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CANCER-ASSOCIATED VOIDING DYSFUNCTION (S ELLIOTT AND J PARISER, SECTION EDITORS)

Voiding Dysfunction After Neobladder Urinary Diversion

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Abstract

Purpose of Review Radical cystectomy and urinary diversion remains the gold standard treatment for patients with high risk or muscle invasive bladder cancer. Despite the fact that a majority of patients are eligible for orthotopic neobladder, over 85% of patients receive incontinent urinary diversions, primarily over concerns for complications or postoperative voiding dysfunction. In this review, we explore the incidence, etiology, and treatment of voiding dysfunction after orthotopic neobladder creation in male and female patients.

Recent Findings Voiding dysfunction after orthotopic neobladder consists of urinary incontinence and urinary retention. Both are well-recognized potential sequelae, but occur more commonly in female patients. Recent studies have characterized voiding dysfunction as a dynamic problem that improves with time. While treatment options are limited, several techniques exist to minimize the risks of voiding dysfunction after orthotopic neobladder.

Summary Despite excellent functional outcomes in the majority of patients, concerns over voiding dysfunction after orthotopic neobladder may in part explain the disparity in receipt of incontinent versus continent urinary diversions. More prospective and patient-reported studies of voiding outcomes are required and newer more effective treatment options for voiding dysfunction are needed.

Keywords Urinary diversion · Neobladder · Bladder cancer · Radical cystectomy · Urothelial carcinoma · Voiding dysfunction · Urinary retention

Introduction

Radical cystectomy (RC) with pelvic lymph node dissection and urinary diversion (UD) is the gold standard therapy for patients with muscle invasive bladder cancer and certain high-risk non-muscle invasive tumors [1, 2]. The choice of orthotopic neobladder (ONB), ileal conduit, or continent cutaneous urinary diversion is a critical one that depends on patient- and physician-related factors. Several oncologic, functional, and metabolic contraindications exist to ONB, including a positive urethral margin, urethral stricture disease, extensive gross extravesical disease, renal or hepatic dysfunction, and a physical or mental impairment to perform self-catheterization [3]. Despite these, most patients are eligible for an ONB and will choose one if offered [4, 5]. Perceived advantages of ONB include improved body image and the ability to have spontaneous voiding without an external appliance [6, 7]. However, recent series show that almost 90% of all patients undergoing RC in the USA today receive ileal conduit urinary diversion. The odds of receiving an ONB are higher for patients treated at academic or high-volume centers, suggesting the importance of surgeon comfort or experience with the procedure [8•, 9•]. While exact reasons for the disparity in urinary diversions are unknown, patient- and physician-reported reasons for choosing an incontinent diversion over ONB primarily include concerns over urinary functional outcomes [5].

The functional goals of ONB creation are to create a reservoir with similar function to the native bladder, with adequate low-pressure storage and socially acceptable voiding. Dysfunction in either domain, while not the norm, can occur

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and manifests as urinary incontinence or urinary retention. Herein, we explore voiding dysfunction after ONB, its etiology, treatment or prevention, and unique differences in male and female patients.

A Failure to Store—Urinary Incontinence

Incidence and Etiology

Despite concerns over urinary incontinence after ONB, adequate continence is achieved in the majority of patients. Reported rates of daytime continence vary from 70 to 100% after ONB [10–19], but can be as low as 50% in female patients [18]. Nighttime continence rates typically lag behind daytime rates and range from 50 to 95% [10–18] (Table 1). However, these numbers come mostly from older retrospective studies without patient-reported severity or documentation of continence over time. A recent series from our institution showed that continence is dynamic and improves with time. We studied 188 men who received ONB using a validated patient-reported pad usage questionnaire. Continence was defined as the use of no pads or pads that were essentially dry and for protection only. Daytime continence improved from 59% at 3 months after surgery and to 92% at 12–18 months after surgery. Nighttime continence similarly improved from 28% at 3 months to 51% at 18–36 months after surgery [15••]. A study by Anderson et al. documented the severity of incontinence in 49 female patients receiving ONB at their institution. At a median follow-up of 8.9 months, 57% were continent during the day. Incontinence was reported as mild (1 pad per day) in 29% of patients, moderate (2–4 pads per day) in 9%, and severe (5 or more pads per day) in 62%. Nighttime incontinence was present in 55% of patients and was mild in 59%, moderate in 7.4%, and severe in 14.8% [17].

Continence after ONB creation depends on the reservoir (adequate pouch capacity and pressure) and outlet (intact urethra and sphincter mechanism). The two most common types of neobladder performed are that of Hautman [10], which uses approximately 70 cm of ileum and Studer [20], which uses approximately 60 cm. Both rely on detubalarized segments of bowel that are reconfigured into a spherical shape. Detubularization serves to eliminate unwanted contractions that may increase pressure via peristaltic activity. Reconstruction of the detubularized bowel into a spherical shape allows for the greatest capacity as volume increases by the radius cubed. Similarly, a larger spherical radius provides for the lowest internal pressure per LaPlace's law [21]. One purported reason for the improvement in continence over time is an increased capacity and decreased pressure as the

Table 1 The incidence of voiding dysfunction after orthotopic neobladder

Author, location	Year	*N* (% male)	Daytime continence	Nighttime continence	Catheterization
Stein et al., Los Angeles, CA	1997	34 (0%)	88%	82%	15% (Some form of intermittent catheterization)
Hautman et al., Ulm, Germany	1999	363 (100%)	83.7%	66.3%	3.9% (some intermittent catheterization) 1.7% (regular intermittent catheterization)
Steven et al., Copenhagen, Denmark	2000	166 (100%)	93.4% (6 months) 97.7% (1 year) 98.6% (3 years) 100% (5 years)	60.3% (6 months) 75.2% (1 year) 79.7% (3 years) 94.6% (5 years)	15.4% (6 months) 32.9% (3 years) 43.2% (5 years) (Catheterization performed for residuals > 100 cc)
Abol-Enein et al., Mansoura, Egypt	2001	344 (77%)	93.3%	80%	–
Lee et al., Kyogju, Korea	2003	139 (78%)	67% (Hautman) 67% (Studer)	47% (Hautman) 40% (Studer)	9.5% (Hautman) 9.3% (Studer) (Catheterization performed for residuals > 100 cc)
Stein et al., Los Angeles, CA	2004	209 (80%)	87%	72%	20% (men) 43% (women) (Some form of intermittent catheterization)
Studer et al., Bern, Switzerland	2006	482 (91%)	92%	79%	22% (post-void residual > 100 cc) 2.9% (regular intermittent catheterization)
Anderson et al., Nashville, TN	2012	49 (0%)	57%	45%	30.6% (Mean post-void residual 134.9 cc)
Gross et al., Bern, Switzerland	2015	73 (0%)	49%	–	–
Clifford et al., Los Angeles, CA	2016	188 (100%)	59% (3 months) 92% (12–18 months)	28% (3 months) 51% (18–36 months)	10% (catheterization at least once per day) 5.3% (catheterization due to incomplete emptying)

bowel stretches. Median capacity for ileal ONBs typically increases to approach 500 cc after 1 year, regardless of technique [11, 22–24].

An intact external urinary sphincter is essential in achieving urinary continence. However, even if preserved, this sphincter is under autonomic voluntary control, which explains the lower rates of continence at night and slower time to nocturnal continence as compared with awake daytime continence. Nocturnal incontinence occurs from sphincter relaxation in conjunction with the lack of detrusor-sphincter feedback that existed prior to RC [25]. The relationship of pouch capacity, pressure, and sphincter function is clear in the nocturnal setting where incontinence is more likely to occur in patients with a relaxed sphincter, higher pouch pressures, and greater residual urine [26].

Techniques to Preserve Continence

Detubularization and creation of an ONB with adequate volume and pressure are essential in attaining proper reservoir storage for continence. An adequate ONB outlet can be obtained through meticulous apical dissection to provide urethral length and nerve sparing techniques. Preservation of nerve branches from the pelvic plexus and pelvic branch of the pudendal nerve is known to preserve control of the urinary sphincter and supporting pelvic floor [27–29], but also preserves sensation in the membranous urethra [30]. This preservation of sensation explains the ability of nerve sparing procedures to improve both daytime and nighttime continence, as some have suggested leakage of urine into the membranous urethra produces either a reflex or voluntary contraction of the external sphincter [25, 28].

In males, nerve sparing during RC is performed as in radical prostatectomy with preservation of the neurovascular bundles that traverse along the posterolateral plane of the prostate [31]. In females, the neurovascular tissue passes medial to the ureters and lateral to the cervix as well as in the paravaginal areas. Thus, vaginal wall dissection should not be performed more dorsal than the 2 and 10 o'clock positions if possible to minimize nerve injury [32].

Additional techniques that have been reported to avoid nerve injury and maintain urethral support during RC include pelvic organ sparing operations. In men, this includes prostate sparing RC and in females, uterine and vaginal sparing RC. A recent multi-center study from Europe by Voskulien et al. reported their experience with prostate sparing RC for BC. They included 185 patients who, after extensive evaluation to exclude prostate cancer or urothelial cancer at the bladder neck and prostatic urethra, underwent prostate sparing surgery. After a median of 7.5 years, daytime continence was 95.6% and nighttime was 70.2% [33•]. In our experience, we have performed prostate sparing RC and ONB in patients with benign disease to maintain sexual function, but the additional benefit in terms of continence does not appear great enough to outweigh the risks of local and prostatic urothelial recurrence [34]. Higher urinary retention rates are also a concern in older males.

On the other hand, reproductive organ sparing RC and ONB in select females with bladder cancer appears less controversial. Reports from our institution and others have shown the only predictors of reproductive organ involvement in females undergoing RC to be hydronephrosis, trigonal involvement, a palpable posterior bladder mass, and clinical node positive disease [35•, 36]. The benefits of sparing the vagina in women include avoidance of neurovascular dissection and benefits of sparing the uterus include longer urethral lengths and higher urethral closing pressures with resultant better continence [18••]. In the previously mentioned study by Anderson et al. that examined the severity of incontinence in females receiving ONB, the only predictor of daytime continence was prior hysterectomy [17]. We therefore now perform reproductive organ sparing RC in females without high-risk features.

Treatment of Incontinence

Treatment options for urinary incontinence after ONB are limited and consist mostly of conservative therapies, depending on the etiology and severity of incontinence. A detailed history of voiding patterns is essential in guiding treatment strategies. In both males and females, overflow incontinence must be ruled out as a source of incontinence and in females, neobladder-vaginal fistula must be ruled out. After this, first-line options are the same as they would be for any patient with a native bladder and stress urinary continence. These options include pelvic floor strengthening through Kegels exercises or formal pelvic floor physical therapy. Timed voiding is essential to prevent overflow incontinence during the day and particularly at nighttime as elevated residual volumes are a known risk factor for nighttime incontinence. There is currently no limit for what is considered a normal post-void residual for a neobladder, but in general should be less than 250 cc. Surgical options include urethral bulking agents and obstructive slings in women, though caution should be taken in retropubic dissection as patients are at greater risk of bowel or neobladder injury [37]. We have successfully placed artificial urinary sphincters in men with incontinence after ONB, and often times with concomitant inflatable penile prosthesis [38•]. This encourages a thorough preoperative discussion in men whose disease characteristics may limit a nerve sparing procedure.

A Failure to Empty—Urinary Retention

Incidence and Etiology

Emptying failure following ONB construction is a known, but uncommon risk of surgery. Definitions of emptying failure

vary in the literature and include either a complete inability to void or a need for catheterization due to elevated residuals. Catheterization rates are more common in females and range from 15 to 43% [13, 16, 17, 39]. Catheterization rates in males vary from 3.9 to 43% [10–15] with rates of catheterization due a complete inability to void ranging from 1.7 to 5.3% of men [10, 14, 15] (Table 1).

The etiology of emptying failure after ONB has been attributed to mechanical obstruction or dysfunctional voiding, which has been described as post-void residual (PVR) > 100 cc without signs of obstruction. A study by Simon et al. of 655 male patients who received ONB found that 75 (11.5%) had at least one episode of emptying failure. The majority of cases (8%) were due to mechanical obstruction, which included benign anastomotic strictures, neobladder mucosal protrusion into the urethra, foreign bodies, and local tumor recurrence. All cases of obstruction were treated with either transurethral procedures or palliative chemotherapy, which resolved obstruction from tumor recurrence in 8/13 patients. The patients with dysfunctional voiding were managed indefinitely with intermittent catheterization [40]. Ji et al. performed a similar study in 231 males with ONB and found that 16% had emptying failure with 10.8% due to mechanical obstruction and 5.2% due to dysfunctional voiding [41]. We do not routinely instruct patients to perform catheterizations or to check PVRs if asymptomatic and our most recent study of male patients receiving ONB found a self-reported any catheterization rate of 10% with only 5.3% catheterizing due to an inability to void [15]. If patients are asymptomatic and have no hydronephrosis, electrolyte abnormality, incontinence, or recurrent infections, there is no indication to check post-void residuals.

An anatomic cause of emptying failure in women includes neocystocele formation where obstruction results from urethral angling and kinking due to downward displacement of the ONB neck and lack of periurethral support after hysterectomy or removal of the vagina. Finley et al. studied this phenomenon in an investigation of 21 female patients after ONB. All patients had undergone prior or concurrent hysterectomy. Emptying failure occurred in 7 (36.8%) patients with one due to stricture and the others due to neocystocele formation. Dynamic pelvic MRI was performed in 4 of these patients and they found an average ONB descent of 1.8 cm with voiding and average change in neocystourethral angle from resting to straining of 17.8 degrees. Intermittent catheterization was required in all patients but one who voided to completion only after manually reducing her prolapse [39].

The etiology of dysfunctional voiding is less understood and diagnosed only after exclusion of mechanical obstruction. Evacuation of urine in patients with ONB occurs through an increase in abdominal pressure through straining in conjunction with voluntary relaxation of the external sphincter. Again, reflex relaxation of the sphincter cannot occur after removal of the native bladder, but an intact pudendal nerve allows for voluntary sphincter relaxation [42]. A lack of coordination between sphincter relaxation and abdominal straining has been proposed. However, Steven and Poulsen evaluated 7 male patients with dysfunctional voiding after ONB using electromyography and found sphincteric relaxation present in all [11]. Other non-obstructive causes of urinary retention include elongation and kinking of the neobladder neck and progressive pouch enlargement with neobladder atony [43, 44].

Techniques to Prevent Emptying Failure

Several surgical principles in ONB creation ensure adequate emptying. Placement of the neourethra in the most dependent portion of the reservoir, prevention of excessive funneling of the neobladder neck, and creation of a small but adequate capacity reservoir have been described, but it is unclear whether these have significant impact on urinary retention or continence [14, 43, 44]. We perform a "modified" Studer pouch with neourethra at the distal end of the suture line [45] with similar continence rates to classic Studer or Hautman pouches (Table 1). The prevention of neocystocele formation in females may be accomplished with uterine or vaginal preservation. Some authors have suggested prophylactic sacrocolpopexy with fixation of the vaginal stump to prevent prolapse [46•, 47]. In a trial of 44 female patients who underwent RC with hysterectomy and ONB, Zyczkowski et al. randomized 24 to receive prophylactic sacrocolpopexy with an 8 × 3 cm polypropylene mesh. Only one patient required intermittent catheterization but mean PVRs were 65 cc in the study group and 184 cc in the control group [46]. We routinely perform sacrocolpopexy with either biologic or polypropylene mesh in all females receiving ONB at our institution.

Treatment of Emptying Failure

The treatment of patients with emptying failure should include a cystourethroscopy to rule out mechanical obstruction from rare causes such as anastomotic strictures and foreign bodies such as pouch stones and mucosal folds. The evaluation of mucosal fold as a causative factor for urinary retention can be made with the cystoscope near the bladder neck and the inflow off. Some groups have described transurethral resection of mucosal folds to relieve obstructing tissue although the experience and success of this procedure is limited [48]. Other causes of mechanical obstruction can be treated with transurethral procedures. A recurrence of disease in the urethra must also be ruled out and treated accordingly. Unfortunately, the treatment options for dysfunctional voiding are limited and essentially require intermittent catheterization.

Conclusion

While RC and urinary diversion remains the standard of care for patients with high risk or muscle invasive bladder cancer, almost 90% of patients receive incontinent diversions as opposed to ONB. Concerns over voiding dysfunction and misconceptions about urinary incontinence and retention, may in part drive this discrepancy. However, these problems are not common and may be prevented with careful patient selection and special technical considerations such as nerve sparing and organ sparing procedures when feasible. Future work will require more prospective and patient-reported studies to better characterize and understand voiding dysfunction after ONB. Treatment options for voiding dysfunction after ONB remain limited for both male and female patients and more effective options are needed.

Compliance with Ethical Standards

Conflict of Interest The authors declare that they have no conflict of interest.

References

Papers of particular interest, published recently, have been highlighted as:
- • Of importance
- •• Of major importance

1. Chang SS, Boorjian SA, Chou R, Clark PE, Daneshmand S, Konety BR, et al. Diagnosis and treatment of non-muscle invasive bladder cancer: AUA/SUO Guideline. J Urol. 2016;196(4):1021–9.
2. Chang SS, Bochner BH, Chou R, Dreicer R, Kamat AM, Lerner SP, et al. Treatment of non-metastatic muscle-invasive bladder cancer: AUA/ASCO/ASTRO/SUO Guideline. J Urol. 2017;198(3):552–9.
3. Daneshmand S, Bartsch G. Improving selection of appropriate urinary diversion following radical cystectomy for bladder cancer. Expert Rev Anticancer Ther. 2011;11(6):941–8.
4. Hautmann RE. Which patients with transitional cell carcinoma of the bladder or prostatic urethra are candidates for an orthotopic neobladder? Current urology reports. 2000;1(3):173–9.
5. Ashley MS, Daneshmand S. Factors influencing the choice of urinary diversion in patients undergoing radical cystectomy. BJU Int. 2010;106(5):654–7.
6. Nagele U, Anastasiadis AG, Stenzl A, Kuczyk M. Radical cystectomy with orthotopic neobladder for invasive bladder cancer: a critical analysis of long-term oncological, functional, and quality of life results. World J Urol. 2012;30(6):725–32.
7. Cerruto MA, D'Elia C, Siracusano S, Gedeshi X, Mariotto A, Iafrate M, et al. Systematic review and meta-analysis of non RCT's on health related quality of life after radical cystectomy using validated questionnaires: better results with orthotopic neobladder versus ileal conduit. Eur J Surg Oncol : J Eur Soc Surg Oncol Br Assoc Surg Oncol. 2016;42(3):343–60.
8. • Farber NJ, Faiena I, Dombrovskiy V, Tabakin AL, Shinder B, Patel R, et al. Disparities in the use of continent urinary diversions after radical cystectomy for bladder cancer. Bladder Cancer (Amsterdam, Netherlands). 2018;4(1):113–20. **This study used the National Inpatient Sample to show the disproportionate rate of incontinent urinary diversions performed in the United States**.
9. • Lin-Brande M, Nazemi A, Pearce SM, Thompson ER, Ashrafi AN, Djaladat H, et al. Assessing trends in urinary diversion after radical cystectomy for bladder cancer in the United States. Urol Oncol. 2019;37(3):180.e1-.e9. **This study used the National Cancer Database to show that the rate of continent diversions is decreasing even in high volume and academic centers**.
10. Hautmann RE, de Petriconi R, Gottfried HW, Kleinschmidt K, Mattes R, Paiss T. The ileal neobladder: complications and functional results in 363 patients after 11 years of follow-up. J Urol 1999;161(2):422–427; discussion 7-8.
11. Steven K, Poulsen AL. The orthotopic Kock ileal neobladder: functional results, urodynamic features, complications and survival in 166 men. J Urol. 2000;164(2):288–95.
12. Lee KS, Montie JE, Dunn RL, Lee CT. Hautmann and Studer orthotopic neobladders: a contemporary experience. J Urol. 2003;169(6):2188–91.
13. Stein JP, Dunn MD, Quek ML, Miranda G, Skinner DG. The orthotopic T pouch ileal neobladder: experience with 209 patients. J Urol. 2004;172(2):584–7.
14. Studer UE, Burkhard FC, Schumacher M, Kessler TM, Thoeny H, Fleischmann A, et al. Twenty years experience with an ileal orthotopic low pressure bladder substitute–lessons to be learned. J Urol. 2006;176(1):161–6.
15. •• Clifford TG, Shah SH, Bazargani ST, Miranda G, Cai J, Wayne K, et al. Prospective evaluation of continence following radical cystectomy and orthotopic urinary diversion using a validated questionnaire. J Urol. 2016;196(6):1685–91. **Recent paper using patient-reported outcomes to show that continence after neobladder is dynamic and improves over time with excellent functional outcomes at 12 to 18 months**.
16. Stein JP, Grossfeld GD, Freeman JA, Esrig D, Ginsberg DA, Cote RJ, et al. Orthotopic lower urinary tract reconstruction in women using the Kock ileal neobladder: updated experience in 34 patients. J Urol. 1997;158(2):400–5.
17. Anderson CB, Cookson MS, Chang SS, Clark PE, Smith JA Jr, Kaufman MR. Voiding function in women with orthotopic neobladder urinary diversion. J Urol. 2012;188(1):200–4.
18. •• Gross T, Meierhans Ruf SD, Meissner C, Ochsner K, Studer UE. Orthotopic ileal bladder substitution in women: factors influencing urinary incontinence and hypercontinence. Eur Urol. 2015;68(4):664–71. **Prospective study of female patients receiving neobladder that showed the importance of preservation of the uterus and nerves in attaining continence**.
19. Abol-Enein H, Ghoneim MA. Functional results of orthotopic ileal neobladder with serous-lined extramural ureteral reimplantation: experience with 450 patients. J Urol. 2001;165(5):1427–32.
20. Studer UE, Danuser H, Merz VW, Springer JP, Zingg EJ. Experience in 100 patients with an ileal low pressure bladder substitute combined with an afferent tubular isoperistaltic segment. J Urol. 1995;154(1):49–56.
21. Hinman F Jr. Selection of intestinal segments for bladder substitution: physical and physiological characteristics. J Urol. 1988;139(3):519–23.
22. Marim G, Bal K, Balci U, Girgin C, Dincel C. Long-term urodynamic and functional analysis of orthotopic "W" ileal neobladder following radical cystectomy. Int Urol Nephrol. 2008;40(3):629–36.
23. Skolarikos A, Deliveliotis C, Alargof E, Ferakis N, Protogerou V, Dimopoulos C. Modified ileal neobladder for continent urinary diversion: functional results after 9 years of experience. J Urol. 2004;171(6 Pt 1):2298–301.

24. Satkunasivam R, Santomauro M, Chopra S, Plotner E, Cai J, Miranda G, et al. Robotic intracorporeal orthotopic neobladder: urodynamic outcomes, urinary function, and health-related quality of life. Eur Urol. 2016;69(2):247–53.
25. Madersbacher S, Mohrle K, Burkhard F, Studer UE. Long-term voiding pattern of patients with ileal orthotopic bladder substitutes. J Urol. 2002;167(5):2052–7.
26. El Bahnasawy MS, Osman Y, Gomha MA, Shaaban AA, Ashamallah A, Ghoneim MA. Nocturnal enuresis in men with an orthotopic ileal reservoir: urodynamic evaluation. J Urol. 2000;164(1):10–3.
27. Hollabaugh RS Jr, Dmochowski RR, Steiner MS. Neuroanatomy of the male rhabdosphincter. Urology. 1997;49(3):426–34.
28. Kessler TM, Burkhard FC, Perimenis P, Danuser H, Thalmann GN, Hochreiter WW, et al. Attempted nerve sparing surgery and age have a significant effect on urinary continence and erectile function after radical cystoprostatectomy and ileal orthotopic bladder substitution. J Urol. 2004;172(4 Pt 1):1323–7.
29. Hubner WA, Trigo-Rocha F, Plas EG, Tanagho EA. Urethral function after cystectomy: a canine in vivo experiment. Urol Res. 1993;21(1):45–8.
30. Hugonnet CL, Danuser H, Springer JP, Studer UE. Urethral sensitivity and the impact on urinary continence in patients with an ileal bladder substitute after cystectomy. J Urol. 2001;165(5):1502–5.
31. Walsh PC. The discovery of the cavernous nerves and development of nerve sparing radical retropubic prostatectomy. J Urol. 2007;177(5):1632–5.
32. Bhatta Dhar N, Kessler TM, Mills RD, Burkhard F, Studer UE. Nerve-sparing radical cystectomy and orthotopic bladder replacement in female patients. Eur Urol. 2007;52(4):1006–14.
33.• Voskuilen CS, van de Putte EE F, Perez-Reggeti JI, van Werkhoven E, Mertens LS, van Rhijn BWG, et al. Prostate sparing cystectomy for bladder cancer: a two-center study. Eur J Surg Oncol: J Eur Soc Surg Oncol Br Assoc Surg Oncol. 2018;44(9):1446–52. **Contemporary multi-center study reporting functional and oncologic outcomes after prostate sparing cystectomy and neobladder**.
34. Stein JP, Hautmann RE, Penson D, Skinner DG. Prostate-sparing cystectomy: a review of the oncologic and functional outcomes. Contraindicated in patients with bladder cancer. Urol Oncol. 2009;27(5):466–72.
35.• Gregg JR, Emeruwa C, Wong J, Barocas DA, Chang SS, Clark PE, et al. Oncologic outcomes after anterior exenteration for muscle invasive bladder cancer in women. J Urol. 2016;196(4):1030–5. **Retrospective study reporting on risk factors for pelvic organ involvement in females at the time of radical cystectomy that may preclude reproductive organ sparing surgery**.
36. Djaladat H, Bruins HM, Miranda G, Cai J, Skinner EC, Daneshmand S. Reproductive organ involvement in female patients undergoing radical cystectomy for urothelial bladder cancer. J Urol. 2012;188(6):2134–8.
37. Quek ML, Ginsberg DA, Wilson S, Skinner EC, Stein JP, Skinner DG. Pubovaginal slings for stress urinary incontinence following radical cystectomy and orthotopic neobladder reconstruction in women. J Urol. 2004;172(1):219–21.
38.• Loh-Doyle JC, Ashrafi A, Nazemi A, Ghodoussipour S, Thompson E, Wayne K, et al. Dual prosthetic implantation after radical cystoprostatectomy and neobladder: outcomes of the inflatable penile prosthesis and artificial urinary sphincter in bladder cancer survivors. Urology. 2019;127:127-32. **Large series that showed the feasibility of dual prosthetic implantation after cystectomy and neobladder in male patients.**
39. Finley DS, Lee U, McDonough D, Raz S, deKernion J. Urinary retention after orthotopic neobladder substitution in females. J Urol 2011;186(4):1364–1369.
40. Simon J, Bartsch G Jr, Kufer R, Gschwend JE, Volkmer BG, Hautmann RE. Neobladder emptying failure in males: incidence, etiology and therapeutic options. J Urol. 2006;176(4 Pt 1):1468–72 discussion 72.
41. Ji H, Pan J, Shen W, Wu X, Zhang J, Fang Q, et al. Identification and management of emptying failure in male patients with orthotopic neobladders after radical cystectomy for bladder cancer. Urology. 2010;76(3):644–8.
42. Gotoh M, Mizutani K, Furukawa T, Kinukawa T, Ono Y, Ohshima S. Quality of micturition in male patients with orthotopic neobladder replacement. World J Urol. 2000;18(6):411–6.
43. Porru D, Madeddu G, Campus G, Montisci I, Caddemi G, Scarpa RM, et al. Urodynamic analysis of voiding dysfunction in orthotopic ileal neobladder. World J Urol. 1999;17(5):285–9.
44. Nesrallah LJ, Srougi M, Dall'Oglio MF. Orthotopic ileal neobladder: the influence of reservoir volume and configuration on urinary continence and emptying properties. BJU Int. 2004;93(3):375–8.
45. Daneshmand S. Urinary Diversion: Springer; 2017.
46.• Zyczkowski M, Muskala B, Kaletka Z, Bryniarski P, Nowakowski K, Bogacki R, et al. Sacrocolpopexy with polypropylene tape as valuable surgical modification during cystectomy with orthotopic ileal bladder: functional results. Biomed Res Int. 2015;2015:306191. **Small prospective study with results suggesting improved functional outcomes with prophylactic sacrocolpopexy at the time of cystectomy and neobladder in females**.
47. Torzsok P, Bauer S, Forstner R, Sievert KD, Janetschek G, Zimmermann R. Laparoscopic radical cystectomy and ileal neobladder for muscle invasive bladder cancer in combination with one stage prophylactic laparoscopic sacrospinal fixation to avoid future pelvic organ prolapse. J Endourol Case Rep. 2016;2(1):59–61.
48. Bartsch G, Simon J, Gschwend Juergen E, Hautmann Richard E, Volkmer BG. 51: Subneovesical obstruction in men with an ileal neobladder: incidence, etiology and therapeutic options. J Urol. 2004;171(4S):14.