias were observed in cats. Thirty-eight (2.7%) animals of this study showed combined electrocardiographic abnormalities in the same tracing. Examples of the arrhythmias observed in dogs and cats are shown in figure 1.

Among dogs, 380 (27.8%) were presented with some arrhythmia (Figure 2). Abnormalities of impulse formation were observed in 148 (38.9%) dogs (Figure 3): atrial bigeminy (1/380; 0.3%), accelerated idioventricular rhythm (1/380; 0.3%), ventricular trigeminy (1/380; 0.3%), junctional tachycardia (3/380; 0.8%), junctional escape rhythm (4/380; 1.1%), ventricular bigeminy (6/380; 1.6%), continuous supraventricular tachycardia (6/380; 1.6%), continuous ventricular tachycardia (6/380; 1.6%), intermittent ventricular tachycardia (6/380; 1.6%), intermittent supraventricular tachycardia (12/380; 3.2%), atrial premature complexes (13/380; 3.5%), atrial fibrillation (17/380; 4.5%) and ventricular premature complexes (72/380; 19.3%) (Figure 4).

Abnormalities of impulse conduction were presented by 116 (30.5%) dogs (Figure 3): left bundle branch block (2/380; 0.5%), third-degree atrioventricular block (3/380; 0.8%), right bundle branch block (3/380; 0.8%), sinoventricular rhythm (4/380; 1.1%), left anterior fascicular block (7/380; 1.9%), second-degree atrioventricular block (12/380; 3.2%), first-degree atrioventricular block (29/380; 7.8%) and sinoatrial block/sinus arrest (56/380; 15%) (Figure 5).

A total of 109 (28.7%) dogs had heart rate disturbances: sinus bradycardia (11/380; 2.9%) and sinus tachycar-

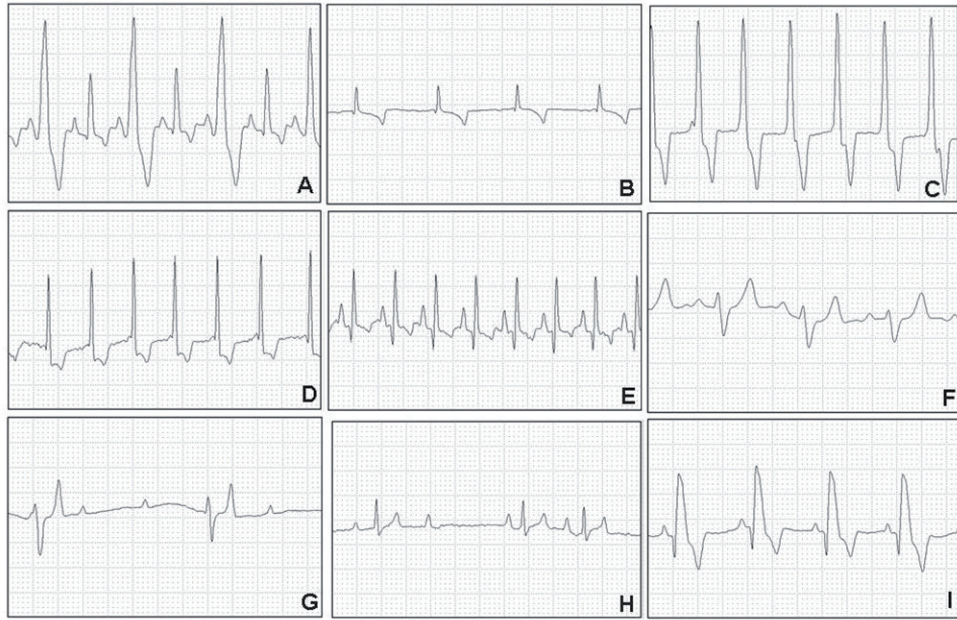


Figure 1 – Examples of some cardiac arrhythmias found in this study in dogs and cats. Legend: A) Ventricular Bigeminy (dog). B) Sinoventricular rhythm (cat). C) Ventricular tachycardia (cat). D) Atrial Fibrillation (dog). E) Supraventricular tachycardia (dog). F) Right bundle branch block (cat). G) Idioventricular rhythm (dog). H) Second-degree atrioventricular block (dog). I) Left bundle branch block (dog)

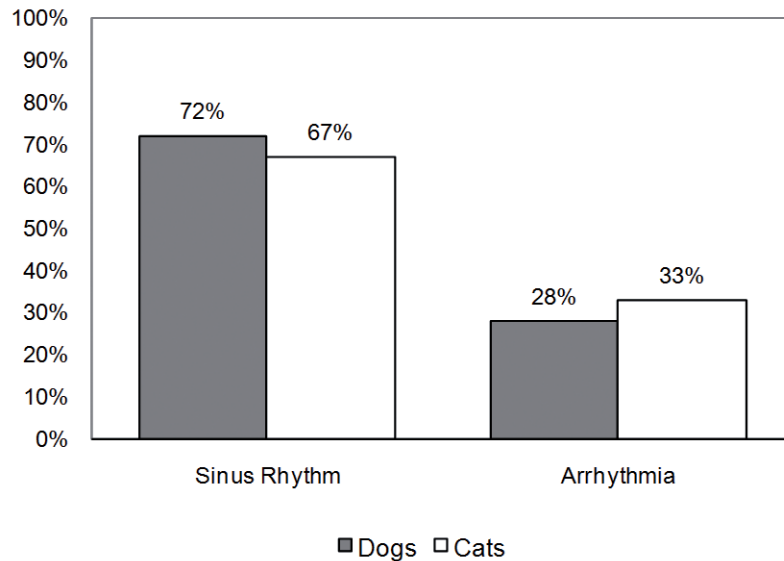


Figure 2 – Cardiac rhythms frequency in dogs and cats

dia (98/380; 26.2%) (Figure 3). Also, seven dogs (1.8%) showed simultaneous formation and conduction abnormalities (Figure 3). Only one dog (1/380; 0.3%) showed a complex disorder (pre-excitation syndrome).

Eighteen cats (33.3%) showed some arrhythmia (Figure 2). Abnormalities of impulse conduction were presented by 13/18 (72%) cats: left anterior fascicular block (1/18; 5.6%), sinoatrial block/sinus arrest

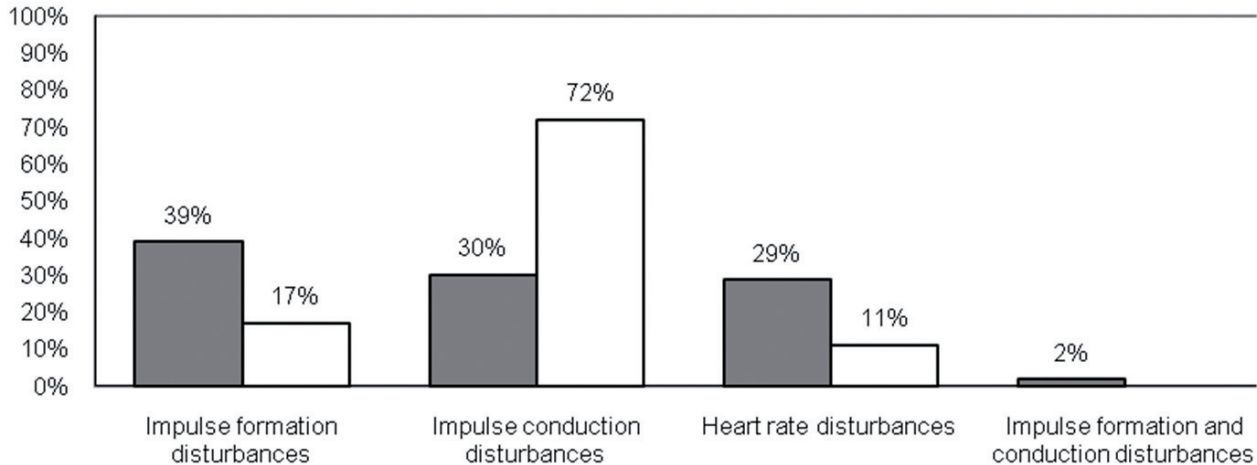


Figure 3 – Frequency of abnormalities of impulse formation and/or conduction and disturbances of heart rate in dogs and cats

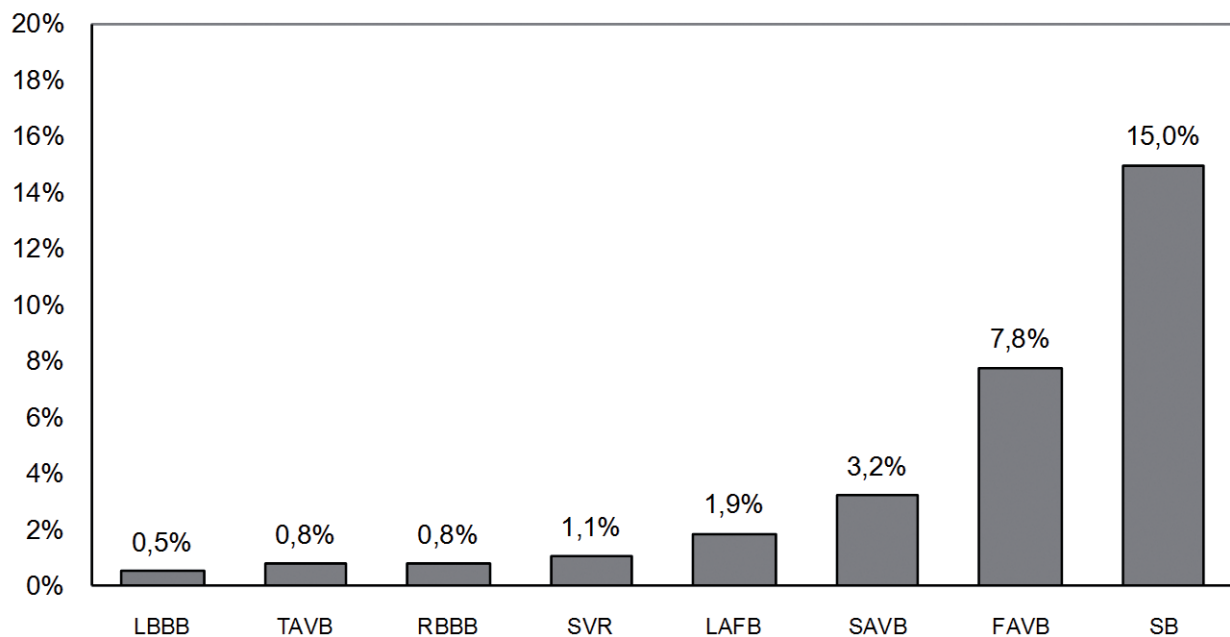


Figure 4 – Frequency of arrhythmias as a result of impulse conduction abnormalities in dogs. Legend: LBBB - Left bundle branch block. TAVB - Third-degree atrioventricular block. RBBB - Right bundle branch block. SVR - Sinoventricular rhythm. LAFB - Left anterior fascicular block. SAVB - Second-degree atrioventricular block. FAVB - First-degree atrioventricular block. SB - Sinoatrial block/sinus arrest

(1/18; 5.6%), right bundle branch block (4/18; 22.2%) and sinoventricular rhythm (7/18, 38.9%) (Figure 6). Three (16.7%) of them had abnormalities of impulse formation: continuous atrial tachycardia (1/18; 5.6%),

continuous ventricular tachycardia (1/18; 5.6%) and intermittent ventricular tachycardia (1/18; 5.6%) (Figure 6). In relation to heart rate disturbances, only two (2/18; 11%) cats showed sinus tachycardia (Figure 6).

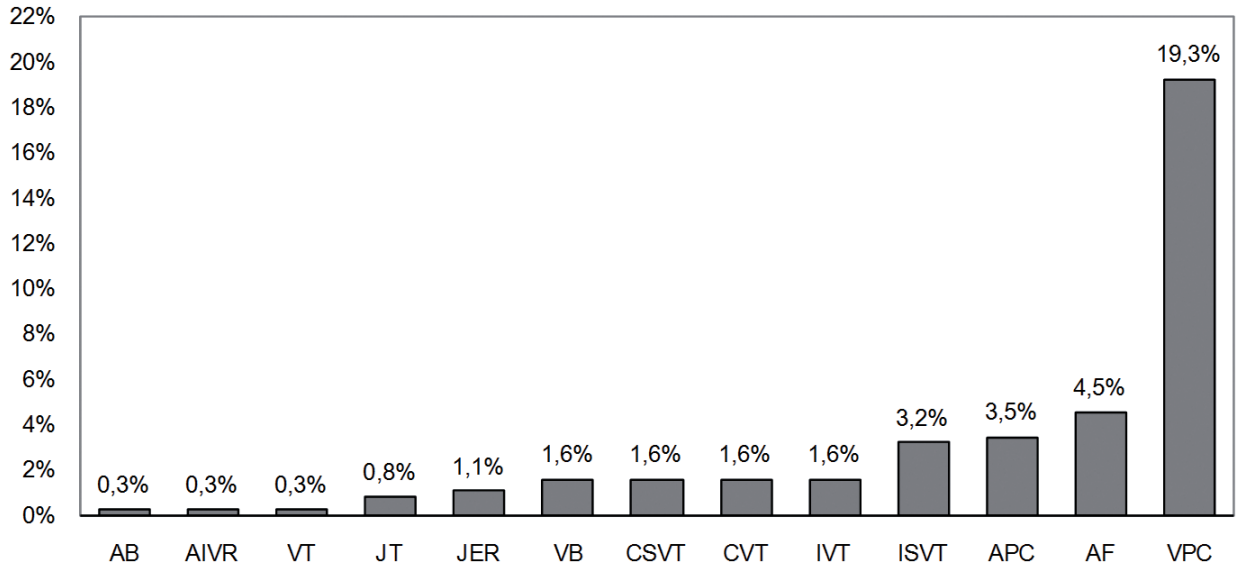


Figure 5 – Frequency of arrhythmias as a result of impulse formation abnormalities in dogs. Legend: AB – Atrial bigeminy. AIVR - Accelerated Idioventricular rhythm. Accelerated Idioventricular rhythm. Accelerated Idioventricular rhythm. VT - Ventricular trigeminy. JT – Junctional tachycardia. JER - Junctional escape rhythm. VB - Ventricular Bigeminy. CSVT - Continuous supraventricular tachycardia. CVT - Continuous ventricular tachycardia. IVT - Intermittent ventricular tachycardia. ISVT - Intermittent supraventricular tachycardia. APC - Atrial premature complexes. AF - Atrial Fibrillation. VPC - Ventricular premature complexes

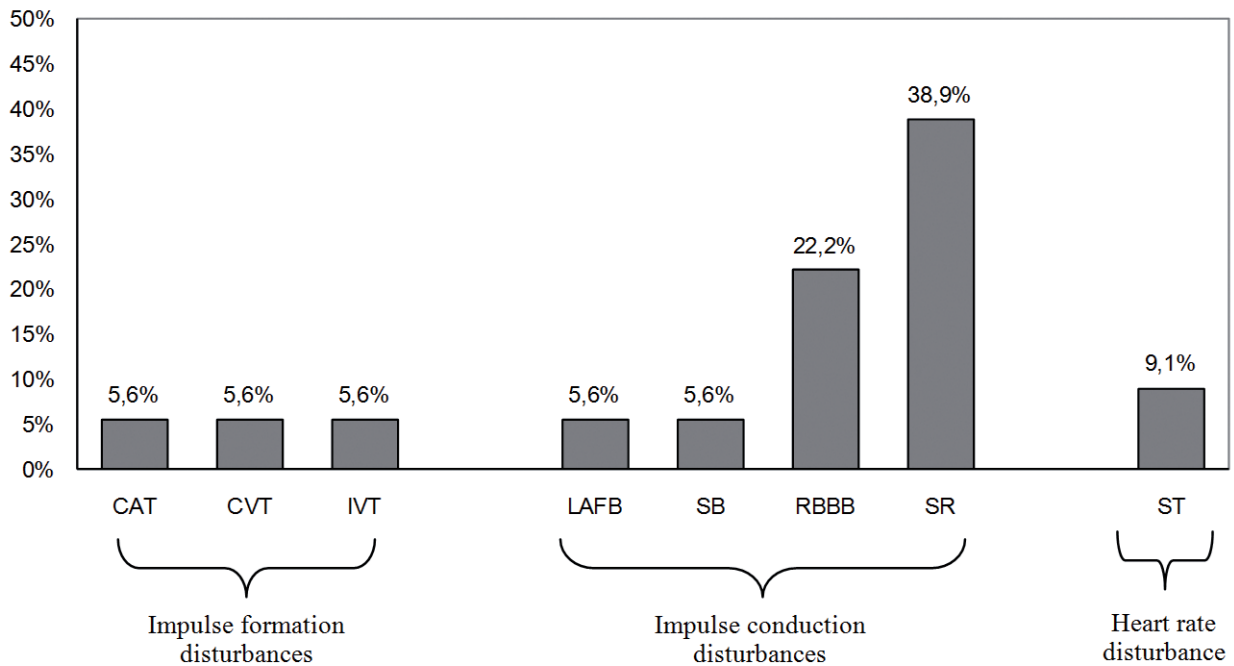


Figure 6 – Frequency of arrhythmias in cats. Legend: AT - Continuous atrial tachycardia. CVT - Continuous ventricular tachycardia. IVT - Intermittent ventricular tachycardia. LAFB - Left anterior fascicular block. SB - Sinoatrial block. RBBB - Right bundle branch block. SR - Sinoventricular rhythm. ST - Sinus tachycardia

Discussion

There are only a few publications on studies about prevalence of cardiac arrhythmias in dogs^{4,5,6,7} and there is a lack of these studies in cats from hospital population. Only case-reports were found in the literature regarding arrhythmias in cats^{8,9,10,11,12,13,14}, or reports of cats with specific arrhythmias^{12,15,16}, or studies on Holter monitoring in un sedated healthy cats^{17,18,19}. Some studies performed in distinct dog breeds showed a variation in prevalence of cardiac arrhythmias that could be associated with the most common diseases in those populations^{4,7}.

In this study, the number of ECGs evaluated was significant ($n = 1,426$) and showed a larger prevalence of arrhythmias among dogs (27.8%) when compared with two other studies (7%⁷ and 4.1%⁴, respectively). This fact could be explained by the difference between inclusion criteria adopted in each study. This study included all ECGs of dogs performed in that period, regardless of the primary disease presented by the animal, while other studies included only dogs with evidence of cardiac abnormalities⁴ or clinically normal⁷. The results showed that disturbances of excitability and impulse formation were the most common causes of arrhythmias in dogs. Other research has reported similar results⁴.

Sinus tachycardia was the most common abnormality found in dogs (26.2%). In most cases, it could be related to physiological conditions as fear or stress that explain the large prevalence of dogs presented with this rhythm³. As a disturbance of heart rate, sinus bradycardia was less common than tachycardia and only 11 dogs (2.9%) presented this abnormality. Slow sinus rhythm can be a normal finding or be associated with cardiac and systemic alterations².

Concerning disturbances of impulse formation, ventricular premature complexes (VPCs) were the most common abnormalities (including ventricular bigeminy and trigeminy) recorded in 79 dogs (21.1%) in this study, also demonstrated by Patterson et al.⁴.

Another study showed that 97.5% of dogs with idiopathic dilated cardiomyopathy had VPCs²⁰. In the present study, ventricular tachycardia (VT) occurred in 3.2% of dogs (six with continuous VT and six with intermittent VT). Patterson et al.⁴ showed a larger prevalence (6.4%), but only represented by intermittent ventricular tachycardia. Considering specific populations, dogs with idiopathic dilated cardiomyopathy²⁰ and healthy Boxers^{21,22} also showed a larger prevalence of ventricular arrhythmias (45%, 58.3% and 70%, respectively). Accelerated idioventricular rhythm (AIVR) was not common in this study. A prevalence of 5.5% had been showed by Guglielmini et al.²³. Causes of VPCs, VT and AIVR include any cardiac or systemic disorder, with the most common of these including primary cardiac diseases^{1,2}.

Other studies reported a 25.5% prevalence of atrial fibrillation (AF)⁵ in dogs with cardiac disease. In the present study only 4.5% of dogs (with or without cardiac disease) had this disturbance. The difference between the percentages could be explained by the distinct population of dogs. AF most often occurs in dogs when marked atrial enlargement is present secondary to a primary cardiac disease^{2,20}, although this was not the purpose of the study, most of these dogs did have cardiac disease.

Atrial premature complexes, including atrial bigeminy, were recorded in 3.8% of dogs, a lesser prevalence than found by Patterson et al.⁴ (11.3%). Eighteen dogs (4.8%) had supraventricular tachycardia (SVT) (continuous or intermittent). Patterson et al.⁴ showed a prevalence of 2.4% of dogs with intermittent SVT. Causes of these abnormalities are most commonly related to a structural cardiac atrial lesion² and dogs with cardiomyopathy²⁰.

The pre-excitation syndrome is a complex disorder involving abnormalities of both excitability and conduction. Most of the times, it is an incidental and clinically silent finding. In this study, only one dog showed this syndrome, as observed by Patterson et al.⁴.

Junctional tachycardia was found in three dogs and could be associated with digitalis toxicity or cardiac disease³. Junctional escape rhythm was considered an impulse formation disturbance, however it is secondary to all causes of sinus bradycardia, sinus arrest, atrioventricular (AV) block, digitalis toxicity, increased vagal tone and sick sinus syndrome³. Four dogs showed this disturbance in this study in consequence to third-degree AV block.

As the most common disturbance of impulse conduction, sinus arrest was observed in 14.5% of dogs, a greater prevalence compared with a healthy dog population in other study (3.4%)⁷. Most of the time, sinus arrest was associated with pronounced sinus arrhythmia. However, it could not be differentiated from sinoatrial block due to difficulty in determining the type of disturbance of the sinus impulse in a routine ECG. It could be a normal incidental finding in brachycephalic breeds or it could be associated to pathologic conditions that cause stimulation of the vagus nerve, atrial conditions and sick sinus syndrome³.

Other conduction disturbances to be considered although not necessarily related to rhythm disturbance, are the bundle branch blocks (BBB), which were not common. Three dogs (0.8%) presented right BBB, and two dogs (0.5%) presented left BBB. There are many causes of BBB and they may be due to a variety of pathologic changes including hypertrophy, dilation and inflammation¹. Although the left anterior fascicular (LAF) block is more common in cats¹, seven dogs (1.9%) showed this disturbance of impulse conduction.

Atrioventricular blocks are defined as delays or stoppages of conduction between the atria and the ventricles¹. Both first and second-degree AV blocks may occur in dogs that are clinically normal and healthy³. Also, the second-degree AV blocks could be associated with causes of increased vagal tone³. Third-degree AV blocks are sometimes functional,

but are commonly associated with a structural lesion, inflammatory or degenerative¹. Atrioventricular blocks are reported on the cardiomyopathy in the English Cocker Spaniel²⁴. The results showed that a total of 44 dogs (11.8%) presented with some type of AV block and the first-degree AV block was the most common (7.8%). Patterson et al.⁴ showed a frequency of 0.9% of AV block, with similar frequency between first and second-degree AV block (0.4%) and 0.1% of third-degree AV block.

Sinoventricular rhythm was not common but was recorded in four dogs (1%). This rhythm is secondary to systemic diseases³.

In the study reported here, a large percentage of ECGs of cats showed arrhythmias. Disturbances of conduction were the most important causes of arrhythmia in cats, an opposite result compared with ECGs abnormalities found in cats with heart disease, which showed a prevalence of 6.6% in conduction abnormalities and 60.5% in abnormalities of impulse formation²⁵.

The sinoventricular rhythm was the most common disturbance of conduction in this study. It was probably in consequence of hyperkalemia, as evidenced by Tag and Day²⁶. Urethral obstruction was also very common and it is probably the most common cause of sinoventricular rhythm in cats. As mentioned above, the LAF block is the type of conduction block most common in cats and commonly found in cats with feline idiopathic cardiomyopathy²⁷, however, only one cat (5.6%) had LAF block in this study. Four cats (22.2%) had right BBB, a higher prevalence than showed by Riesen et al.²⁵ in 0.3% of cats with cardiac disease.

Among abnormalities of impulse formation, ventricular tachycardia (intermittent or continuous) was the arrhythmia most often recorded in cats, but it was represented by only two cats. No cats had VPCs in this study, while VPCs were observed even in healthy cats in three different studies during Holter monitoring^{17,18,19}. In the present study, one cat had continuous

atrial tachycardia. Supraventricular and ventricular tachycardia were reported in cats with hyperkalemia^{12,26} and cardiac disease²⁵. One case of persistent atrial standstill not related with hyperkalemia is presented in the literature⁹. A study reported 50 cats with atrial fibrillation that was detected when signs of decompensated cardiac disease were evident, but also was commonly identified as an incidental finding¹⁰. In the present study no cases of atrial fibrillation were observed among cats. This fact is related to the popu-

lation studied. Most cats included in this study had urethral obstruction, and not cardiac disease.

Conclusion

The most common rhythm disturbances in cats and dogs brought to the Veterinary Hospital at the School of Veterinary Medicine and Animal Science, Botucatu - SP were sinus tachycardia and ventricular premature complexes in dogs and sinoventricular rhythm in cats in the population studied.

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