

## Extracorporeal ureter handling during laparoscopic pyeloplasty: tips and tricks for beginners

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**Introduction** Laparoscopic preparation of the ureter is a challenging part of upper urinary tract reconstruction, due to limited depth perception provided by the camera and lack of wristed motion of most laparoscopic instruments needed for adequate spatulation and scar tissue removal. One solution has been to perform the more difficult portions of the surgery in an extracorporeal manner. A hybrid intracorporeal-extracorporeal approach to upper tract ureteral reconstruction facilitates ureteral preparation at the stage of mastering the technique.

**Material and methods** This retrospective study included 100 patients with primary ureteropelvic junction obstruction, who underwent laparoscopic pyeloplasty from 2014 to 2017. The patients were stratified into 2 groups: those who underwent conventional laparoscopic surgery and those who were managed with the hybrid approach. For the hybrid approach, externalizing the ureter to skin level required additional mobilization of the upper urinary tract.

**Results** A total of 47 patients underwent conventional laparoscopic pyeloplasty and 53 – hybrid surgery. The maximum body mass index was 32. The hybrid approach was 8.5 minutes shorter compared to the conventional approach ( $p < 0.001$ ). No complications higher than Clavien-Dindo IIIb ( $n = 2$ ) were observed (in both groups). Complete success (the resolution of pain and/or hydronephrosis) was observed in 92.5% in the hybrid group and in 95.7% in the conventional treatment group.

**Conclusions** Hybrid pyeloplasty may be considered safe and effective. It has the advantage of making the surgery less challenging and time-consuming while offering improved precision. The advantages of the technique are particularly apparent during training. This technique can be recommended in the learning process of the surgeon.

**Key Words:** hydronephrosis ↔ ureteropelvic junction obstruction ↔ laparoscopic pyeloplasty ↔ extracorporeal ureter handling

## INTRODUCTION

The main reconstructive technique for ureteropelvic junction obstruction (UPJO) is pyeloplasty. Current principles of reconstructive surgery of the upper urinary tract require removal of the involved segments with subsequent creation of a water-tight, tension-free anastomosis. To do this, the tissue must

be handled delicately and precisely. While improved surgical equipment may contribute to improved outcomes, surgeon experience was often cited as the main indicator for successful surgery. Principles of reconstructive surgery of the upper urinary tract remain the same regardless of approaches used (open, laparoscopic or robot-assisted). During laparoscopy, preparing the surfaces of the urinary tract

for subsequent creation of anastomosis and intracorporeal suturing is generally regarded as the most technically challenging step. Inadequate laparoscopic instruments (especially for less experienced young surgeons) may be responsible for prolonged surgery and higher complication rates with the most severe complication being anastomotic stenosis [1, 2]. Therefore, a surgeon should perform such operations after extensive learning. Cases with narrow ureters are the most difficult to manage [3]. The above-mentioned aspects have led to some precise intracorporeal steps of laparoscopic reconstructive surgery becoming substituted with extracorporeal steps [4–7].

## MATERIAL AND METHODS

We retrospectively identified 100 patients with primary UPJO, who underwent laparoscopic surgical reconstruction (pyeloplasty) between 2014 and 2017. Patients were stratified into 2 groups: 47 (47%) underwent conventional laparoscopic surgery (completely intracorporeal) and 53 (53%) were managed with the hybrid approach (a combination of intracorporeal and extracorporeal surgery). We used the hybrid technique in the following cases: difficulties in introduction of scissors into the ureter lumen; severe narrowing, when it was more suitable to find the lumen using extracorporeal technique and microsurgical scissors; when additional resection of the ureter was necessary (usually during repeated surgery on the ureter to remove scar tissue). For the hybrid approach, externalizing the ureter to skin level required additional mobilization of the upper urinary tract. Patient demographics and clinical characteristics are shown in Table 1.

### The hybrid technique

The ports were placed in the standard configuration for the respective surgery being attempted. For the hybrid approach group, we installed an additional port directly above the region of interest under visual (laparoscopic) control. The positioning did not differ between the groups however. In the hybrid group, 2–6 cm of the middle third of the ureter were mobilized in addition to the upper third (in comparison to the conventional treatment group). The exact length of the additionally mobilized ureter was dependent on body mass index (BMI). The ureter was externalized through the closest port after the abdomen was desufflated. Skeletonization of the ureter was only performed at the intended site of the anastomosis. The extracorporeal stage included excision of the remaining renal pelvis, removal of scar tissue and spatulation with Pott's atraumatic scissors.

The ureter was stented with the help of a hydrophilic guidewire. After that, 4-0 vicryl stay suture was placed in the ureter (Figure 1). The ureter was then returned to the abdomen and the anastomosis was completed using the conventional technique.

All surgeries were carried out by a single surgeon. The Anderson-Hynes dismembered pyeloplasty was used for all cases. The stents were removed 28–35 days after surgery. Complete success was defined as the absence of pain in addition to a substantial decrease in upper urinary tract dilatation as seen on ultrasound or computed tomography (CT). We used low-dose contrast enhanced CT in order to assess the pelvis width and height, the pelvicalyceal system dilatation, and UPJ diameter. Partial success was defined as absence of pain, but no significant reduction in hydronephrosis. Failure was defined as either anastomotic stenosis, unresolved pain or worsening upper urinary tract dilatation. The 5-point verbal rating scale was used to evaluate pain intensity (Table 2) [8]. The results were assessed by two urologists (the surgeon and the cli-

**Table 1.** Patient demographics and clinical characteristics

Characteristics	Hybrid group (n = 53)	Conventional treatment group (n = 47)	p-value
Age, years	16–72 (37.68 ±15.37)	19–66 (39.36 ±12.75)	0.5966
Sex (M/F)	22/31	19/28	
Side (left/right)	20/33	29/18	
BMI	18.10–37.10 (24.49 ±4.69)	17.8–40 (23.67 ±5.17)	0.3557
Pain severity	1.19 ±0.96	1.38 ±0.767	0.3285
Aberrant vessels	12 (22.6%)	14 (29.8%)	0.1595
Stages of hydronephrosis (Onen's alternative grading system [9])			
2	44 (83.0%)	39 (83.0%)	0.0237
3	9 (17.0%)	8 (17.0%)	0.3225
Secondary stones, n (%)	11 (20.8%)	10 (21.3%)	0.3225

F – female; M – male; BMI – body mass index

**Table 2.** The 5-point verbal rating scale

Severity	Description
0	No pain
1	Mild pain
2	Moderate pain
3	Severe pain
4	Very severe pain

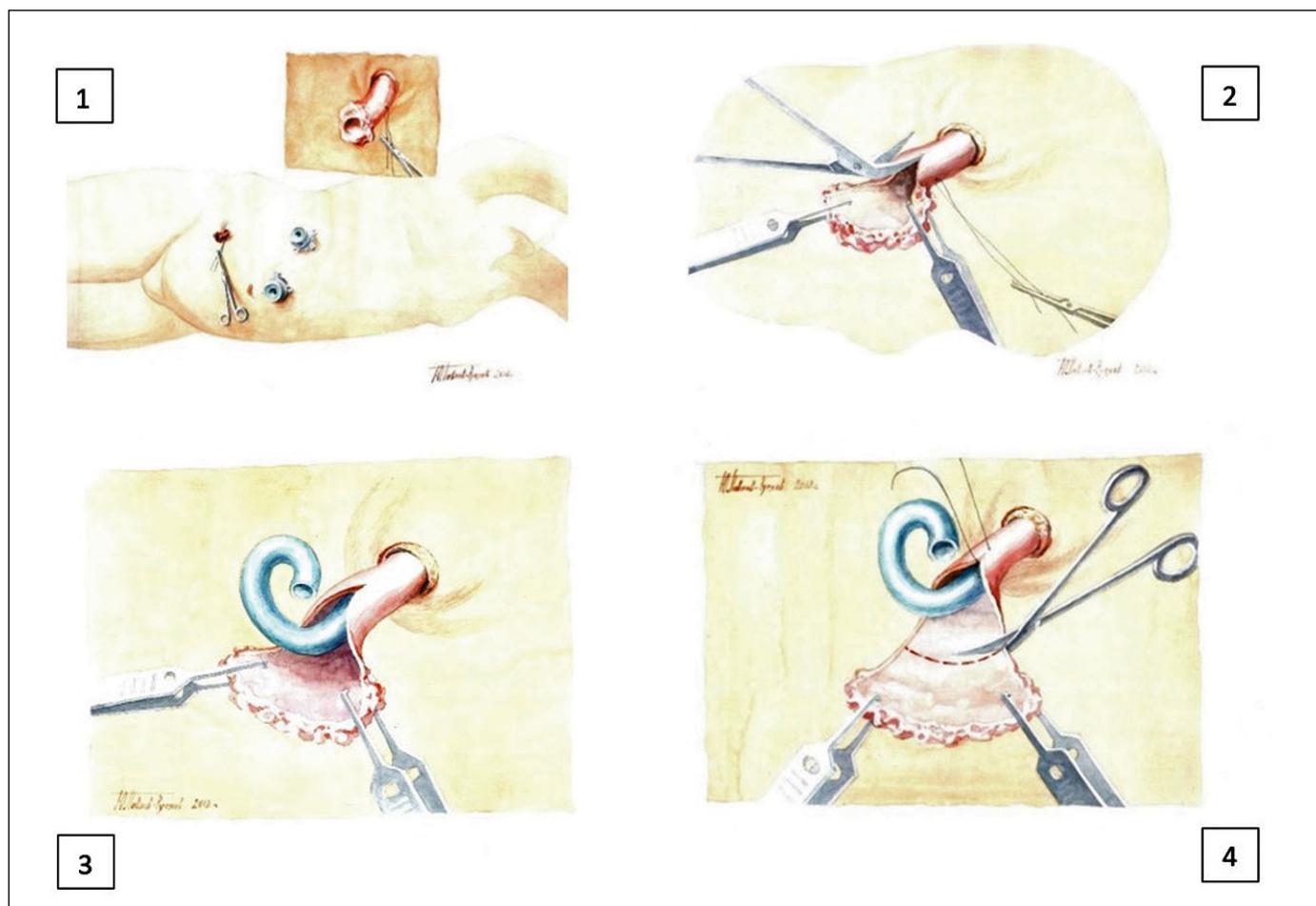


Figure 1. Steps of extracorporeal ureter handling.

nician) and a radiologist. Statistical analysis was carried out with the help of Pearson's chi-squared test.

## RESULTS

Table 3 compares postoperative outcomes of the two groups. Surgery lengths for intra- and extracorporeal manipulations were assessed and compared. In the hybrid group, the surgery was more time-efficient requiring, on average, 8.5 minutes less ( $p < 0.001$ ). In all cases the ureter was successfully externalized for extracorporeal handling. Maximum mobilization of the middle third of the ureter during laparoscopic pyeloplasty was close to 6 cm in a female patient with a BMI of 32.

The most severe complication was anastomotic failure. It was observed in 5 patients (9.4%) in the hybrid group and 3 patients (6.4%) in the conventional treatment group. In 2 cases, the anastomotic leak prompted laparoscopic peritoneal toilet, stent change and additional suturing to close the leak (Clavien-Dindo Grade IIIb). In other cases, stent change

Table 3. Postoperative outcomes

Parameters	Hybrid group (n = 53)	Conventional group (n = 47)	p-value
Surgery time, min	120–340 (222.17 ± 53.89)	165–360 (232.13 ± 54.01)	0.3411
EBL, ml	63.58 ± 23.46	50.74 ± 22.26	0.0137
Ureter handling stage, min	9.57 ± 0.86	16.25 ± 3.70	<0.0001
Complications, %	12 (22.6%)	4 (8.5%)	0.0476
Anastomotic failure, n (%)	5 (9.4%)	3 (6.4%)	0.1595
Pelvic tamponade, n (%)	5 (9.4%)	1 (2.1%)	0.0442
Acute pyelonephritis, n (%)	2 (3.8%)	0	0.1595
Patients available for follow-up, n (%)	51 (96.2%)	42 (89.4%)	0.0237
Pain severity (3 months after surgery)	0.30 ± 0.46	0.34 ± 0.48	0.6876
Complete success, %	49 (92.5%)	45 (95.7%)	0.1595
Partial success, %	4 (7.5%)	2 (4.3%)	0.1595
Anastomotic stenosis, %	0	0	

EBL – estimated blood loss

and/or percutaneous nephrostomy were enough (IIIa). Acute pyelonephritis that developed in 2 patients in the hybrid group (3.8%) responded to non-surgical treatment.

A total of 93 patients returned for follow-up in the clinic: 51 patients (96.2%) from the hybrid group and 42 patients (89.4%) from the conventional treatment group. Due to geographical factors, 2 patients of the hybrid group and 5 patients of the conventional treatment group filled questionnaires via telephone interview. Pain severity prior to and 3 months after surgery was  $1.23 \pm 0.97$  and  $0.32 \pm 0.47$  in the hybrid group and  $1.37 \pm 0.61$  and  $0.31 \pm 0.47$  in the conventional treatment group respectively.

Ultrasonography and low-dose contrast enhanced CT revealed no statistically significant differences in upper urinary tract dilatation between the groups. Thus, the outcomes were classified as complete success in 49 patients (92.5%) in the hybrid group and in 45 patients (95.7%) in the conventional treatment group. Partial success was observed in 4 cases (7.5%) in the hybrid group and in 2 cases (4.3%) in the conventional treatment group. The satisfactory outcomes were registered. None of the patients required revision.

## DISCUSSION

Surgical instruments remain a technological gap in reconstructive laparoscopic surgery. Despite the advent of smart instruments that are 3 mm in diameter, they are still relatively cumbersome, which often prevents surgeons from completing the most demanding steps of surgery quickly and precisely. The list of disadvantages of laparoscopic surgery is further expanded by the following factors:

- A. limited movement: the hands of a surgeon possess 7 degrees of freedom while laparoscopic equipment only allows for four [1];
- B. as a rule, no 3D-imaging, which leads to discoordination between the surgeon's eyes and hands;
- C. physiological tremor which easily reaches the working part of the long non-flexible instrument;
- D. challenges when placing ports to create optimal 'angles of attack' in patients with varying body types and renal topography [1, 2].

Furthermore, a number of needle holders lack ergonomic handles. The most time-consuming and challenging aspects of the intracorporeal technique for the novice laparoscopic surgeons were spatulation of the physiologically narrow ureter and precise suturing of the lower end of the spatulated and stented ureter. Inadvertent injury, tearing or crushing of such ureters with laparoscopic instruments is thus easy, especially at the stage of mastering the

technique. The issue of proper fixation of hollow organs and instruments inside them is yet to be solved. As a result, adequate sufficient spatulation of a narrow-mobilized ureter may sometimes prove a real challenge.

Despite possible troubles with ureter handling, laparoscopic pyeloplasty is an efficient treatment strategy, even for those with recurrent obstruction. Previously Guliev has described a technique using retroperitoneoscopic access based on 178 cases, which showed the effectiveness of the procedure and was associated with relatively little trauma, a quick recovery, and good cosmetic effects [10]. However, such a great efficiency is reachable only for experienced surgeons, whereas an unconventional technique of laparoscopic surgery has been developed to circumvent possible issues with residents benefiting from this the most [4–9]. In order to optimize anastomosis creation in patients with hydronephrosis at the stage of mastering laparoscopic pyeloplasty, we employed extracorporeal ureter handling. Effectiveness of a similar technique was previously well described by Nadu et al., who reported 20 successful cases of extracorporeal pyeloplasty [11]. The authors reported no failures, and only one stent-related complication. The main advantages of the extracorporeal technique over the intracorporeal approach are simplicity, precision, speed, absence of technical challenges due to limitations of laparoscopic instruments, absence of tremor and secure positioning of instruments in the novice surgeon's hands. The ureter handling stage lasted 8.5 minutes less on average due to faster ureter handling and stenting. The advantages of the extracorporeal approach are most evident in cases of physiologically narrow ureters where creating an adequate anastomosis is challenging even for an expert. The technique proved to be feasible in patients with BMI over 30. In flank position, the abdominal skin, adipose tissue and the contents of the abdominal cavity shift downward which substantially eases ureter externalization. In such patients careful planning of the iliac working port positioning is of paramount importance. Apart from that, additional mobilization of 4–6 cm of the middle third of the ureter is needed. As our results show, additional mobilization has no influence on postoperative urodynamics.

## Limitations

The conventional treatment group included 47 patients who underwent conventional laparoscopic pyeloplasty. These patients received treatment while the technique was still being integrated into practice. We are well aware of the possibility that once

a surgeon achieves proficiency, the time difference between the modifications may become less significant. However, under any circumstances, we consider extracorporeal ureter handling a more precise and less demanding technique. Time improvement of 8 minutes, despite being statistically significant, may not influence the outcomes very much. Therefore, we consider that the main advantage of the technique is an ability to employ it in difficult cases, even in less experienced hands.

## CONCLUSIONS

Extracorporeal ureter handling may be employed during laparoscopic reconstructive pyeloplasty at the stage of mastering the technique. Apart from offering additional precision and ease of anastomosis creation, the extracorporeal approach allows for

shortening surgery. The technique may also be recommended for patients with physiologically narrow ureters where intracorporeal spatulation, stenting and placing the first stitch can be difficult. Hybrid pyeloplasty requires additional partial mobilization of the middle third. In cases of high BMI, the mobilized middle third of the ureter may be as long as 6 cm. Additional mobilization of the ureter to the extent described above does not affect the anastomosis, upper urinary tract and the outcomes in general. We thus consider extracorporeal ureter handling a good aid for any surgeon practicing laparoscopic reconstructive surgery on the upper urinary tract, especially at the stage of mastering the technique.

## CONFLICTS OF INTEREST

All authors state that they have no conflict of interest that might potentially bias their work.

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