

# Knotless Laparoscopic Radical Prostatectomy: A Preliminary Experience

Lu-Lin Ma, Jian-Fei Ye, Wen-Hao Tang

Department of Urology, Peking University Third Hospital, Beijing 100191, China

**Key words:** Knotless; Laparoscopy; Radical Prostatectomy; Vesicourethral Anastomosis

## INTRODUCTION

Radical prostatectomy is the standard for the cure of localized prostate cancer. With the development of laparoscopic and robotic techniques, laparoscopic radical prostatectomy (LRP) or robotic-assisted radical prostatectomy (RARP) has been widely accepted with advantages of less invasiveness, shorter recovery, less blood loss, and better visualization of the operative region compared to open techniques.<sup>[1-4]</sup>

Laparoscopic suturing and knot-tying are the most difficult steps for most surgeons, especially for novice surgeons. The dorsal venous complex (DVC) ligation and vesicourethral anastomosis (VUA) are the most challenging parts during LRP.<sup>[1-3]</sup> We will introduce a unique technique using unidirectional single running self-retaining sutures for DVC ligation and VUA during LRP has been reported in the literature.

## METHODS

Four hundred and forty-six consecutive LRP were carried out at our institution from February 2004 to September 2014. From December 2013 to September 2014, nine knotless LRP were performed by experienced laparoscopist with experience of more than 500 LRP (L. Ma). All the characteristics of patients are shown on Table 1. Demography, perioperative data of patients were collected for further analysis with Statistical Package for the Social Sciences (SPSS) (Version 16.0 for Windows; SPSS Inc., Chicago, IL). Data are shown as the mean  $\pm$  standard deviation (range). Preoperatively, all patients with localized prostate cancer underwent routine preoperative evaluations including complete history taking, physical examination, laboratory investigations including prostate specific antigen (PSA) level, magnetic resonance imaging (MRI) of the prostate, and transrectal biopsy.

Bone scanning or positron emission tomography/computed tomography (PET/CT) is necessary for selected patients suspicious of metastasis.

The procedure is described briefly as below.

### Developing the extra peritoneal space

Under general anesthesia, the patient is put in Trendelenburg position. The working space for extraperitoneal approach is created by a cost-effective self-made balloon dilator. Four trocars are placed respectively at the subumbilical area with a 13-mm trocar, at the border of rectus abdominis 3 cm below with a 12-mm trocar right and 5-mm trocar left, and at the incision 2 cm above the right anterior superior iliac spine with a 5-mm trocar.

### Pelvic lymphadenectomy

Dissection is carried out proximally to the iliac bifurcation and distally to the pubis. The precise course of the obturator nerve and vessels can be identified by retracting the lymph node packet medially. The distal extent of the lymph node packet is divided, retracted cranially, and bluntly separated from the obturator vessels and nerve.

### Control of the dorsal vein complex

The deep DVC is sutured using a 15-cm 1-0 1/2 circle barbed self-retaining suture (V-Loc 180, Covidien, Mansfield, MA, USA) with three bites at the same place [Figure 1]. No knot is required for this step.

### Bladder neck transection

Close identification of the bladder neck between the prostate and bladder is the key for small neck outlet, which helps perform VUA. After the transaction of the anterior wall of the bladder, the tip of Foley catheter can be suspended to the abdominal wall in order to lift the prostate.

### Dissection of seminal vesicles and vasa deferentia

Following the transaction of the bladder neck, the ampullary segments of the vasa deferentia could be found and the vasa

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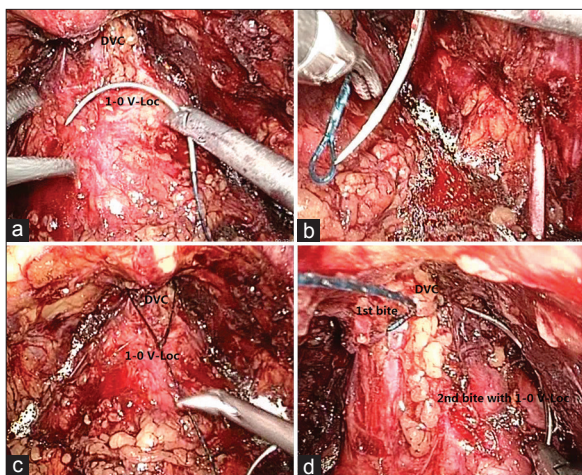
**Address for correspondence:** Dr. Wen-Hao Tang,  
Department of Urology, Peking University Third Hospital, 49 North Garden  
Road, Haidian, Beijing 100191, China  
E-Mail: bysyuro@gmail.com

**Table 1: Outcomes of patients**

Items	Outcomes
No. of patients	9
Age (year)	72.7 ± 4.8 (65 - 81)
Volume of prostate (ml)	41.2 ± 17.5 (13 - 68)
Body mass index (kg/m <sup>2</sup> )	25.5 ± 1.8 (22 - 28)
Operative time (minutes,)	187.8 ± 65.2 (103 - 307)
DVC ligation time (minutes)	3.3 ± 2.2 (2 - 8)
Anastomosis time (minutes)	26.0 ± 13.0 (13 - 50)
Blood loss (ml)	170.0 ± 245.2 (30 - 800)
Transfusion (ml)	0
Open conversion	0
Lymphadenectomy (%)	78
NVB reservation (%) <sup>†</sup>	100
Complication rate (%)	11
Anastomosis leakage (%)	0
Novice operator (%)	56
Postoperative hospital stay (day)	6.7 ± 1.8 (5 - 9)
Duration of catheter (day)	12.8 ± 3.6 (7 - 18)
Continence POM 1 (Pads/day) <sup>‡</sup>	1.8 ± 1.6 (0 - 5)
Preoperative PSA (ng/ml) <sup>§</sup>	17.6 ± 17.7 (4.7 - 37.9)
Postoperative PSA (ng/ml) POM 1	0.04 ± 0.06 (0 - 1.5)
Gleason score	6.8 ± 0.7 (0 - 1.2)
pTNM	
pT1cN0M0	4
pT2cN0M0	5
pT3bN0M0	0
Positive margin (%)	11

<sup>†</sup>NVB: Neurovascular bundles; <sup>‡</sup>POM: Postoperative month;

<sup>§</sup>PSA: Prostate specific antigen; DVC: Dorsal venous complex.



**Figure 1:** Control of the DVC with 1-0 V-Loc. (a) Suturing of the DVC. (b) Threading into the end. (c) Make the first “Knot”. (d) Second bite to make tightness.

deferentia are transected. The seminal vesicles are divided by harmonic scalpel laterally.

### Posterior dissection between the prostate and rectum

Cold dissection is performed distally between Denovilliers’ fascia and the anterior propria fascia of the rectum posterior, avoiding use of electrocoagulation which may lead to delayed thermal injury to the rectum. Any substantial bleeding could

be clipped by metal clips or suture. Then the pedicles are controlled with locking polymer clips. Any electrocoagulation is limited to prevent thermal injury to the neurovascular bundle (NVB) nearby.

### Nerve sparing technique

NVB could be preserved using either interfascial dissection between the prostatic fascia and levator fascia or intrafascial dissection between the prostatic capsule and prostatic fascia. For experienced surgeons, well identification of the prostatic capsule via the intrafascial dissection could lead to satisfactory functional outcome as well as oncological outcomes. The main branches of the NVB are located at the 5- and 7-o’clock positions. However, there still is some high anterior release of nerve bundles at the 2- to 5-o’clock and 7- to 10-o’clock positions. Intact preservation of the NVB and close identification and dissection of the anatomical structures, such as prostatic capsule and fascia, play the most important role in the postoperative functional and oncological outcomes.

### Dissection of the prostatic apex and urethra

The apical dissection is required to avoid either common positive margins or injury to parasympathic nerve fibers and external striated urethral sphincter at the 3- to 5- and 7- o’clock to 9- o’clock position. The urethra should be preserved about 0.5-1 cm long as to perform VUA.

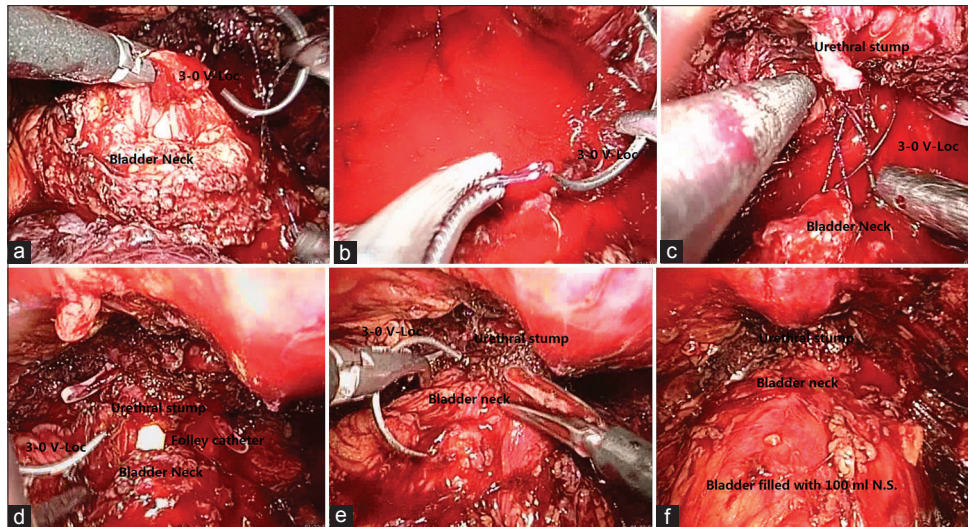
### Vesicourethral anastomosis

A unidirectional single running suture is performed with a 23-cm 3-0 5/8 circle barbed self-retaining suture with one needle driver (V-Loc 90, Covidien, Mansfield, MA, USA). The first bite started at 3 o’clock and then goes clockwise [Figure 2], and the “knot” is made by threading the needle into the ending loop. The remaining sutures are the same as the single-knot LRP. No knot-tying is required for this step too.

Moreover, 200 ml of normal saline is injected into the bladder to test the water tightness of the anastomosis. A drain is placed in the pelvis. The specimen is retrieved via the circumumbilical incision.

## RESULTS

The outcomes of knotless LRP were shown on Table 1. The mean age of the patients is 72.7 ± 4.8 (65–81) years old. The mean volume of prostate is 41.2 ± 17.5 (13–68) ml. The mean body mass index is 25.5 ± 1.8 (22–28) kg/m<sup>2</sup>. The operative time was 187.8 ± 65.2 (103–307) minutes, the DVC ligation time was 3.3 ± 2.2 (2–8) minutes and the anastomosis time was 26.0 ± 13.0 (13–50) minutes. The estimated blood loss was 170.0 ± 245.2 (30–800) ml. No blood transfusion, open conversion was required. The postoperative hospital stay was 6.7 ± 1.8 (5–9) days, the duration of catheter was 12.8 ± 3.6 (7–18) days. No anastomosis leakage was found. Lymphadenectomy and NVB reservation were done in 78% and all patients. None of them received neoadjuvant hormone therapy. No patients suffer from major complications



**Figure 2:** Vesicourethral anastomosis. (a) First bite at 3 o'clock. (b) Threading into the end. (c) Suturing the back wall. (d) Indwelling the catheter. (e) Complication of the UVA. F. Test for urine leakage.

requiring re-operation or massive bleeding. One of the patients suffered from minor complications of lymphatic leakage which was cured by conservative treatments. Continence at 1 month postoperatively reveals 1.8 pads/day for the patients. The mean levels of preoperative and 1 month postoperative PSA of the patients were  $17.6 \pm 17.7$  (4.7–37.9) ng/ml and  $0.04 \pm 0.06$  (0–1.5) ng/ml. The postoperative Gleason score was  $6.8 \pm 0.7$  (0–1.2). The pathologic results showed five cases of pT1cN0M0 and five cases of pT2cN0M0.1 of the patient got positive margin.

## DISCUSSION

Radical prostatectomy is the standard for the cure of localized prostate cancer. The first open radical prostatectomy was performed through a peritoneal approach by Young in 1905.<sup>[5]</sup> Millin first described the retropubic approach of radical prostatectomy in 1947.<sup>[6]</sup> But these two approaches were not developed because of severe morbidities such as massive intraoperative hemorrhage, postoperative sexual dysfunction, and incontinence. The morbidities were dramatically dropped until several anatomic studies of periprostatic structures were theorized, including the concepts of DVC by Reiner and Walsh in 1979,<sup>[7]</sup> NVB by Walsh *et al* in 1982,<sup>[8]</sup> and striated urethral sphincter by Oelrich in 1980.<sup>[9]</sup> The first successful LRP was performed by Schussler *et al* in 1992,<sup>[10]</sup> while the first RARP was performed by Arambal *et al* in 1997.<sup>[11]</sup> With the development of the instruments, pure laparoscopic or RARP was widely adopted in different countries with advantages of less invasiveness, shorter recovery, less blood loss, and better visualization of the operative region compared to open techniques.<sup>[1-3]</sup>

To simplify the procedure, van Velthoven introduced a laparoscopic running suture technique with a single knot,<sup>[12]</sup> which was popular all around the world. Recently, a lot of modified van Velthoven techniques were reported to facilitate

VUA using the barbed suture instead of polyglycolic acid suture during RARP.<sup>[13-16]</sup> In these studies, the procedures were all performed by experienced surgeons using expensive robotics.<sup>[13-16]</sup>

Inadequate ligation of DVC can lead to massive hemorrhage. Management of bleeding not only prolongs operative time and may injure the NVB and sphincteric fibers using coagulation.<sup>[2]</sup> Thus adequate suturing and knot-tying of the DVC is the most effective way to avoid this situation, but knot-tying is not easy in limited working space. Various techniques including ligation,<sup>[2]</sup> bulldog,<sup>[17]</sup> and selective suture ligation<sup>[18]</sup> were reported to control the DVC. The barbed suture was also introduced to control the DVC during RARP.<sup>[19]</sup> In our experience, the DVC ligation time of 3.1 minutes in knotless LRP was comparable to 3.15 minutes in RALP reported by Massoud *et al*.<sup>[19]</sup> And no coagulation occurred after dissecting the DVC due to hemorrhage in knotless LRP.

Suboptimal VUA may result in urine leakage and poor continence. To simplify the procedure, van Velthoven introduced a laparoscopic running suture technique with a single knot.<sup>[12]</sup> A lot of modified van Velthoven techniques were reported using clips or barbed self-retaining suture to facilitate VUA during LRP or RARP.<sup>[13-16]</sup> In these studies, the suture was performed bidirectionally with two needle drivers in which the loops of both suture threaded by the opposite needles.<sup>[13-16]</sup> We introduce a unidirectional running suture with a single-needle driver barbed self-retaining suture. The first bite started at 3 o'clock and then goes clockwise with a unidirectional running suture. The mean VUA time of 19.0 minutes in knotless LRP is satisfying.

The results of our modified technique are relatively satisfying. In these six patients, no patients suffer from major complications requiring re-operation or massive bleeding. One of the patients suffered from minor complications of lymphatic leakage which was cured by conservative

treatments. No acute retention, recatheterization, bladder neck contracture, calculus formation, or stricture occurred. One of the patients got positive margin. Postoperative continence is acceptable for patients.

In conclusion, the modified approach of knotless LRP could be an easy and safe technique. As it is easy to learn and perform, it may encourage the novice laparoscopists with limited suturing experience to master this difficult procedure and expand the use for more patients with prostate cancer in most institutions lack of robotics. But further and long-term study is needed to examine the efficacy of knotless LRP.

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