Choledochal tube stenting for decompression of the extrahepatic portion of the biliary tract in dogs: 13 cases (2002–2005)

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Objective—To determine clinicopathologic features, surgical management, complications, and long-term outcome associated with diseases of the extrahepatic portion of the biliary tract treated via choledochal stent placement in dogs.

Design—Retrospective case series.

Animals—13 dogs.

Procedure—Data were obtained from medical records, and follow-up information was obtained via reexamination or telephone interview with owners or referring veterinarians.

Results—10 dogs had extrahepatic biliary obstruction (EHBO), 6 as a result of pancreatitis. Two dogs had rupture of the common bile duct associated with cholelithiasis. In 1 dog, a stent was placed prophylactically after gastroduodenostomy was performed for a perforated duodenal ulcer. Nine of 13 dogs survived the perioperative period and were discharged. No recurrence of EHBO or other complications developed in the discharged dogs while the stents were in place. Median follow-up period from surgery to last owner contact was 13.3 months. In 1 dog, the stent was removed endoscopically 10 months after surgery and EHBO recurred 9 months after stent removal because of cholangitis. In 4 of 5 dogs that were discharged from the hospital, in which the fate of the stent could be confirmed and the stent was secured to the duodenal wall with absorbable suture materials, the stents were passed in the feces 1 to 11 months after surgery.

Conclusions and Clinical Relevance—Choledochal tube stenting is an effective method of decompression of the extrahepatic portion of the biliary tract in dogs and provides a less complex alternative to traditional cholecystoenterostomy techniques in select cases. (J Am Vet Med Assoc 2006;228:1209–1214)

Canine extrahepatic biliary diseases are uncommon and often surgically challenging. Extrahepatic biliary obstruction and leakage of bile with subsequent bile peritonitis represent the most common clinical syndromes. The most common causes of extraluminal biliary obstruction are pancreatitis and neoplasia. Intraluminal obstruction can be caused by cholangitis.

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Criteria for Selection of Cases

Medical records of all dogs at the MJR-VHUP between 2002 and 2005 that were treated with biliary stents as part of management of extrahepatic biliary tract disease were reviewed. Cases were included only if dogs underwent an exploratory laparotomy during which biliary stenting was performed and if a complete medical record was available for review. Records were excluded from the study if a biliary stent was not sutured to the duodenal wall and left in place after surgery or if the medical record was incomplete.
Procedures
Data obtained from the medical records included information on signalment, history, clinical signs, physical examination, laboratory testing, diagnostic imaging studies, pathologic findings, and outcome. All dogs underwent a complete exploratory laparotomy. In all dogs, a duodenotomy was performed 3 to 6 cm distal to the pylorus on the antimesenteric border over the anticipated location of the major duodenal papilla. A stent was passed retrograde through the major duodenal papilla, and patency of the biliary tree was evaluated. In most dogs, flushing of sterile saline (0.9% NaCl) solution through the stent into the common bile duct was used to judge patency. If choleliths were present, they were either removed via a cholecodochoomy or flushed back into the gallbladder from where they were removed via cholecystotomy or cholecystectomy. If patency could not be established by the passage of a stent across the area of obstruction, an alternative procedure was performed; records of those dogs were not included in the present retrospective study. The choledochal stents were 5- to 10-cm sections of red rubber catheters. Approximately half the length of the stent was passed through the major duodenal papilla into the common bile duct, with the other half of the stent residing in the duodenum. The stents were secured in place by passing sutures through the stent wall and through the submucosa of the duodenal wall just aboral to the major duodenal papilla. In some dogs, samples of gallbladder (n = 6), bile (5), and liver (2) were submitted for aerobic and anaerobic microbial culture. Information on complications and outcome was obtained by reexamination at MJR-VHUP or by telephone interview with the owner or local veterinarian.

Results
Signalment—Records of 13 dogs met the criteria for inclusion in the study. The study cohort included 8 spayed female dogs, 4 castrated male dogs, and 1 sexually intact male dog. Median age at evaluation was 10.1 years (range, 3.5 to 13.8 years). Median weight was 20.4 kg (44.9 lb; range, 4.8 to 40 kg [10.6 to 88 lb]). Many breeds were represented, including mixed-breed dogs (n = 3); Rottweilers (2); and 1 each of Miniature Schnauzer, Miniature Dachshund, Pug, Standard Poodle, Labrador Retriever, Golden Retriever, and Jack Russell Terrier.

History—Clinical signs included vomiting (12/13 dogs), icterus (8/13), anorexia (5/13), lethargy (3/13), signs of abdominal pain (2/13), diarrhea (2/13), weight loss (1/13), polydipsia and polyuria (1/13), and purulent vulval discharge (1/13). All dogs were evaluated at the MJR-VHUP without a history of previous biliary disease or having undergone previous biliary surgery.

Clinicopathologic findings—Results of a CBC were available in 12 of 13 dogs. Eight of 12 dogs were anemic. Overall, 7 of 12 dogs had neutrophilia, 5 of which had a degenerative left shift indicated by a high band neutrophil count. Nine of 12 dogs had monocytosis (Table 1).

A complete serum biochemical panel was available for all dogs. Serum activities were high for alanine aminotransferase in 12 of 13 dogs, aspartate aminotransferase in 11 of 13 dogs, alkaline phosphatase in all dogs, and γ-glutamyl transferase in 10 of 13 dogs. Twelve of 13 dogs had high total bilirubin concentration. Cholesterol concentration was greater than reference range in 11 of 12 dogs. Six of 13 dogs had low serum albumin concentration before surgery. Three of 13 dogs were azotemic before surgery (Table 1).

The 1-stage prothrombin time and the activated partial thromboplastin time were within reference range in all 9 dogs tested before surgery. Fibrin degradation product concentration was greater than reference range in 3 of 9 dogs.

Diagnostic imaging—Thoracic radiographs were taken in 9 of 13 dogs. In 2 dogs, there was evidence of lung consolidation suspected to be associated with aspiration pneumonia. Abdominal radiographs were performed in 4 of 13 dogs. One dog had evidence of peritoneal effusion. One dog had evidence of a tubular fluid-filled viscus in the caudal portion of the abdomen associated with pyometra. Two dogs had hepatomegaly.

Abdominal ultrasonography was performed in 11 of 13 dogs. Common bile duct distension was seen in 8 dogs. Gallbladder distension was seen in 7 dogs, with wall thickening in 5 dogs. Gas in the gallbladder was seen in 2 dogs, and choledoliths were visualized in 1 dog. One dog subsequently had a diagnosis of a gallbladder mucocele with a typical stellate pattern caused by gelatinous bile in the lumen of the gallbladder. Hepatomegaly was diagnosed in 5 dogs. Seven dogs had an irregular hypoechoic pancreas suggestive of pancreatitis. Two dogs had a space-occupying lesion at the location of the major duodenal papilla; at surgery, 1 of these 2 dogs had a 5 × 5 × 5-cm mass of chronic inflammatory tissue located adjacent to the papilla and the other had a duodenal abscess involving the papilla.

Microbiologic findings—Of 6 dogs in which aerobic bacteriologic cultures of the gallbladder were performed, only 1 had positive results consisting of Escherichia coli and an Enterococcus sp. All 6 anaerobic cultures yielded negative results. Of 5 dogs in which bacteriologic culture of bile was performed, only 1 had positive results on anaerobic culture (Staphylococcus intermedius). No aerobic bacteriologic cultures of bile yielded growth. Two of 4 dogs had positive results of

### Table 1—Laboratory variables (median [range]) before surgery in 13 dogs treated for EHBO with biliary stents

<table>
<thead>
<tr>
<th>Variable</th>
<th>Preoperative</th>
<th>Reference range</th>
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<tbody>
<tr>
<td>Hct (%)</td>
<td>38.7 (19–48)</td>
<td>40.3–60.3</td>
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<tr>
<td>WBCs (× 10³/μL)</td>
<td>22.5 (8.5–50)</td>
<td>5.3–19.8</td>
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<td>Neutrophils (× 10³/μL)</td>
<td>18.5 (6.13–42)</td>
<td>3.1–14.4</td>
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<td>Band neutrophils (× 10³/μL)</td>
<td>0 (0–4,100)</td>
<td>0–0.2</td>
</tr>
<tr>
<td>Monocytes (× 10³/μL)</td>
<td>2.1 (0.99–3.29)</td>
<td>0.1–1.4</td>
</tr>
<tr>
<td>Alkaline phosphatase (U/L)</td>
<td>4,090 (207–8,383)</td>
<td>20–155</td>
</tr>
<tr>
<td>Alanine aminotransferase (U/L)</td>
<td>750 (61–3,141)</td>
<td>16–91</td>
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<tr>
<td>γ-Glutamyl transferase (U/L)</td>
<td>89 (5–233)</td>
<td>7–24</td>
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<tr>
<td>Aspartate aminotransferase (U/L)</td>
<td>199 (46–498)</td>
<td>22–250</td>
</tr>
<tr>
<td>Total bilirubin (mg/dL)</td>
<td>9.8 (0.4–73.1)</td>
<td>0.3–0.9</td>
</tr>
<tr>
<td>Cholesterol (mg/dL)</td>
<td>512 (250–1,014)</td>
<td>128–317</td>
</tr>
<tr>
<td>Albumin (g/dL)</td>
<td>2.6 (1.2–3)</td>
<td>2.5–3.7</td>
</tr>
<tr>
<td>BUN (mg/dL)</td>
<td>9 (4–211)</td>
<td>5–30</td>
</tr>
<tr>
<td>Creatinine (mg/dL)</td>
<td>0.85 (0.5–10)</td>
<td>0.7–1.8</td>
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aerobic bacteriologic culture from the pancreas that yielded *E coli* and *Enterococcus* sp. None had anaerobic growth. One of 2 dogs had anaerobic growth of non-hemolytic *Streptococcus* sp from bacteriologic culture of hepatic parenchyma.

**Surgical time**—Median duration of surgical procedures was 3 hours and 30 minutes with a range of 2 hours and 25 minutes to 6 hours and 45 minutes. Median total duration of anesthesia was 5 hours and 15 minutes with a range of 3 to 7 hours and 45 minutes.

**Surgical pathologic findings and treatment**—In 10 dogs, stents were placed as a result of EHBO. At surgery, 6 dogs had pancreatitis with inflammation and edema occluding the major duodenal papilla. One of these dogs also had a pancreatic abscess adjacent to the terminal part of the common bile duct. Debridement of necrotic tissue and stent placement into the major duodenal papilla through a duodenotomy incision, as described, were performed in all 6 dogs. One dog had a mass of chronic inflammatory tissue in the area of the papilla, causing EHBO. One dog had a duodenal abscess obstructing the major duodenal papilla, which was debrided and lavaged. Stent placement occurred 3 days after a biliary mucocele was treated by use of cholecystectomy in a dog that had persistent evidence of biliary obstruction after the first surgery. The EHBO was caused by chronic cholangiohepatitis in a dog that also had inflammatory bowel disease.

Two dogs had ruptures in the common bile duct; 1 dog had necrotizing cholecystitis associated with cholelithiasis and a tear in the common bile duct with secondary bile peritonitis. Primary repair of the common bile duct, cholecystectomy, and stent placement across the site of repair were performed. This dog needed another surgery 4 days later to resuture the site of primary repair in the common bile duct, which was leaking. The second dog also had a tear in the common bile duct associated with cholelithiasis. This dog underwent cholecystotomy for cholelith removal as well as primary repair of the common bile duct and stent placement.

In the final dog, a stent was placed after exploratory laparotomy for a pyometra revealed a perforated duodenal ulcer. The gastro-duodenoanostomy (Billroth I procedure) that was performed required suturing directly adjacent to the intramural bile duct, and a stent was placed in the common bile duct as a prophylactic measure to avoid swelling-induced cholestasis after surgery. In addition to the procedures described, a jejunostomy tube was placed at the time of surgery in 4 dogs.

**Stents**—In all dogs, red rubber catheters were used as choledochal stents. The size of the catheter was recorded in 9 of 13 dogs. Eight- (n = 4 dogs), 5- (3), 10- (1), and 12- (1) F catheters were used. In 12 of 13 dogs, absorbable suture material (chromic catgut or polydioxanone) was used to suture the stents to the duodenal submucosa. In the remaining dog the stent was sutured in place with polypropylene. The stents were passed in the feces in 4 dogs from 1 to 11 months after surgery. Stent passage was not detected directly by any owners, but stents were confirmed to be absent on abdominal radiography at follow-up examination. Four dogs were euthanized within a week after surgery, and the stents had not passed at the time of death. In 3 dogs, the fate of the stent was unknown.

In 1 dog that was euthanized 5 months after surgery because of a humeral osteosarcoma, the stent was still in place at necropsy. This stent had been sutured to the duodenal wall with polypropylene because a large mass of inflammatory tissue at the major duodenal papilla was presumed by the surgeon to be neoplastic, and the stent was placed as a long-term palliative measure. Histologically, there was moderate to severe fibrosis in the wall of the common bile duct with a lymphoplasmacytic cellular infiltrate. In this dog, the stent appeared to have been well tolerated for the 5 months it was in place and it is unknown whether the histologic changes were the result of the stent or were residual from the previous episode of EHBO.

In 1 dog, the stent was removed endoscopically 10 months after surgery because the dog was having episodes of pyrexia of unknown origin. However, at the time of stent removal, serum liver enzyme activities were within reference ranges and the signs were not thought to be related to the stent. After visualizing the stent exiting the major duodenal papilla, bile could be seen exiting the papilla around the outside of the stent. An endoscopic forceps was used to extract the stent from the common bile duct. The stent was then pulled out as the endoscope was removed. In this dog, the stent was presumably held in place by adherence to the wall of the common bile duct because the sutures originally placed were no longer visible. In 2 dogs in which stents were recovered after having been in place for 5 months (recovered at necropsy) and 10 months (recovered endoscopically), the lumen of the stents was occluded but bile was flowing freely around the stent and no evidence of EHBO was present. Of dogs that survived the perioperative period, in which stents were placed with absorbable sutures and the fate of the stents was known, 4 of 5 dogs passed the stents in the feces after surgery.

**Postoperative outcome**—Four of 13 dogs died within 1 week of surgery. In 3 of these 4 dogs, hyperbilirubinemia did not resolve after surgery; 1 dog developed necrotizing pancreatitis and underwent a partial pancreatectomy but was euthanized because of respiratory distress syndrome 1 day after the second surgery; 1 dog developed severe azotemia and was euthanized 3 days after surgery and found to have severe pancreatic necrosis and bilateral pyelonephritis with acute tubular necrosis at necropsy; 1 dog developed a pancreatic abscess and underwent a second exploratory laparotomy 6 days after initial stent placement but was euthanized shortly after the second surgery because of sepsis. In the 2 dogs that required a second surgery, the bile duct stent was still patent because bile was evident exiting at the major duodenal papilla. In the remaining dog that died in the first post-surgical week, bilirubin concentration decreased from
73.1 to 21.5 mg/dL, but the dog was euthanized 3 days after surgery because of probable development of a pulmonary thromboembolism, although this was not confirmed by necropsy.

Nine dogs were discharged from the hospital and made a full recovery from their episodes of EHBO. In all of these dogs, bilirubin concentration decreased rapidly after surgery (in 1 dog hyperbilirubinemia was not present before surgery). No recurrence of obstruction occurred in these dogs while the stents were in place. Mean follow-up time from surgery to last owner contact was 13.3 months (range, 4 to 24 months). In the 1 dog in which endoscopic stent removal had been performed, a recurrence of EHBO with gallbladder rupture caused by cholangitis occurred 9 months after stent removal. After cholecystectomy, the dog made a full recovery. One dog was euthanized because of osteosarcoma 5 months after stent placement. One dog died of unknown causes 16 months after stent placement. The remaining 7 dogs were alive at the time of this study.

Discussion

In the veterinary literature to date, there are only a few case reports discussing the use of stents as an aid to the management of biliary tract disease. In most cases, T-tube stents were used because of biliary tract trauma.

Biliary rerouting procedures, such as cholecysto-duodenostomy and cholecystojejunostomy, have been used successfully for EHBO or biliary trauma but result in permanent alteration of the normal anatomic features of the extrahepatic biliary tract and can be associated with a number of complications. There is a paucity of information in the veterinary literature documenting the complication rate in a large number of cases, presumably because of the infrequent occurrence of these diseases. In 1 report of 60 dogs that underwent various biliary tract surgeries, no significant difference in outcome was detected between dogs treated with cholecystoenterostomies versus other surgical procedures, although nonfatal complications were not reported and no dogs were treated with biliary stents. In a study of cats, ascending cholangiohepatitis has been detected after cholecystoenterostomy. In the study reported here, no conclusive evidence of ascending cholangiohepatitis, reobstruction, structure formation, or other complications occurred while the stents were in place for a median period of 13.3 months. In 1 dog, obstruction of the cystic duct led to acute cholecystitis and gallbladder rupture 9 months after endoscopic stent removal. Although no complications were seen while the stents were in place, the authors consider that these complications could occur if the stents remain in place for a considerable time after surgery. Long-term follow-up of a greater number of dogs will be required to discover whether these complications occur with any frequency.

Surgical mortality rate in this study was 31%, which is similar to or lower than that in several other reports of dogs undergoing biliary tract surgery. Case numbers were inadequate to meaningfully evaluate any potential effect on perioperative mortality rate of decreased surgery or anesthesia time by placing a stent versus performing a cholecystoenterostomy. However, biliary stenting may represent an alternative, less complicated surgical option for management of diseases of the extrahepatic biliary tract and may prevent some peri- and postoperative complications in the future. Greater case numbers will be required to investigate this question further.

Red rubber catheters were used in the present study simply because they were available in a variety of sizes to accommodate the variable diameter of the common bile duct, which depends on the size of the dog and the degree of dilatation of the duct. The ideal features of a cholecdochal stenting material for dogs are unknown. In humans, much debate surrounds the use of self-expanding metal stents versus polyethylene stents. Metallic stents are patent for a longer period in humans with malignancies of the distal portion of the bile duct; however, they are difficult to remove either endoscopically or surgically after they are placed. Polyethylene stents have a 30% rate of occlusion with biliary sludge, however, these stents can be exchanged easily via endoscopy. Several experimental studies in dogs have evaluated the long-term efficacy of covered and uncovered metallic endoprostheses, although those studies did not use a model of EHBO. In the 2 dogs in the present study in which stents were retrieved after having been in place for 5 and 10 months, respectively, lumina were occluded in both instances. However, in both dogs, bile was flowing freely through the common bile duct and out into the duodenum around the stent and no clinical evidence of EHBO was apparent. Research reveals that protein adsorption to the stent wall followed by adherence of bacteria, plant, and food material, partly through duodenobiliary reflux, results in development of a protein biofilm that slowly narrows the luminal diameter of the stent until complete occlusion occurs. In canine patients, this may not be as serious a problem as in humans because most dogs in this study were being treated for potentially reversible disease processes, such as acute pancreatitis, biliary tract trauma, and biliary mucocele, which rarely recur. Thus, short-term decompression of the biliary tract is likely to be adequate in most dogs. Most humans are being treated for either bile duct strictures secondary to alcohol-related chronic pancreatitis or malignancies that require long-term decompression. Therefore, it is likely that in dogs, the use of nonmetallic stents may be preferable for most situations because they may pass in the feces more readily or be easily removed endoscopically.

In this study, the stents were sutured to the duodenal walls with absorbable suture material in all but 1 dog. In that dog, a large mass of firm tissue located adjacent to the major duodenal papilla was assumed to be neoplastic, so the stent was sutured in place with polypropylene with the assumption that it would be there purely as a palliative measure. In the other dogs, eventual suture dissolution, duodenal peristalsis, and passage of the stent in the feces were anticipated. This occurred in 4 of 5 dogs in which the fate of the stent could be confirmed. It appears that in some dogs, the stents are held in place simply by adhesion to the wall.
of the common bile duct or duodenum; this occurred in 1 dog in which the stent was removed endoscopically 10 months after surgery. Subsequently, consideration should be given to removing the stent endoscopically after 3 to 6 months if all evidence of the underlying disease process has resolved and the stent was not placed for palliation of malignancy. This was easily performed in the 1 dog in which it was attempted. The endoscope was passed into the descending duodenum, where the stent was visualized exiting the major duodenal papilla. The stent can be grasped either with an endoscopic biopsy forceps or a snare, after which it can be allowed to pass out in the feces or be recovered per os. Stent removal may also prevent bacterial colonization and inflammatory changes in the extrahepatic ducts that resulted from an indwelling transpapillary stent in a canine model.16

Obstruction to flow of bile in the peripancreatic portion of the common bile duct caused by acute pancreatitis was the most common reason for the use of biliary stents in this report. Biliary rerouting techniques would also have represented an acceptable form of management in these dogs. The advantage of using a stent is that, if bile flow can be maintained for as long as it takes for the pancreatic inflammation, edema, or abscess to be treated, the dog can make a full recovery with no alteration to the normal anatomic features of the biliary tract, and in our experience, recurrence is rare. In this study, only 3 dogs had no serum biochemical evidence of resolution of biliary obstruction after surgery. These 3 dogs died 2 to 6 days after surgery, and 2 of them had a patent biliary tract with bile flow around the stent at the second laparotomy. The reason for sustained hyperbilirubinemia and high serum enzyme activities indicating cholestasis was unknown. Possible causes were severe intrahepatic biliary stasis, hepatic necrosis, or hemolysis of host or transfused erythrocytes. Another consideration is whether the stenting procedure could have led to the progression from pancreatitis to pancreatic necrosis or abscess formation. Retrograde flushing of the pancreatic duct is possible when attempting to pass the stents, and care should be taken not to enter the pancreatic duct, if possible. It is also possible that some degree of pancreatic inflammation, edema, or abscess formation could play a role in the progression of pancreatitis. The authors consider this unlikely because of the bile flow seen around the stents and the considerable communication of pancreatic drainage between lobes in the dog.17 In addition, the principle conduit for exocrine pancreatic drainage in dogs is the accessory pancreatic duct exiting at the minor duodenal papilla, which is unaffected by the stenting procedure.18 Of dogs with pancreatic disease in our study, 3 of 6 died in the postoperative period. In another study19 in which mortality rates in a cohort of dogs that underwent a variety of surgical procedures for management of biliary disease were reported, death occurred in 6 of 12 dogs with underlying pancreatic disease and was higher than with any other underlying etiology. Although in neither study a significant difference in mortality rate in dogs that underwent surgery because of pancreatic disease was detected, compared with other causes, it may be reasonable to advise owners that prognosis in such cases is guarded.

In 2 dogs in this study, tears to the common bile duct associated with cholelithiasis were managed by primary repair of the duct, followed by stent placement. Both of these dogs had a favorable outcome, although in 1 dog, reoperation was required to resuture the initial primary repair in the common bile duct because of dehiscence. No evidence of clinically relevant strictures developing after passage of the stent has been detected in either dog. Neither dog, however, had a postoperative cholangiogram to assess duct narrowing at the site of previous rupture. It is unknown what effect the presence of the stent has on the quality of healing of the common bile duct wall.

Stent placement was performed 3 days after a biliary mucocele was treated via cholecystectomy in a dog that had persistent evidence of biliary obstruction after the first surgery. The authors now routinely flush out the common bile duct in dogs with biliary mucoceles to ensure that all thick gelatinous bile has been removed. In uncomplicated cases, routine placement of a biliary stent after cholecystectomy for a biliary mucocele is unnecessary and not advocated because reconstruction represents a rare complication of mucocele management.20

The authors consider the following to be potential indications for choledochal stenting in dogs: short-term stenting for reversible disease processes; internal support after the primary repair of biliary trauma; palliation of malignancy; and, possibly, drainage of the obstructed biliary tract prior to definitive surgical management in patients that are severely compromised. Short-term management of reversible disease was the most common indication for stenting in the dogs in this study. Although stents have been used successfully as a support for primary repair of common bile duct tears, benefits of the stent are still unknown.6,10 Randomized controlled studies are required to evaluate the potential benefit of primary repair versus primary repair with stent support and what effect the stent has on incidence of dehiscence or postoperative stricture formation. Although none of the dogs in this study had malignant disease, this is a major cause of extrahepatic biliary tract obstruction in dogs.7 Pancreatic adenocarcinoma and bile duct carcinoma are the most common causes of malignant obstruction in dogs. These dogs may be in a compromised state and will usually have a guarded prognosis because most malignancies in this area are of an aggressive nature with high metastatic potential. Choledochal stenting may provide a less invasive and less time-consuming option for palliation of malignancies, compared with rerouting procedures. Preoperative biliary drainage is frequently advocated in humans who are systemically compromised to allow preoperative stabilization prior to definitive surgery for any kind of obstructive biliary disease. This is most frequently performed endoscopically or via a percutaneous approach and reduces intraoperative morbidity rate in some studies21,22 but not in others.23,24 The development of endoscopic retrograde cholangiopancreatography in dogs may represent a helpful, minimally invasive modality for investigation of diseases of the extrahepatic biliary tract as well as making endoscopic choledochal stent placement possi-
Endoscopic stent placement may prove helpful in decreasing anesthetic time, complications that arise from surgical stent placement, morbidity rate, and mortality rate.

References