ORIGINAL RESEARCH PAPER
Volume-9 | Issue-5 | May-2020 | PRINT ISSN No. 2277 - 8179 | DOI : 10.36106/ijsr
INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

ABILITY OF PREOPERATIVE URINE MICROSCOPY TO PREDICT STONE COMPOSITION

Urology

Dr Manu M K Additional Professor, Department of Urology, Government Medical College, Trivandrum.

Dr. Aravind S Ganapath* Senior Resident , Department of Urology, Government Medical College, Trivandrum. *Corresponding Author

Dr Darsan Sadasivan Senior Resident, Department of Urology, Government Medical College, Trivandrum.

ABSTRACT

Determination of stone composition is considered to be crucial for the optimal management of urolithiasis. It is important for three reasons. Firstly, composition is related to hardness, which in turn affects the outcome of extracorporeal shockwave lithotripsy (ESWL); hard stones may be resistant to ESWL treatment. Secondly, stones related to various metabolic syndromes, such as cysteine stones or uric acid stones may require systemic medical treatment. Finally, knowing the stone composition enables some preventive efforts. This is a study conducted to find the ability of a simple test i.e. urine microscopy to predict the actual composition of stone. Total 346 patients participated in this study conducted at Government Medical College Trivandrum and it was concluded that urine microscopy is a good predictor of actual stone composition.

KEYWORDS

Urolithiasis, Crystalluria, Urine Microscopy

INTRODUCTION

Urolithiasis is a disease known since ages. Stones maybe formed anywhere in the genito urinary tract. It mainly affects men but the incidence in females is on the rise(1). Vesical calculi accounts for 5% of all urolithiasis(2). Worldwide changes in dietary habits and socioeconomic reforms have caused significant changes in presentation of urolithiasis including bladder stones(3). The incidence of vesical calculus has declined in developed countries over the last 5 decades(2). There has been much new revolutionary advancement in surgical technology for stone removal. But surgical management alone won't give a comprehensive cure as recurrence is the rule of the game(1). So it is essential to understand the etiopathogenesis of stone formation to identify and prevent the risk factors that leads to this crippling disease.

Determination of stone composition is considered to be crucial for the choice of an optimal treatment algorithm(1). It is important for three reasons. Firstly, composition is related to hardness, which in turn affects the outcome of extracorporeal shockwave lithotripsy (ESWL); hard stones may be resistant to ESWL treatment. Secondly, stones related to various metabolic syndromes, such as cysteine stones or uric acid stones may require systemic medical treatment. Finally, knowing the stone composition enables some preventive efforts (drug treatment, dietary restrictions) (2).

Simple renal calculi are those with a stone burden of <2 cm (aggregate diameter) and normal renal anatomy. Most simple renal calculi (80-85%) can be treated successfully with shock wave lithotripsy. However, lithotripsy may fail or be less effective when stones are larger; stones are located in dependent or obstructed parts of the collecting system; stones are made up of calcium oxalate monohydrate, brushite, or cystine; the patient is obese or has a body build that inhibits proper imaging; or it is difficult to target the stone for shock wave delivery and subsequent fragmentation (5).

There have been many attempts to predict stone composition by analyzing metabolic status, searching for microcrystals in urine sediment, and finally by means of radiological examinations. In most cases minerals found in crystals from urine sediment corresponded to those found in stones. However, the accuracy of these methods is yet to be analysed.

AIM OF THE STUDY

To determine ability of preoperative urine microscopy to predict the stone composition.

Methodology

- **Study design:** Diagnostic test evaluation
- **Study setting:** Urology department in Medical College Hospital, Thiruvananthapuram
- Duration of study: One year
- Study population: Patients presenting with urolithiasis to Urology department of Medical college, Thiruvananthapuram
- Inclusion criteria:
- Patients undergoing surgery for Urolithiasis at Urology department of Medical college, Thiruvananthapuram and willing to participate in the study.

- **Exclusion criteria:**

1. Patients with no crystals seen on urine micros copy
2. Patients who are not willing to participate in the study.

- Sample size

Sample size was calculated using the formula,

$$N=\frac{4Xpxq \times 100}{D^2 \text{ Prevalence}}$$

Prevalence o f renal stone which can undergo ESWL=80 percent (3)

So sample size is 320

- Sampling technique: Consecutive sampling
- Study variables:
  - Preoperative urine micros copy for crystals
  - Post-operative ston e analysis

- **DATA COLLECTION TOOLS:**
- Proforma
- Investigation results of urine microscopy for crystalluria and stone analysis report.

- **DATA COLLECTION TECHNIQUE**
- An informed consent written in the local language was read to the study subjects and signature would be obtained. All the questions in the proforma was read to the study subjects and response was recorded. Investigation reports and previous medical reports were used for filling relevant parts of the proforma.

- **DATA ANALYSIS**
- Data was entered in excel sheets and analysed using appropriate statistical software.
- All quantitative variables were expressed as mean and standard deviation and all qualitative variables were expressed as proportion.
- Significance level of 95% Confidence Interval was determined for all analysis

RESULTS

Total 346 patients participated in the study. In urine microscopy only two reports were available – uric acid or calcium oxalate crystals. In

stone analysis 4 types of reports were available- uric acid, calcium oxalate, calcium oxalate and calcium phosphate, calcium oxalate and uric acid. 226(65%) patients had calcium oxalate in microscopy and upon stone analysis all of them had calcium oxalate stones. 148(65%) of them were pure calcium oxalate stones and rest were having calcium phosphate and uric acid along with calcium oxalate. 120(35%) patients had uric acid crystals in urine microscopy and upon stone analysis 78(65%) of them had uric acid stones. Only 24(20%) patients among them had pure uric acid stones. Upon Kappa analysis to measure the agreement between urine microscopy and stone analysis it is found that for calcium oxalate stones the agreement is 0.246 and for uric acid stone is 0.552. For calcium oxalate stones urine microscopy has 70% sensitivity, 100% specificity and 72.3% accuracy. For uric acid stones urine microscopy has 75% sensitivity, 82.6% specificity and 8 0.3% accuracy.

Table 1- Results of Calcium oxalate stones

Ca Oxalate (microscopy)	CaOxalate (Stone Analysis)		Total
	Ca oxalate	Uric acid	
Ca oxalate	226	0	226
Uric acid	96	24	120
Total	322	24	346

Table 2- Results of Uric acid stones

Uric acid (microscopy)	Uric acid (UrineAnalys)		Total
	Uric acid	Calcium oxalate	
Uric acid	78	42	120
Calcium oxalate	26	200	226
Total	104	242	346

DISCUSSION

Nephrolithiasis is a disease with a high and even rising incidence. It has a high morbidity, generates high costs and has a high recurrence rate. Urinalysis is of importance especially in recurrent stone formers. It allows the identification and quantification of risk factors and the establishment of individual risk profiles. Based on these individual risk profiles, rational therapy for metaphylaxis of kidney stones lowers stone recurrence rates significantly.

The pathogenesis of stone formation is very complex. The first step is formation of supersaturated urine. Then the previously dissolved molecules precipitate out to form crystals. The crystals lead to stone formation once it gets aggregated due to stasis. Stone formation is influenced by promoters and inhibitors of stone formation.

Solubility point is the concentration point at which the dissolved and crystal forms are in equilibrium and addition of further crystals lead to precipitation and stone formation. But presence of inhibitors of stone formation helps in exceeding this limit leading to a metastable state. But at formation product state salts won't be staying in solution and crystallization occurs. Concentration product of common stone components is usually in the metastable state and preventive measures are aimed at this state. Crystal formation can occur in metastable state due to conditions like stasis or heterogeneous nucleation(1,6).

The earliest crystal structures that won't dissolve are the nuclei. They can form by homogenous or heterogeneous nucleation. Heterogeneous nucleation occurs by adsorption of the crystal to other surfaces like other crystals, epithelial cells or debris.

Inhibitors of stone formation are mainly magnesium, citrate, nephrocalcin, Tamm- Horsfall protein, uropontin, pyrophosphate and bikunin. Magnesium complexes with oxalate and reduces calcium oxalate super saturation. Nephrocalcin and Tamm- Horsfall proteins inhibit calcium oxalate crystal aggregation. Citrate complexes with calcium and also directly inhibits precipitation and agglomeration of calcium oxalate crystals. Uropontin inhibits nucleation, aggregation as well as growth of calcium oxalate crystals. Bikunin inhibits calcium oxalate crystallization, aggregation and growth. Substances like oxalate can induce renal tubular cell damage and promote crystal retention rather than excretion. Subepithelial calcium apatite plaques help in stone formation by acting as anchor sites(1).

The common types of urinary calculi are calcium oxalate, calcium phosphate, uric acid, triple phosphate, cysteine and drug stones. Broadly urinary calculi can be classified as calcium stones and non-calcium stones. Calcium oxalate accounts for 60% of all stones(1,7). A stone has both crystalline and non-crystalline components. The matrix or the non-crystalline component comprises only 2.5% of the stone by weight.

Various metabolic abnormalities are identified in stone formers. The most common metabolic abnormality identified in calcium stone formers is hypercalciuria. Hypercalciuria can be absorptive, renal or resorptive. Other common metabolic abnormalities identified in stone formers are hyperuricosuria, hypocitraturia, hyperoxaluria, hypomagnesuria and cystinuria. Hyperoxaluria maybe primary, enteric or dietary. Hyperuricosuria may lead to calcium stones also by heterogeneous nucleation. Generally levels above 600 mg/day are considered as significant hyperuricosuria. Increased dietary purine intake is the most common cause of hyperuricosuria. Hypocitraturia is considered significant when levels are less than 320mg/day(1).

Crystalluria is a marker of urine supersaturation with substances deriving from metabolic disorders, inherited diseases or drugs. According to a study by Kaid-Omar et al in 1999 minerals found in crystals from urine sediments corresponded to those found in stones and crystalluria studies could be of clinical interest to predict the main crystalline phase of calcium-containing stones in order to define the best procedures for stone removal(4,8,9). The main issue is identification of uric acid stones, because they can be dissolved by oral chemolysis. This is an argument for making efforts to determine this fact prior to any treatment.

Stone analysis is an important part in the evaluation of patients having stone disease. Chemical and physical methods are both used for analysis. In some cases, the metabolic disease implied in stone formation is unrecognized by standard metabolic investigations while the stone may contain particular component allowing diagnosis.

CONCLUSION

Early morning urine microscopy for crystals is a cheap, simple, non invasive yet sensitive test for determination of stone composition. It is having a good accuracy for diagnosing uric acid containing stones. It can be used to tailor the management of urolithiasis especially for diet regulation and medical management.

REFERENCES

1. Wein et al. - CAMPBELL-WALSH UROLOGY, ELEVENTH EDITION. pdf.
2. Schwartz and Stoller - 2000 - THE VESICAL CALCULUS.pdf.
3. Hammad FT, Kaya M, Kazim E. Bladder calculi: did the clinical picture change? Urology. 2006 Jun;67(6):1154–8.
4. Philippou et al. - 2012 - The Management of Bladder Lithiasis in the Modern .pdf.
5. Kim JW, Oh MM, Park HS, Cheon J, Lee JG, Kim JJ, et al. Intravesical Prostatic Protrusion Is a Risk Factor for Bladder Stone in Patients With Benign Prostatic Hyperplasia. Urology. 2014 Nov;84(5):1026–9.
6. Ewa et al. Predicting stone composition before treatment – can it really drive clinical decisions? Cent European J Urol 2014; 67: 392-396
7. Eliahou R, Hidas G, Duvdevani M, Sosna J, Semin Ultrasound CT MR. 2010 Aug; 31(4):315-20.
8. Nicole L Miller and James E Lingeman. Management of kidney stones. The British Medical Journal 2007 March ; 334(7591): 468-472
9. Kaid–Omar Z, Daudon M, Attar A, Semmoud A, Lacour B, Addou A. Correlations between crystalluria and composition of calculi. Prog Urol. 1999; 9: 633–641