Bladder Reconstruction

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1. Introduction

Indications for bladder reconstruction are varied and typically reserved for patients who have failed more conservative options. Reconstruction for malignant indications is often dictated primarily by cancer stage while benign indications are subject to a vast array of considerations. Many reconstruction techniques exist, and these patients require careful preoperative evaluation and counseling to determine the best option.

2. Definition

Bladder reconstruction includes urinary diversion and enterocystoplasty, or bladder augmentation. Urinary diversion is defined as surgical rerouting of urine to exit the body other than via the native bladder and/or urethra with the exception of orthotopic diversions. In contrast, bladder augmentation enhances bladder capacity and compliance by incorporating bowel segments into the bladder wall without altering the bladder outlet. Urinary diversions include: cutaneous ureterostomies, urinary conduits (urostomy), continent cutaneous urinary reservoirs, and orthotropic urinary reconstruction (neobladder).

3. Risk Factors and Indications

Indications for urinary diversion include oncologic and non-oncologic pathologies. Oncologic indications for urinary diversion include primary bladder malignancy, pelvic malignancies with tumor invasion into the bladder, or any other malignant process which involves and interrupts the urinary system. Pelvic exenteration or radical cystectomy may be performed for urologic, gynecologic, colorectal, or other retroperitoneal/pelvic malignancies. Patients with a history of pelvic radiation for malignancy may develop subsequent issues resulting in end-stage bladder dysfunction including hemorrhagic cystitis, urethral stricture, altered compliance, refractory incontinence, various fistulas, and refractory pain.

Non-oncologic indications for bladder reconstruction include neurogenic bladder, vesicoureteral dysfunction, overactive bladder, chronic cystitis/bladder pain syndrome, refractory urethral stricture disease, and radiation cystitis. These surgeries are typically performed to protect renal function or as a last resort to improve quality of life after other treatment options have failed.[1,2,3]

4. Epidemiology and Pathophysiology

Epidemiology

Bladder cancer is estimated to account for 4.2% of all cancers diagnosed in the United States in 2022, or approximately 81,180 new cases.[4] Data from the National Cancer Database revealed that 27,170 radical

cystectomies for bladder cancer were done between 2004 and 2013. Over the study period, the utilization of continent diversion declined from 17.2% in 2004 to 2006 to 12.1% in 2010 to 2013. This may be accounted for by the rising number of minimally invasive radical cystectomies, as when analyzing high-volume facilities, the continent diversion rate was 19.7% for those performing >75% open approach and 10.2% for those performing >75% minimally invasive approach.[5]

Pathophysiology of Bowel Segments in Urinary Diversion

The stomach, ileum or colon may all be used for urinary diversion, but the differing physiological features of each segment must be considered.[6,7] Jejunum is typically avoided due to significant electrolyte disturbances. Different bowel segments have specific absorptive and secretory properties.[8] The addition of each bowel segment to the urinary tract and the loss of each bowel segment from the intestinal tract results in differing effects and may promote secondary malignancy. [6] (See **Table 1**).

Table 1: Pathophysiology of Bowel Segments in Urinary Diversion

Bowel Segment	Absorptive/Secretory Properties	Urinary Tract Addition Effects	Intestinal Tract Loss Effects	Secondary Malignancy Potential
Stomach	Less permeable to solutes, produces less mucous	Net excretion of chloride, hypochloremic metabolic alkalosis, rare ulcers		
Jejunum	*Not recommended due to significant electrolyte abnormalities	Hyperkalemic, hypochloremic metabolic acidosis		
Ileum	Higher reabsorption of electrolytes when used as a reservoir	Hyperchloremic metabolic acidosis with total-body potassium depletion and hypocalcemia	Vit B_{12} deficiency, diarrhea, fat malabsorption, post-op bowel obstruction in 10% of patients	Late carcinoma/ adenocarcinoma development.
Colon	Higher reabsorption of electrolytes when used as a reservoir	Hyperchloremic metabolic acidosis with total-body potassium depletion and hypocalcemia	Fewer nutritional effects than ileum with ileocecal valve intact, 4% post-op bowel obstruction	Late carcinoma/ adenocarcinoma development. Higher adenocarcinoma risk with fecal and urinary streams combined

5. Diagnosis and Evaluation

Pre-operative Evaluation

When determining the appropriate bowel segment for use, patient medical and surgical history with careful physical examination must be obtained to inform surgical decision making. Bowel history should include bowel function, bowel diseases, prior procedures, and prior radiation. In patients who have had prior bowel resection, the utilized bowel segment should include the prior anastomotic segment, when possible, to avoid bowel devascularization. Physical examination should include evaluation for any evidence of metastatic disease if the indication for urinary diversion is malignancy. The abdominal examination for all patients should assess for prior surgical scars and abdominal habitus for surgical planning, and (if applicable) stoma placement. Patients should be assessed for manual dexterity if a continent urinary diversion or neobladder is planned as ability to perform self-catheterization is required. Renal and hepatic function must be assessed due to risk from increased electrolyte reabsorption from continent cutaneous and orthotopic urinary diversions.

Preoperative planning for any type of urinary diversion must include contingency planning and patient counseling regarding alternate diversions based on surgical findings. Oncologic control must not be compromised for patient preference of type of urinary diversion. Patients who opt for an orthotopic diversion must be counseled that presence of cancer at the urethral margin may alter the type of urinary diversion performed. When comparing diversions, there are no conclusive studies to suggest one type is superior for upper tract preservation or infection. In addition, overall quality of life is classically thought to be similar regardless of diversion technique. However, decision regret regarding choice of diversion correlates with lower quality of life. [9,10,11,12] Fortunately, decision regret is rare when patients are counseled on all reconstructive options and allowed to make an informed decision.[12] This is why the AUA Guideline for Muscle-Invasive Bladder Cancer recommend that all patients undergoing radical cystectomy should be counseled on all types of urinary diversion.[13]

When helping a patient choose the best urinary diversion for their situation, it is important to consider many factors. For orthotopic neobladder, urethral stricture disease would be a relative contraindication. As mentioned above, it is also important to assure they have the ability to perform self-catheterization if needed. For continent cutaneous diversions, the same consideration to manual dexterity is imperative. One may also consider the abdominal wall depth and its impact on the catheterizable channel. Last, a patient's body habitus may require unique surgical considerations for each type of diversion. For example, morbidly obese patients with very thick abdominal walls may require modification of techniques for stoma creation, such as an end-loop (Turnbull) stoma for ileal conduits in order to avoid mesenteric vascular compromise. Additionally, both body habitus and pelvic bone shape may pose challenges for orthotopic neobladder creation, particularly during open procedures. The potential implications of these factors and others should be reviewed with patients to help them choose the best urinary diversion for their situation.

Recent retrospective studies utilizing validated patient questionnaires suggest that the choice of urinary diversion significantly affects aspects of post-operative quality of life. Follow-up of patients after neobladder creation demonstrates lower scores in the urinary function domain when compared to conduit or continent cutaneous diversion. However, urinary bother scores are similar between diversion types. Additionally, patients with neobladders appear to have more favorable cognitive and emotional function scores on follow-up surveys. Sexual bother scores tended to be lower in patients with neobladder diversion. Prospective, longitudinal studies will help to further elucidate the impact of urinary diversion selection on quality of life.[14,15,16]

Post-operative Pathways

History and physical examination of post-operative patients should be focused to evaluate for possible morbidities of urinary diversion. History should include questions regarding fever, pain, voiding dysfunction, incontinence, stoma problems, bowel dysfunction, and quality of life. Physical examination should include examination for recurrence of malignancy in oncology patients and examination of the stoma for applicable diversions.

Appropriate **laboratory studies** include a CBC and basic metabolic panel to assess for anemia, acidosis/alkalosis or electrolyte abnormalities due to absorptive/secretory properties of the bowel segment employed. Vitamin B_{12} is absorbed in the distal ileum and should be checked in patients who have ileum used for urinary diversion to assess for deficiency.[7,8] This will typically require long-term supplementation in neobladder patients due to the length of ileum used. Due to the decreased bowel absorption in this setting, this supplementation should be via intramuscular injection or sublingual tablet. Urine cytology and urethral washing cytology may be assessed in urothelial carcinoma patients, particularly those with orthotopic urinary diversions. Urinalysis and/or urine culture should be checked in patients symptomatic for urinary tract infection and microscopic hematuria on urinalysis may be an early indication of malignancy. Gross hematuria, particularly in oncology patients, should be expeditiously evaluated.

An evidence-based multimodal care pathway known as enhanced recovery after surgery (ERAS) should be strongly advocated in all patients undergoing radical cystectomy with urinary diversion. These pathways have been shown to decrease GI complications and reduce hospital length of stay.[17] ERAS pathways incorporate pre-operative (carbohydrate loading, prehabilitation, alvimopan usage), intra-operative (decreased fluid load, minimized blood loss and bowel manipulation), and post-operative (omission of nasogastric tube, early ambulation, non-opioid analgesia) factors.

Radiologic studies and endoscopic evaluation may be performed if there is concern for post-operative urinary obstruction, infection, retention, or development of secondary malignancy. To evaluate for obstruction at the ureteral anastomosis, ultrasound or CT scan can reveal hydronephrosis beyond what may be expected for urinary diversion. In the absence of hydronephrosis, obstruction is unlikely though hydronephrosis may be seen without obstruction in the setting of a refluxing anastomoses or chronic dilation. Further workup often includes a loopogram/pouchogram to determine for reflux of contrast. Nuclear renography or CT/MR urography can also evaluate for obstruction. In benign diversion, obstruction is most often from benign/ischemic stricture, particularly of the left ureter if tunneled under the sigmoid colon. Appropriate imaging of the stricture may be needed with an antegrade nephrostogram. If the diversion was for oncologic indications, benign/ischemic strictures are still most common, but recurrence of malignancy needs to be ruled out. This may require cytology, retrograde or antegrade ureteroscopy, and possible biopsy. For bladder augmentation, neobladders, or continent diversions, cystoscopy may need to be performed at regular intervals to rule out malignancy or when there is suspicion for stones or other abnormality. Urodynamics may be utilized to investigate the health and safety of the upper tracts (compliance), capacity of the reservoir, or causes of incontinence. [18] The bowel may be assessed for chronic diarrhea, partial or complete obstruction, anastomotic leaks, fistula, or malignancy with GI radiologic studies and endoscopy.

6. Treatment and Surgical Techniques

Cutaneous Ureterostomies

Cutaneous ureterostomies allow for urinary drainage from the kidneys without bowel resection and reanastomosis. This avoids the long-term sequelae of electrolyte and absorptive abnormalities associated with bowel segment use. Although infrequently utilized, cutaneous ureterostomies may be a suitable alternative to other forms of diversion after radical cystectomy in elderly patients with substantial comorbidities, or in

patients where resection of the bowel may carry significant risk (i.e. short gut syndrome, inflammatory bowel disease). Exclusion of bowel resection and reanastomosis may lead to decreased peri-operative complications in this patient population.[19] The primary complication of cutaneous ureterostomy is stricture or obstruction at the ureterostomy site. This may be managed with stenting or with reanastomosis. However, initial postoperative stenting for greater than 3 months has been shown to decrease risk of stricture.[20]

Conduits

Ileal conduits utilize a segment of ileum to connect the ureters to a urostomy which exits at the abdominal wall through the rectus muscle, typically at the peak of the abdominal fat roll. [21] Pre-operative marking of the stoma site with an experienced clinician, such as a certified Wound Ostomy Continence Nurse (WOCN), is particularly helpful and is recommended by the AUA (https://www.auanet.org/Documents/education/clinical-guidance/Stoma-Marking.pdf). Ureteral anastomoses for ileal conduits include **Bricker technique** (two separate anastomoses) and the **Wallace technique** (one common anastomosis). Colonic conduits may be performed using **transverse or sigmoid colon** segments, with transverse colon conduits preferred in patients with a history of pelvic radiation.

Continent Cutaneous Urinary Reservoirs

Continent cutaneous urinary reservoirs allow for storage of urine combined with self-catheterization to empty urine.[7] Ileal, colonic, and gastric bowel segments have all been utilized for cutaneous urinary reservoir creation, with the right colon being the most common contemporary technique. Continence in catheterizable channels is created by use of the ileocecal valve, channel tunneling, an intussuscepted nipple valve, flap valve, or hydraulic valve.

Ileal continent cutaneous urinary reservoirs (Kock pouch and “T” pouch) use a nipple valve and preserve the ileocecal valve. As nipple and flap valve formation can be difficult, many urologists use other methods of continent cutaneous urinary diversion where the ileocecal valve is employed as the continence method. [7] **Colon continent cutaneous urinary reservoirs** can be performed from the right colon (Indiana, Miami, and Mainz pouches), the transverse colon, and the sigmoid colon and use the ileocecal valve as the continence mechanism. **Gastric continent cutaneous urinary reservoirs** use a wedge-shaped segment of stomach from the greater curvature and employ a Mitrofanoff continence mechanism.[22]

Orthotopic Urinary Reconstruction (Neobladders)

Orthotopic urinary reconstruction may be performed using ileum (Studer, Hautmann, D-LUP, and T neobladders) or the right colon (Mainz neobladder) or sigmoid colon.[23,24] Neobladders must be able to store adequate volume of urine at low pressure and rely on an adequate sphincter to maintain continence. A storage volume of 400-500 mL of urine is recommended. The bowel segment used is detubularized and reconstructed into a spherical shape. The rhabdosphincter is the urinary continence mechanism for orthotopic neobladders. An estimated 10-25% of patients retain urine and require intermittent catheterization while others experience urinary incontinence, particularly at night.[8] Orthotopic neobladder urinary retention or “hypercontinence” is more common in females.

Bladder Augmentation

Patients with neurogenic bladder can develop high pressure, small capacity bladders that present a danger to the upper tracts due to their decreased compliance. Augmenting the dome of the bladder with a detubularized segment of ileum can allow for increased capacity and lower storage pressures (increased compliance). Depending on the desired bladder capacity, the section of ileum may be 20-40 cm in length. Commonly, patients will rely on catheterization after augmentation. [20] Bladder augmentation is additionally a late stage

option for refractory cases of IC/BPS and OAB.[1,2] Although there is not a definitive association with bladder augmentation, it is important to remember that the neurogenic bladder patient population is at an increased risk of aggressive bladder malignancy.[25]

Intracorporeal Diversion

With the increasing utilization of laparoscopic and robotic surgery, intracorporeal diversion is becoming more common. The possible advantages including decreased readmission rates, decreased perioperative blood transfusion rates, and shorter length of hospitalization. However, this may come at the tradeoff of longer operative times and a steep learning curve for intracorporeal diversion. Numerous centers are currently performing intracorporeal diversions with close attention to their outcomes. Recent studies suggest that there is a substantial learning curve, but complications improve significantly with surgeon experience.[26,27,28,29] A recent randomized trial of open cystectomy and diversion versus robotic with intracorporeal diversion found lower complication rates and more time out of the hospital in the first 90 days with the robotic technique.[30] Further investigations will help to clearly define the role of this technique.

7. Treatment Complications

Complications vary depending on which technique is employed. Bowel obstruction, bowel leak, urinary leak, ureteral-enteric anastomotic stricture, and parastomal hernia are some of the more common clinically significant complications.[7,6,18,23]

Bowel obstruction

The reported rates of bowel obstruction after urinary diversion vary significantly based on the type of diversion performed. Ileal conduit diversions have approximately 7-10% rate of small bowel obstruction. This is similar to the reported rates of gastric conduit associated bowel obstruction. Colon conduits have a lower rate of bowel obstruction at approximately 4%. Management of early post-operative bowel obstruction in the absence of peritoneal signs should be similar to post-operative ileus. If supportive therapy fails, abdominal exploration is likely warranted. In the long term, intestinal stenosis may occur causing symptoms or chronic partial small bowel obstruction. Obstruction is commonly secondary to ischemia, adhesions, internal hernia, or local infection near the anastomosis. Keys to prevention include: utilization of non-radiated bowel segments, ensuring the bowel appears well vascularized prior to anastomosis, and closure of all apertures. In all patients with malignant indications and a more remote history of diversion, it is important to consider recurrent malignancy as a potential etiology for obstruction.[26,31,32]

Bowel leak

Bowel leak is a rare, morbid, and potentially fatal complication after urinary diversion. Intestinal leak is estimated to occur in approximately 1-2% of cases. The mean time to diagnosis of bowel leak is 12 days post-operatively, but some presentations occur beyond 30 days after primary surgery. Management of bowel leak is nuanced and often dictated by both clinician experience and patient-specific factors. Both conservative and operative intervention are options depending on the clinical scenario. Risk factors include ischemia, local infection, drain placement onto the anastomosis, and anastomosis of radiated bowel.[26]

Urine Leak

The rate of urinary leak after radical cystectomy with urinary diversion is less than 5%. Modern stent technology has been credited with a reduction in the rate of urine leak after diversion. However, the necessity of ureteral stenting after urinary diversion is being challenged by some institutions, particularly in the case of intracorporeal diversion.[33] Early urinary leak can be diagnosed by high abdominal drain output, elevated drain creatinine levels, elevated serum creatinine levels secondary to reabsorption, chemical peritonitis, ileus, or

abdominal distention. The primary management for urinary leak is maximizing urinary drainage and diversion of urine away from the site of leakage. This can include prolonged catheter drainage and/or percutaneous drainage. In some situations, percutaneous nephrostomy tube placement may be required.[26,31,32]

Uretero-enteric Stricture

Ureteral stricture occurrence is estimated to occur in 3-10% of patients. Presentation may be asymptomatic imaging findings, pain, infection, or worsening renal function. The initial management is often percutaneous nephrostomy tube with subsequent conversion to internal ureteral stent if primary retrograde stenting is not feasible. Definitive management may be attempted endoscopically, but endoscopic management is only successful in 50-60% of cases at 2-year follow-up. Surgical repair is the most definitive long-term solution. It is important to rule-out malignancy as a cause for obstruction when applicable. Ureteral stenting at the time of initial surgery does not prevent subsequent ureteral stricture formation.[26,31,32]

Parastomal Hernia

Parastomal hernia is a common complication after conduit creation. The incidence of clinically evident hernia after conduit diversion is approximately 28-40%. As many as 30% of these patients who develop hernia are subsequently referred for surgical repair due to symptoms such as discomfort, bowel symptoms, or pouching difficulties. At the time of creation, conduits should traverse the rectus body perpendicular to the rectus fascia to minimize hernia formation, and the stoma should be placed away from abdominal folds for ease of pouching and urostomy management. Anterior fascial fixation sutures do not decrease the rate of parastomal hernia formation. The placement of prophylactic mesh is currently under investigation, as it has shown promise in colorectal surgery patients. [26,31,34,35] One such trial revealed that prophylactic implantation of sublay mesh reduced the incidence of clinical parastomal hernia from 23% to 11%, with a modest increase in operative time and no increase in complications.[36]

8. Costs

Expenditures for bladder cancer care were estimated to be approximately $4 billion in 2010 and are projected to exceed $5 billion per year in 2020.[37] A study of the Nationwide Readmission Database showed that continent urinary diversion after cystectomy is associated with higher costs and increased readmission rates when compared to incontinent diversion.[38]

9. Clinical Care Pathway

A thorough history and physical examination should be performed for all patients who will undergo radical cystectomy. Patients should be counseled regarding their options for urinary diversion and alternate options for urinary diversion should be planned and discussed pre-operatively in the event the desired diversion cannot be performed. Post-operatively patients should be monitored for malignancy recurrence if cystectomy was performed for cancer and should be monitored for complications and electrolyte abnormalities associated with urinary diversion.

10. Take Home Message

Bladder reconstruction involves many complex factors and is difficult to homogenize to one patient population. The main indication for reconstruction is radical cystectomy for bladder cancer. Typically, ileum or colon is used due to lower rates of electrolyte abnormalities. The most common diversion is an ileal conduit due to its relative surgical simplicity and comparable quality of life compared to other diversions.

Videos

A Novel Technique of Robotic-Assisted Simple Cystectomy during Robotic-Assisted Urinary Diversion for Benign Indications

Robotic Augmentation Enterocystoplasty and Appendicovesicostomy

Robot-Assisted Laparoscopic Intracorporeal Ileal Conduit Urinary Diversion: Step-By-Step

THE STEPWISE APPROACH TO ROBOTIC-ASSISTED LAPAROSCOPIC INTRACORPOREAL URINARY DIVERSION

Robotic-assisted Laparoscopic Boari Flap

Emergent Robotic-Assisted Repair of Intraperitoneal Bladder Injury

Presentations

Bladder Reconstruction Presentation 1

References

1 Lightner, D. J., et al. "Diagnosis and Treatment of Overactive Bladder (Non-Neurogenic) in Adults: Aua/Sufu Guideline Amendment 2019." J Urol 202.3 (2019): 558-63. Print.

2 ☆ Hanno P et al. Diagnosis and Treatment of Interstitial Cystitis/Bladder Pain Syndrome: AUA Guideline Amendment J Urol. 2015 May;193(5):1545-53

3 Al Hussein Al Awamlh B, Lee DJ, Nguyen DP, Green DA, Shariat SF, Scherr DS. Assessment of the quality-of-life and functional outcomes in patients undergoing cystectomy and urinary diversion for the management of radiation-induced refractory benign disease. Urology. 2015 Feb;85(2):394-400.

4 Siegel, RL, Miller, KD, Fuchs, HE, Jemal, A. Cancer statistics, 2022. CA Cancer J Clin. 2022. https://doi.org/10.3322/caac.21708

5 Lin-Brande, M., et al."Assessing Trends in Urinary Diversion after Radical Cystectomy for Bladder Cancer in the United States." Urol Oncol 37.3 (2019): 180.e1-80.e9. Print.

6 Dahl DM: Use of intestinal segments in urinary diversion. In: Campbell Walsh Urology, vol. 3, 2016, Chapter 97.

7 DeCastro GJ, McKiernan JM, Benson MC: Cutaneous continent urinary diversion. In: Campbell Walsh Urology, vol. 3, 2016, Chapter 98.

8 ☆ Novak TE, SM: Fluid, electrolyte and acid-base abnormalities in urological practice. AUA Update Series 2006; 25.

9 Cody, June D, et al. “Urinary Diversion and Bladder Reconstruction/Replacement Using Intestinal Segments for Intractable Incontinence or Following Cystectomy.” Cochrane Database of Systematic Reviews, 2012, doi:10.1002/14651858.cd003306.pub2.

10 Large MC, Malik R, Cohn JA, Richards KA, Ganshert C, Kunnavakkum R, Smith ND, Steinberg GD. Prospective health-related quality of life analysis for patients undergoing radical cystectomy and urinary diversion. Urology. 2014 Oct;84(4):808-13.

11 Siracusano, S., et al. "Quality of Life Following Urinary Diversion: Orthotopic Ileal Neobladder Versus Ileal Conduit. A Multicentre Study among Long-Term, Female Bladder Cancer Survivors." Eur J Surg Oncol 45.3 (2019): 477-81. Print.

12 ☆ Check DK, Leo MC, Banegas MP, et al. Decision Regret Related to Urinary Diversion Choice among Patients Treated with Cystectomy. J Urol. 2020;203(1):159-163.

13 ☆ Chang SS, Bochner BH, Chou R et al: Treatment of non-metastatic muscle-invasive bladder cancer: AUA/ASCO/ASTRO/SUO guideline. J Urol 2017; 198: 552.

14 Goldberg, Hanan, et al. “Orthotopic Neobladder vs. Ileal Conduit Urinary Diversion: A Long-Term Quality-of-Life Comparison.” Urologic Oncology: Seminars and Original Investigations, vol. 34, no. 3, 2016, doi:10.1016/j.urolonc.2015.10.006.

15 Gellhaus, Paul T., et al. “Long-Term Health-Related Quality of Life Outcomes Following Radical Cystectomy.” Urology, vol. 106, 2017, pp. 82–86., doi:10.1016/j.urology.2017.03.053.

16 Cerruto, Maria Angela, et al. “Health-Related Quality of Life After Radical Cystectomy: A Cross-Sectional Study With Matched-Pair Analysis on Ileal Conduit vs Ileal Orthotopic Neobladder Diversion.” Urology, vol. 108, 2017, pp. 82–89., doi:10.1016/j.urology.2017.06.022.

17 Tyson MD, Chang SS. Enhanced Recovery Pathways Versus Standard Care After Cystectomy: A Meta-analysis of the Effect on Perioperative Outcomes. Eur Urol. 2016 Dec;70(6):995-1003.

18 Fichtner J. Follow-up after urinary diversion. Urol Int. 1999;63(1):40-5

19 Longo, N., et al. "Complications and Quality of Life in Elderly Patients with Several Comorbidities Undergoing Cutaneous Ureterostomy with Single Stoma or Ileal Conduit after Radical Cystectomy." BJU Int 118.4 (2016): 521-6. Print.

20 ☆ Rodríguez AR, Lockhart A, King J, et al. Cutaneous ureterostomy technique for adults and effects of ureteral stenting: an alternative to the ileal conduit. J Urol. 2011;186(5):1939-1943. doi:10.1016/j.juro.2011.07.032

21 ☆ Bianchi M, Trinh QD, Sun M et al.: Discharge patterns after radical cystectomy: contemporary trends in the United States. J Urol 2012; 187: 1206.

22 ☆ Update Series: Contemporary Evaluation and Management of Vesicovaginal Fistula. Ehlert M, Haraway AM and Atiemo HO, Vol. 32, Lesson 7, 2013 https://auau.auanet.org/content/update-series-volume-32-2013

23 Skinner, E, Daneshmand S: Orthotopic Urinary Diversion. In: Campbell-Walsh Urology, vol. 3, 2016, Chapter 99.

☆ † El-Galley R, Keane T: Orthotopic neobladder. AUA Update Series 2003; Volume 22, Lesson 36.

24 Excellent review of orthotopic neobladder with illustrations of each different technique. Thorough and detailed update.

25 Welk BK, Herschorn S: Augmentation Cystoplasty. AUA Update Series 2012; Volume 31, Lesson 20.

26 Guru, KA: Minimally Invasive Urinary Diversion. In: Campbell-Walsh Urology, vol. 3, 2016, Chapter 100

27 Ahmed, Kamran, et al. “Analysis of Intracorporeal Compared with Extracorporeal Urinary Diversion After Robot-Assisted Radical Cystectomy: Results from the International Robotic Cystectomy Consortium.” European Urology, vol. 65, no. 2, 2014, pp. 340–347., doi:10.1016/j.eururo.2013.09.042.

28 Hussein, Ahmed Aly, et al. “Mp49-01 Outcomes Of Intracorporeal Urinary Diversion After Robot-Assisted Radical Cystectomy: Results From The International Robotic Cystectomy Consortium.” The Journal of Urology, vol. 199, no. 4, 2018, doi:10.1016/j.juro.2018.02.1592.

29 Bertolo, R., et al. "Perioperative Outcomes and Complications after Robotic Radical Cystectomy with Intracorporeal or Extracorporeal Ileal Conduit Urinary Diversion: Head-to-Head Comparison from a Single-Institutional Prospective Study." Urology 129 (2019): 98-105. Print.

30 Catto JWF, Khetrapal P, Ricciardi F, et al. Effect of Robot-Assisted Radical Cystectomy With Intracorporeal Urinary Diversion vs Open Radical Cystectomy on 90-Day Morbidity and Mortality Among Patients With Bladder Cancer: A Randomized Clinical Trial. JAMA. 2022;327(21):2092–2103. doi:10.1001/jama.2022.7393

31 Amini, Erfan, and Hooman Djaladat. “Long-Term Complications of Urinary Diversion.” Current Opinion in Urology, vol. 25, no. 6, 2015, pp. 570–577., doi:10.1097/mou.0000000000000222.

32 Anderson, Christopher B., and James M. Mckiernan. “Surgical Complications of Urinary Diversion.” Urologic Clinics of North America, vol. 45, no. 1, 2018, pp. 79–90., doi:10.1016/j.ucl.2017.09.008.

33 Tan, Wei Phin, et al. “Intentional Omission of Ureteral Stents During Robotic-Assisted Intracorporeal Ureteroenteric Anastomosis: Is It Safe and Feasible?” Urology, vol. 102, 2017, pp. 116–120., doi:10.1016/j.urology.2017.01.014.

34 Pisters, Andrew L., et al. “Anterior Fascial Fixation Does Not Reduce the Parastomal Hernia Rate After Radical Cystectomy and Ileal Conduit.” Urology, vol. 83, no. 6, 2014, pp. 1427–1432., doi:10.1016/j.urology.2014.01.041.

35 Farnham, Scott B., and Michael S. Cookson. “Surgical Complications of Urinary Diversion.” World Journal of Urology, vol. 22, no. 3, 2004, pp. 157–167., doi:10.1007/s00345-004-0429-5.

36 Liedberg F, Kollberg P, Allerbo M, Baseckas G, Brandstedt J, et al. Preventing Parastomal Hernia After Ileal Conduit by the Use of a Prophylactic Mesh: A Randomised Study. European Urology, Volume 78, Issue 5, 757 - 763

37 Mariotto, A. B., et al. “Projections of the Cost of Cancer Care in the United States: 2010-2020.” JNCI Journal of the National Cancer Institute, vol. 103, no. 2, Dec. 2011, pp. 117–128., doi:10.1093/jnci/djq495.

38 Joice, Gregory A., et al. “Hospitalisation and Readmission Costs after Radical Cystectomy in a Nationally Representative Sample: Does Urinary Reconstruction Matter?” BJU International, 2018, doi:10.1111/bju.14448.