ORIGINAL RESEARCH

Assessment of chemical composition of renal stones

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ABSTRACT

Background: Nephrolithiasis is a prevalent health issue, particularly among those of working age, with its prevalence on the rise and varying widely across different geographical regions worldwide. The present study was conducted to assess chemical composition of renal stones.**Materials & Methods:**54 patients of renal stones were selected.Initially, the specimens were swabbed for microbial growth, then carefully washed with deionized water and dried. Morphological features, including color, shape, and other characteristics, were observed. The stones were X-rayed to assess their opacity. The core and surface sections of the kidney stone were cut using a scalpel. It was then ground with a pestle and mortar to create a fine, homogeneous powder for qualitative estimation of various constituents.**Results:**Out of 54 patients, 30 were males and 24 were females. Chemical composition was inorganic in 3 males and 2 females, carbonate in 6 males and 4 females, oxalate in 4 males and 3 females, phosphate in 6 males and 5 females, ammonia in 3 males and 3 females, uric acid in 2 males and 3 females, magnesium in 4 males and 3 females and organic in 2 males and 3 females. The difference was non- significant (P> 0.05). Bacteriological profile was sterile in 5 males and 3 females, Proteus in 7 males and 6 females, candidain 2 males and 2 females, P aeruginosa in 1 female, Citrobacter diversus in 2 males and 1 female and citrobacterfreundii in 2 males and 1 female, Enterobacter species6 males and 7 females, staphylococcus aureus in 1 male and 1 female and contaminated5 males and 2 females. The difference was non- significant (P> 0.05).**Conclusion:** Stones of MgNH4 PO4 (struvite) were the most frequently observed type of renal calculi in patients, signifying a Proteus spp. infection that can arise from impaired urinary drainage and lead to chronic UTIs.

Keywords: Citrobacter diversus, Nephrolithiasis, phosphate

INTRODUCTION

Nephrolithiasis is a prevalent health issue, particularly among those of working age, with its prevalence on the rise and varying widely across different geographical regions worldwide.[1] In the USA, it stands at 8.8% (95% CI, 8.1-9.5), with rates of 10.6% (95% CI, 9.4-11.9) in men and 7.1% (95% CI, 6.4-7.8) in women.[2] Kidney stones are generally made up of calcium salts, uric acid, cysteine, and struvite.Calcium oxalate and calcium phosphate constitute the majority of stone types, making up nearly 80% of cases.[3] They are followed by uric acid (5-10%), struvite (5%), and cysteine (1%), with traces of other types in the remaining cases. Taking into account the age distribution of calcium stones, they are mainly found in men during their 40s.[4]

Men and individuals with gout or metabolic syndrome also frequently develop uric acid stones. Struvite stones are prevalent among women, particularly in patients who need chronic bladder catheterization.[5]This type of stone can reach a considerable size, filling the renal pelvis and calyces to create the characteristic “staghorn” appearance.[6] While kidneys retain water, this necessitates the excretion of substances with low solubility. Urinary stones typically form due to an imbalance between two opposing physical properties: the solubility and precipitation of salts. In the body, these two opposing physical properties are balanced by normal physiological processes and certain substances that prevent crystallization in urine.[7]

The process of stone formation is intricate and consists of various stages, such as the creation of crystals in supersaturated urine due to an increased excretion of molecules that make up the stone or a decrease in urine volume. This is followed by crystal nucleation and repeated aggregation, culminating in the development of a clinical stone.[8,9]The present study was conducted to assess chemical composition of renal stones.

MATERIALS & METHODS

The study was carried out on 54 patients of renal stones in the department of biochemistry. All gave their written consent to participate in the study.

Data such as name, age, gender etc. was recorded. Initially, the specimens were swabbed for microbial growth, then carefully washed with deionized water and dried. Morphological features, including color, shape, and other characteristics, were observed. The stones were X-rayed to assess their opacity. The core and surface sections of the kidney stone were cut using a scalpel. It was then ground with a pestle and mortar to create a fine, homogeneous powder for qualitative estimation of various constituents. Results thus obtained were subjected to statistical analysis. P value < 0.05 was considered significant.

RESULTS

Table I Distribution of patients

Total- 54		
Gender	**Male**	**Female**
Number	30	24

Table I shows that out of 54 patients, 30 were males and 24 were females.

Table II Assessment of chemical composition

Composition	Male	Female	P value
Inorganic	3	2	0.73
Carbonate	6	4	
Oxalate	4	3	
Phosphate	6	5	
Ammonia	3	3	
Uric acid	2	3	
Magnesium	4	3	
Organic	2	3	

Table II, graph I shows that chemical composition was inorganic in 3 males and 2 females, carbonate in 6 males and 4 females, oxalate in 4 males and 3 females, phosphate in 6 males and 5 females, ammonia in 3 males and 3 females, uric acid in 2 males and 3 females, magnesium in 4 males and 3 females and organic in 2 males and 3 females. The difference was non- significant (P> 0.05).

Graph IAssessment of chemical composition

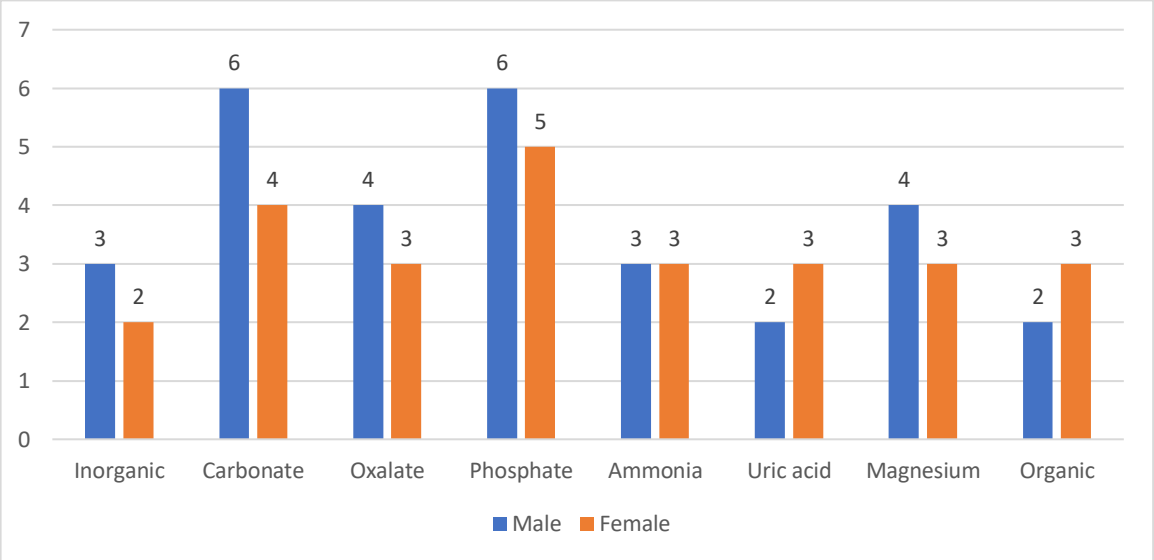

Table III Bacteriological profile of the kidney stone

Profile	Male	Female	P value
Sterile	5	3	0.51
Proteus	7	6	
Candida	2	2	
P aeruginosa	0	1	
Citrobacter diversus	2	1	
Citrobacter freundii	2	1	

Enterobacter species	6	7	
Staphylococcus aureus	1	1	
Contaminated	5	2	

Table III shows that bacteriological profile was sterile in 5 males and 3 females, Proteus in 7 males and 6 females, candida in 2males and 2 females, P aeruginosa in 1 female, Citrobacter diversus in 2 males and 1 female and citrobacterfreundii in 2males and 1 female, Enterobacter species6males and 7 females, staphylococcus aureus in 1male and 1 female and contaminated5males and 2females. The difference was non-significant (P> 0.05).

DISCUSSION

To get complete information about the chemical composition and physicochemical principles underlying the formation of stone there is a need for more precise information.[10, 11]At present there is no single analytical procedure that provides an exact quantitative analysis of urinary calculi.[12]The present study was conducted to assess chemical composition of renal stones.

We found that out of 54 patients, 30 were males and 24 were females. RisalSet al[13] studied composition of 47 renal stones collected from surgical patients admitted to NMCTH over a period of 13 months (July 2005 to July 2006). All stones were of mixed type. Calcium was present in all stones. Oxalate, phosphate and uric acid were present in 95.7%, 87.2% and 34.0% patients respectively. The probable composition, as construed from analysis, suggests that calcium oxalate stones are predominant. Strikingly, the prevalence was very high in 20 years age group.

We found that chemical composition was inorganic in 3 males and 2 females, carbonate in 6 males and 4 females, oxalate in 4 males and 3 females, phosphate in 6 males and 5 females, ammonia in 3 males and 3 females, uric acid in 2 males and 3 females, magnesium in 4 males and 3 females and organic in 2 males and 3 females. We found that bacteriological profile was sterile in 5 males and 3 females, Proteus in 7 males and 6 females, candidain 2 males and 2 females, P aeruginosa in 1 female, Citrobacter diversus in 2 males and 1 female and Citrobacter freundii in 2 males and 1 female, Enterobacter species6 males and 7 females, staphylococcus aureus in 1 male and 1 female and contaminated5 males and 2 females. Jawalekar Set al[14] by analysis of 100 stones the chemical composition observed with mean +/- SD value for calcium is 25.68 +/- 5.38, for Calcium oxalate hydrate crystal is 32.84 +/- 17.28 which contains oxalic acid 20.35 +/- 10.70, for Apatite crystal is found to be 41.70 +/- 16.56 which contains inorganic phosphate 8.09 +/- 3.08. Total uric acid found in these stones is 27.12 +/- 11.42. Major componentswere calcium oxalate 32.8% (combined monohydrate and dihydrate), Phosphate 41.7%, Magnesium ammonium phosphate hexahydrate 3.3% and uric acid 27.1%. No pure stone was obtained. Calcium oxalate was present in nearly all stones, and the majority of renal calcium stones contains mixtures of calcium oxalate and calcium phosphates in addition some contains uric acid or magnesium ammonium phosphate.

The shortcoming of the study is small sample size.

CONCLUSION

Authors found that stones of MgNH4 PO4 (struvite) were the most frequently observed type of renal calculi in patients, signifying a Proteus spp. infection that can arise from impaired urinary drainage and lead to chronic UTIs.

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