ATRIAL SEPTAL DEFECT IN A FERRET (*MUSTELA PUTORIUS FURO*)

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Abstract

A 2-year-old, male castrated ferret (*Mustela putorius furo*) was presented with progressive abdominal distention and loss of muscle mass despite normal appetite. Physical examination findings included pale mucous membranes, a prolonged capillary refill time, a pulse rate greater than 300 beats/min, and severe abdominal distention. Abdominal ultrasound showed free abdominal fluid and an enlarged liver with distended hepatic veins and caudal vena cava. During the echocardiographic examination, abnormalities observed included a 2-mm-diameter left-to-right shunting atrial septal defect (ASD) with concurrent severe dilatation of the right atrium and eccentric hypertrophy of the right ventricle with mild pulmonary hypertension. All other echocardiographic measurements were within normal limits. The owner declined treatment, and the ferret was euthanized. Postmortem examination confirmed the ultrasonographic findings. The free abdominal fluid (200 mL) was a non-septic fibropurulent exudate. Decompensated right-sided heart failure due to ASD and exudative peritonitis of undetermined origin were the final diagnoses. To our knowledge, this is the first report of an ASD in a ferret.

Key words: atrial septal defect; cardiac; congenital; ferret; heart

An approximately 2-year-old, male castrated ferret (*Mustela putorius furo*) was presented to the referring veterinarian with progressive abdominal distention and cachexia with normal appetite. The same clinical signs were noted shortly after the arrival of the ferret at a ferret shelter 7 weeks before presentation. The history of the ferret before this period was unknown. The referring veterinarian considered ascites to be the most likely cause of the abdominal distention, because further physical examination was unremarkable. Serum chemistry performed by the same veterinarian showed hypoalbuminemia (1.2 g/dL; reference range, 3.4-4.8) and a normal total protein concentration (5.2 g/dL; reference range, 4.3-6.0). Proteinuria was determined with a dipstick (+++, >3 g/L). Treatment was started with furosemide (unknown dose) and an unspecified feeding protocol; no clear improvement was observed over 12 days of treatment, after which the ferret was referred to the Division of Zoological Medicine at Utrecht University.

When the ferret was initially examined at the Veterinary Teaching Hospital, abnormal findings included pale mucous membranes, a capillary refill time greater than 2 seconds, a heart rate greater than 300 beats/min, and severe abdominal distention with a positive fluid wave (Fig. 1). A heart murmur was not auscultated, nor was jugular distention noted. Abdominal ultrasound

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1557-5063/13/2201-$30.00
http://dx.doi.org/10.1053/j.jepm.2012.12.011

FIGURE 1. Photograph of patient with severe abdominal distention due to ascites and loss of muscle mass.

in the conscious patient showed ascites with an echogenic aspect, a severely enlarged liver, a distended caudal vena cava, and distention of the hepatic veins (Fig. 2). Other abdominal organs were within normal limits. During a subsequent echocardiographic examination, a left-to-right shunting ostium secundum atrial septal defect (ASD), 2 mm diameter, was diagnosed (Fig. 3). The shunt had a maximum flow velocity of 0.7 m/s during atrial diastole, corresponding to a pressure gradient of 2 mm Hg. Severe dilation of the right atrium and severe eccentric hypertrophy of the right ventricle were noted (Fig. 4). The tricuspid valve appeared to have a normal morphologic aspect, and with color-flow Doppler, a moderate to severe insufficiency was visible with a maximum blood flow velocity of 2.4 m/s (corresponding to a pressure gradient of 23 mm Hg) during ventricular systole. With the right-sided parasternal short-axis heart base view, the pulmonary artery annulus diameter was slightly larger than the aortic annulus diameter. Maximum pulmonic blood flow velocity was 0.9 m/s during ventricular systole; with color-flow Doppler, a mild pulmonic artery insufficiency was noted (Table 1). No other cardiac abnormalities were diagnosed. The owner declined treatment, and the patient was subsequently euthanized with a commercial euthanasia solution (0.5 mL intravenously) (T61; MSD Animal Health, Boxmeer, Netherlands) and submitted for postmortem examination.

On gross examination, the heart was pale brown and both the right atrium and ventricle were dilated. A 2-mm round defect was present in the dorsomedial atrial septum. The tricuspid and bicuspid valves were morphologically normal. The lungs were edematous. Approximately 200 mL of fibrinopurulent exudate was present in the abdominal cavity. The enlarged liver was covered with yellow-beige material, and both kidneys were pale beige. Impression smears (Hemacolor quick stain; Merck, Darmstadt, Germany) of the abdominal exudate and the liver showed toxic neutrophilic granulocytes. Tissue samples from the heart, lung, liver, spleen, pancreas, and kidney were fixed in 10% buffered formalin, embedded in paraffin, cut at 4 μm, and stained with hematoxylin-eosin. In addition, the heart was stained with phosphotungstic acid hematoxylin.

Histologically, the heart showed cardiomyocytes with cytoplasmic pallor. On phosphotungstic acid hematoxylin staining, subendocardial loss of normal stained cardiomyocytes was evident. The lung was edematous with many alveolar macrophages. The liver showed porto-portal bridging fibrosis with extensive periportal lym-

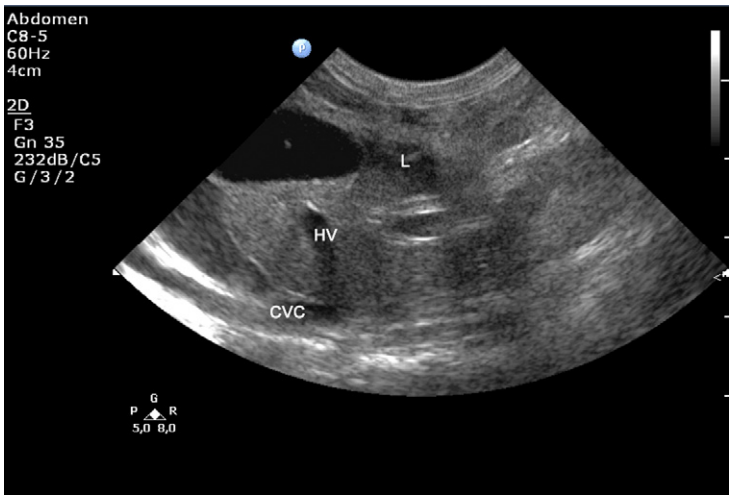

FIGURE 2. Abdominal ultrasound shows severe hepatomegaly and distention of the caudal vena cava (CVC) and hepatic veins (HV). (L, liver.)