Septate gallbladder in a dog with cholecystitis: A case report and literature review

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Abstract: A 5-year-old, Yorkshire terrier was presented due to the acute onset of vomiting and diarrhoea. The imaging studies showed an abnormally separated gallbladder with a thickened wall, a tortuous common bile duct that contained hyperechoic materials. A cholecystectomy was performed because of the failure of the conservative management. The gallbladder was partially divided by a septum and communicated with the cystic duct. Histologically, the dog was diagnosed as having cholecystitis and choledochitis. To the author’s knowledge, this is the first clinical description of a symptomatic septate gallbladder in a dog. Although congenital gallbladder abnormalities are rare in animals, a septate gallbladder can predispose to an inflammatory biliary disease due to the abnormal bile flow.

Keywords: cholecystectomy; cholestasis; congenital abnormalities; gallbladder diseases

Embryologically, the liver develops from the hepatic diverticulum, which is distinguished into the pars hepatica (cranial part) and the pars cystica (caudal part). The gallbladder and the common bile duct (CBD) develop from the pars cystica (Causey et al. 2010). The pars cystica initially vacuolates to a hollow, then expands by the proliferation of the epithelial lining, which is later recanalised. It has been reported that a septate gallbladder can occur in the case of inappropriate vacuolisation (Mahato 2010). A septate gallbladder is a congenital hepatobiliary disorder which is occasionally identified in cats (Ergin et al. 2013), but rarely reported in dogs (Mircean et al. 2008). Symptomatic gallbladder malformations are rare in both dogs and cats. Thus, anatomic disorders of the gallbladder are usually determined at necropsy (Ergin et al. 2013).

This case described clinical and diagnostic features of a rare congenital gallbladder anomaly combined with symptomatic cholecystitis in a dog. The abnormal septum of the gallbladder is thought to contribute to cholestasis, which may be related to the associated clinical signs.

Case description

A 5-year-old, intact male, Yorkshire terrier (body weight, 2.3 kg) was referred because of acute intermittent vomiting and inappetence for 2 weeks. The dog was treated with antiemetics and antibiotics; however, there was no clinical improvement. On physical examination, the dog had an elevated body temperature (39.8 °C), abdominal pain and was mildly dehydrated. The results of the complete blood count test showed a haemoconcentration (haematocrit, 62.8%; reference, 37–55%). The results of the serum biochemistry profiles revealed...
increased hepatobiliary enzymes [alkaline phosphatase, 10.77 μkat/l, reference interval (RI), 0.33–2.59 μkat/l; alanine transaminase (ALT), 20.62 μkat/l, RI, 0.05–0.84 μkat/l; aspartate transferase (AST), 13.71 μkat/l, RI, 0.17–0.62 μkat/l; total bilirubin (T. Bil), 15.39 μmol/l, RI, 1.71–11.97 μmol/l and gamma glutamyl transpeptidase, 2.76 μkat/l, RI, 0.07–0.42 μkat/l]. The C-reactive protein concentration (37 mg/l, RI; 0–20 mg/l, Vcheck V200; Bionote, Hwaseong, Republic of Korea) was also elevated. The SNAP-cPL test (IDEXX Laboratories, Westbrook, Maine, USA) was negative. The thoracic radiographs showed a reduced luminal diameter of the caudal vena cava that was compatible with the volume depletion. Ultrasonography (US) was used to evaluate the hepatobiliary system. The gallbladder had a separate lumen that was divided by a septum (Figure 1A). The wall of the gallbladder was thickened with increased echogenicity. A cystic duct was enlarged. No other abnormalities were found on the abdominal US. A computed tomography (CT) examination was conducted to further identify the morphologic disorders of the gallbladder and nearby anatomic structures. The lumen of the gallbladder appeared to be completely separated by a septum (Figure 1B) and connected by an enlarged cystic duct. Small cystic duct calculi were visualised as a densely calcified structure (Figure 1C and 1D). A tortuous CBD without an obstruction was noted. Based on the test results, the dog was diagnosed as having a septate gallbladder with a cystic duct stone and cholecystitis. The dog was managed conservatively with intravenous fluid therapy (a balanced electrolyte solution), cefazolin sodium (22 mg/kg b.i.d., i.v., Cefozol Inj; Korus, Chuncheon, Republic of Korea), metronidazole (10 mg/kg b.i.d., i.v., Metrinal Inj; Daehan, Seoul, Republic of Korea), tramadol (3 mg/kg b.i.d., i.v., Maritrol Inj; Jeil, Seoul, Republic of Korea), vitamin K1 (1 mg/kg s.c., Phytonadione; Daehan, Seoul, Republic of Korea), and S-adenosyl-l-methionine [(SAMe); 20 mg/kg b.i.d., orally (p.o.); Zentonil, Vétoquinol, France] for 4 days. Abnormalities such as the haemoconcentration and elevated levels of ALT, AST, and T. Bil.
were mildly improved during the treatment; however, clinical signs such as inappetence and vomiting were not resolved and the other test results became worse. Because the conservative management was not effective in this dog, a cholecystectomy was decided upon as the next course of treatment.

The dog was premedicated with atropine sulfate (0.044 mg/kg s.c., Atropine Inj; Jeil, Seoul, Republic of Korea) and butorphanol (0.22 mg/kg i.v., Butophan Inj; Myungmoon, Seoul, Republic of Korea), and the anaesthesia was induced with propofol (5 mg/kg i.v., Provive Inj; Myungmoon, Seoul, Republic of Korea). Isoflurane (Isotroy, Troikaa, India) was used to maintain the anaesthesia with oxygen. A celiotomy was performed. The gallbladder was incised, and the bile was evacuated by flushing with 0.9% saline to prevent peritonitis. The gallbladder wall was grossly thickened and continued to the enlarged cystic duct (Figure 1E). The gallbladder was incompletely divided by a septum (Figure 1F).

The viscosity of the bile inside the gallbladder was increased, and the bile inside the smaller lumen was stagnant. Small cystic duct stones were removed, and a 3-Fr soft catheter without a stylet (Buster cat catheter; Kruuse, Langeskov, Denmark) was temporarily inserted into the gallbladder and the patency of the CBD was confirmed by the saline flushing. The test result of the bacterial culture from the bile was negative.

The histopathology showed that the large gallbladder wall had mucosal, muscular, and adventitial layers (Figure 2A). The mucosal layer had a simple columnar epithelium, which was necrotised and a haemorrhage was observed in the submucosal layer. The smaller gallbladder wall exhibited an abnormal epithelium, which was degenerated and replaced with cuboidal type cells with round nuclei. A mild fibroblastic proliferation was noted. In addition, a loss of the mucosal folds was noted when compared with the normal gallbladder wall (Figure 2B). The hypertrophy of the epithelium in the cystic duct was marked with an inflammatory response (mostly neutrophils and macrophages) (Figure 2C). Thus, this dog was diagnosed as having cholecystitis and choledochitis with septate gallbladder and cystic duct stones.

The laboratory abnormalities began to improve 2 days after the surgery. On the 5th day, the dog was discharged with cephalexin (30 mg/kg b.i.d., p.o., Medicephal cap; Korus, Chuncheon, Republic of Korea), metronidazole (10 mg/kg b.i.d., p.o., Flasinyl Tab; CJ Healthcare, Seoul, Republic of Korea), tramadol (3 mg/kg b.i.d., p.o., Tridol Cap; Yuhan, Seoul, Republic of Korea), SAMe (20 mg dog b.i.d., p.o.), and ursodeoxycholic acid (10 mg/kg b.i.d., p.o., Usosan Tab; Korea United Pharm, Seoul, Republic of Korea) for 2 weeks. The intermittent vomiting disappeared, and the decreased appetite was resolved 3 weeks after the surgery. The dog completely returned to normal in two months and no other abnormalities were noted during the 2-year follow-up period.

DISCUSSION AND CONCLUSIONS

The dog in the present case showed abdominal pain and vomiting which did not respond to the conservative treatments. The clinical signs of this
dog may be due to the cholecystitis and choledochitis with a predominantly neutrophilic inflammation.

However, the exact cause of the inflammation was not identified in this dog. Bactibilia could be the main cause of the inflammation, another pathology such as a non-infectious biliary tract or a gastrointestinal disease may be possible (Tamborini et al. 2016; Harrison et al. 2018). One study identified 30% of the suspected canine hepatobiliary disease showed to have a bile cytology and be culture-positive (Peters et al. 2016). According to another previous retrospective study (Harrison et al. 2018), the concurrent antibiotic treatments at the time of the liver or bile culture could have led to a false-negative culture result. In the present case, the dog already received conventional antibiotics and the culture of the bile failed to identify the causative agents. A concurrent hepatopathy, inflammatory bowel disease, and pancreatic problem were not identified in this dog. Thus, the pathogenesis of the cholecystitis and choledochitis in this dog remained unclear.

In this dog, a separated thickened gallbladder and a tortuously dilated cystic duct with small cystic calculi were observed. The bile was stagnant in one side. Based on these findings, cholecystitis with cholestasis was suspected in this dog. One study evaluated the relationship between the motility of the bile and bacterial cholecystitis (Lawrence et al. 2015). According to the study, an immobile biliary sludge was diagnosable for bactibilia (70% sensitivity and 100% specificity). The relationship between a septate gallbladder and cholestasis has been studied in humans. The abnormal septum can inhibit the gallbladder motility, which can result in an interruption in the flow of the bile (cholestasis) (Karaca et al. 2011). Furthermore, the septum separating the duct that connects both lumens can also cause cholestasis by itself (Mahato 2010).

In the veterinary literature, most of the gallbladder anomalies were asymptomatic, which were usually discovered incidentally. In dogs, this aberrant gallbladder malformation is quite rare and only one case of an incidentally found septate gallbladder was reported (Mircean et al. 2008) (Table 1).

<table>
<thead>
<tr>
<th>Signalment</th>
<th>Clinical signs</th>
<th>Biochemical findings</th>
<th>Ultrasound features</th>
<th>Disease progress</th>
<th>Reference</th>
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</thead>
<tbody>
<tr>
<td>Cocker Spaniel; 12Y, female</td>
<td>incidental finding (no clinical signs)</td>
<td>mildly elevated ALP and GGT</td>
<td>septate gallbladder</td>
<td>no information</td>
<td>Mircean et al. (2008)</td>
</tr>
<tr>
<td>Tabby cat; 5Y, male</td>
<td>loss of appetite, fatigue, weight loss, vomiting, icterus</td>
<td>leukopenia, hyperproteininaemia, markedly increased ALP, AST, bilirubin</td>
<td>bilobed gallbladder, extrahepatic biliary obstruction, cholangiohepatitis</td>
<td>choledochoduodenostomy, died on 16 days after surgery</td>
<td>Ergin et al. (2013)</td>
</tr>
<tr>
<td>Domestic shorthair cat; 5M, male</td>
<td>vomiting (caused by kidney disease)</td>
<td>metabolic acidosis, hypercalcemia, elevated creatinine</td>
<td>bilobed gallbladder, bilateral renomegaly with renal pelvic dilatation</td>
<td>died the day after presentation</td>
<td>Moentk and Biller (1993)</td>
</tr>
<tr>
<td>Domestic shorthair cat; 10Y, neutered male</td>
<td>inappetence, weight loss, pyrexia, distended abdomen</td>
<td>anaemia, leucocytosis, azotaemia, mild hyperbilirubinemia, hypoalbuminemia, hypocalcaemia, hypokalaemia, increase in AST and lipase</td>
<td>double gallbladder (duplex), gallstones, cholelithiasis, enlarged and hypoechoic pancreas, ruptured left gallbladder</td>
<td>choledochoduodenostomy, euthanised 72 hours postoperatively</td>
<td>Moores and Gregory (2007)</td>
</tr>
<tr>
<td>Domestic shorthair cat; 6Y, neutered male</td>
<td>acute vomiting, anorexia, lethargy</td>
<td>mild pre-renal azotaemia</td>
<td>suspicious of a bilobed or duplex gallbladder, diffuse hepatic hypoechoegenicity, hypoechoic mottling of the right limb of the pancreas</td>
<td>exploratory laparotomy, left cholecystectomy, doing well within 7 months follow-up</td>
<td>Woods et al. (2012)</td>
</tr>
</tbody>
</table>

ALP = alkaline phosphatase; AST = aspartate transferase; GGT = gamma-glutamyl transpeptidase
However, the incidence of gallbladder anomalies seems relatively common in cats (Otte et al. 2017). One anatomical literature review (Boyden 1926) reported an average of 1 in 8 cats (12.5%) have some type of gallbladder malformation, while another author suggested these anatomical variants are occasionally found in cats, but they are uncommon (Center 2009). When searching the clinical database for gallbladder anomalies in cats, one case of a bilobed gallbladder and two cases of a duplex gallbladder with accompanying clinical signs have been reported (Moore et al. 2007; Woods et al. 2012; Ergin et al. 2013) (Table 1). In these cases, cholangiohepatitis and an extrahepatic biliary tract obstruction (EHBO) could be the causes of the clinical signs. The EHBO causes cholestasis that can result in the CBD dilation (Center 2009; Ergin et al. 2013). Another case report described a cat with a bilobed gallbladder showing vomiting. However, the clinical signs were due to a kidney disease and the bilobed gallbladder was an incidental finding (Moentk and Biller 1993).

A cholecystography and a CT examination can provide an accurate visualisation of the gallbladder and biliary anatomy (Allan and Dixon 1975; Causey et al. 2010; Kim et al. 2019). In the present case, the ultrasonography showed a thickened gallbladder wall with a separated lumen and an enlarged cystic duct, but it was impossible to detect the small cystic calculi and the anatomic relationship between the two lumen and cystic duct. Thus, a further imaging examination could be helpful for the accurate diagnosis of the biliary system. A cholecystectomy is recommended for patients with a gallbladder inflammation with a septate gallbladder (Mahato 2010; Ergin et al. 2013).

In conclusion, biliary system abnormalities can be predisposing factors for bile stasis, inflammation, and cholelithiasis. Even though, congenital gallbladder abnormalities are rare in animals especially in dogs, the structural gallbladder anomaly can be considered as a differential diagnosis of dogs with non-specific gastrointestinal signs with abdominal pain. To the author’s knowledge, this is the first clinical description of a symptomatic septate gallbladder associated with cholecystitis in a dog.

**Conflict of interest**

The authors declare no conflict of interest.

**REFERENCES**


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