

# Gallbladder and Liver Lobe Torsion in a Young Cat Presented with Hemoabdomen

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## ABSTRACT

An 11 mo old domestic shorthair presented with acute lethargy. The cat was hypothermic and bradycardic and had pale pink mucous membranes, poor pulses, and a distended abdomen. Point-of-care ultrasound identified significant abdominal effusion, which was diagnosed to be a hemoabdomen. Bloodwork revealed hyperlactatemia, regenerative anemia, neutrophilia, hypoproteinemia, hypoalbuminemia, and increased alanine aminotransferase. The cat received an allotransfusion and a subsequent canine xenotransfusion and received further supportive therapy. After stabilization, abdominal ultrasonography diagnosed a gallbladder and liver lobe torsion with hemoabdomen. Exploratory laparotomy confirmed the torsion of the right medial and quadrate hepatic lobes together with the gallbladder. Cholecystectomy and lobectomy of the affected lobes were performed using a surgical stapler. The cat was discharged after 4 days. Histopathology confirmed hemorrhagic infarction of the liver lobes and gallbladder, consistent with the described torsion, and the hepatic pseudocyst. It also demonstrated a mucocele in the gallbladder. One month postoperatively, the cat had totally recovered. Hepatic lobe torsion without neoplasia is a rare disease in cats, with variable clinical signs. Gallbladder torsion is a hitherto unreported condition in cats. This is the first report of gallbladder and liver lobe torsion with secondary hemoabdomen in a cat, successfully treated by one-stage surgery. (*J Am Anim Hosp Assoc* 2021; 57:■■■-■■■. DOI 10.5326/JAAHA-MS-7090)

## Introduction

Gallbladder torsion is a rare condition in veterinary medicine, which has only been reported sporadically in dogs.<sup>1,2</sup> Gallbladder torsion without liver lobe torsion has been reported in one dog and is referred to as “wandering gallbladder” in humans.<sup>1</sup> Liver lobe torsion is also an uncommon finding.<sup>3-6</sup> Feline liver lobe torsions have been described in four cases to date.<sup>5-8</sup> Only one case revealed a hemo-peritoneum without evidence of neoplasia.<sup>8</sup> Clinical signs in companion animals appear to be variable and may be acute or chronic, vague and unspecific, or related to pain or bleeding and can vary from mild to collapse and sudden death.<sup>3-6</sup> All reported cases of feline liver lobe torsions occurred in adult cats, and none showed concurrent gallbladder torsion.

The liver is located in the cranial abdomen, protected from trauma by the rigid thoracic cage, and deeply fissured in dogs and cats, dividing it into four lobes (left, right, quadrate, caudate), four sublobes, and two processes (papillary and caudate). The gallbladder is located between the quadrate and the right medial lobes, partly attached and partly free.<sup>9-11</sup> The liver is loosely tethered to surrounding organs by a series of structures: caudate lobe to the right kidney with the hepatorenal ligament, the region of the porta hepatis to the lesser curvature of the stomach with the hepatogastric ligament and the proximal duodenum with the hepatoduodenal ligament.<sup>9-11</sup> This case report describes an uncommon presentation of a hemoabdomen in a young cat secondary to gallbladder and liver lobe torsion without evidence of neoplastic process, managed with

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ALP (alkaline phosphatase); ALT (alanine aminotransferase); AST (aspartate aminotransferase); GGT ( $\gamma$ -glutamyltransferase); POCUS (point-of-care ultrasound); RI (reference interval); TA (thoracoabdominal)

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blood transfusion and successfully treated by one-stage liver lobe lobectomy and cholecystectomy.

## Case Report

A 4.350 kg 11 mo old spayed female domestic shorthair was presented to the emergency service of Clinique Vétérinaire Universitaire de Liège University for evaluation of acute severe lethargy. The cat was found by the owners in lateral recumbency and an initial suspicion of trauma was expressed. On physical examination, the cat was hypothermic (32°C) and relatively bradycardic (150 beats/min) with pale pink mucous membranes, poor pulses, and a distended abdomen. The systolic blood pressure measured indirectly using a Doppler device was 50 mm Hg. All these parameters were consistent with a state of shock. Point-of-care ultrasonography (POCUS) identified significant abdominal effusion. Abdominocentesis yielded serosanguinous fluid consistent with a hemoabdomen (packed cell volume: 13%; total protein 70 g/L; erythrocytes on cytology). The bloodwork revealed a severe anemia (hematocrit of 9.8%; reference interval [RI], 30.3–52.3%), a reticulocytosis (158 K/ $\mu$ L; RI, 3–50 K/ $\mu$ L), a moderate neutrophilia ( $16.27 \times 10^3/\mu\text{L}$  [ $16.27 \times 10^9/\text{L}$ ]; RI,  $2.3\text{--}10.29 \times 10^3/\mu\text{L}$  [ $2.3\text{--}10.29 \times 10^9/\text{L}$ ]), a mild hypoproteinemia (53 g/L [5.3 g/dL]; RI, 57–89 g/L [5.7–8.9 g/dL]), a mild hypoalbuminemia (21 g/L [2.1 g/dL]; RI, 23–39 g/L [2.3–3.9 g/dL]), a hyperlactatemia (10.5 mmol/L; RI, 0.6–2.50 mmol/L), a significant increase of alanine aminotransferase (ALT; 432 U/L; RI, 12–130 U/L), a moderate hyperglycemia (2.93 g/L [293 mg/dL]; RI, 0.71–1.59 g/L [71–159 mg/dL]), and a hypokalemia (3 mmol/L; RI, 3.5–5.8 mmol/L). The cat's blood type was assessed using a commercially available immunochromatography test, indicating type A. Coagulation times were not measured at that time owing to insufficient sample availability.

The cat received supportive care, while an emergency transfusion of type A packed red blood cells using an 18 micron aggregate filter was performed (blood type A 3.75 mL/kg) over 30 min (7.5 mL/kg/hr), allowing for stabilization of the cat (temperature 37°C, heart rate 235 beats/min, systolic blood pressure 90 mm Hg). Rapidly thereafter, the cat's condition deteriorated again, with a systolic blood pressure of 60 mm Hg, only transiently responding to boluses of Hartmann's solution (10 mL/kg over 10 min) and hydroxyethyl starch 130/0.4 (5 mL/kg over 10 min). Ongoing abdominal hemorrhage was suspected, lactate concentration had decreased to 6.5 mmol/L, but meanwhile, the cat had a packed cell volume of 15%. Owing to a lack of compatible feline blood products, the cat received a second transfusion with canine packed red blood cells (DEA 1.1 negative). The cat received 13.5 mL/kg over 4 hr with a 200 micron blood filter. After transfusion, heart rate (200 beats/min), systolic pressure (100 mm Hg), temperature (38°C), and blood lactate

concentration (2 mmol/L) had normalized. Abdominal and chest radiographs showed a large right cranial abdominal mass with decreased serosal detail, suspected to be of hepatic origin. The lungs did not display any abnormalities, and there were no signs compatible with a diaphragmatic hernia, ribs fracture, pneumothorax, or pleural effusion, decreasing the suspicion of initial trauma with secondary hemorrhage.

Abdominal ultrasonography revealed a large volume of free echogenic fluid in the peritoneal cavity, generalized hyperechoic fat, and mild adenomegaly (**Figure 1**). A large hepatic cavitory lesion (8 × 6 cm) was observed within the right medial liver lobe. This cavitory lesion was well delineated by a thin hyperechoic wall and contained hyperechoic septae and biphasic hyperechoic fluid. Also, the right medial liver lobe was increased in size and diffusely heterogeneous with hypoechoic areas, and no vascularization was observed in this lobe at the Doppler examination. This abnormal lobe had little contact with other liver lobes. The gallbladder was abnormally located in the left cranial abdomen and its wall was thickened. Intrahepatic biliary ducts of the other liver lobes were visible, suggesting dilation of these ducts. The portal vein decreased in diameter at the level of the hepatic hilus. These images were consistent with a liver lobe torsion involving the gall bladder (**Figure 1**). Because of the hyperacute symptoms, the strong suspicion of an underlying acute liver lobe torsion, the near normal protein and albumin concentrations, and the results of the abdominal ultrasound, coagulation parameters were not controlled before surgery. The cat was premedicated with methadone<sup>a</sup> (0.1 mg/kg IV) and midazolam<sup>b</sup>



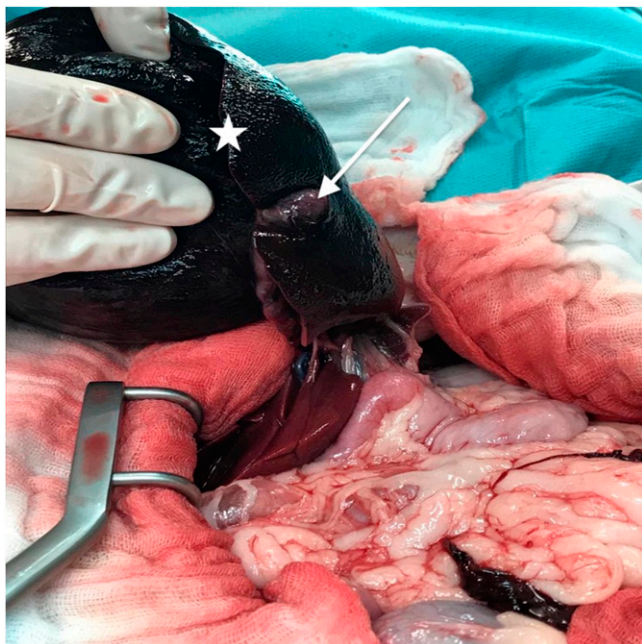
**FIGURE 1**

*Ultrasonographic image of the right medial hepatic lobe. Ultrasonographic image of the twisted, enlarged, heterogeneous right medial hepatic lobe. No flow could be observed on Doppler examination. Cranial to this lobe, free peritoneal echogenic fluid (F) is observed. Caudal to the diaphragm interface, note the normal hepatic (H) parenchyma. Diaphragm interface (I).*

(0.3 mg/kg IV), induced with alfaxalone<sup>c</sup> (0.5 mg/kg IV), and intubated, and anesthesia was maintained with isoflurane<sup>d</sup> in oxygen and a constant rate infusion of fentanyl<sup>e</sup>. Perioperatively, the cat received crystalloids (Hartmann's solution 5 mL/kg/hr). Exploratory laparotomy was performed, revealing a right medial and quadrate hepatic lobe and gallbladder torsion at the level of the cystic duct. The right medial hepatic lobe had the appearance of a large cystic hemorrhagic mass (**Figure 2**). Lobectomy of the affected lobes and cholecystectomy were performed at the level of the twisted vascular pedicle using a surgical stapler<sup>f</sup>. No other gross pathologic abnormalities were noted, and the abdominal cavity was routinely closed. The cat quickly and uneventfully recovered from surgery. Buprenorphine (15 µg/kg q 8 hr) was administered for 48 hr to provide postoperative analgesia, and cephalexin was administered prophylactically for 24 hr postoperatively. The cat was hospitalized for 4 days to screen for delayed transfusion reactions but was discharged without any signs of hemolysis or delayed reactions. Bloodwork before discharge demonstrated a regenerative anemia with a hematocrit of 21% and severe reticulocytosis (570 K/µL).

Histopathologic examination of the liver lobes confirmed a pseudocyst within the right liver lobe, hepatic hemorrhagic infarction with thrombi formation, and a gallbladder mucocele.

One month postoperatively, the cat had fully recovered, hematology was within normal limits, and ALT and aspartate aminotransferase (AST) were only slightly and nonsignificantly increased (ALT 139



**FIGURE 2**

*Intraoperative view. The twisted right medial and quadrate hepatic lobes (star) with the gallbladder (arrow).*

U/L; RI, 12–130 U/L and AST 63 U/L; RI, 15–51 U/L). In view of the cat's good general condition and hepatic values, ultrasonography was declined by the owner. One year after the surgery, the cat was doing well without any abnormalities reported by the owner.

## Discussion

Liver lobe torsion has previously been reported in four cats, with successful management in three.<sup>5,7,8</sup> Hemoperitoneum secondary to liver lobe torsion has been described in two cats, being associated with hepatocellular carcinoma in one case.<sup>6,8</sup> To the authors' knowledge, this is the first report of concurrent gallbladder and liver lobe torsion in a cat. This is the second case of hemoperitoneum secondary to liver lobe torsion without signs of neoplasia.<sup>8</sup> All cats previously described with liver lobe torsion were adult or elderly cats.<sup>5–8</sup> This is the first known report of an immature cat with a liver lobe torsion.

Liver lobe torsions are associated with a wide variety of clinical presentations. Anemia and hypovolemic shock may occur because of severe hemoabdomen, as reported in this case. Other common hematologic findings are neutrophilia and leukocytosis, due to endogenous glucocorticoid release<sup>3</sup> or due to inflammatory mediators leaking from the thrombosed/infarcted organs. Biochemical abnormalities are nonspecific and variable or compatible with hepatic injury. In this case, only ALT was significantly increased preoperatively, although AST was not measured. ALT and AST increase secondary to hepatocellular injury and altered cell membrane permeability. During obstruction of the biliary system (such as gallbladder torsion), alkaline phosphatase (ALP), ALT, AST, and  $\gamma$ -glutamyltransferase (GGT) may be increased, although ALP may be only moderately increased compared with ALT. Indeed, in the cat, the half-life of ALP is only 6 hr compared with 72 hr in dogs.<sup>12</sup> In this case, 1 mo after, the hepatic enzymes were only slightly and nonsignificantly increased. In light of the sudden deterioration of the cat's general state, the rapid identification of a hemoabdomen on POCUS, and the lack of any overt icterus, bilirubin was not assessed. Moreover, serum bilirubin levels usually have a poorer sensitivity than ALP and GGT in detecting cholestasis because localized cholestasis may increase ALP and GGT concentrations without any increases in serum bilirubin.

Blood lactate concentration was severely increased at presentation. Hyperlactatemia occurs particularly in shock because of a generalized decreased oxygen supply and anaerobic metabolism.<sup>12</sup> Regional hypoperfusion of the twisted liver lobes and decreased hepatic metabolism also may have contributed to the initial hyperlactatemia.

Coagulation times were not assessed in this patient, despite the confirmed hemoabdomen, as upon presentation insufficient sample

was obtained in an unstable patient. Upon stabilization, a strong suspicion of liver lobe torsion and acute hemoabdomen was identified. No other signs indicative of coagulopathy or hepatic dysfunction were identified. Moreover, the association of clinical coagulopathy with biliary tract disease, as seen in humans, has rarely been reported in cats, besides an increase in one-stage prothrombin time in 8 of 18 cats in one study.<sup>10</sup> Based on these factors, coagulation times were not assessed preoperatively. Nevertheless, the hemoabdomen and likely inflammatory state of this patient could also have been considered indications to assess coagulation preoperatively and after initial stabilization.

Hemoabdomen was rapidly detected on POCUS of the abdomen, a rapid and noninvasive procedure, realized during initial stabilization, with good sensitivity and specificity for the detection of free cavitory fluid, and allowing for rapid fluid aspiration and analysis.<sup>13</sup> Lisciandro and colleagues developed an abdominal fluid scoring system based on the number of positive sites and correlated patient fluid scores with the degree of anemia. A similar prospective study in 49 traumatized cats failed to find a correlation with the degree of anemia.<sup>14</sup> In this case, three of four sites were positive and the hematocrit was 9.6%.

The patient required multiple blood transfusions, the second being a canine xenotransfusion owing to unavailability of feline compatible blood and the urgency of the situation. The cat was monitored for acute and delayed immunologic or nonimmunologic reactions; however, adverse reactions were not observed. No severe acute adverse reactions have been reported in the literature for cats receiving a single transfusion with canine blood.<sup>15</sup>

Owing to the nonspecific clinical presentation, diagnostic imaging is required to diagnose liver lobe and gallbladder torsion. Abdominal ultrasonography identified a hypoechoic, mixed echogenicity mass, compatible with tissue infarction and necrosis secondary to lobe torsion. Doppler assessment can support the diagnosis of liver lobe torsion if the blood flow is decreased or absent within the hepatic vessels. In more chronic cases, echogenic foci with reverberation artefact or shadowing may be seen if gas-producing organisms are present. Abdominal fluid may accumulate secondary to necrosis, venous congestion, or bacterial peritonitis.<sup>16</sup> Multiple cyst-like areas continuous with the liver can be noticed. The main differential diagnosis for such complex ultrasonographic appearance is hemorrhagic or infected cyst, primary hepatobiliary or metastatic neoplasia, abscess or organizing hematoma, alveolar echinococcosis, or telangiectasis.<sup>16</sup>

Computed tomography and MRI have a high sensitivity in detecting liver lobe torsion.<sup>3,5,6</sup> In this case report, ultrasound images were compatible with a hepatic cyst, liver lobe and gallbladder torsion, and free peritoneal liquid. No further imaging appeared

indicated owing to the signalment of the patient (young cat), the acute history, and the strong suspicion on ultrasound.

In the cases described in the literature, two cats had left lateral liver lobe torsion, one had a papillary process of the caudate lobe torsion, and one cat had a hepatocellular carcinoma on the twisted right medial lobe. There is no obvious association between liver lobe torsion and hepatic masses.<sup>4,17</sup> A study with 42 dogs with hepatocellular carcinoma reported 1 dog with liver lobe torsion, whereas a second paper reporting 41 cats with nonhematopoietic hepatic neoplasia did not mention any case of liver lobe torsion.<sup>4,17</sup> The incidence of liver lobe torsion secondary to hepatic masses therefore appears to be low. In the cat described in this report, the authors still suspect the liver lobe torsion likely occurred secondary to the presence of the pseudocyst in the right medial lobe. Gallbladder torsion occurred because of anatomic relations with the twisted lobes. Findings on histopathologic evaluation described recent hemorrhagic infarction in the hepatic parenchyma, in contrast to chronic signs of the presence of the pseudocyst. Previous reports have suggested that the left lateral lobe is predisposed to torsion because of the laxity of the hepatogastric ligament, its large size, its mobility, and its anatomic separation from the other lobes.<sup>3,5</sup> Traumatic disruption of the left triangular ligament as a cause of liver lobe torsion has been described in a horse and in one dog with diaphragmatic hernia.<sup>6</sup>

Emergency celiotomy is recommended after initial stabilization. Repositioning of the lobe before removal is not recommended as it may lead to thromboembolism and/or release of toxins and oxygen radicals resulting in further compromise of the patient.<sup>1,3,6</sup> Treatment usually involves complete excision of affected lobes. Stapling was shown to offer the advantages of speed, simplicity, more complete excision, and reduced inflammation at the site of excision compared with blunt dissection and ligation.<sup>18</sup> Results of research in dogs suggest that surgical stapling is an efficient and safe method of lobectomy and is becoming the standard of care despite frequent use of ancillary methods to control minor hemorrhage.<sup>9,10,18</sup> Liver lobectomy with a thoracoabdominal (TA) stapler has been described as a safe procedure. Use of vascular staples like the TA 30-V3 provides optimum compression of the vasculature as it uses three staggered layers of staples compared with two layers in the standard TA cartridges.<sup>9</sup> Liver lobectomy in case of liver lobe torsion has a good prognosis if early management is instituted. However, the outcome of cats undergoing liver lobectomy has been negatively associated with abdominal effusion, preoperative anemia, or perioperative transfusions.<sup>19</sup>

Mortality for nondiversory biliary surgical procedures in cats appears low, although cases reported and follow-up times recorded are limited and short.<sup>20</sup> In this case report, the outcome was

favorable. Surgery was uneventful, without bile leakage and hypotension during anesthesia. Hypotensive events have a high reported perioperative prevalence during biliary tract surgeries in cats. It has not been associated with decreased prognosis, although the number of cases may be too low to confirm this.<sup>10</sup> The long-term outcome in this case was good and highlights the necessity of early diagnosis as bile leakage would probably have worsened the prognosis.

## Conclusion

This report describes the successful management of gallbladder and right medial and quadrate hepatic lobe torsion in a cat with secondary hemoabdomen, treated successfully by one-stage surgery. No evidence of hepatic or gallbladder neoplasia was highlighted. Gallbladder torsion is an extrahepatic biliary affection that was unreported so far in cats. ■

### FOOTNOTES

- <sup>a</sup> Comfortan; Eurovet Animal Health BV, Bladel, Netherlands
- <sup>b</sup> Midazolam Mylan; Mylan BVBA, Hoeilaart, Belgium
- <sup>c</sup> Alfaxan; Jurox Limited, Dublin, Ireland
- <sup>d</sup> Iso-Vet; Piramal Critical Care BV, Voorschoten, Netherlands
- <sup>e</sup> Fentanyl; Dechra Regulatory BV, Bladel, Netherlands
- <sup>f</sup> Thoracoabdominal V3 single-use stapler; Covidien, Dublin, Ireland

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