Comparison of Robotic-assisted *versus* Retropubic Radical Prostatectomy Performed by a Single Surgeon

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Abstract. *Background: To compare perioperative outcomes between patients undergoing robotic-assisted laparoscopic radical prostatectomy (RALP) and patients undergoing retropubic radical prostatectomy (RRP) performed by a single surgeon in Taiwan. Patients and Methods: This study was a retrospective review of 30 consecutive patients who underwent RRP and 30 initial patients who underwent RALP. The preoperative parameters, operation parameters (operative time, vesicourethral anastomosis time, blood loss, transfusion and complication rates) and postoperative parameters (post-operative stay, catheter duration, cystography received, continence rate, sexual function and histopathologic factors) were evaluated. Results: Preoperative clinical parameters were similar between groups. Vesicourethral anastomosis time was shorter in RRP group than in RALP group. RRP had higher incidence of bilateral pelvic lymph node dissection than RALP (100% vs. 73.3%), but lower incidence of neurovascular bundle preservation (6.7% vs. 53.3%). Significant differences were found in blood loss (RALP 314 mL vs. RRP 912 mL) and transfusion rates (RALP 13.3% vs. RRP 60%) between groups. A statistically significant difference was found in incidence of cystograms performed between RRP and RALP groups (93.3% vs. 43.3%) before removing urethral catheter. Positive surgical margin was 20% in RRP group vs. 50% in RALP group, demonstrating statistical significance. Shorter catheterization duration and postoperative stays were found with RALP. Three-month continence rate was higher in RALP patients than in RRP patients (76.7% vs. 36.7%, p=0.04). Conclusion: RALP is minimally invasive with less blood loss and lower transfusion rates than RRP. RALP had greater incidence of neurovascular bundle preservation and faster convalescence than RRP.*

Options for surgical treatment of localized prostate cancer include radical retropubic prostatectomy (RRP), laparoscopic radical prostatectomy (LRP) and robotic-assisted laparoscopic radical prostatectomy (RALP). Since 1980, when RRP was adopted by Walsh *et al*., the procedure has remained the gold standard for surgical treatment of localized prostate cancer (1).

LRP was first reported by Schussler *et al*. in 1992 (2). Vallacien and Guillonneau performed LRP in 1998 and refined the technique (3-4). However, LRP is a challenging surgical technique with a steep learning curve, requiring at least 60 cases to obtain proficiency (4).

Since the introduction of da Vinci robotic surgery in urology in 1999, urology surgeries have had the advantage of 3-dimensional stereoscopic optics, computer elimination of tremor and scaled-down movement with the use of an endo-wrist instrument with seven degrees of freedom of range of motion. The first RALP was performed by Binder and Kramer in Frankfurt in May 2000 (5). Thereafter, Vattikuti Urology Institute at Henry Ford performed the procedure under the Vallancien' training program in Oct. 2002, reporting a comparison of 48 LRP procedures and 50 RALP procedures (6). When RRP was compared with RALP in the first 30 cases, preliminary results of RALP were comparable to the "best-in-class" values for LRP reported in the literature prior to that time (7). Blood loss was minimal and patients felt less pain and were discharged earlier from the hospital after RALP (7). The learning curve for RALP was shown to be faster than that for LRP (8). Ahlering *et al*. described the learning curve of a non-laparoscopic surgeon performing RALP in just 12 cases (9). Eighteen operations were needed to complete the learning curve as reported by

Abbreviations: LRP, laparoscopic radical prostatectomy; RALP, robotic-assisted laparoscopic radical prostatectomy; RRP, retropubic radical prostatectomy.

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Wu *et al*. (10). Patel *et al*. suggested that the learning curve for RALP was 25 cases (11, 12). Here, a comparison of 30 initial cases of RALP with 30 consecutive cases of RRP, all performed by one surgeon at our institute, is presented.

Patients and Methods

This study was a retrospective review of 30 consecutive patients undergoing RRP and 30 initial patients undergoing RALP, with all surgeries performed by single surgeon (Y.C. Ou) between April 2004 and April 2007. The decision to perform either RALP or RRP was made by patient preference after a discussion with the attending surgeon about the risks and benefits of each approach. The preoperative parameters (age, body mass index, American Society of Anesthesiologists anesthetic/surgical risks class (ASA), serum prostate-specific antigen (PSA), PSA density, Gleason score and clinical stage), operation parameters (operative time, vesicourethral anastomosis time, blood loss, transfusion rate and complication rate) and postoperative parameters (post-operative stay, catheter duration, cystography received, continence rate, potency rate and intercourse rate, histopathologic factors and biochemical failure rate) were evaluated.

Retropubic radical prostatectomy. RRP was performed using Walsh's technique (1). A lower midline incision was made about 12 cm below the umbilicus to the pubis. Vesicourethral anastomosis was performed using 6 interrupted sutures with 2-0 vicryl.

Robotic-assisted laparoscopic radical prostatectomy. RALP was performed as described by Patel (13, 14) with minor modifications. For cases one through six, a four-arm approach was taken; from case seven onward, a three-arm approach with five trocars was chosen. The 12 mm camera port was placed above the umbilicus and two 8 mm ports were placed for robotic arms. Two assistant ports were inserted, one 5 mm at 4 cm right lateral to the camera port and the other 12 mm at 3 cm above the anterior superior iliac crest. The puboprostatic ligament was preserved in all cases. Dissection of the bilateral pelvic lymph nodes and bilateral neurovascular preservation procedures were discretionary and were determined according to the preoperative tumor status and intraoperative conditions. Urethrovesical anastomosis was performed using the Van Velthoeven technique with two 16 cm 3-0 Monocryl and continuous stitches (15). An 18 French silicon Foley catheter with a 10 mL balloon was used. Then, the intraoperative urinary bladder was injected with 200 ml normal saline to confirm that there was no leakage. Continence was defined as "no need for the patient to wear a pad." Prostate specific antigen (PSA) failure was defined as two consecutive post-operative PSA results of >0.2 ng/mL.

Results

Preoperative clinical characteristics were similar between RRP and RALP surgical groups (Table I). Operation parameters in both groups are shown in Table II. Although the operation time was similar in both groups, the vesicourethral anastomosis time was shorter in the RRP group than in the RALP group. RRP had a higher incidence of performing bilateral pelvic lymph node dissection (BPLND) than RALP (100% *vs*. 73.3%, respectively), but lower incidence of performing neurovascular bundle preservation (NVB) (6.7% *vs*. 53.3%, respectively); differences between groups were statistically significant. Blood loss and transfusion rates were less in the RALP group than in the RRP group, demonstrating statistical significance. The complication rate was similar in both groups. Five complications of RALP included urinary bladder injury and vesicourethral anastomosis tear in one case and intraoperative bleeding in another case. These two cases were converted to mini-laparotomy (6 cm) procedures without sequelae. Further, urinary bladder injury in one case, lymph leakage for two weeks in one case and mild vesicourethral anastomosis stricture needing urethral sounding once in one case. Three complications of RRP included rectal injury with intraoperative repair in one and mild vesicourethral anastomosis leakage in two cases with longer duration of Foley catheter (11 days and 17 days, respectively). RRP group had a higher incidence of checking

Table I. *Comparison of preoperative clinical characterestics of robotic assisted versus retropubic radical prostatectomy in single surgeon.*

Clinical data	Group 1: RALP	Group 2: RRP
Age (years)	67.27±6.21	70.03±6.10*
BMI	24.22±3.16	24.09±3.28
ASA, I/II/III	5/15/10	4/17/9
PSA (ng/ml)	16.45±18.80	15.89±14.15
PSA density	0.47±0.43	0.48±0.53
Biopsy percentage	15.9±10.47%	17.33±14.53%
Biopsy Gleason score	6.13±0.9	6.22±1.62
Clinical stage T1/T2/T3	15/15/0	9/19/2

*$p<0.05$, BMI: body mass index, PSA density: PSA/prostate volume by transrectal sonography; ASA: American Society of Anesthesiologists anesthetic/surgical risks class.

Table II. *Comparison of operation parameters of robotic assisted versus retropubic radical prostatectomy in single surgeon.*

Factors	Group 1: RALP	Group 2: RRP
Operation time (hours)	3.42±1.71	3.55±0.62
BPLND	22/30 (73.3%)	30/30 (100%)**
NVB: neurovascular bundle preserving	16/30 (53.3%)	2/30 (6.7%)****
Anastomosis time (min)	43.85±11.36	17.67±3.53****
Blood loss (ml)	314±284	912±370****
Transfusion rate	4/30 (13.3%)	18/30 (60%)****
Complications	5/30 (16.7%)	3/30 (10%)
Cystogram	13/30 (43.3%)	28/30 (9.3%)****

BPLND: Bilateral pelvic lymph node dissection, *$p<0.05$, **$p<0.01$, ***$p<0.001$, ****$p<0.0001$.

Table III. *Comparison of postoperative parameters of robotic assisted versus retropubic radical prostatectomy in single surgeon.*

Factors	Group 1: RALP	Group 2: RRP
Foley catheter (day)	7.70±2.08	9.20±2.86*
Post-op. Stay (day)	7.33±2.32	8.37±2.22*
Surgical margin positive	15/30 (50%)	6/30 (20%)*
pT2	2/15 (13.3%)	0/15 (0%)
pT3	13/15 (86.7%)	6/15 (40%)*
Specimen volume (ml)	40.23±16.71	48.63±20.73
Tumor volume	8.75±7.97	11.44±11.90
Tumor percentage	21.44±17.77	23.53±21.44
Pathology Gleason score	7.22±1.09	6.70±1.64
Node positive	2/30 (6.7%)	3/30 (10%)
PSA failure at 15 months	6/30 (20%)	5/30 (16.7%)

$p<0.05$, $^{**}p<0.01$, $^{***}p<0.001$, $^{****}p<0.0001$.

Table IV. *Comparison of continence and sexual function outcomes of robotic assisted versus retropubic radical prostatectomy in single surgeon.*

Factors	Group 1: RALP	Group 2: RRP
Continence within	6 (20%)/23 (76.7%)/ 1	(3.3%)/11
(36.7%)**/		
1 wk/3mo/6mo/12mo	29 (96.7%)/30 (100%)25	(83.3%)/29
(96.6%)		
Potency at 12 month	14/16 (87.5%)	1/2 (50%)
Bilateral NVB	11/11 (100%)	1/1 (100%)
Unilateral NVB	3/5 (60%)	0/1 (0%)
Intercourse at 12 month	10/16 (60%)	1/2 (50%)
Bilateral NVB	9/11 (81.8%)	1/1 (100%)
Unilateral NVB	1/5 (20%)	0/1 (0%)

NVB: neurovascular bundle preserving; $p<0.05$, $^{**}p<0.01$, $^{***}p<0.001$, $^{****}p<0.0001$.

cystograms (93.3% *vs*. 43.3%) before removal of urethral catheters than in the RALP Group, demonstrating statistical significance.

Postoperative parameters are shown in Table III. Overall, RALP had shorter catheterization duration and post-operative stays. Positive surgical margin (PSM) was 20% in RRP *versus* 50% in RALP, demonstrating statistical significance. The urinary continence and sexual functions are revealed in Table IV. Three-month continence rate was higher in RALP than RRP (76.7% *vs*. 36.7%, $p=0.04$). The continence rate at one year was similar between groups. Sixteen of 30 patients received RALP with bilateral or unilateral NVB preservation, while only two RRP patients received NVB, with an overall potency and intercourse rate at 12 months of 87.5% and 60%, respectively.

Discussion

This is the first report of a comparison of RALP *versus* RRP performed by a single surgeon in Taiwan. The goal was to elucidate the results of the initial experience during the learning curve for RALP. Does a surgeon's immature technique with RALP compromise the interests of the patient? Data showed that RALP is promising because of its reasonable operation time and moderate complication rates. Short-term outcomes of robotic-assisted radical prostatectomy were shown to be better than those of RRP in this series. A single surgeon performed the surgeries in this study to eliminate the variability in learning curves for RALP and RRP among different surgeons. Menon and Tewari's group reported a comparison between outcomes of several different surgeons performing open procedures with the outcomes of one robotic surgeon (7, 16). Two procedures were performed by different surgeons with bias related to variability of training, technique and experience. These results are consistent with those of Menon's study, which compared 30 initial patients undergoing RALP and 30 consecutive patients undergoing RRP, concluding that surgeons experienced in conventional RRP can learn RALP within a reasonable time and with acceptable complication rates (7). Baseline, operative and post-operative parameters between Menon's series and Ou's series undergoing RALP are shown in Table V. The presented series had higher PSA scores and clinical stages than Menon's series. The operative parameters were similar in both groups. At this institution,

Table V. *The baseline, operation and postoperation parameters between Menon's series and Ou's series undergoing robotic-assisted laparoscopic radical prostatectomy.*

	Menon	Ou
Baseline	(N=30)	(N=30)
Age (yrs)	62	67
BMI	30	24.3
PSA (ng/mL),mean	9.94	16.46
Biopsy Gleason score	6.3	6.1
Clinical stage T1/T2	22(83%)/8(17%)	
15(50%)/15(50%)		
Prostate volume (mL)	58.8	35
PSA density	0.169	0.47
Operation parameters		
Console time (min)	233	226
Estimated blood loss (mL)	329	315
Transfusion rate	2/30(6.7%)	4/30(13%)
Conversion rate	1/30 (3.3%)	2/30(6.7%)
Postoperation parameters		
Catheterization(days)	10.7	7.7
Positive surgical margin	8/30 (26.6%)	15/30 (50%)
Node positive	0	2/30 (6.7%)
Pathology: Gleason score	6.9	7.1

PSA density: PSA/ prostate volume measured by transrectal ultrasonography.

the learning curve for RALP for a single surgeon included console time and anastomosis time. The average console time was reduced from 295 minutes to 214.5 minutes to only 166.5 minutes in the first 10 cases, second 10 cases and third 10 cases, respectively. The anastomosis time was reduced from 59 minutes to 44.5 minutes to 39.5 minutes in the first 10 cases, second 10 cases and third 10 cases, respectively. The surgeon's skill became stable with a console time of less than three hours and vesicourethral anastomosis time of 40 minutes, with a learning curve of about 30 cases. Ahlering *et al*. reported an anastomosis time of 50 minutes for cases 1 to 5 and 21 minutes for cases 36 to 45 (9). More experience is needed for delicate bladder neck dissection and skillful sutures in order to achieve an anastomosis time of less than 30 minutes. Console time was among the parameters that improved significantly between the initial and later surgeries. The console time in this case was 226 minutes. This time is reasonable compared to that of 233 minutes reported by Menon for the initial 30 cases (7).

After completing the learning curve for RALP, outcomes of RALP procedures were much improved. A comparison of results of the first 200 RALP surgeries performed by Menon with 100 consecutive contemporary RRP surgeries confirmed the advantages of RALP with regard to blood loss, transfusion rates, postoperative pain and hospitalization time (16). Ahlering *et al*. reported analyzing their clinical experience with cases 1 to 45 (9), and they believed that the RALP learning curve was sufficiently mature. Ahlering and colleagues compared the last 60 RALP procedures (cases 46 to 105) with 60 RRP procedures and concluded that RALP had oncologic and urinary outcomes that were at least equal to RRP outcomes. RALP offers the benefits of minimally invasive surgery and does not compromise clinical or pathologic outcomes (17).

The tamponade effect prevents venous bleeding under pneumoperitoneum of 12-15 mmHg during RALP procedures. Mean estimated blood loss (EBL) was 329 mL for RALP and 970 mL for RRP in Menon's series (7). The transfusion rate was 7% for RALP and 30% for RRP. In this study, the mean estimated blood loss (EBL) was 314 mL for RALP and 912 mL for RRP. The high transfusion rate of 60% with RRP in this series is attributed to "transfusion trigger" by anesthesiologist's decision in the clinical practice during surgery. In this study of RALP outcomes, blood loss and transfusion rates declined from 353 mL and 20% in the first 15 cases to 276 mL and 6.7% in the subsequent 15 cases. These results are consistent with Menon's findings of initial 20 cases and subsequent 10 cases in which blood loss decreased from 400 mL to 202 mL and the blood transfusion rated decreased from 6% to 0% (7).

The greatest advantage of RALP is rapid recuperation and a very short hospital stay. Patel reviewed the length of hospital stays for RALP and reported only 1.08 to 5.5 days (13). Taiwanese patients are reluctant to be discharged from the hospital if they are still catheterized. Furthermore, in Taiwan, ward expenses are paid by health insurance, not by patients. Therefore, postoperative hospitalization may be longer in certain cultures and under different health insurance coverage systems. The postoperative stay was shorter following RALP surgeries than following RRP in our series. Menon *et al*. reported that RAP patients were discharged earlier from the hospital than RRP patients (7). Ahlering *et al*. reported the same trend of hospital stays with an average of 25.9 hours for RALP and 52.8 hours for RRP (17).

In Menon's series, duration of catheterization was 13.7 days in the RRP group *versus* 10.7 days in the RALP group, compared to 9 days in the RRP group *versus* 7 days in the RALP group in Ahlering's series and 8.37 days in RRP group *versus* 7.33 days in the RALP group in this series. The important thing is continence rate and the time to achieve continence. One benefit of RALP is better continence rates and an earlier return of continence because of improved preservation of the urethral sphincter and urethral length. A high-quality, 3D endoscopic camera in the da Vinci system provides better visualization of the apex, allowing the surgeon to finely dissect and preserve the urethral sphincter (18). Pasticier *et al*. reported that 80% of patients achieved restored continence at 9 days (19). Patel *et al*. reported continence rates of 47%, 82%, 89%, 92% and 98% at 1, 3, 6, 9 and 12 months, respectively (11-13). Ahlering *et al*. reported no difference between groups in the continence rate at three months (76% for RALP, 75% for RRP) (17). In this series, the continence rate at 12 months was similar in both groups, although statistically significant differences were shown in the three-month continence rate between the RALP group (76.6%) and the RRP group (36.7%). The probable reason for the relatively good continence results in the RALP group is that the puboprostatic ligament-sparing technique in this modified procedure improves the speed of return of urinary continence. Previous studies have reported that the median time until continence was achieved after surgery was significantly shorter (p=0.01) for the puboprostatic ligament-sparing group than for the standard method (6.5 and 12 weeks, respectively) (20). Takenaka *et al*. recently reported that preservation of the puboprostatic collar and puboperineoplasty contributed to early recovery of urinary continence after robotic radical prostatectomy, with an immediate continence rate of 42.1% just after catheter removal (21).

In this study, 53.3% (16 of 30) RALP patients had an opportunity to receive bilateral or unilateral neurovascular bundle preservation, and the overall postoperative potency and intercourse rate at 12 months was 87.5% and 60%, respectively. Patients receiving RRP had only a 6.2% overall potency and intercourse rate (2 of 30 patients) with NVB preservation. The greater incidence of potency and intercourse rates with RALP are due to improvements in technique and

patient's demand. The factors that influence erectile function include previous level of sexual function, age and intraoperative injury of the neurovascular bundle. Menon *et al*. reported potency and intercourse rates of 82% and 64%, respectively, in patients younger than 60 years of age, and 75% and 38%, respectively, in patients older than 60 (16). Recently, the new technique of prostatic fascia preservation and athermal robotic techniques to avoid neurovascular injury have resulted in better potency rates of 97% at one year postoperative follow-up (22, 23).

With respect to oncological outcomes, little difference was seen in positive surgical margin (PSM) rate in T2 (13.3% for RALP *vs*. 0% for RRP). The incidence of PSM in pathologic T3 was higher in RALP than in RRP (86.7% *vs*. 40%, respectively). A PSA failure rate of 20% at 15 months for RALP and 16.7% for RRP were also observed. The high incidence of PSM in RALP is caused by more advanced tumors, inadequate surgical technique and poor patient selection for NVB preservation. In Patel's review, the PSM rate range was 0 to 20% for patients at T2 and 0 to 75% for T3 (13). Ahlering *et al*. reported one surgeon's outcomes from 60 RALP procedures in which the PSM rate for pathologic stage >T3 was 50% (17), while Atug *et al*. reported that the PSM tended to diminish from 45.4% to 21.2% to 11.7% as the surgeon's experience increased over about 30 cases (24). Reducing the positive surgical margin rate is undoubtedly a challenge for the novice as experience is gained during the initial 30 cases. The rate of positive surgical margins and nodes in advanced tumors was higher in this series than in Menon's series (7). This series had higher PSADs (due to higher PSAs and lower prostate volumes) than in Menon's series (0.47 *vs*. 0.169, respectively). Radwan *et al*. reported that PSAD results are strong predictors of advanced pathologic features and biochemical failure after radical prostatectomy (25).

Smith *et al*. reviewed papers related to RALP and RRP and concluded that RALP is consistently associated with decreased blood loss, limited postoperative pain and shorter hospital stays. Most intra-institutional comparisons demonstrate better postoperative continence and potency with RALP. RALP provides outcomes at least comparable, and in some measures, superior to open surgery (26). However, surgeons with extensive experience with RRP may set higher standards for the learning curve because of expectations. Webster *et al*. reported a nonrandomized study comparing 159 RALPs and 154 RRPs. The authors did not show any significant advantage in terms of postoperative pain scores between RALP and RRP groups (27). They also reported similar transfusion rates in open and robotic groups (28). Smith reported that the learning curve for RALP was 150 procedures, comparable to routine RRP (29). Surgeon comfort and confidence comparable to that of RRP did not occur until 250 RALP procedures had been performed (29).

In conclusion, performance of RALP is continuing to grow because of patient interest, benefits and demand. RALP is a minimally invasion procedure with less blood loss and lower transfusion rates than RRP. It offers a greater chance of preserving NVB and more rapid convalescence than RRP.

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