Original Article

Safety and efficacy of hepaticoduodenostomy for biliary reconstruction after extrahepatic mid-bile duct cancer surgery

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Background: Bile duct resection and reconstruction for bile duct cancer (BDC) is a complex surgical and oncologic procedure that requires extensive resection and reconstruction of the biliary tract. Hepaticojejunostomy is commonly performed for biliary reconstruction after extrahepatic mid-bile duct resection, while hepaticoduodenostomy (HD) is performed only rarely due to the risk of ascending cholangitis. However, the efficacy of HD has not been well-established in extrahepatic mid-BDC surgery. In this study, we aimed to analyze the outcomes of HD in patients who underwent bile duct resection for extrahepatic mid-BDC.

Methods: We retrospectively analyzed 38 extrahepatic mid-BDC patients who underwent bile duct resection in our center between January 2018 and June 2023. We compared postoperative outcomes, cancer recurrence, and patient survival between hepaticojejunostomy (n=20) and HD (n=18) groups.

Results: Operation time for the HD group was significantly shorter than that of the hepaticojejunostomy group (188 *vs.* 206 min, P=0.044) with no significant differences in postoperative outcomes. Regression analysis showed that a HD was not associated with a significantly high risk of cancer recurrence or decrease in patient survival.

Conclusions: HD appears to have comparable operative benefits, postoperative complications, and oncologic outcomes to hepaticojejunostomy in extrahepatic mid-BDC patients.

Keywords: Bile duct cancer (BDC); hepaticoduodenostomy (HD); hepaticojejunostomy; postoperative complications; prognosis

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Introduction

Bilio-enteric reconstruction is necessary for various indications such as malignant or benign biliary disease, bile duct injury, and choledocho- or hepatolithiasis. Roux-en-Y hepaticojejunostomy (RYHJ) has been the preferred procedure for several decades and has become the standardized method for bilio-enteric reconstruction. However, RYHJ requiring an additional jejuno-jejunostomy (JJ) may be difficult in patients with extensive intra-abdominal adhesions or with a history of small bowel or gastric resections, and the Roux-en-Y limb is potentially problematic.

Hepaticoduodenostomy (HD) is the simplest form of biliary-digestive anastomosis as it involves minimal modifications to the normal anatomy. It is considered a comparatively less complex approach than RYHJ for bilio-enteric reconstruction and is commonly executed within surgical procedures like choledochal cyst excision. Nonetheless, RYHJ is preferred over HD due to the association of HD with specific complications such as sump syndrome and alkaline reflux (1,2). Incidence of sump syndrome has been reported to range between 0–8% in HD and is caused by bile stasis and accumulation of debris in the bile duct after a biliary-digestive anastomosis (3,4). Some studies have suggested that chronic recurrent cholangitis caused by HD is a predisposing factor for late development of cholangiocarcinoma (5,6).

However, some studies have concluded that HD leads to acceptable surgical outcomes based on low incidences of sump syndrome and alkaline reflux (3,7). The surgical and oncological efficacy of HD in extrahepatic mid-bile duct cancer (BDC) patients has not previously been reported, and previous studies have not studied patients with malignant disease or directly compared HD and RYHJ. Our aim in this study was to compare postoperative outcomes after HD or RYHJ in patients requiring bilio-enteric reconstruction for extrahepatic mid-BDC. This study also investigated oncologic outcomes after HD in patients with extrahepatic mid-BDC. We present this article in accordance with the STROBE reporting checklist (available at https://gs.amegroups.com/article/view/10.21037/gs-24-155/rc).

Highlight box

Key findings

- Hepaticoduodenostomy (HD) appears to have comparable operative benefits, postoperative complications, and oncologic outcomes to hepaticojejunostomy.

What is known and what is new?

- Hepaticojejunostomy is commonly performed for biliary reconstruction after bile duct resection, while HD is performed only rarely due to the risk of ascending cholangitis.
- HD is comparable or superior to hepaticojejunostomy in terms of operative time, postoperative complications, and oncologic outcomes. Particularly, HD should be considered in bile duct cancer (BDC) patients with a history of previous stomach or small bowel resection and those necessitating follow-up through endoscopic approaches.

What is the implication, and what should change now?

- Further research with larger patient populations and longer follow-up periods is needed to fully evaluate the long-term safety and efficacy of HD in BDC patients.

Methods

Study population

From January 2018 to June 2023, a single-center retrospective cohort study was conducted with 69 patients who underwent bile duct resection for extrahepatic BDC at Soonchunhyang University Bucheon Hospital. We excluded 17 patients who underwent pancreatoduodenectomy for distal BDC and 14 patients who underwent liver resection for proximal BDC (Klatskin tumor); the remaining 38 eligible patients were included in our analyses, and their tumor location was between the liver hilum and suprapancreatic margin of common bile duct. Based on the bilio-enteric reconstruction approach, we divided patients into two groups: an RYHJ group (n=20) and an HD group (n=18). The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The study was approved by the institutional review board of Soonchunhyang University Bucheon Hospital (No. SCHBC 2023-08-007) and informed consent was waived because of the retrospective nature of the study and the analysis used anonymous clinical data.

Surgical procedures and definitions of variables

The conventional surgical procedure for an extrahepatic mid-BDC is segmental resection of the bile duct with concurrent lymph node dissection. Retrocolic RYHJ were used as a standard reconstruction method in the RYHJ group and all HJs were anastomosed with one hepatic duct. In the case of HD, if the duodenum was sufficiently redundant through kocherization, the decision to perform HD was made by the operator in the operating field considering factors such as patient age, co-morbidities, and presence of adhesions due to previous surgeries. One Jackson-Pratt drain was left in the abdominal cavity in the foramen of Winslow near the hepaticojejunostomy.

Postoperative complications were reviewed based on medical records charted by attending physicians. General complications were graded using the Clavien-Dindo (C-D) classification (8). Recurrence-free survival (RFS) was defined as the time between the date of bile duct resection and the date of disease recurrence. Recurrence was determined by surgeons or oncologists when any suspicious lesions were identified on follow-up computed tomography scans. Overall survival (OS) was calculated from the date of bile duct resection to the date of death from any cause.

Statistical analyses

Statistical analyses were conducted to assess the differences between the two groups using independent *t*-tests in median values with interquartile range (IQR). Differences between the groups were examined using χ^2 test or Fisher's exact test and presented in numbers and percentages. To explore factors associated with postoperative complications, a logistic regression model was used. Univariable and multivariable Cox regression models were used to identify risk factors associated with disease recurrence and OS. Statistical significance was defined as a P value less than 0.05. Data analyses were conducted using the R software version 4.0.5 (The R Foundation for Statistical Computing, Vienna, Austria).

Results

Baseline characteristics and postoperative outcomes

Median age of patients in the RYHJ group was 65 years (IQR, 54–82 years), and this group of 20 patients comprised 14 males (70.0%) and six females (30.0%). The median age of patients in the HD group was 64 years (IQR, 22–76 years), and this group comprised 12 male (66.7%) and six female (33.3%) patients (*Table 1*). There were no significant differences in underlying diseases or American Society of Anesthesiologists score. There were also no significant differences in preoperative lab findings, modality of preoperative biliary drainage, or neoadjuvant chemotherapy between the two groups.

We compared postoperative outcomes in demographic and perioperative characteristics between patients who underwent RYHJ and those who underwent HD, as outlined in *Table 2*. The RYHJ group experienced a longer operation time than the HD group (206 *vs.* 188 min, P=0.044). However, there were no significant differences in estimated blood loss (P=0.58) or postoperative length of hospital stay (P=0.53). There were also no significant differences between the two groups in postoperative lab findings or pathologic outcomes. Postoperative complication rates were similar between groups (15.0% in the RYHJ group *vs.* 16.7% in the HD group; P>0.99), bile leak was 1 case in RYHJ group and ascending cholangitis was 1 case in HD group. There were nine cases of recurrence in the RYHJ group (45.0%) and six cases of recurrence in the HD group (33.3%). The recurrence sites were resection margin, portocaval area, and peritoneum. Six patients in the RYHJ group (30.0%) died, along with four patients in the HD group (22.2%). There was no statistically significant difference in recurrence rate (P=0.68) or survival rate (P=0.71) between the two groups.

Survival and risk factor analyses

RFS was determined by Kaplan-Meier analysis (*Figure 1*). The Kaplan-Meier curve showed no statistically significant difference in RFS (P=0.78) or in OS (P=0.58) between the two groups (*Figure 2*).

Risk factors for major complications were assessed using logistic regression models (*Table 3*). We selected variables that were universal risk factors of complication and main outcomes of this study. HD was not a significant factor in complications, including ascending cholangitis (P=0.88). Cox regression models to determine risk factor analysis for BDC recurrence revealed that level of carbohydrate antigen 19-9 (CA19-9) [hazard ratio (HR) =1.431, 95% confidence interval (CI): 1.086–2.157, P=0.008] and lymph node metastasis (HR =2.620, 95% CI: 1.356–9.269, P=0.01) had a significant relationship with recurrence after bile duct resection (*Table 4*). However, no variables in Cox regression models for risk factor analysis of OS were statistically significant, and HD was not a significant factor for either recurrence (P=0.69) or OS (P=0.91) (*Table 5*).

Discussion

The prognosis and surgical success of extrahepatic BDC have improved gradually over time, with a reported overall

Table 1 Preoperative patient's characteristics

Variables	Hepaticojejunostomy (n=20)	Hepaticoduodenostomy (n=18)	P value
Age (years)	65 [54–82]	64 [22–76]	0.24
Sex			>0.99
Male	14 (70.0)	12 (66.7)	
Female	6 (30.0)	6 (33.3)	
Body mass index (kg/m^2)	23.2 [18.1–33.8]	24.0 [16.7–32.1]	0.73
Underlying disease			
Hypertension	10 (50.0)	9 (50.0)	>0.99
Diabetes mellitus	4 (20.0)	6 (33.3)	0.46
Cardiovascular disease	1 (5.0)	3 (16.7)	0.32
Cerebrovascular disease	1 (5.0)	3 (16.7)	0.32
Chronic kidney disease	0 (0.0)	1 (5.6)	0.47
ASA score			0.35
1	3 (15.0)	3 (16.7)	
2	14 (70.0)	9 (50.0)	
3	3 (15.0)	6 (33.3)	
Pre-op. laboratory findings			
Albumin (g/dL)	3.7 [2.9–4.7]	3.5 [2.6–4.6]	0.35
Total bilirubin (mg/dL)	1.0 [0.4–5.8]	1.8 [0.5–14.0]	0.26
AST (U/L)	41 [16–79]	40 [10–113]	0.46
ALT (U/L)	34 [7–201]	22 [7–138]	0.48
CEA (ng/dL)	2.4 [1.0–21.4]	2.9 [0.6–380]	0.73
CA19-9 (mg/dL)	41 [4–1,161]	20 [5–3,948]	0.98
Pre-op. bile drainage			
ERBD	16 (80.0)	14 (77.8)	>0.99
Metal stent	1 (5.0)	0	0.57
PTBD	1 (5.0)	2 (11.1)	0.59
ENBD	1 (5.0)	2 (11.1)	0.59
Neoadjuvant treatment	2 (10.0)	1 (5.6)	0.67

Values are reported as median [interquartile range] for continuous variables and as counts with percentages for categorical variables. ASA, American Society of Anesthesiologists; op., operation; AST, aspartate transaminase; ALT, alanine transaminase; CEA, carcinoembryonic antigen; CA19-9, carbohydrate antigen 19-9; ERBD, endoscopic retrograde biliary drainage; PTBD, percutaneous transhepatic biliary drainage; ENBD, endoscopic nasobiliary drainage.

5-year survival rate for extrahepatic BDC in Korea of 27.5%; furthermore, 45.9% of patients receive surgical treatment within 4 months of diagnosis (9,10). RYHJ is currently the preferred choice over HD for bilio-enteric reconstruction in patients who are treated surgically for extrahepatic mid-BDC. This is primarily due to concerns of complications, such as sump syndrome, after HD (11-13). After HD, the remnant extrahepatic bile duct and intrahepatic bile duct become a potential sump (reservoir for food materials and liquids) (2,14). Accumulation of

Table 2 Postoperative outcomes between hepaticojejunostomy and hepaticoduodenostomy groups

Variables	Hepaticojejunostomy (n=20)	Hepaticoduodenostomy (n=18)	P value
Operation time (min)	206 [131–315]	188 [109–268]	0.044
Estimated blood loss (mL)	100 [50–300]	100 [50–1,200]	0.58
Hospital stays (days)	10 [8–20]	10 [6–22]	0.53
Post-op. laboratory findings			
Albumin (g/dL)	3.2 [2.4–3.9]	3.2 [2.6–4.6]	0.93
Total bilirubin (mg/dL)	1.4 [0.4–4.8]	1.2 [0.4–11.5]	0.65
AST (U/L)	61 [23–184]	61 [15–119]	0.56
ALT (U/L)	52 [7–139]	52 [11–94]	0.70
Pathologic outcomes			
Tumor size (cm)	2.1 [0.5–4.2]	2.3 [0.5–3.5]	0.85
Lymph node metastasis	7 (35.0)	5 (27.8)	0.89
Differentiation			0.59
Well	3 (15.0)	4 (22.2)	
Moderate	15 (75.0)	13 (72.2)	
Poor	2 (10.0)	1 (5.6)	
Perineural invasion	13 (65.0)	12 (66.7)	>0.99
Lympho-vascular invasion	1 (5.0)	1 (5.6)	>0.99
Resection margin (mm)	1.0 [0.1–21.0]	2.0 [0.1–10.0]	0.28
Complication	3 (15.0)	3 (16.7)	>0.99
C-D classification			0.82
0	17 (85.0)	15 (83.3)	
1	1 (5.0)	2 (11.1)	
2	2 (10.0)	1 (5.6)	
Ascending cholangitis	0	1 (5.6)	0.47
Adjuvant treatment	12 (60.0)	8 (44.4)	0.52
Recurrence	9 (45.0)	6 (33.3)	0.68
Death	6 (30.0)	4 (22.2)	0.71

Values are reported as median [interquartile range] for continuous variables and as counts with percentages for categorical variables. op., operation; AST, aspartate transaminase; ALT, alanine transaminase; C-D, Clavien-Dindo.

debris and static bile in this inadequately drained reservoir serves as a nidus for bacterial proliferation, subsequently impeding normal biliary drainage. This obstruction may lead to complications such as recurrent cholangitis, hepatic abscess, or biliary obstruction (2). In addition, indications for HD have not been well established, especially in malignant disease, and the mechanism underlying alkaline reflux associated with HD remains unknown. However, several studies have reported HD to have comparable postoperative complication rates, including that of ascending cholangitis, with RYHJ (3,15). One study reported no HD-related gastroduodenal ulcers when using H_2-inhibitors or proton pump inhibitor (16). Therefore, this study aimed to compare postoperative and oncologic

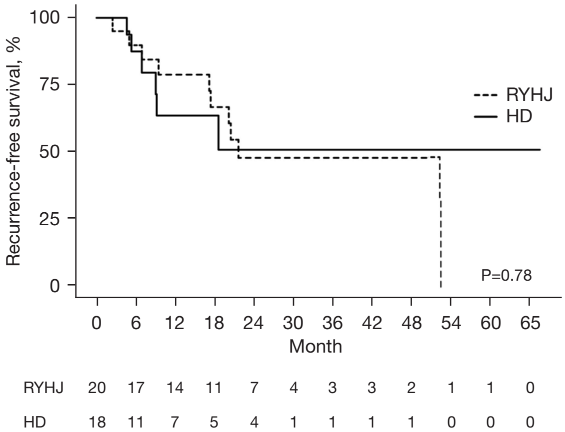

Figure 1 Recurrence-free survival estimated using the Kaplan-Meier method. RYHJ, Roux-en-Y hepaticojejunostomy; HD, hepaticoduodenostomy.

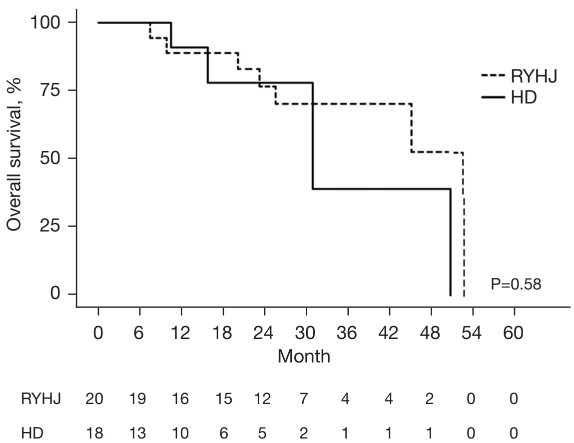

Figure 2 Overall survival estimated using the Kaplan-Meier method. RYHJ, Roux-en-Y hepaticojejunostomy; HD, hepaticoduodenostomy.

outcomes between RYHJ and HD in patients requiring bilio-enteric reconstruction for BDC; our findings are similar to those reported in the studies described above.

The HD group had a significantly shorter operative time than the RYHJ group (188 *vs.* 206 min, P=0.044) and a lower incidence of sump syndrome (5.6%) than expected. HD has some surgical advantages compared with RYHJ; in particular, it does not require an additional JJ. A prolonged operative time, leakage at the anastomosis site, and mechanical complications in both the afferent and efferent limbs contribute to unfavorable outcomes in RYHJ with JJ (17,18). However, HD is a simpler form of biliary-digestive anastomosis than RYHJ, avoiding the above-mentioned risks with minimal alterations to the normal anatomy. In particular, it may be a superior surgical option to RYHJ in patients who have undergone previous abdominal surgery. Some patients who have undergone stomach or small bowel surgery require bile duct resection for extrahepatic mid-BDC. In these cases, there are challenges in the formation of RYHJ and JJ. Under such circumstances, even if the existing anastomosis is maintained, a complex bowel structure will be formed after RYHJ with JJ. Removal of the existing anastomosis and implementation of RYHJ with JJ pose risk of short bowel syndrome, which can potentially shorten the remaining small bowel. Additionally, there is risk of tension on the RYHJ anastomosis, contingent upon the structure of the mesentery. If there is potential for tension on the RYHJ anastomosis, the operation time can be prolonged. Furthermore, multiple anastomoses can increase the risk of postoperative intestinal adhesions and anastomosis leakage. Our results indicate that HD is relatively safe and feasible compared to RYHJ in these patients. While RYHJ remains preferable for patients with a standard anatomy, HD may be preferable in instances of challenging anatomical conditions. HD may be a viable alternative to RYHJ, particularly if it avoids extensive small bowel resection or multiple anastomoses. However, HD can be challenging when cancer excising the bile duct that just below the hepatic hilar bifurcation and re-anastomosing it, even with full kocherization. There is a limitation that HD can only be performed when anatomical conditions are satisfied. Therefore, further investigations exploring the feasibility of HD and surgical as well as oncologic outcomes are needed.

An additional advantage of HD is the feasibility of endoscopic follow-up (3,19). Generally, BDC recurrences post-operation tend to manifest at the resection margin, which is difficult to assess endoscopically in patients who have undergone RYHJ. Moreover, situations arise where bile duct resection is the only feasible option for advanced BDC, such as instances of indeterminate margin status, R1 resection with residual cancer, and liver resection due to a limited remaining liver volume. In cases of malignant anastomosis stricture in such patients, palliative intervention is only viable through percutaneous transhepatic bile drainage (20). However, patients who have undergone HD can potentially be followed endoscopically and have endoscopic-based interventions, potentially contributing to improved quality of life through jaundice control. Although none of the recurrent patients in our study underwent

Table 3 Logistic regression for risk factor analysis of complication

Characteristics	Univariable			Multivariable		
	HR	95% CI	P value	HR	95% CI	P value
Sex (female)	1.100	0.172–7.029	0.91	–	–	–
Age (≥60 years)	1.667	0.169–6.479	0.66	–	–	–
Diabetes mellitus	0.511	0.052–5.002	0.56	–	–	–
Hypertension	1.002	0.175–5.720	>0.99	–	–	–
High ASA score (≥3)	1.786	0.269–5.856	0.54	–	–	–
Preoperative biliary drainage	1.154	0.113–7.781	0.90	–	–	–
Neoadjuvant chemotherapy	1.323	0.932–1.879	0.11	1.426	0.873–2.121	0.13
Tumor size	2.492	0.812–7.610	0.10	2.337	0.753–7.254	0.14
Lymph node metastasis	1.048	0.165–6.646	0.96	–	–	–
Estimated blood loss	1.000	0.994–1.005	0.86	–	–	–
Hepaticoduodenostomy	1.133	0.198–6.486	0.88	1.250	0.198–7.903	0.81

ASA, American Society of Anesthesiologists; HR, hazard ratio; CI, confidence interval.

Table 4 Cox regression for risk factor analysis of recurrence

Characteristics	Univariable			Multivariable		
	HR	95% CI	P value	HR	95% CI	P value
Sex (female)	0.349	0.078–1.560	0.16	–	–	–
Age (≥60 years)	0.614	0.212–1.774	0.36	–	–	–
Diabetes	2.870	0.989–8.331	0.053	–	–	–
Hypertension	2.099	0.701–6.286	0.18	–	–	–
High ASA score (≥3)	1.799	0.560–5.773	0.32	–	–	–
CA19-9	1.124	1.031–1.486	<0.001	1.431	1.086–2.157	0.008
Total bilirubin	1.131	1.004–1.274	0.043	0.696	0.407–1.189	0.18
Neoadjuvant chemotherapy	0.696	0.091–5.312	0.72	–	–	–
Tumor size	2.118	1.050–4.270	0.03	1.714	0.408–7.192	0.46
Lymph node metastasis	3.343	1.079–8.356	0.03	2.620	1.356–9.269	0.01
Adjuvant chemotherapy	3.931	1.316–7.737	0.02	4.329	0.246–9.281	0.31
Hepaticoduodenostomy	1.155	0.381–3.504	0.79	0.464	0.018–2.107	0.69

ASA, American Society of Anesthesiologists; CA19-9, carbohydrate antigen 19-9; HR, hazard ratio; CI, confidence interval.

endoscopic treatment, it remains plausible that HD could enhance the survival outcomes of patients experiencing BDC recurrence with biliary drainage. In our study, overall oncologic outcomes were similar between the HD and RYHJ groups. Our study can be the basis for further large-scale, prospective studies to investigate the associations between survival and sump syndrome, alkaline intestinal fluid reflux, endoscopic follow-up, and other factors that may affect patient prognosis after HD.

Despite the positive findings, the study had some limitations. First, it was a retrospective study that only involved a single center and a relatively small cohort.

Table 5 Cox regression for risk factor analysis of overall survival

Characteristics	Univariable			Multivariable		
	HR	95% CI	P value	HR	95% CI	P value
Sex (female)	0.617	0.126–3.031	0.55	–	–	–
Age (≥60 years)	1.813	0.364–9.023	0.46	–	–	–
Diabetes	2.483	1.359–5.412	0.046	2.464	0.495–6.269	0.27
Hypertension	1.566	0.417–5.880	0.50	–	–	–
High ASA score (≥3)	1.799	0.560–5.773	0.32	–	–	–
CA19-9	1.124	1.031–1.486	<0.001	1.027	0.826–2.583	0.08
CEA	1.143	1.025–1.274	0.01	1.093	0.965–1.237	0.16
Total bilirubin	1.102	0.860–1.413	0.44	–	–	–
Neoadjuvant chemotherapy	0.773	0.088–6.820	0.81	–	–	–
Tumor size	1.774	0.828–3.802	0.14	–	–	–
Lymph node metastasis	3.835	1.289–8.597	0.02	4.595	0.155–9.629	0.17
Adjuvant chemotherapy	5.931	1.316–7.737	0.02	4.329	0.246–9.281	0.31
Hepaticoduodenostomy	1.286	0.308–5.368	0.73	0.722	0.488–2.117	0.91

ASA, American Society of Anesthesiologists; CA19-9, carbohydrate antigen 19-9; CEA, carcinoembryonic antigen; HR, hazard ratio; CI, confidence interval.

Therefore, there may have been some selection bias, and the generalizability of the results is limited. Second, there was a limited number of cases and numerous variables included in the regression analyses. In particular, a larger sample size is imperative to achieve more robust and dependable regression analyses results. Third, due to the absence of objective indications based on surgical or patient characteristics, HD was performed based on the subjective decision of the operator and surgical findings. Therefore, it is challenging to establish specific standards for our results in patients with extrahepatic mid-BDC. Another limitation is that the study only followed patients for 1 to 5 years, which may not be sufficient to evaluate the long-term clinical features and complications of HD in extrahepatic mid-BDC patients. Therefore, studies with longer follow-up periods are needed to assess the long-term outcomes of HD. Nevertheless, to the best of our knowledge, this is the first case series study to report the safety and efficacy of HD in patients with extrahepatic mid-BDC. We provide evidence that HD with bile duct resection is a safe and feasible method in extrahepatic mid-BDC patients. In particular, HD is a beneficial surgical option for patients with extrahepatic mid-BDC who have a history of prior stomach or small bowel resection. Additionally, this technique could be considered in cases requiring postoperative follow-up through endoscopic approaches after bile duct resection. However, further research is needed to determine the long-term outcomes of HD and to identify the optimal patient selection criteria.

Conclusions

In our study, HD appears to have comparable postoperative complications, and oncologic outcomes to RYHJ in patients requiring bilio-enteric reconstruction for extrahepatic mid-BDC. Particularly, HD should be considered in extrahepatic mid-BDC patients with a history of previous stomach or small bowel resection and those necessitating follow-up through endoscopic approaches. Further research with larger patient populations and longer follow-up periods is needed to fully evaluate the long-term safety and efficacy of HD in extrahepatic mid-BDC patients.

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Footnote

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Data Sharing Statement: Available at https://gs.amegroups.com/article/view/10.21037/gs-24-155/dss

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Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at https://gs.amegroups.com/article/view/10.21037/gs-24-155/coif). The authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The study was approved by the institutional review board of Soonchunhyang University Bucheon Hospital (No. SCHBC 2023-08-007) and informed consent was waived because of the retrospective nature of the study and the analysis used anonymous clinical data.

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