

Available online at [www.sciencedirect.com](http://www.sciencedirect.com)

ScienceDirect

journal homepage: [www.elsevier.com/locate/radcr](http://www.elsevier.com/locate/radcr)

## Case Report

# Percutaneous transhepatic bilioenteric neoanastomosis: A novel approach for managing bile duct injuries following choledochal cyst resection in patients with anatomical variations of the biliary tree: A case study ☆,☆☆

Tran Quoc Hoa, MD, PhD<sup>a,b</sup>, Nguyen Thai Binh, MD, PhD<sup>c,d</sup>, Pham Son Nam, MD<sup>d</sup>, Phan Nhan Hien, MD<sup>d,e,\*</sup>

<sup>a</sup>Department of Anatomy, Hanoi Medical University, Hanoi, Viet Nam

<sup>b</sup>Department of General Surgery, Hanoi Medical University, Hanoi, Viet Nam

<sup>c</sup>Radiology Department, Hanoi Medical University, Hanoi, Viet Nam

<sup>d</sup>Radiology Center, Hanoi Medical University Hospital, Hanoi, Viet Nam

<sup>e</sup>Radiology Department, Seoul St' Mary Hospital, Colleague of Medicine, The Catholic University of Korea, Seoul, Korea

## ARTICLE INFO

## Article history:

Received 19 November 2023

Revised 23 November 2023

Accepted 24 November 2023

## Keywords:

Bile duct injuries

Choledochal cysts

Percutaneous transhepatic

bilioenteric neoanastomosis

Variant biliary anatomy

## ABSTRACT

Bile duct injuries are rare complications of hepatobiliary pancreatic surgery, leading to severe complications if not timely diagnosed and treated, with surgery traditionally being the primary treatment option. However, percutaneous transhepatic or endoscopic interventions have recently gained widespread use. We present a case study of a patient with variant biliary anatomy, who suffered biliary tract injury postcholedochal cyst resection and Roux-en-Y hepaticojejunostomy; successfully treated with percutaneous transhepatic bilioenteric neoanastomosis, guided by ultrasound and digital subtraction angiography (DSA).

© 2023 The Authors. Published by Elsevier Inc. on behalf of University of Washington.

This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>)

☆ Acknowledgments: This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

☆☆ Competing Interests: The authors declare that there is no conflict of interest.

\* Corresponding author.

E-mail address: [hienpn0600@hmu.vn](mailto:hienpn0600@hmu.vn) (P.N. Hien).

<https://doi.org/10.1016/j.radcr.2023.11.063>

1930-0433/© 2023 The Authors. Published by Elsevier Inc. on behalf of University of Washington. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>)

## Introduction

Choledochal cysts represent a rare congenital anomaly of the biliary system, characterized by the isolated abnormal dilation of the intrahepatic or extrahepatic bile ducts, or a combination of both. Stone formation and cholangitis are the 2 most common complications in patients with choledochal cysts. Laparoscopic cyst excision and Roux-en-Y hepaticojejunostomy are considered the primary treatment options for most cases [1].

Anatomical variations in the biliary tract pose a risk factor for biliary complications in hepato-biliary surgery, particularly bile duct injury post cholecystectomy and surgeries involving the choledochal duct [2]. Depending on the types of the biliary injury, different treatment approaches are selected, such as endoscopic, percutaneous transhepatic, or surgery; however, percutaneous transhepatic are often the first choice for managing prior complications and for definitive or adjunctive surgical treatment [3,4].

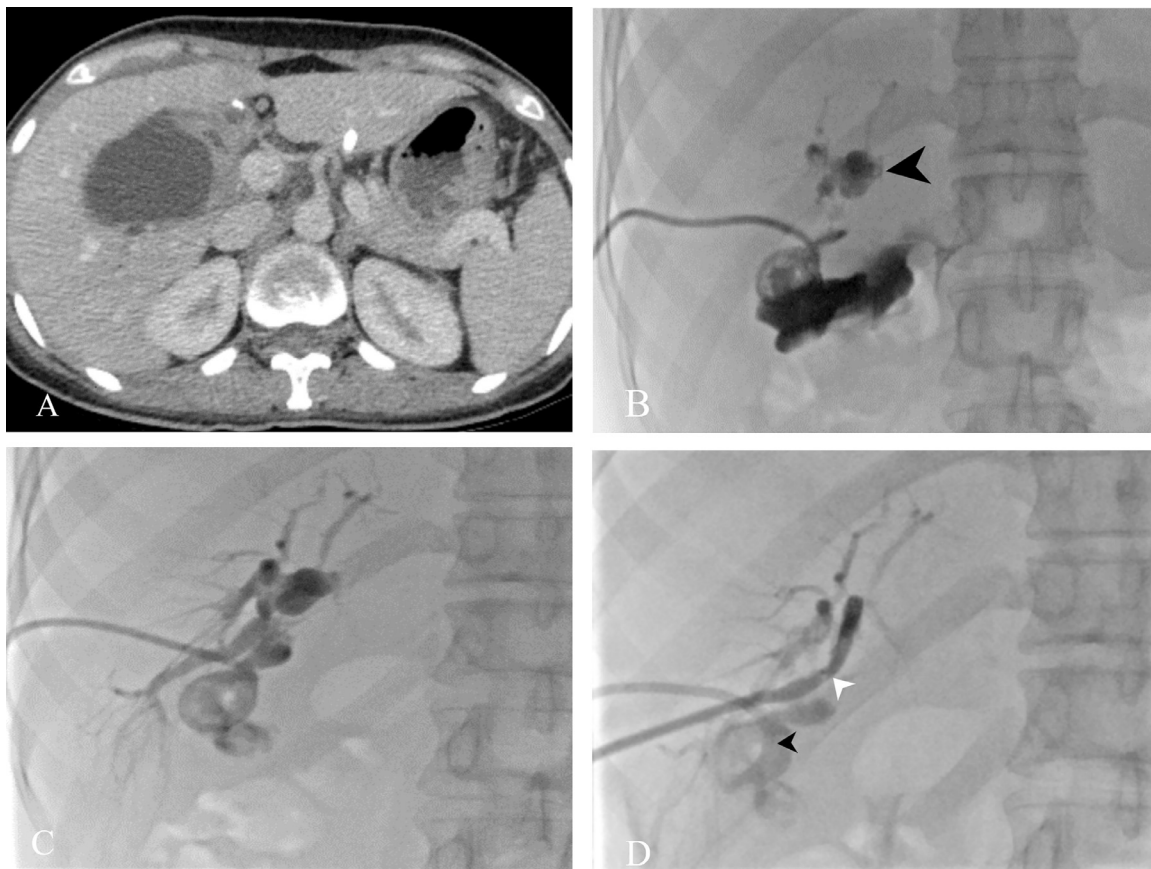
We present a case using the technique of percutaneous transhepatic bilioenteric neoanastomosis (PTBN) to treat a patient with right posterior segmental bile duct injury following choledochal cyst resection, who had biliary anatomical variations including the absence of a right hepatic duct, with the

right posterior segmental bile duct (RPBD) draining directly into the common hepatic bile duct.

## Case presentation

A 22-year-old female patient presented with a history of chronic right flank pain. Abdominal ultrasonography and magnetic resonance cholangiopancreatography diagnosed a type 1 choledochal cyst according to the Todani classification, with the choledochal cyst's largest diameter measuring 5 cm. The patient underwent laparoscopic excision of the choledochal cyst combined with a Roux-en-Y hepaticojejunostomy.

Three months postsurgery, the patient developed abdominal pain accompanied by fever. Laboratory findings on admission with a white blood cell count (WBC) of 7.65G/L (Reference range: 4.4-10.9 G/L), neutrophilia at 76.5% (Reference range: 37%-80%), bilirubin at 12.7  $\mu\text{mol/L}$  (Reference range: <17.1  $\mu\text{mol/L}$ ), AST of 80 U/L (Reference range <40 U/L), and ALT of 42 U/L (Reference range <40 U/L). Abdominal CT imaging revealed a 6 cm fluid collection at the hepatic hilum, along with mild dilatation of the right RPBD. Percutaneous drainage of the fluid collection was performed using an 8F Pigtail catheter (ReSolve, Merit, South Jordan, UT), which yielded biliary fluid.



**Fig. 1 – (A)** CT scan upon patient admission showing a large biloma in the hepatic hilum region with a diameter of 6 cm; **(B and C)** Drainage of the biloma using an 8F drainage catheter, with imaging through the catheter revealing the right posterior segmental bile duct (RPBD); **(D)** Placement of a 9F drainage catheter into the RPBD.



**Fig. 2 – (A) Insertion of a 16 G Agiocath needle through the tunnel of the RPBID drainage catheter; (B), under the guidance of DSA and ultrasound, the needle is advanced through liver parenchyma towards the jejunal loop; (C), after confirming the needle's position within the jejunal loop, a 0.035 guide wire is threaded from the right posterior segmental bile duct into the jejunal loop; (D), a 6F drainage catheter is initially placed into the bilioenteric neoanastomosis, subsequently replaced with an 8F drainage catheter after 2 weeks.**

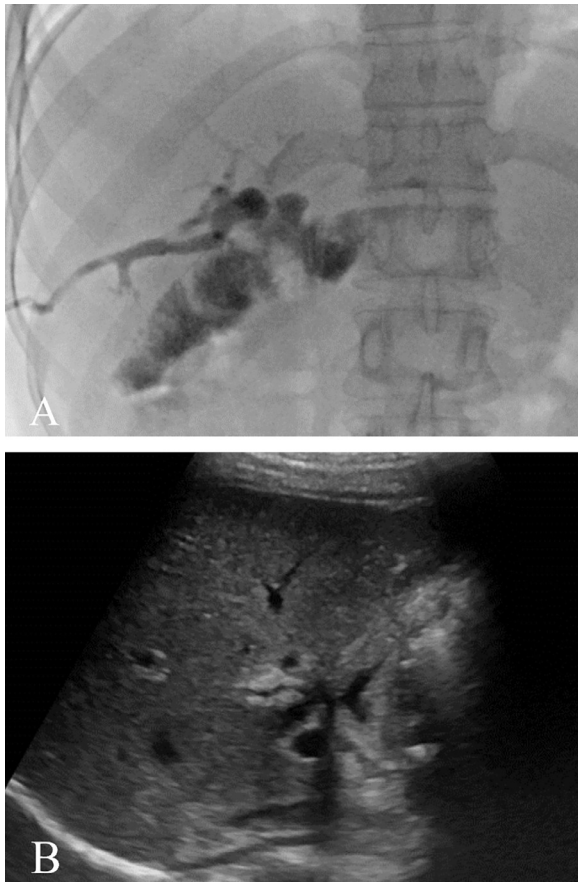
Contrast injection into the biloma demonstrated the RPBID, but there was no visualization of the anterior segmental bile duct or left hepatic bile ducts, nor contrast flow into the hepaticojejunostomy site. After 3 days, following resolution of the infection, a 9F drainage catheter was placed percutaneously in the RPBID. One week postbiliary drainage catheter placement, the fluid collection catheter was removed. Follow-up imaging showed no biliary leakage into the peritoneal cavity. Subsequently, the patient underwent PTBN.

Prior to the removal of the biliary drainage, a 0.035-inch guide wire (Terumo, Shibuya-ku, Tokyo, Japan) was threaded through the catheter into the RPBID. Subsequently, and needle 16 gauge (BD Angiocath, NY) was introduced into the same biliary branch through the drainage track. Under DSA and ultrasound guidance, the needle traversed the hepatic parenchyma towards the jejunal loop of the hepaticojejunostomy. After contrast injection confirmed jejunal loop visualization, a 6F drainage catheter was placed with the tip in the jejunal loop and the side hole at the RPBID. Good contrast flow into the jejunal loop was observed. Two weeks later, the catheter was replaced with a larger 8F catheter. One month postprocedure, the catheter was removed, and follow-up imaging demonstrated good flow from the RPBID

into jejunal loop. The patient underwent regular 6-month follow-up, with ultrasound showing no fluid collection, mild bilateral intrahepatic ductal dilatation, no evidence of fluid collections, and no signs of infection or biliary stasis.

## Discussion

Biliary tract injuries are a rare complication associated with hepatobiliary pancreatic surgeries, leading to serious complications if not diagnosed and treated promptly [4]. In surgeries involving resection of the choledochal cyst combined with a Y-shaped hepaticojejunostomy, according to Zhang's study, the complication rate related to the biliary tract was 5.6% [1]; in another study by Lee, the biliary complication rate was 2.7%. This rate did not differ significantly between laparoscopic and open surgeries [5]. In contrast, for cholecystectomy, the postoperative biliary tract injury rate increased from 0.2% in open surgeries to 0.5% in laparoscopic surgeries [3]. One of the risk factors for biliary tract injury is the presence of variant biliary anatomy. Thorough preoperative biliary anatomy assessment is crucial, not only in liver transplantation but



**Fig. 3 – After 3 months the drainage catheter was removed: (A), imaging through the catheter tunnel shows a well-functioning bilioenteric neoanastomosis, with no evidence of leakage into the abdominal cavity or beneath the hepatic capsule; (B), ultrasound examination at 6 months reveals mild dilation of the intrahepatic bile ducts, without any abnormal fluid collections around the hepatic region.**

also in all surgeries involving the biliary tract [6,7]. Zhang suggests that intraoperative cholangiography helps minimize the risk of biliary tract injury [1] (Fig. 1).

Management of bile duct injuries typically involves a multidisciplinary approach, dependent on the type of injury, time of detection, overall condition of the patient, and the complications being faced. Accurate assessment of the injury aids in selecting the safest and most effective treatment method. Surgery has traditionally been the preferred option, though it comes with its own complexities and potential complications. In patients who have undergone hepaticojejunostomy, percutaneous interventions are increasingly favored [8]. The creation of bilioenteric neoanastomosis has been reported by some authors as a viable solution for patients with postoperative biliary tract injuries [9,10]. Wnuk suggests that combining cone beam CT imaging with balloon insertion into the jejunal loop is a safer alternative compared to traditional transjejunal approaches [11–13]. In our clinical case, the percutaneous transhepatic approach under ultra-

sound and DSA guidance was a safe and convenient choice. Varying the size of the drainage catheter from small to large at different stages, instead of using balloon dilatation from the beginning, minimizes the risk of hepatic and jejunal loop trauma at the anastomosis site (Fig. 2).

One of the challenges in performing PTBN is the potential for stricture formation in the newly formed biliary conduit. In our patient, during a follow-up period of 6 months, there was no evidence of stricture formation or any infection (Fig. 3). However, regular monitoring is essential, and the placement of a covered stent should be considered for future management.

## Conclusion

Percutaneous transhepatic bilioenteric neoanastomosis, guided by ultrasound and DSA, presents a novel option for patients with postoperative biliary tract injuries, particularly in cases involving hepaticojejunostomy. Future surveillance for potential restenosis remains imperative.

## Ethical approval

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. For this type of study formal consent is not required.

## Consent for publication

Consent for publication was obtained for every individual person's data included in the study.

## Patient consent

Written informed consent for the publication of this case report was obtained from the patient.

## REFERENCES

- [1] Zhang B, Wu D, Fang Y, Bai J, Huang W, Liu M, et al. Early complications after laparoscopic resection of choledochal cyst. *Pediatr Surg Int* 2019;35:845–52.
- [2] Michael Brunt L, Deziel DJ, Telem DA, Strasberg SM, Aggarwal R, Asbun H, et al. Safe cholecystectomy multi-society practice guideline and state-of-the-art consensus conference on prevention of bile duct injury during cholecystectomy. *Surg Endosc* 2020;34:2827–55.

- [3] Tropea A, Pagano D, Biondi A, Spada M, Gruttadauria S. Treatment of the iatrogenic lesion of the biliary tree secondary to laparoscopic cholecystectomy: a single center experience. *Updates Surg* 2016;68:143–8.
- [4] Cohen JT, Charpentier KP, Beard RE. An update on iatrogenic biliary injuries: identification, classification, and management. *Surg Clin* 2019;99(2):283–99.
- [5] Lee C, Byun J, Ko D, Yang H-B, Youn JK, Kim H-Y. Comparison of long-term biliary complications between open and laparoscopic choledochal cyst excision in children. *Ann Surg Treat Res* 2021;100(3):186–92.
- [6] Thompson CM, Saad NE, Quazi RR, Darcy MD, Picus DD, Menias CO. Management of iatrogenic bile duct injuries: role of the interventional radiologist. *Radiographics* 2013;33(1):117–34.
- [7] Choi JW, Kim TK, Kim KW, Kim AY, Kim PN, Ha HK, et al. Anatomic variation in intrahepatic bile ducts: an analysis of intraoperative cholangiograms in 300 consecutive donors for living donor liver transplantation. *Korean J Radiol* 2003;4(2):85–90.
- [8] Nguyen HV, Do DH, Van Nguyen H, Vu TH, Hong QQ, Vo CT, et al. Treatment of complex complications after choledochal cyst resection by multiple minimal invasive therapies: a case report. *Int J Surg Case Rep* 2020;73:130–3.
- [9] Steinbrück I, Otto H, Ullrich S, Ruether C, Fischbach R, Pohl J, et al. Endoscopic neo-anastomosis by Rendez-vous technique for the treatment of complete occlusion of bilioenteric anastomoses and distal bile ducts (case series). *Zeitschrift für Gastroenterologie* 2021;59(11):1197–204.
- [10] McPherson SJ, Gibson RN, Collier NA, Speer TG, Sherson ND. Percutaneous transjejunal biliary intervention: 10-year experience with access via Roux-en-Y loops. *Radiology* 1998;206(3):665–72.
- [11] Lee SM, Kim HB, Lee IJ. Fluoroscopy-guided transgastric hepaticoanastomosis in a patient with bile leakage associated with biliary obstruction after left hepatic trisectionectomy. *J Vasc Interv Radiol* 2015;26(11):1748–50.
- [12] Kloeckner R, Dueber C, dos Santos DP, Kara L, Pitton MB. Fluoroscopy-guided hepaticojejunostomy in recurrent anastomotic stricture after repeated surgical hepaticojejunostomy. *J Vasc Interv Radiol* 2013;24(11):1750–2.
- [13] Wnuk N, Pabon-Martinez AM, Mahvash A, Chintalapani G, Aloia TA, Odisio BC. Percutaneous-transhepatic creation of a bilioenteric neoanastomosis in a patient with bile duct injury using cone-beam computed tomography. *Int J Gastroint Interv* 2019;8(1):41–4.