A Refined Approach to the Repair of Postcholecystectomy Bile Duct Strictures

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Objective: To assess the results of a refined approach to repair of postcholecystectomy bile duct strictures.

Design: An 11-year retrospective review of patients who had surgical repair of bile duct strictures developing late after cholecystectomy.

Setting: A major university teaching hospital in France.

Patients and Interventions: During an 11-year period from 1987 to 1997, 22 patients (mean [±SD] age, 55 ± 15 years) were operated on for bile duct strictures after cholecystectomy (11 after laparoscopic surgery and 11 after open surgery). Thirteen (59%) of the 22 patients had previous repair. Most patients had episodic cholangitis (14 patients [64%]) and biochemical evidence of cholestasis (20 patients [91%]). There were 5 Bismuth type 1 strictures; 4, type 2; 7, type 3; 5, type 4; and 1, type 5. The average (±SD) time from initial surgery to repair was 6.3 ± 9.6 years. Intraoperative cholangiography was used to plan the repair in 18 patients (82%). Fifteen patients (68%) were repaired with high Hepp-Couinaud hepaticojejunostomies. The last 4 patients had the hilum exteriorized by the posterior approach to improve access.

Results: There was 1 intraoperative complication (bleeding) and 4 postoperative complications (biloma, fistula, and 2 cholangitis). There were no deaths; mean (±SD) length of stay was 12.8 ± 5.8 days; and mean (±SD) follow-up was 4.8 ± 3.3 years (range, 1-10.7 years). Three patients were reoperated on, 1 with an obstructed Roux-en-Y limb and the 2 others for incisional hernias. Eighteen patients remain well, 3 had sporadic recurrent cholangitis after surgery that resolved spontaneously, and 1 patient remains unwell requiring antibiotics to control cholangitis.

Conclusions: Hepp-Couinaud hepaticojejunostomy without stenting remains a reliable repair of postcholecystectomy strictures. Intraoperative cholangiography and exteriorizing the hilum by the posterior approach are useful adjuncts to this technique.


IN THEIR definitive paper in 1956 Hepp and Couinaud outlined the technique for repair of high bile duct strictures by lowering the hilar plate and hepaticojejunostomy to the left hepatic duct. While the wisdom of this high anastomosis to healthy bile duct mucosa is clear, the various approaches to preoperative and postoperative care remain the subject of much debate. Hepp and Couinaud used intraoperative cholangiography to define the anatomy and stented their anastomoses in the 2 patients they described. Today many authors recommend extensive preoperative investigations to identify anatomy, and many place endoscopic or percutaneous stents in these patients prior to surgery. Repair is accomplished without relying on stents during, after, or after surgery. The nonoperative approach to benign bile duct strictures with either transhepatic or endoscopic dilatation and stenting recently has gained popularity. Long-term results are variable but are always inferior to surgical repair. The affect of repeated dilation, stent changes, and episodic cholangitis on the patient’s quality of life are also a concern.

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PATIENTS AND METHODS

Twenty-two patients with strictures developing after cholecystectomy were treated surgically at Pontchaillou Hospital, Rennes, France, between 1987 and 1997. There were 15 female and 7 male patients, with a mean (±SD) age of 55 ± 14 years. The patient’s hospital records were reviewed and long-term follow-up was obtained by mailed questionnaires. Further follow-up was obtained by telephone with the patient and/or the referring physician, if required. Mean (±SD) length of follow-up was 4.8 ± 3.3 years (range, 1-10.7 years). Results are expressed as mean ± SD. Unpaired t tests were performed using Stata Quest software (Release 2; Stata Corporation, Los Angeles, Calif).

Eleven patients received their injury at laparoscopic cholecystectomy, 5 of whom were converted to open cholecystectomy. The other 11 sustained their injury during open cholecystectomy. In 4 patients the injury may have resulted from an open common bile duct exploration. One patient had Mirizzi type 2 syndrome diagnosed at initial surgery that was repaired with suture over a T tube. One patient had a low hepaticojunostomy at the initial procedure for a completely severed bile duct. There was immediate repair of only 2 other patients (suture over T tube). Thirteen patients (59%) were reoperated on after the initial surgery: 8 had hepaticojunostomies, 3 had drainage procedures, 1 had an end-to-end anastomosis; and 1 had dilation of a stricture. Two of these patients had 2 previous attempts at repair. Two of the patients had their initial cholecystectomy at Pontchaillou Hospital; the remainder were referred from outside institutions.

Patients presented in 4 basic patterns. Two patients had a persistent biliary fistula more than 6 months after cholecystectomy and 2 patients only had pain. Four patients had jaundice; the remaining 14 patients suffered repeated episodes of cholangitis with findings of fluctuating elevations in their liver function test results. There was biochemical evidence of cholestasis in 20 (91%) of the 22 patients at the preoperative assessment.

All patients had an initial abdominal ultrasonographic and biochemical evaluations. Patients without previous intestinal derivation were subjected to an endoscopic retrograde cholangiopancreatogram (13 patients [59%]) to establish the diagnosis and rule out retained common bile duct stones or papillary stenosis. Patients who underwent previous bypass surgery had various procedures: 4 had transhepatic cholangiography, and 2 underwent computed tomography. One patient had a magnetic resonance imaging cholangiogram and 1 had a hepato-pancreatic duct scan. Both patients with fistulae underwent fistulograms. The ERCP investigations were successful in establishing the lower limits of the stricture in all 13 patients; 1 had a retained stone removed below the stricture. There were 2 episodes of post-ERCP pancreatitis requiring hospitalization of the patients. Two of the 4 transhepatic cholangiographic investigations adequately demonstrated the proximal anatomy. All patients received antibiotics at the time of their investigation; no preoperative stents were placed.

At surgery, the technique was as follows: A midline incision was preferred. The adhesions surrounding the hilum were taken down. If a previous hepaticojunostomy had been performed, the Roux-en-Y limb was dissected up to the anastomosis. A loop cholangiogram was then performed by placing a clamp across the distal limb and inserting an angiographic catheter into the bile lumen and securing it with a purse-string suture. Radiocontrast medium was then injected into the bile lumen and the roentgenogram taken (7 patients). Five of these patients had the anastomosis assessed by endoscopy through a small enterotomy in the Roux-en-Y limb using the rigid choledoscope. Patients without previous bowel anastomosis were approached by dissecting above the stricture. The bile duct was found by needle aspiration and intraoperative cholangiography was performed through the needle to delineate the proximal anatomy.

To expose the proximal bile duct adequately required varying degrees of surgery. Four patients had low strictures that were easily found; these patients did not have intraoperative cholangiography. The remainder required dissection high in the hilum to take down the hilar plate exposing the left hepatic duct. In all cases the intraoperative cholangiography was successful in showing the proximal anatomy. As a rule, the sclerosed hilm was not dissected and instead healthy bile ducts well above the stricture were exposed for a wide anastomosis, usually across the convergence.

Four patients had the left and right intrahepatic ducts exposed by exteriorizing the entire hepatic hilum using the posterior approach. This approach has been previously described. In short, the anterior hilar plate dissection is extended by making a posterior incision in the caudate process to dissect the posterior part of the plate and then completely detach the hilm from liver parenchyma. The hilm was then encircled with tapes and brought from its interior position to an exterior location providing very adequate exposure to the left and right hepatic ducts.

The proximal levels of bile duct strictures and operative procedures are listed in Table 1. Low hepaticojunostomies were defined as below the level of the bifurcation. High hepaticojunostomies were anastomoses that required an incision in either the right or the left hepatic ducts. Two patients with mild stenosis had dilation and reconstruction of their Roux-en-Y limbs. Extensive destruction of the convergence required separate segmental ductal anastomoses in 2 patients. The anastomoses were performed with interrupted 3.0 to 7.0 polydioxanone sutures (Ethicon Inc, Somerville, NJ) using loop magnification. Full-thickness bile duct wall was sutured to jejunal submucosa, and seromuscular layers with the posterior wall knots tied on the inside. Jejunal mucosa was not included in the suture. Temporary extracorporeal stents were used in 1 patient where multiple anastomoses to small segmental ducts were done.

RESULTS

Intraoperative assessment revealed 8 patients with proximal ducts dilated more than 1.5 cm. In the remaining 14 patients the ducts were less than 1.5 cm in diameter, of which 4 were described as normal and 3 were described as fine. In 2 patients excluded ducts from a previously created hepaticojunostomy were found. In 3 other patients, problems with the previously created Roux-en-Y limb were believed to contribute to the cholangitis: 2
Roux-en-Y limbs were very short (<40 cm) and the other had adhesions blocking the Roux-en-Y limb.

There was 1 intraoperative complication: bleeding (14 U of packed red blood cells were transfused) in a patient with a biliocutaneous fistula and an extensive inflammatory reaction at the hilum. There were 4 postoperative complications, 1 bilaoma that was drained percutaneously without the development of a fistula. One fistula did occur postoperatively and this closed after 2 weeks of observation. Three patients underwent reoperation, 2 for incisional hernias and the other for obstruction of the Roux-en-Y limb. The average length of hospital stay was 12.8 ± 5.8 days. There were no deaths.

The results of preoperative and postoperative liver biochemistry studies are given in Table 2. There was a decline in all factors in the immediate postoperative period. Three patients had persistent elevation of their serum alkaline phosphatase levels at the most recent follow up (2 are asymptomatic).

Fourteen (64%) of the 22 patients had a liver biopsy at the time of surgery. In no case was the liver biopsy specimen normal. Six patients had results described as mild: fibrosis confined to the portal area and mild proliferative and inflammatory changes. Six patients had moderate changes: bridging fibrosis and/or moderate inflammatory changes. There were 2 patients whose biopsy specimens were reported as showing extensive bridging fibrosis with regenerative nodules/cirrhosis.

Long-term results were categorized according to the system of clinical grading suggested by Terblanche*10: grade 1, no biliary symptoms and normal liver function; grade 2, transitory symptoms—currently no symptoms and normal liver function; grade 3, clear-cut related symptoms at follow-up visit and/or deteriorating liver function; and grade 4, recurrent strictures requiring correction or therapy. Normal liver function implies normal bilirubin and liver transaminase levels. A mildly elevated level of serum alkaline phosphatase was accepted as normal provided the level had decreased from the preoperative level. Eighteen patients were entirely well (Terblanche grade 1). Three had sporadic episodes of cholangitis postoperatively that resolved completely after receiving short courses of antibiotics (Terblanche grade 2). One patient remains unwell, requiring prolonged antibiotic therapy to control symptoms of cholangitis (Terblanche grade 3). There have been no reoperations or stenting for bile duct strictures.

This article demonstrates excellent long-term results of bile duct stricture repair after cholecystectomy. The approach used was to establish the diagnosis and then proceed to surgery without extensive investigations or temporary extracorporeal stenting. The precise proximal anatomy was determined by intraoperative cholangiography, followed by careful hepaticejunostomy to healthy bile ducts well above the injury. This technique was facilitated by lowering the hilar plate and/or using the posterior approach to exteriorize the hilum. Patients with devascularized lobes underwent resections and postoperative temporary extracorporeal stenting was used in only 1 patient.

The anatomy of the bile ducts above the convergence is extremely variable. Couinaud has suggested that in 30% of persons the anatomy of the left hepatic duct may not be suitable for these high repairs by simply taking down the hilar plate.11 The main problem is the variability in the position of the duct to segment IV. This duct may enter posteriorly very close to the convergence or may divide the drainage of the left lobe into a segment IV/III duct and a segment IV/II duct. Thus, the use of just the anteriorly placed duct for the repair will drain only half of the left lobe. Furthermore, when the left ductal system is split so also is the right ductal system, creating a confusing situation where there is neither a right nor a left hepatic duct proper (17% of cases).11

French surgeons have stressed that intraoperative cholangiography is necessary to appreciate intrahepatic bile duct anatomy.11-13 Failure to appreciate this anatomy may result in the complete or partial exclusion of segmental ducts and result in recurrent cholangitis in the face of a seemingly wide open anastomosis.14 Two of our patients were found to have excluded ducts that may have contributed to their cholangitis. Patients with devascularized livers,15 found in 2 patients in this series, or Roux-en-Y limb obstruction16 (3 patients) can also present with recurrent cholangitis. Often, it is very difficult to uncover bile ducts in the scarred hepatic pedicle. Finding the duct by needle aspiration and then performing a cholangiogram instantly shows the surgeon the position of the bile ducts and creates a “road map for repair.” This approach also increases the likelihood of finding accessory ducts, high stones, or other strictures. We believe intraoperative cholangiography is more useful than trying to find the bile ducts by feeling for preoperatively placed stents; thick

**Table 1. Bismuth Level of Stricture and Operative Procedure**

<table>
<thead>
<tr>
<th>Bismuth Type</th>
<th>No. (%) of Patients</th>
<th>Operative Procedure*</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>5 (23)</td>
<td>Low HJ (n = 3) and dilation (n = 2)</td>
</tr>
<tr>
<td>2</td>
<td>4 (18)</td>
<td>Low HJ (n = 1) and high HJ (n = 3)</td>
</tr>
<tr>
<td>3</td>
<td>7 (32)</td>
<td>High HJ</td>
</tr>
<tr>
<td>4</td>
<td>5 (23)</td>
<td>High HJ†</td>
</tr>
<tr>
<td>5</td>
<td>1 (4)</td>
<td>Low HJ</td>
</tr>
</tbody>
</table>

* HJ indicates hepaticejunostomy. † Two patients had right-sided hepatectomy and left-sided hepaticejunostomy for associated vascular injuries and hepatic ischemia.

**Table 2. Preoperative and Postoperative Liver Biochemistry Study Results**

<table>
<thead>
<tr>
<th>Factor</th>
<th>Before Surgery</th>
<th>After Surgery</th>
<th>P</th>
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<tbody>
<tr>
<td>Total bilirubin, µmol/L (mg/dL)</td>
<td>56 ± 79</td>
<td>21 ± 19</td>
<td>.08</td>
</tr>
<tr>
<td>Alkaline phosphatase, U/L</td>
<td>(5.6 ± 7.9)</td>
<td>(2.1 ± 1.7)</td>
<td></td>
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<tr>
<td>Alanine aminotransferase, U/L</td>
<td>370 ± 321</td>
<td>210 ± 122</td>
<td>.07</td>
</tr>
<tr>
<td>Glutamyltransferase, U/L*</td>
<td>93.8 ± 61.2</td>
<td>60.5 ± 84.4</td>
<td>.18</td>
</tr>
<tr>
<td></td>
<td>542 ± 547</td>
<td>164 ± 142</td>
<td>.007</td>
</tr>
</tbody>
</table>

* Indicates a significant difference.
scar tissue and glissonian sheath covering these ducts can make identification of stents difficult.

Hepp and Couinaud\(^1\) established the principles of repairing these lesions 40 years ago. They outlined the technique of exposing the left hepatic duct by “taking down the hilar plate.” However, this approach may not always provide adequate exposure, with the left hepatic duct still deep in the liver parenchyma or situated behind the portal vein in 5.6% of cases.\(^{11}\) In these circumstances Champeau\(^17\) has suggested opening the umbilical fissure, the main portal fissure, and even the resection of segment IV as possible ways of improving exposure of the left hepatic duct. We prefer to use the posterior approach\(^9\) to encircle the entire intrahepatic hilum and bring it and the bile ducts from their deep position to a more superficial extrahepatic location. The bile ducts are not always dilated as was the case in 7 of our patients. These cases can be particularly difficult and adequate exposure is of paramount importance. Furthermore, the dissection of the ducts on the left side and high on the right side are facilitated for Bismuth type 3 and type 4 stricture repairs. One need not worry about devascularizing these high ducts by separating the glissonian sheath from the liver parenchyma as their blood supply is from within the sheaths and changes from axial to direct once the convergence is reached.\(^{10}\) This is probably the main reason that the level of the stricture often migrates up to the level of the convergence.\(^{10}\) The anastomosis to the left hepatic duct should be as wide as possible to reduce the risk of restricture. We often carry the incision across the convergence onto the right hepatic duct to be sure both sides of the liver are adequately drained and any central ducts are included.

Temporary extracorporeal stenting of anastomoses is always a topic of controversy. Proponents of stenting often follow a strict protocol of preoperative and postoperative stenting including various tests and cholangiograms.\(^2\)\(^{-}\)\(^5\)\(^,\)\(^20\)\(^,\)\(^21\) There is, however, little evidence that stents are necessary as many authors have publishing equivalent or better results without them.\(^6\)\(^,\)\(^13\)\(^,\)\(^22\)\(^-\)\(^26\) To date there is no randomized trial supporting their use and decompression decreases bile duct size making the procedure more difficult.\(^6\) Furthermore, a neglected stent can be the focus of morbidity and even mortality from infection or bleeding.\(^6\) We use stents only to protect difficult anastomoses to small segmental ducts where leakage is more superficial extrahepatic location. The bile ducts are always provide adequate exposure, with the left hepatic duct still deep in the liver parenchyma or situated behind the portal vein in 5.6% of cases.\(^{11}\) In these circumstances Champeau\(^17\) has suggested opening the umbilical fissure, the main portal fissure, and even the resection of segment IV as possible ways of improving exposure of the left hepatic duct. We prefer to use the posterior approach\(^9\) to encircle the entire intrahepatic hilum and bring it and the bile ducts from their deep position to a more superficial extrahepatic location. The bile ducts are not always dilated as was the case in 7 of our patients. These cases can be particularly difficult and adequate exposure is of paramount importance. Furthermore, the dissection of the ducts on the left side and high on the right side are facilitated for Bismuth type 3 and type 4 stricture repairs. One need not worry about devascularizing these high ducts by separating the glissonian sheath from the liver parenchyma as their blood supply is from within the sheaths and changes from axial to direct once the convergence is reached.\(^{10}\) This is probably the main reason that the level of the stricture often migrates up to the level of the convergence.\(^{10}\) The anastomosis to the left hepatic duct should be as wide as possible to reduce the risk of restricture. We often carry the incision across the convergence onto the right hepatic duct to be sure both sides of the liver are adequately drained and any central ducts are included.

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We offer a simplified approach to the difficult problem of postcholecystectomy bile duct strictures that re-