Multiple gastric erosions diagnosed by means of capsule endoscopy in a dog

Brian T. Hardy DVM
Jessica Gentile-Solomon DVM
Jeffrey A. Solomon MD, MBA

A 6-year-old spayed female Golden Retriever was evaluated by one of the authors (JG-S) because of a 2-week history of progressive hyporexia progressing to anorexia with signs of abdominal pain. The dog was not receiving any medications and had no known exposure to toxins, foreign bodies, or other inciting causes of gastrointestinal mucosal injury. The owner reported that the dog had a recent weight loss of 2.7 kg (6 lb), and physical examination revealed mild loss of body condition (body condition score, 4/9; body weight, 25 kg [55 lb]), with signs of pain on palpation of the cranial aspect of the abdomen and a body condition score of 4 (scale, 1 to 9). A CBC revealed mild microcytosis and hypochromasia; results of serum biochemical analysis were within the respective reference ranges, and abdominal ultrasonography revealed no abnormalities. Capsule endoscopy was performed, and numerous gastric erosions and hemorrhages were detected, with rare dilated lacteals in the proximal aspect of the small intestine.

TREATMENT AND OUTCOME
Treatment was initiated with omeprazole and sucralfate for 6 weeks, and the dog was transitioned to a novel protein diet. Capsule endoscopy was repeated at the end of the initial treatment course and revealed overall improvement, with a few small erosions remaining; medical treatment was continued for an additional 2 weeks. At last follow-up 9 months after treatment ended, the dog was clinically normal.

CLINICAL RELEVANCE
Capsule endoscopy was useful for initial detection and subsequent reevaluation of gastrointestinal lesions in this patient without a need for sedation or anesthesia. Information obtained in the follow-up evaluation was valuable in identifying a need to extend the duration of medical treatment. (J Am Vet Med Assoc 2016;249:926–930)
subjective improvement, with a few erosions remaining that were in various stages of healing (Figure 2). No new lesions were detected in the gastrointestinal tract. The medical treatment was continued for an additional 2 weeks because of the persistent gastric lesions. The owners declined a third capsule endoscopy procedure to reassess the patient; however, at last follow-up 9 months after the medical treatment was completed, the dog had a normal appetite and was clinically normal on physical examination, with a body weight of 28.1 kg (61.8 lb). The novel protein diet was continued.

Discussion

Capsule endoscopy is a novel imaging modality in which miniature cameras are used to capture diagnostic images of the gastrointestinal tract in a patient without the need for sedation or anesthesia. The dog of this report passed the capsule during normal defecation approximately 24 hours after oral administration both times that the procedure was performed. There were no adverse effects related to capsule endoscopy during either procedure. The single-use capsule endoscopy device is ingestible and fully automated, and it is propelled through the gastrointestinal tract by peristalsis. The device used in the patient described here consisted of a battery, a white light-emitting diode light source, 4 autofocus cameras, a microprocessor, and an internal image-storage system contained within a translucent, biocompatible plastic capsule that measured 11 \( \times \) 31 mm and weighed approximately 4 g. It was capable of capturing 360° panoramic images up to 5 times/s and had a battery life of approximately 15 hours. Images were downloaded through a software program available from the manufacturer installed on a desktop computer. In addition to downloading images, the software allowed for image playback at variable speed (up to 8 \( \times \) real-time speed), still and video image capture, image magnification, variable image display configurations, red color detection (to enhance detection of bleeding lesions), and generation of a report describing imaging findings and recommendations. Alternatively, the manufacturer provides image download, analysis, and report generation by a small animal internal medicine specialist as a service, as was done for the dog of this report.

In capsule endoscopic studies of human patients, the time typically required to review the acquired images has been reported to range from 40 to 60 minutes, depending on the reviewer’s degree of experi-
ence. Several techniques have been developed to decrease the amount of time required for review. A high frame rate during playback and use of alternate viewing modes have been shown to shorten reading times to 16 to 30 minutes while maintaining the ability to reliably detect lesions. The veterinarian interpreting the data for the dog of this report had analyzed > 100 sets of capsule endoscopy images, and analysis of images for this patient required approximately 30 minutes, with various playback rates used.

Commonly reported causes for gastrointestinal ulcers and erosions in dogs include medications (eg, NSAIDs and steroids), severe systemic disease (eg, sepsis, shock, or disseminated intravascular coagulation), liver failure, chronic kidney disease, eosinophilic or lymphoplasmacytic inflammatory bowel disease, extreme exercise, neurologic disease, and mast cell tumors. Less commonly, infectious agents (including fungal, bacterial, viral, and parasitic organisms), caustic substances, and other neoplastic disease have been implicated as causes of ulcers in dogs. Research in dogs has not focused on gastrointestinal erosions specifically, but the causes are likely similar. No specific underlying cause for gastrointestinal erosions was identified in the dog of this report. The patient was not receiving any medications, and results of physical examination and routine diagnostic tests did not indicate organ dysfunction or systemic disease. The mucosal fissures and dilated lacteals detected by capsule endoscopy suggested the potential for concurrent primary gastrointestinal disease. However, the clinical importance of these subjectively mild changes remained unknown because histopathologic evaluation of the lesions was not performed.

The most commonly reported clinical sign in dogs with gastrointestinal ulceration is vomiting. Although less frequently described, hematemesis, melena, anorexia, weight loss, and signs of abdominal pain may also be present. The owners of the dog of this report reported no vomiting, hematemesis, or melena. Clinopathologic abnormalities including anemia, hypoproteinemia, and high BUN concentration can support a diagnosis of gastrointestinal ulceration, but these findings are not specific to the disease. The rate and chronicity of blood loss influence the classification of anemia and the ability to observe gross melena. Regenerative and nonregenerative anemia have been reported in and hematologic evidence of iron deficiency has been identified in small numbers of dogs with gastroduodenal ulcers. The patient of this report had Hct, reticulocyte count, serum albumin and globulin concentrations, and BUN concentration within the reference ranges; however, mild microcytosis and hypochromasia, suggestive of early iron deficiency, were also present.

Gastric and duodenal ulcers and erosions can be diagnosed by various imaging techniques. Contrast radiography and ultrasonography can be used to identify lesions in some instances, but gastroduodenoscopy is reported to be the most sensitive method for detection. Disadvantages of conventional endoscopy include a requirement for general anesthesia and the fact that visual examination is limited to the stomach and proximal aspect of the duodenum, as well as a need for extensive training and expensive equipment. In addition to allowing visual evaluation of the entire length of the small intestine and proximal colon, the location of lesions detected with capsule endoscopy can be estimated through visual identification of nearby landmarks (eg, the pylorus or the passage from the ileum into colon), and the frame number and elapsed time are automatically recorded by the capsule. Although not performed for the patient of this report, serial radiographs can be obtained during transit of the capsule (which is radiopaque) and used to triangulate the approximate location of an abnormality by taking into account the time at which a lesion is imaged and the time when a radiograph was obtained.

Treatment of gastrointestinal ulcers and erosions in dogs consists of gastric acid suppression, cytoprotective medication, and treatment or elimination of the primary cause. Duration of gastroprotectant treatments may vary depending on the severity and primary cause of the ulcers; however, initial treatment is routinely recommended for 2 to 3 weeks. In this case, because of the large number of erosions and uncertain etiopathogenesis, a longer course of treatment was recommended. Proton pump inhibitors have been shown to be more efficacious than histamine-2 receptor antagonists for acid suppression in dogs and have been recommended for this purpose. Sucralfate facilitates healing and acts as a cytoprotectant by binding to ulcerated areas of mucosa and limiting further acid and enzymatic penetration into the damaged tissue. Additionally, sucralfate has been shown to stimulate gastric mucus and HCO₃⁻ production through prostaglandin-dependent and non–prostaglandin-dependent mechanisms and to increase epidermal growth factor–mediated cell renewal.

The effectiveness of the medical treatment regimen of omeprazole and sucralfate in the dog of this report was supported by the capsule endoscopy finding that most erosions had healed and that the remainder had a substantially improved appearance at a 6-week recheck examination. Mucosal healing is rarely visually confirmed in dogs with gastrointestinal ulcers because of the necessity for 1 or more additional endoscopy procedures. In this patient, despite a rapid resolution of clinical signs, persistent erosion was detected, prompting prolonged treatment. If the follow-up imaging had not been performed, treatment would have been discontinued prior to complete healing (on the basis of empirical guidelines recommending a 2- to 3-week treatment period), and the erosive lesions could have subsequently worsened.

Severe gastrointestinal ulceration can progress to perforation and septic peritonitis. Despite surgical intervention, prognosis in these cases is guarded, and survival of 8 of 15 and 10 of 16 dogs was reported in 2
Capsule endoscopy is used for a range of indications in human medicine. It was initially approved for evaluation of patients with obscure gastrointestinal bleeding and is still extensively used for this purpose.18 Use of the method has since expanded to include the evaluation and monitoring of patients with iron deficiency anemia, inflammatory bowel diseases such as Crohn disease and ulcerative colitis, small intestinal tumors, polyposis syndromes, celiac disease, NSAID-related enteropathy, and abdominal pain.19–25

Technological advances have made it possible to evaluate the esophagus and colon by capsule endoscopy as well.26,27 The most common complication of the procedure in human patients is capsule retention, defined as failure to pass the capsule within 2 weeks after ingestion. The overall retention rate has been reported as 14 of 1,000 (1.4%),28 with variations depending on the presence and type of underlying disease from 0 of 773 (0%) in healthy control subjects to 4 of 19 (21%) in patients with suspected obstruction.29,30 Capsule retention has most commonly been reported in people with neoplastic lesions, Crohn disease or a history of NSAID use (both of which commonly cause strictures in people), or postoperative adhesions causing a narrowed bowel lumen.25 Medical treatment (eg, promotility agents), endoscopic retrieval, or surgical removal may be necessary in such patients.25 Capsule aspiration and perforation of the gastrointestinal tract by retained capsules have also been rarely reported.31,32 Therefore, contraindications to capsule endoscopy include known gastrointestinal obstruction and swallowing disorders.33 Small patient size may limit the size of capsule that can pass through the gastrointestinal tract, but successful capsule endoscopy has been performed in infants as young as 10 months old and weighing as little as 7.9 kg (17.4 lb).34

Reports of capsule endoscopy in the veterinary literature are sparse, and to the authors’ knowledge, these have only included healthy dogs. Those studies35–37 investigated the efficacy and rapidity of effect of anthelmintic agents and the effect of different bowel preparation methods on image quality. Additionally, dogs have been used for in vivo testing of modified capsule endoscope prototypes.38,39 No complications secondary to the procedure were reported in those studies; however, a potential limitation to the use of capsule endoscopy in dogs is incomplete examinations of the GI tract in the event of failure of the capsule to reach the colon before the battery life ends. Incomplete evaluations were reported in 3 of 18 (17%) dogs in 1 study,45 although repeating the procedure resulted in complete evaluations in all 3 dogs. However, the system used in that study45 had a reported battery life of approximately 8 hours, in contrast to the approximate 15-hour battery life of the capsule used in the dog of the present report. It is important to consider that failure to achieve imaging of the gastrointestinal tract can potentially indicate delayed gastrointestinal motility, either as a primary problem or as a component of the underlying disease being investigated with the endoscopic procedure. Treatment with prokinetic medications prior to capsule endoscopy has commonly been done in humans, but the efficacy of these treatments for increasing the likelihood of complete examination is variable.40,41

It is also possible that some small dogs may be unable to pass the capsule by normal defecation. However, in a study by Lee et al,45 the dogs used were small (mean weight, 6.0 kg, [13.2 lb]), and all passed the capsules within 27 hours after administration without apparent difficulty. The capsules used in that study45 were 11 mm in diameter, identical to that of the capsule used in the dog of this report. Because the gastrointestinal mucosa can be obscured by digesta or fluid during capsule endoscopy, various bowel-preparation protocols have been recommended in human patients. Polyethylene glycol and simethicone are routinely used, but consensus on the optimal preparation method has not been reached.41 Oral administration of polyethylene glycol resulted in better capsule endoscopy image quality in a small number of healthy dogs than did 0.9% NaCl solution, particularly in the distal portions of the gastrointestinal tract.37 Fairly large volumes were required (25 to 30 mL of polyethylene glycol solution/kg [11.4 to 13.6 mL/lb], administered twice), which could potentially affect tolerability for some patients or perceived invasiveness of the procedure for owners. Other studies45,46 have shown adequate image quality after fasting alone, with no difference in results after fasting for 24 versus 48 hours.

Numerous other imaging modalities are used for the assessment of the GI tract, including surgery and contrast-enhanced radiography, ultrasonography, endoscopy, CT, and MRI. Each modality has benefits and limitations in regard to sensitivity and specificity of lesion detection, availability, cost, ease of use, procedure time needed, training requirements, need for anesthesia, and usefulness in collection of biopsy samples. The sensitivity and specificity of capsule endoscopy have not been determined in dogs, and studies to compare capsule endoscopy to the gold standard methods of diagnosing gastrointestinal disease are warranted.

Acknowledgments

Drs. Hardy and Solomon are shareholders in Infiniti Medical LLC. Dr. Gentile-Solomon is a consultant for Infiniti Medical LLC.

Footnotes

a. ALICAM, Infiniti Medical LLC, Menlo Park, Calif.
b. Accel TB Wipes, Virox Technologies Inc, Oakville, ON, Canada.
c. ALICAM Reader, Infiniti Medical LLC, Menlo Park, Calif.
d. ALICAM Software, Infiniti Medical LLC, Menlo Park, Calif.
References

1. Graham AH, Leib MS. Effects of prednisone alone or predni-
sone with ultralow-dose aspirin on the gastroduodenal mu-

2. Sennello KA, Leib MS. Effects of deroxacin or buffered aspi-

3. Ward DM, Leib MS, Johnston SA, et al. The effect of dosing in-
val on the efficacy of misoprostol in the prevention of aspirin-


13. Bersenas AM, Mathews KA, Allen DG, et al. Effects of ranitidine, famotidine, pantoprazole, and omeprazole on intragas-


16. Rees WD. Mechanisms of gastroduodenal protection by su-


19. Arnott ID, Lo SK. The clinical utility of wireless capsule en-

20. Carlo JT, DeMarco D, Smith BA, et al. The utility of capsule endoscopy and its role for diagnosing pathology in the gastroin-

21. Gay G, Delvaux M, Frederic M. Capsule endoscopy in non-
steroidal anti-inflammatory drugs—enteropathy and mis-

22. Hale MF, Sidhu R, McAllindon ME. Capsule endoscopy: cur-

23. Redondo-Cerezo E, Sánchez-Capilla AD, De La Torre-


troenterol Hepatol 2015;9:79–89.


coxib, naproxen plus omeprazole, and placebo. Clin Gastro-
enterol Hepatol 2005;3:133–141.


port and literature compilation of an increasingly reported complication. Dig Dis Sci 2011;56:2758–2762.


35. Lee AC, Epe C, Simpson KW, et al. Utility of capsule endos-


eglutatin on the efficacy of misoprostol in the prevention of aspirin-

38. Filip D, Yadid-Pecht O, Andrews CN, et al. Self-stabilizing co-
operative system for a self-propelling capsule endoscope using a mag-


40. Koulouzidis A, Giannakou A, Yung DE, et al. Do prokinetics influence the completion rate in small-bowel capsule endos-

41. Kotwal VS, Attar BM, Gupta S, et al. Should bowel prepara-
tion, antifoaming agents, or prokinetics be used before video capsule endoscopy? A systematic review and meta-analysis. Eur J Gastroenterol Hepatol 2014;26:137–145.