Association of race and 30-day postoperative complications after urologic oncology surgery

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ABSTRACT

INTRODUCTION: We aimed to evaluate the association between race and postoperative complications in patients undergoing urologic cancer surgeries, comparing 30-day outcomes between black and white-identifying patients using propensity score matching.

METHODS: Adult patients undergoing urologic cancer surgeries from 2015–2019 were identified from the National Surgical Quality Improvement Program database. Black-identifying patients were matched 1:1 with white-identifying patients based on surgical procedure, demographics, and medical history. The primary outcome was 30-day mortality. Secondary outcomes included specific complications, such as unplanned readmission, reintubation, and reoperation; myocardial infarction; renal insufficiency; cardiac arrest; surgical site infections (SSIs) and septic shock. Odds ratios (ORs) with 95% confidence intervals (CIs) were estimated using logistic regression.

RESULTS: Among 110 028 patients (mean age 46.8 years; 79.1% male; 12.7% black-identifying), a matched cohort of 28 056 was analyzed. No significant difference in 30-day mortality (OR 1.18, 95% CI 0.86–1.63, p=0.296) was observed. Secondary outcomes showed higher odds of unplanned readmission (OR 1.12, 95% CI 1.02–1.24, p=0.018), reintubation (OR 1.36, 95% CI 1.03–1.81, p=0.032), renal insufficiency (OR 1.84, 95% CI 1.37–2.47, p<0.001), and cardiac arrest (OR 1.49, 95% CI 1.01–2.20, p=0.043), but lower odds of myocardial infarction (OR 0.65, 95% CI 0.43–0.99, p=0.048), superficial SSIs (OR 0.65, 95% CI 0.50–0.85 p=0.001), and septic shock (OR 0.67, 95% CI 0.45–0.98, p=0.041) among black-identifying patients.

CONCLUSIONS: While no significant difference in 30-day mortality was observed, black-identifying patients were at an increased risk of several postoperative complications compared to white-identifying patients. These observations warrant further investigations into health equity within urology.

INTRODUCTION

Health disparities refer to the differences in healthcare between groups of people that are rooted in broader social, economic and/or environmental inequities within society.[1-3] The medical community has long been concerned with health disparities arising from demographic factors such as gender, race, and sexual orientation.[2] These disparities result in unequal access to health services, impeding the equitable provision of high-quality and comprehensive care to members of diverse populations.[1-4]

While several disparities may be underlying inequities in the current healthcare system, racial disparities have been a recent focus of health research and are especially evident in post-surgical outcomes.[4-6] The literature suggests that patients from different racial backgrounds may have differing experiences regarding complications, recovery, and long-term results after undergoing similar surgical procedures.[6] This type of disparity is broadly observed across surgical specialties; however, it is under-investigated in the field of urology.[7]

Urologic cancer procedures can be complex and invasive, entailing inherent risks and potential complications.[7] While common urologic complications are well known, there is a dearth of literature examining racial disparities in postoperative outcomes. Accordingly, the objective of this study was to compare the rates of several postoperative complications among black-identifying and white-identifying patients undergoing major urologic cancer surgeries.

KEY MESSAGES

In an analysis of 110 028 urologic cancer surgery cases between 2015 and 2019:

- No differences were seen in 30-day postoperative mortality between white and black patients.
- There was higher 30-day postoperative complication rates and unplanned readmission among black patients.
- Racial disparities may be influenced by patient, provider, or systemic factors.

METHODS

Study design

This retrospective cohort study was conducted to examine the association between patient race and postoperative outcomes in adult patients undergoing urologic oncology surgeries (i.e., nephroureterectomy, radical prostatectomy, radical cystectomy, radical nephrectomy, and partial nephrectomy). The study used data from the National Surgical Quality Improvement Program (NSQIP) to analyze the impact of race on postoperative complications, with a specific focus on black-identifying and white-identifying patients. NSQIP is a widely recognized and validated registry of surgical outcomes that encompasses a wide array of hospitals in the U.S. and Canada.[8] The study used patient records spanning from 2015–2019 to ensure a comprehensive and representative evaluation of urologic cancer procedures. This study was exempted from the University of Toronto Institutional Review Board, as it uses publicly available, deidentified, anonymized datasets.

Patient selection and exclusion

All adult patients who underwent urologic cancer surgeries in NSQIP-participating hospitals between 2015 and 2019 were considered for inclusion in the study. NSQIP captures 30-day postoperative complications with high inter-rater reliability and robust data collection methods, making it a valuable tool for evaluating surgical morbidity and mortality. Additionally, NSQIP has been validated for tracking major surgical complications in urologic oncology procedures, including cystectomy, prostatectomy, and nephrectomy.[9,10] To ensure the integrity and completeness of the data, missing data was managed with complete case analysis under the missing at random assumption, and patients with missing baseline variable information were excluded, which accounted for 28 223 patients (20.4%).

Propensity score matching

Propensity score matching was conducted to mitigate potential confounding variables. Black-identifying patients were matched with white-identifying patients in a 1:1 ratio using a nearest-neighbor propensity score matching protocol without replacement. The matching process considered the type of surgical procedure and baseline variables, which may have significant differences between the two racial groups.

Covariates for matching included age, Hispanic ethnicity, comorbidities (i.e., diabetes, congestive heart failure, chronic obstructive pulmonary disease, hypertension, renal failure, dialysis, and disseminated cancer), bleeding disorders, transfusion history, sepsis, wound classification, American Society of Anesthesiologists (ASA) classification, body mass index, operative year, and inpatient/outpatient status.

The Current Procedural Terminology (CPT) code was also included in the matching process to account for differences between included procedures. A caliper width of 0.02 of the standard deviation of the logit of the propensity score was applied during the matching process to ensure a precise and well-matched cohort. The quality of the balanced cohort was assessed using a threshold of <0.1 standard mean difference between the two matched cohorts for each baseline variable.

Outcomes

The primary outcome of interest was 30-day mortality. Secondary outcomes included individual 30-day postoperative complications, such as unplanned readmission, reoperation, reintubation, superficial, deep, and organ/space surgical site infections (SSI), pneumonia, pulmonary embolism, ventilator use for more than 48 hours, acute renal failure, progressive renal insufficiency (defined by NSQIP as a postoperative increase in serum creatinine of >2 mg/dL from baseline), urinary tract infection, stroke, myocardial infarction, deep vein thrombosis, sepsis, and septic shock.

Statistical analysis

Odds ratios (ORs) with corresponding 95% confidence intervals (CIs) and p-values for each outcome measure were estimated using logistic regression on the propensity score matched cohort. All statistical analyses were

conducted using R, version 4.1.1 (R Foundation for Statistical Computing, Vienna, Austria) at a significance level of 95% (p=0.05; two-tailed).

RESULTS

From a total of 138 251 patients who underwent urologic cancer surgery in NSQIP hospitals from 2015–2019, 110 028 patients (46.8±11.4 years, 79.1% male) met the study's eligibility criteria (Figure 1). Prior to matching, black-identifying patients made up 12.7% of the study population. Compared to white-identifying patients, black-identifying patients were generally younger (mean age 43.5 vs. 47.3 years), more likely to be smokers (21.4% vs. 15.8%), and had a higher prevalence of certain comorbidities, such as hypertension and diabetes. They were also less likely to undergo radical cystectomy (1.2% vs. 2.3%) and nephroureterectomy (1.7% vs. 3.6%), but more likely to undergo radical prostatectomy (50.0% vs. 38.7%) (Table 1).

After matching, a well-balanced cohort of 28 056 patients was included for analysis (Table 2). There was no significant difference in the primary outcome of 30-day mortality between black-identifying and white-identifying patients (OR 1.18, 95% CI 0.86–1.63, p=0.296). Among the secondary outcomes, black-identifying patients were more likely to experience unplanned readmission (OR 1.12, 95% CI 1.02–1.24, p=0.018), unplanned reintubation (OR 1.36, 95% CI 1.03–1.81, p=0.032), progressive renal insufficiency (OR 1.84, 95% CI 1.37–2.47, p<0.001), cardiac arrest (OR 1.49, 95% CI 1.01–2.20, p=0.043), and require a blood transfusion (OR 1.16, 95% CI 1.05–1.28, p=0.003). Conversely, they had lower odds of myocardial infarction (OR 0.65, 95% CI 0.43–0.99, p=0.048), SSIs (OR 0.65, 95% CI 0.50–0.85, p=0.001), and septic shock (OR 0.67, 95% CI 0.45–0.98, p=0.041) compared to white-identifying patients (Table 3).

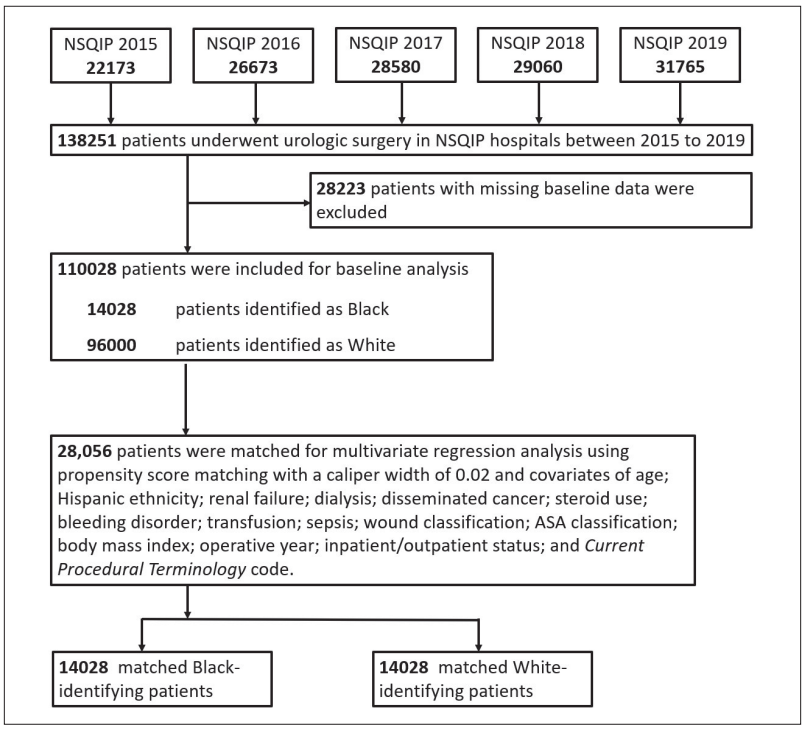

Figure 1. Patient flowchart of inclusion and exclusion criteria. NSQIP: National Surgical Quality Improvement Program.

DISCUSSION

In this study, using a large, representative registry of patients undergoing urologic oncology surgeries, 30-day mortality rates post-surgery were not different between black-identifying and white-identifying patients. Black-identifying patients were less likely to be diagnosed with myocardial infarction, superficial SSIs, and septic shock; however, they experienced significantly higher rates of unplanned readmission, reintubation, renal insufficiency, cardiac arrest, and bleeding complications. These results suggest that racial disparities in postoperative outcomes persist despite standardization efforts through quality improvement programs such as NSQIP.

The higher rates of renal insufficiency and unplanned reintubation observed among black-identifying patients may reflect preoperative factors, differences in perioperative fluid management, or variation in intensive care unit admission thresholds.[10-12] It is also important to consider that historical methods for estimating kidney function, such as estimated glomerular filtration rate (eGFR), included a race-based coefficient that systematically inflated GFR values in black-identifying patients.[13,14] This may have led to under-recognition of preoperative renal dysfunction and could partially confound the disparity observed in postoperative renal insufficiency.[13,14] As clinical practice shifts towards race-neutral eGFR equations, future studies may yield more accurate assessments of baseline renal function across racial groups.[14]

Additionally, lower odds of myocardial infarction and sepsis in black-identifying patients suggest that these differences are not uniform across complications and may be influenced by hospital factors, such as procedural volume and access to specialized perioperative care. Possible explanations for the lower incidence of myocardial infarction in black-identifying patients may be differential baseline cardiovascular profiles or perioperative management practices; however, it is also possible that incomplete or differential capture of complications across racial groups in NSQIP contributed to this finding.

As the database relies on standardized abstraction by clinical reviewers, subtle variations in reporting accuracy or diagnostic coding may influence outcome classification between groups. Given that hospital volume is a well-established predictor of urologic surgery outcomes, future research should examine whether minority patients disproportionately receive care at lower-volume centers, which may lack specialized perioperative protocols and enhanced recovery pathways.[12] Targeted referral strategies, postoperative monitoring programs, and increased access to minimally invasive surgical techniques may help improve outcomes in at-risk populations;[12] however, addressing the root causes of these disparities requires examining the systemic, patient, and provider-level factors that shape access to high-quality perioperative care and postoperative outcomes.

One systemic factor potentially explaining these disparities is hospital volume, with high hospital volumes generally associated with positive surgical outcomes.[12,15-19] Historically, minority groups have had limited access to high-volume hospitals, which may be due to a lack of access to health insurance or primary care providers.[15,20-22] Patients treated at high-volume hospitals often present with fewer post-surgical morbidities and mortality.[15] Additionally, literature has consistently shown racial differences in care offered at either high- or low-volume hospitals.[15,23]

In the context of urologic cancer surgeries, a 2008 study by Gooden et al showed that mortality inequalities for both radical cystectomy and prostatectomy procedures decreased when controlling for hospital volume.[24] Unfortunately, as NSQIP does not provide hospital identifiers, we could not assess hospital volume in this analysis.

A second systemic factor of importance is the patient population of participating hospitals. Literature has extensively shown that the racial distribution of patients in hospitals is linked to surgical outcomes. For example, a 2008 study on colon cancer patients identified that hospitals with a high proportion of black-identifying patients (>40%) had lower average one-year survival rates post-surgery.[25] Furthermore, recent reports have outlined that up to 25% of racial disparities may be attributable to black-identifying patients receiving care in lower-volume or 'lower-quality' hospitals, with fewer resources to support patients following surgery.[15,26]

Patient factors contributing to the observed disparities are more complex, with varying associations between race, socioeconomic status, and insurance coverage in both Canada and the U.S.[15] A larger proportion of the non-white population in the U.S. have uninsured status,

Table 1. Characteristics of the 110 028 patients included in the baseline analysis prior to matching

Patient characteristics	White-identifying	Black-identifying	p
N	96,000	14,028	
Age in mean years (SD)	47.3 (11.5)	43.5 (10.7)	<0.001
Sex, n (%)			
Male	75 908 (79.1)	11 065 (78.9)	0.608
Hispanic ethnicity (%)			<0.001
Yes	5620 (5.9)	130 (0.9)	
No	87 490 (91.1)	13 464 (96.0)	
Unknown	2890 (3.0)	434 (3.1)	
Urologic procedure received (%)			<0.001
Cystectomy	2180 (2.3)	170 (1.2)	
Nephroureterectomy	3443 (3.6)	244 (1.7)	
Partial nephrectomy	16 589 (17.3)	2475 (17.6)	
Radical nephrectomy	18 808 (19.6)	2843 (20.3)	
Radical prostatectomy	37 174 (38.7)	7020 (50.0)	
Outpatient (%)	25 740 (26.8)	2577 (18.4)	<0.001
Emergency case (%)	340 (0.4)	40 (0.3)	0.221
Year of operation (%)			0.045
2015	15 870 (16.5)	2186 (15.6)	
2016	18 619 (19.4)	2756 (19.6)	
2017	19 967 (20.8)	2898 (20.7)	
2018	20 062 (20.9)	3019 (21.5)	
2019	21 482 (22.4)	3169 (22.6)	
Smoker (%)	15 201 (15.8)	3006 (21.4)	<0.001
Functional health status (%)			<0.001
Independent	94 339 (98.3)	13 795 (98.3)	
Partially dependent	1040 (1.1)	168 (1.2)	
Totally dependent	176 (0.2)	35 (0.2)	
Unknown	445 (0.5)	30 (0.2)	
Wound classification (%)			<0.001
Clean	10 951 (11.4)	1944 (13.9)	
Clean/contaminated	83 536 (87.0)	11 888 (84.7)	
Contaminated	1062 (1.1)	126 (0.9)	
Dirty/infected	451 (0.5)	70 (0.5)	
Moribund	13 (0.0)	0 (0.0)	
Body mass index in mean kg/m² (SD)	29.8 (6.1)	30.3 (6.4)	<0.001

SD: standard deviation.

Table 2. Baseline characteristics of the 28 056 patients matched for multivariate regression analysis

Patient characteristics	White-identifying	Black-identifying	p
N	14 028	14 028	
Age in mean years (SD)	43.4 (11.3)	43.5 (10.6)	0.423
Sex, n (%)			<0.001
Male	11 448 (81.6)	11 065 (78.9)	
Hispanic ethnicity (%)			0.325
Yes	155 (1.1)	130 (0.9)	
No	13 445 (95.8)	13 464 (96.0)	
Unknown	428 (3.1)	434 (3.1)	
Urologic procedure received (%)			0.773
Cystectomy	179 (1.3)	170 (1.2)	
Nephroureterectomy	251 (1.8)	244 (1.7)	
Partial nephrectomy	2560 (18.2)	2475 (17.6)	
Radical nephrectomy	2782 (19.8)	2843 (20.3)	
Radical prostatectomy	6986 (49.8)	7020 (50.0)	
Outpatient (%)	2532 (18.0)	2577 (18.4)	0.496
Emergency case (%)	46 (0.3)	40 (0.3)	0.589
Year of operation (%)			0.20
2015	2072 (14.8)	2186 (15.6)	
2016	2739 (19.5)	2756 (19.6)	
2017	2998 (21.4)	2898 (20.7)	
2018	3093 (22.0)	3019 (21.5)	
2019	3126 (22.3)	3169 (22.6)	
Smoker (%)	3022 (21.5)	3006 (21.4)	0.827
Functional health status (%)			0.767
Independent	13 796 (98.3)	13 795 (98.3)	
Partially dependent	158 (1.1)	168 (1.2)	
Totally dependent	43 (0.3)	35 (0.2)	
Unknown	31 (0.2)	30 (0.2)	
Wound classification (%)			0.786
Clean	1970 (14.0)	1944 (13.9)	
Clean/contaminated	11 844 (84.4)	11 888 (84.7)	
Contaminated	139 (1.0)	126 (0.9)	
Dirty/infected	75 (0.5)	70 (0.5)	
Moribund	0 (0.0)	0 (0.0)	
Body mass index in mean kg/m² (SD)	30.5 (6.2)	30.3 (6.4)	0.04

SD: standard deviation.

Table 3. Odds of outcome for secondary outcomes (composite measures of major 30-day postoperative complications) for black-identifying vs. white-identifying patients

Outcome variable	Odds ratio (95% CI)	p
Unplanned readmission	1.12 (1.02–1.24)	**0.018**
Unplanned reoperation	1.11 (0.94–1.30)	0.220
Unplanned reintubation	1.36 (1.03–1.81)	**0.032**
Death	1.18 (0.86–1.63)	0.296
Superficial SSI	0.65 (0.50–0.85)	**0.001**
Deep SSI	1.50 (0.72–3.12)	0.276
Organ/space SSI	1.04 (0.83–1.30)	0.730
Dehiscence	0.78 (0.47–1.27)	0.318
Pneumonia	1.20 (0.94–1.53)	0.140
Pulmonary embolism	1.41 (0.84–1.55)	0.394
Ventilator >48 hours	1.14 (0.82–1.59)	0.444
Progressive renal insufficiency	1.84 (0.96–1.84)	**<0.001**
Acute renal failure	1.33 (0.96–1.84)	0.086
Urinary tract infection	1.07 (0.92–1.25)	0.383
Stroke	1.45 (0.79–2.64)	0.230
Cardiac arrest	1.49 (1.01–2.20)	**0.043**
Myocardial infarction	0.65 (0.43–0.99)	**0.048**
Bleeding requiring transfusion	1.16 (1.05–1.28)	**0.003**
Deep vein thrombosis	1.25 (0.96–1.64)	0.100
Sepsis	0.98 (0.77–1.24)	0.857
Septic shock	0.67 (0.45–0.98)	**0.041**

Bold font indicates statistical significance. CI: confidence interval; SSI: surgical site infection.

concomitant morbidities, and low-income status, which may interfere with optimal and timely surgical care, leading to worse outcomes.[15] Additionally, literature indicates that for certain urologic conditions, such as prostate and bladder cancer, black-identifying patients may present later in disease than white-identifying patients prior to surgery.[10] Late presentation may occur because of both patient factors (e.g., mistrust in the healthcare system and generational trauma) and systemic factors (e.g., limited access to quality-improving hospitals).[15] Literature has also identified that where there is presumably equal access to care, racial differences in late presentation appear to subside.[9] As such, promoting equitable access to care may minimize excess morbidity and mortality due to late presentation.

Finally, healthcare provider factors may have also mediated the observed health disparities. There is evidence of racial differences in the appropriateness and type of procedures received for patients in both Canada and the U.S. For example, in a 2022 study conducted by Mohanty et al researchers identified that significant social and racial disparities in access to minimally invasive urologic surgeries persisted across the U.S.[27] Specifically, black-identifying patients were 22% less likely to undergo minimally invasive prostatectomies compared to white-identifying patients between the years of 2001 and 2005, potentially exacerbating postoperative comorbidities in this population.[27]

Additionally, several retrospective cohort studies have demonstrated that black-identifying patients are less likely to receive surgeries from high-volume urologists than white-identifying patients.[22,23,28,29] This disparity can be attributed to several factors, including significant segregation within North American healthcare systems, physician bias, differential access to primary and hospital care, and fewer resources allocated to urologists serving predominantly minority patient populations.[22,23,28,29]

Provider-level disparities, along with systemic and patient-level factors, continue to drive inequities in surgical outcomes. Despite advancements in perioperative care and quality improvement initiatives since 2019, disparities in access to high-volume hospitals, specialized perioperative care, and minimally invasive techniques persist. Although this study uses NSQIP data from 2015–2019, more recent literature has consistently documented racial disparities in surgical outcomes.[6,30,31] The persistence of these disparities suggests that systemic factors influencing postoperative outcomes remain highly relevant.

Limitations

While various mechanisms may account for the observed outcomes, our study has limitations.

First, uncontrolled potential confounders may have affected the outcomes. These include variations in surgeon experience, surgeon race identification, hospital location, socioeconomic status, and insurance status. Although we sought to minimize the risk of confounding through propensity score matching and multivariable regression analysis to pair black-identifying and white-identifying patients, this approach only accounts for observed variables and cannot eliminate the possibility of residual confounding due to unmeasured or unknown factors.

Second, while this study identifies certain outcomes, the NSQIP database does not provide the reasons behind these outcomes, which are almost certainly more complex and nuanced in nature.

Third, a large proportion of our cohort underwent lower-risk procedures, such as radical prostatectomy, which may have diluted our ability to detect disparities that could be more pronounced in higher-risk surgeries, such as radical cystectomy.

Fourth, the NSQIP database only tracks 30 days of morbidity and mortality postoperatively and does not provide data on the relative severity of different comorbidities.[32]

Fifth, the mean age of our cohort was younger than what is typically reported in Canadian population-based studies of prostatectomy patients, which often cite a median age of 63–65 years.[33,34] This discrepancy may reflect the inclusion of outpatient surgeries or differences in institutional participation within NSQIP and may limit the generalizability of our findings to older patient populations.

Sixth, while NSQIP is a robust clinical registry, it lacks granular demographic and contextual data that may affect surgical outcomes.

Finally, racial classification in NSQIP is based on self-identification, which does not capture underlying genetic ancestry or cultural heterogeneity within broad categories like "Black" and "White." Individuals from diverse ethnic backgrounds may have self-identified similarly, but differed in their social, environmental, or biological contexts, factors that influence health outcomes and are not captured by this database.

Nevertheless, despite key limitations, the NSQIP database remains the most extensive and reliable source for postoperative outcome data given its large number of patients, inter-rater reliability, and operative data points, making it suitable for our research question.

CONCLUSIONS

Although 30-day mortality did not differ significantly between groups, black-identifying patients experienced higher rates of several postoperative complications following urologic cancer surgeries. These disparities may be driven by patient, provider, and systemic factors that influence the quality of perioperative care.

The increased risk of renal insufficiency, cardiac arrest, and unplanned readmission in black-identifying patients underscores the need for targeted interventions to improve surgical outcomes in minority populations.

Future efforts should prioritize perioperative risk stratification, standardized postoperative monitoring, and improved access to specialized perioperative care.

Additionally, given the well-established link between hospital volume and urologic surgical outcomes, further research should evaluate whether disparities in hospital referral patterns and access to high-volume centers contribute to these differences. Addressing these inequities is essential to ensuring equitable postoperative outcomes in urologic cancer surgery.

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