

GENDER AND AGE DISTRIBUTION AND CHEMICAL COMPOSITION OF RENAL STONES

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ABSTRACT

Background: Renal stones are commonest urological disease worldwide. The objectives of this study were to determine the gender and age distribution, and chemical composition of renal stones in District Dera Ismail Khan, and its adjacent areas.

Material & Methods: This cross sectional study was conducted at the Department of Urology, DHQ Teaching Hospital, Dera Ismail Khan, from December 2011 to January 2013. All patients with renal stones were eligible for inclusion in this study. These stones were submitted for chemical analysis for calcium, uric acid, cystine, oxalate, carbonate, phosphate, ammonia, and magnesium contents using stone analysis kit (Merck). Age in years was analyzed as mean and range. Gender, age grouping and chemical composition of stones were analyzed as frequency and percentage.

Results: Out of 70 patients 62 were males (88.58%) and 8 females (11.42%). The mean age was 33 years (05-65 years). Calcium oxalate was found in all stones (100%); however 3 stones (4.2%) were pure calcium oxalate stones. Out of 70 cases, the 15 (21.5%) stones had calcium oxalate and phosphate. Uric acid was present in 36 (51.5%) cases in mixed form but 17 stones had uric acid greater than calcium oxalate while 16 stones (22.5%) were of mixed variety with ammonium, magnesium, and cystine content. Cystine was found in 31 (44.2%) stones in mixed form.

Conclusion: The most common renal stones were calcium oxalate and uric acid and most of the stones were of mixed variety with calcium oxalate, urates and phosphates as the predominant constituents.

KEY WORDS: Kidney Calculi; Chemical Analysis; Urat-Calcium Oxalate Stone; Uric Acid; Cystine; Urologic diseases.

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INTRODUCTION

Renal stone is the commonest urological disorder with multifactorial etiopathogenesis.¹ Its prevalence in Western populations is 10%²⁻⁴, although geographical and ethnic differences among populations have been reported.⁵ The majority of stone formation is due to disturbances either in the metabolism and excretion of stone constituents or in promoters and inhibitors of crystallization.⁶ Clinical and epidemiological studies have documented that several types of risk factors are involved in the disease etiology, such as dietary habits, fluid intake, warm climate, and familial occurrence.^{1,7} Geographic factors contribute to the development of stones.⁵ Areas of high humidity and elevated temperatures appear to be contributing factors.⁸ Men are more

frequently affected by urolithiasis than women³, with a ratio of 3:1. Initial presentation predominate in the third and fourth decades of life.⁵

There are five major types of urinary stones: calcium oxalate, calcium phosphate, struvite (magnesium ammonium phosphate), uric acid, and cystine.⁷ The exact cause depends on the type of stone. The most common types are composed of calcium, and for that reason most urinary stones (85%) are radiopaque. They are more common in men between age 20–30 years.⁸ Calcium can combine with other substances, such as oxalate (the most common substance), phosphate, or carbonate to form the stone.⁹ Oxalate is present in certain foods such as spinach and vitamin C supplements.⁶ Uric acid stones can be radiolucent yet frequently are composed of a combination of uric acid and calcium oxalate and thus are radiopaque. They can occur with gout or chemotherapy. Diseases of the small intestine increase the risk of such stones.¹⁰

Cystine stones frequently have a smooth-

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edged, ground-glass appearance.³ Cystinuria is an autosomal recessive disorder and distal renal tubular acidosis may be transmitted as a hereditary trait, thus urolithiasis occurs in up to 75% of patients affected with this disorder.¹¹ Radiographically cystine stones appear lightly opaque (due to the sulphur content) with homogeneous density, typically a “ground-glass” appearance.

Struvite stones are mostly found in women who have a urinary tract infection. These stones can grow very large and can block the kidney, ureter, or bladder.¹²

Analysis of renal calculi is an essential step in the treatment of the patient with nephrolithiasis.¹³ The objectives of this study were to determine the gender and age distribution, and chemical composition of renal stones in District Dera Ismail Khan, and its adjacent areas.

MATERIAL AND METHODS

This cross sectional study was conducted at the Department of Urology, District Head Quarters Teaching Hospital, Dera Ismail Khan, Pakistan from December 2011 to January 2013. A sample of 70 patients was selected by non-probability convenience technique. All patients with renal stones were included in this study. X-Ray KUB and ultrasonography were done for location of stones. Other relevant investigations were done. These stones were removed conservatively, with endoscopic procedure or open nephrolithotomy by a single urologist. (Khan G). The stones were analyzed for uric acid, cystine, oxalate, carbonate, phosphate, ammonia, calcium and magnesium contents using stone analysis kit (Merck).

Gender and age in years and age grouping were demographic variables. Chemical composition of renal stones was a research variable. Age grouping was done as follows: 01-20 years, 21-40 years, 41-60 years and more than 60 years. Age in years was analyzed as mean and range. Gender, age grouping and chemical composition of stones were analyzed as frequency (number) and relative frequency (%).

RESULTS

Out of 70 patients with renal stones whose stones were chemically analyzed, there were 62 males (88.58%) and 8 females (11.42%). The mean age was 33 years with a range of 05-65 years. The commonest age group involved was of 21-40 years while the least commonly involved age group was of more than 60 years as shown in table 1.

Calcium oxalate was found in all stones (100%); however 3 cases (4.2%) were pure calcium oxalate

Table 1: Age group distribution of patients with renal stones (n=70)

S No.	Age groups	Frequency	Percentage
1	01-20 years	09	12.8%
2	21-40 years	46	65.8%
3	41-60 years	13	18.6%
4	> 60 years	2	02.8%
Total		70	100 %

Table 2: Chemical composition of renal stones (n=70)

S.No.	Type of stones	Frequency	(%)
1	Calcium Oxalate (Pure)	03	4.2 %
2	Calcium oxalate & Phosphate	15	21.5 %
3	Uric acid predominant	36	51.4 %
4	Mixed stone	16	22.9
Total		70	100 %

Table 3: Distribution of mixed renal stones (n=16)

S.No.	Type of stones	Frequency	(%)
1	Ca ox+ Mg	1	06.3
2	Ca ox+Po4+NH4	1	06.3
3	Ca ox+Po4+N-H4+Mg+Cys	2	12.5
4	Ca ox+Po4+Cys	6	37.5
5	Ca ox+Mg+Cys	2	12.5
6	Ca ox+N-H4+Mg+Cys	1	06.3
7	Ca ox+Cys	3	18.6
Total		16	100 %

Ca ox= calcium oxalate, Mg= magnesium, Po4= phosphate, NH4= ammonium, Cys= cysteine

stones. Out of 70 cases, 15 (21.5%) stones had calcium oxalate and phosphate. Uric acid was present in 36 (51.4%) cases in mixed form but 17 stones had uric acid greater than calcium oxalate while rest of the 16 cases (22.9%) were of mixed variety with ammonium, magnesium, and cystine content as shown in table 2.

Out of 70 cases, cystine was found in 31 (44.2%) stones in mixed form. Table 3 gives the frequency and %age of 16 mixed renal stones.

DISCUSSION

According to our study the renal stones were more common in males than females with a ratio of 7.8:1. This is in comparable to the studies by Rajput et al who found male to female ratio of 4:1 and Arain et al estimated male to female ratio of 3.8:1.^{14,15} Another study conducted by Khan et al, in Saudi Arabia found a male to female ratio of 5:1 and in study by Nazir et al, male to female ratio was 2.5:1.^{16,17}

In our study the prevalence of renal stones was highest for age group of 21 to 40 years to be 46 (65.8%) followed by 41-60 years to be 13 (18.6%). It was less common in age group of 01-20 years to be nine (12.8%) and above 60 years to be two (2.8%). The mean age was 33 years, this is comparable to study conducted by Rajput et al where the commonest age group was 21 to 40 years, and study conducted by Arain et al found a mean age of 29 years for renal stones while Ahmad et al had maximum incidence in age group 30 to 50 years.^{14,15,18}

The information of chemical composition of renal stones is essential for knowing their etiology.¹⁵ The therapy for the renal stone disease is also based on analysis of calculi. With the help of chemical composition, proper management of the disease and prevention of its recurrence is possible. In our study pure calcium oxalate stones were less (4.2%), however calcium oxalate was most common salt present in all stones in mixed form mainly as predominant constituent. In study by Sial et al, the pure calcium oxalate stones were 5 (10%), calcium oxalate plus calcium phosphate were 10 (20%) and stones having uric acid in mixed form were 60%, although sample size was small (n=50).¹⁹ These results are very similar to our study.

In our study mixed uric acid stones were 51.4%. In a study from Karachi by Rizvi et al,²⁰ 75 renal calculi were analyzed. The commonest were calcium oxalate calculi followed in frequency by calculi containing calcium oxalate plus uric acid and those containing calcium phosphate. No pure uric acid or ammonium urate calculi were reported. In this study 59.7% of the calculi contained uric acid while in studies reported by Zafar et al, Khalil et al and Sial et al, 43.3%, 40.8% and 60% of their calculi respectively contained uric acid.^{21,22,19} In another study reported from Karachi by Shah Jehan et al, 52.8% of the upper urinary calculi contained uric acid.²³ These results are very similar to our study.

The physiological and environmental factors responsible for uric acid stones are persistent urine acidity, hyperuricosuria and decreased urine volume. Much of the population cannot afford frequent intake of purine rich food such as meat, fish and poultry with resultant hyperuricosuria.²⁴ Low urine volume and low pH is encountered in dehydration and

dehydration is due to long summers with very high temperatures leading to diminished urinary output, persistent urine acidity and super saturation of urine with uric acid. Combination of all these in turn lead to uric acid crystallization and stone formation.

The diversity in the chemical composition of renal stones in different studies is due to diversity in dietary habits, environmental factors, climate and genetic variations. Other studies from Pakistan show variable data like Zafar et al analyzed 258 upper renal tract calculi and reported that pure calcium oxalate calculi were the commonest variety (33.7%) of calculi followed by mixed calculi containing calcium oxalate plus uric acid (22.4%) and calculi composed of ammonium urates and those of calcium oxalate plus calcium phosphate each making up 18.9% of the total number.²¹ Khalil et al analyzed 137 urinary calculi from Quetta valley and reported that most frequent calculi were those containing calcium oxalate and uric acid (29.1%) followed by calculi containing calcium oxalate (25.5%), struvite calculi (16.7%) and calcium oxalate and phosphate calculi (13.8%). Calculi containing uric acid or ammonium urate accounted for 11% of the calculi analyzed.²²

In our study, calcium oxalate and phosphate calculi were in 21.5% cases. In a study from Lahore by Khan most of the upper urinary calculi were of mixed composition containing calcium oxalate and uric acid followed by calculi containing calcium oxalate and phosphate (25%).²⁵ These results are similar to our study, although his sample size was small with 37 upper urinary tract calculi. No struvite calculi were reported by Sial et al and no such stones were found in present study too.¹⁹ In our study cystine was found in 31 stones out of 70 in mixed form. Cystinuria is an autosomal recessive disorder and distal renal tubular acidosis may be transmitted as a hereditary trait, thus urolithiasis occurs in up to 75% of patients affected with this disorder.¹¹ In general, cystine stones constitute 1–2% of urinary calculi. The worldwide prevalence of cystinuria varies considerably, affecting 1 in 20,000 people. Cystine constitutes 6–8% of paediatric renal calculi. Various studies showed that the peak age of onset of stones is in the third decade of life but can occur at any age. Most people with cystinuria have recurrent episodes of stones in their lifetime. Stone analysis provides definitive proof of the composition of stone.²⁵⁻²⁷

CONCLUSION

The commonest renal stones were of calcium oxalate and uric acid; most of the stones were of the mixed variety with calcium oxalate as the predominant constituent. Higher prevalence of renal stones was observed in male population. The prevalence of renal stones was highest for age group of 21 to 40 years.

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CONFLICT OF INTEREST
 Authors declare no conflict of interest.
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