Post-Operative Pain Scores and Level of Regional Anesthesia Expertise: Using Clinical Outcomes to Assess Procedural Proficiency

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Introduction
Proficiency in Regional Anesthesia (RA) techniques is a vital part of the practice of anesthesiology and it is known that trainees completing a minimal quota of procedures does not equate with acquisition of all the skill sets necessary to perform an appropriately selected, timely, safe and successful nerve block [1]. Regional anesthesia rotations with expert faculty and use of adjunctive teaching methods including simulation, cadaver dissection, robotics and web-enhanced didactics improved the learning experience and the overall competency for residents performing these techniques and particularly the visuospatial coordination required for Ultrasound Guided (USG) procedures [2-4]. Global procedural scores and performance times for axillary and inter-scalene brachial plexus nerve blockade by nerve stimulation and ultrasound guidance lowered scores in all groups. Nerve blockade failure was frequent with chronic opioid use and trauma.

Method
Sciatic nerve blockade by nerve stimulation and ultrasound guidance and training level of the resident performing the procedure were recorded. Patient obesity, trauma, chronic pain, opioid use and preoperative pain scores were compared to post-procedure pain scores and opioid analgesic requirements. 102 patients received sciatic nerve blockade from 47 trainees over a 36 month interval. A significant relation between training level and improved pain scores was not demonstrated but transition from nerve stimulation to ultrasound guidance lowered scores in all groups. Nerve blockade failure was frequent with chronic opioid use and trauma.

Conclusion: Analgesic outcomes should be an integral part of assessment of proficiency in regional anesthesia techniques. Evaluating outcomes of procedures throughout training will longitudinally assess technical expertise.

Keywords: Regional anesthesia; Body mass index; Opioid; SNB

Abstract

Background and Objectives: Peripheral nerve blockade requires regional anesthesia skills that trainees learn in several formats. Technical proficiency has shifted from a quota to comprehensive procedural evaluation. Successful nerve blockade is the clinical endpoint validating proficiency but patient, technical and procedural factors influence this result. The purpose of this study was to determine if procedural expertise for sciatic nerve blockade influenced postoperative pain scores and opioid requirements and if patient factors, technique and repetition influenced this outcome.

Method: Sciatic nerve blockade by nerve stimulation and ultrasound guidance lowered scores in all groups. Nerve blockade failure was frequent with chronic opioid use and trauma.

Results: 102 patients received sciatic nerve blockade from 47 trainees over a 36 month interval. A significant relation between training level and improved pain scores was not demonstrated but transition from nerve stimulation to ultrasound guidance lowered scores in all groups. Nerve blockade failure was frequent with chronic opioid use and trauma.

Conclusion: Analgesic outcomes should be an integral part of assessment of proficiency in regional anesthesia techniques. Evaluating outcomes of procedures throughout training will longitudinally assess technical expertise.

Keywords: Regional anesthesia; Body mass index; Opioid; SNB
or chronic pain, worst pain score in the preceding 24 hour interval and maintenance preoperative 24 hour opioid dosage converted to mg of intravenous Morphine Sulfate (MS). All patients received general inhalational endotracheal anesthesia with sevoflurane and intraoperative analgesia in the form of intravenous fentanyl, morphine and/or hydromorphone for their surgery. Postoperative analgesia in those patients with inadequate pain relief following sciatic nerve blockade was administered as intravenous fentanyl, morphine and/or hydromorphone for their surgery. Postoperative analgesia for the enrolled patients for gender, age, American Society of Anesthesiologists (ASA) physical status, Body Mass Index (BMI) and intraoperative opioid doses in mg of intravenous MS and the academic level of resident trainees that performed the nerve block are summarized in Table 1. No significant differences were observed between patient groups receiving nerve blockade for each class of resident trainees. Trainee and nerve block procedure characteristics with respect to number of trainees in each cohort and number and type of nerve stimulator and ultrasound guided techniques and number of repeat observations on unique patients are listed in Table 2. Reduced postoperative opioid requirements following ultrasound guided compared to nerve stimulator directed procedures was observed for all trainee groups but the differences did not reach statistical significance. Table 3 is the summary of these procedural outcomes with respect to postoperative pain scores and procedural outcomes with respect to postoperative pain scores and body mass index (BMI) and intraoperative opioid doses in mg of intravenous MS were also recorded.

### Results

102 patients were enrolled and received a SNB from 47 anesthesiology resident trainees over a 48 month interval. The preoperative demographics for the enrolled patients for gender, age, American Society of Anesthesiologists (ASA) physical status, Body Mass Index (BMI) and intraoperative opioid doses in mg of intravenous MS and the academic level of resident trainees that performed the nerve block are summarized in Table 1. No significant differences were observed between patient groups receiving nerve blockade for each class of resident trainees. Trainee and nerve block procedure characteristics with respect to number of trainees in each cohort and number and type of nerve stimulator and ultrasound guided techniques and number of repeat observations on unique patients are listed in Table 2. Reduced postoperative opioid requirements following ultrasound guided compared to nerve stimulator directed procedures was observed for all trainee groups but the differences did not reach statistical significance. Table 3 is the summary of these procedural outcomes with respect to postoperative pain scores and

### Table 1: Patient demographics categorized by level of trainee performing sciatic nerve blockade.

<table>
<thead>
<tr>
<th>Academic Year of Residency Training</th>
<th>Male Patients(59)</th>
<th>Female Patients(43)</th>
</tr>
</thead>
<tbody>
<tr>
<td>R1</td>
<td>R2</td>
<td>R3</td>
</tr>
<tr>
<td>Number of Patients (n)</td>
<td>4</td>
<td>12</td>
</tr>
<tr>
<td>Mean Age(yrs)</td>
<td>58.3 (11.6)</td>
<td>54.6 (15.2)</td>
</tr>
<tr>
<td>Mean ASA Physical Status</td>
<td>2 (1)</td>
<td>2 (1)</td>
</tr>
<tr>
<td>Mean BMI (kg/m2)</td>
<td>30.2 (5.3)</td>
<td>28.2 (4.1)</td>
</tr>
<tr>
<td>Mean Pre-op Pain score</td>
<td>2 (3)</td>
<td>5 (2)</td>
</tr>
<tr>
<td>Obesity(n)</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Chronic Opioid Use (n)</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>Trauma (n)</td>
<td>1</td>
<td>7</td>
</tr>
<tr>
<td>Mean Intraoperative Opioid Dose</td>
<td>25.5 (14.6)</td>
<td>46.6 (26.04)</td>
</tr>
</tbody>
</table>

(Obesity = BMI > 30kg/m2. Opioid dose converted to mg intravenous morphine. Numbers in parentheses are SD.)
for each cohort of resident trainees and their respective outcomes for was slight improvement in this parameter with the transition from expertise and improved pain scores was not demonstrated but there the NS groups supports this finding. A relation between level of RA opioid requirement for analgesia in the USG groups compared to SNB has been reported by others and the observed lower postoperative reach statistical significance. Improvement in pain control with USG compared to the NS cohorts for all training levels but this did not at month 19. Postoperative pain scores varied in the USG groups varied because the group practice changed from NS to USG for SNB in intraoperative opioid doses. The technique for performing SNB procedure groups for gender, age, ASA physical status, BMI and performed repeat procedures through a 3 month rotation and the

Discussion

The patient characteristics were comparable in all trainee procedure groups for gender, age, ASA physical status, BMI and intraoperative opioid doses. The technique for performing SNB varied because the group practice changed from NS to USG for SNB at month 19. Postoperative pain scores varied in the USG groups compared to the NS cohorts for all training levels but this did not reach statistical significance. Improvement in pain control with USG SNB has been reported by others and the observed lower postoperative opioid requirement for analgesia in the USG groups compared to the NS groups supports this finding. A relation between level of RA expertise and improved pain scores was not demonstrated but there was slight improvement in this parameter with the transition from NS to USG SNB in all groups.

Table 4 is a summary of the patient subgroups with respect to preoperative chronic maintenance opioid therapy, trauma and obesity for each cohort of resident trainees and their respective outcomes for postoperative pain scores and opioid requirements. These categories of patients have been reported elsewhere to be challenging for the success of peripheral nerve blockade for postoperative analgesia. Patients with preceding trauma had higher postoperative opioid requirements than other patient categories even though pain scores for each training level were within one point above or below the non-trauma related procedures. All chronic opioid using patient groups reported higher postoperative pain scores and had higher postoperative opioid usage compared to the non-trauma related procedure groups for every training level. Obesity was variable with respect to postoperative opioid requirement and the doses administered were lower than the non-trauma related procedures in the R1 and R4 training groups and higher in the R2 and R3 trainee groups. Statistical analysis could not be performed due to the small sample sizes for each group of patients and trainees.

Resident trainees repeating SNB over the course of a 3 month rotation demonstrated varying results with respect to postoperative pain scores. Failure of nerve blockade appears to be related to chronic opioid use and trauma while obesity had a variable outcome in postoperative pain scores.

The regional anesthesia curriculum for all trainees was maintained constant through the course of their specialty training and for this study and is summarized in Table 5. Although the numbers of patients and residents were small there is a downward trend in pain scores as the senior level trainees repeated the procedure on different patients as demonstrated in Figure 3. Decrease in pain scores with repetition and consistently successful SNB outcomes would support the notion that the trainee is advancing in clinical proficiency for this technique.

Limitations of this study include that not every SNB performed by the trainee was assessed and therefore patient selection bias prevents generalizations concerning clinical proficiency and regional anesthesia expertise with respect to successful nerve blockade. The small number of patients in each group and the trauma, obesity, and opioid usage subgroups for each training level lead to inferences that one of these criteria might impact clinical outcomes but all were observed to play a role in pain scores. Selection of the 10 point pain score was not the best assessment tool for analgesic control because its discrete finite numbering system does not allow the more precise recording of data permitted by the continuous Visual Analog Scale (VAS). Using pain as a subjective clinical variable to objectively quantify a procedure outcome is challenging due to the many patient.

Table 3: Procedure Outcome by Training Level and Technique Performed for Sciatic Nerve Blockade.

<table>
<thead>
<tr>
<th>Trainee Level (n)</th>
<th>Procedures (n)</th>
<th>BMI (kg/m²)</th>
<th>Preoperative Pain Score</th>
<th>Preoperative Opioids</th>
<th>Intraoperative Opioids</th>
<th>Postoperative Opioids</th>
<th>Postoperative Pain Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>R1(3)</td>
<td>3</td>
<td>24.77(2.95)</td>
<td>4(4)</td>
<td>23.49(29.89)</td>
<td>31.23(6.01)</td>
<td>40.83(35.83)</td>
<td>3(1)</td>
</tr>
<tr>
<td>R2(5)</td>
<td>5</td>
<td>24.56(2.66)</td>
<td>2(2)</td>
<td>14.27(23.19)</td>
<td>30.4(31.43)</td>
<td>5.8(6.8)</td>
<td>2(2)</td>
</tr>
<tr>
<td>R3(10)</td>
<td>16</td>
<td>30.38(7.59)</td>
<td>5(4)</td>
<td>11.4(21.04)</td>
<td>30.67(20.36)</td>
<td>18.98(15.39)</td>
<td>3(3)</td>
</tr>
<tr>
<td>R4(8)</td>
<td>9</td>
<td>29.67(5.48)</td>
<td>6(2)</td>
<td>13.25(23.81)</td>
<td>43.5(10.65)</td>
<td>16.57(20.52)</td>
<td>3(2)</td>
</tr>
</tbody>
</table>

Data reported are mean (SD). Opioids are converted to and expressed in mg intravenous Morphine sulphate. Postoperative refers to time of discharge from the post anesthesia care unit.

Figure 1: Post Anesthesia Mean Pain Score for Training Level and Sciatic Nerve Block Technique. R1 to R4 – Academic year of trainee, NS – Nerve Stimulator, US – Ultrasound Guided, Y axis – Pain Score, Vertical bars are SD.
factors that contribute to its perception. This study demonstrates this phenomenon with cohorts with lower average pain scores having greater opioid requirements than groups with higher scores both in the preoperative and postoperative phases of their surgery.

**Conclusion**

There is no overall direct relation between level of RA expertise and improved pain scores but there was observed improvement with the transition from NS to USG SNB in all groups. Patient...
factors including trauma, chronic opioid use and subjective pain quantification influence the desired clinical outcome of successful nerve blockade but the observed trend is for improvement as trainees repeat SNB. Adequate analgesia is an important parameter for assessment of proficiency in RA techniques and should be included in trainee procedure logs. Future studies need to address the limitations of this study which include using the VAS continuum instead of the discrete pain score and recording outcomes for all RA procedures through the entire training curriculum instead of sporadic periodic observations of performance which can lead to inaccuracies for assessment of RA technical expertise. The authors report no external funding source for this study and also report no declarations of interest.

Essentials

Patient outcomes of clinical procedures performed by resident trainees are an important component of the overall assessment of adequate proficiency in these technical skills.

- Pain relief following regional anesthetic procedures is the vital clinical endpoint but this is challenging to achieve due to subjective patient variables that influence pain scores.
- The transition from nerve stimulator to ultrasound guided procedures demonstrated improvement in pain scores and reduced postoperative opioid use for pain control.
- Repetition of the procedure during a rotation yielded lower pain scores in patients for some trainee cohorts.
- Universal documentation of patient outcomes from regional anesthetic procedures is proposed as a critical aspect of assessing proficiency in technical expertise for trainees.

References