PATHOGENETIC ROLE OF METABOLIC DISORDERS IN CHILDREN WITH NEPHROLITHIASIS

812 children with nephrolithiasis were examined. Metabolism disorders were defined including hypercalciuria and hypernatriuria in 37.3±2.4% of children, calciuria - in 62.5±5.3%, phosphaturia - in 26.6±2.5%, hyperoxaluria - in 83.1±1.76%, and hyperuricosuria - in 51.7±4.7% have been fixed in 812 children with nephrolithiasis. In 80% events kidney stones contained 63-84% urinal calcium and oxalate acids. The study has revealed that kidney H+ secretion was decreased in all patients with nephrolithiasis accompanied with metabolic acidosis. The study has made possible to describe state of metabolism in patients with nephrolithiasis, define the occurrence frequency of the main metabolic disorders, and evaluate the importance of the specific biochemical investigations of this disease.

Key words: Metabolic disorder, nephrolithiasis in children.

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Introduction

It is believed that the process of metabolic disorders is the main link in the mechanisms of lithogenesis (see, e.g., Alon, Zimmerman, and Alon, 2004; Areses Trapote, A., Urbie Garagorr, Uabetagoven Arrieba, Mingo Monge, Arruebarrena Lizarrage, 2004; Sternberg, Greenfield, Williot, and Wan, 2005; Cameron, Sakhae, and Moe, 2005).

It is acknowledged that the irrational diet, excessive use of foods containing lithogenic substances have relevant importance in forming some types of nephrolithiasis. There is regularity between disorder temper in mineral metabolism of patients with nephrolithiasis and composition of lithogenesis. Thus, it is important to elucidate this interconnection; improper understanding of its mechanism makes impossible any purposeful treatment of patients with nephrolithiasis and planning of any prophylactic programs of lithogenesis relapses (Carmen R. Amaro, Jose Golfberg, Joaol L. Amaro, Carlos R. Padovani, 2005; Lancina Martin, Rodriguez-Rivera, Novas Castro, Rodriguez Gomez et al., 2002; Coe, Evan, and Worcester, 2005).

This work investigates the content of calcium, natrium, potassium in blood serum and urine excretion.

Materials and methods

Calcium was defined by method of flame photometry (Pokrovskiy, 1969); inorganic phosphorus - by colorimetrical method (Pokrovskiy, 1969); magnesium - by complexometric method; urine PH index, buffer base shift [BE], standard buffer system [SB], and ammonia in urine were defined using Conway method (Pokrovskiy, 1969); acid-base titration and pH were defined by potentiometric titration (Toderov, 1966), content of urine acid - by spectrophotometer (Menshikov, 1987), urine oxalate (Sivarionovskiy, 1969). Besides these special methods of investigations the common protein and albuminous fraction, urea in blood and urine excretion, diurnal urine excretion, creatinine clearance, USI (ultrasonics), intravenous excretory urography were defined.
Results and discussion

Electrolytic exchange of potassium and natrium was found abruptly disturbed in 37.3% of children having nephrolithiasis and living in a hot climate. Daily loss of protein tends to expand (grow) in connection with increasing of urine potassium, natrium and calcium excretion.

From 586 observed children the hyperoxaluria was revealed in 83.1% of patients; in 51.7% of cases it was found in combination with hyperuricosuria 51.7%.

With increasing of inorganic phosphate content in urine their urinary excretion is increased. Phosphatemia is closely connected with the content of urea in blood, the change of buffer base, the displacement of urine pH.

Hyperphosphatemia, hyperkalemia cause the distinct acidification into the alkaline side and the formation of phosphate stones. The disturbance of urine acidification which makes conditions for lithogenesis was found in 96% patients with nephrolithiasis. H+ secretion is reduced in all patients with nephrolithiasis.

It is known that calcium, natrium are related to vital electrolytes involving in regulating vascular tension, water, carbohydrate and amino acid metabolism which inhibit salt crystallization in urine. In this connection, the mentioned electrolytes were studied in children with nephrolithiasis.

Potassium in blood is defined in 812 patients with nephrolithiasis. Hypokalemia (Table 1) was fixed in 84 (10.3%) children, hyperkalemia - in 108 (12.8%), hyponatremia - in 86 (10.5%) patients. Urine excretion, low potassium content in daily urine was found in 102 (12.5%) children, hypercalciuria - in 304 (37.3%), and low natrium content in urine - in 83 (10.2%) patients.

In 216 observed patients hypermagnemia was noted in 32.6% of patients, hypermagneuria - in 44%, urine excretion - in 26% of sick children. The concentration of magnesium in the blood has usually high consistency, since this ion is involved in activation of many cellular enzymes. Frequent decreasing of its content in blood and their deducing is considered as risk factor of lithogenesis.

Comparative analysis demonstrated the correlation of potassium and natrium metabolism with changes of other indices in case of nephrolithiasis. In particular, close correlation of increasing potassium excretion with phosphate lithogenesis in urinary tracts (r=0.84) and calcium (r=0.77) was established. Sodium excretion showed close correlation with
intensive daily protein loss (r=0.58) and titrated acid (r=0.69). Urine potassium excretion increased in the presence of proteus vulgaris (r=0.89).

We examined urine oxalate excretion in 586 patients with urolithiasis. From these patients hyperoxaluria was defined in 487 (83.1%) persons. Hyperoxaluria was often combined with hyperuricosuria - 289 (51.7%) patients. Hyperoxaluria and hypercalciuria performed as the frequent form of metabolic disorders (30-60%), and urinary calculus contained calcium salts in of 80% of cases.

Hypercalciuria, hyperphosphatemia, and hyperparathyroidism in pyelonephritis are consequences of disorders of tubuli renal function and can be the cause of lithogenesis (Lancina Martin et al., 2002). Considering this, the phosphate-calcium metabolism and urine pH in 710 and 812 patients were also studied. Hypercalcemia was defined in 74 (9.1%), hyperphosphatemia - in 39 (5%), hypercalciuria with hyperoxaluria - in 327 (55.8%), hypercalciuria was observed in 412 (50.7%), hyperphosphaturia - in 189 (26.6), hypercalciuria with hyperphosphaturia - in 126 (17.7%) from 710 patients, hypercalciuria with hyperuricosuria in 284 (36%) from 780 patients.

Correlation analysis showed that increasing of phosphorus in blood is closely corresponded with urine phosphorus excretion (r=0.86); increasing of phosphorus in blood conditioned also relationship of phosphatemia with blood urea (r=0.84) and BE (r=0.77). Phosphaturia was often observed in coralline renal calculus (r=0.89).

Disturbance of phosphorus-calcium metabolism was connected with urine acidification. In particular, hypercalciuria was followed by urine pH shift to the alkaline side (r=0.74). Urine acidification disorder is one of the important risk factor of lithogenesis. As is known, shift of urine acidification into the strongly sour side causes formation of aciduria.

Urinary pH change into sour side within 4.5-5.5 was defined in 589 (72.3%) patients, 7.0-7.4 - in 204 (23.8%) patients. So, the acidification disorder conditioning lithogenesis was defined in 96% patients with nephrolithiasis. Daily ammonia excretion and titrated acidity were established in 480 children; blood pH, BE, and SB - in 300 patients with nephrolithiasis. Distinct metabolic acidosis was found in all investigated children with bilateral nephrolithiasis regardless of their ages. It manifested as reliable decreasing of concentration of standard and genuine sodium bicarbonate; and, most importantly, the marked deficiency of buffer base was noted.

Blood acid-base disorder related to metabolic acidosis was expressed among the children with unilateral urolithiasis (revealed in 84.14% of cases). The frequency of acidosis remained constant in every age group of examined children with oxalate phosphate urolithiasis (85%).

The study has revealed that kidney H+ secretion was decreased in all patients with nephrolithiasis accompanied with metabolic acidosis. Bilateral lithogenesis was accompanied by more distinct repressing of H+ secreting kidney ability (Table 1). Particularly, in children with unilateral nephrolithiasis, the titrated acidity decreased more than 4 times and ammonia - twofold than in healthy children; while in children with bilateral nephrolithiasis these indices decreased in 9 and 4 times, accordingly. Minor lowering of urine titrated acidity was found in children having unilateral nephrolithiasis and normal indices of blood acid base.

Thus, in children with oxalate-phosphate calculus (regardless of uni or bilateral formation), not only decreases the quantity of intercalative cells in kidney collecting tubes of urinary tracts, but also ultrastructures of these cells change demonstrating functional inability of producing H+.

It should be pointed out that the hot simmer in Uzbekistan bears essential risk factor causing drastic increasing of extrarenal liquid loss, developing its relative shortage, and increasing of urine nephrotoxic metabolites.
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