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Multivisceral Pancreatic Resections: Worth the Risk?

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Abstract

Introduction: As mortality associated with pancreatic surgery decreases, there has been an increasing drive towards extended resections for locally advanced pancreatic cancer. However, the overall impact of multivisceral resections on morbidity and mortality remains unclear.

Methods: An IRB-approved retrospective chart review was conducted amongst patients who underwent pancreatic resection by a surgical oncologist at a single institution between July 2005 and July 2010. Patients were grouped into four categories based on extent of resection: Standard Whipple (SW), Multivisceral Whipple (MVW), Distal Pancreatectomy (DP) and Multivisceral Distal Pancreatectomy (MVDP). Measured variables included demographics, Length of Stay (LOS), operating room time, margin status, postoperative morbidity, 30-day mortality, and median survival.

Results: 192 patients were identified, with 145 who underwent standard and 47 multivisceral (MV) resections. Demographics were similar between the two groups. Multivisceral procedures were associated with a higher incidence of positive margins (40.5% *vs*. 22.9%, p=0.01), longer operating times (4.9 *vs*. 3.8 hours, p<0.001), and increased surgical complications (55.3% *vs*. 34.7%, p=0.012). 30-day mortality was comparable between all groups, but survival was significantly shorter in patients who underwent multivisceral compared to standard resections (22 months *vs*. 11 months, p=0.002).

Conclusion: Although multivisceral pancreatic resections may be performed with acceptable morbidity and mortality in the appropriate patient population, there does not appear to be a survival benefit.

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Introduction

Pancreatic cancer is a lethal condition, with most patients presenting with unresectable disease and overall survival at 5% [1]. Although chemotherapy and radiation play a critical role in the treatment of this disease, only surgery offers the potential for long-term survival. Despite this, 5-year survival remains at 15% to 20% after surgical resection [1-5]. Traditional approaches for resectable tumors include a Standard Whipple procedure (SW) and distal pancreatectomy with or without splenectomy (DP), with mortality rates as low as 5% at high volume centers [6-7].

Given these improvements in surgical outcomes, many have advocated for a more aggressive operative approach to locally advanced pancreatic disease [7,8]. In 1977, Fortner and colleagues first introduced a multivisceral pancreatectomy procedure. Despite the high morbidity and mortality at 83% and 9% reported from this study [9], multiple authors have since published updated results after such procedures. The definitions of "multivisceral" or "extended" pancreatectomy procedures have varied, including standard pancreatic resections with [1] Extended Lymphadenectomy (ELND), [2] total pancreatectomy, [3] additional organ(s), and/or [4] arterial or venous resections [10-13]. While it has been established that extended lymphadenectomy in this setting results in higher morbidity with no survival benefit, concomitant venous resection at the time of pancreatectomy has demonstrated comparable morbidity and mortality to their standard counterparts [14-22]. When defined based on additional organ resection, however, the benefit of Multivisceral Resections (MVR) have been controversial [14,20,22]. Proponents of the more aggressive multivisceral approach have suggested that local involvement of pancreatic disease may represent tumor location more than tumor biology [19]. Enbloc resections therefore increase the likelihood of negative margins and may improve survival rates. Arguments against this approach, however, highlight the increased

Table 1: Patient, Tumor, and Resection Characteristics for Patients who Underwent Pancreatic Resections, by Type and Extent of Surgery.

Characteristic	Whipple (N=132) n (%)	Standard Whipple (n=106) n (%)	Multivisceral Whipple (n=26) n (%)	p-value for Whipple*	All DP (N=60) Mean ± SD	Standard DP (n=39) n (%)	Multivisceral DP (n=21) n (%)	p-value for DP*
Patient Characteristics								
Male sex	71 (53.4)	56 (52.8)	15 (57.7)	0.656	30 (50.9)	18 (47.4)	12 (57.1)	0.472
Age, in years (median (range))	66.0 (66.0)	66.0 (66.0)	66.5 (53.0)	0.784	66.0 (69.0)	66.0 (69.0)	57.0 (40.0)	0.924
BMI, in kg/m^2 (median (range))	25.9 (40.9)	26.0 (40.9)	25.4 (31.0)	0.871	26.6 (28.8)	28.1 (26.4)	25.2 (21.5)	0.027
ASA classification				0.148				0.031
1	3 (2.3)	1 (1.0)	2 (7.7)		0	0	0	
2	55 (42.0)	47 (45.2)	8 (30.8)		28 (47.5)	21 (55.3)	7 (33.3)	
3	69 (52.7)	53 (51.0)	15 (57.7)		28 (47.5)	17 (44.7)	11 (52.4)	
4	4 (3.1)	3 (2.9)	1 (3.9)		3 (5.1)	0	3 (14.3)	
Tumor Characteristics								
Histology				0.009				0.035
Pancreatic or periampullary cancer	91 (68.4)	73 (68.9)	17 (65.4)		12 (20.3)	8 (21.1)	4 (19.1)	
Chronic pancreatitis	10 (7.5)	8 (7.6)	2 (7.7)		6 (10.2)	3 (7.9)	3 (14.3)	
Intraductal papillary mucinous neoplasm/ cystic neoplasm	10 (7.5)	10 (9.4)	0		16 (27.1)	14 (26.8)	2 (9.5)	
Duodenal adenoma	7 (5.3)	7 (6.6)	0		4 (6.8)	4 (10.5)	0	
Neuroendocrine tumor	13 (9.8)	8 (7.6)	5 (19.2)		12 (20.3)	6 (15.8)	6 (28.6)	
Other primary	2 (1.50)	0	2 (7.7)		3 (5.1)	0	3 (14.3)	
Metastasis	0	0	0		6 (10.2)	3 (7.9)	3 (14.3)	
Malignant pathology	106 (79.7)	81 (76.4)	24 (92.3)	0.072	33 (55.9)	16 (42.1)	17 (81.0)	0.004
Characteristics of Malignant Lesions								
Stage				0.633				0.019
1a	2 (1.5)	2 (1.9)	0		3 (5.0)	2 (5.1)	1 (4.8)	
1b	14 (10.6)	12 (11.3)	1 (4.0)		3 (5.0)	2 (5.1)	1 (4.8)	
2a	10 (7.6)	8 (7.6)	2 (8.0)		3 (5.0)	3 (7.7)	0	
2b	56 (42.4)	42 (39.6)	14 (56.0)		2 (3.3)	0	2 (9.5)	
3	10 (7.6)	9 (8.5)	1 (4.0)		4 (6.7)	1 (2.6)	3 (14.3)	
4	0	0	0		3 (5.0)	0	3 (14.3)	
R status				0.004				0.276
1	40 (30.1)	26 (24.6)	14 (53.9)		9 (15.0)	5 (12.8)	4 (19.1)	
2	0	0	0		1 (1.7)		1 (4.8)	
Resection Characteristics								
Time in operating room, in hours (median (range))	4.2 (6.4)	4.1 (4.8)	4.9 (5.8)	<0.001	3.0 (9.4)	2.5 (6.6)	4.9 (6.6)	<0.001
Number of additional organs resected				<0.001				<0.001
1	7 (5.3)	0	7 (26.9)		10 (16.7)	1 (2.6)	9 (42.9)	
2	16 (12.0)	0	16 (61.5)		11 (18.3)	0	11 (52.4)	
3 or 4	3 (2.3)	0	3 (11.5)		1 (1.7)	0	1 (4.8)	

*p-value by Mann-Whitney U-test for continuous outcome or χ^2 for categorical outcomes. Note that results were similar when Fisher's exact test was used for 2 x 2 tables

morbidity and mortality accompanying these complex procedures, particularly in a population with a median survival of less than two years. At our institution, MVR was performed for local organ or vessel involvement diagnosed at the time of surgery for locally advanced pancreatic disease. Given the lack of consensus regarding this topic, we conducted the current study to compare the outcomes of multivisceral *vs.* standard pancreatic resections at a university-affiliated community hospital.

Patients and Methods

IRB-approved retrospective chart review was used to identify all patients who underwent pancreatic resection at a university-affiliated

Table 2: Complications and Outcomes of Pancreatic Resections, by Extent of Surgery.

Result of Operation	Overall (N = 192) n (%)	Standard Pancreatectomy (n = 145) n (%)	Multivisceral Pancreatectomy (n = 47) n (%)	p-value*
Complications				
Surgical complications	99 (51.6)	68 (46.9)	31 (66.0)	0.023
Delayed Gastric Emptying (DGE)	66 (34.4)	45 (31.0)	21 (44.7)	0.087
DGE requiring PEG	28 (14.6)	21 (14.5)	7 (14.9)	0.945
Intra abdominal abscess	46 (24.0)	31 (21.4)	15 (31.9)	0.141
Pancreatic fistula	21 (10.9)	13 (9.0)	8 (17.0)	0.124
Wound infection	13 (6.8)	7 (4.8)	6 (12.8)	0.06
Fluid collection	9 (4.7)	6 (4.1)	3 (6.4)	0.527
Reoperation	9 (4.7)	5 (3.5)	4 (8.5)	0.154
Nonsurgical complications	83 (43.2)	53 (36.6)	30 (63.8)	0.001
Thoracentesis	21 (10.9)	8 (5.5)	13 (27.7)	<0.001
Pulmonary embolus/deep vein thrombosis	9 (4.7)	6 (4.1)	3 (6.4)	0.527
Major cardiopulmonary complication	12 (6.3)	7 (4.8)	5 (10.6)	0.153
Minor cardiopulmonary complication	21 (10.9)	11 (7.6)	10 (21.3)	0.009
Other nonsurgical complications	56 (29.2)	37 (25.5)	19 (40.4)	0.05
Outcomes				
Length of hospital stay, in days (median (range)	11.0 (41.0)	10.0 (41.0)	13.0 (25.0)	0.032
30-day readmission	49 (25.7)	34 (23.5)	15 (32.6)	0.215
30-day mortality	3 (1.6)	3 (2.1)	0	0.32
Survival, in months (median (range))	19.3 (69.3)	21.7 (69.3)	11.0 (65.2)	0.002

*p-value by Mann-Whitney U-test for continuous outcome or χ^2 for categorical outcomes. Note that results were similar when Fisher's exact test was used for 2 x 2 tables

community hospital between July 2005 and July 2010. All procedures were performed by a single fellowship-trained surgical oncologist. Patients were categorized based on type of resection and anatomic extent of resection: Standard Whipple (SW), Multivisceral Whipple (MVW), and standard distal pancreatectomy with or without Splenectomy (DP), or Multivisceral DP (MVDP). MVR was defined as any standard pancreatectomy plus removal of an additional organ or vascular structure. Additional organs included stomach (when greater than fifty percent was removed), liver, kidney, small bowel, and colon. Resected vascular structures included portal vein, superior mesenteric vein, and left renal vein. Whipple procedures with total pancreatectomy or splenectomy were categorized as MVW.

Data collection

Collected variables included demographics, Body Mass Index (BMI), ASA classification, pathology, margin status, time in the operating room, length of hospital stay, postoperative 30-day morbidity and mortality, and survival. Morbidity was classified into surgical and nonsurgical groups. Surgical morbidity included Delayed Gastric Emptying (DGE), DGE requiring Percutaneous Endoscopy Gastrostomy (PEG), intra abdominal abscess, pancreatic fistula, fluid collection without bacterial growth, wound infection, and reoperation. Nonsurgical morbidity included need for thoracentesis, pulmonary embolus or deep vein thrombosis, superior mesenteric vein or portal vein thrombosis, and cardiopulmonary failure. Pancreatic fistulas were defined based on the International Study Group of Pancreatic Surgery (ISGPS) definition [23] as peripancreatic fluid with amylase levels greater than three times the serum level after postoperative day three, or radiographic demonstration of a connection between the drain fluid and pancreaticojejunostomy anastomosis. Survival was measured based on the patient's last date of follow-up or date of death in multidisciplinary records. Survival was considered the primary study endpoint, and all patients were censored at the time of last contact.

Preoperative and operative details

Standard preoperative evaluation included history and physical examination, standard laboratory testing, and imaging including CT or MRI of the abdomen and pelvis. For malignancy, imaging was used to rule out metastatic disease and determine local invasion to surrounding structures. Patients with clear radiographic evidence of direct invasion to the portal vein, superior mesenteric vein, or superior mesenteric artery were excluded. For borderline radiographic involvement, gross inspection at laparotomy was used to determine resectability. No patients in the study received neoadjuvant therapy. For each case, the abdomen was entered using an upper midline incision or bilateral subcostal incisions. The abdomen was explored for metastatic foci including palpation of the cavity, and intra operative ultrasound was used to evaluate for liver metastases. Patients with evidence of metastatic disease or involvement of the celiac, superior mesenteric, or common hepatic arteries were excluded. A pylorus-preserving technique was utilized for Whipple procedures when deemed appropriate. SW consisted of removal of the head of the pancreas, duodenum, gallbladder, and distal stomach. MVR included enbloc removal of surrounding organs and vascular structures including portal, superior mesenteric and renal veins in

Table 3: Complications and Outcomes of Whipple and Distal Pancreatectomy (DP) Resections, by Extent of Surgery.

Result of Operation	Whipple (N=132) n (%)	Standard Whipple (n=106) n (%)	Multivisceral Whipple (n=26) n (%)	p-value for Whipple*	DP (N=60) n(%)	Standard DP (n=39) n (%)	Multivisceral DP (n=21) n (%)	p-value for DP*
Complications								
Surgical complications	79 (59.9)	61 (57.6)	18 (69.2)	0.276	20 (33.3)	7 (18.0)	13 (61.9)	<0.001
Delayed gastric emptying (DGE)	57 (43.2)	43 (40.6)	14 (53.9)	0.221	9 (15.0)	2 (5.1)	7 (33.3)	0.004
DGE requiring PEG	28 (21.2)	21 (19.8)	7 (26.9)	0.427	0	0	0	N/A
Intra abdominal abscess	39 (29.6)	29 (27.4)	10 (38.5)	0.266	7 (11.7)	2 (5.1)	5 (23.8)	0.032
Pancreatic fistula	13 (9.9)	8 (7.6)	5 (19.2)	0.073	8 (13.3)	5 (12.8)	3 (14.3)	0.874
Wound infection	10 (7.6)	7 (6.6)	3 (11.5)	0.394	3 (5.0)	0	3 (14.3)	0.015
Fluid collection	7 (5.3)	6 (5.7)	1 (3.9)	0.711	2 (3.3)	0	2 (9.5)	0.05
Reoperation	7 (5.3)	5 (4.7)	2 (7.7)	0.544	2 (3.3)	0	2 (9.5)	0.05
Nonsurgical complications	61 (46.2)	44 (41.5)	17 (65.4)	0.029	22 (36.7)	9 (23.1)	13 (61.9)	0.003
Thoracentesis	10 (7.6)	5 (4.7)	5 (19.2)	0.012	11 (18.3)	3 (7.7)	8 (38.1)	0.004
Pulmonary embolus/deep vein thrombosis	7 (5.3)	6 (5.7)	1 (3.9)	0.711	2 (3.3)	0	2 (9.5)	0.05
Major cardiopulmonary complication	8 (6.1)	6 (5.7)	2 (7.7)	0.697	4 (6.7)	1 (2.6)	3 (14.3)	0.083
Minor cardiopulmonary complication	14 (10.6)	9 (8.5)	5 (19.2)	0.111	7 (11.7)	2 (5.1)	5 (23.8)	0.032
Other nonsurgical complications	47 (35.6)	34 (32.1)	13 (50.0)	0.09	9 (15.0)	3 (7.7)	6 (28.6)	0.03
Outcomes								
Length of hospital stay, in days (median (range))	14.0 (38.0)	13.0 (38.0)	14.0 (22.0)	0.296	6.0 (30.0)	5.0 (17.0)	10 (25.0)	<0.001
30-day readmission	37 (28.2)	30 (28.3)	7 (28.0)	0.976	12 (20.0)	4 (10.3)	8 (39.1)	0.01
30-day mortality	2 (1.5)	2 (1.9)	0	0.48	1 (1.7)	1 (2.6)	0	0.459
Survival, in months (median (range))	17.0 (69.1)	19.6 (69.1)	10.7 (49.8)	0.006	26.0 (65.8)	29.3 (62.0)	12.4 (63.8)	0.045

*p-value by Mann-Whitney U-test for continuous outcome or χ^2 for categorical outcomes. Note that results were similar when Fisher's exact test was used for 2 x 2 tables

cases of local involvement. If venous resection was necessary due to tumor infiltration, a separate vascular team completed this portion of the procedure, with venous grafts in all cases. Total pancreatectomy was performed for pancreatic head tumors with a positive pancreatic margin on frozen section or intra operative findings concerning for disease extending into the body or tail of the pancreas. In all cases, en bloc resections were completed due to clinical suspicion or gross evidence of macroscopic disease involvement of adjacent structures.

Statistical analysis

SAS 9.2 was used for statistical analysis. To describe the study population, patient and tumor characteristics were compared between standard and MVR groups, using Chi-square tests for categorical variables and Mann-Whitney U-tests for continuous variables. Analysis was performed in the full sample and within strata for type of resection (SW *vs*. MVW and DP *vs*. MVDP), with significance set at p-value <0.05. Similarly, the perioperative course and postoperative morbidity and mortality were compared using a matched pair's analysis. To examine long-term survival, Kaplan-Meier survival curves were estimated for subgroups defined by extent and type of surgery. The proportional hazards assumption did not hold for strata defined by type and extent of resection, so Cox proportional hazards models were not run. To evaluate endpoints of 30-day hospital readmission and surgical complications, logistic regression models were run to evaluate the Odds Ratios (OR) and 95% Confidence Intervals (CI). For each outcome, an unadjusted analysis was run with main effects for type and extent of surgery and their interaction, and an adjusted analysis that added all covariates except histology. A secondary analysis was performed to determine if pathology impacted outcomes. It was hypothesized that patients with malignant pathology and a positive margin would demonstrate shorter median survival compared to their benign counterparts. Pathology was stratified as benign or malignant. Malignant pathology included pancreatic adenocarcinoma, liposarcoma, gastrointestinal stromal tumors, gastric adenocarcinoma, colon cancer, gallbladder adenocarcinoma, and renal cell carcinoma. Benign conditions included chronic pancreatitis, pseudo cysts, intraductal papillary mucinous neoplasms, mucinous and serous cyst adenoma, and benign neuroendocrine tumors. Kaplan-Meier survival curves were estimated with methods similar to the main analysis.

Results

Patient characteristics

Overall, 192 patients underwent pancreatic resections at our institution during the study period, with 145 (74.9%) undergoing standard resection and 47 (25.1%) MVR. There were no statistical differences in baseline demographics between these groups, overall and in strata based on type of surgery (Whipple or distal pancreatectomy; Table 1). Indications for pancreatic resection included periampullary or pancreatic adenocarcinoma (n=103, 54%), chronic pancreatitis or pseudo cyst (n=16, 8%), intraductal papillary neoplasm or cystic neoplasm (n=26, 14%), duodenal adenoma or benign tumor (n=11, 6%), benign neuroendocrine tumor (n=25, 13%), distant metastatic disease (n=6, 3.1%), and

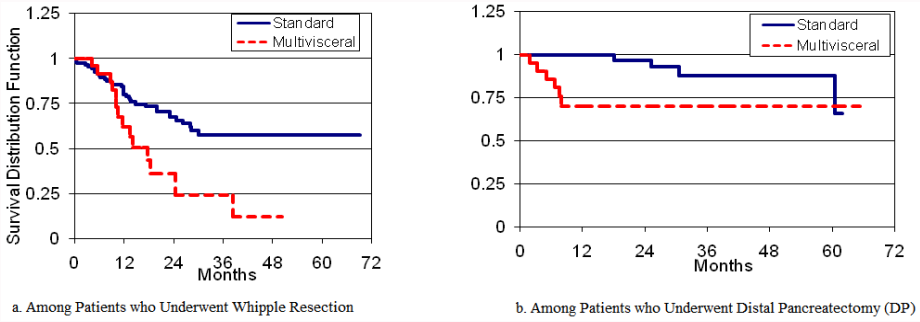

Figure 1: Months of Survival for Patients Who Underwent Pancreatic Resections, by Extent and Type of Surgery.

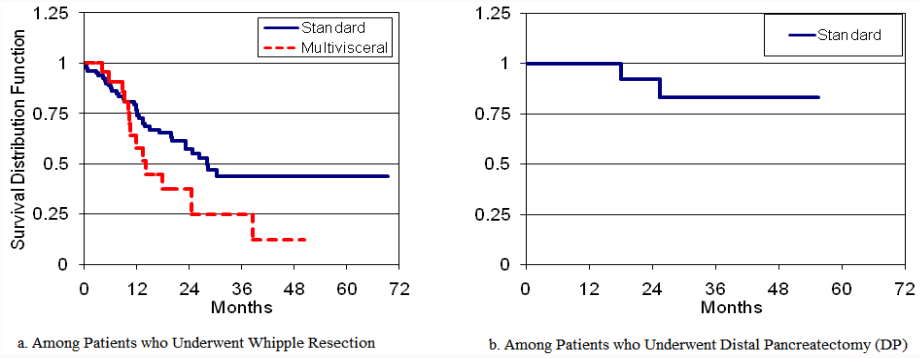

Figure 2: Months of Survival for Patients Who Underwent Pancreatic Resections for Malignant Pathology.

extra pancreatic malignancy with local pancreatic invasion (n=5, 3%). Amongst the 47 MVR patients, 12(26%) underwent venous resection alone, including portal vein, superior mesenteric vein, or left renal vein resection. Five patients had both venous resection and organ removal. Seventeen patients (60%) had one additional organ removed, seven (32%) had two removed, and four (6%) had three removed. The most commonly resected organs were colon (n=13, 28%) and stomach when greater than 50% was removed (n=13, 28%). In one case, a patient had a neuroendocrine tumor and idiopathic thrombocytopenia, so splenectomy was performed in conjunction with a Whipple procedure. Perioperative and postoperative variables were compared between standard and MVR, overall and by anatomic type of surgery (Table 2 and 3). The most frequent complications included DGE (n=66, 34%), intra abdominal abscesses (n=47, 24%), and pancreatic fistulas (n=21, 11%). Although MVW were associated with longer operating times compared to SW, there was no significant difference in rates of overall surgical morbidity. Those in the MVW group, however, were more likely to have non surgical complications, with thoracentesis required in 19% *vs*. 5% of MVW and SW patients, respectively. MVDP had a higher incidence of nearly all complications compared to DP, including surgical and nonsurgical complications. Reoperation included intra abdominal exploration, with six patients in this category. Three patients developed significant abdominal pain between postoperative days three and six with imaging suggesting pneumatosis. At re-exploration, findings included [1] diffuse colonic ischemia, with cecostomy performed; [2] SMA thrombosis, with necrosis of the majority of the small bowel and right colon, with palliative measures; and [3] diffuse purulent fluid without signs of perforation or leak, with washout performed. One patient experienced hemodynamic instability and abdominal compartment syndrome due to hemorrhage within the first 24 hr after MVW with portal vein resection. At relaparotomy, diffuse oozing was noted, but no distinct source of bleeding was isolated. Another patient who underwent MVW including superior mesenteric vein resection had significant anemia and hemodynamic instability on postoperative day four. Intra operatively, necrosis of the small bowel segment involved in each of the anastomoses was identified, requiring reconstruction of the gastrojejunostomy and hepaticojejunostomy with ligation of the pancreatic duct. Reoperation was necessary in only one individual in the distal pancreatectomy group- a patient who underwent MVDP including transverse colectomy for chronic pancreatitis, pseudo cysts, and a splenic artery aneurysm and presented to the hospital on postoperative day 20 with significant hematemesis. After unsuccessful endoscopic interventions, the patient was re-explored and gastric bleeding was isolated to two small vessels requiring suture ligation. One patient required reoperation for epidural hematoma evacuation after epidural placement and neurologic compromise with imaging confirming a large epidural hematoma. This patient did not experience any permanent neurologic dysfunction.

In-hospital mortality

In-hospital and 30-day mortality rates were similar between standard and MVR groups, with only three in-hospital deaths during the study. One decedent was a 73-year-old male with cirrhosis and cholestatic liver disease who underwent SW for an obstructing periampullary tumor with a postoperative course complicated by liver failure, hepatorenal syndrome, and eventual death. The second decedent was a 68-year-old female who underwent SW for cholangiocarcinoma. Postoperatively, she developed a trial fibrillation with rapid ventricular response and ultimately cardiopulmonary failure. Although there were plans for reoperation to investigate for intra abdominal sepsis, the patient experienced a cardiopulmonary arrest prior to re-exploration. A third patient in the DP group died intra operatively after sustaining a cardiac arrest.

Survival

Overall, patients in the standard resection groups had a longer median survival compared to those in the MVR groups (22 *vs*. 11 months, p=0.002). Even when stratified by type of operation, multivisceral operations consistently demonstrated inferior survival (Figure 1). A secondary analysis of survival for patients with malignant pathology showed similar results (17 *vs*. 11 for SW *vs*. MVW; 26*vs*. 11 for DP *vs*. MVDP; Figure 2). Few patients had surgical resection for benign disease.

Discussion

As pancreatic resections have become safer, boundaries regarding the definition of resectability have been challenged [14,15,17,19,20]. In particular, the role and safety of a multivisceral pancreatectomy defined by additional organ removal remains controversial. [14-17,20-29]. Certainly, these technically challenging invasive procedures should be performed at high-volume tertiary care centers where intensive perioperative care is available, but it is unclear if they are accompanied by acceptable morbidity and mortality. Arguments against MVR highlight the increased morbidity and mortality associated with these operations [22], with one study reporting a 3.2 times higher likelihood of postoperative complications after multivisceral compared to standard Whipple procedures [22]. In the largest published series of multivisceral pancreatic resections, Hartwig, et al. [14] compared 101 MVR to 202 standard resections, reporting higher morbidity and mortality when additional organ resection was performed [14]. 55% and 42.8% of patients in the MVR and standard resections groups, respectively, experienced morbidity with 37.6% and 25.3% attributed to surgical complications [14]. Specifically, the authors found an increased incidence of re-exploration in the MVR group, at 22% compared to 9%. Most recently, Burdelski, et al. [22] found that 55 patients with multivisceral pancreatic resections had increased morbidity and mortality compared to 303 patients with standard resections, but significantly lower than the 154 patients who underwent palliative bypass. In contrast, other studies have shown acceptable results for both morbidity and mortality when comparing the two groups. In the present study, surgical complications were more common in the multivisceral group, occurring in 47% *vs*. 66% of standard and MVR groups, respectively. In subgroup analysis, MVDP demonstrated increased morbidity compared to DP for nearly all types of complications, while MVW and SW had similar surgical morbidity. Therefore, multivisceral resections in the setting of a distal pancreatectomy, but not Whipple, were specifically associated with increased surgical morbidity in the current study. This study was limited in part due to the small sample size, particularly for patients with long-term follow-up. However, these numbers are comparable to similar studies in the literature, and long-term follow-up is primarily limited by the poor survival in this patient population. Another limitation is based on the inclusion of patients with a variety of histology types, including conditions with widely varying prognoses. To evaluate the impact of malignant disease processes on survival, a secondary analysis was performed with patients stratified by type of pathology, with results consistent with the main analysis. Finally, as a retrospective chart review, this study is limited in its ability to establish causality, although a randomized controlled trial would not be ethical in this setting. Our study demonstrated acceptable morbidity and short-term mortality after multivisceral pancreatic resections, particularly in the setting of a Whipple procedure. Unlike previous studies, however, our results highlighted unfavorable long-term survival in these cases and suggest that the long-term benefit and specific indications for multivisceral operations should be carefully evaluated prior to resection. In response to these study findings, at our institution neoadjuvant therapy is now utilized more routinely in the multimodal treatment of pancreatic cancer.

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