A 10-year-old, castrated male domestic short-haired cat was presented with an acute history of seizures, lethargy, anorexia, vomiting, and dyspnea. Magnetic resonance imaging of the brain showed multifocal areas of gray matter T2-weighted hyperintensity. The lesions did not enhance with intravenous contrast. The cat was diagnosed at necropsy with feline systemic reactive angioendotheliomatosis, a rare vascular proliferative disorder for which a treatment has not yet been identified. This report is the first to describe associated magnetic resonance imaging changes for this disease.

Key words: angioendotheliomatosis, feline, MRI, reactive, systemic.
Fig. 1. Transverse images at the level of the olfactory bulbs (A and B) and at the level of the frontal lobes (C and D) including T2-weighted images (A and C, TR = 4000 ms, TE = 142.8 ms, slice thickness 5.0 mm) and T1 postcontrast images (B and D, TR = 600 ms, TE = 11.5 ms, slice thickness 5.0 mm). T2 hyperintensity is seen in the left olfactory bulb (long arrow), though this region is hypointense on T1-weighted images. T2 hyperintensity is seen in the region of the caudate nuclei bilaterally (short arrows), which is hypointense on post contrast T1-weighted images.

TE 142.8, 5.0 mm), proton density (TR 4000, TE 20.4, 5.0 mm), fluid attenuating inversion recovery (FLAIR) (TR 6000, TE 110.4, 5.0 mm), gradient-echo (GE) (TR 1188, TE 23.5, 5.0 mm), and T1-weighted (T1W) (TR 600, TE 11.5, 5.0 mm) sequences preintra venous contrast. T2-weighted sagittal images were also obtained (TR 4000, TE 119.0, 3.0 mm). Postintra venous contrast T1W images were obtained in all three standard planes approximately 5 min postmanual intra venous injection of gadolinium-based contrast (transverse, sagittal, and dorsal: TR 600, TE 11.5, 5.0 mm) (0.12 mmol/kg bodyweight, gadoteridol [ProHance; Bracco Diagnostic, Inc., Township, NJ]). Field of view for all images was 20 cm × 20 cm, except for the T1W postc ontast dorsal sequence that had a field of view of 21 cm × 21 cm. Multifocal ill-defined, small regions of hyperintensity were identified on T2W images, primarily in the gray matter at the following locations: both piriform lobes, the caudate nucleus bilaterally, the region of the caudal aspect of the right hippocampus, the ventromedial aspect of the frontal lobe bilaterally, and ventral to the rostral aspect of the lateral ventricles bilaterally (Figs. 1C, 2A, C). These regions were hyperintense on FLAIR and iso- to slightly hypointense on T1W images (Figs. 1D, 2B, D). No abnormal regions of intravenous contrast enhancement were identified. Hyperintensity was noted in the region of the left olfactory bulb on T2W images; this was hyperintense on FLAIR images. This region was hypointense on T1W images pre- and postintra venous contrast (Figs. 1A, B, 3A, B). No regions of signal void were identified on GE images. No abnormalities were identified in the portion of the cervical spine included on the sagittal images. Differentials considered for these findings included a noninfectious or infectious encephalitis, a component of postictal changes, or less likely, neoplasia.

Cisternal cerebrospinal fluid analysis revealed increased protein concentration (60.8 mg/dl; reference interval < 25 mg/dl) and a moderate neutrophilic pleocytosis (14 white blood cells/µl; reference interval < 5/ µl, 75% neutrophils, 20% macrophages, and 5% small lymphocytes). No microorganisms were seen on cytologic examination. Whole blood polymerase chain reaction (PCR) testing for *Mycoplasma turicensis*, *Mycoplasma hemofelis*, *Cytauxzoon felis*, *Anaplasma phagocytophilum*, *Bartonella henselae*, *Bartonella claridgeiae*, *Bartonella quintana*, *Rickettsia rickettsia*, *Rickettsia felis*, and *Ehrlichia* spp. was negative. There was a positive PCR result for *Mycoplasma haemominutum*. Serology for feline leukemia virus and feline immunodeficiency virus was negative. Serology
for feline coronavirus was mildly positive, indicating exposure.

Supportive care was continued, but the cat made little improvements over the 6-day hospitalization period. The owner elected for humane euthanasia due to the grave prognosis.

On gross postmortem examination, the cat had pale, yellow-tinged mucous membranes and subcutaneous and visceral fat. There was a moderate amount of hemorrhagic semiformed feces in the colon and rectum. The ventral surface of the left anterior prosencephalon near the olfactory lobes contained several irregular 0.2–0.5 cm in diameter necrotic dark tan foci. Other significant systemic lesions included multifocal petechial hemorrhages in the small intestines and heart; mild cardiomegaly with right ventricular hypertrophy and left atrial dilatation; pulmonary edema and congestion; and, passive congestion with an increased lobular (“nutmeg”) pattern in the liver.

Microscopically, numerous variably sized blood vessels within both gray and white matter, leptomeninges, and Virchow–Robin space throughout the cerebrum, thalamus, cerebellum, and brainstem contained variably sized, often glomeruloid, intraluminal proliferations of bland spindle to slightly polygonal cells variably separated by slit-like spaces containing erythrocytes that partially or almost completely filled the vascular lumen. In several areas, the occluded vessels surrounded or lay adjacent to variably sized circumscribed foci of malacia (infarct), hemorrhage, and white matter degeneration (Fig. 4A). Many vessels also contained fibrin thrombi (Fig. 4B). Proliferating intraluminal cells had plump, irregularly round to oval vesicular nuclei with coarsely clumped or stippled and marginated chromatin and inconspicuous nucleoli and had modest amounts of poorly defined eosinophilic cytoplasm. Nuclear and cellular atypia and mitotic figures were not observed. Immunohistochemically, the cells stained strongly positive multifocally for Factor VIII and/or muscle specific actin (MSA) suggesting an endothelial cell or pericyte histogenesis, respectively (Fig. 4C, D). Vascular lesions similar to those described in the brain were also observed in the heart (severe), spinal cord, spleen, adrenal, pancreas, extraocular muscles, stomach, small intestine, colon, bone marrow, kidney (rarely), and liver (rarely). Additionally, there was moderate erythroid hyperplasia of bone marrow. Sections of brain, heart, and spleen were negative for Bartonella spp by PCR test (Galaxy Diagnostics, Morrisville, NC). The final histopathological diagnosis was vasculopathy, intraluminal and proliferative, multifocal and disseminated, subacute, moderate to marked, with vascular thrombosis and multiple brain infarcts consistent
with feline systemic reactive angioendotheliomatosis (FSRA).

**Discussion**

Feline systemic reactive angioendotheliomatosis is a rare intravascular proliferative disorder that is multisystemic, fatal, and presumed idiopathic. To the authors’ knowledge, only 13 cases of feline intravascular proliferative disorders have been described in the literature. Feline systemic reactive angioendotheliomatosis can be classified as a variant of reactive angioendotheliomatosis (RAE) or intravascular angiotropic lymphoma, the latter of which has been reported in only one cat, affecting the vessels of the brain and kidney. Reactive angioendotheliomatosis primarily affects juvenile to young adult domestic male cats. It is characterized by intraluminal endothelial and pericyte proliferation, with the heart being the most commonly and severely affected organ. Feline systemic reactive angioendotheliomatosis differs from intravascular lymphoma primarily in that it is endothelial in origin, though is also differentiated cytologically being characterized by obliteration of the lumen of small vessels with glomeruloid whorls of bland spindle cells and microthrombi. Numerous other organs can be affected, including kidneys, spleen, lymph nodes, gastrointestinal tract, brain/meninges, eyes, and pancreas, and less commonly, liver, adrenal glands, thyroid gland, sciatic nerve, subcutis, lung, bone marrow, and urinary bladder. Typically, small arterioles comprise the majority of affected vessels and thrombi within proliferative spindle cell tufts are a common finding. In people, RAE is a rare but self-limiting cutaneous disorder. Although FSRA

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**Fig. 3.** Sagittal images through the left olfactory bulb including T2-weighted images (A, TR = 4000 ms, TE = 119.0 ms, slice thickness 3.0 mm) and T1 postcontrast images (B, TR = 600 ms, TE = 11.5 ms, slice thickness 5.0 mm). T2 hyperintensity is seen in the region of the left olfactory lobe (long arrow), which is hypointense on postcontrast T1 images. T2 hyperintensity in the region of the caudate nucleus (short arrow) is isointense on postcontrast T1 images.
is multisystemic, the lesions are most similar to RAE in people.1,2

The clinical signs of FSRA are variable, but commonly include an acute onset of dyspnea, lethargy, and spontaneous death,1 similar to the patient described in this report. There is an apparent predilection for male cats.1 As death appears imminent, treatment at this time is unknown.

Magnetic resonance imaging findings of FSRA have not yet been reported. A report of intravascular lymphoma in the brain of a 10-year-old Rottweiler–German Shepherd cross demonstrated multifocal hyperintensities on T2-weighted images, FLAIR, and precontrast T1-weighted images, being most apparent on FLAIR images.6 These hyperintensities were located in the thalamus, occipital lobe, cerebellum, and mesencephalic tegmentum. Administration of intravenous contrast yielded mild enhancement of these lesions as well as identification of an additional lesion in the claustrum.8 Noncontrast enhanced MR images of the 7-year-old Siamese with intravascular lymphoma revealed asymmetry in the cerebral cortices with hyperintensities in the right cerebral cortex on T2 and proton density images, as well as thickened/poorly defined gyri in that location.6

These intravascular lymphoma patients differ from the patient in this report in that this patient did not have enhancing lesions, did not have cerebral asymmetry, and was ultimately not diagnosed with lymphoma.

The patient in this report had multifocal regions of T2 hyperintensities in the piriform lobes, caudate nuclei, hippocampus, and frontal lobes with no regions of enhancement. The cause of the T2 hyperintensities may be related to infarction from small vessel occlusion with fibrin thrombosis found on necropsy, and though numerous additional lesions were present on necropsy they were not appreciated on MR images. The cause for the mild dilation of the left rostral horn of the lateral ventricle is unknown, though it may be a normal variant. Thoracic radiographs and abdominal sonographic findings were relatively unremarkable aside from the slightly thickened small bowel with a prominent muscularis layer. Though this can be seen with chronic enteritis, inflammatory bowel disease, or lymphoma among others, in this case, it may have been due to the vasculopathy from FSRA.7 The cytologic and PCR evidence of a Mycoplasma infection in this patient is thought to be an incidental, unrelated finding.
Feline reactive systemic angioendotheliomatosis is a rare multisystemic intravascular proliferative disorder of cats that typically present with acute onset of dyspnea and lethargy. In a patient with a severe multifocal neuroanatomic localization, systemic signs of illness, and multifocal, nonenhancing T2 hyperintensities on brain MRI, FSRA should be considered a differential diagnosis.

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