

## ORIGINAL ARTICLE

# Wirsungostomy as a salvage procedure after pancreaticoduodenectomy

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## Abstract

**Background:** Mortality rates associated with postoperative peritonitis or haemorrhage secondary to pancreatic fistula (PF) after pancreaticoduodenectomy (PD) remain high. This study analysed the results of an alternative management strategy for these life-threatening complications.

**Methods:** All patients undergoing PD between January 2004 and April 2011 were identified. Patients who underwent further laparotomy for failure of the pancreatoco-digestive anastomosis were identified. Since 2004, this problem has been managed by dismantling the pancreatoco-digestive anastomosis and canulating the pancreatic duct remnant with a thin polyethylene tube (Escat tube), which is then passed through the abdominal wall. Main outcome measures were mortality, morbidity and longterm outcome.

**Results:** From January 2004 to April 2011, 244 patients underwent a PD. Postoperatively, 21 (8.6%) patients required re-laparotomy to facilitate a wirsungostomy. Two patients were transferred from another hospital with life-threatening PF after PD. Causes of re-laparotomy were haemorrhage ( $n = 12$ ), peritonitis ( $n = 4$ ), septic shock ( $n = 4$ ) and mesenteric ischaemia ( $n = 1$ ). Of the 21 patients who underwent wirsungostomy, six patients subsequently died of liver failure ( $n = 3$ ), refractory septic shock ( $n = 2$ ) or mesenteric ischaemia ( $n = 1$ ) and nine patients suffered complications. The median length of hospital stay was 42 days (range: 34–60 days). The polyethylene tube at the pancreatic duct was removed at a median of 4 months (range: 2–11 months). Three patients developed diabetes mellitus during follow-up.

**Conclusions:** These data suggest that preservation of the pancreatic remnant with wirsungostomy has a role in the management of patients with uncontrolled haemorrhage or peritonitis after PF.

## Keywords

pancreatic neoplasm, pancreatic resection, pancreatic anastomotic fistula, postoperative haemorrhage, postoperative peritonitis

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## Introduction

Among experienced centres, mortality rates after pancreaticoduodenectomy (PD) have decreased to <5% over the last 20 years, but morbidity rates remain high at 30–50%.<sup>1–3</sup> One of the most common complications after PD is breakdown of the pancreatoco-digestive anastomosis, which leads to pancreatic fistula (PF). This can cause other major complications, such as

haemorrhage, intra-abdominal abscess, bile leak, wound infection and cardiac failure,<sup>4</sup> mainly because of the highly erosive nature of the pancreatic fluid. Mortality in patients with PF is reported to range from 0% to 40%.<sup>2,4–9</sup> Although the majority of patients with PF can be managed conservatively with medical and radiological therapy, re-laparotomy may be required for PF complicated by peritonitis, intra-abdominal abscess or uncontrolled haemorrhage.<sup>10–12</sup> Early diagnosis and appropriate management of postoperative complications are essential to improve surgical results. Outcomes depend on the ability to control the source of sepsis or bleeding. One way to improve prognosis in patients with

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life-threatening complications, such as peritonitis or uncontrolled haemorrhage secondary to PF after PD, is by wirsungostomy, which refers to the complete external catheter drainage of the remaining pancreatic duct after a specific procedure performed to control sepsis or haemorrhage. This study reports a single-centre experience of wirsungostomy used as an alternative to completion pancreatectomy. The study centre performs a high number of pancreatic resections.

## Materials and methods

From January 2004 to April 2011, patients who underwent PD at Haut-Lévêque Hospital, University of Bordeaux Hospital Centre (Centre Hospitalier Universitaire de Bordeaux) were retrospectively identified from the PD database. Patients were included for further study if they had undergone wirsungostomy for PF.

Data analysed for wirsungostomy patients included the postoperative interval between PD and re-laparotomy, the grade and type of complications associated with PF, and surgical parameters such as operative time and amount of bleeding during re-laparotomy. Main outcome measures such as mortality, morbidity and long-term outcome were assessed by interview.

Pancreatic fistulae were identified by the presence of amylase-rich fluid of more than three times the serum concentration collected from postoperative day 3 from the drain placed intraoperatively in the abdomen, in accordance with criteria defined by the International Study Group on Pancreatic Fistula (ISGPF).<sup>13</sup>

Haemorrhage was defined according to ISGPF criteria<sup>14</sup> by three parameters, including onset, location and severity. Early haemorrhage occurred at  $\leq 24$  h after the end of the index operation. The location was either intraluminal or extraluminal. Severe haemorrhage was defined by a drop in haemoglobin level of  $\geq 3$  g/dl, or by clinically significant impairment (e.g. tachycardia, hypotension, oliguria, hypovolaemic shock) requiring blood transfusion, or by the need for invasive treatment (angiographic embolization or re-laparotomy). According to these three parameters, haemorrhages were classified as Grade A, B or C.

Sepsis was defined by the presence of both infection and systemic inflammatory response. Septic shock was defined as severe sepsis (sepsis complicated by organ dysfunction) plus a state of acute circulatory failure characterized by persistent arterial hypotension despite adequate fluid resuscitation.<sup>15</sup>

Postoperative peritonitis was suspected according to the presentation of clinical symptoms such as peritoneal tenderness, abdominal pain and fever of  $>38.5$  °C, and was confirmed at surgery.

Intra-abdominal collection was diagnosed by a computed tomography (CT) scan, which was performed in patients in whom the postoperative course was complicated.

Delayed gastric emptying (DGE) was defined as the inability to return to a standard diet by the end of the first postoperative week and included prolonged nasogastric intubation of the patient

according to the International Study Group of Pancreatic Surgery (ISGPS) definition.<sup>16</sup>

Postoperative complications were retrospectively classified according to the system of Clavien and colleagues for each patient.<sup>17</sup>

## Surgical procedure

The surgical procedure at re-laparotomy included complete exploration and lavage of the abdominal cavity, eradication of all sources of infection and drainage of dependent areas, debridement of necrotic tissues and the establishment of haemostasis by the elective ligation of the source of bleeding.

The pancreatico-digestive anastomosis was dismantled. The jejunal stump was closed using a GIA® stapler. An overcast stitch using a PDS® 4/0 suture was used to secure haemostasis. The proximal third of the remaining pancreatic duct was then cannulated with a thin polyethylene tube with lateral holes at one end (Escat drain) in order to enable better pancreatic fluid drainage. The catheter was then stitched to the pancreatic remnant with a PDS® 5/0 suture by two U-shaped interrupted sutures, and the free end was passed through the abdominal wall and stitched to the skin as a controlled pancreaticocutaneous fistula. Two silicone drains were placed; one of these was positioned behind the hepatico-digestive anastomosis and passed through the right side of the abdominal wall, and the other was placed close to the pancreatic remnant and passed through the left side of the abdominal wall. In some patients a Witzel feeding jejunostomy was performed in the jejunal loop immediately distal to the gastroenterostomy. The abdominal wall was closed in a conventional manner.

Postoperative evaluation of leucocytosis, C-reactive protein (CRP) and glycaemia was systematically performed during hospitalization. No patient received medication to decrease digestive or pancreatic secretion. Parenteral nutrition was started as soon as possible and replaced by enteral or oral feeding once the gastrointestinal ileus had resolved. The silicone drains placed in the abdominal cavity were removed when output reduced to  $<30$  ml.

Patients in whom output via the Escat tube persisted after a few months required an injection of coil (Neoprene®) into the drain. The pancreatic exocrine insufficiency induced was treated with oral pancreatic enzyme when feeding started.

## Results

Of the 244 patients who underwent PD, 62 (25.4%) had a PF. A total of 41 patients (66.1%) with PF of Grades A and B were managed conservatively, whereas 21 patients (33.9%) with Grade C PF required re-laparotomy for wirsungostomy ( $n = 19$ ) or completion pancreatectomy ( $n = 2$ ). Two other patients were transferred from another hospital with Grade C PF that required re-laparotomy for wirsungostomy. Completion pancreatectomy was performed for massive haemorrhage in two patients at the beginning of the series. These two patients were not included for further analysis.

**Table 1** Patient characteristics

Characteristic	n	%
American Society of Anaesthesiologist (ASA) score	21	
1	5	23.8
2	12	57.2
3	4	19.0
Indication for duodenopancreatectomy	21	
Adenocarcinoma of the pancreas	9	42.8
Adenocarcinoma of the ampulla	4	19.0
Adenocarcinoma of the duodenum	1	4.8
Neuroendocrine neoplasm	3	14.2
Intraductal papillary mucinous neoplasm of the pancreas	1	4.8
Cholangiocarcinoma	1	4.8
Gastrointestinal stromal tumour of the duodenum	1	4.8
Metastasis of colonic cancer	1	4.8

The 21 patients who underwent wirsungostomy included 18 men and three women. Their median age was 66 years (range: 48–78 years). Medical comorbidities, defined according to American Society of Anesthesiologists (ASA) scores and indications for PD, are shown in Table 1. Pancreaticoduodenectomy was performed in all patients and was reconstructed with either a pancreaticojejunal ( $n = 20$ ) or pancreaticogastric ( $n = 1$ ) anastomosis.

In the initial postoperative course, 15 patients were diagnosed with Grade C PF. Fluid drainage in six patients was poor in amylase and PF was diagnosed during re-laparotomy. The median time between the initial operation and re-laparotomy was 9 days (range: 2–21 days). All reoperations were performed as emergency procedures.

Patients were reoperated for haemorrhage ( $n = 12$ ) externalized through the abdominal drain ( $n = 7$ ) or into the gastrointestinal tract ( $n = 2$ ) and classified as Grade B ( $n = 1$ ) or C ( $n = 11$ ), peritonitis ( $n = 4$ ), septic shock ( $n = 4$ ) or mesenteric ischaemia ( $n = 1$ ). Haemorrhage for the other three patients was not externalized. The reoperation rate in patients with PF was 33.9% (21 of 62 patients), whereas the overall reoperation rate was 8.6% (21 of 244 patients). In this series, the only cause of reoperation was PF with health-threatening complications. No patients were reoperated for other causes. Haemorrhage occurred in 15 of 62 (24.2%) cases of PF. The overall bleeding rate after PD in this series was 6.1% (15 of 244 patients). Patients with haemorrhage required wirsungostomy ( $n = 12$ ), completion pancreatectomy ( $n = 2$ ) and radiologic embolization ( $n = 1$ ). No haemorrhage occurred without PF. Of the patients who underwent wirsungostomy, 11 had delayed haemorrhages and one had an early haemorrhage. No patient had a sentinel bleed before the haemorrhage requiring re-laparotomy. All patients required intensive care unit (ICU) treatment for life-threatening complications. Ten patients suffered single-organ

dysfunction of Grade IVa and four patients suffered multi-organ dysfunction of Grade IVb.

### Operative characteristics of wirsungostomy

The median operative time was 120 min (range: 60–200 min). The median operative blood loss was 790 ml (range: 100–2000 ml). The median transfusion of packed red blood cells required was 2.3 units (range: 0–6 units). Haemorrhage originated from erosion of the hepatic artery ( $n = 4$ ), the splenic artery ( $n = 1$ ), the stump of the gastroduodenal artery ( $n = 1$ ), and from the cut surface of the pancreatic remnant ( $n = 3$ ). Three patients showed no active bleeding during the procedure.

### Postoperative course after wirsungostomy

Six patients died in the early postoperative period. Three patients who required ligation of the hepatic artery for haemostasis secondary to hepatic artery erosion died of hepatic failure within 3 days postoperatively. Two patients died of refractory septic shock. The last patient died after reoperation for extensive mesenteric ischaemia. The mortality rate of patients with PF was 9.7% (six of 62 patients). Postoperative mortality rates were 19.0% (four of 21 patients) after haemorrhage and 9.5% (two of 21 patients) after peritonitis or septic shock.

Nine patients suffered a combined total of 16 postoperative complications. These included acute kidney failure (in four patients, two of whom required haemofiltration), DGE (in three patients), fistula of the biliodigestive anastomosis (in one patient), pleural effusion (in three patients, two of whom required percutaneous drainage), pneumonia (in one patient), intrahepatic abscess (in one patient with ligation of hepatic artery), abscess of the abdominal wall (in two patients) and re-laparotomy to reposition the catheter of the remaining pancreatic duct (in one patient). Six complications were classified as Grade IIIa, one as Grade IIIb and nine as Grade II. The median length of hospital stay of survivors was 42 days (range: 34–60 days).

### Longterm follow-up

Fifteen patients were available for longterm follow-up. Nine patients developed a pancreatic pseudocyst during the follow-up, but only three of them required analgesic therapy. None required percutaneous or transgastric drainage.

The median time to Escat drain removal was 4 months (range: 2–11 months). During follow-up the drains in two patients were found to be blocked and required a 2-ml injection of serum. Two patients required an injection of coil (Neoprene®) into the drain before removal because drain output of <5 ml persisted.

Three patients developed postoperative diabetes mellitus (DM) requiring insulin therapy. All patients required oral pancreatic enzyme replacement therapy.

Three patients received adjuvant chemotherapy. Six patients developed disease recurrence. Four of these six patients died within 7, 8, 9 and 15 months, respectively, of the PD.

## Discussion

The safety of a pancreatico-digestive anastomosis is closely related to the texture of the pancreatic remnant, which is the main determining factor of PF after PD.<sup>4,17–21</sup> Rates of PF after PD are strictly dependent upon the definitions used. Prior to the ISGPF definition,<sup>13</sup> Bassi *et al.*<sup>22</sup> reported incidences of PF as ranging from 9.9% to 28.5% according to the various definitions of PF. In most patients, PF was not symptomatic and was diagnosed biochemically. However, pancreatic anastomotic breakdown can lead to haemorrhage, peritonitis, sepsis and abscess development and requires re-intervention in 10–15% of patients.<sup>6,17,23–25</sup> This results in a subsequent increase in mortality after PD.<sup>2,3,6,12</sup> Although some studies<sup>6,17,23,25,26</sup> have shown significant reductions in overall rates of re-laparotomy, indicating that many complications can be managed by non-operative means, the same studies reported that around 15–50% of patients required surgical intervention after radiological drainage. In the present study, the reoperation rate for PF was 33.9% (overall reoperation rate: 8.6%) and the mortality rate of patients with PF was 9.7% (overall mortality: 2.4%); this compares with rates of 0–40% reported in the literature.<sup>2,4–9</sup>

Massive haemorrhage is the most critical complication of PF after PD and is associated with high mortality.<sup>12,27,28</sup> Delayed haemorrhage either originates from the gastrointestinal tract as a result of ulceration at an anastomosis or occurs intra-abdominally as a result of pseudoaneurysm secondary to PF.<sup>12,27–29</sup> Blanc *et al.*<sup>12</sup> reported haemorrhage after PD in 27 of 411 patients (6.6%), in only two of whom (7.4%) conservative treatment including coil embolization and exclusion by covered stent was performed (one patient had sentinel bleeding and one demonstrated an isolated fall in haemoglobin level). Angiographic embolization is most useful in patients with sentinel bleeding before massive haemorrhage and haemodynamic instability occur. Patients with PF often require reoperation when haemorrhage occurs.<sup>12,24,27,28</sup> In the present study, the prevalence of massive and life-threatening haemorrhage was 4.9% ( $n = 12$ ), which is in keeping with a rate of post-PD haemorrhage of 5.7% reported in the literature.<sup>30</sup> Four patients required ligation of the hepatic artery and three of these patients died secondary to liver failure caused either by ischaemia of the biliary tree or by fatal recurrent liver abscesses.<sup>8</sup> Haemodynamic instability precluded the administration of endovascular treatment with coil embolization or covered stent in all of these four patients.

When reoperation is required to control massive delayed haemorrhage or sepsis, many surgical procedures can be performed. These include completion pancreatectomy, which is often recommended,<sup>6,10–12,31–33</sup> and the dismantling of the pancreatico-digestive anastomosis and preservation of the pan-

creatic tail with closure<sup>12,33</sup> or with external catheter drainage of the pancreatic duct remnant.<sup>27</sup> Other than the study by de Castro *et al.*,<sup>33</sup> which reported no deaths in a series of nine completion pancreatectomies, and a study conducted by Farley *et al.*,<sup>32</sup> which reported a 24% mortality rate, this procedure is associated with high mortality rates of 38–71%.<sup>6,10,11,31</sup> Tissues in the surgical pancreatic field are very inflamed and are haemorrhagic and fragile. Surgical exploration and the identification of the bleeding vessel related to a PF may be difficult. In these circumstances, completion pancreatectomy is technically demanding and potentially hazardous, and involves a mean operative time of around 160 min and a mean operative blood loss of around 1800 ml.<sup>32</sup> In the present study, the median operative time was 105 min and the median operative blood loss was 700 ml. A recent review of the literature on abdominal trauma recommended that surgeons should avoid extensive procedures in unstable patients.<sup>34</sup> Early control of bleeding achieved by a short operative procedure helps to prevent heat loss, acidosis and coagulopathy in patients who require ICU care. In the present study, patients with life-threatening haemorrhage required the same approach. An earlier study<sup>27</sup> reported the use of external pancreatic duct drainage as a salvage procedure for massive haemorrhage related to PF after PD. Mortality following external pancreatic duct drainage in this study occurred in four of seven patients (57.1%),<sup>27</sup> whereas in the present study death occurred in six of 21 patients (28.6%). Furthermore, completion pancreatectomy induces unstable DM, which is associated with severe hypoglycaemic events and recurrent infections which alter the patient's quality of life.<sup>10,32,35,36</sup> Some authors<sup>36,37</sup> have shown that postoperative diabetes can be avoided if 5 cm of pancreatic remnant can be preserved to allow the persistence of Langerhans cells in the pancreatic parenchyma. In the present study, only three of 15 patients developed DM during longterm follow-up and all DM was well controlled with insulin therapy.

The controlled pancreaticocutaneous fistula, achieved by wirsungostomy, healed spontaneously in the majority of patients in the present study. Only two patients required coil injection to stop the output of the wirsungostomy. In all the other patients the output of the wirsungostomy stopped spontaneously. Nine patients developed a pancreatic pseudocyst after wirsungostomy, but only three required analgesic therapy and none required pseudocyst drainage. The drained pancreatic stump can become fibrotic with pancreatic duct distension. In the event of symptomatic pseudocyst, transgastric drainage is preferable to percutaneous drainage.

Although it is difficult to make comparisons among a small number of patients, these data suggest that preservation of the pancreatic remnant using wirsungostomy has a role in the management of patients with uncontrolled haemorrhage or peritonitis after PF.

## Conflicts of interest

The authors have no conflict of interest.

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