CASE REPORT – OPEN ACCESS

International Journal of Surgery Case Reports 44 (2018) 185–190

Contents lists available at ScienceDirect

International Journal of Surgery Case Reports

journal homepage: www.casereports.com

# A novel combined interventional radiologic and hepatobiliary surgical approach to a complex traumatic hilar biliary stricture☆

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ARTICLE INFO

*Article history:*
Received 20 November 2017
Received in revised form 18 January 2018
Accepted 28 February 2018
Available online 3 March 2018

*Keywords:*
Combined approach
Interventional radiology
Hepatobiliary surgery
Complex traumatic hilar biliary stricture
Case report

ABSTRACT

*INTRODUCTION:* Benign strictures of the biliary system are challenging and uncommon conditions requiring a multidisciplinary team for appropriate management.
*PRESENTATION OF CASE:* The patient is a 32-year-old male that developed a hilar stricture as sequelae of a gunshot wound. Due to the complex nature of the stricture and scarring at the porta hepatis a combined interventional radiologic and surgical approach was carried out to approach the hilum of the right and left hepatic ducts. The location of this stricture was found by ultrasound guidance intraoperatively using a balloon tipped catheter placed under fluoroscopy in the interventional radiology suite prior to surgery. This allowed the surgeons to select the line of parenchymal transection for best visualization of the stricture. A left hepatectomy was performed, the internal stent located and the right hepatic duct opened tangentially to allow a side-to-side Roux-en-Y hepaticojejunostomy (a Puestow-like anastomosis).
*DISCUSSION:* Injury to the intrahepatic biliary ductal confluence is rarely fatal, however, the associated injuries lead to severe morbidity as seen in this example. Management of these injuries poses a considerable challenge to the surgeon and treating physicians.
*CONCLUSION:* Here we describe an innovative multi-disciplinary approach to the repair of this rare injury.
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## 1. Background

Strictures of the bile ducts are a challenging, uncommon condition that requires a multidisciplinary team for appropriate and safe management. Up to 30% of patients with benign strictures have prolonged, complicated courses requiring multiple services for management leading to significant healthcare costs [1]. The majority of recommendations for treating benign biliary strictures relate to common causes of biliary stricture including injury from ischemia or trauma, injury due to chronic pancreatitis, and strictures after liver transplant [2]. Throughout the years, there has been little attention to biliary strictures caused by penetrating trauma, specifically gunshots [3]. We present a case of a patient who sustained a gunshot wound to his abdomen and subsequently developed a hilar stricture that extended into the main right hepatic duct with eventual treatment involving a combined surgical and interventional radiologic (IR) approach. Our work has been reported in line with the SCARE criteria [4].

## 2. Case presentation

A 32-year-old previously healthy male sustained a gunshot wound to the abdomen. Permission was obtained allowing discussion and publication of this case. The bullet went through the right lobe of the liver and anteriorly through the left lobe. The bullet caused injuries to the gallbladder, duodenum, and left diaphragm. The patient underwent emergency surgery noting blood but no bile upon entering the abdomen. Multiple grade II liver lacerations were appreciated and the liver was packed. The patient underwent a cholecystectomy, repair of duodenal injury, repair of diaphragm and placement of chest tube. The patient recovered from surgery and discharged on postoperative (POD) 5, however, on POD 8–he returned with increasing abdominal pain and was found to have a bile leak. The patient underwent multiple radiologic and endoscopic procedures showing contrast extravasation from the region of the confluence of the right and left hepatic ducts or most proximal common hepatic duct (Fig. 1). The bile leak was controlled with placement of bilateral percutaneous internal/external biliary stents. In the months following, the patient was found to have a

☆ All authors have approved the final article should be true and included in the disclosure.

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https://doi.org/10.1016/j.ijscr.2018.02.043
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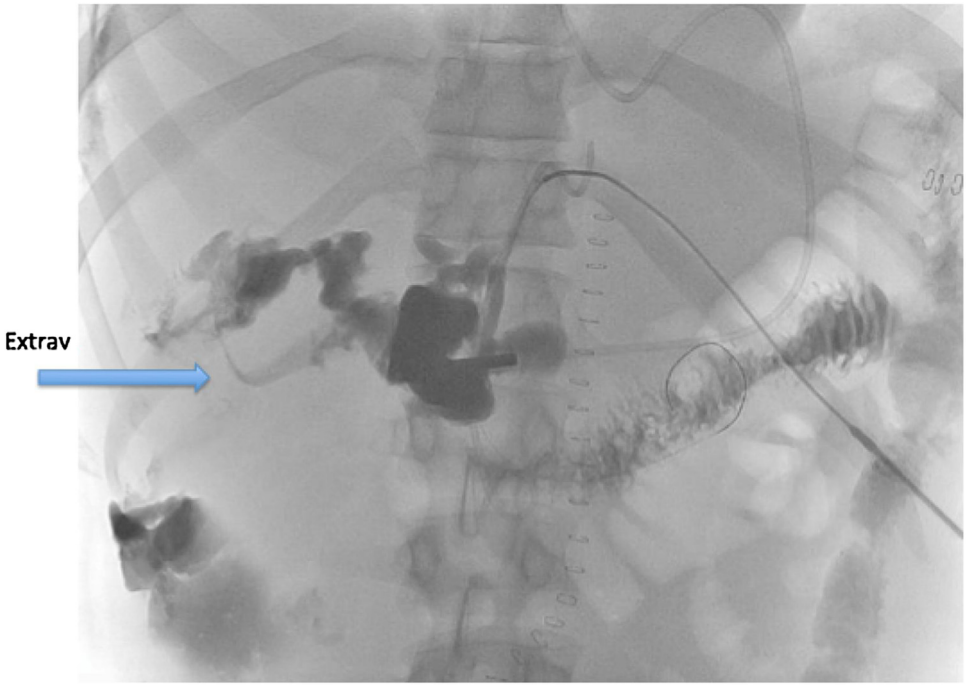


**Fig. 1.** Percutaneous transhepatic cholangiogram demonstrating a bile leak from the confluence of the right and left hepatic ducts or proximal common hepatic duct.

stricture at the confluence of the hepatic ducts. Multiple attempts to treat the stricture with balloon dilatation were unsuccessful, rendering the patient catheter dependent. The patient was referred to a hepatobiliary surgeon approximately 1 year after initial injury. After evaluating the stricture with multiple studies, it appeared that the patient had a high grade stenosis at the confluence of the right and left hepatic ducts that extended proximally into the main right hepatic duct but did not involve the junction of the anterior and posterior sectoral ducts (Figs. 2–4).

The patient was lost to follow-up returning due to weight loss of 35 lbs, constant abdominal pain, nausea, and severe fatigue with inability to perform many functions of daily living. It was recognized surgery with a major hepatectomy would be required but the dissection would be difficult due to distortion of the anatomy at the porta hepatis and confluence of the right and left bile ducts. After discussing the case at our multidisciplinary hepatobiliary oncology conference, a decision was made to treat his stricture operatively using a combined IR and surgical approach. It was determined that the best approach would be to resect the left lobe of the liver to obtain access to the proximal right hepatic stricture. To assist intraoperatively with localizing this area, we used the precision of image guided catheter placement preoperatively followed by intraoperative ultrasound.

## 3. Treatment

The patient went to the IR suite and underwent removal of his right percutaneous internal/external biliary drain over a wire. Two vascular sheaths were placed through the existing tract and a repeat cholangiography was performed. Using the existing wire access and through the vascular sheath two balloons were inserted, placed in the duodenum and positioned just proximal to the stricture in the right hepatic duct. Sheaths were secured and the patient was transported to the operating room.

A right subcostal incision was made. Once the liver was mobilized from the diaphragm, the left internal/external stent was cut from inside the abdomen, freeing the liver (Fig. 5). The bile duct in the porta hepatis was identified and mobilized from the portal vein. An intraoperative ultrasound of the liver was performed while the interventional radiologist manipulated the vascular sheaths. One of the sheaths had a wire through it with a balloon. The balloon was inflated and visualized on ultrasound. With balloon visualization, the parenchymal transection was determined including segments 2, 3, 4b and a portion of 4a. The transection was performed using a clamp-crush technique. The left hepatic duct was noted, with a stent. The stent was removed and the left main pedicle was divided with a linear stapler. Both sheaths were identified passing through the common hepatic duct (Fig. 6). A ductotomy was made in the left hepatic duct and extended to the right hepatic duct immediately proximal to the stricture (Fig. 7). The common bile duct was mobilized and divided distally, and the distal end was closed with 3-0 PDS suture. The common hepatic duct was resected such that the back wall of the confluence and the right hepatic duct orifice, which had the sheaths coming through it, remained. The sheath was removed with the guide-wire in place. An 18-French internal/external drain was threaded over the guide-wire to create the anastomosis. Once the drain was within the liver, the guide-wire was removed.

A latero-lateral bilioenteric single-layer anastomosis was performed with 3-0 PDS suture in a continuous fashion (Puestow-type, pancreaticojejunal anastomosis for chronic pancreatitis). This type of anastomosis was performed due to the need to encompass the long posterior wall of the right hepatic duct, and the area of the ductal confluence that included the bile duct draining segment IV of the liver (Fig. 8). This was a wide-mouth anastomosis approximately 4 cm in length (Fig. 9). The biliary drain was passed through the anastomosis into the jejunum. A side-to-side jejunojejunostomy was performed between the Roux-limb and the alimentary limb. The patient had an uneventful postoperative course and was discharged on POD 6, tolerating regular diet with minimal incisional pain.

## 4. Discussion

Nonsurgical traumatic injuries of the extra and intra hepatic bile ducts are rare [5,6], and account for 0.5% of abdominal injuries in

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