Chronic small bowel disease is a common clinical entity in middle-aged to older cats that is associated with chronic vomiting, weight loss, and diarrhea. The 2 most common causes of chronic small bowel disease are chronic enteritis and lymphoma, and 1 of the most common causes of chronic enteritis is IBD. However, the etiology of IBD is unknown. Therefore, a diagnosis of IBD is made when results of clinical testing and response to treatment rule out known causes of chronic enteritis. Inflammatory bowel disease may be part of a disease complex known as feline triaditis in which cats have concurrent chronic enteritis, pancreatitis, and non supplicative cholangitis.

Definitively determining that chronic small bowel disease is present in cats and distinguishing among the various causes of chronic small bowel disease in affected cats present many diagnostic challenges. Common clinical signs, especially vomiting, are typically chronic and may be accepted as normal by owners, making specific questioning regarding patient history especially important. Owners may be reluctant to grant permission for testing to confirm the presence of chronic small bowel disease and its specific etiology. In a previous study, full-thickness biopsy of the small intestine during a laparotomy was used to achieve a diagnosis. However, many clinicians prefer a less invasive approach, and many non-invasive or minimally invasive tests have been used to aid in the diagnosis and differentiation of chronic small bowel disease and feline triaditis. These include endoscopic biopsy of the small intestine, ultrasonographic evaluation of the muscularis and mucosa of the small intestine, measurement of serum TK activity, CBCs, serum

**Prevalence and underlying causes of histologic abnormalities in cats suspected to have chronic small bowel disease: 300 cases (2008–2013)**

Gary D. Norsworthy, DVM; J. Scot Estep, DVM; Charlotte Hollinger, VMD, MS; Jörg M. Steiner, Med Vet, Dr med vet, PhD; Jennifer Olson Lavallee, DVM; Loren N. Gassler, DVM; Lisa M. Restine, DVM; Matti Kiupel, Dr med vet habil, PhD

**Objective**—To determine prevalence of histologic abnormalities in cats suspected, on the basis of compatible clinical signs and ultrasonographic findings, to have chronic small bowel disease; identify the most common underlying causes in affected cats; and compare methods for differentiating among the various causes of chronic small bowel disease.

**Design**—Retrospective case series.

**Animals**—300 client-owned domestic cats suspected to have chronic small bowel disease.

**Procedures**—Medical records were reviewed to identify cats evaluated because of chronic vomiting, chronic small bowel diarrhea, or weight loss that also had ultrasonographic evidence of thickening of the small intestine. Cats were included in the study if full-thickness biopsy specimens had been obtained from ≥3 locations of the small intestine by means of laparotomy and biopsy specimens had been examined by means of histologic evaluation and, when necessary to obtain a diagnosis, immunohistochemical analysis and a PCR assay for antigen receptor rearrangement.

**Results**—Chronic small bowel disease was diagnosed in 288 of the 300 (96%) cats. The most common diagnoses were chronic enteritis (n = 150) and intestinal lymphoma (124).

**Conclusions and Clinical Relevance**—Results indicated that a high percentage of cats with clinical signs of chronic small bowel disease and ultrasonographic evidence of thickening of the small intestine had histologic abnormalities. Furthermore, full-thickness biopsy specimens were useful in differentiating between intestinal lymphoma and chronic enteritis, but such differentiation was not possible with ultrasonography or clinicopathologic testing alone. (J Am Vet Med Assoc 2015;247:629–635)

**ABBREVIATIONS**

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>EATL</td>
<td>Enteropathy-associated T-cell lymphoma</td>
</tr>
<tr>
<td>fPL</td>
<td>Feline-specific pancreatic lipase</td>
</tr>
<tr>
<td>IBD</td>
<td>Inflammatory bowel disease</td>
</tr>
<tr>
<td>TK</td>
<td>Thymidine kinase</td>
</tr>
<tr>
<td>WSAVA</td>
<td>World Small Animal Veterinary Association</td>
</tr>
</tbody>
</table>

From Alamo Feline Health Center, 16201 San Pedro Ave, San Antonio, TX 78232 (Norsworthy, Lavallee, Gassler, Restine); Texas Veterinary Pathology, 1007 Wagon Wheel Dr, Spring Branch, TX 78070 (Estep); Diagnostic Center for Population and Animal Health, College of Veterinary Medicine, Michigan State University, East Lansing, MI 488910 (Hollinger, Kiupel); and Gastrointestinal Laboratory, College of Veterinary Medicine and Biomedical Sciences, Texas A&M University, College Station, TX 77843 (Steiner). Dr. Lavallee’s present address is Cat Specialist, 612 2nd Avenue, Castle Rock, CO 80109.

Most expenses for cats included in the study were paid by the owners; however, some specialized laboratory testing was paid for by Alamo Feline Health Center and the Gastrointestinal Laboratory at Texas A&M University, for which Dr. Steiner is the Director.

The authors declare that there were no conflicts of interest.

The authors thank Aimee Duffy for data retrieval and assimilation. Address correspondence to Dr. Norsworthy (tenlivesforcats@yahoo.com).
biochemical analyses, and measurement of serum IPL concentrations by immunoreactivity. Other than circulating atypical lymphoid cells in a few cats, clinicopathologic abnormalities in cats with intestinal lymphoma, including anemia, neutrophilia, high hepatic enzyme activities, and hypoalbuminemia, are typically nonspecific.3 Similarly, cats with chronic enteritis have been variably reported to have hematologic abnormalities, including hemoco­centration, anemia, leukocytosis, high hepatic enzyme activities, and altered serum protein concentrations.4,5 A previous study6 of cats with either intestinal lymphoma or chronic enteritis identified alanine aminotransferase activity as a potential differentiating factor, with activities higher than the upper reference limit more common in cats with lymphoma. However, a significant difference between groups was not identified.

Because cell proliferation is one of the hallmarks of cancer, serum activity of the S-phase–specific protein TK-1 has been used to detect hematologic malignancies in dogs and cats.7 In a recent study,7 serum TK activity was measured with a radioenzyme assay in 33 cats with lymphoma (including 17 with gastrointestinal lymphoma), 55 cats with inflammatory disease (including 16 with IBD), and 34 cats with nonhematopoietic neoplasia. Although cats with lymphoma had significantly higher serum TK activity than did healthy cats or cats with inflammatory disease, 8 of the 35 cats with inflammatory disease had activities higher than the upper reference limit, including all of the cats with panc­reatitis. Thus, whether serum TK activity can be used to differentiate gastrointestinal lymphoma from IBD remains unclear.

Histologically, differentiating between chronic enteritis and EATL type 1 (large cell) is straightforward,3 but differentiating between chronic enteritis and EATL type 2 (small cell), which is the most common form of intestinal lymphoma in cats, can be challenging because the inflammatory infiltrates associated with chronic enteritis are morphologically similar to the neoplastic infiltrates associated with EATL type 2. However, ambiguous cases can usually be differentiated by means of immunohistochemical analysis and clonality testing with a PCR assay for antigen receptor rearrangement.8–13

Clearly, more information is needed concerning the prevalence of chronic small bowel disease in cats, the underlying causes, and the best methods for differentiating the various underlying causes. Therefore, the purposes of the study reported here were to determine the prevalence of histologic abnormalities in cats suspected, on the basis of compatible clinical signs and clinicopathologic findings, to have chronic small bowel disease; identify the most common underlying causes in affected cats; and compare methods for differentiating among the various causes of chronic small bowel disease.

Materials and Methods

Criteria for selection of cases—Medical records of the Alamo Feline Health Center in San Antonio, Tex, were searched to identify cats examined between July 2008 and November 2013 because of possible chronic small bowel disease. Cats were included in the study if they had compatible clinical signs in conjunction with ultrasonographic evidence of thickening of the small intestine (ie, intestinal wall thickness ≥ 0.30 cm in ≥ 2 locations) and if full-thickness biopsy specimens had been collected from ≥ 3 small intestine sites considered likely to be abnormal, as determined by gross examination during a laparotomy after inspection of the entire small intestine. Cats were considered to have compatible clinical signs if they had a history of any or all of the following signs: vomiting ≥ 3 times/mo for at least 3 consecutive months, small bowel diarrhea of ≥ 3 weeks’ duration, and weight loss of ≥ 0.5 kg (1.1 lb) within the past 6 months. Cats that consistently vomited plant material or were hyperthyroid were excluded unless preventing access to plant material or treatment of hyperthyroidism did not result in cessation of vomiting.

Clinicopathologic testing—Blood samples were collected prior to surgery and submitted for a CBC and serum biochemical testing.8 In cats ≥ 10 years of age, serum total thyroxine concentration was measured and the thyroid glands were palpated for enlargement; cats were excluded from the study if hyperthyroidism was suspected or confirmed. Cats were not excluded from the study solely because of clinicopathologic abnormalities compatible with pancreatic or hepatic disease. In cats with evidence of renal dysfunction, whether laparotomy for collection of biopsy specimens was recommended was at the discretion of the attending veterinarian.

In select cats, additional blood samples were collected prior to surgery for measurement of serum TK activity and serum cobalamin concentration. For measurement of serum TK activity, a single blood sample collected in a plain glass tube was submitted to a commercial laboratory.9 Presurgical blood samples obtained from cats with no history of recent exogenous cobalamin administration were submitted to a commercial laboratory10 for measurement of serum cobalamin concentration.

Blood samples were collected before and after surgery from select cats for measurement of serum IPL concentration. Samples were collected immediately prior to surgery, 1 to 2 hours after surgery, approximately 24 hours after surgery, and approximately 10 days after surgery and submitted to a commercial laboratory11 for measurement of serum IPL concentration by means of an immunoreactivity assay.

Abdominal ultrasonography—Cats were included in the study only if they had undergone abdominal ultrasonography and had ultrasonographic evidence of small intestinal thickening. Ultrasonographic examinations were performed by staff veterinarians at Alamo Feline Health Center with an 11-MHz linear probe. The stomach wall was examined for thickness and mass formation, although stomach contents often prohibited observation of all but the most ventral portion of the stomach wall. At least 5, but typically ≥ 8, measurements of small intestine wall thickness, defined as the distance from the serosa to the near side of the lumen, were obtained. Laparotomy and collection of small intestine biopsy specimens were recommended if any measurement of wall thickness was ≥ 0.30 cm or if ≥ 2 measurements were ≥ 0.28 cm.
Cats with some measurements of wall thickness ≥ 0.28 cm and other measurements of wall thickness ≤ 0.25 cm were categorized as having segmental disease. In select cats, the ratio of mucosal to muscularis thickness was calculated.

**Collection and examination of biopsy specimens**—

For laparotomy and collection of biopsy specimens, anesthesia was induced and maintained with isoflurane. Cats were monitored during surgery with a multiparameter surgical monitor, with special attention paid to preventing hypothermia. Because of the advanced age and low body condition scores of most cats, an emphasis was placed on minimizing surgical time.

During the early part of the study period, full-thickness biopsy specimens were obtained from ≥ 3 small intestine sites considered likely to be abnormal following inspection of the entire small intestine, whereas during the latter part of the study period, pancreatic and hepatic biopsy specimens were obtained in addition to the small intestinal biopsy specimens.

Pancreatic and hepatic biopsy specimens were obtained prior to the small intestinal biopsy specimens. Pancreatic specimens were obtained with a 4-mm biopsy punch. For collection of hepatic specimens, an equilateral triangle of hepatic tissue approximately 1 cm on each side was harvested with Metzenbaum scissors. If gross lesions were identified in either organ, those areas were chosen for biopsy. If gross lesions were not identified, an easily accessible lobe of liver was chosen and the edge of either pancreatic limb, avoiding the exocrine pancreatic duct.

Small intestinal biopsy specimens were obtained from the antimesenteric aspect of the intestine, with a scalpel blade used to make a wedge-shaped incision or a 6-mm biopsy punch. Prior to collection of biopsy specimens, the small intestine was examined grossly from the pylorus to cecum, and biopsy specimens were obtained from sites determined to be thicker than normal on the basis of gross observation.

Biopsy specimens were placed in neutral-buffered 10% formalin and submitted to a pathology laboratory owned by one of the authors (JSE). Early in the study period, small intestinal biopsy specimens underwent routine histologic evaluation along with immunohistochemical staining for CD3, CD79a, and CD20. In addition, in cats in which the diagnosis was ambiguous following histologic evaluation and immunohistochemical staining, specimens were submitted to a university-based laboratory for testing with a PCR assay for antigen receptor rearrangement. The histologic diagnosis was also considered ambiguous in cats with dense monomorphic T-cell infiltrates that expanded the entire mucosa to the level of the muscularis mucosa and in cats that had dense, mixed-cellular epithelial and villous infiltrates along with substantial architectural change, and specimens were submitted for testing with the PCR assay for antigen receptor rearrangement to differentiate lymphoma from enteritis. Lymphoma was categorized as T-cell or B-cell on the basis of results of immunohistochemical analysis and as large cell (EATL type 1) or small cell (EATL type 2) on the basis of histomorphology.

Results for each biopsy specimen were classified as lymphoma, chronic enteritis, nonlymphoid neoplasia, other, or normal. If, for any individual cat, specimens were assigned to different categories, then small bowel disease in that cat was classified as segmental.

Hepatic biopsy specimens were assessed by use of the WSAVA Standards for Clinical and Histological Diagnosis of Canine and Feline Liver Disease. Specimens with randomly distributed mixed inflammation and secondary architectural changes consisting of fibrosis or microgranulomas were interpreted as indicative of hepatitis, most likely attributable to mucosal disruption in the intestine secondary to either lymphoma or enteritis. If mixed or lymphocytic portal inflammation and substantial architectural changes were identified, primary hepatitis or cholangiohepatitis was diagnosed. If small lymphocytic infiltrates were identified, particularly in periportal regions and without secondary architectural changes, small cell lymphoma was diagnosed. A diagnosis of hepatitis versus lymphoma was made in conjunction with, but independent of, findings for intestinal biopsy specimens.

**Statistical analysis**—The Mann-Whitney U test was used to compare CBC and serum biochemical test results for cats with chronic enteritis versus lymphoma and, in cats with lymphoma, for cats with mucosal versus transmural invasion. Visual assessment and t tests were used to compare clinicopathologic test results for cats with intestinal neoplasia (ie, lymphoma or nonlymphoid neoplasia) versus chronic enteritis, for cats with intestinal lymphoma versus nonneoplastic conditions (ie, chronic enteritis or other), and for cats with intestinal lymphoma versus any condition other than lymphoma. For cats with > 1 intestinal lesion, the more clinically important process (ie, neoplasia rather than enteritis) was used as the grouping variable. Values of P < 0.05 were considered significant.

Serum fPL concentrations obtained before and 24 hours after surgery were compared by means of a Wilcoxon matched-pairs signed rank test to determine whether pancreatic biopsy resulted in an increase in serum fPL concentrations. Serum fPL concentrations were compared with histopathologic findings to assess agreement. Sensitivity and specificity of using presurgical serum TK activity to detect lymphoma were cal-
culated; a χ² test was used to determine whether pre-surgical serum TK activity (within reference limits vs high) was significantly associated with cause of chronic small bowel disease (lymphoma vs not lymphoma).

**Results**

Three hundred cats met the criteria for inclusion in the study. Data for the first 100 cats evaluated during the study period have been published previously. All 300 cats recovered fully from surgery, were discharged from the hospital 2 nights after surgery, and lived at least 60 days after hospital discharge.

Of the 300 cats, 159 (53%) were male and 141 (47%) were female. Median age was 11 years (range, 1 to 19 years), with 141 (47%) cats being ≥ 12 years old and 81 (27%) being ≥ 14 years old. Fifty-four (18%) cats were purebred, with the remainder being of mixed breeding. Overall, 53 of the 300 (18%) cats were examined because of weight loss (≥ 0.5 kg within the past 6 months) alone, 95 (32%) were examined because of weight loss and vomiting (≥ 3 times/mo for at least 3 consecutive months), 119 (40%) were examined because of vomiting alone, 20 (7%) were examined because of weight loss and small bowel diarrhea (≥ 3 weeks’ duration), and 13 (4%) were examined because of diarrhea alone.

Overall, 288 of the 300 (96%) cats had histologic abnormalities. One hundred fifty (50%) had chronic enteritis, 124 (41.3%) had lymphoma (107 [35.7%] with small cell lymphoma and 17 [5.7%] with large cell lymphoma), 11 (3.7%) had nonlymphoid neoplasia (10 [3.3%] with mast cell disease and 1 [0.3%] with adenocarcinoma), and 3 (1.0%) had other conditions (2 [0.7%] with histoplasmosis and 1 [0.3%] with coccidiosis). For the remaining 12 (4%) cats, results of histologic examination were classified as normal. Overall, 99 (33%) cats were classified as having segmental disease because > 1 disease process was identified in small intestinal biopsy specimens (Figure 1).

Of the 300 cats, 249 (83%) had some ultrasonographic measurements of wall thickness ≥ 0.28 cm and other measurements ≤ 0.25 cm, indicating that these cats had segmental disease. Subjectively, however, there did not appear to be an association between segmental disease (present vs absent) and underlying cause (lymphoma, chronic enteritis, nonlymphoid neoplasia, other, or normal). Mean ratio of mucosal to muscularis thickness was not significantly (P = 0.783) different between cats with chronic enteritis (n = 134) and cats with lymphoma (106).

In 31 cats (14 with and 17 without lymphoma), a single presurgical blood sample was submitted for measurement of serum TK activity. In 11 of the 31 cats, serum TK activity was higher than the upper reference limit; however, only 6 of these 11 cats were determined to have lymphoma on the basis of histopathologic findings. In the remaining 20 cats, including 8 cats with lymphoma, serum TK activity was within reference limits. We did not detect a significant (P = 0.688) association between serum TK activity (within reference limits vs high) and cause of chronic small bowel disease (lymphoma vs not lymphoma). Thus, sensitivity of serum TK activity for detecting lymphoma in cats with chronic small bowel disease was 53% (6/11; 95% confidence interval, 28% to 79%) and specificity was 60% (12/20; 95% confidence interval, 38% to 78%).

Neutrophil count, RBC count, PCV, Hct, serum alanine aminotransferase activity, amylase activity, and...
had pancreatic lymphoma (median fPL concentration, g/L; range, 0.2 to 9.2 µg/L), 5 µfPL concentration, 2.3 g/L), 9 had acinar atrophy (median range, 0.3 to 7.9 µg/L), 4 had amyloidosis (median fPL concentration, 2.4 g/L; range, 0.1 to 8.6 µg/L), 19 had pancreatitis (ie, vomiting, lethargy, anorexia, or fever) following pancreatic biopsy. None of the cats developed signs of acute pancreatitis. However, none of the cats had clinical signs of diabetes mellitus or developed diabetes mellitus in the 2 months after surgery. Of the 9 cats with acinar atrophy, 6 had high fPL concentrations.

Serum cobalamin concentration was measured in 78 cats with no history of recent exogenous cobalamin administration (47 with chronic enteritis, 26 with lymphoma, and 5 without histologic abnormalities) and was low (reference range, 150 to 1,000 ng/L) in 2 (3%). One of the cats with hypocobalaminemia had chronic enteritis, and the other had lymphoma.

**Discussion**

Results of the present study confirmed previous findings1 that a high percentage of cats with clinical signs compatible with chronic small bowel disease (ie, chronic vomiting, chronic small bowel diarrhea, and weight loss) and ultrasonographic evidence of small intestinal thickening have clinically relevant small intestinal histologic abnormalities. The fact that 288 of the cats with lymphoma, only 28 had concurrent hepatitis, and only 10 had concurrent hepatic neoplasia (ie, lymphoma or nonlymphoid neoplasia) and cats with chronic enteritis, between cats with intestinal lymphoma and cats with any condition other than lymphoma (data not shown). When only cats with lymphoma were considered, significant differences in clinicopathologic test results were not found between cats with mucosal and transmural invasion. Of the 124 cats with lymphoma, only 10 had concurrent hepatic lymphoma, only 28 had concurrent hepatitis, and only 15 had a high serum fPL concentration. Of the 150 cats with chronic enteritis, only 5 had concurrent hepatic lymphoma, only 33 had concurrent hepatitis, and only 10 had a high serum fPL concentration.

**Samples**

Samples were collected for measurement of serum fPL concentration immediately prior to surgery (n = 154), 1 to 2 hours after surgery (12), approximately 24 hours after surgery (132), and approximately 10 days after surgery (18) from cats that underwent pancreatic biopsy. None of the cats developed signs of acute pancreatitis (ie, vomiting, lethargy, anorexia, or fever) following pancreatic biopsy.

For the 164 cats that underwent pancreatic biopsy, 126 were normal or had nodular hyperplasia (median fPL concentration, 1.8 µg/L; range, 0.1 to 8.6 µg/L), 19 had amyloidosis (median fPL concentration, 2.4 µg/L; range, 0.3 to 7.9 µg/L), 9 had acinar atrophy (median fPL concentration, 2.3 µg/L; range, 0.2 to 9.2 µg/L), 5 had pancreatic lymphoma (median fPL concentration, 2.2 µg/L; range, 0.3 to 4.2 µg/L), and 5 had pancreatic inflammation (median fPL concentration, 7.8 µg/L; range, 3.2 to 21.3 µg/L). Four of the 5 cats with pancreatic inflammation and 2 of the 5 cats with pancreatic inflammation had presurgical serum fPL concentrations within reference limits. Of the 126 cats that were normal or had nodular hyperplasia, 93 (73.8%) had presurgical serum fPL concentrations within reference limits, and 17 (13.5%) had concentrations above the cutoff suggested for a diagnosis of feline pancreatitis. Of the 19 cats with amyloidosis, potentially a precursor to diabetes mellitus, 12 had presurgical serum fPL concentrations within reference limits and 5 had concentrations above the cutoff suggested for a diagnosis of feline pancreatitis. However, none of the cats had clinical signs of diabetes mellitus or developed diabetes mellitus in the 2 months after surgery. Of the 9 cats with acinar atrophy, 6 had high fPL concentrations.

**Table 1—Results of hematologic and serum biochemical testing for cats suspected to have chronic small bowel disease that were determined to have intestinal lymphoma or chronic enteritis.**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Reference interval</th>
<th>Lymphoma No. of cats</th>
<th>Median (range)</th>
<th>Chronic enteritis No. of cats</th>
<th>Median (range)</th>
</tr>
</thead>
<tbody>
<tr>
<td>WBC count (X 10^9 cells/mL)</td>
<td>5.5–17.0</td>
<td>57</td>
<td>11.7 (3.8–53.2)</td>
<td>70</td>
<td>10.9 (2.7–28.0)</td>
</tr>
<tr>
<td>Lymphocyte count (X 10^9 cells/mL)</td>
<td>1.5–7.5</td>
<td>52</td>
<td>2.6 (0.6–14.7)</td>
<td>65</td>
<td>2.1 (0.6–40.0)</td>
</tr>
<tr>
<td>Monocyte count (X 10^9 cells/mL)</td>
<td>0–0.8</td>
<td>50</td>
<td>0.5 (0.1–4.4)</td>
<td>65</td>
<td>0.5 (0.1–4.2)</td>
</tr>
<tr>
<td>Neutrophil count (X 10^9 cells/mL)</td>
<td>2.5–12.5</td>
<td>51</td>
<td>8.6 (1.6–88.1)</td>
<td>66</td>
<td>6.2* (0.2–21.3)</td>
</tr>
<tr>
<td>Eosinophil count (X 10^9 cells/mL)</td>
<td>0–1.5</td>
<td>52</td>
<td>0.6 (0.1–46.0)</td>
<td>67</td>
<td>0.5 (0.0–8.2)</td>
</tr>
<tr>
<td>RBC count (X 10^9 RBCs/mL)</td>
<td>6.4–11.5</td>
<td>56</td>
<td>7.9 (2.0–11.3)</td>
<td>66</td>
<td>8.7* (5.5–11.3)</td>
</tr>
<tr>
<td>Hemoglobin (g/dL)</td>
<td>8.9–15.6</td>
<td>53</td>
<td>12.3 (5.8–16.5)</td>
<td>66</td>
<td>13.0 (8.5–16.3)</td>
</tr>
<tr>
<td>PCV (%)</td>
<td>29–46</td>
<td>53</td>
<td>37 (24–45)</td>
<td>64</td>
<td>40* (20–40)</td>
</tr>
<tr>
<td>Hct (%)</td>
<td>28–44</td>
<td>59</td>
<td>37 (13–52)</td>
<td>75</td>
<td>40* (26–48)</td>
</tr>
<tr>
<td>Platelet count (X 10^9 platelets/mL)</td>
<td>300–800</td>
<td>50</td>
<td>37 (0–814)</td>
<td>65</td>
<td>358 (115–684)</td>
</tr>
<tr>
<td>Albumin (g/dL)</td>
<td>2.2–4.4</td>
<td>102</td>
<td>2.4 (1.0–4.4)</td>
<td>104</td>
<td>3.5 (2.3–4.6)</td>
</tr>
<tr>
<td>Alkaline phosphatase (U/L)</td>
<td>10–90</td>
<td>111</td>
<td>20 (5–93)</td>
<td>135</td>
<td>20 (0–93)</td>
</tr>
<tr>
<td>Alanine aminotransferase (U/L)</td>
<td>20–100</td>
<td>114</td>
<td>58 (24–712)</td>
<td>138</td>
<td>49* (16–245)</td>
</tr>
<tr>
<td>Amylase (U/L)</td>
<td>300–1,100</td>
<td>102</td>
<td>98 (439–2,047)</td>
<td>103</td>
<td>845* (103–1,851)</td>
</tr>
<tr>
<td>Total bilirubin (mg/dL)</td>
<td>0.1–0.6</td>
<td>104</td>
<td>0.3 (0.1–1.4)</td>
<td>103</td>
<td>0.3 (0.0–1.9)</td>
</tr>
<tr>
<td>BUN (mg/dL)</td>
<td>10–30</td>
<td>115</td>
<td>27 (12–83)</td>
<td>140</td>
<td>25* (8–57)</td>
</tr>
<tr>
<td>Calcium (mg/dL)</td>
<td>6–11.8</td>
<td>103</td>
<td>10.2 (5.8–27.0)</td>
<td>103</td>
<td>10.1 (6.8–12.0)</td>
</tr>
<tr>
<td>Phosphorus (mg/dL)</td>
<td>3.4–8.3</td>
<td>107</td>
<td>3.9 (2.3–5.7)</td>
<td>108</td>
<td>4.1 (1.8–5.8)</td>
</tr>
<tr>
<td>Creatinine (mg/dL)</td>
<td>0.3–2.1</td>
<td>117</td>
<td>1.5 (0.6–3.6)</td>
<td>141</td>
<td>1.5 (0.6–3.4)</td>
</tr>
<tr>
<td>Glucose (mg/dL)</td>
<td>70–150</td>
<td>116</td>
<td>118 (51–554)</td>
<td>137</td>
<td>115 (85–406)</td>
</tr>
<tr>
<td>Sodium (Eq/L)</td>
<td>142–164</td>
<td>102</td>
<td>147 (100–165)</td>
<td>104</td>
<td>148 (128–154)</td>
</tr>
<tr>
<td>Potassium (mEq/L)</td>
<td>3.7–5.8</td>
<td>106</td>
<td>4.2 (2.1–5.3)</td>
<td>106</td>
<td>4.2 (3.1–5.9)</td>
</tr>
<tr>
<td>Total protein (g/dL)</td>
<td>5.4–8.2</td>
<td>112</td>
<td>7.3 (3.4–9.7)</td>
<td>135</td>
<td>7.4 (4.5–9.9)</td>
</tr>
<tr>
<td>Globulin (g/dL)</td>
<td>1.5–5.7</td>
<td>103</td>
<td>3.8 (2.6–7.1)</td>
<td>105</td>
<td>4.0 (2.0–7.0)</td>
</tr>
</tbody>
</table>

*Value is significantly (P < 0.05) different from value for cats with lymphoma.
300 (96%) cats in the present study had histologic abnormalities suggested that laparotomy and collection of small intestine biopsy specimens can be justified in cats with compatible clinical signs coupled with ultrasonographic evidence of small intestinal wall thickening.

Importantly, a high percentage (249/300 [83%]) of cats in the present study had ultrasonographic evidence of segmental thickening of the small intestine (ie, some ultrasonographic measurements of wall thickness ≥ 0.28 cm and other measurements ≤ 0.25 cm), suggesting that gross inspection of the entire small intestine is important to identify areas best suited for collection of biopsy specimens. Our finding that 33% (99/300) of cats in the present study had > 1 disease process identified in small intestinal biopsy specimens further indicated that chronic small bowel disease in cats can often be segmental. Given these findings and given the fact that endoscopy can typically only be used to collect biopsy specimens from the proximal portion of the duodenum, we believe that laparoscopy with collection of full-thickness small intestine biopsy specimens is the method of choice for diagnosing chronic small bowel disease in cats.

Findings of the present study should not be interpreted to mean that intestinal lymphoma or chronic enteritis always results in thickening of the small intestinal wall in cats. We elected to include in our study only those cats that had both compatible clinical signs and ultrasonographic evidence of small intestinal thickening, because we have found that a high percentage of owners would permit surgical biopsy when presented with this combination of findings. We did not recommend surgical biopsy for cats with compatible clinical signs in which ultrasonographic measurements of small intestinal wall thickness were normal. Therefore, we do not know whether or how often these cats had lymphoma or chronic enteritis.

Chronic enteritis (n = 150) and lymphoma (124) were the 2 most common diseases in the present study, accounting for > 95% of the diagnoses. Notably, the youngest cats with lymphoma were 6 years old, suggesting that intestinal lymphoma is unlikely in cats < 6 years of age. However, both chronic enteritis and lymphoma were diagnosed in geriatric cats.

Findings in the present study suggested that relative thickness of the small intestinal mucosa and muscularis layers could not be reliably used to diagnose the underlying disease process. Unlike in a prior study,16 ratios between these 2 small intestinal layers were not found to be different between cats with chronic enteritis and lymphoma. Therefore, this approach should not be used in lieu of full-thickness biopsy and histologic evaluation. It is noteworthy that the cases included in the prior study16 were evaluated between 1998 and 2006, which precedes the availability of reliable immunohistochemical analysis and the PCR assay for antigen receptor rearrangement used to confirm the underlying diagnosis in the present study. Thus, some of the cases included in that previous study may have been misdiagnosed.

Measurement of serum TK activity was also not found to be a reliable method of diagnosing lymphoma in the present study, with high serum TK activity associated with low sensitivity and specificity for a diagnosis of lymphoma.

Measurement of serum fPL concentration has been reported to be a sensitive method of diagnosing pancreaticitis in cats. Thus, serum fPL concentration was measured in cats in the present study that underwent pancreatic biopsy in an attempt to identify pancreatic acinar cell damage. Although we identified a significant increase in serum fPL concentration 24 hours after surgery, this change was likely clinically unimportant, and none of the cats developed signs of acute pancreatitis. Nevertheless, monitoring for clinical signs of pancreatitis following pancreatic biopsy is still prudent.

Pancreatic nodular hyperplasia was a common finding in cats of the present study, but no overt clinical signs of pancreatic disease were observed. This was not surprising, given that pancreatic nodular hyperplasia has been considered a change associated with aging in dogs and would be expected to also be a change associated with aging in cats.17 Although 41.3% (124/300) of the cats in the present study had small intestinal lymphoma, only 15 of the 124 (12.1%) cats with lymphoma had a high serum fPL concentration prior to surgery. Similarly, only 10 of the 130 (6.7%) cats with chronic enteritis had a high serum fPL concentration prior to surgery. Nineteen of 164 (11.6%) cats that underwent pancreatic biopsy had pancreatic amyloidosis, which may be associated with the development of diabetes mellitus.18 None of these cats had clinical signs of diabetes mellitus or developed diabetes mellitus in the 2 months after surgery; however, it would appear to be prudent to monitor them over time for possible development of diabetes mellitus.

Cats with chronic small bowel disease have previously been reported to have low serum cobalamin concentrations approximately 60% to 78% of the time19,20; however, in our study, only 2 of 73 (3%) cats with chronic enteritis or lymphoma had a low cobalamin concentration prior to surgery. Further studies are needed to better understand these conflicting data.

In analyzing results of the present study, we considered whether, in cats with chronic small bowel disease, concurrent inflammation of the pancreas and liver could be used to indirectly indicate that underlying intestinal changes were more likely to be inflammatory (ie, reflective of feline triaditis) than neoplastic. It is possible for pancreatic biopsy to yield false-negative results if focal disease is present and not grossly evident, resulting in biopsy of normal tissue. Measurement of serum fPL concentration should be a more sensitive test for detecting focal disease and inflammation, if present. Nevertheless, a low percentage of cats in the present study had concurrent pancreatitis and chronic enteritis.

Although several clinicopathologic variables differed significantly between cats with intestinal lymphoma and cats with chronic enteritis in the present study, the differences were not considered diagnostically useful. There was extensive overlap in the values; furthermore, many of the results fell within reference intervals. Similarly, when only cats with lymphoma were considered, significant differences related to depth of invasion were not identified, likely as a result of the predominant impact of mucosal injury regardless of the presence of transmural disease, or the impact of systemic illness. Considering that both neoplastic and inflamma-
tory processes cause local tissue damage and systemic alterations, including changes in chemical mediators such as cytokines, it is not unexpected that clinicopathologic findings overlapped for these groups. Additionally, in cats with intestinal lymphoma or chronic enteritis, there may be concurrent diseases, including hepatobiliary and pancreatic injury, which can contribute to hematologic changes. In the present study, we did not test for differences between groups when cats were grouped on the basis of the presence or absence of hepatic or pancreatic disease because the number of individuals with concurrent conditions was deemed too low to reach reliable conclusions. However, numbers of cats in the chronic enteritis and lymphoma groups with concurrent hepatic and pancreatic diseases were similar. Given the limited repertoire of cellular responses to injury, limitations of traditional hematologic profiles, and the dynamic interactions of body systems in generalized illness, it is the authors’ opinion that it would be unlikely for a strongly differentiating pattern of clinicopathologic changes between intestinal lymphoma and chronic enteritis to be found. Clinicopathologic testing provides valuable information for determination of organ health, safety of anesthesia, and other clinical decision points, but diagnostically useful patterns of hematologic results were not identified within the examined factors in this large cohort of cats. Thus, our data indicated that serum TK activity, serum IFL concentration, serum cobalamin concentration, and results of preoperative CBC and serum biochemical profiles cannot reliably be used to differentiate intestinal lymphoma from chronic enteritis in cats suspected to have chronic small bowel disease.

Of the 300 cats in the present study, 81 (27%) were ≥ 14 years old. Many practitioners feel uncomfortable performing anesthesia and abdominal surgery on cats this old, yet all 300 of these cats made a full recovery. We believe the keys to surgery in geriatric cats are preanesthetic workup, multiparameter anesthetic monitoring with special attention to core body temperature, a safe anesthetic protocol, and minimal surgery time. In conclusion, results of the present study indicated that a high percentage of cats with clinical signs of chronic small bowel disease and ultrasonographic evidence of thickening of the small intestine had histologic abnormalities. Full-thickness biopsy specimens were useful in differentiating between intestinal lymphoma and chronic enteritis, but such differentiation was not possible with ultrasonography or clinicopathologic testing alone.

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