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Postoperative Outcomes Associated With Neuraxial vs General Anesthesia Following Bilateral Total Knee Arthroplasty

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ABSTRACT

Background: There is sparse evidence on the benefit of neuraxial (NA) vs general anesthesia (GA) as the primary anesthetic in postoperative outcomes following bilateral total knee arthroplasty. We sought to elucidate differences in outcomes in this surgical population using a national database.
Methods: We used data from the National Surgical Quality Improvement Program from 2007 to 2013 and compared rates of various postoperative outcomes in propensity-matched cohorts (NA vs GA).
Results: After exclusion, there were 1957 patients included in the final analysis, of which 26% received NA as the primary anesthetic. Propensity-matched cohorts were generated to ensure no differences in various comorbidities (including bleeding disorders or inadequate cessation of anticoagulation therapy), case duration, and patient demographics between both cohorts. Among the matched cohorts, there were no differences in preoperative platelet count, hematocrit, or international normalized ratio. NA was associated with decreased blood transfusion requirement and decreased total number of units of blood products transfused ($P < .0001$ for both outcomes). However, there were no differences in other outcomes, including hospital length of stay, pulmonary embolism, deep vein thrombosis, or urinary tract infections.
Conclusion: Our study demonstrates that in matched cohorts, NA is associated with decreased blood transfusion requirements in patients undergoing bilateral total knee arthroplasty when compared to GA as the primary anesthetic.

Total knee arthroplasty (TKA) is one of the most common orthopedic procedures performed worldwide [1]. In 2012, over 700,000 TKAs were performed in the United States alone and there has since been a consistent increase in the number of primary and revision TKAs [2,3]. Compared to data in 2003, the number of TKAs is expected to increase by 673% by the year 2030 [4].

The benefits of primary anesthesia type—whether a general (GA) or neuraxial anesthetic (NA) technique is performed—for joint arthroplasty are unclear. However, several studies have shown an improvement in various postoperative outcomes, including infection and mortality [5–8]. Simultaneous bilateral total knee arthroplasty (BTKA)—defined as the performance of TKA on bilateral knees during the same surgical encounter—is increasingly being performed [9], but is associated with increased morbidity and mortality as compared to unilateral TKA [10]. Whether or not anesthetic technique plays a role in morbidity and mortality is a worthwhile investigation. There is a lack of recent evidence comparing anesthetic choice with morbidity and mortality in BTKA. Stundner et al [11] studied an administrative database containing discharge information from ~400 acute hospitals and compared outcomes of BTKAs based on primary anesthesia type and

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essentially found that there was no difference in mortality; however, there was a decrease in blood transfusion requirements in the NA group. What was unclear was whether there were any differences between NA and GA groups in terms of baseline comorbidities, anticoagulation therapy status, or laboratory values that would both preclude a neuraxial approach and increase risk of blood transfusion.

Therefore, the primary purpose of this study was to investigate a different national database, National Surgical Quality Improvement Program (NSQIP), and compare preoperative laboratory values—international normalized ratio (INR), platelet count, and hematocrit—and blood transfusion rates in propensity-matched cohorts. A covariate of interest will include bleeding disorders that encompass conditions with blood clotting abnormalities or inadequate cessation of anticoagulation therapy before surgery. Finally, we also investigate rates of other pertinent postoperative outcomes in the matched groups.

Materials and Methods

Data Collection

Data were obtained from the publicly available dataset, American College of Surgeons NSQIP for the years 2007-2013. This is a multicenter, prospective, outcome-oriented database. Because the database is de-identified, it meets the criteria of the Health Insurance Portability and Accountability Act to protect personal information and was exempt from the consent requirement by our institutional review board. This database contains data from >200 participating hospitals for patients who underwent major surgical procedures. NSQIP undergoes a systemic sampling process called the 8-day cycle, which was developed to prevent bias in choosing cases for assessment. All bilateral TKA were identified in the database by presence of primary surgical Common Procedural Terminology code of 27447 with a concurrent procedure with the same code.

In this retrospective cohort study, we explored the rate of various postoperative outcomes following BTKAs and compared 2 cohorts: those who underwent GA vs NA for the operation. Outcomes included occurrence of transfusion of blood products during hospital stay, total units of blood products given during hospital stay, hospital length of stay, superficial surgical site infection, deep surgical site infection, wound dehiscence, pneumonia, unplanned reintubation, pulmonary embolism, deep vein thrombosis, renal injury, and urinary tract infection. Confounding variables included in the analysis were age, body mass index, sex, case duration, smoker (ie, if patient smoked within 1 year of surgical admission), diabetes mellitus, chronic obstructive pulmonary disease, hypertension, chronic steroid use within 30 days of surgery, history of a bleeding disorder, preoperative functional disability (defined as independent or dependent with activities of daily living) and American Society of Anesthesiologists Physical Status classification score. In NSQIP, bleeding disorder is defined as a condition that places a patient at risk of excessive bleeding due to some deficiency of blood clotting elements, including vitamin K deficiency, hemophilia, thrombocytopenia, and chronic anticoagulation therapy that has not been appropriately discontinued before surgery (does not include patients on chronic aspirin therapy). These variables were chosen based on its potential association with postoperative adverse events. For functional status and American Society of Anesthesiologists Physical Status class, an additional category for missing data was included in order to maintain sample size. Cases with missing data for primary anesthesia type, anesthesia type not categorized as GA or NA (epidural, spinal, or combined epidural-spinal), and missing data for body mass index were removed from the analysis (Fig. 1).

Statistical Analysis

R, a software environment for statistical computing (R version 3.3.0), was used to perform all statistical analyses. Pearson chi-square, Wilcoxon rank sum test, and Student *t*-test were used to measure differences in demographic data between both cohorts (ie, GA vs NA). *P* value less than .05 was considered statistically significant. The "MatchIt" package [12] for R statistical software was used for propensity score matching. "MatchIt" improves statistical models by preprocessing data with nonparametric matching methods [13]. A 2:1 (GA:NA) propensity score matching method (using nearest neighbor matching without replacement) was used to create matched cohorts. Propensity score for primary anesthesia type was determined using logistic regression based on all covariates included in this analysis. To determine balance between matched groups, an absolute standardized difference that is less than 0.2 for each variable was considered adequate. Rates of postoperative occurrence of transfusion of blood products during hospital stay, superficial surgical site infection, deep surgical site infection, wound dehiscence, pneumonia, unplanned reintubation, pulmonary embolism, deep vein thrombosis, renal injury, and urinary tract infection were compared in both matched cohorts with chi-square test. The total units of blood products given during hospital stay and hospital length of stay were compared with Welch 2-sample *t*-test. Because we were analyzing 12 outcomes, we chose a $P < .004$ as statistically significant.

Results

There were a total of 2,820,370 cases in NSQIP, of which 81,679 underwent a TKA. From these, a total of 2078 underwent BTKAs during the same surgical encounter. After exclusion, there were 1957 patients included in the final analysis (119 of the original total were removed due to lack of information regarding primary anesthesia type). Table 1 outlines the demographics in both cohorts. Cases performed under GA tended to be longer than those

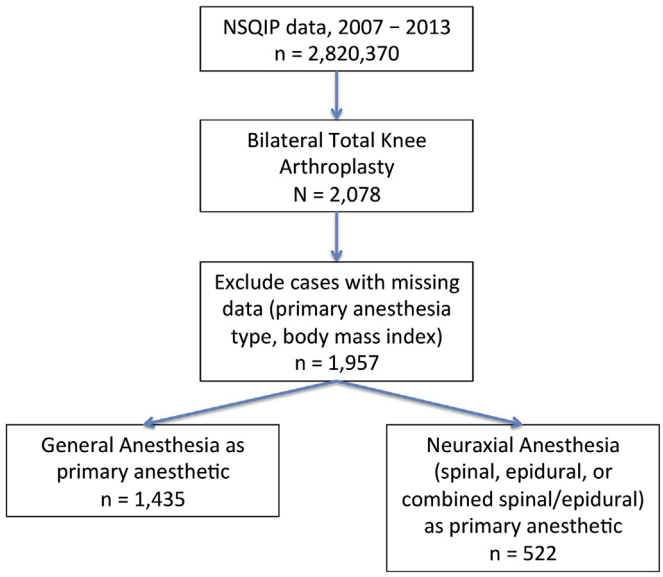

Fig. 1. Flow diagram illustrating methodology of inclusion and exclusion criteria of the study. NSQIP, National Surgical Quality Improvement Program.