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Evaluation of Risk Factors for Morbidity and Mortality after Pylorectomy and Gastroduodenostomy in Dogs

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Objectives—To (1) identify and describe the type and frequency of postoperative complications after pylorectomy and gastroduodenostomy in dogs and (2) identify preoperative and intraoperative risk factors, including the presence of neoplasia, prognostic for patient mortality after surgery.
Study Design—Case series.
Animals—Dogs (n = 24) treated by pylorectomy and gastroduodenostomy.
Methods—Medical records (2000–2007) for 2 teaching hospitals of dogs treated that had pylorectomy and gastroduodenostomy were reviewed. Pre-, intra-, and postoperative data were obtained from the medical record.
Results—Of the 24 dogs, 75% survived 14 days, but 10 (41%) died by 3 months. Overall median survival time (MST) was 578 days. On log-rank univariate analysis, preoperative weight loss ($P = .001$) and malignant neoplasia ($P = .01$) were associated with decreased survival time. Dogs with malignant neoplasia had a MST of 33 days. Common postoperative morbidity included hypoalbuminemia (62.5%) and anemia (58.3%).
Conclusions—Pylorectomy with gastroduodenostomy has a good short-term outcome but long-term survival time is poor in dogs with malignant neoplasia.
Clinical Relevance—Overall, most dogs treated with pylorectomy and gastroduodenostomy survived the postoperative period; however, preoperative weight loss and malignant neoplasia were associated with decreased survival time. Because dogs with malignant neoplasia have markedly shortened survival times, pertinent preoperative, diagnostics steps should be exhausted to identify underlying neoplasia.

INTRODUCTION

PYLORECTOMY AND gastroduodenostomy (Billroth I) allows for wide excision of abnormal pyloric tissue and increases gastric outflow.[1] Indications include gastric neoplasia, chronic hypertrophic pyloric gastropathy, and perforated pyloric ulcers.[1] Surgical goals include elimination of gastric outflow obstruction or perforation and obtaining a diagnostic surgical biopsy. End-to-end gastroduodenostomy is technically similar to small intestinal anastamosis but requires a complete understanding of the peripyloric anatomy including the location of the common bile duct and major duodenal papilla to avoid serious complications. There is little information on types of complications, complication rates, and survival times after this uncommon procedure in dogs and cats.[1–6] Complication rates and predictors for morbidity and mortality after human gastric surgery have been established.[7,8] Reported complications include pleural effusion, anastomotic leakage, abdominal abscess, pancreatitis, and peritonitis.[7,8] Risk factors for postoperative complications include operating time, blood loss, pancreatic invasion, age, combined organ resection, and Billroth type.[7,8]

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Our purpose was to (1) identify and describe the type and frequency of postoperative complications associated with Billroth surgery and (2) identify preoperative and intraoperative factors, including presence of neoplasia, associated with short-term and/or long-term survival.

MATERIALS AND METHODS

Inclusion Criteria

Medical records (2000–2007) of dogs that had pylorectomy and gastroduodenostomy at the Animal Medical Center and the University of Pennsylvania School of Veterinary Medicine were reviewed. Records were considered complete if they contained all of the following: an initial history, physical examination, preoperative blood work, preoperative abdominal ultrasonography and thoracic radiographs, surgical report, histopathologic diagnosis, and postoperative care documentation until discharge from the hospital including treatment sheets and twice daily examinations.

Retrieved Data

Pre-, intra-, and postoperative data (from surgery until discharge) was obtained from the medical record.

Preoperative Data. Signalment, body weight, presence or absence of 3 common presenting complaints (vomiting, anorexia, weight loss) and duration of clinical signs, hematocrit (HCT), white blood cell (WBC) count, albumin (Alb) and total bilirubin (TBili) concentrations, and endoscopic (gastroscopy, duodenoscopy) findings were recorded. Preoperative presence of metastasis was determined by a board certified radiologist review of thoracic radiographs and/or abdominal ultrasound examinations on all dogs. Presence of preoperative aspiration pneumonia was determined by evaluation of thoracic radiographs by a board certified radiologist.

Intraoperative Data. Duration of surgery, concurrent procedures performed (pancreatectomy, biliary surgery, placement and type of feeding tube), presence of peritonitis (positive bacterial culture), and presence of hypotension (systolic blood pressure <80 mmHg for 15 minutes determined by Doppler or oscillometric measurement or requiring vasopressor therapy) were recorded.

Postoperative Data. Blood pressure, Alb and blood glucose concentration, WBC count, HCT, blood product administration, development of aspiration pneumonia (based on thoracic radiographs), ultrasonographic evidence of pancreatitis, development of peritonitis (based on fluid analysis) and need for a 2nd surgery.

Histopathology reports were reviewed to determine presence of malignant neoplasia, benign disease, and/or metastasis. All histopathologic diagnoses, including presence of intraabdominal metastasis, were confirmed by 1 pathologist at each institution. Presence or absence of neoplasia at the surgical margin was recorded if detailed in the original histopathology report.

Overall survival time was defined as number of days from surgery to date of death. Postoperative outcome was divided into 2 groups (survivors, nonsurvivors) based on dogs that survived >14 days after surgery. Dogs that survived 14 days were assumed to have surpassed the direct consequences of the surgical procedure (e.g., anastomotic leakage). Date of death was determined by reevaluation exams at either institution or phone calls to the referring veterinarian and/or owner. Dogs were considered lost to follow-up if the owner could not be contacted by phone or through their referring veterinarian.

Surgical Procedure

Pylorectomy and gastroduodenostomy was performed[1] through a ventral median celiotomy; complete abdominal exploration was performed in each dog including evaluation for evidence of metastasis and/or peritonitis. Proximity of the common bile duct and pancreas to the pylorus was noted. Stay sutures were placed in the proximal part of the duodenum and pyloric antrum. The ventral portion of the hepatogastric ligament was transected to improve pyloric mobility and observation when needed. Local branches of the right gastric and gastroepiploic artery and vein were ligated with stainless-steel hemostatic clips or sutures and transected. Mesenteric and omental attachments were removed from the portion of stomach and duodenum to be excised.

Noncrushing forceps were placed orad to the planned gastrectomy site and aborad to the duodenectomy site. The abnormal pylorus and duodenum with 1 cm of grossly normal tissue proximal and distal was excised sharply with either a scalpel blade or Metzenbaum scissors. A modification of this technique used a thoracoabdominal (TA) stapler to seal the stomach orad to the pylorus and then sharply excise the abnormal tissue. Gastroduodenal anastomosis was performed in a single layer closure using 3-0 or 4-0 absorbable suture in 2 simple continuous patterns (running from the mesenteric border to antimesenteric border bilaterally) or a simple interrupted pattern. The dorsal surface was apposed first using the stay sutures to rotate the stomach and duodenum as needed to place sutures. A modification of the anastomosis technique involved opening a portion of the gastric staple line to match the diameter of the duodenal opening. Anastomosis was performed as described with suture. A 2nd modification included a duodenal end-to-side anastomosis to the gastric body. This end-to-side anastomosis was performed with suture after the stomach had been sealed with the TA stapler and the abnormal pyloric tissue had been excised. Based on surgeon preference, the suture or staple lines were reinforced with a 2nd inverting layer (Lembert or Cushing pattern). Partial pancreatectomy, if necessary, was performed by the suture fracture technique with preservation of the pancreatic and common bile ducts. Biliary diversion was accomplished by cholecystoenterostomy when needed.[9] Gastrostomy, jejunostomy, or gastrojejunostomy tubes[10] were placed at the surgeons' discretion.

Statistical Analysis

Results are expressed numerically as median and range. Differences in variables (age, body weight, history of preoperative weight loss, duration of clinical signs, duration of surgery, presence of hypoalbuminemia, presence of neoplasia, presence of complete surgical resection, presence of metastasis) between the 2 outcome groups (survivors, nonsurvivors) assessed at 14 days postoperatively, were compared by *t*-test or Mann–Whitney rank sum test for continuous data, or by Fisher's exact test for categorical variables.

Overall median survival time (MST) was calculated using Kaplan–Meier survival analysis and reported with 95% confidence interval (CI). For overall survival, dogs were censored if (1) death was not associated with the surgical procedure or their underlying disease, (2) they were lost to follow-up, or (3) they were alive at the end of the study. Categorical variables were evaluated to determine association with overall survival time by log-rank analysis. Differences were considered significant at $P < .05$.

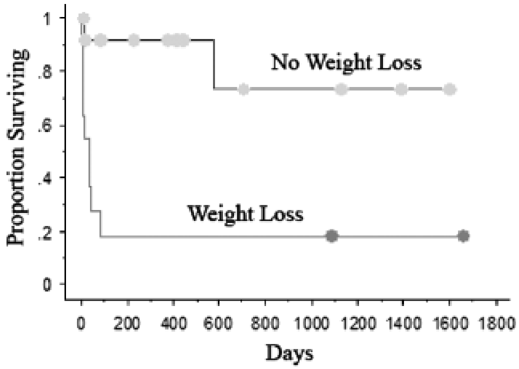

Fig 1. Kaplan–Meier analysis for overall survival time of the 11 dogs with preoperative weight loss compared with 13 dogs without preoperative weight loss. Day of surgery was designated as day 0. Dots represent censored observations.

RESULTS

Dogs

Twenty-four dogs (10 female, 14 male) met the inclusion criteria. There were 5 (20%) intact males, 9 (37.5%) castrated males, 3 (12.5%) intact females, and 7 (29%) spayed females. Mean age at surgery was 7.7 years (median, 8.6 years; range, 6 months–13.6 years). Mean body weight was 26.9 kg (median, 23.6 kg; range, 2.4–72.3 kg). Breeds represented were mixed breed (n = 3), Chow Chow (n = 2), Rottweiler (n = 2), French Bulldog (n = 2), Shih Tzu (n = 2), Pekingese, Bull Mastiff, Maltese, Chihuahua, Labrador retriever, Rhodesian Ridgeback, Akita, English Bulldog, Greyhound, Siberian Husky, Bichon Frise, and a Bouvier des Flanders. Sex and breed were not significantly associated with overall survival time. No significant difference was noted in age at surgery ($P = .9$) or weight ($P = .9$) between 14-day outcome groups.

Preoperative Findings

Clinical Signs. The most common presenting complaints were vomiting (23 dogs, 96%), anorexia (16 dogs, 62.5%), and weight loss (11 dogs, 45.8%). Other presenting complaints included polyuria/polydipsia (2 dogs), gastric bloating (1), and diarrhea (1). Mean duration of clinical signs was 41.1 days (median, 12 days; range, 2–180 days). Preoperative weight loss ($P = .001$) was associated with decreased overall survival with a MST of 33 days (95% CI = 6–47 days; Fig 1). Neither duration of clinical signs nor any other presenting complaint was associated with decreased overall survival time. No significant difference was noted in duration of clinical signs ($P = .9$) or presence of preoperative weight loss ($P = .06$) between 14-day outcome groups.

Clinical Pathology Findings. Six (25%) dogs had preoperative hypoalbuminemia (Alb < 2.5 g/dL). Mean preoperative Alb was 2.9 g/dL (median, 3.0 g/dL; range, 1.0–5.0 g/dL). Six (25%) dogs were anemic preoperatively (HCT < 37%). Mean preoperative HCT was 41.1% (median, 40.4%; range, 22.1–58%). Six (25%) dogs had preoperative leukocytosis (WBC > 16000 cells/μL). No dogs were leucopenic (WBC < 5000 cells/μL). Mean WBC was 15,900 cells/μL (median, 13,200 cells/μL; range, 6580–34,800 cells/μL). Five (21%) dogs had hyperbilirubinemia (TBili > 0.4 mg/dL). Mean TBili was 0.28 mg/dL (median, 0.2 mg/dL; range, 0–0.8 mg/dL). None of these 4 preoperative laboratory values was significantly associated with overall survival. No significant difference was noted in presence of hypoalbuminemia ($P = .28$) between 14-day outcome groups.

Thoracic Radiography. None of the dogs had preoperative pneumonia, but 1 dog had metastasis on thoracic radiographs that was not detected before surgery but was found on subsequent review. Eight (33%) dogs had findings compatible with regional metastasis on abdominal ultrasonography. Abnormalities included local lymph node enlargement, hepatic nodules, and gastric nodules. Five of these dogs had confirmed metastasis on histopathologic examination; 3 dogs had local lymph node metastasis and 2 had liver metastasis. Of the other 3 dogs with suspicious metastasis on abdominal ultrasonography 1 had hepatocellular carcinoma and 2 had hepatonodular hyperplasia. There was only 1 dog without evidence of metastasis on abdominal ultrasonography that had histologic evidence of metastasis to the local lymph node. Presence of regional or distant metatastasis on radiographs or ultrasonography was not significantly associated with overall survival ($P = .86$).

Endoscopic Findings. Preoperative endoscopy was performed in 10 dogs and 6 had endoscopic biopsies.

Biopsy histopathology from 4 dogs matched the surgical sample histopathology. Three endoscopic biopsies that matched the surgical biopsies were inflammatory disease including gastritis, mucosal hyperplasia, and ulcers. The other matching biopsy was a gastric papillary adenoma. In 2 dogs that did not have matching endoscopic and surgical biopsies, both endoscopic specimens had inflammatory disease and surgical histopathology showed gastrointestinal stromal tumor in 1 dog and pyloric adenocarcinoma in 1 dog.

Intraoperative Evaluation

Mean surgical duration was 208 minutes (median, 217 minutes; range, 125–310 minutes). Three dogs (13%) had concurrent procedures; 1 dog had cholecystojejunostomy, 1 dog had cholecystojejunostomy and partial pancreatectomy, and 1 dog had partial pancreatectomy. One cholecystojejunostomy dog had postoperative anemia and hypoalbuminemia and was euthanatized at 14 days because of persistent anorexia and lethargy. This dog had lymphoma in the gastroduodenal biopsy. Partial pancreatectomy and cholecystojejunostomy was performed in 1 dog to treat a perforated duodenal ulcer and septic peritonitis. Although there were substantial postoperative complications, the dog was discharged at 5 days and was alive at 1599 days. The dog that had partial pancreatectomy lived 231 days after surgery.

Feeding tubes placed in 10 (42%) dogs included 4 gastrojejunostomy, 4 gastrostomy, and 2 jejunostomy tubes. No major complications associated with feeding tubes were identified. Six dogs that had feeding tubes had preoperative weight loss. Five dogs with feeding tubes were diagnosed with neoplasia on histopathology. Two dogs with feeding tubes had additional surgical procedures (partial pancreatectomy, biliary diversion).

Three dogs (12.5%) had septic peritonitis at surgery and confirmed with bacterial culture. One dog had intestinal incisional dehiscence from a previous surgery and the other 2 dogs had ruptured gastrointestinal ulcers. Two (8%) dogs became hypotensive during the procedure. Surgical duration, presence of septic peritonitis, hypotension, or concurrent procedures were not significantly associated with overall survival. Duration of surgery ($P = .9$) was not significantly different between 14-day outcome groups.

Postoperative Evaluation

Survival. Follow-up information was obtained for all dogs, although 1 dog was lost to follow-up at 21 days. One dog, that had surgery for excision of a leiomyoma, died after being hit by car and was censored at 1359 days. Six dogs were alive at the end of the study. Mean follow-up of surviving dogs was 551 days (median, 474 days). Six (25%) dogs were in the nonsurvivor outcome group (died or were euthanatized within 14 days of surgery). Twenty-one (88%) dogs were discharged from the hospital. MST of dogs discharged from the hospital was not reached and was >1659 days. Reasons for death or euthanasia at any time during the study included persistent or recurrent anorexia and/or weakness (6 dogs), progression of neoplasia (4), sepsis (2), persistent dull mentation (2), aspiration pneumonia with severe respiratory difficulty (1), recurrent pancreatitis (1), and hit by car (1). Overall Kaplan–Meier MST was 578 days (lower 95% CI = 33; upper 95% CI = incalculable; Fig 2).

Clinical Pathology Findings. Thirteen of 17 dogs (76.5%) had postoperative hypoalbuminemia (mean, 2.0 g/dL; median, 2.1 g/dL; range, 1.2–3.2 g/dL). Fourteen of 24 dogs (58.3%) had postoperative anemia (mean, 33.5%; median, 34%; range, 12–46%).

Postoperative Care and Complications. Eight of 24 dogs (33%) required blood products including plasma, whole blood, or packed red blood cells. Other complications included hypotension in 4 of 24 dogs (16.7%), hypoglycemia in 4 of 24 (16.7%), aspiration pneumonia in 3 of 24 dogs (12.5%), ultrasonographic evidence of pancreatitis in 3 of 24 dogs (12.5%) and septic peritonitis in 2 of 24 dogs (8.3%). Two dogs (8.3%) that developed septic peritonitis because of anastomotic leakage required a 2nd celiotomy; 1 dog had initial surgery to treat necrotizing pancreatitis and survived 231 days from the original surgery and the 2nd dog had initial surgery to treat a perforated duodenal ulcer and survived 1125 days after original surgery.

Neoplasia. Thirteen (42%) dogs had malignant neoplasia including adenocarcinoma (n = 7 dogs), plasmacytoma (n = 2), and poorly differentiated carcinoma, gastrointestinal stromal tumor, lymphoma, undifferentiated

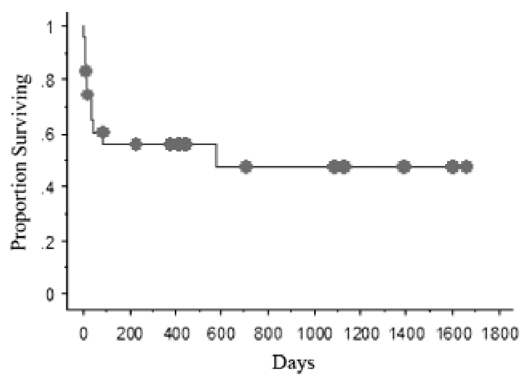

Fig 2. Kaplan–Meier analysis for overall survival time of 24 dogs that had pylorectomy and gastroduodenostomy. Day of surgery was designated as day 0. Dots represent censored observations.

sarcoma (n = 1). Two dogs had benign tumors (leiomyoma, papillary adenoma).

Eight dogs had complete resections of the neoplastic disease whereas 5 dogs had incomplete resections, and excised tissue margins were not reported in 2 histopathologic reports of 2 dogs. Dogs with incomplete surgical resections had an overall MST of 33 days (lower 95% CI = 2; upper 95% CI = incalculable) which was not significantly different from the overall MST of 578 days (lower 95% CI = 8, upper 95% CI = incalculable) for dogs with complete excision of the neoplasia ($P = .15$). No significant difference was detected in the number of complete and incomplete resections of neoplasia between outcome groups ($P = .2$) as only 1 dog with incomplete margins died within the 14-day postoperative period.

Six dogs had inflammatory gastrointestinal disease including chronic gastritis with mucosal hypertrophy (4) and polypoid gastritis (2). One dog had necrotizing pancreatitis which was resected along with a portion of the proximal duodenum and pylorus. Dogs with malignant neoplasia had an overall MST of 33 days (95% CI = 14–578 days) which was significantly different than the overall MST of >1659 days for dogs with benign diseases ($P = .01$; Fig 3). The number of dogs with neoplasia ($P = 1.0$) was not significantly different between outcome groups, as only 4 of 15 dogs with neoplasia died within the 14-day postoperative period.

Metastatic Disease. Eight (33%) dogs had metastasis confirmed by histopathology; 5 dogs had metastasis to the gastric lymph nodes. Two dogs had liver and splenic metastasis and 1 dog had liver metastasis only. Metastatic disease was not significantly associated with overall survival ($P = .07$). Dogs with metastatic disease had a MST of 33 days (95% CI = 2–47 days) compared with MST > 1659 days for dogs without metastatic disease. No significant difference was noted for dogs that had metastasis ($P = 1.0$) between 14-day outcome groups. Only 2 of 8 dogs with metastasis died within the 14-day postoperative period.

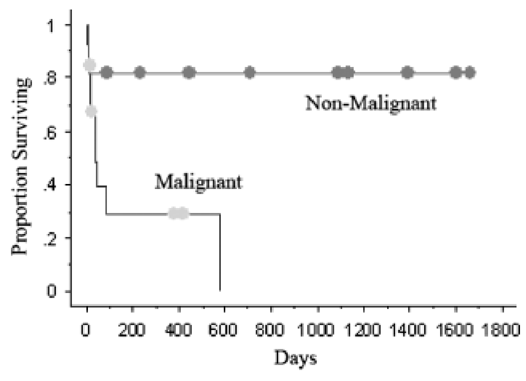

Fig 3. Kaplan–Meier analysis for overall survival time of the 13 dogs with malignant neoplasia compared with 11 dogs with benign disease. Day of surgery was designated as day 0. Dots represent censored observations.

DISCUSSION

We evaluated factors that may be associated with both long-term (overall survival time) and short-term outcome (surviving >14 days) after pylorectomy and gastroduodenostomy. Preoperative weight loss and the presence of malignant neoplasia were the only factors significantly associated decreased overall survival. Presence of metastasis ($P = .07$) approached significance for association with decreased overall survival. In assessment of the 14-day outcome groups, presence of preoperative weight loss ($P = .06$) was the only factor that neared significant difference between postoperative outcome groups. Thus dogs that have preoperative weight loss have short overall survival times and may be more likely to die in the early postoperative period. In comparison, dogs with neoplasia and dogs with metastatic neoplasia were not more likely to die in the postoperative period but had poor overall survival times. Pylorectomy and gastroduodenostomy had a good short-term outcome in this cohort of dogs with 75% (18/24) dogs surviving >14 days. So whereas, this procedure is indicated to obtain a histopathologic diagnosis and to increase gastric outflow in dogs with neoplastic or nonneoplastic disease, long-term survival time is poor in dogs with malignant neoplasia.

Influence of Weight Loss

Weight loss or malnutrition has been shown to be a significant risk factor for postoperative complications and mortality in gastric and other types of surgery in people.[11–14] Weight loss in patients with acute or chronic disease can occur by several mechanisms including: decreased energy intake, increased energy consumption and changes in nutrient metabolism Decreased oral food intake has a deleterious effect on gut structure, reduces gut mass, and decreases production of gut hormones.[15] People with preoperative weight loss have a poor plane of nutrition and may have an inadequate metabolic response to surgical stress.[14] Increased metabolic demand after surgery causes release of catabolic hormones (cortisol, catecholamines) and down regulation of anabolic hormones (androgens, growth hormone).[14] This physiologic response to surgical trauma promotes sodium and water retention and increases protein catabolism prolonging intestinal healing.[15] Nutritional deficiency and the associated consequences may explain the statistically significant increased mortality rate associated with a history of preoperative weight loss we observed in these dogs. Preoperative weight loss was associated with significantly shortened overall survival and approached significance for association with dogs that died in the 14-day postoperative period. A limitation of the preoperative weight loss variable is that only 7 of 11 dogs had weight loss of varying degrees documented by examination at the 2 hospitals. Presence or absence of preoperative weight loss was evaluated as a categorical variable and not as a continuous variable. As such, dogs considered to have moderate weight loss, significant weight loss or a history of weight loss were evaluated as 1 group compared with dogs that did not have historical weight loss. Furthermore, the amount of weight loss may reflect the chronicity of the disease process, although an increased duration of clinical signs was not associated with decreased overall survival.

Influence of Malignant Neoplastic Disease

Presence of malignant neoplasia was associated with statistically significant decreased overall survival. Presence of metastasis on histopathology approached a statistical significant association with decreased overall survival. Overall median survival of dogs with malignant neoplasia and dogs with metastasis were short at 33 days. Dogs without an underlying malignancy or without metastatic disease had a MST that was not reached at study end, and was >4 years. The lack of statistical significance between dogs with and without metastasis likely represents a type II statistical error associated with the small sample sizes.[16]

Morbidity and mortality secondary to neoplasia can occur through several mechanisms including: delayed healing, altered nutrient metabolism, metastatic disease, coagulopathies including disseminated intravascular coagulation and local tumor recurrence. It is not surprising that dogs with malignant gastroduodenal neoplasia had shorter survival. In a recent retrospective study, underlying neoplasia was found to increase mortality rates in dogs being treated with thoracotomy.[17] In people, malignancy has also been determined to be an independent risk factor for morbidity and mortality after gastrointestinal surgery.[18] In a retrospective study of canine gastric neoplasia, where adenocarcinoma was the most common tumor type, the long-term prognosis was poor.[6] Adenocarcinoma was the most common tumor type in our study occurring in 7 dogs and undifferentiated carcinoma in 1 dog out of the 15 cases of neoplasia.

Presence of neoplasia (benign and malignant) may be determined preoperatively as a mass on abdominal ultrasonography or by endoscopy. In our dogs, endoscopic biopsy results did not always concur with surgical histopathologic diagnosis so the preoperative determination of malignancy may be difficult. This finding is similar to a previous study comparing full thickness and endoscopic gastrointestinal biopsies where endoscopic small intestine biopsies were inadequate for differentiating inflammatory bowel disease from lymphoma.[19] Additionally, radiographs and abdominal ultrasonography may be assessed preoperatively for evidence of metastasis. Only 33% of our dogs had metastasis detected preoperatively and 33% ultimately had metastatic neoplasia diagnosed on histopathology. Five (62.5%) of 8 dogs with preoperative evidence of metastasis had spread of disease confirmed on histopathology. Only 1 dog was diagnosed with metastatic disease on histopathology without preoperative evidence suggestive of metastasis. Noninvasive diagnostic tests such as radiography and ultrasonography can detect only gross metastatic lesions but did so with relative accuracy in this study.

Microscopic disease is only detected by histopathologic examination leading to the lower percentage of dogs diagnosed preoperatively with metastatic neoplasia. Dogs with neoplasia were not more likely to die in the 14-day postoperative period (4/15 dogs with neoplasia). Similarly, dogs with metastasis were not more likely to die in the 14-day postoperative period (2/8 dogs with metastasis died but their MST was slightly >1 month). Pylorectomy and gastroduodenostomy can be performed to obtain a histopathologic diagnosis in dogs with neoplasia and metastasis without increased mortality in the early postoperative period compared with dogs without neoplasia.

Other Factors

Other preoperative factors shown to be negatively associated with survival in gastric surgery in people include hypoalbuminemia and concurrent pancreatectomy or biliary surgery at the time of gastric surgery.[7,8,12] Dogs and cats with hypoalbuminemia were also shown to be at increased risk of dehiscence at intestinal anastomotic sites.[20] Five of 6 dogs with preoperative hypoalbuminemia had nonneoplastic disease requiring gastroduodenostomy including necrotizing pancreatitis and perforated duodenal ulcer. Although, preoperative hypoalbuminemia was not associated decreased short-term or long-term survival, this may again represent Type II error.

The more common postoperative complications included hypoalbuminemia, anemia, hypotension, and hypoglycemia. Only 2 (8.3%) dogs had dehiscence of the gastroduodenostomy, septic peritonitis and required a 2nd surgery. Both dogs had good outcomes, surviving 231 and 1125 days after the 1st surgery. This compares favorably with a 14.4% prevalence of anastomotic leakage after intestinal anastomosis in dogs reported by Ralphs et al[20] Only 3 dogs had additional surgical procedures at the time of gastroduodenostomy including 1 partial pancreatectomy, 1 cholecystojejunostomy, and 1 dog that had both procedures. The small number of dogs being treated with multiple surgical procedures likely precluded statistically significant associations.

Study Limitations

The surgical procedure was not standardized and was performed by multiple surgeons at 2 large teaching hospitals. Pre- and postsurgical treatment of dogs was not standardized. The effect of variations in surgical technique and postoperative treatments cannot be evaluated with respect to survival time. Necropsy examinations were not available for any of the dogs and would be necessary to definitively determine the cause of death. Gastroduodenostomy is an uncommon procedure, even at 2 large teaching hospitals, which resulted in a small number of cases and subsequent low power for statistical analysis.

Gastroduodenostomy is an uncommon procedure but overall, most dogs will survive for 14 days. We found that preoperative weight loss and the presence of malignant neoplasia were significantly associated with decreased overall survival after pylorectomy. Pertinent diagnostics steps should be exhausted to identify underlying neoplasia in dogs because these dogs have a poor prognosis for long-term survival after gastroduodenostomy.

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