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**Case Report**

# A case series of emergency pancreaticoduodenectomies: What were their indications and outcomes?

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Emergency pancreaticoduodenectomy (EPD) is a rarely performed operation. It is important to know the indications and outcomes of EPD to have a better understanding of its application in clinical practice. A review of eight consecutive cases of EPD was done. Between January 2003 and December 2021, 8 out of 370 patients (2.2%) in a single center received pancreaticoduodenectomy as emergency. There were six males and two females with a median age of 45.5 years. The indications were trauma in three patients, bleeding tumors in two patients, and one patient each in obstructing duodenal tumor, postoperative complication and post-endoscopic retrograde cholangiopancreatography (ERCP) complication. The median operative time and blood loss were 427.5 minutes and 1,825 mL, respectively. There was no operative mortality. Seven patients (87.5%) had postoperative complications. Three patients (37.5%) developed postoperative grade B pancreatic fistula. The median postoperative hospital stay was 23.5 days. Five patients were still alive while three patients survived for 13, 31, and 42 months after the operation. The causes of death were recurrent tumors in two patients, and sepsis in one patient. According to this case series, EPD is associated with increased morbidity and pancreatic fistula, but is still deserved in life-threatening situations and long-term survival is possible after EPD.

**Key Words:** Pancreaticoduodenectomy; Whipple operation; Emergency operation; Pancreatic trauma

## INTRODUCTION

Pancreaticoduodenectomy (PD) is an ultra-major operation with significant postoperative morbidity and mortality. In an elective setting, patients are carefully selected and prepared for this type of surgery. Besides, experienced surgical and anesthetic teams are required to achieve an optimal outcome for the operation. Nevertheless, emergency PD (EPD) is occasionally required for pancreaticoduodenal injury, complications of the pancreaticoduodenal region disease, or as a salvage procedure for certain postoperative or post-endoscopic retrograde cholangiopancreatography (ERCP) complications. In these cases, operative outcomes can be compromised due to inadequate patient preparation and improper patient selection. Here we would like to review the indications and outcomes of all consecutive patients who underwent EPD in a single center between January 2003 and December 2021. This study was approved by the local ethics committee (CREC Ref No. 2022.561).

## CASES

During the study period, 370 PD were performed in our institution. Of the 370 patients, eight patients (2.2%) received EPD. The patient demographics and operation characteristics are shown in Table 1. There were six males and two females, and the median age was 45.5 years (range, 23–67 years). More than half of the EPD cases were unplanned preoperatively. The indications were trauma in three patients, bleeding tumors in two patients, and one patient each in obstructing duodenal tumor, postoperative complication and post-ERCP complication. Half of the operations were done after office hours with two at night time and another two at midnight. Hepato-biliary-pancreatic

**Table 1.** Patient demographics and operation characteristics

| Patient no. | Year of operation | Sex | Age (yr) | Indication for operation | Time of operation | Planned EPD | Type of PD | Management of pancreatic stump | Additional procedure at time of EPD |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2004 | M | 60 | Bleeding tumor | Mid-night | No | W | PJ | Right hemicolectomy |
| 2 | 2006 | F | 43 | Bleeding tumor | Day | Yes | W | PJ | |
| 3 | 2007 | M | 67 | Obstructing tumor | Day | Yes | W | PJ | |
| 4 | 2015 | M | 33 | Trauma | Night | No | W | Drain | Right nephrectomy, drainage of liver abscess |
| 5 | 2017 | M | 31 | Trauma | Day | No | W | PJ | Splenectomy, colectomy, small bowel resection, closure of liver laceration, repair of abdominal wall |
| 6 | 2017 | M | 48 | Trauma | Mid-night | No | W | PJ | |
| 7 | 2020 | F | 51 | Post-ERCP complication | Day | No | W | PJ | |
| 8 | 2021 | M | 23 | Postoperative complication | Night | Yes | PPPD | PJ | |

ERCP, endoscopic retrograde cholangiopancreatography; EPD, emergency pancreaticoduodenectomy; PD, pancreaticoduodenectomy; M, male; F, female; W, Whipple operation; PPPD, pylorus preserving pancreaticoduodenectomy; PJ, pancreaticojejunostomy.

(HBP) surgeons were involved in all the operations. A standard Whipple operation was done in all patients except one who had a pylorus-preserving PD. A pancreaticojejunostomy (PJ) was performed for all patients except one whose pancreatic stump was just drained. Additional procedures apart from PD were required in three patients.

The operative outcomes are shown in Table 2. The median operative time was 427.5 minutes (270-540 minutes) and blood loss was 1,825 mL (1,200–10,000 mL). There was no operative mortality. Seven patients (87.5%) had postoperative complications, including one Clavien-Dindo grade II, two grade IIIA and four grade IIIB complications. Three patients (37.5%) developed postoperative pancreatic fistula (POPF), all were grade B. The length of postoperative hospital stay ranged from 10 to 138 days (median 23.5 days). Five patients were still alive while 3 patients survived for 13, 31, and 42 months after the operation. The causes of death were recurrent tumors in two patients, and sepsis in the last patient.

**Table 2.** Short- and long-term outcomes of operation

| Patient no. | Operation duration (min) | Blood loss (mL) | Mortality | Main complication and grade | POPF and grade | LOS (day) | Survival (mon) | Cause of death |
|---|---|---|---|---|---|---|---|---|
| 1 | 375 | NA | No | Collection Grade IIIA | Grade B | 10 | 31 | Carcinomatosis |
| 2 | 420 | NA | No | No | No | 11 | Still alive | |
| 3 | 390 | 2,000 | No | Collection Grade II | Grade B | 14 | 13 | Distant metastasis |
| 4 | 270 | 10,000 | No | Enterocutaneous fistula Grade IIIB | No | 138 | 42 | Sepsis, liver abscess |
| 5 | 540 | 7,200 | No | Collection Grade IIIA | Grade B | 27 | Still alive | |
| 6 | 520 | 1,500 | No | Hemoperitoneum Grade IIIB | No | 49 | Still alive | |
| 7 | 435 | 1,650 | No | Retroperitoneal abscess Grade IIIB | Biochemical | 32 | Still alive | |
| 8 | 435 | 1,200 | No | DJ leak and afferent limb obstruction Grade IIIB | No | 20 | Still alive | |

NA, not available; DJ, duodenojejunostomy; POPF, postoperative pancreatic fistula; LOS, length of stay after operation.

A brief account of each patient is presented below according to category of indications for EPD.

## Trauma

Patient 4 fell from a height after substance abuse resulting in multiple injuries. Thoracic aortic injury with pseudoaneurysm and partial transection was managed with endovascular aortic stenting. There were multiple abdominal injuries including perforated duodenum, gangrene of ascending and transverse colon, and hepatic laceration and contusion. The initial operation included right hemicolectomy, repair of duodenum, gastrojejunostomy and ileostomy. However, the patient developed bleeding from gastroduodenal artery pseudoaneurysm secondary to duodenal leakage, which failed to control with angiographic embolization. The second laparotomy was performed 10 days after the first one. The pancreatic head was also found to be necrotic and right kidney hematoma was found to be infected during the operation, thus PD and right nephrectomy were performed. No reconstruction of the pancreatic stump was attempted due to the high risk of POPF. The common hepatic duct was drained via a tube which was exteriorized. The third laparotomy was done 3 days after the second one. The pancreatic stump was noted to be dusky and unhealthy, a completion total pancreatectomy and splenectomy were performed with construction of hepaticojejunostomy (HJ). Postoperation, there was bile leak which resolved with conservative treatment and enterocutaneous fistula which failed multiple attempts of closure. Patient was eventually discharged after more than 4 months hospitalization. He had brittle diabetic control and had repeated admissions due to hyperglycemia and sepsis. He eventually succumbed three and a half years after EPD due to sepsis, liver abscess and urinary tract infection.

Patient 5 suffered from abdomen penetration injury by a metal vehicle tow hook with evisceration of the transverse colon and profuse bleeding. Emergency laparotomy revealed splenic and liver laceration as well as pancreatic transection at the neck with multiple perforations over the first and second parts of the duodenum. PD, splenectomy, small bowel resection, transverse colectomy and exteriorization, and closure of liver lacerations were done. The patient suffered from postoperative intra-abdominal collection and pleural effusion, both resolved with percutaneous drainage. The patient subsequently had closure of the stoma and reverted to normal life.

Patient 6 had known depression and attempted suicide by multiple self-stabbing over the epigastrium with a knife. The patient was in shock on admission. Emergency laparotomy revealed major bleeding from a torn mesenteric vessel. There were also 1 cm duodenal perforation and 5 mm gastric antral perforation and liver laceration, all were closed primarily. The patient developed severe abdominal pain and tachycardia 4 days after the operation. Emergency computed tomography (CT) revealed pneumoperitoneum and hemoperitoneum. A second laparotomy was performed, the whole duodenum was

unhealthy with further multiple perforation sites ranging from 2 mm to 8 mm. PD was performed. The patient developed hypotension and abdominal distension the next day. Re-laparotomy was performed, and a 4-liter hemoperitoneum due to mesenteric bleeding was noted with hemostasis achieved. All anastomoses were intact. The patient subsequently received percutaneous drainage for intra-abdominal collection. The patient remained well stable after discharge and returned to normal life.

## Bleeding

Patient 1 had a history of good health. Presented with epigastric pain, repeated vomiting and tarry stool. Oesophagogastroduodenoscopy (OGD) revealed a circumferential ulcerative lesion at the D1/D2 junction, but biopsy was negative for malignancy. CT revealed circumferential wall thickening of the D2 causing a partial obstruction. The patient subsequently developed massive gastrointestinal bleeding and failed endoscopic hemostasis. An emergency operation was performed. Active bleeding was noted from an ulcerative lesion at the D2 infiltrating pancreatic head and root of the transverse colon. EPD and right hemicolectomy were done. The patient developed postoperation intra-abdominal collection which resolved with percutaneous aspiration. Drain fluid was high in amylase. The patient could be discharged on day 10 after surgery. Pathology confirmed 2.5 cm duodenal carcinoma invading through the duodenal wall. The patient had another laparotomy done for intestinal obstruction due to carcinomatosis 16 months after EPD and succumbed 31 months after the index operation.

Patient 2 presented with epigastric pain and tarry stool. OGD revealed extrinsic bulging from the medialwall of D2 with active oozing of blood. CT revealed a 9.9 cm large thick-walled cystic tumor over the medial aspect of D2, a suspected pancreatic head tumor with duodenal invasion or a duodenal gastrointestinal tumor (GIST) with pancreatic involvement. In view of persistent bleeding and the presence of a tumor, EPD was performed. The patient made an uneventful recovery and was discharged home on day 11. Pathology revealed 11 cm duodenal GIST with a clear resection margin. No adjuvant imatinib was given. The patient remained stable without recurrent disease for 16 years.

## Obstruction

Patient 3 presented with repeated vomiting, OGD revealed a polypoid tumor mass at the antrum causing obstruction, and a scope could not pass through. Biopsy of the tumor was negative for malignancy. CT revealed a pyloric tumor with regional lymphadenopathy. An emergency operation was performed for obstructing pyloric tumor. Intraoperatively, a tumor was found invading the pancreatic head and first part of the duodenum, so EPD was done. The patient complicated with POPF requiring total parenteral nutrition but collection was too deep-seated for percutaneous drainage. The patient eventufully recovered

and was discharged home on day 14. Pathology confirmed adenocarcinoma of gastric antrum invading the duodenum, with metastasis to 16 out of 28 lymph nodes. The patient refused adjuvant chemotherapy. He developed local recurrence and metastases to the para-aortic lymph nodes, adrenal gland and bone, one year after operation and died 13 months after EPD.

### Post-ERCP complication

Patient 7 presented with acute cholangitis to another hospital. ERCP was performed with a common bile duct stone removed, followed by laparoscopic cholecystectomy the next day. The patient developed persistent abdominal pain and CT reveal retroperitoneal collection with suspected duodenal perforation. Laparotomy was done 4 days after cholecystectomy with primary repair of the perforation site and drainage of retroperitoneal collection. However, the patient had persistent abdominal pain and bile leak from a drain and was transferred to our institute for further management. Repeated CT revealed diffuse peritonitis containing gas in the right and central retroperitoneum, extended inferiorly to the pelvis and bilateral the pelvic side walls, and superiorly to perihepatic space. In view of persistent sepsis, laparotomy was offered 10 days after the previous laparotomy. During the operation, two perforation sites, 1 cm and 2 cm in size, were noted involving the distal half of the D2 and D2/3 junction, with grossly contaminated retroperitoneum and diffuse purulent exudate in the intraperitoneal cavity. EPD was decided as further repair of duodenal perforations was deemed unsecure. The patient required another laparotomy on postoperative day 8 after EPD due to retroperitoneal and inter-loop abscess. There was no anastomotic leakage. The patient eventually went home after 31 days. She remained stable since discharge.

### Postoperative complication

Patient 8 was diagnosed with a 1.2 cm insulinoma at the pancreatic uncinate process. Robotic enucleation of the tumor was performed. The patient had persistent abdominal pain and fever after the operation. CT revealed a suspected pancreatic leak with peripancreatic inflammation and fluid collection. Ultrasound-guided drainage of abdominal collection was done. Drain fluid was high in amylase. ERCP was done 4 days after surgery. Contrast media extravasation was noted at the pancreatic duct and a pancreatic stent was inserted. However, the patient still experienced severe abdominal pain with on-and-off fever after pancreatic stent insertion. Repeated CT revealed a moderate amount of peripancreatic fluid centered around the surgical defect which tracked along the perihepatic space, subhepatic space, right paracolic gutter and pelvis. The collection appeared more rim-enhancing, suggestive of ongoing inflammation. Laparotomy was done on day 7 due to uncontrolled pancreatic leak and sepsis. During the operation, the pancreatic stent was exposed at the previous enucleation site with leakage of pancreatic juice and bile. EPD was performed. However,

the patient developed a persistent fever and increased white cell counts. Another CT on day 7 after EPD revealed suspected afferent limb obstruction and duodenojejunostomy (DJ) anastomotic leak. Re-laparotomy with omental patch repair of DJ leakage site, revision of HJ and Braun's jejunojejunostomy was performed on the same day. The patient gradually recovered from the third operation and was discharged home on day 20 after EPD. He remained well and was free from hypoglycemic attacks for almost 2 years.

## DISCUSSION

In the literature, EPD were rarely reported, and most were case reports or case series [1-12]. In this series, EPD accounted for just 2.2% of all cases of PD. The rate for nontraumatic causes has been reported to be 0.3% to 3% [10]. Indications for EPD were mainly classified into traumatic or nontraumatic causes. Nontraumatic causes were further classified as uncontrolled bleeding, perforation, ischemia and iatrogenic injuries. The reported mortality for EPD ranged from 0% to 40%, and the associated morbidity ranged from 50% to 80% [1-12]. Long-term outcomes of patients receiving EPD are rarely reported.

For pancreaticoduodenal trauma, EPD is indicated if there is extensive devitalization of the pancreatic head and duodenum in whom there is no prospect of a repair, or ductal disruption in the pancreatic head or ampulla of Vater [13]. In our series, patient 5 had multiple duodenal perforations and pancreatic neck transection making an EPD a logical surgical remedy. Patients 4 and 6 had multiple duodenal perforations and primary repair had been attempted in the initial operation but failed. Both required a subsequent EPD for control of persistent duodenal leak and sepsis. It should be noted that concomitant major visceral injury and resection of other organs is not uncommon in patients with multiple trauma like patients 4 and 5. Thus, the magnitude of surgery is usually more than just a PD in trauma cases.

For non-trauma causes, these are commonly divided into uncontrolled bleeding, perforation, ischemia or iatrogenic injury. In our series, patients 1 and 2 belonged to uncontrolled bleeding due to duodenal tumors, while patients 7 and 8 belonged to the last category. The indication of EPD for patient 3 in this series was controversial as duodenal obstruction usually does not warrant an emergency surgery and nasogastric decompression could relieve the acute problem without surgery. We did not have any EPD with an indication of ischemia which was previously reported due to duodenal ischemia/necrosis or pancreatic necrosis secondary to necrotizing pancreatitis [14]. Noniatrogenic perforation is usually secondary to tumor perforation or bowel ischemia. Iatrogenic injuries include complications after endoscopy or surgery. Most duodenal perforations have occurred after ERCP, but perforations after OGD necessitating an EPD have been reported [14]. EPD performed for complications after surgery included pancreatectomy, gastrectomy and

ampullectomy. Patient 8 in our series represented a salvage PD for the uncontrolled pancreatic leak after pancreatic head enucleation.

In this series, there was no operative mortality, but the morbidity was 87.5% and the POPF rate was 37.5%. During a similar period in our institution, the mortality, morbidity and POPF rate of elective PD were 1.7%, 51.4%, and 10.1%, respectively [15]. No doubt PD carried a higher risk in an emergency setting despite HBP surgeons being involved in all the cases in this series. But it should also be noted that more than half of the cases were unplanned EPD and half of them were done after office hours with two cases performed at midnight. This could add much more stress to the operating surgeons with the operation done at odd hours and unexpectedly. The median blood loss of 1,825 mL and length of hospital stay of 23.5 days were also compared unfavorably with elective cases (mean blood loss 740 mL, hospital stay 18.3 days) [15]. Nevertheless, EPD was meant for life-saving and in this sense, it was regarded as successful given that there was no operative mortality and all except three patients survived till now without long-term complications. Out of the three mortalities, two were due to relapse of malignancy while the last patient who eventually had a total pancreatectomy died due to poorly controlled diabetes mellitus and sepsis.

In the literature, an EPD mortality rate of 0% to 40% was reported [1-12]. Gulla et al. [6] reported a cumulative mortality rate of 29% for EPD from 1964 to 2013. The mortality rates varied with different indications. In an analysis of 220 EPD for trauma indication from 61 publications, Krige et al. [16] found an overall mortality rate of 34%. For nontraumatic cases, a systemic review by Popa et al. [14], which included 66 patients from 25 articles and one large retrospective study of 409 patients from the American College of Surgeons National Surgical Quality Improvement (NSQIP) database, showed a mortality rate of 19.69% in the 66 patient cohort and 10.3% in the NSQIP database cohort [17]. For mortality with different indications, it was 7.69% in the malignant cases, 50% in the necrotic lesion group, 33.33% in the perforation group, and 30.76% in the bleeding group [14]. Both post-ERCP and postoperative complication groups had a mortality rate of 22.22% [14]. In the analysis of the 66-patient cohort, Popa et al. [14] found a morbidity rate of 62%, POPF rate of 21.21%, blood loss of 800 mL and a length of hospital stay of 27 days for EPD. Long-term survival was rarely reported in the literature, with the longest survival of 60 months reported [18]. In contrast, our series included one patient who survived for more than 15 years after EPD.

The choice of standard Whipple or pylorus-preserving PD in EPD depends on whether the proximal part of D1 can be safely preserved. All except one patient in this series had a standard Whipple. It appears that a standard Whipple may be safer if the viability of D1 is a concern. In this series, seven patients had a PJ reconstruction, and only one patient had a drainage tube placed near the pancreatic stump. As a damage control measure, that particular patient also did not receive HJ reconstruction, and this was only performed in the subsequent operation. A two-stage PD with delayed fashioning of PJ has been advocated to bridge severely ill patients in emergency settings and avoid POPF development [8,9,19]. However, a study has shown that there is no difference in mortality between one-stage and two-stage EPD for hemodynamically unstable trauma patients [20]. Other authors advocate pancreaticogastrostomy (PG) for the management of pancreatic stump since in most cases of EPD the pancreas was soft with a nondilated pancreatic duct, together with the common finding of edematous jejunual wall, a duct-to-mucosa PJ would be technically demanding [3,12]. Nevertheless, the HBP surgeons in our institution performed duct-to-mucosa PJ and employed the same technique in emergency settings, and the results showed that POPF and complication rates were still acceptable. Other methods of managing the pancreatic stump were primary closure of the pancreatic stump or the cannulation of the pancreatic duct with a tube, forming an external pancreatostomy, but the results were inconclusive due to the limited number of cases done usually in unfavorable intraoperative conditions [14]. The results of this case series can throw some lights on the overall management and anticipated outcomes in the rare occasion of EPD. Although there is expected increased morbidity and mortality, EPD is still deserved in situations that are life-threatening. Common indications are pancreaticoduodenal trauma, uncontrolled bleeding, perforation, ischemia and iatrogenic injury of the pancreaticoduodenal region. The involvement of experienced HBP surgeons and timely operation are important for optimal surgical outcomes. Long-term survival is possible if complications and POPF can be successfully managed in the early postoperative period.

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## CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

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