Ann Surg Oncol (2022) 29:3122–3133
https://doi.org/10.1245/s10434-021-11161-0

Annals of
SURGICAL ONCOLOGY
OFFICIAL JOURNAL OF THE SOCIETY OF SURGICAL ONCOLOGY

ORIGINAL ARTICLE – GASTROINTESTINAL ONCOLOGY

Racial Disparities in Surgery for Malignant Bowel Obstruction

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ABSTRACT

Background. Operative management of patients with malignant bowel obstruction (MBO) may provide effective palliation, but is associated with substantial risks. This study aimed to analyze racial and ethnic differences in surgical outcomes for patients with MBO.

Methods. This retrospective study, using National Surgical Quality Improvement Program (NSQIP) registry data from 2010 to 2019, compared differences in outcomes by race and ethnicity for 2762 patients undergoing surgery for MBO. Multivariable logistic regression controlled for relevant covariates.

Results. Black patients (n = 407) had higher rates of preoperative comorbidity and were more likely than White patients (n = 2081) to have major complications (28.5% vs 21.8%; p = 0.0031), overall complications (47.4% vs 40.4%; p = 0.0087), a longer median hospital stay (12 days; interquartile range [IQR, 8–19 days] vs 10 days [IQR, 7–17 days]; p = 0.0007), and unplanned readmission (17.1% vs 12.9%; p = 0.0266). Black patients had a similar mortality rate to that of White patients and were less frequently discharged to home (67.6% vs 73.0%; p = 0.0315). Differences in morbidity between Black patients and White patients persisted after controlling for potentially confounding variables. Hispanic patients had lower mortality than White patients (6.3% vs 13.1%; p = 0.0130) and a longer hospital stay (12 days [IQR, 8–18 days] vs 10 days [IQR, 7–17 days]; p = 0.0313). Outcomes did not differ between Asian patients and White patients.

Conclusions. This study demonstrated significant disparities for Black patients undergoing surgery for MBO. Understanding and addressing what drives these differences, including systemic inequalities such as access to care and racial biases, is essential to the achievement of more equitable, higher-quality patient care.

Surgical decision-making in the management of malignant bowel obstruction (MBO) is challenging due to a complex interplay of clinical considerations, goals of care, and a paucity of evidence in the literature to guide practice.[1–3] As a common sequela of advanced cancer, particularly gastrointestinal or ovarian cancer, MBO often causes abdominal pain, nausea, vomiting, bloating, and appetite loss.[2,4] Nonoperative treatment with supportive care, endoscopic stenting, or gastrostomy tube placement is often the first line of treatment.[3] However, with persistent or complete obstructions, surgical intervention with bowel resection, bypass, and/or ostomy creation is typically considered.[3,5] Yet many patients with MBO have disseminated cancer and are poor surgical candidates due to large disease burden and malnutrition.[2] Therefore, these patients often have a narrow therapeutic margin for surgical palliation of MBO.[5] Existing evidence demonstrates that operative management often alleviates obstructive symptoms and allows resumption of a diet, but carries high risk of mortality, serious complications, recurrence, and lengthened hospitalization.[2,4,6]

The decision to operate in the setting of MBO is nuanced, and developing an understanding of individual patient goals is essential.[1] Focused discussions addressing prognosis, end-of-life goals, and risks of surgery are central to shared decision-making.[1,7] Generally, these operations are not performed for curative intent, with symptom relief and quality of life prioritized over prolongation of life.[1,7] Although palliative care and hospice services are important

First Received: 5 August 2021
Accepted: 13 November 2021;
Published Online: 18 January 2022

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adjuncts to the achievement of these goals, evidence points to lower utilization and delays in initiation of these services for Black, Hispanic, and Asian patients.[8–15]

Additional disparities have been identified for Black patients undergoing cancer care, including an underuse of surgery and chemotherapy,[16–18] and a higher cancer mortality rate than for other ethnoracial groups.[19,20] Potential contributors to these disparities may include Black patients presenting at an advanced disease stage, having a higher comorbidity burden, being seen less often by high-volume surgeons, having systemically limited access to care, and experiencing higher social vulnerability.[21–25]

Growing evidence shows disparities among ethnoracial groups encompassing oncologic management and palliative care utilization. When surgical palliation is considered for patients with MBO, understanding the relationship between race/ethnicity, management options, and expected outcomes is vital. Although race and ethnicity are imprecise social constructs, in this context, they can aid in identifying modifiable systemic disparities.[26,27]

The primary aim of this study was to compare ethnoracial differences in major morbidity after surgery, defined as complications that require invasive intervention and risk organ failure or death.[28] The secondary aims included comparing ethnoracial differences with respect to preoperative factors, operative characteristics, overall postoperative morbidity, postoperative mortality, need for reoperation, hospital length of stay (LOS), discharge disposition, and readmission. We hypothesized that Hispanic, Asian, and Black patients have significantly worse outcomes after surgery for MBO than White patients.

METHODS

Study Design and Patient Population

This retrospective study included data collected from 2010 through 2019 from the registry of the American College of Surgeons National Surgical Quality Improvement Program (NSQIP), a multi-institutional quality improvement registry that collects perioperative data through 30 days after major surgical procedures at more than 700 participating sites.[29] Patients were identified who had disseminated cancer and a primary postoperative diagnosis of intestinal obstruction from a cause other than adhesions (ICD-9 codes 560.89, 560.9; ICD-10 codes K56.60, K56.69), similar to previously published methods.[30]

The consensus definition of MBO for clinical trials requires clear evidence of bowel obstruction, obstruction beyond the ligament of Treitz, and either incurable intra-abdominal primary cancer or non-intra-abdominal primary cancer with intraperitoneal disease.[31] In this definition, the location of MBO is specified because obstructions proximal to the ligament of Treitz are primarily treated endoscopically.[31] However, the NSQIP database includes only patients undergoing surgical procedures and does not specify MBO location, which cannot always be determined based on the procedure performed.

The patients were categorized by race/ethnicity. The study first grouped all the patients with Hispanic ethnicity regardless of race, then grouped the non-Hispanic patients as non-Hispanic White, non-Hispanic Black or African American, or non-Hispanic Asian, referenced as White, Black, and Asian, respectively. Native American or Alaska Native and Native Hawaiian or Pacific Islander populations were excluded from the analysis due to a small sample size. Patients with unknown race and ethnicity were also excluded.

The Duke University Health System Institutional Review Board determined the study to be exempt from review (Pro00107261). This study was conducted in accordance with the Checklist to Evaluate the Science of Surgical Database Research, the NSQIP-specific guide, and the RECORD statement.[32–34]

Variable Definitions

Independent patient variables were grouped for clinical relevance, as subsequently described, to facilitate interpretation and analysis. The variables included were age (those recorded as "90+" were changed to 90 for analysis), sex, direct admittance versus transferred (from other health care facilities), body mass index (BMI: underweight [<18.5 kg/m^2], normal [18.5–24.99 kg/m^2] overweight [25–29.99 kg/m^2], or obese [$\geq$30 kg/m^2]), American Society of Anesthesiologists (ASA) classification (1–2 [no disturbance–mild disturbance] or 3–5 [severe disturbance–moribund]), functional status (independent or dependent [partially or totally]), weight loss (>10% during 6 months), immunosuppression (long-term with corticosteroids or other immunosuppressive agents), diabetes (with or without insulin), hypertension (requiring pharmacologic treatment), congestive heart failure (CHF), smoking (cigarettes within 12 months previously), dyspnea (with moderate exertion or at rest), severe chronic obstructive pulmonary disease (COPD), ventilator dependence (within 48 h after surgery), ascites, acute renal failure (within 24 h after surgery), dialysis (within 2 weeks after surgery), open wound, bleeding disorder, preoperative red blood cell (RBC) transfusion (within 72 h after surgery), and preoperative sepsis (systemic inflammatory response syndrome, sepsis, or septic shock). Preoperative lab values from the most recent lab drawn within 90 days before the procedure, including albumin (g/dL), creatinine (mg/dL), bilirubin (mg/dL), hematocrit (%), and white blood cell (WBC) count ($\times 10^9$ cells/L), were used.

Preoperative LOS indicated the days from hospital admission to operation. All current procedural terminology (CPT) codes, including "primary," "concurrent," and "other" CPT categories, were evaluated to group procedure types. Procedures involving the small bowel, large bowel, or stomach were identified, and bowel procedures were sub-categorized as resection/bypass, ostomy, or other.

Outcome Definitions

The primary outcome was 30-day major morbidity, defined as Clavien-Dindo classification grade 3 or 4 disease requiring invasive intervention with risk of organ failure or death.[28] Major morbidity included deep or organ space surgical-site infection (SSI), wound dehiscence, pulmonary embolism (PE), ventilation longer than 48 h after surgery, unplanned reintubation, acute renal failure, progressive renal insufficiency, sepsis, septic shock, myocardial infarction (MI), cardiac arrest requiring cardiopulmonary resuscitation (CPR), and cerebrovascular accident (CVA).

The secondary outcomes were 30-day mortality, overall morbidity, reoperation (unplanned return to the operating room), unplanned readmission, total LOS (days from admission to discharge), and discharge destination. Overall morbidity included all major complications in addition to superficial SSI, pneumonia, urinary tract infection (UTI), intra- or postoperative blood transfusion, and deep venous thrombosis (DVT) requiring therapy. Discharge destination was dichotomized as discharge to home indicating "home" or "facility which was home," or as not discharged to home.

Statistical Analysis

Descriptive statistics were performed to compare ethnoracial differences in baseline characteristics. For all analyses, White race was the reference group. Categorical variables were compared using chi-square or Fisher's exact test as appropriate and reported as frequencies or proportions. Continuous variables were compared using Wilcoxon rank sums, with median and interquartile ranges (IQR) reported. Multivariable logistic regression models were created to assess ethnoracial differences in major morbidity and overall morbidity while controlling for potential confounders.

Variables were selected for inclusion in the model by first assessing the univariate significance of all preoperative and operative characteristics for the outcome of major morbidity to identify those with a significance level of p lower than 0.05 for consideration of inclusion in the model. Additionally, forward stepwise selection using all preoperative and operative characteristics was performed to ensure that no important variables were overlooked. The final selection of variables for the model was based on these results in addition to clinical knowledge of which variables are known to have an impact on morbidity after surgery to ensure that the included variables were clinically relevant.

Results were reported using odds ratios (ORs) and 95% confidence intervals (95% CIs). All statistical tests were two-sided, with a p value lower than 0.05 considered statistically significant. Analyses were performed using JMP version 15.1, SAS Institute, Cary, North Carolina.[35]

RESULTS

Patient Characteristics

From 2010 to 2019, 173,960 patients had disseminated cancer, and 3211 (1.8%) of these patients had a postoperative diagnosis of bowel obstruction. Eight patients (0.2%) were removed from the analysis because the procedures performed would not be indicated for MBO (e.g., hip arthroplasty or exploration of the retroperitoneum). Of the remaining 3203 patients, 441 (13.8%) were excluded because their ethnoracial group was unknown or had a sample size that was too small for analysis.

The final cohort for the analysis was comprised of 2762 patients: 2081 White patients (75.3%), 407 Black patients (14.7%), 159 Hispanic patients (5.8%), and 115 Asian patients (4.2%). Figure 1 outlines the steps for patient selection.

The demographic and preoperative characteristics by ethnoracial group are described in Table 1. The overall cohort had a median age of 65 years (IQR, 56–73 years) and was 54.7% female (n = 1510). Compared with other ethnoracial groups, White patients were relatively older (66 years; IQR, 57–74 years) and more likely to have been transferred from another institution (n = 403, 19.4%). Black patients were more likely than White patients to be underweight (10.2% vs 7.0%; p = 0.0295), to be obese (25.0% vs 19.0%; p = 0.0060) or to have diabetes (17.9% vs 12.7%; p = 0.0051), hypertension (54.1% vs 44.7%; p = 0.0006), ventilator dependence (1.7% vs 0.5%; p = 0.0183), acute renal failure (3.2% vs 1.1%; p = 0.0012), or preoperative RBC transfusion (8.1% vs 4.1%; p = 0.0005). Black patients also were more likely to have a higher median level of creatinine (0.88 mg/dL [IQR, 0.7–1.18 mg/dL] vs 0.8 mg/dL [IQR, 0.6–1.03 mg/dL]; $p < 0.0001$) or bilirubin (0.6 mg/dL [IQR, 0.4–0.9 mg/dL] vs 0.5 mg/dL [IQR,

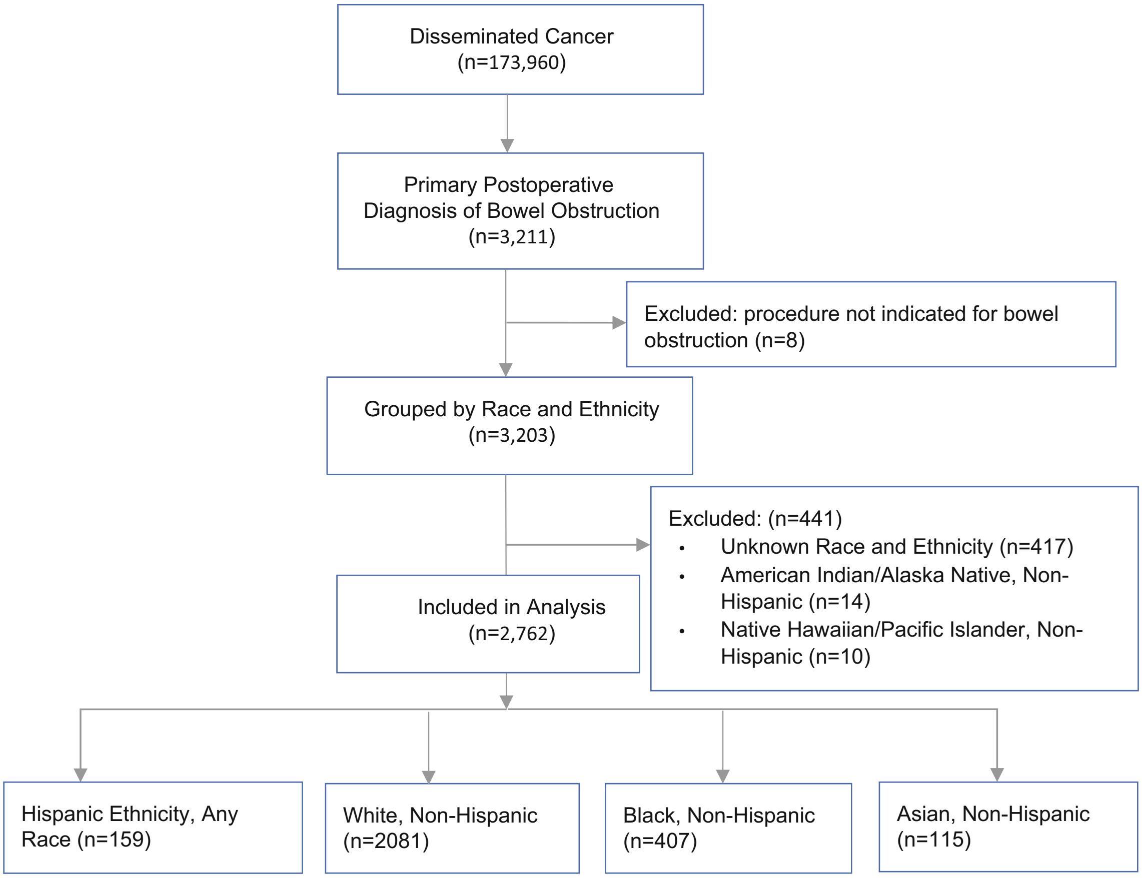

FIG. 1 Steps of selection for study inclusion

0.4–0.8 mg/dL]; $p = 0.0359$), and a lower median level of hematocrit (31.6% [IQR, 27.95–35.5%] vs 33.3% [IQR, 29.8–37.2%]; $p < 0.0001$). Hispanic and Asian patients were similar to White patients in terms of preoperative characteristics and labs, often having fewer comorbidities. There were no ethnoracial differences in sex, ASA classification, dependent functional status, weight loss, immunosuppression, CHF, ascites, dialysis, open wounds, sepsis, preoperative albumin, or postoperative WBC count.

Operative characteristics by ethnoracial group are described in Table 2. Overall, 42.4% of the patients had a small bowel procedure, 50.4% had a colorectal procedure, and 7.2% had a gastric procedure, with 53.2% receiving an ostomy and 4.8% receiving a gastrostomy. Emergency procedures were more likely for Black patients (37.1% vs 30.0%; $p = 0.0046$) and Asian patients (39.1% vs 30.0%; $p = 0.0381$) than for White patients. Asian patients also were more likely to have a small bowel procedure (52.2% vs 42.1%; $p = 0.0334$) and less likely to have a colorectal procedure (39.1% vs 51.2%; $p = 0.0116$) than White patients. The analysis found no ethnoracial differences in preoperative LOS (median, 2 days; IQR, 1–5 days), wound classification (clean/contaminated most common, 67.6%), or operation time (median, 102 min; IQR, 69–158 min).

Postoperative Outcomes

The results from the univariate analyses of postoperative outcomes are described in Table 3. The overall 30-day mortality rate was 12.6%. Additionally, 23.0% of the patients had at least one major complication, with 41.5% of the patients having at least one overall complication and 23.1% having two or more overall complications. The most common complications were RBC transfusion (16.0%), sepsis (8.3%), superficial SSI (7.2%), organ space SSI (7.1%), pneumonia (5.5%), and septic shock (4.7%). The median LOS was 11 days (IQR, 7–17 days), with a median time from operation to discharge of 7 days (IQR, 5–12 days). The unplanned reoperation rate was 7.8%, and the unplanned readmission rate was 17.6%. Most of the patients (72.8%) were discharged to home.

A comparison of outcomes by ethnoracial group showed that Black patients were more likely than White patients to have at least one major complication (28.5% vs 21.8%; $p = 0.0031$), at least one overall complication (47.4% vs 40.4%; $p = 0.0087$), and two or more overall complications (23.1% vs 17.2%; $p = 0.0044$). The complications significantly more likely among Black patients were prolonged ventilation (6.6% vs 3.8%; $p = 0.0112$), progressive renal

TABLE 1 Demographic and preoperative characteristics by ethnoracial group[a]

	White (n = 2081, 75.3%)	Black (n = 407, 14.7%)		Hispanic (n = 159, 5.8%)		Asian (n = 115, 4.2%)		Overall (n = 2762)
	n (%)	n (%)	p Value[b]	n (%)	p Value[b]	n (%)	p Value[b]	n (%)
Median age: years (IQR)	66 (57–74)	63 (54–70)	<0.0001[c]	58 (50–69)	<0.0001[c]	64 (52-73)	0.0381[c]	65 (56-73)
Female Sex	1148 (55.2)	212 (52.1)	0.2500	89 (56.0)	0.8483	61 (53.0)	0.6520	1510 (54.7)
Transferred	403 (19.4)	61 (15.0)	0.0374[c]	18 (11.4)	0.0132[c]	8 (7.0)	0.0009[c]	490 (17.8)
BMI (kg/m^2)[d]								
<18.5	144 (7.0)	41 (10.2)	0.0295[c]	12 (7.6)	0.7693	22 (20.0)	<0.0001[c]	219 (7.9)
18.5–24.99	602 (29.4)	152 (37.6)		65 (41.4)		62 (56.4)		1194 (43.2)
25–29.99	915 (44.6)	110 (27.2)		48 (30.6)		21 (19.1)		781 (28.3)
≥30	390 (19.0)	101 (25.0)	0.0060[c]	32 (20.4)	0.6746	5 (4.6)	0.0001[c]	528 (19.1)
ASA Classification 3–5	1839 (88.5)	372 (91.4)	0.0917	142 (89.3)	0.7693	97 (85.1)	0.2629	2450 (88.9)
Dependent functional status	167 (8.1)	42 (10.3)	0.1283	11 (7.0)	0.6259	6 (5.3)	0.2827	226 (8.2)
Weight loss	369 (17.7)	81 (19.9)	0.2983	36 (22.6)	0.1210	19 (16.5)	0.7405	505 (18.3)
Immunosuppression	214 (10.3)	30 (7.4)	0.0708	11 (6.9)	0.1736	14 (12.2)	0.5177	269 (9.7)
Diabetes	265 (12.7)	73 (17.9)	0.0051[c]	25 (15.7)	0.2792	12 (10.4)	0.4697	375 (13.6)
Hypertension	931 (44.7)	220 (54.1)	0.0006[c]	50 (31.5)	0.0011[c]	39 (33.9)	0.0229[c]	1240 (44.9)
CHF	20 (1.0)	8 (2.0)	0.1162	4 (2.5)	0.0853	2 (1.7)	0.3216	34 (1.2)
Smoking	335 (16.1)	79 (19.4)	0.1008	16 (10.1)	0.0436[c]	10 (8.7)	0.0337[c]	440 (15.9)
Dyspnea	189 (9.1)	34 (8.4)	0.6380	3 (1.9)	0.0018[c]	7 (6.1)	0.2728	233 (8.4)
COPD	153 (7.4)	20 (4.9)	0.0770	5 (3.1)	0.0458[c]	1 (0.9)	0.0080[c]	179 (6.5)
Ventilator	11 (0.5)	7 (1.7)	0.0183[c]	1 (0.6)	0.5876	1 (0.9)	0.4765	20 (0.7)
Ascites	243 (11.7)	41 (10.1)	0.3522	18 (11.3)	0.8926	14 (12.2)	0.8718	316 (11.4)
Acute renal failure	23 (1.1)	13 (3.2)	0.0012[c]	1 (0.6)	1.0000	1 (0.9)	1.0000	38 (1.4)
Dialysis	10 (0.5)	4 (1.0)	0.2655	1 (0.6)	0.5559	2 (1.7)	0.1274	17 (6.2)
Open wound	61 (2.9)	12 (3.0)	0.9851	7 (4.4)	0.3305	2 (1.7)	0.7709	82 (3.0)
Bleeding disorder	233 (11.2)	37 (9.1)	0.2116	17 (10.7)	0.8455	6 (5.2)	0.0450[c]	293 (10.6)
RBC transfusion	85 (4.1)	33 (8.1)	0.0005[c]	9 (5.7)	0.3395	4 (3.5)	0.7482	131 (4.7)
Sepsis	437 (21.0)	103 (25.3)	0.0539	41 (25.8)	0.1556	25 (21.7)	0.8498	606 (22.0)
Median albumin: g/dL (IQR)	3.2 (2.6–3.7)	3.2 (2.6–3.8)	0.2710	3.1 (2.6–3.7)	0.7629	3.2 (2.7–3.75)	0.6469	3.2 (2.6–3.7)
Median creatinine: mg/dL (IQR)	0.8 (0.6–1.03)	0.88 (0.7–1.18)	<0.0001[c]	0.7 (0.59–0.9)	0.0008[c]	0.7 (0.52–0.95)	0.0021[c]	0.8 (0.61–1.04)
Median bilirubin: mg/dL (IQR)	0.5 (0.4–0.8)	0.6 (0.4–0.9)	0.0359[c]	0.5 (0.4–0.8)	0.9792	0.6 (0.4–1)	0.0012[c]	0.5 (0.4–0.8)
Median hematocrit:% (IQR)	33.3 (29.8–37.2)	31.6 (27.95–35.5)	<0.0001[c]	32.35 (29.15–36.6)	0.2007	32.9 (28.4–34.93)	0.0101[c]	33 (29.3–37)
Median WBC: $\times 10^9$ cells/L (IQR)	7.73 (5.4–10.6)	7.1 (5–10.43)	0.0877	7.35 (5.01–11.11)	0.5881	7.2 (4.85–9.76)	0.0846	7.6 (5.3–10.6)

IQR interquartile range, *BMI* body mass index, *ASA* American Society of Anesthesiologists, *CHF* congestive heart failure, *COPD* chronic obstructive pulmonary disease, *RBC* red blood cell, *WBC* White blood cell

[a]Missing data include sex (n = 1), transfer status (n = 3), BMI (n = 40), ASA class (n = 5), functional status (n = 10), albumin (n = 283), creatinine (n = 27), bilirubin (n = 192), hematocrit (n = 24), and WBC (n = 22)

[b]p Values are for comparisons between the White reference group and the other ethnoracial groups

[c]$p < 0.05$

[d]p Values were provided only for ethnoracial differences within the underweight and obese BMI groups given that those are the most clinically relevant

TABLE 2 Operative characteristics by ethnoracial group[a]

	White (n = 2081, 75.3%)	Black (n = 407, 14.7%)		Hispanic (n = 159, 5.8%)		Asian (n = 115, 4.2%)		Overall (n = 2762)
	n (%)	n (%)	p Value[b]	n (%)	p Value[b]	n (%)	p Value[b]	n (%)
Emergency procedure	624 (30.0)	151 (37.1)	0.0046[c]	54 (34.0)	0.2928	45 (39.1)	0.0381[c]	874 (31.6)
Median preoperative LOS: days (IQR)	2 (1–5)	2 (1–6)	0.3081	3 (1–7)	0.0611	2 (1–5)	0.8156	2 (1–5)
Wound classification			0.9523		0.6065		0.6634	
1 (clean)	139 (6.7)	29 (7.1)		7 (4.4)		9 (7.8)		184 (6.7)
2 (clean/contaminated)	1401 (67.3)	227 (68.1)		106 (66.7)		82 (71.3)		1866 (67.6)
3 (contaminated)	337 (16.2)	62 (15.2)		30 (18.9)		15 (13.0)		444 (16.1)
4 (dirty/infected)	204 (9.8)	39 (9.6)		16 (10.1)		9 (11.2)		268 (9.7)
Median operation time: min (IQR)	102 (69– 157)	108 (70–169)	0.3050	111 (66–164)	0.4117	96.5 (66.75–150.5)	0.5456	102 (69–158)
Small bowel procedure[d]	876 (42.1)	168 (41.3)	0.8853	66 (41.5)	0.7599	60 (52.2)	0.0334[c]	1170 (42.4)
Resection/bypass	653 (31.4)	121 (29.7)		52 (32.7)		43 (37.4)		869 (31.5)
Ostomy	215 (10.3)	40 (9.8)		14 (8.8)		16 (13.9)		285 (10.3)
Other	55 (2.6)	13 (3.2)		5 (3.1)		4 (3.5)		77 (2.8)
Colorectal procedure[e]	1066 (51.2)	200 (49.1)	0.4415	81 (50.9)	0.9453	45 (39.1)	0.0116[c]	1392 (50.4)
Resection	652 (31.3)	119 (29.2)		44 (27.7)		26 (22.6)		841 (30.4)
Ostomy	423 (20.3)	86 (21.1)		39 (24.5)		20 (17.4)		568 (20.6)
Other	22 (1.1)	3 (0.7)		3 (1.9)		0 (0.0)		28 (1.0)
Small or large bowel procedure[f]	43 (2.1)	8 (2.0)	0.8957	4 (2.5)	0.5723	4 (3.5)	0.3073	59 (2.1)
Gastric procedure[g]	142 (6.8)	37 (9.1)	0.1055	13 (8.2)	0.5172	8 (7.0)	0.9561	200 (7.2)
Ostomy[h]	1110 (53.3)	214 (52.6)	0.7787	86 (54.1)	0.8553	59 (51.3)	0.6702	1469 (53.2)
Gastrostomy[i]	103 (5.0)	18 (4.4)	0.6513	11 (6.9)	0.2763	1 (0.9)	0.0449[c]	133 (4.8)

LOS hospital length of stay, *IQR* interquartile range

[a]Missing data: operation time (n = 2)

[b]p Values are for comparisons between the White reference group and the other ethnoracial groups

[c]$p < 0.05$

[d]Small bowel "resection/bypass" includes enterectomy, enteroenterostomy, and enterotomy; "ostomy" includes ileostomy or jejunostomy; and "other" includes enterorrhaphy of perforations, unlisted procedure of the small intestine, and stricturoplasty

[e]Colorectal "resection/bypass" includes proctectomy and colectomy; "ostomy" includes colostomy; and "other" includes unlisted procedure of the rectum or colon, biopsy of the anorectal wall, proctopexy, suture of perforations, rectal abscess drainage, colonic lavage, and colotomy exploration

[f]Small or large bowel includes procedures that did not specify which location had surgery, including excision of lesions in the small or large intestine, closure enterostomy of the large or small intestine, placement enterostomy/cecostomy, and unlisted procedure of the intestine

[g]Gastric includes gastrojejunostomy or gastroduodenostomy, unlisted procedure of the stomach, gastrectomy, gastrotomy, gastrorrhaphy, excision of a malignant lesion or biopsy of the stomach. Gastrostomy includes laparoscopic, open, or percutaneous gastrostomy placement

[h]Ostomy includes any ostomy of the large or small intestine

[i]Gastrostomy includes laparoscopic, open, or percutaneous gastrostomy tube placement

insufficiency (3.2% vs 1.1%; p = 0.0012), cardiac arrest (3.0% vs 0.7%; p = 0.0005), and RBC transfusion (19.4% vs 15.2%; p = 0.0329).

Black patients also had a longer median LOS (12 days [IQR, 8–19 days] vs 10 days [IQR, 7–17 days]; p = 0.0007) and a longer time from operation to discharge (9 days [IQR, 5–13 days] vs 7 days [IQR, 5–11 days]; p = 0.0006). Black patients were less likely to be discharged to home (67.6% vs 73.0%; p = 0.0315) and more likely to have an unplanned readmission (17.1% vs 12.9%; p = 0.0266).

Hispanic patients had a lower mortality rate than White patients (6.3% vs 13.1%; p = 0.0130), and a longer LOS (12 days [IQR, 8–18 days] vs 10 days [IQR, 7–17 days]; p = 0.0313). Asian patients did not differ significantly in postoperative outcomes from White patients.

The results of the multivariable logistic regression analyses are displayed in Table 4. After adjustment for

TABLE 3 Univariate analysis of 30-day postoperative outcomes by ethnoracial group[a]

	White (n = 2081, 75.3%)	Black (n = 407, 14.7%)		Hispanic (n = 159, 5.8%)		Asian (n = 115, 4.2%)		Overall (n = 2762)
	n (%)	n (%)	p Value[b]	n (%)	p Value[b]	n (%)	p Value[b]	n (%)
Mortality	272 (13.1)	57 (14.0)	0.6108	10 (6.3)	0.0130[c]	8 (7.0)	0.0557	347 (12.6)
Overall morbidity								
≥1	841 (40.4)	193 (47.4)	0.0087[c]	69 (43.4)	0.4604	43 (37.4)	0.5200	1146 (41.5)
≥2	357 (17.2)	94 (23.1)	0.0044[c]	34 (21.4)	0.1758	19 (16.5)	0.8606	504 (18.2)
Major morbidity (≥1)	453 (21.8)	116 (28.5)	0.0031[c]	41 (25.8)	0.2389	24 (20.9)	0.8200	634 (23.0)
Reoperation	139 (7.7)	33 (9.1)	0.3712	8 (5.6)	0.3607	7 (7.2)	0.8497	187 (7.8)
Unplanned readmission	306 (17.1)	79 (21.9)	0.0266[c]	20 (14.1)	0.3636	17 (17.5)	0.9029	422 (17.6)
Median LOS: days (IQR)	10 (7–17)	12 (8–19)	0.0007[c]	12 (8–18)	0.0313[c]	11 (8–19)	0.1561	11 (7–17)
Median operation to discharge: days (IQR)	7 (5–11)	9 (5–13)	0.0006[c]	8 (5–13)	0.1074	8 (5–14)	0.1059	7 (5–12)
In hospital >30 days	35 (2.0)	13 (3.6)	0.0517	2 (1.4)	1.0000	2 (2.1)	0.7140	52 (2.2)
Discharged to home	1408 (73.0)	254 (67.6)	0.0315[c]	115 (77.7)	0.2117	86 (80.4)	0.0926	1863 (72.8)
Complication								
Superficial SSI	152 (7.3)	26 (6.4)	0.5120	16 (10.1)	0.2030	4 (3.5)	0.1200	198 (7.2)
Deep SSI	31 (1.5)	8 (2.0)	0.4796	4 (2.5)	0.3083	2 (1.7)	0.6903	45 (1.6)
Organ space SSI	144 (6.9)	37 (9.1)	0.1230	10 (6.3)	0.7620	4 (3.5)	0.1519	195 (7.1)
Wound dehiscence	39 (1.9)	7 (1.7)	0.8327	2 (1.3)	1.0000	1 (0.9)	0.7205	49 (1.8)
Pneumonia	112 (5.4)	26 (6.4)	0.4173	8 (5.0)	0.8499	7 (6.1)	0.7451	153 (5.5)
Unplanned reintubation	59 (2.8)	16 (3.9)	0.2369	5 (3.1)	0.8031	4 (3.5)	0.5693	84 (3.0)
Pulmonary embolism	27 (1.3)	7 (1.7)	0.5020	2 (1.3)	1.0000	1 (0.9)	1.0000	37 (1.3)
Ventilator >48 h	80 (3.8)	27 (6.6)	0.0112[c]	8 (5.0)	0.4577	4 (3.5)	1.0000	119 (4.3)
Progressive renal insufficiency	23 (1.1)	13 (3.2)	0.0012[c]	2 (1.3)	0.6965	3 (2.6)	0.1521	41 (1.5)
Acute renal failure	23 (1.1)	6 (1.5)	0.4575	2 (1.3)	0.6965	2 (1.7)	0.3799	33 (1.2)
Urinary tract infection	98 (4.7)	15 (3.7)	0.3643	8 (5.0)	0.8537	7 (6.1)	0.5003	128 (4.6)
Stroke/CVA	7 (0.3)	0 (0.0)	0.6074	1 (0.6)	0.4457	1 (0.9)	0.3502	9 (0.3)
Cardiac arrest requiring CPR	15 (0.7)	12 (3.0)	0.0005[c]	1 (0.6)	1.0000	0 (0.0)	1.0000	28 (1.0)
Myocardial infarction	16 (0.8)	3 (0.7)	1.0000	1 (0.6)	1.0000	1 (0.9)	0.6006	21 (0.8)
RBC Transfusion	316 (15.2)	79 (19.4)	0.0329[c]	29 (18.2)	0.3038	18 (15.7)	0.8920	442 (16.0)
DVT requiring therapy	58 (2.8)	17 (4.2)	0.1337	3 (1.9)	0.7982	2 (1.7)	0.7679	80 (2.9)
Sepsis	170 (8.2)	38 (9.3)	0.4364	16 (10.1)	0.4042	6 (5.2)	0.2564	230 (8.3)
Septic shock	92 (4.4)	24 (5.9)	0.1965	6 (3.8)	0.7005	8 (7.0)	0.2042	130 (4.7)

LOS hospital length of stay, *IQR* interquartile range, *SSI* surgical-site infection, *CVA* cerebrovascular accident, *CPR* cardiopulmonary resuscitation, *RBC* red blood cell, *DVT* deep venous thrombosis

[a]Missing data: total LOS (n = 44), days from operation to discharge (n = 42), still in hospital >30 days (n = 213), discharge destination (n = 202), reoperation (n = 419), unplanned readmission (n = 419)

[b]p Values are for comparisons between the White reference group and the other ethnoracial groups

[c]$p < 0.05$

clinically relevant preoperative and operative characteristics, the multi-categorical ethnoracial variable was not significantly associated with major morbidity (p = 0.1061) or overall morbidity (p = 0.1487). However, Black patients had significantly higher odds of experiencing a major complication (OR, 1.42; 95% CI, 1.07–1.88; p = 0.0152) or overall complication (OR, 1.34; 95% CI, 1.05–1.73; p = 0.0208) than White patients.

TABLE 4 Multivariable logistic regression model for odds of postoperative major and overall morbidity by ethnoracial group[a]

	Major morbidity (≥1)			Overall morbidity (≥1)		
	OR[b]	95% CI	*p* Value	OR[b]	95% CI	*p* Value
Ethnoracial group						
White	Referent			Referent		
Black	1.42	1.07–1.88	0.0152[c]	1.34	1.05–1.73	0.0208[c]
Hispanic	1.18	0.77–1.81	0.4477	1.08	0.70–1.56	0.6986
Asian	1.19	0.69–2.08	0.5291	1.05	0.66–1.68	0.8372
Age (years)	1.00	0.99–1.01	0.7842	1.00	0.99–1.01	0.6262
BMI (kg/m^2)						
<18.5	1.50	1.03–2.18	0.0346[c]	1.28	0.92–1.78	0.1386
18.5–24.99	Referent			Referent		
25–29.99	1.07	0.83–1.39	0.5862	1.05	0.84–1.30	0.6853
≥30	1.30	0.98–1.73	0.0698	1.39	1.09–1.78	0.0080[c]
Diabetes	0.91	0.67–1.24	0.5438	0.92	0.71–1.20	0.5505
Hypertension	1.21	0.96–1.53	0.1007	1.13	0.93–1.37	0.2309
ASA class 3–5	0.95	0.66–1.35	0.7566	1.19	0.88–1.60	0.2504
Ascites	1.39	1.03–1.89	0.0355[c]	1.46	1.12–1.92	0.0054[c]
Ventilator	2.48	0.81–7.59	0.1022	1.72	0.51–5.82	0.3685
Sepsis	2.28	1.78–2.91	<0.0001[c]	1.89	1.51–2.37	<0.0001[c]
Albumin (g/dL)	0.78	0.67–0.91	0.0013[c]	0.70	0.61–0.79	<0.0001[c]
Creatinine (mg/dL)	1.30	1.13–1.49	0.0001[c]	1.28	1.11–1.47	0.0003[c]
Bilirubin (mg/dL)	1.21	1.05–1.39	0.0074[c]	1.11	0.97–1.26	0.1251
WBC ($\times 10^9$ cells/L)	1.02	1.00–1.03	0.0887	1.02	1.00–1.03	0.0556
Emergency	0.90	0.71–1.13	0.3490	1.15	0.94–1.41	0.1638
Operative time (h)	1.26	1.17–1.36	<0.0001[c]	1.40	1.30–1.52	<0.0001[c]
Wound classification						
1 (clean)	Referent			Referent		
2 (clean/contaminated)	1.67	0.94–2.97	0.0783	1.20	0.81–1.77	0.3644
3 (contaminated)	2.93	1.60–5.38	0.0005[c]	1.94	1.26–301	0.0028[c]
4 (dirty/infected)	5.00	2.67–9.37	<0.0001[c]	2.33	1.45–3.75	0.0005[c]
Preoperative LOS (days)	1.01	1.00–1.02	0.2334	1.01	1.00–1.03	0.0719
Small bowel Resection/bypass[d]	1.71	1.35–2.17	<0.0001[c]	1.60	1.30–1.96	<0.0001[c]
Colorectal resection[e]	1.71	1.34–2.19	<0.0001[c]	1.61	1.30–2.00	<0.0001[c]

OR odds ratio, *CI* confidence interval, *BMI* body mass index, *ASA* American Society of Anesthesiologists, *WBC* White blood cell, *LOS* hospital length of stay

[a]All variables included in this logistic regression model are listed in the table

[b]Odds ratios for continuous variables are per unit change in regressor (e.g., per hour change in operative time)

[c]$p < 0.05$

[d]Small bowel resection/bypass includes enterectomy, enteroenterostomy, and enterotomy

[e]Colorectal resection includes proctectomy and colectomy

DISCUSSION

This study demonstrated that Black patients had a significantly higher risk of major and overall 30-day postoperative morbidity, a longer LOS, a lower probability of discharge to home, and higher rates of unplanned readmission after surgery for MBO than White patients. The complications more likely for Black patients were prolonged ventilation, progressive renal insufficiency, cardiac arrest, and RBC transfusion. The 30-day mortality rates did not differ significantly between Black and White patients.

Many factors contribute to ethnoracial disparities in surgical outcomes, with differences in preoperative health as one potential cause.[22] Black patients in this study had greater preoperative comorbidity and more emergency procedures than White patients, suggesting suboptimal medical management of chronic illness before surgery, likely secondary to impaired health care access and inequities in care received, creating a more emergent need for intervention and increased surgical risk at the time of presentation.[36–38] Importantly, differences in morbidity for Black versus White patients persisted after controlling for comorbidities and emergency procedures in the multivariable model, suggesting that additional systemic inequalities are contributing.

Disparities in operative management and outcomes for Black patients have been identified in many other studies, including longer preoperative LOS,[39] fewer minimally invasive procedures,[40] more debilitating surgery,[41] longer total LOS,[42–44] higher rates of major complications,[36] and higher mortality rates.[42,43] These findings highlight the necessity of addressing potential disparities in patient care. They are particularly salient in the context of palliative interventions, such as surgery for MBO performed to alleviate symptoms and improve quality of life.[1,7]

With a high likelihood of major complications, clear communication of postoperative risks and understanding of patient goals are crucial.[2,45] Patients often prioritize maximizing time at home toward the end of life, making outcomes such as prolonged LOS and lower likelihood of discharge to home for Black patients an important consideration.[45,46] In addition to addressing the higher rates of preoperative comorbid conditions observed for Black patients, identification of other opportunities to improve surgical outcomes is needed.

Another contributing factor may be that Black patients are more likely to undergo aggressive interventions at the end of life[8–15] and less likely to have a do-not-resuscitate (DNR) order, even when they have a more severe illness.[47,48] The reasons for this may include decreased palliative care utilization; impaired communication due to differences in language, culture, religion, or spirituality; overly optimistic beliefs about life-sustaining treatment; and/or provider mistrust.[49–51]

Implicit racial bias also can influence the way providers communicate with patients and may ultimately affect patient satisfaction, trust, and health-related behaviors.[52] For example, physicians may hold the belief that Black patients with end-stage cancer are more likely than White patients to want potentially life-extending therapies,[53] and may be less likely to discuss prognosis during palliative care conversations with Black and Latino patients who have advanced cancer.[8] Additionally, Black patients have been shown to have a 30% higher likelihood of operative delay for small bowel obstruction,[39] and are more likely to experience delays in initiation of cancer treatment for many common solid tumors.[54]

Differential treatment by physicians based on race, even if unintentional, may explain why Black patients were more likely to receive surgery for MBO with more preoperative comorbidities and a greater severity of illness. Therefore, it is important for providers to reflect consistently on how their biases could potentially have an impact on communication about goals of care, clinical management recommendations, timeliness of treatment, and other facets of cancer care.

Quality of care also varies widely by specific surgeon or hospital. Many factors shown to be associated with improved outcomes, such as having surgery performed by a specialist,[55] receiving minimally invasive surgery,[56] engaging in palliative care,[57] and having surgery at a high-volume hospital,[25] are less likely for Black patients or at hospitals serving larger proportions of ethnoracial minorities. Decreasing racial disparities in surgical mortality has been shown over time, but not for hospitals serving higher proportions of Black patients, emphasizing the need for more focus on these institutions.[58]

Surgical outcomes are influenced not only by care provided at the hospital, but also by a complex interplay of social determinants of health, including the resources to which patients have access.[59] The impact of social vulnerability (e.g., poor access to educational opportunities, socioeconomic disadvantage, and language barriers) on postoperative outcomes is most pronounced for Black patients.[60] Those living in communities with higher social vulnerability have higher morbidity, greater mortality, and longer LOS after resection for cancer,[61] as well as disproportionately decreased hospice use.[9] Socioeconomic factors and insurance status have been shown to confound survival differences between Black patients and White patients with colorectal cancer.[62,63] Controlling for measures of social vulnerability was not feasible in the context of the current study, so such factors could explain the observed differences in outcomes by ethnoracial group.

In this study, Hispanic patients had a longer LOS, but all other outcomes were similar or superior to those of White patients. This difference may be explained in part by lower rates of preoperative comorbidities for this cohort. Findings have shown Hispanic patients to have lower morbidity and mortality due to cancer than White patients, but "Hispanic" encompases a heterogeneous group, and outcomes may differ significantly based on country of origin, immigration status, and language fluency.[64] Outcomes did not differ significantly between White and Asian patients. This may have been due to the smaller sample of Asian patients and consequently a lower statistical power for detecting the rarer complications. Asian Americans have been understudied with respect to disparities research and comprise a heterogeneous group with potential differences in outcomes depending on which sub-populations are analyzed.[65,66] Further research is needed for both Hispanic and Asian populations to identify disparities and associated drivers corresponding to specific sub-populations.

This study had several limitations. First, using ethnoracial categories creates mutually exclusive groups for a social construct that in reality is much more fluid and imprecise.[27] However, this is a common approach to identification of systemic disparities and opportunities for intervention.

Second, the cohorts of Asian and Hispanic patients were the smallest in this study, and the database did not allow for analysis by sub-population such as ancestral country of origin. Thus, further investigation of these groups and other ethnoracial groups is needed.

Third, several other patient characteristics were not included in the NSQIP database that could contribute to poor outcomes or confound the results (e.g., hospital-level or surgeon-level clustering, education level, geographic location, socioeconomic factors, primary cancer type, tumor histology, driver mutations, or lesbian, gay, bisexual, transgender, queer, and questioning (LGBTQ+) identity. Future studies are needed to further analyze the impact of these factors.

Fourth, as described in the "Study Design and Patient Population" section, due to the retrospective nature of the NSQIP database, the ideal inclusion criteria for the diagnosis of MBO could not be applied.[31]

Fifth, the NSQIP database does not allow insight into more nuanced factors influencing decision-making such as goals-of-care discussions, patient satisfaction, or symptoms experienced. This limitation is common for large database studies of MBO.[4,6,30,67] Finally, the NSQIP database is limited to a 30-day window, and hence outcomes outside of that time frame are not available for study.

In conclusion, Black patients had a higher risk of major and overall morbidity after surgery for MBO than White patients, independent of clinically relevant preoperative and operative characteristics. Black patients had mortality rates similar to those of White patients, but had higher rates of preoperative comorbidities, emergency procedures, prolonged LOS, and unplanned readmission, and a lower probability of being discharged to home. These findings have an important impact on surgical decision-making for MBO because any complications or prolonged hospitalization toward the end of life are major considerations. Differences in outcomes for Black patients have potential contributing factors including barriers to palliative care, implicit racial biases affecting communication, higher rates of comorbidities, greater social vulnerability, and clustering of lower-quality care at hospitals serving primarily Black patients. These disparities were not observed for Hispanic or Asian patients, although further research is needed to ensure that all opportunities to improve care are identified and addressed for these populations, as well as for other underrepresented groups. Future analyses controlling for potentially confounding variables such as socioeconomic status, education level, and tumor histology are indicated to identify underlying causes for these inequities. Surgeons should be mindful of the factors that have an impact on outcomes by ethnoracial group and how these can be mitigated to provide equally high-quality care across groups.

ACKNOWLEDGMENT We thank Dr. Steven Grambow, Ph.D. for providing his expertise and suggestions for the statistical analysis portion of this study.

CONFLICT OF INTEREST The authors declare that they have no conflict of interest.

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