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ORIGINAL ARTICLE

# Early continence after ileal neobladder: objective data from inpatient rehabilitation

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## Abstract

**Purpose** To evaluate early continence of patients who underwent inpatient rehabilitation after radical cystectomy (RC) and orthotopic bladder substitution (ONB).

**Methods** We conducted a retrospective analysis on the data of 283 patients who underwent a three weeks inpatient rehabilitation after RC and ONB for bladder cancer between January 2016 and July 2017. All patients were treated with a special multimodal continence therapy. The continence status was evaluated by measuring urine loss by a 24-h pad test and urine volume on uroflowmetry at the beginning (T1) and at the end (T2) of inpatient rehabilitation. Multivariate linear regression analysis was performed to identify independent predictors of urine loss.

**Results** Median patient age was 63 years. NS was documented for 142 patients (50.2%). Median urine loss decreased significantly ($p < 0.001$) in the 24-h pad test, from 442 gm at T1 (median 29 days after surgery) to 88 gm at T2 (median 50 days after surgery). Urine volume increased significantly ($p < 0.001$) from a median of 78 ml at T1 to a median of 157 ml at T2. Age ($p = 0.002$), diabetes ($p = 0.031$), obesity ($p = 0.003$), and nerve sparing ($p = 0.011$) were identified as independent predictors for urine loss at the end of inpatient rehabilitation.

**Conclusion** Continence improved significantly during the three weeks of inpatient rehabilitation. Younger age, the absence of diabetes or obesity, and NS resulted in better continence in the early postoperative period after ONB.

**Keywords** Urinary bladder neoplasms · Cystectomy · Urinary diversion · Urinary incontinence · Rehabilitation

## Introduction

For nonmetastatic muscle-invasive bladder cancer, radical cystectomy (RC) and urinary diversion via orthotopic bladder substitution (ONB) is a well-established standard treatment [2, 24]. Evaluation of urinary incontinence following ONB mainly occurs at a follow-up one year or later after surgery and typically is based on the numbers of pads patients need to use or on incontinence questionnaires [1, 3, 20, 21].

To our knowledge, there is no published study yet concerning urinary continence during the early recovery period after ONB based on the objective data.

Patients who are treated with RC and ONB, often struggle with side effects, such as incontinence as well as emotional problems. In order that people can reach the important goal of reintegration into social life, German social laws entitle cancer patients to receive an average of three weeks rehabilitation. The German guidelines recommend to offer all patients several weeks of inpatient rehabilitation following hospital discharge [18]. Given this unique vantage, we sought to evaluate urinary continence and the impact of possible predictors in a contemporary ONB cohort using objective data from 24-h pad test and uroflowmetry.

## Methods

### Data source and study population

This retrospective study relies on clinical data of male patients who were treated in a specialized center for urological rehabilitation (Clinics Hartenstein, Bad Wildungen,

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Germany) between January 2016 and July 2017. After the ethical study approval by an institutional research committee (IRB no. FF29/2017), we evaluated 359 patients who previously received RC and ONB for bladder cancer in various hospitals across Germany. Ultimately, 283 patients were included and 76 were excluded because either data concerning NS ($n=30$) or continence status ($n=46$) were absent.

### Outcome measures

The continence status of patients was evaluated at the beginning (T1) and at the end (T2) of a 3–4 weeks inpatient rehabilitation admission.

### Inpatient rehabilitation

Patients were treated with a multimodal continence therapy:

(1) Osteopathic physiotherapy (individual sessions three times per week, group sessions six times per week).
(2) Instruction on a selective urethral sphincter training.
(3) Education on neobladder management and care (micturition diary, at first instruction to empty the neobladder every 2–3 h during the day as well as at night (nocturnal awakening by alarm clock), careful increase of neobladder volume to achieve sensitivity concerning the neobladder volume, prevention of residual urine volume with special mechanisms for emptying the neobladder).

In addition, patients were advised to drink at least 2–3 L of fluids per day to prevent dehydration as well as to prevent mucous accumulation in the neobladder. In cases of excessive mucous formation, we applied aspiration and flushing of the neobladder with normal saline via a transurethral catheter. For patients without improvement in daytime continence within two weeks of therapy, we performed a video-assisted biofeedback-sphincter training via transurethral endoscopy. Patients suffering from severe nocturnal incontinence were given anticholinergic drugs at night to reduce neobladder peristalsis.

### Variables

Baseline characteristics comprised patient age, Karnofsky performance status, body mass index (BMI), the existence of cardiovascular diseases (CVD) and/or diabetes, tumor stage, nodal stage, and NS status.

Continence status was evaluated at T1 and T2 by measuring urine loss by a 24-h pad test and urine volume on uroflowmetry. Complete continence was defined as 0 g of urine loss on 24-h pad test.

### Statistical analysis

Descriptive statistics of categorical variables comprised frequencies and proportions, whereas medians and interquartile ranges were presented for continuous variables. Between-group comparisons of quantitative variables were analyzed using the Mann–Whitney *U* test and Kruskal–Wallis test, respectively. The Wilcoxon test was used to assess the level of significance between quantitative variables noted at T1 versus T2. The Chi square test (McNemar) was used to compare changes in proportions. Linear regression analysis was performed to identify independent predictors for lower urine loss. Significance was considered at $p<0.05$. Analyses were performed with IBM SPSS version 25.

## Results

### Baseline characteristics

Our study included a sample of 283 male patients (Table 1). Inpatient rehabilitation started at a median of 29 days (IQR

**Table 1** Characteristics of 283 patients at the beginning of inpatient rehabilitation, 29 days (IQR 25–35) after RC and ONB

| Variables | Value |
|---|---|
| Patients, *n* (%) | 283 (100) |
| Age (years) | |
| Median (IQR) | 63 (57–69) |
| Karnofsky performance status (%) | |
| Median (IQR) | 80 (70–80) |
| BMI (kg/m$^2$) | |
| Median (IQR) | 25 (23–28) |
| Cardiovascular disease, *n* (%) | 121 (42.8) |
| Diabetes, *n* (%) | 19 (6.7) |
| Tumor stage, *n* (%) | |
| pT0 | 8 (2.8) |
| pTa/is/1 | 100 (35.3) |
| pT2 | 107 (37.8) |
| pT3 | 59 (20.8) |
| pT4 | 9 (3.2) |
| No. of lymph nodes removed, median (IQR) | 17 (11–25) |
| Nodal stage, *n* (%) | |
| pN0 | 251 (88.7) |
| pN1 | 15 (5.3) |
| pN2 | 17 (6.0) |
| Nerve sparing, *n* (%) | 142 (50.2) |
| Age (years) with nerve sparing, median (IQR) | 59.0 (55.8–66.0) |
| Age (years) without nerve sparing, median (IQR) | 67.0 (61.0–72.5) |

*IQR* interquartile range, *BMI* body mass index

25–35) and ended with a median of 50 days (IQR 46–56) after surgery. Median patient age was 63 years (IQR 57–69). The proportion of patients with cardiovascular disease and diabetes was 42.8% and 6.7%, respectively. Most patients presented a tumor stage ≤ pT2 (76.0%) and had tumor-free lymph nodes (88.7%). Intraoperative NS was documented for 142 patients (50.2%). Their median age was significantly lower as compared to those without NS (59 versus 67 years; $p < 0.001$).

## Continence parameters

The median 24-h urine loss decreased significantly ($p < 0.001$) from 442 gm (IQR 117–910) at T1 to 88 gm (IQR 0–402) at T2 (Table 2). Conversely, the urine volume at uroflowmetry increased significantly from a median of 78 ml (IQR 5–161) at T1 to a median of 157 ml (IQR 67–284) at T2 ($p < 0.001$). At the end of inpatient rehabilitation six patients were unable to empty their neobladder through normal micturition and performed clean intermittent self-catheterization.

Anticholinergic drugs were given to 62 patients at night (21.9%). Their nighttime urine loss was significantly higher as compared to those without anticholinergic drugs (T1: 305 gm versus 202 gm, $p = 0.012$ and T2: 76 gm versus 33 gm, $p = 0.032$). Video-assisted biofeedback-sphincter training via transurethral endoscopy was performed in 20 patients (7.1%). Their urine loss on 24-h pad test was significantly higher as compared to those without endoscopy (T1: 974 gm versus 405 gm, $p = 0.003$ and T2: 551 gm versus 81 gm, $p < 0.001$).

Younger patients received more often NS and had lower urine loss as compared to older patients ($p < 0.001$). The median urine loss on 24-h pad test decreased significantly during the inpatient rehabilitation ($p < 0.001$) in all age groups (Table 3).

## Predictors for urine loss

Median urine loss at T2 was significantly different between the age groups ($p < 0.001$) and between patients with versus without diabetes (495 gm versus 83 gm, $p = 0.021$), obesity (337 gm versus 84 gm, $p = 0.018$) and NS (50 gm versus 220 gm, $p < 0.001$), respectively. In a multivariate linear regression analysis, patient age, obesity, diabetes, and NS were identified as independent predictors of urine loss at the end of inpatient rehabilitation (Table 4). On average, 24-h urine loss increased by 11 gm with every year of life

**Table 2** Changes of continence parameters during inpatient rehabilitation after RC and ONB

| Variable | T1 29 days (25–35) after surgery | T2 50 days (46–56) after surgery | *p* value* |
|---|---|---|---|
| Daytime voiding frequency | | | |
| Median (IQR) | 8 (6–9) | 7 (6–8) | 0.001 |
| Nighttime voiding frequency | | | |
| Median (IQR) | 4 (3–4) | 3 (3–4) | < 0.001 |
| Pads in 24-h | | | |
| Median (IQR) | 8 (4–12) | 4 (2–6) | < 0.001 |
| Pads at day | | | |
| Median (IQR) | 4 (2–7) | 2 (1–4) | < 0.001 |
| Pads at night | | | |
| Median (IQR) | 3 (2–4) | 2 (1–3) | < 0.001 |
| 24-h pad test urine loss (gm) | | | |
| Median (IQR) | 442 (117–910) | 88 (0–402) | < 0.001 |
| Daytime urine loss (gm) | | | |
| Median (IQR) | 160 (7–509) | 15 (0–156) | < 0.001 |
| Nighttime urine loss (gm) | | | |
| Median (IQR) | 226 (67–466) | 41 (0–230) | < 0.001 |
| Uroflowmetry urine volume (ml) | | | |
| Median (IQR) | 78 (5–161) | 157 (67–284) | < 0.001 |
| Complete continence | | | |
| 24-h | 21 (7.4) | 71 (25.1) | < 0.001 |
| At day, *n* (%) | 54 (19.1) | 112 (39.6) | < 0.001 |
| At night, *n* (%) | 27 (9.5) | 84 (29.7) | < 0.001 |

*IQR* interquartile range

*Wilcoxon test or Chi square test (McNemar) as appropriate

**Table 3** Nerve sparing and urine loss in age groups

| Age | *n* (%) | Nerve sparing, *n* (%) | Urine loss (gm) at 24-h pad test, median (IQR) | | *p* value* |
|---|---|---|---|---|---|
| | | | At T1 (median 29 days after surgery) | At T2 (median 50 days after surgery) | |
| ≤ 59 years | 99 (35.0) | 72 (72.7) | 258 (26–562) | 39 (0–162) | < 0.001 |
| 60–69 years | 120 (42.4) | 53 (44.2) | 490 (189–1098) | 152 (3–424) | < 0.001 |
| ≥ 70 years | 64 (22.6) | 17 (26.6) | 708 (164–1163) | 282 (30–759) | < 0.001 |
| *p* value* | – | < 0.001 | < 0.001 | < 0.001 | – |

*IQR* interquartile range

*Chi square test (Pearson) or Kruskal–Wallis test as appropriate

**Table 4** Multivariate linear regression model to identify independent predictors of urine loss (measured by 24-h pad test) at the beginning (T1) and at the end (T2) of inpatient rehabilitation

| | Variable | *t* | Regression coefficient | 95% CI | *p* value |
|---|---|---|---|---|---|
| Urine loss at T1 | Age | 3.406 | 20.458 | 8.6 to 32.3 | 0.001 |
| | BMI ≥ 30 kg/m$^2$ | 2.995 | 388.681 | 132.3 to 645.0 | 0.003 |
| | CVD | 0.299 | 27.820 | − 156.2 to 211.8 | 0.766 |
| | Diabetes | 2.079 | 397.858 | 19.9 to 775.8 | 0.039 |
| | Nerve sparing | − 1.259 | − 117.428 | − 301.7 to 66.8 | 0.210 |
| Urine loss at T2 | Age | 3.15 | 11.4 | 4.3 to 18.5 | 0.002 |
| | BMI ≥ 30 kg/m$^2$ | 3.05 | 238.2 | 84.0 to 392.4 | 0.003 |
| | CVD | − 1.73 | − 96.7 | − 207.4 to 14.0 | 0.087 |
| | Diabetes | 2.17 | 249.9 | 22.6 to 477.3 | 0.031 |
| | Nerve sparing | − 2.57 | − 144.3 | − 255.2 to − 33.5 | 0.011 |

*T1* 29 days (25–35) after surgery, *T2* 50 days (46–56) after surgery

*BMI* body mass index, *CVD* cardiovascular disease

($p = 0.002$), 24-h urine loss was 238 gm higher in patients with obesity versus those without obesity ($p = 0.003$), 24-h urine loss was 250 gm higher in patients with diabetes versus those without diabetes ($p = 0.031$) and 24-h urine loss was 144 gm lower in patients with NS versus those without NS ($p = 0.011$).

## Discussion

Continence has a significant impact on quality of life after RC and ONB [9, 17]. During 3–4 weeks inpatient rehabilitation median urine loss on 24-h pad test decreased significantly and urine volume at uroflowmetry increased significantly. Physiotherapy with osteopathic visceral techniques reduce intraabdominal pressure and improve arterial blood flow as well as venous and lymphatic drainage. Craniosacral techniques affect the neuronal plasticity and lead to faster regeneration of the neuronal structure responsible for the function of the external urethral sphincter.

Continence in most patients improves during the initial 6–12 months postoperatively. Up to 85–90% of patients report using one or no pad in a 24-h period one year after surgery [11, 12].

Many studies assessed factors influencing urinary continence. Creation of a low pressure reservoir and preservation of the external urethral sphincter are considered to be of great importance for the maintenance of postoperative urinary continence [14, 15]. The pelvic autonomic nerves, specifically the sympathetic fibres, are known to innervate the urethral sphincter at rest and assure urinary continence [8]. For all patients who desire sexual function preservation, NS should be discussed and offered as long as it will not compromise oncological control [22]. The impact of NS on urinary continence is still controversial [7, 13, 16, 23]. Our multivariate linear regression analysis shows that NS is associated with lower urine loss at the end of inpatient rehabilitation. Urine loss on 24-h pad test was 144 gm lower in patients with NS versus those without NS. However, NS is not an independent predictor on urine loss at the beginning of inpatient rehabilitation. This could be interpreted by an effect-like neuropraxia, because Furrer et al. described that the impact of NS on urinary continence becomes more apparent over time [7]. It has to be addressed that the classification of the NS in our study based on the documentation in the medical discharge reports of the hospitals. There is also a lack of information on the details of NS procedure. Thus, these results have to be interpreted with caution.

Nighttime continence is compromised by some special circumstances. Mills and Studer described excessive nocturnal urine output due to the shift of water from the reservoir wall to the concentrated urine [19]. El Basnasahwy et al. described a decreased nocturnal sphincter tonus, the loss of the detrusor sphincter reflex and the loss of afferent input from the detrusor to the brain, as well as pressure spikes within the reservoir by increased nightly peristalsis of the intestinal wall as possible causes of nighttime incontinence after ONB [4, 6]. Moreover, El Basnasahwy et al. found the positive effect of the anticholinergic drug Oxybutynin on nocturnal enuresis [5]. Based on these findings, the use of anticholinergic drugs for severe nighttime incontinence is part of our multimodal rehabilitation program.

Hammerer et al. showed that sphincter function decreases with the patient age [10]. Ahmadi et al. described that increasing age predicts worse urinary function after RC and ONB, but is not associated with the pad use [1]. Kessler et al. as well as Clifford et al. showed better continence rates in patients younger than 65 years [3, 16]. In line with this, our study identified patient age as an independent predictor of combined daytime and nighttime continence at the period of early recovery. Overall, the median age of our patients is similar to other outcome studies according to RC and ONB [7, 9]. However, patients with attempted NS are particularly young in our study with a median of 59 years. This could explain the good results of early continence in the group of younger patients in our study.

The influence of diabetes on continence after RC and ONB was also evaluated in the literature. Ahmadi et al. described that patients with diabetes did not show a significant difference in patterns of pad use as compared to those without diabetes, while Clifford et al. found that diabetes was associated with worse continence [1, 3]. Our study identified diabetes and obesity ($\geq 30$ kg/m$^2$) as further independent predictors of early continence after RC and ONB. On an average, 24-h urine loss was 250 gm higher in patients with diabetes versus those without diabetes and 24-h urine loss was 238 gm higher in patients with obesity versus those without obesity.

In our study, age, obesity, diabetes, and NS had an impact on early continence after RC and ONB. However, these factors could also impact the way how patients are able to follow the multimodal continence therapy. Older, comorbid patients could have more problems performing the rehabilitation program.

Despite its strengths, our study is not devoid of limitations. Namely, the retrospective nature, short follow-up, and incomplete data concerning intraoperative NS and continence status for some patients initially chosen for our study. In our study, no distinction was made between different types of neobladder construction and open or robot-assisted RC and ONB. Since almost all patients in Germany receive rehabilitation, there is no control group without physiotherapeutic intervention. The effect of time on the early urinary continence is unknown. Our study includes no data on the quality of life. Despite its limitations, our study shows the extent of incontinence after RC and ONB in a nonselective sample of patients from inpatient rehabilitation. We propose further research with longer follow-up to evaluate midterm continence after RC and ONB.

## Conclusion

A rehabilitation program with a special multimodal continence therapy in a specialized center for urological rehabilitation could improve early continence after RC and ONB. Based on the objective results from 24-h pad test and uroflowmetry, our study proves the significant positive influence of younger age, the absence of diabetes, or obesity and attempted NS on early continence.

**Author contribution** BE: Project development, data collection/analysis, manuscript writing. SB: Data analysis. JN: Manuscript editing. GM: Project development, data collection/analysis, manuscript writing/editing.

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### Compliance with ethical standards

**Conflict of interest** All authors declare no conflict of interest.

**Research involving human and/or animal participants** The study involves no research on human participants or human tissue.

**Informed consent** All patients gave their informed consent prior to data collection. Data analysis started after ethical study approval by an institutional research committee (IRB no. FF29/2017).

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