Original Article

Pediatric nephrolithiasis in Khyber Pakhtunkhwa Province, Pakistan

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ABSTRACT

Objective: To determine the frequency of various stone types in children less than 15 years of age.

Methodology: In this cross sectional study, data and stone samples were collected from 145 patients admitted in tertiary care hospitals of Peshawar. Chemical composition of stones was identified using DiaSys urinary calculi analysis kit. Data was analyzed through SPSS version 16.0.

Results: Mean age of the children was 7.37± 4.1 years. Stone formation was more common in males (M/F1.5:1). Family history was present in 44.14% patients. Majority (32.4%) of renal stones were heterogeneous in composition. Pure calcium oxalate was present in 26.2% stones. Calcium oxalate was the principal constituent in 98% stone samples, followed by calcium phosphate (58.6%), ammonium urate (45.5%) and uric acid (4.13%).

Conclusion: Majority of renal stones were heterogeneous in composition with calcium oxalate as a principal constituent. Family history may be a strong indicator of stone formation.

KEY WORDS: Renal stones, Chemical composition, Family history.

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INTRODUCTION

Urolithiasis is an important health problem and common in some parts of the world. The occurrence varies according to geographic area, ethnic distribution, and socioeconomic status of the population.[1] The site of localization of stone in the renal system is not uniform throughout the world. The changes in localization are attributed to variations in dietary habits and socioeconomic conditions.[1]

Pakistan lies in the Afro-Asian stone belt which includes Sudan, Egypt, Saudi Arabia, the United Arab Emirates, Iran, Pakistan, India, Myanmar, Thailand, Indonesia and Philippines.[1] The prevalence in Pakistan is 10-15%.[2]

The etiology of stone formation depends on dietary habits, metabolic and anatomic abnormalities.[2] Diet high in oxalate, sodium and animal protein, low in calcium increases the risk of urolithiasis. High dietary calcium scavenges oxalate present in gut and decreases urinary oxalate excretion. Management of pediatric urolithiasis necessitates thorough metabolic workup and patients having positive family history require proper follow up to prevent stone recurrence.[3]

Hypercalciuria is common in patients with calcium oxalate nephrolithiasis and contribute to urine hypersaturation to calcium oxalate.[4] Dehydration and diarrhea further aggravate the problem.[5]

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As scarce data is available on renal/ urological stones in children from Pakistan therefore the present study was carried out to find out various stone types of the renal origin in children from Khyber Pakhtunkhwa.

METHODOLOGY

This was a two years (February, 2009 to January 2011) cross sectional study based on sequential sampling technique. Patients aged below 15 years operated for stones of the urinary tract in tertiary care teaching hospitals of district Peshawar namely, Institute of Kidney Diseases, Lady Reading Hospital and Khyber Teaching Hospital were included in the study. Patients with anatomical abnormality were excluded from the study.

Ethical approval was taken before the commencement of study and informed consent was taken from the patient/parents. They were interviewed for demographic, dietary, clinical and family history on a questionnaire and stone samples were taken for chemical analysis. Socioeconomic status was evaluated on the basis of monthly family income from all sources. Family income below Rs.10,000 was taken low socioeconomic group, Rs.10,000-30,000 middle socioeconomic and family income above Rs.30,000 was taken as high socio economic group. Family history was assessed by asking all the participants if parent, uncle, grandfather or grandmother had ever renal stone. Stones were washed and completely dried at 37°C in an oven. Stones were analyzed for chemical composition by using DiaSys urinary calculi analysis kit.

The data was entered and analyzed using SPSS version 16 in the form of frequencies (percentages) and Mean ±SD.

RESULTS

One hundred and forty five children operated for urinary tract stones were included in the two years study period. There were 86(59%) males and 59(41%) females. Stone formation was more common in males with a gender ratio of 1.5:1. Mean age was 7.37±4.1 years. Most of the children belonged to low socioeconomic class having mean monthly family income of Rs.8291± 5.28 (Table-I).

Table-I: Demographic characteristics (n=145).

Age	7.37+ 4.1 years
Mean	8.0 years
Median	
Children less than 05 years	44(30.3%)
Children between 05-09 years	53(36.6%)
Children more than 10 years of age	48(33.1%)
Sex	
Males	86(59%)
Females	59(41%)
Male to female ratio	1.5:1
Monthly family Income (Mean+ SD)	8291+ 5.28 (Rs.)
Number of family members(Mean+ SD)	6.2+ 3.08

Majority 130(90%) of children were using ground water for drinking. The intake of oxalate rich foods like chocolate, soft drinks, peanuts, spinach, raw tomatoes and meat, a rich source of purines was also very low (Table-II).

Clinical presentation showed different signs and symptoms in children with urolithiasis. Among those abdominal pain was the major manifestation in 102 (70%) cases, followed by fever in 94 (64.8%), vomiting in 77(53.1%), anuria in 53(36%) and burning micturation in 66(45.5%) children. Diagnosis was made in majority 106(73%) of the patients due to the presence of symptoms, 26 (18%) were recurrent stone formers and the remaining 13 (8.9%) were diagnosed incidentally. Regarding family history of stones in first or second degree relatives, 64(44.14%) children had a positive family history of stones formation. (Table-III).

Majority 47(32.4%) of renal stones were of mixed composition, consisting of calcium oxalate, calcium phosphate and ammonium urate followed by pure calcium oxalate in 38(26.2%) stones. Combination of calcium oxalate and calcium phosphate was present in 31(21.4%) stones. Uric acid was present in combination with calcium oxalate and calcium phosphate in 06 (4.1%) samples (Table-IV).

Calcium oxalate was the principle constituent, present in 143(98%) of pediatric stones, followed by

Table-II: Source of drinking water and dietary habits (n=145).

Source of drinking water	*N*	*%*
Canal	03	2.0
Spring	12	8.0
Ground water	130	90
Number of glass of water drunk per day(Mean+ SD)	3.04+1.36	
Number of cups of tea taken / day(Mean+ SD)	3.0+ 1.6	
	N	*%*
Patients drink a cup of milk daily	19	13
Patients eating chocolates frequently	37	25
Patients using soft drinks frequently	28	19.3
Patients eating peanuts frequently	40	28
Patients eating spinach frequently	12	8
Patients eating chillies frequently	14	9.7
Patients eating raw tomatoes frequently	54	37
Patients eating meat frequently	22	15

Table-III: Clinical characteristics.

Signs and Symptoms (n=145)	*Frequency*	*%*
Fever	94	64.8
Abdominal pain	102	70
Macroscopic hematuria	40	27.6
Anuria	53	36
Burning micturation	66	45.5
Vomiting	77	53.1
How did the patient know about stone? (n =145)		
Incidental	13	8.9
Symptomatic	106	73
Recurrent stone formers	26	18
Family history (n=64)		
Positive family history	64	44.1
Maternal	21	32.8
Paternal	38	59.4
Both	05	7.8

calcium phosphate and ammonium urate present in 85(58.6%) and 66(45.5%) stones respectively. One stone each (0.7%) was of pure cystine and xanthene (Table-V).

DISCUSSION

The present data reveals almost equal age distribution in all stone forming children. The number of children below five years of age in this study is almost identical to number shown in two different studies conducted in Armenia[6] and Tunesia.[7]

The male predominance seen in the present study is in agreement with other reports.[6,8-12] However it seems more pronounced in bladder stones.[12,13] It supports the argument that renal and bladder lithiasis are different clinical entities.[14] Similar to other studies.[9,12,15] abdominal pain, fever, macroscopic hematuria and anuria were the common signs and symptoms.

The risk of urolithiasis is significantly increased with a family history of stone independent of their dietary habits.[16] Family history of stones was present in 44% children unlike 12.8% shown in a study.[14] Family history has been shown to be associated with 45-50% cases in different studies.[11,17,18] Such a high proportion of patients with positive family history indicate the contribution of genetic factors in the pathogenesis of kidney stones. Despite the strong association between family history and kidney stones, many children in the present study who had kidney stones did not have family history. Another possible explanation other than genetic factor is common dietary and environmental exposures in the same family.

Majority (90%) of patients were dependent on ground water for drinking. Ground water might be a source of high fluoride content which provokes nephrolithiasis.[19] High urinary concentration of fluoride has an indirect effect on urinary oxalate. In the presence of increased concentration of fluoride, part of the intestinal calcium is precipitated as calcium fluoride leaving less calcium available to oxalate which in turn enhances oxalate absorption from the intestine subsequently increases urinary oxalate concentration.[19]

Table-IV: Overall composition of stones (n=145).

Overall Composition	*Frequency*	*%*
Calcium Oxalate	38	26.2
Calcium Oxalate + Calcium Phosphate	31	21.4
Calcium Oxalate + Calcium Phosphate + Ammonium Urate	47	32.4
Calcium Oxalate + Calcium Phosphate + Uric Acid	06	4.1
Calcium Oxalate + Ammonium Urate	19	13.1
Calcium Oxalate + Struvite + Calcium Phosphate	01	0.7
Calcium Oxalate + Struvite	01	0.7
Cystine	01	0.7
Xanthene	01	0.7

Food habits and dietary constituents influence the biochemical parameters such as oxalate, uric acid and calcium.[20] Low dietary calcium can be a risk factor for urolithiasis for its possible role in binding gut oxalate and reduce urinary oxalate. Similar observation was found in our results where only 13% of patients were taking a cup of milk daily. Though peanuts, spinach, tomatoes, chocolates and soft drinks are rich oxalate sources[21] but our results show very few of patients were taking these food items frequently.

It seems complicated to compare data on stone analysis because of diversity in age group selected, stone localization and method of stone analysis. Urinary calculi can be analyzed by conventional chemical method, Infrared spectroscopy and x-ray crystallography.[15,21,22] There are some disadvantages of analysis by chemical method such as its inability to differentiate between calcium oxalate monohydrate and calcium oxalate dihydrate, two

Table-V: Individual distribution of different components in stones (n=145).

Component	*Frequency*	*%*
Calcium Oxalate	143	98.6
Calcium Phosphate	85	58.6
Ammonium Urate	66	45.5
Uric Acid	06	4.13
Struvite	02	1.37
Cystine	01	0.7
Xanthene	01	0.7

important species of calcium oxalate. Similarly it cannot distinguish among different crystalline forms of calcium phosphate like whitlokite, carbapatite, and brushite. Beside these, some rare stone types like xanthene and 2, 8 dihydrooxy adenine can not be identified by using kit method. In our study one of the suspected xanthene stone was confirmed through serum uric acid level of the patient. In patients with xanthene stones, serum uric acid remains negligible due to the absence of enzyme xanthene oxidase which oxidizes xanthene to uric acid.

Unfortunately, some studies[14,23] on stone analysis have not been focused on pediatric age in our country, except those from Karachi.[12,24,25] Similar to our results, a study from Sindh Institute of Urololgy and Transplatation has reported 78% stones, mixed in composition in Pakistani children.[12] Calcium oxalate was the predominant constituent (98.6%) as reported in different studies.[6,12] Major difference was observed in stones with calcium phosphate. Calcium phosphate was detected in (58.6%) stones; similar findings were reported in a study conducted in South Africa.[26] Ammonium urate, a common ingredient of pediatric stone was the third abundant constituent found in these samples. This finding is in consistent with other studies.[6,13] Similarly, rare stone types like xanthene and cystine were found in the same frequency as reported earlier.[12,24] Infectious stones were seen only in (1.37%) stones. It indicates that urinary tract infection does not seem to be directly associated with stone disease in children.[9] Uric acid stones are very uncommon in children, which is not an unusual outcome.[6]

In pediatric age, calcium oxalate was the most common component of renal stones. Calcium phosphate was not present in homogenous form but in combination with other components. Unlike bladder calculi, none of the stone was pure ammonium urate. Uric acid is an uncommon constituent of pediatric renal calculi. Stone forming patients were taking calcium deficient diet as they belong to poor socioeconomic group.

CONCLUSIONS

Majority of renal stones in pediatric age are mixed in composition. Poor socioeconomic condition, family history of calculus disease and low dietary calcium levels are important factors. Stone analysis can be helpful for physicians to manage stone disease at early age. Controlled studies are needed to document the role of calcium and oxalate rich diets in urolithiasis.

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