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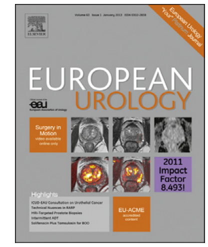

Platinum Priority – Stone Disease

Editorial by Brian R. Matlaga on pp. 93–94 of this issue

Temporal Trends, Practice Patterns, and Treatment Outcomes for Infected Upper Urinary Tract Stones in the United States

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Abstract

Background: The incidence of infected urolithiasis is unknown, and evidence describing the optimal management strategy for obstruction is equivocal.
Objective: To examine the trends of infected urolithiasis in the United States, the practice patterns of competing treatment modalities, and to compare adverse outcomes.
Design, setting, and participants: A weighted estimate of 396 385 adult patients hospitalized with infected urolithiasis was extracted from the Nationwide Inpatient Sample, 1999–2009.
Outcome measurements and statistical analysis: Time trend analysis examined the incidence of infected urolithiasis and associated sepsis, as well as rates of retrograde ureteral catheterization and percutaneous nephrostomy (PCN) for urgent/emergent decompression. Propensity-score matching compared the rates of adverse outcomes between approaches.
Results and limitations: Between 1999 and 2009, the incidence of infected urolithiasis in women increased from 15.5 (95% confidence interval [CI], 15.3–15.6) to 27.6 (27.4–27.8)/100 000); men increased from 7.8 (7.7–7.9) to 12.1 (12.0–12.3)/100 000. Rates of associated sepsis increased from 6.9% to 8.5% ($p = 0.013$), and severe sepsis increased from 1.7% to 3.2% ($p < 0.001$); mortality rates remained stable at 0.25–0.20% ($p = 0.150$). Among those undergoing immediate decompression, 113 459 (28.6%), PCN utilization decreased from 16.1% to 11.2% ($p = 0.001$), with significant regional variability. In matched analysis, PCN showed higher rates of sepsis (odds ratio [OR]: 1.63; 95% CI, 1.52–1.74), severe sepsis (OR: 2.28; 95% CI, 2.06–2.52), prolonged length of stay (OR: 3.18; 95% CI, 3.01–3.34), elevated hospital charges (OR: 2.71; 95%CI, 2.57–2.85), and mortality (OR: 3.14; 95%CI, 13–4.63). However, observational data preclude the assessment of timing between outcome and intervention, and disease severity.
Conclusions: Between 1999 and 2009, women were twice as likely to have infected urolithiasis. Rates of associated sepsis and severe sepsis increased, but mortality rates remained stable. Analysis of competing treatment strategies for immediate decompression demonstrates decreasing utilization of PCN, which showed higher rates of adverse outcomes. These findings should be viewed as preliminary and hypothesis generating, demonstrating the pressing need for further study.

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1. Introduction

Kidney stone disease (urolithiasis) represents a significant burden on health care in the United States, with an estimated \$5.3 billion annually in direct and indirect costs [1]. Although the prevalence of urolithiasis is unknown because it is often asymptomatic, recent estimates demonstrate that >8.8% of the US adult population have been diagnosed with urolithiasis in their lifetime [2]. The rising prevalence in the United States has been linked to increasing rates of obesity, diabetes, and metabolic syndrome. Untreated upper urinary tract calculi may result in obstruction, with the classic symptoms of flank pain, nausea, vomiting, and hematuria. Occasionally, infection in the obstructed urinary tract poses an imminent threat to the patient and may induce significant morbidity including sepsis, pyonephrosis (suppurative destruction of renal parenchyma), and even death [3].

The treatment of infected and obstructive urolithiasis involves prompt decompression of the renal collecting system either by retrograde ureteral catheterization (RUC) or percutaneous nephrostomy (PCN) [4]. PCN avoids general anesthesia, as well as instrumentation of the infected urinary tract, and it is classically considered a safer method of drainage in critically ill patients [5]. There is no empirical evidence to support this paradigm, and existing comparative analyses are inconclusive and limited by small sample size [6,7].

In the current study, we examine the epidemiology of infected urolithiasis in the United States. We assess trends in the incidence and the distribution of practice patterns of competing treatment modalities. Finally, we assess adverse outcomes related to each intervention strategy.

2. Patients and methods

2.1. Data source

Relying on the Nationwide Inpatient Sample (NIS), hospital discharges in the United States between January 1, 1999, and December 30, 2009, were abstracted. The NIS is a set of longitudinal hospital inpatient databases included in the Healthcare Cost and Utilization Project family, created by the Agency for Healthcare Research and Quality through a federal and state partnership [8].

Each discharge includes up to 15 inpatient diagnoses and procedures per hospitalization. All procedures and diagnoses are coded using the International Classification of Disease, 9th Revision, Clinical Modification (ICD-9-CM). Included patient and sociodemographic characteristics are patient gender, race, age, expected source of payment, ZIP code of residence, and outcomes (in-hospital complications and mortality), as well as hospital information (unique hospital identifier and location).

2.2. Patient and hospital characteristics

Available independent variables for analysis were age, race (white, black, Hispanic, other including Asian/Pacific Islander, Native American, and unspecified), and insurance status combined in general groups, namely private insurance, Medicare, Medicaid, and other (self-pay). Baseline patient comorbidities were determined using the Charlson Comorbidity Index (CCI), as adapted by Deyo and colleagues for use in administrative data sets [9]. Hospital characteristics include hospital region (Northeast, Midwest, South, West), obtained from the American Hospital Association Annual Survey of Hospitals and defined by the US Census Bureau. Hospitals were divided into academic and nonacademic institutions; their status was obtained from the American Hospital Association Annual Survey of Hospitals.

Table 1 – International Classification of Diseases, 9th revision, codes of urinary tract infection or pyelonephritis

595.0	Acute cystitis
595.9	Cystitis unspecified
599.0	Urinary tract infection, site not specified; infections affecting structures participating in the secretion and elimination of urine: the kidneys, ureters, urinary bladder, and urethra
590.00	Chronic pyelonephritis without lesion of renal medullary necrosis
590.01	Chronic pyelonephritis with lesion of renal medullary necrosis
590.1	Acute pyelonephritis
590.1	Acute pyelonephritis without lesion of renal medullary necrosis
590.11	Acute pyelonephritis with lesion of renal medullary necrosis
590.2	Renal and perinephric abscess
590.3	Pyeloureteritis cystica
590.8	Other pyelonephritis or pyonephrosis not specified as acute or chronic
590.8	Pyelonephritis; unspecified inflammation of the kidney and its pelvis due to infection
590.81	Pyelitis or pyelonephritis in diseases classified elsewhere

2.3. Study cohort

All patients between January 1999 and December 2009, ≥18 yr of age, with a primary or secondary diagnosis code of 592.0 (calculus of kidney) or 592.1 (calculus of the ureter) were abstracted [10] and assessed for concomitant urinary tract infection (UTI) or pyelonephritis (ICD-9 codes in Table 1) adapted from Dicianno and Wilson [11]. These patients with concomitant urolithiasis and infection served as our study cohort. We then examined patients within this population undergoing ureteral catheterization (ICD-9: 59.8) versus nephrostomy (55.02) or percutaneous nephrostomy without fragmentation (55.03) on the first day of admission. Patients undergoing transurethral removal of obstruction from ureter and renal pelvis (56.0), percutaneous nephrostomy with fragmentation (55.04), or nephroscopy (55.21) were excluded from the analysis.

2.4. Outcomes

Sepsis was defined as previously described and validated [12–14], by the presence of any of the following ICD-9 codes: 020.0 (septicemic), 038 and subtypes (septicemia), 785.52 (septic shock), 790.7 (bacteremia), 995.91 (sepsis), and 995.92 (severe sepsis). Severe sepsis was associated with organ failure and graded by the number of associated organ system dysfunctions or failures [15,16]. Table 2 demonstrates the ICD-9 codes associated with each organ dysfunction.

Length of stay (LOS) was calculated by subtracting the admission date from the date of discharge. Prolonged length of stay (pLOS) was defined as a hospitalization beyond the 75th percentile cut-off of 4 d. Elevated hospital charges (EHCs) were defined as those beyond the 75th percentile of \$28 245 (normalized to 2009 dollars). Perioperative mortality was coded from patient disposition.

2.5. Statistical analysis

Weighted population estimates were derived by applying stratum weights to the discharges according to the stratum from which the discharge was drawn [8]. Incidences were normalized to population