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Does Neuraxial Anesthesia Decrease Transfusion Rates Following Total Hip Arthroplasty?

Bryan D. Haughom, MD [a], William W. Schairer, MD [b], Benedict U. Nwachukwu, MD [b], Michael D. Hellman, MD [a], Brett R. Levine, MD, MS [a]

[a] Department of Orthopaedic Surgery, Rush University, Chicago, Illinois
[b] Department of Orthopaedic Surgery, Hospital for Special Surgery, New York, New York

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ABSTRACT

Perioperative transfusions increase complications and cost following THA. Current series evaluating neuraxial anesthesia and blood loss following THA are small and utilize heterogeneous populations. Using the NSQIP database we compared transfusion rates following THA with neuraxial and general anesthesia. Between 2005 and 2012, 28,857 THAs (11,317 neuraxial anesthesia) were identified. Univariate analysis showed lower rates of transfusion, pneumonia, unplanned intubation, prolonged intubation, stroke, all complications, and medical complications in the neuraxial group. Operative time and length of stay were shorter with neuraxial anesthesia as well. After adjusting for patient comorbidities, a multivariate regression model showed fewer transfusions with neuraxial anesthesia. The multivariate regression model showed additional independent risk factors for transfusion including gender, operative time, elevated INR, and a history of hypertension, metastatic cancer, and renal failure.

Total hip arthroplasty (THA) is one of the most common orthopedic procedures performed in the United States, with estimates indicating increasing demand in the coming decades [1,2]. Successful outcomes following primary THA have been demonstrated in both short and long term series [3–6]. However, many risk factors for complications have been identified, including perioperative blood loss and the need for perioperative blood transfusion [7,8]. A number of approaches to mitigate blood loss have been described, including antifibrinolytics, reinfusion drains, bipolar sealants, hypotensive anesthesia, and erythropoietin administration [9–13]. Additionally, there has been interest in evaluating the role of neuraxial versus general anesthesia in minimizing perioperative blood loss and the need for allogenic blood transfusions [14].

Neuraxial anesthesia, including spinal and epidural, has been shown to have variable effects on intraoperative parameters including blood loss and operative time, as well as postoperative mortality and morbidity [14–20]. In a landmark meta-analysis, Rodgers et al [19] demonstrated that neuraxial anesthesia had widespread benefit when compared to general anesthesia, particularly in the setting of orthopedic surgery. They showed neuraxial anesthesia to reduce the need for significant (two or more units) blood transfusion following surgery. Further analyses have evaluated the influence of neuraxial anesthesia on blood loss in orthopedic surgery. In the setting of primary THA, several meta-analyses have shown neuraxial anesthesia to have variable effects on intraoperative and postoperative blood loss as well as postoperative transfusion rates [14,16–18].

Although rising evidence demonstrates the deleterious effects of blood transfusions following elective hip arthroplasty, little literature has fully evaluated the impact of anesthetic techniques in mitigating the need for postoperative blood transfusion. Current studies in the literature evaluating the impact of neuraxial anesthesia on blood loss parameters, and specifically the need for blood transfusions following THA, are heterogeneous and include smaller patient cohorts.

The current literature available includes not only heterogeneous anesthetic techniques (e.g. spinal, epidural, and regional) but heterogeneous surgical procedures as well (e.g. hip and knee arthroplasty). Furthermore, current studies are relatively small in size. The purpose of this study was to determine the impact of neuraxial anesthesia on postoperative blood transfusion following primary THA by using a large national database (American College of Surgeons National Surgical Quality Improvement Database; NSQIP). Our aim was to determine the independent risk factors for transfusion following primary THA.

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Reprint requests: Bryan D. Haughom, MD, Department of Orthopaedic Surgery, Rush University, 1611 W. Harrison Blvd, Suite 200, Chicago, IL 60612.

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Methods

Data Source

The NSQIP is a prospectively collected clinical database maintained by the American College of Surgeons [21]. Information regarding clinical and outcomes data is gathered from over 400 hospitals as of 2012. A specially trained clinical reviewer prospectively collects information from the medical chart regarding any complication, readmission, or re-operation [22,23]. The database holds information about patient demographics, preoperative medical comorbidities, surgical details, and preoperative laboratory results. This dataset has been used to assess post-surgical outcomes and to improve quality of care [24,25]. Data collection continues postoperatively for 30 days, regardless of whether the patient has been discharged.

Patient Selection

All primary THAs in the NSQIP dataset, between 2005 and 2012, were identified by Current Procedural Terminology codes (CPT code: 27130). In order to ensure only primary THAs were included in our analysis, patients with a primary diagnosis code of malignancy, mechanical complication, fracture, or infection were excluded from our analysis. Additionally, patients with a wound classification other than 'clean' were excluded as this was deemed a miscoded variable in the setting of a primary THA. Patients were grouped by whether they received general anesthesia ($n = 17{,}540$) or neuraxial anesthesia ($n = 11{,}317$); patients with an anesthesia type that was not coded or ambiguously coded (i.e. "other", "local") were excluded. Neuraxial anesthesia included patients with either spinal or epidural anesthesia. Of note, the NSQIP dataset only documents the highest level of anesthesia, and thus patients who received a combined spinal and epidural anesthesia would be coded as spinal anesthesia.

Outcomes

NSQIP operative and postoperative outcomes are identified from individual patient medical records as opposed to insurance claims [26]. We divided thirty-day postoperative outcome variables into surgical and medical complications. Surgical complications included surgical site infection, wound dehiscence, and reoperation, while medical complications included pneumonia, unplanned intubation, deep vein thrombosis (DVT), pulmonary embolism (PE), ventilation over 48 hours, renal insufficiency, acute renal failure, urinary tract infection (UTI), coma, stroke, peripheral neurological deficit, cardiac arrest, myocardial infarction, sepsis, death, and unplanned hospital readmission.

Statistical Analysis

The NSQIP database is non-randomized observational cohort. To control for potential selection bias associated with the decision of neuraxial versus general anesthesia, we utilized a propensity score analysis. This analysis defines the conditional probability of receiving neuraxial versus general anesthesia, and is calculated using preoperative variables including gender, race, body mass index (BMI), laboratory values, preoperative medical comorbidities, and operative variables such as American Society of Anesthesiologist (ASA) classification. Of note, preoperative albumin values were excluded from the propensity score as it was incompletely recorded (52.1% missing; $n = 16{,}121$). Propensity scores give adjusted estimates in the presence of confounding variables, effectively creating a randomized controlled study in the ideal situation in which all observed covariates are controlled [27]. Three different methods of adjustment are described when using propensity score analyses—matching, covariate regression, and stratification adjustment [28]. Our study utilized covariate regression to adjust for bias that may have affected the decision to perform neuraxial versus general anesthesia.

Comparisons were done using t-tests and chi-squared tests for continuous and categorical variables, respectively. Preoperative medical comorbidities, laboratory values, and demographic information are presented with unadjusted and propensity score adjusted *P*-values (Table 1). Operative time and post-operative transfusion and complication rates were compared using a similar univariate analysis (Table 2).

To assess for independent risk factors for receiving a post-operative blood transfusion, we created a multivariable logistic regression model. Potential variables for the model were the pre-operatively observed variables in Table 1; operative time was also included as it was hypothesized *a priori* that longer operative time would be associated with increased risk of blood transfusion. These variables were tested independently against association with blood transfusion; those variables with a *P*-value less than 0.1 were selected for initial inclusion in the model. With these initially selected variables, a backward stepwise multivariate regression was performed, iteratively removing variables from the model with a *P*-value greater than 0.05. This created a multivariate

Table 1
Preoperative Demographic, Medical Comorbidities, and Laboratory Values.

	Neuraxial Anesthesia	General Anesthesia	*P*-Value	Adjusted *P*-Value
Number	11317.00	17540.00	–	–
Age (years)	65.91	64.48	<0.001	0.932
Female	0.56	0.55	0.170	0.996
ASA class	2.35	2.41	<0.001	0.911
BMI (kg/m^2)	29.68	30.19	<0.001	0.973
Race—White	72.99%	83.41%	<0.001	0.696
Race—Black	4.83%	6.86%	<0.001	0.946
Race—Asian	1.71%	1.20%	<0.001	0.989
Race—other	20.47%	8.53%	<0.001	0.612
Congestive heart failure	0.25%	0.37%	0.073	0.965
Myocardial infarction	0.05%	0.05%	0.780	0.999
History of cardiac surgery	1.91%	2.06%	0.358	0.968
PCI	2.69%	2.46%	0.240	0.984
Angina	0.17%	0.18%	0.774	0.956
COPD	4.25%	3.89%	0.133	0.994
Renal failure	0.03%	0.09%	0.064	0.991
Alcohol use	1.60%	1.66%	0.696	0.993
Peripheral vascular disease	0.37%	0.36%	0.932	0.986
Dialysis	0.14%	0.24%	0.073	0.652
CVA with deficits	0.30%	0.58%	0.001	0.927
CVA no deficits	0.67%	0.77%	0.340	0.964
Paraplegia	0.12%	0.13%	0.863	0.988
Hemiplegia	0.09%	0.18%	0.056	0.965
Quadraplegia	0.00%	0.00%	-	-
Chemotherapy	0.11%	0.10%	0.757	0.981
Metastatic cancer	0.21%	0.29%	0.202	0.988
Steroid use	2.83%	3.32%	0.020	0.938
Weight loss (>10%)	0.28%	0.36%	0.238	0.968
Bleeding disorder	1.77%	3.01%	<0.001	0.628
Recent operation	0.07%	0.13%	0.165	0.988
DM	11.14%	11.40%	0.496	0.995
Hypertension	57.73%	57.84%	0.851	1.000
TIA	1.98%	2.11%	0.447	0.950
Smoking	12.20%	14.40%	<0.001	0.938
DM—ion-insulin	8.87%	8.55%	0.338	0.989
DM—insulin	2.27%	2.86%	0.002	0.971
Functionally independent	96.94%	96.06%	<0.001	0.961
Inpatient	99.63%	98.88%	<0.001	0.892
Resident	27.42%	28.25%	0.295	0.897
Preoperative creatinine	0.92	0.93	0.019	0.754
Preoperative albumin	4.15	4.12	<0.001	0.000
Preoperative WBC	7.02	7.07	0.030	0.946
Preoperative HCT	40.64	40.26	<0.001	0.886
Preoperative platelet count	247.03	250.37	<0.001	0.230
Preoperative INR	1.03	1.04	0.264	0.961
Preoperative BUN	18.30	18.04	0.010	0.979

ASA: American Society of Anesthesiologists; BMI: body mass index; PCI: percutaneous coronary intervention; COPD: chronic obstructive pulmonary disease; CVA: cerebral vascular accident; DM: diabetes mellitus; TIA: transient ischemic attack; WBC: white blood cell count; HCT: hematrocrit; INR: international normalized ratio; BUN: blood urea nitrogen.