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## Venous Thromboembolism Following Total Knee Arthroplasty: Does Race Matter?

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### ABSTRACT

**Background:** Venous thromboembolism (VTE) (deep venous thrombosis and pulmonary embolism) is a known complication following total knee arthroplasty (TKA). Recent literature has identified differences in VTE risk based on race with African Americans having higher risk of VTE. This study evaluated the impact of race on VTE following TKA using a large multicenter database.

**Methods:** We queried the American College of Surgeons National Surgical Quality Improvement Program to identify patients who underwent primary TKA in 2010–2014. Patients were stratified based on race: Asian, Black/African American, White, and Other. Demographics were compared to determine the impact on 30-day postoperative complications. Multivariate logistic regression analysis was performed to control for confounding demographics and comorbidities between races. Primary outcomes included overall complications and VTE.

**Results:** In total, 96,230 patients were included. Univariate analysis demonstrated that Blacks had a significantly higher rate of any complication (5.5%), deep venous thrombosis (1.3%), and pulmonary embolism (1.1%) than other races ( $P = .007$ ,  $P < .001$ , and  $P < .001$ , respectively). Overall mortality rate did not differ between races ( $P = .26$ ). Multivariate regression analysis identified that Blacks were significantly more likely to have a VTE than Whites (odds ratio 1.7, 95% confidence interval 1.4–2.0). Overall complications were significantly higher for Blacks than Whites (odds ratio 1.1, 95% confidence interval 1.02–1.3). There were no differences in the rates of VTE or overall complications between Asians/Other races and Whites.

**Conclusion:** Blacks have a significantly higher risk of VTE following primary TKA than other races. Future studies should investigate causes for this disparity.

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Venous thromboembolism (VTE), including deep venous thrombosis (DVT) and pulmonary embolism (PE), is a relatively uncommon complication following total knee arthroplasty (TKA). The rate of symptomatic VTE within 3 months of TKA has been reported to be between 0.7% and 5% [1–6]. Many organizations, including the American Academy of Orthopedic Surgeons and the American College of Chest Physicians, have provided statements

and/or guidelines with recommendations regarding VTE prevention in an effort to decrease the rate of VTE in this patient population [6,7].

Risk stratification is important for identifying patients with an unacceptably higher risk of VTE who may require more potent chemoprophylaxis after TKA. Risk factors for VTE that have been identified include hypercoagulability, history of VTE, cancer, family history, elevated body mass index (BMI), bilateral surgery, and operative time >2 hours [1,2]. Some studies suggest that race and ethnicity play a role in the risk of VTE [8–10]. Furthermore, Black race has been identified as a predictor of increased mortality and overall complications following hip and knee arthroplasty [11]. However, despite this association between Black race and the risk of VTE, as well as major complications following total joint arthroplasty, race is not included as a risk factor in many studies of VTE after total joint arthroplasty. The purpose of this study is to

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**Table 1**  
Patient Characteristics by Race.

Characteristic	American Indian/Alaska Native/ Native Hawaiian/Pacific Islander (n = 892)	Asian (n = 2319)	Black/African (n = 7420)	White (n = 85,599)	P Value
<b>Demographic</b>					
Age, mean (SD)	63.8 ± 9.83	69.6 ± 9.1	63.0 ± 10.0	66.9 ± 9.8	<.0001
Female gender (%)	57.06	67.7	73	61.6	<.0001
<b>Preoperative health and comorbidities</b>					
BMI (kg/m <sup>2</sup> ), mean (SD)	33.7 ± 6.6	29.1 ± 5.5	35.5 ± 7.9	32.9 ± 7.0	<.0001
Recent weight loss (%)	0.00	0.1	0.2	0.2	.688
Diabetes mellitus (%)	22.53	28.1	25.4	16.6	<.0001
Smoking (%)	14.01	3.3	14.6	8.2	<.0001
Alcohol (%)	2.04	0.5	1	2.4	.0027
Chronic obstructive pulmonary disease (%)	2.8	1.6	3.7	3.7	<.0001
Coronary artery disease (MI or CHF) (%)	0.34	0.3	0.4	0.2	.0396
Peripheral vascular disease (%)	0.00	0	0.8	0.5	.7159
Hx of TIA (%)	3.1	1	3.0	2.6	.4489
Dialysis (%)	0.11	0.3	0.5	0.1	<.0001
Steroids (%)	4.82	3.1	4.4	3.4	<.0001
Bleeding disorder (%)	2.02	2.7	1.9	2.7	.0005
Preoperative blood transfusion (%)	0.11	0.2	0.1	0.1	.031
Open wound or wound infection (%)	0.0	0.0	0.0	0.0	
Radiation therapy (%)	0.00	0	0.0	0.04	1
Chemotherapy (%)	0.00	0	0.6	0.2	.0676
Other recent operation (%)	0.00	2.1	0.3	0.3	.0086
Preoperative sepsis (%)	0.00	0.0	0.0	0.0	
<b>Preoperative laboratory values</b>					
WBC, mean (SD)	7.1 ± 1.9	6.9 ± 2.1	6.6 ± 2.3	7.1 ± 2.1	<.0001
Hematocrit, mean (SD)	40.4 ± 4.2	39.6 ± 4.1	38.7 ± 4.02	40.8 ± 4.01	<.0001
Platelets, mean (SD)	256.7 ± 76.8	244.6 ± 66.5	253.2 ± 68.9	243.1 ± 66.2	<.0001
Creatinine, mean (SD)	0.9 ± 0.5	0.9 ± 0.7	0.9 ± 0.6	0.9 ± 0.4	<.0001
Serum albumin, mean (SD)	4.1 ± 0.4	4.2 ± 0.3	4.0 ± 0.4	4.1 ± 0.4	<.0001
INR, mean (SD)	1.0 ± 0.1	1.0 ± 0.3	1.0 ± 0.2	1.0 ± 0.3	.0437
<b>Operative variables</b>					
<b>Wound class</b>					
Clean	100	100	100	100	
Clean-contaminated	0.00	0	0	0.0	
Contaminated	0.00	0	0	0.0	
Dirty or infected	0.00	0	0	0.0	
<b>ASA class (%)</b>					
1 - no disturbance	2.13	1.5	1	1.8	<.0001
2 - mild disturbance	42.94	58.8	41.4	50.8	
3 - severe disturbance	53.25	39.1	55.2	45.7	
4 - life threatening disturbance/5	1.68	0.6	2.4	1.6	
Length of operation, mean (SD)	101.4 ± 41.65	94.4 ± 37.1	103.7 ± 42.5	95.0 ± 38.9	<.0001
Length of stay, mean (SD)	3.4 ± 1.5	3.2 ± 1.9	3.3 ± 2.6	3.1 ± 2.3	<.0001

MI, myocardial infarction; CHF, congestive heart failure; Hx of TIA, history of transient ischemic attack; WBC, white blood cell; INR, international normalized ratio; SD, standard deviation.

evaluate differences in the rate of VTE depending on patient race while controlling for confounding demographics and comorbidities using a large multicenter database.

## Materials and Methods

### Data Collection

The American College of Surgeons National Surgical Quality Improvement Program (ACS NSQIP) database was queried using Current Procedural Terminology code 27447 (arthroplasty, knee, condyle, and plateau; medial and lateral compartments with or without patellar resurfacing) to identify all patients who had undergone primary TKA between 2010 and 2014. The ACS NSQIP database contains data from over 680 hospitals across the United States. The details of the ACS NSQIP data collection methods have been previously described and use of the NSQIP database has been adopted across orthopedic research [12–19]. Briefly, trained data abstracters, termed surgical clinical reviewers, prospectively collect preoperative and 30-day postoperative morbidity and mortality data at each of the participating institutions, including both academic and private institutions [20]. Internal auditing

mechanisms ensure high-quality data with an overall disagreement rate of <1.8% [14,21].

### Outcomes

Morbidity and mortality data collected for the ACS NSQIP database are strictly defined and collected for 30 days post-operatively. A complete list of complications is provided within the ACS NSQIP data user guide [14]. Individual 30-day mortality and complication rates following primary TKA were calculated and categorized for statistical analysis. The composite category “total complications” included mortality and all individual complications as well as pneumonia, unplanned intubation, DVT, PE, renal insufficiency, acute renal failure, urinary tract infection, stroke, peripheral nerve injury, cardiac arrest, myocardial infarction, blood transfusions (administration of any packed or whole blood cell product up to 72 hours post-operatively), sepsis, septic shock, and reoperation. A single patient could potentially suffer multiple individual complications within a composite category, but was counted only once for the composite calculation. The composite category “VTE” included DVT and PE.

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