Permanent Stoma: A Quality Outcome in Treatment of Rectal Cancer and Its Impact on Length of Stay

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Research article

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Abstract

Background

This study aimed to identify socioeconomic predictors of permanent stoma in rectal cancer treatment and examine its association with length of stay at the treatment facility.

Methods

Rectal cancer patients were identified from the Agency for Health Care Administration Florida Hospital Inpatient Discharge Dataset. Multivariate regression models were utilized to identify demographic, and socioeconomic factors associated with receiving a permanent stoma as well as the associated length of stay of these patients.

Results

Of 2,630 rectal cancer patients who underwent surgery for rectal cancer, 21% had a permanent stoma. The odds of receiving permanent stoma increased with higher Elixhauser score, metastatic disease, residing in Southwest Florida, and having Medicaid insurance or no insurance/self-payers ($p<0.05$). Patients with a permanent stoma had a significantly extended stay after surgery ($p<0.001$).

Conclusions

Patients with a permanent stoma following cancer resection were more likely to have open surgery, had more comorbidities, and had a longer length of stay. Additionally, the payer type significantly affected the length of stay and odds of receiving a permanent stoma.

Background

Colorectal cancer is the third most common type of cancer worldwide and also the third most common cause of mortality related to cancer in the United States (1). Surgical resection is the mainstay of treatment in patients with rectal cancer. In some cases, a stoma (temporary or permanent) is necessary as part of the rectal cancer treatment. The decision to proceed with either type of stoma is complex and multifactorial. Ideally, clinical and technical factors should decide the type and approach of surgery (2). However, several authors have found disparities in the receipt of care associated with sex, age, race, health insurance, and other sociodemographic and geographic factors (3-6). Given the importance of all these aspects in delivering optimal care, it is crucial to determine how each might influence the care progress and receipt of a permanent stoma. Presently, no current literature effectively studies the impact of all the factors together on receipt of stoma in rectal cancer patients.

Thus, the purpose of this study was to evaluate the factors associated with the odds of having a permanent stoma following resection in patients with rectal cancer. In addition, we assessed the factors associated with a longer length of stay (LOS) at the treatment facility, in the same cohort of individuals.

Methods

Patients with rectal cancer were identified from the Florida Agency for Health Care Administration (AHCA) - 2015-2018 Hospital Inpatient dataset using the ICD-10 codes C19 and C20 (7). The Florida inpatient dataset is an administrative dataset that includes all patient admissions from hospitals in Florida. It includes non-patient identifiable data for a patient's admission and provides diagnosis and procedure codes and patient demographic information. Using ICD 10 codes, we included patients who underwent “resection of tumor,” “resection with colostomy,” or “resection with ileostomy” for the treatment of rectal cancer (see Supplemental Table 1). Additionally, patients who underwent procedures identified as emergent or urgent were excluded. Due to the de-identified and publicly available nature of the dataset, this research was categorized as exempt by the Institutional Review Board.

Dependent Variable

The primary dependent variable for this study was the receipt of a permanent stoma. Patients who underwent colostomy with resection were grouped as having “permanent stoma.” Patients who underwent ‘only resection of rectal cancer’ or ‘resection with ileostomy’ were included in the group “no permanent stoma” as either a stoma was not created in these surgeries or a temporary stoma was created to allow the anastomosis to heal completely.

Also, LOS at the surgical facility was studied as the second dependent variable. LOS was available as a continuous variable with distribution skewed towards the right. Logarithmic transformation of this variable was utilized to normalize the distribution, and the range was limited to exclude patients who stayed more than 14 days in the surgical facility.

Independent Variables

Patient characteristics included in the analysis were demographics such as age, sex, and race/ethnicity. Race and ethnicity were categorized as White, African American, and Hispanic or Latino. Patient’s payer type, rural/urban location, and residential region in Florida were added to the model to adjust for the influence of the patient’s social factors on the LOS at the surgical facility. Payer type included Commercial, Medicaid, Medicare, Medicare Managed Care, and others, including self-payers and uninsured. We also adjusted for the comorbidity score using the Elixhauser Scoring system (8). We created three categories indicating the presence of 0, 1-2, greater than 3 comorbidities. Metastatic status of cancer and obesity may significantly influence the patient’s likelihood of receiving a permanent stoma and LOS at a treatment facility and were included separately in the analysis. The type of surgical approach, open/minimally invasive, was also adjusted for in the study. The two approaches are quite different and may bias the influence on the LOS after surgery.

Statistical analysis

We first conducted a bivariate analysis to examine the factors associated with having a permanent stoma created to treat rectal cancer. Pearson chi-square test and Kruskal-Wallis test were used to compare categorical and continuous variables, respectively. Multivariate logistic regression analysis was conducted to understand the characteristics of patients more likely to be associated with getting a permanent stoma. The logarithmic transformation of the LOS variable met the assumptions of linear regression. Multivariate linear regression was then performed to compare the LOS at the surgical facility for the rectal cancer patients, after adjusting for permanent stoma and other covariates.

Results

This study included 2,630 patients who underwent surgical procedures to treat rectal cancer between 2015 to 2018 in 182 Florida hospitals; 552 (21%) out of these had a permanent stoma. The overall patient characteristics are summarized in Table 1. The majority of the population was male (1576, 59.9%). While the mean age of the study population was 62.8 years with a standard deviation of 12.2 years, the mean age of patients who ultimately had a permanent stoma was significantly higher than those who did not ($p<0.01$). The majority of the population was White (1946, 75.9%), followed by Hispanic/Latino (443, 17.3%) and African-American (176, 6.9%). There were 1,872 (71.2%) patients with 1 or more comorbidities, 547 (20.8%) patients with metastatic cancer, and 360 (13.7%) were found to be obese. With an increase in the Elixhauser score, the percentage of patients undergoing surgery for permanent stoma proportionately increased ($p=0.02$). Similarly, metastasis was associated with a higher chance of having a permanent stoma ($p<0.01$). Obesity was not significantly related to having a permanent stoma ($p<0.72$).

Though most of the rectal cancer patients in the study population had commercial insurance (47.4%) compared to other insurances, the commercially insured patients had a lower risk of receiving a permanent stoma. The patient's specific county, whether rural or urban, was not associated with having a permanent stoma surgery for treatment of rectal cancer ($p=0.09$); however, the geographic location of their residence in Florida was significantly associated with receiving a permanent stoma ($p=0.01$). The mean and median LOS was significantly longer in patients with permanent stoma surgery (mean 6.6 days, std. dev. 2.9 vs. mean 5.4 days, std. dev. 2.8). Finally, in our cohort of patients undergoing management for rectal cancer, more patients underwent open surgery instead of Minimally Invasive Surgery (MIS) ($p<0.01$).

Logistic regression models for receipt of a permanent vs. non-permanent stoma (Table 2) showed that the odds of having a permanent stoma surgery increased with age (OR 1.02, 95% CI 1.00-1.03). The odds of receiving a permanent stoma were significantly higher in patients who had more than 3 comorbidities (OR 1.37, 95% CI 1.01-1.87) and those who had metastatic disease (OR 1.74, 95% CI 1.36-2.22). Compared to patients with commercial insurance, those who had Medicaid insurance (OR 1.80, 95% CI 1.18-2.74) or had no insurance/self-payers (OR 1.83, 95%CI 1.12-3.02) were more likely to have a permanent stoma formed at surgery. Additionally, compared to those residing in Northeast Florida, patients residing in Southwest Florida (OR 1.62, 95% CI 1.06-2.46) were more likely to get a permanent stoma.

Additional factors associated with being discharged later (Table 3) were male gender (p=0.01), presenting with comorbidities (p=0.01 and p<0.01), and metastatic cancer (p=0.02), and receiving open surgery (p<0.01). African American patients (p=0.01), those covered by Medicaid (p<0.01), and patients residing in Central (p=0.01), Southwest (p=0.01), Southeast (p=0.02), and West Central Florida (p=0.03) also spent a significantly longer time at the hospital.

Discussion

This analysis's principal findings show that several factors are associated with the odds of receiving a permanent stoma when undergoing surgery for rectal cancer. In our study, these included: age, a higher number of comorbidities, metastatic disease, open surgery, being uninsured or having Medicaid insurance, and having surgery in South West Florida compared to the other parts of Florida.

A post anastomotic leak is one of the most dreaded complications due to an increased risk of mortality and morbidity for the patients (5). A temporary stoma is primarily created to reduce contamination from a leak at the primary anastomosis (9). These are usually reversed in 8 weeks (or sooner), generally following confirmation of satisfactory anastomotic healing by contrast studies (2). In contrast, permanent stomas are most often created in situations where the cancer involves the sphincter, when a negative margin cannot be achieved, in widely metastatic or unresectable diseases, and in prohibitive comorbidities of the patient that preclude anastomoses (10). The most commonly associated complaint with these stomas is an inferior quality of life (11, 12). Reasons for this potentially include a patient’s worsened body image, stoma-specific long and short-term complications, and limitations to daily activities, to name a few (2).

Our study found a higher rate of permanent stomas in patients with comorbidities and the elderly. The surgical approach for these patients should be made on a case-by-case basis, considering the extent of the disease, overall health condition of the patient, preoperative anorectal function, and the surgeon’s experience in dealing with such cases. Suboptimal disease control in these patients can result in a local recurrence; local recurrence being the most consistent risk factor for permanent stoma in the literature (13). Despite the extensive efforts in sphincter preservation, some patients eventually require a permanent stoma. Elderly patients with a poor sphincter would have a poor quality of life if intestinal continuity restoration resulted in fecal incontinence. Sometimes an anastomosis is technically doable, but even if that was the case, in some patients we would not want to do an anastomosis in the off chance that they have a leak, which would be a life ending event for them(13).

Our analysis of socioeconomic factors revealed that individuals on Medicaid insurance had a higher odds of receiving a permanent stoma than those on Commercial insurance. Multiple studies have previously reported similar findings (14, 15). These results may be explained by differences associated with the severity of disease. Previous work has identified that Medicaid patients tend to seek or receive care in the more advanced stages of the disease (4), making them more likely to receive a permanent stoma as an outcome of surgery. Though there are other possible factors involved, these are likely the main contributors for this cohort of patients.

The second part of our analysis focused on evaluating the factors that impact LOS for patients undergoing surgery for rectal cancer. We found these to be both patient and treatment specific. In recent years, LOS has progressively decreased. While this aspect is promising and not wholly unexpected, it is multifactorial and isn't easy to fully understand based solely on the data provided in this analysis. The literature has already widely described that patients with more comorbidities, metastatic cancer, or receiving open surgery often require a more extended stay in the hospital (16, 17). These aspects directly impact the clinical recovery of such patients as longer perioperative treatments, multidisciplinary procedures or exams, and additional care is needed. Our analysis further reflected these facts.

Significant disparities were reported for African American patients and those covered by Medicaid. Race and insurance status are among the most common variables associated with healthcare disparities (18, 19). These findings have been previously reported in different settings and conditions (20, 21). Sharp et al. demonstrated that African American patients undergoing the creation of an intestinal stoma had a higher complication rate and a longer LOS than Caucasian patients (22). Further, Hecht et al. suggested that race and socioeconomic status, such as low income, could predict who may suffer from poorer surgical outcomes (23).It is not entirely clear how such factors interact and, ultimately, how disparities occur. Merely looking at the healthcare policies might not be enough, since a more complex interaction of social, cultural, and psychological factors is also responsible. This interaction may differ from state to state, given the population’s heterogeneity in many of these aspects, including racial distribution, median income, level of education, and healthcare facilities distribution.

Limitations of this study include those involved in retrospective analyses of the database available on AHCA. For example, limited control of confounders, selection bias, and a high reliance on accurate data-keeping have to be considered. It is well known that types and the stage of cancer significantly influence the type of surgery performed on patients. Given the database's nature, we could not adjust for disease stage except for patients with metastatic cancer. This inability to adjust for the cancer stage could represent a confounder as more advanced stages may require a more extended procedure and a justified need for a permanent stoma. Additionally, lack of this information also limits our scope to accurately capture data about those temporary stomas, which were not reversed eventually. Since this critical information was unavailable to us, it forms a major limitation of our study. The available dataset also did not provide information regarding postoperative complications and readmissions. The availability of this data would have helped form better associations with the LOS in these patients. This study's findings can be used to formulate prospective studies in the future to establish these associations further. Additionally, since this database represents patients only in Florida, it may have limited generalizability at the national level.

Conclusions

Our analysis found that in patients who underwent open surgery, those with a greater number of comorbidities, and patients on Medicaid insurance had a higher chance of having a permanent stoma as an outcome of the surgery and had a significantly higher length of stay. These findings emphasize the importance of improving our healthcare structure to reach those still deprived of it, as highlighted by our study. The gap in healthcare delivery shows no signs of narrowing, and as this study and others have shown, it is widening, a worrisome trend. Further studies are warranted to understand why these disparities provide all patients with the most optimal treatment available.

Abbreviations

1. AHCA: Agency for Health Care Administration
2. CI: Confidence Interval
3. ERAS: enhanced Recovery After Surgery
4. ICD: International Classification of Diseases
5. LOS: Length of Stay
6. MIS: Minimally Invasive Surgery
7. OR: Odds Ratio

Declarations

Ethics approval and consent to participate

The study was performed in accordance with the Declaration of Helsinki and was categorized as exempt by the Mayo Clinic's Institutional Review Board.

Consent for publication

Not Applicable

Availability of data and materials

The datasets supporting the conclusions of this article are available in the Florida Agency for Health care Administration (AHCA) repository, which is available at https://www.floridahealthfinder.gov/Researchers/OrderData/order-data.*aspx* (7). A link to the dataset has been archived at https://perma.cc/58NZ-BBPR.

Competing interests

The authors declare that they have no competing interests.

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Author’s contributions

1. Conception and design: RL, SB, AS, DC;
2. Administrative support: AS, DC;
3. Provision of study materials or patients: AS, SK, DC;
4. Collection and assembly of data: SB, AS;
5. Data analysis and interpretation: All authors;
6. Manuscript Writing: All authors;
7. Final approval of manuscript: All authors.

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Not Applicable

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Tables

Table 1: Characteristics of patients who had permanent stoma surgery for the treatment of rectal cancer.

	Permanent Stoma			
Variable	Yes (N=552)	No (N=2078)	Total (N=2630)	p-value
Sex				0.14[1]
Females	206 (37.3%)	848 (40.8%)	1054 (40.1%)	
Males	346 (62.7%)	1230 (59.1%)	1576 (59.9%)	
Age				<0.01[2]
Median (Range)	66.0 (32.0, 94.0)	63.0 (22.0, 97.0)	63.0 (22.0, 97.0)	
Mean (SD)	65.1 (12.0)	62.2 (12.2)	62.8 (12.2)	
Race				0.02[1]
White	427 (77.3%)	1519 (73.09%)	1946 (74.0%)	
African American	44 (7.9%)	132 (6.4%)	176 (6.7%)	
Hispanic or Latino	73 (13.2%)	370 (17.8%)	443 (16.8%)	
Missing	8	57	65	
Elixhauser Score				0.01[1]
0	134 (24.2%)	624 (30.0%)	758 (28.8%)	
1-2	257 (46.5%)	984 (47.3%)	1241 (47.2%)	
3-5	161 (29.1%)	470 (22.6%)	631 (24.0%)	
Metastatic cancer				<0.01[1]
No	401 (72.6%)	1682 (80.9%)	2083 (79.2%)	
Yes	151 (27.3%)	396 (19.0%)	547 (20.8%)	
Obesity				0.72[1]
No	479 (86.8%)	1791 (86.1%)	2270 (86.3%)	
Yes	73 (13.2%)	287 (13.8%)	360 (13.7%)	
Patient Payer				<0.01[1]
Medicare	147 (26.6%)	416 (20.0%)	563 (21.4%)	
Medicare Managed Care	121 (21.9%)	407 (19.5%)	528 (20.1%)	
Medicaid	46 (8.3%)	123 (5.9%)	169 (6.4%)	

Commercial	205 (37.1%)	1041 (50.0%)	1246 (47.4%)	
Other	33 (6.0%)	91 (4.3%)	124 (4.7%)	
Patient Region				0.05[1]
Southwest Florida	108 (19.6%)	313 (15.0%)	421 (16.7%)	
Northeast Florida	48 (8.7%)	233 (11.2%)	281 (11.1%)	
Northwest Florida	36 (6.5%)	108 (5.1%)	144 (5.7%)	
Southeast Florida	101 (18.3%)	371 (17.9%)	472 (18.7%)	
Central Florida	97 (17.6%)	384 (18.4%)	481 (19.0%)	
South Florida	41 (7.4%)	254 (12.2%)	295 (11.7%)	
West Central Florida	88 (15.9%)	343 (16.5%)	431 (17.1%)	
Missing	33	72	105	
Patient County				0.09[1]
Rural	37 (6.7%)	104 (5.0%)	141 (5.6%)	
Urban	482 (87.3%)	1902 (91.5%)	2384 (94.4%)	
Missing	33	72	105	
Year				0.36[1]
2015	43 (7.8%)	184 (8.9%)	227 (8.6%)	
2016	192 (34.8%)	759 (36.5%)	951 (36.2%)	
2017	148 (26.8%)	576 (27.7%)	724 (27.5%)	
2018	169 (30.6%)	559 (27.0%)	728 (27.7%)	
Length of Stay (Days)				<0.01[2]
Median (Range)	6.0 (1.0, 14.0)	5.0 (1.0, 14.0)	5.0 (1.0, 14.0)	
Mean (SD)	6.6 (2.9)	5.4 (2.8)	5.6 (2.8)	
Surgical Approach				<0.01[1]
Open Surgery	306 (55.4%)	868 (41.2%)	1174 (47.6%)	
Minimally Invasive Surgery	196 (35.5%)	1097 (52.8%)	1293 (52.4%)	
Missing	50	113	163	

[1] *Chi-Square p-value;* [2] *Kruskal-Wallis p-value*

Table 2: Multivariate analysis of factors associated with odds of patients having a permanent stoma surgery

Odds Ratio Estimates				
Effect	**Point Estimate**	**95% Wald Confidence Limits**		**Pr > ChiSq**
Male	1.20	0.96	1.48	0.10
Age	1.02	1.01	1.03	0.01
Race				
White	-	-	-	-
African American	1.03	0.67	1.58	0.89
Hispanic or Latino	0.97	0.68	1.38	0.85
Elixhauser Score				
Elixhauser score 0	-	-	-	-
Elixhauser score 1-2	1.10	0.84	1.43	0.50
Elixhauser score 3-5	1.37	1.01	1.87	0.05
Metastatic cancer	1.74	1.37	2.23	<0.01
Obese	0.90	0.66	1.23	0.50
Patient Payer				
Commercial	-	-	-	-
Medicaid	1.80	1.18	2.74	0.01
Medicare	1.18	0.82	1.71	0.38
Medicare Managed Care	0.97	0.67	1.42	0.88
Other	1.84	1.12	3.02	0.02
Patient Region				
Northeast Florida	-	-	-	-
Central Florida	1.28	0.84	1.95	0.26
Northwest Florida	1.44	0.84	2.47	0.19
South Florida	0.83	0.47	1.46	0.52
Southeast Florida	1.34	0.87	2.06	0.18
Southwest Florida	1.62	1.06	2.46	0.03
West Central Florida	1.32	0.86	2.03	0.21

Year				
2015	-	-	-	-
2016	1.13	0.76	1.69	0.55
2017	1.18	0.78	1.78	0.43
2018	1.21	0.80	1.82	0.37
Urban	0.68	0.43	1.07	0.09
Open Surgery	1.88	1.52	2.33	<0.01

Table 3: Multivariate analysis predicting the length of stay in patients who underwent surgery for permanent stoma

Parameter	Estimate	Standard Error	t Value	Pr > |t|
Permanent Stoma	1.02	0.14	7.32	<0.01
Male	0.33	0.11	2.98	0.01
Age	-0.02	0.01	-0.29	0.77
Race				
White	-	-	-	-
African American	0.68	0.23	3.02	0.01
Hispanic or Latino	-0.06	0.18	-0.33	0.74
Elixhauser Score				
Elixhauser score 0	-	-	-	-
Elixhauser score 1-2	0.42	0.14	3.14	0.01
Elixhauser score 3-5	1.39	0.17	8.42	<0.01
Metastatic Cancer	0.33	0.134	2.36	0.02
Obese	0.31	0.16	1.91	0.06
Patient Payer				
Commercial	-	-	-	-
Medicaid	0.99	0.23	4.30	<0.01
Medicare	0.09	0.20	0.44	0.66
Medicare Managed Care	0.21	0.20	1.08	0.28
Other	0.47	0.28	1.67	0.10
Patient Region				
Northeast Florida	-	-	-	-
Central Florida	0.56	0.22	2.59	0.01
Northwest Florida	-0.27	0.29	-0.95	0.34
South Florida	-0.08	0.27	-0.28	0.78
Southeast Florida	0.71	0.22	3.20	0.01
Southwest Florida	0.49	0.22	2.27	0.02
West Central Florida	0.47	0.22	2.12	0.03
Urban	-0.07	0.25	-0.28	0.78

Year				
2015	-	-	-	-
2016	-0.40	0.21	-1.96	0.05
2017	-0.57	0.21	-2.69	0.01
2018	-0.76	0.21	-3.57	0.01
Open Surgery	1.23	0.11	10.95	<0.01