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ORIGINAL ARTICLE

## ORGANIZATION OF UROLOGICAL CARE FOR PATIENTS WITH IATROGENIC URETERAL INJURY

### ORGANIZACJA OPIEKI UROLOGICZNEJ DLA PACJENTÓW Z JATROGENNYM USZKODZENIEM MOCZOWODU

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#### ABSTRACT

**Introduction:** We conducted a retrospective assessment of diagnostic and therapeutic approaches in patients with iatrogenic ureteral injury, who were treated in a specialized medical center.

**The aim:** The aim of the research was to determine the optimal treatment method for correction of iatrogenic ureteral defects.

**Materials and methods:** The study included 73 patients with iatrogenic ureteral injury. In 70 cases ureteral reconstruction was carried out with the help of Boari bladder flap. The effectiveness of this approach was assessed retrospectively by analysis of the complications and long-term results of the treatment.

**Results:** The length of the bladder flap varied from 3 to 21 cm and averaged  $9.8 \pm 1.4$  cm. In 6 (8.2%) cases a successful reconstructive surgery of the ureter up to the level of its upper third was performed. The overall frequency of intraoperative complications did not exceed 12.9%. The total frequency of early postoperative complications was high (75.8%), however, they were not severe and required surgical correction only in one (1.4%) case. The total number of positive long-term results (good + satisfactory) amounted to 91.5%. Nephrectomy was required only in 2 (2.3%) cases.

**Conclusions:** The Boari bladder flap operation should be considered as the basis of the algorithm for providing medical care to patients with iatrogenic ureteral injury. This type of surgery makes it possible to completely replace the damaged or having doubtful blood supply portion of the ureter even with the defects extending to its upper third. The main advantages of this surgery technique are good blood supply of tubularized bladder flap and a high level of positive long-term results.

**KEY WORDS:** Boari bladder flap, reconstructive surgery of the ureter, trauma of the ureter

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#### INTRODUCTION

Damage to the ureters is a very serious medical problem, since it is often associated with iatrogenic injury, can be difficult to diagnose and cause serious complications, including peritonitis, massive urinomas, renal failure and formation of ureterovaginal fistulas. The most common cause of ureteral damages is considered to be gynecological surgery. There is indication in the literature that those are the surgeries which approximately in 75% of cases are associated with the ureteral injury [1]. In particular, hysterectomy is accompanied by the urinary tract damages in 4.8% of cases, 2.2% of them are ureteral injuries [2]. After the surgical correction of prolapse this number increases up to 7.3%. Among the other causes of iatrogenic ureteral trauma are surgeries on the rectum and sigmoid colon, ureteroscopy, as well as reconstructive surgery of the aorta and iliac vessels [3].

Complexity of surgical correction of the ureteral defects directly depends on their length and location. For instance, minor defects of the lower third of the affected organ require various modifications of simple ureterocystone-

ostomy. However, in case of extensive damage reaching the middle and upper third of the ureter, a surgeon finds himself in a difficult situation, which may require the use of psoas hitch, as well as complicated options for reconstruction of the upper urinary tract including transuretero-ureteral anastomosis, Boari flap ureteroneocystostomy, intestinoplasty of the ureter or kidney autotransplantation [4-6]. Each of these methods has obvious disadvantages. In particular, it is necessary to take into account the high risk of damage to the contralateral ureter in cases of ureteroureterostomy, intestinal complications in cases of ileal ureter replacement, and loss of the kidney in cases of autotransplantation due to problems with vascular anastomosis or prolonged ischemia [7-9]. Boari bladder flap technique was first performed more than 100 years ago, but so far in the literature there are only few reports about this surgical technique in small series of patients [10-13]. In recent years Boari-flap technique has begun to be used for correction of long defects of the ureter, including reconstruction up to the level of its middle and upper third [14]. However, the objective results of this approach are not clear yet. At

**Table I.** Range of iatrogenic ureteral pathology

Ureteral pathology	N (%)
Obstetric-gynecologic trauma	63 (86.3%)
Ureteroscopic trauma	3 (4.1%)
Trauma after rectal extirpation or resection	5 (6.8%)
Trauma after aorto-femoral bypass	2 (2.8%)

present, the choice of one or another technique is individual and depends primarily on surgical experience and capability of a medical institution.

## THE AIM

We conducted a retrospective assessment of diagnostic and therapeutic approaches for patients with iatrogenic ureteral injury, who were treated in a specialized medical center.

## MATERIALS AND METHODS

The study included 73 patients (69 females and 4 males). Their average age was  $46.8 \pm 5.6$  years old (22 to 78). The range of iatrogenic ureteral pathology in these patients is presented in Table I. The right-side damage occurred in 32 (43.9%) cases, the left-side - in 35 (47.9%) cases, bilateral - in 6 (8.2%). Preliminary radiation therapy for gynecological tumors was carried out in 6 (8.2%) patients. Ureteral trauma of a solitary kidney was observed in 2 (2.8%) patients. Ureterovaginal fistulas were found in 23 (33.3%) out of 69 females, as well as vesicoureterovaginal fistulas - in 3 (4.3%) females. In 5 (6.8%) patients massive retroperitoneal urinomas were identified, in the other 2 (2.8%) - urinary peritonitis. In 5 (6.8%) cases trauma of the duplicated ureters was detected. Defects of the ureter were limited to the level below its crossover with the iliac vessels in 33 (45.2%) patients, to the level 3 cm above its crossover with the iliac vessels in 34 (46.6%) patients and extended up to the level of its upper third in the other 6 (8.2%) patients. Bladder capacity in the whole population averaged  $250 \pm 38.8$  ml.

Diagnostic algorithm included examination of complaints and medical history of patients, urinalysis and hematology tests, biochemistry (glucose, total protein, creatinine, electrolytes), ultrasonography, contrast-enhanced multi-detector computed tomography (MDCT), cystoscopy and gynecological examination. In 20 (27.4%) cases urodynamics was performed.

Treatment approaches included ureteroscopy with ureteral stenting attempt. In 28 (38.4%) patients with ureteral obstruction and acute pyelonephritis, the percutaneous nephrostomy was performed at hospital admission. Retroperitoneal space urinomas were also drained with the use of puncture drainage. 70 patients undergone Boari bladder flap procedure for reconstruction of the ureter. In 2 (2.8%) cases of bilateral injury synchronous reconstruction was performed, in the other 4 (5.7%) cases surgery was carried out in two stages.

Due to severe fibrosis of the retroperitoneal space, anastomosis between the ureter and tubular bladder flap was carried out through the abdominal cavity in 4 (5.7%) cases. For correction of the vesicoureterovaginal fistulas reimplantation of the ureter via Boari-flap procedure was combined with suturing of the vesicovaginal fistula via O'Connor technique. One female patient underwent a two-stage total reconstruction of the upper third of the ureter using the renal pelvis tubular flap and reconstruction of the lower and middle third of the ureter with the use of the bladder tubular flap. Another female patient with the solitary kidney had Boari-flap procedure following colpoceleisis due to a giant vesicovaginal fistula.

The performed surgical techniques were quite different from the classical Boari bladder flap operation due to the use of the least number of sutures to connect the ureter with the vesical flap and lack of its fastening to the lumbar muscle. The procedure included infusion of 250-300 ml of normal saline solution into the bladder, as well as mobilization of its apex and lateral surfaces. The bladder mobilization range depended on the length of the flap. For dissecting a flap longer than 5 cm the contralateral and rear part of the bladder was exposed. The flap distal part width was at least 2.0 cm, its base width was at least 4.0 cm long. The psoas hitch was performed only in 2 (2.9%) cases. In most of the cases (67 patients, 95.7%) a submucosal tunnel at least 10 mm long was created in the flap distal part. The ureter and stent were passed through the tunnel and secured to the bladder mucosa with one interrupted stitch. Afterwards, the flap was tubularized and fixed to the ureteral adventitia with four interrupted sutures. In 3 (4.3%) cases simple anastomosis was used between the flap and a ureter without formation of a submucosal tunnel. Kidney mobilization was carried out in 26 (37.1%) patients. The urethral catheter was removed at 2 weeks, and the ureteral stent at 2 months after surgery. The average follow-up period was  $24.6 \pm 3.4$  months. The results were evaluated at three, six and twelve months postoperatively, based on the analysis of patient complaints, clinical evidence, ultrasound data, MDCT or excretory urography.

Functional results were divided into three types: good (absence of complaints and obstructive changes on visual investigation, good renal function), satisfactory (absence of complaints, good renal function, moderate obstructive changes) and bad (obstructive changes, deterioration of renal function, frequent exacerbation of pyelonephritis, kidney pain complaints, severe dysuria symptoms). Statistical analysis was carried out using standard descriptive statistics methods by means of "Statistica 8.0" software.

**Table II.** Main results in patients with Boari bladder flap

	<b>Total (n = 70)</b>
Preliminary radiation therapy, n (%)	8 (11.4%)
Flap length, cm	9.8 ± 1.4
Intraoperative complications	
- iliac vessels injury	1 (1.4%)
- IVC injury	1 (1.4%)
- > 500 ml blood loss	7 (10%)
Early postoperative complications	
- urine leakage from PO wound	8 (11.4%)
- pyelonephritis exacerbation	23 (32.9%)
- persistent bowel paresis	13 (18.6%)
- severe dysuria	7 (10%)
- chronic urinary retention	2 (2.9%)
Long-term functional result	
- good	58 (82.9%)
- satisfactory	6 (8.6%)
- bad	6 (8.5%)
Bladder capacity reduction with persistent hyperactivity	2 (2.3%)
Boari flap re-operation	3 (4.3%)
Nephrectomy	2 (2.3%)

## RESULTS AND DISCUSSION

The interval between the ureter damage and iatrogenic injury diagnosis ranged from 0 to 36 days (on average, 6.8 ± 2.6 days). The proportion of intraoperative diagnosis did not exceed 8.2% (6 patients). The most informative diagnostic method was MDCT, which allowed us to correctly visualize the presence and localization of ureteral injuries, obstructive changes in the upper urinary tract, the presence of urinomas in the retroperitoneal space, as well as ureterovaginal and vesicovaginal fistulas in all cases.

Ureteral stenting was successful only in 3 (4.1%) cases. In two of these female patients ligature transection was performed. In one patient stenting helped to eliminate a ureterovaginal fistula, which had developed two days before the procedure.

The main results of the study are presented in Table II. The vesical flap length varied from 3 to 21 cm and averaged 9.8 ± 1.4 cm. The overall intraoperative complication rate did not exceed 12.9%. In most cases, the complications were associated with severe cicatricial and inflammatory changes in the retroperitoneal space after radiotherapy or previous surgeries, and were serious.

One complication such as injury to the common iliac artery, was recorded in a patient who had undergone two ureterocystoneostomies. This injury was accompanied by a massive bleeding (around 1500 ml) and required iliac artery prosthetic reconstruction.

Although the total level of early postoperative complications was high enough (75.8%), they were not severe, recovered conservatively and required surgical correction only in one (1.4%) case (cystostomy because of prolonged urinary retention). The most common problem was acute

pyelonephritis, which with the same frequency was observed in patients both with short and long vesical flaps. Among specific complications dysuria should be pointed out, which was severe only in patients with flaps extending to the upper third of the ureter. Urine leakage from the wound occurred in 11.4% of patients and reversed at 10 days on average.

The total number of positive long-term results (good + satisfactory result) amounted to 91.5%. Nephrectomy was required only in 2 (2.3%) cases. Boari flap re-operation was successful 2 out of 3 (66.7%) cases.

The persistent decrease of bladder capacity was observed only in 2 out of 70 (2.3%) patients. In our opinion, it was not associated with flap surgery, but rather with radiation therapy in one case, and prolonged inflammatory changes in the urinary bladder in the other case.

Considering diagnostic methods of the iatrogenic injury to the ureter, it should be noted that its intraoperative damage, according to our data, is observed very rarely (8.2%). In vast majority of cases it is diagnosed within one week after surgery. Based on this data, we recommend performing MDCT in all patients after surgeries on pelvic organs or great vessels of the retroperitoneal space, reporting complaints resembling renal colic, acute pyelonephritis or urinary fistula in the early postoperative period.

Our results demonstrate that the attempts of ureteral stenting are undoubtedly justified in most patients with iatrogenic ureteral injury. However, the effectiveness of this method is not great (4.3%).

The management algorithm of ureteral injury correction is quite broad and may comprise various modifications of simple ureterocystoneostomy, psoas hitch, transuretero-ureteral anastomosis, Boari flap uretero-

neocystostomy, intestinoplasty of the ureter or kidney autotransplantation. Based on our experience in Boari flap operation, we believe it has the highest priority among the reconstructive methods for the lower and middle third of the ureter due to its iatrogenic injury. At present we completely discontinued the ligature removal from the ureter and its isolation from infiltrates and cicatricial conglomerates. From our point of view, there is no need to preserve the maximal length of the ureter at the expense of the blood supply of its distal part. The damaged part of the organ or the organ portion with doubtful blood supply, should be completely replaced. Ureteral reconstruction with the use of bladder tubular flap completely meets these requirements.

Among the early specific complications severe dysuria syndrome should be pointed out, which is more frequent in patients with reconstruction of the ureter up to the level of its upper third. In our opinion, this can be caused by significant reduction of bladder capacity due to creation of a flap with the maximum length. However, in most cases, dysuria events disappeared within one week after surgery, and the bladder capacity was restored within two months. Persistent reduction of the bladder capacity after one year was registered only in 2 out of 70 (2.9%) patients.

Assessment of the long-term results with an average follow-up period of  $24.6 \pm 3.4$  months suggests that total number of positive results (good + satisfactory result) was very high and amounted to 91.5%.

## CONCLUSIONS

The basis of the algorithm for providing medical care to patients with iatrogenic ureteral injury should be considered Boari bladder flap operation. This type of surgery makes it possible to completely replace the damaged or having doubtful blood supply portion of the ureter even with the defects extending to its upper third. The main advantages of this surgery technique are good blood supply of tubularized bladder flap and a high level of positive long-term results.

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### Authors' contributions:

*According to the order of the Authorship.*

### Conflict of interest:

*The Authors declare no conflict of interest.*

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