7 Robotically Assisted Radical Cystectomy

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Introduction

The role of robot-assisted radical cystectomy (RARC) in the treatment of bladder cancer is evolving. Advocates suggest that this minimally invasive operation offers less blood loss, less pain, and the promise of shorter hospitalizations with fewer complications and equivalent oncologic outcomes. Most of these putative advantages have yet to be proven and are balanced against the increased upfront cost of the robotic platform and longer operative times. Nevertheless, the evidence available to date suggests a robust future for this relatively novel technology.

Modern radical cystectomy with lymph node dissection, as described by Marshall and Whitmore in 1949, has been associated with high complication rates. In that pioneering report of six patients, two expired of surgical complication before leaving the hospital and at least another two had significant morbidity [1]. Since that time, the application of improved operative and in-hospital strategies and care pathways has resulted in decreased mortality and morbidity, but modern series of open radical cystectomy (ORC) continue to be plagued by significant complication rates. When the standardized Clavien-Dindo [2] complication reporting scale is strictly applied, open cystectomy complication rates at centers of excellence reach into the 60–70 % range [3]. Other high-volume centers have reported lower rates, albeit in the absence of a standardized reporting system [4].

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History of Minimally Invasive Cystectomy

Beginning with pure laparoscopic cystectomy in 1995 [5, 6] and transitioning to the robotic approach in 2002 [7], several modestly sized series have been published. Despite a paucity of large, multicenter prospective comparative trials, selected series have shown a benefit to robotic approaches with few data reporting RARC outcomes to be inferior to open cystectomy in clinical or oncologic efficacy. Assessments of cost benefit have also been very difficult to extrapolate beyond any single institution, but in light of the cost of treatment of surgical complications, there exists potential to be cost-effective despite higher upfront costs if RARC results in decreased complications. It bears mentioning that one analysis suggested that the cost of a single complication of cystectomy adds $27,936 to the bill [8], while the incremental cost of the robotic system was found to be $1,640 in a contemporaneous report [9].

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Guidelines have been established that can be used to assess quality of cystectomy and associated lymph node dissection, regardless of approach. Herr et al. and the Bladder Cancer Collaborative Group evaluated the collective experience of 16 experienced surgeons from four major institutions over a 3-year period (2000–2003) to propose standards for radical cystectomy and pelvic lymph node dissection [10]. A total of 1,091 cystectomy cases were evaluated. Patients were of varying ages, health states, and clinical stages of bladder cancer. Of the 16 surgeons, seven operated on <50 cases, five on 50–100, and four completed >100. Surgeons used a standard or extended bilateral node dissection in 80 % of patients and 20 % had a limited lymph node dissection (9 %) or no node dissection (11 %).

A limited lymph node dissection was used in 35 % of patients aged >75 years and in half receiving previous extensive pelvic treatment (pelvic surgery, chemotherapy, and radiation therapy). The overall positive margin rate was 6.5 %, and margins were positive in 12 % of patients with locally advanced disease. The mean number of lymph nodes examined for all patients was 12.5 (Ref 5 – see ref 11 from original Herr paper) but varied widely among individual patients having anatomically similar lymph node dissections.

For experienced surgeons, defined as performing at least ten radical cystectomy surgeries per year, the collaborative group proposed surgical quality benchmarks. The benchmarks stated the surgeon should achieve negative surgical margins in >90 % of cases and remove a mean of 10–14 nodes, recognizing that such standards will not be met in some of the most difficult cases.

Whether the operation is performed through a minimally invasive approach (robotic or laparoscopic) or open surgical approach, the principles of radical cystectomy remain the same. Surgeons are accountable for surgical margins, extent of node dissection, and both serve as quality metrics, which have been proven to correlate with bladder cancer survival outcomes.

It is worth noting that most series of RARC well exceed these guidelines for margin status and nodal collection (positive margins under 10 % and greater than ten lymph nodes collected). Undoubtedly, case and patient mix will impact any surgeon or institution's outcomes.

Surgical Indications and the Learning Curve

Urothelial carcinoma that invades the detrusor muscle and superficial disease resistant to intravesical treatment are the primary indications for radical cystectomy. The possibility of decreased surgical morbidity may allow for higher utilization of "early" cystectomy in cases of high-grade superficially invasive disease, an indication that is commonly underutilized. In some unusual histologic variants such as nested variant or micropapillary disease, immediate cystectomy may be recommended for superficial disease [11].

Learning Curve

Similar to all surgical procedures, robotic cystectomy has a learning curve. One assessment suggested that complication rates decrease after 20 cases while blood loss, margin status, and lymph node yield were constant across higher vs. lower tertiles of case volume in the hands of surgeons already experienced in ORC [12]. Roswell Park Cancer Center [13] and the International Robotic Cystectomy Consortium database [14] both show a clear decrease in surgical time that is associated with a surgeon completing 20 cases; interestingly, this was achieved at Roswell Park Cancer Center despite increasing time being devoted to the LND and resulting higher nodal yields. Some of the earliest cases in both those reports lasted over 10 h in total operative time, but improvements appear rapid.

Presumably, the surgeons involved in the generation of these curves had significant exposure to both open cystectomy and robotic prostatectomy, and these learning curves may not be representative of what a less experienced practitioner could experience. Also, a significant element in the operative speed may be a surgical team improvement as familiarity with the steps of the case is developed beyond that which comes from increased surgeon efficiency. It seems reasonable that in a surgeon's early experience, especially those with less experience with RALP, case selection be confined to patients with lower body mass index (BMI) and those without significant comorbidities.

Patient Selection

The selection of robotic vs. open approach is clearly one best assessed in the context of each individual surgeon and team experience. Comparative outcomes are still hard to assess at this relatively early point on the track record of robotic cystectomy, but it is worth noting that in virtually all published series, robotic cystectomy takes longer to perform than open, but is associated with notably lower blood loss (Fig. 7.1).

Obesity

Laparoscopic surgery is generally suitable for the obese, although the ventilatory challenges of the Trendelenburg position can be prohibitive in certain patients. An initial assessment of ventilator

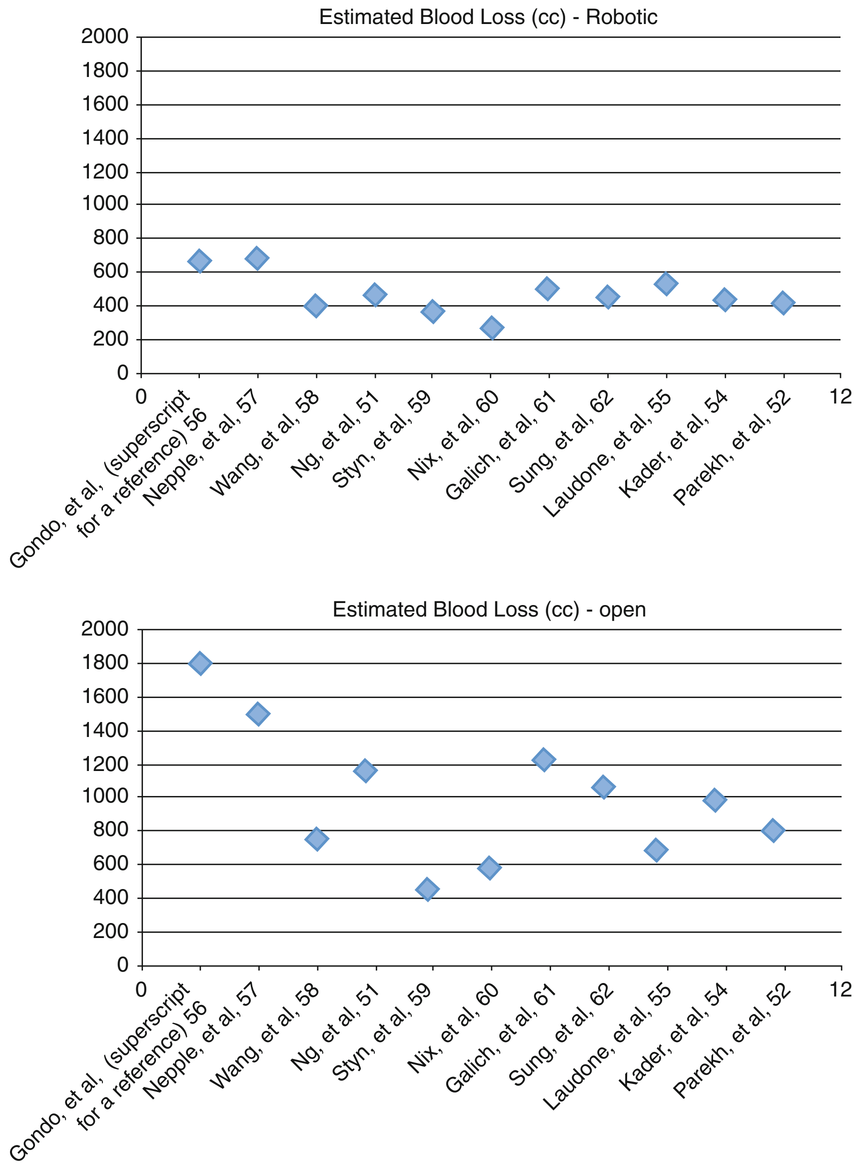

Fig. 7.1 Estimated blood loss, by study, from the robotic and open arms of 11 published comparative studies. All studies show statistical significance between ORC and RARC in estimated blood loss [49, 50, 52–60]

pressures in the Trendelenburg position is critical, especially in patients at risk of extended surgical times. Extra-long trocars are available for the obese, and Butt et al. showed that outcomes were not different between BMI under 25 and those above 30, although they found the positive margin rate to be higher for obese patients compared to nonobese when confronted with higher T-stage disease [15]. Results from the largest currently available database suggest a small but statistically significant additional risk of complication in those with a BMI over 30 [16]. Surgeon and institutional experience should guide patient selection.

Prior Surgery

Prior surgery was initially viewed as a relative contraindication to laparoscopic abdominal entry and surgery [17]. As experience has grown, those relative contraindications have been overcome. Groups have reported success with robotically assisted approaches in virtually all challenging situations, including cystectomy in the presence of prior ostomy [18].

Neoadjuvant Chemotherapy

Neoadjuvant chemotherapy is a level 1 recommendation in many cases of MIBC [19]. Recent results from the 939 patient International Robotic Cystectomy Consortium database suggest that there exists an increased risk of complications in those patients that undergo neoadjuvant chemotherapy with a relative risk of any complication and high-grade complication in the range of 1.5–1.8 in the first 90 days [16].

Elderly

Muscle invasive cancer is primarily a disease of the elderly. Despite large reports showing that radical cystectomy is feasible and safe and remains the most effective modality for the treatment of MIBC in patients over the age of 80, use of this modality is lower than in younger counterparts [20]. While surgical selection is undoubtedly more challenging in the truly elderly, patients lacking severe comorbidities should be considered for this operation. Paradoxically, some newer reports suggest that RC may be particularly well suited to the elderly [21]. This may be directly related to the nearly universal finding of lower blood loss and presumably decreased fluid shifts with the robotic approach when compared to open.

Prior Radiotherapy

Robot-assisted salvage prostatectomy after failed local radiotherapy has been shown to be not only feasible but in at least some hands able to produce results that are superior to open prostatectomy in similar conditions [22]. Salvage open cystectomy after failed curative radiotherapy for bladder cancer appears feasible but has been associated with a significant complication rate; one series found a 16 % 3-month mortality rate and a tripling of anastomotic leaks at 9 % compared to 3 % in non-radiated patients [23]. In another series LND was performed in only 48 % by surgeon preference and presumably represents the increased difficulty of perivascular dissection in the postradiation setting [24]. A report addressing ORC after 60 Gy or more of pelvic radiation showed 32 % likelihood of Clavien-Dindo grade 3–5 complications at 90 days and an overall complication rate of 77 % [25]. These are higher than most contemporary non-radiated series, but appear reasonable in this setting.

Given the apparent feasibility of robotic-assisted prostate surgery after radiation, the extension of the operation to include the bladder in this same situation seems reasonable, especially given the decreased need for urethral anastomotic reconstruction in the setting of conduit urinary diversion. Published reports are scant; nonetheless, in experienced hands this may prove to be an appropriate therapy [26]. The largest database of RARC to date, the International Robotic Cystectomy Consortium, records 15 cases of postradiation RARC representing just 2 % of the total recorded patients [16]. Specific outcomes are not reported for these patients, however, preventing conclusions. In our experience, the operation is feasible but technically challenging; centers possessing experience with salvage robotic-assisted prostatectomy will likely be comfortable with this operation.

Palliative Cystectomy

Palliative cystectomy is a poorly studied area of this disease. Appropriate indications for this operation are poorly defined, but include persistent hemorrhage and avoidance of pelvic morbidity. The balance of surgical risk to benefit for this major operation is difficult to calculate, but palliative cystectomy is generally best applied to younger patients with significant ongoing morbidity from localized tumor, in the setting of adequate functional and nutritional status. One smaller series addressing cystectomy in patients over 75 years of age included seven cystectomies for palliative indications such as intractable hematuria and pain. These patients experienced a much higher morbidity and a 29 % in-hospital mortality when compared to the curative intent cohort, but no attempt was made to compare them to nonoperated counterparts [27]. Other reports in the open surgical literature show acceptable results for palliative cystectomy managed with cutaneous diversion and avoidance of bowel resection [28]; whether these challenging cases are appropriate for a robotic approach remains unstudied.

Lymph Node Dissection

The ability to perform a pelvic lymph node dissection (PLND) is a critical component of high-quality surgery for bladder cancer, serving as a diagnostic and therapeutic procedure [29]. Multiple large series have demonstrated that performing PLND contributes to improved survival in patients with bladder cancer [30]. The optimal extent of PLND and best outcome measures of PLND quality continue to be debated which is evident in the literature on robotic cystectomy. A standard PLND is defined as removal of lymph tissue up to the common iliac bifurcation to include the internal iliac, obturator, and external iliac lymph nodes [31]. Extended PLND is generally thought to include the standard template as well as lymph nodes up to the aortic bifurcation, laterally to the genitofemoral nerve, distally to the node of Cloquet, as well as the presacral lymph nodes [32]. Evidence of survival benefit for extended vs. standard PLND is debated, given the many variables to consider in the series used for evidence of benefit. Several authors have proposed that lymph node yield may indeed be a surrogate of surgical quality since it correlates with survival outcomes [33]. However, consensus opinions on the superiority of survival outcomes in extended PLND cite the low level of evidence, but note the improved diagnostic ability and trend towards improved disease-free survival in extended PLND [34].

With the advent of robotic surgery for bladder cancer, the debate over technical aspects of PLND has continued. Effect on survival outcomes is most evident in large series that include higher-stage tumors with several years of follow-up. However, data describing outcomes of RARC with PLND are not mature, and early series were selected for lower-risk tumors, which may not demonstrate the benefit of PLND as well as more comprehensive series. For these reasons, some authors question whether these outcomes can be judged with the available data [35], and reserve judgment about efficacy until the results of randomized trials are mature. Nevertheless, the ability to recapitulate the technique of open cystectomy and PLND has been investigated. In a study by Davis et al., the authors performed robotic extended PLND for bladder cancer in 11 patients with open extended PLND performed directly afterward in the same patients [36]. In 80 % of patients, no additional lymph nodes were detected with the open technique, demonstrating that a high-quality dissection is possible using a robotic technique. The median operative time for the PLND was 117 min, demonstrating the investment in time necessary for robotic extended PLND. Although the benefit of extended PLND will continue to be debated, it appears that robot PLND can provide a similar lymph node dissection to open techniques.

Robot-assisted radical cystectomy – equipment list (note that requirements for intracorporeal diversion are not included here).

1. Da Vinci Surgical System (Intuitive Surgical, Sunnyvale, CA). “S” or “Si” recommended.

2. Veress Needle or access device of choice, 2×10/12 mm disposable ports, 3×8 mm robotic ports, 5 mm assist port.
3. Da Vinci instruments – Monopolar Da Vinci scissors, bipolar fenestrated grasper, 2× Da Vinci Large Needle Driver. Consider da Vinci vessel sealer if available. Fourth arm – "Prograsp" graspers.
4. Hem-o-lok clip appliers (2) with large clips.
5. Laparoscopic vascular staplers, articulating, "45" and "60" as desired.
6. Suture:
    (a) Male: 2–0 Vicryl on rb-1 and SH as needed and as surgeon preference for dorsal venous complex.
    (b) Female: same as male, likely will need 9″ 2-0 Vicryl on SH for repair of the anterior vaginal wall.
    (c) Others: we recommend having a 4-in., 4-0 Prolene on Rb-1 with Lapra-Ty® pre-affixed in the event of vascular/venous injury during lymphadenectomy.
7. 5 mm suction irrigator (long).
8. Appropriate open surgical equipment for performance of diversion.
9. Port closure device for 12 mm ports, if desired.

Technique

Positioning

Patients are positioned supine with a mild break in the table. In order to secure the patient to the table in Trendelenburg position, the use of chest straps or direct skin-to-gel adhesion is utilized. Skin-to-gel positioning is effective but, for longer cases, can be associated with skin traction burns on the patient's back if steep Trendelenburg is used. If intracorporeal diversion is contemplated, shallower Trendelenburg will facilitate bowel manipulation without gravitational effects pulling the bowel cephalad and out of the robotic operative field.

The legs are separated on orthopedic spreader bars or placed in low lithotomy in well-padded stirrups; the thighs should be close and parallel to the abdomen to minimize distortion of the pelvic floor. Orogastric/nasogastric tubes and bladder drainage catheter are placed.

Ports

Port placement is similar to that utilized in robotically assisted prostatectomy, but modified a few centimeters upwards to give better access to the upper pelvic vessels for extended lymph node dissection. Different approaches exist for assistance; some surgeons prefer to use two bedside assistants in lieu of the so-called "4th arm" of the robotic system. An additional upper paramedian assist port may be helpful to facilitate stapled control of the bladder vasculature if stapling is planned.

Our approach to male cystectomy occurs in a stepwise fashion as follows:

1. Ureteral identification and dissection
   Beginning on the right, the ureters are identified at the level of the common iliac artery (Fig. 7.2). This may be used as the superior boundary for lymph node dissection template at a later point if desired. Using great care to preserve vascular tissue around the ureter as much as possible, the ureter is dissected free for a small distance above the vessels and followed into the deep pelvis to the ureterovesical junction (Fig. 7.3). Small feeder vessels originating from the iliac system are usually encountered and controlled with cautery; caution is important to avoid any cautery effect on or near the ureter and the associated extramural longitudinal blood supply. An identical procedure is completed on the contralateral side; maximization of length and blood supply on the left side is especially important given the need for tunneling at a later date.
2. Completion of posterior plane
   Once the ureters are freed to their hiatus with the bladder, the peritoneal incisions are connected and the retrovesical space developed behind the bladder. Ureters may be tagged, clipped, and cut at this point; we prefer to leave them intact to assist with orientation. Dissection proceeds carefully behind the bladder and seminal vesicles to the level of the prostate; Denonvillier's fascia is transected, and at the level of the prostate, the prerectal yellow fat is identified and the rectum carefully dissected free from the prostate as far as possible. Vasa deferentia are clipped and cut,

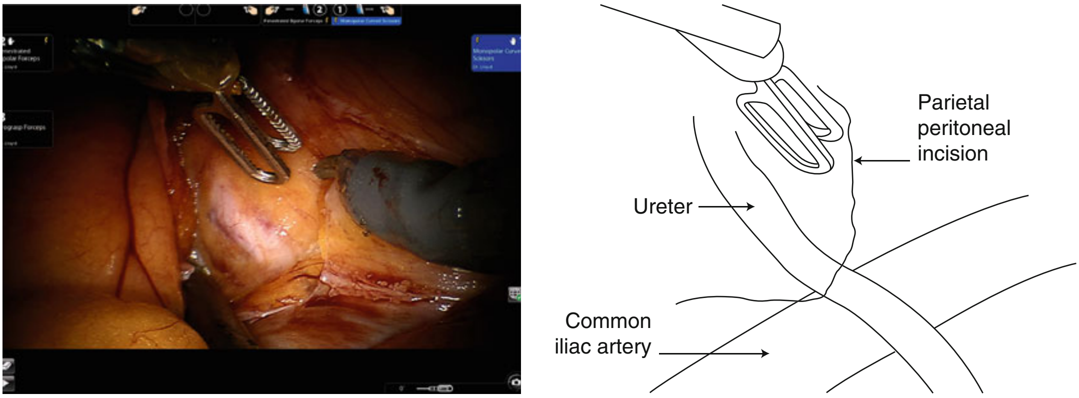

Fig. 7.2 The parietal peritoneum is incised and the ureter on the right is identified as it crosses the common iliac artery

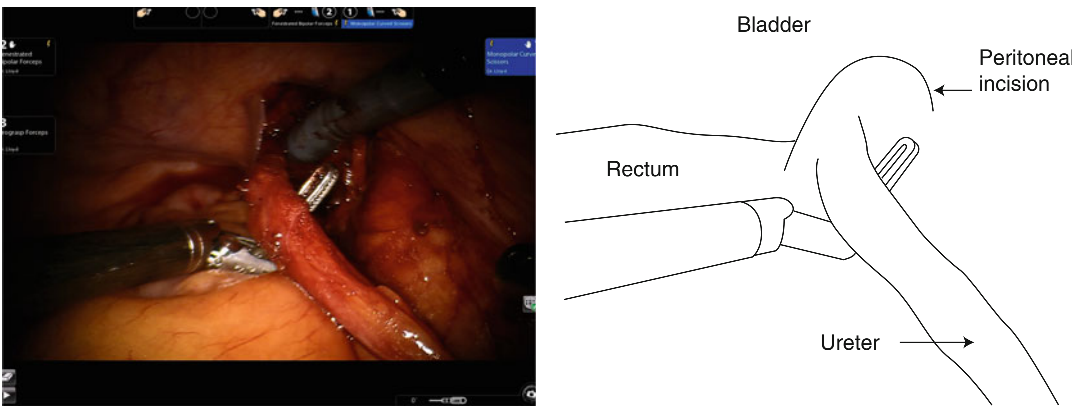

Fig. 7.3 The ureter is circumferentially freed with maximal preservation of periureteral tissue and dissected to the hiatus of the bladder

and the small arterial branches to the seminal vesicles are carefully controlled with clips or cautery as appropriate. The lateral bounds of this dissection are the vascular pedicles of the bladder and prostate, beginning with the superior vesical artery. Great care is taken to widely establish separation between the rectum and bladder to minimize chances of rectal injury.

3. Lateral space creation

Delineation of the lateral aspects of the bladder and vascular pedicles is performed at this point. The goal of this step is the identification of the vascular pedicles. Peritoneal incision is performed along the lateral aspect of the medial collateral ligament, with care taken to leave the anterior suspension of the bladder intact. Early release of the anterior bladder support will significantly increase difficulty in posterior dissection from the loss of bladder support and should be avoided. The lateral incisions are connected to the posterior incision to form a "u" and the space lateral to the bladder freed distally to the endopelvic fascia and nerve sparing/prostatic fascial release performed if nerve sparing is desired. Even with anterior anatomical support intact, the "fourth arm" can be well utilized to additionally retract the bladder so as to provide stretch on the pedicles and facilitate dissection. The endopelvic fascia is released in the fashion of radical prostatectomy. Next, the medial umbilical ligaments are transected close to their junction with the internal iliac artery.

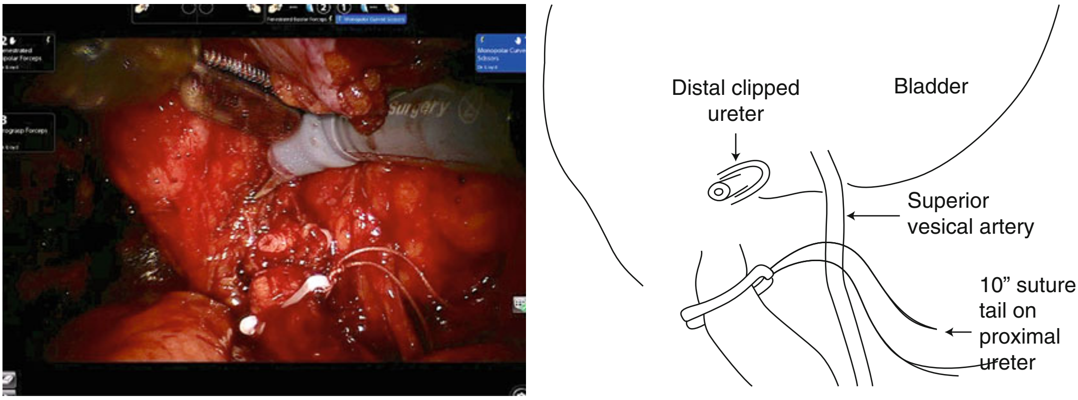

Fig. 7.4 Once the posterior and lateral spaces have been adequately developed, the ureter is doubly clipped and transected. For extracorporeal diversion, the clip on the proximal ureter is tagged with a 10″ 3-0 Vicryl for identification and manipulation

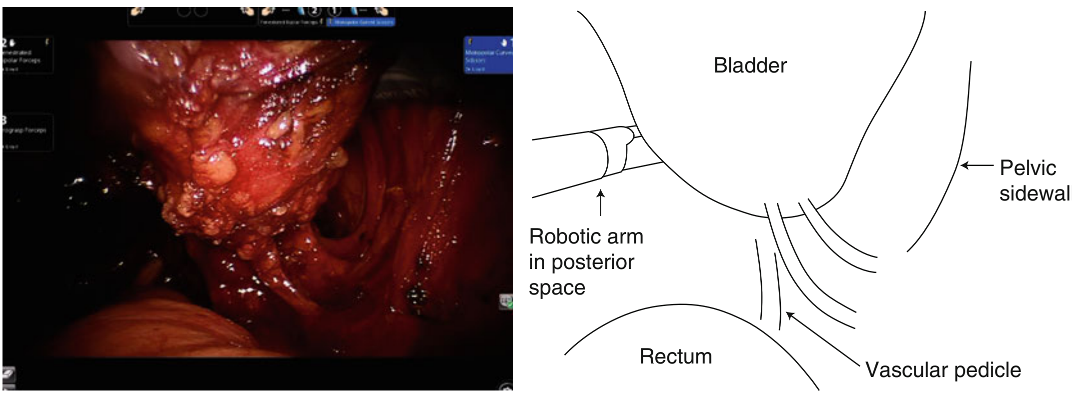

Fig. 7.5 With the ureter tucked into the upper abdomen, the rectum is dissected posteriorly away from the bladder and the vascular pedicle is identified

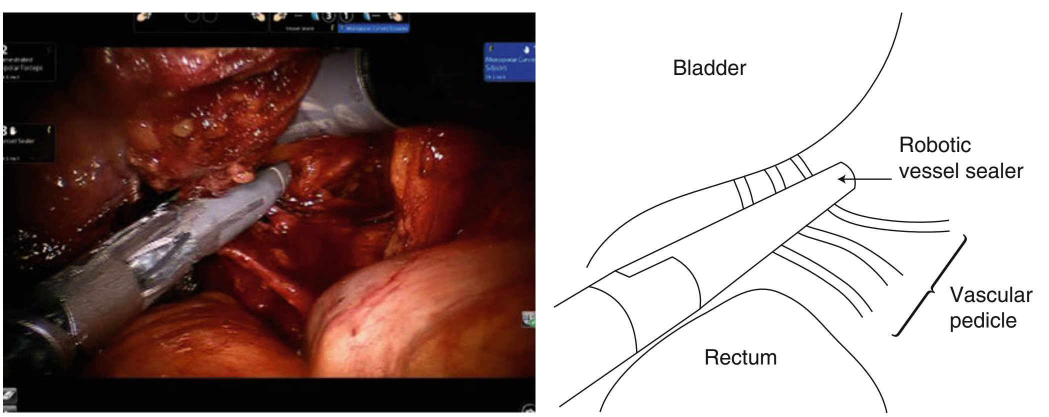

Fig. 7.6 Once the upper portion of the vascular pedicle is isolated, it can be clipped or cauterized at surgeon preference. This is shown here with the robotic vessel sealer

The ureters are doubly clipped, divided, and tucked into the upper abdomen well away from the operative field (Figs. 7.4 and 7.5). We recommend Hem-o-lok clips (Teleflex Medical, Research Triangle Park, NC, USA) with a color-coded 10″ suture tied to the heel of the clip that is applied proximally to facilitate manipulation of the ureter through a smaller incision at diversion.

4. Takedown of vascular pedicles
   Many different technologies are available for safe control of the superior vesical artery and vascular pedicles of the bladder. Clips, laparoscopic stapling devices, and direct ablation with other hemostatic technology can be employed at surgeon discretion (Fig. 7.6). Those using an externally applied laparoscopic stapler may consider using a 12 mm upper paramedian port to assist application of this device along the axis of the pedicles as the angles encountered from the lateral ports may be awkward for stapler use. As in prostatectomy, adequate distal division of attachments facilitates mobility and completion of the apical dissection. We have had favorable experience with the robotic vessel sealer (Intuitive Medical, Sunnyvale, CA, USA) and are assessing its utility for division of the superior vesical artery, which we have historically secured with clips. A group at Vanderbilt compared the similar LigaSure Impact device (Covidien, Dublin, Ireland) to stapler use and found no difference in blood loss and a simplification of vascular control during cystectomy [37].
5. Control of dorsal venous complex
   The balance of anterior bladder suspension is now released and the anterior space of Retzius dissected. In men, the dorsal venous complex is controlled after placement of 1–2 securing sutures in the fashion of a radical prostatectomy. A vascular stapler may be utilized alternatively.
6. Dissection of urethra
   The urethra is dissected free. If neobladder is planned, care is taken to preserve adequate urethral length. The bladder side of the specimen is controlled with a Hem-o-lok clip to prevent spillage of contents during transection. If ileal conduit is planned, the urethra is dissected as far distal as possible. If the patient has had previous pelvic radiation, the stump is carefully oversewn to prevent persistent urethral leakage of peritoneal fluid through a fixed and fibrotic urethra. If there is likelihood of subsequent urethrectomy such as known CIS or prostatic invasion, margins are sent and a clip left to allow identification of complete urethral extirpation should that become necessary later. The specimen is freed and placed in a large bag; we prefer the 12 mm Inzii device (Applied Medical, Rancho Santa Margarita, CA, USA) as it allows use of smaller 12 mm ports with full bag size.
7. Lymph node dissection
   Lymph node dissection is completed with an upper boundary to the level of the ureters crossing the iliac artery. This is carried laterally along the upper edge of the iliac artery adjacent to the genitofemoral nerve, with great care taken to remove all tissue surrounding the great vessels and into the obturator fossa. Finally, all tissue is removed from the distribution of the internal iliac artery in the deep pelvis. The specimen is placed in a separate smaller bag; we do not label tissue laterality as this has no additive benefit in prognosis or therapy. Clips are utilized selectively to decrease risk of lymph leak. In high-risk cases, or those felt likely to benefit from extended dissection, LND can be carried as high as the level of the inferior mesenteric artery on the aorta.

Creation of Extracorporeal Urinary Diversion

For ileal conduit, diversion may be performed either intracorporeally or extracorporeally. For surgeons newer to RAC, extracorporeal diversion is familiar and expedient. Once the lymphadenectomy has been completed, the ureters are recovered from where they have been tucked in the upper quadrants and good mobility verified. Ideally, freedom that extends a short distance above the common iliac artery will be available, especially on the left side.

The ileum and ileocecal junction should be identified; a premeasured suture can be utilized to march out 15–20 cm of terminal ileum and a long tagging suture of 3-0 silk placed in the serosa at the distal extent of the anticipated conduit. This is left full length to allow easy extraction through a small incision. Any attachments of the cecum that may hamper terminal ileal freedom are taken down.

Next, the ureter must be passed behind the sigmoid at roughly the level of the sacral promontory. With the colon gently retracted anteriorly, a passageway can usually be developed by gentle manipulation behind the incised retroperitoneum. Care should be taken to avoid vascular injury when crossing the midline, especially in the setting of aneurysmal dilatation or ectasia. Once an instrument has been easily passed from right to left and an appropriately sized space created behind the colon, the left ureteral tagging suture is grasped and the ureter pulled through to the right where it can be again assessed for adequate length and freedom. Alternatively, left ureteral passage can be accomplished open, although this often requires a larger abdominal incision.

Once both ureters lie in the right paracolic gutter and the terminal extent of planned conduit is tagged, all three tagging sutures are placed in a needle driver through an assist port and secured in place. The robot is undocked and table taken out of Trendelenburg; a small incision is made in the subumbilical midline and all tagging sutures passed out of it. The small bowel is pulled up and bowel resection performed to provide an adequate conduit of roughly 15 cm without unnecessary redundancy. It has been our preference to mature the ostomy at the premarked site prior to performing the ureteroenteric implantation. Once this is done, spatulated ureteral implants of roughly 1.5 cm are made with urinary diversion stents inserted via the matured ostomy and up each ureter. Interrupted 4-0 Monocryl used for implantation with great care taken to avoid any trauma to the distal ureter. A 4-0 chromic suture is used to secure the stent to the mucosa of the ostomy. At this point a closed suction drain is gently placed in the pelvis through a lateral port site, the fascia and incision are closed, and the patient taken to recovery.

Creation of Intracorporeal Urinary Diversion

Non-continent Urinary Diversion (Ileal Conduit)

Intracorporeal urinary diversion can divided broadly into six major steps: port placement, patient repositioning, bowel segment identification, bowel resection/bowel reanastomosis, ureteroenteric anastomosis, and ileal conduit stoma completion. Below is a summary of each step individually.

Port Placement and Patient Repositioning

Most centers use port placement for robot-assisted cystectomy that is similar to their robot-assisted prostatectomy port placement. When performing an intracorporeal urinary diversion, the bedside surgical assistant should have two assistant ports (at least 12 mm) to allow passage of the stapler from either the left or right side of the patient. Passage of the stapler from the left side has technical advantages and provides a better angle for the urinary diversion portion of the robotic-assisted cystectomy. If a right-side bedside assistant is preferred for the extirpative portion of the procedure, a 12-mm port can be exchanged for the 8-mm fourth arm port to allow stapler passage from the left during the urinary diversion [38].

After the RARC and lymph node dissection portions of the operation have been completed, the robot is undocked allowing for the patient position to be changed from steep Trendelenburg to a neutral operating room bed position. The robot is then re-docked for the urinary diversion. It is optional to re-dock the fourth robotic arm or use this lateral 8 mm port for the bedside assistant. Alternatively, if the cystectomy portion can be completed with less head-down positioning, it may prove unnecessary to reposition the bed.

Bowel Segment Selection for Urinary Diversion

The first step is to identify the ileocecal junction and spare 15–20 cm of terminal ileum. A 20-cm silk suture or a premarked Penrose drain is used to aid in the measurement of the appropriate bowel length to be utilized for the ileal conduit.

Once the segment of ileum is identified, the proximal and distal ends of the bowel are tagged with a 3-0 Vicryl stitch.

Bowel Resection and Reanastomosis

The next step is to harvest the ileal segment and restore intestinal continuity. An atraumatic Cadiere forceps (Intuitive Surgical Inc, Sunnyvale, CA, USA) are used in the right and left robotic arms for bowel manipulation. Distal transection of ileum is performed with an endovascular 60-mm laparoscopic stapler (endoGIA, Covidien, Norwalk, CT, USA). The stapler is introduced by the bedside assistant through the left lateral 12-mm assistant port while the robotic surgeon aligns the bowel and mesentery to be divided.

The stapler is placed in a perpendicular orientation across the bowel and mesentery, with the tips of the stapler aimed at the root of the mesentery. The Endo GIA stapler is fired to divide the bowel and mesentery. The identical technique is used at the other end of the bowel segment. The initial tissue load (3.5-mm thickness) transects the small bowel and a portion of the adjacent mesentery. If necessary, the mesenteric window can be further developed using electrocautery or an additional vascular stapler load (2.5-mm thickness). The transected bowel segment (close to the cecum) can be marked with a purple-dyed 3-0 Vicryl suture. After proximal division of the ileal segment, another purple-dyed 3-0 Vicryl suture is placed to mark the proximal transected ileum. The Endo GIA stapler is reintroduced into the 12-mm left lateral port and the arms for bowel manipulation. To restore intestinal continuity, the violet sutures on the proximal and distal cut ends of the bowel are used for traction. The anastomosis is created by excising a small amount of stapled bowel at each end with robotic scissors. Bowel continuity is reestablished with a standard side-to-side ileoileal anastomosis using a 60-mm laparoscopic tissue stapler load to anastomose the adjacent antimesenteric ileal walls. To complete the bowel anastomosis, the remaining bowel opening is stapled closed by deploying the same Endo GIA stapler transversely to finish the side-to-side anastomosis. The mesenteric defect is not closed. The ileoileal bowel anastomosis is performed cephalad to the excluded ileal conduit segment, keeping the isolated ileal conduit segment caudal to the mesentery. If there is difficulty in obtaining the appropriate orientation, the stapler should be introduced through a different port.

Ureterointestinal Anastomosis and Ileal Conduit Stoma

An approach that mimics the technique used in an extracorporeal urinary diversion is typically selected by the surgeon. Two of the more commonly employed techniques are the Wallace or Bricker techniques for ureterointestinal anastomosis. The assistant grasps the stay suture on the selected segment of the ileum. A small opening is made in the distal staple line (ostomy end) which allows passage of the laparoscopic suction/irrigator into the ileal conduit for this segment to be irrigated prior to the ureterointestinal anastomosis. The distal end of the conduit following the ureterointestinal anastomosis will be fashioned into a stoma at a premarked area for the stoma on the abdominal wall.

Both ureters are spatulated 2 cm and the posterior walls of the ureters are sutured side to side (Wallace technique) using 15 cm running 4-0 Biosyn or Monocryl. Two single-J 40-cm ureteral stents with the guide wire inserted are introduced through the distal end of the ileal conduit. The stents are then pushed up into the ureters on each side, the guide wires removed, and the ureterointestinal anastomosis is completed using two 15-cm 4-0 Biosyn or Monocryl sutures.

For the Bricker technique, each ureter is spatulated approximately 2 cm, and an incision is made at the selected site on the ileal conduit for the anastomosis. A continuous 4-0 Monocryl or 4-0 Vicryl suture on an RB-1 needle is used for the anastomosis. After suturing the posterior wall, with three interrupted stitches, a 7 F, single-J, ileoureteral stent is inserted through the distal end of the conduit and advanced up the ureter into the renal pelvis. The anterior wall is closed using a continuous suture. The identical procedure is then performed on the contralateral side.

Before undocking the robot, the ostomy side of the conduit is tagged with a 3-0 polyglactin suture and brought out through the closest port site to the ostomy site. This allows the surgeon to readily locate the conduit at the time of ostomy creation.

Continent Urinary Diversion (Orthotopic Ileal Neobladder)

When constructing an orthotopic ileal neobladder, a segment of bowel that can easily descend into the deep pelvis is selected. It is important to mark the midpoint and ends of this segment with sutures. To ensure this segment reaches the urethra, a tonsil clamp (female patients) or a Lowsley retractor (male patients) can be advanced through the urethra, so the suture on the selected segment of the ileum can be grasped to ensure adequate descent of the midpoint of the bowel to the urethra in a tension-free manner [39].

Multiple techniques of intracorporeal orthotopic neobladder construction have been described previously [38–46]. In this section, we highlight several of the key technical points for the more commonly performed intracorporeal orthotopic neobladders.

U-Shaped Stapled Reservoir

For the U-shaped staple reservoir, the antimesenteric border of the bowel segment is lightly cauterized using the monopolar scissors to distinctly mark the antimesenteric border. Next, the suture identifying the midportion of the bowel segment is grasped, thereby pulling the segment into the deep pelvis, which allows the bowel to be oriented into a U shape. To help approximate the antimesenteric sides, three sutures, spaced 3 cm apart, are placed along the antimesenteric border. At the proximal and distal edges of the bowel segment, laparoscopic scissors are used to excise a small portion of the staple line.

Through the 12-mm right-sided assistant port, the endoscopic stapler is advanced so that each jaw of the stapler is placed into the previously opened ends of the proximal and distal bowel segment. The stapler is deployed on the antimesenteric portion of each bowel section, which effectively detubularizes the bowel and forms the reservoir. The remaining bowel opening is closed after the ureterointestinal anastomosis is completed by either firing an additional staple load or using a 2–0 Vicryl suture on an SH needle.

To complete the neobladder, the last step is to anastomosis the neobladder to the urethra. Pruthi et al. [39] originally describe using a 3-0 Vicryl suture on a round-bodied (RB) needle and placing two interrupted sutures at the 5 o'clock and 7 o'clock positions posteriorly. Following placement of the posterior stitches, a new Foley catheter (20 or 22 French) is introduced into the neobladder and the remainder of the anastomosis completed in a running fashion on each side.

Studer Neobladder

After finishing the radical cystectomy and the pelvic lymph node dissection, the first step is to make an anastomosis between the ileum and the urethra. Wiklund and colleagues use the 0° lens during this initial step [43]. Appropriate mobilization of the ileum allows for a tension-free urethral anastomosis and also facilitates the suturing required to construct the neobladder.

An alternative way to pull the ileal segment downward to the urethra uses two Liga-Loop (Braun-Dexon, Spangenberg, Germany) strings positioned through the mesenteric border around the intestine and adjacent to the site of the anastomosis [44].

A 20 French opening is made in the antimesenteric site on the ileum using robotic scissors. A running anastomosis is completed using the Van Velthoven technique with two 18 cm long 4-0 Biosyn® suture. A 50-cm segment of the ileum will be used to construct the orthotopic neobladder. The ileum is stapled 40 cm proximal and 10 cm distal to the urethral-ileal anastomosis. After restoring the bowel continuity, the distal 40 cm of the isolated ileal segment is detubularized along its antimesenteric border, leaving a 10 cm intact proximal isoperistaltic afferent limb. Next, the posterior part of the Studer reservoir is closed using a running suture (25 cm, 3-0 Biosyn®). After completing the posterior part, the distal third to half of the anterior portion of the reservoir is closed using the same suture material. The remaining portion of the neobladder is left open to facilitate the ureterointestinal anastomosis and closed as the last part of the procedure using a running 3-0 Biosyn® suture. The urethral catheter balloon is then inflated and the neobladder filled to check for any leakage.

When placing the ureteral stents, the single-J 40-cm ureteral stents are introduced through two separate 4-mm incisions in the lower abdominal wall and then pulled through the afferent limb and advanced up the ureters into the renal pelvis. Each stent is anchored to the afferent limb using a 15 cm 4-0 Biosyn® suture. Optionally, the stents can be internalized and secured to the urethral catheter with nonabsorbable sutures and the stents are removed 3 weeks postoperatively at the same time of Foley catheter removal.

Others have reported slightly different modifications and techniques to creating the Studer neobladder intracorporeally. Desai and colleagues report using intravenous indigo-cyanine green to identify the major mesenteric blood vessels to be preserved in selecting the ileal segment for construction of the neobladder [42]. This group uses a marked Penrose drain or an open ureteral access stent as a ruler. Sixty centimeter of ileum is selected; the proximal 15 cm is reserved as the afferent limb of the neobladder. From the remaining 44 cm, an undyed suture is placed at 22 cm to denote the apex of the posterior plate for the Studer neobladder. The undyed marking suture (at 22 cm) can be grasped by the fourth robotic arm and retracted into the pelvis, which aids in the symmetrical alignment of the two 22 cm ileal segments.

The urethroileal anastomosis is completed prior to anterior closure of the pouch by Desai and colleagues [42]. Another option to the Van Velthoven technique is to use a double armed 3-0 or 4-0 suture on an RB-1 needle to complete the urethra-neobladder anastomosis. Anterior closure is aided by the placement of a midpoint horizontal mattress suture that divides the anterior closure into two equal halves with alignment of the neobladder edges.

Blute Jr. and colleagues evaluated the pressure-flow characteristics of various neobladder configurations used in intracorporeal urinary diversions [47]. Four neobladder configurations were constructed, each using 20 cm of human cadaveric small intestine. The hand-sewn Studer pouch was compared with a circular loop, W-pouch, and U-pouch with stapled anastomoses. The cystometric capacities of the stapled U-pouch, W-pouch, Circle pouch, and Studer pouch were 167.3, 177.5, 114, and 145.2 ml, respectively. The first increase in intravesical pressure was at 90.3, 103, 50, and 85 ml, respectively. The greatest compliance of 3.81 ml/cmH_2O was demonstrated in the U-pouch, with the W-pouch revealing a compliance of 3.44 ml/cmH_2O. The least compliant neobladder was the circle pouch (2.24 ml/cmH_2O) followed by the standard Studer pouch (2.94 ml/cmH20). While a limitation of this study is that only 20 cm of cadaveric small intestine was used in this study, the authors concluded that alternative neobladder configurations demonstrate equivalent pressure-flow studies in this experimental model.

Complications and Cost Analysis

Thorough doctor-patient discussion of complications relevant to RARC should include all the complications seen in ORC, and the possibility of access-related injury to bowel or vasculature and need for conversion to open surgery should be noted. Comparison of complication rates between ORC and RARC is difficult and requires use of a validated reporting system such as the Clavien-Dindo. Further, it is becoming apparent that many complications, including a fair amount of those termed major (Clavien grades 3–5), occur more than 30 days after surgery, thus favoring 90-day complication rates as most useful. Kauffman et al. showed that while 16 % of their RARC had major complications by this definition, fully half of those occurred between 31 and 90 days of surgery [48]. Nonrandomized comparisons from this same institution showed significant differences in 30-day overall complication rates as well as 90-day major complication rates favoring RARC [49]. However, a more recent prospectively randomized trial from Memorial Sloan-Kettering failed to show a difference in complication rates between these two modalities at that institution according to a late-breaking release at the 2013 American Urological Association meeting. Another recent trial has reported early pathologic data showing equivalent nodal collection and margin rates; long-term outcomes are still to be determined [50].

In the modern era, no discussion is complete without a cost analysis, and this is especially true regarding the new and expensive technology associated with the daVinci platform. Multiple factors contribute to the overall expense of an operation: direct surgical costs in the operating room that include time and technology, hospital costs that are largely related to length of stay, and costs incurred by complications in the hospital as well as after discharge. It bears noting the previously cited data suggesting that a large number of complications occur after 30 days and are only captured on 90-day postoperative follow-up.

Within the domain of direct costs, RAC is more costly: amortization of the robotic system itself, disposable goods and OR time generally all exceed the in-room costs of ORC. At one institution that produces open cystectomy outcomes that are closely comparable to RAC (equivalent complication rates and hospital stay; ORC showing higher transfusion rates), costs were close with RAC consuming $1,640 more in direct hospital costs [9].

Ignoring improvements in hard-to-define concepts such as societal costs associated with less work missed and similar issues, cost-effectiveness can still occur if a new technology decreases other more expensive medical events. Cystectomy, by nature rife with complications, is an excellent venue for such assessment. The cost of complications associated with cystectomy is impressive: a 2007 analysis of these costs by Konety and Allareddy from the National Inpatient database showed costs from each complication incurred another 29 % in costs above baseline, and two complications added 65 % to the bill [51]. A 2012 analysis that was limited to hospital-acquired complications by Kim et al. found that a single complication doubled the in-hospital costs of the operation (from $26,306 to $54,242) although their definition of complication was issues that occurred at a rate of only 11 % and thus more likely to represent higher-grade problems [8]. Any significant decrease in events of this cost magnitude clearly opens the door for expensive equipment to easily pay for itself.

Assessments directly comparing ORC to RARC cost are limited. Cost modeling is difficult to do and can be influenced by geography, baseline robotic volume, robot-associated costs, surgeon and team experience, accuracy of complication capture, presence of cystectomy pathway, and countless other factors that influence true total cost. A recent large comparison of 100 ORC to 100 RARC showed an estimated ORC blood loss of 986 ml compared to RARC losses of 423 ml, with transfusion rates of 47 and 15 %, respectively [52]. In this series, complications were substantially more common in the ORC cohort, including more than twice as common in the severe Clavien grades III–V major complications (10 % vs. 22 %). Conversely, an interim report from Memorial Sloan-Kettering in New York, released at the 2013 AUA meeting, found no difference in hospitalization or 90-day complication rates in their hands [53]. In the face of changing costs, the improved efficiency of experience and economies of scale that apply to this operation, no clear answer will exist until multi-institutional and regional assessments are completed.

Conclusion

The application of robot assistance to radical cystectomy offers an interesting and enticing alternative to open surgery. In virtually all published reports to date, this approach results in lower blood loss but longer surgical times when compared to its open counterpart. The expense of robotic technology must be continually justified by improvements in efficacy, morbidity and cost. Whether robot-assisted laparoscopy becomes the standard approach for radical cystectomy remains to be seen. But regardless of the answer to this always-dynamic query, lessons learned from the investigation will continue to benefit patients undergoing cystectomy by any technique in the future.

References

1. Marshall VJ, Whitemore WF. A technique for the extension of radical surgery in the treatment of vesical cancer. Cancer. 1949;2:424.
2. Dindo D, Demartines N, Clavien PA. Classification of surgical complications: a new proposal with evaluation in a cohort of 6336 patients and results of a survey. Ann Surg. 2004;240:205.
3. Shabsigh A, Korets R, Vora KC, et al. Defining early morbidity of radical cystectomy for patients with bladder cancer using a standardized reporting methodology. Eur Urol. 2009;55:164.

4. Lowrance WT, Rumohr JA, Chang SS, et al. Contemporary open radical cystectomy: analysis of perioperative outcomes. J Urol. 2008;179:1313.
5. de Badajoz Sánchez E, Gallego Perales JL, Reche Rosado A, et al. Laparoscopic cystectomy and ileal conduit: case report. J Endourol. 1995;9:59.
6. Puppo P, Perachino M, Ricciotti G, et al. Laparoscopically assisted transvaginal radical cystectomy. Eur Urol. 1995;27:80.
7. Gettman MT, Blute ML, Peschel R, et al. Current status of robotics in urologic laparoscopy. Eur Urol. 2003;43:106.
8. Kim SP, Shah ND, Karnes RJ, et al. The implications of hospital acquired adverse events on mortality, length of stay and costs for patients undergoing radical cystectomy for bladder cancer. J Urol. 2012; 187:2011.
9. Smith A, Kurpad R, Lal A, et al. Cost analysis of robotic versus open radical cystectomy for bladder cancer. J Urol. 2010;183:505.
10. Herr H, Lee C, Chang S, et al. Standardization of radical cystectomy and pelvic lymph node dissection for bladder cancer: a collaborative group report. J Urol. 2004;171:1823.
11. Kamat AM, Dinney CP, Gee JR, et al. Micropapillary bladder cancer: a review of the University of Texas M. D. Anderson Cancer Center experience with 100 consecutive patients. Cancer. 2007;110:62.
12. Richards KA, Kader K, Pettus JA, et al. Does initial learning curve compromise outcomes for robot-assisted radical cystectomy? A critical evaluation of the first 60 cases while establishing a robotics program. J Endourol. 2011;25:1553.
13. Guru KA, Perlmutter AE, Butt ZM, et al. The learning curve for robot-assisted radical cystectomy. JSLS. 2009;13:509.
14. Hayn MH, Hussain A, Mansour AM, et al. The learning curve of robot-assisted radical cystectomy: results from the International Robotic Cystectomy Consortium. Eur Urol. 2010;58:197.
15. Butt ZM, Perlmutter AE, Piacente PM, et al. Impact of body mass index on robot-assisted radical cystectomy. JSLS. 2008;12:241.
16. Johar RS, Hayn MH, Stegemann AP, et al. Complications after robot-assisted radical cystectomy: results from the International Robotic Cystectomy Consortium. Eur Urol. 2013;64:52.
17. Gadacz TR, Talamini MA. Traditional versus laparoscopic cholecystectomy. Am J Surg. 1991;161:336.
18. Lloyd G, Rashid H, Wu G. Complex pelvic surgery in the setting of prior ostomy. Kyoto: World Congress of Endourology; 2011.
19. Meeks JJ, Bellmunt J, Bochner BH, et al. A systematic review of neoadjuvant and adjuvant chemotherapy for muscle-invasive bladder cancer. Eur Urol. 2012;62:523.
20. Hollenbeck BK, Miller DC, Taub D, et al. Aggressive treatment for bladder cancer is associated with improved overall survival among patients 80 years old or older. Urology. 2004;64:292.
21. Knox ML, El-Galley R, Busby JE. Robotic versus open radical cystectomy: identification of patients who benefit from the robotic approach. J Endourol. 2013;27:40.
22. Kaffenberger SD, Keegan KA, Bansal NK, et al. Salvage robotic assisted laparoscopic radical prostatectomy: a single institution, 5-year experience. J Urol. 2013;189:507.
23. Chahal R, Sundaram SK, Iddenden R, et al. A study of the morbidity, mortality and long-term survival following radical cystectomy and radical radiotherapy in the treatment of invasive bladder cancer in Yorkshire. Eur Urol. 2003;43:246.
24. Eswara JR, Efstathiou JA, Heney NM, et al. Complications and long-term results of salvage cystectomy after failed bladder sparing therapy for muscle invasive bladder cancer. J Urol. 2012;187:463.
25. Eisenberg MS, Dorin RP, Bartsch G, et al. Early complications of cystectomy after high dose pelvic radiation. J Urol. 2010;184:2264.
26. Lee DJ, Rothberg MB, McKiernan JM, et al. Robot-assisted radical cystoprostatectomy in complex surgical patients: single institution report. Can J Urol. 2009;16:4664.
27. Zebic N, Weinknecht S, Kroepfl D. Radical cystectomy in patients aged > or = 75 years: an updated review of patients treated with curative and palliative intent. BJU Int. 2005;95:1211.
28. Nogueira L, dos Reis RB, Machado RD, et al. Cutaneous ureterostomy with definitive ureteral stent as urinary diversion option in unfit patients after radical cystectomy. Acta Cir Bras. 2013;28 Suppl 1:43.
29. Karl A, Carroll PR, Gschwend JE, et al. The impact of lymphadenectomy and lymph node metastasis on the outcomes of radical cystectomy for bladder cancer. Eur Urol. 2009;55:826.
30. Buscarini M, Josephson DY, Stein JP. Lymphadenectomy in bladder cancer: a review. Urol Int. 2007;79:191.
31. Mills RD, Fleischmann A, Studer UE. Radical cystectomy with an extended pelvic lymphadenectomy: rationale and results. Surg Oncol Clin N Am. 2007; 16:233.
32. Stein JP. The role of lymphadenectomy in patients undergoing radical cystectomy for bladder cancer. Curr Oncol Rep. 2007;9:213.
33. Youssef RF, Raj GV. Lymphadenectomy in management of invasive bladder cancer. Int J Surg Oncol. 2011; 2011: Article ID 758189.
34. Tilki D, Brausi M, Colombo R, et al. Lymphadenectomy for bladder cancer at the time of radical cystectomy. Eur Urol. 2013;64:266.
35. Keren Paz GE, Laudone VP, Bochner BH. Does minimally invasive surgery for radical cystectomy provide similar long-term cancer control as open radical surgery? Curr Opin Urol. 2013;23:449.
36. Davis JW, Gaston K, Anderson R, et al. Robot assisted extended pelvic lymphadenectomy at radical cystectomy: lymph node yield compared with second look open dissection. J Urol. 2011;185:79.

37. Thompson IM, Kappa SF, Morgan TM, et al. Blood loss associated with radical cystectomy: a prospective, randomized study comparing Impact LigaSure vs. stapling device. Urol Oncol. 2013;32:45.e11–5.
38. Johnson D, Castle E, Pruthi RS, et al. Robotic intracorporeal urinary diversion: ileal conduit. J Endourol. 2012;26:1566.
39. Pruthi R, Nix J, McRackan D, et al. Robotic-assisted laparoscopic intracorporeal urinary diversion. Eur Urol. 2010;57:1013.
40. Collins J, Tyritzis S, Nyberg T, et al. Robot-assisted radical cystectomy: description of an evolved approach to radical cystectomy. Eur Urol. 2013;64:654.
41. Collins J, Wiklund P, Desai M, et al. Total intracorporeal robotic cystectomy: are we there yet? Curr Opin Urol. 2013;23:135.
42. Goh A, Gill I, Lee D, et al. Robotic intracorporeal orthotopic ileal neobladder: replicating open surgical principles. Eur Urol. 2012;62:891.
43. Hosseini A, Adding C, Nilsson A, et al. Robotic cystectomy: surgical technique. BJU Int. 2011;108:962.
44. Jonsson M, Adding L, Hosseini A, et al. Robot-assisted radical cystectomy with intracorporeal urinary diversion in patients with transitional cell carcinoma of the bladder. Eur Urol. 2011;60:1066.
45. Josephson D, Chen J, Chan K, et al. Robotic-assisted laparoscopic radical cystoprostatectomy and extracorporeal continent urinary diversion: highlight of surgical techniques and outcomes. Int J Med Robot. 2010;6:315.
46. Murphy D, Anderson P. Robotic radical cystectomy with intracorporeal neobladder: ready for prime time? Eur Urol. 2013;64(5):742–3.
47. Blute M, George A, Herati A, et al. Intracorporeal neobladder reconstruction: pressure-flow urodyamic studies in cadaveric orthotopic neobladders. BJU Int. 2012;109:434.
48. Kauffman EC, Ng CK, Lee MM, et al. Critical analysis of complications after robotic-assisted radical cystectomy with identification of preoperative and operative risk factors. BJU Int. 2010;105:520.
49. Ng CK, Kauffman EC, Lee MM, et al. A comparison of postoperative complications in open versus robotic cystectomy. Eur Urol. 2010;57:274.
50. Parekh DJ, Messer J, Fitzgerald J, et al. Perioperative outcomes and oncologic efficacy from a pilot prospective randomized clinical trial of open versus robotic assisted radical cystectomy. J Urol. 2013;189: 474.
51. Konety BR, Allareddy V. Influence of post-cystectomy complications on cost and subsequent outcome. J Urol. 2007;177:280.
52. Kader AK, Richards KA, Krane LS, et al. Robot-assisted laparoscopic vs open radical cystectomy: comparison of complications and perioperative oncological outcomes in 200 patients. BJU Int. 2013;112: E290.
53. Laudone V, Silberstein J, Keren-Paz G, et al. Interim analysis of a prospective, randomized trial comparing robotic and open radical cystectomy. Presented at the American Urological Association Annual Meeting. San Diego, 2013.
54. Gondo T, Yoshioka K, Nakagami Y, et al. Robotic versus open radical cystectomy: prospective comparison of perioperative and pathologic outcomes in Japan. Jpn J Clin Oncol. 2012;42:625.
55. Nepple KG, Strope SA, Grubb RL, et al. Early oncologic outcomes of robotic vs. open radical cystectomy for urothelial cancer. Urol Oncol. 2013;31:894.
56. Wang GJ, Barocas DA, Raman JD, et al. Robotic vs open radical cystectomy: prospective comparison of perioperative outcomes and pathological measures of early oncological efficacy. BJU Int. 2008;101:89.
57. Styn NR, Montgomery JS, Wood DP, et al. Matched comparison of robotic-assisted and open radical cystectomy. Urology. 2012;79:1303.
58. Nix J, Smith A, Kurpad R, et al. Prospective randomized controlled trial of robotic versus open radical cystectomy for bladder cancer: perioperative and pathologic results. Eur Urol. 2010;57:196.
59. Galich A, Sterrett S, Nazemi T, et al. Comparative analysis of early perioperative outcomes following radical cystectomy by either the robotic or open method. JSLS. 2006;10:145.
60. Sung HH, Ahn JS, Seo SI, et al. A comparison of early complications between open and robot-assisted radical cystectomy. J Endourol. 2012;26:670.