Surgeon Volume and Elective Resection for Colon Cancer: An Analysis of Outcomes and Use of Laparoscopy

Rachelle N Damle, MD, Christopher W Macomber, MD, MBA, Julie M Flahive, MS, Jennifer S Davids, MD, W Brian Sweeney, MD, FACS, Paul R Sturrock, MD, Justin A Maykel, MD, FACS, Heena P Santry, MD, FACS, Karim Alavi, MD, FACS

BACKGROUND: Surgeon volume may be an important predictor of quality and cost outcomes. We evaluated the association between surgeon volume and quality and cost of surgical care in patients with colon cancer.

STUDY DESIGN: We performed a retrospective study of patients who underwent resection for colon cancer, using data from the University HealthSystem Consortium from 2008 to 2011. Outcomes evaluated included use of laparoscopy, ICU admission, postoperative complications, length of stay, and total direct hospital costs by surgeon volume. Surgeon volume was categorized according to high (HVS), medium (MVS), and low (LVS) average annual volumes.

RESULTS: A total of 17,749 patients were included in this study. The average age of the cohort was 65 years and 51% of patients were female. After adjustment for potential confounders, compared with LVS, HVS and MVS were more likely to use laparoscopy (HVS, odds ratio [OR] 1.27, 95% CI 1.15, 1.39; MVS, OR 1.16 95% CI 1.65, 1.26). Postoperative complications were significantly lower in patients operated on by HVS than LVS (OR 0.77 95% CI 0.76, 0.91). The HVS patients were less likely to require reoperation than those in the LVS group (OR 0.70, 95% CI 0.53, 0.92) Total direct costs were $927 (95% CI -$1,567 to -$287) lower in the HVS group compared with the LVS group.

CONCLUSIONS: Higher quality, lower cost care was achieved by HVS in patients undergoing surgery for colon cancer. An assessment of differences in processes of care by surgeon volume may help further define the mechanism for this observed association. (J Am Coll Surg 2014;218:1223−1230. © 2014 by the American College of Surgeons)

Despite declines in the incidence rates of colorectal cancer over the last decade, it remains the third most common malignancy in the US.[1] Laparoscopic-assisted colectomy (LAC) was considered an acceptable approach for colon cancer resection after the Clinical Outcomes of Surgical Therapy (COST) trial demonstrated similar disease-free survival in patients undergoing LAC and open colectomy.[2] Multiple randomized controlled trials have either confirmed the findings of the COST trial, or demonstrated increased overall and disease-free survival with LAC.[3,4] Laparoscopic-assisted colectomy has also been associated with improved quality of life as well as fewer complications, decreased mortality, and lower costs.[5] Even though the use of laparoscopy has steadily increased over time,[3] it is still offered to only a minority of patients with CRC.[6,7]

Previous studies have analyzed morbidity and mortality outcomes in relation to surgeon and hospital volume in colorectal surgery, but the relationship between volume and use of LAC has not been well established.[8] Using data from the University HealthSystem Consortium (UHC), we examined LAC use and 30-day outcomes in patients undergoing surgery for colon cancer according to surgeon volume. We hypothesized that higher surgeon volume would be associated with higher use of LAC, lower complication rates, and lower costs, compared with lower volume surgeons, independent of hospital volume.

Disclosure Information: Nothing to disclose.

Support: Dr Santry received the University of Massachusetts Clinical Scholar Award (HPS) UL1RR031982, 1KL2RR031981-01, and UL1TR000161 from the NIH.

Presented at the New England Surgical Society 94th Annual Meeting, Hartford, CT, September 2013.

Received October 11, 2013; Revised January 16, 2014; Accepted January 16, 2014.

From the Department of Surgery (Damle, Macomber), the Center for Outcomes Research (Flahive, Santry), and the Division of Colorectal Surgery (Davids, Sweeney, Sturrock, Maykel, Alavi), University of Massachusetts Medical School, Worcester, MA.

Correspondence address: Rachelle N Damle, MD, University of Massachusetts, 55 Lake Ave Room S3-752, Worcester, MA 01655. email: rachelledamle@gmail.com

ISSN 1072-7515/14/$36.00
http://dx.doi.org/10.1016/j.jamcollsurg.2014.01.057

Abbreviations and Acronyms
CRC = colorectal cancer
HVS = high volume surgeon
LAC = laparoscopic-assisted colectomy
LVS = low volume surgeon
MVS = medium volume surgeon
OR = odds ratio
UHC = University HealthSystem Consortium

METHODS

Source of data

The UHC database collects inpatient data from 116 participating academic medical centers and 276 of their affiliates, comprising nearly 95% of US nonprofit medical centers. The database includes all patients hospitalized at participating institutions. Variables collected include ICD-9 (International Classification of Diseases, 9th edition) codes for diagnoses and procedures, physician specialty, length of stay, risk-adjusted severity of illness scores, and hospital associated costs. The UHC converts hospital charges into cost estimates based on federal-wage data for each hospital location, allowing for meaningful cost comparisons between centers, regardless of hospital location.

After exemption status by the IRB was received, the UHC database was queried for adult patients, 18 years or older, with ICD-9 diagnostic codes for colon or rectosigmoid cancers (153.0–153.4, 153.6–153.8, 154.0) present on admission between 2008 and 2011. These years were studied because they allowed for analysis of surgeon volume, as the unique surgeon identification numbers changed in 2012. To identify patients who underwent cancer resection, this cohort was limited to those with ICD-9 procedure codes for open and laparoscopic colectomy (45.71, 45.73–45.76, 45.79, 45.8, 45.81–45.82, 17.33–17.36, 17.39). Patients were excluded if they underwent both colon and mid- to lower-rectal resection in the same hospitalization, or if their hospitalization was urgent or emergent based on categorization in the database.

Outcomes measures

The primary outcome of interest was the use of laparoscopy, which was determined by ICD-9 procedure codes for laparoscopic colectomy. Secondary outcomes were frequency of complications (eg, stroke, pneumonia, hemorrhage/hematoma, reopening of surgical wound, cellulitis, urinary tract infection, myocardial infarction, venous thromboembolism, sepsis), ICU admission rate after initial procedure, inpatient length of stay, and total direct hospital costs. Postoperative complications were coded in the database based on risk pools according to procedure type by UHC. Reoperation was defined by ICD-9 procedure codes for exploratory laparotomy or laparoscopy (54.10, 54.11, 54.12, 54.19), small or large bowel resection (17.33–17.36, 17.39, 45.71, 45.73–45.76, 45.79, 45.8, 45.81–45.82, 48.42, 48.51, 48.52, 48.62, 48.63, 45.00, 45.00–45.02, 45.50–45.52, 45.61–45.63, 46.73), or stoma creation/revision (46.01, 46.03, 46.10, 46.11, 46.13, 46.20, 46.22, 46.23, 46.39) occurring at least 1 day after the primary procedure, including during any readmission stays. Additional covariates used for analysis included age, sex, race, comorbid diagnoses (based on ICD-9 diagnosis codes), 3M APR-DRG Admission Severity of Illness Score (3M Health Information Systems), and insurance status. Severity of illness was reclassified into low (minor and moderate) and high (major and extreme) for ease of analysis.

Surgeon and hospital volume categories

Once the cohort was identified, unique physician identifiers were used to examine the distribution of yearly surgeon volume. Surgeons who performed less than 1 colectomy per year averaged over the 4-year study period were excluded. Surgeon volume was classified as high, medium, or low based on the observed distribution of average annual surgeon volume. High volume was defined as greater than or equal to the 90th percentile (>11 colectomies per year), medium volume between the 50th and 90th percentiles (5 to 11 colectomies per year), and low-volume as the 50th percentile or less (<5 colectomies per year). The 50th percentile cutoff for LVS was chosen instead of the 25th percentile to allow for similar numbers of patients in each group for analysis, in addition to the authors' decision that there was little clinical relevance for distinguishing between performing 2 colectomies per year (the 25th percentile cutoff) vs 4

Table 1. Summary of Surgeon and Hospital Volume Groups Over the Study Period

Variable	Low	Medium	High	Very high
Surgeons				
Definition of group*	<5	5–11	>11	–
Surgeons, n	1,274	379	64	–
Cases,† n	3,916	7,038	6,975	–
Hospitals				
Definition of group*	<9	9–18	19–37	>37
Hospitals, n	49	48	46	50
Cases,† n	575	2,033	4,046	11,095

*Average number of colectomies for cancer per year.
†Total number of cases over the study period.