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Comparison of Outcomes Between Total Abdominal and Partial Colectomy for the Management of Severe, Complicated *Clostridium Difficile* Infection

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Abstract

BACKGROUND: Patients with severe, complicated *Clostridium difficile* infection (CDI) may ultimately require a colectomy. Although associated with high morbidity and mortality, a total colectomy has been the mainstay of surgical treatment. However, small studies have suggested partial colectomy may provide equivalent outcomes. We compared the outcomes of partial and total colectomy for CDI in a nationwide database.

STUDY DESIGN: We performed a retrospective study using the American College of Surgeons National Surgical Quality Improvement Project (NSQIP). Patients with a primary diagnosis of *Clostridium difficile* colitis from 2007 to 2015, who underwent a total abdominal or partial colectomy, were analyzed. Postoperative mortality rate, complications, and length of stay were evaluated. Logistic regression controlling for patient and clinical factors evaluated the impact of type of operation performed.

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RESULTS: There were 733 colectomies for CDI, of which 151 (20.6%) were partial colectomies. Patients with a partial colectomy had a slightly higher 30-day mortality rate (37.1%) compared with total abdominal colectomy patients (34.7%, p = 0.58). However, logistic regression controlling for patient factors demonstrated no statistically significant difference for partial colectomy in 30-day mortality (odds ratio [OR] 1.21, 95% CI 0.76 to 1.96) or complication rate (OR 0.92, 95% CI 0.51 to 1.62) compared with total colectomy. There was no difference in days to surgery (4.6 partial vs 5.0 total, p = 0.70). Total abdominal colectomy trended toward a longer postoperative stay (18.0 vs 15.1 days for partial, p = 0.08).

CONCLUSIONS: In a national database, a significant percentage of operations for CDI are partial colectomies. There were no significant differences found in mortality or complications between partial and total colectomy for severe complicated CDI. (J Am Coll Surg 2019;■:1–6. © 2018 by the American College of Surgeons. Published by Elsevier Inc. All rights reserved.)

Clostridium difficile infection (CDI) is the leading cause of hospital-acquired gastrointestinal disease in the US. In hospitalized patients, CDI has been increasing, reaching a prevalence rate of 13.1 per 10,000 in the US.[1] The overall in-hospital mortality rate for patients with CDI in some conservative estimates is 7.1%.[2] United States health care expenditure related to CDI is estimated to be $3.2 billion annually, proving to be a major burden on the US health care system.[3] Taken together, effective treatment and management of CDI is imperative in ensuring quality of care and reduction of costs.

To this end, treatment guidelines have been designed to stratify patients by disease severity and subsequently recommend evidence-based treatment options for optimal care.[4] Diagnostic criteria for CDI include acute onset of diarrhea with documented toxigenic strains of *Clostridium difficile*. Patients are classified as mild-to-moderate, severe disease, severe and complicated, and recurrent (return of CDI within 8 weeks of completing therapy). Patients meeting the minimal diagnostic criteria are classified as having mild-to-moderate CDI. Patients classified as severe have elevated leukocyte counts, abdominal tenderness, and reduced serum albumin levels. Severe, complicated patients who are refractory to pharmacologic intervention are referred to surgical services for disease management.

The preferred treatment for severe, complicated CDI is total abdominal colectomy (TAC), which has been shown to decrease mortality.[5] Superiority of TAC over segmental-based (partial) colectomy (PC) for management of fulminant CDI has been attributed to disease control, given the diffuse colonic involvement that theoretically results in overall lower rates of mortality.[6] However, a few studies have reported that salvage of some of the colon may produce equivalent outcomes to sub-total colectomy in patients with severe, complicated CDI.[7] This is particularly interesting because total abdominal colectomy usually results in end ostomies, which are fraught with complications.[8] Whether TAC is superior to PC, as previously assumed, is in question.

Our study aimed to examine the health outcomes of patients who underwent total abdominal colectomy vs patients who underwent partial colectomy for severe, complicated CDI in the US. We hypothesized that the majority of patients with severe CDI undergo TAC and that TAC is associated with fewer postoperative complications and deaths.

METHODS

Data source

Data obtained from the American College of Surgeons Surgical Quality Improvement Program (NSQIP) were analyzed. The NSQIP is a multi-institutional database with preoperative risk factors, and 30-day post-surgery patient outcomes. Trained reviewers collect all data. All NSQIP patients are risk-adjusted and case-mix-adjusted for comparison. Institutional Review Boards provided exemption for this study protocol.

Study population

All patients older than 18 and with an *International Classification of Diseases, Ninth Revision code* of 008.45, intestinal infection due to *Clostridium difficile*, between 2007 and 2015, were included. Patients with a Current Procedural Terminology (CPT) codes for primary procedure of CPT 44150, CPT 44151, CPT 44155, CPT 44157, and CPT 44158 were classified as having undergone an open TAC. Patients with CPT 44210, CPT 44211, and CPT 44210 codes had a laparoscopic TAC. Patients with CPT44140, CPT 44141, CPT 44143, CPT44144, CPT 44145, CPT 44146, CPT 44147, and CPT 44160 codes were classified as having undergone open PC. Patients with CPT 44204, CPT 44205, CPT 44206, CPT 44207, and CPT 44208 had a laparoscopic PC. All patients included for analysis (n 733) were classified as having undergone TAC (n = 582) or PC (n = 151) based on their CPT code, regardless of open or laparoscopic approach.

Outcomes

The primary outcomes of interest were postoperative 30-day mortality rate, any complication, and length of stay. Length of stay was defined as the number of days after the day of operation to the day of discharge. Any complication was further stratified into wound, cardiac, respiratory, bleeding, neurologic, renal, deep vein thrombosis, sepsis, and urinary traction infection complications. The main comparison was between partial and TAC. Secondary outcomes of interest included 30-day readmission rate, days to surgery, and total length of hospital stay. Total length of hospital stay was defined as the day the patient was admitted to the hospital to the day of discharge.

Statistical analysis

Continuous variables were compared using Student's *t*-test. Categorical variables were compared using chisquare test. All tests were 2-sided. Multivariable logistic regression was used to analyze the outcomes of interest, controlling for age, sex, race/ethnicity, BMI, American Society of Anesthesiologists (ASA) score, functional status, preoperative sepsis, and history of comorbidities. For this analysis the comorbidities used from NSQIP included bleeding disorders, history of smoking, presence of severe COPD, ventilator dependence, ascites, hypertension requiring medication, congestive heart failure, diabetes, and chronic steroid use. Significance level was set at a p value > 0.05. All analysis was performed using SAS software.

RESULTS

Demographics

A total of 733 patients were identified as having undergone TAC or PC for severe, complicated CDI; 582 patients had TAC and 151 patients had PC. The population was primarily female (54.8%). The racial composition of the cohort is reported in Table 1. Patients included for analysis for severe, complicated CDI were generally over the age of 65 years (63.1%) and had a high ASA score (III or greater, n 724, 98.8%). Open procedures were significantly more frequent than laparoscopic procedures (n = 694, $p < 0.0001$).

Complications by surgical procedure

There were no significant differences in 30-day mortality and overall complication rates between patients who underwent TAC and PC (Table 2). Of the cohort included for analysis, the 30-day mortality rate was 35.2% (n = 258). When controlling for patient characteristics, there were no significant differences in 30-day mortality rates for PC patients compared with those who underwent TAC (odds ratio [OR] 1.21, 95% CI 0.76 to 1.96; Table 3). Additionally, when controlling for patient characteristics, there were no significant differences in any complication rate for patients undergoing PC vs patients undergoing TAC (OR 0.92, 95% CI 0.52 to 1.62). There were no significant differences for all other complications between patients who underwent TAC or PC.

Length of stay and total hospital stay by procedure

On average, patients who underwent TAC had a longer postoperative length of stay compared with patients who underwent PC (stay 18.0 vs 15.1 days, $p = 0.08$; Table 4). The mean total length of hospital stay for patients who had TAC was also significantly longer (23.0 vs 19.8 days, $p = 0.11$) than for patients who had a PC. There was no significant difference in days to surgery between patients who had PC or TAC.

DISCUSSION

This study demonstrated that unlike traditional teaching and practice guidelines, TAC and PC have similar rates of complications and 30-day mortality. Moreover, patients who had a PC had shorter length of stay and total hospital stay, when compared with patients who had undergone a TAC. These findings suggest that a PC may be a viable surgical alternative to the widely held gold standard of TAC.[6]

Recent reports have suggested that surgical management of severe, complicated CDI provides a survival advantage over medical therapy.[8] In our sample, the 30-day mortality rate was 35.2% (n 258), which is consistent with mortality estimates ranging from 35% to 80%.[6,9–11] Previous studies have indicated that partial colectomies are associated with decreased survival as compared with total colectomies.[12–14] However, existing literature has not retrospectively compared the 30-day mortality of partial vs TAC in a large, well-curated national cohort. Here, we report a more granular examination of PC vs TAC and show that there is no significant difference in 30-day mortality. It is well known that end ileostomies are fraught with complications and have serious implications in quality of life.[15–17] Given that mortality is similar between partial and total colectomy, routine removal of the entire abdominal colon is called into question, especially when considered in the context of ileostomy complications.

There is a paucity of published studies on the complication rates of PC in the treatment of severe, complicated CDI. In this study, there was no significant difference in aggregate or specific complications between patients who had a PC or a TAC. These results suggest that surgical infection source control was likely achieved equally, although we are unable to ascertain intraoperative decision making in terms of margin of resection.

Interestingly, patients who underwent partial colectomies had a shorter length of stay and shorter total hospital stay. Previous data suggested that the timing of a colectomy is essential to disease management, with earlier colectomies associated with decreased mortality in individuals with severe, complicated CDI.[12,18] Given that the times to surgery were similar in our study cohort, it would imply that those who underwent PC were not selected simply because they presented earlier in their disease course. Furthermore, these findings are potentially important in a health care climate in which length of stay and complication rates are vital measures of quality and financial responsibility.[19]

Although not an outcome of interest, it is interesting to note that despite longstanding teaching and practice management guidelines, many surgeons performed partial colectomies for CDI. Clinical management guidelines have long suggested TAC to treat patients with severe, complicated CDI. Curiously, more than 20% of the sampled individuals in this study had PC to treat severe, complicated CDI, suggesting a substantial deviation from guideline recommendations. Efforts have been made to explore why surgeons do not adhere to surgical management guidelines.[20] It is likely that medical condition and patient and surgical factors drive decision-making to elect PC over TAC. We are unable to ascertain surgical decision-making based on the NSQIP database; however, it likely involves surgeon preference given similar complexity between the 2 groups.

This study has several limitations. Patients are classified as having severe, complicated CDI if they meet any of the following criteria: admission to the ICU, hypotension with a fever equal to or exceeding 38.5°C, ileus or significant abdominal distention, mental status changes, elevated white blood cell count equal to or exceeding 35,000/cu mm, and end-organ failure.[4] Given the broad classification criteria, there is likely heterogeneity in the study cohort that is not accounted for in the comorbidity measures of NSQIP. Nevertheless, the most important markers of patient acuity in CDI including preoperative sepsis, ASA classification, and comorbidities were similar between PC and TAC, suggesting that overall patient complexity was similar. Obtaining patient-specific parameters, as they relate to CDI severity, may help elucidate predictors of mortality and complication rate, which will be the subject of a retrospective review on a multicentered basis.

Data from NSQIP are curated from electronic medical records, not insurance billing records. All NSQIP patients are risk-adjusted and case-mix-adjusted for meaningful comparison.[21] The NSQIP lacks the granularity needed to examine regional differences and hospital characteristics. Finding regional centers of excellence may prove to offer more insight into best practices for treating severe, complicated CDI. For purposes of analysis, we grouped together open and laparoscopic approaches to achieve an adequate sample size.

With the limited number of laparoscopic procedures for CDI, we could not meaningfully infer discrepancies between the rates of laparoscopic approaches in TAC vs PC and whether they are proxies for disease severity. However, given the lack of significant differences in preoperative patient demographics in sepsis and comorbidities, we believe the effect is modest at best for this dataset. Also, surgeons may be more comfortable offering laparoscopic partial colectomy rather than laparoscopic total abdominal colectomy. We suspect that patients were not selected for laparoscopic partial colectomy because they were less urgent, as evidenced by similar days of admission before index operation. Further investigation is warranted to examine the health outcomes of specific surgical approaches (open vs laraoscopic) as predictors. We also cannot ascertain how surgeons determined resection margins (anatomic vs nonanatomic).

Total abdominal colectomy is an aggressive procedure, with cumbersome postoperative care and ostomy-related complications.[22] Partial colectomy, although invasive and presenting with potential complications similar to those of TAC, spares more bowel and may provide a greater quality of life. Although it appears that PC is a viable alternative to TAC, some questions remain unanswered. Subjects of future study include extent of resection and appropriate patient selection.

CONCLUSIONS

There is no significant difference in 30-day mortality and complication rates between patients who had PC and TAC for CDI, calling into question longstanding teaching and practice guidelines. Patients undergoing partial colectomy had shorter length of stay and shorter total hospital stay than patients who underwent a total abdominal colectomy. A prospective randomized controlled clinical trial with intention-to-treat is needed to validate these preliminary findings.

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Abbreviations and Acronyms

ASA	American Society of Anesthesiologists
CDI	*Clostridium difficile* infection
CPT	Current Procedural Terminology
OR	odds ratio
PC	partial colectomy
TAC	total abdominal colectomy

REFERENCES

1. Jarvi W, Schlosser J, Jarvis A, Chinn R. National point prevalence of Clostridium difficile in US health care facility inpatients, 2008. Am J Infect Control 2009;37:263–270. [PubMed: 19278754]
2. Reveles K, Lee G, Boyd N, Frei C. The rise in Clostridium difficile infection incidence among hospitalized adults in the United States: 2001–2010. Am J Infect Control 2014;42: 1028–1032. [PubMed: 25278388]
3. O'Brien J, Lahue B, Caro J, Davidson D. The emerging infectious challenge of Clostridium difficile-associated disease in Massachusetts hospitals: clinical and economic consequences. Infect Control Hosp Epidemiol 2007;28:1219–1227. [PubMed: 17926270]
4. Surawicz C, Brandt L, Binion D, et al. Guidelines for diagnosis, treatment and prevention of Clostridium difficile infections. Am J Gastroenterol 2013;108:478–498. [PubMed: 23439232]
5. Luciano J, Zuckerbraun B. Clostridium difficile infection: prevention, treatment, and surgical management. Surg Clin North Am 2014;94:1335–1349. [PubMed: 25440127]
6. Perera A, Akbari R, Cowher M. Colectomy for fulminant Clostridium difficile colitis: predictors of mortality. Am Surg 2010;76:418–421. [PubMed: 20420254]
7. Neal M, Alverdy J, Hall D, et al. Diverting loop ileostomy and colonic lavage: an alternative to total abdominal colectomy for the treatment of severe, complicated Clostridium difficile infections. Ann Surg 2011;254:423–429. [PubMed: 21865943]
8. Stewart D, Hollenbeak C, Wilson M. Is colectomy for fulminant Clostridium difficile colitis life saving? A systematic review. Colorectal Dis 2013;15:798–804. [PubMed: 23350898]
9. Synnott K, Mealy K, Merry C, et al. Timing of surgery for fulminating pseudomembranous colitis. Br J Surg 1998;85: 229–231. [PubMed: 9501823]
10. Lamontagne F, Labbé A, Haeck O, et al. Impact of emergency colectomy on survival of patients with fulminant Clostridium difficile colitis during an epidemic caused by a hypervirulent strain. Ann Surg 2007;245:267–272. [PubMed: 17245181]
11. Sailhamer E Fulminant Clostridium difficile colitis. Arch Surg 2009;144:433. [PubMed: 19451485]
12. Byrn J, Maun D, Gingold D, et al. Predictors of mortality after colectomy for fulminant Clostridium difficile colitis. JAMA Surg 2008;143:150–154.
13. Koss K, Clark M, Sanders D, et al. The outcome of surgery in fulminant Clostridium difficile colitis. Colorectal Dis 2006;8: 149–154. [PubMed: 16412077]
14. Medich D Laparotomy for fulminant pseudomembranous colitis. Arch Surg 1992;127:847. [PubMed: 1524485]
15. Kwiatt M, Kawata M. Avoidance and management of stromal complications. Clin Colon Rectal Surg 2013;26:112–121. [PubMed: 24436659]
16. Phang P, Hain J, Perez-Ramirez J, et al. Techniques and compl0069cations of ileostomy takedown. Am J Surg 1999;177:463–466. [PubMed: 10414694]
17. Robertson I, Leung E, Hughes D, et al. Prospective analysis of stroma-related complications. Colorectal Dis 2005;7: 279–285. [PubMed: 15859968]
18. Seltman A Surgical management of Clostridium difficile colitis. Clin Colon Rectal Surg 2012;25:204–209. [PubMed: 24294121]
19. Krell R, Girotti M, Dimick J. Extended length of stay after surgery. JAMA Surg 2014;149:815. [PubMed: 25074418]
20. Gunaratnam C, Bernstein M. Factors affecting surgical decisionmaking—a qualitative study. Rambam Maimonides Med J 2018;9:e0003.
21. Huffman K, Cohen M, Ko C, Hall B. A comprehensive evaluation of statistical reliability in ACS NSQIP profiling models. Ann Surg 2015;261:1108–1113. [PubMed: 25211276]
22. Sheetz K, Waits S, Krell R, et al. Complication rates of ostomy surgery are high and vary significantly between hospitals. Dis Colon Rectum 2014;57:632–637. [PubMed: 24819104]

Table 1.

Demographics of Cohort

Characteristic	Total abdominal colectomy n	Total abdominal colectomy %	Partial colectomy n	Partial colectomy %	p Value
Sex					0.34
Female	314	54.0	88	58.3	
Male	268	46.1	63	41.7	
Age, y					0.87
18–40	40	6.9	8	5.3	
40–65	174	29.9	49	32.5	
65–80	257	44.2	66	43.7	
80+	111	19.1	28	18.5	
Race					0.42
White	392	67.4	96	63.6	
Non-Hispanic Black	53	9.1	11	7.3	
Hispanic	30	5.2	6	4.0	
Asian American or Pacific Islander	7	1.2	2	1.3	
Other	100	17.2	36	23.8	
BMI					
Underweight	31	5.3	9	6.0	0.96
Normal weight	178	30.6	49	32.5	
Overweight	170	29.2	42	27.8	
Obese	169	29.0	44	29.1	
Unknown	34	5.8	7	4.6	
American Society of Anesthesiologists classification					0.26
I	1	.17	1	.7	
II	6	1.0	1	.7	
III	102	17.5	34	22.5	
IV	367	63.1	98	64.9	
V	105	18	17	11.3	

Characteristic	Total abdominal colectomy		Partial colectomy		p Value
	n	%	n	%	
None assigned	1	.2	0	0	
Functional status before surgery					0.39
Independent	278	47.8	67	44.4	
Partially dependent	144	24.7	40	26.5	
Totally dependent	152	26.1	39	25.8	
Unknown	8	1.4	5	3.3	
Comorbidity					
Bleeding disorder	163	28	36	23.8	0.31
Current smoker	110	18.9	28	18.5	0.92
History of severe COPD	144	24.7	42	27.8	0.44
Ventilator dependent	210	36.1	53	35.1	0.82
Ascites	104	17.9	25	16.6	0.71
Hypertension requiring medication	389	66.8	103	68.2	0.75
Congestive heart failure in 30 d before surgery	60	10.3	15	9.9	0.89
Diabetes	141	24.23	37	24.5	0.94
Steroid use for chronic condition	93	16.0	24	15.9	0.98
Dialysis	88	15.1	18	11.9	0.32
Laparoscopic approach	11	1.89	28	18.5	<0.0001
Preoperative sepsis	498	85.6	120	79.5	0.07
Total patients	582	79.4	151	20.6	

Table 2.

Complications by Procedure

Complication	Total abdominal colectomy		Partial colectomy		p Value
	n	%	n	%	
30-d mortality	202	34.7	56	37.1	0.59
30-d readmission	33	5.7	7	4.6	0.79
Any complication *	488	83.85	120	79.47	0.20
Specific complication					
Wound complication	77	13.2	24	15.9	0.40
Cardiac complication	57	9.8	14	9.3	0.85
Deep vein thrombosis	8	1.4	1	0.7	0.48
Pulmonary embolus	11	1.9	2	1.3	0.64
Respiratory complication	332	57.0	81	53.6	0.45
Bleeding complication	250	43.0	59	39.1	0.39
Neurologic complication	10	1.7	5	3.3	0.22
Renal complication	68	11.7	10	6.6	0.07
Urinary tract infection	43	7.4	11	7.3	0.97
Sepsis	201	34.5	48	31.8	0.52
Total patients	582	79.4	151	20.6	

* Any complication includes wound, infectious, respiratory, thromboembolic, renal, neurologic, cardiac, and bleeding complications.

Table 3.

Multivariable Logistic Regression of Morbidity and Mortality Based on Surgical Procedure

Effect	30-d mortality		Any complication	
Procedure	**Point estimate**	**95% confidence limit**	**Point estimate**	**95% confidence limit**
Total colectomy	1.21	0.76–1.96	0.92	0.52–1.62
Partial colectomy	Ref	Ref	Ref	Ref

Modeling controls for procedure, sex, age, race/ethnicity, BMI, American Society of Anesthesiologists class, functional status, and comorbidities.

Table 4.

Mean Length of Stay and Total Hospital Stay by Surgical Procedure

Procedure	Mean d to surgery	SD	p Value	Mean length of stay, d	SD	p Value	Mean total hospital stay, d	SD	p Value
Total abdominal colectomy	5.0	12.1		18.0	19.0		23.1	23.3	
Partial colectomy	4.6	6.0	0.57	15.1	13.2	0.08	19.8	15.1	0.11