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RARC Pasadena Consensus Panel – Surgery in Motion

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Robot-assisted Radical Cystectomy and Urinary Diversion: Technical Recommendations from the Pasadena Consensus Panel

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Abstract

Background: The technique of robot-assisted radical cystectomy (RARC) has evolved significantly since its inception >10 yr ago. Several high-volume centers have reported standardized techniques with refinements and subsequent outcomes.
Objective: To review all existing literature on RARC and urinary diversion techniques and summarize key points that may affect oncologic, surgical, and functional outcomes.
Design, setting, and participants: The Pasadena Consensus Panel on RARC and urinary reconstruction convened May 3–4, 2014, to review the existing peer-reviewed literature and create recommendations for best practice. The panel consisted of experts in open radical cystectomy and RARC. No commercial support was received.
Surgical procedure: The consensus panel extensively reviewed the surgical technique of RARC in men and women, extended pelvic lymph node dissection, extracorporeal urinary diversion, and intracorporeal urinary diversion. Critical aspects of the technique are described.
Outcome measurements and statistical analysis: Preoperative, operative, and postoperative parameters from the largest and most contemporary RARC series, stratified by urinary diversion technique, are presented.
Results and limitations: Preoperative, operative, and postoperative measures of RARC technique adhere closely to the standards established in open surgery.
Conclusions: Refinement of techniques for RARC and urinary diversion over the past 10 yr has made it safe, reproducible, and oncologically sound.
Patient summary: We summarize the critical aspects of surgical techniques reviewed at the Pasadena international consensus meeting on RARC and urinary reconstruction. Preoperative, operative, and postoperative measures of RARC technique adhere closely to the standards established in open surgery.

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1. Introduction

Robot-assisted radical cystectomy (RARC) was first described by Menon et al in 2003 [1]. Over the past 10 yr, RARC has pushed accepted standards of open radical cystectomy (ORC) and become the standard treatment for muscle-invasive bladder cancer. RARC has demonstrated operative, functional, and oncologic outcomes comparable to ORC.

The 2014 Pasadena Consensus Panel on RARC convened to review a decade of experience. In this paper, we summarize the surgical technical recommendations from the consensus group. We highlight aspects of the procedure that facilitate the transition from ORC to RARC and urinary diversion. We also discuss technical points to aid the advanced robotic surgeon. Finally, we emphasize key technical points that may affect oncologic, surgical, and functional outcomes.

2. Methods

The international Pasadena Consensus Panel consisted of a 2-d conference of experts in radical cystectomy and urinary reconstruction who reviewed the existing peer-reviewed literature on RARC, pelvic lymphadenectomy, and urinary reconstruction. This conference was organized in Pasadena, California, and convened at the City of Hope Cancer Center in Duarte, California. No commercial support was obtained for this conference. This report was compiled based on a comprehensive review of the most current surgical techniques. We describe critical points with regard to performing this surgery in a systematic, reproducible, and efficient manner.

3. Results

3.1. *Patient selection*

The degree of difficulty of RARC varies based on patient-related and disease-specific features. Favorable characteristics include the following:

- Absence of previous abdominal surgery
- Favorable body mass index (BMI)
- No previous history of pelvic radiation
- No bulky disease
- No cardiovascular or pulmonary disease
- Good performance status

The selection process should include appropriate preoperative investigations to ensure fitness for surgery, especially the ability to tolerate prolonged pneumoperitoneum and steep Trendelenburg positioning. As the surgeon's robotic experience matures, these limitations approach those of open surgery. Although not absolute contraindications, these unfavorable patient characteristics signal caution:

- BMI >30
- Extravesical disease
- Bulky lymphadenopathy
- Previous vascular surgery
- Previous pelvic radiation
- Previous distal colorectal surgery
- Previous pelvic trauma
- Preexisting cardiovascular/pulmonary disease that is compromised with positioning

Favorable patient characteristics when learning RARC are those likely to allow a timely procedure with minimal risk of complications. More challenging cases are best performed by experienced surgeons.

3.2. *Positioning and port placement*

The preferred patient positioning for RARC is Trendelenburg, with approximately 30° head down. Foam-cushion table liners help prevent the patient from sliding during this positioning. The legs are in stirrups with minimal hip flexion. The knees are flexed a gentle 30° and legs are spread to accommodate the robotic surgical system. Arms may be adducted in arm guards or abducted out on arm boards.

Port placement is similar to that of robot-assisted radical prostatectomy (RARP). The key difference is that the ports are placed more cephalad. Two port-placement configurations are commonly used, one based on anatomic landmarks and the other based on measurements. The first configuration, described by the Karolinska group, places the midline camera port 5 cm above the umbilicus with the second, third, and fourth arms placed at the level of the umbilicus (Fig. 1). The second, measurement-based configuration, described by the City of Hope group, places the midline camera point 25 cm from the pubic symphysis with the second, third, and fourth arms 20–23 cm from the pubic symphysis (Fig. 2). The fourth arm is used on the right or left based on surgeon preference. The assistant's port sites are usually 12-mm ports placed contralateral to the fourth arm laterally and one placed superomedially 3 cm below the costal margin and split between the telescope port and right pararectus port on that same side. Port placement may vary depending on the configuration of the abdominal cavity once pneumoperitoneum is achieved.

Port configuration should facilitate performance of an extended pelvic lymph node dissection (ePLND) and improve access to the afferent limb to perform the ureteral anastomoses during both intracorporeal and hybrid urinary

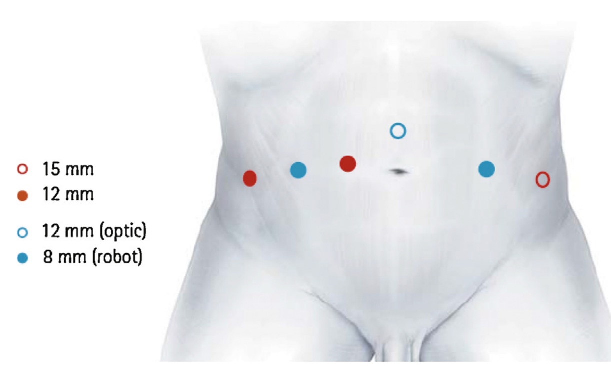

Fig. 1 – Karolinska port-placement configuration.

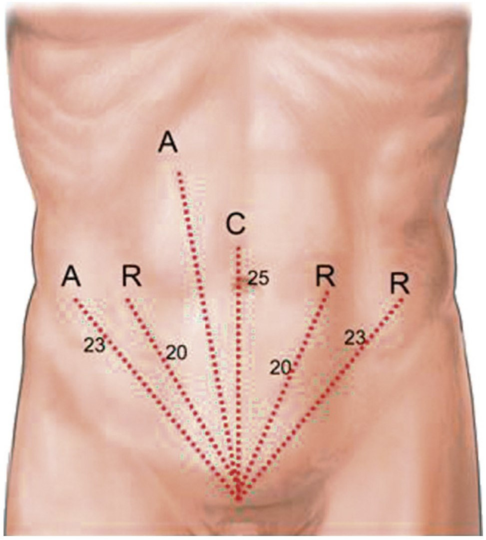

Fig. 2 – City of Hope port placement.
A = assistant, 12 mm; C = camera, 12 mm; R = robot, 8 mm.

diversions. Some authors lessen the degree of Trendelenburg positioning after the cystectomy and ePLND dissection to approximately 15° to facilitate intracorporeal neobladder construction and urethral–neobladder anastomosis.

3.3. *Technical variations for the male cystectomy*

The initial posterior dissection is extremely important in the early setup of RARC. Before mobilizing the bladder, it is essential to develop the plane between the rectum and prostate as distally as possible. At this point, the pararectal space is developed bluntly to avoid damaging the neurovascular bundles that sit just lateral to the rectum.

In patients appropriate for nerve sparing, the tips of the seminal vesicles are identified, but it is not necessary to mobilize the seminal vesicles or the vas deferens. The posterior pedicles are divided without thermal energy along the seminal vesicles. Men who have erectile dysfunction, who are sexually inactive, and/or who have large-volume posterior disease are not considered candidates for nerve sparing. Furthermore, in men with these criteria who are having a cutaneous form of urinary diversion, a wide resection of the posterior and lateral pedicles to the bladder is performed, and the endopelvic fascia is routinely opened when approaching the prostatic apex. Men who are impotent but having a neobladder reconstruction may benefit from nerve sparing because it may improve subsequent urinary continence [2].

After dissecting the urethra circumferentially, a large (gold) Hem-o-Lok clip (Weck Closure Systems, Research Triangle Park, NC, USA) is secured on the urethra just beyond the apex of the prostate, and the urethra is cut just distal to the clip. Principles to guide male RARC draw heavily from the RARP experience when performing nerve sparing [3]. The endopelvic fascia can be preserved or opened depending on the surgeon's preference. A high anterior release of the veil tissue is performed with minimal thermal energy. Once at the apex, the dorsal vein is controlled and the urethra is dissected. The bladder must be emptied before cutting the urethra to prevent spillage of urine. Some surgeons place a posterior stitch in the urethra at this time to facilitate the neobladder–urethra anastomosis later in the procedure. A frozen section of the prostatic urethra is sent to pathology to confirm the absence of malignancy.

3.4. *Technical variations for female cystectomy*

Once the posterior pedicles to the bladder are divided, the uterus (if present) is grasped with a robotic tenaculum to expose the vaginal apex. To maintain pneumoperitoneum and facilitate identification of the vaginal apex, a sponge stick or a vaginal manipulator is used to identify the point at which the apex of the vagina will be opened. The AirSeal (SurgiQuest, Milford, CT, USA) port is very helpful to maintain pneumoperitoneum. Most women undergo simultaneous hysterectomy.

In women who are candidates for neobladders and whose stage of disease allows preservation of the vagina, a plane is established between the bladder and the anterior vaginal wall. The dissection then preserves the lateral vaginal soft tissue, staying close to the posterior lateral border of the bladder when oncologically safe to do so. Stenzl et al have shown that this nerve-sparing technique improves sexual function and urinary continence [4]. Otherwise, as in open anterior exenteration, the anterior vaginal wall is resected along with the bladder. Hemostasis can be challenging alongside the vagina and posterior lateral to the bladder. This tissue is clipped and divided coldly in the nerve-sparing approach or divided with energy (Harmonic Scalpel or Vessel Sealer) when not.

The vagina is closed with absorbable suture. Suspension of the vagina to the sacral promontory or the pubic rami with nonabsorbable suture helps prevent prolapse. Some surgeons advocate placing the peritoneum between the vaginal wall and the neobladder to avoid fistula formation.

3.5. *Extended pelvic lymphadenectomy*

The ORC literature has established ePLND as an essential element of radical cystectomy that affects oncologic outcomes while acting as a surrogate for the quality of the surgical resection. Previous criticism of RARC is that the ePLND cannot be as complete as in open surgery due to limitations accessing the nodes at the aortic bifurcation. However, contemporary RARC series reveal lymph node yields comparable with ORC series [5].

The limits of dissection for ePLND in RARC are identical to those of open surgery. However, as with open surgery, there are some variations among expert robotic surgeons including the proximal limits of dissection and the need to resect the presacral lymph nodes. The three proximal limits of dissection described at the consensus meeting are 2 cm above the aortic bifurcation, the aortic bifurcation, and the crossing of the ureter over the common iliac artery. Technological advances in the robot platform have improved access to the more proximal nodes. There also appears to be a 50–50 divide among robotic surgeons regarding the resection of presacral lymph nodes, more due to prognostic yield rather than to technical challenges.

A hotly debated topic is when to perform the ePLND, that is, before or after the cystectomy. Those who prefer the ePLND before the cystectomy believe the dissection sets up the cystectomy by exposing the pedicles clearly and allowing for meticulous resection of the bladder. In addition, with the urachus still suspended in its anatomic position, the obliterated umbilical artery provides a useful guide toward the internal iliac regions. Several robotic experts also like to perform this portion early on because it is considered one of the most important oncologic components of the procedure and the most technical and time-intensive portions of the operation. Those surgeons that prefer to perform the lymph node dissection after the cystectomy prefer to have more space in which to perform the ePLND. Regardless of when the lymph node dissection is performed, it is critical to adhere to all oncologic principles and to establish a consistent approach that facilitates a systematic and complete RARC and ePLND.

3.6. Cystectomy principles

Detailed descriptions of our cystectomy techniques were described previously [6–9]. Although the technique of cystectomy may vary based on the timing of ePLND (before or after cystectomy), the general principles remain similar. Division of the ureters is typically performed using Hem-o-Lok clips that have color-coded stay sutures that facilitate later identification and orientation. The lateral pedicles are divided using Hem-o-Lok clips, stapler, or LigaSure vessel seal (Covidien, Mansfield, MA, USA), depending on whether a nerve-sparing procedure is being performed. The dorsal vein complex (DVC) in men is divided using a stapler, and some prefer a complete cold dissection of the DVC and oversewing with a hemostatic V-Loc (Covidien) suture. The prostatic urethra is closed before division using an extra-large Hem-o-Lok to prevent tumor spillage. The Endo Catch II 15-mm specimen pouch (Covidien) allows for safe and easy removal of the specimen through relatively small extraction sites.

3.7. Extracorporeal urinary diversion

3.7.1. Incision sites

Several sites have been used for the extraction of specimen and subsequent extracorporeal urinary tract reconstruction including periumbilical midline (incorporating the camera port), infraumbilical midline (separate from the camera port), Pfannenstiel, and McBurney (incorporating right-sided port site for ileal conduits). Murphy recommended against a right-sided incision site because it may increase the risk of ureteroileal anastomotic strictures arising from the need for increased mobilization of the left ureter. Most surgeons use an infraumbilical midline incision that provides the best access to the ureters and afferent limb of the diversion regardless of body habitus.

3.7.2. Ureteral anastomoses

One of the most common concerns regarding extracorporeal urinary diversion is the degree of ureteral mobilization necessary to perform the ureteroenteric anastomosis at the level of the skin incision. Guiding principles include minimizing tension and performing the ureteral anastomosis as proximally to the ureter as possible. Care is taken to ensure correct orientation of the ureter and to avoid any twists. The use of an Alexis wound retractor (Applied Medical, Rancho Santa Margarita, CA, USA) provides optimal exposure through the 7-cm incision (Fig. 3). In patients in whom the ureter needs to be resected more proximally or in obese patients, the surgeon should not hesitate to extend the incision to optimize conditions for the ureteral anastomosis.

The ureteroenteric anastomosis is also approached in a hybrid fashion. For the ileal conduit, the bowel segment is isolated, bowel continuity is reestablished, the incision is closed, and the robot is redocked to perform the ureteral anastomosis. Similarly, for neobladders, the bowel anastomosis and pouch construction are performed extracorporeally, and then the robot is redocked to perform the urethral anastomosis and, subsequently, the ureteral anastomoses. This approach allows the surgeon to use a more proximal, less mobilized, and presumably better perfused ureter. By performing the ureteral anastomoses after the urethral anastomosis, the position of the afferent limb is fixed, minimizing the chance for significant change in the lay of the afferent limb that is sometimes seen after the urethral anastomosis is performed.

3.7.3. Orthotopic neobladder

The most common approach uses an infraumbilical midline incision of approximately 7 cm. An Alexis wound retractor optimizes this exposure. The ileal segment is isolated, and the pouch is constructed in the usual open fashion. The pouch is then placed down into the pelvis with only the afferent limb and bilateral ureters exposed at the incision. The ureteroenteric anastomoses are performed. The abdomen is then closed, and the robot is redocked to perform the urethral–enteric anastomosis using the van Velthoven technique with absorbable suture. This is a time-efficient

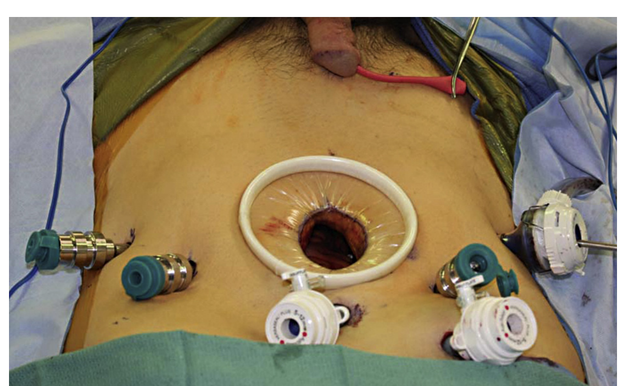

Fig. 3 – Use of the Alexis wound retractor for extracorporeal urinary reconstruction.

technique that minimizes the learning curve. A less commonly used alternative preplaces the interrupted urethral sutures robotically and then performs the urethral–enteric anastomosis in the open fashion.

Some surgeons now perform both the urethral and ureteral anastomoses robotically, performing only the bowel anastomosis and pouch construction in an open fashion for the reasons just mentioned. The rationale is that it provides all the same benefits of the intracorporeal neobladder without the inconvenience of performing all the bowel work intracorporeally.

3.7.4. *Continent cutaneous urinary diversion*

Continent cutaneous urinary diversion remains an important option for those patients who are not candidates for orthotopic urinary diversion. There have been some case reports using an intracorporeal technique; however, most of the experience with RARC has involved an extracorporeal technique. The primary technique was described previously, but modifications have been made [8].

Once the radical cystectomy is complete, the robot is undocked, all ports are kept in place, and a 7- to 8-cm infraumbilical incision is made. The specimen is removed, and a GelPort (Applied Medical, Rancho Santa Margarita, CA, USA) is placed over the Alexis retractor. The patient is tilted to the left side to allow for a safe and expeditious laparoscopic mobilization of the right colon using a hand-assisted technique. This mobilization technique also allows for the use of a Pfannenstiel incision that would not typically give optimal exposure for the colon mobilization. The hand port is then removed, and using only the Alexis retractor, the bowel work is performed to construct the continent cutaneous pouch, the ureteral anastomoses are completed, and the stoma is matured.

3.8. Intracorporeal urinary diversion

3.8.1. *Bowel division and anastomosis*

Proper positioning and safe manipulation of the bowel is essential for intracorporeal urinary tract reconstruction. Two common techniques are the Marionette technique described by Guru et al [10] and a technique that utilizes Ligaloop bands (Braun Dexon, Spangenberg, Germany) positioned in windows between the bowel and mesentery, described by Jonsson et al [11]. Bowel measurements are made using the stapler (10 cm) or the robotic instruments as a reference measure. A 45-mm or 60-mm stapler that is brought in through a left-sided hybrid 15-mm port best facilitates division and reanastomosis of the bowel. Continuity of the bowel is reestablished in a side-to-side fashion along the antimesenteric borders. Some surgeons prefer a separate port in the suprapubic area that will avoid excessive mobilization and rotation of the bowel toward the stapler in the proximally placed ports. They utilize this incision to remove the specimen in men and convert the incision to a Pfannenstiel incision. The opening created between the two bowel segments by the initial staple load rejoining the bowel segments may be further extended by an additional staple load. The bowel anastomosis is then completed by transverse staple load to close the two ileal ends.

3.8.2. *Ileal conduit*

Once the 20-cm segment of ileum is isolated, the ureters are anastomosed to the afferent aspect of the ileal segment using a Wallace or Bricker technique, according to surgeon preference. With the Wallace technique, as described by Jonsson et al [11], single-J ureteral stents are introduced through an assistant's port at the distal aspect of the ileal segment and pulled proximally from the afferent limb opening using a Cadiere forceps and subsequently passed into each ureter. The ureteral–enteric anastomosis is then completed using two 4-0 absorbable Quill sutures (Angiotech, Reading, PA, USA). With the distal stents still outside the abdomen, they are cut shorter. The stoma location is then prepared, with a cruciate incision at the fascia and preplaced absorbable anchoring sutures placed. A 15-mm port is brought through the stomal skin opening and the distal end of the conduit along with the stents secured with a laparoscopic Babcock clamp through the port. Once the specimen is removed, the abdomen is desufflated, and the distal ileum is brought out to mature the stoma.

The Bricker technique, as described by Guru et al [10], starts by creating two small enterotomies in the proximal aspect of the ileal segment. Each ureter is partially transected and spatulated so the distal end can be used as a handle. The anastomosis can be performed with a double-armed 4-0 Vicryl suture (5 cm long) that begins at the angle of the ureteric spatulation and runs on both sides, or interrupted sutures can be used. Once the posterior wall is completed, the stent is placed. A laparoscopic suction tip is gently passed from an enterotomy in the distal ileal conduit segment across the ureteral opening. A wire is placed up the ureter, and the single-J stent is then advanced into the kidney. A 3-0 chromic suture is used to secure the stent to the distal conduit to prevent accidental dislodgement. The distal ureter is then completely divided, and the anastomosis completed. The stoma site is prepared at the premarked location, and a Babcock forceps is used to grasp the distal ileal segment and stents to mature the stoma.

3.8.3. *Neobladder*

The most common technique for intracorporeal neobladder was described by Jonsson et al [11]. Ligaloop bands help position the distal ileum into the pelvis. The ileum must have sufficient mobility to reach down to the urethra without tension. Prior to any bowel division, the urethral–enteric anastomosis is performed 10 cm proximal to the projected distal aspect of the ileal segment. A 20F opening is created at the antimesenteric border using cold shears, and the anastomosis is performed using the van Velthoven technique with a 2×18-cm 2-0 Biosyn suture. The bowel is then divided with a stapler at 10 cm distal and 40–50 cm proximal to the urethral anastomosis. After restoration of bowel continuity, the distal 40 cm of ileal segment is detubularized, and the 10–20 cm of the afferent limb remains intact. The seromuscular portion (avoiding mucosa) of the posterior aspect of the neobladder is closed

Table 1 – Robot-assisted radical cystectomy with extracorporeal urinary diversion: preoperative characteristics

Study	*n*	Age, yr, median/mean	BMI, kg/m^2, median/mean	ASA score ≥3, %	Neoadjuvant chemotherapy, %	Prior abdominal/pelvic radiation, %	Prior abdominal/pelvic surgery, %
Xylinas et al [12]	175	73/NR	27/NR	52	23	10	37
Kader et al [13]	100	NR/67	NR/27	78	10	4	52
Yuh et al [14]	196	70/NR	27/NR	79	22	NR	54
Styn et al [15]	50	NR/67	NR/30	54	46	0	42
Khan et al [16]	50	NR/66	NR/29	18	12	NR	NR
Pruthi et al [17]	100	NR/66	NR/27	NR	NR	NR	NR

ASA = American Society of Anesthesiologists; BMI = body mass index; NR = not reported.

in a running fashion with multiple 25-cm 3-0 Biosyn sutures. The neobladder is then folded transversely, and the distal aspect of the pouch is closed with a running suture, leaving the proximal aspect near the afferent limb open.

The ureters are anastomosed using the Wallace technique. The ureters are spatulated 2–3 cm, and the posterior walls reapproximated using a 15-cm running 4-0 Biosyn suture. Stents are passed through separate "punctures" in the low abdomen with a Venflon cannula to allow the stent and guidewire to be passed. The stents are then pulled into the afferent limb by a Cadiere forceps and passed up each ureter. The ureteral anastomoses are then completed by suturing the Wallace plate to the afferent limb of the neobladder using a 2 × 18 4-0 Biosyn suture. The neobladder is then closed completely, and a Foley catheter is placed.

3.9. *Surgical outcomes*

Tables 1–6 present the perioperative outcomes for the techniques discussed. These tables list the largest and most contemporary published RARC series with extracorporeal and intracorporeal urinary diversion.

3.9.1. *Preoperative characteristics*

Tables 1 and 4 describe the preoperative characteristics of patients undergoing RARC in contemporary series. In the extracorporeal series, average ages range between 67 and 73 yr with a BMI range of 27–30 kg/m^2. The three larger series include 52–79% of patients with an American Society of Anesthesiologists (ASA) physical status classification score ≥3. In the intracorporeal series, ages range from 61 to 71 yr, BMI ranges from 26 to 28 kg/m^2, and the percentage of patients with ASA ≥3 is 33–52%. The percentage of patients with previous abdominal surgery ranged from 37% to 54% and from 18% to 57% in the extracorporeal and intracorporeal groups, respectively.

3.9.2. *Operative characteristics*

In Tables 2 and 5, we describe the operative characteristics of those patients undergoing RARC. The operative times range from 258 to 455 min in the extracorporeal group, but a varied proportion of urinary diversion types should be accounted for when evaluating this parameter. Similarly, the range of 318–594 min in the intracorporeal group reflects a disparate proportion of ileal conduits and neobladders across the groups. In the extracorporeal group,

Table 2 – Robot-assisted radical cystectomy with extracorporeal urinary diversion: operative characteristics

Study	*n*	Length of surgery, min, median/mean	EBL, ml, median/mean	Transfusion, %	Ileal conduit, %	Neobladder, %	Continent cutaneous diversion, %
Xylinas et al [12]	175	360/NR	400/NR	17	62	23	15
Kader et al [13]	100	NR/451	NR/423	15	97	3	0
Yuh et al [14]	196	432/NR	400/NR	44	32	44	24
Styn et al [15]	50	NR/454.9	NR/350	2	72	28	0
Khan et al [16]	50	NR/361	NR/340	4	90	10	0
Pruthi et al [17]	100	258/NR	250/NR	NR	61	38	0

EBL = estimated blood loss; NR = not reported.

Table 3 – Robot-assisted radical cystectomy with extracorporeal urinary diversion: postoperative characteristics

Study	*n*	LOS, d, median/mean	Readmission, %	30-d complications, overall/major, %	90-d complications, overall/major, %	Mortality, 30 d/90 d, %
Xylinas et al [12]	175	7/NR	NR	42/NR	34/NR	2.8/NR
Kader et al [13]	100	6/NR	17	NR	36/10	1/NR
Yuh et al [14]	196	9/NR	NR	NR	80/35	2/4
Styn et al [15]	50	NR/10	28	66/28	NR	0/0
Khan et al [16]	50	NR/10	18	NR	34/10	NR
Pruthi et al [17]	100	NR/5	11	36/8	NR	NR

LOS = length of stay; NR = not reported.

Table 4 – Robot-assisted radical cystectomy with intracorporeal urinary diversion: preoperative characteristics

Study	*n*	Age, yr, median/mean	BMI, kg/m^2, median/mean	ASA score ≥3, %	Neoadjuvant chemotherapy, %	Prior abdominal/pelvic radiation, %	Prior abdominal/pelvic surgery, %
Collins et al [6]	113	NR/64	NR/26	NR	31	NR	NR
Azzouni et al [7]	100	71/NR	28/NR	52	20	NR	57
Goh et al [18]	15	68/NR	27/NR	NR	33	7	41
Canda et al [19] *	27	NR/61	NR/26	33	30	0	18
Pruthi et al [20]	12	NR/61	NR/28	NR	NR	NR	NR

ASA = American Society of Anesthesiologists; BMI = body mass index; NR = not reported.
* Two patients had extracorporeal neobladder construction.

Table 5 – Robot-assisted radical cystectomy with intracorporeal urinary diversion: operative characteristics

Study	*n*	Length of surgery, min, median/mean	EBL, ml, median/mean	Transfusion, %	Ileal conduit, %	Neobladder, %	Continent cutaneous diversion, %
Collins et al [6]	113	390/NR	350/NR	NR	38	62	0
Azzouni et al [7]	100	352/NR	300/NR	10*	100	0	0
Goh et al [18]	15	450/NR	200/NR	53	47	53	0
Canda et al [19] **	27	NR/594	NR/430	NR	7	93	0
Pruthi et al [20]	12	NR/318	NR/221	NR	75	25	0

EBL = estimated blood loss; NR = not reported.
* Intraoperative.
** Two patients had extracorporeal neobladder construction.

Table 6 – Robot-assisted radical cystectomy with intracorporeal urinary diversion: postoperative characteristics

Study	*n*	LOS, d, median/mean	Readmission, %	30-d complications, overall/major, %	90-d complications, overall/major, %	Mortality, 30 d/90 d, %
Collins et al [6]	113	9/NR	NR	48/31	58/37	0/1
Azzouni et al [7]	100	9/NR	20	63/13	81/15	NR/1
Goh et al [18]	15	9/NR	60	73/13	80/20	NR/NR
Canda et al [19] *	27	10/NR	22	48/15	74/26	4/8
Pruthi et al [20]	12	NR/4	17	42/8	58/8	NR/NR

NR = not reported.
* Two patients had extracorporeal neobladder construction.

the estimated blood loss (EBL) ranges from 250 to 400 ml with a 2–44% transfusion rate. For the intracorporeal group, the EBL ranges from 200 to 430 ml with a 10–53% transfusion rate in the two series that reported this parameter.

3.9.3. Postoperative characteristics

Tables 3 and 6 summarize postoperative characteristics of RARC with the two diversion techniques. The length of stay (LOS) in the extracorporeal group ranges between 6 and 10 d, with a 11–28% readmission rate. The LOS for the intracorporeal series is consistently 9–10 d, with one outlying group reporting a mean LOS of 4 d. The overall and major 30- and 90-d complication rates along with 30- and 90-d mortality rates are also identified.

4. Discussion

Over the past decade, surgical robotic technology has become increasingly accessible, and our overall robotic surgical experience has become more robust with refinements in technique and operative times. RARC has transitioned from the novel efforts of innovators and early adopters to what is now becoming the product of the early majority. Still early in our experience, the extracorporeal urinary diversion has made the transition from ORC to RARC palatable to many surgeons. RARC has become established as a standardized and reproducible procedure that provides outcomes comparable with open surgery. The real value in RARC will be how it can improve the established standards in operative and functional outcomes. The magnified vision, along with the delicate dissection allowed for by robotic surgery, should ultimately improve nerve sparing and subsequent continence and potency outcomes. As robotic urinary diversion techniques continue to evolve, operative outcomes such as complication rates and LOS should also improve.

The preoperative characteristics in Table 1 for the extracorporeal urinary diversion reflect that many robotic centers of excellence are embracing RARC as a uniform standard treatment for all patient types, not a selected few. The BMI, ASA scores, and percentage of patients with prior radiation or surgery for those undergoing extracorporeal urinary diversion reflect a population similar to that of the gold standard open series [21]. Intracorporeal urinary diversion is at an earlier stage in its acceptance in the urologic community, as reflected in the sample sizes seen in Table 4.

It is important to note the distribution of urinary diversion types in Table 2. The use of RARC at this point in its evolution must not affect the type of urinary diversion offered to a patient. The proportion of diversion types in extracorporeal series reflects contemporary open series [21]. Although early in its experience, intracorporeal diversion is rapidly developing, thanks to a few innovators championing this effort [7,22]. The increasing adoption of intracorporeal diversion stems from the accessibility of the robot, the increased robotic proficiency among surgeons, and the development of a reproducible technique. The advances in the urinary diversion technique will only be accelerated by the continuing technological improvements in the robot.

The LOS, 5–10 d and 4–10 d in extracorporeal and intracorporeal series, respectively, attests to the nature of bowel surgery. There is not enough evidence to state that robotic surgery consistently improves this parameter. Another factor that may influence LOS is the health care environment of a particular series and country. Enhanced recovery after surgery protocols is likely to shorten LOS for both open and robotic surgery.

At this point in the evolution of RARC, complication rates in both extracorporeal and intracorporeal series do not appear to improve significantly on the established open cystectomy standard [23]. However, one can expect with increasing experience in robotic surgery and advances in robotic platforms that complication rates will ultimately decrease. Our expectation is that this nadir may ultimately improve on that of open surgery.

5. Conclusions

Remarkable progress has been made in RARC, ePLND, and urinary diversion. The technique has been significantly refined since its inception and has been shown to be safe, reproducible, and oncologically sound. Increasing expertise and significant improvements in technology will help improve both operative and functional outcomes.

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Study concept and design: Chan, Murphy, Catto.
Acquisition of data: Chan, Guru, Wiklund, Wilson, Novara.
Analysis and interpretation of data: Chan.
Drafting of the manuscript: Chan.
Critical revision of the manuscript for important intellectual content: Chan, Guru, Wiklund, Wilson, Yuh, Catto.
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Appendix A. Supplementary data

The Surgery in Motion video accompanying this article can be found in the online version at http://dx.doi.org/10.1016/j.eururo.2014.12.027 and via www.europeanurology.com.

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