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**Effect of Anaesthesia Type on Postoperative Mortality and Morbidities: A Matched Analysis of the NSQIP Database**

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Saied NN, Helwani MA, Weavind LM, Shi Y, Shotwell MS, Pandharipande PP

**Abstract**

**Purpose** The purpose of this study was to determine if regional anesthesia was associated with a reduced mortality and morbidity, or decreased length of stay compared to general anesthesia.

**Background** Many surgeries can be performed under either general anesthesia (GA) or regional anesthesia (RA). However, many providers opt to perform GA because it is often faster to perform and/or because they lack expertise in RA. Numerous studies have been published comparing outcomes between GA and RA techniques, most with inconsistent results. It is unclear if RA is associated with reduced 30-day mortality and morbidity, and length of stay compared to GA in patients who are matched on surgical procedure type and ASA physical status.

**Methodology** This was a retrospective analysis that used the American College of Surgeons National Surgical Quality Improvement database (ACS-NSQIP; 2005-2011) to test the hypothesis that RA was associated with reduced 30-day mortality and fewer postoperative complications than GA after adjusting for clinical and patient characteristics. The RA group included patients that received epidural, spinal, or peripheral nerve blocks. The GA group included both those who received GA alone and those who received GA in combination with RA. Regional anesthesia patients were matched based on Current Procedural Terminology (CPT) code and ASA physical status. Patients were excluded if they were mechanically ventilated before surgery or had a procedure lasting longer than four hours. Logistic regression was used to compare differences in 30-day mortality and differences in the rate of: respiratory complications, renal complications, myocardial infarction, DVT/thromboembolism, stroke, peripheral nerve injury, intraoperative complication, and other complications. Cox proportional hazards ratio was used to compare differences in hospital length of stay, with a larger hazard ratio denoting a shorter length of stay. Adjustments were made during the analysis for age, gender, race, BMI, ASA status, functional status before surgery, smoking, alcohol use, weight loss, surgical specialty, emergency procedures, operative time, and for presence of major preoperative comorbidities. Significant outcomes were stratified based on ASA physical status; I or II vs. III vs. IV or V. A P < 0.05 was considered significant.

**Result** There were 1.7 million cases included in the NSQIP database. For this study, 328,540 surgical procedures were matched, 264,421 in the GA group and 64,119 in the RA group. Groups were similar on
demographics and clinical characteristics. The median age was 64.5 years, 52% were male, 18% had general surgery, 21% vascular surgery, 51% orthopedic surgery, and 10% genitourinary surgery; 46% were ASA I or II, 46% ASA III, and 7% ASA IV or V. The most common comorbidity was hypertension (61%), followed by diabetes (19%), history of percutaneous coronary intervention (13%), and 18% smoked. The GA group had a lower rate of severe COPD (5.8% vs. 7.6%) and a higher rate of emergency surgery (5.4% vs. 4.9%).

The 30-day mortality rate was no different in the regional anesthesia only group than in the general anesthesia group (P = 0.81). Administration of RA alone decreased the odds of any complication by 15% compared to anesthetics that included general anesthesia (P < 0.001). Regional anesthesia alone decreased the odds of:

- respiratory complications 24% (P < 0.001)
- DVT/Thrombophlebitis 16% (P = 0.02)
- intraoperative complication 47% (P = 0.006)

All other complications were similar between the groups (Table 1; Figure 1).

Regional anesthesia was associated with a higher likelihood of a slightly, but statistically significantly earlier hospital discharge (3.12 days vs. 3.15 days; P < 0.001). Regional anesthesia appeared to confer the greatest benefit in patients with a higher ASA physical status when considering: hospital length of stay, respiratory complications, and any one complication (Figure 2). The likelihood of early discharge was greatest in the RA group for ASA I or II (P = 0.01), ASA III (P < 0.001), and ASA IV or V (P < 0.001) patients. The rates of respiratory and any one complication were similar between RA and GA groups for ASA I or II patients, but significantly lower in ASA III, IV, or V patients (P < 0.05; Figure 2).

**Conclusion** Regional Anesthesia did not decrease the 30-day mortality rate but was associated with a decreased rate of intraoperative complications, respiratory complications, DVT/thrombophlebitis,

### Table 1. Complication by Anesthesia Type

<table>
<thead>
<tr>
<th></th>
<th>Regional Only N = 64,119</th>
<th>General Anesthesia N = 264,421</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>30-day mortality (%)</td>
<td>0.03</td>
<td>0.02</td>
<td>NS</td>
</tr>
<tr>
<td>Hospital LOS (days)</td>
<td>3.12 ± 7.04</td>
<td>3.15 ± 6.58</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Respiratory Complication (%)</td>
<td>1.23</td>
<td>1.53</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Renal Complication (%)</td>
<td>0.41</td>
<td>0.45</td>
<td>NS</td>
</tr>
<tr>
<td>Myocardial Infarction (%)</td>
<td>0.44</td>
<td>0.41</td>
<td>NS</td>
</tr>
<tr>
<td>DVT/Thrombophlebitis (%)</td>
<td>0.58</td>
<td>0.7</td>
<td>0.02</td>
</tr>
<tr>
<td>Pulmonary embolism (%)</td>
<td>0.31</td>
<td>0.33</td>
<td>NS</td>
</tr>
<tr>
<td>Stroke (%)</td>
<td>0.29</td>
<td>0.29</td>
<td>NS</td>
</tr>
<tr>
<td>Peripheral Nerve Injury (%)</td>
<td>0.07</td>
<td>0.06</td>
<td>NS</td>
</tr>
<tr>
<td>Intraoperative complication (%)</td>
<td>0.04</td>
<td>0.08</td>
<td>0.006</td>
</tr>
<tr>
<td>Any complication (%)</td>
<td>2.84</td>
<td>3.25</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>
and hospital length of stay across a wide range of surgical procedures that were <4 hours in duration. Regional anesthesia was associated with a significantly lower incidence of complications in ASA physical status II, IV, and V patients.

**Figure 1. Odds Ratio for Outcomes**

<table>
<thead>
<tr>
<th>Event</th>
<th>Odds Ratio ± 95% CI</th>
<th>Favors RA</th>
<th>Favors GA</th>
</tr>
</thead>
<tbody>
<tr>
<td>30-day Mortality</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intraoperative Complication</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Peripheral Nerve Injury</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Stroke</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pulmonary Embolism</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>DVT/Thrombophlebitis</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Myocardial Infarction</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Renal Complication</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Respiratory Complication</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Any Complication</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Note:** Results presented as odds ratio ± 95% confidence interval. RA = regional anesthesia only. GA = anesthetic included general anesthesia. Outcomes in red were significant (P < 0.05). Confidence intervals that cross 1 are not significant.

**Figure 2. Outcomes by ASA Physical Status**

<table>
<thead>
<tr>
<th>Event</th>
<th>Odds Ratio ± 95% CI</th>
<th>Favors RA</th>
<th>Favors GA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Respiratory Complication (ASA 1/2)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Respiratory Complication (ASA 3)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Respiratory Complication (ASA 4/5)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Any Complication (ASA 1/2)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Any Complication (ASA 3)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Any Complication (ASA 4/5)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Note:** Results presented as odds ratio ± 95% confidence interval. RA = regional anesthesia only. GA = anesthetic included general anesthesia. Outcomes in red were significant (P < 0.05). Confidence intervals that cross 1 are not significant.
Comment

The results of this study suggest regional anesthesia decreases morbidity, specifically intraoperative, DVT/Thrombophlebitis, and respiratory complications. RA is also associated with a shorter length of stay in procedures less than four hours in duration. It makes sense that respiratory complications are decreased with regional anesthesia because general anesthesia can negatively impair postoperative respiratory function. The results support the theory that RA may decrease the rate of DVT, although, the rate of pulmonary embolism was not decreased with RA.

RA was associated with a decreased hospital length of stay. While the difference is small (only 0.03 days), if you multiply this by the 64,119 surgical procedures included in RA group, that equals 1,923 hospital days saved with RA. In the United States, the average cost per inpatient day is $1,986. Therefore, the administration of regional anesthesia saved approximately $3.8 million dollars over the 6 years of this study. That is a significant cost savings!

There are a few limitations to this study. We do not know which specific surgical procedure types (e.g., orthopedics) to which RA conferred the greatest benefit. Previous studies have found that neuraxial anesthesia is associated with decreased morbidity and mortality in patients undergoing total joint replacement. Another weakness is the investigators did not account for a diagnosis of obstructive sleep apnea, although they did control for BMI. Obstructive sleep apnea is associated with increased perioperative morbidity and mortality. Nonetheless, I think these results are important and, whenever possible, anesthesia providers should consider administering regional anesthesia.

Dennis Spence, PhD, CRNA

The views expressed in this article are those of the author and do not reflect official policy or position of the Department of the Navy, the Department of Defense, the Uniformed Services University of the Health Sciences, or the United States Government.

Notes: this article is available free full text at the following url:
https://academic.oup.com/bja/article/118/1/105/2763306?searchresult=1
Abstract
Purpose  The purpose of this study was to identify predictors of the frequency and duration of oxygen desaturations in ambulatory orthopedic surgery patients.

Background  Little is known about the frequency and severity of postoperative oxygen desaturation and adverse respiratory events in ambulatory surgical patients. Review of the closed claims database determined that 88% of respiratory depression events occurred within the first 24 hours after surgery. Patients undergoing outpatient surgery are believed to have a lower risk of respiratory depression; however, patients with risk factors for respiratory depression (STOP-BANG score ≥ 3) may be at higher risk for respiratory adverse events. This study sought to determine if the STOP-BANG score was predictive of the number of desaturation events and length of desaturation (<90% and <88%) during the first 48 hours after discharge. [Editor’s Note: See note at end for more about the STOP-BANG score.]

Methodology  This was a prospective observational study of adult patients undergoing outpatient orthopedic surgery. After discharge, patients were sent home with a wristwatch-sized pulse oximeter (Respironics NONIN WristOx2 Model 3150), which recorded oximetry data for 48 hours after surgery. Patients also completed the STOP-BANG questionnaire and used a journal to record quality of life metrics and opioid consumption. Investigators used negative binomial regression to analyze the number and duration of desaturation events at the <90% and <88% level based on STOP-BANG scores. Multiple regression was used to identify predictors of the number and duration of oxygen desaturation events. Statistical analysis was appropriate and a P < 0.05 was significant.

Result  There were 50 patients enrolled; 20 male and 30 female. Their mean age was 50 ± 11 years; 38 were ASA I or II; 11 were ASA III, and 1 was an ASA IV. Their average STOP-BANG score was 3.4 ± 2 (range 0-8). Scores ≥3 constitute a high-risk for undiagnosed obstructive sleep apnea. Most patients (n = 46) underwent general anesthesia with (n = 25) or without (n = 21) regional anesthesia. Four patients underwent regional and monitored anesthesia care. Only two patients used home continuous positive airway pressure (CPAP).

As the STOP-BANG score increased, so did the number and duration of desaturation events, with the magnitude of desaturations increasing precipitously at
higher STOP-BANG scores. Even patients with a STOP-BANG score of 0 were predicted to have 30 desaturation events to <90% and 5-10 events to <88% during the 48-hour study period. Patients with a STOP-BANG score of 6 were predicted to have approximately 250 desaturation events <90% and 75 desaturation events <88%. Two patients who used CPAP had STOP-BANG scores of 8 and were predicted to have 198 desaturation events <88% however, CPAP exerted a protective effect, with one patient experiencing only 16 events and the other only 1 event.

A higher STOP-BANG score was indeed predictive of both the number of desaturation events (P < 0.001), and the total duration of desaturation events at <90% and <88% (both P < 0.05). Not surprisingly, use of home CPAP decreased the number, and total duration of desaturation events (both P < 0.01). Interestingly, prescription pain medication use decreased the number of desaturation events (P < 0.01) but was not predictive of the total duration of desaturation events <90% or <88%.

A higher BMI and older age were both predictive of the number of desaturation events. Age was only predictive of the total duration of desaturation events <88% (P < 0.01). Patients with a BMI >35 experienced a 466% increase in the frequency of mild hypoxemic events (<90%) and a 1,473% increase in the risk of severe hypoxemia (<88%). For every 1-year increase in age, patients had a 3% increased risk of mild events (<90%) and 8% increased risk of severe hypoxemic events (<88%).

**Conclusion** The STOP-BANG score may help predict which patients may need Obstructive Sleep Apnea precautions to be implemented to reduce the risk of respiratory depression.

**Comment** Undiagnosed Obstructive Sleep Apnea, OSA, is a significant problem anesthesia providers face every day. Numerous studies have demonstrated that patients with diagnosed and undiagnosed OSA have higher morbidity and mortality rates. Therefore, it is essential that we identify patients who may have undiagnosed OSA so that we may implement OSA risk reduction precautions during the perioperative period.1

All patients, even those without OSA, experience alterations in their sleep architecture postoperatively and will experience worsening sleep-disordered breathing during the first 3 to 5 days after surgery. Typically, there is a rebound effect that occurs on day 2 or 3, with many patients, especially those with STOP-BANG scores >3 and diagnosed OSA, experiencing worsening in their sleep apnea parameters (i.e., apnea hypopnea index and time during sleep with oxygen saturation <90%). Opioids actually decrease rapid eye movement sleep, which is the period during sleep when many apneic and desaturation events occur in sleep-disordered breathing. This may partially explain the finding in this study that increased pain medication consumption decreased desaturation events. Older age and obesity are risk factors for OSA and postoperative respiratory depression, so it is not
surprising the investigators found higher rates of desaturation in older and obese patients. This study also confirms that the STOP-BANG is a useful tool for identifying patients at risk for postoperative respiratory depression.

Anesthesia providers should consider incorporating the STOP-BANG into their preoperative screening process.²

**Dennis Spence, PhD, CRNA**


**Notes:** STOP-BANG description and use as a screening tool described in this publication: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3325050/pdf/aes022.pdf

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Regional Anesthesia

Neuraxial vs. General Anaesthesia for Total Hip and Total Knee Arthroplasty: A Systematic Review of Comparative Effectiveness Research

DOI: 10.1093/bja/aev455
Johnson RL, Kopp SL, Burkle CM, Duncan CM, Jacob AK, Erwin PJ, Murad MH, Mantilla CB

Abstract

Purpose This study was a systematic review and meta-analysis to examine prospective studies that compared perioperative outcomes in patients who received neuraxial anesthesia vs. general anesthesia for total knee and hip arthroplasty.

Background Total knee and hip arthroplasty surgeries are expected to dramatically increase over the next 20 years. Therefore, it is essential that comparative effectiveness research studies be completed to examine perioperative outcomes on anesthetic techniques for total knee and hip arthroplasty. Recent studies have used databases to examine differences in morbidity and mortality based on anesthetic technique; neuraxial vs. general anesthesia. They found reduced mortality rates with neuraxial anesthesia. But these studies were retrospective, and thus prone to bias because of a lack of randomization and data entry errors.

Methodology This was a systematic review of all studies which examined perioperative outcomes in patients undergoing total knee and hip arthroplasty. It compared outcomes between patients who received neuraxial anesthesia (spinal, epidural, or combined spinal epidural) and patients who received general anesthesia alone. The investigators searched MEDLINE, Ovid EMBASE, EBSCO CINAHL, Thomson Reuters Web of Science, and the Cochrane Central Register of Controlled Trials from inception until March 2015. Included studies were randomized controlled trials or prospective observational studies.

The following outcomes were examined:

- mortality
- major morbidity (including)
  - DVT
  - pulmonary embolism
  - cerebral vascular accidents
  - myocardial infarction
- infection
- pulmonary
- wound
- nerve palsies
- patient-experience outcomes (including)
  - PONV
  - postoperative pain beyond 3 months
  - changes in mental status
  - length of hospital stay

Result This analysis included 29 studies involving 10,488 patients. In 16 studies epidural anesthesia was administered, in 10 studies spinal anesthesia, and combined spinal-epidural anesthesia in 2 studies. Epidural infusions were continued postoperatively in 10 studies. The use of spinal anesthesia increased over time. All studies since 2003
used spinal or combined spinal-epidural anesthesia (N = 8).

Length of hospital stay was approximately 0.4 days shorter with neuraxial anesthesia (P = 0.03). Surgical duration was 5 minutes shorter, but this was not significant.

Deep vein thrombosis decreased 49% (7 studies, n = 721) and pulmonary embolism decreased 64% (6 studies, n = 607) with neuraxial anesthesia compared to general anesthesia (P < 0.05). However, in studies, where patients received antithrombotic prophylaxis, no significant differences were found (Figure 1). There were no differences in:

- mortality (7 studies, n = 1,149)
- PONV (5 studies, n = 328)
- surgical site infection (5 studies, n = 8,095)
- chest infection (3 studies, n = 266)
- nerve palsy (2 studies, n = 185)

**Conclusion**  Neuraxial anesthesia appears equally as safe as general anesthesia for total knee and hip arthroplasty without increased complications. Neuraxial anesthesia was associated with a shorter hospital length of stay.

**Comment**

Many anesthesia providers administer neuraxial anesthesia along with multimodal analgesia, which may or may not include peripheral nerve blocks (single shot or continuous). A few years ago we stopped administering postoperative continuous femoral nerve blocks, and our surgeon-administered a periarticular infiltration of local anesthetic admixtures and found we could get patients out of the hospital a day earlier.

Unfortunately, this study did not examine the effect of periarticular injection or peripheral nerve block.

---

**Figure 1. Relative Risk of Complications**

NOTES: DVT = deep vein thrombosis. Rx = treatment. PE = pulmonary embolism. PONV = postoperative nausea & vomiting. Results presented as odds ratio ± 95% confidence interval. Confidence intervals that cross 1 are not significant.
techniques on outcomes and length of stay. Nevertheless, the investigators found that when they pooled results from studies dating back to as far as 1980 that neuraxial anesthesia was associated with a shorter hospital length of stay. No differences were found in mortality or other complications. One reason for this may be that anesthetic agents and surgical techniques have changed a lot since 1980, which could explain the lack of differences found in this meta-analysis.

**Dennis Spence, PhD, CRNA**

The views expressed in this article are those of the author and do not reflect official policy or position of the Department of the Navy, the Department of Defense, the Uniformed Services University of the Health Sciences, or the United States Government.

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