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Case Report

Gallbladder perforation following trauma in an 18-month-old child with a common bile duct cyst[☆]

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ABSTRACT

Gallbladder rupture caused by blunt abdominal trauma is an uncommon injury, particularly in children. This condition occurs even less frequently in children with common bile duct cysts. The history is difficult to obtain, the clinical symptoms are indistinct, and their assessment is obscured by a slew of other lesions. Radiography cannot produce clear images. Thus, the diagnosis is frequently delayed and confirmed only during surgery. Case reports of gallbladder injury after abdominal trauma are relatively rare and there are only 50 case reports in literature for 100 years. Herein, we present the case of an 18-month-old girl who had a ruptured gallbladder funnel due to blunt abdominal trauma caused by domestic violence, with an early clinical presentation of septic shock and chylous effusion. The patient underwent surgery after being diagnosed with chylous ascites that had not responded to medical treatment. Based on the findings, single-stage laparoscopic surgery is confirmed to aid in the diagnosis and treatment of gallbladder injury in the presence of a common bile duct cyst.

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Introduction

Gallbladder rupture after trauma in children has been widely reported in the literature since 1905, and its most common cause is traffic accidents [1]. The incidence of gallbladder injury among blunt and penetrating abdominal trauma was re-

ported as between 1.9% and 2.1% because of its location [1]. Gallbladder is protected by organs, ribs, and shock absorbance courtesy of the liver. Thus, the mechanism of rupture needs to be so hard like knife injuries, abdominal punches, kicks, or falls. We present a case of gallbladder funnel rupture with suspicion of domestic violence in a child with a previously undiagnosed common bile duct cyst. The clinical presentation be-

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Fig. 1 – Abdominal CT image showing abdominal effusion (*) and an edematous wall of the gallbladder ().**

gan with septic shock and progressed to chylous ascites (CA), both of which were unresponsive to medical therapy. Clinical examination is generally ineffective in identifying gallbladder injury in the presence of a common bile duct cyst. Only laparoscopic surgery can confirm the diagnosis.

Case report

An 18-month-old girl had a fever, loose stools, and vomiting episodes several times a day for 3 days before admission. In our general hospital, admitted pediatric patients with septic shock commonly receive intubation, mechanical ventilation, shock treatment, fluid resuscitation, and antibiotic treatment for 24 hours and are transferred to another children's hospital. In the present case, the patient weighed 11 kg and had many bruises on the abdomen, abdominal distension, and hemodynamic instability. Her vital signs were as follows: pulse rate: 180 beats/min, blood pressure: 60/20 mm Hg, and temperature: 38°C. The baby had acidosis based on the following arterial blood gas analysis results: pH: 7.098, pCO₂ level: 55 mm Hg, PaO₂ level: 46.6 mm Hg, HCO₃⁻ level: 16.5 mEq/L, BE: -13.1, and blood lactate level: 4.3 mmol/L.

Blood tests revealed anemia based on the following findings: Hb level: 6.3 g/dL, white blood cell count: 23,319/mm³, neutrophil count: 55%, and CRP level: 136 mg/L. She also had indirect hyperbilirubinemia (bilirubin level: 52.4/40.1 mmol/L), slightly elevated liver enzyme (AST level: 268 U/L and ALT level: 187 U/L), and amylase levels (1418 U/L), and decreased blood albumin level (20 g/L). Coagulation and platelet function were normal.

Abdominal ultrasound and CT revealed a large volume of hypoechoic fluid (Fig. 1), small left pleural effusion, and bilateral fundus consolidation. Brain CT showed appendage edema. The following laboratory findings were noted: lactate level: 3.8 mmol/L, protein level: 20 g/L, amylase level: 583 U/L, glucose level: 6.8 mmol/L, lipase level: 266 U/L, and LDH level:

1133 U/L; bacterial growth was not observed in the culture. Results exclude pleural transudates according to Light's criteria and show a high level of pancreas enzyme. It is more likely pancreatic injuries. The patient was mechanically ventilated and administered antishock medication and antibiotics and received a blood transfusion and peritoneal drainage at ICU department. She responded to these treatments; in particular, shock and infection gradually resolved.

The patient was given partial parenteral nutrition for 3 weeks later. The initial amount of abdominal drainage fluid was 500 mL/d, which then increased gradually to 1 L/d from admission day 14 and 2 L/d from admission day 20 and was maintained at 2-3 L/d thereafter. The abdominal fluid was initially yellow and became clear to milky turbid from admission day 24. The triglyceride level was 3.9 mmol/L; amylase level, was 25 U/L; bilirubin level, was 12.1 μmol/L; white blood cell count, 238; and lymphocyte count: 95%, all of which suggested the presence of chylous effusion (Table 1).

Abdominal and chest CT revealed a thrombus in the left pulmonary artery. For 2 weeks, the patient was weaned off the ventilator; antibiotic treatment was continued; and anticoagulation, Sandostatin treatment, partial parenteral nutrition, and a diet rich in MCTs were added. However, the status of the chyme did not improve. Subserosal necrotic gallbladder funnel with a type IC common bile duct cyst with a diameter of 10-12 mm was identified as an indication for laparoscopic surgery (Fig. 2).

Cholecystectomy, common bile duct resection, and Roux-en-Y hepaticojejunostomy were performed, with the Y loop utilized extra-abdominally. The postoperative course was uneventful, with the amount of peritoneal fluid rapidly decreasing from 1000 mL to tens of milliliters at the beginning of the second week after surgery. The patient was discharged 5 weeks after surgery.

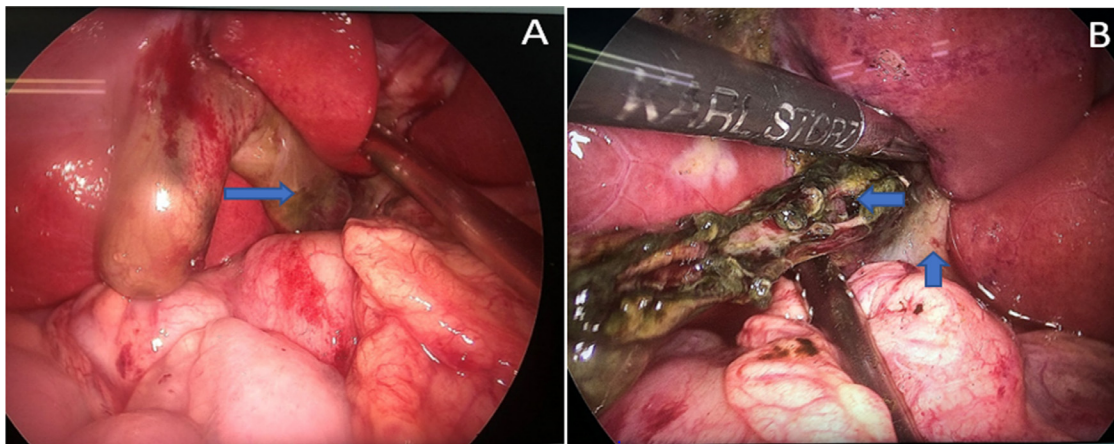
Discussion

The frequency of solid organ damage in patients with blunt abdominal trauma is approximately 10%-22%, of which gallbladder injury accounts for only 1.1%-2% [2]. The diagnosis and management of gallbladder injury are challenging because the clinical picture differs between ages owing to varying anatomical features and the relative position of the viscera in the abdominal cavity. The clinical and subclinical symptoms are subtle. In most cases, a delayed diagnosis results in a late surgical decision, which impacts the postoperative prognosis [1].

Because it is anatomically located under the liver, the gallbladder is protected by the ribs from injury during direct trauma mechanisms by the liver. The mechanisms that can cause gallbladder injury include albinism, which is very rare in children, and a strong impact on the right lower abdominal quadrant, such as the pressure caused by punching or kicking the abdomen. Meanwhile, traffic accidents are known to be the most common cause of gallbladder injury [1]. The diagnosis in children is difficult, as it requires thorough examination and history-taking as well as a combination of imaging studies [3]. In our case, the patient was admitted to the hospital af-

Table 1 – Abdominal fluid test findings from day 1 to day 25.

Blood test finding	D1	D3	D5	D6	D9	D13	D19	D24	D25
Lactate level (mmol/L)	3.8	2.2	3.3	2.7	2.9				4.0
Triglyceride level (mmol/L)				0.47	0.26		0.90	2.114	3.91
Protein level (g/L)	20	18.14	11.99	14.1	13.84	13.17	4.22	3.67	6.4
Amylase level (U/L)	583	181		25					
Glucose level (mmol/L)	6.8	6.9	6.3	5.6	6.3	6		3.8	4.8
Lipase level (U/L)	266								
LDH level (U/L)	1,133	784	392	282		125	61	86	134
Bilirubin level (μ mol/L)		33.9		14.6	12.1				
Rivalta					–	+	+		
Color		Orange	Red	Dark yellow	Yellow	Yellow	Yellow	Yellow	Milky
WBC count		855	8680	7220	1,360	441	1000	338	238
Neutrophil count (%)		4	5	5	0	6	5	5	5
Lymphocyte count (%)		96	95	95	100	94	95	80	95
Red blood cell count (/mm ³)		20,000	51,000	6000	2000		1000	1000	1000

**Fig. 2 – Necrosis at the gallbladder funnel (A) and type IC choledochal cyst (B).**

ter experiencing suspected blunt abdominal trauma. The clinical symptoms are generally subtle and frequently obscured by other associated visceral injuries. Peritonitis symptoms associated with increased bilirubin levels in the peritoneal fluid may indicate bile leakage or biliary tract injury. However, the majority of patients experience only vague abdominal pain that may be accompanied by diarrhea [1,2,4]. The definitive diagnosis of gallbladder perforation is usually confirmed only after the patient undergoes exploratory laparotomy [1]. Our patient was admitted to the hospital with an unknown cause of abdominal effusion that responded to antibiotic therapy and abdominal fluid drainage. The drainage fluid was dark yellow to turbid and opalescent under the microscope, indicating chylous effusion. Fluid biochemistry also revealed a triglyceride level of >200 mg/dL, protein level of 6.4 g/dL, and LDH level of 134 U/L, consistent with the diagnostic criteria for chylous effusion [5].

Browse et al. suggested that there are three groups of causes of chylous effusion: (1) acquired mechanisms causing rupture of the lymphatic system, (2) obstructive fibrosis causing obstruction of the lymphatic system, and (3) some congenital conditions. Acquired causes include trauma, surgery, infection, cirrhosis, or cardiovascular disease [5]. The chylous

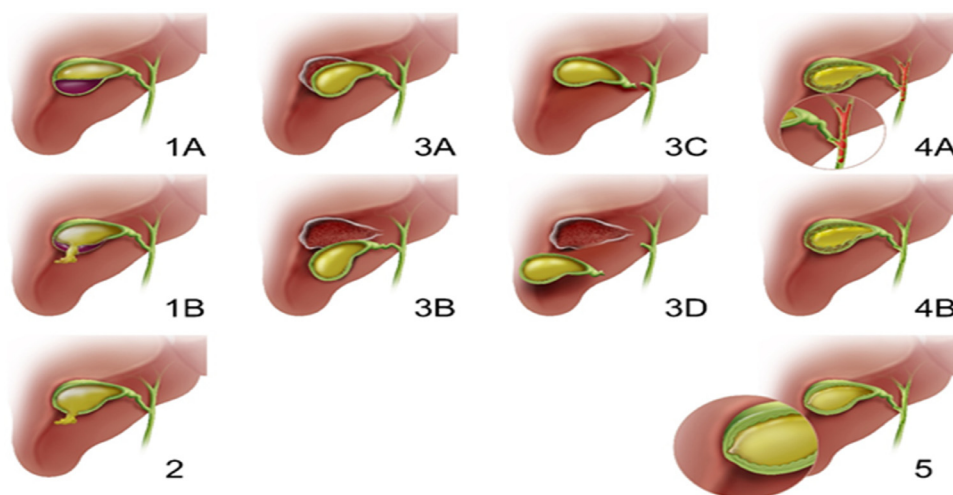
cistern is the structure located at the level of the head of the pancreas, specifically at the L1–L2 vertebrae. The causes of inflammation or concussion at this site can put pressure on the chyme and cause rupture of the lymphatic vessels [6,7]. Furthermore, when high-frequency instruments such as LigaSure or Harmonic are used on the pancreatic duodenum, the lymphatic system can be damaged, resulting in CA [8].

Our patient was admitted to the hospital with blunt abdominal trauma to the epigastrium and right upper abdominal quadrant; no other pathological or surgical causes were identified, implying the importance of properly identifying the cause of the post-traumatic chylous effusion. We decided to administer Sandostatin and apply a partial parenteral nutrition regimen with MCTs. However, the cause of the peritoneal effusion was not determined, and the patient was referred for exploratory laparoscopy; during surgery, the definitive diagnosis was established as gallbladder funnel gangrene with a type IC choledochal cyst [1,9–11].

The clinical classification and management of gallbladder injury were described by Smith and Hastings in 1962. Thereafter, the description and treatment were supplemented and revised by Losanoff and Kjossev [9], as shown in Table 2 and Figure 3.

Table 2 – Losanoff and Kjossev's classification of gallbladder injury [9].

Type	Description	Proposed treatment
1A	Contusion + intramural hematoma	Conservative/cholecystectomy
1B	Contusion + intramural hematoma + necrosis + eventual perforation	Cholecystectomy
2	Wall rupture at injury site	Cholecystectomy
3A	Partial avulsion	Conservative/cholecystopexy/ cholecystectomy
3B	Complete avulsion with intact hepatoduodenal ligament	Cholecystectomy
3C	Hepatoduodenal ligament detachment but with intact liver bed	Cholecystectomy
3D	Total avulsion/traumatic cholecystectomy	Hemostasis/cystic duct clip
4A	Traumatic cholecystitis	Cholecystectomy + evacuation of hemobilia
4B	Calculus cholecystitis complicating trauma	Conservative/cholecystectomy
5	Mucosal tear but with intact gallbladder wall	Cholecystorrhaphy/cholecystectomy

**Fig. 3 – Illustration of Losanoff and Kjossev's classification of gallbladder injury [9].**

The risk factor for gallbladder injury includes a history of blunt abdominal trauma following a large meal, first alcohol intake, or comorbidity causing extrahepatic biliary obstruction [1,3]. In children, the most common cause is extrahepatic biliary obstruction; in our case, the cause was a choledochal cyst [1]. The symptoms are usually subtle during the period of edema and hematoma in the gallbladder wall, and biliary peritonitis symptoms suddenly appear thereafter. Elevations in the levels of liver enzymes, particularly transaminases, are frequently associated with perforated gallbladder wall necrosis. The presence of bilirubin in the peritoneal fluid indicates a gallbladder perforation. Diagnostic imaging can be useful for the diagnosis. Contrast-enhanced CT of the abdomen can reveal a rupture or hematoma, gallbladder wall edema, or large omentum hernia through the gallbladder bed as well as multiple abdominal effusions, indicating the need for exploratory abdominal surgery [1]. Further, ultrasonography can detect gallbladder wall edema or thrombosis, measure gallbladder wall thickness, and evaluate peritoneal fluid as well as guide exploratory peritoneal fluid testing [1,4]. In our case, ascites and pleural effusion were noted in the ultrasonography and CT images. This raises the question of when exploratory surgery must be performed. The experience of radiologists is important in distinguishing the necrotic gallbladder from the normal gallbladder.

Patients with symptoms of biliary peritonitis or abdominal effusion with hyperbilirubinemia must undergo surgical exploration. However, in cases of gallbladder injury accompanied by chylous abdominal effusion, conservative treatment is debatable [1,12].

Livingston et al. reported that only 8% of patients with unexplained abdominal effusion following blunt abdominal trauma required surgery [1]. Ng et al. conservatively treated 25% of their patients, and only 7% had failed treatment [1]. Thus, questions whether peritoneal effusion explains the cause of blunt abdominal trauma and whether surgical exploration is necessary arise. Most clinicians agree to closely monitor each case and make appropriate treatment decisions occasionally [1,10]. Exploratory laparoscopy makes a valuable contribution to the diagnosis and management of gallbladder injury [1,10,11,13]. Most authors support cholecystectomy in the presence of exploratory surgery, while some authors prefer restoration of the gallbladder wall when the gallbladder is in a good condition [12]. Suturing of the gallbladder wall is associated with the risk of progressive necrosis and subsequent perforation of the gallbladder as well as gallstone formation [4,13]. In our case, when laparoscopic exploration of the gallbladder injury associated with a type IC common bile duct cyst with laparoscopic cystectomy or cholecystectomy was planned, Roux-en-Y hepaticojejunostomy was selected [14].

Although the diagnosis and determination of the indication for surgery are difficult, the mortality rate of patients is only approximately 5% according to Schechter [1]. The prognosis of gallbladder lesions with biliary peritonitis is worse than that of peritoneal effusion alone [1,11,13].

Conclusion

Gallbladder injury is uncommon in patients with blunt abdominal trauma, particularly in children. The diagnosis is frequently difficult and commonly missed. History-taking and thorough examination will greatly aid in the diagnosis. Suturing to preserve the gallbladder is still preferred over performing cholecystectomy. The majority of studies in the literature and the current study support single-stage Roux-en-Y surgical treatment with cholecystectomy, cystectomy, and biliary-enteric anastomosis of gallbladder injury in the presence of a common bile duct cyst.

Patient consent

Written informed consent was obtained from the patient for the publication of patient information in this article.

Availability of data and materials

Data sharing is not applicable to this article as no datasets were generated or analyzed during the current study.

Authors' contributions

Tran TT and Ho PD contributed equally to this article as co-first authors. All authors read and approved final version of this manuscript.

Ethics approval

Not applicable.

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