



Health-related quality of life after radical cystectomy and ileal orthotopic neobladder: effect of detailed continence outcomes

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Received: 28 September 2018 / Accepted: 13 January 2019 / Published online: 30 January 2019
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Abstract

Purpose To objectively quantify continence rates and to correlate continence outcomes with health-related quality of life (HRQOL) after radical cystectomy and orthotopic ileal neobladder (ONB).

Methods Questionnaires were sent to 244 patients who underwent radical cystectomy with ONB between 2004 and 2015, and information about the current continence status was retrieved. To objectify postoperative urine loss, daytime and nocturnal pad tests were performed. Continence was defined as need of up to one safety pad. HRQOL was assessed using EORTC QLQ-C30 scoring with global health status being the primary endpoint. Statistical analysis included Fisher's test, Mann-Whitney *U* test, Pearson's rank correlation, and binary regression models ($p < 0.05$).

Results 178 patients (73.0%) answered the QLQ-C30 questionnaires and were included in the study. Median follow-up was 61 months. Median daytime pad use was 1 and median daily urine loss based on pad testing was 4.0 g, leading to a daytime continence rate of 48.5%. Continence had a significant impact on postoperative HRQOL ($p = 0.017$). ICIQ-SF score ($p = 0.001$, OR = 0.805) and need for condom catheter during nighttime ($p = 0.015$, OR = 0.123) were independent predictors for worse HRQOL outcomes based on global health status. A history of pelvic floor muscle training was an independent predictor of increased HRQOL ($p = 0.009$, OR = 10.459).

Conclusions Need of condom urinals and higher ICIQ-SF scores are independent predictors for worse HRQOL outcomes. We show significant beneficial effects of pelvic floor muscle training on patients' HRQOL.

Keywords Cystectomy · Urinary incontinence · Ileal neobladder · Bladder cancer · Quality of life

Abbreviations

BMI	Body mass index
CI	Confidence interval
CIC	Clean intermittent self-catheterization
ECOG	Eastern Cooperative Oncology Group
EORTC	European Organization for Research and Treatment of Cancer
HRQOL	Health-related quality of life
ICIQ-SF	International consultation on incontinence questionnaire short form

OR	Odds ratio
ONB	Orthotopic ileal neobladder
PFMT	Pelvic floor muscle training

Introduction

Bladder cancer is the second most common malignancy in the urinary tract and urothelial carcinoma of the urinary bladder is currently the fourth most common malignancy in men in the Western world [1].

Based on current guidelines, radical cystectomy and consecutive continent or incontinent urinary diversion are part of the gold standard approach for muscle-invasive bladder cancer [2]. Orthotopic ileal neobladder (ONB) has been introduced more than two decades ago and there is robust evidence supporting usage of this type of continent urinary diversion [3]. However, this procedure implies a significant burden for the patient and stress urinary incontinence is a

Electronic supplementary material The online version of this article (<https://doi.org/10.1007/s00345-019-02643-8>) contains supplementary material, which is available to authorized users.

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frequent postoperative complication after ONB. According to the current literature, postoperative daytime continence rates are postulated to vary between 87 and 95.9% whereas nocturnal continence rates range between 72 and 95% [4]. In addition, the method of continence measurement and consecutive classification seems to impact continence rates significantly [5]. It has been shown that SUI significantly impacts health-related quality of life (HRQOL) outcomes after ONB diversion [6–8]. Since most studies focused on outcomes based on pad usage only, little is known about the impact of detailed continence outcomes such as assistive devices, pelvic floor muscle training (PFMT) and chronic urinary retention. In the current study, we provide data on a multitude of detailed continence features and analyse the impact on HRQOL, daytime and nighttime continence rates.

Material and methods

Patient population and standard procedures

Between March 2004 and January 2015, 360 patients underwent radical cystectomy due to bladder cancer and consecutive orthotopic urinary diversion with ONB in one experienced tertiary care centre. Based on institutional records, 116 patients were identified as previously deceased and consequently excluded from the current study. Further exclusion criteria included the following: cystectomy based on benign conditions, urinary diversion other than orthotopic ileal neobladder, age < 40 and > 80, and inability to fill out the questionnaires due to language barrier. Oncological failure was not an exclusion criterion. The radical cystectomy was basically performed as described by Hautmann et al. [9]. A nerve-sparing procedure was performed when optimal resection was not compromised. Postoperatively, all patients were handed out an information sheet that includes basic information about PFMT. Furthermore, all patients were recommended to undergo voluntary specialized PFMT treatment in a rehabilitation facility approximately 4–6 weeks postoperatively.

Study design and data assessment

After approval by an institutional review board, questionnaires were sent to a total number of 244 patients in August 2015 by physicians not being part of the team that performed the cystectomy, and information about the current continence status was achieved. Daily as well as nocturnal pad use and background information about previous conservative incontinence treatment were assessed, and the validated International Consultation on Incontinence Questionnaire short-form (ICIQ-SF) questionnaire was used in a validated German translation. Subgrouping was performed following

Avery et al. [10]. Health-related quality of life (HRQOL) was assessed using the validated European Organization for Research and Treatment of Cancer (EORTC) QLQ-C30 (validated German version) questionnaire [11] following current EORTC instructions [12].

Patients were provided a detailed description of how to perform a home pad test. This description is well established in the institution and has been used in several studies by our working group [5]. Patients were also instructed not use any assisting devices (e.g. condom urinals) during the standardized pad test.

In addition, multiple parameters, hypothetically contributing to the functional outcome after ONB urinary diversion, have been assessed.

Continence was defined as need of no pad or a safety pad and continence rates were calculated for daytime and nighttime, respectively.

To assess bladder capacity, patients were instructed to allow their bladder to fill to subjective maximum capacity and to measure the voided volume consequently.

Functional outcome variables that have been assessed in the questionnaire were correlated with the HRQOL of the respective patient.

Statistical analysis

Primary endpoint was general HRQOL [defined by global health status (GHS; questions 29 and 30)] using previously published cut-off values [13]. Secondary endpoints were the respective QLQ-C30 subdomains as well as daytime and nighttime continence rates. Impact of detailed continence features on the respective endpoints was analysed. For categorical data, Fisher's exact test and Chi² test were used. For continuous data, Mann–Whitney *U* test was performed. Pearson's correlation was used to assess the impact of various functional outcome parameters on HRQOL. For multivariable analysis, a binary logistic regression model was performed. All statistical analyses were created using SPSS V23.0 software (IBM, Armonk, USA). A *p* value < 0.05 was considered to be statistically significant.

Results

Pre- and perioperative patient characteristics

Median follow-up was 70 months (9–136). Follow-up was less than 12 months in 7.8% (*n* = 19) of the patient collective. Median patient age was 66 years (44–83). Patient characteristics are summarized in Table 1. Information regarding HRQOL was available for 178 of 244 patients (73.0%). Three patients underwent surgery for stress urinary incontinence (2 × artificial urinary sphincter, 1 × male

Table 1 Patient characteristics of 178 patients who underwent radical cystectomy and ONB between 2004 and 2015 in one tertiary care centre and were included in the current study

Gender	
Male [n (%)]	155 (87.1)
Female [n (%)]	23 (12.1)
Age [yrs (mean ± SD)]	65.3 ± 9.3
BMI [kg/m ² (mean ± SD)]	26.7 ± 3.9
ECOG performance status	
0 [n (%)]	80 (44.9)
1 [n (%)]	48 (27.0)
2 [n (%)]	9 (5.1)
3 [n (%)]	2 (1.1)
4 [n (%)]	0 (0.0)
5 [n (%)]	0 (0.0)
Bladder cancer characteristics	
High grade [n (%)]	156 (87.6)
Low grade [n (%)]	22 (12.4)
pT2 or less [n (%)]	140 (78.7)
pT3 or more [n (%)]	37 (20.8)
Nodal positive [n (%)]	16 (9.0)
Nerve-sparing procedure [n (%)]	97 (54.5)

Variations in [%] due to missing data

BMI body mass index, ONB orthotopic ileal neobladder, SD standard deviation

sling). During follow-up, recurrence rate was 14.0% ($n=25$), overall survival was 87.6% with a cancer specific survival of 94.4%. Seven patients suffered from chronic urinary retention, six of them performed clean intermittent self-catheterization, with four of them being males.

Functional outcome

Functional outcome results of 178 patients who returned the questionnaires after a median follow-up of 70 months are summarized in Table 2. Briefly, daytime continence rate was 48.5% and nighttime continence rate was 34.9%. Median daily and nocturnal pad usage was 1 (range 0–9). Chronic urinary retention was apparent in 3.9%. A condom urinal catheter was used by 12.9%.

Predictive features for functional outcomes

No statistically significant effects of the timing of the respective follow-up could be found for global health status ($p=0.407$), daytime continence ($p=0.822$) and nighttime continence ($p=0.942$). Respective daytime continence rates were 40.0% (1 year postoperatively), 46.6% (2 years), and 53.3% (5 years or more). The impact of further time points is displayed in Fig. 1 as well as in supplementary Table 1.

Male patients had higher daytime continence rates (49.6 vs. 41.7%, $p=0.147$) and nighttime continence rates (36.0 vs. 25.0%, $p=0.352$) without reaching statistical significance. PFMT has been performed by 68.5% of the patients. Daytime continence rates were 59.7% for patients who performed PFMT compared to 42.9% for those who did not ($p=0.067$). PFMT did not affect nighttime continence rates (34.0 vs. 35.6%, $p=1.000$).

Nerve-sparing surgery did not improve continence outcomes (pads per 24 h, pad test day, pad test night, ICIQ-SF score) significantly. In contrast, we found a significant beneficial effect on IIEF-5 score ($p=0.048$) and global health status ($p=0.019$).

Impact of urinary function on health-related quality of life

Univariate analysis

A summary of the univariate analysis including all pre-defined continence features that have been tested can be found in supplementary Table 2.

We found increased general HRQOL based on global health status for male patients (69.5 vs. 62.7, $p=0.122$). Mean HRQOL based on the EORTC QLQ-C30 global health status was 75.0 ± 22.3 for continent patients compared to 66.0 ± 20.9 for incontinent patients ($p=0.007$).

Mean outcomes of 24 h pad tests, ICIQ-SF score, and daily pad usage of the analysed patient cohort were correlated with the patients' HRQOL using Pearson's correlation (Table 3). Briefly, we found a significant correlation between ICIQ-SF scores and daily pad usage with the general HRQOL based on global health status and functional scales. Functional scales as well as global health status decreased significantly with increasing pad usage and ICIQ-SF scores. Fatigue, insomnia and financial difficulties were positively correlated with the above-mentioned variables. The mean daily urine loss based on 24 h pad testing correlated significantly with financial difficulties but not with global health status.

Table 4 summarizes the results of the univariate analysis of the impact of important functional outcome parameters (daytime and nighttime continence, chronic urinary retention, PFMT, and condom urinal use) on HRQOL subdomains. We found a significantly decreased global health status for patients using a condom urinal ($p=0.049$). Patients who had performed PFMT anytime had a significantly better global health status ($p=0.035$). Daytime and nighttime continence led to increased global health status ($p=0.003$, $p=0.004$, respectively) as well as functioning scales. In addition, sleep disorders were less apparent in continent patients.

Table 2 Continence outcomes for 178 patients who underwent further analysis

Urinary symptoms	
Gross haematuria [<i>n</i> (%)]	113 (63.5)
Increased micturition frequency [<i>n</i> (%)]	26 (14.6)
Painful micturition [<i>n</i> (%)]	69 (38.8)
PFMT performed [<i>n</i> (%)]	122 (68.5)
Bladder capacity	
<200 ml [<i>n</i> (%)]	24 (13.5)
>400 ml [<i>n</i> (%)]	34 (19.1)
Retained sensation for bladder filling/voiding desire [<i>n</i> (%)]	110 (82.7)
Assistive devices	
Clean intermittent self-catheterization [<i>n</i> (%)]	6 (3.4)
Condom catheter [<i>n</i> (%)]	23 (12.9)
Daytime continence status	
Pad usage [median (min–max)]	1 (0–9)
Pad test [g; median ± SD (min–max)]	4 (0–2400)
Continence day [<i>n</i> (%)]	64 (48.5)
Nocturnal continence status	
Pad usage [median (min–max)]	1 (0–7)
Pad test [g; median ± SD (min–max)]	21 (0–1220)
Continence night [<i>n</i> (%)]	44 (34.9)
ICIQ-SF score	
Mean ± SD	10.1 ± 5.4 (0–21)
No incontinence [ICIQ-SF score 0; <i>n</i> (%)]	3 (1.8)
Mild incontinence [ICIQ-SF score 1–5; <i>n</i> (%)]	31 (18.7)
Moderate incontinence [ICIQ-SF score 6–12; <i>n</i> (%)]	78 (47.0)
Severe incontinence [ICIQ-SF score 13–18; <i>n</i> (%)]	40 (24.1)
Very severe incontinence [ICIQ-SF score > 18; <i>n</i> (%)]	14 (8.4)

Median follow-up of 61 months; success defined as need of no pad or one safety pad

ICIQ-SF international consultation on incontinence questionnaire short-form, *PFMT* pelvic floor muscle training, *SD* standard deviation

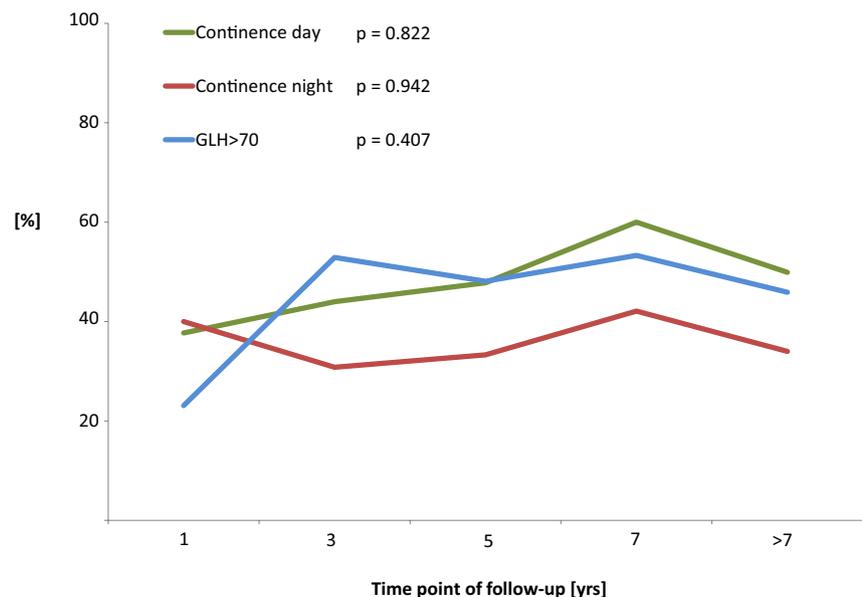
Fig. 1 Analysis of the impact of the respective time point of follow-up on daytime and night-time continence rates and good general health-related quality of life based on the QLQ-C30 Global Health Status (GHS) score (*yr*s years)

Table 3 Pearson's rank correlation of selected QLQ-C30 domains and outcome of 24 h pad testing, ICIQ-SF questionnaire, and daily pad usage

	Pad test day [ml]		Pad test night [ml]		Pads per 24 h		ICIQ-SF score	
	Pearson correlation	<i>P</i>	Pearson correlation	<i>P</i>	Pearson correlation	<i>P</i>	Pearson correlation	<i>P</i>
Dyspnoea	0.014	0.882	−0.020	0.837	0.118	0.183	0.109	0.174
Pain	0.085	0.370	−0.012	0.899	0.134	0.082	0.174	0.025
Constipation	−0.074	0.439	0.144	0.140	0.129	0.145	0.136	0.082
Diarrhoea	−0.010	0.913	−0.118	0.244	−0.006	0.992	0.083	0.289
Nausea/vomiting	−0.021	0.828	−0.026	0.788	0.135	0.127	0.216	0.005
Appetite loss	−0.024	0.797	0.042	0.662	0.249	0.004	0.334	< 0.001
Fatigue	0.071	0.446	0.142	0.038	0.203	0.019	0.336	< 0.001
Insomina	0.000	0.998	−0.017	0.868	0.138	0.114	0.229	0.003
Financial difficulties	0.321	< 0.001	0.267	0.016	0.214	0.008	0.319	< 0.001
Physical functioning	−0.134	0.149	−0.090	0.351	−0.291	0.001	−0.393	< 0.001
Role functioning	−0.108	0.246	−0.071	0.461	−0.241	0.005	−0.371	< 0.001
Cognitive functioning	0.027	0.776	−0.035	0.718	−0.267	0.002	−0.342	< 0.001
Emotional functioning	0.048	0.609	−0.020	0.834	−0.190	0.029	−0.369	< 0.001
Social functioning	−0.081	0.386	−0.082	0.392	−0.247	0.004	−0.504	< 0.001
Global health status	−0.128	0.168	−0.011	0.912	−0.197	0.023	−0.355	< 0.001

P values < 0.05 are shown in bold

ICIQ-SF international consultation on incontinence questionnaire short form

Multivariate analysis

We performed a multivariate analysis of continence features that showed significant results in the univariate analysis using a binary logistic regression model. Endpoint was a global health status > 70 as recently defined by Snyder et al. [13].

Results are summarized in Table 5. Briefly, higher ICIQ-SF scores (regression coefficient −0.217, OR = 0.805, *p* = 0.001) and need for a condom urinal (−2.097, 0.123, *p* = 0.017) correlated with decreased general HRQOL. In contrast, PFMT was an independent predictor of increased general HRQOL (2.347, 10.459, *p* = 0.009).

Discussion

Radical cystectomy and ONB are a cornerstone of modern therapy of muscle-invasive bladder cancer [2]. Amongst others, stress urinary incontinence is a complication that frequently occurs and heavily impairs patients' HRQOL [4]. Within the last decade, a lot of efforts have been undertaken to evaluate postoperative continence outcomes after ileal neobladder reconstruction [4].

In the current study, we focused on the impact of urinary function on HRQOL outcomes based on the validated EORTC QLQ-C30 global health status [11]. Despite being not bladder cancer specific, this validated questionnaire has

been used in the majority of studies investigating HRQOL after orthotopic urinary diversion [14].

A major innovation of the current study is a correlation of a multitude of objectively measured urinary continence features with HRQOL outcomes. Hereby, we found a strong correlation with most functional scale parameters as well as global health status. This correlation was stronger for the validated ICIQ-SF score as well as daily pad usage rather than urine loss based on standardized pad testing. Thus, our results indicate that quantification of urine loss with validated questionnaires and daily pad usage might be sufficient for HRQOL outcome measurement purposes.

Our results are in line with previous studies showing a significant effect of postoperative incontinence on patients' HRQOL. Takenaka analysed HRQOL outcomes in 86 patients after a median follow-up of more than 5 years using the validated SF-36 score and found worse results in incontinent patients [7]. Zahran et al. [6] focused on the effect of nighttime incontinence in 74 women and found a significant impact on HRQOL based on QLQ-C30 as well as FACT score. Imbimbo et al. analysed the HRQOL outcome of 174 ONB patients using the QLQ-C30 as well as QLQ-BLM questionnaire. The authors found the absence of urinary incontinence being an independent predictor of better functioning in terms of relational life, emotional life, and fatigue [8]. In addition, our working group has previously shown that incontinence based on ICIQ-SF score and daily pad usage as well as the existence of urgency symptoms significantly impairs HRQOL after ONB urinary diversion [15].

Table 4 Impact of various functional outcome features on QLQ-C30 domains

	Continence day			Continence night			Chronic urinary retention			PFMT anytime			Condom urinal		
	Yes	No	P	Yes	No	P	Yes	No	P	Yes	No	P	Yes	No	P
	Dyspnoea [mean (SD)]	15.6 (34.0)	26.3 (23.6)	0.034	15.9 (35.6)	24.5 (70.7)	0.129	5.6 (13.6)	20.4 (32.8)	0.265	21.6 (34.9)	17.8 (70.7)	0.514	17.4 (26.3)	20.3 (15.6)
Pain [mean (SD)]	14.5 (23.5)	17.2 (18.7)	0.798	11.2 (20.2)	18.6 (23.6)	0.300	8.3 (13.9)	16.4 (26.0)	0.646	15.8 (25.3)	17.8 (15.8)	0.802	11.6 (21.6)	16.8 (13.7)	0.411
Constipation [mean (SD)]	13.1 (21.3)	11.1 (17.4)	0.224	10.9 (21.5)	12.2 (12.7)	0.809	0.0 (0.0)	12.8 (23.8)	0.146	12.7 (24.2)	8.9 (11.9)	0.889	12.7 (24.2)	8.9 (11.9)	0.308
Diarrhoea [mean (SD)]	14.8 (25.5)	21.7 (47.1)	0.288	12.4 (26.2)	20.3 (18.7)	0.086	16.7 (27.9)	16.9 (27.8)	0.972	18.4 (29.7)	17.7 (14.2)	0.781	18.4 (29.7)	17.8 (14.2)	0.769
Nausea/vomiting [mean (SD)]	2.2 (7.1)	4.5 (4.7)	0.625	1.2 (5.6)	4.2 (2.1)	0.155	5.6 (13.6)	3.8 (11.9)	0.765	2.5 (11.5)	8.9 (23.6)	0.009	2.5 (11.5)	8.9 (23.6)	0.911
Appetite loss [mean (SD)]	2.2 (8.3)	11.6 (8.5)	0.005	1.6 (7.1)	9.3 (47.1)	0.019	5.6 (13.6)	7.3 (19.6)	0.968	16.5 (8.1)	8.9 (23.6)	0.559	6.5 (18.1)	8.9 (23.6)	0.746
Fatigue [mean (SD)]	21.0 (22.4)	33.8 (19.3)	0.005	19.9 (19.8)	31.6 (19.8)	0.032	31.7 (24.4)	27.7 (25.5)	0.574	27.1 (26.1)	34.1 (15.7)	0.218	27.1 (21.1)	28.0 (15.7)	0.881
Insomnia [mean (SD)]	18.2 (29.7)	29.4 (70.7)	0.033	15.2 (26.4)	28.0 (23.6)	0.042	14.3 (26.2)	26.3 (32.6)	0.321	24.6 (33.4)	24.4 (16.3)	0.693	24.6 (33.4)	24.4 (16.3)	0.352
Financial difficulties [mean (SD)]	9.9 (22.8)	15.4 (3.4)	0.316	9.1 (20.8)	14.6 (70.7)	0.421	9.5 (16.3)	16.6 (29.7)	0.794	12.8 (26.6)	11.1 (47.1)	0.897	17.4 (26.3)	16.1 (23.6)	0.423
Physical functioning [mean (SD)]	88.8 (16.2)	78.1 (17.3)	0.005	88.6 (15.5)	79.7 (18.9)	0.077	89.5 (10.8)	82.3 (21.1)	0.496	83.2 (20.2)	78.2 (4.7)	0.715	84.9 (15.3)	82.2 (18.9)	0.936
Role functioning [mean (SD)]	83.6 (23.7)	66.4 (23.6)	0.002	86.4 (22.5)	68.3 (11.8)	0.001	83.3 (21.5)	72.8 (32.4)	0.471	74.9 (30.6)	70.0 (23.6)	0.668	77.5 (30.8)	72.6 (28.5)	0.421
Cognitive functioning [mean (SD)]	88.3 (18.9)	76.4 (23.6)	0.002	90.5 (15.0)	78.3 (23.6)	0.004	83.3 (19.3)	83.4 (23.7)	0.757	82.1 (24.1)	82.2 (23.6)	0.956	80.4 (19.9)	83.9 (31.1)	0.911
Emotional functioning [mean (SD)]	82.9 (19.8)	73.6 (24.3)	0.022	84.7 (17.7)	75.2 (11.8)	0.038	89.3 (18.5)	77.8 (23.5)	0.152	77.6 (23.5)	80.6 (23.6)	0.757	73.6 (19.9)	79.0 (35.4)	0.106
Social functioning [mean (SD)]	80.9 (27.2)	63.2 (47.1)	0.002	83.7 (27.3)	66.3 (35.4)	0.002	66.7 (25.4)	70.2 (32.6)	0.586	70.5 (33.2)	74.4 (35.4)	0.875	67.4 (32.8)	70.4 (23.6)	0.656
Global health status [mean (SD)]	75.1 (22.0)	65.2 (17.7)	0.004	77.5 (21.2)	66.5 (17.7)	0.003	80.9 (15.0)	68.1 (22.4)	0.123	74.4 (22.1)	58.9 (23.6)	0.035	61.6 (18.2)	69.6 (11.8)	0.049

P values < 0.05 are shown in bold

C/C clean intermittent self-catheterization, *PFMT* pelvic floor muscle training

Table 5 Multivariate analysis of hypothesized prognostic features for good postoperative HRQOL (global health status > 70) that showed statistically significant results in univariate analysis

Prognostic feature	Regression coefficient	<i>P</i>	OR	95% CI
24 h pad test [ml]	0	0.960	1.000	0.998–1.003
Higher ICIQ-SF score [#]	–0.217	0.001	0.805	0.710–0.913
Pads per day [#]	–0.156	0.464	0.855	0.563–1.299
PFMT performed [y]	2.347	0.009	10.459	1.814–60.291
Urinal condom [y]	–2.097	0.017	0.123	0.022–0.692
Increased micturition frequency [#]	–0.301	0.759	1.317	0.194–2.822

P values < 0.05 are shown in bold

CI confidence interval, *OR* odds ratio, *y* yes

One of the novelties of the current study is the analysis of the impact of assistive devices of incontinent patients on HRQOL. We found a significant impact on global health status if patients were in need for condom catheters. Since usage of condom urinals indicates incontinence that is severe enough to force the patient to change pads several times, it seems conclusive that patients using a condom catheter have worse HRQOL outcomes. Furthermore, multivariate analysis confirmed the need of condom catheters as independent predictors for worse HRQOL outcomes. To date, there is no evidence regarding the use of condom catheters for post-cystectomy SUI.

Postoperative recovery after ONB reconstruction is complicated by the heavily altered voiding procedure itself. This may lead to SUI as reported above, but may also lead to chronic urinary retention and consecutive urinary tract infections and even chronic kidney damage. In addition, ONB urinary diversion frequently leads to loss of feeling of the neobladder with consecutive loss of desire to void [3]. The self-catheterization rate in our patient cohort, representing the chronic urinary retention rate, is within the pre-described range [4]. We analysed the impact of clean intermittent self-catheterization (CIC) on selected QLQ-C30 domains and found no significant effect on global health status as well as any of the analysed domains. This indicates that chronic urinary retention and consecutive need for CIC are accepted by the respective patients and have a less distinct effect on HRQOL as incontinence. In contrast to our results, Takenaka et al. [7] found that patients who performed CIC had worse HRQOL outcomes determined by SF-36 questionnaire. These findings have clinical implications and are important for pre-operative patient counselling.

Strikingly, we were able to show significantly increased HRQOL outcomes for patients who had performed PFMT anytime after the cystectomy. In multivariate analysis, this patient subgroup had a more than tenfold increased ratio of good HRQOL following the definition of Snyder et al. [13]. To our knowledge, this is the first study to show an independent beneficial effect of PFMT for patients after

radical cystectomy. In addition, we did not observe a beneficial impact of PFMT on QLQ-C30 functioning scores. Regarding post-prostatectomy incontinence, PFMT has been proven to be effective even more than 1 year after the surgery [16]. In a recent meta-analysis, Fernandez et al. [17] concluded that programs should include at least three sets and ten repetitions daily.

It is generally postulated that nerve-sparing procedures are able to improve the ability to control the pelvic floor muscles. Thus, it can be anticipated that it consequently might also enhance the efficacy of PFMT. However, we did not observe a beneficial effect of nerve-sparing surgery on continence rates even though nerve-sparing positively affected the global health status. It has to be addressed that nerve-sparing classification was based on documentation of the respective surgeon and was not objectified. Thus, these results have to be interpreted with caution.

We acknowledge the limitations of our retrospective study. Unfortunately, not all-possible information could be obtained for every participating patient leading to differing patient numbers for various analysed features. For instance, we have not been able to analyse all causes of haematuria. The current study is a cross-sectional study and information about the continence status has not been obtained at different time points. Despite its limitations, the current study provides new insights in the HRQOL outcome after ONB and will affect clinical routine and decision making.

Conclusion

The current study addresses the impact of detailed continence features on HRQOL. We show that the use of condom urinals and an increased ICIQ-SF score are independent predictors for worse HRQOL outcomes. We observe significant beneficial effects of pelvic floor muscle training on patients HRQOL after radical cystectomy.

Author contributions TG Project development, Data Collection, Manuscript writing. JG Project development, Data Collection. AB Project development, Data Collection. GS Project development, Data Collection. FJ Data Collection, Manuscript writing. CGS Project development. AK Project development. AK Project development, Statistical analysis, Manuscript writing.

Compliance with ethical standards

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

Informed consent Informed consent was obtained from all individual participants included in the study.

Ethical approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

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