







Original article

## Prevalence study of arrhythmia in dogs affected for mitral valve disease

Estudo da prevalência de arritmias em cães afetados por doença valvar mitral

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### ABSTRACT

The mitral valve disease is considered more common heart disease between dogs, and occurs mostly in geriatric and small size dogs. The most affected breeds are, Poodle, Pinscher, Yorkshire Terrier, Fox Terrier, among others. The general signs related to heart disease are cough, tachypnea and lethargy. Another common disorder is arrhythmia, basically related to origin or conduction alterations of electric impulses. Both disorders can be associated in the same patient, which makes necessary the realization of complementary tests for earlier diagnosis and placement of appropriate therapy for the dog, such as, chest radiography, electrocardiogram and echocardiogram. The aim of this paper was to observe, by means of cases retrospective study, the relationship between mitral valve disease and different cardiac rhythms. It was possible observe that alterations in cardiac rhythms are closely linked with activating of neurohormonal compensatory mechanisms of organism due to cardiac remodeling caused for mitral valve disease.

### RESUMO

A doença valvar mitral é considerada a cardiopatia mais comum entre cães, e acomete em grande parte cães idosos e de pequeno porte. As raças mais afetadas são Poodle, Pinscher, Yorkshire terrier, Fox terrier, dentre outras. Os principais sinais relacionados à cardiopatia são tosse, taquipneia e letargia. Outro distúrbio comum é a arritmia, basicamente relacionada a alterações na origem ou condução de impulsos elétricos. Ambos os distúrbios podem estar associados no mesmo paciente, o que torna necessário a realização de exames complementares para o diagnóstico precoce e instituição de terapia apropriada para o cão, tais como a radiografia torácica, eletrocardiograma e ecocardiograma. O objetivo deste estudo foi observar, por meio de estudo retrospectivo de casos, a relação entre doença valvar mitral e diferentes ritmos cardíacos. Foi possível observar que alterações nos ritmos cardíacos estão intimamente relacionados à ativação de mecanismos compensatórios neurohormonais do organismo, devido ao remodelamento cardíaco causado por doença valvar mitral.

#### Palavras-chave:

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### INTRODUCTION

The cardiovascular system is responsible for blood circulation through vases, pulmonary and systemic capillaries, making oxygen, carbon dioxide, nutrients, degradation products and water exchange (AARONSON, 1999; MATTHEWS, 1996). The heart has two atrioventricular valves, tricuspid and mitral, the latter being responsible for conducting blood correctly from left atrium to left ventricle, without reflux (CONNEL,

2010). The mitral valve has six elements responsible for its operation and integrity, such as: posterior wall of left atrium, mitral valve ring, anterior and posterior leaflet of mitral valve, tendinous cords, ventricular papillary muscles and ventricular wall (PHILIP, 2011). Due to alterations on structure of mitral valve, the development of mitral valve myxomatous disease (MVMD) occurs, which is the most prevalent among valves heart diseases acquired in dogs (BRIGHT; MEARS, 1997). This disease is age and breed related; hence, geriatric and small size

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dogs are most affected (KITTLESON, 1998; SISSON; KVART; DARKE, 1999).

The cardiac arrhythmias are considered alterations in electrical impulse formation, emission of these or both (HOFFMAN; CRANFIELD, 1964) and, mostly, the presence of arrhythmias exacerbates one preexisting heart disease (JACOBS, 1996). One clinical sign expected in dogs with arrhythmias is syncope. Often, arrhythmias that evoke syncope are associated to a very fast or slow cardiac rhythm, with or without the presence of primary heart disease (NELSON; COUTO, 2015). Several heart diseases can cause arrhythmias in dogs as dilated cardiomyopathy, but dilated cardiomyopathy, mitral valve disease and congenital heart defects are the most common cause (NOSZCZYK-NOWAK; ZACHARSKI; MICHAŁEK, 2018).

There are some clinical characterizations of common disturbances of rhythm and heart rate; the irregular fast rhythms, regular fast rhythms, and regular and irregular bradyarrhythmias. The irregular rhythm is mostly diagnosed and is presented in three forms: premature atrial contractions, which impair the filling of the ventricles, reducing the systolic volume; atrial tachycardia, which cause a more severe hemodynamic impairment than isolated contractions (NELSON; COUTO, 2015); and atrial fibrillation, which is seen as an important arrhythmia and presents a disproportionate and accelerated ventricular response (ALMEIDA et al., 2006).

The fast regular rhythm is composed of sinus tachycardia, supraventricular tachycardia and sustained ventricular tachycardia, being difficult to differentiate both and the therapeutic protocol being similar. These types of arrhythmias decrease cardiac output, blood pressure and coronary perfusion (ECKARDT; BREITHARDT KIRCHHOF, 2006; NELSON; COUTO, 2015).

The bradyarrhythmias can be three different types, such as: sinus bradycardia which is one found common in animals who practice sports (UFBERG; CLARK, 2006), with normally unspecific clinical signs (GUGLIELMINI, 2003); sick sinus node syndrome in which the animal present weakness episodes, Stokes - Adams seizures and syncope due to sinoatrial node dysfunction (MOREIRA et al., 2004); and second and third degree atrioventricular (AV) block. The second degree atrioventricular (AV) block causes irregular heart beat and third degree normally has regular rhythm with escapes rhythms which cause irregularity of this (UFBERG; CLARK, 2006).

The gold standard exam for the diagnosis of arrhythmias is the electrocardiogram, which is considered a non-invasive diagnostic test in which electrical information can be obtained while cardiac activity occurs in the patient (AMSTERDAM et al., 2007). As an electrocardiogram complement, there is continuous electrocardiography (Holter), which monitors the cardiac function of the animal during 24 hours, acquiring

references of the arrhythmias, as well as the exact period in which they occurred (CALVERT, 1998; PETRIE, 2005). This modality of examination is useful to assess the severity and frequency of arrhythmias, as well as the monitoring of treatment efficacy (NELSON; COUTO, 2015).

Mitral myxomatous valvular disease, also known as mitral endocardiosis or chronic mitral valve fibrosis, is the most common cardiopathy among dogs, accounting for approximately 80% of the cases of cardiac diseases attended by veterinarians (AMPUERO, 2017). Recent studies point out that the MMVD commonly affects the left atrioventricular valve, but in 30% of the cases there is also the involvement of the right atrioventricular valve (KEENE et al., 2019).

It is characterized by a disease of degenerative character that causes mitral valve insufficiency. There is a loss of normal valvular architecture, where fibrous tissue is progressively replaced by myxomatous tissue. As degeneration progresses, it causes thickening and shortening of the valve leaflets, allowing blood regurgitation to the atria during ventricular systole, due to partial apposition of the parietal and septal leaflets (AMPUERO, 2017). In addition, MMVD may cause congestive heart failure (CHF) due to increased cardiac work, cardiovascular volume and regurgitation fraction, being the leading cause of death in elderly dogs (AMPUERO, 2017; YATA; KOOISTRA; BEIJERINK, 2019).

As a consequence of chronic regurgitation, there is a dilation of the atria, triggering supraventricular arrhythmias, of atrial and junctional origin, and the supraventricular complexes and supraventricular tachycardia are the most diagnosed. Thus, dogs with MMVD may present ventricular arrhythmias during the entire advancement of the disease, being more prevalent in the pre-clinical phase, when compared to supraventricular arrhythmias (AMPUERO, 2017). In a study conducted in Rio de Janeiro, 108 animals of canine species of both sexes were evaluated, where it was possible to observe that 39 of these had atrial fibrillation and associated mitral valve disease (ALMEIDA, 2006).

The occurrence of ventricular arrhythmias was considered higher in animals with congestive heart failure (CHF) secondary to mitral valve disease (CROSARA, et al., 2010). In big breed dogs with this disease, a more common arrhythmia found is atrial fibrillation (BORGARELLI, 2004).

Some episodes of sinus tachycardia and bradycardia were observed in dogs of Cavalier King Charles Spaniel breed which present mitral valve disease more severe. However, there was no correlation with arrhythmias and dogs age. In this way, it is not possible establish if the arrhythmias were related to dogs age, the disease severity or both (RASMUSSEN, 2012). Other author observed that arrhythmias are a found relativity common in animals affected for mitral valve myxomatous disease, regardless of severity. Due to left

atrium increase the chances of supraventricular arrhythmias rise too. The presence of clinical signs, such as weakness and syncope, in patients with mitral valve disease don't have link with observed arrhythmias (CROSARA et al., 2010).

The occurrence of mitral valve disease arrhythmias is directly related to activation of compensatory neurohormonal mechanisms due to remodeling that left atrium suffer with disease progression. These mechanisms are, increase in sympathetic tonus, vagal tonus reduction, stimulation of renin-angiotensin-aldosterone system and liberation of antidiuretic hormone, which causes systemic vasoconstriction expanded the cardiac workload and can cause a decrease in cardiac output and aggravate mitral regurgitation (NELSON; COUTO, 2006).

Due to stimulation of sympathetic nervous system occurs an increase of cardiac frequency, myocardium contraction and return of venous blood that with disease progression become harmful for animal, causing increase of stress due to post-load. So, the myocardium lift its oxygen needs and consecutively cardiac remodeling become more and more, increasing the chances of patient development cardiac arrhythmias (NELSON; COUTO, 2006).

The present paper has as aim evaluated the possible relation between mitral valve myxomatous disease and cardiac arrhythmias by means of retrospective study of dogs submitted to echocardiogram and electrocardiogram.

## MATERIALS AND METHODS

By means of research in electrocardiographic and echocardiographic reports supplied by a specialized center in veterinary cardiology, it was evaluated 233 dogs, without racial, sex or age range predilection, with data of period of November of 2015 to October of 2017 in region of Bauru/SP. All patients should present mitral valve disease, diagnosed by echocardiographic, to be included in study and have electrocardiographic exam for evaluate cardiac rhythm in each patient.

The animals were separated in four groups: a) dogs without cardiac remodeling, b) dogs with discreet cardiac remodeling, c) dogs with moderate cardiac remodeling, d) dogs with important cardiac remodeling. Inside of these four groups were evaluated the cardiac rhythms.

For the realization of electrocardiogram, the animals were placed in right lateral decubitus on rubber table and were placed the electrodes according to the TEB manufacturer. After this, maintaining the left lateral decubitus it was realized echocardiogram.

## RESULTS

In Table 1, it was presented 233 dogs, separated for groups, evaluated by echocardiogram and electrocardiogram with mitral valve myxomatous disease. It is possible visualize the most common cardiac rhythms according to cardiac increase measured during to echocardiogram.

The most frequently arrhythmia observed in animals with mitral valve disease is sinus arrhythmia (134), following by sinus rhythm (72), sinus tachycardia (23), atrial fibrillation (2), atrioventricular block (1) and junction rhythm.

Table 1 – Data classification: cardiac remodeling X arrhythmia.

	Cardiac Remodeling X Arrhythmia					Total
	Group A (Without cardiac remodeling)	Group B (Discrete cardiac remodeling)	Group C (Moderate cardiac remodeling)	Group D (Important cardiac remodeling)		
Sinus Arrhythmia	60 (65%)	45 (70%)	19 (54%)	10 (24%)	134	
Sinus Rhythm	28 (31%)	17 (27%)	11 (32%)	16 (38%)	72	
Sinus Tachycardia	4 (4%)	2 (3%)	4 (11%)	13 (31%)	23	
Junction rhythm	-	-	1 (3%)	-	1	
Atrial Fibrillation	-	-	-	2 (5%)	2	
2 <sup>nd</sup> degree AV block	-	-	-	1 (3%)	1	
Total	92	64	35	42	233	

The animals in this study were separated in three categories by age rate, such as, 0 to 1 year, 1 to 8 years

and above 8 years, according to cardiac increase visualized on Table 2.

Table 2 – Age range classification.

Age range classification									
	Group (Without remodeling)	A cardiac	Group (Discreet remodeling)	B cardiac	Group (Moderate remodeling)	C cardiac	Group (Important remodeling)	D cardiac	Total
0 to 1 year	-		-		-		-		-
1 to 8 years	26 (28%)		8 (12%)		2 (56%)		1 (2%)		37
Above 8 years	66 (72%)		56 (88%)		33 (94%)		41 (98%)		196
Total	92		64		35		42		233

After analyzing of 233 studied animals, it can be verified that the largest share of affected dogs falls in the age rate above 8 years, while there was no case in animals of 0 to

1 year. The animals were classified in Table 3, according to sex.

Table 3 – Sex classification.

Sex classification									
	Group A (Without remodeling)	cardiac	Group (Discreet remodeling)	B cardiac	Group (Moderate remodeling)	C cardiac	Group (Important remodeling)	D cardiac	Total
Female	61 (66%)		37 (58%)		17 (48%)		15 (36%)		130
Male	31 (34%)		27 (42%)		18 (52%)		27 (64%)		103
Total	92		64		35		42		233

In the A and B groups were can verified the disease prevalence, according to cardiac increase, it was in female (66% and 58%, respectively), while in C and D Groups (52% and 64%, respectively), was males.

In Table 4, the dogs were separated according to its breeds. It can be observing that the most affected breed is Poodle, being present in greater value in all the groups of cardiac size (A Group – 28%; B Group – 36%; C Group – 35% and D Group – 47%).

Table 4 – Breed classification.

Breed classification									
	Group A (Without increase)	cardiac	Group B (Discrete increase)	cardiac	Group C (Moderate increase)	cardiac	Group D (Important increase)	cardiac	Total
Poodle	26 (28%)		24 (36%)		12 (35%)		20 (47%)		82
Mongrel dogs	14 (15%)		7 (10%)		-		2 (5%)		23
Yorkshire	10 (11%)		3 (5%)		-		4 (9%)		17
Teckel	5 (6%)		3 (5%)		3 (8%)		3 (7%)		14
Cocker spaniel	3 (3%)		8 (12%)		1 (3%)		1 (3%)		13

Table 4 – Breed classification (continuação).

Lhasa apso	6 (7%)	5 (7%)	1 (3%)	1 (3%)	13
Maltese	6 (7%)	1 (2%)	5 (15%)	-	12
Pinscher	1 (1%)	2 (3%)	3 (8%)	5 (12%)	11
Shih tzu	4 (5%)	-	4 (11%)	3 (7%)	11
Boxer	1 (1%)	1 (2%)	2 (6%)	2 (5%)	6
Fox terrier	-	3 (5%)	3 (8%)	-	6
Schnauzer	2 (2%)	2 (3%)	-	1 (3%)	5
Beagle	2 (2%)	1 (2%)	-	-	3
German spitz	2 (2%)	-	1 (3%)	-	3
Bichon frise	1 (1%)	1 (2%)	-	-	2
Golden retriever	2 (2%)	-	-	-	2
Labrador retriever	1 (1%)	1 (2%)	-	-	2
Basset hound	-	1 (2%)	-	-	1
Border collie	1 (1%)	-	-	-	1
Great dane	1 (1%)	-	-	-	1
Argentine bulldog	1 (1%)	-	-	-	1
German shepherd dog	1 (1%)	-	-	-	1
Pit bull	1 (1%)	-	-	-	1
Pointer	1 (1%)	-	-	-	1
Pug	-	1 (2%)	-	-	1
Total	92	64	35	42	233

## DISCUSSION

It is possible when to observe the C and D groups, the presence of sinus tachycardia that occurs in more advanced stages of mitral valve disease. This tachycardia is a compensatory means of organism, by the activation of intrinsic factors as an increase of sympathetic tonus and actuation of renin angiotensin aldosterone system (RAAS) as form to recompose hemodynamic function (BAPTISTA, 2013).

According to Dennis (2010) and Tilley and Smith (2008), in cases where there is no cardiac increase sufficient for cause a sinus tachycardia, but there is presence of this in A and B groups, can be associated for execution of physical exercises before exam, patient anxiety or stress, or induced for drugs.

According to Guglielmini et al. (2000) and Soares; Larsson; Yamato (2005) the presence of atrial fibrillation is related to left atrium increase that is possible to observe in D Group, where it is classified the animals with an important cardiac remodeling. However, atrial

fibrillation occurs in low frequency when compared to the others cardiac rhythms, because the animals more affected by MVMD are low size breed dogs and in these patients the atrium increase is not enough for cause this type of arrhythmia, being the most common alteration in large breed dogs. Conversely, according to Borgarelli et al. (2008), this arrhythmia is considered an important factor for death in dogs with MVMD.

Nelson and Couto (2006) declared that supraventricular tachyarrhythmia, as in atrial fibrillation, are the most common in dogs affected by MVMD and occurs a decrease in ventricular filling time, thus leading to increase the oxygen demand.

The predominance of sinus arrhythmia on A, B and C groups, and in lower quantity in D group, match with Muzzi's et al. (2009), in which 95% of arrhythmias in dogs with endocardiosis was sinus arrhythmias. According to Rasmussen et al. (2012), sinus arrhythmias are frequently founded in initial stages of disease, but in the course of disease development, the tachycardia present in more frequency due to activation

of sympathetic autonomous nervous system. Haggstrom et al. (2010) asserted that sinus arrhythmias are related to less severe mitral regurgitation, a fact that corroborate with the findings of this study, in which the animals on A and B groups did not present an important cardiac remodeling yet.

According to Tilley and Smith (2008), the presence of AV block in MVMD is not so common and can indicate an anticipate modification of atrioventricular node. This fact agrees with this study, in which the arrhythmia was observed only in one dog on D group.

According to Carneiro (2011), the disease is related with age, sex and breed, which can be confirmed in Tables 2, 3 and 4.

Keene et al., (2019) stated that the DMVM is 1,5 times more common in male dogs, but in the present study it was possible to observe that most of the dogs affected by the disease are females (see table 3); this divergence may have been caused due to the inclusion criteria in research.

The vast majority of the study animals are above 8 years old (see table 2), which can be confirmed by Ampuero (2017), which affirms the occurrence of cardiopathy in animals over six years of age.

Ampuero (2017), relatou que as raças de pequeno e médio porte são mais acometidas pela DMVM related that small size dogs, as Poodle, Cocker Spaniel, Yorkshire, Scvhauzer, Pischner, Teckel, etc., are most affected by MMVD, which occurs less frequently in big dog breeds, what was observed in this study on Table 4.

## CONCLUSION

According to the results obtained, it was possible to conclude that cardiac arrhythmias are not directly related to mitral valve disease, but rather to one of the consequences caused by this cardiopathy, such as cardiac remodeling, which, according to Evolution of the disease, induces the activation of compensatory mechanisms in the organism, thus stimulating the occurrence of arrhythmias. Therefore, it is extremely important to diagnose the cardiac rhythms present in animals affected by the myxomatous disease of the mitral valve, because depending on the degree of arrhythmia, it is possible to obtain a prognosis in relation to the patient's case.

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