Effects of Patient Demographics on Urinary Calculi Composition and its Distribution in Peshawar

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ABSTRACT

Objective: The current study aimed to assess the potential effects of patient demographics, stone location, and time period on stone composition in Peshawar.

Methods: A retrospective study was designed and a total of 1636 urinary stone samples from different patients were collected in Institute of Kidney Diseases (IKD) Hayatabad. Infrared spectroscopy was used for stone analysis. Clinical and demographic findings were evaluated and compared with urinary calculi composition.

Results: In our study, the male to female ratio of patients was 2.28:1 with a median age of 45.5 years (range 1–90 years). The majority of the kidney stones were of mixed composition. Calcium oxalate stones were more commonly observed in male patients, while female dominance was evident in calcium phosphate, infection stones, or cystine. We found calcium oxalate stones were more common in renal and ureter, while uric acid and infection stones were more common in the bladder. Uric acid and cystine were more common in children, while calcium oxalate and calcium phosphate stones were higher in youth and middle-aged patients.

Conclusion: Patient demographics such as age and sex significantly affected the composition of renal calculi. Similarly, stone location and time period of taking data also affected urinary calculi composition.

Keywords: Renal stones, composition, spectrophotometry, Khyber Pakhtunkhwa, Peshawar.

INTRODUCTION

Renal calculus is a common type of urinary pathology around the world. The prevalence of urinary stones in developing countries is found to be 25% of the total population which may lead to death if not treated on time (1). Once treated, the relapse of urinary stones is around 10% in one year, while it increases to 33% and 50% after five and ten years respectively (2). The treatment and management strategy followed for renal stones primarily depends upon the type of stone. This is important to analyze to prevent the recurrence of stone formation (3).

As we know that urolithiasis composition and incidence differ among given individuals at a specific time period (4). Similarly, the dietary patterns of an individual also influences the type of renal stone as the changes in diet had increased the chances of renal stones disease formation during the last 50 years in our society (5). A lot is unknown about stone composition tests in Peshawar, where there are three clear seasonal changes. To our knowledge, because urinary calculi components change over time,

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there are no published data on how stones are being analysed in our region. From 2012 to 2018, we looked at how different calendar months (seasons), gender, and age affected the distribution of stone types in Peshawar. We also looked at how different stone types were spread out over that time.

MATERIAL AND METHODS

The current descriptive study was conducted between November 2012 to November 2018. The renal calculus sample from patients of age less than 1 year was excluded from the study. The age of the patient was divided into four groups: children (1–14 years), the young (15–44 years), middle-aged (45–59 years), and the elderly (≥60 years). Data was also divided into two periods, 2012–2015 and 2016–2018 to determine the change of stone characteristics with respect to time. Infrared spectroscopy was used to analyse stone composition. Stone was weighed before a representative specimen was taken from all identifiable layers. According to the instruction manual, the samples were pulverized and compressed into pallets and then assessed by an infrared spectrophotometer. The individual stone component was noted, and its percentage composition was calculated. Infection stones were defined as magnesium ammonium urate and/or calcium carbonate apatite in composition. All statistical analyses were carried out using SPSS 20.0. chi-square test was used to analyze the effect of patient's gender, time period, location and age group on stone type. The p-value less than 0.05 was considered statistically significant.

RESULTS

The study included 1137 (69.5%) men and 499 (30.5%) female patients with a ratio of 2.28:1. The median age of the patients was found to be 45.5 years. As per our results, most of the renal stones were composed of different components. The stones of the two periods were compared (50.7% vs. 49.3%) (**Table 1**). Calcium oxalate was the most common stone component 1460 (89.2%). The followed components included calcium phosphate 889 (54.3 %), infection stones 133 (8.1%), uric acid 120 (7.3 %), silica stone 26 (1.5%) and cystine 15 (0.9%) (**Table 2**).

Table1: Distribution of Patients and Stone General Characteristics

Characteristics	Findings
Age	
Mean (range)	45.5years (1-90)
Sex, n (%)	
Male	1137 (69.5)
Female	499 (30.5)
Location, n (%)	
Kidney	1105 (67.5)
Ureter	421 (25.7)
Bladder	89 (5.4)
Urethra	21 (1.3)
Age group, n (%)	
Children	25 (1,5)
Young	750 (45.9)
Middle-aged	586 (35.8)
The elderly	274 (16.8)
Periods, n (%)	
2010-2013	829 (50.7)
2014-2016	807 (49.3)
Stone homogeneity, n (%)	
Pure stones	397 (24.2)
Mixed stones	1239 (75.8)

When stone components were analyzed statistically with respect to the gender, a significant difference was found between the stone composition and patient's sex i.e., the calcium oxalate was higher in stones removed from male patients (89.2% vs. 86.6%), It was evident that in female, calcium phosphate stones were common (59.5% vs. 52.1%), infection stones (14.0% vs. 5.5%) and cysteine (1.8% vs. 0.5%). But there was no difference in uric acid and silica stone between male and female patients (**Table 2**).

Table 2: Occurrence and frequency of Stone Components According to Gender

Stone components	Male n (%)	Female n (%)	Total n (%)	*p*-value
Calcium oxalate	1027(90.3)	433(86.8)	1460(89.2)	**0.033**
Calcium phosphate	592(52.1)	297(59.5)	889(54.3)	**0.005**
Infection stone	63(5.5)	70（14）	133(8.1)	**<0.001**
Uric acid	92(8.1)	28(5.6)	120(7.3)	0.076
Cystine	6(0.5)	9(1.8)	15(0.9)	**0.027**
Silica stone	18(1.6)	8(1.6)	6(1.5)	0.976

The percentage of infectious stones increased dramatically in the late three years (9.8% vs. 6.5%, p>0.05), while the occurrence of calcium phosphate, calcium oxalate, uric acid and cysteine calculus did not change over the time.

Table 3: Occurrence Frequency of Stone Components According to Time Period

Stone components	2010-2013, n (%)	2014-2016, n (%)	*p*-value
Calcium oxalate	738(89)	722(89.5)	0.772
Calcium phosphate	462(55.7)	427(52.9)	0.253
Infection stone	54(6.5)	79（9.8）	0.015
Uric acid	58(7.0)	62(7.1)	0.594
Cystine	11(1.3)	4(0.5)	0.078
Silica stone	0(0)	26(3.2)	<0.001

As per our results, we found a significant difference in calcium oxalate, uric acid and infectious stones according to different locations. The stones composed of calcium oxalate were more common in the kidney and ureter (p<0.008), while uric acid and infectious stones were more common in the bladder area (p<0.008) (**Fig. 1**).

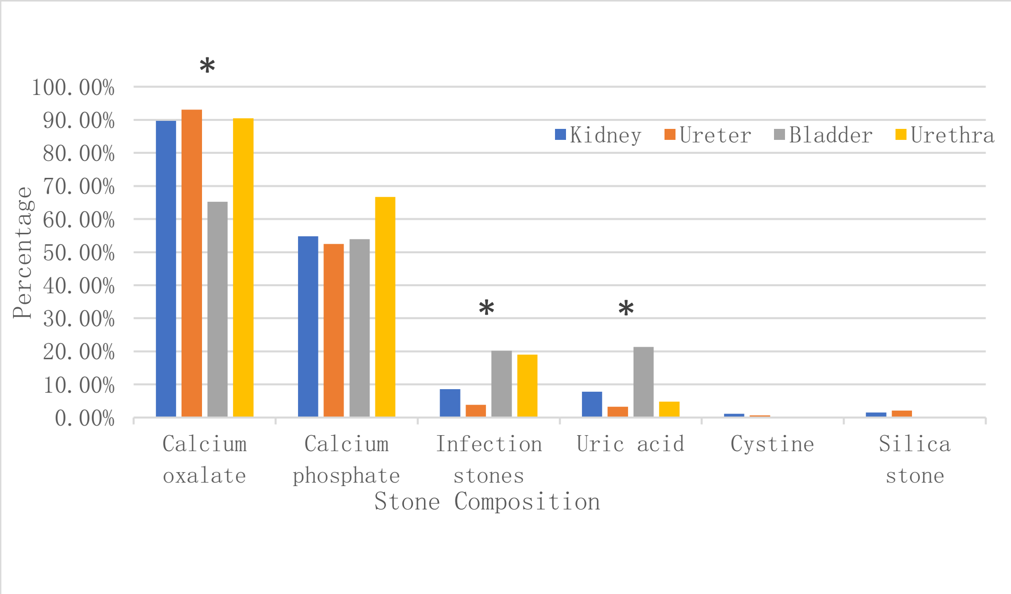

Fig.1.Distribution and Variations by location of stone

The stone composition was significantly different according to age. We found that in children, stones composed of uric acid and cystine were more common (p<0.008), while calcium phosphate and oxalate stones were higher in youth and middle-aged patients(P<0.008). But there is no difference in infection stones between different ages **(Fig. 2)**.

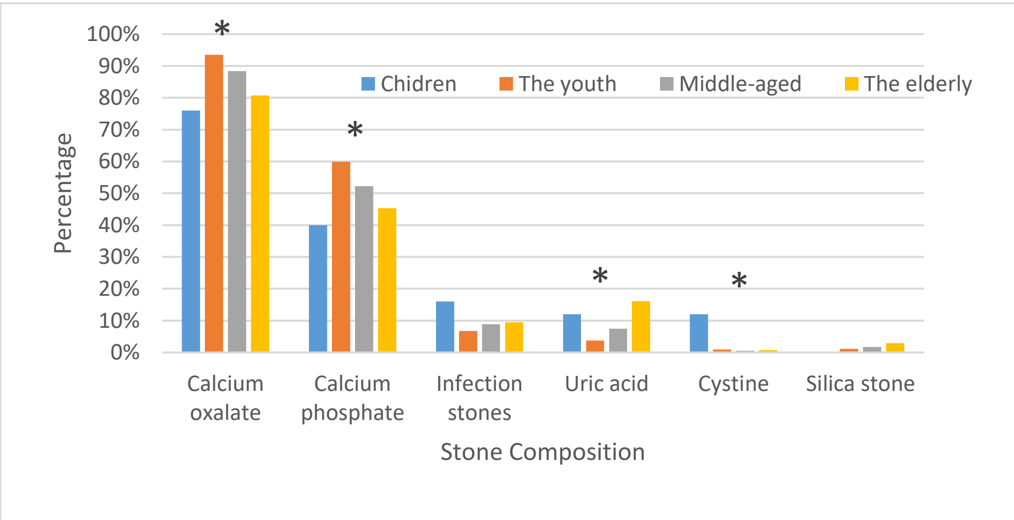

Fig.2: Distribution and the variations by age group

DISCUSSION

Urinary calculi analyses were conducted on 1636 patients and the record was reviewed retrospectively in our setup from 2012 to 2018. Our data indicated that urolithiasis was considered a male-dominant disease (2.28:1 male-female ratio), which was also confirmed by another research [6, 7]. Multi-component stones were most common in our study (75.8%) and this percentage was similar to previously Chinese research and French research, which ranges from 26 to 95 % [8-11].

There was an obvious difference in the stone composition between males and females, this was also observed in our study. We noted a male predominance of calcium oxalate and a female predominance of calcium phosphate and infection stones. Our study results are similar to previous studies [12, 13]. An increased prevalence of Calcium Oxalate (CaOx) stones in males maybe because of dietary factors that raise CaOx supersaturations (e.g., higher protein intake in men) [14]. Calcium phosphate and infection stones were common in women than in men as recurrent urinary tract infections were the main factor for calculus formation in women, which in turn, could raise urinary pH from infection with organisms that contain urease [15]. Our data also confirm the percentage of uric acid (UA) in males was higher than that in females (8.1% and 5.6%), even though the association was not statistically significant in our dataset.

We did not find a change in prevalence of CaP、CaOx and UA stones, from 2012 to 2018, as in other studies [16, 17]. As we know, the incidence of infection stones has overall decreased during the last 30 years in developed countries, likely due to improved medical care [18]. But interestingly, we noted a significant increase in the proportion of infection stones in our study. In our study, the infection stones were of mixed composition, and the major component was calcium oxalate. We hypothesized that these stones become secondarily infected after substandard treatment of calculus [19]. Another plausible explanation may be that the substandard treatment of urinary tract infections and exclusive antibiotic resistance may lead to the formation of such stones. But further studies are necessary to understand these trends.

Many studies had found that there was a relationship between stone composition and the age of the patient [20, 21]. Our study suggested that calcium oxalate stone and calcium phosphate stone were more common in young patients (19–40 years old) than that in elderly patients. This phenomenon can be attributed to the decline in renal phosphorus and calcium concentration with age [22]. In our study, the uric acid stones were significantly found than other stone compositions in geriatric patients. Other factors also had noted to increases in uric acid stone disease in the elderly population. Hyperuricemia, low urine pH, reduced ammonia-genesis, and insulin resistance characteristic of metabolic syndrome could be factors in uric acid stone in older patients [23]. Cystine stones were more common in the younger age group, which was lined with Chinese research [24].

With regard to stone location, we found several significant differences in stone composition among different locations. Calcium oxalate is predominantly found in the upper urinary tract rather than in the bladder. Calcium phosphate was equally distributed between the bladder and the upper tract. These findings are consistent with previously published data [25]. It was seen that infection stones were more common in the lower urinary tract than that in the upper urinary tract, the size of the stone increases secondary to outflow obstruction when the stone is dislodged from the kidney into the bladder.

CONCLUSION

We found that patient demographics, stone location, and time period affect urinary calculi composition. This finding may help to enhance our understanding of the pathophysiology of urolithiasis in the local population.

Authors Contributions

1. Tauheed Farid (TF): Main article writer and researcher
2. Nayab Farid (NF): Sample collection
3. Sidra Humayun (SH): Sample collection and Laboratory work
4. Muhammad Izhar (MI): Laboratory work and sample handling
5. Shahid Farid (SF): data compilation and discussion writing
6. Mohsin Ali (MA): Results analysis and data

compilation.

Conflict of Interests

The authors have no potential conflict of interest relevant to this article to report.

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