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Reversible third-degree atrioventricular block in a toy poodle with degenerative mitral valve disease and pyometra

Bloqueio atrioventricular do terceiro grau em uma Poodle-toy com doença degenerativa valvar mitral e piometra

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Abstract

Third-degree atrioventricular block is a severe cardiac arrhythmia, and is the most common indication of artificial cardiac pacing in dogs. Spontaneous reversion to a normal sinus rhythm is exceedingly rare or exceptional. A 12-year-old toy poodle was referred with a history of abdominal enlargement, anorexia, vomiting and weakness. Abdominal ultrasonography revealed large pyometra. A six-lead electrocardiogram showed third-degree atrioventricular block, while transthoracic Doppler echocardiography showed myxomatous mitral valve disease, and the presence of mitral, tricuspid and aortic regurgitation, which was accompanied by mitral and tricuspid diastolic reflux. Two days after the ovario-salpingo-hysterectomy, a repeat electrocardiogram revealed spontaneous reversal to sinus rhythm, while the diastolic reflux of the mitral and tricuspid valves disappeared. The patient displayed rapid clinical amelioration and eight months after surgery was still alive, receiving treatment for heart failure. As far as we know, this is the first canine case of third-degree atrioventricular block, secondary to endocardiosis and pyometra, which spontaneously reverted to sinus rhythm after surgery.

Keywords: cardiac arrhythmia, degenerative mitral valve disease, diastolic mitral reflux, dog, pyometra, third-degree heart block.

Resumo

O bloqueio atrioventricular de terceiro grau é uma arritmia grave, sendo a indicação mais comum de estimulação cardíaca artificial em cães. A reversão espontânea ao ritmo sinusal é muito rara ou excepcional. Um Poodle-Toy de 12 anos foi encaminhado devido a história de aumento abdominal, anorexia, vômito e fraqueza. A ultrassonografia abdominal revelou piometra volumosa. Em seguida, um eletrocardiograma de seis derivações revelava bloqueio atrioventricular de terceiro grau, enquanto o ecodoppler Doppler transtorácico mostrava doença valvar mitral mixomatosa, destacando a presença de insuficiência mitral, tricúspide e aórtica, acompanhada de regurgitação diastólica mitral e tricúspide. Quarenta e oito horas após ovariosalpingohisterectomia, um novo eletrocardiograma revelou reversão espontânea ao ritmo sinusal, enquanto o refluxo diastólico mitral e tricúspide havia desaparecido. O paciente apresentou rápida melhora clínica e oito meses após a cirurgia ainda estava viva, em tratamento para insuficiência cardíaca. Até onde sabemos, esse é o primeiro caso de bloqueio atrioventricular do terceiro grau em canino, secundário à endocardiose e piometra, que foi espontaneamente revertido ao ritmo sinusal após a cirurgia.

Palavras-chave: arritmia cardíaca, doença degenerativa valvar mitral, refluxo mitral diastólico, cão, piometra, bloqueio atrioventricular do terceiro grau.



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Introduction

Third-degree atrioventricular block (3AVB) is defined as a complete interruption in the transmission of electrical impulses from atria to the ventricles. When this occurs, the heart is commanded by two natural pacemakers, one of these is located above the blocked area and is usually of sinus origin, while the second is located below the blocked area (Goldwasser, 2009). The P waves are visible but have no relationship to the ventricular escape complexes (Willis, 2018). Such findings are very concerning, because there is a high chance of asystole after diagnosis (Schrope & Kelch, 2006). The clinical manifestations of 3AVB result from reduced cardiac output, coronary flow and mean arterial pressure, which is proportional to the degree of bradycardia (Starzl et al., 1955). This results in low organs perfusion, causing subsequent lethargy, weakness, syncopal episodes and death, if not properly treated.

The first case of spontaneous 3AVB in the dog was reported more than 100 years ago at the Physiology Laboratory of Emory University in the United States of America (Bachmann, 1912). Since then, few investigations on frequency of 3AVB in canines have been published, demonstrating that it is a reasonable uncommon arrhythmia. Indeed, its prevalence ranges from 0.006 to 1.43%, representing 0.8-3.58% of all abnormal rhythm disturbances (Patterson et al., 1961; Aptekmann et al., 2010; Noszczyk-Nowak et al., 2017).

Usually, 3AVB occurs in dogs that are middle-aged to geriatric, most having degenerative mitral valve disease (Oyama et al., 2001). Several primary or secondary disorders of the AV conduction system are capable of inducing 3AVB, but usually, the cause is unknown (Willis, 2018). However, many underlying causes for 3AVB in canines have been cited including degeneration and fibrosis of the AV conduction system (Kaneshige et al., 2007), isolated congenital AV block, inherited heart defects, adrenal insufficiency (Patterson et al., 1961), myocarditis, cardiomyopathy, infections, myocardial infarction, hyper-hypokalemia, drugs intoxication (digoxin and calcium channel blockers), cardiac neoplasia, immune-mediated and inflammatory diseases (myasthenia gravis, lupus erythematosus), trauma, inflammation and systemic disorders (Willis, 2018; Santilli et al., 2019) and pancreatitis (Oron et al., 2015).

Historical findings

In November 2017, a 12-year-old intact toy poodle bitch was referred with a history of abdominal distention, anorexia, polydipsia and weakness that had onset five days prior. On physical examination, the dog was found to have a rectal temperature of 37.7 °C, respiratory rate of 38/min, systolic blood pressure of 100 mmHg and bradycardia. Cardiac auscultation revealed a loud left-apical holosystolic murmur.

Abdominal ultrasound revealed massive closed-cervix pyometra. An electrocardiogram was performed, which showed 3AVB, with monomorphic ventricular escape complexes of the right bundle branch type (RBB) and wide P waves which were consistent with left atrial enlargement (Figure 1). The transthoracic echocardiogram showed enlargement of the left atrium, which was

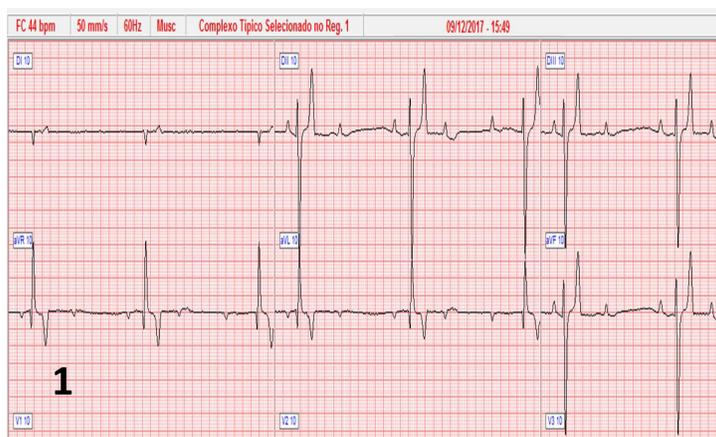


Figure 1. The ECG shows 3AVB, with monomorphic ventricular escape beats of RBB type, with rate of 43/min. Atrial and ventricular activities are dissociated each other. The atrial repolarization is noticeable. The bizarre and wide QRS with RBB pattern indicates that the rescue pacemaker is in the left ventricle. Paper speed = 50 mm/sec; calibration: 1 cm = 1 mV.

associated with myxomatous mitral valve disease, mitro-aortic insufficiency and mitrotricuspid diastolic reflux (Figures 2 and 3). Since the patient had no previous history suggestive of heart failure, myxomatous mitral valve disease ACVIM Stage- B2 was diagnosed (Keene et al., 2019).

The blood count revealed normocytic, normochromic anemia and intense leukocytosis. The serologic 4DX-plus testing was negative for *Dirofilaria immitis*, *Ehrlichia*, Lyme disease and *Anaplasma*.

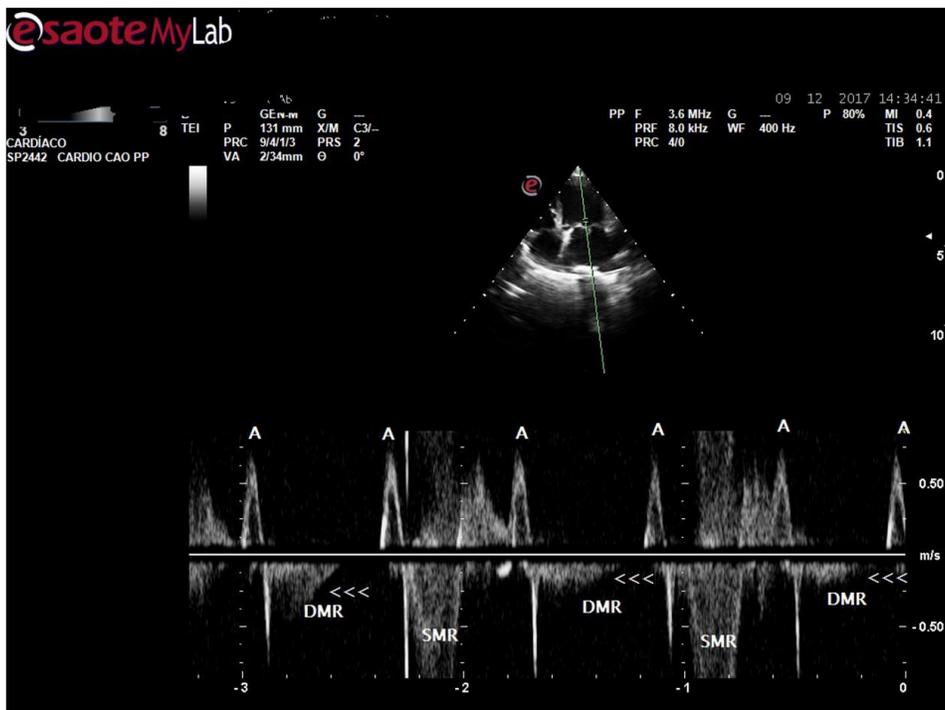


Figure 2. Pulsed spectral Doppler of transmittal flow. The atrial waves (A) are dissociated of ventricular contractions. The systolic mitral regurgitation (SMR) had velocity exceeding the Nyquist limit and the signal was aliased. Weak jet of diastolic mitral reflux (DMR) is shown.

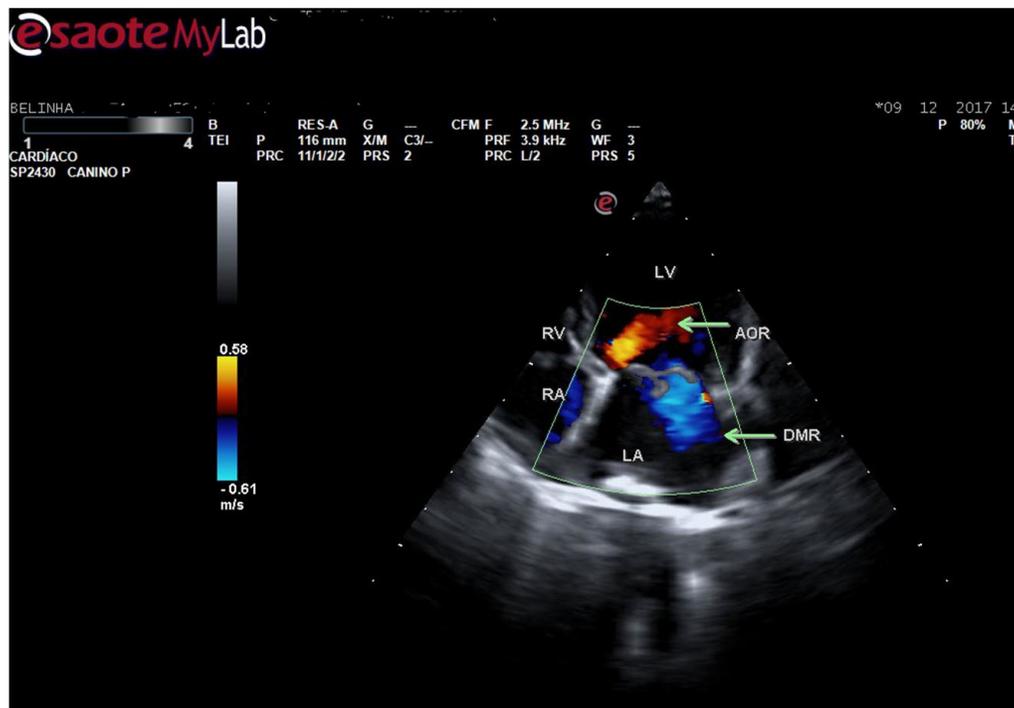


Figure 3. Color flow Doppler mapping (apical 4-chamber view) shows blue color of diastolic mitral reflux (DMR) during 3AVB. LV = left ventricle; RV = right ventricle; RA - right atrio; LA = left atrio; AOR = atrium aorta ratio.

On the same day of the diagnosis, the patient underwent an emergency ovario-salpingo-hysterectomy (OSH) and was administered antibiotics, corticosteroid, intravenous crystalloid fluid therapy, and oxygen supplementation. These interventions resulted in fast clinical amelioration. Forty-eight hours after surgery, the patient was discharged from the hospital and a repeat electrocardiogram revealed complete reversion to sinus rhythm (Figure 4). Meanwhile no more atrioventricular diastolic reflux was detected on the echocardiogram (Figures 5 and 6).

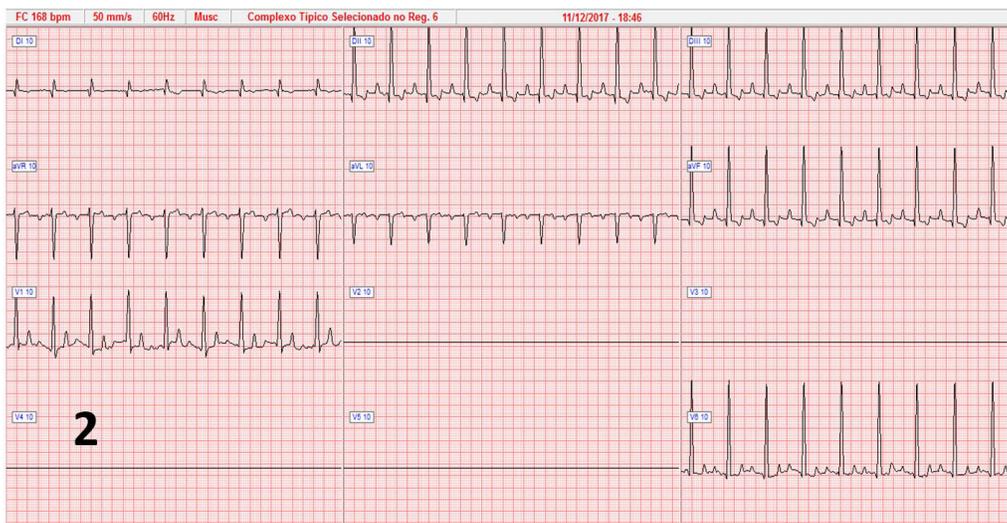


Figure 4. ECG after conversion into normal sinus rhythm. The heart-rate was 160 bpm. The P waves are wide (52 ms), indicative of left atrial enlargement. Paper speed = 50 mm/sec; calibration: 1 cm = 1mV.

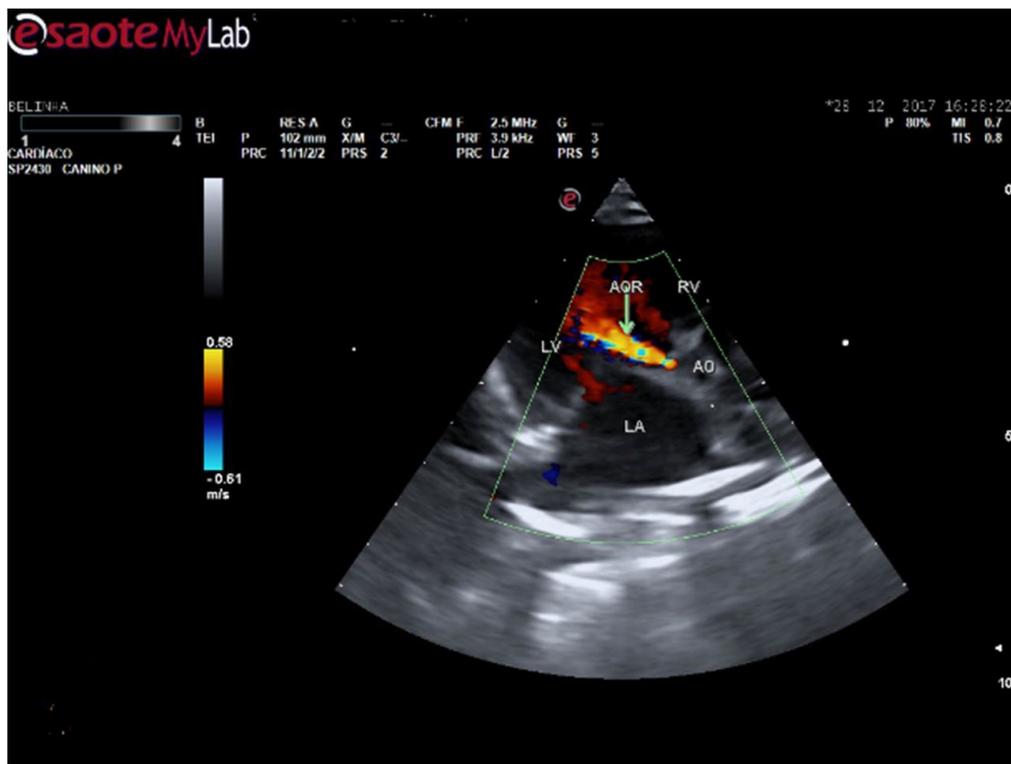


Figure 5. Color flow mapping shows aortic insufficiency (AOR) but no more mitral diastolic reflux after restoration of sinus rhythm. LV = left ventricle; RV = right ventricle; AOR = atrium aorta ratio; LA = left atrium; AO= aorta.

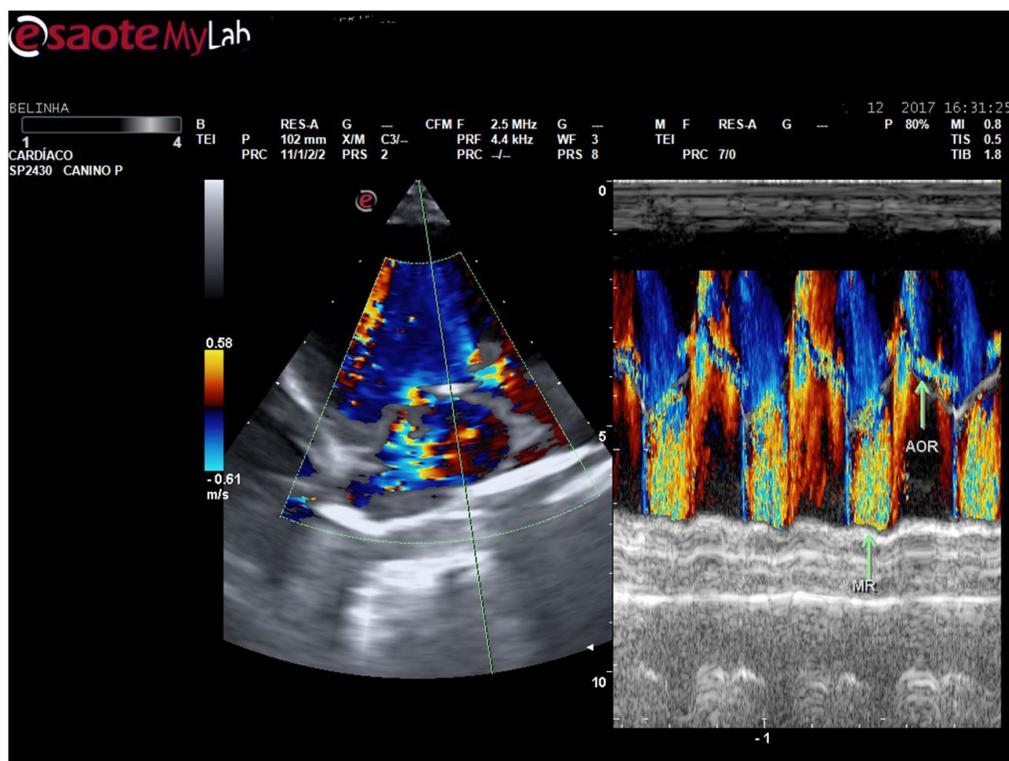


Figure 6. The color Doppler M-mode during sinus rhythm, demonstrating permanence of aortic (AOR) and mitral regurgitation (MR) and absence of atrioventricular diastolic reflux.

Discussion

3AVB is classified as congenital or acquired, and can be transient, intermittent or permanent. It results from an interruption of the electrical impulse between atria and ventricles, due to an anatomical or functional impairment in the AV conduction system (Santilli et al., 2019). This case arrhythmia was classified as transient since it was spontaneously reverted to sinus rhythm after the OSH.

Pyometra, a common illness in bitches, is characterized by purulent inflammation of the uterus, and can cause systemic inflammatory response syndrome or sepsis. Additionally, pyometra can affect multiple organs, including the cardiovascular system, and is associated with poor prognosis. Cardiac complications of pyometra are not surprising because endotoxemia induced by a uterine infection can lead to myocardial injury, which in turn, can lead several complications, including cardiac arrhythmias (Pelander et al., 2008). Given that the patient met the clinical and laboratory criteria of SIRS or SEPSIS (Hauptman et al., 1977; Quintana, 2015), it is plausible that the uterine infection triggered arrhythmia. Concomitantly, the patient had subjacent advanced mitral valve disease which, by itself, may act as predisposing factor for development of atrioventricular conduction disturbances (Kaneshige et al., 2007).

Along with the restoration of sinus rhythm, the echocardiography demonstrated significant mitral and aortic insufficiency but no atrioventricular diastolic reflux (Figure 5 and 6). This interesting hemodynamic phenomenon is common in both humans and canines that have second and 3rd-degree AV block. It appears because in 3AVB the atrial contractions are not followed by adequate synchronization with ventricular systole, and the transmitral gradient reverses during atrial relaxation because the diastolic ventricular pressures are higher than the atrial pressure. At the same time, the atrioventricular valves are partially closed, which results in reflux (Rosenthal & Fox, 1995). Usually, the diastolic reflux is mild, with no hemodynamic significance and can be identified by using both color-flow Doppler and color-flow mapping, as demonstrated in this case-report.

Interestingly, in this particular patient, it is possible that the removal of the significantly enlarged uterus decreased the intra-abdominal pressure on the aorta and abdominal vena cava, which facilitated the hemodynamic improvement.

This rare case highlights that 3AVB, when associated with an infection, i.e., pyometra, is potentially reversible, once the source of the infection is quickly identified and eliminated.

Author contributions

All authors equally contributed to the planning of the study, acquisition of data, subsequent analysis and interpretation, as well preparation of the manuscript.

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