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Treatment of primary obstructive megaureter in children using minimally invasive technologies

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Abstract

Introduction. The final formation of the child's functional systems completed during postnatal ontogeny. To create optimal conditions for the functioning of the body is necessary either to decrease the level of functional requirements to the immature system, or the creation of new operating conditions under which the extended maturation time factor.

Relevance. Currently, the most common treatment for obstructive uropathies is surgical treatment. To create optimal conditions for the functioning of the body, it is necessary either to reduce the level of requirements for an immature functional system, or to create new functioning conditions under which the ripening time factor is extended.

Objective: Rationale and introduction of minimally invasive endoscopic draining techniques aimed at restoring urodynamics by using a PVC intraluminal drainage (stent).

Materials and methods. The possibility of stenting with determination of the size of the ureteric orifice was investigated. The study involved 32 children aged from birth to three years. A retrospective analysis of previously treated 41 patients with obstructive ureterohydronephrosis was performed.

Results. The study found that the optimal age for endoscopic correction of the intramural ureter is up to 3 months of life, when telescopic bougienage with dilation of the

intramural compartment of the compromised ureter can be performed with calibration of the ureteric orifice and stent of the ureter with a corresponding stent.

Retrospective analysis of previously treated patients allowed us to determine the same dependence. Thus, out of 41 patients with obstructive ureterohydronephrosis positive result was achieved in 29 children (70.73%) up to 1 year and 6 (14.63%) over 1 year. The impossibility of performing endoscopic correction of the orifice and stenting of the ureters in the age group up to 1 year was noted only in 1 patient (2.43%), whereas in the group from 1 year to 3 years - in 5 patients (12.19%).

Conclusions. The proposed tactics of treatment of obstructive uropathy in children has advantages in terms of open surgical techniques in the technical simplicity, minimally invasive, maximum physiological, reducing the incidence of postoperative complications. It should be remembered that the effectiveness of endoscopic stenting of the lower parts of the ureter depends on the age of the child.

Key words heterochrony, ureterohydronephrosis, stenting, ureter, children, urodynamics.

Introduction. At all stages of child development, we are faced with phenomena of heterochrony, which can manifest itself in the form of acceleration or retardation, and the more intense the smaller the child's age. The final formation of the functional systems is completed during postnatal ontogenesis [1].

In relation to the pathology of the lower urinary tract, in particular to obstructive ureterohydronephrosis, this is more than relevant. Therefore, to create optimal conditions for the functioning of the body is necessary either to decrease the level of functional requirements to the immature system, or the creation of new operating conditions under which the extended maturation time factor. Since this malformation in many situations is marked disparity of growth and maturation of dysfunction of the lower ureter, which due to lack of diagnostic facilities taken for neuromuscular dysplasia, which entails a series of pathogenetically unfounded, sometimes mutilating surgical interventions [2].

Relevance. Currently, the most common treatment for obstructive uropathies is surgical treatment, the timing and extent of which depends on the degree and severity of impaired urodynamics of kidney function and the manifestation of the infectious process [3].

Palliative surgical methods such as nephrostomy, ureterostomy and their various modifications suggest rather invasive shutdowns of the underlying urinary tract from urodynamics. As a result, in addition to high invasiveness, scarring, and the risk of complications, we expose maturing lower urinary tract temporary dysfunctions, which negatively affects their further development [4].

A promising alternative to open surgical treatment of obstructive megaureter is endoscopic stenting of the ureter, based on an assessment of the phenomena of growth imbalances and dysfunction, tissue and maturation of the urinary system, such as the principle of heterochrony development, leading to clinically significant improvement in urodynamics of the upper urinary tract and increase the renal parenchyma with any degree of expansion of the ureter [5,6,7].

Objective: Rationale and introduction of minimally invasive endoscopic draining techniques aimed at restoring urodynamics by using a PVC intraluminal drainage (stent), which are minimally invasive, do not violate the anatomophysiological integrity of tissues, and ensure rapid restoration of urodynamics with respect to open surgical interventions.

Materials and methods.

Since 2015, we have revised the approach to the age of patients who underwent endoscopic interventions. This was primarily due to the impossibility in a significant number of cases of recanalization of the intramural ureter at an older age due to the complete closure of its lumen [8].

The operation procedure was as follows. Cystoscopy was performed with a KARL STORZ cystoscope. With a physiological solution of sodium chloride, the bladder was filled up to the age value by catheter. The condition of ureteric orifices was assessed. A conductor with a diameter of 1 mm was introduced into the stenosed ureteric orifice. A Fogarty 4,5Fr catheter was passed through the stenotic portion of the ureter so that its balloon was located in the stenotic portion of the ureter. The balloon was inflated, and thus having obtained the dilatation of the stenotic area of the ureter, the latter was stented with stents from 4Fr to 6Fr. In those cases where it was not possible to hold the Fogarty catheter through stenotic ureter, carried telescopic probing ureteral catheter with an increase in their diameter. Stent held 1-4 months.

We were convinced that the earlier an attempt is made to endoscopic drainage, the more often we have a good result in the form of successful stenting and prognosis for restoration of ureter function. Since 2013, we conducted a study of the possibility of stenting with determining the size of ureteric orifice. 32 children from the age of three to three years old were examined. A retrospective analysis of 41 previously treated patients with obstructive ureterohydronephrosis was performed. [9].

Testing of statistical hypotheses about the difference between the average dependent samples was performed using Student's t-test in the application package «Statistica 6.0 for Windows» (StatSoft Inc., № AXXR712D833214FAN5).

Results.

Since 2013, we conducted a study of the possibility of stenting with the definition of the ureteral orifice sizes. The results are shown in table 1.

Table 1. The number of children of different age groups depending on the size of the intramural ureter. (intraoperatively).

Age	Dimensions of the intramural ureter (millimeters)		
	2 mm	1 mm	0 mm
0-1 months (n=7)	5 (15,625%)	2 (6,25%)	0
1-3 months (n=8)	5 (15,625%)	2 (6,25%)	1 (3,125)
3 months - 1 year (n=8)	3 (9,375%)	2 (6,25%)	3 (9,375%)
1-3 years (n=9)	2 (6,25%)	3 (9,375%)	4 (12,5%)
Total	15 (46,875%)	9 (28,125%)	8 (25%)

where «n» is the number of children, «0» is the impossibility of recanalization and bougienage.

Based on the identity of the indicators, children were combined into two groups: 0 - 3 months and 3 months - 1 year. The hypothesis of the presence of differences in the average dependent samples was tested using the Mann-Whitney test. Authentic significant difference between these two groups, $p < 0.05$.

One of the reasons for the impossibility of recanalization is morphological changes in the ureter wall of the post-inflammatory nature against the background of the primary relative violation of urodynamics. As can be seen from the table, the most optimal age for endoscopic correction of the intramural ureter is up to 3 months of life, when telescopic tugging with

balloon or frame dilatation of the intramural ureter with calibration of the mouth and stenting of the ureter with an appropriate stent can be performed with great effect.

Retrospective analysis of previously treated patients allowed us to determine the same dependence. Thus, out of 41 patients with obstructive ureterohydronephrosis positive result was achieved in 29 children (70.73%) up to 1 year and 6 (14.63%) over 1 year. The impossibility of performing endoscopic correction of the orifice and stenting of the ureters in the age group up to 1 year was noted only in 1 patient (2.43%), whereas in the group from 1 year to 3 years - in 5 patients (12.19%).

Discussion.

With obstructive ureterohydronephrosis, in many situations there is a growth imbalance and dysfunction of the maturation of the lower parts of the ureters, which, due to the inability to diagnose, are mistaken for neuromuscular dysplasia, which entails a series of pathogenetically unreasonable, sometimes crippling, organ-bearing surgical interventions. In the case when the maintenance of adequate urodynamics, the main function of the ureter, is provided, events develop in a different way: the maturation and restoration of the function of the lower parts of the ureters occurs with a change in the morphological structure of the walls of the ureter.

The early elimination or minimization of urodynamic disturbances is the basis for reducing the pathological effect of heterochrony on the development and functioning of the urinary system, and therefore on maintaining the functional renal reserve and renoprotection in general.

From this expires tactics change in the treatment and prevention of obstructive uropathy, principle of which is the requirement that the earlier and less traumatic restored urodynamics, the better the result.

Currently, the most commonly used method of treatment of obstructive uropathy is surgical treatment, the timing and extent of which depends on the degree and severity of urodynamic disorders, kidney function and manifestations of the infectious process.

Palliative surgical methods such as nephrostomy, ureterostomy and their various modifications suggest rather invasive shutdowns from the urodynamics of the underlying urinary tract. As a result, in addition to high invasiveness, scarring, and the risk of complications, we expose the ripening lower urinary tract to temporary dysfunction, which negatively affects their further development. Cases of non-surgical elimination of urodynamic disturbances in the intramural and juxtavesical parts of the ureter with ureterohydronephrosis with a high stoma can only be explained by the morphological and functional maturation of

these parts of the ureter, as well as the favorable outcomes of endoscopic antireflux corrections of the mouths of reflexing ureters [11].

The advantage of drainage techniques aimed at restoring urodynamics through the use of intraluminal polyvinyl chloride drainage (stent) is that the anatomophysiological integrity of the tissues is not violated, the urodynamics are restored non-invasively and quickly. At the same time, the problematic departments of the ureter do not turn off, but only the load on them is reduced to a minimum, without violating the principle of “minimum provision”. In addition, the restoration of urodynamics using stenting favorably affects the maturation of the kidney parenchyma and prevents infection of the urinary system, as it prevents contact of the lumen of the urinary tract with the external environment. The possibility of endoscopic dilatation of the intramural ureter and its stenting significantly decreases with increasing age of the child due to pathological changes in the ureter wall and complete closure of the lumen of the ureter [12].

Thus, the effectiveness of endoscopic stenting of the lower parts of the ureter also depends on the age of the child. The earlier and less invasively eliminated the violation of urodynamics, the better the result, both in terms of the technical feasibility of drainage and prognosis, and vice versa: the older the age, the more difficult it is to recanalize the intramural ureter and the worse the result of restoring the morphological structure of the ureter. The morphological assessment of the outcomes of postnatal damage to growing and developing structures remains debatable. We have the right to be wary of the interpretation by morphologists of cases of damage to developing structures and their consequences. The histomorphological state of the tissues of the ureter in obstructive ureterohydronephrosis requires further study [13].

Based on the foregoing, we offer a slightly different attitude towards children with obstructive ureterohydronephrosis. When pyelectasis is ascertained at 32-36 weeks of intrauterine development and / or enlargement of the size of the ureter in any department, even transient, entails a mandatory ultrasound control after birth for 10 days. While maintaining pyeloectasia, comparative control at a month of age is recommended. If an expansion of 10 mm and higher or an increase in size is determined in dynamics, an X-ray examination should be recommended: excretory urography and voiding cystography. A feature of performing excretory urography is the holding of time-delayed images, which is selected individually, on an empty bladder and in a vertical position of the child. When ascertaining a varying degree of ureterohydronephrosis, cystoscopy is performed with an assessment of the ureteric orifices and, if necessary, their dilatation and stenting. [14].

Conclusions

1. The proposed tactics for the treatment of obstructive uropathy in children has advantages with respect to open surgical methods in technical simplicity, minimally invasiveness, maximum physiology, a decrease in the frequency of postoperative complications, and the possibility of preparing for radical surgical interventions.

2. It should be remembered that the effectiveness of endoscopic stenting of the lower parts of the ureter depends on the age of the child. The earlier the violation of urodynamics is eliminated, the better the result, both in terms of the technical feasibility of drainage and prognosis, and vice versa: the older the age, the more difficult it is to recanalize the intramural ureter and the worse the result of restoring the morphological structure of the ureter.

Prospects for further research. Endoscopic stenting of the ureters in the pathology of the intramural and juxtascal ureter, is an alternative to open surgery, and may also be the stage of preparation of the patient for other methods of treatment. Minimally invasive, physiological, technical simplicity of the proposed treatment tactics determine the prospect of further research, opening up new opportunities in the early diagnosis and treatment of anomalies of the urinary system.

Conflict of Interest: None.

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