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Clinical Signs, Causes, and Risk Factors of Pediatric Kidney Stone Disease: A Hospital-Based Case-Control Study

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Abstract

Background: Nephrolithiasis in children is an important cause of morbidity worldwide. The current retrospective study aims at identifying epidemiological characteristics and risk factors of nephrolithiasis among children under 18 years old attending at nephrology clinic of Amir Kabir hospital of Arak, Iran, in 2014.
Methods: The current case-control study was conducted among 166 children in 2 equal groups of cases (with nephrolithiasis) and controls (without kidney stone). Clinical and paraclinical characteristics of children along with their sociodemographic and risk factors were collected. Data were analyzed by SPSS version 20 using Chi-square test and logistic regression analysis.
Results: The current study showed that the most common symptoms of pediatric nephrolithiasis included fever (81.1%), urine discoloration (8.4%), pain (6%) and dysuria (3.6%). Urinary tract infection (42.2%) was the most common cause to seek medical care. The present study findings revealed series of predicative factors for nephrolithiasis including father's occupation, growth retardation, type of nutrition during infancy, weight-for-age percentile, body mass index (BMI), and gestational age.
Conclusions: Findings of the current study, which require further consideration, identified common symptoms of nephrolithiasis in children. Future studies are greatly recommended to investigate risk factors of pediatric nephrolithiasis along with confounders in studies with a larger sample size.

Keywords: Pediatric, Kidney Stone, Risk Factors

1. Introduction

Kidney stones are one of the most common chronic kidney diseases and urinary tract in children and long-term detrimental effects on the kidneys of the child is one of the major causes of children mortality (1). The prevalence of kidney stones in different parts of the world is reported 1% - 15% (2, 3). About 7% of urinary stones are observed in the category under 17 years old (2). It seems that kidney stone is a common disease among adults, but more children are diagnosed with this condition recently. Increased diagnosis of pediatric kidney stone is due to rapid development in radiological imaging and greater awareness among physicians (4, 5). Important causes of this medical problem in children are poor nutrition, sedentary life habits, fluid intake, and the use of inappropriate medication. In addition, several risk factors such as age, gender, genetics, geographical factors, and weather also contribute to its development. For example, in Iran the incidence of kidney stones is 1.7% - 4.1% in children aged 4 to 9 years; whereas, in America it is one in 100,000 children (6-8). Since the early diagnosis of the disease reduces the risk of recurrent kidney stones, awareness of its symptoms and risk factors are quite necessary (9, 10). Iran is on the kidney stone belt (9). That is why it is essential to conduct researches on the prevalence and etiology of this disease in Iran. Therefore, the current study aims at identifying epidemiological characteristics and risk factors of nephrolithiasis among children under 18 years old attending at nephrology clinic of Amir Kabir hospital of Arak in 2014.

2. Methods

2.1. Study Setting

In a hospital-based case-control study, a representative sample was taken from all children aged 3 months to 18 years with kidney stone referred to Amir Kabir hospital in 2014, the only pediatric nephrology clinic in Arak.

2.2. Study Population and Measurements

Patients under 18 years old with a discovered stone using ultrasonography and confirmatory radiography were enrolled into the case group. Totally, 83 patients met the inclusion criteria as case group and consequently, 83 healthy children attending the clinic for routine growth monitoring were selected as controls. Patients with any metabolic or chronic disease and those without a valid growth chart were not eligible to be enrolled into the control group. Patients were informed about study aims, benefits, any potential risk and the right to withdraw from the study at any time with no serious consequences. Furthermore, parents of the subjects signed a written consent form prior to data collection. Several clinical information were obtained including urine analysis, complete blood count (CBC) test, creatinine, electrolytes, history of ureteral stone passage, biochemical analysis of the stone, family history and previous medical history, weight-for-height percentile, body mass index (BMI), and growth retardation. Besides, demographic information of the parents including age, occupation, and education were obtained.

2.3. Definition of Terms

Kidney stones: The presence of calcium oxalate crystals including phosphate and uric acid in the urine collecting system and outside it (8).

2.4. Ethical Consideration

The study objectives were described to all study subjects and their parents before recruitment and accordingly the informed consent was taken. In addition, the study protocol was approved by the ethical committee of Arak University of Medical Sciences, Iran.

2.5. Statistical Analysis

Data were analyzed by SPSS version 20 using descriptive and inferential statistics including frequency, mean, standard deviation, the Chi-square and Fisher exact tests, and logistic regression.

3. Results

The current study investigated the causes and risk factors of pediatric nephrolithiasis using a case-control study with 2 equal groups of 83 children. Table 1 describes sociodemographic and individual characteristics of the participants. Investigating clinical problems revealed that the most common symptoms of pediatric nephrolithiasis included fever (81.1%), urine discoloration (8.4%), pain (6%), and dysuria (3.6%). Nearly one-third (39.4%) of the participants had a combination of symptoms simultaneously. Urinary tract infection (42.2%) was the most common cause to seek medical care.

The univariate logistic regression was run to identify the associations between several variables and nephrolithiasis. The odd ratio and 95% confidence interval (CI) are presented in Table 2. There were significant associations ($P < 0.05$) between nephrolithiasis and father's occupation, growth retardation, growth cessation, growth failure, normal growth, weight-for-height percentile, BMI, gestational age, and type of nutrition during infancy. The likelihood of having kidney stone was higher among children with self-employed fathers. In addition, children with higher BMI, weight-to-height percentile were less likely to have kidney stone. However, it was found that odds of having stone were higher among children born pre term compared to the ones born full term.

Significant variables of univariate logistic regression model were included in the multiple logistic regression. Results of the multiple logistic regression indicated that father's occupation, type of nutrition during infancy, weight-to-height percentile, BMI, and gestational age were significant predictors of nephrolithiasis (Table 2).

4. Discussion

Pediatric nephrolithiasis is a painful and costly disease that may have long term effects on the function of kidney (11-15). The results of the current study showed that the most common symptoms of kidney stone were fever followed by urine discoloration, pain, and dysuria, respectively. However, one-third of the subjects experienced a combination of several symptoms simultaneously. While some specialists believe that signs and symptoms of stones are non-specific and ambiguous, others claim that the most common symptom to seek medical care is hematuria (5). Findings of the present study were consistent with those of some previous researches that indicated the most prevalent symptom of kidney stone was hematuria followed by dysuria, pain, fever, and agitation (16-24). And in the current study, the most common cause was urinary tract infections, consistent with some other studies including the study by Mohkem et al. who helped the children admitted to hospital during 5 years (1383 - 1387) where the most common clinical presentation was hematuria (6).

The study subjects were mainly younger than 5 years old, which might be due to selecting patients from a clinic. Children younger than 5 years old usually express nonspecific symptoms that require visiting a pediatrician at a clinic. However, there is a tendency to visit an urologist among older children with more specific symptoms such as hematuria and urinary tract infection. Results of

Table 1. Descriptive Statistics of Sociodemographic Characteristics[a]

Variable		Control	Case	P Value
Gender	Male	49 (48)	53 (52)	0.75
	Female	32 (51.6)	30 (48.4)	
Family history	No	50 (50)	50 (50)	1.00
	Yes	31 (49.2)	32 (50.8)	
Father's education	Diploma or lower	32 (44.2)	29 (55.8)	0.40
	Top of Diploma	58 (51.8)	54 (48.2)	
Mother's education	High school diploma or lower	64 (47.2)	38 (52.8)	0.64
	Higher than high school diploma	47 (51.1)	45 (48.9)	
Father's job	Self-employed	9 (29)	22 (71)	0.033
	Employee	58 (52.7)	52 (47.3)	
		14 (60.9)	9 (39.1)	
Mother's job	Practitioner	33 (58.9)	23 (41.1)	0.10
	Housewife	48 (44.4)	60 (55.6)	
Family income, USD	Less than 300	16 (59.3)	11 (40.7)	0.46
	300 to 600	26 (44.8)	32 (55.2)	
	More than 600	39 (49.4)	40 (50.6)	
Type of drinking water	Municipal tap water	27 (45.8)	32 (54.2)	0.68
	Filtrated water	29 (49.2)	30 (50.8)	
	Bottled mineral water	25 (54.3)	21 (45.7)	
Growth retardation	No	73 (59.3)	50 (40.7)	< 00.1
	Yes	8 (19.5)	33 (80.5)	
Growth cessation	No	60 (61)	39 (39)	< 00.1
	Yes	20 (31.3)	44 (68.8)	
Slow growth	No	36 (60)	59 (56.7)	0.52
	Yes	45 (43.3)	24 (40)	
Optimum growth	No	43 (42.2)	59 (57.8)	0.24
	Yes	38 (61.3)	24 (38.7)	
Weight at birth	Normal	58 (50.4)	57 (49.6)	0.139
	LBW	15 (39.5)	23 (60.5)	
	VLBW	8 (72.7)	3 (27.3)	
Type of nutrition during infancy	Formula-feeding	39 (42.4)	57 (57.6)	0.038
	Breast-feeding	42 (60)	26 (40)	

[a] Values are expressed as No. (%).

the present study revealed no significant difference in age range of cases and controls. This finding was consistent with those of several studies (11, 19, 20). This is while AlPlay et al. suggested the mean age of diagnosis 5.59 years (21).

Another finding of the current study was the significant associations obtained from simple logistic regression models between nephrolithiasis and father's occupation, growth retardation, growth cessation, growth failure, normal growth, weight-to-height percentile, BMI, gestational age, and the type of nutrition during infancy. The likelihood of having kidney stone was higher among children with self-employed fathers. In addition, children with higher BMI, weight and height percentile were less likely to have kidney stone. However, it was found that the odds of having stone were higher among children born full-term compared to the ones born pre-term. Family history of nephrolithiasis was reported as an important risk factor to develop stone among children (16, 22, 23). Recognizing risk factors of kidney stone among children may lead to early diagnosis and better prognosis of the condition.

4.1. Conclusions

The results of the current study indicated that the most common symptoms of kidney stone were fever followed by urine discoloration, pain and dysuria, respectively; also variables such as father's occupation, growth retardation, type of nutrition during infancy, weight-to-age percentile, BMI, and gestational age had a significant relationship with kidney stone. However, one-third of the participants

experienced a combination of the symptoms simultaneously. Nephrolithiasis is considered a costly health burden with high prevalence and scattered reported cases.

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Footnotes

Authors' Contribution: Parsa Yousefichaijan: study design, data analysis and interpretation, and final approval of the manuscript; Shoboo Rahmati: acquisition and analysis of data, drafting of the manuscript, and final approval of the manuscript; Mehdi Ranjbaran: conception and analysis of the research, interpretation of data, and final approval of the manuscript; Milad Azami: conception and of the research analysis, interpretation of data, and final approval of the manuscript; Sanaz Azami: translation of the article, interpretation of data, and final approval of the manuscript.

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Table 2. Simple Logistic Regression, Multiple Logistic Regression Odds Ratios, and 95% Confidence Interval

Variable	OR	CI	P Value	OR	CI	P Value
Age, mo	0.996	(0.98 - 1.01)	0.59			
Gender	1		0.66			
Male	0.87	(0.46 - 1.63)				
Female						
Family history			0.92			
No	1					
Yes	1.03	(0.55 - 1.94)				
Father's education			0.37			
High school diploma or lower	1					
Higher than high school diploma	0.74	(0.38 - 1.43)				
Mother's education			0.62			
High school diploma or lower	1					
Higher than high school diploma	0.86	(0.42 - 1.59)				
Father's job						
Self-employed	1			1		
Employee	0.37	(0.16 - 0.87)	0.02	0.33	(0.11 - 0.97)	0.044
	0.26	(0.08 - 0.82)	0.02	0.19	(0.05 - 0.74)	0.016
Mother's job						
Practitioner	1			1		
Housewife	1.79	(0.93 - 3.45)	0.08	0.96	(0.41 - 2.25)	0.92
Family income, USD						
Less than 300	1					
300 to 600	1.79	(0.71 - 4.52)	0.22			
More than 600	1.49	(0.62 - 3.62)	0.38			
Type of drinking water						
Municipal tap water	1					
Filtrated water	0.87	(0.42 - 1.79)	0.71			
Bottled mineral water	0.37	(0.33 - 1.54)	0.38			
Growth retardation	1			1		
No	6.02	(2.57 - 14.12)	< 0.001	3.39	(0.96 - 12.07)	0.059
Yes	1			1		
Growth cessation						
No	1					
Yes	3.44	(1.77 - 6.64)	< 0.001	1.65	(0.62 - 4.42)	0.31
Slow growth						
No	1					
Yes	1.97	(1.03 - 3.75)	0.04			
Optimum growth						
No	1					
Yes	0.46	(0.24 - 0.87)	0.018			
Weight at birth						
Normal	1					
LBW	1.56	(0.74 - 3.29)	0.24			
VLBW	0.38	(0.09 - 1.51)	0.17			
Type of nutrition during infancy breast-feeding	1			1		
formula-feeding	2.04	(1.08 - 3.85)	0.029	2.77	(1.23 - 6.27)	0.014
Height percentile	0.87	(0.77 - 0.97)	0.015	0.96	(0.83 - 1.12)	0.62
Weight percentile	0.83	(0.71 - 0.96)	0.013	0.82	(0.68 - 0.99)	0.044
Percentile of body mass index	0.86	(0.56 - 0.82)	< 0.001	0.71	(0.57 - 0.89)	0.004
Gestational age						
Term	1			1		
Preterm	1.95	(1.03 - 3.70)	0.04	2.22	(1.01 - 4.8)	0.047

Abbreviations: CI, confidence interval; OR, odds ratio.