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The Prevalence of Urinary Lithiasis in Children in Van Region, Turkey

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ABSTRACT

We aimed to determine the prevalence and etiology of urinary lithiasis in childhood in our region, Van, Turkey. A total of 1120 children were included in the study. Urinary ultrasonography was performed in all the children between April 2003 and June 2003. During the study, the kidneys were examined longitudinally and transversally using a 3.75 MHz convex probe in a Hitachi EUB -315 ultrasonography machine. The children's ages ranged from 7 years to 14 years (10.16 ± 1.92 years) and 572 (51.1%) were males and 548 (48.9%) females. Urinary ultrasonography showed that 19 (1.7%) children had urinary lithiasis, which was in the right kidney in 15 children and in the left kidney in four children. Urinary lithiasis was in the upper urinary tract in all children. The etiological studies showed metabolic disorder in 14 children, and congenital renal anomaly in one child, but no underlying cause was diagnosed in four children. In conclusion, we found that was the prevalence of urinary lithiasis was 1.7% in school-aged children in our region. It was also noted that all urinary lithiasis was in the upper urinary system and its most common cause was metabolic disorder.

Key words: *Urolithiasis, Child, Prevalence*

Urinary lithiasis is one of the most common illnesses in the urinary system in which the prevalence decreases by age[1,29]. Urinary lithiasis is found rarely in developed Western countries but it is still an important and endemic health problem in countries like Turkey[15,48]. Urinary lithiasis in children constitutes 1% of all urinary lithiasis in people[24]. Recurrence of urolithiasis may be seen in children as in adults and it may cause chronic renal failure[45,48]. Therefore, early diagnosis, determination of etiology and early treatment before development of complications is very important in urinary lithiasis. The prevalence, etiology, clinical characteristics, composition of urinary lithiasis and its location in the kidney are different in various geographical locations[5,7,18,21,30]. It has been noted that this variation is related to climate, genetics, diet, and social and economical factors[12,14,37]. At the beginning of 1960s, urinary lithiasis was mostly seen as a bladder stone, but in recent years, it has mostly appeared in the upper urinary system[6,13,19,35,38,49].

In our study, 1120 children were investigated for urinary lithiasis to determine the prevalence and etiology of urinary lithiasis in childhood in our region, Van, Turkey. Our aim was also to diagnose at an early stage urinary system-related diseases by ultrasonography screening and to refer the patients with urinary lithiasis to the department of urology for treatment.

MATERIALS AND METHODS

Urinary ultrasonography was performed in 1120 children at an elementary school in Van, Turkey between April 2003 and June 2003. In our study, the school and children from the school were randomly selected. Van city is located in the east of Turkey. Its elevation from sea level is 1725 meters. Its total population is about 200,000. In this region, winter is dominant and the socioeconomic status of the population is low. In contrast to other parts of Turkey, in their diet, people frequently consume herb cheese, which contains special regional herbs and has a higher salt ratio than marketed cheeses.

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On ultrasonographic examination, kidneys, ureters and bladder were examined by a radiologist. Kidneys were examined longitudinally and transversally using a 3.75 MHz convex probe in a Hitachi EUB-315 ultrasonography machine. During the ultrasonographic examination, bladder and ureters were imaged at the same time and bilateral ureterovesical junctions were carefully evaluated.

A urinary culture and urinary analysis were performed in all patients with urinary lithiasis. In these children, uric acid, potassium, sodium, phosphorus, magnesium, calcium, creatinine, oxalate and sitrate were also analyzed in urinary samples. Urine was collected in bottles containing 10 ml hydrochloric acid for these investigations[47]. Uric acid, potassium, sodium, phosphorus, calcium and creatinine were determined by means of a Roche brand COBAS Integra 800 auto analyzer using Roche brand commercial kits. Urinary magnesium was determined by means of a Roche brand modular auto analyzer using the colorimetric method. Investigation of oxalate and citrate was determined by the enzymatic colorimetric method using a Sigma brand kit. The stone was analyzed by means of a Biolabo brand stone analyzer at the Department of Biochemistry, Yüzüncü Yıl University, Faculty of Medicine, Van, Turkey.

Metabolic screening was done in children who had urinary lithiasis. To determine the prevalence of urolithiasis, some samples were chosen from these children to find the ratio of children with urinary lithiasis. This illustration method has been defined by Lemeshow et al[27].

The data was grouped using SPSS (Statistical Package for Social Sciences v10.0). The Chi-square test was used in statistical analysis. A P value was accepted as significant when it was less than 0.05.

RESULTS

Mean age of 1120 children was 10.16 ± 1.92 years (7-14 years). Of the children, 572 (51.1%) were boys and 548 (48.9%) were girls. The girl/boy ratio was 1.04. Urinary lithiasis was found in 19 (1.7%) children whose ages were between 7-13 years; 10 (52.6%) of them were girls and nine (47.4%) were boys. Urinary lithiasis was diagnosed in the right kidney in 15 children and in the left kidney in four children. There was no a statistical difference between right and left kidneys or between genders ($p>0.05$). Mean size of urinary lithiasis was 6 ± 1.4 mm (5-9 mm). Hydronephrosis was diagnosed in two cases. While urinary lithiasis was diagnosed in the upper urine system (89.4% at kidney, 10.6% at proximal urether) in no case was a bladder stone noted. There was a positive family history in eight (42.1%) patients with urinary lithiasis (in fathers in six cases and in mothers in two cases). Ureterocele and ureteral duplication was diagnosed as a congenital anomaly in one case (5.2%). Calcium oxalate stone was analyzed in one case. One child (5.2%) had a urinary tract infection caused by *Escherichia coli*.

Table 1 shows the results of calcium, creatinine, sodium, potassium, uric acid, magnesium, oxalate and citrate values in urine samples collected

Table 1. Results of metabolic screening of children with urinary lithiasis in urine collected for 24 hr

Case no	Sex	Age (year)	Urinary volume (ml/day)	pH (Normal: 4.5-8)	Creatinine (Normal: 30-278 mg/dl)	Calcium (mg/dl)	Calcium/ Creatinine	Sodium (Normal: 54-150 mmol/L)	Potassium (Normal: 20-80 mmol/L)	Phosphorus (Normal: 40-140 mg/dl)	Magnesium (Normal: 4.1-13.8 mg/dl)	Uric acid (Normal: 37-92 mg/dl)	Oxalate (Normal: 13-38 mg/24hr)	Citrate (Normal: 76-653 mg/24hr)
1	Female	10	370	8	105.9	7	0.06	303	71.9	96.5	21	16.6	58.6	37.3
2	Female	10	620	6	89.9	15.2	0.16	266	65.1	70.3	14.3	10.3	39	146.4
3	Female	11	550	5	40	21	0.52	92.4	54.3	44	66	10	26.4	507
4	Female	10	800	5	48.9	6.8	0.13	128	37.4	37.2	10.3	21.5	32.1	329.2
5	Female	9	780	5	77.5	7.2	0.09	234	47.34	54.1	7.9	8.5	53.8	313.6
6	Female	8	620	6	65	11.8	0.18	125	43.08	60	10.8	41.2	44.4	420
7	Female	8	900	5.5	103.5	22.9	0.22	154	43.3	69.9	13.1	11.1	25.4	292
8	Female	8	1150	5	34.2	5.6	0.16	173	14.5	20.9	6.1	16.4	30.1	460
9	Female	8	1020	8	60.2	12.9	0.21	225	34.02	42.9	9.8	12.2	45.7	151.9
10	Female	8	420	5.5	127.7	25.5	0.19	351	45.7	58.7	15.8	20.2	49.7	298
11	Male	12	320	5	59.9	4.2	0.07	218	48.3	27	5.1	11.5	37.8	320.9
12	Male	9	400	7	46	70	1.5	112	23	35	77	80	21.1	220
13	Male	13	1520	6	43.7	9.9	0.22	328	26.7	28.1	10.2	14.3	22.5	585.7
14	Male	11	1600	5	22	7.8	0.35	127	29.8	44.3	8.4	26.7	16	379
15	Male	9	1530	5.5	96.4	9.9	0.10	467	65.9	79.7	16.2	15.8	27.4	234
16	Male	8	950	5	78	20	0.25	130	39	46	55	70	80.8	220
17	Male	8	1600	5	93.6	19.7	0.21	344	50.5	85	11.4	17.1	16.9	192.1
18	Male	7	610	5	110	20	0.18	141	55	51	73	22	30.8	45
19	Male	7	900	5.5	32.5	15.7	0.48	-	-	-	-	-	-	-

over 24 hr. Table 2 shows the etiologic causes in 19 cases of urolithiasis. Hypernatriuria is diagnosed in eleven cases (61.1%), hypercalciuria in eight cases (42.1%), hyperoxaluria in seven cases (36.8%), hypocitrateuria in two cases (10.5%) and low potassium excretion in urine in one case (5.2%). Hypocitrateuria, hyperoxaluria and hypernatriuria were found in one case (5.2%), hypernatriuria and hyperoxaluria in four cases (21%), hypernatriuria and hypercalciuria in four cases (21%), hyperoxaluria and hypositraturia in one case (5.2%), and hypercalciuria and hyperoxaluria in one case (5.2%). None of the children had hyperuricosuria and hypomagnesuria. Serum parathyroid hormone levels were normal in all children. While 14 patients (73.6%) with urinary lithiasis had at least one metabolic disorder, only one case (5.2%) had a congenital renal anomaly. No underlying cause was diagnosed in four cases (21%). Urgent surgical intervention was applied in two patients with hydronephrosis. Ureterorenoscopy and pneumotic lithotripsy were performed in one patient. Pyelolitotomi was performed in another patient.

DISCUSSION

It is well known that urolithiasis may not always show symptoms. Therefore, determination of urolithiasis incidence and prevalence from only hospital registration records may not reflect the true ratio of urinary lithiasis. In this study, our aim was to determine the prevalence and etiology of urolithiasis in childhood in our region. Our aim was also to diagnose at an early stage urinary system-related diseases by ultrasonography screening and to refer the patients with urinary lithiasis to the department of urology for treatment. In our study, urinary ultrasonography was performed to determine the prevalence of urinary lithiasis in school children in our region. The prevalence of urolithiasis in school children was found to be 1.7%. In our country, Remzi et al[39] found that the urolithiasis incidence was 0.8% in childhood after screening 1000 children of school age by direct urinary system graph. In our study, the prevalence of urinary lithiasis in school age children was higher than the finding of Remzi et al[39]. In a retrospective study performed in New York using ultrasonography, the prevalence of urolithiasis was found to be 8.6%[4]. It is thought that ultrasonography could be more sensitive than abdominal plain X-ray. Landau et al reported from Israel that Bedouin children had a higher prevalence of urinary lithiasis with 1.02 cases per 1,000 inhabitants at risk versus 0.13 among Jewish children[25]. These data also suggested that the prevalence of urolithiasis varies according to geographical region.

While urolithiasis is seen mostly in male adults, in childhood the male/female ratio is almost equal or only slightly higher in males. Furthermore, the male/female ratio shows great differences among countries. The male/female ratio was found as 2.1 by Moreno Villares et al[32], 1.1 by Nimkin et al[33], 1.6 by Öner et al[34], 1.7 by Tekin et al[47], and 1.8 by Ece et al[12], but Milliner and Murphy[31] found this ratio to be 1.04. In our study, the male/female

Table 2. Etiological causes in cases with urolithiasis

Case no	Hypercalciuria (Normal: < 4 mg/kg/day)	Hyperoxaluria (Normal: 13-38 mg/24 hr)	Hypocitrateuria (Normal: 76-653 mg/24 hr)	Anatomic causes	Idiopathic causes
1	-	58.6	37.3	-	-
2	-	39	-	-	-
3	4.2	-	-	-	-
4	-	-	-	-	+
5	-	53.8	-	-	-
6	-	44.4	-	-	-
7	8.9	-	-	-	-
8	-	-	-	-	+
9	4.5	45.7	-	-	-
10	-	49.7	-	-	-
11	-	-	-	-	+
12	8.4	-	-	-	-
13	5	-	-	-	-
14	-	-	-	+	-
15	-	-	-	-	+
16	4.6	80	-	-	-
17	7.8	-	-	-	-
18	-	-	45	-	-
19	4.7	-	-	-	-

ratio was 1.1, which was similar to the result of Milliner and Murphy (1.04).

Many studies have shown that the cause of idiopathic calcium stones is familial traits[26,31,46]. Stone history in families of children with urolithiasis has shown different results in various studies. Positive family history was found as 60% by Moreno Villares et al[32], 28.2% by Kamoun et al[22], 22% by Tekin et al[47], 54% by Erbağcı et al[15], and 45.7% by Ece et al[12]. In our study, a positive family history was found in 42.1%. This result is in agreement with the study of Ece et al[12].

In developed countries, 79-96% of urinary lithiasis occurs in the upper urinary system, but in developing countries, 67.5-78% of urinary lithiasis occurs in the lower urinary system[17,40,42,51]. Urinary lithiasis developed in the upper urinary system was reported to be at the rate of 89% by Kapadia and Vani[23]. Ece et al[12] reported urinary lithiasis in 65.4% in the upper urinary system, 14.8% in the lower urinary system and 17.3% both in the upper and lower urinary system. Another study, reported a rate of 98.7% in the upper urinary system[47]. In our study, urinary lithiasis was found in the upper urinary system in 100% of children, which was similar to the findings of Tekin et al[47].

In children with urinary lithiasis, the frequency of urinary infection is between 30-76%[17,30,37,43,51]. In cases of primary anatomic disorders and operated urinary system disorder, the incidence of urinary infections has been found to be higher. In cases having a low ratio of the above problems (anatomic disorders, operation), the urinary system infection ratio is lower[10,17,43,51]. It was declared that the prevalence of urinary system infection in children with urolithiasis was 29% by Al-Eisa et al[2], 33% by Özokutan et al[35], and 31.5% by Öner et al[34]. In our study, urinary system infection was found as 5.2%. Our ratio was lower than the results of the literature. Both urolithiasis and urinary tract infections were seen together in children younger than 5 years of age and in male children. In our study, children were older than 5 years old and the infection was more common in girls. Additionally, only one case of urinary system anatomic malformation was present in our study.

In our study, urolithiasis was found in the right kidney in 15 cases (78.9%) and in the left kidney in four cases (21.1%). Sarkission et al[41] diagnosed urinary lithiasis in the right kidney at the rate of 56%. Our findings were similar to this result.

In our cases, the size of urolithiasis was about 5-9 mm (average 6 ± 1.4 mm). Urolithiasis was found as 3-33 mm in a study performed by Erbağcı et al[15], and as 1-15 mm by Van Savage et al[50]. The sizes of the stones found in our study were smaller because the patients were in an asymptomatic period during screening. Other studies have been performed in patients with symptoms of urolithiasis and in hospitals. In our study, hydronephrosis was diagnosed in two cases (10.4%). Hydronephrosis was found to be 43.1% in a series of Remzi et al[38] and 45.9% by Başaklar et al[6]. The low ratio in our study may be due to the reasons mentioned above.

Metabolic disorders, urinary system infection, urinary system obstruction and structural anomalies play an important role in urolithiasis in childhood[24]. Different results concerning the frequency of these factors have been reported among various countries. Metabolic disorders have been reported as 25% by Rizvi and Hussain[40], as 75.1% by Milliner and Murphy[31] and as 48% by Limm et al[28]. In a study performed by Polinsky et al[37] metabolic disorder was found as 32.9% in America and as 12.3% in Europe. Ece et al[12] calculated that metabolic disorder was 34.6% in their cases. In our study, the ratio of metabolic disorders was 73.6%, which was in parallel with Milliner and Murphy's[31] result.

Congenital renal anomaly was noted at the rate of 9% by Paulson et al[36], 5.8% by Kapadia and Vani[23], 5.6% by Başaklar and Kale[6] and 9.4% by Erbağcı et al[15]. In the present study, congenital renal anomaly was found in only one case (5.2%), which consisted of a double collecting system and ureterocele. This result was similar to the results of Kapadia and Vani[23] and Başaklar and Kale[6].

We could not explain the etiology in four urinary lithiasis cases (21%). The underlying etiological factor could not be found in 22% cases in a study performed by Gaches et al[16], 26% by Coward et al[11] and 12% by Öner et al[34]. Our value, 21%, was similar to the findings (22%) of Gaches et al[16] and the findings (26%) of Coward et al[11]. It has been noted that the most frequently seen metabolic disorder was hypercalciuria in different series. Similarly, hypercalciuria was found as 42.1% in our study. Hypercalciuria was found as 38.7% by Al-Eisa et al[2], 42% by Stapleton et al[44], 6% by Polinsky et al[37] in America, 4% in Europe and 25% by Özokutan et al[35]. The rate of 42.1% for hypercalciuria found in our study was parallel with the result of Stapleton et al[44] (42%) and with the result of Al-Eisa et al[2] (38.7%). Hyperoxaluria was found in seven cases (36.8%) in our study. It was found in 15% by Bohles et al[9], 9% by Hari et al[20], 40% by Rizvi and Hussain[40] and 2% by Ece et al[12]. Our findings were similar to those reported by Rizvi and Hussain. Hypositraturia was found in two of our cases (10.4%). Hypositraturia was found in 6% by Sarkission et al[41], 9% by Milliner and Murphy[31], and 8% by Ece et al[12]. In our study, the stone was obtained by operation in one case (5.2%), and was calcium oxalate stone. The ratio of calcium oxalate stone was reported as 57% by Alon et al[3], 48.7% by Biocic et al[8], and 21% by Erbağcı et al[15].

In conclusion, we have found that the prevalence of urinary lithiasis is 1.7% in school-aged children in our region. It was also noted that all urinary lithiasis was in the upper urine system and the most common cause of urolithiasis was metabolic disorders. We think that urinary ultrasonography as a screening tool can be easily and effectively used in the diagnosis of urinary lithiasis in children in future.

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