

## Outcomes of Surgical Repair after Bile Duct Injury During a Laparoscopic Cholecystectomy

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**Abstract:** Background: A laparoscopic cholecystectomy (LC) has resulted in significant advantages for patients with biliary tract stone disease. However, recent reviews of accumulated cases of LC have also shown the incidence of biliary injury to be higher in cases of LC than in cases of conventional open cholecystectomy. Aim: The aim of this study was to review the outcomes after a surgical repair for bile duct injury during an LC. Methods: Nineteen patients who suffered bile duct injury during an LC over a 15-year period were analyzed. Results: A diagnosis of bile duct injury was made during surgery in 13 patients, and after surgery in 6 patients. Eighteen patients suffered an injury to the common bile duct, while the remaining patient had an injury to the right hepatic duct. As for the degree of injury, 12 patients had their bile ducts transected, 1 patient had bile duct necrosis, and 5 patients incurred a partial bile duct injury, while one patient had a clipping injury. A primary closure in 5 patients for a partial injury and the removal of a clip resulted in smooth postoperative courses. The indwelling t-tube over 31 months in one patient who developed bile duct necrosis also showed a favorable postoperative course. For the other 14 patients, duct-to-duct anastomosis was performed in 8 patients, a hepaticojejunostomy was performed in 5, and one patient underwent a hepaticoduodenostomy. However, 7 patients after duct-to-duct anastomosis in 6 and one who underwent a hepaticoduodenostomy developed stricture of the anastomotic sites from 6 to 15 months after surgery. The other two patients with a long-term indwelling stent showed smooth postoperative courses. Three out of the 5 patients who underwent an initial hepatico-jejunostomy developed biliary stricture. These 3 patients were consequently converted to a rehepaticojejunostomy, a liver transplantation and an extended right hepatectomy, respectively. Conclusions: A hepaticojejunostomy remains the gold standard treatment for a severely injured bile duct during an LC. Duct-to-duct anastomosis with the use of a long-term indwelling stent may also be considered when making a surgical repair in some cases.

**Key words:** Laparoscopic Cholecystectomy, Bile Duct Injury Outcomes after Surgical Repair

### Introduction

A laparoscopic cholecystectomy (LC) has resulted in significant advantages for patients including a shorter hospital stay, decreased postoperative morbidity rates and a quicker return to normal activi-

ties for patients with biliary tract stone disease. On the other hand, retrospective studies of LC have also shown the incidence of biliary injury to be higher in cases of LC than in cases where a conventional open cholecystectomy is performed. In general, intraoperative bile duct injury is thought to be an iatrogenic injury in many cases, and there-

fore selecting the appropriate surgical repair of such injuries is becoming increasingly important.<sup>1)</sup> A small but significant proportion of patients will have long-term problems with recurrent cholangitis and the additional risk of developing secondary biliary cirrhosis.<sup>2)</sup>

The aim of this study was to review the outcomes of the surgical repair in patients experiencing bile duct injury during an LC. In addition, the duration of anastomotic stent placement is also discussed based on the clinical data.

#### Patients and methods

The records of 19 patients with bile duct injuries during an LC who were managed at this Hospital over a 15-year period from 1991 through October, 2006, were reviewed. The patients who received a surgical repair included 18 patients with cholecystolithiasis and one with chronic cholecystitis. Seven of the 19 patients who developed biliary stricture after the initial repair procedures were referred to this department for further treatment.

A diagnosis of a bile duct injury was made during surgery in 13 patients, and after surgery in 6 patients, including 2 who were diagnosed on the first postoperative day, while one patient each was diagnosed on the third, sixth, fourteenth, and twentieth postoperative day, respectively (Table 1).

Eighteen of these patients suffered an injury to

the extrahepatic bile duct, while the remaining one patient had an injury to the right hepatic duct. Regarding the degree of injury, 13 patients had their bile ducts transected and one of those had a concomitant injury to the right hepatic artery, 5 patients had a partial bile duct injury, and one patient had a clip injury (Table 2).

The presumed mechanism of the bile duct injury in 13 patients was that the common bile duct was mistaken for the cystic duct. In 5 patients, either a laceration or avulsion of a portion of the lateral wall of the extrahepatic bile duct was treated by extensive use of mono-polar electric cautery. All of the patients developed bile leakage intraoperatively except for one clipping case (Table 3).

The classification of the types of stricture was primarily based on the ductal anatomy as it appeared postoperatively on either percutaneous transhepatic cholangiography (PTC) or endoscopic retrograde cholangiography (ERC).

A statistical analysis was conducted using the unpaired t-test and a difference of  $p < 0.05$  was determined to be statistically significant.

#### Results

Outcomes of patients with a partial bile duct injury (4 patients) (Table 4)

The performed procedures included a primary closure in 3 patients and the removal of a clip in

Table 1

Total patients	A 15-year period from 1991-2006
19 patients	18 with cholecystolithiasis, 1 with cholecystitis
Diagnosis	During surgery 13 patients, After surgery 6 patients (1, 1, 3, 6, 14 and 20 days after surgery)

The numbers in parentheses represent the number of days before a diagnosis of the bile duct injuries after surgery.

Table 2 Different Types of Bile Duct Injury during a Laparoscopic Cholecystectomy

Type of Injury to Bile Duct	Case (%)	Site	
Transection	12 (63)	common bile duct	8
		proper hepatic duct	3
		right hepatic duct	1
Clip	1 (5)	proper hepatic duct	1
Lesion/Leakage	6 (32)	common bile duct	2
		confluence of ducts	4
Total			19

one patient. The patients who had a partial bile duct injury and in whom biliary stents were placed for 28, 37 and 90 all showed an uneventful course for a follow-up period ranging from 102 to 122 months.

The one remaining patient had continuous abdominal pain after the initial surgery and jaundice also gradually developed. On the twenty-ninth postoperative day, this patient underwent a relaparotomy and the junction of the three bile ducts was

found to have been clipped. The clip was removed and a T-tube stent was also implanted for 21 days, and the patient has since shown an uneventful course for 107 months.

The outcomes of surgical repair after transection and severe tissue injury of the bile duct (Table 5)

A) Sphincter preserving method (9 patients)

Eight patients underwent duct-to-duct anasto-

Table 3 Presumed Mechanism of Bile Duct Injury

Mechanism of Injury	Number of Patients
Common bile duct mistaken for cystic duct	13
Common bile duct laceration	3
Extensive cautery injure to bile duct	2
Clipping	1
Total	19

Table 4 Outcomes of a Surgical Repair for a Bile Duct Partial Injury during Laparoscopic Cholecystectomy

Type of Surgical repair	Case	Outcome
Stented primary closure of lesion	3 (28, 37, 90)	smooth 122, 102, 116
Removal of clip	1	smooth 107
Total	4	

The numbers in parentheses represent the number of days with indwelling drains after surgery ; the numbers in angle brackets represent the number of months that the patients were followed up.

Table 5 Outcomes of Surgical Repair for Bile Duct Severe Injury during Laparoscopic Cholecystectomy

A) Preserving method of Oddi sphincter

Type of Surgical Repair	Cases	Outcome
Stented duct-to-duct anastomosis	5 (7, 19, 28, 30, 37)	stricture and cholangitis [1, 6, 6, 8, 15]
		4 (conversion to HJ-stomy)
		1 (reconversion to liver transplantation) 53
3 (30, 90, 305)	1 stent slip out (endoscopic stent replacement) 23	
	smooth 17, 48, 148	
T-tube stented plasty	1 (14)	smooth 31

B) Diversion method of biliary tract

Stented hepaticojejunostomy	5	3 (14, 14, 178) smooth
		2 (14, 14) stricture & recurrent cholangitis [3, 3]
		conversion to re-HJ-stomy 43
		conversion to Extended rt-Hepatectomy 48
Stented choledochoduodenostomy	1 (90)	stricture and cholangitis [11]
		conversion to HJ-stomy 215

The numbers in parentheses represent the number of days with indwelling drains after surgery ; the numbers in angle brackets are the number of months that the patients were followed up. The numbers in the square brackets represent the number of months that the patients underwent resurgery after surgical repair. HJ-stomy is a hepaticojejunostomy

nosis, of which 4 patients eventually developed biliary stricture 6, 6, 8, and 15 months after the initial surgery. Biliary stenting tubes had been placed in these 4 patients for 7, 19, 28 and 37 days respectively, after the initial surgery. The second surgery for these patients was changed to a hepaticojejunostomy and the postoperative courses following the surgery were uneventful for a median follow-up of 49 months (range 38 to 84 months) except for one patient. This patient developed recurrent cholangitis around two years after undergoing the hepaticojejunostomy due to anastomotic stricture. A percutaneous stent placement was performed in this patient, but she repeatedly developed re-cholangitis followed by biliary liver cirrhosis. Finally, a living donor liver transplantation was performed.

The three other patients who had undergone a duct-to-duct anastomosis with stenting tubes placed for 30, 90 and 305 days showed an almost uneventful course following a surgical repair for periods of 29 through 78 months. One patient for whom the internal stent had been placed for about 10 months had a transection of the right hepatic duct.

The other two patients directly underwent a hepaticojejunostomy because both the proximal and distal sites of the transected bile ducts developed severe tissue injury caused by electric cautery.

#### B) Biliary diversion method (6 patients)

The three patients who had undergone a hepaticojejunostomy with stent tube placement for 14, 14 and 178 days showed a mostly uneventful course following a surgical repair for periods of 36 through 94 months.

Two out of 5 patients with an initial hepaticojejunostomy developed biliary stricture. These 3 patients were consequently converted to a re-hepaticojejunostomy and an extended right hepatectomy, respectively.

The remaining one patient who had an injury to the bile duct over more than half its circumference underwent an end-to-side choledocho-duodenostomy. This patient developed intrahepatic stones 14 months after the initial surgery. The second surgical repair was a hepaticojejunostomy and the postoperative course has been uneventful for 104

months.

## Discussion

A laparoscopic cholecystectomy (LC) was demonstrated as early as 1989 to have obvious benefits over open surgery. With decreased postoperative pain, shorter hospital stays, and earlier returns to work; LC quickly replaced open cholecystectomy as the primary surgical strategy.<sup>3,4)</sup> There are no absolute contraindications to an LC, but patients with severe abdominal adhesions or a biliary anatomy which cannot be clearly defined often require an open procedure.

However, the frequency of a bile duct injury as a complication of LC, which occurs in from 0.2 to 0.3% of cases, is still higher than the incidence with a conventional open cholecystectomy (OC; 0.1%).<sup>5)-7)</sup> Although a number of factors have been identified with a higher risk of injury (male gender, complicated gallstone disease, aberrant anatomy) and a number of technical steps have been emphasized to avoid these injuries, the incidence of bile duct injuries has reached a steady-state at least double the rate observed with OC. In general, intraoperative bile duct injury is thought to be an iatrogenic injury in many cases, and the management of the repair procedures is therefore becoming increasingly important.<sup>1)</sup> A small but significant proportion of patients show long-term problems with recurrent cholangitis and also a risk of developing secondary biliary cirrhosis. Moreover, the results of previous studies regarding repair surgery for bile duct injury during LC have also suggested that lesions are more complicated after an LC than after an OC.<sup>8)</sup> This report documents that the long-term follow-up shows most patients to have a successful outcome following a surgical repair.<sup>8)</sup> However, there is a general impression that these patients have an impaired the quality of life (QOL). Although there was a significant difference in the QOL as evaluated from a psychological dimension, bile duct injury patients reported QOL scores in the physical and social domains comparable to those of control patients. The decreased QOL assessment in the psychological dimension may be attributable to the prolonged, complicated, and unexpected nature of

these injuries. Patients reported similar rates of abdominal pain, change in bowel habits, use of pain medications, and recent symptoms of fever or chills after surgical repair, in comparison to LC controls. Thirty-one percent of the responding bile duct injury patients reported having sought legal recourse due to their injury. All QOL domain scores were significantly lower in the patients who pursued a lawsuit versus those who did not. In addition, the increasing number of lawsuits also appears to be associated with a poorer QOL assessment.<sup>9)</sup>

This report describes cases of bile duct injury that were attributed to a misidentification of the bile duct in more than 70% of all patients. All of the patients had a concomitant severe inflammation around Calot's triangle due to chronic cholecystitis. Not only prophylaxis but appropriate treatment becomes important in the event of injury in order to prevent the subsequent occurrence of biliary stricture.<sup>10)</sup> Most patients sustaining a bile duct injury are recognized in the weeks following the LC. Careful preoperative preparation should include the control of sepsis by draining any bile collections or fistulas and complete cholangiography. Long-term results are best achieved in specialized hepatobiliary centers that perform biliary reconstruction with a Roux-en-Y hepaticojejunostomy (HJ-stomy). Success rates over 90% have been reported from several centers to date with an intermediate follow-up.

At present, HJ-stomy should be performed if the defect area of the injured bile duct is wide or if a correct diagnosis is not made during the early postoperative stage.<sup>11)</sup> In the present series, HJ-stomy showed good results for the reconstruction of bile duct injury in all but one patient after an observational period of more than 5 years. However, an HJ-stomy as a biliary-enteric bypass basically eliminates the physiological preventive function of regurgitation by the papilla of Vater. The loss of this physiologic barrier between the digestive tract and the biliary tract may result in intestinobiliary reflux and bacterial colonization of the biliary tract.<sup>13)</sup> In the present series, one exceptional patient who underwent an HJ-stomy due to postoperative stricture developed recurrent cholangitis around two years after surgery. Pellegrini et al.

pointed out that the rate of resticture after an initial repair using an HJ-stomy is 25%. Most importantly, they demonstrated not only that two thirds of recurrences became symptomatic within 2 years after the operation, but that it takes up to 7 years for 90% of all recurrent symptoms to appear.<sup>14)</sup> Up to now, there have been few reports on the long-term results of an HJ-stomy in patients more than 10 years after surgery.<sup>15)</sup> The current cases undergoing an HJ-stomy have a possibility of developing resticture or cholangitis.

On the other hand, if the transected bile duct injury can be immediately diagnosed by intraoperative cholangiography, duct-to-duct biliary anastomosis (DD-stomy) is also recommended.<sup>16)</sup> A stented DD-stomy is usually performed for the reconstruction of injured bile ducts if a diagnosis of bile duct injury was made during surgery. A DD-stomy should be performed; 1) if both the upper and lower edges of resected bile ducts are intact and the diameters are not markedly different, 2) if the length of the resected bile duct is not more than 1cm and 3) if no inflammation or infection is detected around the injured bile duct.<sup>17)</sup> In the present series, 7 patients underwent a DD-stomy and 4 of these patients eventually developed biliary stricture. The stricture rate in our cases of 59.1% is considered to be somewhat high. However, about 40% of all patients also showed an uneventful postoperative course.

The use of a transanastomotic stent for a prolonged period after biliary surgery remains controversial. However, the present trend is to avoid long-term postoperative stenting.<sup>18)</sup> Clearly, excellent results have been reported without the use of stents by both Bithmuth and Myburgh.<sup>19) 20)</sup> However, the purpose of such stents is not only to allow for the temporary decompression of the biliary system and for postoperative cholangiography, but also to assess the adequacy of the anastomosis.<sup>21)</sup> We use a relatively long term stenting during the perioperative period to prevent anastomotic stricture in patients who undergo a DD-stomy after bile duct injury during an LC. If a patient develops anastomotic stricture, it is easier to conduct ballooning dilation procedures through a stent tube. According to these results, no significant difference was observed between the stenting

period through a DD-stomy for less than one month and that of more than one month. The bottom line is that an improvement of a stent which can safely remain indwelling for a long time for benign biliary stricture is required in order to minimize biliary diversion.

In conclusion, an HJ-stomy at a level of good blood supply remains the gold standard for the treatment for a severely injured bile duct during an LC, which also offers satisfactory results in patients after previous interventions have failed. A DD-stomy with the use of a long-term indwelling stent may also be considered when performing a surgical repair in some cases. In addition, minor bile duct lacerations are amenable to conservative therapy with over-sewing and stent placement.

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