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Original Article: Clinical Investigation

Laparoscopic versus open radical cystectomy in 607 patients with bladder cancer: Comparative survival analysis

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Abbreviations & Acronyms
AC = adjuvant chemotherapy
ASA = American Society of Anesthesiologists
CSS = cancer-specific survival
EBL = estimated blood loss
LRC = laparoscopic radical cystectomy
MIBC = muscle-invasive bladder cancer
NAC = neoadjuvant chemotherapy
NMIBC = non-muscle-invasive bladder cancer
ORC = open radical cystectomy
OS = overall survival
PFS = progression-free survival
PLND = pelvic lymph node dissection
PSM = propensity score matching
RCT = randomized controlled trial

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Objectives: To compare perioperative and oncologic survival outcomes between laparoscopic radical cystectomy and open radical cystectomy.

Methods: A total of 607 patients underwent open radical cystectomy (n = 412) or laparoscopic radical cystectomy (n = 195) at a single academic institution from January 2006 to April 2017. Their medical records were retrospectively analyzed. One-to-one propensity score matching was carried out to reduce selection bias. Estimated blood loss and complications were compared. Overall survival, cancer-specific survival and progression-free survival estimates for all patients and patients with locally advanced bladder cancer were analyzed using the Kaplan–Meier method.

Results: Either before or after matching, the laparoscopic radical cystectomy group had less estimated blood loss ($P < 0.001$ and $P < 0.001$) and fewer complications ($P < 0.001$ and $P = 0.008$). There was no difference in the overall survival ($P = 0.216$ and $P = 0.961$) and progression-free survival ($P = 0.826$ and $P = 0.462$) for all the patients having either laparoscopic radical cystectomy or open radical cystectomy. However, the 5-year progression-free survival of open radical cystectomy was higher than that of laparoscopic radical cystectomy ($P = 0.019$ and $P = 0.021$) for patients with locally advanced bladder cancer.

Conclusions: Laparoscopic radical cystectomy is superior to open radical cystectomy in terms of perioperative outcomes, and similar to open radical cystectomy in terms of oncologic outcomes for patients with early stage bladder cancer. However, for patients with locally advanced bladder cancer, laparoscopic radical cystectomy seems to be associated with shorter progression-free survival than open radical cystectomy.

Key words: bladder cancer, laparoscopic radical cystectomy, open radical cystectomy, propensity score matching, survival outcomes.

Introduction

Globally, bladder urothelial carcinoma is the ninth most common form of cancer,[1] and the fourth most common cancer for men.[2] Radical cystectomy is the standard treatment for locally MIBC and recurrent high-grade NMIBC.[3] Although ORC remains the gold standard for treatment of bladder cancer, the advancements in surgical equipment and improvement of surgical techniques have increased the interests for minimally invasive surgery. LRC is one such minimally invasive technique considered to have a longer operative time, less blood loss, fewer perioperative complications and a shorter length of hospital stay.[4] Based on past retrospective studies[5–8] and a RCT study,[9] similar OS, CSS or PFS have been reported. However, previous non-randomized studies showed certain selection bias, with younger age, better physical conditions and earlier stage in the LRC groups; and in the RCT study, the enrolled cases were clinically highly selected, which were poor representative.[9] In addition, due to limited sample sizes in previous studies, no reported study focused on the oncologic outcomes of different stage patients receiving LRC and ORC.

The current study was a retrospective analysis with the largest sample size and long follow-up time. This allowed for the comparison of oncologic outcomes in patients with different stages of bladder cancer who underwent LRC or ORC.

Methods

Patient population

The present study was approved by the clinical research ethics committee of Peking University First Hospital, Beijing, China (protocol number: 2015[977]). Between January 2006 and April 2017, 1026 consecutive patients with urothelial carcinoma of bladder who received LRC or ORC at Peking University First Hospital were enrolled in the present study. Out of these, 23 patients suffered from distant metastasis, 164 patients did not receive PLND, 227 patients were lost during follow up and five patients without complete survival information were excluded. Finally, out of 607 patients, 412 ORC and 195 LRC were considered for the current study (Fig. 1). The indications for radical cystectomy were similar to those reported in our previous study:[10] T2-4aN0M0 tumor, high risk and recurrent NMIBC and Bacillus Calmette–Guérin-resistant Tis, as well as an extensive papillary disease that could not be controlled with transurethral resection of bladder tumor and intravesical therapy alone. All patients were diagnosed using imaging and pathological examination. Patients with cT2-4aN0-xM0 tumor were recommended for NAC, whereas AC was recommended for patients with pT3/4 or pN+ disease if no NAC had been given.[3] The use of chemotherapy increased steadily during the study period, especially in our final cohort. The rate of NAC/AC administered increased from 18.4% in 2006–2011 to 21.4% in 2012–2017.

Surgical technique

The surgical procedure was as described in the previous studies.[11,12] In the present study, all patients who underwent radical cystectomy were operated by professional urological team. The decisions of the operative method of LRC and ORC depended on the patients' condition and the surgeon's habits. Radical cystectomy included en-bloc resection of the bladder and bilateral PLND, which involved the removal of internal iliac, presacral, obturator and external iliac lymph nodes. After radical cystectomy, extracorporeal urinary diversion including ureterocutaneostomy, ileal conduit or orthotopic neobladder were carried out. The decisions of type of urinary diversion were based on the tumor stage and physical condition of patients, which were arrived at after adequate discussions of the doctors with patients, but orthotopic neobladder would be excluded when the urethral invasion was suspected.

Outcomes measures

Perioperative clinical and pathological data

Time of operation, EBL, postoperative length of stay and complication rate were compared between the two groups. All surgical complications occurring within 30 days were classified according to the Clavien–Dindo classification system.[13] Pathological data included the histological type, the extent of tumor, surgical margin status, lymph node yield and number of the positive lymph nodes. Locally advanced bladder cancer was characterized either as pT4 or pN+. The TNM staging system of bladder cancer of the American Joint Committee on Cancer Staging Manual 8th edition was used in the present study.[14]

Oncologic outcomes

Individual postoperative follow-up plans were carried out for all patients through outpatient visits. The history, physical examination, laboratory measurements of blood and urine, as well as a computed tomography scan were carried out every 6 months until the third year and annually thereafter. The survival status of all the patients was updated through a telephone follow up in August 2017.

Statistical analysis

The two study groups were categorized based on two different surgical techniques – LRC and ORC. The normality of continuous variables was tested using the Kolmogorov–Smirnov test. The variables following normal distribution were analyzed by using the independent samples *t*-test, and the Mann–Whitney *U*-test was used to compare the variables that did not follow a normal distribution. Disordered categorical variables were analyzed by using the χ^2-test or Fisher's exact test, and the Mann–Whitney *U*-test was carried out to analyze

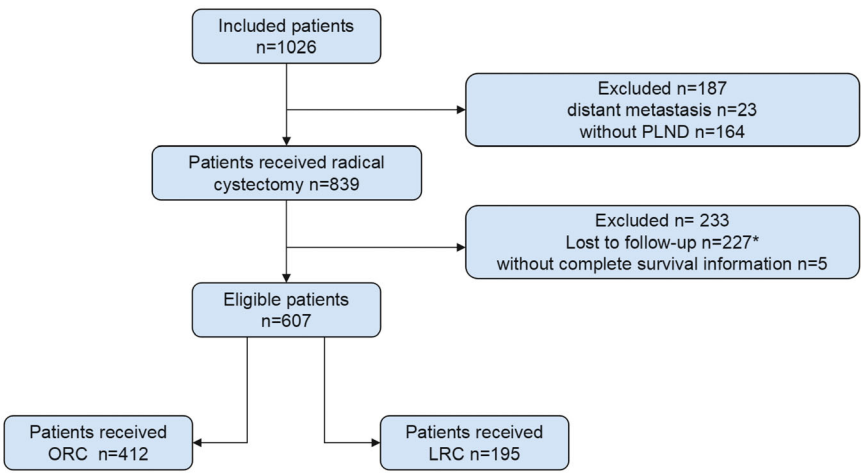

Fig. 1 Flowchart of all eligible patients. *The patients who were lost to follow up were from other cities, and they did not choose to be followed up in our institution, so no follow-up data were available.

the ordered categorical variables. For the purpose of reducing selection bias, a one-to-one matching of propensity scores was carried out.[15] For the propensity score estimation, a logistic regression model based on the following factors was used: operation date, age, ASA score, type of urinary diversion, pathological T stage and pathological nodal stage. The caliper of PSM was 0.05. All clinical characteristics were compared before matching and after matching. Kaplan–Meier curves were used to determine the probability of the OS, CSS and PFS among the patients before matching and after matching. At the same time, log-rank tests were used to explore differences in survival across different pathological T stage and lymph node involvement. In addition, the OS, CSS and PFS of patients with locally advanced tumors pT4 or pN+ were analyzed by using Kaplan–Meier curves. Finally, the multivariable Cox regression analysis of patients with locally advanced tumors was used to test the effect of surgical technique (ORC or LRC) on the risk of progression, we adjusted the matching factors age, operation date, ASA and urinary diversion in PSM, and the factors grade, surgical margin and chemotherapy, which could affect the PFS. All *P*-values were two-sided, and $P < 0.05$ was considered to be statistically significant. All the analysis was carried out using IBM SPSS version 24 (IBM Corporation, Armonk, NY, USA).

Results

During the period of study, a total of 607 patients with urothelial carcinoma of the bladder were enrolled, 412 of the patients received ORC, whereas the remaining patients underwent LRC. After PSM, 316 patients (158 ORC and 158 LRC) were successfully matched. The median follow-up period was 52 months (interquartile range 29–78).

Perioperative and pathological outcomes

The results of the perioperative outcomes are presented in Table 1. Before the matching, the patients in the LRC group were younger ($P = 0.004$), had a lower ASA score ($P = 0.007$) and lower pathological T stage ($P = 0.047$), and received less ureterocutaneostomy ($P < 0.001$), and whose operation date was later ($P < 0.001$) compared with the ORC group. After matching, the two groups had no significant difference in terms of operation date, age, ASA score, type of urinary diversion and pathological T stage. Before and after matching, the LRC group had lower EBL ($P < 0.001$ and $P < 0.001$) and fewer perioperative complications ($P < 0.001$ and $P = 0.008$). However, there was no significant difference in the time of operation between the two groups. Before matching, the postoperative stay of LRC was shorter than ORC ($P = 0.002$), but there was no statistical difference after matching.

With regard to the pathological outcomes, there was no significant difference when comparing pathological nodal stage and pathological grade, although the ORC group had a higher pathological T stage before matching. There was also no significant difference in the number of lymph node yields and positive margins, before and after matching.

Oncologic outcomes

Kaplan–Meier curves before matching are shown in Figure 2. There was no significant difference in the OS probability ($P = 0.216$), CSS probability ($P = 0.619$) and PFS probability ($P = 0.826$) between the LRC group and ORC group. After matching, the OS probability ($P = 0.961$), CSS probability ($P = 0.790$) and PFS probability ($P = 0.462$) were also similar between the two groups (Fig. 3).

Before matching, Kaplan–Meier curves for different pathological T stage and pathological nodal stage were carried out, as shown in Figures S1 and S2. For patients with T4 ($P = 0.230$) or N+ ($P = 0.062$) disease, the PFS of ORC was higher than that of LRC, but there was no statistical difference. After matching, for patients with T4 disease, the PFS of ORC was higher compared with LRC, but there was no statistical difference. For patients with N+ disease, PFS of ORC was higher than LRC, and there was a statistical difference ($P = 0.044$), and the 5-year PFS was 0.532 versus 0.233.

The oncologic outcomes of patients with locally advanced disease pT4 or pN+ were analyzed, and the PSM was used to reduce the selection bias; the clinicopathological characteristics of the patients with locally advanced bladder cancer before matching and after matching are shown in Table S1. Before matching shown in Figure 4, 98 patients received ORC and 46 patients received LRC. There was no significant difference in the OS probability ($P = 0.850$) and CSS probability ($P = 0.496$); however, the PFS of ORC was higher than LRC ($P = 0.019$). In addition, the sites of progression are shown in Table S2. The rate of local recurrence of the LRC group was higher than the ORC group (42.3% *vs* 27.3%), but there was no statistical difference. After matching shown in Figure 5, 35 patients received ORC and 35 patients received LRC, and there was no significant difference in the OS probability ($P = 0.397$) and CSS probability ($P = 0.248$). However, the 5-year PFS was 0.502 versus 0.210 in the ORC and LRC group, which was higher for ORC than LRC ($P = 0.021$). The rate of local recurrence of the LRC group was 45.4%, which was higher than the ORC group (35.7%), but there was no statistical difference.

Finally, a sensitive analysis of Cox regression analysis was carried out, the results are shown in Table S3. Compared with ORC, LRC was associated with a higher risk of progression for patients with locally advanced bladder cancer (hazard ratio 1.906, 95% CI 1.048–3.467, $P = 0.035$).

Discussion

ORC remains the standard treatment for recurrent high-grade NMIBC or MIBC. Despite the improvements in surgical techniques, its morbidity of complications remains high, with the risk reaching 40–65%.[16] With the advent of minimally invasive surgery, many surgeons are beginning to apply minimally invasive techniques, thus promoting the development of LRC and robot-assisted radical cystectomy RARC. Many previous studies showed that LRC and RARC have longer operative time, less EBL and fewer perioperative complications.[4,17,18] However, a recent RCT and a real-world study of early stage cervical cancer showed that minimally invasive radical hysterectomy was

Table 1 Clinicopathological characteristics of the patients before matching and after matching

	Before matching			After matching		
	ORC (n = 412)	LRC (n = 195)	P	ORC (n = 158)	LRC (n = 158)	P
Male	85.6%	88.7%	0.455‡	88.0%	89.9%	0.591‡
Operation date			<0.001†			0.792†
2006–2008	80 (19.4%)	2 (1.0%)		4 (2.5%)	2 (1.3%)	
2009–2011	119 (28.9%)	26 (13.3%)		27 (17.1%)	24 (15.2%)	
2012–2014	131 (31.8%)	76 (39.0%)		64 (40.5%)	70 (44.3%)	
2015–2017	82 (19.9)	91 (46.7%)		63 (39.9%)	62 (39.2%)	
Age (years)	67 (58.5–73.0)	63 (57–71)	0.004†	66 (59–71)	64 (58–72)	0.689†
Body mass index (kg/m^2)	24.02 (21.85–26.57)	24.00 (21.97–26.13)	0.691†	24.22 (22.15–26.45)	24.31 (22.05–26.26)	0.915†
ASA score			0.007†			0.991†
1	26 (6.3%)	21 (10.8%)		12 (7.6%)	11 (7.0%)	
2	327 (79.4%)	158 (81.0%)		130 (82.3%)	132 (83.5%)	
3	58 (14.1%)	15 (7.7%)		16 (10.1%)	14 (8.9%)	
4	1 (0.2%)	1 (0.5%)		0 (0.0%)	1 (0.6%)	
Type of urinary diversion			<0.001‡			0.571‡
Ureterocutaneostomy	102 (24.8%)	31 (15.9%)		32 (20.3%)	31 (19.6%)	
Ileal conduit	296 (71.8%)	144 (73.8%)		116 (73.4%)	121 (76.6%)	
Orthotopic neobladder	14 (3.4%)	20 (10.3%)		10 (6.3%)	6 (3.8%)	
Time of operation (min)	302 (239–380)	302 (237–367)	0.442†	280.5 (223–342)	298.5 (238–360)	0.229†
EBL (L)	700 (400–1100)	200 (100–400)	<0.001†	500 (200–1000)	300 (100–500)	<0.001†
Clavien–Dindo class			<0.001†			0.008†
0	94 (22.8%)	95 (48.7%)		52 (32.9%)	73 (46.2%)	
1	11 (2.7%)	7 (3.6%)		3 (1.9%)	6 (3.8%)	
2	286 (69.4%)	87 (44.6%)		95 (60.1%)	74 (46.8%)	
3	14 (3.4%)	3 (1.5%)		8 (5.1%)	2 (1.3%)	
4	6 (1.5%)	3 (1.5%)		0 (0.0%)	3 (1.9%)	
5	1 (0.2%)	0 (0.0%)		0 (0.0%)	0 (0.0%)	
Postoperative stay (days)	11 (8–14.5)	9 (8–12.5)	0.002†	10 (8–14)	9 (8–12)	0.159†
Clinical T stage			0.179‡			0.347‡
Ta and Tis and T1	76 (18.4%)	30 (15.4%)		31 (19.6%)	25 (15.8%)	
T2	168 (40.8%)	83 (42.6%)		58 (36.7%)	65 (41.1%)	
T3	115 (27.9%)	66 (33.8%)		47 (29.7%)	54 (34.2%)	
T4	53 (12.9%)	16 (8.2%)		22 (13.9%)	14 (8.9%)	
Pathological T stage			0.047‡			0.550‡
Ta and Tis and T1	121 (29.4%)	51 (26.2%)		48 (30.4%)	46 (29.1%)	
T2	153 (37.1%)	67 (34.4%)		53 (33.5%)	54 (34.2%)	
T3	78 (18.9%)	56 (28.7%)		33 (20.9%)	41 (35.9%)	
T4	60 (14.6%)	21 (10.8%)		24 (15.2%)	17 (10.8%)	
Pathological nodal stage			0.553‡			0.765‡
N0	350 (85.0%)	162 (83.1%)		132 (83.5%)	130 (82.3%)	
N+	62 (15.0%)	33 (16.9%)		26 (16.5%)	28 (17.7%)	
Pathological grade			0.673‡			0.468‡
Low grade	45 (10.9%)	19 (9.8%)		15 (9.5%)	19 (12.0%)	
High grade	367 (89.1%)	175 (90.2%)		143 (90.5%)	139 (88.0%)	
Lymphy node yield	10 (6–15)	10 (6–15)	0.754†	10.5 (7–15)	9 (6–14)	0.303†
Negative margin	407 (98.8%)	193 (99.0%)	1.000‡	155 (98.1%)	157 (99.4%)	0.623‡
Positive margin	5 (1.2%)	2 (1.0%)		3 (1.9%)	1 (0.6%)	
No NAC/AC	336 (81.6%)	146 (74.9%)	0.057‡	120 (75.9%)	122 (77.2%)	0.790‡
NAC/AC	76 (18.4%)	49 (25.1%)		38 (24.1%)	36 (22.8%)	

†Mann-Whitney U-test. ‡χ^2 test (or Fisher's exact test).

associated with shorter OS and disease-free survival than traditional open surgery.[19,20] The oncologic safety of minimally invasive surgery for some diseases remains controversial.

Previous non-randomized studies had patient selection bias, as the patients enrolled in the LRC group were younger, had better physical condition and early stage tumors, and the sample size was small.[6–8,21–24] In one RCT study, the sample size was also small and clinically highly selected.[9] To overcome the limitations of published studies, the present study used PSM with patients receiving ORC and LRC.

The present study is so far the largest cohort to compare LRC and ORC with a long follow-up time. Based on this study, the LRC group had lower EBL, fewer complications and shorter postoperative stay, which were similar to previously published studies. Better visibility of laparoscopy contributes to more precise and dedicated manipulation, and the

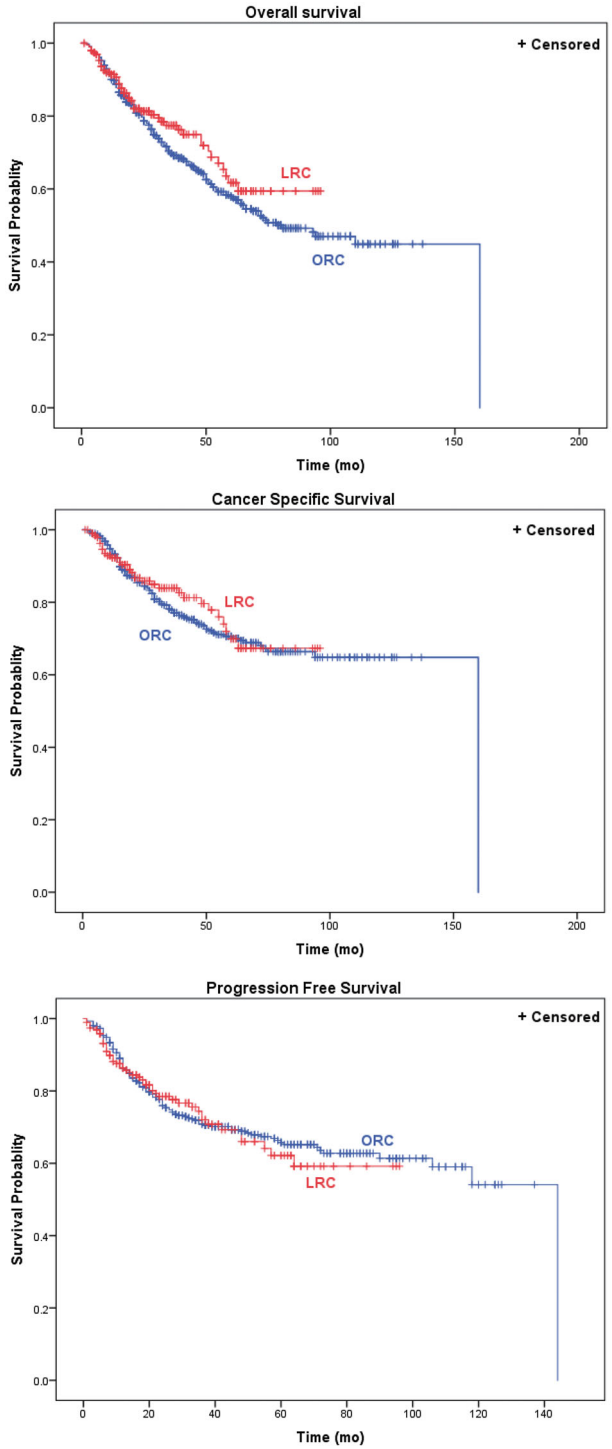

Fig. 2 Kaplan–Meier curves of OS probability, CSS probability and PFS probability in patients who underwent ORC or LRC before matching. The 5-year OS was 0.579 versus 0.617, 5-year CSS was 0.706 versus 0.699, and 5-year PFS was 0.658 versus 0.622 in the ORC and LRC group, respectively. There was no significant difference in the OS probability ($P = 0.216$), CSS probability ($P = 0.619$) and PFS probability ($P = 0.826$).

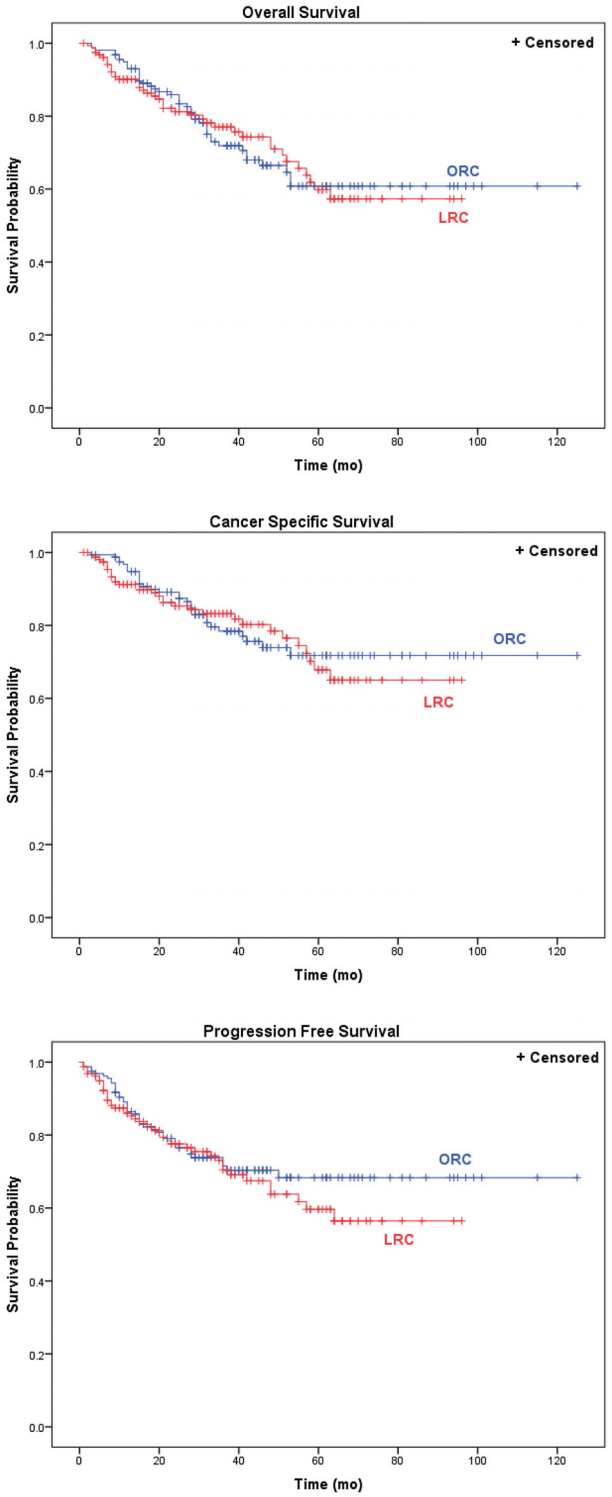

Fig. 3 Kaplan–Meier curves of OS probability, CSS probability and PFS probability in patients who underwent ORC or LRC after matching. The 5-year OS was 0.608 versus 0.598, 5-year CSS was 0.718 versus 0.678, and 5-year PFS was 0.683 versus 0.596 in the ORC and LRC group, respectively. There was no significant difference in the OS probability ($P = 0.961$), CSS probability ($P = 0.790$) and PFS probability ($P = 0.462$).

pneumoperitoneum pressure plays a role in hemostasis. This results in the reduction of blood loss in LRC. Whereas more intestinal manipulation and fluid loss cause more complications and longer postoperative recovery time in ORC.[25]

Regarding the oncologic outcomes, subgroup analysis of different stages of the disease was presented in this study. The study findings indicated that there were similar OS, CSS

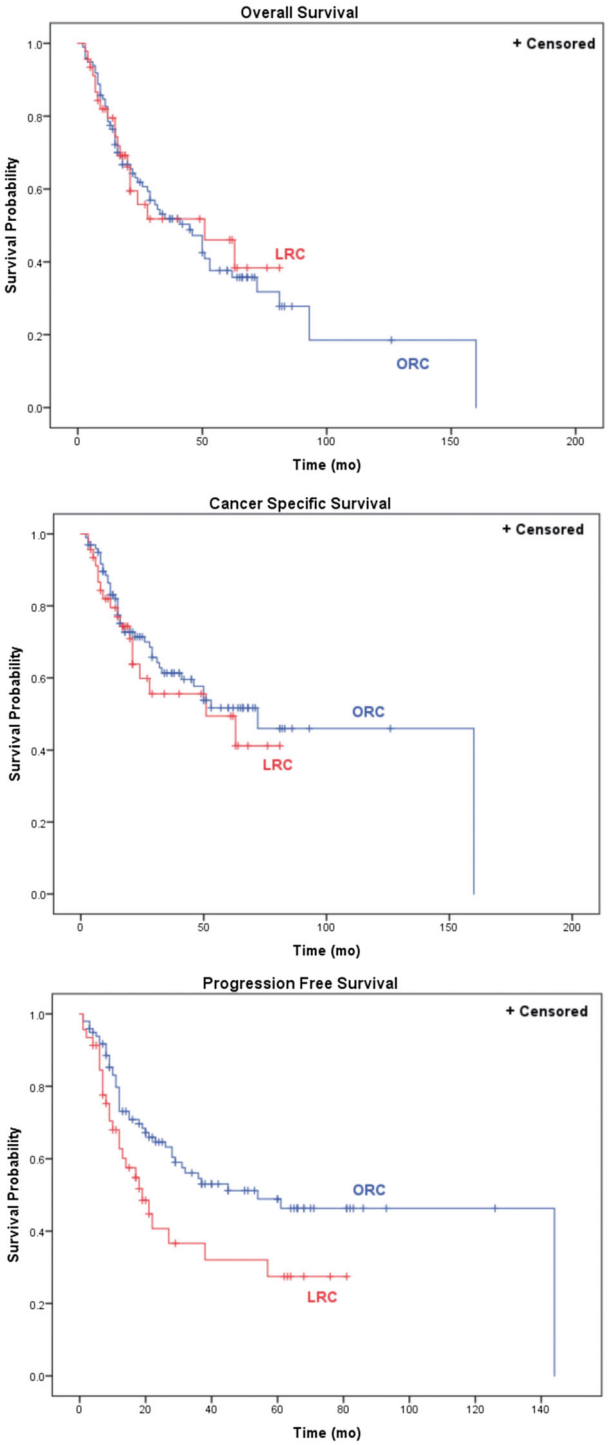

Fig. 4 Kaplan–Meier curves of OS probability, CSS probability and PFS probability in patients with locally advanced bladder cancer pT4 or pN+ who underwent ORC or LRC before matching. The 5-year OS was 0.376 versus 0.460, 5-year CSS was 0.517 versus 0.494, and 5-year PFS was 0.489 versus 0.275 in the ORC and LRC group, respectively. There was no significant difference in the OS probability ($P = 0.850$) and CSS probability ($P = 0.496$); however, the PFS of ORC was higher than LRC ($P = 0.019$).

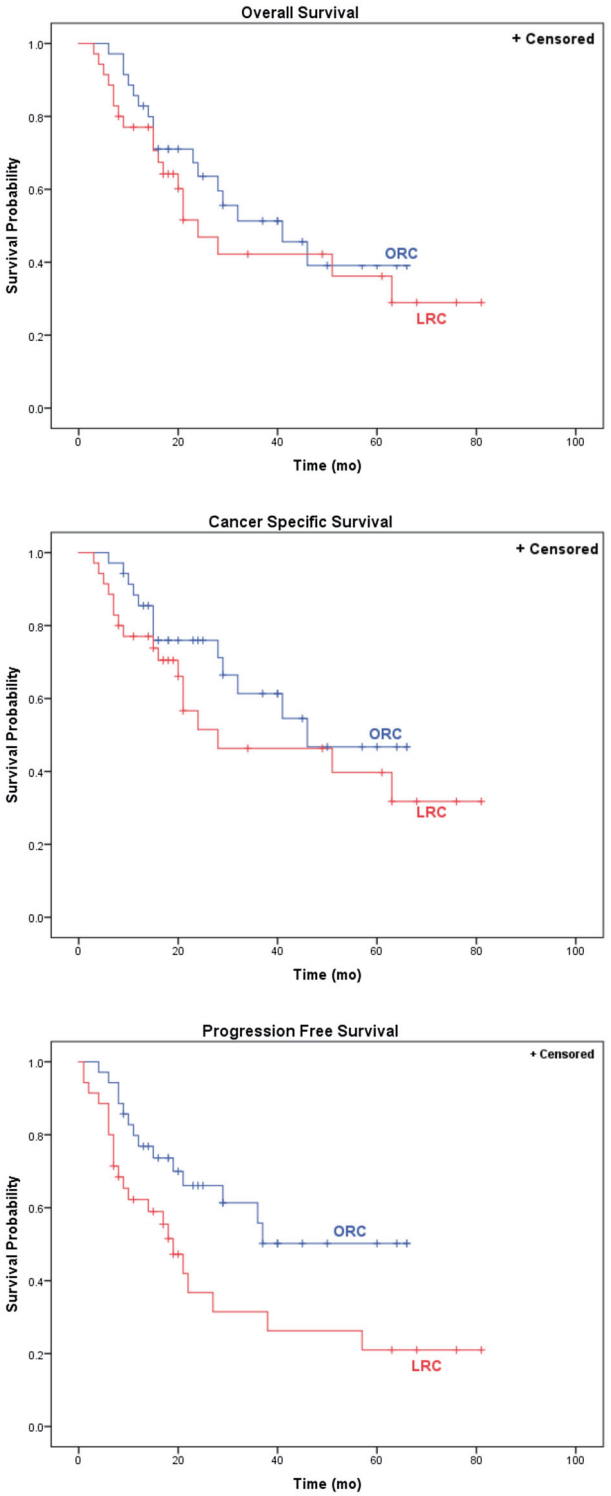

Fig. 5 Kaplan–Meier curves of OS probability, CSS probability and PFS probability in patients with locally advanced bladder cancer pT4 or pN+ who underwent ORC or LRC after matching. The 5-year OS was 0.391 versus 0.362, 5-year CSS was 0.467 versus 0.397, and 5-year PFS was 0.502 versus 0.210 in ORC and LRC group, respectively. There was no significant difference in the OS probability ($P = 0.397$) and CSS probability ($P = 0.248$); however, the PFS of ORC was higher than LRC ($P = 0.021$).

and PFS for patients with the early stage disease between LRC group and ORC group. However, we found that the PFS of patients with pT4 and patients with pN+ in the ORC group tended to be superior to that of the LRC group. In a previous study, Nguyen *et al*. compared the recurrence location of patients receiving ORC and RARC, and there was a difference in the pattern of distant recurrence in that extrapelvic lymph node locations and peritoneal carcinomatosis were more frequent in RARC than in ORC patients.[26] Although further investigations are required to determine whether this difference is due to the surgical technique, the oncologic safety of minimally invasive surgery deserves more attention.

In the present study, we compared the oncologic outcomes of patients with locally advanced bladder cancer between the LRC group and ORC group before matching and after matching. The study findings showed that there was no difference in OS and CSS between the two groups, but the PFS of ORC was better than that of LRC, implying that LRC might promote progression of locally advanced disease compared with ORC. Nowadays, more and more doctors and patients would choose RARC for minimal invasion, including in our institution. However, further study is required for exploring whether RARC could be similar to ORC in oncologic outcomes for patients with locally advanced bladder cancer.

PSM was used to match the patients that received LRC and ORC in the present study. It is desirable to match the factors as much as possible, but increasing the matching factors would cause a decrease in the matching sample size. For balancing the covariates and sample size, variables with $P < 0.1$ in univariable were included as covariates in the model. As shown in Table 1, the baseline characteristics, including body mass index, the male-to-female ratio and the proportion of chemotherapy, achieved a balance after matching. In addition, we believe that the pathological stage could present the stage of cancer more accurately, and there was a significant difference in the pathological stage between the LCR group and ORC group before matching. Therefore, pathological stage rather than clinical stage was included as the covariable in the PSM. There was no statistical difference in clinical stage after matching.

One limitation of the present study was our inability to explain this oncologic difference. Kanno *et al*. showed that prolonged operative time, high pathological stage T3–4 and/or positive lymph nodes, positive surgical margins, and variant histology were independent risk factors for the disseminated recurrence after LRC, which suggested that recurrences after LRC might be caused by tumor dissemination.[27] Advanced tumors are larger in volume and are attached to the surrounding tissue, making surgical removal difficultly, especially for LRC because of the limited manipulation space. Excessive manipulation of tumors, insufficient resection and cutting the positive lymph nodes during lymph node dissection might promote disseminated recurrences. In addition, the effect of CO_2 pneumoperitoneum on growth and spread of tumor cell was suggested in previous studies.[28,29] CO_2 insufflation might increase vascular permeability and diminished intraperitoneal immunity, which might promote the metastasis of tumor cells.[30] However, whether pneumoperitoneum increases the risk of metastasis of bladder cancer remains unknown. In addition, there is less experience of laparoscopic removal of advanced tumors among surgeons; therefore, cancer control after radical prostatectomy appears to be sensitive to the surgeon's experience,[31] and a similar effect might exist in radical cystectomy. We speculated that the oncologic outcomes would be affected by tumor spillage associated with the inadequate technical issue during the manipulation of removing the bladder or resecting the urethra.

There were other limitations to consider in the present study. The patients in the LRC group were younger, had a lower ASA score and lower pathological T stage, and received fewer ureterocutaneostomies. For reducing the selection bias, PSM was carried out in this study. However, after PSM, several unmatched patients were excluded. Second, many patients were lost to follow up in the present study, which biased the results of the study. In addition, the number of lymph nodes was smaller than other studies, which might be caused by the imprecise protocol of lymphadenectomy specimen processing in our institution, where only visible/palpable possible lymph nodes were submitted for microscopic examination. Furthermore, this study was carried out in a single institution, the oncologic outcomes might be affected by the experience of the surgeons. The surgeon factors for operation were not be analyzed, although it must be highlighted that the surgeons carrying out radical cystectomy were all experienced surgeons who had undertaken a large volume of procedures. Therefore, future RCTs with large sample sizes for patients with locally advanced bladder cancer are necessary to provide more convincing evidence of oncologic outcomes.

To our knowledge, the present study is the largest cohort of survival analysis of LRC and ORC, and is the first study to carry out subgroup analysis of different stage bladder cancer. In this retrospective study, LRC was found to be superior to ORC in perioperative outcomes and similar to ORC in oncologic outcomes for patients with early stage bladder cancer. However, for patients with locally advanced bladder cancer, LRC was associated with shorter PFS than ORC.

Acknowledgments

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Conflict of interest

None declared.

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Supporting information

Additional Supporting Information may be found in the online version of this article at the publisher's web-site:

Table S1. Clinicopathological characteristics of the patients with locally advanced bladder cancer before matching and after matching.
Table S2. Sites of recurrence for patients with locally advanced bladder cancer.
Table S3. Univariable/multivariable Cox regression analysis of variables associated with PFS for patients with locally advanced bladder cancer.
Figure S1. Kaplan–Meier curves of PFS in patients with different pathological T stages and nodal stages that underwent ORC or LRC before matching.
Figure S2. Kaplan–Meier curves of PFS in patients with different pathological T stages and nodal stages that underwent ORC or LRC before matching.

Editorial Comment

Editorial Comment from Dr Kanno to Laparoscopic versus open radical cystectomy in 607 patients with bladder cancer: Comparative survival analysis

Radical cystectomy is the standard treatment for locally muscle-invasive bladder cancer and high-risk non-muscle-invasive bladder cancer, but it is a morbid operation with a high complication rate. Therefore, minimally invasive surgery has been introduced to reduce complications. Indeed, meta-analysis and recent randomized controlled trials have reported that complications during minimally invasive radical cystectomy (MIRC) are comparable to those of open radical cystectomy, with longer operation times, but reduced blood loss.