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Original Research Article

Study of Urinary Crystals in Type 2 Diabetics

Joseph Swithin Fernando[1], P Jaya Ganesh[2]

[1]2nd Year MBBS, [2]Professor, Department of Pathology, Saveetha Medical College, Kuthambakkam, Tamil Nadu 600124, India.

Corresponding Author:
P Jaya Ganesh, Professor, Saveetha Medical College, Kuthambakkam, Tamil Nadu 600124, India.
E-mail: swithin.clarin@gmail.com

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Abstract

Introduction: Diabetes mellitus is a quickly rising public health problem due to the seriousness of its complications. It also causes potential harm to the kidneys of diabetic patients and hence preventive and therapeutic measures should be taken against the various types of lithiasis. *Materials and methods:* The survey included 100 type 2 diabetics over a period of 6 months. First morning urine samples were examined with a light microscope for qualitative and quantitative analysis of crystalluria. *Results:* The calcium oxalates were higher in both the genders compared to the other crystalline species, with a frequency of 63% at direct examination. *Conclusion:* The crystalluria observed in type 2 diabetics showed the predominant prevalence of the calcium oxalate type crystals with a frequency of 63.0%, followed by uric acid with a frequency of 29.0%.

Keywords: Crystalluria; Lithiasis; Diabetes mellitus.

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Introduction

Diabetes is a group of metabolic disorders sharing the common feature of hyperglycemia. It is a disease resulting from either a lack of insulin or an incapacity to adequately use normal quantities of insulin. The number of diabetics in India is estimated to be 72 million.[1] Due to its prevalence and because of the frequency and seriousness of its complications, diabetes mellitus constitutes a public health problem in many countries. Different organs, the kidneys in particular, may later undergo fatal consequences.

Urinary lithiasis, and diabetes, is a common problem that affects nearly 12% of the population of industrialized countries.[2] Its rate has increased considerably during the last few years, and there are now three million lithiasics, 100,000 stone expulsions per annum, and a stone recurrence rate of more than 63%.[3] The nature of the stone varies with the patient's gender and age and focuses the influence of risk factors that is dependent on gender, body weight, and other associated pathologies like diabetes.

It is essential to study crystalluria in Type 2 diabetics to reduce the risk of formation of lithiasis and to protect the kidneys from this pathology. We studied the crystalluria of 100 type 2 diabetic patients with the objective of analyzing the types of crystals in them and to know the type of crystal prevalent in males and females. The study was performed at room temperature. The purpose of this study was to identify possible lithiasics or risk factors that develop from certain types of crystals known to cause the formation of stones and thus have a diabetics "cartography." It can be

used to detect genetic pathologies and also assess lithogenic urinary anomalies in nephrolithiasic patients susceptible to lithiasis.

Materials and Methods

Early morning first-voided urine samples from 100 type 2 diabetic patients over a period of 6 months were collected from Saveetha Medical College in Thandalam, Kanchipuram. The patients were grouped according to their gender (47 women, 53 men), all the urine samples were collected in sterile containers and subjected to direct examination within two hours ofvoiding. The samples were centrifuged at 2500 rpm and then examined under a microscope to assess de novo crystallization. The urinary crystals were then classified according to the nature and size of the crystals. The pH of urine samples were measured in the laboratory immediately after collection.

Results

Table 1 displays the nature and frequency of the crystalluria for all the analyzed samples at direct examination. Many crystalline species of metabolic origin were recorded, such as calcium oxalate, triple phosphate, uric acid, and bilirubin. The analysis of 100 urine samples of type 2 diabetics showed a comparatively increase in the calcium oxalate crystals at direct examination with a frequency of 63.0%, followed by uric acid crystals with a rate of 29.0%, triple phosphate with a rate of 7.0% and bilirubin with a rate of 1.0% (Fig. 1).

Table 1: Types of crystals in type 2 diabetic patients

Crystal	Patients
Calcium oxalate	63
Triple phosphate	7
Uric acid	29
Bilirubin	1

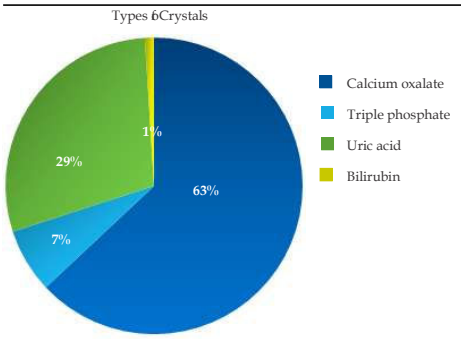

Fig. 1: Types of crystals in type 2 diabetic patients

Regarding the distribution of crystalluria related with gender, there was a significant difference in the frequency of the crystalline species between men and women. As shown in Table 2, crystalluria was more frequent in men for nearly all the crystalline species observed in this study. In men, calcium oxalate had a frequency of 32%, followed by uric acid crystals (18%), triple phosphate (3%), and bilirubin (0%). In women, the frequency of calcium oxalate was (31%), uric acid crystals (11%), triple phosphate (4%) and bilirubin (1%) (Fig. 2).

Table 2: Types of crystals based on gender

Crystal	Male	Female
Calcium oxalate	32	31
Triple phosphate	3	4
Uric acid	18	11
Bilirubin		1

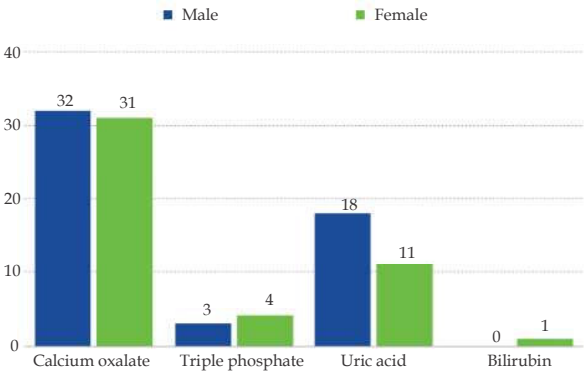

Fig. 2: Types of crystals based on gender

Discussion

Lithiasic pathology is the study of crystalluria, which consists of analyzing the crystals in urine. To obtain a clinically accountable information, it is recommended to make a proper identification of the crystalline species present in the sample under examination. In order to do this one must have knowledge of various morphologies under which the urinary crystals can be observed. Some crystals may have an unusual morphology, often a sign of particular pathological condition, which may be a source of lithogenic risk or renal function problems. Crystalluria is one of the factors that differentiates urine from a healthy subject and lithiasic patient. A multi-parametric study of crystalluria (chemical nature and size of the crystalline species, global crystalline volume, pH, density, urinary cytological analysis, etc.) must be carried out in order to complete the risk of crystallogenesis. Biological

exploration is necessary to identify the biological factors implied in the lithogenic process and specify the causes of anomalies.

The clinical symptoms of lithiasis are systematic and stereotyped. Its location, frequency and chemical nature have progressed significantly. Clinical interrogation and chemical or biological explorations well oriented by analytical results facilitate the knowledge of the lithogenic risk factors, determine the responsible pathology in most cases, and allow the proposition of suitable prophylactic measures. A reliable means to presume the risk in patients from clinical and biological data still remains one of the preoccupations of all clinicians and researchers interested in urinary lithiasis. Studies referring to lithogenic risk of hormonal pathologies, like diabetes and thyroid dysfunction, are not many. Previous works clearly shows the importance of epidemiological and biological links between uric lithiasis and certain pathologies such as metabolic syndrome, major obesity, diabetes, or gout.

People suffering from diabetes run a higher risk of morbidity and mortality than the general population. Epidemiological studies carried out during the last ten years show an alarming increase of diabetes, which is the result of a pathological process commonly known as the metabolic syndrome.[4] This metabolic disorder is characterized by hyperglycemia caused by insulin resistance and a decrease in insulin secretion. Diabetes mellitus is a disease that provokes serious late complications that will alter the sight, renal system, nervous system, and blood circulation.

Few works studied the relationship between diabetes and renal lithiasis. Liu et al.[5] studied the composition of the urine of lithiasic and non-lithiasic diabetic patients compared to healthy subjects and non-diabetic calcic lithiasics. He found that the lithogenic urinary metabolic anomalies were less pronounced and the liability of being lithiasic is lower in diabetics than in normal subjects, indicating that being diabetic does not predispose one to urinary lithiasis per se.

Meydan et al.[6] recently reported that 21% of diabetic patients were affected by urolithiasis, as compared with only 8% in the non-diabetic population, but the chemical type of stones was not examined. Pak et al.[7] reported that 33.9% of 59 stone-forming patients with type 2 diabetes had uric acid stones, as compared with only 6.2% in non-diabetic stone formers.

In comparison with data gathered in other works devoted to non-diabetic stone formers' crystalluria (notably Werness et al.[8], it can be noticed that the nature of the urinary crystals identified is roughly the same in lithiasics and diabetics. However, the crystalluria frequency appears to be moderately increased in type 2 diabetics (almost double that of normal subjects), which indicates that diabetics are more or less likely to develop nephrolithiasis.[9] Supersaturation of the urinary environment is the most important factor of lithogenesis, which generates the primitive insoluble crystal phase and ensures its later growth in most of the cases.

From an analytical point of view, all first morning urine samples that were studied at direct examination had calcium oxalates in the majority of cases. The crystalline species most frequently observed in diabetics was calcium oxalate with a frequency of 63.0%. This shows the natural behaviour of crystalluria evolution between these various types of pathology and allows for differentiation of diabetics from healthy subjects. This finding may be a factor in the tracking of urinary lithiasis in diabetics.

The results of our work show that the average pH of the analyzed urine samples was acidic in almost 75% of cases. This was confirmed by the appearance of uretic crystals with a frequency of 29% in diabetics. This signifies that the acidity sometimes generated by certain metabolic dysfunctions in diabetics can be a lithogenic risk in the formation of purine lithiasis. In a study undertaken about diabetics' lithiasis risk factors, Pak et al.[10] showed that in addition to urine hyperacidity, the fractional excretion of uric acid was not decreased, contrary to what is observed in uric lithiasics with no metabolic syndrome.

The increase in rates of crystalluria of uric acid in diabetics in general, and women diabetics in particular, is an argument for immediate patient care in order to avoid any serious complications. Indeed, a diabetic patient is always threatened by a fatal nephropathy that can cunningly destroy kidneys and precipitate renal insufficiency necessitating hemodialysis. Finally, the surveillance of crystalluria in these patients may allow doctors to evaluate the risk of forming stones and implement adapted preventive measures, such as alkaline diuresis, in patients threatened by lithiasis.

Conclusion

Our research shows increased prevalence for crystalluria in type 2 diabetic patients, which points

out that these patients are more exposed to the risk of forming renal stones threatening their kidneys. This ultimately could be a very useful indicator of lithogenous risk factors of forming uric lithiasis or a prognostic factor of the risk of lithiasis recurrence. In diabetic patients, monitoring crystalluria might be necessary in certain conditions to detect risk and propose preventive measures at the same time.

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