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Metabolic and biochemical factors associated with urinary calculi in children: an experience of 100 cases

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Abstract: Nephrolithiasis is an important cause of morbidity worldwide, which has seen an increasing incidence in developing countries. By early diagnosis and treatment of these risk factors, future stone formation may be prevented. To assess the metabolic and biochemical factors associated with urinary calculi in children. Pediatric patients presenting with urolithiasis formed the sampling frame. Medical records were studied for clinical and laboratory data. Study tools were records of the patients. Metabolic evaluation was done in all children. Hundred pediatric urolithiasis cases were included in this study. Gender wise, there were 42 females (35%) and 78 males (65%) with age ranged from 1 year to 11 years (mean ± S.D., 6.40 ± 1.05 years). Big portion of stones was renal stone. Calcium oxalate stone was most common variety found in nearly 45% of the study participants. Hypocalcaemia was most common variety found in 83.33% of the study participants. Hypocalcaemia along with hyperphosphatasemia was seen in 11.67% of subjects. 56.67% (n=68) cases were managed conservatively, while remaining was managed surgically. 22.5% (n=27) had stone recurrence during follow up and 8 of these had more than one metabolic abnormality. Patients with metabolic and biochemical abnormality are more likely to have stone recurrence. Metabolic and biochemical evaluation is recommended in all pediatric patients as it helps in segregating patients needing medical therapy.
Keywords: Urinary calculi, child, metabolic evaluation, urological abnormalities

INTRODUCTION

Nephrolithiasis is an important cause of morbidity worldwide. While the exact incidence of kidney stone disease in children is unknown, the incidence in children is generally about 2-3% [1]. However its incidence, composition, location and clinical characteristics vary greatly from one country to another [2]. This wide geographic variation is related to climatic, dietary and socioeconomic factors. Genetic inheritance, nutrition, metabolic abnormalities, environmental factors, anatomical characteristics, and calculus-inducing medication are the factors predisposing for urolithiasis in children [3].

An evaluation of metabolic and biochemical factors associated with urolithiasis will assist us to identify children those at increased risk for recurrent stone disease and also to diagnose specific treatable metabolic derangements. By early diagnosis and treatment of these risk factors, future stone formation may be prevented [4].

Clinical and metabolic patterns of urolithiasis have changed over the years [5]. As most children with stone disease have an underlying metabolic abnormality, it is necessary that these children should be cautiously evaluated so that the etiology of their disorder can be obtained.[6] Paucity of literature on this topic also warrants this study. Thus this study was planned to assess the metabolic and biochemical factors associated with urinary calculi in children from northern India.

METHODS

In this study, a cohort of pediatric patients presenting with urolithiasis at a tertiary care health center were chosen retrospectively. This cohort formed the study population. An inclusion criterion was only confirmed cases of pediatric urolithiasis. Ultrasonography and Intravenous pyelography and Computed Tomography confirmed diagnosis of stone disease in selected cases.

Study tools were records of the patients. Clinical and laboratory data was captured from medical records. Metabolic evaluation was done in all children. In children with UTI, metabolic evaluation was performed after treatment and only after confirmation of clear urinalysis and culture report they were included in the study. Urine tests included urinalysis, urine culture, 24 hours urinary pH, volume, calcium, oxalate, citrate, uric acid, and creatinine. Biochemical investigations included Serum calcium, Serum phosphorus, Serum creatinine, Serum uric acid, Serum electrolytes, Serum Parathyroid hormone and Serum albumin. Finally data of 100 pediatric urolithiasis cases were analyzed.

All the proforma were manually checked and edited for completeness and consistency and were then coded for computer entry. After compilation of collected data, analysis was done using Statistical Package for Social Sciences (SPSS), version 21. The results were expressed using appropriate statistical methods. The chi- square (χ^2) test or Fisher's exact test was used to test level of significance.

RESULTS

Data of 120 pediatric urolithiasis cases was analyzed. Gender wise, there were 42 females (35%) and 78 males (65%) with age ranged from 1 year to 11 years (mean ± S.D., 6.40 ± 1.05 years). Stone analysis revealed that big portion of stones was renal stone. Vesicle calculus was least common. On the other hand, Calcium oxalate stone was most common variety found in nearly 45% of the study participants. Least common variety was Cystine and Struvite type of stones. (Table 1)

Table–1: Distribution of urinary calculi among study subjects

Stone analysis- Types and distribution	N	Percentage*
Distribution of stone		
U/L Renal calculi	90	75.00
B/L Renal calculi	22	18.33
Ureteric	10	8.33
Vesicle calculus	7	5.83
B/L Staghorn calculi	6	5.00
Types of stone		
Calcium oxalate	53	44.16
Uric acid	24	20.00
Calcium phosphate	15	12.50
Struvite	14	11.67
Cystine	7	5.83
**Multiple options permitted*		

Regarding pattern of serum metabolic abnormality, hypocalcaemia was most common variety found in 83.33% of the study participants. Hypocalcaemia along with hyperphosphataemia was seen in 11.67% of subjects. Hyperuricaemia was observed in 4.16% of participants. (Table 2)

Table–2: Pattern of serum abnormality

Serum metabolic abnormality	N	Percentage
Hypocalcaemia	100	83.33
Hypocalcaemia + Hyperphosphataemia	14	11.67
Hyperuricaemia	5	4.16
Hypercalcaemia	1	0.83

Regarding urinary metabolic abnormality, Hyperoxaluria was the most common (80.83%) metabolic abnormality detected. 26.67% had Hypercalciuria whereas 20% had high urinary uric acid levels. (Table 3)

Table–3: Pattern of urinary metabolic abnormality

Urinary metabolic abnormality	N	%age*
Hyperoxaluria	97	80.83
Hypercalciuria	32	26.67
Hypocitruria	24	20.00
Hyperuricosuria	19	15.83
**Analysis of single groups*		

Out of total, 56.67% (n=68) cases were managed conservatively, while remaining was managed surgically. 22.5% (n=27) had stone recurrence during follow up and 8 of these had more than one metabolic abnormality. Only 4 out of 27 (14.81%) patients managed conservatively had stone recurrence.

DISCUSSION

Pediatric urolithiasis is a perplexing problem faced by pediatricians as well as urologists across the globe. Genetic inheritance, nutrition, metabolic abnormalities, environmental factors, anatomical characteristics and calculus-inducing medication are the factors predisposing for urolithiasis in children. Urolithiasis is less common in children than in adults. The incidence in children is generally about 2-3% [7]. However its incidence, composition, location and clinical characteristics vary greatly from one country to another. This wide geographic variation is related to climatic, dietary and socioeconomic factors.

True incidence of pediatric urolithiasis might be underestimated due to lack of routine practice of using ultrasonography in children with specific and non- specific UTI symptoms. As per literature, the major symptoms of urolithiasis in childhood are abdominal colic and gross hematuria [8]. Similarly, in the current study top three presentations of pediatric urolithiasis were symptoms of Urinary tract infection (UTI), abdominal pain and flank pain

We observed that majority of study subjects had renal stones. Vesicle calculus was least common. On the other hand, Calcium oxalate stone was most common variety found in nearly 45% of the study participants. Least common variety was Cystine and Struvite type of stones. Erbagci *et al.* in his series of 95 patients found urinary metabolic abnormality in 90% of patients with hypocitruria most common abnormality [3]. Naseri *et al*. in series of 144 patients, 54% patients had urinary metabolic abnormality [9].

Another study from Manipal [7] observed that majority (82.6%) of stones was renal stones. Vesicle calculus was least common. Calcium oxalate stone was most common variety found in half of the study participants. Hyperoxaluria was the most common (79.3%) metabolic abnormality detected. 24% had high urinary uric acid levels whereas 25.9% had Hypercalciuria. She concluded that hyperoxaluria seemed to be the most important metabolic factor of calculus forming in her pediatric series.

A five-year prospective study [10] found that stone risk factor in nephrolithiasis is urine volume and for prevention of stone recurrences, large intake of water is the initial therapy. Thus the treatment of all children with urinary stones starts with the recommendation to maintain a high oral fluid intake and mothers are instructed to give adequate water so as morning sample of urine remains pale yellow or straw colour.

In our study hypocalcaemia was found the most common variety, found in 83.33% of the study participants. Hypocalcaemia along with hyperphosphatasemia was seen in 11.67% of subjects. Hyperuricemia was observed in 4.16% of participants. The usual causes of hypocalcaemia related to diet are low calcium intake, high intake of phosphates, low magnesium. Cause of hypocalcaemia in our study is low calcium intake. It is difficult to find correlation between hypocalcaemia and urolithiasis as majority of the patient had associated low water intake and urine volume.

In this study, 56.67% (n=68) cases were managed conservatively, while remaining was managed surgically. 22.5% (n=27) had stone recurrence during follow up and 8 of these had more than one metabolic abnormality. Only 4 out of 27 (14.81%) patients managed conservatively had stone recurrence. Association of metabolic abnormality with recurrence of Urinary Calculi was found statistically insignificant. Similar findings are reported from Manipal but management modality with recurrence of Urinary Calculi was found statistically significant in our study. This is in contrast to the study by Bhatt S from Manipal [7].

CONCLUSIONS

Patients with metabolic and biochemical abnormality are more likely to have stone recurrence. Metabolic and biochemical evaluation is recommended in all pediatric patients as it helps in segregating patients needing medical therapy.

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