

## ORIGINAL ARTICLE

# Endoscopic Management of Pancreatic Injury Due to Abdominal Trauma

Deepak Kumar Bhasin<sup>1</sup>, Surinder Singh Rana<sup>1</sup>, Chalapathi Rao<sup>1</sup>, Rajesh Gupta<sup>2</sup>, Ganga Ram Verma<sup>2</sup>, Mandeep Kang<sup>3</sup>, Birinder Nagi<sup>1</sup>, Kartar Singh<sup>1</sup>

Departments of <sup>1</sup>Gastroenterology, <sup>2</sup>Surgery, and <sup>3</sup>Radiodiagnosis, Post Graduate Institute of Medical Education and Research (PGIMER), Sector 12. Chandigarh, India

### ABSTRACT

**Context** There is limited experience with pancreatic endotherapy in patients with pancreatic injury due to trauma. **Objective** To retrospectively evaluate our experience of endoscopic management of pancreatic trauma. **Patients** Eleven patients (10 males and 1 female; mean age: 21.8±11.9 years) with pancreatic trauma. **Intervention** Endoscopic therapy. Patients with pseudocyst and a gastroduodenal bulge were treated with endoscopic transmural drainage. Pseudocysts without bulge or patients with external pancreatic fistula were treated with transpapillary drainage. **Results** Seven patients (6 males, 1 female) were treated for symptomatic pseudocyst and 4 patients (all males) were treated for persistent external pancreatic fistula. Three patients with external pancreatic fistula had partial disruption of pancreatic duct (head: 2 cases; tail: 1 case) and were successfully treated with bridging pancreatic stent (2 cases) or bridging nasopancreatic drain (1 case) with resolution of external pancreatic fistula in 4 to 6 weeks. Of seven patients presenting with symptomatic pseudocyst (size range: 4-14 cm), two patients were successfully treated with cystogastrostomy and there has been no recurrence over a follow up of 20 and 16 months, respectively. Five patients underwent transpapillary drainage. Three patients had partial disruption and two had complete disruption. In the former, a bridging nasopancreatic drain was placed in one patient and stent in two patients. All three patients had resolution of pseudocyst within 8 weeks and there has been no recurrence over a follow-up of 11 to 70 months. In two patients with complete disruption, non-bridging stent did not resolve the pseudocysts and required surgery. **Conclusion** Pancreatic injury due to trauma can be effectively treated endoscopically.

### INTRODUCTION

Pancreatic injury is uncommon because the retroperitoneal location of the pancreas offers relative protection as it is protected posteriorly by the spine and paraspinal muscles and anteriorly by the intra-abdominal organs. The pancreatic injury occurs in approximately 5% of patients with blunt abdominal trauma, and 8% of patients with penetrating abdominal injuries [1, 2, 3]. Despite this rarity, pancreatic injury is associated with a mortality of up to 30% and a morbidity of up to 45% [1, 2, 3]. The patients with pancreatic trauma are usually managed surgically. These patients are operated upon immediately or managed conservatively, depending upon clinical stability and extent of the pancreatic injury. The choice of surgical procedure is guided by the integrity of the

main pancreatic duct, extent of pancreatic parenchymal damage, anatomical location of the injury, stability of the patient and degree of associated organ damage [1, 2, 3, 4, 5]. The advancement in endoscopic techniques have led on to successful use of endoscopic transpapillary pancreatic duct stent or nasopancreatic drain in patients with pancreatic duct disruptions in benign pancreatic disorders like pancreatic pseudocyst, pancreatic fistula and pancreatic ascites/pleural effusion [6, 7, 8, 9, 10, 11, 12, 13, 14]. Transpapillary stent or nasopancreatic drain promotes healing of duct disruptions by blocking the leaking duct by bridging the disruption, or by traversing the pancreatic sphincter converting the high-pressure pancreatic duct system to a low pressure system with preferential flow through the stent [15]. The same principle is applied to treat ductal disruptions in patients with pancreatic trauma, but the published experience with endoscopic management of pancreatic trauma is limited. In the current study, we report the long term results of endoscopic therapy in 11 patients with pancreatic injury due to abdominal trauma.

### PATIENTS AND METHODS

We retrospectively evaluated the results of endoscopic therapy in patients with pancreatic injury due to abdominal trauma. Patients with pancreatic mass,

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**Correspondence** Deepak Kumar Bhasin

Department of Gastroenterology; Post Graduate Institute of Medical Education and Research (PGIMER); 1041, Sector 24-B Chandigarh, 160 023; India

Phone: +91-172.272.5056, +91-172.271.5870

Fax: +91-172.274.4401

E-mail: deepakbhasin@gmail.com; dkbhasind@hotmail.com

pregnancy, age less than 18 years, presence of chronic cardiac, renal or pulmonary failure or patients not giving informed consent were excluded. Over the last 7 years, 11 patients (10 males, 1 female; mean age:  $21.8 \pm 11.9$  years) with pancreatic trauma were treated with an attempted endoscopic therapy. Patients with post-traumatic pseudocysts and a gastroduodenal bulge were treated with endoscopic transmural drainage. Post-traumatic pseudocysts without a gastroduodenal bulge or patients with external pancreatic fistula consequent to surgical or radiological drainage of post-traumatic pancreatic fluid collections/necrosis were treated with transpapillary drainage. Endoscopic ultrasound (EUS) guidance was not used in any of the patients.

All the patients selected for the endoscopic therapy were symptomatic and in patients with a pseudocyst, computed tomography (CT) scan was done to note the number and size of the pseudocysts. In patients with pseudocysts, a magnetic resonance imaging (MRI) of the abdomen was also done prior to endotherapy to exclude significant necrosis in the pancreatic fluid collection.

#### **Transpapillary Drainage**

Intravenous ciprofloxacin was administered for antibiotic prophylaxis. Endoscopic retrograde cholangiopancreatography (ERCP) was performed using a side-viewing duodenoscope (TJF 145 or TJF 160, Olympus Optical Co. Ltd., Tokyo, Japan) under conscious sedation by intravenous midazolam. Initially, an attempt was made for contrast free pancreatic duct cannulation and if this was not possible, minimal contrast was injected. After cannulation, minimal contrast was injected to confirm pancreatic duct disruption, defined by free extravasation of contrast outside the pancreatic ductal system as seen on fluoroscopy. Pancreatic duct disruption was defined as complete when the main duct upstream to the disruption was not opacified and it was defined as partial when the main duct was visualized upstream from the site of disruption. On ERCP, it was also noted whether the disruption was involving the main pancreatic duct or the side branch. After confirming the ductal disruption, a 5- or 7-Fr nasopancreatic drain/stent was placed across the papilla into the pancreatic duct by advancing it over a 0.025 or 0.035 inch hydrophilic guide wire (Jagwire<sup>®</sup>, Microvasive<sup>®</sup> Endoscopy, Boston Scientific Corp., Natick, MA, USA). An attempt was made to place the nasopancreatic drain across the area of the disruption and if that was not possible it was placed as close as possible to the disruption.

#### **Transmural Drainage**

Intravenous ciprofloxacin was administered for antibiotic prophylaxis. Endoscopic transmural drainage was performed by standard technique using a side-viewing duodenoscope (TJF 145 or TJF 160, Olympus Optical Co. Ltd., Tokyo, Japan). The site of maximum bulge in the stomach or duodenum was identified and it

was punctured using a needle knife and the tract was secured by placing a hydrophilic guide wire (Jagwire<sup>®</sup>, Microvasive<sup>®</sup> Endoscopy, Boston Scientific Corp., Natick, MA, USA) deep in the cyst cavity. Thereafter, the tract was dilated using a controlled radial expanding balloon up to 12 to 15 mm. After dilatation, a 5- or 7-Fr nasocystic drain and 7-Fr pigtail stent(s) was(were) placed into the cyst cavity by advancing it over a 0.035 inch hydrophilic guide wire.

#### **Experimental Design**

After the procedure all the cases were admitted and kept under observation for 48 to 72 hours and thereafter the patients were discharged, depending upon the clinical situation and other injuries and followed up in the outpatient department till complete resolution of all the pseudocysts or fistula. The nasopancreatic/nasocystic drain was passed beneath the patients clothes and tied at the back of the ear, so as the patient can perform their daily activities and go to work also. Patients were instructed to empty the bag at the time of discharge and advised to record daily output from the drain. Patients were advised to report if there was no output from the drain in 24 hours or the color of the fluid changed to bilious, indicating displacement of the drain. When blockage was suspected (no output for 24 hours), the nasopancreatic/nasocystic drain was initially aspirated and if that did not open the block, it was flushed with sterile saline and flow was established by suction using a disposable syringe. The patients were followed up every 2 weeks for: i) clinical re-evaluation; and ii) abdominal ultrasound. CT abdomen was repeated at the end when there was complete clinical recovery along with complete resolution of pseudocysts on the ultrasound of abdomen or cessation of the fistula output. The patients with transmural drainage underwent ERCP after resolution of the pseudocysts to delineate the pancreatic ductal anatomy. Patients having persistent ductal disruption underwent transpapillary pancreatic duct stent placement and the transmural stents were removed in only those patients who had healing of pancreatic duct disruptions on follow up ERCP.

#### **End Point**

Therapeutic success was defined as symptomatic improvement with radiological resolution of the pseudocyst on CT scan or cessation of the external pancreatic fistula. Therapeutic failure was defined as persistence of pseudocyst or external pancreatic fistula at 8 weeks after endotherapy or need for surgical intervention.

#### **ETHICS**

The study was approved by the institutional ethics committee and a written informed consent was obtained from all the patients. The study protocol conforms to the ethical guidelines of the "World Medical Association Declaration of Helsinki - Ethical Principles for Medical Research Involving Human Subjects" adopted by the 18th WMA General

**Table 1.** Patients with pancreatic injury due to abdominal trauma.

No.	Age (years)	Sex	Complication	Drainage	Duct disruption	Disruption bridged	Surgery	Recurrence	Follow up (months)
1	3	Male	Pseudocyst	Transmural	Partial	Yes	No	No	16
2	5	Male	Pseudocyst	Transmural	Complete	No	No	No	20
3	18	Male	Pseudocyst	Transpapillary	Complete	No	Yes	-	-
4	13	Female	Pseudocyst	Transpapillary	Complete	No	Yes	-	-
5	25	Male	Pseudocyst	Transpapillary	Partial	Yes	No	No	11
6	18	Male	Pseudocyst	Transpapillary	Partial	Yes	No	No	70
7	29	Male	Pseudocyst	Transpapillary	Partial	Yes	No	No	21
8	31	Male	External pancreatic fistula	Transpapillary	Partial	Yes	No	No	12
9	33	Male	External pancreatic fistula	Transpapillary	Partial	Yes	No	No	10
10	42	Male	External pancreatic fistula	Transpapillary	Partial	Yes	No	No	36
11	24	Male	External pancreatic fistula	Transpapillary	Complete	No	Yes	-	-

Assembly, Helsinki, Finland, June 1964 and amended by the 59<sup>th</sup> WMA General Assembly, Seoul, South Korea, October 2008.

**STATISTICS**

The absolute frequencies were used as descriptive statistics.

**RESULTS**

Eleven patients with post-traumatic pancreatic injury were treated with attempted endoscopic drainage (Table 1). All patients had pancreatic injury consequent to blunt trauma to the abdomen and none of the patients had any other intra-abdominal parenchymal or bowel injury. Seven patients (6 males, 1 female) had post-traumatic pseudocysts and four patients (all males) had external pancreatic fistula. Three patients had external pancreatic fistula consequent to percutaneous radiological drainage of post-traumatic pancreatic fluid collections and one patient had external pancreatic fistula following surgical necrosectomy. All the patients had external pancreatic fistula of more than 4 weeks duration and it was draining more than 100 mL/day of pancreatic juice.

**Patients with Post-Traumatic Pseudocysts**

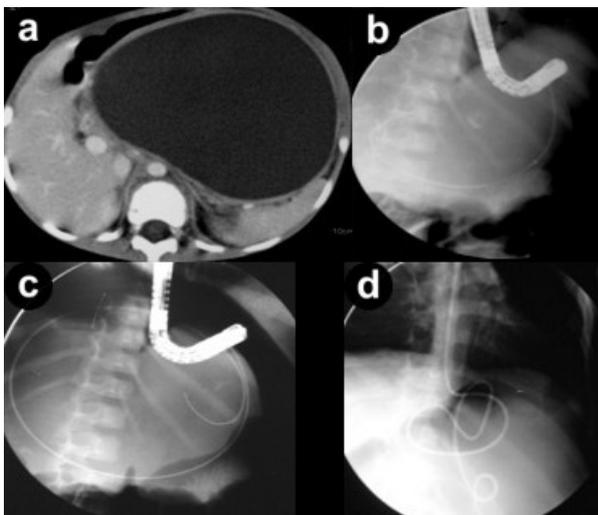
Four patients had a single pseudocyst and three patients had multiple pseudocysts. The size of pseudocysts

ranged from 4 to 14 cm and none of the pseudocysts had significant necrotic debris on MRI. These patients presented 4 to 12 weeks after the abdominal trauma. Two patients with single pseudocyst had a bulge in the stomach and were treated with transmural drainage (Figure 1). There were no complications of the procedure and the pseudocysts resolved with cessation of nasocystic drain output in both the patients in 4 and 5 weeks, respectively. Post-resolution ERCP documented complete and partial disruption of the main duct in the head region in one patient each. A 5-Fr bridging stent was placed in patient with partial disruption and repeat ERCP after 4 weeks documented healing of the disruption. Thereafter, the transmural stents as well as the transpapillary stent was removed. Transmural stents have not been removed in patient with complete disruption. There has been no recurrence of symptoms or the pseudocysts in both these patients over a follow-up of 20 and 16 months.

Five patients with pseudocysts did not have gastroduodenal bulge and were treated with attempted transpapillary drainage. Three patients had partial disruption and two patients had complete disruption of the main pancreatic duct. Four patients had single disruption and one patient had two site disruptions of the main pancreatic duct. The site of pancreatic duct disruptions was head, body and tail in three, two and one patient, respectively. In patients with partial disruption a bridging 5-Fr nasopancreatic drain was placed in one patient and bridging 5-Fr and 7-Fr stents were placed in other two patients. All three patients had resolution of pseudocyst within 8 weeks and there has been no recurrence over a follow up of 11 to 70 months. The ductal disruption was also documented to be healed in these patients on nasopancreatic drain gram or ERCP. In two patients with complete disruption, a non bridging 7-Fr stent was placed. However, in both these patients there was no resolution of pseudocysts and both were treated surgically because of ongoing symptoms.

**Patients with External Pancreatic Fistula**

Of the four patients with external pancreatic fistula, three had partial disruption and one had complete disruption of the main pancreatic duct. All four patients had single disruption of the main pancreatic duct. The site of pancreatic duct disruptions was head, body and



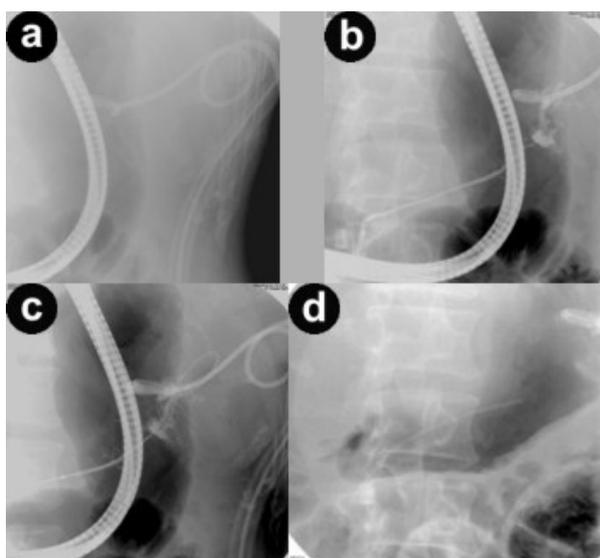
**Figure 1.** a. Large post-traumatic pseudocyst. b. Guide wire pushed into pseudocyst after puncturing with needle knife. c. Guide wire coiled into the pseudocyst. d. A 7-Fr nasocystic drain placed.

tail in two, one and one patient, respectively. One patient with partial disruption in the body had a complex fistula (pancreaticocutaneousjejunal fistula) following surgical necrosectomy. In patients with partial disruption a bridging 5-Fr nasopancreatic drain was placed in one patient and bridging 7-Fr stents were placed in other two patients. All three patients had resolution of external pancreatic fistula within 6 weeks and there has been no recurrence over a follow up of 12 to 36 months (Figure 2). Even patient with complex fistula had complete resolution. The ductal disruption was also documented to be healed in these patients on nasopancreatic drain gram or ERCP. In one patient with complete disruption, a non bridging 7-Fr stent was placed. However, in this patient there was no resolution of external pancreatic fistula even after 8 weeks of drainage and was successfully treated surgically.

There were no complications of the endoscopic therapy and patients tolerated nasopancreatic/nasocystic drain also well. In none of the patients there was dislocation of the nasopancreatic/nasocystic drain. There were also no ductal changes to suggest chronic pancreatitis on follow-up ERCP or nasopancreatic drain gram following the stent or nasopancreatic drain removal.

## DISCUSSION

Pancreatic injury due to abdominal trauma is usually treated surgically and there is limited experience of pancreatic endotherapy in treating these patients. As the integrity of the main pancreatic duct is the most important determinant factor of morbidity and mortality in pancreatic injury, ERCP has been mainly used for detailed imaging of the pancreatic duct in order to define the nature and location of the ductal disruption so that appropriate surgical management can be done [1, 2, 3, 4, 5]. There is limited experience with therapeutic ERCP in such situations probably because



**Figure 2.** a. Post-traumatic external pancreatic fistula. A percutaneous drain noted. b. Pancreatogram shows partial disruption at tail end. c. Guide wire negotiated across the disruption. d. A 7-Fr stent placed across the disruption.

of the logistics of performing therapeutic ERCP at trauma centers, technical problems in performing ERCP in a poly-trauma patient, probably lack of awareness about the role of therapeutic ERCP in these patients and fear of exacerbating the underlying pancreatic injury. However, in the current study we have shown that pancreatic injury consequent to abdominal trauma can be successfully and safely treated with endoscopic therapy alone.

Endoscopic transmural drainage is a useful procedure especially in situations where there is an endoscopic bulge and complete cut off of the main pancreatic duct precludes successful transpapillary drainage as was noted in our study. Sharma *et al.* successfully treated 8 patients with post-traumatic pseudocysts, with endoscopic transmural drainage. There were no complications of the procedure in any patient, and all had complete resolution of pseudocysts within two months [16]. They also found complete cut off of the main pancreatic duct in two patients as was in one of our cases treated with transmural drainage. There are some published case reports also that have demonstrated successful resolution of post-traumatic pseudocysts following endoscopic transmural drainage [17, 18]. Now with availability of endoscopic ultrasound (EUS), drainage of non bulging pseudocysts can also be performed and it would be interesting to study the role of EUS guided drainage of post-traumatic pseudocysts [19].

Endoscopic transpapillary drainage has also been shown to be useful in management of patients with pancreatic injury due to abdominal trauma. It has been used to treat pancreatic ductal disruptions both in the early phase of pancreatic injury as well as later to manage the complications of ductal disruption [1]. Kim *et al.* studied 14 patients with traumatic pancreatic duct injury and on ERCP there was leakage of contrast from the main pancreatic duct into the peritoneal cavity in eight patients, leakage localized to the pancreatic parenchyma in three patients and parenchymal opacification through an injured branch duct in three patients [20]. Patients with free leakage of the contrast into the peritoneum were treated by surgery and those with leakage from the main pancreatic duct confined to the pancreatic parenchyma were treated by placement of a 7-Fr transpapillary pancreatic duct stent within 24-96 h of the injury. At 3-month follow-up, all three patients had complete resolution of main pancreatic duct leak. Mild stenosis of the main pancreatic duct was noted in two of these three patients, but these patients were asymptomatic after one year of follow-up. Houben *et al.* reported their experience of attempted endoscopic transpapillary pancreatic duct stenting in 11 children with pancreatic injury following blunt trauma [21]. An ERCP was performed at a median of 11 days (range: 6-29 days) of injury and a transpapillary pancreatic duct stent was placed in nine patients. In six of the nine, the stent was placed into the collection and in three patients the stent could bridge the disruption. All six patients in whom the stent was

placed into the collection had a successful outcome. One of these required an exchange with a larger stent and another patient needed percutaneous drainage. One of the three patients with a non bridging stent had a successful outcome without need for an additional procedure. The other two patients required additional procedures, including stent exchange and cystogastrostomy. The stents were removed after a median of 127 days (range: 56-193 days). There are other published case reports also describing successful healing of post-traumatic pancreatic pseudocyst and fistula by endoscopic transpapillary drainage by stent or nasopancreatic drain [22, 23, 24, 25, 26, 27].

In contrast to these encouraging results, Lin *et al.* reported significant complications of ERCP and pancreatic duct stenting in traumatic pancreatic injuries [28, 29]. They performed pancreatic duct stenting in three post-trauma patients within 28 h of injury. One patient with associated chronic renal failure had disruption of pancreatic duct in the body and died three days after the stent insertion as a result of sepsis. In the second patient, there was disruption of the pancreatic duct in the body and a 5-Fr 12 cm stent was placed. This patient recovered, but on removal of the stent a ductal stricture was noted. This patient then underwent repeated ERCP. The stent was removed at the seventh ERCP and at that time two separate strictures were noted in the pancreatic duct. The third patient, who underwent ERCP within 16 h of injury, had a major pancreatic duct disruption in the head of the pancreas. A 5-Fr 3 cm pancreatic stent was placed. Six days later, a fluid collection was noted in the peripancreatic space; this was drained under CT guidance. Twenty days later, a longer 5-Fr 7 cm stent was exchanged and the patient recovered uneventfully. At the time of removal of stent, mild pancreatic duct stricture was noted. However, in the current study we have shown that endoscopic transpapillary drainage is safe and effective in treating pancreatic ductal disruptions because of abdominal trauma and none of our patients had ductal strictures following stent removal.

We in our earlier papers, as well as other authors, have shown that endoscopic transpapillary drainage has best results when the pancreatic duct disruption is partial and it can be bridged [7, 9, 12, 13, 14]. In the current study on endoscopic management of pancreatic trauma also, we have demonstrated that transpapillary drainage is effective if the disruption is partial and can be bridged. Patients with complete disruption should be managed surgically or with transmural drainage.

Based on our as well as published experience, we had suggested a management algorithm for patients with pancreatic trauma [1]. Patients with pancreatic injury should be evaluated for ductal integrity and those with normal pancreatic ducts on MRCP may be treated conservatively, whereas patients with pancreatic duct disruptions should undergo transpapillary pancreatic duct stenting, especially if the disruption is partial and can be bridged. Patients with complete duct disruption should be offered surgery. Patients presenting in the

delayed phase with complications of pancreatic duct injury can be treated with endoscopic transpapillary or transmural drainage, or both. Endoscopic transpapillary drainage should be attempted in patients with partial duct disruption, whereas endoscopic transmural drainage alone or in combination with transpapillary drainage may be attempted in patients with bulging pseudocysts and complete duct disruptions. With the availability of EUS, transmural drainage can also be performed for non-bulging pseudocysts.

In conclusion, pancreatic injury due to trauma can be effectively treated endoscopically and patients with complete disruption of the pancreatic duct usually have unfavorable outcome after transpapillary drainage

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