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Original article

Determinants of radical cystectomy operative time

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Abstract

Objective: To examine factors associated with radical cystectomy operative time among Medicare beneficiaries.

Material and methods: Using linked Surveillance, Epidemiology, and End Results-Medicare data, we identified 4,975 patients who underwent a radical cystectomy during 1991 to 2007. Using a validated method of using anesthesia administrative data to quantify operative time, we used generalized estimating equations to examine the association of patient, provider, and hospital factors on radical cystectomy operative time.

Results: We found that mean operative time decreased by 5 minutes per year ($\Delta = -5.3$ min/y, $P < 0.001$). Longer operative times were found in academic centers ($\Delta = +39.0$ min vs. nonacademic), continent diversion ($\Delta = +34.9$ min vs. ileal conduit), surgical excision of ≥ 11 lymph nodes ($\Delta = +24.9$ min vs. 1–5), female ($\Delta = +32.3$ min vs. male sex), and perioperative anesthesia procedures such as placement of central venous catheters or arterial lines ($\Delta = +47.2$ min vs. no procedures), respectively (all $P < 0.01$). In adjusted analysis, higher surgeon volume ($\Delta = -22.0$ min vs. lowest volume) was associated with shorter operative times ($P = 0.002$).

Conclusions: Operative times for cystectomy have been steadily decreasing annually. There is notable variation based on academic affiliation, diversion type and extent of lymphadenectomy, surgeon and hospital volumes, as well as use of anesthetic procedures. Efforts to improve operative time by selective referral to high-volume surgeons or hospitals or both, or judicious use of perioperative procedures may have a positive effect on health care costs and overall quality of care for patients undergoing radical cystectomy for bladder cancer. © 2016 Published by Elsevier Inc.

Keywords: Bladder cancer; Operative time; Radical cystectomy; SEER-Medicare

1. Introduction

Radical cystectomy remains the gold standard treatment for patients with muscle-invasive bladder cancer. The procedure is time-consuming, as it requires extirpation of the bladder and the surrounding organs, pelvic lymphadenectomy, bowel resection, and urinary diversion. Prolonged operative time has been linked to more frequent complications and higher perioperative mortality among patients undergoing reconstructive and orthopedic procedures [1–3], Using National Surgical Quality Improvement Program data, Lavallée et al. [4] demonstrated that cystectomy operative times over 6 hours were associated with a higher incidence of perioperative complications. Moreover, longer operative times are associated with increased expenditures —a 1 hour increment in operative suite time increases overall hospital charges by $1,000 [5].

Most urologists perform this operation infrequently, with half of radical cystectomies in the United States performed by urologists doing only one of these operations annually [6]. With increasing pressure from policymakers and payers to reduce complications and minimize health care costs, a greater understanding of the association between patient, surgeon, and hospital factors with radical cystectomy operative times is important and timely. This is particularly

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relevant as we transition from fee-for-service payment structures to accountable care organizations. However, there is a dearth of information as to mutable factors that contribute to radical cystectomy operative times. To this end, we performed a population-based study to better discern the various patient, provider, and clinical factors that affect radical cystectomy operative time. We hypothesized that operative time would be decreasing over time and operative time would vary significantly based on selected patient, surgeon, and hospital factors.

2. Material and methods

2.1. Data source and analytic cohort

We used Surveillance, Epidemiology, and End Results (SEER) cancer registry data linked to Medicare claims for our analyses. The data were drawn from 18 SEER registries, which comprised approximately 26% of the United States population [7]. In our initial step, we identified 86,606 patients over 65 years of age who were diagnosed with bladder cancer from 1991 through 2007. Next, we restricted this group to 62,746 patients who had both Medicare part A and B coverage without additional health maintenance organization coverage. Among this group, 5,124 patients had claims for radical cystectomy with an appropriate length of stay (i.e., $\geq$2 days) and operative time ($\geq$120 min). Finally, we excluded 149 patients without 12 months of available claims data before diagnosis, leaving a final analytic cohort of 4,975 patients with bladder cancer patients who were treated with a radical cystectomy.

2.2. Exposures and covariates of interest

Patient age and sex were abstracted from the Medicare file. SEER registry data were used to define tumor stage, tumor grade, race, geographic region, and marital status. We used ZIP code of residence and SEER data to define socioeconomic covariates (e.g., median household income, percentage with high school education, and rural/urban status). Patient comorbidity was defined using the Klabunde et al. [8] method of administrative claims from 12 months before diagnosis.

Surgeon characteristics were assessed using American Medical Association Masterfile data, which were linked to physician identifiers available in Medicare data. Surgeon age, employment type (e.g., solo/2-person, group practice, and medical school), and annual cystectomy volume were included. Surgeon and hospital volume was calculated by aggregating all radical cystectomy cases by each unique surgeon or hospital identifier over the course of the study time frame. We split surgeon and hospital volume variables into evenly divided quartiles. Other hospital factors of interest included ownership status, academic affiliation, hospital size, and annual cystectomy volume. Additional anesthesia procedures were identified using the following Current Procedural Terminology (CPT)-4 codes: placement of epidural (62318, 62319, 62310, 62311, and 62350); arterial line (36620); and central venous catheter (93593).

2.3. Outcomes

We used administrative claims by anesthesiologists to define operative time, consistent with our prior work [9] and reported elsewhere [10]. We assumed that the anesthesiologist claims encompass the time from induction to reversal of general anesthesia. We evaluated operative time as a continuous variable in minutes.

2.4. Statistical analysis

For unadjusted analyses, we employed Wilcoxon rank-sum, chi-square, Fisher exact, and *t* tests to evaluate the association between operative time and pertinent covariates of interest. We fit our multivariate linear regression model and estimated the change in operative time based on significant factors identified with stepwise selection using cutoffs of 0.15 for both significance level to enter and significance level to stay. Generalized estimating equations were used to adjust for clustering at the surgeon level [11]. After fitting this model, we generated predicted mean operative time based on quartiles of surgeon and hospital case volume.

All analyses were performed using SAS (version 9.2; Cary, NC) and STATA software (version 13.1; College Station, TX). All statistical tests were 2-tailed, and the probability of a type I error was set at $<$0.05. The institutional review board at the University of California, Los Angeles, exempted our study protocol.

3. Results

Across the time frame of interest, we noted a gradual decrease in operative times for patients treated with radical cystectomy, where the shortest operative times were noted among patients treated with cystectomy from 2004 through 2007. Patient characteristics of the analytic cohort are seen in Table 1. Table 2 demonstrates the other unadjusted associations between surgeon and hospital factors and operative time. The shortest operative time was noted among solo/2-person (median: 376 min) and group practices (median: 385 min) ($P < 0.001$). Regarding hospital factors, the longest operative times were noted among hospitals with NCI Cancer Center affiliation, government hospitals, large hospitals (i.e., 669+ beds), and those with academic affiliation (all $P < 0.01$). Regarding operative factors, performance of radical cystectomy with continent diversion took 65 minutes longer than radical cystectomy with an ileal conduit diversion (449 vs. 384 min, $P < 0.001$) (Table 3).