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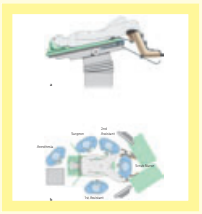

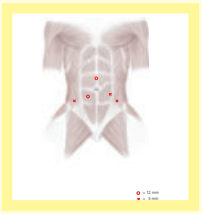

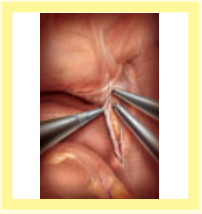

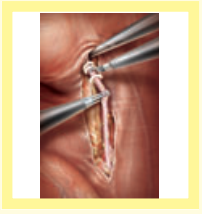

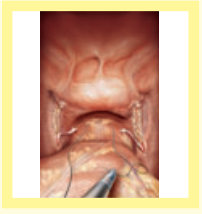

Laparoscopic radical cystectomy

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ILLUSTRATIONS by STEPHAN SPITZER, www.spitzer-illustration.com

INTRODUCTION

Radical cystectomy (RC) is the treatment of choice for high-risk, recurrent, superficial and invasive cancer of the urinary bladder. Laparoscopic RC (LRC) is an attractive minimally invasive alternative to conventional open RC, as it duplicates the open technique, yet is associated with decreased blood loss, and possibly better patient recovery.

Since the initial reports over a decade ago, LRC was slow to gain popularity in the urological community, primarily because of the technical complexity of the procedure [1–3]. As experience with laparoscopic pelvic surgery grew, small series of LRC were reported at the turn of the last century [4,5]. With the dissemination of laparoscopic expertise, in the last 5 years there has been a dramatic increase in the number of cases, with the current worldwide experience being >500.

The technique of LRC is still developing; after our initial descriptions of the purely intracorporeal technique of laparoscopic ileal conduit or ileal neobladder reconstruction [6–9], we now construct the urinary diversion through a laparoscopic-assisted approach for the following reasons: (i) it is technically simpler to learn and teach; (ii) the operating time is shorter than a pure laparoscopic approach; (iii) bowel-related complications are fewer; and (iv) the advantages of a laparoscopic approach to cystectomy are preserved.

In a recent study we found that, compared with the pure laparoscopic (PL) approach, the laparoscopically assisted (LA) approach was better for operative time, blood loss, transfusion rate, time to oral intake, time to ambulation and postoperative complications; the last, requiring re-exploration, developed in 29% vs 11% with the PL and LA approach, respectively.

Our current technique, described here, uses a five-port transperitoneal approach. RC and extended bilateral pelvic lymphadenectomy are performed laparoscopically, followed by construction of an ileal conduit or ileal neobladder through a 6–8 cm midline incision. If an orthotopic neobladder is created, the urethral-neovesical anastomosis is then completed laparoscopically.

INDICATIONS AND CONTRAINDICATIONS

Given adequate laparoscopic expertise, most patients with organ-confined high-risk superficial or invasive bladder cancer are candidates for LRC. Current contraindications include: (i) CT evidence of extravesical spread or bulky lymphadenopathy; (ii) frozen pelvis due to previous surgery or inflammatory pathology; (iii) fixation of the bladder to surrounding structures and pelvic wall on bimanual palpation; and (iv) uncorrected bleeding diathesis. Morbid obesity and previous pelvic radiation can significantly complicate the technical performance of LRC. Previous aorto-iliac vascular surgery and

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endovascular stenting can make the ureteric dissection challenging.

PATIENT PREPARATION

A thorough preoperative evaluation is necessary, including cardiac and medical clearance. Anti-platelet agents need to be discontinued at least a week before surgery. Anticoagulants might need to be bridged to heparin perioperatively. Mechanical bowel preparation includes a clear liquid diet and 4 L of polyethylglycol on the afternoon before surgery. A stoma site is marked before LRC for all patients by a stoma therapist. Broad-spectrum i.v. antibiotics (usually a third-generation cephalosporin and metronidazole) are administered at induction. As such, the patient preparation is the same as for open surgery.

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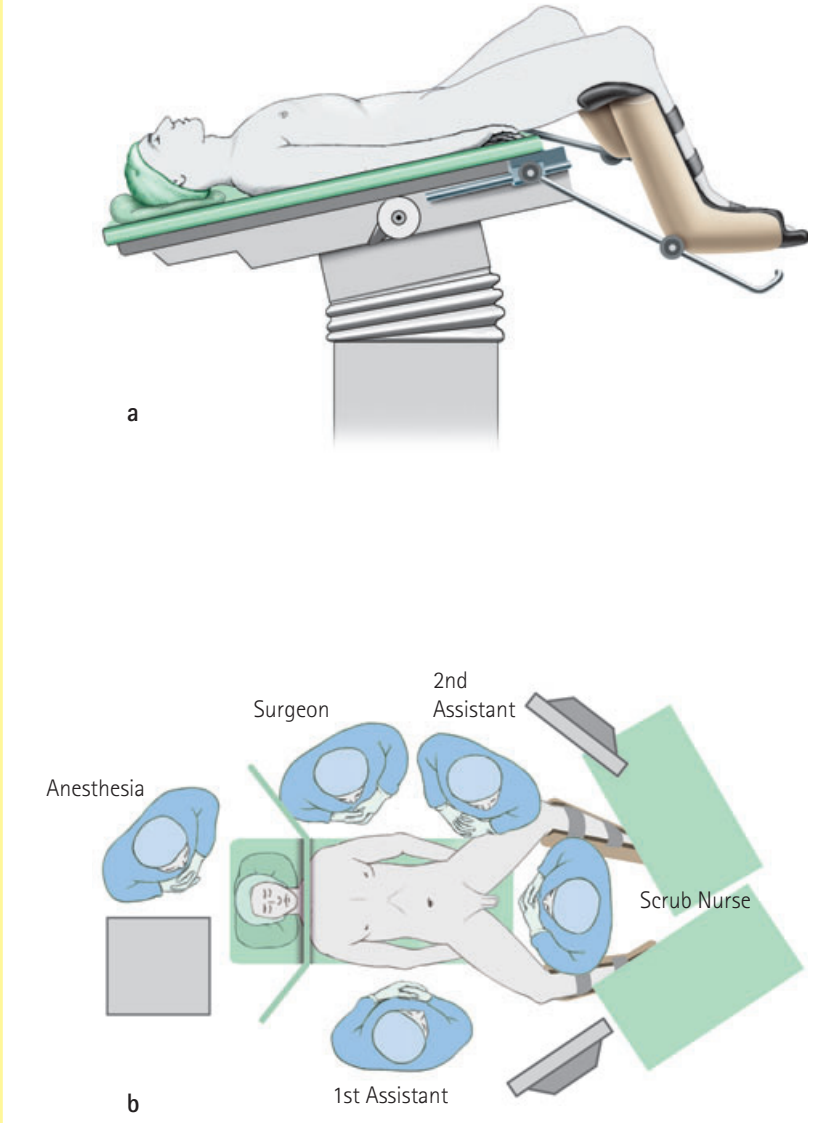
PATIENT POSITIONING AND DRAPING

Figure 1

The patient is secured on the operating table in the low lithotomy position, with both arms adducted and secured to the table, thus allowing access to the patient's perineal area and rectum (Fig. 1a). All pressure points are meticulously padded. Sequential compressing stockings are applied. The operation table is placed in a steep Trendelenburg position and the patient is prepared from the nipples down to the mid-thighs, including the genitalia. A warming blanket covers the upper chest and shoulders. The patient is draped in a sterile fashion using leggings and a special laparoscopy drape. This drape has Velcro™-secured pockets along both sides to keep the various cables and leads neatly tucked away from the operative field. An 18 F Foley catheter is inserted from the operative field after sterile preparation and draping of the patient. The surgical team needs to be aware of the possibility of iodine and latex allergy, as these can potentially be life-threatening.



OPERATING ROOM SET-UP

The surgeon stands on the left side of the patient, while the first assistant stands opposite the surgeon on the right side of the patient (Fig. 1b). The scrub nurse/technician stands between the legs of the patient and has the instrument table behind her/him. If necessary, a second assistant stands to the left of the surgeon. Two, 50 cm laparoscopic flat-panel ceiling-mounted LCD monitors are positioned 20-30 cm above each outstretched foot of the patient, in direct line of sight of the surgeon and the first assistant.

Other laparoscopic peripherals such as the insufflator, light source, camera console, recording equipment and electrocautery are located on a ceiling-mounted boom that is situated behind and to the left of the first assistant. A suction unit is placed just below the boom. An ultrasonic scalpel and bipolar electrocautery unit is placed behind the second assistant. The equipment needed for LRC is summarized in Table 1.

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TABLE 1 Equipment necessary for LRC

Equipment	Laparoscopic peripherals	Energy sources/haemostatics
Trocars: 12 mm × 2, 5 mm × 3, 2-mm Miniport* × 1	Piped supply of CO_2	Monopolar electrocautery
0° laparoscope: 10 mm × 1, 5 mm × 1	High flow insufflator	Bipolar electrocautery with 5 mm handpiece
Hook dissector 5 mm	Light source	Harmonic† scalpel with 5 mm handpiece
Endoshears 5 mm	3CCD camera and console unit	Metal clip applier
5 mm needle driver, ×2	Video recording equipment	10 mm Hem-o-Lok‡ clips and applier
5 mm atraumatic graspers	Suction unit	Laparoscopic staplers
Maryland dissector	50 cm LCD monitor, × 2	
5 mm suction cannula and suction irrigation handpiece	Sterile water for irrigation	
10 mm laparoscopic right-angle dissector		
Endocatch bags: 10 mm, 5 mm		
Carter-Thomason port-closure device		
Defogging fluid and scope warmer		
Two 90-cm J ureteric stents		

**Autosuture, Norwalk, CT, USA; †Ethicon Endo-surgery, Cincinnati, OH, USA; ‡Teleflex Medical, Research Triangle Park, NC, USA.*

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LAPAROSCOPIC ACCESS

Figure 2

A 1.5-cm vertical incision is made in the midline about 2.5 cm above the umbilicus; this incision will later be incorporated into the midline incision for the open bowel work. A 2-mm Miniport™ (Autosuture, Norwalk, CT, USA) is inserted into the abdomen through this incision and CO_2 pneumoperitoneum is created to 15 mmHg. We prefer to use a 2-mm Miniport to obtain initial access rather than a Veress needle, as it allows a higher gas flow rate and direct inspection of the peritoneal cavity with a 2-mm laparoscope in case of doubt.

A 12-mm primary port is placed through the supraumbilical incision, and a 10-mm 0° laparoscope is introduced. Four secondary ports are inserted under vision. A 12-mm right upper port is placed at the previously marked stoma site and is inserted through the belly of the right rectus muscle, carefully avoiding the right inferior epigastric vessels under clear visualization. For ileal conduit diversion, the stoma will be constructed at this site during the 'open' part of the operation. Three other secondary ports are placed: a 5-mm left upper port at the lateral edge of the left rectus muscle just below the level of the umbilicus; and a 5-mm port placed 2.5 cm medial and cephalad to each anterior superior iliac spine. The surgeon typically uses the right-hand 12 mm port and the left para-rectal 5 mm port. The first assistant drives the camera through the midline 12 mm port and simultaneously uses the 5 mm right lateral port for suction and/or retraction.

If a patient has had previous abdominal surgery we prefer initial access through the spatially most distant quadrant, often the left upper quadrant, as most patients with previous surgery have scars either in the midline or in the right half of the abdomen. The steps of the operation are summarized in Table 2 and described in detail below.

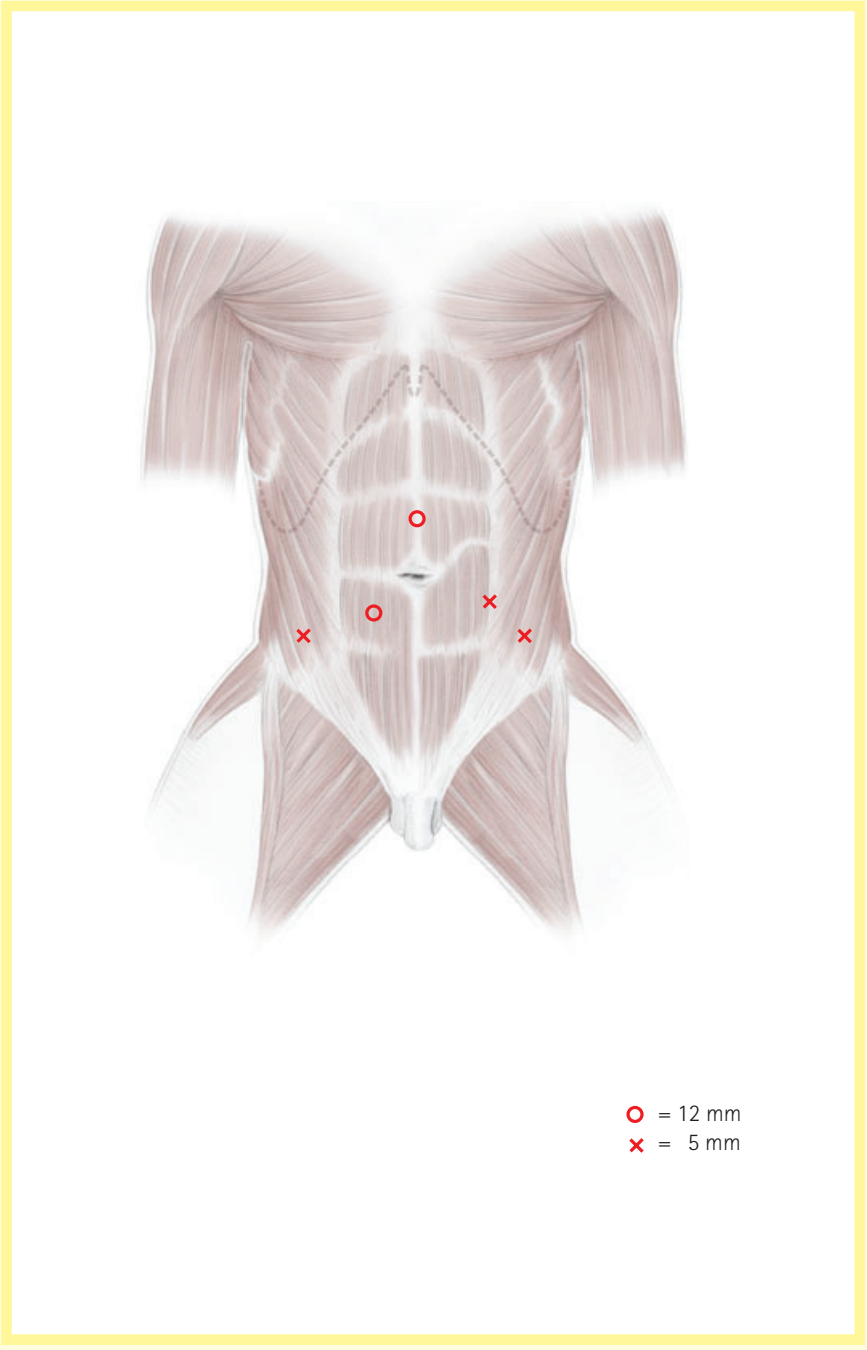

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TABLE 2 The steps of LRC

Technical step	Caveat
Patient in lithotomy position with steep Trendelenburg tilt	Meticulous padding of pressure points is mandatory
Laparoscopic access: five-port transperitoneal access (two 12-mm and three 5-mm ports)	Be extra careful with the Veress needle if there is an associated abdominal aortic aneurysm and the patient is thin. In a scarred abdomen, initial access should be through a spatially distant quadrant
Step 1: Circumferential mobilization of each ureter from pelvic brim down to the VUJ and division of the ureters at the VUJ	Maintain adequate peri-ureteric tissue on the mobilized ureters
Step 2: Retrovesical dissection: posterior peritoneotomy across the cul-de-sac, mobilization of bilateral vasa and seminal vesicles, and incision of Denonvilliers' fascia	Retroprostatic dissection should proceed anterior to the yellow prerectal fat to avoid rectal injury
Step 3: Lateral dissection: lateral peritoneotomy and transection of lateral pedicles with a laparoscopic stapler	Take care to avoid injury to the obturator nerve. In elderly patients, atherosclerotic external iliac vessels can be tortuous and course down into the pelvis before exiting the abdomen; this must be recognized at the outset to avoid injury
Step 4: Anterior dissection: anterior inverted-U shaped peritoneotomy, dissection of the space of Retzius, division of endopelvic fascia	Take care to avoid injury to the inferior epigastric vessels
Step 5: Division of DVC and membranous urethra, specimen entrapment	Perfect haemostasis from the DVC is necessary to avoid delayed bleeding once the pneumoperitoneum is desufflated
Extended lymphadenectomy	When circumferentially mobilizing the right common iliac artery, it is important to remember that the bifurcation of the inferior vena cava is immediately posterior to its proximal part

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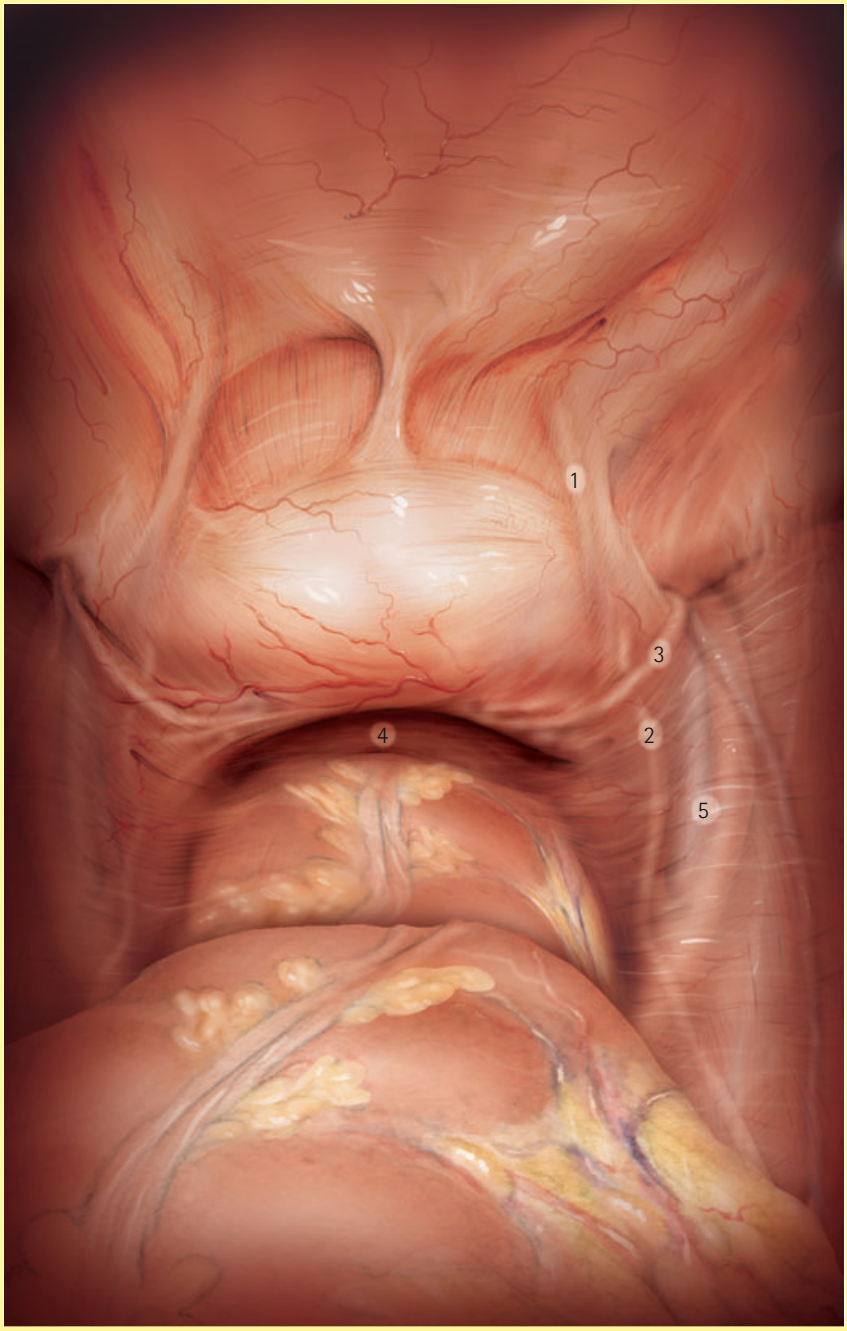
STEP 1: MOBILIZATION AND DIVISION OF THE URETERS

Figure 3

Upon initial inspection the surgeon must identify five important landmarks: (i) the medial umbilical ligaments; (ii) the peritoneal folds overlying the ureters close to the bladder; (iii) the vasa on each side; (iv) the posterior cul-de-sac of the rectovesical pouch; and (v) the iliac vessels. These allow precise orientation during the procedure and expeditious dissection.



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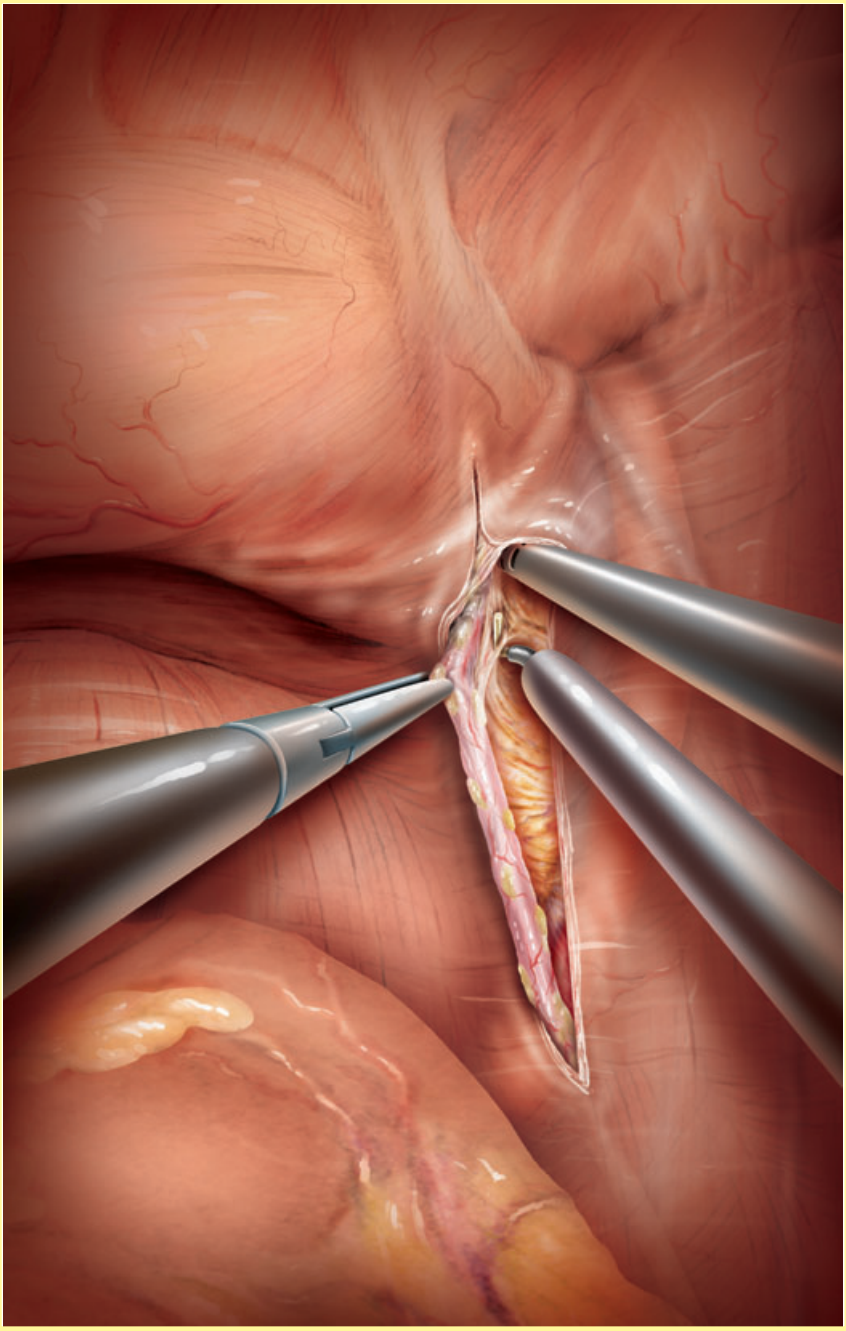

Figure 4

We first identify the peristaltic right ureter as it crosses the iliac vessels at the pelvic brim. Using J-hook electrocautery, the peritoneum is incised along the anterior aspect of the ureter and dissected linearly and distally to the visible peritoneal fold overlying the ureter as it enters the bladder. When circumferentially mobilizing the ureter from the pelvic brim down to the vesico-ureteric junction (VUJ), it is important to maintain an adequate cover of peri-ureteric fatty tissue. Close to the VUJ the superior vesical artery and the vas deferens are visualized crossing the ureter. These are mobilized away from the ureteric surface to obtain maximum ureteric length and do not routinely need division at this point. If this antegrade ureteric dissection proves difficult, one can incise the peritoneum of the ureteric fold closer to the bladder and incise it progressively in a cephalad direction up to the pelvic brim.

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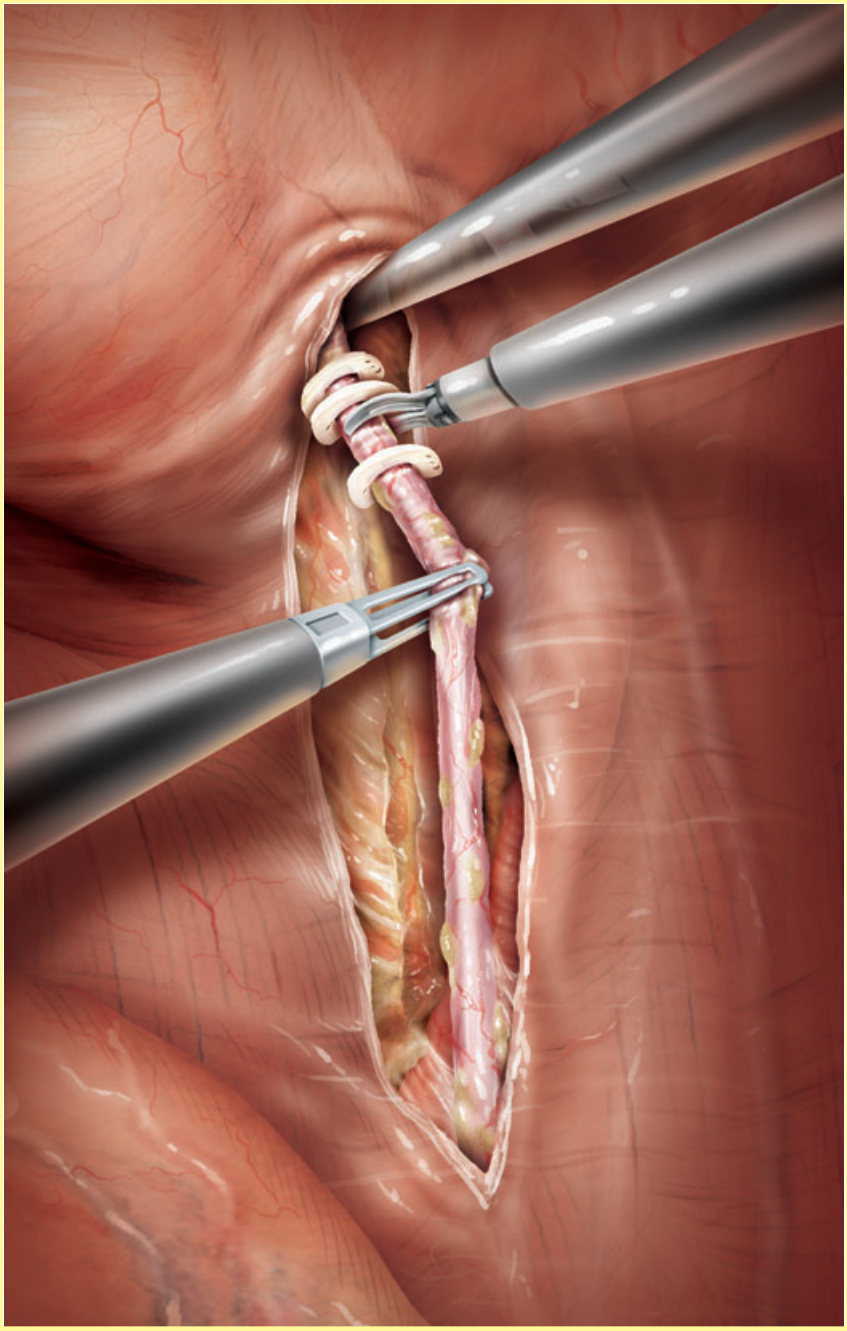
Figure 5

The right ureter is clipped with Hem-o-lok™ clips at the VUJ and divided, such that there are two clips on the bladder side and one on the distal ureter. The two clips on the bladder side of the transected ureter serve as critical landmarks during the subsequent dissection, as they provide a readily identifiable visual clue during transection of the lateral pedicles. The single clip on the cut end of the proximal ureter allows its hydrodistention, which facilitates later uretero-enteric anastomosis. A terminal ureteric biopsy is sent for frozen-section analysis. The left ureter is mobilized similarly. Some patients have significant sigmoid adhesions, which might need to be lysed to allow identification of the left ureter.



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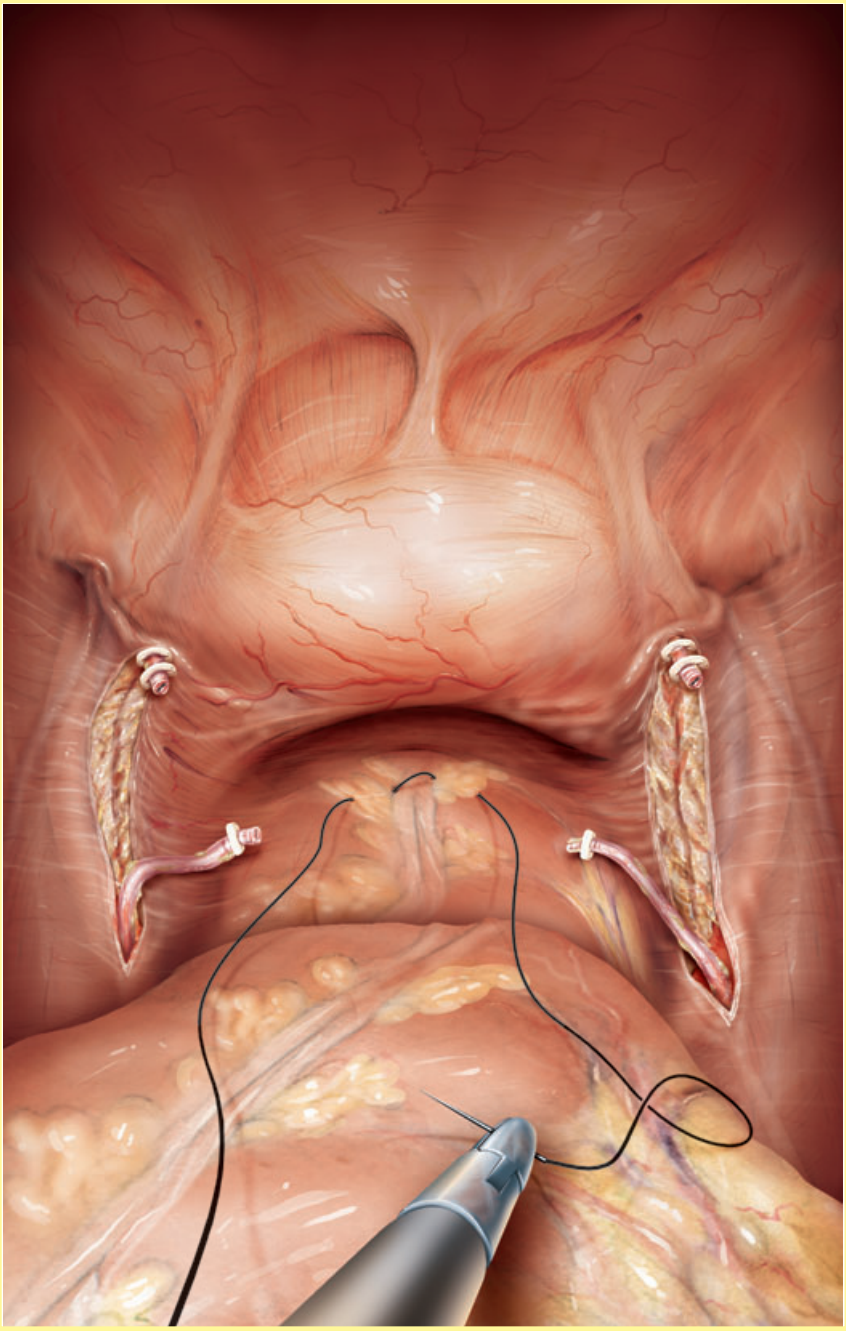

STEP 2: RETROVESICAL DISSECTION

Figure 6

The retrovesical space is now dissected. To achieve this, it is essential to tautly retract the sigmoid colon proximally out of the pelvis to facilitate visualization of the cul-de-sac. We use a 2–0 polypropylene suture on a straight Keith needle inserted into the abdomen directly through the skin in the left hypochondrium. This suture is anchored through two selected appendices epiploicae of the most prominent part of the sigmoid colon and brought back out through the abdominal wall in the left hypochondrium, where it is held taut with a haemostat. This simple manoeuvre efficiently and tautly retracts the sigmoid colon out of the pelvis, obviates the need for an assistant to do so, and provides an excellent view of the operative field.

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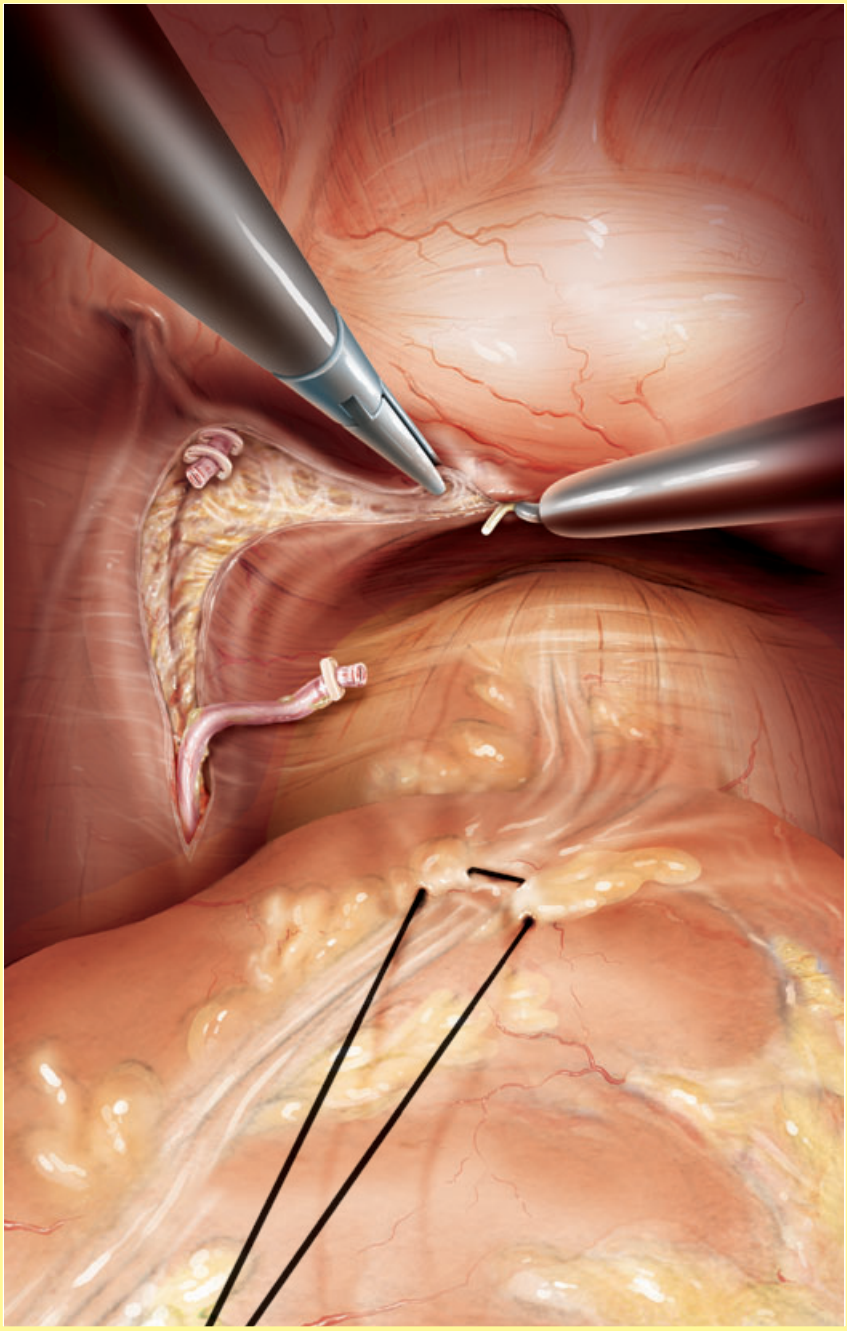
Figure 7

Given that the ureters have already been mobilized and transected, and the lateral peritoneum of the rectovesical pouch is already divided, the two lateral peritoneotomies are now joined across the midline. It is important that the peritoneotomy across the cul-de-sac be created quite distally, such that it is only 1–2 cm anterior to the surface of the rectum. Often there is a subtle transverse peritoneal fold at this location (we refer to it as the 'second peritoneal fold').



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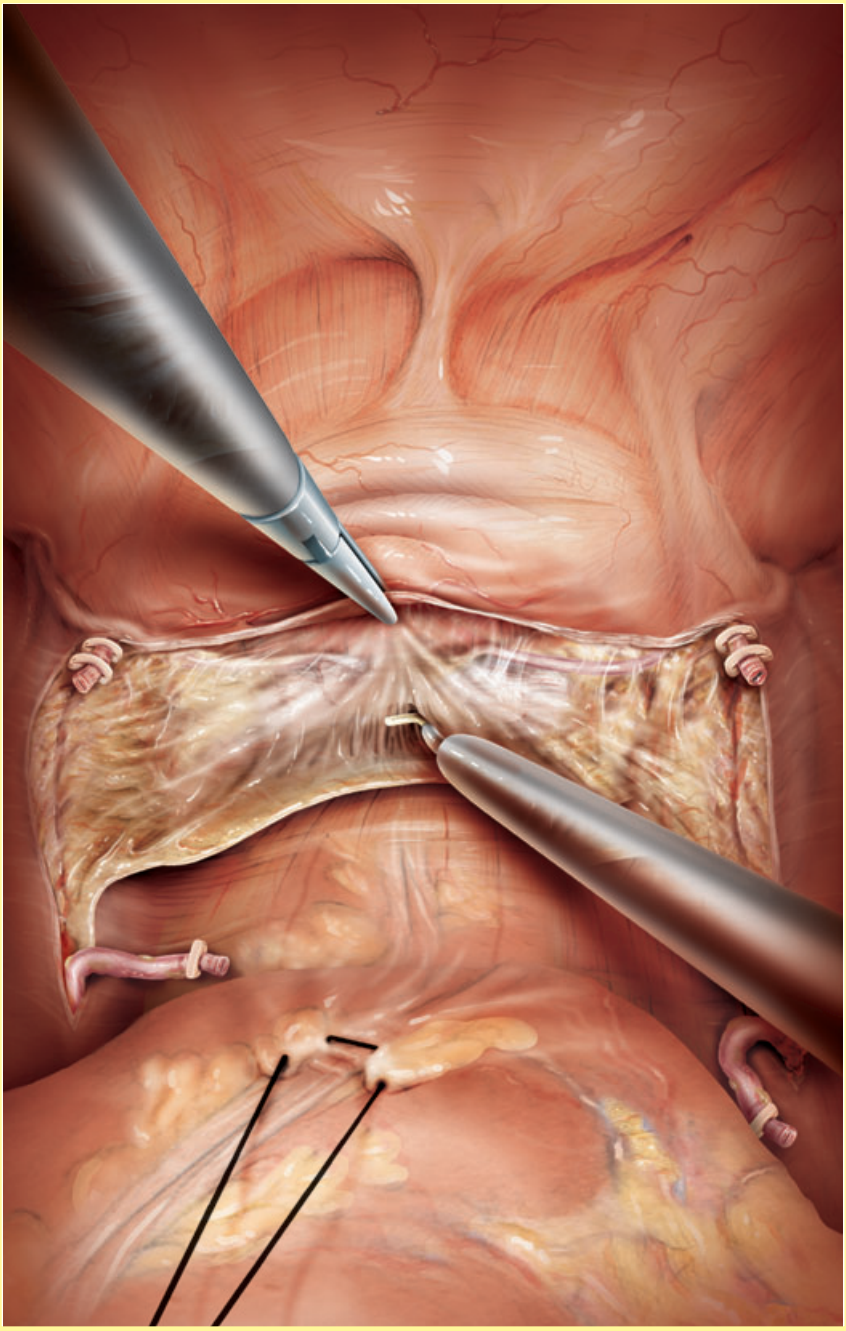

Figures 8 and 9

This plane is now developed between the vasa and seminal vesicles anteriorly, and the anterior surface of the rectum posteriorly. The vessels supplying the seminal vesicles are controlled, and bilateral vasa and vesicles are maintained en bloc with the bladder. Continued dissection brings the posterior layer of Denonvilliers' fascia into view, which is incised with cold endoshears to reveal the yellow prerectal fat posterior to the prostate. This is an important landmark guiding the posterior dissection, the plane of which must remain between the prostate anteriorly and the prerectal fat posteriorly, to minimize chances of rectal injury.

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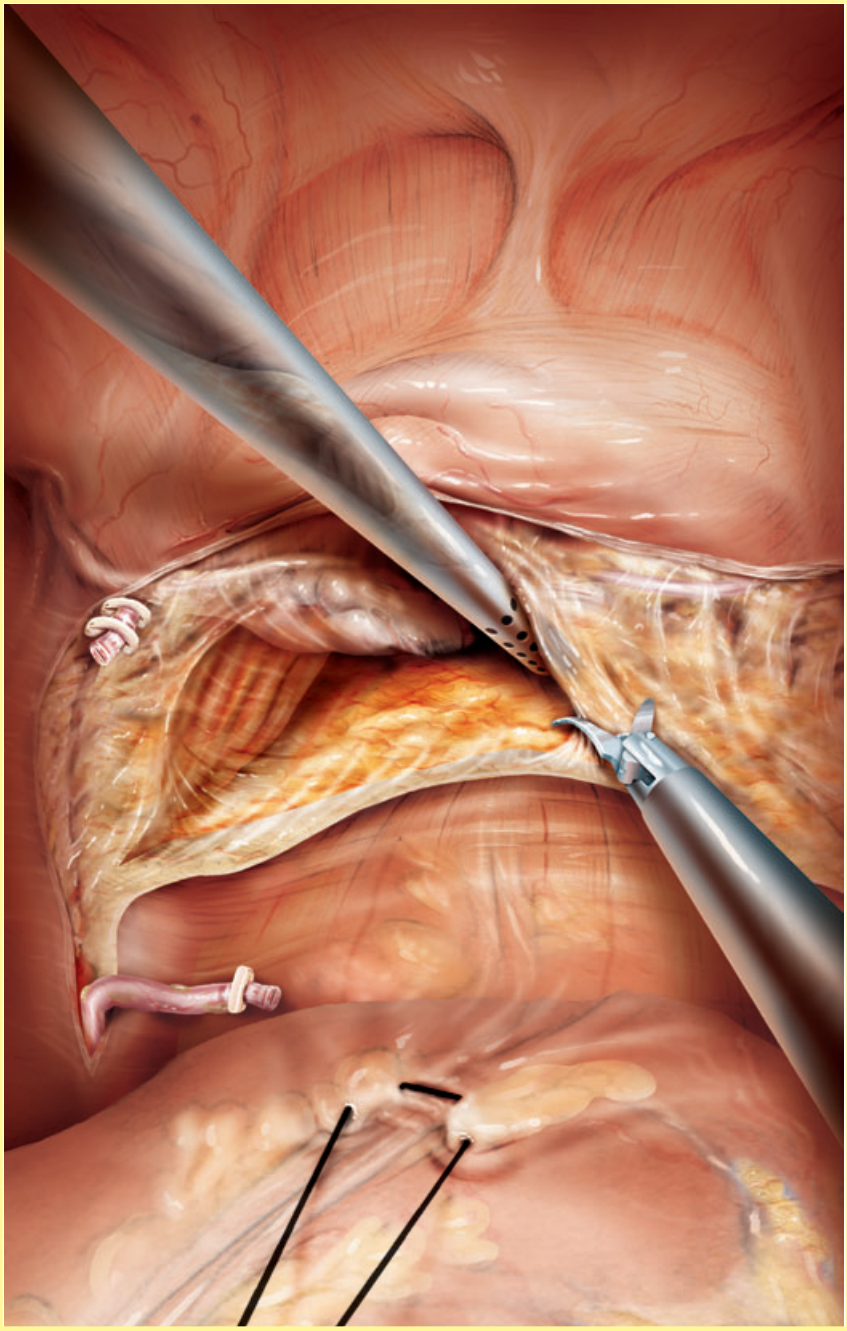

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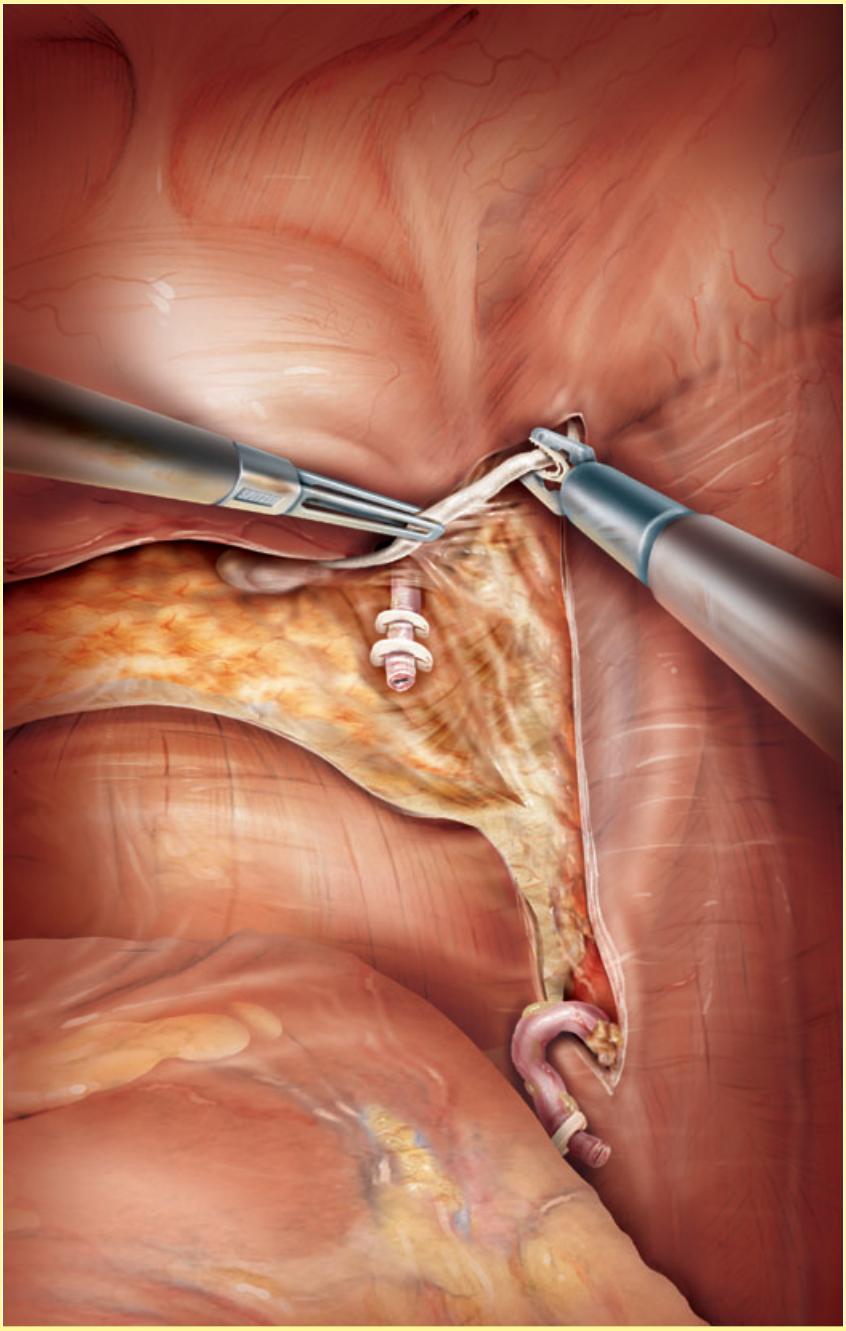

STEP 3: LATERAL DISSECTION AND CONTROL OF VASCULAR PEDICLES

Figure 10

The parietal peritoneum lateral to the medial umbilical ligaments is incised from the vas deferens as it crosses the pelvic brim towards the peritoneotomy across the rectovesical cul-de-sac. The vasa are clipped and divided at the pelvic brim. The space between the bladder and the lateral pelvic wall is now developed bluntly, retracting the bladder medially away from the iliac vessels and the obturator nerve.

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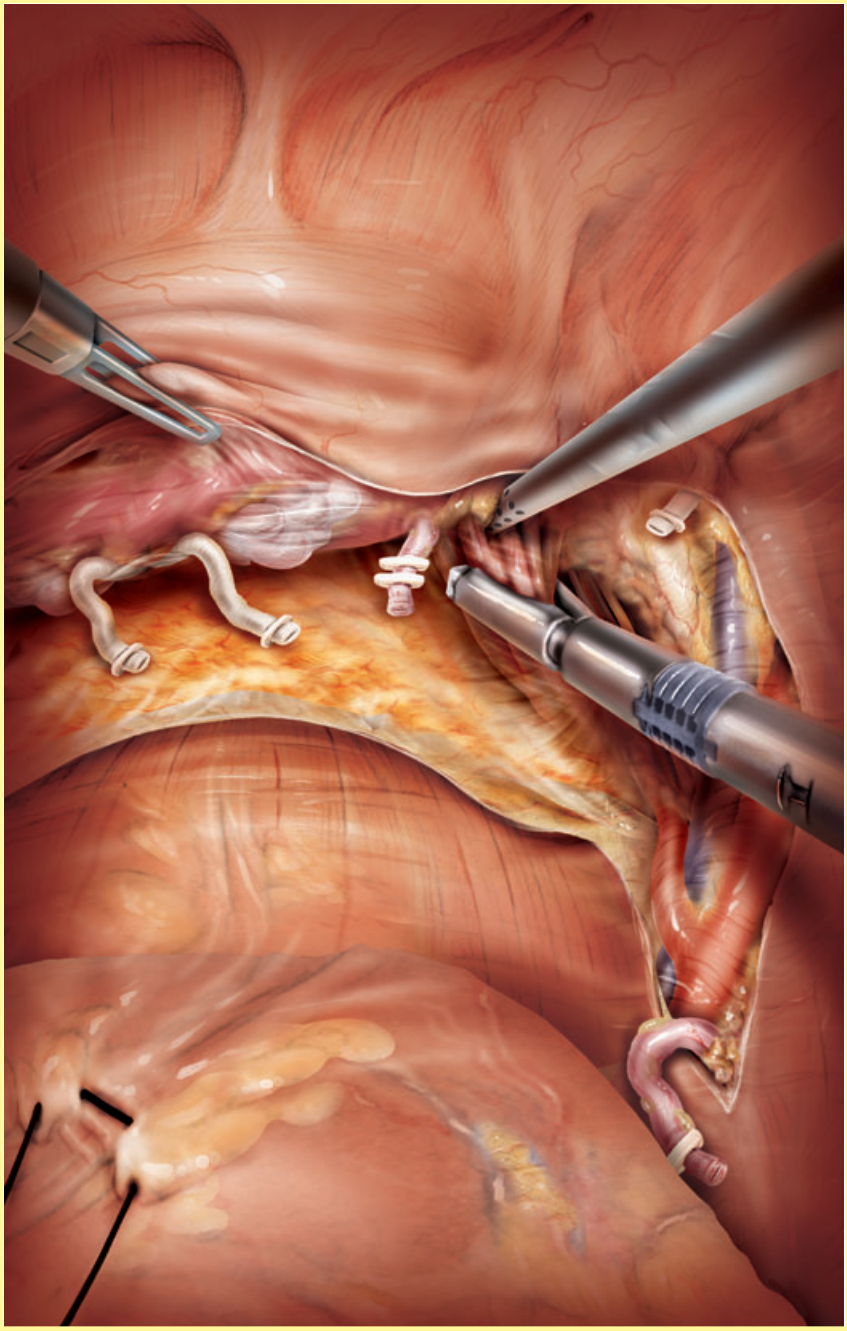
Figure 11

As the bladder is still anteriorly attached to the abdominal wall, this allows the lateral pedicles to be clearly identified bilaterally. The lateral pedicles are now divided with a laparoscopic stapler. Once again, the two clips on the bladder end of the transected juxtavesical ureters serve as critical landmarks for the anteromedial limit of resection; the laparoscopic stapler is deployed just posterolateral to these clips. Usually two or three cartridges are necessary on each side to control the entire width of the lateral pedicles down to the endopelvic fascia on either side.



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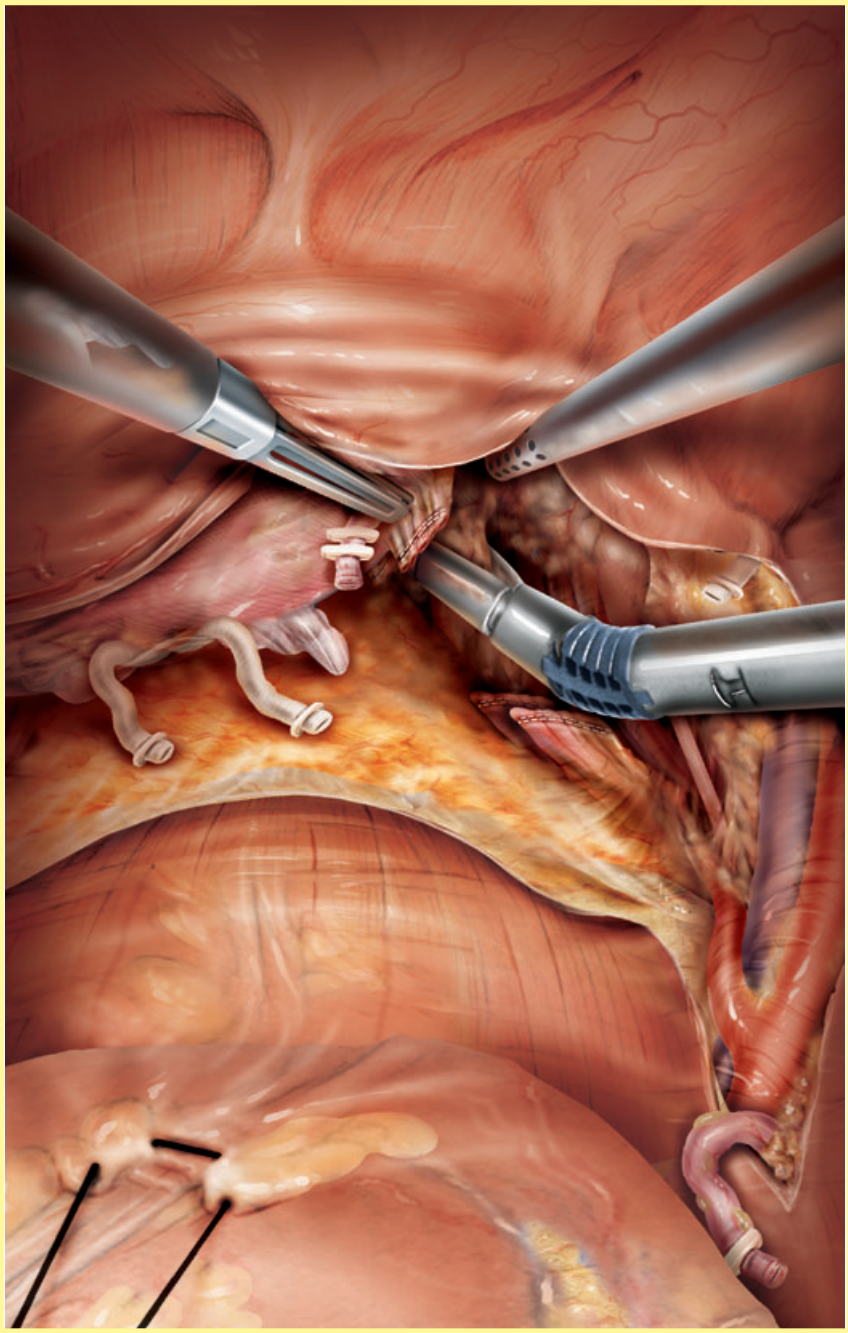

Figure 12

Once the lateral pedicles are divided, the posterior pedicles are often visualized coursing from just lateral to the rectum towards the urinary bladder. These are controlled either with the stapler or divided between sequentially applied Hem-o-lok clips. Usually only the cephalad part of the posterior pedicles can be controlled at this stage; their caudal aspect is addressed after releasing the bladder from the anterior abdominal wall, and completing the anterior dissection. At this point the dissection is close to the anterolateral surface of the rectum. An assistant's finger in the rectum can provide guidance in avoiding rectal injury.

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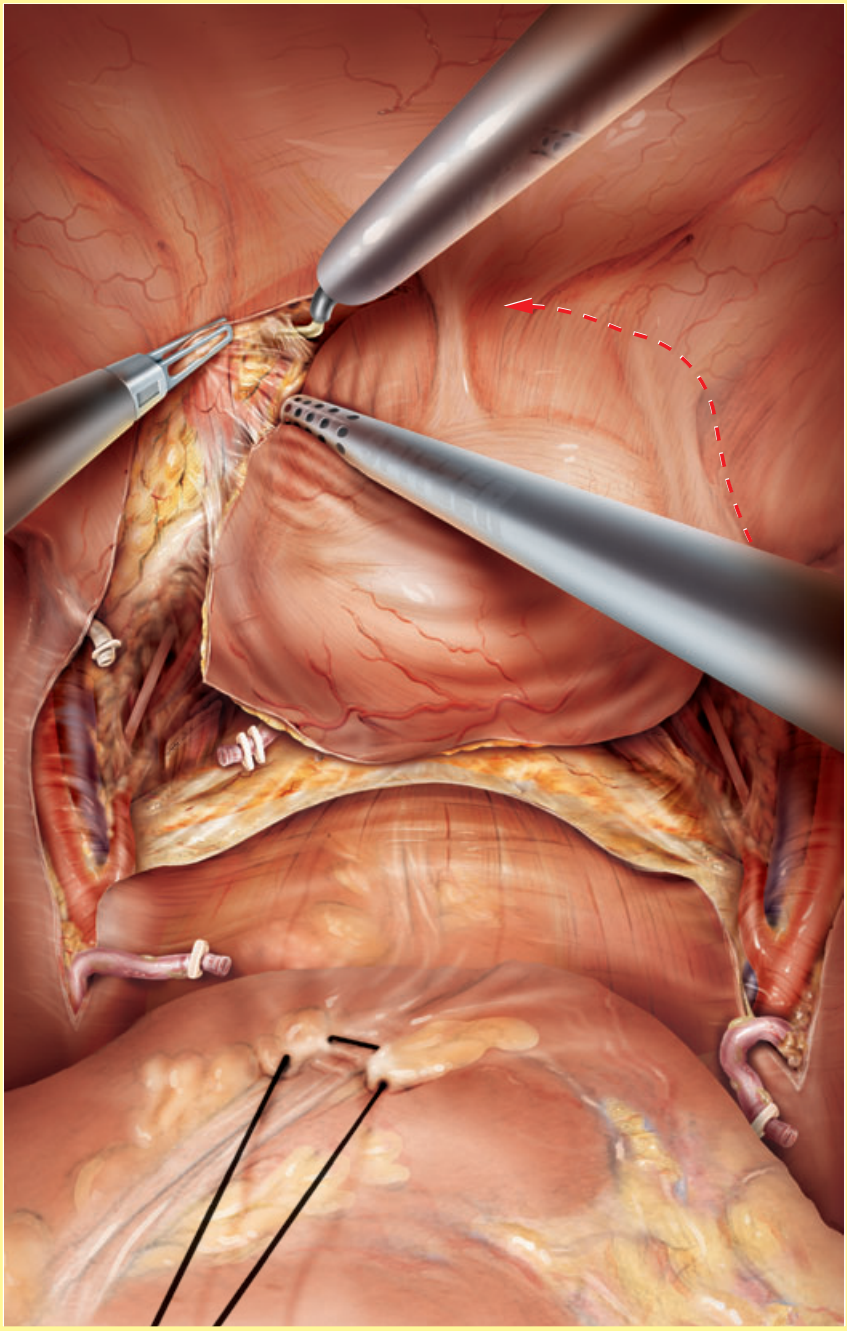
STEP 4: ANTERIOR DISSECTION

Figure 13

A liberal inverted U-shaped incision is made with the J-hook electrocautery, starting lateral to each medial umbilical ligament with the limbs of the U joined anteriorly across the midline at the umbilicus. The urachus and medial umbilical ligaments are divided just caudal to the umbilicus. The bladder is released from the anterior abdominal wall; care is taken to protect the inferior epigastric vessels as they course up from the external iliac vessels to enter the posterior rectus sheath.

The space of Retzius is developed behind the pubic bone. Areolar tissue is dissected away to expose the anterior surface of the prostate and the endopelvic fascia on each side. The endopelvic fascia is incised down to the region of the dorsal venous complex (DVC). The superficial dorsal vein is coagulated and divided with the bipolar forceps. Fat overlying the anterior surface of the prostate is cleared off with the bipolar forceps. The puboprostatic ligaments are divided with cold endoshears.



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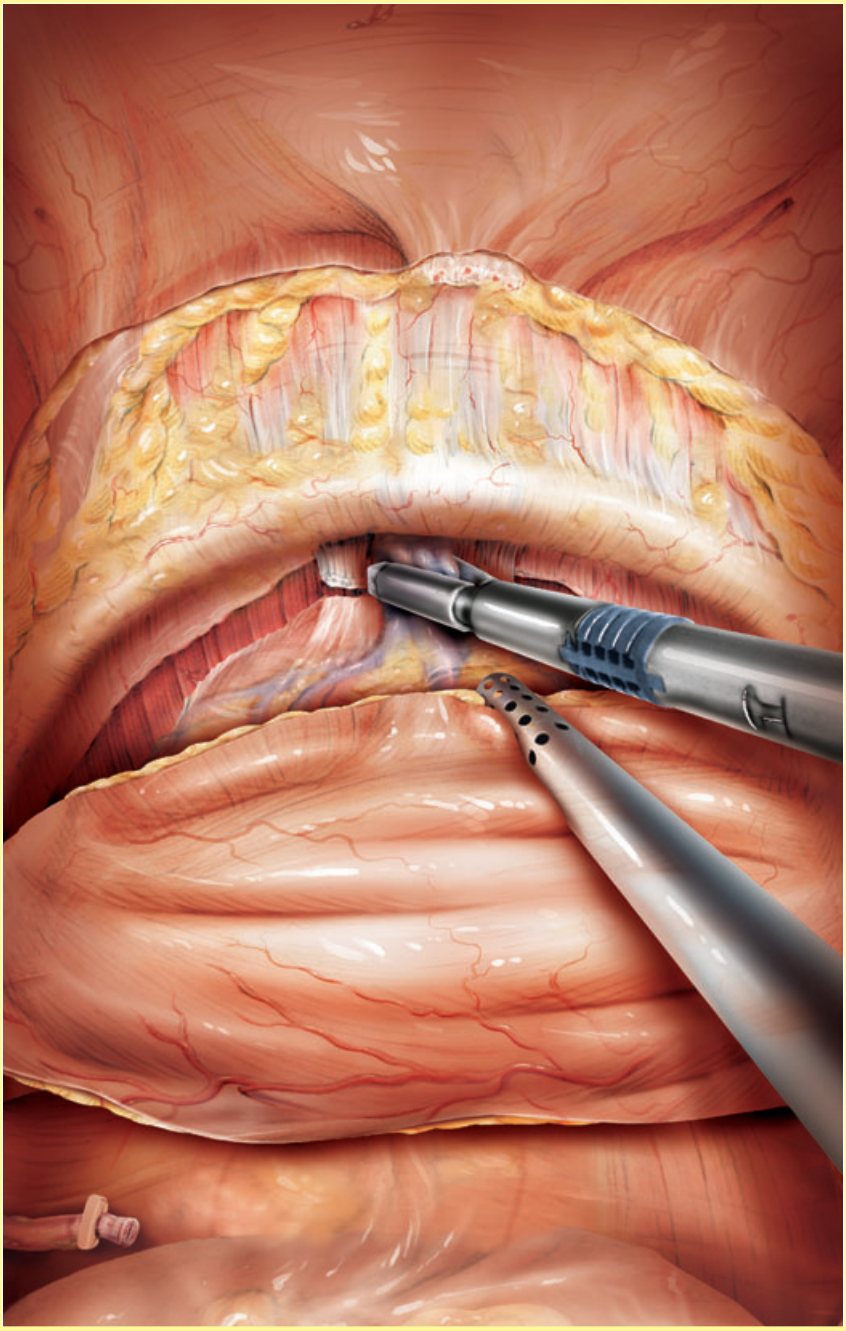

STEP 5: TRANSECTION OF DORSAL VEIN COMPLEX AND MEMBRANOUS URETHRA, SPECIMEN ENTRAPMENT

Figure 14

The DVC is now transected with a laparoscopic stapler. Quite often, an additional suture of 2–0 polyglactin on a CT-1 needle is necessary to secure complete haemostasis of the DVC. The membranous urethra is transected with cold endoshears, the catheter is removed, and the urethra at the prostate apex occluded with a 2–0 polyglactin suture on a CT-1 needle, to prevent local spillage of urine. The remaining posterior pedicles are clipped and divided. The remaining posterior attachments of the prostate apex are divided and the freed specimen is entrapped in a 15-mm Endocatch bag. The mouth of the bag is transiently retrieved outside a port site, double-ligated to prevent any spillage, and returned into the abdomen.

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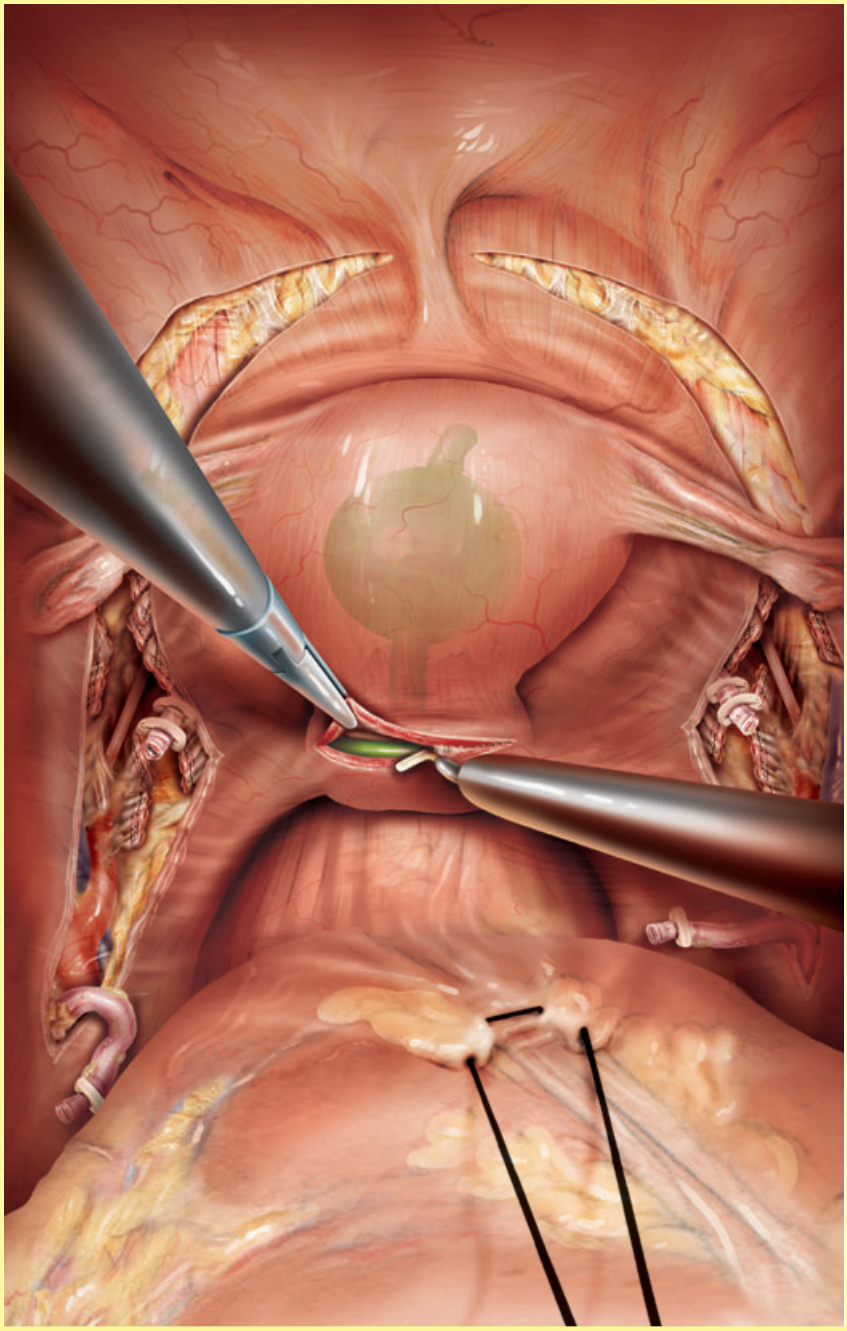
MODIFICATIONS FOR CYSTECTOMY IN THE FEMALE

Figure 15



Once the ureters are clipped and divided, the uterus is anteverted by the RUMI manipulator (Cooper Surgical, Trumbull, CT, USA) and the sigmoid is retracted as described above. The infundibulopelvic ligaments are transected with a laparoscopic stapler. With the uterus still anteverted and the adnexa retracted anteriorly, the peritoneum over the apex of the posterior fornix is scored transversely with the laparoscopic J-hook. The cervical cup aids in identifying the posterior fornix. The remaining posterior dissection and vaginal incision is made after preparing the DVC. The lateral pedicles are transected with laparoscopic staplers and the bladder is dropped in the usual fashion. The DVC is suture-ligated with a 2–0 polyglactin suture on a CT-1 needle.

Attention is now returned to the posterior dissection. With the uterus anteverted transverse incision of the posterior vaginal fornix is completed at the previously scored site. The vaginal incision is extended distally on either side of the urethra, excising a narrow central strip of vagina en bloc with the bladder specimen.

Using a perineal approach the external meatus and distal urethra are circumferentially cored out using electrocautery. After removing the RUMI manipulator, the distal urethra and underlying strip of anterior vaginal wall is dissected free by the transvaginal approach. The specimen is delivered en bloc through the vagina. The vagina is reconstructed by combined perineal and laparoscopic suturing before proceeding with urinary diversion.

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MODIFICATIONS FOR NERVE-SPARING CYSTECTOMY IN MEN

Once the ureters are divided and posterior dissection commences, care is taken to stay on the surface of the seminal vesicles, as the neurovascular bundles run lateral to the apical tip of the vesicles distally towards the prostatovesicular junction. Thermal energy is avoided in the vicinity of the bundles. The plane of dissection is closer to the bladder and further from the rectum. The bundle on either side is dissected away with cold endoshears, and haemostasis secured with Hem-o-lok clips. This is in contrast to the non-nerve-sparing technique, in which a laparoscopic stapler is used for en masse transection of the lateral pedicle more posterolaterally, closer to the rectum, and at a considerable distance from the bladder.

During the anterior dissection, the endopelvic fascia is maintained intact, and the lateral pelvic fascia is incised high on the prostate to drop the bundles posteriorly. The DVC is divided with a laparoscopic stapler, exposing the membranous urethra. The bundles on either side are released from the prostate apex using cold endoshears, and the urethra divided. The remainder of the operation proceeds in the usual fashion. Intraoperative real-time TRUS guidance is of help during nerve-sparing cystectomy, as it can confirm the location of and blood flow in the neurovascular bundles during and after the procedure.

MODIFICATIONS FOR REPRODUCTIVE ORGAN-SPARING CYSTECTOMY IN WOMEN

In carefully selected, sexually active, young women with low-grade organ-confined disease, a more limited approach can be used. Precise dissection of the bladder away from the uterus and vagina is critically important. The uterus is retroverted, the bladder is identified and the peritoneum on the anterior surface of the uterus is incised transversely using a J-hook. With the bladder now retracted anteriorly, dissection is performed along and close to the anterior surface of the uterus, developing this avascular plane. Typically dissection proceeds smoothly until the cervix is reached, where adhesions are often dense. At this point extreme care is taken not to thin the vaginal wall or the bladder. This dissection is carried distally down to the bladder neck, which is the end point of posterior dissection. Anterior dissection is now performed and the lateral pedicles are divided with a stapler. The urethra is prepared in the usual fashion. As the vagina is not opened, the specimen is entrapped in a 15-mm Endocatch bag.

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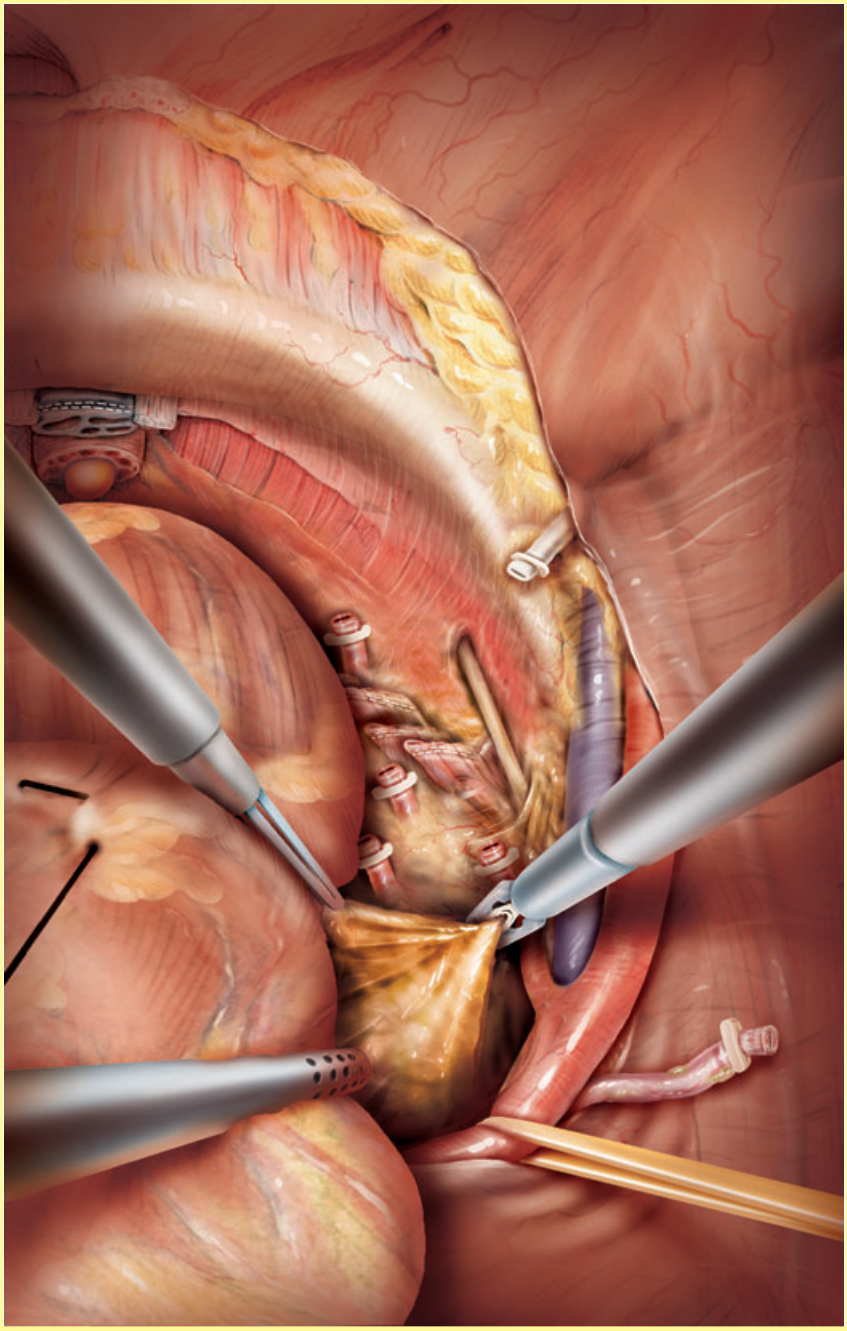
EXTENDED LYMPHADENECTOMY

Figure 16



We perform pelvic lymph node dissection after the LRC. The lateral limit of the dissection is the genitofemoral nerve and the medial limit is the obturator nerve. The distal limit is the inguinal ligament and the proximal limit is the aortic bifurcation. The technique mimics the 'split and roll' technique used during open surgery. Right lymphadenectomy is performed first. The fibroareolar tissue lateral to the genitofemoral nerve is divided, exposing the iliopsoas muscle. The tissue packet is dissected en bloc off the surface of the iliopsoas muscle and swept medially dissecting behind the iliac vessels down to the obturator nerve. Tissue anterior to the external iliac artery and vein is then individually split longitudinally using the J-hook, skeletonizing the vessels circumferentially. The external iliac vein typically appears flat at standard pneumoperitoneum pressures. Occasionally, pneumoperitoneum pressure might need to be decreased to 5 mmHg to facilitate identification of the external iliac vein.

Cephalad dissection along the common iliac artery is facilitated by the fact that the transected ureter has already been mobilized away during the LRC procedure. The circumferentially mobilized common iliac artery is retracted with a vessel loop to retrieve the posterior fibro-fatty-lymphatic tissue distal to the aortic bifurcation. The internal iliac artery is carefully mobilized, taking care to avoid injury to the internal iliac vein. The released tissue packet is rolled medially posterior to the mobilized iliac vessels, delivering it into the pelvis. Dissection along the medial aspect of the packet separates it from the previously identified obturator nerve. Distally, the tissue packet is clipped and transected at the inguinal ligament.

Care must be taken to avoid cutting into any enlarged lymph nodes, to minimize the risk of tumour spillage. The lymphadenectomy specimen is immediately entrapped in an Endocatch bag, avoiding contact with adjacent tissues. Lymphadenectomy is then performed on the left side in similar fashion.

As mentioned, our current preference is to perform this part of the procedure through a 6–8 cm midline incision. The three specimens

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(bladder and two lymphadenectomy specimens) in their separate bags are removed through this incision. The pelvis is carefully inspected to confirm good haemostasis. An ileal conduit or ileal neobladder is fashioned in the usual manner, essentially at or near skin level.

If an ileal conduit is made the stoma is fashioned at the site of the right-sided 12 mm port. This port site is further expanded and a stoma is fashioned in the usual manner. A 10-mm Jackson–Pratt drain is placed in the pelvis and a 24 F Foley catheter is placed in the pelvis through the urethra. The balloon of this catheter is inflated to 50 mL and placed on traction for 24–48 h. The abdominal incision is then closed in layers using looped polydioxanone sutures for the fascial layer and 4–0 subcuticular polyglactin for the skin. The 5-mm port sites are closed with 4–0 subcuticular polyglactin.

For the ileal neobladder the pouch is completed and closed, and the most dependant aspect is defined and a small enterotomy made. This site is tagged with a polyglactin suture and later used for the urethral anastomosis. The ureteric stents and suprapubic tube are brought through separate openings in the anterior wall of the pouch and secured with chromic gut purse-string sutures. The pouch is irrigated to confirm watertight integrity. It is then dropped into the pelvis, one port is reinserted under direct vision, and the abdominal wall is closed in layers as described above. The pneumoperitoneum is then re-established and the other laparoscopic ports are re-inserted. The urethro-neovesical anastomosis is completed laparoscopically using a running pre-knotted double-arm suture of 2–0 poliglecaprone 25 and 2–0 polyglytone 6211 on a UR-6 needle over a 22 F Foley catheter, akin to the technique used for urethrovesical anastomosis during laparoscopic radical prostatectomy. Two 10-mm Jackson-Pratt drains are placed in the pelvis through the left and right lateral 5 mm port sites. The ureteric stents are brought out through the left pararectal 5 mm port site. The suprapubic tube draining the pouch is brought out through the right 12 mm port site. The abdominal cavity is extensively irrigated before closure, and this can be done efficiently using this combined approach.

POSTOPERATIVE CARE

The neobladder is gently irrigated with 50 mL of saline every 4 h to prevent mucus plugging of the catheters. Intravenous fluids and antibiotics are continued until bowel function is regained. Diet is gradually advanced and antibiotics switched to the oral route. The ileo-ureteric stents are removed in 2 weeks, after a negative IVU. The Jackson-Pratt drains are removed sequentially, as per the decrease in their output. The urethral Foley catheter and suprapubic catheter are removed at 4 weeks after a normal cystogram.

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Abbreviations: **(L)RC**, (laparoscopic) radical cystectomy; **PL**, pure laparoscopic; **LA**, laparoscopically assisted; **DVC**, dorsal venous complex; **VUJ**, vesico-ureteric junction.

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