Outcomes of reconstructive hepaticojejunostomy for postcholecystectomy bile-duct injuries

Motassem M. Ali, Mohamed K. Mohamed, Abdel-Moniem Mansour, Amr Abdel-Hamid Abd-El-Kader

Department of General Surgery, Faculty of Medicine, Minia University, Minia, Egypt

Correspondence to Amr Abdel-Hamid Abd-El-Kader, MD, Department of General Surgery, Faculty of Medicine, Minia University, Minia, 61111, Egypt.
Tel: +20 127 734 0340;
e-mail: amr_elheny@ yahoo.com

Received: 14 September 2021
Accepted: 18 September 2021
Published: xx Month 2021

The Egyptian Journal of Surgery 2021, 40:1469–1475

Aim
To analyze and evaluate the presentation, characteristics, related investigation, and outcomes of reconstructive hepaticojejunostomy in patients with postcholecystectomy bile-duct injuries (BDI).
Patients and methods
This study was done in Minia University Hospital (Minia Hepatobiliary Unit), including 26 patients who underwent hepaticojejunostomy Roux-en-Y for postcholecystectomy BDI between May 2017 and May 2020, retrospectively and prospectively.
Results
The study included 26 patients who suffered from iatrogenic BDIs; 19 (73%) patients underwent open cholecystectomy (OC), and seven (27%) patients underwent laparoscopic cholecystetomy (LC). Regarding injury type, the leaking, obstructing, collection, peritonitis, and vascular injuries were 26.9, 46.1, 19.3, 7.7, and 4.4%, respectively. However, the Strasberg classification of injury was as follows: E1=15.4%, E2=46.1%, E3=30.8%, and E4=7.7%. In this retrospective study, between May 2017 and December 2020, 26 patients with major BDI sustained during cholecystectomy and requiring surgical treatment in the form of HJ Roux-en-Y were referred to Minia Hepatobiliary Center. Preoperatively, ultrasound was done for all patients, computed tomography in three (11.5%), PTC in three (11.5%), endoscopic retrograde cholangio-pancreatograpgy (ERCP) in 17 (65%), and magnetic resonance cholangio-pancreatograpgy (MRCP) was done for 16 (61.5%) patients.
Conclusion
Early detection of BDI and early referral to specialized hepatobiliary referral centers are essential for early management of BDI and prevention of its complications. Surgical reconstruction using Roux-en-Y hepaticojejunostomy mucosa to mucosa repair remains the golden-standard procedure of choice for treating these injuries with successful outcome and better long-term result.

Keywords:
bile-duct injuries, hepaticojejunostomy, Minia

Egyptian J Surgery 40:1469–1475

1110-1121

Introduction

Cholecystectomy is one of the most common general surgical operations performed worldwide. The risk of bile-duct injury (BDI) during laparoscopic cholecystectomy is two to three-times higher than during open cholecystectomy. The worldwide incidence of BDI is 0.5% or one in 200 cases. BDI and its consequences result in significant morbidity and may even cause mortality; it also increases the cost of treatment and can be a common reason for medicolegal suits against the surgeons [1,2]. Injuries to the bile ducts are unfortunately not rare and often turn out to be tragedies. A BDI will probably occur, at least once in a lifetime, in the hands of every surgeon who performs laparoscopic cholecystectomy [3].

Cholecystectomy is responsible for 80–85% of BDI. The incidence of BDI following laparoscopic cholecystectomy has increased over the past decade (0.4– 0.6%), despite the expertise gained worldwide in performing this procedure, while its incidence after open cholecystectomy was 0.1–0.2% [4,5].

BDI during cholecystectomy (in order of its frequency and importance) is ignored or misidentified and sometimes aberrant anatomy, inexperience, and/or overconfidence on the part of the surgeon, difficult pathology, bleeding, and thermal injury. Misinterpretation of biliary ductal anatomy, that is, misidentification of the common bile duct (CBD) as the cystic duct, is the commonest etiological factor for

BDI during laparoscopic cholecystectomy; aberrant anatomy (the most common mechanism of BDI is misidentification of anatomy) and difficult pathology are less commonly responsible for the BDI. Aberrant biliary ductal anatomy is frequently blamed but is not usually responsible for majority of the BDI [6].

Multiple classification schemes have been developed to describe CBD injuries. This has been very useful in standardizing discussions and research regarding the incidence of injuries and the outcomes of repair [7,8].

The diagnosis of BDI mandates immediate referral to a hepatobiliary surgeon. Whether the injury is identified during surgery, or at any time in the postoperative period, the operating surgeon should not attempt repair since attempted repair by the injuring surgeon is associated with an increased risk of morbidity and mortality [9]. Each failed repair is associated with some loss of bile-duct length and greatly exacerbates an already-difficult situation [10].

The management of BDI depends on the type, extent, and level of injury, and the time of its diagnosis. Initial proper treatment of BDI diagnosed during the cholecystectomy can avoid the development of a bile-duct stricture. If a major injury is discovered and an experienced biliary surgeon is not available, an external drain and, if necessary, trans-hepatic biliary catheters are placed, and the patient is transferred to a referral center [11]. There is consensus that BDI is best handled in specialized hepatobiliary units. However, the optimal time of operative repair remains controversial [12].

The aim of this study was to evaluate the presentation, characteristics, related investigation, and outcomes of reconstructive hepaticojejunostomy in patients with postcholecystectomy BDI.

Patients and methods

This study was done in Minia University Hospital (Minia Hepatobiliary Unit), including 26 patients who underwent hepaticojejunostomy Roux-en-Y for postcholecystectomy BDI between May 2017 and May 2020, retrospectively and prospectively. This study includes all patients who were subjected to surgical repair of postcholecystectomy BDI. In all patients, the only type of surgical repair done in the form of biliary–enteric anastomosis was hepaticojejunostomy Roux-en-Y. The title, aim, and plan of the study were discussed and approved regarding ethics of research in the General Surgical Department, Minia Faculty of Medicine. Full written and informed consent was obtained from all relevant participant.

Patients

Inclusion criteria

This study included patients with iatrogenic major BDI postcholecystectomy that included all transactions or partial lacerations of the common hepatic duct, common bile duct, or major segmental ducts at porta hepatis and who underwent hepaticojejunostomy Roux-en-Y as a definite treatment.

Exclusion criteria

Patients with noncholecystectomy-related BDI. Patients with cholecystectomy-related BDI that had been managed by other lines of treatment (endoscopically or radiologically), for example, endoscopic retrograde cholangio-pancreatograpgy (ERCP) or other types of surgical repair.

Data collection

Data for this study were obtained from the patients and from the medical records of the patients included in the medical archive of Hepatobiliary Unit of Minia General Surgery Department and all patients gave informed written consent for surgery, possible consequences, and the use of data for scientific purposes.

Preoperative recorded data for patients: Patient demographics that include patient's age and sex, the type of offending cholecystectomy, time of recognition of injury, presentation of patients after injury or at the time of referral includes, presence of drain, preoperative laboratory data, magnetic resonance cholangio-pancreatograpgy (MRCP), ERCP, or PTC, and level of injury.

Intraoperative data include

Findings in exploration, for example, evidence of vascular injury right or main hepatic artery or portal vein injury, presence of collection, and detection of the level of injury according to Strasberg classification [13]

E1–low common hepatic duct (CHD) stricture, with a length of the common hepatic-duct stump of more than 2 cm.
E2–proximal CHD stricture–hepatic-duct stump less than 2 cm.
E3–hilar stricture, no residual CHD, but the hepatic ductal confluence is preserved.
E4–hilar stricture, with involvement of confluence and loss of communication between the right and left hepatic duct.
E5–involvement of aberrant right sectorial hepatic duct alone or with concomitant stricture of the CHD.

Surgical technique

For postcholecystectomy BDI, the hepaticojejunostomy was done in the following steps.

Hepaticojejunostomy steps

The duodenojejunal junction is identified by the ligament of Treitz and inferior mesenteric vein.

(1) About 10–20 cm from the duodenojejunal junction is the site taken for Roux limb.
(2) Jejunum is cut with stapler transection. Roux limb is passed retrocolic to the right of the middle colic artery to reach the CHD area.
(3) End-to-side anastomosis: jejunum is incised over its ant mesenteric border 1 cm proximal to the stapled site, lengthy distal part distal to the proposed anastomosis should not be kept as it may cause blind loop and recurrent infection.
(4) In total, three interrupted-stay sutures are placed in CHD at 3, 9, and 12 o'clock.
(5) Ideally from CHD outside-in, then from the jejunum inside-out, bites are taken, so that knots are placed outside, but posterior knots can be placed inside by taking bites from inside-out and outside if technical difficulty arises.
(6) Posterior-wall anastomosis was either taken interrupted on continuous sutures.
(7) All sutures are placed and kept long with hemostats (rubber over 4×4); only after placing all posterior sutures, the jejunum is pushed gently into the CHD and knots are tied; all threads are kept long and cut at the end.
(8) Anterior sutures are taken similarly with knot placement outside in an interrupted pattern. After taking all bites, knots are tied sequentially at the end.
(9) With parachute technique, the jejunum is pushed and posterior and anterior knots are placed sequentially.
(10) Stenting of the hepaticojejunostomy can be done by 6–8-Fr small stent, epidural stent, but is not mandatory. When it is done, it is brought out through the Roux jejunal limb outside and then through a stab wound through the abdomen.
(11) Entero-enterostomy is done 60 cm distal to the stoma to complete the Roux-en-Y anastomosis, this is usually side-to-side, either hand sewn or stapler.
(12) Finally, a tubal drain is brought out through a separate stab wound on the abdominal wall.

Postoperative data: follow-up

A – Short-term postoperative complications were defined as those occurring within 30 days of the repair surgery or during the same hospitalization.

B – Long-term postoperative complications were those occurring after 30 days postrepair and the most important complication was anastomotic strictures. Clinically significant biliary stricture was defined as a stricture that resulted in signs and symptoms requiring surgical, endoscopic, or percutaneous intervention.

Statistical analysis

Statistical analysis was performed with SPSS, version 23.0. The statistical program SPSS (SPSS Inc., 233 South Wacker Drive, 11th Floor, Chicago, IL 60606-6412) for windows. Data were expressed as range (minimum and maximum), mean and SD for numerical data, or number and percent for categorical data. Student's t test, χ^2, and Fisher exact test were used for comparison as the most appropriate. P value of less than 0.05 was considered statistically significant.

Results

The study included 26 patients who suffered from iatrogenic BDIs; the age of all patients ranged from 20 to 66, with mean 45.4 and SD 11.5. The study included 17 (65.4%) female patients and nine (34.6%) male patients, 19 (73%) patients underwent open cholecystectomy (OC), and seven (27%) patients underwent laparoscopic cholecystetomy (LC).

Regarding injury type, the leaking, obstructing, collection, and peritonitis were 26.9, 46.1, 19.3, and 7.7%, respectively. However, the Strasberg classification of injury was as follows: E1=15.4%, E2=46.1%, E3=30.8%, and E4=7.7% (Table 1).

In this retrospective study, between May 2017 and December 2020, 26 patients with major BDI sustained during cholecystectomy and requiring surgical treatment in the form of HJ Roux-en-Y were referred to Minia Hepatobiliary Center. Preoperatively, ultrasound was done for all patients,

Table 1 Clinical presentation after injury and level of injury as diagnosed by cholangiographic studies according to Strasberg–Bismuth classification

	n (%)
Presentation	
Obstructive jaundice	12 (46.1)
External bile leak (fistula)	7 (26.9)
Biliary collection +abdominal pain	5 (19.3)
Biliary peritonitis	2 (7.7)
Level of injury (Strasberg)	
E1	4 (15.4)
E2	12 (46.2)
E3	8 (30.8)
E4	2 (7.6)
Degree of dilatation	
A (<1.5 cm)	17 (65.4)
B (1.5–3 cm)	9 (34.6)

Table 2 Long-term follow-up and outcome (*N*=24)

Number of patients	*n* (%) [24 (92.3%)]
Follow-up period (month)	The median follow-up was 13 (1–35) months
a – Late complications	5 (20.8)
1– Anastomotic stricture	2 (8.3)
2 – Recurrent cholangitis	2 (8.3)
3 – Both stricture and recurrent cholangitis	1 (4.2)

Table 3 Long-term outcome (Terblanche)

Outcome (Terblanche)	Terblanche clinical grading classification [*n* (%)]
I – excellent	16 (66.7)
II – good	5 (20.8)
III – fair	2 (8.3)
IV – poor	1 (4.2)

computed tomography in three (11.5%), PTC in three (11.5%), ERCP in 17 (65%), and MRCP was done for 16 (61.5%) patients.

In total, 24 patients underwent long-term follow-up with the median follow-up of 13 (1–35) months. Long-term complications were detected in five (20.8%) out of 24 patients with long-term follow-up, in the form of recurrent cholangitis two (8.3%), where the initial attacks developed at 6, 10, 17, and 30 months from definitive surgery, stricture two (8.3%) that occurred at 9, 21, 22, and 25 months from surgery, and both stricture and recurrent cholangitis one (4.2%) that happened at 18 and 25 months from surgery (Table 2).

The long-term outcome according to Terblanche clinical grading system was excellent (grade I) in 16 (66.7%) patients, good (grade II) in five (20.8%) patients, fair (grade III) in two (8.3%) patients, and poor (grade IV) in one (4.2%) patient. As regards McDonald's grading, grades A, B, C, and D were 16/24 (67%), 5/24 (21%), 2/24 (8%), and 1/24 (4%), respectively (Table 3).

There was a significant difference between good and poor outcome after surgical repair regarding interval for referral, level of injury, number of anastomosis, using of stent, operative time, and presence of early complications (Table 4).

Discussion

The surgical approach for repairing postcholecystectomy bile-duct stricture is the most important determinant of postoperative complications and long-term outcomes. Hepaticojejunostomy for postcholecystectomy benign bile-duct strictures offers the best possible long-term results [14]. In this study, jaundice was the most common presentation seen in 12 (46.1%) patients. This result is in agreement with a series of Sikora [15], while in the study of Mishra *et al.* [16], external biliary fistula and biliary collection were the most common presentations (33.6 and 32.9%, respectively). Our explanation for these findings that most of the patients referred to our center (tertiary center) after they had the initial management at their primary hospitals.

In the current study, based on the above cholangiographic studies, the level of stricture was classified according to Strasberg–Bismuth classification into E1 in four (15.4%) patients, E2 in 12 (46.2%) patients, E3 in eight (30.8%) patients, and E4 in two (7.6%) patients. In comparison with the other studies, our study results were comparable to those of Lubikowski *et al.* [17] study in which the E2 level was the most common (54%), while in Huang *et al.* [18] study, E3 (28%) was the most common level. Repair in patients with higher strictures (Strasberg–Bismuth types III and IV were a predictor of failure in some series) [19]. In this study, it had effect on late biliary outcome, despite its effect on early complications (P=0.044). It was independently associated with an overall poor short-term and long-term outcomes in Bansal *et al.* [20] study, and was a significant predictor of postoperative stricture in Walsh *et al.* [21] study.

The occurrence of major postoperative complications was associated with an increased risk of biliary stricture after surgery in Sulpice *et al.* [22] and Booij *et al.* [23] studies, in the same line, in this study, early morbidity was a significant predictor of late biliary morbidity, and it was an independent predictor of late stricture (P=0.018).

In this cohort, we analyzed the factors affecting early morbidity as well as late biliary morbidity. In this study, referral time to our center after injury diagnosis had a significant impact on early complications or late biliary morbidity. It was an independent predictor of worse outcome in de Reuver *et al.* [24] and Martinez-Lopez *et al.* [25] studies, also, longer delay of referral (>3 months) from index surgery was associated with poor outcome in AbdelRafee *et al.* [26] study.

Intra-abdominal sepsis and abscesses (intra-abdominal biloma) even if drained effectively may remain active in the period after surgery, predisposing patients to

Table 4 Comparison between excellent and poor outcome after surgical repair as regards patients' characteristics and preoperative data

	G1: excellent outcome [*N*=21 (87.5%)] [*n* (%)]	G2: poor outcome [*N*=3 (12.5%)] [*n* (%)]	Total [*N*=24 (100%)] [*n* (%)]	*P* value
Age (mean±SD)	41.41±12	40.29±13.09	45.42±11.5	0.713
Sex				
Male	6 (25)	2 (8.3)	8 (33.3)	0.779
Female	15 (62.5)	1 (4.2)	16 (66.7)	
Type of cholecystectomy				
Lap	4 (16.7)	2 (8.3)	6 (25)	0.284
Open	17 (70.8)	1 (4.2)	18 (75)	
Recognition of injury				
Intraoperative	3 (12.5)	0	3 (12.5)	
Early (<2 weeks)	13 (54.2)	2 (8.3)	15 (62.5)	0.072
Intermediate (2–6 weeks)	4 (16.7)	0	4 (16.7)	
Late (> 6 weeks)	1 (4.2)	1 (4.2)	2 (8.3)	
Interval for referral (months)				
<10 days	6.23±14.29	14.58±33.07	7.13±17	0.021
10 days–3 months	2 (8.3)	0	2 (8.3)	
> 3 months	18 (75)	1 (4.2)	19 (79.2)	0.035
	1 (4.2)	2 (8.3)	3 (12.5)	
Jaundice				
Yes	9 (64.3)	2 (8.3)	11 (45.8)	0.930
No	12 (50)	1 (4.2)	13 (54.2)	
Cholangitis+EBF				
Yes	9 (64.3)	1 (4.2)	10 (41.7)	0.590
No	12 (50)	2 (8.3)	14 (58.3)	
WBC ($\times 10^3$)	8.56±4.5	7.34±2.78		0.384
Albumin (g/dl)	3.84±0.51	3.82±0.51		0.899
Bilirubin (mg/dl)	3.51±1.28	5.61±2.98		0.293
ALP (KAU)	32.43±27.01	49.08±34.19		0.045
SGOT (μ/mol)	100.45±70.37	86.57±38.69		0.472
SGPT (μ/mol)	103.17±81.88	80.86±55.48		0.326
Level of injury				
Low (E1, E2)	14 (54.2)	2 (8.3)	16 (66.7)	0.044
High (E3, E4)	7 (29.2)	1 (4.2)	8 (33.3)	
RHA injury				
Yes	0	1 (4.2)	1 (4.2)	0.075
No	21 (87.5)	2 (8.3)	23 (95.8)	
Intra-abdominal biloma				
Yes	3 (12.5)	2 (8.3)	5(20.8)	0.067
No	18 (75)	1 (4.2)	19 (79.2)	
Number of anastomosis				
Single duct	19 (79.1)	2 (2)	21 (87.5)	0.048
Ductoplasty	1 (4.2%)	0	1 (4.2)	
Double ducts	1 (4.2)	1 (62.5)	2 (8.3)	
Stent use				
Yes	6 (25)	0	6 (25)	
No	15 (62.5)	3 (12.5)	18 (75)	0.028
Operative time (min)	158.48±48.03	229.09±79.68		0.016
Early complications				
Yes	7 (29.2)	3 (12.5)	10 (41.2)	
No	14 (58.3)	0	14 (58.3)	0.018

fibrosis, resulting in late anastomotic stricture. Furthermore, inflammatory changes in the surgical bed produce tissue friability, resulting in increased technical difficulty at repair time [27]. Similarly, in this study, sepsis at referral due to biliary peritonitis or severe cholangitis was asignificant predictor of early and late morbidities (P=0.057), despite our aggressive management of it before doing the definitive repair, similarly, it was independent predictor of complications and anastomotic failure after primary

repair in Dominguez-Rosado *et al.* [28] study and was a predictor of severe complications in Patrono *et al.* [29] study and it was the only independent predictor of major morbidity and a significant predictor of late biliary stricture in Sulpice *et al.* [22] study, in the same line, it was an independent predictor of long-term complications in Huang *et al.* [18] study.

In the same way, Schmidt *et al.* [19] found that the presence of active peritonitis was independently associated with long-term complications, such as anastomotic stricture or secondary biliary cirrhosis. Similarly, repair at a stage with active biliary or peritoneal inflammation was a significant predictor of long-term failure in Huang *et al.* [18] study.

In this study, HJ anastomosis was single with one duct in 23 (88.5%) patients, ductoplasty (two-duct anastomosis in one stoma) was done in one (3.8%) patient, and double anastomosis with two ducts (right and left hepatic ducts) in two (7.7%) patients. In review of the literature, Singh *et al.* [30] performed two-duct anastomosis in eight (2.7%) patients, three-duct anastomosis in one (0.3%) patient, and ductoplasty in 19 (6.3%). Bansal *et al.* [20] performed HJ with two-duct anastomosis in two patients with type-IV biliary stricture.The use of trans-anastomotic stents is controversial [31,32]. However, some investigators reported the benefit of stents in avoiding recurrent cholangitis [33]. In the same line, in this study, we used trans-anastomotic stents in 6/26 (23%) of our patients, these stents had a positive impact on our long-term biliary outcome (P=0.028), this was due to the adequate biliary drainage and flow through the anastomosis and the lower intraductal pressure with stents. Similarly, Laukkarinen *et al.* [34] found low rates of anastomotic leakage or stricture in their experimental models when performed Roux-en-Y HJ with a trans-anastomotic stent, also, Moris *et al.* [35] recorded low stricture rate when performed HJ with stenting for biliary obstruction of different causes.

In this study, similarly, we had an acceptable long-term outcome after performing Roux-en-Y HJ bilioenteric reconstruction where it leads to 21/24 (87.5%) good long-term biliary outcomes. Furthermore, it was our most frequent operation. Similarly, the Roux-en-Y HJ offered good long-term outcome or success in 88.3, 89, 90, 91.3, 92, and 97% of patients in Schmidt *et al.* [19], de Reuver *et al.* [24], Pottakkat *et al.* [36], Lubikowski *et al.* [17], Bansal *et al.* [20], and AbdelRafee *et al.* [26] studies, respectively.

Conclusion

Early detection of BDI and early referral to specialized hepatobiliary referral centers are essential for early management of BDI and prevention of its complications. Surgical reconstruction using Roux-en-Y hepaticojejunostomy mucosa to mucosa repair remains the golden-standard procedure of choice for treating these injuries with successful outcome and better long-term result.

We recommend long-term follow-up of the patients after surgical repair for at least 10 years as anastomotic stricture was diagnosed after a long period. Further studies should be performed for the best management of recurrent anastomotic stricture. Associated vascular injuries should be emphasized and accurately evaluated.

Acknowledgements

The authors would like to offer their sincere thanks to all people who participated in the study.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

References

1 Kapoor VK. Management of bile duct injury detected in the post-operative period. In: Kapoor V, editor. Post-cholecystectomy Bile Duct Injury. Singapore: Springer; 2020. pp. 109–125. https://doi.org/10.1007/978-981-15-1236-0_10

2 Kapoor VK. Post-cholecystectomy bile duct injury. Switzerland: Springer Nature; 2020.

3 Sipos P. Increased cholecystectomy rate in the laparoscopic era: a study of the potential causative factors. Surg Endosc 2007; 21:1245.

4 Iannelli A, Paineau J, Hamy A, Schneck AS, Schaaf C, Gugenheim J. Primary versus delayed repair for bile duct injuries sustained during cholecystectomy: results of a survey of the Association Francaise de Chirurgie. HPB 2013; 15:611–616.

5 Lillemoe KD, Jarnagin WR, editors. Master techniques in surgery: hepatobiliary and pancreatic surgery. Philadelphia, PA: Lippincott Williams & Wilkins; 2020.

6 Suhocki P, Meyers W. Injury to aberrant bile ducts during cholecystectomy: a common cause of diagnostic error and treatment delay. Am J Roentgenol 1999; 172:955–959.

7 Mesleh MG, Asbun HJ. Management of common bile duct injury. In: Asbun HJ, *et al.* editors. The SAGES manual of biliary surgery. Switzerland: Springer; 2020. pp. 213–231.

8 Moy BT, Birk JW. A review on the management of biliary complications after orthotopic liver transplantation. J Clin Transl Hepatol 2019; 7:61.

9 Perera MTP, Silva MA, Hegab B, Muralidharan V, Bramhall SR, Mayer AD, Mirza DF. Specialist early and immediate repair of post-laparoscopic cholecystectomy bile duct injuries is associated with an improved long-term outcome. Ann Surg 2011; 253:553–560.

10 Tocchi A, Costa G, Lepre L, Liotta G, Mazzoni G, Sita A. The long-term outcome of hepaticojejunostomy in the treatment of benign bile duct strictures. Ann Surg 1996; 224:162.

11 Mercado MA, Domínguez I. Classification and management of bile duct injuries. World J Gastrointest Surg 2011; 3:43.

12 Pekolj J, Alvarez FA, Palavecino M, Clariá RS, Mazza O, de Santibañes E. Intraoperative management and repair of bile duct injuries sustained during

10,123 laparoscopic cholecystectomies in a high-volume referral center. J Am Coll Surg 2013; 216:894–901.

13 Strasberg SM, Hertl M, Soper NJ. An analysis of the problem of biliary injury during laparoscopic cholecystectomy. J Am Coll Surg 1995; 180:101–125.

14 Chapman WC, Abecassis M, Jarnagin W, Mulvihill S, Strasberg SM. Bile duct injuries 12 years after the introduction of laparoscopic cholecystectomy. J Gastrointest Surg 2003; 7:412–416.

15 Sikora SS. Management of post-cholecystectomy benign bile duct strictures. Indian J Surg 2012; 74:22–28.

16 Mishra PK, Saluja SS, Nayeem M, Sharma BC, Patil N. Bile duct injury—from injury to repair: an analysis of management and outcome. Indian J Surg 2015; 77:536–542.

17 Lubikowski J, Post M, Białek A, Kordowski J, Milkiewicz P, Wójcicki M. Surgical management and outcome of bile duct injuries following cholecystectomy: a single-center experience. Langenbeck's Arch Surg 2011; 396:699–707.

18 Huang Q, Yao HH, Shao F, Wang C, Hu YG, Hu S, Qiu LJ. Analysis of risk factors for postoperative complication of repair of bile duct injury after laparoscopic cholecystectomy. Dig Dis Sci 2014; 59:3085–3091.

19 Schmidt SC, Langrehr JM, Hintze RE, Neuhaus P. Long-term results and risk factors influencing outcome of major bile duct injuries following cholecystectomy. Br J Surg 2005; 92:76–82.

20 Bansal VK, Krishna A, Misra MC, Prakash P, Kumar S, Rajan K, *et al.* Factors affecting short-term and long-term outcomes after bilioenteric reconstruction for post-cholecystectomy bile duct injury: experience at a tertiary care centre. Indian J Surg 2015; 77:472–479.

21 Walsh RM, Henderson JM, Vogt DP, Brown N. Long-term outcome of biliary reconstruction for bile duct injuries from laparoscopic cholecystectomies. Surgery 2007; 142:450–456. discussion 456-457.

22 Sulpice L, Garnier S, Rayar M, Meunier B, Boudjema K. Biliary cirrhosis and sepsis are two risk factors of failure after surgical repair of major bile duct injury post-laparoscopic cholecystectomy. Langenbeck's Arch Surg 2014; 399:601–608.

23 Booij KAC, Coelen RJ, de Reuver PR, Besselink MG, van Delden OM, Rauws EA, Gouma DJ. Long-term follow-up and risk factors for strictures after hepaticojejunostomy for bile duct injury: an analysis of surgical and percutaneous treatment in a tertiary center. Surgery 2018; 163:1121–1127.

24 de Reuver PR, Grossmann I, Busch OR, Obertop H, van Gulik TM, Gouma DJ. Referral pattern and timing of repair are risk factors for complications after reconstructive surgery for bile duct injury. Ann Surg 2007; 245:763–770.

25 Martinez-Lopez S, Upasani V, Pandanaboyana S, Attia M, Toogood G, Lodge P, Hidalgo E. Delayed referral to specialist centre increases morbidity in patients with bile duct injury (BDI) after laparoscopic cholecystectomy (LC). Int J Surg 2017; 44:82–86.

26 AbdelRafee A, El-Shobari M, Askar W, Sultan AM, El Nakeeb A. Long-term follow-up of 120 patients after hepaticojejunostomy for treatment of post-cholecystectomy bile duct injuries: a retrospective cohort study. Int J Surg 2015; 18:205–210.

27 Campana J, Santibañes E. Recurrent biliary strictures after initial biliary reconstruction. In: Dixon E, *et al.* editors. Management of Benign Biliary Stenosis and Injury. Switzerland: Springer International Publishing; 2015. pp. 407–422. DOI: 10.1007/978-3-319-22273-8_38

28 Dominguez-Rosado I, Sanford DE, Liu J, Hawkins WG, Mercado MA. Timing of surgical repair after bile duct injury impacts postoperative complications but not anastomotic patency. Ann Surg 2016; 264:544–553.

29 Patrono D, Benvenga R, Colli F, Baroffio P, Romagnoli R, Salizzoni M. Surgical management of post-cholecystectomy bile duct injuries: referral patterns and factors influencing early and long-term outcome. Updates Surg 2015; 3:7.291–283.

30 Singh R, Brunt LMJAOL, Surgery E. Critical view of safety—its feasibility and efficacy in preventing bile duct injuries. Ann Laparoscop Endoscop Surg 2018; 3:1.

31 Cuendis-Velázquez A, Morales-Chávez C, Aguirre-Olmedo I, Torres-Ruiz F, Rojano-Rodríguez M, Fernández-Álvarez L, Moreno-Portillo M. Laparoscopic hepaticojejunostomy after bile duct injury. Surg Endosc 2016; 30:876–882.

32 Maddah G, Rajabi Mashhadi MT, Parvizi Mashhadi M, Nooghabi MJ, Hassanpour M, Abdollahi A. Iatrogenic injuries of the extrahepatic biliary system. J Surg Res 2017; 213:215–221.

33 Rose JB, Hawkins WG. Diagnosis and management of biliary injuries. Curr Probl Surg 2017; 54:406–435.

34 Laukkarinen J, Sand J, Leppiniemi J, Kellomäki M, Nordback I. A novel technique for hepaticojejunostomy for nondilated bile ducts: a purse-string anastomosis with an intra-anastomotic biodegradable biliary stent. Am J Surg 2010; 200:124–130.

35 Moris D, Papalampros A, Vailas M, Petrou A, Kontos M, Felekouras E. The hepaticojejunostomy technique with intra-anastomotic stent in biliary diseases and its evolution throughout the years: a technical analysis. Gastroenterol Res Pract 2016; 2016:3692096.

36 Pottakkat B, Vijayahari R, Prakash A, Singh RK, Behari A, Kumar A, Saxena R. Factors predicting failure following high bilio-enteric anastomosis for post-cholecystectomy benign biliary strictures. J Gastrointest Surg 2010; 14:1389–1394.