

ORIGINAL ARTICLE

Primary versus delayed repair for bile duct injuries sustained during cholecystectomy: results of a survey of the Association Francaise de Chirurgie

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Abstract

Background: Bile duct injuries (BDIs) sustained during a cholecystectomy still remain a major surgical problem, and it is still not clear whether the injury should be repaired immediately or a delayed repair is preferred.

Methods: A retrospective national French survey was conducted to compare the results of immediate (at time of cholecystectomy), early (within 45 days after a cholecystectomy) and late (beyond 45 days after a cholecystectomy) surgical repair for BDI sustained during a cholecystectomy.

Results: Forty-seven surgical centres provided 640 cases of bile duct injury sustained during a cholecystectomy of which 543 were analysed for the purpose of the present study. The timing of repair was immediate in 194 cases (35.7%), early in 216 cases (39.8%) and late in 133 cases (24.5%). The type of repair was a suture repair in 157 cases (81%), and a bilio-digestive reconstruction in 37 cases (19%) for immediate repair; a suture repair in 119 cases (55.1%) and a bilio-digestive anastomosis in 96 cases (44.9%) for the early repair; and a bilio-digestive reconstruction in 129 cases (97%) and a suture repair in 4 cases (3%) for late repair. A second procedure was required in 110 cases (56.7%) for immediate repair, 80 cases (40.7%) for early repair ($P < 0.05$) and in 9 cases (6.8%) for late repair ($P < 0.001$).

Conclusion: The timing of surgical repair for a bile duct injury sustained during a cholecystectomy influences significantly the rate of a second procedure and a late repair should be preferred option.

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Introduction

A cholecystectomy is associated with a rate of bile duct injury (BDI) that varies from 0.1–0.2% at an open cholecystectomy to 0.4–0.6% for the more common laparoscopic approach (Table 1).^{1–22} Indeed, soon after its introduction, laparoscopic cholecystectomy has been shown to be associated with an increased risk of BDI²³ and this has remained in spite of the increased experience and awareness of the pitfalls specific to the laparoscopic approach and therefore still represents a major surgical challenge.²⁴ In fact, BDI is a devastating complication asso-

ciated with long-term morbidity²⁵ that may result in reduced survival²⁶ and an impaired quality of life.^{27,28}

Surgical repair of a BDI may be technically challenging and it has been shown that this surgery should be best performed in tertiary referral hepatobiliary centres.²⁵ The other main issue in BDI repair concerns the timing of definitive surgical repair. In the present paper, the impact of timing of immediate repair upon the post-operative outcome was investigated in a series of patients with BDIs sustained during a cholecystectomy issued from a retrospective national French survey.

Material and methods

This retrospective study is part of a national survey conducted by the French Surgical Association in 2011 for BDIs sustained during

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Table 1 Major series published in the literature over the study period

Authors	Year	No. of patients	BDI rate (%)
Scott <i>et al.</i> ⁸	1992	12 397	0.80
Deziel <i>et al.</i> ⁹	1993	77 604	0.59
Russel <i>et al.</i> ⁶	1996	30 211	0.04–0.24
Richardson <i>et al.</i> ⁵	1996	5913	0.4–0.8
Adamsen <i>et al.</i> ⁴	1997	7654	0.74
Gigot <i>et al.</i> ¹⁰	1997	9959	0.50
Tagarona <i>et al.</i> ⁷	1998	1630	1.00
Vecchio <i>et al.</i> ¹¹	1998	114 005	0.50
Flum <i>et al.</i> ¹²	2001	30 630	0.25
Krähenbühl <i>et al.</i> ¹³	2001	12 111	0.30
Savassi-Rocha <i>et al.</i> ¹⁴	2003	91 232	0.18
Flum <i>et al.</i> ²⁶	2003	1 570 361	0.50
Nuzzo <i>et al.</i> ¹⁵	2005	56 591	0.42
Debru <i>et al.</i> ¹⁶	2005	3145	0.16
Diamantis <i>et al.</i> ²	2006	3637	0.52
Giger <i>et al.</i> ¹⁷	2006	22 953	0.30
Waage <i>et al.</i> ¹⁸	2006	152 776	0.40
Tantia <i>et al.</i> ¹	2007	13 305	0.39
Karvonen <i>et al.</i> ¹⁹	2007	3736	0.86
Georgiades <i>et al.</i> ³	2008	2184	0.69
Yaghoubian <i>et al.</i> ²⁰	2008	2470	0.80
Ou <i>et al.</i> ²¹	2009	10 000	0.16
Machi <i>et al.</i> ²²	2009	1381	0.20

BDI, bile duct injury.

a cholecystectomy. A questionnaire on bile duct injury sustained during a cholecystectomy between 1990 and 2010 was prepared by three senior authors (J.P., J.G. and A.H.) and sent to all the members of the French Surgical Association independently of their affiliation (university hospital or private clinic). Forty-seven surgical centres (28 university hospitals and 19 private clinics) participated in this study providing 640 cases of BDIs sustained during a cholecystectomy. In each institution, an agreed surgeon was identified as responsible for data collection from patients' clinical files from January 1990 to December 2010 on BDIs sustained during a cholecystectomy either laparoscopic or open. Data were collected according to a standardized questionnaire and entered in a database. For the purpose of the present study, patients not requiring surgical treatment as well as those for whom the surgical technique employed to repair the injury was not clear from the operative charts were excluded from the analysis. The following information was taken from the database: patients' demographics [age, gender and body mass index (BMI)], surgical approach (laparoscopic or open), timing of surgical repair, type of repair, postoperative complications, need for second repair and mortality.

BDIs were defined as injuries to the extra-hepatic biliary tree, whether normal or abnormal anatomically disposed. BDIs after a

hepatectomy, choledochotomy for gallstones, bilioenteric-anastomoses or after removal of biliary drains were excluded from this study.

Repairs were divided into hepatico-jejunostomy (RYHJJ) with a Roux-en-Y limb, a choledo-duodenostomy and direct suture repair without bilio-enteric anastomosis. Information on the operating surgeon affecting the repair was indirectly retrieved from the qualification in hepatobiliary surgery of the centre where the repair was performed.

A repair was defined as immediate when performed at the time of the cholecystectomy, early when performed 1–45 days after the cholecystectomy and late when performed beyond 45 days. The duration of time intervals was based on the hypothesis that 45 days may be in most of the cases enough to perform the bile duct repair under optimal conditions.

The repair was defined as successful when no further surgery, interventional endoscopy or radiology was required up to the time of follow-up.

Patients were divided according to the timing of BDI repair in three groups: immediate, early and late repair and the studied variables compared between the three groups.

Statistics

All data are presented as the mean. The three groups were compared using the chi-square test as appropriate. All statistical analyses were carried out using NCSS 2007 (NCSS, Kaysville, UT, USA). A *P*-value < 0.05 was considered statistically significant.

Results

Of the 640 cases of BDI available for the analysis, 97 patients were excluded from the present study because no surgical treatment was required in 45 cases and the type of surgical treatment was considered as not clear from the operative charts in 52 more cases (Fig. 1). Of the remaining 543 patients, 332 were women and 211

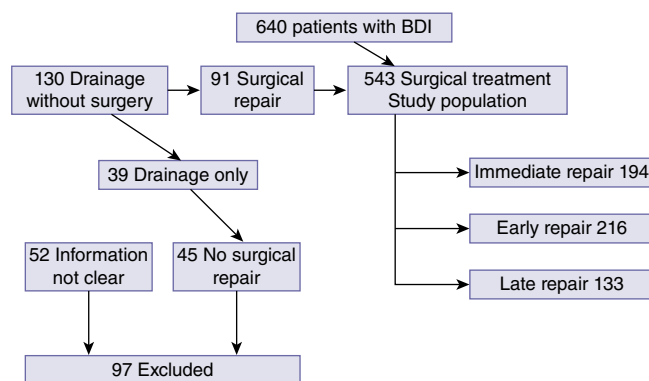


Figure 1 Flow chart of the 640 patients included in the French Surgical Association nation survey on bile duct injury (BDI). BDI; immediate repair: at the time of cholecystectomy; early repair: within 45 days of cholecystectomy; late repair: beyond 45 days of cholecystectomy

men with a mean age of 54 years (range 17–92). The mean BMI was 26.4 kg/m² (range 15–63) with only 36 patients (6.6%) being severely obese (BMI >35 kg/m²) and 35 (6.4%) thin (BMI <20 kg/m²) (Table 2). An open cholecystectomy was undertaken in 83 cases (15.3%), and a laparoscopy in the remaining cases of which 205 (44.6%) underwent conversion to open surgery. The reasons for conversion were the suspicion of BDI in 132 cases (64.4%), technical problems owing to difficulties in exposure, excessive inflammation, bleeding or the presence of common bile duct stones in the remaining cases (35.6%). A per-operative cholangiogram was obtained in 295 cases (54.3%). The diagnosis of BDI was established at the time of cholecystectomy in 193 cases (35.6%), of which 181 (93.8%) underwent immediate repair.

Timing and efficacy of BDI repair

The timing of repair was immediate for 194 patients (35.7%), early for 216 patients (39.8%) and late for the remaining 133 patients (24.5%). There was no difference in age, gender and BMI between the three groups of patients (Table 2).

Surgical treatment

Seventy-seven patients out of 194 (39.7) in the immediate group, 110 out 216 (50.9%) in the early group and all 133 patients in the late repair group were managed in tertiary referral hepatobiliary centres.

In total, 130 of the 640 patients (20.3%) were managed by means of drainage of the subhepatic space (either by means of interventional radiology or surgical exploration) with no attempt to repair at the time of BDI. Of these ninety-one (70%) underwent Roux-en-Y RYHJJ repair, 28 patients (21.5%) as an early repair and 62 patients (47.7%) as a late repair, and 18 (13.8%) were managed with a stent in the bile duct either endoscopically or radiologically. Six patients (4.6%) died before any attempt at BDI repair (Fig. 1).

The RYHJJ technique was employed in 18% of patients undergoing an immediate repair, 42.1% of patients undergoing an early repair and in 95.5% of patients undergoing a late repair ($P < 0.001$). Direct repair was the technique of choice not only in most of the patients who had an immediate repair (81%) but also in

more than half of patients undergoing an early repair (55.1%) (NS). However, this technique was employed in only four patients (2.6%) undergoing a late repair ($P < 0.001$). Choledoco-duodenal repair was employed in only 10 cases in this series equally distributed in the three groups of patients (NS) (Table 2).

Immediate and early repair resulted in a 39.2% and 28.7% rate of post-operative complications, respectively ($P < 0.05$). The rate of post-operative complications was 14.3% in patients undergoing a late repair ($P < 0.01$). Post-operative mortality was higher in the immediate and early repair groups (2.8% and 2.2%, respectively) as compared with the 0.8% rate reported for the late repair group but this difference did not reach statistical significance (Table 3). The late repair resulted in the lowest rate of failure (5.3%) ($P < 0.01$). The RYHJJ resulted in the lowest rate of post-operative complications, mortality as well as failure when performed beyond 45 days of the BDI. One or more stents either endoscopic or radiological were used in the management of 14 (11.3%), 13 (14%) and 2 (20%) patients of the immediate, early and late repair groups, respectively, that experienced primary surgical repair failure (Table 4).

Discussion

The timing of bile duct repair after BDIs sustained during a cholecystectomy is still a matter of debate. Although the best chance for a repair for expert hepatobiliary surgeons involves the subset of patients with injuries detected during surgery, in the vast majority of the cases the surgeon causing the injury has not enough experience to perform the repair. It has been argued that in this case the best choice is to call on an experienced hepatobiliary surgeon to manage this complex surgical situation. However, this is far from being the case in most instances and the injury surgeon may be tempted to make a repair that is destined, in a high percent of the cases, to further complicate an already complex clinical situation. Indeed, in the present national survey of BDIs, 157 patients (80.9%) out of the 194 patients undergoing an immediate repair had a direct repair. As expected, the direct repair failed in a high rate of patients (56%). Furthermore, the RYHJJ repair, that is considered by most the procedure of choice to repair a BDI,

Table 2 Patients characteristics and type of intervention

	Immediate repair No. of patients 194	Early repair No. of patients 216	Late repair No. of patients 133	<i>P</i>
Age	54 (18–89)	54 (17–92)	54 (20–85)	NS
Gender	M 79 F 115	M 82 F 134	M 51 F 82	NS
BMI (kg/m ²)	26.4 (15.8–44)	26.4 (16.4–63)	26.4 (15–44)	NS
RYHJJ	35 (18%)	91 (42.1%)	127 (95.5%)	<0.05
CD	2 (1%)	6 (2.8%)	2 (1.5%)	NS
DR	157 (81%)	119 (55.1%)	4 (3%)	<0.05

RYHJJ, Roux-en-Y Hepatico-jejunostomy; CD, choledoco-duodenostomy; DR, direct repair; NS, not significant.

Table 3 Postoperative complications, postoperative mortality and repair failure in the 3 groups

	Immediate repair No. of patients 194 (%)	Early repair No. of patients 216 (%)	Late repair No. of patients 133 (%)	P
Postoperative complications				
RYHJJ	18/35 (51.4%)	16/91 (17.6%)	16/127 (12.6%)	<0.001
CD	0/2 (0%)	0/6 (0%)	0/2 (0%)	NA
DR	58/157 (36.9%)	46/119 (38.7%)	3/4 (75%)	NS
Postoperative mortality				
RYHJJ	1/35 (2.9%)	2/91 (2.2%)	1/127 (0.8%)	NS
CD	0/2 (0%)	0/6 (0%)	0/2 (0%)	NA
DR	5/157 (3.2%)	2/119 (1.7%)	0/4 (0%)	NS

RYHJJ, Roux-en-Y Hepatico-jejunostomy; CD, choledoco-duodenostomy; DR, direct repair; NS, not significant; NA, not applicable.

Table 4 Surgical repair failure rates according to the timing of repair

Immediate repair 194 patients			Early repair 216 patients			Late repair 133 patients			P
Primary repair procedure No. of patients	Repair failure rate No. of patients (%)	Type of repair	Primary repair procedure No. of patients	Repair failure rate No. of patients (%)	Type of repair	Primary repair procedure (no. of patients)	Repair failure rate No. of patients (%)	Type of repair	
RYHJJ 35	23/35 (62.9%)	Surgery 22/23 (95.7%) Stent 1 (4.3%)	RYHJJ 91	42/91 (46.2%)	Surgery 36/42 (85.7%) Stent 6/42 (14.3%)	RYHJJ 127	9/127 (7.1%)	Surgery 8/9 (88.9%) Stent 1/9(11.1%)	<0.001
CD 2	0/2	Surgery Stent	CD 6	0/6	Surgery Stent	CD 2	1/2 (50%)	Surgery 1/1 (100%) Stent	NS
DR 157	101/157 (64.3%)	Surgery 88/101 (87.1%) Stent 13/101 (12.9%)	DR 119	51/119 (42.9%)	Surgery 44/51 (86.3%) Stent 7/51 (13.7%)	DR 4	0/4	Surgery Stent	<0.001
Total 194	124/194 (63.9%)		Total 216	93/216 (43.1%)		Total 133	10/133 (7.5%)		<0.001

RYHJJ, Roux-en-Y Hepatico-jejunostomy; CD, choledoco-duodenostomy; DR, direct repair; Stent: Interventional endoscopy or radiology for bile duct stent (considered as a repair failure).

resulted in a high rate of post-operative complications and failure when performed as an immediate repair. The most reliable explanation for these data relies in the fact that the injury occurred in a surgical centre qualified in hepatobiliary surgery in only 40% of the cases. Thus, it may be speculated that in more than half of the cases reported in this series, the injury surgeon was not a hepatobiliary surgeon and he or she was not able to take the right surgical decision. Interestingly, this also corresponds to the 60% failure rate that was found in the group of patients undergoing immediate repair. In fact, the injury to the bile ducts, especially when sustained under laparoscopy, not only may involve a thermal injury that jeopardizes the microvascular supply to the biliary tree but is often accompanied by a vascular injury to the right hepatic artery that further complicates the nature of the injury. There may be a loss of substance and continuity that further complicates the choice of an experienced hepatobiliary surgeon in making an immediate repair. As ischaemic damage to the biliary tree cannot reliably be assessed most hepatobiliary surgeons recommend placing a large silastic drain and referring the patient to a tertiary hepatobiliary centre in this situation.²⁹

The other main issue concerns patients with BDI that are seen a few days after the injury and the surgeon must decide whether to make an early or late repair. This depends on the type of injury, the patient's general condition and the presence of peritonitis either

localized or generalized. In the present series, 119 (55.6%) out of 216 patients undergoing an early repair (within 45 days after the injury) had a direct repair that resulted in a 37% failure rate. The remaining 91 patients underwent a RYHJJ repair that resulted in a 39.6% failure rate. The lower failure rate found for the early repair as compared with the results of the immediate repair may be explained by the fact that 111 patients were managed in tertiary hepatobiliary referral centres. The success rate that was obtained for this subset of patients was as high as 90% (100 out of 111 patients). This indicates that the choice of making an early repair is a difficult task and should be undertaken by an experienced hepatobiliary surgeon to offer the patient the best chance of a cure.²⁹

As expected, the best results in this series were found in patients undergoing a late repair. Three main reasons may account for these data. First, all of these patients were managed in tertiary hepatobiliary referral centres. Second, when the repair is made beyond 45 days after the BDI the local inflammatory phenomena accompanying the injury have regressed and the evolution of the damage to the biliary tree vascular supply have stabilized and the level of the injury can be then reliably assessed.³⁰ Third, the RYHJJ, which is considered as the procedure of choice, was performed in almost all the cases providing the lowest rate of post-operative complications and the highest success rate.

The duration of time intervals between the BDI and the attempt to repair is a peculiarity of this study. Indeed, the choice of an interval of 45 days to define early and late repair was based on the hypothesis that this interval of time may be in most of the cases enough to perform the bile duct repair in excellent conditions. Indeed, although most of the reports in the literature refer to a 3-month interval between the BDI and the repair,^{1–22} the present data indicate that good results (6.3% rate of failure) can be expected when an interval of at least 45 days is respected ($P < 0.001$).

Although this study reports a large cohort of patients, it also carries the typical bias of a national retrospective survey. Indeed, the information on the repair surgeon was retrieved indirectly from the qualification in HPB surgery of the centre where the repair was made. However, it would be extremely difficult, if not impossible, to conceive a prospective study on BDI sustained during a cholecystectomy on a national basis encompassing a 20 year period. As the only selection criterion to select surgeons participating in this survey was their affiliation to the French Surgical Association, this resulted in a higher number of academic centres as compared with private clinics (28 academic centres out of 32 versus 18 private clinics out of 750) participating in the survey. Furthermore, this survey provides information on about 10% of BDI over a 20-year period if a 1/1000 cholecystectomy rate and a 0.5% rate of BDI is assumed for a country such as France of 65 million people. Indeed, the selection criterion was chosen in order to obtain a homogeneous population of surgeons that, as fellows of the French Surgical Association, were supposed to adhere to the national guide lines of BDI management and report data faithfully. For these reasons, we believe that the data provided in this study are representative of the management of BDI in France over the study period.

In conclusion, this large French national survey, although biased by its retrospective nature, indicates that the best timing to repair a BDI is beyond 45 days and the best results can be expected in the hands of experienced hepatobiliary surgeons with bilio-enteric repair in the form of the RYHJJ.

Conflicts of interest

The authors declare that they have no conflict of interest.

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