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RESEARCH ARTICLE

A Novel Technique to Temporize a Destructive Common Bile Duct Injury in an Unstable Poly-Trauma Patient

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ABSTRACT

We report a case of a 26-year-old patient presenting as a polytrauma with multiple devastating injuries, including a 1 cm destructive injury to the common bile duct (CBD) along with a laceration to the inferior vena cava (IVC). Studies on temporization strategies for common bile duct injuries in the context of damage control surgery are scarce, and guidelines for management of such injuries are limited due to low quality evidence. Surgical treatment for injuries to the extrahepatic bile ducts are individualized based on location, severity, and stability. In stable patients with less than 50% circumference injuries and healthy common bile duct margins, definitive repair can be attempted primarily. Destructive injuries that encompass greater than 50% circumference in stable patients are more challenging and there is controversy surrounding early versus delayed biliary reconstruction. In this case, an adequately sized T-tube was not available, and closed suction drainage was dismissed due to potential complications with early reconstruction. Due to the patient's critical condition and extraordinary circumstances, a LeMaitre carotid shunt was used to temporize the common bile duct injury for 6 days, a technique not previously described. The patient was then reconstructed with a hepaticojejunostomy in Roux-en-y fashion with a favorable outcome. We believe that this method of temporization may be an especially useful tool in the armamentarium of the surgeon practicing in an austere environment.

Introduction

Studies evaluating strategies to temporize CBD injuries are sparse and reports describing concomitant caval and portal injury are even more rare. Reports of these injuries are lacking, in part, because the outcomes of portal and caval injuries are so poor. Mortality associated with portal injuries has been described to be as high as 52% (1). Injury to the inferior vena cava, alone, due to penetrating trauma, carries 33% mortality before hospital arrival and 66% mortality within 24 hours (2). As a result of such poor outcomes associated with portal injuries, guidelines informing management of CBD injuries are limited and largely extrapolated from iatrogenic injuries following common procedures such as laparoscopic cholecystectomy. However, The World Society of Emergency Surgery (WSES) and American Association for the Surgery of Trauma (AAST) attempted to elucidate management of these injuries in a thorough review published in 2019 (3). The vast majority of the guidelines proposed on extrahepatic biliary injury are graded as a 1C or 2C recommendation (strong recommendation and weak recommendation respectively - both based on low-quality evidence); further confirmation that evidence-based guidelines on these injuries remain elusive. The aim of this case is to report an extraordinary circumstance of a destructive CBD injury that was temporized for 6 days with a vascular shunt. This strategy has not been described previously in the literature and produced a favorable outcome.

Case Report

This is a complex case of a 26-year-old male presenting as a trauma with a gunshot wound to his abdomen. On arrival, he was distressed and appeared pale and diaphoretic. His airway was intact. However, he quickly became altered and had one episode of emesis requiring intubation for airway protection. Intravenous access was established with two peripheral intravenous catheters and a Cordis catheter. Massive transfusion was activated as the patient was hypotensive and tachycardic. Upon evaluation, he had a gunshot wound to the left abdomen with visible eviscerated omentum and another in the right flank. He was taken to the operating room emergently and underwent exploratory laparotomy.

Upon entry into the abdomen, there was copious blood in the lesser sac which bulged out of the abdomen. Each quadrant of the abdomen was packed and then assessed for injuries. The lesser sac was entered and roughly two liters of blood expressed. The supraceliac aorta was compressed

with manual pressure as massive transfusion was continued to keep the patient permissively hypotensive until the bleeding could be identified.

Given the concern for an inferior vena cava or aortic injury and the inability to control bleeding, the supraceliac aorta was formally dissected and clamped. The clamp was released every 30 minutes to allow distal perfusion. A right medial visceral rotation was performed. Bleeding of the inferior vena cava just above the confluence of the right renal vein was identified and repaired primarily with prolene suture.

An extended Kocher maneuver was then performed to evaluate a laceration to the 2nd portion of the duodenum and also revealed a portal injury. The common bile duct had been transected with a 1 cm defect. The portal vein and hepatic artery were intact. The edges of this defect appeared borderline healthy. The laceration in the 2nd portion of the duodenum was transverse and approximately 50% of the circumference of the wall with healthy bleeding edges. This was suture-repaired primarily in two layers.

Attention was then turned to the common bile duct injury. An attempt to place a 14 French T-tube to bridge the defect failed because it could not be threaded distally due to size mismatch. No other sizes were available. Instead, a straight 10 French LeMaitre vascular shunt was placed inside the CBD proximally and distally and the duct was ligated around the shunt with chromic sutures to secure it in place and bridge the defect. Bile was visualized to flow through the shunt into the second portion of the duodenum immediately after placement (Figure 1). Given the patient was persistently hypotensive and beginning to bleed from raw surfaces, the abdomen was packed, and a Bogota bag was utilized for temporary abdominal closure (TAC). One of two Jackson-Pratt (JP) drains was left overlying the CBD. Other procedures performed on index exploration, but not discussed in this report, included a right nephrectomy for a destructive missile injury through the renal hilum, anterior and posterior gastric perforation repair, and wide drainage of a mid-body pancreatic injury.

He was taken to the ICU postoperatively for close monitoring and further resuscitation. Overnight, he expressed nearly four liters of blood from his TAC drains. In the 48 hours following presentation, he would require 21 units of packed red blood cells, 8 units of fresh frozen plasma and 2 units of platelets. While he continued to be massively transfused, vasopressors were required to support a mean arterial pressure of 60-65 mmHg. At one point, he

required norepinephrine, vasopressin and neosynephrine infusions along with massive transfusion to maintain this pressure. He was coagulopathic (international normalized ratio of >2), thrombocytopenic (platelets as low as 20) and acidotic (pH as low as 7.05). Despite his critical condition overnight, by the next morning, his coagulopathy was correcting, his vasopressor

requirement was decreasing, his acidosis was improving, and his drain output decreased. He began to mentate appropriately. That afternoon, the patient was taken to the OR for a second look exploratory laparotomy, where all the sponges were removed, and the abdomen was evaluated. There were no new injuries appreciated and there was no further bleeding. TAC was replaced.

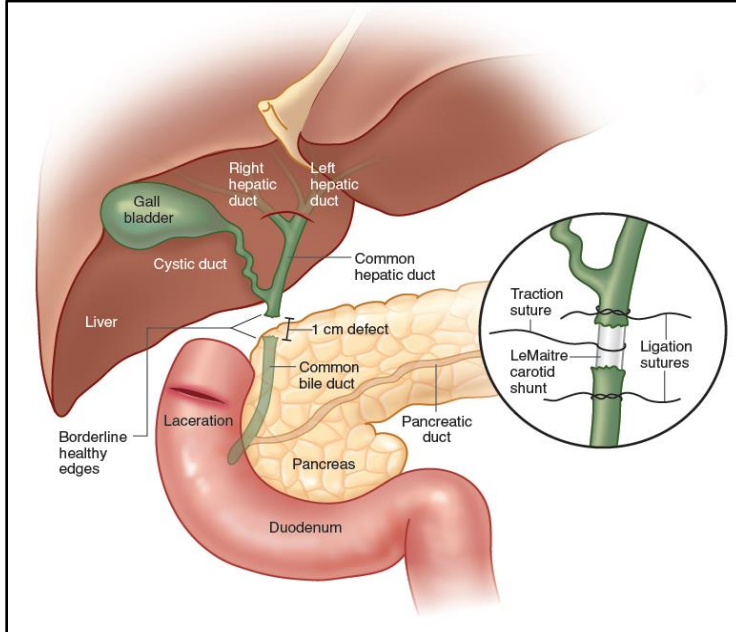


Figure 1: Illustration of the intraoperative findings of the duodenal laceration and common bile duct injury before and after LeMaitre carotid shunt temporization

He recovered well in the ICU afterwards and was weaned off all vasopressors and eventually extubated. His case was presented at multidisciplinary rounds to address options to reconstruct his common bile duct and on postoperative day six, he was taken to the OR for Roux-en-Y hepaticojejunostomy, cholecystectomy, and definitive abdominal closure. Intraoperatively, the shunt was easily identified with the aid of a

green traction suture shown in Figure 2. There was mild inflammatory and fibrous tissue surrounding the shunt that was taken down easily. The duct was debrided to healthy bleeding edges and biliary-enteric anastomosis was created without issue. Post operatively, his liver function tests remained normal and a JP drain, left around the hepaticojejunostomy, was never bilious.

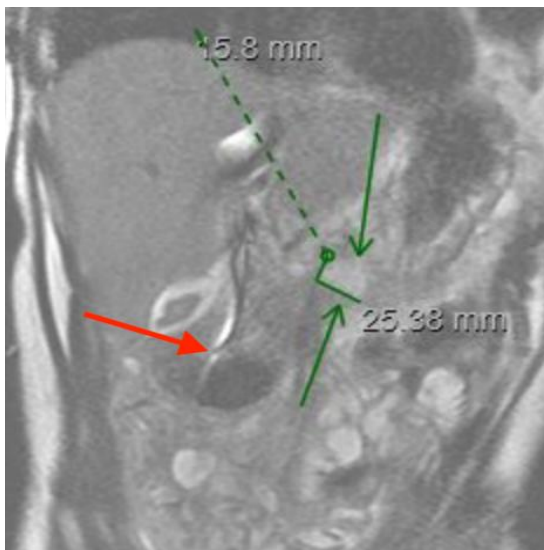


Figure 2: Magnetic resonance cholangiopancreatography (MRCP) following index exploration showing the LeMaitre carotid shunt in the common bile duct protruding into the duodenum (red arrow) and an injury to the mid body of the pancreas (green arrows).

Discussion

We report a complex case of an unstable polytrauma patient with devastating injuries including a 1 cm destructive injury to the common bile duct. Given the patient's critical condition, the injury was temporized with a LeMaitre carotid shunt, a novel strategy that has not been previously described. A T-tube shunt was attempted but was not utilized due to inappropriate size.

Surgical management of injuries of the extrahepatic bile ducts are individualized, given the rarity of these events, and based upon location, severity, and hemodynamic stability (3). Our patient was found to have a complete transection of the distal CBD. This is defined by the AAST Organ Injury Scale as a Grade V injury (>50% transection) shown in Table 1. Our patient was also hemodynamically unstable which is classified as a WSES Class IV extrahepatic biliary injury.

Table 1. AAST Organ Injury Scale for Extra-hepatic Biliary Tree Injuries

| Grade | |
|-------|---|
| I | Gallbladder hematoma/contusion |
| | Portal triad contusion |
| II | Partial gallbladder avulsion from liver bed with intact cystic duct |
| | Gallbladder laceration or perforation |
| III | Complete gallbladder avulsion from liver bed |
| | Cystic duct laceration |
| IV | Partial or complete right or left hepatic duct laceration |
| | <50% Common hepatic duct laceration |
| | <50% Common bile duct laceration |
| V | >50% Common hepatic duct laceration |
| | >50% Common bile duct laceration |
| | Combined right and left hepatic duct injuries |
| | Intraduodenal or intrapancreatic bile duct injuries |

Nonoperative management for hemodynamically stable patients with AAST Grade V injuries is controversial and recommendations range from intensive monitoring to attempted stent placement by an experienced interventional radiologist (3). Operative management of AAST Grade V injuries should utilize reconstruction, either with hepaticojejunostomy or choledochojejunostomy if there is no associated vascular injury (3).

In stable patients with less than 50% circumference injuries (AAST OIS Grade IV) and healthy CBD margins, definitive repair can be attempted primarily, with or without a stent or T-tube, that generally remains in place for weeks to months (4). Although, some studies suggest T-tube drainage after procedures such as common bile duct exploration may be unnecessary (5, 6). Whether this lends insight into management of traumatic

injuries such as the one in our patient is the subject of debate.

More destructive injuries encompassing greater than 50% circumference (AAST OIS Grade V) of the CBD in the stable patient are more challenging and controversial (7). These injuries are not amenable to primary repair due to risk of stenosis, but debridement with an end-to-end tension free anastomosis has been described (8). However, even this strategy carries a risk of biliary stenosis and in 20 cases, Ivatury et al. found that 55% (11 of 20 patients) developed stenosis eventually requiring revision to bilio-digestive anastomosis (9).

With destructive injuries, many still advocate upfront biliary-enteric anastomosis and Roux-en-Y reconstruction. Upfront reconstruction carries a rate of stenosis as low as 4% in some reports (10-13).

Early vs delayed biliary reconstruction remains controversial and reports vary widely (14, 15). A meta-analysis performed by Schreuder et al. compared biliary reconstruction at less than 14 days (early), 14 days to 6 weeks (intermediate) and greater than 6 weeks (delayed). Morbidity was highest in the intermediate group and stricture rate was lowest in the delayed group (12). However, the majority of studies encompassed in this review evaluated bile duct injury after cholecystectomy, not polytrauma. Whether these results can be extrapolated to traumatic injuries remains to be seen. Classically, in hemodynamically unstable patients, externalization of biliary drainage via a temporizing T-tube has also been performed (3). In our case, an adequately sized T-tube was not available. We considered closed suction drainage alone but felt this would complicate delayed reconstruction.

Conclusion

This is a difficult case of an unstable polytrauma patient with critical injuries including laceration of the inferior vena cava requiring damage control. In the process of damage control, a destructive CBD injury was temporized for 6 days with a LeMaitre vascular shunt due to extraordinary circumstances, a technique that has not been previously described. Strategies to temporize and reconstruct such an injury in trauma patients are few in the literature and we believe that this method of temporization may be an especially useful tool in the armamentarium of the surgeon practicing in an austere environment.

Acknowledgements

Figure 1 is illustrated by Ms. Kellie M. Holoski, Medical Illustration

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