Results of Transurethral Correction of Stenotic Developmental Abnormalities of Ureterovesical Junction in Children

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Abstract

Purpose: Improving the results of treatment of stenotic developmental abnormalities of the ureterovesical junction (SDA UVJ) in children.

Materials and Method: Treatment analyzed included 88 pediatric patients (125 ureters) with SDA UVJ, aged 3 months - 15 years.

Results: Endoscopic stenting has been performed using antireflux stents, with subsequent bladder drainage using a urinary catheter. We have also developed an inverted V-shaped ureterocele incision. The UVJ control calibration has been performed using calibration catheters. If the UVJ diameter did not correspond to the age norm, the second stage of treatment was carried out by dilating with conical bouges or by UVJ balloon dilating. Transient complications developed in the immediate postoperative period have been successfully eliminated using conservative measures, in all cases.

Conclusions: The study results imply the effectiveness of endoscopic method in correcting SDA UVJ in children.

Keywords: *Obstructive megaureter, stenotic developmental abnormalities of ureterovesicular junction, endoscopic treatment, children.*

Introduction

The endosurgical treatment of patients with UVJ abnormalities have not almost been used in pediatrics, due to the lack of differential diagnostic criteria for various forms[8] of this disease or indications for such an intervention [14].

Studying the urodynamic disturbance mechanisms led us to the fact that the existing open surgical procedure of patients with stenotic anomalies had to be reconcepted, and the list of indications for endosurgical interventions[7] - expanded. The technique of transurethral ureteroplasty for UVJ stenotic anomalies, using bouginage or balloon dilatation of UVJ with ureteral stenting and ureterocele incision[13], had been previously recognized as effective. For the first time in pediatrics, this approach to the treatment of obstructive megaureter was described by N.V. Dorasvely in his work (1990), which presented two cases of successful endoscopic ureteroplasty using a Fogerty balloon dilator[10]. However, the discrepancies in the results of these interventions performed in younger children still remain[12].

Endosurgical method of treating children with UVJ developmental abnormalities have an increasing number of its supporters[1]. However, insufficiently studied mechanisms of urodynamic disturbance reduce the positive results of such interventions[2]. Forms of UVJ developmental anomalies are diverse, while in children, functional anomalies predominate[6]. All this explains why the differentiated treatment strategy has been chosen for pediatric patients[8].

The aim of this study is to improve the results of treatment of SDA UVJ in children.

Materials and Method

The treatment analyzed included 88 pediatric patients (125 ureters) with SDA UVJ, aged 3 months - 15 years. The research was carried out in the Department

of Intermediate Level Pediatric Surgery (Head of the Department - prof. M.M. Aliev) of TashPMI (Rector - prof. B.T. Daminov), and in the Department of Pediatric Surgery (2014-2019) of the Republican Specialized Scientific and Practical Medical Center of Pediatrics (Director - prof. D.I. Ahmedova).

Indications for endoscopic transurethral correction of organic stenotic anomalies (SA) of UVJ have been determined based on the nature of functional disorders - mild, moderate or severe - according to our diagnostic research algorithm.

3 types of endoscopic correction of UVJ have been performed in 88 patients (125 ureters) with SA (Table 1).

Table 1: The nature of endoscopic interventions performed in children with SA UVJ

Types of UVJ anomalies	Endoscopic method of treatment			Total
	UVJ bouginage**	UVJ balloon dilatation**	Ureterocele incision	
OSA*	8 (11)	21 (29)	16 (18)	53 (66)
FSA*	21 (35)	22 (32)	-	35 (59)
Total	29 (46)	43 (61)	16 (18)	88 (125)

Note: The number of ureters is provided within brackets. * - SA - stenotic anomalies; O - organic; F - functional. ** - UVJ bouginage and balloon dilatation have been performed with mandatory stenting of the lower third of the ureter.

As shown in Table 1, in our practice, we preferred UVJ balloon dilatation with stenting of the lower third of the ureter. In 16 children (18 ureters), the ureterocele incision was performed only with its intravesical form.

During examination cystoscopy, the ureterocele opening was catheterized with a flexible conductor to a depth of 8-10 cm. The ureterocele opening bouginage was performed consecutively using conical bouges Biorad Medisys PVT (India) 6-8-10-12 Fr, along the entire UVJ, under triple video+Carm+ultrasound control. Bouginage up to 6 Fr was carried out for children under the age of 3 years, up to 8 Fr - for children from 4 to 7 years, and up to 12 Fr - for children over 7 years.

Balloon dilatation was performed using a balloon catheter manufactured by Biorad Medisys PVT (India). Balloon catheter was passed over using a flexible conductor, UVJ dilatation up to 6Fr with a pressure of up to 2 Atm/bar was performed for children under the age of 3 years, up to 8Fr with a pressure of up to 3 Atm/bar - for children from 4 to 7 years, and up to 10Fr with a pressure of up to 4 Atm/bar - for children over 7 years. The abundant flow of turbid urine with the failure of a bouge or balloon was considered as an efficacy criterion for dilation (P. Puri et al. 1991).

Results

After bouginage or dilatation, a polyurethane stent with a diameter of 4-10 Fr of the same manufacturer was installed in the lower third of the ureter at one end and into the bladder cavity at the other end. Then, it was passed through the conductor using a 'pusher' (Fig. 1). Stents were placed in the ureter for a period of 20-30 days.

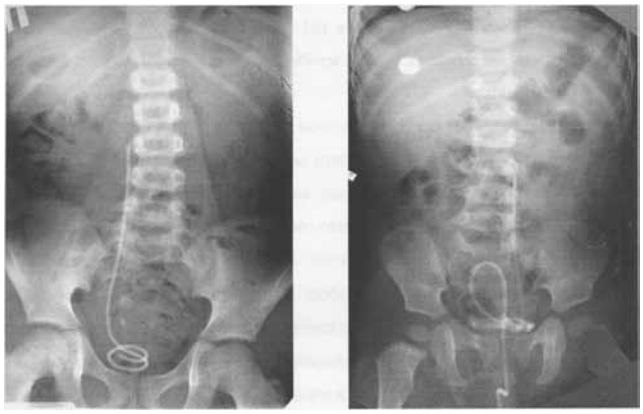

Figure 1. Plain urography. Normal position of the 'low' stent.

During primary stenting of the ureter, the diameter of the stent did not largely exceed 5-6 Fr. With repeated stenting (7 cases), its diameter was 8-10 Fr. After 20-30 days, when the stent was removed, it was determined by cystoscopy whether it is necessary to replace the stent. With that, UVJ control air-blast calibration was performed using calibration catheters. If the UVJ diameter did not meet the age norm, the second stage of treatment included dilating using conical bouges or UVJ

balloon dilating. Then, the larger stent was installed for a period of 20-30 days.

Outcome of treatment in children using double J (JJ) stenting has been more successful than that through high derivative urine using percutaneous puncture nephrostomy. Indications for percutaneous puncture nephrostomy have been determined by pronounced deviation of the ureter and a sharp decrease in its contractility in case of insufficient derivation of urine from the lower ureter. Based on the foregoing, a modification of stents has been developed, that promoted improved drainage of the upper urinary tract. For this purpose, so-called 'low stents' were used. After endosurgical intervention, they were inserted up to the middle third of the ureter or the first knee-shaped bend. In this way, appropriate urinary drainage from all parts of the collecting system was ensured. A thin line from the distal end of the 'low' stent was withdrawn through the external urethral opening, which made it possible to remove the stent without additional instrumental interventions. Endoscopic stenting was performed with antireflux stents Biorad Medisys PVT (India) with the subsequent drainage of the bladder - on the first or the second day - with a Foley 8-12 Fr urethral catheter. The drainage time was determined depending on the age of the child and the urethra diameter.

Discussion

For ureterocele incision, we used endoscopic equipment manufactured by KARL STORZ (Germany): an electrochemical resectoscope 10 CH with loop-shaped electrodes and a hook-shaped cold knife. During ureterocele incision - transverse or semi-lunar - the ureterocele upper wall contracted between the two fixation points (Waldeyer's ring and the proximal urethra), and the free edge of the artifical opening was moved in the proximal direction, as a result of which the opening became U-shaped. The submucous ureteral segment was shortened inversely in proportion to the length of the discission, which could not ensure a tight closure of its walls in the area of the opening.

Taking into account this disadvantage of the conventional method above, we have developed an inverted V-shaped ureterocele incision. In this case, the contracting upper wall of the ureterocele, while retaining both fixation points, does not displace the proximal border of the articular opening, since it does not have free edges oriented perpendicular to the axis of the ureter. Due to this, the length of the submucosal part of the ureter remains unchanged and depends only on the length of the incision performed. After contraction, the upper and lower walls of the ureterocele close tightly, which improves antireflux function. The incision was short, its length did not exceed the length of the working part of the electrode and the hook of the cold knife (3 mm). The intervention was completed by draining the bladder with a Foley 8-12 Fr urethral catheter, at the first or the second day.

UVJ endosurgical intervention was always carried out against the background of antibacterial prophylaxis, 1-2 days before the intervention, depending on the results of common urine and bacterial urine culture tests, determining the sensitivity of the flora to antibiotics.

After surgery, patients stayed in the hospital within 2.06±0.49 days, on average (1-3 days). Upon discharge, patients were advised to maintain an increased fluid intake and take uroseptics and antihistamines, in order to prevent sensitization to stent material. Recommendations had to be observed for the entire period of 20-30 days before the removal of the stent and the subsequent transition from the inpatient to outpatient setting. The dynamics of emptying the lower third of the ureter and the pyelocaliceal system was evaluated through ultrasound, which was performed every 10 days for 1 month. The tendency to a decrease in the diameter of the lower third of the ureter within 2 weeks largely indicated the reversibility of changes in the enlarged ureter. On the 20th-30rd day after ureteral stenting, patients were re-hospitalized, in order to remove or replace the stent. A control excretory urography was performed with 1 or 2 images, depending on the initial state of the upper urinary tract (UUT). After ureterocele incision, the mycystic cystography was performed, in order to extend the study materials.

Transient complications (ureter atony, hemorrhagic cystitis, exacerbation of pyelonephritis, dysuria) developed in the immediate postoperative period have been eliminated by conservative measures, in all patients. Such measures consisted of antibacterial, anti-inflammatory therapy and physiotherapeutic procedures that stimulated ureter contractibility (Table 2).

Table 2: Complications of the immediate period after endoscopic correction for UVJ stenotic abnormalities in children

Method of endoscopic correction	Types of complications			
	Leukocyturia (FOV)	Proteinuria (g/l)	Atony of the ureter (urine discharge/min)	Dysuria
UVJ bouginage n=17	19,3±1,25	0,18±0,9	1,83±0,06	7 (33,3%)
Balloon dilatation UVJn=27	17,1±0,69	0,05±0,1	1,55±0,07	8 (33,3%)
Ureterocele incision n=11	28,3±0,52	0,07±0,07	1,9±0,05	4 (50%)

Note: P < 0.05.

As can be seen from Table 2, the most frequently observed complications of the immediate postoperative period were exacerbation of pyelonephritis and transient urodynamic abnormalities. Infusion and antibacterial therapy led to normalization of body temperature, urine tests and elimination of dysuria.

Excretory urography has been performed in 29 patients (46 ureters), in order to evaluate the results of UVJ endoscopic augmentation with low stenting within 1-3 months after the treatment. Of the 46 cases of examination of kidneys and ureters, in 35 cases (76.1%) a decrease in the degree of enlargement of UUT was recorded, by an average of 47.5±1.1% (Fig. 2, 3, 4), in 9 cases (19.6%) - no changes, and in 2 cases (4.3%) - an increase in the UUT size.

Figure 2. Patient A., 7 years. Excretory urography. III grade megaureter on the left. Before the UVJ bouginage with low stenting on the left.

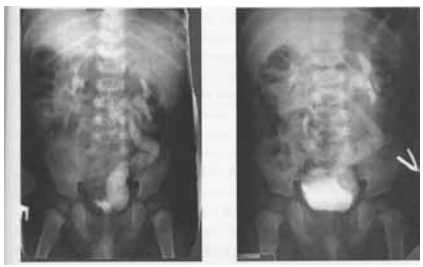

Figure 3. The same patient Excretory urography 1 month after UVJ bouginage with low stenting on the left.

Figure 4. The same patient Excretory urography 3 months after repeated UVJ bouginage with replacement of the low stent on the left after 30 days.

In order to evaluate the results of UVJ endoscopic balloon dilatation with low ureter stenting, within 1-3 months after treatment, excretory urography results have been studied in 43 patients (61 ureters). Of the 61 cases of examination of kidneys and ureters, in 54 cases (88.5%) a decrease in the degree of UUT enlargement was recorded, by an average of 58.4±1.2% (Fig. 5, 6), in 5 cases (8.2%) - no changes, and in 2 cases (3.3%) - an increase in UUT size.

Excretory urography has showed the following results of endoscopic surgery using the modified method of inverted V-shaped ureterocele incision. In 16 patients (18 ureters) a decrease in ureterocele lumen was observed by an average of 68.3%, in 14 ureters (77.8%) - by 57.8% ($p<0.05$) (Fig. 8), in 1 (5.5%) - without reducing UUT size. In 3 cases (16.6%), the vesicoureteral reflux has been observed (Fig. 6, 7), and in 1 case - urethenosis (Fig. 8).

**Fig. 5. Patient V., 5 years.
Excretory urography. II grade megaureter on the right, III grade megaureter on the left. Before UVJ balloon dilatation**

**Fig. 6. The same patient
Excretory urography after 3 months.
Positive result.**

**Fig. 6. Patient S., 6 years
Excretory urography.
Intrauterine ureterocele on the right.**

**Fig. 7. The same patient
Cystography.
Unsatisfactory result.
Vesicoureteral reflux on the right.**

**Fig. 8. Patient F., 4 years.
Excretory urography. Ureter and ureterocele lumen reduction.**

After analyzing the results of the UVJ dilatation with low stenting, we have identified the following reasons for unsatisfactory indicators: 1) stent prolapse into the bladder lumen (Fig. 9.) 2) stent migration into the ureter lumen (1 case) 3) accumulation of salts on the stent surface and its obstruction, which contributed to the exacerbation of pyelonephritis (1 case). When dissecting the ureterocele in a modified way, the fusion of the edges of the incision and the excessive ureterocele tissue dissected have been revealed, which caused vesicoureteral reflux.

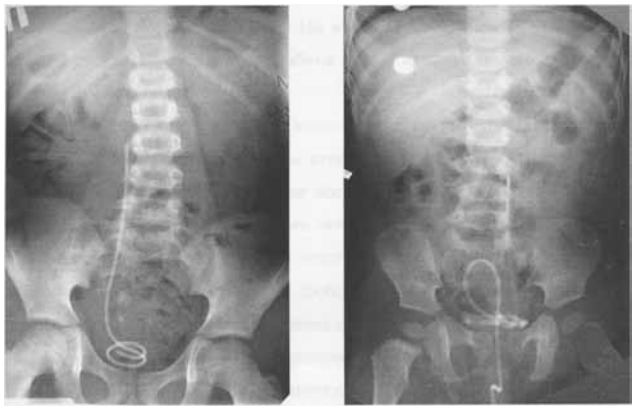

Figure 9. Patient P., 3 years. Plain urography. Stent prolapses into the bladder.

In order to study positive urodynamics after endoscopic correction in SA UVJ within 1-3 months, we used the following special research method: ultrasound of the ureter-cystic urinary discharge (UCUD) using pulse-wave dopplerometry and transformational echopieloscopy (TEC) with diuretic load (Table 3). In patients with positive urodynamics, with pulse-wave dopplerometry of the ureter-bladder discharge of urine, the frequency, duration and maximum speed of UCUD were close to normal values. Analysis of transformational echopieloscopy has showed that the more pronounced the initial dilatation of the ureter, the less its expansion at the time of examination.

The maximum expansion of the distal ureter (35-40% of the initial size) was observed at 5-8 minutes of the examination, and the restoration of the original size usually occurred at 35-45 minutes. During the study period, the expansion of the ureter in this group of patients did not exceed 1.5 cm in diameter, which indicated that its wall tone is preserved.

Table 3: Positive urodynamics in the immediate period after endoscopic correction in children with SA UVJ.

Method of endoscopic correction	The number of ureters	UCUD Doppler ultrasound			TEP		
		Frequency of discharge per 1 min.	T_c (sec)	V_{max} (m/s)	T_{max} (min)	P_{max} (%)	T_i (min)
UVJ bouginage	46	1,93±0,56	1,56±0,18	0,31±0,04	7,3±0,78	39,2±0,46	44,2±0,89
UVJ balloon dilatation	61	2,9±0,2	1,8±0,4	0,34±0,03	5,8±1,1	36,5±3,6	41,1±0,78
Ureterocele incision	18	2,4±0,36	1,2±0,1	0,33±0,02	6,4±0,44	35,8±0,37	37,6±0,69

Note: T_c - duration of one urine discharge; V_{max} - maximum speed of urine discharge; T_{max} – time of maximum expansion of renal collecting system (min); P_{max} – maximum expansion of renal collecting system (%); T_i - the restoration (reduction) time of the size of renal collecting system to its initial values (min.);- $P<0.01$

Conclusions

The obtained results have showed the effectiveness of endoscopic method for the correction of UVJ stenotic anomalies in children. The revealed causes of conservatively reversed complications and unsatisfactory results have mainly depended on the severity of urinary infection and have made it possible to improve the conservative treatment of children with AS UVJ.

Ethical Clearance: No ethical approval is needed.

Source of Funding: Self

Conflict of Interest: Nil

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