# Open Radical Cystectomy

# 24

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## 24.1 Background

In 1962, Drs. Whitmore and Marshall published their series of 230 cases of radical cystectomy for bladder cancer. Following their seminal work, the morbidity and mortality rate for radical cystectomy was reported to be approximately 35 % and 20 %, respectively [1]. Contemporary surgical experience with radical cystectomy is associated with an approximately 10 % early high-grade complication rate and mortality rate as low as 2.5 % [2, 3].

Open radical cystectomy with pelvic lymphadenectomy remains the gold standard for patients with clinically localized muscle-invasive bladder cancer. Other indications for radical cystectomy include carcinoma in-situ (cis) or high-grade tumors refractory to intravesical chemo- or immunotherapy, or recurrent multifocal superficial tumors unable to be managed adequately with repeat transurethral resection [4]. In several large series, the overall recurrence-free survival at 5 years for patients undergoing cystectomy approaches 70 %, ranging from 50 to 60 % for lymph-node positive stage 3 or 4 tumors to 89 % for stage 2 tumors [2, 5]. With the advent of laparoscopic/robotic technology, cystectomy can also be performed using minimally invasive surgical approaches. Robotic-assisted radical cystectomy (RARC) has been shown in retrospective and small prospective trials to be non-inferior to open radical cystectomy [6–10]. Ongoing multi-institutional randomized prospective trials are evaluating whether safety, oncologic control, clinical outcomes, and cost efficacy are comparable between the two techniques [11, 12].

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## 24.2 Preoperative Considerations

### 24.2.1 Staging

After the diagnosis of bladder cancer has been established, patients should undergo complete staging to evaluate for nodal spread and metastases (Fig. 24.1). Relevant laboratory tests include serum liver function tests and alkaline phosphatase to screen for liver and bone metastases. Guidelines vary on using chest X-ray versus

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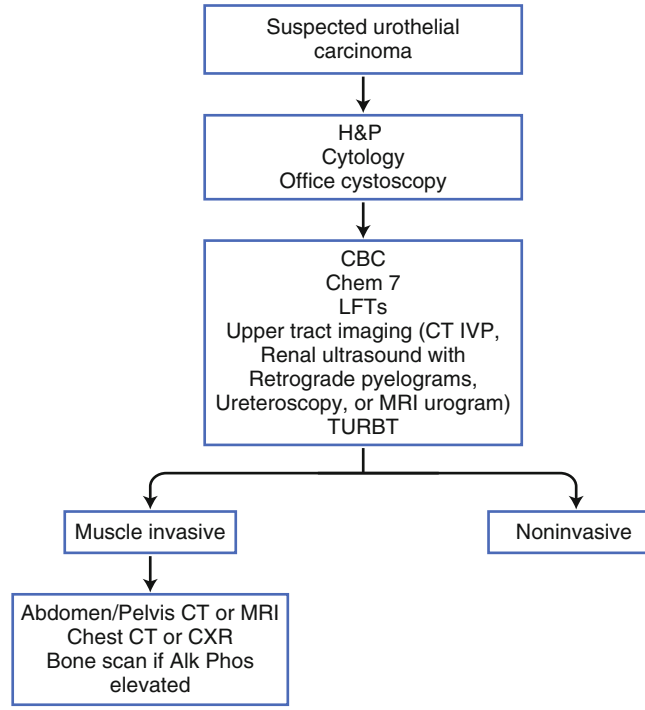


**Fig. 24.1** Evaluation and staging for bladder cancer

computed tomography (CT) for staging evaluation of the chest, but all agree that evaluation for lung metastases is indicated. CT of the abdomen and pelvis should always be obtained to determine whether extravesical extension or lymphadenopathy is present. Positron emission tomography (PET) CT or magnetic resonance imaging (MRI) may also be useful for bladder cancer staging, particularly in instances of non-muscle-invasive disease [13, 14]. Lastly, serum creatinine and calculated glomerular filtration rate (GFR) can provide important information regarding eligibility for certain chemotherapeutic regimens and diversions, as well as being important to obtain baseline values against which to compare long-term renal function post-diversion.

### 24.2.2 Neoadjuvant Treatment Considerations

Preoperative radiation therapy has not been shown to afford surgical candidates any survival benefit, and has not been routinely used since 1979 [15]. However, in instances of extensive comorbidity and poor performance status, endoscopic resection with chemoradiation may be offered for muscle-invasive disease.

The indications for neoadjuvant chemotherapy are discussed in greater detail in "Chapter 30: Management of bladder cancer, role of chemotherapy and controversies surrounding its application" and/or "Chapter 35: Clinical scenario: The role of perioperative chemotherapy." Evidence favors a significant though modest survival benefit from neoadjuvant chemotherapy followed by radical cystectomy compared to radical cystectomy alone, but the optimal regimen, dosing, and schedule remains to be determined [16–19]. Neoadjuvant cisplatin-based chemotherapy combined with external beam radiation may also be useful when considering a bladder-sparing approach for disease management [20, 21]. In carefully selected patients, partial cystectomy has been shown to provide equivalent oncologic outcomes compared to radical cystectomy [22–25]. These patients generally have a solitary lesion located in a suitable location such as the dome of the bladder that can be excised with negative margins, adequate bladder capacity, and no evidence of carcinoma in situ on random bladder biopsies.

### 24.2.3 Type of Diversion

Following the decision to proceed with radical cystectomy, one of the foremost considerations for the patient is the type of diversion: ileal conduit, orthotopic bladder substitution/neobladder, or continent cutaneous reservoir. To date, there are no randomized controlled trials comparing the various types of diversions, and each has its unique sets of characteristics. A careful assessment of a patient's current quality of life and priorities should be weighed. Surgeons should accurately and honestly discuss their respective risks and benefits with the patient, including preoperative and intraoperative patient and tumor-related factors that would preclude one form of diversion or another (Table 24.1).

For instance, a preoperative glomerular filtration rate <35 mL/min is generally accepted as a contraindication to continent diversion due to prolonged contact of urine with bowel [26]. Gastrointestinal conditions, such as Crohn's disease or preexisting short gut syndrome, can be relative contraindications for continent diversion given the longer length of bowel necessary. Men with untreated urethral strictures should not undergo neobladder reconstruction. Tumor extending into the distal prostatic urethra or anterior vagina in females, often diagnosed intraoperatively, would also possibly rule out an orthotopic bladder substitution. Patients who prefer to know definitively what type of diversion they will be receiving can be offered preoperative transurethral biopsies of the bladder neck, prostate in men, and urethra, as this can help determine need for urethrectomy and potential suitability of neobladder reconstruction. However, it is important to keep in mind that the final decision regarding feasibility of an orthotopic bladder substitution is made intraoperatively after frozen section analysis of the distal resection margin. Prior pelvic radiation, once thought to be a contraindication to orthotopic bladder substitution, should not preclude patients from pursuing this option, but patients should be informed that most series report a higher rate of complications in this setting [27, 28].

We recommend that all patients undergoing cystectomy meet with an enterostomal specialist to undergo further counseling regarding pros and cons of each type of diversion, as well as receiving education on postoperative management of specific diversions. All patients who desire continent cutaneous diversion must be able to maintain and perform a consistent schedule of catheterization. Patients undergoing neobladder reconstruction should also be counseled that they may require intermittent catheterization. An optimal stoma site from both a patient and technical perspective is marked before surgery even for patients who choose neobladders, as oncologic findings during surgery may dictate the ultimate form of diversion [29].

### 24.2.4 Preparation for Surgery

The day before surgery, patients are traditionally asked to undergo a mechanical bowel preparation using agents such as oral magnesium citrate or polyethylene glycol, with the goal of having clear stools by that evening to decrease bacterial load and expunge solid fecal contents. It should be noted however that over the last decade, an

**Table 24.1** Contraindications for various forms of urinary diversion

| Contraindications | Neobladder | Continent cutaneous pouch | Ileal conduit |
|---|---|---|---|
| Absolute | Creatinine clearance <35 mL/min<br>Severe hepatic dysfunction<br>TCC in urethral stump<br>Severe urethral stricture | Creatinine clearance <35 mL/min<br>Severe hepatic dysfunction | Short gut (use colon or stomach instead) |
| Relative | Unable/unwilling to self-catheterize<br>Unwilling to follow up regularly<br>Compromised intestinal function<br>Inadequate external sphincter | Unable/unwilling to self-catheterize<br>Unwilling to follow up regularly<br>Compromised intestinal function | |

increasing body of literature suggests that mechanical bowel preparation prior to colorectal and/or intestinal resections may not provide any significant advantage in perioperative outcomes, and may possibly increase the risk of anastomotic leakage, intra-abdominal abscesses and ileus [30]. Patients are also advised to take only a clear liquid diet starting the day before surgery. Patients are instructed to be strictly nil per os (NPO) after midnight, with the exception of routine morning medications. Maintaining hydration is paramount, and patients in whom volume status may be hard to manage at home can be pre-admitted to the hospital the day before surgery for IV hydration and closer monitoring of fluid balance. A type and cross-match is performed with 2 units of packed red blood cells available if needed. Alternate arrangements and contingencies should be made for patients who refuse potential transfusions in accordance with their religious or cultural beliefs. In addition to sequential compression devices, all patients are given subcutaneous heparin immediately prior to surgery for prophylaxis against thromboembolic events.

## 24.3 Surgical Technique and Anatomy

The patient is brought to the operating room and placed supine on the operating table. General anesthesia is induced, an arterial line is inserted, and a nasogastric tube is also placed to help decompress the bowel. The patient is positioned with the iliac crest over the break in the operating table such that flexion of the table allows for hyperextension of the abdomen. The arms may be tucked bilaterally or left abducted in as anatomical a position as possible. All pressure points are adequately padded with egg crate foam or gel pads. Reverse Trendelenburg positioning may also be used to help keep the bowel cephalad and out of the working field. The surgeon should take note of the previously marked stoma site, as a vigorous prep may sometimes wash off the marking. The patient is prepped from the nipples to the midthigh, including the genital region, and draped in sterile fashion. A Foley catheter is then placed sterilely to decompress the bladder.

A vertical midline incision is made from the pubic symphysis, curving at the umbilicus contralateral to the potential stoma site (and even further laterally if an umbilical catheterizable stoma is planned), extending at least 4 cm cephalad. The anterior rectus sheath is identified deep to Camper's and Scarpa's fascia, and incised in the midline. The decussation of fibers in the midline is identified, and the bellies of the rectus muscles are retracted laterally, obviating the need for any division of muscle. The posterior rectus fascia is incised, and the peritoneum entered sharply at the superior portion of the incision. This peritoneal window is carefully enlarged until one hand can be placed in the peritoneal cavity to help protect the bowel contents and assess for any adhesions. Next, the urachus is identified and its origin at the umbilicus is circumscribed. Identification of the lateral umbilical ligaments, through which the inferior epigastric vessels run, will help define the far lateral boundaries of the urachal dissection. A large Babcock or Kelly clamp is placed on this cephalad end for retraction, and the entire urachal remnant is dissected free to be removed en bloc with the cystectomy specimen (Fig. 24.2).

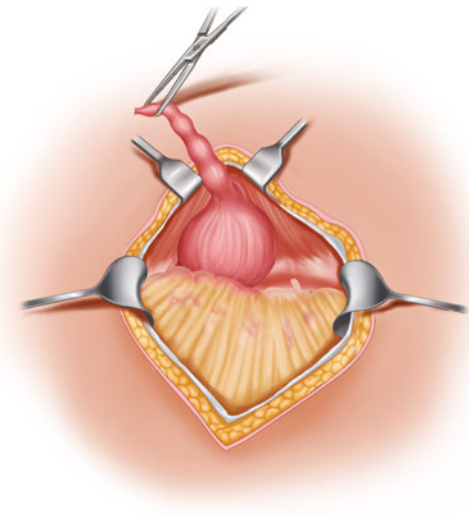

**Fig. 24.2** Dissection of the urachus. Adapted from Weizer AZ, Lee CT. "16: Radical Cystectomy in Women." From Glenn's Urologic Surgery. Eds Graham SD, Keane TE. 7th ed. Lippincott Williams & Wilkins: Philadelphia, 2010; and Stein JP, Skinner DG. Surgical Atlas Radical Cystectomy. BJUI. 2004; 97: 197–221

The entire abdomen is systematically inspected to assess for any visceral metastases. Lysis of adhesions is performed if necessary. In patients undergoing cutaneous catheterizable diversions, inspection of the right colon, terminal ileum, and appendix can be made at this time. Similarly, in patients with a prior history of bowel resection, assessment can be made of prior anastomoses and the adequacy of bowel. At this time, a self-retaining Bookwalter retractor may be placed, and right-angle body wall retractors used to help with exposure.

The avascular white line of Toldt is identified and incised sharply beginning from the cecum and working cephalad, thereby allowing the ascending colon to be reflected medially. Near the hepatic flexure, care is taken to identify the duodenum while mobilizing the mesentery of the small bowel away from it. Similarly, the sigmoid and descending colon are reflected medially by dividing the white line of Toldt up toward the splenic flexure. At this point, a wide space should exist underneath the sigmoid and above the sacrum and iliac vessels, extending as far cephalad as the inferior mesentery artery, through which the left ureter will later be passed (Fig. 24.3). The small bowel and right colon are then packed toward the epigastrum with moist laparotomy pads and malleable blade retractors.

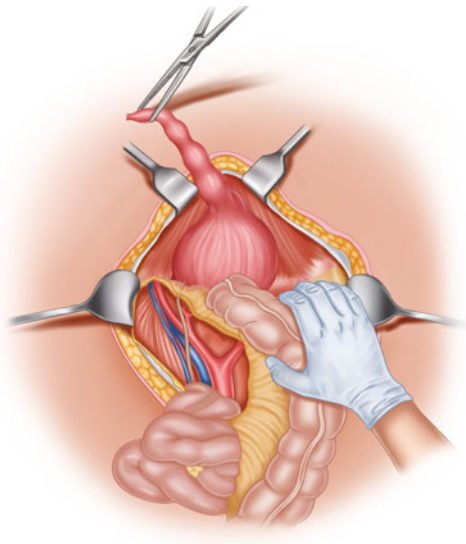

**Fig. 24.3** Creation of mesenteric window for left ureter. Adapted from Stein JP, Skinner DG. Surgical Atlas Radical Cystectomy. BJUI. 2004; 97: 197–221

Next, the ureters are identified at the level of their crossing over the iliac vessels. The ureters are each encircled with a vessel loop, and each is dissected free down toward the ureterovesical junction and cephalad as much as possible. Care is taken to preserve the periadventitial tissue and maintain a healthy vascular supply. As distally as possible, two metal clips are placed to prevent any possible tumor spillage, and the ureter is ligated in between. A cuff of the stay-side ureter distal to the clip may be excised and sent to pathology as a frozen section to assess for tumor or carcinoma in situ at the margin. If transitional cell carcinoma (TCC) or carcinoma in situ (cis) is found at the margin, additional cuffs of ureteral tissue are typically sent until a negative margin is achieved. It is worth noting, however, that the role of sequential ureteral resection for decreasing recurrence is debatable, especially when a pan-urothelial field defect theory is considered [31]. A recent meta-analysis estimates the rate of ureteral upper tract TCC in the setting of high grade muscle-invasive lower tract TCC to be between 0.75 % and 8 % [31, 32]. A clip is generally left on the ureter until the time of ureteroenteric anastomosis in order to allow for temporary passive dilation. In men, the gonadal vessels should be left intact, but in a female patient, the infundibulopelvic ligaments, through which the ovarian vessels run, are ligated at the level of the pelvic inlet. The vas deferens in men and round ligament in women are also clipped and divided.

## 24.4 Male Cystectomy

The lateral pedicle of the bladder is developed, using countertraction provided by a clamp on the urachal remnant to expose the ipsilateral pedicle. The lateral vascular pedicles can be divided using titanium clips, a stapling device with vascular loads, or the Ligasure device. The bladder is then retracted toward the pubis and the rectovesical pouch incised, thereby gaining access to Denonvillier's fascia and allowing for mobilization of the specimen off the rectum via blunt dissection (Fig. 24.4). The bladder, seminal vesicles,

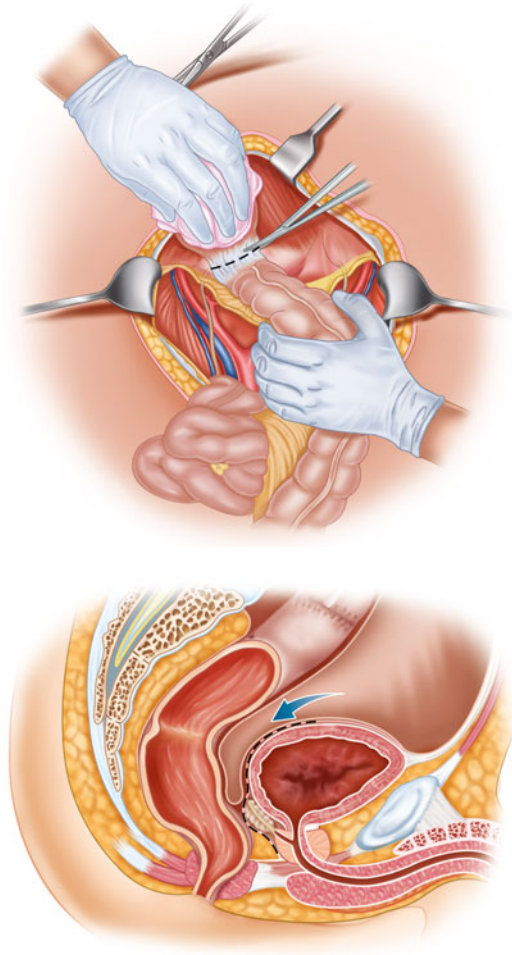

**Fig. 24.4** Accessing Denonvillier's fascia and blunt dissection of the specimen from rectum. Adapted from Ghonheim MA. "15: Radical Cystectomy in Men." from Glenn's Urologic Surgery. Eds Graham SD, Keane TE. 7th ed. Lippincott Williams & Wilkins: Philadelphia, 2010; and Stein JP, Skinner DG. Surgical Atlas Radical Cystectomy. BJUI. 2004; 97: 197–221

and prostate are elevated away from the rectum as far distally as the urogenital diaphragm. The posterior pedicles are ligated using titanium clips or Ligasure. The space of Retzius is developed, and the endopelvic fascia is incised sharply to further expose the prostate (Fig. 24.5). A retropubic approach is used to excise the prostate en bloc with the cystectomy specimen. The dorsal venous complex can be ligated with an endovascular stapler or oversewn as necessary to achieve hemostasis. The urethra is sharply divided. If the patient is undergoing orthotopic substitution, leaving as much functional urethral length as oncologically permitted will improve continence [33]. The cystoprostatectomy specimen is removed en bloc and sent for pathologic analysis. A margin of the urethral stump should be excised and sent to pathology to verify absence of tumor. The pelvis is then carefully inspected for any evidence of rectal injury and bleeding.

## 24.5 Female Cystectomy

Anterior exenteration in a female patient proceeds in a similar fashion. The lateral pedicles of the bladder are defined and ligated. The incision at the pouch of Douglas enables the uterus to be swept anteriorly and the posterior vaginal wall to be separated from the rectum (Fig. 24.6). Posterior pedicles are divided with clips or the Ligasure device. The endopelvic fascia is incised near the posterior urethra. The bladder and uterus are mobilized anteriorly, and the urethra and vagina are divided. Again, a urethral cuff should be sent for frozen section to ensure a negative margin. As with a male cystectomy, preservation of the posterior hypogastric vessels and autonomic nerve fibers is believed to improve continence. Recent literature suggests that leaving the anterior vaginal wall and preservation of an intact vagina also has favorable implications for maintenance of the urethrovaginal sphincter mechanism without increasing positive margin rates [34, 35]. The vaginal cuff should be oversewn with absorbable sutures, providing a watertight closure (Fig. 24.7). Some surgeons may prefer to mobilize a pedicled omental flap to cover the vaginal stump suture line to decrease the possibility of neobladder fistulization. Some data suggest that an omental flap may also help support the neobladder and prevent posterior prolapse and urethro-pouch angulation [36].

Tumor involvement of the bladder neck was once thought to be an absolute contraindication to orthotopic neobladder due to the assumption that the bladder neck provided continence in females, as well as concern for urethral recurrence. However, neuroanatomical studies demonstrated that the rhabdosphincter, located in the distal two-thirds of the urethra, and preservation

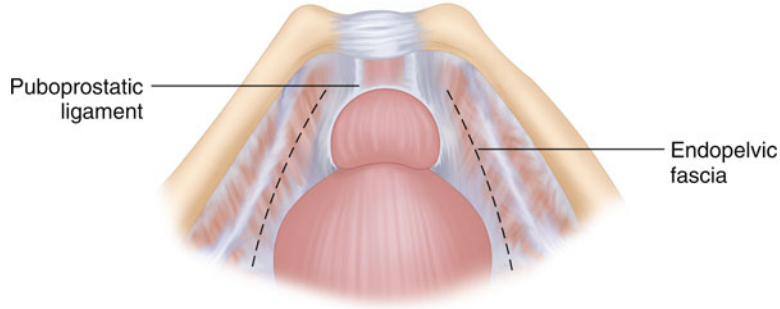


**Fig. 24.5** Incising the endopelvic fascia. Adapted from Touijer K, Guillonneau B, Scardino P, Slawin K. Atlas of Clinical Urology, Volume 3, Chapter 12. LLC: Philadelphia, 2005

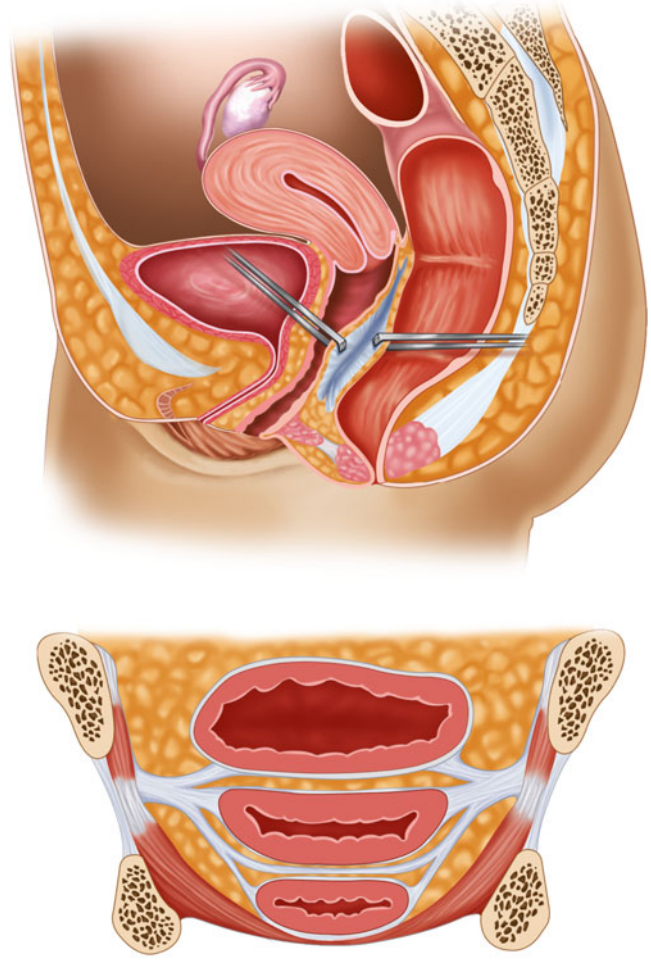

**Fig. 24.6** Incising the pouch of Douglas. Adapted from Stein JP, Skinner DG. Surgical Atlas Radical Cystectomy. BJUI. 2004; 97: 197–221

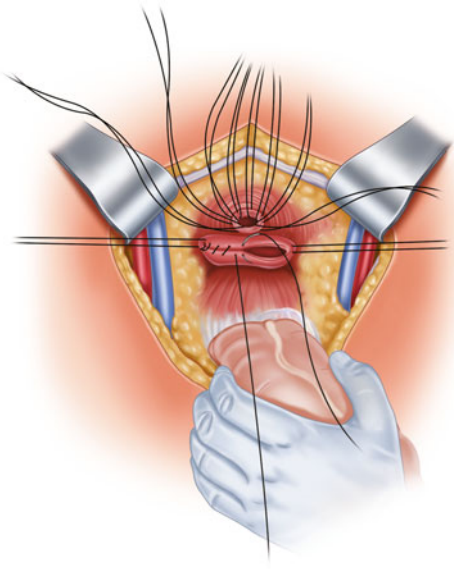

**Fig. 24.7** Oversewing the vaginal stump

of its innervation were key to continence, and not the bladder neck [37]. Bladder neck involvement does however portend a higher risk of urethral recurrence [38].

## 24.6 Lymph Node Dissection

While controversy exists with regard to the anatomic limits of lymphadenectomy, evidence from multiple studies shows that thoroughness of the pelvic lymphadenectomy is associated with improved outcomes and survival vis-a-vis proper staging, but may also provide therapeutic benefit [39–43]. In contrast to colorectal cancer, in which consensus guidelines dictate a minimum yield of 12 lymph nodes, no such thresholds exist for bladder cancer [44]. A series of 322 patients by Herr et al. and a large series of Surveillance, Epidemiology, and End Results (SEER) registry patients suggested that at least ten lymph nodes should be evaluated to have prognostic significance [39, 45]. Stein and Skinner put forth the concept of lymph node density as a prognostic indicator, finding a 10-year recurrence-free survival of 43 % versus 17 % in patients with lymph node densities of 20 % or less and greater than 20 %, respectively [46].

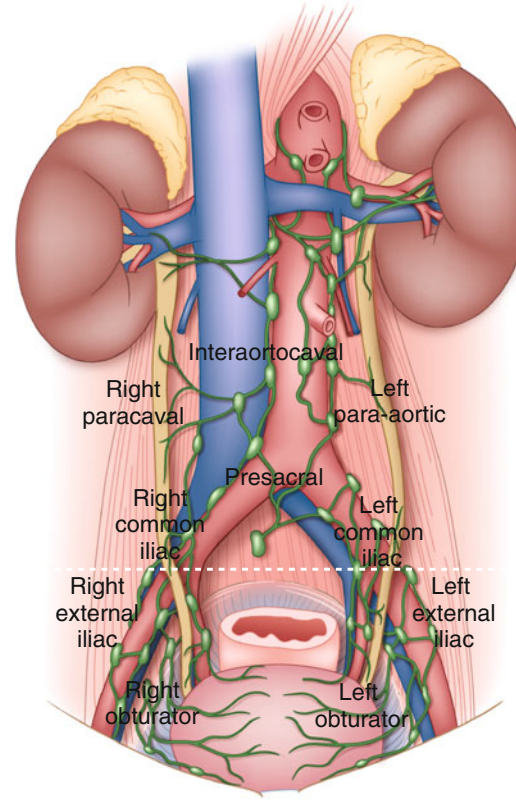


**Fig. 24.8** Extent of standard and extended pelvic lymph node dissection (up to the inferior mesenteric artery)

The boundaries of the standard pelvic lymph node dissection are the bifurcation of the common iliac artery superiorly, the circumflex iliac vein inferiorly including the node of Cloquet, the genitofemoral nerve laterally, and the hypogastric vessels posteriorly. An extended lymph node dissection begins from the inferior mesenteric artery and proceeds caudad as with the standard template. Meticulous care should be taken to clip stay side lymphatic channels to prevent leak and lymphocele formation. Lymph node packets may be sent off separately as common iliac, external iliac, hypogastric, obturator, and presacral/presciatic packets, as studies have shown that individual packets are associated with increased node yield [47, 48]. An extended dissection would include left para-aortic, interaortocaval, and right paracaval packets up to the inferior mesenteric artery (Fig. 24.8) [47]. Further discussion may be found in Chapter 31: The role of pelvic lymphadenectomy at the time of radical cystectomy for bladder cancer.

## 24.7 Diversion

Following bilateral pelvic lymphadenectomy, the remainder of the operation is spent creating the urinary diversion.

### 24.7.1 Ileal Conduit

The previously created window underneath the sigmoid mesentery is located, and the left ureter is passed through toward the right side of the patient. The bowel is unpacked, and a 15-cm segment of terminal ileum, located at least 15 cm proximal to the ileocecal valve, is isolated and inspected to ensure the bowel appears well-vascularized and healthy. The mesentery of the isolated segment is inspected to find an appropriate spot in which division would provide a viable vascular arcade to the conduit segment. The mesentery is divided with the Ligasure device up to the border with the bowel. Two bowel clamps are placed on either end of the conduit segment to control spillage of bowel contents, and the bowel is divided using a GIA™ stapling device. Bowel continuity is then restored using the GIA™ stapler and TA™-60 stapling device to perform a side-to-side functional end-to-end anastomosis. It is our preference to reinforce the stapled anastomosis using non-absorbable sutures in an interrupted Lembert fashion. Mesenteric defects are also reapproximated to decrease the chance of an internal hernia.

The clipped ends of each ureter are trimmed and spatulated. A Bricker or Wallace technique is then used to create the ureteroenteric anastomosis at a site on the proximal end of the conduit, tension-free and without kinking of the ureter. The conduit should maintain an antegrade peristaltic direction toward the skin. Ureteral stents, using small caliber feeding tubes or single-J stents, are inserted retrograde just prior to complete closure of the ureteroenteric anastomoses to help facilitate healing. The ureteroenteric anastomoses may be tested by backfilling the ileal conduit with warm saline and inspecting for any leakage.

The conduit is then brought up to the abdominal wall at the site of previous marking. A fascial defect is created large enough to accommodate two fingers, but not too large so as to predispose to parastomal herniation. The staple line on the skin end of the conduit is excised sharply, and any creeping mesentery is trimmed back slightly to decrease tension. The stoma is matured by fixing the mucosa to the abdominal wall fascia in each quadrant, with additional absorbable interrupted tacking sutures from bowel mucosa to skin edge.

### 24.7.2 Neobladder

We have most commonly performed the Studer orthotopic neobladder [49]. The previously created window under the sigmoid mesentery is located, and the left ureter passed through this toward the right side of the patient. The bowel is unpacked, and a 60-cm segment of terminal ileum, located at least 15 cm proximal to the ileocecal valve, is isolated and inspected to ensure the bowel appears well-vascularized and healthy. The mesentery of the isolated segment is analyzed to find an appropriate spot in which division would provide a viable vascular arcade to the conduit segment. The mesentery and bowel are divided, and bowel continuity is then restored using the GIA™ stapler and TA™-60 stapling device to perform a side-to-side functional end-to-end anastomosis. Mesenteric defects are also reapproximated to decrease the chance of an internal hernia.

The bowel is reconfigured into a U-shape with a 20 cm afferent limb. The antimesenteric border of the segment is incised for approximately 40 cm from its distal end. The clipped ends of each ureter are trimmed and spatulated. A Bricker or Wallace technique is then used to create the end-to-side non-tunneled/Nesbit ureteroenteric anastomosis at a site on the afferent limb, tension-free and without kinking of the ureter. Ureteral stents are inserted retrograde just prior to complete closure of the ureteroenteric anastomoses to help facilitate healing. Distal periureteral tissue can be lightly tacked to the afferent limb and used to cover the anastomosis as well.

The opposite edges of the detubularized bowel are sewn together in either a single or double layer, creating a spherical pouch via four cross-folded segments. Just before completing the

globularization, the most dependent portion of the pouch is determined and a through-and-through hole cut out for the urethro-enteric anastomosis. The pouch should reach the urethral stump in a tension-free manner. Additional length can be obtained by incising the mesentery and peritoneal surface, taking care not to injure the mesenteric vessels supplying the pouch.

After verifying that there is no tumor at the urethral margin frozen section, at least six absorbable sutures are placed from the pouch neourethra to the membranous urethra at 1, 3, 5, 7, 9, and 11 o'clock, to approximate the seromuscular layer of the pouch to the urethra. A large urethral catheter is inserted across the urethro-enteric anastomosis, and the ureteral stents are internalized and fixed to this catheter. The remainder of the orthotopic pouch is then closed. The six previously placed sutures are tied down. The reservoir is backfilled through the catheter to test for any leakage and to flush out any clots.

### 24.7.3 Continent Cutaneous Reservoir

Continent cutaneous diversions are much less common than orthotopic neobladders, and tend to be performed when urethrectomy precludes the possibility of neobladder but patients wish to avoid a stoma with external appliance. Some patients who are concerned about body image but do not want to run the risk of incontinence or have preexisting sphincteric insufficiency may also choose continent cutaneous diversion.

The Indiana pouch takes advantage of the intrinsic ileocecal valve and buttresses it to provide the continence mechanism. The ascending colon is mobilized along the white line of Toldt, and the adjacent terminal ileum approximately 10 cm long is isolated. The cecum is opened along the antimesenteric border and is augmented with an ileal segment to create the reservoir [50]. As with orthotopic substitutions, detubularization of the bowel is key to creating a compliant low-pressure reservoir that will protect the upper tracts. While the cecum is open, the ileocecal junction is imbricated.

Due to the inherent outlet obstruction provided by the continence mechanism, higher reservoir pressures are seen in continent cutaneous diversions compared to continent orthotopic diversions. For this reason, as well as colonization of the reservoir with bacteria, authors have advocated for antirefluxing ureteroenteric anastomoses using the Le Duc, Leadbetter, or Goodwin techniques [51–53]. Regardless of type of technique, the ureteroenteric anastomosis should remain tension-free and without angulation. Again, the left ureter is passed under the previously created window in the sigmoid mesentery, and bilateral uretero-tenial anastomoses are performed. Single J stents or feeding tubes should be used to stent the ureters, exteriorizing the distal ends either through a separate stab incision or attached to the irrigating catheter.

The pouch is closed in a Heineke-Mikulicz fashion to avoid bolus contractions. A stapler is used to taper the ileal segment that will serve as the catheterizable stoma. Similar to Mitrofanoff appendicovesicostomies, use of the appendix for continent cutaneous diversions has been described, especially as it carries a very high continence rate. However, rates of stenosis are much higher and reoperation rates can exceed 30 % [54, 55]. The stoma is then tunneled toward the umbilicus or right lower quadrant and matured. A Foley catheter is placed as a suprapubic tube into the pouch to help divert urine and allow for irrigation.

### 24.7.4 Closure

The pelvis is copiously irrigated with warm saline, and carefully inspected to ensure hemostasis. A Jackson-Pratt drain in the pelvis is recommended regardless of the type of diversion. The abdomen is then closed in multiple layers: rectus fascia, Camper's and Scarpa's fascia, and skin.

## 24.8 Postoperative Management

Our practice has been to remove the nasogastric tube prior to extubation of the patient, as both prospective and observational studies suggest

decreased rates of ileus with early removal [56]. Evidence regarding the utility of gut promotility agents such as metoclopramide has been marginal, although the recently approved peripheral mu-opioid receptor antagonist almivopan has been shown decrease narcotic-induced postoperative ileus with reasonable cost efficacy [56, 57]. Some authors have advocated for placement of a gastrostomy tube during surgery as a means to circumvent the possibility of uncomfortable nasogastric tubes while providing a way of decompressing the stomach should the patient develop an ileus [58]. However, given that most series report rates of ileus in the 15–20 % range, our practice has not been to prophylactically place gastrostomies [35, 59, 60]. Patients may initiate limited oral liquid intake as early as the first postoperative day and are expected to ambulate as well. Other routine prophylactic measures such as sequential compression devices while in bed, subcutaneous Heparin, and regular incentive spirometry are ordered. Postoperative antibiotics such as a second-generation cephalosporin may also be given for 24 h following surgery.

For patients with an orthotopic or continent cutaneous constructions, the Foley catheter may be irrigated as early as the evening of surgery to minimize the risk of mucus plugging. Patients are maintained on thrice daily pouch irrigations while in the hospital, and are generally discharged on at least once daily irrigations. The ureteral catheters are typically removed between 7 and 14 days after surgery. It has not been our custom to evaluate for anastomotic leakage with a pouchogram prior to removing the Foley catheter, but if there is copious output from the Jackson-Pratt drain, a fluid creatinine level may be analyzed. The Jackson-Pratt drain is removed when there is low output and/or no urine leak.

Patients are generally seen in follow-up every 6 months for the first 2 years, and annually thereafter, with routine serum chemistries, urine cytology, and CT scan of the chest, abdomen, and pelvis to evaluate for local or upper tract recurrence, or metastasis. Patients with neobladders and continent cutaneous diversions additionally should have a serum vitamin B12 level checked annually given the larger bowel resection required for the reservoir. High-risk patients (pathologic stage T3-4, positive nodes) should be considered for adjuvant chemotherapy if no neoadjuvant treatment was administered.

## 24.9 Complications

Radical cystectomy with urinary diversion is a major operation with significant morbidity. Complications, while generally minor, occur in approximately 60 % of patients within the first 90 days [59, 61]. It is important to keep in mind that complications may also occur decades after the initial surgery, and thus cystectomy patients require long-term follow-up not only from a purely oncologic point of view.

### 24.9.1 Short Term

All patients regardless of type of diversion are at risk for metabolic acidosis, though the risk is highest for those with continent diversions due to the increased surface area of bowel and longer contact time with urine. Symptoms may be fairly nonspecific: fatigue, nausea, anorexia, possible vomiting, and overall failure to thrive. A serum chemistry panel will reveal a hypochloremic hyperkalemic metabolic acidosis if ileum has been used. Treatment involves replacing bicarbonate. Patients with severe base deficits may need admission for fluids and IV sodium bicarbonate.

Patients with orthotopic neobladders often have incontinence after their Foley catheter is removed, and patients should be counseled preoperatively to expect this. It is important to have patients cycle their pouch by progressively increasing the time interval between urination in order to achieve full bladder capacity. Daytime continence recovers first, followed by nighttime incontinence [62]. Approximately 90 % of patients have daytime continence and 80 % have nighttime continence by 18 months [33, 63]. Bothersome nocturnal incontinence can be mitigated by timed voiding with the help of an alarm clock. Pelvic floor exercises, preservation of the rhabdosphincter, and nerve-sparing all influence

time to recovery of continence [64]. Older patients generally have inferior continence [33]. Patients with intractable stress urinary incontinence may benefit from urethral bulking agents, slings, or artificial sphincter devices [65–67].

On the other hand, acute retention from mucus plugging may also occur, especially due to the relatively larger surface area of bowel used in orthotopic urinary diversion. It can be helpful to check a post-void residual at early follow-up visits to ensure adequate emptying, and to institute clean intermittent catheterization and pouch irrigations on an as needed basis. Retention and stasis also predispose to infection and calculus formation.

### 24.9.2 Long Term

Long-term complications can include obstruction at any level with subsequent renal impairment. Indeed, obstruction is the leading cause of long-term renal deterioration regardless of type of diversion [68]. Obstruction can also lead to recurrent bouts of pyelonephritis in the setting of infection. Ureteroenteric anastomotic strictures may require revision, either with open surgical resection of the stricture and neo-ureteroileal anastomosis, or through endoscopic methods such as balloon dilation and endoureterotomy [69]. A study of 85 ureteroileal strictures found that length of stricture was associated with outcome, and that strictures >1 cm had better success with open revision [70]. Late de novo urethral strictures or outlet obstruction can often be managed endoscopically. Stomal stenosis in the case of an ileal conduit or continent cutaneous diversion generally requires open revision.

Upper tract deterioration may also occur due to reflux of urine. It was initially believed that antireflux valves were necessary to preserve renal function, particularly in the case of orthotopic reconstruction. However, a properly formed spherical reservoir is compliant and thus allows for low-pressure voiding. Any straining is equally transmitted to both the reservoir and upper tracts. Additionally, the isoperistaltic afferent limb serves to diffuse some of the pressure. A prospective randomized study, though with limited follow-up, indeed found higher stricture rates and worse renal impairment with antireflux mechanisms in orthotopic bladder substitution [71]. However for continent cutaneous reservoirs, the outlet which provides continence also enables high pouch pressures. As such, the benefit of antirefluxing ureteric anastomoses must be weighed against higher rates of anastomotic strictures in continent cutaneous diversions [72].

Urinary retention can also be a late effect in orthotopic substitutions, seen even in the absence of identifiable outlet obstruction or dysfunctional voiding, and even in instances in which patients initially had excellent urinary function. For as yet unclear reasons, retention is more common in female patients and with an incidence of up to 50 % at 5 years [63]. Fixation of the neobladder, and supporting the posterior pelvis via omental flaps, sacrocolpopexy, or anchoring the vaginal apex to the round ligaments have been described to improve outcomes, but results are not conclusive [36, 73]. Retention is typically treated with intermittent catheterization, though reduction pouchplasty and fixation have also been described [36].

### 24.9.3 Pouch-Vaginal Fistula

Despite even omental interposition flaps, fistulas between the neobladder and vaginal stump may occur in 1–10 % of female cystectomy cases [74, 75]. Depending on the location of the fistula, many of these may be repaired transvaginally with use of a Martius flap [76].

### 24.9.4 Urethral Recurrence

Several series have demonstrated an overall urethral recurrence rate of between 1.5 and 6 %, occurring even more than a decade after surgery [63]. In a series by Stein et al., prostatic involvement and continent cutaneous diversion were significant predictors for recurrence [77]. Tumor involvement of the bladder neck was once thought to be an absolute contraindication to orthotopic neobladder due to concern for urethral

recurrence as well as the assumption that the bladder neck provided continence in females. However, neuroanatomical studies demonstrated that the rhabdosphincter, located in the distal two-thirds of the urethra, and preservation of its innervation were critical for preservation of continence [37]. Bladder neck involvement does however portend a higher risk of urethral recurrence [38].

## 24.10 Conclusions

Open radical cystectomy remains the gold standard for surgical management of muscle-invasive bladder cancer. Ongoing prospective randomized controlled trials comparing the safety and efficacy of open versus robotic cystectomy will help define the relevance of surgical technique to clinical outcomes. More studies, with standardized reporting of complications and validated instruments for assessing health-related quality of life will be necessary to help define the ideal populations for the various forms of urinary diversion. Improved diagnostics and imaging will allow for more accurate preoperative staging and maximum efficacy of radical cystectomy in the treatment and cure of bladder cancer.

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