

Surgery Illustrated

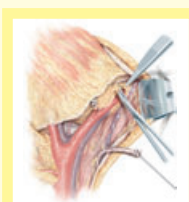
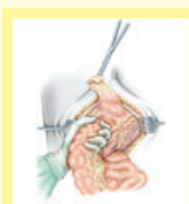
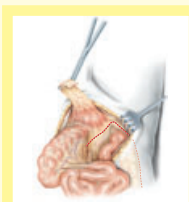
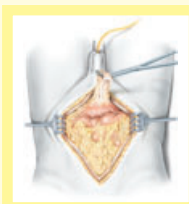
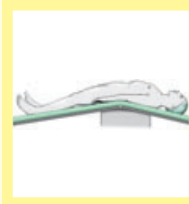
Surgical Atlas

Radical Cystectomy

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



INTRODUCTION

Radical cystectomy has traditionally been considered the standard of therapy for high-grade invasive bladder cancer, with the best survival results and lowest local recurrence rates reported to date [1].

Radical cystectomy provides the optimum result for accurate pathological staging, prevention of local recurrence and overall survival [1,2]. In addition, radical cystectomy may influence the decision for adjuvant chemotherapy based upon clear pathological criteria [3].

With improvements over the past several decades in medical, surgical and anaesthetic techniques, the morbidity and mortality associated with radical cystectomy has dramatically decreased. Before 1970 the perioperative complication rate of radical cystectomy was reportedly close to 35%, with a mortality rate of nearly 20%. This has dramatically diminished to a <10% perioperative complication rate and 2% mortality rate reported in contemporary cystectomy series [1,2]. In addition, radical cystectomy with en bloc pelvic lymphadenectomy provides optimal local control of the tumour. Pelvic recurrence rates in patients undergoing radical cystectomy are <10% for patients with node-negative bladder tumours, and 10–20% for patients with resected pelvic nodal metastases [1,2,4]. Furthermore, TCC is generally resistant to radiation therapy even at high doses. To date,

chemotherapy alone or as adjuvant therapy, coupled with bladder-sparing surgery, has yet to show equivalent recurrence and long-term survival rates to radical cystectomy alone [5,6].

Improvements in urinary diversion now provide both men and women the opportunity to safely undergo orthotopic lower urinary tract reconstruction to the native intact urethra after cystectomy [7]. Clearly, orthotopic reconstruction most closely resembles the original bladder in both location and function, provides a continent means to store urine, and allows volitional voiding urethrally. The orthotopic neobladder eliminates the need for a cutaneous stoma, urostomy appliance or the need for intermittent catheterization in most cases.

A dedicated effort has been made to improve the technique of radical cystectomy and provide an acceptable form of urinary diversion without compromising a sound cancer operation [8–10]. Certain technical issues about the surgical procedure of radical cystectomy are critical to minimize local recurrence and positive surgical margins, and to maximize cancer-specific survival. In addition, attention to surgical detail is important for optimizing the successful outcomes of orthotopic diversion, maintaining the rhabdosphincter mechanism and urinary continence in these patients [10].

PREOPERATIVE EVALUATION

Complete clinical staging for bladder cancer should evaluate the retroperitoneum and pelvis, along with the most common metastatic sites including the lungs, liver and bone. A chest X-ray, liver function tests and serum alkaline phosphatase should be obtained routinely. Patients with an elevated serum alkaline phosphatase or with/without complaints of bone pain should undergo a bone scan. CT of the chest is used when pulmonary metastases are suspected by history, or because of an abnormal chest X-ray. CT of the abdomen and pelvis is routine to evaluate the pelvis and retroperitoneum for any significant lymphadenopathy or local contiguous spread. This radiography should also be used in patients with suspected metastases, elevated liver functions tests, a bladder tumour associated with hydronephrosis, or in those with an extensive primary bladder tumour that is either not mobile or fixed, the results of which may affect the decision for neoadjuvant therapy. However, CT of the primary bladder is neither sensitive nor specific enough to evaluate the degree of bladder wall tumour invasion, or to accurately determine pelvic lymph node involvement with tumour [11,12].

EN BLOC RADICAL CYSTECTOMY AND PELVIC-ILIAC LYMPHADENECTOMY: SURGICAL TECHNIQUE

Patients undergoing radical cystectomy are admitted on the morning before surgery. All patients receive a mechanical and antibacterial bowel preparation the day

before surgery. Intravenous hydration must be considered in these patients to prevent dehydration on arrival at the operating room. In addition, all patients should be evaluated and counselled by the enterostomal therapy nurse before surgery. A clear liquid diet may be consumed until midnight, at which time the patient takes nothing orally. A standard modified Nichols bowel preparation [13] is initiated on the morning of admission, i.e. 120 mL of castor oil orally at 09.00 hours, 1 g neomycin orally at 10.00, 11.00, 12.00, 13.00, 16.00, 20.00 and 24.00 hours, and 1 g of erythromycin base orally at 12.00, 16.00, 20.00 and 24.00 hours. This regimen is generally well tolerated, obviates the need for enemas and maintains nutritional and hydrational support. Intravenous crystalloid fluid hydration is begun in the evening before surgery in those patients admitted to the hospital the day before, and maintained to ensure an adequate circulating volume as the patient enters the operating room. This may be particularly important in the elderly or frail patient with associated comorbidities.

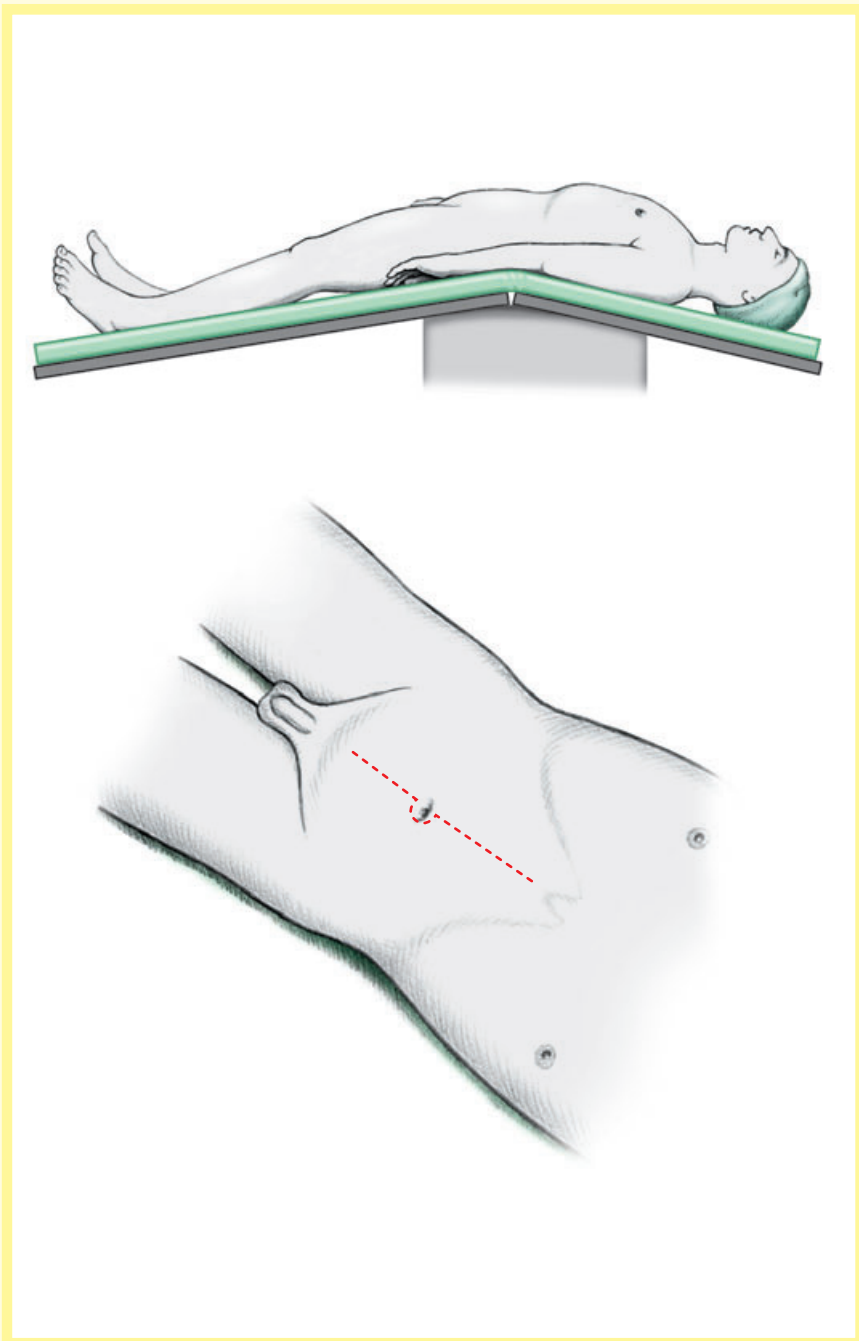
Patients aged >50 years routinely have prophylactic digitalis before cystectomy unless there is a specific contraindication; younger patients do not routinely have this. Digoxin is given orally at 0.5 mg at 12.00, 0.25 mg at 16.00 and 0.125 mg at 20.00 hours. Our experience with digitalis in patients before cystectomy has been positive and there is evidence suggesting that digitalis may decrease the risk of perioperative dysrhythmias and congestive heart failure in the elderly patient undergoing extensive surgery [14,15]. Attention to fluid

management is important in these elderly patients, particularly 3 and 4 days after surgery, when mobilization of third-space fluid is highest, subsequently necessitating the liberal use of diuretics. In addition, intravenous broad-spectrum antibiotics are administered en route to the operating room, providing adequate tissue and circulating levels at the time of incision.

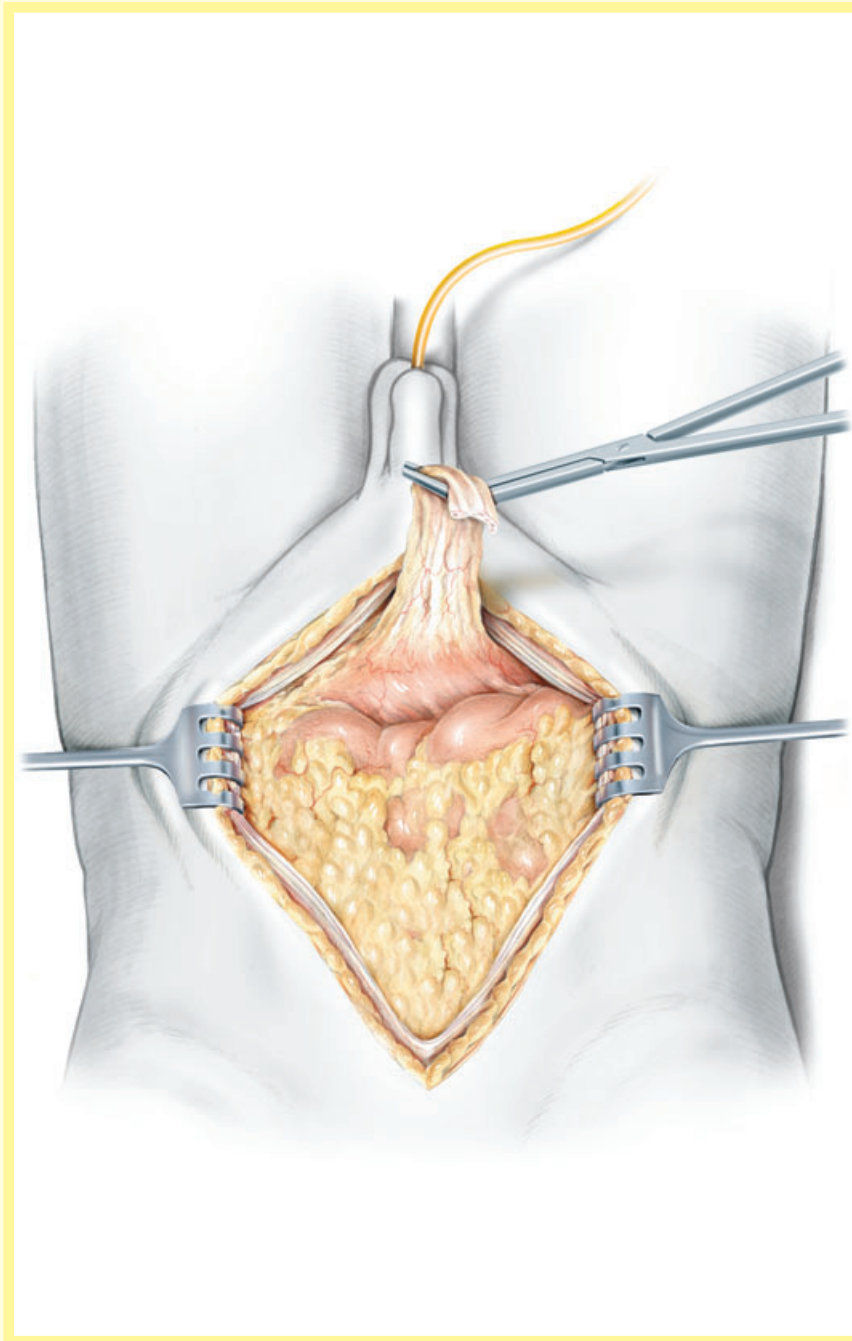
Preoperative evaluation and counselling by the enterostomal therapy nurse is a critical component to the successful care of all patients undergoing cystectomy and urinary diversion. Patients determined to be appropriate candidates for orthotopic reconstruction are instructed how to catheterize urethrally should it be necessary after surgery. All patients are site-marked for a cutaneous stoma, instructed in the care of a cutaneous diversion (continent or incontinent form), and instructed in proper catheterization techniques should medical, technical or oncological factors preclude orthotopic reconstruction. The ideal cutaneous stoma site is determined only after the patient is examined while supine, sitting and standing. Proper stoma site selection is important to patient acceptance, and to the technical success of lower urinary tract reconstruction should a cutaneous diversion be necessary. Incontinent stoma sites are best located higher on the abdominal wall, while stoma sites for continent diversions can be positioned lower on the abdomen (hidden below the belt line), as they do not require an external collecting device. The umbilicus may be used as the site for catheterization, with excellent functional and cosmetic results.

Figure 1

The patient is placed in the hyperextended supine position with the superior iliac crest located at the fulcrum of the operating table. The legs are slightly abducted so that the heels are positioned near the corners of the foot of the table. In the female patient considering orthotopic diversion, the modified 'frog-leg' or lithotomy position is used, allowing access to the vagina. All pressure points should be well padded. The reverse Trendelenburg position levels the abdomen parallel with the floor and helps to keep the small bowel contents in the epigastrium. A nasogastric tube is placed, and the patient prepared from nipples to mid-thigh. In the female patient the vagina is fully prepared. After the patient is draped, a 20 F Foley catheter is placed in the bladder and left to gravity drain. A right-handed surgeon stands on the patient's left side.

**Figure 2**

A vertical midline incision is made extending from the pubic symphysis to the cephalad aspect of the epigastrium. The incision should be carried lateral to the umbilicus on the contralateral side of the marked cutaneous stoma site. When considering the umbilicus as the site for a catheterizable stoma, the incision should be directed 2–3 cm lateral to the umbilicus at this location. The anterior rectus fascia is incised, the rectus muscles retracted laterally, and the posterior rectus sheath and peritoneum entered in the superior aspect of the incision.

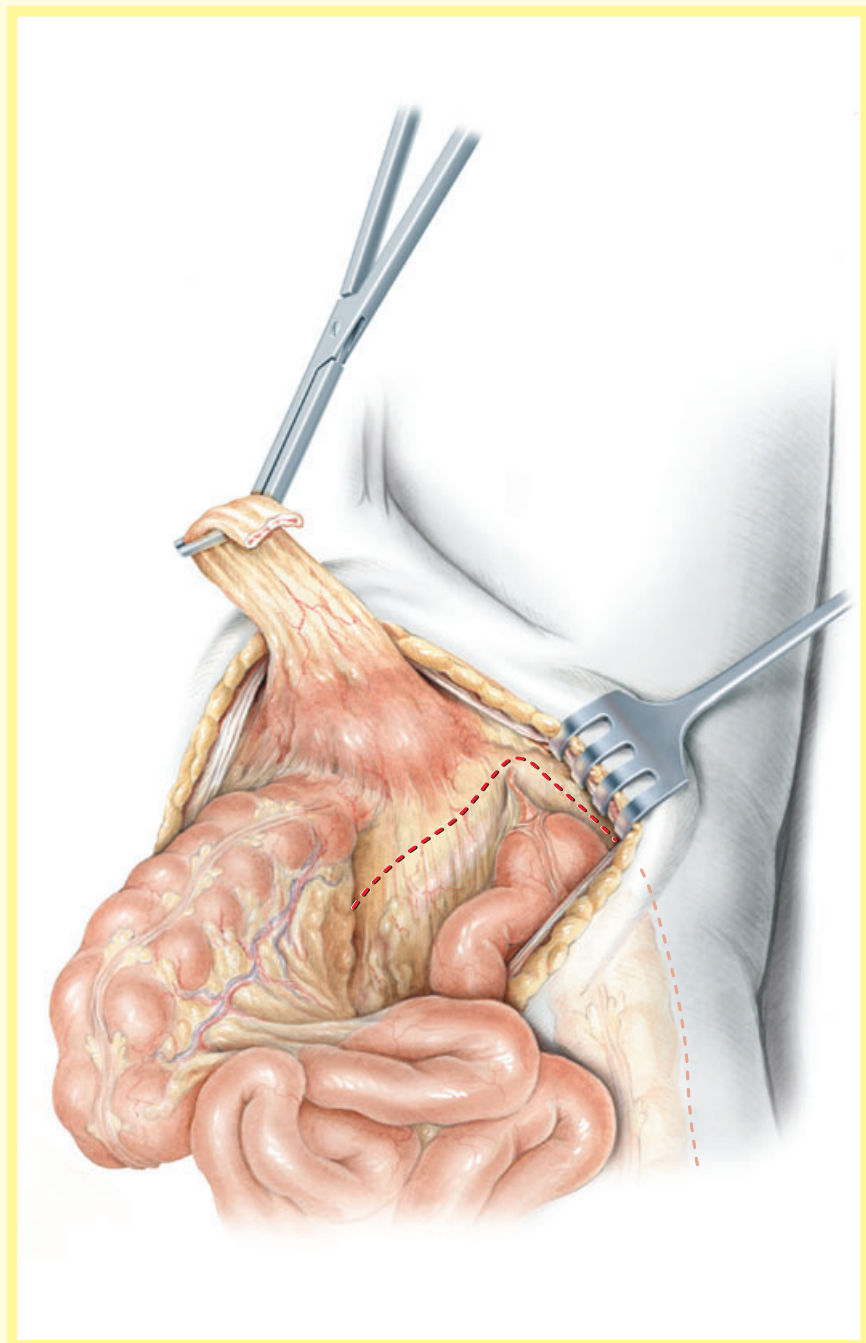
**Figure 3**

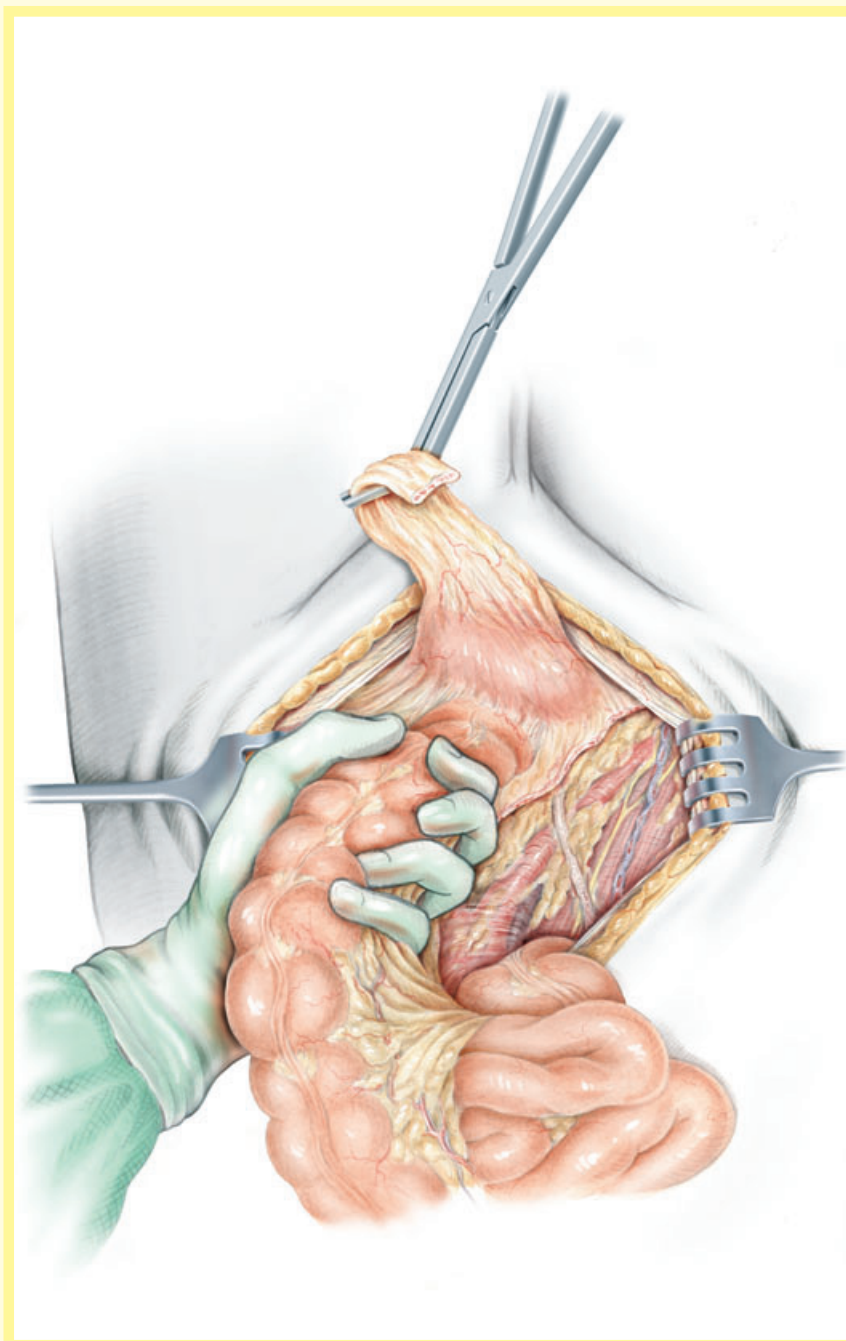
As the peritoneum and posterior fascia are incised inferiorly to the level of the umbilicus, the urachal remnant (median umbilical ligament) is identified, circumscribed, and removed en bloc with the cystectomy specimen. This manoeuvre prevents early entry into a high-riding bladder, and ensures complete removal of all bladder remnant tissue. Care is taken to remain medial and avoid injury to the inferior epigastric vessels (lateral umbilical ligaments) which course posterior to the rectus muscles. If the patient has had a previous cystotomy or segmental cystectomy, the cystotomy tract and cutaneous incision should be circumscribed full-thickness and excised en bloc with the bladder specimen. The medial insertion of the rectus muscles attached to the pubic symphysis can be slightly incised, maximizing pelvic exposure throughout the operation.

A careful, systematic intra-abdominal exploration is used to determine the extent of disease, and to evaluate any hepatic metastases or gross retroperitoneal lymphadenopathy. The abdominal viscera are palpated to detect any concomitant unrelated disease. If there is no contraindication all adhesions should be incised and freed.

Figure 4

The bowel is mobilized beginning with the ascending colon. A large right-angled Richardson retractor elevates the right abdominal wall. The caecum and ascending colon are reflected medially to allow incision of the lateral peritoneal reflection along the avascular/white line of Toldt. The mesentery to the small bowel is then mobilized off its retroperitoneal attachments cephalad (toward the ligament of Treitz) until the retroperitoneal portion of the duodenum is exposed. This mobilization facilitates a tension-free urethro-enteric anastomosis if orthotopic diversion is used. Combined sharp and blunt dissection facilitates mobilizing this mesentery along a characteristic avascular fibro-areolar plane. Conceptually, the mobilized mesentery forms an inverted right triangle; the base is formed by the third and fourth portions of the duodenum, the right edge represented by the white line of Toldt along the ascending colon, the left edge by the medial portion of the sigmoid and descending colonic mesentery, and the apex by the ileocaecal region. This mobilization is critical in setting up the operative field, and facilitates proper packing of the intra-abdominal contents into the epigastrium.



**Figure 5**

The left colon and sigmoid mesentery are then mobilized to the region of the lower pole of the left kidney by incising the peritoneum lateral to the colon along the avascular/white line of Toldt. The sigmoid mesentery is then elevated off the sacrum, iliac vessels and distal aorta in a cephalad direction up to the origin of the inferior mesenteric artery. This manoeuvre provides a wide mesenteric window through which the left ureter will pass (without angulation or tension) for the uretero-enteric anastomosis at the terminal portions of the operation. This sigmoid mobilization also facilitates retraction of the sigmoid mesentery while dissecting the lymph nodes. Care should be taken to dissect along the base of the mesentery and avoid injury to the inferior mesenteric artery and blood supply to the sigmoid colon.

After mobilizing the bowel a self-retaining retractor is placed. The right colon and small intestine are carefully packed into the epigastrium with three moist lap pads, followed by a moistened towel rolled to the width of the abdomen. The descending and sigmoid colon are not packed, and remain as free as possible, providing the necessary mobility required for the ureteric and pelvic lymph node dissection.

The ureters are most easily identified in the retroperitoneum just cephalad to the common iliac vessels. They are carefully dissected into the deep pelvis (several centimetres beyond the iliac vessels) and divided between two large haemoclips. A section of the proximal cut ureteric segment (distal to the proximal haemoclip) is sent for frozen-section analysis to ensure the absence of carcinoma *in situ* or overt tumour. The ureter is then slightly mobilized in a cephalad direction and tucked under the rolled towel to prevent inadvertent injury. Frequently, an arterial branch from the common iliac artery medially, or the aorta, needs to be divided to provide adequate ureteric mobilization. In addition, the rich vascular supply emanating laterally from the gonadal vessels should remain intact and undisturbed. These attachments are an important blood supply to the ureter, which ensure an adequate vascular supply for the uretero-enteric anastomosis at the time of diversion. This is particularly important in irradiated patients. Leaving the proximal haemoclip on the divided ureter during the exenteration allows for hydrostatic ureteric dilatation, and facilitates the uretero-enteric anastomosis. In women, the infundibulopelvic ligaments are ligated and divided at the level of the common iliac vessels.

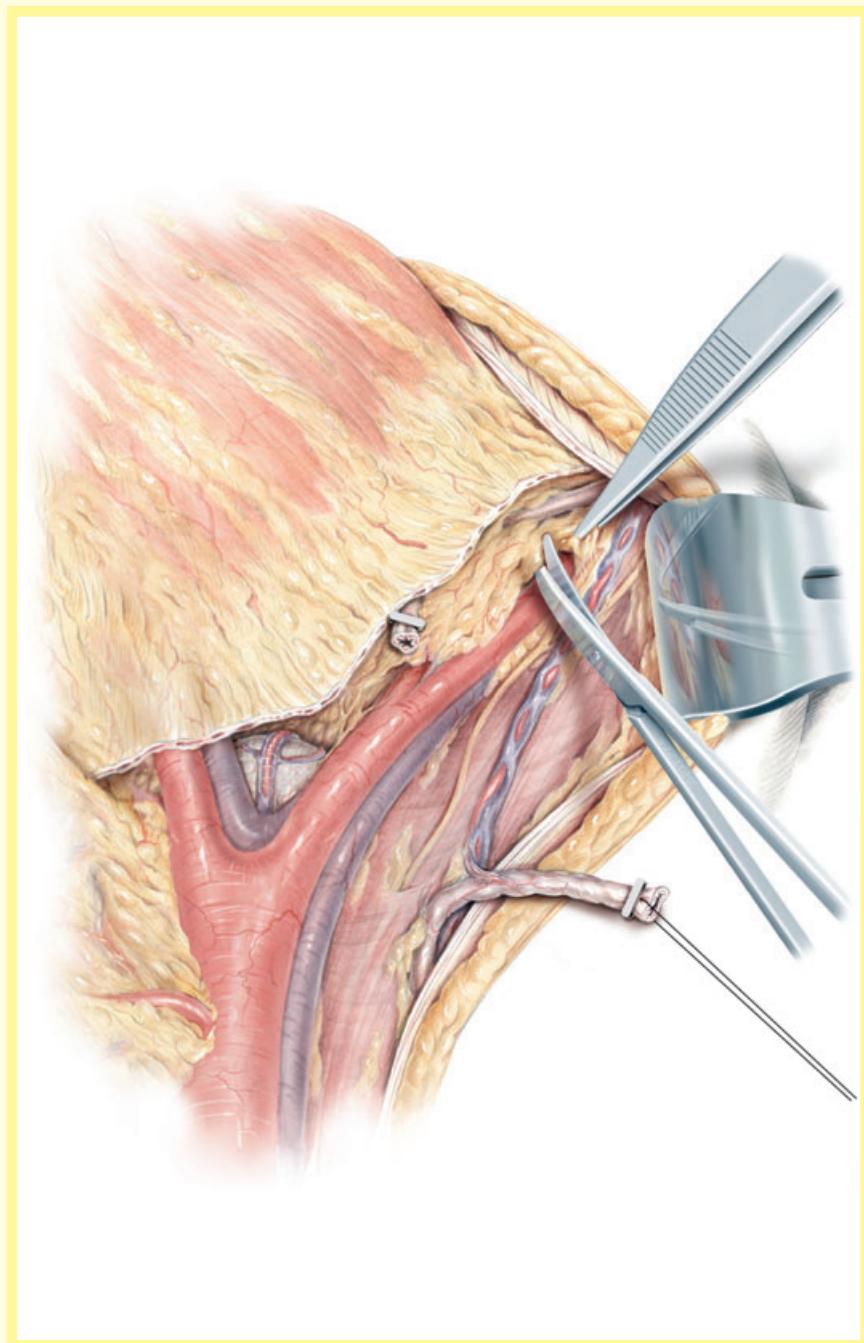
Figure 6

A meticulous pelvic lymph node dissection is routine and en bloc with radical cystectomy. The extent of the lymphadenectomy may vary depending on the patient and the surgeon's preference. An accumulating body of evidence suggests that an extended lymphadenectomy may be beneficial in patients undergoing cystectomy for high-grade, invasive bladder cancer [16–19].

For a combined common and pelvic iliac lymphadenectomy, the lymph node dissection is initiated from the inferior mesenteric artery (superior limits of dissection), and extends laterally over the inferior vena cava to the genitofemoral nerve, representing the lateral limits of dissection. Distally, the lymph node dissection extends to the lymph node of Cloquet medially (on Cooper's ligament) and the circumflex iliac vein laterally.

The cephalad portion (inferior mesenteric artery) of the lymphatics are ligated with haemoclips to prevent lymphatic leak, while the caudal (specimen) side is ligated only when a blood vessel is encountered. Frequently, small anterior tributary veins originate from the vena cava just above the bifurcation, which should be clipped and divided. In men, the spermatic vessels are retracted laterally and spared. In women the infundibulopelvic ligament along with the corresponding ovarian vessels have been previously ligated and divided at the pelvic brim as previously described.

All fibro-areolar and lymphatic tissues are dissected caudally off the aorta, vena cava and common iliac vessels over the sacral promontory into the deep pelvis. The initial dissection along the common iliac vessels is performed over the arteries, skeletonizing them. As the common iliac veins are dissected medially, care is taken to control small arterial and venous branches coursing along the anterior surface of the sacrum. Electrocautery is helpful at this location, which allows the adherent fibro-areolar tissue to be swept off the sacral promontory down into the deep pelvis, with the use of a small gauze sponge. Significant bleeding from these presacral vessels can occur if not properly controlled. Hemoclips are discouraged in this location as they can be easily dislodged from the anterior surface of the sacrum, resulting in troublesome bleeding.



Once the proximal portion of the lymph node dissection is completed, a finger is passed from the proximal aspect of dissection under the pelvic peritoneum (anterior to the iliac vessels), distally toward the femoral canal. The opposite hand can be used to strip the peritoneum from the undersurface of the transversalis fascia, and connects with the proximal dissection from above. This manoeuvre elevates the peritoneum and defines the lateral limit of peritoneum to be incised and removed with the specimen. In men, the peritoneum is divided medial to the spermatic vessels, and lateral to the infundibulopelvic ligament in female patients. The only structure encountered is the vas deferens in the male or

round ligament in females; these structures are clipped and divided.

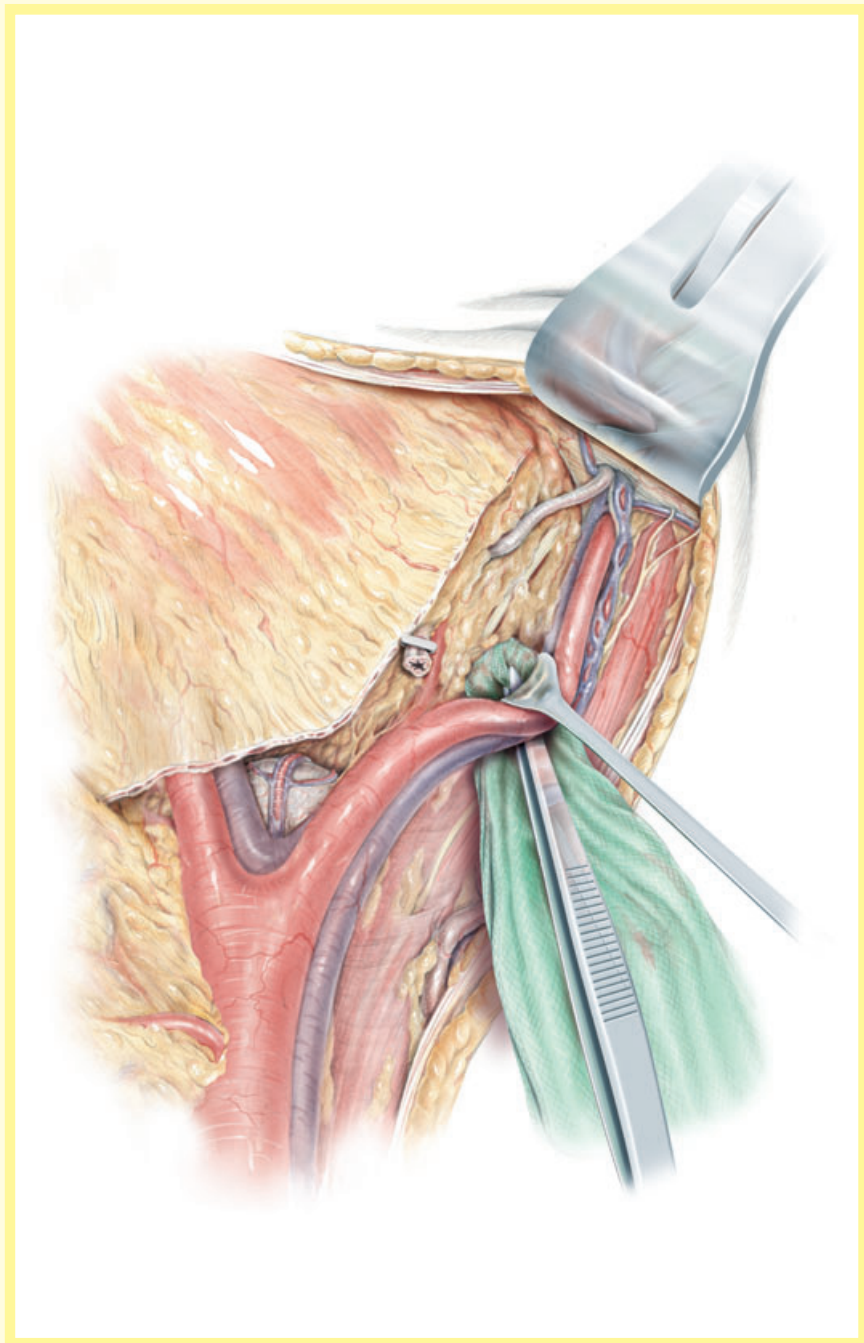
A large right-angled rake retractor (e.g. Israel) is used to elevate the lower abdominal wall, including the spermatic cord or remnant of the round ligament, to provide distal exposure in the area of the femoral canal. Tension on the retractor is directed vertically toward the ceiling, with care taken to avoid injury to the inferior epigastric vessels. This provides excellent exposure to the distal external iliac vessels. The distal limits of the dissection are then identified; the circumflex iliac vein crossing anterior to the external iliac artery distally, the genitofemoral nerve laterally, and

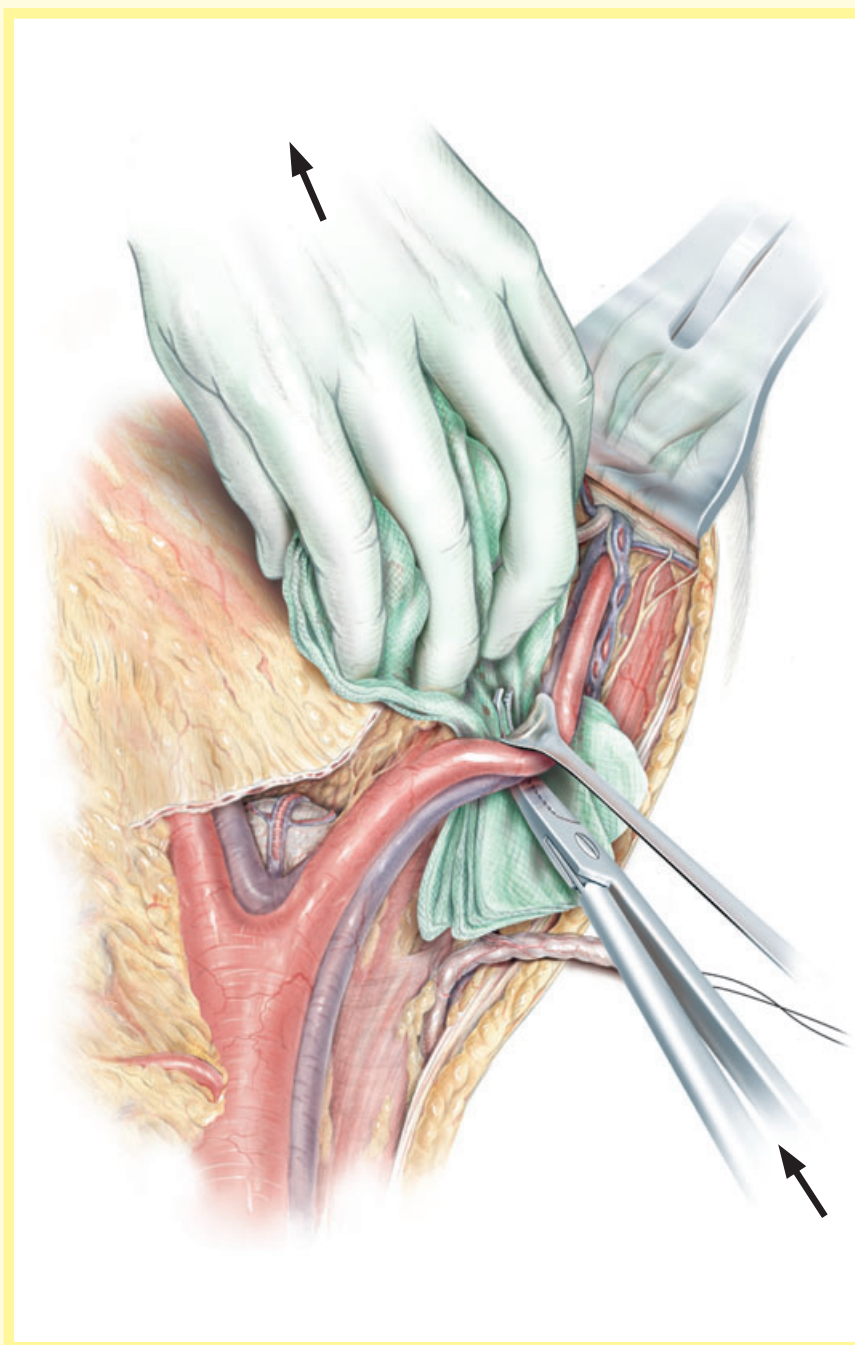
Cooper's ligament medially. The lymphatics draining the ipsilateral leg, particularly medial to the external iliac vein, are carefully clipped and divided to prevent lymphatic leakage. This includes the lymph node of Cloquet (also known as Rosenmuller) which represents the distal limit of the lymphatic dissection at this location. The distal external iliac artery and vein are then circumferentially dissected and skeletonized, with care taken to ligate an accessory obturator vein (present in 40% of patients) originating from the inferiomedial aspect of the external iliac vein.

After completing the distal limits of dissection the proximal and distal dissections are joined.

Figure 7

The proximal external iliac artery and vein are skeletonized circumferentially to the origin of the hypogastric artery. Care should be taken to clip and divide a commonly encountered vessel arising from the lateral aspect of the proximal external iliac vessels coursing to the psoas muscle. The external iliac vessels (artery and vein) are then retracted medially, and the fascia overlying the psoas muscle is incised medial to the genitofemoral nerve. On the left side, branches of the genitofemoral nerve often pursue a more medial course and may be intimately related to the iliac vessels, in which case they are excised.

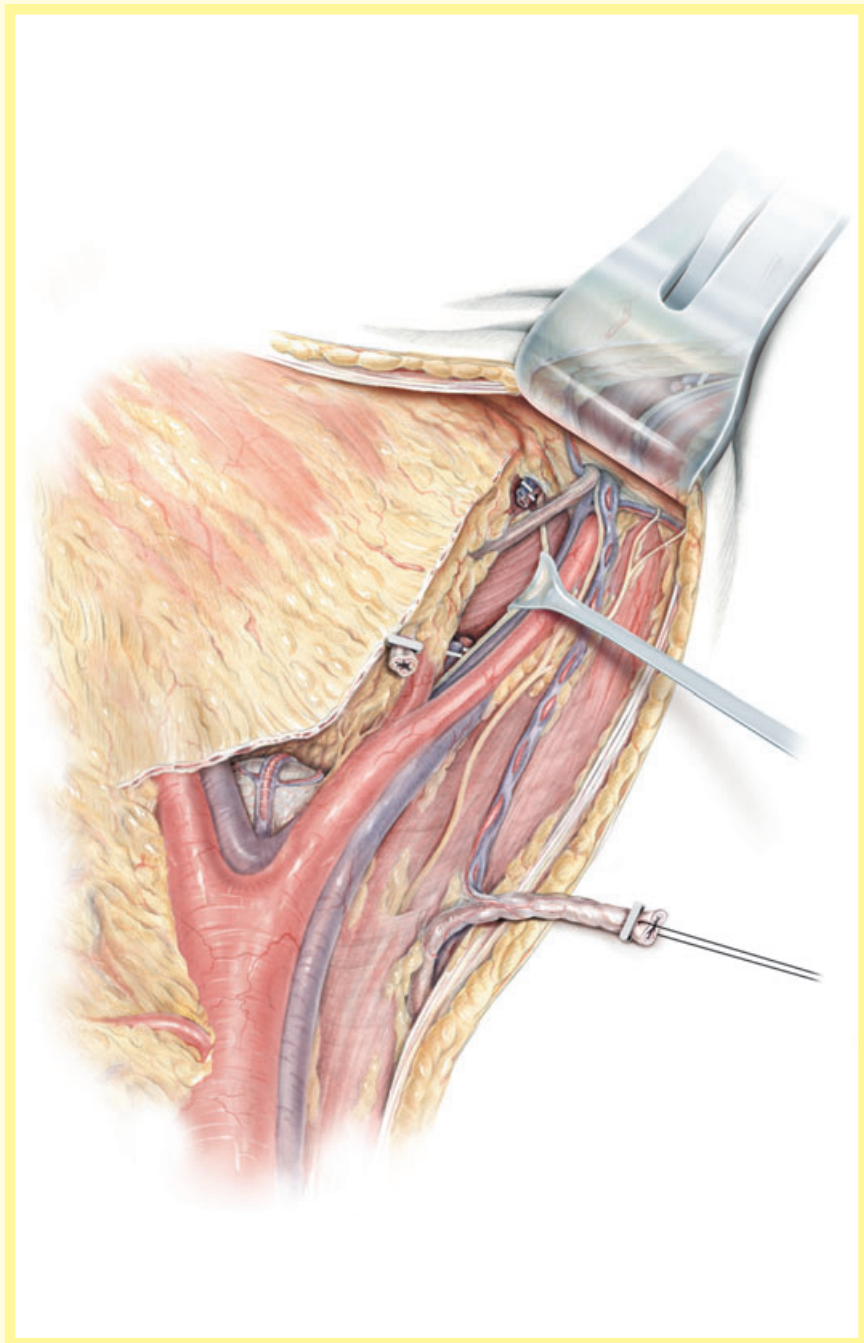


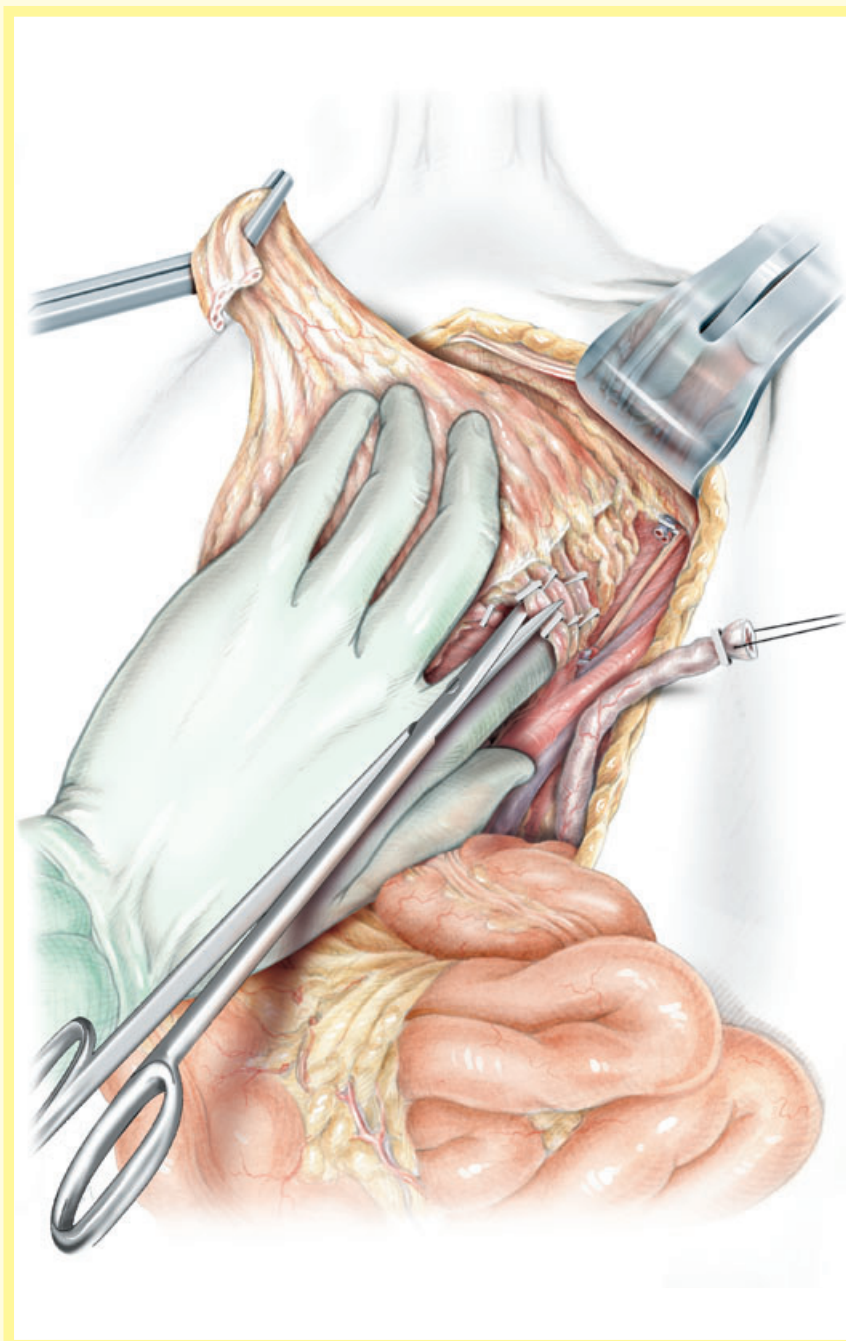
**Figure 8**

At this point the lymphatic tissue surrounding the iliac vessels are composed of a medial and lateral component attached only at the base within the obturator fossa. The lateral lymphatic compartment (freed medially from the vessels and laterally from the psoas) is bluntly swept into the obturator fossa by retracting the iliac vessels medially, and passing a small gauze sponge lateral to the vessels along the psoas and pelvic side-wall. This sponge should be passed anterior and distal to the hypogastric vein, directed caudally into the obturator fossa. The external iliac vessels are then elevated and retracted laterally, and the gauze sponge carefully withdrawn from the obturator fossa with gentle traction using the left hand. This manoeuvre effectively sweeps all lymphatic tissue into the obturator fossa, and facilitates identification of the obturator nerve deep to the external iliac vein.

Figure 9

The obturator nerve is best identified proximally, and carefully dissected free from all lymphatics. The obturator nerve is then retracted laterally along with the iliac vessels. At this point, the obturator artery and vein should be carefully entrapped between the index finger (medial to the obturator nerve) laterally and the middle finger medially with the left hand. This isolates the obturator vessels exiting the obturator canal along the pelvic floor. These vessels are then carefully clipped and divided ensuring that they stay medial to the obturator nerve. The obturator lymph node packet is then swept medially toward the side-wall of the bladder, ligating small tributary vessels and lymphatics from the pelvic side-wall. The nodal packet will be removed en bloc with the cystectomy specimen.



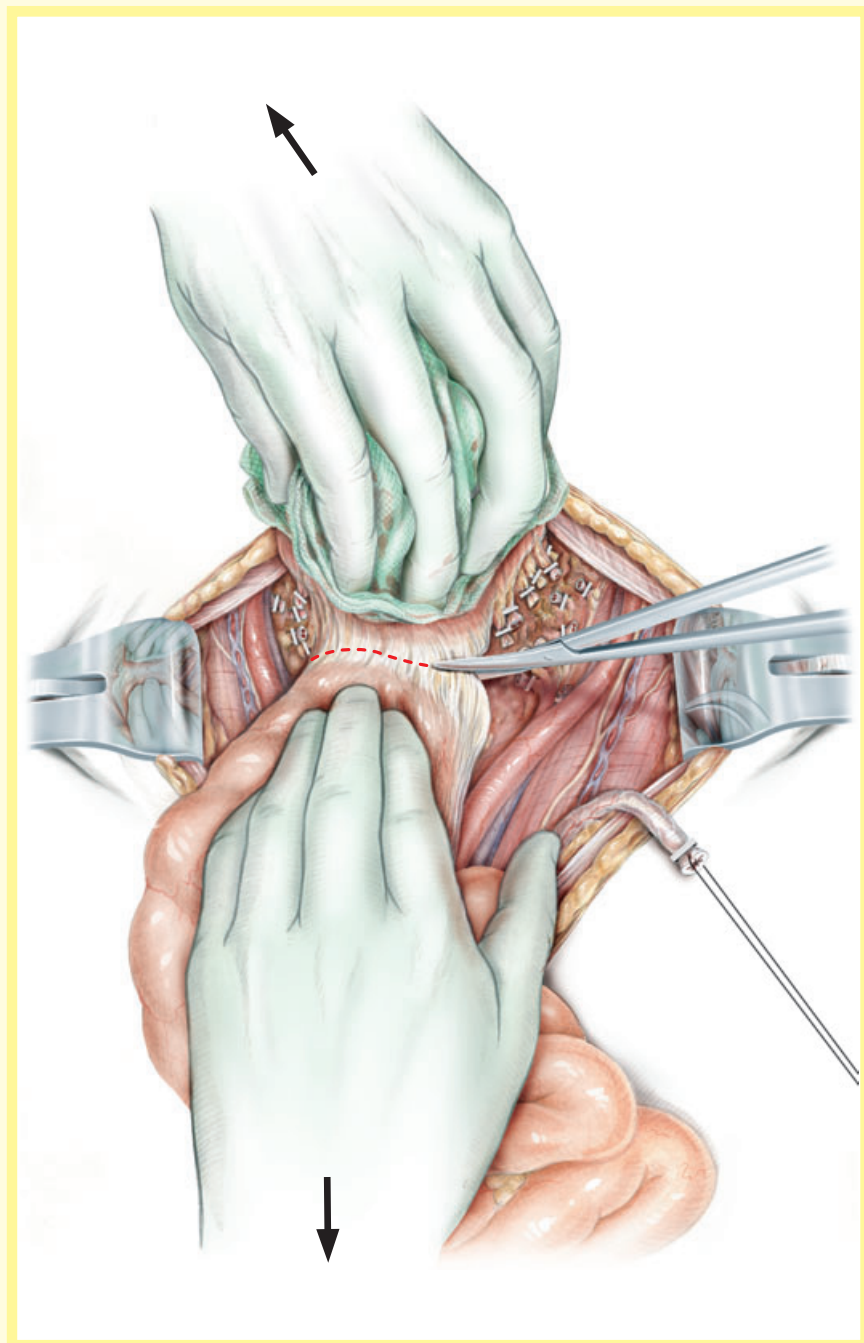
**Figure 10**

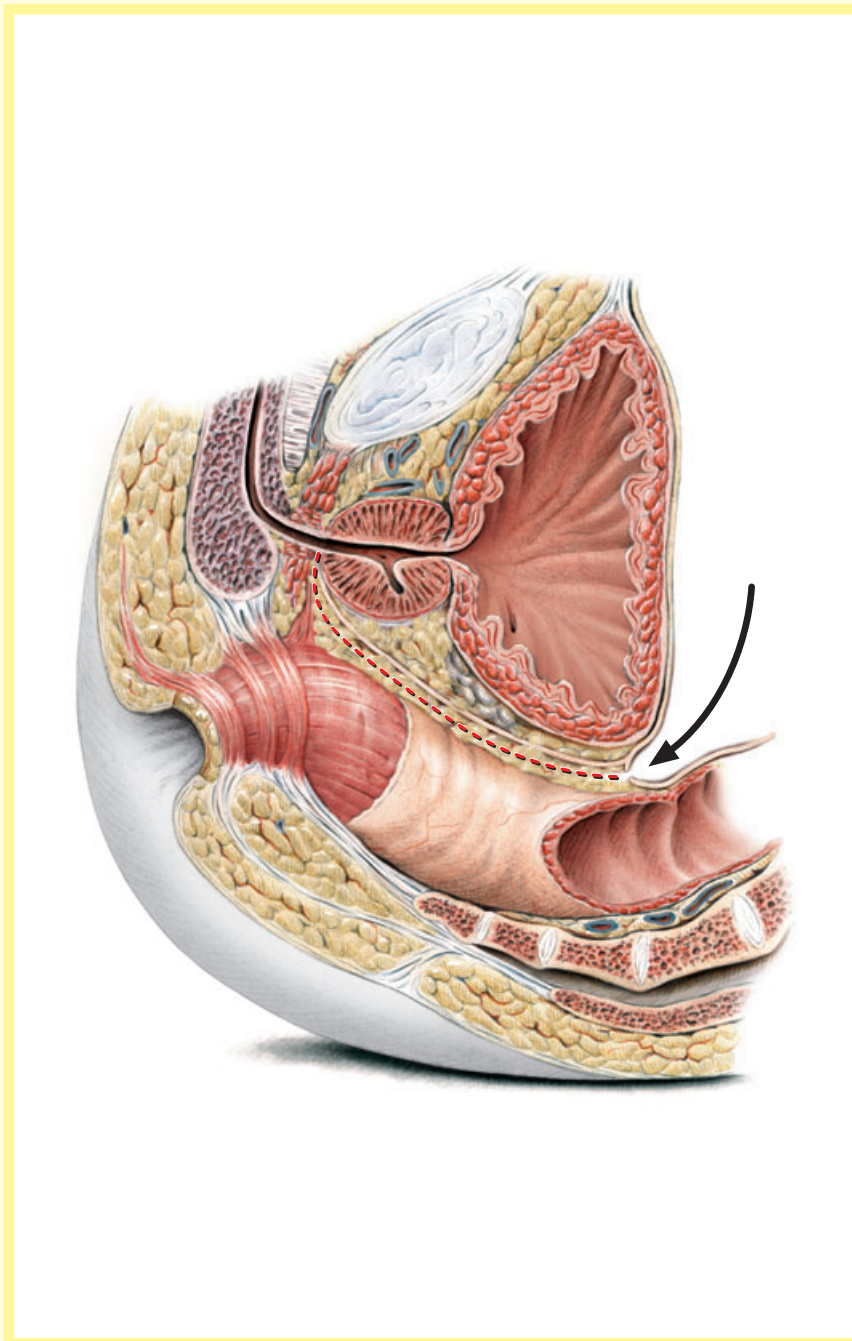
After dissecting the obturator fossa and dividing the obturator vessels, the lateral vascular pedicle to the bladder is isolated and divided. Developing this plane isolates the lateral vascular pedicle to the bladder, a critical manoeuvre in a safe cystectomy with proper vascular control. The lateral vascular pedicle is isolated using the left hand. The bladder is retracted toward the pelvis, placing traction and isolating the anterior branches of the hypogastric artery. The left index finger is passed medial to the hypogastric artery, posterior to the anterior visceral branches, and lateral to the previously transected ureter. The index finger is directed caudally toward the endopelvic fascia, parallel to the sweep of the sacrum. This manoeuvre defines the two major vascular pedicles to the anterior pelvic organs, i.e. the lateral pedicle, anterior to the index finger and composed of the visceral branches of the anterior hypogastric vessel, and the posterior pedicle, posterior to the index finger and composed of the visceral branches between the bladder and rectum.

With the lateral pedicle entrapped between the left index and middle fingers, firm traction is applied vertically and caudally. This facilitates identification and allows individual branches off the anterior portion of the hypogastric artery to be isolated. The posterior division of the hypogastric artery including the superior gluteal, ilio-lumbar and lateral sacral arteries are preserved to avoid gluteal claudication. Distal to this posterior division the hypogastric artery may be ligated for vascular control, but should not be divided as the lateral pedicle is easier to dissect if left in continuity. The largest and most consistent anterior branch to the bladder, the superior vesical artery, is usually isolated and individually ligated and divided easily. The remaining anterior branches of the lateral pedicle are then isolated and divided between haemoclips down to the endopelvic fascia, or as far as is technically possible. With blunt dissection the index finger of the left hand helps to identify this lateral pedicle, and protects the rectum as it is pushed medially. Right-angled haemoclip applicators are ideally suited for properly placing the clips. Each pair of haemoclips is positioned as far apart as possible to ensure that 0.5–1 cm of tissue projects beyond each clip when the pedicle is divided. This prevents the haemoclips from being dislodged, resulting in unnecessary bleeding. Occasionally, in patients with abundant pelvic fat, the lateral pedicle may be thick and require dividing into two manageable pedicles. The inferior vesicle vein serves as an excellent landmark, as the endopelvic fascia is just distal to this structure. The endopelvic fascia just lateral to the prostate may then be incised, which helps to identify the distal limit of the lateral pedicle.

Figure 11

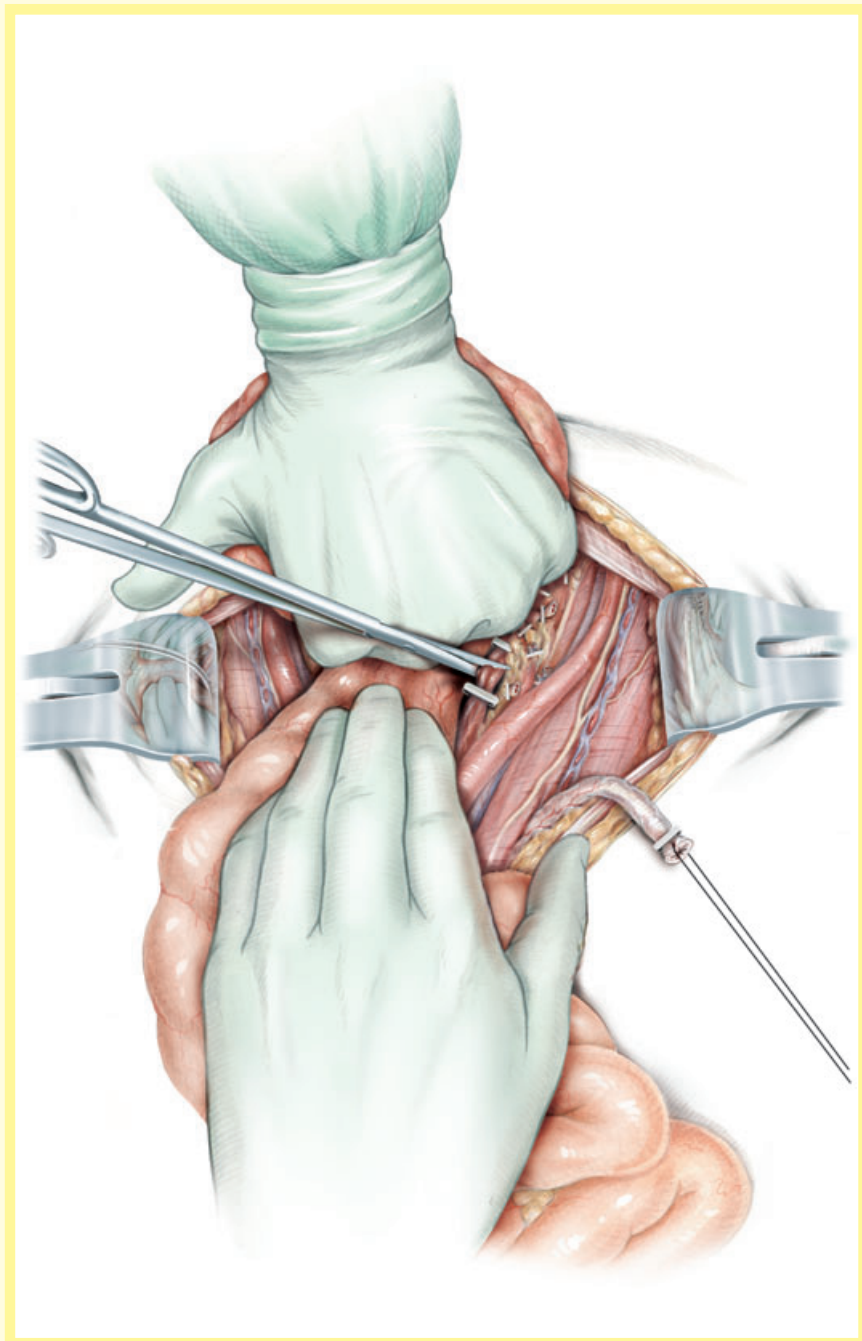
After dividing the lateral pedicles the bladder specimen is retracted anteriorly, exposing the cul-de-sac (pouch of Douglas). The surgeon elevates the bladder with a small gauze sponge under the left hand, while the assistant retracts on the peritoneum of the rectosigmoid colon in a cephalad direction. This provides excellent exposure to the recess of the cul-de-sac, and places the peritoneal reflection on traction, facilitating the proper division. The peritoneum lateral to the rectum is incised, and extended anteriorly and medially across the cul-de-sac to join the incision on the contralateral side.

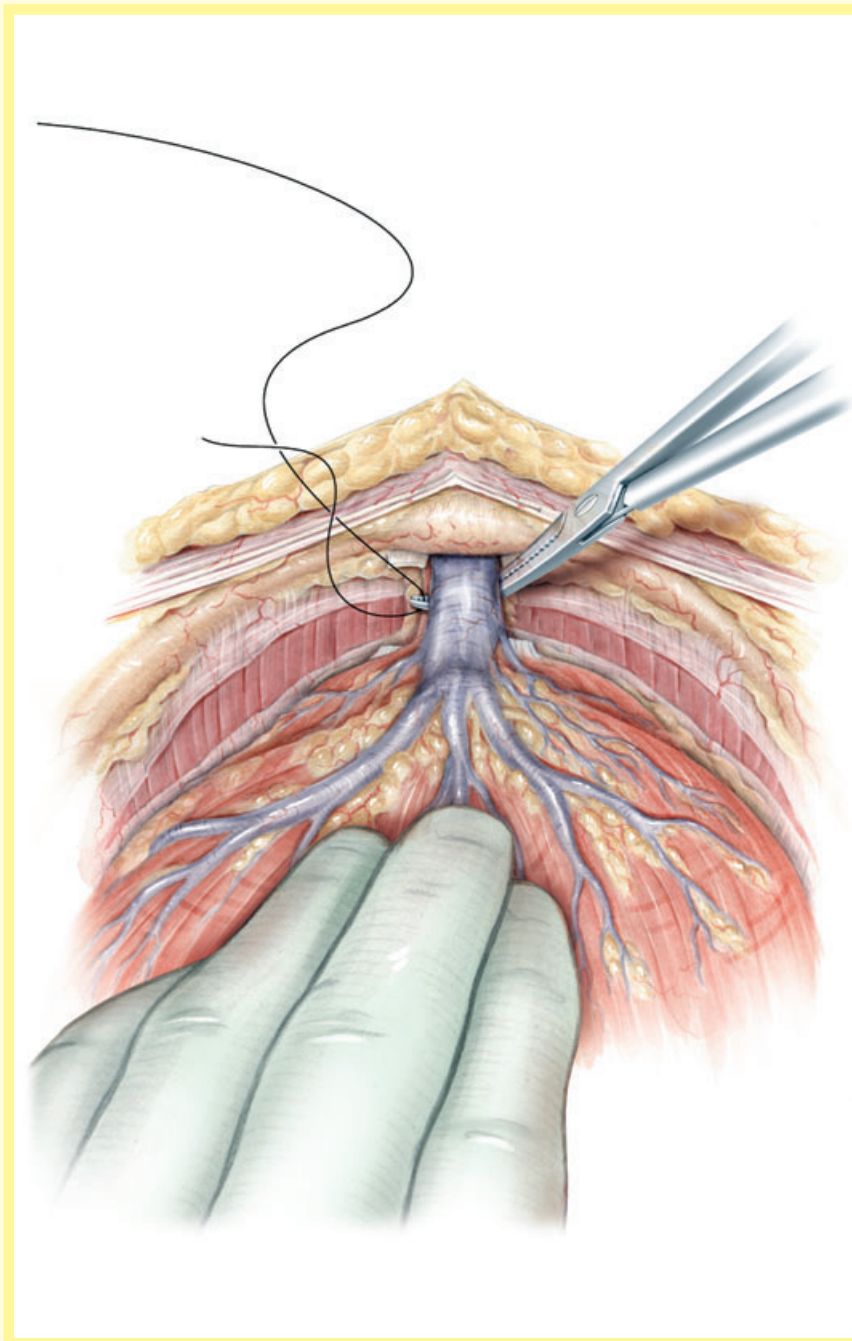


**Figure 12**

An understanding of the fascial layers is critical for the appropriate dissection of this plane. The anterior and posterior peritoneal reflections converge in the cul-de-sac to form Denonvilliers' fascia, which extends caudally to the urogenital diaphragm (large arrow). This important anatomical boundary in the male separates the prostate and seminal vesicles anterior to the rectum posteriorly. The plane between the prostate and seminal vesicles, and the anterior sheath of Denonvilliers' fascia, will not develop easily. However, the plane between the rectum and the posterior sheath of Denonvilliers' fascia (Denonvilliers' space) should develop easily with blunt and sharp dissection. Therefore, the peritoneal incision in the cul-de-sac must be made slightly on the rectal side rather than the bladder side. This allows proper and safe entry and development of Denonvilliers' space between the anterior rectal wall and the posterior sheath of Denonvilliers' fascia.

Once the posterior pedicles have been defined, they are clipped and divided to the endopelvic fascia in the male patient. The endopelvic fascia is then incised adjacent to the prostate, medial to the levator ani muscles (if not done previously), to facilitate the apical dissection. In the female patient, the posterior pedicles including the cardinal ligaments are divided 4–5 cm beyond the cervix. With cephalad pressure on a previously placed vaginal sponge stick, the apex of the vagina can be identified, and incised posteriorly just distal to the cervix. The vagina is then circumscribed anteriorly with the cervix attached to the cystectomy specimen. If there is concern about an adequate surgical margin at the posterior or base of the bladder, then the anterior vaginal wall should be removed en bloc with the bladder specimen, subsequently requiring vaginal reconstruction if sexual function is desired.



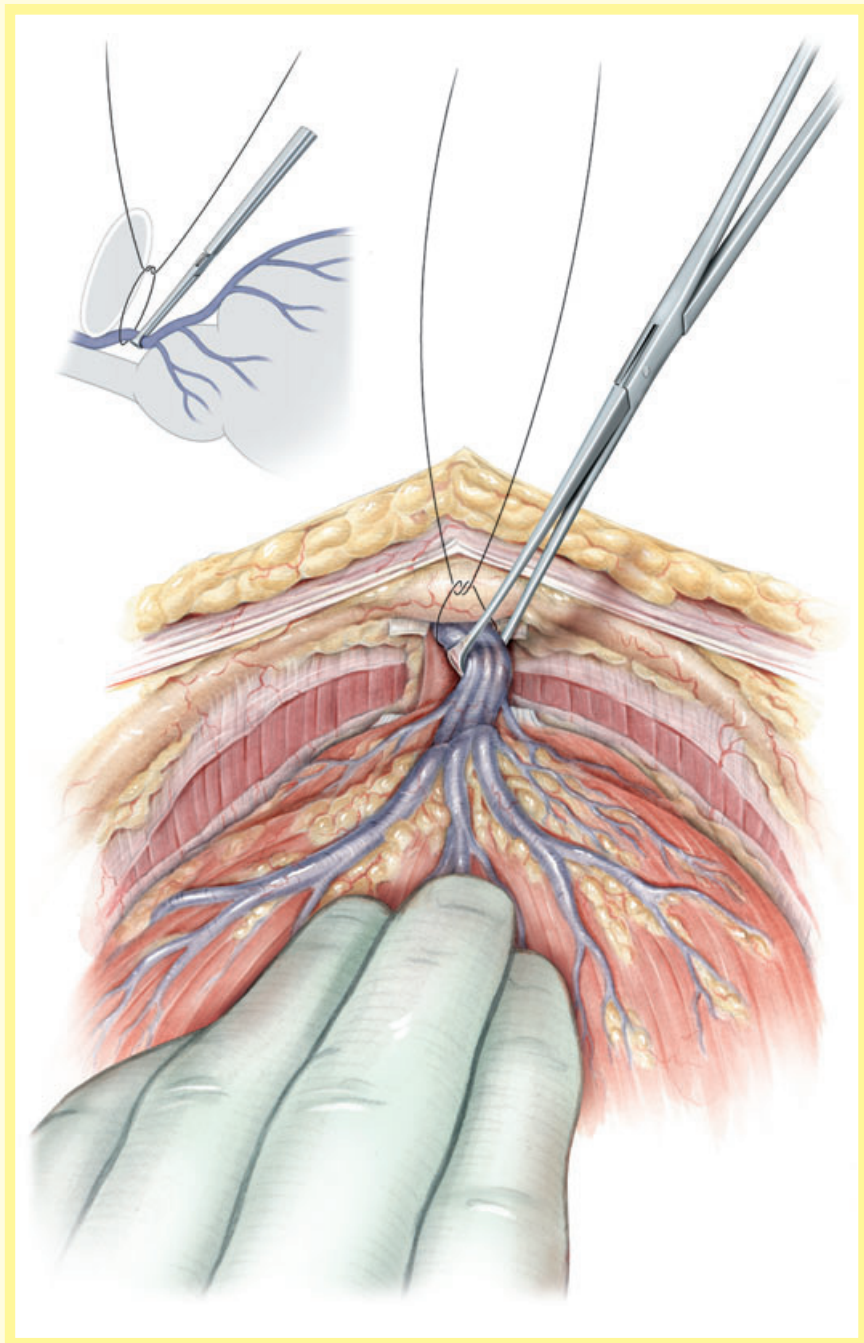
**Figure 14**

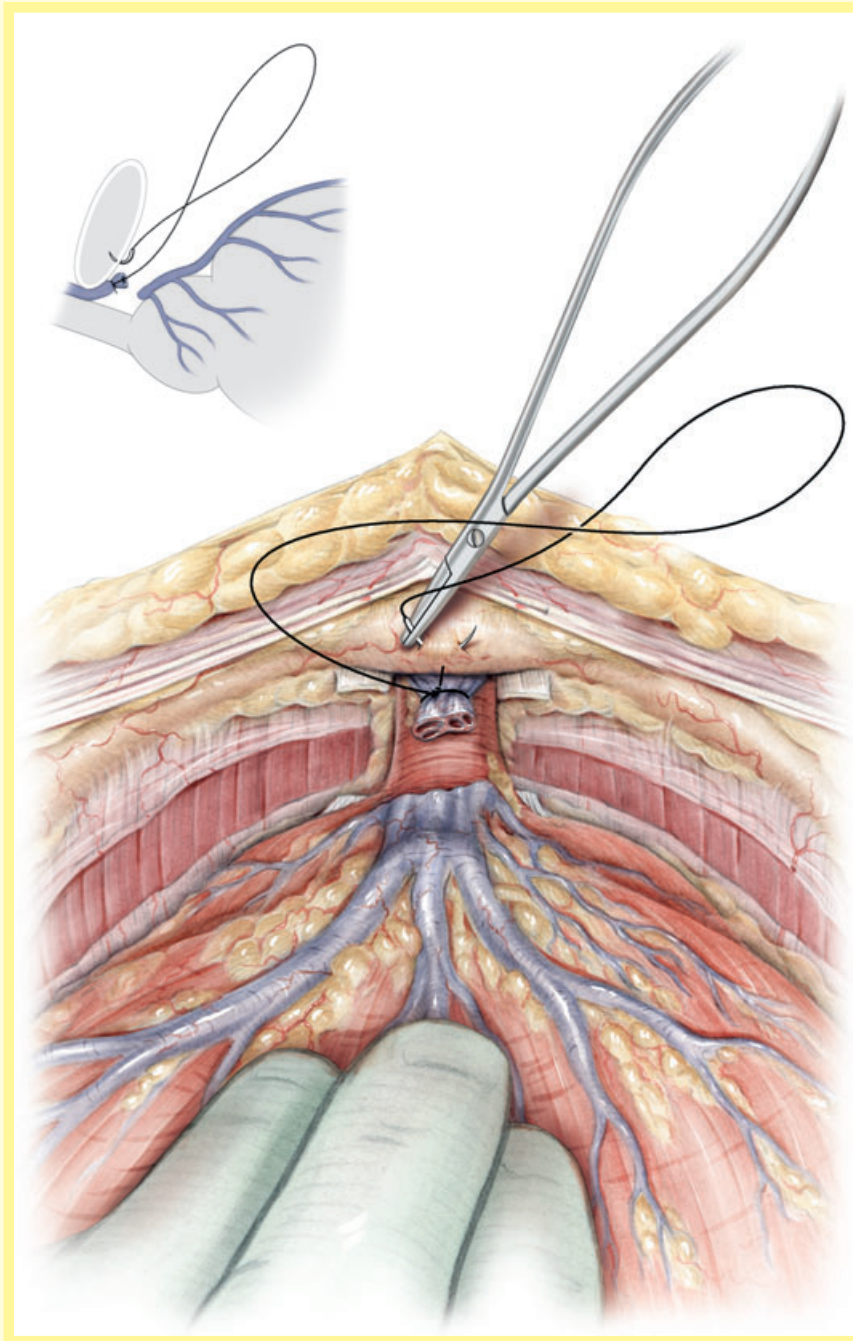
Only after the cystectomy specimen is completely freed and mobile posteriorly is attention directed anteriorly to the pelvic floor and urethra. All fibro-areolar connections between the anterior bladder wall, prostate, and undersurface of the pubic symphysis are divided. The endopelvic fascia is incised adjacent to the prostate and the levator muscles are carefully swept off the lateral and apical portions of the prostate. The superficial dorsal vein is identified, ligated and divided. With tension placed posteriorly on the prostate, the puboprostatic ligaments are identified, and only slightly divided just beneath the pubis, lateral to the dorsal venous complex which courses between these ligaments. Care should be taken to avoid any extensive dissection in this region along the pelvic floor. The puboprostatic ligaments need only to be incised enough to allow for a proper apical dissection of the prostate. The apex of the prostate and membranous urethra now becomes palpable.

Several methods can be used to properly control the dorsal venous plexus. An angled clamp can be carefully passed beneath the dorsal venous complex, anterior to the urethra. The venous complex can then be ligated with a 2-0 absorbable suture, and divided close to the apex of the prostate. If any bleeding occurs from the transected venous complex, it can be oversutured with an absorbable (2-0 polyglycolic acid) suture.

Figure 15

In a slightly different fashion, the dorsal venous complex may be gathered at the apex of the prostate with a long Allis clamp. This may help to better define the plane between the dorsal venous complex and anterior urethra. A figure-of-eight 2-0 absorbable suture can then be placed under direct vision anterior to the urethra (distal to the apex of the prostate) around the gathered venous complex. This suture is best placed with the surgeon facing the head of the table and holding the needle driver perpendicular to the patient. The suture is then tagged with a haemostat. This manoeuvre avoids the unnecessary passage of any instruments between the dorsal venous complex and rhabdosphincter, which could potentially injure these structures and compromise the continence mechanism.



**Figure 16**

After the complex has been ligated it can be sharply divided, with excellent exposure to the anterior surface of the urethra. Once the venous complex has been severed the suture can be used to further secure the complex. The suture is then used to suspend the venous complex anteriorly to the periosteum to help re-establish anterior fixation of the dorsal venous complex and puboprostatic ligaments. This may enhance the recovery of continence. The anterior urethra is now exposed.

Regardless of the above technique to control the dorsal venous complex, the urethra is then incised 270° just beyond the apex of the prostate. A series of 2–0 polyglycolic acid sutures is placed in the anterior urethra, carefully incorporating only the mucosa and submucosa of the striated urethral sphincter muscle anteriorly, the urethra incorporating the rectourethralis muscle or the caudal extent of Denonvilliers' fascia posteriorly. After this the posterior urethra is divided and the specimen removed.

Alternatively, the dorsal venous complex can be sharply transected without securing vascular control of the dorsal venous complex. Cephalad traction on the prostate elongates the proximal and membranous urethra, and allows the urethra to be skeletonized laterally by dividing the so-called 'lateral pillars', extensions of the rhabdosphincter. The anterior two-thirds of the urethra is divided, exposing the urethral catheter. The urethral sutures are then placed; six 2–0 polyglycolic acid sutures are placed equally spaced into the urethral mucosa and lumen anteriorly. The rhabdosphincter, the edge of which acts as a hood overlying the dorsal venous complex, is included in these

sutures if the dorsal venous complex was sharply incised. This manoeuvre compresses the dorsal vein complex against the urethra for haemostatic purposes. The urethral catheter is then drawn through the urethrotomy, clamped on the bladder side, and divided. Cephalad traction on the bladder side with the clamped catheter occludes the bladder neck, prevents tumour spill from the bladder, and provides exposure to the posterior urethra. Two additional sutures are placed in the posterior urethra, again incorporating the rectourethralis muscle or distal Denonvilliers' fascia. The posterior urethra is then divided and the specimen removed. Bleeding from the dorsal vein is usually minimal at this point. If additional haemostasis is required, one or two anterior urethral sutures can be tied to stop the bleeding. Regardless of the technique, frozen-sections of the distal urethral margin of the cystectomy specimen are then analysed, to exclude tumour involvement.

If a cutaneous form of urinary diversion is planned the urethral preparation is slightly modified. Once the dorsal venous complex is secured and divided, the anterior urethra is identified. The urethra is mobilized from above as far distally as possible into the pelvic

diaphragm. With cephalad traction, the urethra is stretched above the urogenital diaphragm, a curved clamp is placed as distal on the urethra as feasible, and divided distal to the clamp. Care must be taken to avoid rectal injury with this clamp. This is prevented by placing gentle posterior traction with the left hand or index finger on the rectum and ensuring the clamp is passed anteriorly. The specimen is then removed. Mobilization of the urethra as distally as possible facilitates a late urethrectomy should it be necessary. The levator musculature can then be re-approximated along the pelvic floor to facilitate haemostasis.

The wide female pelvis allows for better anterior exposure, particularly at the vesico-urethral junction. However, urologists may be less familiar with pelvic surgery in women than in men. In addition, paravaginal vascular control may be troublesome in women, and the venous plexus anterior to the urethra is less well defined in women. When considering orthotopic diversion in female patients undergoing cystectomy, several technical issues are critical to the procedure to maintain the continence mechanism in these women.

Figure 17

When developing the posterior pedicles the posterior vagina is incised at the apex just distal to the cervix. This incision is carried anteriorly along the lateral and anterior vaginal wall forming a circumferential incision.

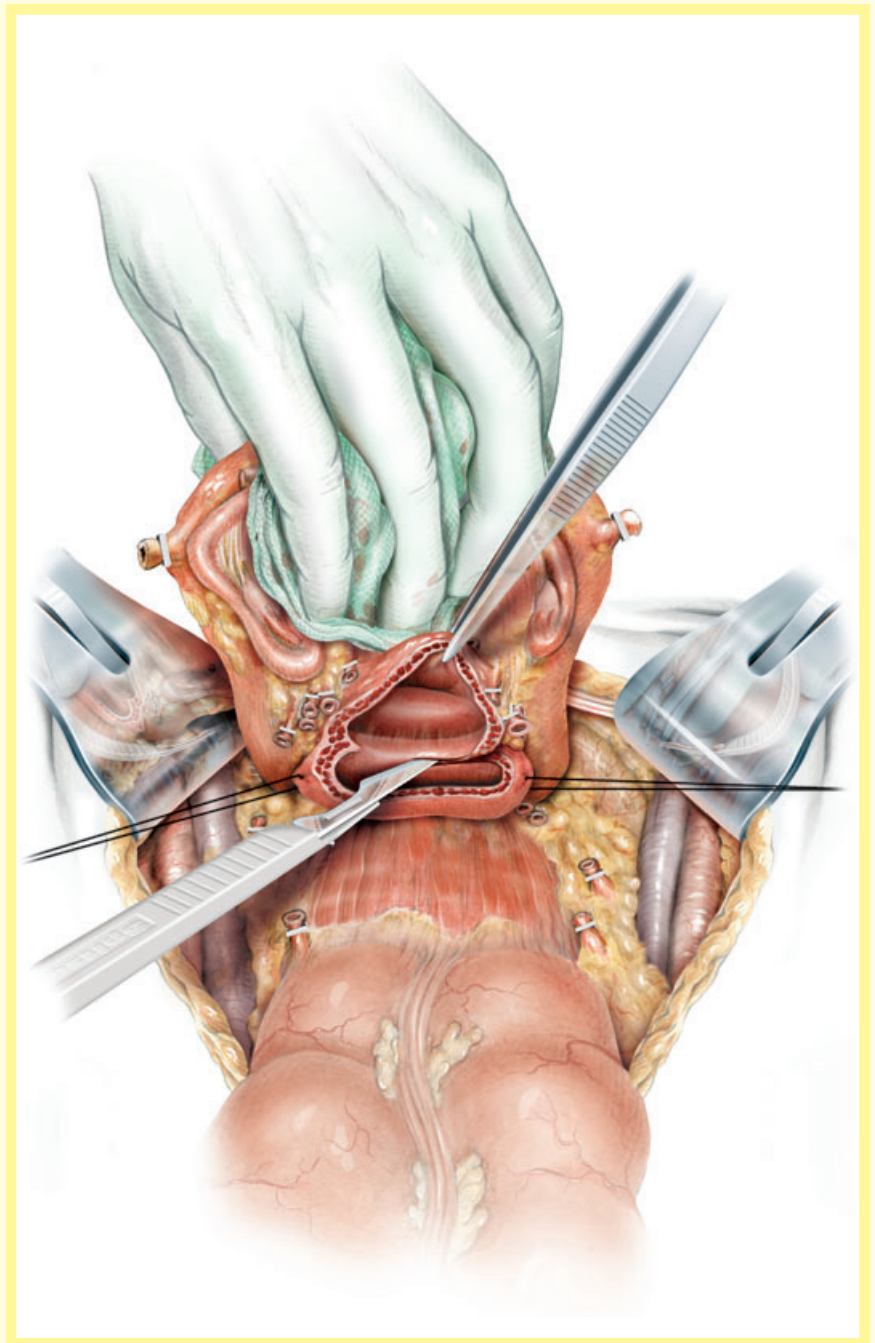


Figure 18

The anterior lateral vaginal wall is then grasped with curved Kocher clamps. This provides counter-traction, and facilitates dissection between the anterior vaginal wall and the bladder specimen. Careful dissection of the proper plane will prevent entry into the posterior bladder and reduce the amount of bleeding in this vascular area. This posterior plane and vascular pedicle are best developed sharply and carried just distal to the vesico-urethral junction. Palpation of the Foley catheter balloon assists in identifying this region. This dissection effectively maintains a functional vagina.

In the case of a deeply invasive posterior bladder tumour in a women, with concern of an adequate surgical margin, the anterior vaginal wall should be removed en bloc with the cystectomy specimen. After dividing the posterior vaginal apex, the lateral vaginal wall subsequently serves as the posterior pedicle and is divided distally. This leaves the anterior vaginal wall attached to the posterior bladder specimen. The Foley catheter balloon again facilitates identification of the vesico-urethral junction. The surgical plane between the vesico-urethral junction and the anterior vaginal wall is then developed distally at this location. A 1-cm length of proximal urethra is mobilized while the remaining distal urethra is left intact with the anterior vaginal wall. Vaginal reconstruction by a clam shell (horizontal), or side-to-side (vertical) technique is required. Other means of vaginal reconstruction may include a rectus myocutaneous flap, detubularized cylinder of ileum, a peritoneal flap, or an omental flap.

No dissection should be used anterior to the urethra along the pelvic floor. The endopelvic fascia should remain undisturbed and not opened in women considering orthotopic diversion. This prevents injury to the rhabdosphincter region and corresponding innervation, which is critical in maintaining the continence mechanism. Anatomical studies show that the innervation to this rhabdosphincter region in women arises from branches off the pudendal nerve that course along the pelvic floor posterior to the levator muscles [20,21]. Any dissection anteriorly may injure these nerves and compromise the continence status.

When the posterior dissection is completed (ensuring to dissect just distal to the vesico-urethral junction), a Statinski vascular clamp is placed across the bladder neck. This clamp placed across the catheter at the bladder neck prevents any tumour spill from the bladder. With gentle traction the proximal urethra is completely divided anteriorly, distal to the bladder neck and clamp.

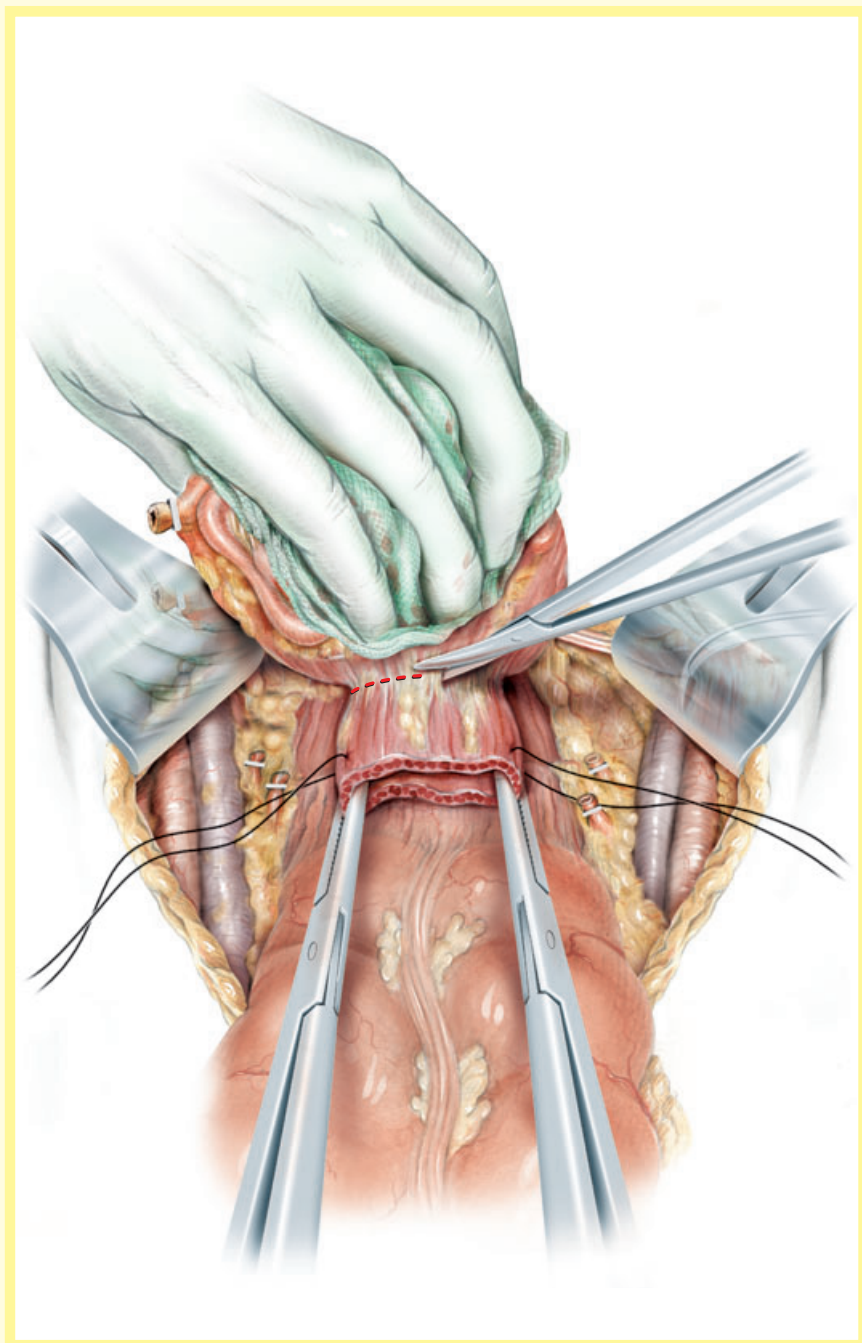


Figure 19

The female urethra is situated more anteriorly than in men, and the urethral sutures can be placed easily after the specimen is completely removed. In all, 10–12 sutures are placed. Frozen sections are analysed from the distal urethral margin of the cystectomy specimen to exclude tumour. Once haemostasis is obtained the vaginal cuff may be closed in two layers with absorbable sutures. The vaginal cuff is then anchored via a colposacropexy using a strut of Marlex mesh to the sacral promontory. This fixes the vagina without angulation or undue tension.

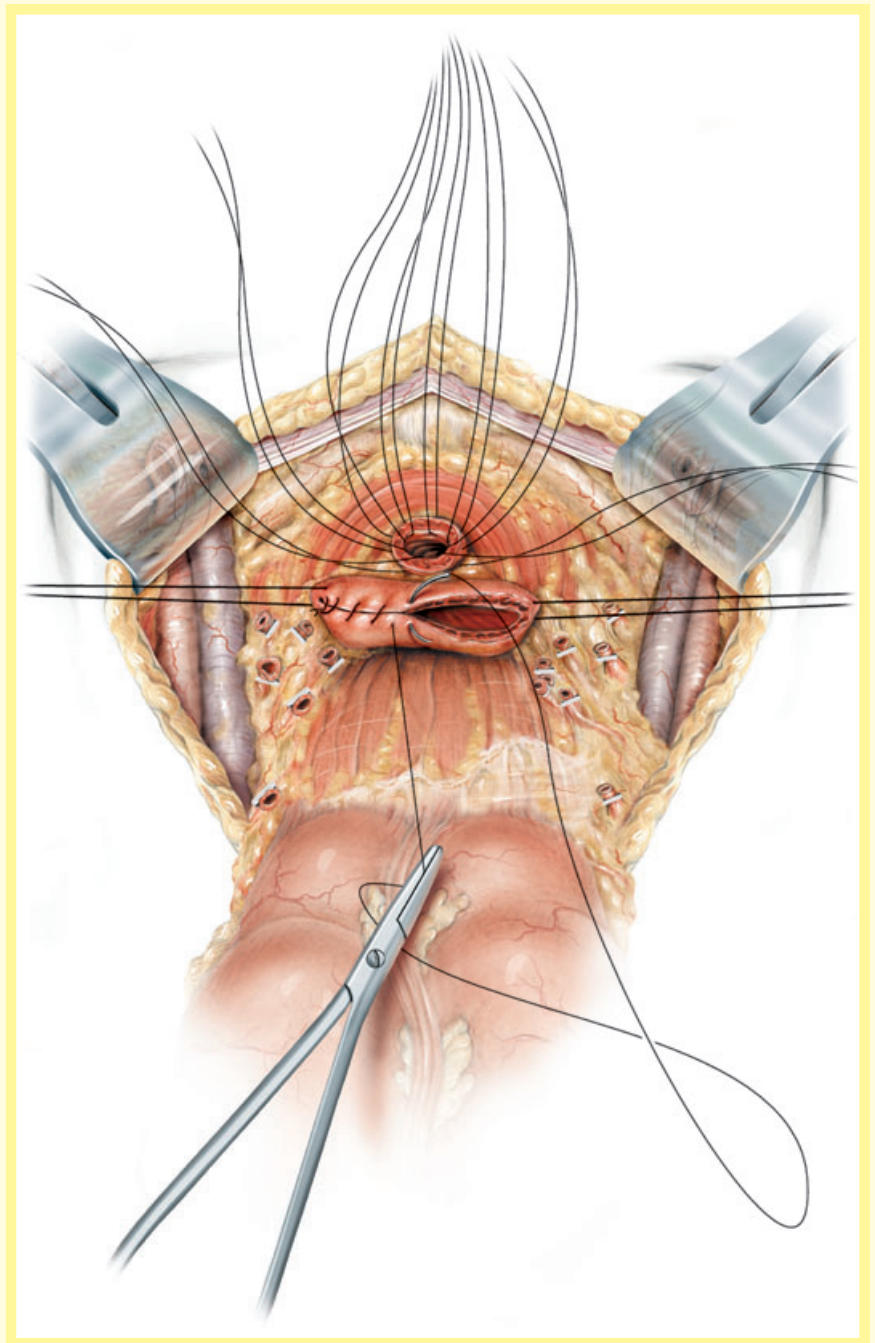
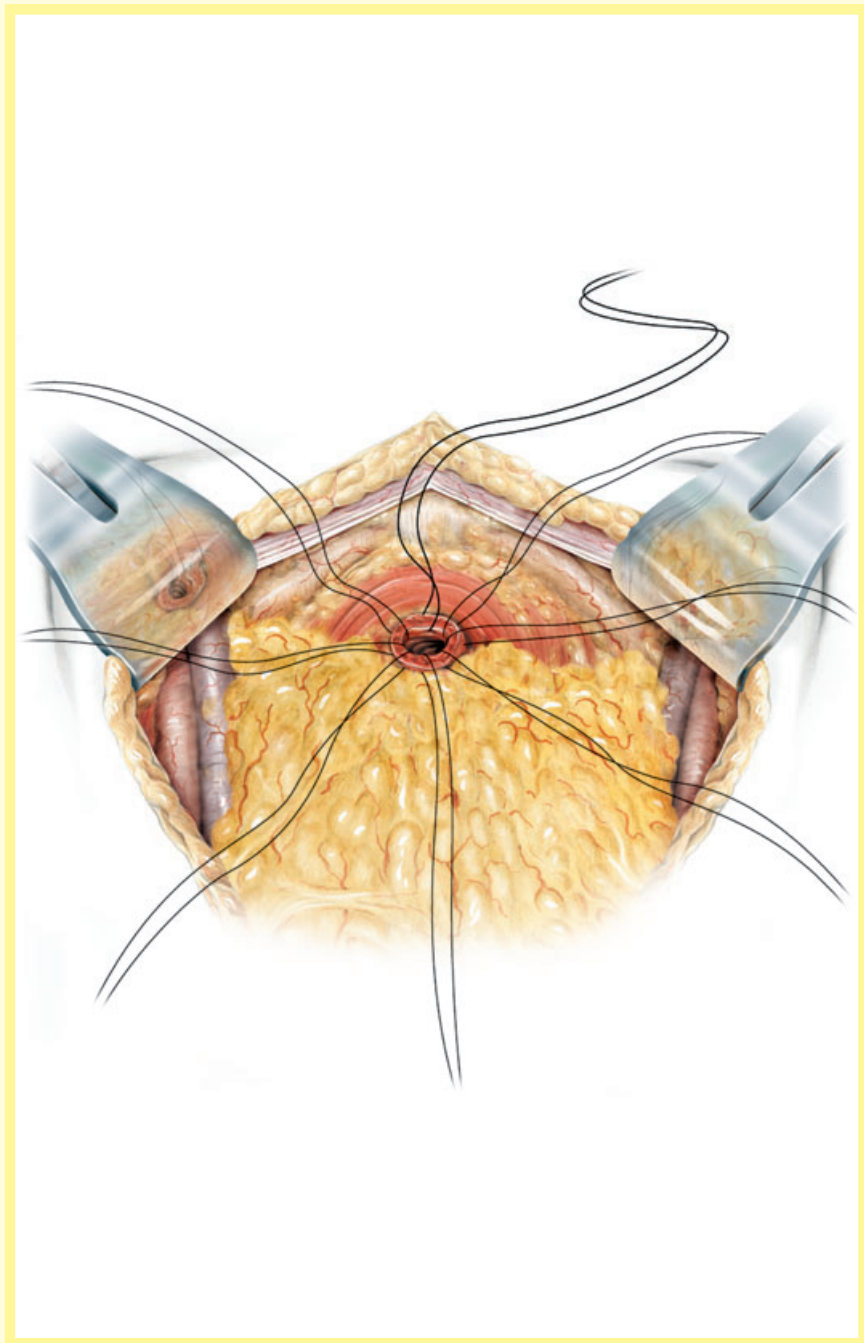


Figure 20

At the terminal part of the operation a well-vascularized omental pedicle graft is placed between the reconstructed vagina and neobladder, and secured to the levator ani muscles to separate the suture lines and prevent fistula.

If a cutaneous diversion is planned in the female patient the posterior pedicles are developed as previously mentioned. Attention is then directed anteriorly and the pubourethral ligaments are divided. A curved clamp is placed across the urethra, and the anterior vaginal wall is opened distally and incised circumferentially around the urethral meatus. The vaginal cuff is closed as previously described and suspended. Alternatively, a perineal approach made be used for this dissection with complete removal of the entire urethra.

After removing the cystectomy specimen the pelvis is irrigated with warm sterile water. The presacral nodal tissue previously swept off the common iliac vessels and sacral promontory into the deep pelvis is collected, and sent separately for pathological evaluation. Nodal tissue in the pre-sciatic notch, anterior to the sciatic nerve, is also sent for histological analysis. Haemostasis is obtained and the pelvis packed with a lap pad while attention is directed to the urinary diversion.



The use of various tubes and drains after surgery is important. The pelvis is drained for urine or lymph leakage with a 2.5 cm Penrose drain for 3 weeks, and a large suction 'haemovac' drain for evacuating blood for 24 h. A gastrostomy tube with an 18 F Foley catheter is routinely placed, using a modified Stamm technique, which incorporates a small portion of omentum (near the greater curvature of the stomach) interposed between the stomach and the abdominal wall [22]. This provides a simple means to drain the stomach, and prevents the need for an uncomfortable nasogastric tube while the postoperative ileus resolves.

POSTOPERATIVE CARE

A meticulous, team-orientated approach to the care of these generally elderly patients undergoing radical cystectomy helps to reduce perioperative morbidity and mortality. Patients are best monitored in the surgical intensive care unit for at least 24 h or until stable. Careful attention to fluid management is imperative, as third-space fluid loss in these patients can be tremendous and deceiving. Patients with compromised cardiac or pulmonary function may require invasive cardiac monitoring with a pulmonary artery catheter placed before surgery, to precisely ascertain the cardiac response to fluid shifts. A combination of crystalloid and colloid fluid replacement is given on the night of surgery, and converted to crystalloid after 1 day. Prophylaxis against stress ulcer is initiated with an H_2 -blocker. Intravenous broad-spectrum antibiotics are continued in all patients and subsequently converted to oral antibiotics as the diet progresses. Pulmonary toilet is encouraged with incentive spirometry, deep breathing and coughing.

Prophylaxis against deep vein thrombosis is important in these patients undergoing extensive pelvic operations for malignancies. The anticoagulation is initiated in the recovery room with 10 mg of sodium warfarin via a nasogastric or the gastrostomy tube. The daily dose is adjusted to maintain a prothrombin time of 18–22 s. If the prothrombin time is >22 s, 2.5 mg of vitamin K is administered intramuscularly to prevent bleeding. At the authors institution, only intermittent compression stockings are

used, with early aggressive ambulation, with no systemic anticoagulation. Pain control by a patient-controlled analgesic system provides comfort, and enhances deep breathing and early ambulation. If digoxin was given preoperatively it is continued until discharge. The gastrostomy tube is removed after 7 days, or later if bowel function is delayed. The catheter and drain management is specific to the form of urinary diversion. Some patients may develop a prolonged ileus or some other complication which delays the quick return of oral intake. In such circumstances, total parenteral nutrition is wisely instituted earlier rather than later, in which situation the patient may become farther behind nutritionally.

SURGICAL TRICKS

Successful packing of the intestinal contents is an art and prevents their annoying spillage into the operative field. Packing begins by sweeping the right colon and small bowel under the surgeon's left hand along the right side-wall gutter. A moist open lap pad is then swept with the right hand along the palm of the left hand, under the viscera along the retroperitoneum and side-wall gutter. In similar fashion, the left side-wall gutter is packed ensuring not to incorporate the descending or sigmoid colon. The central portion of the small bowel is packed with a third lap pad. A moist rolled towel is then positioned horizontally below the lap pads, but cephalad to the bifurcation of the aorta. Occasionally, before placing the first moist lap pad, a mobile greater omental apron can be used to facilitate packing of the intestinal viscera in a similar fashion to the lap pad. After the bowel has been packed, a wide Deaver retractor is placed with gentle traction on the previous packing to provide cephalad exposure.

PITFALLS OF TECHNIQUE

There are several situations which may impede the proper development of this posterior plane. Most commonly, when the incision in the cul-de-sac is made too far anteriorly, proper entry into Denonvilliers' space is prevented. Improper entry can occur between the layers of Denonvilliers' fascia, or even anterior to this, making the posterior dissection difficult, increasing the risk of

rectal injury. Furthermore, posterior tumour infiltration, or previous high-dose pelvic irradiation, can obliterate this plane, making the posterior dissection difficult. To prevent injury to the rectum in these situations, only sharp dissection should be used under direct vision. To prevent a rectal injury, avoid blunt dissection with the finger in areas where normal tissue planes have been obliterated by previous surgery or radiation. Sharp dissection under direct vision will dramatically reduce the potential for rectal injury. If a rectotomy occurs, a two- or three-layer closure is recommended. A diverting proximal colostomy is not routinely required unless gross contamination occurs, or if the patient has received previous pelvic radiation therapy. If orthotopic diversion or vaginal reconstruction is planned, an omental interposition is recommended to prevent fistulization between suture lines.

SURGEON-TO-SURGEON

When using a salvage procedure after definitive radiation treatment (>5000 rads), pelvic lymphadenectomy is usually not used because of the significant risk of iliac vessel and obturator nerve injury [23].

We prefer to spare the anterior vaginal wall if orthotopic diversion is planned. This eliminates the need for vaginal reconstruction, and helps to maintain the complex musculofascial support system and to prevent injury to the pudendal innervation of the rhabdosphincter proximal urethra, both important components to the continence mechanism in women. The anterior vaginal wall is then sharply dissected off the posterior bladder down to the region of the bladder neck (vesico-urethral junction) which is identified by palpating the Foley catheter balloon. At this point, the specimen remains attached only at the apex in men and vesico-urethral junction in women.

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