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Risk of Ischemic Stroke After Perioperative Atrial Fibrillation in Total Knee and Hip Arthroplasty Patients

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ABSTRACT

Background: To determine if new-onset perioperative atrial fibrillation during arthroplasty represents a benign response to intraoperative cardiac stress or is a risk factor for stroke, we evaluated the subsequent risk of ischemic stroke in patients with new-onset atrial fibrillation occurring during primary total knee arthroplasty (TKA) and total hip arthroplasty (THA).

Methods: Discharge data of all adult patients undergoing primary TKA or THA from 1997 to 2013 were queried via the New York Statewide Planning and Research Cooperative System database to find patients with new-onset perioperative atrial fibrillation. These patients were then followed up over time to determine their risk of ischemic stroke.

Results: Of the 312,636 TKA and 215,610 THA unique patient admissions, 3646 (0.7%) had a diagnosis of new-onset perioperative atrial fibrillation. The cohort of patients with this finding was 58.9% female with an average age of 73.6 years and higher prevalence of vascular risk factors. Adjusting for validated stroke risk factors, the risk of ischemic stroke within 1 year after THA or TKA in patients with new-onset atrial fibrillation was 2.7 times higher than in those without a history of atrial fibrillation (odds ratio: 2.7, 95% confidence interval: 1.5–4.8). Hospital length of stay and charges for patients with new-onset atrial fibrillation were also greater than patients with either a prior diagnosis or no diagnosis of atrial fibrillation.

Conclusion: New-onset atrial fibrillation during TKA and THA may indicate risk of ischemic stroke following surgery that should warrant medical follow-up and may increase hospital length of stay and charges.

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Atrial fibrillation is among the most common perioperative cardiac arrhythmias encountered during orthopedic surgery [1,2]. As a result, it has been a well-studied cause of perioperative morbidity, increased length of inpatient stay, and worse post-operative outcomes following orthopedic procedures [3–5]. Prior work has focused primarily on patients who have pre-existing diagnoses of atrial fibrillation and/or does not distinguish new onset from chronic atrial fibrillation [6].

New-onset perioperative atrial fibrillation occasionally arises for the first time during or shortly after an operation in a patient

without a known history of this cardiac arrhythmia [7,8]. Traditionally, new-onset perioperative atrial fibrillation was considered distinct from chronic atrial fibrillation because it was thought to arise from stress on cardiac muscle during large volume shifts and cardiac stress during surgery. Thus, perioperative atrial fibrillation was hypothesized to not confer the same high risk of ischemic stroke compared with chronic atrial fibrillation. However, recent publications have shown that new-onset perioperative atrial fibrillation is also associated with increased long-term risk of stroke after surgery [7]. At this time, no work has specifically focused on the risk of ischemic stroke after new-onset atrial fibrillation that occurs specifically during orthopedic surgery.

Understanding the effects of new-onset atrial fibrillation compared with chronic atrial fibrillation has particular significance in the recent movement toward improved cost-effectiveness and health care value in arthroplasty. Indeed, a prior diagnosis of atrial fibrillation is a preoperative predictor for more complications

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postoperatively. However, studies in the orthopedic literature do not distinguish new-onset atrial fibrillation occurring in the perioperative period from a long-standing, known history of atrial fibrillation [4,6]. For this reason, we evaluated whether new-onset atrial fibrillation occurring during arthroplasty procedures is associated with an increased risk of postoperative ischemic stroke, as well as perioperative cost and length of stay.

Methods

Data

Administrative discharge data of all adult patients undergoing orthopedic surgery or having an ischemic stroke between January 1, 1997 and December 31, 2014 were queried via the New York Statewide Planning and Research Cooperative System (SPARCS) database. The SPARCS is a repository of patient data which contains a unique linkage number allowing tracking of patient admissions over multiple years and across independent admissions throughout the state of New York. Discharge and admission diagnoses are coded using the International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM), and these diagnoses are also associated with a label that indicates whether they were present before the hospitalization or were new onset on that hospitalization. Review of this data was granted an exemption from the institutional review board.

Patients

We included all adult patients (>18 years old) who underwent an orthopedic surgery (designated by federal major diagnostic category code of 8) with discharge dates between January 1, 1997 and December 31, 2013. This allowed for a minimum of 1-year follow-up, as the latest available data were for December 31, 2014. We then further searched this subset for patients undergoing an index surgery of primary total knee arthroplasty or total hip arthroplasty, designated by the ICD-9-CM procedure codes 81.54 and 81.51, respectively.

New-onset perioperative atrial fibrillation was defined as patients having an ICD-9-CM code of 427.3x in any diagnosis position and a variable in the SPARCS data set that indicated that this atrial fibrillation was not present on admission. This “present on admission indicator” was used to find cases of atrial fibrillation which were new onset and not resulting from a prior diagnosis. To further check that this cohort did not have a history of atrial fibrillation, this cohort was then searched retrospectively for the ICD-9-CM code of 427.3x for any previous admissions to ensure no prior history of atrial fibrillation [7,9,10].

Measurements

The predictor variable was new-onset perioperative atrial fibrillation. In addition to identifying these patients by the ICD-9-CM code for atrial fibrillation and the new-onset designator, we confirmed that this was a new atrial fibrillation diagnosis by excluding patients with an atrial fibrillation diagnosis recorded during prior inpatient visits.

The primary outcome variable was ischemic stroke designated by ICD-9-CM codes 433.x1, 434.x1, or 436 in the listed discharge diagnoses. These codes have been previously evaluated for their sensitivity and specificity [11]. We also calculated the CHA2DS2-VASC score for patients as an indicator for their baseline risk of ischemic stroke. The CHA2DS2-VASC score is a commonly used clinical prediction scoring system that has been extensively validated as a predictor for stroke [12–15]. Its calculation consists of addition of the following point per risk factor: congestive heart failure (1 point), hypertension (1 point),

age (2 points if greater than or equal to 75 years, 1 point if between 65 and 74 years), diabetes mellitus (1 point), prior stroke or transient ischemic attack (2 points), vascular disease (1 point), and female gender (1 point) [12,16]. The score was calculated using the diagnoses codes identified for subjects in the SPARCS database.

Statistics

Rates were reported in crude form using descriptive statistics, and cumulative rates were calculated with Kaplan-Meier survival statistics. In building the Kaplan-Meier curve, the time to stroke for each patient was calculated as the number of days from the discharge date of the first arthroplasty hospitalization to the admission date for an inpatient stroke admission. Patients not having a subsequent stroke were censored at time of death if this occurred during an inpatient hospital admission or on December 31, 2014, the latest discharge date in the data. The Wilcoxon rank-sum test was used to calculate *P* values comparing the length of stay and total charges for patients with and without a history of atrial fibrillation. A logistic regression model was used to determine the risk of ischemic stroke within 1 year after total hip arthroplasty (THA) or total knee arthroplasty (TKA) in patients with new-onset atrial fibrillation while adjusting for accepted risk factors for stroke using the CHA2DS2-VASC score. Statistical analysis and data handling were all performed using SAS Software, version 9.4 (SAS Institute, Inc., Cary, NC).

Results

There were 312,636 TKA admissions and 215,610 THA unique patient admissions between 1997 and 2013 with a mean tracking time in the data set of 7.8 ± 5.1 years. Mean age of the overall cohort was 65.9 ± 11.5 years. Most admissions were for female patients (61.3%). The mean length of stay was 4.3 ± 3.1 days.

During these admissions, 3646 (0.7%) had a diagnosis of new-onset perioperative atrial fibrillation and 25,016 (4.7%) admissions had a diagnosis of prior atrial fibrillation. The proportion of females with new-onset perioperative atrial fibrillation was 58.9% compared with 62.0% in the group without atrial fibrillation. Patients with new-onset atrial fibrillation were older and carried more vascular risk factors as compared with patients without any history of atrial fibrillation (Table 1). In particular, patients with

Table 1
Demographic Characteristics of Orthopedic Surgery Patients With New-Onset Perioperative Atrial Fibrillation and No History of Atrial Fibrillation.

	Perioperative Atrial Fibrillation		<i>P</i> Value
	Yes (n = 3646)	No (n = 499,854)	
Age, mean (SD), y	73.6 (9.1)	65.4 (11.4)	<.0001
Female gender	2146 (58.9%)	309,717 (62.0%)	.005
Male gender	1500 (41.1%)	190,137 (38.0%)	
Race/ethnicity			
White	3104 (85.1%)	390,212 (78.1%)	<.0001
Black	144 (4.0%)	42,665 (8.5%)	
Asian	39 (1.1%)	5089 (1.0%)	
Other	232 (6.3%)	38,018 (7.6%)	
Missing	127 (3.5%)	23,870 (4.8%)	
Vascular risk factors			
Hypertension	2129 (58.4%)	276,818 (55.01%)	.0003
Diabetes	637 (17.5%)	78,566 (15.6%)	.0039
Coronary heart disease	723 (19.8%)	51,862 (10.5%)	<.0001
Congestive heart failure	345 (9.5%)	7581 (1.5%)	<.0001
Chronic kidney disease	148 (4.1%)	8667 (1.7%)	<.0001
COPD	235 (6.5%)	20,355 (4.1%)	<.0001
Peripheral vascular disease	87 (2.4%)	5647 (1.1%)	<.0001

P values determined with the *t* test for age and chi-square test for all other variables. SD, standard deviation; COPD, chronic obstructive pulmonary disease.

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