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ORIGINAL ARTICLE

Frequency of Metabolic Abnormalities of Vesical Calculus in Children Younger than 10 Years of Age

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ABSTRACT

Aim: To assess the metabolic abnormalities in children younger than 10 years of age with vesical calculus.
Study design: Retrospective cross-sectional study
Place and duration of study: Department of Urology, Khairpur Medical College Hospital, Khairpur from 1st October 2014 to 30th September 2016.
Methodology: Two hundred and six children age <10 years of age and either gender presented with vesical calculus were enrolled. Demographic information like age, gender, residence, serum electrolytes, calcium, magnesium, phosphate, uric acid, blood, and urine pH were recorded for the purpose of metabolic workup.
Results: **T**he mean age was 4.76±1.22 years and 157 (76.2%) were males and 49 (23.8%) were females. The frequency of metabolic abnormalities was observed in 153 (74.3%) of the patients. A significantly higher prevalence of metabolic abnormalities was observed with male gender (p-value 0.006), dark colored urine as presenting symptoms (p-value 0.022), frequent urination (p-value 0.045), and hematuria (p-value 0.016). Of 153 patients with metabolic abnormalities, hypercalciuria was observed in 45 (29.4%), hypocitraturia in 73 (47.7%), hyperoxaluria in 21 (13.7%), and hyperuricosuria in 14 (9.2%) patients.
Conclusion: The frequency of metabolic abnormalities was high among children with vesical calculus. Moreover, hypocitraturia in these children was observed in majority followed by hypercalciuria, hyperoxaluria, and hyperuricosuria.
Keywords: Metabolic abnormalities, Children, Vesical calculus

INTRODUCTION

Vesical calculus also known as bladder stone is an important renal disorder in children. It occurs due to accumulation of minerals in urine forming sand sized or even rock sized stone, if left untreated[1,2]. The incidence of vesical calculus is higher in developing countries where children are subject to a diet deficient in animal protein, poor hydration, and recurrent diarrhea[3,4]. Moreover, studies also reported that vesical calculus remains a disorder that affects children and it is far more common in boys than in girls.[4,5] Urine infection, incomplete urination, and prior bladder surgeries are reported to be the main cause of bladder stone in children[5].

It is reported that abdominal pain, dark colored urine, frequent urination, pain in the penis or testicles in boys, blood in the urine, difficult urination, urinary incontinence, and nocturnal enuresis are some of the signs and symptoms of bladder stone in children.[6,7] However, studies also reported that children with small sized bladder stone may shows no symptoms[5,6,8].

The global data unfortunately do not provide a definitive and correct picture of bladder calculus frequency mainly due to poor hospital records in developing countries. Several studies have been conducted in countries with a high prevalence of the disease, but data is inconsistent[7,9].

A through literature search has reported dearth of studies from Pakistan that has evaluated the metabolic abnormalities in children with vesical calculus. As renal disorders in children

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are highly prevalent in our part of the world and most of the at-risk children present late in healthcare center. There is a dire need to understand the underlying metabolic disturbance in order to early and prompt diagnose the disease in children. Therefore, this study was planned to assess the metabolic abnormalities in children younger than 10 years of age with vesical calculus.

MATERIALS AND METHODS

This retrospective cross-sectional study was conducted at Khairpur Medical College Hospital, Khairpur from 1st October 2014 to 30th September 2016. The research was approved by the Ethical Review Board. Two hundred and six children aged less than 10 years of either gender presented with vesical calculus was enrolled whereas all those children having calculi in urethra, ureter, and kidney were excluded. Vesical calculi were diagnosed on the basis of urine analysis which shows the presence of microscopic hematuria, pyuria, bacteriuria, crystalluria, and urine cultures positive for urea-splitting organisms. Moreover, radiological investigations such as ultrasonography (USG) and intravenous pyelography (IVP) were also performed. On imaging, the bladder stone size was determined by calculating the largest size of the stone. Data of serum electrolytes, calcium, magnesium, phosphate, uric acid, blood, and urine pH was noted for the purpose of metabolic workup. This information along with the sociodemographic characteristics of the patients like age, gender, and residence were noted. The data was entered and analyzed through

SPSS-25. Chi-Square/Fisher-Exact test was applied and the significance level was set at 0.05.

RESULTS

Table 1: Comparison of metabolic abnormalities with sociodemographic characteristics and presenting complaints (n=206)

Variable	Total	Metabolic Abnormalities		P value
		Yes	No	
Age (years)				
≤5	169	121 (71.6%)	48 (28.4%)	0.061
>5	37	32 (86.5%)	5 (13.5%)	
Gender				
Male	157	124 (79%)	33 (21%)	0.006
Female	49	29 (59.2%)	20 (40.8%)	
Residence				
Rural	114	88 (77.2%)	26 (22.8%)	0.286
Urban	92	65 (70.7%)	27 (29.3%)	
Abdominal Pain				
Yes	167	120 (71.9%)	47 (28.1%)	0.101
No	39	33 (84.6%)	6 (15.4%)	
Dark Colored Urine				
Yes	37	33 (89.2%)	4 (10.8%)	0.022
No	169	120 (71%)	49 (29%)	
Frequent Urination				
Yes	106	85 (80.2%)	21 (19.8%)	0.045
No	100	68 (68%)	32 (32%)	
Pain in penis or testicles in boys (n=157)				
Yes	17	13 (76.5%)	4 (23.5%)	0.788
No	140	111 (79.3%)	29 (20.7%)	
Hematuria				
Yes	75	63 (84.0)	12 (16.0)	0.016
No	131	90 (68.7)	41 (31.3)	

The mean age of the patients was 4.76 ±1.22 years. Majority of the patients were males as compared to females, i.e., 157 (76.2%) and 49 (23.8%) respectively. There were 114 (55.3%) patients belonged to rural area and 92 (44.7%) were from urban area. Abdominal pain was the most common presenting complaint observed in 114(81.1%) of the patients, difficulty urination in 121(58.7%), frequent urination in 106(51.5%), hematuria in 75(36.4%), dark color urine in 37(18%), whereas of 157 males, pain penis or testicles was observed in 17(10.8%) patients. The frequency of metabolic abnormalities was observed in 153(74.3%) of the patients. A significantly higher prevalence of metabolic abnormalities was observed with male gender (p-value 0.006), dark colored urine as presenting symptoms (p-value 0.022), frequent urination (p-value 0.045), and hematuria (p-value 0.016) (Table 1)

Of 153 patients with metabolic abnormalities, hypercalciuria was observed in 45(29.4%), hypocitraturia in 73(47.7%), hyperoxaluria in 21 (13.7%), and hyperuricosuria in 14(9.2%) patients (Table 2). A significant association of hypercalciuria was observed with gender (p-value 0.040), residential status (p-value 0.005), frequent urination (p-value <0.001), and hematuria (p-value <0.001). A significant association of hypocitraturia was observed with dark colored urine (p-value 0.004) and frequent urination (p-value <0.001). A significant association of hyperoxaluria was observed with residential area (p-value <0.001), abdominal pain (p-value <0.001), dark colored urine (p-value 0.010), and hematuria (p-value <0.001). Moreover, a significant association of hyperuricosuria was observed with frequent urination (p-value <0.001) and hematuria (p-value 0.002) (Table 3)

Table 2: Frequency of metabolic abnormalities (n=153)

Metabolic abnormalities	No.	%
Hypercalciuria	56	29.4
Hypocitraturia	73	47.7
Hyperoxaluria	21	13.7
Hyperuricosuria	14	9.2

Table 2: Comparison of hypercalciuria, hypocitraturia, hyperoxaluria, and hyperuricosuria with sociodemographic characteristics and presenting complaints among vesical calculus children with metabolic abnormalities (n=153)

Variable	Hypercalciuria		P value	Hypocitraturia		P value	Hyperoxaluria		P value	Hyperuricosuria		P value
	Yes (n=45)	No (n=108)		Yes (n=73)	No (n=80)		Yes (n=21)	No (n=132)		Yes (n=14)	No (n=139)	
Age (years)												
≤5	35(28.9)	86 (71.1)	0.797	58 (47.9)	63(52.1)	0.915	18(14.9)	103(85.1)	0.421	10 (8.3)	111 (91.7)	0.460
>5	10(31.3)	22 (68.8)		15 (46.9)	17(53.1)		3 (9.4)	29 (90.6)		4 (12.5)	28 (87.5)	
Gender												
Male	41(33.1)	83 (66.9)	0.040	59 (47.6)	65(52.4)	0.946	13(10.5)	111(89.5)	0.016	11 (8.9)	113 (91.1)	0.804
Female	4 (13.8)	25 (86.2)		14 (48.3)	15(51.7)		8 (27.6)	21 (72.4)		3 (10.3)	26 (89.7)	
Residence												
Rural	18(20.5)	70 (79.5)	0.005	43 (48.9)	45(51.1)	0.740	20(22.7)	68 (77.3)	<0.001	7 (8.0)	81 (92.0)	0.551
Urban	27(41.5)	38 (58.5)		30 (46.2)	35(53.8)		1 (1.5)	64 (98.5)		7 (10.8)	58 (89.2)	
Abdominal Pain												
Yes	39(32.5)	81 (67.5)	0.110	62 (51.7)	58(48.3)	0.062	6 (5.0)	114(95.0)	<0.001	13 (10.8)	107 (89.2)	0.169
No	6 (18.2)	27 (81.8)		11 (33.3)	22(66.7)		15(45.5)	18 (54.5)		1 (3.0)	32 (97.0)	
Dark Colored Urine												
Yes	10(30.3)	23 (69.7)	0.899	23 (69.7)	10(30.3)	0.004	0 (0)	33 (100)	0.010	0 (0)	33 (100)	0.040
No	35(29.2)	85 (70.8)		50 (41.7)	70(58.3)		21(17.5)	99 (82.5)		14 (11.7)	106 (88.3)	
Frequent Urination												
Yes	12(14.3)	72 (85.7)	<0.001	59 (70.2)	25(29.8)	<0.001	13(15.5)	71 (84.5)	0.487	0 (0)	84 (100)	<0.001
No	33(47.8)	36 (52.2)		14 (20.3)	5 (79.7)		8 (11.6)	61 (88.4)		14 (20.3)	55 (79.7)	
Hematuria												
Yes	36(57.1)	27 (42.9)	<0.001	27 (42.9)	36(57.1)	0.314	0 (0)	63 (100)	<0.001	0 (0)	63 (100)	0.002
No	9 (10.0)	81 (90.0)		46 (51.1)	44(48.9)		21(23.3)	69 (76.7)		14 (15.6)	76 (84.4)	

DISCUSSION

Vesical calculus is still a major issue in low resource regions[10]. It is reported that due to high intake of oxalate rich vegetables and low animal proteins diet, the risk of development of vesical calculus in these regions is higher.[11,12] Moreover, areas with hot, rigid, and dry climate are also endemic for vesical calculi.[2,13] This study was conducted at a remote area of Sindh Province with the aim to assess the metabolic abnormalities in children younger than ten years of age with vesical calculus. The findings of the study revealed that frequency of metabolic abnormalities was observed in 74.3% children with vesical calculus. A significantly higher prevalence of metabolic abnormalities was observed with male gender, dark colored urine as presenting symptoms, frequent urination, and hematuria.

According to the current study finding, of 153 children with vesical calculus and having metabolic abnormalities, hypocitraturia was observed in majority of the cases, followed by hypercalciuria, hyperoxaluria, and hyperuricosuria. Though studies reporting metabolic abnormalities in children with vesical calculus are scarce, a recent study conducted in India reported that among them the commonest compositions of bladder stone in children, the calcium phosphate was found higher, followed by calcium oxalate, uric acid, and Magnesium ammonium phosphate.[6] In another study conducted in children with urinary stones have reported hypocitraturia predominantly higher followed by high urine sodium, and cystinuria.[14] Hypocitraturia has been shown to be a powerful risk factor for recurrent stone disease in children.[15,16] Citrate also has the ability to prevent nucleation, agglomeration and growth of calcium oxalate and calcium phosphate crystals in final urine as well as in renal tubular urine.[17] By protecting tubular cells from injury lipid per-oxidation will be counteracted.[18]

Studies have shown that ammonium acid urate stones were more common in children, but now the frequency of calcium oxalate and calcium phosphate has increased in low and middle income countries.[19-21] This change in pattern may be due to improved nutritional status and increased intake of animal protein. In this study, hypercalciuria and hyperoxaluria also considerably prevalent in children with vesical calculus were noted.

The findings of current study also reported significant association of hypercalciuria with gender, residence, frequent urination, and hematuria. A significant association of hypocitraturia was observed with dark colored urine and frequent urination. Hyperoxaluria was found significant with residence, abdominal pain, dark colored urine, and hematuria. Furthermore, the current study finding reported a significant association of hyperuricosuria with frequent urination and hematuria. Previous studies did not report comparison of metabolic abnormalities with signs and symptoms. Thus, more in-depth studies are required to validate this finding. The understanding of the patients' characteristics is utmost important for early diagnosis and effective treatment. This will ultimately lead to the better quality of life of the patient.

There are certain limitations in the current study. Firstly, due to retrospective nature of the study, the current study failed to report therapeutic findings and outcome of the children with vesical calculus having metabolic abnormalities. Secondly, certain other determinants and prognostic factors like dietary habits, socioeconomic status of the family, and family history of urinary calculi were not observed. In spite of these limitations, the study is of importance as a through literature search has revealed that metabolic abnormalities in children with vesical calculus in particular is not widely reported from Pakistan. This study has reported findings from a low resource region of the Sindh Province where overall urinary calculi prevalence is higher, and reporting of the data is also scarce. In addition, the study included an ample number of sample size. Multicenter prospective studies are recommended to validate the current study findings. Moreover, analytical studies are also recommended to look for cause and effect among such children.

CONCLUSION

The frequency of metabolic abnormalities was significantly higher among children with vesical calculus. A significantly higher prevalence of metabolic abnormalities was observed with male gender, dark colored urine, frequent urination, and hematuria. Moreover, hypocitraturia was observed in majority followed by hypercalciuria, hyperoxaluria, and hyperuricosuria.

Conflict of interest: None

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