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Original Research Paper

General Surgery

EPIDEMIOLOGY OF PEDIATRIC RENAL STONE DISEASE IN BUNDELKHAND REGION OF INDIA

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ABSTRACT

Background: The incidence of paediatric stone disease is increasing in developing countries and is associated with significant morbidity. It is very important to know the epidemiology of stone disease particularly in pediatric patients in order to provide adequate treatment and to develop preventive strategies.

Methods: After approval from institutional ethical committee, we performed a retrospective note review of radiological data for all children presenting during the period from August 2009 to August 2019, in Government Medical College, Orai (Jalaun) and tertiary care district hospital Jhansi.

Results: As per initial records, 1341 children had underwent abdominal sonography in the study period out of which 312 were omitted due to inadequate patient details or records or due to exclusion criteria. In finally enrolled patient 1029 (622 boys and 407 girls), the median age of presentation was 4.4 years for males (range 1 months - 16.6 years) and 7.25 years (range 1 months - 18.5 years) for females.

Conclusion: In conclusion, we here present the largest cohort of paediatric stone disease in western developed countries published up to date demonstrating that metabolic risk factors accounting for one-third of all calculi with an increased risk of bilateral disease.

KEYWORDS : Epidemiology, Stone disease, Nephrolithiasis, Hypercalciuria, Growth.

INTRODUCTION

The incidence of paediatric stone disease is increasing in developing countries and is associated with significant morbidity[1–3]. It is very important to know the epidemiology of stone disease particularly in pediatric patients in order to provide adequate treatment and to develop preventive strategies. However, like many paediatric disorders, data on pediatric renal stone disease are difficult to find. There are only very few studies in India who had evaluated pediatric nephrolithisis. India comes under the Afro-Asian stone belt which includes Sudan, the Arab Republic of Egypt, Saudi Arabia, the United Arab Emirates, the Islamic Republic of Iran, Pakistan, India, Myanmar, Thailand, Indonesia and Philippines. In this area of the world, the disease affects all age groups, from less than 1 year old to more than 70 years old, with a male-to-female ratio of 2 to 1. The prevalence of calculi ranges from 4% to 20%[4] Within a stone belt, the incidence of urolithiasis varies within the regions due to the local conditions and practices. Further in India till now there is no published literature about the prevalence of calculi in pediatric age group

MATERIALS AND METHODS:

After approval from institutional ethical committee, we performed a retrospective note review of radiological data for all children presenting during the period from August 2009 to August 2019, in Government Medical College, Orai (Jalaun) and tertiary care district hospital Jhansi. All those children were included that were advised ultrasound abdomen for any reason. Among these children only those were included who were scanned by a consultant radiologist with atleast three years of experience in a dedicated, multidisciplinary medical college or hospital. All children were screened with plasma levels of urea, creatinine and routine and microscopic examination of urine for determination of calcium, urate, oxalate, cystine and creatinine (by standard laboratory methods). Medical treatment history was obtained retrospectively from the hospital notes.

Statistics:

Data were analysed for normality using the Kolmogorov-Smirnov test. Non-normal or skewed data are presented in median and range and non parametric tests (or methods) were used for analysis. Significance was assessed by Mann-Whitney U Test for non-parametric data and Chi-Square Test for categorical variables. We used IBM SPSS Statistics Version 15 for Windows.

CONCLUSIONS

We can say that for $1m^3$M20 grade of concrete consumption of fine aggregate is 775.96 kg. Here in specimen M-3 we replace fine aggregate by 24.62 kg of crumb rubber for $1m^3$M20 grades of concrete. So, we can say that up to 15% foundry sand utilized for economical and sustainable development of concrete. Uses of crumb rubber in concrete can reduce the harmfulness to the environment and produce a 'greener' concrete for construction. An innovative supplementary Construction Material is formed through this study.

RESULTS:

Incidence, age, and sex at presentation:

As per initial records, 1341 children had underwent abdominal sonography in the study period out of which 312 were omitted due to inadequate patient details or records or due to exclusion criteria. In finally enrolled patient 1029 (622 boys and 407 girls), the median age of presentation was 4.4 years for males (range 1 months - 16.6 years) and 7.25 years (range 1 months - 18.5 years) for females.

Presenting features:

Retrospective review pf [atient with nephrolithiasis shows that, most children presented with one or more classic symptoms of stone disease (pain, haematuria, UTI) but the frequency of symptoms was variable (Table 1). Of the total group, only 329 (32%) had a history of abdominal pain, with a lower frequency in children<6 years, 370 (36%) had UTI, 278 (27%) macroscopic haematuria, and 133 (13%) had painful haematuria (defined as abdominal pain in combination with macroscopic haematuria). In contrast, 67 (6.5%) patients were asymptomatic and the stone was discovered coincidentally (n = 58) or due to positive family history screening (n =9). Seven (0.6%) presented with features of acute kidney injury.

Table 1. Presenting features of all patients

Presenting features (n=1029)	Number of patients (%)
Symptoms	962 (99.3%)
Abdominal pain	329 (32%)
UTI	370 (36%)
Macroscopic haematuria	278 (27%)
Painful haematuria	133 (13%)
Asymptomatic	67 (6.5%)
Coincidental finding	58 (5.6%)

Data on family history were available in 279 patients. Out of those, 85 (30%) had a family history positive for renal stone diseases: first degree relatives in 11%, second degree relatives in 10% and more than 1 relative affected in 9%. Out of the whole population 25 (2.4%) had a history of prolonged immobility (mainly wheel-chair bound) secondary to various neurological impairment.

As per sonography records ninety-three (9.03%) had primary renal structural abnormalities such as: hydronephrosis, pelvic–ureteric junction stenosis, ureteric-vesico junction stenosis and or cyst. Growth data at presentation were available for 214 patients and weight for 209 patients. For the male group the median centile for height was 25th (range 0.4–99) and for weight 25th (range 0.4– 99) and for the female group 10th (range 0.4–91) and 25th (range 0.4–91), respectively. The median centile for BMI at presentation was the 50th (range 3–97) for boys and also the 50th (range 3–95) for girls.

Urine Examination:

Urine examination findings were available in the records of 792 patients, pus cells (32%) and RBC (22%) were the commonest findings

Stone distribution:

The stone was in the upper tract in 833 children (81%), unilateral on the left in 452 (44%), on the right in 329 (32%), and bilateral in 246 (24%). In 51 (5%) cases the stones were located in the bladder and upper tract. Metabolic abnormality was found in 47% of children with bilateral stone.

Stone composition:

Stone analysis was available in 300 patients (29%). The majority of stone analysed were composed of calcium oxalate or calcium phosphate (78%). Triple phosphate stones were detected in 14%, and cystine stone in 7%. See Table 2.

Table 2: Stone composition and corresponding aetiologies

Stone composition (n =300)	Metabolic	Infective	Idiopathic
Calcium oxalate	44 (14.7%)	8 (2.6%)	50 (16.6%)
Calcium phosphate	42 (14%)	49 (16.3%)	42 (14%)
Triple phosphate	2 (0.7%)	32 (10.7%)	6 (2%)
Cystine	20 (6.7%)	0	0
Uric acid	0	1 (0.3%)	4 (1.3%)

DISCUSSION:

We here present the largest cohort of paediatric stone disease giving details on both, clinical and laboratory data, of India reported to date[1,2,5–12]. This unique study provides data regarding the epidemiology and laboratory characteristics of 1029 paediatric kidney stone formers and assessed the aetiology of nephrolithiasis within this distinctive group. The well-documented male preponderance, especially in the younger age group, has again been confirmed[6,7,13], although a few paediatric series have shown female predominance[10,14]. Most epidemiologic studies of symptomatic urolithiasis in adults also show a male preponderance[15,16].

Most paediatric series note a significant number of adolescents with stones, and an increase in stones in patients in this age group over time[1,3]. Yet in our series there were few patients who presented after 13 years of age, which may reflect a referral bias in our population. It is possible, that older children may be referred to an adult nephrologist or urologist.

Presentation of nephrolithiasis in children is frequently atypical[6], which may explain why only 32% were perceived to have pain and 13% to have had painful macro-haematuria. Adult patients are more likely to present with the classic signs and symptoms of urolithiasis, such as flank or abdominal pain and gross haematuria[17]. This symptom may go unrecognised in younger paediatric patients, who may find it difficult to localise or describe their symptoms. Urinary tract infection was the presenting symptom in more than a quarter of patients who were subsequently noted as having an underlying metabolic abnormality. This indicates the importance of metabolic evaluation in every child presenting with urinary tract infection and stone disease, primarily to initiate a preventive therapy.

In the adult population obesity has been found to be a risk factor for kidney stone formation[18–20]. Similar findings have been reported in an American study of mainly adolescent stone formers (average age 12 years), where 31% of the children were considered obese[7]. That is in contrast to our findings, where we observed that the median centile of weight for male and female stone formers was below the 50th centile for a healthy population. Moreover, the height was also below the 50th centile for a healthy population, demonstrating that paediatric stone formers are more likely to suffer from failure to thrive or that co-morbidity contributed to growth delay. Dwyer et al.[3] and Sas D.J.[2] reported similar findings, stating that obesity is not a contributing factor to the increasing incidence of kidney stones in paediatric stone formers and in fact they have a lower BMI on average than general paediatric population.

The aetiology of paediatric urolithiasis is influenced by the scope of the metabolic work-up, the accepted definition and by the geographic area. The aim of conducting a metabolic and infective evaluation is to be able to implement an appropriate treatment which may minimise the risk of recurrent stones.

Infectious stones were found in 22% of patients, 70% were younger than 6 years at presentation. In the vast majority of the infected stone Proteus was isolated. This is consistent with struvite (i.e., ammonium-magnesium phosphate or triple phosphate) urolithiasis occuring in the presence of infection by urease producing microorganisms. In our cohort 32 (29%) of children with infective stone had pure triple phosphate stone, while the rest had calcium-phosphate or calcium-oxalate stone composition. Nearly ten percent from the infective group ended up with some degree of chronic kidney disease (CKD). However, out of all children who ended up with a degree of chronic kidney disease (n = 35), 26% had an underlying structural abnormality, the likely main contributor to the development of infection and CKD in paediatric stone formers. Other groups have reported the increased risk of CKD with nephrolithiasis among children and adults, especially in the situation of recurrent urinary tract infections[11,21]. Further studies are needed to better define and characterise infective stone associated CKD and the patients at increased risk for this complication.

The stone composition is critical for introducing targeted therapy after urinalyses is completed. Like most stone-forming children, our population demonstrates predominantly calcium oxalate and calcium phosphate stones[7,9].

Comparable to Milliners' group[9], magnesium ammonium phosphate stones were most often noted in the under 6 years age-group.

Interestingly, bilateral stone disease seems to predict having a metabolic abnormality (48% of our cases). It may also predict a more severe stone disease which demands targeted medical and intervention treatment.

The primary limitation of our study is that it is a retrospective audit, resulting in an absence of uniform data sets. Therefore, we are not able to provide data on crystalluria and morphologic analysis which has been shown to be of interest for the etiologic diagnosis of stone disease without available stone. Secondary, urinary citrate was not measured routinely but only at the discretion of the treating physician. Therefore, our study is not able to reflect the true number of patients with hypocitraturia and we cannot draw epidemiological conclusions regarding this metabolic disorder. Also, comprehensive genetic studies will be needed to define how many patients have a genetic cause of their kidney stone disease.

CONCLUSION:

In conclusion, we here present the largest cohort of paediatric stone disease in western developed countries published up to date demonstrating that metabolic risk factors accounting for one-third of all calculi with an increased risk of bilateral disease. In contrast to the adult population, obesity is not a risk factor for stone development in the paediatric population.

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