Subtotal Pancreatoduodenectomy

Use of a Defunctionalized Loop for Pancreatic Stump Drainage

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Background: Since its introduction, pancreaticoduodenal resection for periampullary cancer has undergone numerous modifications. As a result, there has been a dramatic decline in the mortality rate. However, a high morbidity rate, mainly due to pancreatic fistula formation, is still reported.

Objective: To evaluate the results of the use of a defunctionalized jejunal loop in patients undergoing pancreatectoduodenectomy to minimize both the frequency and severity of anastomotic leak.

Setting: Second Surgical Department, Athens University, Aretaieon Hospital, Athens, Greece.

Design: A series of retrospective cases from February 1990 to December 1997.

Patients: One hundred five patients who underwent pancreatectoduodenectomy and had the pancreatic stump drained in a defunctionalized jejunal loop.

Methods: To avoid problems related to fistula formation due to erosion of the anastomoses from activated pancreatic enzymes, a defunctionalized jejunal loop was constructed and the pancreatic stump was invaginated into the end of this loop.

Results: Using the defunctionalized jejunal loop, the mean (± SD) hospitalization was 7.57 ± 1.42 days, the morbidity rate was 11.2%, and the mortality rate was 0.95%.

Conclusions: A modification of pancreatectoduodenectomy for the treatment of pancreatic cancer resulted in an improvement in the immediate results of subtotal pancreatectoduodenectomy. Careful detachment of the posterior surface of the pancreas from the anterior surface of the portal vein and performance of pancreaticojejunal anastomosis to a defunctionalized jejunal loop results in lower mortality and morbidity rates, thus making pancreatectoduodenectomy a safe procedure.

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Increasing at an annual rate of 6% for men and 3% for women, pancreatic carcinoma is the seventh leading cause of cancer death in Greece. Pancreatectoduodenectomy became the operation of choice after Whipple and colleagues described this procedure.

A surgeon performing pancreatectoduodenectomies for cancer of the head of the pancreas faces the following main problems: (1) how to perform a safe dissection between the neck of the pancreas and the portal and superior mesenteric veins, and (2) how to seal the pancreaticojejunal anastomosis.

After the 1960s, many authors suggested that this procedure should be abandoned owing to a high operative mortality rate ranging from 20% to 40% and postoperative morbidity rates ranging from 40% to 60%. Leakage at the pancreaticojejunal anastomosis is responsible for approximately 30% of operative mortality. A decline in both mortality and morbidity rates has recently been reported.

In the present study, we report the results of a technique that secures and simplifies subtotal pancreatectoduodenectomy.

RESULTS

The mortality rate in this series was 0.95%. Since submission of this article, 10 more cases have been added with no deaths, reducing the mortality rate to 0.86%. The patient who died was 72 years old and had developed acute respiratory distress syndrome and multiple organ failure.

Twelve patients had various complications (morbidity rate, 11.42%). Bile leakage was noticed in 2 patients (1.9%). Six patients had septic complications: 3 (2.85%) had an abscess formation, which was treated by computed tomography-guided drainage and the other 3 (2.85%)
PATIENTS AND METHODS

CLINICAL FEATURES

The hospital records of 105 consecutive patients (61 men and 44 women with a mean age of 54.1 years [range, 28-76 years]) who underwent subtotal pancreaticoduodenectomy for pancreatic cancer between February 1990 and December 1997 at the Second Surgical Department of the University of Athens, Aretaieon Hospital, Athens, Greece, were reviewed.

The most common symptom was weight loss (mean ± SD, 8.4 ± 1.1 kg), which occurred in 79 patients (75.2%), followed by jaundice, which occurred in 74 patients (70.5%). Fifty-four patients (51.4%) experienced pain. The mean (± SD) duration of symptoms was 6.9 ± 0.8 weeks.

DIAGNOSIS

Various diagnostic modalities were used to preoperatively evaluate the patients. During the early period, computed tomography, endoscopic retrograde cholangiopancreatography, or percutaneous transhepatic cholangiography were the most common imaging procedures used. From 1992 onward, numerous patients underwent magnetic resonance imaging, magnetic resonance cholangiopancreatography, and transoperative ultrasonography.

OPERATIVE PROCEDURES

Resection

After the duodenum was mobilized and the head of the pancreas thoroughly palpated, a firm decision with regard to operability was made; to this end, transoperative ultrasonography gave additional information (Figure 1). Then, the common bile duct or the common hepatic duct as well as the gastroduodenal artery were dissected and divided. Next, the lower stump of the bile duct and the gastroduodenal artery were retracted downward (Figure 2), and, under direct vision, the anterior surface of the portal vein was dissected from the duodenum and the posterior surface neck of the pancreas. Any small veins were carefully ligated.

As the operation continues, dissection of the lower part of the surface of the neck of the pancreas and the superior mesenteric vein was completed by inserting the index finger downward (Figure 3). Following this maneuver, division of the pancreas was an easy task.

Reconstruction

After the cut surface of the distal pancreatic stump was prepared, an isolated jejunal loop was created and a Roux-en-Y anastomosis was performed (Figure 4). The pancreaticojejunal anastomosis was attached to a defunctionalized jejunal loop to provide a total diversion of the pancreatic juice from the hepaticojejunal and gastrojejunal anastomoses. The pancreaticojejunal anastomosis was done in an end-to-end fashion in 2 layers so that the pancreatic stump could be intussuscepted into the free end of the jejunal loop (Figure 5). The cut end of the pancreatic duct must be anastomosed using 4 to 6 interrupted polyglactin 910 (Vicryl; Ethicon Inc, Somerville, NJ) suture stitches to the intestinal mucosa using loops when necessary.

Anesthetic Management

Careful anesthetic management was of paramount importance. In addition to thorough clinical and laboratory investigation, preoperative care included correction of coagulopathy, nutritional and electrolyte abnormalities, as well as measures for autotransfusion.

In most cases epidural analgesia was planned and insertion of the catheter prior to induction of anesthesia was necessary. Since pancreatic surgery may be associated with major fluid shift, monitoring was required, especially in patients with cardiopulmonary compromise and renal dysfunction.

Since 1935, when Whipple et al2 documented a 2-stage pancreaticoduodenectomy for ampullary cancer, this procedure became the treatment of choice for pancreatic cancer. However, enthusiasm waned during the 1960s, when numerous centers reported operative mortality rates as high as 40%7 and morbidity rates ranging from 40% to 60%.9,10

In the last few years, there has been a dramatic drop in perioperative mortality, which has been reported to be in the range of 1% to 2%, creating renewed interest in subtotal pancreaticoduodenectomy.3,11 Better perioperative care, accumulative experience on the part of surgeons, refinement of surgical materials, improved anesthesiologic management, and a better understanding of patients’ nutritional needs have all contributed to the decline of perioperative mortality rates.7

Although mortality rates are within an acceptable range, high complication rates still remain a problem and range from 25% to 39%.7,11,12 Pancreatic fistula presents the most frequent postoperative complication, with an incidence of 5% to 20%.7 Leakage of the pancreaticojejunal anastomosis has been reported to account for the majority of deaths.3,6 Hicks and

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Brooks\(^6\) reported that in patients undergoing pancreatoduodenectomy, the operative mortality rate was 18%, and this was mainly due to leakage from the anastomosis of the pancreatic remnant. In addition, Monge et al\(^5\) reported an overall operative mortality of 12%, and 50% of the deaths were due to bleeding; they concluded that the greatest postoperative danger was from autodigestion of the tissues near the pancreaticojejunal stoma with resultant hemorrhage. Lerut et al\(^14\) reported that pancreatic fistula was the most common and most important complication in pancreatoduodenectomy, accounting for 75% of early complications. Moreover, pancreatic fistula accounted for 55% of postoperative deaths. Apart from bleeding, pancreatic fistula was also implicated in infective complications.\(^12\) Intra-abdominal sepsis, which was probably related to biliary or pancreatic leaks, was responsible for most of the fatalities after pancreatoduodenectomy.\(^35\)

The aim of the many modifications of the procedure introduced by Whipple et al\(^2\) is the control of the anastomotic leak. Placement of drains to control the anastomotic leak in the area of pancreatic anastomosis may minimize morbidity.\(^7\) However, intensive supportive measures, namely, parenteral nutrition and daily care of the skin around the tube to avoid skin excoriation, are necessary.\(^7\) The use of somatostatin\(^16\) and octreotide\(^17\) is an additional measure in the armamentarium of the physician managing pancreatic fistula.\(^16\) Even reoperation and complete resection of the pancreatic remnant have been suggested\(^18\) in cases of prolonged pancreatic drainage. However, the golden rule in surgery is to anticipate rather than treat a complication. Operative management of the pancreatic duct remains the most important factor in preventing complications after pancreatoduodenectomy. A number of techniques to secure the pancreaticojejunos-tomy have been described in the literature: an oversewn pancreatic duct resulted in a 50% to 79% rate of fistula occurrence,\(^19\)\(^,\)\(^21\) and stenting of the pancreatic duct is still a useful technique,\(^19\) resulting in a lower mortality rate. Because of the high mortality associated with treatment of complicated pancreatic leakage,\(^19\)\(^,\)\(^19\) the morbidity rate remains high.\(^31\)

Much attention has been paid to the management of pancreaticojejunal anastomosis, aiming at the prevention of this complication. In subtotal pancreatoduode-
nectomy, the pancreatic stump can be anastomosed in an end-to-end or end-to-side fashion, by using either the same jejunal loop in continuity with hepaticojejunal and gastrointestinal anastomoses or a Roux-en-Y loop. In the latter technique, the hepatic duct is usually anastomosed to an isolated jejunal loop distally to the pancreaticojejunal anastomosis.22

However, all these methods place the critical pancreaticojejunostomy close to the hepaticojejunal anastomosis. As a consequence, the danger of erosion from activated pancreatic enzymes in case of bile and pancreatic leakage is not obviated. Some authors23 advocate pancreaticogastrostomy to avoid activation of trypsinogen to its active form, trypsin. Additional advantages of this technique include the thickness of the gastric wall and the anatomic proximity of the 2 organs. However, according to Yeo et al.,24 the incidence of leakage in pancreaticogastrostomy is not lower compared with pancreaticojejunostomy. The incidence of pancreatic fistula for the former was 11.7%, compared with 12.3% for the latter. Mason25 concluded that pancreaticogastrostomy is a satisfactory alternative technique that is similar to pancreaticojejunostomy for deconstruction after pancreatoduodenectomy.

Some investigators26,27 have advocated total pancreatectomy for carcinoma of the head of the pancreas to eliminate the morbidity associated with pancreaticojejunostomy. Nonetheless, in a later study,24 it was proved that this procedure was associated with a 14% mortality rate and a morbidity rate as high as 59%. Herter et al.,25 stated that in comparison to pancreatoduodenectomy, total pancreatectomy had a significantly worse prognosis, with a complication rate of 42% and a postoperative mortality rate of 23%.

Total pancreatectomy may be reserved only for patients whose tumors are spread across the line of resection or whose pancreatic remnant is friable and thus predisposed to complications.26,27

Our present data indicate that a significant improvement in the morbidity rate may be achieved by anastomosing the pancreatic stump to a defunctionalized jejunal loop in an end-to-end fashion. To further secure leakage from the pancreaticojejunostomy, a 2-layer anastomosis is performed; the technique involves invagination of the pancreatic stump into the isolated jejunal loop. In the 2-layer anastomosis, the outer layer is completed with interrupted silk sutures and the inner layer with interrupted absorbable sutures incorporated into the pancreatic duct, as has been suggested by other authors.7 Gentleness and attention to technical details are of utmost importance in the prevention of prolonged pancreatic drainage following pancreatoduodenectomy. End-to-end pancreaticojejunal invagination is considered to be the safest option even in patients at high risk; however, when combined with hepaticojejunostomy, the rate of complications and reoperations is about 6%.21

The low morbidity and mortality rates in this series are attributed to the safeguards taken while dissecting the posterior surface of the pancreas from the anterior surface of the portal vein and the superior mesenteric vein, the integrity of the pancreaticojejunal anastomosis, which was confirmed by magnetic resonance cholangiopancreatography, and to the diversion of the pancreatic secretions to the intestinal tract away from other anastomoses.

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IN OTHER AMA JOURNALS

Mortality Differences Between Men and Women Following First Myocardial Infarction
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Context: Mortality after acute myocardial infarction is worse in women than in men, even after adjustment for comorbidity and age dissimilarities between sexes.

Objective: To assess the influence of sex on survival after acute myocardial infarction.


Setting: Four teaching hospitals in northeastern Spain.

Patients: All consecutive patients aged 80 years or younger with first acute myocardial infarction. A total of 331 women and 1129 men were included.

Main Outcome Measure: Survival at 28 days and mortality or readmission at 6 months.

Results: Women were older (mean, 68.6 vs 60.1 years), presented more often with diabetes (52.9% vs 23.3%), hypertension (63.9% vs 42.3%), or previous angina (44.6% vs 37.4%), and developed more severe myocardial infarctions than men (acute pulmonary edema or cardiogenic shock occurred in 24.8% of women and 10.5% of men) (all P<.001). Men were more likely than women to receive thrombolytic therapy (41.3% vs 23.9%; P<.001), but rates of percutaneous transluminal angioplasty and coronary artery bypass graft surgery at 28 days were similar among men and women. The 28-day mortality rate was significantly higher among women (18.5% for women, 8.3% for men; P<.001). Revascularization procedures at 6 months were performed in a similar proportion of women and men. However, women had higher 6-month mortality rates (25.8% in women, 10.8% in men; P<.001) and readmission rates (23.3% for women, 12.2% for men; P<.001). After adjustment, women had greater risk of death than men at 28 days (odds ratio [OR], 1.72; 93% confidence interval [CI], 1.12-2.63) and at 6 months (OR, 1.73; 95% CI, 1.18-2.52).

Conclusions: In this study population, women experienced more lethal and severe first acute myocardial infarction than men, regardless of comorbidity, age, or previous angina.

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