Prevalence and risk factors of Urolithiasis among children age less than 14 years in Tikur Anbessa Teaching Hospital, Addis Ababa, Ethiopia

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Abstract

Background: - *Urolithiasis in the pediatric age group plays an important urologic problem, not only in parts of the world with a high incidence of stone disease such as the near and Far East, but also in the developing and industrialized countries. Pediatric urolithiasis is associated with significant morbidity, particularly recurrent stones as well as the development and progression of renal dysfunction, thus, should not be underestimated. This study will assess the prevalence and risk factors for urolithiasis in children in a tertiary teaching hospital.*

Objectives: *To assesses the prevalence and risk factors of urolithiasis, in children whose age is less than 14 years in Tikur Anbessa Specialized Teaching Hospital.*

Materials and methods*: This is a retrospective cohort study conducted in admitted patients with the diagnosis of urolithiasis in Tikur Anbessa Specialized Teaching Hospital over an eight year period from 2002 to 2010 GC. Data was collected from the records of patients.*

Result: *A total of 63 children with urolithiasis were admitted to Tikur Anbessa Specialized Teaching Hospital over an eight year period. This accounts to 1 in 121 (0.83%) pediatric surgical ward admissions annually. Among those half of the patients (54%) were in the age range between 5-10 years and 85.7% were males. The major clinical symptoms at first presentation were hematuria (63.5%) recurrent urinary tract infection (60.3%), obstructive symptoms (46.0%), flank pain (42.9%) and family history of urolithiasis was preset in (3.2%). Urine culture was done for 38.1% of the children and 25% of them were positive for E.coli or Klebsiella pneumoniae. Pyuria was present in 47.6% of children. All the stones were visualized by ultrasound, almost half of the stones were found in the kidneys (53.9%) and bladder (39.7%). Ureteric stones constituted 6.3%. Sixty six point seven percent of the stones were removed surgically and 19.0% passed spontaneously. Extracorporeal Shock Wave Lithotripsy (ECSWL) was used in 14.3% of children. Stone analysis result was found in 15/63 (23.8%) children and Calcium oxalate was the commonest stone constituting 40%, uric acid 13.3%, calcium oxalate and uric acid(20%),and 26.6% were more than 2 types (mixed) stones. There was recurrence of stone in 9.5% of children and 50% recurred after one year of follow up.*

Conclusion: *Even though the prevalence of urolithiasis in children is low it is not uncommon to see complications like recurrence and renal insufficiency. Any child who presents with hematuria and recurrent urinary tract infection, stone disease has to be ruled out. All stones have to be analyzed and children with stone disease have to be followed even after removal.*

Background

Although pediatric urolithiasis is less frequent than adult stone disease, urolithiasis in the pediatric age group plays an important urologic problem, not only in parts of the world with a high incidence of stone disease such as the Near and Far East, but also in the industrialized countries [1-6]. Pediatric urolithiasis is associated with significant morbidity, particularly recurrent stone as well as the development and progression of renal dysfunction, thus, should not be underestimated. Urolithiasis has become more common in children over the past few decades as a result of rapid variations in habits and increasing affluence. Changing socio-economic conditions have generated changes in the incidence and type of urolithiasis in terms of both the site and the physicochemical composition of the calculi. Major variations in worldwide occurrence of urolithiasis have been reported, according to geographical areas and historical periods. Stone composition has changed substantially over the past decades, with a progressive increase in frequency of calcium oxalate and calcium phosphate stones, even in the eastern hemisphere, where these stones have been traditionally less frequent than uric acid and infection stones. Recent epidemiology studies from different continents and countries report that calcium oxalate accounts for 60% to 90% of stones in children, followed by calcium phosphate (10–20%), struvite (1–14%), uric acid (5–10%), cysteine (1–5%), and mixed or miscellaneous (4%) [1, 7-19].

Hypercalciuria is recognized worldwide as the most frequent underlying factor in calcium oxalate stones, although, in some countries of the eastern hemisphere, hypocitraturia has been reported as the leading cause [1, 20, and 21].

Struvite or infection-related stones were very common in children until the last century, are rarely seen today in industrialized countries, possibly due to improved management of both pediatric obstructive uropathy and urinary tract infections [22]. Nevertheless, epidemiological studies from various countries continue to report a frequency of struvite stones of between 25% and 38% [23-26]. Bladder stones because of malnutrition during the first years of life are currently a frequent finding in various areas of Turkey, Iran, India, China, Indochina and Indonesia [27, 28], although the incidence is proportionally decreasing as social conditions improve.

Nephrolithiasis is responsible for 1 in 1000 to 1 in 7600 pediatric hospital admissions annually throughout the United States , an incidence one-fiftieth that of adult admissions. In the pediatric population, boys show a mild preponderance for stone disease, with a male-to-female ratio of 1.4:1 to 2.1:1. Seventy-five percent of children who have nephrolithiasis have an identifiable predisposition to stone formation. Metabolic risk factors account for more than 50% of cases, structural urinary tract abnormalities account for 32%, and infection accounts for 4%. It is not uncommon to find more than one predisposing factor in the evaluation of a child who has nephrolithiasis (29, 30).

There are few pediatric epidemiologic studies from other countries of the American continent. A study from Venezuela reported that urolithiasis was responsible for 7% of general outpatient consultations in all national children's hospitals during 1998 [12]. In Chile, the reported rate of pediatric urolithiasis was 1.6 in 1,000 pediatric admissions and 4.3% of pediatric nephrology admissions during 2003 [13]. With regard to gender distribution, the

male-to female ratio appears to be higher in White populations than in Black Americans and Hispanics [32-35]. It has been well documented that the incidence of urinary stones is higher in countries with warm or hot climates, probably due to low urinary output and scant fluid intake. A case series from Tikur Anbessa Hospital Department of Pediatrics and Child Health, Addis Ababa, Ethiopia over a ten year period from 1970 to 1980 was reviewed and showed that, there were 48 cases of stones in the urinary tract of which 94% were bladder or urethral stones. The incidence in this hospital material is low accounting for only 0.25% of admissions [46].

The objective of this study is to assess the prevalence and risk factors for urolithiasis, and determine type of stone in our set up and also act as base line information for future study.
Tikur Anbessa referral Teaching Hospital Department of Pediatrics and Child Health has a capacity of 150 beds excluding the Neonatal Intensive Care Unit. The Department of Pediatrics and Child Health trains both under and post graduate students. This analysis includes all admissions to the ward with the diagnosis of urolithiasis.

Materials and methods

Data was collected from the patient cards retrieved by using the record book which is available in the ward and renal clinic with the diagnosis of urolithiasis over an eight year period from 2002 to 2010. Data was entered into a questionnaire prepared to include socio demographic data, clinical history and examination, laboratory tests, possible intervention and outcome of intervention. A total of 63 children with urolithiasis were admitted to Tikur Anbessa Specialized Teaching Hospital over the study period. After the data collection analysis was made using SPSS version 16 soft ware program.

Results

A total of 63 children whose age is less than 14 years with diagnosis of urolithiasis were admitted to pediatrics surgical ward and were on follow up at pediatric renal clinic. This is 1/121(0.83%) of the total admissions to pediatric surgical ward. 34/63(54.0%) were 5-10 years, 15/63(23.8%) were 0-5years and 14/63(22.2%) were 10-14 years old. Males were 54/63(85.7%) and 9/63(14.3%) were females. 48/63(76.2%) were living in a highland area where as 15/63(23.8%) were from lowland area (table 1).

Table-1: Socio-demographic data of children with urolithiasis whose age is less than 14 years, admitted to surgical ward of Tikur Anbessa Specialized Hospital, Addis Ababa, from 2002 to 2010

	Number	Percent
Age(years)		
Less than 5	15	23.8
5-10	34	54.0
10-14	14	22.2
Total	63	100.0
Sex		
Male	54	85.7
Female	9	14.3
Total	63	100.0
Address		
Highland	48	76.2
Lowland	15	23.8
Total	63	100.0

There was hematuria in 40/63(63.5%), history of urinary tract infection 38/63(60.3%), obstructive symptoms or difficulty of urination in 29/63(46.0%), flank pain 27/63(42.9%), and family history of urolithiasis 2/63(3.2%) of children. Twenty-four (38.1%) of children were underweight and 19/63(30.2%) were stunted. Blood pressure was taken in 44/63(69.8%) of the children and all were normotensive. Twenty-one (33.3%) of children had costo-vertebral angle tenderness at presentation where as 14/63(22.2%) had supra-pubic/abdominal mass (Figure-1 and table -2).

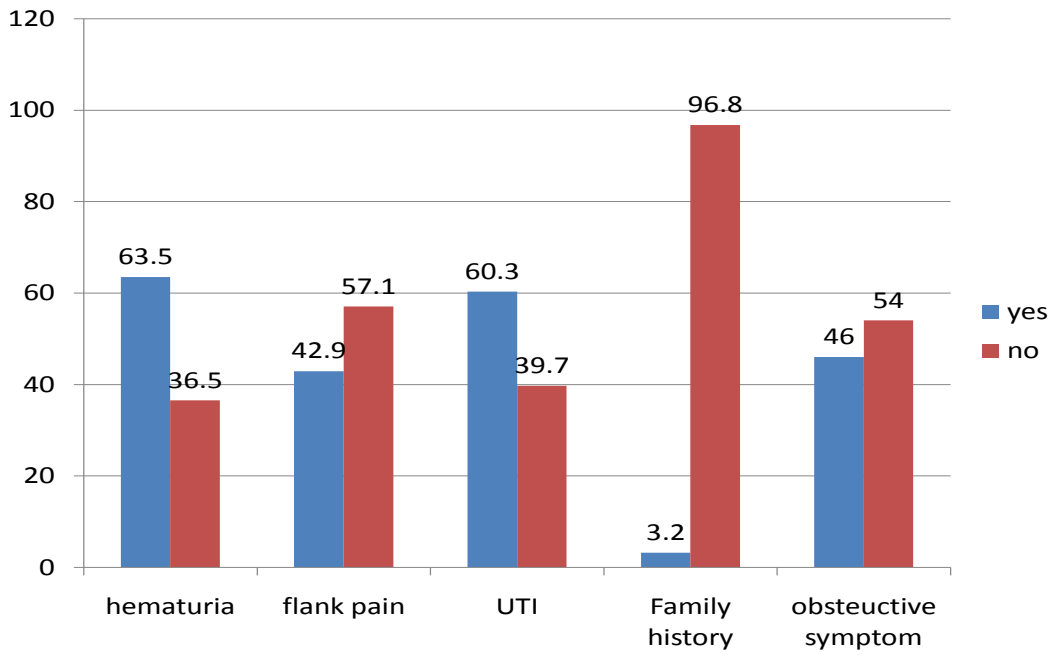

Figure-1: Clinical presentation of children with urolithiasis whose age is less than 14 years, admitted to Tikur Anbessa Specialized Hospital, Addis Ababa, from 2002 to 2010.

Two-thirds, 40/63(63.5%) children diagnosed with urolithiasis had gross or microscopic hematuria and 30/63(47.6%) had pyuria at presentation. Urine culture was done in 24/63(38.1%) children and E.coli and K. pneumoniae were isolated in 6 children. Majority 42/63(66.7%) of children had normal renal function test where as 15/63(23.8%) had abnormal renal function test. In 6 children renal function test was not determined. Serum electrolytes were determined in 28 children and all were normal.

Ultra Sound examination was done in 54/63 children and in all children stones were visualized and in 28/63(44.4%) children the stones were radiopaque which were seen by plain radiography. In 19 children intravenous pyelography (IVP) was done and all stones were localized using IVP. This series showed that 34/63(53.9%) had kidney stones and 25/63(39.7%) and 4/63(6.3%) had bladder and ureteric stone respectively. The kidney stones were on the left side in 14/34(41.2%) and on the right side in 11/34 (33.3%). The stones were bilateral in 9/34(26.5%) children. The` size of the stones were measured by ultrasound and 30/63(47.6%) were greater than 10 mm in diameter where as 16/63(25.4%) were 5-10 mm and 8/63(12.7%) were less than 5 mm.

Two-thirds 42/63 (66.7%) of the children were managed by open surgical intervention where as 12/63(19.0%) passed spontaneously but in 9/63(14.3%) Extracorporeal Shock Wave Lithotripsy (ECSWL) was applied. In 15 children the stone analysis result was documented and among them 6/15 was calcium oxalate, 2/15 was uric acid and 4 had more than two types or mixed type of stones (table 2). In 48 children the stone analysis result was not found. Six children (9.5%) had recurrence of stone disease.

Table-2: Stone analysis result and recurrence in children with urolithiasis whose age is less than 14years, admitted to Tikur Anbessa Specialized Hospital, Addis Ababa, from 2002 to 2010

Stone analysis and recurrence		Frequency	Percent
Stone analysis	Calcium oxalate	6	40.0
	Uric acid	2	13.3
	Calcium oxalate +uric acid	3	20.0
	>2 types (mixed)	4	26.7
	No analysis found	48	-
	Total	63	-
Recurrence	yes	6	9.5
	No	57	90.5
	Total	63	100.0
Time of Recurrence	less than 6months	1	16.7
	6-12months	2	33.3
	Greater than 12 months	3	50.0
	Total	6	100.0

Even though children who had stone analysis results are small in number the type of stone is associated with positive urine culture results P-value of 0.026 but recurrence of stone disease or the type of stone is not associated with age, sex, residence or the presence of pyuria (Table 3 and 4).

Table-3: Socio-demographic and clinical presentation and distribution of stone analysis, in children less than 14 years old who were admitted to Tikur Anbessa Specialized Hospital from 2002 to 2010.

Independent Variable	Type of stone analysis					
	Calcium-oxalate	Uric acid	Mixed	Calcium-oxalate +uric-acid	Stone not analyzed	p-value
Age(years)						
Less than 5	1(6.6%)	-	2(13.3%	1(6.6%)	11(73.3%)	0.859
5-10	4(11.8%)	1(2.9%)	1(2.9%)	1(2.9%)	27(79.4%)	
10-14	1(7.1%)	1(7.1%)	1(7.1%)	1(7.1%)	10(71.6%)	
Sex						
Male	5(9.2%)	1(1.9%)	4(7.4%)	3(5.6%)	41(76.0%)	0.512
Female	1(11.1%)	1(11.1%	-	-	7(77,8%)	
Address						
Highland	6(12.5%)	2(4.2%)	2(4.2%)	2(4.2%)	36(75.0%)	0.380
Lowland	-	-	2(13.3%	1(6.6%)	12(80.0%)	
UTI						
Yes	4(10.5%)	-	3(7.9%)	2(5.2%)	29(76.3%)	0.470
No	2(8.0%)	2(8.0%)	1(4.1%)	1(4.0%)	19(76.0%)	
Pyuria						
Yes	2(6.6%)	-	3(10.0%	2(6.6%)	23(76.7%)	0.413
No	4(12.1%)	2(6.0%)	1(3.0%)	1(3.0%)	25(75.8%)	
Culture						
Grow	1(16.6%)	-	1(16.6%	1(16.6%)	3(50.0%)	0.026
No grow	4(22.2%)	-	3(16.7%	-	11(61.1%)	
Not done	1(2.6%)	2(5.1%)	-	2(5.1%)	34(87.2%)	

Table-4: Socio-demographic and clinical presentation and recurrence of urolithiasis, in children less than 14 years old who were admitted to Tikur Anbessa Specialized Hospital from 2002 to 2010.

Independent Variable	Recurrence		
	yes	No	P-value
Age(years)			
Less than 5	1(6.7%)	14(93.3%)	0.806
5-10	4(11.8%)	30(88.2%)	
10-14	1(7.1%)	13(92.9%)	
Sex			
Male	4(7.4%)	50(92.6%)	0.161
Female	2(22.2%)	7(77.8%)	
Address			
Highland	4(8.3%)	44(91.7%)	0.565
Lowland	2(13.3%)	13(86.7%)	
History 0f UTI			
Yes	3(7.9%)	35(92.1%)	0.587
No	3(12.0%)	22(88.0%)	
Urine Culture			
Grow	-	6(100.0%)	0.484
No growth	1(5.5%)	17(94.5%)	
Not Done	5(12.8%)	34(87.2%)	

Discussion

Pediatric urolithiasis is associated with significant morbidity, particularly recurrence of stone as well as the development and progression of renal dysfunction.

Urolithiasis is responsible for 1 in 121 (0.83%) annual pediatrics surgical ward admissions in Tikur Anbessa Specialized Teaching Hospital. Half of the patients (54%) were in the age range of 5-10 years and 85.7% were male. When we see the clinical presentation of patients with urolithiasis majority of them had Hematuria (63.5%), history of urinary tract infection(60.3%), obstructive symptom 46.0%), flank pain (42.9%), and family history of urolithiasis (3.2%). A similar study done in the region of Qom, Iran showed that males are predominantly affected with stone disease and hematuria was the main clinical presentation (41). Another study done in Benin Teaching Hospital, Nigeria showed that 80% of children with stone disease are males (43). A study conducted at John Hopkins Children's Center from June 1979 to June 1989, showed that the most common symptoms at presentation were flank/abdominal pain and gross hematuria (36).
Out of 24 urine cultures six (25%) grew E.coli and Klebsiella pneumoniae. Pyuria was present in 47.6% of children at presentation, and 23.8% of children had obstructive uropathy which is manifested by elevated serum BUN and Creatinine. The recurrence rate of stone disease in our case series was 9.5%. Age, sex, history of UTI or urine culture results were compared with recurrence risk and the association was not statistically significant. A similar study in the University of Benin Teaching Hospital from 1980 to 1984 in Nigeria showed that 32% had pyuria; urine culture positive in 6% and 10% had recurrence of urolithiasis which is more or less comparable with our study (43).
In 53.9% of our cases the stone was found in the kidney and in 39.7% .of the cases in the bladder. Sixty six point seven percent of the stones were removed surgically where as 19.0% passed spontaneously. Extracorporeal shockwave lithotripsy was used in 14.3% of the cases. A similar study done at John Hopkins Children's center showed that 66% had solitary stone and most commonly found in kidney, 39% of the stone passed spontaneously. In this study the majority of the stones were calcium oxalate containing stone and 20% of the patient had stone recurrence (36). Similarly in our case series calcium oxalate constitute the majority (40%) and calcium oxalate and uric acid (20%). Nine point five percent of children with urolithiasis had recurrence of stone disease of those 50% of them recur after one year of follow up. A retrospective study conducted at Mayo Clinic between 1965 to 1987 among 221 patients and a 12 years review done at women and children hospital of Buffalo and Department of Urology, State of New York from 1991 to 2003 showed that majority of the stones were calcium containing stone and 18% of the stones were related with infection. Similarly in our case series; though the number of stones analyzed is small there is a significant correlation between the type of stone and positivity of urine culture results P-value of 0.026 (37, 38, 39).
A similar study done to assess the risk factor and etiology of urolithiasis in all stone population aged less than 15 years admitted from1991 to 1999 at Arabkir Hospital in Yerevan showed 64% of the stone were removed by surgery, 7% by ECSWL, 25% of the stone passed spontaneously, calcium oxalate

constitute 62% of the stone, uric acid 22% and 20% of them associated with infection (40). This result is very similar with our study.

A descriptive retrospective study done in the adult population in Mekele Hospital, Ethiopia from 2003 to 2006 showed that the majority of the patients were males (74.5%), 46.0% of the stones were found in the bladder and 28.4% in the kidney (44). A retrospective review done among 104 patients who had open surgery for an upper urinary tract stone at Tikur Anbessa Hospital showed that males were predominantly affected with a M:F ratio of 3.7:1; 19% had positive urine culture and stone analysis showed majority (84%) were calcium oxalate. But the study conducted in Ethio-Swedish children hospital, Addis Ababa over a ten years period in 1987 showed that 94% of the stones were isolated from the bladder and urethra which is much higher as compared to our study (45, 46). Studies have shown that the frequency of kidney stones is increasing while the frequency of bladder stones is decreasing over the years (47) due to increasing affluence. This is similar to our finding but large scale epidemiologic studies have to be conducted in our situation to explain the change in the pattern of urolithiasis.

Conclusion and Recommendations

Even though the prevalence of urolithiasis in children is low it is not uncommon to see complications like recurrence and renal insufficiency. Any child who presents with hematuria and recurrent urinary tract infection, stone disease has to be ruled out. All stones have to be analyzed and children with stone disease have to be followed even after removal.

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