Original Research Article

A study on biochemical composition in females with urolithiasis in southern part of Chennai

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International Archives of Integrated Medicine, Vol. 6, Issue 3, March, 2019.

Available online at http://iaimjournal.com/
ISSN: 2394-0026 (P) **ISSN: 2394-0034 (O)**
Received on: 26-02-2019 **Accepted on:** 03-03-2019
Source of support: Nil **Conflict of interest:** None declared.
How to cite this article: T. Srikala Prasad, A. Anandi. A study on biochemical composition in females with urolithiasis in southern part of Chennai. IAIM, 2019; 6(3): 243-247.

Abstract

Background: Urinary stone constitutes one of the commonest diseases in our country. In India, approximately 5-7 million population suffer from stone disease and at least 7-10 per 1000 of Indian population needs hospitalization due to a kidney stone. It has been proposed that comorbidity with essential hypertension, overweight and Type 2 Diabetes Mellitus predispose to kidney stone disease. Few lithogenic risk factors like urinary calcium, oxalate and uric acid excretion, are known to be influenced by the rich animal protein diet, which in turn is frequently related to overweight. In a female patient with basal metabolic index (BMI), 40% higher than standard, there was an (89%) increase in the prevalence of kidney stone.

The aim of the study: To diagnosis the different biochemical composition in women who were diagnosed with urolithiasis.

Materials and methods: This observational study was done in 2018 at, Department of Urogynecology, Institute of Social Obstetrics, Government Kasturba Gandhi Hospital, Chennai. Chemical methods were used to perform stone analysis. Calculi were thoroughly washed with tap water to remove attached debris. Then they were rinsed with deionized water and air dried for two weeks in a plastic container. Once the calculi were dry, they were weighed and then grounded to a fine powder using mortar and pestle. These powdered calculi were used for qualitative and quantitative analysis.

Results: According to the results, all calculi had oxalic acid and uric acid which were the commonest components in calculi. Calcium and phosphorous were the next common components followed by

magnesium. Ammonium ion was detected in 59.5% renal calculi. None of the calculi contained carbonate or cysteine.

Conclusion: Factors like diet and lifestyle plays an important role in the changing epidemiology of kidney stone. Changes in two of the most important environmental factors, diet, and climate, are the significant impact on these trends. Patients who had raised serum calcium and serum uric acid level had larger and multiple calculi bilaterally. There is strong evidence that diminished fluid and dietary calcium consumption is a risk factor and an increase in animal protein intake has an equal impact on kidney stone risk.

Key words

Renal calculi, Uric acid stones, Calcium oxalate stone, Hypercalcemia, Hyperphosphatemia.

Introduction

Urinary tract stones are commonly seen in kidney, ureter, and bladder. The incidence of these stones was higher in males than in females but now women affected by urinary tract stone disease has outpaced that of men. Nephrolithiasis is still more common in men, the incidence rate ratio of men to women with urinary tract stones has narrowed from 3.4 to 1.3 [1]. The most important factor for the stone formation is supersaturation of the urine by stone-forming constituents, including calcium oxalate, and uric acid. These crystals can act as nidus, upon which ions from the supersaturated urine form microscopic crystalline structures [2]. Diet that is high in fruits and vegetables, moderate in low-fat dairy products and low in animal proteins and salt is associated with a lower relative super saturation for calcium oxalate and a marked decrease in risk of incident stone formation [3]. The initial presentation of nephrolithiasis is often with renal colic - severe pain caused by stone passage - triggered by movement of a stone from the renal pelvis into the ureter, which leads to ureteral spasm and possibly obstruction. Pain starts in the flank area and progresses downward and anteriorly into the genital region as the stone moves down the ureter [4]. The pain is not usually aggravated or alleviated by a change of position and may be accompanied by nausea and vomiting. Hematuria is always present but may be microscopic. If the stone is lodged at the ureterovesical junction, it can cause a sensation of urinary frequency and urgency [5]. All symptoms are relieved quite abruptly when the stone moves out of the ureter into the bladder and passes. The differential diagnosis for flank pain and hematuria is not long: papillary necrosis with the passage of a sloughed papilla, renal emboli, renal tumor, sometimes urinary tract infection. Symptoms in women can be similar but may consist only of hematuria, generalized abdominal pain or urinary tract infection [6]. There are several options available for surgical treatment of the 10–20% of symptomatic stones that fail to pass spontaneously [7]. The appropriate modality for a given case depends on the size, location, and type of stone; the presence of anatomical abnormalities or infection also may influence the choice. Extra-corporeal shock wave lithotripsy (ESWL), which uses sound waves to fragment stones into small pieces that can be easily passed, is effective for most stones less than 2 cm in size, although cystine stones and phosphate stones may be resistant to fragmentation. Larger stones, particularly those composed of cystine or struvite, can be approached via percutaneous access through a small flank incision, allowing direct visualization and intracorporeal lithotripsy for stone disruption, and removal of fragments [8].

Materials and methods

This observational study was done in 2018 at, Department of Urogynecology, Institute of Social Obstetrics, Government Kasturba Gandhi Hospital, Chennai. 50 females were included in the study. Chemical methods were used to perform the stone analysis. Calculi were thoroughly washed with tap water to remove

attached debris. Then they were rinsed with deionized water and air dried for two weeks in a plastic container. Once the calculi were dry, they were weighed and then grounded to a fine powder using mortar and pestle. These powdered calculi were used for qualitative and quantitative analysis. Qualitative analysis was done to determine the presence of ammonium ion, carbonic ion, and cystine. Detection of ammonia was done using the Nessler's reagent and carbonate by using HCl Cystine was detected using the method described by Hodgkinson. All powdered renal calculi were analyzed quantitatively for oxalic acid, calcium, phosphorus, uric acid, and magnesium. Oxalic acid estimation was performed using the titrimetric method. Estimation of calcium was done by the spectrophotometric method. .Inorganic phosphorous was determined by phosphomolybdate method of Fiske and Subbarow. Phosphotungstate reduction method was used to estimate the uric acid amount Magnesium estimation was performed using commercially purchased reagent MAGNESIUM liquicolor from Human®. Stones containing more than 20% uric acid were classified as uric acid stones and those containing more than 40% oxalate were considered as oxalate stones. Stones containing more than 10% phosphate with less than 20% uric acid and less than 40% oxalate were phosphate stones. Stones containing more than 3% magnesium were considered as infection (struvite) stones.

Statistical analysis

The data collected were entered in Microsoft Excel 2013 version and double-checked for errors. The data was analyzed using Statistical Package for Software Solutions (SPSS) version 21. The validity of the screening test was evaluated using sensitivity and specificity. The diagnostic efficacy of the test was calculated using positive predictive value and the κ coefficient of agreement.

Results

There were 50 stone samples collected during the study period. The average age was 49.8 years (range: 26 – 76 years). The commonest age group who had surgery for stones was 41 – 60 years (**Table – 1**).

Table – 1: Age distribution.

Age group	Percentage
20-40 years	11(22%)
41-60 years	29(58%)
61-80 years	10 (20%)
Total no of cases	50 (100%)

Table – 2: Type of stones present.

Type	Number (%)
Oxalate	43 (86%)
Phosphate	01 (2%)
Mixed	05 (10%)
Struvite	01 (2%)
Total	50 (100%)

According to the results, all calculi had oxalic acid and uric acid which were the commonest components in calculi. Calcium and phosphorous were the next common components followed by magnesium. Ammonium ion was detected in 59.5% renal calculi. None of the calculi contained carbonate or cysteine (**Table – 2**).

Kruskal-Wallis test was used for the comparison of median values of the different components of the calculi among the different age groups and the differences were not statistically significant (**Table – 3**).

Discussion

Urolithiasis is the aggregation of crystals in the urine. Events that lead to the disruption of equilibrium between promoters and inhibitors of crystallization in the urinary system are liable for stone formation [9]. The disease is ubiquitous with an increasing incidence and prevalence worldwide that appears more pronounced in industrialized countries and a younger population of productive age group [10]. It is a multifactorial disease where the stone is formed at any location within the urinary tract and are responsible for renal colic, which is the most common symptomatic presentation [11]. Most stones

originates within the kidney and proceed distally, creating various degrees of urinary obstruction as they become lodged in narrow areas, including the ureteropelvic junction, pelvic brim, and ureterovesical junction. Location and quality of pain are related to the position of the stone within the urinary tract [12]. The prevalence of kidney stones was 8.8% (95% confidence interval [CI], 8.1–9.5). Among men, the prevalence of stones was 10.6% (95% CI, 9.4–11.9), compared with 7.1% (95% CI, 6.4–7.8) among women [13]. In 117 patients who had past history of renal calculi 62% had high serum calcium level, these data show that a high level of serum calcium level in recurrent cases of kidney stone; and few studies also has similar data of raised calcium level in recurrence of stone disease [14]. Total of 187 patients 63% had high serum uric acid level (>5.7 mg%). There for an individual with kidney stone diseases, there is more chance of raised serum uric acid level [15].

Table – 3: Median value of types of stones in relationship with age.

Analyte	21-40 years	41-60 years	61-80 years	p value
Oxalic acid (mg%)	52.03	52.09	51.64	0.85
Calcium (mg%)	16.61	16.96	17.16	0.84
Phosphorous (mg%)	0.31	0.24	0.28	0.57
Uric acid (mg%)	0.12	0.07	0.06	0.15
Magnesium (mg%)	0.17	0.17	0.14	0.32

Conclusion

Patients who had raised serum calcium and serum uric acid level had larger and multiple calculi bilaterally. There is strong evidence that diminished fluid and dietary calcium consumption is a risk factor and an increase in animal protein intake has an equal impact on kidney stone risk. A kidney stone is higher in warm or hot climates, scanty fluid intake and low urine output. Comorbidity in particular Type II Diabetes mellitus may be a major factor in the development of stone. Our review demonstrated that there was a decrease in stone prevalence among the older age group.

Acknowledgments

The authors would like to thank the Director, Institute of Social Obstetrics, Government Kasturba Gandhi Hospital, and the Assistant Professor of Urogynecology, ISO and KGH, Chennai for helping with data collection and laboratory analyses.

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