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A Case of Postoperative Biliary Leakage Combined with Residual Stones after PTOBF Rigid Choledochoscopy

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Abstract

Objective At present, endoscopic retrograde cholangiopancreatography (ERCP) is employed for diagnosing and treating post-cholecystectomy bile leakage; however, this study concentrates on the clinical effectiveness and feasibility of Stage I rigid choledochoscopy for addressing post-cholecystectomy bile leakage accompanied by residual stones. In patients experiencing postoperative biliary leakage with residual stones, percutaneous hepatic Stage I cholangiopancreatic rigid choledochoscopy may be executed following the unsuccessful attempts of Ttube extraction and ERCP. Consequently, patients experienced resolution of bile leakage and residual stones after Stage I choledochostomy rigid choledochoscopy, yielding favorable outcomes and shortened hospital stays.

Keywords

Stage I Rigid Choledochoscopy; Biliary Leakage； Residual Stones.

1. Introduction

Bile leakage (BL) constitutes the most prevalent postoperative complication of laparoscopic cholecystectomy (LC), exhibiting the highest mortality rate and an annual incidence ranging between 0.3% and 1.5%. A majority of patients do not necessitate specialized treatment, as biliary drainage can facilitate spontaneous healing. In cases unresponsive to conservative treatment, minimally invasive procedures or surgery should be considered. This report examines a case of post-cholecystectomy bile leakage accompanied by residual bile duct stones, which was successfully treated via percutaneous hepatic Stage I rigid choledochoscopy.

2. Case information

2.1. General Information

The patient, an 84-year-old female, presented with pain in the right upper abdomen for one week, occurring more than two months after cholecystectomy. She was diagnosed with gallstone disease and acute suppurative cholecystitis on 2021-07-08 due to discomfort in the right upper abdomen. A laparoscopic cholecystectomy, common bile duct extraction, T-tube drainage, and intestinal adhesion release were performed. Intraoperative injury to the right hepatic duct and repair occurred during Stage I, resulting in postoperative alleviation of abdominal pain. The infrahepatic drainage tube was secure and patent, draining yellowish-brown fluid at a volume of approximately 300 ml/day. Recurrent right upper abdominal pain and discomfort emerged without an evident cause one week prior, unaccompanied by nausea, vomiting, chills, fever, or other discomforts. The patient had a 15-year history of hypertension and diabetes mellitus, regularly taking medication with well-controlled symptoms. No generalized skin or bilateral scleral yellowing was observed during examination; old scars were

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visible in the right upper abdomen, with localized light pressure pain and no rebound pain. The indwelling T-tube was securely fixed; the subhepatic drainage orifice appeared red and swollen, with no blood or exudate surrounding the tube.

Laboratory tests upon admission revealed the following: RBC 3.52×10 12 /L↓，HGB 108 g/L↓，ALB 39.9 g/L↓，GGT 107 U/L↑，ALP 204 U/L↑，HBsAg 16.99 IU/mL↑。CT scan and abdominal enhancement revealed: 1. Postoperative absence of the gallbladder and a nodular, slightly dense shadow of the common bile duct (measuring approximately 12mm x 15mm) (Fig.1). 2. Several liquid hypodense shadows were observed in the perihepatic area, and a drainage tube was left in the operative area (Fig. 2); 3. Dilation of the intrahepatic bile ducts and intrahepatic bile duct stones (Fig. 2)

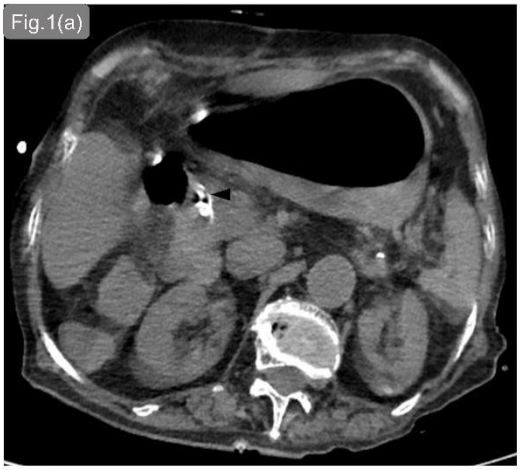

Figure 1(a) illustrates a tansverse section CT scan of the upper abdomen, and Fig.1 (b) illustrates a tansverse section CT scan of the upper abdomen. Nodular slightly hyperdense shadows were observed at the upper end of the common bile duct, and black arrows pointed to choledocholithiasis.

Figure. 2(a) presents a horizontal view of an enhanced abdominal CT scan, Several liquid hypodense shadows were observed in the perihepatic area, and a drainage tube was left in the operative area; Fig.2 (b) presents a sagittal view of an enhanced abdominal CT scan, exhibiting dilated intrahepatic bile ducts and intrahepatic bile duct stones.

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2.2. Methods

Upon admission, the patient received symptomatic treatments such as anti-infection, liver protection, and anti-hepatitis B virus measures, yet experienced no significant relief of abdominal pain. The subhepatic drainage tube drained freely but was still associated with pain at the drainage port. The cause of the abdominal pain remained unclear. To determine whether bile duct injury or stricture was present, magnetic resonance cholangiopancreatography (MRCP) was conducted. Epigastric MRCP revealed: 1. Multiple heterogeneous dilations of intra- and extrahepatic bile ducts (with notable dilation of the left outer lobe intrahepatic bile duct) [Fig.3(a)]; 2. perihepatic effusion with long T2 signal shadow around the confluent area [Fig.3(b)]; 3. T-tube retention status ， and common bile duct stones combined with dilation [Fig.4(a)]; 4. Absence of the gallbladder, no bile duct dissection or bile tumor, presence of bile duct stump [Fig.4(b)]. A three-dimensional reconstruction of the biliary tract was performed using MRCP [Fig. 5(a, b)].

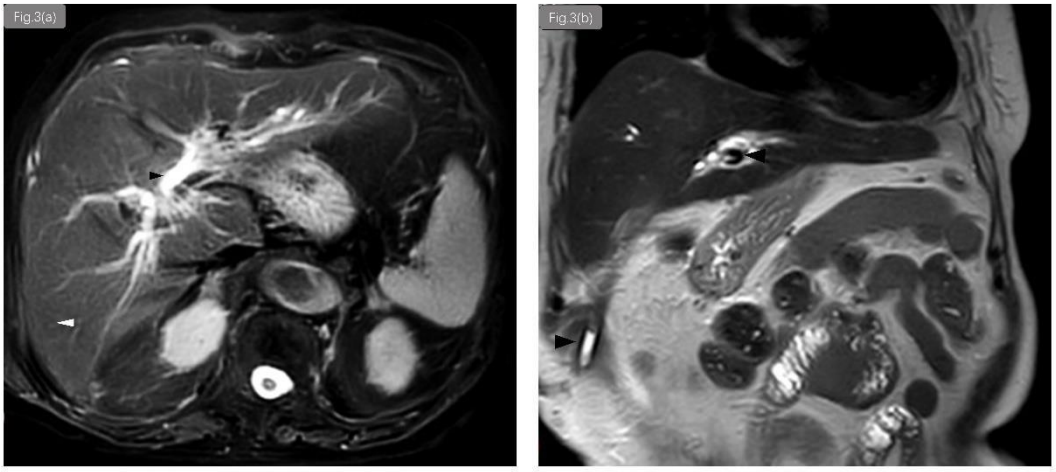

Fig.3 portrays magnetic resonance cholangiopancreatography (MRCP) abdominal enhancement:Fig. 3.(a) highlights both the right and left intrahepatic bile ducts' dilation at the black markings; Fig. 3(b) exhibits a dilated bile duct at black markings and an indwelling subhepatic drainage tube;

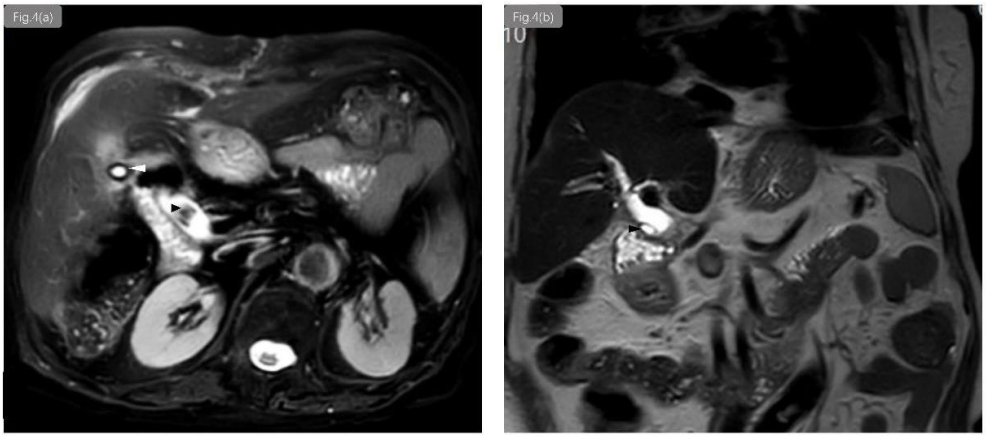

Fig.4 displays the MRCP abdominal view:Fig. 4(a) demonstrates a dilated intrahepatic bile duct with a right intrahepatic bile duct stone visible at the black mark and an indwelling subhepatic drainage tube at the white arrow;Fig4(b) illustrates gallbladder agenesis with the cystic duct stump at the black mark;

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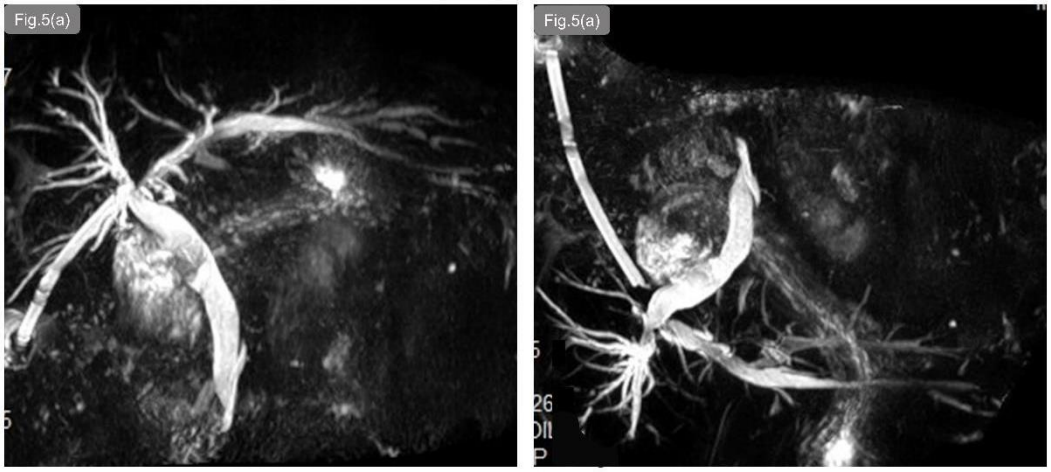

Figure 5. MRCP bile duct 3D reconstructions: Figure 5(a) illustrates the absence of gallbladder and an enlarged left intrahepatic bile duct; a T-tube is present on the left side, revealing multiple stones within the common bile duct located at the T-tube opening and at the junction of the cystic duct and common hepatic duct. Figure 5(b) displays numerous stones in the left intrahepatic bile duct; constriction and elongation are observed at the lower extremity of the common bile duct due to compression and structural disruption.

Despite treatment, the patient continued to experience abdominal pain and discomfort, with redness and swelling at the opening of the abdominal drainage duct. The subhepatic drainage tube flow after laparoscopic cholecystectomy (LC) exceeded 100 ml per day for over a week, and damage to the right hepatic duct occurred during the operation. Postoperative bile leakage resulting from bile duct injury during cholecystectomy could not be ruled out. Cholangiography is the gold standard for diagnosing biliary fistulae. Trans-T-tubular drainage imaging was performed to determine whether intra- and extra-hepatic gallstones were removed and to identify the location and size of the biliary fistula. Imaging revealed high resistance in the catheter, and obstruction was suspected at the medial end of the catheter. Most contrast leaked out of the body through the gap around the catheter wall, while a small amount of contrast diffused into the abdominal cavity [Fig.6]. Patients with biliary fistulas combined with common bile duct stones are highly likely and should be treated promptly. As a treatment modality within the realm of endoscopic interventions, endoscopic retrograde cholangiopancreatography (ERCP) was deliberated upon and ultimately selected to alleviate biliary pressure and ensure adequate bile drainage, thereby promoting fistula recovery. This approach offers the benefits of minimal invasiveness and applicability for both disease diagnosis and management. During the ERCP procedure, routine entry to the descending duodenum revealed a sizable diverticulum in the papilla containing residual matter. The presumed papillary opening appeared entrapped at the diverticulum's edge, oriented towards the diverticulum, as depicted in Figure 7 (a, b, c). Consequently, accessing the papillary opening with the incisional knife and guidewire cannula proved challenging, resulting in an unsuccessful ERCP intervention. To ameliorate the patient's discomfort and pain, percutaneous transhepatic cholangiography (PTC) was executed, successfully puncturing the left intrahepatic bile duct under ultrasound guidance and local anesthesia. Intraoperative observations indicated dilation of bile ducts and common bile ducts in multiple hepatic segments of both the right and left liver, along with a hypodense oval shadow in the upper bile duct as seen in Figure 8 (a, b). However, no biliary fistula was evident intraoperatively. The patient experienced abdominal pain accompanied by an abdominal infection and high-flow leakage. The drainage fluid was a yellow-green bilelike substance devoid of intestinal contents. As there was no spillage of upper gastrointestinal contrast, a duodenal fistula was not considered for the time being. No contrast

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leakage was observed during PTC, and no bile leak orifice was detected, suggesting the likelihood of a high unidirectional flap bile leak. The current diagnosis encompassed: 1) common bile duct stones concomitant with cholangitis; 2) biliary fistula combined with abdominal infection; 3) post-cholecystectomy; and 4) esophageal hiatal hernia. Following a preoperative abdominal ultrasound evaluation to determine the appropriate surgical approach, a percutaneous transhepatic one-step biliary fistulation (PTOBF) combined with laser lithotripsy, mesh basket extraction, bile duct balloon dilation (BDBD), and T-tube drainage was performed under general anesthesia. Figure 9(a) displays bile duct stones found during intraoperative bile duct exploration in stage I PTOBF following laparoscopic cholecystectomy, while Figure 9(b) showcases the utilization of a mesh basket for lithotripsy during PTOBF.

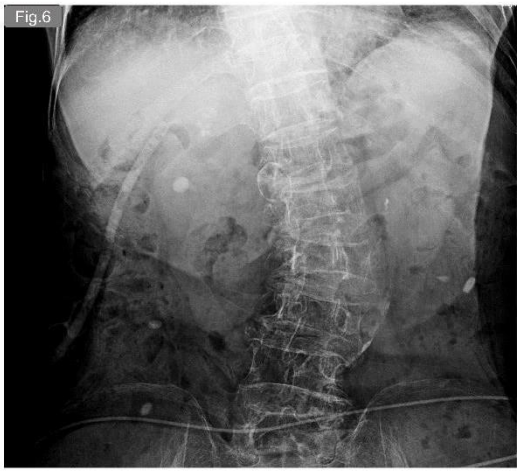

Figure 6: During trans-T-tubular cholangiography, most contrast entry is obstructed, preventing visualization of the bile duct.

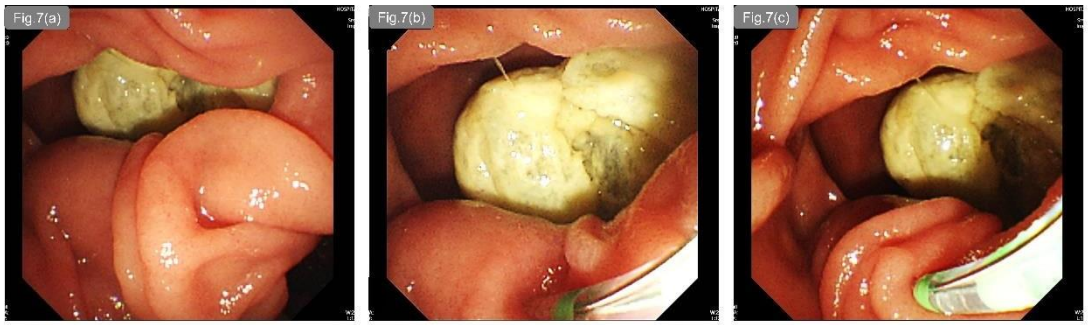

Figure7: ERCP observations include: Fig 7(a) routine access to the descending duodenum with a visible duodenal diverticulum; Fig7(b) yellow contents in the duodenal diverticulum and compression of the large duodenal papilla by the duodenal diverticulum and contents, causing structural changes that hinder retrograde entry into the common bile duct; Fig 7(c) an unsuccessful attempt to access the common bile duct by incising the duodenal sphincter with a knife after guidewire intubation failure.

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Figure 8: PTC imaging reveals: Fig 8(a) successful puncture of the left intrahepatic bile duct via the left side, with contrast injection displaying a dilated common bile duct and a visible low-density stone shadow in the upper middle section; Fig 8(b) dilation of the left and right intrahepatic bile duct and common bile duct, with no evident leak.

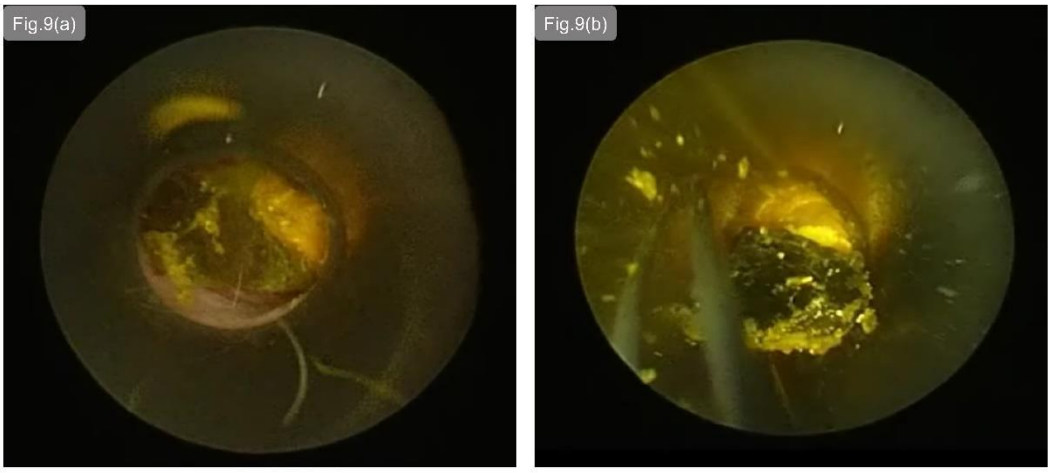

Figure 9. Schematic Diagram of the Procedure: Fig. 9(a) illustrates bile duct stones found during intraoperative bile duct exploration in Stage I TPOBF following LC surgery; Fig. 9(b) demonstrates the utilization of a mesh basket for lithotripsy during TPOBF.

PTOBF Procedure Steps: (1) Under general anesthesia with tracheal intubation, the patient was positioned supine, disinfected, and draped. (2) Ultrasound-guided puncture of the right hepatic duct was performed, with yellowish bile aspirated, and a guidewire inserted. Puncture tubes (10F, 12F, 14F, and 16F) were sequentially placed along the guidewire to dilate the fistula, followed by the placement of a 16F sheath tube. (3) A rigid choledochoscope was introduced through the sheath into the bile duct, revealing the narrowing of the right hepatic duct opening. Balloon dilation and bile duct formation were performed. Multiple stones were observed in the common bile duct, with the largest measuring 1.8cm x 1.5cm and embedded in the common bile duct opening. Laser lithotripsy and lithotripsy mesh baskets were used to remove substantial amounts of debris. Examination of the left hepatic duct was conducted, flushing out a

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small quantity of crushed stones. (4) Biliary drains were placed, and subhepatic drains were replaced. Postoperatively, the drainage tube functioned freely, discharging a yellowish-brown fluid. Postoperative Review Test Indicators (in past tense):WBC 10.18×109/L ↑, HGB 88 g/L ↓, DDC 9.48ug/ml ↑, TBIL 23.7μmol/L ↑, CREA 185μmol/L ↑, UA 502μmol/L ↑, CRP 132.6mg/L ↑, ALB 31.1g/L ↓. Postoperative Recovery: The drainage tube was secured and remained open, with the T-tube draining 100-180ml of yellowish-brown fluid daily, and no apparent fluid flow from the subhepatic drain. Postoperative treatment included anti-infective, antihypertensive, hypoglycemic, antispasmodic, analgesic, hepatoprotective, and cholagogic medications.

3. Results

A postoperative evaluation using abdominal ultrasound revealed no significant peritoneal fluid, leading to the removal of the subhepatic abdominal drainage tube. The biliary T-tube remained in place and was discharged. Two months after surgery, TBIL and CRP levels were normal, and a follow-up abdominal CT scan indicated: 1) postoperative gallbladder agenesis with a visible drainage duct extending from the right liver lobe to the common bile duct; 2) disappearance of the previously observed nodular, slightly dense shadow in the former common bile duct; and 3) absence of several liquid hypodense shadows previously seen in the perihepatic area (Fig 10). The patient experienced no recurrence of abdominal pain or discomfort post-surgery. After two months of follow-up, the patient exhibited improved mobility, restored liver function, and a favorable prognosis following the removal of the indwelling T-tube.

Figure 10. Postoperative Abdominal CT: Fig. 10(a) reveals the drainage tube positioned deep within the common bile duct; Fig. 10(b) displays no visible common bile duct stone shadows; Fig. 10(c) showcases the disappearance of perihepatic fluid.

4. Discussion

Bile leakage(BL) refers to an anomalous condition where bile or bile-containing fluid continuously escapes through an abnormal channel toward an atypical outlet[1]. Patients with BL mostly do not present with jaundice, mostly with a series of vague non-specific symptoms such as abdominal distension and mild abdominal pain[2]. BL presents in many forms and is difficult to identify, thus easily leading to diagnostic delay. In addition to the prevalent causes of bile leakage, such as those of medical origin, traumatic and spontaneous bile leaks also exist. Medically-induced biliary leakage arises from three primary factors: first, the high prevalence of extrahepatic bile duct and vascular anatomical variations, exceeding 50%[3]; second, biliary tract inflammation provoking tissue edema and extensive adhesions, leading to an indistinct gallbladder triangular dissection[4], resulting in gallbladder or bile duct injury; third, the surgeon's overconfidence and emphasis on minimal incisions contribute to suboptimal

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postoperative outcomes, inadequate suturing due to expedited procedures, displaced titanium clips at the stump, and intraoperative electrocoagulation injuries[5].

Diagnosis of biliary leakage is facilitated when one or more of the following criteria are met: 1) a history of prior invasive hepatobiliary procedures or surgery accompanied by postoperative abdominal pain and discomfort; 2) patients with indwelling abdominal drains exhibiting total bile-containing drainage exceeding 150 mL 24 hours post-surgery or drainage surpassing 100 mL on the first postoperative day; 3) abdominal ultrasound or CT indicating perihepatic fluid or a new fluid mass shadow compared to preoperative imaging; 4) cholangiography via a postoperative indwelling T-tube suggesting contrast leakage; 5) laparotomy for bile extraction. In this case, the patient experienced a history of hepatobiliary surgery two months post-LC, unresponsive conservative treatment, and symptoms of abdominal pain and discomfort. Biliary leakage diagnosis was confirmed due to the drainage of bile-containing fluid and the drainage flow consistently exceeding 100 mL/day for over three days.

Factors causing residual stones in patients include: (1) the presence of a normal physiological spiral fold (Heister flap) in the cystic duct lining predisposing to stone retention and obstruction, the variable anatomy of the cystic duct[6], and increased probability of common bile duct stone recurrence following laparoscopic cholecystectomy (LC) due to stone migration. (2) The loss of gallbladder function after LC surgery, including bile concentration and temporary storage, elevates bile flow in the lower bile duct. When the diastolic function of the duodenal papillary sphincter diminishes for various reasons, biliary tension increases. To prevent residual bile duct stones, surgeons often employ laparoscopic grasping forceps during LC procedures to estimate potential cystic duct stones in the sensory gallbladder when utilizing cystic duct clamps and gallbladder transection. Attempting to reduce the incidence of common bile duct residual stones, gentle proximal and distal pressure is applied from the cystic duct confluence to Hartmann's sac.

In the instance of bile leakage concomitant with choledocholithiasis, the crux of treatment lies in prompt intervention, efficacious and ample bile drainage to curtail abdominal dissemination, and biliary decompression to expedite leakage healing. The management of biliary leaks ought to be customized for each patient, contingent upon the location, flow magnitude, coexistence of strictures, and the extent of bile duct damage. In the absence of biliary obstruction and with minimal bile leakage, patients may be managed through strict rest, abstention from oral intake, pharmacotherapy (encompassing hepatoprotective, anti-infective, antispasmodic, gastroprotective agents, and growth inhibitors to facilitate leakage healing), and continuous intraperitoneal drainage to confine peritonitis to the drainage area. Bile leaks can spontaneously heal following adequate drainage and decompression when infection is controlled[7] . For patients without severe bile duct defects or dissections, endoscopic sphincterotomy (EST)[7], endoscopic retrograde cholangiopancreatography (ERCP)[8], fully covered self-expanding metal stents (FCSEMS)[9], endoscopic nasobiliary drainage (ENBD)[10], and percutaneous transhepatic one-step biliary fistulation(PTOBF)are viable therapeutic options for bile drainage due to the minimal volume of bile leakage.

A cholangioscope is an endoscopic instrument enabling surgeons to visually examine the interior of the bile duct and its vicinity. Conventional percutaneous hepatobiliary lithotripsy can be classified into staged and progressive lithotripsy, as well as rigid choledochoscopy and fiber-optic endoscopy, based on the instrumentation employed. The prevalence of traditional percutaneous transhepatic choledochoscopic lithotripsy has increased, with an emergence of more evidence-based medical data. The benefits of PTOBF over PTCSLare now acknowledged to include: 1) elimination of waiting time and discomfort associated with sinus tract formation and dilation following percutaneous hepatic puncture; 2) avoidance of inconvenience in daily living and care resulting from long-term indwelling T-tubes; 3) prevention of risks related to dislodged indwelling catheters due to shallow bile duct entry and respiratory oscillation,

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necessitating bile duct re-puncture for catheter placement; 4) utilization of a bile duct protective sheath as opposed to a fibrous tissue sinus tract in the initial stage, mitigating irritation and damage to the bile duct during lithotripsy, offering bile duct protection and minimizing intraoperative biliary bleeding and postoperative biliary edema; 5) increased accuracy and precision in intra-biliary surgery, circumventing surgical complications such as abdominal adhesions from multiple biliary operations; 6) minimally invasive procedure with a short duration, significantly reducing patients' hospitalization time, decreasing surgical complications, broadening surgical indications, and facilitating clinical application in primary hospitals.

PTOBF is primarily executed through rigid choledochoscopy combined with sheath lithotripsy, offering high extraction efficiency, independence from sinus tract maturation, and the capability for multiple stone extractions via the catheter. This is especially advantageous for patients with a history of multiple biliary procedures. However, it remains crucial to avoid biliary stone extraction during the inflammatory phase. Patients necessitating biliary puncture for decompression and lithotripsy in the subsequent stage, once inflammation has subsided, are those with infected bile ducts. The primary stones formed in infected bile ducts are brown pigmented stones composed of bilirubin and calcium fatty acid soap. These stones are soft in texture and can be removed intraoperatively by clamping stones smaller than the sheath's diameter. For larger stones, the sheath can be employed to crush and divide the stones, whereas pneumatic ballistic lithotripsy may be utilized for harder stones.

Despite the constraints imposed by a rigid choledochoscope, the liver's deformability can be utilized to adjust the angle between the target bile duct and the extraction channel to greater than 45°, facilitating stone removal. Rigid choledochoscopes' lack of maneuverability necessitates the crossover technique for extracting stones from interconnected left and right intrahepatic bile ducts without hilar bile duct stenosis and common bile duct stones via both left and right hepatobiliary approaches. For stones that cannot be removed through a single channel, a multipuncture point, multi-channel extraction strategy may be employed. Bile duct puncture is challenging; therefore, it is crucial to thoroughly evaluate the distribution of bile duct dilation, stenosis, and stones prior to the procedure, favoring the puncture of dilated (≥6 mm diameter) bile ducts and attempting to puncture tertiary branches of the intrahepatic bile duct towards the first hepatic portal to minimize the risk of inadvertent portal vein injury. Additionally, selecting a bile duct with an angle greater than 30° to the target bile duct can facilitate rigid choledochoscopic stone removal. For the majority of hepatic bile duct stones, which are soft and relatively friable, removal can be achieved through the use of lithotripter forceps, mesh basket retrieval, irrigation, negative pressure suction, and extracorporeal percussion. In this case, the patient's MRCP and preoperative liver ultrasound revealed dilation of intra- and extra-hepatic bile ducts and common bile ducts, with significant dilation of the left intrahepatic bile duct. Consequently, we devised a right intrahepatic bile duct approach for stone removal to avoid potential puncture-related risks. During the procedure, a stenosis at the opening of the right hepatic duct was identified and dilated with a balloon. Multiple stones were found in the upper portion of the common bile duct, which were fragmented using laser lithotripsy and retrieved in a mesh basket before being dissolved in the common bile duct opening. The patient experienced postoperative abdominal pain with minimal fluid discharge from the subhepatic drainage tube and approximately 100-180 ml of bile-like fluid draining daily from the T-tube. A CT scan performed two months post-operation revealed no significant stones, and the patient reported no discomfort after T-tube removal.

The patient was admitted with CT and MRCP indicating common bile duct stones and dilated hepatobiliary ducts. During the ERCP procedure, a sizable diverticulum was observed in the papilla at the descending duodenum, making the papillary opening challenging to access, thus leading to the termination of the operation. The diverticulum's traction and compression on the

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bile and pancreatic ducts cause tortuosity and deformation of these ducts and the duodenal papillae, obstructing the excretion of bile and pancreatic juice. Consequently, the accumulation of bile and pancreatic juice results in increased pressure within the bile and pancreatic ducts, and the duct walls become thinner under pressure, promoting bile leakage. The absence of a fistula during PTC could be attributed to: 1. the presence of a unidirectional living flap or a healed fistula; 2. the leak's high location and small size, making it challenging to observe the outflow and flow rate of the contrast medium.

Biliary fistulas, which have not formed to limit bile dissemination and subsequent abdominal infection, frequently do not self-heal through continued drainage. The patient was unsuccessful in local bile drainage and ERCP. Given the patient's age, comorbidities, malnutrition, history of prior abdominal surgery, heightened risk of reoperation with anesthesia, increased likelihood of abdominal adhesions, and surgical complications, it was anticipated that sufficient bile drainage would be performed to alleviate bile duct pressure, fostering bile leak healing. Following interdisciplinary departmental consultations, the subsequent treatment plan was devised: 1. Initially, manage abdominal infection and inflammation, mitigating tissue edema and adhesions; 2. Preoperative abdominal ultrasonography was employed to evaluate the surgical approach, and upon completion of necessary preoperative preparations, a percutaneous transhepatic PTOBF combined with laser lithotripsy, mesh basket extraction, biliary irrigation, bile duct balloon dilation, and T-tube drainage was conducted under general anesthesia.

Upon disgnosing and treating this case, we propose the following insights: (1) Although acute cholecystitis necessitates emergency surgery, it frequently involves bacterial infections typified by Escherichia coli and Enterococcus faecalis. Administering cephalosporin III and metronidazole preoperatively for mild to moderate acute cholecystitis, and cephalosporin IV and metronidazole for severe acute cholecystitis, is vital for patient prognosis[2], as it controls infection, facilitates intraoperative anatomical structure identification, and may substantially reduce postoperative complication incidence; (2) Intraoperative endoscopic retrograde cholangiopancreatography (iERCP) during laparoscopic cholecystectomy (LC) minimizes postoperative complications[3]. Additionally, using indocyanine green intraoperatively[4] significantly enhances biliary tree visualization compared to magnetic resonance cholangiopancreatography (MRCP)[5], enabling early detection of biliary anatomical variants and biliary leaks for prompt intraoperative repair, thereby reducing patient hospitalization duration and improving prognosis; (3) LC does not preclude recurrent choledochal stones; hence, laparoscopic grasping forceps should be employed to gently push Hartmann's sac from proximal to distal from the confluence, mitigating residual stone incidence in the common bile duct; (4) To address suspected bile leakage, first ascertain the leak's location and bile leak flow magnitude, and develop a treatment strategy accordingly; cholangiography is the gold standard for diagnosing biliary fistulae, while endoscopic retrograde cholangiopancreatography (ERCP) possesses high sensitivity and specificity for diagnosing biliary leaks and may be the primary choice for diagnosing and treating biliary leaks; (5) For patients with biliary leakage unresponsive to conservative treatment and ERCP, percutaneous transhepatic cholangiography (PTC) can only serve as an emergency palliative measure for reducing biliary pressure and draining bile, with surgery being the ultimate choice; Phase I percutaneous transhepatic obliteration of biliary fistula (PTOBF) lessens the time required for sinus tract formation, diminishes bile duct irritation and injury, facilitates leak repair via suturing, and most importantly, enables simultaneous hepatic bile duct stone treatment, thereby offering an effective treatment for bile leaks concomitant with hepatic bile duct stones.

In summary, early detection and treatment of bile leaks is essential. Most patients do not necessitate special treatment and can recover spontaneously through biliary drainage. In cases where initial conservative treatment fails, minimally invasive procedures endoscopy such as

PTOBF should be employed for patients with a definitive diagnosis of biliary leakage. Surgery should be the decisive treatment for patients with biliary leakage unresponsive to endoscopic intervention.

5. Conclusion

In this paper, we review this case to analyze the advantages of PTOBF as a treatment option for bile leakage with residual stones. Overall， PTOBF can significantly reduce the length of hospital stay and surgical complications, which is convenient for clinical application in primary hospitals.

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Author contributions

C.L launched an investigation and designed the work;S.Q.D were performed experimental validation and wrote the manuscript; J.H.L collected clinical and pathological data;H.L.L in charge of editing and review;All of the authors have read and approved the final manuscript.

Ethics Statement

This article has passed ethical review, ethical batch number: 2023-ky-kz-061-01.

Conflicts of interest

All remaining authors declare no potential conflicts of interest.

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