Patient Outcomes Comparing CRNA-Administered Peripheral Nerve Blocks and General Anesthetics: A Retrospective Chart Review in a US Army Same-Day Surgery Center

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We compared outcomes between patients receiving general anesthesia (GA) vs regional block (RB) in a military same-day surgery unit (SDSU), where Certified Registered Nurse Anesthetists (CRNAs) delivered all RBs and GA. All patient charts from 2003 through 2006 were reviewed. Patients were included if they were 18 years or older, had an ASA physical status I or II, and underwent a shoulder or knee arthroscopy that used either RB or GA.

Overall, 342 patients met inclusion criteria: 161 GA and 181 RB. With GA, mean anesthesia time was shorter (109.6 vs 135.5 minutes, P < .001), but recovery times were longer (56.7 vs 36.4 minutes, P < .001). SDSU times were nearly identical (GA vs RB, 71.5 vs 72.8 minutes), resulting in a total hospital time that was not significantly different (352.7 vs 347.5). The GA group received more morphine equivalents of narcotic in the operating room (22.9 vs 15.1 mg, P < .001) yet still had higher pain scores postoperatively than the RB group (1.1 vs 0.3, P < .001). The GA group received a significantly greater number of antiemetic doses intraoperatively (0.58 vs 0.04, P < .001) but still had a higher, although nonsignificant, rate of emesis (15.5% vs 10.0%).

Patients receiving RB had less pain and received less analgesia without any increase in postoperative nausea and vomiting, hospital time, or anesthesia-related complications.

Keywords: Nausea and vomiting, pain, regional blocks.

Regional anesthesia began in the late 19th century with the first documented brachial plexus block placed by William Halstead in 1884. Others, such as Bier, introduced spinal and intravenous regional anesthesia (Bier block) as early as 1899. These rudimentary anesthetics formed the foundations of modern regional anesthesia. In recent time, regional anesthesia has been most frequently associated with relatively minor surgical procedures, often referred to as ambulatory surgery, which by definition does not require overnight hospitalization.

Many studies have shown improved outcomes in patients receiving regional anesthesia compared with general anesthesia (GA). Hadzic et al4 examined postoperative nausea and vomiting (PONV) and reported that only 12% of patients receiving peripheral nerve blocks had nausea, whereas 62% of patients receiving GA reported moderate to severe nausea, with 95% of those requiring antiemetics. Williams et al5 reported 9% postoperative nausea among recipients of regional anesthesia compared with 39% reporting nausea after GA. In the same study, 14% of patients receiving regional anesthesia reported pain that required treatment compared with 63% of patients receiving GA. Another study by Hadzic et al6 found that patients who received a peripheral nerve block required no treatment of pain, whereas 80% of those receiving GA required treatment of pain. In the same study, Hadzic et al6 noted a 16% rate of unplanned admissions for patients receiving GA, but no unplanned admissions for those receiving regional anesthesia. A study conducted by Meridy using data from 1979 and 1980 demonstrated a 2.44% unplanned admission rate. This study further segregated admissions related to anesthesia (0.64% of the 1,553 patient charts studied). All anesthesia-related unplanned admissions were patients who received GA, and 80% of those were related to nausea and vomiting.

Another factor that must be considered when assessing the overall effectiveness and value of regional anesthesia compared with GA is time spent in the hospital, in-
cluding operating room (OR) and postanesthesia care unit (PACU) time. Multiple studies have shown that even under varying circumstances, GA is typically less labor intensive in the initial stages of anesthesia care, allowing faster inductions and earlier surgery start times than regional anesthesia, thus resulting in shorter total OR times.\(^8\)\(^-\)\(^10\) However, although GA may save time up front, it may also prolong time to discharge. Pavlin et al\(^11\) found that the time to discharge home for patients who had GA was twice as long as those receiving regional anesthesia. Comparing these studies can be difficult at best because of the vast differences in facilities, patient status, and other confounding factors.

In 2001, Chan et al\(^9\) compared the cost of GA to intravenous regional anesthesia and peripheral nerve blocks. They found intravenous regional anesthesia was the least costly option and peripheral nerve block anesthesia was the most costly option, but neither was significantly different than GA. Once again, decreased pain, nausea, and vomiting were noted in the intravenous regional and the peripheral nerve block groups compared with the GA group, which correlated to decreased demands on nursing staff. In contrast, Schuster et al\(^10\) found that regional anesthesia was more expensive to perform and only had a cost benefit when compared with GA after procedures lasting more than 200 minutes. Chan et al\(^9\) also contended that costs will be reduced only if patients bypass the PACU altogether.

The wealth of literature available regarding anesthesia types, uses, effectiveness, and outcomes in the ambulatory surgery setting provides a basis for further inquiry. Although nearly every aspect of anesthesia and its uses is covered in numerous different studies with numerous different hypotheses, comprehensive integrative studies are missing. Review of the literature confirms the proposed benefits of peripheral nerve block; it also reveals disadvantages with the approach. There is considerable evidence that regional anesthesia is a safe, effective, and appropriate alternative to GA in many cases. A study that considers a variety of variables related to peripheral anesthesia in ambulatory surgery would be useful in determining overall patient outcomes. In addition, there is an obvious lack of literature evaluating the effect on patient outcomes of Certified Registered Nurse Anesthetist (CRNA)–administered regional anesthetics.

We hypothesized that patients receiving CRNA-administered regional blocks (RBs) would have a longer preoperative time, a shorter intraoperative time, a shorter postoperative time and therefore equivalent perioperative times compared with the patients receiving CRNA-administered GA. In addition we hypothesized that RB would result in a lower incidence of PONV, lower pain levels, decreased postoperative opioid consumption, lower incidence of readmission, and a higher incidence of PACU bypass compared with GA.

Materials and Methods

After Institutional Review Board approval, a retrospective review of medical records was conducted covering a span of the 2 most recent years. Patients’ charts were abstracted for inclusion if they were age 18 years or older, American Society of Anesthesiologists (ASA) physical status I or II, and undergoing only shoulder or knee arthroscopy. Patients were included if they received either GA or RB but excluded if they received any form of neuraxial or combined GA and RB technique. Inclusion criteria for the RB group were patients who received an interscalene block for shoulder arthroscopy or femoral nerve block for knee arthroscopy. These criteria ensured that subjects were as homogeneous as possible in terms of types of surgeries and the potential to receive either a GA or RB anesthesia choice, limiting the potential confounds for this retrospective study.

A data collection sheet was created to retrieve data from several medical documents. This served as the main data collection tool. An interrater reliability of data collection was established on the first 10 records collected, with the Cohen \(\kappa = 97.5\) (\(P < .001\)).

The research employed a conceptual model in which independent variables of RB or GA have direct effects on the patient outcomes of opioid consumption, pain levels, PONV, hospital times, PACU bypass, readmission rates, and complications. The model also illustrates potential relationships between dependent variables such as the effect of pain on PONV between the groups. We assessed the differences in patient outcomes between patients receiving GA and those receiving RB for the following 6 dependent time variables: (1) preoperative time—interval of time between admission to the same-day surgery unit (SDSU) and entry into the OR; (2) intraoperative time—
time between entry and exit from the OR; (3) total anesthesia time—time from first contact with anesthesia provider to PACU admission; (4) PACU time—time between admission and discharge from the PACU; (5) SDSU time—time from admission to the SDSU to discharge from the hospital; and (6) total hospital time—from admission to discharge from the hospital. Additionally, we compared patient outcomes for these dependent variables: incidence of PONV—the presence of nausea with or without emesis; doses of antiemetic—total number of doses of antiemetic medication received, regardless of type; pain scores—pain levels given verbally by the patient according to a 1 to 10 numeric pain scale, with 1 indicating no pain and 10 the worst pain possible; opioid consumption—total morphine equivalency for all analgesics given to the patient; readmission rates—incidence of readmission to a hospital following discharge from the SDSU for problems related to the surgical event; PACU bypass—patient transfer from the OR directly to the SDSU if the Aldrete score was greater than or equal to 8; and unexpected events or adverse events—death, cardiac or respiratory arrest requiring cardiopulmonary resuscitation, cardiac or respiratory arrest, cardiac arrest, hypotension, laryngospasm, bronchospasm, hypothermia, hypoglycemia, and others.

### Table: Study Results

<table>
<thead>
<tr>
<th>Study measures</th>
<th>General Mean ± 2 SD</th>
<th>Regional blocks Mean ± 2 SD</th>
<th>P^a</th>
</tr>
</thead>
<tbody>
<tr>
<td>PACU bypass^b</td>
<td>0/161^c</td>
<td>12/181^c</td>
<td>.001^d</td>
</tr>
<tr>
<td>PONV (No. of episodes)^b,e</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>At PACU</td>
<td>11/156^c</td>
<td>6/168^c</td>
<td>.228</td>
</tr>
<tr>
<td>At SDSU</td>
<td>17/159^e</td>
<td>15/179^e</td>
<td>.264</td>
</tr>
<tr>
<td>Overall</td>
<td>25/161^c</td>
<td>18/180^e</td>
<td>.125</td>
</tr>
<tr>
<td>Antiemetics given (No. of doses)^f</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intraoperatively</td>
<td>0.58 ± 1.6</td>
<td>0.04 ± 0.4</td>
<td>.001^d</td>
</tr>
<tr>
<td>At PACU</td>
<td>0.08 ± 0.6</td>
<td>0.04 ± 0.4</td>
<td>.177</td>
</tr>
<tr>
<td>At SDSU</td>
<td>0.12 ± 0.8</td>
<td>0.09 ± 0.6</td>
<td>.538</td>
</tr>
<tr>
<td>Anesthesia-related readmission^b</td>
<td>0/158^c</td>
<td>0/180^b</td>
<td>1.00</td>
</tr>
<tr>
<td>Unexpected events intraoperatively, at PACU and at SDSU^b,g</td>
<td>0</td>
<td>2^h</td>
<td>.184</td>
</tr>
<tr>
<td>Pain levels (0-10)^i</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Preoperatively</td>
<td>2.1 ± 5.4</td>
<td>1.8 ± 4.6</td>
<td>.727</td>
</tr>
<tr>
<td>At PACU admission</td>
<td>1.01 ± 4.8</td>
<td>0.30 ± 2.8</td>
<td>.001^d</td>
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<tr>
<td>At PACU discharge</td>
<td>1.3 ± 3.0</td>
<td>0.27 ± 1.6</td>
<td>.001^d</td>
</tr>
<tr>
<td>At SDSU discharge</td>
<td>1.1 ± 2.8</td>
<td>0.27 ± 2.0</td>
<td>.001^d</td>
</tr>
<tr>
<td>Morphine equivalent given (mg)^f</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intraoperatively</td>
<td>22.9 ± 23.4</td>
<td>15.1 ± 22.2</td>
<td>.001^d</td>
</tr>
<tr>
<td>At PACU</td>
<td>5.7 ± 14.4</td>
<td>3.5 ± 10.4</td>
<td>.001^d</td>
</tr>
<tr>
<td>At SDSU</td>
<td>4.4 ± 16.0</td>
<td>1.3 ± 10.2</td>
<td>.001^d</td>
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<tr>
<td>Perioperative times (min)^f</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Preoperative</td>
<td>85.1 ± 109.4</td>
<td>72.2 ± 85.8</td>
<td>.017^d</td>
</tr>
<tr>
<td>Intraoperative</td>
<td>70.4 ± 64.6</td>
<td>84.3 ± 78.8</td>
<td>.001^d</td>
</tr>
<tr>
<td>Total anesthesia</td>
<td>109.6 ± 84.6</td>
<td>135.5 ± 88.2</td>
<td>.001^d</td>
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<tr>
<td>PACU</td>
<td>56.7 ± 60.2</td>
<td>36.4 ± 6.2</td>
<td>.001^d</td>
</tr>
<tr>
<td>SDSU</td>
<td>72.8 ± 65.6</td>
<td>71.5 ± 2.4</td>
<td>.707</td>
</tr>
<tr>
<td>Total hospital</td>
<td>352.7 ± 166.2</td>
<td>347.5 ± 49.4</td>
<td>.549</td>
</tr>
</tbody>
</table>

^a α set to .05.
^b χ^2, test of independence.
^c Data are given as incident frequency over total valid cases.
^d Statistically significant difference.
^e Each episode of nausea and emesis was counted separately.
^f Independent Student t test.
^g Unexpected events were defined as death, activation of advanced cardiac life support, anaphylaxis, hemorrhage, laryngospasm and bronchospasm, nerve injuries, corneal abrasions, and others.
^h Both cases involved patient’s complaint of chest pain in the SDSU without actual cardiac event.
^i Mann-Whitney U.
monary resuscitation, or hemorrhage that occurred intraoperatively or postoperatively and were related to the anesthesia provided.

In the study institution, blocks were placed by the provider who was performing the case in the preoperative holding area. This same provider followed up the patient until staff turnover in the PACU or SDSU.

The collected data were coded and entered into a statistical software package (SPSS 12.01, SPSS Inc, Chicago, Illinois). Statistical data analysis was conducted using \( \chi^2 \), Mann-Whitney \( U \) test, Student \( t \) test, and logistic regression as appropriate. The PACU bypass, PONV, readmission, and unexpected events were evaluated with \( \chi^2 \). The Mann-Whitney \( U \) statistical test was used to analyze the numeric rating scale for evaluating pain. All scale-level data (analgesic use, time to first pain medication use, preoperative time, intraoperative time, PACU time, SDSU time, and overall hospital time) were evaluated with the Student \( t \) test. All of the statistical analyses were performed with \( \alpha \) set at .05.

**Results**

A total of 656 records were reviewed. Of these, 342 records met the criteria for inclusion into the study: 161 GA and 181 RB. Preoperatively, the GA group had 13 more minutes in preoperative time than did the RB group (mean ± 2 SD, 85.1 ± 109.4 vs 72.2 ± 85.8 minutes, \( P = .017 \)). Intraoperatively, the GA group spent 5.8 fewer minutes in the OR (70.4 ± 64.6 minutes) compared with the RB group (84.3 ± 78.8 minutes, \( P < .001 \)). Additionally, the GA group used 25.9 minutes less anesthesia provider time (109.6 ± 84.6 minutes) compared with the RB group, (135.5 ± 88.2 minutes, \( P < .001 \)).

The GA group, however, spent 20.3 minutes longer in PACU (56.7 ± 60.2 minutes) than the RB group (36.4 ± 36.2 minutes, \( P < .001 \)) (Figure 1). The SDSU and total hospital times were not significantly different (Table; see Figure 1).

Overall, PONV before discharge occurred in 25 patients (15.5%) in the GA group compared with 18 patients (10.0%) in the RB group (\( P = .125 \)); these values were not statistically significant (Figure 2). The GA group received a significantly greater number of antiemetic doses in the OR compared with the RB group (0.58 ± 1.6 vs 0.04 ± 0.4, \( P < .001 \)) (Figure 3). Patients did not receive significantly different amounts (number of doses) of antiemetics in PACU (GA 0.08 ± 0.6 vs RB 0.04 ± 0.2, \( P = .177 \)) or in the SDSU (GA 0.12 ± 0.4 vs RB 0.09 ± 0.3, \( P = .538 \)).

Pain levels were significantly different between the groups in all time periods except preoperatively. On admission to the PACU, the GA group reported a mean pain score of 1.1 ± 4.8, and the RB group reported 0.3 ± 2.8 (\( P < .001 \)). On discharge from the PACU, the RB group had less pain with a score of 0.3 ± 1.6 compared with the GA group at 1.3 ± 3.0 (\( P < .001 \)).

The GA group received significantly more morphine equivalents of analgesics in all areas studied (Figure 4). Intraoperatively, the GA group received a mean of 22.9 ± 23.4 mg of morphine equivalents compared with the RB group of 15.1 ± 22.2 mg (\( P < .001 \)). The GA group continued to receive more morphine equivalents in the PACU and SDSU (5.7 ± 14.4 and 4.4 ± 16 mg, \( P = .001 \)) than did the RB group (3.5 ± 10.4 and 1.3 ± 10.4 mg, \( P < .001 \)).

No readmissions were reported for either group. Additionally, 12 (6.6%) of the patients in the RB group...
bypassed the PACU and were admitted to the SDSU. No one in the GA group met PACU bypass criteria. No anesthesia-related adverse events occurred in either group; however, 2 RB patients complained of vague chest pain postoperatively in the SDSU. Those 2 patients were subsequently discharged once the chest pain was found to not be severe.

**Discussion**

The findings of this study are similar to data found in the literature concerning PONV, pain scores, and hospital times. Although not statistically significant, the PONV rates in this study were similar to other studies of ambulatory surgical patients, with the incidence of PONV at 15.5% in the GA group and 10% in the RB group. Interestingly, although not unexpectedly, the GA group received the larger proportion of antiemetic treatment in the OR (60%) yet still had higher PONV rates in the PACU and SDSU. The lack of difference in the antiemetic use postoperatively is likely because of the anticipatory treatment done preoperatively. In addition, PONV is strongly linked to postoperative pain and GA itself.12

Significant differences existed in analgesic administration and postoperative pain levels in our study. The GA group received significantly more morphine equivalents of analgesics, both intraoperatively and postoperatively, yet had significantly higher pain scores. This was an expected finding considering that the analgesic effects of GA would diminish upon the patients’ awakening, whereas the effects of RB local anesthetics could linger considerably longer depending on the agents used. Although the morphine itself would have little impact on the overall cost, it is of significance from the perspective of patient comfort. Future prospective studies could compare pain levels and analgesic use in the extended postoperative period, perhaps out to 72 hours.

Postoperative pain and PONV can increase postoperative length of stay. Studies by Hadzic et al8, Chan et al,9 and Schuster et al10 have shown GA to be less labor intensive, allowing faster start times than regional anesthesia. Pavlin et al11 found that the time to discharge home for patients undergoing procedures with GA was twice as long as those receiving regional anesthesia. Comparing these studies can be difficult at best because of the vast differences in facilities, patient status, and other factors. Our study found similar results with shorter anesthesia time for GA, but longer PACU time and similar SDSU time. These combined such that total hospital times were not significantly different. With greater control over anesthesia administration than was possible in our retrospective study, future prospective studies could explore more deeply into this very important area of efficiency, better controlling for unique institutional characteristics. Additionally, stratification analysis of the data by surgery type would be useful to determine if differences exist between these groups; however, limitations of sample size in our study did not make stratification possible.

Many studies have compared economic factors between GA and regional anesthesia. A limitation of this study was that it was unable to consider cost comparisons or the factors influencing cost differences.

This study showed that CRNA-administered peripheral regional anesthetics improved selected outcomes in the same-day surgery center. The CRNAs provided safe, effective anesthetics with RB, and the findings of this study strongly support the continued use of RB by CRNAs as a viable anesthetic alternative. Patients receiving RB were more comfortable, had less PONV, and had approximately the same amount of total hospital time. This study can serve as a foundation toward a future prospective study to analyze their effects on patient outcomes.

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**Figure 4. Mean Morphine Equivalents (in mg, ± 2 SD)**

*Indicates significant statistical difference of P < .001.

GA indicates general anesthesia; RB, regional block; PACU, postanesthesia care unit; SDSU, same-day surgery unit.


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