

## Laparoscopy/Robotics

# Initial Experiences with Robot-Assisted Laparoscopic Radical Cystectomy

Se-Yun Kwon, Bum Soo Kim, Tae-Hwan Kim, Eun Sang Yoo, Tae Gyun Kwon

Department of Urology, School of Medicine, Kyungpook National University, Daegu, Korea

**Purpose:** Robot-assisted laparoscopic radical cystectomy (RLRC) is a new option for the treatment of muscle-invasive bladder cancer, and case series for RLRC have been increasing recently. We report our operative technique and initial experiences with RLRC with extracorporeal urinary diversion.

**Materials and Methods:** Between October 2008 and November 2009, 17 consecutive patients with muscle-invasive bladder cancer underwent RLRC, pelvic lymph node dissection, and extracorporeal urinary diversion. Urinary diversion included 13 ileal conduits and 4 orthotopic neobladders (Studer method). Data were collected prospectively on patient demographics, intraoperative parameters, pathologic staging, and postoperative outcomes.

**Results:** The mean patient age was 63.7 years. The mean body mass index was 22.6 kg/m<sup>2</sup>. No patients had a history of previous abdominal surgery. The mean operative time was 379.1 minutes, including 32.6 minutes for pelvic lymph node dissection, 185.2 minutes for RLRC, and 159.4 minutes for urinary diversion. The mean estimated blood loss was 210.5 ml. The mean hospital stay was 20.7 days and the mean time to oral intake and ambulation was 5.0 and 1.3 days, respectively. There were no major perioperative complications. The pathologic reports showed urothelial cell carcinomas in all cases.

**Conclusions:** Our initial clinical experiences indicate that RLRC with pelvic lymph node dissection and extracorporeal urinary diversion is a safe and feasible procedure with minimal blood loss and rapid recovery. Long-term follow up in a larger patient population is needed to determine the true oncological and functional benefit of this procedure.

**Key Words:** Robotics; Urinary bladder neoplasms; Cystectomy

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### Corresponding Author:

Tae Gyun Kwon  
Department of Urology, School of  
Medicine, Kyungpook National  
University, 200, Dongduk-ro,  
Jung-gu, Daegu 700-721, Korea  
TEL: +82-53-420-5841  
FAX: +82-53-421-9618  
E-mail: tgkwon@knu.ac.kr

## INTRODUCTION

Open radical cystectomy (ORC) is currently regarded as the gold standard for the management of muscle-invasive bladder cancer, extensive uncontrollable non-muscle-invasive cancer, and refractory carcinoma in situ (CIS) [1,2]. Although recent development and refinement of surgical technique has improved postoperative patients' quality of life and has reduced complications, ORC is still associated with significant morbidity. Therefore, urologists have attempted various techniques to reduce the morbidity. Laparoscopic radical cystectomy (LRC) is one of the minimally invasive options, and some reports have shown that oncological outcomes were equivalent to ORC [3-5].

However, LRC does not yet have widespread use because

of the technical difficulty of the procedure and long operation time. With the recent development of the da Vinci<sup>®</sup> robot system, robot-associated laparoscopic surgery has been applied to radical cystectomy. Surgeons have begun to report small series of robot-assisted laparoscopic radical cystectomy (RLRC) [6-8]. These reports have demonstrated the surgical effectiveness of RLRC with advantages in blood loss, return of bowel function, and even hospital discharge [9,10]. However, a large case of prospective randomized trials has not been reported. In this study, we present the short-term clinical and oncologic outcomes of our 17 consecutive cases of RLRC with pelvic lymph node dissection and extracorporeal urinary diversion.

**MATERIALS AND METHODS**

Between October 2008 and November 2009, a total of 17 consecutive patients underwent RLRC using the da Vinci<sup>®</sup> robot system (Intuitive Surgical, Sunnyvale, USA) with four robot arms by a single surgeon. The patients included 5 women and 12 men with a mean age of 63.7 years (range, 48-74 years). According to American Society of Anesthesiologists (ASA) risk classification, 10 were ASA score I and 7 were ASA score II. Mean body mass index (BMI) was 22.6 kg/m<sup>2</sup> (range, 18.3-26.5 kg/m<sup>2</sup>) (Table 1).

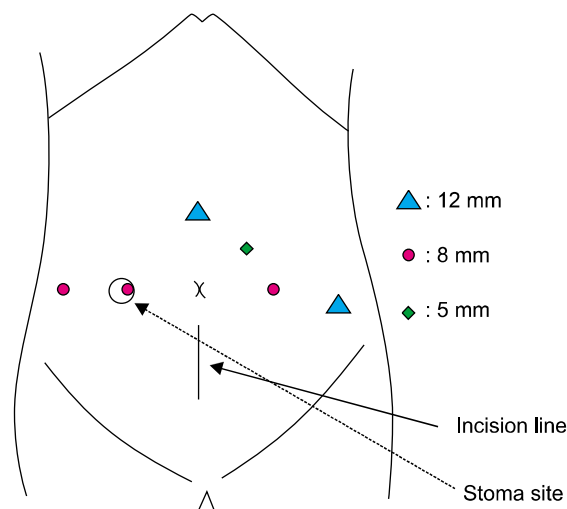
All patients requiring cystectomy were offered the robot-assisted operation if they met the inclusion criteria. These consisted of patients with radiologically localized disease, no history of previous major lower abdominal pelvic surgery, no previous pelvic radiation, and ability to tolerate a steep Trendelenburg position at the anesthetic assessment.

All patients received mechanical bowel preparation (using an osmotic laxative) 2 days prior to surgery and a phosphate enema 8 hours prior to surgery. Intravenous antibiotics were administered at the induction of general anesthesia. An elastic stocking was used for prophylaxis of deep vein thrombosis.

Surgical techniques were as follows. Patients were placed in the extended lithotomy with 30° Trendelenburg position. A six-port transperitoneal approach was used. The 12 mm camera port was inserted in the midline 5 cm above the upper umbilical margin and two 8 mm robotic ports were placed 8 cm away from the umbilicus, along the line from the umbilicus to the anterior spine of the iliac crest (ASIC) bilaterally. An additional 8 mm robotic port for the fourth arm was placed 8 cm directly lateral from the right-sided robotic port. A 12 mm assistant port for retraction and stapling was placed 8 cm lateral from the left-side robotic port. A further 5 mm assistant port for suction and irrigation was placed on the left side between the camera port and the left robotic arm port (Fig. 1). After docking of the robotic system, radical cystectomy was performed by the same process as standard LRC. Standard pelvic lymphadenectomies (both obturator, external iliac) were performed in all patients.

All patients underwent extracorporeal urinary diversions (13 ileal conduits and 4 orthotopic neobladders by Studer method) and 5-7 cm lower midline incisions were made for specimen removal and urinary diversion. In case of an ileal conduit, uretero-ileal anastomosis was performed over 6 Fr double J stents by using 4-0 PDS suture, and the distal end of the conduit was fashioned as a stoma at the right robot arm port site. All orthotopic neobladder was performed by using the Studer method and ureteral stents were used and brought out anteriorly through separate stab wounds. Urethro-enteric anastomosis was then performed intracorporeally after redocking the robotic system (Fig. 2). A Jackson-Pratt drain was placed in the pelvic cavity and around the uretero-enteric anastomosis site, respectively. The nasogastric tube was removed 4 days after surgery and oral liquids were started as tolerated. The drain and ureteral stents were removed at 2-3 weeks after surgery.

Patients were reviewed at 4 weeks and checked by a renal

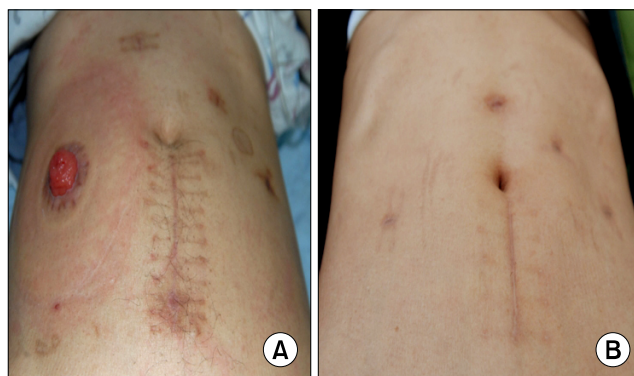


**FIG. 1.** Port placement of robot-assisted laparoscopic radical cystectomy.

**TABLE 1.** Baseline characteristics of the patients

	Total patients
Age (years)	63.7
Sex (male/female)	12/5
Body mass index (kg/m <sup>2</sup> )	22.6
Clinical stage	3 (18)
T1 & CIS (%)	1 (5)
T2 (%)	13 (76)
≥T3 (%)	1.4
ASA score	

CIS: carcinoma in situ, ASA: American Society of Anesthesiologists



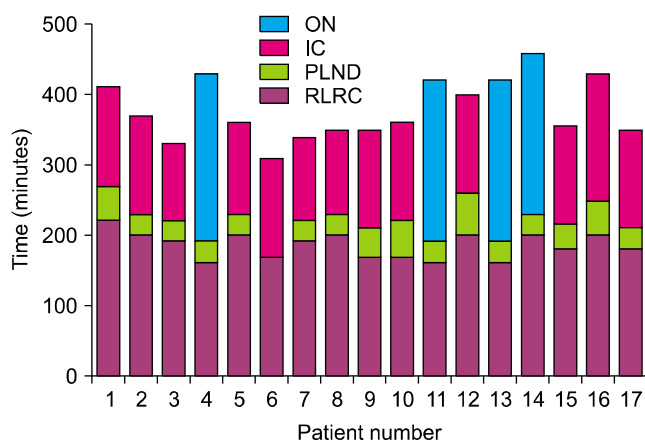
**FIG. 2.** Postoperative surgical wound of robot-assisted laparoscopic radical cystectomy with ileal conduit (A) and orthotopic neobladder (B).

ultrasound at 2 weeks after stent removal, by computed tomography scans at 3 and 6 months postoperatively, and then at 6-month intervals. At these visits, they had a clinical examination, assessment of hemoglobin, electrolytes, creatinine, chloride, bicarbonate, and urethral washing cytology.

## RESULTS

The mean total operative time was 379.1 minutes (range, 330-460 minutes), including 32.6 minutes for pelvic lymph node dissection, 185.2 minutes for RLRC, and 159.4 minutes for urinary diversion. All patients underwent extracorporeal urinary diversions (13 ileal conduits and 4 orthotopic neobladders by the Studer method), and there were no patients who underwent urethrectomy. The mean operative time for the ileal conduit (IC) group was significantly shorter than that for the orthotopic neobladder (ON) group (371.0 minutes vs. 442.5 minutes,  $p=0.010$ ). The detailed operative time of each patient is shown in Fig. 3. No intraoperative complications occurred.

The mean estimated blood loss was 215.3 ml (range, 120-400 ml) for the IC group and 195.0 ml (range, 180-200 ml) for the ON group ( $p=0.871$ ). The overall perioperative transfusion rate for RLRC was 35.2% (6/17). The time to oral intake and time to ambulation were 5.0 days (range, 4-8 days) and 1.3 days (range, 1-3 days), respectively. Mean hospital stay was 20.7 days (range, 11-41 days), including 18.2 days (range, 11-41 days) for the IC group and 27.5 days (range, 17-40 days) for the ON group ( $p=0.245$ ). The time to oral intake (5.1 vs. 4.5 days) and time to ambulation (1.4 vs. 1.0 day) were similar between the groups ( $p > 0.05$ ). Perioperative complications occurred in 4 patients (23.5%), including 1 ileus, 1 acute renal failure, 1 acute pyelonephritis, and 1 urinary leakage. Every complication was successfully managed conservatively (Table 2). There were no significant differences in perioperative outcomes between the male and female groups (Table 3).



**FIG. 3.** Detailed operative time of each patient. ON: orthotopic neobladder, IC: ileal conduit, PLND: pelvic lymph node dissection, RLRC: robot-assisted laparoscopic radical cystectomy.

The pathologic reports showed urothelial cell carcinomas in all cases, and the pathologic stages were 1 TisN0M0, 5 T1N0M0, 1 T1N1M0, 3 T2N0M0, 5 T3N0M0, and 2 T4N0M0. The average number of retrieved lymph nodes was 5.9 (range, 0-18). One patient had lymph node metastasis and 1 of 3 nodes was involved by the tumor. This patient received 3 cycles of adjuvant gemcitabine/cisplatin chemotherapy. No patient had a positive surgical resection margin. The mean follow-up period for RLRC was 8.3 months (range, 3-19 months), and there was no local recurrence or distant metastasis during the follow-up period.

## DISCUSSION

RLRC is in evolution and is a procedure that can combine the minimally invasive advantages of LRC with the technical advantages of robotics. Apart from superior visualization and articulated instrumentation, the improved ergonomic position offered at the robotic console benefits the surgeon during prolonged procedures [11]. In 2003, Menon et al first reported the feasibility of RLRC using the da Vinci<sup>®</sup> surgical system [10]. The operative time ranged from 260 to 308 minutes depending on whether an ileal conduit or orthotopic neobladder was performed. Blood loss was less than 150 ml and surgical margins were clear in all cases. Guru et al reported their experience with RLRC and extracorporeal urinary diversion in 20 patients [9]. The mean total operative time was 442 minutes, including

**TABLE 2.** Comparison of perioperative surgical outcomes between the ileal conduit group the orthotopic neobladder group

	IC	ON	p-value
Mean operative time	371.0	442.5	0.010
Urinary diversion time	137.1	232.5	0.002
Estimate blood loss (ml)	215.3	195.0	0.871
Time to oral intake (days)	5.1	4.5	0.477
Time to ambulation (days)	1.4	1.0	0.296
Postoperative hospital stay (days)	18.2	27.5	0.245
Complication (%) <sup>a</sup>	2 (15)	2 (50)	—
Acute renal failure	1	0	—
Acute pyelonephritis	0	1	—
Ileus	1	0	—
Urine leakage	0	1	—

IC: ileal conduit, ON: orthotopic neobladder, <sup>a</sup>: all complication was successfully managed conservatively

**TABLE 3.** Comparison of perioperative surgical outcomes between male and female patients

	Male	Female	p-value
Mean operative time	387.0	360.0	0.383
Estimate blood loss (ml)	210.8	210.0	0.552
Time to oral intake (days)	5.0	5.0	0.524
Time to ambulation (days)	1.25	1.6	0.241
Postoperative hospital stay (days)	20.1	22.2	0.428

133 minutes for urinary diversion. The mean hospital stay was 10 days and the time to return to strenuous activity was 10 weeks. Rhee et al compared 23 ORC with 7 RLRC cases and found that although blood loss was lower for RLRC, 4 of 7 patients needed transfusion [12]. The operative time was 638 minutes for RLRC compared with 507 minutes for ORC and hospital stay was 11 and 13 days, respectively. Pruthi and Wallen also compared 20 men undergoing RLRC and extracorporeal urinary diversion with 24 matched men who underwent ORC [13]. The mean operative time for RLRC was 6.1 hours as opposed to 3.8 hours for ORC. The mean blood loss was significantly less for RLRC. There were no positive surgical margins. A mean of 19 lymph nodes were removed. Mean time to flatus and bowel movement was significantly shorter than in men undergoing ORC. There were six postoperative complications (30%) in five patients, including one rectal injury (repaired intraoperatively), one postoperative hemorrhage requiring laparotomy, and one parastomal hernia requiring repair.

In our initial experiences, the mean total operative time was 379.1 minutes (range, 330-460 minutes), including 32.6 minutes for pelvic lymph node dissection, 185.2 minutes for RLRC, and 159.4 minutes for urinary diversion. These results were relative longer than that of ORC, which was reported in another study [1]. However, mean estimated blood loss was acceptable (210.5 ml) and diet was usually resumed on postoperative day 4 or 5. The complication rate of our series (23.5%) was similar to other reports. These results might be due to lower intraoperative bleeding and minimal bowel exposure and manipulation. Moreover, shorter surgical wounds and less postoperative pain can be advantages of RLRC.

Although RLRC with complete intracorporeal urinary diversion has been reported [14,15], long operating times have prevented widespread adoption of this approach, and most units prefer an extracorporeal approach for urinary diversion [5,16]. We also performed extracorporeal urinary diversion in all cases to reduce operative time, but in case of orthotopic neobladder, urethro-ileal anastomosis was performed intracorporeally using a robotic system for the surgeon's convenience.

The obvious goal of RLRC must be to maintain the oncologic standards of ORC while reducing the associated morbidity. It is not clear whether pneumoperitoneum has an effect on the spread or recurrence of urothelial cell carcinoma in the medium to long term. It is interesting to note a report of port-site metastasis following RLRC for a pT3bG3 urothelial cell carcinoma of the bladder [17]. It is hoped that this outcome will be a very rare phenomenon, which it appears to be with other types of laparoscopic surgery [18].

Although several studies have reported encouraging short-term oncologic outcomes of RLRC and our perioperative outcomes of RLRC were comparable to ORC, the ultimate oncologic safety of RLRC is not yet clear. To adequately evaluate and validate this procedure, a random-

ized prospective trial is needed to compare ORC, LRC, and RLRC in terms of operative, oncological, and functional outcomes. Moreover, the feasibility of performing RLRC cannot be separated from the costs of developing new surgical methods in the current economic environment. Therefore, the cost/benefit ratio will require continuous review.

## CONCLUSIONS

Although RLRC still has concerns about long operative time and high cost, and long-term follow-up is needed to establish oncologic equivalence with ORC, robot-assisted surgery may provide benefits to patients including minimal blood loss, rapid recovery, and smaller surgical wounds. Our initial clinical experience indicates that RLRC is a safe and feasible procedure that may be an alternative to the open technique.

## Conflicts of Interest

The authors have nothing to disclose.

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