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Intraoperative endoscopic retrograde cholangiopancreatography for traumatic pancreatic ductal injuries: Two case reports

Andrew Canakis, Varun Kesar, Caleb Hudspath, Raymond E Kim, Thomas M Scalea, Peter Darwin

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Abstract

BACKGROUND

In order to successfully manage traumatic pancreatic duct (PD) leaks, early diagnosis and operative management is paramount in reducing morbidity and mortality. In the acute setting, endoscopic retrograde cholangiopancreatography (ERCP) can be a useful, adjunctive modality during exploratory laparotomy. ERCP with sphincterotomy and stent placement improves preferential drainage in the setting of injury, allowing the pancreatic leak to properly heal. However, data in this acute setting is limited.

CASE SUMMARY

In this case series, a 27-year-old male and 16-year-old female presented with PD leaks secondary to a gunshot wound and blunt abdominal trauma, respectively. Both underwent intraoperative ERCP within an average of 5.9 h from time of presentation. A sphincterotomy and plastic pancreatic stent placement was performed with a 100% technical and clinical success. There were no associated immediate or long-term complications. Following discharge, both patients underwent repeat ERCP for stent removal with resolution of ductal injury.

CONCLUSION

These experiences further demonstrated that widespread adaption and optimal timing of ERCP may improve outcomes in trauma centers.

Key Words: Pancreatic ductal injury; Pancreatic leaks; Endoscopic retrograde cholangiopancreatography; Trauma; Endoscopic stenting; Case report

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Core Tip: In the acute setting, intraoperative endoscopic retrograde cholangiopancreatography (ERCP) can effectively diagnosis and manage pancreatic duct (PD) injuries with stenting. At our high-volume trauma center, the on call therapeutic endoscopy team allows for quick and effective mobilization of resources. In this series, the time from admission to ERCP occurred within 6.3 and 5.6 h. The pancreatic injuries healed, and both stents were removed. In cases of traumatic PD injury, we believe that advanced gastroenterology care has the opportunity to improve the timing of diagnosis and treatment as a means to potentially reduce the morbidity and mortality associated with such injuries.

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INTRODUCTION

Pancreatic duct (PD) injuries are uncommon (occurring in 3% to 12% of traumas), primarily due its protective retroperitoneal location. They can be difficult to diagnose due to non-specific symptoms and delayed findings on imaging[1]. A delay in diagnosis can result in severe complications, such as a pancreatic fistula, hemorrhage, or abscess by which obtaining a fast and accurate diagnosis is paramount[2,3].

Standard therapy for high grade pancreatic injury with traumatic PD disruption is operative. As the duct itself is not amenable to repair, surgical options are resection and/or simple drainage accepting the inevitable pancreatic fistula. Major pancreatic resection is morbid and can produce nutritional cripples and render patients diabetic. Preoperative imaging is often inaccurate or not feasible. The limited sensitivity (52%) of computed topography (CT) is further complicated by timing, as CT scans performed in less than 24 h of presentation can often miss PD injuries as inflammatory associated changes are yet to manifest[1,4,5]. There is also poor sensitivity associated with magnetic resonance cholangiopancreatography (MRCP) imaging, and many times unstable patients may not be suitable for such imaging[4,6].

The diagnosis of PD transection is often suspected at the time of laparotomy. Knowing whether the PD is actually transected can be difficult. Visual inspection can over diagnose these injuries leading to unnecessary surgery. One would prefer to limit major pancreatic procedures to those patients with hemorrhagic shock or those without other options.

While endoscopic retrograde cholangiopancreatography (ERCP) is the most accurate method for assessing PD integrity and extent of injury, its wide spread use is hindered due to limited resources, local expertise and difficulty performing the procedure itself in an emergent, operative setting[1,7]. ERCP can also be therapeutic as PD stenting can be performed at the time of diagnosis. Stenting a duct that is transected can be challenging but if successful, the duct may heal around the stent and limit the need for major pancreatic resection. In this case series, we present two cases treated at a major urban trauma center where PD injuries were diagnosed with intraoperative ERCP and treated with sphincterotomy and stenting.

CASE PRESENTATION

Chief complaints

Case 1: Multiple gunshot wounds (GSWs).

Case 2: Blunt abdominal trauma.

History of present illness

Case 1: A 27-year-old male presented with four GSWs to the chest and abdomen.

Case 2: A 16-year-old female initially presented to an outside hospital with severe upper quadrant abdominal pain following blunt abdominal trauma. She remained at the hospital for two days with an inability to tolerate per oral intake, nausea, and vomiting.

History of past illness

Both patients had no specific history of past illness.

Personal and family history

No pertinent personal or family history of both patients.

Physical examination

Case 1: Upon arrival he was found to have penetrating GSWs to the left shoulder, left axilla, right flank, and subxiphoid areas.

Case 2: Upon arrival she was afebrile (37 °C), normotensive (119/71 mmHg) but tachycardic (130 beats per min) with abdominal tenderness to palpation.

Laboratory examinations

Case 1: Labs on admission were notable for a white blood cell (WBC) count 10.9 K/mL, hemoglobin 12.5 g/dL, platelets 430 K/mL, international normalized ratio 1, aspartate transaminase (AST) 315, alanine transaminase (ALT) 282, alkaline phosphatase (ALP) 72, total bilirubin 0.2, amylase 127 units/L, lipase 59 units/L and lactate 6.8 nmol/L. He was resuscitated and imaging was obtained.

Case 2: Labs were notable for a WBC 16.6 K/mL, Hg 11 g/dL, AST 23, ALT 12, ALP 74, total bilirubin 2.3 mg/dL, lipase 1160 units/L and amylase 441 units/L.

Imaging examinations

Case 1: Computed tomography angiography of the chest abdomen and pelvis revealed significant injuries, including but not limited to a left ventricle apex cardiac injury, laceration of liver lobe segments two and six, a pancreatic artery pseudoaneurysm (measuring 1.4 cm), and shrapnel wounds to the gallbladder, duodenum, pancreatic head, and hepatic flexure (Figure 1). There was no mention of pancreatic leak.

Case 2: A CT of the abdomen demonstrated a grade III pancreatic injury (thickness pancreatic transection involving the proximal tail and neck), large hemoperitoneum, and a 1 cm posterior splenic laceration for which she was transferred to our center for surgical care (Figure 2).

Further diagnostics

Case 1: He immediately went to the operating room (OR) for exploratory laparotomy where he underwent a non-anatomic bilateral liver resection, cholecystectomy, colon resection with end colostomy, gastric wedge resection, small bowel resection (20 cm) with anastomosis. He had a high-grade injury to his pancreatic head that would have required a Whipple to treat but it was not clear that he had a major PD injury. An intraoperative ERCP demonstrated a ventral PD leak in the head of the pancreas (Figure 3).

Case 2: She was sent directly to the OR, where an exploratory laparotomy revealed 500 mL of pancreatic ascites which was evacuated from the lesser sac and right upper quadrant. There was concern for PD disruption at proximal aspect of the pancreatic tail. An intraoperative ERCP demonstrated a PD leak in the body (Figure 4).

FINAL DIAGNOSIS

Both patients were diagnosed with PD leaks.

TREATMENT

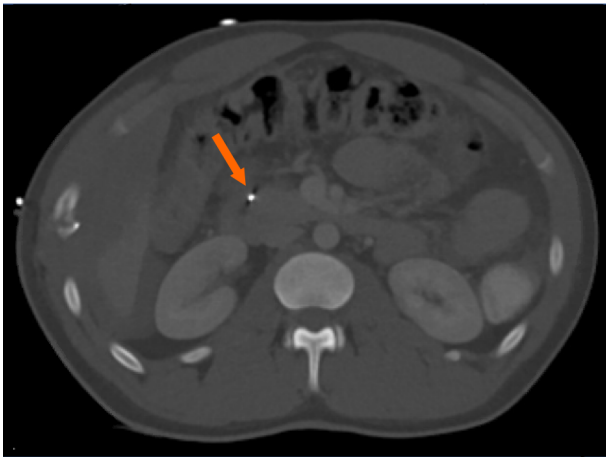
Following the diagnostic ERCP, the first patient, underwent a pancreatic sphincterotomy followed by plastic pancreatic stent placement (5 Fr by 10 cm) (Figure 5). The main pancreatic duct (MPD) was intact. There were no technical challenges or associated complications from the procedure itself. The time from admission to ERCP was 6.35 h (Table 1). A drain was placed, and output decreased from 600 cc/d to 300 cc/d over two days. The drain amylase level was > 24000 units/L. Six days after the ERCP, his labs improved with an AST 46, ALT 77, ALP 89, and a total bilirubin 0.3. His hospital course was protracted related to non-pancreatic complications. He developed an intra-abdominal abscess communicating with the right abdominal wall wound. A CT abdomen pelvis did not show signs of a leak. However, he underwent a repeat ERCP with PD stent exchange to a larger 7 Fr by 10 cm plastic stent 18 d later due to a persistent leak on pancreatogram, with no further issues.

Similarly, in case 2, a 4 mm ventral sphincterotomy was performed followed by placement of a 5 Fr by 13 cm plastic stent into the dorsal pancreatic duct (Figures 6 and 7). There was no evidence of bile leakage. Her pancreas widely drained. The time from hospital admission to ERCP was 5.65 h. The procedure was technically successful with no adverse events. Her abdomen was left open. The next day,

Table 1 Patient characteristics with traumatic pancreatic duct leak

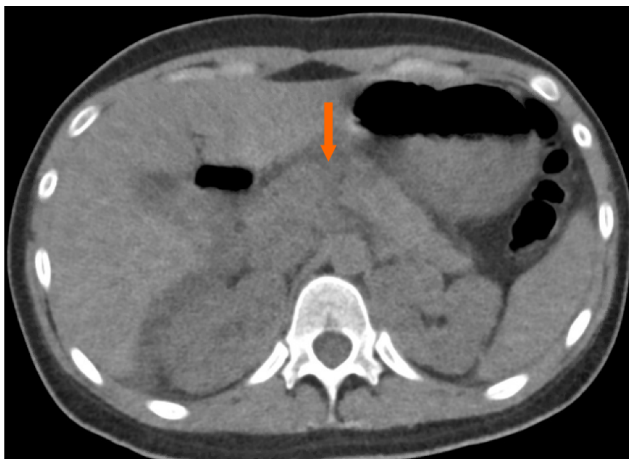
Patient	Age/sex	Etiology	Prior imaging	ERCP findings	Plastic biliary stent (Fr/cm)	Time from admission to ERCP (h)	Length of hospital stay
1	27/male	Gunshot wound	Yes, CTA	Ventral PD leak in the head of the pancreas	5/10 then upsized to 7/10	6.3	25
2	16/female	Blunt trauma	Yes, CT	Dorsal PD leak	5/13	5.6	22

CTA: Computed topography angiography; CT: Computed topography; ERCP: Endoscopic retrograde cholangiopancreatography; PD: Pancreatic duct.



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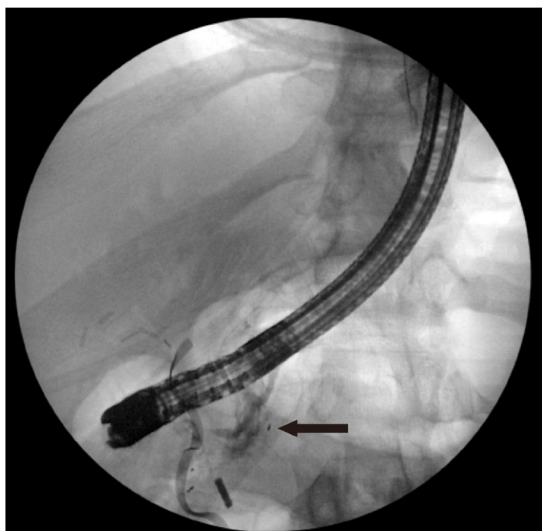
Figure 1 Computed tomography of the abdomen demonstrating bullet shrapnel involving the proximal duodenum and the pancreatic head (arrow).



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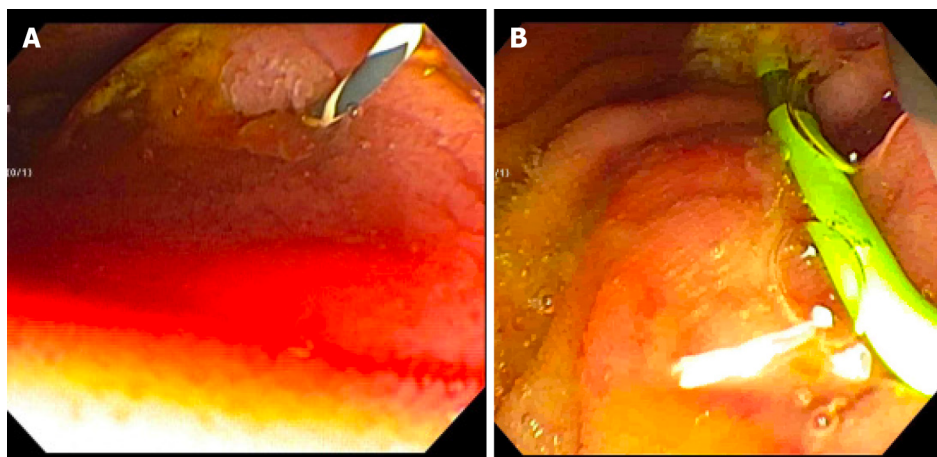
Figure 2 Computed tomography of the abdomen revealing a full-thickness pancreatic transection involving the proximal tail and neck (arrow).

a MRCP confirmed placement of the pancreatic duct stent, which traversed the area of pancreatic transection with the tip of the stent residing in the tail of the pancreas. Two days after her initial surgery, she returned to the OR for abdominal re-exploration, pancreatic debridement, omentopexy, and primary closure.



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Figure 3 Endoscopic retrograde cholangiopancreatography fluoroscopy showing a ventral pancreatic ductal leak in the head of the pancreas (arrow).



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Figure 4 Intraoperative endoscopic retrograde cholangiopancreatography. A and B: Endoscopic view following placement of an angled Visiglide wire into the ventral pancreatic duct (A) and placement of a plastic stent in the dorsal pancreatic duct (B).

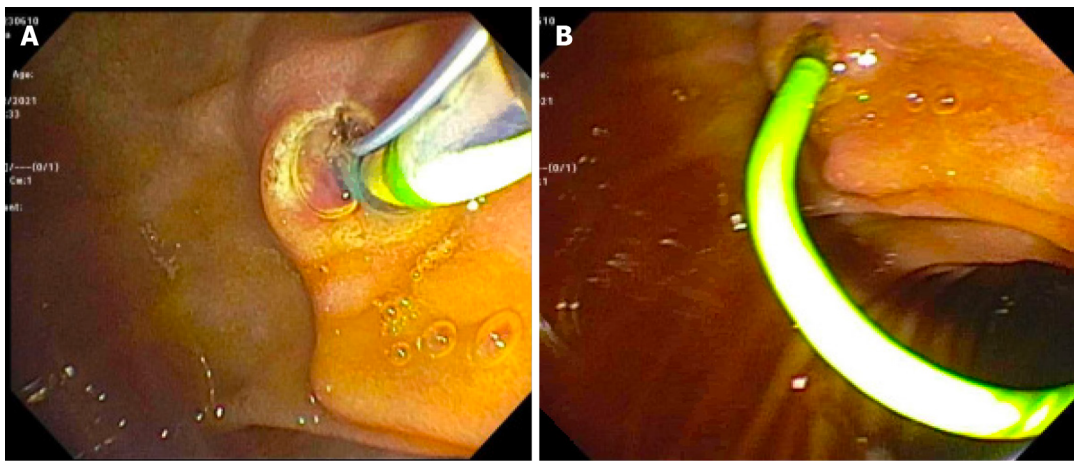
OUTCOME AND FOLLOW-UP

Patient 1 was eventually discharged with a 25 d hospital length of stay. In the outpatient setting he underwent repeat ERCP with stent removal 84 d after discharge, with leak resolution and no further symptoms. The second patient's hospital length of stay was 22 d, and she was discharged without any major ERCP or pancreatic related complications. She underwent a repeat ERCP with stent removal 59 d following its initial placement with resolution of ductal injury.

DISCUSSION

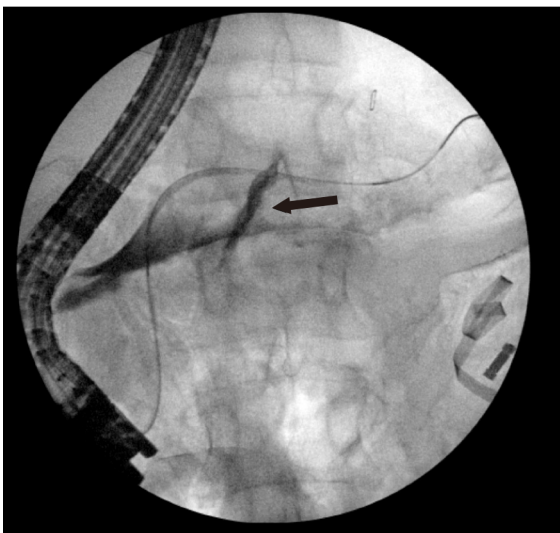
This series demonstrates the efficacy, safety, and feasibility of intraoperative ERCP as a diagnostic and therapeutic tool. In this case series the average time from admission to ERCP occurred within 5.95 h. Both patients also underwent successful stent removal without any post-ERCP complications and resolution in the PD injury.

Clinical manifestations and management of PD leaks are largely dependent on the leak's size and location, where the integrity of the main duct influences prognosis[8]. In the setting of ductal injury, high pressure gradients cause pancreatic juices to flow outwards; as such, transpapillary stenting reduces the pressure gradient with preferential flow through the stent into the duodenum in order for



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Figure 5 Endoscopic view of the pancreatic sphincterotomy and pancreatic duct plastic stent placement. A: Pancreatic sphincterotomy; B: Pancreatic duct plastic stent placement.



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Figure 6 Endoscopic retrograde cholangiopancreatography fluoroscopic view demonstrating a dorsal pancreatic ductal leak (arrow).

the injury to properly heal. At our center, we always perform a sphincterotomy with stent placement instead of employing nasobiliary catheter, with well documented success in cases of hepatic trauma as well[9].

The role of intraoperative ERCP in the trauma setting is not yet well defined. In a study of 71 patients with pancreatic injury, 50 of whom underwent immediate laparotomy, there was a 14% complication and 20% mortality rate[4]. In that study, intraoperative ERCP was not used. Instead, intraoperative visual inspection was undertaken to investigate for ductal injury. Four patients deemed not to have a leak developed pancreatic leaks with abscess formation. ERCP should be considered in the setting of traumatic pancreatic injury with a questionable PD injury. Its high diagnostic accuracy cannot be matched by any combination of a CT abdomen, serum amylase or peritoneal lavage[10]. In a large PD trauma series, an abdominal CT missed the diagnoses of major PD injury in 40.7% (11/27) of patients [11]. Furthermore, in a prospective study of 14 patients with PD injury, those undergoing ERCP greater than 72 h following trauma had higher rates of pancreatic complications and longer hospital stays[12]. In our series, both patients underwent ERCP immediately with no ERCP related complications or delayed lengths of hospital stays. One could postulate that early intraoperative ERCP effectively contained the leak and contributed to these positive outcomes.

ERCP with early stenting has also proven to be an effective and safe option in pediatric cases[13,14]. Yet, there has been some concern regarding the development of strictures, though it's unclear if such a complication occurs from the trauma itself or stent-induced changes[7]. In a small study analyzing long term outcomes for pancreatic stenting from blunt trauma the authors found that only 50% (3/6) of stents were successfully removed at 12, 19, and 39 mo[15]. Such complications were not seen in our patients,



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Figure 7 Intraoperative photo confirming following placement of the pancreatic ductal stent.

likely because the stents were removed significantly earlier with minimal stent exchanges.

Studies exploring pancreatic trauma have not detailed intraoperative timing, which may be an important aspect for reducing complications as well. In a study of 43 patients with major PD trauma, 15 underwent stenting as the first treatment modality with a median time from trauma to ERCP of 6 d[12]. Within this group, there were 17 related complications including pseudocyst formation (8), PD stricture (4), distal pancreatic atrophy from injury site (3), and pancreatic fistulas (2). They also reported two deaths, one of which was related to severe pancreatitis where the stent was removed 8 d after insertion. The other death was attributed to a patient with severe alcoholic liver cirrhosis—unrelated to the stent. In another study of 48 patients with pancreatic trauma (26 blunt and 22 penetrating), the median time from presentation to ERCP was 38 d and only seven patients had a stent inserted for a pancreatic fistula (7) and a MPD stricture (1), whereby all patients avoided surgery[16]. While variable complications have been reported, the heterogeneity of presentations at different centers must be considered. The studies mentioned above did not employ, early intraoperative ERCP.

The logistics of performing intraoperative ERCP can limit its use, especially in cases of poly-trauma. Wise use of this novel technique requires commitment and flexibility from the surgeons and gastroenterologists. In instances of trauma, PD injury, duodenal injury and papilla edema may also increase the difficulty of the procedure itself, thereby increasing the chances of complications such as post-ERCP pancreatitis[17]. In both of our cases, there were no immediate or long term complications from the ERCP. Patient 1 did require upsizing from 5 Fr to 7 Fr stent, which is commonly seen. ERCP may be underutilized due to operator comfortability, lack of awareness of the value of endoscopic treatment in this setting, and equipment availability in the OR. Our high-volume trauma center is unique and is equipped to handle these situations with quick and effective mobilization of resources including on call therapeutic endoscopy.

CONCLUSION

In conclusion, this case series emphasizes the utility of intraoperative ERCP in cases of severe pancreatic trauma. Further studies are needed to clarify the optimal timing and safety outcomes in this setting.

FOOTNOTES

Author contributions: Canakis A reviewed the literature and drafted manuscript; Kesar V, Hudspath C, Kim RE, and Darwin P participated in the therapeutic endoscopic care of the patient; Scalea TM was the patient's trauma surgeon; Darwin P conceptualized the case series idea; Darwin P and Scalea TM provided critical revisions; all authors have read and approve the final manuscript.

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