



Original article

Female radical cystectomy patients have a higher risk of surgical site infections

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Received 7 February 2018; received in revised form 13 April 2018; accepted 21 May 2018

Abstract

Introduction: Surgical site infections (SSI) are common after radical cystectomy. The objectives of this study were to evaluate if female sex is associated with postoperative SSI and if experiencing an SSI was associated with subsequent adverse events.

Methods: This was a historical cohort study of radical cystectomy patients from the American College of Surgeons' National Surgical Quality Improvement Program database between 2006 and 2016. The primary outcome was development of a SSI (superficial, deep, or organ/abdominal space) within 30 days of surgery. Multivariable logistic regression analyses were performed to determine the association between sex and other patient/procedural factors with SSI. Female patients with SSI were also compared to those without SSI to determine risk of subsequent adverse events.

Results: A total of 9,275 radical cystectomy patients met the inclusion criteria. SSI occurred in 1,277(13.7%) patients, 308 (16.4%) females and 969 (13.1%) males (odds ratio = 1.27; 95% confidence interval 1.10–1.47; $P=0.009$). Infections were superficial in 150 (8.0%) females versus 410 (5.5%) males ($P < 0.0001$), deep in 40 (2.1%) females versus 114 (1.5%) males ($P=0.07$), and organ/abdominal space in 118 (6.2%) females versus 445 (6.0%) males ($P=0.66$). On multivariable analysis, female sex was independently associated with SSI (odds ratio = 1.21 confidence interval 1.01–1.43 $P=0.03$). Females who experience SSI had higher probability of developing other complications including wound dehiscence, septic shock, and need for reoperation (all $P < 0.05$).

Conclusions: Female sex is an independent risk factor for SSI following radical cystectomy. More detailed study of patient factors, pathogenic microbes, and treatment factors are needed to prescribe the best measures for infection prophylaxis. © 2018 Elsevier Inc. All rights reserved.

Keywords: Surgical site infection; Wound infection; Radical cystectomy; Female

1. Introduction

Radical cystectomy is associated with frequent and often severe adverse events. As systems for recording patient outcomes have become more sensitive and comprehensive over time, the reported risk of adverse events has increased from 20% to 30% in early 1980s to upward of 80% in recent publications [1–8]. Higher quality data pertaining to adverse events have allowed for more accurate patient

counseling and have identified specific complications that may be targeted for improvement with interventions.

One relatively common complications of radical cystectomy is surgical site infection (SSI). SSI have negative impacts on a patient's quality of life, are expensive to the health care system, and may also delay adjuvant treatments [2,7–12]. Hence, several investigators have studied risk factors for SSI after radical cystectomy [13–19]. Characterizing risk factors for SSI is important as they identify patients at highest risk and may help determine why some of these infections occur.

It is reasonable to suggest that sex may be a risk factor for SSI following radical cystectomy because males and females have different pelvic anatomy. Furthermore, even

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in anatomical regions where anatomy does not differ, such as orthopedic surgery [20,21], neurosurgery [22], and cardiac surgery [23,24], female sex has been associated with a higher infection rate. Previous studies of SSI in cystectomy have not included sex in multivariable analysis [16–19] or were underpowered [13,14] to detect clinically meaningful differences. The purpose of this study was to evaluate the association between sex and SSI after cystectomy in a large prospective cohort.

2. Methods

The Ottawa Health Science Network Research Ethics Board approved this study. De-identified and anonymized patient data from the American College of Surgeons' National Surgical Quality Improvement Program was reviewed from 2006 to 2016. NSQIP data is prospectively derived from over 500 hospitals, mostly in North America. The database is populated through a combination of automated collection and input from trained surgical clinical reviewers. All participating centers capture data for eligible procedures by either including all cases (smaller hospitals), all cases of preselected procedures (usually high risk procedures), or a rotating 8-day cycle (larger hospitals). In this study we used current procedural terminology codes (51575, 51585, 51590, 51595, and 51596) to include all consecutive radical cystectomy cases available in NSQIP. We excluded partial cystectomies and simple cystectomies.

Patient and treatment data were prospectively collected as per standard of care by NSQIP. Data regarding treating institution, surgeon, and tumor characteristics (such as tumor stage or grade) are available in the database. The primary outcome was the incidence of SSI, a composite outcome that included superficial, deep, and organ/abdominal space infections within 30 days of surgery. For NSQIP clinical reviewers, SSI is defined as any clinically relevant infection related to the surgical site. The subtypes are defined as involving the skin or subcutaneous tissue (superficial SSI), involving the fascia and muscle (deep SSI), and involving any part of the anatomy other than the incision such as intraabdominal abscess (organ/abdominal space). Detailed definitions of each characteristic can be found in the 2014 NSQIP User's Guide [25]. A secondary objective was to determine if females who experience an SSI are at higher risk of subsequent adverse events.

Baseline patient information was compared between males and females using *t* tests or chi squared tests. Risk of SSI was adjusted for differences in baseline characteristics between sexes using logistic regression. In the multivariable model, variables with greater than 25% missing data were excluded. Among female patients, risk of subsequent adverse event was compared between those who had an SSI and those who did not have an SSI. For this portion of the analysis, all adverse events that occurred prior to the SSI diagnosis date were not included in the SSI cohort. All

analyses were performed using SAS software, version 9.4 (SAS Institute Inc.).

3. Results

Between 2006 and 2016, a total of 9,275 radical cystectomy patients (1,877 female and 7,398 male) met inclusion criteria. Baseline characteristics are presented in Table 1. Postoperative SSI occurred in 1,277 (13.8%) patients; 308 (16.4%) females and 969 (13.1%) males (odds ratio [OR] = 1.27; 95% confidence interval [CI] 1.10–1.47; $P = 0.009$). Infections were superficial in 150 (8.0%) females versus 410 (5.5%) males; $P < 0.0001$), deep in 40 (2.1%) females versus 114 (1.5%) males; $P = 0.07$), and organ/abdominal space in 118 (6.2%) females versus 445 (6.0%) males ($P = 0.66$). The mean time to SSI was 13.8 ± 6.3 days in females and 14.2 ± 7.0 days in males ($P = 0.69$). The SSI was diagnosed during the hospital admission in 139 (48.4%) females and 422 (46.4%) males ($P = 0.56$). Several baseline factors were different between females and males, and these were included in multivariable analyses (Table 2). The multivariable model excluded albumin and international normalized ratio since greater than 25% of the cohort did not have these data available. Female sex was independently associated with SSI (OR = 1.21; 95% CI 1.01–1.43; $P = 0.03$).

Female patients who had an SSI had a longer length of hospital stay (11 days; IQR 7–21 days versus 8 days; IQR 6–10 days; $P < 0.0001$), had higher risk of subsequent wound dehiscence (OR = 7.93, $P < 0.0001$), were more frequently delayed in weaning supplemental oxygen (OR = 2.03, $P = 0.04$), more commonly developed sepsis (OR = 3.17, $P < 0.0001$) or septic shock (OR = 2.92, $P = 0.001$), and more frequently required return to the operating room (OR = 4.39, $P < 0.0001$) (Table 3). Infection subgroup analyses were performed for all females. Superficial SSI was associated with dehiscence (OR = 4.24, $P = 0.0013$) and return to the OR (OR = 2.41, $P = 0.003$). Deep SSI was associated with dehiscence (OR not estimable due to 0 cell; $P < 0.001$), return to the operating room (OR = 3.64, $P = 0.005$), and sepsis (OR not estimable due to 0 cell; $P < 0.001$). Organ/space SSI was associated with dehiscence (OR not estimable due to 0 cell; $P < 0.001$), return to the operating room (OR = 4.85, $P < 0.0001$), sepsis (OR not estimable due to 0 cell; $P < 0.001$), septic shock (OR not estimable due to 0 cell; $P < 0.001$), and death (OR = 2.36, $P = 0.056$) in female with SSI.

4. Discussion

In this study, we reviewed the incidence of SSI following radical cystectomy. We found that female sex independently increased the odds of SSI by 21%. Furthermore, females that suffered an SSI had a longer length of hospital stay and other complications compared to those who did not.

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