Population Based Data on Urinary Excretion of Various Metabolites in Children of North Western Region of Pakistan

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Abstract

Population based data on urinary excretion of various metabolites of pathological importance, Calcium, Magnesium, Sodium, Potassium, Oxalates, Citrates, Phosphates, Uric acid and urea have been collected from around three hundred children of the Quetta valley. The body weight was in the range of 11-50 kg and the age was in between 4-16 years. The urine excretion average was 987.5±452.5 ml per 24 hours. There was 11.5% incidence of hypercalciuria, 8.5% incidence of hyperuricosuria, 2.0% hyperphosphaturia, 2.5% hypomagnesuria, 3.5% hypocitraturia, 6.5% hypematriuria, 43.5% hypokaliurea and 2.1% hyperoxaluria. Urea excretion average was 23.11±14.99 g per 24 hours. The study provided the basis for childhood reference pattern in urinary excretion of compounds related to various pathological conditions, in particular stone formation in this region (JPMA 48:241, 1998).

Introduction

It is estimated that renal stones are atleast 10 times more common now than they were at the beginning of the century. Nephrolithiasis is a multi factorial condition that occurs when the chemical environment favors crystallization, the urine must be supersaturated with the salts of the crystals (e.g. Calcium, Oxalate and phosphate) and in the absence/low concentration of urinary inhibitors. These inhibitors include small ions such as magnesium and citrate as well as polyanions of high molecular weight such as glycosaminoglycans.

Many epidemiologic variables can modify the urinary risk factors, these include age, sex, heredity, occupation, social class, affluence, geographic location, climate and diet. Of these, diet including fluid intake is the only one that can be easily changed and that has a marked effect on all urinary risk factors. Urolithiasis in children has received little attention in comparison with urolithiasis in the adult population. The development of the urinary tract stones in young patients has raised questions about causing factors and has generated controversy about evaluation and management. Concerns about urolithiasis in paediatric patients are prompted by recent studies that have found hypercalciuria in 2.9 to 3.8% of otherwise healthy children and in 6.2% children brought to an acute-care clinic for minor complaints. Relationship between idiopathic hypercalciuria and hematuria has been shown, suggesting that such children are predisposed to formation of stones. As urolithiasis disease is increasing day by day all over the world among adults and children, it is interesting to investigate the various promoting agents such as uric acid crystals or inhibitors such as magnesium or citrate. Three hundred children of this area were selected to find out the paediatric reference pattern in urinary excretion of compounds in order to facilitate the monitoring of prophylactic treatment.

Materials and Methods
Collection of urine samples: 24 hours urine samples were collected from children belonging to different areas of Quetta. All the samples were stored in the refrigerator at below -20°C until analyzed. Three hundred children aged between 3-16 years (228 male and 72 female) were included in this study. The body weight was in the range of 11-50 kg and the urine excretion average was 987.5±452.5 ml/24 hours. Several metabolites of pathological importance such as urea, uric acid, phosphate, calcium, magnesium, oxalate, citrate, sodium and potassium were quantitatively determined using standard Boehringer kits. Citrate was determined spectrophotometrically by its selective complexation with copper. Copper reacts with citrate and forms a blue complex of bis-citrate-Cu (II). This complex has maximum absorption at 760 nm. The method is established in the authors laboratory and has been applied to the determination of citrate in urine. The limit of detection of this method is 20 mg/dl. The results were correlated with the enzymatic method for citrate, which gave a correlation coefficient of 0.97. The excretion per day of >300 mg calcium for men and >250 mg for women is defined as hypercalciuria, while the excretion per day of >800 mg uric acid for men or >750 mg for women is defined as hyperuricosuria and the excretion of less than 300 mg per day is defined as hypophosphaturia. The excretion of less than 120 mg magnesium per day is defined as hypomagnesuria. The excretion of 200 mg citrate per day is defined as hypocitraturia, more than 200 mmol per day sodium (hypernatriuria), more than 50 mg per day oxalate (hyperoxaluria). The excretion of more than 20 mmol per day of potassium (hyperkaliuria) while excretion of less than 20 mmol per day of potassium (hypokaliuria).

Results

The percentage results among these three hundred children were 11.5% incidence of hypercalciuria, 8.0% hyperuricosuria, 2.0% hyperphosphaturia, 2.5% hypomagnesuria, 3.5% hypocitraturia, 6.5% hypernatriuria and 43.5% hypokaliuria. The urea excretion average was 23.11±14.99 gm per day.

Discussion

Eleven percent hypercalciuria among the 200 children studied is of significant value. Although a correlation was attempted between high dietary calcium intake and an increased risk of stone formation, there were difficulties in comparing data on dietary intake and urinary excretion of calcium. Most studies have indicated that a decrease in calcium intake by stone forming patients results in decreased calcium excretion. However, these studies have also indicated that decreasing the calcium intake without also decreasing the oxalate intake leads to increased oxalate excretion, which carries an even greater risk for subsequent stone formation. This increase is the result of greater concentration of free oxalic acid in the intestine. Excess calcium and oxalate usually form complexes in the intestine that are then excreted in the faeces. When the calcium intake is limited, the reduced amount of unabsorbed calcium left in the intestine results in more free oxalates, which is absorbed by passive diffusion in the colon. The risk in urinary oxalate excretion disappears when dietary oxalate restriction is also imposed, while 2.1% hyperoxalurias is significant. Oxalate is a high risk factor for formation of stones. The dietary components of urinary oxalates is derived from the break-down of dietary oxalate. We have also found 8.0% hyperuricosuria which is also significant and several recent studies have implicated hyperuricosuria as an important risk factor for calciumoxalate stone formation. Other significant parameters include 3.5% hypocitraturia and 43.5% hypokaliuria. There is a relation between hypokaliuria and hypocitraturia. Hypematuria 6.5% is also a risk factor as there is a close association between urinary excretion of sodium and calcium because of many common sites of
absorption along the renal tubules. People with calcium stones are more sensitive to the calciuric effects of sodium than the rest of the population\textsuperscript{12}. This is also worth mentioning that the major source of available drinking water of this area is fountains, lakes and mostly underground water in the form of wells (both open and tube wells). As the available source of drinking water is highly salt rich, containing salts of calcium, phosphates, cathonates and bicarbonates, it is assumed that there is a definite role of such contaminated salt constituents in the elevated rate of these risk factors.

References
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