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Clinical Practice

Effect of anaesthesia type on postoperative mortality and morbidities: a matched analysis of the NSQIP database

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Abstract

Background. The anaesthetic technique may influence clinical outcomes, but inherent confounding and small effect sizes makes this challenging to study. We hypothesized that regional anaesthesia (RA) is associated with higher survival and fewer postoperative organ dysfunctions when compared with general anaesthesia (GA).

Methods. We matched surgical procedures and type of anaesthesia using the US National Surgical Quality Improvement database, in which 264,421 received GA and 64,119 received RA. Procedures were matched according to Current Procedural Terminology (CPT) and ASA physical status classification. Our primary outcome was 30-day postoperative mortality and secondary outcomes were hospital length of stay, and postoperative organ system dysfunction. After matching, multiple regression analysis was used to examine associations between anaesthetic type and outcomes, adjusting for covariates.

Results. After matching and adjusting for covariates, type of anaesthesia did not significantly impact 30-day mortality. RA was significantly associated with increased likelihood of early discharge (HR 1.09; $P < 0.001$), 47% lower odds of intraoperative complications, and 24% lower odds of respiratory complications. RA was also associated with 16% lower odds of developing deep vein thrombosis and 15% lower odds of developing any one postoperative complication (OR 0.85; $P < 0.001$). There was no evidence of an effect of anaesthesia technique on postoperative MI, stroke, renal complications, pulmonary embolism or peripheral nerve injury.

Conclusions. After adjusting for clinical and patient characteristic confounders, RA was associated with significantly lower odds of several postoperative complications, decreased hospital length of stay, but not mortality when compared with GA.

Key words: general anaesthesia; patient outcome; regional anaesthesia; registry

General and regional anaesthesia are the two major types of anaesthetic techniques used to provide safe and effective surgical conditions. While many, though not all, surgical procedures can be performed under either technique, general anaesthesia (GA) has been the default anaesthetic technique for most, because of a lack of expertise in regional techniques among some anaesthesia providers, or as a result of surgeon preference.[1] While GA produces unconsciousness, its global effect on the central nervous system also produces haemodynamic and metabolic perturbations that are more pronounced when compared with regional anaesthesia (RA).[2] Recent advances in anaesthetic pharmacology and monitoring, along with a better understanding of pathological states has resulted in significantly decreased

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Editor's Key Points

- Regional anaesthesia offers several benefits and can avoid risks of general anaesthesia
- Nonrandomized comparisons of such groups must account for selection bias and confounding, and this requires very large datasets
- This study identified some benefits, including reduced respiratory complications and hospital stay
- Regional anaesthesia was not associated with reduced 30-day mortality

overall mortality and morbidity after GA,[3 4] yet complications do occur and may be related to the anaesthetic technique utilized. Moreover, the impact of anaesthesia management could have longer term effects on overall outcome than what we currently attribute to it.[5]

The effect of anaesthesia type on overall patient outcome has been the interest of numerous studies.[6–10] The majority of these studies have focused on specific surgical procedures and/or groups of patients (e.g. vascular[11] or orthopaedic surgery[12]) and have yielded inconsistent results. There is uncertainty as to whether RA has favourable outcomes compared with GA in a broad range of surgical patients.[13] The remarkably low number of anaesthesia-related deaths in the USA, estimated at only 8.2/million hospital surgical discharges,[3] limits our ability to compare the outcomes of these two techniques in randomized trials. The dearth of large representative samples, confounding, and the small effects have made this a challenging question to answer. We utilized the large American College of Surgeons National Surgical Quality Improvement (ACS-NSQIP) database to test our hypothesis that RA may be associated with higher survival and fewer postoperative organ dysfunctions when compared with GA, after adjustment for clinical and patient characteristicconfounders.

Methods

Data source

The Institutional Review Board at Vanderbilt University Medical Centre approved this study. We accessed unidentified pooled data from the ACS-NSQIP (2005-2011) database, which collects over 250 patient variables for surgeries from over 300 participating community and academic medical centres across the USA. Data are collected and entered by trained professionals to ensure accuracy and reliability. The ACP-NSQIP database includes patient characteristics, major perioperative risk factors, comorbidities, procedure type and duration, anaesthesia type, postoperative complications including organ dysfunctions and 30-day mortality, and hospital length of stay. As we used unidentified retrospective patient data, consent was deemed unnecessary and was not obtained.

Study population

Anaesthesia types reported in the ACP-NSQIP database as epidural, spinal, or peripheral nerve block anaesthesia were all considered as part of the RA group. Anaesthetics in which a regional technique may have been used in combination with a general anaesthesia, were classified as a general anaesthetic (primary anaesthetic) for the purpose of this study. Patients who received a regional anaesthetic were matched to those who received a general anaesthetic according to Current Procedural Terminology (CPT) code and ASA physical status. This had the effect of excluding those CPT codes and ASA physical status combinations for which there were no regional anaesthetic matches; thus our cohort comprised of matched patients undergoing procedures where both types of anaesthetic options were considered appropriate. In addition, patients in the RA group who could not be matched were excluded from analysis.

Outcomes of interest

The primary outcome was 30-day postoperative mortality. Secondary outcomes were hospital length of stay (LOS) and the occurrence of the following postoperative organ dysfunctions: respiratory complications (pneumonia, reintubation or respiratory failure requiring mechanical ventilation for more than 48 h), myocardial infarction (MI), renal complications (progressive renal insufficiency as defined by an increase in serum creatinine by $>2.0\,mg\,dl^{-1}$ above baseline value, or new onset renal failure requiring renal replacement therapy), deep venous thrombosis (DVT), pulmonary embolism, stroke, peripheral nerve injury (PNI) and major intraoperative complications (death and/or cardiac arrest).

Statistical analysis

As mechanically ventilated patients and procedures lasting more than four h are more likely to receive GA, those procedures were excluded before matching, Figure 1. To reduce selection bias caused by procedure type and the overall severity of comorbid illness, patients in the RA group were matched to patients in the GA group in a ratio of 1:10 with replacement (i.e. patients in the GA group were eligible to match with multiple patients in the RA group). Patients were matched exactly with respect to CPT code and ASA status grouping (1 or 2, 3, and 4 or 5). After matching, weighted multiple regression analysis was used to examine the covariate-adjusted associations between type of anaesthetic (RA *vs* GA) and each outcome. Logistic regression was used for binary categorical outcomes, and Cox proportional hazards regression was used for the time-to-event outcome. Weighting was used to account for the 1:10 matching ratio (each match received 1/10 weight). We adjusted for age, gender, race, BMI, ASA status, functional status before surgery, smoking, alcohol use, weight loss, surgical specialty, emergency status of procedure, operative time, and for presence of major preoperative comorbidities, including hypertension, diabetes mellitus, and history of the following: severe chronic obstructive pulmonary disease, coronary artery disease (angina, MI and/or prior coronary intervention), renal dysfunction ($Cr > 3\,mg\,dl^{-1}$), stroke (with or without deficit), and history of disseminated cancer. A natural cubic spline function with three knots was used for continuous variables (age, BMI and surgical time) to allow for nonlinear covariate associations. Wald-type confidence intervals and tests were used for simple inferences. A likelihood ratio test was used to evaluate simultaneous hypotheses. The effects of anaesthetic type are presented as odds ratios (OR) (or hazard ratio (HR) for the time-to-event outcomes) with corresponding 95% confidence interval. This approach was selected in favour of a marginal approach (e.g. propensity score matching) in order to more fully describe the effect of anaesthetic type on postoperative mortality and morbidity. All analyses were implemented using R 3.1.2 (R Foundation for Statistical Computing, Vienna, Austria). A significance level of 0.05 was used for statistical inference.

Results

Of the 1.7 million procedures in the NSQIP database 328,540 surgical procedures were matched after exclusions, which included