7 Robot-Assisted Anterior Pelvic Exenteration for Bladder Cancer in the Female

Jeffrey W. Nix and Raj S. Pruthi

Introduction

Radical cystectomy remains one of the most effective oncologic treatments for patients with muscle-invasive bladder cancer and for those with high-grade, recurrent, noninvasive tumors. There continues to be an increasing number of anecdotal reports and case series for minimally invasive approaches to cystectomy. Laparoscopic and robot-assisted techniques have been shown to be viable approaches to cystectomy, demonstrating acceptable surgical and perioperative results [1–5]. A recent multi-institutional analysis encompassing four centers showed acceptable pathologic and perioperative outcomes for a robotic approach to radical cystectomy [6]. Potential benefits of laparoscopic and robotic approaches that have been described include lower surgical blood loss, early return of bowel function, and more rapid postoperative convalescence [3–5]. The majority of these series have reported techniques and outcomes in a predominantly male patient population. The applications of such novel techniques to female cystectomy and anterior exenterative procedures have not been well documented and described. However, given the successful application of robotic techniques in male patients, and given the growing experience of robotic approaches to hysterectomy, salpingo-oophorectomy, and other female pelvic procedures in the gynecologic literature, the stage has been set for the application of robotic approaches to anterior pelvic exenteration for female patients with bladder cancer [7, 8].

Cystectomy in male and female patents is different with regard to the surgical approach. Female patients have a broader pelvis with more ready access to the apical/urethral dissection than the male [9]. On the other hand, female pelvic anatomy may be less familiar to urologic surgeons due to the wealth of surgical experience in male patents, primarily owing to the treatment of prostatic diseases and malignancies. Even with bladder cancer, the preponderance of patients is male by a ratio of 3:1 [10]. Furthermore, the female cystectomy procedure includes exenteration of the anterior pelvic organs including the uterus, fallopian tubes, ovaries, and occasionally part or all of the anterior vaginal wall. Such procedures can be associated with increased blood loss and added morbidity that has been observed in female patients versus male patients in open radical cystectomy series by experienced surgeons [11].

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J.W. Nix, M.D. (✉)
Urologic Oncology Branch, National Cancer Institute, National Institutes of Health, 9000 Rockville Pike, 10 Center Drive, CRC Rm. 1-5940W, Bethesda, MD 20892, USA
e-mail: jeffrey.nix@nih.gov

R.S. Pruthi, M.D., F.A.C.S. (✉)
Department of Urology, The University of North Carolina at Chapel Hill, Chapel Hill, NC, USA
e-mail: rpruthi@med.unc.edu

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Herein we describe our technique and experience with robot-assisted radical anterior pelvic exenteration in the female including preoperative preparation, surgical steps, postoperative care while also describing our perioperative and pathologic outcomes of this novel procedure. We describe the stepwise approach to the robot-assisted radical anterior pelvic exenteration for urothelial carcinoma in the female allowing the urologic surgeon to more readily overcome the procedural learning curve.

Methods

Preoperative Evaluation

All patients should undergo appropriate preoperative lab work, imaging studies (chest X-ray, abdominal/pelvic cross-sectional imaging) and endoscopic resection with bimanual examination (i.e., transurethral resection of bladder tumor [TURBT]). Decisions for neoadjuvant chemotherapy should be made at the discretion of the treating medical team. At our institution, neoadjuvant chemotherapy is typically utilized in patients with clinical T3–4 tumors or suspected node positive disease. Overall, indications and preoperative decisions should not be changed by the surgical tool or approach utilized. Bladder cancer is an unforgiving disease and despite the novelty of such minimally invasive procedures and the potential short-term surgical and perioperative benefits, it remains imperative that any such procedure abide to the indications, standards, and principles of the open operation. It is paramount to observe and maintain the oncologic principles of radical cystectomy irrespective of surgical modifications.

Patient Selection

Appropriate patients, especially early in one's learning curve, include those who generally are in good health and performance status. We tend to avoid the robotic approach in patients with severe cardiopulmonary compromise—which is not an uncommon comorbidity due to the high levels of tobacco abuse in this patient population that contributes both to the development of urothelial carcinoma and cardiopulmonary disease. Limitations for patients in poor cardiopulmonary health status is primarily due to the positioning that includes extreme Trendelenburg that may exacerbate ventilatory difficulties and cardiac function.

In one's early experience, prolonged OR times may not be suitable for such patients. We recommend careful patient selection in one's initial experience with robotic anterior pelvic exenteration including patient characteristics as follows:

- Good performance status (independent) [12]
- Non-obese patients (BMI < 30)
- Healthy: age < 70, few comorbidities
- No previous intra-abdominal or pelvic surgery
- No prior chemotherapy or pelvic radiotherapy [13]
- Low volume disease (non-bulky tumors) [13]

Bowel Preparation

Two large prospective randomized trials in elective colorectal surgery, as well as a recent large meta-analysis showed no differeneces in anastamotic leaks, wound infections, fascial dehiscence, or overall morbidity or mortality between patients who received mechanical bowel preparation (MBP) versus no prep [14, 15]. To this end, in all patients undergoing radical cystectomy including those undergoing a robotic approach, we currently no longer perform a mechanical or antibiotic bowel preparation and patients are allowed a regular diet until midnight before surgery. We still use a Fleets® enema the morning of the procedure in order to evacuate the rectum and thereby reduce bowel distension in the deep pelvis.

Intraoperative Considerations

Intraoperative preparation includes shaving the patient from the costal margin to the pubis. The abdomen, perineum, vagina, upper thighs, and perianal area are prepped and draped in the usual sterile fashion. A 20-Fr urethral catheter is inserted. Intraoperative fluids are restricted to 500 ml/h as tolerated by the patient. This minimizes the risk of edema of the face and neck

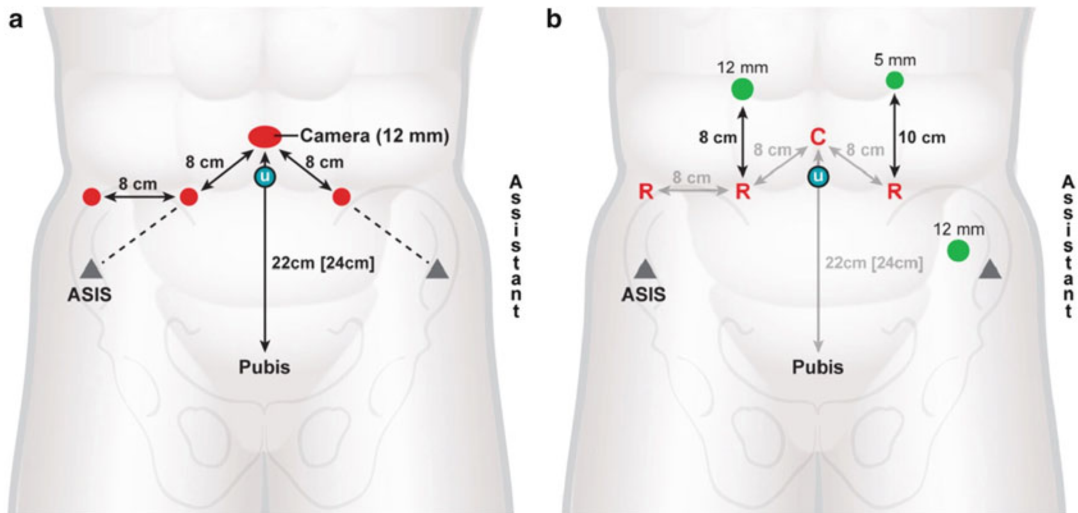

Fig. 7.1 Port placement including robotic ports (*red*) (**a**) and assistant ports (*green*) (**b**)

that can occur due to increased fluids and the steep Trendelenberg position. Multiple studies have also shown that appropriate intraoperative fluid restriction may significantly reduce complications, shorten hospital stay, and time to return of bowel function [16, 17]. A nasogastric or orogastric tube is inserted at the start of the procedure and removed at the end of the case. Occasionally the use of a uterine manipulator is employed and this is placed at the beginning of the case with the patient in the lithotomy position.

Steps of the Procedure

Positioning and Port Placement

Patient Positioning

After positioning, padding, securing, and preparing the patient in the supine position, the table is then placed in a steep Trendelenburg (>20°) position—identical to that of the robotic prostatectomy. For females, we use stirrups and the low lithotomy position with slight hip extension. Great care is taken to adequately pad and support the patient to avoid neuromuscular injury. Sequential compression devices are applied to the legs for DVT prophylaxis. We utilize a bean bag and cross-body taping to secure the patient adequately and test the positioning by tilting the table prior to the skin prep.

Port Placement

Port placement is similar to robotic prostatectomy with the addition of a 12-mm port on the side opposite of the assistant. Figures 7.1a, b and 7.2 demonstrate port placement based on a left-sided assistant. Veress insufflation is achieved through a vertical skin incision above the umbilicus, 22 cm above the symphysis pubis on the deflated abdomen. (In cases in which a more extended lymphadenectomy is anticipated [e.g., para-aortic dissection] or where an intracorporeal diversion is planned, this camera port is placed slightly higher at 24 cm above the symphysis.) The 12-mm camera port is placed here, and the remaining ports are placed under direct vision. Two 8 mm robotic ports are placed 8 cm away from the camera port, along the line from the camera port to the anterior spine of the iliac crest (ASIS) bilaterally. An additional 8 mm robotic port for the fourth arm is placed 8 cm directly lateral to the right sided robotic port. A 12-mm port for retraction and stapling is placed 8 cm cephalad to the robotic port on the right. A 5-mm port is placed 10 cm cephalad to the robotic port on the left. A 12-mm assistant port is placed two fingerbreadths medial and cephalad to the ASIS on the left. The port must be placed at least 8 cm away from the left robotic port and can be moved farther cephalad and lateral if necessary. The

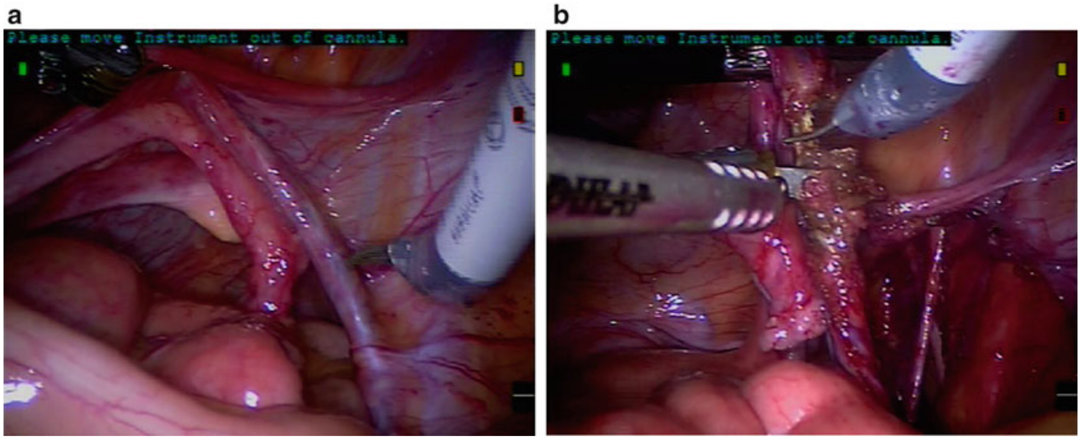

Fig. 7.2 Dissection (**a**) and bipolar fulguration and division (**b**) of ovarian pedicles (IP ligament)

patient is then placed in the steep Trendeleburg position and the robot is docked.

Procedural Steps

See Table 7.1 for list of instruments and accessories.

Divide Ovarian Pedicles (Infundibulopelvic [IP] Ligament)

After any sigmoid adhesions of the left side bladder and pelvis are released sharply, all of the small bowel is vacated from the pelvis. The ovarian pedicles (IP ligaments) are identified on each side superior and lateral to the ovaries themselves (Fig. 7.2a). A window is developed in the broad ligament isolating the ovarian pedicle. They can be ligated with the use of hemolock clips or alternatively fulgurated with the use of bipolar forceps before sharp division (Fig. 7.2b). With the posterior peritoneum overlying the ovarian pedicles incised, this peritoneal incision is extended along the broad ligament lateral to the fallopian tubes in the direction of the uterus and bladder. When the round ligaments are encountered, they are divided with the aid of the bipolar forceps and monopolar scissors. The fundus of the uterus is now freely mobile allowing greater manipulation of the uterus if desired and better visualization of the pelvic structures.

Table 7.1 Instruments and accessories

A. Recommended laparoscopic instruments
• 5 mm endoscopic long suction irrigator (45 mm) • 5 mm endoscopic scissors • 5 mm endoscopic locking grasper • 5 mm endoscopic needle driver (for passing suture) • 10 mm specimen retrieval bag
B. Recommended sutures/clips
• Dorsal vein stitch – 0 Vicryl on CT-2 (6 in.) • Ureteral and terminal ileum tags – 3-0 Vicryl on SH (full length) • Anastomosis stitch (for orthotopic diversion) – 3-0 Vicryl (or Monocryl) suture on RB-1 • Neobladder creation (intracorporeal diversion) – 2-0 Vicryl suture on SH – Stapler with vascular load • Ureteroenteric anastamosis (intracorproeal diversion) – 4-0 Vicryl suture on RB-1 suture • Hem-O-lock® (Weck Closure Systems, RTP, NC) large and extra large clips with endoscopic applier • Endovascular stapler/cutter with 60 mm vascular loads (e.g., Endo-GIA, Covidien, Mansfield, MA)
C. Recommended robotic instruments
• Two large needle drivers • Hot shears (monopolar curved scissors) • Maryland bipolar forceps • Cadiere bipolar graspers • Double fenestrated graspers (intracorporeal diversion)

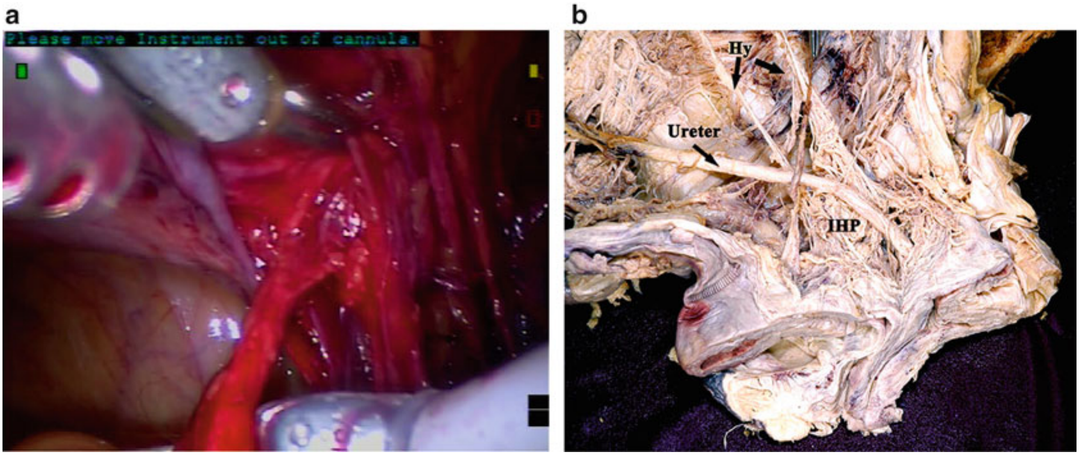

Fig. 7.3 (**a**) identification and dissection of ureters (**b**) Anatomic relationship between distal ureter and inferior hypogastric plexus. Photo used with permission by Keiichi Akita, Professor Clinical Anatomy, Tokyo Medical and Dental University

Isolate Ureters

With the posterior peritoneum incised along the ovaries and fallopian tubes, the medial edge of that incised peritoneum is grasped and lifted. The ureter can be found underlying and somewhat adhered to the posterior peritoneum along this medial leaflet. The ureter is encircled and the ureter is bluntly and sharply dissected distally down towards the level of the bladder (Fig. 7.3a). One should avoid grasping the ureter with the robotic instruments to avoid crush injury and resultant devascularization to the ureter itself. As one approaches the bladder they will encounter the uterine vasculature crossing lateral to medial towards the level of the cervix. Overly aggressive distal dissection in this area can result in bleeding as well as inadvertant damage to pelvic splanchnic nerves supplying portions of the vagina. Careful meticulous dissection in this area will identify the uterine vessels traveling just superficial to the ureter as they branch at the junction of the cervix and the vagina to form ascending and descending perforators to both structures. These uterine vessels (a.k.a the ventral vesicouterine ligament) can be isolated from the dorsally located ureter and transected with electrocautery. The ureter can easily be ligated at this point in most instances with adequate length for subsequent diversion. Hemolock clips (if desired a suture can be secured to the clips for the ureter as a tag for later identification) are used to ligate the ureters and they are divided at this level on each side. The transected ureters are tucked into the upper quadrants away from the pelvic dissection. If extra length on the ureters is desired, careful dissection posterior to the ureter at this level is mandatory, as the surgeon will encounter the vaginal artery and inferior hypogastric nerves. The nerves are located lateral and posterior to the ureter at the level of the uterine artery and ureter crossing in the dorsal vesicouterine ligament [8]. As the ureter enters the bladder, there is an avascular space just posterior to the ureter that can be widened with blunt dissection. Retraction of the ureter lateral and ventral will expose the dorsal vesicouterine ligaments, with its enclosed nerves, and prevent their transection. In general this extra ureteral length is not required. However, knowledge of the anatomy here will prevent transection of these nerves especially when dissecting lateral to the vagina at this level or if partial vaginectomy is required for proper surgical margins of the bladder (Fig. 7.3b).

Posterior Bladder Dissection

The peritoneum is incised between the level of the uterus and vagina (posteriorly) and the bladder (anteriorly): this incision can be made right at the level of the peritoneal reflection. With this lateral (“east to west”) incision made, the plane between the bladder and the vagina can be developed bluntly. With the uterine manipulator or a vaginal sponge stick in place, the dissection is carried along the vaginal wall to create an

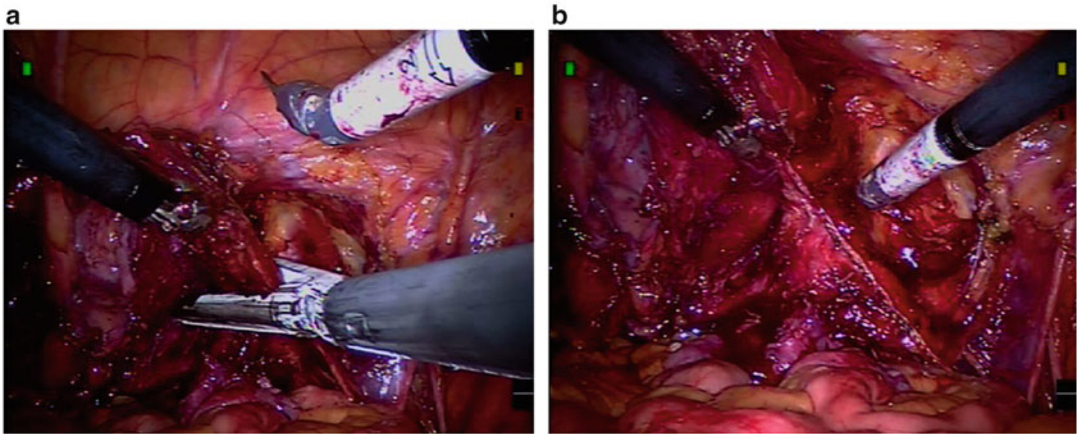

Fig. 7.4 Placement of endovascular stapler to divide pedicles (**a**) and image of divided bladder pedicle (**b**)

adequate wide margin on the level of the posterior bladder wall. In cases where a vaginal-sparing procedure is anticipated, this dissection can be taken down to the level of the bladder neck and urethra preserving the underlying arcus tendinous pelvic fascia (ATPF) The levator fascia, covering the levator ani complex, as it descends medially attaches to the arcus tendinous pelvic fascia (ATPF). The ATPF is composed of the pubocervical fascia, lying between the bladder and the vagina, as well as the rectovaginal septum. These structures are connected to one another as this fascial complex runs laterally to medially [19]. The preservation of this structure is important in nerve-sparing cystectomy as hstiologic studies have identiifed numerous sympthatic and parasympathetic nerve fibers within this mesh-like structure. This fascial plane also acts as a support structure and therfore preservation may decrease occurrence of pelvic organ prolapse and improve voiding patterns in orthotopic diversions [20]. However, as discussed in later sections, this fascial plane is difficult to distinguish as one reaches the level of the proximal urethra, and the muscular component of the anterior vaginal wall can contribute significantly to the posterior urethra at this level. If any aspect of the anterior vaginal wall is to be removed, the vagina can be entered and the anterior vaginal wall taken *en bloc* with the bladder thus creating the plane of dissection within the vagina itself.

Lateral Dissection

The peritoneum is incised just lateral to the medial umbilical ligaments on each side. This incision is carried laterally along side the bladder and extending posteriorly to the previously made peritoneal incisions overlying the ureter and between the bladder and uterus/vagina. (Of note the urachal and medial umbilical attachments are left intact to help suspend the bladder and facilitates the posterior and lateral dissection and the stapling of the bladder pedicles.) Blunt dissection can be used to develop the lateral perivesical space without much difficulty down to the level of the endopelvic fascia. In a non-orthotopic diversion or non-nerve-sparing procedure, the endopelvic fascia can be incised at this point. The lateral vascular pedicles of the bladder including the superior vesical artery can now be readily visualized.

Securing Bladder Pedicles

A laparoscopic endovascular stapler is used to ligate and transect the vascular pedicles to the bladder (Fig. 7.4a, b). Usually a single fire of a 60-mm stapler/cutter is sufficient to secure the bladder pedicles on each side. Alternatively these pedicles can be secured using the bipolar cautery or with the use of hemolock clips and then sharply divided. In cases where the anterior vaginal wall is to be taken *en bloc* with the bladder, the posterior plane of this dissection can be within the

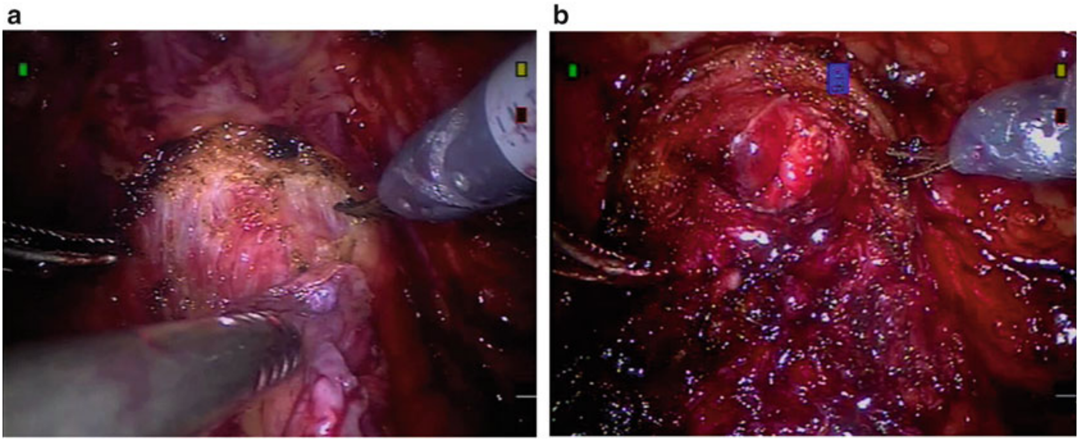

Fig. 7.5 Transection of urethra at the level of the bladder neck (**a**) in an orthotopic diversion. The bladder neck–urethral junction can be visualized and confirmed with catheter movement. Adequate urethral length remains after transection (**b**)

vagina itself—as opposed to between the bladder and vagina in a vaginal-sparing procedure. Vaginal entry can result in loss of pneumoperitoneum. To maintain insufflation pressure a moist laparotomy pad or large occlusive dressing (e.g., Tegaderm dressing, 3M Corp., St Paul, MN) is used to occlude the vaginal outlet and prevent loss of pneumoperitoneum.

Anterior Dissection

With the posterior and lateral dissections complete, attention is then turned anteriorly. The peritoneum is incised anteriorly through the medial umbilical ligament and the urachus thereby "dropping" the bladder. The anterior prevesical space is bluntly developed down to the level of the pubis and exposing the endopelvic fascia on each side. In an orthotopic diversion the endopelvic fascia is left intact to avoid any perturbance of the underlying continence mechanism in the female. In a non-orthotopic diversion the endopelvic fascia is incised, as noted previously, to allow for complete distal dissection of the bladder neck and urethra.

Bladder Neck/Urethral Dissection

The bladder neck is then approached anteriorly. In an orthotopic diversion, great care is made to create this transection precisely at the level of the bladder neck (Fig. 7.5a). Careful and continued evaluation at the location of the bladder neck is performed with the Foley catheter balloon in place to help visualize and identify the bladder neck. For this portion of the procedure the surgeon must carefully consider the competing interests of a sound cancer operation and functional preservation for the best quality of life postsurgically. However the clinican must remember that the foremost concern is for removal of cancerous tissue. Therefore the appropriate disseciton must be a case-by-case decision. In this context it is important to note that a functional and anatomical dissection can be achieved. Several principles are important to consider in regards to functional outcome: the preservation of the ATPF, maximizing urethral length, and preservation of lateral periurethral tissue. The first of these, ATPF preservation has been previously described in the section on posterior bladder dissection.

The contribution that urethral length provides for continence is debated; however, many urologists feel that both urethral length and closing urethral pressure are important considerations in female continence. Animal studies have shown that in a denervated urethra that closing urethral pressure is markedly decreased, therefore urethral length could be increasingly important in this situation [20]. This would argue for transection of the urethra as close to the bladder neck as possible.

However the composition of the posterior urethral wall is varied and has been shown, in cadaveric studies, to include significant contributions from the detrusor muscle in some cases [19]. It is therefore important that the clinician is mindful of this when completing the bladder neck dissection for the orthotopic diversion. Authors have advocated urethral transection as close as 5 mm to the bladder neck to around 1 cm, however, the decision is obviously a balance between sound oncologic principles and functional preservation and must be made at the time of dissection. Also the urethral margin that is performed for frozen section, if orthotopic diversion is desired, should make sure to include a portion of the posterior urethra based on anatomic and histologic studies.

The most common histologic appearance of the posterior urethra shows significant contribution from the anterior vaginal wall [19]. This makes a combined approach to the urethra ideal in our experience. The posterior plane dissection, as described above, significantly aids in delineation of the posterior plane up to the level of the bladder neck and posterior urethra. Then once the bladder is released from its peritoneal attachments the urethra can be isolated with an anterior approach.

The preservation of the lateral peri-urethral tissues is not dissimilar to the dissection that is carried out in the male patient. This tissue contains the perineal membrane, a U-shaped structure at the level of the mid urethra. This supporting structure consisting of collagen and elastic fibers and runs from the anterior mid urethra posterio lateral to the vagina and terminates at the level of the perineal body. This structure is felt to provide support for the urethra and contains in its lateral portion abundant nervous tissue. The cavernous nerves that supply innervation to the vaginal vestibule and vestibular glands runs through the ATPF on the posteriolateral side of the vagina and as it runs more superficial penetrates and runs on the lateral portion of the perineal membrane to supply these structures. Therefore protection of this tissue and medial dissection of the urethra and perineal membrane will aid in sexual preservation for the patient [19].

In the non-orthotopic diversion, the urethra can be dissected quite distally. When a complete urethrectomy is desired, we circumferentially incise the urethra at the beginning of the case before docking the robot. Bovie electrocautery on cutting current can help release the urethra from the vaginal mucosa and allow for a more complete urethrectomy when approached transperitoneally with the robotic dissection. Before transecting or delivering the urethra, we will typically place an extra large hemolock clip on the bladder (specimen) side to avoid any urine spillage.

After urethral transection, some remaining posterior lateral attachments will remain and these can often be divided with blunt and sharp dissection and with the use of monopolar and bipolar cautery. If the anterior vaginal wall has been incised en bloc, the entire bladder and anterior vaginal wall specimen can be removed through the vagina or placed in an impermeable bag.

Specimen Retrieval

In cases of an orthotopic diversion after the bladder neck has been transected at the appropriate level, the Foley catheter is left in place and the remainder of the bladder specimen is completely freed dividing any remaining posterior–lateral attachments. The catheter is clipped with an extra large hemolock (to avoid any urinary spillage and contamination), the Foley is transected, and the cut end is brought into the pelvis (Fig. 7.6a). The specimen is then placed in an impermeable retrievable bag that is moved out of the pelvis (Fig. 7.6b). The pelvis is irrigated, vaginal surface inspected, and hemostasis ensured. A urethral margin is sent for frozen section evaluation.

Vaginal Reconstruction/Hysterectomy/Oophorectomy

This portion of the procedure can either be performed before or after the cystectomy. Blunt and sharp dissection allows for complete freeing up of fallopian tubes and ovaries down to the level of the cervix. The uterus is lifted and the peritoneum is incised circumferentially at the level of the cervix. The lateral tissue at the level of the cervix is fulgurated with the liberal use of the bipolar

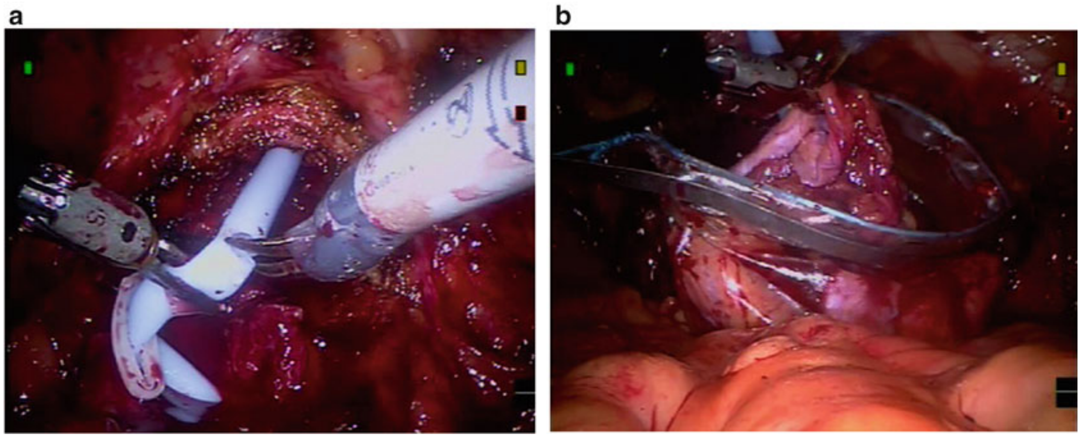

Fig. 7.6 Division of catheter (**a**) and placement of bladder in specimen bag (**b**)

forceps as this is the site of much of the uterine blood supply. The uterus can then be transected at the level of the cervix again with liberal use of monopolar and bipolar cautery. As previously discussed the hypogastric nerves and inferior hypogastric plexus will be located deep to the cardinal ligaments at this level and should not be encountered in a transcervical or supracervical hysterectomy. With the transection complete, the uterus, fallopian tubes, and ovaries are freed and removed out of the pelvis. In a vaginal-sparing procedure, the small os at the level of the cervix remains the only opening into the vagina and this is closed with a figure-of-eight 0 Vicryl suture on a CT2 needle. If the anterior vaginal wall was excised en bloc with the bladder, this defect can be closed in continuity with the reapproximation of the vaginal walls. We typically use a 0 Vicryl suture on a CT2 needle to reconstruct the vagina in a caudad to cephalad (i.e., north to south) manner. Depending on the remaining vaginal anatomy, this can also be done in a transverse manner if appropriate. If orthotopic diversion is desired the surgeon should attempt to prevent overlapping suture lines or plan for interposition of omental tissue if necessary.

Pelvic Lymphadenectomy

The initial surgical step is to identify and expose the external iliac artery and vein. On occasion, these vessels are readily visualized laparoscopically. In some cases, particularly in obese patients, the vessels need to be located and exposed from within the overlying retroperitoneal fat. In such cases, the external iliac artery can be located by noting pulsations along its anticipated course. Blunt dissection (e.g., with the closed scissor tips by the surgeon or with the suction irrigator by the assistant) along the external iliac artery and vein exposes these structures. Blunt and sharp dissection is carried down to the anterior surface of the external iliac artery. The vein can then be found lying immediately adjacent (posterior and medial) to the artery. It is important to dissect into the correct fibroalveolar plane just overlying the artery and the vein. This will allow for easier and more precise dissection of the lymph node packets for the remainder of the procedure. Margins of lymphadenectomy vary according to the discretion of the surgeon, and generally include the obturator nodes, the external iliac nodes, and the common iliac nodes. Para-aortic lymphadenectomy is also possible, particularly with the use of the Da Vinci S and Si systems which allows for more range of motion of the robotic arms. It is important that the surgeon is familiar with the neuroanatomy of the distal aorta at its termination into the common iliac arteries. The superior hypogastric nerve fibers and plexus, containing sympathetic and afferent somatic innervation to pelvic structures, will be located overlying the distal aorta at this level. In patients with significant retroperitoneal fat, these nerve structures may be difficult to visualize and require careful dissection.

The obturator and hypogastric lymph node dissection is begun by locating and developing the medial border of the external iliac vein, thereby exposing the obturator fossa posteriorly. Dissection along the external iliac vein must be done with great care to avoid a venous injury, because the vein is decompressed due to the steep Trendelenberg position. With the medial edge of the external iliac vein identified, the plane between the vein and the obturator packet can be extended to the pubic bone distally. Care must be made to identify the circumflex vein distally and any aberrant branches of the external iliac or obturator veins. Blunt and sharp dissection with the aid of monopolar scissors and fenestrated bipolar graspers—and with the appropriate counter traction placed by the assistant or the surgeon's nondominant hand—can be used to facilitate this dissection by retracting the vein laterally and the obturator node packet medially. Once the dissection off the external iliac vein is complete, the nodal packet can be dissected bluntly off the obturator nerve and vessels posteriorly. In a transperitoneal approach it is not necessary to ligate every lymphatic channel. Monopolar and bipolar cautery can aid in division of smaller lymphatic channels and the use of laparoscopic clips (e.g., Hem-o-lock™ clips) can be used to ligate larger lymphatic channels, pedicles, and vein branches as necessary. The pubic bone and anterior surface of obturator nerve and vessels mark the distal margin of the nodal packet. With the obturator packet freed and divided distally (down to and including the so-called node of Cloquet), it is peeled backed in the cephalad direction to the level of the hypogastric artery—keeping the obturator nerve, medial border of the external iliac vein, and the medial umbilical ligament in clear view. The medial umbilical ligament should be retracted medially to achieve proper exposure for the hypogastric dissection.

The base of the node packet near the internal iliac artery must be dissected with care as the internal iliac artery does not have the same fibroalveolar sheath as the external vessels. Consequently, the nodal tissue can be somewhat adherent with greater need for sharp dissection and coagulation of lymphatic and vascular attachments before division of the cephalad aspect of the packet near the level of the internal iliac artery.

Once the obturator/hypogastric dissection is complete, the extended dissection is undertaken, beginning distally, cephalad to and along the external iliac artery. Again, it is crucial to dissect down to the correct fibroalveolar plane over the artery. While avoiding the circumflex vein distally, all lymphatic tissue is taken between the external iliac vein and artery and laterally on the psoas muscle to the genitofemoral nerve. With this packet divided distally, this lymph tissue is teased and dissected in the cephalad direction with blunt and sharp dissection, occasionally using monopolar and bipolar cautery. Unlike the external iliac vein, it is quite rare to encounter aberrant branches off of the artery, and this dissection is readily performed proximally up to and along the common iliac vessels. One needs to remain cognizant that the ureter will be encountered crossing over the common iliac vessels. If desired, a para-aortic dissection can be accomplished robotically (particularly with the new generation—da Vinci S or Si—robot). If a para-aortic dissection is anticipated and the classic da Vinci platform is used, it may be necessary to place the robotic ports approximately 2 cm superior or cephalad than the typical configuration.

Tagging the Ureters

Before undocking the robot, the ureters are returned to the pelvis. At the distal end of each ureter, a full length 3-0 Vicryl stitch on an SH needle is placed as a tag, and the ends are brought out through the assistant ports on each side. This allows for ready identification and localization of both ureters. A 3-0 Vicryl stitch is placed in the terminal ileum to allow for its ready identification during the urinary diversion. In the case of an orthotopic neobladder, 3-0 Vicryl sutures (on RB-1 needles) are placed at the 5 o'clock and 7 o'clock positions in the urethra and left in the pelvis. These posterior sutures are sometimes the most difficult to place in an open fashion and preplacement under robotic guidance is easier. The robot is then undocked. The robot is not re-docked later for the anastomosis, as this portion of the operation is easily accomplished through the small incision made next.

Urinary Diversion

After the robot is undocked, all ports are removed. The ureteral sutures are kept through their corresponding port sites and tagged. It is important to keep the patient in the Tredelenberg position initially in order to prevent the intestine from descending into the pelvis. A 6–8 cm incision is made midway from umbilicus to the pubis to perform the urinary diversion. Typically, an abdominal wall retractor is not required and minimizing abdominal wall retraction may help reduce postoperative incisional musculoskeletal pain. Through this incision any further mobilization of the ureters can be carried out if needed. For an ileal conduit, the left ureter is tunneled under the sigmoid mesentery. In the case of an orthotopic neobladder where the afferent limb lies on the left side, the right ureter is tunneled underneath the sigmoid mesentery. The terminal ileum is identified with the assistance of the preplaced stitch, and the segment of bowel is harvested. The planned urinary diversion is then performed extracorporeally and the ureteroenteric anastomosis completed. For an orthotopic neobladder, the preplaced posterior urethral stitches are placed in their proper position in the neobladder neck. Anterior anastomotic sutures are placed thereafter. After the anastomotic sutures are placed and tagged, the patient is taken out of the Trendelenberg position.

More recently in certain cases we have performed the urinary diversion intracorporeally—including both ileal conduits and orthotopic ileal neobladders (Fig. 7.7). In such cases, the specimen is extracted through the vagina—either through the anterior vaginotomy in cases in which the anterior vaginal wall is removed or through a separate incision in the posterior vaginal wall in a vaginal-sparing procedure. A posterior incision is used in such cases to avoid the potential for overlapping suture lines in cases of orthotopic neobladder creation.

Fig. 7.7 Postoperative picture of female patient who has undergone robotic anterior pelvic exenteration, bilateral pelvic lymphadenectomy, and intracorporeal orthotopic ileal neobladder

A pelvic drain (ten French Jackson–Pratt drain) is placed, and the incisions are closed. Of note, we do not typically reapproximate the fascia on laparoscopic or robotic ports less than or equal to 12 mm.

Postoperative Care

During closure of incisions, fluids are liberalized with the goal of a 1 l bolus of intravenous fluids before leaving the OR. Postoperative care is routine and at the discretion of the surgeon. In our practice we had found no added benefit of leaving the NG tube even overnight and now routinely employ an OG tube intraoperatively that is removed at the end of the case.

After completing the procedure, all patients were taken to the urology inpatient ward and underwent routine postoperative care per our cystectomy care pathway which has previously been reported and which includes the use of

Table 7.2 Cystectomy fast-track program

Preoperative
Counseling/expectations
Outpatient bowel prep (day before surgery)
– Magnesium citrate solution—1 bottle (8 oz) – Fleets® enema – Clear liquid diet
Surgical
– Perioperative antibiotics (seconds or third generation cephalosporin) × 24 h – Removal of OG tube at end of procedure
Postoperative
Prokinetic agents (e.g., metoclopramide 10 mg i.v. q 8 h × 48 h)
Non-narcotic analgesics (e.g., ketorolac 30 mg i.v. q 6 h × 48 h reduce dose to 15 mg i.v. in patients > 65 years)
Early ambulation
Fast-track diet (advanced irrespective of bowel function)
– POD#1—chewing gum initiated (ad lib) otherwise NPO – POD#2—clear liquids—8 oz per 8 h – POD#3—unrestricted clear liquids – POD#4—regular diet

pro-kinetic agents and non-narcotic analgesics. In addition we employ a "fast-track" program of early diet advancement irrespective of status of flatus or bowel movement (see Table 7.2) [12].

The pelvic drain is typically removed prior to discharge. The patient returns at 10–14 days postoperatively for removal of the ureteral stents. In addition, in the case of an orthotopic neobladder, they will return 17–21 days after surgery for a cystogram and catheter removal. Clinical and oncologic follow-up is thereafter performed in stage-specific manner.

Results

We have performed robot-assisted radical cystectomy in 110 cases and applied it to female patients in 30 procedures. Our experience and perioperative outcomes with robotic anterior pelvic exenteration in the first 30 consecutive female cases are shown in Table 7.3 with comparisons made to 80 male patients also undergoing a robot-assisted radical cystectomy. Female patients were older (69.4 years vs. 63.4 years; $p=0.006$) and had shorter OR time (4.4 h vs. 4.8 h; $p=0.046$) but were not different with regard to other perioperative outcomes. It should be noted that our initial learning curve with robot-assisted radical cystectomy of 20 cases were all male patients and these were included in this comparison.

Table 7.3 Perioperative outcomes

	Female ($n=30$)	Male ($n=80$)
Mean age	69.4 years*	63.4 years
Mean BMI	26.3 kg/m^2	27.8 kg/m^2
Mean ASA score	2.8	2.7
Diversion		
Conduit	22	44
Neobladder	8	35
None	0	1
Mean EBL (range)	234 ml	283 ml
Mean OR time (range)	4.4 h*	4.8 h
Post-op		
Mean time to flatus	2.0 days	2.1 days
Mean time to BM	2.7 days	2.8 days
Mean time to discharge	5.1 days	4.7 days
Mean LN yield	18.8	19.1

*$p<0.05$

Pathologic outcomes have also demonstrated an appropriate extirpative procedure in that no patient has a positive margin, and a mean number of lymph nodes removed is 19 (range 9–34) with our standard and extended dissection. Short-term (within 30 days of surgery) complication rate was 23 %. Complications included ileus, a fever of unknown origin, anastamotic urine leak, DVT, acute renal failure, and stent obstruction.

Comment

Despite the novelty of such minimally invasive procedures, several principles and standards must be rigorously evaluated and maintained. First, it remains paramount to observe and maintain the oncologic principles of this operation irrespective of surgical modifications. That is, pathologic endpoints, and consequently oncologic outcomes, must never be compromised with such newer techniques. Second, such procedures should have appropriate perioperative outcomes with regard to operative time, surgical blood loss, and length of hospital stay. Such measures may reflect and impact on patient morbidity and recovery and may also indicate operative difficulty (i.e., the learning curve) for the surgeon. For example, in robotic prostatectomy procedures, operative times have been used as an indirect measure of surgical difficulty and of progress in overcoming the learning curve [22]. Accordingly, novel procedures should not result in insurmountable difficulties or excess morbidities for surgeon or patient alike. Last, any such new procedures should not expose patients to any undue or excessive complications.

In our experience, the oncologic principles and pathologic outcomes appear to be maintained with a robotic approach. In no case has a positive margin observed. In addition, the pelvic lymphadenectomy remains an important aspect of radical cystectomy, and, in our experience, an external iliac and even common iliac lymph node dissection can be readily performed robotically. Indeed, our mean lymph node count of 19 with the robotic approach compares favorably to the mean lymph node count of 16 observed in our open cystectomy experience [5].

Indeed, with regard to perioperative outcomes, the robotic approach to anterior exenteration is associated with a relatively low surgical blood loss. Our low operative blood loss of 234 ml compares favorably to our own open experience and that of other reports in the literature [11, 23]. Indeed, in the report by Lee et al. for open radical cystectomy, blood loss and transfusion requirements in females were significantly higher than that of males [11] In addition, postoperative outcomes including time to flatus, time to bowel movement, and time to hospital discharge are also favorable in our experience.

In our experience, we only attempted robot-assisted radical cystectomy after a wealth of experience and sense of proficiency in both open cystectomy and robotic prostatectomy. And, it is only after an initial robot-assisted radical cystectomy experience of 20 men, did we initiate our robotic series in female patients. It is interesting to note that no differences were observed in the subsequent male series and the concurrent initial female experienc. It appears that a new learning curve for robotic anterior exenteration does not appear to have clinical difficulties or complications with regard to OR time, blood loss, and postoperative convalescence when the female experience is embarked upon after an initial approach in male patients. In other words, transition to proficiency in anterior pelvic exenteration occurred readily with near identical outcomes as the concurrent male experience. It is unclear as to how these outcomes would have differed if female patients were part of that initial learning curve.

In conclusion, in our experience, the robotic anterior exenteration has been readily adapted to the surgical treatment of bladder cancer. The approach appears to achieve the clinical and oncologic goals of radical cystectomy in the female.

Editors' Commentary

Erik P. Castle and Raj S. Pruthi

Cystectomy in male and female patents is different with regard to the surgical approach. Female patients have a broader pelvis with more ready access to the apical/urethral dissection than the male. On the other hand, female pelvic anatomy may be less familiar to urologic surgeons due to the wealth of surgical experience in male patents, primarily owing to the treatment of prostatic diseases and malignancies. Even with bladder cancer, the preponderance of patients are male by a ratio of 3:1. It is therefore not surprising that urologists may be less familiar with female pelvic surgical anatomy, especially with regard to laparoscopic and robotic approaches. Furthermore, the female cystectomy procedure includes exenteration of the anterior pelvic organs including the uterus, fallopian tubes, ovaries, and occasionally part or all of the anterior vaginal wall. Such procedures can be associated with increased blood loss and added morbidity that has been observed in female patients versus male patients in open radical cystectomy series by experienced surgeons.

In our experience, we only attempted the robot-assisted radical cystectomy after a wealth of experience and sense of proficiency in both open cystectomy and robotic prostatectomy.

And, it is only after an initial robotic cystectomy experience of 20 men, did we initiate our robotic series in female patients.

This chapter describes the technique and experience with robot-assisted radical anterior pelvic exenteration in the female including preoperative preparation, surgical steps, postoperative care while also describing our perioperative and pathologic outcomes of this novel procedure. The stepwise approach will hopefully allow the urologic surgeon to more readily overcome the procedural learning curve encountered with robotic surgery in the female patient.

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