EVALUATION OF URINARY ABNORMALITIES IN NEPHROLITHIASIS PATIENTS FROM MARATHWADA REGION"

Sharda R. Deshmukh*, Zia H. Khan**

* *Dept. of Biochemistry, M.I.M.S.R. Medical College and Y.C.R. Hospital, Latur 412 531.*

***H.O.D., Dept. of Biochemistry, Shri Shivaji College of Arts, Commerce and Science, Akola 444 001*

ABSTRACT

Urinary abnormalities were evaluated in 100 renal stone patients with first episode of renal stone having age 22 to 45 years from both sex and compared to 100 normal healthy control group having same age group from both sex. Twenty-four hours urinary oxalate, calcium, uric acid, sodium, magnesium, phosphorus and citrate were estimated. The urinary pH was also determined. In stone formers urinary oxalate, calcium, sodium and uric acid excretions were significantly higher when compared with control group. Whereas citrate, phosphate and magnesium excretion were significantly lower in stone formers when compared with control.

The pH of urine in stone formers was lower than the controls. High dietary intake of purine rich diet causes elevated excretion of uric acid, which leads to calcium oxalate crystal formation and precipitation. Other risk factors such as urinary oxalate, calcium also related to formation of renal calculi.

Hypocitraturia is the main cause of renal calculi along with hypomagnesiuria and hypophosphaturia in the patient of Marathwada region. On the basis of urinary abnormalities further stone formation in the patient can be prevented by dietary modifications.

KEY WORDS

Hypocitraturia, Hypomagnesiuria, Hypophosphaturia, Nephrolithiasis, Renal calculi.

INTRODUCTION

Nephrolithiasis is a common disorder marked by kidney stone. It is significant Medical and Surgical problem because of incidence, recurrence and severe consequences. Kidney stones (Calculi) are hardened mineral deposits that form in the kidney. The stone contains different chemical salts originate from a wide variety of metabolic and environmental disturbances (1).

It is generally conceded that there is no one etiological factor responsible for the formation of renal calculi. Rate of incidence of kidney stone varies regionally with countries (2), because of differences in diet, climate, soil and water quality (3, 4, 5). The endogenous factors such as obstruction, infection, metabolic disturbances such as hyper-parathyroidism, renal

acidosis plays an important role in the formation of renal calculi.

Considering the variation in causes of kidney stone, present study was undertaken to find out the exact cause of renal calculi formation in the Marathwada Region of Maharashtra State.

MATERIALS AND METHODS

Selection of the Patients

100 patients (65 males and 35 females) suffering from Nephrolithiasis having age group of 22 to 45 years, attending the various hospitals in Marathwada region were constituted in the experimental group.

The diagnosis of Nephrolithiasis was done by imaging test i.e. ultrasonography. The patients suffering from nephrolithiasis for the first time were included in the experimental group. The patients suffering from any other diseases were excluded. All patients were consuming the diet of Marathwada region which specifically consist of spinach, tomatoes, large quantity of groundnuts, jawar roti, and frequently non-vegetarian diet. The source of drinking water was from bore-well (hard) water.

Author for Correspondence :

Dr. Z.H. Khan,
Head, Dept. of Biochemistry,
Shri Shivaji College,
Akola
E-mail: ziakhan7862@rediffmail.com

Control group

100 normal healthy individuals (65 males and 35 females) having age group 22 to 45 years were constituted in the control group. All controls were free from the diseases including nephrolithiasis.

Collection of samples

The twenty-four hours urine samples were collected in a wide capped clean transparent graduated plastic collection bottle. The preservatives such as 10N hydrochloric acid was used for calcium and oxalate, 10N sulphuric acid was used for citrate, thymol crystals were used for sodium, uric acid, magnesium and phosphorus. The samples were preserved in refrigerator. Volume of specimen was noted and used for analysis of biochemical parameters. For pH determination morning samples were used.

The biochemical parameters such as Oxalate, Citrate, Uric acid, Calcium, Phosphate, Sodium and Magnesium were analyzed using Sigma diagnostics assay kits. The RA-50 chemistry analyzer was used to carry out all analysis.

Citrate was estimated using colorimetric standard method (6). Sodium and potassium were estimated by "Mediflame double channel Flame Photometer", Systronics make.

The pH of urine was detected using dipsticks from Tecodiagnosics. The value of each parameters were compared between controls and stone formers. The results were expressed as mean $\pm$ standard deviation and statistical analysis of the data was performed by student's unpaired t-test.

RESULTS

The twenty-four hour urinary calcium, oxalate, uric acid and sodium excretion were significantly higher in stone

formers when compared with normal control group ($P < 0.001$). The twenty-four hour urinary citrate and phosphate excretion was significantly lower when compared with normal control group ($P < 0.001$). The magnesium excretion was also lower in stone formers when compared with normal control group ($P < 0.05$) (Table I).

The pH of urine in stone formers was 5.10 ± 0.054 whereas in control group it was 6.48 ± 0.04 ($P < 0.001$).

DISCUSSION

Urinary stone disease is a major health problem in many parts of the world and endemic in India (7). In our study twenty-four hour urinary calcium, oxalate, uric acid and sodium concentrations were higher in stone formers. These are the major risk factors in first time stone formers and in recurrent stone formers (8).

It is our assumption that the more concentration of calcium in tubular filtrate may be due to some abnormality in calcium metabolism. It may be at the hormonal level or at the level of ossification of bone (dysfunction of osteoblasts and osteoclasts), which needs further study. As a consequence of high concentration of calcium in tubular filtrate the more chances of formation of renal calculi.

Uric acid induces the heterogeneous nucleation of calcium oxalate stone (Coe *et al.*, 1975). It was proposed that uric acid crystals adsorb and inactivate natural urine inhibitors such as glycosaminoglycans (9). The higher concentration of urate in urine may be due to high intake of purine rich diet and hence increased concentration of urate causes precipitation of calcium oxalate crystals.

Oxalate in urine may arise either as an end product of intermediary metabolism or from dietary sources

Table 1. Twenty four hour urinary constituents in first time stone formers and control group

Parameters	Stone formers Group (n = 100)	Control Group (n = 100)	P Significance
Calcium (mg/24 hrs)	182.4 $\pm$ 8.726	90.39 $\pm$ 2.712 ^a	Significant
Oxalate (mg/24 hrs)	40.90 $\pm$ 1.957	24.21 $\pm$ 1.373 ^a	Significant
Uric acid (mg/24 hrs)	485.9 $\pm$ 31.64	266.1 $\pm$ 8.962 ^a	Significant
Sodium (m Eq/24 hrs)	211 $\pm$ 3.73	172 $\pm$ 3.25 ^a	Significant
Citrate (mg/24 hrs)	148.9 $\pm$ 5.035	390.8 $\pm$ 7.412 ^a	Significant
Magnesium (mg/24 hrs)	113 $\pm$ 12.5	150 $\pm$ 11.8 ^b	Significant
Phosphate (mg/24 hrs)	226 $\pm$ 14.4	427 $\pm$ 8.02a	Significant

Statistical analysis was performed by student's t-test.

The data are expressed as mean $\pm$ S.D.

a = $P < 0.001$; b = $P < 0.05$.

(10). Oxalate complexes with calcium to form calcium oxalate salt. The solubility of calcium oxalate salt is affected by changes in the urinary pH. In present study urinary pH of stone formers was 5.1 ± 0.05 , which indicates that at this pH calcium oxalate solubility is minimum and hence urine get supersaturated with calcium oxalate. Hence pH 5.1 ± 0.05 is the optimum pH for stone formation. The pH was favorable for stone formation in control group even though the stone was not formed, it may be due to the high level of urinary inhibitors such as Citrate, Magnesium and Phosphate.

The adequate dietary calcium, low animal proteins, low salt diet decreases urinary excretion of both calcium and oxalate (11, 12). The excretion of sodium was significantly increased in stone formers that may be due to high dietary intake of salt, which causes higher excretion of calcium and oxalate.

In our study twenty-four hours urinary Citrate, Magnesium and Phosphate excretion were significantly reduced in stone formers. These substances are known to be major inhibitors of crystallization of calcium oxalate and growth of the crystals.

The intratubular citrate protonation depends on ambient pH. The low luminal fluid pH decreases free citrate and Tolerable oxalate. The tolerable oxalate is the metastable limit of calcium oxalate solubility. The low luminal fluid pH drives the reabsorption of protonated citrate. Therefore free citrate and tolerable oxalate are necessarily low. The lower citrate concentration may be due to distal tubular dysfunction. Magnesium inhibits oxalate absorption and excretion, thus prevent its supersaturation. Normally magnesium is complexed with calcium as well as oxalate and decreases its excretion. Thus decreased magnesium concentration in nephrolithiasis results in increased urinary oxalate level, as sufficient magnesium is not available to form the magnesium-oxalate complex. The previous study showed that urinary magnesium excretion was higher in children than adult, hence incidence of nephrolithiasis in children is very low as compared with the adults in developed western countries (13, 14, 15).

The dietary components influence the biochemical parameters such as Oxalate, Uric acid, Calcium, and Sodium etc. As in Marathwada region diet contains groundnuts, tomatoes, spinach, animal proteins etc, use of more salt in dietary preparations and bore-well water for drinking purpose. Thus these factors may serves as risk factors in addition to other risk factors for stone formation in the marathwada region.

CONCLUSION

In stone formation multiple etiological factors are responsible. In the present study it is concluded that

hypocitraturia is the main cause of renal calculi along with hypomagnesuria and hypophosphaturia in the patients of Marathwada region.

On the basis of urinary abnormalities, dietary modifications such as low intake of groundnuts, tomatoes, spinach, animal proteins, salt etc, and soft drinking water can be suggested to the stone formers, so as to prevent further stone formation.

REFERENCE

1. Kumar, R., Kapoor, R., Mittal, B., Kumar, A. and Mittal, R.D. (2003). Evaluation of urinary abnormalities in urolithiasis patients: A study from North India. *Indian Journal of Clinical Biochemistry* 18 (2), 209-215.
2. Michael, Soucie, Ralph, J., Coates, William, McClellan, Harland, Austina and Michael, Thun (1996). Relation between Geographi variability in kidney stones prevalence and risk factors for stones. *American Journal of Epidemiology* 143 (5), 487-495.
3. Robertson, W.G., Peacock, M., Marshal, R.W. *et al.* (1975). Seasonal variations in the composition of urine in relation to calcium stone formation. *Clin. Sci. Mol. Med.* 49, 597-602.
4. Churchil, D., Bryant, D., Fodor, G. *et al.* (1978). Drinking water hardness and urolithiasis. *Ann. Intern. Med.* 88, 513-514.
5. Sierakowski, R., Finlaysin, B. and Landes, R. (1979). Stone incidence as related to water hardness in different geographical regions of the United States. *Urol. Res.* 7, 157-160.
6. Rajagopal, G. (1985). A simple calorimetric procedure for estimation of citric acid in urine. *Ind. J. Exp. Biol.* 22, 391-392.
7. Nayar, D., Kapil, U. and Dogra, P.N. (1997). Risk factors in urolithiasis. A cause control study. *The Indian practitioner* 50 (3), 209-214.
8. Rao, T.V.R.K. and Sofia, Bano. (2003). Clinico-Biochemical indexing of calcium urolithiasis on the basis of urinary citrate to calcium ratio and inhibition of meneralisation of urinary stone forming by human urine. *Indian Journal of Clinical Biochemistry*, 18 (1), 52-60.
9. Grover, R.K., Ryall, R.L. and Marshall, U.R. (1990). Effect of urate on calcium oxalate crystallisation in human urine: Evidence for a Promotory role of Hyperuricosuria in urolithiasis. *Clin. Sci.* 79, 9-15.
10. Earnest, D.L. (1979). Enteric hyperoxaluria. *Adv. Intern. Med.* 24, 407.

11. Loris, Borhi, Jania, Schianchi, *et al.* (2002). Comparison of two diets for the prevention of recurrent stones in idiopathic hypercalciuria. *The New Eng. Journal of Medicine* 346 (2), 77-84.
12. Martin, G. (1991). *Cogan. Fluid and Electrolytes physiology and pathophysiology*. First edition printice - Hall International Inc. London. Charles F. Evans.
13. Schwille, P.O., Schimied, A. *et al.* (1999). Magnesium, Citrate, Magnesium Citrate and Magnesium alkali citrate Modulators of Calcium oxalate crystallisation in urine: Observation in patients with recurrent idiopathic urolithiasis. *Urol Res.* 27, 117-126.
14. Miyak, O., Yoshimura, K., Yoshioka, T., Koide, T. and Okuyama, A. (1998). High urinary excretion level of citrate magnesium in children. Potential etiology for the reduced incidence of pediatric urolithiasis. *Urol Res.* 26 (3), 209-213.
15. Churchill, D.N., Moloney, C.M., Nalan. R., Gault, M.H. and Winsor. G. (1980). Pediatric urolithiasis in the 1970s. *J. Urol.* 123, 237.