Radical Cystectomy in the Elderly: National Trends and Disparities in Perioperative Outcomes and Quality of Care

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Key Words

Transitional cell carcinoma · Cystectomy · Postoperative complications · Perioperative care

Abstract

Introduction: To examine national trends of radical cystectomy (RC) for urothelial carcinoma of urinary bladder in octogenarian patients and to assess the rates of adverse outcomes. **Materials and Methods:** Within the Nationwide Inpatient Sample (NIS), we focused on RCs performed between 1998 and 2007. Age was stratified as <80 versus ≥80 years. Propensity-based matched analyses were used to account for treatment selection biases. Generalized linear regression analyses were fitted to predict adverse perioperative events according to age. **Results:** Of 12,274 RC patients, 1,605 were ≥80 years (13.1%). The RC rates in octogenarians increased significantly from 9.9% in 1998 to 13.7% in 2007. Most elderly patients were treated at low-/intermediate-volume hospitals (81.7%) and nonacademic centers (60.6%). After propensity score matching, the inpatient mortality rate was higher in octogenarians (4.6 vs. 2.6%, $p < 0.001$). In multivari-

able analyses, octogenarians were at increased risk of blood transfusions (OR: 1.30) and postoperative complications (OR: 1.22). **Conclusions:** Most octogenarians undergoing RC are treated at low-/intermediate-volume hospitals and at non-academic centers. The inpatient hospital mortality is about twice as high in these patients, and adverse perioperative outcomes are more frequent. Such patients may benefit from RC at high-volume and/or academic centers to maximally reduce adverse perioperative outcomes.

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Introduction

In 2010, urothelial carcinoma of the urinary bladder was diagnosed in 70,530 individuals in the United States and resulted in over 14,000 deaths [1]. The National Comprehensive Cancer Network (NCCN) guidelines [2]

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recommend radical cystectomy (RC) for healthy patients with muscle-invasive disease. While RC has been shown to have excellent overall outcomes in the hands of expert surgeons [3], patients ≥ 80 years of age have the highest cancer-specific mortality rates [4].

The impact of patient age on oncological outcomes and access to optimal therapies has attracted much attention [5–9]. For example, in patients undergoing radical prostatectomy for prostate cancer, elderly patients have higher rates of intraoperative complications, postoperative complications, and in-hospital mortality [10]. Several studies [5, 11, 12] have assessed cancer control rates after RC in the elderly and several have found that urothelial carcinoma of the urinary bladder in the elderly are treated less aggressively [9, 13, 14]. However, far fewer studies [7, 15] have examined perioperative outcomes in octogenarians.

In this study, our aim was to examine national trends in adverse perioperative outcomes (intraoperative and postoperative complications, blood transfusions, transfer to a facility, and in-hospital mortality) in octogenarian patients treated with RC.

Patients and Methods

Data Source

We utilized the discharge records from the Nationwide Inpatient Sample (NIS). The NIS is a part of the Healthcare Cost and Utilization Project, sponsored by the Agency for Healthcare Research and Quality, and is recognized as the largest all-payer inpatient care database in the United States. As of 2007, the NIS contained outcomes from over 8 million hospital stays, thereby representing a 20% stratified sample of community hospitals, including academic and specialty hospitals within the United States [16].

All patients with a primary diagnosis of urothelial carcinoma of the urinary bladder (ICD-9-CM code 188) were identified within the NIS database. The cystectomy procedure code (ICD-9-CM 57.7) resulted in the identification of 12,274 patients who underwent RC between 1998 and 2007.

Variable Definition

Variables evaluated included patient age, year of surgery, race, Charlson Comorbidity Index (CCI), annual hospital volume (AHV), urban versus rural hospital location, academic institutional status, and hospital region (South vs. West vs. Northeast vs. Midwest). CCI was derived from ICD-9 codes in accordance with previously reported criteria [17] and stratified according to low (0–2) versus high (≥ 3). AHV was defined according to the number of RCs performed at each participating institution during each study calendar year, and categorized as low (1–5 cases/year), intermediate (6–10 cases/year) and high (≥ 11 cases/year). Transfer to a facility at discharge is defined as transfer to a short-term hospital or another type of facility (not including home health care). All other variables were extracted using a previously defined methodology [18].

Intraoperative, Postoperative Complications, and Blood Transfusions during Hospitalization

The NIS records up to 15 diagnoses and procedures per in-hospital admission. The presence of any complication was defined using ICD-9 diagnoses 2–15, the specifics of which have been demonstrated previously [18]. Patients were stratified by 0 versus 1 or greater complications during hospitalization. We used the same stratification to evaluate the rates of homologous blood transfusions.

Statistical Analyses

Frequencies and proportions were reported for categorical variables. Means, medians, and data ranges were reported for continuous variables. For continuous variables, normality was assessed using the Kolmogorov-Smirnov test [19], the Shapiro-Wilk test [20], and graphical plots. As continuous variables were not found to be normally distributed, univariate comparisons were made using the Mann-Whitney test. χ^2 tests were used to compare the statistical significance of differences in proportions. To limit inherent baseline provider and patient differences between octogenarians and nonoctogenarians, a 3-to-1 propensity score-matched analysis was performed [21, 22]. Propensity scores were computed by modeling logistic regression with the dependent variable as the odds of being ≥ 80 years of age, and the independent variables as sex, race, ZIP code income, CCI, insurance status, urinary diversion, year of surgery, hospital location, and hospital volume. Subsequently, the covariate balance between the matched groups was examined.

Then, we used logistic regression models complemented by generalized estimating equations [23] to examine the effect of age on postoperative complication, homologous blood transfusion, and transfer to a facility. All models were further adjusted for race, CCI, AHV, insurance, hospital location (urban vs. rural), academic status, and hospital region. All statistical analyses were performed using the R statistical package system (R Foundation for Statistical Computing, Vienna, Austria), with a two-sided significance level set at $p < 0.05$.

Results

Between 1998 and 2007, 12,274 patients underwent RC, of whom 1,605 were ≥ 80 years (13.1%). The rates of RC in octogenarians increased significantly during the study period from 9.9% in 1998 to 13.7% in 2007 ($p = 0.007$; fig. 1). Table 1 shows the hospital and patient characteristics of the study cohort. The mean age of the octogenarian RC patients was 82.9 years (range: 80–95). Most elderly patients were treated at low or intermediate AHV institutions (81.7%) or at nonacademic centers (60.6%). In univariable analyses (table 1), octogenarians had higher rates of intraoperative complications (3.4 vs. 2.3%, $p = 0.009$), postoperative complications (35.9 vs. 29.4%, $p < 0.001$), homologous blood transfusions (34.3 vs. 26.2%, $p < 0.001$), in-hospital mortality (4.6 vs. 2.0%, $p < 0.001$), total hospital charges (USD 67,537 vs. 60,121, $p < 0.001$), and transfer to a facility (33.4 vs. 11.1%, $p < 0.001$).

Table 1. Characteristics of 12,274 patients in the NIS who underwent RS in the USA between 1998 and 2007

	Non-octogenarian	Octogenarian	Overall	p
Number of patients	10,669 (86.9)	1,605 (13.1)	12,274 (100)	
Year of surgery				0.002
1998–2001	3,801 (35.6)	498 (31.0)	4,299 (35.0)	
2002–2004	3,356 (31.5)	538 (33.5)	3,894 (31.7)	
2005–2007	3,512 (32.9)	569 (35.5)	4,081 (33.2)	
Mean age (median), years	66.3 (68.0)	82.9 (82.0)	68.5 (70.0)	
IQR	61–74	81–84	14	<0.001
Range	40–79	80–95	40–95	
AHV				
Low (1–5)	6,818 (63.9)	1,045 (65.1)	7,863 (64.1)	0.4
Intermediate (6–10)	1,752 (16.4)	267 (16.6)	2,019 (16.4)	
High (≥11)	2,099 (19.7)	293 (18.3)	2,392 (19.5)	
Race				
White	6,931 (65.0)	1,097 (68.3)	8,028 (65.4)	0.03
Black	368 (3.4)	39 (2.4)	407 (3.3)	
Other	565 (5.3)	77 (4.8)	642 (5.2)	
Unknown	2,805 (26.3)	392 (24.4)	3,197 (26.0)	
Charlson score				
0	7,303 (68.5)	1,052 (65.5)	8,355 (68.1)	<0.001
1	2,448 (22.9)	367 (22.9)	2,815 (22.9)	
2	516 (4.8)	89 (5.5)	605 (4.9)	
≥3	402 (3.8)	97 (6.0)	499 (4.1)	
Diversion type				<0.001
Noncontinent	9,258 (86.8)	1,528 (95.2)	10,786 (87.9)	
Continent	799 (7.5)	13 (0.8)	812 (6.6)	
Unknown	612 (5.7)	64 (4.0)	676 (5.5)	
Insurance status				<0.001
Private	3,699 (34.7)	105 (6.5)	3,804 (31.0)	
Medicaid	424 (4.0)	11 (0.7)	435 (3.5)	
Medicare	6,081 (57.0)	1,468 (91.5)	7,549 (61.5)	
Other	465 (4.4)	21 (1.3)	486 (4.0)	
Teaching status				
Teaching	3,749 (35.1)	633 (39.4)	4,382 (35.7)	0.001
Nonteaching	6,920 (64.9)	972 (60.6)	7,892 (64.3)	
Hospital region				0.07
Northeast	2,024 (19.0)	326 (20.3)	2,350 (19.1)	
Midwest	2,563 (24.0)	353 (22.0)	2,916 (23.8)	
South	3,828 (35.9)	555 (34.6)	4,383 (35.7)	
West	2,254 (21.1)	371 (23.1)	2,625 (21.4)	
Hospital location				
Rural	701 (6.6)	127 (7.9)	828 (6.7)	0.05
Urban	9,968 (93.4)	1,478 (92.1)	11,446 (93.3)	
Mean length of stay (median), days	11.1 (9.0)	12.5 (10.0)	11.3 (9.0)	<0.001
IQR	7–12	8–14	5	
Range	0–161	1–93	0–161	
Mean hospital charges (median), USD	60,121 (46,177)	67,537 (50,824)	61,096 (46,624)	<0.001
IQR	32,095–67,984	34,649–78,113	32,408–69,167	
Transfer to a facility	536 (33.4)	1,182 (11.1)	1,718 (14.0)	<0.001
Homologous blood transfusion	2,795 (26.2)	551 (34.3)	3,346 (27.3)	<0.001
Intraoperative complication	250 (2.3)	55 (3.4)	305 (2.5)	0.009
Postoperative complication	3,132 (29.4)	576 (35.9)	3,708 (30.2)	<0.001
In-hospital mortality	217 (2.0)	74 (4.6)	291 (2.4)	<0.001

Values are n (%) unless otherwise indicated.

Fig. 1. Annual rate of RC in octogenarians within the NIS 1998–2007.

Following propensity-matched analysis, 4,815 nonoctogenarians were matched to 1,605 octogenarians. Standardized mean differences between the two groups in terms of patient and hospital characteristics were less than 10%. The differences in demographic characteristics were not significant in the matched cohort, which reflected a high degree of similarity (table 2). The remainder of the analyses was conducted in the post-propensity-matched cohorts.

In the matched cohort, univariable analysis still showed a difference in intraoperative complications, but this difference failed to reach statistical significance (3.4 vs. 2.6%, $p = 0.097$). However, octogenarians still had higher rates of postoperative complications (35.9 vs. 31.5%, $p = 0.001$), homologous blood transfusions (34.3 vs. 28.7%, $p < 0.001$), in-hospital mortality (4.6 vs. 2.6%, $p < 0.001$), total hospital charges (USD 67,537 vs. 64,509, $p < 0.001$), and transfer to a facility (33.5 vs. 15.8%, $p < 0.001$; table 3).

Table 4 shows the multivariable analyses in the matched cohort. Specifically, octogenarian patients were at higher risk of homologous blood transfusions (OR: 1.30, $p < 0.001$), postoperative complications (OR: 1.22, $p < 0.001$), and transfer to a facility (OR: 2.81, $p < 0.001$).

Medicare patients have a higher risk of postoperative complications (OR: 1.37, $p = 0.007$) and transfer to a facility (OR: 1.94, $p < 0.001$). CCI was the strongest predictor of transfer to a facility (CCI ≥ 3 vs. 0–2, OR: 1.68, $p < 0.001$) and postoperative complications (CCI ≥ 3 vs. 0, OR: 1.43, $p = 0.002$). Females were at a higher risk for blood transfu-

sions (OR: 1.50, $p < 0.001$) and transfer to a facility (OR: 1.80, $p < 0.001$), but at a lower risk for postoperative complications (OR: 0.81, $p = 0.001$). African-American patients were at a higher risk for blood transfusions (OR: 1.65, $p = 0.004$). Finally, patients treated at hospitals with a higher annual volume of cases were at a lower risk of transfer to a facility (per additional case OR: 0.98, $p = 0.001$).

Discussion

RC has been shown to provide optimal long-term oncological control across all age groups [3, 24]. In a landmark study, perioperative complications for patients of all ages undergoing RC were examined in the National Surgical Quality Improvement Program (NSQIP) database, which relies on Veterans Affairs Medical Centers (VAMC) nationwide. In this study, Hollenbeck et al. [25] reported that 30.5% of the patients had at least one complication and every 10-year increase in age increased the adjusted risk of having at least one complication by 30%. However, the study was restricted to VAMC patients and the mean age of the studied cohort was 65.5 years, very similar to the younger cohort in our study (mean age: 66.3 years). In contrast, Donat et al. [7] in a single institutional series of octogenarian patients ($n = 117$) from a high-volume tertiary center of excellence (Memorial Sloan-Kettering Cancer Center) revealed an equivalent ('non-significantly higher') rate of minor complications (55 vs. 50%), major complications (17 vs. 13%), and 5-year cancer-specific mortality rates (26 vs. 25%) relative to younger patients. Despite the equivalence of adverse outcomes at tertiary care centers, several population-based studies [9, 13, 14] showed that RC is underutilized in octogenarians. This pattern may be due to concerns about higher perioperative morbidity and mortality in the elderly [26, 27]. In the current study, our objective was to test the hypothesis that perioperative RC outcomes may indeed be less favorable in octogenarian patients. While there are a number of small series on perioperative outcomes after RC in the elderly, there is a paucity of large-scale studies, especially with regard to national trends in contemporary perioperative RC outcomes [8, 28].

There were several noteworthy findings. First, direct comparisons of perioperative outcomes showed significant differences between octogenarians and their younger counterparts. Specifically, even after propensity score matching, the rates of homologous blood transfusions (34.2 vs. 28.7%, $p < 0.001$), postoperative complications (35.9 vs. 31.5%, $p < 0.001$), adverse discharge disposition

Table 2. Propensity-matched (1:3) demographic characteristics of RC patients in the USA between 1998 and 2007 (n = 6,420)

	Nonoctogenarian	Octogenarian	Overall	p
Number of patients	4,815 (100)	1,605 (20)	6,420 (80)	
Year of surgery				
1998–2001	1,523 (31.6)	498 (31.0)	2,021 (31.5)	0.9
2002–2004	1,596 (33.1)	538 (33.5)	2,134 (33.2)	
2005–2007	1,696 (35.2)	569 (35.5)	2,265 (35.3)	
Median AHV (range)	3 (1–7)	3 (2–8)	3 (2–7)	0.1
Race				
White	3,330 (69.2)	1,097 (68.3)	4,427 (69.0)	0.9
Black	103 (2.1)	39 (2.4)	142 (2.2)	
Other	220 (4.6)	77 (4.8)	297 (4.6)	
Unknown	1,162 (24.1)	392 (24.4)	1,554 (24.2)	
Female	1,023 (21.2)	357 (22.2)	1,380 (21.5)	0.4
Charlson score				
0	3,203 (66.5)	1,052 (65.5)	4,255 (66.3)	0.9
1	1,067 (22.2)	367 (22.9)	1,434 (22.3)	
2	267 (5.5)	89 (5.5)	356 (5.5)	
≥3	278 (5.8)	97 (6.0)	375 (5.8)	
Diversion type				
Noncontinent	4,591 (95.3)	1,528 (95.2)	6,119 (95.3)	0.7
Continent	36 (0.6)	13 (0.8)	43 (0.7)	
Unknown	194 (4.0)	64 (4.0)	258 (4.0)	
Insurance status				
Private	326 (6.8)	105 (6.5)	431 (6.7)	1.0
Medicaid	48 (0.7)	11 (0.7)	42 (0.7)	
Medicare	4,397 (91.3)	1,468 (91.5)	5,865 (91.4)	
Other	61 (1.3)	21 (1.3)	82 (1.3)	
ZIP code income				
Very low	633 (13.1)	210 (13.1)	843 (13.1)	1.0
Low	1,163 (24.2)	394 (24.5)	1,557 (24.3)	
High	1,327 (27.6)	444 (27.7)	1,771 (27.6)	
Very high	1,605 (33.3)	529 (33.0)	2,134 (33.2)	
Unknown	87 (1.8)	28 (1.7)	115 (1.8)	
Teaching status				
Teaching	1,899 (39.4)	633 (39.4)	2,532 (39.4)	1.0
Nonteaching	2,916 (60.6)	972 (60.6)	3,888 (60.6)	
Hospital region				
Northeast	1,014 (21.1)	326 (20.3)	1,340 (20.9)	0.9
Midwest	1,070 (22.2)	353 (22.0)	1,423 (22.2)	
South	1,615 (33.5)	555 (34.6)	2,170 (33.8)	
West	1,116 (23.2)	371 (23.1)	1,487 (23.2)	
Hospital location				
Rural	386 (8.0)	127 (7.9)	513 (8.0)	0.9
Urban	4,429 (92.0)	1,478 (92.1)	5,907 (92.0)	

Values are n (%) unless otherwise indicated. Multivariable predictions of various complications from several independent complication-specific regression models for octogenarians vs. nonoctogenarians undergoing RS.

(33.4 vs. 15.8%, $p < 0.001$), and in-hospital mortality (4.6 vs. 2.6%, $p < 0.001$) were significantly higher in octogenarians. Second, when specific subsets of postoperative complications were examined, we demonstrated that elderly patients were at higher risk for cardiac complica-

tions (5.9 vs. 4.5%, $p < 0.001$). In multivariable analyses, octogenarian patients were at higher risk of homologous blood transfusions (OR: 1.30, $p < 0.001$), postoperative complications (OR: 1.22, $p < 0.001$), and transfers to a facility (OR: 2.81, $p < 0.001$).

Table 3. Independent predictors of complications in multivariable analyses of 12,274 patients who underwent RS

	Nonoctogenarian	Octogenarian	Overall	p
Number of patients	4,815 (100)	1,605 (20)	6,420 (80)	
Transfer to facility	760 (15.8)	536 (33.4)	1,296 (20.2)	<0.001
Homologous blood transfusion	1,384 (28.7)	551 (34.3)	1,935 (30.1)	<0.001
Intraoperative complication	125 (2.6)	55 (3.4)	180 (2.8)	0.097
Postoperative complication	1,517 (31.5)	576 (35.9)	2,093 (32.6)	0.001
Cardiac complication	218 (4.5)	94 (5.9)	312 (4.9)	0.037
Vascular complication	28 (0.6)	12 (0.7)	40 (0.6)	0.466
Respiratory complication	159 (3.3)	70 (4.4)	229 (3.6)	0.052
Digestive complication	828 (17.2)	309 (19.3)	1,137 (17.7)	0.064
Urinary complication	161 (3.3)	52 (3.2)	213 (3.3)	0.873
Wound complication	197 (4.1)	64 (4.0)	261 (4.1)	0.884
Hematoma complication	143 (3.0)	57 (3.6)	200 (3.1)	0.246
Seroma complication	20 (0.4)	12 (0.7)	32 (0.5)	0.105
Infection complication	182 (3.8)	70 (4.4)	252 (3.9)	0.299
In-hospital mortality	125 (2.6)	74 (4.6)	199 (3.1)	<0.001
Mean length of stay (median), days	11.65 (9)	12.48 (10)	11.86 (9)	
IQR	7–13	8–14	7–13	<0.001
Mean hospital charges (median), USD	64,509 (48,025)	67,537 (50,824)	65,272 (48,702)	
IQR	33,091–73,113	34,649–78,113	33,407–74,356	0.011

Values are n (%) unless otherwise indicated. Treatment characteristics and perioperative outcomes of RC patients in the USA between 1998 and 2007 [propensity matched (1:3), n = 6,420].

Taken together, these findings convincingly show that the adverse perioperative outcomes were more frequent in the elderly. This risk elevation needs to be communicated to elderly RC candidates. However, the increased risks are not prohibitive. Therefore, RC represents a valid treatment option for octogenarians. Importantly, detailed cardiopulmonary preoperative evaluation is warranted to optimize their functional status and maximally reduce cardiopulmonary complications.

Third, we report higher rates of transfer to a facility for elderly patients undergoing RC. We have previously reported the discharge patterns for patients of all ages undergoing RC and discussed the importance of hospital volume, insurance status, and academic status of the treating institution in predicting transfer to a facility [18]. In the current study, it is noteworthy that octogenarians had a 2.8-fold higher risk for nonroutine transfer to a facility for further care following discharge, even after controlling for multiple patient and sociodemographic factors (including the above-mentioned factors that were significant in previous analyses). This consideration is important in early discharge planning and in RC cost considerations.

While our findings demonstrate that RC rates in octogenarians increased between 1998 and 2007, most RCs

were performed at low-to-intermediate AHV centers. This finding is significant because, in our analysis, patients treated at high AHV hospitals were at a significantly lower risk for transfer to a facility at discharge. In an exhaustive systematic review, Goossens-Laan et al. [29] confirmed the inverse relationship between surgical volume and postoperative mortality after RC. Similarly, Hollenbeck et al. [30] reported that for every 111 RCs regionalized to higher volume centers annually, one life would be saved. Our findings indicate that octogenarians represent an ideal group for volume-based referral to more specialized centers of care.

From a practical perspective, our findings indicate that elderly age is a significant risk factor and negative prognosticator for multiple adverse perioperative endpoints. This is especially true for patients with high CCI as well as patients with Medicaid insurance. It is clear that the majority of RCs in the elderly were performed in low-to-intermediate volume hospitals and nonacademic centers. One reason for this may include the reluctance of elderly patients to seek care further away from their home environment with possible implications for support from network of family and friends. However, from a health policy perspective, our results provide a stronger argument for regionalization of care for this particularly vulnerable

Table 4. Propensity-matched (1:3) demographic characteristics of RC patients in the USA between 1998 and 2007 (n = 6,420)

	Postoperative complications			Transfer to a facility			Homologous blood transfusion		
	OR	95% CI	p	OR	95% CI	p	OR	95% CI	p
Year of surgery (ref. 1998–2001)									
2002–2004	0.98	0.84–1.14	0.771	0.99	0.83–1.18	0.878	1.61	1.30–2.00	0.000
2005–2007	1.03	0.89–1.19	0.690	1.11	0.93–1.32	0.272	1.72	1.38–2.14	0.000
AHV	1.00	0.99–1.00	0.260	0.98	0.97–0.99	0.001	1.00	0.98–1.00	0.364
Race (ref. White)									
Black	1.20	0.82–1.74	0.347	0.92	0.59–1.44	0.715	1.65	1.17–2.33	0.004
Other	1.11	0.86–1.42	0.436	0.60	0.42–0.86	0.006	1.35	1.03–1.77	0.030
Unknown	1.05	0.91–1.21	0.483	0.88	0.75–1.04	0.144	0.72	0.59–0.88	0.001
Female	0.81	0.71–0.92	0.001	1.80	1.57–2.07	0.000	1.50	1.32–1.70	0.000
Charlson score (ref. 0–2)									
≥3	1.43	1.14–1.78	0.002	1.68	1.31–2.17	0.000	1.02	0.82–1.27	0.857
Diversion type (ref. noncontinent)									
Continent	0.71	0.36–1.38	0.310	0.37	0.13–1.08	0.069	1.27	0.65–2.50	0.491
Unknown	0.87	0.65–1.16	0.344	0.99	0.70–1.39	0.942	0.82	0.61–1.11	0.204
Insurance status (ref. private)									
Medicaid	1.54	0.80–2.96	0.194	1.27	0.50–3.25	0.620	0.80	0.34–1.87	0.603
Medicare	1.37	1.09–1.71	0.007	1.94	1.42–2.63	0.000	1.00	0.80–1.26	0.982
Other	1.08	0.61–1.92	0.784	1.17	0.56–2.44	0.680	1.79	1.08–2.97	0.025
ZIP code income (ref. very low)									
Low	0.89	0.74–1.08	0.231	0.98	0.78–1.24	0.859	1.17	0.97–1.42	0.110
High	0.95	0.79–1.16	0.635	1.05	0.84–1.32	0.654	1.12	0.91–1.37	0.279
Very high	0.91	0.75–1.10	0.326	1.00	0.80–1.26	0.979	1.18	0.96–1.45	0.120
Unknown	1.08	0.70–1.65	0.739	0.69	0.39–1.21	0.196	0.79	0.50–1.24	0.299
Teaching status (ref. teaching)									
Non-teaching	0.96	0.85–1.10	0.571	0.75	0.64–0.87	0.000	0.90	0.76–1.08	0.261
Hospital region (ref. Northeast)									
Midwest	0.91	0.76–1.10	0.328	0.83	0.67–1.02	0.075	0.60	0.5–0.81	0.001
South	0.85	0.73–1.00	0.054	0.51	0.42–0.63	0.000	0.82	0.61–1.09	0.161
West	1.11	0.93–1.33	0.263	0.60	0.48–0.75	0.000	0.97	0.73–1.28	0.805
Hospital location (ref. rural)									
Urban	0.89	0.72–1.10	0.286	0.94	0.73–1.20	0.601	1.04	0.76–1.42	0.828

subset of patients. To the best of our knowledge, other studies have not specifically focused on national perioperative outcomes for octogenarians undergoing RC and risk-quantification for specific complications.

Our study is not without limitations. Lack of data pertaining to individual surgical volume represents a drawback. Ideally, this variable would have been included in the analyses. It is important to note that this limitation equally applies to octogenarian and nonoctogenarian patients. Consequently, it is unlikely that it affected the results of our study. Other variables that may have influenced the results are also not available. For example, patient factors (disease characteristics, personal preferences, education) and socioeconomic variables could not be examined in multivariable modeling. We report on perioperative outcomes after RC in a US cohort, but it remains uncertain if our findings are applicable to other populations.

Conclusions

Octogenarians are at increased risk of adverse perioperative outcomes after RC, namely blood transfusions, postoperative complications, adverse discharge disposition, and in-hospital mortality. Surgeons should pay special attention to the prevention and expectant management of cardiopulmonary complications. From a health policy perspective, these patients are at higher risk of adverse outcomes and would benefit from treatment at referral centers where better outcomes have been reported.

Disclosure Statement

Nothing to disclose.

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