

Laparoscopy/Robotics

Retropubic Versus Robot-Assisted Laparoscopic Prostatectomy for Prostate Cancer: A Comparative Study of Postoperative Complications

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Purpose: To compare the complications of radical retropubic prostatectomy (RRP) with those of robot-assisted laparoscopic prostatectomy (RALP) performed by a single surgeon for the treatment of prostate cancer.

Materials and Methods: The postoperative complications of 341 patients who underwent RRP and 524 patients who underwent RALP for prostate cancer at the Asan Medical Center between July 2007 and August 2012 were retrospectively reviewed and compared. Complications were classified according to the modified Clavien classification system.

Results: RALP was associated with a shorter length of hospital stay (mean, 7.9 days vs. 10.1 days, $p < 0.001$) and duration of urethral catheterization (6.2 days vs. 7.5 days, $p < 0.001$) than RRP. Major complications (Clavien grade III-IV) were less common in the RALP group than in the RRP group (3.4% vs. 7.6%, $p = 0.006$). There were no significant differences in medical complications between procedures. Considering surgical complications, urinary retention (7.0% vs. 2.7%, $p = 0.002$) and wound repair (4.1% vs. 0.2%, $p < 0.001$) were more common after RRP than after RALP. Extravasation of contrast medium during cystography was more common in the RRP group than in the RALP group (10.0% vs. 2.1%, $p < 0.001$).

Conclusions: RALP is associated with a lower complication rate than RRP.

Keywords: Complications; Prostate; Prostate neoplasms; Prostatectomy

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INTRODUCTION

Prostate cancer is the most common solid organ malignancy in men in the United States and the second leading cause of cancer death [1]. Over the past 80 years, radical retropubic prostatectomy (RRP) has been the most common form of surgical treatment for prostate cancer. However, in the last 8 years, there has been a paradigm shift in surgically treated prostate cancer with the adaptation of robot-assisted laparoscopic prostatectomy (RALP). Because of the presence of three-dimensional magnification and tools with 7 degrees of freedom that can duplicate

hand movements with high accuracy, RALP has gained notable popularity in both the United States and Europe; furthermore, it is estimated that more than 75% of radical prostatectomies are performed by use of the da Vinci robotic platform (Intuitive Surgical Inc., Sunnyvale, CA, USA) [2,3].

The feasibility, safety, and early functional efficacy of RALP have been well documented. A recent population-based analysis comparing RALP and RRP procedures undertaken between 2003 and 2005 concluded that men undergoing RALP experienced significantly fewer 30-day complications, blood transfusions, and anastomotic stric-

tures and shorter lengths of stay [4]. In another study, postoperative pain scores were less with RALP than with RRP [5]. Other studies have also consistently shown that blood loss and length of hospital stay are less in patients who undergo RALP than in those who undergo RRP [5,6].

However, there is lack of uniformity in documenting and reporting complications that may result in incomplete capture of data and may make comparisons among different surgical approaches or institutional series problematic. Menon et al. [7] compared the complications at one institution between RRP performed by one group of surgeons and RALP performed by a different group of surgeons. Although the study was prospective and covered the same period, inter-surgeon differences in technique may have weakened the ability to objectively compare differences in complications. Moreover, most studies did not use a formal reporting system for complications or a uniform grading system. In this study, we compared the complications of RRP with RALP performed by a single surgeon using the modified Clavien system.

MATERIALS AND METHODS

1. Patients

Three hundred forty-one RRP and 524 RALPs were performed by a single surgeon (C.S.K.) between July 2007 and August 2012. The conducting surgeon had substantial experience with RRP but no experience with RALP at the start of the study period; in fact, he did not have any experience with laparoscopic radical prostatectomy. In Korea, the cost to the hospital for RALP is much greater than that for RRP because RRP is covered by national insurance, whereas RALP is not. Therefore, the choice of surgical method was made on the basis of counseling with patients, considering the severity and extent of their disease and their characteristics.

The preoperative workup for both groups consisted of serum prostate-specific antigen measurement, 10- to 12-core biopsies for cancer detection, magnetic resonance imaging, and a bone scan. Prostate volume and clinical stage were evaluated by transrectal ultrasonography and digital rectal examination, respectively. The risk of disease progression was classified by using the D'Amico risk classification [8]. Comorbidities (e.g., diabetes mellitus, hypertension, chronic obstructive pulmonary disease, and cardiovascular disease) and social history were assessed. Anesthesiologists within our institution determined the patients' American Society of Anesthesiologists scores [9].

Tumors were graded histologically according to the Gleason grading system [10], and the pathological stage was defined according to the TNM staging classification [11]. On the fifth to sixth postoperative day, cystography with anteroposterior and lateral views was performed to evaluate the anastomotic tightness. If there was no leak as evidenced by cystography, the urethral catheter was removed.

2. Surgical techniques

The RRP entailed a modification of the Walsh "anatomical radical retropubic prostatectomy" [12]. Briefly, a lower midline abdominal incision was made, entering the space of Retzius. Bilateral pelvic lymph node dissection was then performed. The endopelvic fascia was opened from the base of the prostate to the apex. The dorsal venous complex was then ligated and transected. Thereafter, for the cases in which a nerve-sparing procedure was attempted, the surgeon dissected the lateral aspects from the prostate allowing the neurovascular bundles to retract laterally. The urethra was then transected following exposure of its anterior surface. Ligation of the prostatic pedicles was then performed. The attachments between the bladder and the prostate were then divided and the surgical specimen was removed. The vesicourethral anastomosis with six separate sutures was typically performed over a 20-Fr urethral catheter.

In RALP, pneumoperitoneum was established by using a Veress needle and five trocars were then inserted. Bladder mobilization allowed entry into the space of Retzius. Bilateral pelvic lymph node dissection was performed for sampling purposes in all patients. The endopelvic fascia was then incised. The prostate was dissected with an antegrade approach, beginning with a bladder neck-sparing procedure. For all potent patients, the neurovascular bundles were spared athermally on sides not suspicious for cancer extension. A continuous suture was performed during the creation of the vesicourethral anastomosis with two 3-0 Monocryl sutures tied together, as described by van Velthoven [13].

3. Evaluation of complications

Medical and surgical complications were retrospectively collected for all patients through a combination of institutional electronic medical records, including operative and nursing notes, discharge summaries, outpatient and emergency room visits, and written correspondence with patients regarding complications. Any complications that occurred within 90 days of surgery were analyzed and categorized as either medical or surgical. Complications were classified according to the modified Clavien system [14]. This system determines the severity of a complication by using a scale with five grades. Grade I complications are designated as any deviation from the normal postoperative course that do not require extra therapy (with the exception of antiemetic, antipyretic, analgesic, and antidiarrheal drugs). Grade II complications necessitate pharmacologic treatment with drugs other than the drugs mentioned for the grade I complications. This grade includes the need for blood transfusion or hyperalimentation. Grade III complications are defined as complications necessitating surgical, endoscopic, or radiologic intervention. This grade is subdivided into grades IIIa and IIIb on the basis of the need for general anesthesia. Grade IV complications are life-threatening and necessitate intensive care, often leaving the patient with residual disability. A grade V complica-

TABLE 1. Characteristics of the 341 patients who underwent radical retropubic prostatectomy and the 524 patients who underwent robot-assisted laparoscopic prostatectomy

Characteristic	RRP	RALP	p-value
No. of patients	341	524	
Age (y)	64.9±6.7	64.9±7.0	0.255
Diabetes mellitus	55 (16.1)	77 (14.7)	0.566
Hypertension	154 (45.2)	217 (41.4)	0.276
Chronic obstructive pulmonary disease	14 (4.1)	20 (3.8)	0.831
Cardiovascular disease	39 (11.4)	58 (11.1)	0.867
History of previous operation	63 (18.5)	97 (18.5)	0.989
Smokers	145 (42.5)	255 (48.7)	0.077
Alcohol drinkers	193 (56.6)	289 (55.2)	0.676
ASA score			0.766
1/2	333 (97.7)	510 (97.3)	
3	8 (2.3)	14 (2.7)	
Body mass index (kg/m ²)	24.7±2.7	24.6±2.7	0.645
Prostate-specific antigen (ng/mL)	9.7±11.2	10.1±11.4	0.188
Prostate volume (gm)	36.2±17.8	36.0±16.9	0.579
D'Amico classification			0.263
Low	110 (32.3)	171 (32.6)	
Intermediate	115 (33.7)	200 (38.2)	
High	116 (34.0)	153 (29.2)	
Neoadjuvant hormone therapy	28 (8.2)	41 (7.8)	0.837
Operation time (min)	170.8±61.3	146.4±47.4	0.211
Hospital stay (d)	10.1±3.2	7.9±5.1	<0.001
Mean duration of catheterization (d)	7.5±2.4	6.2±2.6	<0.001
Pathologic stage			0.816
Organ-confined	220 (64.5)	347 (66.2)	
Extracapsular extension	90 (26.4)	135 (25.8)	
Seminal vesicle invasion	31 (9.1)	42 (8.0)	
Pathologic Gleason score			0.820
Unknown due to neoadjuvant hormone therapy	27 (7.9)	33 (6.3)	
≤6	58 (18.5)	83 (16.9)	
7	189 (60.2)	305 (62.1)	
8-10	67 (21.3)	103 (21.0)	
Pathologic lymph node involvement			0.158
Nx	31 (9.1)	27 (5.1)	
N0	295 (86.5)	484 (92.4)	
N1	15 (4.4)	13 (2.5)	

Values are presented as mean±standard deviation or number (%).

RRP, radical retropubic prostatectomy; RALP, robot-assisted laparoscopic prostatectomy; ASA, American Society of Anesthesiologists.

tion represents the death of a patient as the result of the complication.

4. Statistical analysis

Patient characteristics are reported as the mean and standard deviation. The two-tailed Pearson chi-square test was used to assess differences in the variables between the RRP and RALP groups. A p-value less than 0.05 was considered statistically significant in these comparisons. All statistical analyses were performed by using IBM SPSS ver. 21.0 (IBM Co., Armonk, NY, USA).

RESULTS

The demographic and clinical characteristics of the two

groups are shown in Table 1. The clinical stage, D'Amico classification, pathological stage, pathological Gleason grade, and treatment characteristics of all patients are also shown in Table 1. The patients' characteristics were not significantly different between treatment approaches. The mean hospital stay (7.9 days vs. 10.1 days, $p < 0.001$) and mean urethral catheter duration (6.2 days vs. 7.5 days, $p < 0.001$) were significantly shorter in the RALP group than in the RRP group, respectively.

The postoperative complications for the two groups by use of the Clavien classifications are shown in Table 2. The complication rate of the RALP group was lower than that of the RRP group (27.3% vs. 68.0%, respectively). Among them, there were more major complications defined as Clavien grade III or more in the RRP group (3.4% vs. 7.6%,

TABLE 2. Complications by Clavien classification in patients undergoing radical retropubic prostatectomy and robot-assisted laparoscopic prostatectomy

Variable	RRP	RALP
Overall complications	232 (68.0)	143 (27.3)
Clavien grade		
I	55 (16.1)	84 (16.0)
II	151 (44.3)	41 (7.8)
IIIa	10 (2.9)	11 (2.1)
IIIb	15 (4.4)	4 (0.8)
IV	1 (0.3)	3 (0.6)

Values are presented as number (%).

RRP, radical retropubic prostatectomy; RALP, robot-assisted laparoscopic prostatectomy.

TABLE 3. Frequency of medical complications in patients undergoing radical retropubic prostatectomy and robot-assisted laparoscopic prostatectomy

Variable	RRP	RALP	p-value
Cardiac problem	5 (1.5)	3 (0.6)	0.180
Myocardial infarction	0 (0)	0 (0)	
Pneumonia	2 (0.6)	1 (0.2)	0.333
Urinary tract infection	3 (0.9)	1 (0.2)	0.144
Respiratory distress	3 (0.9)	3 (0.6)	0.595
Respiratory failure	1 (0.3)	0 (0)	0.215
Acute renal failure	3 (0.9)	3 (0.6)	0.595
Pulmonary thromboembolism	0 (0)	0 (0)	
Cerebrovascular accident	2 (0.6)	1 (0.2)	0.333

Values are presented as number (%).

RRP, radical retropubic prostatectomy; RALP, robot-assisted laparoscopic prostatectomy.

respectively). In the RALP group, Clavien grade III complications included anastomotic leakage, infected lymphocele, wound dehiscence, surgical reintervention, and anal abscess. Clavien grade III complications in the RRP group also included anastomotic leakage, wound dehiscence, and urethral dilation. Concerning Clavien grade IV complications, one patient in the RRP group was taken to the intensive care unit (ICU) after surgery because of the occurrence of stroke. Three cases of stroke and ICU care owing to small bowel injury and postoperative bleeding were included in the Clavien grade IV complications in the RALP group.

The incidence of medical complications (Table 3) was not significantly different between the two groups. The rates of cardiac problems, pneumonia, urinary tract infections, respiratory distress, respiratory failure, acute renal failure, and cerebrovascular accidents were similar in both groups. Myocardial infarction and pulmonary thromboembolism did not occur in any patient.

The incidence of surgical complications is listed in Table 4. Urinary retention was more common in the RRP group

TABLE 4. Frequency of surgical complications in patients undergoing radical retropubic prostatectomy and robot-assisted laparoscopic prostatectomy

Variable	RRP	RALP	p-value
Femoral neuropathy	7 (2.1)	13 (2.5)	0.682
Urinary retention	24 (7.0)	14 (2.7)	0.002
Transfusion	144 (42.2)	33 (6.3)	<0.001
Postoperative ileus	6 (1.8)	12 (2.3)	0.593
Extravasation of contrast medium at cystography	34 (10.0)	11 (2.1)	<0.001
Wound repair	14 (4.1)	1 (0.2)	<0.001
Reoperation	2 (0.6)	2 (0.4)	0.664
ICU care	1 (0.3)	3 (0.6)	0.554

Values are presented as number (%).

RRP, radical retropubic prostatectomy; RALP, robot-assisted laparoscopic prostatectomy ICU, intensive care unit.

(7.0% vs. 2.7%, respectively; $p=0.002$). The need for perioperative blood transfusion was also significantly higher in the RRP group (42.2% vs. 6.3%, respectively; $p<0.001$). Conversely, wound repairs (4.1% vs. 0.2%, $p<0.001$) and extravasation of contrast medium at cystography (10.0% vs. 2.1%, $p<0.001$) were more common in the RRP group than in the RALP group, respectively. There was no significant difference in femoral neuropathy (RRP, 2.1%; RALP, 2.5%; $p=0.682$), postoperative ileus (RRP, 1.8%; RALP, 2.3%; $p=0.593$), reoperation (RRP, 0.6%; RALP, 0.4%; $p=0.664$), or postoperative ICU care (RRP, 0.3%; RALP, 0.6%; $p=0.554$) rates between the groups.

DISCUSSION

Reports from several centers have demonstrated the superiority of RALP over open and laparoscopic prostatectomy with respect to surgical outcomes [15-17]. Menon et al. [7] compared RRP and a robotic approach (30 patients in each group) and reported transfusion rates of 17% and 7% and complication rates of 6% and 6%, respectively. In a similar study, Ahlering et al. [18], comparing the newly introduced RALP with RRP, observed satisfying outcomes in terms of complication rates (6.7% vs. 10%, respectively). Ficarra et al. [19] also showed the superiority of RALP (105 patients) over RRP (103 patients) with respect to postoperative transfusion rates (1.9% vs. 14%, respectively). However, in the aforementioned studies, multiple surgeons performed the RRP and RALP procedures, and the perioperative complications were not classified by use of the Clavien system. Philippou et al. [20] compared complications arising from RRP and RALP procedures performed by the same surgeon; however, the study was limited by a small sample size.

We found that the incidence of Clavien grade III-IV complications was significantly lower in the RALP group (3.4%) than in the RRP group (7.6%). This finding is notable because of the large sample size, the inclusion of a single sur-

geon series, and the use of the Clavien system for classification of the complications. The previously noted advantages of RALP were confirmed in the present study, in which two comparative groups of patients were managed by use of an identical postoperative regimen. The conducting surgeon had abundant experience (10 years) in RRP but had no experience in RALP, or in laparoscopic radical prostatectomy, at the start of the study period. Thus, effects of the initial learning curve would be expected to be present in the RALP data. The fact that the complication rates were lower in the RALP group despite the inclusion of a learning curve adds weight to the argument supporting this surgical method in the treatment of prostate cancer.

The rate of wound repair after RRP in this study was 4.1%, which was approximately 20 times higher than the rate in the RALP group (0.2%). The incidences of wound repairs in the United States and Europe have been reported to be 0.3% to 3.2% after RRP [21,22], whereas two multicenter studies from Japan have reported a higher incidence of between 6.0% and 7.5% [23,24]. The skin incision in RRP is much longer than the short umbilical incision used in RALP for specimen retrieval and this difference might be important when trying to explain the higher incidence of wound repair in the RRP group. Although these were not culture-confirmed complications and therefore seroma could not be separated from true wound infections, the more frequent rate of wound infection in the RRP group than in the RALP group could be another possible cause of the higher wound repair rate with RRP.

We found that the incidence of extravasation of contrast medium during cystography was higher in the RRP group (10.0%) than in the RALP group (2.1%). One possible explanation for the lower extravasation rate in the RALP group is that a watertight anastomosis was more likely with the robotic technique owing to better visualization and the use of a running anastomosis. Therefore, there were fewer patients with urine extravasations than in the RRP group. Similarly, the urinary retention rate of the RRP group (7.0%) was significantly higher than that of the RALP group (2.7%). Khemees et al. [25] reported that patient- or surgery-specific risk factors for urinary retention were not identified, but they suggested that acute urinary retention develops as the result of edema at the anastomosis. We believe that the running anastomotic suture of RALP might facilitate initial voiding because earlier healing to a watertight state could lead to an earlier decrease in edema. Our suggestion is supported by a previous study showing that running anastomotic suture of laparoscopic prostatectomy allowed early catheter removal [26].

Considering the duration of hospitalization, our values were far longer in both study arms than those reported in series from the United States [15], which probably reflected the different pathways of management. Specifically, owing to the differences in economic health systems and cultural backgrounds, Korean patients often stay in the hospital until the urinary catheter is removed, whereas

patients in the United States are usually discharged quickly in the case of an uneventful early postoperative course.

Hemorrhage is the most common intraoperative complication associated with RRP. Comparing transfusion rates from different hospitals can be misleading, because the indication for blood transfusion may vary with clinical practice, but the transfusion rate of the RRP group in our study was much higher than that reported in other studies [6,18]. Blood transfusion rates of between 3% and 34% have been reported in RRP patient series [27-29]. Arai et al. [30] reported that only 6.9% of patients who had predonated an autologous blood subsequently received an allogenic transfusion in an RRP series. By contrast, among the patients who donated no autologous blood before RRP, 45% subsequently received an allogenic transfusion. It is likely that the transfusion rate of our study was high because the patients did not receive autologous transfusion, granulocyte-stimulating factor, or cell saver. Moreover, in the early phase of this study, the patients tended to receive transfusion for rapid recovery if their hemoglobin was lower than 10 g/dL after surgery, even though postoperative bleeding was not suspected. However, more recently, patients underwent blood transfusion only when their postoperative hemoglobin was lower than 8 g/dL or had a tendency to decrease. Thus, the transfusion rates of the RRP and RALP group were decreased to 18.8% and 0% in the last 50 cases. Irrespective of the change in the transfusion rate, the difference in transfusion rate between the RRP and RALP groups was significant in our study. One explanation for the seven times lower transfusion rate in the RALP group (6.3%) than in the RRP group (42.2%) could be a tamponading effect resulting from the pneumoperitoneum, which is beneficial in preventing venous bleeding, the most common source of blood loss during RRP. Loss of refinement in the technique of vascular control during RRP may also have contributed to the result.

This study was limited by the lack of randomization. The selection of treatment method was based mainly on the preferences of the patients. There are challenges in implementing a randomized trial because patients are usually unwilling to be randomly assigned to different treatments and may only accept robotic surgery. However, the clinical characteristics of the patients were not significantly different between the two groups in the present study. A further limitation was that there were fewer patients in the RRP group. This could, of course, have influenced the results, but this must be considered unlikely as an explanation of the difference in complications between these two groups. As previously discussed, the lack of surgical experience with RALP compared with the significant experience with RRP must also be considered when reviewing the outcomes from this study. Furthermore, only complications that occurred within 90 days of the surgery were included in this report. Late complications such as bladder neck contractures and the need for further surgery for urinary incontinence should be considered in further studies.

CONCLUSIONS

The introduction of RALP at our institution resulted in a decreased number of patients with urinary retention, extravasation of contrast medium during cystography, and wound repair after surgery. Blood transfusion was less common with RALP patients than with RRP patients. Our results show that RALP is associated with a lower complication rate than is RRP, especially the rate of major complications.

CONFLICTS OF INTEREST

The authors have nothing to disclose.

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