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Original Research Article

Utility of urinary calcium/creatinine ratio in evaluation of urinary stone formers: a Sudanese case control study

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ABSTRACT

Background: Hypercalciuria is a common cause of urinary stone formation in both children and adults; one of the components of the comprehensive evaluation of stone formers is to measure 24 hours urinary calcium, which is a complicated method especially in children, therefore some physicians depend on calcium creatinine ratio instead of it. The objective of this study was to assess the utility of calcium/creatinine ratio as an evaluation tool for hypercalciuria in urinary stone formers.
Methods: This was a case control study in which forty patients of urinary stone formers along with fifteen healthy controls group were enrolled; after fulfilling specific inclusion and exclusion criteria a questionnaire was filled, then an early morning urinary samples were collected for calcium and creatinine measurement to calculate the calcium creatinine ratio.
Results: The results showed significantly higher mean value of calcium/creatinine ratio in the stone formers group compared with controls one. Also there were statistically insignificant differences in the urinary calcium between the two groups. Moreover this study showed higher mean values of both calcium and calcium/creatinine ratio in recurrent stone formers when compared with first time stone former.
Conclusions: This study concluded that calcium/creatinine ratio is a useful and easier method for the initial evaluation of stone formers.

Keywords: Hypercalcuria, Urinary stone formation, Urinary calcium / creatinine ratio

INTRODUCTION

Urinary stones occur in 8-15% of Europeans and North Americans during their lives. The majority of stones (~80%) are composed of calcium oxalate and the remainder is composed of uric acid (5-10%), struvite or carbonate apatite (secondary to infection), cystine (1%) and rare stones.[1] The physiochemical mechanism of nephrolithiasis has not been well determined on the molecular level; this is crucial to the control and prevention of renal stone formation.[2] There are two ways to perform a metabolic evaluation of a stone former: limited evaluation or comprehensive evaluation. Components of the limited evaluation include serum electrolytes, creatinine, calcium, uric acid, phosphorus, stone analysis and urinalysis including urine PH.

The most important outcome of the limited evaluation is to diagnose uncommon but potentially serious systemic conditions, such as primary hyperparathyroidism or distal renal tubular acidosis. In contrast, a comprehensive evaluation goes beyond the limited evaluation with ideally 24-hour urine collections and hormonal assessment, imaging techniques.[3,4] All patients presenting

with renal stones should have a measurement made of their renal function, the importance of knowing their renal function is to determine the urgency with which further investigations and treatment should be performed, so that further renal damage can be avoided. Other investigations will include urine culture for fastidious microorganisms. Diagnostic algorithm is designed for the investigation of patients following their acute presentation.

Investigation of the etiology of renal stones is based on urine chemistry rather than analysis of the stone itself because the accuracy of stone analysis is generally poor and, even when accurate, does not explain the pathophysiology of stone formation except in the rare inherited disorders e.g., cystinuria. Clinicians can diagnose high urine calcium by asking patients to collect urine for 24hour or to provide a random urine specimen.[1] Due to the difficulty of obtaining a 24hour urine collection especially in children, random urine calcium to creatinine ratio (UCa/Cr) is used by some clinical practitioners to screen for Hypercalciuria as it is found to have a good correlation with the 24-hour calcium excretion.[5,9] Traditionally, UCa/Cr of >0.41 has been regarded as abnormal and suggestive of Hypercalciuria.[5] In children urinary Ca/Cr ratio is a useful and reliable method for determining Hypercalciuria and also is a non-invasive and relatively inexpensive method.[6]

Objective of the study

The objectives of this study were to find out the differences between urinary stone formers and matched controls group of non-stone formers in their amount of urinary excretion of calcium, and calcium/creatinine ratio, and to assess using them as a first level evaluating methods in urinary stone formers.

METHODS

This is a prospective case control study conducted at outpatient clinics in several urology centers in Khartoum state during the period of May 2015-June 2015. A questionnaire containing demographic data, clinical information includes duration of the illness and recurrence of stones formation was filled. Forty patients who were diagnosed as having urinary stones for treatment or had lithotripsy/surgery (stone formers) were selected and enrolled in the study, besides age and sex matched fifteen healthy individuals as controls group. Patients presented with obstructive uropathy or have renal failure were excluded.

An informed consent was obtained from the patients. Patients were given a urine collection cup, and written instructions for urine collection and fifteen milliliters of urine was collected, then urinary calcium and creatinine level were measured using colorimetric end point dye binding method for calcium, and modified Jaff's reaction with deproteinization for creatinine in both groups. Consequently, calcium/creatinine ratio was calculated from the measured values.

Statistical analysis

Data was collected and statistical analysis using the Statistical Package for Social Science (SPSS) version (20.0) software was used to investigate for correlation of urinary calcium and calcium/creatinine ratio between the stone formers and the controls group.

RESULTS

For the stone formers group, the age is ranging from (19-80 years) with a mean value of 40 years, while a range of (19-72) and a mean of 41 years for the controls group.

Table 1: Correlation of urinary calcium in stone formers and the controls groups.

Urinary calcium	Range	Mean value	SD	P value
Stone formers group	2-4.7 mmol/l	3.46 mmol/l	0.75mmol/l	P > 0.05
controls group	2.7-4.1 mmol	3.4 mmol/l	0.47moml/l	

Urinary calcium measurement showed a range of 2-4.7mmol/l and a mean of 3.46 mmol/l and standard deviation equals to 0.75 mmol/l for stone formers group, whilst measurements for the controls group showed a range of 2.7-4.1 mmol, a mean of 3.4 mmol/l and a standard deviation of 0.47 moml/l; comparing the two groups P value showed no significant variation between them in their urinary calcium excretion Table 1.

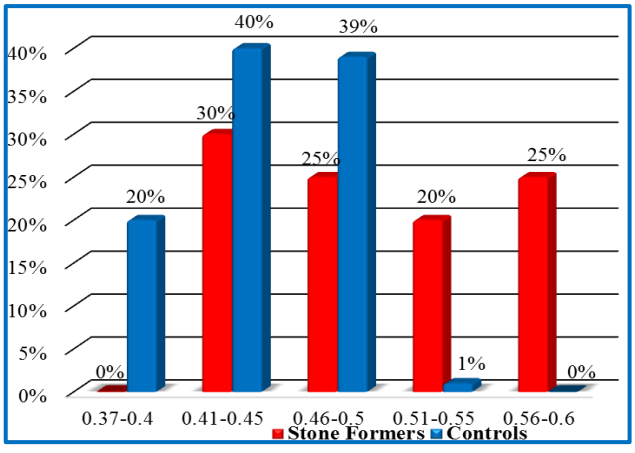

Figure 1: Comparison of urinary calcium/creatinine ratio mmol/Lin stone formers and controls group.

On the other hand urinary calcium/creatinine ratio in urinary stone formers group showed a range of 0.41-0.6 mmol/l and a mean of 0.5 mmol/l with standard deviation of 0.06 mmol/l. additionally, 45% (18) of the stone

formers had a ratio more than 0.51. Calcium/creatinine ration in the control group ranging from 0.31-0.51 it means no single individual of the control group had a urinary calcium/creatinine ratio more than 0.51 mmol/l (Figure 1). Moreover statistical correlation showed significantly increased calcium/creatinine ratio in the stone formers compared with the controls group, Table 2.

Table 2: Correlation of Ca/Creatinine ration in the stone former and the controls groups.

Ca/ Creatinine ratio	Range	Mean value	SD	P value
Stone formers	0.41-0.6 mmol/l	0.5 mmol/l	0.06 mmol/l	P < 0.05
Controls group	0.31-0.51 mmol	0.44 mmol/l	0.03moml/l	

Out of forty stones formers, 25 (62%) had recurrent stones, while only 15 (37.5%) presented with stone for the first time. Also readings of urinary calcium in these two groups showed a mean of 3.28 mmol/l in the first time stone formers, while the mean was 3.65 mmol/l in recurrent stone formers. However, comparing the calcium/creatinine ratio showed a mean of 0.48 in the first time stone formers and a mean of 0.51 mmol/l in recurrent stone formers, additionally there was statistically significant higher values in recurrent time stone formers in both urinary calcium and calcium creatinine ratio.

DISCUSSION

Never the less, urinary calcium mean value between stone formers and controls group were different, they were not statistically significant; this is most probably attributed to the different values of urinary calcium during single day and the day to day variation, Ryall et al.[7] Additionally, it was proven by some studies that spot urinary calcium is not suitable way for evaluating urinary calcium excretion.[1] Most of the treating doctors depend on 24 hrs urinary calcium even though this is a complicated and difficult method, especially for children and infants, therefore some practitioners use another evaluating method that showed consistency with 24 hours urinary calcium, it is calcium/creatinine ratio by Jones et al and Mrinaletal.[1,6]

The study showed higher mean value of calcium/creatinine ratio in stone formers group (0.5mmol/l) compared to (0.44 mmol/l), for the controls group which is statistically significant, P value<0.05; this is completely consistent with Gokce et al and Natalie et al studies.[5,9] Additionally (18) 45% of the stone former had a mean calcium/creatinine ratio more than 0.51 mmol/l while only one individual of the control group had as such a high level. Also the results of this study explored that the recurrent stone formers had a remarkably higher level of both urinary calcium mean value and calcium/creatinine ratio if compared with first time stone formers, these findings were strongly supported by several published studies.[10,11]

CONCLUSION

The authors in this study concluded that, calcium/creatinine ratio showed a higher level in urinary stone formers group than the controls group, so it can be a useful method in the first level evaluation of urinary stone formers.

Recommendation

This study recommended using Ca/creatinine ratio as initial and first level evaluation of urinary stone formers.

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Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

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