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Complications of Urinary Diversion

Learning Objective: At the conclusion of this continuing medical education activity, the participant will be able to identify and manage the most common postoperative complications of urinary diversion in the early and late postoperative period.

This AUA Update aligns with the American Board of Urology Modules on Oncology, Urinary Diversion and Adrenal. Additional information on this topic can be found in the AUA Core Curriculum section on Oncology – Adult.

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INTRODUCTION

Radical cystectomy with urinary diversion is one of the most complex procedures in urology. Despite enhanced recovery after surgery (ERAS) pathways, it is still associated with high morbidity and increased hospital readmission rates.[1] Complication rates are as high as 58%–77% within the first 30 days even when performed at high-volume centers.[1–4]

The most common types of complications stem from infectious (25%–64%), gastrointestinal (GI; 14%–45%), renal/genitourinary (11%–27%) and wound-related (5%–15%) issues.[1–3] **One series of 1142 patients reported a 64% overall complication rate within 90 days of surgery, with most complications (67%) occurring early during the operative hospital admission.**[2] **Patient factors such as advanced age and severe comorbidities have been associated with increased mortality and postoperative complications, while urinary diversion type and neoadjuvant chemotherapy have not been shown to significantly increase complications.**[4,5]

There is variation within the urological literature as to the definition of early versus late complications. For the purposes of this Update, we will consider early complications to be those occurring within the first 90 days after surgery.

EARLY COMPLICATIONS

Bowel-related complications. **Bowel-related complications are common following radical cystectomy with urinary diversion, with an overall incidence of approximately 30%.**[1,2,6] Early complications include ileus, bowel obstruction, anastomotic bowel leak, fistula, *Clostridium difficile* (C. diff) colitis and GI bleeding (see table). **Ileus is the most common type of bowel-related complication, occurring in up to 26% of patients, and is likely a direct result of the urinary diversion related to intestinal resection with re-anastomosis.**[2,3,5] Small-bowel obstruction is less common, occurring in 7%–10%, and anastomotic bowel leak is rare, reported in 1%–3% of patients.[2,3]

More contemporary data obtained from a randomized phase 3 trial, Robot-Assisted Radical Cystectomy versus Open Radical Cystectomy (RAZOR), compared outcomes from patients undergoing radical cystectomy using an open versus robotic approach. While blood loss and length of stay were significantly decreased in the robotic cohort, the rate of overall complications was not different between the two groups. Overall bowel-related complication rates were similar to historical data.[7]

The adoption of ERAS pathways following radical cystectomy has significantly decreased the time to return of bowel function and length of hospital stay.[8] Carbohydrate loading prior to surgery has been shown to reduce physiological stress response postoperatively. Measures taken intraoperatively to maintain normothermia and limit fluid resuscitation, as well as utilization of multimodal non-narcotic analgesia, avoidance of a mechanical bowel preparation and nasogastric tubes promote earlier return to bowel function. Additionally, early enteral stimulation and use of alvimopan have significantly reduced the time to flatus and bowel movement.[9]

In a single institution study, data were collected prospectively for 169 patients undergoing radical cystectomy from 2012–2014 who were placed on ERAS pathways postoperatively. As part of a subset analysis, this group was then compared to a historical cohort matched for age, sex, body mass index, Charlson comorbidity index and pathology stage. The most common complications in both groups were bowel and infection-related. Although the overall complication rate was similar for the historical cohort and the ERAS cohort, the GI complications were significantly lower in the ERAS group (16.6% versus 29.6%, p=0.01).[1]

Urinary anastomotic and suture line leak. Urine leaks following urinary diversion generally occur at the ureteroenteric anastomosis, along the staple line of the conduit, at the suture lines of the continent diversion or at the neovesical-urethral anastomosis of an orthotopic diversion. **The incidence of urine leak ranges from 2%–7.7% in the urological literature and is as high as 15% in series that include previously irradiated patients undergoing pelvic exenteration (see table).**[2,3,10]

Hautmann et al reviewed a series of 363 patients undergoing radical cystectomy with creation of an ileal neobladder and found that of all complications that occurred postoperatively, 75 (31%) were directly related to the urinary diversion.[3] **The most common complications in the neobladder population were persistent urine leak (7.7%), pyelonephritis/infection (7.4%) and symptomatic obstruction of the ureteroileal anastomosis (3%).**

Urine leaks are typically identified in the early postoperative course and are clinically suspected with decreased urine output from the urinary diversion and increased pelvic drain output. Other common signs include increased wound drainage or prolonged ileus. An elevated peritoneal fluid creatinine above that of a serum obtained within a similar time period is suggestive of a urine leak. Radiographic confirmation of a leak can be made by computerized tomography (CT) urogram, loopogram (ileal conduit) or cystogram (neobladder). The majority of urine leaks are self-limiting and can be managed conservatively with prolonged pelvic drainage and/or neobladder drainage.[11] Placement of percutaneous nephrostomy tubes can be used for urinary diversion if necessary. Surgical repair is rarely warranted, and issues with tissue integrity in the early postoperative period can make surgical intervention unsuccessful.[10]

A prospective randomized trial evaluated the benefit of perioperative stenting to reduce the risk of urine leak.[12] The data revealed a trend toward increased urine leaks in patients without stents; however, this finding was not statistically significant. Return to bowel function was noted to be significantly earlier for patients with ureteral stenting. Less incidence of metabolic acidosis occurred in stented patients due to better urinary drainage with decreased contact by the intestinal mucosa.

ABBREVIATIONS: C. diff=*Clostridium difficile*, CT=computerized tomography, ERAS=enhanced recovery after surgery, GI=gastrointestinal, PSH=parastomal hernia, UES=ureteroenteric anastomotic stricture, UTI=urinary tract infection

Infection. Infection after radical cystectomy can have many etiologies, including wound infections and other hospital acquired infections such as C. diff and pneumonia. Infections specifically related to urinary diversion most commonly present as urinary tract infections (UTIs), pyelonephritis or urine leaks, with development of infected intra-abdominal fluid collections. Bowel anastomotic leaks are rare (1%–2%) but can also occur as a complication secondary to the urinary diversion.[2,3]

In one series, the most common reason for readmission within 90 days of surgery was urinary tract infection.[1] A separate single institution study identified the two most common urinary pathogens after radical cystectomy to be Candida and Enterococcus.[13] The authors also found that for patients with a fungal infection, the 30-day mortality rate was significantly higher (14% versus 1%, p <0.001). This led to a change in perioperative antibiotics at their institution to include fluconazole in the regimen.

The development of C. diff infection following cystectomy has also been associated with increased length of stay, cost and mortality.[14] Reported rates of C. diff are inconsistent across institutions, with rates as high as 25.5%. A contemporary meta-analysis performed in 2018 found the average rate of C. diff to be 5% across 35 single institution studies. Reported rates in national databases were much lower at 1.92%, which authors in this study suggested may indicate under-reporting. However, multi-institutional studies were not included, and perioperative antibiotic regimens varied.[15]

Appropriate use and discontinuation of perioperative antibiotics can help prevent C. diff infections. Recent guidelines from the American Urological Association and the Centers for Disease Control and Prevention recommend a single dose of antibiotics prior to incision, but more studies are needed in this area. **Additionally, adoption of ERAS pathways has been shown to decrease length of stay and therefore potentially decrease the risk of acquiring a nosocomial infection.** One study reported that although overall complication rates were similar between patients on ERAS pathways versus traditional postoperative care, infectious-related complications were significantly lower in the ERAS cohort (11.8% versus 20.4%, p=0.05).[1]

LATE COMPLICATIONS

Decline in renal function. Normal physiological decline of renal function with age is expected, and chronic diseases such as hypertension, diabetes mellitus and certain medications also contribute to renal impairment.[16] Almost half of all adults older than 70 years are found to have an estimated glomerular filtration rate <60 ml/min/1.73 m^2. Whether decline in renal function with age is greater in those with a urinary diversion is not fully known. Renal decline is reported in 20%–50% of individuals with a urinary diversion within the first 5 years.[16–21] Several studies demonstrate that after longer term follow-up, renal decline can be as high as 71% and 74% at ten years in conduit and continent diversions, respectively.[18,19] It is important to recognize that although renal function will often continue to decline over time irrespective of diversion type, end-stage renal disease is uncommon.

However, there are specific problems that can develop because of a urinary diversion that often contribute to renal decline. Vigilant surveillance, at least annually, for evidence of newly acquired obstruction, stone formation or metabolic abnormalities is necessary for a patient's lifetime to allow for prompt intervention. Other than a detailed health history, testing should include annual serum chemistry and further imaging as indicated.

Metabolic and nutritional changes. Urinary diversions are associated with the potential to develop electrolyte abnormalities due to the reabsorption of excreted metabolites. **The bowel segment used, length of bowel and the time the urine is in contact with the enteric mucosa influence the likelihood of developing metabolic abnormalities.[22] Commonly employed bowel segments are the ileum and colon, and both can trigger a hyperchloremic hypokalemic metabolic acidosis.[21] Although the overall incidence of metabolic acidosis is low, it more commonly occurs in patients with impaired renal function.** Most cases of metabolic acidosis are subclinical; however, symptoms can include lethargy, anorexia, weight loss and muscle weakness.[3,21,22] **It is often treated by oral sodium bicarbonate (1–2 gm 3 times daily) but flatulence can reduce compliance.** Alternative treatments include sodium citrate (1–3 gm 4 times daily) or, in instances of avoiding sodium load, nicotinic acid (500 mg–2 gm extended-release) or chlorpromazine (25–50 mg 4 times daily).

Resection of the terminal ileum can lead to reduced absorption of vitamin B12. However, B12 deficiency can take many years to manifest due to large body stores, and monitoring serum B12 is not needed for 3–5 years after surgery. Mild forms of the disease manifest as insidious onset of lethargy and more severe cases as inflammation of the tongue or neurological problems such as numbness in the extremities, difficulty walking, memory loss or cognitive dysfunction.[23–25] It is imperative to recognize this vitamin deficiency as the neurological sequelae can be irreversible, and to treat when recognized. The incidence of B12 deficiency is generally low but reported as high as 30%.[3,20–25] Oral replacement with high doses (1–2 gm daily) may be as effective as parenteral administration (1 gm monthly), and sublingual replacement is available.[26]

STOMAL PROBLEMS

Contact dermatitis and stomal retraction. Contact irritation of the skin, skin infections (ie Candida) and pouching difficulties are common problems of the stoma of conduit diversions (fig. 1). The problems are best managed in collaboration with a certified ostomy nurse. The Wound, Ostomy, and Continence Nurses Society™ (https://www.wocn.org) is an excellent resource.

Irritation of the skin and pouching difficulties may be secondary to poor siting of the stoma at surgery, including too close to prominent bones, near the umbilicus or old surgical scars, or in deep peristomal creases. Preoperative stoma site selection should be performed with the patient in various positions (standing, sitting and supine), and certain situations such as obesity, cachectic patients and physically challenged persons (such as those confined to wheelchairs or wearing braces) may require special considerations when selecting stoma sites. Collaborating with a certified ostomy nurse is highly preferred.

Stomal retraction occurs when the stoma is drawn or pulled back below the skin level. It can involve the entire stoma or may be limited to the mucocutaneous junction. It can occur early in the postoperative period or much later. **Later stomal retraction may occur secondary to chronic peristomal irritation with scar at the mucocutaneous junction or from excessive weight gain.**[27–29] Retracted stomas present with urine undermining the pouching system, persistent leakage, shortened pouch wear time and

Figure 1. Contact dermatitis of peristomal skin.

peristomal irritant dermatitis. The goal of managing a retracted stoma is to maintain a secure seal between the pouch and the skin. This often requires modification in pouching techniques and use of barrier pastes or wedges to fill small indentations. Conservative measures work most of the time, but surgical revision may be required.[21,27]

Stomal stenosis. Mucocutaneous detachment of an ostomy can result in stomal retraction or stenosis as the separation heals by secondary intention. **Stomal stenosis is not common and was reported to occur in 2.4% of 1057 patients after a median follow-up of 9.4 years (fig. 2).**[21,27] It is common that a stomal stenosis gradually leads to urinary tract obstruction, but in others acute back pain and projectile urinary stream may be part of the presentation, especially if stenosis is at the level of the fascia. A dilated ileal conduit seen on CT scan can be an early sign of stomal stenosis. Gentle digital manipulation of the stoma or attempting to place a catheter often provides clues as to the anatomical level of the stenosis (skin or fascia).

Figure 2. Significant stomal stenosis with retraction of stoma.

Temporizing measures may include placing a small-caliber catheter into the conduit and securing it in place. In other circumstances, if reliable drainage of the conduit is not possible or there are signs of serious infection, it is prudent to place bilateral nephrostomy tubes. Following resolution of the acute problems, definitive surgical revision is necessary.

Parastomal hernia. **Unlike stomal stenosis, parastomal hernias (PSHs) are common following a conduit.** In most, PSHs are asymptomatic, while in others, the hernia may lead to significant morbidity. Potential problems include an abdominal bulge, pain over the stomal site, difficulty pouching and, rarely, bowel or urinary obstruction (fig. 3).[28–30]

The reported incidence of a PSH varies depending on whether defined by radiological or clinical criteria. **Donahue et al reported that almost 50% of patients have a PSH on CT scan within two years of surgery (see table).**[30] However, only 68% of the hernias diagnosed by imaging were present by physical examination, and only 27% were symptomatic. **Important risk factors for PSH include female gender, higher body mass index and low albumin.**[30]

Most symptomatic patients are successfully managed with a hernia belt or binder and weight loss. If conservative measures fail, then referral for surgical repair is recommended, including robot-assisted laparoscopic approach. **However, success rates for surgical repair tend to be poor, and surgery can be associated with a high rate of complications.**[30–32] Surgical options for hernia repair include repair with native tissues, repair with prosthetic mesh or biologics, or relocation of the stoma. Both repair with native tissues and relocation of the stoma are less favored than mesh placement due to higher hernia recurrence rates.[32] Patients presenting with acute bowel or urinary tract obstruction often require surgical repair emergently or soon after the acute problem is resolved.[32]

There has been considerable interest in prevention of PSH at the time of the index operation. Surgical techniques that include securing the conduit to the anterior fascia, cruciate versus a vertical incision in the fascia, transrectus versus lateral pararectus stoma placement and end versus loop (Turnbull) stomas have not demonstrated any differences in PSH rates.[32] **However, randomized trials of prophylactic mesh placement at the time of colostomy or ileostomy creation have demonstrated that synthetic mesh placed at the time of the index operation reduced PSH rates without increasing complication rates.**[31] There are currently ongoing randomized controlled trials in United States and Europe of mesh placement in patients undergoing urinary diversion, and results are eagerly anticipated.

Ureteroenteric anastomotic stricture. Ureteroenteric anastomotic stricture (UES) can lead to loss of kidney function, infection and need for additional surgical procedures. **Reports vary on the incidence of UES, with some as low as 2%–3%, but most describe a prevalence approaching 10% (see table).**[21,33–36] Most occur within one year of the operation, and strictures of the left ureter are more common. The rate of UES formation is not different when comparing conduit and continent diversions or Bricker (2-unit) versus Wallace (1-unit) non-refluxing surgical techniques.[21,33–36] **It had long been assumed that the Bricker approach was associated with higher stricture rates, but a recent study and a meta-analysis demonstrate this not to be true.**[36]

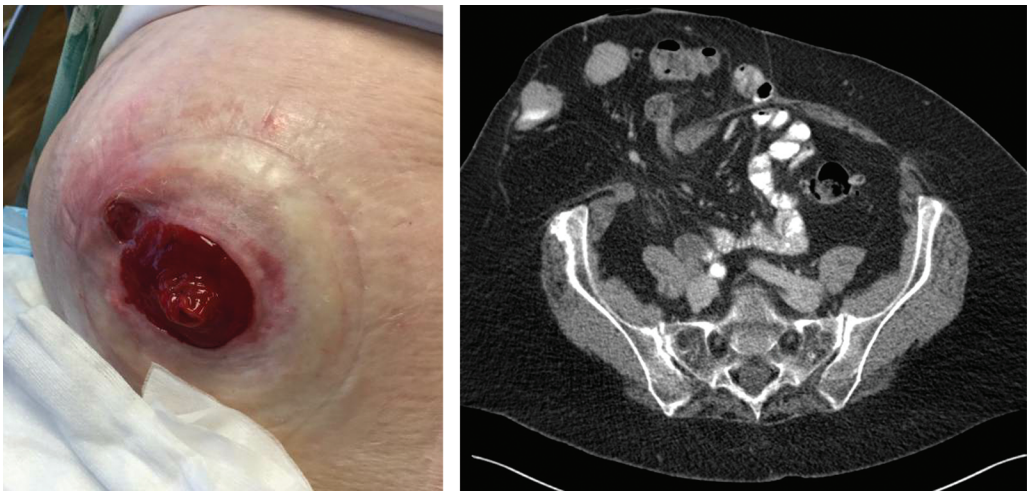

Figure 3. Clinical (left) and radiographic (right) appearance of large parastomal hernia containing bowel.

With routine surveillance imaging and measurement of serum creatinine following radical cystectomy, it is common that new onset of silent hydronephrosis and worsening of renal function are the first clues to the presence of a UES. At other times, the investigation of acute flank pain or an episode of acute pyelonephritis leads to a diagnosis of a UES. The diagnosis in indeterminate cases may need to be confirmed by lower tract urography. A loopogram or cystogram will demonstrate the absence of reflux of contrast material into the lower ureter. Further investigations can include a furosemide renal scan or placement of a percutaneous nephrostomy tube followed by antegrade urography. **It is important to remember that a urine cytology, in addition to imaging, is necessary to aid in the assessment of a potential malignant recurrence at the site of the anastomosis.** If there is any suspicion of a malignant stricture, further endoscopic evaluation and biopsy are often warranted before a more definitive surgical procedure.

Open repair with excision of the UES is the gold standard. Despite the high rate of success with open surgery, the procedure can be associated with significant morbidity. **Robotic surgery has evolved to include repair of UES and shows promise of similar rates of success with reduced morbidity. There are also several reported series of endoscopic management of UES, including balloon dilation or endoureterotomy, and success rates can approach 50%.**[37] Success with open surgical revision approaches 80%, but morbidity is less with endourological management of UES. Factors that predict for endourological success include length of the stricture (<1 cm), side of the stricture (right) and total contribution to renal function of the affected kidney (>25%). For UES >1 cm in length or a failed endoureterotomy, surgical revision is recommended.[37]

Prevention of stricture is key, and meticulous surgical technique likely reduces the incidence of UES, with reports as low as 2.6%.[33] Delicate handling, minimizing mobilization, dividing the ureter near its crossing over the iliac vessels to avoid distal segmental blood supply and excising any redundant ureter at the time of the index operation are considered important principles. Whether to perform an interrupted suture technique versus a continuous suture was studied, and a running suture may be associated with a higher rate of UES, but the findings were not conclusive.[38] The use of ureteral stents to bridge the anastomosis and improve outcomes is contentious but is thought to ensure accurate alignment and provide mechanical support to the anastomosis, thus preventing urine leak and subsequent stricture formation. However, in a series of 362 patients, Regan and Barrett reported that stenting of ureteroileal anastomoses did not reduce stricture or urinary leak rates.[39] The same finding was confirmed in a contemporary case series, although stenting reduced ileus rates.[40]

Change in orthotopic neobladder function. A better understanding of how neobladder function changes with age and by gender with uniform definitions of incontinence would improve patient counseling.[3,23,41–44] Nevertheless, a meta-analysis of over 2000 patients, mostly men, reported daytime continence of 80%–87% and nighttime continence of 60%–85% with relatively short follow-up.[41] Studies consistently report that daytime continence is achieved by most within the first year and nighttime continence can continue to improve for up to three years.[23] A recent study compared two neobladder constructions and reported that almost 40% had urinary leakage, mostly at night, and 17% had no control or almost continual leakage at a median follow-up of 4.5 years.[42] Clean intermittent catheterization for urinary retention was necessary in 10% of patients.

Neobladder emptying failure or urinary retention rates increase with time and occur more often in women, approaching 16%–25% (see table).[44–48] The hypercontinence in women is attributed to the posterior prolapse of the neobladder during Valsalva maneuvers and associated kinking of the urethra.[46–48] Proposed measures to prevent rotational descent include not performing a concurrent hysterectomy, using omentum to fill the posterior pelvis, suspension of the vagina to the round ligaments and fixation of the neobladder to the rectus muscle. Each of these concepts requires greater validation as to whether they prevent hypercontinence.

Incidence of emptying failure in men is lower and was reported as 11% at a follow-up of 36 months.[49] Mechanical causes of urinary retention include a neovesical-urethral anastomotic stricture or redundant folds of bowel mucosa at the anastomosis. These can be managed by endoscopic surgery with varying success; however, local tumor recurrence or voiding dysfunction can also cause urinary retention.[49] **Change in neobladder function should be carefully evaluated for the potential of a local tumor recurrence, and cross-sectional imaging of the pelvis and urethroscopy may be helpful.** If there is no mechanical cause

or tumor recurrence, then conservative strategies including reducing fluid intake in the evening, voiding at timed intervals, double voiding and pelvic floor rehabilitation may benefit some patients with dysfunctional emptying failure before instituting clean intermittent catheterization.

Change in function of a continent catheterizable urinary diversion. Compared to a conduit, stomal stenosis of the catheterizable limb of a continent diversion is more common, reported to occur in 15%–30% of patients (see table).[50,51] It requires surgical revision when dilation is not successful.[51–53] Most catheterizable limbs are constructed from the appendix or terminal ileum and sited within the umbilicus or lower abdominal wall. These factors can influence the rate of stenosis, as the use of an appendiceal channel and placement of the stoma in the umbilicus can be associated with a higher incidence of stricture.[52,53]

Incontinence can also develop over time because of a dysfunctional continence mechanism, poor pouch compliance or uninhibited pouch contractions. Pouch urodynamics and contrast studies are important tools in the evaluation of the urinary reservoir. It is important to treat an active UTI and any stones in the reservoir before conducting further investigations for reservoir incontinence. Despite the limited data, a trial of anticholinergics or a combination of atropine and diphenoxylate for a poorly compliant, high-pressure reservoir may be beneficial before considering reservoir augmentation.[54]

Urolithiasis. **The possibility of developing urinary tract stones is higher with any form of urinary diversion when compared to the general population. Contributing factors include metabolic acidosis (hypocitraturia), shorter gut (hyperoxaluria), recurrent urinary tract infections (struvite stones), incomplete emptying of the urinary reservoir and the presence of surgical staples or mucus acting as a stone nidus.**[55,56] The likelihood of developing stones is higher in continent diversions when compared to a conduit.[56,57] A large series of ileal conduit patients reported that 13.4% developed kidney stones long-term and a small number also developed stones within the ileal conduit.[21] **The rate of stone formation in continent reservoirs can be as high as 10%–15% and increases with longer follow-up (fig. 4).**[56,57]

Most stones that develop within a urinary diversion can be managed endoscopically, and occasionally a percutaneous or open approach may be necessary for a continent catheterizable diversion.[57] Preventing stones is important to minimize morbidity. Screening and treating metabolic abnormalities, improving reservoir emptying, addressing the need to flush mucus from the reservoir, low-dose antibiotic prophylaxis for recurrent infections and encouraging hydration should be considered.[55–57]

Continent diversion rupture or fistulization. Spontaneous rupture of a continent catheterizable urinary diversion is very uncommon and even less likely for an orthotopic neobladder. Case series suggest the incidence of continent diversion rupture is <2%.[35] Presentation can be vague, but high suspicion and careful patient assessment can lead to diagnosis. Continent diversion rupture can present with generalized abdominal pain and distention with decreased urine output suggestive of a bowel obstruction. It is important to realize that generalized peritonitis or an acute abdomen may not be part of the presentation.

Suspicion of reservoir rupture is often investigated by CT urogram, CT cystogram or plain radiography contrast studies. Serum laboratory studies can be suggestive, including spurious elevations in blood urea nitrogen and creatinine, presence of any degree of acidosis and a leukocytosis. Urgent laparotomy and surgical repair are necessary; however, there are a limited number of case reports of managing a small perforation with catheter drainage.

Figure 4. Continent catheterizable urinary diversion with multiple urinary calculi.

Neobladder fistulas to the bowel or vagina can occur even many years after the construction of the diversion, although most occur within the first year. Entero-neobladder fistulas usually involve the prior small-bowel anastomosis or, less often, sigmoid diverticular disease. Presenting symptoms include recurrent UTIs, fecaluria and pneumaturia, and the reported incidence is <3%.[21,58] Conservative management with urinary drainage and bowel rest with parenteral nutrition may be successful for a small fistula, but surgery is necessary in the majority of patients.[59]

The presentation of a neobladder-vaginal fistula is invariably total urinary incontinence. It has been reported in 0%–10% of women and can present either early or late after the surgery (see table).[59] It is often incidental to a concurrent hysterectomy or surgical trauma to the anterior vaginal wall that is repaired and overlapped with a suture line from the neobladder reconstruction. **It is important to place an omental or other interposition flap between the vagina and neobladder at the time of surgery or practice vaginal sparing surgery when feasible.** When a vaginal fistula develops, reconstruction with interposition flaps can be effective, but incontinence or voiding dysfunction can persist and alternative urinary diversion may be necessary.[59]

CONCLUSIONS

Complications following radical cystectomy with urinary diversion are common. The procedure is often more complicated

following severe radiation damage, with even higher complication rates.[60] Although ERAS pathways have been shown to decrease the rate of GI complications, they have not lowered overall early complication rates or prevented hospital readmissions. Late complications following diversion are also common, therefore making long-term follow-up for patients with urinary diversion imperative.

DID YOU KNOW?

- Complications following radical cystectomy with urinary diversion are as high as 58%–77% within the first 30 days. They typically occur early during the operative hospital admission, with the most common being bowel-related (30%) and infection-related (20%–25%).
- While adoption of ERAS pathways has not decreased the overall complication rate following radical cystectomy with urinary diversion, the rate of GI and infectious complications was lower for patients on ERAS pathway compared to conventional management.
- The most common metabolic abnormality seen with urinary diversion using ileum is a hyperchloremic hypokalemic metabolic acidosis, which can be treated with oral sodium bicarbonate. Chronic metabolic acidosis leading to hypocitraturia and a shorter gut causing hyperoxaluria contribute to the higher rate of stone formation in patients with a urinary diversion.
- Changes in orthotopic neobladder function within the first several years following surgery, including urinary incontinence or urinary retention, should be further evaluated by physical examination (in the female), cystoscopy and cross-sectional imaging to rule out tumor recurrence or fistula.
- Long-term follow-up with at least annual serum chemistry and upper tract imaging as indicated is imperative for patients who have undergone urinary diversion. Renal function decline could be secondary to urinary reflux or obstruction from a continent diversion and from anastomotic stricture or tumor recurrence at the ureteroileal anastomoses.

Table. Incidence of complications after urinary diversion

Type	Estimated Incidence
Early complications	
Bowel-related	30%
Ileus	16%–26%
Small-bowel obstruction	7%–10%
Anastomotic bowel leak	1%–3%
Urine leaks	2%–8%
Ureteroileal anastomotic obstruction	3%–4%
Infection—all:	20%–25%
UTI	25%
C. diff colitis	2%–5%
Late complications	
Stomal stenosis–ileal conduit	2%–3%
Parastomal hernia	50%
Ureteroileal stricture	10%
Neobladder orthotopic diversion:	
Hypercontinence	10%–25%
Urinary incontinence	40%
Continent catheterizable diversion:	
Pouch rupture	<2%
Stomal stenosis	15%–30%
Urolithiasis:	
Kidney stones	10%–15%
Catheterizable pouch	10%–15%
Continent diversion fistulas:	
Neobladder-enteric	<3%
Neobladder-vaginal	0%–10%

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Study Questions Volume 40 Lesson 24

1. A 73-year-old man has cT3bN0M0 bladder cancer and right hydronephrosis requiring percutaneous nephrostomy tube drainage. He receives cisplatin-based neoadjuvant chemotherapy, which is complicated by pyelonephritis, urosepsis and bacteremia requiring hospitalization and a 14-day course of antibiotic therapy. He recovers and ultimately undergoes cystectomy and ileal conduit diversion. Three days after surgery, he now has foul-smelling watery diarrhea, a white blood count of 14K and a temperature of 100.5°F. His greatest risk factor for his current condition is
   a. age
   b. locally advanced disease
   c. prior history of antibiotic usage
   d. previous neoadjuvant chemotherapy

2. An otherwise healthy 77-year-old man with high-risk bladder cancer underwent cystectomy and ileal conduit 6 months ago. He appears well and his vital signs are normal. However, his serum sodium is 129, potassium is 4.2, carbon dioxide is 19, chloride is 107, blood urea nitrogen is 19 and creatinine is 1.06. The next step is
   a. observe the patient for 3–6 months
   b. increase his daily water intake
   c. initiate sodium bicarbonate
   d. prescribe chlorpromazine

3. A patient with severe vitamin B12 deficiency, resulting from resection of the terminal ileum, may present with
   a. weight gain
   b. polydipsia
   c. neuralgias
   d. gastrointestinal bleeding

4. Stone formation after continent urinary diversion often results from incomplete emptying and
   a. hypocitraturia and hyperoxaluria
   b. hypercalcemia and excessive uricosuria
   c. chronic bacteriuria and urinary pH <6.0
   d. excess urinary magnesium, ammonium and phosphate

5. A 59-year-old woman is undergoing robotic radical cystectomy and orthotopic neobladder for bacillus Calmette-Guérin unresponsive carcinoma in situ. Intraoperatively, an anterior vaginotomy is made just posterior to the bladder neck. To maximally reduce the risk of future neovesico-vaginal fistula, the surgeon should
   a. convert to an open vaginal repair
   b. use fine polypropylene suture to ensure vaginal closure
   c. interpose omentum between the vaginal and urethral closures
   d. abort the orthotopic neobladder diversion