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## Whipple's pancreaticoduodenectomy: Surgical technique and perioperative clinical outcomes in a single center



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## ABSTRACT

**Introduction:** Pancreatic cancer is the fourth cause of death from cancer in Western countries. The radical surgical resection is the only curative option for this pathology. The prevalence of this disease increases with age in population. The causes of pancreatic cancer are unknown, but we consider risk factors like smoke and tobacco usage, alcohol consumption coffee, history of diabetes or chronic pancreatitis. In this study we report our experience in the treatment of resectable pancreatic cancer and periampullary neoplasms with particular attention to evaluate the evolution of surgical technique and the clinical postoperative outcomes.

**Methods:** In our Department between January 2010 and December 2014 we performed a total of 97 pancreaticoduodenectomy. We considered only resectable pancreatic cancer and periampullary neoplasms defined by absence of distant metastases, absence of local tumor extension to the celiac axis and hepatic artery as the lack of involvement of the superior mesenteric vasculature. None of these patients received neoadjuvant chemotherapy.

**Results:** The mean age of these patients was 64.5 years. Jaundice was the commonest presenting symptom associated to anorexia and weight loss. The mean operative time was 295 min ( $\pm 55$  min). The mean blood loss was 450 ml and median blood transfusion was 1 units. 12.1% of patients had an intra-abdominal complication. The commonest complication was Delayed Gastric Emptying responsible of increased length of hospital stay and readmission rate. Postoperative pancreatic fistula of grade C occurred in 4 patients. 2 patients developed a postpancreatectomy hemorrhage. Perioperative mortality was 4.1%.

**Conclusion:** Pancreaticoduodenectomy is a complex surgical technique and the associated high morbidity and mortality resulted in initial reluctance to adopt this surgery for the management of pancreatic and periampullary tumors. Surgical outcomes of pancreatic surgery are better at high-volume experienced center reporting mortality rates below 5%. We perform an end-to-side duct-to-mucosa pancreaticojejunostomy with routinely use of internal pancreatic stent. However no one technique has been shown to definitely be the solution to the problem of postoperative pancreatic fistula. At our center we have a reasonable volume and our data are comparable to literature data.

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## 1. Introduction

Pancreatic cancer is one of the most important neoplasm in Western countries and it is the fourth cause of death from cancer [1]. The radical surgical resection is the only curative option, but unfortunately more than 80% of patients presents unresectable disease to hospital access. Riall TS et al. showed that the 5-year

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survival following pancreaticoduodenectomy is approximately 15–20% [2]. We know that this survival is higher for the others periampullary neoplasms like distal bile duct cancer (20–25%), ampullary cancer (30–40%) and duodenal cancer (50–60%). For the same reason in the past decades many surgeons recommended only palliative care for patients with periampullary cancers [3,4]. The prevalence of this disease increases with age in population. Patients 20–29 years old have an annual incidence of 0.1 cases of pancreatic cancer per 100,000 population, while patients older than 80 have an annual incidence of 87.2 cases per 100,000 population. The causes of pancreatic cancer are unknown, but we consider risk factors like smoke and tobacco usage, alcohol consumption, coffee, history of diabetes or chronic pancreatitis [5]. In this study we report our experience in the treatment of resectable pancreatic cancer and periampullary neoplasms with particular attention to evaluate the evolution of surgical technique and the clinical postoperative outcomes.

## 2. Methods

In our Department of General and Emergency Surgery at the University Hospital Policlinico “P. Giaccone” of Palermo between January 2010 and December 2014 we performed a total of 97 pancreaticoduodenectomy. In this retrospective study the patient characteristics registered were age, gender, presenting symptoms, past medical history and presence of comorbidity with American Society of Anesthesiology (ASA) score, operative time, postoperative complication including causes of re-laparotomy and death [6,7]. We considered only resectable pancreatic cancer and periampullary neoplasms defined by absence of distant metastases, absence of local tumor extension to the celiac axis and hepatic artery as the lack of involvement of the superior mesenteric vasculature. None of these patients received neoadjuvant chemotherapy [8].

### 2.1. Pre-operative work up

Before surgery all patients were submitted routinely to computed tomography (CT) scan to study the characteristics and size of the lesion. Abdominal magnetic resonance imaging (MRI) and endo-ultrasonography were performed for selected patients [9,10]. Pre-operative biliary drainage was done with ERCP if the serum bilirubin was more than 20 mg/dl or if the patient had fever because of acute cholangitis [11,12].

### 2.2. Surgical technique

All patients were explored using a bilateral subcostal laparotomy. All patients underwent a standard Whipple pancreaticoduodenectomy. For pancreaticojejunostomy we used an end-to-side duct-to-mucosa anastomosis. In this case a two-layer anastomosis was constructed with interrupted absorbable suture material, beginning with a posterior row of seromuscular sutures securing the jejunum to the pancreas. The pancreatic duct-to-mucosa anastomosis was performed to an enterotomy in the jejunum with a second circumferential layer of interrupted sutures, followed by completion of an anterior layer of seromuscular sutures between anterior aspect of jejunum and pancreatic capsule. In other cases we used a modified duct-to-mucosa technique, originally created by Blumgart [13]. In this technique an outer layer of absorbable sutures are first inserted full-thickness anterior-to-posterior through the pancreas with subsequent seromuscular stitches on the jejunum. In both cases we used an internal pancreatic duct stent (size 4–5 Fr) in order to divert the pancreatic secretions away from the pancreaticojejunal anastomosis with

decreased risk for leak formation [14]. Then we performed end-to-side hepaticojejunostomy and finally gastrojejunostomy.

### 2.3. Post-operative analysis

We considered the morbidity like complication that requiring medical or surgical intervention. Causes of morbidity, related to surgical technique, were postoperative pancreatic fistula (POPF), delayed gastric emptying (DGE) and postpancreatectomy hemorrhage with bleeding in the form of fresh blood in nasogastric tube or hematemesis and/or melena necessitating of blood transfusion, embolization or relaparotomy [15–18]. Perioperative mortality was all deaths within 30 days of surgery or in the same admission, irrespective of cause.

## 3. Results

During the study period we treated 97 patients with Whipple procedure, 53 males and 44 females.

Preoperative data: the mean age of these patients was 64.5 years (range 33–83). Jaundice was the commonest presenting symptom associated to anorexia and weight loss; fewer patients had abdominal pain, nausea and vomiting (Table 1). Only 8 patients (7.8%) underwent a preoperative biliary drainage with ERCP, papillotomy and temporary stent. We also registered the presence of comorbidity with American Society of Anesthesiology (ASA) score.

Intraoperative factors: the mean operative time was 295 min ( $\pm 55$  min). The mean blood loss was 450 ml (range 250–700 ml) and the median blood transfusion was 1 (range 0–3) units. In this study we considered only resectable cancer so we did not performed vascular resection. 18 patients went to Intensive Care Unit (ICU) in postoperative period.

Postoperative course: 12.1% of patients had an intra-abdominal complication. The more frequent complication was DGE responsible of increased length of hospital stay and readmission rate. POPF of grade C with re-laparotomy occurred in 4 patients. 2 patients developed a postpancreatectomy hemorrhage. In the first case we noted “digested blood” from the abdominal drain in 6<sup>o</sup> POD. In the second case we observed hematemesis and melena in 12<sup>o</sup> POD. In all 6 cases underwent to re-operation the patients were transferred to ICU. Perioperative mortality was 4.1%. The mean postoperative hospital stay was 21 days (range 11–48).

Pathology: All patients had a malignant etiology. In this study the most common pathology was ductal adenocarcinoma of the head of pancreas (78 cases). We also described ampullary and duodenal cancer (11 cases), distal bile duct cancer (6 cases) and neuroendocrine pancreatic tumor (2 cases). The lymph nodes were involved by the tumor in 38.5% of cases.

**Table 1**

Characteristic of patients underwent to pancreaticoduodenectomy.

Variables	Values (n = 97)
Age	64.5 (range 33–83) years
Sex (%)	
Males	53 (54.6)
Females	44 (45.4)
Symptoms (%)	
Jaundice	89 (92)
Anorexia/weight loss	72 (74)
Abdominal pain	55 (57)
Nausea and vomiting	38 (39)
ASA score	
1–2	9
3–4	88

#### 4. Discussion

An Italian surgeon, Alessandro Codivilla, was the first to perform a pancreaticoduodenectomy. Than Allen O Whipple modified this procedure in 1935, but the complexity of technique and the associated high morbidity and mortality resulted in initial reluctance to adopt this surgery for the management of pancreatic and periampullary tumors [19]. In the United States surgical resection is underutilized for patients with pancreatic cancer: only 27–35% of patients with locoregional disease are resected and this percentage is until lower in elderly patients [20]. Several studies suggest that, despite the increased morbidity and mortality after pancreatic resection in this group, the survival benefit of surgical resection for pancreatic cancer is not diminished with age [21]. In our study we treated patients over 70 years old that needing for a recovery in Intensive Care Unit (ICU) in postoperative period with increased risk to develop cardiac and respiratory complications. It is well documented that the surgical outcome of pancreatic surgery are better at high-volume experienced center that reporting mortality rates below 5% [22]. During the past 5 years of our experience in Whipple procedure we developed a progressive improvement in the different aspects of the surgical technique including less intraoperative bleeding, less pancreatic anastomosis failure and decrease in hospital staying days. We perform an end-to-side duct-to-mucosa pancreaticojejunostomy with routinely use of internal pancreatic stent. This modified technique leads us to decrease pancreatic leaks and fistula with the rationale that stenting prevents the accumulation of pancreatic secretions, so the pancreaticojejunostomy is excluded from direct contact with pancreatic juice [14]. Several studies examined the efficacy of internal and external pancreatic stents in preventing POPF but the results are still in contrast [23,24]. POPF is the most important complication of pancreaticoduodenectomy because, directly or indirectly, contributes to the other morbidity including DGE, postpancreatectomy hemorrhage and death. The number of this surgical procedure is increased in our center during the recent years. Several studies have reported the effect of high-volume center on the surgical and clinical outcome of patients with reduction of perioperative morbidity and mortality.

#### 5. Conclusion

Pancreatic cancer is the fourth cause of death for neoplasm in industrialized countries. A radical pancreaticoduodenectomy is the only chance, but this procedure has significant mortality and morbidity even in high volume centers. There are some factors for predicting the prognosis, such as size of the tumor, degree of differentiation, status of lymph nodes and the involvement of the resected margins. The most important postoperative complication is POPF that is responsible of other surgical and medical complications. For these reasons multiple techniques in anastomosing the pancreatic duct to gastrointestinal (pancreaticojejunostomy) have been described in literature. In this study we used end-to-side duct-to-mucosa anastomosis or Blumgart technique with internal pancreatic stent. However no one technique has been shown to definitively be the solution to the problem. At our center we have a reasonable volume and our data are comparable to literature.

#### Ethical approval

None required.

#### Conflicts of interest

Romano Giorgio and other co-authors have no conflict of

interest.

#### Sources of funding

Romano Giorgio and other co-authors have no study sponsor.

#### Author contribution

Romano Giorgio: study design and writing  
 Agrusa Antonino: study design and writing  
 Galia Massimo: data collections and data analysis  
 Di Buono Giuseppe: data collections, data analysis and writing  
 Chianetta Daniela: data collections and data analysis  
 Sorce Vincenzo: data collections and data analysis  
 Gulotta Leonardo: data collections and data analysis  
 Brancatelli Giuseppe: study design, data collections and data analysis  
 Gulotta Gaspare: study design

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