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Case Report

Autologous Peritoneal Interposition Graft for Repair of Proximal Hepatic Duct Transection after Laparoscopic Cholecystectomy

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Abstract

Transection of the proximal hepatic duct during Laparoscopic Cholecystectomy (LC) is a serious complication that requires complex surgical repair with Roux-en-Y hepaticojejunostomy. In this case report, we present for the first time the short-term outcomes after using an autologous peritoneal graft to create tension-free anastomoses in a 71-year-old, morbidly obese woman with extensive comorbidities.

The patient had suffered complete transection of the proximal hepatic duct during LC. Three months after the original procedure, she underwent surgical repair in which we bridged the distance between the proximal hepatic duct and the short distal jejunal loop by fashioning an autologous peritoneal tubular interposition graft that allowed us to create a tension-free Roux-en-Y hepaticojejunostomy. The procedure was performed successfully. Postoperatively, she developed a wound infection and prolonged bile leakage, and this was treated with surgical repair and percutaneous abdominal drainage. The leakage ceased after 4 months of conservative management. Six months after the procedure, her liver function tests were near normal, with continuous downtrending of alkaline phosphatase. In conclusion, reconstructing the hepatic duct by using an autologous peritoneal interposition graft is safe, easy to do, and should be considered when tension-free biliary-enteric anastomoses cannot otherwise be achieved.

Keywords: Bile duct injury; Hepaticojejunostomy; Laparoscopic cholecystectomy

Introduction

Since Laparoscopic Cholecystectomy (LC) was first introduced in the early 1990s, it has become the gold-standard procedure for patients with gallbladder disease, as it is associated with less postoperative pain, shorter hospital stays, and quicker recovery and return to normal activities compared with open surgery. Nonetheless, Bile Duct Injury (BDI) occurs at a higher rate with LC than it did with open cholecystectomy, albeit progressively less and less frequently since its initial introduction: During LC, the rate for major BDI that requires reconstruction is 0.3%, and the overall biliary complication rate is 1.5% if bile leaks are included, compared with 0.1%–0.2% for open cholecystectomy [1-4]. Considering the large number of LC procedures performed annually in the United States, this suggests that approximately 3000 patients each year have major BDI after LC. These injuries produce significant morbidity, increase health care costs and mortality rates, affect long-term quality of life [5-7], and provoke litigation against general surgeons [8].

Postoperative BDIs are usually classified as either minor or major. Minor injuries (ie, Strasberg types A–D) [9] are the most common [10]. They are not associated with tissue loss and can be repaired either surgically or endoscopically. In contrast, major BDIs (Strasberg types E1–E5) are associated with tissue loss and

require complex repair, including end-to-end repair, Roux-en-Y hepaticojejunostomy, or choledochojejunostomy. The choice of surgical reconstruction is based on the level and extent of the injury, with Roux-en-Y hepaticojejunostomy being the preferred approach for injuries involving the proximal hepatic duct. The complexity of the repair increases with injuries involving the biliary confluence, especially those associated with bile leakage, as attempted reconstruction of a retracted, decompressed hepatic duct in the presence of severe inflammation is extremely difficult, and short-and long-term outcomes are poor. Therefore, it has been suggested that controlling the leakage before repair by placing a percutaneous abdominal drain and transhepatic biliary stent is essential for a successful outcome [11].

The principle underlying biliary reconstruction is to create a tension-free anastomosis between the jejunum and the healthy proximal hepatic duct, with minimal short-term and long-term sequelae. To accomplish this, it is essential to fashion a jejunal limb that is long enough to reach the proximal hepatic duct at the hilum of the liver. This approach becomes more complex when the jejunal limb is too short to reach the confluence of the hepatic duct, which would prevent the desired tension-free anastomosis.

Here, we describe for the first time the creation of a 20-cm tubular autologous peritoneal interposition graft used as a conduit between the jejunal limb and a proximal hepatic duct that had been transected during LC.

Case Presentation

A 71-year-old morbidly obese woman (body mass index of 52) was transferred to our institution for management of BDI after LC 2 months earlier. The patient's past medical history was significant for type 2 diabetes, hypertension, and obstructive sleep apnea. Magnetic resonance cholangiopancreatography and endoscopic retrograde cholangiopancreatography at 8 different hospitals in the region had confirmed complete transection of the common hepatic duct and extensive fluid collection at the hilum of the liver (Figure 1). This had been treated with intravenous antibiotics and multiple percutaneous abdominal drains.

Figure 1: Magnetic resonance cholangiopancreatography showing complete transection of the hepatic duct at the confluence (arrow).

On admission to our hospital, the patient's laboratory results revealed hyponatremia, hyperglycemia, acute kidney injury, severe malnutrition with low albumin and prealbumin, and urinary tract infection. Abdominal drainage catheters were producing >1 liter of bile every day. Cultures from the biliary fluid grew polymicrobial flora and yeast (Table 1). Treatment with intravenous antibiotics and antifungal medications was commenced. The attempted placement of percutaneous transhepatic biliary drainage catheter by our interventional radiologists was unsuccessful due to the patient's body habitus and nondilated biliary system.

Laboratory test (normal range)	On admission	At the time of surgery	At the time of discharge	6-month follow up
Sodium (136–145 meq/L)	126	135	136	139
Potassium (3.5–5.1 meq/L)	4.2	3.9	3.9	4.4
Chloride (98–107 meq/L)	101	100	106	104
CO_2 (22–29 meq/L)	19	21	23	22
BUN (7–21 mg/dL)	21	48	12	20
Creatinine (0.5–1.2 meq/dL)	2.3	0.8	0.6	0.73
Glucose (70–105 mg/dL)	207	178	181	145
Albumin (3.7–4.7 g/dL)	1.9	2.9	2.9	3.6
Alkaline phosphatase (44–121 IU/L)	268	305	406	211
Total bilirubin (0.0–1.2 mg/dL)	0.3	0.4	0.7	0.5
AST (5–34 U/L)	19	14	20	12
ALT (6–55 U/L)	26	11	28	11
WBC (3.5–10.5 K/μL)	15.1	14.7	11.8	12.6
H&H (11.2–15.7 gm/dL)	8.1/26.4	9.8/30.4	9.4	10.1/33
Platelets (150K–450K/μL)	320	379	32.5	423
Hemoglobin A1C (<5.7%)	6.6			
Prealbumin (14–45 mg/dL)	11			

ALT, Alanine Transaminase; AST, Aspartate Aminotransferase; BUN, Blood Urea Nitrogen; H&H, Hemoglobin And Hematocrit; WBC, White Blood Cell Count.

Table 1: Laboratory results at the time of admission, 1 month after admission at the time of surgery, at discharge, and at the 6-month follow up.

Three months after the original LC, surgical exploration and bile duct reconstruction were planned for this patient. During the 4 weeks of hospitalization before surgery, she received aggressive enteral and parenteral nutritional support to optimize her nutritional status. The antibiotic and antifungal medications were continued during this time. By the time of surgery, the urinary tract infection was cleared, her blood glucose level was under better control, and her electrolyte imbalance was corrected.

During the laparotomy, we encountered dense inflammatory reactions in the perihepatic and hilar regions that required tedious dissection to reach the hilum of the liver, where a large cavity filled with bilious fluid was accessed and drained. The hilar plate was then lowered at the base of segment IV, which allowed us to identify the retracted orifice of the proximal hepatic duct at the confluence. Intraoperative choledochoscopy confirmed normal-appearing mucosa of the intrahepatic left and right ducts.

The proximal jejunum was divided about 30 cm from the ligament of Treitz, and a 60-cm Roux-en-Y loop of jejunum was prepared for end-to-side hepaticojejunostomy. However, the jejunal loop was unable to reach the hilum of the liver in either a retrocolic or antecolic fashion because of a short mesentery, distended hepatic flexure of the transverse colon, and thickened edematous mesocolon. The distance between the proximal hepatic duct and the jejunal loop was 20 cm. We therefore removed a 20-cm-long parietal peritoneal sheet from the anterior abdominal wall, without the posterior rectus sheath. This was constructed into a tubular graft by using 5-0 Polydioxanone (PDS) sutures (Ethicon, Inc., Raritan, NJ, USA) to wrap the peritoneal sheet around a suction tube (Figure 2).

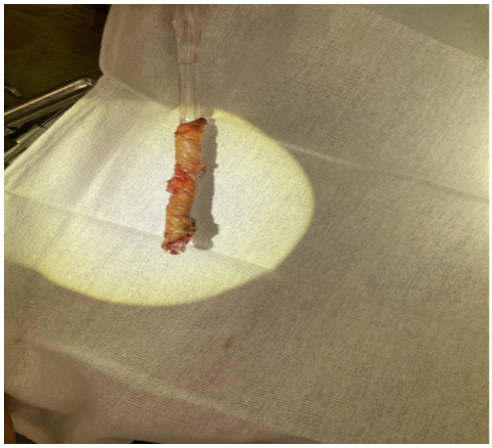

Figure 2: A 20-cm sheet of parietal peritoneum was harvested from the patient's anterior abdominal wall and fashioned into a tubular conduit by wrapping the peritoneal sheet over a suction tube and using 5-0 polydioxanone running sutures.

Using this graft, we created tension-free anastomoses between the hepatic duct and the peritoneal graft proximally, and the jejunal limb distally, using 5-0 PDS in an interrupted fashion (Figure 3). The anastomosis was splinted with an 8.5F Cook biliary drainage catheter (Cook Medical Incorporated, Bloomington, IN, USA) introduced through the skin into the jejunal limb and then into the graft; the catheter was secured at the jejunal end with 5-0 PDS. The jejunal limb at the entrance site of the tube was then tacked to the anterior abdominal wall. Two Jackson-Pratt drains were placed anterior and posterior to the graft and exited the abdomen through a separate stab incision. Operating time was 5 hours and 30 minutes, with 100 mL of blood loss.

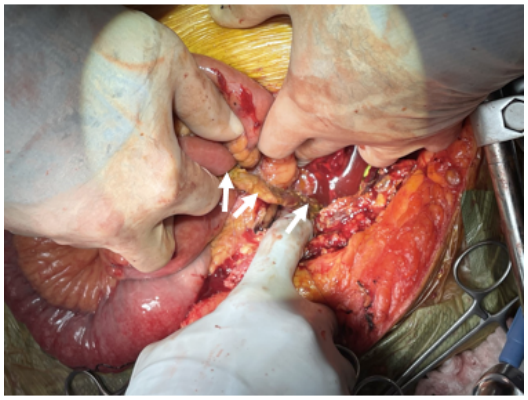

Figure 3: The peritoneal graft (middle arrow) was anastomosed to the transected proximal hepatic duct at the confluence of the hepatic duct (right arrow) and distally to the jejunal loop (left arrow) by using interrupted 5-0 polydioxanone sutures over an 8.5F biliary drainage catheter introduced through the skin into the jejunal loop (not shown).

The patient's postoperative course was complicated by wound infection and bile leakage. The biliary leakage developed on postoperative day 4. A cholangiogram showed a small leakage from the proximal anastomosis; in addition, the percutaneous biliary drainage catheter was inadvertently removed by interventional radiologists during the cholangiogram and could not be replaced. A laparotomy was performed 4 weeks after the index operation as a result of increased biliary drainage from the abdominal drain. The graft appeared healthy, with partial dehiscence of the distal anastomosis that had occurred during the cholangiogram and small leakage from the proximal anastomosis. These were repaired with interrupted PDS sutures.

The patient was discharged on postoperative day 14 with abdominal drains in place. She continued to have small biliary leakage, which stopped after 4 months. The abdominal drains were then removed after a computed tomography scan showed no evidence of intra-abdominal fluid collection. At the 6-month follow-up, her liver function tests were within normal limits; mild elevation of alkaline phosphatase appeared to be trending down. After 8 months of follow-up, she was doing well.

Discussion

To our knowledge, this is the first reported case in which an autologous peritoneal graft was used for biliary reconstruction after BDI. Our method appears to be safe and effective, and creating a biliary-enteric conduit in this manner was easy to do.

Our patient had significant comorbidities, including morbid obesity, poorly controlled type 2 diabetes, and poor nutritional status, all of which made managing her major BDI extremely difficult. The decision to proceed with laparotomy and repair of the bile duct was based largely on her lack of significant clinical progress despite 3 months of conservative management and percutaneous abdominal drainage, along with our inability to control the leakage transhepatically.

The gold standard for biliary reconstruction of a transected proximal hepatic duct is Roux-en-Y hepaticojejunostomy. The fundamental requirements for biliary enteric anastomosis include healthy bile duct mucosa, which we confirmed on intraoperative choledochoscopy, and tension-free mucosa-to-mucosa anastomosis. In our case, the prepared jejunal loop was 20 cm away from the transected proximal hepatic duct, due to patient's body habitus, short mesentery, and severe perihilar and pericolonic inflammation. Creating a 20-cm interposition peritoneal graft provided a viable solution that allowed us to bridge the gap and create tension-free anastomoses.

Of note, the vascularity of the graft was a concern despite healthy-appearing mucosa on its proximal and distal ends, as adequate blood supply is imperative for both short-term and long-

term outcomes. Nevertheless, at the second laparotomy to repair the dehisced distal anastomosis, the graft appeared healthy without ischemic changes. The bile leak eventually ceased, and her liver function was nearly normal.

Other methods for repair, such as interposition jejunal grafts, have been proposed as alternatives to the Roux-en-Y hepaticojejunostomy [12] but would not have been feasible in this case due to the above-mentioned constraints. However, reconstructing the autologous graft to the duodenum could serve as an alternative to the Roux-en-Y hepaticojejunostomy, as it allows easy endoscopic access to the biliary system if needed although at the expense of increased incidence of ascending cholangitis.

The parietal peritoneum is composed of a single layer of ciliated, squamous mesothelial cells that rest on basal lamina and its connective tissue. Recent evidence showed that the peritoneum is more complex than just a serous membrane and that it has a wide array of functions. Using an autologous peritoneal graft for vascular reconstruction was examined recently in a recent systematic review of 15 studies with 94 patients [13]. Two different types of peritoneal sheets (with or without the posterior rectus sheath) had been used, either as a patch or as a tubular conduit for venous reconstruction. The graft patency rate was more than 90%, and the stenosis rate was 5.9%. Creating peritoneal grafts in this manner appears to be safe and readily available for use in venous reconstruction. However, the authors stated that the current data are insufficient for drawing an evidence-based conclusion about routine use.

This case report highlights the difficulties that hepatobiliary surgeons may encounter in managing patients with proximal hepatic duct injury after LC. Nonetheless, we have shown that creating an autologous peritoneal graft, as a conduit is safe and easy to do when tension-free biliary-enteric anastomoses cannot otherwise be achieved. The prolonged postoperative bile leak that developed in our patient was inevitable due to her malnutrition, poorly controlled type 2 diabetes, morbid obesity, and local infection.

We hope that this novel technique may serve as a landmark case for future attempts to utilize a patient's own parietal peritoneum to reconstruct a bile duct, regardless of whether an end-to-end or Roux-en-Y hepaticojejunostomy approach is used. We are confident that short-term outcomes will be much improved in patients with few or no comorbidities.

Disclosures

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Statement of Compliance with Ethical Guidelines: All procedures were approved by the Institutional Review Board of the Baylor College of Medicine and conform to the principles outlined in the Declaration of Helsinki. This report was guided by ethical standards and national and international laws.

Informed Consent Statement: Written informed consent was obtained from the patient to publish this report. No identifying information is presented in this report.

Data Availability Statement: No datasets were generated or analyzed for this case report. All data needed to evaluate the conclusions herein are present in the report.

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