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Major Liver Resection as Definitive Treatment in Post-cholecystectomy Common Bile Duct Injuries

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Abstract

Background Common bile duct injuries (CBDI) are serious complications of cholecystectomies which are often associated with vascular involvement, meaning that their management represents a major challenge to the physician. We present our experience in major hepatectomy due to CBDI, highlighting indications, postoperative complications, and long-term outcomes.

Methods From August 1993 to September 2013, 287 patients with CBDI were treated in our centre. In 15 patients of this group (5 %), a major hepatectomy was performed. Eleven patients presented E4 and four presented E5 injuries of Strasberg classification. Seven patients presented vascular involvement. In 12 patients, prior treatment attempts, either biliodigestive anastomosis, endoscopic or percutaneous drainage, was performed without success. The median time delay between lesional surgery and hepatectomy was 24 months.

Results Right hepatectomy was performed in 10 patients and left hepatectomy in 5. Postoperative morbidity was 60 %. The incidence of serious complications (≥grade IIIa of DC classification) was 40 %. There was no mortality in our study. The mean follow-up was 43.5 months and the overall survival was 100 %. Three patients had a single episode of ascendant cholangitis who were successfully treated with medical treatment. All other patients were asymptomatic during follow-up. No patients required further surgical procedures.

Conclusion In our series, major hepatectomy due to CBDI was a successful treatment with high rates of postoperative morbidity and excellent long-term outcomes which require a multidisciplinary approach in referral centres of HPB surgery.

Introduction

Common bile duct injuries (CBDI) are serious complications of cholecystectomies, associated with significant perioperative morbidity, mortality and reduced long-term quality of life [1, 2]. Failure or delay in the early recognition, as well as poor choice of treatment can lead to serious medical and legal consequences [2, 3].

Due to the worldwide acceptance of laparoscopic approaches in the treatment of gallbladder stones, the incidence of intraoperative injuries has increased [4]. Despite surgical skills improvements and experience in laparoscopic cholecystectomy (LC), the rate of CBDI is still higher than in open surgery, remaining for different series between 0.16 and 1.4 % and 0.07 and 0.3 % for both procedures, respectively [2, 5–7].

Management of CBDI represents a major challenge to the physician, where the treatment depends on multiple

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Table 1 Number of patients according to definitive treatment

Procedure	No of patients
Percutaneous biliary drainage	65
Biliodigestive anastomosis	184
Hepatic resection	15
Included in list for liver transplantation	23[a]

[a] Of the 23 patients included in the liver transplant program, 4 died in the waiting list

factors such as the type of bile duct injury, the patient's clinical condition, previous treatments, injury mechanism and timing of recognition. Management includes endoscopic and percutaneous procedures, surgery and also liver transplant [8, 9]. Regarding surgical options, although CBDI can commonly be managed successfully with a biliary reconstruction, 5.6–15 % of cases in different published series require liver resection [10–15].

Liver resection remains controversial as a treatment of CBDI. However, proximal injuries with concomitant vascular injury, associated liver atrophy, and intrahepatic bile duct stricture in symptomatic patients are known indications of hepatectomy [10–13, 15].

The aim of this study is to analyse our experience in major hepatectomy due to iatrogenic post-cholecystectomy CBDI, and highlight its indications, postoperative morbidity and long-term outcomes.

Methods

From August 1993 to September 2013, 287 patients with CBDI were treated in our centre. Fifteen patients (5 %) were referred to our unit with post-cholecystectomy CBDI requiring major hepatectomy (≥3 segments) as a definitive treatment; these were identified from a prospectively collected database and retrospectively analysed. Variables include sex, age, previous treatments, type of injury, association with vascular injury, indications and timing of repair, and postoperative and long-term outcomes.

All patients were evaluated with ultrasonography (US) and abdominal and pelvic multi-detector tomography (MCDT). Also, in patients with previous bile duct drainage, we performed a percutaneous transhepatic cholangiography (PTC); otherwise, we studied the patient's bile duct with magnetic resonance cholangiopancreatography (MRCP). All patients underwent abdominal angiography to evaluate vascular involvement.

Liver resections were performed in symptomatic patients who presented 3 or more episodes of cholangitis with CBDI (Strasberg's E^4 and E^5 lesions) with also at least one of these three findings: lobar atrophy, vascular injuries or intrahepatic biliary duct strictures.

Surgical technique

A bilateral subcostal incision was performed. We did an abdominal exploration with section of multiple adhesions in patients with prior surgeries. The liver was mobilized by dissecting the ligaments. Prior biliodigestive anastomoses, if present, were resected. Intraoperative Doppler-ultrasound was used to confirm vascular involvement. Hilar structures were exposed. Routinely, an intraoperative cholangiography was performed. Parenchymal transection was performed using an ultrasonic dissector or monopolar electrosurgery device; however, we preferred the cavitron ultrasonic surgical aspirator in combination with the harmonic scalpel for parenchymal transection. Pringle manoeuvre was systematically used. The biliodigestive anastomosis was performed with a Roux-en-Y hepaticojejunostomy, with absorbable sutures and without transanastomotic stenting. Two drains were placed, one in the right subphrenic space and the other at the raw surfaces.

Types of CBDI and post-hepatectomy complications were classified with the Strasberg [16] and Clavien-Dindo [17] classifications, respectively.

Surgery timing was selected according to the clinical condition of the patients, type of injury and the presence of vascular involvement.

Results

In the analysed period, 287 patients were treated with post-cholecystectomy BDI (see Table 1). Fifteen of them (5 %), 8 female, with a mean age of 44.3 years (27–65), underwent major hepatectomy as a definitive treatment.

In all patients, cholecystectomy was performed in other centres. Patient's preoperative characteristics are shown in Table 2. Seven patients had a laparoscopic cholecystectomy as the first surgery, 7 an open approach and one patient underwent an initial laparoscopic surgery and required conversion.

The injury mechanisms were bile duct ligation in 3 cases, section in 2, thermal injury in 8 and unknown in 2 patients. Twelve patients presented previous surgical treatments, six of them percutaneous drainage, seven a previous hepaticojejunostomy (HJ) and one underwent a peritoneal lavage after bile peritonitis, while another patient received endoscopic bile duct dilation before hepatectomy.

All patients presented complex injuries of the bile duct [8]. Eleven patients had Strasberg's E^4 lesions, and the remaining four were E^5 (see Table 3). Seven patients

Table 2 Patients' preoperative characteristics

Patient	Sex	Age	Surgery	Mechanism	Vascular injury	Prior procedures	No of prior procedures
1	F	44	Lap+O	Ligation	–	PBD–HJ	2
2	F	39	Lap	Thermal	–	HJ–PBD–PBD[a]	3
3	M	42	Lap	Thermal	RHA	PBD–ERCP	2
4	F	48	O	Section	–	ERCP–HJ–PBD[a]	3
5	F	30	Lap	Thermal	RHA	PBD	1
6	M	62	O	Unknown	–	HJ	1
7	M	58	O	Ligation	–	HJ	1
8	M	50	O	Ligation	LHA	–	0
9	F	27	Lap	Section	RHA	Biliary peritonitis lavage	1
10	F	60	O	Unknown	–	–	0
11	F	39	Lap	Thermal	RHA	ERCP/PBD	1
12	M	55	O	Thermal	–	PBD–PBD[a]	2
13	M	23	Lap	Thermal	RHA	HJ × 2	2
14	F	23	Lap	Thermal	RHA	HJ × 2	2
15	M	65	O	Unknown	–	–	0

Lap laparoscopic, *O* open, *RHA* right hepatic artery, *PBD* percutaneous biliary drainage, *HJ* hepaticojejunostomy

[a] These underlined procedures were performed in our institution

Table 3 Type of lesion, vascular involvement and surgery indication

Patient	Strasberg's classification	Vascular injury	Time between cholecystectomy and hepatectomy (months)	Indication (all symptomatic patients)
1	E^4	–	10	Intrahepatic stenosis
2	E^4	–	24	Intrahepatic stenosis
3	E^5	RHA	35	Vascular injury/lobar atrophy
4	E^4	–	408	Lobar atrophy
5	E^5	RHA	2	Vascular injury
6	E^4	–	12	Intrahepatic stenosis
7	E^4	–	24	Intrahepatic stenosis
8	E^4	LHA	96	Vascular injury/lobar atrophy
9	E^4	RHA	2	Vascular injury
10	E^5	–	300	Intrahepatic stenosis/lobar atrophy
11	E^5	RHA	48	Vascular injury
12	E^5	–	6	Intrahepatic stenosis/lobar atrophy
13	E^4	RHA	24	Vascular injury
14	E^4	RHA	24	Vascular injury/lobar atrophy
15	E^4	–	276	Lobar atrophy

presented vascular injuries: 6 in the right hepatic artery, all after laparoscopic procedures, and only one in the left hepatic artery, which occurred after a conventional approach. Seven patients had lobar atrophy at the time of diagnosis, while 3 of them had a concomitant ipsilateral arterial injury.

Right hepatectomy was performed in 10 patients and left hepatectomy in 5; resection in 12 patients was associated with biliary reconstruction with Roux-en-Y. Hepaticojejunostomy was not considered in three patients. One of them had a right main bile duct stenosis and a right secondary biliary duct stricture associated with a right hepatic

Table 4 Course of hepatectomy

Patient	Operative time (min)	No of pringle maneuver	RBC units transfusions	Histopathological reports
1	350	2	6	Pronounced periportal inflammation
2	340	2	1	Periportal fibrosis, intrahepatic lithiasis
3	260	3	–	Portal fibrosis, intrahepatic abscesses, intrahepatic lithiasis
4	280	3	2	Portal fibrosis, intrahepatic abscesses
5	560	1	–	Histoarchitecture well preserved, Portal inflammation
6	280	2	3	Periportal fibrosis, intrahepatic lithiasis
7	250	3	2	Periportal fibrosis, intrahepatic lithiasis
8	200	2	1	Pronounced fibrosis
9	230	3	–	Histoarchitecture well preserved, portal inflammation, intrahepatic abscesses
10	220	2	–	Portal fibrosis, intrahepatic lithiasis
11	260	3	4	Portal fibrosis, intrahepatic lithiasis
12	240	3	–	Intrahepatic abscesses
13	300	3	2	Periportal and portal fibrosis, intrahepatic abscesses
14	510	2	–	Periportal fibrosis
15	300	3	2	Periportal fibrosis, intrahepatic lithiasis

Histopathological results

RBC red blood cells

artery lesion. The left duct had an appropriate calibre so that the patient did not require hepaticojejunostomy with the left main duct after the right hepatectomy. The other two patients had prior attempts of reconstruction with major double hepaticojejunostomy, and the stricture only affected drainage of the resected parenchyma.

The mean and the median time delay between lesional surgery and hepatectomy were 85.8 months (range 2–408) and 24 months, respectively.

Major hepatectomy was performed in symptomatic patients (sepsis or recurrence cholangitis) with proximal BDI and associated vascular injury, patients with proximal injuries of the bile duct and lobar atrophy and patients with extensive intrahepatic stenosis. (The indications are specified at Table 3). The course of hepatectomy and histopathological results is detailed in Table 4. The mean length of stay was 9.2 days after surgery (6–20).

Postoperative morbidity was 60 % (9 of 15), with the most frequent complications being intra-abdominal abscess (33 %) and pleural effusions (26.6 %) (see Table 5). Incidence of serious complications (≥grade IIIa of DC classification) was 40 % (6 of 15 patients).

The mean follow-up was 43.5 months (range 2–129), and the overall survival was 100 %. Three patients had a single episode of cholangitis treated with antibiotics and did not require hospitalisation; the MRI cholangiography ruled out biliary stricture, and the suspected diagnosis was ascendant cholangitis. All other patients were asymptomatic during follow-up. No patients required further surgical procedures.

Discussion

Management of complex bile duct injuries remains controversial. Despite CBDI being analysed in numerous publications, there are only a few series of patients who underwent major hepatectomy due to CBDI. Indications of liver resection, surgery timing and patient's management are still unclear.

There are multiple approaches for achieving a definite treatment for post-cholecystectomy CBDI, either endoscopic, percutaneous or surgical that goes from hepaticojejunostomy to liver transplant. Most patients can be successfully managed with mini-invasive treatments [18]. Biliary reconstructions, including the Hepp-Couinaud approach, represent a main indication to treat CBDI with excellent results and good long-term outcomes. Nevertheless, despite some controversy, symptomatic patients (recurrent cholangitis or sepsis) with associated vascular lesions, lobar parenchyma atrophy or intrahepatic bile duct strictures benefit from a liver resection. Lillemoe et al. [19], in their series of 89 patients with CBDI treated either with percutaneous balloon dilatation or surgical reconstruction with a Roux-en-Y hepaticojejunostomy with trans-anastomotic stenting, reported a success rate of 92 %

Table 5 Postoperative morbidity/mortality

Patient	Surgery	Morbidity	Clavien's classification	Long-term outcome	Survival
1	Left hepatectomy	–	–	–	Alive
2	Left hepatectomy	Intra-abdominal Abscess	IIIa	–	Alive
3	Right hepatectomy	Pleural Effusion	II	–	Alive
4	Right hepatectomy	Intra-abdominal abscess	IIIa	Ascendant cholangitis	Alive
5	Right hepatectomy	Intra-abdominal abscess	IIIa	–	Alive
6	Left hepatectomy	–	–	Ascendant cholangitis	Alive
7	Right hepatectomy	–	–		Alive
8	Left hepatectomy	–	–		Alive
9	Right hepatectomy	Intra-abdominal abscess; pleural effusion; wound infection	IIIa, II, II	Ascendant cholangitis	Alive
10	Right hepatectomy	–	–	–	Alive
11	Right hepatectomy	Intra-abdominal abscess; empyema; wound infection; urinary tract infection	IIIa, IVa (thoracotomy postop in ICU), II, II	–	Alive
12	Right hepatectomy	Intra-abdominal abscess; empyema	IIIa, IIIb (VATS)	–	Alive
13	Right hepatectomy	–	–	–	Alive
14	Right hepatectomy	–	–	–	Alive
15	Left hepatectomy	Biliary leak	IIIb (ERCP)	–	Alive

Long-term outcomes

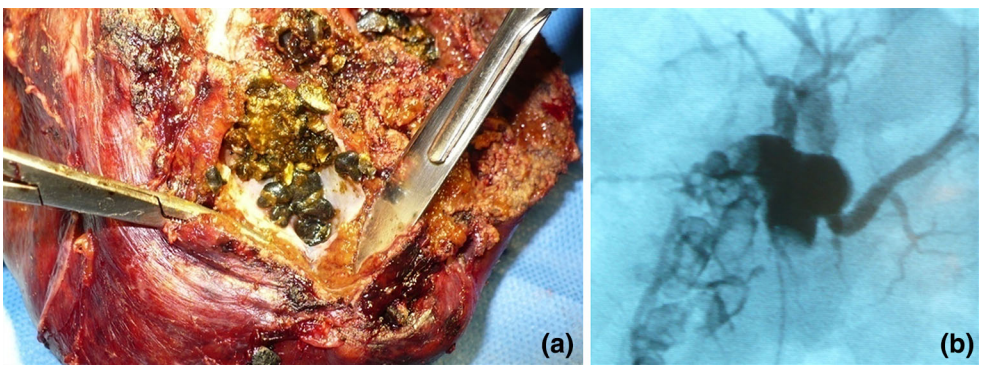

Fig. 1 Intrahepatic lithiasis in a patient with CBDI. Macroscopic view of liver parenchyma (**a**) and intraoperative choangiography (**b**)

when combined surgical and radiologic techniques were performed. Murr et al. [20] also presented encouraging results in 46 patients with higher BDI (42 % with E3 injuries of Strasberg classification). In these patients, a Hepp-Couinaud approach [21–23] was performed to guarantee a non-ischaemic bilioenteric anastomosis, achieving good long-term results. However, despite these encouraging results, patients with CBDI that involve biliary confluence (type 4 or E4) have often reported associated vascular injuries, in which a bilioenteric reconstruction represents a surgical challenge with a high risk of the postoperative development of recurrent strictures or anastomoses stenosis. Moreover, there are reports that show that biliary-enteric anastomosis for CBDI in association with vascular injury presents a high rate of morbidity with reduced long-term survival [1]. On the other hand, another authors [24, 25] presented good long-term results in patients with CBDI and concomitant vascular injuries who underwent hepaticojejunostomy as a definitive treatment (Figs. 1, 2).

In our series, 7 patients presented vascular injuries, 6 of them with right branch of hepatic artery disruption, mostly because of a primary laparoscopic surgery. The disruption of the right branch of the hepatic artery is the most frequent vascular injury [26, 27] associated with CBDI and also a main indication to perform a liver resection. Belghiti presented a series of 55 patients [10] with post-cholecystectomy biliary strictures who underwent surgical repair and reported that the incidence of vascular injury was 47 %, with right-sided hepatic artery disruption being the most frequent finding. Truant et al., in a review of 31 studies [11], showed that the most frequent indication for performing a hepatectomy was patients presenting concurrent arterial and proximal injuries with disruption of the hilar confluence. Similarly, Bektas et al. [28] showed that those vascular lesions placed at or above the bifurcation of the

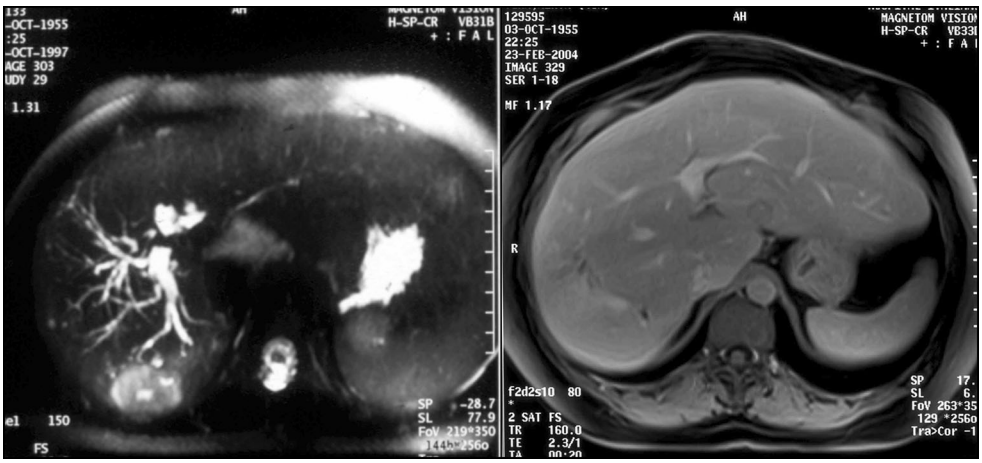

Fig. 2 RMN: CBDI and hemiliver atrophy

hepatic duct in iatrogenic BDI had increased risk of major liver resection. In this study, the Hannover group highlighted the relevance of vascular involvement in CBDI and proposed a new classification of bile duct injuries which included vascular compromise.

Timing of surgery remains under discussion. Although it is clear that a delayed management allows for the accurate assessment of the risk for progression of biliary ischaemia, decision of when patients should undergo a major hepatectomy represents a crucial issue for surgeons who sometimes prefer perform a biliodigestive anastomosis at the time of the bile duct injury. Intraoperative diagnosis gives the surgeon the chance to assess injury severity and to perform immediate treatment. This approach is associated with improved outcomes [29]. However, intraoperative diagnosis is still a large problem and most of the injuries are diagnosed after surgery [30]. In these patients, the optimal timing for treatment is discussed. In this issue, Connor and Garden [6] propose a delayed management, which includes an initial treatment focused on patient resuscitation, drainage of any collections, treatment of sepsis and nutritional support. This management allows the ischaemic bile duct damage to be determined and the biliary anatomy previous to a definitive repair to be defined. In the same line, according to Stewart et al. [3], patients with major bile duct injury should not undergo early definitive repair due to the poor results. Similarly, Strasberg et al. [31], delayed the repair surgery for 3 months from the laparoscopic cholecystectomy. Consistent with the literature, we waited 2–3 months for a definitive treatment. Most patients underwent less-invasive treatments, mostly prior to our medical centre arrival, such as percutaneous drainages or ERCP to treat cholangitis due to biliary stricture or intrahepatic lithiasis. The presence of multiple previous approaches, and a late referral in many cases, can explain the median delay time of 24 months in our series.

In our series, most patients presented a history of previous treatments, either percutaneous, endoscopic or hepaticojejunostomy, with therapeutic failure reported in all cases. It has already been described that each failed surgical treatment damages the vascularisation of patient's bile duct undergoing poor outcomes after surgery [32]. In the same line, Chapman et al. [33] described a series of 130 patients referred for treatment of post-cholecystectomy bile duct injuries and stated that three or more previous attempts at operative repair before referral influenced failure of the stricture repair in long-term follow-up. Liver fibrosis, as a consequence of chronic damage due to vascular compromise in CBDI, was also analysed for Laurent et al. [10]. They described that more than two thirds of patients present with fibrosis grade 2 or more, in which liver resection presented a clear indication for the removal of irreversible fibrotic parenchyma. In our series, liver atrophy was found in 6 of the 15 resected patients (40 %), with half of them being associated with vascular ipsilateral lesions.

Moreover, the presence of complex injuries, in addition to the history of several surgical interventions in the past, makes liver resection in these patients a highly complex surgery, which should only be performed in referral centres with experienced surgeons and with multidisciplinary management. None of these approaches are recommended for inexperienced surgeons [16, 19]. About this concern, Stewart and Way [3]. analysed factors which affect outcomes after BDI repair, showing that unspecialised surgeons without experience in complex liver surgery and the presence of nonsurgical treatment for CBDI, were unsuccessful predictive factors in patients who need another surgical procedure to treat biliary stenosis. Regarding this, Walsh et al. [34], in their series of 133 patients with failed repairs of BDI, presented good results for surgical repairs which were performed at tertiary centres. Furthermore, the management of complications requires referral centres with

not only the presence of experienced surgeons, but also an adequate anaesthetic and also postoperative intensive care unit management.

Similar to other series of major liver resection, we present here a series of patients with high rate of postoperative morbidity [10, 13, 15]. In the same line as Belghiti's series [10], intra-abdominal abscesses were the most frequent complication, which could be successfully treated with percutaneous drainage. We report only one patient with biliary leakage who did not require any invasive treatment. These morbidity rates should be taken into account by the surgeons to perform a careful patient's selection.

Long-term outcomes in these patients were excellent. Twelve patients remain asymptomatic to the present day, and only three patients presented episodes of cholangitis which could be successfully managed with medical treatment. These encouraging results are comparable with prior reports [10].

Conclusion

Major hepatectomy represents the treatment of choice for the definitive management of CBDI in symptomatic patients with vascular lesions, intrahepatic stenosis or lobar atrophy in association with high morbidity, low mortality and good long-term outcomes. Due to its high complexity, these patients should be managed in high referral centres.

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