What Is Your Diagnosis?

In collaboration with the American College of Veterinary Radiology

Figure 1—Transverse (A) and sagittal (B) ultrasonographic images of the terminal aorta of a 5-year-old spayed female Golden Retriever mixed-breed dog with a chronic draining wound over the right tarsus and bilateral hind limb edema.

History

A 5-year-old spayed female Golden Retriever mixed-breed dog was presented for evaluation of a chronic draining wound over the right tarsus and bilateral hind limb edema. The dog had additionally been intermittently febrile and anorectic. Prior treatment with enrofloxacin, clindamycin, and doxycycline (unknown doses) by the primary veterinarian resulted in no improvement in the clinical signs or wound.

Upon examination, the patient was tachycardic (156 beats/min; reference range, 70 to 120 beats/min) and febrile (40.4 °C; reference range, 37.8 to 39.2 °C). Cardiothoracic auscultation and abdominal palpation were clinically normal. There was bilateral moderate inguinal lymph node enlargement; however, no other peripheral lymphadenopathy was palpated. There was a firm mass present along the caudoventral

abdominal body wall with multifocal regions of ulceration and dried exudative material. There were additionally 2 alopecic, erythematous, lichenified lesions present along the lateral aspect of the right tarsus that showed multifocal regions of ulceration and had an exudative discharge. In addition, the entire right hind limb was edematous.

Results of a CBC were within reference limits. Biochemical analysis revealed a hyperproteinemia (8.5 g/dL; reference range, 5.5 to 8.0 g/dL) due to hyperglobulinemia (6.4 g/dL; reference range, 2.1 to 4.2 g/dL). Findings on thoracic radiography were unremarkable (not shown), and abdominal ultrasonography was performed (**Figure 1**).

Formulate differential diagnoses, then continue reading.

Diagnostic Imaging Findings and Interpretation

Abdominal ultrasonography revealed bilaterally enlarged medial iliac lymph nodes (up to 2.4 cm in diameter) and a scant volume of anechoic peritoneal effusion. In addition, there was an ovoid, anechoic structure within the caudal abdomen that measured 4.5 cm in thickness with a 0.4-cm wall. This structure was confluent with the aorta at the aortic trifurcation.

Alison M. Lee, DVM, MS, and Christopher R. Tollefson, DVM*

Department of Clinical Sciences, College of Veterinary Medicine, Mississippi State University, Mississippi State, MS

*Corresponding author: Dr. Tollefson (ct1693@msstate.edu)

<https://doi.org/10.2460/javma.20.09.0524>

Figure 2—Same images as in Figure 1. The terminal aorta is severely dilated, and the wall of the vessel is asymmetrically thickened and heterogeneous in echogenicity. Spontaneous contrast (asterisks) is noted throughout the dilated portion of the terminal aorta, indicating turbulent blood flow.

Spontaneous contrast with a pulsatile swirling motion was noted within the structure, which was in concert with the patient's heartbeat (**Figure 2**). Interrogation with color flow Doppler ultrasonography revealed turbulent and swirling blood flow within the structure. The structure could not be completely interrogated with ultrasonography, as it coursed caudally and was obscured by the pelvis. The ultrasonographic diagnosis was an aortic pseudoaneurysm with probable thrombus formation. Given the dermal findings, an infectious etiology (either bacterial or fungal) resulting in the cutaneous lesions, lymphadenopathy, and aneurysmal dilation was considered likely.

Treatment and Outcome

The patient was sedated and underwent an incisional biopsy of a tarsal lesion, as well as a punch biopsy of the palpated abdominal wall mass. Biopsy samples were submitted for histopathology and aerobic and anaerobic culture. The patient recovered uneventfully and was discharged with instructions to restrict exercise for 2 weeks.

Histopathology of both the tarsal and body wall lesions revealed a mixed population of inflammatory cells, including epithelioid macrophages, multinucleated giant cells, degenerate neutrophils, and eosinophils, centered around necrotic cores. The necrotic cores contained multiple negative profiles that resembled hyphae. Special staining (Gomori methenamine silver stain and periodic acid-Schiff stain) revealed hyphae with nondichotomous branching and uneven, nonparallel walls. Findings were considered highly suggestive for *Pythium insidiosum*. Samples were submitted for PCR assay testing to further identify the causative agent.

Due to the poor prognosis, the owners elected humane euthanasia prior to obtaining the result of the PCR assay. A necropsy was not performed. Results of the PCR assay indicated infection with *Cladosporium* spp.

Comments

Cladosporium spp are filamentous fungi belonging to the dematiaceous fungi and comprise a large portion of the genus *Ascomycota*.¹ *Cladosporium* is a widely distributed saprophyte with 189 identified species and has been reported to cause infections of the lung, skin, eye, and brain of people, as well as the central nervous system, bone, lung, lymph node, and kidney in the dog.¹⁻³ Certain strains of *Cladosporium* have been implicated in allergic airway disease in people as well.⁴ Lesions caused by this fungus are typically associated with phaeohyphomycosis and are localized to cutaneous or subcutaneous infections; spread of infection can progress either through lymphatic or hematogenous spread.¹ In people, most reported infections occur in immunocompromised patients,¹ although *Cladosporium* infection has been reported in canine patients with no known immunodeficiency.²

The most interesting component of this patient's presentation was the formation of a pseudoaneurysm at the terminating aorta. A pseudoaneurysm is distinguished from a true aneurysm in that, whereas an aneurysm is a permanent segmental dilation of a weakened artery involving the tunica intima, tunica media, and tunica adventitia, a pseudoaneurysm involves only the tunica intima and potentially the tunica media.⁵ In people, certain bacterial infections, including *Staphylococcus* spp, *Streptococcus* spp, *Salmonella* spp, *Escherichia coli* spp, *Klebsiella* spp,

Pseudomonas spp, and *Mycobacterium* spp, predispose patients to arterial pseudoaneurysm formation.^{1,5} Although infectious pseudoaneurysm is common in people suffering from bacterial infections, pseudoaneurysm formation resulting from a mycotic infection is rare.¹ In people, pseudoaneurysm formation has been documented in the femoral artery in a patient infected with *Candida albicans* and in a case of *Aspergillus* endocarditis. Pseudoaneurysm formation has also been noted in a branch of a right pulmonary artery in a case of *Cladosporium*.¹ Pseudoaneurysm formation has been noted in dogs suffering from systemic mycosis, including infections of *Candida*, *Aspergillus* spp, and *Graphium* spp; however, reports of pseudoaneurysm formation secondary to *Cladosporium* spp in the dog are lacking. The abdominal aorta, cranial mesenteric arteries, and external iliac arteries are common sites of pseudoaneurysm formation, similar to the case reported here.^{5,6}

Mycotic pseudoaneurysms are typically reported to form in arteries that are adjacent to the focus of infection or are considered to be due to direct invasion of the vessel wall due to intraluminal foci of septic emboli.¹ In this case, however, the aortic pseudoaneurysm was noted at a site distant to the cutaneous lesions. Interestingly, aneurysmal degeneration of the aorta can be induced with exposure to certain inflammatory cells and their proteolytic products, particularly serine elastases, plasminogen activators, and matrix metalloproteases.⁷ Several species of *Cladosporium* contain elastase, so it is possible that the elastase and other protease activity of this fungus contributed to the formation of this pseudoaneurysm.⁴

Computed tomography angiography and ultrasonography are currently the imaging modalities of choice for the imaging of arterial pseudoaneurysm.⁵ In early stages, pseudoaneurysms are reported to manifest on ultrasonography as a thickened and irregular wall, with a hypoechoic halo surrounding.⁵ Hyperechoic fat can also be seen surrounding affected arteries, which is suggested to be due to perivascular steatitis.⁵ Color flow Doppler ultrasonography

typically reveals turbulent blood flow within the pseudoaneurysm.⁵ An endoluminal swirling pattern to the blood can also be seen on color flow Doppler ultrasonography; this is due to low-velocity and turbulent flow within the pseudoaneurysm.⁸ Identification of the causative organism in cases of fungal infection typically depends both on histopathologic evaluation of the affected tissues and special staining. In some cases, advanced diagnostic techniques such as PCR assay are required.¹

Although rare, aortic pseudoaneurysm formation has been noted in both people and dogs secondary to systemic mycotic infection. When a mycotic infection is suspected, abdominal ultrasonography with color flow Doppler ultrasonography or CT angiography can be considered to screen these patients for pseudoaneurysm formation.

References

1. Sunagawa K, Uchino Y, Ishimoto S, et al. Mycotic pseudoaneurysm of a pulmonary artery branch caused by *Cladosporium*. *Pathol Int*. 2018;68:47–52.
2. Poutahidis T, Angelopoulou K, Karamanavi E, et al. Mycotic encephalitis and nephritis in a dog due to infection with *Cladosporium cladosporioides*. *J Comp Pathol*. 2009;140:59–63.
3. Spano M, Zuliani D, Peano A, Bertazzolo W. *Cladosporium cladosporioides*-complex infection in a mixed breed dog. *Vet Clin Pathol*. 2018;47:150–153.
4. Kauffman HF, Tomee JFC, van de Riet MA, Timmerman AJB, Borger P. Protease-dependent activation of epithelial cells by fungal allergens leads to morphologic changes and cytokine production. *J Allergy Clin Immunol*. 2000;105:1185–1193.
5. Morabito S, Specchi S, Eurimedia E, Ferro S, Kuhnert P, Zini E. Computed tomographic and ultrasonographic findings of abdominal arterial pseudoaneurysms caused by systemic mycosis in dogs. *J Small Anim Pract*. 2020;61:300–307.
6. Gershenson RT, Melidone R, Sutherland-Smith J, Rogers CL. Abdominal aortic aneurysm associated with systemic fungal infection in a German shepherd dog. *J Am Anim Hosp Assoc*. 2011;47:45–49.
7. Petrinc D, Liao S, Holmes DR, et al. Doxycycline inhibition of aneurysmal degeneration in an elastase-induced rat model of abdominal aortic aneurysm: Preservation of aortic elastin associated with suppressed production of 92 kD gelatinase. *J Vasc Surg*. 1996;23:336–346.
8. Mahmoud MZ, Al-Saadi M, Abuderman A, et al. “To-and-fro” waveform in the diagnosis of arterial pseudoaneurysms. *World J Radiol*. 2015;7:89–99.