Complete transperitoneal laparoscopic nephroureterectomy in a single position with upper urinary tract urothelial carcinoma and comparative outcomes

Author names, affiliations and E-mail

Chengwu Xiao △, Yang Wang △, Meimian Hua, Wei Zhang, Guanyu Ren, Bin Yang, Qing Yang *

Department of Urology, Changhai hospital affiliated to The Navy Medical University, Shanghai, People’s Republic of China

△ These authors contributed to the work equally.

Chengwu Xiao E-mail: chengwu.xiao@163.com

Yang Wang E-mail: oceansayhello@126.com

Meimian Hua E-mail: huamm19@163.com

Wei Zhang E-mail: zhweismmu@163.com

Guanyu Ren E-mail: 15850177665@163.com

Bin Yang E-mail: 714540373@qq.com

*Corresponding author

Qing Yang*

Department of Urology, Changhai hospital affiliated to The Navy Medical University, Changhai road No.168, People’s Republic of China

Tel: +86-21-31161721

E-mail: 13917781662@163.com
Abstract

Background:
To describe techniques for complete transperitoneal laparoscopic nephroureterectomy for upper urinary tract urothelial carcinoma (UTUC) with a single position and here to report our outcomes.

Materials and methods:
Between January 2016 and June 2019, our group performed 50 complete transperitoneal laparoscopic nephroureterectomy (CTLNU) and 48 laparoscopic nephroureterectomy with open bladder cuff excision (LNOBE) for UTUC without metastases in our group. The clinical data were collected and analyzed retrospectively.

Results:
All 98 patients of radical nephroureterectomy performance were successfully without transferred into open surgery. No significant difference was found in patient’s clinical characteristics. Compare with LNOBE group, the CTLNU group had shorter operative time (98.5 ± 40.3min vs 132.4 ± 60.2min), less blood loss (60.4 ± 20.3ml vs 150.6 ± 50.2ml), shorter length of hospital stay (5.3 ± 2.2d vs 8.1 ± 2.3d), and shorter length of incision (6.3 ± 1.2cm vs 11.5 ± 3.2cm). Pathological stage, tumor grade, recurrence rate was similar between these two groups.

Conclusions:
Complete transperitoneal laparoscopic nephroureterectomy (CTLNU) in a single position had advantages of shorter operation time, less blood loss, and shorter incision length. This operative method could minimize invasive and accelerate recovery of
patients which deserved clinical application and promotion.

**Key words**

Urinary Tract urothelial Carcinoma, Laparoscopy, Nephroureterectomy, a single position
Upper urinary tract urothelial carcinoma (UTUC) rate is only 5-7% of all urothelial carcinoma cases[1]. It is frequently located in renal pelvis and with high frequency of bladder recurrence. Radical nephroureterectomy with the removal of the bladder cuff is the ‘gold standard’ surgery procedure for upper urinary tract urothelial carcinoma[2]. Traditional open nephroureterectomy (ONU) with excision of a cuff of bladder around the ureteral orifice, which required two incision and associated with significant postoperative pain and morbidity[3,4]. Laparoscopic nephroureterectomy with open bladder cuff excision (LNOBE) is one of the pattern surgery for UTUC, the drawback of this surgery required two positions and a larger midline incision in the lower abdomen for bladder-cuff resection. The advantage of complete transperitoneal laparoscopic nephroureterectomy (CTLNU) without re-positioning and re-sterilizing, which was considered a minimally invasive, safe and effective method[5].

Until June 2019, complete laparoscopic nephroureterectomy were performed in 50 cases of UTUC in our group. In this study, the effectiveness of CTLNU was without re-positioning and re-sterilizing. The aim of the study is to introduce this novel technique, which can reduce surgical trauma and promote faster recovery of patients.

METHODS:

Patients

Between January 2016 and June 2019, 98 patients for pathologically or imaging were confirmed upper urinary tract urothelial carcinoma (UTUC). All patients were
evaluated before surgery using IVU, CT or MRI and cystoscopy. Diagnosis in 91 patients was confirmed by cytology. Ureteroscopy with biopsy and cytology was performed in cases of diagnostic doubt in 7 cases. Patient characteristics, demographic data, tumor stage, histological grade were recorded and compared.

**Operating technique**

**Complete transperitoneal laparoscopic nephroureterectomy (CTLNU)**

After the induction of general anaesthesia, a nasogastric tube and transurethral catheter were placed to decompress the stomach and bladder. The patient was placed in a 45-degree flank position to confirm safe(Fig1). Trocar arrangement and incision wound were showed in FIG2A, which were similar to the standard radical laparoscopic transperitoneal nephrectomy[6,7]. The different is that the camera port was at the site of lateral margin of rectus abdominis muscle. Further dissection into the pelvis is only possible after insertion of an additional 5-mm trocar, at the lower abdomen, in the midline between the umbilicus and the xiphoid process.

Before the operation started, let the operating table rotates about 30 degrees to the ventral side, similar position like laparoscopic radical nephrectomy, which could help us to easy exposure renal hilum and resection kidney. Exposure is performed initially by mobilization of the bowel via an incision along the line of Toldt down to the pelvic brim. The ureter is identified, dissected, and clipped with hemo-lok at the pelvic brim to prevent tumor seeding into the lower tract mobilization of the ureter distally toward the urinary bladder. Dissecting and cutting off the renal artery and vein, the kidney was completely excised when it was free along the perirenal fascia and adrenal gland
was preserved.

After this, let the operating table rotates dorsal about 60 degrees, head low and foot high, similar position like the cystectomy to exposure the lower ureter and bladder cuff. The surgeon changes the direction of the camera and working trocars toward the pelvis without the need for patient repositioning. Ureter dissection is continued caudally until the detrusor muscle fibers at the ureterovesical junction are identified. A 1-cm area of bladder adventitia around the ureterovesical junction is cleared, and a bladder incised longitudinally medial to the insertion of the ipsilateral ureter. An adequate bladder cuff is then excised with visual confirmation of the ipsilateral orifice. The bladder defect is closed with continuous suture using a 3-0, 15-cm V-lock suture, secured at both ends with hemo-lok. The bladder is filled and the repair checked for watertightness.

The entire specimen extracted en bloc within an impermeable organ bag, through enlarged transrectus abdominal incision. Two suction drains were placed in the perivesical space and the perirenal space.

**Laparoscopic nephroureterectomy with open bladder cuff excision (LNOBE)**

After the induction of general anaesthesia, a nasogastric tube and transurethral catheter were placed to decompress the stomach and bladder. The patients were placed in a 90-degree full flank position, and 3 laparoscopic ports were placed as standard radical nephrectomy(Fig3). The ureter is also lipped with hemo-lok at the pelvic brim to prevent tumor seeding into bladder. When kidney was completely excised and adrenal gland was preserved, we change the patients into a flat position,
re-disinfecting and re-lay the sheets.

The median incision of the lower abdomen is selected, ureter dissection is continued caudally until the detrusor muscle fibers at the ureterovesical junction are identified. A 1-cm area of bladder adventitia around the ureterovesical junction is cleared and clamped with right angled forceps, the ureteric orifice and bladder mucosa was resected. The defect of bladder wall was closed with continuous suture using 3-0 absorbable suture on muscle and mucosa. The entire specimen extracted en bloc through lower abdominal incision. Two suction drains were placed in the perivesical space and the perirenal space.

**Postoperative care**

All patients underwent immediate bladder irrigation with Hydroxycamptothecin (15 mg dissolved in 50 mL physiological saline) in 24h after surgery.

Follow-up was calculated from the date of surgery to the date of the most recent documented examination. A physical examination and cystoscopy were performed every 3 months in first and second years, and every 6 months yearly thereafter. CT or MRI was performed every 6 months in the first year, and one yearly thereafter.

**Statistical Analysis**

Propensity score matching was performed between patients in these two groups, the data was analyzed by using the SPSS 23.0 software. The chi-square test or Fisher exact test was used to determine any significant differences in the normal data. A Student’s t-test was used to analyze differences in continuous variables. Statistical significance was accepted at $P < 0.05$. 
RESULTS

All laparoscopic procedures were performed successfully, without conversion to open surgery or major complications. The character of patients was showed in Table 1. There was no significant difference in age, side, ASA score, gender, tumor location of these patients who underwent CTLNU and LNOBE.

To analyze the priority and feasibility of CTLNUs, we evaluated the operative time, blood loss, recovery of bowel function, hospitalization time and incision length. In CTLNU group, these indexes were all less than LNOBE group, the mean operative time was 30 minutes less, the mean blood loss was 90 ml less, the hospital stay length was 2 days less, the incision length was 6.3cm and 11.5cm, respectively(P<0.05).

The final pathological examination revealed that the margins of the bladder cuff were negative in all patients. Postoperative pathological examination revealed that the T stage was similar in both groups. The results showed that this surgical method could reduce surgical trauma and promote faster recovery of patients.

DISCUSSION

The incidence of UTUC is much lower than the bladder urothelial carcinoma, accounting for about 5 to 7% of upper urinary tract tumors[1]. Radical nephroureterectomy is the “golden” surgical procedure[2,3]. Nowadays en bloc dissection of kidney, ureter and bladder cuff is the key and standard method for treating UTUC[4,5].

Laparoscopic nephroureterectomy was first performed by Clayman in 1991, which has been proved as a safe and reproducible, mini-invasive technique for upper urinary
tract urothelial carcinoma (UTUC)[6,7,8]. Postoperative pain, length of hospital stay, and convalescence period have all decreased[9,10]. It has been demonstrated that LNU can achieve the same oncologic efficacy, tumor-free margins and recurrence rates, regardless of the type of laparoscopic approach used[11,12].

The “standard” laparoscopic nephroureterectomy (LNU) technique has not been defined and continues to evolve. To date, a number of methods, including open excision[13], cystoscopic detachment and ligation[14], transurethral resection[15], laparoscopic stapling[16], and ureteric intussusception[17], have been presented for managing the distal ureter in LNU. However, no consensus has been achieved with respect to the best method of approaching the distal ureter and bladder cuff.

Patients under CTLNU needn’t to re-positioning, re-sterilizing and re-draping. Compared with the conventional procedure, our procedure has the following features:

(1) The anatomical positions of the trocars are similar as traditional transperitoneal approach and the establishment of them are relatively simple for surgery with laparoscopic experience. (2) The operation performed transperitoneal approach has clear anatomical landmarks and wide operating space. (3) With good operating space and vision for bladder incision, we can make sure the bladder sutured properly, which can reduce postoperative catheter indwelling time. (4) There isn’t need to re-positioning and re-sterilizing, the operation procession can be achieved by nurse’s help which can save about 30mintus. (5) The median incision of lower abdomen in LNOBE also needs to expose the lower ureter, but the extended incision of camera is only used for specimen removed in CTLNU, which is relatively less invasive. (6)
camera port enlarged at the site of lateral margin of rectus abdominis muscle as incision position to remove the specimens can minimize muscle damage and facilitate recovery after surgery.

Compared with LNOBE, the patients under CTLNU needn’t to re-positioning, re-sterilizing and re-draping. The operation position can be attended by change the operating bed angel. There are obviously benefits for the patient who undergoes a CTLNU: less postoperative discomfort, shorter hospital stay, a better cosmetic result, a brief convalescence and oncologic efficacy.

Our study is only respective study but not prospective study, further studies must need using a great number of patients with a longer follow-up period to confirm the advantage of this methods.

CONCLUSION

Although the sample in our study is small, the good results suggest that CTLUN applied to manage the distal ureter and bladder cuff is technically feasible and safe. Our technique offers a complete transperitoneal laparoscopic nephroureterectomy that adheres to oncologic principle without need for patients repositioning, complex endoscopic procedures either before or after nephrectomy.

Although the technique efficiency and initial results are promising, the further study with more patients and with longer follow-up results needed to confirm the efficacy of this technique.

LIST OF ABBREVIATIONS

1. urinary tract urothelial carcinoma UTUC
2. complete transperitoneal laparoscopic nephroureterectomy CTLNU
3. laparoscopic nephroureterectomy with open bladder cuff excision LNOBE
4. laparoscopic nephroureterectomy LNU
5. American Society of Anesthesiologists ASA

**Declarations:**

**Ethics approval and consent to participate**

All patients in our research provided informed consent before the treatment. All procedures in this research were performed in accordance with the principles of the Research Ethics Committee of the Affiliated changhai Hospital of The Navy Medical University.

**Consent for publication**

Not applicable.

**Availability of data and materials**

The data used and analyzed in this research can be obtained from the corresponding author with a reasonable request.

**Competing interests:**

All authors declare that they have no competing interests.

**Funding**

Not applicable.

**Author contributions:** Qing Yang is the corresponding author and responsible for research supervision, coordination, and strategy. Chengwu Xiao is the first author. Yang Wang is the co-first author. Yang Wang, Meimian Hua, Guanyu Ren, Bin Yang
collected clinical data. Chengwu Xiao, Wei Zhang wrote this paper and made statistics and analysis of the data. All authors discussed and approved the manuscript;

Acknowledgements

Not applicable

Authors' information

Chengwu Xiao is the first author. Yang Wang is the co-first author.

Department of Urology, Changhai hospital affiliated to The Navy Medical University, Shanghai, People’s Republic of China

*Corresponding author

Qing Yang

Department of Urology, Changhai hospital affiliated to The Navy Medical University, Changhai road No.168, People’s Republic of China

Tel: +86-21-31161721

Fax: +82-21-35030006

E-mail: 13917781662@163.com

References

1. WS Tan, A Feber, R Sarpong, P Khetrapal, S Rodney, R Jalil, H Mostafid, J Cresswell, J Hicks, A Rane. Who should be investigated for haematuria? Results of a contemporary prospective observational study of 3556 patients. Eur Urol. 2018; 74:10–14.

2. Shengxian Li, Yuchen Pan, Jinghai Hu. Oncologic outcomes comparison of partial
ureterectomy and radical nephroureterectomy for urothelial carcinoma. BMC Urol. 2019; 19: 120.

3. Feng Liu, Wei Guo, Xueying Zhou, Youpeng Ding, Yanan Ma, Yi Hou, Xiangbo Kong, Zhixin Wang. Laparoscopic versus open nephroureterectomy for upper urinary tract urothelial carcinoma: a systematic review and meta-analysis. Medicine (Baltimore) 2018, 35: e11954.

4. Thomas Seisen, Benoit Peyronnet, Jose Luis Dominguez-Escrig, Harman M. Bruins, Cathy Yuhong Yuan, Marko Babjuk, Andreas Böhle, Maximilian Burger, Eva M. Compérat, Nigel C. Cowan, Eero Kaasinen, Joan Palou, Bas W. G. van Rhijn, Richard J. Sylvester, Richard Zigeuner, Shahrokh F. Shariat, Morgan Rouprêt. Oncologic outcomes of kidney-sparing surgery versus radical nephroureterectomy for upper tract urothelial carcinoma: a systematic review by the EAU non-muscle invasive bladder cancer guidelines panel. Eur Urol. 2016; 6: 1052-68.

5. Liu W, Wang Y, Zhong Z, Jiang H, Ouyang S, Zhu L, Xu R. Transperitoneal versus retroperitoneal laparoscopic nephroureterectomy in the management of upper urinary tract urothelial carcinoma: a matched-pair comparison based on perioperative outcomes. Surg Endosc. 2016; 30: 5537-41.

6. Clayman RV, Kavoussi LR, Figenshau RS, Chandhoke PS, Albala DM. Laparoscopic nephroureterectomy: initial clinical case report. J Laparoendosc Surg. 1991; 6:343–9.

7. Benoit Peyronnet, Thomas Seisen, Jose-Luis Dominguez-Escrig, Harman Max Bruins, Cathy Yuhong Yuan, Thomas Lam, Steven Maclellan, James N’dow,
Marko Babjuk, Eva Comperat, Richard Zigeuner, Richard J. Sylvester, Maximilian Burger, Hugh Mostafid, Bas W. G. van Rhijn, Paolo Gontero, Joan Palou, Sharokh F. Shariat, Morgan Roupret. Oncological outcomes of laparoscopic nephroureterectomy versus open radical nephroureterectomy for upper tract urothelial carcinoma: an European Association of Urology guidelines systematic review. Eur Urol Focus. 2019;2: 205-23.

8. Chao Zhang, Fu bo Wang, Xiao lei Shi, Fei Guo, Hui qing Wang, Yue Yang, Xiao feng Gao, Bo Yang. Direct lateral access to renal artery during transperitoneal laparoscopic partial nephrectomy: surgical technique and comparative outcomes. Urology. 2018; 120: 120–4.

9. Makito Miyake; Nobutaka Nishimura; Katsuya Aoki; Chihiro Ohmori; Takuto Shimizu; Takuya Owari; Shunta Hori; Yosuke Morizawa; Daisuke Gotoh; Yasushi Nakai; Satoshi Anai; Kazumasa Torimoto; Nobumichi Tanaka; Kiyohide Fujimoto. Initial experience of complete laparoscopic radical nephroureterectomy combined with transvesical laparoscopic excision of distal ureter in patients with upper urinary tract cancer. World J Surg Oncol. 2020; 18:104–15.

10. Thomas F Chromecki, Eugene K Cha, Harun Fajkovic, Vitaly Margulis, Giacomo Novara, Douglas S Scherr, Yair Lotan, Jay D Raman, Wassim Kassouf, Karim Bensalah, Alon Weizer, Eiji Kikuchi, Marco Roscigno, Mesut Remzi, Kazumasa Matsumoto, Thomas J Walton, Armin Pycha, Vincenzo Ficarra, Pierre I Karakiewicz, Richard Zigeuner, Karl Pummer, Shahrokh F Shariat. The impact of tumor multifocality on outcomes in patients treated with radical nephroureterectomy.
11. Evanguelos Xylinas, Michael Rink, Eugene K. Cha, Thomas Clozel, Richard K. Lee, Harun Fajkovic, Evi Comploj, Giacomo Novara, Vitaly Margulis, Jay D. Raman, Yair Lotan, Wassim Kassouf, Hans-Martin Fritsche, Alon Weizer, Juan I. Martinez-Salamanca, Kazumasa Matsumoto, Richard Zigeuner, Armin Pycha, Shahrokh F. Shariat. Impact of distal ureter management on oncologic outcomes following radical nephroureterectomy for upper tract urothelial carcinoma. Eur Urol. 2014; 65:210–217.

12. Lee H, Kim HJ, Lee SE, Hong SK, Byun SS. Comparison of oncological and perioperative outcomes of open, laparoscopic, and robotic nephroureterectomy approaches in patients with non-metastatic upper-tract urothelial carcinoma. PLoS One. 2019; 14:0210401-10.

13. A. Tsivian, S. Benjamin, and A. A. Sidi, “A sealed laparoscopic nephroureterectomy: a new technique,” European Urology, 2007; 52, 1015-19.

14. I. S. Gill, G. T. Sung, M. G. Hobart, S J Savage, A M Meraney, D K Schweizer, E A Klein, A C Novick. Laparoscopic radical nephroureterectomy for upper tract transitional cell carcinoma: the Cleveland Clinic experience. The Journal of Urology, 2000; 164, 1513-22.

15. B. Ubrig, M. Boenig, M. Waldner, and S. Roth, Transurethral approach to the distal ureter in nephroureterectomy: transurethral extraction vs. “pluck” technique with long-term follow-up. European Urology, 2004; 46, 741–47.

16. B. J. Tan, M. C. Ost, and B. R. Lee, Laparoscopic nephroureterectomy with
bladder-cuff resection: techniques and outcomes. Journal of Endourology, 2005; 19: 664–76.

17. MP Laguna, de la ROSETTE, JEAN J.M.C.H. The endoscopic approach to the distal ureter in nephroureterectomy for upper urinary tract tumor. The Journal of Urology, 2001; 166: 2017-22.
Fig. 1 The position for operation (The patient was placed in a 45-degree flank position to confirm safe; A. rotate operation bed 30 degrees to ventral side for kidney and proximal ureter dissection; B. rotate operating bed 30 degrees to dorsal side, head low and foot high for distal ureter and bladder cuff dissection)

Fig. 2 Trocar arrangement and incision for specimen extraction (left side) for CTLNU: (A) camera port: A 10-mm trocar is placed lateral margin of rectus abdominis muscle of the first finger above the umbilicus; (B) A 5-mm trocar is placed costal margin along the mid-clavicular line; (C) A 12-mm trocar is placed midpoint of the line between the anterior superior iliac spine and the navel (D): 5-mm trocar is inserted in the midline between the umbilicus and the xiphoid process. Specimen extraction is through enlarged transrectus abdominal incision.

Fig. 3 Trocar arrangement and incision for specimen extraction (left side) for LNOBE (A) camera port: A 10-mm trocar is placed lateral margin of rectus abdominis muscle of the first finger above the umbilicus; (B) A 5-mm trocar is placed costal margin along the mid-clavicular line; (C) A 12-mm trocar is placed midpoint of the line between the anterior superior iliac spine and the navel. Specimen extraction is through the median incision of lower abdomen.