

## Embracing the Path of Least Resistance: Endoscopic Treatment of Traumatic Pancreatic and Hepatobiliary Injuries in Polytrauma Patients

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### Abstract

**Objectives:** Traumatic pancreatic and hepatobiliary injuries in polytrauma patients are associated with high morbidity and mortality, especially when resection is utilized. Managing these injuries is often complex, requiring a multidisciplinary approach.

**Methods:** This is a single-center, retrospective case series of adult polytrauma patients with pancreatic or hepatobiliary injuries (HPB) who underwent endoscopic retrograde cholangiopancreatography (ERCP) between January 1, 2021, and December 31, 2023, inclusive. Patients were identified using the Abbreviated Injury Scale (AIS) injury description and the causes of the injury.

**Results:** Seven patients underwent ERCP to manage HPB injuries. The mean age was 31 years, and six of the patients were male. Mechanisms of injury included blunt trauma (two gunshot wounds and two stab wounds), and penetrating trauma (two pedestrians struck and one motor vehicle accident). Six patients had intrahepatic biliary injuries, two had pancreatic duct injuries and one patient had both types of injury. Three of the four patients with intrahepatic injuries had biliary stents placed with a resolution of bile leak; the fourth underwent only sphincterotomy and required repeat ERCP with biliary stenting for persistent leak. Three of these patients had bilomas, requiring percutaneous drainage by interventional radiology. Of the patients with pancreatic duct injuries, all three were stented to prevent pancreatitis. The patient with both a biliary and pancreatic leak required percutaneous drainage for the pancreatic leak. The mean time to ERCP was 8 days. There were no post-ERCP complications. The mean follow-up time was 790 days and there was no reported mortality.

**Conclusion:** Polytrauma patients with HPB injuries should be monitored for biliary and pancreatic leaks and high suspicion for these leaks should be maintained. Endoscopic therapies provide effective treatment for HPB injuries, and surgical drains placed during the initial surgery facilitate early diagnosis of leaks and prompt endoscopic intervention.

**Keywords:** Hepatobiliary injuries; Polytrauma; Traumatic pancreatic; Adult polytrauma patients; Endoscopic retrograde cholangiopancreatography

### Introduction

Polytrauma patients with pancreatic and hepatobiliary (HPB) injuries are at significant risk for developing biliary and pancreatic leaks, which can complicate their clinical course and recovery [1]. Biliary and pancreatic

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leaks are associated with severe pain, increased risk of sepsis from infected fluid collections, fistulation, hepatic failure, and mortality [2]. Given the potential severity of these complications, maintaining a high index of suspicion for such leaks following both blunt and penetrating trauma is crucial. The placement of surgical drains during the initial operation can provide early detection of ongoing leaks, allowing for timely and targeted interventions [3].

Endoscopic therapies, particularly procedures like endoscopic retrograde cholangiopancreatography (ERCP), have emerged as effective treatments for managing HPB injuries, helping to promote healing and prevent further complications [4]. ERCP has a dual role as both a diagnostic and therapeutic tool, making it invaluable in the early detection and management of leaks [5]. Furthermore, ERCP in conjunction with biliary sphincterotomy and stenting is highly effective in resolving bile leaks [6].

In this case series, we identified adult polytrauma patients with HPB injuries who then underwent ERCP between January 1, 2021, and December 31, 2023, after presentation to the Emergency Department (ED) of a Level 1 trauma center in Queens, New York, USA. Patients were identified using the Abbreviated Injury Scale (AIS) injury description and the causes of the injury. We reviewed their initial presentations, hospital courses, and eventual dispositions.

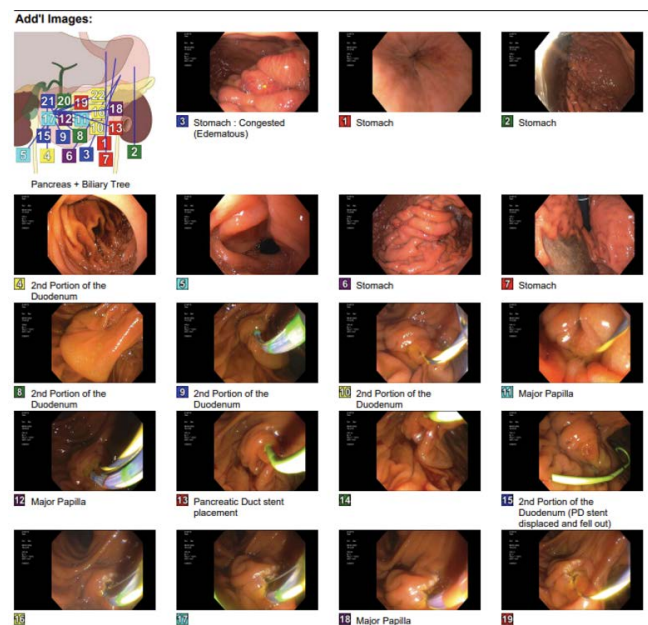
## Case Presentations

### Patient 1

A 37-year-old Hispanic male with a history of alcohol use disorder presented to the ED with multiple gunshot wounds (GSWs) to the anterior chest, lateral chest, midline abdomen, and left arm. The patient was initially alert but rapidly deteriorated while in the ED, exhibiting signs of hypoxia, tachycardia, and hypotension. The patient was emergently intubated, and bilateral thoracostomies were performed. The patient was emergently taken to the operating room (OR), where an exploratory laparotomy was performed. Intraoperatively, the patient underwent a partial gastrectomy and repair of a serosal injury to the cecum. The abdomen was packed, and a temporary closure device was applied. The patient was then transferred to the surgical intensive care unit (SICU), where he remained intubated, sedated, and hemodynamically stable off pressors.

On post-operative (Post-Op) day 2, the patient was taken back to the OR for a second look, wherein he underwent an exploratory laparotomy, removal of trauma dressing and packing, and extensive washout. Initially, he was doing well post-operatively, but in the subsequent 5 days, he developed persistent fevers and severely elevated bilirubin levels. CT imaging of the chest, abdomen, and pelvis revealed an intrahepatic biloma along the gunshot wound tract, as

well as bilateral lower consolidations, and diffuse right infiltrates. Gastroenterology was consulted, and the patient was taken for ERCP. During ERCP, a bile leak was found with suspicion of a common hepatic duct injury (Figure 1). A biliary sphincterotomy was performed, and a stent was placed in the common bile duct (CBD). The patient returned to the SICU for ongoing care, with plans to follow up on liver function tests (LFTs) and Jackson-Pratt (JP) drain outputs. The patient was scheduled for a repeat ERCP in 4-6 weeks for stent removal. The patient's condition improved over the next weeks, and the JP drains were removed on Post-Op day 25. The patient was downgraded to the floor on Post-Op Day 26 and was eventually discharged in stable condition on Post-Op Day 29.



**Figure 1:** ERCP images for patient 1. Bile leak was found with suspicion of common hepatic duct injury. Biliary sphincterotomy was performed and a stent was placed in the common bile duct.

### Patient 2

A 34-year-old Hispanic male with an unknown past medical history was brought in by emergency medical services (EMS) after being found down in the street, possibly a victim of a pedestrian struck by a motor vehicle or an assault. Upon arrival at the ED, the patient was tachycardic to the 140s, with systolic blood pressure (SBP) in the 120s, and oxygen saturation at 100% on room air. The patient was also noted to be intoxicated with alcohol. An extended focused assessment with sonography for trauma (eFAST) exam was positive for fluid in the right and left upper quadrants. He remained hemodynamically unstable and massive transfusion protocol (MTP) was initiated. Despite receiving blood products, the patient remained hypotensive. He was taken emergently to

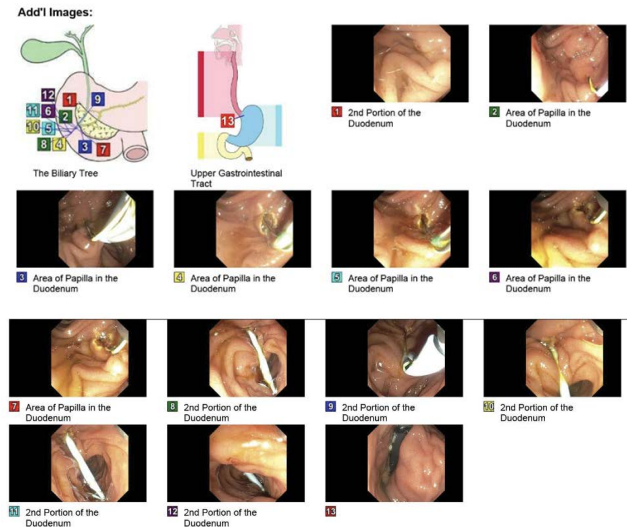
the OR for an exploratory laparotomy, where a grade 5 liver laceration with a 3-liter hemoperitoneum was discovered. The patient underwent packing and placement of a negative pressure abdominal dressing.

Post-operatively, the patient remained hypotensive and unresponsive to MTP. The patient was taken by the Interventional Radiology (IR) team for an angiogram, wherein numerous sites of active extravasation and pseudoaneurysms from several branches of the right hepatic artery were identified. Three branches of the hepatic artery were embolized successfully. The patient was then transferred to the SICU for ongoing care, where he remained intubated, sedated, and on vasopressors. On post-operative day two, the patient was taken back to the OR for a second look and washout—no active bleeding was noted, but a small area of omental oozing was tied off and packing was applied. Post-operative CT imaging revealed bilateral pleural effusions, rib fractures, mild pneumomediastinum, a chest wall hematoma, and a minimally displaced nasal fracture. There was no active bleeding noted from the hepatic parenchyma. The following day he returned to the OR for planned re-evaluation of possible liver parenchymal necrosis; a small amount of necrotic liver tissue was resected from the periphery of segment 7, packing was removed, and Pringle maneuver was performed, allowing for successful hemostasis of significant bleeding from the posterior liver.

Post-operatively, the patient had hyperbilirubinemia and bile-tinged drainage from the JP drains. As a result, the patient underwent an ERCP, during which a stent was placed in the CBD for biliary leak (Figure 2). Post-ERCP hepatobiliary iminodiacetic acid scan (HIDA) and CT scans were done to evaluate for biloma, with the HIDA scan revealing a superior and medial biliary leak in the right lobe of the liver, and the CT scan showing a developing biloma in the right upper quadrant, hypoenhancement of the right kidney suggesting pyelonephritis, and large right and small left pleural effusions. The patient was then taken to the IR suite for right upper quadrant drain placement. Proceduralists placed an 8Fr pearl drainage catheter and an 8Fr automated peritoneal dialysis (APD) catheter in the right perihepatic fluid.

Post-procedurally, the patient's elevated total bilirubin, direct bilirubin, and LFTs improved, with minimal bilious drain. However, 7 days after the HIDA scan, the patient developed new bilious drainage from the abdominal incision with rising LFTs. A repeat CT scan revealed a large abscess involving the right hepatic lobe extending into the right subdiaphragmatic space, with multiple new areas of hemorrhage within the abscess despite the presence of multiple drains. An inferior vena cava (IVC) filter was placed, and the patient was started on IV antibiotics. The patient eventually stabilized and was transferred from the ICU to a step-down unit (SDU). All the drains were removed

by post-operative day 47 and the patient was discharged in stable condition with trauma clinic follow-up.



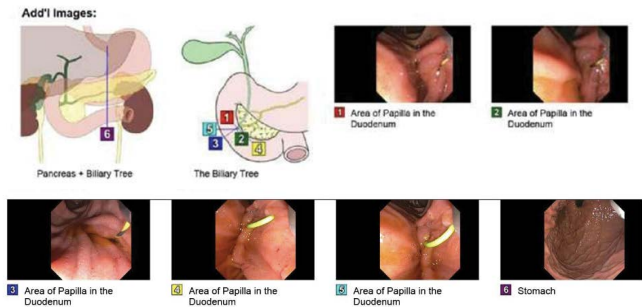
**Figure 2:** ERCP images for patient 2. A bile leak was found, a stent was placed in the common biliary duct and a biliary sphincterotomy was performed.

### Patient 3

A 21-year-old Hispanic male with no past medical history presented to the ED after being struck by a large truck while riding his motorcycle. The front tire ran over his pelvis, resulting in a pelvic fracture with large bleeding and hemorrhagic shock. The patient also had a large perineal and rectal laceration. Providers were unable to pass a Foley catheter through the urethral meatus. On arrival, the patient was found to be alert with GCS 15, a heart rate of 140 beats per minute (bpm) and mean arterial pressures (MAPs) ranging from 70-80 mmHg. He was stabilized with MTP, tranexamic acid (TXA), and QuikClot packing to the perineal laceration. The patient was emergently taken to the IR suite for embolization and was found to have a grade 3 splenic laceration. He was then taken to the OR for perineum exploration, hemostasis, and closure of the perineal wound, along with the creation of a loop sigmoid colostomy for fecal diversion. Intraoperatively, a complex 10-12 cm midline perineal laceration extending into the pelvis was found, with complete avulsion of the anus complex, presacral bleeding, exposed pelvic bone fragments, a preperitoneal pelvic hematoma, urethral disruption, and displaced bladder. Urology was consulted intraoperatively, and they placed a suprapubic catheter. Orthopedics was also consulted, and they stabilized the pelvis with external fixation. The patient was admitted to the SICU post-operatively.

Twenty days following initial presentation, the patient underwent a magnetic resonance cholangiopancreatography (MRCP) which revealed discontinuity of the pancreas in the region of the distal pancreatic body/tail junction, with no

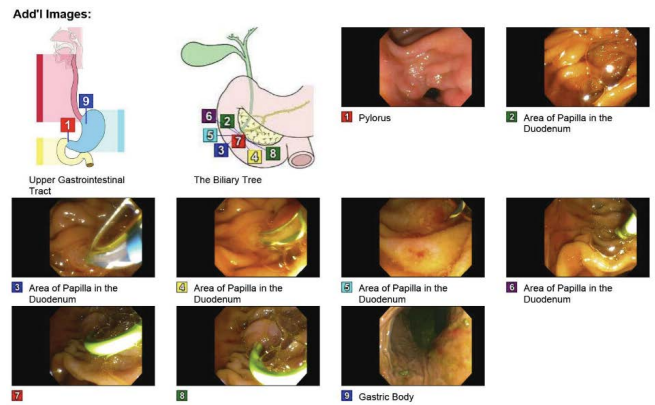
ductal dilation. Still, a pancreatic duct leak could not be ruled out. A lower quadrant drain was placed by IR, which drained about 200 ml of thin grayish fluid. The fluid was found to have an amylase level greater than 7500, raising concern for pancreatic duct disruption. Gastroenterology was consulted for pancreatic duct stent placement. An ERCP was performed, revealing contrast extravasation from the pancreatic duct in the distal body/tail of the pancreas. A 7mm sphincterotomy was made, and a stent was placed into the ventral pancreatic duct (Figure 3). The patient had a prolonged hospital stay complicated by respiratory failure, acute kidney injury, hemorrhagic shock, small bowel obstruction, left pleural effusion, pelvic fluid collections, persistent tachycardia, and multiple surgical interventions, but was eventually discharged to acute rehab after a total length of stay of 180 days.



**Figure 3:** ERCP images for patient 3. A pancreatic leak was found, and a sphincterotomy was performed. A pancreatic stent was placed into the ventral pancreatic duct.

#### Patient 4

A 46-year-old Hispanic male with a past medical history of tuberculosis and alcohol abuse presented to the ED with multiple stab wounds to the right flank and right buttocks. eFAST was positive for free fluid in the abdomen. MTP was activated, and the patient was emergently taken to the OR for an exploratory laparotomy. During the procedure, primary repair of the colon was performed at two sites, two serosal tears were oversewn, three mesenteric bleeders were suture-ligated, a lymphatic duct was clipped, and an AbThera™ open dressing wound vacuum was placed. The patient was then sent to the SICU for hemodynamic monitoring, intubated, and with the abdominal wound vac in place. Gastroenterology was consulted due to concerns of a potential pancreatic duct injury, and an ERCP was planned. Subsequently, the patient returned to the OR for a washout, ileocolic anastomosis, Whitmann Patch placement, placement of a JP drain in the pancreatic bed, AbThera™ wound vacuum placement, and an ERCP with gastroenterology. During the ERCP, no pancreatic duct leak was noted with contrast. A ventral pancreatic duct stent was placed to prevent pancreatitis (Figure 4). 18 days following the initial presentation to the ED, the patient was discharged home with continued drainage via JP drain and arrangements for home services for the patient.



**Figure 4:** ERCP images for patient 4. No pancreatic duct leak was noted. A stent was placed into the ventral pancreatic duct to prevent pancreatitis.

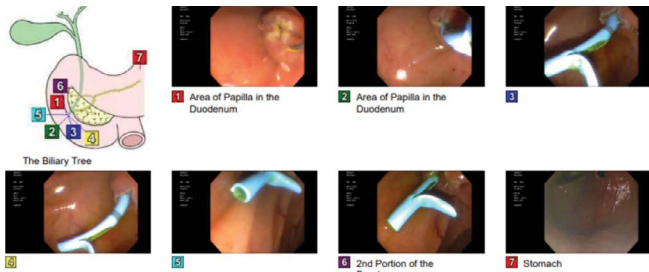
#### Patient 5

A 23-year-old non-Hispanic male with a history of schizophrenia presented via EMS after being found outside a park. On arrival, he was hemodynamically stable but was found to have a right thoracoabdominal stab wound and bowel evisceration. eFAST was positive for intraperitoneal fluid but negative for pericardial effusion, pneumothorax, or thoracic fluid. A portable chest X-ray showed no pneumothorax, frank consolidations, or rib fractures. The patient was taken emergently to the OR for an exploratory laparotomy. Intraoperatively, a liver laceration and a diaphragmatic laceration were identified and repaired. Additionally, a small bowel injury was identified, resected, and anastomosed. An oral gastric tube was placed with an output of approximately 2.4 liters during the procedure. The patient received 2 units of packed red blood cells (pRBCs) and 2 units of fresh frozen plasma (FFP). Finally, a chest tube was also placed, yielding approximately 160 mL of sanguineous output. Postoperatively, the patient was transferred to the SICU.

Two days post-operatively, the patient developed bilious drainage from the chest tube. A chest X-ray showed opacification on the right lung, prompting a CT scan of the chest, abdomen, and pelvis. The patient underwent bronchoalveolar lavage for concern of mucus plugging or edema. Post bronchoscopy, the patient was noted to have right pulmonary edema. The patient continued to have bilious/greenish output from the chest tube, raising concerns for a biliary leak, confirmed by HIDA scan. CT imaging also revealed a large biloma. On Post-Op day 4, IR placed a thoracic catheter drain for bile leak drainage.

On Post-Op day 6, the patient was taken for ERCP, during which a biliary sphincterotomy was performed and a biliary stent was placed (Figure 5). Bile flow was successfully diverted, and the patient was planned for repeat ERCP and stent removal in 8 weeks. The patient was transferred to the step-down unit (SDU) and remained stable. The chest tube

and posterior IR drain were removed on post-operative days 10 and 11, respectively. The patient was intermittently febrile but otherwise hemodynamically stable, with no growth on blood cultures while on IV antibiotics. The patient was discharged on post-operative day 16 in stable condition.



**Figure 5:** ERCP images for patient 5. A biliary leak was found and a biliary sphincterotomy was performed. A stent was placed in the common bile duct for bile leak drainage.

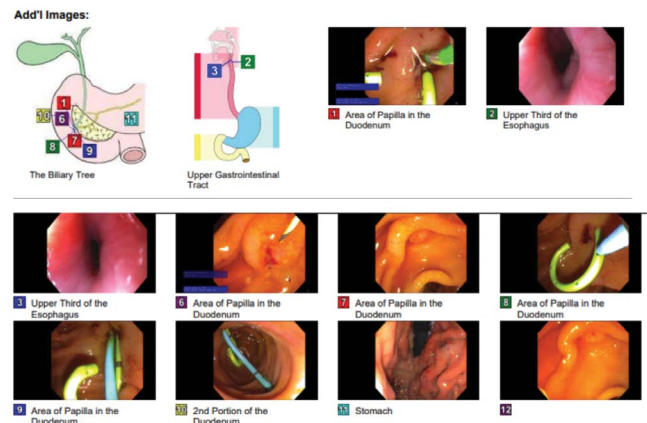
### Patient 6

A 28-year-old Hispanic female with no medical history was brought in EMS following a motor vehicle collision (MVC) at an unknown speed in which she was the restrained driver. Upon arrival, the patient was hypotensive and found to have an open fracture of the right lateral malleolus of the ankle. eFAST was positive for fluid in the right and left upper quadrants and pelvis. Imaging showed a liver laceration, open right anterior lateral 4<sup>th</sup> and 5<sup>th</sup> rib fractures, and a right lower lobe pulmonary contusion. She was transfused 1 unit of pRBCs and taken emergently to the OR for exploratory laparotomy, wherein a grade 3/4 liver laceration involving segments 2, 3, and 4 with active bleeding was identified. Bleeding was controlled by perihepatic packing. A serosal tear on the proximal small bowel was also noted. The abdomen was left open with an AbThera™ dressing to suction, and the estimated blood loss for the procedure was approximately 2 liters.

On post-operative day 2, the patient returned to the OR for the removal of the perihepatic packing and closure of the abdomen. Intraoperative findings revealed that the small intestine was intact from the ligament of Treitz to the ileocecal valve, and the colon was also intact, aside from some areas of fat necrosis in the mesentery of the splenic flexure. Further evaluation showed fat necrosis and bruising around the neck of the pancreas, consistent with a pancreatic injury. The injury was limited to a parenchymal contusion and was managed with the placement of a peripancreatic drain. Additionally, a JP drain was placed around the liver and over the pancreas. Concurrently, the orthopedic surgery team performed open reduction and fixation (ORIF) of the right lateral malleolar fracture.

On post-operative day 5, the patient underwent an MRCP, which showed a prominent bile duct in the left lobe of the

liver with a questionable connection between the bile duct and a moderate amount of free fluid surrounding the left and medial right lobes, suggestive of a bile leak. An ERCP was performed, revealing contrast extravasation in the left intrahepatic bile duct system, indicative of an active bile leak (Figure 6). A sphincterotomy was performed, and a biliary stent was inserted into the left intrahepatic bile duct, along with a pancreatic duct stent to prevent post-ERCP pancreatitis. Imaging on post-operative day 19 showed the development of a liver abscess at the site of the liver laceration, so on post-operative day 24 IR placed a drain in the abscess. Eight days later, repeat CT imaging showed resolution liver abscess. The remainder of the patient's post-operative course was unremarkable and continued to improve. The patient was discharged six weeks later with an IR liver drain, a surgical drain, and intravenous antibiotics, with follow-up care assisted by visiting nursing services.



**Figure 6:** ERCP images for patient 6. An intraparenchymal bile leak was found. A biliary sphincterotomy was performed. A biliary stent was placed into the left hepatic duct and a pancreatic stent was placed into the ventral pancreatic duct.

### Patient 7

A 31-year-old Hispanic male with an unknown medical history was brought in by EMS after sustaining a GSW to the abdomen. Upon arrival, the patient was tachycardic with a heart rate of approximately 120 bpm. Initial portable X-ray imaging revealed a bullet in the right ilium. eFAST was positive for free fluid in the right upper quadrant. The patient was emergently taken for exploratory laparotomy. Intraoperatively, a segment of the proximal transverse colon was found to have a through-and-through injury, necessitating resection. Additionally, a right-sided chest tube was also placed, and repairs were performed on the liver, gallbladder, and gastric injuries. The liver was packed for hemostasis, and the abdomen was left open with a temporary abdominal dressing. The patient was then transferred to the SICU.

A planned second-look laparotomy was performed a few days later, during which the patient underwent a



**Figure 7:** ERCP images for patient 7. A prior sphincterotomy appeared open and a bile leak was found. A stent was removed from the pancreatic duct and a common bile duct stent was placed.

cholecystectomy, colonic anastomosis, gastric debridement and repair, and reevaluation of the liver. Drains were placed above the liver and along the right paracolic gutter. Post-operatively, the patient had persistent bilious output from the right drain. On post-operative day 10, ERCP with sphincterotomy was performed which confirmed a right intrahepatic bile leak. A stent and IR drain were placed to manage the leakage (Figure 7). Later, the patient underwent abdominal wall debridement and closure with an incisional vacuum-assisted closure placement. The patient had a hospital stay of approximately six weeks. The patient was discharged on oral antibiotics and antifungals, and scheduled for repeat ERCP for stent removal in 4-6 weeks.

## Discussion

In this case series, the patients presented with various mechanisms of injury, including gunshot wounds, motor vehicle accidents, and stab wounds, leading to a range of HPB injuries, including liver lacerations, pancreatic duct injuries, and combined biliary and pancreatic injuries. All patients initially underwent emergent surgical intervention with the placement of surgical drains. The placement of surgical drains during this index operation provided an essential mechanism for the early detection of leaks, facilitating timely intervention with ERCP.

Post-surgical ERCP confirmed biliary and/or pancreatic leaks, and sphincterotomy and/or stenting done during ERCP led to the successful resolution of these leaks. Notably, one patient required a repeat ERCP with biliary stenting due to a persistent leak following an initial sphincterotomy, and another required pancreatic stent replacement due to persistent leakage. In addition to ERCP, some patients required IR drains for bilomas and pancreatic collections for fluid drainage and decompression of the biliary system. The mean time to ERCP was 8 days post-injury. No post-ERCP complications were observed, and all patients showed a resolution of their biliary and pancreatic leaks with appropriate follow-up care. The mean follow-up time was 790 days, during which no mortalities were reported.

Our findings align with current best practices, which emphasize the importance of early identification and management of bile leaks to prevent the development of severe complications such as intra-abdominal sepsis [7]. They align with current literature which suggests that ERCP is a safe and effective procedure in the trauma setting for HPB injuries [8-11].

## Conclusion

Management of HPB injuries is inherently complex, necessitating a multidisciplinary approach with vigilant monitoring for biliary and pancreatic leaks and advanced therapeutic interventions. In this case series, management for HPB injuries involved initial surgical intervention and subsequent endoscopic and percutaneous procedures, with successful eventual outcomes and stable discharge in all cases. Surgical drains placed during the index operation are valuable in the early detection of ongoing leaks. Endoscopic therapies, particularly ERCP with stenting, are effective in resolving bile and pancreatic duct leaks with minimal post-procedural complications.

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**Declaration of conflicting interests:** The authors declare no conflict of interest.

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