Chemical Composition of Upper and Lower Urinary Tract Calculi

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One hundred and two cases of urinary tract calculi were divided into two groups. Group I included patients having stones in the upper urinary tract (i.e. Kidney & ureter) while group II comprised of patients having stones in the lower urinary tract (i.e. bladder and urethra). The study was carried out to determine and compare the chemical composition of upper and lower urinary tract calculi. Majority of the stones were mixed variety, uric acid was found to be higher in concentration in the nucleus of the bladder stones compared to upper tract stones.
Key words. Urolithiasis, chemical composition

Upper and lower urinary tract stones can conveniently be considered as two distinct entities having different etiologies and possibly different chemical composition. Stone constituents give us clue regarding the possible metabolic derangement leading to stone formation as well as other epidemiological factors responsible for stone disease. It has been demonstrated that composition of urinary tract calculi is different in the developing countries than the industrialized countries.

In the industrialized countries upper urinary tract stones are predominant. Whereas lower urinary tract stone (bladder and urethra) are relatively uncommon. These upper tract calculi are predominantly calcium oxalate or struvite in composition[1]. These are often related to urinary tract infection, inherited metabolic defects, underlying congenital anomalies, or vesicoureteral reflux[2,3]. In non-industrialized' nations, lower tract calculi are especially common in children and are composed of ammonium urate and/or calcium oxalate[4].

Urolithiasis affliction is very common among the world population. It has morbidity rate of 2-4% of total population, which is similar to that of diabetes mellitus[5]. Calculus disease is the commonest urological ailment in Pakistan

The present study was carried out to determine the chemical composition of upper as were as lower urinary tract calculi and their comparison regarding composition.

Materials and Methods

The study was conducted in the Department of Urology, Mayo Hospital, Lahore from June 1998 to October 1999. The study was prospective and included 102 cases of urinary tract calculi of all ages and either sex. Patients were divided into two groups, Group I included patients having stones in the upper urinary tract (i.e. kidney and ureter) and Group II comprised of patients having stones in the lower tract (i.e. bladder and urethra).

Detailed history, general physical examination as well as examination of genitourinary system was performed. Routine investigations included blood C/E, urine C/E blood urea and serum creatinine. Ultrasonography of urinary system was performed to see the site and size of the stones. Intravenous urography was performed to confirm the findings of ultrasonography and also to assess the function of each kidney, x-ray chest, blood sugar and electrocardiography were performed in those patients who were above the age of 40 years.

The stones recovered after surgery were biochemically analyzed using Merckognost reagent kit by Merck, Germany. The recovered stones were divided in the middle, then central nucleus of the stone was scoped out with knife, the surrounding middle portion was scratched out leaving behind the outer shell. These three layers were individually pulverized and powdered form of these zones were chemically analyzed.

Results

Out of 102 cases, 68(66%) patients were male and 34(33%) were female, with male to female ratio of 2:1. The age of patients ranged between 2-80 years with mean age of 38.5 years. Maximum number of patients belonged to the age group of 21-40 years with the peak incidence between 21-30 years.

Among 102 patients 77(76%) were having upper urinary tract stones while 25(24%) patients had lower urinary tract stones. Out of 77 upper tract calculi 70(68%) were renal and 7(6%) were ureteric. Of the 25 lower urinary tract calculi all were bladder stones. Size of the stones varied from 0.9cm to 7.5cm. The largest stone was found in the urinary bladder.

Results of upper and lower tract stones were compared as regards their composition. Calcium oxalate was found in about 84% of the patients in all the three layers of the upper tract stones, while in case of lower tract stones outer, middle and inner layers showed 98%, 58% and 92% calcium oxalate respectively. Compounds of phosphate occurred more often on the surface (46%) than the middle (22%) and the central layer (29%) in upper urinary tract urolithiasis while lower tract urolithiasis showed almost equal concentration.of phosphate on the surface 18%, middle (12%) and in the centre (20%) respectively. Uric acid occurred on the surface, middle and in the centre in 33%, 23% and 54% respectively in upper tract urolithiasis and 38%, 38% and 64% in case of lower tract stone disease (Table)

Table:1 Comparison of upper and lower urinary tract stone composition

Composition	Upper urinary tract			Lower urinary tract		
	Outer %age	Middle %age	Inner %age	Outer %age	Middle %age	Inner %age
Ca+OX	84.41	44.15	88.31	98.00	58.00	92.00
P	46.75	22.07	29.87	18.00	12.00	22.00
UA	33.76	23.37	54.54	38.00	38.00	64.00

Discussion

Many studies on urinary tract stone analysis have been carried out in Pakistan[6,7,8]. Most of the studies have been carried out by crushing the whole stone followed by analysis of the pulverized material[9,10].

Most stones are composed of a nucleus surrounded by many layers of varying compositions. The constituents of the nucleus of the stone possibly indicate the initial metabolic disorder that led to the formation of stone. Hence it has been advised that stones should be analysed in layers[11].

Shahjehan and Rehman were probably the pioneers in analyzing stones in layers in Pakistan[12]. Most stones in our study were mixtures of two or more compounds, which points to multiplicity of etiological factors.

Comparing calcium oxalate composition of the upper tract stones (84.41%, 44.51%, & 88.31% in outer middle and inner layers respectively) with the lower tract stones (98%, 58% & 92% respectively) reveals marginally more calcium oxalate in the lower tract stones than in the upper tract stones. The significance of these findings is not obvious.

Making a comparison between the phosphate component of the upper and lower tract stone (46.75%, 22.07%, 29.87% versus 18%. 12% and 20% respectively) reveals greater amount of phosphate in the upper tract calculi and this fact is very obvious in the comparison of phosphate constituent of outer layer (46.75 Vs 18%), this probably reflects greater incidence of proteus infection in causing the continuous growth of upper tract stone. Similar results have been reported by other studies.[13]

The occurrence of uric acid in upper tract on the surface, middle and central layers (33.76%, 23.37% and 54.54%) as compared to lower tract stones (38%, 38% and 64%) indicating greater concentration of uric and in the core of stones than in the superficial layers in both groups. This fact also indicates that greater attention should be paid to the possibility of crystallization of urates as a primary event in calculogenesis. Other studies also report the same results[14].

Conclusion

Majority of the stones are of mixed variety, with calcium occurring as a predominant constituent in the three layers. Uric acid content increases gradually from outer to middle and central layers. Uric acid was found to be higher in concentration in the nucleus of the bladder stones. compared to upper tract stones, while phosphate content was lower in the bladder stones as compared to upper tract stones..

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