

PEDIATRIC UROLITHIASIS*

*Doğan Remzi, MD***, *Mehmet A. Bakkaloğlu MD****, *Ilhan Erkan MD****,
*Haluk A. Özen MD*****.

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Although the incidence of pediatric urolithiasis is relatively low in the well developed western countries, in developing countries like Turkey it is still the most common pediatric urological problem. In comparison to the 1 to 3 new cases seen annually at urologic centers of North America, 1799 new cases have been reported by our department within 16 years¹⁻³.

The following is a retrospective study of 524 children suffering from urolithiasis who were admitted to the Hacettepe University Hospital for surgical management between the years 1972 and 1982.

Material and Methods

From January 1972 to January 1982, 524 cases of pediatric urolithiasis were admitted to the Hacettepe University Department of Urology. Of these complete follow-up and adequate medical records could be obtained for 317 cases. Urinalysis, urine culture and routine biochemical analysis were performed on all patients at admission.

All patients had complete radiological studies of the urinary tract to localize the stone and to determine the presence of associated anatomical abnormality. Stone analysis was performed by the X-ray diffraction technique. Age, sex, presenting symptoms, family history, types of operations and complications were noted in all cases. Outpatient charts were reviewed to obtain the results of the treatment, and follow-up ranged from 6 months to 9.5 years.

Results

There were 239 boys (75.3%) and 78 girls (24.7%) in our study, a ratio of 3 to 1. The patients ranged in age from 1/12 years to 16 years. In 45 cases previous stone history was detected. A positive family history was found in 10 children (3.15%).

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- * From the Department of Urology, Hacettepe University Faculty of Medicine, Ankara.
 - ** Professor of Urology, Hacettepe University Faculty of Medicine.
 - *** Associate Professor of Urology, Hacettepe University Faculty of Medicine.
 - **** Lecturer in Urology, Hacettepe University Faculty of Medicine.

TABLE I
Presenting Symptoms

	%
Flank pain	55.9
Symptoms related to urinary infection	38.4
Abdominal pain	25.5
Nausea and vomiting	14.5
Hematuria	12.9

Presenting symptoms

The presenting symptoms of 317 children are listed in Table I. The most common symptoms were noted as flank and abdominal pain with symptoms related to urinary tract infection.

Urinary tract infection

Urine cultures were obtained by clean catch technique, and those with colony counts of more than 100,000 per ml were accepted as positive. At presentation 121 patients (38.1%) had positive urine cultures, *E. coli* and species of *proteus* being the most commonly encountered microorganisms.

The localizations and the deleterious effects of urolithiasis on renal function were demonstrated urographically in all cases. The urographic findings are listed in Tables II and III.

All patients underwent routine biochemical evaluations which included BUN, serum creatinine, calcium, phosphorous and uric acid. In 9.1 % of the cases there were elevated serum creatinine levels. Similarly, in 7.5 % of the cases serum calcium was determined to be above the normal limits. Uric acid tests revealed an elevation in 6.3 % of the cases (Table IV). All of the cases in our study have required surgical

TABLE II
Localization of Stones

	%
Renal calculi	63.7
— Single calculus	28.6
— Multiple calculi	27.3
— Staghorn calculus	7.8
Ureteral calculi	22.8
Bladder calculi	20.1
Urethral calculi	8.1

TABLE III
Urographic Findings in 317 Cases

	%
Hydronephrosis	43.1
Non-functioning kidney	25.2
Dilatation of the involved ureter	15.0
Associated anomaly	11.8
Miscellaneous	4.9

TABLE IV
Results of Routine Serum Biochemistry Tests

	Normal	%	Above normal limits	%
BUN	254	80.2	63	19.8
Creatinine	288	91.9	29	9.1
Calcium	293	92.5	24	7.5
Phosphorous	273	86.2	44	13.8
Uric acid	297	93.7	20	6.3

management, and 425 operative procedures were performed on 317 children. The vast majority of the patients underwent pyelolithotomy, cystolithotomy or ureterolithotomy as seen in Table V.

TABLE V
Types of Operations

	Number	%
Pyelolithotomy	188	44.30
Cystolithotomy	68	16.00
Ureterolithotomy	65	15.00
Nephrectomy	17	4.00
Urethrolithotomy	13	3.00
Nephrolithotomy	31	7.30
Miscellaneous	43	10.10
Total	425	100.00

Stone analysis

Stone analysis was performed by the X-ray diffraction method in all of the cases, the results of which are listed in Table VI.

When the results of stone analysis were reviewed in regard to sex differences, the whewellite type was found to be the leading one in the stones of the girls (83%) while the same crystal structure was found in only 50.2% of the stones in the boys (Table VII).

TABLE VI
Results of Stone Analysis

	Number of stones	%
Whewellite ($\text{CaC}_2\text{O}_4 \cdot \text{H}_2\text{O}$)	191	60.6
Ammonium acid urate ($\text{C}_2\text{H}_3\text{N}_4\text{O}_3 \cdot \text{NH}_4$)	47	14.8
Struvite ($\text{MgNH}_4\text{PO}_4 \cdot 6\text{H}_2\text{O}$)	44	13.9
Uric acid	15	4.7
Cystine	9	2.7
Hydroxyapatite ($\text{Ca}_{10}(\text{PO}_4)_6(\text{OH})_2$)	6	1.8
Weddellite $\text{CaC}_2\text{O}_4 \cdot 2\text{H}_2\text{O}$	4	1.2
Whitlockite $-\text{Ca}_3(\text{PO}_4)_2$	1	0.3
Total	317	100.0

TABLE VII
Distribution of Crystal Structure Between Sexes

	Boys		Girls	
		%		%
Whewellite	121	50.7	65	83.1
Ammonium acid urate	48	20.3	1	1.3
Struvite	37	15.4	8	10.4
Uric acid	14	5.72	2	2.6
Cystine	9	3.5	1	1.3
Hydroxyapatite	5	2.2	1	1.3
Weddellite	4	1.8	—	—
Whitlockite	1	0.4	—	—
Total	239	100.0	78	100.0

The mortality rate was 2.2% while morbidity was 9.7%, the most commonly encountered complication being wound infection. The residual stone rate was found to be 4.1 %; 76 % of the cases were followed for an average of 2.6 years. With appropriate surgical and medical treatment 81.7% of the cases became symptom free.

Discussion

The incidence of urinary tract calculi in children is dependent on the geographical area of presentation and may range from 1:1000 to 1:7000 pediatric admissions⁴⁻⁷. In Turkey urolithiasis is considered to be endemic. This observation is further supported by the study of Remzi et al (Hacettepe) demonstrating a 0.8 % incidence of urolithiasis in school age children⁸.

54.3% of the cases in our group belong to the 0 - 5 year age group. Recent studies, including our report, definitely reveal a decline in the incidence of urolithiasis after 5 years of age⁶⁻⁹.

Although family history has been reported to be positive in over 50% of the children in the endemic areas, family history was positive in only 3.15% of the cases in our study^{5,10}.

In our study, the classical symptoms of urolithiasis that are commonly encountered in adults — flank and abdominal pain — were present in 81.4% of the cases. This is similar to the series of Paulson et al⁵ and Noronha et al¹¹ but contrasts to the series reported by Hodgkinson¹².

The incidence of urinary tract infection in relation to urolithiasis ranges from 9 to 76%^{5,10}. The incidence of urinary tract infection in our study was found to be 38.1%, *E. coli* and *proteus* being the predominating organisms.

As living standards improve and a country develops, the incidence of lower urinary tract urolithiasis decreases while the incidence of renal and ureteral stones increases. While in the series from the United Kingdom and the United States the incidence of bladder stones was about 2-10%^{2,13} in this study the incidence was found to be 20.1%, but this rate is still lower than that reported by Remzi et al³. This might perhaps be taken as an indicator of development in Turkey.

Developmental anomalies of the urinary tract were noted in 11.8% of the cases which were predisposed to stone formation in addition to urinary tract infections. The incidence of urinary tract anomalies associated with urolithiasis varies greatly in the papers dealing with pediatric urolithiasis. Paulson et al reported a 9% incidence of calculus disease in conjunction with congenital anatomic deformities⁵, while Noronha et al reported 50%¹¹ comparable to the 60% reported by Beare et al¹⁴.

Although our policy is to preserve as much renal parenchyma as possible, especially in pediatric patients, we often come across situations in which nephrectomy is the only choice. According to Bennett², the incidence of nephrectomy for stone disease in children is 7%. In our series the rate was 5.2% although a non-func-

tioning kidney due to stones, detected by urography, was observed in 25.2% of the cases.

The international variation in the type of calculi seen in children has long been noticed. Papers from Europe usually report struvite calculi as the most common type^{12,15,16}, while authors from the United States emphasize the higher incidence of metabolic stones^{1,7,13}. For instance, Paulson reported that calcium oxalate stones were present in 68.2% of his cases⁵, while Scholten from the Netherlands found the incidence of struvite stones to be 51%¹⁶. In another study of 100 urinary tract stones in children from the United States, in 62% of the cases the stones were composed mainly of calcium oxalate, while struvite stones were present only in 25%⁶. In our study calcium oxalate stones, including whewellite and weddellite crystals, were present in 61.4 % of the cases. Ammonium acid urate crystals were a close second (14.8%). Only 13.9% of the stones were found to be composed of magnesium ammonium phosphate, i.e. struvite. Thus urinary tract infection does not seem to be closely related to pediatric urolithiasis in Turkey.

The incidence of uric acid stones in pediatric urolithiasis is also a controversial topic. Although early studies, including that of Campbell, reported that more than half of all urinary stones in infants and children consist of uric acid and urates, more recent studies reveal a much smaller percentage of these kinds of stones^{6,7,11}. In our study, ammonium acid urate stones and uric acid stones together comprised 26.3% of all the stones. In most of the studies dealing with stone analysis of children, cystine stones account for 1 % to 5 % of all stones^{2,7,9,14,16}. Similarly, this rate was found to be 2.7% in our study.

Regarding the problems of dialysis and transplantation — economic and social — we should like to stress once again the importance of primary prevention and thus give further importance to the management and investigation of pediatric urolithiasis, which is one of the commonest causes of chronic renal failure in Turkey.

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