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Bowel Obstruction in Elderly Ovarian Cancer Patients: A Population-Based Study

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Abstract

PURPOSE—Bowel obstruction is a common pre-terminal event in abdominal/pelvic cancer that has mainly been described in small single-institution studies. We used a large, population-based database to investigate the incidence, management, and outcomes of obstruction in ovarian cancer patients.

PATIENTS AND METHODS—We identified patients with stages IC-IV ovarian cancer, aged 65 years or older, in the Surveillance, Epidemiology and End Results (SEER)-Medicare database diagnosed between January 1, 1991 and December 31, 2005. We modeled predictors of inpatient hospitalization for bowel obstruction after cancer diagnosis, categorized management of obstruction, and analyzed the associations between treatment for obstruction and outcomes.

RESULTS—Of 8607 women with ovarian cancer, 1518 (17.6%) were hospitalized for obstruction subsequent to cancer diagnosis. Obstruction at cancer diagnosis (HR=2.17, 95% CI: 1.86–2.52) and mucinous tumor histology (HR=1.45, 95% CI: 1.15–1.83) were associated with increased risk of subsequent obstruction. Surgical management of obstruction was associated with lower 30-day mortality (13.4% in women managed surgically vs. 20.2% in women managed non-surgically), but equivalent survival after 30 days and equivalent rates of post-obstruction chemotherapy. Median post-obstruction survival was 382 days in women with obstructions of adhesive origin and 93 days in others.

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CONCLUSION—In this large-scale, population-based assessment of patients with advanced ovarian cancer, nearly 20% of women developed bowel obstruction after cancer diagnosis. While obstruction due to adhesions did not signal the end of life, all other obstructions were pre-terminal events for the majority of patients regardless of treatment.

Introduction

Death due to cancer can involve painful and care-intensive complications, demanding palliative treatments sensitive to patient needs. One such complication is bowel obstruction, wherein recurrent abdominal or pelvic cancer leads to a blocked intestinal tract, which in turn results in nausea, vomiting, and dehydration[1]. Obstruction usually requires inpatient hospitalization[2, 3] and may be the proximal cause of death[4, 5]. Bowel obstruction is particularly common in advanced ovarian cancer patients, with estimates of lifetime incidence ranging up to 35%[6–8].

Obstruction management options can be broadly categorized into surgical treatments, such as bypasses or colostomies, and non-surgical treatments, such as bowel rest with decompression, pharmacological management, or endoscopic placement of a stent at the obstruction site[9]. There exist no formal guidelines for treatment[3], in part because some studies have found surgery to be associated with improved survival[4, 7, 10] while others have found no survival benefit to surgery or attribute minor survival differences to patient selection[6, 11].

To date, most studies of bowel obstruction management and outcomes in the context of recurrent ovarian cancer have been hospital-based and had small sample sizes[4–8, 10–15]. In this study, we estimate the incidence of obstruction in a population-based sample of ovarian cancer patients, using the Surveillance, Epidemiology and End Results (SEER) and Medicare claims linked databases[16]. We also investigate factors associated with bowel obstruction, treatment of bowel obstruction, and outcomes after a hospitalization for obstruction.

Methods

Data Source

We analyzed data from the Surveillance, Epidemiology, and End Results (SEER)–Medicare database, which links SEER's detailed registry data with Medicare claims data[17]. The SEER database contains records of patients diagnosed with cancer in regions that contain approximately 14% of the US population; in 2000, this database was expanded to include approximately 26% of the US population[18].

Cohort Selection

We selected women who had a pathologically confirmed first and primary diagnosis of stage IC, II, III, and IV epithelial ovarian carcinoma between January 1, 1991, and December 31, 2005. Subjects diagnosed exclusively by death certificate or autopsy, those for whom the month of diagnosis was unknown, and those who had Medicare coverage owing to disability or late-stage renal disease rather than age were excluded. We also excluded individuals enrolled in a non-Medicare health maintenance organization at any time from cancer diagnosis to death, as billing claims for these patients may not have been submitted to Medicare for reimbursement.

Patient characteristics

We extracted patient characteristics, including age, race, marital status, date of diagnosis, and tumor characteristics from SEER registry files. We categorized age in five-year increments, and race as white, black, and other or unknown. We considered subjects divorced, separated, single, and widowed at the time of diagnosis to be unmarried. We grouped patients by year of diagnosis (1991–1995, 1996–2000, and 2001–2005), and appointed the diagnosis date as the 15th day of the month of diagnosis. We classified tumor histology as serous, mucinous, endometrioid, or other. We grouped tumor grade into low (well or moderately differentiated), high (poorly differentiated or undifferentiated), and unknown according to ICD-0-2 code[19]. Cases were grouped by nodal involvement into N0 (no lymph nodes involved by tumor), N1 (1–3 lymph nodes involved), N2 (>3 nodes involved), and unknown according to American Joint Committee on Cancer staging criteria[20].

We categorized patients as having had primary tumor resection (PTR) or no PTR on the basis of a physician or hospital claim for oophorectomy, exenteration, or hysterectomy (codes in Appendix 1) within six months of diagnosis. We considered hospitalization at an acute care hospital after cancer diagnosis in which an ICD-9 diagnosis code for bowel obstruction was recorded (560.81, 560.89, 560.9) to constitute an obstruction event; patients in whom the code specific to adhesive bowel obstruction (560.81) was ever used in a MedPAR claim were further categorized as ‘ever-adhesive’. Under the assumption that an obstruction of adhesive etiology might be coded as non-specific obstruction but that malignant obstruction was unlikely to be coded as adhesive, analysis of this subset gave us a view of potential differences in factors affecting obstruction etiology by etiology, albeit one diluted by likely misclassification. We categorized patients as receiving chemotherapy based on Medicare claims files. We categorized patients as having ascites by ICD-9 diagnosis codes (789.5, 789.51, 789.59). Finally, we excluded individuals with a history of bowel obstruction prior to cancer diagnosis to ensure use of an obstruction code did not represent a history of obstruction.

Comorbid Disease

To assess comorbid disease in our cohort, we used the Klabunde adaptation of the Charlson comorbidity index[21, 22]. We analyzed Medicare inpatient and outpatient claims for ICD-9 diagnostic codes[23] for each of 19 health conditions, requiring the appearance of the code to predate cancer diagnosis. We then compiled codes into a composite comorbidity score for each patient[21]. Individuals with no matching claims (8.8%) were given a zero score.

Characteristics of Surgical Treatment for Bowel Obstruction

We considered a physician or hospital claim for gastroenterostomy, entero-enterostomy, bowel resection, enterostomy, and lysis of peritoneal adhesions (codes provided online in Appendix 1) to represent surgical therapy. We did not consider an isolated claim for laparotomy or laparoscopy to constitute surgical therapy in the absence of secondary procedure codes because it is unclear whether surgical correction of the obstruction was attempted.

Outcomes

We used hospital claims files to calculate length of stay and considered horizontal transfers to another acute care hospital part of the same hospitalization. For each patient who had died at the time of last follow-up, we calculated days of life remaining after first post-diagnosis obstruction. We examined all Medicare hospital claims that post-dated the initial claim for

obstruction to assess hospital re-admission rates, post obstruction chemotherapy rates, and to compute a ratio of days in to days out of the hospital post-obstruction.

Statistical Analysis

We used univariable Cox proportional hazards models to assess predictors of time to hospitalization for bowel obstruction and post-obstruction survival. We used Kaplan-Meier curves to compute survival times, median time to obstruction and length of hospital stay. Time-to-obstruction models used date of PTR or cancer diagnosis (if no PTR) as time 0, and treated both death and loss to follow-up as censoring events. The assumption of proportionality was assessed visually. All statistical tests were two-sided and we considered a p-value less than 0.05 statistically significant. We used SAS 9.2 for statistical analyses (SAS Institute, Cary, NC).

Results

We identified 8663 women ≥65 years old diagnosed with stages IC-IV ovarian carcinoma. We excluded 56 women who had a diagnosis of bowel obstruction prior to the cancer diagnosis. The final cohort was composed of 8607 women, 6966 (80.9%) of whom had died by the time of last follow-up. Of the final cohort, 1518 (17.6%) were hospitalized for bowel obstruction at least once between cancer diagnosis and end of follow-up, including 1357 (19.5%) of those who had died. Among the 1518 hospitalized for obstruction, 982 (64.7%) were hospitalized only once for obstruction, 340 (22.4%) were hospitalized twice and 196 (13.0%) more than twice. In the group with any obstructions, the first post-diagnosis obstruction occurred a median of 477 (IQR 224–901) days after cancer diagnosis.

Table 1 shows the demographic and clinical characteristics and tumor features of the subjects, stratified by hospitalization for bowel obstruction after cancer diagnosis. Because the incidence of obstruction was closely tied to survival time, associations were assessed with univariable Cox-proportional hazard models; these p-values are shown in Table 1. The median age of the cohort was 75 (IQR 71–81).

A multivariable Cox proportional hazard model to determine predictors of obstruction is shown in Table 2. Accounting for all other significant predictors, the 8% of the cohort who presented with obstruction at cancer diagnosis were more than twice as likely to develop an obstruction in the course of their disease (HR 2.17, 95% CI: 1.87–2.52). Mucinous tumor histology was also associated with elevated risk (HR 1.45, 95% CI: 1.15–1.83), an effect likely driven by shorter survival among women with mucinous tumors (236 days vs. 331 days for the serous group). Other factors associated with increased risk included higher stage, younger age at diagnosis and earlier year of diagnosis. Ascites and PTR at diagnosis were not significantly associated with obstruction after accounting for other factors.

Table 3 shows predictors of management strategy among the group that was hospitalized for obstruction. Notably, surgery for obstruction was more common among those with younger age, low nodal stage, poorly differentiated tumors, or ‘ever-adhesive’ status. Surgery for obstruction was not associated with tumor histology or history of chemotherapy.

The median survival after bowel obstruction was 121 days, though survival was much longer in the ‘ever-adhesive’ group (382 days vs. 93 days, $p<0.001$). Surgical management of first post-diagnosis obstruction was also associated with longer median survival after obstruction (162 days vs. 98 days, $p<0.001$), though median survival after 30 days did not differ (133 days vs. 149 days, $p=0.776$). While surgical management was associated with lower hazard of death in a univariable Cox proportional hazards model (HR 0.78, $p<0.001$), the association was not significant (HR 0.90, $p=0.161$) when the model also included ever-

adhesive status. In this model, 'ever-adhesive' status remained highly significant (HR 0.52, p<0.001).

Table 4 shows selected outcomes of hospitalizations for first post-diagnosis obstruction, stratified by management strategy. Those managed surgically were more likely to spend time in the ICU (35.7% vs. 6.9% for those managed non-surgically, p<0.001), while those managed non-surgically had a much higher 30-day mortality (24.2% vs. 13.1%, p<0.001). About 35% of patients were readmitted with a code for obstruction at least once after discharge, and this rate did not differ by management strategy (p=0.403) or 'ever-adhesive' status (p=0.511). Overall, patients lived about 5 days out of the hospital for each day in the hospital regardless of management strategy (p=0.280).

Sensitivity analyses

We were concerned that differential censoring by stage and calendar time might interact with obstruction's status as an end-of-life event to create spurious findings. To assess this, we performed an analysis with the cohort limited to only those for whom 3 or more years of Medicare data was available but who survived less than 3 years (n=4980); earlier year of diagnosis was still significantly associated with obstruction in this group (HR 1.23, 95%CI: 1.05–1.45 comparing 1991–1995 to 2001–2005). Stage also retained an attenuated but still significant association (HR 2.20, 95%CI 1.13–4.26 comparing stage IV to stage IC).

Discussion

In this study of 8607 women diagnosed with ovarian cancer after age 65, 19.5% of those followed from diagnosis to death were hospitalized for bowel obstruction subsequent to their cancer diagnosis. Subsequent obstruction was associated with mucinous tumor histology, younger age, earlier year of diagnosis and history of obstruction at time of cancer diagnosis. About 1 in 4 obstructions were managed surgically, and the median survival after obstruction was poor unless the obstruction appeared to be due to adhesive disease. Surgical management of obstruction was not associated with improved survival, nor was it associated with fewer hospital visits or a greater proportion of life outside of the hospital after obstruction.

The 19.5% lifetime obstruction rate we observed falls near the middle of the 5–42% range frequently cited[24–26]. The rate we observed may be an underestimate of the true lifetime rate of bowel obstruction in ovarian cancer patients for several reasons. First, because we considered only inpatient hospitalizations with billing codes from the hospital stay to constitute obstruction, we may have missed partial obstructions that resolved without hospitalization[27]. Second, our cohort was limited to women over age 65, two years above the median age of ovarian cancer onset[28], while younger age at diagnosis appears to be associated with obstruction. If the lifetime obstruction rate is highest in women diagnosed below age 65, our cohort was enriched with women less likely to develop obstruction. Third, lifetime obstruction rates may include obstructions that occur at or before diagnosis; we counted only post-diagnosis obstructions.

In our final incidence model, the strongest predictor of obstruction after diagnosis was higher stage (HR 4.73, 95%CI: 3.27–6.81 comparing stage IV to stage I); this may reflect that obstruction is an end-of-life event. This conclusion is supported by a sensitivity analysis showing the association with stage was lessened when follow-up was complete across all stages. Obstruction at diagnosis was also associated with significantly elevated risk of obstruction after diagnosis (HR 2.20, 95%CI: 1.88–2.58). This is consistent with reports suggesting that obstruction is frequently an intermittent and recurrent event[29], especially

in the context of ovarian cancer, where reported recurrence rates have ranged as high as 63% [5].

We also found mucinous tumor histology to be associated with an elevated hazard of obstruction; this is consistent with results we found in a study of predictors of bowel obstruction in the context of colon cancer[30]. Further, it has been suggested that the etiology of mucinous ovarian cancer is separate from that of other histologic subtypes[31, 32], and that mucinous ovarian tumors are associated with worse prognosis and poorer response to chemotherapy[33, 34]; it is possible mucinous tumors are similarly associated with greater risk of obstruction. However, it is also possible this apparent risk is simply an artifact of misdiagnosis of women presenting with ovarian masses and mucin in the abdomen due to metastatic non-ovarian cancer[35]; unfortunately, we are unable to assess either hypothesis from SEER-Medicare data alone.

While there are no formal guidelines for treatment decisions, it is generally agreed that patients with poor prognostic status are unlikely to benefit from palliative surgery[1, 4, 13, 36]. In our study, factors associated with surgical management were also linked to prolonged survival, including ‘ever-adhesive’ obstruction, low nodal stage, and no history of obstruction at diagnosis. Interestingly, history of prior chemotherapy did not appear to play a role in determining management strategy, though chemotherapy failure has been suggested as a factor determining appropriateness of surgical intervention[13].

In spite of the improved prognosis among patients selected for surgery, surgery was not associated with an increased probability of receiving chemotherapy after obstruction. The 47.5% rate of post-obstruction chemotherapy we observed in surgically treated patients was below the 65–79% reported in hospital-based studies[5, 12, 14], possibly reflecting referral patterns to the hospitals in which studies were performed. Surgery was not associated with a decrease in readmission rate for obstruction, consistent with Bryan, et al.’s report that management choice did not affect time to reobstruction.[6]

However, those managed surgically did survive about two months longer than those managed non-surgically, consistent with results reported in several hospital studies[4, 7, 10]. This survival benefit was coupled with more post-obstruction time spent in the hospital, such that percent of life after obstruction spent in the hospital was equivalent between surgical and non-surgical groups, consistent with a trend we previously observed examining obstruction outcomes in the context of stage 4 colon cancer[37]. In that study, as in this, surgery’s survival benefit was no longer significant after adjusting for adhesive etiology, consistent with suggestions that the apparent benefits of surgery may be due to factors leading to selection for surgery[6, 11].

Indeed, across management strategies, ‘ever-adhesive’ obstruction was associated with nearly four times longer median survival compared with ‘never-adhesive’. This result is consistent with previous reports that obstructions of benign origin are associated with better survival[8, 38]. While the use of ever- status to categorize obstruction etiology may have resulted in misclassification, we have no reason to believe any misclassification would be differential by survival. Thus, any misclassification should bias the effect of ‘ever-adhesive’ status towards the null.

Our conclusions are strengthened by the long period of observation (80% of subjects were followed from diagnosis to death) and the large sample size compared with prior hospital-based studies. Additionally, as SEER-Medicare draws from a population-based sample, it is reasonable to believe our results can be generalized to other populations of elderly women with ovarian cancer.

However, the study also has limitations. Owing to a lack of specific codes, we were unable to fully distinguish obstructions of malignant origin from benign obstructions and small bowel from colonic obstruction. We were unable to assess many post-obstruction prognostic factors from Medicare claims alone, including nutritional status[13], serum albumin[39], and extent of peritoneal spread[1], limiting our ability to understand why a treatment choice was made. Additionally, we were unable to distinguish chemotherapy given intra-peritoneally rather than intravenously, to assess whether optimal tumor debulking occurred at cancer diagnosis, or to assess the site of obstruction, all of which might have effects on obstruction incidence and outcomes. We were unable to assess the use of several palliative techniques, including stenting at the point of obstruction and anti-secretory medications such as octreotide. Finally, we were unable to assess whether treatments chosen successfully palliated symptoms, an outcome vital to developing management guidelines in this context.

In conclusion, bowel obstruction in the context of advanced ovarian cancer frequently signals the end of life. Obstruction occurs in about 1 in 5 ovarian cancer patients and unless the obstruction is of adhesive origin, median survival is poor regardless of management strategy. These results support clinical treatment of malignant bowel obstruction as a pre-terminal event; in this context, management decisions should be made to optimize patient comfort rather than increase patient survival.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Research Highlights

- Bowel obstruction in 17% of ovarian cancer patients in population based sample
- Post-obstruction survival 382 days for those with adhesions versus 93 days in others.
- No increase in survival with surgery except for those with adhesions.

Table 1

Characteristics of 8607 stage IC-IV ovarian cancer patients in SEER-Medicare diagnosed between 1991 and 2005, stratified by occurrence of bowel obstruction.

	Overall n=8607		No Obstruction n=7089		Obstruction n=1518		Time- to- event p-value
	No.	(%)	No.	(%)	No.	(%)	
Patient characteristics							
Age at Diagnosis							<0.001
65 to 70	1655	(19.2)	1227	(17.3)	428	(28.2)	
70 to 74	2219	(25.8)	1708	(24.1)	511	(33.7)	
75 to 79	2176	(25.3)	1823	(25.7)	353	(23.3)	
80 and up	2557	(29.7)	2331	(32.9)	226	(14.9)	
Race							0.923
White	7740	(89.9)	6350	(89.6)	1390	(91.6)	
Black	432	(5.0)	373	(5.3)	59	(3.9)	
Other or unknown	435	(5.1)	366	(5.2)	69	(4.5)	
Marital Status							0.021
Married	3619	(42.0)	2861	(40.4)	758	(49.9)	
Unmarried	4752	(55.2)	4018	(56.7)	734	(48.4)	
Unknown	236	(2.7)	210	(3.0)	26	(1.7)	
Presenting Features							
Year of Diagnosis							<0.001
1991 to 1995	2377	(27.6)	1853	(26.1)	524	(34.5)	
1996 to 2000	2479	(28.8)	2003	(28.3)	476	(31.4)	
2001 to 2005	3751	(43.6)	3233	(45.6)	518	(34.1)	
Obstruction at diagnosis							<0.001
No	7815	(90.8)	6498	(91.7)	1317	(86.8)	
Yes	792	(9.2)	591	(8.3)	201	(13.2)	
Comorbidity							0.438
Charlson index = 0	6957	(80.8)	5641	(79.6)	1316	(86.7)	
Charlson index = 1	1001	(11.6)	867	(12.2)	134	(8.8)	
Charlson index >= 2	649	(7.5)	581	(8.2)	68	(4.5)	

	Overall n=8607		No Obstruction n=7089		Obstruction n=1518		Time- to- event p-value
	No.	**(%)**	**No.**	**(%)**	**No.**	**(%)**	
Tumor Histology							<0.001
Endometrioid	600	(7.0)	492	(6.9)	108	(7.1)	
Mucinous	454	(5.3)	376	(5.3)	78	(5.1)	
Other	3331	(38.7)	2871	(40.5)	460	(30.3)	
Serous	4222	(49.1)	3350	(47.3)	872	(57.4)	
Primary Tumor Resection							<0.001
No	2958	(34.4)	2714	(38.3)	244	(16.1)	
Yes	5649	(65.6)	4375	(61.7)	1274	(83.9)	
Stage							<0.001
1C	365	(4.2)	334	(4.7)	31	(2.0)	
2	693	(8.1)	614	(8.7)	79	(5.2)	
3	3893	(45.2)	3081	(43.5)	812	(53.5)	
4	3656	(42.5)	3060	(43.2)	596	(39.3)	
Chemotherapy prior to obstruction							<0.001
No	5053	(58.7)	4373	(61.7)	680	(44.8)	
Yes	3554	(41.3)	2716	(38.3)	838	(55.2)	
Tumor Grade							0.009
Well or moderately differentiated	1458	(16.9)	1177	(16.6)	281	(18.5)	
Poorly differentiated or anaplastic	4143	(48.1)	3307	(46.6)	836	(55.1	
Unknown	3006	(34.9)	2605	(36.7)	401	(26.4)	
Ascites prior to obstruction							0.191
No	5684	(66.0)	4629	(65.3)	1055	(69.5)	
Yes	2923	(34.0)	2460	(34.7)	463	(30.5)	

Table 2

Multivariable Cox Proportional Hazard analysis of association between clinical and tumor characteristics in 8607 stage IC-IV ovarian cancer patients diagnosed in SEER-Medicare database between 1991 and 2005 and bowel obstruction.

	Adjusted Hazard Ratio	95% CI	p
Age at Diagnosis			<0.001
65 to 69	*Reference*		
70 to 74	1.00	0.88 to 1.13	
75 to 79	0.80	0.69 to 0.92	
≥80	0.69	0.59 to 0.81	
Year of Diagnosis			0.001
1991 to 1995	*Reference*		
1996 to 2000	0.84	0.74 to 0.95	
2001 to 2005	0.80	0.71 to 0.91	
Stage			<0.001
1C	*Reference*		
2	1.76	1.16 to 2.68	
3	4.48	3.12 to 6.44	
4	4.82	3.35 to 6.95	
Obstruction at diagnosis			<0.001
No	*Reference*		
Yes	2.18	1.87 to 2.52	
Tumor Histology			0.002
Serous	*Reference*		
Mucinous	1.45	1.14 to 1.83	
Endometrioid	0.89	0.72 to 1.08	
Other	1.13	1.01 to 1.27	

Table 3

Predictors of obstruction management strategy among 1518 women with post-diagnosis bowel obstruction the context of ovarian cancer diagnosed between 1991 and 2005 in SEER-Medicare.

	Overall n=1518		Non-surgical Management n=1145		Surgical Management n=373		
	No.	(%)	No.	(%)	No.	(%)	Chi- squared p-value
Age at Obstruction							0.114
65 to 70	268	(17.7)	193	(16.9)	75	(20.1)	
70 to 74	523	(34.5)	403	(35.2)	120	(32.2)	
75 to 79	401	(26.4)	292	(25.5)	109	(29.2)	
80 and up	326	(21.5)	257	(22.4)	69	(18.5)	
Race							0.295
White	1390	(91.6)	1043	(91.1)	347	(93.0)	
Black	59	(3.9)	45	(3.9)	14	(3.8)	
Other or unknown	69	(4.5)	57	(4.9)	12	(3.2)	
Marital Status							0.061
Married	758	(49.9)	556	(48.6)	202	(54.2)	
Unmarried/Unknown[1]	760	(50.1)	589	(51.4)	171	(45.8)	
Co-morbidity at obstruction							0.367
No comorbidity	1022	(67.3)	760	(66.4)	262	(70.2)	
Charlson index=1	318	(20.9)	243	(21.2)	75	(20.1)	
Charlson index >=2	178	(11.7)	142	(12.4)	36	(9.7)	
Year of Obstruction							0.250
1991–1996	421	(27.7)	321	(28.0)	100	(26.8)	
1997–2001	473	(31.2)	344	(30.0)	129	(34.6)	
2002–2006	624	(41.1)	480	(41.9)	144	(38.6)	
Tumor Histology							0.278
Endometrioid	108	(7.1)	73	(6.4)	35	(9.4)	
Mucinous	78	(5.1)	62	(5.4)	16	(4.3)	
Other	460	(30.0)	345	(30.1)	115	(30.8)	
Serous	872	(57.4)	665	(58.1)	207	(55.5)	
Tumor Grade							0.024
Well or moderately differentiated	281	(18.5)	214	(18.7)	67	(18.0)	

	Overall n=1518		Non-surgical Management n=1145		Surgical Management n=373		
	No.	(%)	No.	(%)	No.	(%)	Chi- squared p-value
Poorly differentiated or anaplastic	836	(55.1)	610	(53.3)	226	(60.6)	
Unknown	401	(26.4)	321	(28.0)	80	(21.4)	
Node Stage							0.010
N0	209	(13.8)	139	(12.1)	70	(18.8)	
N1	130	(8.6)	98	(8.6)	32	(8.6)	
N2	90	(5.9)	66	(5.8)	24	(6.4)	
Missing	1089	(71.7)	842	(73.5)	247	(66.2)	
Obstruction at diagnosis							0.001
No	1331	(87.7)	986	(86.1)	345	(92.5)	
Yes	187	(12.3)	159	(13.9)	28	(7.5)	
Tumor Resection at diagnosis							0.075
No	244	(16.1)	195	(17.0)	49	(13.1)	
Yes	1274	(83.9)	950	(83.0)	324	(86.9)	
Chemotherapy prior to obstruction							0.624
No	680	(44.8)	517	(45.2)	163	(43.7)	
Yes	838	(55.2)	628	(54.8)	210	(56.3)	
Ever-adhesive status							<0.001
No 560.81 claims	1247	(82.1)	999	(87.2)	248	(66.5)	
At least one 560.81 claim	271	(17.9)	146	(12.8)	125	(33.5)	

[1] 26 of 760 are of unknown marital status (3.4%).

Table 4

Selected outcomes of 1518 women hospitalized for bowel obstruction between 1991 and 2005 in SEER-Medicare, stratified by management strategy

	All patients n=1518		Non-surgical management n=1145		Surgical management n=373		
	N	**%/IQR**	**N**	**%/IQR**	**N**	**%/IQR**	**p-value**
Vital status at last follow- up							0.213
Alive	161	10.6%	115	10.0%	46	12.3%	
Deceased	1357	89.4%	1030	90.0%	327	87.7%	
Hospitalization length of stay[2]	8	(4,15)	8	(4, 14)	9	(4, 18)	0.002
1 or more ICU days during hospitalization	212	14.0%	79	6.9%	133	35.7%	<0.001
In-hospital death	160	10.5%	115	10.0%	45	12.1%	0.270
30 day mortality	327	21.6%	277	24.2%	50	13.4%	<0.001
Chemotherapy after obstruction	667	43.9%	490	42.8%	177	47.5%	0.115
Overall post-obstruction survival	121	(37, 467)	98	(32, 432)	162	(52, 558)	<0.001
Days in hospital, median (IQR)[3]	19	(10, 35)	17	(8, 32)	24	(16, 42)	<0.001
Days out of hospital, median (IQR)[5]	94	(19, 432)	80	(17, 412)	137	(29, 536)	0.002
Ratio of days out to days in hospital[4]	5.6:1	(1.7, 14.9)	5.3:1	(1.6, 15.0)	6.2:1	(2.1,14.5)	0.280
Any re-admission for obstruction	536	35.3%	411	35.9%	125	33.5%	0.403

[2] Lifetest, treating in-house death as censored

[3] Lifetest, treating alive at end of follow-up as censored, Wilcoxon rank-sum test

[4] Among those discharged alive who died before end of follow-up (non-surgical and 282 surgical), Mann-Whitney U test