Original Article

Chemical Analysis of Urinary Stones and its Locations Associated to Urinary Tract

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ABSTRACT

OBJECTIVES: To detect the frequency of different types of urinary stone, and location in urinary tract in patients admitted at Liaquat University Hospital Jamshoro.

MATERIAL AND METHODS: This descriptive study was conducted at the department of urology of Liaquat University Hospital Jamshoro from February 2011 to July 2012 (18 months). The study was carried out on 100 patients. All the patients age 15 years and above with urinary calculi, admitted for surgical procedure for stone disease were included in the study. All the demographic data including investigation, surgical procedure and chemical analysis of stone was noted on questionnaire form. Data was analyzed on SPSS program version 16.0

RESULTS: Out of 100 patients, male were 71 and female were 29. Mean age of the patients was 45.0 years. This study noted: 85% calcium, 78% oxalate, 53% uric acid stones in high percentage, and according to location the kidneys were the most affected part for stone disease as compared to ureter and bladder.

CONCLUSIONS: In this study we noted calcium, oxalate, and uric acid were the most common components of urinary stone, kidneys were mostly affected as compared to ureter and bladder. Information and results of this study can help in the improvement of urinary stone prevention.

KEY WORDS: Urinary stone, chemical composition, location.

INTRODUCTION

Urolithiasis is the 3rd most common clinical problem worldwide[1] presenting up to (15%) of population in the western countries[2]. The prevalence of its distribution is variable across the world. A very high incidence area includes Scandinavian countries, Mediterrenanian, British Isles, Australia, and central Europe, some parts of Malaysia, China, Pakistan, and Western India. In our continent the most common stone belt areas includes Myanmar, Sudan, Thailand, Indonesia, phillipines Saudi Arabia, UAE, Pakistan and India.[3]

Urolithiasis is the complex phenomenon and not completely understood till now. No single factor contributed in patho physiology of stone formation but may be due to, infections, hormonal influences, metabolic disturbances, diet factors or obstructions in the urinary system or increasing excretion of chemical components such as oxalate, calcium, carbonate, magnesium, phosphate, and cystine etc[4], and can be due to decrease concentration of stone inhibitors in the urine, such as citrate, phosphate and chloride.

Most common chemical constituents of Urolithiasis includes calcium (75- 80%) followed by calcium oxalate and calcium phosphate. 10 to 15% constituents contain struvite, magnesium, ammonium and phosphate. 6% are composed of uric acid and only 1 to 2 percent contains cystine.[5]

Urolithiasis are twice common among males.[5] Peak incidence is reported in second or third decade of life.[7] Calculi may recur in 50% of patients even after surgical management.[8] As it mostly affects working age group, makes it a major socioeconomic burden on society.[9]

The prevalence of urinary stone has been continuously growing from past 50 years in industrial as well as in developing countries of different geographical locations.[10] Urinary calculi formation is considered to have direct association to the chemical constituents of urine, which can be managed and prevented by environmental and nutritional factors.[11]

Some studies shows an association b/w stone composition and age of the patients.[12,13] Daudon et al[14] in 1995 noted that as age increases the urinary concentration of uric acid increases and its frequency reaches on its peak up to the age range 60-70 years. Koide et al[13] observed the high concentration of calcium oxalate stone in the age of 40 and 50 years in Japan.

Urolithiasis in developing countries is considered to be very different from the industrialized countries.[15] In Tunisia; studies on evolutional epidemiological factors of urinary stone are scarce and have been based on the analysis of a limited number of patients.[12]

Dietary, environmental and genetic factor are important lithogenic risk factors. So excessive consumption of animal proteins rich in oxalate or urates, sodium

chloride, insufficient dietary intake of fruits and potassium rich vegetables affect urine chemistry, low urine pH, high urine calcium and uric acid excretion and low citrate excretion.[16]

The proper and detailed history from patients having Urolithiasis problem could provide significant information of stone formation and on the basis of this a pharmaceutical approach could be applied to prevent the recurrent stone formation.[14, 15] Purpose of this study to find out the complete chemical information of urinary stone constituents in our general population and observation of stone location in urinary system.

MATERIAL AND METHODS

This observational study comprise of 100 patients with urinary stone disease and was conducted at Liaquat university hospital jamshoro, during period of February 2011 to July 2012 (18 months). All patients of 15 year age and above who were admitted for surgical procedures for stone disease were included in the study. The data of Urolithiasis patients was collected from the urology ward after having surgery. Different diagnostic methods includes digital x ray KUB, ultrasound, IVU and CT KUB etc were applied for the diagnosis of stone location in urinary tract system. Surgically removed stone samples were sent to diagnostic research laboratory of Liaquat university hospital for chemical analysis. Patient's age, sex, investigation, surgical procedure and chemical analysis of stone was noted on proforma. Data was entered and analyzed in Statistical Program SPSS version 16.0. Qualitative data such as types of chemical components of urinary stone and its location and numerical variables like age in years were presented as frequencies and percentage.

RESULTS

Total 100 cases were analyzed for chemical composition during the period from February 2011 to August 2012 (18 months). Out of 100 patients 71 were male and 29 were female with the ratio of 2.4:1. The age of subjects having stones were ranging from 15 to 75 years with the mean (SD) age of 45- (16.4). **Table I.**

Table I shows the number of patients by age, sex and side of stones. The greatest number of calculi was observed in age groups of 15-30 (40%) and 31-45 (30%) years.

Out of 100 cases, 89 were unilateral affected left side of urinary tract in 54% cases and right side 35%. Bilateral stones were present only in 11% of cases.

Graph I shows the classification of Urolithiasis according to the anatomical location of stone with most commonly affected the kidney and accounts for 60%, then ureter 23%,and bladder 17%.

Major chemical constituents of urinary stone found noted in this study was, oxalate found in 78% stones, calcium (85%), uric acid (53%), phosphate (25%), magnesium (5%), ammonium (5%), while aspartate was only found in 3% and struvite was noted in (5%) stones.**(Table II)**

Urinary stones composition in this study were as calcium oxalate containing stones were (29%), calcium oxalate + uric acid stones were (37%), calcium oxalate + calcium phosphate stones were (5%), calcium oxalate + calcium phosphate + uric acid stones were (8%), calcium oxalate + aspartate stones were only (3%), calcium phosphate stones were (8%) while pure uric acid stones were (10%) and struvite stones were in 5% of cases. **(Table III)**

TABLE I: BASELINE CHARACTERISTICS OF THE PATIENTS (n=100)

	Frequency	Parentage (%)
Mean age±SD(Rang)		45.0±16.4(15-75)
Sex		
Male	71	(71.0%)
Female	29	(29.0%)
Total	100	(100.0%)
Age group		
15-30	40	(40.0%)
31-45	30	(30.0%)
46-60	15	(15.0%)
61 & above	05	(05.0%)
Total	100	(100.0%)
Stone sidewise		
Left	54	(54.0%)
Right	35	(35.0%)
Bilateral	11	(11.0%)
Total	100	(100%)

GRAPH I: LOCATION WISE DISTRIBUTION OF URINARY STONE

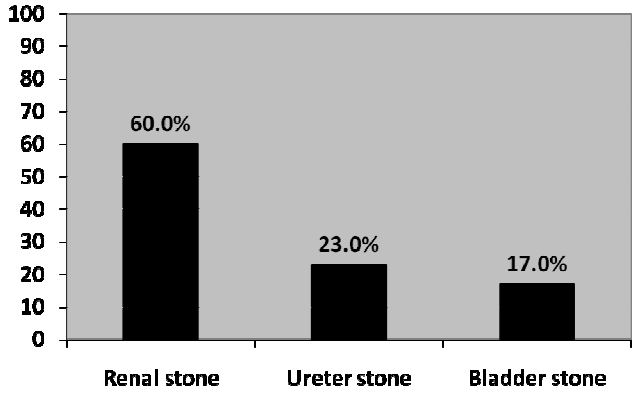

TABLE II: MAJOR CHEMICAL COMPONENTS OF URINARY STONE

Components	Percentage
Calcium	85.0%
Oxalate	78.0%
Uric acid	53.0%
Phosphate	25.0%
Magnesium	5.0%
Ammonium	5.0%
Aspartate	3.0%
Struvite	5.0%

TABLE III: FREQUENCY AND (%) OF STONES WITH CHEMICAL COMPOSITION

Chemical Components	Frequency	%
Calcium oxalate	27	27.0%
Calcium oxalate + Uric acid	35	35.0%
Calcium oxalate + Calcium phosphate	5	5.0%
Calcium oxalate + Calcium phosphate + uric acid	8	8.0%
Calcium oxalate + Aspartate	3	3.0%
Calcium phosphate	7	7.0%
Uric acid (pure)	10	10.0%
Magnesium ammonium phosphate (struvite)	5	5.0%
Total	100	100.0%

DISCUSION

There are many causes of stone formation but some important factors like environmental and dietary factors[17] play important role in initiating the stone formation process.

Our study showed that urinary calculi were more common in the men as compared to women. Out of 100 patients, 71 were male and 29 were female with the ratio of 2.4:1.It may be due to the reason that women produce more estrogen hormone and with the estrogen production they can produce large amount of citric acid which prevent the stone formation. Other study also shows that stones are up to 4 times more common in males as compared to females in the ratio of 2.7:1 which was observed by Shokouhi et al[5] and Rayhan et al[18], Rafique et al[19].

Another study by Stapleton FB[20] reported more involvement of urinary stone disease in men because of having large muscular mass as compared to female.

The age of the patients in this study was above 15 years. The large number of calculi was noted in age groups between, 15-30 year (40%) and 31-45 year (30%). While in some other studies the greatest number of patients were noted in the age group of 21-40 years and 41-60 years with percentage of 52.5% and 25.2% respectively.[21] Highest numbers of the cases were noted with renal stone between the age group of 30-40 years.[22] T.Ogata et al[23] reported that renal stones were mostly seen in 3rd and 4th decades of life.

In this study the highest numbers of stone were found unilateral (89.0%) with most commonly affected the left side (54.0%) than the right (35.0%).Bilateral stones were noted only in 11.0% of patients. According to other studies 93.4% of renal stones cases were unilateral with 60% cases noted on the left side, 33.4% on the right side and just 6.6% bilateral.[22] Bucholz et al[24] also reported the same results which showed that the left kidney most commonly affected by the stone disease.

Distribution of urinary calculi according to the location in urinary tract were also noted, with most commonly affected, the kidney (60.0%) , ureter (23.0%), and bladder (17.0%). If compared to other studies, upper urinary tracts was most commonly affected part, and the bladder stone were noted in10.0%.[15] Other studies also reported the Urinary stone disease mostly affects the kidney (52.4%), ureter (29.4%) and Bladder (18.2%).[25]

In this study, calcium component was noted in 85% of stones, oxalate in 78%, uric acid in 53%, phosphate in 25%, magnesium in 5%, ammonium in 5%, aspartate in 3%, and struvite in 5% cases. Similar results were noted in another study reported the percentage of calcium oxalate was 99.5%, followed by uric acid (40.9%), phosphate (25%), ammonium (7.3%), magnesium (2.15%) and cystine was present in (0.86%).[26]

After the stone chemical analysis the composition of urinary stones in our study reported as, calcium oxalate stones were 29.0%, calcium oxalate + uric acid stones (37.0%), calcium oxalate + calcium phosphate stones (5.0%), calcium oxalate + calcium phosphate + uric acid stones (8.0%), calcium oxalate + aspartate stones (3.0%), calcium phosphate stones (8.0%) while 10% stones were contain pure uric acid and 5% stones contain struvite. Rahman et al[27], noted that, 34% of urinary stone contain calcium oxalate componant. Khalil et al reported that the urinary stone component of calcium oxalate and uric acid were 29.1%.[28] Rafique et al[19] was noted the percentage of calcium oxalate and calcium phosphate, 10.4% and 7%

respectively. Hashmi[29] noticed calcium phosphate in 5% of all of his study cases. Khan et al reported uric acid in 19% and struvite in 3% cases. [7]

CONCLUSION

Calcium, oxalate, and uric acid are the most common chemical components and main causative constituents of urinary stone and kidneys were mostly affected as compare to ureter and bladder. Information and results of this study can help in the improvement of urinary stone prevention. According to this study dietary control and awareness by health education can play an important role in the prevention of Urolithiasis.

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