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Combination of the Upper Urinary Tract and Bladder Drainage Methods after Laparoscopic Uretercystoneoanastomosis

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Abstract **The aim** of the study was to evaluate the efficiency and safety of the upper urinary tract and bladder combination drainage method after laparoscopic uretercystoneoanastomosis. **Introduction.** Laparoscopic interventions have developed from a simple diagnostic procedure into complex reconstructive surgeries. One of the reconstructive procedures performed in urology is laparoscopic ureterocystoneoanastomosis or reimplantation of the ureter. The authors developed an alternative technique for drainage of the upper urinary tract and bladder during laparoscopic ureteroneocystostomy without the use of a ureteral stent. **Material and methods.** 40 patients who received surgical treatment of the lower third of the ureter stricture in the period from 2019 to 2022 were selected for the study. The mean age of all patients was 31.9 ± 14.0 years (M±δ). All patients were divided into 2 groups according to the upper urinary tract drainage method and intubation of the ureter. Group A consisted of 23 patients who were used a ureteral stent. Group B consisted of 17 patients who were performed the developed technique of a combination of bladder and ureter drainage of the upper urinary tract and intubation of the ureter. **Results.** The mean duration of surgery was lower when using a ureteral stent (103.3 ± 12.3 minutes versus 122.1 ± 14.0 minutes; M±δ). The analysis of intraoperative blood loss, intensity of postoperative pain and duration of inpatient treatment revealed no difference between the groups. The median duration for the removal of the urethral catheter in the group with a ureteral stent was lower than the new technique group (8 days versus 18 days). However, the median duration of ureteral intubation was lower with the new technique in comparison with the ureteral stent (18 days versus 29 days). The frequency of postoperative complications did not differ between the groups. **Conclusion.** The developed technique of combination drainage for the bladder and ureter during laparoscopic uretercystoneoanastomosis has similar efficacy and safety in compare with the use of an ureteral stent.

Keywords Laparoscopy, Ureteroneocystostomy, Ureteral stent, Urethral catheter, Ureter reimplantation

1. Introduction

Laparoscopic interventions have developed from a simple diagnostic procedure into complex reconstructive surgeries. Today, the advantages of this method over open interventions are no longer in doubt, and laparoscopy has almost completely replaced open surgery as the first line of treatment for various urological diseases [1]. One of the reconstructive procedures performed in urology is laparoscopic ureterocystoneoanastomosis (UNC) or reimplantation of the ureter. Ureteral reimplantation is most often performed in pediatrics for the treatment of vesicoureteral reflux. In adults, reimplantation of the ureter is indicated for the strictures of the lower third of the ureter. The ureteroneocystostomy with or without Psoas-hitch is the standard surgery in such cases.

Ureteral stent is used for drainage of the upper urinary tract (UUT) and ureteral intubation in laparoscopic UNC. However, this type of drainage is associated with a high frequency of postoperative complications [2]. Alternative methods of UUT drainage and ureteral intubation have not been described in the literature. We have developed a special method for combining drainage of the upper urinary tract and the bladder during laparoscopic UNC.

The aim of the study was to evaluate the efficiency and safety of the upper urinary tract and bladder combination drainage method after laparoscopic uretercystoneoanastomosis.

2. Material and Methods

40 patients who received surgical treatment of the lower

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third of the ureter stricture in the period from 2019 to 2022 at the Republican Specialized Scientific-Practical Medical Center of Urology. The mean age of all patients was 31.9 ± 14.0 years (M±δ). There were 18 (45%) males and 22 (55%) females. All patients were performed standard clinical, laboratory and instrumental examinations: a complete blood count, biochemical blood analysis, ultrasound and X-ray investigation methods. The diagnosis of the disease was determined on the basis of the clinical picture, ultrasound examination and multispiral computed tomography with urinary tract contrast.

Laparoscopic pyeloplasty was performed using endovideosurgical equipment and instruments of KARL STORZ company (Germany). All surgeries were performed by one surgeon.

Surgical intervention was performed according to the standard technique. The patient was placed in the Trendelenburg position with the operating table tilted 15-45°. Access to the abdominal cavity was carried out according to the Hasson method. After installing trocars and inserting instruments into the abdominal cavity through the Todlt line, the corresponding part of the large intestine was mobilized and the retroperitoneal space was opened. Having identified the ureter and the narrowed area, it was resected. The normal end of the ureter was spatulated. The bladder was filled with isotonic solution and a cystotomy was performed at the site of ureter implantation. The anastomosis began with the application of a muscle retaining suture that passed through all layers of the bladder and ureter wall. The ureter was placed in the detrusor trough, and then the edges of the detrusor muscle were brought together over the ureter, creating a submucosal tunnel. A ureteral catheter or stent was installed to drain the upper urinary tract before completing the anastomosis.

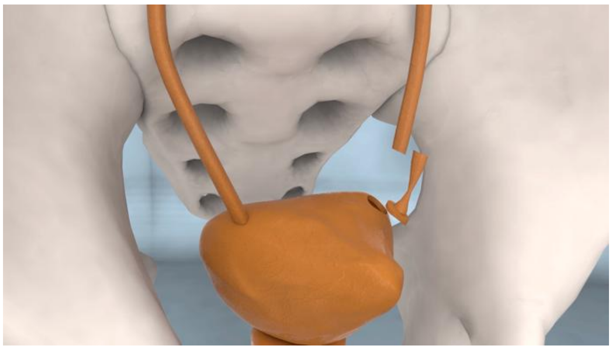
We have developed a technique for combining methods of the upper urinary tract and bladder drainage during laparoscopic uretercystoneoanastomosis. In this technique a ureteral catheter has been passed through the Foley catheter. First, the balloon has been inflated with isotonic solution up to 3-5 ml or with air. A hemostatic clamp has been inserted into the inner hole of the Foley catheter and new hole is made on the catheter between the inner hole itself and the balloon. Then, the balloon has been deflated. The ureteral catheter is grasped with a clamp and pulled inside the new hole. Then a clamp is passed into inner hole and exit through a new hole next to the ureteral catheter. The other end of the ureteral catheter is grasped with a clamp and pulled inwards. With the fingers of the hand or a clamp, the entire catheter is dragged through the working channel of the Foley catheter and brought out. By injecting 3-5 ml of isotonic sodium chloride solution into a special channel of the can, its integrity is checked. The prepared catheter is shown in Figure 1.

Figure 1. Foley catheter 18 Fr with a conducted ureteral catheter

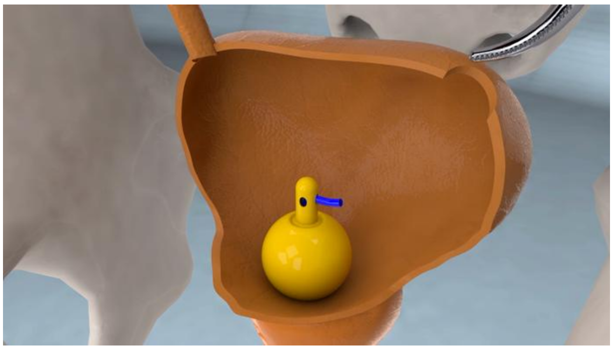
Table 1. Initial characteristics of patients underwent laparoscopic ureterocystoneoanastomosis

Parameter	**Patients Groups depending on the method of drainage**		**Difference between groups; p ***
	Группа А (n = 23)	**Группа Б** (n = 17)	
Mean age (years) – M±δ; 95% CI	28.6 ± 10.6; 24.3–32.9	36.5 ± 16.8; 28.5–44.5	0.1336
Sex:			0.2888
Males, number (%)	12 (52.2 %)	6 (35.3 %)	
Females, number (%)	11 (47.8 %)	11 (64.7 %)	
Body mass index – M±δ; 95% CI	23.8 ± 3.7; 22.3–25.3	24.5 ± 3.6; 22.8–26.2	0.3953
Number of patients with comorbidities (%); number of diseases	5 (21.7 %) 10	4 (23.5 %) 6	0.8934
Side of lesion / surgery:			0.109
Right	14 (60.9 %)	6 (35.3 %)	
Left	9 (39.1 %)	11 (64.7 %)	

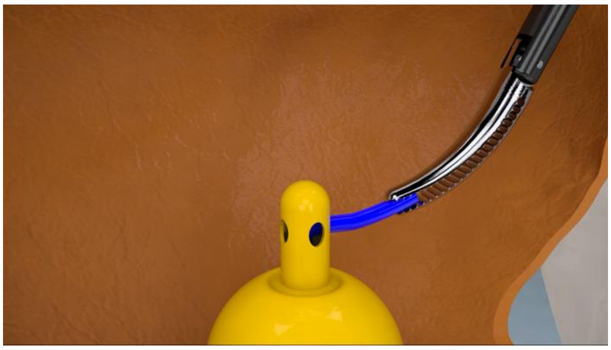
Note: M – arithmetic mean; δ – standard deviation; 95% CI – 95% confidence interval;
* The test compares the characteristics of patients in two groups (t-test or $\chi 2$ test)



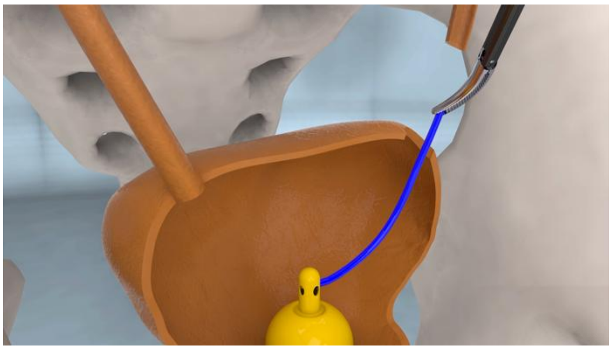
1. Resection of the ureteral stricture zone



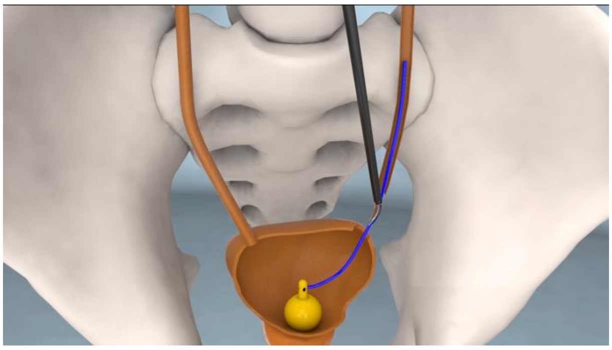
2. Installation of a Foley catheter into the bladder with a ureteral catheter passed through the working channel of the catheter.



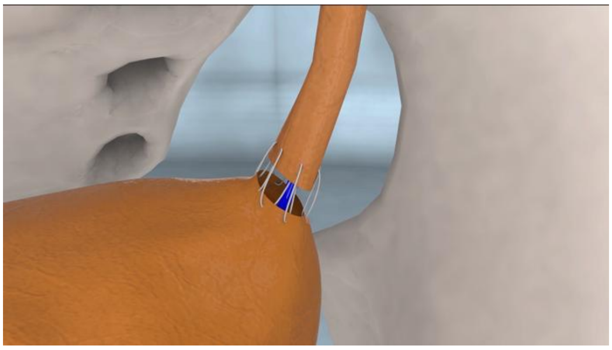
3. Capturing the ureteral catheter with a dissector inside the bladder.



4. Removal of the ureteral catheter from the bladder.



5. Insertion of the ureteral catheter into the ureter up to the proximal ureter.



6. Finishing of the anastomosis.

Figure 2. Various stages of the combination of bladder and upper urinary tract drainage with ureteral intubation during laparoscopic ureteroneocystostomy

When installing the catheter according to the developed technique, the urethral catheter is replaced with a specially prepared Foley catheter with a ureteral catheter. A dissector is inserted through an incision in the wall of the bladder and the tip of the ureteral catheter is grasped. The ureteral catheter is pulled from the bladder into the abdominal cavity. By changing the orientation of the instrument, the ureteral catheter is dragged into the spatulated ureter up to the proximal ureter. The balloon of the Foley catheter is inflated and the urine bag is connected. The ureteral catheter should be inside of the urine bag.

Next, the anastomosis is completed. The anastomosis must be strengthened with additional sutures. Extraperitoneation is performed by connecting the ends of the parietal peritoneum with 3/0 Vicryl sutures. The stages of installing a prepared Foley catheter for drainage of the upper urinary tract and bladder are shown in Figure 2.

All patients were divided into 2 groups according to the upper urinary tract drainage method and intubation of the ureter. Group A consisted of 23 patients who were used a ureteral stent. Group B consisted of 17 patients who were performed the developed technique of a combination of bladder and ureter drainage of the upper urinary tract and intubation of the ureter. The initial characteristics of patients have been presented in Table 1. There was no statistically significant difference between the groups according to the initial characteristics ($p > 0,05$).

To assess the efficiency and safety of the developed technique for combining drainage of the bladder and ureter, a comparative analysis of the results of surgical treatment between groups A and B was performed. We evaluated the following parameters: duration of surgery, intraoperative blood loss, intra- and postoperative complications, severity of postoperative pain, doses of analgesics used, hospital stay days and other parameters. The classification of complications according to Clavien-Dindo was applied to systematize complications after laparoscopic operations [3,4].

A special electronic patient examination card was developed in the form of an electronic database on a personal computer (Microsoft Excel 2021) to identify significant parameters. Quantitative signs were encoded binary (yes, no), and gradations were introduced for qualitative signs. Comparative analysis was carried out using various methods of statistical analysis: Student's t-test, Mann-Whitney U-test, $\chi 2$ test. The level of statistically significant result was considered $p < 0.05$. Statistical data processing was carried out using StatPlus and IBM SPSS Statistics programs.

3. Results

The mean duration of surgery in group A who had a ureteral stent placed during UNC was 103.3 ± 12.3 minutes (M±δ). And in patients of group B, who were performed the developed technique for combining drainage of the bladder and ureter, the duration of the surgery was 122.1 ± 14.0 minutes (M±δ). Statistically significant difference ($p < 0.05$) in the duration of the surgical intervention may be related to the additional time required for the preparation of the Foley catheter and the difficulty of inserting the ureteral catheter into the ureter (Fig. 3).

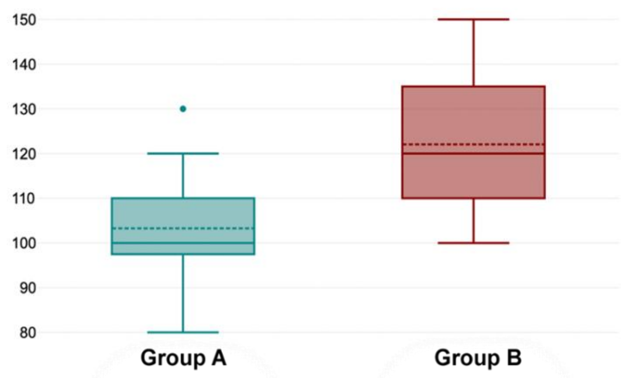


Figure 3. Boxplot of the duration of surgery in comparison of two groups ($p < 0.05$): Group A - ureteral stent (n =23); Group B - a combination of drainage of the bladder and ureter (n = 17)

There was no statistically significant difference between the groups in intraoperative blood loss ($p > 0.05$). The median volume of blood loss during surgery in group A was 30 ml (interquartile range – IQR=20), and in the second group - 50 ml (IQR=10), which is the minimum for laparoscopic surgery.

The severity of postoperative pain syndrome was assessed using the Visual Analogue Scale on days 1 and 3 after surgery. patients were asked to rate the degree of pain from 1 to 10. On day 1 after surgery, the median pain intensity in both groups was 6 points (IQR in group A - 2 points; in group B - 1 point), which did not differ statistically ($p > 0.05$). A similar picture was observed on the 3rd day, the median pain intensity in both groups was 3 points (IQR in group A - 0 points; in group B - 1 point). There was no statistically significant difference between the groups ($p > 0.05$).

The developed technique for combining drainage of the bladder and ureter during laparoscopic UNC does not affect the intensity of postoperative pain, so this technique is safe for use in patients.

A comparative analysis of the duration of inpatient treatment did not reveal a difference between the groups ($p > 0.05$). The average hospital stay in group A was 3.9 ± 0.5 days (M±δ), and in group B it was 3.9 ± 0.7 days (M±δ).

The median time for removal of the urethral catheter in group A (ureteral stent) was 8 days (IQR=2.5). In group B with the new technique of combining drainage of the bladder and ureter this indicator made up 18 days (IQR=5). The median duration of the ureteral stent in the ureter in group A was 29 days (IQR=4). There was a statistically significant difference in the timing of drainage of the urinary tract between the groups ($p < 0.05$) (Fig. 4).

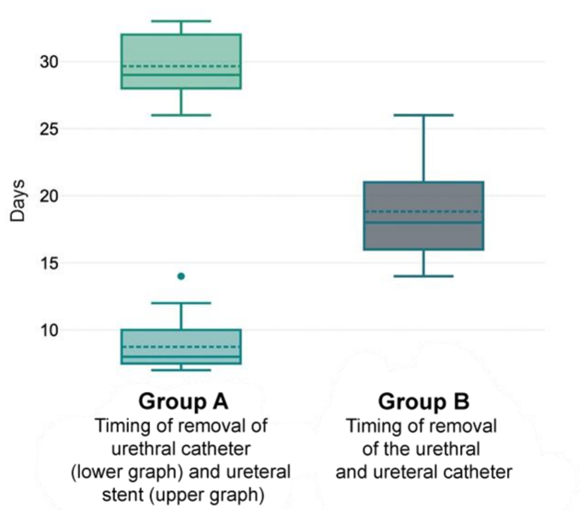


Figure 4. Comparative boxplots analysis of the urinary tract drainage duration after laparoscopic UNC in two groups ($p < 0.05$)

There were no intraoperative complications in patients, possibly due to the small sample size.

A comparative analysis of postoperative complications in patients performed laparoscopic UNC and their characterization according to the Clavien-Dindo classification system showed that there were mainly complications of I and II degrees in patients, which did not require additional interventions.

In particular, the following postoperative complications of the 1st degree were observed: suppuration of the postoperative wound - in 2 (5.0 %) cases; ileus - in 3 (7.5%) patients; mild plexopathy - 3 (7.5%) cases; pronounced dysuric phenomena - in 10 (25.0%) cases and hematuria that does not require blood transfusion - in 5 (12.5%) patients. All complications were eliminated using conservative treatment methods: wound infection was treated with antibiotic therapy and local antiseptics; prokinetics and early activation of the patient were used in ileous; non-steroidal inflammatory drugs or antispasmodics (oxybutynin 5 mg) were used in severe dysuric phenomena. Infusion therapy was used in the case of hematuria, hemostatics, and the drainage of the urinary tract was checked in by ultrasound.

Only exacerbation of urinary tract infection from the complications of the 2nd degree according to Clavien-Dindo was observed in 7 (17.5%) patients Exacerbation of UTI was treated with increased antibiotic therapy or antibiotic change.

Comparative analysis between groups did not reveal a statistical difference in the incidence of postoperative complications ($p > 0.05$). Thus, it can be confidently stated that the proposed new technique for combining drainage of the bladder and ureter is a safe method and does not cause postoperative complications.

Comparative analysis of postoperative complications and their characteristics according to Clavien-Dindo are presented in Table 2.

Table 2. Comparative analysis of postoperative complications incidence and their characteristics according to the Clavien-Dindo classification

Degree	Characteristics	Groups of patients depending on the drainage method		p-value*
		Group A (n = 23)	**Group B** (n = 17)	
I	Suppuration of the postoperative wound	1 (4.3 %)	1 (5.9 %)	0.8258
	Ileus	2 (8.7 %)	1 (5.9 %)	0.7384
	Mild plexopathy	2 (8.7 %)	1 (5.9 %)	0.7384
	Severe dysuric phenomena	7 (30.4 %)	3 (17.6 %)	0.3558
	Hematuria not requiring blood transfusion	3 (13.0 %)	2 (11.8 %)	0.9038
II	Exacerbation of urinary tract infection	5 (21.7 %)	2 (11.7 %)	0.4118
Total		20	10	

* The test compares the characteristics of patients in two groups ($\chi2$-test)

All patients were under dynamic observation to detect relapses of the disease during the year. A relapse of the disease was detected in 1 (2.5%) patient from the total sample. Thus, the efficiency of laparoscopic UNC was 97.5%.

4. Discussion

Laparoscopic surgery has become an integral part of urological practice. Laparoscopic surgery has become an integral part of urological practice. The possibility of performing laparoscopic ureterocystoneoanastomosis was first described by R.M. Ehrlich et al. in 1994 [5]. E. M. McDougall in 1995 performed a laparoscopic ureteral reimplantation on pigs and showed the possibility of creating an antireflux mechanism [6]. Over the past decade, several studies have evaluated laparoscopic ureteral reimplantation and good results and a low complication rate even in cases of complex anatomy were received [7,8]. In 2016, Farina et al. conducted a systematic review evaluating laparoscopic ureteral reimplantation. They concluded that the technique was safe and effective. They reported success rates of up to 96%, shorter hospital stay, less bleeding and less pain in compare with open surgery [9]. M. Riquelme et al. reported a success rate of 95.8% in 81 patients with minor complications requiring reoperation in 2 (2.4%) cases [9]. Rohan Batra et al. compared laparoscopic and robotic UNC and reported about the efficiency of 94.7% and 95.5%, respectively [10]. The efficiency of laparoscopic UNC in our study was 97.5%.

Gupta et al. comparatively evaluated the results of open and laparoscopic UNC. According to the authors, laparoscopic UNC takes longer time (228 minutes), associated with less bleeding (166 ml) and less hospital stay (5.36 days). However, the efficiency of the operation was less than open surgery (96% versus 100%, respectively) [11]. In our study, the average duration of the surgery was 103.3 ± 12.3 minutes (M±δ) in Group A, and 122.1 ± 14.0 minutes (M±δ) in Group B, and the median volume of blood loss in both groups was 50 ml. Similar results were obtained in the study of Zhu et al: the duration of the surgery – 115.0 ± 19.5 minutes, blood loss volume 10.0 ± 1.8 ml [12].

Many authors described postoperative complications of laparoscopic UNC in their studies. So, there were 22.4% of postoperative complications cases in the study of D. F. Alcaraz in patients who underwent laparoscopic UNC. In this study, postoperative wound suppuration and ileus were not observed in the laparoscopic UNC group, while in the open surgery group it was 12% and 8%, respectively [13]. However, in our study, 2 (5.0%) patients had suppuration of the postoperative wound and 3 (7.5%) patients had ileus. Studies report a very high incidence of exacerbations of urinary tract infections (48-68 %) [5,10,13,14], which was not revealed in our research. This complication occurred in 17.5% of cases.

In all studies ureteral stent was used for ureteral intubation and drainage of the upper urinary tract. Alternative drainage methods have not described in the literature.

5. Conclusions

The developed technique of combining drainage of the bladder and ureter during laparoscopic UNC has similar efficiency and safety in compare with the use of a ureteral stent.

However, the duration of the surgical intervention is lengthened due to the time required to prepare the drainage.

Although our proposed method is effective and safe, we think further studies are needed in the long term.

The authors declare no conflict of interest.

This study does not include the involvement of any budgetary, grant or other funds.

The article is published for the first time and is part of a scientific work.

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