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Minimally invasive surgery and sphincter preservation in rectal cancer

Heather L. Yeo, MD, MHS,[a,b,*] *Jonathan S. Abelson, MD,*[a] *Jialin Mao, MD, MSc,*[b] *Meera Cheerharan, MD,*[a] *Jeffrey Milsom, MD,*[a] *and Art Sedrakyan, MD, PhD*[b]

[a] *Department of Surgery, Weill Cornell Medicine, New York-Presbyterian Hospital, New York, New York*
[b] *Department of Healthcare Policy and Research, Weill Cornell Medicine, New York-Presbyterian Hospital, New York, New York*

ARTICLE INFO

Article history:
Received 1 December 2015
Received in revised form
31 December 2015
Accepted 7 January 2016
Available online 14 January 2016

Keywords:
Rectal neoplasm
Colorectal surgery
Minimally invasive surgical procedures
Sphincter preservation
High-volume hospitals

ABSTRACT

Background: National adoption of sphincter-preserving surgery (SPS) and minimally invasive surgery (MIS) has not been well documented. We examined national trends in use of SPS and MIS.

Materials and methods: The National Inpatient Sample was used to evaluate open, laparoscopic, and robotic low anterior resection (LAR) or abdominoperineal resection (APR) for patients undergoing rectal cancer surgery from 2009 to 2011. Trends in SPS and MIS were stratified by hospital volume. Propensity score matching was used.

Results: A total of 24,999 (62.0%) patients underwent LAR, and 15,288 (38.0%) underwent APR from 2009 to 2011. A total of 22,310 (89.2%) LARs were open and 2689 (10.8%) MIS. A total of 11,600 (75.9%) APRs were open and 3688 (24.1%) MIS. Most procedures were at high-volume centers. In propensity-matched analysis, length of stay for LAR was longer in open surgery (6 *versus* 5 d; $P = 0.01$); in APR, MIS patients were less likely to have wound, infectious, urinary, and gastrointestinal complications, and length of stay was shorter (6 *versus* 8 d; $P < 0.01$).

Conclusions: SPS and MIS rates have increased nationally, especially in high-volume centers. In addition, the perioperative benefits seen in randomized clinical trials are maintained in a national database. Further studies should focus on understanding differences in survival and oncologic outcomes with MIS techniques.

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Introduction

The long-term consequences of medical and surgical treatment for patients with resectable rectal cancer therapy can be devastating, leading to life-altering surgery, traditionally with permanent stoma formation [1]. Over the past 20 years, with the advent of neoadjuvant chemotherapy, advanced surgical techniques such as intersphincteric dissection, colonic j-pouch creation, and new stapling devices, preservation of bowel continuity with sphincter-preserving surgery (SPS) have become more common even in cases of very low rectal tumors. This has been especially true at specialized centers and is highlighted by the fact that rates of SPS in the United States vary dramatically (from 20% to 90%) depending on the center, with evidence showing that high-volume centers offer SPS at a higher rate than lower volume centers [1–6].

* *Corresponding author*. Department of Surgery, Weill Cornell Medicine, New York-Presbyterian Hospital, 525 East 68th Street, Box 172, New York, NY 10065. Tel.: +1-212-746-6030; fax: +1-212-746-6370.
E-mail address: hey9002@med.cornell.edu (H.L. Yeo).
0022-4804/$ – see front matter © 2016 Elsevier Inc. All rights reserved.
http://dx.doi.org/10.1016/j.jss.2016.01.010

Another important advancement in rectal cancer treatment has been the evolution from traditional open surgery to using more minimally invasive surgery (MIS). Several randomized trials such as the COLOR II trial have recently supported the use of laparoscopy in rectal resections and reported similar oncologic and perioperative outcomes [7–10]. Robotic surgery on the other hand remains more controversial although some surgeons claim improved 3-D visibility and improved range of motion in the pelvis with robot use [11,12]. Just recently reported at the 2015 Association of Colon and Rectal Surgeons Annual Meeting, the preliminary results of the ROLARR trial are showing similar perioperative outcomes, but the long-term and functional data are yet to be reported [13]. In addition, two recent randomized clinical trials have questioned the noninferiority of laparoscopic surgery in oncologic outcomes in select patients with rectal cancer [14,15].

In this fast-changing treatment environment, there is a paucity of data on patterns of SPS and MIS use for rectal cancer treatment and perioperative outcomes of various techniques over a wide range of medical centers. Previous outcome data on this topic have been from high-volume specialty centers. Recent advancement of coding enables evaluation of both laparoscopic and robotic surgery on a national level with comparison to open surgery [16]. Accordingly, our primary aim was to evaluate the rate of use of MIS and SPS in relation to hospital volume. Our secondary aim was to compare perioperative outcomes for MIS and open techniques for both sphincter preserving and non-sphincter–preserving procedures.

Materials and methods

Data source

The Agency for Healthcare Research and Quality has maintained the National Inpatient Sample (NIS) database since 1988. The NIS contains data on more than 8 million hospital stays from ~1000 hospitals. It is the largest all-payer inpatient database in the United States; it is a stratified 20% sample of inpatient admissions to acute care hospitals nationwide. Data contained within the NIS include patient and hospital demographics, admission and treating diagnoses, inpatient procedures, inhospital mortality, length of hospital stay, hospital charges, and discharge status. The NIS data set has numerous internal quality measures and is validated by the Health Care Cost and Utilization Project by comparison with other similar databases, National Discharge Survey and the Medicare Provider Analysis and Review (http://www.hcup-us.ahrq.gov/nisoverview.jsp).

This study was approved by the Institutional Review Board at Weill Cornell Medical College (protocol no. 1209013064) and conforms to the data-use agreement for the NIS from Health Care Cost and Utilization Project.

Patient population

Study population

We extracted rectal cancer (International Classification of Diseases, Ninth Revision, Clinical Modification [ICD-9-CM 154.1]) patients undergoing low anterior resection (LAR) with or without ostomy (ICD-9-CM 48.62, 48.63) and abdominoperineal resection (APR; ICD-9-CM 48.50, 48.51, 48.52, 48.59) with "International Classification of Diseases, Ninth Revision, Clinical Modification" (ICD-9-CM) codes. Patients with concurrent cancer of recto sigmoid junction or anus (ICD-9-CM 154.0, 154.2, 154.3, 154.8) were excluded. Laparoscopic and robotic surgeries were identified with the laparoscopic APR code (ICD-9-CM 48.51) or concurrent codes for laparoscopic procedure (ICD-9-CM 17.39, 54.21, 54.51) or robotic assisted procedure (ICD-9-CM 17.42, 17.49). Patients who underwent a concurrent diverting stoma (ICD-9-CM 46.01, 46.11, 46.20, 46.21) were also identified. We excluded patients who underwent simultaneous procedures such as rectus flap (ICD-9-CM 86.7, 86.70, 86.71. 86.72, 86.74) and pelvic exenteration (ICD-9-CM code: 68.8) because these patients are likely not candidates for a laparoscopic approach.

We chose recent years, 2009–2011, because coding methods before 2008 may have underrepresented the number of minimally invasive procedures and because new robotic and MIS codes were introduced in mid 2008 [16–18].

Variable definition

Patient age was categorized into <60, 60–69, and 70+ groups. Hospital volume was defined according to average annual rectal procedures performed within each hospital and divided into low (1–10 cases/y), medium (11–25 cases/y), and high-volume centers by tertiles (>25 cases/y) as has been done by several volume outcome studies [19,20]. Major inhospital outcomes included mortality, perioperative complications, discharge disposition, and length of stay (LOS). Other-than-routine discharge was defined as being transferred to another facility or being discharged home with health care. All variables were defined by their ICD-9 codes (Table 1).

Statistical methods

A national weighted sample of 24,999 patients undergoing LAR and 15,288 patients undergoing APR were included in the entire cohort. Categorical variables, including patient demographics, comorbidities, concurrent diverting stoma, and hospital-related characteristics, were presented in percentages. Differences between MIS and open surgery patients were assessed using the chi-square test. Trend in overall LAR and APR surgery volume and open, laparoscopic, and robotic surgery volume within low-, medium-, and high-volume centers as defined by tertiles were depicted graphically.

Comparative analyses

Due to differences of baseline patient and hospital characteristics between patients undergoing open and minimally invasive surgeries, we used propensity score matching to adjust for these differences (see in the following section). Propensity scores were assigned for each patient using multivariate logistic regression. Separate models were fitted for LAR and APR patients with dependent variable as the odds of undergoing MIS and independent variables as patient characteristics (i.e., age, gender, race/ethnicity, primary health care payer, and comorbidities), concurrent diverting stoma (for LAR patients only), and hospital characteristics (i.e.,

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