

Histomorphological changes in the wall of the pyeloureteral segment in young children

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Abstract: Purpose of the study. To study histomorphological changes in the wall of the pyeloureteral segment in infants early age.

Materials and Methods. The data of the results of comprehensive examination and surgical treatment of children aged from 1 month to 3 years who were treated in the urology department of the clinic of the Tashkent Pediatric Medical Institute (Tashkent Pediatric Medical Institute) and in the Training and Methodological Centre of Neonatal Surgery at the Republican Perinatal Centre (RPC) from 2014 to 2022 served as the material for the study. A retrospective and prospective analysis of clinical materials concerning the diagnosis and treatment of 131 children was performed. Among the patients, right-sided hydronephrosis was detected in 49 (37.4%) patients, left-sided obstruction in 73(55.7%) children, and 9 (6.9%) cases had bilateral lesions.

Results. When analysing the characteristics of ureteral structural changes in age groups, it was found that in the group of children older than 1 year of age, the number of reversible and irreversible structural abnormalities did not differ significantly. In the age group of children under 1 year of age, the differences in the frequency of reversible and irreversible ureteral structural changes were statistically significant.

Keywords: Hydronephrosis, children, pyeloureteral segment.

Introduction: Malformations of the genitourinary organs account for 15-45% of all ano- genital malformations of embryonic development. In this case, hydronephrosis due to obstruction of the pyeloureteral segment (PUS) obstruction is the most frequent cause of plastic surgery on the upper urinary tract in children.

According to the literature, the prevalence of PUS obstruction ranges from 2-6 cases per 1000 newborns [1,2,14,18]. According to retrospective studies, antenatal detection of upper urinary tract dilatation is 1:500, but the actual number of surgeries for PUS obstruction remains relatively at the level of 1:1250-1500 live births [8,16,17]. Analysis of the data on morphological abnormalities in the PUS area in hydronephrosis shows that dysplastic changes in the smooth muscle structures of the ureter wall, excessive collagen accumulation in the intermuscular spaces, depletion of innervation in the PUS area, increased leiomyocyte apoptosis, impaired differentiation of the uroepithelium, and various changes in the extracellular matrix are accurately established. However, to date, there is no consensus on the etiology and pathogenesis of morphological changes in the PUS [14,16,17]. In the available literature, there are few studies on the normal morphological picture of the pelvis and ureteric duct in children under one year of age [4,12,14] and in adults (over 18 years of age) [3,7,15].

However, the results of most studies do not characterise in detail the structural changes at the early stages of postnatal ontogenesis and are mainly devoted to, predicting the results of plastic surgeries for obstruction of the pyelo-ureteral segment [9,10,11,18]. Thus, the lack of unified criteria for the indication for one or another type of treatment of congenital hydronephrosis in infants is the reason for contradictory and hardly comparable data.

Purpose of the study was to investigate histomorphological changes in the wall of the pyeloureteral segment in young children.

METHODS

The material for the study was the data of the results of comprehensive examination and surgical treatment of 131 children aged from 1 month to 3 years who were under treatment from 2014 to 2022.

Among the patients, right-sided hydronephrosis was detected in 49 (37.4%) patients, and left-sided obstruction in 73 (37.4%) patients.

left-sided obstruction in 73 (55.7%) children, and 9 (6.9%) cases had bilateral lesions.

lesion. The age of the operated patients ranged from 1 month to 3 years and averaged 10.06 ± 0.3 months. In the distribution of patients by sex, there was a predominance of boys - 100 (76.3%), compared to girls - 31 (23%), both in the total sample and in each age group separately.

Patients older than 3 months were hospitalised at the TashPMI clinic, where the whole spectrum of radiourological examination, including

ultrasonography, excretory urography, micturition cystography, multispiral computed tomography, and clinical and laboratory investigations.

For radioisotope renoscintigraphy, children were referred to the nuclear medicine department of the Republican Specialised Nuclear Medicine Department of the Republican Specialised Scientific and Practical Medical Centre of Endocrinology.

Due to the routine use of ultrasound screening of pregnant women, 71 (54%) fetuses had renal cavity dilation detected antenatally at 26 to 32 weeks gestational age.

All patients underwent a comprehensive examination, which included clinical and laboratory diagnostic methods, radiology, and radiotherapy, laboratory diagnostic methods, radiation, radioisotope, morphological and histological methods of investigation.

In determining the severity of obstruction of the pyelo-urethral segment (PUS), we used the classification proposed by the Society for Foetal Urology, according to which five degrees of congenital hydronephrosis are distinguished. In this case, the 0 degree - unchanged collecting system of the kidney, the 1 degree - moderate enlargement of the central renal complex, the 2 degree - enlargement of the lobule without calicoectasia, the 3 degree - enlargement of the whole PUS without parenchyma atrophy and the 4 degree - significant enlargement of the PUS with renal parenchyma atrophy.

Pathomorphological study of biopsy specimens of the pelvic wall and pelvic-ureteric segment was carried out for the purpose of pathomorphological examination was performed to study the structural changes of the affected parts of the upper urinary tract. The ureter with the area of narrowing was additionally dissected longitudinally to study tissue relationships and to determine the degree of deformation. The material was then washed in running water (24 hours), dehydrated in alcohols of increasing concentration (50o to 100o), and embedded in paraffin. Sections 5-6 μm thick were made on a sledge microtome.

Ultrastructural elements of muscle and connective tissue of biopsy specimens were studied by electron microscopy. General dysplastic and structural changes of the resected part of the pelvis and the ureteral lobule were analysed. The morphological study was carried out in two stages. At the first stage, the whole thickness of the biopsy specimen, each of the constituent layers (mucosa with submucosa, muscular) was analysed on the basis of sections stained with hematoxylin and eosin of the deformed part of the ureter. At the second stage, the volume ratio of connective and muscular tissues was

determined on the slices stained according to the Van-Gizon method. Van-Gizon staining is widely used, because it gives unequal staining of different tissues and allows to distinguish smooth muscle tissue from connective tissue in the studied pyeloureteral segment.

RESULTS AND DISCUSSION

The structural and functional state of the upper urinary tract under normal conditions is characterised by the following features: the epithelium lining it is multilayered. Cubic shaped cells are located on the well-defined basal membrane, the following 3-4 layers are formed by cells of different shapes - rounded cells of different shapes - rounded, oval, spindle-shaped. On the surface of the urinary tract they are flattened and elongated. Under the epithelium there is loose connective tissue with moderate amount of blood capillaries. Fibroblasts and fibrocytes are single, may be detected near the basal membrane along the epithelium. Collagen and elastic fibres are arranged without a definite orientation. The muscular sheath consists of two layers: a longitudinal oblique layer and an outer circular layer. It is characteristic that in the pyelourethral section, bundles of smooth muscle fibres and cells are accompanied by a large number of nerve fibres, which form numerous plaques on the surface of the cells.

of the cells. Between the bundles of smooth muscle cells, the connective tissue layers are thin, contain blood and blood vessels are thin and contain blood capillaries forming a network-like framework. Large bundles of smooth muscle cells around have a more pronounced connective tissue sheath, where arteries are revealed. sheath, where arterial vessels of larger

diameter are identified. The outer adventitial sheath is rich in vessels of different calibre and type, contains many alipocytes, adventitial and other connective tissue cells.

On morphological examination in the area of narrowing of the pyeloureteral segment the structure is polymorphic. It should be noted that all layers of the ureter are involved in the process. At the same time, various degrees of PUS structure disorders are detected, from urothelium hypertrophy to total overgrowth of connective tissue. Along with this, in some cases, predominance of intermuscular tissue layers with epithelium hypertrophy can be noted. In some cases, epithelium and muscle layer may be absent, then a sclerosed area consisting of thickened dense connective tissue with coarse bundles of collagen fibres oriented longitudinally near the lumen, and deeper - in different directions is revealed.

The results of morphological studies performed in 33 children under 3 years of age with ureteral stenosis are presented in Table 1.

Histomorphological 10 changes in the PUS wall in children with ureteral stenosis

In some cases, the epithelium and muscle layer may be absent, then a sclerosed area consisting of thickened dense connective tissue with coarse bundles of collagen fibres oriented longitudinally near the lumen, and deeper in different directions is revealed. Morphological studies performed in 33 children under 3 years of age with ureteral stenosis showed the following spectrum of changes in its structure and are presented in Table 1.

Table 1
Histomorphological 10 changes in the PUS wall in children with ureteral stenosis ureter

| Age | Myocyte hypertrophy, hypertrophy of mucosa | Total fibrosis |
|-----------------------------|--|----------------|
| Up to 1 year (n=19) | 16 | 3 |
| Up to 3 years (n=14) 9 5 | 9 | 5 |
| Total | 25 | 8 |

Hypertrophy of muscle fibres with thickening of the mucosal layer was found in 14 cases

(Fig. 1) and in 11 biopsy specimens the cause of

obstruction was hypertrophy of urothelium, reducing the the ureteral lumen. Diffuse increase of collagen fibres was found in 8 ureters (Figure 2).

Total number of ureters with preserved structure (hypertrophy of myocytes or mucosa).

myocytes or mucosa - 25 ureters) significantly exceeded the number of ureters with deep destructive changes of all layers - 8 ureters. The frequency of PUS obstruction as a result of tissue changes, which may

well be reversible, was significantly higher than the frequency of structural disorders, which were irreversible in nature (Table 2).

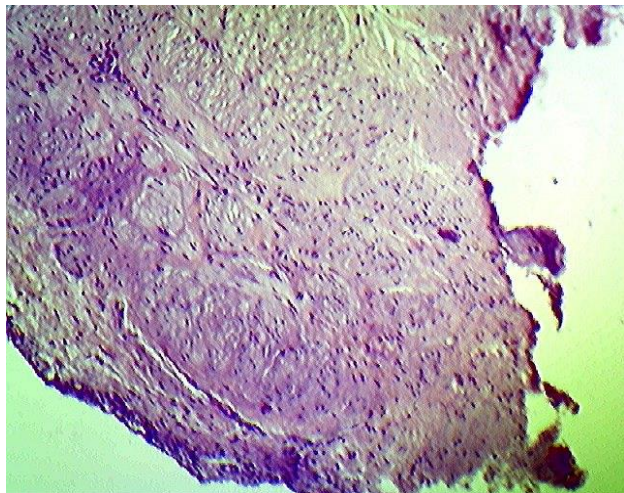


Figure 1. Hypertrophy of myocytes. Colouring haematoxylin and eosin, magnification 100

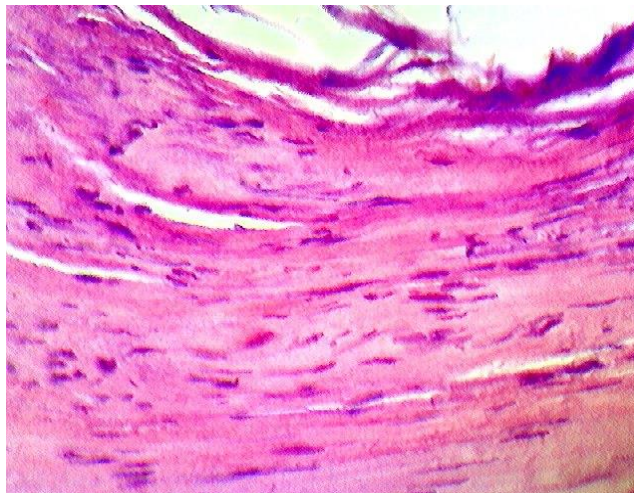


Fig. 2. Diffuse distribution connective tissue with reduction number of myocytes. Van-Gizon, magnification 400.

Table 2

Differences between the frequencies of tissue pathology in the group of children depending on age

| Indicators | Category | n | Observed frequencies | Verifiable frequencies | p |
|-------------------|----------|----|----------------------|------------------------|-------|
| Fibrosis | 1 | 8 | 0,25 | | |
| Not fibrosis | 0 | 25 | 0,75 | 0,5 | 0,014 |
| Older than 1 year | | | | | |
| Fibrosis | 0 | 5 | 0,35 | 0,50 | 0,7 |
| Not fibrosis | 1 | 9 | 0,64 | | |
| До 1 года | | | | | |
| Fibrosis | 0 | 3 | 0,15 | 0,50 | 0,007 |
| Not fibrosis | 1 | 16 | 0,85 | | |

CONCLUSION

Thus, when analysing the characteristics of structural changes of the ureter in age groups, it was found that in the group of children older than 1 year of age, the number of reversible and irreversible structural abnormalities did not differ significantly. In the age group of children under one year of age, the differences in the frequency of reversible and irreversible ureteral structural changes were statistically significant.

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