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CASE REPORT

Congestive heart failure in two pet rabbits

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This case report describes congestive heart failure with pleural effusion in two middle-aged, pet house rabbits. Both had a history of acute onset dyspnoea, weakness and weight loss. Bi-atrial enlargement was seen on echocardiography in both rabbits. One rabbit had atrial fibrillation and ventricular premature complexes identified on electrocardiography. There was a radiographically evident pleural effusion in both rabbits and thoracocentesis was undertaken in one rabbit. These findings were confirmed on post-mortem examination. The aetiology for the underlying heart disease was not found, but the potential types of cardiomyopathies are discussed.

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INTRODUCTION

There are no prior reports of spontaneous congestive heart failure (CHF) with pleural effusion in the pet rabbit and naturally occurring heart disease is infrequently documented. Although Deeb and DiGiacomo (2000) identified cardiomyopathy as a relatively common post-mortem examination finding in older rabbits, they did not describe the underlying primary heart disease. Heart failure and atherosclerosis reportedly increase with age in the older pet rabbit (Deeb and DiGiacomo 2000). Specific infectious causes of myocardial disease, either in laboratory or pet rabbits include salmonella, coronavirus (DiGiacomo and Mare 1994) and *Encephalitozoon cuniculi* (Koller 1969, Csokai 2009a) while chronic stress induced by overcrowding has been linked to dilated cardiomyopathy (Weber and Van der Walt 1973). Congenital heart defects and pericarditis secondary to chronic respiratory infection have also been described (Li and others 1995, Deeb and DiGiacomo 2000).

CASE HISTORIES

Case 1

A seven-year-old, intact male, Rex house rabbit was presented to the Royal (Dick) School of Veterinary Studies [R(D)SVS] with a 3-week history of lethargy, hind limb weakness, dyspnoea and weight loss. Polydipsia and polyuria progressing to reduced thirst and anuria 24 hours before presentation were also reported. Its diet of hay, vegetables and a small amount of complete rabbit pellet and husbandry were excellent.

On examination the rabbit was weak and quiet but alert, with severe dyspnoea, tachypnoea (100 rpm; reference range 30 to 60; Meredith 2006) and open-mouth breathing. Other clinical findings included poor body condition (2·2 kg), mucous membrane pallor and prolonged capillary refill time. Coarse crackle lung sounds, mild tachycardia (heart rate >340 bpm; reference range 198 to 330; Reusch and Boswood 2003) and a cardiac gallop rhythm audible over the sternum were found on thoracic auscultation.

After stabilisation with oxygen an electrocardiogram revealed a normal sinus rhythm (rate 282 bpm). The systolic arterial blood pressure was measured using a standard Doppler technique on the palmar common digital artery. The mean was normotensive at 124 mmHg with a range of 120 to 126 mmHg (reference range 90 to 135 mmHg; Orcutt 2006). Thoracic radiographs confirmed a pleural effusion.

There were bi-atrial enlargement and left ventricular enlargement on echocardiography. Mildly decreased fractional shortening and increased E point to septal separation were recorded, suggesting reduced left ventricular systolic function (Table 1). The interventricular septal thickness at end diastole was increased but all other wall thicknesses were within the normal range reported for rabbits. Pleural and pericardial effusions were noted.

Bilateral thoracocentesis yielded 49 mL of serosanguineous fluid which, on analysis, was a modified transudate (Table 2). Cytologically, the fluid contained macrophages and lymphocytes; bacterial culture yielded no growth. Haematologically

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Table 1. Echocardiographic values from cases 1 and 2*

Parameters	Case 1	Case 2	Reference range
Aorta (cm)	0·51	0·68	0·57 - 0·77
Left atrial dimension diastole (cm)	1·18	1·36	No reference range reported, but 0·17 to 0·58 cm was reported for left atrial dimension systole
Left atrium/aorta	2·31	2	1·06 - 1·7
Right ventricular outflow tract velocity (m/second)	0·60	—	0·73 - 0·93
Left ventricular outflow tract velocity (m/second)	1·16	0·98	0·51 - 0·79
Intraventricular septal thickness at end diastole (cm)	0·34	0·32	0·2 - 0·30
Left ventricular end-diastolic dimension (cm)	1·8	1·32	0·98 - 1·36
Left ventricular posterior wall thickness at end diastole (cm)	0·29	0·44	0·23 - 0·39
Intraventricular septal thickness at end systole (cm)	0·51	0·47	No reference range reported
Left ventricular end-systolic dimension (cm)	1·2	0·62	0·61 - 0·79
Left ventricular posterior wall thickness at end systole (cm)	0·41	0·56	No reference range reported
Fractional shortening (%)	33·76	53·33	34·11 - 44·89
E point to septal separation (cm)	0·24	—	0·05 - 0·1

*Echocardiographic values from cases 1 and 2 and reference range values where they have been established from six-, seven-month-old rabbits that were sedated with diazepam (Marini and others 1999).

Table 2. Thoracic fluid analysis from case 1*

Parameters	Case 1	Reference range
Thoracic fluid		
Protein (g/L)	24·8	25 - 30
Nucleated cell count (µL)	1900	1000 - 7000
Blood		
Neutrophils (heterophils) ($\times 10^9$/L)	8·96	3·09 - 5·15
Creatinine (µmol/L)	699	44·2 - 229
Urea (mmol/L)	39·5	6·14 - 8·38
Phosphate (mmol/L)	3·12	1·28 - 1·92

*Abnormal clinical pathology values from case 1 and reference range values for the thoracic fluid analysis (Dunn and Villiers 1998) and the haematology and serum biochemistry (Harcourt-Brown 2002).

there was mild neutrophilia (8·96×10^9/L; 3·93 to 6·55×10^9/L) and serum chemistry confirmed severe azotaemia (urea 39·5; 6·14 to 8·38 mmol/L and creatinine 699; 44·2 to 229 µmol/L) and hyperphosphataemia (3·12; 1·28 to 1·92 mmol/L). Standard medical treatment failed to stabilise the rabbit and it died 24 hours after presentation.

At gross post-mortem examination, the atria were bilaterally moderately enlarged. The right and left ventricular walls measured 2 and 6 mm, respectively, which is thicker than available reference ranges by 8 and 32%, respectively (Latimer and Sawin 1959). The left atrium contained a thrombus (Fig 1). The pericardial sac and the pleural space contained 1 and 90 mL of serosanguineous fluid, respectively. The kidneys were diffusely grey/white with irregular capsular surfaces and irregular bands of fibrous tissue interspersed with residual areas of cortex.

Microscopically in the myocardium of the left ventricular free wall and interventricular septum there was multi-focal loss of myofibres and replacement by fibrous tissue. There was variation in myofibre diameter due to myofibre atrophy and hypertrophy. Widespread myofibres had vacuolated sarcoplasm and some were mineralised (Fig 2). Left atrial thrombosis (Fig 3) was confirmed and there was marked left atrial endocardial fibrosis (Fig 4).

Microscopically, the cortical surface of the kidneys was irregular due to parenchymal loss and collapse. Radiating bands of fibrosis extended into the medulla accompanied by tubular atrophy and loss. There was a mild tubular degeneration and regeneration as well as tubular mineralisation. The interstitium was infiltrated by moderate numbers of lymphocytes, plasma cells and fewer heterophils. Mineralisation of the tunica media was present in several blood vessels. A carbol-fuschin stain was negative for microorganisms.

Case 2

A seven-year-old, female neutered, cross-breed house rabbit was presented to the R(D)SVS with a 3-month history of weight loss despite a good appetite. A more recent 5-day history of dyspnoea, lethargy and hind limb weakness was reported. Its diet and husbandry were similar to case 1.

The rabbit was quiet and alert but weak and in poor body condition (2·4 kg). Moderate dyspnoea and tachypnoea (68 rpm) were present. Coarse crackle lung sounds, muffled heart sounds and tachycardia (360 bpm), with an irregularly irregular cardiac rhythm, were detected on auscultation. The femoral pulse was weak and irregular with no pulse deficits detected.

Haematologically, there was mild neutrophilia (8·1×10^9/L; reference range 3·93 to 6·55×10^9/L) and moderate monocytosis (1·7×10^9/L; reference range 0·3 to 1·3×10^9/L) (Harcourt-Brown 2002). On electrocardiography there was atrial fibrillation with a rapid ventricular response rate (350 bpm) and frequent ventricular premature complexes (VPCs). Deep S-waves were present in lead II (Fig 5). Thoracic and abdominal radiographs confirmed a pleural effusion and indicated hepatomegaly (Figs 6 and 7). Echocardiography indicated bilateral atrial enlargement, mitral and tricuspid valve regurgitation and pleural and mild pericardial effusions (Table 1). The rabbit died a few days later despite treatment with furosemide (2·4 mg Dimazon injection 5%; Intervet UK Ltd) (1 mg/kg sc every 12 hours).

At gross post-mortem examination, the thoracic cavity contained 45 mL of serous fluid admixed with fibrin clots. The lung lobes were consolidated and there were fibrinous adhesions between the visceral and parietal pleura. Both atria and ventricles were mildly dilated. There was diffuse myocardial pallor with several pale flecks on the apical epicardium. The kidneys were bilaterally symmetrical but paler than normal. Histopathological examination of these tissues was not performed.

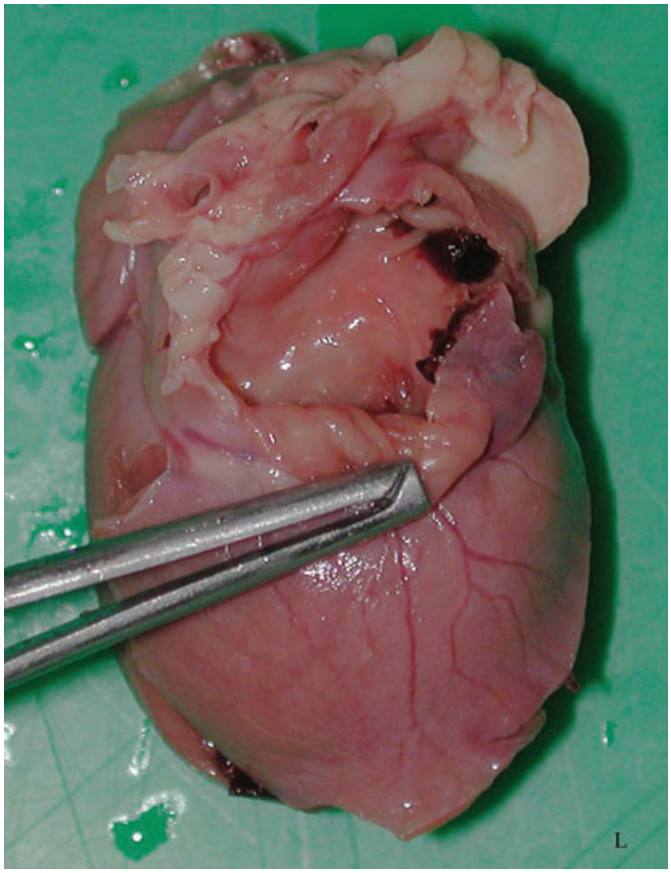

FIG 1. Gross post-mortem examination of left atrium in an adult rabbit (case 1) showing firmly attached thrombus in the left atrium. 127×165 mm (300×300 DPI)

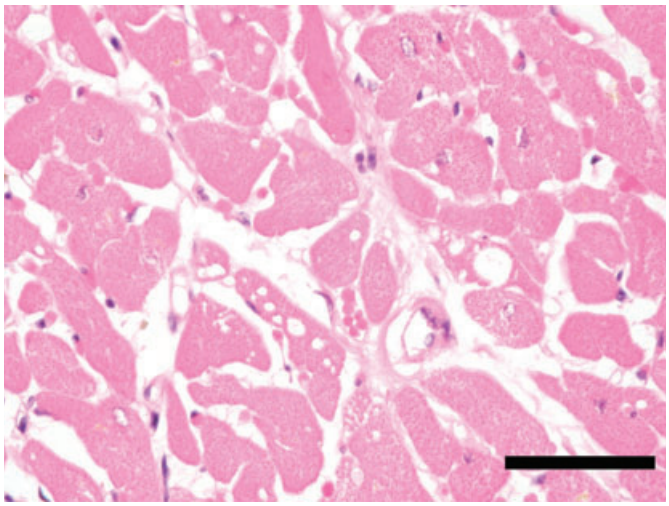

FIG 2. Microscopic section of a rabbit myocardium, left ventricular wall (case 1), showing a number of myofibres contain clear, discrete, round, cytoplasmic vacuoles. H&E stain. Bar=50 mm

DISCUSSION

There is one short communication of CHF due to cardiomyopathy of unknown aetiology in a pet rabbit (Martin and others 1987). That case had some similarities to the two rabbits reported herein, including acute onset dyspnoea, atrial fibrillation and VPCs. Pathological similarities included bilateral atrial enlargement, pericardial effusion and myocardial degeneration. However, there were some differences. In the previously reported rabbit severe cardiomegaly was present but pleural effusion and renal lesions were absent. In this current report, the aetiology of the heart disease remained undetermined in both rabbits. In case 1, the gross and microscopic features and lack of significant vascular disease correlated best with a primary cardiomyopathy, most likely hypertrophic cardiomyopathy (HCM). This was supported by the increased ventricular wall thickness bilaterally, the bi-atrial dilation, myocardial fibrosis and absence of ventricular dilation. In case 2, the gross cardiac findings were more suggestive of dilated cardiomyopathy. The echocardiographic findings in both cases indicated both asymmetric concentric hypertrophy, atrial dilation and, in case 1, poor systolic function, suggesting an unclassified cardiomyopathy.

As well as cardiomyopathy, the two rabbits had chronic nephropathy in common, although case 2 was diagnosed based on gross post-mortem examination alone. In case 1, histopathological examination confirmed extensive interstitial fibrosis, interstitial nephritis, parenchymal collapse and mineralisation, consistent with end-stage renal disease.

Renal fibrosis has been previously reported in the rabbit. One histological survey identified its presence in 14% of rabbits and highlighted increasing prevalence with age (Hinton 1981). Thus, renal fibrosis may be an incidental, age-related finding. However, case 1 also had clinically appreciable renal disease, with the history suggesting acute deterioration due to end-stage renal failure. The renal lesions in case 2 may have been incidental as the history, clinical signs and biochemistry did not indicate concurrent renal dysfunction.

A common cause of lapine nephritis is *E. cuniculi*. Histological examination and special staining is considered the most sensitive method of diagnosis (Csokai 2009b). As these were both negative in case 1, this parasite was considered an unlikely cause in this particular case, despite the lack of serological testing.

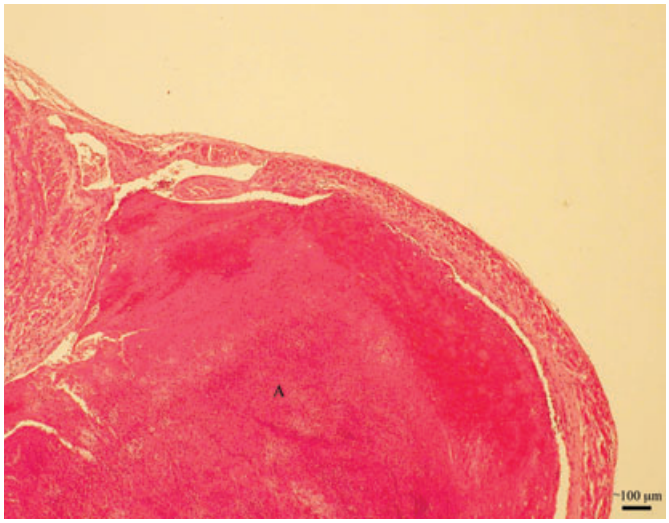

FIG 3. Microscopic section of a rabbit left atrium wall (case 1) showing a large thrombus intimately attached. A=thrombus. H&E stain. ×40

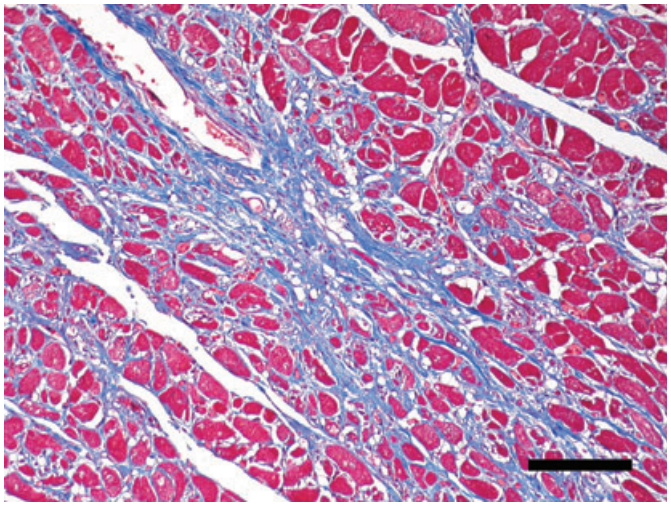

FIG 4. Microscopic section of a rabbit myocardium, left ventricular wall (case 1). There is extensive fibrosis (blue) effacing the myofibres and dissecting through the myocardial interstitium. Masson's trichrome. Bar=50 mm

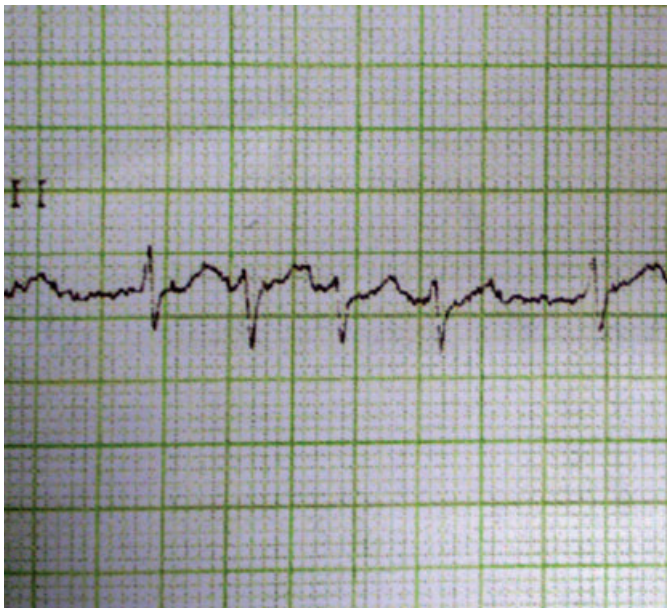

FIG 5. Electrocardiogram of a rabbit (case 2) showing a PQRS complex with deep S-waves, followed by three consecutive ventricular premature complexes found on lead II. A vertical calibration of 2 cm/mV and a horizontal paper speed of 50 mm/second were used

A mural thrombus was also found in one of these previously reported rabbits (Hurley and others 1994). This is a well-recognised phenomenon in cats with HCM linked to increased turbulence (Kittleson 1995). Pleural effusion also occurs in cats with HCM and CHF. One suggested theory for this is that the visceral pleural veins drain into the pulmonary veins such that elevated pulmonary vein pressure favours the formation of an effusion (Kittleson 1995), but has not been proven in species with thin visceral pleura (rabbit, dog and cat) (King 1999).

The response to treatment is difficult to assess in this case report as both animals deteriorated rapidly. Further investigation into the aetiology, pathology, diagnosis, treatment and prognosis of CHF in the pet rabbit is required.

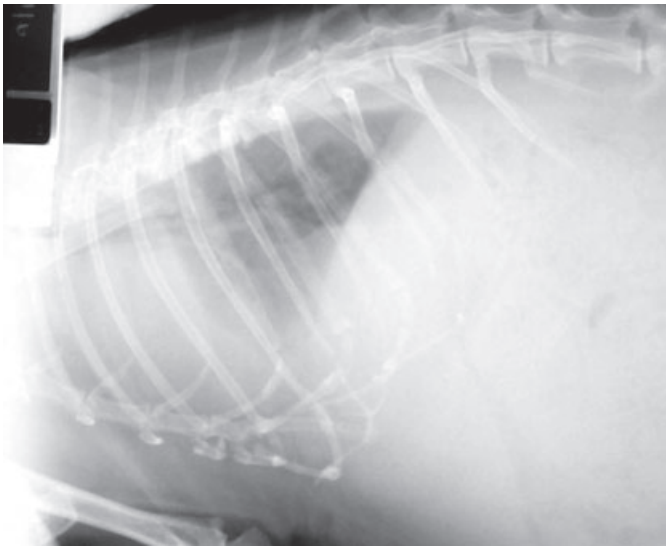

FIG 6. Lateral thoracic radiograph of a rabbit (case 2) showing evidence of pleural effusion

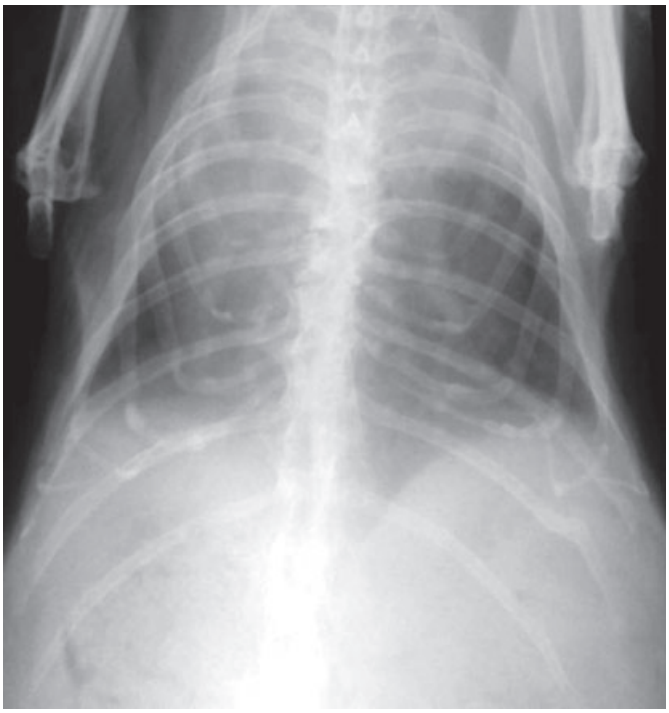

FIG 7. Dorsoventral thoracic radiograph of a rabbit (case 2) showing evidence of pleural effusion

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Conflict of interest

None of the authors of this article has a financial or personal relationship with other people or organisations that could inappropriately influence or bias the content of the paper.

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