

Porcelain aorta in a cat with feline leukemia virus and suspected mediastinal lymphoma

Aorta de porcelana em um gato com vírus da leucemia felina e suspeita de linfoma mediastinal

Aorta de porcelana en un gato con virus de la leucemia felina y sospecha de linfoma mediastínico

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Abstract

A five-year-old domestic cat with pleural effusion and renal failure was referred for cardiology evaluation. The cat had positive serology for feline leukemia virus (FELV) and was suspected of having mediastinal lymphoma. According to laboratory results, the patient's renal failure was classified as Chronic Kidney Disease (CKD) IRIS stage-3. Radiographic examination of the chest indicated a massive pleural effusion. After thoracocentesis, new chest radiographs revealed vascular calcification, extending from the aortic root to the abdominal aorta, including the celiac and cranial mesenteric arteries. It also demonstrated an increase in volume and calcification of both kidneys. Ultrasonography of the mediastinum showed a heterogeneous hypoechoic mass suggestive of lymphoma. The walls of the thoracic aorta were thickened and hyperechoic, concomitant with mild valve insufficiency. Due to the similarity of the patient's radiographic and echocardiograph findings with those described in humans with the so-called “porcelain aorta”, we propose the same nomination for this specific case. Extensive calcification of the aorta seems to be extremely rare in domestic cats, considering that the veterinary literature includes very few publications. The objective of this case report was to present the results of clinical history, laboratory, and image changes in a cat FELV-positive, suspected lymphoma, CKD, hypercalcemia, and evidence of extensive aorta calcification, concomitant to aortic valve insufficiency.

Keywords: Aorta calcification; Porcelain aorta; Vascular mineralization; CKD; Cat.

Resumo

Um gato doméstico de cinco anos de idade com efusão pleural e insuficiência renal foi encaminhado para avaliação cardiológica. O gato apresentava sorologia positiva para vírus da leucemia felina (FELV) e era suspeito de ter linfoma mediastinal. De acordo com os resultados laboratoriais, a insuficiência renal do paciente foi classificada como Doença Renal Crônica (DRC) IRIS estágio-3. O exame radiográfico do tórax indicou derrame pleural volumoso. Após toracocentese, novas radiografias de tórax revelaram extensa calcificação vascular, indo desde a raiz da aorta até a

aorta abdominal, incluindo as artérias celíaca e mesentérica cranial. Também demonstrou aumento de volume e calcificação de ambos os rins. A ultrassonografia do mediastino mostrou massa hipoecóica heterogênea sugestiva de linfoma. As paredes da aorta torácica estavam espessadas e hiperecóicas, concomitantes com insuficiência valvar leve. Devido à semelhança dos achados radiográficos e ecocardiográficos do paciente com os descritos em humanos com a chamada “aorta de porcelana”, propomos a mesma denominação para este caso específico. A calcificação extensa da aorta parece ser extremamente rara em gatos domésticos, considerando que a literatura veterinária inclui pouquíssimas publicações. O objetivo deste relato de caso foi apresentar os resultados da avaliação clínica, laboratorial e alterações de imagem em um gato FELV positivo, suspeita de linfoma, DRC, hipercalcemia e evidências de calcificação extensa da aorta, concomitante à insuficiência valvar aórtica.

Palavras-chave: Calcificação aortica; Aorta em porcelana; Mineralização vascular; DRC; Gato.

Resumen

Se remitió para evaluación cardiológica un gato doméstico de cinco años con derrame pleural e insuficiencia renal crónica. El gato tenía serología positiva para el virus de la leucemia felina (FELV) y se sospechaba que padecía linfoma mediastínico. Según los resultados de laboratorio, la insuficiencia renal del paciente se clasificó como Enfermedad Renal Crónica (ERC) IRIS estadio-3. El examen radiológico de tórax indicó un derrame pleural masivo. Después de la toracocentesis, nuevas radiografías de tórax revelaron una calcificación vascular extensa, que se extendía desde la raíz aórtica hasta la aorta abdominal, incluidas las arterias celíaca y mesentérica craneal. También demostró un aumento de volumen y calcificación de ambos riñones. La ecografía del mediastino mostró una formación hipoecóica heterogénea sugestiva de linfoma. Las paredes de la aorta torácica estaban engrosadas e hiperecóicas, concomitantemente con insuficiencia valvular aórtica leve. Debido a la similitud de los hallazgos radiológicos y ecocardiográficos del paciente con los descritos en humanos con la llamada “aorta de porcelana”, proponemos el mismo nombre para este caso específico. La calcificación extensa de la aorta parece ser extremadamente rara en gatos domésticos, considerando que la literatura veterinaria contempla poquíssimas publicaciones. El objetivo de este reporte de caso fue presentar los resultados de la historia clínica, laboratorio y cambios de imagen en un gato FELV positivo, sospecha de linfoma, ERC, hipercalcemia y evidencia de calcificación extensa de la aorta, concomitante a insuficiencia valvular aórtica.

Palabras clave: Calcificación de aorta; Aorta de porcelana; Mineralización vascular; IRC; Gato.

1. Introduction

In human medicine, porcelain aorta (PA) is a term used to define a structural aortic wall disease, characterized by extensive calcification of the thoracic aorta (Abramowitz et al., 2015; Rimilah et al. 2023).

The frequency of PA human population oscillates from 0.4 to 5.4% of patients undergoing to cardiac surgery (Vázquez-Roque, 2015), but shows increasing prevalence in the elderly, and is frequently associated with calcification of aortic valve and coronary arteries, reflecting a subjacent atherosclerotic disease (Abramowitz et al., 2015). The calcification can be located within the tunica intima, be eccentric, and initiates at the base of necrotic fibro-fatty plaques, the atherosclerotic type, or may be located in the tunica media, the non-atherosclerotic type, the so-called Monckberg calcification (Amorin et al., 2013).

PA has been found in patients with chronic kidney disease (Pitoulis et al., 2024; Carrel & Vogt, 2022), chest irradiation for mediastinal tumors (Daitoku et al, 2004; Michelena et al., 2011), and in several inflammatory diseases as Takayasu arteritis (Maikap et al., 2020), Systemic lupus erythematosus (Hirose et al., 2020), Rheumatoid arthritis (Canpolat et al., 2013), HIV infection (Abramowitz et al. 2015; Bajdechi et al., 2022).

Diagnosis of PA is often an incidental finding on routine cardiology evaluation of elderly patients during cardiovascular surgery (by manual palpation of atherosclerotic thoracic aorta) or by chest x-ray as part of planning for cardiac surgery (Michelena et al 2011). In the clinical practice, different imaging modalities are used to identify PA: plain thoracic radiography, fluoroscopy, computed tomography, nuclear magnetic resonance and ultrasound (Carrel & Vogt, 2022).

Aorta calcification seems to be rare in dogs and exceeding rare in domestic cats. In fact, in a radiograph study at Glasgow University Veterinary School, aortic and cardiac mineralization was found in 21 of 3443 (0.61%) dogs, while in 786 cats none of such alterations was found (Schwarz et al., 2002). Curiously, however, is that aorta calcification in the cat has a historical background: the legendary French physiologist Alex Carrel (Nobel Prize of Physiology & Medicine 1913) at the

beginning of the 1900`s, published a detailed description of severe calcification and atherosclerosis of the arterial system in a cat with renal transplant (Carrel, 1908). Almost one century later was reported the first radiographic characterization of mineralized vascular arteriosclerosis in a domestic cat (Lefbom et. al., 1996).

The first case of extensive aorta mineralization, reaching celiac and mesenteric arteries, was described in a cat with CKD (Keppie, Nelson and Rosenstein 2006). Another case of severe mineralization of systemic blood vessels in a cat with congenital hypothyroidism and hypercalcemia was reported in Japan (Tanaka et al., 2020), bringing new contribution to the value of radiography for the diagnosis of cardiovascular mineralization in the feline patients.

The objective of this case report was to present the results of clinical history, laboratory, and image changes in a cat FELV-positive, suspected lymphoma, CKD, hypercalcemia, and evidence of extensive aorta calcification, concomitant to aortic valve insufficiency.

2. Methodology

In this case report was used a descriptive-qualitative methodology detailing the clinical, laboratorial and imaging findings in case of a feline patient with CKD and extensive aorta calcification (Pereira et al., 2018). For radiography was used the digital direct radiograph X-Ray System Metron-DVM 7.20 (Epona Tech LCc., Creston, CA 93432), without using sedation or anesthesia of the patient. For ultrasonography was used the equipment Esaote MyLab X-5 Ultrasound System (Esaote S. p. A. Genova, Italy).

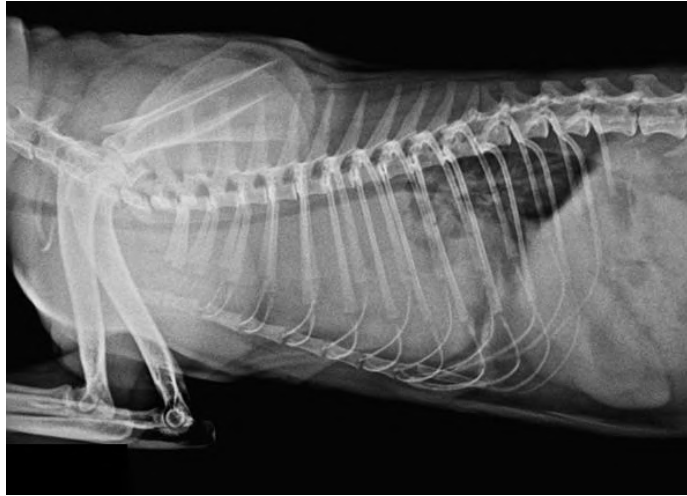
3. Case Description

A five-year-old male shorthaired domestic cat with dyspnea, anorexia and poor body score condition was referred for cardiologic evaluation due to dyspnea. Chest radiographs detected large pleural effusion, while laboratory results demonstrated uremia and hypercalcemia. For dyspnea alleviation, a volume of 30 ml of bloody liquid was withdrawn via thoracocentesis. The cat had previous positive serology testing for feline leukemia virus (FELV) and was suspected of having mediastinal lymphoma. The cat received human interferon, prednisolone, furosemide, ondasertrone, amoxicillin, and nutritional food supplement. He initiated vomiting, worsening dyspnea, weight loss, weakening, and finally died after almost two months.

4. Results

Plain chest radiographs suggested large pleural effusion (Figure 1). After removal of 30ml of pleural liquid by thoracentesis (Figure 2), a new X-ray revealed a mediastinal "soft-tissue mass" and apparently no pleural effusion. Furthermore, the image demonstrated extensive calcific demarcation of the aorta walls, affecting thoracic and abdominal aorta, as well as the celiac and cranial mesenteric arteries, and both kidneys (Figure 3).

Figure-1 - Right lateral radiograph projection.



Source: Authors (2023).

Notice a large thoracic opacity and dorsal displacement of the trachea, suggesting pleural effusion.

Figure 2 - Fluid collected from pleural cavity.



Source: Authors (2023).

Pleural fluid collected through thoracentesis, showing bloody appearance.

Figure 3 - Plain right lateral thoracic radiography.



Notice the extensive calcification of aorta, extending from the sinotubular junction (SJ), to ascending aorta (AAo), descending aorta (DAo), abdominal aorta (AbAo), celiac (>) and cranial mesenteric arteries (<). Radiopacity is evident in the cranial mediastinum (*). Both kidneys (K) were also radiopaque, compatible with diffuse calcification. S=liver; S=spleen. Source: Authors (2023).

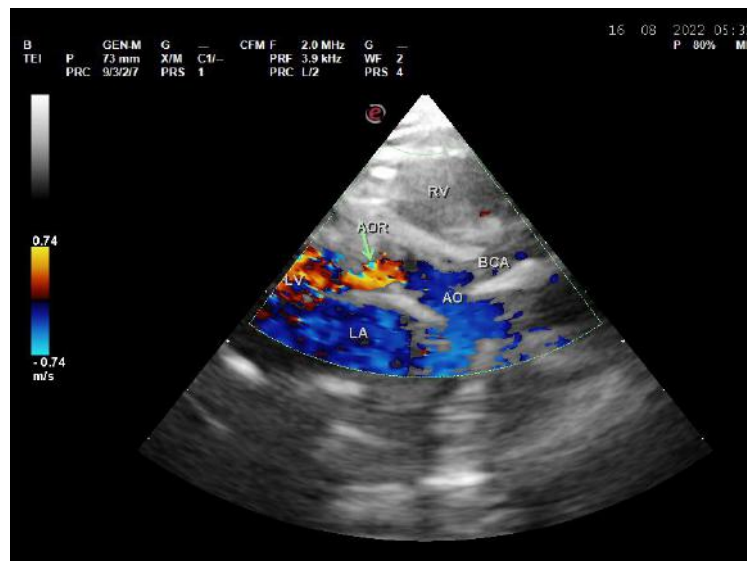
Echocardiograph examination showed aortic walls thickened and echogenic, with irregularity of its internal surface, suggesting atherosclerotic changes, similar to findings in humans with porcelain aorta. Furthermore, was also noted aortic valve thickening (Figure 4), accompanied by mild insufficiency on color image mapping (Figure 5). Mediastinal ultrasound revealed heterogeneous mass, suggestive of tumor (Figure 6). However, was not performed cytological examination of the pleural liquid, neither serological marker for lymphoma.

Figure 4 - Right parasternal longitudinal axis view.



Bi-dimensional echocardiography image showing thickened aortic valve (>), as well as of the aortic walls (LV= left ventricle; LA= left atrium; RV= right ventricle. AO=aorta). Source: Authors (2023).

Figure 5 - Two-dimensional color-mapping echocardiogram, right parasternal longitudinal axis view.



Notice thickening of the aortic walls. Doppler study shows mild aortic regurgitation (AOR). LV= left ventricle; LA= left atrium; RV= right ventricle. AO=aorta. Source: Authors (2023).

Figure 6 - Mediastinal ultrasound image.



Source: Authors (2023).

Ultrasound of the cranial mediastinum showing heterogeneous, hypochoic formation, suggestive of tumoral mass.

The haemogram was within normal reference range for cats (Table-1), while blood chemistry demonstrated elevation of alanine transferase, serum protein, total calcium, urea and creatinine (Table-2).

Table 1 - Blood examination.

Haemogram	Results	Reference values *
Red Blood Cells (x10 ⁶ cells/ μ L)	8.8	5.0 – 10
Hemoglobin (g /dL)	13	8.0 – 16.0
Haemathocrit (%)	43	24.0 – 45.0
MGV (fL)	48.9	39.0 – 56.0
MCHC (g/dL)	30.2	30.0 – 36.0
White Blood Cells (cells/ μ L)	9.400	5,5000 – 19.000
Metamyelocytes (cells/ μ L)	0	0
Myelocytes (cells/ μ L)	0	0
Banded neutrophil (cells/ μ L)	0	0 - 2
Basophils	0	0-300
Lymphocytes (cells/ μ L)	1.598	1.500-7.000
Monocytes (cells/ μ L)	376	100 850
Eosinophils (cells/ μ L)	752	100-1500
Segmented	6.674	2.500-12.500
Platelets (units/ μ L)	216.000	200.000 – 600.0000

* Values in Veterinary Medicine. Lab Medicine 30(3): 194-197, 2018. Source: Authors (2023).

Table 2 - Blood chemistry.

Analytes	First Day	30 days later	Reference values *
Alanine transferase (IU/L)	221	47	10-100
Creatinine (mg/dL)	2.1	3.2**	0.6 – 2.4
Urea (mg/dL)	70	134	14 - 36
Calcium (mg/dL)	16.8		8.2 - 10.8
Alkaline phosphatase (IU/L)	46	37	10 – 50
Plasmatic Protein (g/dL)	9.4		6 - 8

* Values in Veterinary Medicine. Lab Medicine 30 (3): 194-197, 2018. ** IRIS stage 3 classification (moderate azotemia). Source: Authors (2023).

5. Discussion

Calcification is a process in which calcium salts are deposited in a tissue, resulting from abnormalities in blood and tissue levels of calcium and phosphate. Soft tissue calcification is classified as idiopathic, dystrophic and metastatic. The idiopathic form appears without tissue lesion or abnormal calcium-phosphorus level, while dystrophic calcification can develop in injured tissue. Meanwhile, the metastatic calcification occurs with deposition of calcium in non-injured tissue due disorders of calcium-phosphate physiology (Hammond et al., 2014).

Metastatic calcification frequently occurs in humans and in small animals with chronic kidney disease (Hammond et al., 2014). In domestic cats CKD is common) and, in consequence, vascular calcification may occurs in uremic individuals (Ambrosio *et al.* 2020; Keppie et al.,2006).

Our imaging findings are in line with the first report of the veterinary literature (Lefbom, 1996) in witch was demonstrated the radiographic signs of mineralized arteriosclerosis in a domestic cat, affecting the aortic outflow tract, aortic valve, celiac artery, and cranial mesenteric artery.

This type of mineralization arteriosclerosis presumably occurred in our case, since the patient had hypercalcemia and chronic renal insufficiency identified to as IRIS Stage-3 (moderate uremia), according with Criteria of the International Renal Interest Society (Table 3).

Table 3 - Staging of Feline Chronic Kidney Disease-CKD (Criteria of the International Renal Interest Society).

Classification	Stage-1	Stage-2	Stage-3	Stage-4
Serum creatinine (Mg/dl)	<1,6	1,6-2,8	2,9-5,0	>5,0
Serum creatinine ($\mu\text{mol/l}$)	<140	140-250	251-440	>440
Median survival (days)	Unknown	1151	679	35

Source: Authors (2023).

The roentgenogram findings from our patient were identical to the findings of Lefbom, Adams & Weddle (1996), who demonstrated arterial mineralization and arteriosclerosis with the correspondent radiographic signs in a domestic cat with uremia.

Also, the radiological changes observed in this case were characterized by calcific demarcation of the aorta, in witch is in line with the definition of porcelain aorta as “extensive calcification of the ascending aorta and aortic arch”, as described elsewhere (Abramowitz et al., 2015; Amorim et al., 2013; Hector et al. 2011; Hirose et al, 2020; Michelena et al., 2011, reason why we propose to use same terminology for this specific case.

The mass shown on thoracic ultrasonography of the mediastinum demonstrated characteristics similar to those described in the literature in cases of feline mediastinal lymphoma (Hammond et al., 2014).

6. Conclusion

This report documented a case of extensive aorta calcification in a domestic cat, presumably associated with chronic kidney disease-CKD stage-III. The radiographic and ultrasound changes observed in the patient are in line with the definition of porcelain aorta as traditionally described for human medicine.

We suggest further studies to elucidate the mechanism involved in vascular calcification in felines with CKD, aiming the development of a possible treatment for this vasculopathy.

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