



Original Research

Multidimensional Analysis of Urinary Stone Diseases in Pediatric Patients

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Abstract

Objectives: Urinary tract stones are less common in children than in adults. Determining the etiology is the most important step to achieve successful treatment and prevent future recurrence. The aim of this study was to investigate the clinical characteristics and possible risk factors for urinary stone disease in pediatric patients.

Methods: The data of 126 patients with urinary stone disease who were treated in a pediatric nephrology clinic between 2000 and 2014 were analyzed retrospectively. A total 126 patients were enrolled in the study: 70 (55%) male and 56 (45%) female patients were included. The complaints, age of diagnosis, family histories, and stone location were examined. Direct urine microscopic examination, complete urinalysis, and urine culture were performed for all of the patients. Calcium, uric acid, oxalate, citrate, magnesium, and cystine levels were measured in urine collected in a 24-hour period. Serum electrolyte, blood urea nitrogen, creatinine, calcium, phosphorus, uric acid, and albumin levels were measured. Urinary ultrasound was performed. Stone analysis was conducted using the X-ray diffraction method. The mean age of the patients was 55 months (range: 1-162 months) at presentation.

Results: In all, 34% of the patients had a family history of urinary stone disease. The rate of previous urinary tract infection was 26%. It was determined that 34% of the patients had been taking vitamin D and 5% had been taking a high dose. Metabolic risk factors determined were: hypercalciuria in 41%, hypocitraturia in 30%, hyperoxaluria in 14%, hyperuricosuria in 10%, and cystinuria in 5%. Among the group, 81% of the patients had kidney stones, 6.5% had ureter stones, and 2.5% had bladder stones. Furthermore, it was determined that 45% of the stones were composed of calcium oxalate, 35% had calcium phosphate stones, 14.2% had uric acid stones, and 13.3% had cystine stones. In 52% of the cases, extracorporeal shock wave lithotripsy was performed, and 71% underwent surgical treatment.

Conclusion: Metabolic evaluation and stone analysis should be performed to prevent future recurrences in children with urinary stone disease and lifelong follow-up should be emphasized.

Keywords: Nephrolithiasis; stone; urinary system.

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Urinary stones are less common in children than in adults.^[1] When all age groups are evaluated together, cases of pediatric urolithiasis constitute 2% to 2.5% of all

cases. The frequency of pediatric stone disease is reported as 1/1000-7600 cases. Urinary system stones are more common in boys than girls, with a male/female ratio of 1.5.

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Upper urinary system stones are more common in developed countries and bladder stones are more common in developing countries.^[2] Upper urinary system stones have been detected with greater frequency in recent years in our country.^[3, 4]

In urolithiasis cases, it is very important to determine the etiology in order to achieve success in treatment and prevent recurrence. A metabolic disorder has been reported in 12% to 50% of pediatric cases.^[3, 4, 5] In a research study, Thomas et al.^[1] observed anatomical anomalies in 44%, infections in 30%, idiopathic etiologies in 14%, and metabolic causes in 12% of the urinary stone cases studied. Metabolic causes were found in 20% to 30% in most of studies that determined an etiological classification.^[3, 4] Today, extracorporeal shock wave lithotripsy (ESWL) and endourological interventions have largely replaced open surgical procedures as the primary treatment modality.

Methods

The data of 126 pediatric patients diagnosed with urinary stone disease between 2000 and 2014 at a children's nephrology outpatient clinic were analyzed retrospectively. The patient complaints, age at diagnosis, family histories, and stone location were determined. Direct urine microscopic examination, complete urinalysis, and urine culture were performed for all of the patients. Twenty-four hour urine calcium, uric acid, oxalate, citrate, magnesium, and cystine levels were measured. The results were compared with the normal reference values and the patients with a metabolic risk factor were determined. Serum electrolyte, blood urea nitrogen, creatinine, calcium, phosphorus, uric acid, albumin measurements, urinary ultrasound, and stone analysis were performed (X-ray diffraction method).

The treatment modalities applied were recorded. Dietary sodium restriction and abundant fluid intake were recommended for the patients who were in the idiopathic group. The patients with metabolic causes were treated according to the etiology. Patients with a urinary tract infection (UTI) were treated with the appropriate antibiotics according to the culture antibiogram results. Patients with frequent UTIs received oral antibiotic prophylaxis.

Results

A total of 126 cases were evaluated from a 14-year period. Seventy (55%) patients were male and 56 (45%) were female. The mean age at admission was 55 months (range: 1-162 months). There was a family history of a stone in 34%, history of UTI in 26%, vitamin D use in 34%, 5% of whom were using a high dose. Metabolic factors were found in 56 (45%), UTI in 26 (33%), and idiopathic etiologies in 29

Table 1. Metabolic risk factors detected in children with urolithiasis

Metabolic risk factors	n	%
Hypercalciuria	24	41
Hypocitraturia	16	30
Hyperoxaluria	8	14
Hyperuricosuria	5	10
Cystinuria	3	5

Table 2. Localization of the stones

Localization	n	%
Renal pelvis	102	81
Ureter	21	16.5
Bladder	3	2.5
More than 1 localization	24	19

Table 3. The results of stone analysis

Stone type	n	%
Calcium oxalate	56	45
Calcium phosphate	35	27
Uric acid	18	14.2
Cystine	17	13.3

(37%) patients. The metabolic causes revealed were hypercalciuria in 41%, hypocitraturia in 30%, hyperoxaluria in 14%, hyperuricosuria in 10%, and cystinuria in 5% of the patients.

The metabolic risk factors detected in children with urolithiasis are shown in Table 1.

Stones were seen in the kidneys in 81%, the ureter in 16.5%, the bladder in 2.5%, and more than 1 location in 19% of the patients. The localization of the stones is displayed in Table 2.

Calcium oxalate was detected in 45%, calcium phosphate in 35%, uric acid in 14.2%, and cystine in 13.3% of the stones removed. These patients underwent ESWL in 52% of the cases and surgical interventions, including open surgery, ureteroscopy, retrograde intrarenal surgery, and percutaneous nephrolithotomy were applied in 71%. The results of stone analysis are provided in Table 3.

Discussion

The diagnosis of urolithiasis in children is difficult because the complaints are usually nonspecific; nonetheless, early diagnosis is very important to reduce morbidity. It has been established that kidney stones are more common in men.^[6] ^{7]} In our study, 55% of the patients were male and 45% were female. It has also been reported that children with kidney stones often have a family history of stones.^[8, 9]

In our study, a family history was found in 34% of the cases, which is consistent with the literature findings. There was a 28% history of a UTI in the family in our study, while it was 48% in Coward's study [6], 70% in the study conducted by Erbağcı et al.[8], and 48% was reported by Alpay et al.^[10]

It has been reported that 1% to 2% of stones in patients followed up with the diagnosis of urolithiasis were related to the use of drugs.^[11] Calcium and vitamin D supplementation have been found to play an important role in the nucleation and growth of metabolic stones.^[11] In 5% of our patients, vitamin D was used in higher doses than recommended. In recent years, the potential role of the widespread use of vitamins and overdosing of vitamin D has been examined for an association with an increased incidence of kidney stones. Vitamin D with calcium supplements may result in hypercalciuria and nephrolithiasis, especially in patients with underlying hypercalciuria.^[12, 13]

In our study, the most common metabolic risk factor was hypercalciuria, which was determined at 42%. The rate was 25.8% in the study contributed by Özokutan et al.^[3] Research has found that stones were most frequently located in the upper urinary tract.^[10, 14] In our patients, a large percentage (81%) of the stones were located in the kidney. Etiopathogenesis-targeted treatment and follow-up are as important as the diagnosis and metabolic analysis of pediatric stone patients. However, data from after the treatment could not be reported in our group because some of the patients were lost to follow-up. This is a weak point of our study. This work should be viewed as an examination of the detection of the etiology and metabolic features of urolithiasis in children.

After surgery to remove a stone, some patients and their families may think that the treatment is complete, despite presentation with contrary information. This may be one of the reasons why they are lost to follow-up. The retrospective nature of our study made it difficult to collect and evaluate long-term data. Prospective follow-up of patients is particularly important in terms of follow-up of treatment response and prevention of recurrence.

Conclusion

The diagnosis and metabolic analysis of pediatric stone disease requires increased awareness and a careful approach. Documentation of postoperative stone analysis and compliance with long-term preventive treatment have been lacking. In order to reduce the morbidity associated with pediatric stone diseases, close collaboration between clinics of pediatric urology and pediatric nephrology is necessary.

Disclosures

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