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# DIAGNOSTICS AND DYNAMIC OBSERVATION OF CONGENITAL MALFORMATIONS OF THE URINARY SYSTEM ORGANS IN FIRST-YEAR CHILDREN

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**Introduction.** Congenital malformations of the urinary system occupy a leading place in the progression of children chronic kidney disease. Therefore, the purpose of our study was to monitor the abnormalities of children kidney defects and to determine the tactics of managing patients with obstructive malformations in a polyclinic. **Materials and methods.** We analyzed the data of 126 children medical records for the period from 2014 to 2020, in whom ultrasound changes in the kidneys and urinary tract was detected in the first month of life. Obstructive variants of renal defects was recorded in 102 (80.95 ± 3.50 %) children. Depending on the presence of urinary syndrome. Children with obstructive defects were ranked into two groups: Cohort I included 30 (29.41 ± 4.51%) children with kidney anomalies in whom a urinary tract infection was registered, and Cohort II included 72 (70.59 ± 4.51 %) a child with kidney abnormalities without changes in urine tests. **Results.** Pyelectasias prevail in the structure of kidney anomalies in infants – in 65.08 ± 4.25% of cases, which disappear spontaneously in 68.63 ± 4.59 %. The negative echographic dynamics of defects was significantly more often recorded in children with the addition of urinary tract infections ($\chi 2 = 5.47$, with $p = 0.01$). For children with obstructive variants of kidney anomalies, early accession of urinary tract infection is characteristic – at 6 months with a frequency of exacerbation 2 times a year. Conclusions. If pyeloectasia is detected at the age of 1 month, it is necessary to conduct a sonographic study in dynamics at 3 and 12 months, and at 6 months – to prescribe a general urinalysis and bacteriological examination of urine

**Keywords:** infants, congenital malformations of the urinary system, urinary tract infection, ultrasound diagnostics, pyeloectasia.

**Introduction.** Despite the significant advances in modern medicine in the diagnosis of diseases, the problem of congenital malformations does not lose its importance [4,13]. The most common types of defects include congenital anomalies of the kidney and urinary tract (CAKUT), which accounts 20 to 50% of all reported cases [5,10,11]. It is well known that congenital malformations of CHI are the cause of chronic kidney disease (CKD) and end stage renal failure (ESRD) in children, affecting their growth, development and socialization [5,10,11]. Accession of urinary tract infection (UTI) in patients with structural abnormalities of the CAKUT leads to earlier scarring and thinning of the renal parenchyma and, as a consequence, a decrease in glomerular and tubular renal function [5,8].

The method of ultrasound prenatal diagnostics allows to prevent the birth of children with uncorrected malformations, to detect kidney anomalies in the early stages of the disease, but its effectiveness, according to various sources, ranges from 0.6 to 14% [7,8]. Therefore, in the Russian Federation, in the first month of life, all children undergo a planned ultrasound examination of the kidneys, which makes it possible to diagnose CAKUT that have not been verified in the antenatal period. For example, when conducting mass neonatal screening in the Chuvash Republic, it was found that the share of CAKUT not detected at the stages of prenatal diagnosis is 15.5% among the entire child population of the region [9]. According to Vito Antonio Caiulo et al (2012), as a result of mass postnatal screening of 17,783 infants carried out over eighteen years, the proportion of congenital malformations of the kidneys was 0.96% [12]. Yinv Gong et al (2018), during an ultrasound examination of 12,350 newborns over five years, diagnosed CAKUT in 1180 (13.4%) people [10]. It should be noted that today there is no unified approach to interpreting the results of sonograms in relation to the size of the pyelocaliceal system (PCS) in children. Most of the studies are devoted to the postnatal management of children with prenatally diagnosed variants of kidney and urinary tract defects, but there is practically no work on assessing the dilatation of the pyelocaliceal system, if abnormalities of the pyelocaliceal system were detected in the first months of a child's life during routine examination [7,8]. Therefore, the purpose of our study was to monitor congenital kidney defects in children and determine the tactics of managing patients with obstructive malformations in a polyclinic.

**Materials and research methods.** An analysis of 1256 outpatient medical records (form No. 112 / y) were carried out among the clinics of Vladivostok for the period from 2014 to 2020, of which 126 (10%) children at the age of 1 month during the first screening examination revealed ultrasound changes in the kidneys and urinary tract. 65 girls (51.59 ± 4.45%) and 61 boys (48.41 ± 4.45%) took part in the work, and then all children were followed–up until they reached one year of age. All patients underwent a standard clinical and laboratory examination, and underwent ultrasound diagnostics at the age of 1, 3, 6 and 12 months. Statistical processing was carried out using the Statistica version 10.0 software. The assessment of the significance of the factors was carried out using X2 Pearson. Differences were considered statistically significant at $p < 0.05$.

**Results and its discussion.** In children with congenital anomalies of the kidney and urinary tract, pyeloectasias prevailed, which were registered in 82 (65.08 ± 4.25%) children, in second place was hydronephrosis – in 15 (11.90 %) children; pyelocaliceal system (PCS) – in 9 (7.14 %), hydrocalicosis – in 5 (3.97%), vesicoureteral reflux (VUR) – in 5 (3.97 %), renal hypoplasia – in 3 (2.4%), renal agenesis – in 2 (1.59 %), in isolated cases such pathologies as: horseshoe kidney, polycystic kidney disease, lumbar

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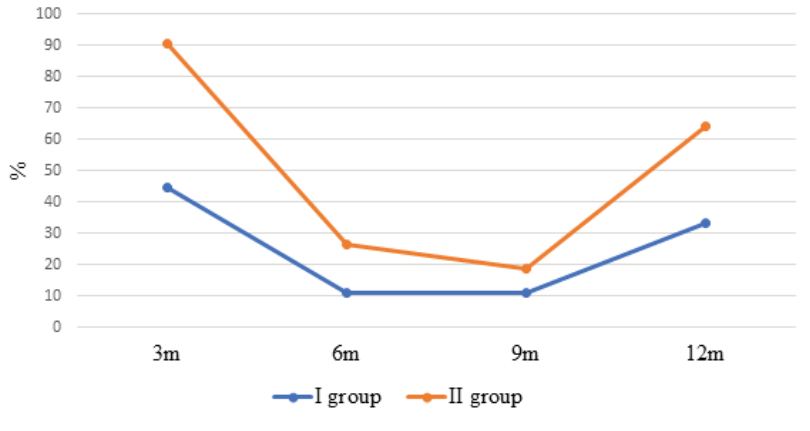
dystopia, combination of iliac dystopia and hypoplasia of the kidney, a combination of hydronephrosis and kidney cysts (0.79 %). In 7 (5.56 %) children, renal and urinary tract anomalies were diagnosed in the antenatal period: of these, pyelectasis was detected in 2 cases, renal hydronephrosis also in two children, in one case – iliac dystopia with hypoplasia of the left kidney and polycystic kidney disease.

Congenital anomalies of the kidney and urinary tract were combined with minor cardiac anomalies (opened oval window, Eustachian valve of the inferior vena cava, additional chord of the left ventricle) in 21 (41.18 ± 6.89%) children, with pathology of the hepatobiliary tract (deformation of the biliary bladder, kink of the gallbladder) – in 17 (33.33 ± 6.60%), with orthopedic pathology (torticollis, varus or valgus deformity of the feet) – in 7 (13.73%), with umbilical hernias – in 6 (11.76%).

Obstructive variants of kidney defects in the form of pyeloectasia, hydronephrosis and hydrocalicosis were recorded in 102 (80.95 ± 3.50%) cases. Depending on the presence of urinary syndrome, they were ranked into two groups: cohort I included 30 (29.41 ± 4.51%) children with UTI combined with renal abnormalities, and cohort II included 72 (70.59 ± 4, 51%) of a child with kidney abnormalities without changes in urine tests. In the group of children with UTI against the background of congenital malformations, girls were significantly more often recorded than in the second (70.00 ± 8.31% and 38.89 ± 5.75%, respectively, $\chi 2$ = 8.211, with p = 0.0042), which agrees with the literature data – the risks of developing UTI against the background of the CAKUT are 30% higher in girls and in children with grade 3–4 hydronephrosis [8,14]. In the first cohort, the mean age of UTI manifest was 6.17 ± 0.67 months, and the frequency of exacerbations was 2.07 ± 0.28 times per year of observation. Pathogenic microorganisms were isolated in 10 (33.33%) children in bacteriological analysis of urine, in 70% of cases uropathogens of the Enterobacteriaceae family were found.




Dynamics of spontaneous resolution of CHS dilatation in children with congenital malformations of OMS according to echographic examination data

Of great importance in the obstructive uropathy diagnosis in children during the first months of life is the determination of the dilatation of the PCS; in the works of various authors, the size of the pelvis is considered to be from 0.2 to 0.7 cm [1,6]. In group I, the sizes of the PCS of the right and left kidney during ultrasound diagnosis of pyeloectasias did not differ statistically and were determined in the range – 0.51 ± 0.04 cm and 0.52 ± 0.03 cm, respectively (p> 0.05), and in children with hydronephrosis recorded a more significant dilatation of the pelvis on the left than on the right – 1.35 ± 0.17 cm

**Table 1**

**Sizes of the kidneys in group I, depending on the age of the child, (M ± m)**

| Age, months | Right kidney | | | Left kidney | | | p |
|---|---|---|---|---|---|---|---|
| | Length, sm | Width, sm | Parenchyma thickness, mm | Length, sm | Width, sm | Parenchyma thickness, mm | |
| 1 | 4.44±0.12 | 2.16±0.03 | 9.76± 0.12 | 4.67±0.12 | 2.2±0.06 | 9.61± 0.13 | >0.05 |
| 3 | 5.19± 0.08 | 2.51±0.07 | 10.15±0.19 | 5.43± 0.13 | 2.54± .08 | 10.04±0.26 | >0.05 |
| 6 | 5.51 ± 0.11 | 2.61± 0.05 | 10.2 ± 0.19 | 5.79± 0.14 | 2.62±0.06 | 10 ± 0.22 | >0.05 |
| 9 | 5.94 ± 0.19 | 2.61± 0.08 | 10.71± 0.18 | 5.98± 0.24 | 2.64± 0.12 | 10.5 ± 0.22 | >0.05 |
| 12 | 6.29 ± 0.14 | 2.75± 0.07 | 10.96± 0.18 | 6.5 ± 0.14 | 2.8 ± 0.08 | 11.14 ± 0.2 | >0.05 |

**Table 2**

**Sizes of the kidneys in group II, depending on the age of the child, (M ± m)**

| Age, months | Right kidney | | | Left kidney | | | p |
|---|---|---|---|---|---|---|---|
| | Length, sm | Width, sm | Parenchyma thickness, mm | Length, sm | Width, sm | Parenchyma thickness, mm | |
| 1 | 4.37±0.06 | 2.09±0.02 | 9.49 ± 0.09 | 4.54±0.07 | 2.11±0.02 | 9.53 ± 0.09 | >0.05 |
| 3 | 4.91±0.06 | 2.28±0.02 | 10.02±0.06 | 4.97±0.07 | 2.33±0.04 | 10.03± 0.06 | >0.05 |
| 6 | 5.61±0.09 | 2.43±0.04 | 10.16±0.14 | 5.63±0.09 | 2.43±0.04 | 10.23±0.14 | >0.05 |
| 9 | 6.24±0.29 | 2.81±0.13 | 10.86±0.26 | 6.26±0.31 | 2.8±0.13 | 10.86 ± 0.26 | >0.05 |
| 12 | 6.33±0.09 | 2.83±0.04 | 11.03±0.13 | 6.45±0.11 | 2.83±0.04 | 11.12± 0.12 | >0.05 |

and 0.78 ± 0.1 cm, respectively, with p = 0.0233. In group II, the size of the PCS with pyeloectasia on the right averaged 0.51 ± 0.04 cm, and on the left – 0.57 ± 0.02 cm, which does not statistically differ from the data in patients of the first cohort (p> 0.05). In hydronephrosis in children with CAKUT without UTI attachment, the average sizes of the pelvis of the right and left kidney were determined at the level of 0.54 ± 0.03 cm and 0.9 ± 0.1 cm, respectively (p> 0.05). It is noteworthy that the expansion of the PCS in children with UTI against the background of hydronephrosis on the right and on the left was more significant than in patients of group II (p <0.05).

Most experts are of the opinion that in 50% of cases, hydronephrosis detected at the stages of prenatal diagnosis can independently resolve by one year of life [7,8]. In our study, spontaneous regression of enlarged renal PCS according to the results of sonograms in group I was observed in 18 (60%) children, of which: after 3 months in 8 (44.45%), after 6 months – in 2 (11.11 %), after 9 months – in 2 (11.11%) observed patients, by 12 months – in 6 (33.33%) (Pic. 1). No dynamics was revealed in 5 (16.7%) children, negative echographic changes were recorded in 7 (23.3%) patients, as a result of which 4 children underwent surgical treatment. In the second group, the regression of PCS expansion was documented in 52 (72.2%) children, of which: after 3 months in 24 (46.1%) children, after 6 months – in 8 (15.4%), after 9 months – in 4 (7.7%) patients, by 12 months – in 16 (30.8%). In 15 (20.8%) children, no dynamic changes were noted throughout the observation period, and in 5 (7%) patients, negative dynamics was documented by 12 months of age.

According to the literature, the presence of recurrent UTIs can adversely affect the functional state of the renal parenchyma in children with congenital anomalies of the kidney and urinary tract and increase the need for surgical treatment [5,8], which is also confirmed by the data of our study – in the group of UTIs with a combination of concurrent malformations, more negative dynamics than in the comparison group ($\chi 2 = 5.47$, with a significance level of p = 0.01), and pyeloureteroplasty was indicated for children only from cohort I. When ultrasound examination of the kidneys state, it is necessary to assess not only the expansion of the PCS, but also the length, width, and thickness of the renal parenchyma [2,3,8]. We analyzed the ratio of sizes between the right and left kidneys in the study groups. 4 children were excluded from the first cohort, because due to negative echographic dynamics (PCS more than 25 mm), the children underwent pyeloureteroplasty. The results of the study showed that in both groups there was no significant difference when comparing sizes of the right and left kidneys (Tables 1 and 2).

It is believed that the thickness of the parenchyma in children during the first six months of life is in the range of 8–11 mm, from six to twelve months – 9–12 mm [2]. In our study, according to the results of sonograms, in patients of both groups, the parenchyma thickness corresponded to age norms.

**Conclusions**

1. In the structure of the kidneys and urinary tract anomalies in infants, pyelectasias prevail in 65.08 ± 4.25% of cases (with an average dilatation of the PCS of 0.5 cm).

2. Spontaneous regression of the expansion of the PCS is characteristic of 68.63 ± 4.59% of the subjects.

3. Negative echographic dynamics is reliably more often recorded when UTI is attached ($\chi 2 = 5.47$, with a significance level of p = 0.01)

4. For children with CAKUT early addition of UTI is characterized – at 6 months with a frequency of exacerbation 2 times a year.

5. In the presence of an obstructive type of kidney anomalies, it is necessary to carry out a dynamic sonographic study at 3 and 12 months of life, and at 6 months – to prescribe a general urine analysis and a bacteriological study of urine.

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