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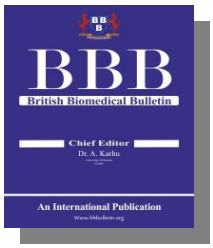


Original

# Chemical Composition of Urinary Stones in Patients with Urolithiasis in Sana'a, Yemen

**Mahmoud Ogaili *[1,2,4], Mahfouz Nasser[1,4], Ruqia Shrafadin[1], Nasser Baoom[5], Abdullah Shopit[3,4], Mohammed Amood AL-Kamarany[3,4]**

[1]*Department of Medical Laboratory – Faculty of Medicine and Health Sciences, Hodeidah University, P.O. Box 3114, Hodeidah City, Yemen,*
[2]*Department of Biochemuistry - National Center for Public Health Laboratories, Ministry of Health and Public, Sana'a City, Yemen*
[3]*Department of Pharmaceutical and Biomedical Sciences, Department of Clinical Pharmacy, College of Clinical Pharmacy, Hodeidah University, P.O. Box 3114, Hodeidah City, Yemen*
[4]*Tihama Foundation for Research and Drug Studies, Hodeidah City, Yemen*
[5]*Department of Surgery – Faculty of Medicine and Health Sciences, Aden University, Aden City, Yemen*

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**Corresponding author:** Department of Medical Laboratory-Faculty of Medicine and Health Sciences, Hodeidah University, P.O. Box 3114, Hodeidah City, Yemen, Department of Biochemuistry-National Center for Public Health Laboratories, Ministry of Health and Public, Sana'a City, Yemen, Tihama Foundation for Research and Drug Studies, Hodeidah City, Yemen.
**E-mail address:** drmahogli@yahoo.com

A B S T R A C T

This study was aimed to identify of chemical composition of kidney stones of patient in Sana'a, Yemen because the lack of research done in this field. The study was integrated within the clinical practice. Patients, mothers or child's guardian received a simple explanation for the aim of the study as an ethical issue. 581 samples of chemical compositions were collected and analyzed in the National Center for Public Health Laboratories Sana'a, Yemen according to qualitative method. The results showed that 54.6 % of the calcium oxalate, 6.3 % of the uric acid, 0.7 % of the calcium phosphate, 29.6 % of the calcium oxalate and uric acid, 6.7 of the calcium oxalate and calcium phosphate, 1 % calcium oxalate and calcium carbonate, 0.5 % of the calcium oxalate, calcium phosphate and uric acid, 0.5 % of the calcium oxalate, calcium carbonate and uric acid, and 0.2 % calcium phosphate and uric acid. In conclusion, calcium oxalate was the most predominant chemical compositions in stones and it represents common urological problem in Sana'a, Yemen.

## Introduction

Urolithiasis is a common and a major cause of morbidity worldwide including Yemen. The history of renal stones dates back to times of Egyptian mummies[1]. They were found in 1 % of all autopsies[2]. Urinary stones have become increasingly common in most parts of the world in recent years[3]. Kidney stone analysis is the test done on the stone which cause problems when they block the flow of urine through or out of the kidneys. The stones cause severe pain and are also associated with morbidity and renal damage[4]. Kidney stones are a risk factor for chronic kidney disease and progression to end-stage renal disease[5].

In general, urinary stones may contain various combinations of chemicals. The most typical stones contain calcium in combination with either oxalate or phosphate. Much less common are the uric acid stones and the rare cystine stones. The study is aimed to analyze the chemical composition of kidney stone among children, adults and elderly in Sana'a city, Yemen. Knowledge of the chemical composition of renal stone may be of great importance both as a guide for the clinical management and also for better understanding of physicochemical principles underlying the formation of calculi that may help to give advice and suggestions for the people and patients to carry out preventive measures in reducing the risk of the prevalence and recurrence of urolithiasis[6-9].

## Material and Methods

### Study design

A cross-sectional observational study conducted by recruiting case-series of children, adults and elderly who have Urolithiasis within the age group from 29 days to 92 years. Patients, mothers or child's guardian received a simple explanation (age and gender) by urologist and medical analyst for the aim of the study as an ethical issue. If they agreed, the sample was sent to laboratory that gives guide treatment. The study was done in the department of biochemistry, National Center for Public Health Laboratories (NCPHL), Ministry of Health and Public, Sana'a City, Yemen from October 2010 until February 2014. NCPHL is the reference laboratory in Yemen.

### Sample collection and analysis

581 kidney stones were collected from referred patients (children, adults and elderly) with diagnosis of Urolithiasis. Each stone samples (different size) were collected in a clean leak-proof detergent free wide-necked containers and numbered serially. These stones were washed with the distilled water to remove the debris, dried completely. The samples were analyzed according to the kit of biolab company, (France) a qualitative method. The analysis of data obtained namely, percentage of different kidney stones were carried out by using Excel 2010.

## Results

The personal data, namely age and sex on the five hundred and eighty one sample were recorded and results showed that the age of the patients included in this study between 29 days to 92 years with 4:1 male: female ratio.

581 samples, namely 478 males and 103 females were collected from hospital, nephrology centers, clinics of renal diseases and hemodialysis center. Table 1 showed that 86 % of the patients were ranging between 19 to 50 years of age. In addition, the results showed the incidence of nephrolithiasis (kidney stones) is rising worldwide, namely in Yemen, especially in men with increasing age.

On the other hand, the data obtained of the stone types were shown in Table 2.

From the table, 54.6 % of the calcium oxalates showed the highest percentage of stone component, 0.2 % of the calcium phosphate and uric acid (mixed stones) was the lowest percentage of kidney stone. On the other mean, the results proved that 61.6 % of the pure stone and 38.4 % of the mixed stone.

**Discussion**

Preventing recurrence is largely specific to the type of stones that come in different varieties: (1) calcium-containing stones; (2) uric acid stones; (3) struvite stones; and (4) cystine stones. Most calcium stones are formed when the calcium combines with oxalate. Occasionally, calcium may also combine with carbonate or phosphate, substances that are found in the body naturally. Oxalate is a waste product of metabolism. It would be of no interest to us at all if it did not combine with the calcium, eat to make the crystals that form the most common type of kidney stone. Uric acid is a product of metabolism. It results from the metabolism of the purines, which are found in all animal protein and many seeds and plants. Therefore, all meat breaks down into uric acid. The plant sources of uric acid are seeds such as beans, peas, and lentils[4,5].

Yemen being in the stone belt zone has a high incidence of renal stone disease. The Chemical analysis of the stones which was 581 presented in the four years from 2010 to 2014 has been discussed in the study. The mean age was 43.9 years, with an insignificant sex difference. In our study almost 86 % of the patients were ranging between 19 to 50 years of age. This shows that renal calculi affect the working age group.

The male/female ratio was 4:1. This may be because of the larger muscle mass of men as compared to women or there could be other unknown gender related factors. Thus, the daily breakdown of the tissue results in increased metabolic waste and a predisposition of stone formation. The other most significant cause may be because of the male urinary tract being more complicated than the female urinary tract[4]. Kidney stones result when urine becomes too concentrated and substances in the urine crystallize to form stones. Besides dietary factor, the most common cause of kidney stones is not drinking enough water[10,11]. Excessive consumption of meat protein leads to a marked increase in kidney stones because meat causes the over acidification of urine causing the increased excretion of oxalate, calcium and uric acid, whereas the excretion of citrate-which provides protection against stone formation is decreased. Overly acidic urine is the main risk factor for the formation of uric acid stones. Dietary oxalate contributes to about half of the urinary oxalate[12].

Spinach, rhubarb, beets, chocolate, nuts, tea, wheat bran, strawberries, and soya foods are known to increase urinary oxalate concentrations[13]. Also, vitamin C supplementation may increase urinary oxalate excretion and the risk of calcium oxalate crystallization in patients who form calcium stones as oxalate is the oxidized product of vitamin C[14]. The main risk factors for calcium stones are a low volume of urine, increased excretion of oxalic acid and calcium and a deficiency of citrate, which inhibits crystallization in the urine. Also the sodium contained in common salt can increase the risk of stone formation, probably by increasing the urinary excretion of calcium[15]. Calcium oxalate was the most common chemical composition in our study (64.6%). This was followed by uric acid (6.3%) and calcium phosphate (0.6%). The findings somewhat differ from the textbooks[2] and previous studies were performed in other countries[16-19].

In a study conducted in Pakistan, it was seen that calcium oxalate was the most common composition (87.5%), while uric acid, calcium phosphate, cystine and struvite were predominant compositions in 6.5%, 1.29%, 0 % and 4.3% respectively[16]. Khan *et al* saw calcium oxalate the most common stone component in 78%, uric acid in 19% and struvite in 3 %[18]. No cystine and calcium phosphate was found in their study.

In Table 3, comparing all these studies, it is seen that the incidence of calcium oxalate stones in our study was on the lower side. This might be due to decrease intake of vegetables and cereals by the low socioeconomic status of the patients[4]. It is also seen that the uric acid stones were not very common and no single cysteine stone was found. The reason could be less consumption of protein diet. The percentage of struvite stones. In our study population was zero comparable with other studies[16-19]. The study could not find the living standard of urolithiasis patients. Finally, specific type of kidney stone is as measures to prevent kidney stones include dietary modifications, nutritional supplements, and medications.

## Conclusion

Kidney stone analysis is a test done on a kidney stone to see what chemicals are in it this stone causes problems when they block the flow of urine through or out of the kidneys and risk factor for chronic kidney disease. The incidence of nephrolithiasis (kidney stones) is rising worldwide, namely in Yemen, especially in men and with increasing age. The chemical composition of stone in Yemen is calcium-containing stones (oxalate, phosphate and carbonate) and uric acid stone that gives guide treatment and information that may prevent more stones from forming.

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**Table 1.** Relationship between kidney stone and patients age

| Age | % |
|---|---|
| 29 Day –12 Months | 0.7 |
| 1 – 12 Years | 7.2 |
| 13 – 18 Years | 2.8 |
| 19 – 60 Years | 86* |
| 61 – 95 Years | 3.3 |
| Total | 100 |

*High incidence

**Table 2.** Data obtained of the stones analysis based on pure and mixed composition of stone

| Chemical Composition of Kidney Stones | % | % |
|---|---|---|
| Calcium oxalate | 54.6 | Pure stone 61.6 |
| Uric acid | 6.3 | |
| Calcium phosphate | 0.7 | |
| Calcium oxalate and uric acid | 29.6 | Mixed stone 38.4 |
| Calcium oxalate and calcium phosphate | 6.7 | |
| Calcium oxalate and calcium carbonate | 1 | |
| Calcium oxalate, calcium phosphate and uric acid | 0.5 | |
| Calcium oxalate, carbonate and uric acid | 0.5 | |
| Calcium phosphate and uric acid | 0.2 | |
| Total | 100 | 100 |

**Table 3.** Comparison of our results with other previous studies

| Type of Stones | Our Study | Pakistan (2011)[16] | Iran (2008)[17] | KSA (2004)[18] | Japan (2003)[19] |
|---|---|---|---|---|---|
| Calcium Oxalate | 54.6 | 87.5 | 80.2 | 78 | 81.6 |
| Calcium Phosphate | 0.7 | 1.29 | 2.4 | 0 | 5.1 |
| Uric Acid | 6.3 | 6.5 | 16.2 | 19 | 9.6 |
| Struvite** | 0 | 4.3 | 0.4 | 3 | 3.7 |
| Cystine | 0 | 0 | 0.6 | 0 | 0 |
| Others | 38.4 * | 0.43 | 0.2 | 0 | 0 |

*: Mixed stone
**: Magnesium ammonium phosphate