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Depressive Symptoms in Patients Scheduled for Hyperthermic Intraperitoneal Chemotherapy With Cytoreductive Surgery: Prospective Associations With Morbidity and Mortality

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ABSTRACT

Purpose
The current study examined prospective relationships between preoperative depressive symptoms and short-term (30-day morbidity and readmission) and long-term (overall survival) outcomes after hyperthermic intraperitoneal chemotherapy with cytoreductive surgery (HIPEC + CS).

Methods
Ninety-eight patients scheduled for HIPEC + CS completed the Center for Epidemiologic Studies–Depression (CES-D) scale before surgery. Demographic and disease-specific factors and information about morbidity and readmission within 30 days after discharge were gathered from medical records. Survival was measured from date of surgery to death.

Results
Twenty-eight percent of patients had CES-D scores indicative of clinically significant depressive symptoms. Thirty-day morbidity occurred in 31.9% of patients and readmission in 22.2%. At the time of analysis (median follow-up of 49 months), 71.6% of patients were deceased, with median survival time of 11 months for those who died. After adjusting for relevant preoperative demographic and disease-specific factors, depressive symptoms were associated with greater odds of 30-day morbidity (n = 68; odds ratio, 5.50; 95% CI, 1.23 to 24.73; $P = .03$) and greater likelihood of 30-day readmission (n = 72; odds ratio, 5.92; 95% CI, 1.27 to 27.64; $P = .02$). Depressive symptoms were associated with shorter survival after adjustment for preoperative demographic and disease-specific factors (n = 87; hazard ratio, 1.88; 95% CI, 1.07 to 3.31; $P = .03$). This association was no longer significant when intraoperative/postoperative prognostic variables were added to the statistical model (n = 87; hazard ratio, 1.31; 95% CI, 0.72 to 2.37; $P = .37$).

Conclusion
Patients with clinically significant levels of preoperative depressive symptoms are at risk for poor clinical outcomes after HIPEC + CS, including greater risk of 30-day morbidity and readmission. Further research is warranted to determine biobehavioral mechanisms and examine whether effective interventions targeting preoperative depressive symptoms can reduce postoperative risk in this patient population.

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INTRODUCTION

Depressive symptoms are common among patients with cancer, with prevalence of emotional disorders in oncology populations approaching 40%.[1,2] Depressive symptoms have been demonstrated to predict early mortality across a variety of populations of patients with cancer.[3-5] A meta-analysis of 25 independent studies (most examining breast cancer, hematologic malignancies, lung cancer, or mixed cancer populations) reported mortality rates up to 25% higher in patients experiencing elevated depressive symptoms and up to 39% higher in patients diagnosed with clinical depression, even after adjustment for potential confounding variables such as cancer stage.[6] In the context of GI cancer, a population-based Danish study reported that being hospitalized for depression before

stomach cancer diagnosis was associated with worse 1-year relative survival in men.[7] A recent study of patients with metastatic colorectal cancer receiving chemotherapy found that patient-reported depression was associated with overall survival after adjustment for traditional medical prognostic factors.[8] To date, no prospective studies have examined whether preoperative patient-reported depressive symptoms are associated with increased risk of mortality in patients undergoing surgery for colorectal or other GI cancers.

When assessed before surgical treatment of cancer, depressive symptoms may also help to identify patients at risk for adverse short-term clinical outcomes such as postoperative morbidity and readmission. Postoperative morbidity and readmissions after complex cancer surgery cause significant patient suffering as well as increased costs and strain on hospital resources,[9] and these short-term outcomes are receiving increased attention in the surgical oncology literature.[10-12] Identifying potentially modifiable factors to decrease readmissions is an increasingly important goal of health care providers, hospital administrators, and policy makers.[13,14] Depressive symptoms have been identified as a risk factor for hospital readmission in noncancer populations.[15] Whether preoperative depressive symptoms are prospectively associated with increased risk of postoperative morbidity or readmission after cancer surgery has not yet been investigated.

Hyperthermic intraperitoneal chemotherapy with cytoreductive surgery (HIPEC + CS) involves surgical resection of all visible macroscopic peritoneal disease followed by treatment of residual microscopic peritoneal disease with regional chemotherapy. This aggressive combination treatment modality has been demonstrated to extend survival for many patients with peritoneal carcinomatosis (PC), but there is significant postoperative morbidity as well as variability in treatment effects on prognosis.[16,17] Preoperative depressive symptoms may contribute to variability in these important clinical outcomes and may thus facilitate timely identification of patients at risk for poor short-term and long-term outcomes. Supporting this hypothesis is a recent study indicating that patients who experienced postoperative complications had lower preoperative emotional well-being scores on a measure of health-related quality of life.[18]

The goals of the current study were to examine the relationship between preoperative depressive symptoms and short-term (ie, 30-day morbidity and readmission) and long-term (mortality) outcomes in patients undergoing HIPEC + CS for PC.

METHODS

Sample

A total of 105 patients scheduled for HIPEC + CS at a large academic medical center between March 2010 and July 2012 completed measures of patient-reported depressive symptoms. Patients were referred to the study by their surgical oncologist at the time of consent to surgery. At this time, written informed consent was obtained, and a validated depressive symptom measure was completed (mean, 19 days before surgery; SD, 16 days; range, 1 to 71 days). This study was approved by the University of Pittsburgh's Institutional Review Board.

Depressive Symptoms

The Center for Epidemiologic Studies Depression Scale (CES-D)[19] was used to assess depressive symptoms before surgery. The CES-D is a 20-item self-report questionnaire that asks respondents to rate depressive symptoms in the past week using a four-point scale ranging from 0 (rarely or none of the time) to 3 (most or all of the time). A score of 16 or above was classified as meeting criteria for clinically significant depressive symptoms.[20] The validity and strong psychometric properties of the CES-D, as well as the high levels of sensitivity and specificity associated with the commonly used cut point of ≥ 16, have been demonstrated for patients with a variety of different types of cancer.[21] The cut point of 16 has been commonly used in prospective studies of patients with cancer to examine associations between clinically significant patient-reported depressive symptoms and mortality.[5]

Preoperative Control Variables

Age, race, and sex were extracted from the patient information section of the medical record and examined as potential covariates, given prior associations with depressive symptoms and/or post-HIPEC outcomes.[18,22,23] Additional variables gathered from patient medical records were also examined as potential covariates and included: body mass index, diagnosis, previous cytoreductive surgery, time between initial diagnosis and index surgery, American Society of Anesthesiologists (ASA) Physical Status, Peritoneal Cancer Index (PCI), Completeness of cytoreduction (CC) score, number of anastomoses, and length of postoperative stay.

Description of Surgical Treatment and Control Variables

Because of the aggressive nature of the procedure, patients undergoing HIPEC + CS must have a good performance status and no comorbidities that would make the surgery high risk. Diagnostic laparoscopy was routinely performed to confirm resectability, and CS was performed as described by Bao and Bartlett.[24] After CS, HIPEC was performed using a standard institutional protocol described by Gusani et al.[22] Volume of disease was quantified intraoperatively by the PCI.[25] CC score was rated by the surgeon on the basis of assessment of the extent of residual disease after completion of the CS. Number of anastomoses and length of postoperative hospital stay were extracted from medical records by trained residents and fellows. Preoperative, intraoperative, and postoperative variables found in preliminary analyses to be significantly associated with depressive symptoms and/or any of the three clinical outcomes were included as covariates in multivariate models.

Clinical Outcomes

Thirty-day morbidity and readmission. Information about morbidity and readmissions within 30 days postdischarge were extracted from the medical record, including inpatient records for readmissions within the same medical system, postoperative outpatient visit and telephone contact notes, and scanned records from outside hospitals and clinics. Morbidity was defined as any grade of morbidity for any organ system, including cardiac, pulmonary, renal, and infectious morbidity, within 30 days of index discharge. Readmission was defined as admission to any hospital within 30 days of index discharge. Readmission status with regard to outside facilities was determined by direct patient reporting during documented phone calls or outpatient visits and/or by outside hospital records. No patients were assumed to be negative for readmission based solely on the absence of a readmission to a system facility. Electronic medical records were reviewed by residents and fellows who were closely trained and supervised by a full-time data manager with an MD degree who maintains this database. The data manager and data extractors were blind to study hypotheses and CES-D scores.

Vital status. Survival was measured from date of surgery until date of death, gathered from the Social Security Death Index, electronic medical record, and obituaries in July 2015. Only patients whose outcome data could be specifically verified by medical records, Social Security Death Index, and/or obituaries were included in the relevant analyses. Patients for whom data were not available for 30-day outcomes (typically because they were lost to follow-up after their initial postoperative visit 1 to 2 weeks after

Table 1. Sociodemographic and Clinical Characteristics of the Sample

Variable	No. of Patients	Mean ± SD (range) or %
Age, years	98	54.83 ± 11.43 (18-78)
Sex	98	55% men
Race	97	95% white
Body mass index	98	27.24 ± 5.75 (18.30-53.90)
Diagnosis	98	46% appendiceal cancer, 31% colorectal cancer, 24% other
Prior cytoreductive surgery	97	47% yes
Time between diagnosis and surgery	98	1.86 years ± 2.03 years (17 days to 10.86 years)
ASA physical status	98	20% 2 (mild systemic disease), 71% 3 (severe systemic disease), 8% 4 (severe life-threatening systemic disease)
Peritoneal Cancer Index	97	16.16 ± 9.74 (0-39)
Completeness of cytoreduction	97	64% CC0 (no disease), 14% CC1 (≤ 0.25 cm), 9% CC2 (0.25-2.5 cm), 12% CC3 (≥ 2.5 cm)
No. of anastomoses	98	45% 0, 38% 1, 13% 2, 4% 3
Length of postoperative stay, days	98	15.84 ± 17.37 (0-138)
Depressive symptoms (CES-D)	98	11.26 ± 8.02 (0-32)
30-day morbidity	69	31.9% yes
30-day readmission	72	22.2% yes
Median survival, years	88	2.00 (40 days to 5.31 years)

Abbreviations: ASA, American Society of Anesthesiologists; CES-D, Center for Epidemiologic Studies-Depression scale.

discharge) and/or for survival were coded as missing and not included in analyses for that outcome.

Data Analysis

Data analyses were conducted using SPSS Version 22. Descriptive statistics were first performed to characterize the sample and the distribution and frequency of variables. Variables were categorized for analyses using the following groups: sex (male *v* female), race (white *v* other), diagnosis (appendiceal cancer, colorectal cancer, other), prior cytoreductive surgery (yes *v* no), and completeness of cytoreduction (CC 0 or 1, CC 2 or 3). The CES-D was dichotomized according to established clinical cutoff as described above (score ≥ 16).

Sample sizes varied across analyses owing to missing data; 72 patients had readmission data, 69 had morbidity data, and 88 had vital status confirmed. There were no significant differences between patients with and without data for these three outcomes with regard to age, sex, race, body mass index, diagnosis, time since diagnosis, prior cytoreductive surgery, depressive symptoms, or number of anastomoses for any of the three outcomes (Appendix Table A1, online only). Patients missing readmission data had longer postoperative length of stay ($r[104] = -0.25$; $P < .01$), and patients missing vital status data had lower peritoneal cancer index scores ($r[104] = 0.25$; $P < .01$) and lower ASA scores (eg, mild systemic disease *v* severe life-threatening systemic disease; $r[104] = 0.25$; $P < .01$). Analysis of variance and χ^2 analysis were used to examine associations between the presence of preoperative clinically significant depressive symptoms and demographic and clinical variables. Unadjusted associations between depressive symptoms and 30-day outcomes were tested using χ^2 analysis. Multivariate logistic regressions were used to test relationships between the presence of clinically significant depressive symptoms and short-term outcomes (ie, 30-day morbidity and readmission) after adjusting for demographic and clinical covariates.

Unadjusted associations between the presence of clinically significant depressive symptoms and survival were tested using Kaplan-Meier estimates. After evaluating the assumption of proportional hazard, Cox regression analyses were used to test the adjusted relationship between depressive symptoms and survival.

Table 2. Differences in Sociodemographic and Clinical Characteristics Between Patients With and Without Clinically Significant Depressive Symptoms

Variable	Clinically Significant Depressive Symptoms Present (n = 27)	Clinically Significant Depressive Symptoms Not Present (n = 71)	Test Statistics	*P*
Preoperative				
Age, years	50.67 (10.80)	56.41 (11.34)	t(96) = 2.27	.03
Sex	48% women	43% women	χ^2 = .16 (1, n = 98)	.69
Race	12% nonwhite	3% nonwhite	χ^2 = 2.96 (1, n = 97)	.09
Body mass index	27.21 (4.69)	27.25 (6.14)	t(96) = 0.3	.98
Diagnosis	44% appendiceal, 33% CRC, 22% other	46% appendiceal, 30% CRC, 24% other	χ^2 = 0.13 (2, n = 98)	.94
ASA	15% 2, 74% 3, 11% 4	23% 2, 70% 3, 7% 4	χ^2 = 1.01 (2, n = 98)	.61
Time since diagnosis	743.67 (875.32)	655.94 (685.92)	t(96) = −.52	.60
Prior CRS	56% yes	44% yes	χ^2 = .99 (1, n = 97)	.32
Intraoperative/postoperative				
CC	41% incomplete	14% incomplete	χ^2 = 8.04 (1, n = 97)	< .01
PCI	18.56 (10.85)	15.24 (9.19)	t(95) = −1.51	.13
No. of anastomoses	44% 0, 37% 1, 15% 2, 4% 3	45% 0, 38% 1, 13% 2, 4% 3	χ^2 = 0.09 (3, n = 98)	.99
LOS	12.63 (8.06)	17.06 (19.71)	t(96) = 1.13	.26

NOTE. Numbers in parentheses are standard deviations.
Abbreviations: ASA, American Society of Anesthesiologists Physical Status; CC, completeness of cytoreduction; CRC, colorectal cancer; CRS, cytoreductive surgery; LOS, length of stay; PCI, Peritoneal Cancer Index.

RESULTS

Sample Characteristics

Demographic and clinical variables and depressive symptom scores for the 98 patients included in any of the analyses are presented in Table 1.

Prevalence of Depression

Before surgery, 28% of the study sample had a score of 16 or greater on the CES-D. This observed prevalence of clinically significant levels of depressive symptoms is similar to rates reported in other studies of patients with cancer that used the CES-D.[3,5]

As displayed in Table 2, patients with clinically significant depressive symptoms were significantly younger than those without and less likely to have complete cytoreduction, but there were no significant differences in sex, race, body mass index, diagnosis, prior cytoreductive surgery, time between diagnosis and index surgery, ASA physical status, PCI score, number of anastomoses, or length of hospital stay.

Preoperative Depressive Symptoms and 30-Day Outcomes

In unadjusted analyses, the presence of clinically significant depressive symptoms was significantly associated with greater likelihood of 30-day morbidity (57.9% patients with clinically significant depressive symptoms *v* 22.0% patients without; χ^2 [1, n = 69] = 8.17; $P < .01$) and 30-day readmission (47.4% patients with clinically significant depressive symptoms *v* 13.2% patients without, χ^2 [1, n = 72] = 9.44; $P < .01$).

Multivariate analyses adjusted first for age and diagnosis (preoperative factors); the presence of clinically significant depressive symptoms remained significantly associated with 30-day morbidity (odds ratio, 4.26; 95% CI, 1.21 to 14.99; $P = .02$) and readmission (odds ratio, 4.90; 95% CI, 1.32 to 18.14; $P = .02$). Multivariate models then further adjusted for PCI, CC, and hospital length of stay (intraoperative and postoperative factors). Results of these logistic regression analyses are presented in Table 3. Associations between the presence of clinically significant depressive symptoms and 30-day morbidity and readmission remained significant after multivariate adjustment.

Preoperative Depressive Symptoms and Survival

At the time of analysis (median follow-up of 49 months), 71.6% of patients were deceased. For those who had died, the median time from surgery to death was 11 months (SD, 13.9 months; range, 40 days to 4.39 years). These outcomes are consistent with the literature, which reports that 30-day mortality after HIPEC is uncommon.[22,24] Kaplan-Meier analysis yielded an overall median survival time of 1.08 years for patients reporting clinically significant depressive symptoms, compared with 1.72 years for those not endorsing clinically significant depressive symptoms before surgery (log-rank χ^2 [1] = 4.60; $P = .03$).

The association between the presence of clinically significant depressive symptoms and survival 4 years later remained significant after adjustment for age and diagnosis (hazard ratio, 1.88; 95% CI, 1.07 to 3.31; $P = .03$). After adjustment for intraoperative PCI and postoperative CC and length of stay, preoperative clinically significant depressive symptoms were no longer significantly related to mortality (Table 4). Thirty-day readmission (but not morbidity) was also significantly associated with survival (hazard ratio, 2.70; 95% CI, 1.15 to 6.35; $P = .02$).

DISCUSSION

In a sample of patients with PC scheduled for curative surgery, preoperative patient-reported clinically significant depressive symptoms were significantly associated with greater risk for poor clinical outcomes within 30 days of hospital discharge, including morbidity and readmission. This study is the first to report significant associations between preoperative depressive symptoms and 30-day morbidity and readmission risk after major cancer surgery. In addition to the burden for caregivers, patients, and families, hospital readmissions in particular have been highlighted as an area of potential cost savings under the Affordable Care Act,

Table 3. Multivariate Logistic Regression Models of Associations With 30-Day Outcomes

	Odds of 30-Day Morbidity (n = 68)		Odds of 30-Day Readmission (n = 72)	
Variable	OR (95% CI)	*P*	OR (95% CI)	*P*
Age, years	1.00 (.94 to 1.06)	.96	0.99 (.94 to 1.05)	.81
Diagnosis				
Colorectal	18.60 (2.38 to 145.12)	.01	27.32 (2.46 to 302.98)	.01
Other	10.08 (1.55 to 64.67)	.02	12.74 (1.38 to 117.88)	.03
Appendiceal (referent)	1.00		1.00	
PCI score	1.10 (1.01 to 1.19)	.03	1.10 (.99 to 1.21)	.06
CC score				
2 or 3	0.31 (.04 to 2.69)	.29	0.12 (.01 to 1.48)	.10
0 or 1 (referent)	1.00		1.00	
Hospital LOS, days	1.03 (.98 to 1.09)	.23	1.01 (0.92 to 1.11)	.82
Depression				
CES-D ≥ 16	5.50 (1.23 to 24.70)	.03	5.92 (1.27 to 27.64)	.02
CES-D < 16 (referent)	1.00		1.00	

Abbreviations: CC, completeness of cytoreduction; CES-D, Center for Epidemiologic Studies Depression scale; LOS, length of stay; OR, odds ratio; PCI, Peritoneal Cancer Index.

Table 4. Cox Regression Models for Survival From Time Of HIPEC + CS (n = 87)

Variable	HR (95% CI)	*P*
Age, years	1.00 (.97 to 1.02)	.73
Diagnosis		
Colorectal	3.68 (1.94 to 7.00)	<.01
Other	1.61 (0.81 to 3.20)	.18
Appendiceal (referent)	1.00	
PCI score	1.04 (1.01 to 1.08)	.02
CC score		
2 or 3	2.47 (1.22 to 5.00)	.01
0 or 1 (referent)	1.00	
Hospital LOS, days	1.02 (1.01 to 1.03)	<.01
Depression		
CES-D ≥ 16	1.31 (0.72 to 2.37)	.37
CES-D < 16 (referent)	1.00	

Abbreviations: CC, completeness of cytoreduction; CES-D, Center for Epidemiologic Studies Depression scale; HIPEC + CS, hyperthermic intraperitoneal chemotherapy with cytoreductive surgery; HR, hazard ratio; LOS, length of stay; PCI, Peritoneal Cancer Index.

with reduced Medicare reimbursements for hospitals with excess readmission rates.[14] This policy has increased recent emphasis on identifying patients at risk for potentially costly readmissions as well as the development of comprehensive strategies to reduce hospital readmissions.

The presence of clinically significant preoperative depressive symptoms was associated with overall survival in univariate analyses and after adjustment for potentially confounding preoperative factors, including age and diagnosis. These findings are consistent with the broader literature linking depressive symptoms to premature mortality in cancer survivors.[5,26] A novel finding in the current study was that the association between clinically significant preoperative depressive symptoms and survival was no longer significant after controlling for intraoperative and postoperative factors previously reported to be associated with increased risk of mortality after surgery (ie, extent of peritoneal disease, completeness of cytoreduction, and length of stay). It should be noted that one limitation of the current study is that depressive symptoms were only assessed once, and repeated assessments of depressive symptoms before and after cancer treatment may yield stronger associations with mortality.[26]

Although the association between clinically significant depressive symptoms and survival was not significant after adjusting for intraoperative and postoperative prognostic factors, preoperative screening for depressive symptoms may nevertheless provide important information about long-term postoperative risk. As noted in the current as well as previous studies,[12] 30-day readmission is prospectively associated with long-term survival. Thus, depressive symptoms may have an indirect effect on mortality via these short-term clinical outcomes.

The significant association between preoperative clinically significant depressive symptoms and 30-day clinical outcomes persisted after statistical adjustment for known prognostic factors, including extent of peritoneal disease and completeness of surgical cytoreduction. These results suggest that preoperative depressive symptoms do not merely reflect extent of disease. Moreover, given that we found no association between depression and length of hospital stay, results raise the possibility that clinical effects of preoperative depressive symptoms may begin to emerge after postoperative hospital discharge. The care transition from hospital to home and the first 30 days after discharge may represent a critical period for patient monitoring and support,[10] especially as patients travel farther from home to tertiary care centers for complex cancer surgeries.[11]

Additional research is warranted to elucidate the clinical, behavioral, and/or biologic pathways by which preoperative depressive symptoms may prospectively relate to short-term and long-term clinical outcomes. Depressive symptoms in the context of PC may result from several contributing factors, including the psychologic stress of the metastatic diagnosis and planned surgery as well as inflammatory pathways related to the cancer or its previous treatment.[27-30] We have previously reported that preoperative neurovegetative depressive symptoms are associated with serum IL-6,[29] but biomarker data were available for only one third of the current sample. Because patients with clinically significant depressive symptoms were also less likely to have undergone complete cytoreduction (but did not differ from those without significant symptoms with regard to tumor volume), it is tempting to speculate that elevated inflammatory pathways play a role in both patient-reported symptoms and differences in tumor phenotype that can impede CC. Determining biobehavioral pathways linking depressive symptoms to clinical outcomes after cancer surgery in adequately powered studies is an important goal for future research.

Several limitations of the current study warrant mention. First, the reported results reflect secondary data analysis; data were not collected systematically to test hypotheses about depression and clinical outcomes. We were limited by the information available in the medical record and the Social Security Death Index, and we lacked data on cause of death. Data on clinical outcomes were not missing at random, as patients who provided short-term outcome data were more likely to have had shorter postoperative length of stay, whereas those with long-term survival data had significantly more extensive peritoneal disease and worse preoperative overall health assessment; as a result of nonrandom missing data, the reported associations between clinically significant depressive symptoms and outcomes may have been somewhat overestimated, and results should be replicated. Depressive symptoms were assessed at the time of consent for HIPEC + CS treatment, and whether symptoms were present before the patient's cancer diagnosis or decision to pursue this aggressive treatment or whether depressive symptoms persisted after surgery cannot be determined. The CES-D is a brief self-report assessment of depressive symptoms in the past week and does not yield information about psychiatric diagnoses or history. We also lacked information about whether patients were receiving antidepressant medication or other treatment of depression. Finally, the sample size for this preliminary study was modest, yielding models with wide CIs; longitudinal studies with larger samples are needed to more precisely estimate effects and determine sources of variability.

The presence of clinically significant depressive symptoms represents a potentially modifiable risk factor that was significantly related to increased risk for 30-day morbidity and readmission in this sample of patients with metastatic PC. Although the reported associations do not prove a causal relationship, preoperative screening using validated patient-reported measures of depressive symptoms may identify a group of patients at risk for worse postoperative outcomes who might benefit from additional perioperative support

and/or monitoring. Results also highlight the potential clinical and economic value of treating depression in patients undergoing surgery for PC, although more research is needed to determine whether changes in depressive symptoms lead to changes in clinical risk as well as the ideal timing and nature of interventions targeting depression.

AUTHORS' DISCLOSURES OF POTENTIAL CONFLICTS OF INTEREST

Disclosures provided by the authors are available with this article at www.jco.org.

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AUTHORS' DISCLOSURES OF POTENTIAL CONFLICTS OF INTEREST

Depressive Symptoms in Patients Scheduled for Hyperthermic Intraperitoneal Chemotherapy With Cytoreductive Surgery: Prospective Associations With Morbidity and Mortality

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Appendix

Table A1. Differences in Sociodemographic and Clinical Characteristics Between Patients With and Without Clinical Outcome Data

	Missing Morbidity (n = 36, *v* 69 With)		Missing Readmission (n = 33, *v* 72 With)		Missing Vital Status (n = 19, *v* 88 With)	
Variable	Effect Size Indicator	*P*	Effect Size Indicator	*P*	Effect Size Indicator	*P*
Preoperative variables						
Age	$r(105) = 0.06$	.56	$r(105) = 0.07$	.51	$r(105) = 0.16$	.11
Sex	$\Phi = .06$	.55	$\Phi = .05$	.65	$\Phi = -.06$	.51
Race	$\Phi = .07$	.48	$\Phi = .06$	.56	$\Phi = .10$	.31
Body mass index	$r(104) = -0.04$	.67	$r(104) = -0.09$	.39	$r(104) = -0.15$	.14
Diagnosis	$\Phi = .16$	.27	$\Phi = .18$	.20	$\Phi = .06$	.84
ASA physical status score	$r(104) = 0.00$	.99	$r(104) = 0.06$	.58	$r(104) = 0.29$; those without data had lower ASA scores (ie, better health)	< .01
Time since diagnosis	$r(104) = -0.07$	.51	$r(104) = -0.08$	.41	$r(104) = -0.02$	.81
Prior cytoreductive surgery	$\Phi = .11$	.28	$\Phi = .05$	.60	$\Phi = -.06$	.54
Elevated depressive symptoms	$\Phi = -.06$	.54	$\Phi = -.10$	.30	$\Phi = -.06$	.57
Intraoperative/postoperative variables						
Completeness of cytoreduction	$\Phi = -.19$	.06	$\Phi = -.07$	.48	$\Phi = .16$	.11
Peritoneal Cancer Index	$r(104) = -0.08$	.44	$r(104) = -0.03$	.79	$r(104) = 0.25$; those without data had PCI 10 *v* 17 for those with data	< .01
No. of anastomoses	$\Phi = .21$	.19	$\Phi = .23$	.14	$\Phi = .14$	.57
Length of stay	$r(104) = 0.02$	.88	$r(104) = -0.25$; those without data had LOS 22 *v* 12.75 for those with data	< .01	$r(104) = 0.11$	.27

Abbreviation: ASA, American Society of Anesthesiologists; LOS, length of stay; PCI, Peritoneal Cancer Index.