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Original article

Characterization of perioperative infection risk among patients undergoing radical cystectomy: Results from the national surgical quality improvement program

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Abstract

Objectives: To evaluate the incidence, risk factors, and timing of infections following radical cystectomy (RC).

Methods: The American College of Surgeons National Surgical Quality Improvement Project database was queried to identify patients undergoing RC for bladder cancer from 2006 to 2013. Characteristics including year of surgery, age, sex body mass index, diabetes, smoking, renal function, steroid usage, preoperative albumin, preoperative hematocrit, perioperative blood transfusion (PBT), and operative time were assessed for association with the risk of infection within 30 days of RC using multivariable logistic regression.

Results: A total of 3,187 patients who had undergone RC were identified, of whom 766 (24.0%) were diagnosed with a postoperative infection, at a median of 13 days (interquartile ranges 8-19) after RC. Infections included surgical site infection (SSI) (404; 12.7%), sepsis/septic shock (405; 12.7%), and urinary tract infection (UTI) (309; 9.7%). On multivariable analysis, body mass index ≥ 30 kg/m^2 (odds ratios [OR] $= 1.52$; $P < 0.01$), receipt of a PBT (OR $= 1.27$; $P < 0.01$), and operative time ≥ 480 minutes (OR $= 1.72$; $P < 0.01$) were significantly associated with the risk of infection. When the outcomes of UTI, SSI, and sepsis were analyzed separately, operative time ≥ 480 minutes remained independently associated with increased infection risk in each model (OR $= 2.11$ for UTI, OR $= 1.63$ for SSI, and OR $= 1.80$ for sepsis/septic shock; all $P < 0.05$), whereas PBT was associated with SSI and sepsis/septic shock (OR $= 1.33$ and OR $= 1.29$, respectively; both $P < 0.05$).

Conclusions: Approximately 25% of patients undergoing RC experience an infection within 30 days of surgery. Several potentially modifiable risk factors for infection were identified, specifically PBT and prolonged operative time, which may represent opportunities for future care improvement.

Keywords: Bladder cancer; Radical cystectomy; Infection; Risk factors; Urinary diversion; NSQIP

1. Introduction

Although radical cystectomy (RC) represents a standard treatment for muscle-invasive bladder cancer as well as high-risk non–muscle-invasive disease [1], the morbidity of the procedure remains substantial. Indeed, complications have been reported to occur in up to 78% of patients undergoing RC [2–6]. In addition to patient-related sequelae, perioperative complications increase the risk of readmission, and the cost of care [7–9].

Infectious complications are of particular concern after RC given the use of intestinal substitution for urinary reconstruction. Perioperative infections, including urinary tract infections (UTI), surgical site infections (SSI), and sepsis, have been noted in 20% to 40% of patients following RC [3–5,10,11]. Importantly, however, limited specific analyses exist regarding infectious events after RC, as most often complications have been analyzed in aggregate. Moreover, most data to date on this topic consist of

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reports from single high-volume centers, and as such, the generalizability of these data is uncertain [3,4,11]. Understanding risk factors for infectious events may not only facilitate patient counseling and monitoring, but further may allow for intervention and correction of modifiable variables.

Our hypothesis is that infectious complications following RC are associated with specific clinical factors, the identification of which may improve patient care. Herein, therefore, we used a large national dataset to evaluate clinical factors associated with patients' risk of postoperative infection following RC.

2. Materials and methods

2.1. Data source and cohort development

The American College of Surgeons National Surgical Quality Improvement Project (ACS-NSQIP) is a prospectively maintained database of patients undergoing surgical procedures at 435 hospitals [12]. Data in the ACS-NSQIP dataset are collected by trained surgical clinical reviewers. Morbidity and mortality outcomes are collected to 30 days postoperatively. To develop the present cohort, the 2006 to 2013 ACS-NSQIP database was queried to identify patients with bladder cancer (International Classification of Diseases, Ninth Revision, codes: 188.0 to 188.9, and 233.7) undergoing RC (Current Procedural Terminology codes: 51570, 51575, 51580, 51585, 51590, 51595, and 51596) (Fig. 1). Patients with a documented infection at the time of RC were excluded from analyses, as were patients undergoing concurrent organ resection, including nephrectomy, nephroureterectomy, and total pelvic exenteration. The final analytic cohort consisted of 3,187 patients.

2.2. Patient characteristics and outcomes

Preoperative characteristics including age, sex, smoking status (classified as current [within 1 y of surgery] vs. not current), race/ethnicity, body mass index (BMI), diabetes (yes or no), current steroid use (yes or no), estimated glomerular filtration rate, serum albumin level, and preoperative hematocrit were recorded. Additionally, operative time, receipt of a perioperative blood transfusion (PBT; inclusive of intraoperative and postoperative during hospitalization), and year of surgery were captured. BMI was analyzed as a dichotomous variable (<30 kg/m^2 vs. ≥ 30 kg/m^2) [13], consistent with previous RC series [3,14]. Hematocrit levels were defined based on sex thresholds as normal (male: $\geq$42%; female: $\geq$38%), with low (male: 32%–41%; female: 28%–37%), and very low (male: $<$32%; female $<$28%) considered for each 10% decrease in hematocrit [15]. Operative time was categorized into quartiles and rationalized to the nearest hour ($<$240 min, 240–359 min, 360–479 min, and $\geq$480 min).

The primary outcome of the study was the occurrence of any infection, including UTI, SSI, or sepsis/septic shock, within 30 days of RC. Separate analyses for each infection-type (UTI, SSI, and sepsis/septic shock) were performed as well. The definitions for each of these events used by ACS-NSQIP are provided in Supplemental Table S1. For patients in whom an infection occurred, the timing of the diagnosis of infection relative to RC was documented as well.

2.3. Data analysis

Preoperative characteristics of the patient cohort were described using frequencies/percentages and medians/interquartile ranges (IQR). Associations of patient characteristics with the occurrence of infection were assessed using χ^2 or

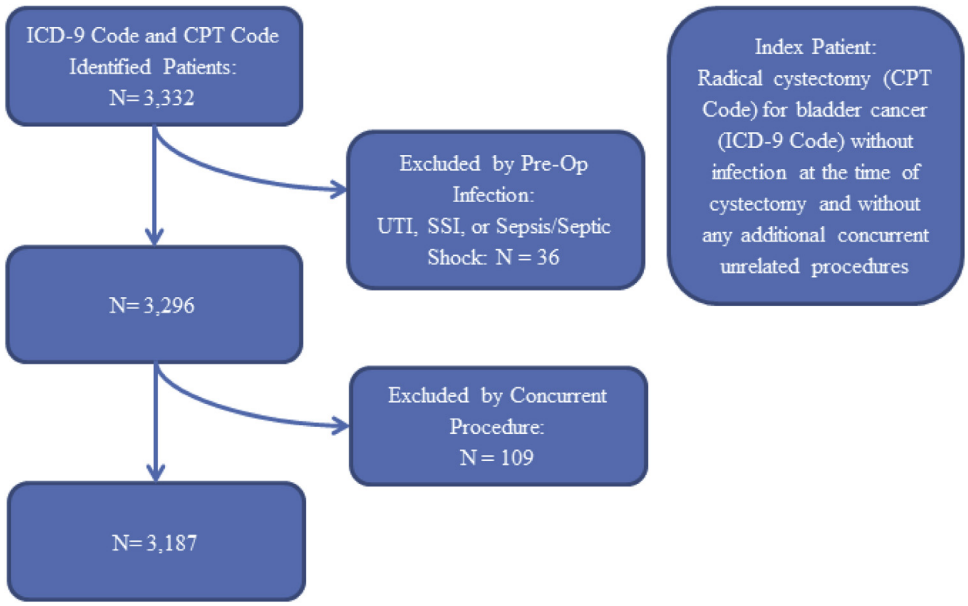

Fig. 1. Cohort selection. Final analytic cohort representative of patients undergoing RC without prior infection or concurrent organ resection.