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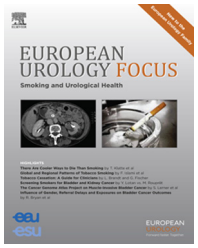

Epidemiology

Complications Following Common Inpatient Urological Procedures: Temporal Trend Analysis from 2000 to 2010

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Abstract

Background: Measuring procedure-specific complication-rate trends allows for benchmarking and improvement in quality of care but must be done in a standardized fashion.
Design, setting, and participants: Using the Nationwide Inpatient Sample, we identified all instances of eight common inpatient urologic procedures performed in the United States between 2000 and 2010. This yielded 327 218 cases including both oncologic and benign diseases. Complications were identified by *International Classification of Diseases*, Ninth Revision codes. Each complication was cross-referenced to the procedure code and graded according to the standardized Clavien system.
Outcome measurements and statistical analysis: The Mann-Whitney and chi-square were used to assess the statistical significance of medians and proportions, respectively. We assessed temporal variability in the rates of overall complications (Clavien grade 1–4), length of hospital stay, and in-hospital mortality using the estimated annual percent change (EAPC) linear regression methodology.
Results and limitations: We observed an overall reduction in length of stay (EAPC: −1.59; $p < 0.001$), whereas mortality rates remained negligible and unchanged (EAPC: −0.32; $p = 0.83$). Patient comorbidities increased significantly over the study period (EAPC: 2.09; $p < 0.001$), as did the rates of complications. Procedure-specific trends showed a significant increase in complications for inpatient ureterorenoscopy (EAPC: 5.53; $p < 0.001$), percutaneous nephrolithotomy (EAPC: 3.75; $p < 0.001$), radical cystectomy (EAPC: 1.37; $p < 0.001$), radical nephrectomy (EAPC: 1.35; $p < 0.001$), and partial nephrectomy (EAPC: 1.22; $p = 0.006$). Limitations include lack of postdischarge follow-up data, lack of pathologic characteristics, and inability to adjust for secular changes in administrative coding.
Conclusions: In the context of urologic care in the United States, our findings suggest a shift toward more complex oncologic procedures in the inpatient setting, with same-day procedures most likely shifted to the outpatient setting. Consequently, complications have increased for the majority of examined procedures; however, no change in mortality was found.
Patient summary: This report evaluated the trends of urologic procedures and their complications. A significant shift toward sicker patients and more complex procedures in the inpatient setting was found, but this did not result in higher mortality. These results are indicators of the high quality of care for urologic procedures in the inpatient setting.

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1. Introduction

Postoperative complication rates are an important indicator of surgical quality. Despite widespread efforts for surgical safety, a recent population-based study using the Medicare Patient Safety Monitoring System reports that improvements in surgical complication rates still lag well behind the strides seen in medical illnesses like heart attacks, heart failure, and pneumonia [1]. In urology, low or declining complication rates have been observed in a wide variety of procedures, including radical prostatectomy [2], partial and radical nephrectomy [3,4], pyeloplasty [5], transurethral resection of prostate [6,7], ureteroscopy [8], and percutaneous nephrolithotomy [9].

Given the current emphasis on improving quality and transparency in health care, there is a need for systematic, population-based measurement of complications [10]. In response, the European Association of Urology (EAU) convened an ad hoc guideline committee, which resulted in a framework for reporting complications in the urologic literature [11]. One of the proposed methods was the Clavien grading of postoperative complications on a standardized scale of 1–4 [12], which has been reported to be underused in urology [13]. The use of other standardized systems for grading and reporting complications, such as the Martin-Donat criteria, have been advocated but seldom implemented into urologic reports [14,15].

On the basis of these considerations, we designed a study to describe and examine population-based trends in urologic complications using an adapted Clavien classification for urologic procedures. We hypothesized that there would be significant changes of urologic complications over the past decade.

2. Materials and methods

2.1. Study population

We used the Nationwide Inpatient Sample (NIS) to retrospectively identify 327 218 unweighted patients aged ≥18 yr who underwent radical prostatectomy (RP), radical cystectomy (RC), radical nephrectomy (RN), partial nephrectomy (PN), transurethral resection of the prostate (TURP), ureterorenoscopy (URS), percutaneous nephrolithotripsy (PCNL), or pyeloplasty (PP) between 2000 and 2010. The choice of procedures was based on a set of criteria evaluating dissemination and representativeness of the specific procedures. Final decisions were based on a consensus of each participating author. The NIS contains data from approximately 8 million inpatient admissions each year, approximating a 20% stratified sample of community hospitals from participating states within the United States [16].

2.2. Covariates

Baseline comorbidity was calculated according to the Charlson Comorbidity Index (CCI) using a previously described methodology [17] as adapted by Deyo and colleagues [18]. Complications during the same inpatient admission were defined according to the Clavien classification, using diagnosis and procedure codes from the *International Classification of Diseases*, Ninth Revision (ICD-9) to grade complication severity [19–21]. Clavien grade 1–4 complications were also aggregated into one overall complication category and subsequently evaluated for each urologic procedure. The specific ICD-9 codes used for complications are described in Supplementary Table 1. We extracted data on covariates including patient race, age, sex, and insurance status, as well as hospital type (urban vs rural, large vs small, and teaching vs nonteaching). According to the EAU guidelines, we determined that our study met 7 of the 10 Martin criteria [11].

2.3. Statistical analyses

Descriptive statistics focused on frequencies and proportions for categorical variables. Means, medians, and ranges were reported for continuously coded variables. The Mann-Whitney and chi-square tests were used to assess the statistical significance of medians and proportions, respectively. We focused on temporal variability in the rates of overall complications (Clavien grade 1–4), length of hospital stay, and in-hospital mortality using estimated annual percent change (EAPC) linear regression methodology as previously described [22,23].

All tests were two sided with a statistical significance set at $p < 0.05$. Analyses were conducted using SPSS v.20 (IBM Corp., Armonk, NY, USA) and the R statistical package v.3.1.2 (R Foundation for Statistical Computing, Vienna, Austria). An institutional review board waiver was obtained prior to conducting this study, in accordance with institutional regulation when dealing with deidentified administrative data.

3. Results

3.1. Baseline characteristics

The unweighted sample of 327 218 patients represents an estimated 1.6 million hospitalizations. Baseline characteristics of the study population are depicted in Table 1. The mean age was 64 yr; TURP patients represented the oldest cohort (72 yr) and PP patients the youngest (42 yr). The population was predominantly male (87.5%), with the exception of PCNL and PP, which were both predominantly female (51.0% and 60.8% female patients, respectively). Of the men and women included, the vast majority was white (ranging from 90% in RC to 79% in PCNL), with black and Hispanic patients composing the second and third most prevalent racial groups. The study population was relatively healthy (93.5% had CCI score <1), and most had either private insurance or Medicare (45.9% and 22.7%, respectively).

The majority of patients were treated at large (68%) and urban (89.5%) hospitals. The most common procedure at urban hospitals was PN (95.2%); the least common was URS (81.2% at urban hospitals). Hospital status (teaching vs nonteaching) was balanced overall (54.8% vs 45.2%) but varied widely by procedure ranging from 73% in teaching hospitals for PN to 39% in URS.

3.2. Procedural trends

The volume of all annually performed urologic procedures did not significantly change across the study period, with an EAPC of +0.28% ($p = 0.69$). When stratified by procedure type, we observed an increase in volume for the oncologic procedures. This included PN (EAPC: +15.96; $p < 0.001$), RN (EAPC: +2.19; $p = 0.004$), RC (EAPC: +5.39; $p < 0.001$), and