Race and 30-Day Morbidity in Pediatric Urologic Surgery

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abstract

BACKGROUND AND OBJECTIVE: Quality improvement in surgery involves identifying patients at high risk for postoperative complications. We sought to assess the impact of race and procedure type on 30-day surgical morbidity in pediatric urology.

METHODS: The National Surgical Quality Improvement Program–Pediatrics (NSQIP-P) is a prospective registry of surgical cases from 50 and 56 pediatric hospitals in 2012 and 2013, respectively. We performed a cohort study of children followed in NSQIP-P who underwent urologic surgery. Forty unique operations were stratified into 6 clinically related procedure groups: ureteral, testicular, renal, urinary diversion, penile and urethral, or bladder procedures. Outcomes were 3 different composite measures of 30-day morbidity. Primary predictors were patient race and procedural group. Multivariate logistic regression was used to identify associations between race, procedure type, and postoperative morbidity.

RESULTS: Of 114 395 patients in the NSQIP-P cohort, 11 791 underwent pediatric urologic procedures. Overall 30-day complication rate was 5.9% and was higher in bladder and urinary diversion procedures. On multivariate analyses, non-Hispanic black compared with non-Hispanic white children had higher odds of 30-day overall complications (odds ratio 1.34; 95% confidence interval, 1.03–1.74) and 30-day hospital-acquired infection (odds ratio 1.54; 95% confidence interval, 1.08–2.20). Bladder and urinary diversion procedures relative to testicular procedures had significantly higher odds of surgical morbidity across all composite outcome measures.

CONCLUSIONS: Black race and bladder and urinary diversion operations were significantly associated with 30-day surgical morbidity. Future efforts should identify processes of care that decrease postoperative morbidity among children.

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WHAT'S KNOWN ON THIS SUBJECT: Black compared with white race has increasingly been recognized as a risk factor for adverse surgical outcomes in multiple adult surgical specialties. Less is known about the impact of race on surgical complications among children.

WHAT THIS STUDY ADDS: Within pediatric urology, black compared with white children had significantly higher odds of 30-day overall complications and nosocomial infections. Bladder and urinary diversion procedures were associated with greater postoperative morbidity.

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Quality improvement in surgical practice has increasingly been emphasized, especially after passage of the Affordable Care Act.[1,2] Improving surgical quality includes maximizing successful operative outcomes, minimizing perioperative morbidity, and eliminating perceived disparities in care. Consequently, much effort has been placed on elucidating strategies to decrease complications,[3] reduce readmissions and reoperations,[4–6] and identify risk factors for adverse events.[6,7]

Recently, patient race has been identified as an important risk factor associated with surgical readmissions,[6–8] complications,[9] and survival among adults.[10] Within adult urology, racial disparities have been observed in outcomes for prostate cancer,[11,12] kidney cancer,[13] bladder cancer,[14,15] kidney transplantation,[16] and benign prostatic hyperplasia.[17] Black race has also been associated with adverse outcomes in pediatric patients undergoing general surgery,[18] cardiac surgery,[19] and otolaryngologic procedures.[20] It is unknown whether racial disparities exist for pediatric urologic operations, which include commonly referred conditions (eg, cryptorchidism, hypospadias), high-risk procedures (eg, bladder exstrophy repair), and patients with multiple comorbidities (eg, myelomeningocele, chronic kidney disease). The complexity and breadth of pediatric urologic conditions have been recognized in official surgical specialty referral recommendations released by the American Academy of Pediatrics.[21]

Previous studies of surgical morbidity in pediatric urology have reported results from a single institution or procedure, have assessed outcomes by using different definitions of complications, and have analyzed retrospectively collected data. These limitations have restricted understanding of how patient-level characteristics such as race or procedure-level elements such as type of operation are associated with surgical morbidity. National, prospectively collected data on complications offer the ideal opportunity to identify these risk factors, which can then facilitate development of comprehensive quality improvement initiatives to enhance surgical outcomes.[2]

In 2005, the American College of Surgeons developed and implemented the National Surgical Quality Improvement Program–Pediatrics (NSQIP-P).[22] This collaborative effort, which prospectively records 30-day postoperative complications after pediatric surgical operations, grew from 4 institutions in 2005 to 56 hospitals in 2013. The inclusion of various children's hospitals across the United States, which have different sizes and patient populations, make it an ideal database to examine perioperative quality measures on a national, standardized scale. Consequently, NSQIP-P has been used in other surgical subspecialties to aid in quality improvement programs.[23,24]

Our objective was to examine the impact of race and type of pediatric urologic procedures on surgical morbidity. Because bladder procedures include major complex reconstructive operations such as bladder augmentation with bowel or closure of bladder exstrophy, we hypothesized that operations on the bladder and nonwhite race are associated with greater surgical morbidity.

METHODS

Study Design and Data Set

This study was a secondary analysis of data collected prospectively in NSQIP-P from 2012 to 2013.

After α-[22] and β-phase[25] testing, the NSQIP-P database formally expanded nationwide in 2012. This data set is a national sample of pediatric surgical cases performed at 50 participating hospitals in 2012 and 56 hospitals in 2013. Preoperative, intraoperative, and postoperative variables were collected, including 30-day postoperative mortality and morbidity outcomes in both inpatient and outpatient settings. Each participating site has a full-time trained clinical reviewer who abstracts and audits the data to ensure high accuracy, completeness, and precision.[26,27] As part of the rigorous and standardized NSQIP-P data collection process, data are included only from hospitals with >80% follow-up of patients. The sampling method for NSQIP-P has been previously described.[22,23,25] Because the data set is completely deidentified, this study was determined to be non–human subjects research and deemed exempt from review by our institutional review board.

Cohort Selection

We combined the 2 released versions of NSQIP-P from 2012 and 2013, yielding an initial cohort of 114 395 patients aged 0 to 17 years. We identified patients who underwent a urologic procedure as their primary operation by using Common Procedural Terminology (CPT) codes. Patients who underwent concomitant urologic surgeries were included because we wanted to cover all urologic procedures. As part of the NSQIP-P exclusion criteria, patients who underwent procedures by different surgical teams under the same anesthetic were excluded from the data sets.[26,27] Although no specific explanation for this exclusion was provided by the American College of Surgeons, we surmise that it probably was to allow linkage of complications to a single specialty rather than several.

Outcome Measures

The primary outcome was 30-day overall complications. This composite measure consists of any 30-day postoperative complication measured by NSQIP-P. These include surgical site infection (SSI), pneumonia, reintubation, renal insufficiency, urinary tract infection (UTI), venous thrombotic events, neurologic sequelae (coma, seizure, stroke, nerve injuries), graft failure, cardiac arrest, transfusion, sepsis, central line–associated bloodstream infection (CLABSI), unplanned readmission, or unplanned reoperation. Secondary outcomes were 30-day serious adverse event (SAE) and 30-day hospital-acquired infection (HAI), which are subsets of the primary outcome of overall complications. We analyzed these secondary outcomes to explore associations between race and procedure type and more serious and infectious surgical complications. Composite SAE includes the following unplanned 30-day serious postoperative events: reintubation, cardiac arrest, sepsis, readmission, or reoperation. Composite HAI includes 30-day nosocomial infections that were absent preoperatively: UTI, SSI, pneumonia, or CLABSI.

The composite outcomes were chosen because of their clinical and public health relevance, their ability to provide different comprehensive assessments of overall surgical performance,[28] their use in previous analyses of NSQIP-P,[23,29,30] and the expected overall low incidence of single adverse events. Because a single patient may experience >1 complication, outcome events were based on the number of patients experiencing any complication, rather than number of complications.

Primary Predictor Selection

Our primary predictors were patient race and type of pediatric urologic procedure. Race was stratified into non-Hispanic whites, non-Hispanic blacks, and "other" races, which included the small percentages of Hispanics (10%), Asians (3%), American Indians (0.4%), Native Hawaiians (0.2%), and unreported race (10%) in the cohort. Because of the heterogeneity of all other races in "other" that render interpretation difficult, only comparisons of non-Hispanic blacks and non-Hispanic whites are discussed in this analysis. Based on CPT codes, we excluded procedures with <10 cases out of concern for small sample sizes leading to unstable estimates. This left 40 unique CPT codes, which were stratified into 6 distinct clinically related procedure groups: ureteral, testicular, renal, urinary diversion, penile and urethral, or bladder procedures (Supplemental Table 7). This stratification was done to reduce the total number of predictors to prevent multicollinearity and to facilitate ascertainment of associations between related operations and outcomes. The combining of individual procedures into clinically related groups has also been performed in other surgical fields to help narrow the target area for quality improvement.[23] Because they had the fewest observed complications compared with the other groups, testicular procedures were coded as the referent for ease of interpretation.

Covariate Selection

Preoperative clinical characteristics included in the analyses were age, sex, admission status, year of operation, case urgency, wound class, and overall number of baseline comorbidities as captured by the NSQIP-P data collection tool (see Supplemental Table 8 for frequencies of comorbidities). Age at surgery was grouped as a categorical variable to avoid the assumption of a linear relationship between age and the outcomes. Admission status was either inpatient or outpatient. Case urgency was separated into elective, urgent, or emergent. Wound class was divided according to Centers for Disease Control and Prevention guidelines[31] into clean, clean–contaminated, contaminated, and dirty/infected. The baseline comorbidities were recorded as binary variables and assigned equal weight for summation because severity within each comorbidity could not be assessed. Total number of comorbidities per patient was grouped into 0, 1, 2, or >2. As part of the hospital contracts with NSQIP-P, no data that could potentially identify individual hospitals were included in the released data sets; thus, no hospital-level characteristics were available for analysis.

Statistical Analysis

Bivariate analyses with Pearson χ^2 or Fisher exact tests (for frequencies <10) were performed for each outcome measure. All variables were placed in a multivariate logistic regression model for each composite outcome, yielding 3 fully adjusted models.

Potential effect modification between race and procedural group was examined by the addition of interaction terms in the regression models and was evaluated with Wald tests. All tests were 2-tailed, with statistical significance defined as $P < .05$. Analyses were performed in Stata, version 14.1 (Stata Corp, College Station, TX).

RESULTS

The final cohort of the 2012 and 2013 NSQIP-P data sets included a total of 11 791 children who underwent urologic surgery (Table 1). Frequencies of complications are summarized in Table 2. The event rate per outcome and bivariate analysis results are shown in Table 3. The overall complication rate was 5.9%, with 698 of 11 791 patients experiencing 994 complications. In unadjusted analyses, patients who were female, in older age groups, inpatients, had higher wound class, underwent nonelective surgery, or

TABLE 1 Patient Characteristics

Variable	Median (Interquartile Range)	*n* (%)
Total count		11 791 (100)
Sex		
Female		2436 (20.7)
Male		9355 (79.3)
Age (continuous)	1.7 (0.8–5.2)	
Age (categorical), y		
<2		6228 (52.8)
2–4		2472 (21.0)
5–9		2069 (17.6)
10–13		681 (5.8)
≥14		341 (2.9)
Race		
Non-Hispanic white		7558 (64.1)
Non-Hispanic black		1366 (11.6)
Other		2867 (24.3)
Admission status		
Inpatient		4039 (34.2)
Outpatient		7752 (65.8)
Year of operation		
2012		5437 (46.1)
2013		6354 (53.9)
Case type		
Elective		11 673 (99.0)
Urgent		50 (0.4)
Emergent		68 (0.6)
Wound class		
Clean		2475 (21.0)
Clean–contaminated		9218 (78.2)
Contaminated		79 (0.7)
Dirty/infected		19 (0.2)
Baseline comorbidities		
0		9329 (79.1)
1		1676 (14.2)
2		521 (4.4)
>2		265 (2.3)
Procedural group		
Testicular		862 (7.3)
Renal		1324 (11.2)
Urinary diversions		430 (3.7)
Ureteral		2164 (18.4)
Penile and urethral		6550 (55.6)
Bladder		461 (3.9)

TABLE 2 Frequencies of Surgical Complications

Morbidity	*n* (%)
SSI[a]	117 (1.0)
UTI[a]	215 (1.8)
CLABSI[a]	5 (0.04)
Pneumonia[a]	7 (0.1)
Renal insufficiency	14 (0.1)
Transfusion of blood	81 (0.7)
Venous thromboembolism	1 (0.01)
Neurologic injury	7 (0.1)
Graft failure	2 (0.02)
Unplanned reoperation[b]	146 (1.2)
Unplanned readmission[b]	356 (3.0)
Cardiac arrest[b]	4 (0.03)
Reintubation[b]	11 (0.1)
Sepsis[b]	28 (0.2)

[a] Included in secondary outcome of HAI.
[b] Included in secondary outcome of SAE.

had more baseline comorbidities experienced significantly higher rates of complications compared with their respective counterparts. Bladder (23%) and urinary diversion (22%) procedures had the highest rates of overall 30-day complications relative to the other procedure groups.

On multivariable logistic regression modeling for our primary outcome, non-Hispanic black children and bladder, urinary diversion, renal, and ureteral procedures were associated with higher odds of 30-day complications (Table 4). Non-Hispanic black children had 34% higher odds of experiencing any postoperative complication relative to non-Hispanic white children (odds ratio [OR] 1.34; 95% confidence interval [CI], 1.03–1.74). Compared with testicular procedures, bladder procedures (OR 5.79; 95% CI, 3.39–9.88) and urinary diversions (OR 4.27; 95% CI, 2.48–7.33) conferred significantly higher odds of postoperative complication. The test for an interaction of procedural grouping with race was not statistically significant ($P = .15$).

For our secondary outcomes, patients undergoing urinary diversions, bladder, renal, or ureteral procedures had higher adjusted odds of experiencing any 30-day SAE (Table 5). Urinary diversions and bladder procedures relative to testicular procedures conferred the highest increased odds of postoperative SAE (OR 5.44; 95% CI, 2.77–10.70 and OR 3.51; 95% CI, 1.74–7.09, respectively). The association between non-Hispanic blacks and SAE was not statistically significant (OR 1.33; 95% CI, 0.97–1.81). The test for an interaction of procedural grouping with race was not statistically significant ($P = .15$).

Adjusted analyses demonstrated associations between non-Hispanic black children and bladder and urinary diversion procedures and our secondary outcome of any 30-day HAI (Table 6). Relative to non-Hispanic white patients, non-Hispanic blacks had 53% higher odds of experiencing a postoperative HAI (OR 1.53; 95% CI, 1.08–2.19). Bladder operations (OR 4.01; 95% CI, 1.86–8.68) and urinary diversion procedures (OR 3.67; 95% CI, 1.70–7.93) were associated with higher odds of postoperative HAI compared with testicular procedures. The test

TABLE 3 Number of Patients With Events and Bivariate Analysis of Composite Morbidity Outcomes

Variable	Overall Complications, *n* (%)	*P*	SAE, *n* (%)	*P*	HAI, *n* (%)	*P*
Patients with events	698 (5.9)		440 (3.7)		325 (2.8)	
Sex		<.001		<.001		<.001
Female	255 (10.5)		149 (6.1)		125 (5.1)	
Male	443 (4.7)		286 (3.1)		200 (2.1)	
Age, y		<.001		.001		.001
<2	337 (5.4)		211 (3.4)		148 (2.4)	
2–4	142 (5.7)		89 (3.6)		71 (2.9)	
5–9	119 (5.8)		75 (3.6)		57 (2.8)	
10–13	60 (8.8)		34 (5.0)		31 (4.6)	
≥14	40 (11.7)		26 (7.6)		18 (5.3)	
Race		.746		.681		.295
Non-Hispanic white	438 (5.8)		280 (3.7)		195 (2.6)	
Non-Hispanic black	84 (6.2)		55 (4.0)		42 (3.0)	
Other	176 (6.1)		100 (3.5)		88 (3.1)	
Admission status		<.001		<.001		<.001
Inpatient	479 (11.9)		292 (7.2)		219 (5.4)	
Outpatient	219 (2.8)		143 (1.8)		106 (1.4)	
Year of operation		.823		.738		.663
2012	319 (5.9)		204 (3.8)		146 (2.7)	
2013	379 (6.9)		231 (3.6)		179 (2.8)	
Case urgency		<.001		<.001		1.00
Elective	673 (5.8)		420 (3.6)		323 (2.8)	
Urgent	11 (22.0)		10 (20.0)		1 (2.0)	
Emergent	14 (20.6)		5 (7.4)		1 (1.5)	
Wound class		<.001		<.001		<.001
Clean	84 (3.4)		49 (2.0)		30 (1.2)	
Clean–contaminated	602 (6.5)		381 (4.1)		288 (3.1)	
Contaminated	9 (11.4)		4 (5.1)		6 (7.6)	
Dirty/infected	3 (15.8)		1 (5.3)		1 (5.3)	
Total comorbidities		<.001		<.001		<.001
0	399 (4.3)		248 (2.7)		196 (2.1)	
1	158 (9.4)		97 (5.8)		70 (4.2)	
2	87 (16.7)		53 (10.2)		38 (7.3)	
>2	54 (20.4)		37 (14.0)		21 (7.9)	
Procedural grouping		<.001		<.001		<.001
Testicular	24 (2.8)		14 (1.6)		11 (1.3)	
Ureteral	176 (8.1)		117 (5.4)		93 (4.3)	
Renal	124 (9.4)		87 (6.6)		38 (2.9)	
Urinary diversions	94 (21.9)		67 (15.6)		49 (11.4)	
Penile and urethral	173 (2.6)		110 (1.7)		87 (1.3)	
Bladder	107 (23.2)		40 (8.7)		47 (10.2)	

P values are for each composite outcome index; Fisher's exact test ($n < 10$) or χ^2 test was used for categorical variables.

for an interaction of procedural grouping with race was not statistically significant ($P = .13$).

DISCUSSION

In our study of a prospectively followed cohort of children who underwent urologic surgery at >50 hospitals in the United States, we found that type of procedure and patient race were associated with postoperative morbidity. Our study used standardized reporting of 30-day surgical complications to identify specific procedure groups within pediatric urology, namely bladder procedures and urinary diversions, that are associated with higher risk of postoperative morbidity. As hypothesized, bladder procedures, which include bladder exstrophy repair and enterocystoplasty (ie, bladder augmentation), were associated with higher odds of complications. Similarly, urinary diversions, which include appendicovesicostomy, were also strongly associated with surgical morbidity.

Exstrophy repair, enterocystoplasty, and appendicovesicostomy are among the largest and most complex surgeries within pediatric urology and are known to have high rates of complications because of the invasiveness of the procedures, incorporation of bowel for the latter 2, and frequent need for prolonged urinary system catheterization. Before our study, however, the heterogeneity in defining, assessing, and recording published complications have precluded direct comparison across procedures.[30,32–34]

For example, in bladder exstrophy, most reports of complications after repair are limited to single-institutional case series. The rates of major complications range from 11% to 25%, although they often exclude postoperative transfusion rates, which may be as high as 50%.[32,33] Similarly, 1 of the largest studies of enterocystoplasty outcomes is a single-institution retrospective analysis of 500 consecutive cases that demonstrated 34% reoperation rate but did not assess for symptomatic UTI or SSI after initial surgery.[34] By comparison, after including transfusion, reoperation, UTI, and SSI among our complications, we found a 23% overall 30-day complication rate among all bladder procedures assessed in our study. This difference in complication rates helps demonstrate that accurate portrayals of perioperative risks, which are essential to patient counseling, may be limited without the use of uniform measures of complications.

Increasing awareness of surgical outcomes and patient safety has stimulated a search for risk factors for surgical complications.[23,35] Once procedures can be accurately assessed and compared in the same context, opportunities for initiating quality improvement can be undertaken. For example, at a children's hospital in Canada, appendectomy compared with other procedures was identified as being associated with high SSI rates, leading to an institution-wide review, internal case–control studies to identify risk factors, and establishment of a best practice protocol.[24] In pediatric urology, recognition that variation exists in high-risk operations such as bladder exstrophy repair was the first step in a recent effort to improve surgical outcomes. The resulting initiative was the development of a multi-institutional collaboration to standardize care and provide peer mentorship from expert surgeons for this complex and rare condition.[36] By continuously planning and performing key changes in surgical technique, studying outcomes and making adjustments, then repeating the process, the collaboration offers promise of improving surgical care.[37]

TABLE 4 Multivariable Logistic Regression Analysis of Composite Overall Complications Outcome

Variable	OR	95% CI	*P*
Sex			
Female	Reference	—	—
Male	1.05	0.86–1.28	.63
Age, y			
<2	Reference	—	—
2–4	0.76	0.61–0.95	.01
5–9	0.56	0.44–0.71	<.001
10–13	0.67	0.48–0.92	.01
≥14	0.70	0.48–1.04	.08
Race			
Non-Hispanic white	Reference	—	—
Non-Hispanic black	1.34	1.03–1.74	.03
Other	1.15	0.95–1.40	.14
Admission status			
Inpatient	Reference	—	—
Outpatient	0.46	0.35–0.61	<.001
Year of operation			
2012	Reference	—	—
2013	1.09	0.93–1.29	.27
Case urgency			
Elective	Reference	—	—
Urgent	1.55	0.74–3.26	.25
Emergent	2.27	1.12–4.62	.09
Wound class			
Clean	Reference	—	—
Clean–contaminated	1.43	1.11–1.84	.005
Contaminated	1.20	0.55–2.64	.64
Dirty/infected	1.76	0.46–6.75	.41
Total comorbidities			
0	Reference	—	—
1	1.80	1.46–2.22	<.001
2	3.14	2.39–4.14	<.001
>2	3.68	2.60–5.21	<.001
Procedural grouping			
Testicular	Reference	—	—
Renal	2.01	1.20–3.38	.008
Urinary diversions	4.27	2.48–7.33	<.001
Ureteral	2.08	1.24–3.50	.006
Penile and urethral	1.00	0.63–1.57	.99
Bladder	5.79	3.39–9.88	<.001

The second finding from our study is that non-Hispanic black children had a greater probability of surgical complications after we adjusted for important patient-level confounders. In the broader context of national surgical readmissions and morbidity, studies of Medicare[7,9] and adult National Surgical Quality Improvement Program–Pediatrics[6] databases have demonstrated significantly higher risk among blacks compared with whites. Racial disparities are also well described in adult urology.[11–17] Among other pediatric surgical specialties, black race has been adversely associated with surgical outcomes in general surgery,[18] cardiac surgery,[19] and otolaryngology.[20] Therefore, we hypothesized that similar findings would be present in pediatric urology. However, race has not been previously well examined as a predictor of outcomes in pediatric urology, with studies either excluding race from their analyses[38] for unclear

TABLE 5 Multivariable Logistic Regression Analysis of Composite SAE Outcome

Variable	OR	95% CI	*P*
Sex			
Female	Reference	—	—
Male	1.21	0.95–1.54	.12
Age, y			
<2	Reference		
2–4	0.77	0.59–1.00	.05
5–9	0.60	0.45–0.81	.001
10–13	0.66	0.45–0.99	.046
≥14	0.84	0.53–1.33	.45
Race			
Non-Hispanic white	Reference	—	—
Non-Hispanic black	1.33	0.97–1.81	.07
Other	1.04	0.82–1.32	.73
Admission status			
Inpatient	Reference	—	—
Outpatient	0.57	0.41–0.80	.001
Year of operation			
2012	Reference	—	—
2013	1.03	0.85–1.26	.76
Case urgency			
Elective	Reference	—	—
Urgent	2.62	1.23–5.58	.01
Emergent	1.12	0.42–3.02	.82
Wound class			
Clean	Reference	—	—
Clean–contaminated	1.56	1.13–2.15	.007
Contaminated	0.99	0.34–2.92	.99
Dirty/infected	2.25	0.47–10.84	.31
Total comorbidities			
0	Reference	—	—
1	1.82	1.41–2.35	<.001
2	2.92	2.09–4.08	<.001
>2	4.06	2.73–6.04	<.001
Procedural grouping			
Testicular	Reference	—	—
Renal	2.77	1.44–5.32	.002
Urinary diversions	5.44	2.77–10.70	<.001
Ureteral	2.79	1.44–5.38	.002
Penile and urethral	1.02	0.57–1.83	.94
Bladder	3.51	1.74–7.09	<.001

reasons or being limited, by the data sets used, to exploring associations with timing of surgery rather than with complications.[39–41] Additionally, multiple risk score nomograms in the pediatric surgery literature did not specifically assess race as a predictor of outcomes,[42–44] which highlights the clinical importance of our finding.

The public health implications of possible racial disparities in pediatric urologic complications certainly warrant additional exploration. The mechanisms probably are complex and multifactorial. One possible explanation is that black patients may be more likely to receive care at hospitals with fewer resources, which may drive the association between race and outcomes.[45] Recent studies have shown that black adults have higher odds of readmission after major surgery than whites, but after adjustment for site of care, the strength of the association is attenuated but not eliminated.[7,8,45] However, NSQIP-P has restrictions in their hospital contracts prohibiting release of information pertaining to stratification by hospital or region,[26,27] thus preventing evaluation of interhospital variation in this data set.

Another potential and biologically plausible explanation for the racial disparities is variable innate immune response and thus susceptibility by race to potential infections. Certain genetic polymorphisms in the human immune system, especially in the Toll-like receptor family, are well known to predispose to recurrent UTIs.[46] One study tested various Toll-like receptor ligands by using identical protocols in children of European versus African descent and found different innate cytokine responses.[47] Clinically, black compared with white race has been significantly associated with infectious complications. Among hospitalized adult patients, blacks were found to have 34% higher odds of developing HAI, including CLABSI, UTI, and pneumonia, compared with whites.[48] Similarly, among adults who underwent elective vascular surgical procedures, blacks were found to have 77% higher odds of subsequent pneumonia, UTI, SSI, or sepsis compared with white patients.[49] As we found in our secondary outcomes, black race was significantly associated with HAI but not SAE. Thus, increased susceptibility to HAI among blacks could be a primary driver of the racial disparities in surgical morbidity.

We also identified other key variables consistently associated with increased odds of surgical complications across all our outcome measures. Younger age and more baseline comorbidities were associated with greater surgical morbidity. These associations have been observed among pediatric surgical patients assessed for in-hospital mortality[43] and among pediatric urology patients assessed for surgical complications.[44]

Our results should be interpreted in light of their limitations. First, as mentioned, our study is limited by lack of data on hospital characteristics, which prevents analysis of interhospital variation and its potential impact on our racial disparity findings. However, hospital-level characteristics in other studies only attenuated and did not completely eliminate the associations seen between black race and worse surgical outcomes, which remained highly significant.[7,8,45] Second, with any observational study, the potential for bias and unmeasured confounding exists. However, selection bias is probably minimized by the prospective sampling methods of NSQIP-P and the minimal loss to follow-up during the 30-day postoperative window. Furthermore, misclassification of exposures and outcomes would probably be nondifferential by race, thus biasing toward the null. We also included and explored potential confounders recorded in NSQIP-P and adjusted for them in multivariate regression models. Third, the use of composite measures of complications loses data granularity recorded in individual complications. However, composite measures may better explain variation in complications and better predict future performance.[28] Fourth, NSQIP-P is not a randomly selected representative sample of the national pediatric population. However, the database does represent >50 hospitals per year across the nation, constituting different patient populations, and is likely to continue to expand. The racial makeup of our cohort (11.6% black) also is consistent with national racial demographics from the 2014 US census (13.2% black).[50] It is likely that our results can be generalized to most patients undergoing pediatric urologic surgery around the country. The large sample size also allows precise estimates of effect, which is particularly important given the rarity of surgical complications in pediatric urology.

TABLE 6 Multivariable Logistic Regression Analysis of Composite HAI Outcome

Variable	OR	95% CI	*P*
Sex			
Female	Reference	—	—
Male	0.98	0.74–1.30	.90
Age, y			
<2	Reference	—	—
2–4	0.82	0.61–1.11	.19
5–9	0.59	0.42–0.82	.002
10–13	0.78	0.51–1.20	.26
≥14	0.73	0.42–1.26	.25
Race			
Non-Hispanic white	Reference	—	—
Non-Hispanic black	1.53	1.08–2.19	.02
Other	1.35	1.04–1.76	.03
Admission status			
Inpatient	Reference	—	—
Outpatient	0.44	0.30–0.65	<.001
Year of operation			
2012	Reference	—	—
2013	1.14	0.91–1.44	.24
Case urgency			
Elective	Reference	—	—
Urgent	0.23	0.03–1.73	.15
Emergent	0.21	0.03–1.57	.13
Wound class			
Clean	Reference	—	—
Clean–contaminated	1.93	1.29–2.89	.001
Contaminated	2.61	1.01–6.76	.048
Dirty/infected	1.90	0.23–15.34	.55
Total comorbidities			
0	Reference		—
1	1.47	1.09–1.99	.01
2	2.46	1.68–3.63	<.001
>2	2.39	1.45–3.95	.001
Procedural grouping			
Testicular	Reference	—	—
Renal	0.97	0.45–2.11	.95
Urinary diversions	3.67	1.70–7.93	.001
Ureteral	1.71	0.81–3.64	.16
Penile and urethral	0.90	0.46–1.74	.75
Bladder	4.01	1.86–8.68	<.001

CONCLUSIONS

We have shown that >20% of children undergoing bladder and urinary diversion procedures have postoperative complications. Additionally, we found possible racial disparities against non-Hispanic blacks in terms of overall postoperative complications and HAI. Efforts to determine hospital-level variation in complication rates and identify processes of care that decrease postoperative morbidity should be undertaken given their potential implications for policymaking in reducing health disparities.

ABBREVIATIONS

CI: confidence interval
CLABSI: central-line associated bloodstream infection
CPT: common procedural terminology
HAI: hospital-acquired infection
NSQIP-P: National Surgical Quality Improvement Program–Pediatrics
OR: odds ratio
SAE: serious adverse event
SSI: surgical site infection
UTI: urinary tract infection

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Race and 30-Day Morbidity in Pediatric Urologic Surgery

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