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Platinum Priority – Bladder Cancer
Editorial by John S. McGrath on pp. 718–719 of this issue

The Fate of Radical Cystectomy Patients after Hospital Discharge: Understanding the Black Box of the Pre-readmission Interval

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Article info

Article history:
Accepted July 12, 2016

Associate Editor:
James Catto

Keywords:
Bladder cancer
Readmission
Communications
Postoperative
Follow-up

Abstract

Background: Radical cystectomy has one of the highest 30-d hospital readmission rates but circumstances leading to readmission remain poorly understood.
Objective: To examine the postdischarge period and better understand hospital readmission after radical cystectomy.
Design, setting, and participants: We conducted a retrospective cohort study of patients treated with radical cystectomy for bladder cancer from 2005 to 2012 using our institutional database.
Outcome measurements and statistical analysis: We assessed patient communication with any healthcare system after hospital discharge based on timing, methods, and concern types. Logistic regression and Cox proportional-hazards analyses were used to compare post-discharge concerns among readmitted and nonreadmitted patients. We internally validated the logistic model using a bootstrap resampling technique.
Results and limitations: One-hundred patients (23%) were readmitted within 30 d of index discharge. Readmitted patients were more likely to use the emergency department with initial concerns compared with nonreadmitted patients (27% vs 1.0%, $p < 0.001$). Patients who took longer to first communicate their concerns and who were able to tolerate their symptoms longer had lower odds of readmission. Patients who reported infection (adjusted hazard ratio: 2.8, 95% confidence interval: 1.4–5.8) and failure to thrive concerns (adjusted hazard ratio: 4.4, 95% confidence interval: 2.0–9.3) were more likely to be readmitted compared with those who communicated noninfectious wounds and/or urinary concerns.
Conclusions: Radical cystectomy patients who contact the health system soon after discharge or communicated infectious or failure to thrive symptoms (fever, poor oral intake, or vomiting) are more likely to experience readmission as opposed to those that endorse pain, constipation, or ostomy issues. Better understanding of this pre-readmission interval can optimize postdischarge practices.
Patient summary: We looked at bladder cancer patients who had surgery and the reasons why they were readmitted to hospital. We found patients who had a fever or difficulty with eating and maintaining their weight had the highest chance of being readmitted.

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http://dx.doi.org/10.1016/j.euf.2016.07.004
2405-4569/

1. Introduction

Radical cystectomy is a complex and morbid operation with one of the highest 30-d hospital readmission rates across all major surgical procedures (~25%) [1–4]. The Centers for Medicare and Medicaid Services Hospital Readmissions Reduction Program scrutinizes excess 30-d readmissions and reduces payments to hospitals with high rates [5,6]. Readmission after radical cystectomy could become the focus of cost-saving policies for healthcare systems [7].

Understanding how, when, and why readmissions occur after hospital discharge is critical to developing effective interventions. We have shown that most readmissions after cystectomy occur within 2 wk of discharge, and patients are hospitalized for an average of 1 wk upon readmission. The most common etiologies for readmission include infection, failure to thrive, and urinary and gastrointestinal disorders [8,9]. However, *how* readmissions occur is still not well characterized. Further, there is limited understanding of the evolution of clinical concerns and patient communications after hospital discharge but before readmission.

For these reasons, we conducted an in-depth analysis of communications with patients during the pre-readmission interval to unpack how readmissions occur. Overall, our study aims to inform how readmissions occur after radical cystectomy patients leave the hospital.

2. Materials and methods

2.1. Study population

We conducted a retrospective cohort study of patients treated with radical cystectomy for bladder cancer from 2005 to 2012 based on our tertiary care institutional database. We included patients regardless of operative technique (ie, robotic vs open), neoadjuvant chemotherapy, and urinary diversion type (ie, ileal conduit vs neobladder). Prior studies have shown an index length of stay of longer than 11 d for radical cystectomy patients is associated with an increased rate of readmissions [9]. Therefore, we chose to examine cystectomy patients who had an initial length of stay of less than 10 d to target findings toward the majority of patients who will be communicating with the health system and for whom optimizing follow-up communication strategies could help understand readmission risk beyond typical known factors (eg, postoperative complications). We also excluded patients with insufficient records for analyses (n = 45). Insufficient records include patients who did not have one or more variables recorded in the electronic medical system. This resulted in a study population of 440 patients.

2.2. Outcomes

The primary outcome was hospital readmission within 30 d following radical cystectomy discharge. Patients readmitted after 30 d of their index hospital discharge date were defined as nonreadmitted per the Centers for Medicare and Medicaid Services definition [6]. Several secondary outcomes were assessed including: (1) the timing and methods used for patient communications with the healthcare system (both at their operative hospital and at other institutions), (2) the specific concerns that patients or caregivers had during those communications, and (3) how these varied across readmitted and nonreadmitted patients.

2.3. Pre-readmission communications and concerns

We used data from our institutional radical cystectomy database and electronic medical record review to conduct this study. Communication and concern data were independently extracted by two authors (N.K. and B.L.). To examine the timing of initial communication between the patient and the healthcare system, we assessed the first time (in days) patients or caregivers had any type of documented communication with a healthcare system after index discharge. The method of first communication could be a telephone call, follow-up office visit, or emergency department encounter (both at operative and secondary hospitals).

We categorized the reason for the first communication as either a *concern* or *nonconcern* with respect to its clinical relevance. We defined a *concern* as any clinical difficulty the patient or their caregiver might experience that subsequently results in communication with the healthcare system (eg, postoperative pain). This was further characterized based on clinical organ system. A *nonconcern* represented any communication with the healthcare system not due to clinical concerns for the patient or their family (eg, question about scheduling outpatient follow-up care, medication prescription refill request, etc.).

We further categorized each *concern* based on its timing, method of communication, and symptoms. We assessed the days to first *concern* based on index hospital discharge date and lead time to first *concern*. Lead time (in days) was defined as how long a patient experienced his or her *concern* prior to the postdischarge communication (eg, patient had been vomiting for 3 d). We also characterized the method used to communicate the concern as telephone call, scheduled follow-up office visit, or emergency department encounter (both at operative and secondary hospitals).

Next, we grouped each *concern* according to signs and symptoms based on prior work [8,9]. These groups included infectious, gastrointestinal, noninfectious wound and urinary. We classified gastrointestinal concerns as nausea, vomiting, constipation, obstipation, poor oral intake, or diarrhea. To further stratify gastrointestinal concerns, we separated those patients with symptoms of failure to thrive (including poor oral intake, weight loss, and vomiting). Infectious concerns included fever, culture proven or urinalysis positive urinary tract infection, surgical site, and wound infections (ie, redness, swelling and/or pain around the incision, fever, or purulent discharge), or urinary sepsis (as diagnosed and documented by a healthcare practitioner). Noninfectious wound and urinary concerns included discoloration in the urine (eg, hematuria), urinary catheter-related difficulty, ostomy care issues, as well as redness around the surgical incision site, wound dressing difficulty, and postoperative pain. There was agreement for the majority of cases according to these categories during the chart abstraction. In cases of disagreement, there was discussion among the coauthors until a consensus was reached to ensure fidelity of the results.

2.4. Statistical analyses

First, we conducted bivariate analyses to examine demographic and clinical factors among readmitted and nonreadmitted cystectomy patients. We examined demographic factors (age, sex, race, American Society of Anesthesiologists [ASA] physical status classification score [I–II, III–IV], body mass index [BMI]), as well as clinical factors such as use of neoadjuvant chemotherapy and Clavien-Dindo classification of surgical complications during the index admission. We used a Student t test, Mann-Whitney U test, and Cochran-Mantel-Haenszel chi-square tests where appropriate.

Secondly, we performed multivariable logistic regression analyses adjusting for the following variables: age, sex, race, ASA score, BMI, inpatient Clavien-Dindo complication grade, days to first concern, first concern lead time, and all three concern categories, with the main

outcome being 30-d hospital readmission. To conduct internal validation of our final model, we used nonparametric bootstrapping (n = 10 000) with stratified resampling for sensitivity analyses [10–12]. A logistic regression model with bias-corrected 95% confidence intervals (CIs) was generated using the 10 000 bootstrapped samples. We also further distinguished the failure to thrive concerns from the gastrointestinal concerns for risk stratification purposes in our bootstrapped model.

Lastly, we used a Cox proportional-hazards model to test the degree to which days to first concern and type of concern were associated with freedom from readmission (in days; calculated as 1 minus the probability of readmission) among the readmitted cohort. We included the same set of covariates in our time-to-event model as in our logistic regression models. We used the noninfectious wound and urinary concern type as the reference category because these clinical concerns were the least concerning risk factors for readmission compared with the other two concern types, infection, and failure to thrive.

All analyses were performed using SAS version 9.4 software (SAS Institute, Cary, NC, USA) and IBM SPSS software for Windows 7.0 Enterprise (SPSS Inc., Chicago, IL, USA). All testing was two-sided, and the probability of a Type I error was set at 0.05. The study protocol was approved by the University of Michigan Institutional Review Board.

3. Results

Our total population included 440 cystectomy patients of which 23% were readmitted within 30 d during the years 2005–2012 (Table 1). On bivariate analyses, nonreadmitted and readmitted cystectomy patients did not differ on age, sex, race, ASA classification, BMI, Clavien complications, neoadjuvant chemotherapy, or urinary diversion type. Among the four concern categories, the readmitted cohort had significantly greater infectious, gastrointestinal, and failure to thrive concerns (all $p < 0.05$). Conversely, the nonreadmitted cohort reported a greater proportion of noninfectious wound and urinary concerns ($p < 0.001$). With respect to timing of communication, readmitted patients had a shorter time to first concern versus their nonreadmitted peers (mean 6.9 d vs 17 d, respectively, $p < 0.001$) and trended toward a shorter first concern lead time (mean 2.3 d vs 6.1 d, respectively, $p = 0.06$). The median index length of stay was 7 d.

As illustrated in Figure 1, readmitted and nonreadmitted patients differed in their methods of first communication. Readmitted cystectomy patients were more likely to use the emergency department as the means to communicate their first concern versus the nonreadmitted cohort (27% vs 1%, respectively, $p < 0.001$) and less likely to use telephone services (56% vs 72%, respectively, $p < 0.001$). Within gastrointestinal, infection, noninfectious wound and urinary concern groups, patients' readmission risk differed depending on the nature of their first postdischarge communication ($p \leq 0.001$, 0.054, 0.049, respectively; Appendix). Patients appeared more likely to be readmitted when their first communication postdischarge was an emergency room visit compared with a first communication in the clinic or by telephone.

As shown in Table 2, other than age of the patient, no demographic variables were predictive of hospital read-

Table 1 – Demographic and clinical characteristics of the study population

Variable	Nonreadmitted n = 340 (77)	Readmitted n = 100 (23)	p value[a]
Age, mean, yr (SD)	66 (11)	65 (10)	0.73
Sex, n (%)			0.64
Male	256 (75)	63 (63)	
Race, n (%)			0.82
Nonwhite	10 (3)	5 (5)	
White	330 (97)	95 (95)	
ASA classification, n (%)			0.51
ASA Class I and II	166 (48)	41 (41)	
ASA Class III and greater	174 (51)	59 (59)	
BMI, mean, kg/m^2 (SD)	28 (5)	29 (6)	0.29
Neoadjuvant chemotherapy[b], n (%)	143 (42)	44 (44)	0.73
Clavien-Dindo classification, n (%)			0.84
Grade 0 and I	275 (81)	80 (80)	
Grade II and greater	65 (19)	20 (20)	
Urinary diversion type, n (%)			0.37
Ileal conduit	206 (61)	56 (56)	
Neobladder	132 (39)	44 (44)	
Concern category[c], n (%)			
Noninfectious wound and urinary	130 (38)	15 (15)	<0.001
Infection	27 (8)	42 (42)	<0.001
Gastrointestinal	67 (20)	31 (31)	0.02
Failure to thrive[d]	20 (6)	26 (26)	<0.001
Days to first concern, mean, d (SD)	17 (19)	6.9 (6)	<0.001
First concern lead time, mean, d (SD)	6.1 (12)	2.3 (2)	0.06

ASA = American Society of Anesthesiologists Physical Status; BMI = body mass index; SD = standard deviation.

[a] The p values for age and BMI done using a Student t test; days to first concern and first concern lead time doing using Mann-Whitney U test; sex, race, ASA score, concern category, and diversion type done using Mantel-Haenszel chi-square statistic.

[b] Neoadjuvant chemotherapy includes patients receiving and not receiving cisplatin.

[c] Proportion of concern category among nonreadmitted and readmitted patients.

[d] Failure to thrive is a subgroup of gastrointestinal patients.

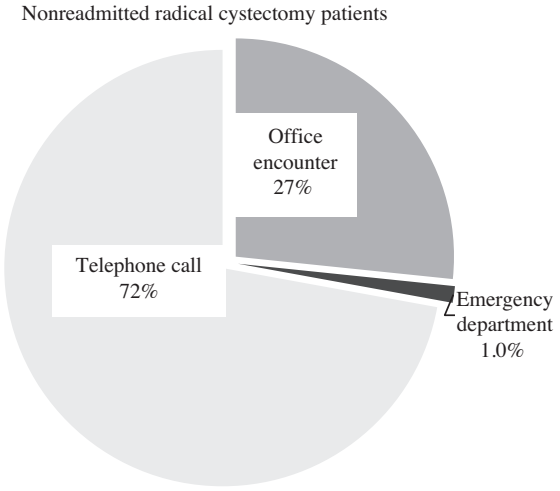

Fig. 1 – Communication method for relaying first concerns after hospital discharge among radical cystectomy patients. There were dramatic differences in the methods used by readmitted and nonreadmitted patients to first communicate their concerns. Readmitted cystectomy patients were more likely to use the emergency department as the means to communicate their first concern versus the nonreadmitted cohort (27% vs 1%, respectively, $p < 0.001$) and less likely to use telephone services (56% vs 72%, respectively, $p < 0.0001$).

mission following radical cystectomy in our initial multivariable model. We excluded neoadjuvant chemotherapy and urinary diversion type as these were not significant on bivariate analyses. Further, cancer stage and urinary diversion type were not found to be associated with readmission on univariate analysis, validating previous work on readmissions following radical cystectomy [9]. Patients classified as ASA Class III or greater had increased odds of readmission (adjusted odds ratio [aOR]: 2.2, 95% CI: 1.1–4.4). We also found that increasing days to first concern (aOR: 0.95, 95% CI: 0.91–0.98), increasing lead time (aOR: 0.88, 95% CI: 0.78–0.99), as well as noninfectious wound and urinary concerns (aOR: 0.15, 95% CI: 0.05–0.47) were all associated with decreased odds of readmission.

We next performed a sensitivity analysis with gastrointestinal concerns stratified further as failure to thrive. We found that infection concerns noted during the first communication were associated with more than a 7-fold increase in the odds of readmission (bias corrected odds ratio [bcOR]: 7.1, 95% CI: 3.6–18; Table 3). Furthermore, failure to thrive concerns had an almost 9-fold increase in the odds of readmission (bcOR: 8.8, 95% CI: 4.4–23). Noninfectious urinary and wound concerns were predictive of decreased odds of readmission (bcOR: 0.52, 95% CI: 0.38–0.70). We again found decreasing odds of readmission with increasing days to first concern (bcOR: 0.94, 95% CI: 0.92–0.97) as well as increasing lead time (bcOR: 0.86, 95% CI: 0.76–0.95). Patients classified as ASA III or greater trended towards increased odds of readmission as well ($p = 0.06$).

Lastly, we found several demographic, concern type, and communication variables associated with freedom from readmission in our Cox proportional-hazards model (Table 4). For example, every decade of increasing age was associated with a 50% increase in earlier readmission (adjusted hazard ratio: 1.5, 95% CI: 1.1–2.0). Patients who reported infection and failure to thrive concerns had a significantly higher risk of earlier readmission compared with those who expressed noninfectious wound and urinary concerns (both $p < 0.05$). Patients with inpatient complications Grade III or greater also had an increased risk of readmission ($p = 0.02$). With respect to communication with the healthcare system, increased time (in days) to the first communication for any concern was again associated with a decreased risk of readmission ($p < 0.001$). As illustrated in Figure 2, first concerns related to infection and failure to thrive had the lowest adjusted probabilities of being free from hospital readmission.

4. Discussion

This study revealed that patients readmitted after radical cystectomy tend to communicate infectious and failure to thrive type concerns (including fever, poor oral intake, and

Table 2 – Influence of demographics and concern category information on hospital readmission following radical cystectomy

Patient characteristics & concern category	Multivariable adjusted, OR (95% CI)	*p* value	Multivariable bias corrected, OR[a] (95% CI)	*p* value
Age	0.97 (0.93, 0.99)	0.05	0.97 (0.94, 1.0)	0.23
Male	Reference		Reference	
Female	1.1 (0.51, 2.3)	0.80	1.1 (0.43, 2.6)	0.91
Nonwhite	Reference		Reference	
White	0.80 (0.15, 4.3)	0.79	0.62 (<0.01, 5.8)	0.65
ASA Class I and II	Reference		Reference	
ASA Class III or greater	2.2 (1.1, 4.4)	0.02	2.1 (0.88, 5.6)	0.06
BMI	1.0 (0.96, 1.1)	0.55	1.0 (0.95, 1.1)	0.64
Clavien-Dindo Grade II or less	Reference		Reference	
Clavien-Dindo Grade III or greater	2.0 (0.8, 4.6)	0.13	2.1 (0.60, 8.4)	0.19
Noninfectious wound and urinary	0.15 (0.05, 0.47)	0.001	0.52 (0.38, 0.70)	0.006
Infection	1.8 (0.53, 6.0)	0.35	7.1 (3.6, 18)	<0.001
Gastrointestinal	0.53 (0.17, 1.7)	0.29	8.8 (4.4, 23)	<0.001
Days to first concern	0.95 (0.91, 0.98)	0.004	0.94 (0.92, 0.97)	0.002
First concern lead time	0.88 (0.78, 0.99)	0.03	0.86 (0.76, 0.95)	0.03

ASA = American Society of Anesthesiologists Physical Status; BMI = body mass index; CI = confidence interval; OR = odds ratio.
[a] Bias corrected OR with 10 000 bootstrap iterations.

Table 3 – Cox proportional-hazard model of readmitted radical cystectomy patients based on demographic and first concern category data

Risk factors	Parameter coefficient	Adjusted hazard ratio (95% CI)	*p* value
Age per 10 yr	0.04	1.5 (1.1, 2.0)	0.005
Male		Reference	
Female	−0.29	0.75 (0.43, 1.3)	0.32
Nonwhite		Reference	
White	−0.80	0.45 (0.13, 1.6)	0.22
ASA Class II or less		Reference	
ASA Class III or greater	0.78	1.1 (0.62, 1.9)	0.78
BMI	0.03	1.0 (0.99, 1.1)	0.15
Clavien-Dindo Grade II or less		Reference	
Clavien-Dindo Grade III or greater	0.70	2.0 (1.1, 3.7)	0.02
Noninfectious wound and urinary		Reference	
Infection	1.1	2.8 (1.4, 5.8)	0.003
Failure to thrive	1.5	4.4 (2.0, 9.3)	<0.001
Days to first concern	−0.15	0.86 (0.81, 0.91)	<0.001
First concern lead time	0.03	1.0 (0.90, 1.2)	0.65

ASA = American Society of Anesthesiologists Physical Status; BMI = body mass index; CI = confidence interval.

vomiting) more frequently than their nonreadmitted peers. Furthermore, these patients were at greater risk of readmission especially when compared with patients who communicated catheter-related difficulty or postoperative pain. This unique clinical data helps to contextualize the evolution of clinical concerns and how they lead to readmission.

We found that readmitted patients were more likely to use the emergency department as a means of first communication for any concern both at their operative and secondary hospitals versus nonreadmitted patients. Patients were also much less likely to be readmitted if they communicated their first concern at a later point in time from their index discharge or if they were experiencing their concerns for a longer period of time (ie, longer lead time). The significance of this finding is that cystectomy patients who are readmitted tend to contact the healthcare system with concerns earlier during their postdischarge period and after fewer days of experiencing symptoms.

Targeting interventions during symptomatic lead time periods may thwart readmissions or lessen their burden through earlier patient support. These findings could help improve risk stratification for readmission and aid in patient counseling during outpatient follow-up care and communications [13,14]. Overall, this information provides further context as well as a more patient-centric viewpoint of the pre-readmission interval.

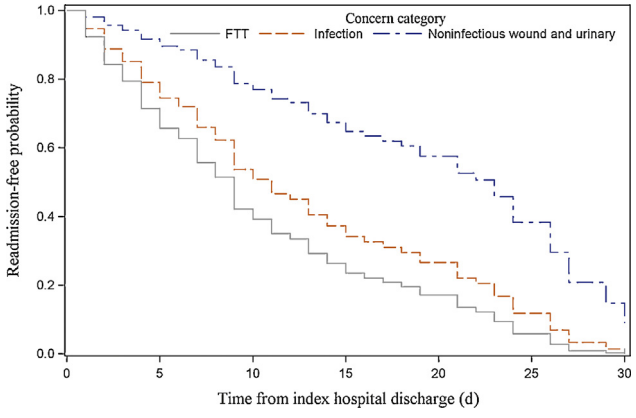

Fig. 2 – Freedom from hospital readmission among 100 readmitted radical cystectomy patients according to communication concerns during the pre-readmission interval. First concerns related to infection and failure to thrive (FTT) had the lowest adjusted probabilities of being free from hospital readmission after radical cystectomy discharge.

Radical cystectomy is accompanied with a significant risk of adverse events, and hospital readmission for these patients tends to be resource intensive [9,15,16]. Consistent with prior literature, we found most demographic and clinical characteristics did not predict readmission [17]. Our findings help elucidate the differences in the postdischarge communication trends between readmitted and nonreadmitted cystectomy patients.

The time to communicate clinical concerns after leaving the hospital and the types of concerns remained important factors for readmission. Improved understanding of the communication characteristics after radical cystectomy could lead to better discharge and follow-up care practices, more complete risk stratification, and streamlined care coordination [13]. For example, operative hospitals could establish telemedicine services for ease of communication after hospital discharge focusing on patients who call within the 1st 10 d [18]. Care transition strategies in other disease states that could be relevant include communication with primary care providers [19], team-based transition-of-care programs [20], and hospital-community partnerships [21], among others. One example of this involves primary care providers contacting patients within 24 h of hospital discharge, leading to fewer postdischarge medication discrepancies. Others include more embedded, systems-level strategies, like The Greater New Haven Coalition for Safe Transitions and Readmission Reductions [21] and Project Re-engineered Discharge [22]. With finite resources available, it is important for providers and hospital administrators to work together to tailor findings given the specific needs of their patients and health systems; the findings presented here can guide the adoption of previously successful interventions in high-risk surgical patient populations. Better readmission risk prediction models and optimal follow-up care practices using multidisciplinary approaches could also reduce the

readmission burden [23,24]. For instance, delay-time analysis, a systems engineering method, can derive optimal outpatient care regimens based on our current understanding of radical cystectomy outcomes [25]. However, although this study adds clarity to the timing and nature of initial communication with respect to readmission risk, it does not directly address the frequency of patient-provider communications. The frequency of communication, a more nuanced parameter in the pre-readmission interval, could be associated with the severity of a patient concern, provider follow-up protocols, or individual patient factors. Previous studies have shown the positive effect of regular, vigilant follow-up communication between patient and provider; future investigation should aim to implement and tailor this knowledge for radical cystectomy patients [26]. Without further research regarding follow-up care practices after radical cystectomy, readmissions following this surgery will remain a significant burden.

These findings should be considered in the context of several limitations. First, the retrospective nature of this study created challenges consistent with any observational study [27]. However, to our knowledge, no longitudinal administrative data exists that collects information regarding communication or other factors in the pre-readmission interval. The American College of Surgeons National Surgical Quality Improvement Program, State Inpatient Databases, or readily available data resources from the Department of Veterans Affairs do not routinely capture this type of data [28–30]. Secondly, clinical documentation practices may also limit the precision of the data. However, these data are obtained from a robust electronic medical record used for both clinical documentation and billing purposes. This would be particularly relevant to patients going to the emergency department, which accounted for nearly one-third of the first communications in our study. In addition, we minimized data entry errors by having two authors independently collect the data. Thirdly, we acknowledge that there may be unmeasured communications in our study. Nonetheless, we believe our rigorous approach to data extraction from inpatient and outpatient electronic medical records captured the majority of postdischarge communications. Further, our study population focuses on cystectomy patients with an index hospitalization length of stay of less than 10 d. This helps to minimize potential confounding from patients with longer index hospitalizations, and therefore, required more intensive outpatient follow-up. We acknowledge that the readmission rate for this cohort is borderline low given that we examined a relatively average risk cohort so that the findings are generalizable to the majority of patients. Finally, geographic distance from the operating hospital may affect a patient's readmission risk. It has been shown that farther distance from the hospital does not affect quality metrics for radical cystectomy such as time to cystectomy or utilization of chemotherapy, although it does predict 90-d mortality in multivariate analysis [31]. While radical cystectomy patients receive comparable care on well-defined perioperative quality metrics, it may be more difficult to provide uniform care in the vague pre-readmission interval given geographic differences. This deserves further investigation. Furthermore, readmission and postoperative care may indeed depend on transition practices between the operating hospital, primary care physician, and local community resources. These factors should be taken into account when designing patient follow-up protocols and evaluating integrated care systems.

5. Conclusions

This study characterized key differences between nonreadmitted and readmitted patients after radical cystectomy. We believe outpatient follow-up care strategies for cystectomy patients should take into consideration communications during the pre-readmission interval as a bellwether for readmission. This may lead to a better understanding of how to best prevent readmissions, or at least, lessen their intensity for patients in need of inpatient care.

Author contributions: Naveen K. Krishnan had full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

Study concept and design: Krishnan, Li, Jacobs, Borza, Lesse, Lavieri, Helm, Skolarus.
Acquisition of data: Krishnan, Li, Hollenbeck, Morgan, Hafez, Weizer, Montgomery, Lee, Lesse, Skolarus.
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Statistical analysis: Krishnan, He, Lavieri, Helm, Skolarus.
Obtaining funding: None.
Administrative, technical, or material support: Krishnan, Jacobs, Ambani, He, Hollenbeck, Morgan, Hafez, Weizer, Montgomery, Lee, Lesse, Lavieri, Helm, Skolarus.
Supervision: Krishnan, Jacobs, Ambani, Borza, He, Hollenbeck, Morgan, Hafez, Weizer, Montgomery, Lee, Skolarus.
Other: None.

Financial disclosures: Naveen K. Krishnan certifies that all conflicts of interest, including specific financial interests and relationships and affiliations relevant to the subject matter or materials discussed in the manuscript (eg, employment/affiliation, grants or funding, consultancies, honoraria, stock ownership or options, expert testimony, royalties, or patents filed, received, or pending), are the following: None.

Funding/Support and role of the sponsor: Bruce Jacobs is supported in part by the National Institutes of Health Institutional KL2 award (KL2TR000146-08), the GEMSSTAR award (R03AG048091), the Jahnigen Career Development Award, and the Tippins Foundation Scholar Award. Brent Hollenbeck is supported in part by Research Scholar Grant RSGI-13-323-01-CPHPS from the American Cancer Society and by NIH/NCI grant R01 CA168691, National Institute of Aging, Agency for Healthcare Research and Quality (R01 HS18726). He is also an Associate Editor of Urology. Ted Skolarus is supported by a VA HSR&D Career Development Award-2 (CDA 12-171).

Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at doi:10.1016/j.euf.2016.07.004.

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