

Comparison of suture material for vesico-urethral anastomosis in robotic radical prostatectomy

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Introduction The aim of this study was to compare outcomes after vesicourethral anastomosis (VUA) with barbed suture (BS) and non-barbed monofilament suture (NBS) in robot-assisted laparoscopic radical prostatectomy (RALRP) in a match – pairs design.

Material and methods Medical recordings of 385 consecutive patients with prostate carcinoma have been evaluated, and 70 patients who have undergone RALRP-BS were compared with 70 patients with RALRP-NBS in a matched – pairs design. Preoperative clinical parameters (age, prostate-specific antigen, clinical stage, Gleason score of the prostate biopsy, and prostate volume) and operative data (operation, docking, console, posterior reconstruction (PR), anastomosis times, duration of catheter, length of hospital stay, estimated blood loss, time to perform the anastomosis and its quality) were evaluated, as well as postoperative parameters (pathological stage, Gleason score, specimen weight, follow-up duration, biochemical recurrence, complication rates, and duration of postoperative analgesic treatment).

Results No statistically significant difference was found for pre-operative parameters between the two groups. Although, anastomosis time, quality of anastomosis, duration of urethral catheter and total anesthesia time were significantly less in the RALRP-BS group than in the RALRP-NBS group ($P < 0.01$). Other peri- and postoperative parameters were not statistically significant between the two groups. Pathological data and the follow-up period and complication rates were similar between the two groups.

Conclusions This study showed that, RALRP-BS is a safe, efficient and cost-effective PR and VUA during RALRP than compared with RALRP-NBS. Shorter anastomosis time, operative time and posterior reconstruction time, while it may be equivalent with regard to estimated blood loss (EBL), catheterization time and early continence rates at 4–6 weeks.

Key Words: robotic radical prostatectomy ↔ vesicourethral anastomosis
↔ barbed suture ↔ monofilament suture

INTRODUCTION

Robot-assisted laparoscopic radical prostatectomy (RALRP) is one of the best current approaches for treatment of localized prostate cancer worldwide [1]. It is well known that robot-assisted surgery have some advantages over laparoscopic or open surgical reconstruction especially in vesicourethral anastomosis (VUA) when performing van-Velthoven run-

ning suture technique and posterior reconstruction (PR). Unfortunately, VUA has a complex nature such as discordances between the bladder neck and urethral size, limited working space in the deep pelvis, bimanual dexterity, instrument manipulation and suture types. Although it depends on surgical experience, weak closure of a VUA may result urinary leakage, prolonged urethral catheterization and other complications [2, 3, 4].

During the era of laparoscopic radical prostatectomy, different anastomotic sutures were traditionally used, including the braided suture type polyglactin-910 (Vicryl®; Ethicon, J and J Medical, Somerville, NJ, USA) and monofilament suture type polyglecaprone-25 (Monocryl®, J&J Medical, Somerville, NJ, USA). Monocryl has gained additional popularity with RARP due to its smooth texture and ease of use for running VUA.

The V-Loc 180 unidirectional barbed (40 barbs per inch [2.5 cm]) self-anchoring suture (Covidien, Mansfield, MA, USA), a polyglyconate suture composed of a 180-day absorbable copolymer of glycolic acid and trimethylene carbonate, was approved for soft-tissue closure in March 2009 [5]. It has been widely used due to several advantageous properties, including the ability to hold tissue tension and avoid knot-tying, a decrease in the risk of a urine leak, and shorter anastomotic time [3, 4].

The aim of this study is to explore the impact on outcomes of barbed suture compared to non-barbed suture in VUA post-RARP.

MATERIAL AND METHODS

Between March 2010 and November 2019, 385 patients had undergone RALRP by the same surgeon (T.E.). Of these patients, 255 had transperitoneal RALRP and 130 had extraperitoneal RALRP. After excluding the first 50 cases of RALRP for learning curve, 335 patients have been evaluated. The 70 patients who had undergone RALRP-BS were further evaluated and compared with 70 patients undergoing RALRP-NBS in a matched-pairs analysis.

Surgical technique

The technique of RARP has been previously described [6]. We used the daVinci four-arm system (Intuitive Surgical, Sunnyvale, CA, USA). All cases were approached transperitoneally or extraperitoneally with initial dissection of periprostatic fat tissue. Pelvic lymphadenectomy was routinely performed on men with a PSA >10 ng/ml, a primary Gleason score (GS) of 4 or clinical stage T2b. The prostate was then exposed and dissected in an antegrade fashion. Nerve-sparing approach was performed using a clipless, inter- or intra-fascial techniques without using thermal energy. A running VUA was performed using barbed suture (V-Loc) or a non-barbed monofilament suture to ensure water-tight closure.

Barbed suture (BS) vesiourethral reconstruction (with two 6-inch V-Loc, 15.2 cm, interlocked barbed polyglyconate sutures); starting with a 6-o'clock,

outside-in, transmural bite of the bladder followed by an inside-out bite of the posterior urethra. The outside-in bites along the bladder and the inside-out urethral bites were continued from 6- to 10-o'clock, each time cinching the tissue with the right needle driver straddling the suture to avoid urethral tearing. The right arm of the barbed suture was then used to complete a synchronous process starting from an outside-in 5-o'clock bladder bite to a 5-o'clock inside-out urethral throw. Repetitious passes were continued for the entire right side. The right arm was finally brought through the anterior urethral side and cut with a 2–3 cm stump. The left wall was then completed in a running fashion from the 10- to 12-o'clock location and again finished on the anterior urethra. The integrity of the VUA was verified with 150 ml of normal saline instilled in the bladder. The two cut-ends were left untied, allowing a completely knot-free reconstruction.

Non-barbed suture anastomotic reconstruction was performed with two 6-inch (15.2 cm) 3-0 polyglecaprone 25 (Monocryl; Ethicon) sutures tied together. Initial throws were placed at the 6-o'clock position of the bladder neck followed by urethral bites with the assistance of a perineal pressure. With good mucosal apposition, the left hemi-anastomosis was continued with the assistance of the bedside surgeon's needle driver. Sequential bites were thrown as the assistant maintained tension with the instrument. At the 11- to 12-o'clock position, the final throw was passed through the urethral stump and the tension was optimized with both robotic instruments. The assistant then cinched the suture clip at the tissue surface to lock the suture. The same technique was repeated on the right side. After VUA completion, a catheter was placed and the bladder was filled with 150 ml of physiological saline. Inspection of the anterior closure was then performed to ensure there was no leakage. If there was leakage, we drained the bladder, tightened the suture line and placed another absorbable suture (3/0 Vicryl). Although weak closure of some points of anastomosis with monofilament suture, we had sutured with extra 3/0 Vicryl absorbable suture these weak points on two or three patients.

We have been performed modified posterior reconstruction (PR) suture (Rocco) with 2/0 PDS in all patients. PR was performed with an initial bite taken at the 5-o'clock from vesico-prostatic anterior Denonvillier's fibers at retro-trigonal area followed by a bite taken at the periurethral rectourethralis muscle. The suture was pulled through until the interlocked loops with the tissue, providing resistance, as a knot would. A second bite was then taken from

the midline retrotrigonal area behind the bladder followed by a 6-o'clock bite of the periurethral tissue. Care was taken to ensure there was no cephalad traction on the bladder before cinching. Finally, a final 7-o'clock suture was taken on the bladder-side retrotrigonal tissue ensuring again not to include any mucosa and detrusor muscle fibers. These sutures were suspended ischium pubis arm bilaterally after posterior reconstruction. That modification was decreased straight of anastomosis. We believe that the suspension technique is important for early continence after RARP.

Additionally; 5 right inguinal herniorrhaphy, 5 left inguinal herniorrhaphy, 4 bilateral inguinal herniorrhaphy, 1 left pyeloplasty were performed simultaneously with RARP procedures.

Operation time, catheterization time, length of hospital stay, preoperative and postoperative hemoglobin values, estimated blood loss (EBL), time to perform the anastomosis and its quality, and duration of analgesic treatment were recorded. The soundness of the anastomosis was evaluated by infusing 200 ml saline into the bladder through a urethral catheter after the vesico-urethral anastomosis was completed and was classified into 4 groups: no leak, mild leak, moderate leak, and severe leak. Following RARP, the Foley catheter was routinely removed on early postoperative day (POD) 4 or 5 without cystography in BS group. We do not prefer to remove catheter POD 2 or 3; because we have already known that early hypercontinence rate was only 35–50%. However, we could not find the courage to remove the Foley catheter POD 4 or 5 in NBS group without cystography. There was no hypercontinence or anastomosis stricture in all of our patients early and late post-operative periods.

Postoperative parameters were evaluated, including pathologic stage and Gleason score, specimen volume, follow-up duration, and biochemical recurrence rates. Peri-operative complications were collected and classified according to the modified Clavien-Dindo system [7].

All patients had given written informed consent before the surgery for the use of the collected data at any time. The principles of the Declaration of Helsinki for research involving human subjects were followed during the study, and the confidentiality of the patients' data was guaranteed.

Numeric data were compared by independent t test, and the χ^2 test was used for the comparison of the nonnumeric outcomes. $P < 0.05$ was considered statistically significant. All statistical analyses were performed with the IBM Statistical Package for Social Sciences (SPSS) Software, version 22 (Armonk, New York, USA).

Table 1. Demographic, operative and pathologic results of RALRP-NBS and RALRP-BS

	RALRP-NBS (n:70)	RALRP-BS, (n:70)	P
Age (years)	62.71 ±7.01	62.89 ±7.32	.877
BMI (kg/m ²)	27.25 ±3.85	27.32 ±3.09	.936
Mean pre-operative PSA (ng/ml)	7 (3.8–120)	7.4 (3.9–76)	.744
TRUS prostate weight (g)	52.2 ±14.4	53.1 ±13.8	.823
Clinical stage			
T1c	36 (51)	29 (41)	
T2a	19 (27)	24 (34)	.327
T2b	12 (17)	9 (12)	
T2c	8 (11)	8 (11)	
Biopsy GS			
6	45 (64.2)	43 (61.4)	.867
7	16 (22.8)	17 (24.2)	
≥8	9 (12.8)	10 (14.2)	
OR time (min)	130 (95–240)	125 (105–160)	.006
Total GA time (min)	170 (0–270)	150 (120–185)	<0.001
Hospitalization time (days)	3 (0–7)	3 (3–7)	.986
Catheterization time (days)	7 (5–14)	6 (4–8)	<0.001
Duration of analgesic treatment (days)			
Narcotic	1.2 ±0.4	1.4 ±0.6	.857
Non-narcotic	2.1 ±0.3	1.9 ±0.7	.904
EBL (ml)	145 (20–450)	120 (10–320)	0.609
Preoperative Hb (g/dl)	14 ±1.496	14.2 ±1.33	.534
Postoperative tHb (g/dl)	12.6 ±1.39	12.68 ±1.42	.847
Delta Hb (g/dl)	1.26 ±1.28	1.43 ±0.95	.246
Trocar insertion time (min)	19.5 (7–45)	15 (7–30)	0.001
Docking time (min)	5 (2–8)	5 (2–7)	0.097
Console time (min)	110 (80–180)	100 (90–140)	0.038
Posterior reconstruction (PR) suture time (min)	9.4 ±1.67	9.1 ±1.35	.494
Anastomosis time (min)	13.25 (10.2–25.1)	11.2 (8.5–14.2)	<0.001
Anastomosis quality			
Watertight	59 (85)	64 (91.4)	
Mild leak	10 (15)	6 (8.6)	<0.001
Moderate leak	0	0	
Severe leak	0	0	
Pathological stage			
T2	48 (68.5)	46 (65.7)	.942
T3a	12 (17.1)	15 (21.4)	
T3b	10 (14.2)	9 (12.8)	
Pathological GS			
6	22 (31.4)	24 (34.2)	.929
7	35 (50)	32 (45.7)	
≥8	13 (18.5)	14 (20)	
Specimen weight (g)	45 (20–120)	47 (27–130)	.543
TM weight (g)	3.6 (0.1–55)	3.4 (0.1–26.7)	.773
Access			
Extraperitoneal	51 (72.9)	13 (18.6)	.001
Transperitoneal	19 (27.1)	57 (81.4)	

Table 1. *Continued*

	RALRP-NBS (n:70)	RALRP-BS, (n:70)	P
Simultaneous surgeries	9 (12.8)	7 (10)	
Inguinal herniorrhaphy	8	7	
Left	3	2	.978
Right	2	3	
Bilateral	2	2	
Pyeloplasty	1		

BMI – body mass index; PSA – prostate-specific antigen; TRUS – transrectal ultrasonography; GS – Gleason score; EBL – estimated blood loss; Delta Hb – decrease in hemoglobin; TM – tumor; OR time – operation time; GA – general anesthesia; min – minutes; SD – standard deviation
Data are shown as mean \pm SD or n (%)

Table 2. *Perioperative complications grouped according to Clavien-Dindo classification and follow-up of RALRP-BS and RALRP-MS groups*

	RALRP-NBS (n:70)	RALRP-BS, (n:70)	P
Minor complications (Grade 1–2)	14 (20)	18 (25)	.893
Grade 1	9	14	
Grade 2	5	4	
Major complications (Grade 3–5)	1	1	
Grade 3 a	1 (Lymphocele)	1 (Umbilical hernia)	
Follow-up duration (month)	40.8 \pm 11.5	48.2 \pm 12.8	.153
Biochemical recurrence	2	3	.264
Bladder neck contracture	N/A	N/A	
Total incontinence	N/A	N/A	

RESULTS

The patients' demographics and the operative and pathology results are presented in (Table 1). No statistically significant difference was determined for age, body mass index (BMI), preoperative prostate-specific antigen (PSA) level, transrectal ultrasonography-determined prostate weight, and clinical stage between the 2 groups. Regarding the pathology findings (Table 1) Gleason score sums of the preoperative prostate biopsy and the specimen after prostatectomy, pathological stage, and specimen weights were not significantly different among the groups. Preoperative and postoperative hemoglobin values, EBL, duration of catheterization, hospital length of stay, time to perform the anastomosis and its quality classification, and duration of analgesic treatment were also similar between the 2 groups.

While the anastomosis time and quality, catheterization and total anesthesia time were significantly less

in RALRP-BS group than in the RALRP-NBS group ($P < 0.05$). Other parameters were not statistically significant between two groups. Biopsy GS, pathological GS, clinical and pathologic stage of prostatectomy specimens were not statistically significant between two groups ($P > 0.05$).

Perioperative complications according to the Clavien-Dindo classification (minor: grades 1 and 2; major: grades 3, 4, and 5) are shown in Table 2. Conversion to open surgery was not considered in both groups. Myocardial infarction or transient ischemic attack were assessed in only two patients early post-operative period. One lymphocele (4 cm) was observed in RALRP-NBS group and one umbilical hernia was observed in RALRP-BS group. All patients in both groups had similar follow-up duration and biochemical recurrence rate during this period. None of the patients were observed to have bladder neck contracture and total incontinence in both groups during the follow-up time.

DISCUSSION

Robot assisted laparoscopic radical prostatectomy (RALRP) has become one of the primary procedures for performing radical prostatectomy since 2001 [8]. And also it has both easy and complex steps. Although robotic platform allows us to perform tension free anastomosis and easy knot tying easily, VUA is still the most critical and important part of RALRP [9].

However these advances in robotic surgical developing such skills remains challenging due to complex steps and related complications [10]. We observed that, increasing surgical experience in RALRP improves the efficiency to use camera and instruments for the VUA step especially that it is important for needle driver positions and entry angles. We believed that this details decreased tissue damage and anastomosis tension [11].

Quality of VUA is highly contributed with early continence recovery after surgery. In addition, anastomosis related complications such as urinary leak resulting in ileus, urinary retention, prolonged catheterization and pelvic abscesses might also effect on continence recovery. Bladder neck stricture is another important long-term complication of low quality VUA [12].

The most common suture materials for VUA at present are the Monocryl monofilament suture and the Vicryl braided suture and the most commonly used one that is barbed synthetic absorbable suture (V-Loc Wound Closure Device, Covidien, Mansfield, MA) [13].

Since its first application for VUA in 2009, BS has been widely used for reconstruction of anastomosis

gradually. Several studies comparing it and conventional non-barbed suture (NBS) have been reported. However, most are small series and some have conflicting results. Weld et al. [14] were the first to describe an *in vitro* study showing no significant difference in the strength of tissue re-approximation between 0-SAS Quill barbed suture (Angiotech, Vancouver, Canada) and 0-PDS monofilament (Ethicon, Cincinnati, OH, USA). Subsequently, Hruby et al. showed the feasibility of laparoscopic barbed suture VUA in a porcine model ($n = 30$) and reported that histopathological evaluation of the groups at one week of follow-up revealed significantly lower fibrosis scores for the barbed suture compared with the standard monofilament VUA. Conversely, no significant difference was reported at 3 and 7 weeks. The effect of barbed suture on early inflammatory response is unclear [15]. Moran et al. showed that V-loc suture material *in vitro* is faster and subjectively safer than monofilament [16]. In a prospective randomized study of Kevin et al. about the barbed suture technique; they found a significant reduction in nurses' preparation time, reconstruction time and cost [17]. Recent meta-analysis of three RCTs and six observational studies including 786 patients Li et al. concluded that BS was safe with significantly reduced anastomosis time, operative time and PR time compared to NBS for UVA during RARP. No significant difference was found in EBL, catheterization time, or early continence rates at 4–6 weeks, 3 months and 6–12 months after surgery [18].

According to our series, we could say that in NBS usage the anastomosis is slower and sometimes there can be a decrease in tension. This may lead to extravasation. In 3 cases because of the anastomosis with NBS got loose, we had to support those sutures with extra vicryl suture. While we could take the catheter out safely with the BS without cystography at the fourth day, we could not do it with the monocryl sutures in safe manners.

Delayed VUA leakage and bladder neck reconstruction were not observed in either group during the time of 6 months long follow-up in our series. We also reached that in BS group; anastomosis time

and quality were significantly better than in the NBS group.

In a study of Cakici et al. which compares polyglactone sutures with barbed suture technique found that: the amount of leakage in the cystogram, the time of catheter withdrawal, and UVA anastomosis duration was significantly shorter at the first week with the barbed suture technique used. Early period and first month's urinary continence was found to be significantly better also. There was no significant difference found about continence in the third month [19, 20]. Despite the relevance of the findings, the present study has some limitations. It represents a single-surgeon and single-institution series and thus cannot be generalized to all surgeons as technique-specific factors can affect the results described. Relatively small number of patients evaluated in each group, which may affect the reliability of statistical analysis. But we think that organizing a matched-pair analysis has compensated this to some degree. A retrospective study instead of a prospective randomized one provides lower level evidence. Another limitation was the lack of the data about the number of lymph nodes removed because of this data was not present for every patient.

CONCLUSIONS

Our study indicated that barbed suture (BS) compared with non-barbed monofilament suture (NBS) and the use of the unidirectional barbed suture provides a safe, efficient and cost-effective posterior reconstruction (PR) and vesicourethral anastomosis (VUA) during robot-assisted radical prostatectomy (RARP). Use of the interlocked barbed suture technique prevents slippage, precluding the need for assistance, knot tying, and constant reassessing of anastomosis integrity. Future multi-center, well-designed randomized controlled trials (RCTs) with longer follow-up are needed to confirm and update the findings of our research.

CONFLICTS OF INTEREST

All of the authors declare that no competing financial interests exist.

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