Robot Assisted Anterior Pelvic Exenteration for Bladder Cancer in Female

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Abstract

The standard-of-care management of muscle invasive bladder cancer in females is anterior pelvic exenteration. This involves the surgical excision of the urinary bladder and the female reproductive organs in addition to pelvic lymphadenectomy. Among many factors, performing this procedure robotically requires thorough knowledge of female laparoscopic pelvic anatomy in order to conduct this complex surgery in a safe and efficient manner. However, most urologic surgeons are more familiar with male pelvic anatomy given the prevalence of the more frequently performed robotic prostatectomy. Our technique was developed based on minimal deviation from robotic radical cystectomy in males and this chapter will review its various steps and highlight the main differences.

Keywords

Cystectomy · Female cystectomy · Anterior pelvic exenteration · Robot assisted radical cystectomy in females · Robot assisted radical cystectomy

Introduction

Bladder cancer is the fourth most common cancer and the eighth most common cause of cancer related deaths in the United States. It caused more than 16,000 deaths in the United States in 2016. Although bladder cancer is more common in males compared to females (male to female ratio is 3:1) females usually present with more advanced stage of bladder cancer. Several studies identified female gender as an independent risk factor for death from this disease [1–3]. Similarly, other studies reported higher incidence of prolonged hospital stay, need for intensive care units admission and higher blood loss in female patients when compared to their male counterparts [4, 5].

The initial successful experience in robotic prostate surgery has naturally resulted in exploring the role of the robot in treating bladder cancer. Robot assisted radical cystectomy (RARC) was successfully performed for the first time in a male patient in 2003 [6] and the first RARC in a female patient was reported shortly afterward [7]. The last decade witnessed the publication of

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numerous studies that established the safety and efficacy of RARC in treating muscle invasive bladder cancer [8–11]. However, this procedure is still technically demanding for most urologists especially in females as they are more familiar with male laparoscopic pelvic anatomy.

In order to ensure complete cancer eradication, anterior pelvic exenteration (APE) is considered the gold standard therapy for female patients with muscle invasive bladder cancer. A standard APE for bladder cancer in females should ideally include surgical excision of the urinary bladder, urethra, anterior vaginal wall, uterus, bilateral fallopian tubes and the ovaries. However, a vaginal or urethral sparing procedure can be performed in cases of orthotopic diversions or in sexually active females [if oncologically safe in the absence of bladder neck involvement and the presence of low-stage disease (≤cT2)]. In this chapter, we will describe our stepwise approach for a standard APE and we will highlight the variations of vaginal or urethral sparing procedures.

Preoperative Preparation

The preoperative preparation in female patients is not significantly different from their male counterparts. Women being considered for robot-assisted radical cystectomy (RARC) should undergo complete metastatic and staging evaluation. Particular attention needs to be paid to abdominal and pelvic cross sectional imaging to evaluate local extension of the disease into adjacent female reproductive organs, presence or absence of lymphadenopathy, and anatomic abnormalities. Past surgical and gynecological history such as history of hysterectomy may alter the surgical plan.

Following detailed preoperative anesthesia evaluation, all patients should be strategically marked immediately prior to surgery for the potential urostomy site (even if an orthotopic neobladder is planned). This should be performed in the sitting and standing positions. Education regarding urostomy or neobladder care and maintenance should be initiated preoperatively. Bowel preparation is limited to patients who received preoperative radiation therapy. Several studies demonstrated the lack of benefit of bowel preparation in terms of infectious and anastomotic leakage complications [12–14]. Moreover, certain reports demonstrated higher tendency of prolonged ileus after radical cystectomy when bowel preparation is used [15].

The preoperative initiation of a μ opioid receptor antagonist (Alvimopan) has been shown to decrease the duration of postoperative ileus, postoperative hospital stay and need for parenteral nutrition in cystectomy patients [16, 17]. Currently, this represents a standard part of our perioperative care unless contraindicated.

Broad-spectrum antibiotics covering gram-negative, gram-positive, and anaerobic organisms are administered 60 min prior to skin incision. In order to decrease postoperative thromboembolic complications, mechanical prophylaxis in the form of long sequential compressions and elastic stockings are placed on the lower extremities prior to anesthesia induction as well as pharmacological prophylaxis with low molecular weight heparin. Postoperatively, heparin is continued until independent ambulation is achieved.

Patient Positioning

A nasogastric tube is placed for decompression of the stomach. An arterial line may be inserted for intraoperative monitoring. The urethral catheter is placed after the patient is prepped and positioned in a sterile fashion. The patient is placed in low lithotomy position with arms tucked to the side. Care must be taken to ensure the patient's hands and elbows are adequately padded. The patient will be placed in extreme/maximal Trendelenburg during the case and this must be tested prior to prepping and draping the patient. A chest strap may be employed; however, patients rarely move on the bed with the arms tucked and the legs in low lithotomy stirrups.

Management of the Urethra

The female urethra can be excised one of two ways. One option is to dissect it out robotically and carry the dissection to the introitus from a

cephalad to caudal approach. Another option is to perform the dissection transvaginally before docking the robot. The authors have found that in cases of radical cystourethrectomy, scoring the urethral meatus with cautery and dissection a small portion of the distal urethra can make identification of the limits of the robotic dissection easier. In some cases we carry the dissection between the anterior vaginal wall and posterior bladder wall much like a dissection one would do for an anterior colporrhaphy. We usually infiltrate the space with a saline or lidocaine solution with epinephrine prior to dissection to separate the tissues and enhance vascular control. With the use of the Si da Vinci surgical system, meticulous hemostasis should be performed prior to switching to the robotic portion of the procedure as these tissues are quite vascular and can bleed without notice when the robot is docked between the legs. However, with the newer Xi da Vinci surgical system, the robot can be side docked and the assistant can have a better simultaneous access to the patient introitus during the robotic portion of the procedure.

Positioning of Operating Room Equipment and Personnel

The list of robotic instruments that we use during this procedure is shown in Table 53.1. The robot is docked between the patients legs or from the side (for the Xi da Vinci) with the robotic arms oriented in a cephalad direction. The third robotic arm is positioned on the patient's right side if an intracorporeal diversion is to be performed. If an extracorporeal diversion is to be performed then it can be positioned based on surgeon preference. The bed side assistant stands on the contralateral side in relation to the third robotic arm. The positioning of operating room equipment and personnel is demonstrated in Fig. 53.1.

Port Placement

Access and establishment of the pneumoperitoneum can be performed with a Veress or Hassan technique depending on surgeon preference and likelihood of adhesions. An important point is to resist the temptation to place one of the working port incisions at the conduit site. In general, patients are marked so as the stoma is located through the rectus muscle and a working port in this location would be too medial and result in external collision.

A total of six ports are utilized during the operation. This includes two assistant and four robotic ports. With the da Vinci Si, the camera port is 12-mm and the rest of the robotic ports are 8-mm. With the Xi da Vinci surgical system, all ports are 8 mm in size including the camera port. Our port placement with the Si and Xi is identical.

As mentioned earlier if an intracorporeal diversion is planned, the third arm should be placed on the right. However, if an extracorporeal diversion is planned it can be placed on either side depending on surgeons' preferences. Herein,

Table 53.1 List of robotic and laparoscopic instruments required during the procedure

Surgeon Instrumentation			Assistant instrumentation
Arm 1	Arm 2	Arm 3	• Laparoscopic suction-irrigator • Laparoscopic blunt tip grasper • Laparoscopic needle driver • Laparoscopic scissors • Laparoscopic vessel sealing device (LigaSure™)[c] • Hem-o-lock clip applier • Laparoscopic vascular stapler (Endo-GIA 30–2.5)[c] • Reusable specimen retrieval bag
• Curved monopolar scissors • Needle driver • Robotic vessel sealer[a,b] • Hem-o-lock clip applier[*] • Endowrist stapler[a,b]	• Maryland bipolar grasper or vessel sealer • Needle driver	• Prograsp dissector	

[a]The use of these instruments is optional and can be substituted with assistant held devices
[b]Used with the Si or Xi daVinci surgical system
[c]The use of this instrument is optional

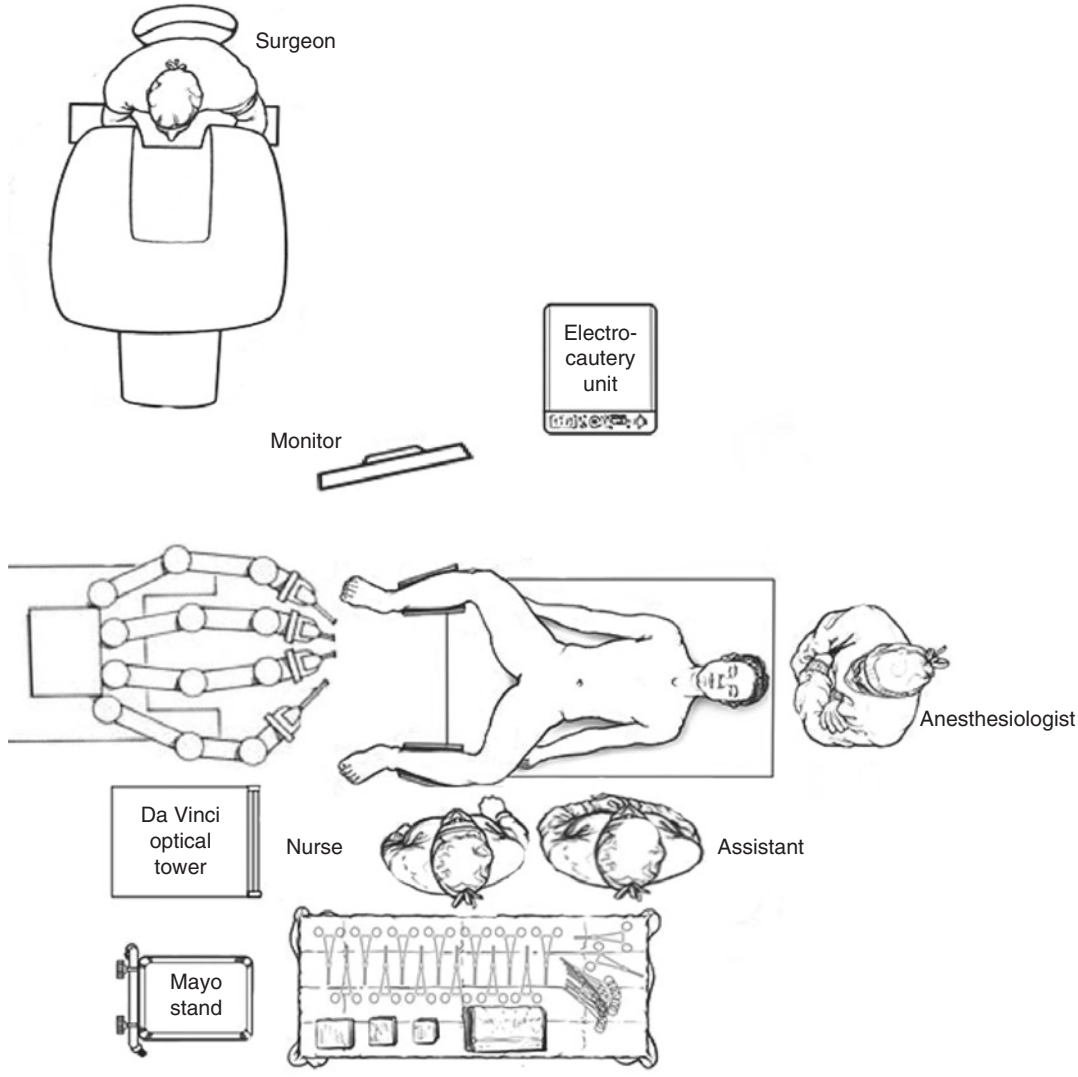

Fig. 53.1 Operative room set up

we will describe the port location as if the third robotic arm is on the ride side of the patient. When the third robotic arm is placed on the left side, the ports should be simply placed in mirrored locations.

In general, the ports are arranged as diagrammed in Fig. 53.2. The camera port is placed in the midline cephalad to the umbilicus. This port is 3–4 c cephalad for ileal conduits and lowered slightly for neobladder diversions. Two 8 mm robotic ports are placed 8–9 cm lateral from the midline and approximately 1 cm above the superior aspect of the umbilicus to allow for proximal ureteral and lymphadenectomy dissection. These will be used for robotic arm number 1 and 2 on the right and left respectively. The third robotic arm port is placed along the same horizontal line and as lateral as possible on the right side. The two assistant ports are placed lateral and caudad to the second robotic port on the left side. The assistant ports should be a 15 mm port and 5 mm port. A 15 mm port is mandatory

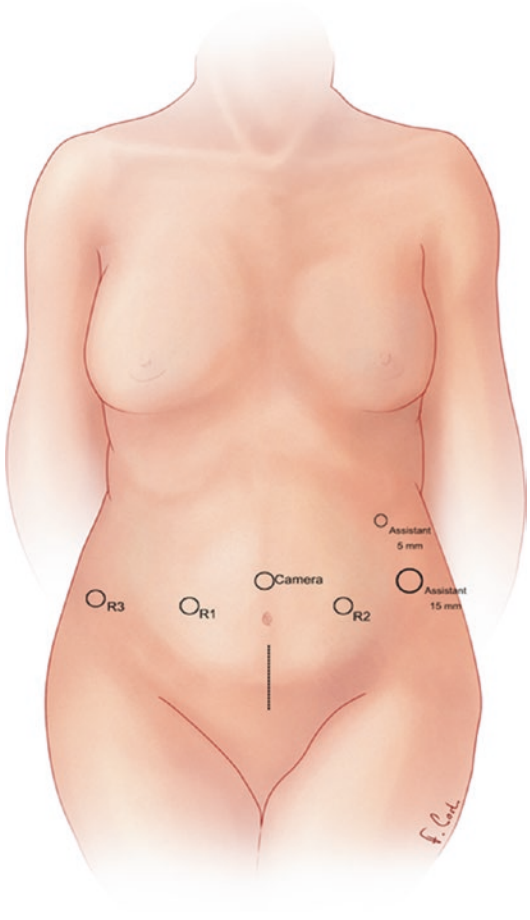

Fig. 53.2 Template of port placement. *R1* first robotic port, *R2* Second robotic port, *R3* Third robotic port

in these cases for easier extraction of the specimen during lymph node dissection. Often, a 12 mm port is used as second assistant port (instead of 5 mm) especially when the pedicle is controlled with a stapler as this gives a better angle to staple it.

Our technique implies starting the procedure with pelvic lymphadenectomy as this will facilitate anatomic dissection of the vascular pedicle.

Division of the Infundibulopelvic Ligament

This is the first step that needs to be performed in a female cystectomy prior to starting the lymphadenectomy and ureteral dissection. Once

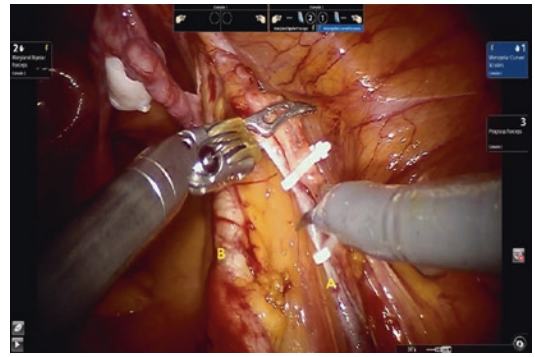

Fig. 53.3 Division of the infundibulopelvic ligament/gonadal vessels. *A* Infundibulopelvic ligament, *B* Right external iliac artery

identified, they can be controlled with locking clips, staplers or suture ligation (Fig. 53.3). The peritoneal incision is extended inferomedially through the broad ligament toward the pelvis just lateral and parallel to the uterus. The round ligament will be encountered and should be divided in a similar manner. Completion of this step will free the uterus and will make it easy to manipulate it to visualize deeper pelvic structures. Once completed, the fallopian tubes can be retracted medially and anterior to the uterus and thus provides good exposure to the ureters and iliac vessels for subsequent ureteral dissection and lymphadenectomy respectively.

Mobilization of the Sigmoid and Left Colon

The left colon and sigmoid colon should be released from the left side wall to allow access to the left iliac vessels and left ureter. This is done along the white line of Toldt where the sigmoid colon is released from the lateral abdominal wall as high as possible and reflected medially and superiorly out of the surgical field. At this point the only remaining bowel that should be visualized is the sigmoid and the rectum.

Development of the Paravesical Spaces

The medial umbilical ligament should be identified and retracted medially with the third arm or the assistant. The peritoneum just lateral to the

Fig. 53.4 Fully developed paravesical space. *A* Right external iliac artery, *B* Right internal iliac artery, *C* Right medial umbilical ligament

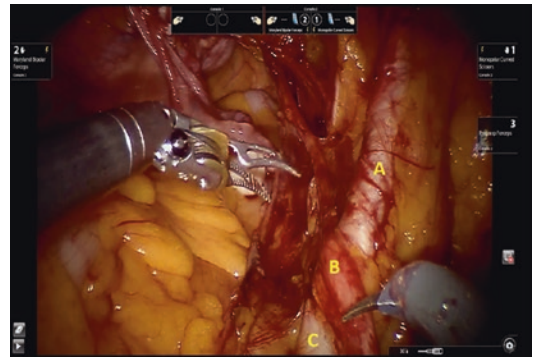

Fig. 53.5 Ureter identified as it is crossing the common iliac artery bifurcation. *A* Right external iliac artery, *B* Right ureter, *C* Right common iliac artery

ligament and medial to the iliac vessels should be incised. The incision extends from the anterior abdominal wall to the bifurcation of the common iliac artery and just parallel to the ligament itself. Care should be taken to make this incision as superficial as possible to avoid injury to underlying vascular structures. Once an incision is made the dissection should be carried caudad to expose the endopelvic fascia. Care should be taken to avoid injury to the epigastric vessels while dissecting close to the anterior abdominal wall. Creation of the paravesical space will subsequently make the lymphadenectomy easier and provide an ample working space (Fig. 53.4). It should be emphasized that the remaining bladder attachments to the anterior abdominal wall should not be disturbed as this will help to maintain anterior retraction.

Identification, Mobilization and Division of the Ureters

The ureter is identified crossing over the iliac vessels at the bifurcation of the common iliac artery (Fig. 53.5). The ureter should be dissected free of its underlying structures while preserving as much periureteric tissue as possible. The distal end can be dissected down to its insertion into the bladder. The umbilical artery or the superior vesical artery should be seen just lateral to the insertion of the ureter into the bladder and can be clipped and divided to allow for greater ureteral length. The ureter can be clipped with a locking clip that has a pre-tied suture to the crotch of the clip (Fig. 53.6). One may use a different color suture for the left and right sided clips. The ureter

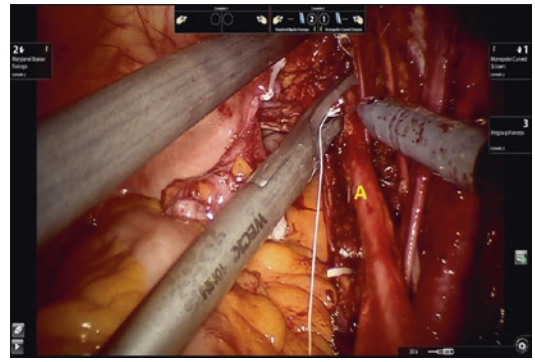

Fig. 53.6 Tagged clip applied to the distal right ureter. *A* Right ureter

is divided and a margin may be sent for frozen section. The ureter should be dissected free of its lateral attachments as far cephalad as possible but preservation of some medial blood supply from the common iliac artery is preferred to maintain good blood supply.

Pelvic Lymphadenectomy

The dissection is begun on the external iliac artery. A "split-and-roll" technique is utilized. Dissection is extended both proximally and distally along the shaft of the external iliac artery. The dissection should be carried proximally along the common iliac artery up to the bifurcation of the aorta. It should be noted that the right common iliac artery crosses over the right common iliac vein. This is important to remember when performing "split-and-roll" along the common right iliac artery as the common iliac vein

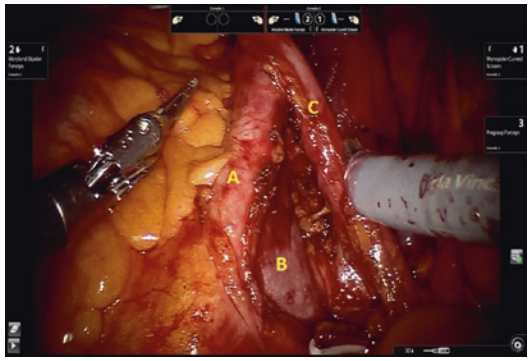

Fig. 53.7 Completed right common iliac lymphadenectomy. *A* Right common iliac artery, *B* Right common iliac vein, *C* Right ureter

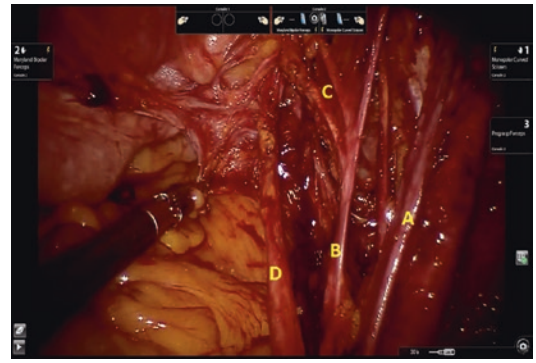

Fig. 53.8 Superior vesical and umbilical arteries. *A* Right external iliac vein, *B* Right umbilical artery, *C* Right superior vesical arteries, *D* Right ureter

will be encountered (Fig. 53.7). A space between the lateral aspect of the external iliac vessels and the medial wall of the psoas muscle is developed. Developing this space and retracting the vessels medially, allows more extensive dissection and ensure early visualization of the obturator nerve. The obturator nerve is easily identified by orienting oneself with the pubic ramus and external iliac vessels. By following a line directly posterior to the point where the external iliac vein crosses the pubic ramus, one can find the obturator nerve and vessels. No blind cutting should be done until adequate visualization of the obturator nerve is achieved. We highly encourage splitting and rolling the nerve as one would do for any vessels to prevent injury. Use of cautery can help identify the nerve when the obturator reflex is triggered. The hypogastric artery can be skeletonized down to the take-off of the umbilical artery. Lymph nodes can be removed in separate packets with 10 mm specimen retrieval bags.

During the lymphadenectomy the umbilical and superior vesical arteries should be clearly seen (Fig. 53.8). These vessels can be clipped with a locking clip or taken with an endovascular staple load. In the most caudal part of the dissection, the uterine vessels can be seen crossing anterior to the ureter "water under the bridge" and can be controlled at that point (Fig. 53.9). This will help minimize the risk of inadvertent injury during later steps of the procedure.

At the end of lymphadenectomy, the left ureter can be transposed behind the sigmoid mesentery with the help of the third robotic arm. The surgeon may opt to place a locking clip onto both ureteral tags to facilitate delivery of the ureters into the abdominal incision. The ileum should be tagged to allow for orientation during extracorporeal work. It is often helpful to mobilize the lateral attachments of the cecum at this point. This will make delivery of the ileum into the abdominal incision easier and make identification of the distal portion of the ileum easier.

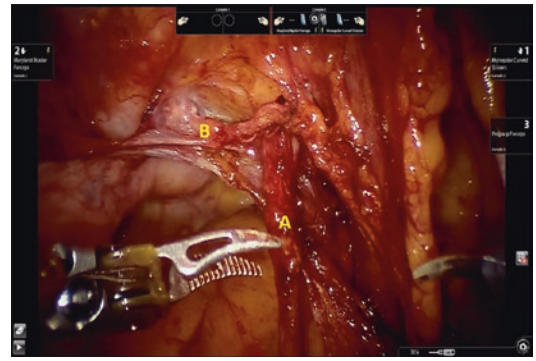

Fig. 53.9 Anatomic relation of the uterine artery and the ureter. *A* Right ureter, *B* Right uterine artery crossing anterior to the ureter

Hysterectomy, Bilateral Salpingoopherectomy, and Vaginal Dissection

Proper retraction of the female reproductive organs is key during this step of the procedure. In general, the uterus should be manipulated by the bedside assistant or third robotic arm in the desired direction. The authors have used a variety of types of uterine manipulators to move the

uterus and "seal" the vaginal cuff. However, we believe that a sponge stick in the vagina is adequate for this part of the procedure.

In a standard APE a horizontal peritoneal incision is made along the posterior fornix while the assistant maintains traction anteriorly. This vaginal incision is extended slightly anteriorly and distally along the anterolateral wall of the vagina so that the anterior wall of the vagina remains attached to the specimen. It is important to preserve as much of the lateral wall of the vagina as it lies in close proximity to the autonomic branches of the pelvic plexus. As the incision of the vaginal wall is extended distally, the vascular pedicles of the bladder will be encountered. The lateral vascular pedicles are intimate with the lateral wall of the vagina and to control these vessels properly they must be separated from the vagina before ligation. These pedicles can be controlled in a variety of ways. As described above, if a meticulous extensive pelvic lymphadenectomy was performed, the uterine vessels should have been identified and divided earlier. While performing the distal portion of the dissection, the surgeon should be cognizant of the location of the arcus tendinous fascia pelvis and avoid its injury in nerve sparing procedures or if a neobladder reconstruction is planned since it may contain autonomic nerves in the pelvis and provide support that prevent pelvic organ prolapse. Once the distal extent of the vaginal wall incisions are reached, attention is turned to dropping the bladder from its anterior attachments, dorsal vein complex and urethral dissection as described below.

Vaginal Sparing Procedures

If a vaginal sparing procedure is intended, the dissection starts along a transverse peritoneal incision between the bladder and the vagina. A space posterior to the bladder is then developed with a combination of blunt and sharp dissection. The dissection should proceed as distal as possible. As mentioned earlier, completing some of the dissection transvaginally can make proper identification of the space anterior to the vaginal wall much easier. This dissection will remain anterior so nerve sparing is already being performed. A combination of lateral and anterior dissection is often used in an alternating fashion to complete the dissection. The vascular pedicles of the bladder will be delineated while the dissection proceeds and will be controlled in the same manner. Once anterior dissection is completed, a circumferential incision along the posterior fornix is extended anteriorly at the level of the cervix. This will detach the uterus and the cervix and surgeon can then proceed with the cystectomy.

Anterior Dissection

The medial and median umbilical ligaments should be divided as proximal as possible with electrocautery (Fig. 53.10). The dissection is carried lateral to the medial umbilical ligaments and caudad over the anterior surface of the bladder toward the symphysis pubis. Completion of this step will free the bladder from all of its attachments. If not already done, the endopelvic fascia should be incised bilaterally at this stage. The apical dissection of the vagina is then started. The pubovaginalis ligaments are analogous to the puboprostatic ligaments and cutting them will provide further access to the dorsal vein complex.

Dissection, Ligation and Division of the Urethra

Dissection of the urethra depends on the type of urinary diversion intended. In case of ileal conduit, the urethra should be traced all the way to the external urethral meatus. This should be

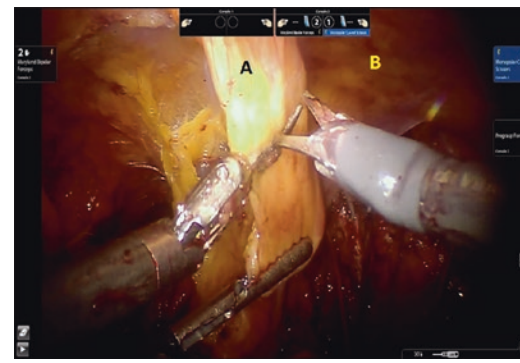

Fig. 53.10 Dividing the median umbilical ligament. *A* Median umbilical ligament, *B* Anterior abdominal wall

performed carefully and meticulous hemostasis to avoid uncontrolled bleeding from the venous plexus that surround the urethra. Once completely dissected, a locking clip is applied to the catheter and the catheter is transected to avoid any spillage of urine into the peritoneal cavity. In case of an orthotopic urinary diversion, the urethra should be circumferentially dissected and the bladder neck area is delineated by gently pulling on the Foley catheter balloon. Careful excision of the bladder neck area should be performed. The middle and lower thirds of the urethra should be preserved to maintain the continence mechanism as this is the area of the rhabdosphincter. A urethral margin should be sent for frozen section and neobladder should not be performed unless a negative margin is ensured.

Specimen Extraction

The entire specimen can be entrapped in a 15-mm specimen retrieval bag. It will be extracted though a 5- to 6-cm infraumbilical or periumbilical incision. Prior to extraction, the tags on the ureters and the ileum should be grasped in a locking grasper to allow delivery of all tags into and through the extraction incision. This will allow for extracorporeal creation of the urinary diversion of the surgeons choice.

Vaginal Reconstruction

It is very important that the closure be performed in a "clamshell" fashion. Avoid rolling the posterior vaginal wall into a tube" in an attempt to preserve length. It has a high likelihood of breakdown or being too narrow for intercourse. We use a barbed suture (1-0) on a CT1 needle to transversely close the vagina in running fashion and then reinforce with three or four interrupted sutures. The integrity of this closure is checked manually and by inserting a vaginal pack to help with visualization. We recommend using one or two permanent sutures such as polypropylene to perform a lateral paravaginal fixation to provide some lateral support. Vaginal prolapse is not uncommon after radical cystourethrectomy since all anterior and superior support has been excised and paravaginal fixation can provide at least some lateral support.

Post-operative Care

Recently there have been many advances in post-operative care of the cystectomy patient. In general, minimizing antibiotics, ambulating the patient quickly and early refeeding have been undertaken. While many of the pathways are subjective and reflect surgeon preference, there are some common themes and key points. First, decreasing IV antibiotics to 24 h of coverage in most patients, barring any extenuating circumstances. Secondly, use of alvimopan has been demonstrated to shorten post-operative opiod associated ileus. Liberal use of peri-operative anticoagulation for deep venous thrombosis prophylaxis. We use subcutaneous heparin or enoxaparin peri-operatively and in some cases up to 1 month post-operatively. A nasogastric tube is not left routinely in robotic or open patients. Early ambulation and aggressive physical therapy is also important to avoid deconditioning. Finally, we monitor electrolytes including sodium, bicarbonate and creatinine every 48 h after discharge for 1 week to identify failure to thrive early. In combination, these measures have allowed us to discharge patients between 4 and 7 days after surgery.

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