Outcomes of revisional surgery for stenosed hepaticojejunostomy procedures

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Received: 24 December 2023
Revised: 9 January 2024
Accepted: 20 January 2024
Published: 22 March 2024

The Egyptian Journal of Surgery 2024, 43:564–571

Background
Although hepaticojejunostomy provides durable and efficient access for bilioenteric continuity, it is not free from complications, as stenosis could occur in 25% of cases. Radiologically guided interventions are the best options for managing stenosed anastomoses. However, about 30% of stenosed patients show failure. Thus, surgical intervention (redo) is a must in such circumstances. Herein, we describe the outcomes of redo surgery for patients diagnosed with stenosed hepaticojejunostomy after failed radiological interventions.

Patients and methods
During the study period, we encountered 52 patients with stenosed hepaticojejunostomy, from whom 20 cases showed failed radiological intervention, and they were enrolled in our study, and their data were collected and retrospectively reviewed.

Results
The primary procedure was performed for cholecystectomy-related biliary injury (80%), choledochal cyst (15%), and as a step of the Whipple procedure (5%). All patients presented with jaundice, while 25% of them had cholangitis. Radiological assessment showed Bismuth class I, II, III, and IV in 20, 45, 25, and 10%, respectively. The time interval between the primary and the redo procedure ranged between 6 months and 5 years. Operative time ranged between 110 and 150 min, and hospital stay ranged between 4 and 10 days. Postoperative complications included bile leakage (5%), pulmonary embolism (5%), wound infection (20%), and incisional hernia (10%). No patients developed restenosis during the follow-up period. History of cholangitis was a significant risk factor for postoperative morbidity.

Conclusion
Revisional procedures for stenosed hepaticojejunostomy are considered safe and efficacious. The safety is manifested in the accepted complication rate, while the efficacy is manifested in the excellent success rate. However, it should be preserved only for patients with failed radiological interventions.

Keywords:
outcomes, redo procedures, stenosed hepaticojejunostomy

Egyptian J Surgery 43:564–571

1110-1121

Introduction

Hepaticojejunostomy is a type of bilioenteric anastomoses that describes the creation of an anastomosis between the hepatic duct and the small bowel [1]. It is indicated to establish biliary continuity with the alimentary tract in various benign (cholecystectomy-related bile duct injury and choledochal cyst) and malignant disorders (as a step of pancreaticoduodenectomy for periampullary neoplasms) [2–4].

Despite the availability of less invasive methods for biliary drainage, like radiology-guided interventions and endoscopic drainage techniques [5,6], the hepaticojejunostomy procedure still offers a definitive, time-honored, and durable solution for the establishment of bilioenteric continuity [7]. Nonetheless, the hepaticojejunostomy procedure has its own complications. The most dreadful one is anastomotic stricture, which occurs in 2–25% of these cases [8,9].

Improper management of that complication could lead to serious consequences, including recurrent cholangitis, biliary cirrhosis, portal hypertension, and eventually liver cell failure [2,10]. Thus, early diagnosis and treatment are crucial to improve patient outcomes. The management of such cases includes either

percutaneous radiologically guided interventions or redo operations [3].

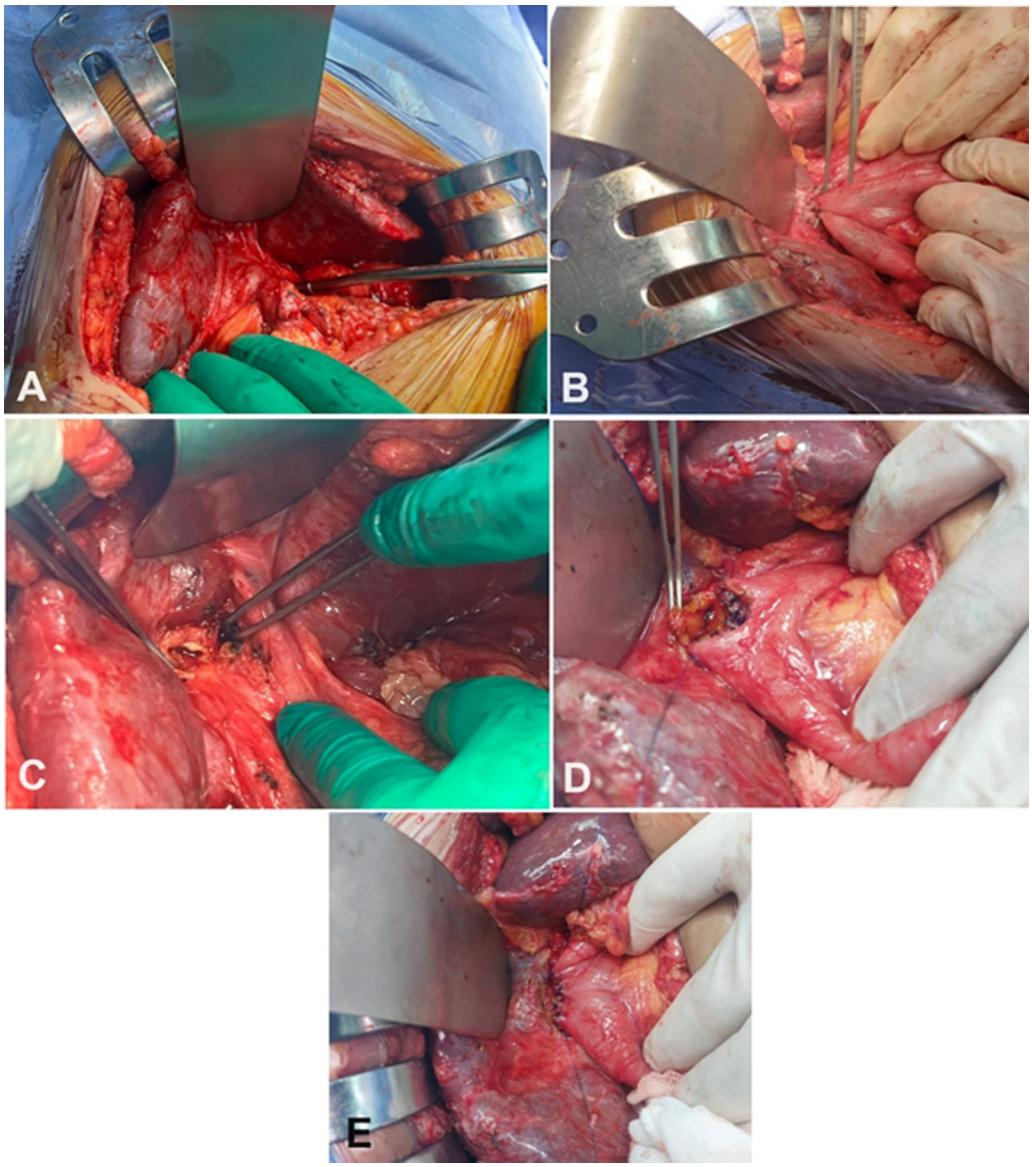
Currently, nonsurgical options (radiologically guided), including percutaneous dilatation, stent insertion, or both, are the preferred methods for the management of stenosed bilioenteric anastomosis [11]. That could be explained by the great advances in hepatobiliary radiological interventions and the risk of redo surgery, which carries a high risk for morbimortality [3,12]. However, there is a reported failure rate for radiological interventions in such cases (up to 30%), which necessitates surgical management despite its high risks [13,14].

The Egyptian setting is poor with studies describing the outcomes of redo surgery for stenosed hepaticojejunostomy after failed radiological interventions. That was a fair motive for us to conduct the current research to handle that scientific point, which is understudied in Egypt.

Patients and methods

This is a retrospective analysis of patients who underwent redo operations for stenosed hepaticojejunostomy after failed radiologically guided interventions at Al-Rajhy Hospital, Assiut University between January 2017 and December 2020 (4-year period). The data of these cases were collected from our medical archive, and patients who had the primary hepaticojejunostomy for malignant indication lost at follow-up were excluded from this research. Ethical approval was obtained from the faculty of Medicine

Figure 1



Preoperative MRCP images showing stenosed hepaticojejunostomy with dilated intrahepatic biliary radicles: (a) Bismuth III and (B) Bismuth II. MRCP, magnetic resonance cholangiopancreatography.

ethics committee. Consent wer taken from the patients preoperative.

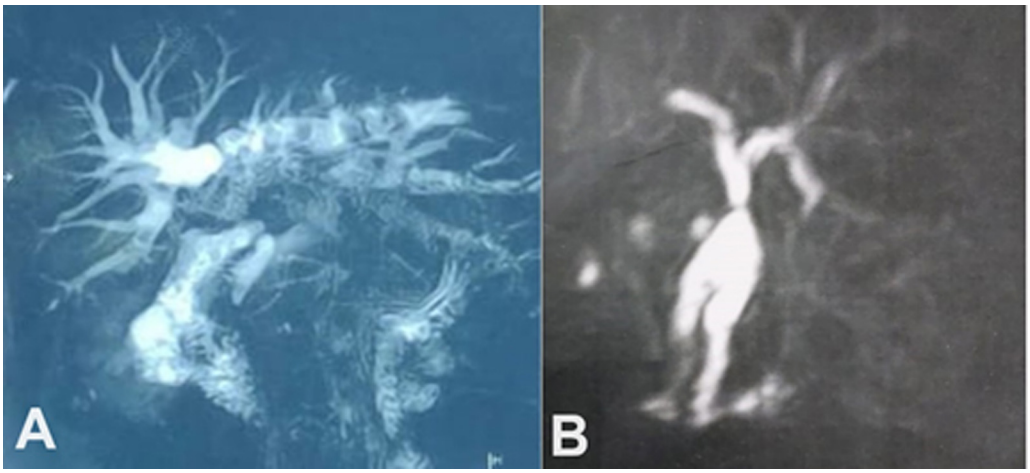
All patients received the standard preoperative evaluation and preparation, which is routinely performed in our center. That evaluation included history taking (focusing on the complaint, the indication, and time elapsed since the primary procedure), clinical examination (focusing on complexion and upper abdominal examination), and laboratory investigations (focusing on leukocyte count and cholestatic markers). Preoperative serum bilirubin ranged between 3 and 8 mg/dl (mean=4.65±1.71). In addition, all patients are evaluated by pelviabdominal ultrasound (to assess the presence of intrahepatic biliary dilatation) and magnetic resonance cholangiopancreatography (for objective delineation of the biliary anatomy and to confirm the presence of anastomotic strictures) (Fig. 1). The level of biliary tract interruption was classified according to the Bismuth–Corlette classification [15]. Patients with signs of active cholangitis were initially treated with i.v. fluid and broad-spectrum antibiotics till the resolution of their inflammatory state (by normalization of their leukocyte count and C-reactive protein) and decline in their cholestatic markers.

The redo procedure was performed under general anesthesia when the patient was in an anti-Trendelenburg position. Abdominal exploration was done through a right subcostal incision. Meticulous adhesiolysis was performed till we entered the abdominal cavity. The liver and the Roux loop were identified. After the dissection of adhesions between the loop and the visceral surface of the liver, segment i.v. was cranially retracted for better visualization of the porta hepatis. The dissection was continued till reaching the stenosed anastomosis. The anastomosis was then divided by a sharp surgical scissors, and care was taken not to injure the underlying portal vein when dividing the posterior wall of the anastomosis. Intrahepatic biliary radicles were cleared of debris or mud and then washed with warm saline (Fig. 2).

The ends of the hepatic ducts were cleared from the fibrous tissue until we reached a healthy duct wall with shiny mucosa. Spatulation was done toward the left side if needed. The opening in the Roux loop was also cleared from the fibrous tissue until it had an adequate diameter opening with healthy bleeding margins. If the end of the Roux loop appeared unhealthy, it was resected until we reached a healthy bowel region, and a new anastomosis was created. The anastomosis was done using polydioxanone 3/0 or 4/0 sutures. The posterior wall was done in a continuous manner, while the anterior wall was done in an interrupted manner. After a good wash and hemostasis of the surgical field, a surgical drain was inserted into the Morrison pouch, followed by closure of the abdominal wall in layers.

During the postoperative period, frequent assessment, proper analgesia, and early mobilization were ensured. Oral fluid intake was allowed if the patient had good intestinal sounds with sound abdominal examination (often on the second or third postoperative days). The patients were monitored for postoperative complications, and if encountered, it was recorded and managed. The patients were discharged from

Figure 2



Procedure steps: (a) dissection of adhesions between the Roux loop and the visceral liver surface. (b) Complete freeing of the stenosed anastomosis. (c) Opening the anastomosis and clearing the bile duct from stones and debris. (d) The redo hepaticojejunostomy posterior wall. (e) The redo hepaticojejunostomy anterior wall.

the hospital when they were able to tolerate oral intake, their pain controlled by oral analgesics, and free of complications. The skin stitches were removed after 2–3 weeks, and follow-up visits were scheduled every 6 months for all patients. The patients were followed till December 2023, and that provided about a 3–7-year follow-up duration for the included cases.

The data of the 20 patients were collected, and these data included patients' demographic variables (age and sex), medical comorbidities, indication of the first hepaticojejunostomy, patient presentation, Bismuth classification, the time interval between the initial and redo procedures, operative time, intraoperative blood loss, intraoperative complications, the duration of hospitalization, and the incidence of postoperative complications (including wound infection, bile leakage, etc.). Bile leakage was diagnosed when there was an increase in bilirubin levels in the surgical drain more than three times compared with the serum levels on the third postoperative day or later [16].

Study outcomes

The main outcome of the present study was the procedure's success, which was defined by absent cholangitis attacks with no evidence of anastomotic stricture [17]. Other outcomes included operative time, intraoperative complication, hospitalization period, and the incidence of postoperative complications.

Statistical analysis

The data of the 20 patients were collected and then organized and analyzed using the SPSS (IBM Corp., Armonk, NY, USA) software for Windows (version 26). Numerical data were expressed as means and medians (with SDs and ranges, respectively). Categorical data were presented as numbers and frequencies. Regression analysis was also performed to delineate the risk factors for postoperative complications, considering any P value of less than 0.05 to be significant.

Results

The age of the included 20 patients ranged between 30 and 65 years (mean=48.05). Most study participants were women, as they formed 65% of the study population. The distribution of comorbidities was as follows: morbid obesity (20%), hypertension (15%), and diabetes mellitus (10%).

Most patients underwent the initial hepaticojejunostomy for iatrogenic common bile duct injury related to cholecystectomy (16 cases, 80%). Six of these cases were discovered intraoperatively, and they were corrected during the same cholecystectomy procedure, while another six patients were discovered 6 weeks after the procedure. The remaining three cases were discovered within 2 weeks after the procedure.

Other indications for hepaticojejunostomy in our study included choledochal cyst (15%) and as a part of the reconstruction phase during the pancreaticoduodenectomy procedure (5%), which was performed for an ampullary villous adenoma with dysplasia. Table 1 summarizes the previous data.

All patients presented with jaundice and recurrent itching, while only five (25%) patients had manifestations of acute cholangitis. These cases were initially managed by i.v. fluids and antibiotics till the resolution of their acute inflammatory state. No patients required percutaneous biliary drainage (PTD) before the operation. Preoperative magnetic resonance cholangiopancreatography revealed the presence of Bismuth class I, II, III, and IV in 20, 45, 25, and 10% of cases, respectively. The time interval between the initial hepaticojejunostomy and the redo procedure ranged between 6 months and 5 years. No patients were referred to PTD in our study. We mean by radiological intervention either balloon dilatation or stenting. If failed, we ordered the radiologist not to drain the biliary system as we intended to keep it distended to make a wide stoma in the redo procedure (Table 2).

The duration of the redo procedure ranged between 110 and 150 min (mean=129 min), while intraoperative blood loss ranged between 150 and 350 ml (mean=249 ml). Intraoperative complication

Table 1 Demographic variables and indications of initial hepaticojejunostomy

Variables	Data (N=20)
Age (years)	48.05±9.46
	49.5 (30–65)
Sex [n (%)]	
Male	7 (35)
Female	13 (65)
Indication of the first hepaticojejunostomy [n (%)]	
Iatrogenic biliary injury	16 (80)
Choledochal cyst	3 (15)
Part of pancreaticoduodenectomy	1 (5)
The time interval between cholecystectomy and the initial hepaticojejunostomy (N=16) [n (%)]	
Discovered intraoperatively	6 (37.5)
Within 2 weeks	4 (25)
After 6 weeks	6 (37.5)

Table 2 Patient presentation, Bismuth classification, and duration elapsed since the initial hepaticojejunostomy

Variables	Data [*n* (%)]
Presentation	
Jaundice	20 (100)
Cholangitis	5 (25)
Bismuth classification	
I	4 (20)
II	9 (45)
III	5 (25)
IV	2 (10)
The time interval between the initial and redo procedures	
Within 6 months	4 (20)
1 year	8 (40)
After 2 years	7 (35)
5 years	1 (5)

Table 3 Operative data and hospitalization period in the study cases

Variables	Mean±SD	Median	Range
Operative time (min)	129±12.83	125	110–150
Blood loss (ml)	249±35.37	240	150–350
Hospitalization period (days)	5.85±1.76	5	4–10

occurred only in one patient, who developed colonic injury secondary to dissection of the dense adhesions, and that injury was detected intraoperatively and repaired by interrupted Vicryl 3/0 sutures. The mean duration of hospitalization was 5.85 days (range, 4–10 days) (Table 3).

Wound infection was the most common postoperative complication (20%), and all patients were managed by surgical drainage, frequent dressing, and systemic antibiotics. One patient had bile leakage that resolved spontaneously during 1 week with no need for intervention. Another patient developed subsegmental pulmonary embolism that was managed by anticoagulants with ICU monitoring with no need for invasive intervention or invasive ventilation strategies. Incisional hernia occurred in two (10%) cases during the follow-up period (Table 4). No mortalities were encountered in our study, and no patients developed restenosis during the follow-up period (100% success rate).

Regression analysis revealed that presentation with cholangitis was a strong predictor for postoperative

Table 4 Postoperative complications

Complications	Incidence (*N*=20) [*n* (%)]
Bile leakage	1 (5)
Wound infection	4 (20)
Subsegmental pulmonary embolism	1 (5)
Incisional hernia	2 (10)

Table 5 Risk factors for postoperative complications (morbidity)

		Multivariate analysis		
Variables	Univariate analysis	OR	95% CI for OR	*P* value
Age	0.505			
Male sex	0.848			
Diabetes mellitus	0.264			
Hypertension	0.188			
Obesity	0.064			
Postcholecystectomy bile duct injury	R			
Choledochal cyst	0.946			
Post Whipple operation	0.739			
Early within 2 weeks	R			
After 6 weeks	0.486			
Discovered intraoperatively	0.214			
Jaundice	R			
Cholangitis	0.035*	1.451	1.018–1.648	0.035*
Bismuth I	R			
Bismuth II	0.790			
Bismuth III	0.486			
Bismuth IV	0.616			
Redo within 6 months	R			
Redo within 1 year	0.764			
Redo after 2 years	0.522			
Redo within 5 years	0.964			
Operative time	0.427			
Blood loss	0.578			

CI, confidence interval; OR, odds ratio. *p value less than 0.05.

morbidity on both univariate and multivariate analyses (Table 5).

Discussion

This retrospective study handled the perioperative and long-term outcomes after redo hepaticojejunostomy for patients with stenosed primary anastomosis after failed radiological interventions.

It is expected to encounter some failures for radiologically guided interventions when dealing with patients with stenosed bilioenteric anastomosis. First of all, the stenosis could be caused by extensive fibrosis and scarring, which may be challenging for these minimally invasive interventions as the balloon may not fully dilate, or the stent could not be fully extended. That leads to ineffective radiological intervention. In addition, some hepaticojejunostomies may have complex anatomy like angular or tortuous tracts, and the presence of multiple previous anastomoses requiring multiple puncture points and repeated interventions. Even if the radiological intervention had succeeded, the fibrosis is still present and ongoing, leading to recurrent stenosis, especially if balloon dilatation was only performed without stent insertion [18].

None of our patients required PTD in our study. In our opinion, if the radiological intervention fails and the surgical option has been decided for the patient, preoperative biliary drainage is not recommended unless the patient has active cholangitis and is not responding to conservative treatment. We believe that preoperative drainage will decompress the biliary system, leading to a decrease in the diameter of biliary radicles. Thus, we prefer to keep it dilated to encounter a more dilated biliary system during the operation. This helps in the early identification of the hepatic duct as well as the creation of satisfactory and wide anastomosis (our opinion).

In our study, the mean age of our cases was 48.05 years. Other studies reported lower ages (30s) [19,20], while Zhu *et al.* [2] reported older ages (61.6 years).

Our study revealed a higher predominance of the female sex compared with the male one. Other studies revealed a higher prevalence for women when dealing with stenosed hepaticojejunostomy cases [19,20]. This is in contrast with Booij *et al.* [21], who identified the male sex as a significant predictor for stricture formation after hepaticojejunostomy (P=0.005).

In our study, cholecystectomy-related biliary injury was the most common indication for the primary procedure (80%), and coincides with Bhat *et al.* [19], who reported that the same indication was present in 65% of their redo cases, while choledochal cyst excision is attributed for the rest of cases (35%).

In our study, most patients had an interval of 1–2 years between the primary and revisional procedures. This is in accordance with previous two studies, which reported that the stenosis was often detected within 12–18 months after the primary hepaticojejunostomy procedure [2,22]. Others reported that the same complication could occur earlier, and they attributed its incidence to inappropriate suture materials, small ducts, excessive diathermy use, and infection [23].

Bhat and colleagues reported a longer operative duration (average 223 min). That could be explained by the fact that these authors included patients with Bismuth V class, and segment IV resection was also needed in some cases [19]. The former needs more dissection at the hepatic hilum and hilar plate to reach a satisfactory duct for anastomosis creation, while the latter also spends some time, leading to some blood loss, and it is usually needed in patients with difficult ducts, which could explain the time difference between the results of Bhat and colleagues.

Our findings revealed that the hospitalization period ranged between 4 and 10 days (mean=5.85 days). Other authors reported a period of between 5 and 18 days (median=8 days) [20]. In addition, Bhat *et al.* [19] described a median hospitalization period of 10 days. Differences in center protocols and postoperative complications could explain the previous differences.

Our findings showed an incidence of 5% for bile leakage. Kadaba *et al.* [22] reported an incidence of 3.7% for the same complication after bilioenteric anastomosis, which is close to our findings. In addition, Pottakkat *et al.* [20] reported that the same complication occurred in 6% of their cases, and it resolved spontaneously in these cases.

Wound infection was encountered in 20% of our study cases, and it was superficial and responded well to drainage, antibiotics, and dressings. Zafar *et al.* [24] agreed with our findings as the same adverse event had the highest prevalence among other postoperative complications (23%).

Incisional hernia was encountered in 10% of our patients, and that lies within the range of incidence

of the same adverse event after laparotomy (2–20%) [25–27].

During the scheduled follow-up period (3–7 years), no patients developed recurrence of stenosis (no cholangitis, jaundice, or itching), making our success rate 100%. In the same context, Chaudhary *et al.* [9] and Pottakkat *et al.* [20] reported clinical success in the majority of their patients after revisional hepaticojejunostomy surgery (90 and 94%, respectively). However, Bhat *et al.* [19] reported that recurrence of stenosis occurred in 26% of their cases (six patients), and half of them responded to balloon dilatation while the other half required second revisional surgery (follow-up 2–8 years). Other older studies reported even lower success rates (about 50%) [28,29].

Our findings revealed that preoperative cholangitis, although it was properly managed first, was an independent risk factor for postoperative morbidity. This is in agreement with previous studies that documented the association between preoperative cholangitis and poor outcomes after different biliary operations [30,31].

The reader should know that we scheduled the patients who had cholangitis for surgery after normalization of their inflammatory markers and improvement in their condition. That duration ranged between 1 and 3 weeks after the resolution of the attack. The effect of the duration between the resolution of the last cholangitis attack and biliary surgery and its impact on perioperative outcomes should be studied in larger scale studies.

Our study has some limitations notably its retrospective nature and the collection of a small patient sample from a single surgical center, which are the main drawbacks that should be addressed in the upcoming studies.

Conclusion

According to the preceding findings, revisional procedures (redo) for stenosed hepaticojejunostomy are considered safe and efficacious. The safety is manifested in the accepted complication rate, while the efficacy is manifested in the excellent success rate. However, it should be preserved only for patients with failed radiological interventions.

Financial support and sponsorship
Nil.

Conflicts of interest
There are no conflicts of interest.

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