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Racial disparities in the use of laparoscopic surgery to treat colonic diverticulitis Are not fully explained by socioeconomics or disease complexity

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ABSTRACT

Background: Several studies have demonstrated favorable outcomes for laparoscopic surgery over open surgery for the treatment of diverticular disease. This study was designed to analyze the relationship between race, socioeconomic status and the use of laparoscopy to address diverticulitis.

Methods: A retrospective analysis of 53,054 diverticulitis admissions was performed using data from the 2009–2013 National Inpatient Sample (NIS). The primary outcome was the use of laparoscopic versus open colectomy. Bivariate analysis and multivariable logistic regression were used to determine the raw and adjusted odds by race, insurance status, and median household income.

Results: Overall, 41.6% of colectomies involved the use of laparoscopy. Black patients were 19% less likely than White patients to undergo laparoscopic surgery. Hispanic patients were no more or less likely to undergo laparoscopic colectomy. Lacking private insurance was a strong predictor of undergoing open surgery. Lower income patients were 33% less likely to receive minimally invasive colectomies.

Conclusions: These results demonstrate disparities in surgical treatment. Further research is warranted to understand and ameliorate treatment differences which can contribute to outcome disparities.

1. Introduction

Multiple studies have established that postoperative outcomes are superior for laparoscopic colectomy when compared to open colectomy for diverticular disease. A Cochrane Review published in 2005 concluded that laparoscopic colectomy is associated with lower morbidity owing to shorter hospital stays, decreased postoperative pain, less ileus, and improved pulmonary function.[1] In 2009, Klarenbeek et al. published the results of the Sigma trial, a multicenter randomized controlled trial comparing laparoscopic sigmoid resection to open sigmoidectomy for symptomatic diverticulitis, in which they found less major complications and better short-term quality of life in the minimally invasive group.[2,3] Larger population studies using national databases have corroborated the results of the Sigma trial and further demonstrated lower mortality for laparoscopic colectomy for all indications collectively and diverticular disease, specifically.[4,5] Even in the setting of complicated diverticulitis, Mbadiwe et al. demonstrated lower postoperative complications associated with laparoscopic colectomy with primary anastomosis when compared to the open colectomy.[6] A more recent meta-analysis suggests that the shorter lengths of stay and number of complications for laparoscopic colectomy over conventional surgery are sustained in the era of enhanced recovery after surgery (ERAS) programs.[7] Analyses comparing of the costs of the two techniques have demonstrated either no significant difference between the groups or lower costs for laparoscopic surgery, indicating that the minimally invasive approach is not only clinically favorable, but also cost-effective.[8–10]

The pervasive existence of racial and socioeconomic disparities in healthcare delivery and outcomes in the United States has been well-documented by the Institute of Medicine.[11] In a study of racial disparities in presentation and outcomes for surgically treated diverticulitis using inpatient data from the Medicare Provider Analysis and Review, Schneider et al. uncovered that Black race was

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associated with a greater risk of urgent/emergent admission and mortality.[12] In a retrospective review of Nationwide Inpatient Sample admissions for diverticulitis, Lidor et al. demonstrated a higher odds of mortality associated with being Black, uninsured or underinsured.[13] Given that race was not found to be a predictor of undergoing colostomy, the authors attributed the observed racial differences in the study to the fact that Black patients were more likely to present with complicated disease, and they concluded that insurance status was a more powerful predictor of complicated presentation, treatment and outcome. Both studies demonstrated higher hospital charges for Black patients.[12,13] An examination of the New York Statewide Planning and Cooperative Systems Database demonstrated that patients of minority race and ethnicity as well as non-private insurance were less likely to undergo operative intervention, and those with Medicaid or no insurance experienced higher mortality.[14] In addition to being less likely to undergo surgery for diverticulitis, Medicare patients have been noted to experience significantly longer time from admission to surgery than privately insured patients.[15]

The impact of differential surgical management on racial and socioeconomic disparities in surgical outcomes is poorly understood. The purpose of this study was to examine a nationally representative sample to determine whether there are differences in the utilization of laparoscopic surgery to treat diverticulitis by race, insurance status, and household income even when adjusting for differences in chronic illness, disease severity, and treatment setting. We hypothesized that minority race and ethnicity, being uninsured or underinsured, and having a lower household income would be associated with lower odds of undergoing a laparoscopic surgical procedure for diverticulitis.

2. Materials and methods

A retrospective analysis of admissions for surgical admission for diverticulitis using discharge data from the 2009–2013 National Inpatient Sample (NIS), Healthcare Cost and Utilization Project (HCUP), Agency for Healthcare Research and Quality program. Inclusion criteria were a primary *International Classification of Diseases, Ninth Revision* (ICD-9) diagnosis code of diverticulitis (562.11 Diverticulitis of colon without mention of hemorrhage or 562.13 Diverticulitis of colon with hemorrhage) and a procedure code for colectomy. See Table 1. The outcome was utilization of laparoscopic surgery.

The independent variables of interest were race, primary payer, and income, which is estimated by the median household income of the patient's ZIP code. Information gathered about patient demographic characteristics included age, sex, additional diagnoses, metropolitan versus rural location (defined as a county with at least 50,000 or less), and urgency of admission. Degree of comorbidity was quantified by cumulative Elixhauser Comorbidity Index (ECI).[16,17] Complicated disease was defined by concomitant ICD-9 codes for peritonitis, abscess, obstruction, fistula, perforation, or sepsis.

Bivariate analysis of baseline characteristics was conducted using t-tests and ANOVA for continuous variables and chi square tests for categorical variables. A multiple logistic regression model including age, gender, ECI, disease complexity, urgency of admission, metropolitan/rural location, and treatment at an academic medical center was used to calculate the adjusted odds of undergoing a laparoscopic procedure by race, insurance status, and income. In addition to the covariates, each independent variable was corrected for the others within the model such that the odds of laparoscopic surgery by race were adjusted for insurance status and income. The odds of laparoscopic surgery by insurance status were adjusted for race and income. The odds of laparoscopic surgery by income were adjusted for race and insurance status.

All statistical analyses were performed using SAS version 9.4 (SAS Institute Inc, Cary, NC). Statistical significance was determined by a p-value < 0.05. This research study met criteria for designation as non-human subjects research by the Augusta University Institutional Review Board.

3. Results

A total of 53,054 admissions met study inclusion criteria. The baseline study population characteristics are displayed in Table 2. Overall, 58.4% of procedures were performed open versus 41.6% performed laparoscopically. A slight majority of the patients were female. Most had uncomplicated disease, elective admission, private insurance, and income greater than or equal to $48,000. The overwhelming majority of patients originated from metropolitan settings and were treated at non-academic medical centers.

Bivariate analysis comparing Whites and Non-White revealed significant variability in baseline characteristics between the groups such that minority patients were younger on average, and a larger percentage presented urgently or emergently with complicated disease (see Table 3). A larger proportion of White patients came from higher income zip codes and received care at non-academic medical centers. Further analysis of Non-White patients demonstrated significant variability in baseline characteristics between minority groups (see Table 4).

The logistic regression model to predict the risk-adjusted odds of undergoing a laparoscopic operation for diverticulitis included 10 variables: age, gender, ECI, complexity of diverticular disease, urgency of admission, academic medical center designation, geographic setting, race, primary payer, and income. The most powerful predictors of undergoing an open surgical procedure

Table 1
International classification of disease, ninth revision, procedure codes.

Laparoscopic surgery		Open surgery	
Laparoscopic multiple segmental resection of large intestine	17.31	Open and other multiple segmental resection of large intestine	45.71
Laparoscopic cecectomy	17.32	Open and other cecectomy	45.72
Laparoscopic right hemicolectomy	17.33	Open and other right hemicolectomy	45.73
Laparoscopic resection of transverse colon	17.34	Open and other resection of transverse colon	45.74
Laparoscopic left hemicolectomy	17.35	Open and other left hemicolectomy	45.75
Laparoscopic sigmoidectomy	17.36	Open and other sigmoidectomy	45.76
Other laparoscopic partial excision of large intestine	17.39	Other and unspecified partial excision of large intestine	45.79
Laparoscopic total intra-abdominal colectomy	45.81	Total intra-abdominal colectomy	45.8
Laparoscopic robotic assisted procedure[a]	17.42	Open total intra-abdominal colectomy	45.82
Laparoscopy[a]	54.21	Other and unspecified total intra-abdominal colectomy	45.83

[a] When used in combination with an open surgery procedure code.