



Gender-related outcomes in robot-assisted radical cystectomy: A multi-institutional study

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Purpose: Robot-assisted radical cystectomy (RARC) optimizes patient recovery and has outcomes comparable with those of open surgery. This study aimed to compare the perioperative and oncologic outcomes of RARC in female and male patients.

Materials and Methods: A retrospective cohort study of the Korean Robot-Assisted Radical Cystectomy Study Group database from 2007 to 2019 identified 749 patients (111 females and 638 males). Female were matched 1:1 to male by propensity score matching using a logistic regression. We compared perioperative outcomes, oncologic outcomes, and complications between the two groups.

Results: The female group had comparable perioperative outcomes to the male group in terms of operation time, lymph node yield, positive surgical margin, blood transfusion rate, and hospitalization days. Complication rate and grade were not significantly different between the two groups. The most common complication was infection in female and gastrointestinal complications in male. We compared the 5-year overall, disease-specific, and recurrence-free survival of female and male: 58.2% vs. 68.0% ($p=0.495$), 75.7% vs. 79.3% ($p=0.645$), and 40.8% vs. 53.5% ($p=0.913$), respectively. On multivariable analysis, T stage ($>T2$), postoperative complications, and positive surgical margin were prognostic factors of poor outcome. Sex was not an independent predictor of the three survivals.

Conclusions: The current study suggests that RARC in female has comparable perioperative and oncologic outcomes to those in male. The complication rate of RARC in female was comparable to that in male, but the type of complications differed by sex.

Keywords: Cystectomy; Female; Robotic surgical procedures; Treatment outcome; Urinary bladder neoplasms

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INTRODUCTION

Minimally invasive surgery is used in the treatment of bladder cancer to optimize patient recovery by reducing blood loss and postoperative complications. Since the advent of robot-assisted radical cystectomy (RARC), many studies have reported that the oncologic outcomes and complications of RARC are comparable to those of open radical cystectomy (ORC) [1]. In the Robot-Assisted Radical Cystectomy Versus Open Radical Cystectomy (RAZOR) trial, robotic cystectomy was noninferior to open cystectomy in terms of early oncologic outcomes [2]. The International Robotic Cystectomy Consortium (IRCC) database also reported comparable long-term oncologic outcomes for RARC and ORC [3,4]. In a single-institutional study, RARC with intracorporeal urinary diversion had comparable midterm oncologic outcomes to ORC [5]. Functional outcomes of RARC have been reported in a randomized controlled setting and proven to be comparable to ORC. Mastroianni et al. [6] suggested that RARC with intracorporeal urinary diversion has equivalence to ORC for most health-related quality of life measures.

Although the oncologic and functional outcomes of RARC have been validated, there is sparse literature evaluating the perioperative and oncologic outcomes of RARC in women. Bladder cancer has been reported to have more unsatisfactory outcomes in women than in men. In patients who undergo radical cystectomy, female gender is associated with worse overall, cancer-specific, and recurrence-free survival (RFS) [7-9] because of multifactorial etiologies, such as carcinogen exposure and anatomic, genetic, hormonal, and socioeconomic differences [10,11]. In the diversion of RARC, orthotopic bladder substitution is not frequently performed in female patients because orthotopic bladder substitution in women is associated with urinary retention [12,13] and urethral recurrence [14]. Moreover, little is known about the nerve-sparing technique in female patients. This study aimed to compare the perioperative and oncologic outcomes of RARC in female and male.

MATERIALS AND METHODS

Data from 749 patients in the Korean Robot-Assisted Radical Cystectomy Study Group (KORARC) database who underwent robotic radical cystectomy between April 2007 and November 2019 in 11 tertiary referral centers (21 surgeons) in the Republic of Korea were collected and analyzed retrospectively. The KORARC database is a web-based electronic database originating from the Korean Society of Endourology and Robotics. All analyses were performed in

accordance with the Declaration of Helsinki after approval by the Institutional Review Board of the Korea University Anam Hospital (approval number: 2019AN0102). Written informed consent was obtained from all study participants.

All 749 patients with a mean follow-up of 30.8 months were categorized into two groups (111 females and 638 males). The female patients were propensity-score-matched with the male patients because of the wide differences in sample size between the two groups. Demographics, preoperative treatment, clinical stage before RARC, preoperative laboratory findings, intraoperative outcomes, oncologic outcomes, and complications were compared between the two groups. Both clinical and pathologic stages were classified according to the American Joint Committee on Cancer TNM staging system.

1. Surgical technique

RARC was performed using a six-port transperitoneal approach with the DaVinci Surgical System (Intuitive Surgical Inc., Sunnyvale, CA, USA). Cystoprostatectomy was performed in male patients, whereas female patients had either anterior pelvic exenteration or reproductive-organ-sparing cystectomy (preservation of the uterus, vagina, and bilateral ovaries) [15]. Pelvic lymph node (LN) dissection was performed in standard, extended, or limited regions [16].

A urinary diversion was made as an orthotopic bladder substitution, ileal conduit pouch, or ureterocutaneostomy using either an extracorporeal or intracorporeal approach. Decision on the type of urinary diversion was made with consideration of age, sex, patient counsel, tumor location, and each surgeon's experience and preference. Orthotopic bladder substitution was performed in patients without any urethral stricture or urethral tumor invasion, insufficient length of small bowel to be harvested for neobladder, short ureteral length due to a repeatedly positive ureteral frozen margin, or other technical issues making orthotopic bladder substitution impossible. Nerve sparing was performed on the unilateral or bilateral side, if indicated, in both groups.

2. Perioperative outcomes and follow-up

Perioperative outcomes included total operation time, open conversion rate, extent of LN dissection, number of LN yields, estimated blood loss, blood transfusion rate, transfusion amount, and hospitalization days. Pathologic T and N stage, number of positive LNs, positive surgical margin (PSM), and histology were compared between the two groups. Complications were based on the Clavien–Dindo classification system.

Patients were followed up after RARC with radiologic evaluation to identify any local or metastatic recurrence.

Oncologic outcomes included overall survival (OS), disease-specific survival (DSS), and RFS. OS was defined as the time from RARC to death, including death due to any cause; DSS was defined as the time from RARC to death due to bladder cancer; and RFS was defined as the time from RARC to local or metastatic recurrence.

3. Statistical analysis

We used an independent two-sample t-test to analyze the quantitative variables. Values of quantitative variables are presented as means with standard deviation or medians with interquartile range. Qualitative variables were compared using the chi-square test and Fisher's exact test. To reduce the imbalance in sample size and covariates, we performed propensity-score-matched analysis.

Kaplan–Meier curves were used to depict OS, DSS, and RFS. Multivariable analysis using the Cox proportional hazards model with backward selection was used to identify independent predictors of all three survivals. Multivariable analysis included variables such as institution; sex; age; body mass index; American Society of Anesthesiology (ASA) score; history of abdominal surgery; underlying cardiac, pulmonary, or renal disease; hypertension; diabetes mellitus; neoadjuvant chemotherapy; preoperative hemoglobin level; glomerular filtration rate; albumin level; number of LN yields; type of urinary diversion; corporeal type; pathologic T stage greater than T2; pathologic N stage; PSM; and postoperative complications. All statistical analyses were performed using IBM SPSS Statistics 25 (IBM Corp, Armonk, NY, USA). Statistical significance was defined as $p < 0.05$.

4. Propensity score matching

Females were matched 1:1 to males by propensity score matching using a logistic regression. In propensity score matching, we used 18 clinical covariates: age; body mass index; ASA score; underlying cardiac, pulmonary, or renal disease; hypertension; diabetes mellitus; smoking history; neoadjuvant chemotherapy; clinical T and N stage; preoperative hemoglobin level; glomerular filtration rate; albumin level; type of urinary diversion; corporeal type; and nerve sparing. After the matching, the baseline characteristics of the two groups were compared to evaluate the quality of covariate balance.

RESULTS

1. Baseline characteristics

The baseline characteristics of the two groups before and after the propensity-matched analysis are depicted in Table

1. Before matching, the male group had a higher smoking rate than their female counterparts, whereas more female patients than male patients had a history of abdominal surgeries. Of the 749 patients, female had less orthotopic bladder substitution and nerve-sparing procedures than did male. After the propensity-matched analysis, 67 patients were assigned to each group. The baseline characteristics of the two groups were not significantly different (Table 1).

2. Perioperative outcomes

Female had similar perioperative outcomes to male as listed in Table 2. The median LN yield was 17 in both groups ($p = 0.351$). None of the 134 patients had conversion to open surgery during RARC. The complication rate was 63.6% in female and 58.2% in male ($p = 0.521$), demonstrating that radical cystectomy still results in high morbidity. Both groups had grade II complications most often, according to the Clavien–Dindo classification. None of the patients had grade V complications. In female patients, the most frequent type of complication was postoperative infection, including urinary tract infection, acute pyelonephritis, wound infection, and bacteremia (28.8%), while in male patients, gastrointestinal complications, including paralytic/mechanical ileus, inguinal hernia, and incisional hernia, were the most common type (25.4%) (Table 2).

3. Oncologic outcomes

Pathologic T stage, N stage, and positive LNs were not significantly different between the two groups. PSM was 3.0% in female and 4.5% in male ($p > 0.999$). At 5 years postoperatively, OS was 58.2% and 68.0%, DSS was 75.7% and 79.3%, and RFS was 40.8% and 53.5% in female and male, respectively (Table 3).

In the multivariable analysis, patients with ASA 3 status had significantly worse OS than did those with ASA 1 status. Pathologic T stage greater than T2 was associated with worse OS, DSS, and RFS. Postoperative complications were associated with worse OS and DSS. PSM was associated with worse RFS (Table 4).

The Kaplan–Meier survival analysis of OS, DSS, and RFS by sex, T stage, and complication status is depicted in Figs. 1–3. OS differed by ASA classification and RFS differed by margin status in the Kaplan–Meier analysis (Fig. 4).

DISCUSSION

We compared 111 females and 638 males who underwent RARC, which is a relatively large sample size. Before the matched analysis, the percentage of orthotopic bladder sub-

Table 1. Baseline characteristics

Parameter	Before propensity matching			After propensity matching		
	Female (n=111)	Male (n=638)	p-value	Female (n=67)	Male (n=67)	p-value
Age (y)	68.0 (58.0–74.0)	68.0 (58.0–74.0)	0.437	68.0 (60.0–74.0)	68.0 (61.0–75.0)	0.515
BMI (kg/m ²)	23.5 (21.4–26.7)	24.2 (22.3–26.2)	0.679	23.6 (21.8–27.7)	24.1 (22.3–26.2)	0.994
ASA score			0.430			0.979
ASA 1	27 (24.3)	189 (29.8)		16 (23.9)	17 (25.4)	
ASA 2	73 (65.8)	397 (62.5)		42 (62.7)	41 (61.2)	
ASA 3	11 (9.9)	49 (7.7)		9 (13.4)	9 (13.4)	
Underlying disease						
Cardiac	7 (6.3)	68 (10.7)	0.159	5 (7.5)	5 (7.5)	>0.999
Pulmonary	6 (5.4)	46 (7.2)	0.490	5 (7.5)	4 (6.0)	>0.999
Renal	17 (15.3)	103 (16.1)	0.826	12 (17.9)	13 (19.4)	0.825
HTN	47 (42.3)	277 (43.4)	0.833	26 (38.8)	27 (40.3)	0.860
DM	25 (22.5)	148 (23.2)	0.876	15 (22.4)	15 (22.4)	>0.999
Smoking			<0.001			0.604
None	108 (97.3)	281 (44.4)		64 (95.5)	65 (97.0)	
Former smoker	2 (1.8)	266 (42.0)		2 (3.0)	2 (3.0)	
Current smoker	1 (0.9)	86 (13.6)		1 (1.5)	0 (0.0)	
Prior abdominal surgery	43 (40.6)	137 (21.9)	<0.001	26 (38.8)	20 (29.9)	0.275
Family history of cancer	4 (3.6)	19 (3.0)	0.764	3 (4.5)	1 (1.5)	0.365
Prior treatment						
Number of TURBT	1.33±1.09	1.52±1.27	0.100	1.39±1.26	1.43±1.13	0.829
Intravesical therapy	16 (14.4)	85 (13.3)	0.756	9 (13.4)	10 (14.9)	0.804
Neoadjuvant chemotherapy	14 (12.7)	110 (17.4)	0.222	9 (13.4)	9 (13.4)	>0.999
Prior partial cystectomy	3 (3.5)	11 (2.2)	0.438	2 (3.6)	0 (0.0)	0.496
Clinical T stage			0.495			0.896
NMIBC	36 (34.0)	223 (37.4)		23 (34.3)	20 (29.9)	
T2	54 (50.9)	282 (47.2)		33 (49.3)	35 (52.2)	
T3	15 (14.2)	73 (12.2)		10 (14.9)	10 (14.9)	
T4	1 (0.9)	19 (3.2)		1 (1.5)	2 (3.0)	
Clinical N stage			0.292			0.927
N0	99 (93.4)	552 (95.2)		63 (94.0)	62 (92.5)	
N1	4 (3.8)	15 (2.6)		3 (4.5)	4 (6.0)	
N2	1 (0.9)	10 (1.7)		1 (1.5)	1 (1.5)	
N3	2 (1.9)	3 (0.5)		0 (0.0)	0 (0.0)	
Laboratory findings						
Hb (g/dL)	11.6 (10.3–12.6)	13.2 (11.6–14.4)	<0.001	11.7 (10.8–12.6)	12.1 (10.0–13.2)	0.961
GFR (mL/min/1.73 m ²)	78.0 (58.2–93.3)	77.0 (62.0–91.3)	0.710	79.0 (58.6–93.1)	77.0 (59.5–90.4)	0.670
Albumin (g/dL)	4.0 (3.5–4.3)	4.1 (3.6–4.4)	0.013	4.0 (3.5–4.3)	3.8 (3.3–4.3)	0.833
PLT (×10 ³ /μL)	242 (196–290)	218 (175–265)	0.005	231 (194–290)	217 (187–265)	0.491
Diversion type			0.028			0.985
Orthotopic bladder	47 (44.8)	356 (58.7)		29 (43.3)	30 (44.8)	
Ileal conduit pouch	53 (50.5)	228 (37.6)		37 (55.2)	36 (53.7)	
Ureterocutaneostomy	5 (4.8)	22 (3.6)		1 (1.5)	1 (1.5)	
Corporeal type			0.921			>0.999
Intracorporeal	28 (26.4)	163 (26.0)		17 (25.4)	17 (25.4)	
Extracorporeal	78 (73.6)	465 (74.0)		50 (74.6)	50 (74.6)	
Nerve sparing	16 (14.4)	288 (45.8)	<0.001	14 (20.9)	14 (20.9)	>0.999

Values are presented as median (interquartile range), number (%), or mean±standard deviation.

BMI, body mass index; ASA, American Society of Anesthesiology; HTN, hypertension; DM, diabetes mellitus; TURBT, transurethral resection of bladder tumor; NMIBC, non-muscle-invasive bladder cancer; Hb, hemoglobin; GFR, glomerular filtration rate; PLT, platelet.

Table 2. Perioperative outcomes and complications

Parameter	Female	Male	p-value
OP time (min)	425 (338–553)	430 (340–550)	0.491
Open conversion rate	0 (0.0)	0 (0.0)	>0.999
LN dissection			0.184
Standard	12 (23.5)	10 (20.0)	
Extended	36 (70.6)	40 (80.0)	
Limited	3 (5.9)	0 (0.0)	
LN yield (n)	17 (10–26)	17 (11–24)	0.351
EBL (mL)	400 (200–600)	400 (300–600)	0.346
Blood transfusion rate	13 (19.7)	15 (22.7)	0.670
Transfusion (mL)	320 (267.5–605)	320 (320–640)	0.634
Hospitalization (d)	14 (12–18.5)	15 (12–21.25)	0.077
Readmission rate	35 (53.0)	31 (46.3)	0.436
Complication rate	42 (63.6)	39 (58.2)	0.521
Clavien–Dindo grade			0.588
Grade I	4 (9.5)	1 (2.6)	
Grade II	21 (50.0)	21 (53.8)	
Grade III	15 (35.7)	14 (35.9)	
Grade IV	2 (4.8)	3 (7.7)	
Type of complications			
Gastrointestinal	6 (9.1)	17 (25.4)	0.013
Cardiovascular	1 (1.5)	0 (0.0)	0.496
Pulmonary	1 (1.5)	0 (0.0)	0.496
Genitourinary	12 (18.2)	9 (13.4)	0.453
Infection	19 (28.8)	12 (17.9)	0.138
Wound	5 (7.6)	6 (9.0)	0.773
Vascular	4 (6.1)	1 (1.5)	0.208
Hematological	1 (1.5)	3 (4.5)	0.619
Neurological	1 (1.5)	0 (0.0)	0.496
Etc.	10 (15.2)	6 (9.0)	0.272

Values are presented as median (interquartile range) or number (%). OP, operation; LN, lymph node; EBL, estimated blood loss.

stitution was 44.8% of female RARC cases and 58.7% of male RARC cases. The disparity may have resulted from the post-operative concern that hypercontinence after RARC is relatively high in female patients [12,13] and because of oncologic concerns about urethral recurrence after surgery [14]. Finley et al. [13] emphasized that pseudocystocele and urethral kinking are anatomical changes associated with urinary retention after orthotopic bladder substitution. Sparing of the gynecologic organs, such as the round ligament, during radical cystectomy may play a role in continence [17,18]; however, further prospective comparative studies are needed. Ali-el-Dein et al. [14] reported a low rate of urethral recurrence after radical cystectomy following orthotopic bladder substitution, suggesting the continued use of this type of diversion.

The overall rates of orthotopic bladder substitution in our study were higher than those reported in prior studies. For example, Groeben et al. [19] compared rates of continent

Table 3. Oncologic outcomes

Parameter	Female	Male	p-value
T stage			0.407
T0	3 (4.5)	4 (6.2)	
Tis	6 (9.0)	0 (0.0)	
Ta	4 (6.0)	2 (3.1)	
T1	8 (11.9)	8 (12.5)	
T2			
T2a	9 (13.4)	12 (18.8)	
T2b	8 (11.9)	10 (15.6)	
T3			
T3a	16 (23.9)	12 (18.8)	
T3b	8 (11.9)	10 (15.6)	
T4			
T4a	5 (7.5)	6 (9.4)	
T4b	0 (0.0)	0 (0.0)	
N stage			0.999
N0	49 (75.4)	48 (76.2)	
N1	10 (15.4)	9 (14.3)	
N2	5 (7.7)	5 (7.9)	
N3	1 (1.5)	1 (1.6)	
Positive LN (n)	0.74±2.08	0.80±2.44	0.884
PSM	2 (3.0)	3 (4.5)	>0.999
Histology			
ALI	24 (35.8)	24 (36.9)	0.895
PNI	11 (16.7)	18 (28.1)	0.117
Squamous metaplasia	8 (12.1)	4 (6.2)	0.248
Glandular metaplasia	3 (4.5)	4 (6.2)	0.716
2-y survival			
OS	88.7	74.1	
DSS	92.6	82.6	
RFS	62.5	60.1	
5-y survival			
OS	58.2	68.0	
DSS	75.7	79.3	
RFS	40.8	53.5	

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

LN, lymph node; PSM, positive surgical margin; ALI, angiolymphatic invasion; PNI, perineural invasion; OS, overall survival; DSS, disease-specific survival; RFS, recurrence-free survival.

urinary diversion in the United States and Germany. They reported that continent urinary diversion was performed in 8.6% of male patients and 4.1% of female patients in the United States. In Germany, 37.4% of male patients and 20.9% of female patients had continent diversion. Age, female gender, and low-volume center were predictors of incontinent urinary diversion in a multivariable analysis. In our study, the relatively high rate of continent urinary diversion could be explained by our use of a database based on a high-volume center and surgeons with proficient surgical technique

Table 4. Multivariable analysis of OS, DSS, and RFS by Cox proportional hazards model with backward selection

Survival	Parameter	HR	95% CI	p-value
OS (n=116)	ASA			0.062
	ASA 1	1		
	ASA 2	3.613	(0.986–13.238)	0.052
	ASA 3	6.643	(1.350–32.696)	0.020
	T stage (>T2 vs. T0–T2)	2.521	(1.038–6.124)	0.041
DSS (n=113)	Complication	3.488	(1.268–9.599)	0.016
	T stage (>T2 vs. T0–T2)	4.365	(1.298–14.678)	0.017
RSS (n=118)	Complication	9.097	(1.172–70.634)	0.035
	T stage (>T2 vs. T0–T2)	2.713	(1.459–5.046)	0.002
	Positive surgical margin	3.351	(1.136–9.886)	0.028
	Complication	1.942	(0.988–3.817)	0.054

OS, overall survival; DSS, disease-specific survival; RFS, recurrence-free survival; HR, hazard ratio; CI, confidence interval; ASA, American Society of Anesthesiology.

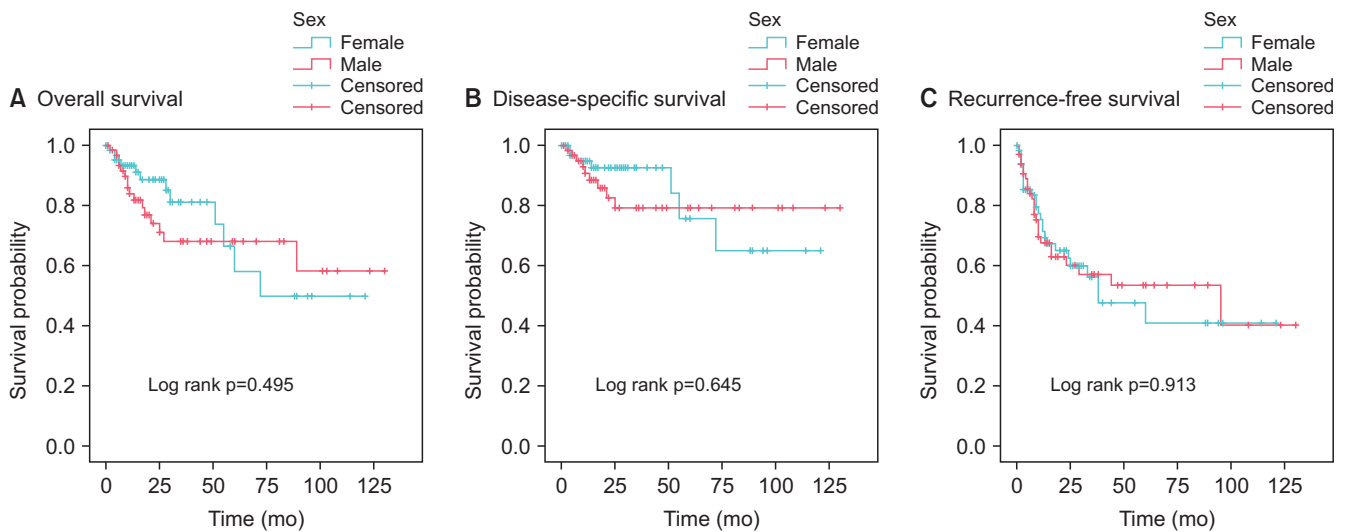


Fig. 1. Kaplan–Meier survival analysis of (A) overall survival, (B) disease-specific survival, and (C) recurrence-free survival by sex.

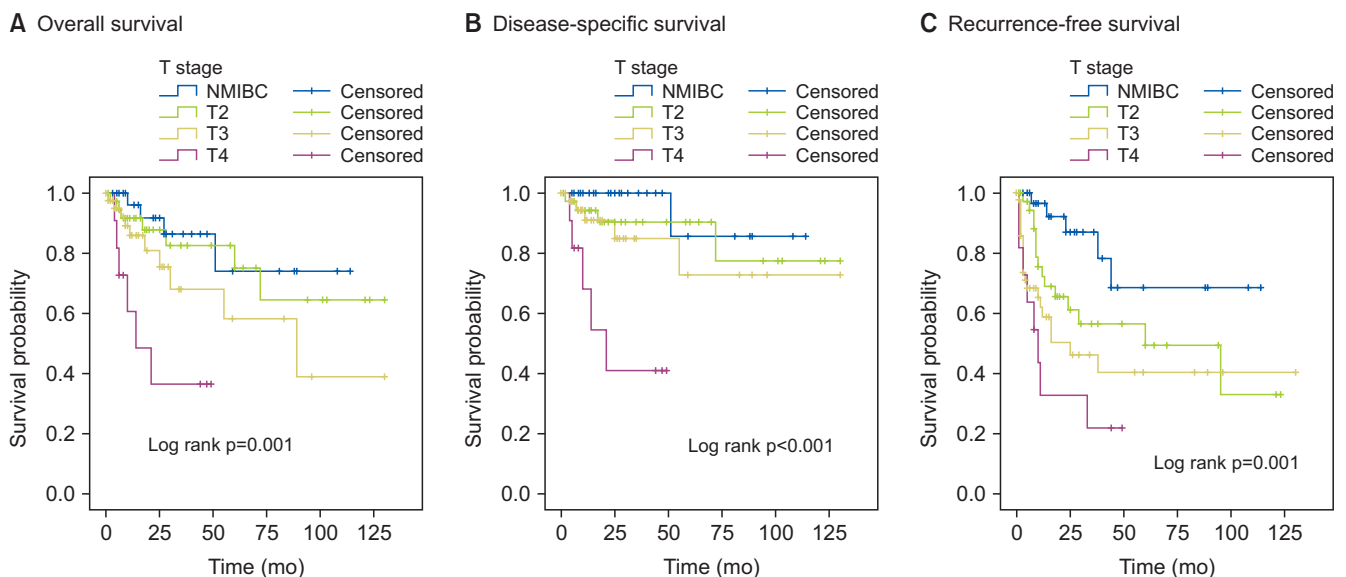


Fig. 2. Kaplan–Meier survival analysis of (A) overall survival, (B) disease-specific survival, and (C) recurrence-free survival by T stage. NMIBC, non-muscle-invasive bladder cancer.

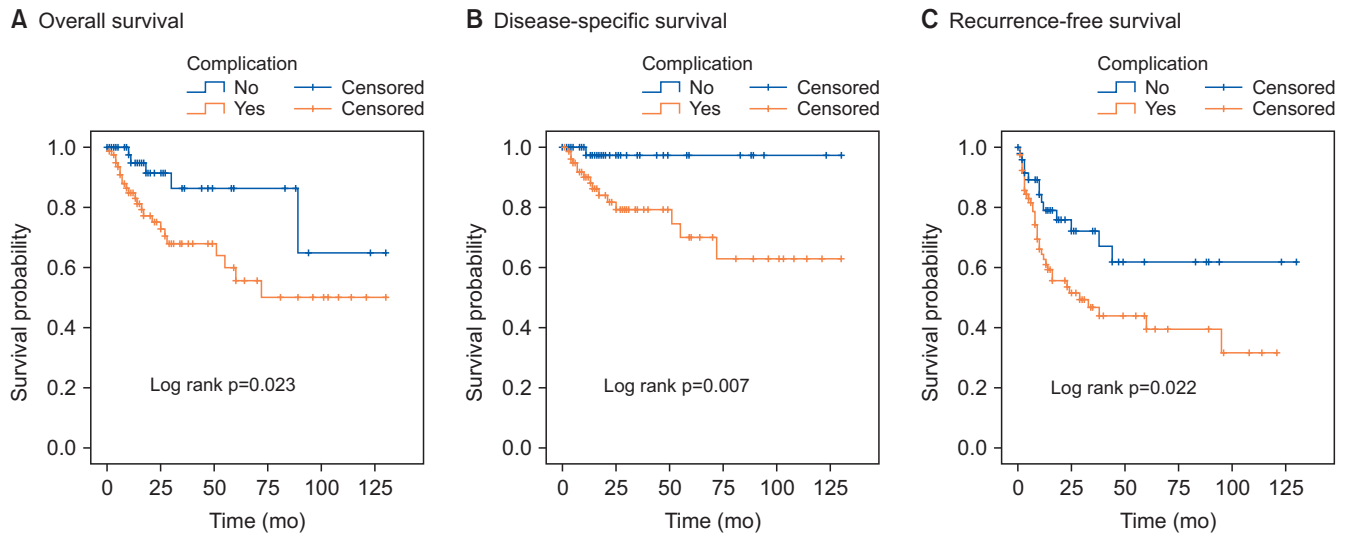


Fig. 3. Kaplan–Meier survival analysis of (A) overall survival, (B) disease-specific survival, and (C) recurrence-free survival by complication status.

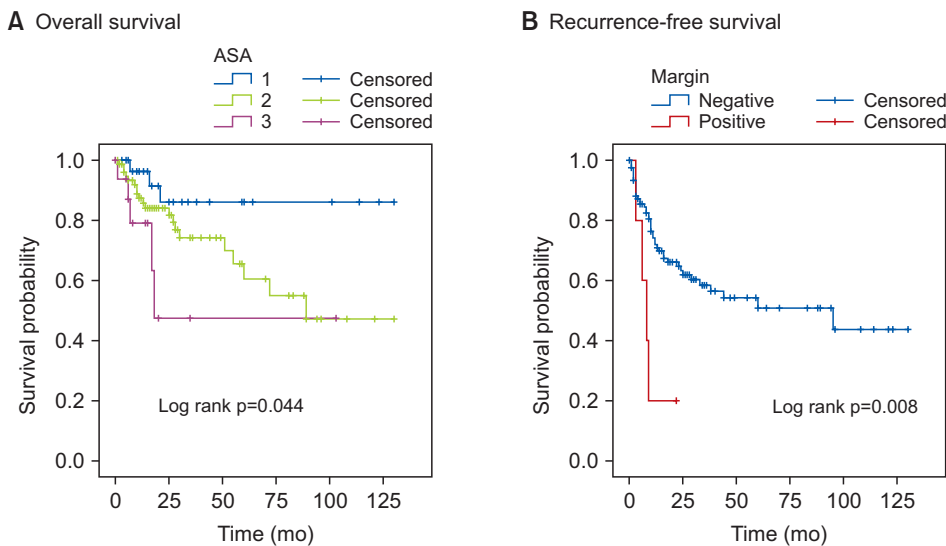


Fig. 4. Kaplan–Meier survival analysis of (A) overall survival by ASA classification and (B) recurrence-free survival by margin status. ASA, American Society of Anesthesiology.

in orthotopic bladder substitution.

The percentage of nerve-sparing procedures was 14.4% of female RARC cases and 45.8% of male RARC cases before the propensity-score-matched analysis. Nerve sparing in female radical cystectomy is a challenging and poorly understood procedure. Bhatta Dhar et al. [20] and Hinata et al. [21] demonstrated the anatomy and surgical procedure of nerve-sparing dissection in female radical cystectomy. However, reports on the oncologic and functional outcomes of the nerve-sparing technique in female radical cystectomy are lacking. The infrequent performance of nerve sparing in female RARC is due to this lack of evidence and it being an unfamiliar technique.

By using propensity-score-matched analysis, we could control for potential confounding variables such as diversion type, corporeal type, and nerve sparing. We found that

RARC presented comparable perioperative outcomes and complications in female patients as in their male counterparts. However, the patterns of complications differed. In the female group, the most common complication was infection (28.8%). On the other hand, the male group experienced gastrointestinal complications the most often (25.4%). Abdi et al. [22] found that female gender is associated with a higher postoperative infection rate in radical cystectomy. Vaginal microflora may play a role in surgical site infection, but the mechanism is not clear. Future studies are required to investigate the effect of vaginal flora on infection after radical cystectomy in women. Information about the bacteria cultured at the site of infection would be helpful.

The oncologic outcomes of historical ORC or RARC reports are listed in Table 5 [3,4,23-26]. In the present study, a PSM was found in 3.0% of female undergoing RARC and in

Table 5. Comparison of oncologic outcomes in ORC and RARC

Study	Total	Follow-up (mo)	LN yield (n)	5-y OS (%)	5-y DSS (%)	5-y RFS (%)	PSM (%)	O/R
Ghoneim et al., 2008 [23]	2,720	66	-	56	-	-	-	O
Stein et al., 2001 [24]	1,054	122	-	66	-	68	-	O
Hautmann et al., 2012 [25]	1,100	38	18	58	71	70	-	O
Raza et al., 2015 [4]	702	67	16	50	75	67	8	R
Hussein et al., 2019 [3]	446	64	14	52	71	61	7	R
Zhang et al., 2020 [26]	948	26	-	72	-	-	5.9	O/R
Current study								
Overall	134	30	17	67	79	48	3.8	R
Female	67	28	17	58	76	41	3.0	R
Male	67	32	17	68	79	53	4.5	R

ORC, open radical cystectomy; RARC, robot-assisted radical cystectomy; LN, lymph node; OS, overall survival; DSS, disease-specific survival; RFS, recurrence-free survival; PSM, positive surgical margin; O/R, open/robot; -, not mentioned.

4.5% of male, which is comparable with the rates reported in previous studies [2-4,26]. In our study, 5-year OS, DSS, and RFS were lower in female RARC patients than in their male counterparts. Previous studies have reported that female gender is a poor prognostic factor in bladder cancer [7-9]. For example, Kluth et al. [7] investigated 8,102 patients (1,605 women) who underwent radical cystectomy for urothelial carcinoma of the bladder and reported that female gender was associated with cancer-specific mortality. To explain the gender disparity, multifactorial etiologies such as carcinogen exposure and anatomic, genetic, hormonal, and socioeconomic differences have been suggested [10,11]. Although the more advanced disease presentation in women than in men could contribute to the difference in survival, women still had worse prognosis in stage-adjusted analysis [27]. Hormonal etiologies have been suggested, such as androgen receptor and estrogen receptor, yet the mechanisms are under investigation [28,29]. Inequalities in health care may be one of the etiologies that explain the compromising outcomes. Smith et al. [30] reported that environmental and socioeconomic factors such as smoking, unemployment, air pollution ozone days, and employment in the mining industry could affect bladder cancer mortality. In addition, the effects of environmental and socioeconomic factors differed by gender.

However, in the multivariable analysis, female gender was not an independent predictor of the three survivals, suggesting that other factors listed in Table 4 may have contributed to the difference. The patients in our study underwent expensive robotic surgery, and any gender-related disparity in socioeconomic status in these patients would be vague. Other robotic studies have reported similar findings. Hussein et al. [3] and Raza et al. [4] reported long-term oncologic outcomes using the IRCC database. In multivariable analysis, female gender was not an independent predictor of

survival in either study.

To our knowledge, the KORARC database is the largest multi-institutional cohort investigating the outcomes of RARC in the Republic of Korea. However, this study had some limitations. First, the retrospective cohort study design from the multi-institutional database had low consistency in surgical procedures because 21 surgeons were involved. To compensate for this bias, we included the institution as one of the variables in the Cox proportional hazards model. Since the present study had a retrospective design, the database is dependent on review of medical records. This could result in some missing information. Selection and recall biases could also occur. Second, long-term follow-up data and functional outcomes are needed to further compare the outcomes between the two groups. Third, neoadjuvant chemotherapy was administered to 12.7% of the female group and 17.4% of the male group, which was relatively low. Variables such as cycles and types of neoadjuvant chemotherapy were missed. Fourth, this study did not have a central pathologist and as such interobserver variability in pathologic reports could occur.

CONCLUSIONS

The perioperative outcomes in female RARC patients were comparable to those of the male counterparts. Female gender was not associated with poor oncologic outcomes in this study. Complication rate and grade of the female patients were similar to those of the male patients. However, complication type differed by sex.

CONFLICTS OF INTEREST

The authors have nothing to disclose.

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