18 Transperitoneal Robot-Assisted Radical Prostatectomy: Posterior Approach

Jennifer Kuo, Jason Joseph, and Li-Ming Su

Patient Selection

The indications for robot-assisted laparoscopic radical prostatectomy (RALP) are identical to that for open surgery, that is, patients with clinical stage T2 or less with no evidence of metastasis either clinically or radiographically (computed tomography and bone scan). Absolute contraindications include uncorrectable bleeding diatheses or the inability to undergo general anesthesia due to severe cardiopulmonary compromise. Patients who have received neoadjuvant hormonal therapy or who have a history of prior complex lower abdominal and pelvic surgery such as partial colectomy, inguinal mesh herniorrhaphy, or prior transurethral resection of the prostate (TURP) pose a greater technical challenge due to distortion of normal anatomy and adhesions. Morbidly obese patients pose additional challenges due to the potential respiratory compromise encountered when placing these patients in a steep Trendelenburg position as well as the relatively limited working space and limitations of trocar size and instrumentation length. Patients with large prostate volumes (e.g., >70 g) are often associated with longer operative times, blood loss, and hospital stay than those with smaller glands. Salvage surgery after failure of primary treatment (e.g., radiation, brachytherapy, cryotherapy, high-intensity focused ultrasound) has been successfully reported in properly selected patients, but should be approached with caution due to the higher attendant risks and complications [1, 2]. These more complex patient scenarios should be avoided in a surgeon's early experience with RALP. However, these patient features are not by themselves absolute contraindications.

Preoperative Preparation

Bowel Preparation

One bottle of citrate of magnesium can be provided the day before surgery in order to evacuate bowel contents and prepare the colon in the event of a rectal injury. However, with experience, the authors no longer utilize any formal oral bowel preparation. The patient's diet is limited to clear liquids the day prior to surgery. A Fleet Enema (C.B. Fleet Company, Inc., Lynchburg, VA) is administered the morning of surgery. A broad-spectrum antibiotic such as cefazolin is administered intravenously 30 min before surgery. Ideally, aspirin and other anticoagulants should be held at least 7–10 days prior

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to surgery; however, the authors have noticed no significant difference in complications or blood loss in those patients where aspirin could not be safely held.

Informed Consent

In addition to bleeding, transfusion, and infection, patients undergoing RALP must be aware of the potential for conversion to open surgery. As with open surgery, patients must be counseled on the risk of impotence, incontinence, incisional hernia, and adjacent organ injury (e.g., ureter, rectum, bladder, small bowel). The risks of general anesthesia must also be presented to the patient as RALP cannot be performed under regional anesthesia.

Obtaining a baseline assessment of the patient's preoperative urinary and sexual function are critical in guiding preoperative counseling in providing a realistic forecast of return of urinary and sexual function following surgery even despite efforts at preserving the neurovascular bundles. Use of a validated questionnaire such as the Sexual Health Inventory for Men and International Prostate Symptom Score allow for an objective evaluation of baseline function.

Operative Setup

At our institution, we use the da Vinci® Si HD Surgical System (Intuitive Surgical, Inc., Sunnyvale, CA) with a four-armed technique. As such, only one assistant is required and is placed on the patient's right side. Across from the assistant is the scrub technician with video monitors placed for easy viewing by each team member. A Mayo stand is placed next to the assistant for commonly used instrumentation. After the patient is placed in the steep Trendelenburg position, the patient-side surgical robotic cart is positioned between the patient's legs. The final operating room setup is as shown in Fig. 18.1. Having a large operating room, ideally dedicated solely to robotic surgery, is important as these surgeries require significant equipment that is large as well as delicate. Moving this equipment from one operating room to another risks damage and may delay surgery.

Patient Positioning and Preparation

Having a dedicated team versed in robotic surgery helps to ensure a smooth and efficient surgery. Preoperative briefings allows for the entire team including the surgeon, circulating nurse, scrub technician, and anesthesiologist to identify the patient and planned procedure as well as verbalize any concerns so that these may be addressed and resolved before beginning the surgery. This includes communication with the anesthesiologist, making them aware of surgical expectations and anticipated challenges such as placement of an orogastric tube, intravenous access, fluid administration, and end-tidal carbon-dioxide monitoring especially with the patient placed in the steep Trendelenburg position.

Once in the operating room, the patient is placed in a supine position. After induction of general endotracheal anesthesia, the patient's arms are tucked to the sides using two draw sheets and egg-crate padding (Fig. 18.2a–d). To secure the patient's arms, one draw sheet is left below the arm, while the second draw sheet is held taught against the patient's abdomen. The arm is placed on an egg-crate padding to provide additional cushion (Fig. 18.2a). The first draw sheet is then brought over the arm and tucked below the patient while using the second draw sheet to slightly lift and roll the patient to aid in tucking (Fig. 18.2b). The second draw sheet is then brought down and tucked under the patient while an assistant gently lifts the ipsilateral hip to aid in securing the second draw sheet. Alternatively, arm sleds padded with egg-crate padding may be used. Finally, the hand and wrist are protected using an additional egg-crate padding, keeping the thumb directed upward (Fig. 18.2c). The patient's legs are abducted and placed in a gently flexed position on a split leg table to allow for access to the rectum and perineum. The patient's legs are secured to the split leg supports with egg-crate padding and adhesive tape.

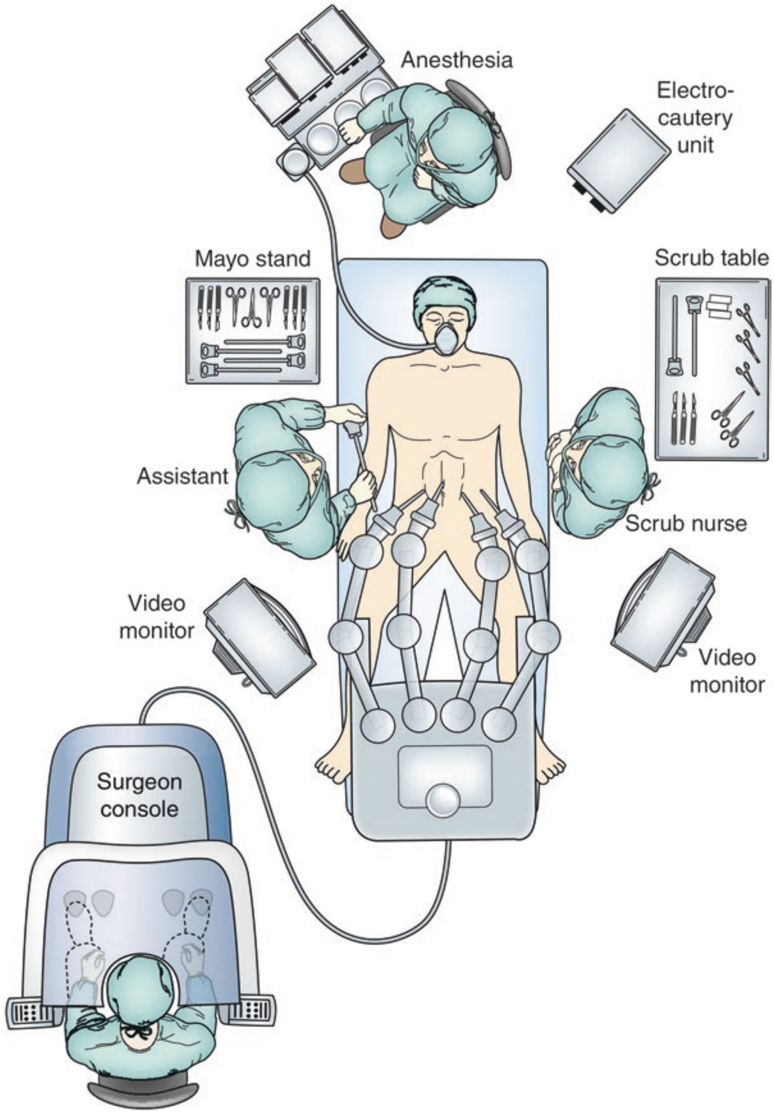

Fig. 18.1 Operating room setup for transperitoneal robot-assisted laparoscopic radical prostatectomy (RALP) demonstrating standard configuration of operating room personnel and equipment (© 2009 Li-Ming Su, M.D., University of Florida)

Alternatively, yellow fin stirrups may be used; however, docking of the fourth arm can at times be compromised by the relatively wide profile of the stirrups as compared to the more narrow split leg supports. Sequential compression stocking devices are placed on both legs and activated. Fixed shoulder pad supports to prevent the patient from cephalad migration in the Trendeleburg position should be avoided as this can result in compression and neuropraxic injury. Instead, the patient is secured to the operating room table above the xyphoid process with egg-crate padding and a band of heavy cloth tape across the chest or in a criss-cross pattern. A gel pad can be placed beneath the patient to minimize slippage during the steep Trendelenburg position. The patient is placed in steep Trendelenburg and is ready for shaving and prepping (Fig. 18.2d). An orogastric tube is inserted to decompress the stomach and a 16 Fr urethral catheter is placed under sterile conditions so that it can be accessed throughout the surgery by the bedside assistant.

The prostate biopsy pathology is again reviewed on the day of surgery to help guide the

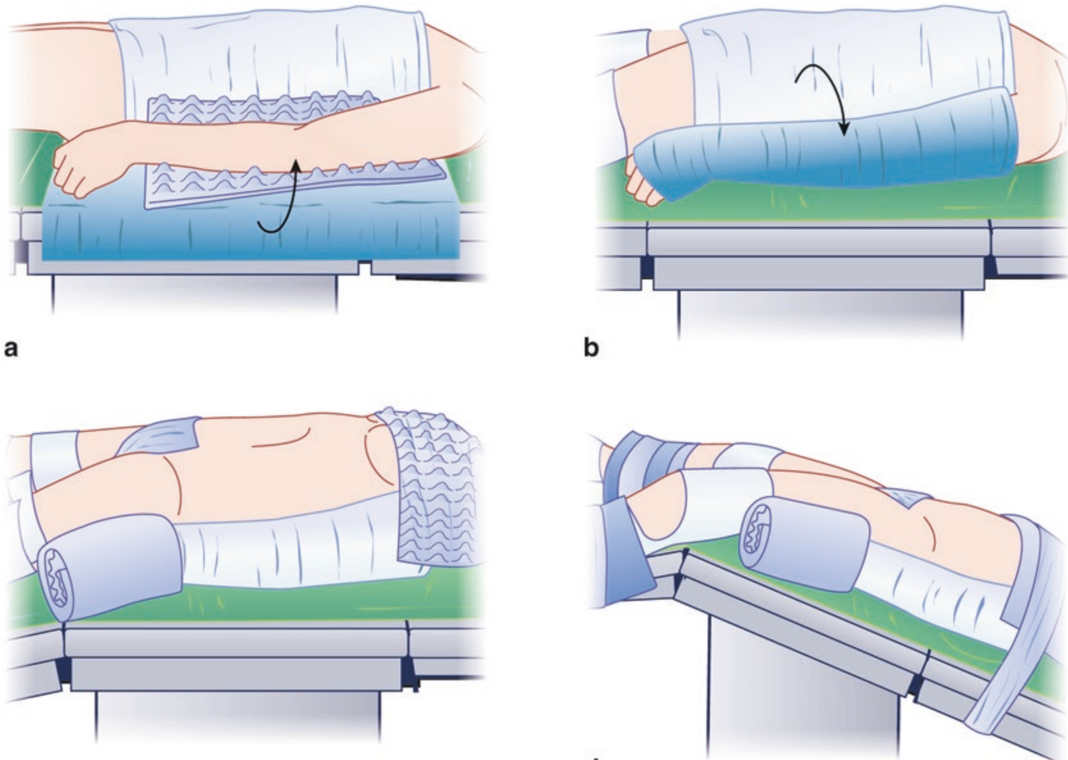

Fig. 18.2 Patient positioning including padding along the patient's arms, hands, and chest (© 2009 Li-Ming Su, M.D., University of Florida)

intraoperative surgical approach. By mapping the approximate site-specific locations of cancer based upon sextant biopsy findings, a surgeon can begin to formulate a tentative plan for bilateral vs. unilateral vs. incremental neurovascular bundle (NVB) preservation. If high-risk features (i.e., high-grade disease, high percent core involvement, palpable disease) are present, plans for a non-nerve-sparing approach may be prudent. A digital rectal examination can be performed with the patient now under general anesthesia as this is the best opportunity to examine the prostate, while the patient is fully relaxed. This is the only time during the surgery that the surgeon has true tactile feedback to assess the size, shape, and abnormalities of the patient's prostate, especially along the posterolateral border adjacent to the location of the NVB.

Trocar Configuration

In total, six trocars are placed transabdominally (Fig. 18.3). The first trocar is a 12 mm trocar for the endoscope and camera and is placed 15–17 cm superior to the pubic symphysis and generally just above the umbilicus. Two 8 mm pararectus trocars are placed 8–9 cm lateral and 2–3 cm caudal to camera trocar on the left and right sides. These accommodate the second and third robotic arms. An additional 8 mm trocar is placed 8–9 cm lateral to the left pararectus trocar in the left lumbar region high above the iliac crest and accommodates the fourth arm of the robot, allowing for intraoperative retraction among other uses. For the surgical assistant, a 12 mm trocar is placed 8–9 cm lateral to right pararectus trocar in the right lower quadrant above the anterior iliac spine

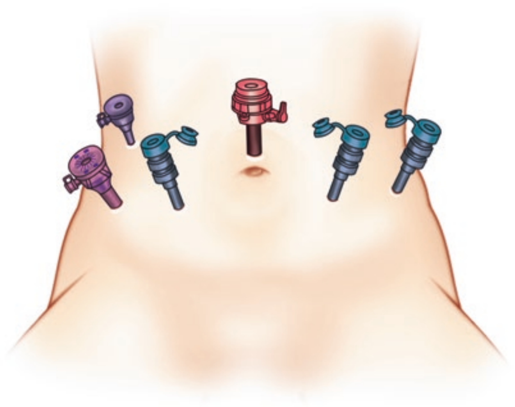

Fig. 18.3 Trocar configuration for transperitoneal robot-assisted laparoscopic radical prostatectomy (RALP) (© 2009 Li-Ming Su, M.D., University of Florida)

at the same level as the pararectus trocars. An additional 5 mm assistant trocar is placed in the right upper quadrant at the apex of a triangle made between the assistant trocar and the right pararectus trocar.

Instrumentation and Equipment List

Equipment

- da Vinci® Si HD Surgical System (four-arm system; Intuitive Surgical, Inc., Sunnyvale, CA)
- EndoWrist® Maryland bipolar forceps or PK dissector (Intuitive Surgical, Inc., Sunnyvale, CA)
- EndoWrist® curved monopolar scissors (Intuitive Surgical, Inc., Sunnyvale, CA)
- EndoWrist® ProGrasp™ forceps (Intuitive Surgical, Inc., Sunnyvale, CA)
- EndoWrist® needle drivers (2) (Intuitive Surgical, Inc., Sunnyvale, CA)
- EndoWrist® Mega™ SutureCut™ needle driver (1) (Intuitive Surgical, Inc., Sunnyvale, CA)
- InSite ®Vision System with 0° and 30° lens (Intuitive Surgical, Inc., Sunnyvale, CA)

Trocars

- 12 mm trocars (2)
- 8 mm robotic trocars (3)
- 5 mm trocar (1)

Recommended Sutures

- Ligation of the deep dorsal vein complex (DVC): 0 PDS suture on a CT-1 needle cut to 10 in. and 4-0 polyglactin suture on an RB1 needle cut to 6 in. (if necessary)
- Modified Rocco stitch and vesicourethral anastomosis: double armed 2-0 Quill Monoderm™ (Quill Medical, Inc., Research Triangle Park, NC) barbed suture (16 × 16 cm) on taper point needles (17 mm, half-circle)
- Anterior bladder neck closure (if necessary): 2-0 polyglactin suture on a UR-6 needle cut to 6 in.
- Anterior bladder neck intussusception suture: 2-0 PDS suture on an SH needle cut to 6 in.

Instruments Used by the Surgical Assistant

- Laparoscopic needle driver
- Laparoscopic scissors
- Blunt tip grasper
- Suction irrigator device
- Hem-o-lok® clip applier (Teleflex Medical, Research Triangle Park, NC)
- Small, Medium-Large and Extra Large Hemo-lok ® clips (Teleflex Medical, Research Triangle Park, NC)
- 10 mm specimen entrapment bag
- Sponge on a stick
- SURGICEL® hemostatic gauze (Ethicon, Inc., Cincinnati, OH)
- 18 Fr silicone urethral catheter
- Hemovac or Jackson-Pratt closed suction pelvic drain

Step-by-Step Technique (Videos 18.1, 18.2, 18.3, 18.4, 18.5, 18.6, 18.7, 18.8, 18.9, 18.10, 18.11, 18.12, 18.13, 18.14, 18.15, and18.16)

Step 1: Abdominal Access and Trocar Placement

For a transperitoneal RALP approach, pneumoperitoneum is established using a Veress needle inserted at the base of the umbilicus. Alternatively, an open trocar placement with a Hasson technique can be used. The insufflation pressure is maintained at 15 mmHg. A 12 mm trocar is placed immediately above the umbilicus (approximately 15–17 cm from the pubic symphysis) under direct visualization using a visual obturator. Occasionally, this trocar is placed infraumbilical if the distance from the umbilicus and pubic symphysis is more than 15 cm. Secondary trocars, as mentioned above, are then placed under laparoscopic view. The da Vinci® robot is then positioned between the patient's legs and the four robotic arms are docked to their respective trocars.

Once intraperitoneal access and a pneumoperitoneum are established, the camera is inserted through the 12 mm supraumbilical trocar. The console surgeon controls camera movement by depressing the foot pedals and using brief arm movements to affect camera and instrument positioning. Stereo endoscopes with either angled (30°) or straight ahead (0°) viewing are available and interchangeable at various portions of the procedure. However, our preference is to use the 0° lens throughout the entire operation. Under direct visualization, the robotic arms are then loaded with instruments and positioned within the operative field at which point the console surgeon takes control. The curved monopolar scissors are placed in the second robotic arm ("right hand" of the console surgeon) while Maryland bipolar forceps are inserted into the third robotic arm ("left hand"). Finally, the fourth arm is used to control a ProGrasp™ forceps (Intuitive Surgical, Inc., Sunnyvale, CA). Once the bedside-assistant advances these instruments into proper position within the operative field, the robotic arms, in general, do not require any further adjustment for the remainder of the case. When instruments are exchanged, the robot will retain "memory" of the precise location of the removed instrument within the body, and therefore the new instrument will return to a few millimeters short of the last position automatically, reducing the risk for accidental injury to intra-abdominal and pelvic structures. The electrocautery settings used during the operation are 30 W for both monopolar and bipolar electrocautery.

Step 2: Dissection of Seminal Vesicles and Vas Deferens (Table 18.1)

Upon initial inspection of the operative field, the relevant landmarks include the bladder, median (urachus) and medial umbilical ligaments, vas deferens, iliac vessels, and rectum (Fig. 18.4). Frequently, adhesions are encountered within the pelvic cavity especially between the sigmoid colon and the left lateral pelvic side wall, which are released using sharp dissection. During transperitoneal-posterior approach, the initial step is retrovesical dissection of the vas deferentia and seminal vesicles (SVs) following the same principles described by the Montsouris technique [3]. After using the ProGrasp™ forceps to retract the sigmoid colon out of the pel-

Table 18.1 Dissection of seminal vesicles and vas deferens: surgeon and assistant instrumentation

Surgeon instrumentation			
Right arm	Left arm	Fourth arm	Assistant instrumentation
• Curved monopolar scissors	• Maryland bipolar grasper	• ProGrasp™ forceps	• Suction-irrigator
Endoscope lens: 0°			• Hem-o-lok® clip applier

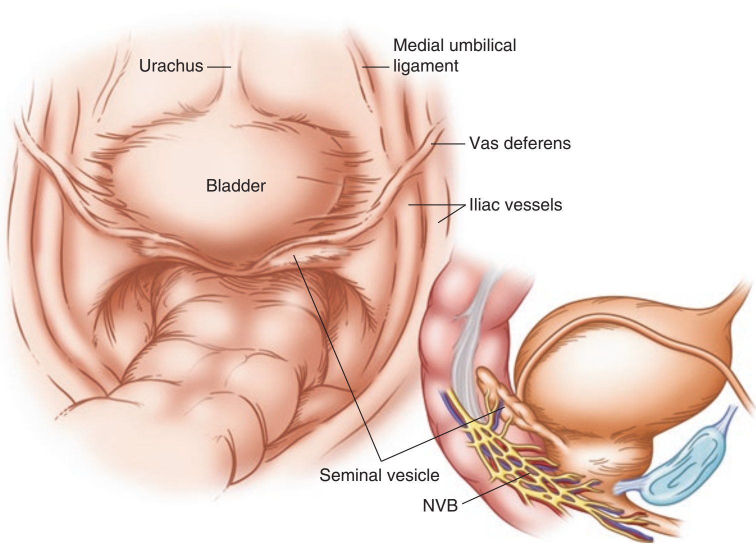

Fig. 18.4 Anatomic landmarks within the pelvis. Upon initial inspection of pelvis, the bladder, urachus, medial umbilical ligaments, vas deferens, and iliac vessels as well as the rectum should be identified to serve as anatomical landmarks to aid in dissection

vic cavity, the vas deferens is identified laterally coursing over the medial umbilical ligaments. The peritoneum overlying the vas deferens is incised sharply and the vas is traced medially to its coalescence with the ipsilateral SV. The contralateral vas is then dissected. Hemoclips are placed on the vasa superior to their coalescence into the ejaculatory ducts, and the vasa are freed anteriorly off of the posterior aspect of the bladder to aid in later identification of the vasa during division of the bladder neck. The vasa are transected near the coalescence so as to not leave long vasal ends that may become a hindrance later in the operation.

Next the SVs are dissected. The assistant provides counter traction by lifting the bladder at the 12 o'clock position to improve exposure to the SVs. The posterior dissection of the SV is carried out first as very few blood vessels are encountered along this relatively avascular plane. Next, the anterior dissection of the SV is performed using gentle, blunt dissection to define and isolate the two to three vessels that often course along the anterolateral surface of the SV. Hemoclips are judiciously applied to these vessels along the lateral surface of the SV starting from the tip and traveling toward the base. These vascular packets are divided using cold scissors, and use of thermal energy is avoided if possible during this dissection in efforts to avoid injury to the nearby NVBs (Fig. 18.5).

Step 3: Posterior Dissection of the Prostate

The SVs and vasa are lifted anteriorly with the ProGrasp™ forceps and a 2–3 cm horizontal incision is made through the posterior layer of Denonvillier's fascia approximately 0.5 cm below the base of the SVs (Fig. 18.6). In patients with low-volume, nonpalpable disease, the posterior dissection plane is developed between Denonvillier's fascia posteriorly and the prostatic fascia anteriorly to help facilitate later release of the NVB located along the posterolateral surface of the prostate. In the case of high volume or palpable disease, this posterior dissection should be carried out one layer deeper, between Denonvillier's fascia and the prerectal fat plane, thus maintaining additional tissue coverage along the posterior aspect of the prostate. In addition, in cases of prior acute prostatitis, this prerectal fat plane if often preserved with few adhesions and may be a safer plane of dissection in these unique cases.

The assistant provides counter traction by applying gentle pressure at the 6 o'clock position using a suction-irrigator, retracting Denonvillier's fascia and the rectum posteriorly. The surgeon elevates the posterior aspect of the prostate with the Maryland bipolar forceps (left hand) using blunt dissection with the curved monopolar scissors (right hand) to develop this avascular plane

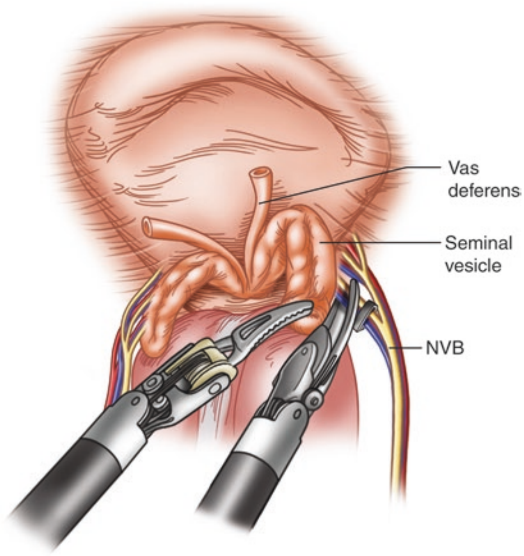

Fig. 18.5 Seminal vesicle dissection. Anterolateral dissection of the SV is performed using Hem-o-lok® clips and cold scissors. Electrocautery should be avoided if possible during this step due to the close proximity of the NVBs (© 2009 Li-Ming Su, M.D., University of Florida)

along the posterior aspect of the prostate. Using gentle sweeping motions, all posterior attachments are released as far as possible toward the prostatic apex. Thorough and wide dissection of the rectum off of the posterior prostate is critical in order to minimize the risk of rectal injury during subsequent steps such as division of the urethra and dissection of the prostatic apex. Once again, thermal energy should be minimized especially along the medial aspect of the NVBs.

Step 4: Developing the Space of Retzius

The bladder is dissected from the anterior abdominal wall by dividing the urachus high above the bladder and incising the peritoneum bilaterally just lateral to the medial umbilical ligaments (Fig. 18.7). Prior to dividing the medial umbilical ligaments, the obliterated umbilical vessels must be controlled with bipolar electrocautery prior to

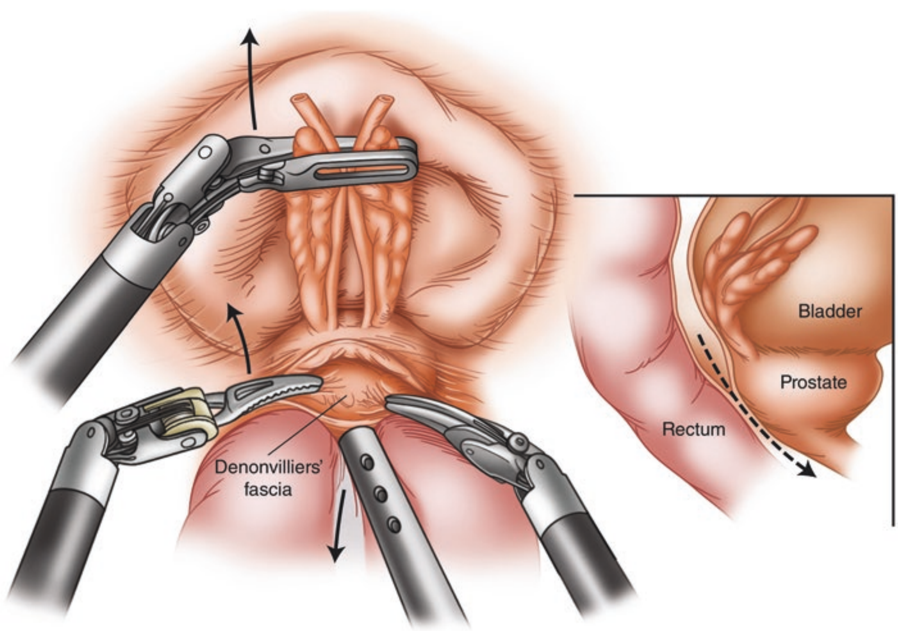

Fig. 18.6 Posterior dissection of the prostate. During the posterior dissection of the prostate, the fourth robotic arm is used to lift the SVs anteriorly. Denonvillier's fascia is incised horizontally 0.5 cm below the base of the SVs and the dissection is carried caudally toward the prostatic apex (© 2009 Li-Ming Su, M.D., University of Florida)

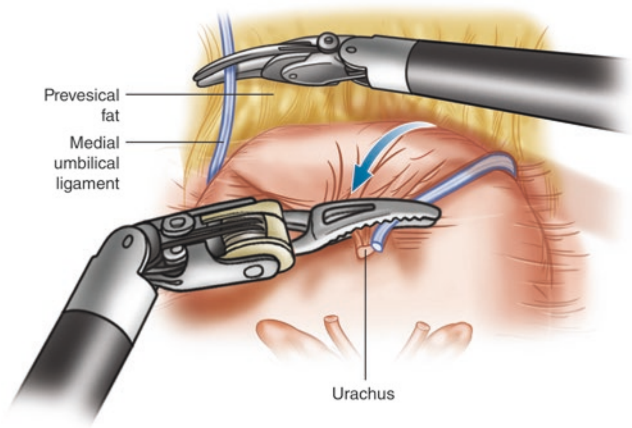

Fig. 18.7 Entering the space of retzius. The bladder is dissected from the anterior abdominal wall by dividing the urachus and medial umbilical ligaments laterally. The presence of fatty alveolar tissue ensures the correct plane that is extended down to the pubic symphysis (© 2009 Li-Ming Su, M.D., University of Florida)

division so as to avoid unwanted bleeding. The presence of fatty alveolar tissue confirms the proper plane of dissection within the space of Retzius. Applying posterior traction on the urachus, the prevesical fat is identified and bluntly dissected, exposing the pubic symphysis. The dissection is maintained within the pelvic brim in order to avoid injury to the iliac vessels laterally. The bladder is released laterally to the point where the medial umbilical ligament crosses the vas deferens. This ensures that the bladder is optimally mobilized from the pelvic side wall so as to avoid tension at the vesicourethral anastomosis during the later steps of the operation.

The fat overlying the anterior prostate is then removed to improve exposure of the prostate. Using mainly blunt dissection, this fat pad is dissected from a lateral to medial direction, which simultaneously helps to isolate the superficial DVC. These vessels travel anterior to the prostatic apex and through the anterior prostatic fatty tissue and are coagulated with bipolar electrocautery prior to division. The fat pad is rolled off of the prostate in a cephalad direction from apex to base. The distal branches of the superficial DVC are then coagulated with bipolar electrocautery prior to division allowing for the fat pad to be removed as a single specimen. Upon removal of the anterior fat, visible landmarks include the anterior aspect of the bladder and prostate, puboprostatic ligaments, endopelvic fascia, and pubis (Fig. 18.8). Using the ProGrasp™ forceps to grasp and retract the bladder, the endopelvic fascia and puboprostatic ligaments are sharply divided exposing the levator muscle fibers attached to the lateral and apical portions of the prostate. The endopelvic fascia is first divided from the mid prostate dissecting toward the base. The endopelvic fascia at the apex is left to the end as often there are small vessels travesing between the sidewall and the prostatic apex that can bleed, obscuring the operating field. The levator muscle fibers are meticulously and bluntly dissected from the surface of the prostate and preserved, exposing the prostatic apex, DVC, and urethra.

Step 5: Ligation of the Deep Dorsal Venous Complex (Table 18.2)

The ProGrasp™ forceps is used to bunch the deep DVC along the anterior prostatovesical junction while simultaneously applying slight cephalad traction. This provides optimal exposure of the DVC and pubis. A 0-PDS suture on a CT-1 needle is passed by the assistant to the surgeon using a laparoscopic needle driver and the DVC is suture ligated using a slip knot or figure-of-eight suture (Fig. 18.9). The needle is passed beneath the DVC from right to left and anterior to the urethra. Securing the DVC as far away from the prostatic apex as possible can help minimize iatrogenic entry into the prostatic apex during later division of the DVC. A second DVC stitch is placed distal to the first and used to suspend the DVC to the inferior pubic symphysis. The DVC

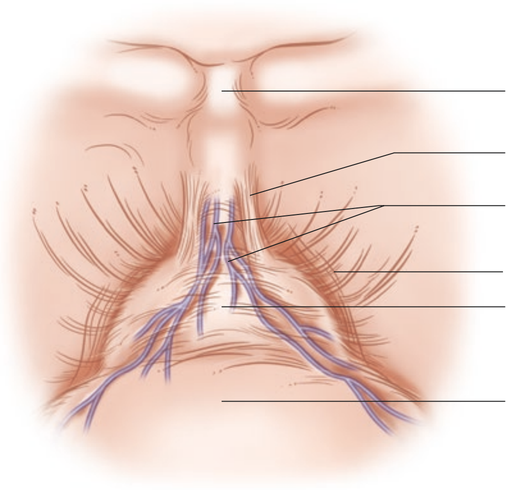

Fig. 18.8 View of the anterior prostate. The fat overlying the anterior prostate is dissected in a lateral to medial direction and removed in a single packet by rolling the tissue from the apex toward the base of the prostate. Bipolar electrocautery is used to transect the superficial DVC. This helps to better expose the anterior prostate and bladder, puboprostatic ligaments, and endopelvic fascia (© 2009 Li-Ming Su, M.D., University of Florida)

Table 18.2 Ligation of the deep dorsal venous complex: surgeon and assistant instrumentation

Surgeon instrumentation			
Right arm	Left arm	Fourth arm	Assistant instrumentation
• Mega™ SutureCut™ needle driver	• Needle driver	• ProGrasp™ forceps	• Suction-irrigator
Endoscope lens: 0°			• Laparoscopic needle driver

is not divided until later in the operation and immediately prior to prostatic apical dissection and division of the urethra. An additional 0-PDS suture may be placed along the anterior bladder neck to prevent venous back bleeding and to help identify the contour of the prostate for subsequent bladder neck transection. The authors prefer the use of the Mega™ SutureCut™ needle driver when suturing as this facilitates suture cutting by the operative surgeon and obviates the need for the assistant to change instruments to perform this task.

Step 6: Anterior Bladder Neck Transection (Table 18.3)

The anterior bladder is divided using monopolar electrocautery. With experience, the proper plane of dissection can be visualized by simply inspecting the contour of the prostate and bladder neck [4]. Several maneuvers are used to better delineate this plane of dissection. First, visual inspection of the prevesical adipose tissue as it transitions to the bare anterior prostate gland often defines the bladder neck. Second, lifting the dome of the bladder in a cephalad direction with the ProGrasp™ forceps often reveals a "tenting" effect that defines the point at which the bladder connects to the less mobile base of the prostate. Third, performing a "bimanual pinch" by compressing the tissues of the bladder and prostate between the two robotic instruments allows the surgeon to gain a sense of where the plane lies. Using this technique and visual cues, the surgeon will note that the bladder tissue easily coapts between the two instruments while the prostate tissue remains more substantive and more "stiff." Finally, having the bedside assistant provide traction on the urethral catheter, bringing the balloon to the bladder neck, also provides a visual cue to the proper plane of dissection. Use of all four of these maneuvers is advised during one's early experience with RALP so as to avoid inadvertent entry into the base of the prostate resulting in a posi-

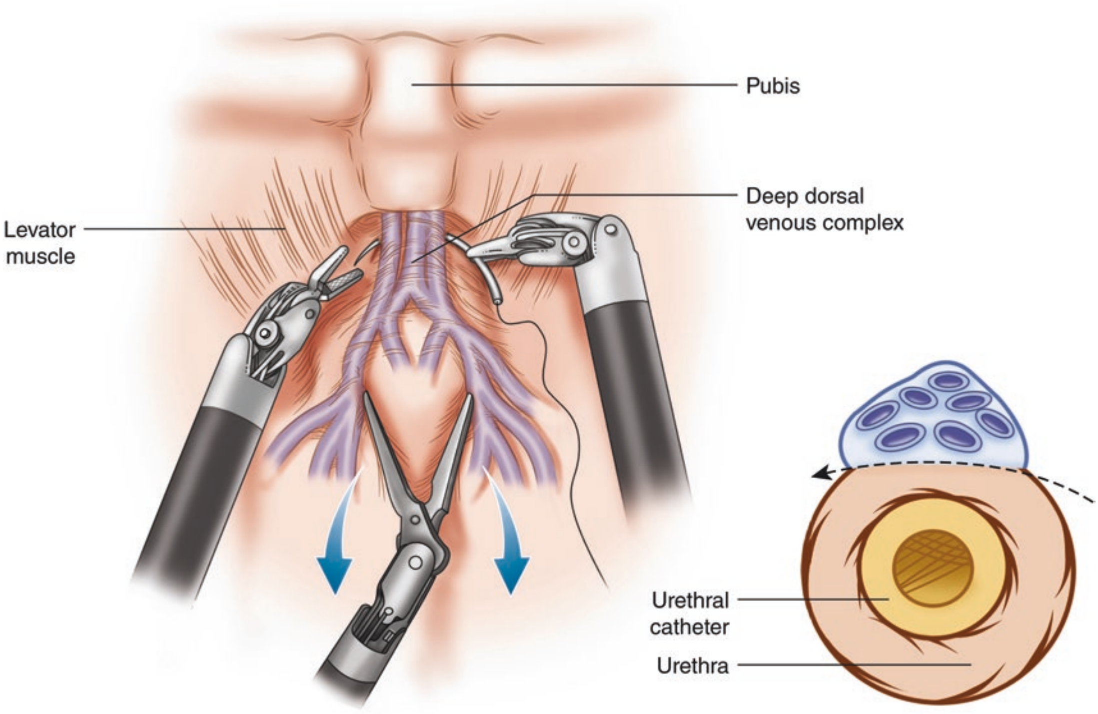

Fig. 18.9 Ligation of the deep dorsal venous complex. The DVC is secured by passing the needle below the venous complex and anterior to the urethra, ligating the DVC as distal to the apex as possible (© 2009 Li-Ming Su, M.D., University of Florida)

Table 18.3 Anterior bladder neck transection: surgeon and assistant instrumentation

Surgeon instrumentation			
Right arm	Left arm	Fourth arm	Assistant instrumentation
• Curved monopolar scissors	• Maryland bipolar grasper	• ProGrasp™ forceps	• Suction-irrigator
Endoscope lens: 0°			• Hem-o-lok® clip applier

tive bladder neck margin. When in doubt, a more proximal plane of dissection at the bladder neck is advised with later bladder neck reconstruction, if necessary, to correct for any discrepancy between the bladder neck opening and urethra.

The anterior bladder neck is divided horizontally staying close to the midline. Carrying the dissection too laterally can result in unwanted bleeding from the lateral bladder pedicles. Once the anterior bladder neck is transected, the urethral catheter is exposed. The catheter balloon is decompressed and the catheter tip is advanced through the anterior bladder defect. The Prograsp™ is then used to grasp the catheter tip and provide traction by pulling superiorly toward the anterior abdominal wall. The proximal end of the catheter is cinched by the assistant at the penile meatus thus creating a "hammock" effect, suspending the prostate anteriorly. This maneuver provides improved exposure to the posterior bladder neck.

Step 7: Posterior Bladder Neck Transection

The posterior bladder wall is inspected to identify the presence or absence of a median lobe as well as the location of the ureteral orifices (Fig. 18.10). If a median lobe is encountered, dissection of the posterior bladder neck is performed beneath the protruding median lobe by lifting the median lobe anterior with the Maryland forceps or ProGrasp™ forceps. Similar to the anterior bladder neck, the posterior bladder neck is divided horizontally along the midline avoiding the lateral pedicles. Once the mucosa is incised, the posterior bladder neck is divided from the base of the prostate with monopolar electrocautery by taking an approximately 45° downward angle of dissection. This angle helps to avoid inadvertent entry into the prostate as well as excessive thinning of the posterior bladder neck. If excessive bleeding is encountered, one should be concerned about the possibility of inadvertent entry into the prostate gland. When dividing the posterior bladder neck, one should ensure that the posterior bladder wall thickness remains uniform with the anterior bladder neck thickness.

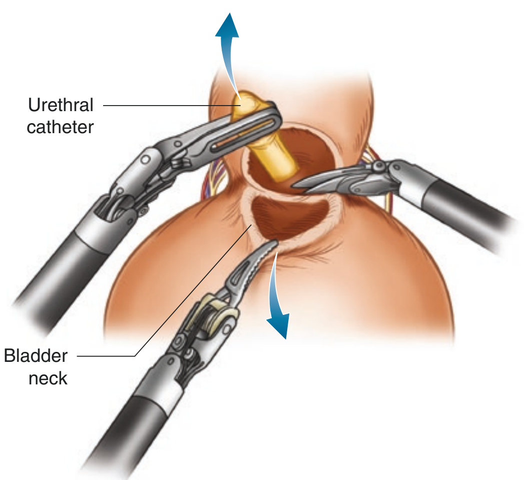

Fig. 18.10 Posterior bladder neck division. Horizontal dissection is carried out through the posterior bladder neck in a 45° downward angle to prevent entry into the prostate base and excessive thinning of the posterior bladder neck (© 2009 Li-Ming Su, M.D., University of Florida)

Upon entering the retrovesical space, the SVs and vas deferentia that have been previously dissected are grasped and brought through the opening created between the bladder neck and prostate. This is one of the unique advantages of the transperitoneal posterior approach to RALP as since the SVs and vasa have been already dissected in previous steps, these structures are now easily identified and do not require extensive dissection especially in cases of a median lobe where visualization is compromised. The bladder pillars (i.e., remaining anterolateral attachments between the bladder and prostate base) are divided either between hemoclips as the terminal branches from the DVC travel through this tissue.

Step 8: Lateral Interfascial Dissection of the Neurovascular Bundles

The NVB travels between two distinct fascial planes that surround the prostate, namely the levator fascia and prostatic fascia (Fig. 18.11). For select patients with low-risk disease (i.e., low-grade, low-volume, nonpalpable disease), a more aggressive approach to NVB preservation may be taken, preserving the NVB along with a generous amount of periprostatic fascia containing accessory nerves, which have been suggested by some to improve postoperative erectile function [5]. This high anterior release of the periprostatic fascia and NVB entails a longitudinal incision of the levator fascia along the more anteromedial border of the prostate. For patients with intermediate-risk disease, a more conservative approach to NVB preservation may be taken so as to avoid an iatrogenic positive margin from dissecting too close to the surface of the prostate. In such cases, a standard release of the NVB may be chosen by incising the levator fascia along the 5 and 7 o'clock position along the posterolateral surface of the prostate.

In preparation for the lateral release of the NVBs, the base of the prostate or tip of the urethral catheter is grasped with the ProGrasp™ and retracted medially, exposing the lateral surface of the prostate. An opening in the levator fascia is

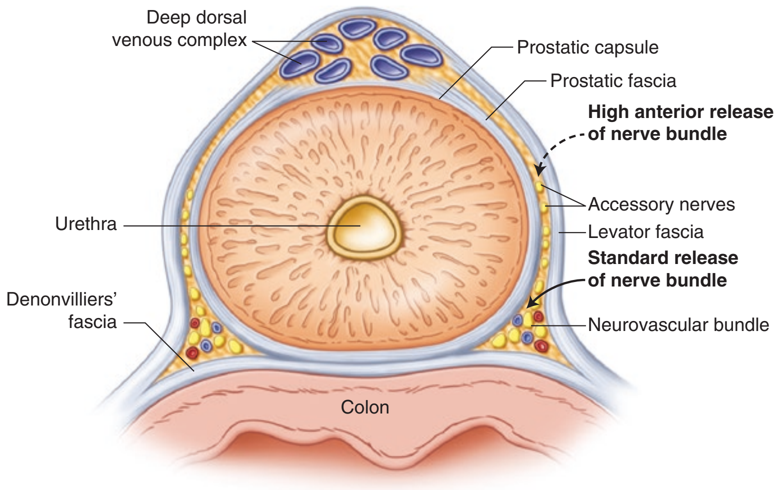

Fig. 18.11 Schematic cross section of the periprostatic fascial planes and NVBs. Anatomically, the NVBs run between the levator fascia and above the prostatic fascia (i.e., interfascial plane). The high anterior release of the NVB is begun by making a higher incision of the levator fascia along the anteromedial border of the prostate as compared to a more posterolateral incision made for a standard nerve-sparing procedure (© 2009 Li-Ming Su, M.D., University of Florida)

made by sharp incision and carried out toward the apex and base (Fig. 18.12). The interfascial plane (i.e., between the levator and prostatic fascia) is developed gently using blunt dissection. A groove between the NVB and prostate (i.e., the lateral NVB groove) is created by progressively developing this interfascial plane toward the posterolateral aspect of the prostate. Dissection continues in close approximation to the surface of the prostatic fascia in efforts to optimize quantitative cavernous nerve preservation. If bleeding occurs from periprostatic vessels, insufflation pressure can be temporarily increased and pressure applied to the source of bleeding with SURGICEL® hemostatic gauze. Hemostasis with electrocautery should be avoided if possible during dissection near the NVBs as these energy sources have been shown to be harmful to cavernous nerves function in both canine and human studies [6, 7]. Proximal dissection of the NVB is carried to the level of the prostatic pedicles.

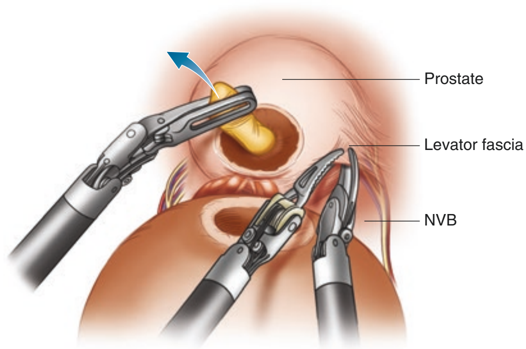

Fig. 18.12 Incising the levator fascia. Using the fourth robotic arm to provide countertraction on the prostate, the levator fascia is incised longitudinally along the anteromedial border of the prostate to perform the high anterior release. The sharp dissection is carried out toward the apex and base, developing the lateral NVB groove (© 2009 Li-Ming Su, M.D., University of Florida)

Step 9: Ligation of the Prostatic Pedicles

The SVs and vasa are lifted anteriorly with the ProGrasp™ forceps defining the proximal extent of the prostatic pedicles located at the 5 and 7 o'clock positions. Having already accomplished the lateral release of the NVB and established the lateral NVB groove, this helps to define the distal limit of the prostatic pedicles (Fig. 18.13). The assistant provides further exposure of the pedicles by applying posterior and cephalad counter traction on the bladder neck. The surgeon creates tissue packets within the prostatic pedicles and two to three medium-large Hem-o-lok® clips are applied to control the prostatic vessels in lieu of electrocautery. Great care must be taken so as to avoid past pointing with the hemoclips resulting in potential entrapment of the nearby NVB.

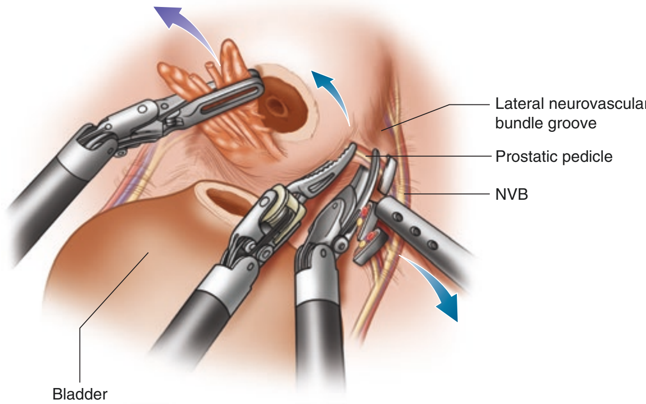

Fig. 18.13 Ligation of the prostatic pedicles. Countertraction is again provided by use of the fourth robotic arm to help display the prostatic pedicles. The previously formed lateral NVB groove helps to identify the precise location of the NVB in reference to the prostatic pedicle, thus minimizing nerve injury during clip placement (© 2009 Li-Ming Su, M.D., University of Florida)

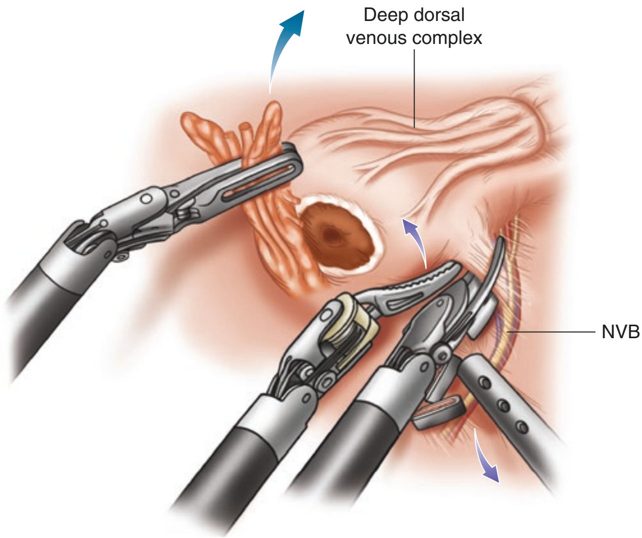

Fig. 18.14 Antegrade preservation of the neurovascular bundle. Combined blunt and sharp dissections are used to free the final prostatic attachments from the NVB as far distally toward the apex as possible (© 2009 Li-Ming Su, M.D., University of Florida)

Step 10: Antegrade Neurovascular Bundle Preservation

After division of the prostatic pedicles, dissection is carried out toward the previously defined lateral NVB groove in an "antegrade" or "descending" manner (Fig. 18.14). As the posterior dissection between the rectum and prostate has already been completed, the medial border of the NVB is already visibly defined. Both the medial border of the NVB and lateral NVB groove serve as critical landmarks to help guide the proper angle and direction of dissection to optimize antegrade NVB preservation. The remaining attachments between the NVBs and prostate are gently teased off of the posterolateral surface of the prostate using a combination of blunt and sharp dissection. When small vessels coursing between the NVB and prostate are encountered, small hemoclips may be used. Antegrade dissection of the NVBs is carried out as far distally toward the apex as possible. The use of electrocautery and direct manipulation of the NVB is minimized to avoid injury to the cavernous nerves. If adhesions are encountered between the NVB and prostate, slightly wider dissection may be carried out in efforts to avoid an iatrogenic positive surgical margin, especially in locations at risk for extraprostatic extension of cancer. As such, incremental preservation of cavernous nerves can often be achieved without having to sacrifice the entire NVB (i.e., wide excision of NVB).

Step 11: Division of the Deep Dorsal Venous Complex

The DVC is divided sharply just proximal to the previously placed DVC suture. Great care must be taken to avoid inadvertent entry into the prostatic apex, resulting in an iatrogenic positive apical margin. Spot electrocautery may be required for minor arterial bleeding from the DVC. If adequate dissection of the NVBs has been accomplished in previous steps, the NVBs should be visible immediately adjacent and lateral to the DVC. Attention should be paid to avoid the use of electrocautery specifically at this location. Occasionally, additional 4-0 polyglactin DVC sutures may be required if large venous sinuses are encountered that were not adequately secured or if the original DVC suture becomes dislodged. After complete division of the DVC, a notch representing the anterior aspect of the prostatourethral junction should be visible.

Step 12: Prostatic Apical Dissection and Division of Urethra

As the distal portion of the NVBs lie in intimate association with the lateral aspect of the prostatic apex, the remaining attachments between the NVB and prostatic apex are gently and meticulously dissected free using sharp dissection without electrocautery (Fig. 18.15). The anterior urethra is divided sharply, taking care to preserve the NVBs coursing along the posterolateral surface of the urethra. With the urethral catheter now exposed, the tip of the catheter is withdrawn by the assistant into the urethral stump. Prior to division of posterior urethra, great care must be taken to inspect the contour of the posterior prostatic apex. In some patients, the posterior prostatic apex can protrude beneath and beyond the posterior urethra resulting in an iatrogenic positive margin if not identified and cut across. Having already completed the posterior prostatic dissection, little additional dissection is often required to free the prostate in its entirety once the posterior urethra and posterior rhabdosphincter is divided.

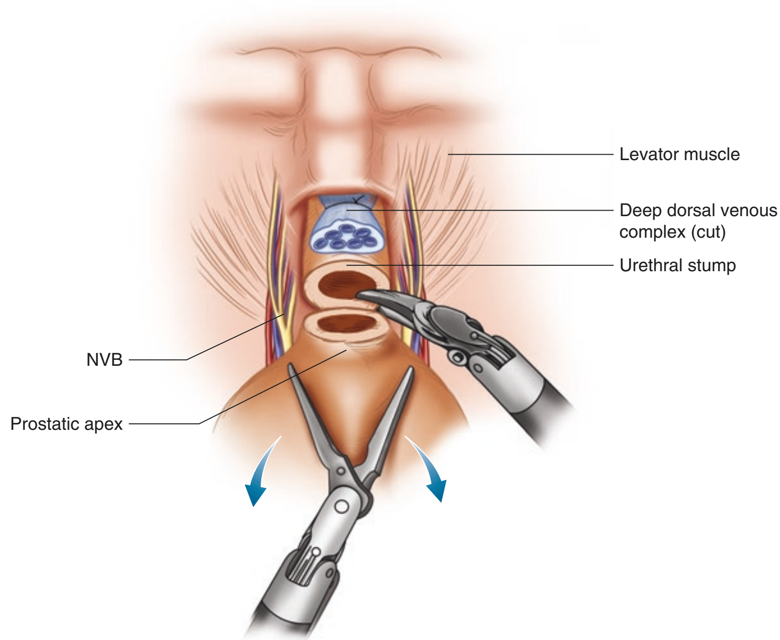

Fig. 18.15 Division of prostatic apex. After transecting the DVC, the anterior urethra is divided sharply, taking care to preserve the NVBs coursing along the posterolateral surface of the urethra. The posterior urethra is also divided sharply after carefully inspecting for the presence and contour of the posterior prostatic apex (© 2009 Li-Ming Su, M.D., University of Florida)

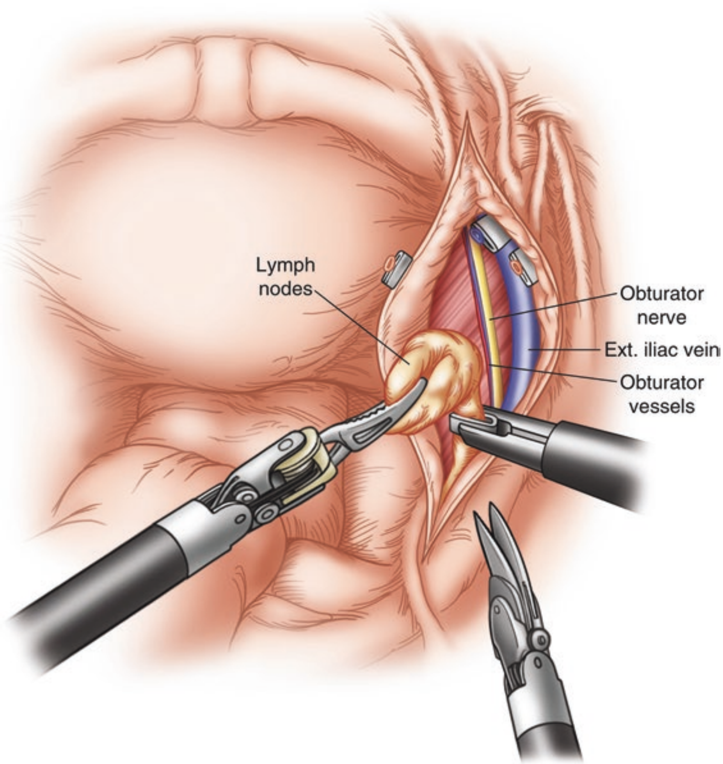

Fig. 18.16 Pelvic lymph node dissection. Anatomic landmarks during pelvic lymph node dissection include the external iliac vein, obturator nerve, pubic symphysis, and bifurcation of the iliac vessels (© 2009 Li-Ming Su, M.D., University of Florida)

Step 13: Pelvic Lymph Node Dissection

With the prostate now removed and prior to completion of the vesicourethral anastomosis, a pelvic lymph node dissection is completed. As with an open approach, a key initial step is separation of the nodal packet from the external iliac vein. The lymph node packet is grasped, retracted medially, and a relatively avascular plane between the lymph node packet and lateral pelvic sidewall is identified and dissected using blunt dissection and spot monopolar electrocautery. Dissection is carried out proximally to the iliac bifurcation and distally to the pubis, thus defining the lateral extent of the lymph node packet. By retracting the lymph node packet medially, the precise course of the obturator nerve and vessels can be identified and protected (Fig. 18.16). After securing the distal extent of the lymph node packet with hemoclips, the packet is then retracted cranially to separate it from the obturator vessels and nerves. The proximal extent of the lymph node packet is then secured with hemoclips at the bifurcation of the iliac vessels. The lymph nodes can usually be removed as a single packet and are extracted in the specimen entrapment bag along with the prostate specimen. For identification purposes, a single Hem-o-lok®clip is applied to the left packet to distinguish it from the right pelvic lymph nodes.

Step 14: Laparoscopic Inspection and Entrapment of the Prostate Specimen (Table 18.4)

Prior to entrapment of the specimens, the margins of the prostate are closely inspected by laparoscopic means. If a close margin is noted, excision of site-specific tissue for frozen section analysis may be performed along the bed of the prostate; however, with experience this should be a rare occurrence. The prostate specimen along with the pelvic lymph nodes are placed in an entrapment bag and stored in the right lower quadrant of the abdomen until completion of the operation.

Table 18.4 Laparoscopic inspection and entrapment of the prostate specimen: surgeon and assistant instrumentation

Surgeon instrumentation			
Right arm	Left arm	Fourth arm	Assistant instrumentation
• Curved monopolar scissors	• Maryland bipolar grasper	• ProGrasp™ forceps	• Suction-irrigator
Endoscope lens: 0°			• 10 mm specimen entrapment bag

Table 18.5 Posterior support of the vesicourethral anastomosis (modified Rocco stitch): surgeon and assistant instrumentation

Surgeon instrumentation			
Right arm	Left arm	Fourth arm	Assistant instrumentation
• Mega™ SutureCut™ needle driver	• Needle driver	• ProGrasp™ forceps	• Suction-irrigator
Endoscope lens: 0°			• Laparoscopic needle driver
			• Sponge on a stick

Step 15: Posterior Support of the Vesicourethral Anastomosis (Modified Rocco Stitch) (Table 18.5)

To help reduce tension at the vesicourethral anastomosis and provide support to the bladder neck, reapproximation of the remnant Denonvillier's fascia, posterior detrusor, and posterior rhabdosphincter located below the urethra is performed [8]. A double-armed 2-0 barbed Monoderm™ suture is passed by the assistant to the surgeon using a laparoscopic needle driver and the remnant Denonvillier's fascia and superficial detrusor from the posterior bladder is brought together with the posterior rhabdosphincter located below the urethra using a running continuous suture (Fig. 18.17). A total of two bites on both the right and left sides are often sufficient to reapproximnate these layers. Use of a urethral catheter and perineal pressure to visualize the urethral lumen allows for easier identification of the posterior rhabdosphincter lying just posterior to the urethra. In theory, this stitch also helps to bring the sphincteric complex into the peritoneal cavity, restoring its natural positioning and therefore promoting earlier return of urinary continence.

Step 16: Vesicourethral Anastomosis

A critical first step in accomplishing the vesicourethral anastomosis is the establishment of secure posterior tissue approximation. The posterior anastomosis is typically the site of greatest tension. It is at risk for disruption and subsequent urinary leakage during passage of the urethral catheter if mucosa-to-mucosa approximation of the posterior anastomosis is not established. To avoid this complication, the assistant can apply pressure to the perineum using a sponge stick to better reveal the posterior urethra during placement of the posterior urethral bites. The previously placed 2-0 barbed Monoderm™ suture used for the modified Rocco stich is also used for the vesicourethral anastomosis. The suture is transitioned from the Rocco stich to the anastomosis by passing the needle outside-in at the 5 and 7 o'clock positions at the bladder neck and then inside-out on the urethra (Fig. 18.18). A urethral catheter is passed and withdrawn repeatedly to identify the urethral opening during the urethral bites of the anastomosis. Once the two sutures are run up to the 3 and 9 o'clock position, respectively, ending

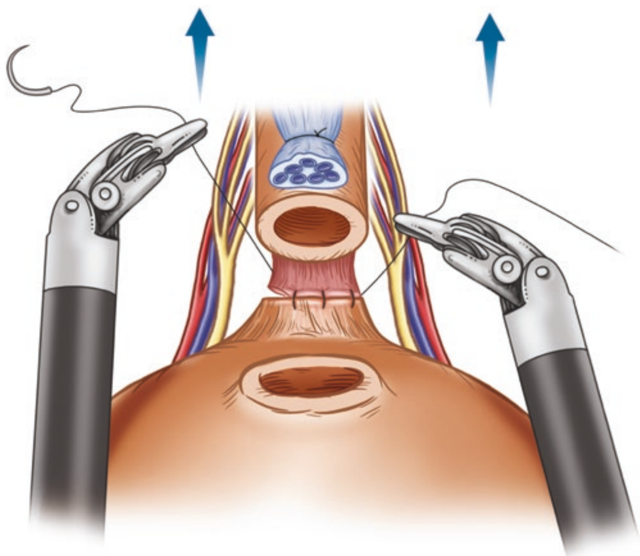

Fig. 18.17 Modified Rocco stitch. The remnant Denonvillier's fascia and superficial detrusor from the posterior bladder is brought together with the posterior rhabdosphincter located below the urethra using a running continuous 2-0 barbed suture (© 2009 Li-Ming Su, M.D., University of Florida)

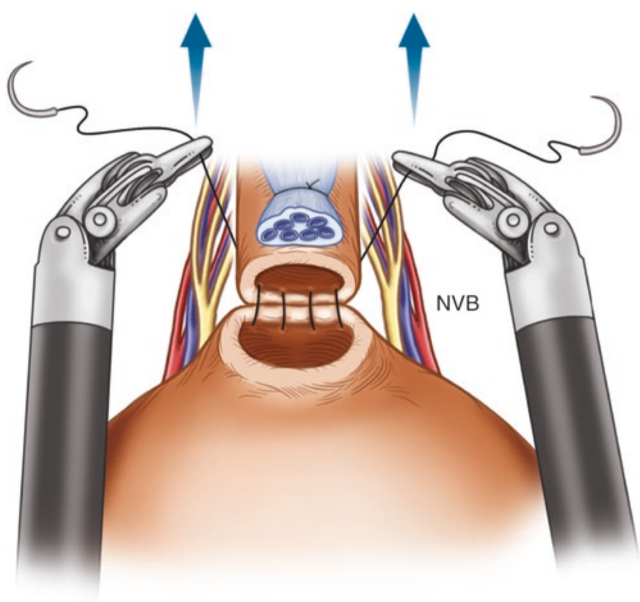

Fig. 18.18 Running vesicourethral anastomosis. The vesicourethral anastomosis is accomplished in a running continuous fashion. The anastomosis is begun by starting each suture at the 5 and 7 o'clock positions, outside-in along the posterior bladder neck. Corresponding inside-out bites are taken of the urethra at the 5 and 7 o'clock positions. A urethral catheter is passed and withdrawn repeatedly to identify the urethral opening during the urethral bites of the anastomosis (© 2009 Li-Ming Su, M.D., University of Florida)

inside-out on the urethral side of the anastomosis, the two ends of the sutures are lifted *anteriorly*, cinching the bladder neck down to the urethra. Great care must be taken not to lift back or in a cephalad direction as this will result in applying excessive forces on the urethral bites resulting in tearing of the urethral tissues. The anterior portion of the anastomosis is completed by running the right arm of the suture to the 12 o'clock position while tension is maintained on the left arm of the suture using the ProGrasp™ device to lift the suture anteriorly. Next, the ProGrasp™ is used to apply tension on the right suture while the left suture is used to complete the anastomosis, reversing the suture outside-in on the urethral bite to allow for the two sutures to be tied across the anastomosis. If any remaining redundancy in the bladder opening is noted as compared to the urethral opening, an anterior bladder neck closure suture can be placed using 2-0 polyglactin suture on a UR6 needle in an interrupted figure of eight closure. Additionally, a bladder neck intussusception suture can be placed using 2-0 PDS suture on an SH needle in a horizontal figure of eight closure anterior and 2 cm proximal to the bladder neck in order to increase bladder funneling and resistance for optimal restoration of postoperative continence.

Following completion of the anastomosis, a final 18 F urethral catheter is placed by the assistant and the balloon inflated with 20 ml of sterile water. The integrity of the anastomosis is tested by filling the bladder with approximately 120 mL of saline through the urethral catheter. Any visible leaks at the anastomosis may be repaired with additional sutures as necessary. A closed suction pelvic drain is placed exiting the left lower quadrant fourth arm 8 mm robotic trocar site and secured to the skin with 2-0 nylon suture.

Step 17: Delivery of the Specimens and Exiting the Abdomen

The entrapment bag containing the prostate and lymph node specimens is delivered via extension of the supraumbilical incision and fascia. The fascia is closed primarily with 0-PDS interrupted sutures to prevent incisional hernia. The 8 mm and 5 mm robotic trocars generally do not require fascial closure but are simply closed subcutaneously. The fascia of the 12 mm assistant trocar also does not generally require formal closure if a nonbladed, self-dilating trocar is used.

Postoperative Management

Intravenous narcotics are provided for postoperative pain. Alternatively, ketorolac may be administered if the risk of bleeding and renal insufficiency is low. Patients are provided liquids on the day of surgery and advanced to regular diet on postoperative day 1 as tolerated. Hospital stay is in general 1–2 days. The pelvic drain is removed prior to discharge if outputs are low. However, if a urine leak is suspected, the fluid may be sent for creatinine and the drain maintained for an additional few days to a week off of suction if an anastomotic leak is confirmed. A cystogram can be performed on postoperative day 7 to ensure a water tight vesicourethral anastomosis prior to removal of the urethral catheter if the integrity of the anastomosis is in question.

Special Considerations

A large-size prostate gland and/or presence of a median lobe may dictate a more proximal incision of the bladder neck, leaving a large bladder neck opening and the ureteral orifices at close proximity to the edge of the bladder neck. Either an anterior or posterior tennis racquet closure of the bladder neck using 2-0 polyglactin suture on a UR-6 needle may be required if there is significant discrepancy between the bladder neck opening and urethra. If the ureteral orifices are located along the immediate edge of the posterior bladder neck, a 5 and 7 o'clock figure-of-eight suture may be placed using 2-0 monocryl suture to imbricate the ureteral orifices and keep them out of harm's way prior to completion of the vesicourethral anastomosis.

On occasions, a subclinical inguinal (direct or indirect) hernia is identified during RALP. It is the authors' opinion that these hernias be fixed if possible at the time of surgery so as to avoid symptoms or strangulation down the road. Our practice is to apply a polypropylene mesh to cover the hernia defect after fully reducing the hernia and tack the mesh into place using either a laparoscopic hernia stapler or 2-0 PDS suture. The mesh is then covered with either a peritoneal flap or the bladder to avoid direct contact with the bowels and minimize the chance of bowel fistulization.

In the rare event of a rectal injury, prompt identification and repair is paramount. Large defects may be identified by the assistant by transrectal digital inspection of the rectum. Smaller injuries may be missed by this maneuver and therefore insufflation of the rectum with air in a saline-filled pelvis (through a catheter placed transrectally) can identify bubbles at the site of a small rectal defect. Once identified, the edges of the defect are clearly delineated and the injury closed in multiple layers with 2-0 silk suture. An omental flap may be brought beneath the bladder to cover the repair as an additional layer and interpose between the rectum and vesicourethral anastomosis in efforts to avoid a rectovesical fistula.

Other more complex patient scenarios will be the subject of a later chapter entitled “Robot-Assisted Laparoscopic Radical Prostatectomy: Management of the Difficult Case.”

Steps to Avoid Complications

For novice robotic surgeons, establishing a consistent operative schedule with at least 1–2 RALPs per week can help promote consistency and standardization of surgical approach by the surgeon and surgical team alike. The use of a skilled surgical assistant knowledgeable in laparoscopic and robotic surgery and equipment is perhaps one of the most important steps to gaining consistency in technique, improving operative efficiency, and avoiding complications. Such an individual can aid in obtaining optimal and timely exposure and visualization during each step of the operation as well as troubleshoot instrumentation issues such as instrument exchanges and clashing of robotic arms at the bedside.

It is our practice to achieve meticulous hemostasis throughout all steps of the surgical dissection where the risk of electrocautery effect on the NVB is negligible. By maintaining hemostasis, tissue planes, important anatomic structures, and landmarks remain well visualized. This helps to facilitate a cleaner and more precise dissection, which in turn can lead to improved patient outcomes. When working in close proximity to the anatomic course of the NVB, electrocautery is avoided as much as is possible and instead hemoclips or superficial absorbable (e.g. 4-0 polyglactin) sutures are applied to small arteries and veins. In addition to this, direct manipulation of the NVBs as well as traction is minimized in efforts to maintain the integrity of the cavernous nerves as well as optimize postoperative recovery of erectile function. In terms of optimizing postoperative incontinence, the length of the urethral stump is optimized and integrity of the surrounding supportive tissues of the urethra is maintained.

Ureteral and rectal injuries are rare events during RALP and by in large avoidable if proper steps are followed. Ureteral injury can occur during three steps of a transperitoneal posterior approach to RALP. First, the ureter may be encountered during dissection of the vas deferens. Maintaining close dissection to the adventitia of the vas will help prevent inadvertent compromise to the nearby ureter traveling lateral and posterior to the vas. Second, the ureter may be injured during completion of the vesicourethral anastomosis especially in cases of a large bladder neck opening where the ureteral orifices are in close proximity to the posterior bladder neck. In such cases, imbrication of the ureteral orifices prior to performing the anastomosis may reduce compromise to the ureters as mentioned previously. Lastly, the ureter may in theory be encountered during dissection of the pelvic lymph nodes. During dissection of the proximal extent of the lymph node packet at the iliac bifurcation, use of thermal energy should be minimized as this may compromise the ureter as it passes over the iliac vessels. Rectal injuries, in general, can be avoided by thorough and dissection of the rectum and overlying Denonvillier’s off of the posterior aspect of the prostate. With inadequate dissection of the rectum, the prostate remains adherent posteriorly to the rectum, making these attachments difficult to visualize and safely dissect free once the bladder neck and urethra are divided. Therefore, wide dissection of the rectum off of the entire posterior border of the prostate is strongly recommended early in the operation as is the case with the posterior approach to RALP.

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