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Pathology in Practice

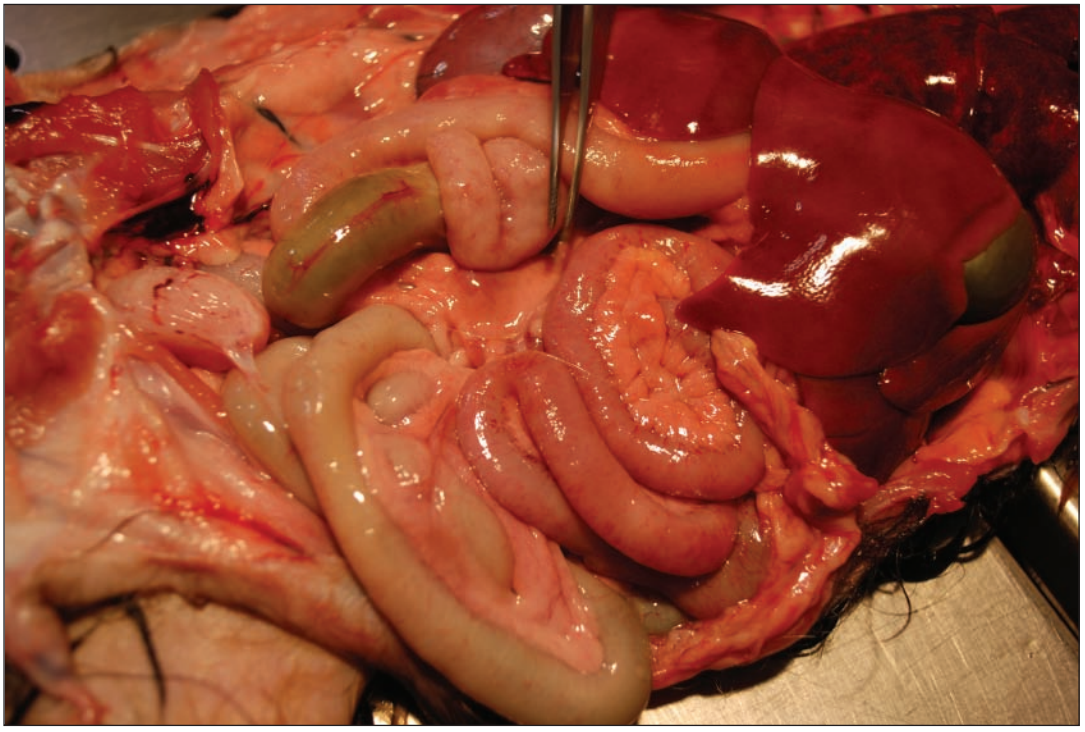

Figure 1—Photograph of a portion of the abdomen of a 7-week-old Rottweiler that was evaluated because of a 2-day history of vomiting and diarrhea. The small intestine is visible. Notice the evidence of segmental enteritis in the jejunum, with the affected (reddened) segment on the right.

History

A 7-week-old sexually intact male Rottweiler was evaluated by a referring veterinarian because of a 2-day history of vomiting and diarrhea. Several other puppies in the litter and puppies in other litters at the breeding facility had recently died with similar clinical signs. In an attempt to deworm the dog, the owners administered sulfadimethoxine and metronidazole. No improvements in clinical signs were reported. The dog was referred to the Boren Veterinary Medical Teaching Hospital at Oklahoma State University for further assessment.

Clinical and Gross Findings

At the initial evaluation, the dog weighed 2.4 kg (5.3 lb). Abnormal physical examination findings included a body condition score of 3 (scale of 9), marked dehydration, rectal temperature of 40.1°C (104.1°F), and pale pink mucous membranes. The feces appeared yellow-gray and pasty. On auscultation, the dog was tachycardic but lung sounds were considered normal; heart rate was 190 beats/min, and respiratory rate was 30 breaths/min. The dog died prior to institution of treatment, and necropsy was performed.

Gross examination revealed that the dog was in poor nutritional condition with absence of subcutaneous and intra-abdominal fat stores. The serosal surface of a 20-cm-long segment of jejunum was reddened with prominent blood vessels and a dull pitted surface (**Figure 1**). Mesenteric lymph nodes were moderately large. There were no other gross abnormal findings.

Formulate differential diagnoses from the history, clinical findings, and Figure 1—then turn the page →

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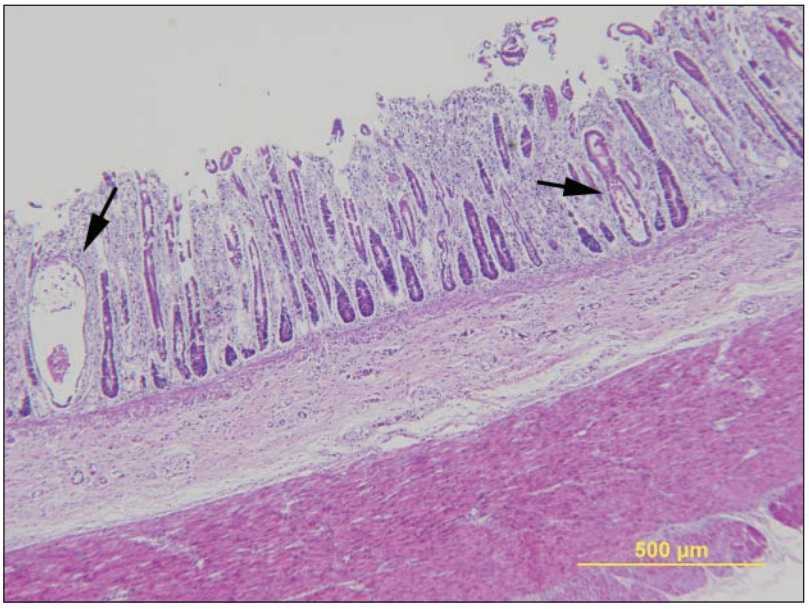

Figure 2—Photomicrograph of a section of the jejunum obtained from the dog in Figure 1. Notice the marked crypt necrosis (arrows) with villus blunting. H&E stain; bar = 500 µm.

Histopathologic Findings

Specimens of lung, liver, kidneys, heart, spleen, duodenum, jejunum, and ileum were immersion-fixed in neutral-buffered 10% formalin. Tissues were sectioned and routinely processed for histologic examination. Sections were stained with H&E stain. On histologic examination, the normal architecture of the jejunum was markedly disrupted by diffuse blunting and fusion of intestinal villi with collapse of mucosal architecture. Intestinal crypts were multifocally ectatic and contained sloughed epithelial cells, necrotic cellular debris, and occasional erythrocytes **(Figure 2)**. Evidence of inflammation was minimal, compared with the severity of necrosis within the small intestine. Within the spleen, there was multifocal necrosis of lymphoid follicles. Histologic findings for all other tissues were considered normal.

Morphologic Diagnosis

Severe, acute, diffuse, necrotizing enteritis (jejunum) with marked villous blunting and fusion and severe, multifocal, lymphoid necrosis of the spleen.

Comments

Enteritis with accompanying vomiting and diarrhea in young dogs may be associated with a variety of causes, including infectious diseases and ingestion of toxins.[1,2] Infectious causes of enteritis in dogs include infection with viruses (parvoviruses, coronaviruses, rotaviruses, and morbilliviruses), bacteria (*Salmonella* spp, *Clostridium* spp, and *Campylobacter jejuni*), or parasites (*Ancylostoma caninum*, *Trichuris vulpis*, *Toxocara canis*, *Cryptosporidium* spp, and *Isospora* spp). Toxic causes of enteritis include ingestion of castor beans[3] (*Ricinus communis*) or anticoagulant rodenticide. Other potential causes include intussusception or ingestion of a foreign body.

In the dog of this report, fluorescent antibody testing that was performed on whole-tissue sections of the tongue and jejunum yielded positive results for canine parvovirus antigen. In conjunction with the gross and histologic changes, it was determined that the dog had parvovirus enteritis. Enteritis caused by canine parvovirus 2 (CPV-2) is one of the most common infectious disorders of dogs.[4] Parvoviral infections most commonly develop in dogs < 6 months old and are typically associated with gastrointestinal disease or more rarely with myocardial disease.[5] Although rare, viral myocarditis attributable to CPV-2 infection can develop in the offspring of CPV-2–naïve bitches because the puppies do not receive maternal anti–CPV-2 antibody during the first 2 weeks after birth.[6] Clinical signs of parvoviral enteritis include vomiting, diarrhea, anorexia, dehydration, and death. A presumptive antemortem diagnosis of parvovirus enteritis can be obtained on the basis of the history, clinical signs, and elimination of other causes of diarrhea.[5]

Canine parvovirus 2 is a member of the genus parvovirus in the Parvoviridae family. Parvovirus virions have icosahedral symmetry, are 25 nm in diameter, are nonenveloped, and have single-stranded DNA.[7] Multiple subtypes of CPV-2 have been identified and include CPV-2a, CPV-2b, and CPV-2c. In the United States, CPV-2b commonly causes disease in dogs; however, there is an increasing number of dogs with parvovirus enteritis caused by CPV-2c.[8] This emergence of CPV-2c within the United States is associated with an increase in parvoviral infections in well-managed and properly vaccinated dogs, including vaccinated adults.[8] Although parvoviral infections in appropriately vaccinated animals are apparently increasing, a recent US study[9] involving 2 commercially available vaccines determined that those vaccines can prevent infection with or disease caused by all variants of canine parvovirus including CPV-2c.

Canine parvovirus 2 spreads rapidly from dog to dog via oronasal exposure to virus-laden feces or contaminated fomites. Viral replication of CPV-2 begins in tonsils, retropharyngeal lymphoid tissue, and mesenteric lymph nodes.[10] Virus infection of systemic and intestinal lymphoid tissues occurs as early as day 3 after exposure and is associated with viremia. Virus infection of intestinal epithelium (ie, the crypts of Lieberkühn) occurs within 4 to 6 days after exposure.[10] Infection of the intestinal epithelium leads to the loss of intestinal villi with resultant vomiting and diarrhea. Viral infection of lymphoid tissues results in lymphoid necrosis and destruction of myeloproliferative cells; as a result, lymphopenia and, in severe cases, panleukopenia and immunosuppression develop. In addition, CPV-2 localizes within the epithelium of the oral and esophageal mucosa, tongue, bone marrow, thymus, heart, spleen, lungs, liver, and kidneys.[4]

Similar to findings in the dog of this report, gross lesions of parvovirus enteritis typically include thickening, roughening, and segmental discoloration (reddening) of the intestinal wall of affected regions of small intestine; fibrin adheres to the intestinal serosa, and intestinal contents vary from watery to mucoid and are occasionally bloody. The segmental enteritis and granular appearance of the serosal surface of an affected section of small intestine is characteristic of the enteric lesions caused by CPV-2.[6] Histologic changes associated with parvovirus enteritis are characterized by necrosis of intestinal crypt epithelium; villi are typically shortened to obliterated, inflammatory infiltrate is present within the lamina propria, and dilation of intestinal crypts with necrotic sloughed cellular debris is evident. Intranuclear inclusion bodies may be seen within crypt epithelium. It should be noted that histologic changes vary from minimal to severe, depending on immune system competency and duration of illness. Other histologic changes may include a nonsuppurative myocarditis with myocardial intranuclear inclusion bodies, lymphoid necrosis, and bone marrow hypocellularity characterized by depletion of myeloid cells, erythroid cells, and megakaryocytes.[4,6,8] Histologically, the presence of lymphoid necrosis helps to differentiate parvoviral enteritis from coronaviral enteritis.

Patient-side fecal ELISAs are available to detect parvoviral antigen in canine feces.[8,11] False-positive and false-negative test results are reported to occur. Inappropriate vaccination methods (oral administration) can result in false-positive results.[8] In 1 study,[11] the fecal parvovirus ELISA[a] detected only 41 of 89 (46%) dogs with canine parvovirus infection. Other commonly performed diagnostic tests include fluorescent antibody testing of fresh samples of intestinal or tongue tissue and hemagglutination testing of fecal samples; virus isolation and PCR assays can be performed on feces or fresh intestinal and tongue tissues.[4,8,11] Immunohistochemical analysis of formalin-fixed sections of tongue or intestine can also be performed. For optimal results, sections of the gastrointestinal tract containing gross lesions should be submitted for confirmation of canine parvovirus infection.

Dogs with parvovirus enteritis are treated on the basis of clinical signs, which may include restoration of fluid and electrolyte balance and prevention of secondary bacterial infections that result in septicemia.[4] Both commensal bacteria and secondary pathogens, including *Escherichia coli*, *Salmonella* spp, *Clostridium difficile*, and *Clostridium perfringens*, have been isolated from the lungs and liver of dogs with parvoviral enteritis and from IV catheter tips used during treatment of affected dogs.[8,12,13] Septicemia as a result of these secondary bacterial infections contributes to the high mortality rates associated with parvoviral enteritis in dogs.[8,12] In 1 report,[12] postmortem findings indicated that 88 of 98 (90%) canine parvovirus-positive dogs had septicemic colibacillosis.

Canine parvovirus 2 is a common pathogen of dogs, and given the emergence of CPV-2c in the United States, it is critical for practitioners to educate clients about prevention of this disease through proper sanitation and vaccination.

a. SNAP canine parvovirus antigen test, IDEXX Laboratories Inc, Westbrook, Me.

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