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Spectrum of Pediatric Urolithiasis in Western India

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Of 1,211 patients with urolithiasis treated at this institution over a nine years period, there were 77 (6.4%) pediatric cases. The commonest age group was 6-10 years (55.8%). Male : female ratio was 7.6 : 1. Hindus constituted 72.7% of the patients There was no significant seasonal variation. The commonest site was urinary bladder (67.5%). The upper : lower urinary tract stone ratio was 1 : 2.85. Majority belonged to the lower-middle or poor income groups having a cereal based diet with minimal or poor protein intake.

The common constituents of stones were calcium (98.7%), oxalate (87%), phosphate (84.4%) and uric acid (76.6%). Of all these, uric acid had the richest concentration (grade of + + or more) in 93.2%. Only 4 stones (5.2%) were "pure" : calcium oxalate - 3 and calcium phosphate - 1; whereas 73 (94.8%) were mixed stones. Of these, 9 (11.7%) were "predominent" mixed stones, with only one constituent having rich concentration (grade of + + or more) and all others being either trace or +. The rest 64 (83.1%) were "heterogenous" mixed stones having rich concentration of more than one constituent.

Key Words *: Urolithiasis; Urinary calculi; Epidemiology; Pediatric stones; Urologic diseases*

There is a marked variation in the spectrum of urolithiasis between the children of developed and developing countries.[1,2,3] Half a century back, bladder stones were a common problem in the European children.[4] As these nations increased their productivity and became industrialised, and as the average income and the quality of food improved, bladder stones disappeared in the Western world and the pattern of pediatric urolithiasis became akin to the adults viz. preponderence of the upper urinary tract stones.[3,5,6] In a developing country like India, however, the bladder stones still predominate in the pediatric age group.[1,2,4] The Indian studies on pediatric urolithiasis are mainly from the northern parts.[7-10] This study was undertaken, therefore, to highlight the epidemiology and stone consitutent patterns in the children of Western India, viz. the city of Bombay.

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MATERIAL AND METHODS

This study includes 77 pediatric stone

patients seen at our institution over a nine years period from January, 1981 till December 1989. The patient data-sheets were analysed for the various epidemiological factors like age and sex distribution, religion, location of the stone in the urinary tract, and for monthly and seasonal incidence. Also, their socio-economic status and dietary habits were studied. Data was also obtained regarding the number of total hospital admissions, number of pediatric admissions and total number of stone patients during the nine years period.

After appropriate operative management, the stones were retrieved and subjected to the standard wet chemical analysis to define the presence and grade of major stone constituents like calcium oxalate, phosphate, uric acid and carbonate.[11] Each element was graded as absent, trace, +, ++, +++, and ++++ on subjective assessment on analysis, depending on the degree of chemical reaction.

Depending on the number of constituents, the stones were either categorised as the "Pure" stone (single constituent), or "mixed" stone (more than one constituent). The mixed stones were further categorised into"predominent" and "heterogenous" type of mixed stones. The "predominent" mixed stone was one with one major stone constituent having an analysis grade of ++ or more and all other constituents although present, having a grade of either trace or +. On the other hand a "heterogenous" mixed stone was one having two or more stone constituents with an analysis grade reading of ++ or more.

The frequency of positivity of various constituents and the incidence of various types of stones were studied.

RESULTS

During the nine years study period there were a total of 77 pediatric stone patients. The total number of hospital admissions during the same period was 4,50,263. Out of these, 1,211 cases were stone patients, giving an overall rate of 27 stone patients per 10,000 hospital admissions. The number of pediatric hospital admissions during this nine years was 94,538. Out of these 77 were stone cases, giving a rate of 8.1 stone patients per 10,000 hospital admissions for pediatric patients. When taken as a fraction of total 1,211 stone patients, seen over the nine years, the 77 pediatric stone patients amounted to 6.4%.

The monthly and seasonal incidence over the total nine years period showed no significant variation during the three major Indian seasons of summer (24 patients - 31.2%), monsoon (26 patients - 33.8%), and winter (27 patients - 35%).

Of these 77 patients, the largest number - 43 patients (55.8%) belonged to the age group of 6-10 years. Twenty nine patients (37.7%) belonged to the 0-5 years group. Only 5 patients (6.5%) belonged to the 11-12 years group. The youngest patient was a male child of one year and the oldest was 12 years old.

Sixty eight patients (88.3%) were male children whereas only 9 (11.7%) were female children, giving a male : female ratio of 7.6 : 1.

The commonest religion was Hindu with 56 patients (72.7%). There were 11 Muslims (14.3%) and 5 Christians and Sikhs each (6.5% each).

The commonest location of the stone in the urinary tract was urinary bladder, having 52 stones (67.5%). The kidney was next most common with 19 stones (24.7%).

There was only one stone (1.3%) in the ureter and 5 stones (6.5%) were in the urethra. The upper tract (kidney and ureter) to the lower tract (bladder and urethra) stone ratio was 1 : 2.85.

Socio-economically, the majority of the patients belonged to the lower and middle income populations. The diet was mainly cereal based, consisting of chapatis (made of wheat) and/or polished rice. The amount of animal proteins in the diet was low in them. There was, however, no evidence or gross malnourishment of vitamin deficiency in these patients.

The various stone constituents and their grades on wet chemical analysis are shown in Table 1. The common constituents were calcium in 76 patients (98.7%), oxalate in 67 patients (87%), phosphate in 65 patients (84.4%) and uric acid in 59 patients (76.6%). Carbonate was present in only 25 patients (32.5%).

The number of stones having a grade of + + or more on chemical analysis for a given constituent is shown on Table 2. This revealed that uric acid had the richest concentrations. Out of the 59 stones showing presence of uric acid, as many as 55 (93.2%) had concentration grade of + + or more. This was richer than calcium also, where, 69 out of 76 calcium positive stones (90.8%) had concentration grade of + + or more.

The largest number of 73 stones (94.8%) were of mixed variety, whereas only 4 stones (5.2%) were of pure category (Figure 1). Of these, 3 stones (3.9%) were pure calcium oxalate and 1 (1.3%) was pure calcium phosphate stone. Out of the 73 mixed stones, 64 (83.1%) were of "heterogenous" variety, having two or more constituents with concentration grade of + + or more.

Table 1. The Gradewise Analysis Readings for Each Element.

Constituent	Absent		Trace		+		+ +		+ + +		+ + + +	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Calcium	1	1.3	1	1.3	6	7.8	23	29.9	24	31.2	22	28.6
Oxalate	10	13	6	7.8	13	16.9	21	27.3	14	18.3	13	16.9
Phosphate	12	15.6	6	7.8	11	14.3	19	24.7	15	19.5	14	18.2
Uric Acid	18	23.4	4	5.2	-	-	12	15.6	18	23.4	25	32.5
Carbonate	52	67.5	13	16.9	6	7.8	3	3.9	2	2.6	1	1.3

Table 2. The Richness of Concentration (grade of + + or more on analysis) for Each Element.

Constituent	Positive in	Grade ≥ + + in	Percentage
Calcium	76	69	90.8
Oxalate	67	48	71.6
Phosphate	65	48	73.8
Uric Acid	59	55	93.2
Carbonate	25	6	24

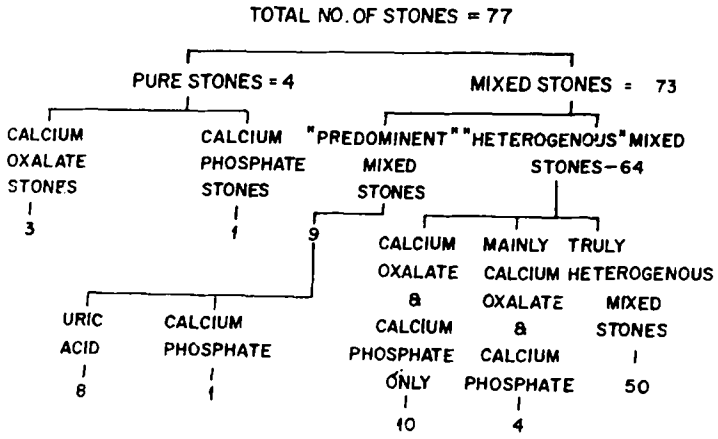

Fig. 1. Classification of stones

Of these, 10 stones (13%) contained calcium oxalate and calcium phosphate only; 4 stones (5.2%) contained mainly calcium oxalate and calcium phosphate; whereas the rest 50 stones (64.9%) were truly heterogenous mixed stones, containing all major components with an analysis grade of + + or more. The rest 9 mixed stones (11.7%) were of "predominent" variety, containing only one component with an analysis grade of + + or more, the rest, although present, had a grade of either trace or +. Of these, 8 (10.4%) were predominently uric acid mixed stones and 1 (1.3%) was predominently calcium phosphate mixed stone.

DISCUSSION

In the developed countries, vesical calculi have practically disappeared in children,[4] and instead, upper urinary tract stones are more commonly seen.[3,5,6] This has been attributed to various factors such as improved nutritional standards, especially increased proteins : cereals ratio and better living standards.[12] In contrast, bladder stones are commonly found in the children of developing countries, as reported from Thailand,[13,14] Indonesia[2] and India.[10] The predominently cereal based diets with very little animal proteins contribute to this high incidence.[1,2,15] Also, repeated attacks of diarrhoea and dehydration lead to passage of concentrated acidic urine, favouring precipitation of calculi.[15] However, various reports have failed to find evidence of severe protein-energy malnutrition, Kwashiorkor, marasmus or vitamin deficiency in these patients.[2] Srivastava et al found only 6 out of 132 pediatric stone patients from Afghanistan suffering from mild degree of protein-energy malnutrition.[12] In our series, there was no evidence of gross malnourishment in any of the patients. The majority of our

class of patients, however, came from the middle to lower income groups. The principal items of diet were chappatis (made of wheat) and polished rice, i.e. a cereal based diet. The amount of animal proteins was low. Also, the practice of prolonged breast feeding is common in the poor income group patients. The human breast milk, in contrast to cow's milk, is very low in phosporus, as is polished rice. Such low phosphorus diets result in high peaks of urinary ammonia excretion.[2]

The stone incidence rate was 8.1/10,000 pediatric hospital admissions. Thalut et al reported an incidence of 8.3/10,000 population/year from Indonesia.[2] Srivastava et al found suprapubic cystolithotomy to account for almost 20% of all operations in Afghanistan.[12]

Although, some reports have indicated higher incidence of stones during the summer season[16,17,18] we could not find any significant seasonal variation. Bombay has a typical coastal climate and the temperatures do not fluctuate very much during the three Indian seasons.

The overall male preponderence for urolithiasis is reflected in our pediatric patients. In fact, the sex ratio was 7.6 in favour of male children, in contrast to the overall male : female ratio of 2.8 : 1 for all the 1,211 stone patients. Other reports from developing nations confirm this male dominence. Srivastava et al found only 7 girls in a study of a total of 132 patients.[12] Halstead reported a ratio of 10 : 1 in Thailand;[19] Thalut et al found a sex ratio or 12 : 1 in favour of males from Indonesia.[2] Others have reported Male : Female ratios as high as 20 : 1 from Syria[20] and China[21] The western literature, in contrast, shows a ratio of 4 : 1.[3,5,6]

Muslims have been found to have a higher incidence of stones than Hindus in some Indian studies.[22,23,24] Our study gave a Hindu : Muslim ratio of 5 : 1. This is in variation with the previous reports. But when the ratio of Hindus and Muslims in the general population is considered, this is more or less proportionate.

Bladder stones were the commonest site of urolithiasis in children in our series. Gaur et al found 131 out of 200 stones to be vesicle.[9] Kabra et al reported that out of 1,144 stones, 721 were bladder stones.[10] Other studies from India,[7,8] Thailand[13,14] Indonesia,[2] and Afghanistan,[12] have also corroborated this. In future, with improving standards of living and increased amounts of animal proteins in diet, this endemicity of bladder stones may disapper in India, especially in the urban populations. The rich socio-economic class of the major Indian cities already has a western pattern of urolithiasis.

A knowledge of the chemical constituents of the urinary calculi helps in understanding the pathogenesis of their formation and, in an individual case, aids the physician in its proper management.[9] Although wet chemical analysis method has its drawbacks[25] it gives fairly reliable clue to stone composition.[26,27]

The commonest elements in our series were calcium, oxalate and phosphate. In contrast to adult stones having only 52.7% positivity rate for uric acid, as many as 76.6% of the pediatric stones had uric acid present. Also, in terms of richness of concentration, uric acid was the richest with 93.2% of the uric acid positive stones showing an analysis reading of ++ or more. High incidence of uric acid and urate has been found by Aurora et al[7], Asper et al,[28] Teotia et al,[15] and Gershoff et al.[29] Srivastava et al found 78% stones to contain

calcium oxalate and uric acid in children of Afghanistan.[12]

The pattern of stone composition varies markedly from region to region.[30,31] Our series had the highest incidence of mixed stones. This was also found by Sutor et al,[31] Popellier et al,[32] Aurora et al,[7] and Srivastava et al.[12]

Conclusion

We conclude, that the incidence of pediatric urolithiasis is 8.1/10,000 hospital admissions at our institution. There is a preponderence of males over females and vesicle stones over other locations. There is no significant seasonal variation. The commonest stones were of mixed type and uric acid was richest in concentration.

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HEALTH AND DEVELOPMENT IN THE 1990s

Despite the economic problems that characterized the 1980s, there has been some progress even in the lesser developed countries. Global trends in such critical indicators as infant mortality and life expectancy at birth are improving. During the past decade, three to four years have been added to life expectancy, which globally is now about 61.5 years. Now, on average, the number of children who die in infancy is 15 per thousand in the developed countries, and 79 per thousand in the developing world. Some 60% of the children in developing countries who reach their first birthday have been immunized against the major childhood diseases, compared with fewer than 5% in 1974.

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