frontiers | Frontiers in Medicine

TYPE Case Report
PUBLISHED 03 October 2024
DOI 10.3389/fmed.2024.1429127

OPEN ACCESS

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RECEIVED 07 May 2024
ACCEPTED 12 September 2024
PUBLISHED 03 October 2024

CITATION
Fu C, Jin H, Fang L and Xu H (2024) Laparoscope combined with ureteroscope in the treatment of bile duct stones and cholecystolithiasis in a child: a case report and literature review.
Front. Med. 11:1429127.
doi: 10.3389/fmed.2024.1429127

Laparoscope combined with ureteroscope in the treatment of bile duct stones and cholecystolithiasis in a child: a case report and literature review

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Cholecystolithiasis combined with bile duct stones is more and more common in children, but the surgical treatment is still controversial. We report on a 3-year-old boy, who underwent laparoscope combined with ureteroscope for choledocholithiasis with cholecystolithiasis. This combination therapy offers the possibility to treat pediatric patients with cholecystolithiasis and bile duct stones in low-resource settings where ERCP experience and child-specific surgical instruments are not available. Additionally, a comprehensive review of previous studies was conducted to summarize the surgical treatments. The surgical treatment of children should be made according to the specific situation to maximize the success of the operation and reduce the risk.

KEYWORDS

cholecystolithiasis, bile duct stones, pediatric surgery, endoscopic retrograde cholangiopancreatography, case study, choledocholithiasis, gallstones

Introduction

Cholecystolithiasis are one of the most common diseases in the digestive system, with a notable rise in incidence observed among pediatric patients in recent years (1–3). Bile duct stones (choledocholithiasis) are often secondary to cholecystolithiasis, often leading to severe symptoms such as abdominal pain, jaundice, and cholangitis. In the past, open surgery was the primary approach for treatment, albeit associated with prolonged surgical trauma and recovery periods, imposing significant burdens on both children and their families. Nowadays, with the development and combined application of laparoscopic and endoscopic techniques, minimally invasive treatment in children has achieved remarkable results. We reported a successful case of using flexible ureteroscope for bile duct exploration to treat bile duct stones. This case not only contributes valuable clinical experience but also underscores the advantages of employing multiple endoscopic techniques in tandem.

Case presentation

A 3-year-old boy was referred to our hospital due to persisting abdominal pain after 3 days of symptomatic treatment in local hospital. The patient's past and family history were normal.

Physical examination revealed no jaundice, but notable tenderness and rebound tenderness were observed in the right upper quadrant. Laboratory examination revealed normal levels of total bilirubin and direct bilirubin. However, γ-glutamyl transpeptidase was elevated at 160.2 U/L, while levels of aspartate aminotransferase and alanine aminotransferase were elevated at 66.8 U/L and 164.4 U/L, respectively. Alkaline phosphatase was also elevated at 317.9 U/L. The leukocyte count was 9.83×10^9/L, and the C-reactive protein (CRP) level was 8 mg/L. Abdominal ultrasound showed that the bile duct stone was located in the pancreatic segment of the common bile duct (CBD), measuring approximately 8 mm, accompanied by a dilatation of the CBD of approximately 9 mm. Abdominal computed tomography (CT) showed cholecystolithiasis, bile duct stones and dilatation of intrahepatic and extrahepatic bile ducts (Figure 1). Magnetic resonance cholangiopancreatography (MRCP) was unsuccessful because the child was unable to cooperate. Considering the potential increased risk of developmental delays, attention deficit hyperactivity disorder (ADHD), and psychiatric disorders, we opted not to perform MRCP under general anesthesia (4).

Due to the pronounced symptoms of abdominal pain and alterations in blood routine and liver function, we opted for laparoscopic cholecystectomy (LC) in conjunction with bile duct exploration using a flexible ureteroscope. The patient received a preoperative intravenous injection of cefotaxime to prevent infection. A 10 mm camera port, fitted with a blunt trocar, was inserted above the umbilicus through a small incision. Three 5 mm ports were inserted under direct vision, one near the xiphoid, and the others in the right and the left flank (Figure 2). We exposed the infundibulum and cystic duct, utilizing a second forceps introduced through the right flank port to grasp the infundibulum and expose the triangle of Calot. Subsequently, we isolated the cystic duct, the CBD, and the cystic artery. After dissection of the cystic duct and artery, the cystic artery was clipped and transected. The CBD was longitudinally incised by 0.8 cm at its upper portion. Under direct laparoscopic visualization, a 6.5Fr flexible ureteroscope was inserted through the trocar hole beneath the xiphoid. A grasp forceps was used to guide the flexible ureteroscope into the CBD and slowly enter the scope for exploration (Figure 3). After identifying the stones, they were carefully extracted using a stone retrieval basket under the guidance of the ureteroscope (Figure 4). Following exploration, the flexible ureteroscope was retracted to ensure no residual stones remained in the CBD (Figure 5). During the operation, mild bile duct inflammation was observed and the stones were completely removed. Considering the risk of T-tube dislodgement in the pediatric patient, we performed simple interrupted everting suturing of the CBD using 5–0 PDS II sutures without placing a T-tube drain. The patient had an uneventful postoperative recovery and was discharged 4 days later. During the three-year follow-up period after surgery, the child did not experience a recurrence of bile duct stones.

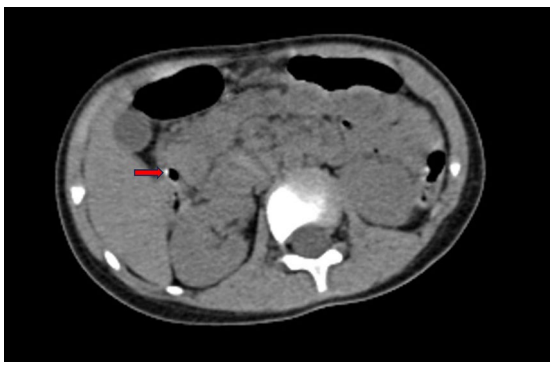

FIGURE 1
CT showed bile duct stones and dilated bile duct. The red arrow indicates clearly visible bile duct stones.

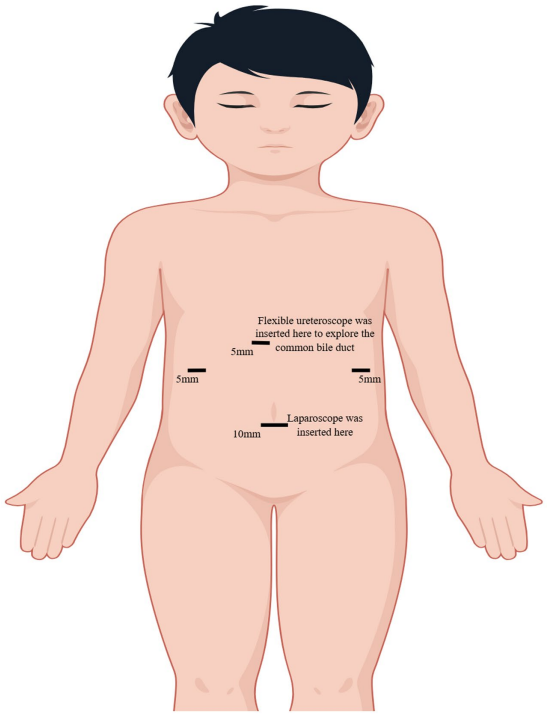

FIGURE 2
Port sites. By Figdraw.

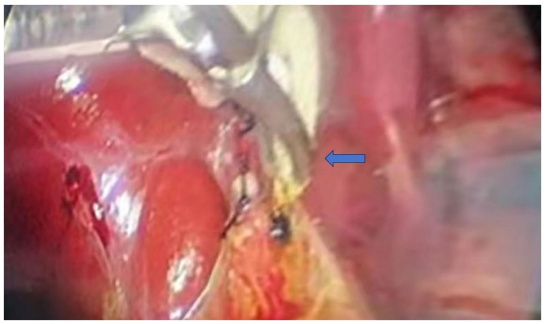

FIGURE 3
Flexible ureteroscope was inserted into the common bile duct under the guidance of grasping forceps during the operation. The blue arrow indicates the forceps guiding the flexible ureteroscope during bile duct exploration.

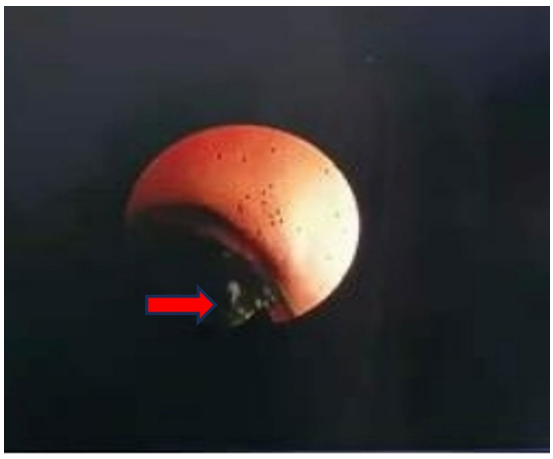

FIGURE 4
Bile duct exploration showed common bile duct stones. The red arrow points to the bile duct stones as seen in the ureteroscope's field of view.

FIGURE 5
The bile duct stones were removed under ureteroscope. The ureteroscope's field of view shows a clear bile duct with no residual stones.

Discussion

The prevalence of gallstones in adults is approximately 10 to 15%, with 10 to 20% of these individuals also having bile duct stones (5, 6). Compared to adults, the incidence in children is lower, at approximately 1.9 to 4% (7). Potential factors contributing to cholelithiasis in children encompass obesity, hemolytic disease, premature birth, and reliance on total parenteral nutrition (8–10). Unlike adults, children with gallstones have more obvious symptoms (1, 11, 12). However, clinical presentations in pediatric cases are frequently nonspecific, compounded by limited expressiveness in children, thus increasing the likelihood of missed diagnosis or misdiagnosis (12). Ultrasonography is the preferred examination method. When bile duct dilatation exceeds 6 mm, there is a high probability of bile duct stones (13). For children, it is also important to consider differentiation from choledochal cysts and pancreaticobiliary maljunction. MRCP and cholangiography can enhance diagnostic sensitivity and specificity.

At present, there is no consensus on the optimal surgical method for treating cholecystolithiasis and bile duct stones in pediatrics. Therapeutic techniques include laparotomy, laparoscopic surgery, percutaneous intervention, and endoscopic retrograde cholangiopancreatography (ERCP) (14). With the advancement of endoscopic technology, the utilization of ERCP for bile duct stones treatment in children is progressively increasing (15–17). LC + ERCP are two independent surgical procedures, necessitating coordinated efforts among multiple teams and amplifying the anesthesia-related risks (18). Children undergoing ERCP treatment face radiation exposure, which may negatively impact their growth and development and increase the risk of cancer (19). Moreover, due to the fragile development of the duodenal papilla in children, surgical incisions and dilations may compromise its normal function. Additionally, ERCP poses potential serious complications such as pancreatitis and duodenal perforation (20). We also need to recognize that the situations in which ERCP is applicable are also limited by a lack of medical resources and operator's expertise.

Recent study had shown that ERCP and laparoscopic common bile duct exploration (LCBDE) can be safely and effectively used in children (21). Laparoscopic bile duct exploration in children with bile duct stones encompasses various techniques, including combination with choledochoscope, cystoscope, and ureteroscope. In addition, Destro et al. also applied Virtual Reality combined with minimally invasive surgical techniques to the preoperative evaluation of pediatric patients, providing a new perspective for the diagnosis and treatment of pediatric hepatobiliary diseases (22). By leveraging the technical advantages of duodenoscopy, laparoscopy, choledochoscopy, or ureteroscope, the diagnosis and treatment of pediatric patients with bile duct stones can be tailored to achieve individualized and minimally invasive therapeutic goals. Compared with LC+ ERCP, this treatment can decrease length of stay and the frequency of ductal stent placement (23–26). In our study, laparoscopy and 6.5Fr thin flexible ureteroscope were used according to the condition of the child. The slender profile of the thin ureteroscope facilitates smoother insertion into the bile duct, reducing procedural difficulty. Moreover, its design ensures ample space between the lens body and the bile duct, thereby enhancing the success rate of both operation and stone removal while significantly mitigating the risk of bile duct injury. By utilizing flexible ureteroscope for choledoscopy, we avoided the potential injuries caused by direct clamping, thereby enhancing the safety and reliability of the procedure. Rothstein et al. also suggested that combined ureteroscope may be helpful depending on the patient's body size (27).

To comprehensively investigate and consolidate the management of cholecystolithiasis combined with bile duct stones in children, we conducted a thorough review and analysis of prior studies (18, 25, 28–44) (Supplementary Table 1). Our findings indicate that a majority of pediatric patients typically present with abdominal pain, often accompanied by a history of inherited hematologic disorders. Laboratory investigations commonly reveal elevated levels of total bilirubin and liver enzymes. Furthermore, ultrasound or imaging examinations frequently detect bile duct dilatation and stones. The main surgical methods were LC + ERCP or LCBDE, but the specific approaches or surgical instruments were different. For example, choledochoscope, ureteroscope, cystoscope

and so on can be used in bile duct exploration. Moreover, the operative approach may involve access via the cystic duct or the CBD. For LC + ERCP, the sequence of the two procedures also differed among studies. In addition, we also note that for these two surgical methods, we need to avoid the occurrence of complications such as bleeding, pancreatitis, and retained stones.

At present, there is no clinical guideline for the treatment of children with cholecystolithiasis and bile duct stones. This article aims to provide a feasible surgical treatment for children and summarize previous methods to enhance awareness among medical practitioners. The selection of specific clinical treatment should be individualized based on comprehensive consideration of the patient's condition, cost-effectiveness, safety and feasibility of surgical plans, which is worthy of further exploration and practice.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors on request.

Ethics statement

The studies involving humans were approved by the First Hospital of Jilin University IRB (No. 2024–529). The studies were conducted in accordance with the local legislation and institutional requirements. Written informed consent was not obtained from the individual(s) for the publication of any potentially identifiable images or data included in this article because Patient consent was waived due to all data having been de-identified. This report does not contain any personal information that could lead to the identification of the patient.

Author contributions

CF: Conceptualization, Writing – original draft. HJ: Software, Writing – original draft. LF: Data curation, Writing – review & editing. HX: Conceptualization, Supervision, Writing – review & editing.

Funding

The author(s) declare that no financial support was received for the research, authorship, and/or publication of this article.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Supplementary material

The Supplementary material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fmed.2024.1429127/full#supplementary-material

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