

Cost-Effective Analysis of Surgical Palliation Versus Endoscopic Stenting in the Management of Unresectable Pancreatic Cancer

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Background: Ductal carcinoma of the pancreas is unresectable for cure in the majority of patients. We reviewed our results and cost effectiveness of surgical and endoscopic biliary bypass for unresectable pancreatic cancer to evaluate the comparable outcomes.

Methods: Between 1990 and 1992, 136 patients were managed operatively or endoscopically for pancreatic carcinoma. Excluding potentially curative resections and patients without follow-up, 34 patients endoscopically stented and 32 patients surgically bypassed were evaluated.

Results: Mean patient age was older (72.1 vs. 69.3 years) but average performance status was comparable (0.8 vs. 0.9 Eastern Cooperative Oncology Group grading) in the medical treatment group. The initial hospital stay was significantly longer for surgical patients (mean 14 vs. 7 days, $p < 0.001$), with higher average charges (\$18,325 vs. \$9,663). Twelve stented patients required rehospitalization (average charge of \$4,029), and eight surgical patients were readmitted (average charge of \$6,776). An average of 1.7 stent changes (average charge \$1,190) were required. Mean survival was longer for the stented group (9.7 vs. 7.3 months, $p = 0.13$).

Conclusions: Endoscopic stenting for unresectable pancreatic cancer provides equivalent duration of survival at reduced cost and shorter hospital stay, although subsequent stent changes are necessary. When curative resection is not possible, endoscopic biliary drainage should be considered a good first choice for palliative management.

Key Words: Unresectable pancreatic cancer—Surgical palliation—Endoscopic palliation.

Ductal carcinoma of the pancreas is unresectable for cure in the vast majority of patients. Of the estimated 27,000 new cases of pancreatic carcinoma in the United States, 85–90% are unresectable at the time of diagnosis (1–3). Operative and endoscopic palliation both have been established as options for these patients, although strict guidelines for the

choice of procedure have been difficult to establish (4,5).

Surgical palliation has been advocated as the treatment of choice for younger patients (<60 years of age), patients with expected survival >6 months, and patients with impending duodenal obstruction (5–9). Recently published prospective, randomized studies comparing the effectiveness of biliary endoprosthesis versus surgical bypass have suggested the superiority of endoscopic stenting in palliation (10–12). Biliary endoprostheses have been used with shorter hospitalization and similar morbidity to that of surgical bypass (13,14). The major drawback to endobiliary stenting has been the occurrence of recurrent jaundice due to late stent occlusion (15). Obstructive jaundice is the most common presenting symptom (60–70% of patients seeking treat-

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ment) (7), and the relief of the biliary obstruction represents one of the major goals for the surgeon. To delineate whether surgical or endoscopic management of malignant biliary obstructions differed in costs or results, we performed a retrospective analysis of open and endoscopic biliary bypass for unresectable pancreatic cancer and detailed cost analysis to examine and compare relative cost effectiveness.

METHODS

Between 1990 and 1992, 136 patients were managed by operative or endoscopic treatment for pancreatic carcinoma at the Mayo Clinic in Rochester, Minnesota. Patients who had radiologic evidence including computed tomography (CT) scan, ultrasound, or endoscopic retrograde cholangiopancreatography (ERCP) findings of pancreatic malignancy or who had a pancreatic biopsy confirming malignancy were included. After excluding those patients who had potentially curative resections (n = 36) and patients without follow-up (n = 34) (patient, family, or physician contacts were attempted), 34 patients who had undergone endoscopic stents placement and 32 patients who had undergone surgical bypass remained for analysis. Patient records were retrospectively reviewed for patient age, gender, site of tumor, presence of metastases, Eastern Cooperative Oncology Group (ECOG) performance status (0-4) (Table 1) (16) at the time of initial presentation, and hepatobiliary function tests (total and direct bilirubin, aspartate aminotransferase [AST], alkaline phosphatase, prothrombin time, hemoglobin, white cell count, and

TABLE 1. ECOG scale

Grade	Description
0	Fully active, able to perform all predisease activities without restriction
1	Restricted in physically strenuous activity but ambulatory and able to perform work of a light or sedentary nature, e.g., light housework or office work
2	Ambulatory and capable of all self-care but unable to perform any work activities; up and about >50% of waking hours
3	Capable of only limited self-care, confined to bed or chair \geq 50% of waking hours
4	Completely disabled, cannot perform any self-care, totally confined to bed or chair

Adapted with permission (16).

TABLE 2. Laboratory values

	Surgical bypass (n = 32)	Medical endoprosthesis (n = 34)
Total bilirubin (mg/dl)	10.6	9.8
Prothrombin time (s)	12.5	12.5
Albumin (g/dl)	3.4	3.4

p = NS.

platelets) (Table 2). Initial and subsequent procedure charges also were extracted from patient records. When patients were rehospitalized at facilities other than the Mayo Clinic, the charges were calculated using Mayo Clinic billing schedules in order to attain standardization. Differences between the medical and surgical groups were evaluated by using Student's *t* test. All patients were followed for a minimum of 24 months, or until death.

RESULTS

Thirty-two patients underwent surgical bypass for unresectable pancreatic cancer. Patients selected for surgical management had a mean age of 69.3 years (range 43-85), with a mean ECOG status of 0.9 (Table 3). There were 20 men and 12 women. Six patients had preoperative percutaneous biopsy results positive for carcinoma, and the remainder had histologic confirmation at surgery. Twenty patients underwent cholecystojejunostomy, eight patients underwent choledochojejunostomy, and three patients underwent choledochoduodenostomy for their biliary bypass. One patient required a roux-en-Y hepaticojejunostomy as palliation secondary to tumor infiltration of the hepatoduodenal ligament. In this group of 32 patients, 21 also had a gastric bypass at the time of surgery, of which the majority were prophylactic (Table 4). Eighteen patients had a loop gastrojejunostomy (14 antecolic and four retrocolic), and three patients had a roux-en-Y gastrojejunostomy.

There was one postoperative death in the surgical group secondary to pancreatitis. Short-term morbidity, defined as those events occurring within 30 days of the procedure, occurred in 33% of patients (Table 5). The most frequent form of morbidity was delayed gastric emptying. Average initial hospital stay for surgically treated patients was 14 days, with mean total charges of \$18,325. Eight surgical patients required at least one rehospitalization

TABLE 3. *ECOG performance status for medical and surgical patients*

ECOG	No. of patients	
	Medical	Surgical
0	16	15
1	11	4
2	3	11
3	4	2
4	0	0

(range 1–4 hospitalization days), with mean charges of \$6,776. The reasons for rehospitalization included delayed gastric emptying ($n = 3$), and recurrent biliary obstruction ($n = 2$), which required percutaneous or endoscopic stenting. The mean survival time in these patients was 7.3 months (range 7 days to 29 months).

Thirty-four patients underwent endoscopic biliary decompression for unresectable pancreatic cancer. Nonsurgical management was based on patient request or concomitant comorbid factors that made the patient a high-risk surgical candidate. Endoscopic biliary stents of 10–12 French (F) in diameter were placed. No expandable prostheses were placed during this period. The mean patient age was older in the medical group (72.1 years, range 44–100), although this difference was not significant. The mean ECOG status was comparable for both groups (0.8 medical vs. 0.9 in the surgical group, $p = \text{NS}$) (Table 3). The endoscopically treated group was made up of 17 men and 17 women. Twenty-six patients had a tissue diagnosis of pancreatic carcinoma before the procedure. The remaining eight patients had CT, ultrasound, or ERCP findings consistent with malignant obstruction of the biliary duct, and in these patients mean survival was <8 months. One patient died after stent placement as the result of a gastrointestinal hemorrhage. Endo-

TABLE 5. *30-Day morbidity for patients undergoing surgical management*

Morbidity	No. of episodes	%
Delayed gastric emptying	4	12
Biliary obstruction	2	6
Acute renal failure	1	3
Gastrointestinal hemorrhage	1	3
Pneumonia	1	3
Pancreatic abscess	1	3
Wound infection	1	3
Pancreatitis ^a	1	3

^a Death.

TABLE 4. *Operative procedures performed in 32 patients with unresectable carcinoma of the pancreas*

Procedure	No. of patients	%
Cholecystojejunostomy	20	63
Choledochojejunostomy	8	25
Choledochooduodenostomy	3	9
Roux-en-Y hepaticojejunostomy	1	3
Gastric bypass at time of biliary bypass	21	66

scopic attempts to control the bleeding were unsuccessful and the exact site of bleeding in the duodenum was not determined. The most frequent morbidity in the endoprosthesis group was cholangitis, and the overall morbidity rate of 21% was similar to that of the surgical group (Table 6). Only one patient (3%) required surgical bypass for gastric outlet obstruction 20 months after endoscopic biliary bypass. The mean survival time in the endoscopic treatment group was 9.7 months (range 10 days to 35 months). The mean hospital stay for these patients was 7 days, with an average charge of \$9,663. Twelve patients required rehospitalization (1–4 hospitalization days), with mean total charges of \$4,029. The other patients had stent changes performed on an outpatient basis or died before further stent changes were required. Overall, patients required a mean of 1.7 stent changes (range zero to six) at a cost of \$1,190 during their period of palliation.

A significant difference was observed in the duration of the initial hospital stay between surgical and medical patients (mean 14 vs. 7 days, $p < 0.001$). The total initial charges were significantly higher for surgical patients when compared with those of the medical group (Fig. 1). Although more medical patients required rehospitalization, mean charges for these instances was less than for the surgical group (\$4,029 vs. \$6,776) (Table 6). When

TABLE 6. *30-Day morbidity for patients managed by endoscopic biliary stent placement*

Morbidity	n	%
Cholangitis	3	9
Bacteremia	3	9
Perforation of tumor	2	6
Gastrointestinal hemorrhage ^a	2	6
Perforation of biliary duct	1	3
Post-ERCP pancreatitis	1	3
Bile peritonitis	1	3
Gastric outlet obstruction ^b	1	3

^a Death in one patient.

^b Required surgical bypass.

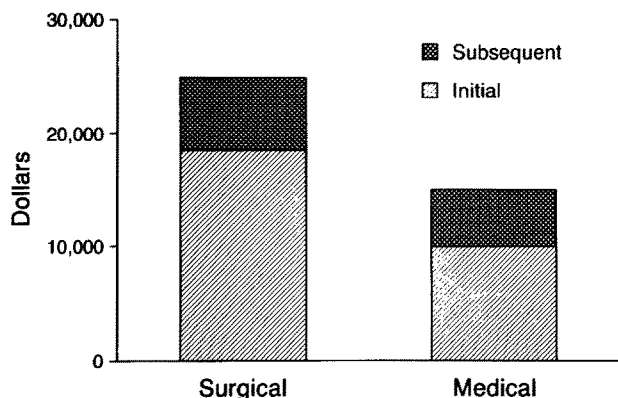


FIG. 1. Mean hospitalization charges (initial and subsequent) comparing medical versus surgical groups. Total costs differed between the groups.

the total charges are categorized as hospitalization, physician clinic fees, and outpatient stent changes, the medical group patients accrued slightly lower average charges in all categories (Table 7). The results did not demonstrate a significant difference in survival (Fig. 2) or morbidity rates between the two groups.

DISCUSSION

The treatment of pancreatic carcinoma remains palliative for most patients (1-3), and mean survival is measured in weeks to months. Decision making in the palliative treatment of carcinoma of the pancreas has thus become increasingly demanding with the broadening of therapeutic options. Establishment of histologic confirmation via percutaneous or endoscopic sampling, accurate staging, and a heightened evaluation and assessment of concomitant risk factors are important. The establishment of a therapeutic plan to achieve the primary treatment objectives for each patient should alleviate symptoms effectively, minimize the duration of hospitalization, and improve the overall quality of life when the goals are tumor palliation.

Obstructive jaundice is the most common symptom requiring palliation (7). The relief of jaundice provides an effective treatment for pruritis in addition to improving patient morale and overall perfor-

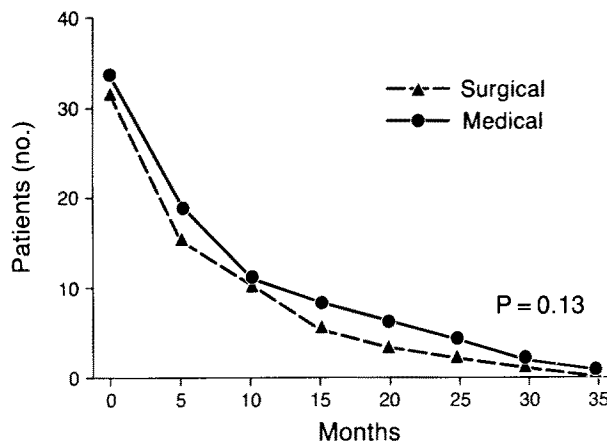


FIG. 2. Survival postprocedure. There is no statistical difference between medical and surgical groups.

mance status. Palliative surgical bypass has increased slightly in frequency from 45% (of all patients with pancreatic cancer) to 49% during the periods of 1971-1980 and 1981-1990, respectively (17). The mean mortality rate for palliative surgical bypass procedures has declined from 17% to 14% during these periods, with some institutions reporting mortality rates as low as 10% (3), with a mean hospital stay of 17 days (17). In our series of patients, the mortality rate was 3.5% in the surgical group, with a early morbidity rate of 33%. The medical group had similar rates of mortality (2.9%) and morbidity (21%).

The type of biliary enteric bypass performed and the necessity of performing a gastric bypass procedure continue to be subjects of debate. The rate of recurrent obstructive jaundice after choledochoenteric bypass varies from 0% to 15% (5,7,8,18), although the incidence of obstruction, biliary sepsis, or both may increase to 34% after cholecystoenteric bypass (18). In our series, 63% of patients underwent cholecystoenteric bypass and 25% underwent choledochoenteric bypass, although we did not compare the morbidity rates associated with each of these procedures.

Since the introduction of endoscopic placement of biliary endoprosthesis in 1979 (19), this technique

TABLE 7. Comparison of mean charges by treatment

	Initial hospitalization			Outpatient stent changes	Subsequent hospitalization		
	Inpatient	Clinic	Total		Inpatient	MD fees	Total
Medical	\$5,086	\$4,577	\$9,663 ^a	\$2,023	\$2,532	\$1,495	\$6,052 ^a
Surgical	\$11,470	\$6,584	\$18,325 ^a	—	\$4,708	\$2,067	\$6,776 ^a

^a p < 0.05, Medical versus surgical group for initial and subsequent hospitalization fees.

has become an alternate method for the palliative therapy of malignant biliary tract obstruction. Experienced endoscopists are able to successfully place stents in >90% of patients (10,17,20), with a 30-day mortality rate of 11–17% (21,22). The most common form of morbidity associated with endoprosthetic drainage remains stent occlusion, which may result in recurrent jaundice and cholangitis. Stent occlusion requiring replacement occurs in 6–23% of patients with conventional plastic stents (11,17,20,22). Expandable metallic biliary endoprostheses were expected to incur a longer patency period given the greater diameter size after deployment (4 vs. 10 mm); however, a recent report suggested that patency rates are comparable (22). Evaluation of 10-F and 11.5-F stents showed occlusion in 4.2% and 10.8% at 3 and 6 months, respectively (17). The optimal timing for elective stent replacement is still under debate (17), although routine prophylactic stent changes every 2–4 months is recommended.

Determining the comparable efficiency of endoscopic stenting and surgical biliary bypass requires evaluation of multiple factors. As demonstrated in our retrospective review, mean patient age was older, with comparable ECOG performance status in the medical group (Table 3). The morbidity rates of 21% and 33% for the stented and surgical patients, respectively, were not statistically different. However, surgical patients were hospitalized for a significantly longer period of time than stented patients (14 vs. 7 days) after the initial therapeutic procedure. Patients undergoing endoscopic stenting incurred an increased rehospitalization rate primarily related to stent changes. These results of the effectiveness of endoscopic versus surgical bypass for palliation of biliary obstruction are comparable with the previously published prospective study of Earnshaw et al. (20); the prospective randomized studies of Andersen et al. (10), Smith et al. (11), and Shepard et al. (12); and the retrospective reviews performed by Sonnenfeld et al. (13) and Hyoty (14). This is the first published study to compare costs between patients undergoing endoscopic or surgical bypass. The absolute monetary value may vary depending on the institution's geographic location. In our review, endoscopic stenting incurred a decreased initial hospitalization, clinic and total cost when compared with surgical bypass. Although there were slightly more admissions for the medical group, the cost for physician charges, procedures, and total cost for rehospitalization were lower over-

all (Table 7). The majority of stent changes were performed on an outpatient basis, with only 1.7 stent changes required per patient because the mean survival time was only 9 months. Stent reinsertion has a 100% success rate in our review; however, failed stent reinsertion may require transhepatic stent placement or surgical bypass (20).

Patients who present initially with symptoms of gastric or duodenal obstruction in addition to obstructive jaundice should be managed surgically. The development of gastric or duodenal obstruction is reported to occur in 15–30% but occurred in a single patient in our series (3%) after endoscopic biliary tract stenting. Previously published prospective randomized studies have demonstrated subsequent gastric or duodenal obstruction in 0% (10), 2% (11), and 9% (12). Patients who develop duodenal obstruction may be managed with the placement of a percutaneous endoscopic gastrostomy (PEG) to relieve symptoms of gastric distention. With the advent of the laparoscopic era, the potential for successful management of this complication by minimally invasive techniques is possible for those patients who are not candidates for a PEG (23).

This article is the first to perform a cost analysis of endoscopic versus surgical biliary bypass. The duration of initial hospital stay and cost are significantly reduced for the endoscopically managed group of patients. Although morbidity associated with stent occlusion required more subsequent rehospitalizations, the cost incurred from stent changes is comparable with the rehospitalization costs for the surgical group. Future alterations in stent design may allow for prolonged periods of time between stent changes in this group of patients. In conclusion, we believe that when curative resection of carcinoma of the pancreas is not possible, and no signs or symptoms of gastrointestinal obstruction exist, palliative biliary stenting by endoscopy provides an equivalent duration of survival with a significant reduction in hospitalization time at significantly less cost. Endoscopic biliary drainage should be considered the first choice for palliative management in patients with incurable pancreatic adenocarcinoma with bile duct obstruction.

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