Pediatric Urolithiasis—Does Body Mass Index Influence Stone Presentation and Treatment?

Kathleen Kieran,* Dana W. Giel, Brent J. Morris, Jim Y. Wan, Chrisla D. Tidwell, Andrew Giem, Gerald R. Jerkins and Mark A. Williams

From the Division of Pediatric Urology, Department of Urology, University of Tennessee Memphis-LeBonheur Children's Medical Center, Memphis, Tennessee

Abbreviations and Acronyms

BMI = body mass index

CDC = Centers for Disease Control

LBW = lower percentile body weight

NBW = normal percentile body weight

UBW = upper percentile body weight

Study received institutional review board approval.

* Correspondence: Division of Pediatric Urology, University of Tennessee Health Science Center-LeBonheur Children's Medical Center, 770 Estate Pl., Memphis, Tennessee 38123 (e-mail: kkieran@utmem.edu).

Purpose: Pediatric obesity is a major public health concern in the United States. We investigated the association of body mass index with presentation and outcome in children with urolithiasis.

Materials and Methods: We identified all patients 2 to 18 years old at our institution with a radiographically confirmed first renal or ureteral stone between January 2003 and June 2008. Data abstracted included demographics, stone characteristics, treatment and metabolic evaluation. Patients were stratified into 3 body mass index categories, including lower (10th percentile or less for age), normal (10th to 85th percentile) and upper (85th percentile or greater) percentile body weight.

Results: Of the children 62 boys (55.4%) and 50 girls (44.6%) were evaluable. Mean age at diagnosis was 11.8 years. Body mass index stratification showed lower percentile body weight in 11 patients (9.8%), normal percentile body weight in 55 (49.1%) and upper percentile body weight in 46 (41.1%). Mean stone diameter was 5.0 mm. Of the stones 31 (27.7%) were in the kidney or ureteropelvic junction and 81 (72.3%) were in the ureter. Surgery was done in 87 patients (78.9%) and stone clearance was accomplished by 1 (69.0%) or 2 (31.0%) procedures in all. Lower percentile body weight patients presented earlier than normal and upper percentile body weight patients (9.0 vs 12.2 and 12.0 years, respectively, $p = 0.04$). Neither stone size nor the number of procedures required for stone clearance differed significantly by body mass index.

Conclusions: Upper percentile body weight was not associated with earlier stone development, larger stones or the need for multiple surgical procedures. In lower percentile body weight patients symptomatic renal stones developed significantly earlier than in normal or upper percentile body weight patients. Stone size and the surgical intervention rate were similar regardless of body mass index. Further research may identify potential factors predisposing children with lower percentile body weight to early stone development.

Key Words: kidney, ureter, urolithiasis, thinness, obesity

THE obesity rate in the United States is skyrocketing with 34.1% of American adults now considered overweight (BMI 25 to 29.9 kg/m^2) and 32.2% obese (BMI 30 kg/m^2 or greater).[1] Recent estimates characterize a significant proportion of the pediatric population as overweight with 31.9% of children above the 85th percentile and 11.3% above the 97th percentile for age adjusted BMI.[2] Annually $147 billion is spent in the United States to treat obesity related conditions with obese patients generating costs 42%

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higher than their normal weight counterparts.[3] In 2005 inpatient care for obesity and obesity related conditions in children alone accounted for $237 million.[4] The adverse impact of obesity on medical and surgical outcomes is well documented for various conditions, including prostate cancer, degenerative joint disease, cardiovascular disease and trauma.[5]

Nephrolithiasis affects 5% to 10% of the population at any given time.[6] Stone development in adults has been extensively studied and numerous risk factors have been identified, ranging from altered hydration status to metabolic disorders to urinary stasis.[7,8] The stone development rate is significantly higher in overweight and obese adults than in the general population.[6] Technical factors and a high comorbidity incidence in obese patients may necessitate multiple procedures and higher acuity care to achieve definitive treatment of the stone burden in these patients.[9]

The incidence of nephrolithiasis in children has increased in the last decade.[10] Compared with the adult literature there are currently relatively few published studies of pediatric nephrolithiasis. Thus, the scope of the problem and the impact on the health care system are presently poorly understood. Although some children have identifiable metabolic abnormalities on 24-hour urine collection, anatomical anomalies of the urinary tract or obvious predisposing factors, eg immobility, the risk factors for stone formation have not been well elucidated in most children.[10]

Anecdotally we noted at our institution that many children who present with nephrolithiasis are above normal weight for age. In this study we reviewed our institutional experience with nephrolithiasis. We hypothesized that the presentation and outcome in children with stones may differ in overweight and underweight children compared with their normal weight counterparts.

MATERIALS AND METHODS

After obtaining institutional review board approval we used ICD-9 codes (592.x) to identify all patients 2 to 18 years old who presented with a radiographically confirmed renal or ureteral calculus between January 2003 and June 2008. Patients with a definite history of nephrolithiasis were excluded from study. All institutional sites, eg inpatient admissions, outpatient surgery, clinics and emergency department, were included. To ensure comprehensive identification of patients with stones a separate query was performed using CPT codes to identify patients who had undergone procedures commonly performed for renal or ureteral calculi, eg cystoscopy with stent placement, ureteroscopy, lithotripsy or stone extraction. These 2 lists were cross-referenced and we identified no additional patients using CPT codes.

Data were collected on demographics, BMI, stone characteristics, medical and surgical therapies, and metabolic evaluation, when done. In patients with recurrent stones only the first stone episode was included in analysis. When a patient had multiple stones, only the stone most likely to have prompted evaluation and treatment was included in analysis. In patients with renal as well as ureteral calculi this was generally the ureteral stone while in those with multiple renal stones this was the largest renal stone.

For the purpose of analysis we stratified patients into 3 BMI categories according to CDC age adjusted BMI percentiles for children, including LBW—10th percentile or less, NBW—10th to 85th percentile and UBW—85th percentile or greater.[1] These categories approximate the age specific BMI percentiles used at CDC to delimit underweight (5th percentile or less), normal weight (5th to 85th percentile) and overweight (85th percentile or greater) children. Due to the few children meeting the strict CDC criteria for underweight we expanded this category to include children at or below the 10th percentile, as in prior publications.[11]

Statistical analysis was done using SAS®, version 9.2. Demographic variables are described using measures of central tendency. BMI groups were compared using 1 and 2-way ANOVA with Tukey's HSD post hoc test to further elucidate differences between groups. Data were considered statistically significant at $p \leq 0.05$.

RESULTS

A total of 132 patients met study criteria. BMI information was available in 112 patients (84.8%) with a mean ± SD age of 11.8 ± 3.9 years and a mean BMI of 21.2 ± 6.5 kg/m^2. Mean maximum stone diameter was 5.0 ± 3.5 mm. Table 1 lists demographics. Imaging in all patients was prompted by a complaint of abdominal or flank pain. Of the patients 11 (9.8%) had LBW, 55 (49.1%) NBW and 46 (41.1%) had UBW. A total of 25 patients (22.3%) had multiple stones, including 17 (68%) with 2 and 8 (32%) with 3. Of the index stones 21 (18.8%) were in the kidney, 10 (8.9%) were at the ureteropelvic junction and 81 (72.3%) were in the ureter at initial presentation. Surgery was done in 87 patients (77.7%) to treat the stone, of whom 60 (69.0%) underwent a single procedure and 27 (31.0%) required 2 procedures for stone clearance. No patient underwent more than 2 procedures for stone treatment.

Table 2 shows patient characteristics stratified by BMI. There were no significant differences across BMI distributions for family history of nephrolithiasis ($p = 0.59$), comorbidity ($p = 0.83$) or gender distribution ($p = 0.60$). LBW patients presented with stones significantly earlier than NBW or UBW patients (9.0 vs 12.2 and 12.0 years, respectively, $p = 0.04$). This relationship persisted when renal ($p = 0.005$) but not ureteral ($p = 0.42$) stones were considered independently. Stone size ($p = 0.18$), number of procedures required for stone clearance ($p = 0.11$) and stone recurrence rates ($p = 0.68$) were similar across BMI groups.