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Characterising 'bounce-back' readmissions after radical cystectomy

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Objective

To examine predictors of early readmissions after radical cystectomy (RC). Factors associated with preventable readmissions may be most evident in readmissions that occur within 3 days of discharge, commonly termed 'bounce-back' readmissions, and identifying such factors may inform efforts to reduce surgical readmissions.

Patients and Methods

We utilised the Healthcare Cost and Utilization Project's State Inpatient Databases to examine 1867 patients undergoing RC in 2009 and 2010, and identified all patients readmitted within 30 days of discharge. We assessed differences between patients experiencing bounce-back readmission compared to those readmitted 8–30 days after discharge using logistic regression models and also calculated abbreviated LACE scores to assess the utility of common readmissions risk stratification algorithms.

Results

The 30-day and bounce-back readmission rates were 28.4% and 5.6%, respectively. Although no patient or index hospitalisation characteristics were significantly associated with bounce-back readmissions in adjusted analyses, bounce-back patients did have higher rates of gastrointestinal (14.3% vs 6.7%, $P = 0.02$) and wound (9.5% vs 3.0%, $P < 0.01$) diagnoses, as well as increased index and readmission length of stay (5 vs 4 days, $P = 0.01$). Overall, the median abbreviated LACE score was 7, which fell into the moderate readmission risk category, and no difference was observed between readmitted and non-readmitted patients.

Conclusion

One in five readmissions after RC occurs within 3 days of initial discharge, probably due to factors present at discharge. However, sociodemographic and clinical factors, as well as traditional readmission risk tools were not predictive of this bounce-back. Effective strategies to reduce bounce-back readmission must identify actionable clinical factors prior to discharge.

Keywords

Cystectomy, hospital readmissions, postoperative complications, bladder cancer, #BladderCancer, #blcsm

Introduction

Readmission after major cancer surgery is common and costly [1,2]. Despite ongoing policy and provider efforts aimed at reducing readmissions, this remains a persistent issue across surgical disciplines [3–6]. Nowhere is this problem more evident than after radical cystectomy (RC). This procedure has the highest readmission rate amongst all major surgeries, with 20–30% of patients readmitted within 30 days of discharge, a rate that has not changed in over two decades [1,7–9]. Although published studies have helped characterise the cohort of patients readmitted after RC, identifying risk factors for preventable readmissions remains difficult [10,11].

Patients readmitted quickly after the initial discharge, so-called 'bounce-backs,' represent a unique subgroup where readmissions may be preventable, either because of an unrecognised or uncontrolled problem present at initial discharge or due to poorly coordinated discharge planning. This raises the question of whether some of these readmissions could be prevented by delaying discharge or more proactively managing clinical problems present at discharge. However, prior work suggests that targetable and mutable factors driving readmission after RC are elusive. It may be the case that very early readmissions are largely unmodifiable, consistent with existing findings across the full 30-day readmission time frame [12,13].

In this context, we sought to better characterise factors associated with bounce-back readmissions after RC. Specifically, we assessed differences in index hospitalisations and readmissions between patients readmitted within 3 days of initial discharge and those not readmitted or readmitted later in the postoperative course to ascertain predictors of rapid readmission. We hypothesised that the patients who had bounce-back readmissions could be identified using factors in administrative data, allowing for potentially improved risk stratification and intervention targeting. In doing so, the present study allows for a better understanding of factors associated with preventable readmissions after RC and can guide subsequent readmission reduction efforts.

Patients and Methods

Data Source

We used the Healthcare Cost and Utilization Project's State Inpatient Databases (SIDs) for New York, Iowa, North Carolina, and Washington during the years 2009 and 2010. The SID files include clinical and non-clinical data, and capture inpatient hospital records from community hospitals. These records include information on all patient discharges regardless of payer, and cover ~97% of all community hospital discharges in the USA [14]. Community hospitals in this data are defined by the American Hospital Association and include nonfederal, short-term general and specialty hospitals, including academic medical centres. Within these data, we identified 1869 patients who underwent RC.

Outcomes

Our primary outcome was bounce-back readmission, defined as a readmission within 3 days of discharge. As a secondary outcome, we also assessed later readmissions (4–7 and 8–30 days). These time windows were selected because in addition to the bounce-back period of interest, most readmissions after RC occur in the first week after discharge. Thus, we wanted to assess if there were any further differences in these patients readmitted in the first week vs later in the postoperative course. We collected all readmissions within 30 days of discharge following RC, which were then stratified into discrete time intervals before analysis.

Statistical Analysis

We assessed differences between readmitted and non-readmitted patients, and across the three readmission timeframe groups using Pearson's chi-squared and Fisher's exact tests for categorical variables, and Student's *t*-test and Wilcoxon rank-sum test for continuous variables. We examined patient demographics (age, gender, race, Charlson Comorbidity Index [CCI] score, primary payer, state of hospitalisation, residence population), index hospitalisation (length of stay, resource utilisation, complications), and discharge (disposition, time of day) characteristics [15,16]. Complications were assessed using validated International Classification of Diseases, 9th Edition, (ICD-9) codes, which were examined and counted as complications if they appeared during the index admission hospital record [17]. We then compared readmission hospitalisation characteristics including: reasons for readmission, readmission route, length of stay, mortality, reoperation, resource utilisation, and disposition.

To assess for predictors of bounce-back readmission we fit a multiple logistic regression model with bounce-back readmission as the outcome and 8–30 day readmission as the comparison group. We felt that the group of patients most likely to have identifiable and possibly modifiable factors present at the time of discharge compared to other groups would be those in the bounce-back period, which is why we elected to use this group as our primary comparison rather than using the entire first post-discharge week. Factors included were selected a priori based on clinical relevance and included: age, gender, CCI score, index length of stay, and postoperative complications. We also fit models with the same predictors to compare bounce-back readmissions with non-readmitted patients, and later readmissions with non-readmitted patients.

Lastly, to understand the utility of a commonly used readmission prediction tool in RC patients, we calculated LACE ('L', length of stay of the index admission; 'A', acuity of the admission, specifically if the patient is admitted through the Emergency Room [ER] vs an elective admission; 'C', comorbidities, incorporating the CCI; 'E', number of ER visits within the last 6 months) scores for all index hospitalisations and compared readmitted patients to those who were not. The LACE score uses length of stay, admission acuity, comorbidity, and ER visits to stratify patients based on readmission risk and has been assessed in a variety of clinical settings [18]. Subsequent studies have also applied a modified version of this score to administrative data in the prediction of death and readmission [19]. As the SID records do not include ER visits, we calculated an abbreviated score using index length of stay, non-emergent admission type for all patients, and the previously calculated CCI scores. Generally, patients with scores ≥10 are considered at highest risk for readmission, whilst scores of 5–9 are considered moderate; ER visits may contribute up to 4 points to the final score, so our calculated scores are necessarily underestimates of the true LACE scores and corresponding readmission risk in this cohort.

All analyses were conducted using Statistical Analysis System (SAS®) software, version 9.4 (SAS Institute, Cary, NC, USA) and all testing was two-sided using an α of 0.05. This study was deemed Institutional Review Board exempt by the University of Michigan Institutional Review Board.

Results

There were 1869 patients who underwent RC during the study period. The overall 30-day readmission rate in these patients was 28.4%. Amongst patients readmitted within 30 days, 19.7% were readmitted during the bounce-back period of 0–3 days (Fig. 1); which represents an overall bounce-back readmission rate of 5.6%. There were no significant differences in demographic or index hospitalisation characteristics between patients readmitted during the bounce-back period vs those readmitted at a later period (8–30 days, Table 1). When compared to non-readmitted patients, readmitted patients had a longer median index length of stay (8 vs 9 days, $P = 0.03$) and were more frequently discharged to skilled nursing facilities (10% vs 15%, $P < 0.01$).

We found several differences in the readmission hospitalisation characteristics between bounce-back readmissions and those occurring later (Table 2). Compared to later readmissions, patients who had bounce-back readmission were more likely to have new gastrointestinal (GI) (14% vs 7%, $P = 0.02$) or wound diagnoses (9% vs 3%, $P < 0.01$), and had a longer median length of stay during their readmissions (5 vs 4 days, $P = 0.01$). Assessment of complication subtypes showed that despite these differences in diagnoses at the time of readmission, rates of GI and wound complications during the index admission did not differ significantly between bounce-backs and other patients. The most prevalent readmission diagnoses across all groups were GI, urinary, and infection.

On multivariable logistic regression comparing bounce-back to later readmissions, neither age, gender, CCI score, index length of stay, nor postoperative complications were significant predictors of bounce-back readmission (Table 3). Similarly, no significant independent predictors were observed when comparing either readmission time frame to non-readmitted patients. The overall median LACE score amongst all patients in the cohort was 7, the same as amongst readmitted patients. Although these values are underestimates due to lack of ER visit data, all patients in the cohort would be considered moderate risk based on these results. When comparing abbreviated LACE scores between readmitted and non-readmitted patients, there was no significant difference in the median score (7 vs 7, $P = 0.87$).

Discussion

One in five readmissions after RC occurs within the first 3 days after discharge. Commonly available patient and procedural factors present in administrative data were not effective in identifying RC patients at highest risk of bounce-back readmission. We found differences in length of stay and discharge disposition between readmitted and non-readmitted patients, but no differences in any demographic or index hospitalisation parameters between early or late readmissions. Consequently, no factors were predictive of readmission,

Fig. 1 Number of patients readmitted after discharge. Shaded area = bounce-back readmissions.

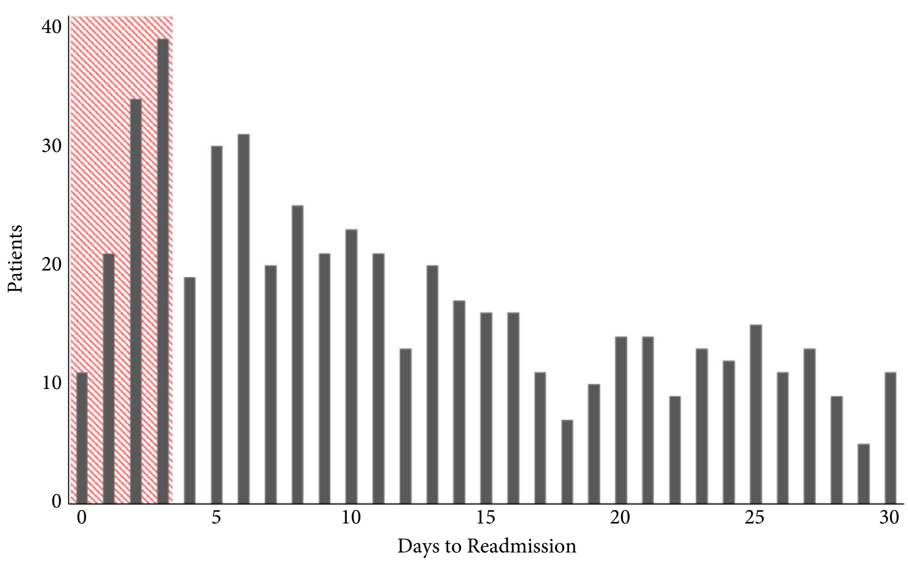

Table 1 Patient and index hospitalisation characteristics across readmission time frames

Characteristic	Not readmitted (*N* = 1338)	Readmitted (*N* = 531)				P^{**}
		0–3 day readmission (*n* = 105)	4–7 day readmission (*n* = 100)	8–30 day readmission (*n* = 326)	P^{*}	
Age, years, mean (SD)	67.7	67.9 (0.9)	67.8 (1.0)	67.6 (0.6)	0.95	0.90
Gender, % male	82.1	80.0	86.0	84.4	0.30	0.39
Race, %						
White	89.3	91.7	88.8	89.6	0.67	0.96
Black	6.1	5.2	6.7	6.1		
Hispanic	2.9	3.1	2.3	2.9		
Asian or Pacific Islander	1.6	0	2.2	1.4		
CCI score, %						
0	24.2	30.5	23.0	22.1	0.13	0.54
1	0.8	0	0	1.5		
2	41.9	45.7	47.0	44.5		
3	33.0	23.8	30.0	31.0		
Payer, %						
Medicare	56.1	56.2	54.0	58.0	0.79	0.09
Medicaid	4.5	4.8	4.0	6.7		
Private	36.0	37.1	40.0	34.0		
Other	3.4	1.9	2.0	1.2		
State, %						
NY	62.3	63.8	67.0	66.3	0.24	0.18
WA	15.2	11.4	14.0	15.0		
NC	18.6	20.9	16.0	17.5		
IA	3.9	3.8	3.0	1.2		
Residence population size, %						
1 000 000	53.7	61.9	56.0	57.1	0.66	0.07
50 000–999 999	29.7	23.8	25.0	24.2		
10 000–49 999	10.0	8.6	13.0	12.9		
<10 000	6.6	5.7	6.0	5.8		
Index length of stay, days, median (IQR)	8.0 (7, 12)	8.0 (7, 11)	9.0 (7, 14)	9.0 (7, 13)	0.52	**0.03**
Index resource utilisation, %						
Blood transfusion	66.9	70.5	67.0	68.4	0.69	0.49
Imaging	30.9	34.3	35.0	33.4	0.87	0.22
ICU	43.7	51.4	41.0	47.6	0.49	0.19
Postoperative complications, %	65.7	64.0	67.8	62.6	0.74	0.12
Index discharge disposition, %						
Home	29.7	18.1	20.0	27.0	0.18	**<0.01**
Home care	60.0	65.7	63.0	59.2		
SNF	10.3	16.2	17.0	13.8		
Discharge time of day, %						
08:00–13:00 h	45.5	40.5	37.0	46.0	0.21	0.47
13:00–18:00 h	47.5	60.0	55.6	47.6		
18:00–08:00 h	6.9	2.5	7.4	6.4		

*ICU, intensive care unit; SNF, skilled nursing facility. *P values for comparison of 0–3 vs 8–30 day readmissions groups. **P values for comparison of non-readmitted vs all readmitted patients. Bold values are for statistically significant differences with P < 0.05.*

either bounce-back or late, in our multivariable analysis. For the readmission hospitalisation, differences were observed only in the reason for readmission and length of stay. Lastly, when using an abbreviated version of a common readmission risk stratification algorithm (LACE), we found that all RC patients were at least at moderate risk of readmission, which did not differ between readmitted and non-readmitted patients. This underscores the difficulty in accurately predicting which patients will have post-discharge complications and ultimately be readmitted. These findings may also reflect an inherent limitation of administrative data to predict some complicated and nuanced clinical scenarios such as readmissions.

The present study adds to the growing body of literature assessing factors associated with readmission timing in major surgery patients. Similar to our present findings, a recent study examining a large cohort of colorectal surgery patients found that demographic differences were minimal between patients readmitted early and late after index discharge, and that GI complications were more prevalent in early readmissions [20]. In that cohort, significant predictors of early vs late readmissions included wound disruption and neurological complications. The authors concluded that earlier readmissions were more closely related to non-modifiable patient and operative factors, whilst those readmissions occurring later were more

Table 2 Readmission characteristics across readmission time frames

Characteristic	0–3 day readmission (n = 105)	4–7 day readmission (n = 100)	8–30 day readmission (n = 326)	P^*
Readmission diagnoses, %				
Infection	9.5	12.0	11.3	0.60
Failure to thrive	8.6	3.0	8.6	0.99
Urinary	10.5	11.0	10.7	0.94
GI	14.3	8.0	6.7	**0.02**
Haematological	6.7	3.0	6.7	0.98
Metabolic/endocrine	6.7	10.0	11.0	0.19
Wound	9.5	3.0	3.0	**<0.01**
NPMO	6.7	7.0	7.1	0.89
Vascular	4.7	2.0	4.9	0.95
Cardiac	9.5	5.0	5.8	0.19
Pulmonary	7.6	4.0	5.5	0.43
Female	0.9	0	0.3	0.40
Other	19.0	15.0	18.7	0.94
Readmission source, %				
Home	29.5	18.0	27.9	**<0.01**
ER	29.5	40.0	42.6	
SNF	1.9	3.0	1.8	
OSH	4.8	6.0	1.8	
Clinic	0.9	2.0	6.1	
Other/missing	33.3	31.0	19.6	
Readmission length of stay, days, median (IQR)	5 (3,9)	5 (3,9)	4 (3,7)	**0.01**
Readmission mortality, %	3.8	2.0	2.8	0.58
Readmission resource utilisation, %				
Blood transfusion	28.6	26.0	22.7	0.22
Imaging	72.4	77.0	77.6	0.27
ICU	11.4	16.0	12.9	0.69
Readmission reoperation, %	14.3	11.0	13.2	0.77
Readmission discharge disposition, %				
Home	32.0	27.6	40.9	0.44
Home care	49.0	45.9	42.9	
SNF	15.0	24.5	13.3	

*ICU, intensive care unit; NPMO, nonmedical prescription opioids; OSH, outside hospital; SNF, skilled nursing facility. *P values for comparison of 0–3 vs 8–30 day readmissions groups. Bold values are for statistically significant differences with P < 0.05.*

Table 3 Multivariable logistic regression model output of adjusted odds ratios (95% CI) examining predictors of bounce-back readmission (0–3 days) compared to later readmission (8–30 days) and non-readmission

Predictor	Bounce-back vs late readmission	Bounce-back vs non-readmission	Late readmission vs non-readmission
Age	1.0 (1.0–1.0)	1.0 (1.0–1.0)	1.0 (1.0–1.0)
Gender			
Male	Referent	Referent	Referent
Female	1.4 (0.7–2.8)	1.1 (0.6–1.9)	0.8 (0.5–1.1)
CCI score			
0	Referent	Referent	Referent
1–2	0.5 (0.2–1.3)	0.7 (0.3–1.5)	1.3 (0.7–2.4)
>2	0.4 (0.2–1.1)	0.5 (0.2–1.1)	1.1 (0.6–2.1)
Index length of stay	1.0 (1.0–1.0)	1.0 (1.0–1.0)	1.0 (1.0–1.0)
Postoperative complications	1.0 (0.6–1.7)	1.1 (0.7–1.8)	1.1 (0.8–1.5)

Abbreviations: CCI, Charlson Comorbidity Index; ER, Emergency Room; ICD-9, International Classification of Diseases, 9th Edition; GI, gastrointestinal; RC, radical cystectomy; SID, State Inpatient Database.

frequently linked to targetable factors such as renal complications. Conversely, another study utilising data from medical discharges, found that early readmissions were associated with acute illness burden, whereas later readmissions were more often related to markers of chronic disease [21]. Similarly, recent work in Medicare patients found the significance of hospital factors in readmissions to be largely limited to the first week after discharge, whilst later readmissions were explained by non-hospital factors such as household income [22].

In RC patients specifically, our present results align well with prior analyses of Medicare data that found GI, urinary, and infection amongst the most common readmissions diagnoses and that the highest intensity readmission episodes are more likely in patients with earlier, rapid readmissions [8,23]. Other recent work has shown that readmissions to hospitals other than that which performed the RC were more likely to occur later in the readmissions period, although this effect was predominantly observed after the 30 day period used in our present study [24]. Lastly, as readmissions have been linked to postoperative complications, it was recently demonstrated that the significant majority of these complications occur very early in the postoperative period [25]. This connection also helps to underscore recent results showing that increased, targeted patient contact early in the postoperative course could avert a significant proportion of readmissions after RC, although other data suggest that most readmissions after RC are non-modifiable [13,26]. While it may be the case that RC has a particularly large proportion of non-modifiable readmissions compared to other surgical procedures, characterising and identifying those modifiable factors remains critically important. In a patient population with readmission rates as high as those seen following RC, even a comparatively smaller percentage of modifiable readmissions represents a significant portion of the overall patient cohort. Thus accurate and early recognition of those patients at highest risk of modifiable readmission will continue to be an essential pursuit. Taken together with existing literature, our present results lend support to the notion that readmissions after RC are a particularly challenging problem due to both the inherent morbidity of the procedure and the relative illness and frailty of the patient population.

Our present study has several limitations. Using data from only four States raises questions about generalisability. However, the States included in this analysis represent diverse and divergent regions and so are likely to adequately capture any unmeasured variations related to local practice patterns and comorbidity burdens. The present analysis also lacks information regarding type of urinary diversion or receipt of neoadjuvant chemotherapy, which could conceivably have effects on readmission timing. Concerns regarding these covariates should be minimal as existing work has not found differences in readmission rates after RC related to either of these factors [8,27,28]. Despite capturing data across four States and multiple years, the overall number of bounce-back readmissions was low, which limited the ability to include other potentially informative variables in the multivariable regressions. Our present data do not capture any outpatient encounters, either in clinic or the ER unless they in turn lead to admission. As such, we cannot comment on variations in outpatient contact with patients in this cohort. Similarly, these data do not have information on hospital- or surgeon-specific factors, such as enhanced recovery pathways or practice volume. However, given the negligible impact of more proximal patient and procedural characteristics analysed here, the overall effects of such influences on the dynamics of readmission timing are likely minor. While we were able to assess the significance of discharge time of day on bounce-back readmissions, which has been found to be significant in other cohorts, the structure of these data did not allow us to assess the importance of weekend vs weekday discharge [21]. More broadly, our present results are limited by the administrative nature of these data. We are unable to assess other factors which likely impacted readmissions and their timing, such as poorly coordinated care or individual patient and provider thresholds for readmission. Lastly, we were not able to account for planned vs unplanned readmissions in this cohort; however, we believe the number of planned readmissions to be small and unlikely to systematically bias our overall findings.

These limitations notwithstanding, the issue of readmissions following RC is one of increasing importance. The Centers for Medicare and Medicaid Services' Hospital Readmissions Reduction Program, which was implemented in 2012 as part of the Affordable Care Act, expanded to include surgical care in 2014 in the form of readmissions penalties following total hip and knee arthroplasty. The programme has already expanded to include coronary artery bypass grafting and it is likely to expand to other conditions over coming years [29]. Consequently, both policymakers and urologists have clear incentives to accurately identify those RC patients at highest risk of readmission and implement programmes to help mitigate those hazards. Promising approaches include telemedicine interventions, as well as data-driven targeting of post-discharge contact with patients [26,30,31]. Further, although RC is a relatively low-volume procedure and represents a small proportion of overall readmissions, it is possible that lessons learned in reducing readmissions following this procedure could prove valuable in other clinical settings, given its high rates of complications and readmissions.

Conclusions

Accurately detecting RC patients most likely to be rapidly readmitted after discharge is challenging. Based on the present study, those patients who will ultimately bounce-back appear demographically and clinically similar to peers who will be readmitted later or not at all, and common risk stratification algorithms may be of limited use following RC. Further research with more granular data is needed to help identify and potentially target modifiable causes for post-RC readmissions. Increasing insights about where, when, and how to best focus resources on the problem of post-RC readmissions should eventually yield important benefits for patients, as well as providers.

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Conflicts of Interest

None.

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Abbreviations: CCI, Charlson Comorbidity Index; ER, Emergency Room; ICD-9, International Classification of Diseases, 9th Edition; GI, gastrointestinal; RC, radical cystectomy; SID, State Inpatient Database.