ORIGINAL ARTICLE

Are Right-Sided Colectomy Outcomes Different From Left-Sided Colectomy Outcomes?

Study of Patients With Colon Cancer in the ACS NSQIP Database

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Importance: Optimization of surgical outcomes after colectomy continues to be actively studied, but most studies group right-sided and left-sided colectomies together.

Objective: To determine whether the complication rate differs between right-sided and left-sided colectomies for cancer. As a secondary analysis, we investigated hospital length of stay.

Design: We identified patients who underwent colectomy for colon cancer in the 2005-2008 American College of Surgeons National Surgical Quality Improvement Program database and stratified cases by right and left side. Preoperative, intraoperative, and postoperative factors were compared. Multivariable techniques were used to assess the impact of the side of colectomy on operative outcome measures, adjusting for covariates.

Setting: Hospitals within the American College of Surgeons National Surgical Quality Improvement Program database.

Patients: We identified 4875 patients who underwent elective laparoscopic or open colectomy for right-sided or left-sided colon cancer in the database.

Main Outcomes and Measures: Major complications and surgical site infection (SSI) rates.

Results: In the 4875 colectomies studied, a laparoscopic approach was used in 42% of cases and at similar frequency in right-sided and left-sided colectomies. Thirty-day mortality (1.5%) was similar in both groups. Major complications were seen in 17% of patients in each group. Superficial SSI was more likely to occur in patients who underwent left-sided colectomy (8.2% vs 5.9%). Among patients with postoperative sepsis or deep or organ space SSIs, more patients in the left-sided colectomy group underwent reoperation compared with the right-sided colectomy group (56% vs 30%). Laparoscopic right-sided colectomy patients were more likely to have a prolonged hospital length of stay than laparoscopic left-sided colectomy patients (odds ratio, 1.39; 95% CI, 1.09-1.78).

Conclusions and Relevance: The outcomes after colectomy for cancer are comparable in right-sided and left-sided resections, except for in the case of superficial SSI, which is less common in right-sided resections. Further research on SSI after colectomy should incorporate right vs left side as a potential preoperative risk factor.

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Postoperative outcomes following colon and rectal surgery have been well studied, especially in the past decade. With previously reported complication rates between 20% and 30% after colectomy,[1] there is strong interest in understanding patterns of morbidity after colectomy and seeking ways to improve outcomes. To our knowledge, most studies do not differentiate between right-sided and left-sided colectomies. While not clearly documented in the literature, surgeons may perceive an ileocolic anastomosis, as occurs after a right-sided colectomy, as presenting lower risk than other colorectal anastomoses.

In studies of complications after colorectal surgery, a distinction is made between abdominal procedures and pelvic procedures, particularly with regard to the location of the anastomosis performed.[2-4] This distinction is important to surgeons because patients with an anastomosis to the extraperitoneal rectum are at higher risk for poor healing than an anastomosis performed in the peritoneal cavity.[5] Ileocolic anastomosis is perceived to carry different risks than a colocolonic anastomosis, although few studies have examined this question.[6] In a recent study of patients with metastatic colon cancer who underwent resection of the primary tumor, right-sided cancers were more likely to be resected than left-sided or rectal lesions, potentially owing to a perception among surgeons that right-sided hemico-

lectomy is associated with lower surgical morbidity than left-sided resections.[7] Furthermore, in a recent study using the University HealthSystem Consortium clinical database, patients who underwent right-sided colectomy were found to have better outcomes than those who underwent left-sided colectomy, particularly among those with malignant disease. However, only inpatient complications were reported, with no information on preoperative comorbidities.[8]

With regard to malignancy, patients with right-sided colon cancers are different than those with left-sided cancers. They are older, present at a more advanced stage, and have a higher unadjusted mortality rate postoperatively.[9] Whether complications after right-sided colectomy are different or occur at a different rate than complications after left-sided colectomy is an infrequently investigated area. A recent study by Masoomi et al[10] based on the 2007 Nationwide Inpatient Sample (NIS) demonstrated that among 76 818 colectomies, there was a higher rate of abscess in left-sided colectomy patients but higher rates of urinary tract infections, pneumonia, and ileus in right-sided hemicolectomy patients. However, because the NIS database is only compiled based on inpatient hospital data, it lacks information on 30-day morbidity and 30-day mortality. Given the volume of colon resections performed in the United States and the increased attention to risk-adjusted outcomes, a clear understanding of the impact of the side of resection—right vs left—is important in an assessment of complications after colectomy.

The purpose of this study was to use a large sample of patients who underwent elective surgery to determine whether complications and hospital length of stay (LOS) occurred more commonly after left-sided vs right-sided colectomy for colon cancer. In an effort to study patients who had a primary anastomosis, we used restrictive Current Procedural Terminology (CPT) codes that specified that an anastomosis was performed.

METHODS

We used the 2005-2008 American College of Surgeons (ACS) National Surgical Quality Improvement Program (NSQIP) Participant Use File. The ACS NSQIP obtains data on patients undergoing inpatient and outpatient surgical procedures from more than 250 university and private sector medical centers. Preoperative patient characteristics, intraoperative procedure characteristics, and 30-day postoperative mortality and complications, including more than 136 variables, are recorded in the data set and are well described elsewhere in the literature.[11,12]

PATIENTS

We identified 4875 patients who underwent elective laparoscopic or open colectomy for right-sided or left-sided colon cancer. Patients who underwent a right-sided colectomy were defined as those patients who had a partial colectomy with ileocolic anastomosis (CPT code 44160 or 44205) and had an *International Classification of Diseases, Ninth Revision* diagnosis code for malignant neoplasm of the cecum (153.4), ascending colon (153.6), or hepatic flexure (153.0). Patients who underwent left-sided colectomy were defined as those patients who had a partial colectomy with anastomosis or with coloproctostomy (CPT codes 44140, 44204, 44145, or 44207) and had an *International Classification of Diseases, Ninth Revision* diagnosis code for malignant neoplasm of the descending colon (153.2) or sigmoid colon (153.3). Our CPT codes were selected to include only patients who had an anastomosis performed. Patients were excluded if they underwent an emergency procedure (n=192) or had preoperative sepsis (n=144), major bleeding (n=14), open wound or wound infection (n=51), or ventilator dependence (n=2).

Patient characteristics were derived from reported NSQIP variables as follows: race/ethnicity was dichotomized to white or nonwhite, American Society of Anesthesiologists (ASA) classification was dichotomized to 3 or greater or less than 3, smoking was dichotomized as currently smoking or not currently smoking, functional status was dichotomized as independent or not independent, age was classified in 4 categories, and body mass index (BMI, calculated as weight in kilograms divided by height in meters squared) was classified in 5 categories: less than 18.5, 18.5-24.9, 25.0-29.9, 30.0-34.9, and 35.0 or greater. We stratified age in categories based on prior research examining the effect of age on postoperative complications.[13] Body mass index was stratified in categories based on conventions from prior NSQIP literature.[14] Cardiac disease was defined as a history of congestive heart failure, myocardial infarction, angina within 1 month of surgery, percutaneous coronary intervention, or cardiac surgery. Pulmonary disease was defined as dyspnea with moderate exertion or at rest, history of severe chronic obstructive pulmonary disease, or current pneumonia. Preoperative renal failure was defined as acute renal failure in the 24 hours prior to surgery or preoperative acute or chronic hemodialysis. The following preoperative laboratory values were included in our analyses as binary covariates based on normal value cutoffs noted in parentheses: white blood cell count (11.0/μL; to convert to $\times 10^9$ per liter, multiply by 0.001), creatinine (1.6 mg/dL; to convert to micromoles per liter, multiply by 88.4), and platelet count (150 $\times 10^3$/μL; to convert to $\times 10^9$ per liter, multiply by 1.0). Preoperative hematocrit was included as a categorical value with the following values: severe (21% to 25%) moderate (26% to 29%), mild (30% to 37%), and no anemia (≥38%) (to convert to proportion of 1.0, multiply by 0.01), as described elsewhere in the literature.[15]

OUTCOME DEFINITIONS

We examined 3 short-term operative outcomes with multivariable analyses: superficial surgical site infection (SSI), major complications, and prolonged LOS. Superficial SSI has been specifically defined by ACS NSQIP and is detailed in the literature.[16] We included the following in our definition of major complications: deep incisional infection, organ-space SSI, wound disruption, pneumonia, reintubation, pulmonary embolism, progressive renal insufficiency, acute renal failure, cerebrovascular accident, coma, cardiac arrest, myocardial infarction, sepsis, septic shock, the need for return to the operating room, or more than 48 hours on a ventilator. Major complications did not include superficial SSI, deep venous thrombosis, or urinary tract infection. Patients who died were excluded from postoperative LOS analysis. Prolonged LOS was defined as a LOS above the 75th percentile, consistent with the convention used in other NSQIP studies regarding LOS.[17] Because LOS between open and laparoscopic procedures is known to differ, the 75th percentile was calculated separately for laparoscopic and open procedures.[18]

STATISTICAL ANALYSES

For unadjusted comparison between our groups, we used the χ^2 test for categorical outcomes and the analysis of variance test

Table 1. Patient Characteristics and Comorbidities

	No. (%)		
	Right-Sided Colectomy (n = 2222)	Left-Sided Colectomy (n = 2653)	*P* Value
Age, y			
≤49	129 (5.8)	342 (12.9)	<.001
50-64	520 (23.4)	940 (35.4)	
65-79	888 (40.0)	961 (36.2)	
≥80	685 (30.8)	685 (15.5)	
Sex			
Male	988 (55.5)	1404 (47.1)	<.001
Female	1234 (44.5)	1249 (52.9)	
Race/ethnicity			
White	1742 (78.4)	1863 (70.2)	<.001
African American	226 (10.2)	238 (9.0)	
Hispanic	53 (2.4)	151 (5.7)	
Other	48 (2.1)	153 (5.8)	
Unknown	153 (6.9)	248 (9.3)	
ASA classification			
1 or 2	951 (42.8)	1424 (53.7)	<.001
≥3	1271 (57.2)	1229 (46.3)	
BMI			
<18.5	44 (2.0)	61 (2.3)	.002
18.5-24.9	761 (34.2)	773 (29.1)	
25.0-29.9	751 (33.8)	941 (35.5)	
30.0-34.9	399 (18.0)	506 (19.1)	
≥35.0	267 (12.0)	372 (14.0)	
Current smoker	258 (11.6)	320 (12.1)	.63
Current alcohol use	69 (3.1)	96 (3.6)	.33
Functional status			
Independent	2123 (95.5)	2590 (97.6)	<.001
Weight loss >10%	128 (5.8)	118 (4.5)	.04
No comorbidity	608 (27.4)	996 (37.5)	<.001
Comorbidity			
Diabetes mellitus	411 (18.5)	466 (17.6)	.40
Cardiac disease	371 (16.7)	325 (12.3)	<.001
Pulmonary disease	480 (21.6)	329 (12.4)	<.001
Renal failure	14 (0.6)	16 (0.6)	.90
Preoperative chemotherapy	23 (1.0)	18 (0.7)	.17
Preoperative radiotherapy	6 (0.3)	4 (0.2)	.36
Preoperative laboratory tests			
Albumin <3.0 mg/dL	178 (8.0)	108 (4.1)	<.001
Albumin missing value	647 (29.1)	927 (34.9)	
WBC count <11/μL	1995 (89.8)	2330 (87.8)	.002
Creatinine >1.6 mg/dL	132 (5.9)	117 (4.4)	<.001
Platelet count <150 ×10^3/μL	82 (3.7)	103 (3.9)	.007
Severe anemia, hematocrit<26%	46 (2.1)	29 (1.1)	<.001
Moderate anemia, hematocrit 26% to 28%	181 (8.2)	76 (2.9)	<.001
Mild anemia, hematocrit 29% to 37%	1114 (50.1)	859 (32.4)	<.001
No anemia, ≥38%	820 (36.9)	1562 (58.9)	<.001
Unknown hematocrit	61 (2.8)	127 (4.8)	

Abbreviations: ASA, American Society of Anesthesiologists; BMI, body mass index (calculated as weight in kilograms divided by height in meters squared); WBC, white blood cell count.

SI conversion factors: To convert creatinine to micromoles per liter, multiply by 88.4; hematocrit to proportion of 1.0, multiply by 0.01; platelet count to ×10^9 per liter, multiply by 1.0; and WBC count to ×10^9 per liter, multiply by 0.001.

for continuous outcomes. Multivariate logistic regression was used to assess our primary outcomes. Analyses were performed in SAS version 9.2 (SAS Institute Inc).

Table 2. Intraoperative Characteristics

	No. (%)		
	Right-Sided Colectomy	Left-Sided Colectomy	*P* Value
Laparoscopic procedure	929 (41.8)	1074 (40.5)	.34
Wound classification			
Clean/contaminated	2068 (93.1)	2480 (93.5)	.83
Contaminated	127 (5.7)	144 (5.4)	
Dirty	27 (1.2)	29 (1.1)	
Operative duration, mean (SD), min	130.2 (59.5)	162.5 (71.9)	<.001
Median	120	150	<.001
No. of red blood cell units transfused intraoperatively			
0	2068 (93.1)	2525 (95.1)	.002
1-2	136 (6.1)	103 (3.9)	
≥3	18 (0.8)	25 (1.0)	

RESULTS

Of the 4875 patients with colon cancer identified, 46% (n = 2222) underwent a right-sided colectomy with ileocolic anastomosis. Left-sided colectomies were performed in 54% of patients (n = 2653). Right-sided colectomies were no more likely to be performed laparoscopically than left-sided colectomies (42% vs 40%, respectively).

Characteristics of patients who required a right-sided vs left-sided colectomy are shown in **Table 1**. Patients who underwent a right-sided colectomy were more likely to be older and male. Of note, 22% of all patients were older than 80 years of age, and the proportions of patients in this age category were significantly higher in right-sided colectomies (31% vs 15%, $P < .001$). Right-sided colectomy patients were more likely than left-sided colectomy patients to have an ASA classification of 3 or greater (57% vs 46%, $P < .001$), to have preoperative cardiac disease (17% vs 12%, $P < .001$), to have preoperative pulmonary disease (22% vs 12%, $P < .001$), to be anemic ($P < .001$), to have hypoalbuminemia (8% vs 4%, $P < .001$), and less likely to be independent in their functional status (95% vs 98%, $P = < .001$). More patients who underwent left-sided colectomy had no major preoperative comorbidities (37% vs 27%, $P < .001$). No differences were seen in diabetes mellitus status, smoking status, or alcohol use. Patients who had a left-sided colectomy had a slightly higher BMI, with more morbidly obese patients (14% vs 12%, $P = .002$). Patients who had a right-sided colectomy were more likely to be white (78% vs 70%, $P < .001$).

Table 2 shows the intraoperative characteristics. Left-sided colectomies took longer to perform (mean, 162 vs 130 minutes; $P < .001$). During surgery, patients who had a right-sided colectomy more frequently received 1 or more blood transfusions (7% vs 5%, $P = .002$).

POSTOPERATIVE OUTCOMES

Mortality at 30 days after both right-sided and left-sided colectomies was low and not different between groups

Table 3. Unadjusted Analyses of Postoperative Mortality, LOS, and Morbidity

	No. (%)		
	Right-Sided Colectomy	Left-Sided Colectomy	*P* Value
30-d mortality	40 (1.8)	32 (1.2)	.08
Postoperative LOS, mean (SD)	6.9 (5.5)	6.5(5.2)	<.001
Median	6	5	<.001
Patients with >7 d postoperative LOS	804 (36.2)	840 (31.7)	<.001
Patients with no medical or surgical complications	1852 (83.4)	2199 (82.9)	.55
Surgical complications			
Superficial SSI	130 (5.9)	217 (8.2)	.002
Deep SSI	17 (0.8)	25 (0.9)	.50
Organ space SSI	44 (2.0)	48 (1.8)	.66
Wound dehiscence	25 (1.1)	26 (0.9)	.62
Sepsis	102 (4.6)	106 (4.0)	.31
Reoperation	98 (4.4)	118 (4.5)	.95
Bleeding requiring ≥5 U	8 (0.4)	7 (0.3)	.55
Severe SSI			
Patients with deep or organ space SSI who had sepsis	34 (55.7)	37 (50.7)	.56
Patients with deep or organ SSI or sepsis requiring reoperation	22 (36.1)	41 (56.2)	.02
Medical complications			
Pneumonia	63 (2.8)	48 (1.8)	.02
Need for reintubation	52 (2.3)	58 (2.2)	.71
Pulmonary embolism	22 (1.0)	13 (0.5)	.04
Renal failure	18 (0.8)	18 (0.7)	.59
Myocardial infarction	6 (0.3)	8 (0.3)	.84
Cardiac arrest	19 (0.9)	10 (0.4)	.04
Minor medical complication			
Urinary tract infection	65 (2.9)	79 (2.9)	.91
Deep venous thrombosis	27 (1.2)	21 (0.8)	.31

Abbreviations: LOS, length of stay; SSI, surgical site infection.

(**Table 3**). There was no difference in the proportion of patients who had at least 1 complication (17% in both groups, $P > .05$). Superficial SSIs were more likely to occur in patients who underwent left-sided colectomy (8.2% vs 5.9%, $P = .002$). Among patients who had deep infection, organ space infection, or postoperative sepsis, a higher proportion of patients required reoperation in the left-sided colectomy group (56% vs 36%, $P = .02$).

In univariate analysis, the following medical complications were significantly more common in patients who underwent right-sided colectomy: pneumonia (2.8% vs 1.8%), pulmonary embolism (1.0% vs 0.5%), and cardiac arrest (0.9% vs 0.4%).

MULTIVARIABLE ANALYSES

Patients who underwent right-sided colectomies were less likely to have superficial SSIs after adjusting for preoperative patient characteristics, comorbidities, wound classification, and operative duration characteristics (odds ratio [OR], 0.68; 95% CI, 0.53-0.87). Major complications were equally as likely in both groups after adjusting for covariates. In evaluation of open colectomies alone, major complications were equally as likely in right-sided and left-sided colectomy groups. In evaluation of laparoscopic colectomies alone, major complications were also equally as likely in the right-sided and left-sided colectomy groups (**Table 4**). However, laparoscopic right-sided colectomy patients were more likely to have a prolonged LOS than laparoscopic left-sided colectomy patients (OR, 1.39; 95% CI, 1.09-1.78). There was no difference in prolonged LOS between open colectomy groups.

Other significant predictors of superficial SSI were hypoalbuminemia (OR, 1.67; 95% CI, 1.09-2.54) and BMI greater than 35 compared with BMI less than 25 (OR, 2.26; 95% CI, 1.59-3.22). The following patient and procedure characteristics were not predictive of superficial SSI: age, sex, race/ethnicity, ASA classification, BMI between 25.0 and 29.9, BMI between 30.0 and 34.9, smoking status, alcohol use, functional status, preoperative weight loss, diabetes mellitus status, cardiac conditions, pulmonary conditions, preoperative renal failure, preoperative chemotherapy, preoperative white blood cell count of greater than 11/μL, preoperative creatinine level greater than 1.6 mg/dL, preoperative platelet count less than 150×10^3/μL, operative duration, and wound classification 3 vs 2.

Significant predictors of major complications in our multivariable analysis were ASA classification 3 or 4, currently smoking at the time of surgery, alcohol use, partially or fully dependent functional status, preoperative weight loss, hypoalbuminemia, wound classification 3 or 4, and operative duration longer than 180 minutes (**Table 5**).

DISCUSSION

Using the 2005-2008 multi-institutional ACS NSQIP database, we found that mortality and major complica-

Table 4. Summary of the Multivariable Analyses of the Impact of Right-Sided vs Left-Sided Colectomy on Postoperative Outcomes

	Superficial SSI	Major Complications	Prolonged LOS
All cases			
Left (n = 2653)	1 [Reference]	1 [Reference]	
Right (n = 2222)	0.68 (0.53-0.87)[a]	1.05 (0.84-1.31)	
Open			
Left (n = 1579)		1 [Reference]	1 [Reference][b]
Right (n = 1293)		0.97 (0.74-1.28)[a]	0.87 (0.74-1.04)[a]
Laparoscopic			
Left (n = 1074)		1 [Reference]	1 [Reference][c]
Right (n = 929)		1.37 (0.91-2.05)[a]	1.39 (1.09-1.78)[a]

Abbreviations: LOS, length of stay; SSI, surgical site infection.

[a] Adjusted for age, sex, race/ethnicity, American Society of Anesthesiologists classification, body mass index, smoking status, alcohol use, functional status, preoperative weight loss, diabetes mellitus status, presence of cardiac comorbidities, presence of pulmonary comorbidities, presence of renal failure, chemotherapy, preoperative serum albumin, white blood cell count, creatinine, platelet count, hematocrit, procedure, wound classification, and operative duration of longer than 3 hours.

[b] Prolonged LOS is defined as discharged alive after 9 days.

[c] Prolonged LOS is defined as discharged alive after 7 days.

Table 5. Predictors of Major Postoperative Complications Among 4875 Patients[a]

	Odds Ratio (95% CI)
Demographics	
Sex, male vs female	1.245 (0.997-1.553)
BMI	
25-30 vs <25	0.944 (0.718-1.241)
39-35 vs <25	1.354 (0.994-1.845)
>35 vs <25	1.747 (1.242-2.457)
Age, y	
50-64 vs <50	0.838 (0.542-1.294)
65-79 vs <50	0.983 (0.640-1.511)
>80 vs <50	1.449 (0.914-2.298)
Comorbidities	
Chemotherapy, Y vs N	1.329 (0.498-3.554)
Renal failure, Y vs N	1.379 (0.508-3.741)
Pulmonary comorbidities, Y vs N	1.277 (0.988-1.650)
Cardiac comorbidities, Y vs N	1.298 (0.984-1.712)
Diabetes mellitus, Y vs N	1.067 (0.818-1.393)
Weight loss, Y vs N	1.536 (1.03-2.284)
Functional status, other vs independent	1.933 (1.033-2.284)
Alcohol use, Y vs N	2.480 (1.574-3.909)
Smoking, Y vs N	1.383 (1.010-1.894)
ASA classification, 3 or 4 vs 1 or 2	1.605 (1.244-2.070)
Preoperative laboratories	
Hematocrit	
26-38 vs >37	1.260 (0.812-1.954)
29-37 vs >37	1.156 (0.905-1.476)
<26 vs >37	1.450 (0.707-2.978)
Unknown vs >37	0.942 (0.279-3.177)
Creatinine, >1.6 vs <1.6, mg/dL	1.346 (0.890-2.036)
WBC count, 11+ vs <11, /μL	1.285 (0.887-1.862)
Albumin, >3 vs <3, mg/dL	0.560 (0.393-0.797)
Platelets, >150 vs <150, $\times 10^3$/μL	0.688 (0.441-1.074)
Intraoperative factors	
Operative duration, >3 vs <3, h	1.516 (1.202-1.913)
Procedure, right vs left	1.051 (0.841-1.312)
Wound classification	
3 vs 2	1.584 (1.089-2.305)
4 vs 2	2.767 (1.387-5.520)

Abbreviations: ASA, American Society of Anesthesiologists; BMI, body mass index (calculated as weight in kilograms divided by height in meters squared); WBC, white blood cell.

SI conversion factors: To convert creatinine to micromoles per liter, multiply by 88.4; hematocrit to proportion of 1.0, multiply by 0.01; platelet count to $\times 10^9$ per liter, multiply by 1.0; and WBC count to $\times 10^9$ per liter, multiply by 0.001.

[a] $C = 0.706$.

tions were similar for right-sided and left-sided colectomies; however, in right-sided colectomies, patients were less likely to have a superficial SSI. Patients who underwent laparoscopic right-sided colectomy were more likely to have a prolonged LOS compared with patients who underwent laparoscopic left-sided colectomy. Furthermore, we found that patients who had a right-sided colectomy were older and significantly more likely to have preoperative cardiac and pulmonary comorbidity and hypoalbuminemia. Right-sided resections took less time than left-sided resections.

Thirty-day mortality was not different comparing right-sided and left-sided resections for colon cancer. This finding is in contrast to a recent study from Germany that retrospectively examined a large number of patients with colon cancer and found a higher rate of in-hospital mortality for right-sided colon cancers compared with left-sided colon cancers (2.4% vs 1.4%).[19] There was a higher degree of preoperative morbidity in the German study: 85% in the right-sided colon cancer group and 83% in the left-sided colon cancer group, compared with our study's NSQIP comorbidity of 73% in the right-sided group and 63% in the left-sided group.

After adjusting for preoperative patient characteristics, the risk for major complications was not different for right-sided vs left-sided colon resections. This may be somewhat surprising in light of the technically less challenging anastomosis performed after a right-sided colectomy. Our study is in contrast to the findings from the University HealthSystem clinical database, which studied a large number of patients (n = 15 080) and found that right-sided colectomy for malignancy resulted in fewer complications than left-sided colectomy (26.8% vs 28.3%, $P < .05$).[8] However, this was a small difference and included wound infections, which, as in our study, were less common in the right-sided colectomy group (4.2% vs 5.5%). Our study is also in contrast to the 2007 NIS study, which reported a higher rate of abscess in left-sided colectomy patients but higher rates of urinary tract infection, pneumonia, and ileus in right-sided colectomy patients.[10]

However, the University HealthSystem Consortium study did not report preoperative patient comorbidities or include them in risk adjustment. The NIS database is compiled only based on inpatient hospital data and lacks information on readmissions, 30-day morbidity, and 30-day mortality; therefore, it cannot account for these factors in the analysis. Therefore, the NSQIP data used in our study are likely to be more accurate in the assessment of complications than administrative data from the University HealthSystem Consortium or NIS studies.

Our results have implications for future analyses of outcomes after colectomy for cancer. Our unadjusted results showed a higher rate of pneumonia, pulmonary embolism, and cardiac arrest in patients who underwent a right-sided colectomy, but these higher rates were not supported by the multivariable analysis and may in fact be related to preoperative comorbidities rather than the operative site. Thus, whether a colon resection is right sided or left sided should not need to be incorporated into risk-adjustment tools that impact an institution's serious complication rate. On the other hand, in an era during which health care–associated infections are targeted by pay for performance and public reporting policies, it is important to know that right-sided colectomies have a different rate of SSI than left-sided colectomies.

Our analysis demonstrated that right-sided resection had a lower risk for superficial SSI, with an adjusted OR of 0.68. Superficial SSI comprises most SSIs, and institution-specific rates of SSI are a closely examined postoperative outcome. The decreased rate of SSI is not explained by more laparoscopic techniques in the right-sided resection patients. According to our results, an institution's rate of wound infection may be observed to be higher than average if a high proportion of left-sided resections is performed. Our finding that right-sided resections resulted in fewer superficial SSIs is likely related to decreased bacterial contamination from a more proximal transection of the bowel. The NSQIP does not collect data on compliance with Surgical Care Improvement Project[20] measures, which may decrease the risk for SSI, but it seems unlikely that Surgical Care Improvement Project measures would be less frequently implemented in left-sided resections. Operative duration and wound classification are strong predictors of wound infection and may protect against SSI in right-sided colectomies, but our study adjusted for these intraoperative variables. The right colon as an operative site should be included as a variable in future risk adjustment tools examining SSI. This finding supports the opinion of other authors who highlight the varied nature of colorectal surgical resections with regard to risk for SSI.[21] Smith et al[22] found that right-sided colectomy was associated with fewer incisional SSIs (13% vs 23%), but the finding was not statistically significant, likely owing to the small size of the study.

Prior studies on LOS after colectomy using the NSQIP database have found that patients had a shorter LOS if a laparoscopic approach was used.[13,23,24] These studies did not stratify by the side of resection. In our study, right-sided colectomy patients had a trend toward longer LOS than left-sided colectomy patients (median, 6 vs 5 days; OR, 0.93; 95% CI, 0.78-1.10). Patients who underwent a laparoscopic right-sided colectomy were more likely to have a prolonged LOS (>7 days) than patients who underwent laparoscopic left-sided colectomy (OR, 1.39; 95% CI, 1.09-1.78). While LOS has multiple etiologies, we hypothesize that LOS in the NSQIP database may serve as a proxy for unreported complications such as postoperative ileus, postoperative delirium, and atrial fibrillation. We recommend continued examination of short-term outcomes after laparoscopic colectomy. Previous favorable outcomes with regard to LOS may have been heavily influenced by patient selection, and a broader application of laparoscopic techniques may erode the recovery benefit. In addition, application of fast-track or enhanced-recovery protocols to colectomy patients in general has the potential to minimize LOS benefits after laparoscopic colectomy.[25]

In conclusion, in our risk-adjusted analysis of elective colectomy for cancer in the ACS NSQIP database, right-sided colectomy was found to carry a similar risk for complication as left-sided colectomy, with the exception of fewer superficial SSIs occurring in the right-sided colectomies.

Prolonged LOS was more likely after a laparoscopic right-sided colectomy than a laparoscopic left-sided colectomy. Our findings suggest that further research of improvement of surgical outcomes after elective colectomy for cancer can continue to group colon resections together, except when SSI is being studied.

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