

Outcomes of Shock Wave Lithotripsy and Ureteroscopy for Treatment of Pediatric Urolithiasis



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Abbreviations and Acronyms

AHRQ = Agency for Healthcare Research and Quality
CCS = Clinical Classifications Software
ER = emergency room
GEE = generalized estimating equation
GU = genitourinary
HCUP = Healthcare Cost and Utilization Project
SASD = state specific ambulatory surgery and services database
SEDD = state specific emergency department database
SID = state specific hospital inpatient database
SWL = shock wave lithotripsy
URS = ureteroscopy

Purpose: Shock wave lithotripsy has been commonly used to treat children with renal and ureteral calculi but recently ureteroscopy has been used more frequently. We examined postoperative outcomes from these 2 modalities in children.

Materials and Methods: We reviewed linked inpatient, ambulatory surgery and emergency department data from 2007 to 2010 for 5 states to identify pediatric admissions for renal/ureteral calculi treated with shock wave lithotripsy or ureteroscopy. Unplanned readmissions, additional procedures and emergency room visits were extracted. Multivariate logistic regression using generalized estimating equations to adjust for hospital level clustering was performed.

Results: We identified 2,281 admissions (1,087 for shock wave lithotripsy and 1,194 for ureteroscopy). Ages of patients undergoing ureteroscopy and those undergoing shock wave lithotripsy were similar (median 17.0 years for both cohorts, $p = 0.001$) but patients were more likely to be female (63.4% vs 54.7%, $p < 0.0001$), to be privately insured (69.8% vs 62.2%, $p < 0.0005$) and to have a ureteral stone (81.0% vs 34.8%, $p < 0.0001$). Patients undergoing ureteroscopy demonstrated a lower rate of additional stone related procedures within 12 months (13.6% vs 18.8%, $p < 0.0007$) but a higher rate of readmissions (10.8% vs 6.3%, $p < 0.0002$) and emergency room visits (7.9% vs 4.9%, $p < 0.0036$) within 30 days post-operatively. On multivariable analysis patients undergoing ureteroscopy were nearly twice as likely to visit an emergency room within 30 days of the procedure (OR 1.97, $p < 0.001$) and to be readmitted to inpatient services (OR 1.71, $p < 0.01$).

Conclusions: Ureteroscopy is now used more commonly than shock wave lithotripsy for initial pediatric stone intervention. Although repeat treatment rates did not differ between procedures, ureteroscopy patients were more likely to be seen at an emergency room or hospitalized within 30 days of the initial procedure.

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A growing body of literature suggests that the prevalence of pediatric urolithiasis in the United States is increasing.¹⁻³ We recently found the economic impact of pediatric urolithiasis to be significant, with a conservative estimate of more than \$375 million yearly.⁴ It is noteworthy that this figure does not include the broader financial impact experienced by families and caregivers as a result of lost time and productivity when caring for a sick child.

Recently there has been considerable interest in reevaluating best practices for the management of pediatric urolithiasis. Most pediatric patients with stone disease, similar to adults, need no surgical intervention. In fact, most will pass stones spontaneously, with or without adjunctive pharmacological therapy, and have no lasting sequelae.⁵⁻⁷ However, surgical intervention is needed in approximately 20% to 25% of patients.^{2,3}

Shock wave lithotripsy has been the historical gold standard for treatment of pediatric renal and ureteral calculi since the late 1980s and continues to be the foundation of current clinical practice guidelines.⁸⁻¹⁰ However, advances in endoscopic technology have made the use of ureteroscopic lithotripsy a viable and increasingly common alternative treatment modality.^{9,11,12} Despite substantial differences in invasiveness, cost and intraoperative/postoperative characteristics, studies directly comparing these 2 procedures in pediatric patients are lacking. Given current efforts to improve care quality and optimize cost management, a clearer understanding of the current state of pediatric endourological practice and the efficacy of available treatment modalities is needed. We performed a comparative effectiveness study to characterize differences in procedure frequency, postoperative readmissions and ER visits, and repeat treatment rates for pediatric patients (18 years or younger) with urolithiasis who underwent initial intervention with SWL or URS.

METHODS

Data Source

We analyzed state specific ambulatory surgery and services databases, emergency department databases and hospital inpatient databases from HCUP, sponsored by AHRQ. We limited our analysis to 2007 to 2010 for California, Florida, North Carolina and Utah, and 2008 to 2010 for New York due to data completeness and availability.

SASDs include annual, state specific, encounter level data for ambulatory surgeries and may also include

various types of outpatient services such as observation stays, lithotripsy, radiation therapy, imaging, chemotherapy, and labor and delivery. SEDDs comprise annual, encounter level databases cataloguing visits to hospital affiliated ERs that do not result in admissions. SIDs include annual, state specific, encounter level inpatient data and encompass about 97% of all U.S. hospital discharges. Using HCUP supplemental variables for revisit analysis, these state specific databases can be linked to track sequential visits for individual patients in each setting within a given timeframe. Per AHRQ requirements we restricted reporting of any events occurring in fewer than 15 patients.

Patient Selection

We identified pediatric patients (18 years or younger) with upper tract urolithiasis who underwent either SWL or URS as defined by ICD-9 (International Classification of Diseases, 9th revision, Clinical Modification) and CPT (Current Procedural Terminology) codes. Patients with neurogenic bladder, ureterocele, megaureter, posterior urethral valves, bladder exstrophy, kidney transplant or prune belly syndrome were excluded (supplementary Appendixes 1 and 2, <http://jurology.com/>).

Outcome Selection

The primary outcomes were subsequent inpatient admission or ER visit within 30 or 90 days of the initial procedure, and additional urolithiasis resolution procedure (SWL or URS) performed within 365 days of the initial procedure. All diagnoses were extracted, and genitourinary related diagnoses were selected to exclude subsequent encounters unlikely to be related to urolithiasis procedures using CCS codes from AHRQ. A cutoff of 365 days for additional urolithiasis procedures was chosen to better characterize the success of initial intervention.

Statistical Analysis

Predictor variables were a priori selected based on biological plausibility and/or demonstrated associations per the literature. Covariates included in the final model were age, gender, insurance payer (public vs private), median household income quartiles by zip code, Charlson comorbidity index, treatment year, treatment modality (SWL vs URS) and effect of center specific clustering. We fit an unadjusted logistic regression model to test for a trend in URS utilization.

Bivariate analyses were performed to compare patient demographics and hospital level characteristics of patient cohorts. We used chi-square, Fisher exact or Kruskal-Wallis test as appropriate based on data characteristics and distribution. We used a GEE model to account for the fact that patients within the same hospital tended to have similar outcomes. Given the structure of this data set, individual patients were unable to be tracked across multiple states. When patients were seen in 2 different states, they were considered unique at both encounters. The GEE model accounted for state and hospital level clustering since within the Nationwide Inpatient Sample

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