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Review Article: Special Contribution

Current Status of Robot-Assisted Radical Cystectomy: What is the Real Benefit?

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ABSTRACT

In recent years, robot-assisted radical cystectomy has received attention worldwide as a useful procedure that helps to overcome the limitations of open radical cystectomy. We compared the surgical technique, perioperative and oncological outcomes, and learning curve of robot-assisted radical cystectomy with those of open radical cystectomy. The indications for robot-assisted radical cystectomy are identical to those of open radical cystectomy. Relative contraindications are due to patient positioning in the Trendelenburg position for long periods. Urinary diversion is performed either extracorporeally with a small skin incision or intracorporeally with a totally robotic-assisted maneuver. Accordingly, robot-assisted radical cystectomy can be performed safely with an acceptable operative time, little blood loss, and low transfusion rates. The lymph node yield and positive surgical margin rate were not significantly different between robot-assisted radical cystectomy and open radical cystectomy. The survival rates after robot-assisted radical cystectomy are estimated to be similar to that after open radical cystectomy. However, the recurrence pattern is different between robot-assisted radical cystectomy and open radical cystectomy, i.e., extrapelvic lymph node recurrence and peritoneal carcinomatosis were more frequently found in patients who underwent robot-assisted radical cystectomy than in those who underwent open radical cystectomy. Further validation is necessary to prove the feasibility of oncological control. A steep learning curve is one of the benefits of the new technique. The experience of only 50 robot-assisted radical prostatectomies is a minimum requirement for performing feasible robot-assisted radical cystectomy, and surgeons who have performed only 30 surgeries can reach an acceptable level of quality for robot-assisted radical cystectomy.

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Abbreviations: CSS, cancer specific survival; DFS, disease-free survival; ECUD, extracorporeal urinary diversion; ICUD, intracorporeal urinary diversion; ORC, open radical cystectomy; OS, overall survival; PLND, pelvic lymph node dissection; PSM, positive surgical margin; RARC, robot-assisted radical cystectomy; RARP, robot-assisted radical prostatectomy

Key words bladder cancer; complication; oncological outcome; robot-assisted radical cystectomy; urinary diversion

The gold standard treatment for patients with muscle-invasive and high-risk superficial bladder cancer is open radical cystectomy (ORC) with pelvic lymph node dissection (PLND).[1] However, ORC is a challenging procedure requiring not only high-quality cancer control but also functional preservation, for which urinary diversion using the intestinal tract is performed. Moreover, perioperative morbidity of ORC is not always low, even when performed by an experienced surgeon, while considering the high probability of blood transfusion owing to extensive intraoperative bleeding, postoperative wound pain resulting from a longer skin incision, postoperative ileus caused by prolonged open abdominal surgery and excessive handling of the intestinal tract, and longer hospitalization resulting from a delay in the recovery of general health.[2] Therefore, some patients cannot undergo ORC owing to advanced age, performance status, and the presence of multiple comorbidities, and so on.

Since the first report of robot-assisted radical cystectomy (RARC) by Menon et al.[3] in 2003, many studies have documented that RARC is less-invasive and equivalent in oncologic efficacy compared to ORC. In recent years, RARC has received attention worldwide as a useful procedure that helps to overcome the limitations of ORC.[4] In the United States, the proportion of RARC being performed has increased steadily over the years, from 0.6% in 2004 to 12.8% in 2010.[5] Owing to increasing use of RARC, we compared the surgical technique, perioperative and oncological outcomes, and learning curve of RARC with those of ORC.

SURGICAL TECHNIQUE

Patient selection

The indications for RARC are identical to those of ORC. There are no absolute contraindications for RARC. However, we should take care not to injure the rectum in patients with a history of extensive pelvic surgery and radiation. Relative contraindications come from patient positioning in the Trendelenburg position over long period. We should carefully select patients with angle

closure glaucoma, intracranial aneurysm, severe mitral valve insufficiency, and severe pulmonary dysfunction.

Positioning and port placement

The patient is placed in the Trendelenburg position with the head placed at angle of approximately 20–25°. The angle in RARC is less steep than that in robot-assisted radical prostatectomy (RARP). Except for the angle, the patient positioning is almost the same as in RARP. Port placement is also similar to that of RARP. Fig. 1 shows the configuration used in Tottori University. The camera port is placed at the midline, i.e., 18 cm from the pubic symphysis, which is 2–3 cm higher than that in RARP. Besides the configuration in RARP, a second assistant 12 mm port is added 7 cm above from the midpoint between the camera and the left robotic port.

Technique for cystectomy

If necessary, the urethra was detached via the perineal approach to the genitourinary diaphragm before a console maneuver. Our RARC procedure is summarized as follows; i) detachment of the ureters; ii) dissection of the posterior surface of the bladder; iii) dissection of the lateral surface of the bladder; iv) cutting of the vascular pedicle of the bladder and ureters; v) dissection of the posterior surface of the prostate by making an incision of the Denonvilliers' fascia; vi) dissection of the anterior surface of the bladder and prostate, by cutting the dorsal vein complex and vii) extraction of the urethra inside the pelvis.

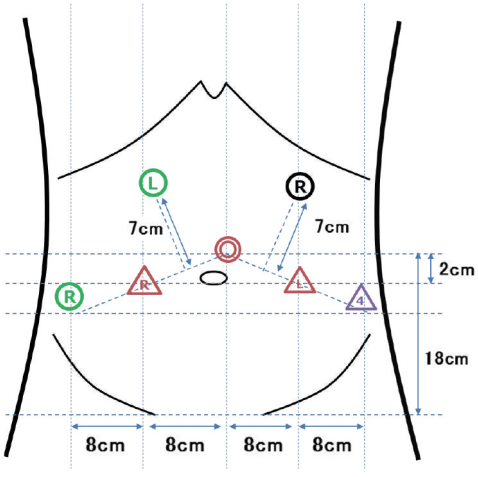

Fig. 1. Port position.
: Camera port (12mm)
: Robot right arm (8mm)
: Robot left arm (8mm)
: Robot 4th arm (8mm)
: 1st assistant right arm (12mm)
: 1st assistant left arm (12mm)
: 2nd assistant (12mm)

Technique for PLND

The area for performing PLND includes the external, internal, common iliac, and obturator lymph nodes.[6] Although there are some debates whether to perform PLND before or after cystectomy, the surgical principle is more critical than the order. The obliterated umbilical artery provides a very useful landmark and the proximal limit is cautiously decided with good vision.[7]

Urinary diversion

Urinary diversion is performed either extracorporeally with a small skin incision or intracorporeally with a totally robotic-assisted maneuver.

In extracorporeal urinary diversion (ECUD),[8] subumbilical (separate from the camera port) or periumbilical (camera port) midline incision is used for extraction of the specimen and subsequent manipulations. Most surgeons prefer a 5–7 cm long subumbilical midline incision with a wound retractor that provides the best access to the ureters and the distal ileum. Care is taken to isolate the ileum for urinary diversion and to perform ureteral anastomosis especially in obese patients and in whom the ureters need to be resected more proximally. We usually perform urethro-neovesical anastomosis robotically after pouch formation completion and ureteral anastomosis.

In intracorporeal urinary diversion (ICUD), bowel division and anastomosis is completely performed robotically. Some procedures of intracorporeal neobladder include those by Guru,[9] Jonsson,[10] Gill[11] and so on. To improve efficiency of pouch formation, several robotic modifications have been used. One modification is using a shorter bowel and another is when to perform urethroileal anastomosis, i.e., before or after pouch formation completion. The masterpiece of intracorporeal orthotopic ileal neobladder is described by Gill et al.[11] as follows: i) 60 cm distal ileum isolation (44 cm for the pouch, 16 cm for the chimney); ii) detubularization of the ileum and completion of the posterior plate; iii) 90° counterclockwise rotation and the urethroileal anastomosis; iv) anterior pouch closure and v) bilateral ureteroileal anastomosis to the chimney by using the Bricker technique with a ureteral stent.

Perioperative outcomes

Novara et al.[12] performed a systematic review and cumulative analysis of perioperative outcomes and complications of RARC in compared to ORC. They showed statistically significant differences in the operative time ($P < 0.00001$ in favor of ORC), blood loss ($P < 0.00001$ in favor of RARC), transfusion ($P < 0.00001$ in favor of RARC), and in-hospital stay ($P = 0.003$ in favor of RARC), whereas the intraoperative complication rate was similar. Among postoperative complication, the rates for any grade of complications at 90 days ($P < 0.0001$) and for grade 3 complications at 90 days ($P = 0.04$) were in favor of RARC. However, the rates of any grade complications at 30 days ($P = 0.09$) and grade 3 complications at 30 days ($P = 0.14$) as well as the 30-day ($P = 0.18$) and 90-day ($P = 0.23$) mortality rates were similar for RARC and ORC. Thus, RARC can be performed safely with an acceptable operative time, little blood loss, and low transfusion rates. Although the risk of intraoperative complication is low, postoperative complication and readmission after discharge are common.

ONCOLOGICAL OUTCOME

Lymphnode yields

Abaza et al.[7] showed that similar template technique to open could be performed, i.e., external iliac, internal iliac, common iliac, obturator, and presacral to aortic bifurcation. The mean lymph node yield was 37.5. Davis et al.[13] reported that he removed only an additional 4 lymph nodes with the open approach after 43 lymph nodes were removed robotically. The robotic procedure is technically safe and feasible because vascular injuries were rare and the lymphocele rates were 0–9%. Yuh et al.[14] showed that there was no significant difference in the lymph node yield between RARC and ORC while considering standard, extended, and total cases, ($P = 0.20$, 0.26 and 0.07, respectively).

Positive surgical margin rate

The overall positive surgical margin (PSM) rate was 0–26% (mean, 5.6%).[15, 16] According to the pathological stage, the PSM rate was 1–1.5% in pT2 and 0–25% in pT3 or higher disease. Cumulative analysis showed no significant difference between RARC and ORC (5% vs. 7%, $P = 0.13$).

Survival and recurrence

Recently, a few reports[17–19] showed the 5-year survival rates as an outcome was similar between RARC and ORC. At 1, 3 and 5 years, disease-free survival (DFS) was 79–96%, 67–76%, and 53–74%, respectively; cancer specific survival (CSS) was 88–94%, 68–83%, and 66–80%, respectively; and overall survival (OS) was 82–90%, 61–80%, and 39–66%, respectively.[14] Table 1 shows the oncologic outcomes followed more than 3 years after surgery. Accordingly, the survival rates of RARC are similar to that of ORC. Nguyen et al.[20] reported notable differences between RARC and ORC considering the recurrence pattern. Within 2 years after surgery, there was no major difference in the local recurrence (18% vs. 23%) and distant metastasis (29% vs. 36%) between RARC and ORC. On multivariate analysis, RARC was not a predictor of recurrence. However, there were distinct different patterns of distant metastasis. Extrapelvic lymph node recurrence (23% vs. 15%) and peritoneal carcinomatosis (21% vs. 8%) were more frequently found in patients who underwent RARC than in those who underwent ORC. As the numbers of patients was small, further validation is necessary to prove the feasibility of oncological control.

LEARNING CURVE

A steep learning curve is one of the benefits of a new technique. Hayn et al.[21] examined whether the number of previous RARP performed by surgeons affected the outcomes of RARC. In surgeons who had performed less than 50 RARP, the operative time was longer, blood

Table 1. Oncologic outcomes followed more than 3 years after surgery

Reference	Cases, no.	Study design	Follow-up, mo	Neoadj. chem, %	Adj. chem, %	DFS, %			CSS, %			OS, %		
						1y	3y	5y	1y	3y	5y	1y	3y	5y
Mmeje et al, 2013	50	Multi-institutional	41.5	12	46		43	39					55	45
Khan et al, 2013	14	Prospective	84	28	14		50			75			64	
Snow-Lisy et al, 2014	17	Retrospective	67								69			39
Xylinas et al, 2013	175	Retrospective	37		19		67	63		68	66			
Raza et al, 2014	99	Retrospective	73.9	6	29			53			68			42
Yuh et al, 2014	162	Retrospective	52	23			76	74		83	80		61	54

Adj. chem, adjuvant chemotherapy; CSS, cancer specific survival; DFS, disease-free survival; mo, month; Neoadj. chem, neoadjuvant chemotherapy; no., number; OS, overall survival; y, year.

loss was more, and lymph node yield was lesser compared to those who had performed more than 50 RARP. Therefore, the experience of only 50 RARP is a minimum requirement for performing RARC of a certain quality. Hayn et al.[22] also demonstrated the actual learning curve for RARC in another study. It was estimated that 21 patients were required for the operative time to reach 6.5 h, 30 patients for a lymph node yield of 20, 30 patients for the PSM rate to be less than 5%, and 24 patients for the PSM rate to be less than 15% in pathologic T3–4 patients. However, the mean estimated blood loss was only 408 ml, and the learning curve was nearly flat. The study demonstrated an acceptable level of proficiency by only the 30th case for proxy measures of RARC quality.

CONCLUSIONS

Remarkable progress has been made in RARC with PLND and urinary diversion. RARC can be safely performed by a surgeon who has performed more than 50 RARP. However, recent data showed different oncological outcomes considering the different recurrence patterns from ORC. Further studies about the outcomes considering the recurrence patterns and long-term survival data are required.

The author declares no conflict of interest.

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