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Studies on the Chemical Composition and Presentation of Urinary Stones in relation to Sex and Age among Human Population of Multan, Pakistan

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The present study was carried out to investigate chemical composition of urinary stones in patients of different age groups of human population in Multan, Pakistan for a period of 18 months from July 2001 to January 2003. In order to obtain patients history different hospitals including Nishtar hospital Multan, Life kidney stone center, Siyal medical center and Medicare hospital were visited. Of the 263 cases of urinary stones, 193(73.38%)were in kidney, 57(21.67%) were in the urinary bladder, 13(4.94%) were in ureter. The three predominant symptoms associated with urinary stones were lumber pain, 88(33.46%), burning in micturition 72(27.37%) and heamaturia 103(39.16%).Other related symptoms were vomating 75(28.51%), fever 50(19.01%), dribbling 25(9.50%), pysuria 34(12.92%), dysuria 30(11.40%) and retention 49(18.63%).According to the chemical composition of the urinary stones, most of the stones examined in this study were of calcium oxalate + uric acid 66(25.09%), calcium oxalate 57(21.67%), calcium oxalate + calcium phosphate 51(19.39%), pure uric acid 44(16.73%), calcium oxalate + calcium phosphate + uric acid 29 (11.02%), pure calcium phosphate, 3(1.14%) and others 13 (4.94%) were of mixed lithiasis. Of these cases the incidence of formation of calcium oxalate + uric acid stone, was maximum in males of age group 14 - 49 years.

Key words: Urinary stones, sex, age, chemical composition, population

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Introduction

Kidney stones, one of the most painful of the urologic disorders are not a product of modern life. Scientists have found evidences of kidney stones in a 7,000- year old Egyptian mummy. Nephrolithiasis or kidney stones are small hard crystals formed when substances like calcium, uric acid, magnesium, ammonium and phosphates precipitate out of urine and build up on the inner surface of kidney (Good Enough ***et al.***, 1990). Kidney stone is a hard mass developed from crystals that separate from the urine and aggregate up on the inner surface of the kidney (Coe ***et al.***, 1992 and Savitz, 1999). Curhan ***et al.*** (1997) has defined kidney stone as a lump, which is formed when the urine becomes overly concentrated with certain substances like Calcium, Uric acid and Oxalates etc. Among these most prevalent (75%) are Calcium stones.Stones develop when there are imbalances of components in urine that are due to one or a combination of the following conditions; hypercalciuria, hyperuricosuria, hypocitraturia and several other factors including the acute shortage of water as in desert and arid areas, dietary habits, life style and genetic factors (Gault ***et al.***, 1993 and Baggio, 1999). Kidney stone is a disorder, which may be problematic and is caused due to various factors. It may be cured and preventive measures should be taken otherwise it may cause other disruptions. It may dead to the development of hydronephrosis, which is an aseptic dilation of the kidney due to partial obstruction to the outflow of urine, in this way kidney may become palpable (Ahsan, 1997). Kidney stones or renal Calculi are best described as the concretion of minerals and organic matter that forms in the kidneys. They often became so large that they impair normal renal functions. They occur in a variety of shapes, colors, textures and sizes. It is the sharp edges of these crystals that cause the unbearable pain as they pass through the urinary tracts (Rodgers, 2000). Our kidneys are located on either side of the spine, just up under the bottom ribs in the superior lumber region where they receive some protection from the lower part of the rib cage. (Mareib, 1994). An adult kidney is about 12.5cm (5 inches) wide and 2.5cm (1 inch) thick. The right kidney is positioned slightly lower than the left. It is convex laterally and has a medial indentation called the hilus. Several structures, including the ureter, the renal blood vessels and nerves enter or exit the kidney at the hilus (Marieb, 1994). Kidneys are well supplied with blood via the renal pelvis where it is stored until voided. From the bladder, the urine flows to the outside via the urethra, (which in the male also serves as a part of the reproductive tract) (Carter, 1996). Kidney stones arise within the collecting ducts and grow in the renal pelvis, only resulting in obstruction of the ureteropelvic junction or proceed down the ureter. Some stones never make it beyond the renal pelvis, being too large to pass the ureteropelvic junction. If a stone is to move on, however, the first likely point of obstruction is at the ureteropelvic junction, the “headwaters” of the drainage. Internal diameter there can be as small as 2-3mm. Common stones are unlikely to fix in the next segment, the abdominal spindle, which can pass a 10mm ureterolith. The ureter narrows to about 4mm as it passes into the pelvis crossing over the iliac vasculature and it narrows again in the posterior pelvis as it crosses under the hypogastric vessels. The last obstacle for a passing stone in the ureterovesicular junction, where the lumen may be as narrow as 1mm (Harding ***et al.***, 1984). The most common type of stone contains Calcium that is not used by the bones and muscles and goes to the kidneys. In most people, the kidneys flush out the

extra Calcium with the rest of the urine (Hosking ***et al.***, 1983). People who have stones keep the Calcium in their kidneys. The Calcium that stays behind joins with other waste products to form a stone (Asplin, 1992). The most common type of stone contains Calcium in combination with either Oxalate or Phosphate (Curhan 1993). They are 2 or 3 times more common in men. (Coe ***et al.***, 1992). Uric acid stones may form when there is too much Uric acid in urine. If any one tends to form Uric acid stones, one may need to cut back on the amount of meat one eat (Asplin, 1992). Uric acid and urate stones are yellow or brown in color and are not opaque to X-ray. Urate stones are softer and are commonly found in children (Ahsan, 1997). Cystine stones are rare. Cystine is one of the building blocks that make up muscles, nerves and other parts of the body. The disease that causes Cystine stones run in families (Asplin and favus, 1996). Cystine stones are soft and pink or yellow in color. They are radio opaque to the Sulphur they contain (Ahsan, 1997). The purpose of the present study is to asses the chemical composition and presentation of urinary stones in human population of Multan. Ancillary purpose of the research was to find out the relationship of urinary stones with age and sex. This study will provide us with the answers related to nature and causes of kidney stones and their possible preventions.

Materials and Methods

The present study was carried out to assess the chemical composition and presentation of urinary stones in relation to sex and age among human population of Multan, Pakistan for a period of 18 months from July 2001 to January 2003. The present study was based on the data of the patients (n=263) admitted in different hospitals including Nishtar Hospital, Life Kidney Stone Center, Siyal Medical Center and Medicare Hospital Multan for complaint of kidney stones. One hundred and ninety five male and sixty eight female of different age groups were analyzed. The male population was divided into three age groups i.e. old male (age above 50 years), mature male (age 13 to 50 years) and young male (age below 13 years). The female population was also divided into similar three groups. Efforts were made to include samples of all those persons who were willing to cooperate in carrying out the purpose of present study. Ultrasound of kidney, ureter and urinary bladder was examined. X-rays of kidneys ureter and urinary bladder were performed after over night fasting and giving maximum one liter of water before developing X-rays so that stones could be easily visible. The findings of ultrasound and X-rays were studied and recorded. After the operation each stone was carried to Khan Diagnostic Laboratory where they were physically and bio-chemically analyzed by infrared spectroscopy and wet chemical analysis. Infrared spectroscopy is an extremely powerful analytical technique for both qualitative and quantitative analysis. The infrared spectrum of unknown substance is interpreted by the use of specific light frequencies. The samples were washed with deionized water and dried in air. The I.R. spectrums of all samples were recorded. The standard spectrums of calcium, magnesium, phosphate and oxalate were also recorded. In wet chemical analysis method the stone powder was obtained by pulverizing the small stones in an agate mortar. Stone powders were qualitatively analyzed for the presence of various substances by treating the powder with the chemical agents provided by the chemical kit (Merck) for the diagnosis of various types of chemical stones. The chemical composition and physical existence of the stones were then recorded and statistically analyzed (Coe ***et al.***, 1992).

Results

The present study revealed that tendency of single stone formation was higher (64.63%) as compared to double (22.05%) or multiple stones (13.30%) in all age groups of both sexes (Table 1). The data further suggested that occurrence of stones is maximum (73.38%) in kidney as compared to ureter (21.67%) and urinary bladder (4.94%) in all age groups of both sexes (Table 2). The results showed that the tendency of formation of oval shaped stones(46%) was highest. The percentage of rounded stones (26.99%), crystalline stones (11.40%), spiny stones (10.20%) and spindle shaped stones was (5.32%) (Table 3).

The results suggested that tendency of formation of hard stones (96.20%) was greater than soft stones (3.80%) in all age groups of both sexes (Table 4). According to data white colored stones were highest in percentage (38.40%) then brown colored (36.88%), yellow colored (16.73%), gray colored (5.32%) and grayish brown (2.66%) (Table 5). According to chemical composition the highest percentage of the stones was Calcium Oxalate plus Uric acid (25.09%), followed by Calcium Oxalate (21.67%), Calcium Oxalate plus Calcium Phosphate (19.39%), pure Uric acid (16.73%), Calcium Oxalate plus Calcium Phosphate plus Uric acid (11.02%), pure Calcium Phosphate, (1.14%) and others (4.94%) were of mixed lithiasis (Table 6). The most common symptom of urinary stones was burning plus heamaturia (39.16%) followed by lumber pain plus burning (33.46%) and lumber pain plus burning plus heamaturia (27.37%). The results regarding the associated symptoms of urinary stones showed that among the associated symptoms vomiting (28.51%), fever (19.01%), retention (18.63%), pysuria (12.92%), dysuria (11.40%) and dribbling (9.50%) are common.

Table 1: Urinary stone patients with single, double and multiple stones

Type	Age	Sex	N	Single	Double	Multiple
Old	> 50	M	38	27	8	3
Mature	13 -50	M	98	56	19	23
Young	< 13	M	59	44	12	3
Old	> 50	Fe	22	14	7	1
Mature	13 -50	Fe	24	14	6	4
Young	< 13	Fe	22	15	6	1
Total			263	170	58	35
% age				64.63%	22.05%	13.30%

Table 2: Patients with occurrence of urinary stones in kidney, ureter and urinary bladder

Type	Age	Sex	N	Kidney	Ureter	Bladder
Old	> 50	M	38	30	7	1
Mature	13 -50	M	98	74	20	4
Young	< 13	M	59	38	18	3
Old	> 50	Fe	22	16	3	3
Mature	13 -50	Fe	24	20	3	1
Young	< 13	Fe	22	15	6	1
Total			263	193	57	13
% age				73.38%	21.67%	4..94%

Table 3: Presentation of different shapes of urinary stones in patients of all age groups of both sexes

Type	Age	Sex	N	Oval	Spiny	Rounded	Spindle	Crystalline
Old	> 50	M	38	19	6	8	3	2
Mature	13 -50	M	98	47	8	26	6	11
Young	< 13	M	59	21	6	16	1	15
Old	> 50	Fe	22	6	4	11	1	0
Mature	13 -50	Fe	24	18	1	2	2	1
Young	< 13	Fe	22	10	2	8	1	1
Total			263	121	27	71	14	30
% age				46%	10.2%	26.99%	5.32%	11.40%

Table 4: Occurrence of hard and soft urinary stones in patients of all age groups of both sexes

Type	Age	Sex	N	Hard	Soft
Old	> 50	M	38	36	2
Mature	13 -50	M	98	94	4
Young	< 13	M	59	58	1
Old	> 50	Fe	22	22	0
Mature	13 -50	Fe	24	23	1
Young	< 13	Fe	22	20	2
Total			263	253	10
% age				96.20%	3.80%

Table 5: Presentation of different colors of urinary stones in patients of all age groups of both sexes

Type	Age	Sex	N	Yellow	White	Brown	Gray	Grayish brown
Old	> 50	M	38	6	12	18	0	2
Mature	13 -50	M	98	10	42	35	7	4
Young	< 13	M	59	9	20	25	4	1
Old	> 50	Fe	22	8	9	5	0	0
Mature	13 -50	Fe	24	6	6	10	2	0
Young	< 13	Fe	22	5	12	4	1	0
Total			263	44	101	97	14	7
% age				16.73%	38.40%	36.88%	5.32%	2.66%

Table 6: Chemical analysis of urinary stones in patients of all age groups of both sexes

Type	Age	Sex	N	Uric acid 100%	Calcium oxalate 100%	Calcium phosphate. 100%	Calcium Oxalate +Uric Acid	Calcium Oxalate +Calcium Phosphate.	Calcium Oxalate + Calcium Phosphate + Uric Acid.	Mix
Old	> 50	M	38	11	2	1	6	7	5	6
Mature	13 -50	M	98	10	32	1	29	12	12	2
Young	< 13	M	59	10	12	0	12	18	5	2
Old	> 50	Fe	22	3	2	0	5	5	6	1
Mature	13 -50	Fe	24	9	6	0	9	0	0	0
Young	< 13	Fe	22	1	3	1	5	9	1	2
Total			263	44	57	3	66	51	29	13
% age				16.7%	21.67%	1.14%	25.09%	19.39%	11.02%	4.9%

Table 7: Presentation of predominant symptoms of urinary stones in patients of all age groups of both sexes

Type	Age	Sex	N	Lumber.pain +burning	Lumber.pain+ burning +hematuria	Burning + hematuria
Old	> 50	M	38	9	10	19
Mature	13 -50	M	98	19	32	47
Young	< 13	M	59	28	19	12
Old	> 50	Fe	22	8	1	13
Mature	13 -50	Fe	24	10	3	11
Young	< 13	Fe	22	14	7	1
Total			263	88	72	103
% age				33.46%	27.37%	39.16%

Table 8: Presentation of associated symptoms of urinary stones in patients of all age groups of both Sexes

Type	Age	Sex	N	Vomiting	Fever	Dribbling	Pysuria	Dysuria	Retention
Old	> 50	M	38	15	6	6	2	3	6
Mature	13 -50	M	98	26	15	6	15	14	22
Young	< 13	M	59	11	11	7	10	8	12
Old	> 50	Fe	22	7	5	2	2	3	4
Mature	13 -50	Fe	24	9	7	2	2	1	3
Young	< 13	Fe	22	7	6	2	3	1	2
Total			263	75	50	25	34	30	49
% age				28.51%	19.01%	9.50%	12.92%	11.40%	18.63%

Discussion

Urinary stones are one of the most painful diseases which effect human and are most common disorder of the urinary tract. As Pakistan is situated in the stone kit this disease is responsible for considerable morbidity. The present study was carried out to investigate chemical composition and presentation of urinary stones in patients of different age groups of human population in Multan, Pakistan.The results of the present study revealed that among the reported operated cases kidney stone is most prevalent in mature patients of an age group 13-50 years. These results agree with that of Nordin ***et al.*** (1972), who described that for kidney stones the distribution of age is normal with a peak age of recurrence at about 35 years. Coe ***et al.*** (1992) observed that those between the ages of 35-50 years are in the peak stone formation period. Curhan ***et al.*** (1998) also described that 3rd and 5th decades of age are more prevalent for kidney stones. Whereas Milton (2001) described that kidney stones occur mostly in 20-30 years old age group but it can happen to anyone to any age. According to Ahmed (1983) maximum incidence of renal stone is found in the age of 30-50 years. The reported cases also indicate that prevalence of kidney stones is higher in males 195 (74.14%) as compared with females 68 (25.86%). The results also agree with that of Estepa ***et al.*** (1997) who have described that in white populations male to female ratio is higher than 1. According to Coe ***et al.*** (1979) stone disease is two or three times more common in males than in females. Milton (2001) also concluded that male get kidney stone more often than female. Spengler (2000) also agrees that kidney stones are three times more common in male than in female. The higher prevalence of nephrolithiasis in males can be described by the effect of sex hormones on some lithogenic risk factors: Androgens

appeared to increase, the urinary oxalate excretion and deposition of calcium oxalate in the kidney both of these are the main risk factors to form kidney stones while the estrogens decrease the urinary oxalate excretion and kidney calcium oxalate deposition. So there is more prevalence of this problem in males as compared to females (Fan ***et al.***, 1999). The results show that tendency of single stone formation is greater 170 (64.63%) as compared to double or multiple stones (Table 1). Large sized stone formation is the result of enhanced attachment of crystals to the surface of cells in the papillae and is reduced by the inhibitors of crystal growth and aggregation that are normally present in the renal tubular fluid (Coe ***et al.***, 1992). The crystalline stones along with flow of urine move in the ureter and finally in urinary bladder and urethra. An enlarged kidney stone that does not pass out of the body cause severe abdominal pain. If proper medical attention in not received to remove the blockage, can lead to permanent loss of kidney function. A large kidney stone can even rupture the collection system of the kidney (Savitz and Leslie, 1999). These stone may be of different shapes and sizes. The data from the present study shows that oval shaped stones are maximum in all groups of both sexes 121 (46%). While spiny stones are minimum 27(10.2%) in occurrence (Table 3). The first step in the formation of stones is the formation of microscopic crystals in the lumen of renal tubules as a result of super saturation of the luminal fluid with calcium oxalate or calcium phosphate (Strauss ***et al.***, 1982). Finally there is phenomenon of crystal growth and their attachment with each other. This binding is very strong forming hard stones. The result shows that 253(96.2%) stones are very hard in occurrence while remaining 10(3.80%) are in the process of formation (Table 4). Stone formation in enhanced by the attachment of crystals to the surface of cells in the papillae and is reduced by the inhibitors of crystal growth and aggregation that are normally present in the renal tubular fluid (Coe ***et al.***, 1992). The simplest theory of stones formation in that crystalluria occurs when the urine is over saturated with sparingly soluble salts and this may be so persistent that crystal aggregates form, become lodged in urinary tract and grow in the saturated urine to stone (Peacock and William, 1978). Normally urine contains chemicals that prevent the crystal formation. These inhibitors do not seem to work for every one, so some people form stones (Ebisuno and Lieske, 1999; Wesson, 1998). Calculi are formed by syngenesis, not by incrustation of organic scaffold. The latter occurs only in rare exceptions (Phylipsborn, 1958). The data of the present study shows that stones are of different colors. It has been observed that maximum stones are white 101 (38.40%) and brown 97 (36.88%) (Table 5). It is because of the fact; maximum stones contain Calcium and Uric acid. Calcium stones are white in color and their surface is rough. Their sharp projections damage the mucosa of the renal pelvis, so that heamaturia results. Uric acid and urate stones are yellow or brown in color and are smooth and hard. They are not opaque to X-rays. Urate stones are softer and are commonly found in children (Ahsan, 1997). It is revealed from the data of present study that chemically most of the stones are of Calcium Oxalate + Uric acid 66(25.09%), Calcium Oxalate 57(21.67%), Calcium Oxalate + Calcium Phosphate 51(19.39%), pure Uric acid 44(16.73%), Calcium Oxalate + Calcium Phosphate + Uric acid 29(11.02%), pure Calcium Phosphate, 3(1.145) and others 13(4.94%) were of mixed lithiasis. Most abundant stones are Calcium containing stones. Calcium that is not used by the bones and muscles goes to the kidneys. In most people, the kidneys flush out the extra Calcium with the rest of the urine

(Hosking ***et al.***, 1983). People who have stones keep the Calcium in their kidneys. The Calcium that stays behind joins with other waste products to form a stone (Asplin, 1992). The most common type of stone contains Calcium in combination with either Oxalate or Phosphate (Curhan ***et al.***, 1993). These stones consist of about 75% of all stones. They are 2 or 3 times more common in men (Coe ***et al.***,1992). Uric acid stones form when there is too much Uric acid in diet. In mix lithiasis traces of Cystine are also observed, but Cystine stones are rare. Cystine is one of the building blocks that make up muscles, nerves and other parts of the body. Cystine can build up in the urine to form a stone The rational basis for Oxalate restriction relies on the fact that Calcium Oxalate is the main component of most renal stones and that there is a lower urinary Oxalate content than Calcium (Ca/Ox ratio is 5:1). This means that small changes in Oxalate concentration have much larger effects on Calcium Oxalate crystallization than larger changes in Calcium concentration. The nutrient that clearly has universal effects on most of the urinary parameters involved in stone formation is protein. High protein intake of animal origin contributes to hyperuricosuria due to the purine overload, to hyper oxaluria due to the higher Oxalate synthesis and to hypocitraturia due to the higher citrate tubular reabsorption (Breslau ***et al.***, 1988: Holmes ***et al.***, 1993). Another kind of climate related effect involves occupational conditions. Among workers exposed to hot climate and massive sweating, the prevalence of nephrolithiasis is higher (Caruana and Buckalew, 1988). As climate of Multan is extremely hot and temperature in summer reaches up to 50°C dehydration and low fluid intake can be a possible cause of stone formation along with other factors. Long term dehydration (possibly due to inadequate intake of fluids) and its resulting concentrated urine is an important factor of renal Calculi formation (Gary ***et al.***, 1999). A high fluid intake is a very important goal to reduce urine super saturation. The three predominant symptoms of urine stones observed from the present study are lumber pain, burning and hematuria while associated symptoms are vomiting, fever, dribbling, pysuria, dysuria and retention (Table 7 and 8). Usually, the first symptom of a kidney stone is extreme pain. The pain often begins suddenly when a stone moves in the urinary tract, causing irritation or blockage. Typically, a person feels a sharp, cramping pain in the back and inside the area of the kidney or in the lower abdomen. Sometimes nausea and vomiting occur. Later, pain may spread to the groin (Coe ***et al.***, 1992). If the stone is too large to pass easily, pain continues as the muscles in the wall of the tiny ureter try to squeeze the stone along into the bladder. As a stone grows or moves, blood may appear in the urine. As the stone moves down the ureter closer to the bladder, patient may feel the need to urinate more often or feel a burning sensation during urination (Coe ***et al.***, 1997). Curhan ***et al.*** (1993) has described the following symptoms of kidney stone in patients. Nausea, abnormal urine color, chills, fever, testicle pain, urinary hesitancy, excessive urination at night, painful urination, abdominal pain and blood in the urine.

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