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HEALTHY CHILDREN AND CHILDREN WITH UROLITHIASIS: METABOLISM OF SOME MICROELEMENTS

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Cover Page Footnote

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Abstract

Background. *Microelements (ME) are the one of the most important part of biologic active substaces like hormones, enzymes, proteins and others that participate in processes in the human body. In fact, many studies showed a clear links with metabolic disorders and urolithiasis in children.*

Methods. *The study included the observation of 150 children from 3 to 14 years old with urolithiasis and complicated urinary tract infections. We analyzed two main variants of the course of the disease before and after surgical removal of calculi from the urinary tract against the background of the traditional and complex metabolic-dietary method of treatment, which was developed by the authors.*

Results. *The development of acute calculous pyelonephritis (CP) in children is closely connected with a sharp iron deficiency (compared to healthy children), cobalt, zinc, manganese, selenium, respectively. In this case, a significant increase in the amount of copper was observed. Carrying out intensive metabolite therapy (MT) for 18 days contributed to a noticeable increase in iron (compared with the data before treatment), manganese and a decreased in copper levels, while at the same time, normalization of cobalt (compared with the basic treatment data), zinc and selenium was observed.*

Conclusion. *Metabolic disorders in ME is a one great trigger factor of abnormal metabolism of cellular biocenosis and the formation of kidney stones and urinary tract. Management of the metabolism of ME contained in the tissues of the body is possible with the help of the so-called claw compounds, which include natural complexing agents of amino acids, vitamins.*

KEY WORDS: *microelements in normal and with urolithiasis in children, castor compounds of microelements, natural complexing agents of amino acids, vitamins.*

BACKGROUND

The structure and functional activity of biological membranes, as it is well-known, are closely interacted with metabolic processes in general and with the metabolism of lipids, essential

microelements (Fe, I, Cu, Zn, Co, Cr, Mo, Se, Mn) that are necessary for normal functioning of the body. They are part of enzymes, vitamins, hormones and other biological active substances (Dekhkanov et al, 2018).

Microelements (ME) are the most important component of construction of hormones, enzymes, proteins and other highly active compounds, take part in the regulation of metabolic processes in the body, enhance bioenergy processes, increase antibody formation and detoxification properties of various systems, and affect the body's immunobiological reactivity (Dekhkanov et al, 2018; Skalny & Kudrin, 2001).

It is proved that microelements play a vital role in the life of humans. Their insufficiency or redundancy can cause not only physiological changes, but also endemic diseases (Lopatkin et al, 1980; Pulatov, 1990).

Researchers observed a profound metabolic disorders in children suffering from urolithiasis (Beknazarov, 1985; Sulaymanov, 1980; Utegenov, 1980). Namely, a significant decrease in the concentration of copper, manganese, bromine, and cobalt was observed in the blood serum of sick children with urolithiasis. In parallel with pathological changes in the levels of iron, zinc, bromine, cobalt, copper, blood plasma, the content of albumin in the blood serum decreases and the content of alpha - gamma - globulin and potassium in the blood serum increases. Furthermore, the level of creatinine in the blood plasma increases. The changes in the concentration of in zinc, rubidium, and bromine in the urine depend on the amount of kidney stones (Beknazarov, 1985). Protein components, essential microelements, vitamins and coenzymes

play an important role in the functioning of membrane structures (Beknazarov, 1985).

The polyetological nature of urolithiasis and the abundance of causal factors (prerenal, renal and postrenal) lead to relatively homogeneous physicochemical disturbances in the colloidal and crystalloid equilibrium of urine and stone formation.

Stone formation depends on a number of physico-chemical processes that occurs in the body as a whole and in the urinary system in particular. The supersaturation of stone-forming substances in the blood and urine entails the formation of crystals of salts and microlites, which are a favorable condition for the formation of stones. The precipitation of salts in the urine is prevented by citrates, hippuric acid, magnesium, zinc, manganese, cobalt ions, as well as the concentration of hydrogen ions, which is 5.6-6.0 in the urine. The addition of urinary infection significantly increases the frequency of relapses and worsens the course of the disease (Gres et al, 2012; Utegenov, 1980). Microelements in serum of children with urolithiasis complicated by obstructive pyelonephritis in the acute stage there is an imbalance in the content of trace elements in serum, in the form of accumulation of iron and selenium and a deficiency of copper, zinc, cobalt and manganese, which indicates the depth of the pathological process (Utegenov, 1997).

The concentration of zinc and copper in blood serum in patients with chronic renal failure is positively correlated with daily excretion of zinc and copper in urine (Pavlov, 1998).

Due to the disorders within the cell imbalance of trace elements, energy deficiency occurs, leading to metabolic disturbances, followed by calcium overloading of the tubular epithelial cells. In turn, this leads to a dysfunction of the reabsorption of both calcium and other substances in the kidneys. Potassium and magnesium enter from the tubule epithelial cell into the interstitial space, and then into the lumen of the peritubular capillary according to the concentration gradient. This process mainly courses passively (Krikun, 2009).

With hypercalciuria, hyperphosphaturia and hyperparathyroidism, the addition of urinary tract infections can cause stone formation. In particular, hypercalciuria was accompanied by a shift in the pH of the urine to the alkaline side. Urinary acidification is a major risk factor for stone formation. As you know, a sharp change in the acidification of urine in the acidic side creates a threat of uric acid formation, and in the alkaline side - phosphate lithiasis (Utegenov et al, 2000).

The lack of manganese in the diet causes an increase in the concentration of calcium and phosphorus in the blood serum, reduces the content of hemoglobin and white blood cells. There is a synergy between magnesium and vitamin B6, between selenium and tocopherol, retinol acetate and ascorbic acid contribute to better absorption of iron, chromium is easily metabolized with ascorbic acid (Dekhkanov et al, 2018). In case of impaired calcium metabolism, the occurrence of recurrent calcium-oxalate stones, with the oxalate

form of urolithiasis, the formation of recurrent phosphate calculi is possible with the combination of urinary urease-producing infection (Konstantinova & Yanenko, 2011; Levitsky, 2010).

Excessive simultaneous intake of protein, sodium chloride, citric acid in combination with calcium-containing products contributes to hypercalcemia and hypercalciuria. The processes of formation of calcium ultrafiltrate depend on the quantity and quality of incoming bile acids and the nature of the food. A decrease in the amount of bile acids in the small intestine inhibits the formation of ultrafiltrate and calcium absorption, and vitamin D metabolites increase the absorption of calcium in the intestine and increase its excretion by the kidneys (Kolpakov, 2006).

Thus, impairment in the metabolism of microelements is one of the causative factors in the formation of stones in the urinary tract. At present, a number of studies have appeared that give reason to assert that, by promoting or opposing the inclusion of microelements in the body tissues in certain biochemical cycles, it is possible to direct the course of certain biochemical processes in the body along the desired path. The exchange of trace elements contained in body tissues can be controlled with the help of so-called claw compounds, which include natural complexing agents of amino acids, vitamins, acids of the Krebs cycle and artificial complexing agents, etc.

It should be noted that trace elements in the form of cobalt, zinc sulfate, copper sulfate, together with the use of coenzymes

of B vitamins, an antioxidant of vitamins E, C, PP and protein preparations - albumin, synthetic mixtures of amino acids, led to an improvement in the metabolism of oxalacetic and uric acids, inorganic phosphorus and calcium, trace elements and lipid peroxidation indicators in children with urinary tract infections in the presence of urolithiasis (Bruchanov et al, 2009; Dekhkanov, 1994; Makarova et al, 2005; and Rumyantseva et al, 2006).

A biologically active food supplement containing zinc and ascorbic acid increased the content of IgM, C3 and C4 components of complement in blood serum, and also increased the content of secretory IgA in saliva (Utegenov et al, 2000). Magnesium L-asparaginate and Magnesium chloride in combination with pyridoxine under crystalline conditions of oxalates caused by pyridoxine deficiency reduce crystal formation (Spasov et al, 2008; and Spasov et al, 2009).

After the introduction of magnesium salts, a significant decrease in the Ca/Mg ratio of urine was noted compared with the control group, and the ratio of oxalate/creatinine in urine that decreased after all. The most pronounced effect on this indicator was exerted by magnesium L-asparaginate in combination with vitamin B6, magnesium salts significantly reduce the excretion of oxalates, the formation of crystals of calcium oxalate, and increase the pH of urine (Kolpakov, 2006).

PURPOSE OF THE STUDY

Based on the above listed data, we set the task of studying the content of certain trace elements in plasma, erythrocytes, and urine upon admission of sick children with complicated forms of urinary tract infections against the background of urolithiasis. To analyze the changes in the dynamics against the background of the traditional and developed by us therapy before and after removal of salt stones from the urinary tract.

MATERIAL AND METHODS

STUDY POPULATION

In Tashkent Pediatric Medical Institution (TashPMI) clinics, the content of microelements of copper, iron, manganese was studied in 150 children from 3 to 14 years old. Separately studied in the dynamics before and after removal of the calculus from the urinary tract in 26 children who received traditional therapy in comparison with 29 children who received a comprehensive metabolic and dietary treatment (Patent No. 462 dated March 16, 1994).

BLOOD SERUM ANALYSIS

In order to examine the microelements like Fe, Cu, Mn, Co, Zn, Se in erythrocytes, plasma, and daily urine, we used the neutron activation method developed by Kist et al (1967) in the neutron activation laboratory of the Institute of Nuclear Physics of the Academy of Sciences of the Republic of Uzbekistan.

This method is characterized by high accuracy, relatively low labor intensity, a wide range of element studies, and the possibility of automation of processes. In addition, a minimal amount of material can be investigated, and the sensitivity of activation analysis for most trace elements is significantly higher than conventional analytical methods.

All measurements were carried out on a Ge (Li) detector with a volume of 64 cm with a resolution of 3.5 KeV along the Co_{60} 1330 KeV line connected to the LP-4900 multichannel analyzer. For a comparative analysis, reference blood samples of healthy children obtained by the Institute of Nuclear Physics according to the method of Zhuk (1987).

In this regard, we studied the state of microelements' metabolism in serum, erythrocytes and urinary excretion in 150 sick children with single and multiple kidney stones aged 3 to 14 years, the control group consisted of 50 children of the same age. There were 81 patients with single kidney stones and 69 with multiple stones. MEs in serum, erythrocytes, and urine were determined by the neutron activation method (Lagutina and Utts, 1991).

RESULTS

An analysis of the dynamics of the content of ME in red blood cells in children with single kidney stones in the treatment process is presented in Table 1. As can be seen from the data obtained, with the development of acute calculous pyelonephritis (CP) in children, there is a

sharp iron deficiency (compared with healthy children), cobalt, zinc, manganese, selenium, respectively. In this case, a significant increase in copper is observed. Carrying out intensive metabolite therapy (MT) for 18 days contributes to a noticeable increase in iron (compared with the data before treatment), manganese and a decrease in copper levels, while at the same time, normalization of cobalt (compared with the basic treatment data), zinc and selenium is observed. Due to the effectiveness of MT, the reaction from the maintenance of ME in this group of children to surgical intervention is not so pronounced as in children who received basic treatment (BT) before surgery. Conducting further MT in the postoperative period may allow to normalize the level of iron, copper, cobalt, manganese, selenium.

In order to clarify the question of how much the level of urinary excretion of ME changes with the development of CP in children, we studied the dynamics of urinary excretion of ME during treatment. As can be seen from table 1, with the development of an acute form of CP in children with single kidney stones, urinary excretion of all studied MEs sharply increases, with the exception of manganese, the level of which in the urine drops sharply. It should be noted that manganese deficiency is observed in red blood cells and in serum. Intensive metabolite therapy (MT) for 18 days contributed to a marked improvement in urinary excretion of ME, while normalization of the level of copper should be noted.

Table 1

Dynamics of trace elements in red blood cells, in serum and urinary excretion in acute form of calculous pyelonephritis with single kidney stones (a-basic, b-metabolite treatment) (X + m)

Durations of the study	ME, mkmol/l					
	Iron	Copper	Cobalt	Zinc	manganese	Selenium
n=a/b	35/46	35/46	35/46	35/46	35/46	35/46
In RBC:						
Healthy children, n=50	18,29+0,52	14,46+0,31	0,49+0,002	34,96+1,09	1,72+0,012	0,76+0,014
At admission	9,17+0,30	21,83+0,75	0,112+0,006	22,63+1,14	0,423+0,009	0,423+0,009
a.						
b.	8,42+0,43	22,22+0,91	0,116+0,007	24,5+1,24	0,676+0,06	0,402+0,014
18 th day	11,42+0,29	18,47+0,67	0,201+0,009	27,17+0,96	1,373+0,011	0,580+0,009
a.						
b.	13,08+0,42	16,48+0,71	0,551+0,028	31,86+1,13	1,413+0,012	0,703+0,017
1-3 days after operation	8,13+0,20	22,87+0,46	0,085+0,007	19,17+0,67	1,235+0,021	0,483+0,010
a.						
b.	10,17+0,32	20,17+0,49	0,264+0,012	23,75+0,89	1,34+0,008	0,560+0,023
32 nd day, before discharge	11,29+0,24	18,70+0,49	0,199+0,012	22,04+0,58	1,38+0,012	0,644+0,004
a.						
b.	16,58+0,45	16,22+0,50	0,450+0,025	29,75+0,55	1,79+0,017	0,83+0,021
n=35/46	In serum:					
Healthy children, n=50	53,0+1,39	45,24+0,88	0,244+0,004	24,0+0,51	3,10+0,06	0,508+0,013
At admission	85,0+1,39	22,0+0,69	0,032+0,001	15,0+0,39	0,713+0,013	0,600+0,002
a.						
b.	86,0+0,93	24,0+0,65	0,024+0,002	16,0+2,14	0,371+0,010	0,607+0,013
18 th day	72,29+0,97	29,35+0,64	0,055+0,003	18,29+0,36	1,025+0,034	0,530+0,076
a.						
b.	50,63+3,25	38,43+0,75	0,105+0,009	22,0+0,47	1,730+0,015	0,458+0,013
1-3 days after operation	80,0+4,84	18,52+0,49	0,038+0,003	11,29+0,42	0,82+0,018	0,648+0,008
a.						
b.	63,0+1,056	24,04+0,59	0,065+0,004	17,25+0,37	1,72+0,04	0,630+0,010
32 nd day, before discharge	70,42+0,94	32,22+0,59	0,089+0,020	15,63+0,29	1,031+0,026	0,648+0,008
a.						
b.	51,38+0,69	43,39+0,87	0,201+0,016	24,0+0,40	2,74+0,032	0,550+0,006
n=35/36	Excretion with urine:					
Healthy	34,29+1,08	1,86+0,031	0,080+0,004	4,86+0,33	0,394+0,007	0,153+0,005

children, n=50						
At admission	97,38±3,0	4,71±0,098	0,217±0,011	18,92±0,64	0,075±0,005	0,337±0,001
a.						
b.	104,0±2,31	4,72±0,097	0,202±0,01	20,0±0,65	0,079±0,001	0,331±0,013
18 th day	74,29±2,0	3,25±0,061	0,137±0,009	14,96±0,50	0,257±0,010	0,283±0,006
a.						
b.	50,33±1,43	1,92±0,071	0,117±0,007	12,21±0,62	0,274±0,007	0,225±0,007
1-3 days after operation	86,0±1,39	4,065±0,05	0,205±0,010	22,50±0,56	0,189±0,006	0,454±0,005
a.						
b.	59,0±1,42	3,078±0,05	0,210±0,013	16,04±0,43	0,25±0,009	0,33±0,007
32 nd day, before discharge	58,0±0,81	3,30±0,07	0,188±0,009	14,0±0,44	0,260±0,006	0,319±0,011
a.						
b.	35,0±1,21	1,71±0,04	0,085±0,005	9,08±0,33	0,37±0,004	0,15±0,006

Table 2

Dynamics of MEs in red blood cells, in serum and urinary excretion during exacerbation of Chronic calculous pyelonephritis (CCP) with bilateral (multiple) kidney stones (a-basic, b-metabolite treatment) (X + m)

Durations of the study	ME, mkmol/l					
	Iron	Iron	Iron	Iron	Iron	Iron
n=a/b	34/35	34/35	34/35	34/35	34/35	34/35
In RBC						
At admission	6,61±0,34	31,41±0,59	0,068±0,0008	16,0±0,82	0,628±0,023	0,250±0,009
a.						
b.	7,16±0,36	32,15±0,72	0,065±0,008	15,48±0,82	0,679±0,055	0,251±0,011
18 th day	9,0±0,31	25,0±0,59	0,094±0,006	28,0±0,60	0,982±0,019	0,368±0,007
a.						
b.	12,13±0,40	18,0±0,75	0,120±0,002	23,0±0,60	1,418±0,012	0,553±0,10
1-3 days after operation	6,13±0,25	31,0±0,61	0,064±0,002	16,0±0,62	0,762±0,017	0,248±0,009
a.						
b.	9,38±0,31	21,0±0,067	0,092±0,003	16,0±0,62	1,252±0,0012	0,702±0,012
32 nd day, before discharge	9,0±0,22	24,0±0,40	0,139±0,0014	18,0±0,59	1,61±0,015	0,702±0,012
a.						
b.	13,0±0,29	16,15±0,41	0,177±0,008	25,0±0,59	1,60±0,015	0,767±0,007
n=34/35	In serum:					
At admission	105,0±1,74	16,0±0,81	0,010±0,007	13,0±1,37	0,337±0,010	0,848±0,033
a.						

b.	103,0+1,72	16,0+1,08	0,026+0,001	12,84+1,32	0,371+0,008	0,867+0,029
18 th day	82,17+1,17	20,42+1,04	0,043+0,00012	15,16+0,26	0,968+0,022	0,674+0,026
a.						
b.	73,18+1,52	30,0+1,08	0,026+0,001	19,12+0,76	1,734+0,015	0,547+0,20
1-3 days after operation	96,0+0,77	14,44+0,44	0,0155+0,0012	13,29+0,54	0,575+0,021	1,105+0,040
a.						
b.	85,42+1,12	23,17+0,87	0,0187+0,007	14,62+0,52	0,885+0,013	0,789+0,017
32 nd day, before discharge	81,78+1,08	30,41+0,64	0,130+0,042	15,49+0,54	0,682+0,018	0,828+0,029
a.						
b.	66,33+1,07	41,0+1,03	0,138+0,001	21,49+0,51	2,201+0,028	0,498+0,012
n=34/35	Excretion with urine:					
At admission	111,35+1,57	3,22+0,12	0,292+0,0015	27,0+1,13	0,084+0,001	0,568+0,021
a.						
b.	112,21+1,66	3,48+0,12	0,29+0,009	26,8+1,14	0,079+0,001	0,571+0,022
18 th day	94,26+1,07	2,51+0,09	0,197+0,0026	19,0+0,65	0,171+0,005	0,426+0,018
a.						
b.	73,0+1,49	1,91+0,06	0,173+0,006	14,79+0,42	0,274+0,007	0,295+0,013
1-3 days after operation	100,3+1,29	2,16+0,08	0,239+0,003	22,56+0,59	0,171+0,005	0,588+0,017
a.						
b.	87,21+1,44	2,45+0,05	0,221+0,003	16,14+0,42	0,151+0,014	0,151+0,003
32 nd day, before discharge	84,74+0,80	1,78+0,06	0,189+0,006	14,023+0,33	0,141+0,05	0,425+0,015
a.						
b.	60,21+5,21	1,67+0,03	0,129+0,007	9,013+0,21	0,327+0,007	0,193+0,007

Analysis of data after surgery shows that as a result of surgery, there is a sharp increase in urinary excretion in almost all MEs, especially in the group receiving BT. Therefore, MT allows to some extent stabilize the exchange of ME by the time of surgery and thereby prevent a sharp deterioration in their metabolism, which occurs with basis therapy (BT). Further postoperative treatment, especially in the group treated with MT, leads to a complete

normalization of the level, urinary excretion of iron, copper, cobalt, manganese and selenium.

DISCUSSIONS

Thus, MT is the best way to completely stabilize the level of ME in the body of children suffering from acute KP with single stones, which in turn helps to improve the overall metabolism in the patient's body. In the case of the transition of the acute form of CP to a chronic form and with multiple

kidney stones (MKSs), the detected imbalance of ME increases, which indicates the depth of the pathological process. As can be seen from table 2, in children with CCP in the acute stage with 2-sided multiple stones, there is a strong deficit in the red blood cells of iron, cobalt and zinc, manganese and selenium. Unlike other MEs, the level of copper in red blood cells rises sharply. Chronic deficiency of ME in red blood cells helps to reduce the activity of a number of enzymes involved in cellular metabolism. In this regard, we studied the effect of MT on the state of ME in children with CCP in the acute stage. Carrying out intensive MT allows by the 18th day to significantly increase the level of most ME in red blood cells - iron, cobalt, zinc, manganese. Thanks to MT, the response from the ME to the stressful situation during surgery is not as pronounced as with BT. Further treatment allows to stabilize the level of copper, manganese, selenium in the group receiving MT at the time of discharge. The remaining MEs, despite a significant increase in their content, still do not reach normal values. All this indicates that despite the very good positive effect of MT, for longer normalization of the composition of ME in children with CCP in the acute stage with bilateral MKS, a longer treatment is required.

An analysis of the content of ME in serum in children with CCP in the acute stage shows that with the development of pathology, a sharp imbalance in the content of ME is noted. So, there was a sharp accumulation in the serum of iron and

selenium, at the same time there is a deficiency in the serum of copper, zinc, cobalt and manganese. Unlike the acute form, the ME deficiency in CCP is more pronounced, which indicates the depth of the pathological process. Conducting MT for 18 days contributes to a certain increase in the level of ME in serum, but despite a relative improvement in their value, the control values did not reach. In this regard, after the operation, there was a sharp decrease in the content of ME, both in the group receiving basic treatment and the group receiving MT, which is the body's response to stress during surgery. Continued postoperative treatment, especially in the MT group, showed a marked increase in the levels of copper, zinc, cobalt, manganese and a decrease in iron levels. Of all ME in serum, selenium content was normalized completely after MT. Consequently, the presence of a pronounced effect in MT, compared with the baseline, did not completely eliminate the deficiency of ME in serum. To clarify the question of how much the renal systems involved in the excretion of ME in children suffering from CCP in the acute stage are affected, we studied the dynamics of excretion of ME with urine during treatment.

As can be seen from the data obtained (Table 2), the development of CCP in children was accompanied by a sharp increase in urinary excretion of iron, copper, cobalt, zinc, and selenium. Manganese excretion was sharply reduced. Therefore, the presence of a high level of urinary excretion of most MEs contributes to an

imbalance in the body of children. The use of MT to correct the exchange of ME, already on the 18th day of treatment, leads to a significant decrease in urinary excretion of most ME while normalizing the level of copper. Due to the fact that MT contributes to an improvement in metabolism compared to BT, after surgical intervention in the group treated with MT, the increase in urinary excretion was not as pronounced as in children treated with BT. Continued MT in the postoperative period contributes to a significant improvement in the exchange of ME in children with CCP. So, according to the data at discharge after MT, normalization in the urine of the level of copper and manganese is noted. In relation to other MEs, a significant decrease in urinary excretion levels was observed: iron, cobalt, zinc, zinc and selenium, but despite the intensive MT, the above indicators do not reach normal values.

Thus, metabolic - dietary therapy contributes to a more rapid normalization of microelements. Therefore, the basis of the pathogenesis of CP in children were: a deficiency of vitamins and an imbalance in the microelement composition, which entails a whole cascade of metabolic disorders in carbohydrate, amino acid, and lipid metabolism.

Previous clinical and biochemical studies (Sulaimanov et al, 1990; Utegenov et al, 1989; and Utegenov et al, 1990) revealed deviations in the content of bioelements (iron, copper, cobalt, zinc) and a change in protein-amino acid metabolism (Levitsky, 1990), provision of the body with vitamins

A, E, C, B1, B6 , immunological reactivity (Utegenov et al, 1990), established the pathogenetic relationship of these disorders with the frequency and nature of the violation of membrane phospholipids (Utegenov et al, 1991). Based on the results of clinical, biochemical, bacteriological, functional studies and the study of the salt composition of removed kidney stones, in the treatment of this disease we took into account the entire correction of urostatics, normalization from the main metabolic pathways of the conversion of substances in the body, increased energy supply, lipid and protein synthesis processes.

So, to normalize energy metabolism, and as a plastic material for cells of the tubules of the kidneys and other organs and systems, vitamin and non-vitamin coenzyme preparations, antioxidants, antiplatelet agents, bio-microelements, synthetic amino acid mixtures, native plasma, albumin were used. For these purposes, lipoic acid, calcium pantothenate, riboflavin mononucleotide, pyridoxalphosphate, nicotinamide, tocopherol acetate, trental, chimes, cupir, cobamamide, ferramide, zinc sulfate were also used.

The proposed method of treatment was carried out in 81 patients, of which 46 with single, 35 with multiple kidney stones (the main group receiving metabolic treatment). The comparison group (control-basic treatment) consisted of 69 patients, of whom 35 were single, 34 were multiple kidney stones, with CP (Utegenov et al, 1991).

CONCLUSIONS

Impaired metabolism of ME is one of the causative factors for abnormal metabolism of cellular biocenosis and the formation of kidney stones and urinary tract. By contributing or counteracting the inclusion of microelements in the body tissues in certain biochemical cycles, the course of certain biochemical processes in the cell and the body as a whole can be directed along the desired path. Management of the metabolism of ME contained in the tissues of the body is possible with the help of the so-called claw compounds, which include natural complexing agents of amino acids, vitamins. Only complex metabolic diet therapy before and after removal of calculi from the urinary tract in children with urolithiasis significantly reduces excretion, formation and crystallization of microliths in the urinary tract, and increases urine pH.

STUDY LIMITATIONS

We could not perform sample size calculation for each arm of the study in our research. Thus, further researches may be required with an adequate sample size and with control groups to show more clear and exact results.

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ETHICAL APPROVAL

The ethical approval for the study was granted by the Committee of Ethical Approval for Researches under the Ministry of Health of the Republic of Uzbekistan.

CONSENT

Written informed consent was obtained from all participants' parents of the research for publication of this paper and any accompanying information related to this study. A copy of the written consent is available for review by the authors.

CONFLICT OF INTEREST

The authors declare that they have no competing interests.

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