Metabolic Evaluation of Urolithiasis and Obesity in a Midwestern Pediatric Population

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Purpose: The incidence of urolithiasis has been proved to be increasing in the adult population, and evidence to date suggests that the same holds true for the pediatric population. While adult urolithiasis is clearly linked to obesity, studies of pediatric patients have been less conclusive. We hypothesized that a population of otherwise healthy children with stones would have an increased body mass index compared to a control population, and that obese pediatric stone formers would have results on metabolic assessment that are distinct from nonobese stone formers.

Materials and Methods: We retrospectively reviewed the charts of all patients 10 to 17 years old with upper tract urolithiasis without comorbidities treated between 2006 and 2011. Mean body mass index of our population was compared to state data, and 24-hour urine collection results were compared between obese and nonobese patients with stones.

Results: The obesity rate in 117 patients with urolithiasis did not differ significantly from the obesity rate derived from the 2007 National Survey of Children's Health (observed/expected ratio 1.11, 95% CI 0.54−1.95). Using t-test and chi-square comparisons, overall 24-hour urine collection data did not show statistically significant differences.

Conclusions: Our results do not confirm obesity as a risk factor for pediatric urolithiasis in otherwise healthy patients. We also found no substantial metabolic differences between healthy nonobese stone formers and obese patients. While the pediatric literature is mixed, our study supports the majority of published series that have failed to establish a link between pediatric urolithiasis and obesity.

Key Words: obesity, pediatrics, urolithiasis

Abbreviations and Acronyms

BMI = body mass index

BMI% = body mass index percentile

BSA = body surface area

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THE incidence of kidney stones is increasing in adults and appears to be increasing in children, although the evidence is more limited in the latter. Analysis of the Pediatric Health Information System database demonstrated an increase in admissions for urolithiasis, from 13.9 cases per hospital in 1999 to 32.6 cases in 2008.[1] Single institutional reporting has revealed the same trend.[2,3] These increases may exist because of better reporting, increased diagnosis due to more frequent use of computerized tomography or changes in referral patterns. However, the contemporary trend of increased incidence of stone disease continues, a finding that would be unexpected if driven by bias alone.[4] Given the physical costs associated with this diagnosis, along with the societal costs, targeting

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appropriate risk factors for stone formation is highly relevant.

A number of factors contribute to the increasing incidence of urolithiasis in the adult population, including a well-defined relationship between high BMI and stone formation.[5–7] While it is well established that the prevalence of high BMI is increasing in the pediatric population,[8,9] the link between obesity and pediatric stone disease is less clear. We sought to find evidence of a relationship with obesity in an otherwise healthy sample of pediatric stone formers.

Others have examined this association previously. Conclusions have been mixed regarding a correlation with BMI. Kim et al used age matched controls and failed to show a statistical link.[10] Two additional studies using population matched controls also failed to demonstrate an increased incidence of obesity among stone formers.[4,11] Conversely urolithiasis was associated with higher odds of obesity in a matched case control study using the Pediatric Health Information System database.[12]

Similarly metabolic assessment, a key diagnostic tool in preventing pediatric stone disease, has resulted in differing conclusions regarding obese vs nonobese patients. A 2009 California study of 43 children suggested that as calculated BMI percentile increased, supersaturation of calcium phosphate increased and urinary oxalate excretion decreased, while urinary calcium, citrate and pH were unchanged.[13] However, a 2012 series revealed only a decreased urinary citrate level when comparing overweight to normal weight children.[11] A study from Turkey in 2008 found that urinary oxalate excretion increased and urinary citrate decreased in children with urolithiasis and high BMI compared to nonobese patients.[14]

Thus, the pediatric literature is limited and contradictory regarding the link between high BMI and risk of urolithiasis, as well as findings regarding metabolic assessment. It is unclear whether the disparities are related to differences in study design or represent a true variation in regional findings. Our study adds further knowledge in this area. Our primary hypothesis is that otherwise healthy pediatric patients with stones will have an increased incidence of high BMI compared to controls. Our secondary hypothesis is that obese pediatric stone formers will have results on metabolic assessment that are distinct from stone formers with a normal BMI.

MATERIALS AND METHODS

This study consisted of a retrospective case-control chart review of children presenting with urinary calculi at a major tertiary care pediatric hospital and health system. This series compares disease characteristics of urolithiasis in groups categorized as obese (case) and nonobese (control). Comparisons of obesity rates were also made between the case group of stone formers with data from the general pediatric population in Wisconsin via the 2007 National Survey of Children's Health.[15] The study was approved by the Children's Hospital of Wisconsin institutional review board. Statistical calculations were performed using Microsoft® Excel® 2007.

Selection Criteria

The target population of this study was chosen as a representative sample of pediatric stone formers. Initial inclusion criteria consisted of a diagnosis of "calculus of kidney," "calculus of ureter" or "urinary calculus, unspecified" (ICD-9 codes 592.0, 592.1 and 592.9, respectively) from 2006 to 2011. These diagnoses were confirmed by the presence of radiographic evidence or stone analysis in patient charts. A search for "uric acid calculus" diagnoses (ICD-9 code 274.11) was performed but yielded no additional subjects for inclusion. Patient charts with ICD-9 codes 788.0 and 789.0 (representing renal colic and abdominal pain, respectively) were also examined to ensure that no urolithiasis was missed. However, these codes failed to supply additional subjects. Subjects from birth to 18 years at initial presentation or with recurring presentation between 2006 and 2011 were included. These inclusion criteria yielded 299 patients with a history of urolithiasis.

Diagnoses of lower urinary tract stones (urethral and bladder stones) and congenital abnormalities of the kidneys (ICD-9 codes 594.2, 594.8, 594.9 and 753.3) were used as exclusion criteria to avoid confounding bias. Any patient with a confirmed history of cystine stones, spina bifida, cerebral palsy, extended immobility within 3 months of stone presentation, metabolic abnormality, endocrine abnormality, rheumatological abnormality, gastrointestinal abnormality, surgical genitourinary reconstruction, chromosomal abnormality, profound developmental delay, malignancy or neurogenic bladder was excluded for the same reason. After excluding for confounders 177 of the 299 subjects younger than 19 years remained.

Study subjects were further focused to most closely mirror adults with urolithiasis because of known correlations between obesity and stone formation in adults. The final study population included 125 patients 10 to 17 years old. Demographic data characterizing study subjects according to gender, race and age at presentation are outlined in table 1.

Data Collection

Weight and height were recorded within 4 months before or after initial or earliest documented stone presentation within the study period. One exception was a subject with no recorded height within the allotted time frame and a recorded stable height outside the time frame. Body mass index was calculated for each subject if height and weight were recorded within acceptable time parameters using BMI = weight (kg)/height^2 (m^2). Body mass index percentile was further calculated to account for the variation observed in children of different ages and genders,[10,16]