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Original article

Hospitalization before surgery and subsequent risk of infective complications after radical cystectomy: A population-based analysis

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Abstract

Introduction: The length of stay prior to surgery increases the risk of postoperative infections (PIs) in several surgical settings, such as cardiac, orthopedic, and general surgery. However, data for urological oncology procedures are limited. We examined PI rates after radical cystectomy (RC) according to the length of stay prior to RC (LOSPRC).

Materials and methods: A total of 24,242 patients with bladder cancer treated with RC between 1998 and 2013 were abstracted from the National Inpatients Sample database. We evaluated changes over time in LOSPRC (0 vs. 1 vs. 2 days or more) and tested its effect on PI rates. Multivariable logistic regression analyses were adjusted for the year of surgery, sex, age, ethnicity, comorbidities, hospital location, teaching status, hospital surgical volume, and number of hospital beds.

Results: Overall, 19,401 (80.0%), 3,990 (16.5%), and 851 (3.5%) individuals with LOSPRC of 0, 1. and 2 or more were identified. The proportion of LOSPRC 0 patients increased from 61.4% in 1998 to 91.0% in 2013 ($P < 0.001$), whereas the opposite trend was observed for LOSPRC 1 and 2 or more. In multivariable logistic regression analyses predicting PIs, LOSPRC of 1 (odds ratio: 1.38; 95% CI: 1.25–1.53; $P < 0.001$) and LOSPRC of 2 or more (odds ratio: 2.15; 95% CI: 1.81–2.55; $P < 0.001$) achieved independent predictor status.

Conclusions: A delay in surgery as short as 1 day significantly increases the risk of PIs after RC. In consequence, same day of admission surgery policies should be further promoted to reduce the risk of PIs.

Keywords: Bladder cancer; Infections; NIS

1. Introduction

Postoperative infective complications, such as pyelonephritis, pneumonia, or sepsis, are common in bladder cancer (BCa) individuals after radical cystectomy (RC). Prevalence of postoperative infections (PIs) ranges from 4% to 25% [1–5]. They predispose to longer hospitalization, increased use of hospital resources and worse outcomes after elective surgery [2,3,6–8].

In the fields of cardiac [9,10], orthopedic [11], and general surgery [10,12,13], several studies demonstrated the presence of an increased risk for PIs according to the length of stay before surgery. However, such studies are single-institution series [9,11–13] or are based on surgeries with PI rates that may be different than major urologic oncology procedures, such as RC. Moreover, few population-based reports are available [10], and available single-institution series refer to historical cohorts [10,11,14,15]. In consequence, it is difficult to generalize and apply these findings directly to urologic oncology. Based on these premises, we

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tested whether PI rates are affected by the length of hospital stay prior to RC (LOSPRC) in BCa.

2. Materials and methods

2.1. Data source and study population

The present study relied on the National Inpatients Sample (NIS) database from the Healthcare Cost and Utilization Project [16]. The NIS database is considered the largest all-payer inpatient care database in the United States and comprises around 20% of all admissions in the United States. It represents a stratified sample of community hospitals from participating states including academic and specialty hospitals in the United States. Until 2011, all data published in the NIS database included all discharges from a sample of participating hospitals. From 2012, the data published in the NIS database represent a sample of discharges from all participating hospitals [17].

The present study cohort consisted of individuals diagnosed with BCa and treated with RC between 1998 and 2013. Relying on discharge records, we used International Classification of Diseases, 9th edition (ICD-9-CM) diagnostic and procedure codes from the hospital claims data in the NIS in order to identify patients with BCa diagnosis (ICD-9-CM diagnostic codes: 188.0–188.9, 233.7, 236.7, 239.4) treated with RC (ICD-9-CM codes: 57.71, 57.79). Patients with unknown age or aged <18 years, sex, all nonelective admissions as well as all individuals with a claim for metastatic disease (ICD-9-CM codes: 197.x, 198.x) were excluded. This resulted in a cohort of 24,242 BCa patients treated with RC. The study population was categorized in 3 groups, based on the number of the (LOSPRC; 0 vs. 1 vs. 2 or more).

2.2. Variable definition and statistical analyses

Patient characteristics included age at surgery, sex, and race (White, African American, and Other). The Charlson comorbidity index (CCI) quantified comorbidities [18]. Hospital characteristics were teaching status (teaching vs. nonteaching), location (urban vs. rural), United States region (northeast vs. midwest vs. south vs. west), and hospital surgical volume. The latter was calculated for each year and hospitals were stratified according to its tertiles [19].

First, we tested the association between LOSPRC and the rate of PIs, defined as any infection during hospital stay after RC. This comprised urinary tract infection (UTI) (ICD-9-CM diagnosis codes: 590.1x, 590.2, 590.8x, 590.9, 599.0), surgical site infection (SSI) (ICD-9-CM diagnosis codes: 567.0, 567.1, 567.2x, 567.3x, 9985x), pneumonia (ICD-9-CM diagnosis codes: 480.x, 481, 482.x, 483.x, 484.x, 485, 486, 997.3x), or bloodstream infection/sepsis (ICD-9-CM diagnosis codes: 995.91, 995.92, 998.0, 999.3x, 038.xx, 785.52, 415.12, 790.7).

Second, additional stratification was performed according to age, comorbidities, sex, race as well as teaching status of the hospital and location of the hospital. Frequency tables displayed patient characteristics, according to LOSPRC. Chi-square and Kruskal-Wallis tests were used to evaluate the statistical significance of associations between categorical and continuous variables, respectively.

Third, we examined PI rates according to LOSPRC categories (0 vs. 1 vs. 2 or more) for each year, and we tested temporal trends using the annual percentage change with the least squares linear regression method. Lowess smoother weighted functions were used in plots.

Fourth, univariable and multivariable logistic regression analyses tested PI predictors, after adjusting for year of surgery, age, sex, race, comorbidities, hospital location, teaching status, hospital surgical volume, and bed size. Fifth, we relied on sensitivity analyses after excluding outliers, defined as individuals with LOSPRC higher than 5 days. Finally, we examined the effect of potential unmeasured confounders that might nullify the increase in PI risk associated with the variable of interest.

All statistical tests were 2-sided with a level of significance set at $P < 0.05$. Analyses were performed using the R software environment for statistical computing and graphics (version 3.3.2; http://www.r-project.org/).

3. Results

Table 1 depicts clinical and pathological characteristics of the 24,242 patients included in the study. The median age was 70 years (interquartile range: 62–77). LOSPRC stratification revealed 19,401 patients (80.0%) with LOSPRC of 0 vs. 3,990 (16.5%) with LOSPRC of 1 vs. 851 (3.5%) with LOSPRC of 2 or more. Of all, 12.5% ($n = 3,027$) experienced PIs after RC.

The characteristics of patients with LOSPRC of 1 or 2 or more differed from those with LOSPRC of 0. Specifically, patients with LOSPRC of 0 were younger than their counterparts with LOSPRC of 1 or 2 or more (69 vs. 71 vs. 71 years, respectively; $P < 0.001$). More individuals with CCI of ≥ 3 were present among individuals with LOSPRC of 1 or 2 or more, compared to patients with LOSPRC of 0 (4.5% and 5.8% vs. 3.3%, respectively; $P < 0.001$). Conversely, the proportion of patients with CCI of 0 or 1 was lower among individuals with LOSPRC of 1 or 2 or more, compared to patients with LOSPRC of 0 (88.3% and 85.5% vs. 89.4%, respectively; $P < 0.001$). Similarly, a higher proportion of Whites was observed among individuals with LOSPRC of 0, compared to patients with LOSPRC of 1 or 2 or more (77.9% vs. 74.6% vs. 74.2%; $P < 0.001$).

Statistically significant differences were also observed according to hospital characteristics. Specifically, LOSPRC 0 patients were more frequent at high surgical volume