

Retrospective Study

Liver resection for the treatment of post-cholecystectomy biliary stricture with vascular injury

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METHODS: From a prospective database of patients treated for benign biliary strictures at our hospital, cases that underwent liver resections were reviewed. All cases were referred after one or more attempts to repair bile duct injuries following cholecystectomy (open or laparoscopic). Liver resection was indicated in patients with Strasberg E3/E4 (hilar stricture) bile duct lesions associated with vascular damage (arterial and/or portal), ipsilateral liver atrophy/abscess, recurrent attacks of cholangitis, and failure of previous hepaticojejunostomy.

RESULTS: Of 148 patients treated for benign biliary strictures, nine (6.1%) underwent liver resection; eight women and one man with a mean age of 38.6 years. Six patients had previously been submitted to open cholecystectomy and three to laparoscopic surgery. The mean number of surgical procedures before definitive treatment was 2.4. All patients had Strasberg E3/E4 injuries, and vascular injury was present in all cases. Eight patients underwent right hepatectomy and one underwent left lateral sectionectomy without mortality. Mean time of follow up was 69.1 mo and after long-term follow up, eight patients are asymptomatic.

CONCLUSION: Liver resection is a good therapeutic option for patients with complex postoperative biliary stricture and vascular injury presenting with liver atrophy/abscess in which previous hepaticojejunostomy has failed.

Key words: Abscess; Atrophy; Benign; Bile ducts; Cholecystectomy; Hepatectomy; Stenosis; Vascular system injury

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Abstract

AIM: To report experience with liver resection in a select group of patients with postoperative biliary stricture associated with vascular injury.

Core tip: Bile duct injury is a major concern due to its complex treatment and long-term complication rate. Associated vascular injury most commonly occurs during cholecystectomy, but can also occur during bile duct repair. Definitive treatment procedures are challenging due to the association of bile duct and vascular injuries. We describe our experience in treating these complex patients. Liver resection was reserved for patients with Strasberg E3/E4 (hilar stricture) bile duct lesions associated with vascular damage (arterial and/or portal), ipsilateral liver atrophy/abscess, recurrent attacks of cholangitis, and failure of the previous hepaticojejunostomy.

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INTRODUCTION

Cholecystectomy is one of the most common operations performed nowadays and, despite technical advances and surgical skills (especially in laparoscopic procedures), bile duct injury (BDI) still occurs. The incidence of BDI is approximately 0.2%-0.3% in patients undergoing an open procedure, and 0.5%-0.8% in those undergoing laparoscopic cholecystectomy^[1-3]. Despite the low incidence when adopting safe measures (such as the critical view approach, routine intraoperative cholangiogram), BDI can still occur. When dealing with an acute lesion, most general surgeons would not be able to perform an adequate repair, mainly due to lack of surgical expertise. In this scenario, referring the patient to a specialist can avoid further biliary and vascular damage. Some reports have estimated 7% of vascular injuries in autopsy series of individuals who had been submitted to an open cholecystectomy^[4]; in patients with diagnosed BDI, however, the incidence is higher, ranging from 12% to 39%^[4-7].

When vascular injury (VI) occurs in association with BDI, the classical surgical approach with a Roux en Y bilioenteric anastomosis may not offer good long-term results in some patients. The main reason could be the lack of an adequate arterial blood supply of the repaired duct^[8-11]. Instead of complex intrahepatic biliary reconstructions or even liver transplantation (when irreversible parenchyma liver damage has occurred), some authors have advocated liver resection and biliary reconstruction in selected cases with good long-term results^[12,13]. The aim of the present study was to report our experience with liver resection in a select group of patients with postoperative bile duct

stricture associated with VI.

MATERIALS AND METHODS

From a prospective database of patients treated for benign biliary strictures at our hospital, review of the medical records of patients submitted to liver resection was undertaken. All cases were referred to our center after one or more attempts to repair BDI following cholecystectomy (open or laparoscopic).

All cases were discussed in a multidisciplinary meeting with radiologists and hepatobiliary surgeons. Patients were evaluated with liver function tests. CT angiogram and MRI cholangiography scans were performed to evaluate liver atrophy and vascular and biliary anatomy. In patients with percutaneous transhepatic biliary drains, cholangiograms were performed in order to assess the biliary anatomy. BDI were classified according to Strasberg's classification^[3].

Liver resection was indicated in patients with Strasberg E3/E4 (hilar stricture) bile duct lesions associated with vascular damage (arterial and/or portal), ipsilateral liver atrophy/abscess, recurrent attacks of cholangitis, and failure of the previous hepaticojejunostomy. None of the patients had signs of liver insufficiency or portal hypertension. The final decision was taken intraoperatively after hilar dissection, cholangiographic evaluation, and liver assessment. Hepaticojejunostomy was performed as high as possible and in a standardized technique as described elsewhere^[14]. Only one patient (Table 1) had a right hepatectomy without hepaticojejunostomy (complete right biliary duct lesion with ipsilateral liver necrosis due to VI).

Variables examined were gender, number of previous surgical repair attempts, symptoms, type of vascular damage, type of biliary lesion and liver resection, mean operative time, blood transfusion, postoperative complications, length of post-hospital stay, recurrence of symptoms, mean time of follow-up, and complications related to the surgical procedure.

The clinical outcome was evaluated according to the Terblanche classification: grade I = no biliary symptoms, grade II = transitory or no current symptoms, grade III = clearly related symptoms requiring medical therapy, and grade IV = recurrent stricture requiring correction or related to death. Grades I and II represent excellent or good results, grade III represents fair results, and grade IV represents poor results^[15].

RESULTS

From 2000 to 2011, a total of 148 patients were treated for benign biliary strictures, and nine (6.1%) underwent liver resection; one man and eight women with a mean age of 38.6 years (range: 27-59 years). All patients underwent cholecystectomy as the first surgical procedure elsewhere; six patients had been

Table 1 Patient and procedure characteristics

Case	Previous surgeries (<i>n</i>)	Time from injury to liver resection (mo)	Vascular injury	Strasberg's classification	Operative time (h)	Type of liver resection
1	6	17	RHA	E 4	8	RH
2	1	49	RHA	E 4	11	RH
3	2	204	RHA	E 4	7	RH
4	1	24	RPV	E 4	10	RH
5	6	45	RHA	E 4	3	RH
6	1	8	RHA	E 4	9	RH
7	2	72	LPV	E 4	5	LLS
8	1	24	RHA	E 3	6	RH
9	2	5	RHA	E 3	8	RH

LPV: Left portal vein; LLS: Left lateral sectionectomy; RH: Right hepatectomy; RHA: Right hepatic artery; RPV: Right portal vein.



Figure 1 Computed tomography findings. A, B: Computed tomography (CT) angiogram showing right hepatic artery injury in one case (arrow); C, D: CT showing right portal vein injury in another case.

submitted to open and three to laparoscopic surgery. The mean number of surgical procedures and mean time before referral to our hospital were 2.4 (range: 1-6) and 49.8 mo, respectively (Table 1).

Cholangitis and jaundice were the most common symptoms in 88.9 and 55.6% of the patients, respectively. Liver abscess was found in one patient and was treated with intravenous antibiotics and percutaneous transhepatobiliary drainage prior to surgery.

All patients had lesions classified as Strasberg E3/E4. Arterial VI was present in seven cases and portal vein injury in two (Figure 1).

Seven of the patients underwent right hepatectomy with Roux en Y hepaticojejunostomy and one underwent left lateral sectionectomy with Roux en Y hepaticojejunostomy. Only one patient had a right hepatectomy without hepaticojejunostomy due to a right hepatic artery and right bile duct ligation. The patients' characteristics and treatment are detailed in Table 1.

The mean operative time was 7.5 h, and four patients did not receive blood transfusions. Postoperative complications were observed in three patients, infection being the most common (peritonitis due to bile leak, wound and central venous catheter-related). One patient

Table 2 Postoperative results

Case	Biliary fistula	Length of hospital stay (d)	Follow-up (mo)	Terblanche grade
1	0	20	12.8	I
2	1	62	156.8	I
3	0	7	117.2	IV
4	0	10	41.0	I
5	0	8	67.9	I
6	0	7	26.9	I
7	0	7	21.0	I
8	0	8	109.2	I
9	0	18	69.6	III

Table 3 Outcome results in reported series of liver resections with five or more patients with bile duct injury and vascular injury

Ref.	n	Morbidity	Mortality	Good long-term results
Frilling <i>et al</i> ^[21]	5	NS	25%	NS
Thomson <i>et al</i> ^[12]	8	62.5%	0%	100%
de Santibáñez <i>et al</i> ^[18]	9	33.3%	0%	NS
Laurent <i>et al</i> ^[19]	18	61.1%	0%	72%
Current series	9	33.3%	0%	88%

NS: Not stated.

underwent reoperation due to peritonitis and developed renal and pulmonary complications that prolonged his hospital stay. The mean postoperative stay was 16.3 d (range: 7–62 d). There was no perioperative mortality.

Mean time of follow-up was 69.1 mo (range: 18–120 mo). Long-term complications were observed in two patients: one with an incisional hernia and another with cirrhosis and portal hypertension (this patient was referred for liver transplantation). Good long-term results were observed in 8/9 patients (Table 2).

DISCUSSION

Treatment of BDI associated with VI requires a multidisciplinary approach from interventional radiologists, endoscopists, and hepatobiliary surgeons. Therapeutic success depends on patient selection, surgical expertise, and the timing of surgery. Failed attempts to treat this condition are associated with a worse prognosis^[16]. The scarcity of evidence in dealing with this uncommon complication and the lack of randomized trials make the patient approach challenging and reliant on personal/single institutional experience.

Nowadays, liver resection can be performed with acceptable morbidity and mortality rates in specialized centers^[17]. The main indication for liver resection in patients with biliary stricture and preserved liver function is an associated VI leading to recurrent attacks of cholangitis. Some groups emphasize that for the treatment of such a complex condition, liver resection

should be attempted before liver transplantation^[9,12,18,19]. The rationale for this approach is that by removing the atrophic parenchyma and performing a bilioenteric anastomosis in well-vascularized tissue, good long-term results can be achieved. Moreover, liver resection may prevent future development of biliary malignancy due to biliary stasis and repeated cholangitis^[12,13,20]. Beyond that, the removal of the damaged hemiliver with wide exposure of the biliary tree can contribute to the performance of a safe and large anastomosis in non-fibrotic, well-vascularized tissue. In Table 3, we summarize the results of liver resection for BDI associated with VI performed by specialized teams.

Some patients, due to recurrent attacks of cholangitis, may develop secondary liver fibrosis, cirrhosis, and portal hypertension. In this setting, liver transplantation should be considered^[13]. However, in some patients with transitory liver dysfunction during cholangitis, definitive treatment with liver resection could be offered, once recovery of normal liver function is observed after infection control. In this select group of patients, liver transplantation could be postponed.

Liver resection in patients with previous hilar manipulation, jaundice, multi-resistant bacterial colonization, malnutrition, coagulation impairment, and long hospitalization can carry high rates of morbidity and mortality. Detailed preoperative work-up, with a multidisciplinary approach (interventional radiologists to drain the obstructed biliary tree, experienced hepatobiliary surgeons to perform an adequate surgical treatment, infectious disease physicians, and dietitians) is essential to a successful outcome^[16].

Liver resection for the treatment of complex BDI can lead to good long-term results in 72%–100% of patients^[8,18,19,21], results comparable to less-complex injuries treated by hepaticojejunostomy^[12,14,19,22,23]. These results are mainly due to the improvement in surgical technique, perioperative care, and a rigorous selection of patients^[12,18,19,21,24]. Prior to committing to liver resection, less-aggressive surgical approaches, such as hepaticojejunostomy extending to the left duct, either guided by percutaneous transhepatic cholangiography or unguided, should be considered.

Laurent *et al*^[19], in the largest series reported, showed good long-term results of hepatectomy in 94% of patients with BDI and VI. In their opinion, despite a high morbidity rate, liver resection should be attempted before liver transplantation. Thomson *et al*^[12] reported that liver resection can have good results in the majority of patients with BDI and associated VI. In our experience, 1/9 patients was referred for liver transplantation due to chronic liver failure and portal hypertension^[12,18].

de Santibáñez *et al*^[13] emphasizes that patients with BDI who developed secondary biliary cirrhosis can be treated with liver transplantation with very good results (one-year survival of 91.7%). On the

other hand, organ shortage is a reality, and sparing transplantation in patients with benign lesions that could be treated by resection seems a reasonable choice.

Our experience suggests that hepatic resection may be the optimal approach in well-selected patients in whom previous hepaticojejunostomy has failed before the development of irreversible liver injury. In a select group of patients with complex biliary strictures associated with VI presenting with liver atrophy and/or abscess, liver resection can be a good therapeutic option when performed in a specialized center.

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COMMENTS

Background

Bile duct injury (BDI) is a major concern due to its complex treatment and long-term complication rate. Associated vascular injury (VI) most commonly occurs during cholecystectomy but can also occur during bile duct repair attempts.

Research frontiers

The association of BDI and VI makes definitive treatment a challenging procedure. Here, we describe our experience in treating these complex patients.

Innovations and breakthroughs

In this report, we describe our experience in treating patients with BDI and VI. Liver resection was reserved for patients with Strasberg E3/E4 (hilar stricture) bile duct lesions associated with vascular damage (arterial and/or portal), ipsilateral liver atrophy/abscess, recurrent attacks of cholangitis, and failure of the previous hepaticojejunostomy.

Peer-review

This is an excellent paper and important contribution to the body of literature regarding biliary strictures. Although this only applies to a small subset of patients, it is important to be aware of this option in patients with recurrent strictures.

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