



Risk factors for repeat surgical intervention in pediatric nephrolithiasis: A Pediatric Health Information System database study

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Summary

Introduction

Successful surgical therapy for pediatric upper urinary tract calculi (UUTC) minimizes the need for repeat surgical interventions. However, staged procedures, whether planned or unplanned, are sometimes necessary. We assessed predictors of repeat intervention for children with UUTC using a nationwide administrative dataset.

Methods

Using the Pediatric Health Information System (PHIS) dataset, we assessed children with UUTC undergoing shock wave lithotripsy (SWL) or ureteroscopy (URS) for an index stone from January 2010 to June 2015. Primary outcome was additional treatment for nephrolithiasis within 90 days. Patient and procedural variables were assessed as potential risks for retreatment. Multivariable logistic regression models were used to compare the risk of retreatment adjusting for potential confounding factors.

Results

A total of 2788 patients undergoing URS (2,216, 79.5%) and SWL (572, 20.5%) were identified. SWL, stenting at the index operation without pre-index stenting, chronic comorbidities, renal calculi, and age <5 years were independent risk factors for retreatment. Use of ureteral stenting, most commonly employed in URS, was also a strong predictor of retreatment. Odds for reintervention, adjusted by multivariate modeling, are shown in the Figure.

Conclusions

Adjusting for measured confounders, SWL is associated with a 2.6-fold higher risk of repeat stone-related interventions. Additional patient-related factors also increase likelihood of retreatment. Intra-operative stent placement is a strong predictor of retreatment, perhaps serving as a marker for complex cases or planned staged procedures. Prospective studies are needed to assess comparative effectiveness of SWL and URS and improve monotherapeutic success for children with UUTC.

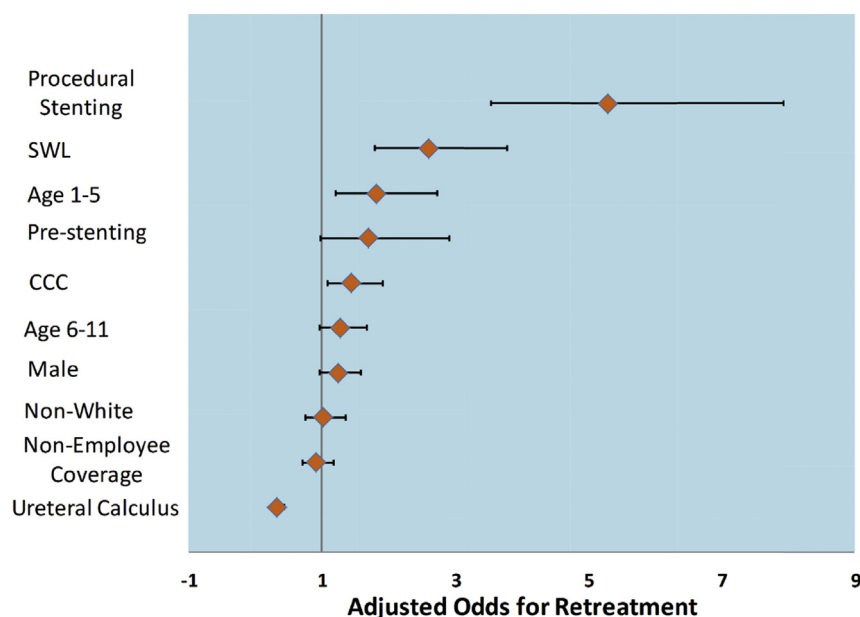


Figure Odds of repeat intervention, adjusted on multivariate analysis.

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Introduction

Up to 22% of children presenting with an acute episode of upper urinary tract calculi (UUTC) will require surgical intervention [1]. Extracorporeal shock wave lithotripsy (SWL) and ureteroscopy (URS) are well-accepted treatment modalities for ureteral and smaller renal calculi [2–5]. Up to 25% of children will require repeat intervention for urinary stone clearance, either because of planned or unplanned retreatments, pre-stenting for ureteral access, or stent removal [1,6].

While stone-free rate is generally considered to be the “gold-standard” of treatment success, retreatment rates are recognized as important outcomes in urinary stone surgery [7]. With costs of hospital-based treatment for pediatric UUTC exceeding \$375 million per year, there exists a need to optimize care by minimizing waste and unnecessary intervention [8]. Furthermore, the potential risks of general anesthetic on neurodevelopment in childhood creates an imperative to improve mono-therapeutic success rates [9,10]. To this end, defining risk factors for repeat surgical intervention in children with UUTC is an important step towards optimizing their surgical care.

We sought to evaluate surgical retreatment rates for children undergoing URS and SWL using the Pediatric Health Information System (PHIS) with a goal of defining risk factors for surgical retreatment. We hypothesized that URS would have a lower retreatment rate than SWL while younger children and those with comorbid conditions would have higher retreatment rates.

Methods

Study population

We performed a retrospective cohort study of children aged 1–17 years with a diagnosis of nephrolithiasis based on International Classification of Disease, Ninth Revision (ICD-9) codes undergoing SWL or URS for an initial treatment of UUTC. Current Procedural Terminology (CPT) codes were utilized to define surgical intervention. Relevant ICD-9 and CPT codes are included in the [Appendix](#). Index treatment was defined as absence of previous surgical intervention for UUTC (SWL, URS, percutaneous nephrolithotomy or open stone surgery) in the previous 6 months. To avoid clustering of treatment choices, patients were only included in the study for their index treatment, and thus all patients were unique. Patients with prior ureteral stenting and percutaneous nephrostomy were included, with these procedures captured as potential confounders. Patients undergoing URS and SWL simultaneously were excluded.

Data source

The PHIS database is an administrative dataset comprising inpatient, ambulatory surgery, emergency department, and observation unit encounters from more than 45 free-standing children’s hospitals affiliated with the Children’s Hospital Association. Combined quality-assurance measures for the data are undertaken by the Children’s Hospital

Association and individual participating hospitals [11]. As data quality-assurance measures continually evolve within the PHIS dataset, we chose to include patients treated from 2010 through June 2015, to ensure adequate follow-up prior to the ICD-10 conversion. One hospital was a significant outlier given a low number of procedures reported and was excluded from analysis.

Demographic variables captured

Patient-level demographic variables captured via PHIS included age, gender, race/ethnicity, insurance type, geographic region, year of surgery, and stone location (as defined by ICD-09 code 592.1), patient comorbidity, and presence of any stone-related intervention (ureteral stent or nephrostomy) within 60 days prior to intervention. Notably, patient comorbidity in PHIS is based on the presence of complex chronic conditions (CCC) [12]. Peri-operative variables captured included treatment type (SWL vs. URS), stent placement before and during the index procedure, and presence of post-operative complication at the index encounter [13].

Primary outcome

Primary outcome was secondary retreatment within 90 days of initial treatment. Retreatments were defined as CPT or ICD-09 procedure codes indicating repeat lithotripsy or stone extraction (see [Appendix](#)). Second-look procedures, such as nephroscopy or ureteroscopy, were not included if they did not indicate stone treatment. Likewise, ureteral stent removal was not included as a repeat intervention. The rationale for this definition was to strictly assess secondary procedures in which retreatment was undertaken for residual stone burden to serve as a proxy for surgical success rates.

Statistical analysis

Demographic variables mentioned above were tabulated, and also cross-tabulated versus treatment choice and primary outcome. To better assess the effect of treatment choice, a multivariable mixed-effects logistic model was estimated for the odds of secondary treatment within 90 days. Besides treatment choice, the model adjusted for age, gender, race/ethnicity (dichotomized to non-Hispanic white vs. all other), insurance (employer vs. all other), chronic comorbidities, stent placement during the 60 days pre-index, stent placement during the index procedure, stone location (ureter, kidney, or both/unknown), and complications. Hospital site was adjusted for as a random intercept. Noting the strong observed associations between treatment choice, stent placement, and outcomes, interactions between the explanatory variables involved (treatment, stent before, stent during) were evaluated for inclusion in the model, using the Bayesian information criterion (BIC). No additional automated model-selection method was employed, and two-sided *p*-values under 0.05 were considered significant. A sensitivity model adjusted for hospital as a fixed effect rather than a random intercept. All analyses were carried out using R, version 3.3

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