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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

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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

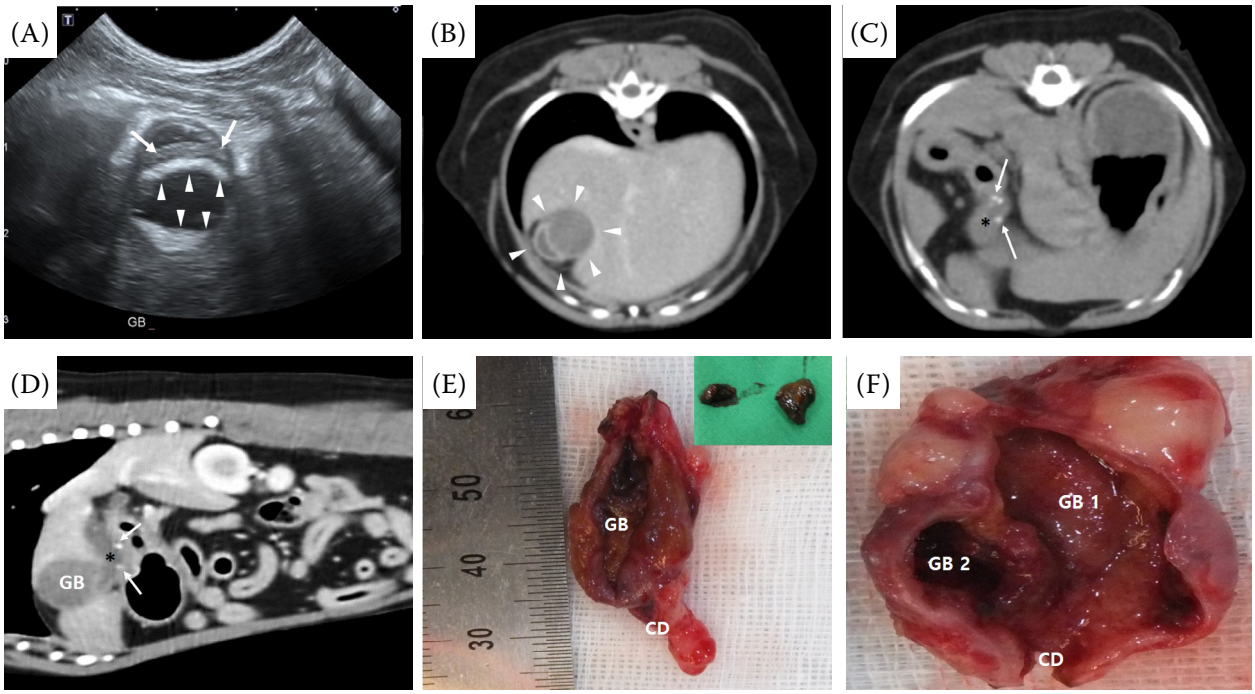

Figure 1. Image of the septate gallbladder in a dog with cholestasis

(A) Abdominal ultrasonography, transverse view of the gallbladder (GB), showed an abnormal structure separating gallbladder (arrows) and hyperechogenic linear structure along the wall of the gallbladder (arrowheads). (B) Transverse section of CT at the 7th thoracic vertebra level showed a well-defined, encapsulated round gallbladder (arrowheads); a curved hyper-attenuated structure was noted. (C&D) Small cystic duct calculi were visualized (arrows) and a tortuous common bile duct (asterisk) without obstruction was noted. (E) GB was thickened and partially divided as two lumens with a longitudinal septum. (F) Both gallbladders [larger lumen (GB 1) and smaller lumen (GB **2**)] shared the opening of cystic duct (CD). Immobilized stagnant bile was removed from GB 2 (insert on up right corner of Figure 1E)

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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

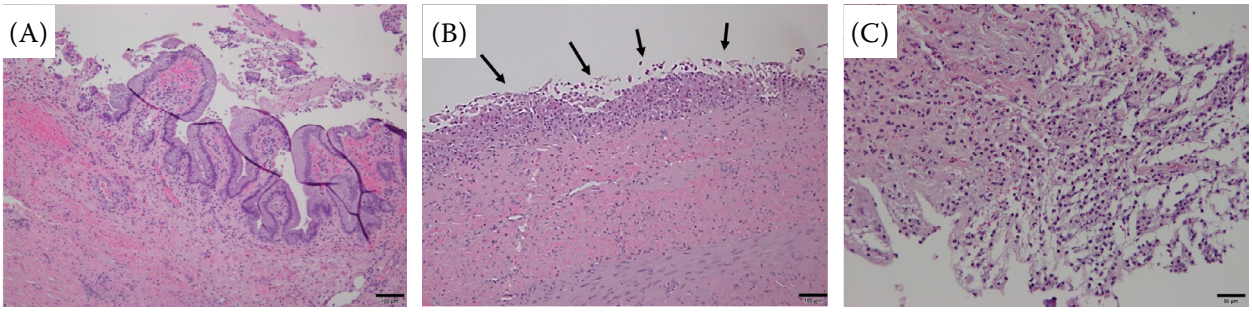

Figure 2. Histopathological images of both lumens of the septate gallbladder

Note the separate mucosal and smooth muscle layers fused in both large (A) and small (B) septate gallbladder lumen wall. (A) The larger gallbladder lumen wall still had mucosal folds with a simple columnar epithelium (H&E stain, bar = 100 μm). (B) However, the smaller gallbladder lumen wall showed a degenerated epithelium composed of cuboidal cells, loss of mucosal folds (arrow) (H&E stain, bar = 200 μm). (C) Hypertrophy of the epithelium in the cystic duct was marked with neutrophilic inflammatory response (H&E stain, bar = 50 μm)

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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 1. Summary of all the reported gallbladder anomaly cases in dogs and cats

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

ALP = alkaline phosphatase; AST = aspartate transferase; GGT = gamma-glutamyl transpeptidase

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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 (Moores and Gregory 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 etal. 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

Allan GS, Dixon RT. Cholecystography in the dog: The choice of contrast media and optimum dose rates. Vet Radiol Ultrasound. 1975 May;16(3):98-104.

Boyden EA. The accessory gall-bladder – An embryological and comparative study of aberrant biliary vesicles occurring in man and the domestic mammals. Amer J Anat. 1926 Nov;38(2):177-231.

Causey MW, Miller S, Fernelius CA, Burgess JR, Brown TA, Newton C. Gall bladder duplication: Evaluation, treatment, and classification. J Pediatr Surg. 2010 Feb;45(2): 443-6.

Center SA. Diseases of the gallbladder and biliary tree. Vet Clin North Am Small Anim Pract. 2009 May;39(3):543-98.

Ergin I, Senel OO, Sen Y, Bumin A. Bilobed gallbladder in a cat. Revue Méd Vét. 2013 Oct;164(10):453-6.

Harrison JL, Turek BJ, Brown DC, Bradley C, Callahan Clark J. Cholangitis and cholangiohepatitis in dogs: A descriptive study of 54 cases based on histopathologic diagnosis (2004–2014). J Vet Intern Med. 2018 Jan;32(1): 172-80.

Karaca T, Yoldas O, Bilgin BC, Bilgin S, Evcik E, Ozen S. Diagnosis and treatment of multiseptate gallbladder with recurrent abdominal pain. Case Rep Med. 2011;2011: 162853.

Kim D, Park S, Kim C, Yoon S, Choi J. Ultrasound-guided transhepatic computed tomography cholecystography in beagle dogs. J Vet Sci. 2019 Jul;20(4):e37.

Lawrence YA, Ruaux CG, Nemanic S, Milovancev M. Characterization, treatment, and outcome of bacterial cholecystitis and bactibilia in dogs. J Am Vet Med Assoc. 2015 May 1;246(9):982-9.

Mahato NK. Septate gallbladder: Gross and histological perspectives in an uncommon occurrence. Int J Anat Var. 2010 May;3(1):70-2.

Mircean M, Giurgiu G, Scurtu I, Popovici C, Kiss T. Observations regarding the comparative value of ultrasonography and laboratory diagnosis of hepatobiliary diseases in dogs. Bulletin UASVM Veterinary Medicine. 2008;65 (2):20-5.

Moentk J, Biller DS. Bilobed gallbladder in a cat: Ultrasonographic appearance. Vet Radiol Ultrasound. 1993 Sep; 34(5):354-6.

Moores AL, Gregory SP. Duplex gall bladder associated with choledocholithiasis, cholecystitis, gall bladder rupture and septic peritonitis in a cat. J Small Anim Pract. 2007 Jul;48(7):404-9.

Otte CM, Penning LC, Rothuizen J. Feline biliary tree and gallbladder disease: Aetiology, diagnosis and treatment. J Feline Med Surg. 2017 May;19(5):514-28.

https://doi.org/10.17221/108/2020-VETMED

Peters LM, Glanemann B, Garden OA, Szladovits B. Cytological findings of 140 bile samples from dogs and cats and associated clinical pathological data. J Vet Intern Med. 2016 Jan-Feb;30(1):123-31.

Tamborini A, Jahns H, McAllister H, Kent A, Harris B, Procoli F, Allenspach K, Hall EJ, Day MJ, Watson PJ, O'Neill EJ. Bacterial cholangitis, cholecystitis, or both in dogs. J Vet Intern Med. 2016 Jul;30(4):1046-55.

Woods KS, Brisson BA, Defarges AM, Oblak ML. Congenital duplex gallbladder and biliary mucocele associated with partial hepatic cholestasis and cholelithiasis in a cat. Can Vet J. 2012 Mar;53(3):269-73.

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