Robot-assisted radical cystoprostatectomy in complex surgical patients: single institution report

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LEE DJ, ROTHBERG MB, MCKIERNAN JM, BENSON MC, BADANI KK. Robot-assisted radical cystoprostatectomy in complex surgical patients: single institution report. The Canadian Journal of Urology. 2009;16(3):4664-4670.

Objective: *To evaluate the safety and feasibility of robotic-assisted radical cystoprostatectomy (RRCP) in a salvage setting for patients with a history of radiation and chemotherapy treatment, complex pelvic anatomy, and significant comorbidities.*

Materials and methods: *Over a 5 month period, six patients who met these criteria underwent RRCP for urothelial carcinoma. Two of the patients had major cardiovascular disease and were previously denied an open procedure subsequently underwent chemotherapy with external beam radiation protocol. One patient had brachytherapy for prior prostate cancer, and three additional patients had neoadjuvant chemotherapy with large diverticula, measuring up to 12 cm in size. Data was collected on patient demographics, comorbidities, intraoperative parameters, and postoperative outcomes.*

Results: *The mean age was 70.4 years (range 53-84 years) with an average BMI of 25.8 (23.33-28.37). All patients were male. All six RRCPs were completed without intraoperative complications or open conversion. The estimated blood loss was 296 cc (150 cc-500 cc). Four patients had pathologic pT3a disease, one patient had pT4a, and one patient had pT1 urethral squamous cell carcinoma. Four of the patients had positive nodes. All six patients had negative surgical margins. The patients were discharged within a mean of 12 days (range 7-28 days).*

Conclusions: *Robot-assisted radical cystoprostatectomy is a minimally invasive option in men with complex surgical anatomy and multiple comorbidities. Short term follow up indicates good clinical and pathologic outcome and physiologic benefit of minimally invasive surgery. However a larger cohort with long term follow up is needed to assess the oncologic efficacy of RRCP.*

Key Words: cystectomy, bladder carcinoma, robot, laparoscopy, salvage, chemotherapy

Introduction

Bladder cancer represents the fifth most common malignancy in the United States, with approximately 68180 new cases and 14100 deaths in 2008.[1] Although most cancers are superficial at diagnosis, about 20%-40% progress to muscle invasive cancers.[2-4] Open radical cystoprostatectomy (ORCP) with lymph node dissection is the standard treatment for patients with muscle invasive bladder cancer and is effective for patients with high grade, recurrent bladder cancers, with well documented oncologic outcomes.[5-7] However, ORCPs remain a complex procedure with morbidity rates up to 45% and mortality rates up to 3% in contemporary series.[6,8-13] The elderly, who comprise the majority of patients with bladder cancer, are especially susceptible as morbidity and mortality rates following ORCPs are independently associated with age and increasing comorbidities.[14,15]

Accepted for publication March 2009

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Recent studies have suggested that minimally invasive techniques can reduce short and long term morbidity rates while maintaining similar oncologic outcomes to open procedures. Menon and colleagues first described the feasibility and safety of robotic-assisted radical cystoprostatectomy (RRCP) with pelvic lymph node dissection in 2003.[16] Since then, multiple reports have shown improvement in morbidity rates, decreased blood loss and transfusion requirement, shorter hospital stay, and faster return to normal daily function[17-21] with similar pathologic outcome, lymph node yield, and short term recurrence rates.[6,18,22]

Prior treatment with external beam radiation and systemic chemotherapy can also affect surgical outcomes in pelvic surgery. The reactive tissue associated with radiotherapy can make radical cystectomy technically challenging. Salvage prostatectomy has been associated with a higher rate of complications and surgical morbidity, worse continence rates, higher incidence of rectal injury, and higher blood transfusion requirements.[23-26]

Previously, we described the first case report[27] of a successful salvage RRCP on a patient with multiple comorbidities who had a recurrence of bladder cancer after external beam radiation therapy (ERBT) and systemic chemotherapy. Now, we report the feasibility and safety of RRCP on six patients who were considered difficult surgical patients due to multiple comorbidities, difficult anatomy, and neoadjuvant treatments.

Patients and methods

Between December 2007 and June 2008, twelve patients underwent RRCP with six patients meeting our criteria for complex RRCP; five patients had transitional cell carcinoma and one patient had squamous cell carcinoma of the urethra. All procedures were performed by a minimally invasive fellowship trained surgeon at a single institution using the da Vinci S robotic system (Intuitive Surgical, Sunnyvale CA, USA). All the patients underwent RRCP, which was followed by open urinary diversion by one of three experienced surgeons. Patient data was obtained through a prospectively collected database. The outcome measures included patient demographics, preoperative status, operative time, operative blood loss, postoperative complications, and pathological outcomes. Patient characteristics are listed in Table 1.

Surgical technique

Our procedure follow principles of previously published technique of robotic radical cystectomy.[28] The patients were placed in a steep Trendelenburg position in dorsal lithotomy. Six ports were placed; 12 mm periumbilical camera port, three 8 mm robotic ports, one 5 mm assistant port and one 12 mm assistant port. The daVinci S robot was then docked to the patient. Initially, the ureters were identified, dissected out bilaterally to the ureterovesical junction, and doubly clipped with Hem-o-lok clips and divided. Next, the posterior portion of the dissection was completed by following the vas deferens into the seminal vesicles, and continued posteriorly to the apex of the prostate. The soft tissue surrounding the seminal vesicles was kept en block to ensure wide margin resection. The pedicles of the bladder were identified and divided. The endopelvic fascia was opened and the prostatic pedicles were divided to the apex bilaterally. Dissection of the posterior plane continued along the surface of the rectum to ensure wide margins. The remaining bladder attachments were divided. Transection of the dorsal venous complex was completed down to the urethra. A running 2-0 Vicryl stitch was used to ligate the dorsal venous complex after it was divided. Dissection of the urethra was then continued down to the urogenital diaphragm in those patients requiring urethrectomy. Clamps were placed proximally and distally with hemo-o-lock clips, and the urethra was divided. Lymphadenectomy followed the zones as described by Burkhard and Studer.[29] Upon completion of the robot-assisted procedure, the urinary diversion was completed by extension of the midline camera port site.

Results

Individual patient data for the six patients is listed in Table 1. The mean age was 58.4 years (range 53-84 years) with an average BMI of 26.72 (23.33-29.89), and all patients were men. Two of the patients had major cardiovascular comorbidities with ASA scores of 3 and Carlson Age Comorbidity Index scores greater than 10, both of whom were denied an open cystectomy previously. As a result, both patients were placed on a chemoradiation protocol for the bladder cancer with subsequent recurrence of tumor. Three of the patients had failed prior BCG treatment, and one patient had failed MVAC treatment. Four of the patients had large diverticula, ranging from 5 cm to12 cm in size with tumor. CT scans of patients two and three showing the bladder cancer can be seen in Figures 1 and 2, respectively. Lastly, one patient developed urethral squamous cell carcinoma 10 years after brachytherapy for prostate cancer and underwent RRCP.

All six RRCPs were completed without any intraoperative complications or open conversion. The mean estimated blood loss for the RRCP portion of the case was 296 cc (range 125 cc-500 cc). The three patients

TABLE 1. **Characteristics of patients undergoing robotic-assisted radical cystoprostatectomy (RRCP)**

	Patient number					
	1	**2**	**3**	**4**	**5**	**6**
Age	55.2	83	53.6	84.3	67.4	79
BMI	27.77	24.33	28.37	23.33	26.63	24.27
ASA score	2	3	2	3	2	2
CACI	5	10	3	11	4	5
Diagnosis	Bladder TCC	Bladder TCC	Bladder TCC	Bladder TCC	Bladder TCC	Urethral SCC
Intravesicle treatment	BCG	BCG			BCG	
Prior chemotherapy	mitomycin	carboplatin	MVAC	carboplatin	GC	
Prior radiation		XRT		XRT		Brachytherapy (prostate)
Complex anatomy	Left diverticulum (4 cm)	Posterior diverticulum (5 cm)	Large posterior diverticulum	Posterior diverticulum (12 cm)		
Prior surgery	Right inguinal hernia, lap cholecystectomy	CABGx3; bilateral CEA, lap appendectomy		CABGx2; AVR, bilateral hernia		Lap appendectomy
Operative						
Estimated blood loss (cc)	500	125	300	200	150	500
Urinary diversion	Ileoconduit	Ileoconduit	Ileoconduit	Ileoconduit	Neobladder	Ileoconduit
Pathologic stage	pT3a pN2	pT3a pN0	pT3a pN2	pT4a pN2	pT3a pN2	
Histologic grade	High grade G3	High grade G3	High grade G3	High grade G3	High grade G3	Squamous cell carcinoma
Lymph nodes removed (N)	11	32	35	24	19	18
Lymph nodes positive (N)	4	0	20	4	5	0
Surgical margins	Negative	Negative	Negative	Negative	Negative	Negative
Postoperative						
Length of stay (days)		7	10	7	13	7 28*
Complications	None	None	Wound infection	Febrile UTI	None	ileus, bacteremia

BMI = body mass index; ASA = American Society of Anesthesiologists score; CACI = Charlson age comorbidity index; DM = diabetes mellitus type 2; CAD = coronary artery disease; CABG = coronary arterial bypass graft; CEA = carotid endarterectomy; AVR = aortic valve replacement; BCG = bacillus calmette-guerin; XRT = radiation therapy; MVAC = methotrexate + vinblastine + doxorubicin + cisplatin; GC = gemcitabine+cisplatin; TCC = transitional cell carcinoma; SCC = squamous cell carcinoma; Lap = laparoscopic.
*patient discharged to acute rehabilitation on postoperative day 28

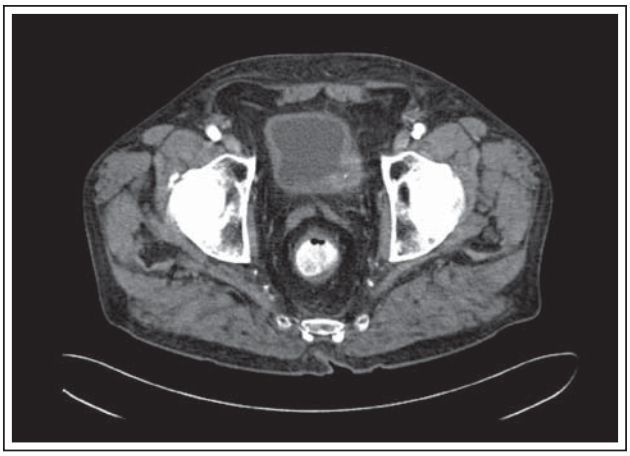

Figure 1. CT abdomen/pelvis with IV contrast of patient 2.

who received prior radiation therapy had significant fibrosis located primarily at the lateral pelvic side wall and posteriorly along the rectum. Two of those patients also had large diverticula that added to the technical complexity. Five of the patients had transitional cell carcinoma of the bladder, while the postbrachytherapy patient had squamous cell carcinoma of the urethra. Surgical margins were negative in all patients. A mean of 23 lymph nodes were removed and examined (range 11-35), with four patients having positive lymph node disease. Four patients had pT3a disease, one patient had pT4a disease, and one patient had pT1 disease of the urethra after brachytherapy treatment for prostate cancer.

The median length of stay postoperatively for the patients was 8.5 days, while the mean hospital stay was 12 days (range 7-28). Postoperative complications included one patient with MRSA urinary tract infection, one with funguria, and one patient with

Figure 2. CT abdomen/pelvis with IV contrast of Patient 3.

wound infection. All patients were treated successfully with parenteral antibiotics or antifungal medication. The mean time to return to normal diet was 4 days, and all patients were ambulatory by postoperative day 2.

Discussion

Invasive transitional cell carcinoma of the bladder often requires aggressive therapy because it is a lethal disease; the survival rate is less than 15% if left untreated.[30] ORCPs allow wide excision of the bladder, extensive lymph node dissection, and flexibility regarding urinary diversion options. However, long open abdominopelvic procedures on patients who are more likely to be older and have more comorbidities may increase the morbidity of the procedure due to many factors, and is sometimes prohibitive in this elder patient population. With complication rates of radical cystoprostatectomies approaching 45%,[6,8-13] it is important to reduce the morbidity while maintaining the same high oncologic and clinical outcomes as ORCPs. Several investigators have reported that RRCPs can reproduce the clinical outcomes of ORCPs with decreased blood loss, bowel exposure, and decreased recovery time.[17-21]

In our case series from December 2007 to June 2008, RRCPs were performed on six patients who presented with difficult surgical circumstances. Two of the patients were denied open radical cystectomy due to severe cardiovascular disease, arterial bypass surgery, and bilateral carotid endarterectomy, greater than 80 years of age and were treated with chemotherapy and radiation. One additional patient developed urothelial malignancy after brachytherapy for prostate cancer. These three patients had significant scarring and fibrous adhesions due to the prior chemoradiation therapy, which is associated with higher morbidity than standard surgical procedures.[31] Salvage radical prostatectomies, a similar procedure to salvage RRCPs, are associated with 5 year continence rates of 68%, and blood transfusion rates of 13%-17% due to the technical difficulty from radiation damage.[23-26] Four of our patients also had large bladder diverticula filled with tumor, adding further complexity to the procedure.

Despite the challenging clinical characteristics of these patients, RRCP was performed without any significant intraoperative or perioperative complications. The estimated blood loss, transfusion rate, surgical margin rate, and postoperative complication and morbidity rates were similar to several other larger series.[16-18,21,22,32] The mean blood loss was 296 cc (range 150 cc-550 cc), and no positive margins were seen in any of the patients. The average length of stay was 12 days (7-28).

Menon and colleagues were the first to report on their experience with 17 RRCPs, with a mean blood loss under 150 cc, mean operative time of 140 min for the cystectomy portion and 120 min for the ileal conduit creation, with no positive margins.[16] The surgical techniques and similar outcomes were then reproduced at other hospitals. Wang and colleagues compared 33 patients undergoing RRCPs and 21 patients undergoing ORCPs, showing significantly decreased blood loss, earlier return of bowel function, and shorter hospital stays.[18] Hemal and colleagues followed 48 patients who underwent RRCP, showing mean cystectomy and pelvic lymphadenectomy time of 178 minutes, mean blood loss of 456 cc, and one patient with positive margins.[32] Pruthi and colleagues followed 20 patients who received RRCP, and found mean operative time of 366min for the cystectomy and urinary diversion creation, with a mean blood loss of 313 cc.[17] Guru and colleagues followed 20 patients who underwent RRCP, and found the mean total operative time to be 442 min, mean blood loss of 555 cc, with a mean start of clear diet at the fourth postoperative day, and a mean hospital stay of 7 days.[21] Abraham and colleagues compared 20 patients who underwent laparoscopic radical cystoprostatectomies against 14 who underwent RRCP, and found that patients who had RRCPs had significantly decreased blood loss, transfusion rates, and mean time to oral intake.[33]

Although the perioperative outcomes of RRCP have been well documented, there is a relative paucity of literature describing the long term oncologic outcomes because of the recent advent of RRCP. The long term oncologic outcomes following ORCP are well established. Stein and colleagues reported on 1054 patients and showed recurrence free and 5 year survival rates at 68% and 66%, respectively.[6] Madersbacher and colleagues reported that the 5 year recurrence free and overall 10 year survival rates on 507 patients was 73% and 62%, respectively.[34] Pruthi and colleagues reported on 50 patients who had RRCP, with a mean follow up time of 13.2 months, and found that the overall survival rate and disease specific survival rate were 90% and 94%, respectively.[22] Haber and Gill reported on a group of 37 patients who had laparoscopic radical cystoprostatectomies with a mean follow up time of 31 months, and reported metastases in 5.4% of the patients, and overall survival rates and cancer specific survival rates after 5 years were 63% and 92%, respectively.[35] Haber and Gill also reported on a separate group of 76 patients with a mean follow up time of 25 months, with an overall survival rate and cancer specific survival rate at 2 years of 84.2% and 94.5%, respectively.[36] These studies indicate that the initial data on the short term oncologic outcomes of RRCP are similar to those of ORCP, but need continuous long term evaluation.

This series does not attempt to make comparison to open radical prostatectomy, as our data has not been compared to our contemporaneous open radical cystectomy series. It is important to note that our team has extensive robotic experience, chiefly from our prostatectomy experience, that has allowed us to perform these challenging procedures. Extensive experience with laparoscopic pelvic anatomy enables the surgeon to identify the anatomical landmarks despite the difficult circumstances, and make accurate decisions about the planes of dissection. RRCP may also allow greater visualization of the small and difficult to access visual field of the pelvis. The daVinci robot shows a 10-12x magnification of the pelvis in three-dimensions, and allows the user to scale hand motions for precise instrument control from a range of 2:1 to 5:1, which may also aid in fine dissection techniques needed in complex scenarios.[37]

Although we have shown the feasibility and safety of RRCPs, there are several limitations to the applications from this case series. First, after the cystoprostatectomy was performed with the robot, the robot was de-docked from the patient and the urinary diversion procedure was performed through an open incision. Although the cosurgeons who performed the open procedures were experienced surgeons, the application of the perioperative outcomes of this case series is limited. It is not possible to attribute the low morbidity outcomes of these patients solely to the robot-assisted procedure. However, the removal of the bladder and the prostate is considered the more anatomically challenging and hemodynamically unstable portion of a cystoprostatectomy. The minimal blood loss, short operative time, and negative surgical margins in all of the patients supports previous reports of RRCPs and is suggestive that robot assistance may be comparable to open radical cystectomy with the added benefits of minimally invasive surgery.

Another limitation to the case series is that the follow up period is very short to accurately determine functional and oncologic outcomes for the patients. Although the short term results for the patients have been promising, the long term implications will need to be evaluated. Given the paucity of literature regarding long term outcomes of robotic-assisted cystectomies, we will continue to follow the clinical course of the patients.

Conclusion

This complex patient series demonstrates that RRCP can be performed in complex anatomical and physiological bladder cancer patients with excellent short term outcome. Although the initial data is encouraging, further long term prospective follow up is required to fully validate the oncologic efficacy of robotic-assisted cystectomy. □

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EDITORIAL COMMENT

Application of robot-assisted surgery has progressed with its use in the pelvis especially for radical cystectomy and hysterectomy. Despite this advance, the average patient undergoing robot-assisted radical cystectomy is older, has multiple comorbid conditions and potential for metastatic disease which needs to be addressed with thorough oncologic diligence. Fairey et al[1] in their retrospective analysis of 314 patients found that severe medical comorbidity was associated with an increased 90 day mortality and risk of postoperative complication. Megwalu II et al[2] evaluated 675 patients and revealed that comorbidity was an independent predictor of overall survival. This paper brings to light a critical component observed in patients who are surgical candidates for advanced localized bladder cancer. However, robot-assisted radical cystectomy should be cautiously introduced at centers which have already established their robot-assisted surgical programs. Extensive experience in robot-assisted radical prostatectomy and a significant background in open oncologic surgery are required to manage the burden of this lethal disease.

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