

Percutaneous management of bile duct stones in children: results of 12 cases

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PURPOSE

We aimed to evaluate the effectiveness of percutaneous transhepatic removal of bile duct stones in children.

METHODS

The study included 12 pediatric patients (4 males, 8 females; age range, 1–16 years; mean age, 6.6 years) who underwent percutaneous transhepatic removal of bile duct stones between September 2007 and December 2015. Demographic data, patient symptoms, indications for interventions, technical and clinical outcomes of the procedure, and complications were retrospectively evaluated.

RESULTS

Of 12 children, five children with cholelithiasis underwent cholecystectomy subsequently. The overall technical and clinical success rate was 100%. One patient had cholangitis as a complication during the follow-up and was treated medically.

CONCLUSION

Percutaneous transhepatic removal of bile duct stones is a safe and effective method for the treatment of children with biliary stone disease. It is a feasible alternative when the endoscopic procedure is unavailable or fails.

Percutaneous biliary interventions in children are performed primarily for liver transplant complications. The other indications are classified as malignant or benign biliary obstruction (1–7). Biliary obstruction caused by an underlying malignancy or common bile duct (CBD) stones is not a frequently encountered problem in children. The prevalence of cholelithiasis is between 0.13% and 2% in children, and CBD stones occur in 10%–20% of children with cholelithiasis (8). Endoscopic retrograde cholangiopancreatography (ERCP) is the preferred method for evaluation and management of pancreaticobiliary disorders including biliary obstruction due to stones and stricture, acute and chronic pancreatitis, choledochal cysts, and bile leaks (4, 5). Many centers have age and size limitation for ERCP and it is often difficult to perform in small infants. In such cases, percutaneous methods are preferred as an alternative (2, 3). In this paper, we present the results of percutaneous transhepatic management of bile duct stones in 12 children.

Methods

Patients

The study included 12 pediatric patients (4 males, 8 females; age range, 1–16 years; mean age, 6.6 years) who underwent percutaneous transhepatic bile duct stone removal between September 2007 and December 2015. Demographic data, patient symptoms, indications for interventions, technical and clinical outcomes of the procedure, and procedure-related complications were retrospectively evaluated. Demographic data of the children who underwent percutaneous removal of CBD stones are displayed in the Table. Approval for the study was granted by the Institutional Research Ethics Committee.

All children were symptomatic; the presenting symptoms were obstructive jaundice, biliary colic, and cholangitis with abdominal pain.

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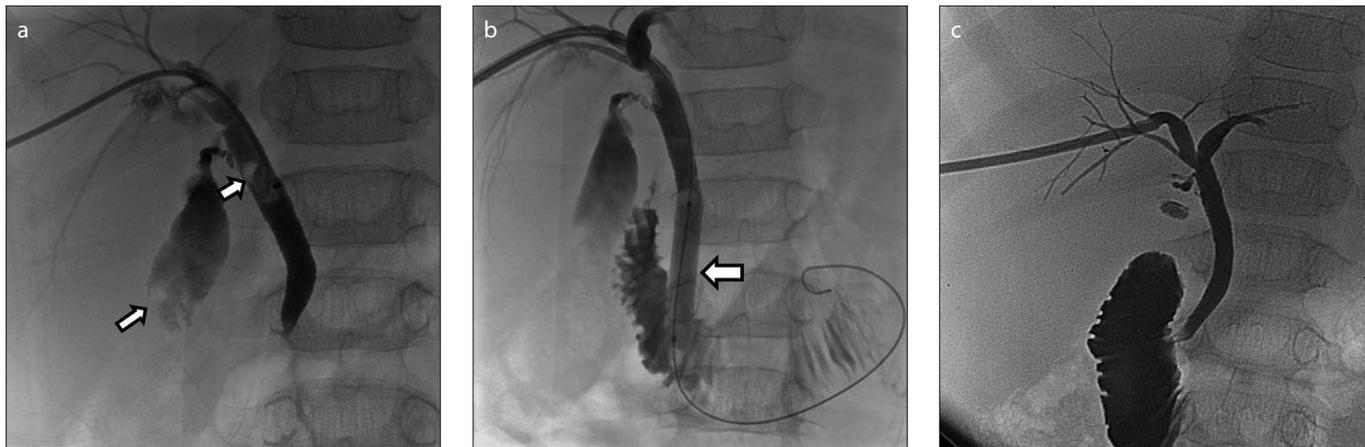


Figure. a–c. One-year-old female patient presented with jaundice and serum bilirubin level of 8.1/7.1 mg/dL. Percutaneous transhepatic cholangiography image (a) shows two stones, 6 mm in diameter (arrows) in the common bile duct with mild dilatation of the biliary tree. After 8 mm balloon dilatation of the Oddi sphincter (b, arrow), the stones were pushed into the duodenum by a Fogarty balloon catheter (not shown). Control cholangiography (c) after laparoscopic cholecystectomy demonstrates normal caliber of the biliary tree with free flow of bile to the duodenum.

Liver function tests, serum bilirubin levels, complete blood count, and blood coagulation parameters were reviewed, and any coagulation disorder was corrected before the procedure. Abdominal ultrasonography (US) examination was performed routinely, and magnetic resonance imaging (MRI) findings were carefully examined to evaluate the biliary system before the procedure. The diagnosis of biliary stone disease was made from clinical examination, US, and MRI examination.

Completion of the interventional procedure was accepted as technical success. Complete resolution or reduction of symptoms was defined as clinical success.

Technique

Informed consent was obtained from the parents of all children before the procedure. All procedures were performed under intravenous sedation provided by a qualified anesthesiologist. Continuous monitoring was performed during the operation in all cases. Intravenous broad-spectrum antibi-

otic (cephalosporin) prophylaxis was administered before the procedures, except in patients already receiving antibiotic treatment. The procedures were performed with fluoroscopy guidance under standard sterile conditions. Low pulse rate fluoroscopy and optimal collimation were used to reduce radiation exposure and gonadal protection.

Using a right intercostal approach, percutaneous transhepatic cholangiography was performed to evaluate the biliary tree. A 21-gauge Chiba needle (Cook Medical) was advanced into the liver parenchyma. After removing the stylet, the needle was retracted slowly during injection of nonionic contrast media (Iopromide, Ultravist 370, Schering Pharma) until a biliary duct was opacified. If no bile duct was displayed on the initial trial, this maneuver was repeated in different directions without leaving the liver capsule. When a central duct was entered, a more peripheral duct was punctured using a second needle to reduce the risk of hemorrhagic complications. After biliary opacification, a 0.018-inch microguide was advanced into the hepatic duct via the needle. A coaxial introducer system (Boston Scientific) was placed into the bile duct over the microguide. Entrance to the bile duct was obtained after removing the stiffener and 4 French (F) dilator, and more contrast material was administered to ensure the complete opacification of the biliary tree. Dilatation of the tract was performed using a 7 F dilator over a 0.035-inch floppy tip guidewire (Boston Scientific), and a 7 or 8 F introducer was placed into the common hepatic duct. The guidewire was advanced

into the duodenum through the sphincter of Oddi, via the sheath. Then, balloon dilatation catheter (XXL, Boston Scientific/Medi-tech) was placed across the sphincter over the wire. The balloon diameter, ranging from 8 to 12 mm, was selected according to the transverse diameter of the largest stone size. The balloon length was 40 mm. The balloon was inflated until indentation of the sphincter shield was obtained for 30–60 s. Following dilatation, the expulsion of all the stones into the duodenum was performed with an over-the-wire Fogarty balloon catheter (Fig.). After this process, an 8 F external biliary drainage catheter (Flexima, Boston Scientific) was placed into the common hepatic duct to provide biliary system decompression.

Results

Control cholangiography was performed via the existing catheter 2–7 days (median, 3.1 days) after the procedure in all patients. When normal bile flow and absence of residual stone were verified, the catheter was removed, and the tract was closed using gelfoam sponge.

The overall technical and clinical success rates were 100%. The serum bilirubin levels and symptoms of cholangitis returned to normal following the procedures and medical treatment in all patients.

Bile duct stones were successfully pushed into the duodenum in all patients. Of 12 children, five with concomitant cholelithiasis underwent cholecystectomy subsequently, one of whom had a duplicated gallbladder with double cystic duct

Main points

- Biliary stone disease is rarely seen in children, and clearance of bile duct stones can be a challenging task in children.
- Percutaneous transhepatic removal of bile duct stones is a safe and effective method for the treatment of children with biliary stone disease.
- It may be used as an alternative technique when the endoscopic procedure is unavailable or fails.

Table. Demographic data of the children who underwent percutaneous removal of common bile duct stones

Patient no.	Age (yrs)/Sex	Predisposing factor	Cholelithiasis	Largest stone diameter (mm)	Number of stones	Balloon diameter (mm)	Complication	Follow-up (months)
1	11/M	Thalassemia	Yes	7	2	8	-	28
2	3/F	-	No	10	3	12	-	20
3	7/F	-	No	7	4	8	-	33
4	10/F	-	No	8	4	10	-	41
5	16/F	-	Yes	8	1	10	-	60
6	1/F	-	Yes	6	2	8	-	21
7	4/F	-	Yes	10	4	12	Cholangitis	31
8	3/F	Type I choledochal cyst	No	5	1	8	-	32
9	3/M	Anomalous PBDJ	No	6	1	8	-	24
10	4/M	-	No	5	1	8	-	11
11	8/F	Thalassemia	Yes	-	Sludge	8	-	15
12	9/M	-	No	5	>4	8	-	26

M, male; F, female; PBDJ, pancreaticobiliary duct junction.

and one had type 1 choledochal cyst. The patient with choledochal cyst underwent choledochoduodenostomy after percutaneous biliary drainage, developed the catheter was withdrawn after surgery. Only one patient had cholangitis as a complication during the follow-up and was treated medically. There was no procedure-related mortality. All children remained asymptomatic during the follow-up period. The mean follow-up time was 28.5 months (range, 11–60 months).

Discussion

In this study, we present our experience in the management of 12 children with CBD stones causing biliary obstruction. Complete clearance of the bile duct was achieved with symptomatic improvement by percutaneous stone expulsion into the duodenum in all cases. To the best of our knowledge, this is the first report demonstrating that percutaneous stone expulsion into the duodenum is a safe and effective method for the treatment of children with biliary stone disease.

Biliary obstruction is rarely seen in children from either benign or malignant causes. Biliary atresia, choledochal cyst, and choledocholithiasis are the most common benign causes whereas rhabdomyosarcoma is the most common malignant cause (9). Gallbladder and CBD stones rarely occur in children, and are seen in patients with predisposing factors or diseases such as hematologic problems, distal ileum dis-

orders, choledochal cysts, or pancreaticobiliary duct anomalies (8, 10). Clearance of bile duct stones can be a challenging task in small children, and is based on the availability of expertise of endoscopy, intervention, or surgery. Percutaneous interventional techniques, endoscopic methods or surgical procedures are available for the treatment of children with CBD stones.

Open or laparoscopic CBD exploration is the method for removal of bile duct stones in children (11–13). The success rate of laparoscopic CBD exploration is between 60% and 87.5% with 0%–30% complication rates (11–13). Lau et al. (12) reported eight cases that underwent laparoscopic CBD stone removal after laparoscopic cholecystectomy using saline flush, balloon catheters, nitinol stone extractor, and glucagon. Procedures were successful in seven patients. We think that surgery may be considered when the stones cannot be managed nonsurgically.

Stone extraction may be performed endoscopically with or without sphincterotomy, and may be combined with laparoscopic cholecystectomy, if needed. ERCP has 95%–100% success rate and 3.2%–7.7% complication rate (4, 5, 14–17). Effect of sphincterotomy on the papilla such as biliopancreatic reflux, cholangitis, and the risk of papillary stenosis is unclear in children over the long-term. However, ERCP is not always accessible to children or not available in all centers. In such cases, percutaneous transhepatic stone removal is an alternative method for the management of CBD stones. Although high success rates of percutane-

ous transhepatic biliary stone removal have been reported in adult populations (18–20), there have been no studies about percutaneous bile duct stone removal in children. Percutaneous transhepatic biliary procedures are often challenging in children, particularly in newborn, due to the small size of bile ducts. Our study demonstrates that percutaneous transhepatic management of CBD stones is safe and effective in children.

A variety of options are available for treatment of children with choledochocystolithiasis. Treatment of choledocholithiasis as well as cholecystolithiasis is possible surgically as a single stage procedure (11, 12). Endoscopic sphincterotomy and subsequent cholecystectomy is a two-stage procedure. In the current study, five children with choledochocystolithiasis underwent laparoscopic cholecystectomy following percutaneous clearance of the CBD stones. In these children, external drainage catheters were withdrawn to allow for demonstration of absence of residual stones following cholecystectomy.

When bile duct stones are detected in children, predisposing factors including hemolytic disorders, choledochal cyst, and anomalous pancreaticobiliary junction should be excluded (10, 13). In our series, predisposing factors including choledochal cyst (n=1), thalassemia (n=2), an anomalous pancreaticobiliary junction (n=1) were detected in four children. No recognizable predisposing factors were detected in the remaining children.

In children, complications of percutaneous transhepatic biliary procedures are infection and bleeding due to trauma (e.g., sepsis, cholangitis, and hemobilia), perforation, malposition of the catheter, or catheter blockage (1–5). In the current study, cholangitis was seen in one patient who was treated medically. No additional complications and no mortality were noted.

The main limitations of this study are the retrospective nature of the study and the small number of patients.

In conclusion, percutaneous transhepatic expulsion of bile duct stones into the duodenum is a safe and effective method in treatment of pediatric patients with biliary stone disease. It is a feasible alternative when the endoscopic procedure is unavailable or has failed.

Conflict of interest disclosure

The authors declared no conflicts of interest.

References

- Schirmer BD, Winters KL, Edlich RF. Cholelithiasis and cholecystitis. *J Long Term Eff Med Implants* 2005; 15:329–338. [\[CrossRef\]](#)
- Racadio JM, Kukreja K. Pediatric biliary interventions. *Tech Vasc Interv Radiol* 2010; 13:244–249. [\[CrossRef\]](#)
- Atchie B, Kalva S, Josephs S. Pediatric biliary interventions. *Tech Vasc Interv Radiol* 2015; 18:276–284. [\[CrossRef\]](#)
- Troendle DM, Barth BA. Pediatric considerations in endoscopic retrograde cholangiopancreatography. *Gastrointest Endosc Clin N Am* 2016; 26:119–136. [\[CrossRef\]](#)
- Giefer MJ, Kozarek RA. Technical outcomes and complications of pediatric ERCP. *Surg Endosc* 2015; 29:3543–3550. [\[CrossRef\]](#)
- Belenky A, Mor E, Bartal G, et al. Transhepatic balloon dilatation of early biliary strictures in pediatric liver transplantation: successful initial and mid-term outcome. *Cardiovasc Intervent Radiol* 2004; 27:491–494. [\[CrossRef\]](#)
- Lorenz JM, Denison G, Funaki B, Leef JA, Van Ha T, Rosenblum JD. Balloon dilatation of biliary-enteric strictures in children. *AJR Am J Roentgenol* 2005; 184:151–155. [\[CrossRef\]](#)
- Debray D, Franchi-Abella S, Irtan S, Girard M. Cholelithiasis in infants, children and adolescents. *Presse Med* 2012; 41:466–473. [\[CrossRef\]](#)
- Akinci D, Gumus B, Ozkan OS, et al. Percutaneous management of tumoral biliary obstruction in children. *Pediatr Radiol* 2007; 37:975–980. [\[CrossRef\]](#)
- Krishna RP, Lal R, Sikora SS, Yachha SK, Pal L. Unusual causes of extrahepatic biliary obstruction in children: a case series with review of literature. *Pediatr Surg Int* 2008; 24:183–190. [\[CrossRef\]](#)
- Muller CO, Boimond MB, Rega A, Michelet D, El Ghoneimi A, Bonnard A. Safety and efficacy of one-stage total laparoscopic treatment of common bile duct stones in children. *Surg Endosc* 2015; 29:1831–1836. [\[CrossRef\]](#)
- Lau BJ, Sydorak RM, Shaul DB. Laparoscopic techniques for safe and successful removal of common bile duct stones in pediatric patients. *J Laparoendosc Adv Surg Tech A* 2014; 24:362–365. [\[CrossRef\]](#)
- Bonnard A, Seguier-Lipszyc E, Liguory C, et al. Laparoscopic approach as primary treatment of common bile duct stones in children. *J Pediatr Surg* 2005; 40:1459–1463. [\[CrossRef\]](#)
- Osanaï M, Maguchi H, Takahashi K, et al. Safety and long-term outcomes of endoscopic papillary balloon dilation in children with bile duct stones. *Gastrointest Endosc* 2011; 73:619–623. [\[CrossRef\]](#)
- Durakbasa CU, Balik E, Yamaner S, et al. Diagnostic and therapeutic endoscopic retrograde cholangiopancreatography (ERCP) in children and adolescents: experience in a single institution. *Eur J Pediatr Surg* 2008; 18:241–244. [\[CrossRef\]](#)
- Vegting IL, Tabbers MM, Taminiau JA, Aronson DC, Benninga MA, Rauws EA. Is endoscopic retrograde cholangiopancreatography valuable and safe in children of all ages? *J Pediatr Gastroenterol Nutr* 2009; 48:66–71. [\[CrossRef\]](#)
- Issa H, Al-Haddad A, Al-Salem AH. Diagnostic and therapeutic ERCP in the pediatric age group. *Pediatr Surg Int* 2007; 23:111–116. [\[CrossRef\]](#)
- Ilgit ET, Gürel K, Onal B. Percutaneous management of bile duct stones. *Eur J Radiol* 2002; 43:237–245. [\[CrossRef\]](#)
- Ozcan N, Kahriman G, Mavili E. Percutaneous transhepatic removal of bile duct stones: results of 261 patients. *Cardiovasc Intervent Radiol* 2012; 35:890–897. [\[CrossRef\]](#)
- Gil S, de la Iglesia P, Verdú JF, de España F, Arenas J, Irurzun J. Effectiveness and safety of balloon dilation of the papilla and the use of an occlusion balloon for clearance of bile duct calculi. *AJR Am J Roentgenol* 2000; 174:1455–1460. [\[CrossRef\]](#)