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Long-term bowel dysfunction and decision regret in diverticulitis: A mixed methods study

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ABSTRACT

Background: This study had aimed to describe long-term decision regret, bowel dysfunction, and the overall quality of life in patients with diverticulitis, and to determine if elective colectomy was associated with these patient-reported outcome measures.
Methods: This mixed-methods, survey-based study was administered to a national cohort of patients in the United States with diverticulitis. We measured decision regret (Brehaut Decision Regret), bowel dysfunction (Low Anterior Resection Syndrome score), and the overall quality of life (EuroQol 5 Dimension) in this population. We asked open-ended questions to elucidate factors that influenced patients' choices between elective colectomy and observation.
Results: Among the 614 respondents, 294 (48%) chose between colectomy and observational management, 94 (15%) had surgery, and 157 (26%) had major Low Anterior Resection Syndrome. Of the 294 that chose between colectomy and observational management, 51 (17%) experienced decision regret. Colectomy was associated with an average decrease in the Brehaut Decision Regret score by 6 points but was not associated with a categorical measure of decision regret (Brehaut Score $\geq$50). Bowel dysfunction and overall quality of life were not significantly associated with colectomy. Disease-related factors, psychosocial factors, and interactions with physicians were commonly cited as reasons for pursuing colectomy or observational management.
Conclusion: Patients with self-reported diverticulitis describe high levels of decision regret and bowel dysfunction regardless of chosen management strategy. Physicians should be aware that psychosocial factors can strongly influence a patient's choice between colectomy and observational management. We advocated for future prospective studies using patient reported outcome metrics to improve outcomes in diverticulitis.

Introduction

Each year there are more than 2.7 million outpatient visits and 200,000 inpatient admissions for diverticulitis.[1] Despite the extensive prevalence of this disease, optimal non-emergency treatment strategies have proven elusive. Current guidelines recommend that the decision to pursue elective colectomy or observational management be individualized, under the principles of shared decision-making.[2]

An understanding of the long-term outcomes after this shared decision-making is lacking. Although substantial research has focused on the morbidity and mortality of colectomy for diverticular disease, a comprehensive assessment of the value of clinical care requires patients to describe their own experience regarding their symptoms and feelings.[3] These "patient-reported outcomes" (PROs) can pertain to anything a patient may experience, including pain, bowel dysfunction, reductions in activities of daily living, stress/anxiety, etc. Patient-reported outcome measures (PROMs) are the tools or instruments used to measure these outcomes. The primary goal of management of diverticulitis is to optimize the

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patient's quality of life (QOL); therefore, describing the PROs of decision regret, bowel dysfunction, and overall QOL in a generalizable sample of patients with diverticulitis, and understanding how these PROs differ after colectomy or observation will help inform the shared decision-making process surrounding elective colectomy.

To address this knowledge gap, we conducted a mixed-methods, survey-based study of a national sample of patients suffering from diverticulitis, with the aim of describing long-term decision regret, bowel dysfunction, and overall QOL and their association with colectomy. We hypothesized that, relative to observational management, colectomy would be associated with reduced decision regret, less bowel dysfunction, and improved overall QOL.

Methods

We conducted a mixed-methods study in which we distributed a web-based survey assessing the PROs of decision regret, QOL, and bowel dysfunction (Supplemental online material). The survey took between 10–15 minutes to complete. This project was reviewed and approved by Vanderbilt University Medical Center's Institutional Review Board (Study Numbers 190867 and 201335) with the submission of the survey constituting implied consent.

Survey design

The survey was distributed to 4 Cohorts (Figure 1). To form Cohort 1, we distributed a link to the survey alongside an Institutional Review Board-approved description in Facebook and Reddit groups focused on diverticulitis. Cohort 2 consisted of respondents >40 years who were contacted via ResearchMatch, a national health volunteer registry supported by the U.S. National Institutes of Health as part of the Clinical Translational Science Award program.[4] We queried ResearchMatch's database of patients (who self-reported their medical and demographic information) for patients with diverticulitis. Cohort 3 was contacted via our institution's e-mail–based Research Notifications Distribution Listserv. Lastly, Cohort 4 consisted of patients seen in Vanderbilt University Medical Center's Colorectal Surgery Clinic between 2014 and 2019.

Eligibility included those who were aged ≥18 years, diagnosed with diverticulitis, and living in the United States. The participants were excluded from our study if they had emergency surgery for an episode of acute diverticulitis or had an ostomy, which we used as a proxy for surgery to treat acute, complicated diverticulitis. The participants who completed the survey had the option to enter into a raffle for 1 of 5 $50 gift cards. The responses to both surveys were collected and managed using REDCap, a secure and Health Insurance Portability and Accountability Act-compliant electronic data capture tool hosted by Vanderbilt University Medical Center.[5,6] We used the Strengthening the Reporting of Observational studies in Epidemiology cross-sectional checklist when writing our manuscript.[7]

Patient reported outcome measures

We used 4 PROMs to assess decision regret, bowel dysfunction, and QOL. To measure decision regret surrounding the decision to pursue colectomy versus observational management of diverticulitis, we used the Brehaut Decision Regret scale.[8] This validated scale asks participants a set of 5 questions, yielding a score of

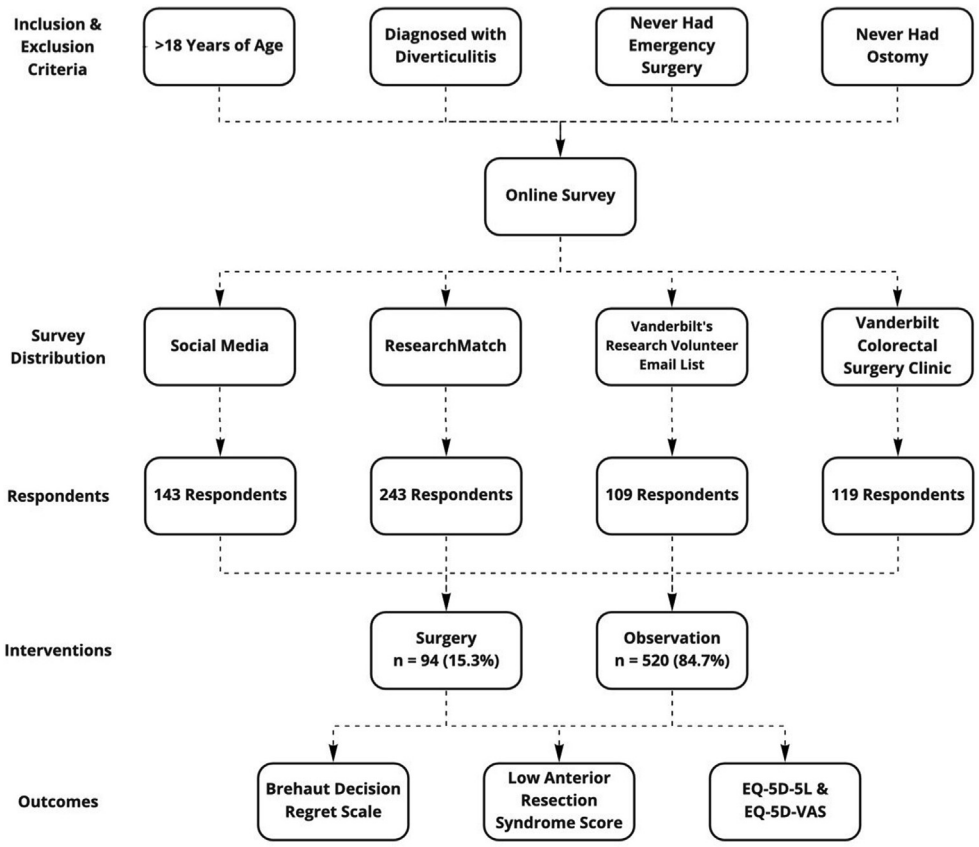

Figure 1. Flowchart detailing recruitment strategy. Decision regret, bowel dysfunction, and overall quality of life are outcomes that were measured across all cohorts. *EQ-5D-5L,* EuroQol 5 Dimension 5 Level survey; *EQ-5 VAS,* EuroQol 5 visual analog scale.

0–100 (0 meaning no regret, 100 meaning maximum regret). Prior studies have set a range of Brehaut score cutoffs for decision regret, with 2 of the most common being ≥50 and >25.[9,10] We reported rates of decision regret for both these cutoffs, but performed our statistical modeling using the cutoff of ≥50.

Bowel dysfunction was assessed with the Low Anterior Resection Syndrome (LARS) score, which asks a series of 5 standardized, multiple-choice questions to quantify bowel dysfunction.[11] These questions yield a score from 0–42; a score of 0–20 represents no LARS, 21–29 represents minor LARS, and 30–42 represents major LARS. Participants were categorized as having LARS if they reported a LARS score >29, consistent with a severity of major LARS.[11] We administered the LARS score to all participants, both surgical and observational, which was in line with the contemporary use of this PROM.[12]

We used the EuroQol 5 Dimension 5 Level survey (EQ-5D-5L) and EuroQol 5 visual analog scale (EQ-5D VAS) tools to measure QOL in survey recipients. The EQ-5D-5L index measures QOL based on self-reported measurements of function in 5 different domains: mobility, self-care, usual activities, pain/discomfort, and anxiety/depression.[13] To generate EQ-5D-5L index scores for each respondent, we used the standardized EQ-5D-5L value set for the United States, as previously described.[14] We also used the EQ-5D VAS tool, which asks participants to rate their overall QOL from 0–100 on a visual analog scale.

Covariates

To control for potential confounding, we captured the following variables: age, zip code, ethnicity, race, sex, body mass index, age at diagnosis, number of diverticulitis episodes, number of hospitalizations for diverticulitis, history of a drain, time since colectomy, complications, family history of diverticulitis, smoking history, and medical comorbidities. To capture the effect of medical comorbidities, we calculated a modified Disease Burden Impact Scale (DBIS).[15] In addition to asking about 25 common medical conditions, as previously described, we also added an "other" comorbidity that was given the weight of 1 comorbidity in our DBIS.[16]

Statistical methods

Descriptive and univariable analyses with the Wilcoxon test and χ^2 analysis were done in the R package Hmisc (REDCap, Nashville, TN).[17] The primary analysis focused on 3 outcomes: decision regret score, QOL, and LARS score. For decision regret and LARS, the models were fitted for both the continuous and categorical versions of the variables (eg, regret/no regret, LARS/no LARS). The EQ-5D-5L index and EQ-5D VAS variables were fitted separately to examine the effects on QOL.

Colectomy status was the primary covariate of interest. The missing covariate data were imputed with the chained equations procedure described by van Buuren and Groothuis-Oudshoorn using the mice package for R with 20 repetitions.[18] The imputation procedures were based on the defaults in mice: pmm for continuous variables, logistic or polynomial regression for categorical variables. Our random number seed was set to 231,351. All of the missing variables that had <30% missing were imputed (Supplemental Table SI). The Brehaut scores and complications-related variables were not imputed, and also not used as predictor variables for imputation.

In this study, the measured outcome was not rare and the most potentially confounding variables were numeric. These factors, in combination with the risk of discarding data in a propensity match analysis, compelled us to create multivariable models to adjust for potential confounding factors and other covariates. All of the models were adjusted for a prespecified set of covariates: cohort, age (modeled using cubic splines), number of episodes, hospitalizations (categorized as 1, 2, 3, or 4+), drain status, DBIS score, years since diagnosis, and the other outcome variables (continuous versions).[19] For example, the model with decision regret as the outcome was adjusted for EQ-5D-5L, EQ-5D VAS, and continuous LARS. Meta-analyses were performed using the R package meta to estimate the overall effect of colectomy across cohorts.[20] We used random-effects models with the DerSimonian-Laird estimator in all analyses, because between-cohort heterogeneity was expected due to variability in data collection and sample characteristics.[21] Heterogeneity was tested using Cochran's Q statistic, quantified by the I^2 value, and was further assessed in sensitivity analyses.[22] We compared pre- and postoperative EQ-5D VAS scores with a student's t test. All statistical analyses were performed in R 4.0.3. All statistical tests were 2-sided and considered significant at $P < .05$.

Qualitative analysis

A series of open-ended questions were asked to further explore decision-making and regret. The patients undergoing both colectomy and observation were asked, "What was the most important factor in deciding to have/not have surgery?" The patients undergoing colectomy were additionally asked, "What do you know now that you wish you knew before surgery?"

The answers were analyzed thematically using a constant comparative approach.[23] Coding for major themes was conducted independently by 2 investigators (NH and AH) and discussed to consensus iteratively using thematic analysis.[24] Coding was managed using a Microsoft Excel spreadsheet template developed by the study team. The analysis consisted of interpreting the sorted coded quotes and identifying higher order themes and connections between themes.

Results

Study population

Overall, 614 participants who met the inclusion criteria completed the survey (Figure 1). Descriptive data was presented by management (Table I) and cohort (Supplemental Table SII). Overall, 294 patients (48%) had discussed surgical treatment for their diverticulitis with their physician or surgeon, of which 94 (32%) underwent elective colectomy for their disease. The median age at diagnosis was 50 years. The main significant differences between groups were that the colectomy group had a longer average time since diagnosis (Surgery: 11.0 years versus Medical: 8.6 years; $P = .02$), was more likely to have had a drain (Surgery: 12% versus Medical: 3%; $P < .001$), and reported a higher average number of diverticulitis episodes (Surgery: 8.4 versus Medical: 5.1; $P = .004$) and hospitalizations for diverticulitis (Surgery: 1.9 versus Medical: 0.7; $P < .001$). We asked patients who had surgery in cohorts 1–3 to self-report postoperative complications. Of the 47 patients who had surgery in these cohorts, we found that 14 (29.8%) self-reported a complication and 7 (14.9%) stated that their complication required hospitalization.

Decision regret, bowel dysfunction, and QOL

Using our Brehaut score cutoff of ≥50, 51 of the 294 patients (17%) who discussed surgical treatment of their diverticulitis with their physician or surgeon had regret about their decision to pursue colectomy or observation. At a cutoff of >25, 87 of 294 patients (30%) expressed decision regret. Although 11% of patients who chose colectomy experienced decision regret, 21% of observational

Table I
Demographic and outcome variables by intervention

Variable	Colectomy (n = 94)	Observation (n = 520)	*P* value
Age, y, mean (SD)	60.4 (11.2)	59.1 (10.9)	.29
Sex			.58
Female	65 (69%)	380 (73%)	
Male	29 (31%)	138 (27%)	
Ethnicity			.99
Hispanic/Latinx	3 (7%)	33 (7%)	
Not Hispanic/Latinx	44 (93%)	415 (93%)	
Race			< .001
American Indian or Alaska Native	0	<5	
Asian	0	<5	
Black	5 (5%)	22 (4%)	
Native Hawaiian or Other Pacific Islander	0	0	
White	88 (94%)	472 (91%)	
>1 race	<5	19 (4%)	
Prefer not to say/unknown	0	<5	
Body mass index, kg/m^2, mean (SD)	29.8 (6.7)	30.8 (7.6)	.30
Age at diagnosis, y, mean (SD)	49.6 (12.2)	50.5 (11.2)	.51
Years since diagnosis, mean (SD)	11.0 (9.6)	8.6 (8.4)	.02
No. of diverticulitis episodes, mean (SD)	8.4 (10.3)	5.1 (7.7)	.004
No. diverticulitis hospitalizations, mean (SD)	1.9 (2.0)	0.7 (1.4)	< .001
Drain: yes	11 (12%)	17 (3%)	< .001
Disease burden index severity, mean (SD)	7.6 (7.2)	9.5 (9.6)	.11
Family history of diverticulitis	47 (50%)	219 (42%)	.16
Smoking			.73
Never smokers	26 (55%)	253 (56%)	
Former smokers	18 (38%)	153 (34%)	
Current smokers	3 (6%)	42 (9%)	
Pack-years, mean (SD)	7.2 (14.9)	9.9 (17.7)	.26

Data are presented as means (SD) for continuous variables and counts (%) for categorical variables. Welch's 2-sided *t* test was used to assess differences in continuous variables. The $\chi 2$ analysis was used to assess differences in categorical variables.
SD, standard deviation.

patients experienced decision regret. Undergoing colectomy was associated with a decrease in the Brehaut decision regret score by 6.00 points ($P = .02$; 95% CI: 0.86–11.14); however, the colectomy did not affect the overall odds of experiencing clinically significant decision regret ($P = .12$; 95% CI: 0.24–1.18) (Figure 2, *A*; Table II). Bowel dysfunction was significantly associated with decision regret (odds ratio [OR]: 1.04; 95% CI: 1.005–1.08).

LARS was reported by 157 of 614 patients (26%). Colectomy was not associated with a change in LARS (Figure 2, *B*; Table II). Colectomy was not associated with a significant difference in EQ-5D-5L or EQ-5D VAS QOL scores (Figures 2, *C and D*; Table II).

Factors influencing decision to pursue colectomy or observation

For both of the patients who chose colectomy and those who chose observation, 3 main themes emerged in the decision-making process: disease-related factors, psychosocial factors, and interactions with physicians (Table III).

The patients who underwent colectomy cited disease-related factors that led to their decision to pursue colectomy, including a desire to live a more normal life, unpleasant symptoms like pain, issues with defecation, and the frequency and severity of their episodes. These patients also cited concerns about long-term antibiotic use and the desire to avoid emergency surgery or an ostomy.

> *"Unable to stop recurring infections and having to continually be taking powerful antibiotics. Dealing with continual intestinal pain."*

The psychosocial factors that influenced the decision to pursue colectomy included living in a remote location, fear and stress caused by diverticulitis, and the need to care for family. Finally, the interactions with health care providers (surgeons, gastroenterologists, and internists) were influential.

> *"[I chose surgery because] I had small kids at the time & needed to be present for them."*

The patients who chose not to have a colectomy reported similar themes in decision-making, but with different (and often opposite) reasoning (Table III). Many reported that their symptoms were well controlled with medical management or not severe enough to warrant colectomy. Others cited concerns around disease recurrence and surgery, including pain, potential complications from surgery, comorbidities, and the potential need for an ostomy. Finally, some patients were dissuaded from surgery because they didn't feel like they had a good rapport with their surgeon.

The psychosocial factors that played a large role in the decision to not pursue colectomy included the expense of surgery, the inability to take time off work, the need to provide care for family, lack of insurance, and lack of social support. Some patients also spoke to the psychologic fear of both an ostomy and that the surgery would not adequality address their problem.

> *"I am [the] caregiver for my husband who has cancer and is disabled."*

The patients experiencing decision regret who chose not to undergo colectomy reported similar reasons for not pursuing colectomy as observational patients without decision regret.

Regret after colectomy

The patients who underwent colectomy were asked what they wish they knew before colectomy. Three themes emerged from responses: lifestyle modifications, positive results of surgery, and negative results of surgery (Table III).

Patients stated that they would have wanted to be aware that eating a healthier diet, avoiding dehydration, and increasing fiber in

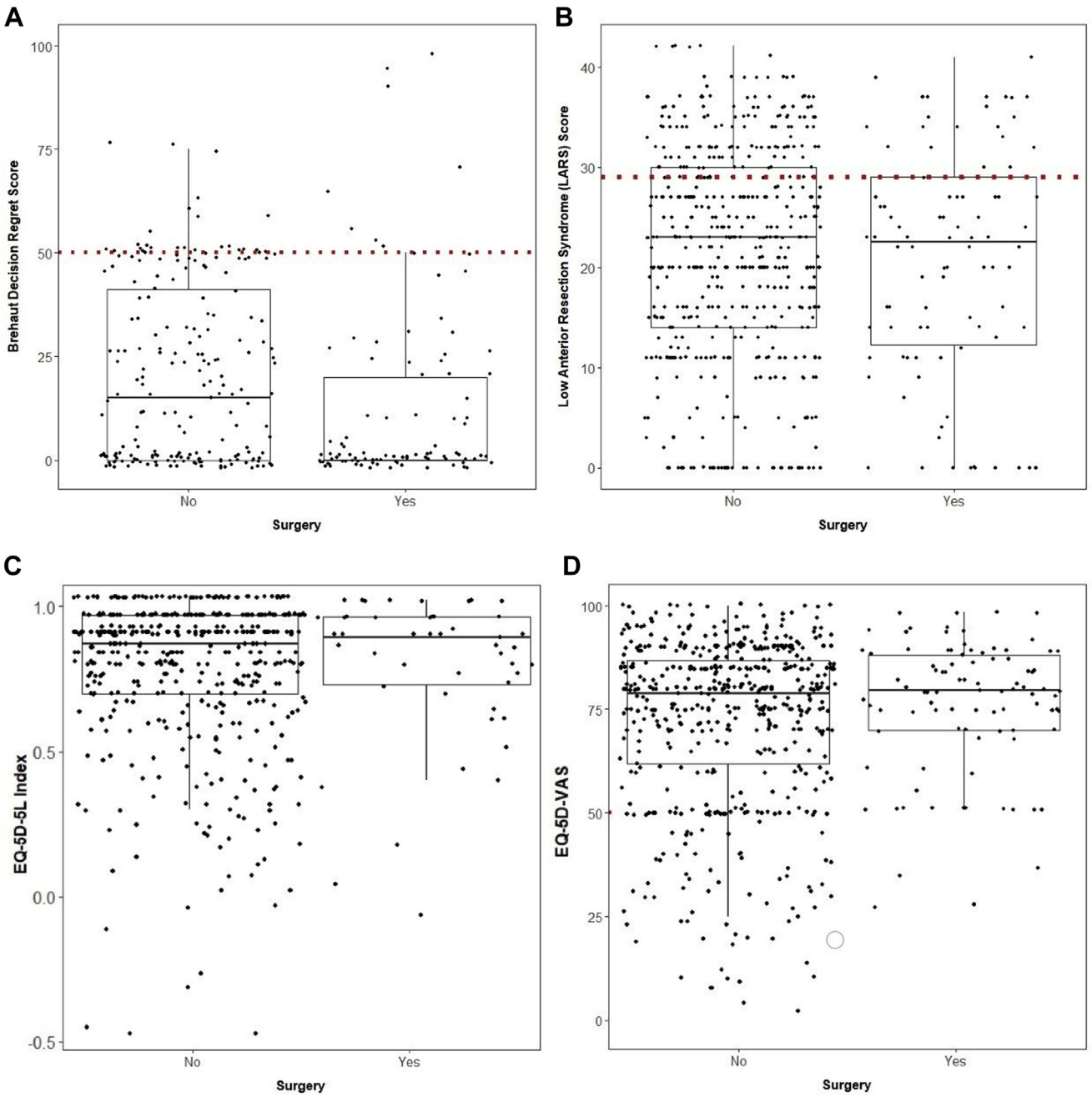

Figure 2. Box and whisker plots demonstrating the univariate effect of colectomy on the (A) Brehaut Decision Regret scores, (B) Low Anterior Resection Syndrome (LARS) scores, (C) EuroQol 5 Dimension 5 Level survey index scores, and (D) EuroQol 5 visual analog scale scores. On the x-axes, "yes" represents the colectomy group, while "no" denotes the observational group. The Brehaut Decision Regret score ranges from 0–100, with 0 meaning no regret and 100 meaning maximum regret. The LARS score ranges from 0–42; a score of 0–20 represents no LARS, 21–29 represents minor LARS, and 30–42 represents major LARS. The red lines in figures 2, *A and B* represent cutoffs for decision regret (≥50) and major LARS (>29). *EQ-5D-5L,* EuroQol 5 Dimension 5 Level survey; *EQ-5 VAS,* EuroQol 5 visual analog scale.

their diet could have helped their symptoms. Additionally, they would have wanted to be aware of the positive results of colectomy. Patients talked about how much better they felt after surgery and the improvement in QOL. Several commented that they wished they had surgery earlier.

"How the sigmoidectomy would give me my life back."

Patients also commented about the negative results of colectomy. They reported they were unaware of the potential severity of complications after surgery and that recovery was more arduous than expected. Others shared disappointment that the surgery did not fix all their symptoms and that there was a potential for recurrence. Finally, some patients reported a decrease in QOL after surgery.

"That my diet and quality of life would be diminished."

Discussion

The primary goal of elective surgery, including elective colectomy for diverticulitis, is to improve a patient's lived experience. Although both QOL and bowel dysfunction measure a patient's lived experience after surgery, decision regret plays a particularly

Table II
Effect of colectomy on PROMs

Models for categorical variables	Odds ratio with colectomy	95% CI	*P* value
Brehaut Decision Regret	0.53	0.24–1.18	.12
LARS score	0.78	0.40–1.53	.47
Models for continuous variables	**Effect of colectomy on average total score**	**95% CI**	***P* value**
Brehaut Decision Regret	−6.00	0.86–11.14	.02
LARS score	−0.49	−3.14 to 2.16	.72
EQ-5D-5L	0.02	−0.04 to 0.07	.59
EQ-5D VAS	−0.08	−4.36 to 4.53	.97

The PROMs of Brehaut Decision Regret score and LARS score were assessed as both categorical and continuous variables.
CI, confidence interval; *EQ-5D-5L,* EuroQol 5 Dimension 5 Level survey; *EQ-5 VAS,* EuroQol 5 visual analog scale; *LARS,* Low Anterior Resection Syndrome; *PROM,* patient-reported outcome measure.

outsized role. If a patient regrets the decision to pursue surgery, then the surgery should be considered a failure, because it indicates that the patient considers the downsides of surgery to be greater than the derived benefits. Decision regret could, therefore, be considered the ultimate outcome after elective colectomy for diverticulitis.

Our mixed-methods, cross-sectional study in a national sample of patients with diverticulitis found that at least 1 in 6 patients who chose between colectomy and observation experienced decision regret. Although the patients who underwent colectomy reported decreased decision regret, this effect may not have been clinically significant. This rate of decision regret was very high compared with decisions about other surgical and medical treatments that have been studied.[10]

However, despite their outsized role, the PROs of decision regret, bowel dysfunction, and QOL remain rarely studied in the management of diverticulitis.[3,25,26] To the best of our knowledge, our study was only the second to assess decision regret in patients with diverticulitis, and the first to explore why it develops.[27]

Further setting our study apart is that we used both quantitative and qualitative measures to assess decision regret. Although the Brehaut score is a validated tool for measuring decision regret, it measures global decision regret and therefore cannot differentiate between the causes of decision regret.[8] Therefore, we chose to complement this quantitative measurement with qualitative open-ended questions assessing why patients chose surgery versus observation and why they developed decision regret. By matching these qualitative responses to the quantitative Brehaut scores, we were able to derive deeper insights into the patient's decision-making process than with quantitative methods alone. Moreover, our use of qualitative methods allowed one to hypothesize why patients suffer decision regret, which is the first step in the development of tools that can quantitatively measure the different causes of decision regret following elective colectomy for diverticulitis.

Our finding that 1 in 4 patients with diverticulitis has major severity LARS suggested that levels of bowel dysfunction are high among patients who suffer from diverticulitis. It should also be noted that our results positively associated bowel dysfunction and decision regret. Still, we found no overall difference in rates of LARS between patients who underwent colectomy or observational management. A 2018 study that used the Colorectal Functional Outcome questionnaire to prospectively measure bowel

Table III
Factors influencing decision making

Query	Theme	Quote from colectomy patient	Quote from observation patient
Most important factor in decision making	Disease factors	"Being admitted and suddenly they're telling me they have to check for sepsis, and then the heavy antibiotics they gave me were all a pretty scary event. I initially resisted the option of surgery but [had] multiple more episodes the same year I was hospitalized, I ended up back in my doctor's office asking for a surgery referral."	"I have diverticula far apart on my colon so the concern was that I wouldn't be able to remove it all. I also just felt that the risks of a major surgery outweighed the improvement to my quality of life given that my attacks are generally managed by fasting and medication."
	Psychosocial factors	"I lived in a remote location, and I was worried about a bowel rupture far from an ER. An in-law had emergency surgery and a temporary ostomy for diverticulitis a year or two before I developed the condition, and that scared me."	"My children. I'm their only caregiver and unfortunately there is nobody to care for them if I'm in the hospital."
	Interaction with physician	"Although my surgery wasn't an emergency, I was told by my surgeon that a sigmoid colectomy was imperative to my health."	"I did not like the surgeon."
What do you wish you had known?	Lifestyle modification	"That some of the same trigger foods prior to surgery still give me terrible pain. Any kind of lettuce or nuts will put me in the fetal position, so I've had to eliminate them completely. Zero regrets about surgery though. It gave me my life back."	N/a
	Positive results of colectomy	"That the surgery was effortless; out of the hospital in 48 hours. Remarkable recovery. I avoided all of the horror stories shared by friends. Should have had the surgery 2 years earlier than I did. Also wasn't aware of the extent of the disease; I was risking my life."	N/a
	Negative results of colectomy	"That recovery is not as easy as the internet makes it sound. There is no "you'll feel better in 2 weeks". I felt good enough to work a desk job, but it took another 9 months to feel comfortable wearing blue jeans, and at almost a year post op I still get sore when doing heavy and work (eg, ab workouts, shoveling, digging up bushes/landscaping)."	N/a

N/a, not applicable.

dysfunction following elective sigmoid resection for diverticular disease found no difference in bowel dysfunction in the early postoperative period.[28] Other studies are mixed. Although some suggest that gastrointestinal QOL rises after elective colectomy, others have found that between 2% to 44% of patients have no improvement or worsened bowel dysfunction since colectomy.[28–38] In this context, our results suggest that colectomy may not improve long-term bowel function in diverticulitis.

Although our study's findings provide insights to patients and physicians during the shared decision-making process, we recognize its limitations, including the possibility of nonresponse bias. We attempted to reduce this possibility and gain an accurate sampling by drawing participants from 4 independent sources, maximizing close-ended questions with radio buttons, making all open-ended questions optional, and using previously-validated PROM questionnaires.[39] Still, the patients experiencing very positive, or very negative effects from their diverticulitis or colectomy may have felt more compelled to complete our survey, biasing rates of decision regret and bowel dysfunction. Some groups may have been underrepresented in our survey. For example, nearly three-quarters of the participants were female, despite male sex being a risk factor for diverticulitis, and over 9 in 10 respondents were White.[40] By electronically distributing the survey, we may have drawn a younger, more technologically savvy population, potentially reducing the average age at diagnosis. The nontraditional nature of these sources (eg, social media and email lists) makes our response rate difficult to interpret when compared with traditional survey response rates. Further research should be performed with a focus on groups that were underrepresented in this study's population.

As the study was anonymous, it is possible that the same participant completed the survey in 2 different cohorts. Given the minimal amount of compensation provided however, we feel that the probability of participants creating duplicate entries is very low.

Although the electronically distributed survey methodology in this study allowed us to capture data from a national sample of participants, it restricted our ability to confirm the survey responses with more objective measures taken from patient charts or in-person clinical evaluations. This may result in a patient's gastrointestinal symptoms being attributed to diverticulitis, when they are actually secondary to another disorder, such as irritable bowel syndrome.

As such, our conclusions assumed that patients self-reporting diverticulitis do indeed have diverticulitis. We believed that this was reasonable and that any misclassification bias due to improper self-reporting was minimal. First, diverticulitis is a specific diagnosis that requires interaction with health care professionals and a CT scan for diagnosis and treatment. Unlike "the flu" or "bronchitis," the patients will rarely self-diagnose and treat diverticulitis without an initial encounter with a physician and valid diagnosis. Second, if patients are misattributing symptoms of irritable bowel syndrome to diverticulitis, we would expect more of these patients to be in the non-operative group. This differential misclassification would likely bias our findings toward the null hypothesis. Thus, although our observations of significant association would likely still be valid, we would state with less certainty that a lack of observed differences exists.

We could not account for all possible confounding variables in our models, particularly in our models of decision regret. Decision regret is a complex mental state that is influenced by a multitude of biopsychosocial factors.[41]

Finally, the cross-sectional nature of our survey prevented us from collecting baseline measurements of decision regret, bowel dysfunction, and overall QOL before the shared decision-making process. These limitations left us unable to measure change in these PROs over time, preventing inferences of causality and limiting inferences of association between the PROs and a chosen intervention.

With these limitations in mind, this study should be viewed as more exploratory, rather than definitive.

Ultimately, our study informed the shared decision-making conversation between the patients with diverticulitis and their surgeons. Qualitative responses to our survey demonstrated that many patients do not feel as though they understand the positives and negatives of surgery. This was likely a failure of comprehension, as the risks and benefits of elective surgery are rarely omitted by surgeons when making treatment decisions or obtaining surgical consent. Nevertheless, our findings represented an opportunity to improve patient-physician communication. Decision aids and other interventions aimed at improving shared decision-making may prove efficacious.[27]

Surgeons also need to inquire about and address psychosocial factors including fear, social and familial obligations, and surgery cost; we found these psychosocial factors posed significant barriers to patients pursuing indicated colectomy. Our analysis of QOL, bowel dysfunction, and decision regret was intended to give patients and physicians the best idea about the effect of elective colectomy on these PROs to date. This knowledge will be important for any surgeon to take into a discussion about surgery for diverticulitis.

In conclusion, it is particularly important that surgeons and patients are aware of our findings that over 1 in 6 patients who choose between colectomy and observational management of diverticulitis express decision regret, and over 1 in 4 experience severe bowel dysfunction. There is a need to improve these outcomes, and further research should focus on identifying and addressing factors that contribute to decision regret and bowel dysfunction. Prospective studies that measure change in decision regret, bowel dysfunction, and QOL over time would be ideal. Interventions should be aimed at intraoperative methods of reducing the rate of LARS, such as preservation of the inferior mesenteric artery (only applicable for colectomy patients), improving preoperative education, and treating pre-existing LARS.[42] Ultimately, understanding how PROs like decision regret, bowel dysfunction, and overall QOL vary over time and in response to various interventions is critical for improving the care of patients with diverticulitis.

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Conflict of interest/Disclosure

The authors report no biomedical financial interests or other potential conflicts of interest.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at [https://doi.org/10.1016/j.surg.2020.05.036].

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