Original Article

Comparison of Treatment Outcomes between Laparoscopic and Robot-Assisted Laparoscopic Radical Prostatectomy in Clinically Localized Prostate Cancer, A Single-Surgeon Experience

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Objective: To compare the treatment outcomes between laparoscopic radical prostatectomy (LRP) and robot-assisted laparoscopic radical prostatectomy (RALP) in clinically localized prostate cancer in a tertiary care hospital in Thailand by a single-surgeon experience.

Materials and Methods: Between January 2013 and June 2019, 171 patients with clinically localized prostate cancer underwent minimally invasive radical prostatectomy. These were LRP in 62 patients and RALP in 109 patients. All clinical data were retrospectively reviewed. Patient demographic data, perioperative parameters, pathological reports, oncological outcomes, and functional outcomes including continence and potency rate at 1, 3, 6, and 12 months were compared between groups.

Results: Patients in the RALP group were significantly younger (p=0.03) and had a shorter follow-up period (p=0.004). The estimated blood loss was significantly lower in the RALP group (p=0.001). There were no significant differences in intraoperative and 30-day postoperative complications. Pathological results and overall positive surgical margin rate (PSM) were not significantly different. In pT3 patients, PSM was significantly lower in the RALP group (p=0.045). Oncological outcomes were not different in term of biochemical recurrence (BCR) rate (p=0.3), median time to BCR (p=0.45), BCR-free survival (p=0.81), and overall survival (p=0.99). The continence rate was significantly better in the RALP group in every period after surgery (p=0.01, <0.001, 0.001, and p=0.02 at 1, 3, 6 and 12 months, respectively). The potency rate who performed bilateral neurovascular bundles sparing was not different between groups.

Conclusion: RALP provided a significant improvement of continence recovery and PSM rate in non-organ confined disease. Estimated blood loss was significantly lower among the RALP patient. Larger numbers of patients with longer follow-up will justify proofing these findings.

Keywords: Laparoscopic surgery, Robot-assisted surgery, Radical prostatectomy, Prostate cancer

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Due to the widespread use of the prostate-specific antigen (PSA) screening, prostate cancer has become the fourth commonly detected male cancer in Thailand[1]. Radical prostatectomy (RP) represents the standard definitive surgical treatment for clinically localized prostate cancer in men who have long life expectancy[2]. Both open and minimally invasive surgery, including laparoscopic radical prostatectomy (LRP) and robot-assisted laparoscopic radical prostatectomy (RALP) are the current standard treatment of choice owing to the similar oncological outcomes[3,4]. However, there was clear evidence for less intraoperative blood loss and length of stays in minimally invasive RP compared with open surgery[5].

The main adverse effects of RP are the impact on urinary continence and potency after surgery. Therefore, the outcomes measurement of RP always

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included functional outcomes with oncological outcomes. The standard criteria called "Pentafecta" composed of continence, potency, biochemical recurrence-free survival, no postoperative complication, and negative surgical margin[6].

LRP is known as a technically demanding procedure with a steep learning curve. Surgical experiences required 150 to 200 cases to improve perioperative complication and continence, 200 to 250 cases to minimize positive surgical margin (PSM), and 700 cases to stabilize the potency rate[7]. These difficulties drove the development of the robotic surgical system to shorten the learning curve and improve the surgical outcomes.

Given the peculiar features of the robotic platform, RALP has gained popularity as it allows the surgeon to operate easier while maintaining the minimally invasive nature of the laparoscopic approach. RALP required only 50 cases to minimize blood loss and 150 cases to significantly improve perioperative complications. A surgeon with less experience in laparoscopy can improve the surgical outcomes from the advantages of the robotic surgical system, which are high-definition 3D visualization and fine movement of surgical instruments[8]. RALP showed superior functional outcomes including continence and potency recovery with similar oncologic outcomes than LRP in high volume center[9].

The present study aimed to compare the treatment outcomes including perioperative, oncologic, and functional outcomes between LRP and RALP from a single surgeon experience in a tertiary care hospital in Thailand.

Materials and Methods

Study populations

After obtained approval from the Institutional Review Board and Ethics Committee of Chulalongkorn University, the authors retrospectively reviewed the prospective maintained minimally invasive RP database. Between January 2013 and June 2019, 171 patients with clinically localized prostate cancer underwent minimally invasive RP at King Chulalongkorn Memorial Hospital by a single surgeon (Panumatrassamee K). Sixty-two patients underwent LRP and 109 underwent RALP by using da Vinci® Si Surgical System (Intuitive Surgical, Sunnyvale, CA, USA) with a four-arm approach. The choice of surgery was based on patient preferences. None of the patients received neoadjuvant hormonal treatment or radiation therapy before surgery.

Surgical techniques

LRP and RALP were performed in the standard transperitoneal antegrade approach. The patient was placed in the lithotomy and steep Trendelenburg position. Pneumoperitoneum was created by an open Hasson technique at the periumbilical area. Four additional trocars were inserted under the direct vision in LRP and three robotic trocars with one assistant trocar were used in RALP.

A standard pelvic lymphadenectomy was performed in clinically gross lymph node enlargement or when more than 2% predicted the probability of lymph node metastasis by nomogram[10]. An athermal nerve-sparing with an interfascial plane dissection was attempted in selected patients who had a good preoperative potency and no suspicion of extraprostatic extension by preoperative imaging studies. Bladder neck reconstruction was performed in the case with enlarge prostate gland by reverse tennis-racquets or fish-mouth technique. Posterior reconstruction with Rocco's stitches was performed before anastomosis[11]. The urethro-vesical anastomosis was accomplished using a modified van Velthoven technique by two continuous 3/0 V-loc™ sutures over a 20 Fr urethral catheter[12]. Jackson-Pratt drain was placed in the pelvic cavity before the closure of the incisions. The urethral catheter was removed after no anastomosis leakage was demonstrated by cystography at 1-week after surgery. If there was any evidence of anastomosis leakage, the urethral catheter was kept for an additional week and cystography was repeated.

Serum PSA, continence and potency were assessed at postoperatively 1, 3, 6, and 12 months and then every six months for the follow-up period.

Outcomes measurement and analysis

Analyzed variables included age, body mass index (BMI), American Society of Anesthesiologists (ASA) score, comorbidities, preoperative PSA level, prostate biopsy Gleason grade group, operative time, estimated blood loss (EBL), degree of adhesiolysis, transfusion rate, conversion rate, length of stay, urethral catheter time, intraoperative complications, postoperative complications, pathology reports, continence, and potency rate at 1, 3, 6, and 12 months after surgery.

The primary outcomes of the present study were oncological outcomes including biochemical recurrence-free survival and overall survival. Biochemical recurrence (BCR) was defined by serum PSA greater than 0.2 ng/dL after RP. The secondary

Table 1. Baseline patient's characteristics

	Total (n=171) n (%)	LRP (n=62) n (%)	RALP (n=109) n (%)	p-value
Age (year); median (IQR)	66 (61 to 70)	67.5 (63 to 71)	65 (61 to 70)	0.03
BMI (kg/m^2); median (IQR)	24 (22.3 to 26.3)	23.7 (22.8 to 25.9)	24.2 (22.2 to 26.3)	0.8
ASA classification				0.42
1	26 (15.2)	9 (14.5)	17 (15.6)	
2	124 (72.5)	48 (77.4)	76 (69.7)	
3	21 (12.3)	5 (8.1)	16 (14.7)	
Comorbidities				
Diabetes	38 (22.2)	11 (17.7)	27 (24.8)	0.29
Hypertension	112 (65.5)	42 (67.7)	70 (64.2)	0.64
Dyslipidemia	69 (40.4)	28 (45.2)	41 (37.6)	0.33
Heart disease	16 (9.4)	4 (6.5)	12 (11.0)	0.32
Previous abdominal surgery	31 (18.1)	13 (21.0)	18 (16.5)	0.44
Serum PSA level (ng/dL); median (IQR)	9.4 (7 to 14.5)	10.1 (6.8 to 16.5)	9.1 (7.1 to 14)	0.63
Biopsy Gleason grade group				0.91
GG1	76 (44.4)	26 (41.9)	50 (45.9)	
GG2	68 (39.8)	25 (40.3)	43 (39.5)	
GG3	20 (11.7)	9 (14.5)	11 (10.1)	
GG4	6 (3.5)	2 (3.2)	4 (3.7)	
GG5	1 (0.6)	0 (0.0)	1 (0.9)	
Length of follow-up (month); median (IQR)	26 (12 to 49)	37 (22 to 57)	23 (11 to 41)	0.004

IQR=interquartile range; LRP=laparoscopic radical prostatectomy; RALP=robot-assisted laparoscopic radical prostatectomy; BMI=body mass index; ASA=American Society of Anesthesiologists; PSA=prostate-specific antigen; GG=grade group

outcomes were urinary continence rate, potency in patients with bilateral neurovascular bundle (NVB) sparing, 30-day postoperative complications and PSM rate.

Postoperative complications within 30 days after the procedure were graded by the Clavien-Dindo Classification system[13]. Continence was defined as no pad use or use of the security pad[14]. Potency was defined as the self-report capability of erection enough for intercourse with or without phosphodiesterase type 5 inhibitor[15]. Pathological staging was classified according to The American Joint Committee of Cancer (AJCC) Eighth edition[16].

Statistical analysis was performed by Stata, version 15 (StataCorp. 2017. Stata Statistical Software. College Station, TX: USA). Difference between the two groups used chi-square or Fisher's exact test for categorical data and independent t-test for continuous data. Probability of BCR used Kaplan Meier and log-rank test to compare between two groups. A p-value of less than 0.05 was considered statistically significant.

Results

Baseline patient's characteristics are presented in Table 1. The patients in the RALP group were significantly younger (p=0.03) and had a shorter follow-up period (p=0.004) than in the LRP group. There were no differences in BMI, ASA score, comorbidity, history of previous abdominal surgery, preoperative PSA level, and Gleason grade group from prostate biopsy between the groups.

The operative parameters and postoperative complications are shown in Table 2 and 3. There were no significant differences between the groups in terms of operative time, transfusion rate, degree of adhesiolysis, the proportion of NVB-sparing procedure, length of stay, urethral catheter time, intraoperative complications, and postoperative complications. However, the EBL was significant lower in the RALP group (400 versus 200 mL, p=0.001).

Six intraoperative complications were found. Two occurred in the LRP group (3.2%), one rectal serosa tear treated with laparoscopic repair and one

Table 2. Operative parameters

	Total (n=171) n (%)	LRP (n=62) n (%)	RALP (n=109) n (%)	p-value
Length of stay (day); median (IQR)	10 (9 to 10)	9 (9 to 10)	10 (9 to 10)	0.26
Degree of nerve sparing				0.33
Bilateral	53 (31.0)	17 (27.4)	36 (33.0)	
Unilateral	48 (28.1)	15 (24.2)	33 (30.3)	
Non-nerve sparing	70 (40.9)	30 (48.4)	40 (36.7)	
Pelvic lymphadenectomy	124 (72.5)	42 (67.7)	82 (75.2)	0.29
Transfusion	16 (9.4)	5 (8.1)	11 (10.1)	0.66
Degree of bowel adhesiolysis				0.35
No	146 (85.4)	56 (90.3)	90 (82.6)	
Mild	19 (11.1)	4 (6.5)	15 (13.8)	
Extensive	6 (3.5)	2 (3.2)	4 (3.7)	
Operating time (minute); median (IQR)	190 (170 to 240)	200 (160 to 240)	190 (170 to 225)	0.88
Estimated blood loss (mL); median (IQR)	300 (150 to 500)	400 (200 to 600)	200 (150 to 400)	0.001
Intraoperation complication	6 (3.5)	2 (3.2)	4 (3.7)	0.88

IQR=interquartile range; LRP=laparoscopic radical prostatectomy; RALP=robot-assisted laparoscopic radical prostatectomy

Table 3. Postoperative complications

	Total (n=171) n (%)	LRP (n=62) n (%)	RALP (n=109) n (%)	p-value
Postoperative complication	32 (18.7)	10 (16.1)	22 (20.2)	0.51
Types of complications[1]				0.78
Minor (Clavien grade 1 to 2)	29 (17.0)	9 (14.5)	20 (18.3)	
Major (Clavien grade 3 to 5)	3 (1.8)	1 (1.6)	2 (1.8)	

LRP=laparoscopic radical prostatectomy; RALP=robot-assisted laparoscopic radical prostatectomy

[1] Highest grade of complication was used in patient with more than one complication

in approximate posterior anastomosis suture line, managed with traction balloon urethral catheter. Four occurred in the RALP group (3.7%) and all were posterior bladder injury (buttonhole injury) treated with 2-layer closure robotically. No open conversion, vascular injury, nerve injury, and ureteral injury occurred in the present study.

Thirty-seven postoperative complications occurred in 32 patients (18.7%) within 30-day after surgery. The most common complications were transfusion (9.4%), prolonged anastomosis leakage of more than seven days (4.1%), and gross hematuria (1.8%). Major complications (Clavien grade 3 to 5) were found in three patients (1.8%). The first patient, from the LRP group, had an irreducible femoral hernia requiring emergency surgery (grade 3b). The second patient, from the RALP group, had urinary retention five days after catheter removal managed by reinserted the urethral catheter (grade 3a). The third patient, from the RALP group, had bleeding around the drain port requiring suture under local anesthesia (grade 3a). No Clavien grade 4 to 5 occurred in the present study.

Pathological reports are presented in Table 4. Prostate size, Gleason grade group, and pathological T and N stage were not significantly different between the groups. Overall PSM rate was 38.7% and 36.7% in the LRP and RALP group, respectively (p=0.79). However, the PSM rate in the pT3 stage was significantly lower in the RALP group (70.8% versus 46%, p=0.04).

During the follow-up period, 23% of the patients in the LRP group and 16.5% of the patients in the RALP group had BCR after surgery (p=0.3). The median time to BCR was 14.5 months in the LRP group and 11.5 months in the RALP group

Table 4. Pathology results

	Total (n=171) n (%)	LRP (n=62) n (%)	RALP (n=109) n (%)	p-value
Specimen weight (g); median (IQR)	38 (31.6 to 51.6)	36.9 (30 to 51)	39 (32 to 52)	0.48
Pathological Gleason grade group				0.14
pGG1	31 (18.3)	14 (23.3)	17 (15.6)	
pGG2	96 (56.8)	28 (46.7)	68 (62.4)	
pGG3	20 (11.8)	11 (18.3)	9 (8.3)	
pGG4	13 (7.7)	5 (8.3)	8 (7.3)	
pGG5	9 (5.3)	2 (3.3)	7 (6.4)	
Pathological T stage				0.32
pT2a	24 (14.0)	7 (11.3)	17 (15.6)	
pT2b	6 (3.5)	4 (6.5)	2 (1.8)	
pT2c	62 (36.3)	27 (43.6)	35 (32.1)	
pT3a	58 (33.9)	17 (27.4)	41 (37.6)	
pT3b	17 (9.9)	7 (11.3)	10 (9.2)	
pT4a	4 (2.4)	0 (0.0)	4 (3.7)	
Pathological N stage				0.22
pN0	115 (67.3)	39 (62.9)	76 (69.7)	
pN1	7 (4.1)	1 (1.6)	6 (5.5)	
pNx	49 (28.7)	22 (35.5)	27 (24.8)	
Positive surgical margin	64/171 (37.4)	24/62 (38.7)	40/109 (36.7)	0.79
pT2	22/92 (23.9)	7/38 (18.4)	15/54 (27.8)	0.30
pT3	40/75 (53.3)	17/24 (70.8)	23/51 (45.1)	0.04
pT4	2/4 (50.0)	0 (0.0)	2/4 (50.0)	0.17

IQR=interquartile range; LRP=laparoscopic radical prostatectomy; RALP=robot-assisted laparoscopic radical prostatectomy; GG=Gleason grade

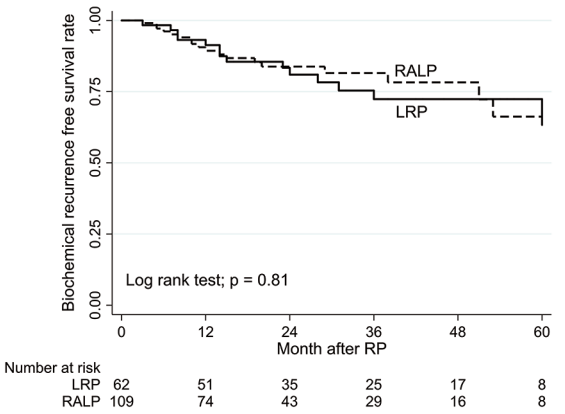

Figure 1. Biochemical recurrence free survival of LRP and RALP

(p=0.45). BCR-free survival was not statistically different between the two groups (p=0.81) (Figure 1). The overall survivals (OS) in the LRP and RALP group were 98.4%, 99.1%, respectively (p=0.99). One patient in the LRP group died 42 months after surgery due to disease progression. One patient in the RALP group died due to multiple organ failures post-Whipple's operation from the tumor at the head of the pancreas at 10 months after surgery.

Urinary continence and potency rate up to 12 months after surgery are presented in Figure 2 and 3. Patients in the RALP group had a better continence recovery rate than the LRP group significantly at every time point (1, 3, 6, and 12 months). Twelve months after surgery, the continence rate in the RALP group was 89.5% and in the LRP group was 73.1% (p=0.02). The potency rate in patients who had bilateral NVBs sparing was higher in the RALP group at every time point but not statistically different.

Discussion

At present, traditional open surgery has been replaced by minimally invasive surgery in almost every surgical fields including in Urology. RP is one of the surgeries in which minimally invasive

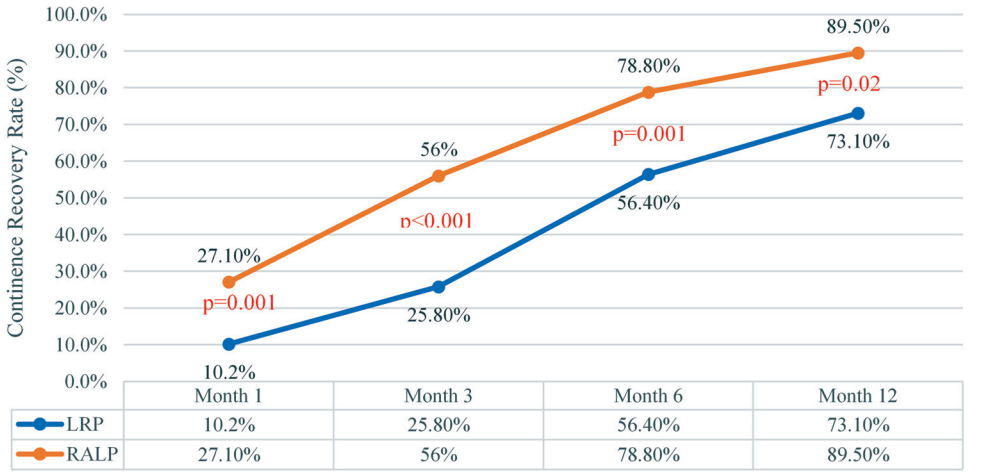

Figure 2. Continence rate at 1, 3, 6, and 12 months after surgery.

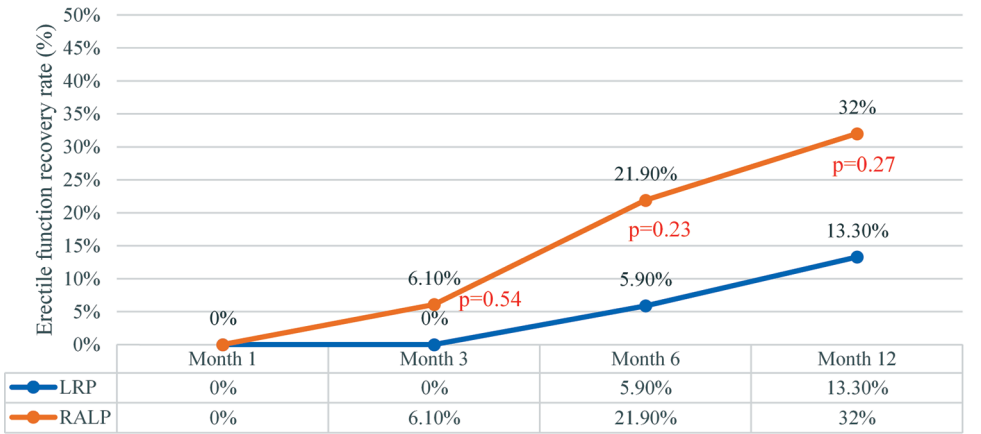

Figure 3. Potency rate at 1, 3, 6, and 12 months after surgery in patient with bilateral NVBs preservation.

techniques were widespread procedures and became the new standard treatment in localized prostate cancer especially in Europe and the USA.

Various studies compared the outcomes between LRP and RALP. Ploussard et al[17] presented a large retrospective study comparing these two procedures performed in an extraperitoneal approach. Oncologic outcomes, continence, and complication rate were not significantly different between the groups. However, RALP had significantly shorter operative time, less blood loss, and shorter length of stay than LRP. The potency rate also favored RALP with 57.7% recovery rate at 12 months compared with 42% in the LRP group.

To date, there are only two randomized controlled trials (RCT) comparing outcomes between LRP and RALP. Asimakopoulos et al[18] showed the significant benefit of RALP in terms of erectile function recovery in the patient who performed bilateral intrafascial nerve-sparing at 12 months after surgery (77% versus 32%, p<0.0001). Porpiglia et al[19] presented a prospective RCT from a single surgeon with the longest follow-up to date. This showed similar BCR and BCR free survival after five years follow-up, however, continence and potency rates were better in patient treated with RALP.

Herein, the authors reported and analyzed all the treatment outcomes between LRP and RALP treated by a single laparoscopic-trained surgeon in a tertiary academic center. The surgical techniques in both groups were similar to a standard transperitoneal approach. Both types of surgery have been started at almost the same time. The first LRP was started in January 2013, while the first RALP was started later in

March 2013. Therefore, the results were not affected by the surgeon's previous surgical experiences. The choice of surgery mainly depends on patient preferences because the expense of both types of surgery cannot be covered by the reimbursement system in Thailand.

All intraoperative parameters and postoperative complications rates were not statistically different between the groups except that EBL was significantly lower in the RALP group (400 versus 200 mL, p=0.001). The median length of stay was 10 days because the hospital cost in Thailand was not expensive and the culture of Thai people, they did not want to be discharged with a urethral catheter. Therefore, the physician routinely admitted patients one day before the surgery and discharge them after the cystography was performed at postoperative day 7. The median length of follow-up was significantly longer in the LRP group due to the high proportion of LRP patients at the beginning of the study (37 versus 23 months, p=0.004).

Most of the complications in the present study were minor and could be managed conservatively. Blood transfusion was the most common complication. Three patients in the LRP group (4.8%) and four patients in the RALP group (3.7%) required urethral catheter for more than seven days after surgery because of prolonged anastomosis leakage. Only three major complications occurred (1.8%), which can represent safe minimally invasive procedures for clinically localized prostate cancer.

PSM was considered an important adverse pathological feature to predict the prognosis. The present study revealed a similar overall PSM rate in both groups. However, the pT3 patients had a significantly lower PSM rate in the RALP group. This could be from a precise dissection of the robotic platform to the high-risk tumor. The authors' PSM rate was higher than the previously published literature[20,21]. The baseline PSA level in the present study was higher than the other studies, which may reflect a higher rate of PSM. Moreover, from a large retrospective study, PSA level and surgeon experience (more than 100 cases) were the significant independent factors for PSM in equal or greater than in the pT3 disease group[17].

All oncological outcomes in terms of BCR rate, time to BCR, BCR-free survival, and overall survival were not different between the groups during the intermediate-term follow-up. Patients with adverse pathologic features including PSM, extraprostatic extension (pT3a), and seminal vesicle invasion (pT3b) were discussed for adjuvant or salvage treatments with external beam radiation (EBRT) at the surgical bed and androgen deprivation therapy (ADT). Patients with lymph nodes metastasis received adjuvant ADT immediately. None of the patients in the present study had BCR after receiving adjuvant treatment during the follow-up period.

Functional outcomes including continence and potency are the important drawbacks affecting the quality of life after RP. In the present study, urinary continence favored RALP over LRP from the first month after surgery which correlated with the published literature[18,21,22]. Advanced age, BMI greater than 30 kg/m², high comorbidity, previous lower urinary tract symptoms (LUTS), and low-volume surgeon experience were the risk factors for urinary incontinence after RALP[23]. In contrast, NVB-sparing was not related to continence recovery as demonstrated in the large retrospective study[17].

The authors analyzed the potency rate of the patients who received bilateral NVB-sparing. The results showed better potency in the RALP group from three months postoperatively, but the difference did not reach statistical significance. The limitations of this evaluation were the lack of comparison of preoperative erectile function in validated questionnaires and the small number of patients. Age, baseline erectile function, and extension of athermal nerve-sparing technique were the most important predictive factors for potency recovery in RALP[24].

The limitations of the present study were its retrospective design. The number of patients was relatively small, with a lower number of patients performed bilateral NVB-sparing. Choices of treatment was based on patient's preference, which caused a selection bias. There was no clear guideline for types and durations of adjuvant and salvage treatment after BCR for every patient. However, the outcomes of the present study were from a single-surgeon experience since the beginning, which included the learning curve period. These will provide additional information to the patient for choosing the treatment options. A larger number of patients with longer follow-up will justify on oncological outcome and potency.

Conclusion

A robotic approach provided a significant improvement of continence recovery and PSM rate in non-organ confined disease. EBL was significantly lower among the RALP patient. These benefits should outweigh the higher expense for the treatment costs.

What is already known on this topic?

RALP is the surgical approach of choice for clinically localized prostate cancer in Europe and the USA. Benefit in some perioperative parameters and functional outcomes have been demonstrated from the high-volume centers and experienced surgeons.

What this study adds?

This study compared the treatment outcomes between RALP and LRP including the learning curve period from a single-surgeon experience. The results showed the superiorly of RALP over LRP in terms of blood loss, continence recovery, and PSM rate in pT3 disease. These benefits of RALP should outweigh the higher treatment costs.

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Conflicts of interest

The authors declare no conflict of interest.

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