



Original research

Emergency pancreaticoduodenectomy: When is it needed? A dual non-trauma centre experience and literature review



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HIGHLIGHTS

- Pancreaticoduodenectomy is nowadays a standardized operation in high volume centers.
- Emergency pancreaticoduodenectomy is performed as life-saving procedure in selected patients.
- Emergency pancreaticoduodenectomy is indicated where a less demolitive approach is unavoidable.

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ABSTRACT

Introduction: Emergency pancreaticoduodenectomy (EPD) has been very rarely reported in literature as a lifesaving procedure for complex pancreatic injury, uncontrollable hemorrhage from ulcers and tumors, descending duodenal perforations, and severe infection. The aim of this study was to analyze the experience of two non-trauma centers and to review the literature concerning emergency pancreaticoduodenectomy.

Methods: From January 2005 to December 2014, from a population of 169 PD (92 females and 77 males; mean age: 61.3, range 23–81) 5 patients (3%; 2 females and 3 males; mean age: 57.8, range: 42–74) underwent EPD for non-traumatic disease performed at two Academic Units of the University of Bari.

Results: The emergency pancreaticoduodenectomy subgroup of patients showed an overall morbidity of 80%, and mortality of 40%. In 80% (4/5) of patients treated by emergency pancreaticoduodenectomy, the pancreatic remnant was not reconstructed, and in 20% (1/5) a pancreaticojejunostomy was performed.

Conclusion: Emergency pancreaticoduodenectomy is an effective life-saving operation reservable to pancreatoduodenal trauma, perforations, and bleeding, unmanageable by a less invasive approach. It should be preferentially approached by surgeons with a high level of experience in hepatobiliary and pancreatic surgery and in trauma centers too, but it should also be in the armamentarium of general surgeons performing hepato-pancreato-biliary surgery.

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1. Introduction

Emergency pancreatic surgery is a very uncommon event,

usually connected to abdominal trauma, although it is also occasionally described for pancreatitis, ruptured aneurysms, bleeding pseudocysts, and progressive multiple organ failure in severe necrotizing pancreatitis [1]. Pancreaticoduodenectomy (PD) is a formidable operation, first described in 1935 by Whipple [2], for the cure of the periampullary tumors and, more recently, for benign diseases too, like chronic pancreatitis, duodenal cystic dystrophy, large adenomas, diverticula and benign periampullary tumors [3,4]. Emergency PD (EPD) has been rarely reported in literature as a lifesaving procedure for complex pancreatic injury, uncontrollable hemorrhage from ulcers and tumors, descending duodenal

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perforations, like in our previous experience [5], and severe infections [6,7]. While mortality rate of PD in elective surgery has shown a significant decrease during the last three decades, with an incidence of <5% in high volume centers, it remains high for EPD, until recently reporting mortality rates of 30%–40% [8,9]. However, given its rarity, there is still little data in literature on EPD, mostly in non-trauma patients.

The aim of this study was to analyze our experience of two non-trauma centers, and to review the literature concerning EPD.

2. Material and methods

From January 2005 to December 2014, from a population of 169 PD (92 females and 77 males; mean age: 61.3, range 23–81), 5 patients (3%; 2 females and 3 males; mean age: 57.8, range: 42–74) underwent EPD performed at two Academic Units of the University of Bari. In 101 (59.8%) cases a *Whipple* and in 68 (40.2%) a *Traverso-Longmire* procedure were respectively performed. In 155 (94.5%) cases, the indication to PD was malignancy, in 9 (5.5%) it was symptomatic chronic pancreatitis. The details of patients undergoing EPD are summarized in Table 1. In all patients treated in elective surgery, the pancreatic remnant was reconstructed, in 86 by pancreaticojejunostomy, in 74 by pancreaticogastrostomy, and in 9 by duct-to-mucosa pancreaticojejunostomy. Overall morbidity rate was 30.1% (51/169), and mortality rate was 1.8% (3/169).

3. Results

The mean postoperative hospital-stay of patients who underwent EPD was 73.6 days (range: 35–110), morbidity was 80%, and mortality rate was 40%. In 80% (4/5) of patients treated by EPD, the pancreatic remnant was not reconstructed, and in 20% (1/5) a pancreaticojejunostomy was performed.

3.1. Patient 1

A 66-year old woman was transferred to our surgical unit 5 days after laparoscopic cholecystectomy with diffuse peritonitis and septic shock. An emergency CT-scan confirmed a massive abdominal effusion, with a suspected descending duodenal wall rupture. An emergency laparotomy was performed and severe biliary peritonitis due to a large laceration resulting from electrocautery damage of the lower duodenal knee was confirmed (Fig. 1). An emergency *Whipple* procedure with pancreaticojejunal anastomosis was performed. During the postoperative period a conservatively managed pancreatic fistula (POPF) was observed. The patient was discharged 59 days after operation.

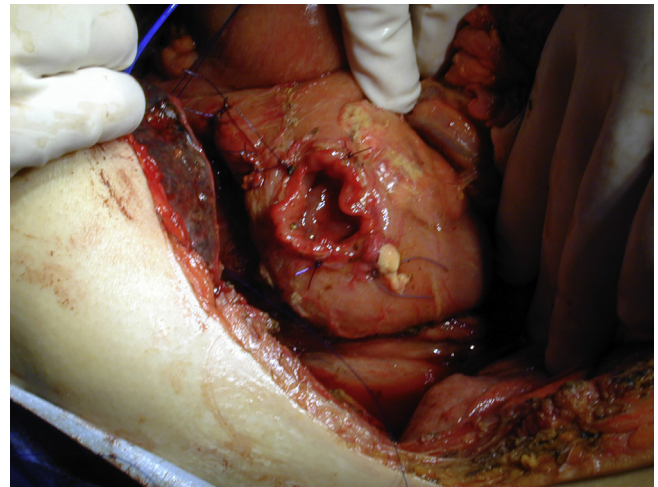


Fig. 1. Laceration resulting from electrocautery damage of the lower duodenal knee.

3.2. Patient 2

A 64-year old man, operated for a cerebral glioblastoma two months earlier, presented jaundice with a stable level of conjugated bilirubin at 7.0 mg/dl and repeated episodes of pancreatitis caused by a non-endoscopic-resectable ampulloma of the Vater's papilla. After repeated biopsies of the lesion demonstrating a moderate grade dysplasia, he underwent surgical ampullectomy with reinsertion of choledochus and *Wirsung's* duct at our Academic hospital. The operation was necessary to permit chemotherapy for glioblastoma. Unfortunately, on the 10th post-operative day, the patient had a dehiscence of the duodenal suture with biliary peritonitis confirmed by CT-scan. An emergency *Whipple* operation was performed with the closure of the pancreatic remnant. The patient died 45 days after the EPD, due to MOF. Surprisingly the pathologic examination of the specimen showed a diffuse infiltration of the surgical wound by poorly differentiated biliary malignant cells.

3.3. Patient 3

A 44-year old man developed a post-ERCP pancreatitis for gallstones disease, and was assisted for two months in the ICU before being transferred to our surgical unit for complex care. During the stay, the patient developed a large area of infected necrosis at the level of the head and body of pancreas, as demonstrated by a CT-scan; failure of antibiotic therapy to control the sepsis lead to surgical intervention. A *Traverso-Longmire* EPD with closure and drainage of the healthy pancreatic tail was performed.

Table 1
Details of patients underwent to EPD.

Pts	Primary procedure	Sex	Age, yr	Diagnosis	Means of diagnosis	Length of stay, d	Type of operation	Outcome
1	Postsurgical complication	F	66	Duodenal perforation following laparoscopic cholecystectomy	Clinical decision, CT scan	59	EPD + PJ	Survival
2	Postsurgical complication	M	74	Dehiscence of duodenal suture postampullectomy	Clinical decision, CT scan	89	EPD + CPS	Death
3	Postendoscopic complication	M	44	Severe necrotizing pancreatitis post ERCP	Clinical decision, CT scan	75	EPD + CPS	Death
4	Postsurgical complication	M	42	Dehiscence of cystojejunostomy for pancreatic pseudocyst	Clinical decision, CT scan	110	EPD + CPS	Survival
5	Postsurgical complication	F	63	Delayed duodenal perforation by foreign body following cholecystectomy	Clinical decision, CT scan	35	EPD + CPS	Survival

PJ indicates pancreaticojejunostomy; CPS indicates closure of the pancreatic stump; PG indicates pancreaticogastrostomy.

After two weeks, the patient underwent a re-laparotomy due to massive bleeding from the tail of the pancreas and underwent a completion total pancreatectomy. He died from a new episode of uncontrollable mesenteric bleeding, 75 days after EPD.

3.4. Patient 4

Emergency consultation was requested in a 42 year old man, an inpatient in ICU. After elective cysto-jejunostomy for pancreatic body pseudocyst he had three emergency reoperations following suture leak, that left him with a proximal duodenal drainage over a tube, a feeding jejunostomy and a colostomy (cecal level) for partial right colectomy. Failure of the purse string suture, holding the duodenal tube in place, as documented on CT scan, resulted in biliary peritonitis. At re-laparotomy, the significant damage of the pancreatic head and body motivated an indication to emergency Whipple procedure. Reconstruction was extremely difficult, as there was no small bowel available for biliary reconstruction, so the gastric antrum was used for hepatico-gastric anastomosis, while pylorus was resected and a gastroenterostomy completed reconstruction of the alimentary tract. The pancreatic stump, on the other hand, was abandoned and drained. He developed a POPF which was conservatively managed, and 110 days after EPD he was discharged. After one year, the gastric *antrum* was functionally separated by the stomach body and *fundus* with a linear stapler, to stop biliary reflux through the stomach. The patient was discharged uneventfully and was seen disease-free one year post surgery at follow up.

3.5. Patient 5

A 63-year old woman was admitted with acute abdomen. She had undergone elective open cholecystectomy and intraoperative cholangiogram for gallstones three years earlier, and she had a history of slow digestion and delayed gastric emptying in the previous four months. At admission, an urgent CT-scan revealed features of a foreign body in the right hypochondrium, and a significant amount of free fluid in the peritoneum. At laparotomy, a swab left in the right subhepatic space was found; it had slowly eroded in the duodenal lumen and had interrupted it, so that two duodenal openings could be seen, a proximal postpyloric and a distal one at D2. The common bile duct was also found open at its middle third in the cavity occupied by the foreign body. Whipple EPD with closure of the pancreatic stump was performed. The patient was cared for in ICU for two weeks, and discharged home from the ward 35 days post surgery. At 1-year follow-up the patient is disease-free.

4. Discussion

Emergency surgery of the pancreatoduodenal tract is rarely performed as a consequence of trauma, endoscopic and/or post-operative complications, uncontrollable bleeding from ulcers and tumors, and dramatic evolution of necrotizing pancreatitis.

Pancreatic trauma is relatively rare, occurring in <5% of patients after a major abdominal injury, but failure in its management may have devastating consequences. Penetrating wounds are usually very rare, but not in certain parts of the world; they represent 75% of pancreatic injuries, and can be determined by stabs or gunshot. Blunt trauma usually occur during road accidents, or during sports or assault blows by kicking and punching which crushes the pancreas against the spine. In both cases, associated injuries are often evident to liver, or to proximal small bowel [10,11]. CT-scan, performed in 100% of cases of this reported experience, is the diagnostic method of choice for the detection of pancreatic injury,

with sensitivity and specificity as high as 80%; MRCP too has been recently added to the diagnostic tools for pancreatic trauma. In physiologically stable patients, endoscopic retrograde colangiography (ERCP) is very useful for detecting pancreatic duct trauma and planning appropriate surgical or endoscopic (internal transpancreatic duct stenting, transductal drainage) corrections for patients who develop post injury complications [12]. Indeed, most pancreaticoduodenal injuries are low grade and can be managed non-operatively; even so when a surgical approach has been agreed, more patients can be treated by lavage-drainage and then with total parenteral nutrition in ICU, eventually reserving an EPD as a two-stage procedure [9,13,14]. The largest study on EPD for trauma to date consists of only 18 patients from a single center [9], and a recent study comparing EPD with non-EPD for severe pancreatoduodenal injuries, concludes that more conservative procedures for high grade injuries, like primary repair, drainage, duodenal exclusion, partial pancreatectomy, may be appropriate [15]. The first description of the use of EPD in two trauma patients dates back to 1964 by Thal [16], and its reported incidence for pancreatic injuries ranges from 0.075% to 5% [17–19]. In a review including 245 cases worldwide of all EPD performed for trauma until 1999, the mortality rate was 31% [20]. However, when massive nonreconstructable injuries involving pancreas, duodenum, common bile duct, or destruction of the ampulla of Vater are evident, the indication to EPD is unavoidable. In these situations though the majority of EPD are performed within 6 h of admission [15]. This data is surprising because these trauma patients should be managed with modern damage control principles (arrest hemorrhage, temporary control contamination, restore physiologic balance) deferring surgery to more favorable conditions; on the other hand, it is demonstrated that patients who underwent EPD for complex trauma died much later than patients with a non-EPD, who died with a median of only one day, usually due to hemorrhage [15]. However, since non-EPD patients are hemodynamically unstable, they would have died anyway. It is evident that it can be a difficult decision for the surgeon to indicate an EPD for trauma, and that there is still no agreement on the timing of operation. A larger series of patients should be analyzed to make definitive guidelines.

ERCP related perforations are a rare but serious complication, occurring in 0.3%–1.3% of ERCP, with higher incidence in therapeutic than diagnostic procedures [21]. Even in this situation, CT-scan is the imaging of choice for diagnosis. However, the trap is that the postoperative pain is often attributed to ERCP pancreatitis, delaying diagnosis [22]. Many of these perforations can be successfully treated by a conservative approach with or without a biliary stent or local repair, momentarily salvaging the emergency state. However, in the light of this, the clinical condition of the patient is crucial: the appearance of biliary peritonitis, fistula formation, focal pancreatitis, could determine an adverse condition, impairing subsequent approach by demolitive surgery. For this reason the timing of operation is fundamental. EPD can represent the final choice, showing curative intent mostly in case of malignancies [1].

Duodenal postoperative perforations usually require immediate surgery. As the consequence of the spreading of laparoscopic cholecystectomy over the last few decades, the incidence of bowel injuries has increased to 0.007–0.9% of cases, especially during initial experience [7,23–25]. While bile duct injury is the most common, bowel and vascular injuries are the most lethal technical complications. Bowel injuries resulting from trocar puncture are usually readily recognized and promptly repaired, whereas thermal injury is often overlooked in the course of the procedure and may manifest itself days or weeks later as a consequence of coagulation necrosis of the bowel wall as a delayed or walled off perforation [23]. A delay in diagnosis may result in sepsis and peritonitis,

contributing to the relatively high associated mortality [26]. However, the overall mortality rate of duodenal perforation secondary to laparoscopic cholecystectomy ranges from 8.3% [26] to 16% [27], but mortality varies from 30% to 75% when sepsis results in a multiorgan failure [28–30]. The site of duodenal injury determines the type of surgical approach, and for this reason, an adequate preoperative imaging by CT-scan multiplanar reconstruction is mandatory. Indeed, laceration of the duodenal bulb or superior flexure of the duodenum can be safely treated with gastric resection by closing the duodenal stump. When the injury is just above or below ampulla of Vater however, resection of the damaged tissue could be difficult. Mucosal or serosal patches and a pedicled graft with a free vascular pedicle created from stomach, jejunum, or ileum tissue have been proposed without proven efficacy in any series [31–34]. Duodenal drainage with a decompression tube, temporary pyloric exclusion, gastrojejunostomy, feeding jejunostomy, gastric resection with external duodenal drainage with Foley or Petzer tubes, have also been recommended with conflicting reports of efficacy [7,35–37]. In the presence of larger defects, Roux-en-Y duodenojejunostomy and EDP procedures have been proposed too [7,38,39], but when sepsis and peritonitis occur, the risk of anastomotic dehiscence is very high.

Endoluminal duodenal bleeding, can usually be managed by endoscopic approach with interventional hemostasis. As second step, early interventional angiography with embolization of pancreaticoduodenal arcades is the treatment of choice [40], but in the presence of erosive tumors it might not solve the problem and is sometimes even contraindicated. Moreover, this procedure could be also ineffective because of the notable collateral blood supply of the pancreaticoduodenal block from the celiac and superior mesenteric arterial circulation. When endoscopic and angiographic attempts have failed, surgery is needed. Non-demolitive operations, like vascular ligations of the bleeding artery usually allow the hemorrhage to be stopped but, sometimes, EPD is unavoidable [1].

Finally, when a dramatic evolution of necrotizing pancreatitis rarely appears, and conservative therapy has failed, the preferred treatment seem to be explorative laparotomy with the position of multiple drainages continuously washing, reserving the EPD to exceptional cases alone, as in one reported in this series.

Successful isolated EPD have been also reported for bleeding from duodenal varices [41], diffuse *B-Cell* Lymphoma of the duodenum [42], giant GIST of the duodenum [43], duodenal paraganglioma [44], and for high flow biliary fistula resulting from a prior right nephrectomy by lumbar approach [45], rupture of a mucinous cystic neoplasm in a pregnant woman [46], ampullary tumor with spontaneous perforation of an aberrant bile duct totally laparoscopically treated [47], and in association with oesophagogastric injury [48]. Moreover, a large series of 18 patients affected by caustic injuries in which an EPD was associated with oesophagogastric injury has been reported by *Lefrancois*, with a mortality rate of 39% (N = 7/18) [49].

In any case, thanks to an improvement in survival and mortality rate, with large series of pancreatic resection without mortality too [50,51], the indication for PD is expanding to older patients and also to those with higher operative risks. This has been determined by the improvement of anesthesia, and of surgical skill in high volume specialized centers, by spreading of critical care surgery, the decrease of operative blood loss and of operating time, the use of new surgical devices, and the optimized management of post-operative complications [3,4]. This leap has made PD a standardized operation in high volume centers, but also in small volume ones. Conversely, EPD still remains an extreme surgical approach in extremely rare circumstances, and its mortality rates are still very significant ranging up to 54% in patients with associated injuries, in specialized and trauma centers too [8,12], although a low mortality

rate has been achieved in smaller series [52–54]. Nevertheless, EPD, as noted before, is reported in literature as the last chance for duodenopancreatic region trauma, postendoscopic or post-operative complications, and bleeding [17]. Also in our previous experience, EPD was employed in only 20% of iatrogenic descending duodenal injuries [7], and minimally invasive approaches have been chosen before approaching pancreatic emergency by EPD [55]. However, starting from its still high mortality rate, the use of this operation should only be given to surgeons who are highly experienced in pancreatic surgery, because prognosis depends, in some part, on the timing to intervention and experience of the operative surgeon [56]. Moreover, even if CT-scan is the diagnostic method of choice, some indications to EPD have been not based on imaging, but on clinical decision.

When an EPD is undertaken, the management of pancreatic stump is still controversial. In elective surgery, pancreaticojejunal, gastrojejunal, and duct-to-mucosa anastomoses are the most widely used methods of reconstruction of the pancreatic stump, and the simple closure of the pancreatic stump by suture, stapler or occlusion/ligation of the pancreatic duct, has nowadays been widely abandoned due to the high fistula rate, pancreatitis, post-operative insulin-dependent diabetes, and reduction of the quality of life. However, when an EPD is performed, usually a soft, normal pancreatic parenchyma, and a normal, non dilated pancreatic duct is found. Consequently, the abandonment of the pancreatic remnant could be the last remaining indication, especially in low-volume centers and in hemodynamically unstable patients, unable to tolerate longer operative time.

In our experience EPD has been employed in 3% of overall PD, always in non-traumatic occurrences, proving to be a life-saving operation in 60% of cases, and confirming itself as a last chance if less demolitive treatment is unfeasible.

5. Conclusions

Emergency pancreaticoduodenectomy is a formidable life-saving operation reservable to pancreatoduodenal trauma, perforations, and bleeding, not manageable by a less invasive approach. It can be preferentially approached by surgeons with a high level of experience in hepatobiliary and pancreatic surgery and in trauma centers too, but it should also be in the armamentarium of general surgeons in all minimal volume hospital performing hepato-pancreato-biliary surgery, under exceptional circumstances.

Ethical approval

Ethical approval was requested and obtained from the “Azienda Universitaria Federico II” ethical committee.

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Author contribution

Germana Lissidini and Mario Testini: Participated substantially in conception, design, and execution of the study and in the analysis and interpretation of data; also participated substantially in the drafting and editing of the manuscript.

Francesco Paolo Prete: Participated substantially in conception, design, and execution of the study and in the analysis and interpretation of data.

Giuseppe Piccinni: Participated substantially in conception, design, and execution of the study and in the analysis and interpretation of data.

Beatrice Di Venere: Participated substantially in conception, design, and execution of the study and in the analysis and interpretation of data.

Angela Gurrado: Participated substantially in conception, design, and execution of the study and in the analysis and interpretation of data.

Simone Giungato: Participated substantially in conception, design, and execution of the study and in the analysis and interpretation of data.

Fernando Prete: Participated substantially in conception, design, and execution of the study and in the analysis and interpretation of data.

Conflicts of interest

All Authors have no conflict of interests.

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