Original Article

Perioperative outcomes of minimally invasive versus open radical cystectomy: A single-center experience

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ABSTRACT

Introduction: Open radical cystectomy (RC) is associated with significant morbidity and the role of minimally invasive surgery (MIS) in reducing morbidity of RC is controversial A direct comparison of various surgical modalities on perioperative outcomes is lacking in the Indian literature. We evaluated outcomes of minimally invasive (robotic and laparoscopic) versus open RC with pelvic lymph node dissection (PLND) performed at our institute from 2014 to 2016.

Methods: Eighty-three patients of RC with PLND were prospectively analyzed from December 2014 to February 2016. All patients of muscle invasive urothelial cancer of the bladder undergoing RC (open or MIS) were included in the study. Based on patients preference they were assigned to one of the three groups (Open RC, robot-assisted RC, or laparoscopic RC). Their demographic profile, preoperative disease stage, operative data like operative time, blood loss, intraoperative complications, histopathological data like pathological stage, lymph-node yield etc., postoperative complications if any and total duration of stay were recorded. These data of laparoscopic, open, and robotic cystectomies were compared in terms of various demographic, histopathologic parameters and perioperative outcomes.

Results: Twenty-nine patients (34.93%) underwent minimally invasive RC with PLND (5 laparoscopic and 24 robotic). The median age of patients was 58 years. Mean number of lymph nodes removed was 22.5 ± 14.6. The total number of lymph nodes removed in laparoscopic surgery was 104 with a yield of 20.6 per patient, in robotic surgery were 627 with a yield of 26.1 per patient, and in open surgery were 1119 with a yield of 20.7 per patient ($P = 0.004$). Clavien-Dindo Grade 2 and 3 complications were seen in 37.5% of robotic, 60% of laparoscopic, and 55.54% of open RC. Average blood loss and operative time in laparoscopic, robotic, and open RC were 511.53 ± 311.02 ml, 552.08 ± 267.63 ml, and 512.05 ± 213.9 ml and 8.23 ± 1.36 h (hrs), 7.53 ± 1.92 h, and 5.85 ± 1.76 h, respectively ($P = 0.68$ and <0.001, respectively).

Conclusions: MIS is associated with significantly longer operative time than open RC. Robotic RC has significantly higher lymph node yield than open or laparoscopic RC. Minimally invasive RC is equivalent to open surgery in terms of perioperative morbidity, mortality, and blood loss.

INTRODUCTION

Nearly 50% patients with muscle invasive bladder cancer (T2–T4) die from their disease within 5 years of diagnosis.[1,2] However, for patients with organ-confined node-negative disease, several serieshave shown excellent 5- and 10-year survival rates after radical cystectomy (RC).[3-6] With increasing experience, a considerable decrease in the mortality and morbidity has been noticed. Several advancements in the recent past have attempted to improve surgical morbidity and oncological outcomes in RC. These include application of minimally invasive surgeries (MIS), namely, laparoscopic and robot-assisted RC (RARC), extended lymphadenectomy templates, and neoadjuvant and adjuvant chemotherapy.[7,8] Although other parameters have shown to change the

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outcomes, the effect of MIS in decreasing the morbidity and improving outcomes remains controversial.[9] Furthermore, such data are scanty in Indian literature.[10] Various open RC studies from India have shown equivalent outcomes to Western counterparts.[10-12] There have been documented differences in Indian patients compared with Western counterparts in terms of different social, economic, religious factors and also disease presentation. All these factors can have a significant influence on the outcomes of RC.[10,11] RARC involves greater cost and its feasibility and acceptability in Indian patients will be better only if the perioperative and oncological outcomes are at least comparable or better than open RC. Our hospital is a tertiary care referral center and is one of the few high-volume centers treating bladder cancer patients in the country. In the present study, we compared our surgical experience in open RC with minimally invasive RC in terms of their perioperative complications from December 2014 to February 2016.

MATERIALS AND METHODS

Study protocol

The study was a prospective cohort design. All the patients of urothelial cancer of the bladder who underwent RC with pelvic lymph node dissection (PLND) at our institute between December 2014 and February 2016 were included in the study. Since MIS has financial implications, the choice of MIS was given to all the eligible patients. Final decision to include the patient into MIS versus open RC was based on the patients choice after counseling. The exclusion criteria were refusal to give consent, nonurothelial cancers, those undergoing partial cystectomy, and those with follow-up of <3 months. For the purpose of study, the patients were divided into three groups: those undergoing open, laparoscopic, and robot-assisted (Da Vinci Si®) RC.

Surgical technique

Open RC was performed with standard lower midline incision. PLND was done in either standard or extended template based on intraoperative findings at the surgeons' discretion. RARC was performed with Da Vinci Surgical Robot Si HD® (Intuitive Surgical, Inc., Sunnyvale, CA, USA). Standard six ports were placed (four Robotic and two assistant ports). The patients were placed in steep Trendelenburg position. Energy sources included bipolar and monopolar cautery. The pedicles were controlled using the Weck® Hem-o-lok® clips. In laparoscopic RC, standard five ports were placed and patients were kept in steep Trendelenburg position. The energy sources included monopolar cautery and Harmonic® device (Ethicon endo surgery). The pedicles were controlled using the Weck® Hem-o-lok® clips. Urinary diversion was performed using ileal segment in all patients. Orthotopic neobladder was constructed using Abol-Enein technique with extramural serosa-lined nonrefluxing ureterointestinal anastomoses. Bricker technique was used in all ureterointestinal anastomoses in ileal conduits. Continent cutaneous diversion was fashioned using W-shaped ileal pouch with catheterizable serosa-lined extramural tapered ileal segment. Urinary diversion in RARC was done extracorporeally through lower midline 7 cm incision.

Perioperative management

Preoperatively, patients were placed on liquid diet 24 h before the scheduled procedure. We do not routinely administer mechanical or antibiotic bowel preparations. Prophylactic single-dose second-generation cephalosporin was given at induction along with metronidazole before opening of bowel. Antibiotics were repeated if the duration of procedure exceeded 4 h. Deep venous thrombosis prophylaxis was given in form of pneumatic compression stockings to all patients. None of the patients received prophylactic low molecular weight heparin. Nasogastric tube was removed on postoperative day 1 and patients were ambulated. Oral sips were allowed from day 1 and gradual increase in liquids was allowed from day 2. Semisolids were given from day 3 and once patient had passed flatus. The single abdominal drain was removed when the output decreased to <30 ml/day. Stoma catheter was removed once bowel activity returned. Splints or Double J stents were removed at 10–14 days later in ileal conduit patients and 3 weeks in orthotopic neobladder patients. The patients received metoclopramide for the treatment of postoperative nausea. Ileus was managed by nasogastric tube insertion, prokinetic agents, electrolytes correction, and in some cases, total parenteral nutrition till bowel function recovered.

Data collection and maintenance

All patients were prospectively followed from the day of admission to the end of study duration. After discharge, the patients were followed in outpatient department 3 monthly for the study duration. All data were entered in a data abstraction form.

Information on patients' demographic characteristics, comorbidities, preoperative laboratory analysis, operative variables, postoperative factors, and complications after RC were recorded. Permission to access patients' data was sought from the hospital administration. The dependent variables (outcomes) for the current study were operative time, blood loss, hospital stay, complications (Clavien-Dindo [CD] Grading), and lymph node yield. Main independent variables included age, gender, body mass index (BMI), smoking status, presence or absence of comorbid factors, intraoperative blood loss, operative time, pT, pN, and 30-day mortality.

Surgical experience

All surgeries were performed by three surgeons well experienced in open and laparoscopic RC. All the surgeons were certified robotic surgeons and had performed at-least 20 robot-assisted procedures including robot-assisted

radical prostatectomies before performing RARC. In view of standardized technique at our institute, the surgeons faced no difficulty in replicating open procedure in RARC. Due to initial experience, we performed the urinary diversion extracorporeally.

Statistical analysis

For skewed data, Kruskal–Wallis test followed by Mann–Whitney test was applied. For normally distributed data, Student *t*-test was applied. Proportions were compared using Chi-square or Fisher's exact tests, depending on their applicability for the groups. Spearman's or Pearson's correlation coefficients were calculated to see relationship of different variables. To see independent predictor for extent logistic regression analysis was applied. All the statistical tests were two-sided and were performed at a significance level of $\alpha = 0.05$. Analysis was conducted using IBM SPSS STATISTICS version 22.0(NY, USA).

RESULTS

A total of 95 patients underwent RC from December 2014 to February 2016. Twelve patients (9 in open arm, 2 in robotic arm, and 1 in laparoscopic arm) were excluded from the studydue to loss to follow-up in 9 patients, nonurothelial histology in final specimen in 2 patients, and abandonment of procedure in 1 patient due to locally advanced disease (T4b) after intraoperative assessment [Figure 1]. Thus, 83 patients were enrolled and analyzed prospectively [Figure 1]. Fifty-four patients underwent open RC and 29 underwent minimally invasive RC (laparoscopic $n = 5$, robotic $n = 24$). Median age of the patients was 58 years. Mean BMI was 22.97 ± 3.82. A history of smoking was present in 51.8% of patients overall. Mean time to follow-up was 13.67 ± 3.12 months. Mean hospital stay after RC was 23 ± 12.5 days. There was no difference between three groups of patients in terms of various demographic parameters ($P = 0.382$) [Table 1]. The three groups were comparable in terms of type of urinary diversion performed, with ileal conduit being the most common diversion (77.2% overall) [Table 2]. Three groups were comparable in terms of extent of PLND performed ($P = 0.878$) [Table 2]. Neoadjuvant chemotherapy (gemcitabine and cisplatin based) was given to 12% (10 out of 83) patients, and adjuvant chemotherapy (gemcitabine and cisplatin based) was given to 30% (25 out of 83) patients based on appropriate indications [Table 1].

The patients in three groups were comparable in terms of various pT stages ($P = 0.341$). Mean lymph node yield

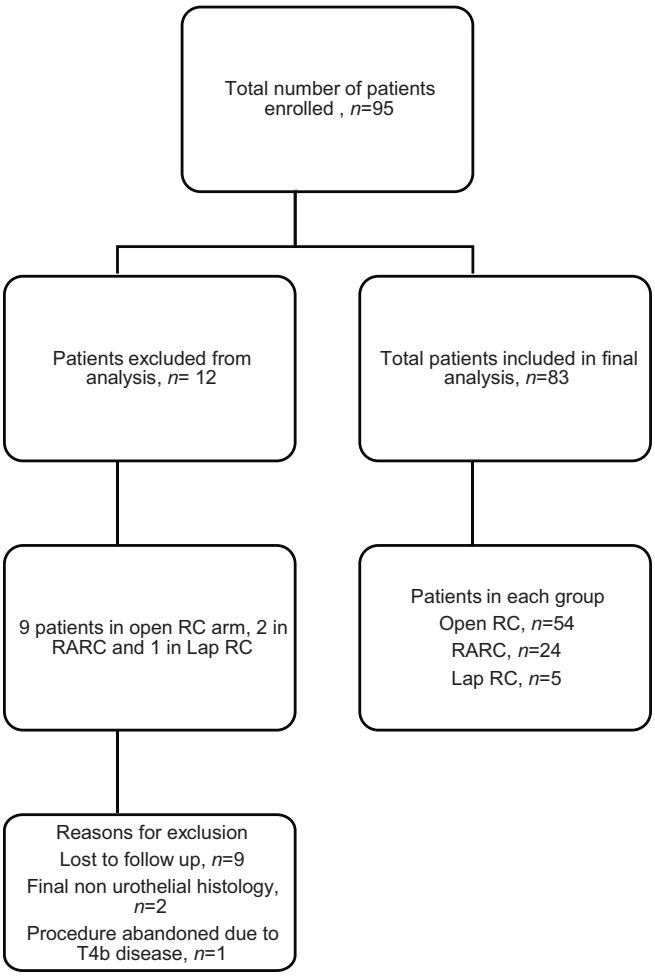

Figure 1: Patients enrolment for analysis

Table 1: Demographic and operative parameters

Parameters	Open RC, *n* (%)	RARC, *n* (%)	Laparoscopic RC, *n* (%)	Total, *n* (%)	*P*
Number of patients	54 (65.06)	24 (28.9)	5 (6.02)	83 (100)	0.192
Median age (years)	58	57	54	58	0.657
BMI	23.08±3.79	23.22±4.17	21.86±4.02	22.97±3.82	0.584
Smoking					
Yes	27 (50)	11 (45.83)	5 (100)	43 (51.8)	0.972
No	27 (50)	13 (54.17)	0	40 (48.2)	
Hypertension					
Yes	10 (18.5)	8 (33.33)	1 (20)	19 (22.89)	0.382
No	44 (81.5)	16 (66.67)	4 (80)	64 (77.11)	
Neoadjuvant chemotherapy	8 (14.8)	1 (4.16)	1 (20)	10 (12.04)	0.878
Adjuvant chemotherapy	15 (27.77)	6 (25)	4 (80)	25 (30.12)	
Mean follow-up time (months)	12.02±3.96	8.68±4.5	12.22±3.52	13.67±3.12	0.532
Hospital stay after RC (days)	23.5±13.4	22.9±11.3	22.6±12.2	23±12.5	0.739

BMI=Body mass index, RC=Radical cystectomy, RARC=Robot-assisted radical cystectomy

was significantly higher in RARC as compared to open and laparoscopic RC (26.13 ± 16.76 vs. 20.66 ± 14.19 and 20.09 ± 10.57, $P < 0.001$), [Table 3]. The lymph node yield was equivalent in open and laparoscopic RC. Positive lymph nodes were seen in 30.12% (25/83) of patients overall (open 16 [29.62%], robotic 6 [25%], and laparoscopic 3 [60%]) [Table 3]. Positive surgical margin was seen in 2 (3.7%), 1 (4.2%), and none patients in open, RARC, and laparoscopic groups, respectively [Table 3]. None of the patients had positive urethral margin.

Mean operative time was significantly higher in laparoscopic and robotic RC as compared to open RC (8.23 ± 1.36 h and 7.53 ± 1.92 h vs. 5.85 ± 1.76 h, respectively, $P < 0.001$) [Table 2]. Mean blood loss was 563.75 ± 280.6 ml. There was no significant difference in mean blood loss between the three groups ($P = 0.672$).

Perioperative complications were seen in 54.21% of patients (45 out of 83). All three groups were comparable in terms of number of postoperative complications and CD grades of complications ($P = 0.364$), [Table 2]. Various different perioperative complications are summarized in Table 4. More patients in RARC required surgical treatment of their complications than open group ($P = 0.029$). Thirty-day mortality was low at 1.2% (2/83). Mortality during follow-up was seen in 19.27% (16/83) of patients overall [Table 2]. Various reasons for death have been

Table 2: Postoperative and follow-up parameters

Parameter	Open RC, *n* (%)	RARC, *n* (%)	Laparoscopic RC, *n* (%)	Total, *n* (%)	*P*
Operative time (h)	5.85±1.76	7.53±1.92	8.23±1.36	6.4±1.99	<0.001
Blood loss (ml)	512.05±213.9	552.08±267.63	511.53±311.02	563.75±280.6	0.672
Type of urinary diversion					
IC	44 (81.48)	15 (62.5)	5 (100)	64 (77.1)	0.534
ONB	6 (11.11)	8 (33.33)	0	14 (16.86)	
CCD	4 (7.4)	1 (4.16)	0	5 (6.02)	
Extent of PLND					
Standard	22 (40.74)	9 (37.5)	2 (40)	33 (39.75)	0.875
Extended	32 (59.25)	15 (62.5)	3 (60)	50 (60.24)	
Number of postoperative complications					
None	23 (42.59)	13 (54.17)	2 (40)	38 (45.78)	0.625
1	22 (40.74)	6 (25)	3 (60)	31 (37.34)	0.364
2	9 (16.66)	5 (20.83)	0	14 (15.83)	
CD grade					
1	1 (1.85)	0	0	1 (1.20)	
2	22 (40.74)	5 (20.83)	1 (20)	28 (33.73)	
3	8 (14.8)	4 (16.67)	2 (40)	14 (16.86)	
4	0	2 (8.33)	0	2 (2.40)	
Treatment of complications					
Medical	26 (84.35)	5 (45.45)	2 (66.67)	34 (73.91)	0.029
Surgical	5 (15.65)	6 (54.55)	1 (33.33)	12 (26.09)	
30 days mortality	1 (1.85)	0	0	1 (1.2)	
Mortality during follow-up	12 (22.22)	2 (8.33)	2 (40)	16 (19.27)	0.372
Recurrence during follow-up	8 (14.8)	3 (12.5)	0	11 (13.25)	
Mean time to death (months)	12.7	6	9.5	8.43	0.278
Mean time to recurrence (months)	3.75	3.33	NA	3.63	0.453
Overall survival (%)	77.78	91.66	60	80.72	0.895
Cancer specific survival (%)	90.74	91.66	80	90.36	

RC=Radical cystectomy, RARC=Robot-assisted radical cystectomy, IC=Ileal conduit, ONB=Orthotopic neobladder, NA=Not available, CCD=Continent cutaneous diversion, CD=Clavien-Dindo, PLND=Pelvic lymph node dissection

Table 3: Pathology parameters

Parameter	Open RC, *n* (%)	RARC, *n* (%)	Laparoscopic RC, *n* (%)	Total, *n* (%)	*P*
Pathological stage					
pT0	7 (12.96)	1 (4.16)	0 (7.7)	8 (11.67)	0.341
pT1	3 (5.55)	3 (12.5)	1 (20)	7 (12.5)	
pT2	27 (50)	17 (70.83)	2 (40)	46 (48.33)	
pT3	15 (27.77)	3 (12.5)	2 (40)	20 (21.67)	
pT4	2 (3.70)	0	0	2 (5.83)	
CIS	2 (3.73)	2 (8.33)	0	4 (4.82)	
pN positive	16 (29.62)	6 (25)	3 (60)	25 (30.12)	0.854
Mean lymph node yield	20.66±14.19	26.13±16.76	20.69±10.57	22.24±14.65	<0.001
Mean lymph node positive	5.8±5.09	5.17±3.97	4.47±7.05	5.84±6.96	0.623
Positive surgical margin	2 (3.7)	1 (4.2)	0	3 (3.6)	

RC=Radical cystectomy, RARC=Robot-assisted radical cystectomy, CIS=carcinoma-in-situ, pN=pathological nodal stage

Table 4: Perioperative complications, causes of death, and recurrences during follow-up after radical cystectomy

Perioperative complications			
Various complications	**Open RC (*n*)**	**RARC (*n*)**	**Laparoscopic RC (*n*)**
Wound related (SSI)	10	4	-
Wound dehiscence	2	3	-
Wound dehiscence requiring closure under GA	-	1	-
Stoma related	2	1 (required revision under GA)	-
Ileus	10	1	2
Subacute intestinal obstruction	2	1 (required exploratory laparotomy)	-
Increased drain output (lymphatic)	5	3	1
Hydronephrosis	2 (unilateral)	1 (bilateral required PCN placement)	-
Postoperative delirium	2	-	-
Ureterointestinal leak	2	-	-
Chylous drain fluid	1	-	-
Pneumonia	1	1	-
Epididymo-orchitis	1	-	-
Total number of events	40	16	3
Causes of death			
Causes of death in various groups	**Open RC (*n*)**	**RARC (*n*)**	**Laparoscopic RC (*n*)**
Metastases	5	2	1
Sepsis	1	0	0
Acute intestinal obstruction	1	0	0
Poor nutrition	2	0	0
Cardiac cause	3	0	1
Total	12	2	2
Recurrences during follow-up			
Recurrences during follow-up (patients' profile)	**Open RC (*n*)**	**RARC (*n*)**	**Laparoscopic RC (*n*)**
Node-positive disease	3	2	0
Extravesical node-negative disease	3	0	0
Organ confined node-negative disease	2	1	0
Total	8	3	0

SSI=Surgical site infection, PCN=Percutaneous nephrostomy, GA=General anesthesia, RC=Radical cystectomy, RARC=Robot-assisted radical cystectomy

enumerated in Table 4. A total of 11 (13.25%) patients overall had recurrence during study follow-up. Majority of recurrences were seen in node positive or extravesical disease (8 out of 11, 72.7%) [Table 4]. Mean duration of recurrence was 3.63 months overall. There was no recurrence in laparoscopic group during study period. Most common pattern of recurrence was distant (8/11) followed by distant plus local in 2 patients and local recurrence in 1 patient. There was no difference in the pattern of recurrences between robotic and open group (P = 0.453) [Table 2]. Overall survival (OS) for the duration of study (16 months) was 79.52%. Cancer-specific survival for the entire cohort was 90.36% [Table 2].

DISCUSSION

RC has been associated with significant morbidity. Various developments in the past have improved outcomes and reduced morbidity of this procedure. Minimally invasive surgery (MIS), including laparoscopic and robotic, have been attempted to reduce postoperative pain and complications of prolonged bowel exposure. However, various studies have shown little reduction in the morbidity of this procedure despite their minimally invasive nature.[7-9]

In our study, the median age of the patients was 58 years. This is consistent with the lower mean age reported in the other Indian studies.[10-13] This is in contrast to older mean age reported in most Western studies.[14]

In our study, RARC was associated with the highest lymph node yield as compared to laparoscopy and open approach. Hu *et al*.[15] analyzed SEER data from 2002 to 2012 of 439 RARC and 7308 open RC (ORC) patients. They found higher lymph node yield in RARC with 41.5% of these having lymph node count ≥10 as compared to open RC with 34.9% having lymph node count ≥10. However, they did not compare the mean lymph node yield. Other studies have not found a significant difference in the lymph node yield between RARC and open RC.[16,17] Lin *et al*.[18] performed a prospective randomized controlled trial of laparoscopic versus open RC. They analyzed 35 patients in each group and found no significant difference in the mean lymph node yield between laparoscopic versus open RC (14.1 ± 6.3 vs. 15.2 ± 5.9, P = 0.467). This matches with the result of our study, where lymph node yield is equivalent between laparoscopic and open RC. In their study, laparoscopic RC was associated with less blood loss, less transfusion requirement, and less analgesic requirements in postoperative period. There was no significant difference in oncologic outcomes between two groups. In our study, the mean lymph node yield was higher in robotic arm, than open and laparoscopic arms. We do not believe that it is a sampling difference since the technique of lymph node

packets sent and analyzed remains the same in all three groups. We believe that good vision and dexterity provided by the robotic surgery enables one to clear the lymphatic bed more thoroughly. Moreover, this finding has important oncologic relevance since it is assumed that higher the lymph node yield better is the oncological outcomes. It needs to be examined over a long term follow-up.

In our study, the mean operative time was significantly higher in laparoscopic and robotic RC as compared to open RC. However, blood loss and perioperative complications in terms of CD grades were equivalent in the three approaches. Most common complication in our study was infectious (24%) followed by gastrointestinal related (16.86%). The perioperative complication rates in our study match with the recently published study by Patidar *et al*.[12] They analyzed the perioperative complications of open RC patients in 212 patients at their institute using CD classification. They found no difference in the complication rates between different types of urinary diversion (P = 0.221). However, in their study, the most common complication was hematologic (28.42%) followed by infectious (18.49%). Gastrointestinal complications were seen in 18.15% of patients in their study. In our study, mean time to return of bowel activity and resumption of oral diet was 4.2 days overall. Return of bowel function was similar in all the three groups (P = 0.674). Overall mean hospital stay after surgery was 23 ± 12.5 days. There was no difference in the mean duration of hospital stay in three groups (23.5 ± 13.4 in open RC vs. 22.9 ± 11.3 days in RARC vs. 22.6 ± 12.2 days in Lap RC, P = 0.739). Our hospital stay is higher than reported in the study by Patidar *et al*.[12] (14.76 ± 7.71 days). The longer hospital stay in our patients is also primarily due to various economic and social factors. As patients come from far off areas with little postoperative care near their home, we tend to keep them till the removal of stitches and teaching appropriate stoma care. Our results are somewhat in line with Khan *et al*.[19] where they analyzed 164 patients and randomized patients into three groups, robotic, laparoscopic (LRC), and open RC. Thirty-day complication rates (as per CD system) varied significantly (ORC: 70%; RARC: 55%; LRC: 26%; P = 0.024). ORC complication rates were significantly higher than LRC (P < 0.01). Ninety-day complication rates showed no significant differences (ORC: 70%; RARC: 55%; LRC 32%; P = 0.068). Mean operative time was significantly longer in RARC than ORC or LRC. ORC showed slower return to diet than RARC or LRC.

Snow-Lisy *et al*.[20] analyzed 121 patients of laparoscopic and RARC from 1999 to 2008 at their institute. In their series 17 patients underwent RARC and rest laparoscopic or laparoscopic-assisted RC. Median blood loss and operative time were 400 ml and 7.5 h, respectively. Postoperative complications were seen in 43% of patients, with CD 2 and 3 complications in 24.79% of all patients. Complications requiring surgical intervention were seen in 11% of patients. They reported OS of 55% and recurrence free survival of 71% at 3 years.

Gondo *et al*.[21] analyzed 26 patients (11 robotic and 15 open RC) between 2008 and 2011. They found a significant decrease in both estimated blood loss (656.9 vs. 1788.7 ml, P = 0.0015) and allogeneic transfusion requirement (0 vs. 40%, P = 0.0237) in the RARC group as compared with open RC group. The total operative time was almost the same (P = 0.2306). Surgery-related complication rates within 30 days were not significantly different (P = 0.4185). The RARC cohort had a larger number of removed lymph nodes than the ORC cohort, and the difference was statistically significant (20.7 vs. 13.8, P = 0.042). In our study, there was no significant difference in the blood loss between MIS and open RC, in contrast with study by Gondo *et al*.[21] This could probably be due to our initial experience with RARC but probably also due to lesser blood loss in open RC as compared to other studies making the difference insignificant. A larger number of patients could have helped in achieving the significant differences in this parameter.

Ahmed *et al*.[22] in their multicenter retrospective study analyzed differences in intracorporeal and extracorporeal urinary diversion after RARC and concluded that outcomes of intracorporeal urinary diversion is comparable to extracorporeal urinary diversion. Intracorporeal and extracorporeal urinary diversion was comparable in terms of operative time, 30-day complication rates, and mean hospital stay (P = 0.086). Intracorporeal diversion was associated with lower gastrointestinal complications ($P \leq 0.001$) and lower 90-day complications (P = 0.02) in their study. In our study, the urinary diversion was performed extracorporeally in RARC. The perioperative complications could have been reduced if intracorporeal diversion had been performed, but in view of our early experience, we preferred extracorporeal diversion. Only a future randomized study in this direction can clarify the real benefits of intracorporeal urinary diversion.

Thus, our data match with the one reported in the Western literature and limited available data from Indian population. Our study has drawbacks in terms of small sample size, lack of randomization, and possible selection bias. We have reported early results of our experience with RARC, which can only be fully realized when compared to open and laparoscopic RC groups. Thus, we decided to study three groups separately. Due to financial constraints involved in RARC, it was not possible to do randomization. Furthermore, the number of patients undergoing laparoscopic RC had decreased due to introduction of RARC. Few merits of our study are that it is a prospective study from a single center, and the results can be more affirmative. There are less chances of missing data or complication in view of prospective nature of study. Thus, our study can be helpful in

guiding future studies, which may conclusively establish the real benefits of RARC over other approaches. Since higher lymph node yield has been shown to be associated with better outcomes,[23,24] our proposition remains that RARC may provide better long-term survival outcomes, which need to be verified in long-term studies.

CONCLUSIONS

RARC and laparoscopic RC are equivalent to open RC in terms of perioperative complications. MIS especially RARC is a good alternative to open RC, but should be performed by experienced surgeons at centers with high volume cases as morbidity due to these procedures is still high. Long-term and randomized trials in future will more conclusively establish the real benefits of minimally invasive RC.

REFERENCES

1. Shabsigh A, Korets R, Vora KC, Brooks CM, Cronin AM, Savage C, *et al.* Defining early morbidity of radical cystectomy for patients with bladder cancer using a standardized reporting methodology. Eur Urol 2009;55:164-74.
2. Lawrentschuk N, Colombo R, Hakenberg OW, Lerner SP, Månsson W, Sagalowsky A, *et al.* Prevention and management of complications following radical cystectomy for bladder cancer. Eur Urol 2010;57:983-1001.
3. Baumgartner RG, Wells N, Chang SS, Cookson MS, Smith JA Jr. Causes of increased length of stay following radical cystectomy. Urol Nurs 2002;22:319-23, 339.
4. Konety BR, Allareddy V, Herr H. Complications after radical cystectomy: Analysis of population-based data. Urology 2006;68:58-64.
5. Mohanty NK, Kumar A, Vasudeva P, Jain M, Prakash S, Arora RP, *et al.* Analysis of the perioperative and five-year oncological outcome of two hundred cases of open radical cystectomy: A single center experience. Indian J Cancer 2012;49:96-101.
6. Konety BR, Dhawan V, Allareddy V, Joslyn SA. Impact of hospital and surgeon volume on in-hospital mortality from radical cystectomy: Data from the health care utilization project. J Urol 2005;173:1695-700.
7. Aboumohamed AA, Raza SJ, Al-Daghmin A, Tallman C, Creighton T, Crossley H, *et al*. Health-related quality of life outcomes after robot-assisted and open radical cystectomy using a validated bladder-specific instrument: A multi-institutional study. Urology 2014;83:1300-8.
8. Leow JJ, Reese SW, Jiang W, Lipsitz SR, Bellmunt J, Trinh QD, *et al.* Propensity-matched comparison of morbidity and costs of open and robot-assisted radical cystectomies: A contemporary population-based analysis in the united states. Eur Urol 2014;66:569-76.
9. Bochner BH, Dalbagni G, Sjoberg DD, *et al*. Comparing open radical cystectomy and robot-assisted laparoscopic radical cystectomy: A randomized clinical trial. Eur Urol Eur Urol. 2015 Jun; 67(6):1042-50.
10. Gupta NP, Kolla SB, Seth A, Dogra PN, Hemal AK, Kumar R, *et al.* Radical cystectomy for bladder cancer: A single center experience. Indian J Urol 2008;24:54-9.
11. Gaitonde K, Goyal A, Nagaonkar S, Patil N, Singh DR, Srinivas V, *et al.* Retrospective review and long-term follow-up of radical cystectomy in a developing country. BJU Int 2002;89 Suppl 1:57-61.
12. Patidar N, Yadav P, Sureka SK, Mittal V, Kapoor R, Mandhani A, *et al.* An audit of early complications of radical cystectomy using clavien-dindo classification. Indian J Urol 2016;32:282-7.
13. Kulkarni JN, Pramesh CS, Rathi S, Pantvaidya GH. Long-term results of orthotopic neobladder reconstruction after radical cystectomy. BJU Int 2003;91:485-8.
14. Smith AB, Deal AM, Woods ME, Wallen EM, Pruthi RS, Chen RC, *et al.* Muscle-invasive bladder cancer: Evaluating treatment and survival in the national cancer data base. BJU Int 2014;114:719-26.
15. Hu JC, Chughtai B, O'Malley P, Halpern JA, Mao J, Scherr DS, *et al*. Perioperative outcomes, health care costs, and survival after robotic-assisted versus open radical cystectomy: A National comparative effectiveness study. Eur Urol 2016;70:195-202.
16. Richards KA, Hemal AK, Kader AK, Pettus JA. Robot assisted laparoscopic pelvic lymphadenectomy at the time of radical cystectomy rivals that of open surgery: Single institution report. Urology 2010;76:1400-4.
17. Bochner BH, Dalbagni G, Sjoberg DD, Silberstein J, Keren Paz GE, Donat SM, *et al.* Comparing open radical cystectomy and robot-assisted laparoscopic radical cystectomy: A Randomized clinical trial. Eur Urol 2015;67:1042-50.
18. Lin T, Fan X, Zhang C, Xu K, Liu H, Zhang J, *et al*. A prospective randomised controlled trial of laparoscopic vs open radical cystectomy for bladder cancer: Perioperative and oncologic outcomes with 5-year follow-upT lin *et al.* Br J Cancer 2014;110:842-9.
19. Khan MS, Gan C, Ahmed K, Ismail AF, Watkins J, Summers JA, *et al.* A single-centre early phase randomised controlled three-arm trial of open, robotic, and laparoscopic radical cystectomy (CORAL). Eur Urol 2016;69:613-21.
20. Snow-Lisy DC, Campbell SC, Gill IS, Hernandez AV, Fergany A, Kaouk J, *et al.* Robotic and laparoscopic radical cystectomy for bladder cancer: Long-term oncologic outcomes. Eur Urol 2014;65:193-200.
21. Gondo T, Yoshioka K, Nakagami Y, Okubo H, Hashimoto T, Satake N, *et al.* Robotic versus open radical cystectomy: Prospective comparison of perioperative and pathologic outcomes in Japan. Jpn J Clin Oncol 2012;42:625-31.
22. Ahmed K, Khan SA, Hayn MH, Agarwal PK, Badani KK, Balbay MD, *et al.* Analysis of intracorporeal compared with extracorporeal urinary diversion after robot-assisted radical cystectomy: Results from the international robotic cystectomy consortium. Eur Urol 2014;65:340-7.
23. Herr HW, Bochner BH, Dalbagni G, Donat SM, Reuter VE, Bajorin DF, *et al.* Impact of the number of lymph nodes retrieved on outcome in patients with muscle invasive bladder cancer. J Urol 2002;167:1295-8.
24. Dhar NB, Klein EA, Reuther AM, Thalmann GN, Madersbacher S, Studer UE, *et al.* Outcome after radical cystectomy with limited or extended pelvic lymph node dissection. J Urol 2008;179:873-8.

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