ORIGINAL ARTICLE

Frequency of Different Metabolic Abnormalities in Children with Renal Stones

ZAKIR KHAN[1], ASHFAQ AHMAD[2], AMMAR BASHIR[3], *MUHAMMAD IQBAL[4], SHAH JEHAN-UR-REHMAN[5]*
Department, Armed Forces Institute of Urology, Rawalpindi
1Postgraduate Resident of Urology, Rawalpindi
[2]Associate Prof. of Urology,
[3]Resident Urology AFIU Rawalpindi,
[4]AP Urology, Social Security Teaching Hospital Lahore,
[5]AP Urology LGH Lahore,
Correspondence to Dr. Ashfaq Ahmad, Email: raja0508@yahoo.com, Cell: 03345915279,

ABSTRACT

Background: Urolithiasis is associated with an identified metabolic abnormality in approximately 40-50% of children. The most commonly observed are hypercalciuria, hyperuricosuria, hyperoxaluria, hypocitraturia and cystinuria with hypercalciuria and hypocitraturia being the most common.
Aim: To determine the frequency of different metabolic abnormalities in children with renal stones.
Study design: Cross sectional study
Settings: Urology and Renal Transplantation Department, Armed Forces Institute of Urology, Rawalpindi.
Study duration: 30th August 2018 to 28th February 2019.
Methods: A total of 113 children with renal stones 1-14 years of age were included. Patients with urinary tract infections, PUV, PUJ obstruction, reflux disease and CRF were excluded. Then 24 hours urine sample was taken and sent to the pathology laboratory for measuring the levels of uric acid, calcium, oxalate, citrate and magnesium. Presence or absence of metabolic abnormalities i.e. hypercalciuria, hyperoxaluria, hypocitraturia, hyperuricosuria and hypomagnesuria was noted.
Results: The mean age of patients was 8.45±3.14 years with age range from 1-14 years. Out of 113, 62 (54.87%) patients were male and females patients 51 (45.13%) were with male to female ratio of 1.2:1. In this study, I have found the hypercalciuria in 54 (47.79%), hyperoxaluria in 24 (21.24%), hypocitraturia in 64 (56.64%), hyperuricosuria in 21 (18.58%) and hypomagnesuria in 39 (34.51%) patients.
Conclusion: It is concluded that frequency of metabolic abnormalities is extremely high in children with renal stones, hypocitraturia and hypercalciuria are the most significant metabolic abnormalities noted in patients.
Keywords: Urolithiasis, Children, Metabolic abnormality.

INTRODUCTION

Renal stone disease also known as nephrolithiasis has become an important cause of childhood morbidity and healthcare expenditure worldwide.[1] In the past, nephrolithiasis has become increasingly prevalent in children. While the true incidence among the paediatric population is unknown, incidence of renal stone disease in children has increased by approximately 6-10%.[2] The incidence among the adult population which was estimated to be about 12% is also reported to be increasing worldwide. Renal stones are usually caused by genetic and environmental factors. Urolithiasis may be caused by anatomical, metabolic and environmental factors. Recurrence varies between 16 to 67% and it is frequently associated with metabolic abnormalities[3,4].

Calcium stones compose the most common stone type[5]. Other stone compositions include uric acid, struvite and other miscellaneous components such as cystine. The most commonly accepted theory is the super saturation, crystallization theory.[4] According to this theory as concentration of solutes in urine increases, the solubility product is reached; above which dissolved solutes can form nuclei of its solid phase. These nuclei can form homogeneously or heterogeneously. Homogeneous nucleation occurs in pure solutions and requires more thermodynamic energy. Heterogeneous nucleation is believed to initiate crystal formation[3].

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Urolithiasis is associated with an identified metabolic abnormality in approximately 40-50% of children. The most commonly observed are hypercalciuria, hyperuricosuria, hyperoxaluria, hypocitraturia and cystinuria with hypercalciuria and hypocitraturia being the most common.[5,6] Sadeghi et al, in 2015, metabolic abnormalities were found in children with urinary stones; hypercalciuria (56%), hypocitraturia (64%), hyperoxaluria (36%), hyperuricosuria (13%), hypocitraturia plus hypercalciuria (40%), hyperoxaluria plus hypercalciuria (23%) and hyperuricosuria plus hypercalciuria (12%).[7] Velasquez-Forero et al in 2016 found hypocitraturia in 70%, hypomagnesuria in 42% and hypercalciuria in 37%.[8]

MATHODOLOGY

After approval from ethical review committee, total 113 patients admitted in Urology and Renal Transplantation of Armed Forces Institute of Urology, Rawalpindi who fulfilling the inclusion and exclusion criteria was selected. Informed written consent was taken from patient's parents or guardians. Then 24 hours urine sample was taken and sent to the pathology laboratory for measuring the levels of uric acid, calcium, oxalate, citrate and magnesium. Presence or absence of metabolic abnormalities i.e. hypercalciuria, hyperoxaluria, hypocitraturia, hyperuricosuria and hypomagnesuria was noted by the researcher himself (as per-operational definition). This all data (age, gender, duration of stone, recurrent stone and metabolic abnormalities i.e. hypercalciuria, hyperoxaluria, hypocitraturia, hyperuricosuria and hypomagnesuria) was recorded.

RESULTS

The mean age of patient was 8.45±3.14 years (Table 1). Out of the 113 patients, 62 (54.87%) were male and 51 (45.13%) were females with male to female ratio of 1.2:1 (Fig. 1). Mean duration of disease was 9.12±2.46 months (Table 2). Distribution of patients according to place of living and other confounding variables Table 3).

In this study, I have found the hypercalciuria in 54 (47.79%), hyperoxaluria in 24 (21.24%), hypocitraturia in 64 (56.64%), hyperuricosuria in 21 (18.58%) and hypomagnesuria in 39 (34.51%) patients (Table 4).

Table 5 & 6 have shown the stratification of metabolic abnormality with respect to duration of disease and place of living respectively. Stratification of metabolic abnormality with respect to side affected and recurrent stone is shown in Table 7 & 8 respectively.

Table 1: Age distribution of patients (n=113)

Age (in years)	No.	%
1-7	56	49.56
8-14	57	50.44
Mean±SD	8.45 ± 3.14	

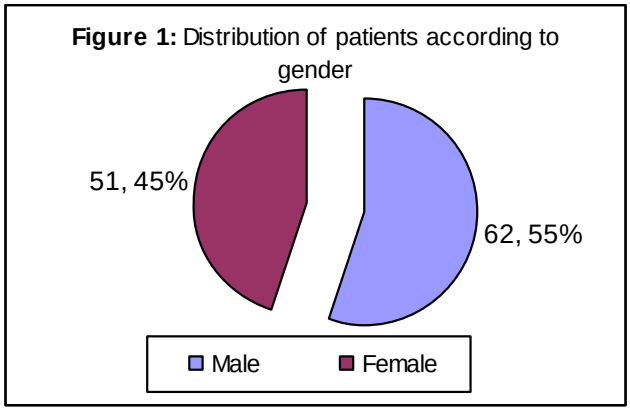

Table 2: Distribution of patients according to duration of disease (n=113).

Duration of disease	No.	%
≤6 months	18	15.93
>6 months	95	84.07
Mean±SD	9.12±2.46	

Table 3: Distribution of patients with status of other confounding variables (n=113)

Confounding variables	Side	No.	%
Side affected	Right	41	36.28
	Left	50	44.25
	Bilateral	22	19.47
Recurrence	Yes	34	30.09
	No	79	69.91

Table 4: Frequency of different metabolic abnormalities in children with renal stones

Metabolic abnormalities	Frequency (%)	
	Yes	No
Hypercalciuria	54 (47.79%)	59(52.21%)
Hyperoxaluria	24 (21.24%)	89(78.76%)
Hyperuricosuria	21 (18.58%)	92(81.42%)
Hypocitraturia	64 (56.64%)	49(43.36%)
Hypomagnesuria	39 (34.51%)	74(65.49%)

Table 5: Stratification of metabolic abnormality with respect to duration of stone.

		≤6 month (n=18)	>6 month (n=95)	P value
Hyper-calciuria	Yes	09	45	0.838
	No	09	50	
Hyper-oxaluria	Yes	02	22	0.252
	No	16	73	
Hyperuri cosuria	Yes	02	19	0.374
	No	16	76	
Hypocitra turia	Yes	10	54	0.920
	No	08	41	
Hypoma gnesuria	Yes	09	30	0.132
	No	09	65	

Table 6: Stratification of metabolic abnormality with respect to side affected.

		Right n=41	Left n=50	B/L n=22	P value
Hyper-calciuria	Yes	22	22	10	0.637
	No	19	28	12	
Hyper-oxaluria	Yes	10	09	05	0.746
	No	31	41	17	
Hyper-uricosuria	Yes	08	09	04	0.982
	No	33	41	18	
Hypo-citraturia	Yes	24	29	11	0.782
	No	17	21	11	
Hypomagne -suria	Yes	11	19	09	0.419
	No	30	31	13	

Table 7: Stratification of metabolic abnormality with respect to recurrent stone.

		Yes (n=34)	No (n=79)	P value
Hypercalciuria	Yes	20	34	0.123
	No	14	45	
Hyperoxaluria	Yes	04	20	0.106
	No	30	59	
Hyperuricosuria	Yes	09	12	0.157
	No	25	67	
Hypocitraturia	Yes	19	45	0.915
	No	15	34	
Hypomagnesuria	Yes	11	28	0.751
	No	23	51	

DISCUSSION

Nephrolithiasis in pediatric patients is generally rare. In various studies the patients at all age ranges with renal lithiasis, the commonness in children varies from 2-2.7%. The various factors can predispose children to develop nephrolithiasis and among them, metabolic and genitourinary variations are especially significant; these are often connected with diet, environmental elements and infectious causes. Nephrolithiasis is related with considerable morbidity and has high recurrence rates. The information on nephrolithiasis in children has increased recently. Many children with urinary lithiasis have basic metabolic irregularities with hypercalciuria being the most prevalent.9,10 Other metabolic risk factors vary in frequency as indicated by various studies.11 Some other metabolic changes that have been described are hypocitraturia, hyperuricosuria, hyperoxaluria, renal tubular acidosis and cystinuria.

In this study, I have found thehypercalciuria in 54(47.79%), hyperoxaluria in 24 (21.24%), hypocitraturia in 64 (56.64%), hyperuricosuria in 21 (18.58%) and hypomagnesuria

in 39(34.51%) patients. In another study done by Velasquez-Forero et al, he found hypocitraturia in 70%, hypomagnesuria in 42% and hypercalciuria in 37%. Because the rate of urinary mineral excretion decreases with ageing, it is unsurprising that in a study the most common metabolic risk factors found for paediatric urolithiasis were hypercalciuria (79.6%) and hypocitraturia (40.9%)[8].

The most common metabolic abnormality was hypercalciuria, followed by cystinuria[13] Alpay et al, found that hypercalciuria was the most common metabolic abnormality, followed by hypocitraturia, hyperoxaluria and hyperuricosuria. The metabolic abnormalities in 87%, including hypercalciuria (33.8%), hypocitraturia (33.1%), hyperoxaluria (26.5%), hyperuricosuria (25.4%), hypocitraturia plus hypercalciuria (21.1%), hyperphosphaturia (20.8%) and cystinuria (5.7%)[14] More recent data from Turkey reported that very frequent metabolic abnormalities in pre-school-age children with urolithiasis were hyperuricosuria and hypocitraturia.[15] Different dietary habits and hereditary factors might influence differences in urine chemistry results. The recurrence rate of pediatric urolithiasis varies from 20% to 48%, but Kim et al. reported that the recurrence rate in South Korea is 13%[16]. A metabolic evaluation of urine samples in pediatric urolithiasis patients is necessary to prevent stone recurrence. Stone analyses were performed and the most common component was calcium oxalate. In endemic countries, like Turkey and Tunisia, calcium oxalate and phosphate stones account for 77-86% of all stones[17,18].

Most number of genes have been suggested as responsible for the pathogenesis of hipercalciúria.19 Hypocitraturia was most commonly indicated metabolic variation present in 52% of children examined between 2003-2005. Hyperuricosuria has been detected in 16-54% of children[20].

In a Turkish study reported that metabolic abnormalities in 92% of cases, including hypocitraturia and hypocalciuria in 40% and 42%. In another study, hypocitraturia was found in both healthy and stone-forming children as 48.8% and 69.8%[21].

Hypercalciuria appears to be the most common metabolic factor with estimated rates of 37-74%[22]. The large range may be due to ethnic and geographic differences. Hyperoxaluria accounts for 2-20% of metabolic abnormalities with more recent studies suggesting a much higher possible frequency of 25-50%.[23] Hyperuricosuria is found in 2-10% of children and adolescent with metabolic stone formation. Hyperuricosuria was detected in 18.58% of our patients, consistent with previous reports. Emlac reported hyperuricosuria in 24.5% of infants with urolithiasis[24] while Goknar reported a rate of 40%[25].

CONCLUSION

It is concluded that the frequency of metabolic abnormalities is very high in children with renal stones, hypocitraturia and hypercalciuria are the most significant metabolic abnormalities noted in these patients. So, we recommend that metabolic assessment in each urinary stones patient should be carried out routinely for advising the proper dietary restrictions and medicine for managing these metabolic these metabolic abnormalities in preventing recurrent stone formation.

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