Reconstruction of major bile duct injuries after laparoscopic cholecystectomy

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ABSTRACT

INTRODUCTION: Bile duct injury (BDI) after cholecystectomy remains a serious complication with major implications for patient outcome. For most major BDIs, the recommended method of repair is a hepaticojejunostomy (HJ). We conducted a retrospective review aiming to examine the perioperative and the long-term outcome after reconstructive HJ at our institution.

MATERIAL AND METHODS: Retrospective review of 41 consecutive patients with BDI sustained during cholecystectomy and subsequently managed with a HJ. The patients were referred to a tertiary hepato-biliary centre during a 15-year period (1994-2008).

RESULTS: A total of 32 cases (78%) were reconstructed within two weeks of injury. While 14 patients (34%) suffered perioperative complications, 22 patients (54%) had a complication-free short as well as long-term outcome. Within a median follow-up period of 9.2 years, ten patients (24%) developed biliary strictures requiring percutaneous dilatation and/or further surgery. Three patients had further segmental hepatectomies and one patient developed secondary biliary cirrhosis necessitating orthotopic liver transplantation. No association was found between timing of repair or level of injury and outcome.

CONCLUSION: Early specialist repair may result in acceptable short as well as long-term outcome; however, the morbidity of reconstructive biliary surgery remains high – particularly in the context of patient expectations before laparoscopic cholecystectomy.

The estimated incidence of bile duct injury (BDI) after laparoscopic cholecystectomy is 0.5% [1]. In the majority of major BDIs, a Roux-en-Y hepaticojejunostomy (HJ) is the preferred method of repair [2], and it is recognized that BDI should be referred early and managed at a specialized hepato-biliary centre [3, 4], though the timing of surgical repair remains controversial [3, 5-7].

Prognostic factors for successful repair of iatrogenic BDI include the level of injury [8, 9], absence of injury to the right hepatic artery, and absence of peritonitis [10].

Although a number of series have reported excellent short-term outcomes after reconstructive HJ [11], long-term complications mainly related to biliary strictures remain a major concern with reported incidences reaching 10-25% [7, 9, 10], which contributes to a decrease in quality of life [12, 13] and an overall high mortality in this patient group [1].

We present a retrospective review of patients with BDI sustained during cholecystectomy, referred to our institution from 1994 to 2008 and subsequently managed with a reconstructive HJ. The aim of the review is to examine perioperative as well as long-term outcome.

MATERIAL AND METHODS

All patients undergoing primary reconstructive bilioenteric anastomosis after BDI sustained during cholecystectomy from 1 January 1994 to 1 January 2009 were identified via patient registers. Patients with non-cholecystectomy-related BDI or with cholecystectomy-related BDI that had been definitively managed by other techniques (endoscopically, radiologically or surgically) were not included in the analysis. Furthermore, 11 patients referred to correct intended final reconstructive BDI repair performed elsewhere or at our institution, but outside the index period were excluded.

The only type of bilioenteric anastomosis performed in the above patient material (except for one choledochojejunostomy) was a HJ.

Patient charts were reviewed retrospectively to analyze perioperative (within 30 days of HJ construction or during the primary hospital stay) as well as long-term outcomes. Patients not currently enrolled at the outpatient clinic were contacted via telephone on 1 February 2009.

According to the above criteria, 41 patients were included in the analysis.

Perioperative management

As a tertiary hepatobiliary referral centre, we recommend that all patients sustaining a BDI during cholecystectomy be referred immediately upon diagnosis, whether intra- or postoperatively. In selected cases, a hepato-biliary surgeon from our institution would travel to the referring hospital to construct the HJ during the primary operation.

If the anatomy of the biliary system proximal to the injury was insufficiently visualized by endoscopic retrograde cholangio-pancreaticography (ERCP) or by

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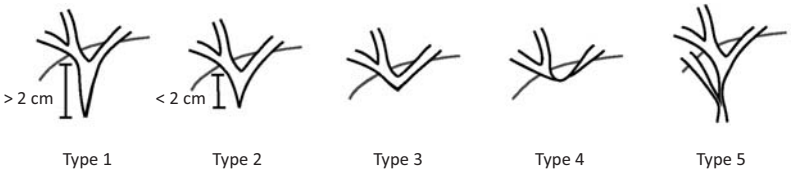
FIGURE 1

Illustration of the Bismuth classification.



Source: [14]

cholangiography through drains left in situ by the primary surgeon, percutaneous transhepatic cholangiography (PTC) was performed immediately upon referral, followed by immediate surgical exploration with HJ construction. Seven patients did not follow this strategy but underwent delayed HJ repair: Five patients had side lesions to the common bile duct initially treated by endoscopy (Strasberg type D injuries) [14] and two patients had previously been treated with biliary stents and been referred for delayed reconstruction. Angiography or computer tomography was not performed routinely.

In brief, surgical reconstruction was performed via a Roux-en-Y hepaticojejunostomy to the biliary confluence after debridement of devitalized tissue. The anastomosis was performed with interrupted, one-layer monofilament sutures. No access loop was constructed. Transhepatic stents were placed only in selected cases depending on the level of injury and/or the presence of biliary peritonitis as well as extensive tissue necrosis. If transhepatic stents were placed during the HJ construction, cholangiography was performed before removal, often after three months. Based on similar considerations, existing percutaneous biliary catheters may have been left in situ during surgery. Drains to the anastomosis were placed routinely.

After discharge, patients were followed in the outpatient clinic. In non-symptomatic patients, liver biochemistry was assessed regularly and, in the absence of initial abnormalities, once annually, often by the primary care physician who referred the patient back to our department for further investigation in case of abnormalities. Routine radiologic imaging was not performed in asymptomatic cases.

Definitions

Laparoscopic cholecystectomy: Any cholecystectomy initiated laparoscopically.

Perioperative complications: Complications within 30 days of HJ or during the primary hospital stay subdivided into cardiovascular (ischaemia, arrhythmia, respiratory failure or pneumonia), thromboembolic (deep venous thrombosis confirmed by ultrasonography), intraabdominal abscess/biloma (requiring drainage by interventional radiology or surgery), wound infection (requiring surgical drainage), anastomotic leakage (requiring reoperation) or reoperation (regardless of cause).

Long-term complications: Defined as biliary complications (strictures, stones, cirrhosis) requiring invasive procedures (invasive radiology or surgery) more than 30 days postoperatively. Due to the lack of generally accepted definitions and objective end-points, cholangitis per se was not registered as a complication, though suspected episodes of cholangitis obviously warranted further investigation, often PTC.

Percutaneous transhepatic cholangiography (PTC): Only interventional PTCs (balloon dilatation, attempted dilatation, lithotripsy) were included. Thus, non-interventional cholangiographies via biliary catheters were not included, regardless of indication.

Biliary stricture: Defined as a radiologically verified symptomatic stricture requiring treatment (balloon dilatation followed by biliary stenting or surgery).

BDI classification: All BDIs were classified according to the Bismuth classification (**Figure 1**) based on the level of the original injury [14] as assessed by radiologic imaging and/or description from the surgeon of the HJ repair.

Statistics

Data are presented as median (range). $p < 0.05$ was considered significant. Univariate analysis to identify risk factors was performed with χ^2 or Fisher's exact test where relevant. Kaplan-Meier estimates were calculated and plotted for analysis of long-term biliary strictures.

RESULTS

Between 1 January 1994 and 1 January 2009, 41 patients underwent HJ repair after CBD injury sustained during cholecystectomy. Patient demographics are listed in **Table 1**. The injury was recognized intraoperatively by the primary surgeon in 13 cases (29%) with a median of five (0-173) and seven (0-624) days from injury to referral and reconstructive surgery, respectively. A total of 15 patients (37%) were referred within one day of injury. In all, 27 patients (66%) were reconstructed within two days of referral, 36 patients (88%) within a week.

All patients, barring three, were alive by 1 February 2009: An 88-year-old patient died from unrelated disease seven years after HJ, one patient died unexpectedly four days after HJ repair and one patient died ten years into a complicated postoperative course including orthotopic liver transplantation.

The distribution of biliary injury level is shown in Table 1.

A total of 22 patients (54%) had an entirely uneventful follow-up (median 9.2 years) with neither perioperative nor long-term complications. In all, 14 patients (34%) had perioperative complications (**Table 2**), including three patients with anastomotic leakage, six with intraabdominal abscess/biloma and four with wound infection. One patient was reoperated on day 32 due to bleeding from the right hepatic artery into the HJ. which required construction of a new HJ. One patient died on the fourth postoperative day after an apparently uncomplicated HJ repair (Bismuth 5 lesion), presumably secondary to a pulmonary embolus. Another three patients underwent PTC immediately after surgery on suspicion of anastomotic leakage (not found).

TABLE 1

Patient demographics.

Sex, n, F/M	33/8
Age at the time of cholecystectomy, yrs, median (range)	43 (22-81)
Cholecystectomy, n, laparoscopic/open	39/2
ASA physical score, n, 1/2/3	29/12/0
Recognition of injury by laparoscopic surgeon, n, yes/no	13/28
Time from injury to referral, days, median (range)	5 (0-173)
Time from referral to HJ, days, median (range)	2 (0-624)
Time from injury to HJ, days, median (range)	7 (0-625)
Level of BDI, n, Bismuth 1/2/3/4/5	4/30/4/2/1
Injury to the right hepatic artery, n, yes/no/not described	6/6/29

ASA = American Society of Anesthesiologists' classification of patient condition; HJ = hepaticojejunostomy ; BDI = bile duct injury.

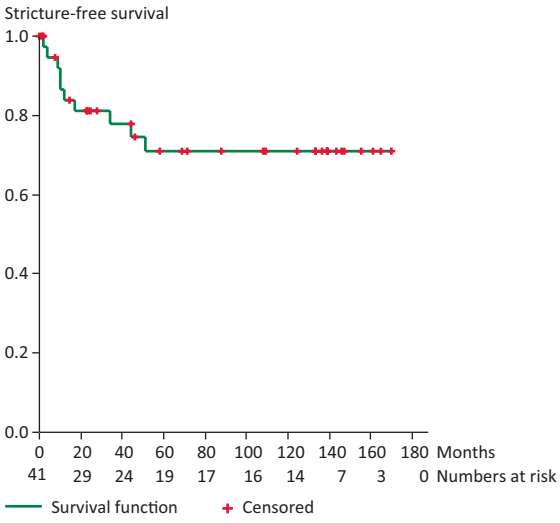
TABLE 2

Outcome.

Hospital stay after HJ, n, days, median (range)	10 (3-61)
Perioperative (< 30 days) complications, n	
Mortality	1
Cardiopulmonary	3
Thromboembolic	1
Wound infection	4
Intraabdominal abscess/biloma	6
Anastomotic leakage	3
Re-HJ	1
Patients with at least one perioperative complication	14
Length of follow-up, months, median (range)	110 (0-172)
Patients with at least one long-term complication, n	10
Patients with PTC with dilatation and/or lithotripsy, n	10
Time from HJ to first PTC, months, median (range)	11 (2-51)
Time from HJ to re-HJ, months (range)	9 (1-18)
Patients with liver resection, n	3
Patients with liver transplantation, n	1

HJ = hepaticojejunostomy; PTC = percutaneous transhepatic cholangiography.

FIGURE 2



Kaplan-Meier plot of stricture-free survival.

Ten patients (24%) had long-term complications related to bile duct stricture. The median follow-up in this subgroup was 126 (43-172) months (Table 2). Biliary strictures were diagnosed a median of 11 months after HJ repair. A Kaplan-Meier estimate of stricture-free survival is shown in **Figure 2**.

Characteristics, interventions and long-term outcome in patients with biliary strictures are described in **Table 3**. In summary, six of these patients eventually underwent re-HJ, one patient underwent a left hepatectomy and one developed secondary biliary cirrhosis requiring orthotopic liver transplantation. The remaining two patients each underwent one percutaneous balloon dilatation and have remained event-free ever since (Table 3).

An associated injury to the right hepatic artery was clearly noted in six cases. No patient had arterial reconstruction or hepatic resection in conjunction with the primary HJ repair. Among these six patients, one later underwent a right hepatectomy (patient one in Table 3), one underwent one percutaneous balloon dilatation (patient nine in Table 3), while the remaining four patients had no long-term biliary complications.

Among the seven patients undergoing delayed HJ repair, two had a perioperative wound infection and none had long-term complications.

Timing of reconstruction (within vs. after two weeks of injury, p = 0.41), presence of cholascos (p = 0.06) or level of injury (Bismuth 1-2 vs. 3-5, p= 1.00) did not significantly affect neither short- nor long-term outcome.

DISCUSSION

In summary, 41 consecutive patients underwent primary HJ repair for cholecystectomy-related BDI in the period

TABLE 3

Characteristics, interventions and long-term outcome in patients with biliary strictures.

Patient number	Injury (Bismuth)	Time from injury to HJ repair (days)	Follow-up (months from HJ)	Perioperative complications	Long-term outcome
1	2	2	43	Intraabdominal abscess. Injury to the RHA	Two attempts at dilatation 17 and 18 months postop. followed by a re-HJ. 19 months later a failed attempt at dilatation was followed by a right hepatectomy due to multiple strictures in the right biliary system. Event-free since (four months)
2	0	2	48	Anastomotic leakage, treated with drainage	One dilatation two months postoperatively followed by a failed attempt one month later. Subsequently a re-HJ was constructed four months postop. Three years later a successful dilatation was performed. Event-free since (eight months)
3	2	10	129	Intraabdominal abscess	One failed attempt at dilatation after ten months followed by re-HJ. Another failed attempt at dilatation six months later was followed by a second re-HJ combined with a resection of the left lateral segments for exposure. Event-free since (113 months)
4	1	7	145	None	One failed attempt at dilatation eight months postop. followed by re-HJ. A new dilatation 45 months later, followed by several attempts at percutaneous lithotripsy and placement of biliary stents remaining to date
5	2	3	151	Cardiopulmonary (atrial fibrillation)	One failed attempt at dilatation four months postop. followed by re-HJ. Event-free since (147 months)
6	2	5	164	None	One failed attempt at dilatation ten months postop. followed by re-HJ. Event-free since (155 months)
7	2	4	66	None. No RHA injury. 20 weeks pregnant at the time of injury	One failed attempt at dilatation 51 months postop. followed by a left hepatectomy as abnormal anatomy precluded a re-HJ. One dilatation took place ten months later. Event-free since (five months)
8	4	7	172	Anastomotic leakage of the jejuno-jejunostomy, sepsis, respiratory insufficiency and kidney failure	One dilatation 34 months postop. Event-free since (138 months)
9	2	10	63	None. Injury to the RHA	One dilatation 12 months postop. Event-free since (51 months)
10	8	3	123	None	One dilatation 44 months postop. Subsequent biliary cirrhosis necessitated orthotopic liver transplantation 76 months postop. Died 47 months later

HJ = hepaticojejunostomy; RHA = right hepatic artery.

1994-2008 with an incidence of short- and long-term complications of 34% and 24%, respectively, and a median follow-up period of 9.2 years.

The strength of this consecutive case series is the complete long-term follow-up and the standardized patient material. As different outcomes have previously been reported in secondary (i.e. patients with prior reconstructive biliary surgery) vs. primary HJ repairs [3, 8], we chose to limit this analysis to primary HJ repairs for clarity.

The 24% incidence of biliary strictures in our material are comparable to reported ranges in the literature for similar patient selections [10], though lower rates of 10-20% have been published [7, 9]. It should be noted however, that only one patient (2%) in our material developed secondary biliary cirrhosis compared to reported ranges up to 10% [10]. Our observation of a median 11-month-period to develop biliary strictures is in accordance with previous findings showing that most biliary strictures occur within two years of repair [9].

There is considerable controversy regarding the optimal timing of repair as some authors have reported early repair (within 4-6 weeks and/or in the presence of peritonitis) to cause a deteriorated long-term outcome [3], while others fail to identify early repair as an individual risk factor [6, 11].

In several large case series, the authors advocate placement of biliary stents while awaiting elective reconstruction, thus avoiding HJ repair in the phase of acute injury [7, 11]. We applied PTC only to visualise the biliary tree if it was not sufficiently visible via ERCP, and 88% of the outpatients were reconstructed within a week of injury, reserving delayed reconstruction for patients with small side lesions in the major biliary ducts after failure of endoscopic treatment.

Though we did not observe an association between level of injury or time of repair and outcome, the relatively small size of the material precludes final interpretations. Vascular injuries, in particular to the right hepatic artery, previously associated with nega-

tive outcome [10] were not systematically assessed and most likely underreported. As patients undergoing primary repairs by a general surgeon were excluded, we cannot comment on the importance of non-specialist vs. specialist repair reported previously [6, 7]. Furthermore, we did not experience the significant patient referral delay reported by others, as 37% of patients were referred within a day of injury (with a median time to referral of five days) compared to the 25 days [3] observed by others.

In summary, BDI after laparoscopic cholecystectomy remains a serious complication with a non-negligible frequency of long-term morbidity. Early reconstruction with HJ performed at a specialist hepatobiliary unit is associated with acceptable short as well as long-term outcomes.

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