

Rocky Top's Rock Collection

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Introduction

Cholelithiasis is uncommon in cats and even more infrequently causes an obstruction. Many different factors can predispose cats to cholelith formation including abnormal biliary motility, abnormal bile composition, or biliary infection⁵. Choleliths can also be linked to several disease processes. Cholelithiasis in cats is most commonly linked to cholecystitis, cholangiohepatitis, and pancreatitis⁶. In many cases, it can be difficult to determine if choleliths are the result of a disease process or if they are the cause. In cats, choleliths are most commonly reported as calcium carbonate or calcium-bilirubinate stones⁸. On presentation, cats with choleliths may have the following clinical signs: vomiting, anorexia, icterus, lethargy, fever, and abdominal pain⁸. However, these signs may be more directly related to the primary cause of the cholelith rather than the stone itself. Though choleliths can be associated with a guarded prognosis, especially when obstructive, they may also be an incidental finding in cats⁶.

History and Presentation

Rocky Top is an approximately 16-year-old, male, neutered, Domestic Shorthair cat that presented to his primary veterinarian on February 29, 2020. He had a 1-day history of vomiting, lethargy, and anorexia. At this visit it was noted that Rocky Top had lost 4.4 lbs (2 kg) since his previous visit in June of 2019 which was a third of his bodyweight. At this visit a grade 2/6 parasternal heart murmur was also auscultated. His primary veterinarian administered subcutaneous fluids and maropitant at this time.

On 3/3/2020, after showing no improvement, Rocky Top presented to an emergency clinic where the primary diagnostic performed was an abdominal ultrasound. The findings were suspicious of a biliary obstruction, so he was subsequently referred to MSU-CVM Internal Medicine Service. On presentation, Rocky Top was irritable, alert, and responsive. He was

normothermic with a temperature of 100.4°F and had a slightly elevated pulse and respiratory rate which were 200 bpm and 40 brpm respectively. No heart murmur was noted at this time. Rocky Top was thin with a body condition score of 3/9. The iris of his right eye was copper colored with underlying green pigmentation, and there was mild icterus of his sclerae and pinnae. He was tense and moderately painful on abdominal palpation. The remainder of his physical exam was unremarkable.

Diagnostic Approach

Initial diagnostic workup at Rocky Top's primary veterinarian included a chemistry panel, total t4 levels, a complete blood count (CBC), FeLV antigen and FIV antibody tests. His chemistry panel revealed several elevations: ALT at 436 IU/L (10-100 IU/L), bilirubin at 1.4 mg/dL (0.1-0.4 mg/dL), and glucose at 243 mg/dl (64-170 mg/dL). Cats with cholelithiasis commonly present with elevated ALT, ALP, AST, GGT, and bilirubin². A stress leukogram was noted on his CBC. A sendoff free T4 test was performed as his total t4 was at the higher end of the reference range for a cat. The free T4 levels later came back consistent with hyperthyroidism. Both FeLV and FIV tests were negative. Upon presentation to MSU-CVM, a repeat chemistry panel was performed that showed an elevated ALT at 451 U/L (7-60 U/L), ALP at 48 U/L (10-42 U/L), bilirubin at 3.0 mg/dL (0.1-0.5 mg/dL), and CK at 406 U/L (50-225 U/L). A coagulation profile was also performed at this time and was within normal limits. A coagulation panel should be performed as extrahepatic bile duct obstruction as well as liver disease can cause a deficiency in vitamin K-dependent clotting factors².

Abdominal radiographs were performed which revealed several mineral opaque structures consistent with cholelithiasis and choledocholithiasis, as well as biliary tree mineralization. As most choleliths in cats contain calcium, they are radiopaque. Therefore, the

presence of choleliths can be diagnosed via abdominal radiographs. Since choleliths may be an incidental finding, an abdominal ultrasound can be used to evaluate the biliary system for dilation, integrity, or thickening. Dilation of the common bile duct greater than 5mm suggests extrahepatic bile duct obstruction, with the upper limit in healthy cats being 4mm⁸. An abdominal ultrasound was performed at an emergency clinic prior to Rocky Top's presentation to MSU-CVM. A choledocholith was noted at the duodenal papilla measuring 4.5mm and several choleliths were within the gallbladder lumen. It is important to assess the integrity of the gallbladder as a gallbladder rupture requires immediate surgical intervention. Serial ultrasonographic exams may be needed to determine if an obstruction is present.

Ultrasonography is the best and most cost-effective method of evaluating the biliary system in cats, with 85% accuracy at diagnosis of extrahepatic bile duct obstructions³. If ultrasonographic exams cannot confirm an obstruction, hepatobiliary scintigraphy may be used. It is more accurate than ultrasound for diagnosis of extrahepatic bile duct obstruction. However, it is limitedly available and requires multiple scans over a 24-hour period in which the patient is radioactive².

Bile cytology and culture should be performed whenever possible to determine which antibiotic therapy, if any, is warranted. Biopsies of the liver and pancreas may also be helpful to determine if any comorbidities are present that may affect medical management, such as cholangiohepatitis or pancreatitis. In Rocky Top's case, samples of the gallbladder and the right medial liver lobe were collected during surgery and were submitted for biopsy. Bile was also collected and submitted for culture. The biopsies revealed lymphoplasmacytic and fibrosing cholecystitis as well as lymphoplasmacytic and suppurative cholangiohepatitis. Increased neutrophils were also observed indicative of a concurrent bacterial infection. The bile cultured a

light growth of *E. coli* that was susceptible to enrofloxacin. *E. coli* is the most frequently cultured organism from the biliary tract².

After Rocky Top's surgery, repeated chemistry panels were performed on March 5, 2020 and March 9, 2020. The chemistry panel from March 5th revealed improving liver values, hypoproteinemia of 5.4 g/dL (6.5-8.4 g/dL), hypocalcemia of 7.0 mg/dL (8.2-10.6 mg/dL), and an elevated CK of 1860 U/L (50-225 U/L). The chemistry panel from March 9th revealed liver and calcium values within normal limits, hypoproteinemia of 6.0 g/dL (6.6-8.4 g/dL), and a mildly elevated CK of 296 U/L (50-225 U/L). The hypoproteinemia is likely due to anorexia and undergoing surgery. The hypocalcemia is likely due to a hypoproteinemia, surgery, and pancreatitis.

Pathophysiology

Choleliths form when bile is supersaturated and there is a nidus for crystallization⁵. Since choleliths are uncommon in cats, much of the pathophysiology behind this condition is extrapolated from other species. In cats, the extrahepatic biliary tract is more similar to humans than dogs as the common bile duct and the major pancreatic duct enter the duodenum at the major duodenal papilla. Since these ducts join, pancreatic and biliary disease often occur simultaneously. The predisposing factors for cholelithiasis can be sorted into three main categories: biliary infection, altered motility, and altered composition⁴. The link between inflammatory diseases and cholelithiasis is incompletely understood, but it is believed that these lead to swelling of the biliary ducts inhibiting normal motility². Altered motility and composition increase the likelihood that bile will become supersaturated. Unlike in dogs, experimental ligation of the common bile duct did not induce cholelith formation which suggests that bile sludge may be an incidental finding⁶.

Many of the disease processes that predispose cats to cholelithiasis can also be caused by cholelithiasis, which can make it difficult to determine the initial cause of cholelith formation. In Rocky Top's case pancreatitis, cholecystitis, cholangiohepatitis, extrahepatic bile duct obstruction, and hyperthyroidism can all be predisposing factors. Hyperthyroidism may have contributed to Rocky Top's cholelithiasis as it decreases the ratio of di- to mono- conjugated bilirubin which is less soluble in bile. In addition to altering bile chemistry, hyperthyroidism can also alter gallbladder motility⁵.

Treatment Options

Treatment options for cholelithiasis vary depending on comorbidities or biliary obstruction. Choleliths that are incidental or asymptomatic may be medically managed by treating the inciting cause. However, in Rocky Top's case where the choleliths become obstructive surgical intervention is required. There are two main surgical options that have been documented as treatment for obstructive choleliths: cholecystectomy or a cholecystoenterostomy. In this case, a cholecystectomy was performed with a duodenotomy to assess the patency of the common bile duct prior to gallbladder excision. For the cholecystoenterostomy, the gallbladder may be joined to either the duodenum or the jejunum. If there is evidence of necrosis or leakage at the site of the obstruction while the gallbladder appears healthy, a cholecystoenterostomy is preferred². A choledochotomy may need to be performed over the stone if there is an immovable cholelith within the common bile duct after repeated catheterization and flushing². Vomiting and anorexia are commonly seen in cats after biliary surgery, so an esophagostomy tube(E-tube) was placed to facilitate the administration of medications and provide nutrition until Rocky Top's appetite returned.

Medical management of choleliths varies but generally consists of antibiotics, pain management, and fluid therapy². In this case, Rocky Top was initially maintained on an intravenous constant rate infusion of fentanyl (3 mcg/kg/hr) before being transitioned to buprenorphine (0.01 mg/kg intravenously every 8 hours). His fluid therapy consisted of intravenous Plasmalyte (73 ml/kg/day then 46 ml/kg/day) as well as oral fluids through his E-tube. As his bile culture was susceptible to enrofloxacin, Rocky Top was administered pradofloxacin at 7.5 mg/kg orally every 24 hours to treat his cholangiohepatitis. Rocky Top was placed on maropitant (1 mg/kg intravenously every 24 hours), pantoprazole (1 mg/kg intravenously every 12 hours), and capromorelin (3 mg/kg orally every 24 hours) to manage clinical signs associated with concurrent pancreatitis that was noted during surgery. Until his appetite resumed, Rocky Top was fed a low-fat gastrointestinal diet as a slurry through his E-tube. Rocky Top was also administered vitamin K (2 mg/kg subcutaneously every 24 hours) and ursodiol (11 mg/kg orally every 24 hours) for hepatic support. Ursodiol replaces hepatotoxic bile acids and is choleric². In this case it was used for its immunomodulatory and anti-apoptotic properties.

Expected Outcomes and Prognosis

The prognosis for cholelithiasis is variable since choleliths may be the cause or the result of disease⁸. Unobstructed choleliths have a good prognosis if the underlying cause is treated appropriately. Obstructive choleliths are associated with a guarded prognosis as this requires biliary surgery. Biliary surgery in cats is associated with a 40% to 60% survival rate, with most of the reported mortality occurring perioperatively². Surgical intervention of an extrahepatic bile duct obstruction has been associated with the following perioperative complications: unresponsive hypotension, decreased myocardial contractility, acute renal failure, disseminated

intravascular coagulation, gastrointestinal hemorrhage, and delayed wound healing⁶.

Unresponsive hypotension is a common surgical complication for patients with obstructive jaundice. Though the pathophysiology behind this is not completely understood, it is theorized that systemic endotoxemia, increased production of nitric oxide, or vagal effects from manipulation of the biliary tract may decrease vascular responsiveness to vasopressors³. Biliary surgery is also associated with renal dysfunction, which is the most common postoperative complication⁷. Short term complications include anemia, hypotension, reobstruction, pancreatitis, and septic or bile peritonitis. Long term complications include reobstruction, cholangitis, exocrine pancreatic insufficiency, intermittent abdominal pain and diarrhea, and duodenal ulceration². Cholecystectomies have been associated with a lower morbidity and mortality rate compared to biliary diversion surgeries. In one study, 7/9 cats had a complete resolution of clinical signs and 1 had a mean follow-up time of 22 months⁴. Recurrence of cholelithiasis has been reported in cases where a cholecystectomy was not performed. Cholecystoenterostomies have been associated with exocrine pancreatic insufficiency if the pancreatic duct is inadvertently ligated, or ciliary cirrhosis and duodenal reflux if the stoma strictures or is too small⁴. If cats survive the perioperative period, the prognosis is usually good.

Rocky Top recovered from his cholecystectomy without complication and was discharged on March 9, 2020. He was sent home on buprenorphine, pradofloxacin, ursodiol, and maropitant. He was discharged with his E-tube in place as he had not yet regained his appetite. However, it was removed on March 24, 2020. His hyperthyroidism is currently being managed by his primary veterinarian with methimazole. According to his owner, Rocky Top has been gaining weight, and his activity level is better than it has been in years.

Conclusion

Cholelithiasis in cats is uncommon and rarely obstructive. Cats may present with vomiting, anorexia, lethargy, dehydration, fever, or icterus. Cholelithiasis may be diagnosed via radiographs, as most choleliths are radiopaque. However, ultrasonography is the diagnostic of choice for determining if an obstruction is present. Cholelithiasis may be the cause or the result of disease, so treatment and prognosis are variable depending on the underlying disease process. Treatment often includes surgery, antibiotics, fluid therapy, and pain management. Biliary surgery in cats has a guarded prognosis and is associated with several perioperative complications including unresponsive hypertension and renal dysfunction. Cholecystectomies are associated with a lower mortality and morbidity rate, as well as a lower likelihood of recurrence.

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