A 10-year-old neutered male mixed-breed dog that weighed 7.9 kg (17.4 lb) was evaluated at the University of Florida Small Animal Hospital for chronic hematochezia and anemia. The dog had a 5-year history of intermittent hematochezia and chronic anemia that were unresponsive to medical treatment.

CLINICAL FINDINGS
Colonoscopy revealed multifocal areas of coalescing tortuous mucosal blood vessels throughout the colon and rectum. Colonic vascular ectasia (angiodysplasia) was diagnosed on the basis of the endoscopic appearance of the lesions.

TREATMENT AND OUTCOME
The dog failed to respond to traditional medical treatments for colonic vascular ectasia and required multiple plasma and blood transfusions. The dog received 4 endoscopic-assisted argon plasma coagulation treatments, which resulted in long-term resolution of gastrointestinal hemorrhage. Colonic perforation occurred during the third argon plasma coagulation treatment. The perforation was surgically repaired. The dog remained free from clinical signs of colonic vascular ectasia for > 1 year after the third argon plasma coagulation treatment and was euthanized because of clinical deterioration associated with progressive heart disease.

CLINICAL RELEVANCE
Endoscopic-assisted argon plasma coagulation treatment is a novel treatment for dogs with colonic vascular ectasia and provided long-term resolution of clinical signs for the dog of this report. In human patients, complications associated with endoscopic-assisted argon plasma coagulation treatment include colonic perforation, which also occurred in the dog of this report. (J Am Vet Med Assoc 2016;248:526–531)
A 10-year-old neutered male mixed-breed dog with CVE was admitted to a veterinary hospital (day 12). Notice the multifocal areas of tortuous, coalescing mucosal vessels that have formed raised erythematous beds of vascular tissue, which are characteristic of CVE. (Figure 1).

The dog was anesthetized for a recheck examination in 1 week. The PT and PTT were measured 5 additional times during management of the case and were within the respective reference ranges.

On days 9 and 11, the dog was reexamined because of anemia (PCV, 16% and 15% on days 9 and 11, respectively) subsequent to persistent hematochezia and required pRBC transfusions to increase its PCV to 32%. Administration of the following medications was initiated: prednisone (0.3 mg/kg [0.14 mg/lb], PO, q 24 h), metronidazole (16 mg/kg, PO, q 12 h), sucralfate (0.5 g, PO, q 8 h), and yunnan baiyao (1 capsule, PO, q 12 h). The dog was discharged from the hospital with instructions for the owner to bring it back for a recheck examination in 1 week. The PT and PTT were measured 5 additional times during management of the case and were within the respective reference ranges at each time.

On day 12, the dog was anesthetized for CT examination of the abdomen and colonoscopy. Because of persistent rectal bleeding, preparation for colonoscopy consisted of withholding food for 48 hours only. Abdominal CT examination revealed no abnormal findings. Colonoscopy revealed multifocal areas of tortuous, coalescing mucosal vessels that formed raised erythematous beds of vascular tissue throughout the transverse and descending colon and rectum (Figure 1); the ascending colon appeared normal. Those findings were consistent with a diagnosis of CVE.1–3 Surgical resection was not an option because of the extent of the lesions. On the basis of results of another study,2 the dog was treated medically with norethindrone and ethinyl estradiol tablets4 (norethindrone, 2.2 µg/kg [1 µg/kg] and ethinyl estradiol, 25 µg/kg [11.4 µg/lb], PO, q 24 h). Administration of sucralfate, yunnan baiyao, and metronidazole was continued as previously described. Prednisone was discontinued following administration of a 7-day tapering dosage regimen.

Despite treatment, the dog required 4 additional pRBC transfusions over the next 22 days (days 13 through 34) for alleviation of anemia subsequent to severe hematochezia. Alternate treatment options such as endoscopic-assisted APC, which is commonly used to treat human patients with gastrointestinal vascular ectasia, were investigated. On day 34, colonoscopy was performed following preparation of the dog by administration of a polyethylene glycol electrolyte solution5 (60 mL/kg, PO, twice, 2 h apart) and warm water enemas. Lesions observed in the transverse and descending colon were unchanged from those observed on day 12. The larger lesions in the transverse and descending colon were ablated by use of an argon plasma coagulator system6 (power setting, 15 W; argon flow rate, 0.8 L/min; activation time, 0.5 to 2.0 seconds) with 2.3-mm straight- and circumferential-fire probes7 (Figure 2). After consultation with a human gastroenterologist, the low energy and gas flow settings were chosen on the basis of the similar colon wall thickness in the dog compared to humans, the model of APC unit used, and the superficial nature of the lesions.5,6 The largest lesions and those that were actively bleeding were treated first, beginning in the transverse colon and working distally to the descending colon. Because of the extent of disease, not all lesions in the descending colon and none of the lesions in the rectum were treated. After the procedure, administration of the norethindrone and ethinyl estradiol tablets was continued as previously described, and administration of tramadol (2 mg/kg [0.9 mg/lb], PO, q 8 h) was initiated for analgesia. Hematochezia resolved within 6 days and anemia resolved within 30 days after the first APC treatment. On the basis of recommendations for human patients, the owner was advised to bring the dog back in 3 to 4 weeks for APC treatment of the untreated lesions. However, the owner declined to bring the dog back...
The dog remained free of clinical signs of CVE for 125 days after the initial APC treatment. On day 159, the dog had a relapse of clinical signs including severe hematochezia, lethargy, and weakness. The dog developed moderate anemia (PCV < 25%) and required 5 pRBC transfusions and 2 FFP transfusions over the next 49 days (days 160 to 208). On day 209, colonoscopy revealed that the number of lesions was approximately half that observed during the previous colonoscopy and approximately 80% of the remaining lesions were in the descending colon and rectum. All visible lesions were treated with APC (second treatment) as previously described. Administration of the norethindrone and ethinyl estradiol tablets was continued. Following the second treatment, hematochezia resolved within 3 days, and the dog remained free of clinical signs of disease for 13 days.

On day 226, the dog had a relapse of clinical signs and required 5 pRBC and 5 FFP transfusions. On day 229, administration of octreotide (19 µg/kg [8.6 µg/lb], SC, q 8 h for 12 days) was initiated. Octreotide is a somatostatin analog that inhibits angiogenesis and enhances platelet aggregation, which might decrease the risk of hemorrhage. Unfortunately, substantial improvement of the clinical signs was not observed during the 12 days that octreotide was administered, and the dog required 2 additional pRBC transfusions and 2 whole blood transfusions.

On day 241, colonoscopy revealed persistent lesions similar in number and location (transverse and descending colon and rectum) as those observed during the colonoscopy performed on day 209; lesions were not observed in the mid portion of the descending colon. During the third APC treatment, several lesions bled excessively and required repeated application of the APC probe. Following the procedure, the dog developed severe abdominal distention. Abdominal radiographs were obtained and revealed evidence of pneumoabdomen. An exploratory laparotomy was performed, during which an approximately 1-cm² area of discoloration with a 1.5-mm perforation in the center was observed in the proximal portion of the descending colon along with 5 to 6 small areas where the serosa appeared thinner than the surrounding serosa. Although the risk of perforation in those areas was low, all abnormal areas were repaired by the use of 4-0 polydioxanone suture and an inverting suture pattern followed by omentalization of the descending colon. The dog recovered from surgery without complications and was discharged from the hospital 4 days later. Administration of the norethindrone and ethinyl estradiol tablets was continued. Hematochezia resolved within 3 days after the APC procedure. To prevent recurrence of clinical signs, colonoscopy was performed 72 days later (day 313) to prophylactically treat the remaining lesions in the distal portion of the descending colon and rectum. No lesions were observed in the ascending, transverse, or proximal portion of the descending colon. All lesions were treated with APC (fourth treatment) as previously described, and administration of the norethindrone and ethinyl estradiol tablets was continued. The dog remained free of clinical signs of CVE for 394 days after the third APC treatment, at which time it was euthanized because of clinical deterioration associated with congestive heart failure. A necropsy was not performed.

Discussion

Colonic vascular ectasia, also known as angiodysplasia, is defined as abnormally dilated blood vessels within the mucosal and submucosal layers of the colon that are lined by only endothelium and contain little or no smooth muscle. Disruption of those fragile vessels commonly results in hemorrhage that can be chronic or intermittent in nature. The exact etiology of CVE is unknown. Diagnosis is made on the basis of results of endoscopic evaluation of the mucosal surface of the colon and does not require histopathologic confirmation. In human patients, potential risk
factors for CVE include aortic stenosis, chronic renal failure, and von Willebrand disease; however, those risk factors have not been assessed in veterinary patients with CVE because only a limited number of cases have been identified. In human medicine, the preferred method for treatment of CVE is endoscopic-assisted APC of the vascular lesions. Other potential treatments include surgical resection, transcatheter embolization, and medical treatments including hormone therapy with estrogen and progesterone, thalidomide, and somatostatin analogs such as octreotide. Colonic vascular ectasia is rare in dogs, with only 6 cases described prior to the present report. Treatments described for dogs with CVE include surgical resection and hormone therapy with estrogen and progesterone.

Argon plasma coagulation is a noncontact method for delivering a high-frequency monopolar current through ionized and electrically conductive argon gas, called argon plasma. The high-frequency current generates heat in the treated tissues, which causes devitalization, coagulation, desiccation, and tissue shrinkage. Benefits of APC include a limited depth of tissue penetration and creation of a uniform area of coagulation with minimal production of smoke or vapors, which makes it well suited for the treatment of diffuse bleeding, tumors, and adenomatous tissue. In human medicine, APC has been used for the treatment of angiodysplasia as well as radiation-induced proctopathy, Barrett’s esophagus, bleeding peptic ulcers, and palliation of esophageal, gastric, and rectal malignancies. The use of APC has been described for the management of gastric and colonic polyps in 2 dogs. To our knowledge, the present report is the first to describe the use of APC for treatment of CVE in a dog.

In human patients, angiodysplasia most frequently involves the colon (55% to 80% of cases), and lesions are predominately located in the cecum and ascending colon. Generally, a few lesions are localized to 1 segment of bowel; however, multiple lesions that involve ≥2 segments of bowel have been reported in up to 27% of human patients, and synchronous lesions elsewhere in the gastrointestinal tract have also been described. When multiple lesions preclude ablation of all lesions during a single APC treatment, further treatment is performed at intervals of 3 to 4 weeks until all identifiable lesions are ablated. This protocol has resulted in long-term resolution of gastrointestinal hemorrhage in approximately 85% of patients treated for colonic angiodysplasia. Patients that relapse or have residual colonic angiodysplasia are often successfully treated with repeated endoscopic-assisted APC.

For the dog of this report, 3 APC treatments resulted in resolution of clinical signs for >1 year before the dog was euthanized because of clinical deterioration associated with progressive heart disease. The initial APC treatment resulted in transient resolution of clinical signs and temporarily obviated the need for plasma and blood transfusions, but not all CVE lesions could be ablated during that treatment because of the extent of the disease. Even though another APC treatment was recommended 3 to 4 weeks after the initial treatment, the owner elected to not pursue further treatment until the clinical signs returned. The fact that the dog relapsed with a need for additional plasma and blood transfusions was not unexpected and was likely the result of the untreated lesions, although development of new lesions or recurrence of previously treated lesions cannot be excluded. Given the resolution of clinical signs after the third APC treatment without a subsequent relapse, we suspect that, had the second APC treatment been performed earlier, the dog may not have needed the additional plasma and blood transfusions, although there is no way to know that for certain.

In human medicine, complications associated with APC include cecal and colonic perforation and colonic explosion; however, those complications are fairly rare and are suspected to occur in <2% of patients. In humans, the use of APC in the colon might be associated with a higher risk of perforation than the use of APC in the small intestines because the colonic wall (thickness, 1.0 to 1.2 mm as determined by abdominal ultrasonography) is thinner than the small intestinal wall (thickness, 1.6 mm as determined by abdominal ultrasonography). The depth of bowel wall penetration during APC treatment is dependent on the power setting, activation time, and distance of the probe from the lesion. Increases in the power setting and activation time or a decrease in the distance of the probe from the lesion will increase the depth of penetration and increase the risk of perforation. The thermal sensitivity of a tissue also affects the depth of APC penetration, and the right colon has the highest thermal sensitivity in humans. Additionally, thermal sensitivity is increased when the bowel lumen is excessively distended with air.

In dogs, the colon wall is approximately 1.5 mm thick as determined by abdominal ultrasonography, which is similar to the thickness of the right colon wall in humans, and thus might be at a higher risk for perforation, compared with other regions of the intestinal tract. Information regarding the use of APC in dogs with CVE is lacking; therefore, the power setting used during APC treatment of the dog of this report (15 W) was selected on the basis of recommendations of a human gastroenterologist and was chosen because it was expected to minimize the risk of bowel perforation. In 2 studies in which the same type of APC unit as that used for the dog of this report was used to treat human patients with intestinal angiodysplasia, the power settings ranged from 15 to 25 W. Because the colonic volume of dogs is smaller than that of humans, the flow rate of argon gas (0.8 L/min) used for the dog of this report was decreased from that used for human patients to prevent overinflation of the colon.

Despite those precautions, a colonic perforation occurred in the dog of this report during the third APC treatment. Repeated treatment of bleeding lesions
might have caused an increase in the activation time or depth of penetration, which resulted in subsequent perforation. An increase in the power setting used might have decreased the need for repeated treatment application or allowed for shorter activation times and prevented the perforation. Also, excessive insufflation of the colon might have increased the thermal sensitivity of the tissue. A dog with inflammatory rectal polyps that was treated with APC at a power setting of 50 W did not develop evidence of a rectal perforation; however, those lesions were likely associated with focal thickening of the rectal wall, which decreased the likelihood of perforation despite the use of a higher power setting, and were located in the rectum, which has a lower thermal sensitivity than the colon. Additionally, the APC unit used for the dog of that study was an older model than the APC unit used for the dog of the present study and requires the use of higher power settings (40 to 60 W) to achieve treatment efficacy, at least in human patients. The APC unit used for the dog of the present report requires lower power settings (15 to 25 W) when treating gastrointestinal lesions as reported in human studies and recommended by the manufacturer. Further studies are necessary to determine the ideal power and gas flow settings for the treatment of specific colonic lesions in dogs. Injection of saline (0.9% NaCl) solution into the submucosa of the colon to form a fluid cushion, or heat sink, between a lesion and the serosa before APC treatment is associated with a significant decrease in the proportion of colonic lesions that develop deep tissue injury secondary to APC treatment and might reduce the risk of bowel perforation. However, injection of saline solution into the colonic submucosa of the dog of this report would have been difficult because of the large number of lesions.

Surgical resection was not pursued for the dog of the present report owing to the extensive involvement of the colon and rectum, which would have required radical resection. Medical management with estrogen and progesterone was initiated prior to APC treatment. The exact mechanism by which hormone therapy decreases bleeding from blood vessels is unknown, and the use of hormone therapy for the treatment of human patients with angiodysplasia is currently considered questionable. Results of early, small uncontrolled studies suggest that hormone therapy might be useful for prevention of recurrent gastrointestinal hemorrhage, but in a more recent randomized clinical trial with long-term follow-up, the number of bleeding episodes and transfusions did not differ significantly between patients that did and did not receive hormone therapy. In veterinary medicine, 2 dogs with extensive CVE lesions throughout the length of the colon that were treated with estrogen and progesterone had resolution of hematochezia and anemia within 6 to 8 weeks, respectively, after initiation of treatment and remained free of clinical signs of the disease for 8 and 24 months, respectively. The dog in the present report received hormone therapy for the duration of the treatment period, and because it was administered in conjunction with other treatment modalities, it is unknown whether it had any mitigating effects on the clinical signs. Further investigation is necessary to determine the efficacy of hormone therapy for the treatment of CVE in dogs.

The dog of the present report was administered octreotide for the treatment of vascular lesions that were missed during the second APC treatment or were located in the small intestines and might have contributed to the recurrence of clinical signs. Up to 20% of human patients with angiodysplasia have vascular lesions in multiple locations throughout the gastrointestinal tract. Results of multiple, small uncontrolled studies suggest that administration of octreotide might decrease the number of plasma or blood transfusions required by human patients with angiodysplasia and refractory gastrointestinal bleeding. Those studies have several limitations including small sample sizes as well as uncontrolled and nonrandomized study populations that were heterogeneous in terms of lesion location and octreotide dose administered. Octreotide did not appear to decrease or prevent gastrointestinal bleeding in the dog of the present report; however, it was administered for only 12 days, which might not have been long enough for the clinical effects of treatment to be manifest. Increasing the dose of octreotide administered to the dog might have been beneficial because some human patients that became refractory to treatment responded when the octreotide dose was increased. Octreotide was not administered for a longer duration to the dog of the present report because of the complications (colonic perforation) that occurred during the third APC treatment and the long-term resolution of clinical signs following surgery to correct the perforation.

To our knowledge, the present report is the first to describe the use of endoscopic-assisted APC for treatment of CVE in a dog. In the dog of this report, APC treatment effectively resolved the clinical signs and obviated the need for plasma and blood transfusions. Compared with surgical resection, APC is a less invasive treatment option. Further evaluation of this technique in a larger group of dogs with CVE is warranted to determine its efficacy. In dogs with severe CVE, multiple APC treatments may be necessary to ablate all lesions and prevent recurrence of gastrointestinal bleeding. For dogs that require multiple APC treatments, we believe that administration of those treatments before recurrence of clinical signs might minimize the number of blood transfusions required by those dogs. However, as evidenced by the dog of the present report, complications such as colonic perforation can occur during APC treatment.

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Footnotes
b. GoLYTELY (PEG-3350 and Electrolytes for oral solution), Braintree Laboratories Inc, Braintree, Mass.
c. APC probe (outside diameter, 2.3 mm; length, 220 cm), ERBE USA Inc, Marietta, Ga.
d. APC2 argon plasma coagulation unit, ERBE USA Inc, Marietta, Ga.

References