Case Report

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Case Report of Pancreatic-Preserving Surgical Drainage for Pancreatic Head Injury with Main Pancreatic Duct Injury

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Abstract

The incidence of pancreatic injury is low among trauma cases, and no clear treatment protocol has been established. Pancreatic injury, accompanied by injury to the main pancreatic duct (grades 3, 4 or 5 pancreatic injury) is generally thought to require surgery. Various surgical procedures are proposed for such cases, considering factors such as the patient ' s general condition. In recent years, however, several reports have been published indicating that conservative treatment was possible, despite injury of the main pancreatic duct. We treated two cases of pancreatic trauma accompanied by injury to the pancreatic head and main pancreatic duct, and obtained good outcomes with drainage-based treatment. Therefore, we report on these cases along with a review of the literature.

Keywords: Pancreatic head; Main pancreatic duct; Injury; Conservative treatment; Octreotide

Introduction

Consent was obtained from the hospital Institutional Review Board and the involved patients. In accordance with the Personal Information Protection Law, the names of the individuals, dates and times were not published.

The incidence of pancreatic injury is rare, accounting for only 5%-7% of abdominal trauma [1]. The treatment strategy for pancreatic trauma greatly affects both the complication rate and mortality rate. Particularly common complications include bleeding, pancreatic leakage, concurrent pancreatitis, and abscess formation. Furthermore, as the pancreas is attached to the retroperitoneum and surrounded by the stomach, duodenum, colon, and major blood vessels, accompanying injury to other organs is reported to occur in 90% or more of cases [2]. As the basic treatment, it is important to decide whether to adopt non-operative management (NOM), and in the event of surgery, whether to adopt damage control, or radical surgery such as resection and reconstruction. This makes it extremely difficult to determine the optimal treatment strategy for pancreatic trauma. Furthermore, pancreatic surgery has long been considered to be a particularly challenging type of gastrointestinal surgery, requiring a high level of skill [3,4].

As a treatment protocol for grades 4 and 5 injury of the pancreatic head, accompanied by injury to the main pancreatic duct, according to the American Association for the Surgery of Trauma-Organ Injury Scale (AAST-OIS), the Japanese Association for the Surgery of Trauma advises selecting an extended distal pancreatectomy. However, when the intraoperative evaluation of the status of the main pancreatic duct and common bile duct is insufficient, it is recommended to perform adequate drainage alone and to then postoperatively perform endoscopic retrograde cholangiopancreatography (ERCP) in order to re-evaluate the status of the main pancreatic duct [5]. On the other hand, the Definite Surgical Trauma Care (DSTC) manual indicates that for injury limited to the pancreatic head, even if injury of the main pancreatic duct is suspected, simple drainage is the optimal procedure [6]. Emergency pancreatectomy and reconstruction is associated with high rates of complications (75%) and mortality. Therefore, the decision to adopt a surgical strategy should only be made following a careful examination [7,8].

We treated two patients with pancreatic head trauma and injury to the main pancreatic duct, for whom good outcomes were obtained with drainage and pancreatic tube placement. We report on these cases together with a review of the literature.

Case 1

Case subject: Male, age 20 years

History of present illness: The subject sustained injury upon colliding with a telegraph pole while driving a car.

Laboratory findings

The initial examination revealed abnormal breathing and circulation. The subject's respiratory rate was 42 breaths/

minute, indicating tachypnea, and his SpO_2 with a 10L mask was 100%. Blood pressure was 120/60 mmHg, with a heart rate of 103 bpm; cold clammy skin was observed. Test results of the Focused Assessment with Sonography for Trauma (FAST) were negative. No abnormalities were observed in the subject ' s airway, central nervous system, and body temperature was normal. The secondary examination revealed pressure pain on the posterior region of the neck, lumbar region, and epigastric region, with swelling and deformity of the left femur.

Blood laboratory results showed elevated white cell count and hepatic enzyme levels (**Table 1**).

Table 1: Case 1, laboratory examination.

WBC	17.4	$\times10^3/\mu l$	RBC	4.74	$\times10^8/\mu l$	Hb	13.8	g/dl
Htc	40.9	%	Plt	254	$\times10^3/\mu l$			
BUN	10	mg/dl	Cre	1	mg/dl	AST	361	IU/l
ALT	214	IU/l	ALP	330	IU/l	γGTP	19	IU/l
AMY	115	IU/l						
PT	66.4	%	PT-INR	1.19		APTT	1	
PaO_2	227	mmHg	$PaCO_2$	53.9	mmHg	BE	-6.9	

Trauma pan-scan computed tomography (CT) revealed free air in the abdominal cavity, with fluid retention extending from the pancreatic head to the hepatoduodenal ligament (**Figure 1**).

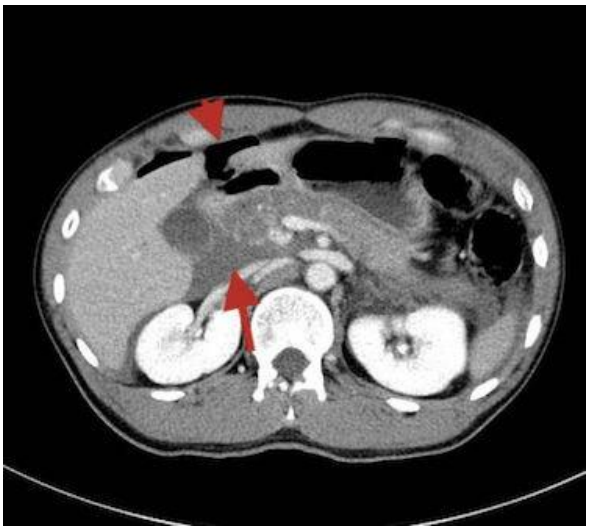


Figure 1: Trauma pan-scan CT: Intraperitoneal free air (arrowhead) and fluid accumulation of hepatoduodenalligament (arrow) were found.

Other findings included traumatic subarachnoid hemorrhage, diaphyseal fracture of the left femur, open fracture of the left patella, bilateral pulmonary contusions, left pneumothorax, fracture of the C7 vertebral arch, and spinous process fractures of the L3 and L4 vertebrae. The subject had an Injury Severity Score (ISS) of 34 points, Revised Trauma Score (RTS) of 7.84 points, with Probability of Survival (Ps) of 0.95. As traumatic gastrointestinal perforation was suspected and retroperitoneal hemorrhage diagnosed, emergency open surgery was performed.

Treatment course

Surgical findings: Upon performing laparotomy by midline incision in the upper abdomen and exposing the greater omentum, injury involving one third of the medial circumference of the duodenal bulb was observed. Because of the possibility of stenosis with simple closure, we performed the repair using a jejunal patch (retrocolic approach). While hematoma was macroscopically observed in the retroperitoneum, there was no clear injury of the pancreatic parenchyma. Because injury of the main pancreatic duct was observed, CLIO DRAINs® were placed below the left and right hemidiaphragms, the anterior surface of the duodenum, and rectovesical pouch, thereby completing the surgery (operative duration of 2 hours and 10 minutes). At the same time, debridement and external fixation were performed for the open fracture of the left patella and the left femoral diaphyseal fracture. The volume of blood loss was 320 ml. A blood transfusion was performed with 500 ml of 5% albumin, four units of red cell concentrate (RCC), and three units of fresh frozen plasma (FFP).

Postoperative progress: Postoperative biochemical examination of drain discharge revealed 3,940 U/L of amylase, indication that pancreatic injury could not be ruled out. Therefore, endoscopic retrograde pancreatography (ERP) was performed on postoperative day 11, and results revealed leakage of contrast medium from the pancreatic head and main pancreatic duct. Moreover, the guidewire could not be passed through distally from the site of injury. Subsequent CT also confirmed intraperitoneal leakage of contrast medium from ERP (**Figure 2**), and complete rupture of the pancreatic duct was suspected (AAST-OISIV).

Although the pancreatic tube could not be placed distal to the injury, postoperative hemodynamics were stable, and for distal drainage of pancreatic fluid, an intra-abdominal drain was deemed effective. Therefore, we decided to take a conservative approach by placing a pancreatic tube proximally to the site of injury. Central venous nutritional management was adopted, and on the same day, a subcutaneous injection of 100 μg of

octreotide was commenced. Following octreotide administration, the volume of discharge in the drain rapidly decreased (**Figure 3**).

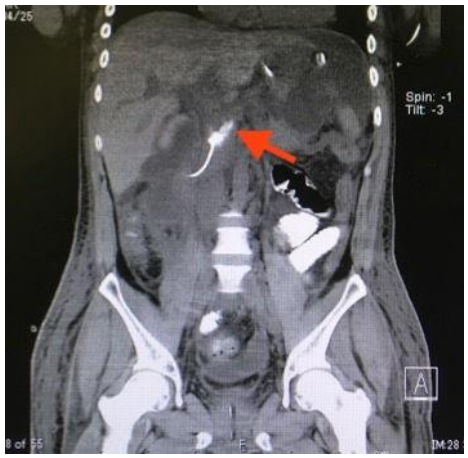
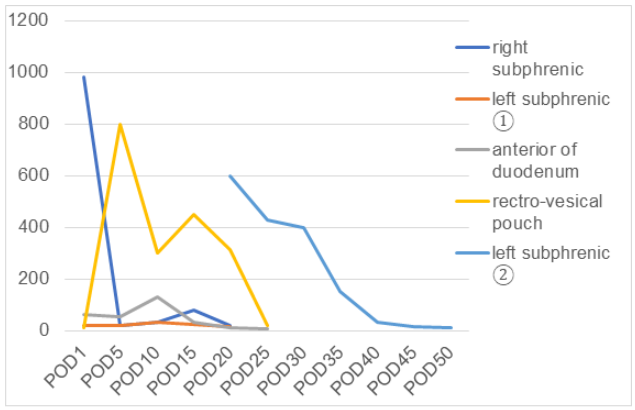


Figure 2: The CT shows proximal pancreatic parenchymal and main pancreatic duct injury (arrow) and leakage of contrast medium into intra-abdominal space after ERP.



ERP	↑
Drainage (OP)	↑(op) ↑↑ ↑
Octreotide	→→→→→→→→→

Figure 3: Treatment, and drainage volume. It seems that the early operation drain is picking up the washing water after the operation. Pancreatic fistule was suspected from persists drainage volume after surgery. Drainage volume dramatically decreased as octreotide was started.

Octreotide administration was continued, with doses administered every two weeks. On day 20 following initial surgery, a nasoesophageal feeding tube was placed endoscopically in the jejunum, and administration of an elemental diet was commenced. The meal volume gradually increased, and three months post-surgery, the patient was switched to oral meals. Over the course of treatment, CT and drain contrast-enhanced examination were frequently performed, and by performing additional CT-guided drainage (below the left diaphragm②), the pancreatic fistula was able to be rapidly localized, and ultimately managed by the drain beneath the left hemidiaphragm (drain②) alone (**Figure 3**). At four months after injury, the drains beneath the left hemidiaphragm ② , and the pancreatic duct tube were removed.

Thereafter, gradual enlargement of a pancreatic pseudocyst was observed, and by three months after drain removal, the cyst had grown to 6 cm in size (**Figures 4A and 4B**). ERP revealed stenosis, with tapering from the pancreatic head to the pancreatic duct, as well as a pancreatic cyst in continuity with the proximal site (**Figure 4C**). Therefore, the guidewire was advanced into the cyst, and an endoscopic nasopancreatic drain (ENPD) was inserted. After insertion of the ENPD, the cyst rapidly shrank (**Figure 4D**), and two weeks later, the ENPD tube was removed. With regard to the pancreatic tail, no pancreatic pseudocyst originating in the pancreatic tail appeared and, as atrophy of the parenchyma was observed over time, it was determined that there was no active external secretion. The subject progressed well thereafter, and was discharged home e months after injury. The subject has not exhibited any subsequent recurrence of pancreatic pseudocyst.

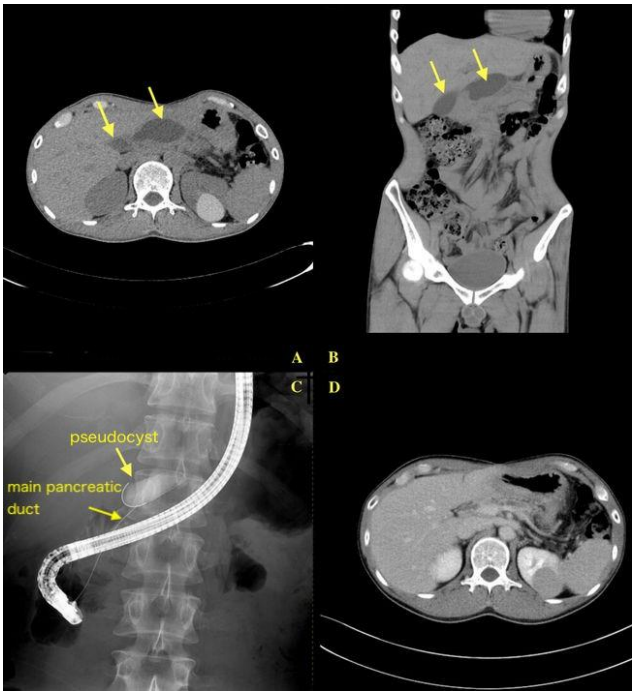


Figure 4: (A-B) A pancreatic pseudocyst appeared after removing left subphrenic② drainage tube. (C): ERP finding. The connection between the pseudocyst and the main pancreatic duct was confirmed. (D): The CT finding after drainage by ERP tube.

Case 2

Case subject: Female, in her 20s.

History of presenting condition: The subject was riding in the front passenger seat of a car that had a head-on collision with another car.

Laboratory findings

The initial examination revealed abnormal breathing. The subject's respiratory rate was 20 breaths per minute, indicating mild tachypnea, and her SpO_2 with a 10 L mask was a 100%. Her blood pressure was 90/40 mmHg, and heart rate was 80 bpm. Although there were no signs of shock observed, such as cold sweats, the FAST results revealed a small echo-free space in Morison's pouch. There were no abnormal findings in the airway or central nervous system, and her body temperature was normal. The secondary examination revealed pressure pain in the left precordium, pressure pain over the left lateral femur, pressure pain and swelling in the lumbar region, with subcutaneous hematoma, and pressure pain and abrasion in the left lower quadrant.

Blood test revealed elevated white cell count, elevated hepatic enzyme levels, and elevated amylase levels (**Table 2**).

Table 2: Case 2, laboratory examination.

WBC	18	$\times10^3/\mu l$	RBC	4.06	$\times10^6/\mu l$	Hb	12.5	g/dl
Htc	38.4	%	Plt	376	$\times10^3/\mu l$			
BUN	9	mg/dl	Cre	0.62	mg/dl	AST	252	IU/l
ALT	188	IU/l	ALP	181	IU/l	γGTP	15	IU/l
AMY	173	IU/l						
PT	94.6	%	PT-INR	1.03		APT	0.9	
PaO_2	401	mmHg	$PaCO_2$	31.4	mmHg	BE	-2.5	

Trauma pan-scan CT revealed bilateral pulmonary contusions, fracture of the left 7th and 8th ribs, with a dislocation-fracture of the T12/L1 vertebral segments. A low density area was also observed in the pancreatic parenchyma of the pancreatic head, so pancreatic head trauma was suspected (**Figure 5**). The subject had an ISS of 21 points, RTS of 7.84 points, and Ps of 0.98.

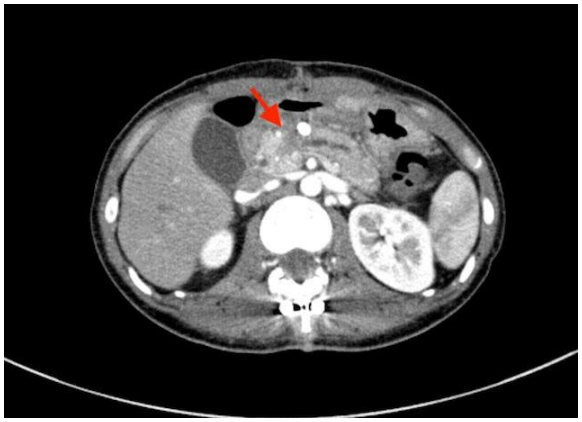


Figure 5: CT shows low density area of pancreatic head, suspect of pancreatic injury.

Treatment course

Upon performing ERP on day 2 of hospitalization, leakage of contrast medium was observed from the main pancreatic duct in the pancreatic head (**Figure 6A**), and injury to the pancreatic head was diagnosed (AAST-OISIV). As a stent could not be placed distal to the injured area an endoscopic retrograde biliary drain (ERBD) and ERP tube were placed up to the proximal end of the injured area (**Figure 6B**). Intra-abdominal drainage was also performed on the same day.

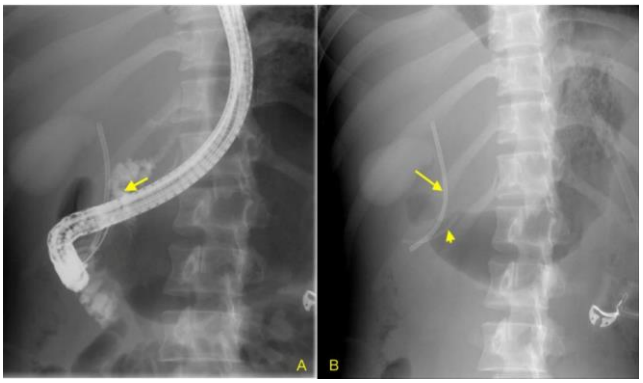


Figure 6: (A) ERP finding. Contrast leakage show from main pancreatic duct (arrow) (B) We put ERBD(arrow) and ERP tube (arrow head) for control of leakage.

Surgical findings: A camera port was inserted via the umbilicus, and upon performing intra-abdominal observation, retention of a moderate volume of hemorrhagic ascites with findings of peritonitis (fibrin adhesion and intestinal adhesion) were observed; laparotomy was performed via midline incision in the upper abdomen. After suction of 800 ml of hemorrhagic ascites, the omental bursa was opened in order to reach the anterior surface of the pancreas, and the site of the pancreatic tear was confirmed. While a small hematoma was observed, no active bleeding occurred. After intra-abdominal lavage, CLIO DRAINs® were inserted into the site of the pancreatic injury, below the left and right hemidiaphragms, Winslow foramen, and rectovesical pouch, thereby completing the surgery (operative duration of 2 hours and 49 minutes). There was 5 ml of blood loss, and a blood transfusion with two units of FFP was administered.

Postoperative course: Central venous nutritional management was adopted, and on postoperative day 2, subcutaneous injections of 100 μg of octreotide were commenced. The volume of drain discharge outside the area of pancreatic injury rapidly decreased (**Figure 7**). Octreotide administration was continued every four weeks. On postoperative day 22, a per oral elemental diet was commenced. The meal volume was gradually increased, and from postoperative day 37, the patient's diet was upgraded to oral meals. On postoperative day 28, fixation was performed for the T12-L1 dislocated fracture. Intra-abdominal drainage was ultimately performed only at the site of the pancreatic injury, and the drain was removed on postoperative day 81. The patient progressed well thereafter, and was discharged home at three months after injury.

Discussion

The treatment of traumatic pancreatic injury should be determined on the basis of the patient's general condition, the presence or absence of injury of the main pancreatic duct, the injury site (pancreatic head or body and tail), and the presence or absence of concurrent injury in other organs. When the main pancreatic duct is injured, if there is concurrent injury involving the sphincter of Oddi, and the bile duct, then pancreatic resection and reconstruction is generally indicated in Japan. [5,6,9] However, when selecting the treatment plan, as it is difficult to evaluate injury of the main pancreatic duct on CT and laparotomy findings, early ERP is recommended. Obtaining sufficient information pertaining to injury of the main pancreatic duct is important for determining the subsequent treatment strategy. Patients with mild parenchymal tear or injury to the main pancreatic duct accompanying sub-capsular injury might then be eligible for subsequent treatment by stenting [9]. Case 1 presented with concurrent cervical spine fracture, femoral fracture, open fracture of the knee, and traumatic subarachnoid hemorrhage. Thus, the timing for ERP needed to be considered in accordance with stabilization of the subject ' s general condition.

In case 2, pancreatic injury was suspected early on, and by performing ERP with surgical drainage without delay, the pancreatic fistula was able to be successfully localized. While opinions may differ among Western countries, depending on the particular institution, regarding the treatment policy for pancreatic injury accompanied by injury to the main pancreatic duct, emergency pancreatectomy and reconstruction is associated with high rates of complications and mortality. Sharpe et al. [10] created an algorithm for pancreatic injury, and reported that good outcomes were obtained with closed negative pressure drainage as the first-line treatment for injury of the pancreatic head. It has also been reported that factors affecting the rate of complications in the treatment of pancreatic injury include AAST grade, and the number of open surgeries, whereas factors that affect the mortality rate include age, shock, transfusion volume, and concurrent injury to other organs [11]. In the present two cases, we believe that good outcomes were able to be obtained because open surgery was performed only once and other factors were controlled well. Octreotide is used for the alleviation of symptoms caused by gastrointestinal hormone-secreting tumors, acromegaly and pituitary gigantism, as well as gastrointestinal obstruction.

Nwariaku et al. [12] examined the effect of octreotide for pancreatic fistula accompanying pancreatic injury, focusing on the reduction of the pancreatic fistula and rate of complications when using octreotide for routine pancreatectomy [13]. As a result, there was no significant difference observed between the group receiving octreotide and the group that did not. However, retrospective examination revealed that this was attributed to there being more patients with a highly severe condition in the group receiving octreotide. A subgroup analysis also reported that in patients with ISS>25, the length of hospital stay was shortened. As shown in **Figure 3**, patient 1 also experienced a marked reduction in the volume of drain discharge after administration of octreotide [14]. Therefore, we believe that octreotide administration was effective. As shown in **Figure 7**, we were able to quickly control the volume of discharge in patient 2 at a low level by implementing early drainage and the administration of octreotide. Localization of the pancreatic fistula is said to be an important factor in conservative treatment, [8] and we believe that localization was successfully achieved in our two patients through treatment combining intra-abdominal drainage, ERP, and octreotide.

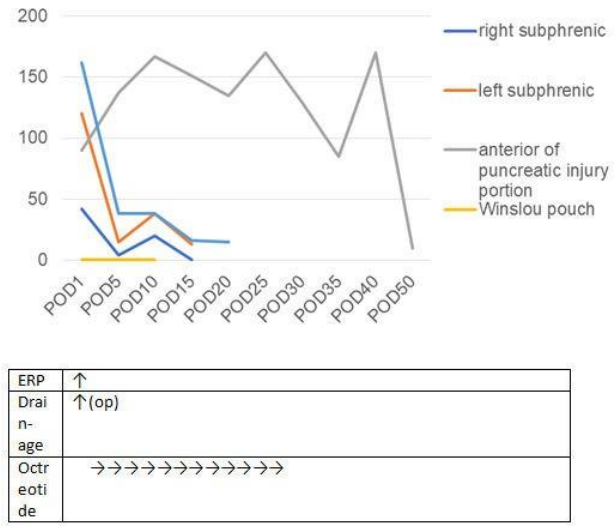


Figure 7: Drainage volume. In this case, the pancreatic fistula was successfully localized more quickly than in the first case.

Abdo et al. [15] described the importance of the SEALANTS approach for conservative treatment of pancreatic duct injury. We believe that we were able to successfully control pancreatic injury in our patients due to appropriate implementation of treatment involving the suppression of gastrointestinal hormones using somatostatin, adequate external drainage, alternative nutrition (jejunostomy), administration of antacids (proton pump inhibitors), nothing per os (NPO) (fasting), total parenteral nutrition (TPN) (central venous nutrition), and stent placement in the pancreatic duct.

Findings

Our findings suggested that it may be possible to treat patients in whom bleeding can be controlled and the leakage of pancreatic fluid can be localized with pancreas-preserving drainage. Even for patients with a high ISS, our results suggested that selecting a minimally invasive treatment combination can help to reduce the rate of postoperative complications and mortality.

Conclusion

We successfully controlled pancreatic fistula and obtained good outcomes for patients with pancreatic injury of the pancreatic head in severe multiple traumas, through treatment combining intra-abdominal drainage, ERP, and octreotide, and thus reported on our experience.

Conflict of Interest

There are no conflicts of interest to declare with regard to this paper.

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