

Chemical Composition of Urinary Calculi in Desert Region of Rajasthan, India

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ABSTRACT A hospital based study was carried out to determine the major chemical components of urinary calculi in desert region of Rajasthan. for this, a total of 188 urinary calculi were analysed by qualitative chemical method, of which 105 were Upper Urinary Tract (UUT) calculi and 83 Lower Urinary Tract (LUT) calculi. The calcium oxalate calculi (23.8%) and calcium oxalate phosphate (25.7%) calculi were higher in UUT calculi, while mixed calculi were higher in LUT calculi. The oxalate component was higher in UUT calculi while ammonium, magnesium carbonate and uric acid components were higher in LUT calculi. The other components like calcium and phosphates were same in both types of calculi.

INTRODUCTION

Urinary stone disease (urolithiasis is known to be one of the oldest diseases affecting mankind universally. The incidence of this disease differs within India and specific stone belts exist in the country, where its incidence is very high (Collobawala, 1971; Kabra et al., 1972). Urolithiasis is very much prevalent in north-west region of Rajasthan which includes Jodhpur, Jaisalmer, Barmer, Bikaner, Ganganagar and surrounding areas (stone belt).

Since our knowledge about the treatment of urolithiasis is confined to only surgical removal, which is also associated with high recurrence rate, little is known about factors which can prevent or restrict the formation of stones in urinary tract. To solve the problem of occurrence and recurrence of urolithiasis, determination of stone composition is considered most important which in turn directly or indirectly can guide the treatment, prognosis and especially the preventive measures.

The observations summarized in the present paper are a part of an epidemiological study of

urolithiasis in desert and non desert districts of Rajasthan. The main objective of the study was to determine the major chemical composition of urinary calculi in the region and the difference, if any, in the chemical composition of calculi with respect to the site of stones.

MATERIAL AND METHODS

The study was carried out at Desert Medicine Research Centre and Urology Department of S.N. Medical College, Jodhpur, Rajasthan. A total of 188 urinary stones received for chemical analysis belonged to 188 patients (168 males and 20 females). The stones were chemically analysed (Beelar et al., 1964) and defined on the basis of their chemical constituents as calcium oxalate, calcium phosphate, calcium oxalate and phosphate, and mixed ones.

RESULTS AND DISCUSSION

Of the 18 urinary stone cases, majority (46.3%) belonged to 15-44 years age group (highest being in 25-34 years age *i.e.* 18.1%), followed by below 15 years (27.1%) and 45 years and above age group (26.6%). The male female ratio was 8 : 1. Higher incidence of urinary stones in males is an universal phenomenon. Among males, upper urinary tract (UUT) stone cases were more prevalent in all age groups except in cases upto 14 years age and 55 years age and above (where lower urinary tract (LUT) stone cases were more prevalent). Among females UUT stone cases were more prevalent). Among females UUT stone cases were more prevalent than LUT stone cases in all age group (Table 1)

The probable combination of radicals as

Table 1: Age-sex wise distribution of urolithiasis cases according to sites

Age group (in years)	Males			Females			Males + Females		
	UUT	LUT	Total	UUT	LUT	Total	UUT	LUT	Total
0-4	2	19	21	1	1	2	3 (2.9)	20 (24.1)	23 (12.2)
5-14	10	14	24	3	0	1	13 (12.4)	15 (18.1)	28 (14.9)
15-24	13	9	22	2	0	2	15 (14.3)	9 (10.8)	24 (12.8)
25-34	21	7	28	6	0	6	27 (27.7)	7 (8.4)	34 (18.1)
35-44	18	8	26	3	0	3	21 (20.0)	8 (9.6)	29 (15.4)
45-54	13	12	25	2	0	2	15 (14.3)	12 (14.5)	27 (14.4)
55+	10	12	22	1	0	1	11 (10.5)	12 (14.5)	23 (12.2)
Total	87	81	168	18	2	20	105 (55.9)	83 (44.1)	188 (100.0)

Figures in the peranthesis are percentages

given in table 2 shows that 18.6 per cent of calculi were pure, whereas, 81.4 per cent were mixed *i.e.* having more than two radicals. Among pure calculi, majority were calcium oxalate (17.0%) and remaining calcium phosphate (1.0%) and uric acid (0.6%). Among mixed calculi, commonest component pattern was calcium oxalate and phosphate (18.6%), followed by calcium oxalate phosphate and uric acid (11.2%), and calcium oxalate phosphate and ammonium (6.4%) and calcium oxalate phosphate ammonium magne-

sium (2.7%). The other combinations constituted the remaining 45.2 per cent of mixed calculi. Among UUT calculi, 26.7 per cent were pure calculi and 91.6 per cent mixed calculi.

The incidence of pure calcium oxalate stones encountered in this study (17.0%) has not been reported so high in studies carried out in other parts of the Rajasthan (Pendse et al., 1984; Singh et al., 1978; Maheshwari et al., 1987). The reasons in variations in the composition of the stones in different parts of the state are not clear, but on the basis of present study at least some of the variations may be attributed to preponderance of UUT calculi.

The mineral components of calculi showed that calcium was present in 181 calculi (96.3%), followed by oxalates in 173 (92.0%), phosphates in 142 (75.5%), ammonium in 96 (51.1%), uric acid in 88 (46.6%) magnesium in 72 (30.6%) and carbonate in 31 of calculi showed that oxalates were high in UUT calculi than LUT calculi whereas, ammonium, magnesium, carbonates and uric acid were higher in LUT calculi than

Table 2: Distribution of chemical composition of calculi according to sites of calculi

Type of stone	Site		
	UUT (No.)	LUT (No.)	Total (No.)
<i>Pure</i>			
Calcium Oxalate	25 (23.8)	7 (8.4)	32 (17.0)
Calcium Phosphate	2 (1.9)	0 (0.0)	2 (1.1)
Uric acid	1 (1.0)	0 (0.0)	1 (0.5)
Sub Total	28 (26.7%)	7 (8.4)	35 (18.6)
<i>Mixed</i>			
Calcium Oxalate and Phosphate	27 (25.7)	8 (9.6)	35 (18.6)
Calcium Oxalate Phosphate and Uric Acid	7 (6.7)	14 (16.9)	21 (11.2)
Calcium Oxalate Phosphate and Ammonium	5 (4.8)	7 (8.4)	12 (6.4)
Calcium Oxalate Phosphate Ammonium and Magnesium	2 (1.9)	3 (3.6)	5 (2.7)
Others	36 (34.3)	44 (53.0)	80 (42.6)
Sub Total	77 (73.3)	76 (91.6)	153 (81.4)
Total	105 (55.9)	83 (44.1)	188 (100.0)

Figures in the peranthesis are percentage

Table 3: Distribution of stones according to mineral constituents and site of calculi

Mineral Constituents	Site		
	UUT	LUT	Total
Calcium	101 (96.2)	80 (96.4)	181 (96.3)
Oxalate	99 (94.3)	74 (89.2)	173 (92.0)
Phosphate	80 (76.2)	62 (74.7)	142 (75.5)
Ammonium	48 (45.7)	48 (57.8)	96 (51.1)
Magnesium	23 (21.9)	35 (42.2)	58 (30.9)
Carbonate	9 (8.6)	22 (26.5)	31 (16.5)
Uric acid/Urate	39 (37.1)	49 (59.0)	88 (46.8)
Total	105	83	188

Figures in the peranthesis are percentages

Table 4: Comparison of chemical composition (in percentage) of calculi reported from various parts of Rajasthan

Mineral Constituents	Jodhpur (Present study)	Jodhpur (Goyal, 1979)	S.E. Raj. (Gaur et al., 1972)	Udaipur (P.P. Singh et al., 1978)	Udaipur (Pendse et al., 1984)	Barmer (Maheshwari et al., 1987)
Calcium	96.3	100.0	91.5	100.0	100.0	71.4
Oxalate	92.0	89.0	68.5	100.0	88.6	89.0
Phosphate	75.5	58.0	54.0	98.9	98.7	58.0
Ammonium	51.1	72.0	56.7	22.4	98.9	72.0
Magnesium	30.9	38.0	35.0	18.4	89.9	100.0
Carbonate	16.5	27.0	23.0	43.8	13.9	14.3
Uric acid/Urate	46.8	24.0	58.5	64.3	64.5	0.0

Table 5: Comparison of chemical composition (in percentage) of calculi reported from different parts of India and America

Mineral Constituents	Jodhpur (Present study)	Ahmedabad (Parikh & Shah, 1962)	Gwalior (Rao, 1964)	Delhi (Malhotra et al., 1968)	Chandigarh (Thind & Nath, 1969)	Ahmednagar (Anderson et al., 1963)	U.S.A. (Herring, 1962)
Calcium	96.3	100.0	99.3	79.9	97.6	90.0	81.5
Oxalate	92.2	38.1	61.7	28.3	92.8	96.6	73.0
Phosphate	75.5	100.0	91.5	56.2	75.5	100.0	79.8
Ammonium	51.0	90.4	81.3	29.7	25.2	10.6	0.0
Magnesium	30.9	28.5	10.6	22.3	35.0	10.6	15.7
Carbonate	16.5	15.9	0.9	9.1	20.1	0.0	0.0
Uric acid/Urate	46.8	76.1	81.1	66.3	35.2	23.3	10.8

UUT. The calcium and phosphates contents were similar in both sites of the calculi (Table 3).

The mineral components of the calculi in the present study from Rajasthan were compared with other studies carried out within the state and outside.

The comparison with the previous study from Jodhpur (Goyal et al., 1979) (Table 4) indicates that the calcium and oxalates in calculi continues to be high. Although, over a period of 18 years, phosphate and uric acid contents have increased and ammonium and magnesium contents have decreased. The composition of stones observed during present study can be fairly compared with Thind and Nath (1969) for calcium, oxalate, phosphate but differ in ammonium, urate, and magnesium. The percentage occurrence of individual chemical radicals is grossly different from that reported for most other Indian places (Table 5). The earlier workers have also reported equally dissimilar results, which probably may be due to varying climatic conditions and dietetic habits in different regions.

The present study reveals that there is a need to carry out comprehensive study to find out rea-

sons for variations in composition of stones reported from different parts of the Rajasthan.

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