Prevalence of malignancy and factors affecting outcome of cats undergoing splenectomy

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OBJECTIVE
To determine the prevalence of splenic malignancy in cats undergoing splenectomy and to investigate possible factors associated with post-operative outcome.

ANIMALS
62 client-owned cats that underwent splenectomy.

METHODS
Medical records of 4 UK-based referral hospitals were searched and data reviewed retrospectively over 17 years. Factors associated with outcomes post-splenectomy were analyzed.

RESULTS
50 out of 62 cats (81%) were diagnosed with splenic neoplasia. Mast cell tumor (MCT, 42%), hemangiosarcoma (HSA, 40%), lymphoma and histiocytic sarcoma (6% each) were the most common tumor types. Fifteen cats (24%) presented with spontaneous hemoabdomen and were all diagnosed with splenic neoplasia. The diagnostic accuracy of cytology to detect splenic malignant lesions was 73% (100% for MCTs and 54% for mesenchymal tumors). Median survival time for cats with nonneoplastic splenic lesions was 715 days (IQR, 18 to 1,368) and 136 days for cats with splenic neoplasia (IQR, 35 to 348); median survival time was longer for cats with splenic MCT when compared to cats with HSA (348 vs 94 days; P < .001). Presence of metastatic disease and anemia (PCV < 24%) at diagnosis were associated with a poorer survival when considering all cats. Presence of anemia, a splenic mass on imaging or spontaneous hemoabdomen were associated with a diagnosis of HSA (P < .001).

CLINICAL RELEVANCE
Benign splenic lesions were uncommon in this cohort of cats. Spontaneous hemoabdomen should prompt the clinician to suspect neoplasia in cats with splenic disease. Anemia and evidence of metastasis at diagnosis were poor prognostic factors regardless of the final diagnosis.

Keywords: feline, splenectomy, mast cell tumor, hemangiosarcoma, hemoabdomen

Splenopathies in cats are uncommonly diagnosed, with a prevalence estimated at 5%, and include primary and metastatic neoplasia, nodular hyperplasia, hematomas, ischemic obstruction and splenitis, among others. Splenic diseases are typically identified by abdominal palpation and diagnosed with abdominal imaging followed by ultrasound-guided cytology or biopsy. Even though cytologic and histopathologic agreement for splenic lesions is reported to be between 59% to 100% in dogs and cats, those studies contained very small numbers of cats. This, together with the different prevalence of splenic diseases between these species, makes the true accuracy of cytology to diagnose feline splenopathies unknown.

The ultrasonographic appearance of the feline spleen is generally considered nonspecific; however, presence of a splenic mass > 1 cm in cats was suggestive of malignancy. In addition to these challenges, changes in the splenic size and parenchyma can be incidental, associated with nonspecific clinical signs or due to systemic disease.
In dogs, splenic masses with or without associated hemoabdomen, are the most common reason for splenectomy, with malignant lesions being diagnosed in 48% to 76% of cases. Hemangiosarcoma (HSA) is the most common splenic tumor reported in dogs, but it appears to be less common in cats with a reported prevalence of 2% to 21%. Nevertheless, it accounts for 60% of all neoplasms of cats presenting with spontaneous hemoabdomen suggesting a link between malignancy and clinical presentation.

Splenectomy in cats was reported to be more prevalent in a small group of cats undergoing splenectomy with or without hemoabdomen and accounted for 53% of all diagnosis followed by HSA (21%) and lymphoma (11%). When diagnosis was solely based on cytology lymphoproliferative diseases (ie, lymphoma) were found to be the most common neoplasm affecting the spleen, likely as part of multi-organ infiltration. Less often, histiocytic sarcoma, other sarcomas, myeloproliferative diseases and myelolipomas can also be found.

In dogs undergoing splenectomy, anemia (PCV < 24%) and intraoperative arrhythmias have been associated with increased risk of perioperative death. Dogs with splenic HSA were significantly more likely to have preoperative anemia, lower mass to splenic volume ratio, lower splenic weight, hemoabdomen, thrombocytopenia, and to have received a blood transfusion, compared to dogs with other malignancies or benign lesions.

Risk factors for cats undergoing splenectomy have not been clearly defined. Weight loss, anorexia, mastocytoma, administration of a blood product, metastasis to regional lymph nodes and a concurrent or historical neoplasia have inconsistently been reported as negative prognostic factors in cats undergoing splenectomy for MCTs.

The objectives of this study were: 1) to assess the prevalence of malignancy in cats undergoing splenectomy, and 2) to identify prognostic factors associated with outcome in this cohort.

**Methods**

This retrospective study used anonymized clinical data and was approved by the social science research ethical review board of the Royal Veterinary College, University of London (approval No. URN SR2020-024). Clinical records from 4 small animal referral hospitals (The Queen Mother Hospital for Animals, Royal Veterinary College; Small Animal Teaching Hospital, University of Liverpool; Small Animal Referral Hospital Langford Vets University of Bristol, North Downs Specialist Referrals) were searched from January 2005 to November 2022 to identify cats that had undergone splenectomy. Investigators independently searched the databases of the referral institutions, using the search engine available in the practice management systems, searching for the keywords "splenectomy," "cat," and "feline."

Cats that underwent splenectomy during the study period that had comprehensive clinical records (medical history, diagnostic procedures, treatments, and follow-up) and a histologic diagnosis were eligible for inclusion in the study. Exclusion criteria included cats that had splenectomy for a traumatic origin, cats without a definitive diagnosis or with incomplete medical records.

Information retrieved from the records included signalment, clinical history, physical examination findings and preoperative blood test results: this included preoperative PCV (if a PCV was not available, hematocrit was recorded and was treated as equivalent to PCV in value) and total solids (TS). Cats were defined as anemic if PCV or Hct was < 24%. Preoperative diagnostic imaging findings (including presence of a mass, splenomegaly, or both on imaging) and cytologic and histopathologic findings. Concordance between cytologic and histologic reports was assessed. Overall accuracy was defined as the ability of cytology to correctly identify neoplastic and nonneoplastic lesions and was assessed as the sum of cases in which cytology and histology agreed in diagnosing a lesion as neoplastic or nonneoplastic, divided by the total number of cases included in the study. Cytology examinations which showed poor cellularity or preservation and were described as nondiagnostic were excluded from this analysis.

Time from presentation to surgery, time from surgery to discharge, concomitant surgical procedures performed under the same general anesthetic, survival to hospital discharge, postoperative treatments and documented local or distant metastasis were also recorded. For cats that received chemotherapy, the drug type was recorded. The reason for splenectomy was determined based on clinical, diagnostic, and histopathological findings.

The occurrence of any intraoperative and postoperative complication was recorded as well as the requirement of additional surgical intervention or medical treatment. According with Follette et al., complications were classified as minor, defined as complications that did not require additional surgical or medical treatment to resolve; moderate, defined as complications that required additional medical but not surgical treatment to resolve; major, defined as complications that required additional surgical treatment to resolve; death, defined as complications leading to postoperative death.

Tumor progression was defined as development of nodal or distant metastasis as confirmed by cytology or histopathology. Post-discharge follow-up was obtained by review of electronic patient records from the referral hospital and referring veterinary practice or by calling the owners.

Survival time was defined as the time from surgery to euthanasia or death. When the information was available, the cause of death was described as either related or unrelated to the splenic disease.

**Data analysis**

Analyses were performed using Microsoft Excel (version 14.00; Microsoft Corp) and SPSS 26.0 (IBM SPSS statistics, version 28.0; IBM Corp). Descriptive statistics were computed for all variables. Continuous explanatory variables assessed included were age, body weight, duration of clinical signs, PCV,
survival. The Shapiro-Wilk test confirmed that none of these data were normally distributed (P < .001 for all) so they were reported as median (IQR). Categorical variables assessed were sex, neuter status, body condition score (1 to 9/9), hyperbilirubinemia, blood transfusion, abdominal effusion, splenic mass, splenomegaly, histologic diagnosis and metastasis.

For each cat, survival time was determined as the time elapsed from the date of surgery to the date of death or censorship. Cats were censored from survival analysis if they were alive at the time of analysis or lost to follow-up. The Kaplan-Meier method and Cox proportional hazards analysis were used to determine the association of a range of variables with the survival time. The outcome variable was survival time, and the explanatory variables were age, gender, duration of clinical signs, anemia, thrombocytopenia, need of a transfusion, weight loss, collapse, abdominal effusion, hemoabdomen, diagnosis of neoplasia, presence of metastasis, splenomegaly, splenic mass, use of chemotherapy. All the variables were initially tested separately via univariate Cox proportional hazards analysis and a multivariate Cox proportional hazards model was then built, which initially included the variables identified as P < .2 on univariate analysis. To eliminate possible confounding factors, the model was built by backward elimination approach until only significant variables (P < .05) were retained in the model. Cox proportional hazards analysis results are reported as OR, 95% CI, and the associated P value. Fisher exact test was used to compare variables including anemia, hypoproteinemia, thrombocytopenia, presence of a mass on diagnostic imaging, hemoabdomen and the requirement for transfusion between cats with a diagnosis of HSA and cats with a diagnosis of MCT; between cats with a diagnosis of HSA and cats with diagnosis of other malignancies other than HSA; between cats with a diagnosis of HSA and cats without a diagnosis of HSA. The level of statistical significance was set at P < .05 for 2-sided analyses.

**Results**

**Population data, clinical presentation, and diagnostic investigations**

In total, 62 cats met the inclusion criteria. The most represented breed was domestic shorthair (44), followed by domestic longhair (5), British shorthair (4), Maine Coon (2), Ocicat (2), Persian (2), Burmese (1), Siamese (1), and Siberian (1). The population included 32 male neutered cats and 30 female neutered cats. At the time of surgery, the median age was 11 years (IQR, 8 to 13 years) and median weight was 4.5 kg (IQR, 3.7 to 5.2 kg). Body condition score ranged from 3/9 to 9/9 (median, 4/9) and the median duration of clinical signs was 18 days (IQR, 7 to 30 days). The most common clinical signs were summarized (Table 1).

**Clinico-pathologic characteristics**

Complete blood count was available for review in all cats. Median PCV was 21% (IQR, 9% to 30%). The most common hematologic abnormalities included anemia (PCV < 24%) in 30 cats with 18 cats showing signs of regeneration, thrombocytopenia (< 200 × 10^9/L) in 15 cats and neutrophilia (> 12 × 10^9/L) in 11 cats. In 6 cats, eventually diagnosed with MCT, circulating mast cells were reported and in 15 cats (24%) CBC was within reference limits.

Coagulation parameters (prothrombin time [PT] and partial thromboplastic time [aPTT]) were assessed in 13 cats and revealed PT (> 11 seconds) and aPTT (> 20 seconds) prolongation in 5 and 3 cats, respectively.

Serum biochemistry was available in 51 cats with the most common abnormalities being elevated alanine aminotransferase (> 60 U/L) in 17 cats, hyperbilirubinemia (total bilirubin > 5.1 µmol/L) in 11 cats, hypoalbuminemia (albumins < 25 g/L) in 10 cats and hypoproteinemia (proteins < 60 g/L) in 8 cats. In 14 cats (27%) serum biochemistry was within normal limits.

Feline leukemia virus and FIV snap tests (Idexx Laboratories) were negative in the 17 cats tested.

**Diagnostic imaging characteristics**

Abdominal ultrasound was the most common diagnostic tool used and it was performed in 55 cats (89%), followed by CT (15 [24%]). Thoracic radiography was used in 22 cats (35%) and echocardiography was performed in 5 cats (8%).

Based on imaging, 20 cats had a splenic mass, 18 cats had diffuse splenomegaly and 14 cats had both. Regional lymphadenopathy was described in 22 cats and peritoneal effusion was present in 27 cats. Other lesions concerning for metastatic disease found on imaging included: hepatic masses/nodules (14), hepatomegaly (9), pulmonary nodules (3) and pancreatic nodules (2).

Analysis from the peritoneal effusion was available in 23 cats and revealed hemoabdomen (15), protein rich transudate (6), neutrophilic exudate (1) and septic neutrophilic exudate (1). Spontaneous hemoabdomen was diagnosed in 12 cats with HSA, 2 cats with MCT, and 1 cat with leiomyosarcoma.

Cytology from the splenic parenchyma was performed in 41 cats and results were compatible with MCT (16), malignant neoplasia (3), mesenchymal neoplasia (3), extramedullary hemopoiesis (3), round cell tumor (2), neutrophilic inflammation (1) and plasma cell tumor (1). Splenic cytology was reported to be normal in 3 cats, and it was not diagnostic in 9 cats.

**Surgical procedures and complications**

Twenty cats received at least 1 pre- or peri-operative blood product transfusion including feline whole...
blood (6), xenotransfusion (5), autotransfusion (4), bovine hemoglobin-based oxygen-carrying infusion (4, Oxyglobin; Dechra) and packed RBCs (3).

All cats underwent surgery which included midline celiotomy and splenectomy. Median time from diagnosis to surgery was 2 days (IQR, 1 to 14 days).

Seventy-six concomitant procedures were performed in 40 cats, with the most common ones being hepatic biopsies (32), lymph node biopsies (10), pancreatic biopsies (9) and gastrointestinal biopsies (5, Supplementary Table S1). Antibacterial and analgesia therapy was prescribed postoperatively at the discretion of the surgeon.

Intraoperative complications were observed in 3 (5%) cats and were considered minor. During the postoperative period, 11 (18%) cats experienced complications, including 4 minor, 3 moderate and 4 causing death (Table 2).

Fifty-eight out of 62 cats survived to hospital discharge resulting in a perioperative mortality rate of 6%.

Histopathology results and diagnostic accuracy of splenic cytology
Histopathologic evaluation revealed a diagnosis of neoplasia in 50 cases (81%) including MCT (21), HSA (20), histiocytic sarcoma (3), lymphoma (3), plasma cell tumor (1), anaplastic sarcoma (1) and leiomyosarcoma (1). In 18 cats there was evidence of tumor involvement in other organs including liver (14), lymph node (5), omentum (2), skin (2), mesentery (1), pancreas (1), and gastrointestinal tract (1).

In 12 cats (19%) in which splenic neoplasia was not identified, splenic histopathology demonstrated: no histopathological abnormalities (5), hyperplasia with extramedullary hematopoiesis (5), neutrophilic inflammation (1) and congestion and fibrosis (1). In 4 cats with a histologically normal spleen, another pathological process was identified, including gastric histiocytic sarcoma (1), hepatic lymphoma (1), pancreatic adenocarcinoma (1), lymphocytic and histiocytic serositis and peritonitis compatible with feline infectious peritonitis (1).

The overall diagnostic accuracy of cytology to detect malignant lesions was 73%. In 2 cats the cytologic diagnosis did not correlate with the histopathologic evaluation: 1 cat suspected to have a malignant neoplasia on cytology had a normal splenic histopathology and 1 cat with no cytological abnormalities in the spleen was diagnosed with a histiocytic sarcoma. Of the 9 cats with a nondiagnostic cytological result, 6 were diagnosed with an HSA and 3 had no histopathological abnormalities. The accuracy of cytology for the diagnosis of MCTs and mesenchymal tumors (HSA and leiomyosarcoma) was 100% and 54%, respectively.

Outcomes
Fifty-one out of 58 (88%) cats surviving to discharge had available follow-up, which ranged from 5 to 1,912 days. Forty-one cats (80%) died or were euthanized at between 5 and 1,342 days following discharge; this was related to splenic neoplasia in 23 cats (56%). Overall median survival time (MST) for cats undergoing splenectomy as estimated for all 51 cats was 159 days (IQR, 35 to 364 days). Cats diagnosed with splenic neoplasia had an MST of 136 days (IQR, 35 to 348 days) whereas cats with a nonneoplastic process had an MST of 715 days (IQR, 18 to 1,368 days; \( P < .001 \)).

<table>
<thead>
<tr>
<th>No.</th>
<th>Diagnosis</th>
<th>Complication</th>
<th>Treatment</th>
<th>Time</th>
<th>Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Histiocytic sarcoma</td>
<td>Hypotension</td>
<td>-</td>
<td>-</td>
<td>Minor</td>
</tr>
<tr>
<td>2</td>
<td>HSA</td>
<td>Hypotension</td>
<td>-</td>
<td>-</td>
<td>Minor</td>
</tr>
<tr>
<td>3</td>
<td>MCT</td>
<td>Inability to excise a mesenteric lymph node</td>
<td>None</td>
<td>-</td>
<td>Minor</td>
</tr>
<tr>
<td>1</td>
<td>Histiocytic sarcoma</td>
<td>Hypotension</td>
<td>-</td>
<td>&lt; 24 h</td>
<td>Death</td>
</tr>
<tr>
<td>2</td>
<td>MCT</td>
<td>Unable to recover from general anesthetic</td>
<td>CPR - Euthanasia</td>
<td>&lt; 24 h</td>
<td>Death</td>
</tr>
<tr>
<td>3</td>
<td>HSA</td>
<td>Hemoabdomen</td>
<td>Blood product transfusion</td>
<td>&lt; 24 h</td>
<td>Moderate</td>
</tr>
<tr>
<td>4</td>
<td>MCT</td>
<td>Hemoabdomen</td>
<td>Blood product transfusion</td>
<td>&lt; 24 h</td>
<td>Moderate</td>
</tr>
<tr>
<td>5</td>
<td>HSA</td>
<td>Symmetric ataxia and partial blindness, suspected thiamine deficiency</td>
<td>Thiamine supplementation</td>
<td>1 d</td>
<td>Minor</td>
</tr>
<tr>
<td>6</td>
<td>HSA</td>
<td>Hypotension</td>
<td>Blood product transfusion</td>
<td>&lt; 24 h</td>
<td>Moderate</td>
</tr>
<tr>
<td>7</td>
<td>Nodular hyperplasia and hematoma</td>
<td>Sudden deterioration, death</td>
<td>-</td>
<td>2 d</td>
<td>Death</td>
</tr>
<tr>
<td>8</td>
<td>Nodular hyperplasia</td>
<td>Deterioration of an immune-mediated hemolytic anemia, death</td>
<td>-</td>
<td>5 d</td>
<td>Death</td>
</tr>
<tr>
<td>9</td>
<td>HSA</td>
<td>Abdominal pleural port obstruction (local tumor extension around the port)</td>
<td>-</td>
<td>11 d</td>
<td>Minor</td>
</tr>
<tr>
<td>10</td>
<td>HSA</td>
<td>Hyporexia</td>
<td>None</td>
<td>6 d</td>
<td>Minor</td>
</tr>
<tr>
<td>11</td>
<td>HSA</td>
<td>Hyporexia</td>
<td>None</td>
<td>7 d</td>
<td>Minor</td>
</tr>
</tbody>
</table>

CRA = Cardio-respiratory arrest. HSA = Hemangiosarcoma. MCT = Mast cell tumor.
Cats with splenic mast cell tumors—Of the 21 cats with splenic MCT, 7 cats had metastatic disease at diagnosis. Chemotherapy was administered to 8 cats including lomustine (4), chlorambucil (3), masitinib (1), followed by vinblastine (1), and toceranib (1). Five of the cats receiving chemotherapy were concurrently treated with prednisolone. Of the 13 cats with available follow-up, 5 died for MCT-related causes. The MST for this subgroup was of 348 days (IQR, 167 to 464 days).

Cats with splenic hemangiosarcoma—Of the 20 cats with splenic HSA, 6 cats had metastatic disease at presentation. Chemotherapy was administered to 7 cats including: doxorubicin (2), metronomic cyclophosphamide or chlorambucil (2), thalidomide (2), and epirubicin (1). Of the 16 cats with splenic HSA and available follow-up, all died for reasons related to splenic HSA due to clinical deterioration or disease progression. The overall MST for this subgroup was 94 days (IQR, 52 to 146 days). Cats diagnosed with HSA were more likely to present with anemia ($P < .001$), a splenic mass ($P < .001$), and hemoabdomen ($P < .001$) compared to cats with a diagnosis of non-HSA.

Risk factors associated with survival after splenectomy

Cox proportional hazards analysis was used to determine factors associated with survival, when considering possible confounding factors (Table 4).

Table 4—Univariate Cox proportional hazards analysis results determining factors associated with survival after splenectomy in cats.

**Table 3**—Age, diagnostics, treatment, and survival based on final diagnosis in 62 cats undergoing splenectomy.

**Imaging features**

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>Median age</th>
<th>Anemia (PCV &lt; 24%)</th>
<th>Hemoabdomen</th>
<th>Transfusion</th>
<th>Mass</th>
<th>Splenomegaly</th>
<th>Combination</th>
<th>Normal</th>
<th>Other organ involvement</th>
<th>Chemotherapy</th>
<th>MST† (d)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MCT (21)</td>
<td>12</td>
<td>4</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>12</td>
<td>1</td>
<td>4</td>
<td>7</td>
<td>8</td>
<td>348</td>
</tr>
<tr>
<td>HSA (20)</td>
<td>11</td>
<td>17</td>
<td>12</td>
<td>13</td>
<td>16</td>
<td>–</td>
<td>4</td>
<td>–</td>
<td>6</td>
<td>6</td>
<td>94</td>
</tr>
<tr>
<td>Histiocytic sarcoma (3)</td>
<td>9, 8, 14</td>
<td>1</td>
<td>–</td>
<td>1</td>
<td>–</td>
<td>2</td>
<td>1</td>
<td>–</td>
<td>1</td>
<td>–</td>
<td>1, 11, 33</td>
</tr>
<tr>
<td>Lymphoma (3)</td>
<td>16, 13, 8</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>–</td>
<td>2</td>
<td>1</td>
<td>–</td>
<td>1</td>
<td>1</td>
<td>–</td>
</tr>
<tr>
<td>Other neoplasia (3)</td>
<td>10, 9, 14</td>
<td>1</td>
<td>–</td>
<td>1</td>
<td>–</td>
<td>2</td>
<td>1</td>
<td>–</td>
<td>1</td>
<td>1</td>
<td>–</td>
</tr>
<tr>
<td>Nonneoplastic lesions (12)</td>
<td>8</td>
<td>4</td>
<td>–</td>
<td>3</td>
<td>–</td>
<td>1</td>
<td>6</td>
<td>1</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
</tbody>
</table>

*Individual ages reported for groups less than 10 cats. †Individual survival times reported for groups < 10 cats.

AS = Anaplastic sarcoma. LS - Leiomyosarcoma. MST = Median survival time. PCT = Plasma cell tumor.

See Table 2 for remainder of key.

**Figure 1**—Kaplan–Meier survival curve for cats with splenic mast cell tumor (n = 21) and splenic hemangiosarcoma (20) treated by splenectomy.
A group of cats undergoing splenectomy for MCTs was 348 days, ranging from 132 to 1140 days. Reported MSTs for cats undergoing splenectomy for MCTs to palliate clinical signs in cats with HSA.

Splenectomy is often considered for cats with splenic MCT, regardless of the extent of the disease and can be used in other locations. Splenectomy is often considered for cats with normal spleens that have concurrent neoplasms in other organ systems. When comparing the MST for a cat with a neoplastic (136 days) versus a nonneoplastic lesion (715 days, 94 to 365 days) for cats without evidence of metastasis.

**Discussion**

The results of the current study showed that neoplasia was the most common diagnosis (81%) in cats undergoing splenectomy, with MCT (42%) and HSA (40%) representing the most common primary neoplasia. While the frequency of splenic MCT was similar to previous reports (35% to 53%), the percentage of cats with HSA was higher in this study compared to the 21% reported by Gordon et al. Nonneoplastic lesions were diagnosed in 19% of cases. The retrospective nature of this study presents challenges in assessing the indications for splenectomy in those cats. However, it may be related to the appearance of the spleen during diagnostic imaging or intraoperatively. It is important to note that cats with a documented or suspected history of trauma were excluded from this study. Moreover, all 15 cats (24%) presented with spontaneous hemoabdomen were diagnosed with splenic neoplasia and HSA was the most common diagnosis (80%), making unwitnessed trauma highly unlikely. In the only study investigating hemoabdomen in cats, Culp et al reported that the etiologies of nontraumatic hemoabdomen in cats were evenly distributed between neoplastic (46%) and nonneoplastic diseases (54%); however, the spleen was the most common location for neoplasia (37%) and HSA was described as the most common tumor (60%).

The accuracy of cytology in this study for diagnosing splenic neoplasia was moderate (73%). This is similar when compared to other studies including predominantly canine samples. As expected, diagnostic accuracy increased in cats with MCTs while nondiagnostic cytology results were common in cats with HSA. Few studies in dogs have attempted to evaluate the use of different diagnostic methods to help differentiate between benign and malignant splenic lesions. However, no sensitive and specific predictors of malignancy were identified and histopathologic evaluation remains the gold standard.

In this study, there was a significant difference between the MST for a cat with a neoplastic (136 days) versus a nonneoplastic lesion (715 days, P < .001), even if some cats with normal spleens had concurrent neoplasms in other locations. Splenectomy is often considered for cats with splenic MCT, regardless of the extent of the disease and can palliate clinical signs in cats with HSA. Previous studies reported MSTs for cats undergoing splenectomy for MCT ranging from 132 to 1140 days. Similar to Kraus et al, who reported a MST of 390 days, the MST for this subgroup of cats undergoing splenectomy for MCTs was 348 days, with over 60% of cats dying or being euthanized for causes not associated to the MCT.

For cats with splenic HSA, outcome data is scarce due to small case numbers and the population heterogeneity. Median survival times of 77 to 197 days have been previously reported. Similarly, an MST of 94 days was reported in our population with all cats dying or being euthanized due to the disease. Based on those results, prognosis for cats diagnosed with a splenic HSA remains poor. This subgroup of cats was more likely to have hemoabdomen, a splenic mass and/or anemia; this presentation should prompt clinicians to favor a diagnosis of HSA.

Prognostic variables in cats undergoing splenectomy have been inconsistently reported in the literature. In this study, preoperative anemia and presence of metastasis in other organs were found to negatively affect survival.

Anemia is a common finding reported in 14% to 70% of cats with MCT and over 80% of cats with visceral HSA. This could indicate a perioperative blood loss (hemoabdomen), hemolysis, microangiopathy, systemic inflammation, disseminated intravascular coagulation, or a chronic disease process. Kraus et al reported that administration of a blood product was a negative prognostic factor in cats undergoing splenectomy for MCTs. The need for a blood transfusion could indicate a greater degree of anemia, but this factor was not correlated with prognosis in this cohort. Evans et al also described that anemic cats with splenic MCTs had numerically shorter tumor specific survival times than nonanemic cats but this difference was not significant, possibly related to the population size.

It has been previously stated that cats with splenic MCT benefit from splenectomy even in the presence of systemic involvement. However, the current literature is conflicting regarding the prognostic impact of distant organ or nodal metastasis. Presence of mastocytoma, liver and lymph node metastasis did not negatively affect prognosis in 2 studies, whereas Sabattini et al reported that cats with a MCT localized to the spleen had better outcomes than those with other organ involvement. By contrast Kraus et al reported that while additional nonsplenic organ involvement did not impact survival, lymph node metastasis negatively affected survival. While in our study involvement of one or more organ system was found to be a negative prognostic factor, the inclusion of cats with HSA and other neoplasia in our analysis could have biased the results; conclusions for specific tumor types cannot be obtained.

The main limitation of the present study is its multicentric retrospective nature, which could have increased the variability in management and treatment of this population. Investigations, staging, perioperative management and follow up protocols were not standardized and occasionally incomplete or inconsistent. Blood smears were not retrospectively reviewed to corroborate prior platelet counts, and therefore pseudothrombocytopenia could not be fully excluded. The variability of the histopathologic diagnosis could preclude a reliable statistical analysis. The histopathological specimens or cytological examinations were not reviewed by a single clinical or anatomical pathologist.

In conclusion, the current study provided evidence that cats undergoing splenectomy are likely to be diagnosed with splenic neoplasia. Splenic HSA was more frequently

Supplementary Materials

Supplementary materials are posted online at the journal website: avmajournals.avma.org