Bile Duct Injury—from Injury to Repair: an Analysis of Management and Outcome

Pramod Kumar Mishra · Sundeep Singh Saluja ·
Mohammed Nayeem · Barjesh Chander Sharma ·
Nilesh Patil

Received: 12 September 2012 / Accepted: 8 April 2013 / Published online: 3 May 2013
© Association of Surgeons of India 2013

Abstract Despite advances in speciality care, mortality and morbidity remain the most important issues in the management of post-cholecystectomy bile duct injuries. We analysed the peri-operative management of post-cholecystectomy bile duct injuries to assess their outcomes. Of 150 patients with post-cholecystectomy bile duct injuries, 13 patients who presented with strictured hepaticojejunostomy were excluded from the analysis. The records of the remaining 137 patients were analysed for type of presentation, management and follow-up. Of 137 injuries, 88 were open and 49 were laparoscopic. Various presentations include acute bile duct injury ($n=5$), bile collection ($n=45$), external biliary fistula ($n=46$) and stricture ($n=41$). After initial management, three patients died (sepsis, $n=2$; pseudoaneurysmal bleed, $n=1$). Of 107 patients who underwent definitive repair, three died (portal hypertension, $n=2$; sepsis, $n=1$). At median follow-up of 30 months, 100 patients had good outcome (grade A, B), and only 4 had bad outcome (grade C, D) as per McDonald grading. Peritonitis and sepsis in the early phase and portal hypertension and cirrhosis in the late phase are the main causes of mortality in patients sustaining bile duct injury during cholecystectomy. Successful management in a

specialist hepatobiliary centre can limit the morbidity in more than 90 % cases.

Keywords Bile duct injury · Benign biliary stricture · Hepaticojejunostomy · External biliary fistula

Introduction

Cholecystectomy is one of the commonest operations performed by surgeons all over the world [1]. Bile duct injury (BDI) occurs in 0.1–0.2 % of open cholecystectomies [2, 3]. Laparoscopic surgery has increased these injuries in terms of both volume (0.4–0.6 %) as well as severity [4–6]. Bile duct injury adds considerably to the morbidity of an otherwise simple operation. Unfortunately, these injuries affect a relatively younger population leading to loss of work as well as considerable financial burden. In the west, these constitute an important cause of litigation and patient dissatisfaction. Prevention of these injuries by proper surgical technique and delineation of anatomy are important aspects. Since most of these injuries occur elsewhere, timely referral and proper management are equally important for achieving good results. With advances in technical expertise and speciality care, 90 % of BDI have been reported to have a good outcome [7, 8]. Despite these advances, mortality and morbidity are associated with post-cholecystectomy bile duct injuries [9, 10]. These may occur before or at the time of definitive repair. Most reports related to these injuries describe the long-term outcomes [7, 8]. There are only few reports describing the early peri-operative management of these patients [9]. We analysed the presentation and management of post-cholecystectomy bile duct injuries to assess the outcomes with respect to causes of mortality and morbidity.

P. K. Mishra · S. S. Saluja (✉) · M. Nayeem · N. Patil
Department of Gastrointestinal Surgery, G B Pant Hospital and
Maulana Azad Medical College, Room no. 219, 2nd floor,
Academic Block, 1, Jawaharlal Nehru Marg,
110002 New Delhi, India
e-mail: sundeepsaluja@yahoo.co.in

B. C. Sharma
Department of Gastroenterology, G B Pant Hospital and Maulana
Azad Medical College, Room no. 203, 2nd floor, Academic Block,
Jawaharlal Nehru Marg,
110002 New Delhi, India

Materials and Methods

One hundred and 50 patients reported to us in the Department of Gastrointestinal Surgery at Govind Ballabh Pant Hospital from 2003 to 2010. Profile of these patients was maintained prospectively in a database. Post-cholecystectomy bile duct injuries presented to us in broadly two categories:

1. Immediate (acute bile duct injury), i.e. within 24–48 h without any contamination and were repaired on table or immediately.
2. Delayed, i.e. after 48 h. The patients in the delayed group were further classified according to mode of presentation.

The *first group* presented with *bile collection* either as *bilioma* or *bile peritonitis*. These patients were investigated with abdominal ultrasound and CT scan, followed by percutaneous drainage (bilioma subgroup) or surgical drainage (peritonitis subgroup) to form a controlled fistula before a delayed definitive repair. These patients were subjected to endoscopic retrograde cholangiopancreatography (ERCP) to assess the type of injury once a controlled fistula was formed. In these patients, either the fistula healed to form a stricture or persisted as external biliary fistula. Subsequent management in these patients was as described below.

The *second group* presented with *external biliary fistula* (EBF). Most of these patients had a controlled fistula at the time of presentation and underwent ERCP after initial abdominal ultrasound. Those with type A Strasberg injuries were managed conservatively while patients with complete cut-off of CBD were repaired after waiting for up to 3 months. Many of them had their fistula closed by this time, while some persisted as EBF. Magnetic resonance cholangiopancreatography (MRCP) was done before definitive repair to assess the type of stricture, extent of biliary dilatation, any aberrant biliary anatomy, atrophy/hypertrophy complex, intrahepatic stones or cholangiolar abscess.

The *third group* included patients presenting with *biliary stricture*. This group had some patients presenting early with rapidly rising bilirubin suggesting complete transection. These patients underwent immediate MRCP along with ultrasound Doppler followed by early repair. Other patients in this group presented late with jaundice associated with recurrent episodes of cholangitis. These patients underwent MRCP at the time of presentation along with Doppler. Endoscopic stenting was attempted in selected patients where stricture was negotiable.

All patients were evaluated with detailed history taking and examination. Biochemical and haematological evaluations were done, including liver function tests, renal function tests and haemogram, while preparing them for operative intervention. An interim intervention to control

cholangitis was done if required. It included intravenous fluids, intravenous antibiotics and drainage of collection, if any.

Biliary injuries and strictures were classified as per Strasberg and Bismuth classification, respectively [3, 11]. Operative repair consisted of Roux-en-Y hepaticojejunostomy as per the Hepp–Couinaud approach [12]. A liver biopsy was performed routinely. Anastomotic stenting was done only occasionally in difficult repairs for prevention of leaks. Long-term stents were not used.

Patients were followed up regularly in the OPD with history taking, examination, liver function test (LFT) and ultrasound. Any abnormality was evaluated as required with MRCP and/or scintigraphy. Those unable to come to OPD were followed up telephonically. Outcome was analysed using the grading system suggested by McDonald and colleagues [13]: grade A, asymptomatic with normal LFT; grade B, asymptomatic or occasional mild symptoms with deranged LFT; grade C, cholangitis, i.e. pain and fever with deranged LFT; grade D, recurrent cholangitis requiring intervention or revision.

Standard statistical analysis was used. Univariate analysis, Student's *t* test, Chi square test or Fischer's exact test were used as appropriate.

Results

One hundred and 50 patients with post-cholecystectomy bile duct injury were managed during this period. Only two patients sustained injury in our hospital while the remaining 148 patients were referred from elsewhere. Of these 150 patients, 13 patients were excluded because the index repair was done elsewhere and they presented to us as strictured hepaticojejunostomy. Of the remaining 137 patients, 20 were males and 117 were females. Eighty-eight patients sustained injury during open cholecystectomy while 49 had injuries following laparoscopic cholecystectomy. The mean age was 38 years (12–80 years). Their presentations were as described in Table 1. External biliary fistula and bile

Table 1 Mode of presentation of post-cholecystectomy bile duct injury

Type of presentation	n=137
Immediate	5
Acute bile duct injury	5
Delayed	132
Bile collection	45
External biliary fistula	46
Stricture	41

collection were the two most common presentations after bile duct injury.

The time interval at which a patient presented after the index surgery varied according to type of presentation. A patient with external biliary fistula had bile in the drain from day 1. A patient with bilioma presented between 48 h to 7 days, while those with bile peritonitis came between 5 to 14 days after cholecystectomy. Of 41 patients with biliary stricture, 12 patients developed progressive jaundice immediately after cholecystectomy. Of the remaining 29 patients who presented late, 22 were diagnosed within 2 years, six after 2 years and 1 case as late as 14 years after surgery.

Management After Initial Presentation

Acute Bile Duct Injury

Of five patients presenting in this group, two occurred at our hospital while three were referred from outside. Injuries at our hospital included an aberrant right anterior sectoral duct injury and another right duct injury with low insertion. Both these patients underwent hepaticojejunostomy and are doing well. Among the referred patients, two had complete transection (one each with Strasberg E-3 and E-4) and underwent definitive hepaticojejunostomy while one had repair of lateral injury (Strasberg D) over T tube. The patient with Strasberg E-4 had associated duodenal and right hepatic artery injury which was repaired in the same setting with a good outcome.

Bile Collection

Of 45 patients with bile collection, 28 had *bilioma* and underwent percutaneous drainage of collection. Twenty-six patients formed a controlled fistula, while two patients required exploratory laparotomy. Of these 26 patients, 5 patients were diagnosed to have Strasberg A injury on ERCP (cystic duct stump leak, $n=3$; cholecystohepatic duct, $n=2$). Those with cystic duct stump underwent stent placement ($n=3$), and the other two improved after percutaneous drainage. Fifteen patients with controlled fistula (healed fistulas, $n=12$; EBF, $n=3$) underwent hepaticojejunostomy as definitive management. Of the remaining six patients, three were lost to follow-up, two are waiting for surgery and one patient died of unrelated disseminated ovarian tumour.

Nineteen patients including two with failed percutaneous drainage underwent exploratory laparotomy for *biliary peritonitis*. Of these, 13 patients (healed fistula, $n=10$; EBF, $n=3$) subsequently underwent definitive repair. Three patients died post-operatively (two due to sepsis; one had bleeding from pseudoaneurysm) (Table 2). The remaining three

patients were lost to follow-up. Of these, one presented later with secondary biliary cirrhosis (child B) and was managed with PTBD.

External Biliary Fistula

Of 46 patients with EBF, fistula closed in 31 patients and subsequently developed stricture. The average time for fistula closure was 60 days (5–240 days). Of these 31 patients, 28 underwent Roux-en-Y hepaticojejunostomy, 1 is waiting for surgery and 2 were lost to follow-up after initial conservative management.

Among the remaining 15 patients, 11 patients with persistent fistula underwent definitive repair with hepaticojejunostomy after a median interval of 3 months (range, 3–6 months) after index surgery. Two patients found to have Strasberg type A injury were treated with endoscopic stenting, while one patient with portal hypertension was managed conservatively with stent placement. One patient is waiting for definitive repair.

Stricture

A total of 41 patients presented with biliary stricture. Twelve patients who had progressive jaundice had a mean bilirubin level of 19.2 mg/dl. These patients underwent definitive repair within 2 weeks of their presentation. Twenty-nine patients had delayed presentation, and their mean bilirubin level was 6.6 mg/dl. Of these, 24 patients underwent definitive repair. Among the remaining five patients, two were treated with biliary stenting; one patient who had complication following ERCP was managed conservatively, and one is awaiting surgery. One patient with secondary biliary cirrhosis developed refractory hypotension during surgery forcing us to abandon the procedure. She was discharged on day 10 and is on follow-up. The overall management of patients is shown in a flow chart (Fig. 1) and Table 3.

Definitive Repair (Hepaticojejunostomy)

Among patients undergoing definitive repair, Bismuth type 3 was the most common type of stricture followed by Bismuth type 2. The overall distribution of type of stricture is shown in Table 4. The average size of hepaticojejunostomy was 2.4 cm (0.5–3.5 cm). The mean blood loss during surgery was 110 ml (50–500 ml). The mean operative time was 229 min (150–420 min). Of five patients who underwent stented anastomosis, two had bile leak in the post-operative period. Significant per-operative findings were bilioma ($n=17$),

Table 2 Characteristics of patients with early and late deaths

	Presentation	Age/sex	Procedure	Cause of death	Hospital stay	Co-morbidity
Early						
P1	Biliary peritonitis	65/f	Expl lap + drainage	Sepsis	6	Nil
P2	Biliary peritonitis	55/f	Expl lap + drainage	Sepsis	15	Hemiparesis
P3	Biliary peritonitis	28/f	Expl lap + drainage, coiled embolization, expl lap and ligation	Bleeding pseudoaneurysm	24	Nil
Late						
P1	BBS with SBC	32/f	Hepaticojejunostomy	Liver failure	28	Portal hypertension
P2	BBS with SBC	34/f	Hepaticojejunostomy	Liver failure	21	Portal hypertension
P3	BBS with gastric fistula	58/f	Hepaticojejunostomy	Sepsis	4	Diabetes, hypertension

Expl Lap exploratory laparotomy, *BBS* benign biliary stricture, *SBC* secondary biliary cirrhosis

atrophy/hypertrophy ($n=8$) and intrahepatic stones and sludge ($n=7$).

Overall, seven patients had bile leaks. All were managed conservatively and did not require any intervention. One patient with bile leak developed stricture at 12 months and

underwent a second surgery. The mortality rate was 3/107 (Table 2). Two patients with secondary biliary cirrhosis developed liver failure and died at post-operative days 21 and 28. One patient who had an associated internal gastric fistula died due to sepsis on day 4.

Fig 1 Flow chart showing profile of patients

Table 3 Overall management 137 patients

Treatment	<i>n</i> =137
Roux-en-Y hepaticojejunostomy	107
Endoscopic stenting [Strasberg A cystic duct stump leak (<i>n</i> =5), PHT (<i>n</i> =1) late stricture (<i>n</i> =2)]	8
Percutaneous drainage alone (Strasberg type A: cholecystohepatic duct)	2
Exploratory laparotomy only (early mortality)	3
Primary management and lost to follow-up	8
Waiting for surgery	5
Trial dissection	1
Disseminated ovarian malignancy	1
Primary repair on T tube (Strasberg type D)	1
Percutaneous transhepatic biliary drainage	1

Follow-up

At median follow-up of 30 months (18–80 months), four patients had grade D outcome. Of these, two patients required revision hepaticojejunostomy while the other two underwent hepatectomy. Three patients had successful outcome while one patient requiring hepatectomy died. Among the rest of the 100 patients, ten had grade B and 90 had grade A as per McDonald grading of outcomes. Various preoperative and intra-operative factors were analysed. None predicted the adverse outcome of hepaticojejunostomy as shown in Table 5.

Secondary Biliary Cirrhosis—Portal Hypertension

Six patients presented with portal hypertension within 24–48 months after bile duct injury. Of six patients with portal hypertension, four had secondary biliary cirrhosis. Of these, one was managed with PTBD and one had refractory hypotension during surgery; therefore, procedure was abandoned. Two patients had successful repair but developed liver failure in the postoperative period and died on 21 and 28 days. Of the remaining two patients, one had a successful repair and outcome and is doing well at 2.5 years, while the other was lost to follow-up after initial management.

Table 4 Bismuth type in patients undergoing hepaticojejunostomy

Bismuth type	Open injury, <i>n</i> =70 (%)	Laparoscopic injury, <i>n</i> =37 (%)
Type 1	7 (10)	0
Type 2	28 (40)	11 (30)
Type 3	26 (37)	15 (41)
Type 4	6 (9)	6 (16)
Type 5	3 (4)	5 (13)

Table 5 Survival analysis to find risk factors for bad outcome for hepaticojejunostomy

	Hazard ratio	Confidence interval	<i>p</i> value
Interval after index surgery	0.80	0.54–1.19	0.28
Cholangitis	3.72	0.38–36.05	0.25
External biliary fistula	1.76	0.18–16.95	0.62
Bilirubin level	1.09	0.93–1.16	0.49
Anastomosis size	0.98	0.14–6.08	0.94
Presence of bilioma	1.96	0.20–18.88	0.55
Atrophy/hypertrophy	0.04	0.0–840996	0.71
Stones	0.04	0.0–164017.7	0.68
Bile leak	4.42	0.46–42.52	0.19

Discussion

Bile duct injury is a serious complication of gallbladder surgery. In the data from the west, laparoscopic injuries have overtaken injuries due to open surgery. Johns Hopkins University has reported its experience in management of 200 cases of bile duct injuries sustained during laparoscopic cholecystectomy [9]. Gouma's group reported 83 % of the injuries were due to laparoscopic surgery [14]. Since our hospital receives patients from far and wide including less equipped rural centres, more of our injuries are after open cholecystectomy (*n*=88) compared to laparoscopic (*n*=49). This ratio may change with time and with the increasing adoption of the laparoscopic approach.

Laparoscopic injuries are more severe as previously described by the Johns Hopkins group [9] and also from our centre by Adarsh Chaudhary et al. [15]. Although the numbers of type 4 and 5 injuries were higher in the laparoscopic group (30 %) compared to the open group (13 %), the difference was not statistically significant in our series. Most of the injuries occur during the first few cases which constitutes the learning curve for this surgery [16]. We emphasise the importance of supervised learning of this procedure. Basic tenets for prevention of this injury should be repeatedly stressed. One should have clear identification of the structures in Calot's triangle before dividing any structures [3, 17]. However, inexperience is not the sole factor for these injuries as surgeons with plenty of experience can cause these injuries as well [17, 18]. These arise out of wrong interpretation of the anatomy and overconfidence. Conversion to open surgery should be seen as a triumph of judgement rather than defeat of laparoscopic skills.

Detection of these injuries at the time of occurrence and their proper management are critical. Majority (10–80 %) of injuries are not identified at the time of operation [9, 18, 19]. Our in-house injuries were limited (*n*=2), and only three patients sustaining these injuries elsewhere reached us in

time for primary repair. If detected at operation or within 48 h, a hepatobiliary surgeon should proceed with repair of these injuries. To emphasise, this repair should only be done by surgeons who are routinely dealing with this problem in a large-volume tertiary centre and not by the operating surgeons with whom the injury has occurred [20]. In a review by Stewart and Law, only 17 % of injuries repaired by the primary surgeons were successful [21]. The best policy for the non-specialist surgeon would be to put in a subhepatic drain and ensure that the patient is referred to a hepatobiliary unit for further management.

Initial presentation of a missed BDI can be subtle due to nonspecific symptoms. Any patient who does not rapidly recover after cholecystectomy should be critically evaluated for BDI with ultrasound and liver function tests. Any fever, pain, persistent vomiting or tachycardia should not be ignored especially if the drain has not been placed. If a drain has been put in, presence of bile is a telltale sign.

Patients with bile collection form the most important subgroup as they are responsible for early mortality following injury before patients can undergo definitive repair. The initial management in these cases includes drainage of collection and control of sepsis. Laparotomy is not required for confirmation of injury. It is required in cases of delayed diagnosis, with bile peritonitis and signs of sepsis. Any associated injuries should also be borne in mind. Patients with bilioma should be treated with percutaneous or laparoscopic drainage. Of 28 patients with bilioma, 26 (93 %) were successfully managed with percutaneous drainage in our series. Biliary peritonitis with sepsis is a lethal complication and is the most important cause of death in the early phase. Three of our patients died during the initial management of peritonitis and septicaemia. These patients were diagnosed and referred late. Early diagnosis and referral of bile duct injury can prevent these deaths. This emphasises the need to subclassify the patients with bile leaks into bile collections and external biliary fistula.

Once the sepsis has been controlled, the management concerns the EBF. When to intervene in these cases is a debatable issue. We prefer to delay the intervention up to 12 weeks as this allows the fistula to heal, the level of injury to stabilize, sepsis and oedema to settle and the ducts to dilate. There is also logistic delay as the median time of referral of these injuries is 3 weeks in most series [9]. Subsequently, one needs time to stabilize these patients before definitive repair is planned. Thomson et al. repaired 22 such cases early with good outcome [22]. Repairing these injuries early may decrease hospital stay and morbidity. On the other hand, early repairs within 3 weeks have shown to give poor results. Most authors pursue a policy to wait for 6–12 weeks [23, 24]. Waiting beyond 3–4 months may place the patient at risk for secondary biliary fibrosis [24]. Our cases have been repaired at a median interval of

3 months (range, 3–6). This includes the time for referral to our hospital, initial management and time on waiting list.

Patient presenting with progressive jaundice should have intervention for definitive repair early after stabilization. Waiting for 6 weeks may worsen the outcome in these patients. All patients in this subgroup were treated within 2 weeks of presentation and had a favourable outcome in our series. Patients having stricture with delayed presentation should be treated electively after complete workup and controlling cholangitis, if any.

We have not used transhepatic stents as these may increase the rate of infective complications. Delineation of the ducts can be effectively done with the help of MRCP, and therefore, we have not felt the need for a stent to identify the ducts intra-operatively. Our results show that good outcome is possible without the use of stents.

Successful repair was seen in 104/107 (97 %) of our patients undergoing hepaticojejunostomy. Secondary biliary cirrhosis ($n=2$) and sepsis ($n=1$) were causes of mortality during definitive management. The adoption of the Hepp–Couinaud approach has improved the results of Roux-en-Y repair [12]. This approach ensures a wide anastomosis in a relatively vascular area. Still, biliary injury repair is a technically complex surgery where failures of 10–19 % have been reported from centres of excellence [25, 26].

The patients who presented with portal hypertension had worse outcome in the late phase of management, i.e. definitive repair. This is the group where patients had repeated cholangitis and did not seek treatment at a tertiary centre. Out of six patients, two proved unfit for operation while two others died in the postoperative phase of liver failure. Only one patient followed up at 1.5 years had a good outcome. Other studies have also reported similar findings [27, 28]. Such patients should be considered for liver transplant.

Factors classically attributed to poor long-term outcome include higher Bismuth grades, presence of cholangitis, external biliary fistula, associated vascular injuries and presence of portal hypertension. In a study from SGPGL, India, preoperative bilirubin, cirrhosis and portal hypertension, previous attempts at anastomosis and repair in the presence of external biliary fistula were found to be significant factors for poor outcome [26]. Early surgery (<3 weeks) was found to be associated with poor outcome by Chaudhary et al. [29]. In our study, no such factors could be statistically defined as only 4 % of our patients had a poor outcome. Patients with bile leaks had increased hospital stay, but on follow-up, six of the seven patients showed good outcome. Our low re-stricture rate and good outcome after hepaticojejunostomy may be attributed to our delayed policy of repair and complete delineation of biliary anatomy and mucosa-to-mucosa anastomosis in all cases. However, it needs to be admitted that our median follow-up is only 30 months, and the outcome needs to be assessed further in the succeeding follow-ups.

Although this is a retrospective study, the profile of the biliary injuries described can help in the diagnosis and management of bile duct injuries. The study highlights the importance of management before definitive repair to further reduce the mortality rate. Good results can be achieved with consistent policies and experience.

Conclusions

Bile duct injuries cause a serious shift in the management of patients of cholecystectomy with considerable morbidity and a definite mortality. Late diagnosis with peritonitis in the early phase and late presentation with portal hypertension, recurrent cholangitis and liver damage in the delayed phase are main causes of mortality. If detected early and properly managed in a specialized centre, the damage can be successfully limited.

References

1. Flum DR, Cheadle A, Prela C, Dellinger EP, Chan L (2003) Bile duct injury during cholecystectomy and survival in Medicare beneficiaries. *JAMA* 290:2168–2173
2. Roslyn JJ, Binns GS, Hughes EF, Saunders-Kirkwood K, Zinner MJ, Cates JA (1993) Open cholecystectomy. A contemporary analysis of 42,474 patients. *Ann Surg* 218:129–137
3. Strasberg SM, Hertl M, Soper NJ (1995) An analysis of the problem of biliary injury during laparoscopic cholecystectomy. *J Am Coll Surg* 180:101–125
4. Waage A, Nilsson M (2006) Iatrogenic bile duct injury: a population-based study of 152 776 cholecystectomies in the Swedish Inpatient Registry. *Arch Surg* 141:1207–1213
5. Nuzzo G, Giuliani F, Giovannini I et al (2005) Bile duct injury during laparoscopic cholecystectomy: results of an Italian national survey on 56,591 cholecystectomies. *Arch Surg* 140:986–992
6. Tania O, Jain M, Khanna S, Sen B (2008) Iatrogenic biliary injury: 13,305 cholecystectomies experienced by a single surgical team over more than 13 years. *Surg Endosc* 22:1077–1086
7. Pottakkat B, Vijayahari R, Prakash A et al (2010) Factors predicting failure following high bilio-enteric anastomosis for post-cholecystectomy benign biliary strictures. *J Gastrointest Surg* 14:1389–1394
8. Lillemoe KD, Melton GB, Cameron JL et al (2000) Postoperative bile duct strictures: management and outcome in the 1990s. *Ann Surg* 232:430–441
9. Sicklick JK, Camp MS, Lillemoe KD et al (2005) Surgical management of bile duct injuries sustained during laparoscopic cholecystectomy: perioperative results in 200 patients. *Ann Surg* 241:786–795
10. Frilling A, Li J, Weber F, Frühauf NR et al (2004) Major bile duct injuries after laparoscopic cholecystectomy: a tertiary center experience. *J Gastrointest Surg* 8:679–685
11. Bismuth H, Majno PE (2001) Biliary strictures: classification based on the principles of surgical treatment. *World J Surg* 25:1241–1244
12. Hepp J (1985) Hepaticojejunostomy using the left biliary trunk for iatrogenic biliary lesions: the French connection. *World J Surg* 9:507–511
13. McDonald ML, Farnell MB, Nagorney DM, Ilstrup DM, Kutch JM (1995) Benign biliary strictures: repair and outcome with a contemporary approach. *Surgery* 118:582–591
14. de Reuver PR, Grossmann I, Busch OR, Obertop H, van Gulik TM, Gouma DJ (2007) Referral pattern and timing of repair are risk factors for complications after reconstructive surgery for bile duct injury. *Ann Surg* 245:763–770
15. Chaudhary A, Manisegran M, Chandra A, Agarwal AK, Sachdev AK (2001) How do bile duct injuries sustained during laparoscopic cholecystectomy differ from those during open cholecystectomy? *J Laparoendosc Adv Surg Tech A* 11:187–191
16. Archer SB, Brown DW, Smith CD, Branum GD, Hunter JG (2001) Bile duct injury during laparoscopic cholecystectomy: results of a national survey. *Ann Surg* 234:549–559
17. Strasberg SM (2008) Error traps and vasculo-biliary injury in laparoscopic and open cholecystectomy. *J Hepatobiliary Pancreat Surg* 15:284–292
18. Lillemoe KD, Martin SA, Cameron JL, Yeo CJ, Talamini MA, Kaushal S et al (1997) Major bile duct injuries during laparoscopic cholecystectomy. Follow-up after combined surgical and radiologic management. *Ann Surg* 225:459–471
19. Krähenbühl L, Sclabas G, Wente MN, Schäfer M, Schlumpf R, Büchler MW (2001) Incidence, risk factors, and prevention of biliary tract injuries during laparoscopic cholecystectomy in Switzerland. *World J Surg* 25:1325–1330
20. Perera MT, Silva MA, Hegab B et al (2011) Specialist early and immediate repair of post-laparoscopic cholecystectomy bile duct injuries is associated with an improved long-term outcome. *Ann Surg* 253:553–560
21. Stewart L, Way LW (1995) Bile duct injuries during laparoscopic cholecystectomy. Factors that influence the results of treatment. *Arch Surg* 130:1123
22. Thomson BN, Parks RW, Madhavan KK, Wigmore SJ, Garden OJ (2006) Early specialist repair of biliary injury. *Br J Surg* 93:216–220
23. Singh V, Kacker LK, Sikora SS, Saxena R, Kapoor VK, Kaushik SP (1997) Post-cholecystectomy external biliary fistula. *Aust N Z J Surg* 67:168–172
24. Sikora SS, Srikanth G, Agrawal V, Gupta RK, Kumar A, Saxena R et al (2008) Liver histology in benign biliary stricture: fibrosis to cirrhosis... and reversal? *J Gastroenterol Hepatol* 23:1879–1884
25. Schmidt SC, Langrehr JM, Hintze RE, Neuhaus P (2005) Long-term results and risk factors influencing outcome of major bile duct injuries following cholecystectomy. *Br J Surg* 92:76–82
26. Sikora SS, Pottakkat B, Srikanth G, Kumar A, Saxena R, Kapoor VK (2006) Postcholecystectomy benign biliary strictures—long-term results. *Dig Surg* 23:304–312
27. Connor S, Garden OJ (2006) Bile duct injury in the era of laparoscopic cholecystectomy. *Br J Surg* 93:158–168
28. Thomson BN, Parks RW, Madhavan KK, Garden OJ (2007) Liver resection and transplantation in the management of iatrogenic biliary injury. *World J Surg* 31:2363–2369
29. Chaudhary A, Chandra A, Negi SS, Sachdev A (2002) Reoperative surgery for postcholecystectomy bile duct injuries. *Dig Surg* 19:22–27