Diagnosis of chronic small bowel disease in cats: 100 cases (2008–2012)

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Objective—To determine whether a diagnosis of chronic small bowel disease could be established in a subset of cats that had clinical signs of chronic vomiting, chronic small bowel diarrhea, weight loss, or a combination of these, combined with ultrasonographically determined thickening of the small bowel.

Design—Retrospective case series.

Animals—100 client-owned domestic cats.

Procedures—Medical records of cats with clinical signs of chronic vomiting, chronic small bowel diarrhea, weight loss, or a combination of these, combined with ultrasonographically determined small bowel thickening, that underwent laparotomy and multiple small bowel biopsies between 2008 and 2012 were examined. Biopsy specimens were submitted for histologic evaluation, immunohistochemical evaluation, and, when findings were ambiguous, PCR assay for antigen receptor rearrangement.

Results—Chronic small bowel disease was diagnosed in 99 of the 100 cats. The most common diagnoses were chronic enteritis and intestinal lymphoma.

Conclusions and Clinical Relevance—Results suggested that cats with clinical signs of chronic small bowel disease should undergo detailed diagnostic testing because they are likely to have clinically important, diagnosable, treatable disease. Clinical signs of small bowel disease, especially weight loss and chronic or recurrent vomiting, are extremely common in cats. These signs should not be considered a normal condition and should not be ignored, regardless of common explanations given by owners, and cats with these signs should undergo appropriate diagnostic testing. (*J Am Vet Med Assoc* 2013;243:1455–1461)

In cats, CSBD is associated with chronic vomiting, weight loss, chronic small bowel diarrhea, or a combination of these. Signs range from mild to severe, and any sign may be the primary reason for evaluation. In some cats, chronic disease may be accepted by the owner as a normal condition; this appears to be especially true of chronic or intermittent vomiting.

Abdominal ultrasonography is a useful noninvasive tool for the diagnosis of CSBD because it allows anatomic assessment of wall thickness, layers, and motility.[1] The ultrasonographic appearance should be alternating hyperechoic and hypoechoic signals for the serosa, muscularis, submucosa, mucosa, and luminal contents.[2] It is not possible to sequentially trace the entire small intestine, so during visual examination of a particular segment, a clinician may not know whether that segment is the duodenum, jejunum, or ileum; however, anatomic landmarks are helpful in identifying specific features of the duodenum and ileum.

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Abbreviations

CSBD	Chronic small bowel disease
EATL	Enteropathy-associated T-cell lymphoma
IBD	Inflammatory bowel disease
PARR	PCR assay for antigen receptor rearrangement

Reference ranges for wall thickness, measured from serosa through mucosa, of various portions of the small intestine have been determined. Wall thickness of the duodenum has been reported as 0.20 to 0.24 cm,[1,3] 0.13 to 0.38 cm,[4] and 0.16 to 0.38 cm.[5] Wall thickness of the jejunum has been reported as 0.21 to 0.25 cm,[1,3] 0.16 to 0.36 cm,[4] and 0.16 to 0.36 cm,[5] whereas wall thickness of the ileum has been reported as 0.25 to 0.32 cm[1,3,4] and 0.16 to 0.36 cm.[5]

Inflammatory bowel disease and EATL are the most common small bowel diseases of middle-aged and older cats.[6–8] Inflammatory bowel disease, a chronic inflammatory disease most frequently characterized by lymphoplasmacytic inflammation, is diagnosed after lymphoma and other known causes of chronic enteritis have been excluded.[6,9] Enteropathy-associated T-cell lymphoma type 2, which is characterized by small lymphocytes, is the most common infiltrative intestinal lymphoma in cats[10–12] and can appear morphologically similar to IBD. Treatment protocols have been reported for IBD and EATL.[13,14]

Differentiation between IBD and EATL type 1 (large cell) typically is straightforward and based on established

histologic criteria. In some cases, the differentiation between IBD and EATL type 2 can pose a challenge because inflammatory infiltrates and neoplastic infiltrates are morphologically similar. Ambiguous cases can be differentiated on the basis of results of immunohistochemical testing and clonality testing by use of PARR.[10–12,15,16] Historically, intestinal lymphoma in cats has been categorized into small cell and large cell histotypes on the basis of histologic features, but with the advent of immunohistochemical analysis and PARR, differentiation and further classification of intestinal lymphoma as a B-cell or T-cell immunophenotype is important for determining a prognosis and developing treatment protocols.[10,17]

The technique used for collection of biopsy specimens affects the quality of the specimens submitted and, hence, the ability to interpret cellular morphology, anatomic changes, and depth of invasion.[7,8,10] Three or more full-thickness biopsy specimens of appropriate size should be collected from locations thought to contain pathological lesions, typically representing different segments of bowel. Investigators in 1 study[18] found that full-thickness biopsy specimens were superior to endoscopically obtained partial-thickness specimens for diagnosis of intestinal lymphoma in cats. During exploratory laparotomy, surgeons can obtain biopsy specimens of gastrointestinal tissues as well as extragastrointestinal tissues such as the liver, pancreas, and lymph nodes.[19] In cats, the disease complex known as triaditis (a comorbidity with chronic enteritis, pancreatitis, and nonsuppurative cholangiohepatitis and cholangitis)[20] may be clinically indistinguishable from chronic enteritis alone; thus, examination of additional biopsy specimens may reveal coexisting diseases.

The objectives of the study reported here were to determine the association between clinical signs of small bowel disease, ultrasonographically determined thickening of the small bowel, and histologic evidence of disease in client-owned cats and to determine the presence of treatable disease in these cats. We hypothesized that these cats would have disease of the small bowel that should be evaluated in detail.

Materials and Methods

Case selection—Medical records of client-owned cats with chronic enteropathy that were treated at Alamo Feline Health Center in San Antonio, Tex, between 2008 and 2012 were examined. For inclusion in the study, cats had to meet the following 2 criteria: appropriate medical history and clinical signs and ultrasonographic examination of the small bowel that revealed a wall thickness ≥ 0.28 cm in ≥ 2 locations. Appropriate medical history and clinical signs were defined as cats that had ≥ 1 of the following 3 findings: history of vomiting (≥ 2 times/mo for at least 3 consecutive months), small bowel diarrhea of several weeks' duration, and weight loss (≥ 0.5 kg [≥ 1.1 lb] within the preceding 6 months). Cats that consistently vomited plant material were excluded. Most expenses for each cat were borne by the cat's owner; some specialized laboratory testing was paid for by Alamo Feline Health Center.

Medical records review—Ultrasonographic examinations were performed on all cats by one of several staff veterinarians by use of an ultrasound machine with an 11-MHz linear probe. The stomach wall was examined to determine the thickness and evidence of masses; in many cases, stomach contents prohibited observation of all but the ventral wall. At least 5 and usually ≥ 8 measurements were made of the walls of the small bowel from the outer surface of the serosa to the inner surface of the mucosa. If ≥ 2 measurements were ≥ 0.28 cm, laparotomy was recommended. A value of 0.28 cm was chosen on the basis of the authors' clinical experience with these and other cats. All cats included in the study underwent surgery.

A preanesthetic biochemical analysis and a CBC or PCV measurement were performed in all cats. Thyroxine concentrations were measured in cats ≥ 10 years old. Cats were excluded from the study if hyperthyroidism was diagnosed. Pancreatic and hepatic clinicopathologic abnormalities were not a basis for exclusion, given that examination of biopsy specimens of the liver or pancreas may aid in a definitive diagnosis. When a cat had renal compromise, the decision to proceed (or not proceed) with surgery was made by the attending clinician.

Full-thickness biopsy specimens were obtained from ≥ 2 small bowel sites during laparotomy; in most cats, ≥ 3 biopsy specimens were collected. As the study progressed, the decision was made to expand the amount of information obtained. Therefore, biopsy specimens of the mesenteric lymph nodes, pancreas, and liver were obtained from some cats. Biopsy specimens of the small bowel were collected on the antimesenteric surface; specimens were collected with a scalpel blade (which was used to make a wedge-shaped incision) or a 6-mm biopsy punch. If biopsy specimens were collected from the pancreas or liver, these specimens were collected before specimens were obtained from the small bowel. A wedge biopsy specimen was obtained from the liver, and a 4-mm biopsy punch was used to obtain a specimen of the pancreas. Grossly abnormal areas in either organ, when present, were selected as sites for collection of biopsy specimens; otherwise, easily accessible sites were chosen. When collection of intestinal biopsy specimens was completed, hepatic and pancreatic biopsy sites were inspected for hemorrhage before closure of the abdominal cavity.

Biopsy specimens were placed in neutral-buffered 10% formalin and submitted to a pathology laboratory[a] owned by one of the authors (JSE). All specimens were submitted for histologic evaluation and examination by use of CD3, CD79a, and CD20 immunohistochemical stains. Specimens from cats with ambiguous results were examined with PARR for T-cell receptor γ or heavy-chain IgG; these 2 tests were performed at a university-based laboratory.[b]

Slides were histologically assessed by a panel of 4 board-certified veterinary pathologists, who used the guidelines for evaluation of intestinal biopsy specimens developed by the World Small Animal Veterinary Association International Gastrointestinal Standardization Group[21] and the diagnostic algorithm used to differentiate lymphoma from inflammation in feline small intestinal biopsy specimens reported in another study.[10] Specimens were characterized on the basis of anatomic

change, type of infiltrate, small cell or large cell histotype, depth of invasion (epithelial, villous, mucosal, deep mucosal, and transmural), and immunophenotype (B cell vs T cell). Cats with enteritis were assigned to 4 categories: reactive lymphoid enteritis (moderate to severe mixed infiltrates without architectural changes), mild enteritis (mild mixed infiltrates with at least 2 major architectural changes [blunting or fusion of intestinal villi, interstitial fibrosis, loss of glands, or crypt lesions]), moderate enteritis (moderate infiltrates with at least 2 moderate architectural changes), and severe enteritis (moderate to severe infiltrates with at least 2 severe architectural changes). All cats with substantial monomorphic infiltrates limited to the epithelium and villi were defined as ambiguous and were tested with PARR. All cats with lymphoma that had dense monomorphic T-cell infiltrates that expanded the entire mucosa down to the lamina muscularis and all cats with enteritis that had mixed-cellular dense epithelial and villous infiltrates along with substantial architectural changes were deemed to be ambiguous. Each was tested with PARR to differentiate between the 2 diseases. Cats with confirmed lymphoma were categorized into T-cell or B-cell immunophenotypes on the basis of results of immunohistochemical analysis, large cell or small cell histotypes determined on the basis of histomorphologic evaluation, and EATL type 1 or EATL type 2.

Results

A total of 165 cats were eligible for inclusion in the study. Surgery was performed on only 100 cats; thus, 65 (39.4%) eligible cats did not undergo surgery and were excluded from the study. Surgery was not performed as a result of a decision made by the owners (most commonly because of expense or skepticism of presence of disease) or veterinarian (typically because a cat was a poor surgical candidate). These owners were then offered dietary or pharmacological therapeutic trials for their cats. Dietary trials consisted of exclusively feeding novel protein diets or hydrolyzed protein diets for 6 to 8 weeks. Pharmacological trials differed among cats on the basis of patient and client factors but typically consisted of a probiotic, metronidazole, fenbendazole, cobalamin, prednisolone, or lomustine, alone or in combination.

The 100 cats consisted of 9 purebred cats and 91 nonpurebred cats. Purebred cats were 3 Maine Coons and 1 each of Abyssinian, Bengal, Ragdoll, Russian Blue, Siamese, and Tonkinese. The nonpurebred cats consisted of 65 domestic shorthair cats, 11 domestic medium-hair cats, and 15 domestic longhair cats. The study population was consistent with the general population of cats examined at the Alamo Feline Health Center; nonpurebred cats comprised 84% of the total population of cats examined at the facility during the study period.

The median and mean age for all 100 cats was 11 years (range, 1 to 18 years; interquartile range, 10 to 14 years). Thirty-four cats were 12 to 14 years old, and 13 were 15 to 18 years old; thus, 47 were ≥ 12 years old. There were slightly more males (n = 56) than females (44) in the study population.

The frequency of clinical signs was summarized. Weight loss was the most frequent clinical sign (70 cats). Vomiting ≥ 2 times/mo was reported for 61 cats, diarrhea was reported for 11 cats, and vomiting and diarrhea were reported for 13 cats. Many cats with vomiting, diarrhea, or vomiting and diarrhea also had weight loss.

Twenty-six cats in the study were evaluated as part of wellness examinations. Each of these 26 cats had clinical signs of CSBD, but the owners did not consider the signs to be clinically important. Explanations provided by the owners for the signs included that the cat ate too fast, was typically nervous, had a sensitive stomach, had hair balls (ie, trichobezoars), or had always had these signs and thus the cat was considered clinically normal. Of these 26 cats, 16 had chronic enteritis, 8 had lymphoma, and 2 had lymphoma and mast cell disease.

Ultrasonographic measurements of the thickness of the wall of the small bowel were obtained. All 100 cats in the study had at least 2 ultrasonographic measurements ≥ 0.28 cm, and 92 had at least 1 measurement ≥ 0.30 cm. Eight cats had maximum small bowel wall measurements of 0.28 or 0.29 cm. Of these 8 cats, 4 had chronic enteritis, 3 had EATL type 2, and 1 was clinically normal. Seventy-six cats had at least 1 ultrasonographic measurement < 0.28 cm. It appeared that CSBD often was segmental, which was frequently confirmed visually during surgery (**Figure 1**).

One of the 100 cats had no abnormal findings during histologic examination of the small bowel biopsy specimens. The other 99 cats had various degrees of inflammation or neoplasia in 1 or more specimens (**Table 1**).

Chronic enteritis was diagnosed in 49 cats (median age, 11 years; range, 1 to 16 years). The predominant infiltrating cells were lymphocytes and plasma cells (42/49 [86%] cats); however, eosinophilic infiltration was detected in 17 of 49 (35%) cats with chronic enteritis. Of these 49 cats, 3 were graded as reactive lymphoid enteritis, 13 as mild enteritis, 32 as moderate enteritis, and 1 as severe enteritis. We chose to use the term enteritis instead of IBD because other known causes of chronic enteritis had not been eliminated, and further data would have been required to establish a diagnosis of IBD.

Intestinal lymphoma was diagnosed in 46 cats (median age, 12 years; range, 8 to 18 years). These were further classified, which revealed 44 T-cell histotypes (38

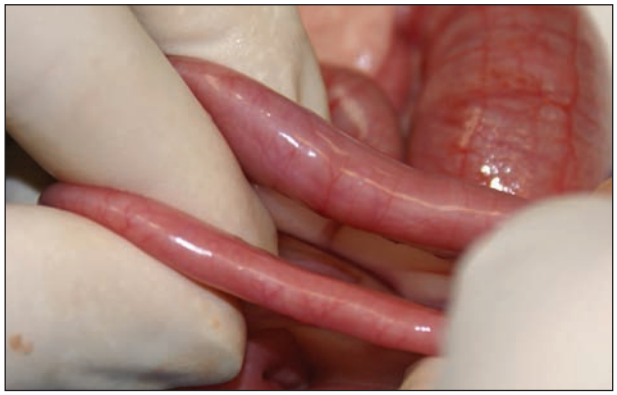

Figure 1—Photograph obtained during exploratory laparotomy in a cat with CSBD. Notice the difference in thickness of the 2 loops of jejunum, which indicates segmental disease.

Table 1—Diagnosis determined on the basis of results of histologic examination of small bowel biopsy specimens collected from 100 cats with clinical signs of chronic enteropathy.

Diagnosis	No. of cats
Histologically normal	1
Enteritis	49
Lymphoplasmacytic	42
Eosinophilic	17
Neutrophilic	7
Histiocytic	1
Neoplasia	50
Lymphoma	46
Small cell	39
T cell	38
B cell	1
Lymphoblastic	7
T cell	6
B cell	1
Mast cell disease	3
Adenocarcinoma	1

The total number of cats exceeds 100 because of redundancy of diagnoses (ie, some cats were classified as having lymphoplasmacytic and eosinophilic enteritis).

EATL type 2 [small cell] and 6 EATL type 1 [large cell]) and 2 B-cell histotypes (1 small cell and 1 large cell).

Cats < 8 years old had enteritis, and cats ≥ 8 years old had enteritis or neoplasia. The cat with the biopsy specimen that had no abnormalities (ie, clinically normal cat) was 5 years old. Age distribution for cats with enteritis and those with lymphoma was determined (**Figure 2**). There was a significant ($P < 0.001$; Student *t* test) difference in age between the cats with enteritis and those with lymphoma, although the means of the 2 groups were similar (10 and 12 years, respectively).

Lymphoma was not the only neoplasm diagnosed in the small bowel specimens. Three cats had mast cell disease, and 1 had an adenocarcinoma (Table 1).

Most (38/39) small cell phenotypes were confirmed as being of T-cell origin, but this was most likely attributable to the inclusion criteria that selected for mucosal thickening and not for obstructive intestinal masses. Immunohistochemical analysis is useful for immunophenotyping and determining specimens that should be evaluated with PARR. We defined ambiguous cases as those that had dense monomorphic epithelial and villous infiltrates, and in these cases, PARR was required for a definitive diagnosis.

Testing by means of PARR was performed on specimens collected from 27 cats (**Table 2**). Of these 27, 12 were originally classified as ambiguous, and 15 were definitive but submitted to confirm that our definition of ambiguous was correct. The 12 originally classified as ambiguous had epithelial and villous monomorphic lymphocytes. Seven of the 12 were confirmed as clonal enteritis, whereas the other 5 were confirmed as nonclonal enteritis. Lymphoma with transmucosal monomorphic lymphocytes was confirmed as clonal in 4 of 4 cats, and 11 of 11 cats with enteritis were confirmed to have nonclonal enteritis. Depth of invasion in cats with confirmed T-cell lymphoma was classified as epithelial (n = 6), villous and epithelial (4), mucosal (5), deep mucosal (2), or transmural (19). Depth of invasion in cats with confirmed B-cell lymphoma was classified as villous (small cell phenotype; n = 1) or transmural (large cell phenotype; 4).

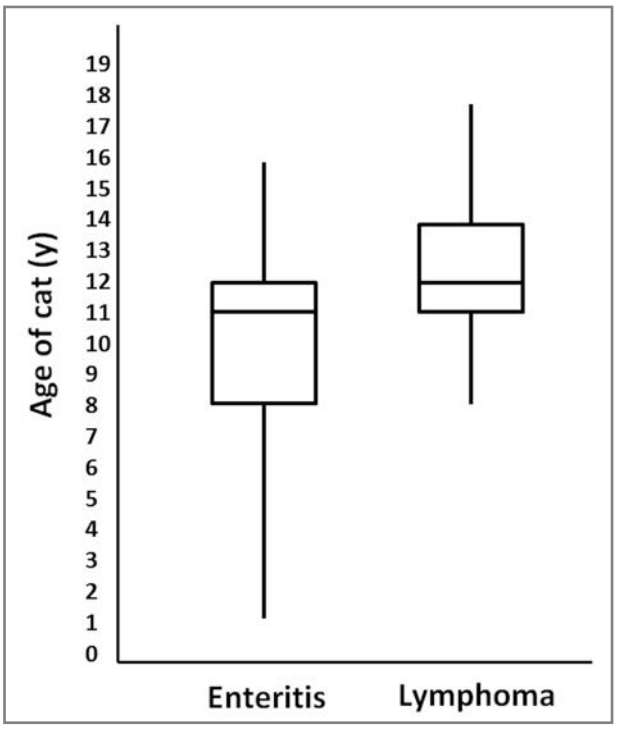

Figure 2—Box-and-whisker plots of age distribution at the time of CSBD diagnosis for 49 cats with enteritis and 46 cats with lymphoma. Each box represents the middle quartiles (25th to 75th percentiles), the horizontal line within each box represents the median, and the whiskers represent the range.

Table 2—Results of PARR testing in 27 cats that had signs of chronic enteropathy with ambiguous findings for histologic examination and IHC analysis.

Histologic diagnosis	No. of cats
Lymphoma	4
Clonal	4
Nonclonal	0
Ambiguous	12
Clonal	7
Nonclonal	5
Enteritis	11
Clonal	0
Nonclonal	11

Two cats were examined because of acute vomiting, which was found to be attributable to obstruction by a hair ball (**Figure 3**). Both cats had a prior history of chronic vomiting. Examination of biopsy specimens collected approximately 5 to 7 cm aborad to the point of obstruction revealed chronic enteritis in one cat and EATL type 2 in the other.

Concurrent biopsy specimens were collected from the small bowel, liver, and pancreas of 42 cats, 21 of which had enteritis. Eight of the 21 (38%) cats with enteritis had concurrent hepatitis without pancreatitis, and 2 of the 21 (10%) with enteritis had concurrent pancreatitis without hepatitis. However, only 1 of 21 (5%) cats with enteritis had concurrent inflammation in both the liver and pancreas. This triple-biopsy approach in the 21 cats with lymphoma of the small bowel revealed lymphoma in the pancreas of 1 (5%) cat and the liver and pancreas of 3 (14%) cats.

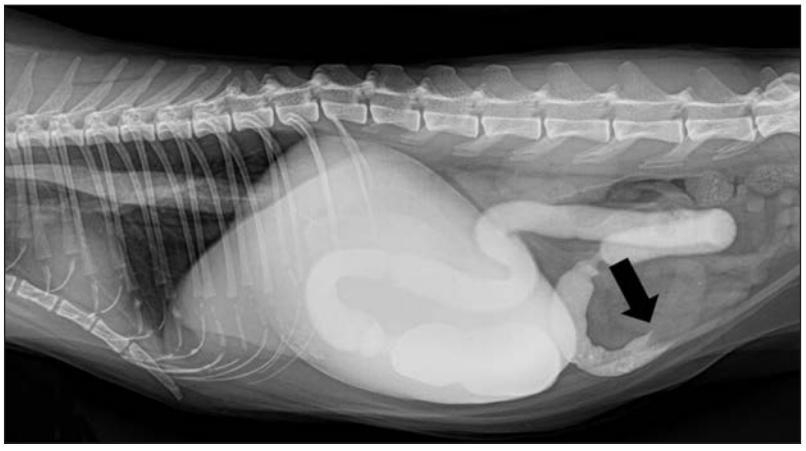

Figure 3—Right lateral radiographic view of a cat with an acute episode of vomiting that was found to have thickened walls of the small bowel. Notice that barium contrast medium stops at the interface with an obstruction (arrow), which was a hair ball that was removed surgically. A biopsy specimen collected approximately 7 cm aborad to the obstruction was examined and yielded a diagnosis of EATL type 2.

Discussion

The most important finding in the study reported here was that signs of CSBD, including seemingly innocuous vomiting, should not be ignored or considered normal, regardless of the perceptions of owners. More than one-fourth of the 100 cats that met the criteria for this study had clinical signs that were detected during wellness examinations. Signs, especially chronic vomiting, of small bowel conditions in these cats were not considered abnormal or were deemed unimportant by owners; therefore, veterinarians should proactively ask owners about signs of small bowel conditions, monitor body weight during wellness and other examinations, and view wellness examinations as opportunities to detect small bowel conditions and other diseases. The fact that the number of owners who refused surgery for cats that had clinical signs detected during wellness examinations was slightly higher than that for cats examined because of illness was not surprising.

Vomiting of hair balls can be a physiologic response to swallowing hair. However, vomiting > 2 times/mo justifies an ultrasonographic examination for the detection of small bowel thickening. It is suspected that hypomotility of the small bowel as a result of CSBD will prevent proper movement of hair through the bowel and thus predispose to hair ball formation. Two cats had hair balls that were surgically removed from the small bowel, and both had underlying CSBD. Therefore, this suggested that in cats with obstructions attributable to hair balls, biopsy specimens of the small bowel should be obtained at the time the hair balls are surgically removed.

The threshold for abnormal thickening of the wall of the small bowel wall in the present study (0.28 cm) was lower than the threshold used by other investigators.[1,3–5] It is possible that some of the cats in other studies had CSBD and subtle clinical signs that were unreported by owners. Therefore, further studies are warranted to determine wall thickness of the normal and abnormal small bowel in cats, with attention paid to selecting clinically normal cats without signs of CSBD.

Age or clinical condition of a cat may potentially hamper efforts to establish a diagnosis. Owners and clinicians may hesitate to proceed with laparotomy for the purpose of obtaining biopsy specimens in some cats because of anesthetic or procedural morbidity and mortality rates. Unfortunately, a large proportion of patients with small bowel disease are older cats, and many of them have neoplasia; thus, the group of cats most likely to develop CSBD is the same group that may be least likely to undergo a surgery necessary to obtain biopsy specimens needed to establish a definitive diagnosis and formulate an effective treatment plan. Therefore, careful selection of perioperative medications, supportive treatments, and monitoring protocols is crucial. Minimizing the duration of surgery is also important. In the present study, none of the cats had severe hypothermia (body temperature < 36°C [97°F]), dehiscence of surgical sites, or surgical-site infections, and there were no perioperative deaths.

Because only 1 of the 100 cats had no abnormal findings during histologic evaluation of biopsy specimens, it can be concluded that the described clinical signs and ultrasonographically derived measurements of wall thickness can be extremely effective for the diagnosis of CSBD (specificity was 99%). There was a strong association between small bowel thickening and CSBD in cats with clinical signs of CSBD. Even mild thickening of 0.28 to 0.29 cm was associated with disease, both inflammatory and neoplastic. Although reference limits for wall thickness of the duodenum can be up to 0.38 cm,[4,5] findings of the present study can lead to questions about that value. We chose 0.28 cm as the threshold value at which further diagnostic testing would be recommended to clients, and we found that examination results for multiple surgical biopsy specimens validated this number as a reasonable cutoff.

Because > 75 cats had at least 1 ultrasonographic measurement within the reference range (< 0.26 cm) but at least 1 other ultrasonographic measurement that was considered abnormal (≥ 0.28 cm), it appeared that CSBD often was segmental. This was frequently confirmed visually during surgery. Histologic findings in these cats also confirmed the segmental nature of CSBD. Laparotomy allows visual examination of the entire small bowel, which permits identification of diseased portions of the bowel in a manner not feasible with endoscopy. On the basis of the data for the present study, we believe visual examination during laparotomy provides a diagnostic advantage.

Cats with CSBD may be young (1 year old) or old (≥ 18 years old). The number of male and female cats with CSBD was almost equal. Although CSBD was detected much more commonly in nonpurebred cats (91/100 cats) in the present study, the Alamo Feline Health Center has few breeders as clients; thus, there is a strong predominance of nonpurebred cats among our patients. Therefore, we could not detect a breed predilection for CSBD and believe it should be considered a differential diagnosis in any breed of cat.

An annual wellness examination is often considered to be a visit strictly for the purpose of vaccination.

However, 26 of the cats with CSBD in the present study had clinical signs identified during wellness examinations and subsequently were found to have CSBD. Of these 26 cats, 10 (38%) had small bowel neoplasia. Therefore, veterinarians should obtain a thorough history, including asking questions about the signs of CSBD, and recommend diagnostic testing, even though owners may not consider chronic vomiting, diarrhea, or weight loss to be clinically important.

It was expected that triad disease would be common in cats with CSBD. However, the number of cats with concurrent enteritis, hepatitis, and pancreatitis (n = 5) was much lower than expected. This calls into question the importance of routinely obtaining hepatic and pancreatic biopsy specimens during diagnostic testing of cats with CSBD. However, examination of those specimens enables clinicians to determine whether lymphoma is multifocal, as was found in 4 cats.

On the basis of the clinical criteria and ultrasonographic evidence of thickened intestinal walls, the present study was conducted to select for infiltrative disease. Most cats with enteritis had mild to moderate enteritis with architectural changes to the villi, epithelium, interstitium, or crypts. The diagnosis of reactive lymphoid enteritis may be controversial, but in the presence of clinical and ultrasonographic evidence of disease, the findings cannot be considered normal. Some believe that reactive lymphoid enteritis does not represent a true enteritis; however, there was an association between reactive lymphoid enteritis and clinical disease in the present study, and findings consistent with that condition should not be regarded as normal.

During the study period and for 6 months thereafter, 205 additional cats that were not part of the present study underwent surgery at the Alamo Feline Health Center. These cats were classified and surgery was recommended on the basis of the same criteria used for the study reported here. Twenty-six (12.7%) of these cats had intestinal lymphomatous masses that caused obstruction or partial obstruction. Thus, the proportion of study cats with infiltrative lymphoma of the small bowel (46/100) was approximately 4 times as high as that of the general population of cats at our facility that had mass-forming lymphoma of the small bowel.

The cause of CSBD in some cats cannot be confirmed with histologic evaluation alone. Immunohistochemical evaluation is useful for immunophenotyping and determining those specimens that should be evaluated with PARR to clearly distinguish EATL from chronic enteritis.

Because our inclusion criteria were intended to select for mucosal thickening and not for obstructive intestinal masses, most lymphoma small cell phenotypes were confirmed as being of T-cell origin. Investigators in previous studies have identified that some specimens yield ambiguous results[7] but others can yield a definitive diagnosis[18]; however, they have not defined the criteria for the basis of this distinction. For the study reported here, we defined ambiguous results as specimens that had dense monomorphic epithelial and villous infiltrates, and PARR was required for a definitive diagnosis of these specimens. Specimens with dense monomorphic infiltrates that extend down to the lamina muscularis and even deeper layers can be confidently diagnosed as lymphoma without additional testing; specimens with dense mixed infiltrates and major architectural changes can confidently be diagnosed as enteritis on the basis of histologic evaluation alone.

Chronic small bowel disease is a common condition in cats. One of the main clinical signs of CSBD, recurrent vomiting, is often dismissed as a clinically unimportant or normal event by cat owners and veterinarians. The use of ultrasonography permits clinicians to select cats from which multiple biopsy specimens of the small bowel should be collected and examined so that CSBD can be confirmed and chronic enteritis and neoplasia can be definitively diagnosed and treated appropriately.

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From this month's *AJVR*

Computed tomographic evaluation to determine efficacy of euthanasia of yearling feedlot cattle by use of various firearm-ammunition combinations

Daniel U. Thomson et al

Objective—To evaluate with CT the efficacy of various combinations of firearms and ammunitions to penetrate and disrupt the brain tissue of cadaveric heads of feedlot steers.

Sample—42 fresh cadaveric heads of 12- to 18-month-old *Bos taurus* steers.

Procedures—For each of 7 combinations of firearms and ammunitions (.22-caliber rifle firing a long rifle 30-grain plated lead solid- or hollow-point round, .223-caliber carbine firing a 50-grain ballistic-tip round, 9-mm pistol firing a 124-grain total metal jacket round, .45-caliber automatic Colt pistol [ACP] firing a 230-grain full metal jacket round, and 12-gauge shotgun firing a 2.75-inch 1.25-ounce No. 4 birdshot shell or a 1-ounce rifled slug), 6 cadaveric heads were shot at an identical distance (3 m), angle, and anatomic location. Heads were scanned with third-generation CT, and images were evaluated to determine extent of penetration, projectile fragmentation, cranial fracture, and likelihood of instantaneous death (≥ 30% destruction of brain tissue or a brainstem lesion).

Results—41 of 42 skulls were penetrated by the projectile. Instantaneous death was considered a likely consequence for 83% (25/30) of heads shot with a rifle-fired .22-caliber solid-point round, pistol-fired .45-caliber ACP round, carbine-fired .223-caliber round, and shotgun-fired birdshot and slug. Of the 18 heads shot with pistol-fired 9-mm and .45-caliber ACP rounds and rifle-fired .22-caliber hollow-point rounds, only 6 had brainstem lesions.

Conclusions and Clinical Relevance—Results suggested that gunshots delivered by all firearm-ammunition combinations except rifle-fired .22-caliber hollow-point rounds and pistol-fired 9-mm rounds were viable options for euthanasia of feedlot cattle. (*Am J Vet Res* 2013;74:1385–1391)

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