ELSEVIER

Urologic Oncology: Seminars and Original Investigations ∎ (2016) ∎∎∎–∎∎∎

UROLOGIC ONCOLOGY

Original article

Technique and outcomes of bladder neck intussusception during robot-assisted laparoscopic prostatectomy: A parallel comparative trial

Hung-Jui Tan, M.D.[a,b], Siwei Xiong, M.D.[b], Aaron A. Laviana, M.D.[b], Ryan J. Chuang, B.S.[b], Eric Treat, M.D.[b], Patrick C. Walsh, M.D.[c], Jim C. Hu, M.D., M.P.H.[b,d,*]

[a] *VA/UCLA Robert Wood Johnson Clinical Scholars Program, University of California, Los Angeles, CA*
[b] *Department of Urology, University of California, Los Angeles, CA*
[c] *Brady Department of Urology, Johns Hopkins Medical Institute, Baltimore, MD*
[d] *Brady Department of Urology, Weill Cornell Medicine New York, New York*

Received 28 December 2014; received in revised form 14 January 2015; accepted 15 January 2015

Abstract

Introduction: Postprostatectomy incontinence significantly impairs quality of life. Although bladder neck intussusception has been reported to accelerate urinary recovery after open radical retropubic prostatectomy, its adaption to robotic surgery has not been assessed. Accordingly, we describe our technique and compare outcomes between men treated with and without bladder neck intussusception during robot-assisted laparoscopic prostatectomy.

Materials and methods: We performed a comparative trial of 48 men undergoing robot-assisted laparoscopic prostatectomy alternating between bladder neck intussusception ($n = 24$) and nonintussusception ($n = 24$). Intussusception was completed using 3-0 polyglycolic acid horizontal mattress sutures anterior and posterior to the bladder neck. We assessed baseline characteristics and clinicopathologic outcomes. Adjusting for age, body mass index, race, and D'Amico risk classification, we prospectively compared urinary function at 2 days, 2 weeks, 2 months, and last follow-up using the urinary domain of the Expanded Prostate Cancer Index—Short Form.

Results: Baseline patient characteristics and clinicopathologic outcomes were similar between treatment groups ($P > 0.05$). Median catheter duration (8 vs. 8 d, $P = 0.125$) and rates of major postoperative complications (4.2% vs. 4.2%, $P = 1.000$) did not differ. In adjusted analyses, Expanded Prostate Cancer Index—Short Form urinary scores were significantly higher for the intussusception arm at 2 weeks (65.4 vs. 46.6, $P = 0.019$) before converging at 2 months (69.1 vs. 68.3, $P = 0.929$) after catheter removal and at last follow-up (median = 7 mo, 80.5 vs. 77.0; $P = 0.665$).

Conclusions: Bladder neck intussusception during robot-assisted laparoscopic prostatectomy is feasible and safe. Although the long-term effects appear limited, intussusception may improve urinary function during the early recovery period.

Keywords: Comparative study; Incontinence; Prostatectomy; Prostate neoplasm

1. Introduction

Despite the widespread adoption of the robotic platform, rates of postprostatectomy incontinence continue to vary widely, affecting 4% to 31% of men over the long term and even more individuals during the early recovery period [1]. Postprostatectomy incontinence negatively affects patient satisfaction and quality of life, often leading to regret among men opting for radical prostatectomy as their treatment for prostate cancer [2]. Among those in need of definitive therapy, fear of temporary or lifelong urinary incontinence has led some men to bypass radical prostatectomy in favor of radiotherapy or newer therapies with limited long-term outcomes, such as high frequency intensity ultrasound or focal therapy with interstitial lasers. Additionally, urinary incontinence adds approximately $5,477 in cost on a per person basis (adjusted for fiscal year 2013), highlighting both the financial- and health-related burden of this adverse outcome [3].

This research was supported by funding from the VA Office of Academic Affiliations through the VA/Robert Wood Johnson Clinical Scholars Program (H.T.) and by the National Institutes of Health Training, Grant no. T32-DK-07789 (E.T.).

* Corresponding author. Tel.: +212-746-4600; fax: +212-746-8396.
E-mail address: jch9011@med.cornell.edu (J.C. Hu).

http://dx.doi.org/10.1016/j.urolonc.2015.01.012
1078-1439/

Although multiple factors (e.g., age, body mass index, prostate volume, and surgeon inexperience) have been associated with postprostatectomy incontinence, several technical modifications have been shown to enhance urinary control following radical prostatectomy. For example, a randomized controlled trial demonstrated that bladder neck preservation reduces urinary leakage, improves social continence, and enhances quality of life. Even so, a significant number of men fail to achieve these results during the early recovery period (i.e., within 3 mo of radical prostatectomy) [1,4,5]. In 2002, Walsh and Marschke [6] described bladder neck intussusception, which improved 3-month continence rates from 54% to 82%, with equivalent continence rates at 1-year when compared with historical controls. Despite these promising results, subsequent findings have been mixed [7,8]. In fact, a recent review assessed athermal division and selective suture ligation of the dorsal vein complex, bladder neck preservation, and posterior reconstruction as beneficial in reducing postprostatectomy incontinence, but there was no mention of bladder neck intussusception as a technical modification to improve urinary control [1,5,9].

Therefore, the purpose of our study was to adapt bladder neck intussusception to the robotic platform and determine whether this technique improves short-term urinary outcomes. In this context, we performed a parallel, comparative trial, alternating men undergoing robot-assisted laparoscopic prostatectomy between bladder neck intussusception vs. nonintussusception (i.e., standard vesicourethral anastomosis).

2. Materials and methods

2.1. Study cohort and surgical technique

From August 2013 through April 2014, 48 men underwent robot-assisted laparoscopic radical prostatectomy consecutively by a single surgeon (J.C.H.) and underwent bladder neck intussusception vs. nonintussusception on an alternating basis. The planned procedure was discussed with each patient and informed consent obtained. To adapt the open technique to the robotic platform, the study surgeon reviewed online videos of open radical prostatectomy bladder neck intussusception and a higher definition version provided by Dr. Walsh [6,10]. Before study enrollment, 10 subjects underwent bladder neck intussusception with robot-assisted prostatectomy during a run-in period. Deidentified, video recordings were uploaded to YouTube and reviewed by Dr. Walsh, who provided critical feedback to improve surgical technique.

All subjects underwent prostate removal via robot-assisted laparoscopic prostatectomy, as described previously [9,11,12]. Using a 4-armed da Vinci Si Surgical System (Intuitive Surgical, Sunnyvale, CA), we performed an antegrade approach in the following order: (1) bladder neck and seminal vesicle dissection with bladder neck sparing, (2) antegrade nerve sparing, (3) pelvic lymph node dissection, (4) apical dissection, and (5) anastomosis.

To ensure optimal identification of the bladder neck during intussusception, we slightly modified our previously described anastomotic technique [13]. First, after placement of the initial 6-o'clock anastomotic suture in the urethral stump before division of the posterior apical prostatic urethra, a stay suture is placed at the 6-o'clock position in the bladder neck. This aids in the identification of the bladder neck, as it often retracts during intussusception.

Next, a 3-0 polyglycolic horizontal mattress suture is placed in the perivesical fat at the edges of the posterior bladder wall where the bladder was previously attached to the prostate and then tied down completely (Fig. 1). Following posterior intussusception, the stay suture at the bladder neck is removed. The vesicourethral anastomosis is then completed in our customary manner using 3 posterior interrupted and 2 running 3-0 polyglycolic sutures that meet and are tied together at the 12-o'clock position. Finally, another 3-0 polyglycolic horizontal mattress suture is placed in the anterolateral perivesical adipose tissue and tied down completely, approximately 4 cm away from the anastomosis (Fig. 2). Visible on cystogram, bladder neck intussusception results in a more narrowed bladder neck, as initially described (Fig. 3). A video description with additional technical details is available for viewing online (http://youtu.be/HrZYQsV3oRI).

2.2. Outcome measures

Urinary function during the early recovery period served as our primary outcome. We used the urinary domain of the

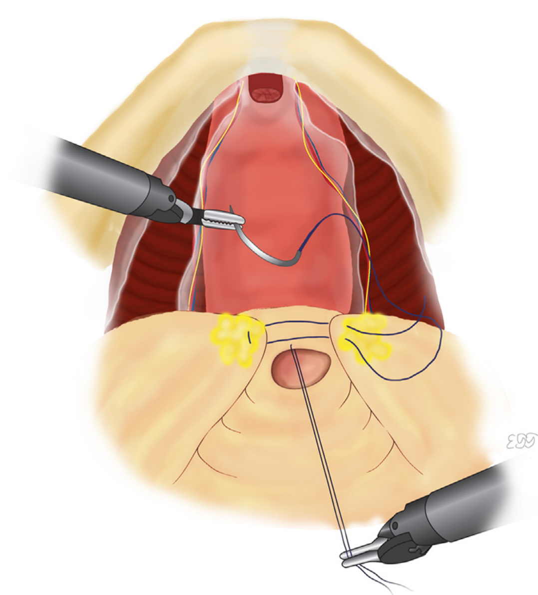

Fig. 1. Posterior bladder neck intussusception. An initial 6-o'clock anastomotic suture is placed inside-out on the urethral stump before division of the posterior apical prostatic urethra (not pictured). A second stay suture at the 6-o'clock position in the bladder neck is placed to prevent retraction of the bladder neck during intussusception. Next, a 3-0 polyglycolic horizontal mattress suture is placed posterolateral to the bladder neck in the perivesical fat and cinched down completely. (Color version of figure is available online.)

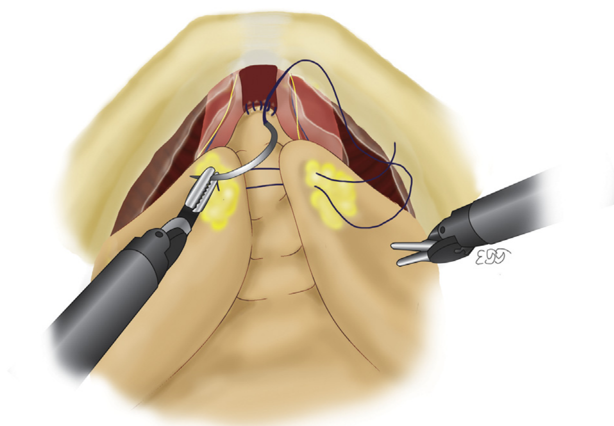

Fig. 2. Anterior bladder neck intussusception. Following the posterior bladder neck intussusception, the stay suture at the 6-o'clock position on the bladder neck is removed (not pictured). The anastomosis is then completed by placing 3 posterior interrupted 3-0 polyglycolic sutures. Two 3-0 polyglycolic sutures are then run in opposite directions and tied together at the 12-o'clock position. Another 3-0 horizontal mattress suture is placed in the anterolateral perivesical adipose tissue and tied down completely, approximately 4 cm away from the anastomosis. (Color version of figure is available online.)

Expanded Prostate Cancer Index—Short Form (EPIC-SF)—a validated questionnaire that rates bowel function, urinary control, sexual function, and health-related quality of life on a scale from 0 to 100, with higher scores representing better outcomes [14]. Because we routinely preserve the bladder neck and divide the dorsal venous complex in an athermal manner (2 modifications that also accelerate recovery), we prospectively assessed urinary function at 2 days, 2 weeks, and 2 months following catheter removal. To gauge longer-term results, we reassessed urinary function 4 to 12 months after surgery. Secondary outcomes included operative features, pathologic findings, catheter duration, and postoperative complications according to the Clavien-Dindo classification system [15].

2.3. Power calculations and statistical analysis

Based on the initial experience reported by Walsh and Marschke [6], we hypothesized that patients treated with bladder neck intussusception would have a more rapid recovery of urinary control. Power calculations indicated that a collective sample of 48 patients would be sufficient to identify an ordinal increase (i.e., 25–33 point increase) in urinary function, assuming a power of 80% and a significance level of 5%. Accordingly, our goal was to enroll 24 subjects each to the treatment/intussusception arm and the nonrandom control/nonintussusception arm.

We used the Student *t* test and the Fisher exact test to compare continuous and categorical variables, respectively. For catheter duration, we used the Wilcoxon rank sum test. Based on factors potentially associated with urinary function, we further adjusted our EPIC-SF urinary domain scores for age, race, body mass index, and D'Amico risk classification. All statistical testing was 2 sided, completed using computerized software (STATA version 13.1, College Station, TX), and performed at the 5% significance level. This study was approved by our Institutional Review Board.

3. Results

Of 48 subjects, 24 men underwent bladder neck intussusception and 24 men served as controls. Patients treated with intussusception vs. nonintussusception were similar in age (59.7 vs. 62.6 y, $P = 0.171$) and body mass index (27.3 vs. 29.5 kg/m^2, $P = 0.102$). Additionally, no difference in race, comorbidity status, previous abdominal surgery, American Society of Anesthesiologists physical status classification score, and D'Amico risk classification was observed ($P > 0.100$). Although not statistically significant, we noted a trend in higher baseline prostate-specific antigen level for those undergoing bladder neck intussusception when compared with nonintussusception (Table 1).

Operative features and outcomes are reported in Table 2. From a technical standpoint, operative time (136.4 vs. 133.1 min, $P = 0.586$), estimated blood loss (179.2 vs. 192.9 ml, $P = 0.451$), and rates of non–nerve sparing (4.2% vs. 4.2%, $P = 1.000$) remained similar between groups. We found no difference in prostate weight, positive lymph nodes, perineural invasion, or final pathologic Gleason score and stage between treatment types ($P > 0.500$). Overall, positive surgical margins occurred in 18.8% of cases—8.7% among men with pT2 disease and 28% among men with pT3 disease—with no difference between intussusception and nonintussusception (16.7% vs. 20.8%, $P = 1.000$).

Using the Clavien-Dindo classification system, 2 patients experienced a major complication (Clavien III–IV), whereas

Fig. 3. Postoperative cystogram demonstrating a narrowed and slightly kinked bladder neck following intussusception—oblique view.

Table 1
Baseline characteristics

	Intussusception, $n = 24$	Nonintussusception, $n = 24$	P value
Age, mean (SD), y	59.7 (1.5)	62.6 (1.5)	0.171
Body mass index, mean (SD), kg/m^2	27.3 (0.8)	29.5 (1.0)	0.102
Nonwhite race (%)	4 (16.7)	3 (12.5)	1.000
PSA level, mean (SD), ng/ml	10.5 (1.7)	7.0 (0.6)	0.060
Comorbidity count (%)			
0	9 (37.5)	6 (25.0)	0.534
≥1	15 (62.5)	18 (75.0)	
Previous abdominal surgery (%)	7 (29.2)	5 (20.8)	0.740
ASA physical status (%)			
1	0 (0.0)	1 (4.4)	0.188
2	19 (79.2)	21 (91.3)	
3	5 (20.8)	1 (4.4)	
D'Amico risk stratification			
Low	6 (25.0)	4 (16.7)	0.699
Moderate	14 (58.3)	17 (70.8)	
High	4 (16.7)	3 (12.5)	

ASA = American Society of Anesthesiologists; PSA = prostate-specific antigen; SD = standard deviation.

6 patients experienced a minor complication (Clavien I–II). Rates of major complications did not differ significantly between treatment groups (4.2% vs. 4.2%, $P = 1.000$). In the group of patients treated with bladder neck intussusception, 2 experienced a urine leak when compared with 1 in the nonintussusception arm. In the intussusception group, both patients faced extended travel time (>2 h driving and flying) and opted for prolonged catheterization (31 and 35 d) until a confirmatory cystogram showing resolution of extravasation could be completed. Length of stay did not differ significantly between treatment groups (1.3 vs. 1.2 d, $P = 0.730$).

Adjusted urinary function EPIC-SF scores are depicted in Fig. 4. At baseline, both the groups presented with similarly high urinary function scores (98.2 vs. 99.6, $P = 0.404$). Although urinary function appeared to be better for those receiving intussusception at the 2-day interval (49.4 vs. 43.1, $P = 0.420$), this did not reach statistical significance. At 2 weeks, men undergoing bladder neck intussusception reported significantly higher urinary function scores when compared with men in the non-intussusception group (65.4 vs. 46.6, $P = 0.019$). Based on specific responses to the EPIC-SF, more men receiving intussusception achieved no leakage, achieved total control, or did not require a pad (62.5% vs. 20.8%, $P = 0.008$) in this time interval (Table 3). EPIC-SF urinary function scores eventually converged with no difference noted at 2 months (69.5 vs. 67.9, $P = 0.929$). At a median follow-up of approximately 7 months (intussusception, 7.25 mo vs. nonintussusception, 7.5 mo), urinary function continued to be similar between the treatment group and the control group (80.5 vs. 77.0, $P = 0.665$).

4. Discussion

Despite several surgical advances, postprostatectomy incontinence remains common, morbid, and costly [1–3]. Although many men eventually improve over time, deficits in urinary control during the early recovery period impair quality of life [1,16]. In an effort to enhance recovery outcomes, several technical modifications have been described for robot-assisted laparoscopic prostatectomy. Although some of these techniques have afforded better urinary control [5,9], as many as half of the men continue to experience postprostatectomy incontinence during the first 3 months after surgery [1], suggesting an opportunity for functional improvement in men undergoing radical surgery for prostate cancer.

Table 2
Operative, pathologic, and clinical outcomes

	Intussusception, $n = 24$	Nonintussusception, $n = 24$	P value
Operative time, mean (SD), min	136.4 (3.0)	133.1 (5.1)	0.586
Estimated blood loss, mean (SD), ml	179.2 (10.7)	192.9 (14.6)	0.451
Non–nerve sparing (%)	1 (4.2)	1 (4.2)	1.000
Pathologic Gleason score (%)			
$3 + 3 = 6$	3 (12.5)	2 (8.3)	0.645
$3 + 4 = 7$ Or $4 + 3 = 7$	16 (66.7)	19 (79.2)	
$4 + 4 = 8$ Or higher	5 (20.8)	3 (12.5)	
Pathologic category, no. (%)			
T2a	9 (37.5)	8 (33.3)	0.904
T2b	1 (4.2)	0 (0.0)	
T2c	3 (12.5)	2 (8.3)	
T3a	10 (41.7)	12 (50.0)	
T3b	1 (4.2)	2 (8.3)	
Positive margin (%)	4 (16.7)	5 (20.8)	1.000
T2a–c	0 (0.0)	2 (15.4)	0.486
T3a–b	4 (28.6)	3 (27.3)	1.000
Prostate size, mean (SD), g	45.9 (5.4)	48.2 (3.0)	0.717
Perineural invasion (%)	6 (25.0)	8 (33.3)	0.752
Positive lymph nodes (%)	1 (4.2)	1 (4.2)	1.000
Length of stay, mean (SD), d	1.3 (0.2)	1.2 (0.2)	0.730
Catheter duration, median, d	8	8	0.125
Postoperative complication	5 (20.8)	3 (12.5)	0.701
Clavien I–II	4 (16.7)	2 (8.3)	0.666
Clavien III–IV	1 (4.2)	1 (4.2)	1.000

SD = standard deviation.

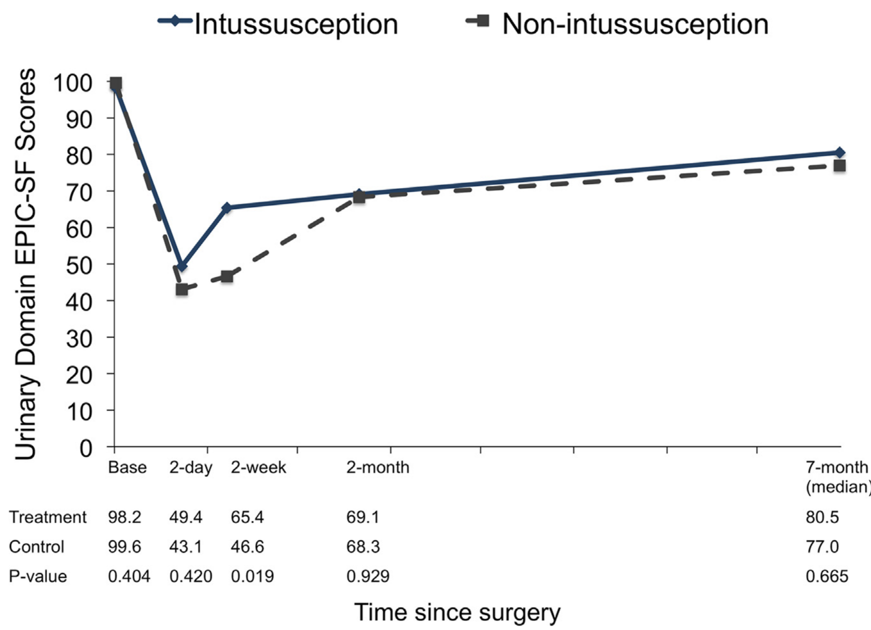

Fig. 4. Baseline, 2-day, 2-week, 2-month, and 7-month (median) EPIC-SF urinary domain scores among men receiving intussusception vs. nonintussusception with robot-assisted laparoscopic prostatectomy. Intussusception with a median follow-up of 7.25 months (interquartile range: 5.5–8.75 mo) vs. nonintussusception with a median follow-up of 7.5 months (interquartile range: 5.0–9.5 mo), $P = 0.766$ based on Wilcoxon rank sum test. Scores are adjusted for age, body mass index, race, and D'Amico risk classification. Significant difference noted at 2 weeks based on an alpha level of 0.05. Unadjusted scores revealed similar findings. (Color version of figure is available online.)

In 2002, after reaching a plateau in functional outcomes [17–19], Walsh and Marschke [6] described bladder neck intussusception as a mechanical means to improve post-prostatectomy incontinence. By using buttressing sutures anterior and posterior to the bladder neck, he increased 3-month continence rates—defined as zero or dry pad—from 54% to 82% without any increase in bladder neck contractures or related complications. However, subsequent assessments have been mixed, and none have assessed this technique in the laparoscopic or robotic setting [7,8].

Table 3
Proportion of patients with no leakage, total control, or zero pads according to the urinary domain of the EPIC-SF

Time interval	Urinary function	Intussusception, $n = 24$	Nonintussusception, $n = 24$	P value
2 Days	No leakage	2 (8.3)	3 (12.5)	1.000
	Total control	3 (12.5)	3 (12.5)	1.000
	No pad use	6 (25.0)	4 (16.7)	0.724
	Any of above	8 (33.3)	6 (25.0)	0.752
2 Weeks	No leakage	4 (16.7)	2 (8.3)	0.666
	Total control	7 (29.2)	3 (12.5)	0.286
	No pad use	10 (41.7)	4 (16.7)	0.111
	Any of above	15 (62.5)	5 (20.8)	0.008
2 Months	No leakage	10 (41.7)	10 (41.7)	1.000
	Total control	12 (50.0)	11 (45.8)	1.000
	No pad use	12 (50.0)	13 (54.2)	1.000
	Any of above	13 (54.2)	13 (54.2)	1.000
7 Months[a] (median)	No leakage	11 (50.0)[b]	14 (58.3)	0.768
	Total control	12 (54.6)[b]	15 (62.5)	0.765
	No pad use	16 (72.7)[b]	13 (54.2)	0.233
	Any of above	17 (77.3)[b]	17 (70.8)	0.742

[a]Intussusception with median follow-up of 7.25 months (interquartile range: 5.5–8.75 mo) vs. nonintussusception with median follow-up of 7.5 months (interquartile range: 5.0–9.5 mo); $P = 0.766$ based on Wilcoxon rank sum test.

[b]Based on $n = 22$ because 2 patients in the intussusception arm were lost to follow-up.

Potential challenges to perform intussusception during laparoscopic surgery are the cephalad camera angle vantage point and running vs. interrupted anastomotic techniques during minimally invasive vs. open surgery. These nuances require subtle modification when performing intussusception during robot-assisted laparoscopic prostatectomy.

Our study demonstrates the feasibility and potential effectiveness of bladder neck intussusception during robot-assisted laparoscopic prostatectomy. Among men with similar features, intussusception may be performed without substantial prolongation of operating time or compromise in clinicopathologic outcomes. Furthermore, patients who underwent intussusception achieved quicker return of urinary function when compared with patients who did not undergo intussusception, with higher urinary function scores at 2 days and statistically significant increases at 2 weeks. The 19-point urinary function score advantage for intussusception at 2 weeks exceeds the 6- to 9-point threshold for clinical significance described previously [20]. Approximately, two-thirds of patients receiving intussusception reported no leakage, complete control, or zero pad use within weeks of surgery, reducing the period of urinary impairment following prostatectomy.

Although these data support the effectiveness of bladder neck intussusception, the therapeutic window appears more compact when compared with that of previous studies [6,7]. In these reports, authors noted higher rates of continence at 3 months, whereas our findings indicate equivalency by 2 months. One potential explanation could be our use of bladder neck preservation—a technique not used during these initial series. Although the follow-up intervals differ slightly, the 2-month urinary outcomes reported in this trial compare favorably to outcomes reported 1 to 3 months postoperatively following bladder neck preservation [5]. Additionally, the effect size at 2 weeks appears to be larger than that observed with bladder neck preservation and on par with selective suturing and athermal division of the dorsal venous complex [5,9]. Given these findings and those reported with open surgery, bladder neck intussusception improves urinary control and may serve as a potential augment or alternative to other well-popularized modifications depending on the surgical circumstances of the procedure.

Although promising, there may be additional opportunities to prolong the effect and improve the safety of bladder neck intussusception. In the initial description, Walsh and Marschke [6] used polyglyconate for the buttressing suture, which spurs less inflammation and better retains tensile strength when compared with the polyglycolic suture [21]. More recently, barbed polyglyconate sutures have been used for the vesicourethral anastomosis in robot-assisted laparoscopic prostatectomy. Although its comparative and cost-effectiveness remains less clear for the anastomosis, polyglyconate and its associated features may extend the benefit of intussusceptions [12,22]. Additionally, we noted 2 urine leaks in the intussusception arm compared with 1 in the control group. Although not significantly different, we have noticed increased tension on the vesicourethral anastomosis with intussusception owing to reduced bladder neck length. To this end, combining bladder neck intussusception with posterior or anterior reconstruction may offer additional anastomotic support, thereby reducing the risk for subsequent urine leaks [1]. Although early results are promising, additional adjustments may add to the technique's safety and effectiveness, as it is assessed in subsequent comparative trials.

Finally, these findings also highlight the potential role for new training methods in urology. With emerging evidence demonstrating a link between peer rating of technical skill and surgical complications, there is growing interest in defining the role for coaching among both novice trainees and experienced surgeons [23,24]. To adapt bladder neck intussusception to robot-assisted prostatectomy, we used video recording, postoperative debriefing, and coaching by a more experienced surgeon. Because of geographic restrictions, we implemented these training tools through social networking interfaces, which have been shown to enhance skill acquisition [24,25]. For instance, proper intussusception technique involves more proximal and robust placement of the horizontal mattress sutures in the perivesical adipose tissue while avoiding bladder muscle—a subtle point that may have been overlooked without critical feedback made available through social media. By bundling these techniques, we rapidly and effectively operationalized bladder neck intussusception to the robotic platform, leading to measurable patient benefit. As we move toward more stringent training and credentialing requirements [26], these training tools may be the most efficient way to ensure proficient adoption of new surgical techniques.

These findings should be considered in the context of the study design. Our study is not randomized and therefore vulnerable to potential selection bias. Although a randomized control would be preferable, we found that, in this instance, issues related to clinical equipoise and patient preference limited our ability to implement such a trial. To address some methodological concerns, we collected data prospectively and used a nonrandom control with both treatment and control groups appearing similar. Slight, nonsignificant differences in age and body mass index may still lead to bias. However, previous studies suggest that the effect of age on postprostatectomy incontinence stems from differences in baseline function, while obesity impairs urinary function over the long term [27,28]. In this study, we observed no difference in baseline function and focused on short-term functional outcomes. Furthermore, we adjusted for several established risk factors for postprostatectomy incontinence. On a separate note, these findings are based on a single surgeon and may have limited generalizability, as outcomes may also rely on surgeon experience, teaching environment, patient population, and concurrent surgical maneuvers (e.g., bladder neck preservation and athermal division of the dorsal venous complex). Larger, multi-institutional assessments may be necessary to gain additional, more generalizable information on safety and effectiveness.

5. Conclusion

Among men undergoing robot-assisted laparoscopic prostatectomy, the addition of bladder neck intussusception enhances early recovery of urinary function while yielding similar clinicopathologic outcomes. With video-based coaching, this technique may be quickly adopted and may help reduce the burden of urinary impairment for men seeking surgical treatment for localized prostate cancer.

Appendix A. Supplementary Material

Supplementary data associated with this article can be found in the online version at 10.1016/j.urolonc.2015.01.012.

References

[1] Ficarra V, Novara G, Rosen RC, et al. Systematic review and meta-analysis of studies reporting urinary continence recovery after robot-assisted radical prostatectomy. Eur Urol 2012;62:405–17.
[2] Schroeck FR, Krupski TL, Sun L, et al. Satisfaction and regret after open retropubic or robot-assisted laparoscopic radical prostatectomy. Eur Urol 2008;54:785–93.
[3] Wagner TH, Hu TW. Economic costs of urinary incontinence in 1995. Urology 1998;51:355–61.
[4] Nyarangi-Dix JN, Radtke JP, Hadaschik B, Pahernik S, Hohenfellner M. Impact of complete bladder neck preservation on urinary continence, quality of life and surgical margins after radical prostatectomy: a randomized, controlled, single blind trial. J Urol 2013; 189:891–8.
[5] Freire MP, Weinberg AC, Lei Y, et al. Anatomic bladder neck preservation during robotic-assisted laparoscopic radical prostatectomy: description of technique and outcomes. Eur Urol 2009;56:972–80.
[6] Walsh PC, Marschke PL. Intussusception of the reconstructed bladder neck leads to earlier continence after radical prostatectomy. Urology 2002;59:934–8.
[7] Wille S, Varga Z, von Knobloch R, Hofmann R. Intussusception of bladder neck improves early continence after radical prostatectomy: results of a prospective trial. Urology 2005;65:524–7.
[8] Sakai I, Harada K, Hara I, Eto H, Miyake H. Intussusception of the bladder neck does not promote early restoration to urinary continence after non-nerve-sparing radical retropubic prostatectomy. Int J Urol 2005;12:275–9.
[9] Lei Y, Alemozaffar M, Williams SB, et al. Athermal division and selective suture ligation of the dorsal vein complex during robot-assisted laparoscopic radical prostatectomy: description of technique and outcomes. Eur Urol 2011;59:235–43.
[10] Schaeffer EM, Partin AW, Lepor H, Walsh PC. Campbell-Walsh urology: chapter 102—radical retropubic and perineal prostatectomy, 10th ed. Saunders: 2011.
[11] Kowalczyk KJ, Huang AC, Hevelone ND, et al. Stepwise approach for nerve sparing without countertraction during robot-assisted radical prostatectomy: technique and outcomes. Eur Urol 2011;60:536–47.
[12] Williams SB, Alemozaffar M, Lei Y, et al. Randomized controlled trial of barbed polyglyconate versus polyglactin suture for robot-assisted laparoscopic prostatectomy anastomosis: technique and outcomes. Eur Urol 2010;58:875–81.
[13] Berry AM, Korkes F, Ferreira M, Hu JC. Robotic urethrovesical anastomosis: combining running and interrupted sutures. J Endourol 2008;22:2127–9.
[14] Wei JT, Dunn RL, Litwin MS, Sandler HM, Sanda MG. Development and validation of the expanded prostate cancer index composite (EPIC) for comprehensive assessment of health-related quality of life in men with prostate cancer. Urology 2000;56:899–905.
[15] Dindo D, Demartines N, Clavien PA. Classification of surgical complications: a new proposal with evaluation in a cohort of 6336 patients and results of a survey. Ann Surg 2004;240:205–13.
[16] Resnick MJ, Koyama T, Fan KH, et al. Long-term functional outcomes after treatment for localized prostate cancer. N Engl J Med 2013;368:436–45.
[17] Walsh PC. Anatomic radical prostatectomy: evolution of the surgical technique. J Urol 1998;160:2418–24.
[18] Walsh PC. Patient-reported impotence and incontinence after nerve-sparing radical prostatectomy. J Urol 1998;159:308–9.
[19] Walsh PC, Lepor H, Eggleston JC. Radical prostatectomy with preservation of sexual function: anatomical and pathological considerations. Prostate 1983;4:473–85.
[20] Skolarus TA, Dunn RL, Sanda MG, et al. Minimally important difference for the expanded prostate cancer index composite short form. Urology 2015;85:101–6.
[21] Bourne RB, Bitar H, Andreae PR, Martin LM, Finlay JB, Marquis F. In-vivo comparison of four absorbable sutures: Vicryl, Dexon Plus, Maxon and PDS. Can J Surg 1988;31:43–5.
[22] Sammon J, Kim TK, Trinh QD, et al. Anastomosis during robot-assisted radical prostatectomy: randomized controlled trial comparing barbed and standard monofilament suture. Urology 2011;78:572–9.
[23] Birkmeyer JD, Finks JF, O'Reilly A, et al. Surgical skill and complication rates after bariatric surgery. N Engl J Med 2013;369: 1434–42.
[24] Hu YY, Peyre SE, Arriaga AF, et al. Postgame analysis: using video-based coaching for continuous professional development. J Am Coll Surg 2012;214:115–24.
[25] Carter SC, Chiang A, Shah G, et al. Video-based peer feedback through social networking for robotic surgery simulation: a multicenter randomized controlled trial. Ann Surg 2015;261:870–5.
[26] Zorn KC, Gautam G, Shalhav AL, et al. Training, credentialing, proctoring and medicolegal risks of robotic urological surgery: recommendations of the society of urologic robotic surgeons. J Urol 2009;182:1126–32.
[27] Wiltz AL, Shikanov S, Eggener SE, et al. Robotic radical prostatectomy in overweight and obese patients: oncological and validated-functional outcomes. Urology 2009;73:316–22.
[28] Brajtbord JS, Punnen S, Cowan JE, Welty CJ, Carroll PR. Age and baseline quality of life at radical prostatectomy—who has the most to lose? J Urol 2014;192:396–401.