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***Retrospective Study***

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

Perini MV *et al*. Bile duct injury and liver resection

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**Abstract**

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

**METHODS:** From a prospective database of patients treated for benign biliary strictures at our hospital, patients submitted to 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 E3-4 (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. There were 8 females and one male with a mean age of 38.6 years. Six patients had been previously 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:** In patients with complex postoperative biliary stricture and vascular injury presenting with liver atrophy/abscess in which a previous hepaticojejunostomy has failed, liver resection can be a good therapeutic option.

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

**Core tip:** 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 attempt. The association of BDI and VI makes definitive treatment a challenging procedure. Here in we describe our experience in treating these complex patients. Liver resection was reserved for patients with Strasberg E3-4 (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 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 around 0.2%–0.3% of patients undergoing an open procedure and 0.5%–0.8% of those undergoing laparoscopic cholecystectomy[1-3]. Despite the low incidence when adopting safe measures (such as the critical view approach, routine intraoperative cholangiogram) it still can 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 bile duct injuries, however, the incidence is higher, ranging from 12% to 39%[4-7].

When vascular injury occurs in association with biliary injury, 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 is to report our experience with liver resection in a selected group of patients with postoperative bile duct stricture associated with vascular injury.

**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 bile duct injuries 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 transhepatobiliary (PTH) drains, cholangiograms were done in order to assess the biliary anatomy. Biliary injuries were classified according to Strasberg’s classification[3].

Liver resection was indicated in patients with Strasberg E3-4 (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 intra-operatively 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 ispilateral liver necrosis due to vascular injury).

Variables analyzed 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, post operative 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 as Grade I: no biliary symptoms; Grade II: transitory symptoms, no current symptoms; Grade III: clearly related symptoms requiring medical therapy; Grade IV: recurrent stricture requiring correction or related to death. Grades I and II represented excellent or good results; grade III, fair results; and grade IV, 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. There were one male and eight female patients with a mean age of 38.6 years (ranging from 27 to 59 years). All patients underwent cholecystectomy as the first surgical procedure elsewhere; six patients had been 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 (ranging from one to six) 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 PTH biliary drainage prior to surgery.

All patients had lesions classified as Strasberg E3-E4. Arterial vascular injury 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 transfusion. 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 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 eight out of nine patients (Table 2).

**DISCUSSION**

Treatment of BDI associated with vascular injury requires a multidisciplinary approach, with 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 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 vascular injury 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 selected 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 pre-operative 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, peri-operative 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 94% of good long-term results of hepatectomy in 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, one out of nine patients was referred for liver transplantation due to chronic liver failure and portal hypertension[12,18].

Santibanes *et al*[13] emphasizes that patients with BDI who developed secondary biliary cirrhosis can be treated with liver transplantation with very good results (1-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 selected group of patients with complex biliary strictures associated with vascular injury 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 attempt.

***Research frontiers***

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

***Innovations and breakthroughs***

Here in we describe our experience in treating these complex patients. Liver resection was reserved for patients with Strasberg E3-4 (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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**Figure 1 Computed tomography.** A and B: Computed tomography (CT) angiogram showing right hepatic artery injury in one case; C and D: CT showing right portal vein injury in another case

**Table 1 Patient characteristics, type of biliary injury, operative time and type of liver resection**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Case** | **Previous surgeries (*n*)** | **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 |

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

**Table 2 Postoperative complications, length of hospital stay, time of follow up and Terblanche classification**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Case** | **Biliary fistula** | **LOS (d)** | **FU (mo)** | **Terblanche** |
| 1 | 0 | 20 | 12.8 | Grade I |
| 2 | 1 | 62 | 156.8 | Grade I |
| 3 | 0 | 7 | 117.2 | Grade IV |
| 4 | 0 | 10 | 41.0 | Grade I |
| 5 | 0 | 8 | 67.9 | Grade I |
| 6 | 0 | 7 | 26.9 | Grade I |
| 7 | 0 | 7 | 21.0 | Grade I |
| 8 | 0 | 8 | 109.2 | Grade I |
| 9 | 0 | 18 | 69.6 | Grade III |

LOS: Length of hospital stay; FU: Follow up.

**Table 3 Morbidity, mortality and long-term 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** |
| Friling *et al*[21] | 5 | NS | 25% | NS |
| Thomson *et al*[12] | 8 | 62.5% | 0 % | 100% |
| Santibanes *et al*[18] | 9 | 33.3% | 0% | NS |
| Laurent *et al*[19] | 18 | 61.1% | 0% | 72% |
| Current series | 9 | 33.3% | 0% | 88% |