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Clinical Case Seminar

CCS1 (1-6)

Arrhythmogenic right ventricular cardiomyopathy in a cat

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Abstract

Cardiomyopathies are a heterogeneous group of disorders of the myocardium, characterized by multiple clinical manifestations with different prognoses (1). In cats, heart disease is frequent and is considered one of the most common causes of death (2,3). ARVC is rare in pets and has a lot of similarities to human ARVC (4,5). Signs of the disease include moderate/severe dilation of the right ventricle, regional or diffuse thinning of the wall, and sometimes aneurysm. The histological examination shows the presence of adipose or fibrous tissue that replaces myocardium, focal myocarditis, and cell apoptosis, more frequent in the right ventricular wall (6). Clinical signs are related to right-sided heart failure; dyspnea caused by pleural effusion, ascites, turgor of the jugular veins, episodes of syncope (5,6). The outcome of the disease is not favorable, especially when the symptoms of heart failure become evident (6).

Key Words: Arrhythmogenic right ventricular cardiomyopathy, cardiac arrhythmia, cardiac disease, feline heart disease

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Introduction

Cardiomyopathies are a heterogeneous group of disorders of the myocardium, characterized by multiple clinical manifestations with different prognosis (1). In cats, heart disease arefrequent and are considered one of the most common causes of death (2,3). ARVC is a rare in pets and has a lot of similarity to human ARVC (4,5). Signs of the disease include moderate / severe dilation of the right ventricle, regional or diffuse thinning of the wall and sometimes aneurysm. The histological examination shows the presence of adipose or fibrous tissue that replaces myocardium, focal myocarditis, and cell apoptosis, more frequent in the right ventricular wall (6). Clinical signs are related to right-sided heart failure; dyspnea caused by pleural effusion, ascites, turgor of the jugular veins, episodes of syncope (5,6). The outcome of the disease is not favorable, especially when the symptoms of heart failure become evident (6).

Clinical Case

A 5-year-old domestic short-haired cat, male, neutered, was referred to the Teaching University Veterinary Hospital - the University of Messina, with a medical history of lethargy, anorexia, and dyspnea which had appeared for ten days. The patient was depressed, normothermic (38.2 °C), and with

dehydration of 5%. Mucous membranes appeared pale, with a capillary refill time of more than 2 seconds. The pulse was small, palpable on both femoral arteries (180 bpm). Breathing was shallow, with a high rate (> 60 arm). On chest auscultation, muffled heart sounds were detected. The blood pressure recorded by the oscillometric method (VET HDO, Digitare Biomedical Technology, Florida, USA), was within the reference ranges for the species under examination (135/98 mmHg)(6). The jugular veins were dilated. The blood count showed normochromic normocytic anemia, while the biochemical and urine tests were normal.

The electrocardiography showed the presence of sinus rhythm with a heart rate of 220 per minute, polymorphic premature ventricular complexes with right bundle branch block morphology, and generalized low voltage. The radiographic examination revealed the presence of effusion in the thoracic cavity and congestion of the pulmonary vessels with slight enlargement of the cardiac silhouette. Echocardiography showed severe right atrial and right ventricular dilation (end-diastolic volume; 18.7 mm; normal values: 5.0 ± 2.1); the right ventricular wall was thinned (1.8 mm; normal values 2.3 ± 0.1) with aneurysms in the apical region and moderate dilatation of the pulmonary trunk. Dilation of the left atrium was also evident (left atrium/aorta ratio 1.8), a pseudonormaltransmitral pattern is recorded, presence of a slight pericardial effusion and a fraction of shortening of 38%. Doppler echocardiography detected tricuspid regurgitation (maximum velocity 4.1 m/s).

The animal was treated with furosemide at a dosage of 2 mg/kg /BID, enalapril 0.25mg/kg/SID and sotalol at 0.5. mg / kg / BID orally. After an initial improvement in the clinical conditions which were stable for about two months, the cat died about sixty days after starting the therapy.

At the necropsy, the cat had a modest quantity of serous haematic liquid fluid in the abdomen and chest; signs of congestion were observed upon opening the lungs. The pericardium appeared thickened, whitish with abundant fat (Fig. 1); also, the presence of an increased serous intrapericardial fluid was highlighted at the opening. The myocardium uniformly increased in volume in the right and left ventricles, showed an altered, almost whitish color (Fig 2).

Fig. 1 Thickened and opaque pericardium

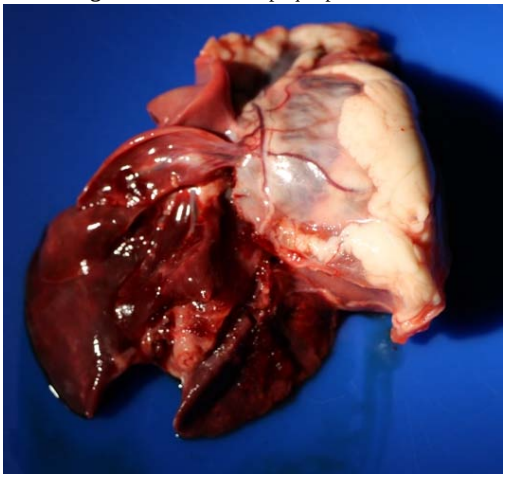
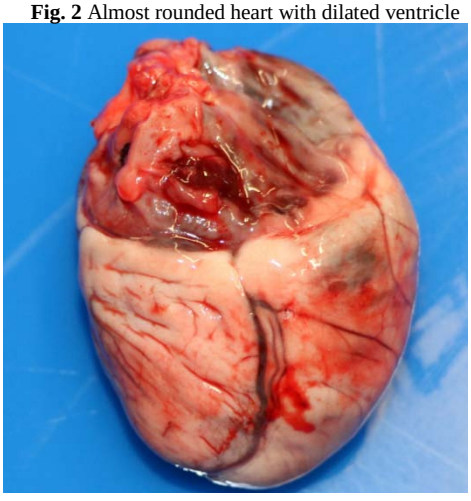
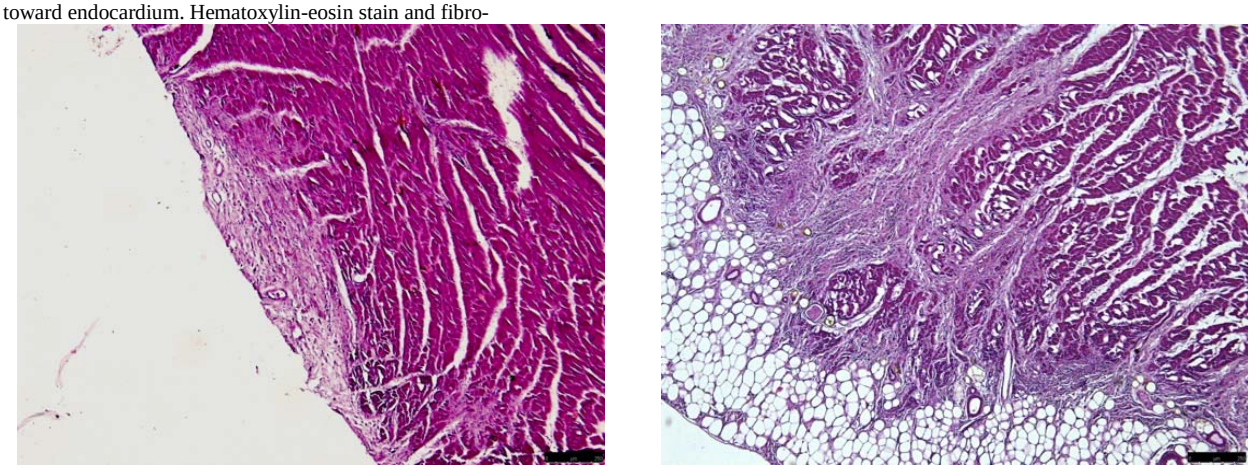


Fig. 2 Almost rounded heart with dilated ventricle



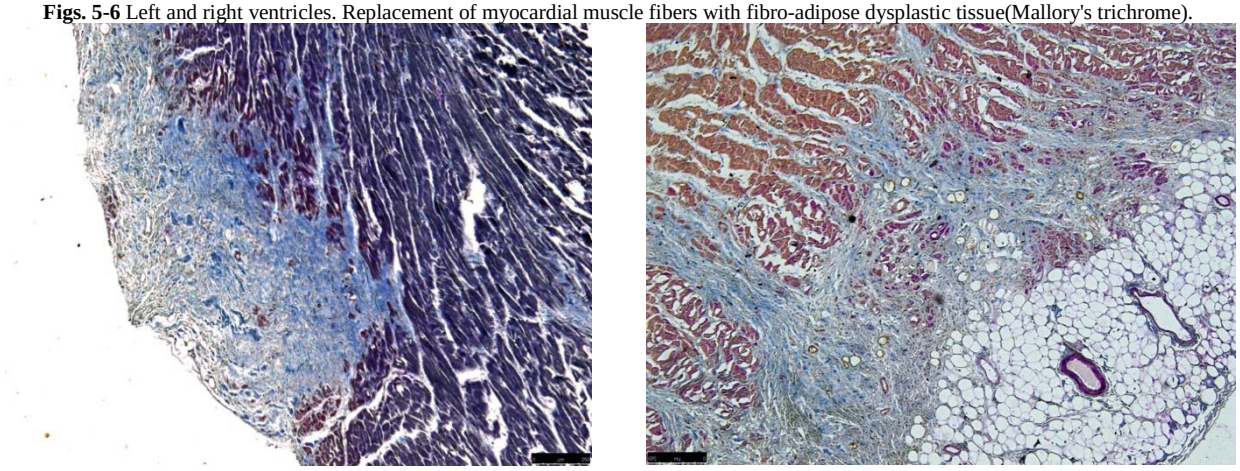
The histological examination conducted on serial sections of both ventricles showed similar pathological conditions (Figs. 3- 4).

Figs. 3-4 Heart: Right and left ventricles. Signs of myocytes degeneration with inflammatory infiltrates fatty tissue extending from epicardium toward endocardium. Hematoxylin-eosin stain and fibro-



Structurally, it was possible to identify various dysplastic areas, infiltrated by fibrous and adipose tissue that replaced the myocardial fibers (Figs. 5-6). The diagnosis of ARVC was therefore based on the clinical and diagnostic findings.

Figs. 5-6 Left and right ventricles. Replacement of myocardial muscle fibers with fibro-adipose dysplastic tissue(Mallory's trichrome).



Discussion and conclusion

ARVC is uncommon cardiomyopathy, described in humans, dogs, and cats (4,5,7,8,9). It is characterized by dilation of the right ventricular cavity associated with ventricular arrhythmias, CHF, and sudden death.

In humans, the prevalence of ARVC has been estimated at 1:2500 to 1:5000 (7). The frequency of sudden death in apparently healthy patients (such as young athletes) is remarkably high (10). Mostly these are familial, autosomal dominant forms, linked to anomalies of the gene responsible for coding the proteins responsible for mechanical cell junctions (plakoglobin, plakophilin, desmoglein, desmocolin, desmoplakin) and the remodeling of intercalary discs (11,12). However, it has recently been shown desmosomal mutations in just less than 20% of patients with ARVC, therefore it is likely that there are still unknown factors at the origin of the disease (13).

ARVC was initially described only in the right ventricle, most recently it was shown that most patients have biventricular involvement (13). The left ventricular show typically subepicardial, and the changes are related more to fibrosis than to fat or fibrofatty infiltration (14). The clinical stages may include a subclinical phase, followed by ventricular arrhythmias, palpitations, syncope, and right ventricular failure (7). The diagnosis is based on structural changes identified by cardiac MRI, echocardiography or angiography, histopathology, as well as characteristic ECG-changes, documentation of arrhythmias, and family history (7).

In dogs, the first case of ARVC was reported in 1983 by Harpster (15). The breeds most affected are the English Bulldog and Boxer (15,16,17). In boxer dogs, a genetic mutation associated with calstabin-2 deficiency has been identified, which is transmitted with an autosomal dominant trait (15,16). Three forms of ARVC are recognized: subclinical, with symptoms, and ARVC with symptoms related to CHF (15). Even in dogs, as in humans, sudden deaths are possible, and it has also been hypothesized that these three forms are a development of the same disease (15). In boxers with ARVC, extensive histological alterations usually occur including fibrofatty replacement of cardiomyocytes of both ventricles, frequent ventricular premature complexes, and ventricular tachycardia (16).

In the cat, the first description was made by Fox et al. (2000), in a retrospective study carried out in the United States, which reported the presence of 12 cases diagnosed between 1995 and 1998 (5). This was followed by other reports in Europe (18). The diagnosis of feline ARVC can be considered a real diagnostic challenge; in fact, no age or breed predispositions are reported, clinical signs, such as dyspnea/tachypnea, jugular vein distention, abdominal and/or pleural effusion, murmurs, and arrhythmias, are often non-specific. Currently, in veterinary medicine the diagnosis of ARVC is made on the combination of family history, the presence of marked enlargement of the right ventricular cavity, ventricular and/or supraventricular arrhythmias, and the results of post mortem examination including right ventricular dilation and fibro-adipose myocardial replacement (6).

In this case, initially, the following diseases were included in the differential diagnosis list: ARVC, hypertrophic cardiomyopathy in its end-stage form, and the outcome of previous myocarditis. Instead, the two most frequent heart diseases in cats are excluded: hypertrophic cardiomyopathy (for normal or even decreased thickness) and restrictive cardiomyopathy (absence of a restrictive transmitral diastolic pattern) (6).

The clinical signs were related to right-sided CHF, furthermore, the ECG exam shows the presence of numerous ventricular ectopic beats, which are considered common in the cat with ARVC (6,8). It was possible to highlight a partial involvement of the left ventricle, which detected both echocardiographic examination and histological analysis (5,9). This latter examination confirmed the diagnosis of feline ARVC, showing fibrosis of the free wall of the right and left ventricles. As already reported in veterinary medicine, cats with ARVC can have biventricular involvement (9). Recently, involvement of the left ventricle or both ventricles has also been shown in human medicine,

suggesting the presence of a more extensive form called "arrhythmogenic cardiomyopathy" (9,13).

In conclusion, ARVC is progressive, non-hypertrophic cardiomyopathy characterized by fibro-adipose infiltration of the ventricular myocardium, rarely described in cats. It is possible that ARVC, as for the human species, has a genetic basis, and therefore is more widespread in the feline species, than what is documented in the literature.

Conflicts of interest

The authors declare no conflict of interest.

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