

Analysis of the Influence of Risk Factors on the Formation of Secondary Oxalate Nephropathies in Children

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Abstract Metabolic disorders nephropathy (MDN) is a large group of kidney diseases with various etiologies and pathogenesis, but combined in that their development is associated with metabolic disorders that can lead to changes in the functional state of the kidneys or structural changes at the level of various structures of the nephron. Statistical variation in the registration of MDN ranges from 27% to 64% in the structure of the incidence of the urinary system in children, and in every day practice of a pediatrician, almost every third patient has a syndrome of metabolic disorders in the urine. We analyzed the influence of risk factors on the formation of secondary oxalate nephropathies in children. Therefore, our results showed that decrease in the volume of fluid consumed, artificial feeding, a violation of the nature of nutrition in children contributes to the formation of calcium oxalate crystalluria and secondary oxalate nephropathy in childhood.

Keywords Metabolic nephropathy, Secondary oxalate nephropathy, Crystalluria, Calcium oxalate crystalluria, Risk factors, Exogenous factors

1. Introduction

Despite significant progress in the development of pediatric nephrology, over the past decade, the problem of kidney disease remains relevant. At the present stage, the issue of the spread of pathology of the urinary system organs and risk factors for its development is debatable. In pediatrics, the problem of the formation of metabolic nephropathy in children is widely discussed [9]. Statistical data show that in the structure of the pathology of the urinary system in the pediatric population, the share of metabolic nephropathy accounts for from 27% to 64% of cases of morbidity [2]. It was found that among metabolic nephropathies, the frequency of occurrence of secondary oxalate nephropathy (SON) associated with impaired oxalic acid metabolism is significantly higher [7] and ranges from 68 to 71% in the crystalluria structure [1]. An excess of the level of oxalate in the urine helps to establish calcium oxalate crystalluria (COC), and a significant increase in plasma oxalate should alert doctors to the development of nephropathy and nephrolithiasis. The spectrum of diseases associated with hyperoxaluria ranges from recurrent kidney stones, nephrocalcinosis and urinary tract infections to chronic kidney disease and end-stage renal disease.

At present, there is a shift in the peak incidence of SON towards an earlier age. In this regard, the question of the risk factors under the influence of which the development of SON is noted is urgent. The factors of exogenous and

endogenous character are distinguished [4]. In our work, we wanted to analyze the factors of an exogenous nature that contributed to the development of COC and SON. The exogenous risk factors include: climatic (dry and hot climate), the composition of drinking water and insufficient drinking regime [13,6], the nature of food [4,5,6,7] including ketogenic nutrition [11].

Considering the above data, in our study we analyzed the impact of exogenous factors on the development of COC and SON in children.

Research material: In order to identify exogenous factors, the analysis of data from 76 children with SON at the age from 6 months to 7 years was carried out. The control group consisted of 30 children of the same age.

2. Research Methods

The following data were taken from the child's outpatient card: age, gender, life history, medical history of the child, frequency of prescribed and taken antibiotic therapy over the last 6 months. Parents of children were questioned for the presence of chronic diseases, the nature and characteristics of the diet of children under 12 months and after, the nature of the volume of fluid consumed during the day. We determined anthropometric indicators (height, weight of the child), and also measured blood pressure (systolic and diastolic), and calculated the mass-to-body index. The diagnosis of oxalate nephropathy was verified on the basis of generally accepted clinical and laboratory tests (complete blood count, urine analysis, urine flow cytometry, urine analysis according to Nechiporenko, determination of

oxalates in daily urine, biochemical blood analysis: determination of total protein, albumin, creatinine, calcium, potassium, phosphorus, magnesium in the blood) and instrumental research methods (ultrasound). All children in the study groups were tested for intestinal microflora. The determination of the daily excretion of oxalates was carried out by the titrimetric method of permanganometry. Hyperoxaluria was an increase in oxalates above 0.5 mg / kg / day.

3. Results and Discussion

Our results showed that in more than 68% of cases in both compared groups, the fact of a decrease in the volume of fluid consumed with some, but not significant excess of the number in the control group of children was established. For the rest of the studied risk factors, significant was observed in the main study group. We identified an imbalance in food consumption, which was noted more often in the main group (43.4%) compared with the control group (26.6%). However, we found excessive consumption of products containing oxalates in both study groups, but to a greater extent in the control group of children (60%) and almost two times less (35.5%) in the main study group. In our research, we also found cases of abuse of products containing artificial colors. In the main group, we established this factor in 15.8% of cases, and in the control group - in 23.3% of cases, i.e. with an insignificant difference.

Table 1. Frequency of exogenous factors in children with COC and SON

Factors	Frequency at SON % (n = 76)	Frequency at % (n = 30)	Final frequency % (n = 106)
Reducing fluid intake	65.8 (50)	76.3 (23)	68.8 (73)
Excessive consumption of oxalate containing foods	35.5 (27)	60 (18)	42.4 (45)
Imbalance in food ingredients	43.4 (33)	26.6 (8)	38.7 (41)
Eating foods containing artificial colors	15.8 (12)	23.3 (7)	17.9 (19)

Despite the fact that violation of the drinking regimen as an exogenous factor was more common in the control group, in our study we compared the level of deficit in the volume of fluid consumed during the day in children in both groups, depending on age, based on the existing body weight.

The analysis of the volume of fluid consumed during the day showed, depending on the age and weight of the child (see Table 2), that the deficit of the received fluid in infants of the main group was 16%, and in the control group - 14%, while in children aged 1 to 3 years in the main group, the deficit of consumed water was 29%, and in the control group - 18%. In children aged 3 to 7 years in the main and control groups, the deficit of consumed water was the same 36%.

Thus, despite the fact that water deficiency was not significantly more often as a risk factor of an exogenous nature for the development of oxaluria was noted in the control group, the degree of water deficiency was significantly more pronounced in oxaluria in children of the main group, i.e. with signs of SON. In turn, a more pronounced decrease in the volume of urine leads to an increase in its concentration, loss of bicarbonates and urinary acidosis, which creates favorable conditions for the onset of crystalluria. Therefore, from a theoretical and practical point of view, the problem of insufficient consumption of the volume of drinking is of considerable interest, and the degree of inadequacy of the drinking regime is considered as one of the main risk factors for the development of SON.

In order to further study the exogenous risk factors for the development and maintenance of hyperoxaluria, we analyzed the nature of nutritional disorders in the studied children. According to a number of authors, the occurrence of metabolic disorders in childhood is influenced by late attachment to the breast, early transfer to mixed or artificial feeding [2,13], which can cause deviations in the health status of children and an increase in the number of nephrological diseases. Therefore, in our study, we analyzed the nature of feeding in infants.

Table 2. Analysis of fluid intake per day in children in the study groups

	Main group	Control group	p- value
6 - 12 months	n = 10	n = 6	
Normal daily volume of fluid (ml / day) (M ± m)	917.60 ± 236.85	1024.00 ± 145.33	0.2843
Volume of consumed liquid (ml / day) (M ± m)	775.00 ± 226.38	883.33 ± 271.42	0.4324
1 - 3 years (2 years 11 months)	n = 29	n = 8	
Normal daily volume of fluid (ml / day) (M ± m)	1198.93 ± 279.67	1134.00 ± 149.47	0.3903
Volume of consumed liquid (ml / day) (M ± m)	932.76 ± 241.75	962.50 ± 302.08	0.8028
3 - 7 years (6 years 11 months)	n = 37	n = 16	
Normal daily volume of fluid (ml / day) (M ± m)	1696.70 ± 392.75	1415.94 ± 290.42	0.006328
Volume of consumed liquid (ml / day) (M ± m)	1247.30 ± 345.40	1037.50 ± 218.71	0.01085
Total	(n = 76)	(n = 30)	
Normal daily volume of fluid (ml / day) (M ± m)	1404.25 ± 447.26	1260 ± 286	0.111
Volume of consumed liquid (ml / day) (M ± m)	1065.13 ± 345.83	987 ± 252	0.261

The study showed (table 3) that in the studied groups the most of the children who were artificially fed (50% and 47%, respectively) were anamnestically identified. At the same time, in the main group there was not a significantly greater number of "artificial" people than in the control group. The same picture was observed in the group with a short period of breastfeeding, when the frequency of the number of children exceeded, but not significantly, in the main group (24% and 20%, respectively). The smallest number in both compared groups was identified as breastfed children (5% and 7%, respectively). It should be noted that in both groups, an equal amount of mixed and natural duration of up to 6 months was found in children in both groups. types of feeding.

Table 3. Comparative characteristics of the types of feeding in children in the first year of life in the studied groups of patients with SON (main) and COC (control)

Type and period of feeding	Main group (n = 76)	Control group (n = 30)	R
Natural throughout the year	4 (5%)	2 (7%)	<0.001
Natural for half a year	6 (8%)	4 (7%)	0.359
Natural for 3 months	18 (24%)	6 (20%)	0.874
Artificial throughout the year	38 (50%)	14 (47%)	0.003
Mixed feeding	10 (13%)	4 (13%)	0.658

Consequently, according to the data of our study, it was found that both in the main (in 74% of cases) and in the control (in 67%) groups, the majority of children were on artificial and natural feeding with a short period of time. These data are consistent with the results of previous studies, indicating that artificial feeding is one of the factors contributing to the emergence and manifestation of oxalate crystalluria [14]. Therefore, our data confirm that artificial feeding is a risk factor for the initiation of hyperoxaluria, but not oxalate nephropathy.

In this regard, we studied nutritional disorders, including excessive use of certain food ingredients and the use of foods rich in oxalates, as an exogenous risk factor in the development of UHI, comparing the results in children of both groups. The comparison was carried out with medical standards for the food set for children (Recommended standards for food consumption in preschool educational institutions, SanPin No. 0348-17 - Hygienic requirements for the organization of high-grade and safe nutrition in preschool educational institutions of the Republic of Uzbekistan). The following set of products was taken into account: meat and fish, milk and milk products, bakery products, vegetables and fruits and their juices, sugar, fat.

Analysis of the nature of food showed (see Table 4) that children aged 1-3 years in the main group consumed 105.3 g of bread products, 35.7 g. cereals and pasta, which corresponded to the normative indicators. Established an increased consumption of sugar - 65.2 grams. at a rate of 50 gr., fruit juices 170 gr. at a rate of 150 gr., potatoes 135 gr at a rate of 120 gr., cocoa products-2 gr. at a rate of 1 gr., confectionery 65 gr. at a rate of 55 gr., fat-65 gr. at a rate of 55 grams. There was an insufficient consumption of such food products as milk and dairy products 250 grams at a rate of 400 grams. Meat, poultry - 45 grams. at a rate of 120 gr, cottage cheese-30 gr. at a rate of 50 g .. Children aged 1-3 years in the main group did not eat fish in the diet.

In children in the main group aged 3-7 years, there was an increased consumption of bakery products - 250 g at the norm of 170 g, cereals and pasta 65 g at the norm of 45 g, sugar 80.7 g at the norm of 60 g, cocoa 5 g at the norm 2 gr, potatoes-225 gr at a rate of 150 gr, fruit juices and fortified drinks 300 gr at a rate of 150 gr., Confectionery 35 gr at a rate of 15 gr, fat 78 gr at a rate of 68 gr. Insufficient consumption of meat products was noted - 75 g at the norm of 150 g, fish - 20 g at the norm of 40 g.

Table 4. Comparative characteristics of food consumption of children in study groups (g / day) depending on age

Product group	Actual consumption		Medical standards	Actual consumption		Medical standards
	Main group children from 1 to 3 years old (n = 29)	Control group Children from 1 to 3 years old (n = 8)		Main group Children from 3 years old to 7 years old (n = 37)	Control group Children from 3 years old to 7 years old (n = 16)	
Bread products	105.3	121.4	100	250	197.4	170
Cereals, pasta	35,7	30.7	35	65	85.5	45
Sugar	65.2	55.5	50	80.7	75.5	60
Milk, fermented milk	250	320	400	450	354	400
Cottage cheese	thirty	42	50	45	50	50
Meat, poultry	45	65	120	75	100	150
A fish	0	0	25	20	15	40
Juices, Fortified drinks	170	185	150	300	250	150
Potatoes	135	140	120	225	235	150
Cocoa	2	3	1	5	10	2
Confectionery flour products	25	30	10	35	50	15
Fat	65	70	55	78	100	68

In the control group at the age of 1-3 years and 3-7 years, an increased consumption of bakery products, sugar, fruit juices, confectionery, potatoes, cocoa, confectionery and fats was also noted.

From the presented results it can be seen that in the diet of children in both study groups, regardless of age, a general pattern can be traced: the lack of meat products, dairy products. But in children aged 3 to 7 years in both groups, an excessive consumption of fruits (in most cases in the form of boxed fruit juices), baked goods, pasta, sugar, fat, cocoa, and potatoes (mainly due to fried) was found. Further analysis of the data showed that children aged 3 to 7 years in both study groups consumed juices more than normal. Recent Research Getting JE. et al. [6] prove that excessive consumption of fruit juices leads to the development of secondary oxalate nephropathy.

4. Conclusions

Analyzing the data, we came to the conclusion that a pronounced decrease in urine volume due to a decrease in the volume of fluid consumed leads to an increase in its concentration, as a result of which favorable conditions are created for the occurrence of COC. Artificial feeding is one of the risk factors for the initiation of COC, but not oxalate nephropathy. It was found that a violation of the nature of nutrition in children contributes to the formation of COC and SON.

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