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Original Contribution

Postoperative outcomes with neuraxial versus general anesthesia in bilateral total hip arthroplasty

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ABSTRACT

Study objective: Current evidence remains limited on the postoperative outcomes of neuraxial (NA) versus general anesthesia (GA) as primary anesthesia type in patients receiving simultaneous bilateral total hip arthroplasty (BTHA). We aimed to evaluate the rates of postoperative outcomes among patients receiving NA versus GA for BTHA.

Design: Retrospective cohort study.

Setting: Multi-institutional.

Patients: A total of 798 patients undergoing BTHA with 519 and 279 who received GA and NA, respectively. We used the American College of Surgeons – National Surgical Quality Improvement Program database for years 2007 to 2016.

Interventions: Patients undergoing BTHA.

Measurements: We propensity-score matched on demographic factors and comorbid conditions to compare rates of postoperative outcomes among cohorts (NA versus GA). We performed Pearson chi-square and Wilcoxon rank sum test to compare NA versus GA cohorts.

Main results: The final analysis included 798 BTHA patients, of which 35% received NA as the primary anesthetic. The median age was 58 years old and 50.8% were female. The rate of perioperative transfusion in the NA and GA group were 20.1% and 29.0%, respectively ($p = 0.02$). There were no significant differences in the rate of postoperative outcomes between patients receiving NA versus GA as their primary anesthesia type (Bonferroni corrected $p < 0.006$ was considered statistically significant).

Conclusion: Our study showed no significant differences in postoperative outcomes between NA versus GA following BTHA. Further studies are needed to investigate outcomes among this surgical population.

1. Introduction

Total hip arthroplasty (THA) is one of the most commonly performed orthopedic procedures in the United States. Demand for THA is projected to increase to over 500,000 procedures annually by 2030, an increase of 174% compared to 2003 data [1]. From a patient perspective, THA consistently demonstrates long-term, significant improvements in quality of life and physical functioning [2,3]. As the number of arthroplasties performed increases, optimizing key aspects of the procedure, such as anesthesia type, may help ensure patient satisfaction and potentially decrease morbidity and mortality rates.

The effect of anesthesia type – neuraxial (NA) vs general anesthesia (GA) – has previously been examined in studies among different orthopedic procedures, the majority of which have demonstrated a reduction in morbidity and mortality with NA [4–9]. However, a comparison of anesthesia type has not been thoroughly examined in simultaneous bilateral total hip arthroplasty (BTHA) – defined as having a THA performed bilaterally during a single-stage operation. BTHA is associated with increased perioperative morbidity compared to unilateral THA, including an increased risk of pulmonary complications and postoperative transfusion requirements [10–12]. The probability of contralateral THA following an index THA is estimated to be between 22 and 33% [13,14]. For those patients that have end stage arthritis of both hips and have failed conservative treatment for both hips,

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simultaneous BTHA may be more cost effective for those that have been medically cleared for the procedure compared to staged BTHA. Simultaneous BTHA is associated with decreased length of hospital stay and costs, along with earlier return to function when compared to two-stage BTHA [15–19]. Given the unique risks and benefits of BTHA, understanding the effect of anesthesia technique may improve post-surgical outcomes. This study aimed to compare morbidity rates following simultaneous BTHA for NA versus GA using a national database, the American College of Surgeons – National Surgical Quality Improvement Program (ACS NSQIP).

2. Methods and methods

2.1. Data collection

In this retrospective population-based study, we used ACS NSQIP, which contains multi-center surgical data from over 600 participating hospitals [20]. NSQIP is de-identified, protects personal information, and was therefore exempt from the consent requirement by our Institutional Review Board. The study population was defined as patients ≥18 years of age who underwent BTHA from 2007 to 2016. We extracted BTHA cases defined by the primary surgical Current Procedural Terminology (CPT) code of 27130 with a concurrent procedure with the same code. BTHA was performed by the same surgical team and under the same primary anesthetic.

We examined the rate of several postoperative outcomes following BTHA among anesthesia type cohorts. Here, we defined primary anesthesia type as NA (epidural, spinal, monitored anesthesia care, and regional) versus GA. NSQIP recorded primary anesthesia as epidural, monitored anesthesia care/intravenous sedation, regional, or spinal. Per NSQIP, patients were assigned GA if they received GA and other forms of anesthesia. Monitored anesthesia care/intravenous sedation was assigned if the patient received monitored anesthesia care/intravenous sedation and other forms of anesthesia. Regional anesthesia was defined as any of the following: spinal, epidural, or peripheral nerve block. Demographic and comorbid condition data included: body mass index (BMI) expressed in units of kg/m^2, age (years), gender, active smoking (cigarette smoking in the year prior to admission for surgery), American Society of Anesthesiologists (ASA) Physical Status class, functional status, in which patients were functionally independent (does not require assistance for activities daily living) or dependent (requires some or total assistance for activities of daily living), congestive heart failure, acute renal injury, dialysis, disseminated cancer, red blood cell transfusion, clean/contaminated wound, chronic obstructive pulmonary disease (COPD), no dyspnea (no shortness of breath preoperatively), diabetes mellitus, chronic steroid use, hypertension, bleeding disorder, and case duration (hours). Clinical significance guided our choice of preoperative factors.

Thirty-day postoperative outcomes were categorized into one of the following: 1) hospital length of stay, defined as the number of days from hospital admission to discharge, 2) pulmonary complications (pneumonia, unplanned reintubation, and pulmonary embolism), 3) sepsis, 4) urinary tract infection (UTI), 5) myocardial infarction, 6) infection (superficial incisional surgical site infection, wound infection, organ space surgical site infection), 7) perioperative red blood cell transfusion (defined as at least one unit of packed or whole red blood cell given anytime between start of surgery and up to 72 h postoperatively), and 8) reoperation. NSQIP Participant Use Data File provides definitions of all variables included in the analysis [21]. Outcomes were selected based on clinical significance and literature evidence suggesting an association with hip surgery outcomes [22,23]. Of the total sample size, we excluded 19 (2.3%) cases with missing data. Fig. 1 outlines the inclusion and exclusion criteria.

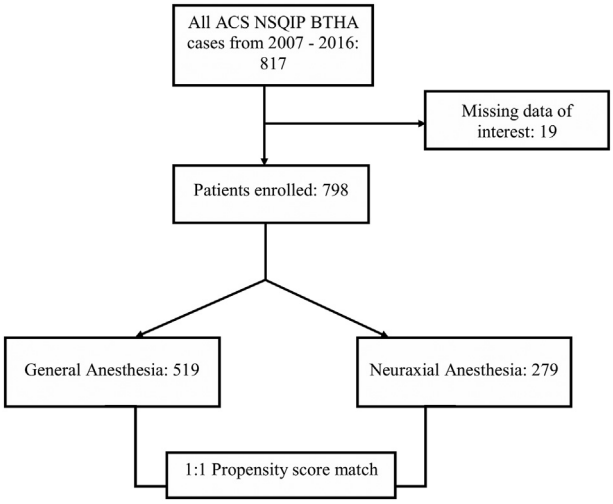

Fig. 1. Flowchart of patients included in the final analysis. Abbreviations: ACS NSQIP = American College of Surgeons National Surgical Quality Improvement Program, BTHA = bilateral total hip arthroplasty.

2.2. Statistical analysis

Statistical analysis was performed using R, a software environment for statistical computing (R version 3.5.1). We used Pearson-chi square and Wilcoxon rank sum test to evaluate differences in demographic and comorbidity data between NA versus GA cohorts. p value < 0.05 was considered statistically significant. The propensity-score matching of NA versus GA cohorts was done with an R package, MATCHIT. MATCHIT preprocesses data with semi-parametric and non-parametric matching methods, thereby reducing model dependence and improving parametric statistical models [24]. To create matched cohorts, we used a 1:1 (GA:NA) propensity score-matching method with nearest neighbor without replacement. Logistic regression was used to calculate the propensity score for anesthesia type cohorts based on age, BMI, gender, case duration, active smoking, diabetes mellitus, COPD, hypertension, bleeding disorder, chronic steroid use, and ASA class. We defined adequate matching as an absolute mean standardized difference (SMD) of ≤ 0.2 for each potential confounder. We then performed Pearson chi-square and Wilcoxon rank sum test to compare the rate of postoperative outcomes among anesthesia type cohorts. Because we are analyzing eight outcomes among propensity-score matched cohorts, we chose a $p < 0.006$ as statistically significant.

3. Results

There were 817 BTHA cases identified from NSQIP. After excluding 2.3% of cases with missing data, the final analysis included 798 patients, of which 279 (35%) received NA. Table 1 outlines the demographics and perioperative factors of each cohort. The median (interquartile range [IQR]) age was 58 years old (52, 65 years old), and a BMI $\geq 30\ kg/m^2$ comprised 46.1% of our study population. The majority (69.7%) of patients had an ASA score ≤ 2. The median (IQR) case duration was 2.64 h (1.99, 3.28 h). Table 2 illustrates the differences in patient characteristics between NA versus GA cohorts before propensity-score matching. Patients with NA versus GA were older (60 versus 57 years old, $p = 0.003$), less likely to have dependent functional status (0.0% versus 2.5%, $p = 0.018$), and had shorter surgical case durations (2.32 versus 2.80 h, $p < 0.001$). There were no significant differences in rates of all other comorbid conditions between cohorts (all $p > 0.05$). Fig. 2 shows the proportion of BTHA cases receiving NA versus GA. The odds of NA versus GA increased significantly per year (OR 1.11, 95% CI: 1.02–1.22, $p = 0.022$).

Table 3 shows the characteristics of the propensity-score matched