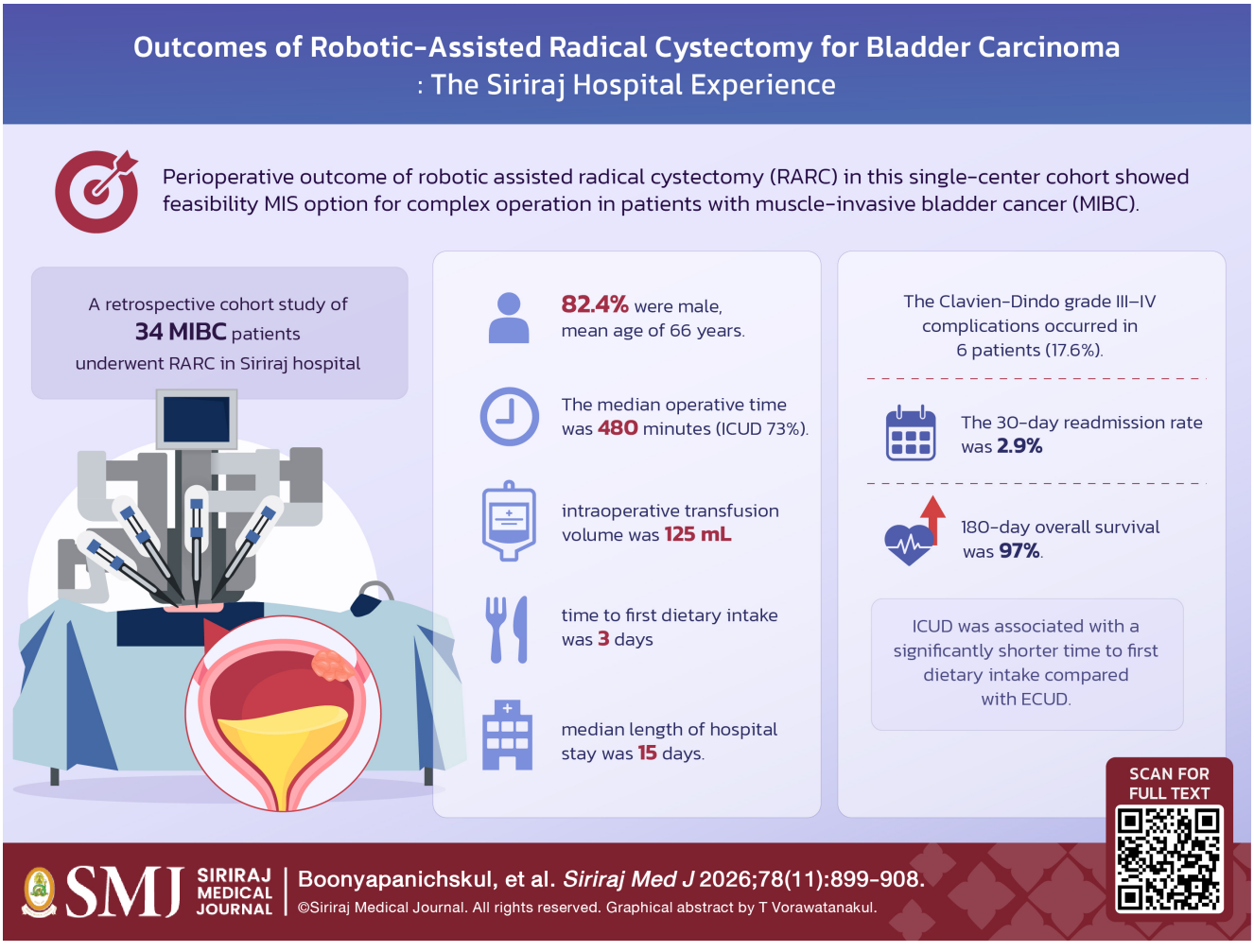
Outcomes of Robotic-Assisted Radical Cystectomy for Bladder Carcinoma: The Siriraj Hospital Experience

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Received 7 August 2026 Revised 14 October 2026 Accepted 16 October 2026
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https://doi.org/10.33192/smj.v78i11.270359

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ABSTRACT

Objective: To evaluate the perioperative outcomes of patients who underwent robotic-assisted laparoscopic radical cystectomy (RARC) at Siriraj Hospital between January 2014 and December 2023.

Materials and Methods: A retrospective review of RARC patients was performed. Analyses encompassed patient demographics, intraoperative and perioperative outcomes including estimated blood loss, complication rates, readmission rates, and short-term survival. A subgroup analysis compared outcomes between patients who underwent intracorporeal urinary diversion (ICUD) and extracorporeal urinary diversion (ECUD).

Results: Of 34 patients, 82.4% were male, with a mean age of 66 years. The median operative time was 480 minutes, estimated blood loss (EBL) was 600 mL, intraoperative transfusion volume was 125 mL, time to first dietary intake was 3 days, and median length of hospital stay was 15 days. The 30-day Clavien-Dindo grade III–IV complications occurred in 6 patients (17.6%). The 30-day readmission rate was 2.9%, and 180-day overall survival was 97%. ICUD was performed in 73.5% of patients and was associated with a significantly shorter time to first dietary intake compared with ECUD (2 vs. 4 days, p = 0.001).

Conclusions: RARC was feasible in this single-center cohort, with a 2.9% 30-day readmission rate. ICUD was associated with a shorter time to first dietary intake than ECUD, while other measured perioperative and short-term oncologic outcomes did not differ significantly between groups. These findings should be interpreted in the context of the retrospective design, small sample size, and potential selection bias.

Keywords: Robotic-assisted radical cystectomy; bladder carcinoma; intracorporeal urinary diversion; extracorporeal urinary diversion; perioperative outcomes (Siriraj Med J 2026;78(11):899-908)

INTRODUCTION

Bladder cancer is one of the most prevalent urologic malignancies in Thailand, with approximately 20%–30% of patients presenting with locally advanced disease.[1] The current standard treatment for muscle-invasive bladder cancer consists of neoadjuvant chemotherapy followed by radical cystectomy. Historically, open radical cystectomy (ORC) has been associated with substantial perioperative morbidity and mortality, prompting interest in minimally invasive alternatives.

Robotic-assisted radical cystectomy (RARC), performed using the da Vinci Surgical System, has emerged as an attractive alternative to ORC, offering potential advantages in surgical precision, reduced blood loss, and improved recovery profiles. Two landmark phase III randomized controlled trials have substantially strengthened the evidence supporting RARC: the iROC trial demonstrated that RARC with intracorporeal urinary diversion resulted in significantly more days alive and out of hospital within 90 days compared to ORC[2], while the RAZOR trial established the oncologic non-inferiority of RARC relative to ORC at two years of follow-up.[3] Furthermore, compared with laparoscopic radical cystectomy (LRC), RARC has been associated with comparable or superior perioperative outcomes.[4] Despite the growing evidence, broader adoption of RARC remains limited in several healthcare settings, particularly where access to robotic infrastructure is constrained by cost and complexity.

Siriraj Hospital has extensive experience in minimally invasive radical cystectomy, initially performing laparoscopic procedures between 2005 and 2013.[6] However, published data regarding perioperative outcomes following RARC in Thailand remain limited. This study aims to address this gap by evaluating the perioperative outcomes of patients undergoing RARC at Siriraj Hospital and comparing outcomes between patients who underwent intracorporeal urinary diversion (ICUD) and those who underwent extracorporeal urinary diversion (ECUD).

MATERIALS AND METHODS

A retrospective chart review was conducted at a single tertiary-care center (Siriraj Hospital, Bangkok, Thailand). All patients who underwent RARC between January 2014 and December 2023 were included. Patient demographics, disease characteristics, intraoperative details, and perioperative outcomes were systematically extracted and analyzed. The urinary diversion procedures included ileal conduit and orthotopic neobladder reconstruction. The ileal conduit was the preferable option for patients with locally advanced diseases or impaired renal function. The choice of urinary diversion (ICUD or ECUD) was made at the time of surgery according to the surgeon experiences, intraoperative findings and technical considerations. In general, ICUD was a feasible option for uncomplicated patients with good quality small bowels and ureters. Postoperative ileus was defined

as a postoperative delay in gastrointestinal recovery characterized by failure to tolerate oral intake and/or persistent gastrointestinal dysfunction requiring clinical management beyond the expected postoperative course. Postoperative intensive care unit (ICU) was booked in every case, but ICU admission was required when patients developed unstable hemodynamics or prolong operative time which needed postoperative ventilation support or intensive monitoring.

The primary outcomes included EBL, intraoperative fluid administration, intraoperative blood transfusion volume, time to first dietary intake, and length of hospital stay. Secondary outcomes included 30-day postoperative complication and readmission rates, as well as 180-day local recurrence, distant metastasis, and overall survival rates. Postoperative complications were graded according to the Clavien-Dindo classification system. A subgroup analysis was performed to compare perioperative outcomes between patients who underwent ICUD and those who underwent ECUD. Statistical analyses were conducted using appropriate tests for continuous and categorical variable. Continuous variables were presented as means with SD or medians with interquartile range. Categorical variables were compared within groups using the Chi-square test and Fisher's exact test. All tests were 2-tailed, and a p-value<0.05 was considered significant. Data were analyzed using SPSS version 18.0 (IBM Corp., Armonk, USA).

RESULTS

Patient characteristics

A total of 34 patients underwent RARC during the study period. The mean age of the cohort was 66 years, and the mean body mass index (BMI) was 25.2 kg/m². Comorbidities were common, with hypertension present in 55.9%, diabetes mellitus in 29.4%, and dyslipidemia in 23.5% of patients. Fifteen patients (44.1%) received neoadjuvant therapy prior to surgery. Baseline demographic and clinical characteristics are summarized in Table 1.

Intraoperative findings and histopathology

Intracorporeal urinary diversion (ICUD) was performed in the majority of patients (73.5%). The median operative time was 480 (IQR: 430–550) minutes. Median EBL was 600 (IQR: 300–1000) mL, median intraoperative blood transfusion volume was 125 (IQR: 0–311) mL, and total intraoperative fluid administration was 3,400 (IQR: 2,900–4,250) mL.

Histopathological evaluation revealed high-grade invasive urothelial carcinoma in 27 patients (79.4%). Four patients (11.8%) demonstrated no residual tumor in the resected specimen, while positive surgical margins were identified in four patients (11.8%). The most common pathological stage was pT3a (n = 10, 29.4%), followed by pT2 (n = 7, 20.6%). Metastatic disease was identified in the resected specimen of two patients (5.8%), including one case of ovarian metastasis and one case of peritoneal metastasis. Variant histology was present in nine patients (26.5%), with squamous differentiation being most frequent subtype. Synchronous prostate cancer was identified in 12 of 28 male patients (42.8%), of whom 8 (66.7%) had Gleason score 3+3 disease. Detailed intraoperative and pathological findings are presented in Table 2.

Postoperative outcomes

Eleven patients (32.4%) required postoperative admission to the intensive care unit (ICU). The median time to first oral intake was 3 days (IQR: 2–4), and the median length of hospital stay was 15 (IQR: 11–23) days. The most common 30-day complications were postoperative ileus (n = 8, 23.5%) and urinary tract infection (n = 8, 23.5%). Clavien-Dindo grade III–IV complications occurred in 6 patients (17.6%); the events recorded as major complications included urinary leakage, postoperative hemorrhage, reintubation, and ileal necrosis. The three cases of urinary leakage classified as major complications were successfully managed with ureteral stent adjustment. One patient developed postoperative DVT and subsequently experienced hemorrhagic complications after initiation of anticoagulation therapy, ultimately requiring placement of an inferior vena cava (IVC) filter. Detailed postoperative outcomes are presented in Table 3. One patient (2.9%) required readmission within 30 days, on postoperative day 14, due to enteritis and an intra-abdominal fluid collection, both of which resolved with intravenous antibiotic therapy.

Oncologic outcomes at 180 days

All 34 patients completed 180 days of follow-up. Local recurrence was identified in seven patients (20.5%), while distant metastasis occurred in eleven patients (32.4%). The most common site of metastasis was the peritoneum (carcinomatosis peritonei; n = 3, 8.8%), followed by the lungs and mediastinum (each n = 2, 5.9%). One patient died during the 180-day follow-up period as a result of metastatic disease, corresponding to a 180-day overall survival rate of 97%. Oncologic outcomes are summarized in Table 4.

Subgroup analysis: ICUD vs. ECUD

Patients were stratified according to the type of urinary diversion into ICUD (n = 25) and ECUD (n = 9) groups.

TABLE 1. Patient demographics and baseline characteristics.

Characteristic	Value
Age (years), mean ± 2SE	66 ± 2
BMI (kg/m²), mean ± 2SE	25.2 ± 1.3
Male sex, n (%)	28 (82.4%)
Prior neoadjuvant therapy, n (%)	15 (44.1%)
Hydronephrosis, n (%)	10 (29.4%)
GFR (mL/min), median (IQR)	65.6 (52–83)
Presenting symptoms	
Hematuria	31 (91.8%)
Dysuria	6 (17.7%)
Flank or suprapubic pain	3 (8.8%)
Obstructive uropathy	1 (2.9%)
Comorbidities	
Hypertension	19 (55.9%)
Diabetes mellitus	10 (29.4%)
Dyslipidemia	8 (23.5%)
Chronic kidney disease	5 (14.7%)
Coronary artery disease	5 (14.7%)
ASA classification	
Class I	9 (26.5%)
Class II	14 (41.2%)
Class III	11 (32.4%)

Values are n (%) or mean ± 2SE or median (IQR).

Abbreviations: BMI, body mass index; GFR, glomerular filtration rate; ASA, American Society of Anesthesiologists

Baseline characteristics were generally comparable between groups, except for ASA classification. A significantly greater proportion of patients in the ICUD group were classified as ASA class III compared with the ECUD group (44% vs. 0%, p = 0.048). All other demographic and preoperative parameters were similar between groups (Table 5). Intraoperative parameters, including operative time, intraoperative fluid administration, EBL, blood transfusion requirements, and histopathological findings, did not differ significantly between the two groups (Table 5). The median time to first oral intake was significantly shorter in the ICUD group than in the ECUD group (2 [IQR: 2–3] vs. 4 [IQR: 4–6] days, p = 0.001). However, no statistically significant differences were observed in length of hospital stay, 30-day complication rate, 30-day readmission, or 180-day survival. The recurrence and postoperative metastasis values currently displayed in Table 6 should be verified against the source dataset before publication because they are inconsistent with the aggregate 180-day outcomes shown in Table 4.

DISCUSSION

Open radical cystectomy (ORC) has long been the standard treatment for muscle-invasive bladder cancer in Thailand. Despite its efficacy, ORC remains associated with substantial perioperative morbidity, even in high-

TABLE 2. Intraoperative parameters and histopathological findings.

Parameter	Value
Intraoperative characteristics	
Operative time (min), median (IQR)	480 (430–550)
Estimated blood loss (mL), median (IQR)	600 (300–1000)
Intraoperative transfusion (mL), median (IQR)	125 (0–311)
Total intraoperative fluid (mL), median (IQR)	3,400 (2,900–4,250)
Tumor pathology	
Invasive urothelial carcinoma, high grade	27 (79.4%)
Noninvasive urothelial carcinoma, high grade	1 (2.9%)
Noninvasive urothelial carcinoma, low grade	1 (2.9%)
Post-treatment effect	1 (2.9%)
No residual tumor	4 (11.8%)
CIS (multifocal)	2 (5.9%)
CIS (present)	6 (17.7%)
Lymphovascular invasion	9 (26.5%)
Perineural invasion	5 (14.7%)
Positive surgical margin	4 (11.8%)
Close surgical margin	6 (17.6%)
Prostate stromal involvement	4 (11.8%)
Variant histology	9 (26.5%)
Pathological stage	
Stage 0	7 (20.6%)
Stage 1	5 (14.7%)
Stage 2	7 (20.6%)
Stage 3a	10 (29.4%)
Stage 3b	3 (8.8%)
Stage 4a	1 (2.9%)
Stage 4b	1 (2.9%)

Values are n (%) or median (IQR).

Abbreviation: CIS, carcinoma in situ

TABLE 3. Postoperative outcomes and complication profile.

Outcome	n (%) or Median (IQR)
Time to first dietary intake (days)	3 (2–4)
ICU admission, n (%)	11 (32.4%)
ICU length of stay (days)	1 (1–3)
Length of hospital stay (days)	15 (11–23)
30-days postoperative Complications	
Clavien-Dindo grade I, n (%)	4 (11.8%)
Clavien-Dindo grade II, n (%)	12 (35.2%)
Clavien-Dindo grade IIIa, n (%)	2 (5.9%)
Clavien-Dindo grade IIIb, n (%)	3 (8.8%)
Clavien-Dindo grade IVa, n (%)	1 (2.9%)
Most common 30-day complications	
Postoperative ileus	8 (23.5%)
Urinary tract infection	8 (23.5%)
Urinary leakage	4 (11.8%)
Major 30-day complications	
Urinary leakage	3 (8.8%)
Postoperative hemorrhage	1 (2.9%)
Reintubation	1 (2.9%)
Ileal necrosis	1 (2.9%)
30-day readmission, n (%)	1 (2.9%)

Values are n (%) or median (IQR).

TABLE 4. Recurrence and metastatic outcomes at 180-day follow-up.

Outcome	n (%)
Local recurrence	7 (20.6%)
Distant metastasis	11 (32.4%)
Carcinomatosis peritonei	3 (8.8%)
Pulmonary metastasis	2 (5.9%)
Mediastinal metastasis	2 (5.9%)
Aortocaval lymph nodes	2 (5.9%)
Paraaortic lymph nodes	1 (2.9%)
Intraabdominal lymph nodes	1 (2.9%)
180-day overall survival	33/34 (97%)

Values are n (%).

TABLE 5. Subgroup characteristics and intraoperative details by urinary diversion type.

Characteristic	ICUD (n = 25)	ECUD (n = 9)	p-value
Age (years), median (IQR)	64 (63–70)	65 (58–70)	0.39
Female sex, n (%)	5 (20%)	1 (11%)	0.549
Neoadjuvant therapy, n (%)	13 (52%)	2 (22.2%)	0.24
ASA classification			0.048
Class I	5 (20%)	4 (44.4%)	
Class II	9 (36%)	5 (55.6%)	
Class III	11 (44%)	0	
Hydronephrosis, n (%)	8 (32%)	2 (22.2%)	0.692
Hemoglobin (g/dL)	11.1 (10.5–11.9)	12.2 (11–13.2)	0.097
Albumin (g/dL)	4.0 (3.6–4.2)	4.1 (4.0–4.4)	0.122
GFR (mL/min)	67 (44–83)	64 (58–69)	0.494
Operative time (min)	480 (445–575)	475 (420–480)	0.241
Intraoperative fluid (mL)	3,400 (2,900–4,250)	3,400 (2,900–4,150)	0.891
EBL (mL)	650 (320–1,000)	520 (300–600)	0.233
Intraoperative transfusion (mL)	266 (0–339)	0 (0–289)	0.203
Neobladder construction, n (%)	8 (32%)	2 (22%)	0.692
Histopathological findings			
High-grade tumor	22 (88%)	7 (77.7%)	0.591
CIS	4 (16%)	2 (22.2%)	0.644
Lymphovascular invasion	6 (24%)	3 (33.3%)	0.670
Perineural invasion	3 (12%)	2 (22.2%)	0.591
Variant histology	8 (32%)	1 (11.1%)	0.386
Prostate stromal invasion	4 (16%)	0	0.554
Positive surgical margin	3 (12%)	1 (11.1%)	1.0
Pelvic LN metastasis	4 (16%)	3 (33.3%)	0.348

Values are n (%) or median (IQR).

Abbreviations: ICUD, intracorporeal urinary diversion; ECUD, extracorporeal urinary diversion; GFR, glomerular filtration rate; EBL, estimated blood loss; CIS, carcinoma in situ; LN, lymph node

TABLE 6. Subgroup postoperative outcomes by urinary diversion type.

Outcome	ICUD (n = 25)	ECUD (n = 9)	p-value
ICU admission, n (%)	9 (36%)	2 (22.2%)	0.682
ICU length of stay (days)	0 (0–0.5)	0 (0–1)	0.493
Length of hospital stay (days)	14 (11–23)	18 (17–19)	0.096
Time to first dietary intake (days)	**2 (2–3)**	**4 (4–6)**	**0.001**
30-day complications, n (%)	15 (60%)	7 (77.8%)	0.439
30-day readmission, n (%)	0	1 (11.1%)	0.265
Local recurrence, n (%)	6 (24%)	1 (11.1%)	0.644
Postoperative metastasis, n (%)	9 (36%)	2 (22.2%)	0.682
Death within 180 days, n (%)	0	1 (11.1%)	0.265

Values are n (%) or median (IQR).

Abbreviations: ICUD, intracorporeal urinary diversion; ECUD, extracorporeal urinary diversion

volume centers. Siriraj Hospital has accumulated extensive experience in minimally invasive radical cystectomy over the past two decades, beginning with the laparoscopic approach.[6,7] More recently, the introduction of the da Vinci Xi Surgical System has facilitated the transition to RARC, while the development of a Siriraj-derived prognostic nomogram has enabled more individualized risk stratification for patients undergoing radical cystectomy.[8]

In the present study, RARC performed at Siriraj Hospital was associated with favorable perioperative outcomes. The median operative time of 480 minutes and median EBL of 600 mL are comparable to those reported in published RARC series. Although the overall 30-day complication rate was 64.7%, most complications were minor and managed conservatively. The most common complications were postoperative ileus and urinary tract infection, both of which resolved with conservative management.

The evidence supporting RARC has been strengthened by two landmark randomized controlled trials. The iROC trial (Intracorporeal Robot-assisted Radical Cystectomy versus Open Radical Cystectomy), a phase III multicenter RCT conducted across nine NHS centers in the UK, enrolled 338 patients with nonmetastatic bladder cancer who were randomized to RARC with intracorporeal reconstruction or ORC. Patients undergoing RARC experienced significantly more days alive and out of hospital within 90 days of surgery than those undergoing ORC (median 82 vs. 80 days; adjusted difference 2.2 days; 95% CI 0.50–3.85; p = 0.01). In addition, the RARC group demonstrated lower rates of thromboembolic events (1.9% vs. 8.3%) and wound complications (5.6% vs. 16.0%), as well as improved quality-of-life outcomes at five weeks postoperatively.[2] Similarly, the RAZOR trial (Randomized Open vs. Robotic Cystectomy), a phase III non-inferiority RCT conducted across 15 academic centers in the United States, randomized 350 patients and demonstrated that 2-year progression-free survival following RARC was non-inferior to that following ORC (72.3% vs. 71.6%; difference 0.7%; 90% CI −8.5 to 9.9%), thereby establishing oncologic equivalence between the two approaches.[3] Together, these trials provide high-level evidence that RARC offers perioperative advantages compared with ORC without compromising cancer control.

Our findings should also be interpreted within the context of Siriraj Hospital's prior experience with laparoscopic radical cystectomy (LRC). A retrospective review of 57 patients who underwent LRC at Siriraj Hospital between 2005 and 2013 reported 5-year overall survival rates of 69.6% among patients with organ-confined disease and 72.4% among those who underwent extended pelvic lymph node dissection.[6] The subsequent transition from LRC to RARC has been supported by comparative studies demonstrating that RARC is associated with shorter hospital stays and comparable

perioperative complication rates relative to LRC.[4] In addition, the technical advantages of robotic platforms, including enhanced instrument dexterity, and three-dimensional visualization, are particularly beneficial during intracorporeal urinary reconstruction, which can be performed more efficiently reliably and reproducibly than with conventional laparoscopically.

In the present study, subgroup analysis demonstrated largely comparable perioperative outcomes between patients undergoing ICUD and ECUD. The only significant difference was a shorter time to first oral intake in the ICUD group (median 2 vs. 4 days; p = 0.001), suggesting faster recovery of bowel function. Despite this advantage, overall length of hospital stay did not differ significantly between groups. This finding is likely attributable to our institutional protocol of retaining patients until ureteral stent removal, which is typically performed on or after postoperative day 14. These findings are consistent with findings from the Asian RARC registry, a multicenter retrospective study of 556 patients that demonstrated lower EBL and a shorter hospital stay among patients undergoing ICUD compared to ECUD (15.7 vs. 17.8 days; p = 0.046).[5] Furthermore, the iROC trial, in which all patients undergoing RARC received intracorporeal reconstruction, provides additional evidence supporting the role of ICUD in facilitating faster recovery.[2]

This study builds on the growing body of institutional evidence from Siriraj Hospital. A recently published nomogram developed from a cohort of 304 patients who underwent radical cystectomy at Siriraj between 2012 and 2023 identified five independent predictors of overall survival — age, preoperative GFR, urinary diversion type, pathological N stage, and lymphovascular invasion. The model demonstrated strong predictive performance with an AUC of 86.6% at 12 months.[8] Collectively, these studies highlight the evolution of radical cystectomy practice at Siriraj, progressing from open surgery to laparoscopic and, more recently, to robotic-assisted approaches, with ongoing refinements in technique and outcomes.

To the best of our knowledge, this is the first publication of a national series on robotic radical cystectomy for MIBC, demonstrating both its feasibility and the evolution of this surgical technique within the Thai Urological Society.

Several limitations of this study should be acknowledged. First, the retrospective design and small sample size (n = 34) limit statistical power and increase susceptibility to selection bias and unmeasured confounding. Second, the ICUD and ECUD groups were small and differed significantly in ASA classification, which may have influenced subgroup comparisons. Third, the choice of urinary diversion approach was not randomized; therefore, differences between ICUD and ECUD may reflect patient selection, surgeon preference, operative considerations, or institutional practice rather than the diversion technique itself. The criteria used to select ICUD versus ECUD should therefore be explicitly documented from the institutional surgical records. Fourth, the learning curve associated with RARC and the operative volume of individual surgeons may have affected perioperative outcomes. Fifth, the 180-day follow-up is insufficient to assess long-term oncologic outcomes. Finally, the discrepancy between the aggregate recurrence/metastasis data in Table 4 and the subgroup counts in Table 6 requires resolution against the source dataset before publication. Future prospective studies with larger cohorts and longer follow-up are needed.

CONCLUSION

RARC was feasible in this single-center cohort, with a 30-day readmission rate of 2.9% and a 17.6% rate of Clavien-Dindo grade III–IV complications. ICUD was associated with a shorter time to first oral intake than ECUD, but no significant differences were observed in the other reported perioperative outcomes. Given the retrospective design, small sample size, imbalance between diversion groups, and limited follow-up, these findings should be considered descriptive and hypothesis-generating. Larger prospective studies are warranted to clarify the comparative effects of ICUD and ECUD and to assess long-term oncologic outcomes.

Data Availability Statement

The raw data used to support the findings of this study are available from the corresponding author upon request.

ACKNOWLEDGEMENTS

The authors would like to thank Ms. Jitsiri Chaiyatho and all coordinators of the Siriraj Hospital for their important contributions to this study.

DECLARATIONS

Grants and Funding Information

Not applicable.

Conflict of Interest

Not applicable.

Registration Number of Clinical Trial

Not applicable.

Author Contributions

Conceptualization and methodology, V.W. and P.B.; Investigation, P.B., S.J., T.H., K.J.; Formal analysis, P.B. and V.W.; Visualization and writing – original draft, P.B.; Writing – review and editing P.B. and V.W.; Funding acquisition, T.T., S.J.; Supervision, T.T All authors have read and agreed to the final version of the manuscript.

Institutional Review Board Statement

The study protocol was approved by the Institutional Review Board/Ethics Committee on Human Research, Faculty of Medicine, Siriraj Hospital (COA no. Si 395/2024).

Use of Artificial Intelligence

No artificial intelligence tools or technologies were used in the writing and analysis.

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