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Impact of Intravesical Prostatic Protrusion on Continence Outcomes after Robotic-Assisted Laparoscopic Radical Prostatectomy

Sheng-Chun Hung, Yen-Chuan Ou*, Cheng-Kuang Yang, Chen-Li Cheng, Hao-Chung Ho, Kun-Yuan Chiu, Chung-Kuang Su, Wen-Ming Chen, Shian-Shiang Wang, Chuan-Shu Chen and Jian-Ri Li

Division of Urology, Department of Surgery, Taichung Veterans General Hospital, Taichung, Taiwan

***Corresponding author:** Ou YC, Division of Urology, Department of Surgery, Taichung Veterans General Hospital, Taichung, Taiwan, ROC, Postal code 40705 No. 1650, Sec. 4, Taiwan Boulevard, Taichung, Taiwan, ROC, Tel: 886-4-23741215; Fax: 886-4-23593160; E-mail: ycou228@gmail.com

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Abstract

Purpose: We try to evaluate the influence of intravesical prostatic protrusion (IPP) in the postoperative continence of patient who received robotic assisted laparoscopic radical prostatectomy.

Methods: A total 600 patients who underwent robotic assisted laparoscopic radical prostatectomy were included in the study. Preoperative MRI was performed in all patients and the vertical distance from the tip of the protruding prostate to the base of the urinary bladder was measured in all sagittal plane. The degree of intravesical prostatic protrusion were divided into three groups (IPP<5 mm, 5 mm<IPP<10 mm, 10 mm<IPP). Surgical procedure was mentioned. Continence was defined as no pad use or only one safety pad per day and assessed at 1, 3 and 12 months postoperatively. The result was examined.

Results: The overall continence rate at 1, 3 and 12 month was 69.2%, 91.33% and 95.5%. Among the three groups, there is significant difference in 1 month, 3 months and 12 months continence rate (IPP<5 mm: 82.5%, 96.3%, 97.7%; 5 mm<IPP<10 mm: 61.9%, 89.4%, 94.4%; 10 mm<IPP: 30%, 75.6%, 88.9%, p<0.001). At first month, 415 patients achieved continence but 195 patients still incontinence and the length of IPP among the two groups were 4.43 mm ± 3.74 mm and 8.69 mm ± 6.63 mm, p<0.001. There is also significant difference in IPP length among continence and incontinence group.

Conclusions: To our result, both of intravesical prostatic protrusion and prostate volume was correlated with recovery of early and one year continence after robotic assisted laparoscopic radical prostatectomy and with inferior outcome.

Keywords: Continence; Intravesical prostatic protrusion; Laparoscopy; Prostate cancer; Radical prostatectomy; Robotic- assisted laparoscopy

Introduction

Radical prostatectomy is the standard treatment for clinically localized prostate cancer [1]. Laparoscopic radical prostatectomy has been used worldwide during the last ten years, and it is minimally invasive and provides an excellent surgical view [2]. Moreover, robotic-assisted laparoscopic radical prostatectomy (RaLRP) is an excellent surgical technique which results in good continence, potency and oncology outcomes [3]. However, despite the significant progress in surgical techniques, incontinence after surgery remains a problem and may affect the quality of life. Prostate weight, patient's age, body mass index (BMI) and prior bladder neck treatment have been reported to be independent risk factors affecting postoperative continence in patients receiving RaLRP [4].

Surgical techniques with preservation, reconstruction and reinforcement of the anatomical structures of the pelvis floor have also been reported to improve the early return of urinary continence after surgery [5,6]. Measuring intravesical prostatic protrusion (IPP), which reflects expansion of the prostate into the bladder neck due to benign prostate hyperplasia, is a useful and non-invasive tool to evaluate bladder outlet obstruction and detrusor function, especially in patients with a relatively small prostate [7]. Patients with a significantly protruding prostate (IPP>10 mm) are at an increased risk of acute urinary retention or vesical stones [8].

Furthermore, a recent study also suggested that patients without significant IPP have better postoperative outcomes after receiving transurethral resection of the prostate [8].

Recently, another study with 242 patients reported that the postoperative urinary incontinence rate in patients undergoing laparoscopic radical prostatectomy was markedly higher in those with larger intravesical prostatic protrusions [9]. We hypothesized that a protruding prostate, of either the median or lateral lobe, would result in difficult dissection and preservation of the bladder neck and smooth muscular internal vesical sphincter, potentially resulting in poor continence outcomes. From 2005 to 2013, we retrospectively reviewed magnetic resonance imaging (MRI) of 600 patients who received RaLRP at our hospital by a single surgeon and tried to determine whether IPP has an impact on postoperative continence outcomes.

Methods

From December 2005 to December 2013, we retrospectively reviewed 600 patients with clinically localized prostate cancer who

underwent RaLRP by a single surgeon and were followed up for at least 1 year at Taichung Veterans General Hospital, Taiwan.

Patients with a history of transurethral resection of the prostate were excluded. All of the patients underwent MRI before the operation. All of the surgical procedures were performed by an experienced urologist and a surgical team. Clinical data and characteristics were collected retrospectively.

The length of IPP was measured as described by Chia et al. [10]. The bladder had to have a capacity of 150 mL to 250 mL before the extent of IPP was measured [11]. The sagittal view of MRI was obtained and the vertical distance from the tip of the protrusion to the circumference of the bladder at the base of the prostate gland were measured (Figure 1).

We measured the degree of IPP using the following grading system: grade I (<5 mm), grade II (5 mm to 10 mm) and grade III (>10 mm) [10]. Prostate volume was measured in the resected prostate postoperatively.

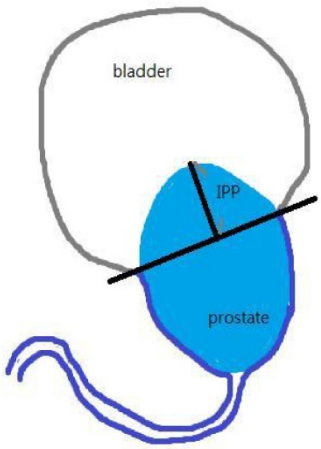

Figure 1: Measurement of intravesical protruding prostate in sagittal plane of MRI.

Perioperative conditions were also recorded. All of the surgical procedures were performed using a da Vinci standard four-arm surgical system (Intuitive Surgical, Sunnyvale, CA, USA) following Dr. Patel's RaLRP procedure, with minor modifications [12,13].

The transperitoneal approach was used, and resection of the prostate was performed from the recto-vesical pouch with posterior dissection of the vas deferens and seminal vesicles. The bladder was then mobilized downward, and anterior dissection of the prostate was performed [13]. Continence components such as Denonvilliers' fascia, puboprostatic ligament, arcus tendineus fascia and levator ani fascia were preserved as far as possible [5]. Posterior reconstruction of the rhabdosphincter was performed to reinforce vesicourethral anastomosis [14].

Vesicourethral anastomosis was performed with two 18-cm 3-O Monocryl continuous sutures, and bladder neck reconstruction was performed if needed [14]. The time of vesicourethral anastomosis and whether or not bladder neck reconstruction was performed were recorded, as these factors may have reflected the difficulty of the procedure and relationship with the degree of IPP.

After surgery, an 18-French Silicon Foley's Catheter was placed for 7-14 days. If bladder neck reconstruction was performed, if the patient had a history of radiation exposure, or if there were any concerns of minor leakage, the catheter was kept in place for a longer period. Postoperative follow-up was routinely performed at 1, 3, 6, 9, 12 months and continence was assessed at each visit.

Pelvic floor muscle exercises were encouraged, and if needed, medication such as anti-muscarinic or tricyclic anti-depressants was added. Continence was defined as not requiring the use of pads or only one safety pad per day.

The Student's t-test was used to assess IPP as a predictor of continence at each time point. The chi-square test was used to assess differences in distributions among categorical variables. Differences in the patients' characteristics were assessed with one way ANOVA.

Results

The patients (n=600) were categorized into three groups as described in the Materials and Methods, and 350 patients were classified as grade I, 160 as grade II, and 90 as grade III. The characteristics of each group are shown in Table 1. The mean lengths of IPP in the three groups were 2.55 mm ± 1.24 mm, 7.21 mm ± 1.19 mm and 15.61 mm ± 5.57 mm, respectively ($p<0.005$). The prostate volume was also significantly different between the three groups (32.65 ml ± 10.69 ml, 42.61 ml ± 13.41 ml and 64.03 ml ± 28.09 ml, respectively, $p<0.005$).

The mean time of vesicourethral anastomosis of all of the patients was 23.16 min ± 9.37 min (21.66 min ± 7.79 min, 23.99 min ± 9.44 min and 27.53 min ± 12.83 min in grade I to grade III, respectively, $p<0.005$). The incidence rates of bladder neck reconstruction were 4.8% (17/350), 8.1% (13/160) and 15.6% (14/90) ($p<0.005$) in the three groups. The time of anastomosis and the incidence of bladder neck reconstruction were significantly higher in the significant IPP group (grade III), which may mean that a more protruding prostate makes the surgical procedure more complicated.

In addition, there were no significant differences in the average volume of blood loss and the number of days of Foley catheter placement among the three groups. The average time intervals to continence were 1.25 ± 0.69 months, 1.70 ± 1.17 months and 2.75 ± 1.65 months in grade I to grade III, respectively ($p<0.005$).

The relationships between preoperative factors and urinary incontinence after RaLRP are shown in Table 2. At the first month after surgery, 415 patients had achieved continence and 185 patients remained incontinent, and there were significant differences in prostate volume and IPP between these two groups of patients (both $p<0.001$). At 3 months postoperatively, 548 patients had achieved continence and 52 patients were still incontinent, and there were still significant differences in prostate volume and IPP (both $p<0.001$). After 1 year of follow up, 573 patients had achieved continence and 27 patients were still incontinent, and there were still significant differences in prostate volume ($p=0.003$) and IPP ($p<0.001$). In summary, the length of IPP and the prostate volume were both significantly correlated with early continence and also at 1 year.

	IPP<5 (N=350)	5<IPP<10 (N=160)	10<IPP (N= 90)	All patients (N = 600)	Significance
IPP (mm)	235 ± 1.24	7.21 ± 1.19	15.61 ± 5.57	5.74 ± 5.20	p<0.005*
Volume (m1)	32.65 ± 10.69	42.61 ± 13.41	64.03 ± 28.09	40.01 ± 18.75	p<0.005*
Vesico urethral anastomosis (min)	21.66 ± 7.79	23.99 ± 9.44	27.33 ± 12.83	23.16 ± 9.37	p<0.005*
Blood loss (m1)	123.51 ± 135.56	111.41 ± 104.92	147.28 ± 183.76	123.85 ± 136.98	p=0167
Foley (days)	7.97 ± 1.74	8.15 ± 2.04	8.37 ± 2.69	8.08 ± 1.99	p=0.07
Bladder neck reconstruction	4.8% (17/350)	8.1% (13/160)	15.6% (14/90)	7.3% (44/600)	p<0.005*
Continence (month)	1.25 ± 0.69	1.70 ± 1.17	2.75 ± 1.65	1.53 ± 1.06	p<0.005*
*One way ANOVA_ Scheffe method. Statistical significance vas defned as p<0.005; IPP=Intravescal Prohtdingprostate.					

Table 1: Preoperative and perioperative condition and continence between the three groups of patients.

		Continence	Incontinence	P-value
Postoperative 1 month	No. of patients	415	185	
	Prostate volume (ml)	35.71 ± 13.80	49.64 ± 24.99	p<0.001*
	IPP (mm)	4.43 ± 3.74	8.69 ± 6.63	p<0.001*
Postoperative 3 months	No. of patients	548	52	
	Prostate volume (ml)	38.61 ± 17.76	54.75 ± 22.43	p<0.001*
	IPP (mm)	5.29 ± 4.56	10.50 ± 8.32	p<0.001*
Postoperative 12 months	No. of patients	573	27	
	Prostate volume (ml)	39.22 ± 18.11	56.73 ± 24.15	p=0.003*
	IPP (mm)	5.55 ± 4.93	9.88 ± 8.37	p<0.001*
*Student t-test. Confidence interval=95%. Statistical significance was defined as p<0.05.				

Table 2: Continence condition after robotic assisted laparoscopic radical prostatectomy.

	IPP<5 (N=350)	5<IPP<10 (N=160)	10<IPP (N=90)	All patient's (N=600)	Significance
Continence 1 month	82.50% (289/350)	61.90% (99/160)	30% (27/90)	69.20% (415/600)	p<0.001*
Continence 3 months	96.30% (337/350)	89.40% (143/160)	75.60% (68/90)	91.33% (548/600)	p<0.001
Continence 12 months	97.70% (342/350)	94.40% (151/160)	88.90% (80/90)	95.50% (573/600)	p<0.001*
Pearson chi-square method. Statistical significance was defined as p<0.05.					

Table 3: Continence rates at 1 month, 3 months and 12 months among the three groups.

Continence at 1, 3, and 12 months postoperatively was assessed according to the degree of IPP (Table 3). The overall continence rates at 1, 3 and 12 months were 69.2% (415/600), 91.33% (548/600) and 95.5% (573/600), respectively. There were significant differences in the continence rates between the three grades at 1, 3 and 12 months (all p<0.001). Urinary continence improved with time in each group, and the length of IPP had a significant impact on postoperative continence at each time interval.

Figure 2 shows the MRI sagittal view of one of the patients with a significantly protruding prostate measuring 34.5 mm. Surgery was performed with the transperitoneal approach and a da Vinci standard four-arm surgical system. The posterior approach and dissection of vas and seminal vesicles was performed first, and then bladder neck dissection and apical dissection were performed after the bladder had been mobilized downward. It took about 35 min to reconstruct the bladder neck and vesicourethral anastomosis.

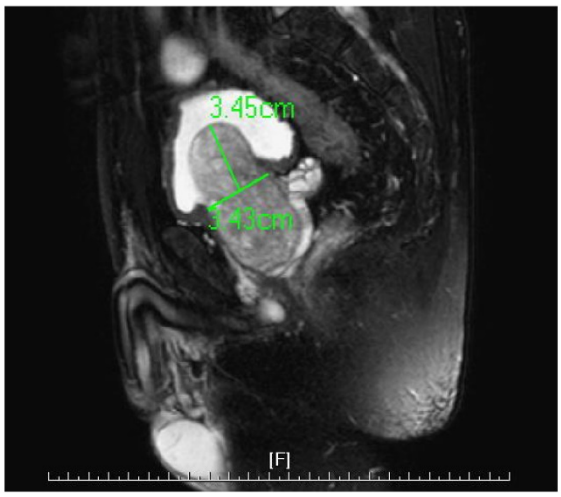

Figure 2: Patient with a significantly protruding prostate. Under MRI, the length of IPP was measured 34.5 mm. PSA 16.12 ng/ml. Prostate volume was measured with specimen after operation and showed about 99.2 gm. Bladder neck reconstruction was performed during surgery. Postoperative continence at 6 months.

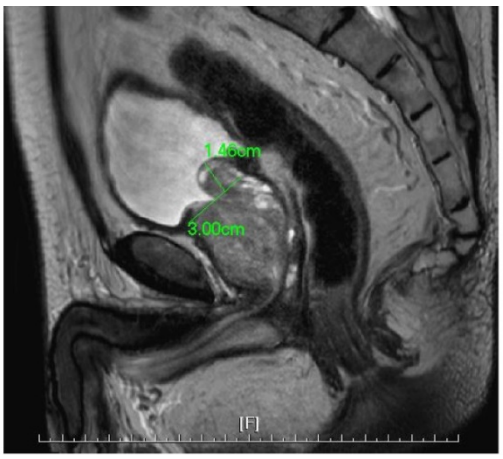

Figure 3: Patient with a significantly protruding prostate. Under MRI, the length of IPP was measured about 14.6 mm. PSA 8.83 ng/ml. Prostate volume was measured with specimen after operation and showed about 45.8 gm. Bladder neck reconstruction was performed during surgery. Postoperative continence at 1 month.

Posterior reconstruction was performed to reinforce the anastomosis, which was challenged with 200 ml normal saline irrigation and showed no leakage. The Foley catheter was kept in place for 14 days and then removed. Intermittent stress urinary incontinence was noted and more than one pad was needed per day until the sixth month.

Figure 3 shows another patient with significant IPP measuring 14.6 mm. Surgery was performed as mentioned above. Bladder reconstruction was also performed and it took about 30 min for vesicourethral anastomosis. After the Foley Catheter was removed, the patient achieved excellent continence at the first month of follow-up without the need of safety pads.

Discussion

This study was conducted at a high volume center with a single operator. Patients with a more protruding prostate receiving RaLRP had worse early and 1-year continence outcomes. This may have been due to surgical difficulty or previous bladder outlet obstruction, and may have improved over time with pelvic training.

The main causes of urinary incontinence after radical prostatectomy are impaired urethral sphincter function, detrusor over activity, reduced bladder compliance and decreased maximal bladder capacity [15,16]. Previous studies have reported that preoperative factors such as prostate weight, patient's age, BMI and prior bladder neck treatment and perioperative factors such as preservation of neurovascular bundles, reconstruction of the bladder neck and reinforcement of the anatomical structures of the pelvis floor may affect continence in patients undergoing radical prostatectomy [4-6]. A previous study reported that the presence of IPP in MRI was significantly associated with early recovery of urinary continence after laparoscopic radical prostatectomy [8]. We attempted to identify whether IPP is an independent factor for postoperative continence after RaLRP. We used the sagittal view on MRI to measure the length of IPP, and found that it had a positive correlation with continence outcomes.

Mariappan et al. [17] reported that IPP measured by transrectal ultrasonography may be a better prognostic factor than prostate volume in patients with BPH receiving medical treatment, especially in those with a relative smaller prostate. Keqin et al. [7] further investigated the effect of IPP, and identified that post-voiding residual urine, the incidence of acute urine retention, and bladder trabeculation occurred more often in patients with significant IPP. With regards to the urodynamic effect, a significantly lower peak flow rate (Qmax) and higher incidence of detrusor overactivity and low bladder compliance have been reported to exist in patients with significant IPP [7]. Nose et al. [18] further confirmed that IPP measured by ultrasonography was positively correlated with bladder outlet obstruction. With regards to transurethral surgical results, Lee et al. [8] reported that IPP is a significant independent factor for predicting better postoperative outcomes of IPSS for transurethral resection of the prostate.

MRI is the mainstay of diagnosis for prostate cancer with regards to staging (tumor volume, extracapsular invasion, seminal vesical invasion and metastatic lymph nodes) and is widely used as a preoperative survey [18]. It is routine clinical practice at our institution to measure IPP in the sagittal plane in preoperative MRI before radical prostatectomy, which may offer more accurate information and high-quality images than transrectal ultrasonography to distinguish the prostate and bladder neck.

Increasing age [19,20], prostate volume [21], BMI [22,23] and perioperative LUTS [24] (lower urinary tract symptoms) have been shown to be independent factors influencing continence after RaLRP. Link et al. [21] reported that a larger prostate size may be associated with more postoperative incontinence, but no influence on continence recovery overall. In contrast to our results, not only IPP but also prostate volume was independent predictors for postoperative early and 1-year continence recovery. However, we did not include the patients' age, BMI or preoperative LUTS in our study.

There may be many perioperative factors that influence continence. Because the prostate itself can prevent stress urinary incontinence in healthy people, it is important to identify and preserve other continence components during surgery, including the sphincter and supportive systems. Preservation of urethral length and sphincter system around the urethra, including inner smooth muscles and striated urogenital sphincter muscles can lead to a significant improvement in early and overall continence [25]. Supportive systems such as Denonvillier's fascia, puboprostatic ligament, endopelvic fascia, levator ani muscle fascia and arcus tendineus fascia should be preserved as far as possible during surgery, and this may reinforce the pelvic floor after surgery [5].

Careful dissection of the prostatovesical junction and preservation of the bladder neck can also accelerate the return of urinary continence as this will maintain most of the circular muscle fibers and urethrovesical angle [26]. We found that IPP was correlated with a lack of bladder neck preservation and an increased incidence of bladder neck reconstruction, which may in turn increase difficulties in surgery and the risk of incontinence.

Posterior reconstruction of the rhabdosphincter, which may be correlated with reinforcing Denonvillier's fascia as a dynamic supporting system and reducing the tension of vesicourethral anastomosis has been reported [12]. Rocco et al. [27] performed a systematic review of posterior musculofascial reconstruction after radical prostatectomy, and also reported that this resulted in better early continence outcomes after surgery.

The reason why IPP contributes to the recovery of continence after surgery is unclear. It is possible that it is related to bladder outlet obstruction and subsequently bladder dysfunction. The significance of IPP may also be correlated with a larger prostate leading to inferior continence outcomes [28]. It is also possible that the more significant the IPP, the greater the difficulty in bladder neck preservation and reconstruction, and this may lead to inferior continence outcomes [29].

Lee and Ha [9] reported 242 patients with prostate cancer who received laparoscopic radical prostatectomy, and those with significant IPP (IPP ≥ 5 mm) had markedly higher postoperative incontinence rates than those with non-significant IPP, which is consistent with our findings. Furthermore, not only IPP but also prostate volume had a significant impact on the continence rates at 1, 3 and 12 months. In addition, a robotic assistant system may be more precise in dissecting the surgical plane, preserving anatomical pelvic structure, reconstructing the bladder neck, and reinforcing anastomosis [30].

There are some limitations to the present study. First, this was a retrospective study and preoperative urinary conditions were not thoroughly recorded. Second, prior comorbidities such as previous urinary tract surgery or systemic diseases were not investigated. Third, the recovery of continence after surgery may be multifactorial; however other factors such as BMI or nerve-sparing procedures were not investigated. Fourth, pad free rate may not be the best indicator of LUTS, and IPSS or questionnaires of health-related quality of life may be a better indicator. However, the pad free rate is easier to analyze.

Lack of preoperative uroflowmetry and post-voiding residual urine data may be another limitation to our result. To our knowledge, bladder voiding function could contribute to postoperative low urinary tract symptoms.

There are so many variables that can contribute to postop continence that it is hard to make a definitive conclusion regarding intravesical prostate protrusion. Despite to our result, bladder neck preservation may contribute to better continence result and thus IPP may result in inferior outcome, there's still some reverse idea. Recently, Hinata et al. [31] reported Fibrosis of the bladder neck muscles would not only cause dysgraphia due to poor vascularity but also lead to loss of function and may lead to some debate to our result.

In conclusion, according to our clinical experience, both IPP and prostate volume were correlated with recovery of early and 1-year continence after RaLRP. In addition, the more significant the IPP, the greater the difficulty in bladder neck preservation and reconstruction, and this may lead to inferior continence outcomes.

Human Ethical Statement

Certification of approval with IRB: CE15215B.

Conflict of Interest

None of the contributing authors have any conflict of interest, including specific financial interests or relationships and affiliations relevant to the subject matter or materials discussed in the manuscript.

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