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# Analysis of biochemical profile of renal stones referred to advanced Biochemistry laboratory of a multispecialty tertiary care Hospital in Punjab

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**ABSTRACT**

*Introduction: Urolithiasis is the third most common urological disease affecting both males and females worldwide. Both genetic and environmental factors contribute to stone formation. Aims and objectives: The present study was aimed to qualitative analyse the renal stones for evaluating their chemical constituents and to report their significance. Material and methods: The study was conducted on 94 renal stones received in Biochemistry laboratory for qualitative analysis over a period of 2 years. Results: It was observed that the highest incidence of renal stones was in the age group of 31-60 years. The incidence in males and females was in the ratio of 3.3:1. The chemical analysis of renal stones showed that 90.4% of the analysed renal stones were of mixed type. Conclusion: The study concluded that it is important to know the chemical composition of stone as it is useful in advising people for taking preventive measures for reducing the risk of prevalence and recurrence can be considerably reduced by suitable reforms in diet and treatment regimen.*

**Key words:** renal stones, urolithiasis, calcium oxalate, urates, phosphates.

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## INTRODUCTION

Urolithiasis is the development of stones in the urinary tract. It is a common disorder of the urinary tract and most painful of urologic disorders. It is considered as the third most common affliction of the urinary tract [1]. It is a complex phenomenon yet not clearly understood. This cannot be contributed to any single factor and may be due to metabolic disturbances, infections, hormonal influences, dietary conditions and habits or obstructions in the bladder or kidney or increased excretion of stone forming components such as calcium, magnesium, oxalate, carbonate, phosphate, urate, cystine etc. [2]. Kidney stones may contain various combinations of chemicals. The most common type of stone contains calcium in combination with either oxalate or phosphate. These chemicals are part of a person's normal diet and make up important parts of the body, such as bones and muscles [3]. Chances of recurrence of nephrolithiasis are quite high. It has been estimated that the recurrence rate of renal calculi is 60% in 7 years [4] and 80% in 18.5 years [5]. For this reason, prevention of urolithiasis is of great importance which depends on the knowledge of the chemical composition of the stone removed.

The prevalence of renal stones has been constantly increasing during past fifty years in industrialized as well as in developing countries and varies depending on race, sex and geographical locations [6, 7]. Although renal stones can

be traced to the earliest antiquity of human history, the primary causative factors remain obscure, but renal stones are suspected to have direct relationship to the composition of urine, which is mainly governed by nutrition and environment [8]. Nutritional factors besides environmental and genetic factors 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 chemistries: low urine pH, high urine calcium and uric acid excretion and low citrate excretion [9]. As a consequence, it leads to urinary crystals and renal stone formation. Since qualitative studies on stone could furnish valuable information on both etiology of renal stones and as a guide for the clinical management and since such a study has not been done in this region, so the present study was undertaken to qualitatively analyze the renal stones with the relationship between the sex, age group and frequency of chemical constituents. Knowledge of chemical composition of renal stones may be of great importance that may help to give advice and suggestions for the general population and patients to carry out preventive measures in reducing the risk of prevalence and recurrence of urolithiasis in this region.

**Aims and objectives**

There was no data on the chemical composition of renal calculi from the population in North India, therefore, the present pilot study was undertaken to qualitatively analyse renal stones with the relation between age, sex and frequency of renal stones according to their chemical composition.

## MATERIALS AND METHODS

The present study was conducted at Department of Biochemistry, Gian Sagar Medical College and Hospital, Ram Nagar, Rajpura, District Patiala. The study was done on 94 renal stones received in Biochemistry laboratory for qualitative analysis. The study consisted of 2 years period. Patients of all ages and both sex were included in the study. Renal stones were washed with distilled water and dried completely in an incubator. The renal stones were ground/crushed into a fine powder and the analysis was done for oxalates, calcium, phosphates, uric acid and carbonates by protocols described by Hodgkinson [10].

The research project was approved by Institute Research Board [IRB] and permitted by the Institute ethical committee [IEC].

## RESULTS

Table 1 depicts the renal stones cases classified and grouped according to age, sex and percentage of occurrence. Age and sex wise distribution of renal stones revealed a greater percentage of males (76.5%). The incidence among females was quite low (23.5%). A male to female's ratio was 3.3:1.

Age wise maximum incidence was in the age group 31- 60 years (60.4%).

It was observed that stones of mixed chemical composition were the commonest (90.4%). Calcium was the main constituent (90.4%) found in renal stones followed by oxalates (81.9%), uric acid (47.8%) and phosphates (43.6%). The least encountered were carbonates (11.7%).

Only a total of 9.6% were found to be pure (single constituent type). These mostly consisted of oxalate and uric acid. Only three stones were found to be of pure uric acid suggesting rarity of such stone.

Oxalate was found in 77 renal stones. In 6 (6.4%) cases, it was present as pure radical, while in remaining 71 (75.5%) stones, it was present along with other radicals. Pure calcium oxalate stones were found in 21.2% of the total cases.

## DISCUSSION

The male to female ratio was 3.3:1 i.e. males have high incidence of renal stones than females. Other studies have also reported occurrence of renal stones higher in males than females. [11, 12, 13, 14]. According to the literature, lithiasis is more common in men than in women; however, the exact rate differs between studies, with several authors reporting that approximately three males are afflicted for every female. Renal stones occur more in males

than females because of the male anatomy: the urethra in the male is small and can easily become obstructed by a stone. The urethra in the female is larger and less prone to stone development.

In our study, stones of mixed composition were the commonest (90.4%). Jehangir [15] from Lahore demonstrated that 80% of renal stones were of mixed type. Other studies also reported same type of finding [13, 14]. Various studies from India as well as other Asian countries showed high urate content in renal calculi. Singh et al [16] from Delhi showed urate in 38.2% of cases. Our results showed 47.8% of stones have uric acid in them.

Several authors have demonstrated that lithiasis usually occurs between the third and fourth decades of an individual's life [17]. This finding was in accordance with our study.

The presence of mixed stones suggests a multi factorial etiology. For calcium calculi, risk factors may vary by population. The risk factors may be hypercalciuria, hyperparathyroidism, hypocitruria, renal tubular acidosis. Hyperoxaluria can be primarily caused by excess ingestion of oxalate containing foods (rhubarb, spinach, cocoa, nuts, pepper, beet and tea) or the excess oxalate absorption due to various enteric diseases (bacterial overgrowth syndromes, chronic pancreatitis or biliary disease) or ileojejunal surgery [18]. Other risk factors may include taking high doses of vitamin C and mild hyperuricosuria [19]. Our study also reported the stones chemically composed of urate which may be due to hyper uricosuria a disorder of uric acid metabolism. Uric acid, a by-product of purine metabolism, is excreted on excess dietary intake of animal protein, resulting in supersaturation of uric acid in urine and in turn uric acid stones. High dietary protein is also associated with increased urinary calcium. Thus, there is a link between non vegetarian diet consumption and both uric acid and calcium stone formation. In fact, in vegetarians stones form a one-third the rate of those eating a mixed diet [20].

A low-calcium and low-oxalate diet, accompanied with an intake of large amounts of water can reduce the risk of making more kidney stones, by reducing urinary calcium and oxalate concentrations. Protein from plant sources (beans and legumes) can be substituted as a dietary alternative to animal protein without negative consequences. Alkali therapy too can be invoked in the case of calcium stone metaphylaxis [21].

Consumption of food items rich in oxalate content (spinach, groundnuts, tomatoes, ice cream, tea, yoghurt etc.) enhances the risk of renal stone formation.

Food habits and dietary constituents are of paramount importance and concern in the management of nephrolithiasis, as they influence the biochemical parameters such as oxalate, uric acid and calcium [22].

Concludingly, it is stated that nutritional and environmental factors seem to play a role in stone formation. Hence dietary intervention on a large scale and health education in this regard may be helpful in preventing the renal stone formation.

**Table 1: Distribution of renal stones in relation to patient's age and sex**

| Age group in years | Number of cases | | Percentage of occurrence | |
|---|---|---|---|---|
| | Males | Females | Males | Females |
| Upto 30 | 20 | 9 | 21.2% | 9.6% |
| 31- 60 | 46 | 11 | 48.9% | 11.7% |
| 61 and above | 6 | 2 | 6.4% | 2.2% |
| Total | 72 | 22 | 76.5% | 23.5% |

**Table 2: Frequency of renal stones according to their chemical composition**

| Chemical constituent | Number of renal stones | Percentage |
|---|---|---|
| Calcium | 85 | 90.4% |
| Oxalate | 77 | 81.9% |
| Phosphate | 41 | 43.6% |
| Uric acid | 45 | 47.8% |
| Carbonate | 11 | 11.7% |

**Table 3: Distribution of chemical composition of renal stones**

| Chemical constituent | Number of renal stones | Percentage |
|---|---|---|
| **Pure** | | |
| Oxalate | 6 | 6.4% |
| Uric acid | 3 | 3.2% |
| **Mixed** | | |
| Ca+ Ox | 20 | 21.2% |
| Ca + Ox + UA | 17 | 18.1% |
| Ca + Ox + UA + $PO_4$ | 21 | 22.3% |
| Ca + Ox + $PO_4$ | 9 | 9.6% |
| Ca + Ox + UA + $PO_4$ + $CO_3$ | 4 | 4.2% |
| Ca + $PO_4$ | 7 | 7.5% |
| Ca + $CO_3$ | 7 | 7.5% |

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