Complications of Recognized and Unrecognized Iatrogenic Ureteral Injury at Time of Hysterectomy: A Population Based Analysis

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Abbreviations and Acronyms

HCUP = Healthcare Cost and Utilization Project

SID = State Inpatient Database

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Purpose: Ureteral injury represents an uncommon but potentially morbid surgical complication. We sought to characterize the complications of iatrogenic ureteral injury and assess the effect of recognized vs delayed recognition on patient outcomes.

Materials and Methods: Patients who underwent hysterectomy were identified in the Healthcare Cost and Utilization Project California State Inpatient Database for 2007 to 2011. Ureteral injuries were identified and categorized as recognized—diagnosed/repaired on the day of hysterectomy and unrecognized—diagnosed/repaired postoperatively. We assessed the outcomes of 90-day hospital readmission as well as 1-year outcomes of nephrostomy tube placement, urinary fistula, acute renal failure, sepsis and overall mortality. The independent effects of recognized and unrecognized ureteral injuries were determined on multivariate analysis.

Results: Ureteral injury occurred in 1,753 of 223,872 patients (0.78%) treated with hysterectomy and it was unrecognized in 1,094 (62.4%). The 90-day readmission rate increased from a baseline of 5.7% to 13.4% and 67.3% after recognized and unrecognized injury, respectively. Nephrostomy tubes were required in 2.3% of recognized and 23.4% of unrecognized ureteral injury cases. Recognized and unrecognized ureteral injuries independently increased the risk of sepsis (aOR 2.0, 95% CI 1.2–3.5 and 11.9, 95% CI 9.9–14.3) and urinary fistula (aOR 5.9, 95% CI 2.2–16 and 124, 95% CI 95.7–160, respectively). During followup unrecognized ureteral injury increased the odds of acute renal insufficiency (aOR 23.8, 95% CI 20.1–28.2) and death (1.4, 95% CI 1.03–1.9, p = 0032).

Conclusions: Iatrogenic ureteral injury increases the risk of hospital readmission and significant, potentially life threatening complications. Unrecognized ureteral injury markedly increases these risks, warranting a high level of suspicion for ureteral injury and a low threshold for diagnostic investigation.

Key Words: ureter, injuries, hysterectomy, intraoperative complications, iatrogenic disease

Ureteral injury represents an uncommon but potentially morbid complication of abdominal and pelvic surgery. Injury can occur as a result of transection, crush injury, obstruction from inadvertent ligation or thermal injury. Prior reports have noted that gynecologic surgery accounted for

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approximately 50% of iatrogenic ureteral injuries, given the proximity of the ureter to the ovary and uterine artery.[1] The rate of injury at hysterectomy ranges from 0.3% to 1.8% of cases.[2–5]

While identifying ureteral injury intraoperatively allows for prompt repair, delayed diagnosis was reported to account for 67% to 87% of ureteral injury cases.[1,6,7] In clinical and legal case series these injuries have been associated with chronic renal insufficiency secondary to obstruction,[6,8] urinoma formation[7] and urinary fistulas.[7,9]

The purpose of this study was to further characterize the long-term complications associated with ureteral injury at hysterectomy and determine the impact of intraoperative recognition vs delayed diagnosis on patient outcomes.

PATIENTS AND METHODS

Data Source

We used the HCUP SID for California, including 2007 to 2011. The development of HCUP SID was sponsored by AHRQ (Agency for Healthcare Research and Quality) to inform health related decisions.[10] HCUP SID includes patient discharge records for all payers with each SID unique to the individual state. Patient data, which are de-identified and protected, include more than 100 clinical and nonclinical variables. Using a unique linkage variable available in the database patients can be followed longitudinally with time and across inpatient admissions.[11]

Patient Selection

To study the long-term sequelae of ureteral injury we chose an index case of hysterectomy. Ureteral injury is a well documented and studied complication of this procedure with an established rate of 0.3% to 1.8% of cases.[2–5] Hysterectomy cases in adults (age 18 years or greater) were identified by the ICD9-CM codes that were previously used in studies of this population.[12] Supplementary table 1 (http://jurology.com/) lists all ICD9-CM codes used in our study.

Patients who underwent cesarean section on the same day as hysterectomy were also identified. Patients treated with anterior exenteration or pelvic evisceration were excluded from analysis, given the anticipated ureteral manipulation during these procedures. Further, to avoid outcome confounding patients with a present on admission diagnosis of hydronephrosis, hydroureter and/or ureteral stricture at the time of hysterectomy were excluded from analysis. Using the unique patient linkage variable inherent in the data set we identified inpatient readmissions within 1 year following the index hysterectomy admission.

Outcome Measures

Patients were assessed for a new diagnosis of ureteral injury during the index hysterectomy admission or at any subsequent inpatient admission within 1 year postoperatively. Ureteral injury was defined as a new diagnosis of ureteral injury or surgical repair of ureteral injury (eg repair of ureteral laceration, ureteroureterostomy or ureteral reimplantation). Upon followup readmission a new diagnosis of hydroureter, hydronephrosis and/or ureteral obstruction/stricture without a concurrent diagnosis of nephrolithiasis were also included as these entities represent presenting signs of an unrecognized ureteral injury.

Ureteral injuries were further defined as recognized or unrecognized. Recognized ureteral injuries were identified and repaired the same day as hysterectomy was performed. Unrecognized ureteral injuries were identified and/or repaired on a day after hysterectomy was performed, during the same admission or upon readmission. Figure 1 shows the patient population and outcomes assessed in the study.

Patient baseline demographic characteristics and medical comorbidities were assessed (supplementary table 2, http://jurology.com/). The Charlson comorbidity score was calculated for each patient as a measure of overall medical comorbidity. Gynecologic preoperative diagnoses were also determined and grouped as benign, malignant, peripartum hemorrhage or other based on ICD9-CM codes (supplementary table 1, http://jurology.com/).

Additional outcomes specific to ureteral injuries were assessed in the populations with no ureteral injury, recognized ureteral injury and unrecognized ureteral injury. Patients were assessed for readmission within 90 days postoperatively. Additional outcomes assessed within 1 year postoperatively in each group included the identification of patients who required nephrostomy tube placement as well as new diagnoses of acute renal failure, sepsis and urinary tract fistula. Unadjusted mortality rates during year 1 postoperatively were determined.

Statistical Analysis

Descriptive statistics were performed. Continuous variables are reported as the median and IQR. The Wilcoxon rank sum test was performed to assess significance. The chi-square test was used for categorical variables. To determine the independent effects of recognized and unrecognized ureteral injuries on patient outcomes we fit separate multivariable logistic regression models by backward selection using the Akaike information criterion to optimize the model without overfitting and adjusted for confounding conditions. Stata®, version 13 was used for all statistical analysis with $p < 0.05$ considered the threshold for statistical significance.

RESULTS

Between 2007 and 2011 in California 223,872 women underwent hysterectomy (fig. 1). Supplementary table 2 (http://jurology.com/) lists the baseline characteristics of the study population. The women had a median age of 47 years (IQR 42–54), 53.2% were Caucasian and 24.9% were Hispanic. Hysterectomy was performed for benign and malignant gynecologic diagnoses in 81.3% and 13.5% of cases, respectively.

Within 1 year postoperatively 1,753 women (0.78%) were diagnosed with ureteral injury following hysterectomy. Compared to patients without a ureteral