A 6.5-year-old 10-kg (22-lb) castrated male mixed-breed dog was referred for evaluation of persistent lethargy, vomiting, thrombocytopenia, anemia, and pyrexia of approximately 1 month’s duration. Treatments administered prior to referral included oral administration of the antiemetic metoclopramide hydrochloride (0.5 mg/kg [0.23 mg/lb], q 12 h) and amoxicillin (25 mg/kg [11.4 mg/lb], q 12 h) for 1 week, followed by oral administration of prednisone (2 mg/kg [0.9 mg/lb], q 12 h) for 1 week. Intermittent seizures began during treatment with prednisone; the frequency of drug administration was decreased (2 mg/kg, q 24 h) 3 days prior to referral.

Clinical and Gross Findings

At the referral examination, the dog was thin and febrile (rectal temperature, 39.7°C [103.4°F]). Neurologic examination revealed slightly decreased conscious proprioception in the hind limbs and truncal sway when standing. No cranial nerve deficits were detected, and forelimb and hind limb reflexes were considered normal. The dog was admitted to the hospital, and CBCs were performed over a period of several days; results indicated that the dog persistently had normocytic, normochromic anemia; thrombocytopenia with large and clumped platelets; and a stress leukogram. Serum antibodies against *Ehrlichia canis* (titer ≥ 1:40) were detected.

Thoracic and abdominal radiography and abdominal ultrasonography revealed no abnormalities. Because the dog continued to have mild seizures approximately every 12 hours, computed tomography of the head was performed. The scan revealed large, well-demarcated, bilateral fluid opacities in the cerebrum, which corresponded to dilated lateral ventricles. The left lateral ventricle was enlarged to a greater extent than the right, consistent with a diagnosis of asymmetric hydrocephalus. A sample of CSF was not collected because of the risk of herniation as a result of increased intracranial pressure associated with hydrocephalus.

The dog was discharged from the hospital without a definitive diagnosis regarding the cause of hydrocephalus. Continued deterioration in quality of life led to euthanasia of the dog within a week after discharge. Asymmetric hydrocephalus was confirmed during necropsy, with the left lateral ventricle more severely dilated than the right (Figure 1). On cut section of the formalin-fixed brain, the neuroparenchyma contained few foci of yellow-brown discoloration; the largest lesion (2 to 3 mm in diameter) was located within the cerebral cortex of the left temporal lobe.

Figure 1—Photograph of a gross transverse section of the brain of a dog that was evaluated because of persistent lethargy, vomiting, thrombocytopenia, anemia, and pyrexia of approximately 1 month’s duration; an ante-mortem diagnosis of hydrocephalus was made, and the dog was subsequently euthanatized because of worsening quality of life. Notice the asymmetric hydrocephalus, which is more severe in the left lateral ventricle (L). Bar = 5 mm.
Histopathologic Findings

The cerebrum, cerebellum, and brainstem all had similar multifocal inflammatory changes that ranged from mild to severe; some foci were sufficiently large to be evident grossly (Figure 2). The most severe lesions were poorly defined, focally extensive, and characterized by numerous macrophages, lymphocytes, and plasma cells with a few neutrophils and eosinophils that infiltrated and effaced the neuroparenchyma (Figure 3). Signs of inflammation were evident in both gray and white matter. Neuronal cell bodies in affected gray matter were necrotic or absent, and neuromophagia was present at the periphery of lesions. Adjacent, less-inflamed neuroparenchyma had spongiosis and contained increased numbers of microglial cells (microgliosis). Scant intra- and extracellular clusters of oval to crescent-shaped merozoites (approx 5 to 7 \( \mu \)m in length) were present in inflammatory foci, particularly those associated with areas of necrosis. Rarely, merozoites radiated from a central residual body, which was consistent with schizotoms dividing via endopolygeny. Apart from locally extensive lesions, neuroparenchyma had perivascular cuffs of mononuclear cells and few granulocytes. The leptomeninges had moderate to marked expansion by a similar mixed population of leukocytes. Within minimally inflamed areas of the cerebral cortex and hippocampus, multiple neurons had hypereosinophilic cytoplasm, angulated cell borders, and pyknotic nuclei consistent with necrosis.

Morphologic Diagnosis

Multifocal granulomatous and necrotizing meningoencephalitis with rare intraleisional protozoa.

Comments

Causes of protozoal encephalitis in dogs include infections with *Toxoplasma gondii*, *Neospora caninum*, *Sarcocystis canis*, and *Sarcocystis neurona*. To further characterize the agent observed microscopically in the dog of this report, immunohistochemical analyses and PCR assay of tissue specimens were subsequently performed. In sections of brain treated with rabbit polyclonal antibody against *S neurona*, individual and clustered merozoites were strongly labeled. After DNA was extracted from formalin-fixed, paraffin-embedded brain sections, a PCR assay was performed with primers specific for a portion of the 18S rRNA gene of apicomplexan protozoa. The nucleotide sequences of the 293-base pair amplified gene product had 100% similarity with sequences of *Sarcocystis* sp (either *S neurona* or *Sarcocystis falcatula*). Given the CNS location of the parasite, the type of parasitic division, the strong immunoreactivity against *S neurona*, and the association of *S falcatula* with avian rather than mammalian intermediate hosts, *S neurona* was the suspected etiologic agent in the dog of this report. Although not observed in tissue sections during microscopic examination, inflammation that resulted in obstruction of the outflow of CSF from the lateral ventricles, perhaps in the region of the third ventricle or mesencephalic aqueduct, was the proposed mechanism by which hydrocephalus developed in the dog.

*Sarcocystis neurona* is the protozoal species most commonly associated with
equine protozoal myeloencephalitis, a progressively debilitating disease of the CNS of horses. This parasite has been associated with cases of encephalitis and myositis in dogs. The microscopic lesions in the brains of dogs with *S. neurona*-associated encephalitis resembled those detected in the dog of this report; the gross lesions in those dogs ranged from inapparent to mild (swollen and flattened cerebral gyri). In horses, as in the dog of this report, few organisms are typically present in brain tissue and they are difficult to detect within lesions. For antemortem diagnosis of equine protozoal myeloencephalitis, western blot analysis of CSF samples is used to detect antibodies against *S. neurona* in horses, but the use of this test in dogs has not been reported to the authors’ knowledge. In the dog of this report, lesions in the brain were not detected by use of computed tomography, likely because of their small size, and collection of a CSF sample was avoided because of the presence of hydrocephalus. These limitations created major challenges in determining the cause of hydrocephalus in this dog before its death.

**References**