Original Article

Can we predict the need for clean intermittent catheterization after orthotopic neobladder construction?

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ABSTRACT

Introduction: We aimed to identify peri-operative and pathologic characteristics that may predict the need for clean intermittent catheterization (CIC) following radical cystectomy (RC) with orthotopic neobladder (ONB) in order to improve patient counseling on choice of urinary diversion.

Materials and Methods: Between July 2004 and February 2013, all patients who underwent RC with ONB were identified. Peri-operative clinical and pathological features were evaluated and correlated with patients reported need for CIC. The independent T-test was performed for continuous variables and Chi-square test was performed for categorical variables. Multivariate forward stepwise logistic regression analysis was used to identify variables that correlated with need for CIC after ONB.

Results: During the study period, 114 patients underwent RC with ONB creation. On univariate analysis, patients with higher body mass index, younger age, and non-vaginal or non-nerve-sparing procedures were more likely to require catheterization for complete emptying. Multivariate analysis demonstrates that conservative surgery (nerve sparing in males or vaginal sparing in females) was associated with a significantly lower rate of requiring CIC (Odds Ratio [OR] 0.20, $P < 0.01$). Surprisingly, older age was also associated with a slightly lower, but statistically significant, rate of requiring CIC (OR 0.92, $P < 0.01$).

Conclusions: When counseling patients regarding the different types of diversions after RC, the potential need for long-term CIC after ONB must be discussed. The clinical factors that appear to increase the need for CIC include non-conservative RC (non-nerve sparing in males and non-vaginal sparing in females) and, to a certain degree, younger age.

Key words: Catheterization, cystectomy, neobladder

INTRODUCTION

Radical cystectomy (RC) remains the standard of care for locally advanced, muscle-invasive and recalcitrant high-grade non-muscle invasive bladder cancer. Unfortunately, RC is associated with significant morbidity and occasional mortality.[1,2] A significant portion of morbidity following RC is associated with the choice of urinary diversion. Although orthotopic neobladder (ONB) has the advantage of preserving body image, improvements in quality of life over ileal conduit have been hard to demonstrate.[3,4] One factor that may be associated with a decreased quality of life is continence status, both incontinence as well as hypercontinence or urinary retention. Rates of hypercontinence with ONB have been reported to range between 4% and 25%.[5] A number of factors have been purported to influence continence,

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including gender, nerve sparing, length of bowel segment and vaginal or uterine sparing in females.[6-8] Although the ONB may be the preferred method for diversion, particularly for younger patients, improved quality of life may not be realized when the patients experience significant long-term voiding dysfunction.[5]

Urodynamic studies in patients with ileal neobladder substitution have shown that good voiding habits are dependent on the ability to perform effective straining and the location of the neobladder.[9] The ability to empty a neobladder has been shown to be dependent on bladder compliance in urodynamic studies.[10] The dynamic mechanism of voiding in patients after neobladder construction have also been evaluated with interactive magnetic resonance imaging, showing that the movements are very different than in naïve bladders.[11]

When counseling patients regarding the potential advantages and disadvantages of the different types of urinary diversion, it is critical to mention the possible need for long-term clean intermittent catheterization (CIC) with ONB. Many patients are resistant to the idea of long-term CIC and may choose a different diversion option when presented with the risk. Thus, it is critical to understand and define the peri-operative factors that may be associated with a patient's risk for requiring CIC for long-term management of their ONB. Herein, we identify the peri-operative clinicopathologic factors associated with the need for long-term CIC following ONB.

MATERIALS AND METHODS

Our study protocol received full approval from the Institutional Review Board in compliance with the Health Insurance Portability and Accountability Act (HIPAA). We conducted a retrospective review of our electronic medical record, identifying all patients between July 2004 and February 2013 who underwent a RC and ONB. All radical cystectomies were performed by one of two fellowship trained Urologic Oncologists at the institution. For patients to be considered for an ONB diversion, they must have a good performance status with an Eastern Cooperative Oncology Group (ECOG) score of 0–2. All patients underwent creation of ONB as originally described by Studer and had approximately 60 cm of distal ileum utilized for neobladder construction.[12] Men who were potent and sexually active prior to surgery had a nerve-sparing procedure completed with special attention to avoid damage to the neurovascular bundles on that lateral portion of the prostate. Women who were sexually active had a vaginal-sparing surgery where the anterior vaginal wall was left intact and not resected along with the posterior bladder wall. Patients had externalized ureteral stents and a urethral and suprapubic catheter immediately post-operatively. The ureteral stents were removed once the patients were tolerating a regular diet prior to discharge. Patients were sent home with both catheters with strict irrigation instructions. Patients returned to the clinic with a cystogram prior to neobladder activation (catheter removal) at 3 weeks post-operatively. All patients were placed on a strict voiding schedule after catheter removal, which included instructions to void every 2 h and to perform CIC twice a day to check for residual urine. After 1 month, if patients had residuals less than 50 mL, they were instructed to stop CIC. In addition, all patients had routine post-void residuals obtained at each clinic visit, and patients with >150 mL of residual were instructed to perform CIC for complete emptying.

Peri-operative clinical and pathologic data on all patients was obtained by chart review and utilized for the analysis of risk factors for the need to perform CIC. The last follow-up appointment is where the catheterization status of the patient was determined. The date of this follow-up was different for each patient depending on the date of their neobladder construction. If a patient required catheterization post-operatively but then resolved prior to their latest visit, they were not considered hypercontinent, requiring CIC. Variables analyzed included age, body mass index (BMI), gender, clinical and pathological stage, presence of diabetes mellitus, administration of neoadjuvant chemotherapy, history of previous abdominal surgeries and anterior vaginal or nerve-sparing procedures in females and males, respectively. Previous surgeries included were any prior abdominal and pelvic procedures; ventral and incisional hernia repairs of the abdomen were also included. The BMI of the patients used for this study was that recorded on the morning of surgery. BMI (kg/m^2) was stratified into three groups, including <30, 30–39 and >40. Clinical stage was based on the pathology report from the last transurethral resection and examination under anesthesia prior to cystectomy and pathological stage was divided into T0/Tis/Ta/T1, T2, T3 or T4. Those with positive nodal disease were considered as a separate group.

A descriptive analysis of all patient characteristics was performed. An independent *t*-test was performed for the continuous variables and a Chi-square test was used for the categorical variables. We included BMI and age as categorical variables in this analysis. A multivariate forward stepwise logistic regression analysis was then used for all variables to determine which ones remained significant for the need to catheterize after neobladder urinary diversion. A *P* value of <0.05 was considered significant. SPSS 10.0 was used for all analyses.

RESULTS

There were 114 patients from July 2004 to February 2013 who underwent RC with ONB urinary diversion. Age at the time of surgery ranged from 30 to 80 years, with a median age of 61 years. The median follow-up of these patients was

39 months. Of this group, 15 were female (13%) and 99 were male (87%). The BMI range at the time of surgery was 18.21–60.5 kg/m^2, with an overall mean of 29 + 6.9 kg/m^2. Table 1 demonstrates the patient characteristics for this study.

Of the 114 patients, 84 (73.7%) did not require CIC for emptying of their neobladder at the last follow-up, while 30 (26.3%) reported having to catheterize at least once a day for completely emptying their ONB. Patients who reported requiring CIC underwent office-based cystoscopy to rule out bladder neck contracture as a cause of the incomplete emptying, and none of the patients included in this group were reported to have a bladder neck contracture at the time of follow-up. It was found that five patients (all male) who required CIC for emptying had ventral incisional hernias identified presumably from abdominal straining for neobladder emptying.

Table 1: Patient characteristics

Variable	*N* (%)
Age (mean years, SD)	60.4+9.4
Clean intermittent catheterization	
Yes	30 (26)
No	84 (74)
BMI, kg/m^2 (mean, SD)	29+6.9
<30	72 (63)
30-39	34 (30)
≥40	8 (7)
Gender	
Female	15 (13)
Male	99 (87)
Clinical stage	
T0/Tis/Ta/T1	34 (30)
T2	72 (63)
T3 and T4	8 (7)
Pathological stage	
T0/Tis/Ta/T1	42 (37)
T2	31 (27)
T3	16 (14)
T4	5 (4)
TX N+	20 (18)
Diabetes Mellitus	
Yes	20 (18)
No	94 (82)
Chemotherapy	
Yes	29 (25)
No	85 (75)
Conservative surgery	
No	70 (61)
Yes	44 (39)
Prior abdominal surgery	
None	104 (91)
Yes	10 (9)

SD=Standard deviation, BMI=Body mass index

On univariate analysis, three factors were statistically significant predictors for the need for CIC and included younger age, higher BMI and undergoing non-conservative surgery (non-nerve sparing in males and non-vaginal sparing in females), Table 2. When age is evaluated as a continuous variable, the mean age in those who required long-term CIC was 62 years compared with 57 years in those who required CIC (P = 0.026). When we stratified age per decade, there was no significant difference. When BMI was used as a continuous variable, patients who performed CIC had a mean BMI of 31.7 versus 28.1 for those who did not catheterize (P = 0.013). Forty-four (39%) patients had a conservative procedure, and only six (20%) of these reported catheterizing while 24 (80%) patients who did not have vaginal- or nerve-sparing procedures required catheterization. Because of the small numbers of patients, we combined males who had nerve sparing and females who had anterior vaginal wall sparing, including them as conservative surgical treatment. As shown in Table 2, all other variables were not significant on univariate analysis.

When these factors were used in a multivariable logistic regression analysis, we found that conservative procedure and age were the only two factors that were significant for increased need for CIC. Table 3 demonstrates that males who underwent a nerve-sparing procedure and females with vaginal sparing had a significantly decreased risk of requiring long-term CIC (Odds Ratio [OR] 0.20, P < 0.01). Surprisingly, older age was associated with a decreased risk of CIC (OR 0.92, P < 0.01). Furthermore, patients <50 years of age were more likely to catheterize than those ≥50 years of age, with an OR of 6.4 (95% confidence interval [CI] 1.06–38, P = 0.042). All other variables evaluated were not statistically significant on multivariable analysis.

The analyses were completed on patients' catheterization status at their last follow-up appointment, with a median of 39 months in the study. Table 4 shows a breakdown of those requiring catheterization and those not requiring catheterization for ONB emptying based on length of follow-up since RC with ONB reconstruction.

DISCUSSION

The ONB has been considered a major advantage over ileal conduit urinary diversion, in that it allows individuals to void per urethra thus preserving body image and obviating the need for an external appliance. However, this improved quality of life may fail to be realized by the patient in whom significant voiding dysfunction occurs.[5] Voiding

Table 2: Univariate analysis comparing the use of CIC and patients' clinicopathological characteristics

Variable	No CIC (%) *n*=84	Performs CIC (%) *n*=30	*P* value
Age (mean, years)	61.58	57	0.026
<50	6 (7)	7 (23)	
50-59	27 (32)	10 (33)	
60-69	38 (45)	8 (27)	
≥70	13 (16)	5 (17)	0.072
BMI (mean, kg/m^2)	28.1	31.7	0.013
<30	57 (68)	15 (50)	
30-39	24 (28)	10 (33)	
≥40	3 (4)	5 (17)	0.035
Gender			
Female	9 (11)	6 (20)	
Male	75 (89)	24 (80)	0.197
Clinical stage			
T0/Tis/Ta/T1	25 (30)	9 (30)	
T2	53 (63)	19 (63)	
T3 and T4	6 (7)	2 (7)	0.995
Pathological stage			
T0/Tis/Ta/T1	32 (38)	10 (33)	
T2	21 (25)	10 (33)	
T3	12 (14)	4 (13)	
T4	4 (5)	1 (4)	
Tx N+	15 (18)	5 (17)	0.934
Diabetes Mellitus			
Yes	13 (15)	7 (23)	
No	71 (85)	23 (77)	0.240
Chemotherapy			
Yes	22 (26)	7 (23)	
No	62 (74)	23 (77)	0.812
Conservative surgery			
No	46 (55)	24 (80)	
Yes	38 (45)	6 (20)	0.017
Prior abdominal surgery			
None	50 (60)	15 (50)	
Yes	34 (40)	15 (50)	0.366

CIC=Clean intermittent catheterization, BMI=Body mass index

Table 3: Multivariate logistic regression analysis of clinicopathological variables and need to perform CIC

	OR	95% CI	*P* value
Age (per year)	0.92	0.88-0.97	0.005
Nerve sparing (males)/ vaginal sparing (females)	0.20	0.06-0.61	0.004

Variables included but not statistically significant in the model were gender, BMI, stage, prior abdominal surgery, gender, chemotherapy and presence of Diabetes Mellitus. OR=Odds ratio, CI=Confidence interval

dysfunction is divided into the failure to empty or the failure to store urine.[13] In our report, we examine the rate of urinary hypercontinence following ONB and peri-operative clinicopathologic risk factors associated with the need for CIC.

Table 4: Requirement of CIC based on time since surgery

Months since surgery	No. of patients (%)	
	Does not require catheterization (*n*=84)	Requires catheterization (*n*=30)
≤6 months (*n*=3)	2 (67)	1 (33)
6-12 months (*n*=5)	2 (40)	3 (60)
12-24 months (*n*=15)	11 (73)	4 (27)
24-36 months (*n*=26)	23 (88)	3 (12)
36-48 months (*n*=26)	19 (73)	7 (27)
48-60 months (*n*=14)	9 (64)	5 (36)
≥60 months (*n*=25)	18 (72)	7 (28)

CIC=Clean intermittent catheterization

Previous studies have reported that between 4% and 25% of patients must perform intermittent self-catheterization due to incomplete emptying of the neobladder.[5,13,14] This is lower than the rate reported in our study. Although speculative, we suggest that this may be due to continued, long-term follow-up (median 39 months) in our patient population and the routine usage of post-operative measurements of post-void residuals in asymptomatic patients in addition to clinical diagnosis in those with symptoms.

Surprisingly, our analyses demonstrated that younger age was a risk factor for needing long-term CIC. This is clearly of importance, as younger patients are frequently considered the ideal candidates for ONB. Interestingly, of the 18 patients >70 years of age, only five (28%) were reported to require long-term CIC. Our findings are contradictory to other reports that have demonstrated no appreciable differences in voiding function following ONB in the elderly.[15] Theoretically, this may be a result of younger patients being more physically and mentally capable of long-term CIC compared with elderly patients, who may demonstrate less compliance. Younger patients may have higher expectations and desire to remain completely dry, which may lead them to catheterize as a precautionary tool to keep their bladder empty and prevent incontinence. Perhaps it is the higher rate of incontinence in the elderly that may lead to a decreased need for CIC, both potential explanations for this result. Those patients who underwent nerve sparing or vaginal sparing were less likely to perform CIC. The need for catheterization can be a dynamic event after neobladder creation. Oftentimes, patients will experience changes with their voiding habits over time. It is important to make this clear to patients when educating and when seeing patients during follow-up visits.

We found in this study that the overall rate of CIC for emptying was 33%, with a median follow-up of 39 months. When separated by length of follow–up, it appears that

catheterization may be required more often within the first year after surgery (60%) and then decrease over time to a rate of 28% in those patients with follow-up times longer than 5 years since ONB creation.

Many factors have been postulated for the precise pathogenesis of urinary retention and elevated residual urine after ONB. Voiding after neobladder often requires a combination of Valsalva voiding and pelvic floor relaxation.[16] In this study population, we found five patients who developed incisional ventral hernias after ONB, and all these patients were male and had hypercontinence requiring CIC. The hernia may be related to the abdominal straining required to empty after ONB, but then the presence of the hernia traps urine causing retention to result without the use of catheterization. Urodynamic studies after ONB have demonstrated that patients with poor emptying ability (defined as residual urine >150 mL) had increased compliance and capacity (1067 mL versus 623 mL) compared with those with a good emptying ability.[10] Studies using urodynamic studies in neobladders have shown a wide range of cystometric capacities (366–1370 mL).[10,17] In one study, it was found that even with hypercontinent patients, the mean pressure of contractions was < 40 cm of water.[10] Other hypotheses of voiding difficulty after ONB also include the inability to relax the external urethral sphincter, inadequate Valsalva and anatomical factors including smooth continuity of the bladder neck to the urethra and appropriate bladder neck funneling.[13,18] Acute urethral angulation has often been the proposed explanation in women after ONB.[19] Although we did not find any significant difference in CIC rates between males and females, studies have consistently found that women are more likely to develop urinary retention than men.[19,20] This may be due to the fact that in this study there were only a small number of female patients that underwent RC and ONB. Even though the exact mechanism of emptying and sensation is not known in patients with ileal neobladder, clearly, prevention of overdistention is of utmost importance to prevent dilatation of the upper urinary tract.[21]

As with any surgery, full discussion of risks, alternatives and benefits is essential. For those undergoing RC, choice of urinary diversion decision can be challenging. Those individuals choosing to undergo ONB for urinary diversion should be educated on the risk of urinary incontinence as well as urinary retention with the potential need for self-catheterization, even in the long-term setting. Patients should understand the post-operative rehabilitation necessary to train the bladder substitute to meet their needs and expectations.[22] Quality of life studies have shown that those with ONB had improved quality of life with regard to mental, physical and social functioning in daily life compared with ileal conduit.[23]

Clearly, there are limitations to our study inherent to a retrospective review. First, our study includes patient's self-reporting of performing CIC for neobladder emptying, which may not represent the true rate of hypercontinence. However, at our institution, we routinely performed post-void residual bladder scan on all patients with ONB at every follow-up visit and we frequently reiterate to patients the importance of compliance. Second, BMI was assessed on the day of surgery and not at the time of follow-up appointment when the report of CIC was determined post-operatively. Furthermore, long-term CIC was not correlated to major changes in BMI post-operatively, a common consequence of RC. Third, information on subsequent surgeries that may affect continence and emptying, such as urethral bulking injections, were not included in our report. On the other hand, patients with long-term retention were routinely ruled out for bladder neck contractures with office-based cystoscopy. In this study, we have only a small number of female patients; therefore, this may not be representative of females undergoing ONB. Those males who underwent nerve sparing and females who had vaginal sparing surgery were combined and analyzed together as conservative management. These findings may be different if there were larger numbers of either group. There is also no patient-reported quality of life assessment at these follow-up time points to determine patient's feelings toward this need for CIC even at long time intervals after surgery. Regardless of the limitations, it is quite clear that adequate patient counseling regarding choice of urinary diversion is imperative. Furthermore, factors that may portent an increased risk of long-term CIC following ONB should be considered when discussing options.

CONCLUSIONS

Patients undergoing RC must be carefully counseled regarding the choice of urinary diversion. One potential disadvantage of ONB is the need for long-term CIC. Our study demonstrates that this risk may be higher than previously reported. Furthermore, patient characteristics associated with increased risk include non-conservative (non-nerve sparing and non-vaginal sparing) surgery, younger age and higher BMI.

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Conflicts of interest
There are no conflicts of interest.

REFERENCES

1. Shabsigh A, Korets R, Vora KC, Brooks CM, Cronin AM, Savage C, *et al*. Defining early morbidity of radical cystectomy for patients with bladder cancer using a standardized reporting methodology. Eur Urol 2009;55:164-74.
2. Stimson CJ, Chang SS, Barocas DA, Humphrey JE, Patel SG, Clark PE, *et al*. Early and late perioperative outcomes following radical cystectomy: 90-day readmissions, morbidity and mortality in a contemporary series. J Urol 2010;184:1296-300.

3. Mansson A, Mansson W. When the bladder is gone: Quality of life following different types of urinary diversion. World J Urol 1999;17:211-8.
4. Dutta SC, Chang SC, Coffey CS, Smith JA Jr, Jack G, Cookson MS. Health related quality of life assessment after radical cystectomy: Comparison of ileal conduit with continent orthotopic neobladder. J Urol 2002;168:164-7.
5. Steers WD. Voiding dysfunction in the orthotopic neobladder. World J Urol 2000;18:330-7.
6. Furukawa T, Hattori R, Kinukawa T, Takeuchi N, Sahashi M, Yamada S, *et al*. Long-term results and quality of life of hemi-Kock orthotopic ileal neobladder after radical cystectomy. Hinyokika Kiyo 1998;44:461-7.
7. Hautmann RE, Miller K, Steiner U, Wenderoth U. The ileal neobladder: 6 years of experience with more than 200 patients. J Urol 1993;150:40-5.
8. 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 followup. J Urol 1999;161:422-8.
9. 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;17:285-9.
10. Iwakiri J, Gill H, Anderson R, Freiha F. Functional and urodynamic characteristics of an ileal neobladder. J Urol 1993;149:1072-6.
11. Muto S, Kamiyama Y, Ide H, Okada H, Saito K, Nishio K, *et al*. Real-time MRI of orthotopic ileal neobladder voiding: Preliminary findings. Eur Urol 2008;53:363-9.
12. Studer UE, Ackermann D, Casanova GA, Zingg EJ. Three years' experience with an ileal low pressure bladder substitute. Br J Urol 1989;63:43-52.
13. Park JM, Montie JE. Mechanisms of incontinence and retention after orthotopic neobladder diversion. Urology 1998;51:601-9.
14. Regalado Pareja R, Huguet Pérez J, Errando Smet C, Lima BX, Chéchile Toniolo G, Villavicencio Mavrich H. Orthotopic bladder replacement: II. Functional results and complications in patients with Studer-type ileal neobladder. Arch Esp Urol 1997;50:234-41.
15. Takenaka A, Soga H, Terakawa T, Kumano M, Furukawa J, Muramaki M, *et al*. Assessment of voiding function of orthotopic neobladders in elderly patients with long-term survival. BJU Int 2009;103:927-30.
16. Mikuma N, Hirose T, Yokoo A, Tsukamoto T. Voiding dysfunction in ileal neobladder. J Urol 1997;158:1365-8.
17. Koraitim MM, Atta MA, Foda M. Desire to void and force of micturition in patients with intestinal bladders. J Urol 1996;155:1214-6.
18. Simon J, Bartsch G Jr, Küfer R, Gschwend JE, Volkmer BG, Hautmann RE. Neobladder emptying failure in males: Incidence, etiology and therapeutic options. J Urol 2006;176:1468-72.
19. Ali-el-Dein B, el-Sobky E, Hohenfellner M, Ghoneim MA. Orthotopic bladder substitution in women: Functional evaluation. J Urol 1999;161:1875-80.
20. Yokoo A, Hirose T, Mikuma N, Tsukamoto T. Ileal neobladder for bladder substitution after radical cystectomy. Int J Urol 1998;5:219-24.
21. Cheng C, Hendry WF, Kirby RS, Whitfield HN. Detubularisation in cystoplasty: Clinical review. Br J Urol 1991;67:303-7.
22. Turner WH, Danuser H, Moehrle K, Studer UE. The effect of nerve sparing cystectomy technique on postoperative continence after orthotopic bladder substitution. J Urol 1997;158:2118-22.
23. Yoneda T, Igawa M, Shiina H, Shigeno K, Urakami S. Postoperative morbidity, functional results and quality of life of patients following orthotopic neobladder reconstruction. Int J Urol 2003;10:19-25.