

Complete laparoscopic nephroureterectomy with thermo-sealing system

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KEY WORDS

ureter ▶ urothelial carcinoma ▶ nephrectomy ▶ laparoscopy ▶ transplantation

ABSTRACT

Introduction. We present our opinions with complete laparoscopic nephroureterectomy (CLNUE) using a thermo-sealing device and a main disadvantage of this technique.

Material and method. From 4/2008 to 12/2009, 19 CLNUEs were performed. Standard laparoscopic nephrectomy (NE) is followed by laparoscopic liberation of ureter which is divided from urinary bladder with bladder cuff by Ligasure® Atlas.

Results. The mean time was 126 (86-160) min, blood loss 58 (0-200) ml. On one woman, a CLNUE was performed ipsilaterally on a transplanted kidney. There was only one complication: a urinary tract infection with *E. coli*. The mean hospital stay was 6.7 (3 to 11) days. Follow-up is known in all patients – mean 11 (1-25) months. The results of the check-up endoscopy are known in 14 cases and in six an intact ureteral orifice was found, which corresponds to insufficient excision of the orifice.

Conclusion. CLNUE is a fast and safe surgery. There is a significant risk to the remaining part of the intramural ureter *in situ* in a less radical approach to the ureterovesical junction. Due to this reason, we are looking for another more reliable method of mini-invasive NUE. CLNUE (including division of the whole ureter in the minor pelvis as well) is feasible even ipsilaterally on a transplanted kidney.

INTRODUCTION

In spite of expanding indications for conservative surgery for transitional cell carcinoma (TCC) of the upper urinary tract (UUT), radical nephroureterectomy (NUE) with the complete removal of the distal ureter including the bladder cuff is the standard care for most patients with TCC of UUT. While laparoscopic nephrectomy as a part of NUE, first described in 1991 [1], has become broadly accepted to-date [2, 3], the approach to the distal ureter and the ureterectomy's timing are still in dispute. Many techniques have been developed to remove the distal intramural ureter during laparoscopic nephroureterectomy. Complete laparoscopic NUE (CLNUE) was previously performed with a stapler [4], however



Fig. 1. Abdomen of patient shortly after complete laparoscopic nephroureterectomy of a native right kidney ipsilateral to the transplanted kidney. Size of all five ports in mm is marked. Final incision for extraction of specimen crossed over scar from transplantation. Arrows show ends of scar following transplantation.

there is a risk of tumor residue in the stapling site [5-7] and titan clips can cause the formation of cystolithiasis [8]. Tsivian et al. [9] described a technique of thermo "sealing" the bladder wall with a bipolar coagulation while utilizing feedback control of a computer by the impedance of the sealed tissue (Ligasure®) in 13 cases. Ligasure was used by Simone et al. [10, 11] as well. Nagele et al. [12] published the same technique with a similar instrument EnSeal® Erbe in one case report and they named this technique, "thermo-fused bladder cuff resection in NUE". We thought this modification of CLNUE with thermosealing systems could remove the aforementioned disadvantages. We want to show the applicability of this technique in clinical practice as well as to describe the advantages and disadvantages of this technique.

MATERIAL

From 4/2008 to 12/2009, 36 patients with suspected TCC of UUT were treated at our institution. Ten patients underwent open surgery (complete or at least open ureterectomy) and seven underwent endoscopic conservative treatments. Nineteen CLNUEs were performed with a thermosealing system and they were evaluated in detail.

Technique of the operation: The laparoscopic nephrectomy is performed initially via a transperitoneal approach in a flank position. After abdominal insufflation with a Veress needle, trocar access is obtained. A 4-trocar configuration is used on the left side

Table 1. Results.

Patient No.	Sex	Side	Localization	Age	pT	Grade	Histology	Follow-up (months) until 31.12.2009	Time of operation (min)	Blood loss	Weight of specimen	Hospitalization (days)	Complications	Results of follow-up, notes
1	M	R	Pelvis	68.7	3a	2	CRCC	20.5	140	200	703	8	0	OK
2	M	R	Pelvis	76.2	3	3	TCC	12.1	130	50	580	7	0	Unrelated death after 12.1 months
3	M	R	Ureter proximal	58.3	2	2	TCC	18.5	130	100	540	5	0	Postoperative cystoscopy: intact ureteral orifice
4	F	L	Pelvis	57.3	a	3	TCC	18.5	110	100	280	3	0	Tx kidney, repeated TUR
5	F	R	Pelvis	75.0	0	0	XGPN	18.0	150	150	480	5	0	OK, no endoscopy
6	M	R	Ureter distal	63.2	1	2	TCC	17.3	150	50	1067	11	0	Postoperative FC: intact ureteral orifice
7	M	L	Pelvis	71.8	1	1	TCC	15.7	160	100	625	8	0	OK
8	F	R	Pelvis	60.0	a	1	TCC	15.7	135	50	430	7	0	OK
9	F	L	Ureter middle	61.9	a	1	TCC	13.2	115	20	300	6	0	After 6 months TUR for TCC pTaG1 at intact ureteral orifice
10	F	L	Pelvis	80.3	0	0	Oncocytoma	13.0	105	0	430	7	0	OK, no endoscopy
11	M	R	Ureter distal	57.4	a	1	TCC	11.5	130	0	350	6	0	After 4 months RRP, after 10 months TUR of multiple tumors including left orifice
12	M	R	Pelvis	63.2	1	1	TCC	9.7	135	30	421	7	0	Postoperative FC: intact ureteral orifice
13	M	L	Pelvis	68.9	2	2	TCC	7.8	90	30	410	5	UTI	OK
14	F	R	Pelvis	78.9	1	2	TCC	6.9	125	20	210	5	0	OK
15	F	R	Pelvis	74.3	1	2	TCC	6.7	86	40	350	8	0	Postoperative FC: intact ureteral orifice
16	M	L	Pelvis	73.1	1	2	TCC	6.2	127	50	900	8	0	pN1 – chemotherapy
17	F	L	Pelvis	71.3	a	1	TCC	1.6	102	0	400	7	0	OK, no endoscopy
18	F	R	Pelvis	65.4	1	1	TCC	0.8	135	50	410	7	0	OK, no endoscopy
19	F	L	Ureter distal	64.5	1	1	TCC	0.6	135	50	410	8	0	panHE, no endoscopy
Average				67.1				11.3	125.8	57.4	489.3	6.7		
Standard deviation				3.7				6.3	20.0	52.3	212.4	1.7		
Minimum				64.5				0.6	86.0	0.0	210.0	3.0		
Maximum				71.3				20.5	160.0	200.0	1067.0	11.0		

Abbreviations: CRCC – clear renal cell carcinoma, F – female, FC – flexible cystoscopy, L – left, M – male, panHE – radical hysterectomy with bilateral adnexectomy, pN1 – in kidney specimen, parahilar lymph node with metastasis of TCC was found by pathologist, R – right, RRP – robotic radical prostatectomy, TCC – transitional cell carcinoma, TUR – transurethral resection of bladder tumor, UK – unknown, UTI – urinary tract infection with E. coli 6th postoperative day, XGPN – xanthogranulomatous pyelonephritis, Tx – transplanted.

Notes: all cases cN0cM0

(Fig.1). On the right side, one more 5 mm trocar is added close to the xyphoid process – here a grasper fixed to the diaphragm for the elevation of the liver is introduced. A standard laparoscopic nephrectomy without division of ureter is performed. The ureter is then dissected distally to the iliac vessels at which point the ureter is clipped (to minimize the potential risk of distal tumor seeding)

and left *in situ*. One more trocar (10 mm) is introduced above the pubic symphysis in the mid line (Fig. 1). Gonadal vessels are transected with Atlas®. The peritoneum is incised above the ureter up to the urinary bladder. The balloon of the catheter is clearly visible in the empty urinary bladder in most cases. Along and under the iliac vessels, the ureter is dissected with a harmonic scalpel or

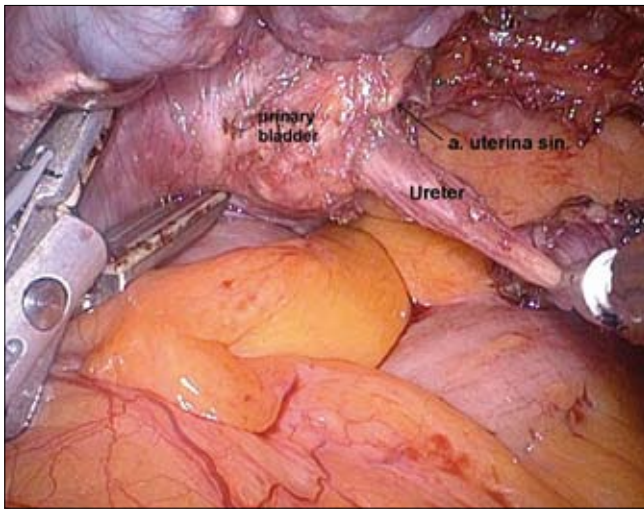


Fig. 2. The view to the pelvis from the right side after complete laparoscopic nephroureterectomy. A completely liberated right ureter is drawn, the urinary bladder is elevated and an intact uterine artery is clearly shown.

Ligasure® Advance®. This phase is tedious due to the relatively narrow operative space and the close relation to the iliac vessels and the bowel. The detrusor muscle fibers at the ureterovesical junction are identified. The ureter is then retracted superiorly and laterally, tenting up the bladder wall at the ureterovesical junction (Fig. 2). A 1.0 cm area of bladder adventitia around the ureterovesical junction is cleared, and a bladder cuff is incised with the use of a 10 mm Ligasure® Atlas®. The uterine artery can be spared. Additional sutures on the bladder wall are not required. A pelvis drain is placed through a 10 mm port in the suprapubic area. The specimen is extracted through a lower abdomen muscle splitting incision in a bag. Fig. 1. The urinary catheter is left for 5-6 days. A standard postoperative follow-up is conducted according to established protocols of UUT TCC.

We were able to complete all planned CLNUEs through the laparoscopic approach. However, in case of difficulties in the minor pelvis, CLNUE can be converted to an open distal ureterectomy or to an "antegrade mini-invasive NUE" [13]. All CLNUEs were performed by a single surgeon skilled in laparoscopy.

RESULTS

The results are shown in detail in the table. We want to emphasize only some details. The mean time of the operation was 125.8 ± 20.0 (86-160) min. Only one complication was recorded: a urinary tract infection. In one woman, a CLNUE was performed ipsilaterally on a transplanted kidney. A similar case was not published to date.

Patients with non-TCC histology were thought to be TCC by preoperative imaging and non-TCC histology were set by pathologist only. The follow-up is known in all patients, but it is too short. The results of the check-up endoscopy are known in 14 and in 6 (42.9%) the ureteral orifice was found intact, representing the insufficient excision of the orifice (Figs. 3, 4). In two patients, a TCC was found and a TURP was performed after 7 months in one patient and 10 months in the other following the CLNUE (Fig. 4).

DISCUSSION

We do not want to discuss the entire comprehensive problem of NUE. We recently reviewed it from our point of view [13] and now we will discuss only complete antegrade laparoscopic NUE (without need of endoscopy) with stress on the method of remov-

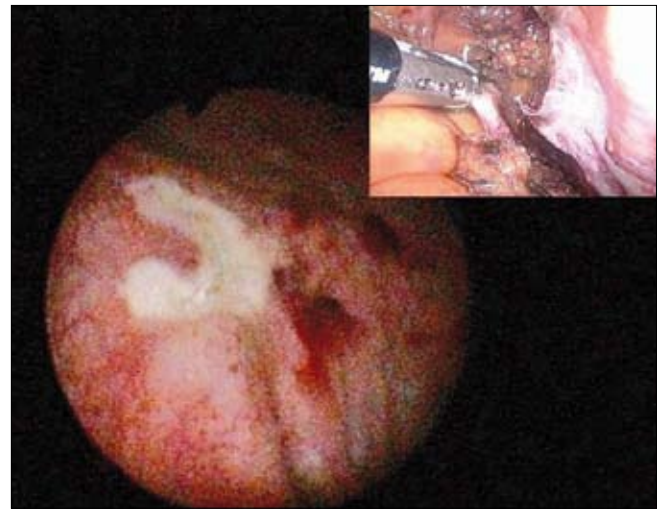


Fig. 3. Right side nephroureterectomy. Peroperative flexible cystoscopy (performed in one case only) shows white coagulation necrosis in the shape of a horseshoe; intact distal part of ureter with orifice is visible under the necrosis. In the upper right corner: Ligasure® Atlas clipping the ureterovesical junction in the same patient is visible.

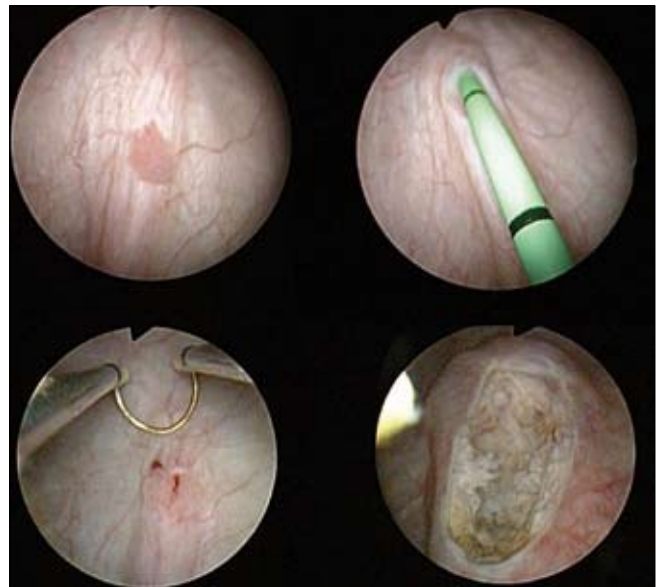


Fig. 4. Endoscopy 7 months later following complete left side laparoscopic nephroureterectomy. Intact left ureteral orifice 5 mm of depth (measured by introduced ureteral catheter) with small pTaG1 tumor. Rest of ureter with tumor was resected.

ing the distal part of the ureter including the bladder cuff. The method using a stapler can be abandoned due to the aforementioned disadvantages. The other options for distal ureterectomy as a part of CLNUE are as follows: thermosealing technique [9-11], sharp excision of a bladder cuff with intracorporeal suturing (purely laparoscopic [14, 15] or robotic [16] or purse-string technique [17]), or the pneumovesicum approach [18].

In the purse-string technique [17], laparoscopic nephrectomy and dissection of the ureter are performed. A purse-string suture is applied at the edge of the dissected bladder and the ureteral cuff is sharply excised under vision. We think this technique is technically more challenging and time consuming (the mean time of the operation was 226 min).

Distal ureterectomy as a part of CLNUE can be performed through the pneumovesicum approach [18]. Three 5 mm ports are introduced to the bladder insufflated with CO₂ pneumovesicum

(10-12 mm Hg). The distal ureter, bladder cuff, and intramural ureter are then completely dissected free using electrocautery. As soon as the distal ureter is dissected, an endo-loop knot is used to ligate the ureter. We don't have experience with this technique and we consider this technique to be complicated.

A further variant of CLNUE was described by Hemal et al. [14] and confirmed by Hattori et al. [15]. Retroperitoneal nephrectomy is followed by dissection of the ureter which is detached with the bladder cuff using scissors and the opened bladder wall is closed with a running suture. This looks like an excellent method. However, this method is probably very challenging and more time consuming for surgeons. The average time of simple dissection and detachment of the ureter with the following suture was 87 min [15]. A similar method using the laparoscopic approach and the da Vinci robotic system, published recently by Hu et al. [19] and Park et al. [16], decreases the technical difficulty of intracorporeal suturing. The disadvantages of the da Vinci system include high cost, a lack of tactile sensation, and increased set-up time. They performed nine [19] and 11 procedures [16]; the mean time was 303 and 193 minutes (in the latest 5 procedures).

Now we want to discuss the advantages and disadvantages of CLNUE with a thermosealing system. We regard the short operation time as the main advantage of this procedure. Tsivian et al. [9] had a mean time of 215 minutes (170-215). We reviewed [13] operative times of laparoscopic NUES in different series and we can conclude that CLNUE, in our present series, was the fastest one [126 (90 -150) min.]. However, a recently published study by Simone et al. [11] showed the mean operative time of laparoscopic NUE at only 82 (50- 140) minutes and in open NUE 78 (35-140) minutes. All 80 procedures (40 plus 40 in prospective randomized studies) were probably performed by a single extremely skilled surgeon. CLNUE with a thermosealing system eliminates further disadvantages of other types of contemporary NUE (repositioning, endoscopy, breach of the UUT, and intracorporeal suturing). The main disadvantage is probably the risk of the intramural part of the ureter remaining intact as it is described for the first time in our presented results. In the original article by Tsivian et al. [9] the ipsilateral ureteral orifice was absent in all patients on control cystoscopy

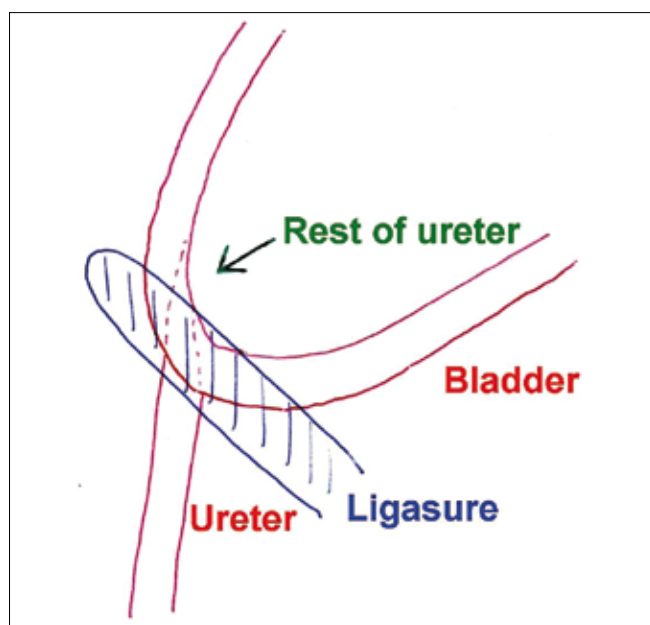


Fig. 5. Scheme of dissection of remaining ureterovesical junction with Ligasure® instrument Atlas® and explanation of possibility of incomplete excision of ureterovesical junction.

3 months after the surgery. Simone et al. did not mention the ureteral orifice remaining intact either [11]. We have found the intramural part of the ureter intact in 42.9% of patients. It is (in comparison with previous reports [9, 11]) probably due to our less radical approach with efforts for minimal complications and furthermore in women for sparing the uterine artery as well (Fig. 2, 5). Of course it is a complication, but fortunately the remaining intact ureteral orifice is accessible to be regularly checked by cystoscopy and it is possible to resect the remnants of the ureter (Fig. 4). Prevention of a remaining ureteral orifice is a more aggressive resection of the ureterovesical junction with a Ligasure® or another type of surgery to remove the distal ureter. We cannot present long term oncological results of CLNUE, but Simone et al. in their prospective study with this technique presented comparable results to open NUE. The mean follow-up was 44 months (range: 6-70) [11].

Conclusion: Due to a significant risk of the remaining part of the intramural ureter *in situ*, we decided to abandon the technique with the thermosealing system and modify our technique of CLNUE. We combined it with endoscopy and excision of the ureterovesical junction, but with a simple method of occluding the ureter (with endo-loop [20], Hem-o-lok® clip [21], or fibrin sealant [22]) thus preventing spillage of tumor cell bearing urine during laparoscopic pluck nephroureterectomy. CLNUE is even feasible ipsilaterally on a transplanted kidney, avoiding open ureterectomy [23].

Acknowledgments:

This work was supported by the Czech government research project MSM 0021620819.

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