

Long-term functional outcomes of vesicourethral anastomosis with bladder neck preservation and distal urethral length preservation after videolaparoscopic radical prostatectomy

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Abstract

Introduction: Radical prostatectomy (RP) is the standard surgical treatment for localized prostate cancer (PCa), with excellent oncologic outcomes; however, complications such as post-prostatectomy incontinence could significantly affect quality of life.

Aim: To provide data on long-term urinary functional outcomes of bladder neck preservation (BNP) combined with distal urethral length preservation (DULP) in patients treated with videolaparoscopic prostatectomy.

Material and methods: In this retrospective study, data were analysed from 619 consecutive patients who underwent laparoscopic radical prostatectomy (LRP) due to localized prostate cancer between November 2014 and December 2018 in a single tertiary care centre in Poland. Of these patients, 227 had BNP and DULP during the procedure. Urinary continence status was assessed in patients at 3, 6, 12, and 18 months after LRP. Cancer resection was assessed by surgical margin status.

Results: In the group with BNP and DULP, urinary continence recurred earlier than it did in the control group up to 3 months after surgery: 204 (89.8%) patients in this group were fully continent compared with 283 (72.2%) in the control group ($p < 0.001$). The difference was also significant after 6 months (95.1% vs. 80.6%, respectively; $p < 0.001$). Despite these early promising results, there was no difference in urinary continence recovery after 12 and 18 months. There was also no difference between the 2 groups regarding surgical margin status of the resected tissue.

Conclusions: Our study showed that BNP combined with DULP is a safe procedure that helps to improve early urinary continence rates after surgery without altering the risk of positive surgical margin.

Key words: prostate cancer, laparoscopic radical prostatectomy, bladder neck preservation, vesicourethral anastomosis.

Introduction

Radical prostatectomy (RP) is a well-established procedure for treating patients with clinically localized prostate cancer (PCa), which in most cases

provides excellent long-term oncological results [1]. Since it was first introduced in 1867 by Billroth, the procedure has evolved and changed in order to provide better results [2, 3]. Nowadays, the success of RP should be measured not only by oncological but

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also by functional results. The goal of this procedure is to provide radical cancer excision without recurrence but with full recovery of urinary continence (UC) and erectile function. Unfortunately, these “trifecta” outcomes can only be achieved in up to 60% of patients [3]. Despite the continual improvement of surgical techniques, including the introduction of laparoscopic and robotic-assisted techniques, urinary incontinence remains a serious postoperative complication that significantly affects quality of life and psychological well-being, regardless of oncological results [4]. Many factors affect the recurrence of UC after RP. Some are patient related, but surgical technique remains a crucial modifiable factor [5]. Several surgical technical modifications have been proposed to minimize the incidence of urinary incontinence, including nerve sparing [6], bladder neck preservation (BNP) [7–10], sparing or reconstruction of the puboprostatic ligament, and posterior reconstruction of the rhabdomyosphincter [11–13]. In our department, BNP with distal urethral length preservation (DULP) is performed whenever possible. The technique aims to minimize damage to the internal sphincter and its neural and vascular supply, maximize the length of the distal urethra, and provide secure vesicourethral anastomosis (VUA), which improves UC recovery after surgery [14].

Aim

The aim of this study was to assess the functional outcomes and oncological safety results of BNP with DULP during laparoscopic radical prostatectomy (LRP) in patients treated in a single tertiary care centre in Poland.

Material and methods

This was a retrospective study. Included in the study were 619 consecutive patients who were diagnosed with localized PCa and underwent LRP between November 2014 and December 2018 in a single tertiary care centre in Poland. Data were extracted from medical records. Patients were divided into 2 groups, depending on LRP technique. A total of 227 patients had BNP combined with DULP, whereas 392 underwent LRP without BNP and DULP. All surgeries were performed by 4 experienced surgeons who had performed more than 100 LRPs. The DULP method used in our study was similar to the technique described by Schlomm *et al.* [14]. The decisions to

perform BNP combined with DULP and regarding the suture type used in VUA were made according to the preferences of the operating surgeon. Patients with a history of transurethral resection of the prostate; comorbidities that may affect UC (e.g. neurogenic disorders); previous radiation treatment for PCa; preoperative stress, urge, or mixed urinary incontinence; a history of urethral trauma or stricture; or a prominent middle lobe were excluded from the study.

Groups were compared for UC, complications, and positive surgical margin (PSM) status. UC at 3, 6, 12, and 18 months after surgery was assessed from pad usage, UC being defined as usage of 0 pads to 1 pad. Complications within the 90-day period after prostatectomy were assessed according to the Clavien-Dindo classification [15].

Patients received a standardized preoperative evaluation that included age, body mass index, preoperative serum prostate-specific antigen level, American Society of Anesthesiologists (ASA) score, clinical stage, biopsy Gleason score, UCSF-CAPRA score (University of California, San Francisco Cancer of the Prostate Risk Assessment score), and prostate volume (measured preoperatively by transrectal ultrasound). Perioperative and postoperative parameters such as total operative time, estimated blood loss, need for transfusion, drainage output, catheterization time, length of hospital stay, pathological results, and PSM rate were also analysed.

All patients were instructed to undergo proper pelvic-floor muscle training, which started at the time of catheter removal and was performed daily with a gradual increase in training load.

The study was approved by the local Ethics Review Committee (approval number 122.6120.176.2016). All procedures were performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki and its later amendments. All procedures were performed according to well-established surgical techniques.

Surgical technique

The laparoscopic procedure was performed extraperitoneally or transperitoneally with an extended lymph node dissection (in the case of risk of lymph node involvement $\geq 5\%$, according to the MSKCC (Memorial Sloan Kettering Cancer Center) nomogram; in the case of high-risk PCa, according to the D’Amico classification).

In the group with BNP and DULP, the bladder neck was carefully dissected and preserved and was considered when the neck diameter was comparable to the diameter of the urethra, i.e. not requiring bladder neck (BN) reconstruction before anastomosis. The saving technique was made according to the preferences of operators who had comparable experience. Dissection started from the fatty avascular connective tissue between the bladder neck and prostate with cold scissors and a bipolar grasper (Photo 1). A nerve-sparing procedure was performed in patients with cT1-cT2a PCa and a biopsy Gleason score ≤ 7 without suspicion of extraprostatic infiltration. Apical dissection of the prostate and division of the urethra were performed meticulously to preserve the maximal length of the distal urethra and to prevent PSMs. The urethra was cut with scissors in the middle between the external urethral sphincter and the apex of the prostate. The diameter of the distal urethra and bladder neck were mostly similar. The tension-free VUA was performed by using 3 different types of sutures [16]. After both ends of the suture were tied, the watertightness of the anastomosis was assessed by filling the bladder with 100–200 ml of sterile physiological saline. If necessary, an additional suture was placed to avoid urinary leakage. After the completion of the anastomosis, the balloon of the catheter was filled with 10 ml of sterile water. An 18 F Redon drain was inserted. In all patients with drainage output over 100 cm³ during the first 8 h after surgery, the creatinine level of the fluid was assessed. The time to catheter removal was determined by the operating surgeon.

Statistical analysis

No sample size calculations were performed before initiating the study. Descriptive statistics for

baseline variables are presented as median (interquartile range) or count and percentage. A χ^2 test (with Yates' correction for 2x2 tables) was used to compare qualitative variables among groups. In the case of low values in contingency tables, Fisher's exact test was used instead. The Mann-Whitney test was used to compare quantitative variables between 2 groups. The significance level for all statistical tests was set to 0.05. StatSoft Inc. (2014) Statistica data analysis software, version 12.0, was used for computations.

Results

Patient characteristics are presented in Table I. Patients in the BNP and DULP group were slightly older than patients without BNP and DULP and had a lower ASA score and age-adjusted Charlson Index score. There were no differences between groups regarding the UCSF-CAPRA score and cancer-related data, including the biopsy Gleason score, preoperative prostate-specific antigen level, and clinical stage.

In the group with BNP and DULP, the V-Loc™ suture for VUA was used in almost 90% of cases, whereas in the control group, the continuous and Van Velthoven [17] sutures were used more often (Table II). Patients in the group with BNP and DULP had a shorter anastomosis and surgery time and a lower incidence of intraoperative anastomotic leak and blood loss (Table II). The length of hospital stay and the catheterization time were also shorter in the BNP and DULP group, but there was no difference in postoperative complications 90 days after surgery between groups (Table II).

In the group with BNP and DULP, UC recurred earlier than in the control group up to 3 months after surgery: 204 (89.8%) patients in this group were fully

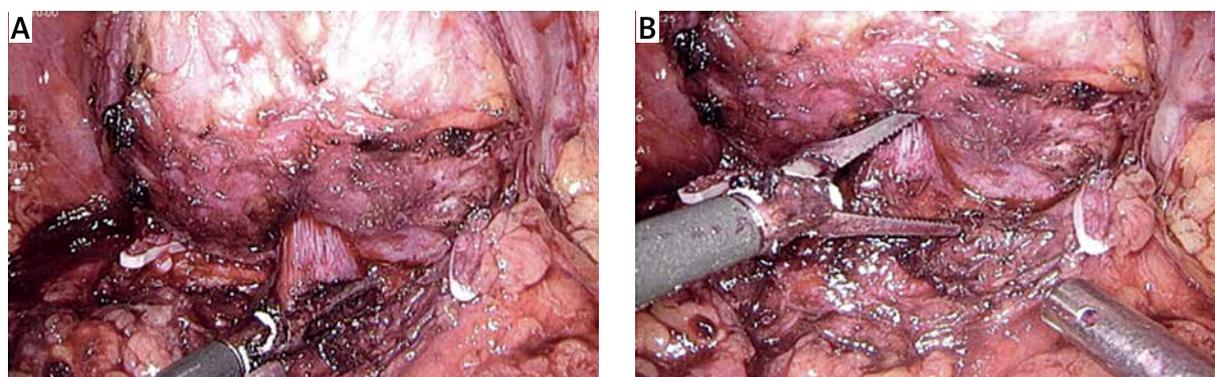


Photo 1. A, B – Bladder neck preservation using a bipolar grasper

Table I. Baseline patient characteristics

Parameter	Bladder neck preservation with DULP (n = 227)	No bladder neck preservation (n = 392)	P-value
Age (median [IQR])	65 [61–68]	64 [59–68]	0.028
Pre-op PSA (median [IQR])	8 [6.1–11.3]	8 [6.12–12.38]	0.683
BMI (median [IQR])	27.44 [24.90–29.41]	27.68 [25.2–30.2]	0.589
Charlson Comorbidity Index (median [IQR])	3.0 [2.0–4.0]	3.0 [2.0–3.0]	< 0.076
Age-adjusted Charlson Index (median [IQR])	4.0 [3.0–5.0]	5.0 [4.0–5.0]	< 0.001*
UCSF-CAPRA score (median [IQR])	3.0 [2.0–4.0]	3.0 [2.00–4.00]	0.774
Biopsy Gleason score (%):			0.125
1	122 (53.7)	227 (57.9)	
2	58 (25.5)	91 (23.2)	
3	17 (7.6)	38 (9.7)	
4	18 (7.9)	23 (5.9)	
5	12 (5.3)	13 (3.3)	
ASA score (%):			0.006*
1	17 (7.5)	20 (5.1)	
2	204 (89.9)	306 (78)	
3	6 (2.6)	66 (16.8)	
Prostate volume (TRUS) (median [IQR])	40 [43–18.2]	40 [45.5–23.2]	0.715
Clinical stage (%):			0.703
cT1	128 (56.39)	230 (58.67)	
cT2	76 (33.48)	120 (30.61)	
cT3	20 (8.81)	37 (9.43)	
cT4	3 (1.32)	5 (1.28)	
D'Amico (%)			0.508
Low risk	81 (35.68)	134 (34.18)	
Intermediate risk	82 (36.12)	159 (40.56)	
High risk	64 (28.19)	99 (25.25)	

DULP – distal urethral length preservation, IQR – interquartile range, pre-op PSA – preoperative prostate-specific antigen, BMI – body mass index, ASA – American Society of Anesthesiologists, UCSF-CAPRA score – University of California San Francisco Cancer of the Prostate Risk Assessment, TRUS – transrectal ultrasound. p – Mann-Whitney test for quantitative variables, chi-squared or Fisher's exact test for qualitative variables. *Statistically significant ($p < 0.05$).

continent compared with 283 (72.2%) in the control group ($p < 0.001$) (Table III). The difference was also significant after 6 months (95.1% vs. 80.6%, respectively; $p < 0.001$). There was no difference between groups in UC recovery after 12 and 18 months (Table III). There was also no difference between groups regarding pathological stage and grade, or PSMs (Table III). A PSM was mostly present in patients whose final histopathological examination result indicated local advancement of PCa (Gleason score 8–10, \geq pT3, or lymph node involvement). In addition, a PSM on the bladder neck or the apex of the prostate usually co-existed with a PSM in other surgical sites.

Discussion

Many factors alter the recurrence of UC after RP. Some are patient related, including age, body mass index, prostate volume, lower urinary tract symptoms before surgery, and comorbidities [18], but the experience of the surgeon and surgical technique remain crucial modifiable factors [13]. The probability of a patient requiring pads after surgery is typically 70–80% after 6 weeks, but improves with time; after 12 months, over 80% of men will regain UC [5]. Moreover, a slight improvement in UC can still be observed through the second year after surgery [19].

Table II. Intraoperative and preoperative data

Parameter	Bladder neck preservation with DULP (n = 227)	No bladder neck preservation (n = 392)	P-value
Prostate weight [g] (median [IQR])	44.09 [37–54]	47 [38.07–61]	0.027*
Anastomosis time (median [IQR])	13 [11–15.25]	17 [13–25]	< 0.001*
Access, n (%):			0.571
Transperitoneal	118 (52)	213 (54.3)	
Extraperitoneal	109 (48)	179 (45.7)	
Suture type, n (%):			< 0.001*
Continuous	10 (3.6)	113 (28.8)	
Van Velthoven	20 (8.8)	120 (30.5)	
V-lock	197 (86.8)	159 (40.5)	
Surgery time (median [IQR])	145 [120–180]	150 [122.5–195]	0.012*
Length of hospital stay [days] (median [IQR])	5 [4–6]	6 [5–7]	< 0.001*
Drainage time [days] (median [IQR])	3 [2–3]	3 [3–5]	< 0.001*
Catheterization time (median [IQR])	15 [12–18]	18 [15–21]	< 0.001*
Blood loss [ml] (median [IQR])	200 [100–217.5]	200 [145–300]	0.003*
Intraoperative anastomotic leak (median [IQR])	19 [8.3]	65 [16.5]	0.006*
Clavien-Dindo complications in 90 days n (%)	41 (18.06)	82 (20.9)	0.451
Clavien-Dindo complications (I–II), n (%)	31 (13.6)	47 (12)	0.634
Clavien-Dindo complications (III–IV), n (%)	14 (6.17)	37 (9.44)	0.202

DULP – distal urethral length preservation, IQR – interquartile range. p – Mann-Whitney test for quantitative variables, χ^2 or Fisher’s exact test for qualitative variables. *Statistically significant ($p < 0.05$).

To date, several modifications have been introduced to improve continence after RP, most of them based on the general rule of minimizing damage to the anatomical structures and restoring the anatomical vesicourethral junction [19–24]. BNP aims to save muscle fibres of the internal sphincter by careful dissection of the prostatic urethra [22, 23]. DULP is achieved by meticulous apical dissection and aims to preserve maximal length of the membranous urethra [25, 26]. Both techniques were proven to provide earlier UC recovery after RP. Despite existing data regarding BNP and DULP in RP, there is still doubt regarding their oncological and functional results in videolaparoscopic RP. The current study did not show significant differences in continent patients between the 2 groups with or without BNP at 12 and 18 months after surgery. Our results are comparable to previously published data [20]. Moreover, the advantage of our study was that we assessed patients in terms of 3 different types of sutures used, which has not been evaluated in other studies [24, 27, 28]. The results of the current study reveal an advantage of BNP with DULP over

no BNP for early postoperative continence. BNP provides improved early continence, which is reflected by the higher percentage of continent and mildly incontinent patients after catheter removal up to 3 months postoperatively. An earlier return to continence was also observed by Nyarangi-Dix *et al.* [24], who showed UC recovery at 3 months after RP in over 80% of patients with BNP compared with less than 60% of patients without BNP. These findings were confirmed in a further meta-analysis by Ma *et al.* [27], which showed that BNP provides faster recovery of UC and better early UC rates.

The DULP method used in the department where the current study was conducted is similar to the technique used by Schlomm *et al.* [14], who described their procedure for full functional-length urethra (FFLU) preservation during RP. They reported that UC rates were 50.1% at 1 week after catheter removal for patients after the FFLU technique versus 30.9% for patients after the non-FFLU technique. There was no difference in UC rates 12 months after surgery. Similarly, in the current study, nearly 90% of patients with BNP and DULP had early UC recur-

Table III. Functional and pathological results

Parameter	Bladder neck preservation with DULP (n = 227)	No bladder neck preservation (n = 392)	P-value
Final Gleason score 3 + 3 = 1, 3 + 4 = 2, 4 + 3 = 3, 8 = 4, 9–10 = 5 (%) ISUP:			0.794
1	56 (24.6)	98 (25)	
2	104 (45.8)	182 (46.4)	
3	45 (19.8)	75 (19.2)	
4	12 (5.4)	24 (6.1)	
5	10 (4.4)	13 (3.3)	
Pathological T stage (%):			0.796
pT2	106 (46.8)	170 (43.4)	
pT3a	104 (45.5)	182 (46.4)	
pT3b	14 (6.3)	33 (8.4)	
pT4	3 (1.4)	7 (1.8)	
Return of continence [months], n (%):			< 0.001*
3 months	204 (89.8)	283 (72.2)	< 0.001*
6 months	216 (95.1)	316 (80.6)	< 0.001*
12 months	217 (95.6)	369 (94.1)	0.435
18 months or never	225 (99.1)	382 (97.4)	0.25
Surgical margin status, n (%):			0.578
Positive	65 (28.7)	119 (30.36)	
Negative	160 (71.3)	273 (69.64)	

DULP – distal urethral length preservation, ISUP – International Society of Urological Pathology. p – Mann-Whitney test for quantitative variables, χ^2 or Fisher's exact test for qualitative variables. *Statistically significant ($p < 0.05$).

rence, whereas only 70% of patients in the control group were continent 3 months after surgery. These results for early UC rates correlate with the findings of Nyarangi-Dix *et al.* [24]. Our study showed no difference between groups in terms of long-term UC rates, unlike the findings reported by Ma *et al.* [27].

In the current study, BNP and DULP techniques were combined to provide the best functional results and to secure VUA. The incidence of significant intraoperative anastomotic leak was less common in the group with BNP and DULP, which is most likely related to a very tight anastomosis in this group.

Combining both techniques could have resulted in a higher incidence of PSM and compromised oncological outcomes, but the study showed no differences between groups for these results. This could be explained by the fact that BNP and DULP were performed by experienced surgeons and the tissue was carefully prepared. Oncological safety of BNP and good functional outcomes have previously been reported [24, 27–29].

The number of intraoperative anastomotic leaks in the BNP and DULP group was lower. It was probably related with the used surgical technique in this group – the bladder neck diameter was comparable to the diameter of the urethra. This probably resulted in better tissue adjustment and lower incidence of leaks in the BNP and DULP group.

There was a difference in anastomotic time between groups, which might be the consequence of different percentages of suture type used for VUA. In the BNP and DULP group V-Loc™ was used in most cases, while in the group without BNP and DULP Van Velthoven sutures were used in more than 30% of patients. The Van Velthoven suture was shown to be more time-consuming [16]. The other possible explanation for the longer anastomotic time in the group without BNP and DULP is the larger diameter of BN and more needle-passes needed for VUA. The catheterization time in the BNP and DULP group was shorter, which might be because the surgeons felt more confident regarding VUA tightness in this group.

Membranous urethral length measured on preoperative mpMRI has been associated with urinary continence outcomes [30]. Unfortunately, in the study we were not able to investigate these associations. Not all patients had mpMRI performed, and the authors did not have access to the available mpMRI scans due to the retrospective study design.

In the current study, no data were available on the nerve-sparing surgery technique, which was one of the study limitations. Other limitations were the retrospective character of the study and the lack of randomization, because the BNP with DULP approach was chosen intraoperatively. Another limitation was the quality of BNP. Data regarding BN, DULP, and nerve-sparing preservation were discussed, but the issue of accurate preservation remains unclear because the definition is subjective and based on individual preferences.

Conclusions

In this study, we assessed BNP with DULP during videolaparoscopic prostatectomy in patients with localized PCa. The results showed that BNP combined with DULP was a safe procedure that improved early UC rates after surgery without altering the PSM rate.

Conflict of interest

The authors declare no conflict of interest.

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