

Double trouble: First degree-atrioventricular block and concealed ventricular preexcitation

Duplo problema: Bloqueio atrioventricular de primeiro grau e pré-excitação ventricular oculta

Doble problema: Bloqueo atrioventricular de primer grado y preexcitación ventricular oculta

Received: 12/16/2024 | Revised: 12/21/2024 | Accepted: 12/21/2024 | Published: 12/23/2024

Gustavo Luiz Gouvêa de Almeida

ORCID: <https://orcid.org/0000-0001-7612-7655>

Serviço de Cardiologia do Hospital Geral da Santa Casa Misericórdia do Rio de Janeiro, Brazil

Centro Veterinário Colina, Brazil

E-mail: vetcolina@pig.com.br

Marcelo Barbosa de Almeida

ORCID: <https://orcid.org/0000-0001-8219-8484>

Centro Veterinário Colina, Brazil

E-mail: vetcolina@hotmail.com

Ana Carolina Mendes dos Santos

ORCID: <https://orcid.org/0000-0002-7760-713X>

Centro Veterinário Colina, Brazil

E-mail: acmvvetcolina@gmail.com

Ângela Vargas de Mattos

ORCID: <https://orcid.org/0000-0003-3354-9094>

Centro Veterinário Colina, Brazil

E-mail: meuanjofreddy@gmail.com

Sophie Ballot

ORCID: <https://orcid.org/0000-0001-5692-9140>

Centro Veterinário Colina, Brazil

E-mail: sb_sophieballot@hotmail.com

Alexandre Lopes

ORCID: <https://orcid.org/0009-0009-8095-0885>

Clínica Veterinária Luciano Passos, Brazil

E-mail: vetrinarialucianopassos@gmail.com

Abstract

This article aims to present a case report of a canine patient with first-degree atrioventricular block and occult ventricular pre-excitation. A 9-year-old male dog, was referred for cardiological evaluation for suspected heart failure. The physical examination revealed a regular heart rhythm, loud holosystolic murmur over the left apex of the heart, accompanied by systolic thrill. Systolic blood pressure was 140 mmHg. The chest X-ray showed evidence of severe cardiomegaly and pulmonary edema, compatible with congestive heart failure. The echodoppler examination demonstrated presence of severe mitro-tricuspid insufficiency and enlargement of the four cardiac chambers. Serial electrocardiographic examination revealed presence of first-degree atrioventricular block concomitant with occult ventricular pre-excitation. To the best of our knowledge, the combination of such different electrocardiographic abnormalities wasn't reported before in a canine patient.

Keywords: Accessory Pathway; Atrioventricular Block; Heart Failure; Ventricular Preexcitation; Wolff-Parkinson-White; Dog.

Resumo

Este artigo tem como objetivo apresentar um relato de caso de um paciente canino com bloqueio atrioventricular de primeiro grau e pré-excitação ventricular oculta. Um cão macho, com 9 anos de idade, foi encaminhado para avaliação cardiológica por suspeita clínica de insuficiência cardíaca. O exame físico revelou ritmo cardíaco regular, sopro holossistólico na altura do ápice do lado esquerdo do coração, acompanhado de frêmito sistólico. A pressão arterial sistólica foi aferida em de 140 mmHg. A radiografia de tórax evidenciou cardiomegalia severa e edema pulmonar, sendo compatível com insuficiência cardíaca congestiva. O exame ecodopplercardiográfico demonstrou a presença de insuficiência mitro-tricúspide e aumento das quatro câmaras cardíacas. O exame eletrocardiográfico seriado permitiu identificar a presença de bloqueio atrioventricular do primeiro grau concomitante com e pré-excitação ventricular oculta. Tanto quanto sabemos, a associação dessas diferentes alterações eletrocardiográficas ainda não havia sido descrita antes em um paciente canino.

Palavras-chave: Via Acessória; Bloqueio Atrioventricular; Insuficiência Cardíaca; Pré-Excitação Ventricular; Wolff-Parkinson-White; Cão.

Resumen

Este artículo tiene como objetivo presentar un caso clínico de un paciente canino con bloqueo auriculoventricular de primer grado y preexcitación ventricular oculta. Un perro macho de 9 años fue remitido para evaluación cardiológica por sospecha clínica de insuficiencia cardíaca. Al examen físico se observó ritmo cardíaco regular, soplo holosistólico a la altura del ápex del lado izquierdo del corazón, acompañado de frémito sistólico. La presión arterial sistólica se midió en 140 mmHg. La radiografía de tórax mostró cardiomegalia severa y edema pulmonar, compatible con insuficiencia cardíaca congestiva. El examen ecocardiográfico Doppler demostró la presencia de insuficiencia mitrotricusípide significativa y agrandamiento de las cuatro cámaras cardíacas. El examen electrocardiográfico seriado permitió identificar la presencia de bloqueo auriculoventricular de primer grado concomitante con preexcitación ventricular oculta. Hasta donde sabemos, la asociación de estos diferentes cambios electrocardiográficos aún no ha sido descrita en un paciente canino.

Palabras clave: Vía Accesorias; Bloqueo Atrioventricular; Insuficiencia Cardíaca; Preexcitación Ventricular; Wolff-Parkinson-White; Perro.

1. Introduction

Ventricular preexcitation (VP) is a term used to define an electrocardiographic disorder in which the electrical impulse generated in the sinus node or atrium activates part of the ventricular myocardium earlier than the normal through an accessory atrioventricular pathway, bypassing the atrioventricular node. Then, the ventricle is depolarized by two wavefronts: the normal and the anomalous, resulting in a hybrid QRS complex that is a fusion beat between normal and abnormal ventricular activation, whose configuration depends on the contribution of each of the both wavefronts (Goldwasser, 2009; Wellens, Brugada & Penn, 1987; Tilley & Smith Jr., 2016).

Accessory atrioventricular pathway (AP) is a bundle of working myocardial cells (Kent fibers) that directly connects the atria to the ventricles. This muscular band was first described in human heart by Stanley Kent more than one century ago (Kent, 1893). Actually, it is considered a remaining tissue from incomplete development of the atrioventricular fibroskeleton (Melis, Beijerink & Santilli, 2024). So, AP constitutes a congenital anomaly that involves the existence of an extra connection capable to conduct the electrical impulse directly from atrium to ventricle (Chhabra, Amandeep & Benham, 2023).

Ventricular preexcitation has been identified in several dog breeds, with male Labrador Retrievers, Golden Retrievers and Boxers mostly affected by the anomaly (Wright et al., 2018; Belachsen et al., 2021; Melis, Beijerink & Santilli, 2024; Santilli et al., 2018).

The clinical significance of VP depends on the frequency and severity of tachyarrhythmia mediated by the AP (Tilley & Smith Jr., 2016). In this case, when VP is accompanied by clinical signs, it constitutes the Wolff-Parkinson-White Syndrome (WPW), while in the absence of episodes of tachyarrhythmias, is best called Wolff-Parkinson-White pattern, or simply ventricular preexcitation (Chou, 1991).

In dogs, VP can be an isolate condition or may be associated with congenital or acquired heart diseases as Ebstein anomaly, degenerative mitral valve disease and dilated cardiomyopathy (Tilley, 1985), while in cats is hypertrophic cardiomyopathy (Hill & Tilley, 1985).

WPW syndrome seems to be rare in canine population. In fact, according to the classical research at University of Pennsylvania, only one case was identified among 3000 dogs studied, (prevalence of 0,33/1000, or 0,03%), constituting the first report of this syndrome in veterinary medicine (Patterson et al., 1961). Five decades later, at Nandini Veterinary Hospital, in Gujarat, India (Varshney et al., 2013), was found one case among 20.000 dogs (prevalence 0.05/1000) screened for arrhythmias. Subsequently, several cases were reported in the veterinary literature (Belachsen et al., 2021; Hill & Tilley, 1985; Nahas et al., 1998; Santilli et al., 2018; Melis, Beijerink & Santilli, 2024).

Comparatively, WPW syndrome is more common in humans than in dogs. In a large-scale human population-based study evolving pediatric and adult patients, the occurrence of the syndrome was calculated in 1~3/1000 individuals, corresponding to a prevalence of 0.1~ 0.3 % (Chhabra, Amandeep & Benham, 2023).

Coexistence of atrioventricular block and ventricular preexcitation is more common among people than in dogs, and most cases have been associated with structural heart disease, in which the combination of both conditions in children and in their families, pointed a possible association between both phenomena (Belokon & Barinova, 1984).

Concealed accessory pathway in dogs rarely is reported in the veterinary literature (Noszczyk-Nowak et al., 2017; Santilli et al., 2006; Wright et al., 2018).

From the best of our knowledge, the coexistence of concealed ventricular preexcitation combined with first degree atrioventricular block in the canine species wasn't reported to date.

This article aims to present a case report of a canine patient with first-degree atrioventricular block and occult ventricular pre-excitation.

2. Methodology

In this case report was used a descriptive-qualitative methodology (Pereira et al., 2018) detailing the clinical, electrocardiographic and imaging findings in a case of ventricular preexcitation associated with a first-degree atrioventricular block in a client-owned dog with advanced heart failure.

For thoracic radiography was used the digital direct radiograph X-Ray System Metron-DVM 7.20 (Epona Tech LLC, Creston, CA 93432). The X-Ray examination included both dorsoventral and right lateral projections. For echocardiographic study was used the Esaote My Lab X-5 Ultrasound System (Esaote S. p.A. Geneva, Italy), following the ACVIM Guidelines For the Diagnosis and Treatment of Myxomatous Mitral Valve Disease in Dogs (Keenne et al., 2019). For electrocardiography was employed the digital computed electrocardiograph system InCardio® (InPulse Animal Health, Florianópolis-Brazil). The patient was restrained on right lateral recumbency during the procedure, according methodology of Willys, Oliveira & Mavropoulou (2019).

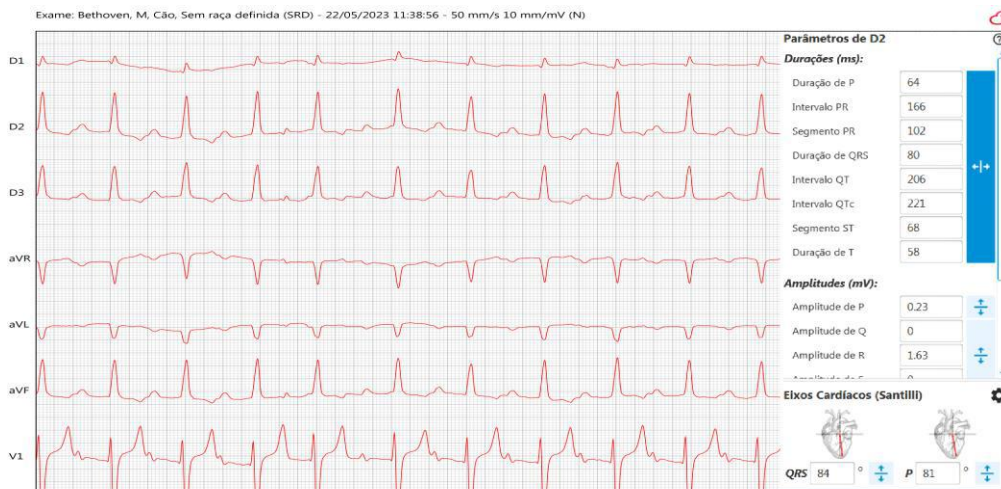
3. Case Description

A nine-year-old, 10 kg, intact mongrel dog was referred by the clinician for cardiologic evaluation due to cough, intolerance to exercise and cardiac murmur.

On physical examination the heart rhythm was regular, 140 bpm. Systolic blood pressure was 130 mmHg and cardiac auscultation demonstrated loud holosystolic murmur, accompanied by systolic fremitus at the left cardiac apex.

The electrocardiogram revealed wide P waves, considered sinus in origin since was positive on the frontal plane, and first-degree atrioventricular block. The QRS complexes were prolonged, accompanied by secondary ventricular repolarization changes, resembling left bundle block (Figure 1).

Figure 1 - Seven-lead computed eletrocardiograma.

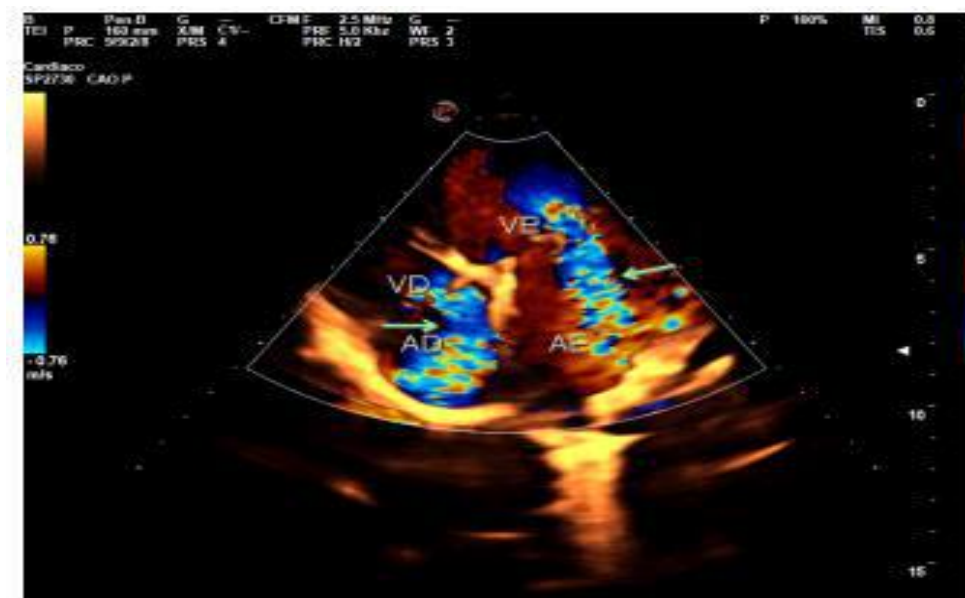


Source: Authors.

The rhythm is predominately regular, average heart rate 146 bpm. The P waves show positivity in leads II, III and aVF, consistent with sinus origin. Each P wave was followed by a QRS complex, with a fixed although P-R interval of 166 ms (reference 60-130 ms).

The transthoracic echocardiogram revealed biatrial and biventricular enlargement, while the collar doppler study demonstrated mitral and tricuspid thickening, accompanied by significant valvular regurgitation (Figure 2), characterizing atrioventricular volume overload associated with degenerative mitral valve disease.

Figure 2 - Bidimensional four-chamber echocardiogram.

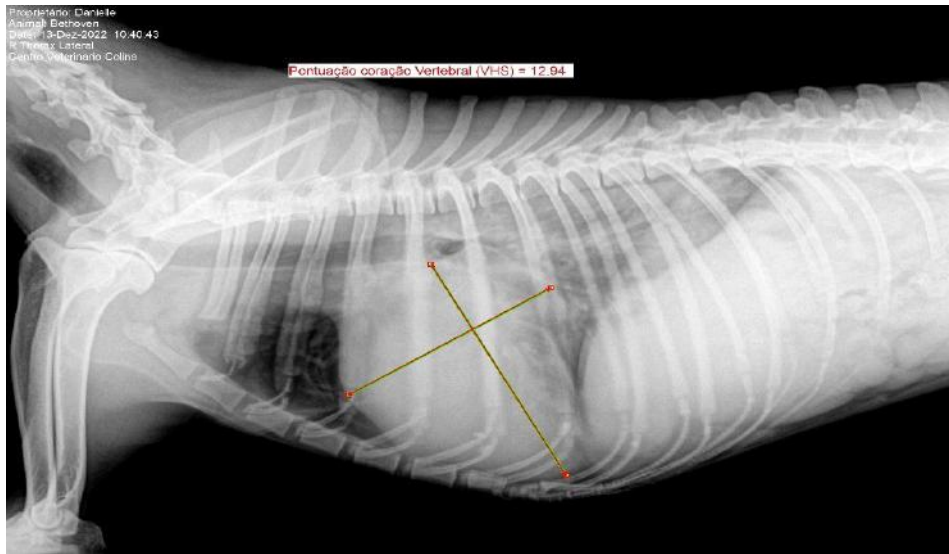


Source: Authors.

This echocardiographic figure demonstrates significant mitral and tricuspid insufficiency.

On thoracic X-ray examination was observed cardiomegaly, trachea displaced dorsally and pulmonary congestion (Figure 3).

Figure 3 - Wright lateral radiographic projection.



Source: Authors.

In Figure 3 note the severe cardiomegaly (VHS 12,94), tracheal bending dorsally and pulmonary edema.

The dog started to receive Pimobendan 3,3 mg/TID; Benazepril 4mg/SID; Coenzime Q10- 20 mg/BID; Sildenafil 22 mg/TID; Diltiazem 6 mg/BID, Amiodarone 100 mg/BID and Aminophiline 100 mg/BID.

On reevaluation five months later, a second electrocardiogram (Figure 4) showed identical alterations seen in the first ECG, although with longer PR interval (208 ms), configuring presence of first-degree atrioventricular block. Also, was noted positive QRS complex in D2/D3/aVF with delta wave, typical of manifest ventricular preexcitation. The rS pattern in V1 and positive delta wave in D2/D3/aVF were consistent with right anterior AP, as previously described elsewhere (Santilly et al., 2007; Perego et al., 2023).

Figure 4 - Seven-lead digital electrocardiogram.



Source: Authors.

ECG tracing depicting sinus rhythm and first-degree atrioventricular block. QRS complexes duration of 86ms (reference <70 ms). Slurring upstroke on initial part of the R wave (> shown in the figure) in D2-D3-aVF (delta wave) and rS

in V1, were consistent with Wolff-Parkinson-White pattern of preexcitation, mediated by right antero-lateral atrioventricular pathway. Noteworthy is that duration of P, P-R and QRS is longer than seen on the first ECG.

4. Discussion

Herein, we highlight a rare case of concealed accessory pathway combined with first-degree atrioventricular block in a dog with advanced heart failure.

In humans, coexistence of atrioventricular block and Wolff-Parkinson-White is not uncommon, since several cases have been reported in children and adults, mostly associated with certain structural heart defects, as hypertrophic cardiomyopathy, discordant atrio-ventricular connections, ventricular septal defect and Ebstein's malformation (Sigfusson et al., 1996; Toulboul et al., 1984). In the veterinary literature, such electrocardiographic combination was not reported before.

However, specifically in relation to concealed accessory pathway canines, a small number of cases was reported (Atkins et al., 1995; Scherlag et al., 1993). In this situation, the accessory pathway is called concealed because, unlike the classical WPW pattern, there is no evidence of ventricular pre-excitation during sinus rhythm (Scherlag et al., 1993), as observed on the first electrocardiogram. Then, the diagnosis of ventricular preexcitation may be challenging or even impossible when anterograde conduction via the AP is intermittent or no evident, as presumable occurred with our patient on the first electrocardiogram. In fact, not always ventricular preexcitation is apparent in a surface ECG, because sometimes is necessary slowing atrioventricular conduction for ventricular preexcitation to be manifested (Latner et al., 2023; Scherlag et al., 1993; Liu, et al., 2001). This probably was the case of our patient in which the first ECG showed sinus rhythm and first-degree atrioventricular block but not delta-waves. However, preexcitation become evident in a subsequent ECG (Figure 4), when the patient have been medicated with amiodarone and diltiazem, drugs capable to decrease sinoatrial automaticity and AV nodal conduction velocity (Florek, Lucas & Girzadas, 2023).

5. Conclusion

This case report documented the occurrence of ventricular preexcitation and concealed accessory pathway associated with first-degree atrioventricular block. To the best of our knowledge, this is the first report of a combination of such electrocardiographic abnormalities in a canine patient.

References

- Atkins, C. E., et al. (1995). Orthodromic reciprocating tachycardia and heart failure in a dog with a concealed posteroseptal accessory pathway. *Journal of Veterinary Internal Medicine*, 9(1), 43-49.
- Belachsen, O., et al. (2021). Segmental septal dyskinesia associated with an accessory pathway and preexcitation in two Golden Retriever dogs. *Journal of Veterinary Cardiology* 36, 6-11.
- Belokon, N. A. & Barinova, V. S. (1984). Significance of atrioventricular block in the development of the Wolff-Parkinson-White syndrome. *Kardiologiya*. 24(12), 39-44. PMID: 6521225.
- Chhabra, L., Goyal, A. & Benham, M. D. (2023). Wolff-Parkinson-White Syndrome. StatPearls [Internet]. StatPearls Publishing; 2024 Jan. www.ncbi.nlm.nih.gov/books/NBK554437/.
- Chou, T. (1991). Wolff-Parkinson-White Syndrome and Its variants. *Electrocardiography in Clinical Practice*. WB Saunders Company. Philadelphia, 429-456.
- Goldwasser, G. (2009). Síndrome de Wolff-Parkinson-White e Lown-Ganong-Levine. in: *Eletrocardiograma orientado para o Clínico*. (3.ed.). 289-300. Rubio Editora. Rio de Janeiro. ISBN978-85-7771-045-4.
- Hill, B. L. & Tilley, L. P. (1985). Ventricular preexcitation in seven dogs and nine cats. *Journal of the American Veterinary Medical Association* 187(10), 1026-1031.
- Florek, J. B., Lucas, A. & Girzadas, D. (2023). Amiodarone. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2024.

- Keene, B. W. et al (2019). ACVIM consensus guidelines for the diagnosis and treatment of myxomatous mitral valve disease in dogs. *J Vet Intern Med.* 11; 33(3), 1127–1140. doi: 10.1111/jvim.15488.
- Kent, A. F. (1893). Researches on the structure and function of the mammalian heart. *J Physiol*, 14, i2–254.
- Nahas, K., Hanton, G., Lodola, A., Rabemampianina, Y., & Sacre-Salem, B. (1998). Type B Ventricular Preexcitation With Abnormal Contraction of the Ventricular Septum in a Dog. *Journal of the American Association for Laboratory Animal Science*, 37(5), 78-81.
- Liu, L., et al. (2001). Atrioventricular conduction: a determinant for the manifestation of ventricular preexcitation in patients with Wolff-Parkinson-White syndrome. *Clinical Physiology*, 21(5), 534-540.
- Melis, C., Beijerink, N., & Santilli, R. (2024). Spontaneous pre-excited supraventricular tachycardias in a Labrador Retriever. *Journal of Veterinary Cardiology*, 54, 57-62.
- Noszczyk-Nowak, A. et al., (2017). Radiofrequency catheter ablation of concealed accessory pathway of the heart in Labrador Retriever. *Med Weter* 73, 505–509.
- Oliveira, P. (2018). Junctional Rhythms. In: Willis R., Oliveira P. and Mavropoulou A. (Eds.) *Electrocardiography. Guide to Canine and Feline Electrocardiography*. Willey Blackwell. Philadelphia., 146-167.
- Patterson, D. F., Detweiler, D. K., Hubben, K., Botts, R. P. (1961). Spontaneous abnormal cardiac arrhythmias and conduction disturbances in the dog (a clinical and pathologic study of 3.000 dogs). *American Journal of Veterinary Research* (22), 355–369.
- Pereira, A. S. et al. (2018). Metodologia da pesquisa científica. [free e-book]. Editora UAB/NTE/UFSM.
- Perego, M. et al. (2023). Electrocardiographic patterns of ventricular pre-excitation in dogs with right-sided accessory pathways. *Vet Res Commun* 47, 1393–1403.
- Romito, G. et al (2019). Preexcitation alternans in a dog. *Journal of Veterinary Cardiology* (24), 1-6.
- Santilli, R. A. et al (2006). Radiofrequency catheter ablation of concealed accessory pathways in two dogs with symptomatic atrioventricular reciprocating tachycardia. *J Vet Cardiol*, 8(2), 157-65. Doi: 10.1016/j.jvc.2006.06.001. PMID: 19083349.
- Santilli, R. A. et al. (2007). Anatomic distribution and electrophysiologic properties of accessory atrioventricular pathways in dogs. *Journal of the American Veterinary Association*, 231(3), 393-398.
- Santilli, R. A. et al. (2018). Radiofrequency catheter ablation of accessory pathways in the dog: the Italian experience. *Journal of Veterinary Cardiology* (5), 384-397.
- Scherlag, B. J. et al., (1993). Radiofrequency ablation of a concealed accessory pathway as treatment of incessant supraventricular tachicardia in a dog. *Journal of the American Veterinary Medical Association* 203(8), 1147-1152.
- Sigfusson, G. A., Webber, S. A. & Lee, B., (1997). Coexistence of atrioventricular block and Wolff-Parkinson-White syndrome in children. *Cardiol Young* (7), 388-392.
- Tilley, L. P. (1985). Ventricular pre-excitation and the Wolf-Parkinson-White syndrome. In: *Essentials of canine and feline electrocardiography: interpretation and treatment*. Second edition. Lea and Febiger, Philadelphia, USA, 176-177.
- Tilley, L. P. & Smith Jr, F.W. K. (2016). Chapter 3: Electrocardiography in: *Manual of Canine and Feline Cardiology*, 49-775. Th Edition. Elsevier. St Louis. Missouri, 62-71.
- Tilley, L. P., Miller, M. S. & Smith Jr., F. W. K. (1993) *Canine and Feline Arrhythmias*. Lea & Febi. Philadelphia. London.
- Varshney, J. P. et al. (2013). Prospective Study of Cardiac Arrhythmias - A survey of 20,000 canines. *Intas Polivet* 14(1), 129-136.
- Willys, R., Oliveira, P. & Mavropoulou, A. (2019). *Electrocardiography. Guide to Canine and Feline Electrocardiography*, 9-19. Wiley Blackwell. Hoboken, New Jersey. USA.
- Wolff, M. D., Parkinson, J. & White, P D (1930). Bundle-branch block with short P-R interval in healthy young people prone to paroxysmal tachycardia. *Heart Journal* (5), 685-704.
- Wright, K. N. et al. (2018). Atrioventricular accessory pathways in 89 dogs: clinical features and outcome after radiofrequency catheter ablation. *Journal of veterinary Internal Medicine*, 32(5), 1517-1529.
- Zhang, Y., Liu, R. & Chen, Y. (2013). Association of WPW syndrome and first-degree atrioventricular block. Electrocardiographic diagnosis. *Herz*, (39), 834–836.