Aortic mineralization in a cat : A case report

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History

A 9-year-old, neutered male, American shorthair cat had resection of a bladder mass (urothelial carcinoma) at a university hospital and was discharged after three days. The following day, after subcutaneous fluid administration at a primary veterinary clinic, the patient developed dyspnea and diagnosed with pleural effusion, pulmonary edema and cardiomyopathy. Pleural drainage and cardiac treatment (Pimobendan and ACE inhibitor) were initiated. Seven days later, the patient came to Aoi Animal Hospital for a second opinion.

Clinicopathological findings

The results of complete blood count and blood chemistry tests were within a normal limit except for a high SNAP NT-proBNP value.
The blood pressure was a high end of normal (138 mmHg; normal value is <140mmHg).

Radiographic and CT imaging findings

Radiographic findings
The right lateral view showed mineralization of vascular wall from the aortic root to the abdominal aorta (Figure 1a). In the ventrodorsal (VD) and dorsoventral views, the left ventricular wall was attached to the thoracic wall, and cardiac enlargement was observed (Fig. 1b). In the VD view, the left kidney was 1.7 times and the right kidney was 2.5 times of the length of the second lumbar vertebral body (Fig. 1b).

Computed Tomography (CT) imaging findings
Mineralization was seen from the aortic root to the abdominal aorta. The heart appeared enlarged (Figure 2a).

Multi-phased, non-selective, intravenous contrast studies were performed. The interventricular septum and the papillary muscle appeared thickened (Figure 2c).

Discussion

In cats, aortic mineralization on thoracic radiographs was rare.[1-4] Two reports showed the cause of aortic mineralization: arteriosclerosis and metastatic calcification due to chronic renal failure. [1,2]
In dogs, aortic mineralization was also rare (21/3443), and it was considered to be no clinical significance.[4]

In humans, however, the incidence of aortic mineralization on thoracic radiographs was 1.9% in men and 2.6% in women (the ages of 30 and 89). [5,6] Furthermore, in humans, aortic mineralization was associated with arteriosclerosis, chronic renal failure, aging and cardiovascular disease.[6-9]

The following is to discuss the pathogenesis of the aortic mineralization in this case.

First, in humans, arteriosclerosis is the most common cause of aortic mineralization.[10] The risk factors of arteriosclerotic damage include hypertension, dyslipidemia, and diabetes mellitus.[11] In this case, dyslipidemia, and diabetes mellitus were negative because of blood test results. In this patient, the blood pressure was within a normal range, but the value was in the high end.[12] Thus, hypertension cannot be completely ruled out.

Second, metastatic calcification due to chronic renal failure was less likely in this patient. Although the patient had the left renal atrophy in the imaging and he was suspected the impaired renal function, his serum calcium levels, urea nitrogen, and creatinine were normal on the blood test. And there appeared to be normal renal excretory function on contrast-enhanced CT imaging.

Third, aging cause degenerative changes and dystrophic calcification. Aging factor cannot be ruled out. However, considering the prevalence of cats, it couldn't be single cause of aortic calcification.

Fourth, in human reports, aortic calcification is associated with cardiovascular diseases.[6,13] Aortic calcification can cause adverse effects on vascular compliance, vasomotion, and plaque stability.[14] Aortic stiffness including aortic calcification correlates with left ventricular afterload.[13] In addition, cardiomyopathy can cause turbulence and reduced perfusion of blood in the aorta, which may have resulted in the aortic mineralization in this case.[15,16]

Finally, this patient had urothelial carcinoma of the bladder in the past. The aortic calcification might have occurred due to the presence of carcinoma. Focus on the molecular biological aspects, osteopontin is a multifunctional glycoprotein that is involved in cardiovascular disease, cancer, and biomineralization (the process by which organisms produce minerals).[17] In humans, studies have shown that overexpression of osteopontin promotes carcinogenesis, progression, and metastasis of multiple malignant tumors.[18] Notably, in humans, increased osteopontin expression has been observed in urothelial carcinoma in bladder.[19] There was no report that examined osteopontin in cats.

It is suspected that both cardiac disease and urothelial carcinoma are related to aortic mineralization in this case.

Conclusion

When aortic mineralization is observed in cats, it should be examined that chronic renal failure and underlying disease that triggers arteriosclerosis. It also has to check the cardiac disease, because there may be a loss of aortic elasticity and increased afterload. Molecular biological mechanisms should be the subject of future research.

Figures and captions

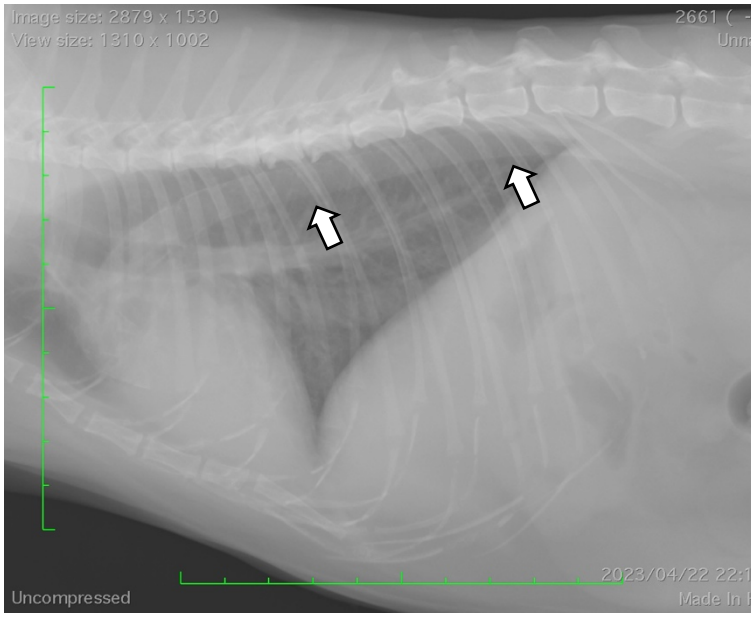

Figure 1 a

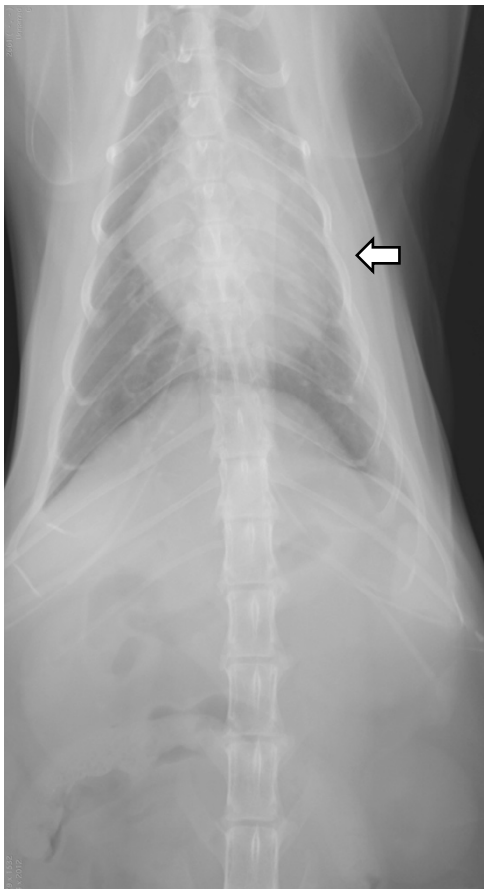

Figure 1 b

1a. Right lateral thoracic and cranial abdomen radiograph (cropped).
Mineralization of the aortic root to abdominal aorta is seen (arrows).
1b. Ventrodorsal thoracic and cranial abdomen radiograph (cropped). The cardiac shadow is wide and appears enlarged. The left kidney appears smaller than normal (arrow).

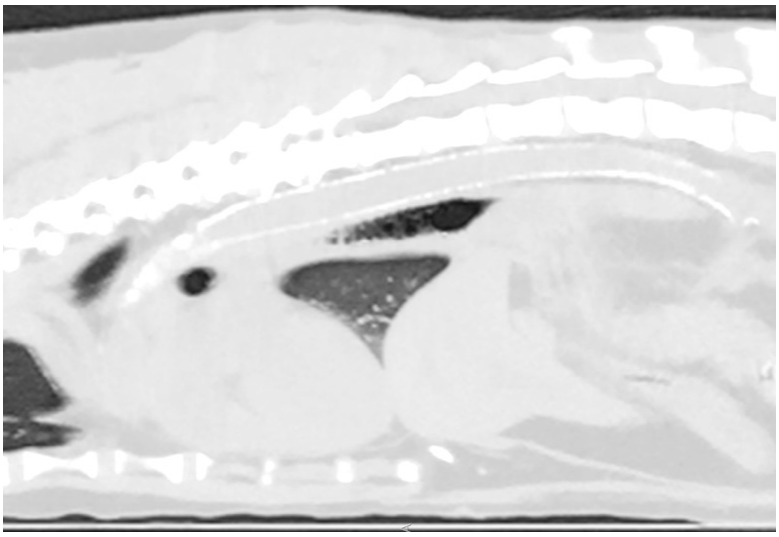

Figure 2a

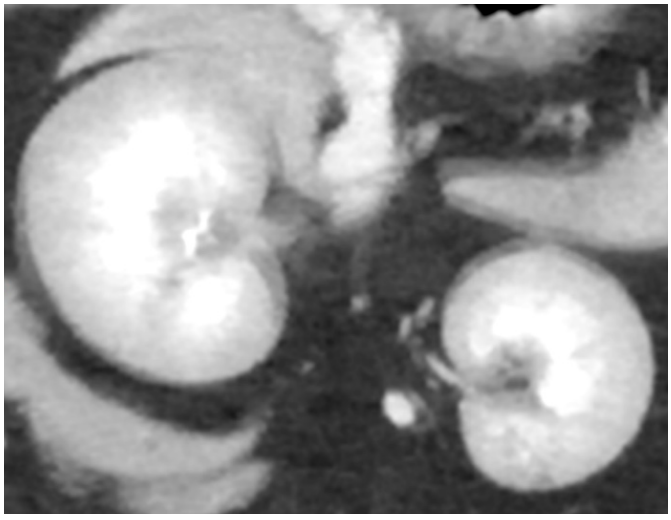

Figure 2 b

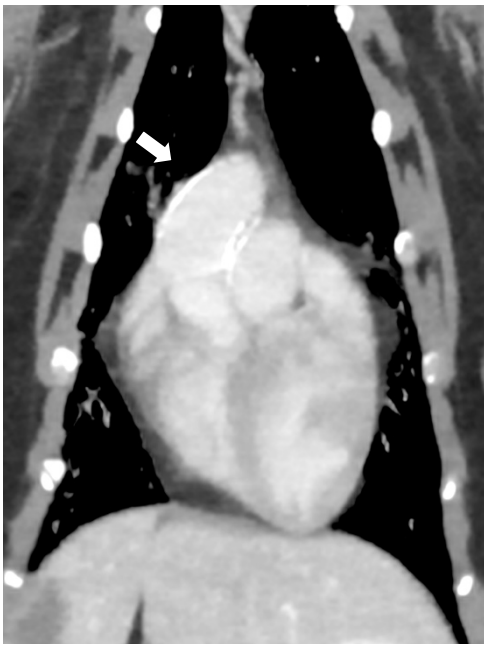

Figure 2 c

2a. Sagittal plain CT image. Mineralization is seen from the aortic arch to abdominal aorta. 2b. Dorsal CT image of the right and left kidneys in the portal venous phase. There is a difference in size between the left and right kidneys, but there appears to be no abnormal renal excretory function. 2c. Dorsal CT image of thoracic in the portal phase. It shows cardiac enlargement and mineralization of the aortic root (arrow).

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