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52 Anatomic Robot-Assisted Radical Cystectomy in Male

Taylor C. Peak and Ashok K. Hemal

Abstract

Radical cystectomy with an extended pelvic lymphadenectomy is the gold standard for patients with muscle-invasive bladder cancer and those with recurrent, high-grade noninvasive disease. As in other urologic malignancies, the use of the robotic platform to perform radical cystectomies has revolutionized the treatment of bladder cancer. It is clear from the results of published reports in the literature, as well as from our own experience at Wake Forest in performing over 250 robot-assisted radical cystectomies (RARC), that the clinical and oncologic goals of the radical cystectomy are achieved. Furthermore, in select patient populations it may even be preferred over the open approach. Therefore, in effort to share our experience with the urologic community, we set out to describe a detailed anatomical description of the steps that are involved in performing the RARC.

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Keywords

Anatomic robotic radical cystectomy · Pelvic lymph node dissection · da Vinci robotic system · Techniques of space

Introduction

Radical cystectomy with an extended pelvic lymphadenectomy is the gold standard for patients with muscle-invasive bladder cancer and those with recurrent, high-grade noninvasive disease. Unfortunately, this operation is also one of the most morbid operations in urology due to its complex nature and the potential short and long-term complications that follow. The use of minimally invasive technology, and specifically, the robotic platform, has revolutionized the field of urologic oncology, leading to decreases in mortality and morbidity with associated improvements in the quality of life of patients.

The first series of robotic radical cystectomies was reported in 2003 by Menon et al. [1]. Since its inception, the robot-assisted radical cystectomy (RARC) has continued to gain popularity throughout the urologic community. Although its use is growing fast, it has yet to gain the same level of widespread acceptance as the robotic prostatectomy. This can be attributed to the high level of surgical complexity, the comorbidities of the often frail, elderly patients, as well as the desire from surgeons to indulge in long surgical

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procedures comprising ablative and reconstructive components. Therefore, this chapter describes a detailed anatomical description of the steps that are involved in performing the RARC, in an effort to provide greater appreciation for the complexity of the case. Furthermore, we will highlight some of the more recent clinical studies that have explored the oncologic efficacy of the procedure.

Indications and Contraindications

Candidates for a robot-assisted radical cystectomy (RARC) are similar to those who undergo an open radical cystectomy, and include patients with muscle-invasive bladder cancer, high-grade non-muscle invasive disease at increased risk of invasion, select cases of advanced disease, as palliative therapy, and finally as salvage treatment. Robotic surgery may be particularly advantageous in select cases of locally advanced bladder cancer because the morbidity and mortality is often too high to undergo open radical cystectomy, and yet often leads to adverse pelvic and urinary symptoms in addition to disease progression, significantly decreasing the patient's quality of life [2].

While there are no absolute contraindications, the surgeon should consider patients who are obese, have had prior pelvic radiation, focal ablation to the prostate, extensive prior abdominal surgeries, or bulky disease as relative contraindications for robotic surgery. In particular, the excessive amount of visceral fat of obese patients often distorts the exact surgical dissection planes and leads to longer operation times, larger blood loss, higher postoperative complication rates, and higher conversion rates. In addition, the steep Trendelenburg that patients are placed in can lead to increased risk of complications in those with a history of angle closure glaucoma, intracranial aneurysm, severe mitral valve insufficiency, and severe pulmonary dysfunction.

Pre-operative Workup

All patients should undergo a thorough pre-operative workup beginning with an extensive history and physical along with the appropriate lab work, imaging studies, and endoscopic assessment. A basic lab work up should include serum chemistries, liver function tests, and complete blood counts. Patients with adequate renal function and no contrast allergies should be clinically staged with CT of the chest, abdomen, and pelvis. If the patient has impaired renal function, then an MRI is a suitable alternative. An elevated alkaline phosphatase or symptomatic bone pain should prompt a bone scan. The transurethral resection should obtain adequate tumor tissue sampling to establish adequate pathologic diagnosis, and if needed re-TURBT should be employed. In addition, a bimanual exam should be performed prior to and after the resection to further establish the local extent of the disease.

Patient Pre-operative Preparation

As per local requirement or patient's preference, we admit patients the day prior to surgery for pre-anesthesia check-up, to meet with the enterostomal therapist pre-operatively for marking and urostomy teaching, mechanical bowel preparation, and a clear liquid diet. Preoperative counseling, including teaching of the Enhanced Recovery after Surgery (ERAS) protocol is essential to improving outcomes in this patient population due to the complexity of post-operative care and follow-up. Evidence highlighting the importance of preoperative enterostomy teaching is predominantly based on the colorectal surgery literature. Nevertheless, many of the principles are the same, and as such it is believed that preoperative education improves postoperative outcomes, including factors related to quality of life, stomal skill acquisition, and long-term adjustment to an ostomy [3–5]. If a neobladder diversion is being considered, then clean intermittent catheterization teaching is also essential because there is the added benefit of improving patients' ability to irrigate mucus if he is not able to empty his neo-bladder.

Given that a radical cystectomy is associated with a 40–60% reduction in functional capacity, it has now become evident that patients should not only be educated prior to surgery, but that they should be advised to physically prepare as well. The reduction in functional capacity for those undergoing cystectomy often manifests as fatigue over the following 8–12 weeks after surgery. Because this is common in all patients undergoing major abdominal surgery, robotic or open, it is now believed that a pre-rehabilitation plan that combines both cardiovascular and resistance exercises should be undertaken by patients in preparation for surgery in order to allow them to return more quickly to baseline.

Bowel Prep

If a mechanical bowel preparation is desired, we recommend Go-lytely. The patient is allowed clear liquids the day before surgery and nothing by mouth after midnight. It should be noted that the advantages of this practice are not well established in the literature. In addition, complications that can arise with such a preparation include preoperative dehydration, electrolyte imbalance, bacterial translocation, and increased susceptibility to enterocolits. There is no evidence to suggest a difference in overall complication rates, gastrointestinal complications, time to discharge, and recovery of bowel function between those patients who received a bowel preparation and those who did not [6].

Positioning

The operation is performed under general endotracheal anesthesia with the patient positioned in the dorsal lithotomy position with sufficient padding around the shoulders, elbows, and sacrum. The patient's arms are tucked at the side of his body with adequate padding in order to prevent compartment syndrome and neuromuscular injuries. Once the patient has been adequately padded and secured, the table is placed in steep Trendelenburg, elevating the pelvis and decreasing its depth for easier surgical access (Fig. 52.1a). As an alternative position, the patient can be left supine while the robot is docked at the side to

Fig. 52.1 (**a**) Steep Trendelenburg position; (**b**) Patient is supine, in 20° Trendelenburg position for side-docking of robot. [Reprinted from Richards et al. [8] with permission from Mary Ann Liebert, Inc. Publishers]

Table 52.1 All required instrumentation for RARC

(a) Non-disposable Instrumentation	
1.	4-arm da Vinci Si system (Intuitive Surgical, Inc., Sunnyvale, CA)
2.	Plasmakinetic bipolar generator (Gyrus ACMI PK; Gyrus ACMI, Norwalk, OH)
3.	Johann Fenestrated 5 mm Grasper (MicroFrance®, Medtronic, Minneapolis, MN)
4.	KOH Macro Needle Holder (KARL STORZ GmbH & Co. KG, Tuttlingen, Germany)
5.	*Hot Shears*™ (Monopolar Curved Scissors) (Intuitive Surgical, Inc., Sunnyvale, CA)
6.	PK® dissecting forceps (Intuitive Surgical, Inc., Sunnyvale, CA)
7.	ProGrasp™ forceps (Intuitive Surgical, Inc., Sunnyvale, CA)
8.	Large needle driver (Intuitive Surgical, Inc., Sunnyvale, CA)
9.	Large SutureCut™ needle driver (Intuitive Surgical, Inc., Sunnyvale, CA)
10.	10 mm Stryker suction tip (Stryker; Kalamazoo, MI)
11.	5 mm long Stryker suction tip (Stryker; Kalamazoo, MI)
12.	Large laparoscopic Hem-o-lok® appliers (WECK, Teleflex Inc., Research Triangle Park, NC)
13.	Extra-large laparoscopic Hem-o-lok® appliers (WECK, Teleflex Inc., Research Triangle Park, NC)
14.	Three 8 mm cannulas with obturator and seals (Intuitive Surgical, Inc., Sunnyvale, CA)
(b) Disposable Instrumentation	
1.	StrykeFlow 2 suction/irrigation system (Stryker; Kalamazoo, MI)
2.	Echelon Flex™ Powered ENDOPATH® Stapler (Ethicon Endo-Surgery, Inc., Cincinnati, OH)
3.	Large and extra-large Hem-o-lok® clips (WECK, Teleflex Inc., Research Triangle Park, NC)
4.	Veress needle (Ethicon Endo-Surgery, Inc., Cincinnati, OH)
5.	One ENDOPATH® XCEL™ 12 mm bladeless bariatric trocar for camera port (Ethicon Endo-Surgery, Inc., Cincinnati, OH)
6.	One ENDOPATH® XCEL™ 5 mm bladeless trocar (Ethicon Endo-Surgery, Inc., Cincinnati, OH)
7.	One ENDOPATH® XCEL™ 15 mm bladeless trocar (Ethicon Endo-Surgery, Inc., Cincinnati, OH)
8.	ENDO CATCH™ II 15 mm Specimen Pouch (Covidien, Norwalk, CT)
9.	Two extra-large Hem-o-lok® clips prepared with suture attached (WECK, Teleflex Inc., Research Triangle Park, NC) for clipping and tagging of the ureters
(c) Optional Instrumentation	
1.	0-Vicryl on CT-1 needle (Ethicon, Inc., West Somerville, NJ)
2.	Echelon ENDOPATH® 45 mm Stapler (Ethicon Endo-Surgery, Inc., Cincinnati, OH)
3.	1–0 V-Loc™ 90 (Glycolic acid-trimethylene carbonate, Covidien, Norwalk, CT) for vaginal reconstruction
4.	*Harmonic* ACE® Curved Shears 8 mm (Ultrasonic Energy Instrument, Intuitive Surgical, Inc., Sunnyvale, CA)
5.	Large Robotic Clip Applier (Intuitive Surgical, Inc., Sunnyvale, CA)
6.	*EndoWrist® One*™ Suction/Irrigator (Intuitive Surgical, Inc., Sunnyvale, CA)
7.	*EndoWrist®* Vessel Sealer (Intuitive Surgical, Inc., Sunnyvale, CA)
8.	*EndoWrist®* Stapler (Intuitive Surgical, Inc., Sunnyvale, CA)
9.	LigaSure Atlas™ (Covidien, Norwalk, CT)
10.	Enseal® Tissue Sealing Device (Ethicon Endo-Surgery, Inc., Cincinnati, OH)
11.	Silicone vessel loops (Aspen Surgical Products, Caledonia, MI)
12.	Endo GIA™ Ultra Universal Stapler (Covidien, Norwalk, CT)
13.	Lapro-Clip™ (Covidien, Norwalk, CT)

avoid prolonged Trendelenburg in patients at risk for cardiopulmonary complications (Fig. 52.1b). The patient's abdomen, perineum, and groin are prepped and draped in the usual sterile fashion. An 18 French Foley catheter is then placed on the sterile field.

All required instrumentation for RARC can be found in Table 52.1a–c [7].

Port Placement

For da Vinci S and Si Robotic Systems

After the patient is draped, access to the abdomen is gained with a Veress needle allowing for insufflation to 15 mm Hg. Alternatively, access can be obtained using an open Hassan's technique for

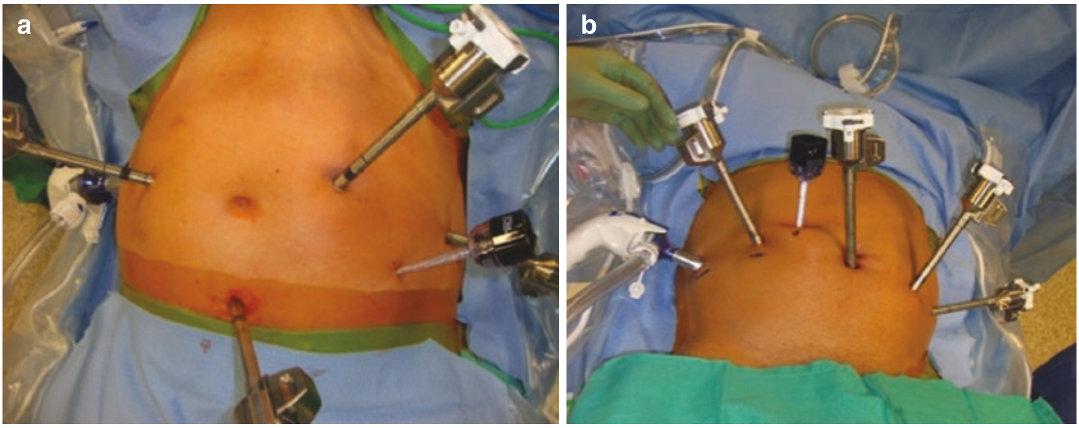

Fig. 52.2 Port placement for the (**a**) da Vinci Si system and (**b**) da Vinci Xi system

camera port placement with subsequent laparoscopic placement of the ports. A12 mm trocar is inserted 5 cm above the umbilicus, allowing for insertion of the camera and inspection of the abdomen and pelvis for access-related injuries, adhesions, and metastatic disease. Under endoscopic guidance, three additional 8 mm robotic ports and two assistant ports are placed (Fig. 52.2a). Two of the 8 mm ports are placed on the right side of the camera port approximately 7–10 cm lateral and at the level of the umbilicus. The third 8 mm port is placed at the level of the umbilicus on left, and an AirSeal trocar is placed in the left lower quadrant of the abdomen approximately 5 cm lateral to the left-sided robotic port and 7 cm superior to the iliac crest. However, in cases where we perform an intracorporeal ileal conduit urinary diversion, the port placement can be reversed. A 15 mm bladeless trocar is placed through the pre-marked stomal site when an ileal conduit is contemplated. A 5 mm port is placed either on the left or the right of the camera port to aid in suction. The robot is then docked between the patient's legs or side-docked. Monopolar Curved Scissors are placed in the right robotic arm, bipolar or plasma kinetic dissecting forceps in the left arm, and the Prograsp™ forces in the third robotic arm. The 30° camera lens can then be used for the majority of the dissection, including the extended pelvic lymph node dissection, in which the 30° lens may be more helpful due to the location deep within the pelvis. The 0° camera lens is helpful when dividing the urethra. Once the ports and instruments are placed, the landmarks of the pelvis must be examined.

For da Vinci Xi Robotic System

With the latest da Vinci Xi system, the six-port transperitoneal approach is utilized, with all working robotic ports placed at the level of umbilicus (Fig. 52.2b). On the Xi system, the 12 mm camera port mentioned previously in the S and Si systems is replaced by a da Vinci 8-mm universal camera-robotic port.

Adhesiolysis

As previously mentioned, one of the relative contraindications for performing a RARC is a prior history of abdominal surgery. This can put the patient at risk for the development of intra-abdominal adhesions, which can lead to bowel injury during entry into the abdomen with the ports and during the procedure itself. However, for those surgeons experienced in robotic surgery, a few principles will serve to prevent such injuries. First, the initial port placement should be away from prior abdominal scars. Furthermore, in difficult cases a 5 mm laparoscope along with laparoscopic tower can be utilized to inspect the intraabdominal cavity for adhesions and possible laparoscopic adhesiolysis. At our center in difficult situations, we

Fig. 52.3 Lysis of adhesions. [Reprinted from Richards et al. [8] with permission from Mary Ann Liebert, Inc. Publishers]

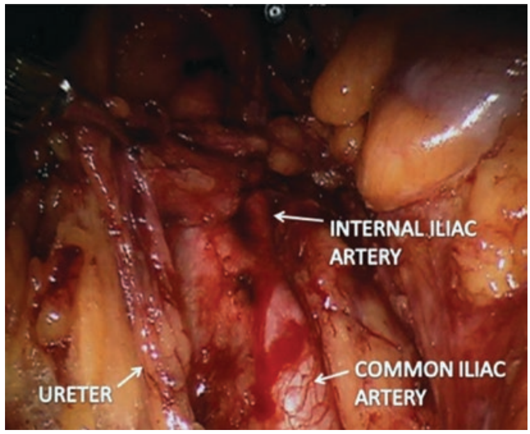

Fig. 52.4 After incising the peritoneum, the ureter can be found at the level of the bifurcation of the common iliac artery. [Reprinted from Richards et al. [8] with permission from Mary Ann Liebert, Inc. Publishers]

perform laparoscopic adhesiolysis prior placing ports and docking the robot.

Once access is obtained, the remaining ports can be safely placed under direct vision away from other adhesions. If the adhesions are extensive, initial lysis can be performed laparoscopically using cold scissors or limited thermal energy (Fig. 52.3). Otherwise, in those who feel more facile with the robot, adhesiolysis can be performed once the robotic camera port and 1–2 robotic ports are placed. Alternatively, as mentioned in above, access can be obtained using an open Hassan's technique for camera port placement with subsequent laparoscopic placement of the other ports.

Our Technique

After gaining substantial experience, we described the technique of the anatomic robotic radical cystectomy in 2012, which we follow routinely [8]. We have continued to make modifications to improve the efficiency of the procedure, and will report our latest technique here.

Dissection of Ureters and Biopsy

The first step is to identify and dissect the ureters after all adhesions in the lower abdomen and pelvis have been lysed. An incision into the posterior peritoneum is performed in order to identify the ureters bilaterally, which are often found at the level of the bifurcation of the common iliac artery (Fig. 52.4). The ureters are isolated proximally along the psoas muscle and distally toward the ureterovesical junction. The course of the lower ureters will be seen as a peritoneal folds that extend from the iliac bifurcation to the posterior bladder wall [9]. The ureter is often encountered running medial and underneath the ipsilateral medial umbilical ligament (superior vesical artery), which can be divided between clips to help provide adequate ureteral length. More distally, the ureter lies just lateral to the seminal vesicles in men, running inferior to the vas deferens before entering the bladder. During the dissection, it is important to avoid excessive skeletonization, leaving a healthy amount of periureteral tissue in order to prevent devascularization and the potential for future ureteral stricture formation. The ureter must be dissected both proximally and distally to the level of the bladder, taking care to avoid unnecessary grasping of the tissue. Distally at the level of ureterovesical junction, the ureter is tagged with colored suture tied Hem-o-lok® clip and divided with the distal margin sent for frozen section analysis. In order to identify the ureters, colored suture tied over Hem-o-lok® clips helps later in the surgery. Similarly, the other ureter is dissected free, tagged, and divided. The left ureter is transposed under the sigmoid mesocolon to the right iliac fossa for subsequent urinary diversion. Thereafter, both ureters are tucked into the upper abdomen, out of the way for further dissection. It should be noted that some experienced surgeons will perform the right-sided lymph node dissection after dissection of the right ureter. Following this, they will perform a mirror dissection on the left side.

Lymph Node Dissection

The lymph node dissection can be performed prior to the cystectomy or after completion, depending on surgeon preference. We prefer to begin the lymph node dissection at the beginning of the case for several reasons. First of all, given the prognostic significance of accurate staging, it is important that the surgeon is "fresh" during this part of the case. Furthermore, by removing the lymph nodes and clearing away the fibro-fatty tissue, you are able to better identify the boundaries of the dissection, as well as major pelvic structures including the ureters, iliac vessels, and obturator nerves. Finally, there is added efficiency by sending the nodes along with the bladder specimen after the case has been completed [8].

The anatomical limits of the dissection include the genitofemoral nerve laterally, the bladder medially, the node of Cloquet inferiorly, and the aortic bifurcation superiorly (Fig. 52.5a). The superior limits of the dissection continue to be extensively discussed among experts, with the previous standard dissection extending only to the bifurcation of the common iliac artery. However, evidence suggests improved survival in those patients with a more extensive lymph node dissection [10, 11]. Moreover, it has been shown

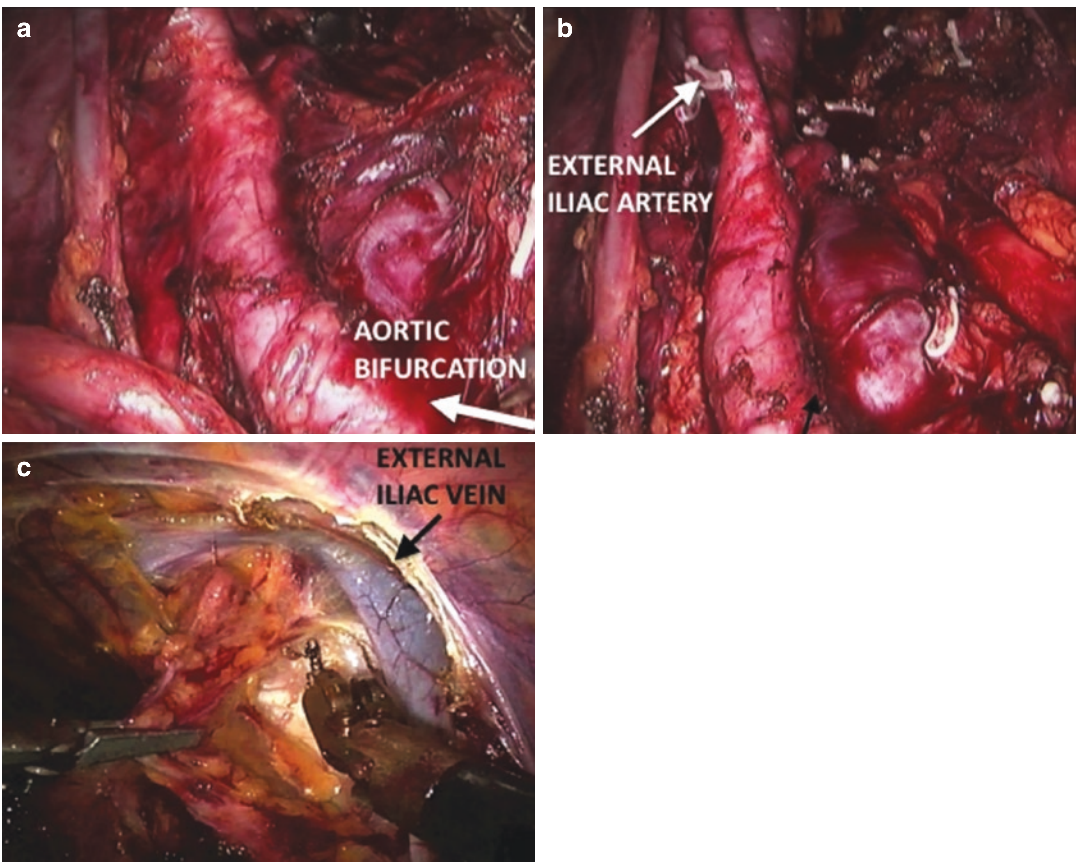

Fig. 52.5 Lymph node dissection. (**a**) Aortic bifurcation as the superior boundary of dissection; (**b**) Visualizing the common iliac artery and external iliac artery pulsating; (**c**) Dissection of the lymph node packet from the obturator fossa. [Reprinted from Richards et al. [8] with permission from Mary Ann Liebert, Inc. Publishers]

that the extent of the dissection during RARC has been associated with both surgeon and institutional case volume [12]. Further randomized controlled trials are under way to better determine the extent of the dissection, and so as of now we believe that the surgeon should at least dissect 2 cm above the common iliac bifurcation. It should be noted that some surgeons dissect all the way up to the inferior mesenteric artery (IMA), in what is considered a high-extended lymph node dissection. This will often depend on the patient's age, comorbidities, and clinical stage but there is no proven advantages.

The lymphatic tissue is dissected using the "split-and-roll" technique. The external iliac artery should first be identified by visualizing pulsations through the tissue (Fig. 52.5b). Just posterior and medial to the artery, the external iliac vein can be found (Fig. 52.5c). It is vital to identify the correct avascular plane of dissection above the artery and vein. These vessels are then isolated using blunt dissection with the suction tip irrigator or closed monopolar scissor tips. The obturator and internal iliac packets are prepared by identifying the medial border of the external iliac vessel. To facilitate this dissection, the bedside assistant can retract the external iliac vein laterally with suction, while the surgeon provides countertraction on the obturator packet medially. The nodal tissue is carefully dissected away from the vein distally to the pubic bone and the node of Cloquet. Care should be taken to avoid injury to the hypogastric nerves that travel along the rectal wall, especially during the nerve-sparing approach where potency is desired. Of note, the circumflex vein and other aberrant vessels of the external iliac or obturator veins can be encountered at the distal-most aspect of this dissection. The veins may be compressed from the pneumoperitoneum, and thus are more susceptible to injury. Compression can be minimized by decreasing the pneumoperitoneum to 10 mmHg. A combination of blunt dissection, release of fibrofatty attachments using monopolar scissors, bipolar or plasma kinetic cauterization of larger vessels and lymphatics, and Hem-o-lok® or Lapro-Clip™ as needed results in a thorough dissection and helps prevention in leakage of lymph. As the obturator packet is peeled back cephalad, it is divided distally. To achieve exposure to the internal iliac packet, the median umbilical ligament should be retracted medially and the external iliac vein should be kept in view. The internal iliac artery does not have the same fibroalveolar sheath as the external iliac artery. This nodal tissue is often more fixed to the artery, and thus may necessitate more sharp dissection and ligation of small blood vessels prior to division of the packet at the level of the bifurcation of the common iliac artery. The robot not only provides certain ergonomic advantages to the surgeon, but also offers multiple imaging modalities that are being evaluated intraoperatively as a means of delineating the extent of the tumor as well as lymph node drainage [13]. In particular, indocyanine green, an infrared fluorophore, has been successfully shown to identify sentinel drainage bilaterally with the use of optical cameras [14, 15]. While still in the early phases of testing, the use of intraoperative optical imaging by way of fluorophores highlights an additional technological advantage of using the robot platform.

Posterior Dissection

The posterior dissection begins with a 6–8 cm inverted, U-shaped incision made in the peritoneum of the cul-de sac above its reflection over the rectum to develop the retrovesical space. The vertical limbs of the U extend to a point approximately 2–3 cm proximal to the bifurcation of the common iliac artery. This begins the process of separating the bladder off of the rectum (Fig. 52.6). Initially, it may help to retract the sigmoid posteriorly and the bladder superiorly. To ensure an adequate surgical margin yet reduce the risk of rectal injury, the surgeon should dissect posterior to Denonvilliers fascia and anterior to the rectal fat. The dissection should continue laterally to connect the incisions that were made during the identification of the ureters. Continuing the dissection posterior, the seminal vesicles and vas deferens are identified. The seminal vesicles, vas, and surrounding small vessels should be dissected free and the vessels around clipped or fulgurated. If a nerve-sparing procedure is being performed, minimal cautery should be used because the thermal energy can severely damage

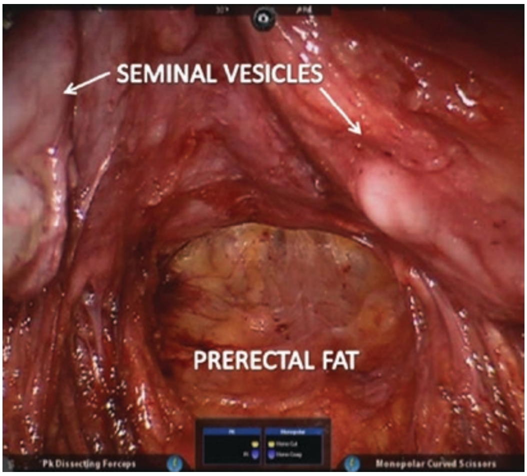

Fig. 52.6 Posterior dissection. [Reprinted from Richards et al. [8] with permission from Mary Ann Liebert, Inc. Publishers]

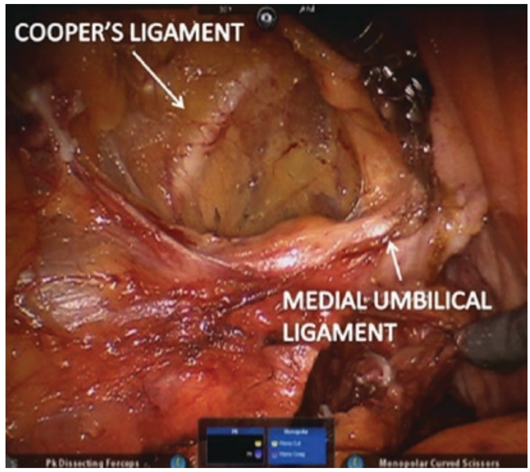

Fig. 52.7 Developing the perivesical space. [Reprinted from Richards et al. [8] with permission from Mary Ann Liebert, Inc. Publishers]

the neurovascular bundles. The third robotic arm can then be used to hold the seminal vesicles upwards in order to establish the plane distally towards the apex of the prostate. As previously mentioned, we have found that it is helpful if a 30° upward-facing lens is used during this part of the dissection because it will allow better visualization at this depth of the pelvis and for posterior dissection of the prostate until the apex of the urethra. This helps in obtaining long length of urethra if you are contemplating neo-bladder.

Creating the Lateral Space and Division of the Lateral and Posterior Pedicles

Once the posterior dissection is complete, attention can be turned towards the lateral dissections in order to develop the perivesical space between the bladder and the pelvic sidewalls (Fig. 52.7). Incisions are made lateral to the medial umbilical ligaments and carried distally to Copper's ligament until the endopelvic fascia is reached using a combination of blunt dissection and cautery. It is important that the umbilical ligaments and urachus are left intact at this point of the dissection, ensuring that the bladder remains attached to the anterior abdominal wall in order to keep it elevated during the ligation of the bladder pedicles. The vas deferens is divided to open the space medial to the external iliac vessels. Using the fourth arm, retract the bladder towards the umbilicus and follow the anterior division of the internal iliac artery. The inferior vesical artery gives off vesical branches and terminates as the prostatic artery. This vessel is dissected until it bifurcates into the urethral artery and capsular artery. The urethral artery is clipped and transected, but the capsular artery, which forms the vascular part of the neurovascular bundle, is preserved. Identification of the capsular artery enables the subsequent preservation of the neurovascular bundles [9]. The umbilical artery and inferior vesical artery are ligated between Hem-o-lok® clips and divided (Fig. 52.8). Small vessels can be controlled using the PK dissecting forceps. In addition, an endovascular stapler can be used to divide the pedicles as another option.

When neurovascular bundle preservation is not needed, the perivesical space between the bladder and lateral pelvic sidewall can be developed bluntly. An incision is made lateral to the medial umbilical ligaments, using blunt dissection and cautery. Dissection is continued medially to the external iliac veins to carefully preserve the obturator nerves and expose the lateral pelvic wall.

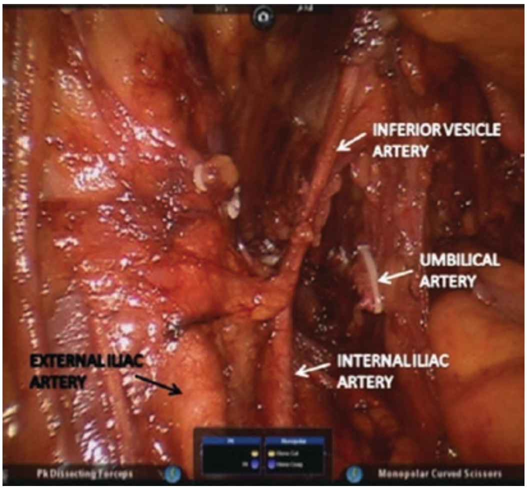

Fig. 52.8 Division of the lateral and posterior pedicles. [Reprinted from Richards et al. [8] with permission from Mary Ann Liebert, Inc. Publishers]

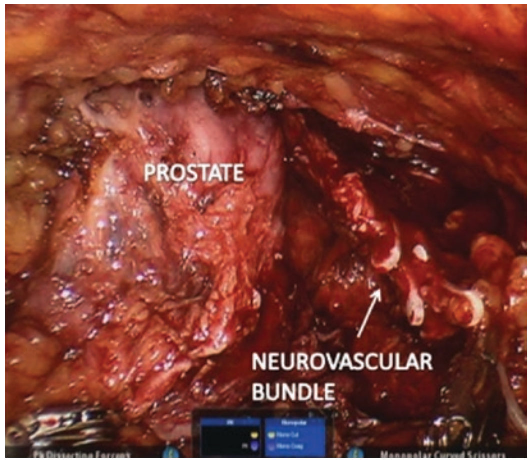

Fig. 52.9 Preservation of the neurovascular bundle using an intrafascial dissection, along with several Hem-o-lok® clips to divide the prostatic pedicle. [Reprinted from Richards et al. [8] with permission from Mary Ann Liebert, Inc. Publishers]

Nerve-Sparing Approach

It is at this point that either a nerve-sparing approach or wide excision can be performed. Examining the prostatectomy data, the nerve-sparing surgery has widely been applied for more than 20 years, becoming the standard in routine clinical care in appropriately selected patients. There has been far less data evaluating the functional and oncologic outcomes with the use of a nerve-sparing approach in radical cystectomy patients, in part due to the different patient population, the lethality of the disease, and the limits of the open procedure. However, with the advent of the robot and the increased dexterity and visualization that it affords the surgeon, more studies are now evaluating its role [1, 16–19].

The dissection can be performed in a similar fashion as for robotic prostatectomy with subtle changes as one should not use thermal energy close to the tip of the seminal vesicles. Furthermore, the hypogastric nerves should be avoided during the lymph node dissection as injury to these nerves can have a negative impact on erectile function. Our approach begins with an incision in the peri-prostatic fascia that is carried distally to the apex of the prostate. The peri-prostatic fascia is swept laterally, avoiding thermal injury or unnecessary traction on the neurovascular bundles. The prostate and bladder are retracted laterally exposing the contralateral prostatic pedicle which is divided between several Hem-o-lok® clips (Fig. 52.9). Alternatively, absorbable Lapro-clip™ can be used with excellent results especially if considering orthotopic neobladder to prevent complications related to erosion of non-absorbable clips. We prefer to perform an intrafascial dissection, as these are not cases of prostate cancer although prostate cancer is quite common in these patients. However, it should be noted that even in experienced hands, the nerve-sparing approach still does not produce the sorts of results seen in patients undergoing radical prostatectomy, with erectile dysfunction affecting up to 80% of men following cystectomy [20]. For this reason, some surgeons have employed a seminal vesicle sparing approach [16]. This approach relies on the ventral surface of prostate showing a triangular area bare of neuronal tissue, known as isosceles triangle. The neurovascular bundle can be detached from lateral prostate-vesicular angle to reach Denonvilliers fascia posteriorly.

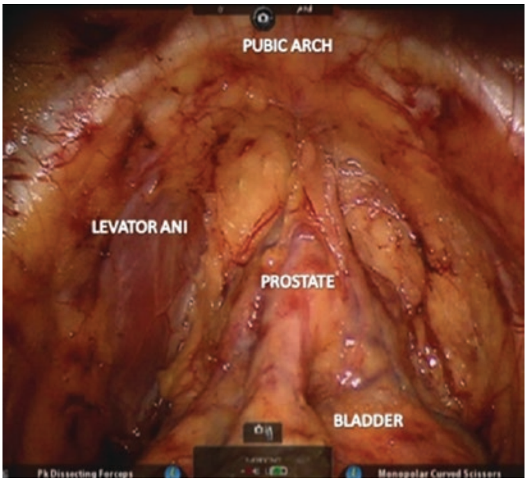

Fig. 52.10 Dropping the bladder to develop the avascular space of Retzius. [Reprinted from Richards et al. [8] with permission from Mary Ann Liebert, Inc. Publishers]

Fig. 52.11 Ligation of the dorsal vascular complex (DVC) with 0-Vicryl on CT-1 needle. [Reprinted from Richards et al. [8] with permission from Mary Ann Liebert, Inc. Publishers]

Anterior Dissection and Dropping the Bladder

Now that the pedicles have been divided, the avascular space of Retzius can be developed by dropping the bladder with incisions of the medial umbilical ligaments, joining them in the midline to divide the median umbilical ligament (urachus) (Fig. 52.10). The endopelvic fascia can be incised from the base of the prostate to the puboprostatic ligaments, and the levator ani muscle fibers should carefully be swept away from the prostate and bladder.

Dorsal Vein Complex Control

The dorsal vascular complex (DVC) is ligated by passing a 0-Vicryl on CT-1 needle underneath the vessels, distal to the prostate (Fig. 52.11). Cold cut scissors can then be used to divide the DVC. Needle drivers are not needed as this suture can be applied with the help of PK® dissecting forceps and ProGrasp™ forceps. As an alternative, the DVC can be divided using bipolar energy, a vessel-sealing device, or Echelon ENDOPATH® 45 mm Stapler. Once again, if a nerve-sparing approach is utilized, thermal energy should be avoided.

Apical Dissection and Division of the Urethra

Once the DVC has been controlled, the urethra is divided at the prostatic apex (Fig. 52.12). Maximum sparing of the urethra is performed if orthotopic neobladder (ONB) is being considered. In some cases, we perform intraprostatic dissection to gain additional length thus increasing functional length in patient with an orthotopic neobladder. The Foley catheter is withdrawn and the urethra is divided. A Hem-o-lok® clip is placed on the prostatic apex to avoid urine and tumor spillage. We have previously placed the clip over the Foley catheter with the balloon inflated, acting as ball valve to aid in traction and counter traction and further prevent spillage of bladder contents. After the division of the urethra, the specimen consisting of the bladder, prostate, and seminal vesicles can be removed en bloc and placed in a 15 cm Endo Catch II bag. It is important that the pneumoperitoneum is lowered to 5 mm Hg to reveal any venous bleeding being occluded by the increased intra-abdominal pressure. Once the surgical field is hemostatic, a closed suction drain can be placed through the lateral robotic port into the pelvis. The bag can be retrieved by extending the camera port incision approximately 4 cm.

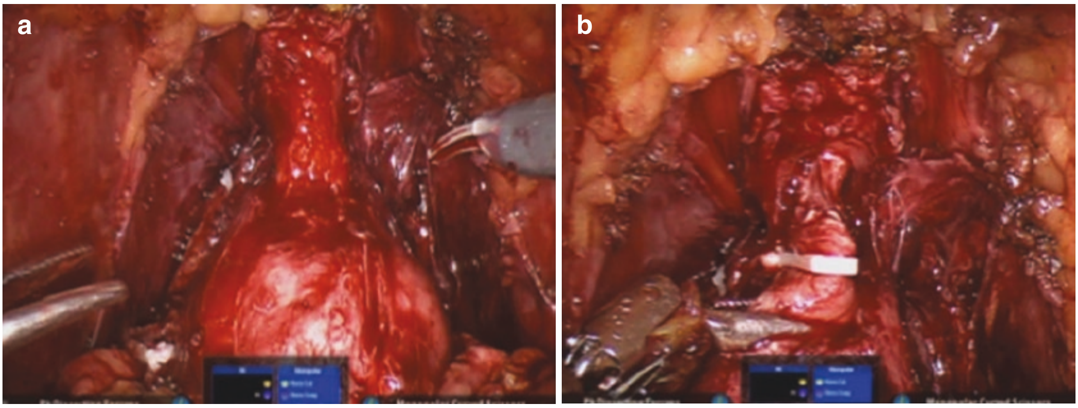

Fig. 52.12 (**a**) Apical dissection of the urethra with maximal sparing of urethra and preservation of the sphincteric complex; (**b**) Division of the urethra with placement of Hem-o-lok® clip to avoid urine and tumor spillage. [Reprinted from Richards et al. [8] with permission from Mary Ann Liebert, Inc. Publishers]

Urinary Diversion

Originally, a hybrid extracorporeal urinary diversion was performed. However, as surgeons have become more familiar with the robot, some are now opting for a totally intracorporeal diversion. Nevertheless, a substantial group of people perform a pure extracorporeal urinary diversion. The details of such a diversion will be covered elsewhere in the book.

Postoperative Care

The postoperative care for all patients after RARC should follow the ERAS protocol. A consensus review has recently been published by the European Robotic Urology Section (ERUS), in order to guide standardized perioperative management of RARC [21]. As part of the postoperative program, the NG tube can be removed shortly after extubation in the recovery unit. Ureteral stents in those patients who receive an ileal conduit can be removed within the first 2 weeks. Orthotopic neobladder patients can have their stents removed within the first 2–4 weeks as well. In order to prevent postoperative ileus, patients can be started on alvimopan. Chewing gum may also promote the return of normal intestinal function. Commonly used promotility drugs such as metoclopramide, serotonin receptor antagonists, and naloxone, have not shown to be effective. Early mobilization is critical, not only in terms of promoting bowel function, but it is associated with improved cardiopulmonary function and independence. While many surgeons will wait for the patient to pass flatus or begin having bowel movements, there is no evidence that fasting supports recovery. A diet can be started as early as the patient can tolerate it. Finally, for discharge, it has been agreed upon by the committee that at a minimum the patient should have adequate pain control, regular diet, normal bowel function, mobilization, and competence in handling their urinary diversion.

Learning Curve

With any new surgical technique, it is important to evaluate the learning curve that is involved with effective implementation. While it is difficult to standardize a learning curve, multiple groups have attempted to evaluate their center's performance using a set of defined outcomes. One group reported on 164 patients' who underwent RARC and found case number was not significantly associated with the frequency of complications, surgical blood loss, positive margins, or survival [22]. However, with experience, the operation time and lymph node yields improved. Richards et al. evaluated their learning curve in 60 consecutive cases of RARC with PLND and found blood loss, positive margins and lymph node yields were unchanged [23]. However, complication rates and operation times continued to decrease with increasing experience. A more recent study expanded upon these results and found, in addition to decreasing operative time, that an experienced mentor can further improve the learning curve of a new surgeon, resulting in decreased operation times and minimizing complications, as well as the need to convert early in their personal series [24].

Results

The technical feasibility of the RARC in the treatment of bladder cancer has been demonstrated in a number of case series. However, one concern faced by surgeons is whether the RARC adheres to key oncologic principles, thus preventing the development of pelvic, peritoneal and port site recurrences. To this point, a large multi-institutional study found that of almost 1400 patients undergoing RARC, 305 (22%) experienced disease relapse, 220 (16%) distant, 154 (11%) local recurrence, 17 (1%) peritoneal carcinomatosis and 5 (0.4%) port-site recurrences. 71 patients (5%) developed early oncologic failure, defined as disease relapse within 90 days of surgery, a decrease from 10% in 2006. The presence of any complication, ≥pT3 disease, and nodal involvement were the only significant predictors of oncologic failure, suggesting that disease-related factors rather than technical factors play a major role [25].

Complication rates of the RARC have also been reported in large multi-institutional studies [26, 27]. Gastrointestinal complications occur most commonly during the post-operative period, approximately 27% of the time. In addition 30 and 90 day mortality has been reported at 1.3% and 4.2%, respectively. These rates are higher in those patients with T4 disease, relative to those with ≤pT3, with the overall 30- and 90-day mortality rates of 0.4% and 1.8% vs 4.2% and 8.5% vs 0.4% and 1.8%, respectively.

Retrospective evidence supports promising functional outcomes in those patients undergoing the robotic nerve-sparing approach. One study found that 63% of patients who underwent the nerve-sparing RARC were potent with or without the help of PDE-5 inhibitors at 12 months [28]. Another group reported a postoperative 45% rate of erection sufficient for penetration with or without PDE-5 inhibitors [17].

When validating a therapy, it is important to compare it to the current standard of care, which in this case is the open radical cystectomy. Therefore, over the past 5 years there have been a number of series comparing both oncologic and functional outcomes of RARC to ORC. Studies have demonstrated no difference in the short-term, and in some cases intermediate, oncologic outcomes when comparing RARC to open cystectomy [29–48]. The results have been summarized in Table 52.2. There have also been several systematic reviews published evaluating the evidence from these series. Tang et al. examined 13 studies and found that although there was a significant difference in the operating time in favor of ORC, patients having RARC might benefit from fewer total complications, less blood loss, shorter length of hospital stay, lower blood transfusion rate, less transfusion needs, shorter time to regular diet, more lymph node yield, and fewer positive lymph node. There was no significant difference between the RARC and ORC regarding positive surgical margins. The RAZOR trial is currently underway to compare ORC to RARC, pelvic lymph node dissection (PLND), and urinary diversion for oncological outcomes, complications and health-related quality of life measures with a primary endpoint of 2-year progression-free survival. The randomized, prospective design of this trial will hopefully clarify many of the questions that urologist have attempted answering over the past decade through small, single-institution, retrospective studies.

In a systematic review based on a comparison of cost analysis between the two techniques, researchers found that despite an increased materials cost, RARC was less expensive than ORC when the cost of complications was considered. Thus, while the upfront cost is greater for

Table 52.2 Robotic versus open radical cystectomy in the literature

Robotic Versus Open Radical Cystectomy in the Literature										
Author	Year	N	Estimated blood loss (mL)	Operative time (Min)	Lymph node yield	Positive surgical margins	Length of stay (days)	Complication rate		Additional comments
								Total	Major	
Kim et al. [34]	2016	ORC: 150	840	466	15	4%	22	NR	NR	The surgical approach was not associated with tumor recurrence, disease-specific mortality, or all-cause mortality after radical cystectomy regardless of pathologic tumor stage.
		LRC: 22	400	524	19.5	0%	12			
		RARC: 58	500*	501.5*	18*	3.4%	28*			
Sharma et al. [30]	2016	ORC: 407	800	302	15	12%	7	59.7%	19.7%	RARC resulted in similar complication rates as ORC, as well as positive surgical margin rates in high-risk cases with no identifiable difference in oncological control.
		RARC: 65	350*	423*	16	10.8%	6	52.3%	13.8%	
Winters et al. [35]	2016	ORC: 58	641	370	17.2	NR	9	38%	NR	For elderly patients undergoing ORC or RARC, there was no significant difference between in complications or the 90 day readmission rate.
		RARC: 29	257*	413*	22.6		7*	38%		
Atmaca et al. [47]	2015	ORC: 42	1314.3	552	17.2	2.4%	18.8	52%	18%	Better trends were detected in the robotic group concerning daytime continence with no pad use (84.6% vs 75%,)and severe daytime incontinence (8.3% vs 16.6%). No significant differences in post-operative mean IIEF scores between groups
		RARC: 32	412.5*	582	25.4*	6.3%	17.4	33%	8%	
Bochner et al. [36]	2015	ORC: 58	676	456	Extended: 31.9 Standard:19.5	4.8%	8	85%	21%	Three- and 6-mo Quality of Life outcomes were similar between ORC and RARC. Cost analysis demonstrated an advantage to ORC compared with RARC.
		RARC: 60	526*	329*	Extended: 30 Standard: 18.9	3.6%	8	84%	21%	
Aboumohamed et al. [37]	2014	ORC: 100	489	350	NR	NR	7	NR	16%	Postoperative analysis revealed better sexual function in ORC group (P = 0.047), with no significant differences between both the groups in urinary, bowel, and body image domains (P = 0.11, 0.58, and 0.93).
		RARC: 82	444	382*			8		23.2%	
Trentman et al. [38]	2014	ORC: 102	601.8	258.8	NR	NR	9.8	NR	NR	Recovery room opiate consumption was significantly less in RARC group: 9.5 ± 8.9 versus 12.6 ± 9.9 mg (morphine equivalents), p = 0.02.
		RARC: 96	257.7*	372.1*			7.1*			
Maes et al. [39]	2013	ORC: 14	942	256.8	9.5	14%	11.4	78.6%	14%	RARC can be accomplished in a community-based, non-tertiary health care setting without compromising perioperative or pathologic outcomes
		RARC: 14	470*	373.8*	11.9	21%	11.2	57.1%	21%	

Parekh et al. [41]	2013	ORC: 20	800	285.5	23	5%	6	25%	NR	No significant differences between oncologic outcomes. There was a trend toward a decrease in excessive length of stay (65% vs 90%, p = 0.11) in RARC compared to ORC. RARC also trended toward fewer transfusions (40% vs 50%, p = 0.26)
		RARC: 20	400*	300	11	5%	6	25%		
Knox et al. [40]	2013	ORC: 84	1522	396	17.7	8%	10.8	64%	NR	Both age groups in RARC had less early complications than ORC patients (p < 0.014). The older group in RARC had less early complication rate (17%) than the younger group in ORC (59%).
		RARC: 58	276*	468*	21.3	7%	6.3*	43%		
Kader et al. [29]	2013	ORC: 100	986	393	15.7	11%	12.2	57%	22%	There were no significant differences between groups for pathological outcomes, including stage, number of nodes harvested or positive margin rates.
		RARC:100	423*	452*	17.7	12%	7.8*	35%	10%	
Richards et al. [42]	2012	ORC: 20	600	370	15	NR	14.5	85%	35%	RARC is a reasonable option in caring for the elderly patient.
		RARC: 20	275*	461*	17		7	45%*	10%*	
Gondo et al. [48]	2012	ORC: 15	1788.7	363.5	13.8	9.1%	37	73.3%	NR	RARC is a safe technique to perform by surgeons who have had over 60 cases of robot-assisted radical prostatectomy
		RARC: 11	656.9*	408.5	20.7*	13.3%	40.2	54.5%		
Styn et al. [43]	2012	ORC: 100	475	349.1	15.2	22%	10.2	NR	21.3(% of total)	No difference in the final pathologic findings, number of lymph nodes removed, or margin status was identified
		RARC: 50	350*	454.9*	13.3	16%	9.5		28.1(% of total)	
Lee et al. [44]	2011	ORC: 103	NR	NR	NR	NR	NR	NR	NR	Despite a higher cost of materials, RARC was less expensive than ORC for ileal conduit and cutaneous continent diversion, but not for orthotopic neobladder. The largest contributor to cost was length of stay. RARC showed a shorter hospital stay, although this did not offset the higher cost of surgery. Complications materially affected cost performance.
		RARC: 83								
Nix et al. [44]	2010	ORC: 20	575	211.2	18	0%	6	50%	NR	This prospective randomized controlled study with a primary end point of lymph node yield demonstrated noninferiority when comparing RARC to ORC.
		RARC: 21	258*	252*	19	0%	5.1	33%		
Ng et al. [46]	2010	ORC: 104	1172	357	15.7	8.7%	8	58.7%	29.8%	RARC is an independent predictor of fewer overall and major complications.
		RARC: 83	460*	375	17.9	7.2%	5.5*	41%	9.6%*	

* represents < 0.05

RARC, it is not the robot that largely drives cost, but instead the length of stay, operative durations, and daily hospitalizations costs that result. They went further to determine that while RARC was less expensive than ORC for patients receiving an ileal conduit or cutaneous continent diversion, the cost advantage deteriorated for orthotopic neobladder.

Conclusion

The anatomic robot-assisted radical cystectomy is now being performed at centers around the world, especially at those with advanced robotics programs. It is clear from the results of published reports in the literature, as well as from our own experience at Wake Forest in performing over 250 RARCs, that the clinical and oncologic goals of a radical cystectomy are achieved. Furthermore, in select patient populations it may even be preferred over the open approach. We are hopeful that with more clinical trials and maturing data from high-volume institutions, the long-term oncologic outcomes will prove comparable to the current standard of care.

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