This retrospective study describes a technique and evaluates outcome associated with laparoscopic splenic biopsy in dogs and cats. Medical records of dogs (n = 10) and cats (n = 5) that had a laparoscopic splenic biopsy performed as part of their diagnostic evaluation for systemic disease were evaluated. Splenic biopsies were performed with the patient in dorsal recumbency using a two-portal approach. In some cases, concurrent organ biopsy was also performed. A pair of 5 mm cup biopsy forceps was used for biopsy collection, and an absorbable gelatin hemostatic sponge was placed at the biopsy site to aid in hemostasis. All patients recovered without major complications. Conversion to an open surgical approach was not required. Median survival time was 180 days, and nine patients were alive at the time of manuscript preparation. Four patients were diagnosed with neoplasia; however, only one had neoplasia involving the spleen. Median survival time for the nonneoplasia group (n = 11) was 300 days. Eight of those patients were alive at time of manuscript preparation. Minimal morbidity was observed in this cohort of clinical patients. Histopathology may be preferred over cytology in some clinical situations, and laparoscopic splenic biopsy provides a minimally invasive diagnostic option. (J Am Anim Hosp Assoc 2013; 49:41–45. DOI 10.5326/JAAHA-MS-5823)
Medical Record Review

In total, 15 patients (10 dogs and 5 cats) underwent laparoscopic splenic biopsy. Those medical records were reviewed for signalment; history; presenting complaint; complete blood count results and serum biochemical analysis; ultrasound findings; ancillary diagnostics; laparoscopic findings; procedure time; histopathology results of the spleen, liver, intestine, or other organs; diagnosis; and survival time.

Procedures

All patients received preoperative analgesia and sedation with buprenorphine (0.005 mg/kg IV) and diazepam (0.2 mg/kg IV). Anesthesia was induced with propofol (4 mg/kg IV) and maintained with isoflurane in oxygen to effect. The fur on the ventral abdomen was clipped in a routine fashion, and an aseptic surgical scrub of the entire area was performed. A 6 mm camera portal was established immediately caudal to the umbilicus using the Hasson technique. A 5 mm 0° laparoscope was inserted into the camera portal. Under direct visualization, a second instrument portal was established, also on the ventral midline, 3–5 cm cranial to the umbilicus. After a brief exploration of the abdominal cavity, the spleen was located and examined. When necessary, the spleen was manipulated with the body of a blunt probe to ensure complete visual examination of the organ. For the biopsy, a pair of 5 mm cup biopsy forceps was used. The capsule of the spleen was broken by clamping the biopsy forceps on the spleen, turning the forceps to twist the fibrous capsule, and pulling the forceps away from the spleen (Figure 1). The biopsy forceps were then clamped closed on the exposed splenic parenchyma to obtain the biopsy samples (Figure 2). Two to four samples were obtained from either the peripheral margin or central areas of the spleen, depending on either the previous ultrasonographic identification of lesions or gross evaluation of the organ during laparoscopy. Pieces of absorbable gelatin hemostatic sponge were applied to the biopsy area using a pair of 5 mm babcock grasping forceps to aid in hemostasis. Routine two layer portal closure involving suturing of the linea alba and skin was performed. Patients were treated postoperatively with buprenorphine (0.005 mg/kg IV q 6 hr pro re nata) and lactated Ringer’s solution (2–6 mL/kg/hr for 12–24 hr). Packed cell volume was measured 6–12 hr after the laparoscopy to assess for clinically relevant decreases. Additional supportive and therapeutic care (as deemed necessary for individual cases) was used as appropriate for the differential diagnoses being considered.

Results

Of 55 patients that underwent laparoscopy, 15 had biopsies of the spleen (10 dogs and 5 cats). Two to four samples were obtained from each spleen. Surgical time ranged from 45 min to 90 min, depending on the number of different organs sampled for histopathology. No procedures were converted to an open surgical approach. Hemorrhage was subjectively assessed to be minimal and was comparable to that typically observed following laparoscopic hepatic biopsy. No patients suffering from a drop in packed cell volume following the procedure (compared with preanesthetic values). All patients recovered from the procedure and were discharged after 12–24 hr of hospitalization.

Signalment, splenic histopathology results, and survival times have been summarized in Table 1. In addition to the splenic biopsy, 14 patients (10 dogs and 4 cats) also had a biopsy of the liver, and 9 patients (5 dogs and 4 cats) had a biopsy of the small
intestine. Two cats had mesenteric lymph node biopsies, and two dogs had a bone marrow aspiration performed as part of their diagnostic evaluation.

Eleven patients were diagnosed with nonneoplastic disease and four patients (all dogs) were diagnosed with neoplasia (two hepatic, one intestinal, and one splenic) as summarized in Table 2. Median survival time for all patients was 180 days (range, 2–720 days), and median survival time was 91 days (range, 2–180 days) for the neoplasia group. Two patients died 2 days and 3 days postoperatively due to a failure to respond to therapy. In neither case was the cause of death secondary to complications associated with the laparoscopic splenic biopsy. The third dog with neoplasia died 180 days postoperatively, but the fourth dog was alive at the time of manuscript preparation.

Median survival time in the nonneoplasia group was 300 days (range, 14–720 days). Eight patients in that group were alive at the time of manuscript preparation. Of the three deceased patients, there were two dogs and one cat with diagnoses of cholangiohepatitis, lymphangiectasia, and inflammatory bowel disease, respectively. Survival times in those patients were 14 days, 150 days, and 150 days, respectively. The cause of death of one patient was unknown (lymphangiectasia), while the other two were euthanized due to failure to respond to therapy for their respective illnesses. Six patients were deceased (three in the neoplasia and three in the nonneoplasia group) at the time of manuscript preparation. Median survival time of those patients was 82 days (range, 2–180 days).

In total, nine patients were alive at the time of data collection. Diagnoses included intestinal disorders (n = 6), including neoplastic gastrointestinal stromal tumor (n = 1), chronic hepatitis (n = 2), and idiopathic hypercalcemia (n = 1). Median survival time of this group of patients at the time of manuscript preparation was 570 days (range, 180–720 days).

### Discussion

Laparoscopic and percutaneous splenic biopsy techniques have been described in the human literature as both safe and clinically beneficial. To the authors’ knowledge, there is no information in the veterinary literature regarding either percutaneous or laparoscopic biopsy of the spleen.

Fifteen patients underwent laparoscopic biopsy of the spleen and were discharged with no apparent complications. The technique described in this manuscript was very similar to previously described techniques for hepatic biopsy.13 A pair of 5 mm biopsy cup forceps was used to harvest biopsies from either the periphery of the spleen or from a specific lesion if one had been noted either by ultrasound or grossly at the time of surgery. None of the cases in this report hemorrhaged profusely postoperatively; however, great care should be taken when performing a biopsy of a mass lesion within the spleen because profuse hemorrhage may result.15 If modestly sized mass lesions are present close to the periphery of the spleen, placement of a loop ligature around the mass could be considered to minimize the risk of hemorrhage. The ligature technique was not deemed necessary in any patients included in
EMH, extramedullary hematopoiesis.

<table>
<thead>
<tr>
<th>Patient</th>
<th>Diagnosis</th>
<th>Splenic histopathology</th>
<th>Survival time (days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 yr old basset hound</td>
<td>Lymphoma</td>
<td>EMH</td>
<td>3</td>
</tr>
<tr>
<td>14 yr old mixed-breed dog</td>
<td>Gastrointestinal stromal tumor</td>
<td>EMH with hemosiderosis</td>
<td>180*</td>
</tr>
<tr>
<td>9 yr old Labrador retriever</td>
<td>Mast cell tumor</td>
<td>Mast cell tumor</td>
<td>180</td>
</tr>
<tr>
<td>6 yr old rottweiler</td>
<td>Round cell neoplasia</td>
<td>EMH</td>
<td>2</td>
</tr>
</tbody>
</table>

* Patient still alive at time of manuscript preparation
EMH, extramedullary hematopoiesis.

this report. The use of an absorbable gelatin sponge was considered helpful in slowing hemorrhage from biopsy sites; however, no objective evaluation of its effect was performed in this study.

Histopathology provides greater diagnostic confidence over cytology, particularly in nonmalignant cases. Survival time and clinical signs in the nonneoplasia group were consistent with nonmalignant disease of the spleen and confirmed by histopathology. A neoplastic process would likely have resulted in shorter survival times. Infiltrative neoplasias such as lymphoma and mastocytosis do not typically result in the formation of well-circumscribed splenic masses and are often identified by fine-needle aspiration. Clinically, lack of evidence of neoplasia in a sample obtained by fine-needle aspiration does not preclude the diagnosis of neoplasia. Furthermore, small cell lymphoma often requires histopathology for diagnosis. Therefore, a safe, minimally invasive method for obtaining splenic tissue for histopathologic evaluation may reduce morbidity and improve diagnostic reliability. Recovery time following splenectomy is greater than laparoscopy, and splenectomized individuals may be more susceptible to infectious disease. Minimally invasive splenic biopsies to diagnose splenic disease may reduce the need for splenectomy in conditions where it would not be therapeutic. It should be noted, however, that the diagnostic accuracy of fine-needle aspiration and laparoscopic biopsy has not been compared.

One patient in this report died 48 hr after laparoscopy. The patient died due to hepatic round cell neoplasia, and there was no indication that complications from the splenic biopsy contributed to the patient’s demise. A second patient with hepatic lymphoma was euthanized 72 hr after laparoscopy due to deteriorating condition and failure to respond to therapy. That patient was clinically symptomatic prior to laparoscopy, and failure to respond to therapy was suspected to be due to severity of lymphoma rather than laparoscopic complications.

Risks associated with this procedure appear to be minimal as all patients, including those that either died or were euthanized, recovered and were discharged <24 hr after the procedure. Deaths were not attributable to the procedure, and no procedures were converted to open. All patients returned to preanesthetic clinical condition within 24 hr, suggesting a low morbidity. Nonetheless, certain limitations do exist with this procedure. Aside from acquisition of the necessary equipment, there is a learning curve to become proficient at laparoscopic evaluation. Furthermore, although a thorough evaluation of the abdomen and surfaces of the organs, including the spleen, can be performed, it is inherently limited compared with exploratory laparotomy. For example, tactile appreciation of the organs is possible, but requires procedural experience because manual palpation (performed during exploratory laparotomy) is not possible during laparoscopic procedures. In addition, manipulation of the small intestine, omentum, and other abdominal organs to view or palpate deeper structures may not be as complete as with exploratory laparotomy, depending on operator experience. Two to four samples were obtained from each patient in this report, which appeared to be adequate for clinical evaluation. Because the patients included in this study were clinical cases, no comparison with biopsies harvested using an open technique were evaluated.

Of the patients with nonneoplastic disease, confidence in the diagnosis was greater due to the availability of histopathologic evaluation of the spleen coupled with gross evaluation at laparoscopy. It is the authors’ impression that the knowledge gained by splenic biopsy aids in the development of a better treatment plan and better client education. That is, the client is able to make better, more informed, decisions regarding their pet’s care with the information available.

**Conclusion**

Laparoscopic splenic biopsy was associated with low morbidity in this cohort of patients. Survival time and clinical signs in the nonneoplasia group were consistent with nonmalignant disease of the spleen confirmed by histopathology. A neoplastic process would likely have resulted in shorter survival times. Laparoscopic splenic biopsy is indicated for diffuse organ disease and is not recommended for large splenic masses where rupture and hemoabdomen are potential risks. The results of histopathology
may provide greater clinical information when compared with cytology and allow for better owner education and treatment plans.

FOOTNOTES

a Buprenorphine; Hospira, Lake Forest, IL
b Diazepam; Hospira, Lake Forest, IL
c PropoFlo; Abbott, Abbott Park, IL
d IsoFlo; Abbott, Abbott Park, IL
e 0° 0.5 mm laparoscope; Karl Storz Veterinary Endoscopy, Goleta, CA
f 5 mm Clickline cup biopsy forceps; Karl Storz Veterinary Endoscopy, Goleta, CA
g Vetspon; Novartis Animal Health Inc., Greensboro, NC
h 5 mm babcock grasping forceps; Karl Storz Endoscopy, Goleta, CA
i Lactated Ringer’s solution; Abbott, Abbott Park, IL

REFERENCES
