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Management of Bowel Obstruction in Patients with Stage IV Cancer: Predictors of Outcome after Surgery

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Abstract

Introduction—Patients with Stage IV cancer and bowel obstruction (BO) present a complicated management problem. We sought to determine if specific parameters could predict outcome after surgery.

Methods—Records of patients with Stage IV cancer and BO treated from 1991–2008 were reviewed. For surgical patients, 30-day morbidity and 90-day mortality were assessed using exact multivariable Logistic regression methods.

Results—Of 198 patients, 132 (66.7%) underwent surgery, 66 medical treatment alone, and demographics were similar. 41 (20.7%) patients were diagnosed with Stage IV cancer and BO synchronously, all treated surgically; the remaining presented metachronously. Medically managed patients were more likely to have received chemotherapy in the 30 days prior to BO [45/66 (68.2%) vs 40/132 (30.3%), $p < 0.01$]. In the surgical group, 30-day morbidity was 35.6%, while 90-day mortality was 42.3%. Median overall survival for synchronous patients was 14.1 months (95 % CI 7.6, 23.2), and 3.7 months (95 % CI 2.5, 5.2) and 3.6 months (95 % CI 1.5, 5.2) for metachronous patients treated surgically and medically, respectively. A multivariate model for 90-day surgical mortality identified low serum albumin, metachronous presentation, and ECOG > 1 as predictors of death ($p < 0.05$). A model for 30-day surgical morbidity yielded low hematocrit as a predictive factor ($p < 0.05$).

Conclusions—This cohort identifies characteristics indicative of morbidity and mortality in Stage IV cancer and BO. Low serum albumin, ECOG > 1 , and metachronous presentation predicted for 90-day surgical mortality. These data suggest factors that can be used to frame treatment discussion plans with patients.

Keywords

bowel obstruction; Stage IV; surgery; complication

Introduction

Bowel obstruction (BO) in patients with metastatic, or Stage IV, cancer can present a difficult management problem. Pre-existing comorbidities, previous treatments with chemotherapy or radiation, and compromised nutritional status make management options for this group of patients limited and challenging¹. BO has been shown to occur in 5–42 % of patients with gynecologic malignancies, and 10–28 % of colorectal cancer patients². Malignant bowel obstruction (MBO) specifically refers to a BO distal to the ligament of Treitz that is either from a primary intra-abdominal cancer, or from a non-abdominal primary cancer with intraperitoneal disease³. However, BO in cancer patients in general can be more heterogeneous, related to a number of causes, including adhesions, radiation, hernia, recurrent tumor, or peritoneal disease⁴. Peritoneal disease specifically presents a difficult diagnostic and management problem. CT scans lack sensitivity in its detection, resulting in missed diagnoses in approximately half of patients with colorectal cancer^{5,6}. The diagnosis of Stage IV cancer and BO may also occur synchronously at the time of initial presentation with an in situ primary tumor, particularly in patients with gynecologic and colorectal malignancies. The limited information regarding the patient and potential outcome impedes clinical decision-making, and often results in difficult discussions of the risks and benefits of disease management options.

One of the primary concerns in providing surgical or endoscopic treatment for patients with BO and Stage IV cancer is the high risk of harming a patient who may have an already limited expected lifespan. Surgical morbidity rates have been reported to be in the range of 9–37 %, and postoperative mortality within 30 days of surgery ranged from 5–32 %^{7,8,9}. Variability also exists in the perceived improvement in quality of life, complicated by various methods of measurement⁷. In a large prospective outcome analysis of palliative surgical and endoscopic procedures, a major post-operative complication also reduced the probability of symptom improvement¹⁰.

Surgical management options can also be variable, and include lysis of adhesions, definitive resection, or more palliative options including bypass of the affected area, or the use of a venting gastrostomy tube¹¹. Endoscopic options include percutaneous endoscopic gastrostomy (PEG) tubes, and more recently the use of colonic or duodenal stents¹².

The current study was undertaken to identify factors predicting for 30-day surgical morbidity and 90-day mortality in a heterogeneous group of patients with Stage IV cancer and BO, to assist in surgical decision-making and facilitate discussion surrounding treatment decisions.

Methods

Patient Characteristics and Cohort

A total of 232 patients with Stage IV cancer and the diagnosis of BO treated at Roswell Park Cancer Institute (RPCI) between January 1, 1991 to December 31, 2008 were identified based on ICD-9 codes. Institutional ethics approval for this retrospective review was obtained. A retrospective review of patient charts was undertaken. Two patients were

excluded as repeats. Eight patients were miscoded, one with no evidence of Stage IV cancer, and seven with no history or documentation of BO. A total of 24 patients did not have complete charts available for review. After the above exclusions, 198 patients were included in final analyses. 157 of these patients presented with Stage IV cancer initially, with subsequent diagnosis of BO; 41 patients presented with BO and Stage IV cancer synchronously, based on imaging or surgical findings. 132 BO patients were treated with a surgical or endoscopic procedure, whereas 66 patients were treated with medical management alone (Figure 1). All patients were treated as inpatients for BO.

Transfer status was considered as the patient being admitted from home, or from another facility (an outside hospital, nursing home). The presence of ascites was determined based on imaging. Primary tumor site was classified as colorectal, genitourinary (gynecologic or urologic), hepatobiliary/upper GI (stomach, esophagus), or other including lung, mediastinum, breast, retroperitoneal, and hematologic malignancies. Serum values were recorded as the first value recorded in the chart after diagnosis of BO.

Outcome Measures

BO was defined as radiologic or surgical evidence of mechanical obstruction within the gastrointestinal tract regardless of etiology. Surgical morbidity was classified based on occurrence of the complication within 30 days of the surgical or endoscopic procedure. The National Surgical Quality Improvement Program (NSQIP) classification of surgical morbidities was selected for collection¹³. Mortality was assessed at 90 days from diagnosis of BO, and was confirmed by Death Registry and Certificate of Death. Patients alive at the end of the study period (09/06/2011) were confirmed by date of last clinic visit.

Statistical Methods

Patients were divided into three exposure groups for analysis: 1. Patients undergoing medical treatment alone, 2. Patients treated with surgery after synchronous presentation of BO, and 3. Patients treated with surgery after metachronous presentation with BO. Between-group comparisons of the distributions of continuous and categorical variables were assessed using the Wilcoxon Rank Sum Test and Fischer's exact test respectively. The probabilities of 30-day morbidity and 90-day mortality were assessed in surgical patients by exact logistic regression methods. Covariates having modest univariate associations with the outcomes (p -value <0.30) were selected as possible model covariates. The main-effects full models were reduced by backward selection with a retention threshold of 0.30. Associations were described using odds ratio estimates and 95 % confidence intervals. Goodness-of-fit was assessed with the Hosmer-Lemeshow test. Between-exposure group overall survival distributions were displayed in Kaplan Meier plots. Overall survival was defined as the number of months between diagnosis of BO and death from any cause. Patients who were still alive were censored at their date of last follow-up. The null hypothesis of no difference in the survival distributions was assessed by the Log Rank test. P -values < 0.05 were considered statistically significant.

Results

In this cohort of 198 patients, one third underwent initial medical management, with the remaining undergoing a surgical or endoscopic procedure (Figure 1). The medical and surgical groups were not different in terms of sex, race, comorbidities, or ECOG status (Table 1). Patients undergoing medical management were more likely to be transferred from an outside facility rather than from home, but this was not significant ($p=0.12$). Primary colorectal tumors were more likely in the surgical group (50 %) than the medical management group (37.9 %) ($p=0.24$). Hematologic parameters such as serum albumin, bilirubin, hematocrit, creatinine, and blood urea nitrogen (BUN) were not statistically different between the two groups, but the medical management group generally had lower platelet levels than the surgical group ($p=0.06$). Patients undergoing medical management were significantly more likely to have received chemotherapy within the 30 days preceding the episode of BO (68.2% vs 30.3% $p<0.01$). About 6% of patients received radiation therapy within 90 days prior to BO. Patients undergoing medical treatment were more likely to die from that particular episode of BO, compared with patients managed surgically, but this did not reach statistical significance. The majority of patients in both groups were admitted for one episode of BO, with two, three, or four admissions being less likely, and not different between the groups. Overall, patients were followed for an average of 13.5 months after diagnosis of BO.

Considering those patients undergoing initial surgical management ($n=132$), one third had synchronous BO presentation as an initial diagnosis (Table 2). The majority of these patients had primary tumor sites being gynecologic or colorectal, and underwent a surgical procedure involving a bowel resection, lysis of adhesions, or ostomy. For those patients with metachronous presentations, the surgical procedures performed were more heterogeneous, including the procedures above, and hernia repair, bowel bypass, or endoscopic procedures such as PEG tube insertion or endoscopic stent placement. Surgical morbidity, within 30 days of surgical procedure, was not different between the two groups, although re-intubation rate for respiratory failure and superficial surgical site infection were higher in the synchronous presentation groups, but did not reach statistical significance. The overall average length of hospital stays for synchronous and metachronous presentations were 12.3 and 14.9 days ($p=0.10$) respectively. The median length of time from diagnosis and admission to surgical or endoscopic procedure was 1 day, with a range of 0–20 days.

When considering patients who initially underwent medical management, two thirds were managed during the hospital admission with a nasogastric (NG) tube (Table 3). Only approximately half of these patients received some form of anti-emetic therapy [Prochlorperazine (Compazine), Metaclopramide (Reglan), Ondansetron (Zofran)], whereas a very small proportion received steroid treatment for nausea. 24.6 % of these patients received supplemental nutrition as total parenteral nutrition (TPN). Average length of stay for the medically treated group was 8.4 days (standard error=0.9).

Thirty-seven patients had at least one additional admission for BO, 16 from the medical management group and 21 from the surgical management group. Three patients from medical management group had medical management at the second admission, while 13

(81.3 %) had a surgical or endoscopic procedure. Sixteen of the 21 (76.2 %) patients in the initial surgical management group had another surgical or endoscopic procedure at their second admission, whereas five had medical management alone.

Considering surgically managed patients only, a multivariable regression was completed to determine factors predictive of 30-day morbidity (Table 4). Occurrence of any morbidity was considered, and this was present in 39 patients. Although presentation with synchronous BO, ECOG status, and transfer status initially were possibly predictive of morbidity, only low hematocrit on admission was predictive of 30-day morbidity (OR 0.91, 95 % CI 0.83, 0.99, $p = 0.02$). The Hosmer-Lemeshow Goodness-of-fit value for this regression was 0.98, indicating the model fits the data reasonably well.

In this same group of patients, 90-day mortality was considered for multivariable regression, because 30-day mortality resulted in a very small number of events for analysis (Table 5). A total of 41 patients experienced the event in the time period. Increasing serum albumin had a protective effect (OR 0.43, 95 % CI 0.19, 0.90, $p=0.03$); synchronous BO had a protective effect relative to metachronous (OR 0.26, 95 % CI 0.06, 0.87, $p = 0.03$), and poor ECOG status greater than 1 (OR 3.18, 95 % CI 1.07, 10.07, $p = 0.04$) were predictive of 90-day mortality. The Hosmer-Lemeshow Goodness-of-fit value for this regression was 0.77, indicating good fit of the model to the data.

Comparison of the overall survival curves for the three groups, 1) surgical management with synchronous BO, 2) surgical management with metachronous BO, and 3) medical management can be found in Figure 2. Median survival for the synchronous BO group was 14.1 months (95 % CI 7.6, 23.2), the metachronous BO group 3.7 months (95 % CI 2.5, 5.2), and the medical management group 3.6 months (95 % CI 1.5, 5.2). A total of 14 patients were alive as of the study end date (09/06/2011).

Discussion

This retrospective study considers morbidity and mortality outcomes for a cohort of Stage IV patients receiving treatment at an NCI-designated cancer center over a 17-year period. This group is heterogeneous in terms of primary cancer site and cause of BO, and presents a clinical picture that is realistic. BO management was classified into medical management, and surgical or endoscopic management groups, with this final group subdivided into patients presenting with BO synchronously or metachronously. All patients presenting synchronously were managed surgically. Treatment decisions were based on individual physician and multidisciplinary opinion. The groups did not differ in demographic characteristics, with the exception that patients receiving chemotherapy within 30 days of diagnosis of BO were significantly less likely to undergo a surgical or endoscopic procedure. This may be related to surgeon choice, given the perceived higher complication rate in patients recently treated with chemotherapy and the effect on overall performance status, nutrition, and the immune system. Considering the long study period, it may be postulated that minimally invasive surgical techniques or endoscopic procedures may have been used more frequently in the more recent years. However, laparoscopic techniques were used very infrequently throughout the study period. The frequency of use of endoscopic

procedures was not different when dividing the study period in two (1991–2000, 2001–2008), with 8 and 14 endoscopic procedures completed in each period, respectively ($p=0.25$). Thus surgical and endoscopic management over this time period did not change significantly.

In considering patients treated with a surgical or endoscopic procedure initially, multivariable regressions were undertaken to identify factors predictive of any 30-day morbidity, and 90-day mortality. A recent study by Wright and colleagues involved the prospective analysis of 35 patients with BO secondary to a malignant process treated both medically and/or surgically, indicating that poor ECOG status (> 1) was predictive in turn of poor survival¹⁴. Other predictive factors of mortality included a high BUN, and low serum albumin. These factors were also found in regression analysis for 90-day mortality in the current study. Although previously published series have assessed 30-day morbidity following surgery for BO in stage IV cancer, similar regression analyses for prediction of such morbidity is not available. The current study only identifies low hematocrit as a predictor of 30-day morbidity, which is difficult to explain as a causative factor.

Median survival rates for the three groups in this cohort yielded interesting information regarding differences based on treatment. For patients presenting synchronously with BO and Stage IV cancer, patients likely having received little to no treatment for cancer previously, median survival was 14.1 months (95 % CI 7.6, 23.2), compared with a much lower survival in those presenting metachronously with BO, at 3.7 months (95 % CI 2.5, 5.2). This number is similar to those patients undergoing medical management alone for BO, with a median survival of 3.6 months (95 % CI 1.5, 5.2). In a large series of patients undergoing palliative surgical intervention at MD Anderson Cancer Center ($n=442$), approximately half had the diagnosis of gastrointestinal obstruction, and only 34 % of these went on to have a surgical procedure for management¹⁵. Median overall survival for the surgical group was 6.9 months (95 % CI 4.9, 10.5), compared with a survival of 2.1 months (95 % CI 1.8, 2.4) for those treated medically. However, not all patients in this cohort underwent surgery for BO, as other causes for surgical consultation such as gastrointestinal bleeding, and wound infection was included. Considering 30-day surgical morbidity, the overall rate for the current study is 35.6 %, which compares favorably to literature values^{5, 10, 16}.

Considering patients managed with medical means only as initial treatment, this study cohort occurred prior to the formal introduction of a palliative care service at RPCI. It is clear from the types of pharmacologic agents selected for use in these patients, or rather those that were not selected, such as steroids and octreotide, that an active palliative care service may have been particularly helpful in managing symptoms, even prior to patients receiving surgical management. Ripamonti and colleagues, as well as other groups, have provided treatment algorithms that clarify the utility of other agents, such as the anticholinergic Scopolamine, neuroleptics such as Haldol, and other pharmacologic agents^{2,4,11}.

The limitations of the current study stem from the convenience-sample used and the inherent incompleteness of data available for review. This cohort spans a long period of time, and it would be expected that management options might have changed over time, in particular

with respect to the utility and evidence for of newer pharmacologic interventions for medical management. RPCI has had a strong endoscopic practice over the study period, which may explain why no differences in endoscopic procedures in the earlier time period and later time period existed. Although a criticism of previous works, the definition of BO in our current study was similar, as any obstruction of the gastrointestinal tract, regardless of benign or malignant etiology¹⁷. In a review of BO in patients with the diagnosis of cancer, benign causes for the obstruction could be found intra-operatively in 3–48 % of cases⁷. Despite these easily correctable causes of obstruction included in our cohort, one might expect survival rates to be slightly better than previously published numbers, in those patients with so-called "malignant bowel obstruction", but were not. Imaging completed pre-operatively may assist in some cases in determining the cause of BO prior to embarking on surgical management, but the ability to determine neoplastic versus non-neoplastic etiology with absolute certainty is increasingly difficult, given prior surgical interventions causing benign adhesions. However, newer techniques regarding morphologic evaluation with respect to imaging techniques may prove helpful in the future¹⁸.

This large cohort presents sobering data regarding survival in patients with Stage IV cancer and BO. In patients with metachronous presentations, survival in those treated surgically or endoscopically versus medically was not different. These data are not meant to suggest that no patient with Stage IV cancer and BO would benefit from a surgical or endoscopic procedure. The striking similarity in survival for the surgically and medically managed groups is intended to be realistic, indicating that the decision-making process when considering surgery is complicated and outcomes can often times be poorer than expected. This also highlights the importance of other factors and outcomes that could not be measured in the current study, including improvement or change in quality of life after surgical intervention. Although objective measures of morbidity and mortality may be of utmost importance to surgeons, medical oncologists, palliative care physicians, and patients when considering management options for BO in Stage IV cancer, there may be other measures that may in fact change with respect to type of management selected that were not studied.

The results from the current study will be used to inform a more patient- and caregiver/ family- centered approach for further research. A prospective study of patients admitted to RPCI with Stage IV cancer and BO, with all patients being evaluated by the palliative care service for symptom management regardless of planned ultimate intervention. Even though quality of life from a patient's perspective can be difficult to measure during the time of presentation with BO, such information from caregivers or family members may assist in further refining such services for this group of patients.

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Figure 1.

Patient Cohort

¹all medically managed patients had metachronous presentations

Figure 2.
Kaplan Meier Survival Curve.

Table 1

Patient Demographics[†]

	Medical Treatment	Surgical Treatment	Overall	p-value
n	66 (33.3 %)	132 (66.7 %)		
Sex				
Male	29 (43.9 %)	50 (37.9 %)	79 (39.9 %)	0.44
Female	37 (56.1 %)	82 (62.1 %)	119 (60.1 %)	
Race				
Caucasian	51 (77.3 %)	115 (87.1 %)	166 (83.8 %)	0.10
Non-Caucasian	15 (22.7 %)	17 (12.9 %)	32 (16.2 %)	
Smoking				
Never	29 (43.9 %)	61 (46.2 %)	90 (45.5 %)	0.88
Current/Past	37 (56.1 %)	71 (53.8 %)	108 (54.5 %)	
Comorbidities				
None	38 (57.6 %)	77 (58.3 %)	115 (58.1 %)	1.00
1 or more	28 (42.4 %)	55 (41.7 %)	83 (41.9 %)	
ECOG Status				
0,1	43 (65.2 %)	98 (74.2 %)	141 (71.2 %)	0.35
2,3,4	23 (34.8 %)	34 (25.8 %)	57 (28.8 %)	
Transfer Status				
From Home	57 (86.4 %)	123 (93.2 %)	180 (90.9 %)	0.12
Other	9 (13.6 %)	9 (6.8 %)	18 (9.1 %)	
Ascites				
Yes	24 (36.4 %)	43 (32.8 %)	67 (34.0 %)	0.64
No	42 (63.6 %)	89 (67.2 %)	131 (66.0 %)	
Weight loss				
Yes	45 (68.2 %)	81 (61.4 %)	126 (63.6 %)	0.43
No	21 (31.8 %)	51 (38.6 %)	72 (36.4 %)	
Primary Site				
Colorectal	25 (37.9 %)	66 (50.0 %)	91 (46.0 %)	0.24
Genitourinary	21 (31.8 %)	29 (22.0 %)	50 (25.3 %)	
Hepatobiliary/Upper GI	12 (18.2 %)	28 (21.2 %)	40 (20.2 %)	
Other: Lung, Mediastinum, Breast, Hematologic	8 (12.1 %)	9 (6.8 %)	17 (8.5 %)	
Albumin				
Mean (st error)	3.3 (0.1)	3.4 (0.1)	3.4 (0.1)	0.24

		Medical Treatment	Surgical Treatment	Overall	p-value
Bilirubin	Mean (st error)	0.6 (0.1)	0.7 (0.1)	0.7 (0.1)	0.48
Hematocrit	Mean (st error)	35.8 (0.6)	35.9 (0.5)	35.9 (0.4)	0.77
Platelets	Mean (st error)	319.5 (19.6)	367.6 (14.6)	350.7 (11.8)	0.06
Creatinine	Mean (st error)	1.2 (0.1)	1.1 (0.1)	1.1 (0.1)	0.05
BUN	Mean (st error)	20.5 (1.8)	20.6 (1.8)	20.6 (1.3)	0.64
Chemotherapy within 30 days of BO	No	21 (31.8%)	92 (69.7 %)	113 (57.1 %)	< 0.01
	Yes	45 (68.2 %)	40 (30.3 %)	85 (42.9 %)	
Radiation therapy within 90 days of BO	Yes	4 (6.2 %)	8 (6.1 %)	12 (6.1 %)	1.00
	No	61 (93.8 %)	124 (93.9 %)	185 (93.9 %)	
Disposition	Home	49 (75.4 %)	108 (81.8 %)	157 (79.7 %)	0.40
	Rehab, Hospice	8 (12.3 %)	15 (11.4 %)	23 (11.7 %)	
	Death	8 (12.3 %)	9 (6.8 %)	17 (8.6 %)	
Number of admissions for BO	1	50 (75.8 %)	111 (84.1 %)	161 (81.3 %)	0.27
	2	13 (19.7 %)	19 (14.4 %)	32 (16.2 %)	
	3	2 (3.0 %)	1 (0.8 %)	3 (1.5 %)	
	4	1 (1.5 %)	1 (0.8 %)	2 (1.0 %)	
Follow-up (Months)	Mean (st error)	13.3 (3.1)	13.6 (1.7)	13.5 (1.5)	0.11

/ Associations between continuous variables were assessed using the Wilcoxon Rank Sum Test, and associations between categorical variables were assessed using Fisher's Exact Test.

Table 2

Surgical Management of Bowel Obstruction¹

		Synchronous Presentation with BO	Metachronous Presentation with BO	p-value
n		41 (31.1 %)	91 (68.9 %)	
Age	Mean (std error)	12.3 (1.3)	14.9 (1.1)	0.09
Sex	Male	7 (17.1%)	43 (47.3%)	<0.01
	Female	34 (82.9%)	48 (52.7%)	
Comorbidities	None	24 (58.5%)	53 (58.2%)	1.00
	1 or more	17 (41.5%)	38 (41.8%)	
Primary Site	Colorectal	21 (51.2 %)	45 (49.5 %)	0.07
	Genitourinary	14 (34.1%)	15 (16.5 %)	
	Hepatobiliary/ Upper GI	5 (12.2 %)	23 (25.3 %)	
	Other: Lung, Mediastinum, Breast, Hematologic	1 (2.5 %)	8 (8.7 %)	
Principal Surgical Procedure	SB/Colon resection	31 (75.6 %)	24 (26.4 %)	< 0.01
	Lysis of Adhesions	3 (7.3 %)	11 (12.1 %)	
	Ostomy	3 (7.3 %)	15 (16.5 %)	
	Hernia repair	0	1 (1.1 %)	
	Bypass	0	9 (9.9 %)	
	Gastrostomy tube ²	0	4 (4.4 %)	
	Endoscopic stent or decompression	0	11 (12.1 %)	
	PEG ³	0	11 (12.1 %)	
	Other ⁴	4 (9.8 %)	5 (5.5 %)	
Morbidity (within 30 days of surgery)	Acute renal failure	1 (2.4 %)	0 (0 %)	0.311
	CVA ⁵	0 (0 %)	2 (2.2 %)	1.000
	Cardiac arrest	1 (2.4 %)	0 (0 %)	0.311
	Deep vein thrombosis	0 (0 %)	2 (2.2 %)	1.000
	Dehiscence	1 (2.4 %)	2 (2.2 %)	1.000
	Myocardial infarction	2 (4.9 %)	6 (6.6 %)	1.000
	Pneumonia	0 (0 %)	1 (1.1 %)	1.000
	Pulmonary embolus	1 (2.4 %)	0 (0 %)	0.311
	Reintubation	3 (7.3 %)	1 (1.1 %)	0.089
	Return to OR on same admission	6 (14.6 %)	8 (8.8 %)	0.364

		Synchronous Presentation with BO	Metachronous Presentation with BO	p-value
	Sepsis	5 (12.2 %)	9 (9.9 %)	0.762
	Deep Surgical Site Infection	2 (4.9 %)	4 (4.4 %)	1.000
	Superficial Surgical Site Infection	6 (14.6 %)	4 (4.4 %)	0.069
	Transfusion	11 (26.8 %)	14 (15.4 %)	0.151
	Urinary Tract Infection	1 (2.4 %)	1 (1.1 %)	0.526
TPN	No	39 (95.1%)	73 (80.2%)	0.03
	Yes	2 (4.9%)	18 (19.8%)	
Emergency Surgery	No	39 (95.1%)	81 (89.0%)	0.34
	Yes	2 (4.9%)	10 (11.0%)	
LOS⁶	Mean (std error)	12.3 (1.3)	14.9 (1.1)	0.09

¹ Associations between continuous variables were assessed using the Wilcoxon Rank Sum Test, and associations between categorical variables were assessed using Fisher's Exact Test.

² Surgically-placed gastrostomy tube

³ Endoscopically-placed percutaneous endoscopic gastrostomy

⁴ Includes total abdominal hysterectomy, bilateral salpingo-oophorectomy, gastrectomy

⁵ Cerebrovascular accident

⁶ Length of stay in hospital (days)

Table 3

Medical Management of Bowel Obstruction

n		66
Nasogastric tube		45 (68.2 %)
Anti-emetic	Compazine	14 (25.0 %)
	Reglan	4 (7.1 %)
	Zofran	10 (17.9 %)
Steroid		5 (7.6 %)
Octreotide		8 (12.1 %)
Narcotic	Hydrocodone	1 (1.5 %)
	Oxycodone	8 (12.1 %)
	Morphine	6 (9.1 %)
	Hydromorphone	10 (15.2 %)
	Fentanyl/Duragesic	14 (21.2 %)
	Methadone	1 (1.5 %)
TPN		16 (24.6 %)
LOS^I	Mean (std error)	8.4 (0.9)

^I Length of stay in hospital (days)

Table 4

Multivariable Regression for 30-day morbidity

Parameter	Reference Group	Odds Ratio Estimate	95 % Confidence Interval	p-value
Synchronous BO	Synchronous vs Metachronous	2.25	0.82, 6.28	0.12
ECOG	2/3/4 vs 1/0	2.37	0.81, 7.14	0.13
Hematocrit	Continuous	0.91	0.83, 0.99	0.02
Transfer Status	From other vs From Home	3.47	0.53, 38.92	0.26

Table 5

Multivariable Regression for 90-day mortality

Parameter	Reference	Odds Ratio Estimate	95 % Confidence Interval	p-value
Albumin	Continuous	0.43	0.19, 0.90	0.03
Synchronous BO	Synchronous vs Metachronous	0.26	0.06, 0.87	0.03
ECOG	2/3/4 vs 1/0	3.18	1.07, 10.07	0.04